DB2® Universal Database for z/OS

Version 8

SQL Reference

SC18-7426-00

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Note

Before using this information and the product it supports, be sure to read the general information under “Notices” on page 1369.

First Edition (March 2004)

This edition applies to Version 8 of IBM DB2 Universal Database for z/OS (DB2 UDB for z/OS), product number 5625-DB2, and to any subsequent releases until otherwise indicated in new editions. Make sure you are using the correct edition for the level of the product.

Specific changes are indicated by a vertical bar to the left of a change. A vertical bar to the left of a figure caption indicates that the figure has changed. Editorial changes that have no technical significance are not noted.

Contents

Chapter 4. Queries 393

Chapter 5. Statements 427

About this book

This book is a reference for Structured Query Language (SQL) for DB2 Universal Database™ for z/OS®.

Unless otherwise stated, references to SQL in this book imply SQL for DB2 UDB for z/OS, and all objects described in this book are objects of DB2 UDB for z/OS. The syntax and semantics of most SQL statements are essentially the same in all IBM® relational database products, and the language elements common to the products provide a base for the definition of IBM SQL. Consult *IBM DB2 Universal Database SQL Reference for Cross-Platform Development* if you intend to develop applications that adhere to IBM SQL.

Important

In this version of DB2 UDB for z/OS, the DB2 Utilities Suite is available as an optional product. You must separately order and purchase a license to such utilities, and discussion of those utility functions in this publication is not intended to otherwise imply that you have a license to them. See Part 1 of *DB2 Utility Guide and Reference* for packaging details.

Visit the following Web site for information about ordering DB2 books and obtaining other valuable information about DB2 UDB for z/OS:
http://www.ibm.com/software/data/db2/zos/library.html

Who should read this book

This book is intended for end users, application programmers, system and database administrators, and for persons involved in error detection and diagnosis.

This book is a reference rather than a tutorial. It assumes that you are already familiar with SQL programming concepts.

When you first use this book, consider reading Chapters 1 and 2 sequentially. These chapters describe the basic concepts of relational databases and SQL, the basic syntax of SQL, and the language elements that are common to many SQL statements. The rest of the chapters and appendixes are designed for the quick location of answers to specific SQL questions. They provide you with query forms, SQL statements, SQL procedure statements, DB2® limits, SQLCA, SQLDA, catalog tables, and SQL reserved words.

Conventions and terminology used in this book

This section explains conventions and terminology used in this book.

Terminology and citations

In this information, DB2 Universal Database for z/OS is referred to as "DB2 UDB for z/OS." In cases where the context makes the meaning clear, DB2 UDB for z/OS is referred to as "DB2." When this information refers to titles of books in this library, a short title is used. (For example, "See *DB2 SQL Reference*" is a citation to *IBM DB2 Universal Database for z/OS SQL Reference*.)

When referring to a DB2 product other than DB2 UDB for z/OS, this information uses the product's full name to avoid ambiguity.

The following terms are used as indicated:

DB2 Represents either the DB2 licensed program or a particular DB2 subsystem.

DB2 PM
Refers to the DB2 Performance Monitor tool, which can be used on its own or as part of the DB2 Performance Expert for z/OS product.

C, C++, and C language
Represent the C or C++ programming language.

CICS® Represents CICS Transaction Server for z/OS or CICS Transaction Server for OS/390®.

IMS™ Represents the IMS Database Manager or IMS Transaction Manager.

MVS™ Represents the MVS element of the z/OS operating system, which is equivalent to the Base Control Program (BCP) component of the z/OS operating system.

RACF®
Represents the functions that are provided by the RACF component of the z/OS Security Server.

Conventions for describing mixed data values

At sites using a double-byte character set (DBCS), character strings can include a mixture of single-byte and double-byte characters. When mixed data values are shown in the examples, the conventions shown in Figure 1 apply:

Convention	Representation
$^{S}{}_{O}$	"shift-out" control character (X'0E'), used only for EBCDIC data
$^{S}{}_{I}$	"shift-in" control character (X'0F'), used only for EBCDIC data
sbcs-string	SBCS string of zero or more single-byte characters
dbcs-string	DBCS string of zero or more double-byte characters
’	DBCS apostrophe
Ｇ	DBCS uppercase G

Figure 1. Conventions used when mixed data values are shown in examples

Industry standards

DB2 UDB for z/OS is consistent with the following industry standards for SQL:

- *Information technology - Database languages - SQL- Part 1: Framework (SQL/Framework) ISO/IEC 9075-1:1999*
- *Information technology - Database languages - SQL- Part 2: Foundation (SQL/Foundation) ISO/IEC 9075-2:1999*
- *Information technology - Database languages - SQL- Part 4: Persistent Stored Modules (SQL/PSM) ISO/IEC 9075-4:1999*

- *Information technology - Database languages - SQL- Part 5: Host Language Bindings (SQL/Bindings) ISO/IEC 9075-5:1999*
- *Information technology - Database languages - SQL- Part 10: Object Language (SQL/OLB) ISO/IEC 9075-10:2000*
- *Information technology - Database languages - SQL- Part 13: SQL Routines and Types Using the Java™ Programming Language (SQL/JRT) ISO/IEC 9075-13:2002*
- *Information technology - Database languages - SQL- Part 14: XML-Related Specifications (SQL/XML) ISO/IEC 9075-14:2003*
- ANSI (American National Standards Institute) X3.135-1999, Database Language SQL

How to read the syntax diagrams

The following rules apply to the syntax diagrams that are used in this book:

- Read the syntax diagrams from left to right, from top to bottom, following the path of the line.

  The ▶▶── symbol indicates the beginning of a statement.

  The ──▶ symbol indicates that the statement syntax is continued on the next line.

  The ▶── symbol indicates that a statement is continued from the previous line.

  The ──▶◀ symbol indicates the end of a statement.
- Required items appear on the horizontal line (the main path).

```
▶▶──required_item──────────────────────────────────────────────▶◀
```

- Optional items appear below the main path.

```
▶▶──required_item──┬───────────────┬───────────────────────────▶◀
                   └─optional_item─┘
```

  If an optional item appears above the main path, that item has no effect on the execution of the statement and is used only for readability.

```
                   ┌─optional_item─┐
▶▶──required_item──┴───────────────┴───────────────────────────▶◀
```

- If you can choose from two or more items, they appear vertically, in a stack.

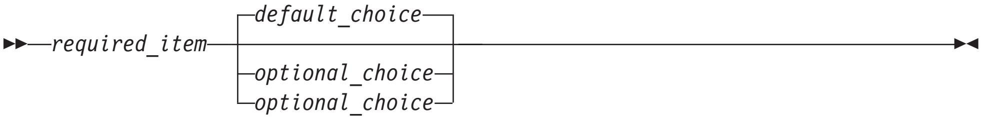
  If you *must* choose one of the items, one item of the stack appears on the main path.

```
▶▶──required_item──┬─required_choice1─┬────────────────────────▶◀
                   └─required_choice2─┘
```

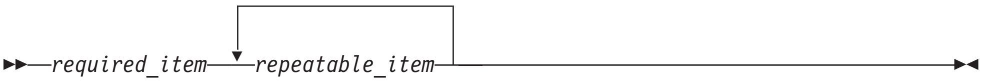
  If choosing one of the items is optional, the entire stack appears below the main path.

```
▶▶──required_item──┬──────────────────┬────────────────────────▶◀
                   ├─optional_choice1─┤
                   └─optional_choice2─┘
```

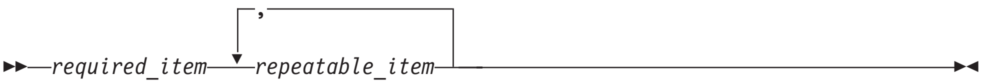
If one of the items is the default, it appears above the main path and the remaining choices are shown below.



- An arrow returning to the left, above the main line, indicates an item that can be repeated.



If the repeat arrow contains a comma, you must separate repeated items with a comma.



A repeat arrow above a stack indicates that you can repeat the items in the stack.

- Keywords appear in uppercase (for example, FROM). They must be spelled exactly as shown. Variables appear in all lowercase letters (for example, *column-name*). They represent user-supplied names or values.
- If punctuation marks, parentheses, arithmetic operators, or other such symbols are shown, you must enter them as part of the syntax.

Accessibility

Accessibility features help a user who has a physical disability, such as restricted mobility or limited vision, to use software products. The major accessibility features in z/OS products, including DB2 UDB for z/OS, enable users to:

- Use assistive technologies such as screen reader and screen magnifier software
- Operate specific or equivalent features by using only a keyboard
- Customize display attributes such as color, contrast, and font size

Assistive technology products, such as screen readers, function with the DB2 UDB for z/OS user interfaces. Consult the documentation for the assistive technology products for specific information when you use assistive technology to access these interfaces.

Online documentation for Version 8 of DB2 UDB for z/OS is available in the DB2 Information Center, which is an accessible format when used with assistive technologies such as screen reader or screen magnifier software. The DB2 Information Center for z/OS solutions is available at the following Web site: http://publib.boulder.ibm.com/infocenter/db2zhelp.

How to send your comments

Your feedback helps IBM to provide quality information. Please send any comments that you have about this book or other DB2 UDB for z/OS documentation. You can use the following methods to provide comments:

- Send your comments by e-mail to db2pubs@vnet.ibm.com and include the name of the product, the version number of the product, and the number of the book. If you are commenting on specific text, please list the location of the text (for example, a chapter and section title, page number, or a help topic title).
- You can also send comments from the Web. Visit the library Web site at:

  www.ibm.com/software/db2zos/library.html

  This Web site has a feedback page that you can use to send comments.
- Print and fill out the reader comment form located at the back of this book. You can give the completed form to your local IBM branch office or IBM representative, or you can send it to the address printed on the reader comment form.

Summary of changes to this book

The major changes to this book are:

Chapter 1, "DB2 concepts" includes new descriptions of materialized query tables, referential constraints, and mixed-byte character strings.

Chapter 2, "Language elements" contains numerous changes to descriptions of naming conventions, assignment and comparison, constants, special registers (including several new special registers), host variable arrays, functions, expressions (including the CAST specification and new expressions scalar fullselect, NEXT VALUE, and PREVIOUS VALUE), and predicates (including the new predicate DISTINCT).

Chapter 3, "Functions" includes changes to many column, scalar, and table functions and addition of several new functions. Also, the term *aggregate functions* is now used to refer to the functions that were previously called *column functions*. The new functions are:
- "DECRYPT_BIT, DECRYPT_CHAR, and DECRYPT_DB" on page 246
- "ENCRYPT_TDES" on page 253
- "GETHINT" on page 260
- "GETVARIABLE" on page 261
- "XML2CLOB" on page 374
- "XMLAGG" on page 205
- "XMLCONCAT" on page 375
- "XMLELEMENT" on page 376
- "XMLFOREST" on page 378
- "XMLNAMESPACES" on page 380

For a list and brief description of all the functions, see Table 42 on page 189.

Chapter 4, "Queries" includes changes for subselect and select-statement. For subselect, the description of the select list is enhanced, the GROUP BY clause is changed to allow expressions, and the FROM clause is expanded to support specifying a cardinality when using a table function and specifying an INSERT statement, which allows selecting values from rows that are being inserted. For select-statement, the description is changed to include support of nested table expressions.

Chapter 5. Statements includes new statements, as well as changed statements. The new statements are:
- "ALTER SEQUENCE" on page 496
- "ALTER VIEW" on page 557
- "CREATE SEQUENCE" on page 721
- "GET DIAGNOSTICS" on page 928
- "GRANT (sequence privileges)" on page 960
- "REFRESH TABLE" on page 1011
- "REVOKE (sequence privileges)" on page 1041
- "SET CURRENT MAINTAINED TABLE TYPES FOR OPTIMIZATION" on page 1067
- "SET CURRENT PACKAGE PATH" on page 1070
- "SET CURRENT REFRESH AGE" on page 1077
- "SET SCHEMA" on page 1090

Statements with new clauses, new values for existing clauses, or other changes include:

- “ALTER FUNCTION (external)” on page 441
- “ALTER FUNCTION (SQL scalar)” on page 458
- “ALTER INDEX” on page 464
- “ALTER PROCEDURE (external)” on page 479
- “ALTER PROCEDURE (SQL)” on page 490
- “ALTER TABLE” on page 504
- “ALTER TABLESPACE” on page 545
- “COMMENT” on page 574
- “CREATE AUXILIARY TABLE” on page 591
- “CREATE DISTINCT TYPE” on page 597
- “CREATE FUNCTION (external scalar)” on page 605
- “CREATE FUNCTION (external table)” on page 628
- “CREATE INDEX” on page 673
- “CREATE PROCEDURE (external)” on page 692
- “CREATE PROCEDURE (SQL)” on page 710
- “CREATE TABLE” on page 734
- “CREATE TABLESPACE” on page 772
- “DECLARE CURSOR” on page 812
- “DELETE” on page 843
- “DROP” on page 866
- “EXECUTE” on page 881
- “EXECUTE IMMEDIATE” on page 886
- “EXPLAIN” on page 889
- “FETCH” on page 903
- “INSERT” on page 972
- “LOCK TABLE” on page 988
- “PREPARE” on page 995
- “REVOKE (table or view privileges)” on page 1046
- “SELECT INTO” on page 1057
- “SET CURRENT PACKAGESET” on page 1074
- “SET PATH” on page 1087
- “UPDATE” on page 1097

Chapter 6, “SQL control statements” includes changes to statements that can be used in SQL procedures and addition of new statements. The new statements that can be used in SQL procedures are:

- “ITERATE statement” on page 1131
- “RESIGNAL statement” on page 1135
- “RETURN statement” on page 1138
- “SIGNAL statement” on page 1140

Appendix F, “DB2 catalog tables” includes descriptions of new and changed catalog tables. (See “New and changed catalog tables” on page 1200 for a summary of all catalog table changes.)

Chapter 1. DB2 concepts

Structured query language

Structured query language (SQL) is a standardized language for defining and manipulating data in a relational database. In accordance with the relational model of data, the database is perceived as a set of tables, relationships are represented by values in tables, and data is retrieved by specifying a result table that can be derived from one or more tables. DB2 UDB for z/OS transforms the specification of a result table into a sequence of internal operations that optimize data retrieval. This transformation occurs when the SQL statement is *prepared*. This transformation is also known as *binding*.

All executable SQL statements must be prepared before they can be executed. The result of preparation is the executable or *operational form* of the statement. The method of preparing an SQL statement and the persistence of its operational form distinguish *static* SQL from *dynamic* SQL.

Static SQL

The source form of a *static* SQL statement is embedded within an application program written in a host language such as COBOL. The statement is prepared before the program is executed and the operational form of the statement persists beyond the execution of the program.

Static SQL statements in a source program must be processed before the program is compiled. This processing can be accomplished through the DB2 precompiler or the SQL statement coprocessor. The DB2 precompiler or the coprocessor checks the syntax of the SQL statements, turns them into host language comments, and generates host language statements to invoke DB2.

The preparation of an SQL application program includes precompilation, the preparation of its static SQL statements, and compilation of the modified source program, as described in Part 5 of *DB2 Application Programming and SQL Guide*.

Dynamic SQL

Programs that contain embedded *dynamic* SQL statements must be precompiled like those that contain static SQL, but unlike static SQL, the dynamic statements are constructed and prepared at run time. The source form of a dynamic statement is a character string that is passed to DB2 by the program using the static SQL PREPARE or EXECUTE IMMEDIATE statement. A statement that is prepared using the PREPARE statement can be referenced in a DECLARE CURSOR, DESCRIBE, or EXECUTE statement. Whether the operational form of the statement is persistent depends on whether dynamic statement caching is enabled. For details on dynamic statement caching, see Part 6 of *DB2 Application Programming and SQL Guide*.

SQL statements embedded in a REXX application are dynamic SQL statements. SQL statements submitted to an interactive SQL facility and to the CALL Level Interface (CLI) are also dynamic SQL.

Deferred embedded SQL

A *deferred embedded* SQL statement is neither fully static nor fully dynamic. Like a static statement, it is embedded within an application, but like a dynamic statement, it is prepared during the execution of the application. Although prepared at run time, a deferred embedded SQL statement is processed with bind-time rules such that the authorization ID and qualifier determined at bind time for the plan or package owner are used. Deferred embedded SQL statements are used for DB2 private protocol access to remote data.

Interactive SQL

In this book, *interactive SQL* refers to SQL statements submitted to SPUFI (SQL processor using file input). SPUFI prepares and executes these statements dynamically. For more details about using SPUFI, see Part 1 of *DB2 Application Programming and SQL Guide*.

SQL Call Level Interface (CLI) and Open Database Connectivity (ODBC)

The DB2 Call Level Interface (CLI) is an application programming interface in which functions are provided to application programs to process dynamic SQL statements. DB2 CLI allows users to access SQL functions directly through a call interface. CLI programs can also be compiled using an Open Database Connectivity (ODBC) Software Developer's Kit, available from Microsoft® or other vendors, enabling access to ODBC data sources. Unlike using embedded SQL, no precompilation is required. Applications developed using this interface can be executed on a variety of databases without being compiled against each of databases. Through the interface, applications use procedure calls at execution time to connect to databases, to issue SQL statements, and to get returned data and status information.

The *DB2 ODBC Guide and Reference* describes the APIs supported with this interface.

Java database connectivity and embedded SQL for Java

DB2 provides two standards-based Java™ programming APIs: Java Database Connectivity (JDBC) and embedded SQL for Java (SQLJ). Both can be used to create Java applications and applets that access DB2.

Static SQL cannot be used by JDBC. SQLJ applications use JDBC as a foundation for such tasks as connecting to databases and handling SQL errors, but can contain embedded static SQL statements in the SQLJ source files. An SQLJ file has to be translated with the SQLJ translator before the resulting Java source code can be compiled.

The *DB2 Application Programming Guide and Reference for Java* describes the APIs supported with these interfaces.

Schemas

A *schema* is a collection of named objects. The objects that a schema can contain include distinct types, functions, stored procedures, sequences, and triggers. An object is assigned to a schema when it is created.

The *schema name* of the object determines the schema to which the object belongs. When a distinct type, function, sequence, or trigger is created, it is given a qualified, two-part name. The first part is the schema name (or the qualifier), which is either implicitly or explicitly specified. The second part is the name of the object. When a stored procedure is created, it is given a three-part name. The first part is a location name, which is implicitly or explicitly specified, the second part is the schema name, which is implicitly or explicitly specified, and the third part is the name of the object.

Schemas extend the concept of qualifiers for tables, views, indexes, and aliases to enable the qualifiers for distinct types, functions, stored procedures, sequences, and triggers to be called schema names.

Tables

Tables are logical structures maintained by DB2. Tables are made up of *columns* and *rows*. There is no inherent order of the rows within a table. At the intersection of every column and row is a specific data item called a *value*. A *column* is a set of values of the same type. A *row* is a sequence of values such that the *n*th value is a value of the *n*th column of the table. Every table must have one or more columns, but the number of rows can be zero.

Some types of tables include:

base table
A table created with the SQL statement CREATE TABLE and used to hold persistent user data.

auxiliary table
A table created with the SQL statement CREATE AUXILIARY TABLE and used to hold the data for a column that is defined in a base table.

temporary table
A table defined by either the SQL statement CREATE GLOBAL TEMPORARY TABLE (a created temporary table) or DECLARE GLOBAL TEMPORARY TABLE (a declared temporary table) and used to hold data temporarily, such as the intermediate results of SQL transactions. Both created temporary tables and declared temporary tables persist only as long as the application process. The description of a created temporary table is stored in the DB2 catalog and the description is shareable across application processes while the description of a declared temporary table is neither stored nor shareable. Thus, each application process might refer to the same declared temporary table but have its own unique description of it. For a complete comparison of the two types of temporary tables, including how they differ from base tables, see Part 2 (Volume 1) of *DB2 Administration Guide*.

materialized query table
A table created with the SQL statement CREATE TABLE and used to contain materialized data that is derived from one or more source tables specified by a fullselect. A source table is a base table, view, table expression, or user-defined table function. The fullselect specifies the queries that are used to refresh the materialized query table and to keep the data in the materialized query table synchronized with the data in the source tables from which the materialized query table was derived. The fullselect is used to determine the column definitions of a materialized query table and is executed against the source tables to populate the materialized query table.

A materialized query table can be either user-maintained or system-maintained. A user-maintained materialized query table can be updated by the user with INSERT, UPDATE, DELETE, and REFRESH TABLE statements and with the LOAD utility. A system-maintained materialized query table can be updated only through the REFRESH TABLE statement.

Materialized query tables can be used to improve the performance of dynamic SQL queries. If the database manager determines that a portion of

| a query could be resolved using a materialized query table, the query may be rewritten by the database manager to use the materialized query table. This decision is based in part on the settings of the CURRENT REFRESH AGE and the CURRENT MAINTAINED TABLE TYPES FOR OPTIMIZATION special registers.

result table
A set of rows that DB2 selects or generates from one or more tables or views.

empty table
A table with zero rows.

sample table
One of several tables sent with the DB2 licensed program that contains sample data. Many examples in this book are based on sample tables. See Appendix A of *DB2 Application Programming and SQL Guide* for a description of the sample tables.

Indexes

An *index* is an ordered set of pointers to rows of a base table or an auxiliary table. Each index is based on the values of data in one or more columns. An index is an object that is separate from the data in the table. When you define an index using the CREATE INDEX statement, DB2 builds this structure and maintains it automatically.

Indexes can be used by DB2 to improve performance and ensure uniqueness. In most cases, access to data is faster with an index. A table with a unique index cannot have rows with identical keys. For more details on designing indexes and on their uses, see *The Official Introduction to DB2 UDB for z/OS*.

Keys

A *key* is one or more columns that are identified as such in the description of a table, an index, or a referential constraint. Referential constraints are described in “Referential constraints” on page 8. The same column can be part of more than one key.

A *composite key* is an ordered set of two or more columns of the same table. The ordering of the columns is not constrained by their ordering within the table. The term *value*, when used with respect to a composite key, denotes a *composite value*. Thus, a rule, such as “the value of the foreign key must be equal to the value of the parent key”, means that each component of the value of the foreign key must be equal to the corresponding component of the value of the parent key.

Unique keys

A *unique key* is a key that is constrained so that no two of its values are equal. DB2 enforces the constraint during the execution of the LOAD utility and the SQL INSERT and UPDATE statements. The mechanism used to enforce the constraint is a *unique index*. Thus, every unique key is a key of a unique index. Such an index is also said to have the UNIQUE attribute.

The columns of a unique key cannot contain null values.

A unique key can be defined using the UNIQUE clause of the CREATE TABLE or ALTER TABLE statement. When a unique key is defined in a CREATE TABLE statement, the table is marked unavailable until the unique index is created by the user. However, if the CREATE TABLE statement is processed by the schema processor, DB2 automatically creates the unique index. When a unique key is defined in an ALTER TABLE statement, a unique index must already exist on the columns of that unique key.

Primary keys

A *primary key* is a unique key that is a part of the definition of a table. A table can have only one primary key, and the columns of a primary key cannot contain null values. Primary keys are optional and can be defined in CREATE TABLE or ALTER TABLE statements.

The unique index on a primary key is called a *primary index*. When a primary key is defined in a CREATE TABLE statement, the table is marked unavailable until the primary index is created by the user unless the CREATE TABLE statement is processed by the schema processor. In that case, DB2 automatically creates the primary index.

When a primary key is defined in an ALTER TABLE statement, a unique index must already exist on the columns of that primary key. This unique index is designated as the primary index.

Parent keys

A *parent key* is either a primary key or a unique key in the parent table of a referential constraint. The values of a parent key determine the valid values of the foreign key in the constraint.

Foreign keys

A *foreign key* is a key that is specified in the definition of a referential constraint using the CREATE or ALTER statement. A foreign key refers to or is related to a specific parent key. A table can have zero or more foreign keys. The value of a composite foreign key is null if any component of the value is null.

Constraints

Constraints are rules that control values in columns to prevent duplicate values or set restrictions on data added to a table.

Constraints fall into the following three types:

- A *unique constraint* is a rule that prevents duplicate values in one or more columns in a table. Unique constraints are unique and primary keys. For example, a unique constraint could be defined on a supplier identifier in a supplier table to ensure that the same supplier identifier is not given to two suppliers.
- A *referential constraint* is a rule about values in one or more columns in one or more tables. For example, a set of tables shares information about a corporation’s suppliers. Occasionally, a supplier’s ID changes. You can define a referential constraint stating that the ID of the supplier in the table must match a supplier ID in the supplier information. This constraint prevents insert, update, or delete operations that would otherwise result in missing supplier information.
- A *check constraint* sets restrictions on data added to a specific table. For example, the constraint could be added to define a salary level for an employee to never be less than a stated amount when salary data is added or updated in a table for personnel information.

Unique constraints

A *unique constraint* is a rule that the values of a key are valid only if they are unique in a table. Unique constraints are optional and can be defined in the CREATE TABLE or ALTER TABLE statements with the PRIMARY KEY clause or the UNIQUE clause. The columns specified in a unique constraint must be defined as NOT NULL. A unique index enforces the uniqueness of the key during changes to the columns of the unique constraint.

A table can have an arbitrary number of unique constraints, with at most one unique constraint defined as a primary key. A table cannot have more than one unique constraint on the same set of columns.

A unique constraint that is referenced by the foreign key of a referential constraint is called the parent key.

Referential constraints

Referential integrity is the state in which all values of all foreign keys at a given DB2 are valid. A *referential constraint* is the rule that the nonnull values of a foreign key are valid only if they also appear as values of its parent key. The table that contains the parent key is called the *parent table* of the referential constraint, and the table that contains the foreign key is a *dependent* of that table.

Referential constraints are optional and can be defined using CREATE TABLE and ALTER TABLE statements. Refer to Part 2 (Volume 1) of *DB2 Administration Guide* for examples.

Referential constraints between base tables are also an important factor in determining whether a materialized query table can be used for a query. For instance, in a data warehouse environment, data is usually extracted from other sources, transformed, and loaded into data warehouse tables. In such an environment, the referential integrity constraints can be maintained and enforced by other means than the database manager to avoid the overhead of enforcing them by DB2. However, referential constraints between base tables in materialized query table definitions are important in a query rewrite to determine whether or not a materialized query table can be used in answering a query. In such cases, you can use informational referential constraints to declare a referential constraint to be true to allow DB2 to take advantage of the referential constraints in the query rewrite. DB2 allows the user application to enforce informational referential constraints, while it ignores the informational referential constraints for inserting, updating, deleting, and using the LOAD and CHECK DATA utilities. Thus, the overhead of DB2 enforcement of referential integrity is avoided and more queries can qualify for automatic query rewrite using materialized query tables.

DB2 enforces referential constraints when:

- An INSERT statement is applied to a dependent table.
- An UPDATE statement is applied to a foreign key of a dependent table.
- An UPDATE statement is applied to the parent key of a parent table.
- A DELETE statement is applied to a parent table. All affected referential constraints and all delete rules of all affected relationships must be satisfied in order for the delete operation to succeed.
- The LOAD utility with the ENFORCE CONSTRAINTS option is run on a dependent table.
- The CHECK DATA utility is run.

The order in which referential constraints are enforced is undefined. To ensure that the order does not affect the result of the operation, there are restrictions on the definition of delete rules and on the use of certain statements. The restrictions are specified in the descriptions of the SQL statements CREATE TABLE, ALTER TABLE, INSERT, UPDATE, and DELETE.

The rules of referential integrity involve the following concepts and terminology:

parent key
A primary key or a unique key of a referential constraint.

parent table
A table that is a parent in at least one referential constraint. A table can be defined as a parent in an arbitrary number of referential constraints.

dependent table
A table that is a dependent in at least one referential constraint. A table can be defined as a dependent in an arbitrary number of referential constraints. A dependent table can also be a parent table.

descendent table
A table that is a dependent of another table or a table that is a dependent of a descendent table.

referential cycle
A set of referential constraints in which each associated table is a descendent of itself.

parent row
A row that has at least one dependent row.

dependent row
A row that has at least one parent row.

descendent row
A row that is dependent on another row or a row that is a dependent of a descendent row.

self-referencing row
A row that is a parent of itself.

self-referencing table
A table that is both parent and dependent in the same referential constraint. The constraint is called a *self-referencing constraint*.

The following rules provide referential integrity:

insert rule
A nonnull insert value of the foreign key must match some value of the parent key of the parent table. The value of a composite foreign key is null if any component of the value is null.

update rule
A nonnull update value of the foreign key must match some value of the parent key of the parent table. The value of a composite foreign key is treated as null if any component of the value is null.

delete rule
Controls what happens when a row of the parent table is deleted. The choices of action, made when the referential constraint is defined, are RESTRICT, NO ACTION, CASCADE, or SET NULL. SET NULL can be specified only if some column of the foreign key allows null values.

More precisely, the delete rule applies when a row of the parent table is the object of a delete or propagated delete operation and that row has dependents in the dependent table of the referential constraint. Let P denote the parent table, let D denote the dependent table, and let p denote a parent row that is the object of a delete or propagated delete operation. If the delete rule is:

- RESTRICT or NO ACTION, an error occurs and no rows are deleted.
- CASCADE, the delete operation is propagated to the dependent rows of p in D.
- SET NULL, each nullable column of the foreign key of each dependent row of p in D is set to null.

Each referential constraint in which a table is a parent has its own delete rule, and all applicable delete rules are used to determine the result of a delete operation. Thus, a row cannot be deleted if it has dependents in a referential constraint with a delete rule of RESTRICT or NO ACTION or the deletion cascades to any of its descendents that are dependents in a referential constraint with the delete rule of RESTRICT or NO ACTION.

The deletion of a row from parent table P involves other tables and can affect rows of these tables:

- If D is a dependent of P and the delete rule is RESTRICT or NO ACTION, D is involved in the operation but is not affected by the operation and the deletion from the parent table P does not take place.
- If D is a dependent of P and the delete rule is SET NULL, D is involved in the operation and rows of D might be updated during the operation.
- If D is a dependent of P and the delete rule is CASCADE, D is involved in the operation and rows of D might be deleted during the operation. If rows of D are deleted, the delete operation on P is said to be propagated to D. If D is also a parent table, the actions described in this list apply, in turn, to the dependents of D.

Any table that can be involved in a delete operation on P is said to be *delete-connected* to P. Thus, a table is delete-connected to table P if it is a dependent of P or a dependent of a table to which delete operations from P cascade.

Check constraints

A *check constraint* is a rule that specifies the values allowed in one or more columns of every row of a table. Check constraints are optional and can be defined using the SQL statements CREATE TABLE and ALTER TABLE. The definition of a check constraint is a restricted form of a search condition that must not be false for any row of the table. One of the restrictions is that a column name in a check constraint on table T must identify a column of T. See Part 2 of *DB2 Application Programming and SQL Guide* for examples.

A table can have an arbitrary number of check constraints. DB2 enforces the constraints when:

- A row is inserted into the table.
- A row of the table is updated.
- The LOAD utility with the ENFORCE CONSTRAINTS option is used to populate the table.

A check constraint is enforced by applying its search condition to each row that is inserted, updated, or loaded. An error occurs if the result of the search condition is **false** for any row.

Triggers

A *trigger* defines a set of actions that are executed when a delete, insert, or update operation occurs on a specified table. When such an SQL operation is executed, the trigger is said to be *activated*.

Triggers can be used along with referential constraints and check constraints to enforce data integrity rules. Triggers are more powerful than constraints because they can also be used to cause updates to other tables, automatically generate or transform values for inserted or updated rows, or invoke functions that perform operations both inside and outside of DB2. For example, instead of preventing an update to a column if the new value exceeds a certain amount, a trigger can substitute a valid value and send a notice to an administrator about the invalid update.

Triggers are useful for defining and enforcing business rules that involve different states of the data, for example, limiting a salary increase to 10%. Such a limit requires comparing the value of a salary before and after an increase. For rules that do not involve more than one state of the data, consider using referential and check constraints.

Triggers also move the application logic that is required to enforce business rules into the database, which can result in faster application development and easier maintenance because the business rule is no longer repeated in several applications, but one version is centralized to the trigger. With the logic in the database, for example, the previously mentioned limit on increases to the salary column of a table, DB2 checks the validity of the changes that any application makes to the salary column. In addition, the application programs do not need to be changed when the logic changes.

Triggers are optional and are defined using the CREATE TRIGGER statement.

For information on using triggers, see Part 2 of *DB2 Application Programming and SQL Guide*.

Storage structures

In DB2, a *storage structure* is a set of one or more VSAM data sets that hold DB2 tables or indexes. A storage structure is also called a *page set*. A storage structure can be one of the following:

table space
A table space can hold one or more base tables, or one auxiliary table. All tables are kept in table spaces. A table space can be defined using the CREATE TABLESPACE statement.

index space
An index space contains a single index. An index space is defined when the index is defined using the CREATE INDEX statement.

Storage groups

Defining and deleting the data sets of a storage structure can be left to DB2. If it is left to DB2, the storage structure has an associated *storage group*. The storage group is a list of DASD volumes on which DB2 can allocate data sets for associated storage structures. The association between a storage structure and its storage group is explicitly or implicitly defined by the statement that created the storage structure.

Alternatively, Storage Management Subsystem (SMS) can be used to manage DB2 data sets. Refer to Part 2 (Volume 1) of *DB2 Administration Guide* for more information.

Databases

In DB2, a *database* is a set of table spaces and index spaces. These index spaces contain indexes on the tables in the table spaces of the same database. Databases are defined using the CREATE DATABASE statement and are primarily used for administration. Whenever a table space is created, it is explicitly or implicitly assigned to an existing database.

Catalog

Each DB2 maintains a set of tables that contain information about the data under its control. These tables are collectively known as the *catalog*. The *catalog tables* contain information about DB2 objects such as tables, views, and indexes. In this book, “catalog” refers to a DB2 catalog unless otherwise indicated. In contrast, the catalogs maintained by access method services are known as “integrated catalog facility catalogs”.

Tables in the catalog are like any other database tables with respect to retrieval. If you have authorization, you can use SQL statements to look at data in the catalog tables in the same way that you retrieve data from any other table in the system. Each DB2 ensures that the catalog contains accurate descriptions of the objects that the DB2 controls.

Views

A view provides an alternative way of looking at the data in one or more tables. A *view* is a named specification of a result table. The specification is an SQL SELECT statement that is effectively executed whenever the view is referenced in an SQL statement. At any time, the view consists of the rows that would result if the fullselect were executed. Thus, a view can be thought of as having columns and rows just like a base table. However, columns added to the base tables after the view is defined do not appear in the view. For retrieval, all views can be used like base tables. Whether a view can be used in an insert, update, or delete operation depends on its definition, as described in “CREATE VIEW” on page 805.

Views can be used to control access to a table and make data easier to use. Access to a view can be granted without granting access to the table. The view can be defined to show only portions of data in the table. A view can show summary data for a given table, combine two or more tables in meaningful ways, or show only the selected rows that are pertinent to the process using the view.

Example: The following SQL statement defines a view named XYZ. The view represents a table whose columns are named EMPLOYEE and WHEN_HIRED. The data in the table comes from the columns EMPNO and HIREDATE of the sample table DSN8810.EMP. The rows from which the data is taken are for employees in departments A00 and D11.

```
CREATE VIEW XYZ (EMPLOYEE, WHEN_HIRED)
  AS SELECT EMPNO, HIREDATE
       FROM DSN8810.EMP
         WHERE WORKDEPT IN ('A00', 'D11');
```

An index cannot be created for a view. However, an index created for a table on which a view is based might improve the performance of operations on the view. The column of a view inherits its attributes (such as data type, precision, and scale) from the table or view column, constant, function, or expression from which it is derived. In addition, a view column that maps back to a base table column inherits any default values or constraints specified for that column of the base table. For example, if a view includes a foreign key of its base table, insert and update operations using that view are subject to the same referential constraint as the base table. Likewise, if the base table of a view is a parent table, delete operations using that view are subject to the same rules as delete operations on the base table. See the description of "INSERT" on page 972 and "UPDATE" on page 1097 for restrictions that apply to views with derived columns. For information on referential constraints, see "Referential constraints" on page 8.

Read-only views cannot be used for insert, update, and delete operations. For a discussion of read-only views, see "CREATE VIEW" on page 805.

The definition of a view is stored in the DB2 catalog. An SQL DROP VIEW statement can drop a view, and the definition of the view is removed from the catalog. The definition of a view is also removed from the catalog when any view or base table on which the view depends is dropped.

The ALTER VIEW statement can be used to cause a view definition to be regenerated using the existing view definition.

Sequences

A sequence provides a way to have the database manager automatically generate unique integer primary keys and to coordinate keys across multiple rows and tables. A *sequence* is a stored object that simply generates a sequence of numbers in a monotonically ascending (or descending) order. A sequence eliminates the serialization caused by programmatically generating unique numbers by locking the most recently used value and then incrementing it.

Sequences are ideally suited to the task of generating unique key values. One sequence can be used for many tables, or a separate sequence can be created for each table requiring generated keys. A sequence has the following properties:

- Has guaranteed, unique values, assuming that the sequence is not reset.
- Has monotonically increasing or decreasing values within a defined range.
- Can have an increment value other than 1 between consecutive values (the default is 1). However, gaps might be introduced in a sequence if a transaction has incremented the sequence and then rolls back or if the DB2 subsystem fails. Updating a sequence is not part of a transaction's unit of recovery.
- Is recoverable. If DB2 should fail, the sequence is reconstructed from the logs so that DB2 guarantees that unique sequence values continue to be generated across a DB2 failure.

Values for a given sequence are automatically generated by DB2. Use of DB2 sequences avoids the performance bottleneck that results when an application implements sequences outside the database. The counter for the sequence is incremented (or decremented) independently of the transaction. If a given transaction increments a sequence two times, that transaction may see a gap in the two numbers that are generated because there may be other transactions concurrently incrementing the same sequence. Furthermore, it is possible that a given sequence can appear to have generated gaps in the numbers, because a transaction that may have generated a sequence number may have rolled back. Additionally, a single user may not realize that other users are drawing from the same sequence.

A sequence is created with a CREATE SEQUENCE statement. A sequence can be referenced using a *sequence-reference*. A sequence reference can appear most places that an expression can appear. A sequence reference can specify whether the value to be returned is a newly generated value, or the previously generated value. For more information, see "CREATE SEQUENCE" on page 721 and "Sequence reference" on page 156.

Although there are similarities, a sequence is different than an identity column. A sequence is an object, whereas an identity column is a part of a table. A sequence can be used with multiple tables, but an identity column is tied to a single table.

Routines

A *routine* is an executable SQL object. The two types of routines are functions and stored procedures.

Functions

A *function* is a routine that can be invoked from within other SQL statements and returns a value or a table. For more information, see "Functions" on page 127.

A function is created with the CREATE FUNCTION statement.

For more information about using functions, see Part 6 of *DB2 Application Programming and SQL Guide*.

Stored procedures

A *stored procedure* (sometimes called a *procedure*) is a routine that can be called to perform operations that can include both host language statements and SQL statements.

Procedures are classified as either SQL procedures or external procedures. SQL procedures contain only SQL statements. External procedures reference a host language program, which may or may not contain SQL statements.

A procedure is created with the CREATE PROCEDURE statement.

Procedures in SQL provide the same benefits as procedures in a host language. That is, a common piece of code need only be written and maintained once and can be called from several programs. Host languages can easily call procedures that exist on the local system. SQL can also easily call a procedure that exists on a remote system. In fact, the major benefit of procedures in SQL is that they can be used to enhance the performance characteristics of distributed applications.

For more information about using stored procedures, see Part 6 of *DB2 Application Programming and SQL Guide*.

Application processes, concurrency, and recovery

All SQL programs execute as part of an *application process*. An application process involves the execution of one or more programs, and is the unit to which DB2 allocates resources and locks. Different application processes might involve the execution of different programs, or different executions of the same program. The means of initiating and terminating an application process are dependent on the environment.

Locking, commit, and rollback

More than one application process might request access to the same data at the same time. Furthermore, under certain circumstances, an SQL statement can execute concurrently with a utility on the same table space[1]. *Locking* is used to maintain data integrity under such conditions, preventing, for example, two application processes from updating the same row of data simultaneously. See Part 5 (Volume 2) of *DB2 Administration Guide* for more information about DB2 locks.

DB2 implicitly acquires locks to prevent uncommitted changes made by one application process from being perceived by any other. DB2 will implicitly release all locks it has acquired on behalf of an application process when that process ends, but an application process can also explicitly request that locks be released sooner. A *commit* operation releases locks acquired by the application process and commits database changes made by the same process.

DB2 provides a way to *back out* uncommitted changes made by an application process. This might be necessary in the event of a failure on the part of an application process, or in a *deadlock* situation. An application process, however, can explicitly request that its database changes be backed out. This operation is called *rollback*.

The interface used by an SQL program to explicitly specify these commit and rollback operations depends on the environment. If the environment can include recoverable resources other than DB2 databases, the SQL COMMIT and ROLLBACK statements cannot be used. Thus, these statements cannot be used in an IMS, CICS, or WebSphere™ environment. Refer to Part 4 of *DB2 Application Programming and SQL Guide* for more details.

Unit of work

A *unit of work* is a recoverable sequence of operations within an application process. A unit of work is sometimes called a *logical unit of work*. At any time, an application process has a single unit of work, but the life of an application process can involve many units of work as a result of commit or full rollback operations. For an explanation of a full rollback or a partial rollback using savepoints, see “Rolling back work” on page 16.

A unit of work is initiated when an application process is initiated. A unit of work is also initiated when the previous unit of work is ended by something other than the end of the application process. A unit of work is ended by a commit operation, a full rollback operation, or the end of an application process. A commit or rollback

[1] See the description of a table space under “Storage structures” on page 11. Concurrent execution of SQL statements and utilities is discussed in Part 5 (Volume 2) of *DB2 Administration Guide*.

operation affects only the database changes made within the unit of work it ends. While these changes remain uncommitted, other application processes are unable to perceive them unless they are running with an isolation level of uncommitted read. The changes can still be backed out. Once committed, these database changes are accessible by other application processes and can no longer be backed out by a rollback. Locks acquired by DB2 on behalf of an application process that protects uncommitted data are held at least until the end of a unit of work.

The initiation and termination of a unit of work define *points of consistency* within an application process. A point of consistency is a claim by the application that the data is consistent. For example, a banking transaction might involve the transfer of funds from one account to another. Such a transaction would require that these funds be subtracted from the first account, and added to the second. Following the subtraction step, the data is inconsistent. Only after the funds have been added to the second account is consistency reestablished. When both steps are complete, the commit operation can be used to end the unit of work, thereby making the changes available to other application processes. Figure 2 illustrates this concept.

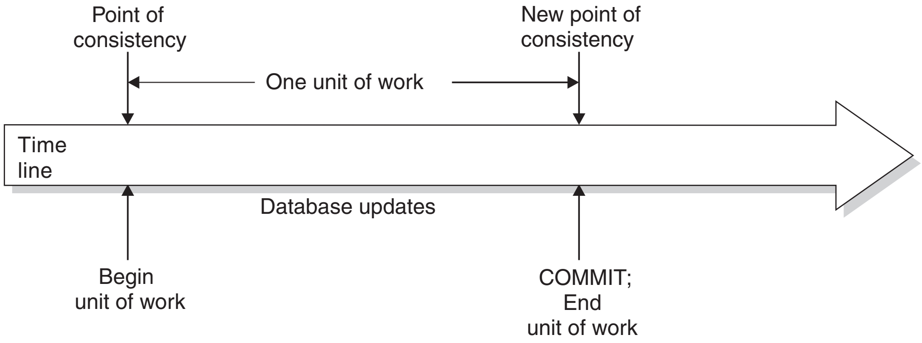


Figure 2. Unit of work with a commit operation

Unit of recovery

A *DB2 unit of recovery* is a recoverable sequence of operations executed by DB2 for an application process. If a unit of work involves changes to other recoverable resources, the unit of work will be supported by other units of recovery. If relational databases are the only recoverable resources used by the application process, then the scope of the unit of work and the unit of recovery are the same and either term can be used.

Rolling back work

DB2 can back out all changes made in a unit of recovery or only selected changes. Only backing out all changes results in a point of consistency.

Rolling back all changes

The SQL ROLLBACK statement without the TO SAVEPOINT clause specified causes a full rollback operation. If such a rollback operation is successfully executed, DB2 backs out uncommitted changes to restore the data consistency that existed when the unit of work was initiated. That is, DB2 *undoes* the work, as shown in Figure 3 on page 17:

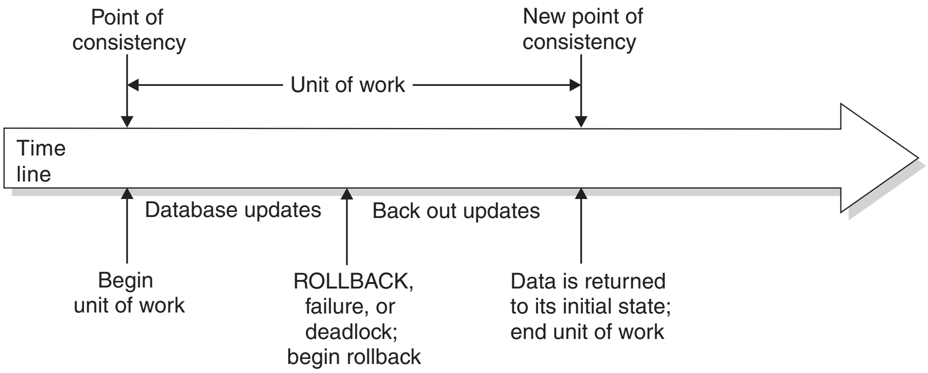


Figure 3. Rolling back all changes from a unit of work

Rolling back selected changes using savepoints

A *savepoint* represents the state of data at some particular time during a unit of work. An application process can set savepoints within a unit of work, and then as logic dictates, roll back only the changes that were made after a savepoint was set. For example, part of a reservation transaction might involve booking an airline flight and then a hotel room. If a flight gets reserved but a hotel room cannot be reserved, the application process might want to undo the flight reservation without undoing any database changes made in the transaction prior to making the flight reservation. SQL programs can use the SQL SAVEPOINT statement to set savepoints, the SQL ROLLBACK statement with the TO SAVEPOINT clause to undo changes to a specific savepoint or the last savepoint that was set, and the SQL RELEASE SAVEPOINT statement to delete a savepoint. Figure 4 illustrates this concept.

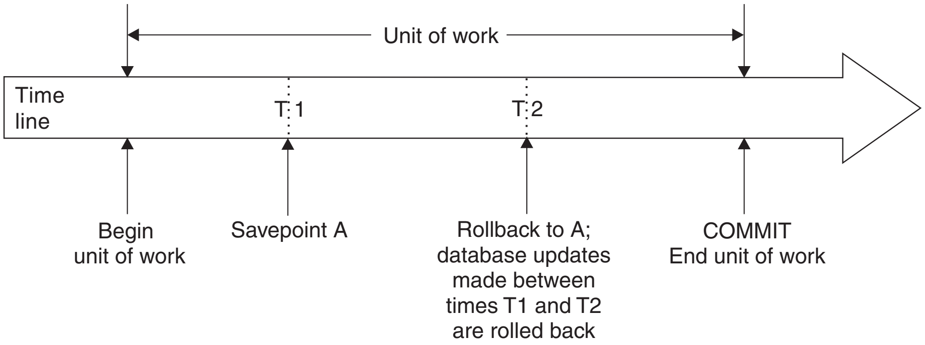


Figure 4. Rolling back changes to a savepoint within a unit of work

Packages and application plans

A *package* contains control structures used to execute SQL statements. Packages are produced during program preparation. The control structures can be thought of as the bound or operational form of SQL statements taken from a *database request module (DBRM)*. The DBRM contains SQL statements extracted from the source program during program preparation. All control structures in a package are derived from the SQL statements embedded in a single source program.

An *application plan* relates an application process to a local instance of DB2, specifies processing options, and contains one or both of the following *elements*:

- A list of package names
- The bound form of SQL statements taken from one or more DBRMs

Every DB2 application requires an application plan. Plans and packages are created using the DB2 subcommands BIND PLAN and BIND PACKAGE, respectively, as described in *DB2 Command Reference*. See Part 5 of *DB2 Application Programming and SQL Guide* for a description of program preparation and identifying packages at run time. Refer to “SET CURRENT PACKAGESET” on page 1074 or “SET CURRENT PACKAGE PATH” on page 1070 for rules regarding the selection of a plan or package element.

Distributed data

A *distributed relational database* consists of a set of tables and other objects that are spread across different, but interconnected, computer systems. Each computer system has a relational database manager, such as DB2, that manages the tables in its environment. The database managers communicate and cooperate with each other in a way that allows a DB2 application program to use SQL to access data at any of the computer systems. The DB2 subsystem where the application plan is bound is known as the *local DB2 subsystem*. Any database server other than the local DB2 subsystem is considered a *remote database server*, and access to its data is a distributed operation.

Distributed relational databases are built on formal requester-server protocols and functions. An *application requester* component supports the application end of a connection. It transforms an application’s database request into communication protocols that are suitable for use in the distributed database network. These requests are received and processed by an *application server* component at the database server end of the connection. Working together, the application requester and application server handle the communication and location considerations so that the application is isolated from these considerations and can operate as if it were accessing a local database.

For more information on Distributed Relational Database Architecture™ (DRDA®) communication protocols, see *Open Group Technical Standard, DRDA Version 3 Vol. 1: Distributed Relational Database Architecture*.

Connections

An application process must be connected to the application server facility of a database manager before SQL statements that reference tables or views can be executed. A *connection* is an association between an application process and a local or remote database server. Connections are managed by applications. An application can use the CONNECT statement to establish a connection to a database server and make that database server the current server of the application process.

Commit processing: When DB2 UDB for z/OS acts as a requester, it negotiates with the database server during the connection process to determine how to perform commits. If the remote server does not support two-phase commit protocol, DB2 downgrades to perform one-phase commits. Otherwise, DB2 always performs two-phase commits, which allow applications to update one or more databases in a single unit of work and are more reliable than one-phase commits. Two-phase commit is a two-step process:

1. First, all database managers involved in the same unit of work are polled to determine whether they are ready to commit.

2. Then, if all database managers respond positively, they are directed to execute commit processing. If all database managers do not respond positively, they are directed to execute backout processing.

DB2 can also provide coordination for transactions that include both two-phase commit resources and one-phase commit resources. If an application has multiple connections to several different database servers, and if any of the connections are one-phase commit connections, then only one database that is involved in the transaction can be updated. The connections to all the other databases that are involved in the transaction are read-only.

Supported SQL statements and clauses: For the most part, an application can use the statements and clauses that are supported by the database manager of the current server, even though that application might be running via the application requester of a database manager that does not support some of those statements and clauses. Restrictions to this general rule for DB2 UDB for z/OS are documented in *IBM DB2 Universal Database SQL Reference for Cross-Platform Development*.

To execute a static SQL statement that references tables or views, the bound form of the statement is used. This bound statement is taken from a package that the database manager previously created through a bind operation.

Distributed unit of work

The *distributed unit of work facility* provides for the remote preparation and execution of SQL statements. An application process at computer system A can connect to a database server at computer system B and, within one or more units of work, execute any number of static or dynamic SQL statements that reference objects at B. All objects referenced in a single SQL statement must be managed by the same database server. Any number of database servers can participate in the same unit of work, and any number of connections can exist between an application process and a database server. A commit or rollback operation ends the unit of work.

Connection management

At any time:

- An SQL connection is in one of the following states:
  - Current and held
  - Current and release-pending
  - Dormant and held
  - Dormant and release-pending
- An application process is in the connected or unconnected state, and has a set of zero or more SQL connections. Each SQL connection is uniquely identified by the name of the database server at the other end of the connection. Only one SQL connection is active (current) at a time.

Initial state of an application process: An application process is initially in the connected state, and it has exactly one SQL connection. The server of that connection is the local DB2 subsystem.

Initial state of an SQL connection: An SQL connection is initially in the current and held state.

Figure 5 on page 20 shows the state transitions:

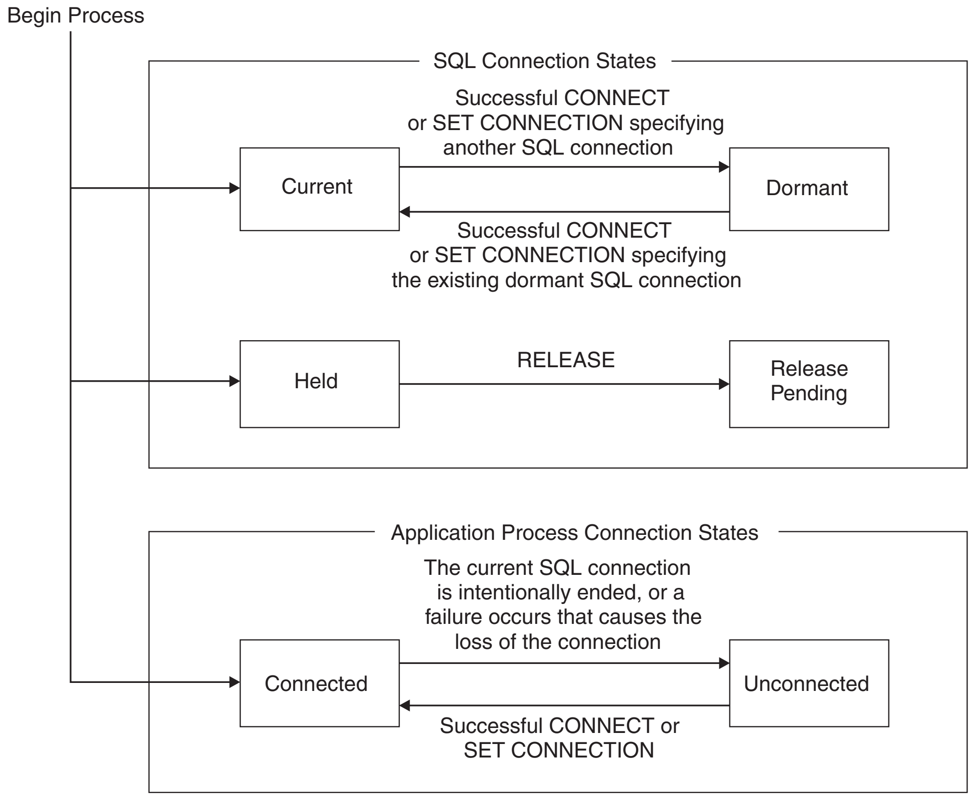

Begin Process
SQL Connection States
Successful CONNECT or SET CONNECTION specifying another SQL connection
Current
Dormant
Successful CONNECT or SET CONNECTION specifying the existing dormant SQL connection
Held
RELEASE
Release Pending
Application Process Connection States
The current SQL connection is intentionally ended, or a failure occurs that causes the loss of the connection
Connected
Unconnected
Successful CONNECT or SET CONNECTION

Figure 5. State transitions for an SQL connection and an application process connection in a distributed unit of work

SQL connection states

If an application process successfully executes a CONNECT statement:

- The current connection is placed in the dormant and held state.
- The new connection is placed in the current and held state.
- The location name is added to the set of existing connections.

If the location name is already in the set of existing connections, an error is returned.

An SQL connection in the dormant state is placed in the current state using:

- The SET CONNECTION statement, or
- The CONNECT statement, if the SQLRULES(DB2) bind option is in effect.

When an SQL connection is placed in the current state, the previously-current SQL connection, if any, is placed in the dormant state. No more than one SQL connection in the set of existing connections of an application process can be current at any time. Changing the state of an SQL connection from current to dormant or from dormant to current has no effect on its held or release-pending state.

An SQL connection is placed in the release-pending state by the RELEASE statement. When an application process executes a commit operation, every release-pending connection of the process is ended. Changing the state of an SQL connection from held to release-pending has no effect on its current or dormant state. Thus, an SQL connection in the release-pending state can still be used until the next commit operation. No way exists to change the state of a connection from release-pending to held.

Application process connection states

A connection to a different database server can be established by the explicit or implicit execution of a CONNECT statement. The following rules apply:

- An application process cannot have more than one SQL connection to the same database server at the same time.
- When an application process executes a SET CONNECTION statement, the specified location name must be in the set of existing connections of the application process.
- When an application process executes a CONNECT statement and the SQLRULES(STD) bind option is in effect, the specified location must not be in the set of existing connections of the application process.

If an application process has a current SQL connection, the application process is in a *connected* state. The CURRENT SERVER special register contains the name of the database server of the current SQL connection. The application process can execute SQL statements that refer to objects managed by that server. If the server is a DB2 subsystem, the application process can also execute certain SQL statements that refer to objects managed by a DB2 subsystem with which that server can establish a connection.

An application process in an unconnected state enters a connected state when it successfully executes a CONNECT or SET CONNECTION statement.

If an application process does not have a current SQL connection, the application process is in an *unconnected* state. The CURRENT SERVER special register contains blanks. The only SQL statements that can be executed successfully are CONNECT, RELEASE, COMMIT, ROLLBACK, and any of the following local SET statements.

- SET CONNECTION
- SET CURRENT APPLICATION ENCODING SCHEME
- SET CURRENT PACKAGE PATH
- SET CURRENT PACKAGESET
- SET *host-variable* = CURRENT APPLICATION ENCODING SCHEME
- SET *host-variable* = CURRENT PACKAGESET
- SET *host-variable* = CURRENT SERVER

(Because the application process is in an unconnected state, a COMMIT or ROLLBACK is processed by the local DB2 subsystem.)

An application process in a connected state enters an unconnected state when its current SQL connection is intentionally ended, or the execution of an SQL statement is unsuccessful because of a failure that causes a rollback operation at the current server and loss of the SQL connection. SQL connections are intentionally ended when an application process successfully executes a commit operation and either of the following are true:

- The SQL connection is in the release-pending state.
- The SQL connection is not in the release-pending state, but it is a remote connection and either of the following are true:
  - The DISCONNECT(AUTOMATIC) bind option is in effect, or

  - The DISCONNECT(CONDITIONAL) bind option is in effect and an open WITH HOLD cursor is not associated with the connection.

An implicit CONNECT to a default DB2 subsystem is executed when an application process executes an SQL statement other than COMMIT, CONNECT TO, CONNECT RESET, SET CONNECTION, RELEASE, or ROLLBACK, and if all of the following conditions apply:

- The CURRENTSERVER bind option was specified when creating the application plan of the application process and the identified server is not the local DB2.
- An explicit CONNECT statement has not already been successfully or unsuccessfully executed by the application process.
- An implicit connection has not already been successfully or unsuccessfully executed by the application process. An implicit connection occurs as the result of execution of an SQL statement that contains a three-part name in a package that is bound with the DBPROTOCOL(DRDA) option.

If the implicit CONNECT fails, the application process is placed in an *unconnected* state.

When a connection is ended

When a connection is ended, all resources that were acquired by the application process through the connection and all resources that were used to create and maintain the connection are returned to the connection pool. For example, if application process P placed the connection to application server X in the release-pending state, all cursors of P at X are closed and returned to the connection pool when the connection is ended during the next commit operation.

When a connection is ended as a result of a communications failure, the application process is placed in an unconnected state.

All connections of an application process are ended when the process ends.

Remote unit of work

The *remote unit of work facility* also provides for the remote preparation and execution of SQL statements, but in a much more restricted fashion than the distributed unit of work facility. An application process at computer system A can connect to a database server at computer system B and, within one or more units of work, execute any number of static or dynamic SQL statements that reference objects at B. All objects referenced in a single SQL statement must be managed by the same database server, and all SQL statements in the same unit of work must be executed by the same database server. However, unlike a distributed unit of work, an application process can have only one connection at a time. The process cannot connect to a new server until it executes a commit or rollback operation on the current server to end that unit of work. This restricts the situations in which a CONNECT statement can be executed.

Connection management

An application process is in one of four states at any time:

- Connectable and connected
- Unconnectable and connected
- Connectable and unconnected
- Unconnectable and unconnected

Initial state of an application process: An application process is initially in the connectable and connected state. The database server to which the application process is connected is determined by a product-specific option that may involve an implicit CONNECT operation. An implicit connect operation cannot occur if an implicit or explicit connect operation has already successfully or unsuccessfully occurred. Thus, an application process cannot be implicitly connected to a database server more than once. Other rules for implicit connect operations are product-specific.

Figure 6 shows the state transitions:

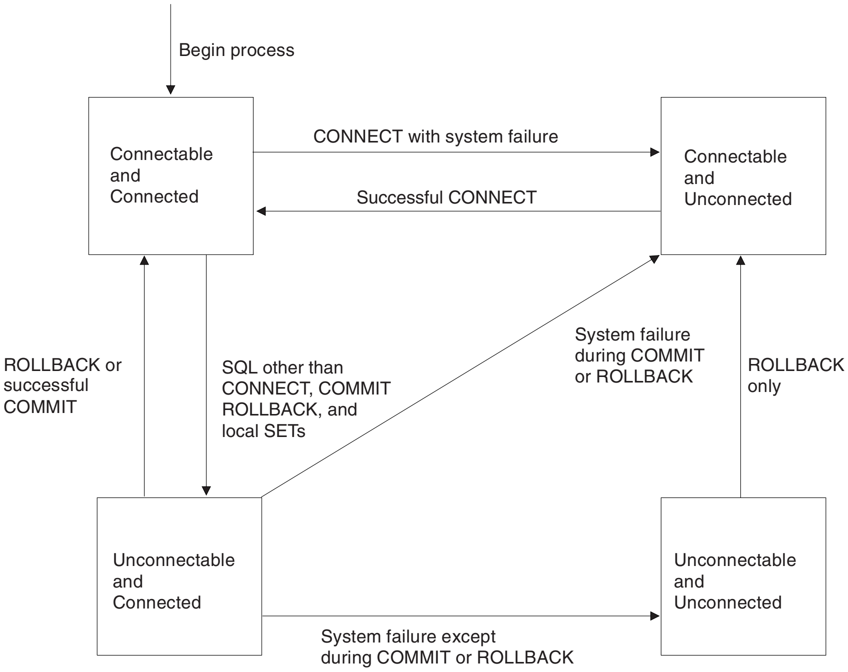

Begin process
Connectable and Connected
CONNECT with system failure
Successful CONNECT
Connectable and Unconnected
ROLLBACK or successful COMMIT
SQL other than CONNECT, COMMIT ROLLBACK, and local SETs
System failure during COMMIT or ROLLBACK
ROLLBACK only
Unconnectable and Connected
Unconnectable and Unconnected
System failure except during COMMIT or ROLLBACK

Figure 6. State transitions for an application process connection in a remote unit of work

In the following descriptions of application process connections, CONNECT can mean:

- CONNECT TO
- CONNECT RESET
- CONNECT *authorization*

It cannot mean CONNECT with no operand, which is used to return information about the current server.

Consecutive CONNECT statements can be executed successfully because CONNECT does not remove an application process from the connectable state. A CONNECT statement does not initiate a new unit of work; a unit of work is initiated by the first SQL statement that accesses data. CONNECT cannot execute successfully when it is preceded by any SQL statement other than CONNECT, COMMIT, RELEASE, ROLLBACK, or SET CONNECTION. To avoid an error, execute a commit or rollback operation before a CONNECT statement is executed.

Connectable and connected state: In the connectable and connected state, an application process is connected to a database server, and CONNECT statements that target the current server can be executed. An application process re-enters this state when either of the following is true:

- The process completes a rollback or a successful commit from an unconnectable and connected state.

- The process successfully executes a CONNECT statement from a connectable and unconnected state.

Unconnectable and connected state: In the unconnectable and connected state, an application process is connected to a database server, and only a CONNECT statement with no operands can be executed. An application process enters this state from a connectable and connected state when it executes any SQL statement other than CONNECT, COMMIT, or ROLLBACK.

Connectable and unconnected state: In the connectable and unconnected state, an application process is not connected to a database server. The only SQL statement that can be executed is CONNECT. An application process enters this state if either of the following is true:

- The process does not successfully execute a CONNECT statement from a connectable and connected state.
- The process executes a COMMIT statement when the SQL connection is in a release-pending state.
- A system failure occurs during a COMMIT or ROLLBACK from an unconnectable and connected state.
- The process executes a ROLLBACK statement from an unconnectable and unconnected state.

Other product-specific reasons can also cause an application process to enter the connectable and unconnected state.

Unconnectable and unconnected state: In the unconnectable and unconnected state, an application process is not connected to a database server and CONNECT statements cannot be executed. The only SQL statement that can be executed is ROLLBACK. An application process enters this state from an unconnectable and connected state as a result of a system failure, except during a COMMIT or ROLLBACK, at the server.

Character conversion

A *string* is a sequence of bytes that can represent characters. Within a string, all the characters are represented by a common encoding representation. In some cases, it might be necessary to convert these characters to a different encoding representation. The process of conversion is known as *character conversion*. Character conversion, when required, is automatic, and when successful, it is transparent to the application.

In client/server environments, character conversion can occur when an SQL statement is executed remotely. Consider, for example, these two cases:

- The values of data sent from the requester to the current server
- The values of data sent from the current server to the requester

In either case, the data could have a different representation at the sending and receiving systems.

Conversion can also occur during string operations on the same system, as in the following examples:

- An overriding CCSID is specified.

  For example, an SQL statement with a descriptor, which requires an SQLDA. In the SQLDA, the CCSID is in the SQLNAME field for languages other than REXX, and in the SQLCCSID field for REXX. (For more information, see Appendix E, "SQL descriptor area (SQLDA)," on page 1173). A DECLARE VARIABLE statement can also be issued to associate a CCSID with the host variables into which data is retrieved from a table.

- The value of the ENCODING bind option (static SQL statements) or the CURRENT APPLICATION ENCODING SCHEME special register (for dynamic SQL) is different than encoding scheme of the data being retrieved.
- A mixed character string is assigned to an SBCS column or host variable.
- An SQL statement refers to data that is defined with different CCSIDs.

The text of an SQL statement is also subject to character conversion because it is a character string.

The following list defines some of the terms used for character conversion.

ASCII Acronym for American Standard Code for Information Interchange, an encoding scheme used to represent characters. The term ASCII is used throughout this book to refer to IBM-PC Data or ISO 8-bit data.

character set
A defined set of characters, a character being the smallest component of written language that has semantic value. For example, the following character set appears in several code pages:

- 26 nonaccented letters A through Z
- 26 nonaccented letters a through z
- digits 0 through 9
- . , : ; ? ( ) ' " / – _ & + % * = < >

code page
A set of assignments of characters to code points. For example, in EBCDIC, "A" is assigned code point X'C1', and "B" is assigned code point X'C1'. In Unicode UTF-8, "A" is assigned code point X'41', and "B" is assigned code point X'42'. Within a code page, each code point has only one specific meaning.

code point
A unique bit pattern that represents a character. It is a numerical index or position in an encoding table used for encoding characters.

coded character set
A set of unambiguous rules that establishes a character set and the one-to-one relationships between the characters of the set and their coded representations. It is the assignment of each character in a character set to a unique numeric code value.

coded character set identifier (CCSID)
A two-byte, unsigned binary integer that uniquely identifies an encoding scheme and one or more pairs of character sets and code pages.

EBCDIC
Acronym for Extended Binary-Coded Decimal Interchange Code, an encoding scheme used to represent character data, a group of coded character sets that consist of 8-bit coded characters. EBCDIC coded character sets use the first 64 code positions (X'00' to X'3F') for control codes. The range X'41' to X'FE' is used for single-byte characters. For double-byte characters, the first byte is in the range X'41' to X'FE' and the second byte is also in the range X'41' to X'FE', while X'4040' represents a double-byte space.

encoding scheme

A set of rules used to represent character data. All string data stored in a table must use the same encoding scheme and all tables within a table space must use the same encoding scheme, except for global temporary tables, declared temporary tables, and work file table spaces. DB2 supports these encoding schemes:

- ASCII
- EBCDIC
- Unicode

substitution character

A unique character that is substituted during character conversion for any characters in the source encoding representation that do not have a match in the target encoding representation.

Unicode

A universal encoding scheme for written characters and text that enables the exchange of data internationally. It provides a character set standard that can be used all over the world. It provides the ability to encode all characters used for the written languages of the world and treats alphabetic characters, ideographic characters, and symbols equivalently because it specifies a numeric value and a name for each of its characters. It includes punctuation marks, mathematical symbols, technical symbols, geometric shapes, and dingbats. DB2 supports these two encoding forms:

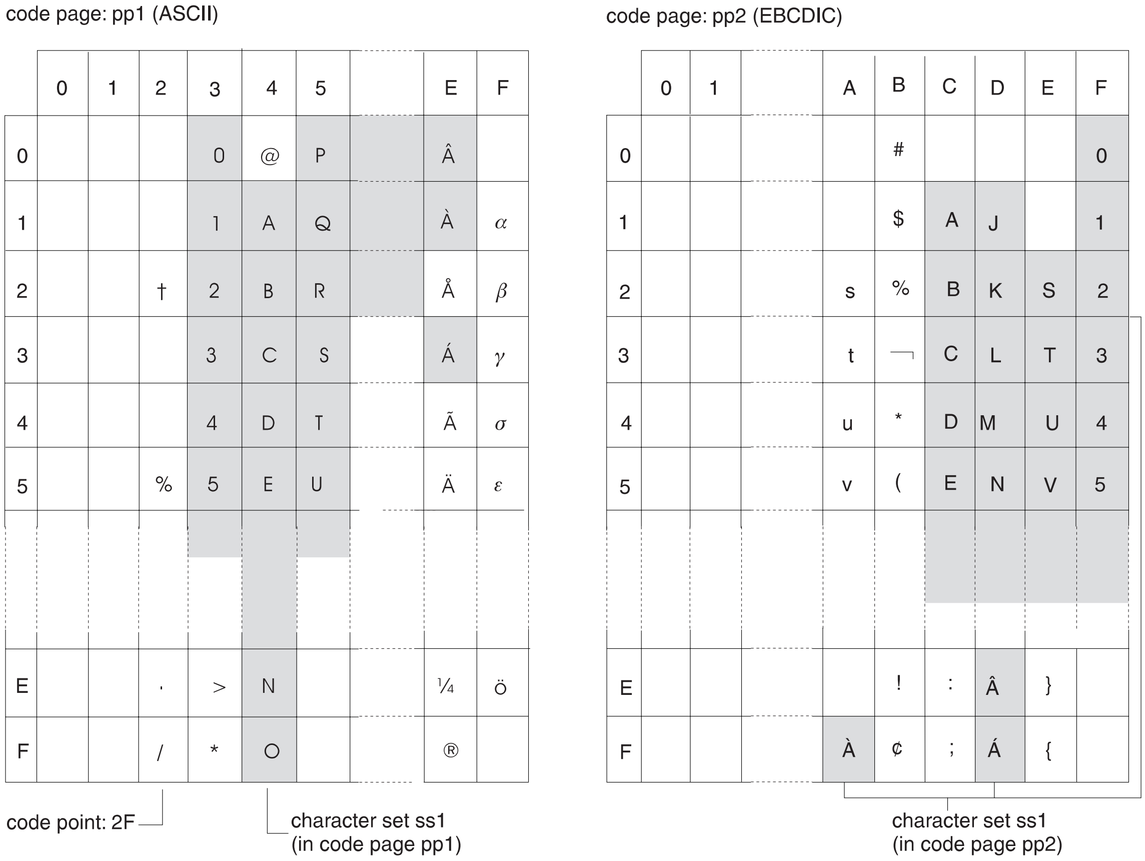
- UTF-8: Unicode Transformation Format, a 8-bit encoding form designed for ease of use with existing ASCII-based systems. UTF-8 can encode any of the Unicode characters. A UTF-8 character is 1,2,3, or 4 bytes in length. A UTF-8 data string can contain any combination of SBCS and MBCS data, including supplementary characters. The CCSID value for data in UTF-8 format is 1208.
- UTF-16: Unicode Transformation Format, a 16-bit encoding form designed to provide code values for over a million characters and a superset of UCS-2. UTF-16 can encode any of the Unicode characters. In UTF-16 encoding, characters are 2 bytes in length, except for supplementary characters, which take two 2-byte code units per character. The CCSID value for data in UTF-16 format is 1200.

Character data (CHAR, VARCHAR, and CLOB) is encoded in Unicode UTF-8. Character strings are also used for mixed data (that is a mixture of single-byte characters and multi-byte characters) and for data that is not associated with any character set (called bit data). Graphic data (GRAPHIC, VARCHAR, and DBCLOB) is encoded in Unicode UTF-16. For a comparison of some UTF-8 and UTF-16 code points for some sample characters, see Figure 9 on page 28. This table shows how a UTF-8 character can be 1 to 4 bytes in length, a non-supplementary UTF-16 character is 2 bytes in length, and how a supplementary character in either UTF-8 or UTF-16 takes two 2-byte code points.

Character conversion can affect the results of several SQL operations. In this book, the effects are described in:
“Conversion rules for string assignment” on page 80
“Conversion rules for operations that combine strings” on page 89
“Character conversion in unions and concatenations” on page 413

Character sets and code pages

Figure 7 shows how a typical character set might map to different code points in two different code pages.



code page: pp1 (ASCII)

	0	1	2	3	4	5		E	F
0				0	@	P		Â	
1				1	A	Q		À	α
2			†	2	B	R		Å	β
3				3	C	S		Á	γ
4				4	D	T		Ã	σ
5			%	5	E	U		Ä	ε
E			·	>	N			¼	ö
F			/	*	O			®	

code point: 2F

character set ss1
(in code page pp1)

code page: pp2 (EBCDIC)

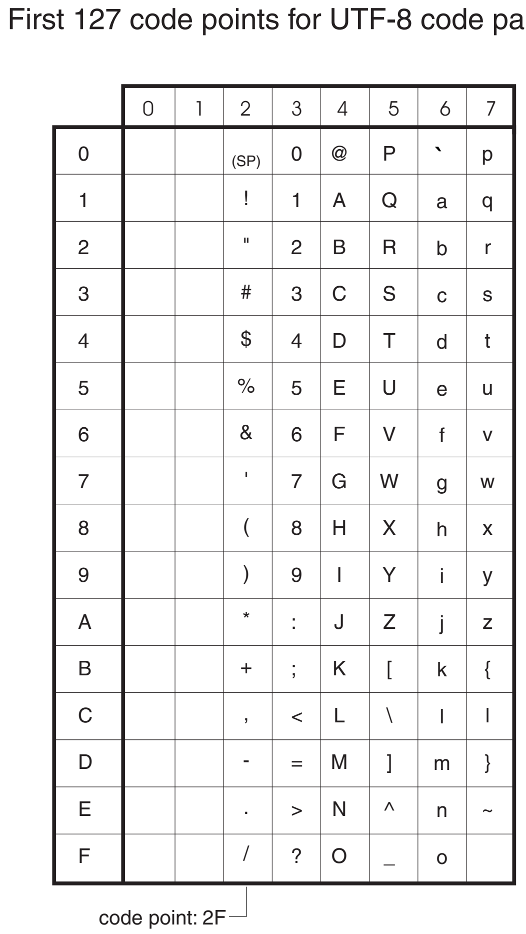
	0	1		A	B	C	D	E	F
0					#				0
1					$	A	J		1
2				s	%	B	K	S	2
3				t	¬	C	L	T	3
4				u	*	D	M	U	4
5				v	(	E	N	V	5
E					!	:	Â	}	
F				À	¢	;	Á	{	

character set ss1
(in code page pp2)

Figure 7. Code page mappings for character set ss1 in ASCII and EBCDIC

Even with the same encoding scheme, different CCSIDs exist, and the same code point can represent a different character in different CCSIDs. Furthermore, a byte in a character string does not necessarily represent a character from a single-byte character set (SBCS).

For Unicode, there is only one CCSID for UTF-8 and only one CCSID for UTF-16. Figure 8 on page 28 shows how the first 127 single code points for UTF-8 are the same as ASCII with a CCSID of 367. For example, in both UTF-8 and ASCII CCSID 367, an A is X'41' and a 1 is X'31'.



First 127 code points for UTF-8 code page

	0	1	2	3	4	5	6	7
0			(SP)	0	@	P	`	p
1			!	1	A	Q	a	q
2			"	2	B	R	b	r
3			#	3	C	S	c	s
4			$	4	D	T	d	t
5			%	5	E	U	e	u
6			&	6	F	V	f	v
7			'	7	G	W	g	w
8			(	8	H	X	h	x
9			)	9	I	Y	i	y
A			*	:	J	Z	j	z
B			+	;	K	[	k	{
C			,	<	L	\	l	|
D			-	=	M	]	m	}
E			.	>	N	^	n	~
F			/	?	O	_	o	

code point: 2F

Figure 8. Code point mapping for the first 127 code points for UTF-8 single-byte characters (CCSID 1200)

Figure 9 shows a comparison of how some UTF-16 and UTF-8 code points map to some sample characters. The character for the eighth note musical symbol takes two 2-byte code points because it is a supplementary character.

Character glyph	UTF-8 code point	UTF-16 code point
M	4D	004D
Ä	C384	00C4
事	E4BA8B	4E8B
♪	F09D85A0	D834DD60

Figure 9. A comparison of how some UTF-8 and UTF-16 code points map to some sample characters

Character encoding for IBM systems is described in *Character Data Representation Architecture Reference and Registry*. For more information on Unicode, see the Unicode standards Web site at http://www.unicode.org.

Coded character sets and CCSIDs

IBM's Character Data Representation Architecture (CDRA) deals with the differences in string representation and encoding. The *Coded Character Set Identifier (CCSID)* is a key element of this architecture. A CCSID is a 2-byte (unsigned) binary number that uniquely identifies an encoding scheme and one or more pairs of character sets and code pages.

A CCSID is an attribute of strings, just as length is an attribute of strings. All values of the same string column have the same CCSID.

Character conversion is described in terms of CCSIDs of the source and target. With DB2 UDB for z/OS, two methods are used to identify valid source and target combinations and to perform the conversion from one coded character set to another:

- DB2 catalog table SYSIBM.SYSSTRINGS

  Each row in the catalog table describes a conversion from one coded character set to another.
- z/OS support for Unicode

  For more information about the conversion services that are provided, including a complete list of the IBM-supplied conversion tables, see *z/OS Support for Unicode: Using Conversion Services*.

In some cases, no conversion is necessary even though the strings involved have different CCSIDs.

Different types of conversions may be supported by each database manager. Round-trip conversions attempt to preserve characters in one CCSID that are not defined in the target CCSID so that if the data is subsequently converted back to the original CCSID, the same original characters result. Enforced subset match conversions do not attempt to preserve such characters. Which type of conversion is used for a specific source and target CCSID is product-specific.

For more information on character conversion, see Appendix A of *DB2 Installation Guide*.

Determining the encoding scheme and CCSID of a string

An encoding scheme and a CCSID are attributes of strings, just as length is an attribute of strings. All values of the same string column have the same encoding scheme and CCSID.

Every string has an encoding scheme and a CCSID that identifies the manner in which the characters in the string are encoded. Strings can be encoded in ASCII, EBCDIC, or Unicode.

The CCSID that is associated with a string value depends on the SQL statement in which the data is referenced and the type of expression. Table 1 on page 30 describes the rules for determining the CCSID that is associated with a string value. The SQL statement operates with a single set of CCSIDs (SBCS, mixed, and graphic) if the SQL statement does not contain any of the following:

- References to columns from multiple tables or views that are defined with CCSIDs from more than one set of CCSIDs (SBCS, mixed, and graphic)
- GX or UX string constants
- References to the XMLCLOB built-in function

- CAST specifications with a CCSID clause
- User-defined table functions

In addition, the SQL statement must not be one of the following statements:

- CALL statement
- SET assignment statement
- SET special register
- VALUE statement
- VALUES INTO statement

If all of these conditions are true, use the second column of Table 1 to determine the CCSID for a string value. Otherwise, use the third column of the table.

Table 1. Rules for determining the CCSID that is associated with string data

Source of the string data	Type 1 rules	Type 2 rules
String constant	If the statement references a table or view, the encoding scheme of that table or view determines the encoding scheme for the string constant. Otherwise, the default EBCDIC encoding scheme is used for the string constant. The CCSID is the appropriate character string CCSID for the encoding scheme.	The CCSID is the appropriate character string CCSID for the application encoding scheme.[1]
Hexadecimal string constant (X'...')	If the statement references a table or view, the encoding scheme of that table or view determines the encoding scheme for the string constant. Otherwise, the default EBCDIC encoding scheme is used for the string constant. The CCSID is the appropriate graphic string CCSID for the encoding scheme.	The CCSID is the appropriate character string CCSID for the application encoding scheme.[1]
Graphic string constant (G'...')	If the statement references a table or view, the encoding scheme of that table or view determines the encoding scheme for the graphic string constant. Otherwise, the default EBCDIC encoding scheme is used for the graphic string constant. The CCSID is the graphic string CCSID for the encoding scheme.	The CCSID is the graphic string CCSID for the application encoding scheme.[1]
Graphic hexadecimal constant (GX'...')	Not applicable.	The CCSID is the graphic string CCSID for the application encoding scheme, which must be ASCII or EBCDIC.
Hexadecimal Unicode string constant (UX'....')	Not applicable.	The CCSID is 1200 (UTF-16).

Table 1. Rules for determining the CCSID that is associated with string data (continued)

Source of the string data	Type 1 rules	Type 2 rules
Special register	If the statement references a table or view, the encoding scheme of that table or view determines the encoding scheme for the special register. Otherwise, the default EBCDIC encoding scheme is used for the special register. The CCSID is the appropriate character string CCSID for the encoding scheme.	The CCSID is the appropriate CCSID for the application encoding scheme.[1]
Column of a table	The CCSID is the CCSID that is associated with the column of the table.	The CCSID is the CCSID that is associated with the column of the table.
Column of a view	The CCSID is the CCSID of the column of the result table of the fullselect of the view definition.	The CCSID is the CCSID of the column of the result table of the fullselect of the view definition.
Expression	The CCSID is the CCSID of the result of the expression.	The CCSID is the CCSID of the result of the expression.
Result of a built-in function	If the description of the function, in Chapter 3, "Functions," on page 189, indicates what the CCSID of the result is, the CCSID is that CCSID. Otherwise, if the description of the function refers to this table for the CCSID, the CCSID is the appropriate CCSID of the CCSID set that is used by the statement for the data type of the result..	If the description of the function, in Chapter 3, "Functions," on page 189, indicates what the CCSID of the result is, the CCSID is that CCSID. Otherwise, if the description of the function refers to this table for the CCSID, the CCSID is the appropriate CCSID of the application encoding scheme for the data type of the result.[1]
Parameter of a user-defined routine	The CCSID is the CCSID that was determined when the function or procedure was created.	The CCSID is the CCSID that was determined when the function or procedure was created.
The expression in the RETURN statement of a CREATE statement for a user-defined SQL scalar function	If the expression in the RETURN statement is string data, the encoding scheme is the same as for the parameters of the function. The CCSID is determined from the encoding scheme and the attributes of the data.	The CCSID is determined from the CCSID of the result of the expression specified in the RETURN statement.
String host variable	If the statement references a table or view, the encoding scheme of that table or view determines the encoding scheme for the host variable. Otherwise, the default EBCDIC encoding scheme is used for the host variable. The CCSID is the appropriate CCSID for the data type of the host variable.	At bind time, the CCSID is the appropriate CCSID for the data type of the host variable for the application encoding scheme. At run time, the CCSID specified in the DECLARE VARIABLE statement, or as an override in the SQLDA. Otherwise, the CCSID is the appropriate CCSID for the data type of the host variable for the application encoding scheme.

Notes:

1. If the context is within a check constraint or trigger package, the CCSID is the appropriate CCSID for Unicode instead of the application encoding scheme.

The following examples show how these rules are applied.

Example 1: Assume that the default encoding scheme for the installation is EBCDIC and that the installation does not support mixed and graphic data. The following statement conforms to the rules for Type 1 in Table 1 on page 30. Therefore, the X'40' is interpreted as EBCDIC SBCS data because the statement references a table that is in EBCDIC. The CCSID for X'40' is the default EBCDIC SBCS CCSID for the installation.

```
SELECT * FROM EBCDIC_TABLE WHERE COL1 = X'40';
```

The result of the query includes each row that has a value in column COL1 that is equal to a single EBCDIC blank.

Example 2: The following statement references data from two different tables that use different encoding schemes. This statement does not conform to the rules for Type 1 statements in Table 1 on page 30. Therefore, the rules for Type 2 statements is used. The CCSID for X'40' is dependent on the current application encoding scheme. Assuming that the current application encoding scheme is EBCDIC, X'40' represents a single EBCDIC blank.

```
SELECT * FROM EBCDIC_TABLE, UNICODE_TABLE WHERE COL1 = X'40';
```

As with Example 1, the result of the query includes each row that has a value in column COL1 that is equal to a single EBCDIC blank. If the current application encoding scheme were ASCII or Unicode, X'40' would represent something different and the results of the query would be different.

Expanding conversions

An *expanding conversion* occurs when the length of the converted string is greater than that of the source string. For example, an expanding conversion occurs when an ASCII mixed data string that contains DBCS characters is converted to EBCDIC mixed data. To prevent the loss of data on expanding conversions, use a varying-length string variable with a maximum length that is sufficient to contain the expansion.

Expanding conversions also can occur when string data is converted to or from Unicode. It can also occur between UTF-8 and UTF-16, depending on the data being converted. UTF-8 uses 1, 2, 3, or 4 bytes per character. UTF-16 uses 2 bytes per character, except for supplementary characters, which use two 2-byte code points for each character. If UTF-8 were being converted to UTF-16, a 1-byte character would be expanded to 2 bytes.

Contracting conversions

A *contracting conversion* occurs when the length of the converted string is smaller than that of the source string. For example, a contracting conversion occurs when an EBCDIC mixed data string that contains DBCS characters is converted to ASCII mixed data due to the removal of shift codes.

Contracting conversions also can occur when string data is converted to or from Unicode data. It can also occur between UTF-8 and UTF-16, depending on the data being converted.

Chapter 2. Language elements

This chapter defines the basic syntax of SQL and language elements that are common to many SQL statements.

Characters

The basic symbols of keywords and operators in the SQL language are *characters* that are classified as letters, digits, or special characters:

- A *letter* is any of the 26 uppercase (A through Z) and 26 lowercase (a through z) letters of the English alphabet plus the three characters reserved as alphabetic extenders for national languages ($, #, and @).[2]
- A *digit* is any one of the characters 0 through 9.
- A *special character* is any character other than a letter or a digit.

Tokens

The basic syntactical units of the language are called *tokens*. A token consists of one or more characters of which none are blanks, control characters, or characters within a string constant or delimited identifier.

Tokens are classified as *ordinary* or *delimiter* tokens:

- An *ordinary token* is a numeric constant, an ordinary identifier, a host identifier, or a keyword.

  Examples:

  ```
  1       .1      +2      SELECT      E      3
  ```

- A *delimiter token* is a string constant, a delimited identifier, an operator symbol, or any of the special characters shown in the syntax diagrams. A question mark (?) is also a delimiter token when it serves as a parameter marker, as explained in “PREPARE” on page 995.

  Examples:

  ```
  ,       'string'       "fld1"       =       .
  ```

Spaces: A *space* is a sequence of one or more blank characters.

Control characters: A *control character* is a special character that is used for string alignment. Treated similar to a space, a control character does not cause a particular action to occur. Table 2 shows the control characters that DB2 recognizes and their hexadecimal values:

Table 2. Hexadecimal values for the control characters that DB2 recognizes

Control character	EBCDIC hex value	Unicode hex value
Tab	05	09
Form feed	0C	0C
Carriage return	0D	0D
New line or next line	15	C285
Line feed (new line)	25	0A

[2] $, # and @ are supported for any CCSID. However, for compatibility with previous releases of DB2, DB2 accepts code points X'5B', X'7B' and X'7C' for $, # and @ even if the CCSID that is specified is not 37 or 500. z/OS also recognizes these special characters in those code points so existing applications can continue to use them.

Tokens, other than string constants and certain delimited identifiers, must not include a control character or space. A control character or space can follow a token. A delimiter token, control character, or a space must follow every ordinary token. If the syntax does not allow a delimiter token to follow an ordinary token, a control character or a space must follow that ordinary token.

Comments in SQL statements: SQL statements can include host language comments or SQL comments. Either type of comment can be specified wherever a space is valid, except within a delimiter token or between the keywords EXEC and SQL. For more information on host language comments, see Part 2 of *DB2 Application Programming and SQL Guide*. SQL comments are subject to the following rules:

- The two hyphens must be on the same line, not separated by a space.
- Comments cannot be continued on the next line.
- Within a statement embedded in a COBOL program, the two hyphens must be preceded by a blank unless they begin a line.
- In Java, SQL comments are not allowed within embedded Java expressions.

This example shows how to include comments in a statement:

```
EXEC SQL CREATE VIEW PRJ_MAXPER   -- projects with most support personnel
  AS SELECT PROJNO, PROJNAME      -- number and name of project
       FROM DSN8810.PROJ
       WHERE DEPTNO = 'E21'       -- systems support dept code
         AND PRSTAFF > 1
END-EXEC.
```

Uppercase and lowercase: A token in an SQL statement can include lowercase letters, but a lowercase letter in an ordinary token is folded to uppercase. However, it is only folded to uppercase in a C or Java program if the appropriate precompiler option is specified. Delimiter tokens are never folded to uppercase.

Example: The statement:

```
select * from DSN8810.EMP where lastname = 'Smith';
```

is equivalent, after folding, to:

```
SELECT * FROM DSN8810.EMP WHERE LASTNAME = 'Smith';
```

Identifiers

An *identifier* is a token used to form a name. An identifier in an SQL statement is an SQL identifier or a host identifier. See Appendix A, “Limits in DB2 UDB for z/OS,” on page 1145 for the identifier length limits that DB2 imposes.

SQL identifiers

SQL identifiers can be *ordinary identifiers* or *delimited identifiers*.

Ordinary identifiers

An *ordinary identifier* is an uppercase letter followed by zero or more characters, each of which is an uppercase letter, a digit, or the underscore character. An ordinary identifier should not be a reserved word. For a list of reserved words, see Appendix B, “Reserved schema names and reserved words,” on page 1151. If a reserved word is used as an identifier in SQL, it must be specified in uppercase and must be a delimited identifier or specified in a host variable.

An SQL ordinary identifier, when used as the name of an alias, column, constraint, correlation, cursor, distinct type, index, schema, sequence, statement, storage group, stored procedure, synonym, table, trigger, user-defined function, or view, can be specified using either DBCS characters or *single-byte character set* (SBCS) characters. However, an SQL ordinary identifier cannot contain a mixture of SBCS and DBCS characters.

The following list shows the rules for forming SQL ordinary identifiers that contain DBCS characters:

- The identifier, if encoded in EBCDIC, must start with a shift-out (X'0E') and end with a shift-in (X'0F'). There must be an even number of bytes between the shift-out and the shift-in. An odd-numbered byte between those shifts must not be a shift-out. DBCS blanks (X'4040' in EBCDIC) are not acceptable between the shift-out and the shift-in.
- The UTF-8 representation of the name must not exceed 128 bytes.
- The identifiers are not folded to uppercase or changed in any other way.
- Continuation to the next line is not allowed.

Example: The following example is an ordinary identifier:

```
SALARY
```

Delimited identifiers

A *delimited identifier* is a sequence of one or more characters enclosed within escape characters. The escape character is the quotation mark (") except for:

- Dynamic SQL when the field SQL STRING DELIMITER on installation panel DSNTIPF is set to the quotation mark (") and either of these conditions is true:
  - DYNAMICRULES run behavior applies. For a list of the DYNAMICRULES bind option values that specify run, bind, define, or invoke behavior, see Table 3 on page 51.
  - DYNAMICRULES bind, invoke, or define behavior applies and installation panel field USE FOR DYNAMIC RULES is YES.

  In this case, the escape character is the apostrophe (').

  However, for COBOL application programs, if DYNAMICRULES run behavior does not apply and installation panel field USE FOR DYNAMICRULES is NO, a COBOL compiler option specifies whether the escape character is the quotation mark or apostrophe.
- Static SQL in COBOL application programs. A COBOL compiler option specifies whether the escape character is the quotation mark (") or the apostrophe (').

A delimited identifier can be used when the sequence of characters does not qualify as an ordinary identifier. Such a sequence, for example, could be an SQL reserved word, or it could begin with a digit. Two consecutive escape characters are used to represent one escape character within the delimited identifier. A delimited identifier that contains EBCDIC DBCS characters also must contain the necessary shift characters.

Leading and embedded blanks in the sequence are significant. Trailing blanks in the sequence are not significant. The length of a delimited identifier does not include the escape characters.

Example: If the escape character is the quotation mark, the following example is a delimited identifier:

“VIEW”

Host identifiers

A *host identifier* is a name declared in the host program. The rules for forming a host identifier are the rules of the host language. In non-Java programs, do not use names beginning with ’DB2’, ’SQ’[3], ’SQL’, ’sql’, ’RDI’, or ’DSN’ because precompilers generate host variable names that begin with these characters. In Java, do not use names beginning with ’__sJT_’.

Restrictions for distributed access

DB2’s internal processing of distributed access must sometimes convert certain identifiers between CCSIDs. If there is any possibility that certain identifiers will be used in distributed access, restrict the identifiers to characters whose representation in Unicode UTF-8 have code points in the range 0 through 127. The identifiers are *authorization-name*, *procedure-name*, and *schema-name*. You do not need to enter the identifiers in Unicode; this restriction refers to conversion that DB2 performs internally.

Naming conventions

The rules for forming a name depend on the type of the object designated by the name. The syntax diagrams use different terms for different types of names. The following list defines these terms.

alias-name
A qualified or unqualified name that designates an alias, table, or view. An alias name designates an alias when it is preceded by the keyword ALIAS, as in CREATE ALIAS, DROP ALIAS, COMMENT ON ALIAS, and LABEL ON ALIAS. In all other contexts, an alias name designates a table or view. For example, COMMENT ON ALIAS A specifies a comment about the alias A, whereas COMMENT ON TABLE A specifies a comment about the table or view designated by A.

authorization-name
An SQL identifier that designates a set of privileges. It can also designate a user or group of users, but DB2 does not control this property. See “Authorization IDs and authorization-names” on page 49 for the distinction between an authorization name and an authorization ID.

aux-table-name
A qualified or unqualified name that designates an auxiliary table. The rules for the name are the same as the rules for *table-name*. See “table-name” on page 44.

bpname
A name that identifies a buffer pool. The following list shows the names of the different buffer pool sizes.

4KB	BP0, BP1, BP2, ..., BP49
8KB	BP8K0, BP8K1, BP8K2, ..., BP8K9
16KB	BP16K0, BP16K1, BP16K2, ..., BP16K9
32KB	BP32K, BP32K1, BP32K2, ..., BP32K9

built-in-type
A qualified or unqualified name that identifies an IBM-supplied data type. A qualified name is SYSIBM followed by a period and the name of the built-in

[3] ’SQ’ is allowed in C, COBOL, and REXX.

data type. An unqualified name has an implicit qualifier, the schema name, which is determined by the rules in "Qualification of unqualified object names" on page 47.

catalog-name
An SQL identifier that designates an integrated catalog facility catalog. The identifier must start with a letter and must not include special characters.

collection-id
An SQL identifier that identifies a collection of packages, such as a collection ID as a qualifier for a package ID. Refer to Chapter 1 of *DB2 Command Reference* for naming conventions.

column-name
A qualified or unqualified name that designates a column of a table or view.

A qualified column name is a qualifier followed by a period and an SQL identifier. The qualifier is a table name, a view name, a synonym, an alias, or a correlation name. unqualified column name is an SQL identifier.

condition-name
An SQL identifier that designates a condition in an SQL procedure, A condition-name must not be a delimited identifier that includes lowercase letters or special characters.

constraint-name
An SQL identifier that designates a primary key, check, referential, or unique constraint on a table.

correlation-name
An SQL identifier that designates a table, a view, or individual rows of a table or view.

cursor-name
An SQL identifier that designates an SQL cursor. In SQLJ, cursor-name is a host variable (with no indicator variable) that identifies an instance of an iterator.

database-name
An SQL identifier that designates a database. The identifier must start with a letter and must not include special characters.

descriptor-name
A host identifier that designates an SQL descriptor area (SQLDA). See "References to host variables" on page 119 for a description of a host identifier. A descriptor name never includes an indicator variable.

distinct-type-name
A qualified or unqualified name that designates a distinct type.

A qualified distinct type name is a two-part name. The first part is the schema name of the distinct type. The second part is an SQL identifier. A period must separate each of the parts. An unqualified distinct type name is an SQL identifier with an implicit qualifier. The implicit qualifier is the schema name, which is determined by the context in which the unqualified name appears as described by the rules in "Qualification of unqualified object names" on page 47.

An unqualified distinct type name is an SQL identifier with an implicit qualifier. The implicit qualifier is the schema name, which is determined by the context in which the distinct type appears as described by the rules in "Qualification of unqualified object names" on page 47.

external-program-name
A name that specifies the program that runs when the function is invoked or the procedure name is specified in a CALL statement.

function-name
A qualified or unqualified name that designates a user-defined function, a cast function that was generated when a distinct type was created, or a built-in function.

A qualified function name is a two-part name. The first part is the schema name of the function. The second part is an SQL identifier. A period must separate each of the parts.

An unqualified function name is an SQL identifier with an implicit qualifier. The implicit qualifier is the schema name, which is determined by the context in which the unqualified name appears as described by the rules in "Qualification of unqualified object names" on page 47.

host-label
A token that designates a label in a host program.

host-variable
A sequence of tokens that designates a host variable. A host variable includes at least one host identifier, as explained in "References to host variables" on page 119.

index-name
A qualified or unqualified name that designates an index.

A qualified index name is an authorization ID or schema name followed by a period and an SQL identifier.

An unqualified index name is an SQL identifier with an implicit qualifier. The implicit qualifier is an authorization ID, which is determined by the context in which the unqualified name appears as described by the rules in "Qualification of unqualified object names" on page 47.

For an index on a declared temporary table, the qualifier must be SESSION.

label
An SQL identifier that designates a label in an SQL procedure. A label must not be a delimited identifier that includes lowercase letters or special characters.

location-name
An SQL identifier of 1 to 16 bytes, that does not include alphabetic extenders, lowercase letters, or Katakana characters. The characters allowed in the delimited form are the same as those allowed in the ordinary form.

package-name
A qualified or unqualified name that designates a package. The unqualified form of a package-name is an SQL identifier. A package-name must not be a delimited identifier that includes lowercase letters or special characters. A package-name in an SQL statement must be qualified. In some contexts outside of SQL, a package name can be specified as an unqualified name.

parameter-name
An SQL identifier that designates a parameter in an procedure or function. A parameter-name must not be a delimited identifier that includes lowercase letters or special characters.

plan-name
An SQL identifier that designates an application plan. The identifier must not be a delimited identifier that includes lowercase letters or special characters.

procedure-name
A qualified or unqualified name that designates a stored procedure.

A fully qualified procedure name is a three-part name. The first part is a location name that identifies the DBMS at which the procedure is stored. The second part is the schema name of the stored procedure. The third part is an SQL identifier. A period must separate each of the parts in a qualified name.

A two-part procedure name is implicitly qualified with the location name of the current server. The first part is the schema name of the stored procedure. The second part is an SQL identifier. A period must separate the two parts.

A one part, or unqualified, procedure name is an SQL identifier with two implicit qualifiers. The first implicit qualifier is the location name of the current server. The second implicit qualifier is the schema name, which is determined by the context in which the unqualified name appears, as described by the rules in “Qualification of unqualified object names” on page 47.

The SQL identifier in a qualified or unqualified name must not be an asterisk (*).

program-name
An SQL identifier that designates an exit routine.

savepoint-name
An identifier that designates a savepoint.

schema-name
An SQL identifier that designates a schema. A *schema-name* that is used as a qualifier of the name of an object is often also an authorization ID. The objects that are qualified with a schema name are distinct types, stored procedures, triggers, sequences, and user-defined functions. Built-in data types and built-in functions are also qualified with a schema name.

sequence-name
A qualified or unqualified name that designates a sequence.

A qualified sequence name is a two-part name. The first part is the schema name. The second part is an SQL identifier. A period must separate each of the parts.

A one-part or unqualified sequence name is an SQL identifier with an implicit qualifier. The implicit qualifier is an authorization ID, which is determined by the context in which the unqualified name appears as described by the rules in “Qualification of unqualified object names” on page 47.

server-name
An SQL identifier that designates an application server. The identifier must start with a letter and must not include lowercase letters or special characters.

specific-name

A qualified or unqualified name that designates a unique name for a user-defined function.

A qualified specific name is a two-part name. The first part is the schema name. The second part is an SQL identifier, and it must not be an asterisk (*). A period must separate each of the parts.

An unqualified specific name is an SQL identifier with an implicit qualifier. The implicit qualifier is the schema name, which is determined by the context in which the unqualified name appears as described by the rules in "Qualification of unqualified object names" on page 47.

A specific name can be used to identify a function to alter, comment on, drop, grant privileges on, revoke privileges from, or be the source function for another function. A specific name cannot be used to invoke a function. In addition to being used in certain SQL statements, a specific name must be used in DB2 commands to uniquely identify a function.

SQL-label

An SQL identifier that designates a label in an SQL procedure. An SQL label must not be a delimited identifier that includes lowercase letters or special characters.

SQL-parameter-name

A qualified or unqualified name that designates a parameter in the SQL routine body of an SQL procedure or SQL function. The unqualified form of an SQL parameter-name must not be a delimited identifier that includes lowercase letters or special characters. The qualified form is a function-name or procedure-name followed by a period and an SQL identifier.

SQL-variable-name

A qualified or unqualified name that designates a variable in the SQL routine body of an SQL procedure. The unqualified form of an SQL variable name is an SQL identifier. An SQL-variable name must not be a delimited identifier that includes lowercase letters or special characters. The qualified form is an SQL label followed by a period and an SQL identifier.

statement-name

An SQL identifier that designates a prepared SQL statement.

stogroup-name

An SQL identifier that designates a storage group.

synonym

An SQL identifier that designates a synonym, a table, or a view. The table or view must exist at the current server. A synonym designates a synonym when it is preceded by the keyword SYNONYM, as in CREATE SYNONYM and DROP SYNONYM. In all other contexts, a synonym designates a local table or view and can be used wherever the name of a table or view can be used in an SQL statement. A qualified name is never interpreted as a synonym.

table-name

A qualified or unqualified name that designates a table.

A fully qualified table name is a three-part name. The first part is a location name that designates the DBMS at which the table is stored. The second part is the authorization ID that designates the owner of the table or a schema name. The third part is an SQL identifier. A period must separate each of the parts.

A two-part table name is implicitly qualified by the location name of the current server. The first part is the authorization ID that designates the owner of the table or a schema name. The second part is an SQL identifier. A period must separate the two parts.

A one-part or unqualified table name is an SQL identifier with two implicit qualifiers. The first implicit qualifier is the location name of the current server. The second is an authorization ID, which is determined by the rules set forth in "Qualification of unqualified object names" on page 47. For a declared temporary table, the qualifier that designates the owner (the second part in a three-part name and the first part in a two-part name) must be SESSION. For complete details on specifying a name when a declared temporary table is defined and then later referring to that declared temporary table in other SQL statements, see "DECLARE GLOBAL TEMPORARY TABLE" on page 824.

table-space-name

An SQL identifier that designates a table space of an identified database. The identifier must start with a letter and must not include special characters. If a database is not identified, DSNDB04 is implicit.

trigger-name

A qualified or unqualified name that designates a trigger.

A qualified trigger name is a two-part name. The first part is the schema name of the trigger. The second part is an SQL identifier. A period must separate each of the parts.

An unqualified trigger name is an SQL identifier with an implicit qualifier. The implicit qualifier is the schema name, which is determined by the context in which the unqualified name appears as described by the rules in "Qualification of unqualified object names" on page 47.

version-id

An identifier[4] of 1 to 64 bytes that is assigned to a package when the package is created. The version ID that is assigned is taken from the version ID associated with the program being bound. Version IDs are specified for programs as a parameter of the DB2 precompiler. Refer to Chapter 1 of *DB2 Command Reference* for naming conventions.

view-name

A qualified or unqualified name that designates a view.

A fully qualified view name is a three-part name. The first part is a location name that designates the DBMS where the view is defined. The second part is the authorization ID that designates the owner of the view. The third part is an SQL identifier. A period must separate each of the parts.

A two-part view name is implicitly qualified by the location name of the current server. The first part is the authorization ID that designates the owner of the view. The second part is an SQL identifier. A period must separate the two parts.

A one-part or unqualified view name is an SQL identifier with two implicit qualifiers. The first implicit qualifier is the location name of the current

[4] The *version-id* can begin with a digit, for example, when it is a timestamp.

server. The second is an authorization ID, which is determined by the context in which the unqualified name appears as described by the rules in "Qualification of unqualified object names" on page 47.

XML-attribute-name
An identifier that is used as an XML attribute name.

XML-element-name
An identifier that is used as an XML element name.

SQL path

The *SQL path* is an ordered list of schema names. DB2 uses the path to resolve the schema name for unqualified data type names (both built-in types and distinct types), function names, and stored procedure names that appear in any context other than as the main object of an ALTER, CREATE, DROP, COMMENT, GRANT or REVOKE statement. Searching through the path from left to right, DB2 implicitly qualifies the object name with the first schema name in the SQL path that contains the same object with the same unqualified name for which the user has appropriate authorization. For functions, DB2 uses a process called function resolution in conjunction with the SQL path to determine which function to choose because several functions with the same name and number of parameters but different parameter data types may be defined in the same schema or other schemas in the SQL path. (For details, see "Function resolution" on page 129.) For procedures, DB2 selects a matching procedure name only if the number of parameters is also the same.

The SQL path does not apply to unqualified procedure names in ASSOCIATE LOCATOR and DESCRIBE PROCEDURE statements. For these statements, an implicit schema name is not generated.

For example of how DB2 uses the SQL path to resolve the schema name, assume that the SQL path is SMITH, XGRAPHIC, SYSIBM, and that and an unqualified distinct type name MYTYPE was specified. DB2 looks for MYTYPE first in schema SMITH, then XGRAPHIC, and then SYSIBM.

The PATH bind option establishes the SQL path used to resolve:

- Unqualified data type and function names in static SQL statements
- Unqualified procedure names in SQL CALL statements that specify the procedure name as a literal (CALL 'literal')

If the PATH bind option was not specified when the plan or package was created or last rebound, its default value is: SYSIBM, SYSFUN, SYSPROC, *plan or package qualifier*.

The CURRENT PATH special register determines the SQL path used to resolve:

- Unqualified data type and function names in dynamic SQL statements
- Unqualified procedure names in SQL CALL statements that specify the procedure name in a host variable (CALL *host-variable*)

Generally, the initial value of the CURRENT PATH special register is one of the following:

- The value of the PATH bind option
- SYSIBM, SYSFUN, SYSPROC, *value of CURRENT SQLID special register* if the PATH bind option was not specified.

If schema SYSIBM or SYSPROC is not explicitly specified in the SQL path, the schema is implicitly assumed at the front of the path; if both are not specified, they are assumed in the order of SYSIBM, SYSPROC. For example, assume that the SQL path is explicitly specified as SYSIBM, GEORGIA, SMITH. As an implicitly assumed schema, SYSPROC is added to the beginning of the explicit path effectively making the path:

```
SYSPROC, SYSIBM, GEORGIA, SMITH
```

For more information about the SQL path for dynamic SQL, see “CURRENT PATH” on page 105 and “SET PATH” on page 1087.

Qualification of unqualified object names

Unqualified object names are implicitly qualified. The rules for qualifying a name differ depending on the type of object that the name identifies.

Unqualified alias, index, sequence, table, trigger, and view names

Unqualified alias, index, sequence, table, trigger, and view names are implicitly qualified as follows:

- For static SQL statements, the implicit qualifier is the identifier specified in the QUALIFIER option of the BIND subcommand used to bind the SQL statements. If this bind option is not in effect for the plan or package, the implicit qualifier is the authorization ID of the owner of the plan or package.
- For dynamic SQL statements, the behavior as specified by the combination of bind option DYNAMICRULES and the run-time environment determines the implicit qualifier. (For a list of these behaviors and the DYNAMICRULES values that determine them, see Table 3 on page 51).
  - If DYNAMICRULES *run behavior* applies, the implicit qualifier is the schema in the CURRENT SCHEMA special register. Run behavior is the default.
  - If *bind behavior* applies, the identifier implicitly or explicitly specified in the QUALIFIER option of the BIND subcommand, as explained above for static SQL statements.
  - If *define behavior* applies, the implicit qualifier is the owner of the function or stored procedure (the owner is the definer).
  - If *invoke behavior* applies, the implicit qualifier is the authorization ID of the invoker of the function or stored procedure.

  Exception: For bind, define, and invoke behavior, the implicit qualifier of PLAN_TABLE, DSN_STATEMNT_TABLE, and DSN_FUNCTION_TABLE (output from the EXPLAIN statement) is always the value in special register CURRENT SQLID.

Unqualified data type, function, procedure, and specific names

The qualification of data type, function, stored procedure, and specific names depends on the SQL statement in which the unqualified name appears:

- If an unqualified name is the main object of an ALTER, CREATE, COMMENT, DROP, GRANT, or REVOKE statement, the name is implicitly qualified with a schema name as follows:
  - In a static statement, the implicit schema name is the identifier specified in the QUALIFIER option of the BIND subcommand used to bind the SQL statements. If this bind option is not in effect for the plan or package, the implicit qualifier is the authorization ID of the owner of the plan or package.

- In a dynamic statement, the implicit schema name is the schema in the CURRENT SCHEMA special register.

- Otherwise, the implicit schema name for the unqualified name is determined as follows:
  - For data type names, DB2 searches the SQL path and selects the first schema in the path such that the data type exists in the schema and the user has authorization to use the data type.
  - For function names, DB2 uses the SQL path in conjunction with function resolution, as described under "Function resolution" on page 129.
  - For stored procedure names in CALL statements, DB2 searches the SQL path and selects the first schema in the path such that the schema contains a procedure with the same name and number of parameters and the user has authorization to use the procedure.
  - For stored procedure names in ASSOCIATE LOCATORS and DESCRIBE PROCEDURE statements, DB2 does not use the SQL path because an implicit schema name is not generated for these statements.

  For information on the SQL path, see "SQL path" on page 46.

Aliases and synonyms

A table or view can be referred to in an SQL statement by its name, by an alias that has been defined for its name, or by a synonym that has been defined for its name. Thus, aliases and synonyms can be thought of as alternate names for tables and views.

An alias can be defined at a local server and can refer to a table or view that is at the current server or a remote server. The alias name can be used wherever the table name or view name can be used to refer to the table or view in an SQL statement. The rules for forming an alias name are the same as the rules for forming a table name or a view name, as explained below. A fully qualified alias name (a three-part name) can refer to an alias at a remote server. However, the table or view identified by the alias at the remote server must exist at the remote server.

Statements that use three-part names and refer to distributed data result in either DRDA access to the remote site or DB2 private protocol access. DRDA access for three-part names is used when the plan or package that contains the query to distributed data is bound with bind option DBPROTOCOL(DRDA), or the value of field DATABASE PROTOCOL on installation panel DSNTIP5 is DRDA and bind option DBPROTOCOL(PRIVATE) was not specified when the plan or package was bound. When an application program uses three-part name aliases for remote objects and DRDA access, the application program must be bound at each location that is specified in the three-part names. Also, each alias needs to be defined at the local site. An alias at a remote site can refer to yet another server as long as a referenced alias eventually refers to a table or view.

The option of referencing a table or view by an alias or a synonym is not explicitly shown in the syntax diagrams or mentioned in the description of SQL statements. But they can be referred to in an SQL statement, with two exceptions: a local alias cannot be used in the CREATE ALIAS statement, and a synonym cannot be used in the CREATE SYNONYM statement. If an alias is used in the CREATE SYNONYM statement, it must identify a table or view at the current server. The synonym is defined on the name of that table or view. If a synonym is used in the CREATE ALIAS statement, the alias is defined on the name of the table or view identified by the synonym.

The effect of using an alias or a synonym in an SQL statement is that of text substitution. For example, if A is an alias for table Q.T, one of the steps involved in the preparation of SELECT * FROM A is the replacement of 'A' by 'Q.T'. Likewise, if S is a synonym for Q.T, one of the steps involved in the preparation of SELECT * FROM S is the replacement of 'S' by 'Q.T'.

The differences between aliases and synonyms are as follows:

- SYSADM or SYSCTRL authority or the CREATE ALIAS privilege is required to define an alias. No authorization is required to define a synonym.
- An alias can be defined on the name of a table or view, including tables and views that are not at the current server. A synonym can only be defined on the name of a table or view at the current server.
- An alias can be defined on an undefined name. A synonym can only be defined on the name of an existing table or view.
- Dropping a table or view has no effect on its aliases. But dropping a table or view does drop its synonyms.
- An alias is a qualified name that can be used by any authorization ID. A synonym is an unqualified name that can only be used by the authorization ID that created it.
- An alias defined at one DB2 subsystem can be used at another DB2 subsystem. A synonym can only be used at the DB2 subsystem where it is defined.
- When an alias is used, an error occurs if the name that it designates is undefined or is the name of an alias at the current server. (The alias can represent another alias at a different server, which can represent yet another alias at yet another server as long as eventually a referenced alias represents a table or view.) When a synonym is used, this error cannot occur.

Authorization IDs and authorization-names

An *authorization ID* is a character string that designates a defined set of privileges. Processes can successfully execute SQL statements only if they have the authority to perform the specified functions. A process derives this authority from its authorization IDs. An authorization ID can also designate a user or a group of users, but DB2 does not control this property.

DB2 uses authorization IDs to provide:

- Authorization checking of SQL statements
- Implicit qualifiers for database objects like aliases, indexes, sequences, tables, triggers, and views

Whenever a connection is established between DB2 and a process, DB2 obtains an authorization ID and passes it to the authorization exit. The list of one or more authorization IDs returned by the exit are used as the authorization IDs of the process.

Every process has exactly one primary authorization ID. Any other authorization IDs of a process are secondary authorization IDs. As explained below, the use of these authorization IDs depends on whether the process is a bind process or an application process.

An *authorization-name* specified in an SQL statement should not be confused with an authorization ID of a process. For example, assume that SMITH is your TSO logon, DYNAMICRULES run behavior is in effect, and you execute the following statements interactively:

```
CREATE TABLE TDEPT LIKE DSN8810.DEPT;

GRANT SELECT ON TDEPT TO KEENE;
```

Also assume that your site has not replaced the default exit routine for connection authorization and that you have not executed SET CURRENT SQLID. Thus, when the GRANT statement is prepared and executed by SPUFI, the SQL authorization ID is SMITH. KEENE is an authorization name specified in the GRANT statement.

Authorization to execute the GRANT statement is checked against SMITH, and SMITH is the implicit qualifier of TDEPT. The authorization rule is that the privilege set designated by SMITH must include the SELECT privilege with the GRANT option on SMITH.TDEPT. There is no check involving KEENE.

If SMITH is the implicit qualifier for a statement that contains NAME1, NAME1 identifies the same object as SMITH.NAME1. If the implicit qualifier is other than SMITH, NAME1 and SMITH.NAME1 identify different objects.

Authorization IDs and schema names

An authorization ID that is the same as the name of a schema implicitly has the CREATEIN, ALTERIN, and DROPIN privileges for that schema.

Authorization IDs and statement preparation

A process that creates a plan or package is called a *bind process*. The connection with DB2 is the result of the execution of a BIND or REBIND subcommand. Both subcommands allow for the specification of the authorization ID of the owner of the plan or package. The authorization ID specified as owner must be one of the authorization IDs of the process, unless one of these has SYSADM or SYSCTRL authority. In this case, the owner can be set to any value. BINDAGENT can specify an owner other than himself (or one of his representatives), but it has to be someone that granted him BINDAGENT. The default owner for BIND is the primary authorization ID. The default owner for REBIND is the previous owner of the plan or package (ownership is unchanged if an owner is not explicitly specified). BIND and REBIND are discussed in Chapter 2 of *DB2 Command Reference*.

The authorization ID used for the authorization checking of embedded SQL statements is that of the owner of the plan or package. If an embedded SQL statement refers to tables or views at a DB2 subsystem other than the one at which the plan or package is bound, the authorization checking is deferred until run time. For more information on this, see “Authorization IDs and remote execution” on page 53.

If VALIDATE(BIND) is specified, the privileges required to use or manipulate objects at the DB2 subsystem at which the plan or package is bound must exist at bind time. If the privileges or the referenced objects do not exist and SQLERROR(NOPACKAGE) is in effect, the bind operation is unsuccessful. If SQLERROR(CONTINUE) is specified, then the bind is successful and any statements in error are flagged. If any statements in error are flagged, an error will occur when you attempt to execute them at run time.

If a plan or package is bound with VALIDATE(RUN), authorization checking is still performed at bind time, but the referenced objects and the privileges required to use these objects need not exist at this time. If any privilege required for a statement does not exist at bind time, an authorization check is performed whenever the statement is first executed within a unit of work, and all privileges required for the statement must exist at that time. If any privilege does not exist, execution of the statement is unsuccessful. When the authorization check is performed at run time, it is performed against the plan or package owner, not the SQL authorization ID. For the effect of this option on cursors, see “DECLARE CURSOR” on page 812.

Authorization IDs and dynamic SQL

This discussion applies to dynamic SQL statements that refer to objects at the current server. For those that refer to objects elsewhere, see “Authorization IDs and remote execution” on page 53.

Bind option DYNAMICRULES determines the authorization ID that is used for checking authorization when dynamic SQL statements are processed. In addition, the option also controls other dynamic SQL attributes such as the implicit qualifier that is used for unqualified alias, index, sequence, table, trigger, and view names; the source for application programming options; and whether certain SQL statements can be invoked dynamically.

The set of values for the authorization ID and other dynamic SQL attributes is called the dynamic SQL statement *behavior*. The four possible behaviors are run, bind, define, and invoke. As Table 3 shows, the combination of the value of the DYNAMICRULES bind option and the run-time environment determines which of behavior is used. DYNAMICRULES(RUN), which implies run behavior, is the default.

Table 3. How DYNAMICRULES and the run-time environment determine dynamic SQL statement behavior

	Behavior of dynamic SQL statements	
DYNAMICRULES value	**Stand-alone program environment**	**User-defined function or stored procedure environment**
RUN	Run behavior	Run behavior
BIND	Bind behavior	Bind behavior
DEFINERUN	Run behavior	Define behavior
DEFINEBIND	Bind behavior	Define behavior
INVOKERUN	Run behavior	Invoke behavior
INVOKEBIND	Bind behavior	Invoke behavior

Note: BIND and RUN values can be specified for both packages and plans. The other values can be specified only for packages.

In the following behavior descriptions, a package that *runs under* a user-defined function or stored procedure package is a package whose associated program meets one of the following conditions:

- The program is called by a user-defined function or stored procedure.
- The program is in a series of nested calls that start with a user-defined function or stored procedure.

Run behavior

DB2 uses the authorization ID of the application process and the SQL authorization ID (the value of special register CURRENT SQLID) for authorization checking of dynamic SQL statements.

A process that uses a plan and its associated packages is called an *application process*. At any time, the SQL authorization ID is the value of CURRENT SQLID. This SQL special register can be initialized by the connection or sign-on exit routine. If the exit does not set a value, the initial value of CURRENT SQLID is the primary authorization ID of the process. You can use the SQL statement SET CURRENT SQLID to change the value of CURRENT SQLID. Unless some authorization ID of the process has SYSADM authority, the new value must be one of the authorization IDs of the process. Thus, CURRENT SQLID usually contains either the primary authorization ID of the process or one of its secondary authorization IDs.

Privilege set: If the dynamically prepared statement is other than an ALTER, CREATE, COMMENT, DROP, GRANT, RENAME, or REVOKE statement, each privilege required for the statement can be a privilege designated by any authorization ID of the process. Therefore, the privilege set is the union of the set of privileges held by each authorization ID.

If the dynamic SQL statement is an ALTER, CREATE, COMMENT, DROP, GRANT, RENAME, or REVOKE statement, the only authorization ID that is used for authorization checking is the SQL authorization ID. Therefore, the privilege set is the privileges held by that single authorization ID of the process.

Implicit qualification: As explained under “Qualification of unqualified object names” on page 47, when an SQL statement is dynamically prepared, the SQL authorization ID is also used as the implicit qualifier for all unqualified tables, aliases, views, indexes, and sequences.

Bind behavior

The same rules that are used to determine the authorization ID for static (embedded) statements are used for dynamic statements. DB2 uses the primary authorization ID of the owner of the package or plan for authorization checking of dynamic SQL statements, as explained in detail under “Authorization IDs and statement preparation” on page 50.

Privilege set: The privilege set is the privileges that are held by the primary authorization ID of the owner of the package or plan.

Implicit qualification: The identifier specified in the QUALIFIER option of the bind command that is used to bind the SQL statements is the implicit qualifier for all unqualified tables, views, aliases, indexes, and sequences. If this bind option was not used when the plan or package was created or last rebound, the implicit qualifier is the authorization ID of the owner of the plan or package.

Define behavior

Define behavior applies only if the dynamic SQL statement is in a package that is run as a stored procedure or user-defined function (or *runs under* a stored procedure or user-defined function package), and the package was bound with DYNAMICRULES(DEFINEBIND) or DYNAMICRULES(DEFINERUN). DB2 uses the authorization ID of the stored procedure or user-defined function owner (the definer) for authorization checking of dynamic SQL statements in the application package.

Privilege set: The privilege set is the privileges that are held by the authorization ID of the stored procedure or user-defined function owner.

Implicit qualification: The authorization ID of the stored procedure or user-defined function owner is also the implicit qualifier for unqualified table, view, alias, index, and sequence names.

Invoke behavior

Invoke behavior applies only if the dynamic SQL statement is in a package that is run as a stored procedure or user-defined function (or *runs under* a stored procedure or user-defined function package), and the package was bound with DYNAMICRULES(INVOKEBIND) or DYNAMICRULES(INVOKERUN). DB2 uses the authorization ID of the stored procedure or user-defined function invoker for authorization checking of dynamic SQL statements in the application package.

Privilege set: The privilege set is the privileges that are held by the authorization ID of the stored procedure or user-defined function invoker. However, if the invoker is the primary authorization ID of the process or the CURRENT SQLID value, secondary authorization IDs are also checked if they are needed for the required authorization. Therefore, in that case, the privilege set is the union of the set of privileges held by each authorization ID.

Implicit qualification: The authorization ID of the stored procedure or user-defined function invoker is also the implicit qualifier for unqualified table, view, alias, index, and sequence names.

Restricted statements when run behavior does not apply: When bind, define, or invoke behavior is in effect, you cannot use the following dynamic SQL statements: ALTER, CREATE, COMMENT, DROP, GRANT, RENAME, and REVOKE.

For more information on authorization and examples of determining authorization for dynamic SQL statements, see Part 3 of *DB2 Administration Guide*. For complete details about the DYNAMICRULES bind option, see *DB2 Command Reference*.

Authorization IDs and remote execution

The authorization rules for remote execution depend on whether the distributed operation is:

- DRDA access with a DB2 UDB for z/OS server and requester
- DRDA access with a server and requester other than DB2
- DB2 private protocol access

DRDA access with DB2 UDB for z/OS only

Any static statement executed using DRDA access is in a package bound at a server other than the local DB2. Before the package can be bound, its owner must have the BINDADD privilege and the CREATE IN privilege for the package’s collection. Also required are enough privileges to execute the package’s static SQL statements that refer to data on that server. All these privileges are recorded in the DB2 catalog of the server, not that of the local DB2. Such privileges must be granted by GRANT statements executed at the server. This allows the server to control the creation and use of packages that are run from other DBMSs.

A user who invokes an application that has a plan at the local DB2 must have the EXECUTE privilege on the plan recorded in the DB2 catalog of the requester. If the application uses a package bound at a server other than the local DB2 and the package is not a user-defined function, stored procedure, or trigger package, the plan owner must have the EXECUTE privilege on the package recorded in the DB2 catalog of the server. The plan needs no other privilege to execute the package. EXECUTE authority is also required to use a package that is a user-defined function, stored procedure, or trigger package; however, the plan owner is not the required holder of the privilege, as explained in Part 3 (Volume 1) of *DB2 Administration Guide*. In the case of trigger packages, the authorization ID of the SQL statement that activates the trigger must have the EXECUTE privilege on the trigger. Again, all these privileges must be recorded in the DB2 catalog of the server.

Having the appropriate privileges recorded as described above allows the execution of the static SQL statements in the package, and the execution of dynamic SQL statements if DYNAMICRULES bind, define, or invoke behavior is in effect. If DYNAMICRULES run behavior is in effect, the authorization rules for dynamic SQL statements is different. Authorization for the execution of dynamic SQL statements must come from the set of authorization IDs derived during connection processing. An application goes through connection processing when it first connects to a server or when it reuses a CICS or IMS thread that has a different primary authorization ID. For details on connection processing, see Part 3 (Volume 1) of *DB2 Administration Guide*.

If an application uses Recoverable Resources Manager Services attachment facility (RRSAF) and has no plan, authority to execute the package is determined in the same way as when the requester is not DB2 UDB for z/OS, which is described next under “DRDA access with a server or requester other than DB2.”

DRDA access with a server or requester other than DB2

DB2 UDB for z/OS as the server: If the requester is not a DB2 UDB for z/OS subsystem, there is no DB2 application plan involved. In this case, the privilege set of the authorization ID, which is determined by the DYNAMICRULES behavior, must have the EXECUTE privilege on the package. Dynamic SQL statements in the package are executed according to the DYNAMICRULES behavior, as described in “Authorization IDs and dynamic SQL” on page 51.

DB2 UDB for z/OS as the requester: The authorization rules for remote execution are those of the server.

DB2 private protocol access

Any statement that refers to a table or view at a DB2 subsystem other than the current server and is bound with bind option DBPROTOCOL(PRIVATE) is executed using DB2 private protocol access. Such statements are processed as deferred embedded SQL statements. The additional cost of the dynamic bind occurs once for every unit of work where the statement is executed. Authorization to execute such statements is checked against the owner of a plan or package. Authorization IDs for executing dynamic statements are handled just as they are for DRDA access. In either case, the pertinent privileges must be recorded in the catalog of the DBMS that executes the statement.

Authorization ID translations

Three authorization IDs played roles in the foregoing discussion. These are the user’s primary authorization ID and those for the owner of the application plan and the owner of a package. Each of these is sent to the remote DBMS. And each may undergo translations before it is used.

For example, a user known as SMITH at the local DBMS could be known, after translation, as JONES at the server. Likewise, a package owner known as GRAY could be known as WINTERS at the server. If so, JONES or WINTERS would be used, instead of SMITH or GRAY, to determine the authorization ID for dynamic SQL statements in the package. If the DYNAMICRULES run behavior applies, JONES, who is executing the dynamic statement at the server, is used. If DYNAMICRULES bind behavior applies, WINTERS, the package owner at the server, is used.

Two sets of communications database (CDB) catalog tables control the translations. One set is at the local DB2, and the other set is at the remote DB2. Translation can take place at either or both sites. For how to use and maintain these tables, see Part 3 (Volume 1) of *DB2 Administration Guide*.

Other security measures

The fact that DB2 authority requirements are satisfied does not guarantee that a user has access to a given server. Other security measures may also come into play. For example, requests to execute remote SQL statements could be denied based on Resource Access Control Facility (RACF®) considerations. Developing such security measures is discussed in Part 3 (Volume 1) of *DB2 Administration Guide*.

Data types

The smallest unit of data that can be manipulated in SQL is called a *value.* How values are interpreted depends on the data type of their source. The sources of values are:

Columns
Constants
Expressions
Functions
Special registers
Variables (such as host variables, SQL variables, parameter markers, and parameters of routines)

DB2 supports both IBM-supplied data types (built-in data types) and user-defined data types (distinct types). This section describes the built-in data types. For a description of distinct types, see “Distinct types” on page 69.

Figure 10 on page 56 shows the built-in data types that DB2 supports.

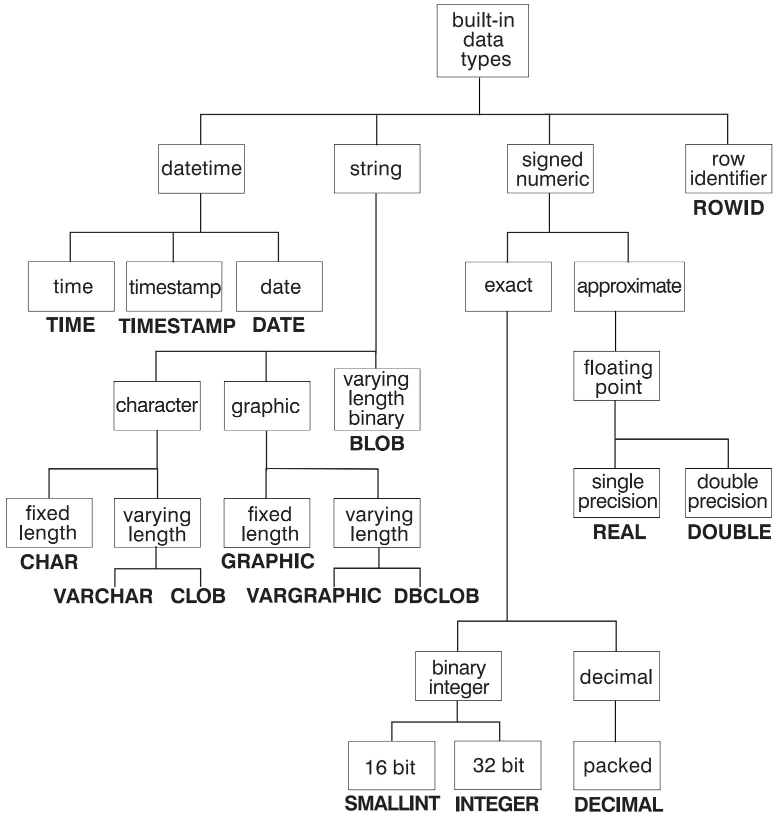


Figure 10. Built-in data types supported by DB2

Nulls

All data types include the null value. Distinct from all nonnull values, the null value is a special value that denotes the absence of a (nonnull) value. Although all data types include the null value, some sources of values cannot provide the null value. For example, constants, columns that are defined as NOT NULL, and special registers cannot contain null values; the COUNT and COUNT_BIG functions cannot return a null value; and ROWID columns cannot store a null value although a null value can be returned for a ROWID column as the result of a query.

Numbers

The numeric data types are binary integer, floating-point, and decimal. Binary integer includes small integer and large integer. Floating-point includes single precision and double precision. Binary numbers are exact representations of integers. Decimal numbers are exact representations of real numbers. Binary and decimal numbers are considered exact numeric types. Floating-point numbers are approximations of real numbers and are considered approximate numeric types.

All numbers have a sign, a precision, and a scale. If a column value is zero, the sign is positive. The precision is the total number of binary or decimal digits excluding the sign. The scale is the total number of binary or decimal digits to the right of the decimal point. If there is no decimal point, the scale is zero.

Small integer (SMALLINT)

A *small integer* is a binary integer with a precision of 15 bits. The range of small integers is -32768 to +32767.

Large integer (INTEGER)

A *large integer* is a binary integer with a precision of 31 bits. The range of large integers is -2147483648 to +2147483647.

Single precision floating-point (REAL)

A *single precision floating-point* number is a short (32 bits) floating-point number. The range of single precision floating-point numbers is about -7.2E+75 to 7.2E+75. In this range, the largest negative value is about -5.4E-79, and the smallest positive value is about 5.4E-079.

Double precision floating-point (DOUBLE or FLOAT)

A *double precision floating-point* number is a long (64 bits) floating-point number. The range of double precision floating-point numbers is about -7.2E+75 to 7.2E+75. In this range, the largest negative value is about -5.4E-79, and the smallest positive value is about 5.4E-079.

Decimal (DECIMAL or NUMERIC)

A *decimal* number is a packed decimal number with an implicit decimal point. The position of the decimal point is determined by the precision and the scale of the number. The scale, which is the number of digits in the fractional part of the number, cannot be negative or greater than the precision. The maximum precision is 31 digits.

All values of a decimal column have the same precision and scale. The range of a decimal variable or the numbers in a decimal column is -*n* to +*n*, where *n* is the largest positive number that can be represented with the applicable precision and scale. The maximum range is $1 - 10^{31}$ to $10^{31} - 1$.

Numeric host variables

Binary integer variables can be defined in all host languages.

Floating-point variables can be defined in all host languages. All languages, except Java, support System/390® floating-point format. Assembler, C, C++, and Java also support IEEE floating-point format. In assembler, C, and C++ programs, the precompiler option FLOAT tells DB2 whether floating-point variables contain data in System/390 floating-point format or IEEE floating-point format.

Decimal variables can be defined in all host languages except Fortran. In COBOL, decimal numbers can be represented in the packed decimal format used for columns or in the format denoted by DISPLAY SIGN LEADING SEPARATE.

String representations of numeric values

Values whose data types are small integer, large integer, floating-point, and decimal are stored in an internal form that is transparent to the user of SQL. However, string representations of numeric values can be used in some contexts. A valid string representation of a numeric value must conform to the rules for numeric constants. For more information, see “Constants” on page 93.

The encoding scheme in use determines what type of strings can be used for string representation of numeric values. For ASCII and EBCDIC, a string representation of a numeric value must be a character string. For UNICODE, a string representation of a numeric value can be either a character string or a graphic string. Thus, the only time a graphic string can be used for a numeric value is when the encoding scheme is UNICODE.

When a decimal or floating-point number is cast to a string (for example, with a CAST specification), the implicit decimal point is replaced by the separator character in effect when the statement was prepared. When a string is cast to a decimal or floating-point value (for example, with a CAST specification), the default decimal separator character in effect when the statement was prepared is used to interpret the string.

Character strings

A *character string* is a sequence of bytes. The length of the string is the number of bytes in the sequence. If the length is zero, the value is called the *empty string*. The empty string should not be confused with the null value.

Default CCSIDs

Table 4 shows how the value of the field MIXED DATA (on installation panel DSNTIPF) determines the default CCSIDs for a character string.

Table 4. Default CCSIDs for character strings

Encoding scheme	Value of MIXED DATA field	Default attribute
ASCII or EBCDIC	NO	Character: SBCS The value of the ASCII CODED CHAR SET or EBCDIC CODED CHAR SET field on installation panel determines the system CCSID for SBCS data.
ASCII or EBCDIC	YES	Character: MIXED The value of the ASCII CODED CHAR SET or EBCDIC CODED CHAR SET field on installation panel DSNTIPF determines the system CCSID for SBCS data, MIXED, and graphic data.
Unicode	Not applicable	Character: MIXED The CCSIDs are: • 367 for SBCS data • 1208 for MIXED data • 1200 for graphic data

Fixed-length character strings

When fixed-length character string distinct types, columns, and variables are defined, the length attribute is specified, and all values have the same length. For a fixed-length character string, the length attribute must be between 1 and 255 inclusive.

Varying-length character strings

The types of varying-length character strings are:

- VARCHAR
- CLOB

A *character large object (CLOB)* column is useful for storing large amounts of character data, such as documents written with a single character set. See “Large objects (LOBs)” on page 62.

When varying-length character strings, distinct types, columns, and variables are defined, the maximum length is specified and this length becomes the length attribute except for C NUL-terminated strings. Actual values may have a smaller value. For varying-length character strings, the length specifies the number of bytes.

For a varying-length character string, the length attribute must between 1 and 32704. For a varying-length character string column, the maximum for the length attribute is determined by the record size that is associated with the table, as described in “Maximum record size” on page 767 the description of the CREATE TABLE statement. For a CLOB string, the length attribute must be between 1 and 2 147 483 647 inclusive. (2 147 483 647 is 2 gigabytes minus 1 byte.) For more information about CLOBs, see “Large objects (LOBs)” on page 62.

Character string variables

Character string variables follow these rules:

- Fixed-length character string variables can be used in all languages except REXX and Java. In C, CHAR string variables are limited to a length of 1.
- Varying-length character string variables can be used in all host languages with the following exceptions:
  - Fortran: varying-length non-LOB character strings cannot be used.
  - Assembler, C, and COBOL: varying-length non-LOB strings are simulated as described in Part 2 of *DB2 Application Programming and SQL Guide*. In C, NUL-terminated strings can also be used.
  - REXX: CLOBs cannot be used.

Character string encoding schemes

Each character string is further defined as one of the following subtypes:

Bit data
Data that is not associated with a coded character set and, therefore, is never converted. The CCSID for bit data is X'FFFF'. The bytes do not represent characters.

SBCS data
Data in which every character is represented by a single byte. Each SBCS string has an associated CCSID. If necessary, an SBCS string is converted before it is used in an operation with a character string that has a different CCSID.

Mixed data
Data that can contain a mixture of characters from a single-byte character set (SBCS) and a multiple-byte character set (MBCS). Each mixed string has an has an associated CCSID. If necessary, a mixed string is converted before an operation with a character string that has a different CCSID. If a mixed data string contains an MBCS character, it cannot be converted to SBCS data.

EBCDIC mixed data may contain shift characters, which are not MBCS data.

When the encoding scheme is Unicode or the DB2 installation is defined to support mixed data, DB2 recognizes MBCS sequences within mixed data string when performing character sensitive operations. These operations include parsing, character conversion, and the pattern matching specified by the LIKE predicate. MBCS sequences are also recognized when the GRAPHIC precompiler option is implicitly or explicitly specified.

Character strings with a CLOB data type can only be SBCS or MIXED. BLOBs should be used for binary strings.

The method of representing DBCS and MBCS characters within a mixed string differs among the encoding schemes.

- ASCII reserves a set of code points for SBCS characters and another set as the first half of DBCS characters. Upon encountering the first half of a DBCS character, the system knows that it is to read the next byte in order to obtain the complete character.
- EBCDIC makes use of two special code points:
  - A shift-out character (X'0E') to introduce a string of DBCS characters.
  - A shift-in character (X'0F') to end a string of DBCS characters.

  DBCS sequences within mixed data strings are recognized as the string is read from left to right. At any time, the recognizer is in SBCS mode or DBCS mode. In SBCS mode, which is the initial mode, any byte other than a shift-out is interpreted as an SBCS character. When a shift-out is read, the recognizer enters DBCS mode. In DBCS mode, the next byte and every second byte after that byte is interpreted as the first byte of a DBCS character unless it is a shift character. If the byte is a shift-out, an error occurs. If the byte is a shift-in, the recognizer returns to SBCS mode. An error occurs if the recognizer is in DBCS mode after processing the last byte of the string. Because of the shift characters, EBCDIC mixed data requires more storage than ASCII mixed data.
- UTF-8 is a varying-length encoding of byte sequences. The high bits indicate the part of the sequence to which a byte belongs. The first byte indicates the number of bytes to follow in a byte sequence.

Examples

For the same mixed data character string, Table 5 shows character and hexadecimal representations of the character string in different encoding schemes. In EBCDIC, the shift-out and shift-in are needed to delineate the double-btye characters.

Table 5. Example of a character string in different encoding schemes

Data type and encoding scheme	Character representation	Hexadecimal representation (with spaces separating each character)
9 bytes in ASCII	元 gen 気 ki	8CB3 67 65 6E 8B43 6B 69
13 bytes in EBCDIC	${}^{S}_{O}$元${}^{S}_{I}$ gen ${}^{S}_{O}$気${}^{S}_{I}$ ki	0E 4695 0F 87 85 95 0E 45B9 0F 92 89
11 bytes in Unicode UTF-8	元 gen 気 ki	E58583 67 65 6E E6B097 6B 69

Because of the differences of the representation of mixed data strings in ASCII, EBCDIC, and Unicode, mixed data is not transparently portable. To minimize the effects of these differences, use varying-length strings in applications that require mixed data and operate on ASCII, EBCDIC, and Unicode data.

Graphic strings

A *graphic string* is a sequence of double-byte characters. The length of the string is the number of characters in the sequence. Like character strings, graphic strings can be empty. An empty string should not be confused with the null value.

Fixed-length graphic strings

When fixed-length graphic string distinct types, columns, and variables are defined, the length attribute is specified and all values have the same length. For a fixed-length graphic string, the length attribute must be between 1 and 127 inclusive. A fixed-length graphic string column can also be called a GRAPHIC column.

Varying-length graphic strings

The types of varying-length graphic strings are:

- VARGRAPHIC
- DBCLOB

A *double-byte character large object (DBCLOB)* column is useful for storing large amounts of double-byte character data, such as documents written with a single double-byte character set. See “Large objects (LOBs)” on page 62.

When varying-length graphic strings, distinct types, columns, and variables are defined, the maximum length is specified and this length becomes the length attribute. Actual values may have a smaller value. For a varying-length graphic string, the length attribute must between 1 and 16352. For a varying-length graphic string column, the maximum for the length attribute is determined by the record size associated with the table, as described “Maximum record size” on page 767 in the description of the CREATE TABLE statement. For a DBCLOB string, the length attribute must be between 1 and 1 073 741 823 inclusive. In UTF-16, although supplementary characters use two 2-byte code points, supplementary characters are still considered double-byte characters. For more information about DBCLOBs, see “Large objects (LOBs)” on page 62.

Graphic string variables

Variables with a graphic string type cannot be defined in Fortran. In addition, graphic string variables follow these rules:

- Fixed-length graphic string host variables can be defined in all host languages, except REXX and Java. In C, fixed-length graphic-string variables are limited to a length of 1.
- Varying-length graphic string variables can be defined in all host languages, with the exception of DBCLOBs which cannot be used in REXX.

Graphic string encoding schemes

Each graphic string can be further defined as one of the following types of data:

Double-byte data

Data in which every character is represented by a character from the double-byte character set (DBCS) that does not include shift-out or shift-in characters. Each double-byte graphic string has an associated ASCII or EBCDIC CCSID.

Unicode data

Data that contains characters represented by two bytes, except supplementary characters, which take two 2-byte code points per character. Each Unicode graphic string is encoded using UTF-16. The CCSID for UTF-16 is 1200.

Binary strings

A *binary string* (BLOB string) is a sequence of bytes. The length of a binary string is the number of bytes in the sequence. The CCSID is 0 (X'0000'). All binary strings are considered to be varying-length strings.

A BLOB column is useful for storing large amounts of non-character data, such as pictures, voice, and mixed media. Another use is to hold structured data for exploitation by distinct types, user-defined functions, and stored procedures. See "Large objects (LOBs)."

Distinct types, columns, and variables all have length attributes. When varying-length distinct types, columns, and variables are defined, the maximum length is specified and this length becomes the length attribute. Actual values may have a smaller value. For a BLOB column, the length attribute must be between 1 and 2 147 483 647 inclusive. (2 147 483 647 is 2 gigabytes minus 1 byte.)

A host variable with a BLOB string type can be defined in all host languages.

For more information about BLOBs, see "Large objects (LOBs)."

Large objects (LOBs)

The term *large object (LOB)* refers to any of the following data types:

CLOB
A *character large object (CLOB)* is a varying-length string with a maximum length of 2 147 483 647 bytes (2 gigabytes minus 1 byte). A CLOB is designed to store large SBCS data or mixed data, such as lengthy documents. For example, you can store information such as an employee resume, the script of a play, or the text of novel in a CLOB. Alternatively, you can store such information in UTF-8 in a mixed CLOB. A CLOB is a varying-length character string.

DBCLOB
A *double-byte character large object (DBCLOB)* is a varying-length string with a maximum length of 1 073 741 823 double-byte characters. A DBCLOB is designed to store large DBCS data. For example, you could store the information mentioned for CLOB (an employee resume, the script for a play, or the text of a novel) in UTF-16 in a DBCLOB. A DBCLOB is a varying-length graphic string.

BLOB
A *binary large object (BLOB)* is a varying-length string with a maximum length of 2 147 483 647 bytes (2 gigabytes minus 1 byte). A BLOB is designed to store non-traditional data such as pictures, voice, and mixed media. BLOBs can also store structured data for use by distinct types and user-defined functions. A BLOB is considered to be a binary string.

Although BLOB strings and FOR BIT DATA character strings might be used for similar purposes, the two data types are not compatible. The BLOB function can be used to change a FOR BIT DATA character string into a BLOB string.

Restrictions using LOBs

With a few exceptions, you can use LOBs in the same contexts in which you can use other varying-length strings. Table 6 shows the contexts in which LOBs cannot be used.

Table 6. Contexts in which LOBs cannot be used

Context of usage	LOB (CLOB, DBCLOB, or BLOB)
A GROUP BY clause	Not allowed
An ORDER BY clause	Not allowed
A CREATE INDEX statement	Not allowed

Table 6. Contexts in which LOBs cannot be used (continued)

Context of usage	LOB (CLOB, DBCLOB, or BLOB)
A SELECT DISTINCT statement	Not allowed
A subselect of a UNION without the ALL keyword	Not allowed
Predicates	Cannot be used in any predicate except EXISTS, LIKE, and NULL. This restriction includes a *simple-when-clause* in a CASE expression. *expression WHEN expression* in a *simple-when-clause* is equivalent to a predicate with *expression=expression*.
The definition of primary, unique, and foreign keys	Not allowed
Check constraints	Cannot be specified for a LOB column

Manipulating LOBs using locators

Because LOB values can be very large, the transfer of these values from the database server to host variables in client application programs can be time consuming. Also, application programs typically process LOB values a piece at a time, rather than as a whole. For these cases, the application can use a *large object locator* (LOB locator) to reference the LOB value.

A LOB locator is a host variable with a value that represents a single LOB value in the database server. LOB locators provide a mechanism for you to easily manipulate very large objects in application programs without having to store the entire LOB value on the client machine where the application program might be running.

For example, when selecting a LOB value, an application program could handle the value in either of these two ways:

- Select the entire LOB value and place it into an equally large host variable. This method is acceptable if the application program is going to process the entire LOB value at once.
- Select the LOB value into a LOB locator. Then, using the LOB locator, the application program can issue subsequent database operations on the LOB value (such as using it as a parameter to the scalar functions SUBSTR, CONCAT, COALESCE, LENGTH, doing an assignment, searching the LOB value with LIKE or POSSTR, or using it as a parameter to a user-defined function or procedure) by supplying the LOB locator value as input. The resulting output of the LOB locator operation, for example, the amount of data that is assigned to a client host variable, would then typically be a small subset of the input LOB value.

LOB locators can also represent more than just base values; they can also represent the value associated with a LOB expression. For example, a LOB locator might represent the value associated with:

```
SUBSTR(lob_value_1 CONCAT lob_value_2 CONCAT lob_value_3 , 42, 6000000)
```

For non-locator-based host variables in an application program, when a null value is selected into that host variable, the indicator variable is set to -1, signifying that the value is null. For LOB locators, however, the meaning of indicator variables is slightly different. Because a LOB locator host variable itself can never be null, a negative indicator variable value indicates that the LOB value represented by the LOB locator is null. The null information is kept local to the client by virtue of the indicator variable value—the server does not track null values with valid LOB locators.

A LOB locator represents a value, not a row or location in the database. Therefore, after a value is selected into a LOB locator, no action that is subsequently performed on the original row or table will affect the value that is referenced by the LOB locator. The value associated with a LOB locator is valid until the transaction ends, or until the LOB locator is explicitly freed, whichever comes first.

A LOB locator is also not a database type, and it is never stored in the database. As a result, it cannot participate in views or check constraints. However, SQLTYPES exist for LOB locators so that they can be described within an SQLDA structure that is used by FETCH, OPEN, CALL and EXECUTE statements.

For more information about manipulating LOBs with LOB locators, see Part 3 of *DB2 Application Programming and SQL Guide*.

Datetime values

The datetime data types are described in the following sections. Datetime values are neither strings nor numbers. Nevertheless, datetime values can be used in certain arithmetic and string operations and are compatible with certain strings. Moreover, strings can represent datetime values, as discussed in “String representations of datetime values” on page 65.

Date

A *date* is a three-part value (year, month, and day) designating a point in time using the Gregorian calendar, which is assumed to have been in effect from the year 1 A.D.[5] The range of the year part is 0001 to 9999. The range of the month part is 1 to 12. The range of the day part is 1 to 28, 29, 30, or 31, depending on the month and year.

The internal representation of a date is a string of 4 bytes. Each byte consists of two packed decimal digits. The first 2 bytes represent the year, the third byte the month, and the last byte the day.

The length of a DATE column as described in the catalog is the internal length, which is 4 bytes. The length of a DATE column as described in the SQLDA is the external length, which is 10 bytes unless a date exit routine was specified when your DB2 subsystem was installed. (Writing a date exit routine is described in Appendix B (Volume 2) of *DB2 Administration Guide*.) In that case, the string format of a date can be up to 255 bytes in length. Accordingly, DCLGEN[6] defines fixed-length string variables for DATE columns with a length equal to the value of the field LOCAL DATE LENGTH on installation panel DSNTIP4, or a length of 10 bytes if a value for the field was not specified.

| A character-string representation must have an actual length that is not greater than
| 255 bytes and must not be a CLOB or DBCLOB.

Time

A *time* is a three-part value (hour, minute, and second) designating a time of day using a 24-hour clock. The range of the hour part is 0 to 24. The range of the minute and second parts is 0 to 59. If the hour is 24, the minute and second parts are both zero.

[5] Historical dates do not always follow the Gregorian calendar. Dates between 1582-10-04 and 1582-10-15 are accepted as valid dates although they never existed in the Gregorian calendar.

[6] DCLGEN is a DB2 DSN subcommand for generating table declarations for designated tables or views. The declarations are stored in z/OS data sets, for later inclusion in DB2 source programs.

The internal representation of a time is a string of 3 bytes. Each byte consists of two packed decimal digits. The first byte represents the hour, the second byte the minute, and the last byte the second.

The length of a TIME column as described in the catalog is the internal length which is 3 bytes. The length of a TIME column as described in the SQLDA is the external length which is 8 bytes unless a time exit routine was specified when your DB2 subsystem was installed. (Writing a date exit routine is described in Appendix B (Volume 2) of *DB2 Administration Guide*.) In that case, the string format of a time can be up to 255 bytes in length. Accordingly, DCLGEN[6] defines fixed-length string variables for TIME columns with a length equal to the value of the field LOCAL TIME LENGTH on installation panel DSNTIP4, or a length of 8 bytes if a value for the field was not specified.

A character-string representation must have an actual length that is not greater than 255 bytes and must not be a CLOB or DBCLOB.

Timestamp

A *timestamp* is a seven-part value (year, month, day, hour, minute, second, and microsecond) that represents a date and time as defined previously, except that the time includes a fractional specification of microseconds.

The internal representation of a timestamp is a string of 10 bytes, each of which consists of two packed decimal digits. The first 4 bytes represent the date, the next 3 bytes the time, and the last 3 bytes the microseconds.

The length of a TIMESTAMP column as described in the catalog is the internal length which is 10 bytes. The length of a TIMESTAMP column as described in the SQLDA is the external length which is 26 bytes. DCLGEN therefore defines 26-byte, fixed-length string variables for TIMESTAMP columns.

A character-string representation must have an actual length that is not greater than 255 bytes and must not be a CLOB or DBCLOB.

Datetime host variables

Character-string host variables are normally used to contain date, time, and timestamp values. However, date, time, and timestamp host variables can also be specified in Java as java.sql.Date, java.sql.Time, and java.sql.Timestamp, respectively.

String representations of datetime values

Values whose data types are date, time, or timestamp are represented in an internal form that is transparent to the user of SQL. But dates, times, and timestamps can also be represented by strings. These representations directly concern the SQL user because there are no special SQL constants for datetime values and, except for Java, no host variables with a data type of date, time, or timestamp. These representations directly concern the SQL user because for many host languages there are no special SQL constants for datetime values and, except for Java, no host variables with a data type of date, time, or timestamp. Thus, to be retrieved, a datetime value must be assigned to a string variable.

The encoding scheme in use determines what type of strings may be used for string representation of datetime values. For ASCII and EBCDIC, a string representation of a datetime value must be a character string. For UNICODE, a string representation of a datetime value can be either a character string or a graphic string. Thus, the only time a graphic string can be used for a datetime value is when the encoding scheme is UNICODE.

In host languages other than Java, a datetime value must be assigned to a string variable. When a date or time is assigned to a string variable, the string format is determined by a precompiler option or subsystem parameter. When a string representation of a datetime value is used in other operations, it is converted to a datetime value. However, this can be done only if the string representation is recognized by DB2 or an exit provided by the installation and the other operand is a compatible datetime value. An input string representation of a date or time with LOCAL specified must have an actual length that is not greater than 255 bytes. The following sections describe the string formats that are recognized by DB2.

Datetime values that are represented by strings can appear in contexts requiring values whose data types are date, time, or timestamp. A string representation of a date, time or timestamp can be passed as an argument to the DATE, TIME, or TIMESTAMP function to obtain a datetime value. A CAST specification can also be used to turn a character representation of a date, time, or timestamp into a datetime value.

Date strings: A string representation of a date is a string that starts with a digit and has a length of at least 8 characters. Trailing blanks can be included, leading blanks are not allowed, and leading zeros can be omitted in the month and day portions.

Table 7 shows the valid string formats for dates. Each format is identified by name and includes an associated abbreviation (for use by the CHAR function) and an example of its use. For an installation-defined date string format, the format and length must have been specified when DB2 was installed. They cannot be listed here.

Table 7. Formats for string representations of dates

Format name	Abbreviation	Date format	Example
International Standards Organization	ISO	yyyy-mm-dd	1987-10-12
IBM USA standard	USA	mm/dd/yyyy	10/12/1987
IBM European standard	EUR	dd.mm.yyyy	12.10.1987
Japanese industrial standard Christian era	JIS	yyyy-mm-dd	1987-10-12
Installation-defined	LOCAL	Any installation-defined form	—

Note: For LOCAL, the date exit for ASCII data is DSNXVDTA, the date exit for EBCDIC is DSNXVDTX, and the date exit for Unicode is DSNXVDTU.

Time strings: A string representation of a time is a string that starts with a digit, and has a length of at least 4 characters. Trailing blanks can be included, leading blanks are not allowed, and leading zeros can be omitted in the hour part of the time; seconds can be omitted entirely. If you choose to omit seconds, an implicit specification of 0 seconds is assumed. Thus 13.30 is equivalent to 13.30.00.

Table 8 on page 67 shows the valid string formats for times. Each format is identified by name and includes an associated abbreviation (for use by the CHAR function) and an example of its use. In the case of an installation-defined time string format, the format and length must have been specified when your DB2 subsystem was installed. They cannot be listed here.

[7] This is an earlier version of the ISO format. JIS can be used to get the current ISO format.

Table 8. Formats for string representations of times

Format name	Abbreviation	Time format	Example
International Standards Organization[7]	ISO	hh.mm.ss	13.30.05
IBM USA standard	USA	hh:mm AM or PM	1:30 PM
IBM European standard	EUR	hh.mm.ss	13.30.05
Japanese industrial standard Christian era	JIS	hh:mm:ss	13:30:05
Installation-defined	LOCAL	Any installation-defined form	—

Note: For LOCAL, the date exit for ASCII data is DSNXVDTA, the date exit for EBCDIC is DSNXVDTX, and the date exit for Unicode is DSNXVDTU.

In the USA format:

- The minutes can be omitted, thereby specifying 00 minutes. For example, 1 PM is equivalent to 1:00 PM.
- The letters A, M, and P can be lowercase.
- A single blank must precede the AM or PM.
- The hour must not be greater than 12 and cannot be 0 except for the special case of 00:00 AM.

Using the ISO format of the 24-hour clock, the correspondence between the USA format and the 24-hour clock is as follows:

- 12:01 AM through 12:59 AM correspond to 00.01.00 through 00.59.00
- 01:00 AM through 11:59 AM correspond to 01.00.00 through 11.59.00
- 12:00 PM (noon) through 11:59 PM correspond to 12.00.00 through 23.59.00
- 12:00 AM (midnight) corresponds to 24.00.00
- 00:00 AM (midnight) corresponds to 00.00.00

Timestamp strings: A string representation of a timestamp is a string that starts with a digit and has a length of at least 16 characters. The complete string representation of a timestamp has the form *yyyy-mm-dd-hh.mm.ss.nnnnnn*. Trailing blanks can be included, leading blanks are not allowed, and leading zeros can be omitted in the month, day, and hour part of the timestamp; trailing zeros can be truncated or omitted entirely from microseconds. If you choose to omit any digit of the microseconds portion, an implicit specification of 0 is assumed. Thus, *1990-3-2-8.30.00.10* is equivalent to *1990-03-02-08.30.00.100000*. A timestamp whose time part is *24.00.00.000000* is also accepted.

SQL statements also support the ODBC or JDBC string representation of a timestamp as an input value only. The ODBC and JDBC string representation of a timestamp has the form *yyyy-mm-dd hh:mm:ss.nnnnnn*.

Restrictions on the use of local datetime formats

The following rules apply to the character-string representation of dates and times:

For input: In distributed operations, DB2 as a server uses its local date or time routine to evaluate host variables and literals. This means that character-string representation of dates and times can be:

- One of the standard formats
- A format recognized by the server's local date/time exit

For output: With DRDA access, DB2 as a server returns date and time host variables in the format defined at the server. With DB2 private protocol access, DB2 as a server returns date and time host variables in the format defined at the requesting system. To have date and time host variables returned in another format, use CHAR(date-expression, XXXX) where XXXX is JIS, EUR, USA, ISO, or LOCAL to explicitly specify the specific format.

For BIND PACKAGE COPY: When binding a package using the COPY option, DB2 uses the ISO format for output values unless the SQL statement explicitly specifies a different format. Input values can be specified in the format described above under “For input” on page 67.

Row ID values

A *row ID* is a value that uniquely identifies a row in a table. A column or a host variable can have a row ID data type. A ROWID column enables queries to be written that navigate directly to a row in the table because the column implicitly contains the location of the row. Each value in a ROWID column must be unique. Although the location of the row might change, for example across a table space reorganization, DB2 maintains the internal representation of the row ID value permanently. When a row is inserted into the table, DB2 generates a value for the ROWID column unless one is supplied. If a value is supplied, it must be a valid row ID value that was previously generated by DB2 and the column must be defined as GENERATED BY DEFAULT. Users cannot update the value of a ROWID column.

The internal representation of a row ID value is transparent to the user. The value is never subject to character conversion because it is considered to contain BIT data. The length of a ROWID column as described in the LENGTH column of catalog table SYSCOLUMNS is the internal length, which is 17 bytes. The length as described in the LENGTH2 column of catalog table SYSCOLUMNS is the external length, which is 40 bytes.

A ROWID column can be either user-defined or implicitly generated by DB2. You can use the CREATE TABLE statement or the ALTER TABLE statement to define a ROWID column. If you define a LOB column in a table and the table does not have a ROWID column, DB2 implicitly generates a ROWID column. DB2:

- Creates the column with a name of DB2_GENERATED_ROWID_FOR_LOBS*nn* .

  DB2 appends *nn* only if the column name already exists in the table, replacing *nn* with 00 and incrementing by 1 until the name is unique within the row.
- Defines the column as GENERATED ALWAYS.
- Appends the column to the end of the row after all the other explicitly defined columns.

An implicitly generated ROWID column is called *a hidden ROWID column*. A hidden ROWID column is not visible in SQL statements unless you refer to the column directly by name. For example, assume that DB2 generated a hidden ROWID column named DB2_GENERATED_ROWID_FOR_LOBS for table MYTABLE. The result table for a SELECT * statement for table MYTABLE would not contain that ROWID column. However, the result table for SELECT COL1, DB2_GENERATED_ROWID_FOR_LOBS would include the hidden ROWID column.

If you add a ROWID column to a table that already has a hidden ROWID column, DB2 ensures that the corresponding values in each column are identical. If the ROWID column that you add is defined as GENERATED BY DEFAULT, DB2 changes the attribute of the hidden ROWID column to GENERATED BY DEFAULT.

In a distributed data environment, the row ID data type is not supported for DB2 private protocol access. For information about using row IDs, see *DB2 Application Programming and SQL Guide*.

XML values

An *XML data type* is an internal representation of XML, and can be used only as input to built-in functions that accept this data type as input. XML is a transient data type that cannot be stored in the database or returned to an application. Valid values for the XML data type include the following:
- An element
- A forest of elements
- The textual content of an element
- An empty XML value

The only supported operation is to serialize (by using the XML2CLOB function) the XML value into a string that is stored as a CLOB value.

The XML data type is not compatible with any other data type. The only predicate that can be applied to the XML data type is IS NULL or IS NOT NULL.

Distinct types

A *distinct type* is a user-defined data type that shares its internal representation with a built-in data type (its *source type*), but is considered to be a separate and incompatible data type for most operations. For example, the semantics for a picture type, a text type, and an audio type that all use the built-in data type BLOB for their internal representation are quite different. A distinct type is created with the SQL statement CREATE DISTINCT TYPE.

For example, the following statement creates a distinct type named AUDIO:

```
CREATE DISTINCT TYPE AUDIO AS BLOB (1M);
```

Although AUDIO has the same representation as the built-in data type BLOB, it is a separate data type that is not comparable to a BLOB or to any other data type. This inability to compare AUDIO to other data types allows functions to be created specifically for AUDIO and assures that these functions cannot be applied to other data types.

The name of a distinct type is qualified with a schema name. The implicit schema name for an unqualified name depends on the context in which the distinct type appears. If an unqualified distinct type name is used:
- In a CREATE DISTINCT TYPE or the object of DROP, COMMENT, GRANT, or REVOKE statement, DB2 uses the normal process of qualification by authorization ID to determine the schema name.
- In any other context, DB2 uses the SQL path to determine the schema name. DB2 searches the schemas in the path, in sequence, and selects the first schema in the path such that the distinct type exists in the schema and the user has authorization to use the data type. For a description of the SQL path, see “SQL path” on page 46.

A distinct type does not automatically acquire the functions and operators of its source type because they might not be meaningful. (For example, it might make sense for a “length” function of the AUDIO type to return the length in seconds rather than in bytes.) Instead, distinct types support *strong typing*. Strong typing ensures that only the functions and operators that are explicitly defined on a distinct type can be applied to that distinct type. However, a function or operator of the source type can be applied to the distinct type by creating an appropriate user-defined function. The user-defined function must be sourced on the existing function that has the source type as a parameter. For example, the following series of SQL statements shows how to create a distinct type named MONEY based on data type DECIMAL(9,2), how to define the + operator for the distinct type, and how the operator might be applied to the distinct type:

```
CREATE DISTINCT TYPE MONEY AS DECIMAL(9,2);

CREATE FUNCTION "+"(MONEY,MONEY)
   RETURNS MONEY
   SOURCE SYSIBM."+"(DECIMAL(9,2),DECIMAL(9,2));

CREATE TABLE SALARY_TABLE
   (SALARY MONEY,
    COMMISSION MONEY);

SELECT SALARY + COMMISSION FROM SALARY_TABLE;
```

A distinct type is subject to the same restrictions as its source type. For example, if a CLOB value is not allowed as input to a function, you cannot specify a distinct type that is based on a CLOB as input.

The comparison operators are automatically generated for distinct types, except those that are based on a CLOB, DBCLOB, or BLOB. In addition, DB2 automatically generates functions for every distinct type that support casting from the source type to the distinct type and from the distinct type to the source type. For example, for the AUDIO type created above, these are generated cast functions:

```
FUNCTION schema-name.BLOB (schema-name.AUDIO) RETURNS SYSIBM.BLOB (1M)
FUNCTION schema-name.AUDIO (SYSIBM.BLOB (1M)) RETURNS schema-name.AUDIO
```

In a distributed data environment, distinct types are not supported for DB2 private protocol access.

Promotion of data types

Data types can be classified into groups of related data types. Within such groups, an order of precedence exists in which one data type is considered to precede another data type. This precedence enables DB2 to support the *promotion* of one data type to another data type that appears later in the precedence order. For example, DB2 can promote the data type CHAR to VARCHAR and the data type INTEGER to DOUBLE PRECISION; however, DB2 cannot promote a CLOB to a VARCHAR.

DB2 considers the promotion of data types when:

- Performing function resolution (see “Function resolution” on page 129)
- Casting distinct types (see “Casting between data types” on page 71)
- Assigning built-in data types to distinct types (see “Distinct type assignments” on page 82)

For each data type, Table 9 on page 71 shows the precedence list (in order) that DB2 uses to determine the data types to which the data type can be promoted. The table indicates that the best choice is the same data type and not promotion to another data type. The table also shows data that are considered equivalent during the promotion process. For example, CHARACTER and GRAPHIC are considered to be equivalent data types.

Table 9. Precedence of data types

Data type[1,2]	Data type precedence list (in best-to-worst order)
SMALLINT	SMALLINT, INTEGER, decimal, real, double
INTEGER	INTEGER, decimal, real, double
decimal	decimal, real, double
real	real, double
double	double
CHAR or GRAPHIC	CHAR or GRAPHIC, VARCHAR or VARGRAPHIC, CLOB or DBCLOB
VARCHAR or VARGRAPHIC	VARCHAR or VARGRAPHIC, CLOB or DBCLOB
CLOB or DBCLOB	CLOB or DBCLOB
BLOB	BLOB
DATE	DATE
TIME	TIME
TIMESTAMP	TIMESTAMP
ROWID	ROWID
A distinct type	The same distinct type

Notes:

1. The data types in lowercase letters represent the following data types:

decimal	DECIMAL(p,s) or NUMERIC(p,s)
real	REAL or FLOAT(*n*) where *n* is not greater than 21
double	DOUBLE, DOUBLE PRECISION, FLOAT or FLOAT(*n*) where *n* is greater than 21

2. Other synonyms for the listed data types are considered to be the same as the synonym listed.

Casting between data types

There are many occasions when a value with a given data type needs to be *cast* (changed) to a different data type or to the same data type with a different length, precision, or scale. Data type promotion, as described in “Promotion of data types” on page 70, is one example of when a value with one data type needs to be cast to a new data type. A data type that can be changed to another data type is *castable* from the source data type to the target data type.

The casting of one data type to another can occur implicitly or explicitly. You can use the function notation syntax or CAST specification syntax to explicitly cast a data type. DB2 might implicitly cast data types during assignments that involve a distinct type (see “Distinct type assignments” on page 82). In addition, when you create a sourced user-defined function, the data types of the parameters of the source function must be castable to the data types of the function that you are creating (see “CREATE FUNCTION” on page 604).

If truncation occurs when a character or graphic string is cast to another data type, a warning occurs if any non-blank characters are truncated. This truncation behavior is similar to retrieval assignment of character or graphic strings. See “Retrieval assignment” on page 79.

Casting between data types

For casts that involve a distinct type as either the data type to be cast to or from, Table 10 shows the supported casts. For casts between built-in data types, Table 11 on page 73 shows the supported casts.

Table 10. Supported casts when a distinct type is involved

Data type ...	**Is castable to data type ...**
Distinct type *DT*	Source data type of distinct type *DT*
Source data type of distinct type *DT*	Distinct type *DT*
Distinct type *DT*	Distinct type *DT*
Data type *A*	Distinct type *DT* where *A* is promotable to the source data type of distinct type *DT* (see "Promotion of data types" on page 70)
INTEGER	Distinct type *DT* if *DT*'s source data type is SMALLINT
DOUBLE	Distinct type *DT* if *DT*'s source data type is REAL
VARCHAR	Distinct type *DT* if *DT*'s source data type is CHAR or GRAPHIC
VARGRAPHIC	Distinct type *DT* if *DT*'s source data type is GRAPHIC or CHAR

When a distinct type is involved in a cast, a cast function that was generated when the distinct type was created is used. How DB2 chooses the function depends on whether function notation or CAST specification syntax is used. (For details, see "Function resolution" on page 129 and "CAST specification" on page 151, respectively.) Function resolution is similar for both. However, in CAST specification, when an unqualified distinct type is specified as the target data type, DB2 first resolves the schema name of the distinct type and then uses that schema name to locate the cast function.

Table 11. Supported casts between built-in data types

	To data type[1]															
Cast from data type –	SMALLINT	INTEGER	DECIMAL	REAL	DOUBLE	CHAR	VARCHAR	CLOB	GRAPHIC	VARGRAPHIC	DBCLOB	BLOB	DATE	TIME	TIMESTAMP	ROWID
SMALLINT	Y	Y	Y	Y	Y	Y	Y									
INTEGER	Y	Y	Y	Y	Y	Y	Y									
DECIMAL	Y	Y	Y	Y	Y	Y	Y									
REAL	Y	Y	Y	Y	Y	Y	Y									
DOUBLE	Y	Y	Y	Y	Y	Y	Y									
CHAR	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
VARCHAR	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
CLOB						Y	Y	Y	Y	Y	Y	Y				
GRAPHIC	Y	Y	Y	Y	Y	Y[2]	Y[2]	Y[2]	Y	Y	Y	Y	Y[3]	Y[3]	Y[3]	
VARGRAPHIC	Y	Y	Y	Y	Y	Y[2]	Y[2]	Y[2]	Y	Y	Y	Y	Y	Y	Y	
DBCLOB						Y[2]	Y[2]	Y[2]	Y	Y	Y	Y				
BLOB												Y				
DATE						Y	Y						Y			
TIME						Y	Y							Y		
TIMESTAMP						Y	Y						Y	Y	Y	
ROWID						Y	Y					Y				Y

Note:

1. Other synonyms for the listed data types are considered to be the same as the synonym listed. Some exceptions exist when the cast involves character string data if the subtype is FOR BIT DATA.
2. The result length for these casts is 3 * LENGTH(graphic string).
3. These data types are castable between each other only if the data is Unicode.

Table 12 shows where to find information about the rules that apply when casting to the identified target data types.

Table 12. Rules for casting to a data type

Target data type	Rules
SMALLINT	“SMALLINT” on page 342
INTEGER	“INTEGER or INT” on page 276
DECIMAL	“DECIMAL or DEC” on page 244
NUMERIC	“DECIMAL or DEC” on page 244
REAL	“REAL” on page 325
DOUBLE	“DOUBLE_PRECISION or DOUBLE” on page 251
CHAR	“CHAR” on page 219
VARCHAR	“VARCHAR” on page 363

Table 12. Rules for casting to a data type (continued)

Target data type	Rules
CLOB	"CLOB" on page 226
GRAPHIC	"GRAPHIC" on page 263
VARGRAPHIC	"VARGRAPHIC" on page 369
DBCLOB	"DBCLOB" on page 241
BLOB	"BLOB" on page 216
DATE	"DATE" on page 233
TIME	"TIME" on page 351
TIMESTAMP	If the source type is a character string, see "TIMESTAMP" on page 352, where one operand is specified. If the source data type is a DATE, the timestamp is composed of the specified date and a time of 00:00:00. If the source data type is a TIME, the timestamp is composed of the CURRENT DATE and the specified time.
ROWID	"ROWID" on page 336

Assignment and comparison

The basic operations of SQL are assignment and comparison. Assignment operations are performed during the execution of statements such as CALL, INSERT, UPDATE, FETCH, SELECT INTO, SET *host-variable*, and VALUES INTO statements. In addition, when a function is invoked or a stored procedure is called, the arguments of the function or stored procedure are assigned. Comparison operations are performed during the execution of statements that include predicates and other language elements such as MAX, MIN, DISTINCT, GROUP BY, and ORDER BY.

The basic rule for both operations is that data types of the operands must be compatible. The compatibility rule also applies to other operations that are described under "Rules for result data types" on page 87. Table 13 on page 75 shows the compatibility matrix for data types.

Table 13. Compatibility of data types for assignments and comparisons. Y indicates that the data types are compatible. N indicates no compatibility. For any number in a column, read the corresponding note at the bottom of the table.

Operands	Binary integer	Decimal number	Floating point	Character string	Graphic string	Binary string	Date	Time	Time-stamp	Row ID	Distinct type
Binary Integer	Y	Y	Y	N	N	N	N	N	N	N	2
Decimal Number	Y	Y	Y	N	N	N	N	N	N	N	2
Floating Point	Y	Y	Y	N	N	N	N	N	N	N	2
Character String	N	N	N	Y	$Y^{4,5}$	N^3	1	1	1	N	2
Graphic String	N	N	N	$Y^{4,5}$	Y	N	1,4	1,4	1,4	N	2
Binary String	N	N	N	N^3	N	Y	N	N	N	N	2
Date	N	N	N	1	1,4	N	Y	N	N	N	2
Time	N	N	N	1	1,4	N	N	Y	N	N	2
Timestamp	N	N	N	1	1,4	N	N	N	Y	N	2
Row ID	N	N	N	N	N	N	N	N	N	Y	2
Distinct Type	2	2	2	2	2	2	2	2	2	2	Y^2

Notes:

1. The compatibility of datetime values is limited to assignment and comparison:
   - Datetime values can be assigned to string columns and to string variables, as explained in “Datetime assignments” on page 81.
   - A valid string representation of a date can be assigned to a date column or compared to a date.
   - A valid string representation of a time can be assigned to a time column or compared to a time.
   - A valid string representation of a timestamp can be assigned to a timestamp column or compared to a timestamp.
2. A value with a distinct type is comparable only to a value that is defined with the same distinct type. In general, DB2 supports assignments between a distinct type value and its source data type. For additional information, see “Distinct type assignments” on page 82.
3. All character strings, even those with subtype FOR BIT DATA, are not compatible with binary strings.
4. On assignment and comparison from Graphic to Character, the resulting length in bytes is 3 * (LENGTH(graphic string)), depending on the CCSIDs.
5. Character strings with subtype FOR BIT DATA are not compatible with Graphic Data.

Compatibility with a column that has a field procedure is determined by the data type of the column, which applies to the decoded form of its values.

A basic rule for assignment operations is that a null value cannot be assigned to:

- A column that cannot contain null values
- A non-Java host variable that does not have an associated indicator variable

  For a host variable that does have an associated indicator variable, a null value is assigned by setting the indicator variable to a negative value. See “References to host variables” on page 119 for a discussion of indicator variables.
- A Java host variable that is a primitive type

  For a Java host variable that is not a primitive type, the value of that variable is set to a Java null value.

Numeric assignments

The basic rule for numeric assignments is that the whole part of a decimal or integer number cannot be truncated. If necessary, the fractional part of a decimal number is truncated.

Decimal or integer to floating-point

Because floating-point numbers are only approximations of real numbers, the result of assigning a decimal or integer number to a floating-point column or variable might not be identical to the original number.

Floating-point or decimal to integer

When a single precision floating-point number is converted to integer, rounding occurs on the seventh significant digit, zeros are added to the end of the number, if necessary, starting from the seventh significant digit, and the fractional part of the number is eliminated.

When a double precision floating-point or decimal number is converted to integer, the fractional part of the number is eliminated.

The following examples show a single precision floating-point number converted to an integer:

Example 1:
The floating-point number `2.0000045E6`
assigned to an integer
column or host variable is: `2000000`

Example 2:
The floating-point number `2.00000555E8`
assigned to an integer
column or host variable is: `200000000`

The following examples show a double precision floating-point number converted to an integer:

Example 1:
The floating-point number `2.0000045E6`
assigned to an integer
column or host variable is: `2000004`

Example 2:
The floating-point number `2.00000555E8`
assigned to an integer
column or host variable is: `200000555`

The following examples show a decimal number converted to an integer:

Example 1:
The decimal number `2000004.5`
assigned to an integer
column or host variable is: `2000004`

Example 2:
The decimal number `200000555.0`
assigned to an integer
column or host variable is: `200000555`

Decimal to decimal

When a decimal number is assigned to a decimal column or variable, the number is converted, if necessary, to the precision and the scale of the target. The necessary number of leading zeros is added or eliminated, and, in the fractional part of the number, the necessary number of trailing zeros is added, or the necessary number of trailing digits is eliminated.

Integer to decimal

When an integer is assigned to a decimal column or variable, the number is converted first to a temporary decimal number and then, if necessary, to the precision and scale of the target. The precision and scale of the temporary decimal number is 5,0 for a small integer or 11,0 for a large integer.

Floating-point to floating-point

When a single precision floating-point number is assigned to a double precision floating-point column or variable, the single precision data is padded with eight hex zeros.

When a double precision floating-point number is assigned to a single precision floating-point column or variable, the double precision data is converted and rounded up on the seventh hex digit.

In assembler, C, or C++ applications that are precompiled with the FLOAT(IEEE) option, floating-point constants and values in host variables are assumed to have IEEE floating-point format. All floating-point data is stored in DB2 in System/390 floating-point format. Therefore, when the FLOAT(IEEE) precompiler option is in effect, DB2 performs the following conversions:

- When a number in short or long IEEE floating-point format is assigned to a single-precision or double-precision floating-point column, DB2 converts the number to System/390 floating-point format.
- When a single-precision or double-precision floating-point column value is assigned to a short or long floating-point host variable, DB2 converts the column value to IEEE floating-point format.

Floating-point to decimal

When a single precision floating-point number is assigned to a decimal column or variable, the number is first converted to a temporary decimal number of precision 6 by rounding on the seventh decimal digit. Twenty five zeros are then appended to the number to bring the precision to 31. Because of rounding, a number less than 0.5×10^{-6} is reduced to 0.

When a double precision floating-point number is assigned to a decimal column or variable, the number is first converted to a temporary decimal number of precision 15, and then, if necessary, truncated to the precision and scale of the target. In this conversion, zeros are added to the end of the number, if necessary, to bring the precision to 16. The number is then rounded (using floating-point arithmetic) on the sixteenth decimal digit to produce a 15-digit number. Because of rounding, a number less in magnitude than 0.5×10^{-15} is reduced to 0. If the decimal number requires more than 15 digits to the left of the decimal point, an error is reported. Otherwise, the scale is given the largest possible value that allows the whole part of the number to be represented without loss of significance.

The following examples show the effect of converting a double precision floating-point number to decimal:

Example 1:

The floating-point number	.123456789098765E-05
in decimal notation is:	.00000123456789098765
	+5
Rounding adds 5 in the 16th position	.00000123456789148765
and truncates the result to	.000001234567891
Zeros are then added to the end of a 31-digit result:	.0000012345678910000000000000000

Example 2:

The floating-point number	1.2339999999999E+01
in decimal notation is:	12.33999999999900
	+5
Rounding adds 5 in the 16th position	12.33999999999905
and truncates the result to	12.3399999999990
Zeros are then added to the end of a 31-digit result:	12.33999999999900000000000000000

To COBOL integers

Assignment to COBOL integer variables uses the full size of the integer. Thus, the value placed in the COBOL data item might be out of the range of values.

Example 1: If COL1 contains a value of 12345, the following statements cause the value 12345 to be placed in A, even though A has been defined with only 4 digits:

```
01  A  PIC  S9999  BINARY.
EXEC SQL SELECT COL1
         INTO :A
         FROM TABLEX
END-EXEC.
```

Example 2: The following COBOL statement results in 2345 being placed in A:

```
MOVE 12345 TO A.
```

String assignments

There are two types of string assignments:

- *Storage assignment* is when a value is assigned to a column or a parameter of a function or stored procedure.
- *Retrieval assignment* is when a value is assigned to a host variable.

The rules differ for storage and retrieval assignment.

Binary string assignment

The following rules apply to binary strings.

Storage assignment: The basic rule is that the length of a string that is assigned to a column or parameter of a function or procedure must not be greater than the length attribute of the column or parameter. If the string is longer than the length attribute of that column or parameter, an error is returned.

Retrieval assignment: The length of a string that is assigned to a host variable can be greater than the length attribute of the host variable. When a string is assigned to a variable and the string is longer than the length attribute of the variable, the string is truncated on the right by the necessary number of bytes. When this occurs, a warning is returned and the value 'W' is assigned to the SQLWARN1 field of the SQLCA. For a description of the SQLCA, see Appendix D, "SQL communication area (SQLCA)," on page 1165.

When a string of length *n* is assigned to a varying-length string variable with a maximum length greater than *n*, the bytes after the *n*th byte of the variable are undefined.

Character and graphic string assignment

The following rules apply when both the source and the target are strings. When a datetime data type is involved, see "Datetime assignments" on page 81. For the special considerations that apply when a distinct type is involved in an assignment, especially to a host variable, see "Distinct type assignments" on page 82.

Storage assignment: The basic rule is that the length of a string that is assigned to a column or parameter of a function or stored procedure must not be greater than the length attribute of the column or the parameter. Trailing blanks are included in the length of the string. When the length of the string is greater than the length attribute of the column or the parameter, the following actions occur:

- If all of the trailing characters that must be truncated to make a string fit the target are blanks and the string is a character or graphic string, the string is truncated and assigned without warning.
- Otherwise, the string is not assigned and an error occurs to indicate that at least one of the excess characters is non-blank.

When a string is assigned to a fixed-length column or parameter and the length of the string is less than the length attribute of the target, the string is padded to the right with the necessary number of SBCS or DBCS blanks. The pad character is always a blank even for columns or parameters that are defined with the FOR BIT DATA attribute.

Retrieval assignment: The length of a string that is assigned to a host variable can be greater than the length attribute of the host variable. When the length of the string is greater than the length of the host variable, the string is truncated on the right by the necessary number of SBCS or DBCS characters. When this occurs, the value W is assigned to the SQLWARN1 field of the SQLCA. Furthermore, if an indicator variable is provided and the source of the value is not a LOB, the indicator variable is set to the original length of the string. The truncation result of an improperly formed mixed string is unpredictable.

When a character string is assigned to a fixed-length variable and the length of the string is less than the length attribute of the target, the string is padded to the right with the necessary number of blanks. The pad character is always a blank even for strings defined with the FOR BIT DATA attribute.

When a string of length *n* is assigned to a varying-length string variable with a maximum length greater than *n*, the characters after the *n*th character of the variable are undefined.

Assignments involving mixed data strings

A mixed data string that contains MBCS characters cannot be assigned to an SBCS column, SBCS parameter, or SBCS host variable. The following rules apply when a mixed data string is assigned to a host variable and the string is longer than the length attribute of the variable:

- If the string is not well-formed mixed data, it is truncated as if it were BIT or graphic data.
- If the string is well-formed mixed data, it is modified on the right such that it is well-formed mixed data with a length that is the same as the length attribute of the variable and the number of characters lost is minimal.

Assignments involving C NUL-terminated strings

A C NUL-terminated string variable referenced in a CONNECT statement need not contain a NUL. Otherwise, DB2 enforces the convention that the value of a NUL-terminated string variable, either character or graphic, is NUL-terminated. An input host variable that does not contain a NUL will cause an error. A value that is assigned to an output variable will always be NUL-terminated even if a character must be truncated to make room for the NUL.

When a string of length *n* is assigned to a C NUL-terminated string variable with a length greater than *n*+1, the rules depend on whether the source string is a value of a fixed-length string or a varying-length string:

- If the source is a fixed-length string and the value of field PAD NUL-TERMINATED on installation panel DSNTIP4 is YES, the string is padded on the right with *x*-*n*-1 blanks, where *x* is the length of the variable. The padded string is then assigned to the variable and a NUL is appended at the end of the variable. If the value of field PAD NUL-TERMINATED is NO, the string is assigned to the first *n* bytes of the variable and a NUL is appended at the end of the variable.
- If the source is a varying-length string, the string is assigned to the first *n* bytes of the variable and a NUL is appended at the end of the variable.

When a string of length *n* is assigned to a C NUL-terminated string variable with a length greater than *n*+1, the rules depend whether the source string is a fixed-length string or a varying-length string:

- If the source is a fixed-length string and the value of field PAD NUL-TERMINATED on installation panel DSNTIP4 is YES, the string is padded on the right with *x*-*n*-1 blanks, where *x* is the length of the variable. The padded string is then assigned to the variable and a NUL is appended at the end of the variable. If the value of field PAD NUL-TERMINATED is NO, the string is assigned to the first *n* bytes of the variable and a NUL is appended at the end of the variable.
- If the source is a varying-length string, the string is assigned to the first *n* bytes of the variable and a NUL is appended at the end of the variable.

Conversion rules for string assignment

A character or graphic string that is assigned to a column or host variable is first converted, if necessary, to the coded character set of the target. Conversion is necessary only if all the following are true:

- The CCSIDs of string and target are different.
- Neither CCSID is X'FFFF' (neither the string nor the target is defined as BIT data).
- The string is neither null nor empty.

An error occurs if:

- The SYSSTRINGS table is used but contains no information about the pair of CCSIDs and DB2 cannot do the conversion through z/OS support for Unicode.
- A character of the string cannot be converted and the operation is assignment to a column or to a host variable that has no indicator variable. For example, a DBCS character cannot be converted to a host variable with an SBCS CCSID.

A warning occurs if:

- A character of the string is converted to a *substitution character*. A *substitution character* is the character that is used when a character of the source character set is not part of the target character set. For example, assuming an EBCDIC target character set, if the source character set includes Katakana characters and the target character set does not, a Katakana character is converted to the EBCDIC SUB X'3F'.
- A character of the string cannot be converted and the operation is assignment to a host variable that has an indicator variable. For example, a DBCS character cannot be converted if the host variable has an SBCS CCSID. In this case, the string is not assigned to the host variable and the indicator variable is set to -2.

Datetime assignments

A value that is assigned to a DATE column, a DATE variable, or a DATE must be a date or a valid string representation of a date. A date can be column, a character-string column, or a character-string variable. A value that is assigned to a TIME column, a TIME variable, or a TIME parameter must be a time or a valid string representation of a time. A time can be assigned only to a TIME column, a character-string column, or a character-string variable. A value assigned to a TIMESTAMP column, a TIMESTAMP variable, or a TIMESTAMP parameter must be a timestamp or a valid string representation of a timestamp. A timestamp can be assigned only to a TIMESTAMP column, a character-string column, or a character-string variable. A valid string representation of a datetime value must not be a BLOB, CLOB, or DBCLOB. A datetime value cannot be assigned to a column that has a field procedure.

When a datetime value is assigned to a string variable or column, it is converted to its string representation. Leading zeros are not omitted from any part of the date, time, or timestamp. The required length of the target varies depending on the format of the string representation. If the length of the target is greater than required, it is padded on the right with blanks. If the length of the target is less than required, the result depends on the type of datetime value involved, and on the type of target.

- If the target is a string column (except for BLOB, CLOB, or DBCLOB), truncation is not allowed. The length of the column must be at least 10 for a date, 8 for a time, and 19 for a timestamp.
- When the target is a host variable, the following rules apply:

  For a DATE: The length of the variable must not be less than 10.

  For a TIME: If the USA format is used, the length of the variable must not be less than 8. This format does not include seconds.

  If the ISO, EUR, or JIS format is used, the length of the variable must not be less than 5. If the length is 5, 6, or 7, the seconds part of the time is omitted from the result and SQLWARN1 is set to 'W'. In this case, the seconds part of the time is assigned to the indicator variable if one is provided, and, if the length is 6 or 7, the value is padded with blanks so that it is a valid string representation of a time.

For a TIMESTAMP: The length of the variable must not be less than 19. If the length is between 19 and 25, the timestamp is truncated like a string, causing the omission of one or more digits of the microsecond part. If the length is 20, the trailing decimal point is replaced by a blank so that the value is a valid string representation of a timestamp.

Row ID assignments

A row ID value can be assigned only to a column, parameter, or host variable with a row ID data type. For the value of the ROWID column, the column must be defined as GENERATED BY DEFAULT and the column must have a unique, single-column index. The value that is specified for the column must be a valid row ID value that was previously generated by DB2.

Distinct type assignments

The rules that apply to the assignments of distinct types to host variables are different than the rules for all other assignments that involve distinct types.

Assignments to host variables: The assignment of distinct type to a host variable is based on the source data type of the distinct type. Therefore, the value of a distinct type is assignable to a host variable only if the source data type of the distinct type is assignable to the host variable.

Example: Assume that distinct type AGE was created with the following SQL statement:

```
CREATE DISTINCT TYPE AGE AS SMALLINT;
```

When the statement was executed, DB2 also generated these cast functions:

```
AGE (SMALLINT) RETURNS AGE
AGE (INTEGER) RETURNS AGE
SMALLINT (AGE) RETURNS SMALLINT
```

Next, assume that column STU_AGE was defined in table STUDENTS with distinct type AGE. Now, consider this valid assignment of a student's age to host variable HV_AGE, which has an INTEGER data type:

```
SELECT STU_AGE INTO :HV_AGE FROM STUDENTS WHERE STU_NUMBER = 200;
```

The distinct type value is assignable to host variable HV_AGE because the source data type of the distinct type (SMALLINT) is assignable to the host variable (INTEGER). If distinct type AGE had been based on a character data type such as CHAR(5), the above assignment would be invalid because a character type cannot be assigned to an integer type.

Assignments other than to host variables: A distinct type can be the source or target of an assignment. Assignment is based on whether the data type of the value to be assigned is castable to the data type of the target. (Table 10 on page 72 shows which casts are supported when a distinct type is involved). Therefore, a distinct type value can be assigned to any target other than a host variable when:

- The target of the assignment has the same distinct type, or
- The distinct type is castable to the data type of the target

Any value can be assigned to a distinct type when:

- The value to be assigned has the same distinct type as the target, or
- The data type of the assigned value is castable to the target distinct type

Example: Assume that the source data type for distinct type AGE is SMALLINT:

```
CREATE DISTINCT TYPE AGE AS SMALLINT;
```

Next, assume that two tables TABLE1 and TABLE2 were created with four identical column descriptions:

```
AGECOL   AGE
SMINTCOL SMALLINT
INTCOL   INTEGER
DECCOL   DEC(6,2)
```

Using the following SQL statement and substituting various values for X and Y to insert values into various columns of TABLE1 from TABLE2, Table 14 shows whether the assignments are valid. DB2 uses assignment rules in this INSERT statement to determine if X can be assigned to Y.

```
INSERT INTO TABLE1 (Y)
     SELECT X FROM TABLE2;
```

Table 14. Assessment of various assignments for example INSERT statement

X (column in TABLE2)	Y (column in TABLE1)	Valid	Reason
AGECOL	AGECOL	Yes	Source and target are same distinct type
SMINTCOL	AGECOL	Yes	SMALLINT can be cast to AGE
INTCOL	AGECOL	Yes	INTEGER can be cast to AGE (because AGE's source type is SMALLINT)
DECCOL	AGECOL	No	DECIMAL cannot be cast to AGE
AGECOL	SMINTCOL	Yes	AGE can be cast to its source type of SMALLINT
AGECOL	INTCOL	No	AGE cannot be cast to INTEGER
AGECOL	DECCOL	No	AGE cannot be cast to DECIMAL

Assignments to LOB locators

When a LOB locator is used, it can only refer to LOB data. If a LOB locator is used for the first fetch of a cursor, LOB locators must be used for all subsequent fetches.

Numeric comparisons

Numbers are compared algebraically, that is, with regard to sign. For example, −2 is less than +1.

If one number is an integer and the other is decimal, the comparison is made with a temporary copy of the integer, which has been converted to decimal.

When decimal numbers with different scales are compared, the comparison is made with a temporary copy of one of the numbers that has been extended with trailing zeros so that its fractional part has the same number of digits as the other number.

If one number is double precision floating-point and the other is integer, decimal, or single precision floating-point, the comparison is made with a temporary copy of the other number which has been converted to double precision floating-point. However, if a single precision floating-point number is compared with a floating-point constant, the comparison is made with a single precision form of the constant.

Two floating-point numbers are equal only if the bit configurations of their normalized forms are identical.

String comparisons

Binary string comparisons

In general, comparisons that involve binary strings (BLOBs) are not supported with the exception of the LIKE, EXISTS, and NULL predicates.

Character and graphic string comparisons

Two strings are compared by comparing the corresponding bytes of each string. If the strings do not have the same length, the comparison is made with a temporary copy of the shorter string that has been padded on the right with blanks so that it has the same length as the other string.

Two strings are equal if they are both empty or if all corresponding bytes are equal. An empty string is equal to a blank string. If two strings are not equal, their relationship (that is, which has the greater value) is determined by the comparison of the first pair of unequal bytes from the left end of the strings. This comparison is made according to the collating sequence associated with the encoding scheme of the data. For ASCII data, characters A through Z (both upper and lowercase) have a greater value than characters 0 through 9. For EBCDIC data, characters A through Z (both upper and lowercase) have a lesser value than characters 0 through 9.

Varying-length strings with different lengths are equal if they differ only in the number of trailing blanks. In operations that select one value from a collection of such values, the value selected is arbitrary. The operations that can involve such an arbitrary selection are DISTINCT, MAX, MIN, and references to a grouping column. See the description of GROUP BY for further information about the arbitrary selection involved in references to a grouping column.

String comparisons with field procedures: If a column with a field procedure is compared with the value of a variable or a constant, the variable or constant is encoded by the field procedure before the comparison is made. If the comparison operator is LIKE, the variable or constant is not encoded and the column value is decoded.

If a column with a field procedure is compared with another column, that column must have the same field procedure and both columns must have the same CCSID set. The comparison is performed on the encoded form of the values in the columns. If the encoded values are numeric, their data types must be identical; if they are strings, their data types must be compatible.

If two encoded strings of different lengths are compared, the shorter is temporarily padded with encoded blanks so that it has the same length as the other string.

In a CASE expression, if a column with a field procedure is used as the *result-expression* in a THEN or ELSE clause, all other columns that are used as *result-expressions* must have the same field procedure. Otherwise, no column used in a *result-expression* may name a field procedure.

Datetime comparisons

A DATE, TIME, or TIMESTAMP value can be compared either with another value of the same data type or with a string representation of that data type. All comparisons are chronological, which means the further a point in time is from January 1, 0001, the *greater* the value of that point in time.

Comparisons involving TIME values and string representations of time values always include seconds. If the string representation omits seconds, zero seconds are implied.

Comparisons involving TIMESTAMP values are chronological without regard to representations that might be considered equivalent. Thus, the following predicate is true:

```
TIMESTAMP('1990-02-23-00.00.00') > '1990-02-22-24.00.00'
```

Row ID comparisons

A value with a row ID type can only be compared to another row ID value. The comparison of the row ID values is based on their internal representations. The maximum number of bytes that are compared is 17 bytes, which is the number of bytes in the internal representation. Therefore, row ID values that differ in bytes beyond the 17th byte are considered to be equal.

Distinct type comparisons

A value with a distinct type can only be compared to another value with exactly the same type because distinct types have strong typing, which means that a distinct type is compatible only with its own type. Therefore, to compare a distinct type to a value with a different data type, the distinct type value must be cast to the data type of the comparison value or the comparison value must be cast to the distinct type. For example, because constants are built-in data types, a constant can be compared to a distinct type value only if it is first cast to the distinct type or vice versa.

Table 15 shows examples of valid and invalid comparisons, assuming the following SQL statements were used to define two distinct types AGE_TYPE and CAMP_DATE and table CAMP_ROSTER table.

```
CREATE DISTINCT TYPE AGE_TYPE AS INTEGER;
CREATE DISTINCT TYPE CAMP_DATE AS DATE;

CREATE TABLE CAMP_ROSTER
   ( NAME               VARCHAR(20),
     ATTENDEE_NUMBER    INTEGER NOT NULL,
     AGE                AGE_TYPE,
     FIRST_CAMP_DATE    CAMP_DATE,
     LAST_CAMP_DATE     CAMP_DATE,
     BIRTHDATE          DATE);
```

Table 15. Examples of valid and invalid comparisons involving distinct types

SQL statement	Valid	Reason
Distinct types with distinct types		

`SELECT * FROM CAMP_ROSTER`
`   WHERE FIRST_CAMP_DATE < LAST_CAMP_DATE;`
	Yes	Both values are the same distinct type.

Distinct types with columns of the same source data type		

`SELECT * FROM CAMP_ROSTER`
`   WHERE AGE > ATTENDEE_NUMBER;`
	No	A distinct type cannot be compared to integer.

Table 15. Examples of valid and invalid comparisons involving distinct types (continued)

SQL statement	Valid	Reason

`SELECT * FROM CAMP_ROSTER`
`   WHERE INTEGER(AGE) > ATTENDEE_NUMBER;`
`SELECT * FROM CAMP_ROSTER`
`   WHERE CAST(AGE AS INTEGER) > ATTENDEE_NUMBER;`
	Yes	The distinct type is cast to an integer, making the comparison of two integers.

`SELECT * FROM CAMP_ROSTER`
`   WHERE AGE > AGE_TYPE(ATTENDEE_NUMBER);`
`SELECT * FROM CAMP_ROSTER`
`   WHERE AGE > CAST(ATTENDEE_NUMBER as AGE_TYPE);`
	Yes	Integer ATTENDEE_NUMBER is cast to the distinct type AGE_TYPE, making both values the same distinct type.

Distinct types with constants		

`SELECT * FROM CAMP_ROSTER`
`   WHERE AGE IN (15,16,17);`
	No	A distinct type cannot be compared to a constant.

`SELECT * FROM CAMP_ROSTER`
`   WHERE INTEGER(AGE) IN (15,16,17);`
	Yes	The distinct type is cast to the data type of constants, making all the values in the comparison integers.

`SELECT * FROM CAMP_ROSTER`
`   WHERE AGE IN`
`   (AGE_TYPE(15),AGE_TYPE(16),AGE_TYPE(17));`
	Yes	Constants are cast to distinct type AGE_TYPE, making all the values in the comparison the same distinct type.

`SELECT * FROM CAMP_ROSTER`
`   WHERE FIRST_CAMP_DATE > '06/12/99';`
	No	A distinct type cannot be compared to a constant.

`SELECT * FROM CAMP_ROSTER`
`   WHERE FIRST_CAMP_DATE >`
`   CAST('06/12/99' AS CAMP_DATE);`
	No	The string constant ’06/12/99’, a VARCHAR data type, cannot be cast directly to distinct type CAMP_DATE, which is based on a DATE data type. As illustrated in the next row, the constant must be cast to a DATE data type and then to the distinct type.

`SELECT * FROM CAMP_ROSTER`
`   WHERE FIRST_CAMP_DATE >`
`   CAST(DATE('06/12/1999') AS CAMP_DATE);`
	Yes	The string constant ’06/12/99’ is cast to the distinct type CAMP_DATE, making both values the same distinct type. To cast a string constant to a distinct type that is based on a DATE, TIME, or TIMESTAMP data type, the string constant must first be cast to a DATE, TIME, or TIMESTAMP data type.

Distinct types with host variables		

`SELECT * FROM CAMP_ROSTER`
`   WHERE AGE BETWEEN :HV_INTEGER AND :HV_INTEGER2;`
	No	The host variables have integer data types. A distinct type cannot be compared to an integer.

`SELECT * FROM CAMP_ROSTER`
`   WHERE AGE`
`   BETWEEN CAST(:HV_INTEGER AS AGE_TYPE)`
`   AND AGE_TYPE(:HV_INTEGER2);`
	Yes	The host variables are cast to distinct type AGE_TYPE, making all the values the same distinct type.

`SELECT * FROM CAMP_ROSTER`
`   WHERE FIRST_CAMP_DATE > :HV_VARCHAR;`
	No	The host variable has a VARCHAR data type. A distinct type cannot be compared to a VARCHAR.

`SELECT * FROM CAMP_ROSTER`
`   WHERE FIRST_CAMP_DATE >`
`   CAST(DATE(:HV_VARCHAR) AS CAMP_DATE);`
	Yes	The host variable is cast to the distinct type CAMP_DATE, making both values the same distinct type. To cast a VARCHAR host variable to a distinct type that is based on a DATE, TIME, or TIMESTAMP data type, the host variable must first be cast to a DATE, TIME, or TIMESTAMP data type.

Rules for result data types

Rules that are applied to the operands of an operation determine the data type of the result. This section explains when those rules apply and lists them by the possible data types of operands.

The rules apply to:

- Corresponding columns in UNION or UNION ALL operations
- Result expressions of a CASE expression
- Arguments of the scalar functions COALESCE and IFNULL
- Expression values of the IN list of an IN predicate

For the result data type of expressions that involve the operators /, *, + and -, see “With arithmetic operators” on page 135. For the result data type of expressions that involve the CONCAT operator, see “With the concatenation operator” on page 139.

Evaluation of the operands of an operation determines the data type of the result. If an operation has more than one pair of operands, DB2 determines the result type of the first pair, uses this result type with the next operand to determine the next result type, and so on. The last intermediate result type and the last operand determine the result type of the operation.

With the exception of the COALESCE function, the result of an operation can be null unless the operands do not allow nulls.

Numeric operands

Numeric types are compatible only with other numeric types.

Table 16. Result data types with numeric operands

One operand	Other operand	Data type of the result
SMALLINT	SMALLINT	SMALLINT
INTEGER	INTEGER	INTEGER
INTEGER	SMALLINT	INTEGER
DECIMAL(w,x)	SMALLINT	DECIMAL(p,x) where p = x+max(w-x,5)[1]
DECIMAL(w,x)	INTEGER	DECIMAL(p,x) where p = x+max(w-x,11)[1]
DECIMAL(w,x)	DECIMAL(y,z)	DECIMAL(p,s) where p = max(x,z)+max(w-x,y-z)[1]s = max(x,z)
REAL	REAL	REAL
REAL	DECIMAL, INTEGER, or SMALLINT	DOUBLE
DOUBLE	any numeric	DOUBLE

Note:

1. Precision cannot exceed 31.

Character and graphic string operands

Character and graphic strings are compatible with other character and graphic strings as long as there is a conversion between their corresponding CCSIDs.

Table 17. Result data types with string operands

One operand	Other operand	Data type of the result
CHAR(x)	CHAR(y)	CHAR(z) where z = max(x,y)
GRAPHIC(x)	CHAR(y)	VARGRAPHIC(y) where y > maximum length of a graphic
GRAPHIC(x)	CHAR(y)	GRAPHIC(z) where z = MAX(x,y)
VARCHAR(x)	VARCHAR(y) or CHAR(y)	VARCHAR(z) where z = max(x,y)
VARCHAR(x)	GRAPHIC(y)	VARGRAPHIC(z) where z = max(x,y)
VARGRAPHIC(x)	VARGRAPHIC(y), GRAPHIC(y), VARCHAR(y), or CHAR(y)	VARGRAPHIC(z) where z = max(x,y)
CLOB(x)	CLOB(y), VARCHAR(y), or CHAR(y)	CLOB(z) where z = max(x,y)
CLOB(x)	GRAPHIC(y) or VARGRAPHIC(y)	DBCLOB(z) where z = max(x,y)
DBCLOB(x)	CHAR(y), VARCHAR(y), CLOB(y), GRAPHIC(y), VARGRAPHIC(y), or DBCLOB(y)	DBCLOB(z) where z = max(x,y)

Character string subtypes are determined as indicated in the following table:

Table 18. Result data types with character string operands

One operand	Other operand	Data type of the result
Bit data	Mixed, SBCS, or bit data	Bit data
Mixed data	Mixed or SBCS data	Mixed data
SBCS data	SBCS data	SBCS data

Binary string operands

Binary strings (BLOBs) are compatible only with other binary strings (BLOB)s. The data type of the result is a BLOB. Other data types can be treated as a BLOB data type by using the BLOB scalar function to cast the data type to a BLOB. The length of the result BLOB is the largest length of all the data types.

Table 19. Result data types with binary string operands

One operand	Other operand	Data type of the result
BLOB(x)	BLOB(y)	BLOB(z) where z = max(x,y)

Datetime operands

A DATE type is compatible with another DATE type or any string expression that contains a valid string representation of a date. A string representation is a value that is a built-in character string data type or graphic string data type. A string representation must not be a CLOB or DBCLOB and must have an actual length that is not greater than 255 bytes. The data type of the result is DATE.

A TIME type is compatible with another TIME type or any string expression that contains a valid string representation of a time. A string representation is a value that is a built-in character string data type or graphic string data type. A string representation must not be a CLOB or DBCLOB and must have an actual length that is not greater than 255 bytes. The data type of the result is TIME.

A TIMESTAMP type is compatible with another TIMESTAMP type or any string expression that contains a valid string representation of a timestamp. A string representation is a value that is a built-in character string data type or graphic string data type. A string representation must not be a CLOB or DBCLOB and must have an actual length that is not greater than 255 bytes. The data type of the result is TIMESTAMP.

Row ID operands

A row ID data type is compatible only with itself. The result has a row ID data type.

Distinct type operands

A distinct type is compatible only with itself. The data type of the result is the distinct type.

Conversion rules for operations that combine strings

When two strings are compared, one of the strings is first converted, if necessary, to the coded character set of the other string. Conversion is necessary only if all of the following are true:

- The CCSIDs of the two strings are different.
- Neither CCSID is X'FFFF' (neither string is defined as BIT data or is a BLOB string).
- The string selected for conversion is neither null nor empty.
- The following conversion tables (Table 21 on page 90 or Table 22 on page 90 indicate when conversion is necessary.

These same rules apply when determine the result CCSID in a fullselect.

The string selected for conversion depends on the type of the operands. For the purpose of CCSID determination, string expressions in a statement are divided into 6 types, as described in the following table.

Table 20. Operand types

Type of operand	CCSID of the operand type
Columns	CCSID from the containing table
String constants	CCSID associated with the application encoding scheme. For dynamic statements, this is the CURRENT APPLICATION ENCODING SCHEME special register. For static statements, this is the ENCODING bind option.
Special registers	CCSID associated with the application encoding scheme. For dynamic statements, this is the CURRENT APPLICATION ENCODING SCHEME special register. For static statements, this is the ENCODING bind option.
Host variables	CCSID specified in the DECLARE VARIABLE statement, associated with the application encoding scheme, or specified in SQLDAID or SQLDA

Table 20. Operand types (continued)

Type of operand	CCSID of the operand type
Derived value based on a column	CCSID of the source of the derived value. A derived value based on a column is an expression whose source is directly or indirectly based on a column. The CCSID of such an expression is the CCSID of its source. For example, the CCSID of SUBSTR(column_1, 5, length(column_2)) is the CCSID of column_1. Note that the CCSID of column_2 has no influence on the CCSID of SUBSTR.
Derived value not based on a column	CCSID of the source of the derived value. A derived value not based on a column is an expression whose source is not directly or indirectly based on any column. The CCSID of such an expression is the CCSID of its source. For example, the CCSID of SUBSTR(’ABDC’, 1, length(’AB″)) is the CCSID of the string constant ’ABCD’.

The following table shows which operand supplies the target CCSID set when the comparison is part of an SQL statement involving multiple tables with different CCSID sets.

Table 21. Operand that supplies the CCSID for character conversion

	Second operand				
First operand	Column value or derived value based on a column	Derived value not based on a column	String constant	Special register	Host variable
Column value or derived value based on a column	1	first	first	first	first
Derived value not based on a column	second	1	1	1	1
String constant	second	1	1	1	1
Special register	second	1	1	1	1
Host variable	second	1	1	1	1

Note: 1. If the CCSID sets are different, both operands are converted, if necessary, to Unicode. SBCS and Mixed are converted to UTF-8. DBCS is converted to UTF-16. See the next table to determine which operand supplies the CCSID for character conversion.

The following table shows which operand is selected for conversion when both operands are based on a column or are not based on a column as represented in the previous table.

Table 22. Operand that supplies the CCSID for character conversion when both operands are based or not based on a column

	Second operand		
First operand	SBCS data	Mixed data	DBCS data
SBCS data		second[1]	second
Mixed data	first[1]		second
DBCS data	first	first	

Note: 1. For ASCII and EBCDIC data, the conversion depends on the value of the field MIXED DATA on installation panel DSNTIPF at the DB2 that does the comparison. If MIXED DATA = YES, the SBCS operand is converted to MIXED. If MIXED DATA = NO, the MIXED operand is converted to SBCS.

For example, assume a comparison of the form:

```
string-constant-SBCS =derived-value-not-based-on-column-DBCS
```

Assume that the operands have different encoding schemes. First look at Table 21 on page 90. The relevant table entry is in the third row and second column. The value for this entry shows that if the CCSID sets are different, the operands are converted to Unicode. The first operand (string-constant-SBCS) is converted to UTF-8 (Mixed) if it is not already Unicode. In addition, the second operand (derived-value-not-based-on-column-DBCS) is converted to UTF-16 (Unicode DBCS) if necessary. After the operands have been converted to Unicode, Table 22 on page 90 is used to determine which operand supplies the specific CCSID for the conversion. The relevant table entry is in the second row and third column. It indicates that the second operand (derived-value-not-based-on-column-DBCS) determines the CCSID because DBCS data takes precedence over Mixed data.

An error occurs if a character of the string cannot be converted, the SYSSTRINGS table is used but contains no information about the pair of CCSIDs of the operands being compared, or DB2 cannot do the conversion through z/OS support for Unicode. A warning occurs if a character of the string is converted to a substitution character.

A derived value based on a column is an expression that includes a column that affects the result CCSID of the expression. For example, in the expression COL1||'abc', COL1 determines the result CCSID. Therefore, the expression COL1||'abc' is considered to be a derived value based on a column that continues to give the column precedence in any further comparisons. The expression CASE WHEN COL1 > 1 THEN 'abc' ELSE 'def' END contains a column that does not affect the result CCSID of the expression and is therefore not considered to be a derived value based on a column.

The following table defines which expressions are considered to be a derived value based on a column.

Table 23. Derived values based on a column

Expression	Condition
expression1 || expression2	expression1 or expression2 is a column or a derived value based on a column
CASE when-clause THEN result-expression ELSE result-expression END	any result-expression is a string-expression that is a column or derived value based on a column
CAST(expression to data-type)	expression is a string-express that is a column or a derived value based on a column and data-type is a string data type
CHAR(character-expression,integer)	character-expression is a column or a derived value based on a column
CLOB(string-expression,integer)	string-expression is a column or a derived value based on a column
CONCAT(expression1,expression2)	expression1 or expression2 is a column or a derived value based on a column

Table 23. Derived values based on a column (continued)

Expression	Condition
COALESCE(expression,expression,...)	any expression is a string-expression that is a column or derived value based on a column
DBCLOB(string-expression,integer)	string-expression is a column or a derived value based on a column
GRAPHIC(expression,integer)	expression is a column or a derived value based on a column
HEX(expression)	expression is a column or a derived value based on a column
IFNULL(expression1,expression2)	any expression is a string-expression that is a column or derived value based on a column
INSERT(expression1,expression2,expression3,expression4)	expression1 (source string) is a column or a derived value based on a column
LCASE/LOWER(string-expression)	string-expression is a column or a derived value based on a column
LEFT(string-expression,integer)	string-expression is a column or a derived value based on a column
LTRIM(string-expression)	string-expression is a column or a derived value based on a column
MAX(expression,expression,...)	any expression is a string-expression that is a column or derived value based on a column
MIN(expression,expression,...)	any expression is a string-expression that is a column or derived value based on a column
NULLIF(expression1,expression2)	expression1 is a string-expression that is a column or derived value based on a column
REPEAT(expression,integer)	expression is a column or derived value based on a column
REPLACE(expression1,expression2,expression3)	expression1 (source string) is a column or a derived value based on a column
RIGHT(string-expression,integer)	string-expression is a column or a derived value based on a column
RTRIM(string-expression)	string-expression is a column or a derived value based on a column
STRIP(string-expression,B|L|T,strip-characters)	string-expression is a column or a derived value based on a column
SUBSTR(string-expression,start,length)	string-expression is a column or a derived value based on a column
TRANSLATE(string-expression,to-string,from-string,pad-character)	string-expression is a column or a derived value based on a column
UCASE/UPPER(string-expression)	string-expression is a column or derived value based on a column
VARCHAR(expression,integer)	expression is a string-expression or graphic-expression that is a column or derived value based on a column
VARGRAPHIC(expression,integer)	expression is a column or derived value based on a column
VALUE(expression,expression,...)	any expression is a string-expression that is a column or derived value based on a column

When a statement contains multiple CCSID sets, if the length of one of the strings changes after CCSID conversion, the string becomes a varying-length string. That is, the data type becomes VARCHAR, CLOB, VARGRAPHIC, or DBCLOB. Table 24 shows the resulting lengths of CCSID conversion, where X is length in bytes.

Table 24. Result length of CCSID conversion, where X represents LENGTH(string in bytes)

		To CCSID								
		EBCDIC			ASCII			Unicode		
From CCSID		**SBCS**	**Mixed**	**DBCS**	**SBCS**	**Mixed**	**DBCS**	**SBCS**	**UTF-8**	**UTF-16**
EBCDIC	SBCS	X	X	X*2[1]	X	X	X*2[1]	X[1]	X*3	X*2
	Mixed	X	X	X*2[1]	X	X	X*2[1]	X[1]	X*3	X*2
	DBCS	X*0.5[1]	X+2	X	X*0.5[1]	X	X	X*0.5	X*1.5	X
ASCII	SBCS	X	X	X*2[1]	X	X	X*2[1]	X[1]	X*3	X*2
	Mixed	X	X*1.8	X*2[1]	X	X	X*2[1]	X[1]	X*3	X*2
	DBCS	X*0.5[1]	X+2	X	X*0.5[1]	X	X	X*0.5	X*1.5	X
Unicode	SBCS	X	X	X*2	X	X	X*2	X	X	X*2
	UTF-8	X	X*1.25	X	X	X	X	X	X	X*2
	UTF-16	X*0.5	X+2	X	X*0.5	X	X	X*0.5	X*1.5	X

Notes:

1. Because of the high probability of data loss, IBM does not provide conversion tables for this combination of two CCSIDs and data subtypes.

Constants

A *constant* (also called a *literal*) specifies a value. Constants are classified as string constants or numeric constants. Numeric constants are further classified as integer, floating-point, or decimal. String constants are classified as character or graphic.

All constants have the attribute NOT NULL. A negative sign in a numeric constant with a value of zero is ignored.

Constants have a built-in data type. Therefore, an operation that involves a constant and a distinct type requires that the distinct type be cast to the built-in data type of the constant or the constant be cast to the distinct type. For example, see Table 15 on page 85, which contains an example of casting data types to compare a constant to a distinct type.

Integer constants

An *integer constant* specifies a binary integer as a signed or unsigned number that has a maximum of 10 significant digits and no decimal point. If the value is not within the range of a large integer, the constant is interpreted as a decimal constant. The data type of an integer constant is large integer.

Examples:

```
64     -15     +100     32767     720176
```

In syntax diagrams, the term *integer* is used for an integer constant that must not include a sign.

Floating-point constants

A *floating-point constant* specifies a double-precision floating-point number as two numbers separated by an E. The first number can include a sign and a decimal point. The second number can include a sign but not a decimal point. The value of the constant is the product of the first number and the power of 10 specified by the second number. It must be within the range of floating-point numbers. The number of characters in the constant must not exceed 30. Excluding leading zeros, the number of digits in the first number must not exceed 17 and the number of digits in the second must not exceed 2.

Examples: The following floating-point constants represent the numbers 150, 200000, -0.22, and 500:

```
 15E1    2.E5   -2.2E-1    +5.E+2
```

Decimal constants

A *decimal constant* is a signed or unsigned number of no more than 31 digits and either includes a decimal point or is not within the range of binary integers. The precision is the total number of digits, including those, if any, to the right of the decimal point. The total includes all leading and trailing zeros. The scale is the number of digits to the right of the decimal point, including trailing zeros.

Examples: The following decimal constants have, respectively, precisions and scales of 5 and 2; 4 and 0; 2 and 0; 23 and 2:

```
 025.50  1000.   -15.   +3758933333333333333333.33
```

Character string constants

A *character string constant* specifies a varying-length character string. There are two forms of character string constant:

- A sequence of characters that starts and ends with a string delimiter, which is either an apostrophe (') or a quotation mark ("). For the factors that determine which is applicable, see “Apostrophes and quotation marks in string delimiters” on page 182. This form of string constant specifies the character string contained between the string delimiters. The number of bytes between the delimiters must not be greater than 32704. The limit of 32704 refers to the length (in bytes) of the UTF-8 representation of the string. If you produced the string in a CCSID other than UTF-8 (for example, an EBCDIC CCSID), the length of the UTF-8 representation might differ from the length of the string’s representation in the source CCSID. Two consecutive string delimiters are used to represent one string delimiter within the character string.
- An X followed by a sequence of characters that starts and ends with a string delimiter. This form of a character string constant is also called a *hexadecimal constant*. The characters between the string delimiters must be an even number of hexadecimal digits. The number of hexadecimal digits must not exceed 32704. A hexadecimal digit is a digit or any of the letters A through F (uppercase or lowercase). Under the conventions of hexadecimal notation, each pair of hexadecimal digits represents a character. A hexadecimal constant allows you to specify characters that do not have a keyboard representation.

Examples:

```
'12/14/1985'    '32'    'DON''T CHANGE'    X'FFFF'    ''
```

The right most string in the example ('') represents an empty character string constant, which is a string of zero length.

A character string constant is classified as mixed data if it includes a DBCS substring. In all other cases, a character string constant is classified as SBCS data. The CCSID assigned to the constant is the appropriate system CCSID of the database server. A mixed string constant can be continued from one line to the next only if the break occurs between single byte characters. A Unicode string is always considered mixed regardless of the content of the string.

For Unicode, character constants can be assigned to UTF-8 and UTF-16. The form of the constant does not matter. Typically, character string constants are used only with character strings, but they also can be used with graphic UTF-16 data. However, hexadecimal constants are just character data. Thus, hexadecimal constants being used to insert data into UTF-16 data strings should be in UTF-8 format, not UTF-16 format. For example, if you wanted to insert the number 1 into a UTF-16 column, you would use X'31', not X'0031'. Even though X'0031' is a UTF-16 value, DB2 treats it as two separate UTF-8 code points. Thus, X'0031' would become X'00000031'.

Datetime constants

A *datetime constant* is a character string constant of a particular format. Character string constants are described under the previous heading, “Character string constants” on page 94. For information about the valid string formats, see “String representations of datetime values” on page 65.

Graphic string constants

A *graphic string constant* specifies a varying-length graphic string. (Shift-in and shift-out characters for EBCDIC data are discussed in “Character strings” on page 58.)

In EBCDIC environments, the forms of graphic string constants are shown in Figure 11 on page 96[8]:

[8] The PL/I form of graphic string constants is supported only in static SQL statements.

Context	Graphic String Constant	Empty String	Example
PL/I	$^{S}_{O}$＇dbcs-string＇Ｇ$^{S}_{I}$ $^{S}_{O}$＇dbcs-string＇$^{S}_{I}$ G Ｇ represents a DBCS G (X'42C7') ＇ represents a DBCS apostrophe (X'427D')	$^{S}_{O}$＇＇Ｇ$^{S}_{I}$ $^{S}_{O}$＇＇$^{S}_{I}$ G	$^{S}_{O}$＇元気＇Ｇ$^{S}_{I}$
All other contexts	G'$^{S}_{O}$dbcs-string$^{S}_{I}$'	G'$^{S}_{O}$$^{S}_{I}$' G'' g'$^{S}_{O}$$^{S}_{I}$' g''	G'$^{S}_{O}$ 元気$^{S}_{I}$'
	N'$^{S}_{O}$dbcs-string$^{S}_{I}$'	N'$^{S}_{O}$$^{S}_{I}$' N'' n'$^{S}_{O}$$^{S}_{I}$' n''	

Figure 11. Graphic string constants in EBCDIC

In SQL statements and in host language statements in a source program, graphic string constants cannot be continued from one line to the next. A graphic string constant must be short enough so that its UTF-8 representation requires no more than 32704 bytes.

DB2 supports two types of hexadecimal graphic string constants.

- UX'xxxx' represents a string of graphic Unicode UTF-16 characters, where *x* is a hexadecimal digit. The number of digits must be a multiple of 4 and must not exceed 32704. Each group of 4 digits represents a single UTF-16 graphic character. For example, the UX constant for 'ABC' is UX'004100420043'. When a UX constant is referenced in a statement containing a single CCSID set, it is converted to the DBCS CCSID of the statement's CCSID set.
- GX'xxxx' represents a string of graphic characters, where *x* is a hexadecimal digit. The number of digits must be a multiple of 4. Each group of 4 digits represents a single double-byte graphic character. The hexadecimal shift-in and shift-out ('OE'X and 'OF'X), which apply to EBCDIC only, are not included in the string. The CCSID assigned to a GX constant is the DBCS CCSID associated with the application encoding scheme. For dynamic statements, this is the CURRENT APPLICATION ENCODING SCHEME special register. For static statements, this is the ENCODING bind option.

  If the MIXED DATA install option is set to NO, a GX constant cannot be used. Instead, a UX constant should be used. A GX constant cannot be used when the encoding scheme is UNICODE.

Special registers

A special register is a storage area defined for a process by DB2. Wherever its name appears in an SQL statement, the name is replaced by the register's value when the statement is executed. Thus, the name acts like a function that has no arguments. The form of a special register is as follows:

special registers

```
►►──┬─CURRENT CLIENT_ACCTNG───────────────────────────────────────┬──────────────────────►◄
    ├─CURRENT CLIENT_APPLNAME─────────────────────────────────────┤
    ├─CURRENT CLIENT_USERID───────────────────────────────────────┤
    ├─CURRENT CLIENT_WRKSTNNAME───────────────────────────────────┤
    ├─CURRENT APPLICATION ENCODING SCHEME─────────────────────────┤
    ├─┬─CURRENT DATE──────┬───────────────────────────────────────┤
    │ │              (1)  │                                       │
    │ └─CURRENT_DATE──────┘                                       │
    ├─CURRENT DEGREE──────────────────────────────────────────────┤
    │              ┌─LOCALE─┐                                     │
    ├─┬─CURRENT────┴────────┴─LC_CTYPE─┬──────────────────────────┤
    │ └─CURRENT_LC_CTYPE───────────────┘                          │
    │                    ┌─TABLE─┐            ┌─FOR OPTIMIZATION─┐│
    ├─CURRENT MAINTAINED─┴───────┴─TYPES──────┴──────────────────┴┤
    ├─CURRENT MEMBER──────────────────────────────────────────────┤
    ├─CURRENT MEMBER──────────────────────────────────────────────┤
    ├─CURRENT OPTIMIZATION HINT───────────────────────────────────┤
    ├─CURRENT PACKAGE PATH────────────────────────────────────────┤
    ├─CURRENT PACKAGESET──────────────────────────────────────────┤
    ├─┬─CURRENT PATH─┬────────────────────────────────────────────┤
    │ └─CURRENT_PATH─┘                                            │
    ├─CURRENT PRECISION───────────────────────────────────────────┤
    ├─CURRENT REFRESH AGE─────────────────────────────────────────┤
    ├─CURRENT RULES───────────────────────────────────────────────┤
    ├─┬─CURRENT SCHEMA──────┬─────────────────────────────────────┤
    │ │                (2)  │                                     │
    │ └─CURRENT_SCHEMA──────┘                                     │
    ├─CURRENT SERVER──────────────────────────────────────────────┤
    ├─CURRENT SQLID───────────────────────────────────────────────┤
    ├─┬─CURRENT TIME──────┬───────────────────────────────────────┤
    │ │              (1)  │                                       │
    │ └─CURRENT_TIME──────┘                                       │
    ├─┬─CURRENT TIMESTAMP──────┬──────────────────────────────────┤
    │ │                   (1)  │                                  │
    │ └─CURRENT_TIMESTAMP──────┘                                  │
    ├─CURRENT TIMEZONE────────────────────────────────────────────┤
    └─USER────────────────────────────────────────────────────────┘
```

Notes:

1 The SQL standard uses the form with the underline.

2 A draft of the SQL: 2003 standard uses the form with the underline.

General rules for special registers

Following these general rules for special registers, each special register is described individually.

Changing register values: A commit or rollback operation has no effect on the values of special registers. Nor does any SQL statement, with the following exceptions:

- SQL SET statements can change the values of the following special registers:
  - – CURRENT APPLICATION ENCODING SCHEME

  - CURRENT DEGREE
  - CURRENT LOCALE LC_CTYPE
  - CURRENT MAINTAINED TABLE TYPES FOR OPTIMIZATION
  - CURRENT OPTIMIZATION HINT
  - CURRENT PACKAGE PATH
  - CURRENT PACKAGESET
  - CURRENT PATH
  - CURRENT PRECISION
  - CURRENT REFRESH AGE
  - CURRENT RULES
  - CURRENT SCHEMA
  - CURRENT SQLID[9]
- SQL CONNECT statements can change the value of CURRENT SERVER.

To determine the value of a special register, you can use a SELECT statement, a SET statement, or, if the statement is within a trigger action, the VALUES statement. For example, any of the following statements would provide the value of special register CURRENT PRECISION:

```
SELECT CURRENT PRECISION FROM SYSIBM.SYSDUMMY1;

SET :hv = CURRENT PRECISION

VALUES(CURRENT PRECISION)
```

CCSIDS for register values: Special registers that contain character strings have an associated CCSID. The particular CCSID depends on the context in which the special register is referenced. For more information, see “Determining the encoding scheme and CCSID of a string” on page 29.

Datetime special registers: The datetime registers are named CURRENT DATE, CURRENT TIME, and CURRENT TIMESTAMP. Datetime special registers are stored in an internal format. When two or more of these registers are implicitly or explicitly specified in a single SQL statement, they represent the same point in time. A datetime special register is implicitly specified when it is used to provide the default value of a datetime column.

If the SQL statement in which a datetime special register is used is in a user-defined function or stored procedure that is within the scope of a trigger, DB2 uses the timestamp for the triggering SQL statement to determine the special register value.

The values of these special registers are based on:

- The time-of-day clock of the processor for the server executing the SQL statement
- The TIMEZONE parameter for this processor. The TIMEZONE parameter is in SYS1.PARMLIB(CLOCKXX).

[9] If the SET CURRENT SQLID statement is executed in a stored procedure or user-defined function package that has a dynamic SQL behavior other than run behavior, the SET CURRENT SQLID statement does not affect the authorization ID that is used for dynamic SQL statements in the package. The dynamic SQL behavior determines the authorization ID. For more information, see the discussion of DYNAMICRULES in Chapter 2 of *DB2 Command Reference*.

To evaluate the references when the statement is being executed, a single reading from the time-of-day clock is incremented by the number of hours, minutes, and seconds specified by the TIMEZONE parameter. The values derived from this are assumed to be the local date, time, or timestamp, where local means local to the DB2 that executes the statement. This assumption is correct if the clock is set to local time and the TIMEZONE parameter is zero or the clock is set to GMT and the TIMEZONE parameter gives the difference from GMT. Universal time, coordinated (UTC) is another name for Greenwich Mean Time (GMT).

Since the datetime special registers and the CURRENT TIMEZONE special register depend on the parameter PARMTZ(SYS1.PARMLIB(CLOCKXX)), their values are affected if the local time at the server is changed by the z/OS system command SET CLOCK. The values of the CURRENT DATE and CURRENT TIMESTAMP special registers might be affected if the local date at the server is changed by the system command SET DATE[10].

Where special registers are processed: In distributed applications, CURRENT APPLICATION ENCODING SCHEME, CURRENT SERVER, and CURRENT PACKAGESET are processed locally. All other special registers are processed at the server.

CURRENT CLIENT_ACCTNG

CURRENT CLIENT_ACCTNG contains the value of the accounting string from the client information that is specified for the connection. The data type is VARCHAR(255).

The value of the special register can be changed by using one of the following application programming interfaces (APIs):

- Set Client Information (sqleseti)
- DB2Connection.setDB2ClientAccountingInformation(String info)
- The RRS DSNRLI SIGNON, AUTH SIGNON, CONTEXT SIGNON, or SET_CLIENT_ID function

In a distributed environment, if the value set by the API exceeds 200 bytes, it is truncated to 200 bytes. If one of these APIs is not used to set the value of the special register, an empty string is returned when the special register is referenced.

Example: Get the current value of the accounting string for this connection.

```
SET :ACCT_STRING = CURRENT CLIENT_ACCTNG
```

CURRENT CLIENT_APPLNAME

CURRENT CLIENT_APPLNAME contains the value of the application name from the client information that is specified for the connection. The data type is VARCHAR(255).

The value of the special register can be changed by using one of the following application programming interfaces (APIs):

- Set Client Information (sqleseti)
- DB2Connection.setDB2ClientApplicationInformation(String info)

[10] Whether the SET DATE command affects these special registers depends on the system level and the program temporary fix (PTF) level of the system.

- The RRS DSNRLI SIGNON, AUTH SIGNON, CONTEXT SIGNON, or SET_CLIENT_ID function

In a distributed environment, if the value set by the API exceeds 32 bytes, it is truncated to 32 bytes. If one of these APIs is not used to set the value of the special register, an empty string is returned when the special register is referenced.

Example: Select the departments that are allowed to use the application that is being used in this connection.

```
SELECT DEPT
  FROM DEPT_APPL_MAP
  WHERE APPL_NAME = CURRENT CLIENT_APPLNAME
```

CURRENT CLIENT_USERID

CURRENT CLIENT_USERID contains the value of the client user ID from the client information that is specified for the connection. The data type is VARCHAR(255).

The value of the special register can be changed by using one of the following application programming interfaces (APIs):

- Set Client Information (sqleseti)
- DB2Connection.setDB2ClientUserInformation(String info)
- The RRS DSNRLI SIGNON, AUTH SIGNON, CONTEXT SIGNON, or SET_CLIENT_ID function

In a distributed environment, if the value set by the API exceeds 16 bytes, it is truncated to 16 bytes. If one of these APIs is not used to set the value of the special register, an empty string is returned when the special register is referenced.

Example: Find out in which department the current client user ID works.

```
SELECT DEPT
  FROM DEPT_USERID_MAP
  WHERE USER_ID = CURRENT CLIENT_USERID
```

CLIENT_WRKSTNNAME

CURRENT CLIENT_WRKSTNNAME contains the value of the workstation name from the client information that is specified for the connection. The data type is VARCHAR(255).

The value of the special register can be changed by using one of the following application programming interfaces (APIs):

- Set Client Information (sqleseti)
- DB2Connection.setDB2ClientWorkstationInformation(String info)
- The RRS DSNRLI SIGNON, AUTH SIGNON, CONTEXT SIGNON, or SET_CLIENT_ID function

In a distributed environment, if the value set by the API exceeds 18 bytes, it is truncated to 18 bytes. If one of these APIs is not used to set the value of the special register, an empty string is returned when the special register is referenced.

Example: Get the name of the workstation that is being used in this connection.

```
SET :WS_NAME = CURRENT CLIENT_WRKSTNNAME
```

|
CURRENT APPLICATION ENCODING SCHEME

CURRENT APPLICATION ENCODING SCHEME specifies which encoding scheme is to be used for dynamic statements. It allows an application to indicate the encoding scheme that is used to process data. This register is not supported in REXX applications or in stored procedures written in REXX.

The initial value of CURRENT APPLICATION ENCODING SCHEME is determined by the value of the ENCODING bind option if the bind option is specified. If the bind option was not specified, then the initial value is the value of field DEFAULT APPLICATION ENCODING SCHEME on installation panel DSNTIPF. You can changes the value of the register by executing the statement SET CURRENT APPLICATION ENCODING SCHEME. For a description of the statement, see "SET CURRENT APPLICATION ENCODING SCHEME" on page 1062.

The value contained in the special register is a character representation of a CCSID. Although you can use the values ASCII, EBCDIC, or UNICODE to set the special register, what is stored in the special register is a character representation of the numeric CCSID that corresponds to the value used in the SET CURRENT APPLICATION ENCODING SCHEME statement. The value ASCII, EBCDIC, or UNICODE is not stored. The CCSID_ENCODING scalar function can be used to get a value of ASCII, EBCDIC, or UNICODE from a numeric CCSID value.

The data type is CHAR(8). If necessary, the value is padded on the right with blanks so that its length is 8 bytes.

For stored procedures and user-defined functions, the initial value of the CURRENT APPLICATION ENCODING SCHEME special register is determined by the value of the ENCODING bind option for the package that is associated with the procedure or function. If the bind option was not specified, then the initial value is the value of the field DEFAULT APPLICATION ENCODING SCHEME field on installation panel DSNTIPF.

For triggers, the initial value of the CURRENT APPLICATION ENCODING SCHEME special register is the value of field DEFAULT APPLICATION ENCODING SCHEME on installation panel DSNTIPF.

Example: The CURRENT APPLICATION ENCODING SCHEME special register can be used like any other special register:

```
EXEC SQL VALUES(CURRENT APPLICATION ENCODING SCHEME) INTO :HV1;
EXEC SQL INSERT INTO T1 VALUES (CURRENT APPLICATION ENCODING SCHEME);
EXEC SQL SET :HV1 = CURRENT APPLICATION ENCODING SCHEME;
EXEC SQL SELECT C1 FROM T1 WHERE C1 = CURRENT APPLICATION ENCODING SCHEME;
```

CURRENT DATE

CURRENT DATE specifies the current date. The data type is DATE. The value of CURRENT DATE in a user-defined function or stored procedure is inherited according to the rules in Table 27 on page 111. For other applications, the date is derived by the DB2 that executes the SQL statement that refers to the special register. For a description of how the date is derived, see "Datetime special registers" on page 98.

Example: Display the average age of employees.

```
SELECT AVG(YEAR(CURRENT DATE - BIRTHDATE))
  FROM DSN8810.EMP;
```

CURRENT DEGREE

CURRENT DEGREE specifies the degree of parallelism for the execution of queries that are dynamically prepared by the application process. The data type of the register is CHAR(3) and the only valid values are 1 (padded on the right with two blanks) and ANY.

If the value of CURRENT DEGREE is 1 when a query is dynamically prepared, the execution of that query will not use parallelism. If the value of CURRENT DEGREE is ANY when a query is dynamically prepared, the execution of that query can involve parallelism. See Part 5 (Volume 2) of *DB2 Administration Guide* for a description of query parallelism.

The initial value of CURRENT DEGREE is determined by the value of field CURRENT DEGREE on installation panel DSNTIP8. The default for the initial value of that field is 1 unless your installation has changed it to be ANY by modifying the value in that field. The initial value of CURRENT DEGREE in a user-defined function or stored procedure is inherited according to the rules in Table 27 on page 111.

You can change the value of the register by executing the statement SET CURRENT DEGREE. For details about this statement, see “SET CURRENT DEGREE” on page 1063.

CURRENT DEGREE is a register at the database server. Its value applies to queries that are dynamically prepared at that server and to queries that are dynamically prepared at another DB2 subsystem as a result of the use of a DB2 private connection between that server and that DB2 subsystem.

Example: The following statement inhibits parallelism:

```
SET CURRENT DEGREE = '1';
```

CURRENT LOCALE LC_CTYPE

CURRENT LOCALE LC_CTYPE specifies the LC_CTYPE locale that will be used to execute SQL statements that use a built-in function that references a locale. Functions LCASE, UCASE, and TRANSLATE (with a single argument) refer to the locale when they are executed. The data type is CHAR(50). If necessary, the value is padded on the right with blanks so that its length is 50 bytes.

The initial value of CURRENT LOCALE LC_CTYPE is determined by the value of field LOCALE LC_CTYPE on installation panel DSNTIPF. The default for the initial value of that field is blank unless your installation has changed the value of that field. The initial value of CURRENT LOCALE LC_CTYPE in a user-defined function or stored procedure is inherited according to the rules in Table 27 on page 111.

You can change the value of the register by executing the statement SET CURRENT LOCALE LC_CTYPE. For details about this statement, see “SET CURRENT LOCALE LC_CTYPE” on page 1065.

Example: Save the value of current register CURRENT LOCALE LC_CTYPE in host variable HV1, which is defined as VARCHAR(50).

```
EXEC SQL VALUES(CURRENT LOCALE LC_CTYPE) INTO :HV1;
```

CURRENT MEMBER

CURRENT MEMBER specifies the member name of a current DB2 data sharing member on which a statement is executing. The value of CURRENT MEMBER is a character string. The data type is CHAR(8). If necessary, the member name is padded to the right with blanks so that its length is 8 bytes.

The value of a CURRENT MEMBER is a string of blanks when the application process is connected to a DB2 subsystem that is not a member of a data sharing group.

The SQL SET statement cannot change the value of CURRENT MEMBER.

Example: Set the host variable MEM to the name of the current DB2 member.

```
EXEC SQL SET :MEM = CURRENT MEMBER;
```

or

```
EXEC VALUES (CURRENT MEMBER) into :MEM;
```

CURRENT MAINTAINED TABLE TYPES FOR OPTIMIZATION

CURRENT MAINTAINED TABLE TYPES FOR OPTIMIZATION specifies a value that identifies the types of objects that can be considered to optimize the processing of dynamic SQL queries. This register contains a keyword representing table types. The data type is VARCHAR(255).

The initial value of CURRENT MAINTAINED TABLE TYPES FOR OPTIMIZATION is determined by the value of field CURRENT MAINT TYPES on installation panel DSNTIP8. The default for the initial value of that field is SYSTEM unless your installation has changed the value of that field. The initial value of CURRENT MAINTAINED TABLE TYPES FOR OPTIMIZATION in a user-defined function or stored procedure is inherited according to the rules in Table 27 on page 111.

You can change the value of the register by executing the SET CURRENT MAINTAINED TABLE TYPES FOR OPTIMIZATION statement. For details about this statement, see "SET CURRENT MAINTAINED TABLE TYPES FOR OPTIMIZATION" on page 1067. The object types controlled by this special register are never considered by static embedded SQL queries.

Example: Set the CURRENT MAINTAINED TABLE TYPES FOR OPTIMIZATION special register so that all materialized query tables are considered.

```
SET CURRENT MAINTAINED TABLE TYPES ALL;
```

CURRENT OPTIMIZATION HINT

CURRENT OPTIMIZATION HINT specifies the user-defined optimization hint that DB2 should use to generate the access path for dynamic statements. The data type is VARCHAR(128).

The value of the register identifies the rows in auth.PLAN_TABLE that DB2 uses to generate the access path. DB2 uses information in the rows in auth.PLAN_TABLE for which the value of the OPTHINT column matches the value of the CURRENT OPTIMIZATION special register. If the value of the register is an empty string or all blanks, DB2 uses normal optimization and ignores optimization hints. If the value of the register includes any non-blank characters and DB2 was installed without optimization hints enabled (field OPTIMIZATION HINTS on installation panel DSNTIP8), a warning occurs.

The initial value of CURRENT OPTIMIZATION HINT is the value of the OPTHINT bind option. The initial value of CURRENT OPTIMIZATION HINT in a user-defined function or stored procedure is inherited according to the rules in Table 27 on page 111. You can change the value of the special register by executing the statement SET CURRENT OPTIMIZATION HINT. For details about this statement, see “SET CURRENT OPTIMIZATION HINT” on page 1069.

Example: Set the CURRENT OPTIMIZATION HINT special register so that DB2 uses the optimization plan hint that is identified by host variable NOHYB when generating the access path for dynamic statements.

```
   SET CURRENT OPTIMIZATION HINT = :NOHYB
```

For more information about telling DB2 how to generate access paths, see Part 6 of *DB2 Application Programming and SQL Guide*.

CURRENT PACKAGE PATH

CURRENT PACKAGE PATH specifies a value that identifies the path used to resolve references to packages that are used to execute SQL statements. The value can be an empty or blank string, or a list of one or more collection IDs, where the collection IDs are enclosed in double quotation marks and separated by commas. Any quotation marks within the string are repeated as they are in any delimited identifier. The delimiters and commas are included in the length of the special register. The data type is VARCHAR(4096). This special register applies to both static and dynamic statements.

The initial value of CURRENT PACKAGE PATH is an empty string. The value is a list of collections only if the application process has explicitly specified a list of collections by means of the SET CURRENT PACKAGE PATH statement. For details about this statement, see “SET CURRENT PACKAGE PATH” on page 1070. The initial value of CURRENT PACKAGE PATH in a user-defined function or procedure is inherited according to the rules in Table 27 on page 111

When CURRENT PACKAGE PATH or CURRENT PACKAGESET is set, DB2 uses the values in these registers to resolve the collection for a package. The value of CURRENT PACKAGE PATH takes priority over CURRENT PACKAGE SET. In a distributed environment, the value of CURRENT PACKAGE PATH at the remote server takes precedence of the value of CURRENT PACKAGE PATH at the local server (the requester). For more information on package resolution, see Part 5 of *DB2 Application Programming and SQL Guide*.

Example: In an application that is using SQLJ packages (in collection SQLJ1 and SQLJ2) and a JDBC package in DB2JAVA, set the CURRENT PACKAGE PATH special register to check SQLJ1 first, followed by SQLJ2, and DB2JAVA:

```
 SET CURRENT PACKAGE PATH = SQLJ1, SQLJ2, DB2JAVA;
```

The following statement sets the host variable to the value of the resulting list:

```
 SET :HVPKLIST = CURRENT PACKAGE PATH;
```

The value of the host variable would be ″SQLJ1″, ″SQLJ2″, ″DB2JAVA″.

CURRENT PACKAGESET

CURRENT PACKAGESET specifies a string of blanks or the collection ID of the package that will be used to execute SQL statements. The data type is VARCHAR(128).

The initial value of CURRENT PACKAGESET is an empty string. The value is a collection ID only if the application process has explicitly specified a collection ID by means of the SET CURRENT PACKAGESET statement. For details about this statement, see “SET CURRENT PACKAGESET” on page 1074. The initial value of CURRENT PACKAGESET in a user-defined function or stored procedure is inherited according to the rules in Table 27 on page 111.

Example: Before passing control to another program, identify the collection ID for its packaged as ALPHA.

```
EXEC SQL SET CURRENT PACKAGESET = 'ALPHA';
```

CURRENT PATH

CURRENT PATH specifies the SQL path used to resolve unqualified data type names and function names in dynamically prepared SQL statements. It is also used to resolve unqualified procedure names that are specified as host variables in SQL CALL statements (CALL *host-variable*). The data type is VARCHAR(2048).

The CURRENT PATH special register contains a list of one or more schema names, where each schema name is enclosed in delimiters and separated from the following schema by a comma (any delimiters within the string are repeated as they are in any delimited identifier). The delimiters and commas are included in the 2048 character length.

For information on when the SQL path is used to resolve unqualified names in both dynamic and static SQL statements and the effect of its value, see “SQL path” on page 46.

The initial value of the CURRENT PATH special register is either:

- The value of the PATH bind option
- ″SYSIBM″, ″SYSFUN″, ″SYSPROC″, ″*value of CURRENT SQLID special register*″ if the PATH bind option was not specified

  If the value of the CURRENT SQLID special register changes after the initial value of PATH special register is established, the value of the PATH special register is unaffected when the CURRENT SQLID is updated. However, if a commit later occurs and a SET PATH statement has not been processed, the value of PATH special register is reinitialized taking into consideration the current value of the CURRENT SQLID special register.

The initial value of CURRENT PATH in a user-defined function or stored procedure is inherited according to the rules in Table 27 on page 111.

You can change the value of the register by executing the statement SET PATH. For details about this statement, see “SET PATH” on page 1087. For portability across the platforms, it is recommended that a SET PATH statement be issued at the beginning of an application.

Example: Set the special register so that schema SMITH is searched before schemas SYSIBM, SYSFUN, and SYSPROC.

```
SET PATH = SMITH, SYSIBM, SYSFUN, SYSPROC;
```

CURRENT PRECISION

CURRENT PRECISION specifies the rules to be used when both operands in a decimal operation have precisions of 15 or less. The data type of the register is CHAR(5). Valid values for the CURRENT PRECISION special register include

'DEC15,' 'DEC31,' or 'Dpp.s' where 'pp' is either 15 or 31 and 's' is a number between 1 and 9. DEC15 specifies the rules that do not allow a precision greater than 15 digits, and DEC31 specifies the rules that allow a precision of up to 31 digits. The rules for DEC31 are always used if either operand has a precision greater than 15. If the form 'Dpp.s' is used, 'pp' represents the precision that will be used as the rules where DEC15 and DEC31 rules are used, and 's' represents the minimum divide scale to use for division operations. The separator used in the form 'Dpp.s' may be either the '.' or the ',' character, regardless of the setting of the default decimal point.

The initial value of CURRENT PRECISION is determined by the value of field DECIMAL ARITHMETIC on installation panel DSNTIP4. The default for the initial value is DEC15 unless your installation has changed it to be DEC31 by modifying the value in that field. The initial value of CURRENT PRECISION in a user-defined function or stored procedure is inherited according to the rules in Table 27 on page 111.

You can change the value of the register by executing the statement SET CURRENT PRECISION. For details about this statement, see “SET CURRENT PRECISION” on page 1076.

CURRENT PRECISION only affects dynamic SQL. When an SQL statement is dynamically prepared and the value of CURRENT PRECISION is DEC15 or D15.s, where ’s’ is a number between 1 and 9, DEC15 rules will apply. When an SQL statement is dynamically prepared and the value of CURRENT PRECISION is DEC31 or D31.s, where ’s’ is a number between 1 and 9, DEC31 rules will apply. Preparation of a statement with DEC31 instead of DEC15 is more likely to result in an error, especially for division operations. Specification of CURRENT PRECISION in the form 'Dpp.s' where 'pp' is either 15 or 31 and 's' represents the minimum divide scale, will in some cases make division errors less likely when 'pp' is set to 31. For more information, see “Arithmetic with two decimal operands” on page 135.

Example 1: Set CURRENT PRECISION so that subsequent statements that are prepared use DEC31 rules for decimal arithmetic:

```
SET CURRENT PRECISION = 'DEC31';
```

Example 2: Set CURRENT PRECISION so that subsequent statements that are prepared use DEC31 rules for decimal arithmetic with a minimum divide scale of 3:

```
SET CURRENT PRECISION = 'DEC31,3';
```

CURRENT REFRESH AGE

CURRENT REFRESH AGE specifies a timestamp duration value with a data type of DECIMAL(20,6). (For a description of durations, see “Datetime operands and durations” on page 142.) This duration is the maximum duration since a REFRESH TABLE statement has been processed on a system-maintained REFRESH DEFERRED materialized query table such that the materialized query table can be used to optimize the processing of a query. This special register affects dynamic statement cache matching.

If CURRENT REFRESH AGE has a value of 99999999999999 (ANY), REFRESH DEFERRED materialized query tables are considered to optimize the processing of a dynamic SQL query. This value represents 9999 years, 99 months, 99 days, 99 hours, and 99 seconds.

The initial value of CURRENT REFRESH AGE is determined by the value of field CURRENT REFRESH AGE on installation panel DSNTIP8. The default for the initial value of that field is 0 unless your installation has changed it to ANY by modifying the value of that field. The initial value of CURRENT REFRESH AGE in a user-defined function or stored procedure is inherited according to the rules in Table 27 on page 111.

You can change the value of the register by executing the SET CURRENT REFRESH AGE statement. For details about this statement, see “SET CURRENT REFRESH AGE” on page 1077.

Example : The following example retrieves the current value of the CURRENT REFRESH AGE special register into the host variable called CURMAXAGE:

```
   EXEC SQL VALUES (CURRENT REFRESH AGE) INTO :CURMAXAGE;
```

The value would be 99999999999999.000000 if set by the previous example.

CURRENT RULES

CURRENT RULES specifies whether certain SQL statements are executed in accordance with DB2 rules or the rules of the SQL standard. The data type of the register is CHAR(3), and the only valid values are 'DB2' and 'STD'.

CURRENT RULES is a register at the database server. If the server is not the local DB2, the initial value of the register is 'DB2'. Otherwise, the initial value is the same as the value of the SQLRULES bind option. The initial value of CURRENT RULES in a user-defined function or stored procedure is inherited according to the rules in Table 27 on page 111.

You can change the value of the register by executing the statement SET CURRENT RULES. For details about this statement, see “SET CURRENT RULES” on page 1079.

CURRENT RULES affects the statements listed in Table 26. The table summarizes when the statements are affected and shows where to find detailed information. CURRENT RULES also affects whether DB2 issues an *existence error* (SQLCODE -204) or an *authorization error* (SQLCODE -551) when an object does not exist.

Table 26. Summary of statements affected by CURRENT RULES

Statement	What is affected	Details on page
ALTER TABLE	Enforcement of check constraints added. Default value of the delete rule for referential constraints. Whether DB2 creates LOB table spaces, auxiliary tables, and indexes on auxiliary tables for added LOB columns. Whether DB2 creates an index for an added ROWID column that is defined with GENERATED BY DEFAULT.	504

Table 26. Summary of statements affected by CURRENT RULES (continued)

Statement	What is affected	Details on page
CREATE TABLE	Default value of the delete rule for referential constraints. Whether DB2 creates LOB table spaces, auxiliary tables, and indexes on auxiliary tables for LOB columns. Whether DB2 creates an index for a ROWID column that is defined with GENERATED BY DEFAULT.	734
DELETE	Authorization requirements for searched DELETE.	843
GRANT	Granting privileges to yourself.	941
REVOKE	Revoking privileges from authorization IDs	1020
UPDATE	Authorization requirements for searched UPDATE.	1097

Example: Set CURRENT RULES so that a later ALTER TABLE statement is executed in accordance with the rules of the SQL standard:

```
SET CURRENT RULES = 'STD';
```

CURRENT SCHEMA

The CURRENT SCHEMA, or equivalently CURRENT_SCHEMA, special register specifies the schema name used to qualify unqualified database object references in dynamically prepared SQL statements. The data type is VARCHAR(128).

For information on when the CURRENT SCHEMA is used to resolve unqualified names in dynamic SQL statements and the effect of its value, see “Qualification of unqualified object names” on page 47.

The CURRENT SCHEMA special register contains a value that is a single identifier without delimiters.

The initial value of the special register is the value of CURRENT SQLID at the time the connection is established. The initial value of the special register in a user-defined function or procedure is inherited according to the rules in Table 27 on page 111.

The value of the special register can be changed by executing the SET SCHEMA statement. The value of CURRENT SCHEMA is the same as the value of CURRENT SQLID unless a SET SCHEMA statement has been issued specifying a different value. After a SET SCHEMA statement has been issued in an application, the values of CURRENT SCHEMA and CURRENT SQLID are separate. Therefore, if the value of SET SCHEMA needs to be changed, a SET SCHEMA statement must be issued.

Example: Set the schema for object qualification to ’D123’.

```
SET SCHEMA = 'D123'
```

CURRENT SERVER

CURRENT SERVER specifies the location name of the current server. The data type is CHAR(16). If necessary, the location name is padded on the right with blanks so that its length is 16 bytes.

The initial value of CURRENT SERVER depends on the CURRENTSERVER bind option. If CURRENTSERVER X is specified on the bind subcommand, the initial value is X. If the option is not specified, the initial value is the location name of the local DB2. The initial value of CURRENT SERVER in a user-defined function or stored procedure is inherited according to the rules in Table 27 on page 111. The value of CURRENT SERVER is changed by the successful execution of a CONNECT statement.

The value of CURRENT SERVER is a string of blanks when:
- The application process is in the unconnected state, or
- The application process is connected to a local DB2 subsystem that does not have a location name.

Example: Set the host variable CS to the location name of the current server.

```
EXEC SQL SET :CS = CURRENT SERVER;
```

CURRENT SQLID

CURRENT SQLID specifies the SQL authorization ID of the process. The data type is VARCHAR(8).

The SQL authorization ID is:
- The authorization ID used for authorization checking on dynamically prepared CREATE, GRANT, and REVOKE SQL statements.
- The owner of a table space, database, storage group, or synonym created by a dynamically issued CREATE statement.
- The implicit qualifier of distinct type, function, procedure, and sequence names when these objects are defined in a CREATE statement.
- The implicit qualifier of all table, view, alias, index, trigger, and sequence names specified in dynamic SQL statements when DYNAMICRULES bind, define, or invoke behavior applies. (When run behavior applies, the CURRENT SCHEMA value is the implicit qualifier. See “Qualification of unqualified object names” on page 47 for more information.)

The initial value of CURRENT SQLID can be provided by the connection or sign-on exit routine. If not, the initial value is the primary authorization ID of the process. The value remains in effect until one of the following events occurs:
- The SQL authorization ID is changed by the execution of a new SET CURRENT SQLID statement.
- A SIGNON or re-SIGNON request is received from a CICS transaction subtask or an IMS independent region.
- The DB2 connection is ended.

The initial value of CURRENT SQLID in a user-defined function or stored procedure is inherited according to the rules in Table 27 on page 111.

CURRENT SQLID can only be referred to in an SQL statement that is executed by the current server.

Example: Set the SQL authorization ID to ’GROUP34’ (one of the authorization IDs of the process).

```
SET CURRENT SQLID = 'GROUP34';
```

CURRENT TIME

CURRENT TIME specifies the current time. The data type is TIME.

The time is derived by the DB2 that executes the SQL statement that refers to the special register. For a description of how the time is derived, see “Datetime special registers” on page 98. The value of CURRENT TIME in a user-defined function or stored procedure is inherited according to the rules in Table 27 on page 111.

Example: Display information about all project activities and include the current date and time in each row of the result.

```
SELECT DSN8810.PROJACT.*, CURRENT DATE, CURRENT TIME
  FROM DSN8810.PROJACT;
```

CURRENT TIMESTAMP

CURRENT TIMESTAMP specifies the current timestamp. The data type is TIMESTAMP.

The timestamp is derived by the DB2 that executes the SQL statement that refers to the special register. For a description of how the timestamp is derived, see “Datetime special registers” on page 98. The value of CURRENT TIMESTAMP in a user-defined function or stored procedure is inherited according to the rules in Table 27 on page 111.

Example: Display information about the full image copies that were taken in the last week.

```
SELECT * FROM SYSIBM.SYSCOPY
  WHERE TIMESTAMP > CURRENT TIMESTAMP - 7 DAYS;
```

CURRENT TIMEZONE

CURRENT TIMEZONE specifies the TIMEZONE parameter in the form of a time duration. The data type is DECIMAL(6,0).

The time duration is derived by the DB2 that executes the SQL statement that refers to the special register. The seconds part of the time duration is always zero. An error occurs if the hours portion of the TIMEZONE parameter is not between -24 and 24. The value of CURRENT TIMEZONE in a user-defined function or stored procedure is inherited according to the rules in Table 27 on page 111.

Example: Display information from SYSCOPY, but with the TIMESTAMP converted to GMT. This example is based on the assumption that the installation sets the clock to GMT and the TIMEZONE parameter to the difference from GMT.

```
SELECT DBNAME, TSNAME, DSNUM, ICTYPE, TIMESTAMP - CURRENT TIMEZONE
  FROM SYSIBM.SYSCOPY;
```

USER

| USER specifies the primary authorization ID of the process. The data type is
| VARCHAR(8).

If USER is referred to in an SQL statement that is executed at a remote DB2 and the primary authorization ID has been translated to a different authorization ID, USER specifies the translated authorization ID. For an explanation of authorization ID translation, see Part 3 (Volume 1) of *DB2 Administration Guide*. The value of USER in a user-defined function or stored procedure is determined according to the rules in Table 27.

Example: Display information about tables, views, and aliases that are owned by the primary authorization ID of the process.

```
SELECT * FROM SYSIBM.SYSTABLES WHERE CREATOR = USER;
```

Using special registers in a user-defined function or a stored procedure

Table 27 shows information you need when you use special registers in a user-defined function or stored procedure.

Table 27. Characteristics of special registers in a user-defined function or a stored procedure

Special register	Initial value when INHERIT SPECIAL REGISTERS option is specified	Initial value when DEFAULT SPECIAL REGISTERS option is specified	Routine can use SET statement to modify?
CURRENT CLIENT_ACCTNG	Inherited from the invoking application	Inherited from the invoking application	Not applicable[4]
CURRENT CLIENT_APPLNAME	Inherited from the invoking application	Inherited from the invoking application	Not applicable[4]
CURRENT CLIENT_USERID	Inherited from the invoking application	Inherited from the invoking application	Not applicable[4]
CURRENT CLIENT_WRKSTNNAME	Inherited from the invoking application	Inherited from the invoking application	Not applicable[4]
CURRENT APPLICATION ENCODING SCHEME	The value of bind option ENCODING for the user-defined function or stored procedure package	The value of bind option ENCODING for the user-defined function or stored procedure package	Yes
CURRENT DATE	New value for each SQL statement in the user-defined function or stored procedure package[1]	New value for each SQL statement in the user-defined function or stored procedure package[1]	Not applicable[4]
CURRENT DEGREE	CURRENT DEGREE[2]	The value of field CURRENT DEGREE on installation panel DSNTIP8	Yes
CURRENT LOCALE LC_CTYPE	Inherited from the invoking application	The value of field CURRENT LC_CTYPE on installation panel DSNTIPF	Yes
CURRENT MAINTAINED TABLE TYPES FOR OPTIMIZATION	Inherited from the invoking application	System default value	Yes
CURRENT OPTIMIZATION HINT	The value of bind option OPTHINT for the user-defined function or stored procedure package or inherited from the invoking application[5]	The value of bind option OPTHINT for the user-defined function or stored procedure package	Yes
CURRENT PACKAGE PATH	An empty string if the routine was defined with a COLLID value; otherwise, inherited from the invoking application	An empty string, regardless of whether a COLLID value was specified for the routine	Yes

Table 27. Characteristics of special registers in a user-defined function or a stored procedure (continued)

Special register	Initial value when INHERIT SPECIAL REGISTERS option is specified	Initial value when DEFAULT SPECIAL REGISTERS option is specified	Routine can use SET statement to modify?
CURRENT PACKAGESET	Inherited from the invoking application[3]	Inherited from the invoking application[3]	Yes
CURRENT PATH	The value of bind option PATH for the user-defined function or stored procedure package or inherited from the invoking application[5]	The value of bind option PATH for the user-defined function or stored procedure package	Yes
CURRENT PRECISION	Inherited from the invoking application	The value of field DECIMAL ARITHMETIC on installation panel DSNTIP4	Yes
CURRENT REFRESH AGE	Inherited from the invoking application	System default value	Yes
CURRENT RULES	Inherited from the invoking application	The value of bind option SQLRULES for the user-defined function package or stored procedure package	Yes
CURRENT SCHEMA	Inherited from the invoking application	The value of CURRENT SQLID when the routine is entered	Yes
CURRENT SERVER	Inherited from the invoking application	Inherited from the invoking application	Yes
CURRENT SQLID	The primary authorization ID of the application process or inherited from the invoking application[6]	The primary authorization ID of the application process	Yes[7]
CURRENT TIME	New value for each SQL statement in the user-defined function or stored procedure package[1]	New value for each SQL statement in the user-defined function or stored procedure package[1]	Not applicable[4]
CURRENT TIMESTAMP	New value for each SQL statement in the user-defined function or stored procedure package[1]	New value for each SQL statement in the user-defined function or stored procedure package[1]	Not applicable[4]
CURRENT TIMEZONE	Inherited from the invoking application	Inherited from the invoking application	Not applicable[4]
USER	Primary authorization ID of the application process	Primary authorization ID of the application process	Not applicable[4]

Table 27. Characteristics of special registers in a user-defined function or a stored procedure (continued)

Special register	Initial value when INHERIT SPECIAL REGISTERS option is specified	Initial value when DEFAULT SPECIAL REGISTERS option is specified	Routine can use SET statement to modify?

Note:

1. If the user-defined function or stored procedure is invoked within the scope of a trigger, DB2 uses the timestamp for the triggering SQL statement as the timestamp for all SQL statements in the package.
2. DB2 allows parallelism at only one level of a nested SQL statement. If you set the value of the CURRENT DEGREE special register to ANY, and parallelism is disabled, DB2 ignores the CURRENT DEGREE value.
3. If the function definition includes a specification for COLLID, DB2 sets CURRENT PACKAGESET to the value of COLLID.
4. Not applicable because no SET statement exists for the special register.
5. If a program within the scope of the invoking program issues a SET statement for the special register before the user-defined function or stored procedure is invoked, the special register inherits the value from the SET statement. Otherwise, the special register contains the value that is set by the bind option for the user-defined function or stored procedure package.
6. If a program within the scope of the invoking program issues a SET CURRENT SQLID statement before the user-defined function or stored procedure is invoked, the special register inherits the value from the SET statement. Otherwise, CURRENT SQLID contains the authorization ID of the application process.
7. If the user-defined function or stored procedure package uses a value other than RUN for the DYNAMICRULES bind option, the SET CURRENT SQLID statement can be executed but does not affect the authorization ID that is used for the dynamic SQL statements in the package. The DYNAMICRULES value determines the authorization ID that is used for dynamic SQL statements. For more information, see the discussion of DYNAMICRULES in Chapter 2 of *DB2 Command Reference*.

Column names

The meaning of a column name depends on its context. A column name can be used to:

- Declare the name of a column, as in a CREATE TABLE statement or in a CREATE FUNCTION statement that defines a table function.
- Identify a column, as in a CREATE INDEX statement.
- Specify values of the column, as in the following contexts:
  - In an *aggregate function*, a column name specifies all values of the column in the group or intermediate result table to which the function is applied. (Groups and intermediate result tables are explained in Chapter 4, “Queries,” which begins page 393.) For example, MAX(SALARY) applies the function MAX to all values of the column SALARY in a group.
  - In a *GROUP BY* or *ORDER BY clause*, a column name specifies all values in the intermediate result table to which the clause is applied. For example, ORDER BY DEPT orders an intermediate result table by the values of the column DEPT.
  - In an *expression,* a *search condition,* or a *scalar function,* a column name specifies a value for each row or group to which the construct is applied. For example, when the search condition CODE = 20 is applied to some row, the value specified by the column name CODE is the value of the column CODE in that row.
- Temporarily, rename a column, as in the *correlation-clause* of a table referenced in a FROM clause or as in the AS clause in the select-clause.

Qualified column names

A qualifier for a column name can be a table name, a view name, an alias name, a synonym, or a correlation name.

Whether a column name can be qualified depends, like its meaning, on its context:

- In some forms of the COMMENT and LABEL statements, a column name must be qualified. This is shown in the syntax diagrams.
- Where the column name specifies values of the column, a column name can be qualified at the user's option.
- In the column list of an INSERT statement, a column name can be qualified.
- In the *assignment-clause* of an UPDATE statement, a column name can be qualified.
- In all other contexts, a column name must not be qualified. This rule will be mentioned in the discussion of each statement to which it applies.

Where a qualifier is optional, it can serve two purposes. See "Column name qualifiers to avoid ambiguity" on page 115 and "Column name qualifiers in correlated references" on page 116 for details.

Correlation names

A *correlation name* can be defined in the FROM clause of a query and after the target table-name or view-name in an UPDATE or DELETE statement. For example, the following clause establishes Z as a correlation name for X.MYTABLE:

```
FROM X.MYTABLE Z
```

With Z defined as a correlation name for table X.MYTABLE, only Z should be used to qualify a reference to a column of X.MYTABLE in that SELECT statement.

A correlation name is associated with a table, view, nested table expression or table function only within the context in which it is defined. Hence, the same correlation name can be defined for different purposes in different statements. In a nested table expression or table function, a correlation name is required.

As a qualifier, a correlation name can be used to avoid ambiguity or to establish a correlated reference. It can also be used merely as a shorter name for a table or view. In the example, Z might have been used merely to avoid having to enter X.MYTABLE more than once.

Names that are specified in a FROM clause are either *exposed* or *non-exposed*. A correlation name is always an exposed name. A table name or view name is said to be exposed in that FROM clause if a correlation name is not specified. For example, in the following FROM clause, a correlation name is specified for EMPLOYEE, but not for DEPARTMENT; therefore, DEPARTMENT is an exposed name, and EMPLOYEE is not an exposed name:

```
FROM EMPLOYEE E, DEPARTMENT
```

The use of a correlation name in the FROM clause also allows the option of specifying a list of column names to be associated with the columns of the result table. As with a correlation name, the listed column names should be the names that are used to reference the columns in that SELECT statement. For example, assume that the name of the first column in the DEPT table is DEPTNO. Given this FROM clause in a SELECT statement:

```
  FROM DEPT D (NUM,NAME,MGR,ANUM,LOC)
```

You should use D.NUM instead of D.DEPTNO to reference the first column of the table.

If a list of columns is specified, it must consist of as many names as there are columns in the *table-reference*. Each column must be unique and unqualified.

Column name qualifiers to avoid ambiguity

In the context of a function, a GROUP BY clause, an ORDER BY clause, an expression, or a search condition, a column name refers to values of a column in some table, view, nested table expression, or table function. The tables, views, nested table expression, or table function reference that might contain the column are called the *object tables* of the context. Two or more object tables might contain columns with the same name. One reason for qualifying a column name is to name the table from which the column comes.

Table designators: A qualifier that names a specific object table is called a *table designator*. The clause that identifies the object tables also establishes the table designators for them. For example, the object tables of an expression in a SELECT clause are named in the FROM clause that follows it, as in this statement:

```
SELECT DISTINCT Z.EMPNO, EMPTIME, PHONENO
  FROM DSN8810.EMP Z, DSN8810.EMPPROJACT
  WHERE WORKDEPT = 'D11'
    AND EMPTIME > 0.5
    AND Z.EMPNO = DSN8810.EMPPROJACT.EMPNO;
```

This example illustrates how to establish table designators in the FROM clause:

- A correlation name that follows a table name, view name, nested table expression, or table function is a table designator. Thus, Z is a table designator and qualifies the first column name after SELECT.
- A table name or view name that is *not* followed by a correlation name is a table designator. Thus, the qualified table name, DSN8810.EMPPROJACT is a table designator and qualifies the EMPNO column.

Avoiding undefined or ambiguous references in DB2 SQL: When a column name refers to values of a column, the following situations result in errors:

- No object table contains a column with the specified name. The reference is undefined.
- The column name is qualified by a table designator, but the table named does not include a column with the specified name. Again, the reference is undefined.
- The name is unqualified and more than one object table includes a column with that name. The reference is ambiguous.

Avoid ambiguous references by qualifying a column name with a uniquely defined table designator. If the column is contained in several object tables with different names, the table names can be used as designators. Ambiguous references can also be avoided without the use of the table designator by giving unique names to the columns of one of the object tables using the column name list following the correlation name.

Two or more object tables can be instances of the same table. A FROM clause that includes *n* references to the same table should include at least *n - 1* unique correlation names.

For example, in the following FROM clause X and Y are defined to refer, respectively, to the first and second instances of the table EMP.

```
SELECT X.LASTNAME, Y.LASTNAME
  FROM DSN8810.EMP X, DSN8810.EMP Y
  WHERE Y.JOB = 'MANAGER'
    AND X.WORKDEPT = Y.WORKDEPT
    AND X.JOB <> 'MANAGER';
```

When qualifying a column with the exposed table name form of a table designator, either the qualified or unqualified form of the exposed table name may be used. However, the qualifier used and the table used must be the same after fully qualifying the table name or view name and the table designator.

Example 1: If the authorization ID of the statement is CORPDATA, the following statement is valid:

```
SELECT CORPDATA.EMPLOYEE.WORKDEPT
  FROM EMPLOYEE;
```

Example 2: If the authorization ID of the statement is REGION, the following statement is invalid because EMPLOYEE represents the table REGION.EMPLOYEE, but the qualifier for WORKDEPT represents a different table, CORPDATA.EMPLOYEE:

```
SELECT CORPDATA.EMPLOYEE.WORKDEPT              <=== INCORRECT
  FROM EMPLOYEE;
```

Example 3: If the authorization ID of the statement is REGION, the following statement is invalid because EMPLOYEE in the select list represents the table REGION.EMPLOYEE, but the explicitly qualified table name in the FROM clause represents a different table, CORPDATA.EMPLOYEE.

```
SELECT EMPLOYEE.WORKDEPT                      <=== INCORRECT
  FROM CORPDATA.EMPLOYEE;
```

Column name qualifiers in correlated references

A *subselect* is a form of a query that can be used as a component of various SQL statements. Refer to Chapter 4, “Queries,” on page 393 for more information on subselects. A *subquery* is a form of a fullselect that is enclosed within parenthesis. For example, a subquery can be used in a search condition. A fullselect that is used to retrieve a single value as an expression within a statement is called a *scalar fullselect* or *scalar subquery*. A fullselect that is used in the FROM clause of a query is called a *nested table expression*.

A subquery can include search conditions of its own, and these search conditions can, in turn, include subqueries. Thus, an SQL statement can contain a hierarchy of subqueries. Those elements of the hierarchy that contain subqueries are said to be at a higher level than the subqueries they contain.

Every element of the hierarchy has a clause that establishes one or more table designators. This is the FROM clause, except in the highest level of an UPDATE, where it is the table or view being updated. A search condition of a subquery can reference not only columns of the tables identified by the FROM clause of its own element of the hierarchy, but also columns of tables identified at any level along the path from its own element to the highest level of the hierarchy. A reference to a column of a table identified at a higher level is called a *correlated reference*.

A correlated reference to column C of table T can be of the form C, T.C, or Q.C, if Q is a correlation name defined for T. However, **a correlated reference in the form of an unqualified column name is not good practice**. The following explanation is based on the assumption that a correlated reference is always in the form of a qualified column name and that the qualifier is a correlation name.

A qualified column name, Q.C, is a correlated reference only if these three conditions are met:

- Q.C is used in a search condition or in a select list of a subquery.
- Q does not name a table used in the FROM clause of that subquery.
- Q does name a table used at some higher level.

Q.C refers to column C of the table or view at the level where Q is used as the table designator of that table or view. Because the same table or view can be identified at many levels, unique correlation names are recommended as table designators. If Q is used to name a table at more than one level, Q.C refers to the lowest level that contains the subquery that includes Q.C.

For example, in the following statement, the correlated reference X.WORKDEPT (in the last line) refers to the value of WORKDEPT in table DSN8810.EMP at the level of the first FROM clause (which establishes X as a correlation name for DSN8810.EMP.). The statement lists employees who make less than the average salary for their department.

```
SELECT EMPNO, LASTNAME, WORKDEPT
  FROM DSN8810.EMP X
  WHERE SALARY < (SELECT AVG(SALARY)
                    FROM DSN8810.EMP
                    WHERE WORKDEPT = X.WORKDEPT);
```

The following example shows a correlated reference in the select list of the subquery.

```
SELECT T1.KEY1
  FROM BP1TBL T1
  GROUP BY T1.KEY1
  HAVING MAX(T1.KEY1) = (SELECT MIN(T1.KEY1) + MIN(T2.KEY1)
                    FROM BP2TBL T2);
```

Resolution of column name qualifiers and column names

Names in a FROM clause are either *exposed* or *non-exposed*. A correlation name for a table name, view name, nested table expression, or reference to a table function is always exposed. A table name or a view name that is not followed by a correlation name is also exposed.

Although DB2 UDB for z/OS does not enforce this rule strictly, in IBM SQL and ANSI/ISO SQL, the exposed names in a FROM clause must be unique, and the qualifier of a column name must be an exposed name. Therefore, for good programming practices, ensure that all exposed names are unique and that all qualified column names are qualified with the appropriate exposed name.

The rules for finding the referent of a column name qualifier are as follows:

1. Let Q be a one-, two-, or three-part name, and let Q.C denote a column name in subselect S. Q must designate a table or view identified in the statement that includes S and that table or view must have a column named C. An additional requirement differs for two cases:
   - If Q.C *is not* in a search-condition or S *is not* a subquery, Q must designate a table or view identified in the FROM clause of S. For example, if Q.C is in a SELECT clause, Q refers to a table or view in the following FROM clause.
   - If Q.C *is* in a *search-condition* and S *is* a subquery, Q must designate a table or view identified either in the FROM clause of S or in a FROM clause of a

subselect that directly or indirectly includes S. For example, if Q.C is in a WHERE clause and S is the only subquery in the statement, the table or view that Q refers to is either in the FROM clause of S or the FROM clause of the subselect that includes S.

2. The same table or view can be identified more than once in the same statement. The particular occurrence of the table or view that Q refers to is determined by a procedure equivalent to the following steps:
   a. The one- and two-part names in every FROM clause and the one- and two-part qualifiers of column names are expanded into a fully-qualified form.

      For example, if a dynamic SQL statement uses FROM Q and DYNAMICRULES run behavior (RUN) is in effect, Q is expanded to S.A.Q, where S is the value of CURRENT SERVER and A is the value of CURRENT SQLID. (If DYNAMICRULES bind behavior is in effect instead, A is the plan or package qualifier as determined during the bind process.) We refer to this step later as “name completion”. An error occurs if the first part of every name (the location) is not the same.
   b. Q, now a three-part name, is compared with every name in the FROM clause of S. If Q.C is in a *search-condition* and S is a subquery, Q is next compared with every name in the FROM clause of the subselect that contains S. If that subselect is a subquery, Q is then compared with every name in the FROM clause of the subselect containing that subquery, and so on. If a FROM clause includes multiple names, the comparisons in that clause are made in order from left to right.
   c. The referent of Q is selected by these rules:
      - If Q matches exactly one name, that name is selected.
      - If Q matches more than one name, but only one exposed name, that exposed name is selected.
      - If Q matches more than one exposed name, the first of those names is selected.
      - If Q matches more than one name, none of which are exposed names, the first of those names is selected.

      If Q does not match any name, or if the table or view designated by Q does not include a column named C, an error occurs.
   d. Otherwise, Q.C is resolved to column C of the occurrence of the table or view identified by the selected name.
3. A warning occurs for any of these cases:
   - The selected name is not an exposed name.
   - The selected name is an exposed name that has an unexposed duplicate that appears before the selected name in the ordered list of names to which Q is compared.
   - The selected name is an exposed name that has an exposed duplicate in the same FROM clause.
   - Another name would have been selected had the matching been performed before name completion.

The rules for resolving column name qualifiers apply to every SQL statement that includes a subselect and are applied before synonyms and aliases are resolved. In the case of a searched UPDATE or DELETE statement, the first clause of the statement identifies the table or view to be updated or deleted. That clause can include a correlation name and, with regard to name resolution, is equivalent to the first FROM clause of a SELECT statement. For example, a subquery in the search condition of an UPDATE statement can include a correlated reference to a column of the updated rows.

The rules for column names in the ORDER BY clause are the same as other clauses.

References to variables

A *variable* in an SQL statement specifies a value that can be changed when the SQL statement is executed. There are several types of variables used in SQL statements:

host variable
Host variables are defined by statements of a host language. For more information about how to refer to host variables, see "References to host variables."

transition variable
Transition variables are defined in a trigger and refer to either the old or new values of columns of the subject table of a trigger. For more information about how to refer to transition variables, see "CREATE TRIGGER" on page 793.

SQL variable
SQL variables are defined by an SQL compound statement in an SQL procedure. For more information about SQL variables, see "References to SQL parameters and SQL variables" on page 1114.

SQL parameter
SQL parameters are defined in an CREATE FUNCTION (SQL Scalar) or CREATE PROCEDURE (SQL) statement. For more information about SQL parameters, see "References to SQL parameters and SQL variables" on page 1114.

parameter marker
Parameter markers are specified in an SQL statement that is dynamically prepared instead of host variables. For more information about parameter markers, see "Parameter markers" on page 1003. in the PREPARE statement.

In this book, unless otherwise noted, the term *host variable* in syntax diagrams is used to describe where a host variable, transition variable, SQL variable, SQL parameter, or parameter marker can be used.

References to host variables

A *host variable* is either of these items that is referred to in an SQL statement:

- A variable in a host language such as a PL/I variable, C variable, Fortran variable, REXX variable, Java variable, COBOL data item, or Assembler language storage area
- A host language construct that was generated by an SQL precompiler from a variable declared using SQL extensions

Host variables are defined directly by statements of the host language or indirectly by SQL extensions as described in Part 2 of *DB2 Application Programming and SQL Guide*. Host variables cannot be referenced in dynamic SQL statements; parameter markers must be used instead. For more information about parameter markers, see "Host variables in dynamic SQL" on page 121.

A host-variable in an SQL statement must identify a host variable that is described in the program according to the rules for declaring host variables.

References to host variables

In PL/I, C, and COBOL, host variables can be referred to in ways that do not apply to Fortran and Assembler language. This is explained in “Host structures in PL/I, C, and COBOL” on page 125. The following applies to all host languages.

The term *host-variable*, as used in the syntax diagrams, shows a reference to a host variable. In a SET *host variable* statement and the INTO clause of a FETCH, SELECT INTO, or VALUES INTO statement, a host variable is an output variable to which a value is assigned by DB2. In a CALL statement, a host variable can be an output argument that is assigned a value after execution of the procedure, an input argument that provides an input value for the procedure, or both an input and output argument. In all other contexts, a host variable is an input variable which provides a value to DB2.

The general form of a host variable reference in all languages other than Java is:

```
►►──:host-identifier──┬─────────────────────────────────┬──────────────────────────►◄
                      │ ┌─INDICATOR─┐                   │
                      └─┴───────────┴─:host-identifier──┘
```

Each host identifier must be declared in the source program, except in a program written in REXX. The first host identifier designates the main variable; the second host identifier designates its indicator variable. The variable designated by the second host identifier must be a small integer. The purposes of the indicator variable are to:

- Specify the null value. A negative value of the indicator variable specifies the null value. A -1 value indicates that the value that was selected was the null value. A -2 value indicates that a numeric conversion or arithmetic expression error occurred in the SELECT list of an outer SELECT statement. A -3 value indicates that values were not returned for the row because a hole was detected on a multiple row FETCH. The value of -3 is used only for multiple-row FETCH statements; otherwise, the only indication of a hole is a warning.
- Record the original length of a truncated string.
- Indicate that a character could not be converted.
- Record the seconds portion of a time if the time is truncated on assignment to a host variable.

For example, if :V1:V2 is used to specify an insert or update value, and if V2 is negative, the value specified is the null value. If V2 is not negative, the value specified is the value of V1.

Similarly, if :V1:V2 is specified in a FETCH or SELECT INTO statement, and if the value returned is null, V1 is not changed and V2 is set to -1 or -2. It is set to -1 if the value selected was actually null. It is set to -2 if the null value was returned because of numeric conversion errors or arithmetic expression errors in the SELECT list of an outer SELECT statement. It is also set to -2 as the result of a character conversion error.

If the value returned is not null, that value is assigned to V1, and V2 is set to zero (unless the assignment to V1 requires string truncation, in which case V2 is set to the original length of the string). If an assignment requires truncation of the seconds part of a time, V2 is set to the number of seconds.

If the second host identifier is omitted, the host variable does not have an indicator variable: the value specified by the host variable :V1 is always the value of V1 and null values cannot be assigned to the variable. Thus, this form should not be used in an INTO clause unless the corresponding result column cannot contain null values. If this form is used for an output host variable and the value returned is null, DB2 will generate an error at run time.

The general form of a host variable reference in Java is:

```
►►─:──┬───────┬──┬─Java-identifier───┬─────────────────────────────────────►◄
      ├─IN────┤  └─(Java-expression)─┘
      ├─OUT───┤
      └─INOUT─┘
```

In Java, indicator variables are not used. Instead, instances of a Java class can be set to a null value. Variables defined as Java primitive types can not be set to a null value.

If IN, OUT, or INOUT is not specified, the default depends on the context in which the variable is used. If the Java variable is used in an INTO clause, OUT is the default. Otherwise, IN is the default.

An SQL statement that refers to host variables must be within the scope of the declaration of those host variables. For host variables referred to in the SELECT statement of a cursor, the OPEN statement rather and the DECLARE CURSOR statement have to be in the same scope.

All references to host variables must be preceded by a colon. (An exception to this rule is when the host variable is used with an SQLDA descriptor.) If an SQL statement references a host variable without a preceding colon, the precompiler issues an error for the missing colon or interprets the host variable as an unqualified column name, which might lead to unintended results. The interpretation of a host variable without a colon as a column name occurs when the host variable is referenced in a context in which a column name can also be referenced.

Host variables in dynamic SQL

In dynamic SQL statements, parameter markers are used instead of host variables. A parameter marker is a question mark (?) that represents a position in a dynamic SQL statement where the application will provide a value; that is, where a host variable would be found if the statement string were a static SQL statement. The following examples show a static SQL statement that uses host variables and a dynamic statement that uses parameter markers:

```
INSERT INTO DEPT VALUES (:HV_DEPTNO, :HV_DEPTNAME, :HV_MGRNO, :HV_ADMRDEPT)

INSERT INTO DEPT VALUES (?, ?, ?, ?)
```

For more information on parameter markers, see “Parameter markers” on page 1003 under the PREPARE statement.

References to LOB host variables

Regular LOB variables (CLOB, DBCLOB, and BLOB) and LOB locator variables (see “References to LOB locator variables” on page 122) can be defined in all host languages, except in REXX. Java supports LOBs but not LOB locators. Where LOBs are allowed, the term *host-variable* in a syntax diagram can refer to a regular host variable or a locator variable. Since these variables are not native data types in host programming languages, SQL extensions are used and the precompilers generate the host language constructs necessary to represent each variable.

When it is possible to define a host variable that is large enough to hold an entire LOB value and the performance benefit of delaying the transfer of data from the server is not required, a LOB locator is not needed. However, it is often not acceptable to store an entire LOB value in temporary storage due to host language restrictions, storage restrictions, or performance requirements. When storing an entire LOB value at one time is not acceptable, a LOB value can be referenced using a LOB locator and portions of the LOB value can be accessed.

References to LOB locator variables

A LOB locator variable is a host variable that contains the locator representing a LOB value on the database server.

A locator variable in an SQL statement must identify a LOB locator variable described in the program according to the rules for declaring locator variables. This is always indirectly through an SQL statement. For example, in C:

```
static volatile SQL TYPE IS CLOB_LOCATOR *loc1;
```

The term *locator-variable*, as used in the syntax diagrams, shows a reference to a LOB locator variable. The meta-variable *locator-variable* can be expanded to include a *host-identifier* the same as that for *host-variable.*

Like all other host variables, a LOB locator variable can have an associated indicator variable. Indicator variables for LOB locator variables behave in the same way as indicator variables for other data types. When a null value is returned from the database, the indicator variable is set and the locator host variable is unchanged. This means a locator can never represent a null value. However, when the indicator variable associated with a LOB locator is null, the value of the referenced LOB value is null.

If a locator variable does not currently represent any value, an error occurs when the locator variable is referenced.

When a transaction commits, LOB locators that were acquired by the transaction are released unless a HOLD LOCATOR statement was issued for the LOB locator. When the transaction ends, all LOB locators are released.

It is the application programmer’s responsibility to guarantee that any LOB locator is used only in SQL statements that are executed at the same server that originally generated the LOB locator. For example, assume that a LOB locator is returned from one server and assigned to a LOB locator variable. If that LOB locator variable is subsequently used in an SQL statement that is executed at a different server unpredictable results will occur.

References to stored procedure result sets

An application, written in a programming language other than Java, can access a result set that is returned from a stored procedure. A result set locator is used by the invoking application to access the result set. A result set locator value for a result set can be obtained from an ASSOCIATE LOCATOR statement or with the

DESCRIBE PROCEDURE statement. For more information, see “ASSOCIATE LOCATORS” on page 558 and “DESCRIBE PROCEDURE” on page 863.

The result set locator value is specified on an ALLOCATE CURSOR statement to define a cursor in the invoking application and to associate it with a stored procedure result set. For more information, see “ALLOCATE CURSOR” on page 436.

A DESCRIBE CURSOR statement can be used in the invoking application to obtain information on the characteristics of the columns of a stored procedure result set. For more information, see “DESCRIBE CURSOR” on page 859.

The application can then access the rows of the result set using FETCH statements with the allocated cursor.

References to result set locator variables

A result set locator variable is a host variable that contains the locator that identifies a stored procedure result set.

A result set locator variable in an SQL statement must identify a result set locator variable described in the program according to the rules for declaring result set locator variables. This is always indirectly through an SQL statement. For example, in C:

```
static volatile SQL TYPE IS RESULT_SET_LOCATOR *loc1;
```

The term *rs-locator-variable*, as used in the syntax diagrams, shows a reference to a result set locator variable. The meta-variable *rs-locator-variable* can be expanded to include a *host-identifier* the same as that for *host-variable.*

When the indicator variable associated with a result set locator is null, the referenced result set is not defined.

If a result set locator variable does not currently represent any stored procedure result set, an error occurs when the locator variable is referenced.

A commit operation destroys all open cursors that were declared in the stored procedure without the WITH HOLD operation and the result set locators that are associated with those cursors. Otherwise, a cursor and its associated result set locator persist past the commit.

References to built-in session variables

DB2 provides several built-in session variables that contain information about the server and application process. The value of a built-in session variable can be obtained by invoking the GETVARIABLE function with the name of the built-in session variable.

DB2 provides the following built-in session variables:

SYSIBM.DATA_SHARING_GROUP_NAME
Contains a string that corresponds to the name of the data sharing group for this DB2 subsystem. If the subsystem is not part of data sharing group, the null value is returned.

SYSIBM.PACKAGE_NAME
Contains a string that corresponds to the name of the package that is currently being executed. If a package is not currently being executed, the

null value is returned. (This situation can occur when the plan that is being executed bound one or more DBRMs directly).

SYSIBM.PACKAGE_SCHEMA
Contains a string that corresponds to the collection id of the package that is currently being executed. If a package is not currently being executed, the null value is returned.

SYSIBM.PACKAGE_VERSION
Contains a string that corresponds to the version of the package that is currently being executed. If a package is not currently being executed, the null value is returned.

SYSIBM.PLAN_NAME
Contains a string that corresponds to the name to the plan that is currently being executed. This session variable can never be null.

SYSIBM.SECLABEL
Contains a string that corresponds to the RACF SECLABEL value, if any, that has been defined for the current userid. If a value has not been defined, the null value is returned.

SYSIBM.SYSTEM_NAME
Contains a string that corresponds to the name of the DB2 UDB for z/OS subsystem, as defined in field SUBSYSTEM NAME on installation panel DSNTIPM. This session variable can never be null.

SYSIBM.SYSTEM_ASCII_CCSID
Contains a value that represents the ASCII CCSIDs that are in use on this system. The information is returned as a comma-delimited string that corresponds to the ASCII CCSID that was specified on installation panel DSNTIPF. The three values that are returned correspond to the SBCS, MIXED, and graphic CCSID that are in use for ASCII data on this system. A value of 65535 for the MIXED or graphic CCSID indicates that this system does not support storing data in that CCSID. This session variable can never be null.

SYSIBM.SYSTEM_EBCDIC_CCSID
Contains a value that represents the EBCDIC CCSIDs that are in use on this system. The information is returned as a comma-delimited string that corresponds to the EBCDIC CCSID that was specified on installation panel DSNTIPF. The three values that are returned correspond to the SBCS, MIXED, and graphic CCSID that are in use for EBCDIC data on this system. A value of 65535 for the MIXED or graphic CCSID indicates that this system does not support storing data in that CCSID. This session variable can never be null.

SYSIBM.SYSTEM_UNICODE_CCSID
Contains a value that represents the Unicode CCSIDs that are in use on this system. The information is returned as a comma-delimited string that corresponds to the UNICODE CCSID that was specified on installation panel DSNTIPF. The three values that are returned correspond to the SBCS, MIXED, and graphic CCSID that are in use for Unicode data on this system. This session variable can never be null.

SYSIBM.VERSION
Contains a string that represents the version of DB2. This string has the form *pppvvrrm* where:

- *ppp* is a product string that is set to the value ’DSN’
- *vv* is a two-digit version identifier such as ’08

- *rr* is a two-digit release identifier such as ’01’
- *m* is a one-digit maintenance level identifier such as ’5’ (Values 1, 3, 4, and 4 are reserved for compatibility mode and enabling-new-function mode, and values 5, 6, 7, 8, and 9 are reserved for new function mode.)

This session variable can never be null.

For example, the following statement sets the value of host variable :hv1 to the name of the plan that is currently being executed:

```
SET :hv1 = GETVARIABLE(SYSIBM.PLAN_NAME);
```

For more information about the GETVARIABLE function, see “GETVARIABLE” on page 261.

Host structures in PL/I, C, and COBOL

A *host structure* is a PL/I structure, C structure, or COBOL group that is referred to in an SQL statement. In Java and REXX, there is no equivalent to a host structure. Host structures are defined by statements of the host language, as explained in Part 2 of *DB2 Application Programming and SQL Guide*. As used here, the term “host structure” does not include an SQLCA or SQLDA.

The form of a host structure reference is identical to the form of a host variable reference. The reference :S1:S2 is a host structure reference if S1 names a host structure. If S1 designates a host structure, S2 must be a small integer variable or an array of small integer variables. S1 is the host structure and S2 is its indicator array.

A host structure can be referred to in any context where a list of host variables can be referenced. A host structure reference is equivalent to a reference to each of the host variables contained within the structure in the order which they are defined in the host language structure declaration. The *n*th variable of the indicator array is the indicator variable for the *n*th variable of the host structure.

In PL/I, for example, if V1, V2, and V3 are declared as the variables within the structure S1, the statement:

```
EXEC SQL FETCH CURSOR1 INTO :S1;
```

is equivalent to:

```
EXEC SQL FETCH CURSOR1 INTO :V1, :V2, :V3;
```

If the host structure has *m* more variables than the indicator array, the last *m* variables of the host structure do not have indicator variables. If the host structure has *m* fewer variables than the indicator array, the last *m* variables of the indicator array are ignored. These rules also apply if a reference to a host structure includes an indicator variable or a reference to a host variable includes an indicator array. If an indicator array or variable is not specified, no variable of the host structure has an indicator variable.

In addition to structure references, individual host variables or indicator variables in PL/I, C, and COBOL can be referred to by qualified names. The qualified form is a host identifier followed by a period and another host identifier. The first host identifier must name a structure, and the second host identifier must name a host variable within that structure.

Host structures in PL/I, C, and COBOL

In PL/I, C, and COBOL, the syntax of *host-variable* is:

```
►►──:─┬─────────────────────┬─host-identifier─────────────────────────────►
      └─host-identifier.────┘

►─┬──────────────────────────────────────────────────────────┬───────────►◄
  │ ┌─INDICATOR─┐                                            │
  └─┴───────────┴─:─┬─────────────────────┬─host-identifier──┘
                    └─host-identifier.────┘
```

In general, a *host-variable* in an expression must identify a host variable (not a structure) described in the program according to the rules for declaring host variables. However, there are a few SQL statements that allow a host variable in an expression to identify a structure, as specifically noted in the descriptions of the statements.

The following examples show references to host variables and host structures:

```
:V1   :S1.V1   :S1.V1:V2   :S1.V2:S2.V4
```

Host-variable-arrays in PL/I, C, C++, and COBOL

A *host-variable-array* is an array in which each element of the array contains a value for the same column. The first element in the array corresponds to the first value, the second element in the array corresponds to the second value, and so on. A host-variable-array can only be referenced in a FETCH statement for a multiple row fetch or in an INSERT statement with a multiple row insert. Host-variable-arrays are defined by statements of the host language as explained in *DB2 Application Programming and SQL Guide*.

The form of a host structure reference is similar to the form of a host variable reference. The reference :COL1:COL1IND is a host-variable-array reference if COL1 designates an array. If COL1 designates an array, COL1IND must be a one dimensional array of small integer host variables. The dimension of the host-variable-array must be less than or equal to the dimension of the indicator array. If an indicator array is not specified, no variable of the main host-variable-array has an indicator variable.

In PL/I, C, C++, and COBOL, the syntax of *host-variable-array* is:

```
►►──:host-identifier──┬──────────────────────────────────┬───────────────►◄
                      │ ┌─INDICATOR─┐                    │
                      └─┴───────────┴─:host-identifier───┘
```

In the following example, COL1 is the main host-variable-array and COL1IND is its indicator array, If COL1 has 10 elements for fetching a single column of data for multiple rows of data, COL1IND must also have 10 entries.

```
EXEC SQL FETCH CURSOR FOR 5 ROWS  INTO :COL1 :COL1IND;
```

Functions

A *function* is an operation denoted by a function name followed by zero or more operands that are enclosed in parentheses. It represents a relationship between a set of input values and a set of result values. The input values to a function are called *arguments*. For example, a function can be passed with two input arguments that have date and time data types and return a value with a timestamp data type as the result.

Types of functions

There are several ways to classify functions. One way to classify functions is as built-in functions, user-defined functions, or cast functions that are generated for distinct types.

Built-in functions

Built-in functions are IBM-supplied functions that come with DB2 UDB for z/OS and are in the SYSIBM schema. Built-in functions include operator functions such as ″+″, aggregate functions such as AVG, and scalar functions such as SUBSTR. Although both aggregate and scalar functions return a single value, their arguments differ. The argument of an aggregate function is a set of like values. Each argument of a scalar function is a single value.

The built-in functions are in schema SYSIBM. A built-in function can be invoked with or without its schema name. Regardless of whether a schema name qualifies the function name, DB2 uses function resolution to determine which function to use. For more information on the process of function resolution, see “Function resolution” on page 129. For specific built-in functions, see the function descriptions in Chapter 3, “Functions,” on page 189.

User-defined functions

User-defined functions are functions that are registered to DB2 in catalog table SYSIBM.SYSROUTINES using the CREATE FUNCTION statement. These functions allow users to extend the function of the database system by adding their own or third party vendor function definitions.

A user-defined function can be an *external*, *sourced*, or SQL scalar function. An external function is defined to the database with a reference to a load module that is executed when the function is invoked. A sourced function is defined to the database with a reference to a built-in function or another user-defined function. Sourced functions are useful for supporting the use of built-in aggregate and scalar functions for distinct types. The definition of an SQL function includes a RETURN statement.

A user-defined function resides in the schema in which it was registered. The schema cannot be SYSIBM. In addition to being external or sourced, user-defined functions can be further categorized as aggregate, scalar, or table functions.

To help you define and implement user-defined functions, sample user-defined functions are supplied with DB2. You can also use these sample user-defined functions in your application program just as you would any other user-defined function if the appropriate installation job has been run. For a list of the sample user-defined functions, see Appendix H, “Sample user-defined functions,” on page 1351. For more information on creating and using user-defined functions, see Part 2 of *DB2 Application Programming and SQL Guide*.

Cast functions

Cast functions are automatically generated by DB2 when a distinct type is created using the CREATE DISTINCT TYPE statement. These functions support casting from the distinct type to the source type and from the source type to the distinct type. The ability to cast between the data types is important because a distinct type is compatible only with itself.

The generated cast functions reside in the same schema as the distinct type for which they were created. The schema cannot be SYSIBM. For more information on the functions that are generated for a distinct type, see “CREATE DISTINCT TYPE” on page 597.

Additional way to classify functions

Another way to classify functions is as aggregate, scalar, or table functions, depending on the input data values and result values. For a list of the aggregate, scalar, and table functions and information on these functions, see Chapter 3, “Functions,” on page 189.

- An *aggregate function* returns a single-value result for the argument it receives. The argument is a set of like values (such as the values of a column). Aggregate functions are sometimes called *column functions.* Built-in functions and user-defined sourced functions can be aggregate functions. An external user-defined function cannot be an aggregate function.
- A *scalar function* also returns a single-value result for the arguments it receives. Each argument is a single value. Built-in functions and user-defined functions, both external and sourced, can be scalar functions. The functions that are created for distinct types are also scalar functions.
- A *table function* returns a table for the set of arguments it receives. Each argument is a single value. A table function can only be referenced in the FROM clause of a subselect. Table functions can be used to apply SQL language processing power to data that is not DB2 data or to convert such data into a DB2 table. For example, a table function can take a file and convert it to a table, get data from the World Wide Web and tabularize it, or access a Lotus Notes® database and return information about mail messages. Only external user-defined functions can be table functions.

Function invocation

Each reference to a scalar or aggregate function (either built-in or user-defined) conforms to the following syntax:

```
►►─function-name─(─┬──────────┬─┬──────────────────────────────┬─)──────────────────────►◄
                   ├─ALL──────┤ ├─expression───────────────────┤
                   └─DISTINCT─┘ └─TABLE──transition-table-name─┘
```

In the above syntax, *expression* cannot include an aggregate function. See “Expressions” on page 133 for other rules for *expression*.

The ALL or DISTINCT keyword can only be specified for an aggregate function or a user-defined function that is sourced on an aggregate function. The TABLE keyword can only be used in a trigger body.

Table functions can be referenced only in the FROM clause of a subselect. For more information on referencing a table function, see the description of the "from-clause" on page 399.

When the function is invoked, the value of each of its parameters is assigned using storage assignment, to the corresponding parameter of the function. Control is passed to external functions according to the calling conventions of the host language. When execution of a user-defined aggregate or scalar function is complete, the result of the function is assigned, using storage assignment, to the result data type. For information about assignment rules, see "Assignment and comparison" on page 74.

Additionally, a character FOR BIT DATA argument cannot be passed as input for a parameter that is not defined as character FOR BIT DATA. Likewise, a character argument that is not FOR BIT DATA cannot be passed as input for a parameter defined as character FOR BIT DATA.

Function resolution

A function is invoked by its function name, which is implicitly or explicitly qualified with a schema name, followed by parentheses that enclose the arguments to the function. Within the database, each function is uniquely identified by its *function signature*, which is its schema name, function name, the number of parameters, and the data types of the parameters. Thus, a schema can contain several functions that have the same name but each of which have a different number of parameters or parameters with different data types. Also, a function with the same name, number of parameters, and types of parameters can exist in multiple schemas.

Because multiple functions with the same name can exist in the same schema or different schemas, DB2 must determine which function to execute. The process of choosing the function is called *function resolution*.

Function resolution is similar for functions that are invoked with a qualified or unqualified function name with the exception that for an unqualified name, DB2 needs to search more than one schema.

Qualified function resolution: When a function is invoked with a schema name and a function name, DB2 only searches the specified schema to resolve which function to execute. DB2 finds the appropriate function instance when all of the following conditions are true:

- The name of the function instance matches the name in the function invocation.
- The number of input parameters in the function instance matches the number of function arguments in the function invocation.
- The authorization ID of the statement has the EXECUTE privilege to the function instance.
- The data type of each input argument of the function invocation matches or is *promotable* to the data type of the corresponding parameter of the function instance.

  For a function invocation that passes a transition table, the data type, length, precision, and scale of each column in the transition table must match exactly the data type, length, precision, and scale of each column of the table that is named in the function instance definition.

  If the function invocation contains no untyped parameter markers, the comparison of data types results in one best fit, which is the choice for execution (see “Determining the best fit” on page 131). For information on the promotion of data types, see “Promotion of data types” on page 70.

For a function invocation that contains untyped parameter markers, the data types of those parameter markers are considered to match or be promotable to the data types of the parameters in the function instance.

- The create timestamp for the function must be older than the bind timestamp for the package or plan in which the function is invoked.

  If a function invoked from a trigger body receives a transition table, and the invocation occurs during an automatic rebind, the form of the invoked function used for function selection includes only the columns of the table that existed at the time of the original BIND or REBIND package or plan for the invoking program.

  If the function invocation contains untyped parameter markers, the comparison can result in more than one best fit. In that case, DB2 returns an error.

  If DB2 authorization checking is in effect, and DB2 performs an automatic rebind on a plan or package that contains a user-defined function invocation, any user-defined functions that were created after the original BIND or REBIND of the invoking plan or package are not candidates for execution.

  If you use an access control authorization exit routine, some user-defined functions that were not candidates for execution before the original BIND or REBIND of the invoking plan or package might become candidates for execution during the automatic rebind of the invoking plan or package. See Appendix B (Volume 2) of *DB2 Administration Guide* for information about function resolution with access control authorization exit routines.

If no function in the schema meets these criteria, an error occurs. If a function is selected, its successful use depends on it being invoked in a context in which the returned result is allowed. For example, if the function returns an integer data type where a character data type is required or returns a table where a table function is not allowed, an error occurs.

Unqualified function resolution: When a function is invoked with only a function name and no schema name, DB2 needs to search more than one schema to resolve the function instance to execute. DB2 uses these steps to choose the function:

1. The *SQL path* contains the list of schemas to search. For each schema in the path, DB2 selects a candidate function based on the same criteria described immediately above for qualified function resolution. However, if no function in the schema meets the criteria, an error does not occur, and a candidate function is not selected for that schema.
2. After identifying the candidate functions for the schemas in the path, DB2 selects the candidate with the best fit as the function to execute. If more than one schema contains the function instance with the best fit (the function signatures are identical except for the schema name), DB2 selects the function whose schema is earliest in the SQL path. If no function in any schema in the SQL path meets the criteria, an error occurs.

The create timestamp of a user-defined function must be older than the timestamp resulting from an explicit bind for the plan or package containing the function invocation. During autobind, built-in functions introduced in a later DB2 release than the DB2 release that was used to explicitly bind the package or plan are not considered for function resolution.

In a CREATE VIEW statement, function resolution occurs at the time the view is created. If another function with the same name is subsequently created, the view is not affected, even if the new function is a better fit than the one chosen at the time the view was created.

For more information on user-defined functions, such as how you can simplify function resolution or use the DSN_FUNCTION_TABLE to see how DB2 resolves a function, see *DB2 Application Programming and SQL Guide*.

Determining the best fit

There might be more than one function with the same name that is a candidate for execution. In that case, DB2 determines which function is the best fit for the invocation by comparing the argument and parameter data types. The data type of the result of the function or the type of the function (aggregate, scalar, or table) under consideration does not enter into this determination.

If the data types of all the parameters for a given function are the same as those of the arguments in the function invocation, that function is the best fit. If there is no exact match, DB2 compares the data types in the parameter lists from left to right, using this method:

1. DB2 compares the data types of the first argument in the function invocation to the data type of the first parameter in each function. Any length, precision, scale, subtype, and encoding scheme attributes of the data types are not considered in the comparison.
2. For this argument, if one function has a data type that fits the function invocation better than the data types in the other functions, that function is the best fit. The precedence list for the promotion of data types in Table 9 on page 71 shows the data types that fit each data type, in best-to-worst order.
3. If the data types of the first parameter for all the candidate functions fit the function invocation equally well, DB2 repeats this process for the next argument of the function invocation. DB2 continues this process for each argument until a best fit is found.

Examples of function resolution: The following examples illustrate function resolution.

Example 1: Assume that MYSCHEMA contains two functions, both named FUNA, that were registered with these partial CREATE FUNCTION statements.

```
1.  CREATE FUNCTION MYSCHEMA.FUNA (VARCHAR(10), INT, DOUBLE) ...
2.  CREATE FUNCTION MYSCHEMA.FUNA (VARCHAR(10), REAL, DOUBLE) ...
```

Also assume that a function with three arguments of data types VARCHAR(10), SMALLINT, and DECIMAL is invoked with a qualified name:

```
   MYSCHEMA.FUNA(VARCHARCOL, SMALLINTCOL, DECIMALCOL)
```

Both MYSCHEMA.FUNA functions are candidates for this function invocation because they meet the criteria specified in “Function resolution” on page 129. The data types of the first parameter for the two function instances in the schema, which are both VARCHAR, fit the data type of the first argument of the function invocation, which is VARCHAR, equally well. However, for the second parameter, the data type of the first function (INT) fits the data type of the second argument (SMALLINT) better than the data type of second function (REAL). Therefore, DB2 selects the first MYSCHEMA.FUNA function as the function instance to execute.

Example 2: Assume that these functions were registered with these partial CREATE FUNCTION statements:

```
1.  CREATE FUNCTION SMITH.ADDIT (CHAR(5), INT, DOUBLE) ...
2.  CREATE FUNCTION SMITH.ADDIT (INT, INT, DOUBLE) ...
3.  CREATE FUNCTION SMITH.ADDIT (INT, INT, DOUBLE, INT) ...
4.  CREATE FUNCTION JOHNSON.ADDIT (INT, DOUBLE, DOUBLE) ...
5.  CREATE FUNCTION JOHNSON.ADDIT (INT, INT, DOUBLE) ...
6.  CREATE FUNCTION TODD.ADDIT (REAL) ...
7.  CREATE FUNCTION TAYLOR.SUBIT (INT, INT, DECIMAL) ...
```

Also assume that the SQL path at the time an application invokes a function is ″TAYLOR″ ″JOHNSON″, ″SMITH″. The function is invoked with three data types (INT, INT, DECIMAL) as follows:

```
SELECT ... ADDIT(INTCOL1, INTCOL2, DECIMALCOL) ...
```

Function 5 is chosen as the function instance to execute based on the following evaluation:

- Function 6 is eliminated as a candidate because schema TODD is not in the SQL path.
- Function 7 in schema TAYLOR is eliminated as a candidate because it does not have the correct function name.
- Function 1 in schema SMITH is eliminated as a candidate because the INT data type is not promotable to the CHAR data type of the first parameter of Function 1.
- Function 3 in schema SMITH is eliminated as a candidate because it has the wrong number of parameters.
- Function 2 is a candidate because the data types of its parameters match or are promotable to the data types of the arguments.
- Both Function 4 and 5 in schema JOHNSON are candidates because the data types of their parameters match or are promotable to the data types of the arguments. However, Function 5 is chosen as the better candidate because although the data types of the first parameter of both functions (INT) match the first argument (INT), the data type of the second parameter of Function 5 (INT) is a better match of the second argument (INT) than Function 4 (DOUBLE).
- Of the remaining candidates, Function 2 and 5, DB2 selects Function 5 because schema JOHNSON comes before schema SMITH in the SQL path.

SQL path considerations for built-in functions

Function resolution applies to all functions, including built-in functions and other functions provided by DB2. With the exception of the DB2 MQSeries® functions, which are in schemas DB2MQ1C and DB2MQ2C , the other built-in functions are in schema SYSIBM. If a function is invoked without its schema name, the SQL path is searched. If SYSIBM is not first in the path, it is possible that DB2 will select another function instead of the intended built-in function. Likewise, if DB2MQ1C and DB2MQ2C are not in the path, it is possible that DB2 will select a function other than one of the provided DB2 MQSeries functions. If schema SYSIBM or SYSPROC is not explicitly specified in the SQL path, the schema is implicitly assumed at the front of the path. DB2 adds implicitly assumed schemas in the order of SYSIBM and SYSPROC. See “SQL path” on page 46 for information on how to specify the path so that the intended function is selected when it is invoked with an unqualified name.

Best fit consideration

After the function is selected, there are still possible reasons why the use of the function may not be permitted. Each function is defined to return a result with a specific data type. If this result data type is not compatible with the context in which the function is invoked, an error occurs. For example, assume functions named STEP are defined with different data types:

```
STEP(SMALLINT)returns CHAR(5)
STEP(DOUBLE)returns INTEGER
```

Assume also that the function is invoked with the following function reference (where S is a SMALLINT column):

```
SELECT ... 3+STEP(S) ...
```

Because there is an exact match on argument type, the first STEP is chosen. An error occurs on the statement because the result type is CHAR(5) instead of a numeric type as required for an argument of the addition operator.

In cases where the arguments of the function invocation are not an exact match to the data types of the parameters of the selected function, the arguments are converted to the data type of the parameter at execution using the same rules as assignment to columns. See "Assignment and comparison" on page 74. Problems with conversions can also occur when precision, scale, length, or the encoding scheme differs between the argument and the parameter. Conversion might occur for a character string argument when the corresponding parameter of the function has a different encoding scheme or CCSID. For example, an error occurs on function invocation when mixed data that actually contains DBCS characters is specified as an argument and the corresponding parameter of the function is declared with an SBCS subtype.

Additionally, a character FOR BIT DATA argument cannot be passed as input for a parameter that is not defined as character FOR BIT DATA. Likewise, a character argument that is not FOR BIT DATA cannot be passed as input for a parameter that is defined as character FOR BIT DATA.

An error also occurs in the following examples:

- The function is referenced in a FROM clause, but the function selected by the function resolution step is a scalar or aggregate function.
- The function calls for a scalar or aggregate function, but the function selected by the resolution step is a table function.

Expressions

An *expression* specifies a value.

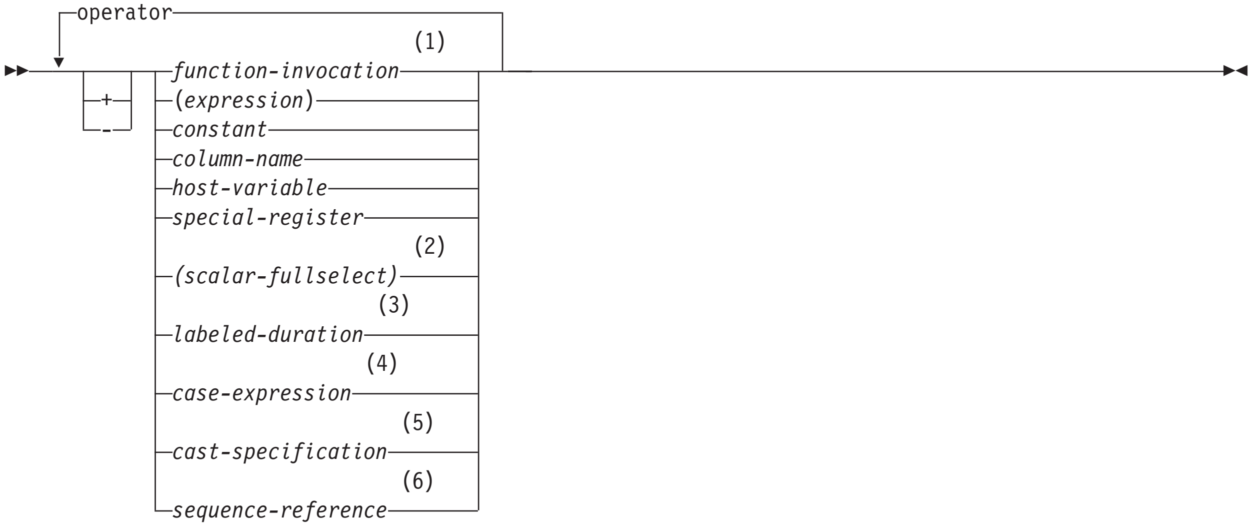
Authorization: The use of some of the expressions, such as a *scalar-fullselect*, *sequence-reference*, or user-defined *function*, requires having the appropriate authorization. For these objects, the privilege set that is defined below must include the following authorization:

- *scalar-fullselect.* For information about authorization considerations, see "Authorization" on page 394.
- *sequence-reference.* The USAGE privilege on the specified sequence, ownership of the sequence, or SYSADM authority. For example, with a NEXT VALUE expression, USAGE authorization on the sequence is required.

- user-defined *function.* Authorization to execute the user-defined function. For information about how the particular function is chosen and authorization considerations, see “Function resolution” on page 129.

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package. If the statement is dynamically prepared, the privilege set is the union of the privilege sets that are held by each authorization ID of the process.

The form of an expression is as follows:



Notes:

1 Includes all functions except table functions. See “Functions” on page 127 for more information.

2 See “Scalar-fullselect” on page 141 for more information.

3 See “Labeled durations” on page 142 for more information.

4 See “CASE expressions” on page 148 for more information.

5 See “CAST specification” on page 151 for more information.

6 See “Sequence reference” on page 156

operator:

```
►►──┬─CONCAT─┬───────────────────────────────────────────────────────►◄
    ├─||─────┤
    ├─/──────┤
    ├─*──────┤
    ├─+──────┤
    └─-──────┘
```

Without operators

If no operators are used, the result of the expression is the specified value.

Examples:

```
SALARY     :SALARY     'SALARY'    MAX(SALARY)
```

With arithmetic operators

If arithmetic operators are used, the result of the expression is a number derived from the application of the operators to the values of the operands. The result of the expression can be null. If any operand has the null value, the result of the expression is the null value. Arithmetic operators (except unary plus, which is meaningless) must not be applied to strings. For example, USER+2 is invalid. Multiplication and division operators must not be applied to datetime values, which can only be added and subtracted.

The prefix operator + (*unary plus*) does not change its operand. The prefix operator - (*unary minus*) reverses the sign of a nonzero operand. If the data type of A is *small integer*, the data type of -A is *large integer*. The first character of the token following a prefix operator must not be a plus or minus sign.

The *infix operators* +, -, *, and / specify addition, subtraction, multiplication, and division, respectively. The value of the second operand of division must not be zero.

Arithmetic with two integer operands

If both operands of an arithmetic operator are integers, the operation is performed in binary and the result is a large integer. Any remainder of division is lost. The result of an integer arithmetic operation (including unary minus) must be within the range of large integers.

Arithmetic with an integer and a decimal operand

If one operand is an integer and the other is decimal, the operation is performed in decimal using a temporary copy of the integer that has been converted to a decimal number with a precision p and scale 0. p is 11 for a large integer and 5 for a small integer. In the case of an integer constant, p depends on the number of digits in the integer constant. p is 5 for an integer constant consisting of 5 digits or fewer; otherwise, p is the same as the number of digits in the integer constant.

Arithmetic with two decimal operands

If both operands are decimal, the operation is performed in decimal. The result of any decimal arithmetic operation is a decimal number with a precision and scale that depend on two factors:

The precision and scale of the operands

In the discussion of operations with two decimal operands, the precision and scale of the first operand are denoted by p and s, that of the second operand by p' and s'. Thus, for a division, the dividend has precision p and scale s, and the divisor has precision p' and scale s'.

Whether DEC31 or DEC15 is in effect for the operation

DEC31 and DEC15 specify the rules to be used when both operands in a decimal operation have precisions of 15 or less. DEC15 specifies the rules which do not allow a precision greater than 15 digits, and DEC31 specifies the rules which allow a precision of up to 31 digits. The rules for DEC31 are always used if either operand has a precision greater than 15.

For static SQL statements, the value of the field DECIMAL ARITHMETIC on installation panel DSNTIP4 or the precompiler option DEC determines whether DEC15 or DEC31 is used.

For dynamic SQL statements, the value of the field DECIMAL ARITHMETIC on installation panel DSNTIP4, the precompiler option DEC, or the special register CURRENT PRECISION determines whether DEC15 or DEC31 is used according to these rules:

- Field DECIMAL ARITHMETIC applies if either of these conditions is true:
  - DYNAMICRULES run behavior applies and the application has not set CURRENT PRECISION.

    For a list of the DYNAMICRULES bind option values that specify run, bind, define, or invoke behavior, see Table 3 on page 51.
  - DYNAMICRULES bind, define, or invoke behavior applies; the value of installation panel field USE FOR DYNAMICRULES is YES; and the application has not set CURRENT PRECISION.
- Precompiler option DEC applies if DYNAMICRULES bind, define, or invoke behavior is in effect, the value of installation panel field USE FOR DYNAMICRULES is NO, and the application has not set CURRENT PRECISION.
- Special register CURRENT PRECISION applies if the application sets the register.

The value of DECIMAL ARITHMETIC is the default value for the precompiler option and the special register. SQL statements executed using SPUFI use the value in DECIMAL ARITHMETIC.

Decimal addition and subtraction: If the operation is addition or subtraction and the operands do not have the same scale, the operation is performed with a temporary copy of one of the operands that has been extended with trailing zeros so that its fractional part has the same number of digits as the other operand.

The precision of the result is the minimum of *n* and the quantity MAX(p-s,p'-s')+MAX(s,s')+1. The scale is MAX(s,s'). *n* is 31 if DEC31 is in effect or if the precision of at least one operand is greater than 15. Otherwise, *n* is 15.

In COBOL, blanks must precede and follow a minus sign to avoid any ambiguity with COBOL host variable names (which allow the use of a dash).

Decimal multiplication: For multiplication, the precision of the result is MIN(n,p+p'), and the scale is MIN(n,s+s'). *n* is 31 if DEC31 is in effect or if the precision of at least one operand is greater than 15. Otherwise, *n* is 15.

If both operands have a precision greater than 15, the operation is performed using a temporary copy of the operand with the smaller precision. If the operands have the same precision, the second operand is selected. If more than 15 significant digits are needed for the integral part of the copy, the statement’s execution is ended and an error occurs. Otherwise, the copy is converted to a number with precision 15, by truncating the copy on the right. The truncated copy has a scale of MAX(0,S-(P-15)), where P and S are the original precision and scale. If, in the process of truncation, one or more nonzero digits are removed, SQLWARN7 in SQLCA is set to W, indicating loss of precision.

When both operands have a precision greater than 15, the foregoing formulas for the precision and scale of the result still apply, with one change: for the operand selected as the copy, use the precision and scale of the truncated copy; that is, use 15 as the precision and MAX(0,S-(P-15)) for the scale.

Let *n* denote the value of the operand with the greater precision or the first operand in the case of operands with the same precision. The number of leading zeros in a 31-digit representation of *n* must be greater than the precision of the other operand. This is always the case if the precision of the operand is 15 or less. With greater precisions, overflow can occur even if the precision of the result is less than 31. For example, the expression:

```
   10000000000000000000000000. * 1
```

will cause overflow because the number of leading zeros in the 31-digit representation of the large number and the precision of the small number are both 5 (see “Arithmetic with an integer and a decimal operand” on page 135).

Decimal division: The rules for a specific decimal division depend on three factors:

- Whether the DEC31 option is in effect for the operation
- Whether p is greater than 15
- Whether p' is greater than 15

The following table shows how the precision and scale of the result depend on these factors. In that table, the occurrence of “N/A” in a row implies that the indicated factor is not relevant to the case represented by the row.

Table 28. Precision (p) and scale (s) of the result of a decimal division

DEC31	p	p'	P	S
Not in effect	≤15	≤15	15	15-(p-s+s')
In effect	≤15	≤15	31	N-(p-s+s'), where N is 30-p' if p' is odd. N is 29-p' if p' is even.
N/A	>15	≤15	31	N-(p-s+s'), where N is 30-p' if p' is odd. N is 29-p' if p' is even.
N/A	N/A	>15	31	15-(p-s+x), where x is MAX(0,s'-(p'-15)) (See Note 2 below)

Notes on decimal division:

1. If the calculated value of ’s’ is negative, an error occurs. If a minimum divide result scale is specified, this error does not occur. A minimum divide result scale of 3 can be specified using the MINIMUM DIVIDE SCALE field on the installation panel DSNTIP4. A minimum divide scale result between 1 and 9 can be specified using the DECIMAL ARITHMETIC OPTION of the form ’Dpp.s’ where ’pp’ is 15 or 31 and represents the precision and ’s’ represents the

minimum divide scale, as a number between 1 and 9. Such a specification overrides the MINIMUM DIVIDE SCALE. When a minimum divide result scale is specified, the formula MAX(s,s’), where s represents the scale derived from the above table and s’ represents the value specified by the minimum divide result scale, is applied and a new scale is derived. The newly derived scale is the scale of the result and overrides any scale derived using the table above.

2. If p' is greater than 15, the division is performed using a temporary copy of the divisor. If more than 15 significant digits are needed for the integral part of the divisor, the statement’s execution is ended, and an error occurs. Otherwise, the copy is converted to a number with precision 15, by truncating the copy on the right. The truncated copy has a scale of MAX(0,s'-(p'-15)), which is the formula for x that appears in row 4 of Table 28. If, in the process of truncation, one or more nonzero digits are removed, SQLWARN7 in SQLCA is set to W, indicating loss of precision.

Arithmetic with floating-point operands

If either operand of an arithmetic operator is floating-point, the operation is performed in floating-point. If necessary, the operands are first converted to double precision floating-point numbers. Thus, if any element of an expression is a floating-point number, the result of the expression is a double precision floating-point number.

An operation involving a floating-point number and an integer is performed with a temporary copy of the integer that has been converted to double precision floating-point. An operation involving a floating-point number and a decimal number is performed with a temporary copy of the decimal number that has been converted to double precision floating-point. The result of a floating-point operation must be within the range of floating-point numbers.

The order in which floating-point operands (or arguments to functions) are processed can affect the results slightly because floating-point operands are approximate representations of real numbers. Because the order in which operands are processed might be implicitly modified by DB2 (for example, DB2 might decide what degree of parallelism to use and what access plan to use), an application that uses floating-point operands should not depend on the results being precisely the same each time an SQL statement is executed.

Arithmetic with distinct type operands

A distinct type cannot be used with arithmetic operators even if its source data type is numeric. To perform an arithmetic operation, create a function with the arithmetic operator as its source. For example, if there were distinct types INCOME and EXPENSES, both of which had DECIMAL(8,2) data types, then the following user-defined function, REVENUE, could be used to subtract one from the other.

```
CREATE FUNCTION REVENUE ( INCOME, EXPENSES )
  RETURNS DECIMAL(8,2) SOURCE "-" ( DECIMAL, DECIMAL)
```

Alternately, the - (minus) operator could be overloaded using a function to subtract the new data types.

```
CREATE FUNCTION "-" ( INCOME, EXPENSES )
  RETURNS DECIMAL(8,2) SOURCE "-" ( DECIMAL, DECIMAL)
```

Alternatively, the distinct type can be cast to a built-in data type and the result used as an operand of an arithmetic operator.

With the concatenation operator

Both CONCAT and the vertical bars (||) represent the concatenation operator. Vertical bars (or the characters that must be used in place of vertical bars in some countries[11]) can cause parsing errors in statements passed from one DBMS to another. The problem occurs if the statement undergoes character conversion with certain combinations of source and target CCSIDs[11]. Thus, CONCAT is the preferable concatenation operator.

When two strings operands are concatenated, the result of the expression is a string. The operands of concatenation must be compatible strings. A binary string cannot be concatenated with a character string, including character strings that are defined as FOR BIT DATA (for more information on the compatibility of data types, see the compatibility matrix in Table 13 on page 75). A distinct type that is based on a string type can be concatenated only if an appropriate user-defined function is created, as explained at the end of this section.

If either operand can be null, the result can be null, and if either is null, the result is the null value. Otherwise, the result consists of the first operand string followed by the second.

Table 29 shows how the string operands determine the data type and the length attribute of the result (the order in which the operands are concatenated has no effect on the result).

Table 29. Data type and length of concatenated operands

One operand	Other operand	Combined length attribute	Result[1]
CHAR(A)	CHAR(B)	<256	CHAR(A+B)[2]
	CHAR(B)	>255	VARCHAR(MIN(A’+B’,32704))[3]
	VARCHAR(B)		VARCHAR(MIN(A’+B’,32704))[3]
VARCHAR(B)	VARCHAR(B		VARCHAR(MIN(A’+B’,32704))[3]
CLOB(A)	CHAR(B)		CLOB(MIN(A’+B’,2G))
	VARCHAR(B)		CLOB(MIN(A’+B’,2G))
	CLOB(B)		CLOB(MIN(A’+B’,2G))
CLOB(A)	GRAPHIC(B)		DBCLOB(MIN(A+B,1G))
	VARGRAPHIC(B)		DBCLOB(MIN(A+B,1G))
	DBCLOB(B)		DBCLOB(MIN(A+B,1G))
GRAPHIC(A)	CHAR(B)		VARGRAPHIC(MIN(A+B,16352)) [4]
	VARCHAR(B)		VARGRAPHIC(MIN(A+B,16352)) [4]
	VARGRAPHIC(B)		VARGRAPHIC(MIN(A+B,16352)) [4]
VARGRAPHIC(A)	CHAR(B)		VARGRAPHIC(MIN(A+B,16352)) [4]
	VARCHAR(B)		VARGRAPHIC(MIN(A+B,16352)) [4]
	GRAPHIC(B)		VARGRAPHIC(MIN(A+B,16352)) [4]
	GRAPHIC(B)		VARGRAPHIC(MIN(A+B,16352)) [4]

[11] In various EBCDIC code pages, DB2 supports code point combinations X'4F4F', X'BBBB', and X'5A5A' to mean concatenation. X'BBBB' and X'5A5A' are interpreted to mean concatenation only on single byte character set DB2 subsystems.

Table 29. Data type and length of concatenated operands (continued)

One operand	Other operand	Combined length attribute	Result[1]
DBCLOB(A)	CHAR(B)		DBCLOB(MIN(A+B,1G))
	VARCHAR(B)		DBCLOB(MIN(A+B, 1G))
	CLOB(B)		DBCLOB(MIN(A+B, 1G))
	GRAPHIC(B)		DBCLOB(MIN(A+B,1G))
	VARGRAPHIC(B)		DBCLOB(MIN(A+B,1G))
	DBCLOB(B)		DBCLOB(MIN(A+B,1G))
BLOB(A)	BLOB(B)		BLOB(MIN(A+B, 2G))

Notes:

1. 2G represents 2 147 483 647 bytes

   1G represents 1 073 741 823 double-byte characters
2. Neither CHAR(A) nor CHAR(B) must contain mixed data. If either operand contains mixed data, the result is VARCHAR(MIN(A'+B',32704)).
3. If conversion of the first operand is required, then A' = 3A; otherwise, it remains A. If conversion of the second operand is required, then B'= 3B; otherwise, it remains B.
4. Both operands are converted to UTF-16, if necessary (that is, the operand is not already UTF-16) and the results are concatenated.

As Table 29 on page 139 shows, the length of the result is the sum of the lengths of the operands. However, the length of the result is two bytes less if redundant shift code characters are eliminated from the result. Redundant shift code characters exist when both character strings are EBCDIC mixed data, and the first string ends with a “shift-in” character (X'0F') and the second operand begins with a “shift-out” character (X'0E'). These two shift code characters are removed from the result.

The CCSID of the result is determined by the rules set forth in “Character conversion in unions and concatenations” on page 413. Some consequences of those rules are the following:

- If either operand is BIT data, the result is BIT data.
- The conversion that occurs when SBCS data is compared with mixed data depends on the encoding scheme. If the encoding scheme is Unicode, the SBCS operand is converted to MIXED. Otherwise, the conversion depends on the field MIXED DATA on installation panel DSNTIPF for the DB2 that does the comparison:
  – Mixed data if the MIXED DATA option at the server is YES[12]
  – SBCS data if the MIXED DATA option at the server is NO.[13]

If an operand is a string from a column with a field procedure, the operation applies to the decoded form of the value. The result does not inherit the field procedure.

One operand of concatenation can be a parameter marker. When one operand is a parameter marker, its data type and length attributes are considered to be the same as those for the operand that is not a parameter marker. The order of concatenation operations must be considered to determine these attributes in the case of nested concatenation.

[12] The result is not necessarily well-formed mixed data.

[13] If the mixed data cannot be converted to pure SBCS data, an error occurs.

No operand of concatenation can be a distinct type even if the distinct type is based on a character data type. To concatenate a distinct type, create a user-defined function that is sourced on the CONCAT operator. For example, if distinct types TITLE and TITLE_DESCRIPTION were both sourced on data type VARCHAR(25), the following user-defined function, named ATTACH, could be used to concatenate the two distinct types:

```
CREATE FUNCTION ATTACH (TITLE, TITLE_DESCRIPTION)
   RETURNS VARCHAR(50) SOURCE CONCAT (VARCHAR(), VARCHAR())
```

Alternatively, the concatenation operator could be overloaded by using a user-defined function to add the distinct types:

```
CREATE FUNCTION "||" (TITLE, TITLE_DESCRIPTION)
   RETURNS VARCHAR(50) SOURCE CONCAT (VARCHAR(), VARCHAR())
```

Scalar-fullselect

A *scalar-fullselect* as supported in an expression is a fullselect, enclosed in parentheses, that returns a single row consisting of a single column value. If the fullselect does not return a row, the result of the expression is the null value. If more than one row is to be returned for a scalar fullselect, an error occurs.

The following naming rules apply to a scalar-fullselect:

- If the AS clause is specified, the name of the result column is the name specified on the AS clause.
- If the AS clause is not specified and the result column is derived from a column, the result column name is the unqualified name of that column.
- All other result column names are unnamed.

The only exception to these rules is for a query with UNION or UNION ALL at the top level. In that case, if the AS clause is not explicitly stated to indicate the result name, the result column name is considered unnamed.

A scalar fullselect cannot be used in the following instances:

- A CHECK constraint in CREATE TABLE and ALTER TABLE statements
- A grouping expression
- A view definition that has a WITH CHECK OPTION
- A CREATE FUNCTION (SQL) statement (subselect already restricted from the expression in the RETURN clause)
- An aggregate function
- An ORDER BY clause
- A join-condition of the ON clause for INNER and OUTER JOINs
- An input parameter in a CALL statement

The following examples illustrate the use of scalar-fullselects. Assume that four tables (PARTS, PRODUCTS, PARTPRICE, and PARTINVENTORY) contain product data.

Example 1 (scalar fullselects in a WHERE clause): Find which products have the prices in the range of at least twice the lowest price of all the products and at most half the price of all the products.

```
SELECT PRODUCT, PRICE FROM PRODUCTS A
    WHERE
     PRICE BETWEEN 2 * (SELECT MIN(PRICE) FROM PRODUCTS)
           AND .5 * (SELECT MAX(PRICE) FROM PRODUCTS);
```

Example 2 (scalar fullselect in a SELECT list): For each part, find its price and its inventory.

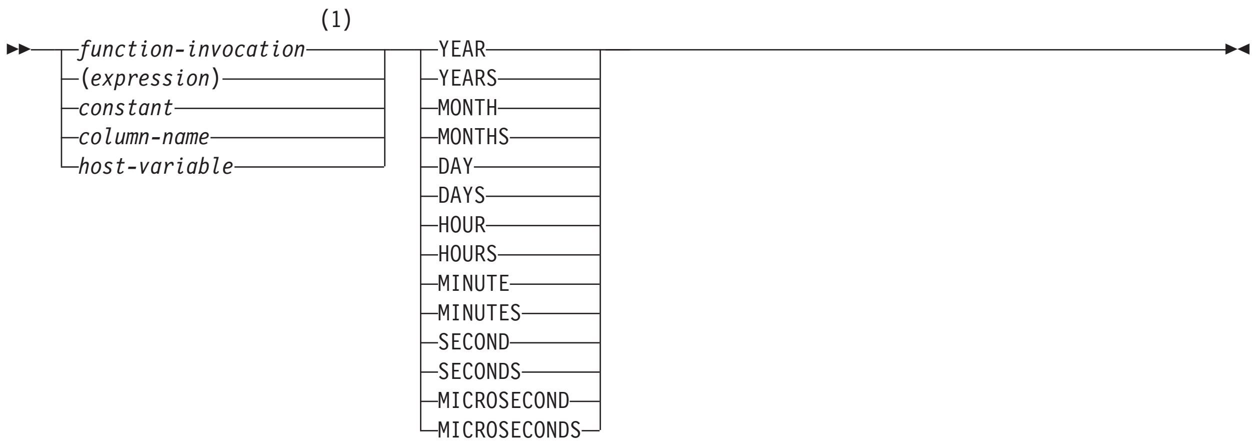
```
SELECT PART,
             (SELECT PRICE FROM PARTPRICE WHERE PART=A.PART),
             (SELECT ONHAND# FROM INVENTORY WHERE PART=A.PART)
           FROM PARTS A;
```

Datetime operands and durations

Datetime values can be incremented, decremented, and subtracted. These operations may involve decimal numbers called durations. A *duration* is a positive or negative number representing an interval of time. The four types of durations are:

Labeled durations

The form a labeled duration is as follows:



Notes:

1 Includes all functions except table functions.

A *labeled duration* represents a specific unit of time as expressed by a number (which can be the result of an expression) followed by one of the seven duration keywords.[14] The number specified is converted as if it were assigned to a DECIMAL(15,0) number.

A labeled duration can only be used as an operand of an arithmetic operator, and the other operand must have a data type of DATE, TIME, or TIMESTAMP. Thus, the expression HIREDATE + 2 MONTHS + 14 DAYS is valid, whereas the expression HIREDATE + (2 MONTHS + 14 DAYS) is not. In both of these expressions, the labeled durations are 2 MONTHS and 14 DAYS.

Date duration

A *date duration* represents a number of years, months, and days expressed as a DECIMAL(8,0) number. To be properly interpreted, the number must have the format *yyyymmdd*, where *yyyy* represents the number of years, *mm* the number of months, and *dd* the number of days. The result of subtracting one DATE value from another, as in the expression HIREDATE - BIRTHDATE, is a date duration.

[14] The singular form of these keywords is also acceptable: YEAR, MONTH, DAY, HOUR, MINUTE, SECOND, and MICROSECOND.

Time duration

A *time duration* represents a number of hours, minutes, and seconds expressed as a DECIMAL(6,0) number. To be properly interpreted, the number must have the format *hhmmss*, where *hh* represents the number of hours, *mm* the number of minutes, and *ss* the number of seconds. The result of subtracting one TIME value from another is a time duration.

Timestamp duration

A *timestamp duration* represents a number of years, months, days, hours, minutes, seconds, and microseconds expressed as a DECIMAL(20,6) number. To be properly interpreted, the number must have the format *yyyyxxddhhmmsszzzzzz,* where *yyyy, xx, dd, hh, mm, ss,* and *zzzzzz* represent, respectively, the number of years, months, days, hours, minutes, seconds, and microseconds. The result of subtracting one TIMESTAMP value from another is a timestamp duration.

Datetime arithmetic in SQL

The only arithmetic operations that can be performed on datetime values are addition and subtraction. If a datetime value is the operand of addition, the other operand must be a duration. The specific rules governing the use of the addition operator with datetime values follow.

- If one operand is a date, the other operand must be a date duration or labeled duration of years, months, or days.
- If one operand is a time, the other operand must be a time duration or a labeled duration of hours, minutes, or seconds.
- If one operand is a timestamp, the other operand must be a duration. Any type of duration is valid.
- Neither operand of the addition operator can be a parameter marker. For a discussion of parameter markers, see Parameter markers in “PREPARE” on page 995.

The rules for the use of the subtraction operator on datetime values are not the same as those for addition because a datetime value cannot be subtracted from a duration, and because the operation of subtracting two datetime values is not the same as the operation of subtracting a duration from a datetime value. The specific rules governing the use of the subtraction operator with datetime values follow.

- If the first operand is a date, the second operand must be a date, a date duration, a string representation of a date, or a labeled duration of years, months, or days.
- If the second operand is a date, the first operand must be a date, or a string representation of a date.
- If the first operand is a time, the second operand must be a time, a time duration, a string representation of a time, or a labeled duration of hours, minutes, or seconds.
- If the second operand is a time, the first operand must be a time, or string representation of a time.
- If the first operand is a timestamp, the second operand must be a timestamp, a string representation of a timestamp, or a duration.
- If the second operand is a timestamp, the first operand must be a timestamp or a string representation of a timestamp.
- Neither operand of the subtraction operator can be a parameter marker.

When an operand in a datetime expression is a string, it may undergo character conversion before it is interpreted and converted to a datetime value. When its CCSID is not that of the default for mixed strings, a mixed string is converted to the default mixed data representation. When its CCSID is not that of the default for SBCS strings, an SBCS string is converted to the default SBCS representation.

Date arithmetic

Dates can be subtracted, incremented, or decremented.

Subtracting dates: The result of subtracting one date (DATE2) from another (DATE1) is a date duration that specifies the number of years, months, and days between the two dates. The data type of the result is DECIMAL(8,0). If DATE1 is greater than or equal to DATE2, DATE2 is subtracted from DATE1. If DATE1 is less than DATE2, however, DATE1 is subtracted from DATE2, and the sign of the result is made negative. The following procedural description clarifies the steps involved in the operation RESULT = DATE1 - DATE2.

Date subtraction: result = date1 - date2

```
• If DAY(DATE2) <= DAY(DATE1)
    then DAY(RESULT) = DAY(DATE1) - DAY(DATE2).

• If DAY(DATE2) > DAY(DATE1)
    then DAY(RESULT) = N + DAY(DATE1) - DAY(DATE2)
      where N = the last day of MONTH(DATE2).
    MONTH(DATE2) is then incremented by 1.

• If MONTH(DATE2) <= MONTH(DATE1)
    then MONTH(RESULT) = MONTH(DATE1) - MONTH(DATE2).

• If MONTH(DATE2) > MONTH(DATE1)
    then MONTH(RESULT) = 12 + MONTH(DATE1) - MONTH(DATE2)
      and YEAR(DATE2) is incremented by 1.

• YEAR(RESULT) = YEAR(DATE1) - YEAR(DATE2).
```

For example, the result of DATE('3/15/2000') - '12/31/1999' is 215 (or, a duration of 0 years, 2 months, and 15 days). In this example, notice that the second operand did not need to be converted to a date. According to one of the rules for subtraction, described under “Datetime arithmetic in SQL” on page 143, the second operand can be a string representation of a date if the first operand is a date.

Incrementing and decrementing dates: The result of adding a duration to a date, or of subtracting a duration from a date, is itself a date. (For the purposes of this operation, a month denotes the equivalent of a calendar page. Adding months to a date, then, is like turning the pages of a calendar, starting with the page on which the date appears.) The result must fall between the dates January 1, 0001 and December 31, 9999 inclusive. If a duration of years is added or subtracted, only the year portion of the date is affected. The month is unchanged, as is the day unless the result would be February 29 of a non-leap-year. Here the day portion of the result is set to 28, and the SQLWARN6 field of the SQLCA is set to W, indicating that an end-of-month adjustment was made to correct an invalid date. Part 2 of *DB2 Application Programming and SQL Guide* also describes how SQLWARN6 is set.

Similarly, if a duration of months is added or subtracted, only months and, if necessary, years are affected. The day portion of the date is unchanged unless the result would be invalid (September 31, for example). In this case the day is set to the last day of the month, and the SQLWARN6 field of the SQLCA is set to W to indicate the adjustment.

Adding or subtracting a duration of days will, of course, affect the day portion of the date, and potentially the month and year. Adding or subtracting a duration of days will not cause an end-of-the-month adjustment.

Date durations, whether positive or negative, can also be added to and subtracted from dates. As with labeled durations, the result is a valid date, and SQLWARN6 is set to W to indicate any necessary end-of-month adjustment.

When a positive date duration is added to a date, or a negative date duration is subtracted from a date, the date is incremented by the specified number of years, months, and days, in that order. Thus, DATE1+X, where X is a positive DECIMAL(8,0) number, is equivalent to the expression:

```
DATE1 + YEAR(X) YEARS + MONTH(X) MONTHS + DAY(X) DAYS
```

When a positive date duration is subtracted from a date, or a negative date duration is added to a date, the date is decremented by the specified number of days, months, and years, in that order. Thus, DATE1-X, where X is a positive DECIMAL(8,0) number, is equivalent to the expression:

```
DATE1 - DAY(X) DAYS - MONTH(X) MONTHS - YEAR(X) YEARS
```

Adding a month to a date gives the same day one month later unless that day does not exist in the later month. In that case, the day in the result is set to the last day of the later month. For example, January 28 plus one month gives February 28; one month added to January 29, 30, or 31 results in either February 28 or, for a leap year, February 29. If one or more months is added to a given date and then the same number of months is subtracted from the result, the final date is not necessarily the same as the original date.

If one or more months are added to a given date and then the same number of months is subtracted from the result, the final date is not necessarily the same as the original date. In addition, logically equivalent expressions may not produce the same result. For example, the following two expressions do not produce the same result:

```
 (DATE('2002 01 31') + 1 MONTH) + 1 MONTH    results in 2002-03-28

 DATE('2002 01 31') + 2 MONTHS               results in 2002-03-31
```

The order in which labeled date durations are added to and subtracted from dates can affect the results. When you add labeled date durations to a date, specify them in the order of YEARS + MONTHS + DAYS. When you subtract labeled date durations from a date, specify them in the order of DAYS - MONTHS - YEARS. For example, to add one year and one day to a date, specify:

```
DATE1 + 1 YEAR + 1 DAY
```

To subtract one year, one month, and one day from a date, specify:

```
DATE1 - 1 DAY - 1 MONTH - 1 YEAR
```

Time arithmetic

Times can be subtracted, incremented, or decremented.

Subtracting times: The result of subtracting one time (TIME2) from another (TIME1) is a time duration that specifies the number of hours, minutes, and seconds between the two times. The data type of the result is DECIMAL(6,0). If TIME1 is greater than or equal to TIME2, TIME2 is subtracted from TIME1. If TIME1 is less than TIME2, however, TIME1 is subtracted from TIME2, and the sign of the result is made negative. The following procedural description clarifies the steps involved in the operation RESULT = TIME1 - TIME2.

Time subtraction: result = time1 - time2

- If `SECOND(TIME2) <= SECOND(TIME1)`
  then `SECOND(RESULT) = SECOND(TIME1) - SECOND(TIME2)`.
- If `SECOND(TIME2) > SECOND(TIME1)`
  then `SECOND(RESULT) = 60 + SECOND(TIME1) - SECOND(TIME2)`
  and `MINUTE(TIME2)` is incremented by 1.
- If `MINUTE(TIME2) <= MINUTE(TIME1)`
  then `MINUTE(RESULT) = MINUTE(TIME1) - MINUTE(TIME2)`.
- If `MINUTE(TIME2) > MINUTE(TIME1)`
  then `MINUTE(RESULT) = 60 + MINUTE(TIME1) - MINUTE(TIME2)`
  and `HOUR(TIME2)` is incremented by 1.
- `HOUR(RESULT) = HOUR(TIME1) - HOUR(TIME2)`.

For example, the result of TIME('11:02:26') - '00:32:56' is 102930 (a duration of 10 hours, 29 minutes, and 30 seconds). In this example, notice that the second operand did not need to be converted to a time. According to one of the rules for subtraction, described under “Datetime arithmetic in SQL” on page 143, the second operand can be a string representation of a time if the first operand is a time.

Incrementing and decrementing times: The result of adding a duration to a time, or of subtracting a duration from a time, is itself a time. Any overflow or underflow of hours is discarded, thereby ensuring that the result is always a time. If a duration of hours is added or subtracted, only the hours portion of the time is affected. Adding 24 hours to the time '00:00:00' results in the time '24:00:00'. However, adding 24 hours to any other time results in the same time; for example, adding 24 hours to the time '00:00:59' results in the time '00:00:59'. The minutes and seconds are unchanged.

Similarly, if a duration of minutes is added or subtracted, only minutes and, if necessary, hours are affected. The seconds portion of the time is unchanged.

Adding or subtracting a duration of seconds affects the seconds portion of the time and may affect the minutes and hours.

Time durations, whether positive or negative, can also be added to and subtracted from times. The result is a time that has been incremented or decremented by the specified number of hours, minutes, and seconds, in that order. Thus, TIME1 + X, where X is a positive DECIMAL(6,0) number, is equivalent to the expression

```
TIME1 + HOUR(X) HOURS + MINUTE(X) MINUTES + SECOND(X) SECONDS
```

Timestamp arithmetic

Timestamps can be subtracted, incremented, or decremented.

Subtracting timestamps: The result of subtracting one timestamp (TS2) from another (TS1) is a timestamp duration that specifies the number of years, months, days, hours, minutes, seconds, and microseconds between the two timestamps. The data type of the result is DECIMAL(20,6). If TS1 is greater than or equal to TS2, TS2 is subtracted from TS1. If TS1 is less than TS2, however, TS1 is subtracted from TS2 and the sign of the result is made negative. The following procedural description clarifies the steps involved in the operation RESULT = TS1 - TS2.

Timestamp subtraction: result = ts1 - ts2

- If `MICROSECOND(TS2) <= MICROSECOND(TS1)`
  then `MICROSECOND(RESULT) = MICROSECOND(TS1) - MICROSECOND(TS2)`.
- If `MICROSECOND(TS2) > MICROSECOND(TS1)`
  then `MICROSECOND(RESULT) = 1000000 + MICROSECOND(TS1)`
  `- MICROSECOND(TS2)`
  and `SECOND(TS2)` is incremented by 1.
- The seconds and minutes part of the timestamps are subtracted as specified in the rules for subtracting times.
- If `HOUR(TS2) <= HOUR(TS1)`
  then `HOUR(RESULT) = HOUR(TS1) - HOUR(TS2)`.
- If `HOUR(TS2) > HOUR(TS1)`
  then `HOUR(RESULT) = 24 + HOUR(TS1) - HOUR(TS2)`
  and `DAY(TS2)` is incremented by 1.
- The date part of the timestamps is subtracted as specified in the rules for subtracting dates.

Incrementing and decrementing timestamps: The result of adding a duration to a timestamp, or of subtracting a duration from a timestamp, is itself a timestamp. Date and time arithmetic is performed as previously defined, except that an overflow or underflow of hours is carried into the date part of the result, which must be within the range of valid dates. When the result of an operation is midnight, the time portion of the result can be '24.00.00' or '00.00.00'; a comparison of those two values does not result in 'equal'. Microseconds overflow into seconds.

Precedence of operations

Expressions within parentheses are evaluated first. When the order of evaluation is not specified by parentheses, prefix operators are applied before multiplication and division, and multiplication, division, and concatenation are applied before addition and subtraction. Operators at the same precedence level are applied from left to right.

Example 1: In this example, the first operation is the addition in (SALARY + BONUS) because it is within parenthesis. The second operation is multiplication because it is a higher precedence level than the second addition operator and it is to the left of the division operator. The third operation is division because it is at a higher precedence level than the second addition operator. Finally, the remaining addition is performed.

```
1.10 * (SALARY + BONUS) + SALARY / :VAR3

    (2)       (1)      (4)      (3)
```

Example 2: In this example, the first operation (CONCAT) combines the character strings in the variables YYYYMM and DD into a string representing a date. The second operation (-) then subtracts that date from the date being processed in DATECOL. The result is a date duration that indicates the time elapsed between the two dates.

```
DATECOL - :YYYYMM CONCAT :DD

       (2)         (1)
```

CASE expressions

```
                                     ┌─ELSE NULL──────────────────┐
►►──CASE──┬─searched-when-clause─┬───┼────────────────────────────┼─END──────────────────►◄
          └─simple-when-clause───┘   └─ELSE──result-expression────┘
```

searched-when-clause:

```
     ┌──────────────────────────────────────────────────┐
     ▼                                                  │
►►───WHEN──search-condition──THEN──┬─result-expression─┬┴──────────────────────────────►◄
                                   └─NULL──────────────┘
```

simple-when-clause:

```
                  ┌────────────────────────────────────────────────────┐
                  ▼                                                    │
►►──expression────WHEN──expression──THEN──┬─result-expression─┬─┴────────────────────►◄
                                          └─NULL──────────────┘
```

A CASE expression allows an expression to be selected based on the evaluation of one or more conditions. In general, the value of the *case-expression* is the value of the *result-expression* following the first (leftmost) *when-clause* that evaluates to true. If no case evaluates to true and the ELSE keyword is present, the result is the value of the *result-expression* or NULL. If no case evaluates to true and the ELSE keyword is not present, the result is NULL. When a case evaluates to unknown (because of NULLs), the case is NOT true and hence is treated the same way as a case that evaluates to false.

searched-when-clause
: Specifies a *search-condition* that is applied to each row or group of table data presented for evaluation, and the result when that condition is true.

simple-when-clause

Specifies that the value of the *expression* prior to the first WHEN keyword is tested for equality with the value of each *expression* that follows the WHEN keyword. It also specifies the result for when that condition is true.

The data type of the *expression* prior to the first WHEN keyword must be compatible with the data types of the *expression* that follows each WHEN keyword. The data type of any of the expressions cannot be a CLOB, DBCLOB or BLOB. In addition, the *expression* prior to the first WHEN keyword cannot include a function that is nondeterministic or has an external action.

result-expression or **NULL**

Specifies the value that follows the THEN and ELSE keyword. It specifies the result of a *searched-when-clause* or a *simple-when-clause* that is true, or the result if no case is true. There must be at least one *result-expression* in the CASE expression with a defined data type. NULL cannot be specified for every case.

All *result-expression*s must have compatible data types. The attributes of the result are determined according to the rules that are described in “Rules for result data types” on page 87. When the result is a string, its attributes include a CCSID. For the rules on how the CCSID is determined, see “Determining the encoding scheme and CCSID of a string” on page 29.

search-condition

Specifies a condition that is true, false, or unknown about a row or group of table data. The *search-condition* can be a predicate, including predicates that contain fullselects (scalar or non-scalar) or row-value expressions. If the CASE expression is in a select list, a VALUES clause, or an IN predicate, the search-condition cannot be a quantified predicate, an IN predicate, or an EXISTS predicate.

END

Ends a *case-expression*.

Two scalar functions, NULLIF and COALESCE, are specialized to handle a subset of the functionality provided by CASE. Table 30 shows the equivalent expressions using CASE or these functions.

Table 30. Equivalent case expressions

CASE expression	Equivalent expression
CASE WHEN e1=e2 THEN NULL ELSE e1 END	NULLIF(e1,e2)
CASE WHEN e1 IS NOT NULL THEN e1 ELSE e2 END	COALESCE(e1,e2)
CASE WHEN e1 IS NOT NULL THEN e1 ELSE COALESCE(e2,...,eN) END	COALESCE(e1,e2,...,eN)

Example 1 (simple-when-clause): Assume that in the EMPLOYEE table the first character of a department number represents the division in the organization. Use a CASE expression to list the full name of the division to which each employee belongs.

```
SELECT EMPNO, LASTNAME,
    CASE SUBSTR(WORKDEPT,1,1)
    WHEN 'A' THEN 'Administration'
    WHEN 'B' THEN 'Human Resources'
```

```
       WHEN 'C' THEN 'Design'
       WHEN 'D' THEN 'Operations'
       END
   FROM EMPLOYEE;
```

Example 2 (searched-when-clause): You can also use a CASE expression to avoid “division by zero” errors. From the EMPLOYEE table, find all employees who earn more than 25 percent of their income from commission, but who are not fully paid on commission:

```
   SELECT EMPNO, WORKDEPT, SALARY+COMM FROM EMPLOYEE
   WHERE (CASE WHEN SALARY=0 THEN 0
               ELSE COMM/(SALARY+COMM)
               END) > 0.25;
```

Example 3 (searched-when-clause): You can use a CASE expression to avoid ″division by zero″ errors in another way. The following queries show an accumulation or summing operation. In the first query, DB2 performs the division before performing the CASE statement and an error occurs along with the results.

```
   SELECT REF_ID,PAYMT_PAST_DUE_CT,
       CASE
       WHEN PAYMT_PAST_DUE_CT=0 THEN 0
       WHEN PAYMT_PAST_DUE_CT>0 THEN
          SUM(BAL_AMT/PAYMT_PAST_DUE_CT)
       END
   FROM PAY_TABLE
GROUP BY REF_ID,PAYMT_PAST_DUE_CT;
```

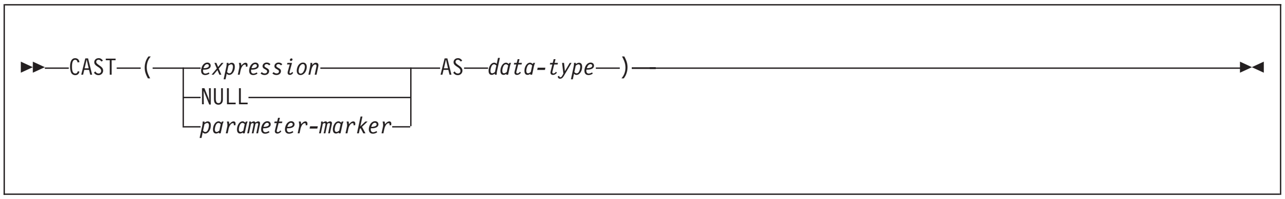
However, if the CASE expression is included in the SUM aggregate function, the CASE expression would prevent the errors. In the following query, the CASE expression screens out the unwanted division because the CASE operation is performed before the division.

```
   SELECT REF_ID,PAYMT_PAST_DUE_CT,
       SUM(CASE
       WHEN PAYMT_PAST_DUE_CT=0 THEN 0
       WHEN PAYMT_PAST_DUE_CT>0 THEN
         BAL_AMT/PAYMT_PAST_DUE_CT
           END)
   FROM PAY_TABLE
GROUP BY REF_ID,PAYMT_PAST_DUE_CT;
```

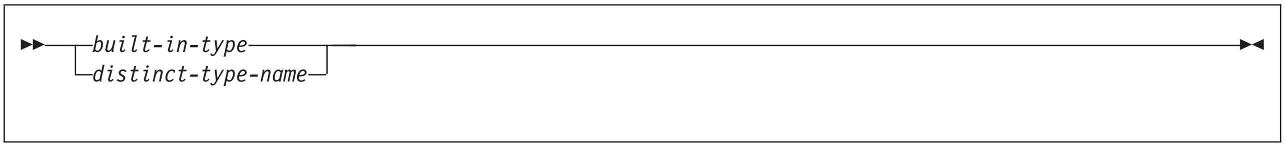
Example 4: This example shows how to group the results of a query by a CASE expression without having to re-type the expression. Using the sample employee table, find the maximum, minimum, and average salary. Instead of finding these values for each department, assume that you want to combine some departments into the same group.

```
   SELECT CASE_DEPT,MAX(SALARY),MIN(SALARY),AVG(SALARY)
   FROM (SELECT SALARY,CASE WHEN WORKDEPT = 'A00' OR WORKDEPT = 'E21'
                              THEN 'A00_E21'
                            WHEN WORKDEPT = 'D11' OR WORKDEPT = 'E11'
                              THEN 'D11_E11'
                            ELSE WORKDEPT
                        END AS CASE_DEPT
         FROM DSN8810.EMP) X
         GROUP BY CASE_DEPT;
```

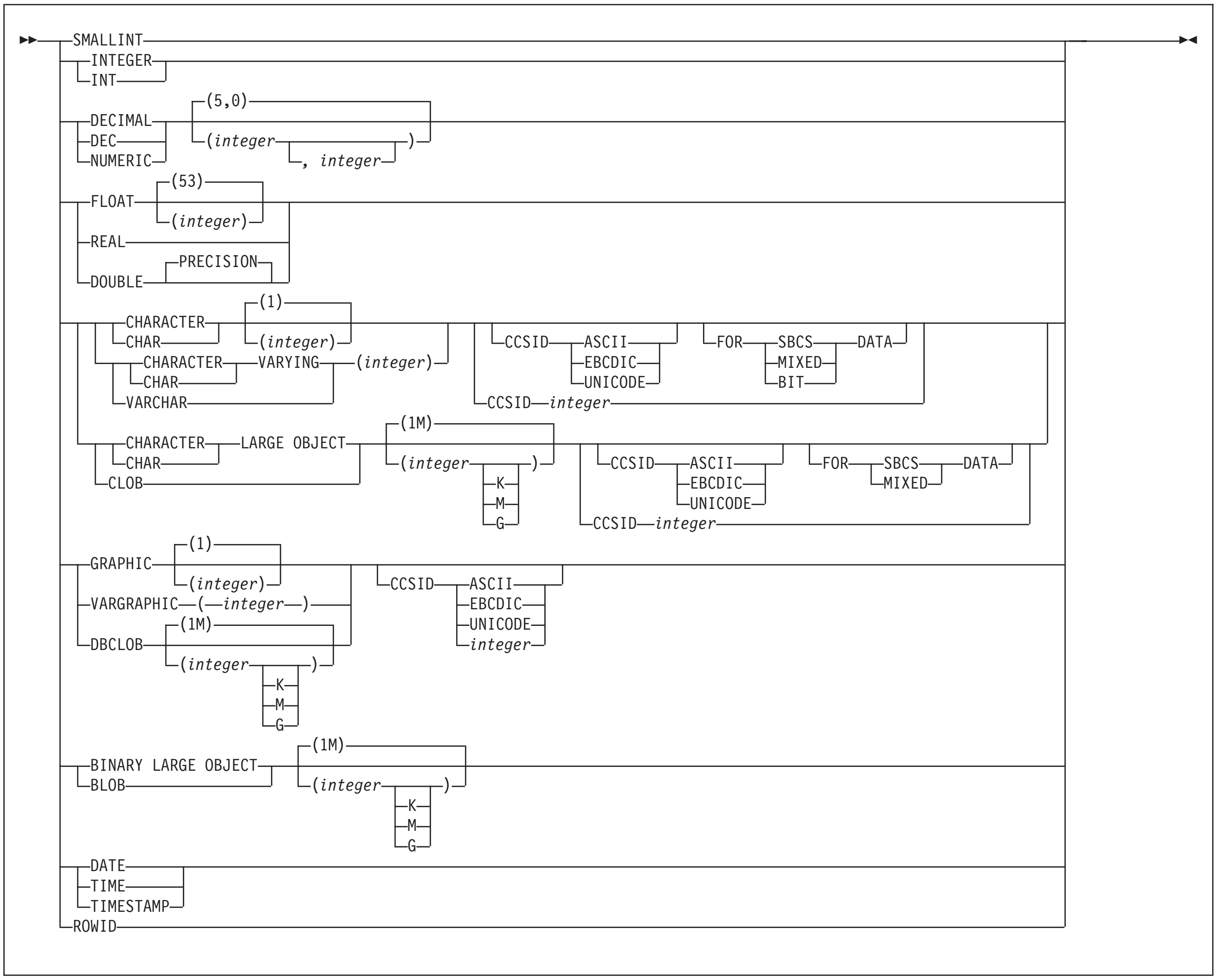
CAST specification



data-type:



built-in-type:



The CAST specification returns the first operand (the cast operand) converted to the data type that is specified by *data-type*. If the data type of either operand is a distinct type, the privilege set must implicitly include EXECUTE authority on the generated cast functions for the distinct type. The CAST specification allows the second operand to be cast to a particular encoding scheme or CCSID if the second operand represents character data. The CCSID clause can be specified following CHAR, VARCHAR, GRAPHIC, VARGRAPHIC, CLOB, and DBCLOB data types. If the CCSID *integer* clause is specified, the FOR *subtype* DATA clause is not allowed because the CCSID clause defines the data subtype.

expression

Specifies that the cast operand is an expression other than NULL or a parameter marker. The result is the value of the operand value converted to the specified *data type*.

Table 10 on page 72 and Table 11 on page 73 shows the supported casts between data types. If you specify an unsupported cast, an error occurs.

When a character string is cast to a character string with a different length or a graphic string is cast to a graphic string with a different length, a warning occurs if any characters except trailing blanks are truncated. A warning also occurs if any bytes are truncated when a BLOB operand is cast.

NULL

Specifies that the cast operand is null. The result is a null value with the specified *data type*.

parameter-marker

A parameter marker, which is normally considered an expression, has a special meaning as a cast operand. When the cast operand is a *parameter-marker*, the *data type* that is specified represents the “promise” that the replacement value for the parameter marker will be assignable to that data type (using “store assignment” rules). Such a parameter marker is considered a *typed parameter marker*. Typed parameter markers are treated like any other typed value for the purpose of function resolution, a DESCRIBE of a select list, or column assignment.

data-type

Specifies the data type of the result. If the data type is not qualified, the SQL path is used to find the appropriate data type. For more information, see “SQL path” on page 46. For a description of *data-type*, see “CREATE TABLE” on page 734. (For portability across operating systems, when specifying a floating-point data type, use REAL or DOUBLE instead of FLOAT.)

- If the cast operand is *expression*, see “Casting between data types” on page 71 and use any of the target data types that are supported for the data type of the cast operand.
- If the cast operand is NULL, you can use any data type.
- If the cast operand is a *parameter-marker*, you can use any data type. If the data type is a distinct type, the application that uses the parameter marker will use the source data type of the distinct type.

CCSID *encoding-scheme*

Specifies the encoding scheme for the target data type. The specific CCSIDs for SBCS, BIT, and MIXED data are determined by the default CCSIDs for the server for the specified encoding scheme. The valid values are ASCII, EBCDIC, and UNICODE.

CCSID *integer*

Specifies that the target data type be encoded using the CCSID *integer*. If the second operand is CHAR or VARCHAR, the CCSID specified must be either a SBCS, MIXED, or FOR BIT (65535) CCSID. If the second operand is GRAPHIC, VARGRAPHIC, or DBCLOB, the CCSID specified must be a DBCS

CCSID. See “Determining the CCSID of the result” on page 153 if neither CCSID *integer* nor CCSID *encoding-scheme* is specified.

Resolution of cast functions: DB2 uses the implicit or explicit schema name and the data type name of *data-type*, and function resolution to determine the specific function to use to convert *expression* to *data-type*. See “Qualified function resolution” on page 129 for more information.

Result of the CAST: When numeric data is cast to character data, the data type of the result is a fixed-length character string, which is similar to the result that the CHAR function would give. (For more information, see “CHAR” on page 219.) When character data is cast to numeric data, the data type of the result depends on the data type of the specified number. For example, character data that is cast to an integer becomes a large integer, which is similar to the result that the INTEGER function would give. (For more information see “INTEGER or INT” on page 276.)

If the data type of the result is character, the subtype of the result is determined as follows:

- If *expression* is graphic, the subtype of the result is mixed.
- If *expression* is a datetime data type, the subtype of the result is SBCS.
- If *expression* is a row ID and *data-type* is not CLOB, the result is bit data.
- If *expression* is character, the subtype of the result is the same as *expression*.
- Otherwise, the subtype depends on the encoding scheme of the result. If the encoding scheme of the result is not Unicode and the field MIXED DATA on installation panel DSNTPF is NO, the subtype of the result is SBCS. Otherwise, the subtype of the result is mixed.

Determining the CCSID of the result: The CCSID of the result depends on whether the CCSID clause was specified and the context in which the CAST specification was specified.

If the CCSID clause was specified, the CCSID clause is used to determine the CCSID of the result as follows:

- If the CCSID clause was specified with EBCDIC, ASCII, or UNICODE, the clause determines the encoding scheme of the result. The CCSID of the result is the appropriate CCSID (from DECP) for that encoding scheme for the data type of the result.
- If the CCSID clause was specified with a numeric value representing bit data (X'FFFF'), the CCSID of the result depends on the data type of the source. If the source data is not string data, the CCSID of the result is the appropriate CCSID for the application encoding scheme. See Note 1 in Table 1 on page 30. If the source is string data, the encoding scheme of the result is the same as the encoding scheme of expression, but the result is considered bit data.
- If the CCSID clause was specified with a numeric value, the value must be one of the CCSID values in DECP, and that number is the CCSID of the result. The encoding scheme of the result is determined from the numeric CCSID.

If the CCSID clause was not specified, the CCSID of the result is 65535 if the result is bit data. Otherwise, if the data type of the result is a character or graphic string data type, the encoding scheme and CCSID of the result are is determined as follows:

- If the *expression* and *data-type* are both character, the encoding scheme of the result is the same as *expression*. For example, assume CHAR_COL is a character column in the following:

```
CAST(CHAR_COL AS VARCHAR(25))
```

The result of the CAST is a varying length string with the same encoding scheme as the input. The CCSID of the result is the appropriate CCSID for the encoding scheme and subtype of the result.

- If the *expression* and *data-type* are both graphic, the encoding scheme and CCSID of the result is the same as *expression*.
- If the result is character, the encoding scheme and CCSID of the result depends on the context in which the CAST specification is specified:
  - If the statement follows the rules that are described for type 1 statements in “Determining the encoding scheme and CCSID of a string” on page 29, the CCSID is determined as follows:
    - If the statement references a table or view, the encoding scheme of that table or view determines the encoding scheme for the result.
    - Otherwise, the default EBCDIC encoding scheme is used for the result.

    The CCSID of the result is the appropriate CCSID for the encoding scheme and subtype of the result.
  - Otherwise, the CCSID of the result is the appropriate CCSID for the application encoding scheme and subtype of the result.
- If the result is graphic, the encoding scheme and the CCSID of the result depends on the context in which the CAST specification is specified:
  - If the statement follows the rules that are described for type 1 statements in “Determining the encoding scheme and CCSID of a string” on page 29, the CCSID is determined as follows:
    - If the statement references a table or view, the encoding scheme of that table or view determines the encoding scheme for the result.
    - Otherwise, the default EBCDIC encoding scheme is used for the result.

    The CCSID of the result is the appropriate CCSID for the encoding scheme and data type of the result.
  - Otherwise, the CCSID of the result is the appropriate CCSID for the application encoding scheme of the result.
- Otherwise, the CCSID of the result depends on the context in which the CAST specification was specified.
  - If the statement follows the rules that are described for type 1 in statements in “Determining the encoding scheme and CCSID of a string” on page 29, the CCSID is determined as follows:
    - If the statement references a table or view, the encoding scheme of that table or view determines the encoding scheme for the result.
    - Otherwise, the default EBCDIC encoding scheme is used for the result.

    The CCSID of the result is the appropriate CCSID for the encoding scheme and data type of the result.

Alternative syntax for casting distinct types: There is alternative syntax for casting a distinct type to its source data type and vice versa. Assume that a distinct type D_MONEY was defined with the following statement and column MONEY was defined with that data type.

```
CREATE DISTINCT TYPE D_MONEY AS DECIMAL(9,2);
```

DECIMAL(MONEY) is equivalent syntax to CAST(MONEY AS DECIMAL(9,2)). Both forms of the syntax use the cast function that DB2 generated when the distinct type D_MONEY was created to convert the distinct type to its source type of DECIMAL(9,2).

However, it is possible that different cast functions may be chosen for the equivalent syntax forms because of the difference in function resolution, particularly the treatment on unqualified names. Although the process of function resolution is similar for both, in the CAST specification as described above, DB2 uses the schema name of the target data type to locate the function. Therefore, if an unqualified data type name is specified as the target data type, DB2 uses the SQL path to resolve the schema name of the distinct type and then searches for the function in that schema. In function notation, when an unqualified function name is specified, DB2 searches the schemas in the SQL path to find an appropriate function match, as described under “Function resolution” on page 129. For example, assume that you defined the following distinct types, which implicitly gives you both USAGE authority on the distinct types and EXECUTE authority on the cast functions that are generated for them:

```
CREATE DISTINCT TYPE SCHEMA1.AGE AS DECIMAL(2,0);
   one of the generated cast functions is:
   FUNCTION SCHEMA1.AGE(SYSIBM.DECIMAL(2,0)) RETURNS SCHEMA1.AGE

CREATE DISTINCT TYPE SCHEMA2.AGE AS INTEGER;
   one of the generated cast functions is:
   FUNCTION SCHEMA2.AGE(SYSIBM.INTEGER) RETURNS SCHEMA2.AGE
```

If STU_AGE, an INTEGER host variable, is cast to the distinct type with either of the following statements and the SQL path is SYSIBM, SCHEMA1, SCHEMA2:

```
Syntax 1:  CAST(:STU_AGE AS AGE);
Syntax 2:  AGE(:STU_AGE);
```

different cast functions are chosen. For syntax 1, DB2 first resolves the schema name of distinct type AGE as SCHEMA1 (the first schema in the path that contains a distinct type named AGE for which you have USAGE authority). Then it looks for a suitable function in that schema and chooses SCHEMA1.AGE because the data type of STU_AGE, which is INTEGER, is promotable to the data type of the function argument, which is DECIMAL(2,0). For syntax 2, DB2 searches all the schemas in the path for an appropriate function and chooses SCHEMA2.AGE. DB2 selects SCHEMA2.AGE over SCHEMA1.AGE because the data type of its argument (INTEGER) is an exact match for STU_AGE (INTEGER) and, therefore, a better match than the argument for SCHEMA1.AGE, which is DECIMAL(2,0).

Example 1: Assume that an application needs only the integer portion of the SALARY column, which is defined as DECIMAL(9,2) from the EMPLOYEE table. The following query for the employee number and the integer value of SALARY could be prepared.

```
SELECT EMPNO, CAST(SALARY AS INTEGER) FROM EMPLOYEE;
```

Example 2: Assume that two distinct types exist in schema SCHEMAX. Distinct type D_AGE was based on SMALLINT and is the data type for the AGE column in the PERSONNEL table. Distinct type D_YEAR was based on INTEGER and is the data type for the RETIRE_YEAR column in the same table. The following UPDATE statement could be prepared.

```
UPDATE PERSONNEL SET RETIRE_YEAR =?
                 WHERE AGE = CAST( ? AS SCHEMAX.D_AGE);
```

The first parameter is an untyped parameter marker that has a data type of RETIRE_YEAR. However, the application will use an integer for the parameter marker. The parameter marker does not need to be cast because the SET is an assignment.

The second parameter marker is a typed parameter marker that is cast to the distinct type D_AGE. Casting the parameter marker satisfies the requirement that comparisons must be performed with compatible data types. The application will use the source data type, SMALLINT, to process the parameter marker.

Example 3: A CAST specification can be used to explicitly specify the data type of a parameter in a context where a parameter marker must be typed. In the following example, the CAST specification is used to tell DB2 to assume that the value that will be provided as input to the TIME function will be CHAR(20). See “PREPARE” on page 995 for a list of contexts when invoking functions where parameter markers can be untyped. For all other contexts when invoking a function, the CAST specification can be used to explicitly specify the type of a parameter marker.

```
INSERT INTO ADMF001.CASTSQLJ VALUES( TIME(CAST(? AS CHAR(20)) ) )
```

Sequence reference

A sequence is referenced by using the NEXT VALUE and PREVIOUS VALUE expressions specifying the name of the sequence.

NEXT VALUE expression

```
►►──NEXT VALUE FOR──sequence-name──────────────────────────────────────────►◄
```

PREVIOUS VALUE expression

```
►►──PREVIOUS VALUE FOR──sequence-name──────────────────────────────────────►◄
```

sequence-name
Identifies a particular sequence. The combination of name and the implicit or explicit schema name must identify an existing sequence at the current server. If no sequence by this name exists in the explicitly or implicitly specified schema, an errors occurs. *sequence-name* must not be the name of an internal sequence object that is generated by DB2 for an identity column. The contents of the SQL PATH are not used to determine the implicit qualifier of a sequence name.

NEXT VALUE expression: A NEXT VALUE expression generates and returns the next value for a specified sequence. A new value is generated for a sequence when a NEXT VALUE expression specifies the name of the sequence. However, if there are multiple instances of a NEXT VALUE expression specifying the same sequence name within a query, the sequence value is incremented only once for each row of the result, and all instances of NEXT VALUE return the same value for a row of the result. NEXT VALUE is a nondeterministic expression with external actions since it causes the sequence value to be incremented.

When the next value for the sequence is generated, if the maximum value for an ascending sequence or the minimum value for a descending sequence of the logical range of the sequence is exceeded and the NO CYCLE option is in effect, then an error occurs. To correct this error, either alter the sequence attributes to extend the range of value or to enable cycles for the sequence or drop and recreate the sequence with a different data type that allows a larger range of values.

The data type and length attributes of the result of a NEXT VALUE expression are the same as for the specified sequence. The result cannot be null.

PREVIOUS VALUE expression: A PREVIOUS VALUE expression returns the most recently generated value for the specified sequence for a previous statement within the current application process. This value can be repeatedly referenced by using PREVIOUS VALUE expressions to specify the name of the sequence. There may be multiple instances of PREVIOUS VALUE expressions specifying the same sequence name within a single statement and they all return the same value.

The data type and length attributes of the result of a PREVIOUS VALUE expression are the same as for the specified sequence. The result cannot be null.

A PREVIOUS VALUE expression can be used only if a NEXT VALUE expression specifying the same sequence name has already been referenced in the current application process.

The PREVIOUS VALUE value persists until the next value is generated for the sequence, the sequence is dropped, or the application session ends. The value is unaffected by COMMIT or ROLLBACK statements as illustrated by the following example. In the example, assume that a sequence has been created with START WITH 1, INCREMENT BY 1.

```
COMMIT
   SELECT NEXT VALUE FOR MYSEQ ... ==> generates a value of 1
   SELECT NEXT VALUE FOR MYSEQ ... ==> generates a value of 2
   COMMIT
   SELECT PREVIOUS VALUE FOR MYSEQ ... ==> returns most recently generated value 2
   SELECT NEXT VALUE FOR MYSEQ ... ==> generates a value of 3
   ROLLBACK
   SELECT PREVIOUS VALUE FOR MYSEQ ... ==> returns most recently generated value 3
   SELECT NEXT VALUE FOR MYSEQ ... ==> generates a value of 4
   SELECT PREVIOUS VALUE FOR MYSEQ ... ==> returns most recently generated value 4
```

Invocation: The NEXT VALUE and PREVIOUS VALUE expressions can be specified in the following places:

- Within the select-clause of a SELECT statement or SELECT INTO statement as long as the statement does not contain a DISTINCT keyword, a GROUP BY clause, an ORDER BY clause, or a UNION keyword
- Within a VALUES clause of an INSERT statement, including a multiple row INSERT statement with multiple VALUES clauses, which can include a NEXT VALUE expression for a particular sequence name for each VALUES clause
- Within the select-clause of the fullselect of an INSERT statement
- Within the SET clause of a searched or positioned UPDATE statement, though NEXT VALUE cannot be specified in the select-clause of the fullselect of an expression in the SET clause

  A PREVIOUS VALUE expression can be specified anywhere with a SET clause of an UPDATE statement, but a NEXT VALUE expression can be specified only in a SET clause if it is not within the select-clause of the fullselect of an expression. For instance, the following uses of sequence references are supported:

```
UPDATE T SET C1 = (SELECT PREVIOUS VALUE FOR S1 FROM T);
UPDATE T SET C1 = PREVIOUS VALUE FOR S1;
UPDATE T SET C1 = NEXT VALUE FOR S1;
```

The following uses of sequence references are not supported;

```
UPDATE T SET C1 = (SELECT NEXT VALUE FOR S1 FROM T);
SET :C2 = (SELECT NEXT VALUE FOR S1 FROM T);
```

- In a SET host-variable statement, except within the select-clause of the fullselect of an expression

  The following uses of sequence references are supported:

  ```
  SET ORDERNUM = NEXT VALUE FOR INVOICE;
  SET ORDERNUM = PREVIOUS VALUE FOR INVOICE;
  ```

  The following uses of sequence references are not supported;

  ```
  SET X = (SELECT NEXT VALUE FOR S1 FROM T);
  SET X = (SELECT PREVIOUS VALUE FOR S1 FROM T);
  ```
- In a VALUES or VALUES INTO statement though not within the select-clause of the fullselect of an expression
- In a CREATE PROCEDURE statement
- In a CREATE FUNCTION statement
- In a CREATE TRIGGER statement

PREVIOUS VALUE is defined to have a linear scope within an application session. Therefore, in a nested application on entry to a nested function, procedure, or trigger, the nested application inherits the most recently generated value for a sequence. That is, an invocation of PREVIOUS VALUE in a nested application reflects sequence activity done in the invoking environment prior to entering the nested application. In addition, on return from a function, procedure, or trigger, the invoking application is affected by any sequence activity in the lower level applications. That is, an invocation of PREVIOUS VALUE in the invoking application after returning from the nested application reflects any sequence activity that occurred in the lower level applications.

Restrictions on the use of NEXT VALUE and PREVIOUS VALUE: Some of the places where the NEXT VALUE and PREVIOUS VALUE expressions cannot be specified include the following:

- Join condition of a full outer join
- DEFAULT value for a column in a CREATE TABLE or ALTER TABLE statement
- Generated column definition in a CREATE TABLE or ALTER TABLE statement
- Materialized query table definition in a CREATE TABLE or ALTER TABLE statement
- Condition of a CHECK constraint
- Input value specification for LOAD
- Create View statement

In addition, the NEXT VALUE expression cannot be specified in the following places:

- CASE expression
- Parameter list of an aggregate function
- Subquery in a context other than those explicitly allowed
- SELECT statement for which the outer SELECT contains a DISTINCT operator or a GROUP BY clause

- SELECT statement for which the outer SELECT is combined with another SELECT statement using the UNION set operator
- Join condition of a join
- Nested table expression
- Parameter list of a table function
- Select-clause of the fullselect of an expression in the SET clause of an UPDATE statement
- WHERE clause of the outer-most SELECT statement or a DELETE, or UPDATE statement
- ORDER BY clause of the outer-most SELECT statement
- IF, WHILE, DO . . . UNTIL, or CASE statements in an SQL routine

Using the NEXT VALUE expression with a cursor: Normally, a SELECT NEXT VALUE FOR ORDER_SEQ FROM T1 would produce a result table containing as many generated values from the sequence ORDER_SEQ as the number of rows retrieved from T1. A reference to a NEXT VALUE expression in the SELECT statement of a cursor refers to a value that is generated for a row of the result table. A sequence value is generated for a NEXT VALUE expression each time a row is retrieved.

If blocking is done at a client in a DRDA environment, sequence values may get generated at the DB2 server before the processing of an application's FETCH statement. If the client application does not explicitly FETCH all the rows that have been retrieved from the database, the application will never see all those generated-but-unFETCHed values of the sequence (as many as the unFETCHed rows). These generated-but-unFETCHed values may constitute a gap in the sequence. If it is important to prevent such a gap, do the following:

- Use NEXT VALUE only in places where it would function without being controlled by a cursor and where block-fetching by the client will have no effect on it.
- If you must use NEXT VALUE in the SELECT statement of a cursor-definition, weigh the importance of preventing the gap against performance and other implications of taking the following actions:
  - Use FETCH FOR 1 ROW ONLY clause with the SELECT statement.
  - Try preventing block-fetch by other means documented in *DB2 Application Programming and SQL Guide*,

Using the PREVIOUS VALUE expression with a cursor: A reference to the PREVIOUS VALUE expression in a SELECT statement of a cursor is evaluated at OPEN time. In other words, a reference to the PREVIOUS VALUE expression in the SELECT statement of a cursor refers to the last value generated by this application process for the specified sequence PRIOR to the opening of the cursor and, once evaluated at OPEN time, the value returned by PREVIOUS VALUE within the body of the cursor will not change from FETCH to FETCH, even if NEXT VALUE is invoked with the body of the cursor.

IF PREVIOUS VALUE is used in the SELECT statement of a cursor while the cursor is open, the PREVIOUS VALUE value would be the last NEXT VALUE for the sequence generated before the cursor was opened. After the cursor is closed, the PREVIOUS VALUE value would be the last NEXT VALUE generated by the application process.

Syntax alternatives and synonyms: For compatibility, the keywords NEXTVAL and PREVVAL can be used as synonyms for NEXT VALUE and PREVIOUS VALUE respectively.

Predicates

A *predicate* specifies a condition that is true, false, or unknown about a given row or group. The types of predicates are:

```
►►──┬─basic predicate──────┬──────────────────────────────────────────────────────►◄
    ├─quantified predicate─┤
    ├─BETWEEN predicate────┤
    ├─DISTINCT predicate───┤
    ├─EXISTS predicate─────┤
    ├─IN predicate─────────┤
    ├─LIKE predicate───────┤
    └─NULL predicate───────┘
```

The following rules apply to predicates of any type:

- Predicates are evaluated after the expressions that are operands of the predicate.
- All values that are specified in the same predicate must be compatible.
- Except for the EXISTS predicate, a subquery in a predicate must specify a single column unless the operand on the other side of the comparison operator is a fullselect.
- The value of a host variable can be null (that is, the variable can have a negative indicator variable).
- The CCSID conversion of operands of predicates that involve two or more operands is done according to“Conversion rules for operations that combine strings” on page 89.

Row-value expression: The operand of several predicates (basic, quantified, DISTINCT, and IN) can be a row-value expression:

```
        ┌─,──────────┐
        ▼            │
►►──(───expression───┴─)──────────────────────────────────────────────────────────►◄
```

A *row-value-expression* returns a single row that consists of one or more column values. The values can be specified as a list of expressions. The number of columns that are returned by the row-value expression is equal to the number of expressions that are specified in the list.

Other predicate examples: In addition to the examples of predicates in the following sections, see “Distinct type comparisons” on page 85, which contains several examples of predicates that use distinct types.

Basic predicate

```
>>──┬─expression──┬─=──────┬─expression────────────────┬───────────────>◄
    │             │  (1)   │                            │
    │             ├─<>─────┤                            │
    │             ├─<──────┤                            │
    │             ├─>──────┤                            │
    │             ├─<=─────┤                            │
    │             └─>=─────┘                            │
    │                          (1)                      │
    └─(row-value-expression)──┬─=──────┬──(row-value-expression)─┘
                              └─<>─────┘
```

Notes:

1 Other comparison operators are also supported[15].

A *basic predicate* compares two values or compares a set of values with another set of values.

When *expression* is a fullselect, the fullselect must return a single result column with a single value, whether null or not null. If the value of either operand is null or the result of the fullselect is empty, the result of the predicate is unknown. Otherwise, the result is either true or false.

When a *row-value-expression* is specified on the left side of the operator (= or <>), another *row-value-expression*, with an identical number of value expressions, must be specified on the right side. The data types of the corresponding expressions or columns of the *row-value-expressions* must be compatible. The value of each expression on the left side is compared with the value of its corresponding expression on the right side. The result of the predicate depends on the operator, as in the following two cases:

- If the operator is =, the result of the predicate is:
  - True if all pairs of corresponding value expressions evaluate to true.
  - False if any one pair of corresponding value expressions evaluates to false.
  - Otherwise, unknown (that is, if at least one comparison of corresponding value expressions is unknown because of a null value and no pair of corresponding value expressions evaluates to false).
- If the operator is <>, the result of the predicate is:
  - True if any one pair of corresponding value expressions evaluates to true.
  - False if all pairs of corresponding value expressions evaluate to false.

[15] The following forms of the comparison operators are also supported in basic and quantified predicates in coded pages where the exclamation point is X'5A': !=, !<, and !> . In addition, in code pages 437, 819, and 850, the forms ¬=, ¬<, and ¬> are supported. All these product-specific forms of the comparison operators are intended only to support existing SQL statements that use these operators and are not recommended for use when writing new SQL statements. A not sign (¬) or the character that must be used in its place in certain countries, can cause parsing errors in statements passed from one DBMS to another. The problem occurs if the statement undergoes character conversion with certain combinations of source and target CCSIDs. To avoid this problem, substitute an equivalent operator for any operator that includes a not sign. For example, substitute '<>' for '¬=', '<=' for '¬>', and '>=' for '¬<'.

- Otherwise, unknown (that is, if at least one comparison of corresponding value expressions is unknown because of a null value and no pair of corresponding value expressions evaluates to true).

For values *x* and *y*:

Predicate	**Is true if and only if ...**
`x = y`	*x* is equal to *y*
`x <> y`	*x* is not equal to *y*
`x < y`	*x* is less than *y*
`x > y`	*x* is greater than *y*
`x <= y`	*x* is less than or equal to *y*
`x >= y`	*x* is greater than or equal to *y*

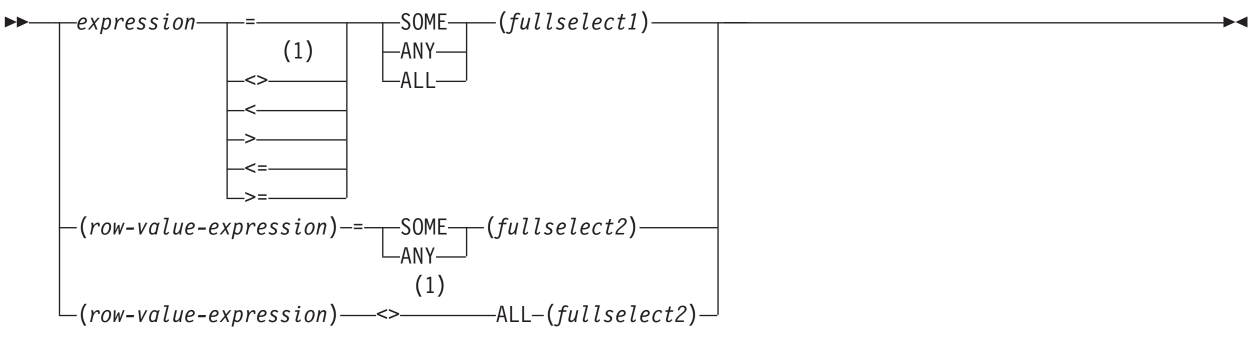
Examples for values x and y:

```
EMPNO = '528671'
SALARY < 20000
PRSTAFF <> :VAR1
SALARY >=  (SELECT AVG(SALARY) FROM DSN8810.EMP)
```

Example: List the name, first name, and salary of the employee who is responsible for the 'SECRET' project. This employee may appear in either the PROJA1 or PROJA2 tables. A UNION is used in case the employee appears in both tables to eliminate duplicate RESEMP values.

```
SELECT LASTNAME, FIRSTNAME, SALARY
  FROM DSN8810.EMP X
  WHERE EMPNO = (
SELECT RESPEMP
  FROM PROJA1 Y
  WHERE MAJPROJ = 'SECRET'
UNION
SELECT RESPEMP
  FROM PROJA2 Z
  WHERE MAJPROJ = 'SECRET');
```

Quantified predicate



Notes:

1 Other comparison operators are also supported[15].

A *quantified predicate* compares a value or values with a collection of values.

When *expression* is specified, *fullselect1* must return a single result column, and can return any number of values, whether null or not null. The result depends on the operator that is specified:

- When the operator is ALL, the result of the predicate is:
  - True if the result of the fullselect is empty or if the specified relationship is true for every value returned by the fullselect.
  - False if the specified relationship is false for at least one value returned by the fullselect.
  - Unknown if the specified relationship is not false for any values returned by the fullselect and at least one comparison is unknown because of a null value.
- When the operator is SOME or ANY, the result of the predicate is:
  - True if the specified relationship is true for at least one value returned by the fullselect.
  - False if the result of the fullselect is empty or if the specified relationship is false for every value returned by the fullselect.
  - Unknown if the specified relationship is not true for any of the values returned by the fullselect and at least one comparison is unknown because of a null value.

When *row-value-expression* is specified, the number of result columns returned by *fullselect2* must be the same as the number of value expressions specified by *row-value-expression*, and *fullselect2* can return any number of rows of values. The data types of the corresponding expressions of the row value expressions must be compatible. The value of each expression from *row-value-expression* is compared with the value of the corresponding result column from *fullselect2*. The value of the predicate depends on the operator that is specified:

- When the operator is ALL, the result of the predicate is:
  - True if the result of *fullselect2* is empty or if the specified relationship is true for every row returned by *fullselect2*.
  - False if the specified relationship is false for at least one row returned by *fullselect2*.
  - Unknown if the specified relationship is not false for any row returned by *fullselect2* and at least one comparison is unknown because of a null value.
- When the operator is SOME or ANY, the result of the predicate is:
  - True if the specified relationship is true for at least one row returned by *fullselect2*
  - False if the result of the fullselect is empty or if the specified relationship is false for every row returned by *fullselect2*.
  - Unknown if the specified relationship is not true for any of the rows returned by *fullselect2* and at least one comparison is unknown because of a null value.

Quantified predicates are equivalent to IN predicates. See Table 35 on page 169 for some examples of equivalent quantified and IN predicates.

Examples: Use the tables below when referring to the following examples. In all examples, “row *n* of TBLA” refers to the row in TBLA for which COLA has the value *n*.

TBLA:

COLA
1
2
3
4

TBLB:

COLB	COLC
2	2
3	--

TBLC:

COLB	COLC
2	2

Example 1: In the following predicate, the fullselect returns the values 2 and 3. The predicate is false for rows 1, 2, and 3 of TBLA, and is true for row 4.

```
COLA > ALL(SELECT COLB FROM TBLB
       UNION
       SELECT COLB FROM TBLC)
```

Example 2: In the following predicate, the fullselect returns the values 2 and 3. The predicate is false for rows 1 and 2 of TBLA, and is true for rows 3 and 4.

```
COLA > ANY(SELECT COLB FROM TBLB
       UNION
       SELECT COLB FROM TBLC)
```

Example 3: In the following predicate, the fullselect returns the values 2 and null. The predicate is false for rows 1 and 2 of TBLA, and is unknown for rows 3 and 4. The result is an empty table.

```
COLA > ALL(SELECT COLC FROM TBLB
       UNION
       SELECT COLC FROM TBLC)
```

Example 4: In the following predicate, the fullselect returns the values 2 and null. The predicate is unknown for rows 1 and 2 of TBLA, and is true for rows 3 and 4.

```
COLA > SOME(SELECT COLC FROM TBLB
       UNION
       SELECT COLC FROM TBLC)
```

Example 5: In the following predicate, the fullselect returns an empty result column. Hence, the predicate is true for all rows of TBLA.

```
COLA < ALL(SELECT COLB FROM TBLB WHERE COLB>3
       UNION
       SELECT COLB FROM TBLC WHERE COLB>3)
```

Example 6: In the following predicate, the fullselect returns an empty result column. Hence, the predicate is false for all rows of TBLA.

```
COLA < ANY(SELECT COLB FROM TBLB WHERE COLB>3
       UNION
       SELECT COLB FROM TBLC WHERE COLB>3)
```

If COLA were null in one or more rows of TBLA, the predicate would still be false for all rows of TBLA.

BETWEEN predicate

```
►►──expression──┬─────┬──BETWEEN──expression──AND──expression──────────────────►◄
                └─NOT─┘
```

The BETWEEN predicate determines whether a given value lies between two other given values specified in ascending order. Each of the predicate's two forms has an equivalent search condition, as shown below:

Table 34. BETWEEN predicate and equivalent search conditions

BETWEEN predicate	Equivalent search condition
`value1 BETWEEN value2 AND value3`	`value1 >= value2 AND value1 <= value3`[1]
`value1 NOT BETWEEN value2 AND value3`	`value1 < value2 OR value1 > value3`[1]
or, equivalently: `NOT(value1 BETWEEN value2 AND value3)`	

Note: 1. May not be equivalent if value1, value2, or value 3 are columns or derived values based on columns that are not the same CCSID set because the clause is evaluated in Unicode.

Search conditions are discussed in "Search conditions" on page 178.

If the operands include a mixture of datetime values and valid string representations of datetime values, all values are converted to the data type of the datetime operand.

Example: Consider predicate:

```
A BETWEEN B AND C
```

The following table shows the value of the predicate for various values of A, B, and C.

Value of A	Value of B	Value of C	Value of predicate
1,2, or 3	1	3	true
0 or 4	1	3	false
0	1	null	false
4	null	3	false
null	any	any	unknown
2	1	null	unknown
3	null	4	unknown

DISTINCT predicate

```
►►──┬─expression──IS──┬─────┬──DISTINCT FROM──expression──────────────────────┬──────────────►◄
    │                 └─NOT─┘                                                  │
    └─(row-value-expression)──IS──┬─────┬──DISTINCT FROM──(row-value-expression)─┘
                                  └─NOT─┘
```

A distinct predicate compares a value with another value or a set of values with another set of values.

The number of elements that are returned by the *row-value-expression* that specified after the distinct operator must match the number of elements that are returned by the *row-value-expression* that is specified prior to the distinct operator. The data types of the corresponding columns or expressions of the *row-value-expressions* must be compatible. When the predicate is evaluated, the value of each expression on the left side is compared with the value of its corresponding expression on the right side. The result of the predicate depends on the form of the predicate.

When the predicate is IS DISTINCT, the result of the predicate is true if at least one comparison of a pair of corresponding value expressions evaluates to true. Otherwise, the result of the predicate is false. The result cannot be unknown.

When the predicate IS NOT DISTINCT FROM, the result of the predicate is true if all pairs of corresponding value expressions evaluate to true (null values are considered equal to null values). Otherwise, the predicate is false. The result cannot be unknown.

The DISTINCT predicate cannot be used in the following contexts:
- The ON *join-condition* of a full outer join
- A check constraint
- A quantified predicate

The following DISTINCT predicate is logically equivalent to the following search conditions:

```
value 1 IS NOT DISTINCT FROM value2

** is logically equivalent to **

(value1 IS NOT NULL AND value2 IS NOT NULL AND value1 = value 2)
** or to **
(value1 IS NULL AND value2 IS NULL)
```

The following DISTINCT predicate is logically equivalent to the following search condition:

```
value 1 IS DISTINCT FROM value2

** is logically equivalent to **

NOT (value1 IS NOT DISTINCT FROM value2)
```

Example 1: Assume that T1 is a single-column table with three rows. Column C1 has the following values: 1, 2, and null. Consider the following query:

```
SELECT * FROM T1
   WHERE C1 IS DISTINCT FROM :HV;
```

The following table shows the value of the predicate for various values of C1 and the host variable.

Value of C1	Value of HV	Result of predicate
1	2	True
2	2	False
null	2	True
1	null	True
2	null	True
null	null	False

Example 2: Assume the same table as in the first example, but now consider the negative form of the predicate in the query:

```
SELECT * FROM T1
   WHERE C1 IS NOT DISTINCT FROM :HV;
```

The following table shows the value of the predicate for various values of C1 and the host variable.

Value of C1	Value of HV	Result of predicate
1	2	False
2	2	True
null	2	False
1	null	False
2	null	False
null	null	True

EXISTS predicate

```
►►──EXISTS──(fullselect)──────────────────────────────────────────────►◄
```

The EXISTS predicate tests for the existence of certain rows. The fullselect can specify any number of columns, and:

- The result is true only if the number of rows that is specified by the fullselect is not zero.
- The result is false only if the number of rows specified by the fullselect is zero.
- The result cannot be unknown.

The SELECT clause in the fullselect can specify any number of columns because the values returned by the fullselect are ignored. For convenience, use:

```
SELECT *
```

Unlike the NULL, LIKE, and IN predicates, the EXISTS predicate has no form that contains the word NOT. To negate an EXISTS predicate, precede it with the logical operator NOT, as follows:

```
NOT EXISTS (fullselect)
```

The result is then false if the EXISTS predicate is true, and true if the predicate is false. Here, NOT is a logical operator and not a part of the predicate. Logical operators are discussed in “Search conditions” on page 178.

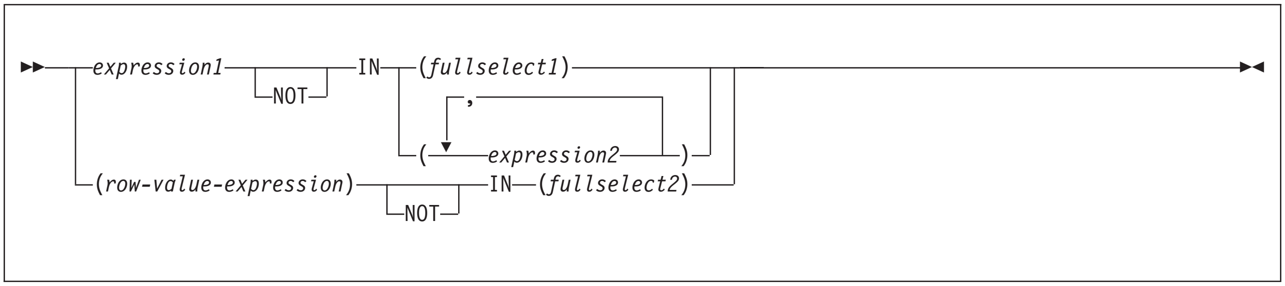
Example 1: The following query lists the employee number of everyone represented in DSN8810.EMP who works in a department where at least one employee has a salary less than 20000. Like many EXISTS predicates, the one in this query involves a correlated variable.

```
SELECT EMPNO
  FROM DSN8810.EMP X
  WHERE EXISTS (SELECT * FROM DSN8810.EMP
                 WHERE X.WORKDEPT=WORKDEPT AND SALARY<20000);
```

Example 2: List the subscribers (SNO) in the state of California who made at least one call during the first quarter of 2000. Order the results according to SNO. Each MONTHnn table has columns for SNO, CHARGES, and DATE. The CUST table has columns for SNO and STATE.

```
SELECT C.SNO
  FROM CUST C
  WHERE C.STATE = 'CA'
  AND EXISTS (
  SELECT *
    FROM MONTH1
    WHERE DATE BETWEEN '01/01/2000 AND '01/31/2000'
    AND C.SNO = SNO
  UNION ALL
  SELECT *
    FROM MONTH2
    WHERE DATE BETWEEN '02/01/2000 AND '02/29/2000'
    AND C.SNO = SNO
  UNION ALL
  SELECT *
  FROM MONTH3
  WHERE DATE BETWEEN '03/01/2000 AND '03/31/2000'
  AND C.SNO = SNO
  )
  ORDER BY C.SNO;
```

IN predicate



The IN predicate compares a value or values with a set of values.

When *expression1* is specified, the IN predicate compares a value with a set of values. When *fullselect1* is specified, the fullselect must return a single result column, and can return any number of values, whether null or not null. The data type of *expression1* and the data type of the result column of *fullselect1* or *expression2* must be compatible. If *expression* is a single host variable, the host variable can identify a structure. Any host variable or structure that is specified must be described in the application program according to the rules for declaring host structures and variables.

When *row-value-expression* is specified, the IN predicate compares values with a collection of values. *fullselect2* must return a number of result columns that is equal to the number of expressions on the left side of the IN predicate. The data type of each expression in *row-value-expression* and the data type of its the corresponding result column of *fullselect2* must be compatible. The value of the predicate depends on the operator that is specified:

- When the operator is IN, the result of the predicate is:
  - True if at least one row returned from *fullselect2* is equal to the *row-value-expression*.
  - False if the result of *fullselect2* is empty or if no row returned from *fullselect2* is equal to the *row-value-expression*.
  - Otherwise, unknown (that is, if the comparison of *row-value-expression* to the row returned from *fullselect2* evaluates to unknown because of a null value for at least one row returned from *fullselect2* and no row returned from *fullselect2* is equal to the *row-value-expression*).
- When the operator is NOT IN, the result of the predicate is:

  True if the result of *fullselect2* is empty or if the *row-value-expression* is not equal to any of the rows returned by *fullselect2*.

  False if the *row-value-expression* is equal to at least one row returned by*fullselect2*.

  Otherwise, unknown (that is, if the comparison of *row-value-expression* to the row returned from *fullselect2* evaluates to unknown because of a null value for at least one row returned from *fullselect2* and the comparison of *row-value-expression* to the row returned from *fullselect2* is not true for any row returned by the *fullselect2*).

The IN predicate is equivalent to the quantified predicate as follows:

Table 35. IN predicate and equivalent quantified predicates

IN predicate	Equivalent quantified predicate
`expression1 IN (expression2)`	`expression1 = expression2`
`expression IN (fullselect1)`	`expression = ANY (fullselect1)`
`expression NOT IN (fullselect1)`	`expression <>  ALL (fullselect1)`

`expression1 IN (expressiona,`
`   expressionb, ...)`
	`expression1 IN ( SELECT * FROM R)`
	When T is a table with a single row and R is a result table formed by the following fullselect:
	`SELECT value1 FROM T`
	`  UNION`
	`SELECT value2 FROM T`
	`  UNION`
	`    .`
	`    .`
	`    .`
	`  UNION`
	`SELECT valuen FROM T`

Table 35. IN predicate and equivalent quantified predicates (continued)

IN predicate	Equivalent quantified predicate
`row-value-expression IN (fullselect2)`	`row-value-expression = SOME (fullselect2)`
`row-value-expression IN (fullselect2)`	`row-value-expression = ANY (fullselect2)`
`row-value-expression NOT IN (fullselect2)`	`row-value-expression <> ALL (fullselect2)`

If the operands of the IN predicate are strings with different CCSIDs, the rules used to determine which operands are converted are those for operations that combine strings. See “Character and graphic string comparisons” on page 84.

Example 1: The following predicate is true for any row whose employee is in department D11, B01, or C01.

```
WORKDEPT IN ('D11', 'B01', 'C01')
```

Example 2: The following predicate is true for any row whose employee works in department E11.

```
EMPNO IN (SELECT EMPNO FROM DSN8810.EMP
  WHERE WORKDEPT = 'E11')
```

Example 3: The following predicate is true if the date that a project is estimated to start (PRENDATE) is within the next two years.

```
YEAR(PRENDATE)  IN (YEAR(CURRENT DATE),
                    YEAR(CURRENT DATE + 1 YEAR),
                    YEAR(CURRENT DATE + 2 YEARS))
```

Example 4: The following example obtains the phone number of an employee in DSN8810.EMP where the employee number (EMPNO) is a value specified within the COBOL structure defined below.

```
77 PHNUM  PIC X(6).
01 EMPNO-STRUCTURE.
   05 CHAR-ELEMENT-1  PIC X(6) VALUE '000140'.
   05 CHAR-ELEMENT-2  PIC X(6) VALUE '000340'.
   05 CHAR-ELEMENT-3  PIC X(6) VALUE '000220'.
   .
   .
   .
EXEC SQL DECLARE PHCURS CURSOR FOR
     SELECT PHONENO FROM DSN8810.EMP
       WHERE EMPNO IN
       (:EMPNO-STRUCTURE.CHAR-ELEMENT-1,
        :EMPNO-STRUCTURE.CHAR-ELEMENT-2,
        :EMPNO-STRUCTURE.CHAR-ELEMENT-3)
END-EXEC.
EXEC SQL OPEN PHCURS
END-EXEC.
EXEC SQL FETCH PHCURS INTO :PHNUM
END-EXEC.
```

LIKE predicate

```
►►──match-expression──┬─────┬──LIKE──pattern-expression──┬───────────────────────────┬──────────►◄
                      └─NOT─┘                            └─ESCAPE──escape-expression─┘
```

The LIKE predicate searches for strings that have a certain pattern. The *match-expression* is the string to be tested for conformity to the pattern specified in *pattern-expression*. Underscore and percent sign characters in the pattern have a special meaning instead of their literal meanings unless *escape-expression* is specified, as discussed under the description of *pattern-expression*.

The following rules summarize how a predicate in the form of "*m* LIKE *p*" is evaluated:

- If *m* or *p* is null, the result of the predicate is unknown.
- If *m* and *p* are both empty, the result of the predicate is true.
- If *m* is empty and *p* is not, the result of the predicate is unknown unless *p* consists of one or more percent signs.
- If *m* is not empty and *p* is empty, the result of the predicate is false.
- Otherwise, if *m* matches the pattern in *p*, the result of the predicate is true. The description of *pattern-expression* provides a detailed explanation on how the pattern is matched to evaluate the predicate to true or false. See the "rigorous description of the pattern" for this information.

The values for *match-expression*, *pattern-expression*, and *escape-expression* must all be character or graphic strings or a mixture of both or they must all be binary strings (BLOBs). None of the expressions can yield a distinct type; however, an expression can be a function that casts a distinct type to its source type.

There are slight differences in what expressions are supported for each argument. The description of each argument lists the supported expressions:

match-expression
An expression that specifies the string to be tested for conformity to a certain pattern of characters.

LIKE *pattern-expression*
An expression that specifies the pattern of characters to be matched.

The expression can be specified by any one of the following:

- A constant
- A special register
- A host variable (including a LOB locator variable)
- A scalar function whose arguments are any of the above (though nested function invocations cannot be used)
- A CAST specification whose arguments are any of the above
- An expression that concatenates (using CONCAT or ||) any of the above

The expression must also meet these restrictions:

- The maximum length of *pattern-expression* must not be larger than 4000 bytes.

- If a host variable is used in *pattern-expression*, the host variable must be defined in accordance with the rules for declaring string host variables and must not be a structure.
- If *escape-expression* is specified, *pattern-expression* must not contain the escape character identified by *escape-expression* except when immediately followed by the escape character, '%', or '_'. For example, if '+' is the escape character, any occurrences of '+' other than '++', '+_', or '+%' in the pattern is an error.

When the pattern specified in a LIKE predicate is a parameter marker and a fixed-length character host variable is used to replace the parameter marker, specify a value for the host variable that is the correct length. If you do not specify the correct length, the select does not return the intended results. For example, if the host variable is defined as CHAR(10) and the value WYSE% is assigned to that host variable, the host variable is padded with blanks on assignment. The pattern used is ’WYSE%   ’, which requests DB2 to search for all values that start with WYSE and end with five blank spaces. If you intended to search for only the values that start with ’WYSE’, you should assign the value ’WYSE%%%%%%’ to the host variable.

If the pattern is specified in a fixed-length string variable, any trailing blanks are interpreted as part of the pattern. Therefore, it is better to use a varying-length string variable with an actual length that is the same as the length of the pattern. If the host language does not allow varying-length string variables, place the pattern in a fixed-length string variable whose length is the length of the pattern.

For more on the use of host variables with specific programming languages, see Part 2 of *DB2 Application Programming and SQL Guide*.

The pattern is used to specify the conformance criteria for values in the *match-expression* where:

- The underscore character (_) represents any single character.
- The percent sign (%) represents a string of zero or more characters.
- Any other character represents a single occurrence of itself.

If the *pattern-expression* needs to include either the underscore or the percent character, the *escape-expression* is used to specify a character to precede either the underscore or percent character in the pattern. For character strings, the terms *character*, *percent sign*, and *underscore* refer to SBCS characters. For graphic strings, the terms refer to double-byte or UTF-16 characters.

A rigorous description of the pattern

This more rigorous description of the pattern ignores the use of the *escape-expression*.

Let *m* denote the value of *match-expression* and let *p* denote the value of *pattern-expression*. The string *p* is interpreted as a sequence of the minimum number of substring specifiers so each character of *p* is part of exactly one substring specifier. A substring specifier is an underscore, a percent sign, or any non-empty sequence of characters other than an underscore or a percent sign.

The result of the predicate is unknown if *m* or *p* is the null value. Otherwise, the result is either true or false. The result is true if *m* and *p* are both empty strings or there exists a partitioning of *m* into substrings such that:

- A substring of *m* is a sequence of zero or more contiguous characters and each character of *m* is part of exactly one substring.
- If the *n*th substring specifier is an underscore, the *n*th substring of *m* is any single character.
- If the *n*th substring specifier is a percent sign, the *n*th substring of *m* is any sequence of zero or more characters.
- If the *n*th substring specifier is neither an underscore nor a percent sign, the *n*th substring of *m* is equal to that substring specifier and has the same length as that substring specifier.
- The number of substrings of *m* is the same as the number of substring specifiers.

It follows that if *p* is an empty string and *m* is not an empty string, the result is false. Similarly, if *m* is an empty string and *p* is not an empty string, the result is false.

The predicate *m* NOT LIKE *p* is equivalent to the search condition NOT (*m* LIKE *p*).

Mixed data patterns: If *match-expression* represents mixed data, the pattern is assumed to be mixed data. For ASCII and EBCDIC, the special characters in the pattern are interpreted as follows:

- An SBCS underscore refers to one SBCS character.
- A DBCS underscore refers to one MBCS character.
- A percent sign (either SBCS or DBCS) refers to a string of zero or more SBCS or MBCS characters.
- Redundant shift bytes in *match-expression* or *pattern-expression* are ignored.

For Unicode, the special characters in the pattern are interpreted as follows:

- An SBCS or DBCS underscore refers to one character (either SBCS or MBCS).
- A percent sign (either SBCS or DBCS) refers to a string of zero or more SBCS or MBCS characters.

When the LIKE predicate is used with Unicode data, the Unicode percent sign and underscore use the code points indicated in the following table:

Character	UTF-8	UTF-16
Half-width %	X'25'	X'0025'
Full-width %	X'EFBC85'	X'FF05'
Half-width_	X'5F'	X'005F'
Full-width_	X'EFBCBF'	X'FF3F'

The full-width or half-width % matches zero or more characters. The full-width or half width _ character matches exactly one character. (For ASCII or EBCDIC data, a full-width _ character matches one DBCS character.)

ESCAPE *escape-expression*

An expression that specifies the escape character to be used to modify the special meaning of the underscore (_) and percent (%) characters in *pattern-expression*. Specifying an expression, which is optional, allows the LIKE predicate to explicitly test that the value contains a ”%’ or ’_’ in the desired character positions. The escape character consists of a single SBCS (1 byte) or DBCS (2 bytes) character. An escape clause is allowed for Unicode mixed (UTF-8) data, but is restricted for ASCII and EBCDIC mixed data.

The expression can be specified by any one of:
- A constant
- A host variable (including a LOB locator variable)
- A scalar function whose arguments are any of the above (though nested function invocations cannot be used)
- A CAST specification whose arguments are any of the above

The following rules also apply to the use of the ESCAPE clause and *escape-expression*:

- The result of *escape-expression* must be one SBCS or DBCS character or a binary string that contains exactly 1 byte.
- The ESCAPE clause cannot be used if *match-expression* is mixed data.
- If *escape-expression* is specified by a host variable, the host variable must be defined in accordance with the rules for declaring fixed-length string host variables.[16] If the host variable has a negative indicator variable, the result of the predicate is unknown.
- The pattern must not contain the escape character except when followed by the escape character, '%' or '_'. For example, if '+' is the escape character, any occurrences of '+' other than '++', '+_', or '+%' in the pattern is an error.

[16] If it is NUL-terminated, a C character string variable of length 2 can be specified.

The following example shows the effect of successive occurrences of the escape character, which in this case is the plus sign (+).

When the pattern string is...	The actual pattern is...
`+%`	A percent sign
`++%`	A plus sign followed by zero or more arbitrary characters
`+++%`	A plus sign followed by a percent sign

Examples

Example 1: The following predicate is true when the string to be tested in NAME has the value SMITH, NESMITH, SMITHSON, or NESMITHY. It is not true when the string has the value SMYTHE:

```
NAME LIKE '%SMITH%'
```

Example 2: In the predicate below, a host variable named PATTERN holds the string for the pattern:

```
NAME LIKE :PATTERN ESCAPE '+'
```

Assume that the string in PATTERN has the value:

```
AB+_C_%
```

Observe that in this string, the plus sign preceding the first underscore is an escape character. The predicate is true when the string being tested in NAME has the value AB_CD or AB_CDE. It is false when this string has the value AB, AB_, or AB_C.

Example 3: The following two predicates are equivalent; three of the four percent signs in the first predicate are redundant.

```
NAME LIKE 'AB%%%%CD'
NAME LIKE 'AB%CD'
```

Example 4: Assume that a distinct type named ZIP_TYPE with a source data type of CHAR(5) exists and an ADDRZIP column with data type ZIP_TYPE exists in some table TABLEY. The following statement selects the row if the zip code (ADDRZIP) begins with '9555'.

```
SELECT * FROM TABLEY
  WHERE CHAR(ADDRZIP) LIKE '9555%';
```

Example 5: The RESUME column in sample table DSN8810.EMP_PHOTO_RESUME is defined as a CLOB. The following statement selects the RESUME column when the string JONES appears anywhere in the column.

```
SELECT RESUME FROM DSN8810.EMP_PHOTO_RESUME
  WHERE RESUME LIKE '%JONES%';
```

Example 6: In the following table, assume COL1 is a column that contains mixed EBCDIC data. The table shows the results when the predicate in the first column is evaluated using the COL1 value in the second column:

Predicates	COL1 Values	Result
WHERE COL1 LIKE 'aaa␎ＡＢ％Ｃ␏'	'aaa␎ＡＢＤＺＣ␏'	True
WHERE COL1 LIKE 'aaa␎ＡＢ␏%␎Ｃ␏'	'aaa␎ＡＢ␏dzx␎Ｃ␏'	True
WHERE COL1 LIKE 'a%␎Ｃ␏'	'a␎Ｃ␏' 'ax␎Ｃ␏' 'ab␎ＤＥ␏fg␎Ｃ␏'	True True True
WHERE COL1 LIKE 'a_␎Ｃ␏'	'a%␎Ｃ␏' 'a␎ＸＣ␏'	True False
WHERE COL1 LIKE 'a␎＿Ｃ␏'	'a␎ＸＣ␏' 'ax␎Ｃ␏'	True False
WHERE COL1 LIKE '␎␏'	Empty string	True
WHERE COL1 LIKE 'ab␎Ｃ␏_'	'ab␎Ｃ␏d' 'ab␎␏␎Ｃ␏d'	True True

Example 7: In the following table, assume COL1 is a column that contains mixed ASCII data. The table shows the results when the predicate in the first column is evaluated using the COL1 value in the second column:

Predicates	COL1 Values	Result
WHERE COL1 LIKE 'aaaＡＢ％Ｃ'	'aaaＡＢＤＺＣ'	True
WHERE COL1 LIKE 'aaaＡＢ%Ｃ'	'aaaＡＢdzxＣ'	True

Example 8: In the following table, assume COL1 is a column that contains Unicode data. The table shows the results when the predicate in the first column is evaluated using the COL1 value in the second column:

Predicates	COL1 Values	Result
WHERE COL1 LIKE 'aaa $^{S}_{O}$ＡＢ％Ｃ$^{S}_{I}$'	'aaa$^{S}_{O}$ＡＢＤＺＣ$^{S}_{I}$' 'aaa$^{S}_{O}$ＡＢ$^{S}_{I}$ dzx$^{S}_{O}$Ｃ$^{S}_{I}$' Empty string	True True False
WHERE COL1 LIKE 'aaa $^{S}_{O}$ＡＢ$^{S}_{I}$ %$^{S}_{O}$Ｃ$^{S}_{I}$'	'aaa$^{S}_{O}$ＡＢＤＺＣ$^{S}_{I}$' 'aaa$^{S}_{O}$ＡＢ$^{S}_{I}$ dzx$^{S}_{O}$Ｃ$^{S}_{I}$' Empty string	True True False
WHERE COL1 LIKE '$^{S}_{O}$$^{S}_{I}$'	'aaa$^{S}_{O}$ＡＢＤＺＣ$^{S}_{I}$' 'aaa$^{S}_{O}$ＡＢ$^{S}_{I}$ dzx$^{S}_{O}$Ｃ$^{S}_{I}$' Empty string	False False True
WHERE COL1 LIKE '$^{S}_{O}$％$^{S}_{I}$'	'aaa$^{S}_{O}$ＡＢＤＺＣ$^{S}_{I}$' 'aaa$^{S}_{O}$ＡＢ$^{S}_{I}$ dzx$^{S}_{O}$Ｃ$^{S}_{I}$' Empty string	True True False
WHERE COL1 LIKE '$^{S}_{O}$＿$^{S}_{I}$ %'	'aaa$^{S}_{O}$ＡＢＤＺＣ$^{S}_{I}$' 'aaa$^{S}_{O}$ＡＢ$^{S}_{I}$ dzx$^{S}_{O}$Ｃ$^{S}_{I}$' Empty string	True True False
WHERE COL1 LIKE '$^{S}_{O}$＿$^{S}_{I}$'	'aaa$^{S}_{O}$ＡＢＤＺＣ$^{S}_{I}$' 'aaa$^{S}_{O}$ＡＢ$^{S}_{I}$ dzx$^{S}_{O}$Ｃ$^{S}_{I}$' Empty string	False False False

NULL predicate

```
►►──expression──IS──┬─────┬──NULL──────────────────────────────────────────────────►◄
                    └─NOT─┘
```

The NULL predicate tests for null values.

The result of a NULL predicate cannot be unknown. If the value of the expression is null, the result is true. If the value is not null, the result is false. If NOT is specified, the result is reversed.

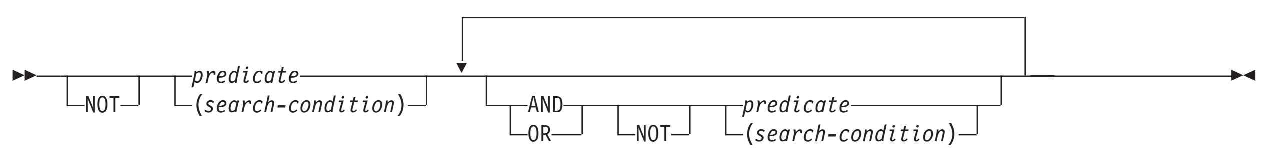
A parameter marker must not be specified for or within the expression.

Example: The following predicate is true whenever PHONENO has the null value, and is false otherwise.

```
PHONENO IS NULL
```

Search conditions

A *search condition* specifies a condition that is true, false, or unknown about a given row or group. When the condition is true, the row or group qualifies for the results. When the condition is false or unknown, the row or group does not qualify.



The result of a search condition is derived by application of the specified *logical operators* (AND, OR, NOT) to the result of each specified predicate. If logical operators are not specified, the result of the search condition is the result of the specified predicate.

AND and OR are defined in the following table, in which P and Q are any predicates:

Table 39. Truth table for AND and OR

P	Q	P AND Q	P OR Q
True	True	True	True
True	False	False	True
True	Unknown	Unknown	True
False	True	False	True
False	False	False	False
False	Unknown	False	Unknown
Unknown	True	Unknown	True
Unknown	False	False	Unknown
Unknown	Unknown	Unknown	Unknown

NOT(true) is false and NOT(false) is true, but NOT(unknown) is still unknown. The NOT logical operator has no affect on an unknown condition. The result of NOT(unknown) is still unknown.

Search conditions within parentheses are evaluated first. If the order of evaluation is not specified by parentheses, NOT is applied before AND, and AND is applied before OR. The order in which operators at the same precedence level are evaluated is undefined to allow for optimization of search conditions.

Example 1: In the first of the search conditions below, AND is applied before OR. In the second, OR is applied before AND.

```
SALARY>:SS AND  COMM>:CC OR BONUS>:BB
SALARY>:SS AND (COMM>:CC OR BONUS>:BB)
```

Example 2: In the first of the search conditions below, NOT is applied before AND. In the second, AND is applied before NOT.

```
NOT SALARY>:SS  AND  COMM>:CC
NOT (SALARY>:SS AND  COMM>:CC)
```

Example 3: For the following search condition, AND is applied first. After the application of AND, the ORs could be applied in either order without changing the result. DB2 can therefore select the order of applying the ORs.

```
SALARY>:SS AND COMM>:CC OR BONUS>:BB OR SEX=:GG
```

Options affecting SQL

Certain DB2 precompiler options, DB2 subsystem parameters (set through the installation panels), bind options, and special registers affect how SQL statements can be composed or determine how SQL statements are processed.

Table 40 summarizes the effect of these options and shows where to find more information. (Some of the items are described in detail following the table, while other items are described elsewhere.)

Table 40. Summary of items affecting composition and processing of SQL statements

Precompiler option	Other[1]	Affects
	DYNAMICRULES bind option	The rules that DB2 applies to dynamic SQL statements. For details about authorization, see “Authorization IDs and dynamic SQL” on page 51. The bind option can also affect decimal point representation, string delimiters, mixed data, and decimal arithmetic. For details about how DB2 applies the precompiler options to dynamic SQL statements when DYNAMICRULES bind, define, or invoke behavior is in effect, see “Precompiler options for dynamic statements” on page 181.
	USE FOR DYNAMICRULES	Use of precompiler options for dynamic statements when DYNAMICRULES bind, define, or, invoke behavior is in effect. For details, see “Precompiler options for dynamic statements” on page 181.
COMMA PERIOD	DECIMAL POINT IS	Representation of decimal points in SQL statements. For details, see page 181.
APOSTSQL QUOTESQL	SQL STRING DELIMITER	Representation of string delimiters in SQL statements. For details, see page 182.
	ASCII CODED CHAR SET	A numeric value that determines the CCSID of ASCII string data. For details, see page 183.
	EBCDIC CODED CHAR SET	A numeric value that determines the CCSID of EBCDIC string data and whether Katakana characters can be used in ordinary identifiers. For details, see page 183.
	UNICODE CCSID	A numeric value that determines the CCSID of Unicode string data. For details, see page 183.

Table 40. Summary of items affecting composition and processing of SQL statements (continued)

Precompiler option	Other[1]	Affects
GRAPHIC NOGRAPHIC	MIXED DATA	Use of ASCII or EBCDIC character strings with a mixture of SBCS and DBCS characters. For details, see page 183.
DATE TIME	DATE FORMAT TIME FORMAT LOCAL DATE LENGTH LOCAL TIME LENGTH	Formatting of datetime strings. For details, see page 184.
STDSQL		Conformance with the SQL standard. For details, see page 184.
NOFOR or STDSQL		Whether the FOR UPDATE clause must be specified (in the SELECT statement of the DECLARE CURSOR statement). For details, see page 185.
CONNECT		Whether the rules for the CONNECT(1) or CONNECT(2) precompiler option apply. For details about the precompiler option, see Part 4 of *DB2 Application Programming and SQL Guide*.
	SQLRULES bind option	Whether a CONNECT statement is processed with DB2 rules or SQL standard rules.
	CURRENT RULES special register	Whether the statements ALTER TABLE, CREATE TABLE, GRANT, and REVOKE are processed with DB2 rules or SQL standard rules. For details, see “CURRENT RULES” on page 107. Whether DB2 automatically creates the LOB table space, auxiliary table, and index on the auxiliary table for a LOB column in a base table. For details, see “Creating a table with LOB columns” on page 766. Whether DB2 automatically creates an index on a ROWID column that is defined with GENERATED BY DEFAULT. For details, see the description of the clause for “CREATE TABLE” on page 734. Whether a stored procedure runs as a main or subprogram. For details, see “CREATE PROCEDURE (external)” on page 692.
	SQLRULES bind option or CURRENT RULES special register	Whether SQLCODE +236 is issued when the SQLDA provided on DESCRIBE or PREPARE INTO is too small and the result columns do not involve LOBs or distinct types. For details, see “DESCRIBE (prepared statement or table)” on page 851 and Appendix E, “SQL descriptor area (SQLDA),” on page 1173. Whether the SELECT privilege is required in a searched DELETE or UPDATE. For details, see “DELETE” on page 843 or “UPDATE” on page 1097.
DEC	DECIMAL ARITHMETIC or CURRENT PRECISION special register	Whether DEC15 or DEC31 rules are used when both operands in a decimal operation have 15 digits or less. For details, see “Arithmetic with two decimal operands” on page 135.

Table 40. Summary of items affecting composition and processing of SQL statements (continued)

Precompiler option	Other[1]	Affects

Note: [1]The entries in this column are fields on installation panels unless otherwise noted.

For further details on precompiler options, see Part 5 of *DB2 Application Programming and SQL Guide*. For more details on bind options, see Chapter 2 of *DB2 Command Reference*.

Precompiler options for dynamic statements

Generally, dynamic statements use the application programming defaults specified on installation panel DSNTIPF. However, if the value of installation panel field USE FOR DYNAMICRULES is NO and DYNAMICRULES bind, define, or invoke behavior is in effect, the following precompiler options are used instead of the application programming defaults:

- COMMA or PERIOD
- APOST or QUOTE
- APOSTSQL or QUOTESQL
- GRAPHIC or NOGRAPHIC
- DEC(15) or DEC(31)

For some languages, the precompiler option defaults to a value and no alternative is allowed. If the value of installation panel field USE FOR DYNAMICRULES is YES, dynamic statements use the application programming defaults regardless of the value of bind option DYNAMICRULES.

For additional information on the effect of precompiler options and application programming defaults on:

- Decimal point representation, see page 181.
- String delimiters, see page 182.
- Mixed data, see page 183.
- Decimal arithmetic, see “Arithmetic with two decimal operands” on page 135.

For a list of the DYNAMICRULES bind option values that specify run, bind, define, or invoke behavior, see Table 3 on page 51.

Decimal point representation

Decimal points in SQL statements are represented with either periods or commas. Two values control the representation:

- The value of field DECIMAL POINT IS on installation panel DSNTIPF, which can be a comma (,) or period (.)
- COMMA or PERIOD, which are mutually exclusive DB2 precompiler options for COBOL

These values apply to SQL statements as follows:

- For a distributed operation, the decimal point is the first of the following values that applies:
  - The decimal point value specified by the requester
  - The value of field DECIMAL POINT IS on panel DSNTIPF at the DB2 where the package is bound
- Otherwise:

  For static SQL statements:

- In a COBOL program, the DB2 precompiler option COMMA or PERIOD determines the decimal point representation for every static SQL statement. If neither precompiler option is specified, the value of DECIMAL POINT IS at precompilation time determines the representation.
- In non-COBL programs, the decimal representation for static SQL statements is always the period.

For dynamic SQL statements:

- If DYNAMICRULES run behavior applies, the decimal point is the value of field DECIMAL POINT IS on installation panel DSNTIPF at the local DB2 when the statement is prepared.

  For a list of the DYNAMICRULES bind option values that specify run, bind, define, or invoke behavior, see Table 3 on page 51.
- If DYNAMICRULES bind, define, or invoke behavior applies, and the value of install panel field USE FOR DYNAMICRULES is YES, the decimal point is the value of field DECIMAL POINT IS.

  If bind, define, or invoke behavior applies, and field USE FOR DYNAMIC RULES is NO, the precompiler option determines the decimal point representation. For COBOL programs, which supports precompiler option COMMA or PERIOD, the decimal point representation is determined as described above for static SQL statements in COBOL programs. For programs written in other host languages, the default precompiler option, which can only be PERIOD, is used.

If the comma is the decimal point, these rules apply:

- In any context, a comma intended as a separator must be followed by a space. Such commas could appear, for example, in a VALUES clause, an IN predicate, or an ORDER BY clause in which numbers are used to identify columns.
- In any context, a comma intended as a decimal point must not be followed by a space.
- If the DECIMAL POINT IS field (and not the precompiler option) determines the comma as the decimal point, DB2 will recognize either a comma or a period as the decimal point in numbers in dynamic SQL.

Apostrophes and quotation marks in string delimiters

The following precompiler options control the representation of string delimiters:

- APOST and QUOTE are mutually exclusive DB2 precompiler options for COBOL. Their meanings are exactly what they are for the COBOL compilers:
  - APOST names the apostrophe (') as the string delimiter in COBOL statements.
  - QUOTE names the quotation mark (") as the string delimiter.

  Neither option applies to SQL syntax. Do not confuse them with the APOSTSQL and QUOTESQL options.
- APOSTSQL and QUOTESQL are mutually exclusive DB2 precompiler options for COBOL. Their meanings are:
  - APOSTSQL names the apostrophe (') as the string delimiter and the quotation mark (") as the escape character in SQL statements.
  - QUOTESQL names the quotation mark (") as the string delimiter and the apostrophe (') as the escape character in SQL statements.

These values apply to SQL statements as follows:

- For a distributed operation, the string delimiter is the first of the following values that applies:

  - The SQL string delimiter value specified by the requester
  - The value of the field SQL STRING DELIMITER on installation panel DSNTIPF at the DB2 where the package is bound
- Otherwise:
  - For static SQL statements:

    In a COBOL program, the DB2 precompiler option APOSTSQL or QUOTESQL determines the string delimiter and escape character. If neither precompiler option is specified, the value of field SQL STRING DELIMITER on installation panel DSNTIPF determines the string delimiter and escape character.

    In a non-COBOL program, the string delimiter is the apostrophe, and the escape character is the quotation mark.
  - For dynamic SQL statements:
    - If DYNAMICRULES run behavior applies, the string delimiter and escape character is the value of field SQL STRING DELIMITER on installation panel DSNTIPF at the local DB2 when the statement is prepared.

      For a list of the DYNAMICRULES bind option values that specify run, bind, define, or invoke behavior, see Table 3 on page 51.
    - If DYNAMICRULES bind, define, or invoke behavior applies and the value of install panel field USE FOR DYNAMICRULES is YES, the string delimiter and escape character is the value of field SQL STRING DELIMITER.

      If bind, define, or invoke behavior applies and USE FOR DYNAMICRULES is NO, the precompiler option determines the string delimiter and escape character. For COBOL programs, precompiler option APOSTSQL or QUOTESQL determines the string delimiter and escape character. If neither precompiler option is specified, the value of field SQL STRING DELIMITER determines them. For programs written in other host languages, the default precompiler option, which can only be APOSTSQL, determines the string delimiter and escape character.

Katakana characters for EBCDIC

The field EBCDIC CODED CHAR SET on installation panel DSNTIPF determines the system CCSIDs for EBCDIC-encoded data. Ordinary identifiers with an EBCDIC encoding scheme can contain Katakana characters if the field contains the value 5026 or 930. There are no corresponding precompiler options. EBCDIC CODED CHAR SET applies equally to static and dynamic statements. For dynamically prepared statements, the applicable value is always the one at the local DB2.

Mixed data in character strings

The field MIXED DATA on installation panel DSNTIPF can have the value YES or NO for ASCII or EBCDIC character strings. The value YES indicates that character strings can contain a mixture of SBCS and DBCS characters. The value NO indicates that they cannot. Mixed character data and graphic data are always allowed for Unicode; that is the MIXED DATA field does not have an effect on Unicode data. A corresponding precompiler option (GRAPHIC or NOGRAPHIC) exists for every host language supported.

For static SQL statements, the value of the precompiler option determines whether ASCII or EBCDIC character strings can contain mixed data. For dynamic SQL statements, either the value of field MIXED DATA or the precompiler option is used, depending on the value of bind option DYNAMICRULES in effect:

- If DYNAMICRULES run behavior applies, field MIXED DATA is used.

For a list of the DYNAMICRULES bind option values that specify run, bind, define, or invoke behavior, see Table 3 on page 51.

- If bind, define, or invoke behavior applies and the value of install panel field USE FOR DYNAMICRULES is YES, field MIXED DATA is used. If USE FOR DYNAMICRULES is NO, the precompiler option is used.

The value of MIXED DATA and the precompiler option affects the parsing of SQL character string constants, the execution of the LIKE predicate, and the assignment of character strings to host variables when truncation is needed. It can also affect concatenation, as explained in “With the concatenation operator” on page 139. A value that applies to a statement executed at the local DB2 also applies to any statement executed at another server. An exception is the LIKE predicate, for which the applicable value of MIXED DATA is always the one at the statement’s server.

The value of MIXED DATA also affects the choice of system CCSIDs for the local DB2 and the choice of data subtypes for character columns. When this value is YES, multiple CCSIDs are available for ASCII and EBCDIC data (SBCS, DBCS, and MIXED). The CCSID specified in the ASCII CODED CHAR SET or EBCDIC CODED CHAR SET field is the MIXED CCSID. In this case, DB2 derives the SBCS and MIXED CCSIDs from the DBCS CCSID specified installation panel DSNTIPF. Moreover, a character column can have any one of the allowable data subtypes—BIT, SBCS, or MIXED.

On the other hand, when MIXED DATA is NO, the only ASCII or EBCDIC system CCSIDs are those for SBCS data. Therefore, only BIT and SBCS can be data subtypes for character columns.

Formatting of datetime strings

Fields on installation panel DSNTIP4 (DATE FORMAT, TIME FORMAT, LOCAL DATE LENGTH, and LOCAL TIME LENGTH) and DB2 precompiler options affect the formatting of datetime strings.

The formatting of datetime strings is described in “String representations of datetime values” on page 65. Unlike the subsystem parameters and options previously described, a value in effect for a statement executed at the local DB2 is not necessarily in effect for a statement executed at a different server. See “Restrictions on the use of local datetime formats” on page 67 for more information.

SQL standard language

DB2 SQL and the SQL standard are not identical. The STDSQL precompiler option addresses some of the differences:

- STDSQL(NO) indicates that conformance with the SQL standard is not intended. The default is the value of field STD SQL LANGUAGE on installation panel DSNTIP4 (which has a default of NO).
- STDSQL(YES)[17] indicates that conformance with the SQL standard is intended.

When a program is precompiled with the STDSQL(YES) option, the following rules apply:

Declaring host variables: All host variable declarations except in Java and REXX must lie between pairs of BEGIN DECLARE SECTION and END DECLARE SECTION statements:

[17] STDSQL(86) is a synonym, but STDSQL(YES) should be used.

```
BEGIN DECLARE SECTION

 (one or more host variable declarations)

END DECLARE SECTION
```

Separate pairs of these statements can bracket separate sets of host variable declarations.

Declarations for SQLCODE and SQLSTATE: The programmer must declare host variables for either SQLCODE or SQLSTATE, or both. SQLCODE should be defined as a fullword integer and SQLSTATE should be defined as a 5-byte character string. SQLCODE and SQLSTATE cannot be part of any structure. The variables must be declared in the DECLARE SECTION of a program; however, SQLCODE can be declared outside of the DECLARE SECTION when no host variable is defined for SQLSTATE. For PL/I, an acceptable declaration can look like this:

```
DECLARE SQLCODE BIN FIXED(31);
DECLARE SQLSTATE CHAR(5);
```

In Fortran programs, the variable SQLCOD should be used for SQLCODE, and either SQLSTATE or SQLSTA can be used for SQLSTATE.

Definitions for the SQLCA: An SQLCA must not be defined in your program, either by coding its definition manually or by using the INCLUDE SQLCA statement. When STDSQL(YES) is specified, the DB2 precompiler automatically generates an SQLCA that includes the variable name SQLCADE instead of SQLCODE and SQLSTAT instead of SQLSTATE. After each SQL statement executes, DB2 assigns status information to SQLCODE and SQLSTATE, whose declarations are described above, as follows:

- SQLCODE: DB2 assigns the value in SQLCADE to SQLCODE. In Fortran, SQLCAD and SQLCOD are used for SQLCADE and SQLCODE, respectively.
- SQLSTATE: DB2 assigns the value in SQLSTAT to SQLSTATE. (In Fortran, SQLSTT and SQLSTA are used for SQLSTAT and SQLSTATE, respectively.)
- No declaration for either SQLSTATE or SQLCODE: DB2 assigns the value in SQLCADE to SQLCODE.

If the precompiler encounters an INCLUDE SQLCA statement, it ignores the statement and issues a warning message. The precompiler also does not recognize hand-coded definitions, and a hand-coded definition creates a compile-time conflict with the precompiler-generated definition. A similar conflict arises if definitions of SQLCADE or SQLSTAT, other than the ones generated by the DB2 precompiler, appear in the program.

Positioned updates of columns

The NOFOR precompiler option affects the use of the FOR UPDATE clause. The NOFOR option is in effect when either of the following are true:

- The NOFOR option is specified.
- The STDSQL(YES) option is in effect.

Otherwise, the NOFOR option is not in effect. The following table summarizes the differences when the option is in effect and when the option is not in effect:

Table 41. The NOFOR precompiler option

When NOFOR is in effect	When NOFOR is not in effect
The use of the FOR UPDATE clause in the SELECT statement of the DECLARE CURSOR statement is optional. This clause restricts updates to the specified columns and causes the acquisition of update locks when the cursor is used to fetch a row. If no columns are specified, positioned updates can be made to any updatable columns in the table or view that is identified in the first FROM clause in the SELECT statement. If the FOR UPDATE clause is not specified, positioned updates can be made to any columns that the program has DB2 authority to update.	The FOR UPDATE clause must be specified.
DBRMs must be built entirely in virtual storage, which might possibly increase the virtual storage requirements of the DB2 precompiler. However, creating DBRMs entirely in virtual storage might cause concurrency problems with DBRM libraries.	DBRMs can be built incrementally using the DB2 precompiler.

Precompiler options do not affect ODBC behavior.

Mappings from SQL to XML

To construct XML data from SQL data, the following mappings are performed:
- SQL character sets to XML character sets
- SQL identifiers to XML names
- SQL data values to XML data values

DB2 maps SQL to XML data according to industry standards. For complete information, see *Information technology - Database languages - SQL- Part 14: XML-Related Specifications (SQL/XML) ISO/IEC 9075-14:2003*.

Mapping SQL character sets to XML character sets

The character set used for XML data is Unicode UTF-8. SQL character data is converted into Unicode when it is used in XML built-in functions.

Mapping SQL identifiers to XML names

Strings that start with ’XML’, in any case combination, are reserved for standardization, and characters such as ’#’, ’{’, and ’}’ are not allowed in XML names. Many SQL identifiers containing these characters have to be escaped when converting into XML names.

Full escaping is applied to SQL identifiers that are column names to derive an XML name. The mapping converts a colon (:) to _x003A_, _x to _X005F_x, and other restricted characters to a string of the form _xUUUU_ where xUUUU_ is the Unicode value for the character. An identifier with an initial ″xml″ (in any case combination) is escaped by mapping the initial ’x’ or ’X’ to _x0058_ or _0078_, respectively, while the partially escaped variant does not.

Mapping SQL data values to XML data values

SQL data values are mapped to XML values based on SQL data types. The following data types are not supported and cannot be used as arguments to XML value constructors:

- ROWID
- Character sting defined with the FOR BIT DATA attribute
- BLOB
- Distinct types based on ROWID, FOR BIT DATA character string, or BLOB

For supported data types, the encoding scheme for XML values is Unicode.

Chapter 3. Functions

A *function* is an operation denoted by a function name followed by zero or more operands that are enclosed in parentheses. It represents a relationship between a set of input values and a set of result values. The input values to a function are called *arguments*.

The types of functions are aggregate, scalar, and table. A built-in function is classified as a aggregate function or a scalar function. A user-defined function can be a column, scalar, or table function. For more information on the types of functions, see “Functions” on page 127.

One set of functions that DB2 provides are DB2 MQSeries functions, which integrate MQSeries messaging operations within SQL statements. The functions help you integrate MQSeries messaging with database applications. You can use the functions to access MQSeries messaging from within SQL statements and to combine MQSeries messaging with DB2 database access.

The MQSeries functions are installed into DB2 and provide access to the MQSeries server using AMI (Application Messaging Interface). AMI supports the use of an external configuration file (the AMI repository) to store configuration information. AMI uses two key concepts: service point and policy. A service point is a logical endpoint from which a message may be sent or received. Policy defines the quality of service option that should be used for a given messaging operation. The MQSeries functions can read, receive, or send messages to the queue specified by the service and policy in the AMI repository. The functions can be scalar or table functions. For more information on using MQSeries functions, see the information on enabling MQSeries functions in *DB2 Installation Guide* and on programming techniques in *DB2 Application Programming and SQL Guide*.

Table 42 lists the functions that DB2 supports.

Table 42. Supported functions

Function name	Description	Page
ABS	Returns the absolute value of its argument	208
ACOS	Returns the arc cosine of an argument as an angle, expressed in radians	209
ADD_MONTHS	Returns a date that represents the date argument plus the number of months argument	210
ASIN	Returns the arc sine of an argument as an angle, expressed in radians	212
ATAN	Returns the arc tangent of an argument as an angle, expressed in radians	213
ATANH	Returns the hyperbolic arc tangent of an argument as an angle, expressed in radians	214
ATAN2	Returns the arc tangent of *x* and *y* coordinates as an angle, expressed in radians	215
AVG	Returns the average of a set of numbers	196
BLOB	Returns a BLOB representation of its argument	216
CCSID_ENCODING	Returns the encoding scheme of a CCSID with a value of ASCII, EBCDIC, UNICODE, or UNKNOWN	217

Table 42. Supported functions (continued)

Function name	Description	Page
CEILING	Returns the smallest integer greater than or equal to the argument	218
CHAR	Returns a fixed-length character string representation of its argument	219
CLOB	Returns a CLOB representation of its argument	226
COALESCE	Returns the first argument in a set of arguments that is not null	228
CONCAT	Returns the concatenation of two strings	230
COS	Returns the cosine of an argument that is expressed as an angle in radians	231
COSH	Returns the hyperbolic cosine of an argument that is expressed as an angle in radians	232
COUNT	Returns the number of rows or values in a set of rows or values	197
COUNT_BIG	Same as COUNT, except the result can be greater than the maximum value of an integer	198
DATE	Returns a date derived from its argument	233
DAY	Returns the day part of its argument	235
DAYOFMONTH	Similar to DAY	236
DAYOFWEEK	Returns an integer in the range of 1 to 7, where 1 represents Sunday	237
DAYOFWEEK_ISO	Returns an integer in the range of 1 to 7, where 1 represents Monday	238
DAYOFYEAR	Returns an integer in the range of 1 to 366, where 1 represents January 1	239
DAYS	Returns an integer representation of a date	240
DBCLOB	Returns a DBCLOB representation of its argument	241
DECIMAL or DEC	Returns a decimal representation of its argument	244
DECRYPT_BIT, DECRYPT_CHAR, or DECRYPT_DB	Returns the decrypted value of an encrypted argument	246
DEGREES	Returns the number of degrees for an argument that is expressed in radians	249
DIGITS	Returns a character string representation of a number	250
DOUBLE or DOUBLE_PRECISION	Returns a double precision floating-point representation of its argument	251
ENCRYPT_TDES	Returns the argument as an encrypted value	253
EXP	Returns the exponential function of an argument	255
FLOAT	Same as DOUBLE	251
FLOOR	Returns the largest integer that is less than or equal to the argument	257
GENERATE_UNIQUE	Returns a bit character string that is unique compared to any other execution of the function	258
GETHINT	Returns the embedded password hint from encrypted data, if one exists	260
GETVARIABLE	Returns a varying-length character string representation of a session variable	261

Table 42. Supported functions (continued)

Function name	Description	Page
GRAPHIC	Returns a GRAPHIC representation of its argument	263
HEX	Returns a hexadecimal representation of its argument	266
HOUR	Returns the hour part of its argument	267
IDENTITY_VAL_LOCAL	Returns the most recently assigned value for an identity column	268
IFNULL	Returns the first argument in a set of two arguments that is not null	272
INSERT	Returns a string that is composed of an argument inserted into another argument at the same position where some number of bytes have been deleted	273
INTEGER or INT	Returns an integer representation of its argument	276
JULIAN_DAY	Returns an integer that represents the number of days from January 1, 4712 B.C.	278
LAST_DAY	Returns a date that represents the last day of the month of the date argument	279
LCASE	Returns a string with the characters converted to lowercase	280
LEFT	Returns a string that consists of the specified number of leftmost bytes of a string	281
LENGTH	Returns the length of its argument	283
LN	Returns the natural logarithm of an argument	284
LOCATE	Returns the position at which the first occurrence of an argument starts within another argument	285
LOG10	Returns the base 10 logarithm of an argument	287
LOWER	Returns a string with the characters converted to lowercase	288
LTRIM	Returns the characters of a string with the leading blanks removed	289
MAX	Returns the maximum value in a set of column values	200
MAX (scalar)	Returns the maximum value in a set of values	290
MICROSECOND	Returns the microsecond part of its argument	291
MIDNIGHT_SECONDS	Returns an integer in the range of 0 to 86400 that represents the number of seconds between midnight and the argument	292
MIN	Returns the minimum value in a set of column values	201
MIN (scalar)	Returns the minimum value in a set of values	293
MINUTE	Returns the minute part of its argument	294
MOD	Returns the remainder of one argument divided by a second argument	295
MONTH	Returns the month part of its argument	297
MQPUBLISH	Publishes a message to the specified MQSeries publisher, and returns a varying-length character string that indicates whether the function was successful or unsuccessful	298
MQREAD	Returns a message from a specified MQSeries location (return value of VARCHAR) without removing the message from the queue	300
MQREADALL	Returns a table containing the messages and message metadata from a specified MQSeries location with a VARCHAR column and without removing the messages from the queue	384

Table 42. Supported functions (continued)

Function name	Description	Page
MQREADALLCLOB	Returns a table containing the messages and message metadata from a specified MQSeries location with a CLOB column and without removing the messages from the queue	386
MQREADCLOB	Returns a message from a specified MQSeries location (return value of CLOB) without removing the message from the queue	302
MQRECEIVE	Returns a message from a specified MQSeries location (return value of VARCHAR) with removal of message from the queue	304
MQRECEIVEALL	Returns a table containing the messages and message metadata from a specified MQSeries location with a VARCHAR column and with removal of messages from the queue	388
MQRECEIVEALLCLOB	Returns a table containing the messages and message metadata from a specified MQSeries location with a CLOB column and with removal of messages from the queue	390
MQRECEIVECLOB	Returns a message from a specified MQSeries location (return value of CLOB) with removal of message from the queue	306
MQSEND	Sends data contained in msg-data to a specified MQSeries location, and returns a varying-length character string that indicates whether the function was successful or unsuccessful	308
MQSUSBSCRIBE	Registers a subscription to MQSeries messages that are published on a specified topic, and returns a varying-length character string that indicates whether the function was successful or unsuccessful	310
MQUNSUBSCRIBE	Unregisters an existing subscription to MQSeries messages that are published on a specified topic, and returns a varying-length character string that indicates whether the function was successful or unsuccessful	312
MULTIPLY_ALT	Returns the product of the two arguments as a decimal value, used when the sum of the argument precisions exceeds 31	314
NEXT_DAY	Returns a timestamp that represents the first weekday, named by the second argument, after the date argument	315
NULLIF	Returns NULL if the arguments are equal; else the first argument	317
POSSTR	Returns the position of the first occurrence of an argument within another argument	318
POWER	Returns the value of one argument raised to the power of a second argument	320
QUARTER	Returns an integer in the range of 1 to 4 that represents the quarter of the year for the date specified in the argument	321
RADIANS	Returns the number of radians for an argument that is expressed in degrees	322
RAISE_ERROR	Raises an error in the SQLCA with the specified SQLSTATE and error description	323
RAND	Returns a double precision floating-point random number	324
REAL	Returns a single precision floating-point representation of its argument	325
REPEAT	Returns a character string composed of an argument repeated a specified number of times	326
REPLACE	Returns a string in which all occurrences of an argument within a second argument are replaced with a third argument	328

Table 42. Supported functions (continued)

Function name	Description	Page
RIGHT	Returns a string that consists of the specified number of rightmost bytes of a string	330
ROUND	Returns a number rounded to the specified number of places to the right or left of the decimal place	332
ROUND_TIMESTAMP	Returns a timestamp rounded to the unit specified by the timestamp format string	334
ROWID	Returns a row ID representation of its argument	336
RTRIM	Returns the characters of an argument with the trailing blanks removed	337
SECOND	Returns the second part of its argument	338
SIGN	Returns the sign of an argument	339
SIN	Returns the sine of an argument that is expressed as an angle in radians	340
SINH	Returns the hyperbolic sine of an argument that is expressed as an angle in radians	341
SMALLINT	Returns a small integer representation of its argument	342
SPACE	Returns a string that consists of the number of blanks the argument specifies	343
SQRT	Returns the square root of its argument	344
STDDEV or STDDEV_SAMP	Returns the standard deviation (/n), or the sample standard deviation (/n-1), of a set of numbers	202
STRIP	Returns the characters of a string with the blanks (or specified character) at the beginning, end, or both beginning and end of the string removed	345
SUBSTR	Returns a substring of a string	347
SUM	Returns the sum of a set of numbers	203
TAN	Returns the tangent of an argument that is expressed as an angle in radians	349
TANH	Returns the hyperbolic tangent of an argument that is expressed as an angle in radians	350
TIME	Returns a time derived from its argument	351
TIMESTAMP	Returns a timestamp derived from its arguments	352
TIMESTAMP_FORMAT	Returns a timestamp for a character string expression, using a specified format to interpret the string	354
TRANSLATE	Returns a string with one or more characters translated	355
TRUNCATE	Returns a number truncated to the specified number of places to the right or left of the decimal point	358
TRUNC_TIMESTAMP	Returns a timestamp truncated to the unit specified by the timestamp format string	360
UCASE	Returns a string with the characters converted to uppercase	361
UPPER	Returns a string with the characters converted to uppercase	362
VARCHAR	Returns the varying-length character string representation of its argument	363
VARCHAR_FORMAT	Returns a character string representation of a timestamp, with the string in a specified format	368

Table 42. Supported functions (continued)

Function name	Description	Page
VARGRAPHIC	Returns a graphic string representation of its argument	369
VARIANCE or VARIANCE_SAMP	Returns the variance, or sample variance, of a set of numbers	204
WEEK	Returns an integer that represents the week of the year with Sunday as the first day of the week	372
WEEK_ISO	Returns an integer that represents the week of the year with Monday as first day of a week	373
XML2CLOB	Returns a CLOB representation of an XML value	374
XMLAGG	Returns an XML type that represents a concatenation of XML elements from a collection of XML elements	205
XMLCONCAT	Returns a transient XML type that represents a forest of XML elements generated by concatenating a variable number of arguments	375
XMLELEMENT	Returns a transient XML type that represents an XML element	376
XMLFOREST	Returns a transient XML type that represents a forest of XML elements that all share a specific pattern	378
XMLNAMESPACES	Returns the declaration of one or more XML namespaces	380
YEAR	Returns the year part of its argument	382

Aggregate functions

The following information applies to all aggregate functions, except for the COUNT(*) and COUNT_BIG(*) variations of the COUNT and COUNT_BIG functions.

The argument of an aggregate function is a set of values derived from an expression. The expression must not include another aggregate function. The scope of the set is a group or an intermediate result table as explained in Chapter 4, “Queries,” on page 393.

If a GROUP BY clause is specified in a query and the intermediate result from the FROM, WHERE, GROUP BY, and HAVING clauses is the empty set, then the aggregate functions are not applied and the result of the query is the empty set.

If the GROUP BY clause is not specified in a query and the intermediate result table of the FROM, WHERE, and HAVING clauses is the empty set, then the aggregate functions are applied to the empty set.

For example, the result of the following SELECT statement is the number of distinct values of JOB for employees in department D11:

```
SELECT COUNT(DISTINCT JOB)
  FROM DSN8810.EMP
  WHERE WORKDEPT = 'D11';
```

The keyword DISTINCT is not an argument of the function but rather a specification of an operation that is performed before the function is applied. If DISTINCT is specified, redundant duplicate values are eliminated. If ALL is implicitly or explicitly specified, redundant duplicate values are not eliminated.

An aggregate function can be used in a WHERE clause only if that clause is part of a subquery of a HAVING clause and the column name specified in the expression is a correlated reference to a group. If the expression includes more than one column name, each column name must be a correlated reference to the same group.

The result of the COUNT and COUNT_BIG functions cannot be the null value. As specified in the description of AVG, MAX, MIN, STDDEV, SUM, and VARIANCE, the result is the null value when the function is applied to an empty set. However, the result is also the null value when the function is specified in an outer select list, the argument is given by an arithmetic expression, and any evaluation of the expression causes an arithmetic exception (such as division by zero).

If the argument values of an aggregate function are strings from a column with a field procedure, the function is applied to the encoded form of the values and the result of the function inherits the field procedure.

Following in alphabetic order is a definition of each of the built-in aggregate functions.

AVG

```
        ┌─ALL──────┐
►►──AVG(─┼──────────┼─numeric-expression)──────────────────────────────────────►◄
        └─DISTINCT─┘
```

The schema is SYSIBM.

The AVG function returns the average of a set of numbers.

The argument values can be of any built-in numeric data type, and their sum must be within the range of the data type of the result.

The data type of the result is the same as the data type of the argument values, except that the result is a large integer if the argument values are small integers, and the result is double precision floating-point if the argument values are single precision floating-point. The result can be null.

If the data type of the argument values is decimal with precision *p* and scale *s*, the precision (P) and scale (S) of the result depend on *p* and the decimal precision option:

- If *p* is greater than 15 or the DEC31 option is in effect, P is 31 and S is max(0,28-*p*+*s*).
- Otherwise, P is 15 and S is 15-*p*+*s*.

The function is applied to the set of values derived from the argument values by the elimination of null values. If DISTINCT is specified, redundant duplicate values are also eliminated.

If the function is applied to an empty set, the result is the null value. Otherwise, the result is the average value of the set. The order in which the summation part of the operation is performed is undefined but every intermediate result must be within the range of the result data type.

If the type of the result is integer, the fractional part of the average is lost.

Example: Assuming DEC15, set the DECIMAL(15,2) variable AVERAGE to the average salary in department D11 of the employees in the sample table DSN8810.EMP.

```
EXEC SQL SELECT AVG(SALARY)
  INTO :AVERAGE
  FROM DSN8810.EMP
  WHERE WORKDEPT = 'D11';
```

COUNT

```
          ┌─ALL──────┐
►►──COUNT(──┬─┼──────────┼──expression──┬─)──────────────────────────────────────────────►◄
          │ └─DISTINCT─┘               │
          └─*───────────────────────────┘
```

The schema is SYSIBM.

The COUNT function returns the number of rows or values in a set of rows or values.

The argument values can be of any built-in data type other than a BLOB, CLOB, or DBCLOB.

The result is a large integer. The result cannot be null.

The argument of COUNT(*) is a set of rows. The result is the number of rows in the set. Any row that includes only null values is included in the count.

The argument of COUNT(*expression*) or COUNT(ALL *expression*) is a set of values. The function is applied to the set of values derived from the argument values by the elimination of null values. The result is the number of nonnull values in the set, including duplicates.

The argument of COUNT(DISTINCT *expression*) is a set of values. The function is applied to the set of values derived from the argument values by the elimination of null values and redundant duplicate values. The result is the number of different nonnull values in the set.

Example 1: Set the integer host variable FEMALE to the number of females represented in the sample table DSN8810.EMP.

```
EXEC SQL SELECT COUNT(*)
  INTO :FEMALE
  FROM DSN8810.EMP
  WHERE SEX = 'F';
```

Example 2: Set the integer host variable FEMALE_IN_DEPT to the number of departments that have at least one female as a member.

```
EXEC SQL SELECT COUNT(DISTINCT WORKDEPT)
  INTO :FEMALE_IN_DEPT
  FROM DSN8810.EMP
  WHERE SEX = 'F';
```

COUNT_BIG

```
            ┌─ALL──────┐
►►──COUNT_BIG(──┬─┼──────────┼──expression──┬──)──────────────────────────────────────►◄
            │ └─DISTINCT─┘              │
            └─*─────────────────────────┘
```

The schema is SYSIBM.

The COUNT_BIG function returns the number of rows or values in a set of rows or values. It is similar to COUNT except that the result can be greater than the maximum value of an integer.

The argument values can be of any built-in data type other than a BLOB, CLOB, or DBCLOB.

The result of the function is a decimal number with precision 31 and scale 0. The result cannot be null.

The argument of COUNT_BIG(*) is a set of rows. The result is the number of rows in the set. A row that includes only null values is included in the count.

The argument of COUNT_BIG(*expression*) or COUNT_BIG(ALL *expression)* is a set of values. The function is applied to the set of values derived from the argument values by the elimination of null values. The result is the number of nonnull values in the set, including duplicates.

The argument of COUNT_BIG(DISTINCT *expression*) is a set of values. The function is applied to the set of values derived from the argument values by the elimination of null and redundant duplicate values. The result is the number of different nonnull values in the set.

Example 1: The examples for COUNT are also applicable for COUNT_BIG. Refer to the COUNT examples and substitute COUNT_BIG for the occurrences of COUNT. The results are the same except for the data type of the result.

Example 2: To create a sourced function that is similar to the built-in COUNT_BIG function, the definition of the sourced function must include the type of the column that can be specified when the new function is invoked. In this example, the CREATE FUNCTION statement creates a sourced function that takes a CHAR column as input and uses COUNT_BIG to perform the counting. The result is returned as a double precision floating-point number. The query shown counts the number of unique departments in the sample employee table.

```
CREATE FUNCTION RICK.COUNT(CHAR()) RETURNS DOUBLE
       SOURCE SYSIBM.COUNT_BIG(CHAR());

SET CURRENT PATH RICK, SYSTEM PATH;

SELECT COUNT(DISTINCT WORKDEPT) FROM DSN8810.EMP;
```

The empty parenthesis in the parameter list for the new function (RICK.COUNT) means that the input parameter for the new function is the same type as the input parameter for the function named in the SOURCE clause. The empty parenthesis in the parameter list in the SOURCE clause (SYSIBM.COUNT_BIG) means that the length attribute of the CHAR parameter of the COUNT_BIG function is ignored when DB2 locates the COUNT_BIG function.

MAX

```
          ┌─ALL──────┐
►►──MAX(──┼──────────┼─expression)──────────────────────────────────────────────────►◄
          └─DISTINCT─┘
```

The schema is SYSIBM.

The MAX function returns the maximum value in a set of values.

The argument values can be of any built-in data type other than a BLOB, CLOB, DBCLOB, or row ID. Character string arguments cannot have a maximum length greater than 255, and graphic string arguments cannot have a maximum length greater than 127.

The data type of the result and its other attributes (for example, the length and CCSID of a string) are the same as the data type and attributes of the argument values. The result can be null.

The function is applied to the set of values derived from the argument values by the elimination of null values.

If the function is applied to an empty set, the result is the null value. Otherwise, the result is the maximum value in the set.

The specification of DISTINCT has no effect on the result and is not advised.

Example 1: Set the DECIMAL(8,2) variable MAX_SALARY to the maximum monthly salary of the employees represented in the sample table DSN8810.EMP.

```
EXEC SQL SELECT MAX(SALARY) / 12
  INTO :MAX_SALARY
  FROM DSN8810.EMP;
```

Example 2: Find the surname that comes last in the collating sequence for the employees represented in the sample table DSN8810.EMP. Set the VARCHAR(15) variable LAST_NAME to that surname.

```
EXEC SQL SELECT MAX(LASTNAME)
  INTO :LAST_NAME
  FROM DSN8810.EMP;
```

MIN

```
           ┌─ALL──────┐
►►──MIN(───┼──────────┼─expression)────────────────────────────────────────────►◄
           └─DISTINCT─┘
```

The schema is SYSIBM.

The MIN function returns the minimum value in a set of values.

The argument values can be of any built-in data type other than a BLOB, CLOB, DBCLOB, or row ID. Character string arguments cannot have a maximum length greater than 255, and graphic string arguments cannot have a maximum length greater than 127.

The data type of the result and its other attributes (for example, the length and CCSID of a string) are the same as the data type and attributes of the argument values. The result can be null.

The function is applied to the set of values derived from the argument values by the elimination of null values.

If the function is applied to an empty set, the result is the null value. Otherwise, the result is the minimum value in the set.

The specification of DISTINCT has no effect on the result and is not advised.

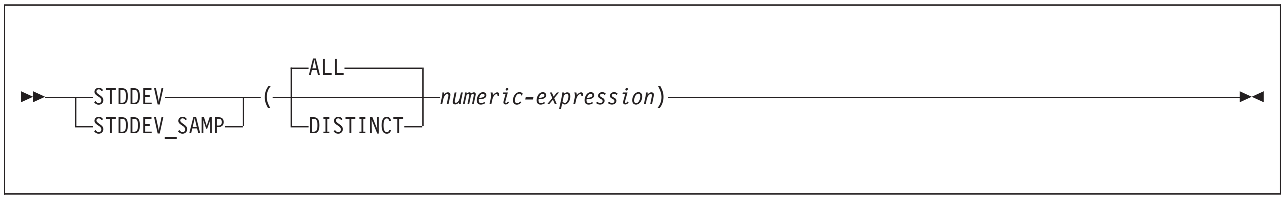
Example 1: Set the DECIMAL(15,2) variable MIN_SALARY to the minimum monthly salary of the employees represented in the sample table DSN8810.EMP.

```
EXEC SQL SELECT MIN(SALARY) / 12
  INTO :MIN_SALARY
  FROM DSN8810.EMP;
```

Example 2: Find the surname that comes first in the collating sequence for the employees represented in the sample table DSN8810.EMP. Set the VARCHAR(15) variable FIRST_NAME to that surname.

```
EXEC SQL SELECT MIN(LASTNAME)
  INTO :FIRST_NAME
  FROM DSN8810.EMP;
```

STDDEV



The schema is SYSIBM.

The function returns the biased standard deviation (*/n*) or the sample standard deviation (*/n-1*) of a set of numbers, depending on which keyword is specified:

STDDEV
The formula that is used to calculate the biased standard deviation is logically equivalent to:

```
STDDEV = SQRT(VAR)
```

STDDEV_SAMP
The formula that is used to calculate the sample standard deviation is logically equivalent to:

```
STDDEV = SQRT(VARIANCE_SAMP)
```

The argument values must each be the value of any built-in numeric data type, and their sum must be within the range of the data type of the result.

The result of the function is a double precision floating-point number. The result can be null.

Before the function is applied to the set of values derived from the argument values, null values are eliminated. If DISTINCT is specified, redundant duplicate values are also eliminated.

If the function is applied to an empty set, the result is the null value. Otherwise, the result is the standard deviation of the values in the set.

The order in which the values are aggregated is undefined, but every intermediate result must be within the range of the result data type.

STDDEV_POP can be specified as a synonym for STDDEV.

Example: Using sample table DSN8810.EMP, set the host variable DEV, which is defined as double precision floating-point, to the standard deviation of the salaries for the employees in department 'A00' (WORKDEPT='A00').

```
SELECT STDDEV(SALARY)
  INTO :DEV
  FROM DSN8810.EMP
  WHERE WORKDEPT = 'A00';
```

For this example, host variable DEV is set to a double precision float-pointing number with an approximate value of 9742.43.

SUM

```
        ┌─ALL──────┐
►►─SUM(─┼──────────┼─numeric-expression)──────────────────────────────►◄
        └─DISTINCT─┘
```

The schema is SYSIBM.

The SUM function returns the sum of a set of numbers.

The argument values can be of any built-in numeric data type, and their sum must be within the range of the data type of the result.

The data type of the result is the same as the data type of the argument values, except that the result is a large integer if the argument values are small integers, and the result is double precision floating-point if the argument values are single precision floating-point. The result can be null.

If the data type of the argument values is decimal, the scale of the result is the same as the scale of the argument values, and the precision of the result depends on the precision of the argument values and the decimal precision option:

- If the precision of the argument values is greater than 15 or the DEC31 option is in effect, the precision of the result is min(31,P+10), where P is the precision of the argument values.
- Otherwise, the precision of the result is 15.

The function is applied to the set of values derived from the argument values by the elimination of null values. If DISTINCT is specified, redundant duplicate values are also eliminated.

If the function is applied to an empty set, the result is the null value. Otherwise, the result is the sum of the values in the set. The order in which the summation is performed is undefined but every intermediate result must be within the range of the result data type.

Example: Set the large integer host variable INCOME to the total income from all sources (salaries, commissions, and bonuses) of the employees represented in the sample table DSN8810.EMP. If DEC31 is not in effect, the resultant sum is DECIMAL(15,2) because all three columns are DECIMAL(9,2).

```
EXEC SQL SELECT SUM(SALARY+COMM+BONUS)
  INTO :INCOME
  FROM DSN8810.EMP;
```

VARIANCE or VARIANCE_SAMP

```
                                ┌─ALL──────┐
►►──┬─VARIANCE──────┬──(──┼──────────┼──numeric-expression)──────────────────────►◄
    └─VARIANCE_SAMP─┘         └─DISTINCT─┘
```

The schema is SYSIBM.

The function returns the biased variance (/n) or the sample variance (/n-1) of a set of numbers, depending on which keyword is specified:

VARIANCE
The formula used to calculate the biased variance is logically equivalent to:

```
VARIANCE = SUM(X**2)/COUNT(X) - (SUM(X)/COUNT(X))**2
```

VARIANCE_SAMP
The formula used to calculate the sample variance is logically equivalent to::

```
VARIANCE_SAMP = (SUM(X**2) - ((SUM(X)**2) / (COUNT(*)))) / (COUNT(*) - 1)
```

The argument values can be of any built-in numeric type, and their sum must be within the range of the data type of the result.

The result of the function is a double precision floating-point number. The result can be null.

Before the function is applied to the set of values derived from the argument values, null values are limited. If DISTINCT is specified, redundant duplicate values are also eliminated.

If the function is applied to an empty set, the result is the null value. Otherwise, the result is the variance of the values in the set.

The order in which the values are added is undefined, but every intermediate result must be within the range of the result data type.

VAR or VAR_POP can be specified as synonym for VARIANCE, and VAR_SAMP can be specified as a synonym for VARIANCE_SAMP.

Example 1: Using sample table DSN8810.EMP, set host variable VARNCE, which is defined as double precision floating-point, to the variance of the salaries (SALARY) for those employees in department (WORKDEPT) 'A00'.

```
SELECT VARIANCE(SALARY)
  INTO :VARNCE
  FROM DSN8810.EMP
  WHERE WORKDEPT = 'A00';
```

The result in VARNCE is set to a double precision-floating point number with an approximate value of 94915000.00.

If VARIANCE_SAMP had been specified to find the sample variance of the salaries, the result in VARNCE would be set to a double precision-floating point number with an approximate value of 94915000.00.

XMLAGG

```
>>──XMLAGG(XML-value-expression──┬─────────────────────────────────────┬─)──────────────────────────><
                                 │            ┌─,──────────────────┐   │
                                 │            ↓          ┌─ASC──┐  │   │
                                 └─ORDER BY───┴─sort-key─┼──────┼──┴───┘
                                                         └─DESC─┘
```

sort-key

```
>>──┬─column-name─┬─────────────────────────────────────────────────────────────────────><
    └─expression──┘
```

The schema is SYSIBM.

The XMLAGG function returns a concatenation of XML elements from a collection of XML elements. The XMLAGG function has one argument with an optional ORDER BY clause. The ORDER BY clause specifies the ordering of the rows from the same grouping set to be processed in the aggregation. If the ORDER BY clause is not specified or the ORDER BY clause cannot differentiate the order of the sort key value, then the order of rows from the same group to be processed in the aggregation is arbitrary.

XML-value-expression

Specifies an expression whose value is the transient XML data type. The transient XML data type only exists during query processing. There is no persistent data of this type and it is not an external data type that can be declared in application programs.

Unlike the arguments for other aggregate functions, a scalar fullselect is allowed in *XML-value-expression*.

sort-key

Specifies a sort key value that is either a column name or an expression. The ordering is based on the SQL values of the sort keys, which may or may not be used in the XML value expression. If the sort key value is a constant, it does not refer to the position of the output column (in contrast to constant in the ORDER BY clause of a SELECT statement). Instead, it is a constant that has no impact on the ordering. A CLOB cannot be used as a sort key. A character string expression cannot have a length greater than 4000 bytes.

If the sort key value is a character string that uses an encoding scheme other than Unicode, the ordering might be different. For example, a column PRODCODE uses EBCDIC. For two values, (″P001″ and ″PA01″), relationship ″P001″ > ″PA01″ holds in EBCDIC, whereas ″P001″ < ″PA01″ is true in UTF-8. If the same sort key values are used in the XML value expression, use the CAST specification to convert the sort key to Unicode to keep the ordering of XML values consistent with that of the sort key.

The function is applied to the set of values, derived from the argument values by the elimination of null values. The result type is XML. The result can be null. If all inputs are null or no rows exist, the result of XMLAGG is null.

Example: Group employees by their department, generate a ″Department″ element for each department with its name as the attribute, nest all the ″emp″ elements for employees in each department, and order the ″emp″ elements by ″lname.″

```
   SELECT XML2CLOB (XMLELEMENT
         ( NAME "Department",
           XMLATTRIBUTES ( e.dept AS "name" ),
           XMLAGG ( XMLELEMENT ( NAME "emp", e.lname)
                    ORDER BY e.lname)
                  ) ) AS "dept_list"
     FROM employees e
     GROUP BY dept ;
```

The result of the query would look similar to the following result, where the result column is a CLOB and the content is formatted for convenience.

```
   dept_list
 ---------------------------------------------
<Department name="Accounting">
  <emp>SMITH</emp>
  <emp>Yates</emp>
 </Department>
 <Department name="Shipping">
  <emp>Martin</emp>
  <emp>Oppenheimer</emp>
 </Department>
------------------------------------------------
```

Scalar functions

A scalar function can be used wherever an expression can be used. However, the restrictions that apply to the use of expressions and aggregate functions also apply when an expression or aggregate function is used within a scalar function. For example, the argument of a scalar function can be an aggregate function only if an aggregate function is allowed in the context in which the scalar function is used.

If the argument of a scalar function is a string from a column with a field procedure, the function applies to the decoded form of the value and the result of the function does not inherit the field procedure.

Example: The following SELECT statement calls for the employee number, last name, and age of each employee in department D11 in the sample table DSN8810.EMP. To obtain the ages, the scalar function YEAR is applied to the expression:

```
CURRENT DATE - BIRTHDATE
```

in each row of DSN8810.EMP for which the employee represented is in department D11:

```
SELECT EMPNO, LASTNAME, YEAR(CURRENT DATE - BIRTHDATE)
  FROM DSN8810.EMP
  WHERE WORKDEPT = 'D11';
```

Following in alphabetic order is the definition of each of the built-in scalar functions.

ABS

```
►►──ABS(numeric-expression)──────────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The ABS function returns the absolute value of a number.

The argument must be an expression that returns a value of any built-in numeric data type.

The result of the function has the same data type and length attribute as the argument. The result can be null. If the argument is null, the result is the null value.

ABSVAL can be specified as a synonym for ABS. DB2 supports this keyword to provide compatibility with previous releases.

Example: Assume that host variable PROFIT is a large integer with a value of -50000. The following statement returns a large integer with a value of 50000.

```
SELECT ABS(:PROFIT)
  FROM SYSIBM.SYSDUMMY1;
```

ACOS

```
►►──ACOS(numeric-expression)──────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The ACOS function returns the arc cosine of the argument as an angle expressed in radians. The ACOS and COS functions are inverse operations.

The argument must be an expression that returns the value of any built-in numeric data type. The value must be greater than or equal to -1 and less than or equal to 1. If the argument is not a double precision floating-point number, it is converted to one for processing by the function.

The result of the function is a double precision floating-point number. The result can be null; if the argument is null, the result is the null value.

Example: Assume that host variable ACOSINE is DECIMAL(10,9) with a value of 0.070737202. The following statement:

```
SELECT ACOS(:ACOSINE)
  FROM SYSIBM.SYSDUMMY1;
```

returns a double precision floating-point number with an approximate value of 1.49.

ADD_MONTHS

```
►►──ADD_MONTHS(expression,numeric-expression)──────────────────────────────────────►◄
```

The schema is SYSIBM.

The ADD_MONTHS function returns a date that represents *expression* plus *numeric-expression* months.

expression must be a date, a timestamp, or a valid string representation of a date or timestamp. A string representation is a value that is a built-in character string data type or graphic string data type. A string representation must not be a CLOB or DBCLOB, and must have an actual length that is not greater than 255 bytes. For the valid formats of string representations of dates and timestamps, see “String representations of datetime values” on page 65.

The result of the function is a DATE. The result can be null; if any argument is null, the result is the null value.

If *expression* is the last day of the month or if the resulting month has fewer days than the day component of *expression*, then the result is the last day of the resulting month. Otherwise, the result has the same day component as *expression*.

numeric-expression can be any zero-scale numeric value.

Example 1: Assume today is January 31, 2000. Set the host variable ADD_MONTH with the last day of January plus 1 month.

```
SET :ADD_MONTH = ADD_MONTHS(LAST_DAY(CURRENT_DATE), 1);
```

The host variable ADD_MONTH is set with the value representing the end of February, 2000-02-29.

Example 2: Assume DATE is a host variable with the value July 27, 1965. Set the host variable ADD_MONTH with the value of that day plus 3 months.

```
SET :ADD_MONTH = ADD_MONTHS(:DATE,3);
```

The host variable ADD_MONTH is set with the value representing the day plus 3 months, 1965-10-27.

Example 3: It is possible to achieve similar results with the ADD_MONTHS function and date arithmetic. The following examples demonstrate the similarities and contrasts.

```
SET :DATEHV = DATE('2000-2-28') + 4 MONTHS;
SET :DATEHV = ADD_MONTHS('2000-2-28', 4);
```

In both cases, the host variable DATEHV is set with the value ’2000–06–28’.

Now consider the same examples but with the date ’2000–2–29’ as the argument.

```
SET :DATEHV = DATE('2000-2-29') + 4 MONTHS;
```

The host variable DATEHV is set with the value ’2000–06–29’.

```
   SET :DATEHV = ADD_MONTHS('2000-2-29', 4);
```

The host variable DATEHV is set with the value ’2000–06–30’.

In this case, the ADD_MONTHS function returns the last day of the month, which is June 30, 2000, instead of June 29, 2000. The reason is that February 29 is the last day of the month. So, the ADD_MONTHS function returns the last day of June.

ASIN

```
►►──ASIN(numeric-expression)──────────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The ASIN function returns the arc sine of the argument as an angle expressed in radians. The ASIN and SIN functions are inverse operations.

The argument must be an expression that returns the value of any built-in numeric data type. The value must be greater than or equal to -1 and less than or equal to 1. If the argument is not a double precision floating-point number, it is converted to one for processing by the function.

The result of the function is a double precision floating-point number. The result can be null; if the argument is null, the result is the null value.

Example: Assume that host variable ASINE is DECIMAL(10,9) with a value of 0.997494987. The following statement:

```
SELECT ASIN(:ASINE)
  FROM SYSIBM.SYSDUMMY1;
```

returns a double precision floating-point number with an approximate value of 1.50.

ATAN

```
►►──ATAN(numeric-expression)──────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The ATAN function returns the arc tangent of the argument as an angle expressed in radians. The ATAN and TAN functions are inverse operations.

The argument must be an expression that returns the value of any built-in numeric data type. The value must be greater than or equal to -1 and less than or equal to 1. If the argument is not a double precision floating-point number, it is converted to one for processing by the function.

The result of the function is a double precision floating-point number. The result can be null; if the argument is null, the result is the null value.

The result is greater than or equal to - $\Pi/2$ and less than or equal to $\Pi/2$.

Example: Assume that host variable ATANGENT is DECIMAL(10,9) with a value of 14.10141995. The following statement:

```
SELECT ATAN(:ATANGENT)
  FROM SYSIBM.SYSDUMMY1;
```

returns a double precision floating-point number with an approximate value of 1.50.

ATANH

```
►►──ATANH(numeric-expression)──────────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The ATANH function returns the hyperbolic arc tangent of a number, expressed in radians. The ATANH and TANH functions are inverse operations.

The argument must be an expression that returns the value of any built-in numeric data type. The value must be greater than -1 and less than 1. If the argument is not a double precision floating-point number, it is converted to one for processing by the function.

The result of the function is a double precision floating-point number. The result can be null; if the argument is null, the result is the null value.

Example: Assume that host variable HATAN is DECIMAL(10,9) with a value of 0.905148254. The following statement:

```
SELECT ATANH(:HATAN)
  FROM SYSIBM.SYSDUMMY1;
```

returns a double precision floating-point number with an approximate value of 1.50.

ATAN2

```
►►──ATAN2(numeric-expression-1,numeric-expression-2)──────────────────────────────►◄
```

The schema is SYSIBM.

The ATAN2 function returns the arc tangent of *x* and *y* coordinates as an angle expressed in radians. The first and second arguments specify the *x* and *y* coordinates, respectively.

Each argument must be an expression that returns the value of any built-in numeric data type. Both arguments must not be 0. Any argument that is not a double precision floating-point number is converted to one for processing by the function.

The result of the function is a double precision floating-point number. The result can be null; if any argument is null, the result is the null value.

Example: Assume that host variables HATAN2A and HATAN2B are DOUBLE host variables with values of 1 and 2, respectively. The following statement:

```
SELECT ATAN2(:HATAN2A,:HATAN2B)
  FROM SYSIBM.SYSDUMMY1;
```

returns a double precision floating-point number with an approximate value of 1.1071487.

BLOB

```
►►──BLOB(string-expression──┬─────────────┬─)──────────────────────────────────────────────►◄
                            └─,──integer──┘
```

The schema is SYSIBM.

The BLOB function returns a BLOB representation of a string of any type or a row ID type.

string-expression
An expression that returns a value that is a built-in character string, graphic string, binary string, or a row ID type.

integer
An integer value that specifies the length attribute of the resulting binary string. The value must be an integer between 1 and the maximum length of a BLOB.

Do not specify *integer* if *expression* is a row ID type.

If you do not specify *integer* and *string-expression* is an empty string constant, the length attribute of the result is 1, and the result is an empty string. Otherwise, the length attribute of the result is the same as the length attribute of *string-expression*, except when the input is graphic data. In this case, the length attribute of the result is twice the length of *expression*.

The result of the function is a BLOB. If the first argument can be null, the result can be null; if the first argument is null, the result is the null value.

The actual length of the result is the minimum of the length attribute of the result and the actual length of *string-expression* (or twice the length of *string-expression* when the input is graphic data). If the length of *string-expression* is greater than the length attribute of the result, truncation is performed. A warning is returned unless the first input argument is a character string and all the truncated characters are blanks, or the first input argument is a graphic string and all the truncated characters are double-byte blanks.

Example 1: The following function returns a BLOB for the string 'This is a BLOB'.

```
SELECT BLOB('This is a BLOB')
  FROM SYSIBM.SYSDUMMY1;
```

Example 2: The following function returns a BLOB for the large object that is identified by locator myclob_locator.

```
SELECT BLOB(:myclob_locator)
  FROM SYSIBM.SYSDUMMY1;
```

Example 3: Assume that a table has a BLOB column named TOPOGRAPHIC_MAP and a VARCHAR column named MAP_NAME. Locate any maps that contain the string 'Engles Island' and return a single binary string with the map name concatenated in front of the actual map.

```
SELECT BLOB(MAP_NAME || ':  ') || TOPOGRAPHIC_MAP
  FROM ONTARIO_SERIES_4
  WHERE TOPOGRAPHIC_MAP LIKE BLOB('%Engles Island%')
```

CCSID_ENCODING

```
►►──CCSID_ENCODING(expression)──────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The CCSID_ENCODING function returns the encoding scheme of a CCSID in the form of a character string with a value of one of the following: ASCII, EBCDIC, UNICODE, or UNKNOWN.

The argument can be of any built-in data type other than a character string with a maximum length greater than 255 or a graphic string with a length greater than 127. It cannot be a CLOB or DBCLOB.

The result of the function is a fixed-length character string of length 8, which is padded on the right if necessary. If the argument can be null, the result can be null. If the argument is null, the result is the null value.

If *expression* returns string data, the CCSID of the result is the SBCS CCSID that corresponds to the CCSID of *expression*.

Example 1: The following function returns a CCSID with a value for EBCDIC data.

```
SELECT CCSID_ENCODING(37) AS CCSID
  FROM SYSIBM.SYSDUMMY1;
```

Example 2: The following function returns a CCSID with a value for ASCII data.

```
SELECT CCSID_ENCODING(850) AS CCSID
  FROM SYSIBM.SYSDUMMY1;
```

Example 3: The following function returns a CCSID with a value for Unicode data.

```
SELECT CCSID_ENCODING(1208) AS CCSID
  FROM SYSIBM.SYSDUMMY1;
```

Example 4: The following function returns a CCSID with a value of UNKNOWN.

```
SELECT CCSID_ENCODING(1) AS CCSID
  FROM SYSIBM.SYSDUMMY1;
```

CEILING

```
►►──CEILING──(numeric-expression)──────────────────────────────────────────►◄
```

The schema is SYSIBM.

The CEILING function returns the smallest integer value that is greater than or equal to the argument.

The argument must be an expression that returns a value of any built-in numeric data type.

The result of the function has the same data type and length attribute as the argument except that the scale is 0 if the argument is DECIMAL. For example, an argument with a data type of DECIMAL(5,5) results in DECIMAL(05,0). The result can be null. If the argument is null, the result is the null value.

CEIL can be specified as a synonym for CEILING.

Example 1: The following statement shows the use of CEILING on positive and negative values:

```
SELECT CEILING(3.5), CEILING(3.1), CEILING(-3.1), CEILING(-3.5)
  FROM FROM SYSIBM.SYSDUMMY1;
```

This example returns: 04., 04., -03., -03.

Example 2: Using sample table DSN8810.EMP, find the highest monthly salary for all the employees. Round the result up to the next integer. The SALARY column has a decimal data type.

```
SELECT CEILING(MAX(SALARY)/12)
  FROM DSN8810.EMP;
```

This example returns 04396. because the highest paid employee is Christine Haas who earns $52750.00 per year. Her average monthly salary before applying the CEILING function is 4395.83.

CHAR

Datetime to Character:

```
►►──CHAR(datetime-expression──┬───────────────┬──)──────────────────────────────────────────►◄
                              └─,──┬─ISO───┬──┘
                                   ├─USA───┤
                                   ├─EUR───┤
                                   ├─JIS───┤
                                   └─LOCAL─┘
```

Character to Character:

```
►►──CHAR(character-expression──┬─────────────┬──)──────────────────────────────────────────►◄
                               └─,──integer──┘
```

Graphic to Character:

```
►►──CHAR(graphic-expression──┬─────────────┬──)────────────────────────────────────────────►◄
                             └─,──integer──┘
```

Integer to Character:

```
►►──CHAR(integer-expression)───────────────────────────────────────────────────────────────►◄
```

Decimal to Character:

```
►►──CHAR(decimal-expression──┬───────────────────────┬──)──────────────────────────────────►◄
                             └─,──decimal-character──┘
```

Floating-Point to Character:

```
►►──CHAR(floating-point-expression)────────────────────────────────────────────────────────►◄
```

Row ID to Character:

```
►►──CHAR(row-ID-expression)────────────────────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The CHAR function returns a fixed-length character string representation of one of the following values:

- An integer number if the first argument is a small or large integer
- A decimal number if the first argument is a decimal number
- A floating-point number if the first argument is a single or double precision floating-point number
- A string value if the first argument is any type of string
- A datetime value if the first argument is a date, time, or timestamp
- A row ID value if the first argument is a row ID

The result of the function is a fixed-length character string (CHAR).

If the first argument can be null, the result can be null. If the first argument is null, the result is the null value.

Datetime to Character

datetime-expression
An expression that is one of the following three built-in data types:

date The result is the character string representation of the date in the format that is specified by the second argument. If the second argument is omitted, the DATE precompiler option, if one is provided, or else field DATE FORMAT on installation panel DSNTIP4 specifies the format. If the format is to be LOCAL, field LOCAL DATE LENGTH on installation panel DSNTIP4 specifies the length of the result. Otherwise, the length of the result is 10.

LOCAL denotes the local format at the DB2 that executes the SQL statement. If LOCAL is used for the format, a date exit routine must be installed at that DB2.

An error occurs if the second argument is specified and is not a valid value.

time The result is the character string representation of the time in the format specified by the second argument. If the second argument is omitted, the TIME precompiler option, if one is provided, or else field TIME FORMAT on installation panel DSNTIP4 specifies the format. If the format is to be LOCAL, the field LOCAL TIME LENGTH on installation panel DSNTIP4 specifies the length of the result. Otherwise, the length of the result is 8.

LOCAL denotes the local format at the DB2 that executes the SQL statement. If LOCAL is used for the format, a time exit routine must be installed at that DB2.

An error occurs if the second argument is specified and is not a valid value.

timestamp
The result is the character string representation of the timestamp. The length of the result is 26. The second argument must not be specified.

The CCSID of the result is determined from the context in which the function was invoked. For more information, see “Determining the encoding scheme and CCSID of a string” on page 29.

ISO, EUR, USA, JIS, or LOCAL
Specifies the date or time format of the resulting character string. For more information, see “String representations of datetime values” on page 65.

Character to Character

character-expression
An expression that returns a value of a built-in character string.

integer
The length attribute for the resulting fixed-length character string. The value must be an integer constant between 1 and 255.

If the length is not specified, the length attribute of the result is the minimum of 255 and the length attribute of *character-expression*. If *character-expression* is an empty string constant, an error occurs.

The actual length is the same as the length attribute of the result. If the length of *character-expression* is less than the length attribute of the result, the result is padded with blanks to the length of the result. If the length of *character-expression* is greater than the length attribute of the result, the result is truncated. Unless all of the truncated characters are blanks, a warning is returned.

If *character-expression* is bit data, the result is bit data. Otherwise, the CCSID of the result is the same as the CCSID of *character-expression*.

Graphic to Character

graphic-expression
An expression that returns a value of a built-in graphic string.

integer
The length attribute for the resulting fixed-length character string. The value must be an integer constant between 1 and 255.

If the length is not specified, the length attribute of the result is the minimum of 255 and the length attribute of *graphic-expression*. The length attribute of *graphic-expression* is *(3 * length(graphic-expression))*. If *graphic-expression* is an empty string constant, an error occurs.

The actual length is the same as the length attribute of the result. If the length of *graphic-expression* is less than the length attribute of the result, the result is padded with blanks to the length of the result. If the length of *graphic-expression* is greater than the length attribute of the result, the result is truncated. Unless all of the truncated characters are blanks, a warning is returned.

The CCSID of the result is the character mixed CCSID that corresponds to the graphic CCSID of *graphic-expression*.

Integer to Character

integer-expression
An expression that returns a value that is a built-in integer data type (SMALLINT or INTEGER).

The result is the fixed-length character string representation of the argument in the form of an SQL integer constant. The result consists of *n* characters that are the significant digits that represent the value of the argument with a preceding minus sign if the argument is negative. The result is left justified, and its length depends on whether the argument is a small or large integer:

- For a small integer, the length of the result is 6. If the number of characters in the result is less than 6, the result is padded on the right with blanks to a length of 6.
- For a large integer, the length of the result is 11; if the number of characters in the result is less than 11, the result is padded on right with blanks to a length of 11.

A positive value always includes one trailing blank.

The CCSID of the result is determined from the context in which the function was invoked. For more information, see “Determining the encoding scheme and CCSID of a string” on page 29.

Decimal to Character

decimal-expression
An expression that returns a value that is a built-in decimal data type. To specify a different precision and scale for the expression’s value, apply the DECIMAL function before applying the CHAR function.

decimal-character
Specifies the single-byte character constant (CHAR or VARCHAR) that is used to delimit the decimal digits in the result character string. The character must not be a digit, a plus sign (+), a minus sign (–), or a blank. The default is the period (.) or comma (,). For information on what factors govern the choice, see “Decimal point representation” on page 181.

The result is the fixed-length character string representation of the argument in the form of an SQL decimal constant. The result includes a decimal-character and *p* digits, where *p* is the precision of the *decimal-expression*. If the argument is negative, the first character of the result is a minus sign. Otherwise, the first character is a blank, which means that a positive value always has one leading blank.

The leading blank is not returned for CAST(*decimal-expression* AS CHAR(*n*)).

The length of the result is 2+*p*, where *p* is the precision of the *decimal-expression*.

The CCSID of the result is determined from the context in which the function was invoked. For more information, see “Determining the encoding scheme and CCSID of a string” on page 29.

Floating-Point to Character

floating-point-expression
An expression that returns a value that is a built-in floating-point data type (DOUBLE or REAL).

The result is the fixed-length character string representation of the argument in the form of a floating-point constant. The length of the result is 24 bytes.

If the argument is negative, the first character of the result is a minus sign. Otherwise, the first character is a digit. If the value of the argument is zero, the result is 0E0. Otherwise, the result includes the smallest number of characters that can represent the value of the argument such that the mantissa consists of a single digit, other than zero, followed by a period and a sequence of digits.

If the number of characters in the result is less than 24, the result is padded on the right with blanks to length of 24.

The CCSID of the result is determined from the context in which the function was invoked. For more information, see “Determining the encoding scheme and CCSID of a string” on page 29.

Row ID to Character

row-ID-expression
An expression that returns a value that is a built-in row ID data type.

The result is the fixed-length character string representation of the argument. It is bit data.

The length of the result is 40. If the length of *row-ID-expression* is less than 40, the result is padded on the right with hexadecimal zeroes to length of 40.

Recommendation: To increase the portability of applications, use the CAST specification when the first argument is numeric, or the first argument is a string and the length argument is specified. For more information, see “CAST specification” on page 151.

Example 1: HIREDATE is a DATE column in sample table DSN8810.EMP. When it represents 15 December 1976 (as it does for employee 140):

```
EXEC SQL SELECT CHAR(HIREDATE, USA)
  INTO :DATESTRING
  FROM DSN8810.EMP
  WHERE EMPNO = '000140';
```

returns the string value '12/15/1976' in character-string variable DATESTRING.

Example 2: Host variable HOUR has a data type of DECIMAL(6,0) and contains a value of 50000. Interpreted as a time duration, this value is 5 hours. Assume that STARTING is a TIME column in some table. Then, when STARTING represents 17 hours, 30 minutes, and 12 seconds after midnight:

```
CHAR(STARTING+:HOURS, USA)
```

returns the value '10:30 PM'.

Example 3: Assume that RECEIVED is defined as a TIMESTAMP column in table TABLEY. When the value of the date portion of RECEIVED represents 10 March 1997 and the time portion represents 6 hours and 15 seconds after midnight, this example:

```
SELECT CHAR(RECEIVED)
  FROM TABLEY
  WHERE INTCOL = 1234;
```

returns the string value '1997-03-10-06.00.15.000000'.

Example 4: For sample table DSN8810.EMP, the following SQL statement sets the host variable AVERAGE, which is defined as CHAR(33), to the character string representation of the average employee salary.

```
EXEC SQL SELECT CHAR(AVG(SALARY))
  INTO :AVERAGE
  FROM DSN8810.EMP;
```

With DEC31, the result of AVG applied to a decimal number is a decimal number with a precision of 31 digits. The only host languages in which such a large decimal variable can be defined are Assembler and C. For host languages that do not support such large decimal numbers, use the method shown in this example.

Example 5: For the rows in sample table DSN8810.EMP, return the values in column LASTNAME, which is defined as VARCHAR(15), as a fixed-length character string and limit the length of the results to 10 characters.

```
SELECT CHAR(LASTNAME,10)
  FROM DSN8810.EMP;
```

For rows that have a LASTNAME with a length greater than 10 characters (excluding trailing blanks), a warning that the value is truncated is returned.

Example 6: For the rows in sample table DSN8810.EMP, return the values in column EDLEVEL, which is defined as SMALLINT, as a fixed-length character string.

```
SELECT CHAR(EDLEVEL)
  FROM DSN8810.EMP;
```

An EDLEVEL of 18 is returned as CHAR(6) value '18   ' (18 followed by four blanks).

Example 7: In sample table DSN8810.EMP, the SALARY column is defined as DECIMAL(9,2). For those employees who have a salary of 52750.00, return the hire date and the salary, using a comma as the decimal character in the salary (52750,00).

```
SELECT HIREDATE, CHAR(SALARY, ',')
  FROM DSN8810.EMP
  WHERE SALARY = 52750.00;
```

The salary is returned as the string value ' 0052750,00'.

Example 8: Repeat the scenario in Example 7 except subtract the SALARY column from 60000.00 and return the salary with the default decimal character.

```
SELECT HIREDATE, CHAR (60000.00 - SALARY)
  FROM DSN8810.EMP
  WHERE SALARY = 52750.00;
```

The salary is returned as the string value ' 0007250.00'.

Example 9: Assume that host variable SEASONS_TICKETS is defined as INTEGER and has a value of 10000. Use the DECIMAL and CHAR functions to change the value into the character string ' 10000.00'.

```
SELECT CHAR(DECIMAL(:SEASONS_TICKETS,7,2))
  FROM SYSIBM.SYSDUMMY1;
```

Example 10: Assume that columns COL1 and COL2 in table T1 are both defined as REAL and that T1 contains a single row with the values 7.1E+1 and 7.2E+2 for the two columns. Add the two columns and represent the result as a character string.

```
SELECT CHAR(COL1 + COL2)
  FROM T1;
```

The result is the character value '1.43E2   '.

CLOB

Character to CLOB:

```
►►──CLOB(character-expression─┬────────────┬─)──────────────────────────────────────►◄
                              └─,──integer─┘
```

Graphic to CLOB:

```
►►──CLOB(graphic-expression─┬────────────┬─)────────────────────────────────────────►◄
                            └─,──integer─┘
```

The schema is SYSIBM.

The CLOB function returns a CLOB representation of a string.

Character to CLOB

character-expression
An expression that returns a value of a character string. If *character-expression* is bit data, an error occurs.

integer
An integer constant that specifies the length attribute of the resulting CLOB data type. The value must be between 1 and the maximum length of a CLOB.

If you do not specify *integer* and *character-expression* is an empty string constant, the length attribute of the result is 1, and the result is an empty string. Otherwise, the length attribute of the result is the same as the length attribute of *character-expression*.

The result of the function is a CLOB. If the first argument can be null, the result can be null; if the first argument is null, the result is the null value.

The actual length of the result is the minimum of the length attribute of the result and the actual length of *character-expression*. If the length of *character-expression* is greater than the length specified, the result is truncated. Unless all of the truncated characters are blanks, a warning is returned.

The CCSID of the result is the same as the CCSID of *character-expression*.

Graphic to CLOB

character-expression
An expression that returns a value of a graphic string.

integer
An integer constant that specifies the length attribute of the resulting CLOB data type. The value must be between 1 and the maximum length of a CLOB.

If you do not specify *integer* and *graphic-expression* is an empty string constant, the length attribute of the result is 1, and the result is an empty string. Otherwise, the length attribute of the result is *(3 * length(string-expression))*.

The result of the function is a CLOB. If the first argument can be null, the result can be null; if the first argument is null, the result is the null value.

The actual length of the result is the minimum of the length attribute of the result and the actual length of *graphic -expression*. If the length of *graphic-expression* is greater than the length specified, the result is truncated. Unless all of the truncated characters are blanks, a warning is returned.

The CCSID of the result is the character mixed CCSID that corresponds to the graphic CCSID of *graphic-expression*.

Example: The following function returns a CLOB for the string 'This is a CLOB'.

```
SELECT CLOB('This is a CLOB')
  FROM SYSIBM.SYSDUMMY1;
```

COALESCE

```
                          ┌─────────────────┐
                          ▼                 │
►►──COALESCE──(expression────,expression────┴──)──────────────────────────►◄
```

The schema is SYSIBM.

The COALESCE function returns the value of the first nonnull expression.

The arguments must be compatible. For more information on compatibility, refer to the compatibility matrix in Table 13 on page 75. The arguments can be of either a built-in or user-defined data type.[18]

The arguments are evaluated in the order in which they are specified, and the result of the function is the first argument that is not null. The result can be null only if all arguments can be null. The result is null only if all arguments are null.

The selected argument is converted, if necessary, to the attributes of the result. The attributes of the result are determined using the “Rules for result data types” on page 87. If the COALESCE function has more than two arguments, the rules are applied to the first two arguments to determine a candidate result type. The rules are then applied to that candidate result type and the third argument to determine another candidate result type. This process continues until all arguments are analyzed and the final result type is determined.

The COALESCE function can also handle a subset of the functions provided by CASE expressions. The result of using COALESCE(e1,e2) is the same as using the expression:

```
CASE WHEN e1 IS NOT NULL THEN e1 ELSE e2 END
```

VALUE can be specified as a synonym for COALESCE.

Example 1: Assume that SCORE1 and SCORE2 are SMALLINT columns in table GRADES, and that nulls are allowed in SCORE1 but not in SCORE2. Select all the rows in GRADES for which SCORE1 + SCORE2 > 100, assuming a value of 0 for SCORE1 when SCORE1 is null.

```
SELECT * FROM GRADES
  WHERE COALESCE(SCORE1,0) + SCORE2 > 100;
```

Example 2: Assume that a table named DSN8810.EMP contains a DATE column named HIREDATE, and that nulls are allowed for this column. The following query selects all rows in DSN8810.EMP for which the date in HIREDATE is either unknown (null) or earlier than 1 January 1960.

```
SELECT * FROM DSN8810.EMP
  WHERE COALESCE(HIREDATE,DATE('1959-12-31')) < '1960-01-01';
```

[18] This function cannot be used as a source function when creating a user-defined function. Because it accepts any compatible data types as arguments, it is not necessary to create additional signatures to support user-defined distinct types.

The predicate could also be coded as COALESCE(HIREDATE,'1959-12-31') because for comparison purposes, a string representation of a date can be compared to a date.

Example 3: Assume that for the years 1993 and 1994 there is a table that records the sales results of each department. Each table, S1993 and S1994, consists of a DEPTNO column and a SALES column, neither of which can be null. The following query provides the sales information for both years.

```
SELECT COALESCE(S1993.DEPTNO,S1994.DEPTNO) AS DEPT, S1993.SALES, S1994.SALES
  FROM S1993 FULL JOIN S1994 ON S1993.DEPTNO = S1994.DEPTNO
  ORDER BY DEPT;
```

The full outer join ensures that the results include all departments, regardless of whether they had sales or existed in both years. The COALESCE function allows the two join columns to be combined into a single column, which enables the results to be ordered.

CONCAT

```
►►──CONCAT(string-expression-1,string-expression-2)────────────────────────────────►◄
```

The schema is SYSIBM.

The CONCAT function combines two string arguments. The arguments must be compatible strings. For more information on compatibility, refer to the compatibility matrix in Table 13 on page 75.

The result of the function is a string that consists of the first string followed by the second string. If either argument can be null, and if either is null, the result is the null value.

The CONCAT function is identical to the CONCAT operator. For more information, see “With the concatenation operator” on page 139.

Example: Using sample table DSN8810.EMP, concatenate column FIRSTNME with column LASTNAME. Both columns are defined as varying-length character strings.

```
SELECT CONCAT(FIRSTNME, LASTNAME)
  FROM DSN8810.EMP;
```

COS

```
►►──COS(numeric-expression)─────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The COS function returns the cosine of the argument, where the argument is an angle expressed in radians. The COS and ACOS functions are inverse operations.

The argument must be an expression that returns the value of any built-in numeric data type. If the argument is not a double precision floating-point number, it is converted to one for processing by the function.

The result of the function is a double precision floating-point number. The result can be null; if the argument is null, the result is the null value.

Example: Assume that host variable COSINE is DECIMAL(2,1) with a value of 1.5. The following statement:

```
SELECT COS(:COSINE)
  FROM SYSIBM.SYSDUMMY1;
```

returns a double precision floating-point number with an approximate value of 0.07.

COSH

```
►►──COSH(numeric-expression)──────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The COSH function returns the hyperbolic cosine of the argument, where the argument is an angle expressed in radians.

The argument must be an expression that returns the value of any built-in numeric data type. If the argument is not a double precision floating-point number, it is converted to one for processing by the function.

The result of the function is a double precision floating-point number. The result can be null; if the argument is null, the result is the null value.

Example: Assume that host variable HCOS is DECIMAL(2,1) with a value of 1.5. The following statement:

```
SELECT COSH(:HCOS)
  FROM SYSIBM.SYSDUMMY1;
```

returns a double precision floating-point number with an approximate value of 2.35.

DATE

```
►►──DATE(expression)──────────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The DATE function returns a date derived from a value.

The argument must be an expression that returns one of the following built-in data types: a date, a timestamp, a character string, a graphic string, or any numeric data type.

- If *expression* is a character or graphic string, it must not be a CLOB or DBCLOB, and its value must be one of the following:
  - A valid string representation of a date or timestamp with an actual length that is not greater than 255 bytes. For the valid formats of string representations of dates and timestamps, see "String representations of datetime values" on page 65.
  - A character or graphic string with an actual length of 7 that represents a valid date in the form *yyyynnn*, where *yyyy* are digits denoting a year and *nnn* are digits between 001 and 366 denoting a day of that year.
- If *expression* is a number, it must be greater than or equal to one and less than or equal to 3652059.

If the argument is a string, the result is the date represented by the string. If the CCSID of the string is not the same as the corresponding default CCSID at the server, the string is first converted to that CCSID.

The result of the function is a date. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The other rules depend on the data type of the argument:

If the argument is a timestamp, the result is the date part of the timestamp.

If the argument is a date, the result is that date.

If the argument is a number, the result is the date that is *n*-1 days after January 1, 0001, where *n* is the integral part of the number.

If the argument is a string, the result is the date represented by the string. If the CCSID of the string is not the same as the corresponding default CCSID at the server, the string is first converted to that CCSID.

Example 1: Assume that RECEIVED is a TIMESTAMP column in some table, and that one of its values is equivalent to the timestamp '1988-12-25-17.12.30.000000'. Then, for this value:

```
DATE(RECEIVED)
```

returns the internal representation of 25 December 1988.

Example 2: Assume that DATCOL is a CHAR(7) column in some table, and that one of its values is the character string '1989061'. Then, for this value:

```
DATE(DATCOL)
```

returns the internal representation of 2 March 1989.

Example 3: DB2 recognizes '1989-03-02' as the ISO representation of 2 March 1989. Therefore:

```
DATE('1989-03-02')
```

returns the internal representation of 2 March 1989.

DAY

```
►►──DAY(expression)────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The DAY function returns the day part of a value.

The argument must be an expression that returns one of the following built-in data types: a date, a timestamp, a character string, a graphic string, or any numeric data type.

- If *expression* is a character or graphic string, it must not be a CLOB or DBCLOB, and its value must be a valid string representation of a date or timestamp with an actual length that is not greater than 255 bytes. For the valid formats of string representations of dates and timestamps, see "String representations of datetime values" on page 65.
- If *expression* is a number, it must be a date duration or a timestamp duration. For the valid formats of datetime durations, see "Datetime operands" on page 88.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The other rules for the function depend on the data type of the argument:

If the argument is a date, timestamp, or string representation of either, the result is the day part of the value, which is an integer between 1 and 31.

If the argument is a date duration or timestamp duration, the result is the day part of the value, which is an integer between -99 and 99. A nonzero result has the same sign as the argument.

Example 1: Set the INTEGER host variable DAYVAR to the day of the month on which employee 140 in the sample table DSN8810.EMP was hired.

```
EXEC SQL SELECT DAY(HIREDATE)
  INTO :DAYVAR
  FROM DSN8810.EMP
  WHERE EMPNO = '000140';
```

Example 2: Assume that DATE1 and DATE2 are DATE columns in the same table. Assume also that for a given row in this table, DATE1 and DATE2 represent the dates 15 January 2000 and 31 December 1999, respectively. Then, for the given row:

```
DAY(DATE1 - DATE2)
```

returns the value 15.

DAYOFMONTH

```
►►──DAYOFMONTH(expression)──────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The DAYOFMONTH function returns the day part of a value. The function is similar to the DAY function, except DAYOFMONTH does not support a date or timestamp duration as an argument.

The argument must be an expression that returns a value of one of the following built-in data types: a date, a timestamp, a character string, or a graphic string.

If *expression* is a character or graphic string, it must not be a CLOB or DBCLOB, and its value must be a valid string representation of a date or timestamp with an actual length that is not greater than 255 bytes. For the valid formats of string representations of dates and timestamps, see “String representations of datetime values” on page 65.

The result of the function is a large integer between 1 and 31, which represents the day part of the value. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example: Set the INTEGER variable DAYVAR to the day of the month on which employee 140 in sample table DSN8810.EMP was hired.

```
SELECT DAYOFMONTH(HIREDATE)
  INTO :DAYVAR
  FROM DSN8810.EMP
  WHERE EMPNO = '000140';
```

DAYOFWEEK

```
►►──DAYOFWEEK(expression)──────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The DAYOFWEEK function returns an integer in the range of 1 to 7 that represents the day of the week where 1 is Sunday and 7 is Saturday. For another alternative, see “DAYOFWEEK_ISO” on page 238.

The argument must be an expression that returns a value of one of the following built-in data types: a date, a timestamp, a character string, or a graphic string.

If *expression* is a character or graphic string, it must not be a CLOB or DBCLOB, and its value must be a valid string representation of a date or timestamp with an actual length that is not greater than 255 bytes. For the valid formats of string representations of dates and timestamps, see “String representations of datetime values” on page 65.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example 1: Using sample table DSN8810.EMP, set the integer host variable DAY_OF_WEEK to the day of the week that Christine Haas (EMPNO = '000010') was hired (HIREDATE).

```
SELECT DAYOFWEEK(HIREDATE)
  INTO :DAY_OF_WEEK
  FROM DSN8810.EMP
  WHERE EMPNO = '000010';
```

The result is that DAY_OF_WEEK is set to 6, which represents Friday.

Example 2: The following query returns four values: 1, 2, 1, and 2.

```
SELECT DAYOFWEEK(CAST('10/11/1998' AS DATE)),
       DAYOFWEEK(TIMESTAMP('10/12/1998', '01.02')),
       DAYOFWEEK(CAST(CAST('10/11/1998' AS DATE) AS CHAR(20))),
       DAYOFWEEK(CAST(TIMESTAMP('10/12/1998', '01.02') AS CHAR(20)))
  FROM SYSIBM.SYSDUMMY1;
```

DAYOFWEEK_ISO

```
►►──DAYOFWEEK_ISO(expression)──────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The DAYOFWEEK_ISO function returns an integer in the range of 1 to 7 that represents the day of the week, where 1 is Monday and 7 is Sunday. For another alternative, see “DAYOFWEEK” on page 237.

The argument must be an expression that returns a value of one of the following built-in data types: a date, a timestamp, a character string, or graphic a string.

If *expression* is a character or graphic string, it must not be a CLOB or DBCLOB, and its value must be a valid string representation of a date or timestamp with an actual length that is not greater than 255 bytes. For the valid formats of string representations of dates and timestamps, see “String representations of datetime values” on page 65.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example 1: Using sample table DSN8810.EMP, set the integer host variable DAY_OF_WEEK to the day of the week that Christine Haas (EMPNO = '000010') was hired (HIREDATE).

```
SELECT DAYOFWEEK_ISO(HIREDATE)
  INTO :DAY_OF_WEEK
  FROM DSN8810.EMP
  WHERE EMPNO = '000010';
```

The result is that DAY_OF_WEEK is set to 5, which represents Friday.

Example 2: The following query returns four values: 7, 1, 7, and 1.

```
SELECT DAYOFWEEK_ISO(CAST('10/11/1998' AS DATE)),
       DAYOFWEEK_ISO(TIMESTAMP('10/12/1998', '01.02')),
       DAYOFWEEK_ISO(CAST(CAST('10/11/1998' AS DATE) AS CHAR(20))),
       DAYOFWEEK_ISO(CAST(TIMESTAMP('10/12/1998', '01.02') AS CHAR(20)))
  FROM SYSIBM.SYSDUMMY1;
```

Example 3: The following list shows what is returned by the DAYOFWEEK_ISO function for various dates.

```
DATEDAYOFWEEK_ISO

1997-12-28      '7'
1997-12-31      '3'
1998-01-01      '4'
1999-01-01      '5'
1999-01-04      '1'
1999-12-31      '5'
2000-01-01      '6'
2000-01-03      '1'
```

DAYOFYEAR

```
►►──DAYOFYEAR(expression)──────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The DAYOFYEAR function returns an integer in the range of 1 to 366 that represents the day of the year where 1 is January 1.

The argument must be an expression that returns a value of one of the following built-in data types: a date, a timestamp, a character string, or a graphic string.

If *expression* is a character or graphic string, it must not be a CLOB or DBCLOB, and its value must be a valid string representation of a date or timestamp with an actual length that is not greater than 255 bytes. For the valid formats of string representations of dates and timestamps, see “String representations of datetime values” on page 65.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example: Using sample table DSN8810.EMP, set the integer host variable AVG_DAY_OF_YEAR to the average of the day of the year on which employees were hired (HIREDATE):

```
SELECT AVG(DAYOFYEAR(HIREDATE))
  INTO :AVG_DAY_OF_YEAR
  FROM DSN8810.EMP;
```

The result is that AVG_DAY_OF_YEAR is set to 202.

DAYS

```
▸▸──DAYS(expression)────────────────────────────────────────────────────▸◂
```

The schema is SYSIBM.

The DAYS function returns an integer representation of a date.

The argument must be an expression that returns a value of one of the following built-in data types: a date, a timestamp, a character string, or a graphic string.

If *expression* is a character or graphic string, it must not be a CLOB or DBCLOB, and its value must be a valid string representation of a date or timestamp with an actual length that is not greater than 255 bytes. For the valid formats of string representations of dates and timestamps, see "String representations of datetime values" on page 65.

The result of the function is a large integer. If the argument can be null, the result can be null. If the argument is null, the result is the null value.

The result is 1 more than the number of days from January 1, 0001 to *D*, where *D* is the date that would occur if the DATE function were applied to the argument.

Example: Set the INTEGER host variable DAYSVAR to the number of days that employee 140 had been with the company on the last day of 1997.

```
EXEC SQL SELECT DAYS('1997-12-31') - DAYS(HIREDATE) + 1
  INTO :DAYSVAR
  FROM DSN8810.EMP
  WHERE EMPNO = '000140';
```

DBCLOB

Character to DBCLOB:

```
►►──DBCLOB(character-expression──┬────────────┬─)──────────────────────────────────►◄
                                 └─,──integer─┘
```

Graphic to DBCLOB:

```
►►──DBCLOB(graphic-expression──┬────────────┬─)────────────────────────────────────►◄
                               └─,──integer─┘
```

The schema is SYSIBM.

The DBCLOB function returns a DBCLOB representation of a character string value, with the single-byte characters converted to double-byte characters, or a graphic string value.

The result of the function is a DBCLOB.

If the first argument can be null, the result can be null; if the first argument is null, the result is the null value.

The length attribute and actual length of the result are measured in double-byte characters because the result is a graphic string.

Character to DBCLOB

character-expression
An expression that returns a value that is an EBCDIC-encoded or Unicode-encoded character string. It cannot be BIT data. The argument does not need to be mixed data, but any occurrences of X'0E' and X'0F' in the string must conform to the rules for EBCDIC mixed data. (See “Character strings” on page 58 for these rules.)

integer
The length attribute of the resulting DBCLOB. The value must be an integer constant between 1 and the maximum length of a DBCLOB.

If *integer* is not specified and *character-expression* is an empty string constant, the length attribute of the result is 1, and the result is an empty string. Otherwise, the length attribute of the result is the same as the length attribute of *character-expression*.

The actual length of the result is the minimum of the length attribute of the result and the actual length of *character-expression*. If the length of *character-expression*, as measured in single-byte characters, is greater than the specified length of the result, as measured in double-byte characters, the result is truncated. Unless all the truncated characters are blanks appropriate for *character-expression*, a warning is returned.

The CCSID of the result is the graphic CCSID that corresponds to the character CCSID of *character-expression*.

For EBCDIC input data:

Each character of *character-expression* determines a character of the result. The argument might need to be converted to the native form of mixed data before the result is derived. Let M denote the system CCSID for mixed data. The argument is not converted if any of the following conditions is true:

- The argument is mixed data and its CCSID is M.
- The argument is SBCS data and its CCSID is the same as the system CCSID for SBCS data. In this case, the operation proceeds as if the CCSID of the argument is M.

Otherwise, the argument is a new string S derived by converting the characters to the coded character set identified by M. If there is no system CCSID for mixed data, conversion is to the coded character set that the system CCSID for SBCS data identifies.

The result is derived from S using the following steps:

- Each shift character (X'0E' or X'0F') is removed.
- Each double-byte character remains as is.
- Each single-byte character is replaced by a double-byte character.

The replacement for a single-byte character is the equivalent DBCS character if an equivalent exists. Otherwise, the replacement is X'FEFE'. The existence of an equivalent character depends on M. If there is no system CCSID for mixed data, the DBCS equivalent of X'xx' for EBCDIC is X'42xx', except for X'40', whose DBCS equivalent is X'4040'.

For Unicode input data:

Each character of *character-expression* determines a character of the result. The argument might need to be converted to the native form of mixed data before the result is derived. Let M denote the system CCSID for mixed data. The argument is not converted if any of the following conditions is true:

- The argument is mixed data, and its CCSID is M.
- The argument is SBCS data, and its CCSID is the same as the system CCSID for SBCS data. In this case, the operation proceeds as if the CCSID of the argument is M.

Otherwise, the argument is a new string S derived by converting the characters to the coded character set identified by M.

The result is derived from S using the following steps:

- Each non-supplementary character is replaced by a Unicode double-byte character (a UTF-16 code point). A non-supplementary character in UTF-8 is between 1 and 3 bytes.
- Each supplementary character is replaced by a pair of Unicode double-byte characters (a pair of UTF-16 code points).

The replacement for a single-byte character is the Unicode equivalent character if an equivalent exists. Otherwise, the replacement is X'FFFD'.

Graphic to DBCLOB

graphic-expression
An expression that returns a value that is an EBCDIC-encoded or Unicode-encoded graphic string.

integer
The length attribute for the resulting varying-length graphic string. The value must be an integer constant between 1 and the maximum length of a DBCLOB.

If *integer* is not specified and *graphic-expression* is an empty string constant, the length attribute of the result is 1, and the result is an empty string. Otherwise, the length attribute of the result is the same as the length attribute of *graphic-expression*.

The actual length of the result is the minimum of the length attribute of the result and the actual length of *graphic-expression*. If the length of *graphic-expression* is greater than the length attribute of the result, truncation is performed. Unless all of the truncated characters are double-byte blanks, a warning is returned.

The CCSID of the result is the same as the CCSID of *graphic-expression*.

Example: Assume that the application encoding scheme is Unicode. The following statement returns a graphic (UTF-16) host variable.

```
VALUES DBCLOB('123')
  INTO :GHV1;
```

DECIMAL or DEC

Numeric to Decimal:

```
►►──┬─DECIMAL─┬──(numeric-expression──┬─────────────────────────┬─)──────────────────────────────►◄
    └─DEC─────┘                       └─,precision──┬─────────┬─┘
                                                    └─,scale──┘
```

String to Decimal:

```
►►──┬─DECIMAL─┬──(string-expression──┬──────────────────────────────────────────────────┬─)──────────►◄
    └─DEC─────┘                      └─,precision──┬──────────────────────────────────┬─┘
                                                   └─,scale──┬──────────────────────┬─┘
                                                             └─,decimal-character───┘
```

The schema is SYSIBM.

The DECIMAL function returns a decimal representation of a number or string representation of a number.

Numeric to decimal

numeric-expression
An expression that returns a value of any built-in numeric data type.

precision
An integer constant with a value in the range of 1 to 31. The value of this second argument specifies the precision of the result.

The default value depends on the data type of the first argument as follows:
- 5 if the first argument is a small integer
- 11 if the first argument is a large integer
- 15 in all other cases

scale
An integer constant that is greater than or equal to zero and less than or equal to *precision*. The value specifies the scale of the result. The default value is 0.

The result of the function is the same number that would occur if the argument were assigned to a decimal column or variable with precision *p* and scale *s*, where *p* and *s* are specified by the second and third arguments. An error occurs if the number of significant digits required to represent the whole part of the number is greater than *p-s*.

String to decimal

string-expression
An expression that returns a value of a character or graphic string (except a CLOB or DBCLOB) with a length attribute that is not greater than 255 bytes. The string must contain a string representation of a number. Leading and trailing blanks are removed from the string, and the resulting substring must conform to the rules for forming a string representation of an SQL integer or decimal constant.

precision

An integer constant with a value in the range of 1 to 31. The value of this second argument specifies the precision of the result.

The default value depends on the data type of the first argument as follows:

- 5 if the first argument is a small integer
- 11 if the first argument is a large integer
- 15 in all other cases

scale

An integer constant that is greater than or equal to zero and less than or equal to *precision*. The value specifies the scale of the result. The default value is 0.

decimal-character

A single-byte character constant used to delimit the decimal digits in *string-expression* from the whole part of the number. The character cannot be a digit, plus (+), minus (-), or blank. The default value is period (.) or comma (,); the default value cannot be used in *string-expression* if a different value for *decimal-character* is specified.

The result is the same number that would result from CAST(*string-expression* AS DECIMAL(*p*,*s*)). Digits are truncated from the end of the decimal number if the number of digits to the right of the decimal separator character is greater than the scale *s*. An error is returned if the number of significant digits to the left of the decimal character (the whole part of the number) in *string-expression* is greater than *p-s*.

The result of the function is a decimal number with precision of *p* and scale of *s*, where *p* and *s* are the second and third arguments. If the first argument can be null, the result can be null; if the first argument is null, the result is null.

Recommendation: To increase the portability of applications when the precision is specified, use the CAST specification. For more information, see "CAST specification" on page 151.

Example 1: Represent the average salary of the employees in DSN8810.EMP as an 8-digit decimal number with two of these digits to the right of the decimal point.

```
SELECT DECIMAL(AVG(SALARY),8,2)
  FROM DSN8810.EMP;
```

Example 2: Assume that updates to the SALARY column are input as a character string that uses comma as the decimal character. For example, the user inputs 21400,50. The input value is assigned to the host variable NEWSALARY that is defined as CHAR(10), and the host variable is used in the following UPDATE statement:

```
UPDATE DSN8810.EMP
  SET SALARY = DECIMAL (:NEWSALARY,9,2,',')
  WHERE EMPNO = :EMPID;
```

DECRYPT_BIT, DECRYPT_CHAR, and DECRYPT_DB

```
►►──┬─DECRYPT_BIT──┬──(encrypted-expression──┬──────────────────────────────────────────────────────────┬──)──────────►◄
    ├─DECRYPT_CHAR─┤                         └─,──┬─password-string-expression─┬──┬──────────────────┬─┘
    └─DECRYPT_DB───┘                              └─DEFAULT────────────────────┘  └─,──ccsid-constant─┘
```

The schema is SYSIBM.

The decryption functions (DECRYPT_BIT, DECRYPT_CHAR, and ECRYPT_DB) return a value that is the result of decrypting encrypted-data. The password used for decryption is either the *password-string-expression* value or the ENCRYPTION PASSWORD value, which is assigned by the SET ENCRYPTION PASSWORD statement. The decryption functions can only decrypt values that are encrypted using the ENCRYPT_TDES function.

encrypted-expression
: An expression that returns the string value to be encrypted. The length attribute for the data type of *data-string-expression* must be greater than or equal to 0 (zero). The length attribute is limited to 32640 if *hint-string-expression* is specified and 32672 if *hint-string-expression* is not specified.

password-string-expression
: An expression that returns a CHAR or VARCHAR value with at least 6 bytes and no more than 127 bytes. This expression must be the same password that was used to encrypt the data or decryption will result in a different value than was originally encrypted. If the value of the password argument is null or not provided, the data will be decrypted using the ENCRYPTION PASSWORD value, which must have been set for the session.

DEFAULT
: The data is decrypted using the ENCRYPTION PASSWORD value, which must have been set for the session.

ccsid-constant
: A constant integer value representing the CCSID in which the data should be returned by the decryption function. The default is

- The ENCODING bind option of the plan or package being executed for static SQL statements
- The value of the APPLICATION ENCODING special register for dynamic SQL statements

The result of the function is determined by the function that is specified and the data type of the first argument, as shown in Table 43 on page 247. If the cast from the actual type of the encrypted data to the function's result is not supported, a warning or error is returned.

Table 43. Result of the decryption function

Function	Type of first argument	Actual type of encrypted data	Result
DECRYPT_BIT	FOR BIT DATA[1]	CHAR, VARCHAR	VARCHAR FOR BIT DATA
DECRYPT_BIT	FOR BIT DATA	GRAPHIC, VARGRAPHIC (UTF16)	Warning or error
DECRYPT_BIT	FOR BIT DATA	GRAPHIC, VARGRAPHIC (not UTF16)	Warning or error
DECRYPT_CHAR	FOR BIT DATA	CHAR, VARCHAR	VARCHAR(3)
DECRYPT_CHAR	FOR BIT DATA	GRAPHIC, VARGRAPHIC (UTF16)	VARCHAR(3)
DECRYPT_CHAR	FOR BIT DATA	GRAPHIC, VARGRAPHIC (not UTF16)	Warning or error
DECRYPT_DB	FOR BIT DATA	CHAR, VARCHAR, GRAPHIC, VARGRAPHIC	VARGRAPHIC

Note 1: FOR BIT DATA means CHAR or VARCHAR FOR BIT DATA

If *encrypted-data* included a hint, the hint is not returned by the function. The length attribute of the result is the length attribute of *encrypted-data* minus the length of the control information, which can be either 16 or 24 bytes. The actual length of the value that is returned by the function will match the length of the original string that was encrypted. If *encrypted-data* includes bytes beyond the encrypted string, these bytes are not returned by the function.

If the first argument can be null, the result can be null; if the first argument is null, the result is the null value.

If the data is decrypted using a different CCSID than the originally encrypted value, it is possible that expansion may occur when converting the decrypted value to this CCSID. In such situations, the *encrypted-data* value should be cast to a VARCHAR string with a larger number of bytes.

For additional information about using the decryption functions, see “ENCRYPT_TDES” on page 253 and “GETHINT” on page 260..

Example 1: Set the ENCRYPTION PASSWORD value to ’Ben123’ and use it as the password to insert a decrypted social security number into the table. Decrypt the value of the added social security number, using the ENCRYPTION PASSWORD value.

```
SET ENCRYPTION PASSWORD ='Ben123';

INSERT INTO EMP(SSN) VALUES ENCRYPT_TDES('289-46-8832');

SELECT DECRYPT_CHAR(SSN) FROM EMP;
```

This example returns the value ’289-46-8832’.

Example 2: Decrypt the social security number that is inserted into the table. Instead of using the ENCRYPTION PASSWORD value, explicitly specify ’Ben123’ as the encryption password.

```
SELECT DECRYPT_CHAR(SSN,'Ben123') FROM EMP;
```

This example returns the value ’289-46-8832’.

Example 3: Insert a decrypted social security number into the table, explicitly specifying ’Ben123’ as the password. Decrypt the data and have it converted to CCSID 1208.

```
SET ENCRYPTION PASSWORD ='Ben123';

INSERT INTO EMP(SSN) VALUES ENCRYPT_TDES('289-46-8832');

SELECT DECRYPT_CHAR(SSN) FROM EMP;
```

When a CCSID is specified, it may be necessary to explicitly cast the data to a longer value to ensure that there is room for expansion when the data is decrypted. The following example illustrates the technique:

```
SELECT DECRYPT(CAST(SSN AS VARCHAR(57)),'Ben123',1208) FROM SSN;
```

In the first case, where the data is not cast to a longer value, the result is a VARCHAR(11) value. In the second case, to allow for expansion, SSN is cast as VARCHAR(57) (11 * 3 + 24). Casting the data to a longer value allows for three times expansion in the normal VARCHAR(11) result. Three times expansion is often associated with a worst case of ASCII or EBCDIC to Unicode UTF-8 conversion. In both cases in this example, the result is the VARCHAR(11) value ’289-46-8832’.

DEGREES

```
►►──DEGREES(numeric-expression)──────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The DEGREES function returns the number of degrees of the argument, which is an angle expressed in radians.

The argument must be an expression that returns the value of any built-in numeric data type. If the argument is not a double precision floating-point number, it is converted to one for processing by the function.

The result of the function is a double precision floating-point number. The result can be null; if the argument is null, the result is the null value.

Example: Assume that host variable HRAD is a DOUBLE with a value of 3.1415926536. The following statement:

```
   SELECT DEGREES(:HRAD)
     FROM SYSIBM.SYSDUMMY1;
```

returns a double precision floating-point number with an approximate value of 180.0.

DIGITS

```
►►──DIGITS(numeric-expression)──────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The DIGITS function returns a character string representation of the absolute value of a number.

The argument must be an expression that returns the value of one of the following built-in numeric data types: SMALLINT, INTEGER, or DECIMAL.

If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The result of the function is a fixed-length character string representing the absolute value of the argument without regard to its scale. The result does not include a sign or a decimal point. Instead, it consists exclusively of digits, including, if necessary, leading zeros to fill out the string. The length of the string is:

- 5 if the argument is a small integer
- 10 if the argument is a large integer
- *p* if the argument is a decimal number with a precision of *p*

The CCSID of the result is determined from the context in which the function was invoked. For more information, see "Determining the encoding scheme and CCSID of a string" on page 29.

Example 1: Assume that an INTEGER column called INTCOL containing a 10-digit number is in a table called TABLEX. INTCOL has the data type INTEGER instead of CHAR(10) to save space. List all combinations of the first four digits in column INTCOL.

```
SELECT DISTINCT SUBSTR(DIGITS(INTCOL),1,4)
  FROM TABLEX;
```

Example 2: Assume that COLUMNX has the data type DECIMAL(6,2), and that one of its values is -6.28. Then, for this value:

```
DIGITS(COLUMNX)
```

the value '000628' is returned.

The result is a string of length six (the precision of the column) with leading zeros padding the string out to this length. Neither sign nor decimal point appear in the result.

DOUBLE_PRECISION or DOUBLE

Numeric to Double:

```
►►──┬─DOUBLE_PRECISION─┬──(numeric-expression)──────────────────────────────►◄
    └─DOUBLE───────────┘
```

String to Double:

```
►►──┬─DOUBLE_PRECISON─┬──(string-expression)───────────────────────────────►◄
    └─DOUBLE──────────┘
```

The schema is SYSIBM.

The DOUBLE_PRECISION or DOUBLE function returns a double precision floating-point representation of a number or string representation of a number.

Numeric to Double

numeric-expression
An expression that returns a value of any built-in numeric data type.

The result is the same number that would occur if the expression were assigned to a double precision floating-point column or variable.

String to Double

string-expression
An expression that returns a value of a character or graphic string (except a CLOB or DBCLOB) with a length attribute that is not greater than 255 bytes. The string must contain a string representation of a number.

The result is the same number that would result from CAST(*string-expression* AS DOUBLE PRECISION). Leading and trailing blanks are removed from the string, and the resulting substring must conform to the rules for forming a string representation of an SQL floating-point, integer, or decimal constant.

The result of the function is a double precision floating-point number. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Recommendation: To increase the portability of applications, use the CAST specification. For more information, see “CAST specification” on page 151.

FLOAT can be specified as a synonym for DOUBLE or DOUBLE_PRECISION.

Example: Using sample table DSN8810.EMP, find the ratio of salary to commission for employees whose commission is not zero. The columns involved in the calculation, SALARY and COMM, have decimal data types. To eliminate the possibility of out-of-range results, apply the DOUBLE function to SALARY so that the division is carried out in floating-point.

```
SELECT EMPNO, DOUBLE(SALARY)/COMM
  FROM DSN8810.EMP
  WHERE COMM > 0;
```

ENCRYPT_TDES

```
►►──ENCRYPT_TDES(data-string-expression──┬──────────────────────────────────────────────────────────┬──)──────────►◄
                                         └─,password-string-expression─,hint-string-expression──┘
```

The schema is SYSIBM.

The ENCRYPT_TDES function returns a value that is the result of encrypting *data-string-expression* using the Triple DES encryption algorithm. The password used for encryption is either the *password-string-expression* value or the ENCRYPTION PASSWORD value, which is assigned using the SET ENCRYPTION PASSWORD statement.

data-string-expression
An expression that returns the string value to be encrypted. The length attribute for the data type of *data-string-expression* must be greater than or equal to 0 (zero). The length attribute is limited to 32640 if *hint-string-expression* is specified and 32672 if *hint-string-expression* is not specified.

password-string-expression
An expression that returns a CHAR or VARCHAR value with at least 6 bytes and no more than 127 bytes. The value represents the password that is used to encrypt *data-string-expression*. If the value of the password argument is null or not specified, the data is encrypted using the ENCRYPTION PASSWORD value, which must have been set for the session.

hint-string-expression
An expression that returns a CHAR or VARCHAR value up to 32 bytes that is to help data owners remember passwords (for example, 'Ocean' as a hint to remember 'Pacific'). If a hint value is specified, the hint is embedded into the result and can be retrieved using the GETHINT function. If this argument is null or not specified and no hint was specified when the ENCRYPTION PASSWORD was set, no hint is embedded in the result.

The result of the function is VARCHAR. The encoding scheme of the result is the same as the encoding scheme of *data-string-expression*. The result is bit data.

The length attribute of the result is:

- When *hint-string-expression* is specified, the length attribute of the non-encrypted data + 24 bytes + number of bytes to the next 8 byte boundary + 32 bytes for the hint.
- With *hint-string-expression* is not specified, the length attribute of the non-encrypted data + 24 bytes + the number of bytes to the next 8 byte boundary.

If the first argument can be null, the result can be null; if the first argument is null, the result is the null value.

The encrypted result is longer than the *data-string-expression* value. Therefore, when assigning encrypted values, ensure that the target is declared with a length that can contain the entire encrypted value.

When encrypting data, be aware of the following points:

- **Encryption algorithm:** The internal encryption algorithm used is Triple DES cipher block chaining (CBC) with padding. The 128-bit secret key is derived from the password using an MD5 hash.
- **Encryption passwords and data:** It is the user's responsibility to perform password management. After data is encrypted, only the password that is used to encrypt it can be used to decrypt it. If a different password is used to decrypt the data than was used to encrypt the data, the results of decryption will not match the original string. No error or warning is returned. Be careful when using CHAR variables to set password values because they may be padded with blanks. The encrypted result may contain null terminator and other non-printable characters.
- **Table column definitions:** When defining columns and types to contain encrypted data, always calculate the length attribute as follows:
  - For encrypted data with an embedded hint, the column length should be the length attribute of the non-encrypted data + 24 bytes + number of bytes to the next 8 byte boundary + 32 bytes for the hint.
  - For encrypted data with an embedded hint, the column length should be the length attribute of the non-encrypted data + 24 bytes + number of bytes to the next 8 byte boundary.

  Here are some sample column length calculations, which assume that a hint is not embedded:

  ```
  Maximum length of non-encrypted data          6 bytes
  24 bytes for encryption key                  24 bytes
  Number of bytes to the next 8 byte boundary   2 bytes
                                              ---------
  Encrypted data column length                 32 bytes

  Maximum length of non-encrypted data         32 bytes
  24 bytes for encryption key                  24 bytes
  Number of bytes to the next 8 byte boundary   0 bytes
                                              ---------
  Encrypted data column length                 56 bytes
  ```
- **Administration of encrypted data:** Encrypted data can be decrypted only on servers that support the decryption functions that correspond to the ENCRYPT_TDES function. Therefore, replication of columns with encrypted data should only be to servers that support the decryption functions.

ENCRYPT can be specified as a synonym for ENCRYPT_TDES. DB2 supports this keyword to provide compatibility with other products in the DB2 UDB family.

Example 1: Encrypt the social security number that is inserted into the table. Set the ENCRYPTION PASSWORD value to 'Ben123' and use it as the password.

```
 SET ENCRYPTION PASSWORD ='Ben123';
 INSERT INTO EMP(SSN) VALUES ENCRYPT_TDES ('289-46-8832');
```

Example 2: Encrypt the social security number that is inserted into the table. Explicitly specify 'Ben123' as the encryption password.

```
INSERT INTO EMP(SSN) VALUES ENCRYPT_TDES ('289-46-8832','Ben123');
```

Example 3: Encrypt the social security number that is inserted into the table. Specify 'Pacific' as the encryption password, and provide 'Ocean' as a hint to help the user remember the password of 'Pacific'.

```
INSERT INTO EMP(SSN) VALUES ENCRYPT_TDES ('289-46-8832','Pacific','Ocean');
```

returns a double precision floating-point number with an approximate value of 31.62.

EXP

```
►►──EXP(numeric-expression)──────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The EXP function returns a value that is the base of the natural logarithm (e) raised to a power specified by the argument. The EXP and LN functions are inverse operations.

The argument must be an expression that returns the value of any built-in numeric data type. If the argument is not a double precision floating-point number, it is converted to one for processing by the function.

The result of the function is a double precision floating-point number. The result can be null; if the argument is null, the result is the null value.

Example: Assume that host variable E is DECIMAL(10,9) with a value of 3.453789832. The following statement:

```
   SELECT EXP(:E)
     FROM SYSIBM.SYSDUMMY1;
```

returns a double precision floating-point number with an approximate value of 31.62.

FLOAT

```
►►──FLOAT(numeric-expression)──────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The FLOAT function returns a floating-point representation of a number or string representation of a number.

FLOAT is a synonym for the DOUBLE function. See “DOUBLE_PRECISION or DOUBLE” on page 251 for details.

FLOOR

```
►►──FLOOR(numeric-expression)──────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The FLOOR function returns the largest integer value that is less than or equal to the argument.

The argument must be an expression that returns a value of any built-in numeric data type.

The result of the function has the same data type and length attribute as the argument. When the argument is DECIMAL, the scale of the result is 0 and not the scale of the input argument. For example, an argument with a date type of DECIMAL(5,5) results in DECIMAL(5,0).

The result can be null. If the argument is null, the result is the null value.

Example 1: Using sample table DSN8810.EMP, find the highest monthly salary, rounding the result down to the next integer. The SALARY column has a decimal data type.

```
SELECT FLOOR(MAX(SALARY)/12)
  FROM DSN8810.EMP;
```

This example returns 04395 because the highest paid employee is Christine Haas who earns $52750.00 per year. Her average monthly salary before applying the FLOOR function is 4395.83.

Example 2: This example demonstrates using FLOOR with both positive and negative numbers.

```
SELECT FLOOR( 3.5),
       FLOOR( 3.1),
       FLOOR(-3.1),
       FLOOR(-3.5)
FROM SYSIBM.SYSDUMMY1;
```

This example returns (leading zeroes are shown to demonstrate the precision and scale of the result):

```
03. 03. -04. -04.
```

GENERATE_UNIQUE

```
►►──GENERATE_UNIQUE()──────────────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The GENERATE_UNIQUE function returns a bit data character string 13 bytes long (CHAR(13) FOR BIT DATA) that is unique compared to any other execution of the same function. The function is defined as not-deterministic. Although the function has no arguments, the empty parentheses must be specified when the function is invoked.

The result of the function is a unique value that includes the internal form of the Universal Time, Coordinated (UTC) and, if in a sysplex environment, the sysplex member where the function was processed. The result cannot be null.

The result of this function can be used to provide unique values in a table. Each successive value will be greater than the previous value, providing a sequence that can be used within a table. The sequence is based on the time when the function was executed.

This function differs from using the special register CURRENT TIMESTAMP in that a unique value is generated for each row of a multiple row insert statement or an insert statement with a fullselect.

The timestamp value that is part of the result of this function can be determined using the TIMESTAMP function with the result of GENERATE_UNIQUE as an argument.

Example: Create a table that includes a column that is unique for each row. Populate this column using the GENERATE_UNIQUE function. Notice that the UNIQUE_ID column is defined as FOR BIT DATA to identify the column as a bit data character string.

```
CREATE TABLE EMP_UPDATE
 (UNIQUE_ID VARCHAR(13)FOR BIT DATA,
  EMPNO CHAR(6),
  TEXT VARCHAR(1000));

INSERT INTO EMP_UPDATE VALUES (GENERATE_UNIQUE(),'000020','Update entry 1...');

INSERT INTO EMP_UPDATE VALUES (GENERATE_UNIQUE(),'000050','Update entry 2...');
```

This table will have a unique identifier for each row if GENERATE_UNIQUE is always used to set the value the UNIQUE_ID column. You can create an insert trigger on the table to ensure that GENERATE_UNIQUE is used to set the value:

```
CREATE TRIGGER EMP_UPDATE_UNIQUE
  NO CASCADE BEFORE INSERT ON EMP_UPDATE
  REFERENCING NEW AS NEW_UPD
  FOR EACH ROW MODE DB2SQL
  SET NEW_UPD.UNIQUE_ID = GENERATE_UNIQUE();
```

With this trigger, the previous INSERT statements that were used to populate the table could be issued without specifying a value for the UNIQUE_ID column:

```
INSERT INTO EMP_UPDATE (EMPNO,TEXT) VALUES ('000020','Update entry 1...');

INSERT INTO EMP_UPDATE (EMPNO,TEXT) VALUES ('000050','Update entry 2...');
```

The timestamp (in UTC) for when a row was added to EMP_UPDATE can be returned using:

```
SELECT TIMESTAMP(UNIQUE_ID), EMPNO, TEXT FROM EMP_UPDATE;
```

Therefore, the table does not need a timestamp column to record when a row is inserted.

GETHINT

```
►►──GETHINT(encrypted-data)──────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The GETHINT function returns a hint for the password if a hint was embedded in the encrypted data. A password hint is a phrase that helps you remember the password with which the data was encrypted (for example, ’Ocean’ might be used as a hint to help remember the password ’Pacific’).

encrypted-data
: An expression that returns a CHAR FOR BIT DATA or VARCHAR FOR BIT DATA value that is a complete, encrypted data string. The data string must have been encrypted with the ENCRYPT_TDES function.

The result of the function is VARCHAR(32). The result can be null; if the argument is null or no hint was specified when the ENCRYPT_TDES function was used to encrypt the data, the result is the null value.

The encoding scheme of the result is the same as the encoding scheme of *encrypted-data*. If *encrypted-data* is bit data, the CCSID of the result is the default character CCSID for that encoding scheme. Otherwise, the CCSID of the result is the same as the CCSID of *encrypted-data*.

For additional information about this function, see “DECRYPT_BIT, DECRYPT_CHAR, and DECRYPT_DB” on page 246 and “ENCRYPT_TDES” on page 253.

Example: This example shows how to embed a hint for the password when encrypting data and how to later use the GETHINT function to retrieve the embedded hint. In this example, the hint ’Ocean’ is used to help remember the encryption password ’Pacific’.

```
INSERT INTO EMP (SSN) VALUES ENCRYPT_TDES ('289-46-8832','Pacific','Ocean');
SELECT GETHINT (SSN) FROM EMP;
```

The value that is returned is ’Ocean’.

GETVARIABLE

```
►►──GETVARIABLE(string-constant──┬───────────────────────────────┬──)───────────────►◄
                                 ├─,──default-value──────────────┤
                                 └─,──CAST──(──NULL AS──VARCHAR(1)──)─┘
```

The schema is SYSIBM.

The GETVARIABLE function returns a varying-length character-string representation of the current value of the session variable that is identified by *string-expression*.

string-constant
Specifies a string constant that contains the name of the session variable whose value is to be returned. The string constant:

- Must have a length that does not exceed 142 bytes.
- Must contain the fully qualified name of the variable, with no embedded blanks. Delimited identifiers must not be specified.
- Must not contain lowercase letters or characters that cannot be specified in an ordinary identifier.

The schema qualifier for the variable must be:

- SESSION for user-defined session variables. User-defined session variables are established via the connection or signon exit routines. For more information about setting user-defined session variables, see Appendix B of *DB2 Administration Guide*.
- SYSIBM for built-in session variables. For a list of the built-in session variables, see “References to built-in session variables” on page 123.

default-value
Specifies a string constant that contains the value to be returned if the specified variable does not exist or is not supported by DB2. *default-value* must be a string constant that does not exceed 255 bytes

CAST(NULL AS VARCHAR(1))
Specifies that a null value is to be returned if the specified variable does not exist or is not supported by DB2.

The data type of the result is VARCHAR(255). The result can be null.

The CCSID of the result is the CCSID for Unicode mixed data.

Example 1: Use the GETVARIABLE function to set the value of host variable :hv1 to the name of the plan that is currently being executed. The name of the built-in session variable that contains the name of the plan is SYSIBM.PLAN_NAME.

```
SET :hv1 = GETVARIABLE('SYSIBM.PLAN_NAME');
```

If DB2 does not support the name of the session variable, an error is returned. For example, the following statement returns an error because DB2 does not support a built-in session variable that is named SYSIBM.XYZ.

```
SET :hv1 = GETVARIABLE('SYSIBM.XYZ');
```

Example 2: Use the GETVARIABLE function to set the value of host variable :hv2 to the value for the user that is defined in user-defined session variable TEST. If the session variable has not been set or cannot be found, have the function return the value 'TEST FAILED'.

```
SET :hv2 = GETVARIABLE('SESSION.TEST','TEST FAILED');
```

Example 3: Use the GETVARIABLE function to set the value of host variable :hv3 to a string representations of the SYSTEM EBCDIC CCSIDs. The name of the built-in session variable that contains the system EBCDIC CCSIDs is SYSIBM.SYSTEM_EBCDIC_CCSID.

```
SET :hv3 = GETVARIABLE('SYSIBM.SYSTEM_EBCDIC_CCSID');
```

Regardless of the setting of the field MIXED DATA on the installation panel (YES or NO), the function returns three comma-delimited values that correspond to the SBCS, MIXED, and GRAPHIC CCSIDs for the encoding scheme.

For example, if the statement were issued on a system with the field MIXED DATA on the installation panel equal to NO and the default system CCSID of 37, this string would be returned:

'37,65534,65534'

If the statement were issued on a system with the field MIXED DATA on the installation panel equal to YES and a default system CCSID of 930 (the mixed CCSID for the system), this string would be returned:

'290,930,300'

GRAPHIC

Character to Graphic:

```
►►─GRAPHIC(character-expression─┬────────────┬─)──────────────────────────────────►◄
                                 └─,─integer─┘
```

Graphic to Graphic:

```
►►─GRAPHIC(graphic-expression─┬────────────┬─)────────────────────────────────────►◄
                               └─,─integer─┘
```

The schema is SYSIBM.

The GRAPHIC function returns a graphic representation of a character string value, with the single-byte characters converted to double-byte characters, or a graphic string value if the first argument is a graphic string.

The result of the function is a fixed-length graphic string (GRAPHIC).

If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The length attribute of the result is measured in double-byte characters because it is a graphic string.

Character to Graphic

character-expression

An expression that returns a value that is an EBCDIC-encoded or Unicode-encoded character string. It cannot be BIT data. The argument does not need to be mixed data, but any occurrences of X'0E' and X'0F' in the string must conform to the rules for EBCDIC mixed data. (See “Character strings” on page 58 for these rules.)

The value of the expression must not be an empty string or have the value X'0E0F' if the string is an EBCDIC string.

integer

The length of the resulting fixed-length graphic string. The value must be an integer constant between 1 and 127. If the length of *character-expression* is less than the length specified, the result is padded with double-byte blanks to the length of the result.

If *integer* is not specified, the length of the result for an EBCDIC string is the minimum of 127 and the length attribute of *character-expression*, excluding shift characters. For a Unicode (UTF-8) string, the length is data dependent, but does not exceed 127.

The CCSID of the result is the graphic CCSID that corresponds to the character CCSID of *character-expression*. If the input is EBCDIC and there is no system CCSID for EBCDIC GRAPHIC data, the CCSID of the result is X'FFFE'.

For EBCDIC data:

Each character of *character-expression* determines a character of the result. The argument might need to be converted to the native form of mixed data before the result is derived. Let M be the system CCSID for mixed data. The argument is not converted if any of the following conditions is true:

- The argument is mixed data and its CCSID is M.
- The argument is SBCS data and its CCSID is the same as the system CCSID for SBCS data. In this case, the operation proceeds as if the CCSID of the argument is M.

Otherwise, the argument is a new string S derived by converting the characters to the coded character set identified by M. If there is no system CCSID for EBCDIC mixed data, conversion is to the coded character set that the system CCSID for SBCS data identifies.

The result is derived from S using the following steps:

- Each shift character (X'0E' or X'0F') is removed.
- Each double-byte character remains as is.
- Each single-byte character is replaced by a double-byte character.

The replacement for an SBCS character is the equivalent DBCS character if an equivalent exists. Otherwise, the replacement is X'FEFE'. The existence of an equivalent character depends on M. If there is no system CCSID for mixed data, the DBCS equivalent of X'xx' for EBCDIC is X'42xx', except for X'40', whose DBCS equivalent is X'4040'.

For Unicode data:

Each character of *character-expression* determines a character of the result. The argument might need to be converted to the native form of mixed data before the result is derived. Let M be the system CCSID for mixed data. The argument is not converted if any of the following conditions is true:

- The argument is mixed data, and its CCSID is M.
- The argument is SBCS data, and its CCSID is the same as the system CCSID for SBCS data. In this case, the operation proceeds as if the CCSID of the argument is M.

Otherwise, the argument is a new string S derived by converting the characters to the coded character set identified by M.

The result is derived from S by using the following steps:

- Each non-supplementary character is replaced by a Unicode double-byte character (a UTF-16 code point). A non-supplementary character in UTF-8 is between 1 and 3 bytes.
- Each supplementary character is replaced by a pair of Unicode double-byte characters (a pair of UTF-16 code points).

The replacement for a single-byte character is the Unicode equivalent character if an equivalent exists. Otherwise, the replacement is X'FEFE'.

Graphic to Graphic

graphic-expression
An expression that returns a value that is a graphic string. The graphic string must not be an empty string.

integer
The length of the resulting fixed-length graphic string. The value must be an integer constant between 1 and 127. If the length of *graphic-expression* is less than the length specified, the result is padded with double-byte blanks to the length of the result.

If *integer* is not specified, the length of the result is the minimum of 127 and the length attribute of *graphic-expression*.

If the length of the *graphic-expression* is greater than the specified length of the result, the result is truncated. Unless all the truncated characters are blanks, a warning is returned.

The CCSID of the result is the same as the CCSID of *graphic-expression*.

Example: Assume that MYCOL is a VARCHAR column in TABLEY. The following function returns the string in MYCOL as a fixed-length graphic string.

```
SELECT GRAPHIC(MYCOL)
  FROM TABLEY;
```

HEX

```
▶▶──HEX(expression)──────────────────────────────────────────────────────────▶◀
```

The schema is SYSIBM.

The HEX function returns a hexadecimal representation of a value.

The argument must an expression that returns a value of any built-in data type. A character or binary string must not have a maximum length greater than 16352. A graphic string must not have a maximum length greater than 8176.

The result of the function is a character string. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The result is a string of hexadecimal digits. The first two represent the first byte of the argument, the next two represent the second byte of the argument, and so forth. If the argument is a datetime value, the result is the hexadecimal representation of the internal form of the argument.

If the argument is a graphic string, the length of the result is four times the maximum length of the argument. Otherwise, the length of the result is twice the (maximum) length of the argument.

If the argument is a fixed-length string and the length of the result is less than 255, the result is a fixed-length string. Otherwise, the result is a varying-length string with a length attribute that depends on the following considerations:

If the argument is not a varying-length string, the length attribute of the result string is the same as the length of the result.

If the argument is a varying-length character or binary string, the length attribute of the result string is twice the length attribute of the argument.

If the argument is a varying-length graphic string, the length attribute of the result string is four times the length attribute of the argument.

If *expression* returns string data, the CCSID of the result is the SBCS CCSID that corresponds to the CCSID of *expression*. Otherwise, the CCSID of the result is determined from the context in which the function was invoked. For more information, see "Determining the encoding scheme and CCSID of a string" on page 29.

Example: Return the hexadecimal representation of START_RBA in the SYSIBM.SYSCOPY catalog table.

```
SELECT HEX(START_RBA) FROM SYSIBM.SYSCOPY;
```

HOUR

```
►►──HOUR(expression)─────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The HOUR function returns the hour part of a value.

The argument must be an expression that returns a value of one of the following built-in data types: a time, a timestamp, a character string, a graphic string, or a numeric data type.

- If *expression* is a character or graphic string, it must not be a CLOB or DBCLOB, and its value must be a valid string representation of a time or timestamp with an actual length of not greater than 255 bytes. For the valid formats of string representations of times and timestamps, see “String representations of datetime values” on page 65.
- If *expression* is a number, it must be a time or timestamp duration. For the valid formats of time and timestamp durations, see “Datetime operands” on page 88.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The other rules depend on the data type of the argument:

If the argument is a time, timestamp, or string representation of either, the result is the hour part of the value, which is an integer between 1 and 24.

If the argument is a time duration or timestamp duration, the result is the hour part of the value, which is an integer between -99 and +99. A nonzero result has the same sign as the argument.

Example: Assume that a table named CLASSES contains a row for each scheduled class. Also assume that the class starting times are in a TIME column named STARTTM. Select those rows in CLASSES that represent classes that start after the noon hour.

```
SELECT *
  FROM CLASSES
  WHERE HOUR(STARTTM) > 12;
```

IDENTITY_VAL_LOCAL

```
►►──IDENTITY_VAL_LOCAL()─────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The IDENTITY_VAL_LOCAL function is a nondeterministic function[19] that returns the most recently assigned value for an identity column. Although the function has no input parameters, the empty parentheses must be specified when the function is invoked.

The result is DECIMAL(31,0), regardless of the actual data type of the identity column that the result value corresponds to.

The value that is returned is the value that was assigned to the identity column of the table identified in the most recent row INSERT statement with a VALUES clause for a table with an identity column. The INSERT statement has to be issued at the same level; that is, the value has to be available *locally* within the level at which it was assigned until replaced by the next assigned value. A new level is initiated when a trigger, function, or stored procedure is invoked. A trigger condition is at the same level as the associated triggered action.

The assigned value can be a value supplied by the user (if the identity column is defined as GENERATED BY DEFAULT) or an identity value that was generated by DB2.

The result can be null. The result is null in the following situations:

- When a single row INSERT statement with a VALUES clause has not been issued for a table containing an identity column at the current processing level
- When a COMMIT or ROLLBACK of a unit of work occurred since the most recent INSERT statement that assigned a value

The result of the function is not affected by the following statements:

- An INSERT statement with a VALUES clause for a table that does not contain an identity column
- An INSERT statement with a subselect
- A ROLLBACK TO SAVEPOINT statement

Notes

The following notes explain the behavior of the function when it is invoked in various situations:

Invoking the function within the VALUES clause of an INSERT statement

Expressions in an INSERT statement are evaluated before values are assigned to the target columns of the INSERT statement. Thus, when you invoke IDENTITY_VAL_LOCAL in an INSERT statement, the value that is used is the most recently assigned value for an identity column from a

[19] Being nondeterministic affects what optimization (such as view processing and parallel processing) can be done when this function is used and in what contexts the function can be invoked. For example, the RAND function is another built-in scalar that is not deterministic. Using nondeterministic functions within a predicate can cause unpredictable results.

previous INSERT statement. The function returns the null value if no such INSERT statement had been executed within the same level as the invocation of the IDENTITY_VAL_LOCAL function. Each INSERT statement involving an IDENTITY column causes the identity value to be copied into connection-specific storage in DB2. Thus, the most recent identity value is used for a connection, regardless of what is happening with other concurrent user connections.

Invoking the function following a failed INSERT statement

The function returns an unpredictable result when it is invoked after the unsuccessful execution of a single row INSERT with a VALUES clause for a table with an identity column. The value might be the value that would have been returned from the function had it been invoked before the failed INSERT or the value that would have been assigned had the INSERT succeeded. The actual value returned depends on the point of failure and is therefore unpredictable.

Invoking the function within the SELECT statement of a cursor

Because the results of the IDENTITY_VAL_LOCAL function are not deterministic, the result of an invocation of the IDENTITY_VAL_LOCAL function from within the SELECT statement of a cursor can vary for each FETCH statement.

Invoking the function within the trigger condition of an insert trigger

The result of invoking the IDENTITY_VAL_LOCAL function from within the condition of an insert trigger is the null value.

Invoking the function within a triggered action of an insert trigger

Multiple before or after insert triggers can exist for a table. In such cases, each trigger is processed separately, and identity values generated by SQL statements issued within a triggered action are not available to other triggered actions using the IDENTITY_VAL_LOCAL function. This is the case even though the multiple triggered actions are conceptually defined at the same level.

Do not use the IDENTITY_VAL_LOCAL function in the triggered action of a before insert trigger. The result of invoking the IDENTITY_VAL_LOCAL function from within the triggered action of a before insert trigger is the null value.

The value for the identity column of the table for which the trigger is defined cannot be obtained by invoking the IDENTITY_VAL_LOCAL function within the triggered action of a before insert trigger. However, the value for the identity column can be obtained in the triggered action by referencing the trigger transition variable for the identity column.

The result of invoking the IDENTITY_VAL_LOCAL function in the triggered action of an after insert trigger is the value assigned to an identity column of the table identified in the most recent single row INSERT statement. That statement is the one invoked in the same triggered action that had a VALUES clause for a table containing an identity column. If a single row INSERT statement with a VALUES clause for a table containing an identity column was not executed within the same triggered action before invoking the IDENTITY_VAL_LOCAL function, then the function returns a null value.

Invoking the function following an INSERT with triggered actions

The result of invoking the function after an INSERT that activates triggers is the value actually assigned to the identity column (that is, the value that would be returned on a subsequent SELECT statement). This value is not necessarily the value provided in the VALUES clause of the INSERT statement or a value generated by DB2. The assigned value could be a value that was specified in a SET transition variable statement within the triggered action of a before insert trigger for a trigger transition variable associated with the identity column.

Examples

Example 1: Set the variable IVAR to the value assigned to the identity column in the EMPLOYEE table. The value returned from the function in the VALUES statement should be 1.

```
CREATE TABLE EMPLOYEE
(EMPNO        INTEGER GENERATED ALWAYS AS IDENTITY,
 NAME         CHAR(30),
 SALARY       DECIMAL(5,2),
 DEPTNO       SMALLINT);

INSERT INTO EMPLOYEE
(NAME, SALARY, DEPTNO)
VALUES ('Rupert', 989.99, 50);

VALUES IDENTITY_VAL_LOCAL() INTO :IVAR;
```

Example 2: Assume two tables, T1 and T2, have an identity column named C1. DB2 generates values 1, 2, 3, . . . for the C1 column in table T1, and values 10, 11, 12, . . . for the C1 column in table T2.

```
CREATE TABLE T1 (C1 SMALLINT GENERATED ALWAYS AS IDENTITY,
                 C2 SMALLINT );

CREATE TABLE T2 (C1 DECIMAL(15,0) GENERATED BY DEFAULT AS IDENTITY
                                   (START WITH 10),
                 C2 SMALLINT );

INSERT INTO T1 (C2) VALUES (5);

INSERT INTO T1 (C2) VALUES (5);

SELECT * FROM T1;

    C1           C2
-----------   ----------
          1            5
          2            5

VALUES IDENTITY_VAL_LOCAL() INTO  :IVAR;
```

At this point, the IDENTITY_VAL_LOCAL function would return a value of 2 in IVAR. The following INSERT statement inserts a single row into T2 where column C2 gets a value of 2 from the IDENTITY_VAL_LOCAL function

```
INSERT INTO T2 (C2) VALUES (IDENTITY_VAL_LOCAL());

SELECT * FROM T2
 WHERE C1 = DECIMAL(IDENTITY_VAL_LOCAL(),15,0);

              C1                         C2
 ----------------------------------   ----------
                                 10            2
```

Invoking the IDENTITY_VAL_LOCAL function after this insert would result in a value of 10, which is the value generated by DB2 for column C1 of T2. Assume another single row is inserted into T2. For the following INSERT statement, DB2 assigns a value of 13 to identity column C1 and gives C2 a value of 10 from IDENTITY_VAL_LOCAL. Thus, C2 is given the last identity value that was inserted into T2.

```
INSERT INTO T2 (C2, C1) VALUES (IDENTITY_VAL_LOCAL(), 13);
```

Example 3: The IDENTITY_VAL_LOCAL function can also be invoked in an INSERT statement that both invokes the IDENTITY_VAL_LOCAL function and causes a new value for an identity column to be assigned. The next value to be returned is thus established when the IDENTITY_VAL_LOCAL function is invoked after the INSERT statement completes. For example, consider the following table definition:

```
CREATE TABLE T1 (C1 SMALLINT GENERATED BY DEFAULT AS IDENTITY,
                 C2 SMALLINT);
```

For the following INSERT statement, specify a value of 25 for the C2 column, and DB2 generates a value of 1 for C1, the identity column. This establishes 1 as the value that will be returned on the next invocation of the IDENTITY_VAL_LOCAL function.

```
INSERT INTO T1 (C2) VALUES (25);
```

In the following INSERT statement, the IDENTITY_VAL_LOCAL function is invoked to provide a value for the C2 column. A value of 1 (the identity value assigned to the C1 column of the first row) is assigned to the C2 column, and DB2 generates a value of 2 for C1, the identity column. This establishes 2 as the value that will be returned on the next invocation of the IDENTITY_VAL_LOCAL function.

```
INSERT INTO T1 (C2) VALUES (IDENTITY_VAL_LOCAL());
```

In the following INSERT statement, the IDENTITY_VAL_LOCAL function is again invoked to provide a value for the C2 column, and the user provides a value of 11 for C1, the identity column. A value of 2 (the identity value assigned to the C1 column of the second row) is assigned to the C2 column. The assignment of 11 to C1 establishes 11 as the value that will be returned on the next invocation of the IDENTITY_VAL_LOCAL function.

```
INSERT INTO T1 (C2, C1) VALUES (IDENTITY_VAL_LOCAL(), 11);
```

After the 3 INSERT statements have been processed, table T1 contains the following:

```
SELECT * FROM T1;

C1          C2
----------- -----------
          1          25
          2           1
         11           2
```

The contents of T1 illustrate that the expressions in the VALUES clause are evaluated before the assignments for the columns of the INSERT statement. Thus, an invocation of an IDENTITY_VAL_LOCAL function invoked from a VALUES clause of an INSERT statement uses the most recently assigned value for an identity column in a previous INSERT statement.

IFNULL

```
►►──IFNULL(expression,expression)──────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The IFNULL function returns the first nonnull expression.

IFNULL is identical to the COALESCE scalar function except that IFNULL is limited to two arguments instead of multiple arguments. For a description, see “COALESCE” on page 228.

Example: For all the rows in sample table DSN8810.EMP, select the employee number and salary. If the salary is missing (is null), have the value 0 returned.

```
SELECT EMPNO, IFNULL(SALARY,0)
  FROM DSN8810.EMP;
```

INSERT

```
►►──INSERT(source-string,start,length,insert-string)──────────────────────────►◄
```

The schema is SYSIBM.

The INSERT function returns a string where, beginning at *start* in *source-string*, *length* bytes have been deleted and *insert-string* has been inserted.

source-string
: An expression that specifies the source string. The expression must return a value that is a built-in character or graphic string data type that is not a LOB. The actual length of the string must be greater than zero.

start
: An expression that returns an integer. The integer specifies the starting point within the source string where the deletion of bytes and the insertion of another string is to begin. The value of the integer must be in the range of 1 to the length of *source-string* plus one.

length
: An expression that returns an integer. The integer specifies the number of bytes for character data or the number of characters for graphic data that are to be deleted from the source string, starting at the position identified by *start*. The value of the integer must be in the range of 0 to the length of *source-string*.

insert-string
: An expression that specifies the string to be inserted into the source string, starting at the position identified by *start*. The expression must return a value that is a built-in character or graphic string data type that is not a LOB.

If *source-string* and *insert-string* have different CCSID sets, then *insert-string* (the string to be inserted) is converted to the CCSID of *source-string* (the source string).

The encoding scheme of the result is the same as *source-string*. The data type of the result of the function depends on the data type of *source-string* and *insert-string*:

- VARCHAR if *source-string* is a character string. The CCSID of the result depends on the arguments:
  - If either *source-string* or *insert-string* is character bit data, the result is bit data.
  - If both *source-string* and *insert-string* are SBCS:
    - If both *source-string* and *insert-string* are SBCS Unicode data, the CCSID of the result is the CCSID for SBCS Unicode data.
    - If *source-string* is SBCS Unicode data and *insert-string* is not SBCS Unicode data, the CCSID of the result is the mixed CCSID for Unicode data.
    - Otherwise, the CCSID of the result is the same as the CCSID of *source-string*.

  - Otherwise, the CCSID of the result is the mixed CCSID that corresponds to the CCSID of *source-string*. However, if the input is EBCDIC or ASCII and there is no corresponding system CCSID for mixed, the CCSID of the result is the CCSID of *source-string*.
- VARGRAPHIC if *source-string* is a graphic. The CCSID of the result is the same as the CCSID of *source-string*.

The length attribute of the result depends on the arguments:

- If *start* and *length* are constants, the length attribute of the result is:

  ```
  L1 - MIN((L1 - V2 + 1), V3) + L4
  ```

  where:
  L1 is the length attribute of *source-string*
  V2 is the value of *start*
  V3 is the value of *length*
  L4 is the length attribute of *insert-string*
- Otherwise, the length attribute of the result is the length attribute of *source-string* plus the length attribute of *insert-string*. In this case, the length attribute of *source-string* plus the length attribute of *insert-string* must not exceed 32704 for a VARCHAR result or 16352 for a VARGRAPHIC result.

The actual length of the result is:

```
A1 - MIN((A1 - V2 + 1), V3) + A4
```

where:
A1 is the actual length of *source-string*
V2 is the value of *start*
V3 is the value of *length*
A4 is the actual length of *insert-string*

If the actual length of the result string exceeds the maximum for the return data type, an error occurs.

If any argument can be null, the result can be null; if any argument is null, the result is the null value.

Example 1: The following example shows how the string 'INSERTING' can be changed into other strings. The use of the CHAR function limits the length of the resulting string to 10 bytes.

```
SELECT CHAR(INSERT('INSERTING',4,2,'IS'),10),
       CHAR(INSERT('INSERTING',4,0,'IS'),10),
       CHAR(INSERT('INSERTING',4,2,''),10)
  FROM SYSIBM.SYSDUMMY1;
```

This example returns 'INSISTING ', 'INSISERTIN', and 'INSTING '

Example 2: The previous example demonstrated how to insert text into the middle of some text. This example shows how to insert text before some text by using 1 as the starting point (*start*).

```
SELECT CHAR(INSERT('INSERTING',1,0,'XX'),10),
       CHAR(INSERT('INSERTING',1,1,'XX'),10),
       CHAR(INSERT('INSERTING',1,2,'XX'),10),
       CHAR(INSERT('INSERTING',1,3,'XX'),10)
  FROM SYSIBM.SYSDUMMY1;
```

This example returns 'XXINSERTIN', 'XXNSERTING', 'XXSERTING ', and 'XXERTING   '

Example 3: The following example shows how to insert text after some text. Add 'XX' at the end of string 'ABCABC'. Because the source string is 6 characters long, set the starting position to 7 (one plus the length of the source string).

```
SELECT CHAR(INSERT('ABCABC',7,0,'XX'),10)
  FROM SYSIBM.SYSDUMMY1;
```

This example returns 'ABCABCXX '.

INTEGER or INT

Numeric to Integer:

```
►►──┬─INTEGER─┬──(numeric-expression)──────────────────────────────────►◄
    └─INT─────┘
```

String to Integer:

```
►►──┬─INTEGER─┬──(string-expression)───────────────────────────────────►◄
    └─INT─────┘
```

The schema is SYSIBM.

The INTEGER or INT function returns an integer representation of a number or string representation of a number.

Numeric to Integer

numeric-expression
An expression that returns a value of any built-in numeric data type.

The result is the same number that would occur if the argument were assigned to a large integer column or variable. If the whole part of the argument is not within the range of integers, an error occurs. If present, the decimal part of the argument is truncated.

String to Integer

string-expression
An expression that returns a value of a character or graphic string (except a CLOB or DBCLOB) with a length attribute that is not greater than 255 bytes. The string must contain a string representation of a number.

The result is the same number that would result from CAST(*string-expression* AS INTEGER). Leading and trailing blanks are eliminated and the resulting string must conform to the rules for forming an integer constant. If the whole part of the argument is not within the range of integers, an error is returned.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Recommendation: To increase the portability of applications, use the CAST specification. For more information, see “CAST specification” on page 151.

Example 1: Using sample table DSN8810.EMP, find the average salary of the employees in department A00, rounding the result to the nearest dollar.

```
SELECT INTEGER(AVG(SALARY)+.5)
  FROM DSN8810.EMP
  WHERE WORKDEPT = 'A00';
```

Example 2: Using sample table DSN8810.EMP, select the EMPNO column, which is defined as CHAR(6), in integer form.

```
SELECT INTEGER(EMPNO)
  FROM DSN8810.EMP;
```

JULIAN_DAY

```
►►──JULIAN_DAY(expression)────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The JULIAN_DAY function returns an integer value representing a number of days from January 1, 4713 B.C. (the start of the Julian date calendar) to the date specified in the argument.

The argument must be an expression that returns one of the following data types: a date, a timestamp, or a valid string representation of a date or timestamp. An argument with a character string data type must not be a CLOB. An argument with a graphic string data type must not be a DBCLOB. A string argument must have an actual length that is not greater than 255 bytes. For the valid formats of string representations of dates and timestamps, see “String representations of datetime values” on page 65.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example 1: Using sample table DSN8810.EMP, set the integer host variable JDAY to the Julian day of the day that Christine Haas (EMPNO = '000010') was employed (HIREDATE = '1965-01-01').

```
SELECT JULIAN_DAY(HIREDATE)
  INTO :JDAY
  FROM DSN8810.EMP
  WHERE EMPNO = '000010';
```

The result is that JDAY is set to 2438762.

Example 2: Set integer host variable JDAY to the Julian day for January 1, 1998.

```
SELECT JULIAN_DAY('1998-01-01')
  INTO :JDAY
  FROM SYSIBM.SYSDUMMY1;
```

The result is that JDAY is set to 2450815.

LAST_DAY

```
►►──LAST_DAY(expression)──────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The LAST_DAY scalar function returns a date that represents the last day of the month indicated by *expression*.

The argument must be an expression that returns one of the following data types: a date, a timestamp, or a valid string representation of a date or timestamp. An argument with a character string data type must not be a CLOB. An argument with a graphic string data type must not be a DBCLOB. A string argument must have an actual length that is not greater than 255 bytes. For the valid formats of string representations of dates and timestamps, see “String representations of datetime values” on page 65.

The result of the function is a DATE. The result can be null; if the value of *date-expression* is null, the result is the null value.

Example 1: Set the host variable END_OF_MONTH with the last day of the current month.

```
SET :END_OF_MONTH = LAST_DAY(CURRENT_DATE);
```

The host variable END_OF_MONTH is set with the value representing the end of the current month. If the current day is 2000-02-10, then END_OF_MONTH is set to 2000-02-29.

Example 2: Set the host variable END_OF_MONTH with the last day of the month in EUR format for the given date.

```
SET :END_OF_MONTH = CHAR(LAST_DAY('1965-07-07'), EUR);
```

The host variable END_OF_MONTH is set with the value ’31.07.1965’.

LCASE

```
►►──LCASE(string-expression)──────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The LCASE function returns a string in which all the characters have been converted to lowercase characters.

The LCASE function is identical to the LOWER function. For more information, see “LOWER” on page 288.

LEFT

```
►►──LEFT(string-expression,integer)──────────────────────────────────────────►◄
```

The schema is SYSIBM.

The LEFT function returns the leftmost *integer* bytes of *string-expression*.

string-expression
An expression that specifies the string from which the result is derived. The string must be a character, graphic, or binary string. A substring of *string-expression* is zero or more contiguous bytes of *string-expression*.

The string can contain mixed data. However, because the function operates on a strict byte-count basis, the result is not necessarily a properly formed mixed data character string.

integer
An expression that specifies the length of the result. The value must be an integer between 0 and *n*, where *n* is the length attribute of *string-expression*.

The *string-expression* is effectively padded on the right with the necessary number of padding characters so that the specified substring of *string-expression* always exists. The encoding scheme of the data determines the padding character:

- For ASCII SBCS data or ASCII mixed data, the padding character is X'20'.
- For ASCII DBCS data, the padding character depends on the CCSID; for example, for Japan (CCSID 301) the padding character is X'8140', while for simplified Chinese it is X'A1A1'.
- For EBCDIC SBCS data or EBCDIC mixed data, the padding character is X'40'.
- For EBCDIC DBCS data, the padding character is X'4040'.
- For Unicode SBCS data or UTF-8 (Unicode mixed data), the padding character is X'20'.
- For UTF-16 (Unicode DBCS) data, the padding character is X'0020'.
- For binary data, the padding character is X'00'.

The result of the function is a varying-length string with a length attribute that is the same as the length attribute of *string-expression* and a data type that depends on the data type of *string*:

- VARCHAR if *string-expression* is CHAR or VARCHAR
- CLOB if *string-expression* is CLOB
- VARGRAPHIC if *string-expression* is GRAPHIC or VARGRAPHIC
- DBCLOB if *string-expression* is DBCLOB
- BLOB if *string-expression* is BLOB

The actual length of the result is *integer*.

If any argument of the function can be null, the result can be null; if any argument is null, the result is the null value.

The CCSID of the result is the same as that of the *string-expression*.

Example 1: Assume that host variable ALPHA has a value of 'ABCDEF'. The following statement:

```
SELECT LEFT(:ALPHA,3)
  FROM SYSIBM.SYSDUMMY1;
```

returns 'ABC', which are the three leftmost characters in ALPHA.

Example 2: Assume that host variable NAME, which is defined as VARCHAR(50), has a value of 'KATIE AUSTIN' and the integer host variable FIRSTNAME_LEN has a value of 5. The following statement:

```
SELECT LEFT(:NAME, :FIRSTNAME_LEN)
  FROM SYSIBM.SYSDUMMY1;
```

returns the value 'KATIE'.

Example 3: The following statement returns a zero length string.

```
SELECT LEFT('ABCABC',0)
  FROM SYSIBM.SYSDUMMY1;
```

Example 4: The FIRSTNME column in sample EMP table is defined as VARCHAR(12). Find the first name for an employee whose last name is ’BROWN’ and return the first name in a 10-byte string.

```
SELECT LEFT(FIRSTNME,10)
  FROM DSN8810.EMP
  WHERE LASTNAME='BROWN';
```

This function returns a VARCHAR(10) string that has the value of ’DAVID’ followed by 5 blank characters.

LENGTH

```
►►──LENGTH(expression)──────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The LENGTH function returns the length of a value.

The argument must be an expression that returns a value of any built-in data type.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The result is the length of the argument. The length does not include the null indicator byte of column arguments that allow null values. The length of strings includes blanks. The length of a varying-length string is the actual length, not the maximum length.

The length of a graphic string is the number of double-byte characters. Unicode UTF-16 data is treated as graphic data; a UTF-16 supplementary character takes two DBCS characters to represent and as such is counted as two DBCS characters.

The length of all other values is the number of bytes used to represent the value:
- 2 for small integer
- 4 for large integer
- The integer part of (*p*/2)+1 for decimal numbers with precision *p*
- 4 for single precision floating-point
- 8 for double precision floating-point
- The length of the string for strings
- 4 for date
- 3 for time
- 10 for timestamp
- The length of the row ID

Example 1: Assume that FIRSTNME is a VARCHAR(12) column that contains 'ETHEL' for employee 280. The following query:

```
SELECT LENGTH(FIRSTNME)
  FROM DSN8810.EMP
  WHERE EMPNO = '000280';
```

returns the value 5.

Example 2: Assume that HIREDATE is a column of data type DATE. Then, regardless of value:

```
LENGTH(HIREDATE)
```

returns the value 4, and

```
LENGTH(CHAR(HIREDATE, EUR))
```

returns the value 10.

LN

```
►►──LN(numeric-expression)──────────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The LN function returns the natural logarithm of the argument. The LN and EXP functions are inverse operations.

The argument must be an expression that returns the value of any built-in numeric data type. If the argument is not a double precision floating-point number, it is converted to one for processing by the function.

The result of the function is a double precision floating-point number. The result can be null; if the argument is null, the result is the null value.

LOG is a synonym for LN.

Example: Assume that host variable NATLOG is DECIMAL(4,2) with a value of 31.62. The following statement:

```
   SELECT LN(:NATLOG)
     FROM SYSIBM.SYSDUMMY1;
```

returns a double precision floating-point number with an approximate value of 3.45.

LOCATE

```
►►──LOCATE(search-string,source-string──┬────────┬──)────────────────────────────────►◄
                                        └─,start─┘
```

The schema is SYSIBM.

The LOCATE function returns the starting position of the first occurrence of one string (called the *search-string*) within another string (called the *source-string*). If the *search-string* is not found and neither argument is null, the result is zero. If the *search-string* is found, the result is a number from 1 to the actual length of the *source-string*. If the optional *start* is specified, it indicates the character position in the *source-string* at which the search is to begin.

search-string

An expression that specifies the string that is to be searched for. *search-string* must return a value that is a built-in character string data type, graphic string data type, or binary string data type with an actual length that is no greater than 4000 bytes. The expression can be specified by any of the following:

- A constant
- A special register
- A host variable (including a LOB locator variable)
- A scalar function whose arguments are any of the above (though nested function invocations cannot be used)
- A CAST specification whose arguments are any of the above
- An expression that concatenates (using CONCAT or ||) any of the above

These rules are similar to those that are described for *pattern-expression* for the LIKE predicate.

source-string

An expression that specifies the source string in which the search is to take place. *source-string* must return a value that is a built-in character string data type, graphic string data type, or binary string data type. The expression can be specified by any of the following:

- A constant
- A special register
- A host variable (including a LOB locator variable)
- A scalar function whose arguments are any of the above (though nested function invocations cannot be used)
- A CAST specification whose arguments are any of the above
- A column name
- An expression that concatenates (using CONCAT or ||) any of the above

start

An expression that specifies the position within *source-string* at which the search is to start. It must be an integer that is greater than or equal to zero. If *start* is specified, the LOCATE function is equivalent to:

```
POSSTR(SUBSTR(source-string, integer), search-string) + integer - 1
```

If *start* is not specified, the search begins at the first character of the source string and the LOCATE function is equivalent to:

```
POSSTR(source-string, search-string)
```

The first and second arguments must have compatible string types. For more information on compatibility, see “Conversion rules for operations that combine strings” on page 89.

The result of the function is a large integer. If any argument can be null, the result can be null; if any argument is null, the result is the null value.

For more information about LOCATE, see the description of “POSSTR” on page 318.

Example 1: Find the location of the first occurrence of the character 'N' in the string 'DINING'.

```
SELECT LOCATE('N', 'DINING')
  FROM SYSIBM.SYSDUMMY1;
```

The result is the value 3.

Example 2: For all the rows in the table named IN_TRAY, select the RECEIVED column, the SUBJECT column, and the starting position of the string 'GOOD' within the NOTE_TEXT column.

```
SELECT RECEIVED, SUBJECT, LOCATE('GOOD', NOTE_TEXT)
  FROM IN_TRAY
  WHERE LOCATE('GOOD', NOTE_TEXT) <> 0;
```

LOG10

```
►►──LOG10(numeric-expression)──────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The LOG10 function returns the common logarithm (base 10) of a number.

The argument is an expression that returns the value of any built-in numeric data type. If the argument is not a double precision floating-point number, it is converted to one for processing by the function.

The result of the function is a double precision floating-point number. The result can be null; if the argument is null, the result is the null value.

Example: Assume that host variable HLOG is an INTEGER with a value of 100. The following statement:

```
SELECT LOG10(:HLOG)
  FROM SYSIBM.SYSDUMMY1;
```

returns a double precision floating-point number with an approximate value of 2.

LOWER

```
►►──LOWER(string-expression)──────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The LOWER function returns a string in which all the characters have been converted to lowercase characters.

string-expression
An expression that specifies the string to be converted. The string must be a character or graphic string. A character string argument must not be a CLOB, and a graphic string argument must not be a DBCLOB.

The alphabetic characters of the argument are translated to lowercase characters based on the value of the LC_CTYPE locale in effect for the statement. For example, characters A-Z are translated to a-z, and characters with diacritical marks are translated to their lowercase equivalent, if any. The locale is determined by special register CURRENT LOCALE LC_CTYPE. For information about the special register, see “CURRENT LOCALE LC_CTYPE” on page 102.

If the LC_CTYPE locale is blank when the function is executed, the result of the function depends on the data type of *string-expression*.

- For ASCII and EBCDIC, if *string-expression* specifies a graphic string expression, then an error occurs. For a character string expression, characters A-Z are translated to a-z and characters with diacritical marks are not translated. If the string contains MIXED or DBCS characters, full-width Latin capital letters A-Z are converted to full-width Latin small letters a-z.
- For Unicode, *string-expression* can be either a character string expression or a graphic string expression. The characters A-Z are translated to a-z and all other characters, including characters with diacritic marks, are left unchanged. If LOCALE LC_CTYPE is not blank, an error occurs. Full-width Latin capital letters A-Z are converted to full-width Latin small letters a-z.

The length attribute, data type, subtype, and CCSID of the result are the same as the argument. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

LCASE is a synonym for LOWER.

Example: Return the characters in the value of host variable NAME in lowercase. NAME has a data type of VARCHAR(30) and a value of 'Christine Smith'. Assume that the locale in effect is blank.

```
SELECT LCASE(:NAME)
  FROM SYSIBM.SYSDUMMY1;
```

The result is the value 'christine smith'.

LTRIM

```
►►──LTRIM(string-expression)─────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The LTRIM function removes blanks from the beginning of a string expression. The LTRIM function returns the same results as the STRIP function with LEADING specified:

```
STRIP(string-expression,LEADING)
```

The argument must be an expression that returns a value that is a built-in character string data type or a graphic string data type. The argument must not be a CLOB or a DBCLOB. The characters that are interpreted as leading blanks depend on the encoding scheme of the data and the data type:

- If the argument is a string, the leading DBCS blanks are removed. For data that is encoded in ASCII, the ASCII CCSID determines the hex value that represents a double-byte blank. For example, for Japan (CCSID 301), X'8140' represents a double-byte blank, while it is X'A1A1' for Simplified Chinese. For EBCDIC-encoded data, X'4040' represents a double-byte blank. For Unicode-encoded data, X'0020' represents an SBCS or UTF-8 blank.
- Otherwise, leading SBCS blanks are removed. For data that is encoded in ASCII, X'20' represents a blank. For EBCDIC-encoded data, X'40' represents a blank. For Unicode-encoded data, X'0020' represents a double-byte blank.

The result of the function depends on the data type of its argument:

- VARCHAR if the argument is a character string
- VARGRAPHIC if the argument is a graphic string

The length attribute of the result is the same as the length attribute of *string-expression*. The actual length of the result is the length of the expression minus the number of characters removed. If all of the characters are removed, the result is an empty string.

If the argument can be null, the result can be null; if the argument is null, the result is the null value. The CCSID of the result is the same as that of *string-expression*.

Example: Assume that host variable HELLO is defined as CHAR(9) and has a value of ' Hello'.

```
SELECT LTRIM(:HELLO)
  FROM SYSIBM.SYSDUMMY1;
```

The result is 'Hello'.

MAX

```
                          ┌─────────────────┐
                          ▼                 │
►►──MAX(expression─────,expression───┴──)──────────────────────────────────────────►◄
```

The schema is SYSIBM.

The MAX scalar function returns the maximum value in a set of values. The arguments must be compatible. For more information on compatibility, refer to the compatibility matrix in Table 13 on page 75. All but the first argument can be parameter markers. There must be two or more arguments.

Each argument must be an expression that returns a value of any built-in data type other than a CLOB, DBCLOB, BLOB, or ROWID. Character string arguments cannot have an actual length greater than 255, and graphic string arguments cannot have an actual length greater than 127.

The arguments are evaluated in the order in which they are specified. The result of the function is the largest argument value. The result can be null if at least one argument is null; the result is the null value if one of the arguments is null.

The selected argument is converted, if necessary, to the attributes of the result. The attributes of the result are determined using the “Rules for result data types” on page 87. If the MAX function has more than two arguments, the rules are applied to the first two arguments to determine a candidate result type. The rules are then applied to that candidate result type and the third argument to determine another candidate result type. This process continues until all arguments are analyzed and the final result type and CCSID is determined.

GREATEST can be specified as a synonym for MAX.

Example 1: Assume the host variable M1 is a DECIMAL(2,1) host variable with a value of 5.5, host variable M2 is a DECIMAL(3,1) host variable with a value of 4.5, and host variable M3 is a DECIMAL(3,2) host variable with a value of 6.25. The function

```
   MAX(:M1,:M2,:M3)
```

returns the value 6.25.

Example 2: Assume the host variable M1 is a CHAR(2) host variable with a value of ’AA’, host variable M2 is a CHAR(3) host variable with a value of ’AA ’, and host variable M3 is a CHAR(4) host variable with a value of ’AA A’. The function

```
   MAX(:M1,:M2,:M3)
```

returns the value ’AAA’.

MICROSECOND

```
►►──MICROSECOND(expression)──────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The MICROSECOND function returns the microsecond part of a value.

The argument must be an expression that returns a value of one of the following built-in data types: a timestamp, a character string, a graphic string, or a numeric data type.

- If *expression* is a character or graphic string, it must not be a CLOB or DBCLOB, and its value must be a valid string representation of a timestamp with an actual length of not greater than 255 bytes. For the valid formats of string representations of times and timestamps, see “String representations of datetime values” on page 65.
- If *expression* is a number, it must be a timestamp duration. For the valid formats of timestamp durations, see “Datetime operands” on page 88.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The other rules depend on the data type of the argument:

If the argument is a timestamp or string representation of a timestamp, the result is the microsecond part of the value, which is an integer between 0 and 999999.

If the argument is a duration, the result is the microsecond part of the value, which is an integer between -999999 and 999999. A nonzero result has the same sign as the argument.

Example: Assume that table TABLEX contains a TIMESTAMP column named TSTMPCOL and a SMALLINT column named INTCOL. Select the microseconds part of the TSTMPCOL column of the rows where the INTCOL value is 1234:

```
SELECT MICROSECOND(TSTMPCOL) FROM TABLEX
  WHERE INTCOL = 1234;
```

MIDNIGHT_SECONDS

```
►►──MIDNIGHT_SECONDS(expression)──────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The MIDNIGHT_SECONDS function returns an integer value that is greater than or equal to 0 and less than or equal to 86400 that represents the number of seconds between midnight and the time specified by the argument.

The argument must be an expression that returns a value of one of the following built-in data types: a time, a timestamp, a character string, or a graphic string. If *expression* is a character or graphic string, it must not be a CLOB or DBCLOB, and its value must be a valid string representation of a time or timestamp with an actual length of not greater than 255 bytes. For the valid formats of string representations of times and timestamps, see "String representations of datetime values" on page 65.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example 1: Find the number of seconds between midnight and 00:01:00, and midnight and 13:10:10. Assume that host variable XTIME1 has a value of '00:01:00', and that XTIME2 has a value of '13:10:10'.

```
SELECT MIDNIGHT_SECONDS(:XTIME1), MIDNIGHT_SECONDS(:XTIME2)
  FROM SYSIBM.SYSDUMMY1;
```

This example returns 60 and 47410. Because there are 60 seconds in a minute and 3600 seconds in an hour, 00:01:00 is 60 seconds after midnight ((60 * 1) + 0), and 13:10:10 is 47410 seconds ((3600 * 13) + (60 * 10) + 10).

Example 2: Find the number of seconds between midnight and 24:00:00, and midnight and 00:00:00.

```
SELECT MIDNIGHT_SECONDS('24:00:00'), MIDNIGHT_SECONDS('00:00:00')
  FROM SYSIBM.SYSDUMMY1;
```

This example returns 86400 and 0. Although these two values represent the same point in time, different values are returned.

MIN

```
                      ┌──────────────┐
                      ▼              │
▶▶──MIN(expression────,expression───┴─)──────────────────────────────────────▶◀
```

The schema is SYSIBM.

The MIN scalar function returns the minimum value in a set of values. The arguments must be compatible. For more information on compatibility, refer to the compatibility matrix in Table 13 on page 75. All but the first argument can be parameter markers. There must be two or more arguments.

Each argument must be an expression that returns a value of any built-in data type other than a CLOB, DBCLOB, BLOB, or ROWID. Character string arguments cannot have an actual length greater than 255, and graphic string arguments cannot have an actual length greater than 127.

The arguments are evaluated in the order in which they are specified. The result of the function is the smallest argument value. The result can be null if at least one argument is null; the result is the null value if one of the arguments is null.

The selected argument is converted, if necessary, to the attributes of the result. The attributes of the result are determined using the “Rules for result data types” on page 87. If the MIN function has more than two arguments, the rules are applied to the first two arguments to determine a candidate result type. The rules are then applied to that candidate result type and the third argument to determine another candidate result type. This process continues until all arguments are analyzed and the final result type and CCSID is determined.

LEAST can be specified as a synonym for MIN.

Example 1: Assume the host variable M1 is a DECIMAL(2,1) host variable with a value of 5.5, host variable M2 is a DECIMAL(3,1) host variable with a value of 4.5, and host variable M3 is a DECIMAL(3,2) host variable with a value of 6.25. The function

```
  MIN(:M1,:M2,:M3)
```

returns the value 4.5.

Example 2: Assume the host variable M1 is a CHAR(2) host variable with a value of ’AA’, host variable M2 is a CHAR(3) host variable with a value of ’AAA’, and host variable M3 is a CHAR(4) host variable with a value of ’AAAA’. The function

```
  MIN(:M1,:M2,:M3)
```

returns the value ’AA’ .

MINUTE

```
►►──MINUTE(expression)─────────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The MINUTE function returns the minute part of a value.

The argument must be an expression that returns a value of one of the following built-in data types: a time, a timestamp, a character string, a graphic string, or a numeric data type.

- If *expression* is a character or graphic string, it must not be a CLOB or DBCLOB, and its value must be a valid string representation of a time or timestamp with an actual length of not greater than 255 bytes. For the valid formats of string representations of times and timestamps, see “String representations of datetime values” on page 65.
- If *expression* is a number, it must be a time or timestamp duration. For the valid formats of time and timestamp durations, see “Datetime operands” on page 88.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The other rules depend on the data type of the argument:

If the argument is a time, timestamp, or string representation of either, the result is the minute part of the value, which is an integer between 0 and 59.

If the argument is a time duration or timestamp duration, the result is the minute part of the value, which is an integer between -99 and 99. A nonzero result has the same sign as the argument.

Example: Assume that a table named CLASSES contains one row for each scheduled class. Assume also that the class starting times are in the TIME column named STARTTM. Using these assumptions, select those rows in CLASSES that represent classes that start on the hour.

```
SELECT * FROM CLASSES
  WHERE MINUTE(STARTTM) = 0;
```

MOD

```
►►──MOD(numeric-expression-1,numeric-expression-2)──────────────────────────────►◄
```

The schema is SYSIBM.

The MOD function divides the first argument by the second argument and returns the remainder.

The formula used to calculate the remainder is:

```
MOD(x,y) = x - (x/y) * y
```

where `x/y` is the truncated integer result of the division. The result is negative only if the first argument is negative.

Each argument must be an expression that returns a value of any built-in numeric data type. The second argument cannot be zero.

If an argument can be null, the result can be null; if an argument is null, the result is the null value.

The attributes of the result are based on the arguments as follows:

- If both arguments are integers, the data type of the result is a large integer.
- If one argument is an integer and the other is a decimal, the data type of the result is decimal with the same precision and scale as the decimal argument.
- If both arguments are decimal, the data type of the result is decimal. The precision of the result is min(*p-s,p'-s'*) + max(*s,s'*), and the scale of the result is max(*s,s'*), where the symbols *p* and *s* denote the precision and scale of the first operand, and the symbols *p'* and *s'* denote the precision and scale of the second operand.
- If either argument is a floating-point number, the data type of the result is double precision floating-point.

  The operation is performed in floating-point. If necessary, the operands are first converted to double precision floating-point numbers. For example, an operation that involves a floating-point number and either an integer or a decimal number is performed with a temporary copy of the integer or decimal number that has been converted to double precision floating-point. The result of a floating-point operation must be within the range of floating-point numbers.

Example: Assume that M1 and M2 are two host variables. Find the remainder of dividing M1 by M2.

```
SELECT MOD(:M1,:M2)
  FROM SYSIBM.SYSDUMMY1;
```

The following table shows the result for this function for various values of M1 and M2.

M1 data type	M1 value	M2 data type	M2 value	Result of MOD(:M1,:M2)
INTEGER	5	INTEGER	2	1
INTEGER	5	DECIMAL(3,1)	2.2	0.6
INTEGER	5	DECIMAL(3,2)	2.20	0.60
DECIMAL(4,2)	5.50	DECIMAL(4,1)	2.0	1.50

MONTH

```
►►──MONTH(expression)─────────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The MONTH function returns the month part of a value.

The argument must be an expression that returns one of the following built-in data types: a date, a timestamp, a character string, a graphic string, or a numeric data type.

- If *expression* is a character or graphic string, it must not be a CLOB or DBCLOB, and its value must be a valid string representation of a date or timestamp with an actual length of not greater than 255 bytes. For the valid formats of string representations of dates and timestamps, see "String representations of datetime values" on page 65.
- If *expression* is a number, it must be a date or timestamp duration. For the valid formats of date and timestamp durations, see "Datetime operands" on page 88.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The other rules depend on the data type of the argument:

If the argument is a date, timestamp, or string representation of either, the result is the month part of the value, which is an integer between 1 and 12.

If the argument is a date duration or timestamp duration, the result is the month part of the value, which is an integer between -99 and 99. A nonzero result has the same sign as the argument.

Example: Select all rows in the sample table DSN8810.EMP for employees who were born in May:

```
SELECT * FROM DSN8810.EMP
  WHERE MONTH(BIRTHDATE) = 5;
```

MQPUBLISH

```
►►──MQPUBLISH(──┬──────────────────────────────────────────────────┬──msg-data──,──topic-list──┬─────────────────────┬──)──────────►◄
                └─publisher-service──,──┬──────────────────────┬───┘                            │                (1)  │
                                        └─service-policy──,────┘                                └─,──correl-id────────┘
```

Notes:

1 *correl-id* can be specified only if a publisher service and a service policy have been defined.

The schema is DB2MQ1C or DB2MQ2C.

The MQPUBLISH function publishes the data that is contained in *msg-data* to the MQSeries publisher that is specified in *publisher-service*, using the quality-of-service policy that is defined by *service-policy*. A list of topics for the message must be specified, and an optional user-defined message correlation identifier can also be specified. The MQPUBLISH function requires the installation and configuration of an MQSeries-based publish and subscribe system, such as Websphere MQSeries Integrator. See *www.ibm.com/software/MQSeries* for more details. The function returns a value of '1' if successful or '0' if unsuccessful.

publisher-service

An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The value of the expression must not be the null value, an empty string, or a string with trailing blanks. The expression must have an actual length that is no greater than 48 bytes. The value of the expression refers to a service point that is the logical MQSeries destination to which the message is sent. A service point is defined in the DSNAMT repository file, and it specifies a logical end-point from which a message is sent or received. A service point definition includes the name of the MQSeries queue manager and the name of the queue. See *MQSeries Application Messaging Interface* for more details.

If *publisher-service* is not specified, the DB2.DEFAULT.PUBLISHER is used.

service-policy

An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The value of the expression must not be the null value, an empty string, or a string with trailing blanks. The expression must have an actual length that is no greater than 48 bytes. The value of the expression refers to the MQSeries AMI service policy that is used in handling this message. A service policy is defined in the DSNAMT repository file, and it specifies a set of quality-of-service options that are to be applied to this messaging operation. These options include message priority and message persistence. See *MQSeries Application Messaging Interface* for more details.

If *service-policy* is not specified, the DB2.DEFAULT.POLICY is used.

msg-data

An expression that returns a value that is a built-in character string data type. If the expression is a CLOB, the value must not be longer than 1 MB. Otherwise, the value must not be longer than 4000 bytes. The value of the expression specifies the data to be sent via MQSeries. A null value, an empty string, and a fixed length string with trailing blanks are all considered valid values.

topic-list

An expression that returns a value that is a built-in string data type that is not a

CLOB, DBCLOB, or BLOB. The value of the expression must not be the null value, an empty string, or a string with trailing blanks. The expression must have an actual length that is no greater than 40 bytes. The value of the expression specifies the topics for the message publication. One or more topics can be specified, where the topics are separated with a colon. For example, ’t1:t2:the third topic’ indicates that the message is associated with all three topics: t1, t2, and ’the third topic’.

correl-id

An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The value of the expression must not be the null value or an empty string, and it must have an actual length that is no greater than 24 bytes. The value of the expression specifies the correlation identifier to be associated with this message. The *correl-id* is often specified in request-and-reply scenarios to associate requests with replies.

A null value, an empty string, and a fixed length string with trailing blanks are all considered valid values. However, when the *correl-id* is specified on another request such as MQPUBLISH, the *correl-id* must be specified the same to be recognized as a match. For example, specifying a value of ’test’ for *correl-id* on MQRECEIVE will not match a *correl-id* value of ’test   ’ (with trailing blanks) specified earlier on an MQPUBLISH request.

If *correl-id* is not specified, a correlation identifier is not used, and a correlation identifier is not added to the message.

The result of the function is a varying-length string with a length attribute of 1. The result is nullable, even though a null value is never returned.

The CCSID of the result is the system CCSID that was in effect at the time that the MQSeries function was installed into DB2.

Example 1: Publish the string ’Testing 123’ to the default publisher service (DB2.DEFAULT.PUBLISHER), using the default service policy (DB2.DEFAULT.POLICY). Do not specify a topic or correlation identifier for the message.

```
   SELECT DB2MQ2C.MQPUBLISH('Testing 123')
     FROM SYSIBM.SYSDUMMY1;
```

Example 2: Publish the string ’Testing 345’ to the publisher service ’MYPUBLISHER’ under the topic ’TESTS’, using the default service policy (DB2.DEFAULT.POLICY). Do not specify a correlation identifier for the message.

```
  SELECT DB2MQ2C.MQPUBLISH('MYPUBLISHER','Testing 345', 'TESTS')
     FROM SYSIBM.SYSDUMMY1;
```

Example 3: Publishes the string ’Testing 678’ to the publisher service ’MYPUBLISHER’ under the topic ’TESTS, using the service policy ’MYPOLICY’. Specify a correlation identifier of ’TEST1’ for the message.

```
  SELECT DB2MQ2C.MQPUBLISH('MYPUBLISHER','MYPOLICY','Testing 678', 'TESTS', 'TEST1')
     FROM SYSIBM.SYSDUMMY1;
```

All of the examples return a value of ’1’ if they are successful.

MQREAD

```
►►──MQREAD(──┬─────────────────────────────────────┬──)───────────────────────────────►◄
             └─receive-service──┬───────────────────┬─┘
                                └─,──service-policy─┘
```

The schema is DB2MQ1C or DB2MQ2C.

The MQREAD function returns a message from the MQSeries location that is specified by *receive-service*, using the quality-of-service policy that is defined in *service-policy*. Performing this operation does not remove the message from the queue that is associated with *receive-service*, but instead returns the message at the beginning of the queue.

receive-service

An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The value of the expression must not be the null value, an empty string, or a string with trailing blanks. The expression must have an actual length that is no greater than 48 bytes. The value of the expression refers to a service point that is the logical MQSeries destination from which the message is received. A service point is defined in the DSNAMT repository file, and it represents a logical end-point from which a message is sent or received. A service point definition includes the name of the MQSeries queue manager and the name of the queue. See *MQSeries Application Messaging Interface* for more details.

If *receive-service* is not specified, DB2.DEFAULT.SERVICE is used.

service-policy

An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The value of the expression must not be the null value, an empty string, or a string with trailing blanks. The expression must have an actual length that is no greater than 48 bytes. The value of the expression refers to an MQSeries AMI service policy that is used in handling this message. A service policy is defined in the DSNAMT repository file, and it specifies a set of quality-of-service options that are to be applied to this messaging operation. These options include message priority and message persistence. See *MQSeries Application Messaging Interface* for more details.

If *service-policy* is not specified, DB2.DEFAULT.POLICY is used.

The result of the function is a varying-length string with a length attribute of 4000. The result can be null. If no messages are available to be returned, the result is the null value.

The CCSID of the result is the system CCSID that was in effect at the time that the MQSeries function was installed into DB2.

Example 1: Retrieve the message at the beginning of the queue that is specified by the default service (DB2.DEFAULT.SERVICE), using the default policy (DB2.DEFAULT.POLICY).

```
SELECT MQREAD()
  FROM TABLE;
```

The message at the beginning of the queue specified by the default server and using the default policy is returned as VARCHAR(4000).

Example 2: Read the message from the beginning of the queue specified by the service MYSERVICE, using the default policy MYPOLICY.

```
SELECT MQREAD('MYSERVICE','MYPOLICY')
  FROM TABLE;
```

The message at the beginning of the queue specified by MYSERVICE and using MYPOLICY is returned as VARCHAR(4000).

MQREADCLOB

```
►►──MQREADCLOB(──┬──────────────────────────────────────┬──)────────────────────────────►◄
                 └─receive-service──┬──────────────────┬─┘
                                    └─,──service-policy─┘
```

The schema is DB2MQ1C or DB2MQ2C.

The MQREADCLOB function returns a message from the MQSeries location that is specified by *receive-service*, using the quality-of-service policy that is defined in *service-policy*. Performing this operation does not remove the message from the queue that is associated with *receive-service*, but instead returns the message at the beginning of the queue.

receive-service

An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The value of the expression must not be the null value, an empty string, or a string with trailing blanks. The expression must have an actual length that is no greater than 48 bytes. The value of the expression refers to a service point that is the logical MQSeries destination from which the message is received. A service point is defined in the DSNAMT repository file, and it represents a logical end-point from which a message is sent or received. A service point definition includes the name of the MQSeries queue manager and the name of the queue. See *MQSeries Application Messaging Interface* for more details.

If *receive-service* is not specified, DB2.DEFAULT.SERVICE is used.

service-policy

An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The value of the expression must not be the null value, an empty string, or a string with trailing blanks. The expression must have an actual length that is no greater than 48 bytes. The value of the expression refers to an MQSeries AMI service policy that is used in handling this message. A service policy is defined in the DSNAMT repository file, and it specifies a set of quality-of-service options that are to be applied to this messaging operation. These options include message priority and message persistence. See *MQSeries Application Messaging Interface* for more details.

If *service-policy* is not specified, DB2.DEFAULT.POLICY is used.

The result of the function is a CLOB with a length attribute of 1 MB. The result can be null. If no messages are available to be returned, the result is the null value.

The CCSID of the result is the system CCSID that was in effect at the time that the MQSeries function was installed into DB2.

Example 1: Read the message from the queue specified by the default service (DB2.DEFAULT.SERVICE), using the default policy (DB2.DEFAULT.POLICY).

```
SELECT MQREADCLOB(0)
  FROM TABLE;
```

The message at the beginning of the queue specified by the default service and using the default policy is returned as a CLOB.

Example 2: Read the message from the queue specified by the service MYSERVICE, using the default policy (DB2.DEFAULT.POLICY).

```
SELECT MQREADCLOB('MYSERVICE')
  FROM TABLE;
```

The message at the beginning of the queue specified by MYSERVICE and using the default policy is returned as a CLOB.

MQRECEIVE

```
►►──MQRECEIVE(──┬────────────────────────────────────────────────────────┬──)────────────►◄
                └─receive-service──┬───────────────────────────────────┬─┘
                                   └─,──service-policy──┬────────────┬─┘
                                                        └─,──correl-id─┘
```

The schema is DB2MQ1C or DB2MQ2C.

The MQRECEIVE function returns a message from the MQSeries location specified by *receive-service*, using the quality-of-service policy defined in *service-policy*. Performing this operation removes the message from the queue that is associated with *receive-service*.

receive-service
An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The value of the expression must not be the null value, an empty string, or a string with trailing blanks. The expression must have an actual length that is no greater than 48 bytes. The value of the expression refers to a service point that is the logical MQSeries destination from which the message is received. A service point is defined in the DSNAMT repository file, and it represents a logical end-point from which a message is sent or received. A service point definition includes the name of the MQSeries queue manager and the name of the queue. See *MQSeries Application Messaging Interface* for more details.

If *receive-service* is not specified, DB2.DEFAULT.SERVICE is used.

service-policy
An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The value of the expression must not be the null value, an empty string, or a string with trailing blanks. The expression must have an actual length that is no greater than 48 bytes. The value of the expression refers to an MQSeries AMI service policy that is used in handling this message. A service policy is defined in the DSNAMT repository file, and it specifies a set of quality-of-service options that are to be applied to this messaging operation. These options include message priority and message persistence. See *MQSeries Application Messaging Interface* for more details.

If *service-policy* is not specified, DB2.DEFAULT.POLICY is used.

correl-id
An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The expression must have an actual length that is no greater than 24 bytes. The value of the expression specifies the correlation identifier that is associated with this message. A correlation identifier is often specified in request-and-reply scenarios to associate requests with replies. The first message with a matching correlation identifier is returned.

A null value, an empty string, and a fixed length string with trailing blanks are all considered valid values. However, when the *correl-id* is specified on another request such as MQSEND, the *correl-id* must be specified the same to be recognized as a match. For example, specifying a value of 'test' for *correl-id* on MQRECEIVE does not match a *correl-id* value of 'test   ' (with trailing blanks) specified earlier on an MQSEND request.

If *correl-id* is not specified, a correlation identifier is not used, and the message at the beginning of the queue is returned.

The result of the function is a varying-length string of length attribute of 4000. The result can be null. The result is null if no messages are available to return.

The CCSID of the result is the system CCSID that was in effect at the time that the MQSeries function was installed into DB2.

Example 1: Retrieve the message from beginning of the queue specified by the default service (DB2.DEFAULT.SERVICE), using the default policy (DB2.DEFAULT.POLICY).

```
SELECT MQRECEIVE()
  FROM TABLE;
```

The message at the beginning of the queue specified by the default service and using the default policy is returned as VARCHAR(4000) and is deleted from the queue.

Example 2: Retrieve the first message with a correlation identifier that matches ’1234’ from the beginning of the queue specified by the service MYSERVICE, using the policy MYPOLICY.

```
SELECT MQRECEIVE('MYSERVICE','MYPOLICY','1234')
  FROM TABLE;
```

The message with CORRELID of ’1234’ from the beginning of the queue specified by MYSERVICE and using MYPOLICY is returned as VARCHAR(4000) and is deleted from the queue.

MQRECEIVECLOB

```
►►──MQRECEIVECLOB(──┬──────────────────────────────────────────────────────┬──)──────────────►◄
                    └─receive-service──┬──────────────────────────────────┬─┘
                                       └─,──service-policy──┬───────────┬─┘
                                                            └─,──correl-id─┘
```

The schema is DB2MQ1C or DB2MQ2C.

The MQRECEIVECLOB function returns a message from the MQSeries location that is specified by *receive-service*, using the quality-of-service policy that is defined in *service-policy*. Performing this operation removes the message from the queue that is associated with *receive-service*.

receive-service

An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The value of the expression must not be the null value, an empty string, or a string with trailing blanks. The expression must have an actual length that is no greater than 48 bytes. The value of the expression refers to a service point that is the logical MQSeries destination from which the message is received. A service point is defined in the DSNAMT repository file, and it represents a logical end-point from which a message is sent or received. A service point definition includes the name of the MQSeries queue manager and the name of the queue. See *MQSeries Application Messaging Interface* for more details.

If *receive-service* is not specified, DB2.DEFAULT.SERVICE is used.

service-policy

An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The value of the expression must not be the null value, an empty string, or a string with trailing blanks. The expression must have an actual length that is no greater than 48 bytes. The value of the expression specifies an MQSeries AMI service policy that is used in handling this message. A service policy is defined in the DSNAMT repository file, and it specifies a set of quality-of-service options that are to be applied to this messaging operation. These options include message priority and message persistence. See *MQSeries Application Messaging Interface* for more details.

If *service-policy* is not specified, DB2.DEFAULT.POLICY is used.

correl-id

An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The expression must have an actual length that is no greater than 24 bytes. The value of the expression specifies the correlation identifier that is associated with this message. A correlation identifier is often specified in request-and-reply scenarios to associate requests with replies. The first message with a matching correlation identifier is returned.

A null value, an empty string, and a fixed length string with trailing blanks are all considered valid values. However, when the *correl-id* is specified on another request such as MQSEND, the *correl-id* must be specified the same to be recognized as a match. For example, specifying a value of ’test’ for *correl-id* on MQRECEIVECLOB does not match a *correl-id* value of ’test   ’ (with trailing blanks) specified earlier on an MQSEND request.

If *correl-id* is not specified, a correlation identifier is not used, and the message at the beginning of the queue is returned.

The result of the function is a CLOB with a length attribute of 1 MB. The result can be null. If no messages are available to be returned, the result is the null value.

The CCSID of the result is the system CCSID that was in effect at the time that the MQSeries function was installed into DB2.

Example 1: Retrieve the message from the beginning of the queue specified by the default service (DB2.DEFAULT.SERVICE), using the default policy (DB2.DEFAULT.POLICY).

```
SELECT MORERECEIVECLOB()
  FROM TABLE;
```

The message at the beginning of the queue specified by the default service and using the default policy is returned as a CLOB and is deleted from the queue.

Example 2: Retrieve the message from the beginning of the queue specified by the service MYSERVICE, using the policy (DB2.DEFAULT.POLICY).

```
SELECT MQRECEIVECLOB('MYSERVICE')
  FROM TABLE;
```

The message at the beginning of the queue specified by MYSERVICE and using the default policy is returned as a CLOB and is deleted from the queue.

MQSEND

```
►►──MQSEND(──┬─────────────────────────────────────────┬──msg-data──┬──────────────────┬──)──────────►◄
             └─send-service──,──┬────────────────────┬─┘            │              (1) │
                                └─service-policy──,──┘              └─,──correl-id─────┘
```

Notes:

1 *correl-id* cannot be specified unless a send service and a service policy are also specified.

The schema is DB2MQ1C or DB2MQ2C.

The MQSEND function sends the data that is contained in *msg-data* to the MQSeries location that is specified by *send-service*, using the quality-of-service policy that is defined in *service-policy*. The returned value is '1' if the function was successful or '0' if unsuccessful.

send-service

An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The value of the expression must not be the null value, an empty string, or a string with trailing blanks. The expression must have an actual length that is no greater than 48 bytes. The value of the expression refers to a service point that is the logical MQSeries destination to which the message is sent. A service point is defined in the DSNAMT repository file, and it represents a logical end-point from which a message is sent or received. A service point definition includes the name of the MQSeries queue manager and the name of the queue. See *MQSeries Application Messaging Interface* for more details.

If *send-service* is not specified, DB2.DEFAULT.SERVICE is used.

service-policy

An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The value of the expression must not be the null value, an empty string, or a string with trailing blanks. The expression must have an actual length that is no greater than 48 bytes. The value of the expression specifies an MQSeries AMI service policy that is used in handling this message. A service policy is defined in the DSNAMT repository file, and it specifies a set of quality-of-service options that are to be applied to this messaging operation. These options include message priority and message persistence. See *MQSeries Application Messaging Interface* for more details.

If *service-policy* is not specified, DB2.DEFAULT.POLICY is used.

msg-data

An expression that returns a value that is a built-in character string data type. If the expression is a CLOB, the value must not be longer than 1 MB. Otherwise, the value must not be longer than 4000 bytes. The value of the expression is the message data that is to be sent via MQSeries. A null value, an empty string, and a fixed length string with trailing blanks are all considered valid values.

correl-id

An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The expression must have an actual length that is no greater than 24 bytes. The value of the expression specifies the correlation identifier that is associated with this message. A correlation identifier is often specified in request-and-reply scenarios to associate requests with replies. *correl-id* must not be specified unless *send-service* and *service-policy* are also specified.

A null value, an empty string, and a fixed length string with trailing blanks are all considered valid values. However, when the *correl-id* is specified on another request such as MQRECEIVE, the *correl-id* must be specified the same to be recognized as a match. For example, specifying a value of 'test' for *correl-id* on MQSEND does not match a *correl-id* value of 'test   ' (with trailing blanks) specified subsequently on an MQRECEIVE request.

If *correl-id* is not specified, a correlation identifier is not sent.

The result of the function is a varying-length string with a length attribute of 1. The result is nullable, even though a null value is never returned.

The CCSID of the result is the system CCSID that was in effect at the time that the MQSeries function was installed into DB2.

Example 1: Send the string ″Testing msg″ to the default service (DB2.DEFAULT.SERVICE), using the default policy (DB2.DEFAULT.POLICY) and no correlation identifier.

```
SELECT MQSEND('Testing msg')
  FROM TABLE;
```

The message is sent to the default service, using the default policy.

Example 2: Send the string ″Testing 123″ to the service MYSERVICE, using the policy MYPOLICY and the correlation identifier ″TEST3″.

```
SELECT MQSEND('MYSERVICE','MYPOLICY','Testing 123','TEST3')
  FROM TABLE;
```

The string ″TESTING 123″ is sent to MYSERVICE, using MYPOLICY and the correlation identifier ″TEST3″.

MQSUBSCRIBE

```
►►──MQSUBSCRIBE(──┬───────────────────────────────────────────┬──topic-list)──────────────────►◄
                  └─subscriber-service──,──┬─────────────────────┬─┘
                                           └─service-policy──,───┘
```

The schema is DB2MQ1C or DB2MQ2C

The MQSUBSCRIBE function is used to register interest in MQSeries messages published on specified topics. The *subscriber-service* specifies a logical destination for messages that match the specified topics. Messages that match the specified topics are placed on the queue defined by *subscriber-service*. The messages can then be read or received through a subsequent invocation of the MQREAD, MQRECEIVE, MQREADALL, or MQRECEIVEALL functions. The MQSUBSCRIBE function requires the installation and configuration of an MQSeries-based publish and subscribe system, such as Websphere MQSeries Integrator. See *www.ibm.com/software/MQSeries* for more details.

The function returns a value of '1' if successful or '0' if unsuccessful. A successful execution of this function causes the publish and subscribe server to forward messages that match the specified topics to the service point defined by *subscriber-service.*

subscriber-service
An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The value of the expression must not be the null value, an empty string, or a string with trailing blanks. The expression must have an actual length that is no greater than 48 bytes. The value of the expression refers to a service point that is the logical MQSeries subscription point to which messages that match the specified topics are sent. A subscriber's service point is defined in the DSNAMT repository file, and it specifies a logical subscription point to which a message is sent. A service point definition includes the name of the MQSeries queue manager and the name of the queue. See *MQSeries Application Messaging Interface* for more details.

If *subscriber-service* is not specified, the DB2.DEFAULT.SUBSCRIBER is used.

service-policy
An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The value of the expression must not be the null value, an empty string, or a string with trailing blanks. The expression must have an actual length that is no greater than 48 bytes. The value of the expression refers to the MQSeries AMI service policy that is used in handling this message. A service policy is defined in the DSNAMT repository file, and it specifies a set of quality-of-service options that are to be applied to this messaging operation. These options include message priority and message persistence. See *MQSeries Application Messaging Interface* for more details.

If *service-policy* is not specified, the DB2.DEFAULT.POLICY is used.

topic-list
An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The value of the expression must not be the null value, an empty string, or a string with trailing blanks. The expression must have an actual length that is no greater than 40 bytes. The value of the

expression specifies the types of messages to receive. Only messages published with the specified topics are received by this subscription. Multiple subscriptions can coexist. One or more topics can be specified, where the topics are separated with a colon. For example, ’t1:t2:the third topic’ indicates that the message is associated with all three topics: t1, t2, and ’the third topic’.

The result of the function is a varying-length string with a length attribute of 1. The result is nullable, even though a null value is never returned.

The CCSID of the result is the system CCSID that was in effect at the time that the MQSeries function was installed into DB2.

Example 1: Register an interest in messages that contain the topic ’Weather’. Allow the message to be sent to the default subscriber service point (DB2.DEFAULT.SUBSCRIBER), using the default service policy.

```
SELECT DB2MQ2C.MQSUBSCRIBE('Weather')
  FROM SYSIBM.SYSDUMMY1;
```

Example 2: Registering an interest in messages that contain the topic ’Stocks’. Specify ″PORTFOLIO-UPDATES″ as the subscriber service point to which the message is to be sent, using service policy ’BASIC-POLICY’.

```
SELECT DB2MQ2C.MQSUBSCRIBE ('PORTFOLIO-UPDATES','BASIC-POLICY','Stocks')
   FROM SYSIBM.SYSDUMMY1;
```

All of the examples return a value of ’1’ if they are successful.

MQUNSUBSCRIBE

```
►►──MQUNSUBSCRIBE(──┬──────────────────────────────────────────────┬──topic-list)──────────────►◄
                    └─subscriber-service──,──┬───────────────────┬─┘
                                             └─service-policy──,─┘
```

The schema is DB2MQ1C or DB2MQ2C

The MQUNSUBSCRIBE function is used to unregister an existing message subscription. The *subscriber-service*, *service-policy*, and *topic-list* identify which subscription is canceled. The MQUNSUBSCRIBE function requires the installation and configuration of an MQSeries-based publish and subscribe system, such as Websphere MQSeries Integrator. See *www.ibm.com/software/MQSeries* for more details.

The function returns a value of '1' if successful or '0' if unsuccessful. A successful execution of this function causes the publish and subscribe server to remove the subscription that is identified by the given parameters. Messages that match the specified topics are no longer sent to the service point defined by *subscriber-service.*

subscriber-service
An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The value of the expression must not be the null value, an empty string, or a string with trailing blanks. The expression must have an actual length that is no greater than 48 bytes. The value of the expression refers to a service point that is the logical MQSeries subscription point to which messages that match the specified topics are sent. A subscriber's service point is defined in the DSNAMT repository file, and it specifies a logical subscription point to which a message is sent. A service point definition includes the name of the MQSeries queue manager and the name of the queue. See *MQSeries Application Messaging Interface* for more details.

If *subscriber-service* is not specified, the DB2.DEFAULT.SUBSCRIBER is used.

service-policy
An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The value of the expression must not be the null value, an empty string, or a string with trailing blanks. The expression must have an actual length that is no greater than 48 bytes. The value of the expression refers to the MQSeries AMI service policy that is used in handling this message. A service policy is defined in the DSNAMT repository file, and it specifies a set of quality-of-service options that are to be applied to this messaging operation. These options include message priority and message persistence. See *MQSeries Application Messaging Interface* for more details.

If *service-policy* is not specified, the DB2.DEFAULT.POLICY is used.

topic-list
An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The value of the expression must not be the null value, an empty string, or a string with trailing blanks. The expression must have an actual length that is no greater than 40 bytes. The value of the expression specifies the types of messages to receive. Only messages published with the specified topics are received by this subscription. Multiple

subscriptions can coexist. One or more topics can be specified, where the topics are separated with a colon. For example, ’t1:t2:the third topic’ indicates that the message is associated with all three topics: t1, t2, and ’the third topic’.

The result of the function is a varying-length string with a length attribute of 1. The result is nullable, even though a null value is never returned.

The CCSID of the result is the system CCSID that was in effect at the time that the MQSeries function was installed into DB2.

Example 1: Cancel the subscription for messages that contain the topic ’Weather’. The subscriber is registered with the default subscriber service point (DB2.DEFAULT.SERVICE) with the default service policy (DB2.DEFAULT.SERVICE).

```
SELECT DB2MQ2C.UNMQSUBSCRIBE('Weather')
  FROM SYSIBM.SYSDUMMY1;
```

Example 2: Cancel the subscription for messages that contain the topic ’Stocks’. The subscriber is registered with the subscriber service point ’PORTFOLIO-UPDATES’ with the service policy ’BASIC-POLICY’.

```
SELECT DB2MQ2C.MQUNSUBSCRIBE ('PORTFOLIO-UPDATES','BASIC-POLICY','Stocks')
   FROM SYSIBM.SYSDUMMY1;
```

All of the examples return a value of ’1’ if they are successful.

MULTIPLY_ALT

```
►►──MULTIPLY_ALT(exact-numeric-expression-1,exact-numeric-expression-2)──────────────────────►◄
```

The schema is SYSIBM.

The MULTIPLY_ALT scalar function returns the product of the two arguments as a decimal value. It is provided as an alternative to the multiplication operator, especially when the sum of the precisions of the arguments exceeds 31.

Each argument must be an expression that returns the value of any built-in exact numeric data type (DECIMAL, INTEGER, or SMALLINT).

The result of the function is a DECIMAL. The precision and scale of the result are determined as follows, using the symbols p and s to denote the precision and scale of the first argument, and the symbols p' and s' to denote the precision and scale of the second argument.

- The precision is MIN(31, p+p')
- The scale is:
  - 0 if the scale of both arguments is 0
  - MIN(31, s+s') if p+p' is less than or equal to 31
  - MAX(MIN(3, s+s'), 31-(p-s+p'-s')) if p+p' is greater than 31.

The result can be null if at least one argument can be null; the result is the null value if one of the arguments is null.

The MULTIPLY_ALT function is a better choice than the multiplication operator when performing decimal arithmetic where a scale of at least 3 is desired and the sum of the precisions exceeds 31. In these cases, the internal computation is performed so that overflows are avoided and then assigned to the result type value using truncation for any loss of scale in the final result. Note that the possibility of overflow of the final result is still possible when the scale is 3.

The following table compares the result types using MULTIPLY_ALT and the multiplication operator:

Type of Argument1	Type of Argument2	Result using MULTIPLY_ALT	Result using multiplication operator
DECIMAL(31,3)	DECIMAL(15,8)	DECIMAL(31,3)	DECIMAL(31,11)
DECIMAL(26,23)	DECIMAL(10,1)	DECIMAL(31,19)	DECIMAL(31,24)
DECIMAL(18,17)	DECIMAL(20,19)	DECIMAL(31,29)	DECIMAL(31,31)
DECIMAL(16,3)	DECIMAL(17,8)	DECIMAL(31,9)	DECIMAL(31,11)
DECIMAL(26,5)	DECIMAL(11,0)	DECIMAL(31,3)	DECIMAL(31,5)
DECIMAL(21,1)	DECIMAL(15,1)	DECIMAL(31,2)	DECIMAL(31,2)

NEXT_DAY

```
►►──NEXT_DAY(datetime-expression,string-expression)──────────────────────────►◄
```

The schema is SYSIBM.

The NEXT_DAY scalar function returns a timestamp that represents the first weekday, named by *expression*, that is later than the date *datetime-expression*. If *datetime-expression* is a timestamp or valid string representation of a timestamp, the timestamp value has the same hours, minutes, seconds, and microseconds as *expression*. If *datetime-expression* is a date, or a valid string representation of a date, then the hours, minutes, seconds, and microseconds value of the result is 0.

datetime-expression
An expression that returns one of the following built-in data types: a date, a timestamp, a character string, or a graphic string. If *datetime-expression* is a character or graphic string, it must not be a CLOB or DBCLOB, and its value must be a valid string representation of a date or timestamp with an actual length of not greater than 255 bytes. For the valid formats of string representations of dates and timestamps, see “String representations of datetime values” on page 65.

string-expression
An expression that returns a built-in character string data type or graphic string data type. The value must be one of the following values specified either as the full name of the day or the specified abbreviation:

Day of week	**Abbreviation**
MONDAY	MON
TUESDAY	TUE
WEDNESDAY	WED
THURSDAY	THU
FRIDAY	FRI
SATURDAY	SAT
SUNDAY	SUN

The minimum length of the input value is the length of the abbreviation. Any characters immediately following a valid abbreviation are ignored.

The result of the function is a TIMESTAMP. The result can be null; if any argument is null, the result is the null value.

Example 1: Set the host variable NEXTDAY with the date of the Tuesday following April 24, 2000.

```
SET :NEXTDAY = NEXT_DAY(CURRENT_DATE, 'TUESDAY');
```

The host variable NEXTDAY is set with the value of ’2000–04–25–00.00.00.000000’, assuming that the value of the CURRENT_DATE special register is ’2000–04–24’.

Example 2: Set the host variable NEXTDAY with the date of the first Monday in May, 2000. Assume the host variable DAYHV = ’MON’.

```
SET :NEXTDAY = NEXT_DAY(LAST_DAY(CURRENT_TIMESTAMP),:DAYHV);
```

The host variable NEXTDAY is set with the value of ’2000-05-01-12.01.01.123456’, assuming that the value of the CURRENT_TIMESTAMP special register is ’2000-04-24-12.01.01.123456’.

NULLIF

```
►►──NULLIF(expression,expression)──────────────────────────────────────────►◄
```

The schema is SYSIBM.

The NULLIF function returns null if the two arguments are equal; otherwise, it returns the value of the first argument.

The two arguments must be compatible and comparable. (See the compatibility matrix in Table 13 on page 75.) Neither argument can be a BLOB, CLOB, DBCLOB, or distinct type. Character-string arguments are compatible and comparable with datetime values.

The attributes of the result are the attributes of the first argument.

For example, if the result of the first argument is a character string, the result of the other must also be a character string; if the result of the first argument is number, the result of the other must also be a number.

The result of using NULLIF(e1,e2) is the same as using the CASE expression:

```
CASE WHEN e1=e2 THEN NULL ELSE e1 END
```

When e1=e2 evaluates to unknown because one or both arguments is null, CASE expressions consider the evaluation not true. In this case, NULLIF returns the value of the first argument.

Example: Assume that host variables PROFIT, CASH, and LOSSES have decimal data types with the values of 4500.00, 500.00, and 5000.00 respectively. The following function returns a null value:

```
NULLIF (:PROFIT + :CASH , :LOSSES)
```

POSSTR

```
►►──POSSTR(source-string,search-string)──────────────────────────────────────►◄
```

The schema is SYSIBM.

The POSSTR function returns the starting position of the first occurrence of one string (called the *search-string*) within another string (called the *source-string*). If *search-string* is not found and neither argument is null, the result is 0. If *search-string* is found, the result is a number from 1 to the actual length of *source-string*.

source-string
An expression that specifies the source string in which the search is to take place. *source-string* must return a value that is a built-in character string data type, graphic string data type, or binary string data type. The expression can be specified by any of the following:

- A constant
- A special register
- A host variable (including a LOB locator variable)
- A scalar function whose arguments are any of the above (though nested function invocations cannot be used)
- A column name
- A CAST specification whose arguments are any of the above
- An expression that concatenates (using CONCAT or ||)any of the above

search-string
An expression that specifies the string that is to be searched for. *search-string* must return a value that is a built-in character string data type, graphic string data type, or binary string data type with an actual length that is no greater than 4000 bytes. The expression can be specified by any of the following:

- A constant
- A special register
- A host variable (including a LOB locator variable)
- A scalar function whose arguments are any of the above (though nested function invocations cannot be used)
- A CAST specification whose arguments are any of the above
- An expression that concatenates (using CONCAT or ||) any of the above

These rules are similar to those that are described for *pattern-expression* for the LIKE predicate.

The first and second arguments must have compatible string types. For more information on compatibility, see “Conversion rules for operations that combine strings” on page 89.

If the *search-string* and *source-string* have different CCSID sets, then the *search-string* is converted to the CCSID set of the *source-string*.

Both *search-string* and *source-string* have zero or more contiguous positions. For character strings and binary strings, a position is a byte. For graphic strings, a position is a DBCS character. Graphic Unicode data is treated as UTF-16 data; a UTF-16 supplementary character takes two DBCS characters to represent and as such is counted as two DBCS characters.

The strings can contain mixed data.

- For ASCII data, if the search string or source string contains mixed data, the search string is found only if the same combination of single-byte and double-byte characters are found in the source string in exactly the same positions.
- For EBCDIC data, if the search string or source string contains mixed data, the search string is found only if any shift-in or shift-out characters are found in the source string in exactly the same positions, ignoring any redundant shift characters.
- For UTF-8 data, if the search string or source string contains mixed data, the search string is found only if the same combination of single-byte and multi-byte characters are found in the source string in exactly the same position.

The result of the function is a large integer. If either of the arguments can be null, the result can be null; if either of the arguments are null, the result is the null value. The value of the result is determined by applying these rules in the order in which they appear:

- If the length of the search string is zero, the result is 1.
- If the length of the source string is zero, the result is 0.
- If the value of the search string is equal to an identical length substring of contiguous positions from the value of the source string, the result is the starting position of the first such substring within the value of the source string.
- If none of the above conditions are met, the result is 0.

Example: Select the RECEIVED column, the SUBJECT column, and the starting position of the string 'GOOD BEER' within the NOTE_TEXT column for all rows in the IN_TRAY table that contain that string.

```
SELECT RECEIVED, SUBJECT, POSSTR(NOTE_TEXT, 'GOOD BEER')
  FROM IN_TRAY
  WHERE POSSTR(NOTE_TEXT, 'GOOD BEER') <> 0;
```

POWER

```
►►──POWER(numeric-expression-1,numeric-expression-2)─────────────────────────────►◄
```

The schema is SYSIBM.

The POWER function returns the value of *numeric-expression-1* to the power of *numeric-expression-2*.

Each argument must be an expression that returns the value of any built-in numeric data type. If either argument includes a DECIMAL or REAL data type, the arguments are converted to a double precision floating-point number for processing by the function.

The result of the function depends on the data type of the arguments:

- If both arguments are SMALLINT or INTEGER, the result is INTEGER.
- Otherwise, the result is DOUBLE.

The result can be null; if any argument is null, the result is the null value.

Example 1: Assume that host variable HPOWER is INTEGER with a value of 3. The following statement:

```
SELECT POWER(2,:HPOWER)
  FROM SYSIBM.SYSDUMMY1;
```

returns the value 8.

Example 2: The following statement:

```
SELECT POWER(0,0)
  FROM SYSIBM.SYSDUMMY1;
```

returns the value 1.

QUARTER

```
►►──QUARTER(expression)──────────────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The QUARTER function returns an integer in the range of 1 to 4 that represents the quarter of the year in which the date occurs. For example, the function returns a 1 for any dates in January, February, or March.

The argument must be an expression that returns one of the following built-in data types: a date, a timestamp, a character string, or a graphic string. If *expression* is a character or graphic string data type, it must not be a CLOB or DBCLOB, and its value must be a valid string representation of a date or timestamp with an actual length of not greater than 255 bytes. For the valid formats of string representations of dates and timestamps, see “String representations of datetime values” on page 65.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example 1: The following function returns 3 because August is in the third quarter of the year.

```
SELECT QUARTER('1996-08-25')
  FROM SYSIBM.SYSDUMMY1
```

Example 2: Using sample table DSN8810.PROJ, set the integer host variable QUART to the quarter of the year in which activity number 70 for project 'AD3111' occurred. Activity completion dates are recorded in column ACENDATE.

```
SELECT QUARTER(ACENDATE)
  INTO :QUART
  FROM DSN8810.PROJ
  WHERE PROJNO = 'AD3111' AND ACTNO = 70;
```

QUART is set to 4.

RADIANS

```
►►──RADIANS(numeric-expression)────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The RADIANS function returns the number of radians for an argument that is expressed in degrees.

The argument must be an expression that returns the value of any built-in numeric data type. If the argument is not a double precision floating-point number, it is converted to one for processing by the function.

The result of the function is a double precision floating-point number. The result can be null; if the argument is null, the result is the null value.

Example: Assume that host variable HDEG is an INTEGER with a value of 180. The following statement:

```
SELECT RADIANS(:HDEG)
  FROM SYSIBM.SYSDUMMY1;
```

returns a double precision floating-point number with an approximate value of 3.1415926536.

RAISE_ERROR

```
►►──RAISE_ERROR(sqlstate,diagnostic-string)──────────────────────────────►◄
```

The schema is SYSIBM.

The RAISE_ERROR function causes the statement that invokes the function to return an error with the specified SQLSTATE (along with SQLCODE -438) and error condition. The RAISE_ERROR function always returns NULL with an undefined data type.

sqlstate
An expression that returns a character string (CHAR or VARCHAR) of exactly 5 characters. The *sqlstate* value must follow these rules for application-defined SQLSTATEs:

- Each character must be from the set of digits ('0' through '9') or non-accented upper case letters ('A' through 'Z').
- The SQLSTATE class (first two characters) cannot be '00', '01', or '02' because these are not error classes.
- If the SQLSTATE class (first two characters) starts with the character '0' through '6' or 'A' through 'H', the subclass (last three characters) must start with a letter in the range 'I' through 'Z'.
- If the SQLSTATE class (first two characters) starts with the character '7', '8', '9', or 'I' though 'Z', the subclass (last three characters) can be any of '0' through '9' or 'A through 'Z'.

diagnostic-string
An expression that returns a character string with a data type of CHAR or VARCHAR and a length of up to 70 bytes. The string contains EBCDIC data that describes the error condition. If the string is longer than 70 bytes, it is truncated.

To use this function in a context where “Rules for result data types” on page 87 do not apply, such as alone in a select list, you must use a cast specification to give a data type to the null value that is returned. The RAISE_ERROR function is most useful with CASE expressions.

Example: For each employee in sample table DSN8810.EMP, list the employee number and education level. List the education level as Post Graduate, Graduate and Diploma instead of the integer that it is stored as in the table. If an education level is greater than 20, raise an error ('70001') with a description.

```
SELECT EMPNO,
  CASE WHEN EDLEVEL < 16 THEN 'Diploma'
       WHEN EDLEVEL < 18 THEN 'Graduate'
       WHEN EDLEVEL < 21 THEN 'Post Graduate'
       ELSE RAISE_ERROR('70001',
                        'EDUCLVL has a value greater than 20')
  END
  FROM DSN8810.EMP;
```

RAND

```
►►──RAND(──┬────────────────────┬──)───────────────────────────────────────────────►◄
           └─numeric-expression─┘
```

The schema is SYSIBM.

The RAND function returns a random floating-point value between 0 and 1. An argument can be used as an optional seed value.

If an argument is specified, it must be an integer (SMALLINT or INTEGER) between 0 and 2 147 483 646.

The result of the function is a double precision floating-point number. The result can be null; if the argument is null, the result is the null value.

A specific seed value, other than zero, will produce the same sequence of random numbers for a specific instance of a RAND function in a query each time the query is executed. RAND(0) is processed the same as RAND().

RAND is a nondeterministic function.

Example: Assume that host variable HRAND is an INTEGER with a value of 100. The following statement:

```
SELECT RAND(:HRAND)
  FROM SYSIBM.SYSDUMMY1;
```

returns a random floating-point number between 0 and 1, such as the approximate value .0121398.

To generate values in a numeric interval other than 0 to 1, multiply the RAND function by the size of the desired interval. For example, to get a random number between 0 and 10, such as the approximate value 5.8731398, multiply the function by 10:

```
SELECT (RAND(:HRAND) * 10)
  FROM SYSIBM.SYSDUMMY1;
```

REAL

Numeric to Real:

```
►►──REAL(numeric-expression)──────────────────────────────────────────────────►◄
```

String to Real:

```
►►──REAL(string-expression)───────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The REAL function returns a single precision floating-point representation of a number or string representation of a number.

Numeric to Real

numeric-expression
An expression that returns a value of any built-in numeric data type.

The result is the same number that would occur if the argument were assigned to a single precision floating-point column or variable. If the numeric value of the argument is not within the range of single precision floating-point, an error occurs.

String to Real

string-expression
An expression that returns a value of a character or graphic string (except a CLOB or DBCLOB) with a length attribute that is not greater than 255 bytes. The string must contain a string representation of a number.

The result is the same number that would result from CAST(*string-expression* AS REAL). Leading and trailing blanks are eliminated and the resulting string must conform to the rules for forming an SQL floating-point, integer, or decimal constant.

The result of the function is a single precision floating-point number. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Recommendation: To increase the portability of applications, use the CAST specification. For more information, see “CAST specification” on page 151.

Example: Using sample table DSN8810.EMP, find the ratio of salary to commission for employees whose commission is not zero. The columns involved, SALARY and COMM, have decimal data types. To express the result in single precision floating-point, apply REAL to SALARY so that the division is carried out in floating-point (actually double precision) and then apply REAL to the complete expression so that the results are returned in single precision floating-point.

```
SELECT EMPNO, REAL(REAL(SALARY)/COMM)
  FROM DSN8810.EMP
  WHERE COMM > 0;
```

REPEAT

```
►►──REPEAT(string-expression,integer)──────────────────────────────────────►◄
```

The schema is SYSIBM.

The REPEAT function returns a string composed of *string-expression* repeated *integer* times.

string-expression
An expression that specifies the string to be repeated. The string must be any type of character string except a CLOB, or any type of graphic string except a DBCLOB. The actual length of the string must be 32704 bytes or less.

integer
integer must be a positive value that specifies the number of times to repeat the string.

If any argument can be null, the result can be null; if any argument is null, the result is the null value. The encoding scheme of the result is the same as *string-expression*. The data type of the result of the function depends on the data type of string-expression:

- VARCHAR if *string-expression* is a character string
- VARGRAPHIC if *string-expression* is graphic string

The CCSID of the result is the same as the CCSID of *string-expression*.

If *integer* is a constant, the length attribute of the result is the length attribute of *string-expression* times *integer*. Otherwise, the length attribute depends on the data type of the result:

- 32704 for VARCHAR
- 16352 for VARGRAPHIC

The actual length of the result is the actual length of *string-expression* times *integer*. If the actual length of the result string exceeds the maximum for the return type, an error occurs.

Example 1: Repeat 'abc' two times to create 'abcabc'.

```
SELECT REPEAT('abc',2)
  FROM SYSIBM.SYSDUMMY1;
```

Example 2: List the phrase 'REPEAT THIS' five times. Use the CHAR function to limit the output to 60 bytes.

```
SELECT CHAR(REPEAT('REPEAT THIS',5), 60)
  FROM SYSIBM.SYSDUMMY1;
```

This example results in 'REPEAT THISREPEAT THISREPEAT THISREPEAT THISREPEAT THIS   '.

Example 3: For the following query, the LENGTH function returns a value of 0 because the result of repeating a string zero times is an empty string, which is a zero-length string.

```
SELECT LENGTH(REPEAT('REPEAT THIS',0))
  FROM SYSIBM.SYSDUMMY1;
```

Example 4: For the following query, the LENGTH function returns a value of 0 because the result of repeating an empty string any number of times is an empty string, which is a zero-length string.

```
SELECT LENGTH(REPEAT('', 5))
  FROM SYSIBM.SYSDUMMY1;
```

REPLACE

```
►►──REPLACE(source-string,search-string,replace-string)──────────────────────────────►◄
```

The schema is SYSIBM.

The REPLACE function replaces all occurrences of *search-string* in *source-string* with *replace-string*. If *search-string* is not found in *source-string*, *source-string* is returned unchanged.

source-string
An expression that specifies the source string. The expression must return a value that is a built-in character or graphic string data type that is not a LOB, and it cannot be an empty string.

search-string
An expression that specifies the string to be removed from the source string. The expression must return a value that is a built-in character or graphic string data type that is not a LOB, and it cannot be an empty string.

replace-string
An expression that specifies the replacement string. The expression must return a value that is a built-in character or graphic string data type that is not a LOB. If the expression is an empty string, nothing replaces the string that is removed from the source string.

The actual length of each string must be 32704 bytes or less. If the expressions have different CCSID sets, then the expressions are converted to the CCSID set of *source-string* (the source string).

The encoding scheme of the result is the same as *source-string*. The data type of the result of the function depends on the data type of *source-string*, *search-string*, and *replace-string*:

- VARCHAR if *source-string* is a character string. The CCSID of the result depends on the arguments:
  - If *source-string*, *search-string*, or *replace-string* is bit data, the result is bit data.
  - If *source-string*, *search-string*, and *replace-string* are all SBCS:,
    - If *source-string*, *search-string*, and *replace-string* are all SBCS Unicode data, the CCSID of the result is the CCSID for SBCS Unicode data.
    - If *source-string* is SBCS Unicode data, and *search-string* or *replace-string* are not SBCS Unicode data, the CCSID of the result is the mixed CCSID for Unicode data.
    - Otherwise, the CCSID of the result is the same as the CCSID of *source-string*.
  - Otherwise, the CCSID of the result is the mixed CCSID that corresponds to the CCSID of *source-string*. However, if the input is EBCDIC or ASCII and there is no corresponding system CCSID for mixed, the CCSID of the result is the CCSID of *source-string*.
- VARGRAPHIC if *source-string* is a graphic. The CCSID of the result is the same as the CCSID of *source-string*.

The length attribute of the result depends on the arguments:

- If the length attribute of *replace-string* is less than or equal to the length attribute of *search-string*, the length attribute of the result is the length attribute of *source-string*.
- Otherwise, the length attribute of the result is:

  ```
  (L3 * (L1/L2)) + MOD(L1,L2)
  ```

  where:

  L1 is the length attribute of *source-string*
  L2 is the length attribute of *search-string*
  L3 is the length attribute of *replace-string*

  If the result is a character string, the length attribute of the result must not exceed 32704. If the result is a graphic string, the length attribute of the result must not exceed 16352.

The actual length of the result is the actual length of *source-string* plus the number of occurrences of *search-string* that exist in *source-string* multiplied by the actual length of *replace-string* minus the actual length of *search-string*. If the actual length of the result string exceeds the maximum for the return data type, an error occurs.

If any argument can be null, the result can be null; if any argument is null, the result is the null value.

Example 1: Replace all occurrences of the character 'N' in the string 'DINING' with 'VID'. Use the CHAR function to limit the output to 10 bytes.

```
SELECT CHAR(REPLACE('DINING','N','VID'),10)
  FROM SYSIBM.SYSDUMMY1:
```

The result is the string 'DIVIDIVIDG'.

Example 2: Replace string 'ABC' in the string 'ABCXYZ' with nothing, which is the same as removing'ABC' from the string.

```
SELECT REPLACE('ABCXYZ','ABC','')
  FROM SYSIBM.SYSDUMMY1:
```

The result is the string 'XYZ'.

Example 3: Replace string 'ABC' in the string 'ABCCABCC' with 'AB'. This example illustrates that the result can still contain the string that is to be replaced (in this case, 'ABC') because all occurrences of the string to be replaced are identified prior to any replacement.

```
SELECT REPLACE('ABCCABCC','ABC','AB')
  FROM SYSIBM.SYSDUMMY1:
```

The result is the string 'ABCABC'.

RIGHT

```
►►──RIGHT(string-expression,integer)──────────────────────────────────────────►◄
```

The schema is SYSIBM.

The RIGHT function returns the rightmost *integer* bytes of *string-expression*.

The CCSID of the result is the same as that of the *string-expression*.

string-expression
An expression that specifies the string from which the result is derived. The string must be a character, graphic, or binary string. A substring of *string-expression* is zero or more contiguous bytes of *string-expression*.

The string can contain mixed data. However, because the function operates on a strict byte-count basis, the result is not necessarily a properly formed mixed data character string.

integer
An expression that specifies the length of the result. The value must be an integer between 0 and *n*, where *n* is the length attribute of *string-expression*.

The *string-expression* is effectively padded on the right with the necessary number of padding characters so that the specified substring of *string-expression* always exists. The encoding scheme of the data determines the padding character:

- For ASCII SBCS data or ASCII mixed data, the padding character is X'20'.
- For ASCII DBCS data, the padding character depends on the CCSID; for example, for Japan (CCSID 301) the padding character is X'8140', while for simplified Chinese it is X'A1A1'.
- For EBCDIC SBCS data or EBCDIC mixed data, the padding character is X'40'.
- For EBCDIC DBCS data, the padding character is X'4040'.
- For Unicode SBCS data or UTF-8 data (Unicode mixed data), the padding character is X'20'.
- For UTF-16 data (Unicode DBCS data), the padding character is X'0020'.
- For binary data, the padding character is X'00'.

The result of the function is a varying-length string with a length attribute that is the same as the length attribute of *string-expression* and a data type that depends on the data type of *string-expression*:

- VARCHAR if *string-expression* is CHAR or VARCHAR
- CLOB if *string-expression* is CLOB
- VARGRAPHIC if *string-expression* is GRAPHIC or VARGRAPHIC
- DBCLOB if *string-expression* is DBCLOB
- BLOB if *string-expression* is BLOB

If any argument of the function can be null, the result can be null; if any argument is null, the result is the null value. The CCSID of the result is the same as that of *string-expression*.

Example 1: Assume that host variable ALPHA has a value of 'ABCDEF'. The following statement:

```
SELECT RIGHT(ALPHA,3)
  FROM SYSIBM.SYSDUMMY1;
```

returns the value 'DEF', which are the three rightmost characters in ALPHA.

Example 2: The following statement returns a zero length string.

```
SELECT RIGHT('ABCABC',0)
  FROM SYSIBM.SYSDUMMY1;
```

ROUND

```
►►──ROUND(numeric-expression-1,numeric-expression-2)─────────────────────────────────►◄
```

The schema is SYSIBM.

The ROUND function returns *numeric-expression-1* rounded to *numeric-expression-2* places to the right of the decimal point.

numeric-expression-1
An expression that returns a value of any built-in numeric data type.

numeric-expression-2
An expression that returns a value of a built-in small integer data type or large integer data type. The absolute value of integer specifies the number of places to the right of the decimal point for the result if *numeric-expression-2* is not negative. If *numeric-expression-2* is negative, *numeric-expression-1* is rounded to the sum of the absolute value of *numeric-expression-2*+1 number of places to the left of the decimal point.

If the absolute value of *numeric-expression-2* is larger than the number of digits to the left of the decimal point, the result is 0. (For example, ROUND(748.58,-4) returns 0.)

If *numeric-expression-1* is positive, a value of 5 is rounded to the next higher positive number. If *numeric-expression-1* is negative, a value of 5 is rounded to the next lower negative number.

The result of the function has the same data type and length attribute as the first argument except that the precision is increased by one if the argument is DECIMAL and the precision is less than 31. For example, an argument with a data type of DECIMAL(5,2) results in DECIMAL(6,2). An argument with a data type of DECIMAL(31,2) results in DECIMAL(31,2).

The result can be null. If any argument is null, the result is the null value.

Example 1: Calculate the number 873.726 rounded to 2, 1, 0, -1, and -2 decimal places respectively.

```
SELECT ROUND(873.726,2),
       ROUND(873.726,1),
       ROUND(873.726,0),
       ROUND(873.726,-1),
       ROUND(873.726,-2)
       ROUND(873.726,-3),
       ROUND(873.726,-4),
  FROM SYSIBM.SYSDUMMY1;
```

This example returns the values 0873.730, 0873.700, 0874.000, 0870.000, 0900.000, 1000.000, and 0000.000.

Example 2: To demonstrate how numbers are rounded in positive and negative values, calculate the numbers 3.5, 3.1, -3.1, -3.5 rounded to 0 decimal places.

```
SELECT ROUND(3.5,0),
       ROUND(3.1,0),
       ROUND(-3.1,0),
       ROUND(-3.5,0)
  FROM SYSIBM.SYSDUMMY1;
```

This example returns the values 04.0, 03.0, -03.0, and -04.0. (Notice that in the positive value 3.5, 5 is rounded up to the next higher number while in the negative value -3.5, 5 is rounded down to the next lower negative number.)

ROUND_TIMESTAMP

```
►►──ROUND_TIMESTAMP(expression─┬────────────────┬─)────────────────────────────────►◄
                               └─,format-string─┘
```

The schema is SYSIBM.

The ROUND_TIMESTAMP scalar function returns a timestamp that is the *expression* rounded to the unit specified by the *format-string*. If *format-string* is not specified, *expression* is rounded to the nearest day, as if 'DD' is specified for *format-string*.

expression must be an expression that returns a value that is one of the following built-in data types: a timestamp, a character string, or a graphic string. If *expression* is a character or graphic string, it must not be a CLOB or DBCLOB, and it must contain a valid string representation of a timestamp with an actual length that is not greater than 255 bytes. For the valid formats of string representations of timestamps, see "String representations of datetime values" on page 65.

Allowable values for *format-string* are listed in Table 44.

The result of the function is a TIMESTAMP. The result can be null; if any argument is null, the result is the null value.

Notes

The following format models are used with the ROUND_TIMESTAMP and TRUNC_TIMESTAMP functions.

Table 44. ROUND_TIMESTAMP and TRUNC_TIMESTAMP format models

Format Model	Rounding or Truncating Unit	ROUND_TIMESTAMP Example	TRUNC_TIMESTAMP Example
CC SCC	One greater than the first two digits of a four digit year. (Rounds up on the 50th year of the century)	Input Value: 1897-12-04-12.22.22.000000 Result: 1900-01-01-00.00.00.000000	Input Value: 1897-12-04-12.22.22.000000 Result: 1800-01-01-00.00.00.000000
SYYYY YYYY YEAR SYEAR YYY YY Y	Year (Rounds up on July 1st)	Input Value: 1897-12-04-12.22.22.000000 Result: 1898-01-01-00.00.00.000000	Input Value: 1897-12-04-12.22.22.000000 Result: 1897-01-01-00.00.00.000000
IYYY IYY IY I	ISO Year (Rounds up on July 1st)	Input Value: 1897-12-04-12.22.22.000000 Result: 1898-01-01-00.00.00.000000	Input Value: 1897-12-04-12.22.22.000000 Result: 1897-01-01-00.00.00.000000
Q	Quarter (Rounds up on the sixteenth day of the second month of the quarter)	Input Value: 1999-06-04-12.12.30.000000 Result: 1999-07-01-00.00.00.000000	Input Value: 1999-06-04-12.12.30.000000 Result: 1999-04-01-00.00.00.000000
MONTH MON MM RM	Month (Rounds up on the sixteenth day of the month)	Input Value: 1999-06-18-12.12.30.000000 Result: 1999-07-01-00.00.00.000000	Input Value: 1999-06-18-12.15.00.000000 Result: 1999-06-01-00.00.00.000000

Table 44. ROUND_TIMESTAMP and TRUNC_TIMESTAMP format models (continued)

Format Model	Rounding or Truncating Unit	ROUND_TIMESTAMP Example	TRUNC_TIMESTAMP Example
WW	Same day of the week as the first day of the year (Rounds up on the 12th hour of the 3rd day of the week, with respect to the first day of the year)	Input Value: 2000-05-05-12.12.30.000000 Result: 2000-05-06-00.00.00.000000	Input Value: 2000-05-05-12.15.00.000000 Result: 2000-04-29-00.00.00.000000
IW	Same day of the week as the first day of the ISO year (Rounds up on the 12th hour of the 3rd day of the week, with respect to the first day of the ISO year)	Input Value: 2000-05-05-12.12.30.000000 Result: 2000-05-08-00.00.00.000000	Input Value: 2000-05-05-12.15.00.000000 Result: 2000-05-01-00.00.00.000000
W	Same day of the week as the first day of the month (Rounds up on the 12th hour of the 3rd day of the week, with respect to the first day of the month)	Input Value: 2000-05-17-12.12.30.000000 Result: 2000-05-15-00.00.00.000000	Input Value: 2000-05-17-12.15.00.000000 Result: 2000-05-15-00.00.00.000000
DDD DD J	Day (Rounds up on the 12th hour of the day)	Input Value: 2000-05-17-12.59.59.000000 Result: 2000-05-18-00.00.00.000000	Input Value: 2000-05-17-12.59.59.000000 Result: 2000-05-17-00.00.00.000000
DAY DY D	Starting day of the week (Rounds up with respect to the 12th hour of the third day of the week. The first day of the week is always Sunday).	Input Value: 2000-05-17-12.59.59.000000 Result: 2000-05-14-00.00.00.000000	Input Value: 2000-05-17-12.59.59.000000 Result: 2000-05-14-00.00.00.000000
HH HH12 HH24	Hour (Rounds up at 30 minutes)	Input Value: 2000-05-17-23.59.59.000000 Result: 2000-05-18-00.00.00.000000	Input Value: 2000-05-17-23.59.59.000000 Result: 2000-05-17-23.00.00.000000
MI	Minute (Rounds up at 30 seconds)	Input Value: 2000-05-17-23.58.45.000000 Result: 2000-05-17-23.59.00.000000	Input Value: 2000-05-17-23.58.45.000000 Result: 2000-05-17-23.58.00.000000
SS	Second (Rounds up at 500000 microseconds)	Input Value: 2000-05-17-23.58.45.500000 Result: 2000-05-17-23.58.46.000000	Input Value: 2000-05-17-23.58.45.500000 Result: 2000-05-17-23.58.45.000000

Example

Set the host variable RND_TMSTMP with the input timestamp rounded to the nearest year value.

```
SET :RND_TMSTMP = ROUND_TIMESTAMP(TIMESTAMP_FMT('2000-08-14 17:30:00',
                                                'YYYY-MM-DD HH24:MM:SS', 'YEAR');
```

The value set is 2001-01-01-00.00.00.000000.

ROWID

```
►►──ROWID(expression)──────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The ROWID function casts a value to a row ID.

The argument must be an expression that returns a value of a character data type, other than a CLOB, with a maximum length that is no greater than 255 bytes. Although the character string can contain any value, it is recommended that the character string contain a row ID value that was previously generated by DB2 to ensure a valid row ID value is returned. For example, the function can be used to convert a ROWID value that was cast to a CHAR value back to a ROWID value.

If the actual length of *expression* is less than 40, the result is not padded. If the actual length of *expression* is greater than 40, the result is truncated. If non-blank characters are truncated, a warning is returned.

The result of the function is a row ID.

The length attribute of the result is 40. The actual length of the result is the length of *expression*.

If the argument can be null, the result can be null; if the argument is null, the result is the null value. However, a null row ID value cannot be used as the value for a row ID column in the database.

Example: Assume that table EMPLOYEE contains a ROWID column EMP_ROWID. Also assume that the table contains a row that is identified by a row ID value that is equivalent to X'F0DFD230E3C0D80D81C201AA0A280100000000000203'. Using direct row access, select the employee number for that row.

```
SELECT EMPNO
  FROM EMPLOYEE
  WHERE EMP_ROWID=ROWID(X'F0DFD230E3C0D80D81C201AA0A280100000000000203');
```

RTRIM

```
►►──RTRIM(string-expression)──────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The RTRIM function removes blanks from the end of a string expression. The RTRIM function returns the same results as the STRIP function with TRAILING specified:

```
STRIP(string-expression,TRAILING)
```

The argument must be an expression that returns a value of any built-in character string data type or graphic string data type, other than a CLOB or DBCLOB. The characters that are interpreted as trailing blanks depend on the encoding scheme of the data and the data type:

- If the argument is a graphic string, then the trailing DBCS blanks are removed. If the data is encoded in ASCII, the ASCII CCSID determines the hex value that represents a double-byte blank. For example, for Japan (CCSID 301), X'8140' represents a double-byte blank, while it is X'A1A1' for Simplified Chinese. For EBCDIC-encoded data, X'4040' represents a double-byte blank. For Unicode-encoded data, X'0020' represents a double-byte blank.
- Otherwise, the trailing SBCS blanks are removed. For data that is encoded in ASCII, X'20' represents a blank. For EBCDIC-encoded data, X'40' represents a blank. For Unicode-encoded data, X'20' represents an SBCS or UTF-8 blank.

The result of the function depends on the data type of its argument:

- VARCHAR if the argument is a character string
- VARGRAPHIC if the argument is a graphic string

The length attribute of the result is the same as the length attribute of *string-expression*. The actual length of the result is the length of the expression minus the number of characters removed. If all of the characters are removed, the result is an empty string.

If the argument can be null, the result can be null; if the argument is null, the result is the null value. The CCSID of the result is the same as that of *string-expression*.

Example: Assume that host variable HELLO is defined as CHAR(9) and has a value of 'Hello '.

```
SELECT RTRIM(:HELLO)
  FROM SYSIBM.SYSDUMMY1;
```

This example removes the trailing blanks and results in 'Hello'.

SECOND

```
►►──SECOND(expression)────────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The SECOND function returns the seconds part of a value.

The argument must be an expression that returns a value of one of the following built-in data types: a time, a timestamp, a character string, a graphic string, or a numeric data type.

- If *expression* is a character or graphic string, it must not be a CLOB or DBCLOB, and its value must be a valid string representation of a time or timestamp with an actual length of not greater than 255 bytes. For the valid formats of string representations of times and timestamps, see “String representations of datetime values” on page 65.
- If *expression* is a number, it must be a time or timestamp duration. For the valid formats of time and timestamp durations, see “Datetime operands” on page 88.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The other rules depend on the data type of the argument:

If the argument is a time, timestamp, or string representation of either, the result is the seconds part of the value, which is an integer between 0 and 59.

If the argument is a time duration or timestamp duration, the result is the seconds part of the value, which is an integer between -99 and 99. A nonzero result has the same sign as the argument.

Example 1: Assume that the variable TIME_DUR is declared in a PL/I program as DECIMAL(6,0) and can therefore be interpreted as a time duration. Then, when TIME_DUR has the value 153045:

```
   SECOND(:TIME_DUR)
```

returns the value 45.

Example 2: Assume that RECEIVED is a TIMESTAMP column and that one of its values is the internal equivalent of '1988-12-25-17.12.30.000000'. Then, for this value:

```
   SECOND(RECEIVED)
```

returns the value 30.

SIGN

```
►►──SIGN(numeric-expression)──────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The SIGN function returns an indicator of the sign of the argument. The returned value is:

-1 if the argument is less than zero
0 if the argument is zero
1 if the argument is greater than zero

The argument must be an expression that returns a value of any built-in numeric data type, except DECIMAL(31,31).

The result of the function has the same data type and length attribute as the argument except that when the argument is DECIMAL, the precision is increased by one if the argument's precision and scale are equal. For example, an argument with a data type of DECIMAL(5,5) results in DECIMAL(6,5).

If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example: Assume that host variable PROFIT is a large integer with a value of 50000.

```
SELECT SIGN(:PROFIT)
  FROM SYSIBM.SYSDUMMY1;
```

This example returns the value 1.

SIN

```
►►──SIN(numeric-expression)──────────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The SIN function returns the sine of the argument, where the argument is an angle expressed in radians. The SIN and ASIN functions are inverse operations.

The argument must be an expression that returns the value of any built-in numeric data type. If the argument is not a double precision floating-point number, it is converted to one for processing by the function.

The result of the function is a double precision floating-point number. The result can be null; if the argument is null, the result is the null value.

Example: Assume that host variable SINE is DECIMAL(2,1) with a value of 1.5. The following statement:

```
SELECT SIN(:SINE)
  FROM SYSIBM.SYSDUMMY1;
```

returns a double precision floating-point number with an approximate value of 0.99.

SINH

```
►►──SINH(numeric-expression)────────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The SINH function returns the hyperbolic sine of the argument, where the argument is an angle expressed in radians.

The argument must be an expression that returns the value of any built-in numeric data type. If the argument is not a double precision floating-point number, it is converted to one for processing by the function.

The result of the function is a double precision floating-point number. The result can be null; if the argument is null, the result is the null value.

Example: Assume that host variable HSINE is DECIMAL(2,1) with a value of 1.5. The following statement:

```
   SELECT SINH(:HSINE)
     FROM SYSIBM.SYSDUMMY1;
```

returns a double precision floating-point number with an approximate value of 2.12.

SMALLINT

Numeric to Smallint:

```
►►──SMALLINT(numeric-expression)──────────────────────────────────────────►◄
```

String to Smallint:

```
►►──SMALLINT(string-expression)───────────────────────────────────────────►◄
```

The schema is SYSIBM.

The SMALLINT function returns a small integer representation of a number or string representation of a number.

Numeric to Smallint

numeric-expression
An expression that returns a value of any built-in numeric data type.

The result is the same number that would occur if the argument were assigned to a small integer column or variable. If the whole part of the argument is not within the range of small integers, an error occurs. If present, the decimal part of the argument is truncated.

String to Smallint

string-expression
An expression that returns a value of character or graphic string (except a CLOB or DBCLOB) with a length attribute that is not greater than 255 bytes. The string must contain a string representation of a number.

The result is the same number that would result from CAST(*string-expression* AS SMALLINT). Leading and trailing blanks are eliminated and the resulting string must conform to the rules for forming an SQL integer constant. If the whole part of the argument is not within the range of small integers, an error is returned.

The result of the function is a small integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Recommendation: To increase the portability of applications, use the CAST specification. For more information, see “CAST specification” on page 151.

Example: Using sample table DSN8810.EMP, find the average education level (EDLEVEL) of the employees in department 'A00'. Round the result to the nearest full education level.

```
SELECT SMALLINT(AVG(EDLEVEL)+.5)
  FROM DSN8810.EMP
  WHERE DEPT = 'A00';
```

Assuming that the five employees in the department have education levels of 19, 18, 14, 18, and 14, the result is 17.

SPACE

```
►►──SPACE(numeric-expression)──────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The SPACE function returns a character string that consists of the number of SBCS blanks that the argument specifies.

The argument must be an expression that returns the value of a built-in integer data type. The integer specifies the number of SBCS blanks for the result, and it must be between 0 and 32767.

The result of the function is a varying-length character string (VARCHAR) that contains SBCS data.

If *numeric-expression* is a constant, the length attribute of the result is the constant. Otherwise, the length attribute of the result is 4000. The actual length of the result is the value of *numeric-expression*. The actual length of the result must not be greater than the length attribute of the result.

If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example: The following statement returns a character string that consists of 5 blanks followed by a zero-length string.

```
SELECT SPACE(5), SPACE(0)
  FROM SYSIBM.SYSDUMMY1;
```

SQRT

```
►►──SQRT(numeric-expression)─────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The SQRT function returns the square root of the argument.

The argument must be an expression that returns the value of any built-in numeric data type. If the argument is not double precision floating point, it is converted to a double precision floating-point number for processing by the function.

The result of the function is a double precision floating-point number. The result can be null; if the argument is null, the result is the null value.

Example: Assume that host variable SQUARE is defined as DECIMAL(2,1) and has a value of 9.0. Find the square root of SQUARE.

```
SELECT SQRT(:SQUARE)
  FROM SYSIBM.SYSDUMMY1;
```

This example returns a double precision floating-point number with an approximate value of 3.

STRIP

```
►►──STRIP(string-expression─┬──────────────────────────────────┬─)─────────────────────►◄
                            └─┬─,BOTH─────┬──┬─────────────────┬┘
                              ├─,B────────┤  └─,strip-character┘
                              ├─,LEADING──┤
                              ├─,L────────┤
                              ├─,TRAILING─┤
                              └─,T────────┘
```

The schema is SYSIBM.

The STRIP function removes blanks or another specified character from the end, the beginning, or both ends of a string expression.

The first argument is an expression that returns a value that is of any built-in character string data type or graphic string data type, other than a CLOB or DBCLOB.

The second argument indicates whether characters are removed from the beginning, the end, or both ends of the string. If you do not specify a second argument, blanks are removed from both the beginning and end of the string.

The third argument must be a single-character constant that indicates the SBCS or DBCS character that is to be removed. The first and third argument must have compatible string types. For more information on compatibility, see “Conversion rules for operations that combine strings” on page 89. If the data type is not appropriate or the value contains more than one character, an error is returned.

If you do not specify the third argument, the following occurs:

- If the first argument is a graphic string, the default strip character is a DBCS blank. The hex representation of a DBCS blank depends on the encoding scheme and CCSID of the data. For example, for data encoded in ASCII, a DBCS blank for Japan (CCSID 301) is X'8140', while for simplified Chinese it is X'A1A1'. For EBCDIC DBCS, X'4040' is interpreted as a DBCS blank. For UTF-16 (Unicode DBCS), X'0020' is interpreted as a DBCS blank.
- Otherwise, the default strip character is an SBCS blank. If the data is encoded in ASCII, then X'20' represents a blank. If the data is encoded in EBCDIC, then X'40' represents a blank. If the data is encoded in UTF-8 (Unicode mixed), then X'20' represents a blank.

The result of the function is a varying-length string with the same maximum length as the length attribute of the string. The actual length of the result is the length of the expression minus the number of characters removed. If all of the characters are removed, the result is an empty, varying-length string.

If *string-expression* and *strip-character* have different CCSID sets, *strip-character* is converted to the CCSID of *string-expression*. The CCSID of the result is the same as that of the string. If the first argument can be null, the result can be null; if the first argument is null, the result is the null value.

Example 1: Assume that host variable HELLO is defined as CHAR(9) and has a value of '   Hello':

```
STRIP(:HELLO)
```

This example results in 'Hello'. If there had been any ending blanks, they would have been removed, too.

Rewrite the example so that no beginning blanks are removed.

```
STRIP(:HELLO,TRAILING)
```

This results in '   Hello'.

Example 2: Assume that host variable BALANCE is defined as CHAR(9) and has a value of '000345.50':

```
STRIP(:BALANCE,L,'0')
```

This example results in '345.50'.

SUBSTR

```
►►──SUBSTR(string-expression,start──┬─────────┬──)──────────────────────────►◄
                                    └─,length─┘
```

The schema is SYSIBM.

The SUBSTR function returns a substring of a string.

string-expression
: An expression that specifies the string from which the result is derived. The string must be a character, graphic, or binary string. If *string-expression* is a character string, the result of the function is a character string. If it is a graphic string, the result of the function is a graphic string. If it is a binary string, the result of the function is a binary string.

A substring of *string-expression* is zero or more contiguous characters of *string*. If *string-expression* is a graphic string, a character is a DBCS character. If *string-expression* is a character string or a binary string, a character is a byte. The SUBSTR function accepts mixed data strings. However, because SUBSTR operates on a strict byte-count basis, the result will not necessarily be a properly formed mixed data string.

start
: An expression that specifies the position within *string-expression* to be the first character of the result. The value of integer must be between 1 and the length attribute of *string-expression*. (The length attribute of a varying-length string is its maximum length.) A value of 1 indicates that the first character of the substring is the first character of *string-expression*.

length
: An expression that specifies the length of the resulting substring. If specified, *length* must be an expression that returns a value that is a built-in integer data type. The value must be greater than or equal to 0 and less than or equal to *n*, where *n* is the length attribute of *string-expression* - *start* + 1. The specified length must not, however, be the integer constant 0.

If *length* is explicitly specified, *string-expression* is effectively padded on the right with the necessary number of characters so that the specified substring of *string-expression* always exists. Hexadecimal zeroes are used as the padding character when *string-expression* is BLOB data. Otherwise, a blank is used as the padding character.

If *string-expression* is a fixed-length string, omission of *length* is an implicit specification of LENGTH(*string-expression*) - *start* + 1, which is the number of characters (or bytes) from the character (or byte) specified by start to the last character (or byte) of *string-expression*. If *string-expression* is a varying-length string, omission of length is an implicit specification of the greater of zero or LENGTH(*string-expression*) - *start* + 1. If the resulting length is zero, the result is the empty string.

If *length* is explicitly specified by an integer constant that is 255 or less, and *string-expression* is not a LOB, the result is a fixed-length string with a length attribute of *length*. If *length* is not explicitly specified, but *string-expression* is a fixed-length string and *start* is an integer constant, the result is a fixed-length string with a length attribute equal to LENGTH(*string-expression*) - *start* + 1. In all other cases, the result is a varying-length string. If length is explicitly specified by an integer constant, the length attribute of the result is length; otherwise, the length attribute of the result is the same as the length attribute of *string-expression*.

If any argument of SUBSTR can be null, the result can be null. If any argument is null, the result is the null value. The CCSID of the result is the CCSID of *string-expression*.

Example 1: FIRSTNME is a VARCHAR(12) column in sample table DSN8810.EMP. One of its values is the 5-character string 'MAUDE'. When FIRSTNME has this value:

```
Function ...              Returns ...

SUBSTR(FIRSTNME,2,3)      'AUD'
SUBSTR(FIRSTNME,2)        'AUDE'
SUBSTR(FIRSTNME,2,6)      'AUDE' followed by two blanks
SUBSTR(FIRSTNME,6)        a zero-length string
SUBSTR(FIRSTNME,6,4)      four blanks
```

Example 2: Sample table DSN8810.PROJ contains column PROJNAME, which is defined as VARCHAR(24). Select all rows from that table for which the string in PROJNAME begins with 'W L PROGRAM'.

```
SELECT * FROM DSN8810.PROJ
  WHERE SUBSTR(PROJNAME,1,12) = 'W L PROGRAM ';
```

Assume that the table has only the rows that were supplied by DB2. Then the predicate is true for just one row, for which PROJNAME has the value 'W L PROGRAM DESIGN'. The predicate is not true for the row in which PROJNAME has the value 'W L PROGRAMMING' because, in the predicate's string constant, 'PROGRAM' is followed by a blank.

Example 3: Assume that a LOB locator named my_loc represents a LOB value that has a length of 1 gigabyte. Assign the first 50 bytes of the LOB value to host variable PORTION.

```
SET :PORTION = SUBSTR(:my_loc,1,50);
```

Example 4: Assume that host variable RESUME has a CLOB data type and holds an employee's resume. This example shows some of the statements that find the section of department information in the resume and assign it to host variable DeptBuf. First, the POSSTR function is used to find the beginning and ending location of the department information. Within the resume, the department information starts with the string 'Department Information Section' and ends immediately before the string 'Education Section'. Then, using these beginning and ending positions, the SUBSTR function assigns the information to the host variable.

```
SET :DInfoBegPos = POSSTR(:RESUME, 'Department Information Section');
SET :DInfoEnPos = POSSTR(:RESUME, 'Education Section');
SET :DeptBuf = SUBSTR(:RESUME, :DInfoBegPos, :DInfoEnPos - :DInfoBegPos);
```

TAN

```
►►──TAN(numeric-expression)──────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The TAN function returns the tangent of the argument, where the argument is an angle expressed in radians. The TAN and ATAN functions are inverse operations.

The argument must be an expression that returns the value of any built-in numeric data type. If the argument is not a double precision floating-point number, it is converted to one for processing by the function.

The result of the function is a double precision floating-point number. The result can be null; if the argument is null, the result is the null value.

Example: Assume that host variable TANGENT is DECIMAL(2,1) with a value of 1.5. The following statement:

```
SELECT TAN(:TANGENT)
  FROM SYSIBM.SYSDUMMY1;
```

returns a double precision floating-point number with an approximate value of 14.10.

TANH

```
►►──TANH(numeric-expression)──────────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The TANH function returns the hyperbolic tangent of the argument, where the argument is an angle expressed in radians. The TANH and ATANH functions are inverse operations.

The argument must be an expression that returns the value of any built-in numeric data type. If the argument is not a double precision floating-point number, it is converted to one for processing by the function.

The result of the function is a double precision floating-point number. The result can be null; if the argument is null, the result is the null value.

Example: Assume that host variable HTANGENT is DECIMAL(2,1) with a value of 1.5. The following statement:

```
SELECT TANH(:HTANGENT)
  FROM SYSIBM.SYSDUMMY1;
```

returns a double precision floating-point number with an approximate value of 0.90.

TIME

```
►►──TIME(expression)──────────────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The TIME function returns a time derived from a value.

The argument must be an expression that returns a value of one of the following built-in data types: a time, a timestamp, a character string, or a graphic string. If *expression* is a character or graphic string, it must not be a CLOB or DBCLOB, and its value must be a valid string representation of a time or timestamp with an actual length of not greater than 255 bytes. For the valid formats of string representations of times and timestamps, see “String representations of datetime values” on page 65.

The result of the function is a time. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The other rules depend on the data type of the argument:

If the argument is a time, the result is that time.

If the argument is a timestamp, the result is the time part of the timestamp.

If the argument is a string, the result is the time or time part of the timestamp represented by the string. If the CCSID of the string is not the same as the corresponding default CCSID at the server, the string is first converted to that CCSID.

Example: Assume that a table named CLASSES contains one row for each scheduled class. Assume also that the class starting times are in the TIME column named STARTTM. Using these assumptions, select those rows in CLASSES that represent classes that start at 1:30 P.M.

```
SELECT *
  FROM CLASSES
  WHERE TIME(STARTTM) = '13:30:00';
```

TIMESTAMP

```
►►──TIMESTAMP(expression-1──┬───────────────┬─)──────────────────────────────────►◄
                            └─,expression-2─┘
```

The schema is SYSIBM.

The TIMESTAMP function returns a timestamp derived from its argument or arguments.

The rules for the arguments depend on whether the second argument is specified.

- **If only one argument is specified:**

  The argument must be an expression that returns a value of one of the following built-in data types: a timestamp, a character string, or a graphic string. If *expression* is a character or graphic string, it must not be a CLOB or DBCLOB and its value must be one of the following:

  – A valid string representation of a date or timestamp with an actual length that is not greater than 255 bytes. For the valid formats of string representations of dates and timestamps, see “String representations of datetime values” on page 65.

  – A character or graphic string with an actual length of 8 that is assumed to be a zSeries® Store Clock value.

  – A character or graphic string with an actual length of 14 that represents a valid date and time in the form *yyyymmddhhmmss*, where *yyyy* is the year, *mm* is the month, *dd* is the day, *hh* is the hour, *mm* is the minute, and *ss* is the seconds.

- **If both arguments are specified:**,

  The first argument must be an expression that returns a value of one of the following built-in data types: a date, a character string, or a graphic string. The second argument must be an expression that returns a value of one of the following built-in data types: a time, a character string, or a graphic string. A character or graphic string must be a valid string representation of a time.

  If *expression-1* is a character or graphic string, it must not be a CLOB or DBCLOB, and its value must be a valid string representation of a date with an actual length that is not greater than 255 bytes. If *expression-2* is a character or graphic string, it must not be a CLOB or DBCLOB, and its value must be a valid string representation of a time with an actual length that is not greater than 255 bytes. For the valid formats of string representations of dates and times, see “String representations of datetime values” on page 65.

The result of the function is a timestamp. If either argument can be null, the result can be null; if either argument is null, the result is the null value.

The other rules depend on whether the second argument is specified:

If both arguments are specified, the result is a timestamp with the date specified by the first argument and the time specified by the second argument. The microsecond part of the timestamp is zero.

If only one argument is specified and it is a timestamp, the result is that timestamp.

If only one argument is specified and it is a string, the result is the timestamp represented by that string. The timestamp represented by a string of length 14 has a microsecond part of zero. The interpretation of a string as a Store Clock value will yield a timestamp with a year between 1900 to 2042.

If an argument is a string with a CCSID that is not the same as the corresponding default CCSID at the server, the string is first converted to that CCSID.

Example: Assume that table TABLEX contains a DATE column named DATECOL and a TIME column named TIMECOL. For some row in the table, assume that DATECOL represents 25 December 1988 and TIMECOL represents 17 hours, 12 minutes, and 30 seconds after midnight. Then, for this row:

```
TIMESTAMP(DATECOL, TIMECOL)
```

returns the value '`1988-12-25-17.12.30.000000`'.

TIMESTAMP_FORMAT

```
►►──TIMESTAMP_FORMAT(string-expression,format-string)──────────────────────────►◄
```

The schema is SYSIBM.

The TIMESTAMP_FORMAT function returns a timestamp.

string-expression
An expression that returns a value of any built-in character string data type or graphic string data type, other than a CLOB or DBCLOB, with a length attribute that is not greater than 255 bytes. Leading and trailing blanks are removed from the string, and the resulting substring is interpreted as a timestamp using the format specified by *format-string*.

format-string
A character string constant with a length that is not greater than 255 bytes. *format-string* contains a template of how *string-expression* is to be interpreted as a timestamp value. Leading and trailing blanks are removed from the string, and the resulting substring must be a valid template for a timestamp. The only valid format for the function is:

’YYYY-MM-DD HH24:MI:SS’

where:

YYYY	4-digit year
MM	Month (01-12, January = 01)
DD	Day of month (01-31)
HH24	Hour of day (00–24, when the value is 24, the minutes and seconds must be 0).
MI	Minutes (00–59)
SS	Seconds (00–59)

The result of the function is a timestamp.

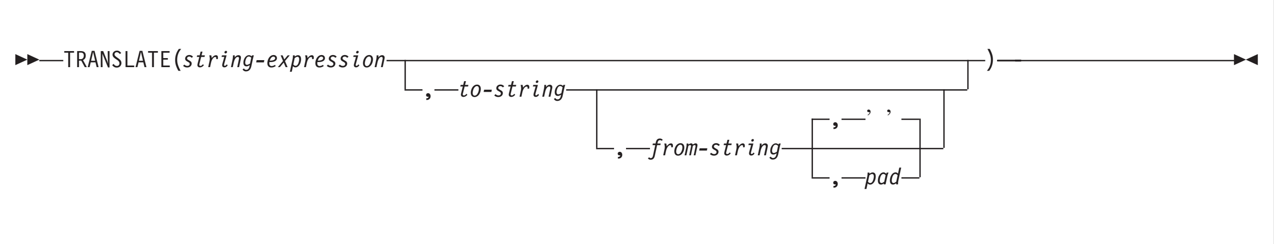
If the argument can be null, the result can be null; if the argument is null, the result is the null value.

TO_DATE can be specified as synonym for TIMESTAMP_FORMAT.

Example: Set the character variable TVAR to the value of CREATEDTS from SYSIBM.SYSDATABASE if it is equal to one second before the beginning of the year 2000 (’1999-12-31 23:59:59’). The character string should be interpreted in the only format that can be specified for the function.

```
SELECT VARCHAR_FORMAT(CREATEDTS,'YYYY-MM-DD HH24:MI:SS')
  INTO :TVAR
  FROM SYSIBM.SYSDATABASE;
  WHERE CREATEDTS =
 TIMESTAMP_FORMAT('1999-12-31 23:59:59','YYYY-MM-DD HH24:MI:SS');
```

TRANSLATE



```
>>──TRANSLATE(string-expression──┬──────────────────────────────────────────────┬──)──────────><
                                 └─,──to-string──┬────────────────────────────┬─┘
                                                 │                  ┌─,── ' '─┐│
                                                 └─,──from-string───┼─────────┼┘
                                                                    └─,──pad──┘
```

The schema is SYSIBM.

The TRANSLATE function returns a value in which one or more characters of *string-expression* may have been converted to other characters.

string-expression
: An expression that specifies the string to be converted. *string-expression* must return a value that is a built-in character or graphic string data type that is not a LOB.

to-string
: A string that specifies the characters to which certain characters in *string-expression* are to be converted. This string is sometimes called the *output translation table*. *to-string* must return a value that is a built-in character or graphic string data type that is not a LOB.

  If the length of *to-string* is less than the length of *from-string*, *to-string* is padded to the length of *from-string* with the *pad* or a blank. If the length of *to-string* is greater than *from-string*, the extra characters in *to-string* are ignored without warning.

from-string
: A string that specifies the characters that if found in *string-expression* are to be converted. This string is sometimes called the *input translation table*. When a character in *from-string* is found, the character in *string-expression* is converted to the character in *to-string* that is in the corresponding position of the character in *from-string*.

  from-string must return a value that is a built-in character or graphic string data type that is not a LOB.

  If *from-string* contains duplicate characters, the first occurrence of the character is used, and no warning is issued. The default value for *from-string* is a string that starts with the character X'00' and ends with the character X'FF' (decimal 255).

pad
: A string that specifies the character with which to pad *to-string* if its length is less than *from-string*. *pad* is an expression that must return a value that is a built-in character or graphic string data type that is not a LOB and has a length of 1. A length of 1 is one single byte for character strings and one double byte string for graphic strings. The default is a blank that is appropriate for *string-expression*.

If *string-expression* is the only argument that is specified, the characters of its value are converted to uppercase based on the LC_CTYPE locale in effect for the statement, which is determined by special register CURRENT LOCALE LC_CTYPE. For example, a-z are converted to A-Z, and characters with diacritical marks are converted to their uppercase equivalent, if any. (For a description of the uppercase tables that are used for this conversion, see *IBM National Language Support Reference Manual Volume 2*.)

If the LC_CTYPE locale is blank when the function is executed, the result of the function depends on the data type of *string-expression*.

- For ASCII and EBCDIC, if *string-expression* specifies a graphic string expression, then an error occurs. For a character string expression, characters a-z are converted to A-Z and characters with diacritical marks are not translated.
- For Unicode, *string-expression* can be either a character string expression or a graphic string expression, and LOCALE LC_CTYPE must be blank (no locale specified). The characters a-z are converted to A-Z and all other characters, including characters with diacritic marks, are left unchanged. If LOCALE LC_CTYPE is not blank, an error occurs.

If more than one argument is specified, the result string is built character-by-character from *string-expression* with each character in *from-string* being converted to the corresponding character in *to-string*. For each character in *string-expression*, the *from-string* is searched for the same character. If the character is found to be the *n*th character in *from-string*, the resulting string will contain the *n*th character from *to-string*. If *to-string* is less than *n* characters long, the resulting string will contain the *pad*. If the character is not found in *from-string*, it is moved to the result string without being converted.

The string can contain mixed data. If only one argument is specified, the UPPER function is performed on the argument, and the rules for operating on mixed data in the UPPER function are observed. Full-width Latin small letters a-z are converted to full-width Latin capital letters A-Z. Otherwise, the function operates on a strict byte-count basis, and the result is not necessarily a properly formed mixed data character string.

The encoding scheme of the result is the same as *string-expression*. The data type of the result of the function depends on the data type of *string-expression*, *to-string*, *from-string*, and *pad*:

- VARCHAR if *string-expression* is a character string. The CCSID of the result depends on the arguments:
  - If *string-expression*, *to-string*, *from-string*, or *pad* is bit data, the result is bit data.
  - If *string-expression*, *to-string*, *from-string*, and *pad* are all SBCS:,
    - If *string-expression*, *to-string*, *from-string*, and *pad* are all SBCS Unicode data, the CCSID of the result is the CCSID for SBCS Unicode data.
    - If *string-expression* is SBCS Unicode data, and *to-string*, *from-string*, or *pad* are not SBCS Unicode data, the CCSID of the result is the mixed CCSID for Unicode data.
    - Otherwise, the CCSID of the result is the same as the CCSID of *string-expression*.
  - Otherwise, the CCSID of the result is the mixed CCSID that corresponds to the CCSID of *string-expression*. However, if the input is EBCDIC or ASCII and there is no corresponding system CCSID for mixed, the CCSID of the result is the CCSID of *string-expression*.
- VARGRAPHIC if *string-expression* is a graphic. The CCSID of the result is the same as the CCSID of *source-string*.

If the first argument can be null, the result can be null. If the argument is null, the result is the null value.

Example 1: Return the string 'abcdef' in uppercase characters. Assume that the locale in effect is blank.

```
SELECT TRANSLATE ('abcdef')
  FROM SYSIBM.SYSDUMMY1
```

The result is the value 'ABCDEF'.

Example 2: Assume that host variable SITE has a data type of VARCHAR(30) and contains 'Hanauma Bay'.

```
SELECT TRANSLATE (:SITE)
  FROM SYSIBM.SYSDUMMY1
```

Returns the value 'HANAUMA BAY'. The result is all uppercase characters because only one argument is specified.

```
SELECT TRANSLATE (:SITE, 'j', 'B')
  FROM SYSIBM.SYSDUMMY1
```

Returns the value 'Hanauma jay'.

```
SELECT TRANSLATE (:SITE, 'ei', 'aa')
  FROM SYSIBM.SYSDUMMY1
```

Returns the value 'Heneume Bey'.

```
SELECT TRANSLATE (:SITE, 'bA', 'Bay', '%')
  FROM SYSIBM.SYSDUMMY1
```

Returns the value 'HAnAumA bA%'.

```
SELECT TRANSLATE (:SITE, 'r', 'Bu')
  FROM SYSIBM.SYSDUMMY1
```

Returns the value 'Hana ma ray'.

Example 3: Assume that host variable SITE has a data type of VARCHAR(30) and contains 'Pivabiska Lake Place'.

```
SELECT TRANSLATE (:SITE, '$$', 'Ll')
  FROM SYSIBM.SYSDUMMY1
```

Returns the value 'Pivabiska $ake P$ace'.

```
SELECT TRANSLATE (:SITE, 'pLA', 'Place', '.')
  FROM SYSIBM.SYSDUMMY1
```

Returns the value 'pivAbiskA LAk. pLA..'.

TRUNCATE

```
►►──TRUNCATE(numeric-expression-1,numeric-expression-2)──────────────────────────────────►◄
```

The schema is SYSIBM.

The TRUNCATE function returns *numeric-expression-1* truncated to *numeric-expression-2* places to the right of the decimal point.

numeric-expression-1
: An expression that returns a value of any built-in numeric data type.

numeric-expression-2
: An expression that returns a small or large integer data type. The absolute value of the integer specifies the number of places to truncate. The value of *numeric-expression-2* determines whether truncation is to the right or left of the decimal point.

  If *numeric-expression-2* is not negative, *numeric-expression-1* is truncated to the absolute value of *numeric-expression-2* places to the right of the decimal point.

  If *numeric-expression-2* is negative, *numeric-expression-1* is truncated to 1 + (the absolute value of *numeric-expression-2*) places to the left of the decimal point. If 1 + (the absolute value of *numeric-expression-2*) is greater than or equal to the number of digits to the left of the decimal point, the result is 0. For example, `TRUNCATE(748.58,-4)` returns 0.

The result of the function has the same data type and length attribute as the first argument. The result can be null. If any argument is null, the result is the null value.

TRUNC can be specified as a synonym for TRUNCATE.

Example 1: Using sample employee table DSN8810.EMP, calculate the average monthly salary for the highest paid employee. Truncate the result to two places to the right of the decimal point.

```
SELECT TRUNCATE(MAX(SALARY)/12,2)
  FROM DSN8810.EMP;
```

Because the highest paid employee in the sample employee table earns $52750.00 per year, the example returns the value 4395.83.

Example 2: Return the number 873.726 truncated to 2, 1, 0, -1, -2, -3, and -4 decimal places respectively.

```
SELECT TRUNC(873.726,2),
       TRUNC(873.726,1),
       TRUNC(873.726,0),
       TRUNC(873.726,-1),
       TRUNC(873.726,-2)
       TRUNC(873.726,-3),
       TRUNC(873.726,-4)
  FROM TABLEX
  WHERE INTCOL = 1234;
```

This example returns the values 873.720, 873.700, 873.000, 870.000, 800.000, 0000.000, and 0000.000.

TRUNC_TIMESTAMP

```
►►──TRUNC_TIMESTAMP(expression──┬────────────────┬─)──────────────────────────────────►◄
                                └─,format-string─┘
```

The schema is SYSIBM.

The TRUNC_TIMESTAMP scalar function returns a timestamp that is the *expression* truncated to the unit specified by the *format-string*. If *format-string* is not specified, *expression* is truncated to the nearest day, as if 'DD' was specified for *format-string*.

expression
: An expression that returns a value of any of the following built-in data types: a timestamp, a character string, or a graphic string. If expression is a character or graphic string, it must not be a CLOB or DBCLOB, and its value must be a valid string representation of a timestamp with an actual length that is not greater than 255 bytes. For the valid formats of string representations of dates and timestamps, see "String representations of datetime values" on page 65.

format-string
: A character string constant with a length that is not greater than 255 bytes. *format-string* contains a template of how the timestamp represented by expression should be truncated. For example, if *format-string* is 'DD', the timestamp that is represented by *expression* is truncated to the nearest day. Leading and trailing blanks are removed from the string, and the resulting substring must be a valid template for a timestamp. Allowable values for *format-string* are listed in Table 44 on page 334.

The result of the function is a TIMESTAMP. The result can be null; if any argument is null, the result is the null value.

Example: Set the host variable TRNK_TMSTMP with the current year rounded to the nearest year value.

```
SET :TRNK_TMSTMP = TRUNC_TIMESTAMP('2000-03-14-17.30.00', 'YEAR');
```

The host variable TRNK_TMSTMP is set with the value 2000-01-01-00.00.00.000000.

UCASE

```
►►──UCASE(string-expression)─────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The UCASE function is identical to the UPPER function. For more information, see “UPPER” on page 362.

UPPER

```
►►──UPPER(string-expression)──────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The UPPER function returns a string in which all the characters have been converted to uppercase characters.

string-expression
: An expression that specifies the string to be converted. *string-expression* must return a value that is a built-in character or graphic string. A character string argument must not be a CLOB, and a graphic string argument must not be a DBCLOB.

The alphabetic characters of the argument are translated to uppercase characters based on the value of the LC_CTYPE locale in effect for the statement. For example, characters a-z are translated to A-Z, and characters with diacritical marks are translated to their uppercase equivalent, if any. The locale is determined by special register CURRENT LOCALE LC_CTYPE. For information about the special register, see “CURRENT LOCALE LC_CTYPE” on page 102.

If the LC_CTYPE locale is blank when the function is executed, the result of the function depends on the data type of *string-expression*.

- For ASCII and EBCDIC, if *string-expression* specifies a graphic string expression, then an error occurs. For a character string expression, characters a-z are translated to A-Z and characters with diacritical marks are not translated. If the string contains MIXED or DBCS characters, full-width Latin small letters a-z are converted to full-width Latin capital letters A-Z.
- For Unicode, *string-expression* can be either a character string expression or a graphic string expression. The characters a-z are translated to A-Z and all other characters, including characters with diacritic marks, are left unchanged. If LOCALE LC_CTYPE is not blank, an error occurs. Full-width Latin small letters a-z are converted to full-width Latin capital letters A-Z.

The length attribute, data type, subtype, and CCSID of the result are the same as the expression. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example: Return the string 'abcdef' in uppercase characters. Assume that the locale in effect is blank.

```
SELECT UPPER('abcdef')
  FROM SYSIBM.SYSDUMMY1
```

The result is the value 'ABCDEF'.

VARCHAR

Character to Varchar:

```
►►──VARCHAR(character-expression──┬────────────┬──)──────────────────────────────►◄
                                  └─,──integer─┘
```

Graphic to Varchar:

```
►►──VARCHAR(graphic-expression──┬────────────┬──)────────────────────────────────►◄
                                └─,──integer─┘
```

Datetime to Varchar:

```
►►──VARCHAR(datetime-expression)──────────────────────────────────────────────────►◄
```

Integer to Varchar:

```
►►──VARCHAR(integer-expression)───────────────────────────────────────────────────►◄
```

Decimal to Varchar:

```
►►──VARCHAR(decimal-expression──┬──────────────────────┬──)──────────────────────►◄
                                └─,──decimal-character─┘
```

Floating-point to Varchar:

```
►►──VARCHAR(floating-point-expression)────────────────────────────────────────────►◄
```

Row ID to Varchar:

```
►►──VARCHAR(row-ID-expression)────────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The VARCHAR function returns a varying-length character string representation of a character string, graphic string, datetime value, integer number, decimal number, floating-point number, or row ID value.

The result of the function is a varying-length character string (VARCHAR). If the first argument can be null, the result can be null; if the first argument is null, the result is the null value.

Character to Varchar

character-expression
An expression that returns a value that is a built-in character data type.

integer
Specifies the length attribute for the resulting varying-length character string. The value must be an integer constant between 1 and 32767. If the length is not specified, the length of the result is the same as the length of *character-expression*.

If second argument is not specified and if the *character-expression* is an empty string constant, the length attribute of the result is 1 and the result is an empty string. Otherwise, the length attribute of the result is the same as the length attribute of the first argument.

The actual length of the result is the minimum of the length attribute of the result and the actual length of *character-expression*. If the length of *character-expression* is greater than the length attribute of the result, the result is truncated. Unless all the truncated characters are blanks appropriate for *character-expression*, a warning is returned.

If *character-expression* is bit data, the result is bit data. Otherwise, the CCSID of the result is the same as the CCSID of *character-expression*.

Graphic to Varchar

graphic-expression
An expression that returns a value that is a built-in graphic data type.

integer
The length attribute for the resulting varying-length character string. The value must be an integer constant between 1 and 32740.

If second argument is not specified, the length attribute of the result is determined as follows (where *n* is the length attribute of the first argument):

- If the *graphic-expression* is the empty graphic string constant, the length attribute of the result is 1.
- If the result is SBCS data, the result length is *n*.
- If the result is mixed data, the result length is (3*(*length(string-expression)*)).

The actual length of the result is the minimum of the length attribute of the result and the actual length of *graphic-expression*. If the length of the character expression is greater than the length attribute of the result, the result is truncated. Unless all the truncated characters were blanks appropriate for *graphic-expression*, a warning is returned.

The CCSID of the result is the character mixed CCSID that corresponds to the graphic CCSID of *graphic-expression*.

Datetime to Varchar

datetime-expression
An expression whose value has one of the following three built-in data types:

date The result is a varying-length character string representation of the date in the format that is specified by the DATE precompiler option, if one is provided, or else field DATE FORMAT on installation panel DSNTIP4 specifies the format. If the format is to be LOCAL, field LOCAL DATE LENGTH on installation panel DSNTIP4 specifies the length of the result. Otherwise, the length attribute and actual length of the result is 10.

LOCAL denotes the local format at the DB2 that executes the SQL statement. If LOCAL is used for the format, a time exit routine must be installed at that DB2.

An error occurs if the second argument is specified and is not a valid value.

time The result is a varying-length character string representation of the time in the format specified by the TIME precompiler option, if one is provided, or else field TIME FORMAT on installation panel DSNTIP4 specifies the format. If the format is to be LOCAL, the field LOCAL TIME LENGTH on installation panel DSNTIP4 specifies the length of the result. Otherwise, the length attribute and actual length of the result is 8.

LOCAL denotes the local format at the DB2 that executes the SQL statement. If LOCAL is used for the format, a time exit routine must be installed at that DB2.

An error occurs if the second argument is specified and is not a valid value.

timestamp
The result is the varying-length character string representation of the timestamp. The length attribute and actual length of the result is 26.

The CCSID of the result is determined from the context in which the function was invoked. For more information, see “Determining the encoding scheme and CCSID of a string” on page 29.

Integer to Varchar

integer-expression
An expression that returns a value with a small or large integer data type.

The result is a varying-length character string representation (VARCHAR) of the argument in the form of an SQL integer constant.

The length attribute of the result depends on whether the argument is a small or large integer as follows:

- If the argument is a small integer, the length attribute of the result is 6 bytes.
- If the argument is a large integer, the length attribute of the result is 11 bytes.

The actual length of the result is the smallest number of characters that can be used to represent the value of the argument. Leading zeroes are not included. If the argument is negative, the first character of the result is a minus sign. Otherwise, the first character is a digit.

The CCSID of the result is the SBCS CCSID of the appropriate encoding scheme.

Decimal to Varchar

decimal-expression
An expression that returns a value that is a built-in decimal data type. To specify a different precision and scale for the expression's value, apply the DECIMAL function to the expression before applying the VARCHAR function.

decimal-character
Specifies the single-byte character constant (CHAR or VARCHAR) that is used to delimit the decimal digits in the result character string. The character must not be a digit, a plus sign (+), a minus sign (–), or a blank. The default is the period (.) or comma (,). For information on what factors govern the choice, see "Decimal point representation" on page 181.

The result is a varying-length character string representation (VARCHAR) of the argument in the form of an SQL decimal constant. The result includes a character that represents the decimal point and *p* digits where *p* is the precision of *decimal-expression*.

The length attribute of the result is 2+*p* where *p* is the precision of *decimal-expression*. The actual length of the result is the smallest number of characters that can be used to represent the result, except that trailing zeros are included. Leading zeros are not included. If the argument is negative, the result begins with a minus sign. Otherwise, the result begins with a digit.

The CCSID of the result is determined from the context in which the function was invoked. For more information, see "Determining the encoding scheme and CCSID of a string" on page 29.

Floating-Point to Varchar

floating-point-expression
An expression that returns a value that is a built-in floating-point data type.

The result is a varying-length character string representation (VARCHAR) of the argument in the form of an SQL floating-point constant.

The length attribute of the result is 24. The actual length of the result is the smallest number of characters that can represent the value of the argument such that the mantissa consists of a single digit other than zero followed by a period and a sequence of digits. If the argument is negative, the first character of the result is a minus sign; otherwise, the first character is a digit. If the argument is zero, the result is 0E0.

The CCSID of the result is determined from the context in which the function was invoked. For more information, see "Determining the encoding scheme and CCSID of a string" on page 29.

Row ID to Varchar

row-ID-expression
An expression that returns a value that is a built-in row ID data type.

The result is a varying-length character string representation (VARCHAR) of the argument. It is bit data.

The length attribute of the result is 40. The actual length of the result is the length of *row-ID-expression*.

Example: Assume that host variable JOB_DESC is defined as VARCHAR(8). Using sample table DSN8810.EMP, set JOB_DESC to the varying-length string equivalent of the job description (column JOB defined as CHAR(8)) for the employee with the last name of 'QUINTANA'.

```
SELECT VARCHAR(JOB)
  INTO :JOB_DESC
  FROM DSN8810.EMP
  WHERE LASTNAME = 'QUINTANA';
```

VARCHAR_FORMAT

```
►►──VARCHAR_FORMAT(expression,format-string)──────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The VARCHAR_FORMAT function returns a character representation of a timestamp in the format indicated by *format-string*.

expression
An expression returns a value of a built-in timestamp data type.

format-string
A character string constant with a maximum length that is not greater than 255 bytes. *format-string* contains a template of how *timestamp-expression* is to be formatted. Leading and trailing blanks are removed from the string, and the resulting substring must conform to the rules for formatting a timestamp. The only valid format that can be specified for the function is:

’YYYY-MM-DD HH24:MI:SS’

where:

YYYY	4-digit year
MM	Month (01-12, January = 01)
DD	Day of month (01-31)
HH24	Hour of day (00–24, when the value is 24, the minutes and seconds must be 0).
MI	Minutes (00–59)
SS	Seconds (00–59)

The result is the varying-length character string that contains the argument in the format specified by *format-string*. *format-string* also determines the length attribute and actual length of the result. The CCSID of the result is determined from the context in which the function was invoked. For more information, see “Determining the encoding scheme and CCSID of a string” on page 29.

If the argument can be null, the result can be null; if the argument is null, the result is the null value.

TO_CHAR can be specified as a synonym for VARCHAR_FORMAT.

Example: Set the character variable TVAR to the timestamp value of CREATEDTS from SYSIBM.SYSDATABASE, using the character string format supported by the function to specify the format of the value for TVAR.

```
SELECT VARCHAR_FORMAT(CREATEDTS,'YYYY-MM-DD HH24:MI:SS')
  INTO :TVAR
  FROM SYSIBM.SYSDATABASE;
```

VARGRAPHIC

Character to Vargraphic:

```
►►──VARGRAPHIC(character-expression──┬────────────┬──)─────────────────────────────►◄
                                     └─,──integer─┘
```

Graphic to Vargraphic:

```
►►──VARGRAPHIC(graphic-expression──┬────────────┬──)───────────────────────────────►◄
                                   └─,──integer─┘
```

The schema is SYSIBM.

The VARGRAPHIC function returns a varying-length graphic string representation of a character string value, with the single-byte characters converted to double-byte characters, or a graphic string value.

The result of the function is a varying-length graphic string (VARGRAPHIC).

If the first argument can be null, the result can be null; if the first argument is null, the result is the null value.

The length attribute and actual length of the result are measured in double-byte characters because the result is a graphic string.

Character to Vargraphic

character-expression
An expression that returns a value that is an EBCDIC-encoded or Unicode-encoded character string. It cannot be BIT data. The argument does not need to be mixed data, but any occurrences of X'0E' and X'0F' in the string must conform to the rules for EBCDIC mixed data. (See “Character strings” on page 58 for these rules.)

integer
The length attribute of the resulting varying-length graphic string. The value must be an integer constant between 1 and 16352.

If *integer* is not specified and if the *character-expression* is an empty string constant or has a value X'0E0F', the length attribute of the result is 1 and the result is an empty string. Otherwise, the length attribute of the result is the same as the length attribute of the first argument.

The actual length of the result is the minimum of the length attribute of the result and the actual length of *character-expression*. If the length of *character-expression*, as measured in single-byte characters, is greater than the specified length of the result, as measured in double-byte characters, the result is truncated. Unless all the truncated characters are blanks appropriate for *character-expression*, a warning is returned.

The CCSID of the result is the graphic CCSID that corresponds to the character CCSID of *character-expression*. If the input is EBCDIC and there is no system CCSID for EBCDIC GRAPHIC data, the CCSID of the result is X'FFFE'.

For EBCDIC input data:

Each character of *character-expression* determines a character of the result. The argument might need to be converted to the native form of mixed data before the result is derived. Let M denote the system CCSID for mixed data. The argument is not converted if any of the following conditions is true:

- The argument is mixed data and its CCSID is M.
- The argument is SBCS data and its CCSID is the same as the system CCSID for SBCS data. In this case, the operation proceeds as if the CCSID of the argument is M.

Otherwise, the argument is a new string S derived by converting the characters to the coded character set identified by M. If there is no system CCSID for mixed data, conversion is to the coded character set that the system CCSID for SBCS data identifies.

The result is derived from S using the following steps:

- Each shift character (X'0E' or X'0F') is removed.
- Each double-byte character remains as is.
- Each single-byte character is replaced by a double-byte character.

The replacement for a single-byte character is the equivalent DBCS character if an equivalent exists. Otherwise, the replacement is X'FEFE'. The existence of an equivalent character depends on M. If there is no system CCSID for mixed data, the DBCS equivalent of X'xx' for EBCDIC is X'42xx', except for X'40', whose DBCS equivalent is X'4040'.

For Unicode input data:

Each character of *character-expression* determines a character of the result. The argument might need to be converted to the native form of mixed data before the result is derived. Let M denote the system CCSID for mixed data. The argument is not converted if any of the following conditions is true:

- The argument is mixed data, and its CCSID is M.
- The argument is SBCS data, and its CCSID is the same as the system CCSID for SBCS data. In this case, the operation proceeds as if the CCSID of the argument is M.

Otherwise, the argument is a new string S derived by converting the characters to the coded character set identified by M.

The result is derived from S using the following steps:

- Each non-supplementary character is replaced by a Unicode double-byte character (a UTF-16 code point). A non-supplementary character in UTF-8 is between 1 and 3 bytes.
- Each supplementary character is replaced by a pair of Unicode double-byte characters (a pair of UTF-16 code points).

The replacement for a single-byte character is the Unicode equivalent character if an equivalent exists. Otherwise, the replacement is X'FFFD'.

Graphic to Vargraphic

graphic-expression
An expression that returns a value that is an EBCDIC-encoded or Unicode-encoded graphic string.

integer
The length attribute for the resulting varying-length graphic string. The value must be an integer constant between 1 and 16352.

If *integer* is not specified and if the *graphic-expression* is an empty string constant, the length attribute of the result is 1 and the result is an empty string. Otherwise, the length attribute of the result is the same as the length attribute of the first argument.

The actual length of the result depends on the number of characters in *graphic-expression*. If the length of *graphic-expression* is greater than the length specified, the result is truncated. Unless all of the truncated characters are double-byte blanks, a warning is returned.

The CCSID of the result is the same as the CCSID of *graphic-expression*.

Example: Assume that GRPHCOL is a VARGRAPHIC column in table TABLEX and MIXEDSTRING is a character-string host variable that contains mixed data. For various rows in TABLEX, an application uses a positioned UPDATE statement to replace the value of GRPHCOL with the value of MIXEDSTRING. Before GRPHCOL can be updated, the current value of MIXEDSTRING must be converted to a varying-length graphic string. The following statement shows how to code the VARGRAPHIC function within the UPDATE statement to ensure this conversion.

```
EXEC SQL UPDATE TABLEX
  SET GRPHCOL = VARGRAPHIC(:MIXEDSTRING)
  WHERE CURRENT OF CRSNAME;
```

WEEK

```
►►──WEEK(expression)──────────────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The WEEK function returns an integer in the range of 1 to 54 that represents the week of the year. The week starts with Sunday, and January 1 is always in the first week.

The argument must be an expression that returns a value of one of the following built-in data types: a date, a timestamp, a character string, or a graphic string. If *expression* is a character or graphic string, it must not be a CLOB or DBCLOB, and its value must be a valid string representation of a date or timestamp with an actual length that is not greater than 255 bytes. For the valid formats of string representations of dates and timestamps, see “String representations of datetime values” on page 65.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example: Using sample table DSN8810.PROJ, set the integer host variable WEEK to the week of the year that project 'AD2100' ended.

```
SELECT WEEK(PRENDATE)
  INTO :WEEK
  FROM DSN8810.PROJ
  WHERE PROJNO = 'AD2100';
```

The result is that WEEK is set 6.

WEEK_ISO

```
►►──WEEK_ISO(expression)────────────────────────────────────────────────────►◄
```

The schema is SYSIBM.

The WEEK function returns an integer in the range of 1 to 53 that represents the week of the year. The week starts with Monday and includes 7 days. Week 1 is the first week of the year to contain a Thursday, which is equivalent to the first week containing January 4. Thus, it is possible to have up to 3 days at the beginning of the year appear as the last week of the previous year, or to have up to 3 days at the end of a year appear as the first week of the next year.

The argument must be a date, a timestamp, or a valid string representation of a date or timestamp. A string representation must not be a BLOB, CLOB, or DBCLOB and must have an actual length that is not greater than 255 bytes. For the valid formats of string representations of dates and timestamps, see “String representations of datetime values” on page 65.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

Example 1: Using sample table DSN8810.PROJ, set the integer host variable WEEK to the week of the year that project 'AD2100' ended.

```
SELECT WEEK_ISO(PRENDATE)
  INTO :WEEK
  FROM DSN8810.PROJ
  WHERE PROJNO = 'AD2100';
```

*Example 2:*The following list shows what is returned by the WEEK_ISO function for various dates.

```
DATEWEEK_ISO

1997-12-28      '52'
1997-12-31       '1'
1998-01-01       '1'
1999-01-01      '53'
1999-01-04       '1'
1999-12-31      '52'
2000-01-01      '52'
2000-01-03       '1'
```

XML2CLOB

```
►►──XML2CLOB(XML-value-expression)──────────────────────────────────────────►◄
```

The schema is SYSIBM.

The XML2CLOB function returns a CLOB representation of an XML value. The XML2CLOB function provides applications with an interface that is used to access the transient XML data type. A transient XML data type is a data type that only exists during query processing. There is no persistent data of this type, and it is not an external data type that can be declared in application programs.

To allow applications to gain access to XML data, XML2CLOB converts an XML value into a CLOB. The CLOB value contains a Unicode text string for the XML value in a UTF-8 encoding scheme. XML2CLOB must be used to convert an XML value to a character string before passing it as an argument to any built-in function other than XML2CLOB, COALESCE, or an XML publishing function, or before passing it as an argument to a user-defined function or a stored procedure. XML2CLOB must also be used to convert an XML value to a character string for storing it in a table using INSERT and UPDATE.

XMLCLOB must be used in the top-level SELECT list for a query or view definition for XML values.

XML-value-expression
: An expression whose value is the XML type that is returned, for example from the XMLELEMENT or XMLAGG function.

The result of the function is a CLOB. If the argument can be null, the result can be null. If the argument is null, the result is the null value. The length attribute of the result is the maximum serialized length for the argument. The actual length of the result is the actual length of the string for the *XML-value-expression*. The maximum length of the result CLOB is 2 147 483 647 bytes (2GB-1).The result is mixed character data. The CCSID of the result is the CCSID for mixed Unicode data (1208).

Example: Construct a CLOB from the XML value returned by the XMLELEMENT function, which is a simple XML element with ″Emp″ as the element name and employee name as the element content.

```
SELECT e.id, XML2CLOB(
           XMLELEMENT ( NAME "Emp",
                     e.fname || ' '  || e.lname
              ) ) AS "result"
FROM employees e;
```

The result of the query would look similar to the following result:

```
ID     Result
---------------------------------------------
1001   <Emp>John Smith</Emp>
1206   <Emp>Mary Martin</Emp>
```

XMLCONCAT

```
                                     ┌──────────────────────────┐
                                     ▼                          │
►►──XMLCONCAT(XML-value-expression───,──XML-value-expression───┴──)───────────────────────────►◄
```

The schema is SYSIBM.

The XMLCONCAT function returns a forest of XML elements that are generated from a concatenation of two or more arguments. A forest is an ordered set of subtrees of XML nodes.

XML-value-expression
: Specifies an expression whose value is the XML data type. If the value of *XML-value-expression* is null, it is not included in the concatenation.

The result of the function is the transient XML type. The transient XML data type only exists during query processing. There is no persistent data of this type, and it is not an external data type that can be declared in application programs. The result can be null; if all the arguments are null, the null value is returned.

Example: Concatenate first name and last name elements by using “first” and “last” element names for each employee.

```
SELECT XML2CLOB( XMLCONCAT
                ( XMLELEMENT ( NAME "first", e.fname),
                  XMLELEMENT ( NAME "last", e.lname)
                         ) ) AS "result"
FROM employees e;
```

The result of the query would look similar to the following result, where the ″result″column is a CLOB:

```
result
 ---------------------------------------------
 <first>John</first><last>Smith</last>
 <first>Mary</first><last>Smith</last>
```

XMLELEMENT

```
                                                                                ┌──────────────────────────┐
                                                                                ▼                          │
►►──XMLELEMENT(─NAME──XML-element-name──┬────────────────────┬─┬────────────────────┬──┬─────────────────────────┬┴─)──────────►◄
                                        └─,──XML-namespaces──┘ └─,──XML-attributes──┘  └─,──XML-element-content──┘
```

XML-attributes

```
                    ┌─,──────────────────────────────────────────────────┐
                    ▼                                                    │
►►──XMLATTRIBUTES(──XML-attribute-value──┬───────────────────────────┬──┴─)──────────────►◄
                                         └─AS──XML-attribute-name────┘
```

The schema is SYSIBM.

The XMLELEMENT function returns an XML element from one or more arguments: an element name, an optional collection of namespace declarations, an optional collection of attributes, and zero or more arguments that make up the element's content.

NAME
The keyword NAME marks the identifier that is supplied to XMLELEMENT for the element name.

XML-element-name
Specifies an identifier that is used as the XML element name. The name must be an XML QName. If the name is qualified, the namespace prefix must be declared within the scope.

XML-namespaces
An XMLNAMESPACES function that declares one or more namespaces for the function. If specified, *XML-namespaces* must be the second argument of the function. The namespaces that are declared are in the scope of the XMELEMENT function. The namespaces apply to any nested XML functions within the XMLELEMENT function, regardless of whether or not they appear inside another subselect.

XML-attributes
Specifies the attributes for the XML element. It can be used in the XMLELEMENT function as the third argument if *XML-namespaces*s is specified or as the second argument if *XML-namespaces* is not specified.

XML-attribute-value
An expression that specifies the value of the attribute. The expression cannot be ROWID, character string defined with the FOR BIT DATA attribute, BLOB, a distinct type based on these types, or XML. The result of the expression is mapped to an XML value according to the mapping rules from an SQL value to an XML value. If the value is null, the corresponding XML attribute is not included in the XML element. See "XML values" on page 69.

AS *XML-attribute-name*
Specifies an identifier that is used as the attribute name.

If *XML-attribute-name* is not specified, the expression for *XML-attribute-value* must be a column name, and the attribute name will be created from the column name using the fully escaped mapping from a column name to an XML attribute name.

An attribute name must be an XML QName , and it cannot be ″xmlns″ or prefixed with ″xmlns:″. That is, XMLATTRIBUTES cannot be used to declare XML namespaces. If the attribute name is a qualified name, the namespace prefix must be declared within the scope. The attribute names for an element must be unique for the XML element to be well-formed.

The result of the function is the transient XML data type. The transient XML data type only exists during query processing. There is no persistent data of this type, and it is not an external data type that can be declared in application programs. The XMLATTRIBUTES function is used with XMLELEMENT to specify attributes for the XML element. The result cannot be null.

Example 1: For each employee ID, create an empty XML element named Emp with an ID attribute equal to the ID.

```
SELECT e.id, XML2CLOB ( XMLELEMENT ( NAME "Emp",
                            XMLATTRIBUTES ( e.id )
                  ) ) AS "result"
FROM employees e;
```

The result of the query would look similar to the following result:

```
ID     result
---------------------------------------------
1001   <Emp ID="1001"></Emp>
1206   <Emp ID="1206"></Emp>
null   <Emp></Emp>
```

Example 2: Produce an XML element named Emp for each employee, with nested elements for the employee’s full name and the date the employee was hired.

```
SELECT e.id, XML2CLOB
   (XMLELEMENT (NAME "Emp",
             XMLELEMENT (NAME "name",e.fname || ' ' ||e.lname),
             XMLELEMENT (NAME "hiredate",e.hire)))
     AS "result"
FROM employees e;
```

The result of the query would look similar to the following result:

```
ID     result
---------------------------------------------
1001   <Emp>
       <name>John Smith</name>
       <hiredate>2000-05-24</hiredate>
       </Emp>
1206   <Emp>
       <name>Mary Martin</name>
       <hiredate>1996-02-01</hiredate>
       </Emp>
```

XMLFOREST

```
                                  ┌─,─────────────────────────────────┐
                                  ▼                                   │
►►──XMLFOREST(──┬──────────────────┬───expression──┬─────────────────────┬─┴─)────────────────────►◄
                └─XML-namespaces──,─┘              └─AS──XML-element-name─┘
```

The schema is SYSIBM.

The XMLFOREST function returns a forest of XML elements that all share a specific pattern from a list of expressions, one element for each argument. A forest is an ordered set of subtrees of XML nodes.

XML-namespaces
: An XMLNAMESPACES function that declares one or more namespaces for the function. If specified, *XML-namespaces* must be the first argument of the function. The namespaces declared are in scope of the XMLFOREST function. The namespaces apply to any nested XML functions within the XMLFOREST function, regardless of whether or not they appear inside another subselect.

expression
: Specifies an expression that is used as an XML element content. The result of the expression is mapped to an XML value according to the mapping rules from an SQL value to an XML value. The expression cannot be a ROWID, character string defined with the FOR BIT DATA attribute, BLOB, or a distinct type based on these types. If the result of an expression is null, it is not included in the concatenation result for XMLFOREST. See "XML values" on page 69.

AS *XML-element-name*
: Specifies an identifier that is used for the XML element name.

  If *XML-element-name* is not specified, *expression* must be a column name, and the element name will be created from the column name. The fully escaped mapping will be used to map the column name to an XML element name.

  An XML element name must be an XML QName. If the name is qualified, the namespace prefix must be declared within the scope.

The result of the function is the transient XML data type. The transient XML data type only exists during query processing. There is no persistent data of this type, and it is not an external data type that can be declared in application programs. The result of the function is the concatenation of the elements, each of which is an XML element from an argument. The result can be null; if all arguments are null, the result is the null value.

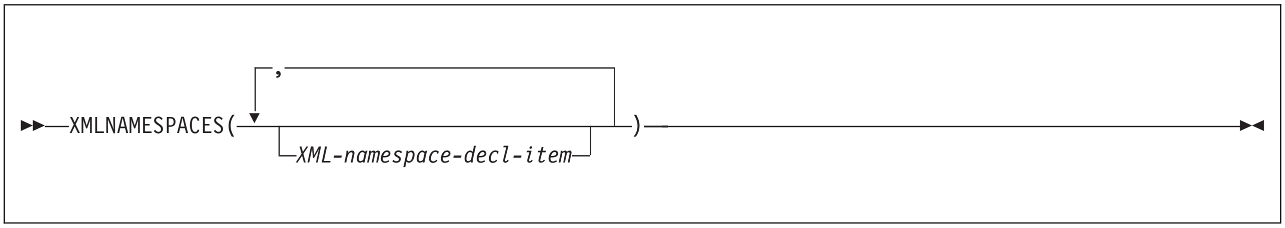
Example: Generate an ″Emp″ element for each employee. Use employee name as its attribute and two subelements generated from columns HIRE and DEPT by using XMLFOREST as its content. The element names for the two subelements are ″HIRE″ and ″department″.

```
SELECT e.id, XML2CLOB ( XMLELEMENT
      ( NAME "Emp",
        XMLATTRIBUTES ( e.fname || ' '  || e.lname
                        AS "name" ),
                XMLFOREST ( e.hire,
                           e.dept AS "department" )
                         ) ) AS "result"
        FROM employees e;
```

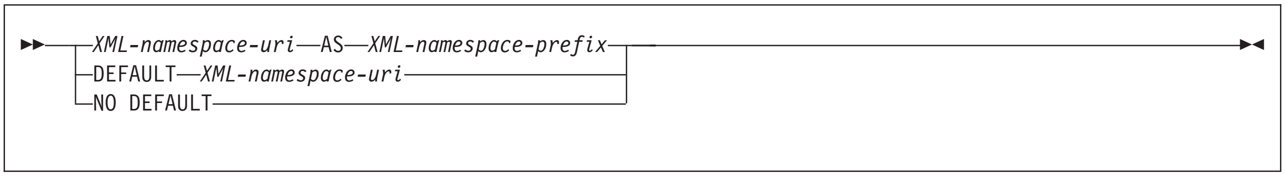
The result of the query would be similar to the following result:

```
ID     result
---------------------------------------------
1001   <Emp name="John Smith">
         <HIRE>2000-05-24</HIRE>
         <department>Accounting</department>
           </Emp>
1001   <Emp name="Mary Martin">
         <HIRE>1996-02-01</HIRE>
         <department>Shipping</department>
           </Emp>
```

XMLNAMESPACES



XML-namespace-decl-item:



The schema is SYSIBM.

The XMLNAMESPACES function declares one or more XML namespaces.

XML-namespace-uri
: A character string literal that is the namespace name. It cannot be a UX, GX, or graphic string literal. *XML-namespace-uri* can be an empty string constant only if it is being specified for DEFAULT.

AS *XML-namespace-prefix*
: An identifier that is the namespace prefix, bound to the namespace name (namespace URI) that is specified. The identifier must be an XML NCName. It cannot be ″xml″ or ″xmlns″. No two XML namespace prefixes can be the same in the same XMLNAMESPACES function.

DEFAULT
: Declares the *XML-namespace-uri* that follows as the default namespace. *XML-namespace-uri* can be an empty string.

NO DEFAULT
: Declares that there is no default namespace.

At most, one default namespace or NO DEFAULT can be specified.

XMLNAMESPACES can only be used in XMLELEMENT or XMLFOREST. In XMLELEMENT, XMLNAMESPACES can only be used as the second argument. While in XMLFOREST, it can only be the first argument.

The following namespace prefixes are pre-defined in SQL/XML: ″xml″, ″xs″, ″xsd″, ″xsi″, and ″sqlxml″. Their bindings are:

- xmlns:xml = ″http://www.w3.org/XML/1998/namespace″
- xmlns:xs = ″http://www.w3.org/2001/XMLSchema″
- xmlns:xsd = ″http://www.w3.org/2001/XMLSchema″
- xmlns:xsi = ″http://www.w3.org/2001/XMLSchema-instance″
- xmlns:sqlxml= ″http://standards.iso.org/iso/9075/2003/sqlxml″

Example 1: Generate an ″employee″ element for each employee. The employee element is associated with XML namespace ″urn:bo', which is bound to prefix ″bo″. The element contains attributes for names and a hiredate subelement.

```
SELECT e.empno, xml2clob(XMLELEMENT(NAME "bo:employee",
                         XMLNAMESPACES('urn:bo' as "bo"),
                         XMLATTRIBUTES(e.lastname, e.firstnme),
                         XMLELEMENT(NAME "bo:hiredate", e.hiredate)))
FROM employee e where e.edlevel = 12;
```

The result of the query would be similar to the following result:

```
00029 <bo:employee xmlns:bo="urn:bo" LASTNAME="PARKER" FIRSTNME="JOHN">
      <bo:hiredate>198-5-3</bo:hiredate>
      </bo:employee>
00031 <bo:employee xmlns:bo="urn:bo" LASTNAME="SETRIGHT"
      FIRSTNME="MAUDE">
      <bo:hiredate>1964-9-12</bo:hiredate>
      </bo:employee>
```

Example 2: Generate two elements for each employee using XMLFOREST. The first ″lastname″ element is associated with the default namespace ″http://hr.org″, and the second ″job″ element is associated with XML namespace ″http://fed.gov″, which is bound to prefix ″d″.

```
SELECT empno, xml2clob(XMLFOREST(
       XMLNAMESPACES(DEFAULT 'http://hr.org', 'http://fed.gov' AS "d"),
          lastname, job AS "d:job"))
FROM employee where edlevel = 12;
```

The result of the query would be similar to the following result:

```
00029 <LASTNAME xmlns="http://hr.org" xmlns:d="http://fed.gov">PARKER
      </LASTNAME>
      <d:job xmlns="http://hr.org" xmlns:d="http://fed.gov">
      OPERATOR</d:job>
00031 <LASTNAME xmlns="http://hr.org" xmlns:d="http://fed.gov">
      SETRIGHT</LASTNAME>
      <d:job xmlns="http://hr.org" xmlns:d="http://fed.gov">
      OPERATOR</d:job>
```

YEAR

```
▸▸—YEAR(expression)———————————————————————————————————————————▸◂
```

The schema is SYSIBM.

The YEAR function returns the year part of a value.

The argument must be an expression that returns one of the following built-in data types: a date, a timestamp, a character string, a graphic string, or a numeric data type.

- If *expression* is a character or graphic string, it must not be a CLOB or DBCLOB, and its value must be a valid string representation of a date or timestamp with an actual length of not greater than 255 bytes. For the valid formats of string representations of dates and timestamps, see "String representations of datetime values" on page 65.
- If *expression* is a number, it must be a date or timestamp duration. For the valid formats of date and timestamp durations, see "Datetime operands" on page 88.

The result of the function is a large integer. If the argument can be null, the result can be null; if the argument is null, the result is the null value.

The other rules depend on the data type of the argument specified:

If the argument is a date, a timestamp, or a string representation of either, the result is the year part of the value, which is an integer between 1 and 9999.

If the argument is a date duration or a timestamp duration, the result is the year part of the value, which is an integer between -9999 and 9999. A nonzero result has the same sign as the argument.

Example: From the table DSN8810.EMP, select all rows for employees who were born in 1941.

```
SELECT *
  FROM DSN8810.EMP
  WHERE YEAR(BIRTHDATE) = 1941;
```

Table functions

A table function can be used only in the FROM clause of a statement. Table functions return columns of a table and resemble a table created through a CREATE TABLE statement. Table functions can be qualified with a schema name.

Following in alphabetic order is a definition of each of the table functions.

MQREADALL

```
                                                               (1)
>>──MQREADALL(──┬─────────────────────────────────────┬──┬───────────────┬──)──────────────><
                └─receive-service─┬─────────────────┬─┘  └─┬───┬─num-rows─┘
                                  └─,─service-policy─┘       └─,─┘
```

Notes:

1 The comma is required before *num-rows* when any of the preceding arguments to the function are specified.

The schema is DB2MQ1C or DB2MQ2C.

The MQREADALL function returns a table containing the messages and message meta-data from the MQSeries location that is specified by *receive-service*, using the quality-of-service policy that is defined in *service-policy*. Performing this operation does not remove the messages from the queue that is associated with *receive-service*.

receive-service
An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The value of the expression must not be the null value, an empty string, or a string with trailing blanks. The expression must have an actual length that is no greater than 48 bytes. The value of the expression refers to a service point that is the logical MQSeries destination from which the message is read. A service point is defined in the DSNAMT repository file, and it represents a logical end-point from which a message is sent or received. A service point definition includes the name of the MQSeries queue manager and the name of the queue. See *MQSeries Application Messaging Interface* for more details.

If *receive-service* is not specified, DB2.DEFAULT.SERVICE is used.

service-policy
An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The value of the expression must not be the null value, an empty string, or a string with trailing blanks. The expression must have an actual length that is no greater than 48 bytes. The value of the expression refers to an MQSeries AMI service policy that is used in handling this message. A service policy is defined in the DSNAMT repository file, and it specifies a set of quality-of-service options that are to be applied to this messaging operation. These options include message priority and message persistence. See *MQSeries Application Messaging Interface* for more details.

If *service-policy* is not specified, DB2.DEFAULT.POLICY is used.

num-rows
An expression that specifies the maximum number of messages to return. It must be an expression that returns a built-in integer data type.

If *num-rows* is not specified or the value of expression is zero, all available messages are returned.

The result of the function is a table with the format shown in Table 45 on page 385. All the columns are nullable.

Table 45. Format of the resulting table for MQREADALL

Column name	Data type	Contains
MSG	VARCHAR(4000)	The contents of the MQSeries message
CORRELID	VARCHAR(24)	The correlation ID that is used to relate messages
TOPIC	VARCHAR(40)	The topic that the message was published with, if available
QNAME	VARCHAR(48)	The name of the queue from which the message was received
MSGID	CHAR(24)	The unique, MQSeries-assigned identifier for the message
MSGFORMAT	VARCHAR(8)	The format of the message, as defined by MQSeries

Example 1: Retrieve all the messages from the queue specified by the default service (DB2.DEFAULT.SERVICE), using the default policy (DB2.DEFAULT.POLICY).

```
SELECT *
  FROM TABLE (MQREADALL()) T;
```

The messages and all the metadata are returned as a table.

Example 2: Retrieve the first 10 messages from the beginning of the queue specified by the default service (DB2.DEFAULT.SERVICE), using the default policy (DB2.DEFAULT.POLICY).

```
SELECT *
  FROM TABLE (MQREADALL(10)) T;
```

The first 10 messages and all the columns are returned as a table.

MQREADALLCLOB

```
                                                                               (1)
►►──MQREADALLCLOB(──┬─────────────────────────────────────────┬──┬──────────────────┬──────)────────────►◄
                    └─receive-service──┬────────────────────┬─┘  └──┬───┬─num-rows─┘
                                       └─,──service-policy──┘       └─,─┘
```

Notes:

1 The comma is required before *num-rows* when any of the preceding arguments to the function are specified.

The schema is DB2MQ1C or DB2MQ2C.

The MQREADALLCLOB function returns a table containing the messages and message meta-data from the MQSeries location that is specified by *receive-service*, using the quality-of-service policy that is defined in *service-policy*. Performing this operation does not remove the messages from the queue that is associated with *receive-service*.

receive-service

An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The value of the expression must not be the null value, an empty string, or a string with trailing blanks. The expression must have an actual length that is no greater than 48 bytes. The value of the expression refers to a service point that is the logical MQSeries destination from which the message is read. A service point is defined in the DSNAMT repository file, and it represents a logical end-point from which a message is sent or received. A service point definition includes the name of the MQSeries queue manager and the name of the queue. See *MQSeries Application Messaging Interface* for more details.

If *receive-service* is not specified, DB2.DEFAULT.SERVICE is used.

service-policy

An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The value of the expression must not be the null value, an empty string, or a string with trailing blanks. The expression must have an actual length that is no greater than 48 bytes. The value of the expression refers to an MQSeries AMI service policy that is used in handling this message. A service policy is defined in the DSNAMT repository file, and it specifies a set of quality-of-service options that are to be applied to this messaging operation. These options include message priority and message persistence. See *MQSeries Application Messaging Interface* for more details.

If *service-policy* is not specified, DB2.DEFAULT.POLICY is used.

num-rows

An expression that specifies the maximum number of messages to return. It must be an expression that returns a built-in integer data type.

If *num-rows* is not specified or the value of expression is zero, all available messages are returned.

The result of the function is a table with the format shown in Table 46 on page 387. All the columns in the table are nullable.

Table 46. Format of the resulting table for MQREADALLCLOB

Column name	Data type	Contains
MSG	CLOB(1M)	The contents of the MQSeries message
CORRELID	VARCHAR(24)	The correlation ID that is used to relate messages
TOPIC	VARCHAR(40)	The topic that the message was published with, if available
QNAME	VARCHAR(48)	The name of the queue from which the message was received
MSGID	CHAR(24)	The unique, MQSeries-assigned identifier for the message
MSGFORMAT	VARCHAR(8)	The format of the message, as defined by MQSeries

The CCSID of the result is the system CCSID that was in effect at the time that the MQSeries function was installed into DB2.

Example 1: Retrieve all the messages from the queue specified by the default service (DB2.DEFAULT.SERVICE), using the default policy (DB2.DEFAULT.POLICY).

```
SELECT *
  FROM TABLE (MQREADALLCLOB()) T;
```

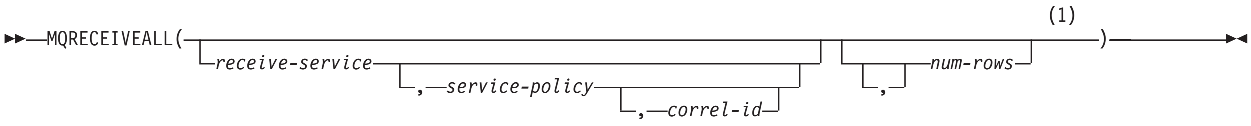
The messages and all the metadata are returned as a table.

Example 2: Retrieve all the messages from the queue specified by the service MYSERVICE, using the default policy (DB2.DEFAULT.POLICY).

```
SELECT T.MSG, T.CORRELID
  FROM TABLE (MQREADALLCLOB('MYSERVICE')) T;
```

Only the MSG and CORRELID columns are returned as a table.

MQRECEIVEALL



Notes:

1 The comma is required before *num-rows* when any of the preceding arguments to the function are specified.

The schema is DB2MQ1C or DB2MQ2C.

The MQRECEIVEALL function returns a table containing the messages and message meta-data from the MQSeries location that is specified by *receive-service*, using the quality-of-service policy that is defined in *service-policy*. Performing this operation removes the messages from the queue that is associated with *receive-service*.

receive-service

An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The value of the expression must not be the null value, an empty string, or a string with trailing blanks. The expression must have an actual length that is no greater than 48 bytes. The value of the expression refers to a service point that is the logical MQSeries destination from which the message is read. A service point is defined in the DSNAMT repository file, and it represents a logical end-point from which a message is sent or received. A service point definition includes the name of the MQSeries queue manager and the name of the queue. See *MQSeries Application Messaging Interface* for more details.

If *receive-service* is not specified, DB2.DEFAULT.SERVICE is used.

service-policy

An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The value of the expression must not be the null value, an empty string, or a string with trailing blanks. The expression must have an actual length that is no greater than 48 bytes. The value of the expression refers to an MQSeries AMI service policy that is used in handling this message. A service policy is defined in the DSNAMT repository file, and it specifies a set of quality-of-service options that are to be applied to this messaging operation. These options include message priority and message persistence. See *MQSeries Application Messaging Interface* for more details.

If *service-policy* is not specified, DB2.DEFAULT.POLICY is used.

correl-id

An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The expression must have an actual length that is no greater than 24 bytes. The value of the expression specifies the correlation identifier that is associated with this message. A correlation identifier is often specified in request-and-reply scenarios to associate requests with replies. Only those messages with a matching correlation identifier are returned.

A null value, an empty string, and a fixed length string with trailing blanks are all considered valid values. However, when the *correl-id* is specified on another request such as MQSEND, the *correl-id* must be specified the same to be recognized as a match. For example, specifying a value of 'test' for *correl-id* on MQRECEIVEALL does not match a *correl-id* value of 'test   ' (with trailing blanks) specified earlier on an MQSEND request.

If *correl-id* is not specified, a correlation identifier is not used, and the message at the beginning of the queue is returned.

num-rows

An expression that specifies the maximum number of messages to return. It must be an expression that returns a built-in integer data type.

If *num-rows* is not specified or the value of expression is zero, all available messages are returned.

The result of the function is a table with the format shown in Table 47. All the columns are nullable.

Table 47. Format of resulting table for MQRECEIVEALL

Column name	Data type	Contains
MSG	VARCHAR(4000)	The contents of the MQSeries message
CORRELID	VARCHAR(24)	The correlation ID that is used to relate messages
TOPIC	VARCHAR(40)	The topic that the message was published with, if available
QNAME	VARCHAR(48)	The name of the queue from which the message was received
MSGID	CHAR(24)	The unique, MQSeries-assigned identifier for the message
MSGFORMAT	VARCHAR(8)	The format of the message, as defined by MQSeries

The CCSID of the result is the system CCSID that was in effect at the time that the MQSeries function was installed into DB2.

Example 1: Retrieve all the messages from the queue specified by the default service (DB2.DEFAULT.SERVICE), using the default policy (DB2.DEFAULT.POLICY).

```
SELECT *
  FROM TABLE (MQRECEIVEALL()) T;
```

The messages and all the metadata are returned as a table and deleted from the queue.

Example 2: Retrieve all the messages from the beginning of the queue specified by the service MYSERVICE, using the policy MYPOLICY.

```
SELECT T.MSG, T.CORRELID
  FROM TABLE (MQRECEIVEALL('MYSERVICE','MYPOLICY','1234')) T;
```

Only messages with CORRELID of '1234' and only the MSG and CORRELID columns are returned as a table and removed from the queue.

MQRECEIVEALLCLOB

```
                                                                                  (1)
►►──MQRECEIVEALLCLOB(──┬──────────────────────────────────────────────────┬──┬───────────────────┬──────)──────────►◄
                       └─receive-service──┬────────────────────────────────┬┘  └─┬───┬──num-rows──┘
                                          └─,──service-policy──┬──────────────┬┘     └─,─┘
                                                               └─,──correl-id─┘
```

Notes:

1 The comma is required before *num-rows* when any of the preceding arguments to the function are specified.

The schema is DB2MQ1C or DB2MQ2C.

The MQRECEIVEALLCLOB function returns a table containing the messages and message metadata from the MQSeries location that is specified by *receive-service*, using the quality-of-service policy that is defined in *service-policy*. Performing this operation removes the messages from the queue that is associated with *receive-service*.

receive-service

An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The value of the expression must not be the null value, an empty string, or a string with trailing blanks. The expression must have an actual length that is no greater than 48 bytes. The value of the expression refers to a service point that is the logical MQSeries destination from which the message is read. A service point is defined in the DSNAMT repository file, and it represents a logical end-point from which a message is sent or received. A service point definition includes the name of the MQSeries queue manager and the name of the queue. See *MQSeries Application Messaging Interface* for more details.

If *receive-service* is not specified, DB2.DEFAULT.SERVICE is used.

service-policy

An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The value of the expression must not be the null value, an empty string, or a string with trailing blanks. The expression must have an actual length that is no greater than 48 bytes. The value of the expression refers to an MQSeries AMI service policy that is used in handling this message. A service policy is defined in the DSNAMT repository file, and it specifies a set of quality-of-service options that are to be applied to this messaging operation. These options include message priority and message persistence. See *MQSeries Application Messaging Interface* for more details.

If *service-policy* is not specified, DB2.DEFAULT.POLICY is used.

correl-id

An expression that returns a value that is a built-in string data type that is not a CLOB, DBCLOB, or BLOB. The expression must have an actual length that is no greater than 24 bytes. The value of the expression specifies the correlation identifier that is associated with this message. A correlation identifier is often specified in request-and-reply scenarios to associate requests with replies. Only those messages with a matching correlation identifier are returned.

A null value, an empty string, and a fixed length string with trailing blanks are all considered valid values. However, when the *correl-id* is specified on another request such as MQSEND, the *correl-id* must be specified the same to be recognized as a match. For example, specifying a value of 'test' for *correl-id* on MQRECEIVEALLCLOB does not match a *correl-id* value of 'test   ' (with trailing blanks) specified earlier on an MQSEND request.

If *correl-id* is not specified, a correlation identifier is not used, and the message at the beginning of the queue is returned.

num-rows

An expression that specifies the maximum number of messages to return. It must be an expression that returns a built-in integer data type.

If *num-rows* is not specified or the value of expression is zero, all available messages are returned.

The result of the function is a table with the format shown in Table 48. All the columns are nullable.

Table 48. Format of resulting table for MQRECEIVEALLCLOB

Column name	Data type	Contains
MSG	CLOB(1M)	The contents of the MQSeries message
CORRELID	VARCHAR(24)	The correlation ID that is used to relate messages
TOPIC	VARCHAR(40)	The topic that the message was published with, if available
QNAME	VARCHAR(48)	The name of the queue from which the message was received
MSGID	CHAR(24)	The unique, MQSeries-assigned identifier for the message
MSGFORMAT	VARCHAR(8)	The format of the message, as defined by MQSeries

The CCSID of the result is the system CCSID that was in effect at the time that the MQSeries function was installed into DB2.

Example 1: Retrieve all the messages from the queue specified by the default service (DB2.DEFAULT.SERVICE), using the default policy (DB2.DEFAULT.POLICY).

```
SELECT *
  FROM TABLE (MQRECEIVEALLCLOB()) T;
```

The messages and all the metadata are returned as a table and deleted from the queue.

Example 2: Retrieve all the messages from the beginning of the queue specified by the service MYSERVICE, using the policy (DB2.DEFAULT.POLICY).

```
SELECT T.MSG, T.CORRELID
  FROM TABLE (MQRECEIVEALLCLOB('MYSERVICE')) T;
```

Only the MSG and CORRELID columns are returned as a table and removed from the queue.

Chapter 4. Queries

A *query* specifies a result table or an intermediate table. A query is a component of certain SQL statements. There are three forms of a query:

A *subselect*
A *fullselect*
A *select-statement*

A subselect is a subset of a fullselect, and a fullselect is a subset of a select-statement.

Another SQL statement called SELECT INTO is described in "SELECT INTO" on page 1057. SELECT INTO is not a subselect, fullselect, or a select-statement.

Authorization

For any form of a query, the privilege set that is defined below must include one of the following:

- Ownership of the table or view
- The SELECT privilege on the table or view
- DBADM authority for the database (tables only)
- SYSADM authority
- SYSCTRL authority (catalog tables only)

For each user-defined function that is referenced in a query, the EXECUTE privilege on the user-defined function is also required.

If the *select-statement* is part of a DECLARE CURSOR statement, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package.

For dynamically prepared statements, the privilege set depends on the dynamic SQL statement behavior, which is specified by bind option DYNAMICRULES:

Run behavior
: The privilege set is the union of the privilege sets that are held by each authorization ID of the process.

Bind behavior
: The privilege set is the privileges that are held by the authorization ID of the owner of the plan or package.

Define behavior
: The privilege set is the privileges that are held by the authorization ID of the owner of the stored procedure or user-defined function.

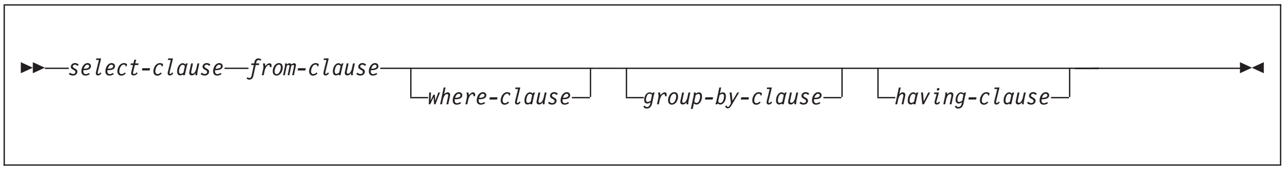
Invoke behavior
: The privilege set is the privileges that are held by the authorization ID of the invoker of the stored procedure or user-defined function.

For a list of the DYNAMICRULES values that specify run, bind, define, or invoke behavior, see Table 3 on page 51.

When any form of a query is used as a component of another statement, the authorization rules that apply to the query are specified in the description of that statement. For example, see "CREATE VIEW" on page 805 for the authorization rules that apply to the subselect component of CREATE VIEW.

If your installation uses the access control authorization exit (DSNX@XAC), that exit may be controlling the authorization rules instead of the rules that are listed here.

subselect

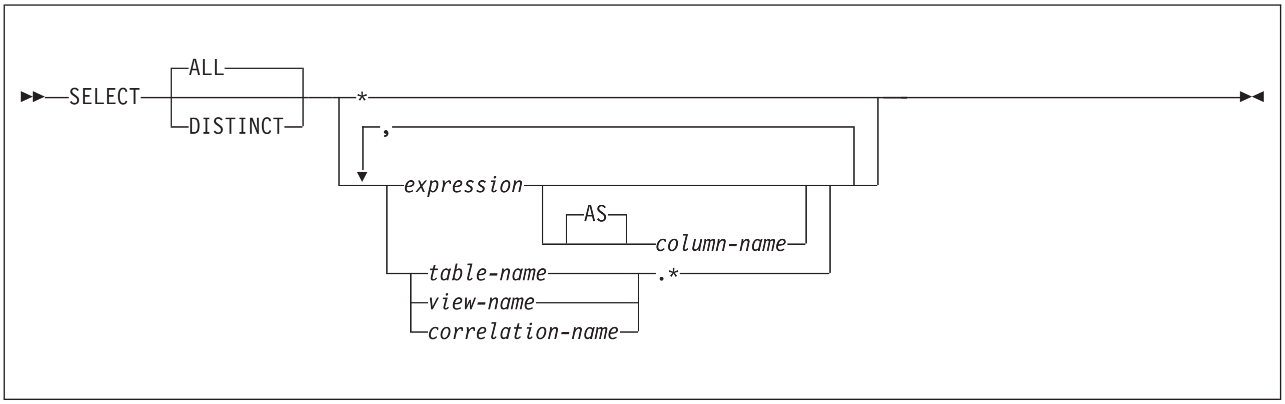


The *subselect* is a component of the fullselect.

A subselect specifies a result table derived from the result of its first FROM clause. The derivation can be described as a sequence of operations in which the result of each operation is input for the next. (This is only a way of describing the subselect. The method used to perform the derivation may be quite different from this description.)

The clauses of the subselect are processed in the following sequence:
1. FROM clause
2. WHERE clause
3. GROUP BY clause
4. HAVING clause
5. SELECT clause

select-clause



The SELECT clause specifies the columns of the final result table. The column values are produced by the application of the *select list* to R. The select list is a list of names and expressions specified in the SELECT clause, and R is the result of the previous operation of the subselect. For example, if SELECT, FROM, and WHERE are the only clauses specified, then R is the result of that WHERE clause.

ALL
Retains all rows of the final result table and does not eliminate redundant duplicates. This is the default.

DISTINCT
Eliminates all but one of each set of duplicate rows of the final result table.

Two rows are duplicates of one another only if each value in the first row is equal to the corresponding value in the second row. For determining duplicate rows, two null values are considered equal.

Select list notation:

***** Represents a list of names that identify the columns of table R. The first name in the list identifies the first column of R, the second name identifies the second column of R, and so on.

The list of names is established when the statement containing the SELECT clause is prepared. Therefore, * does not identify any columns that have been added to a table after the statement has been prepared.

expression
Can be any expression of the type that is described in "Expressions" on page 133. Each *column-name* in the expression must unambiguously identify a column of R.

AS *column-name*
Names or renames the result column. The name must not be qualified and does not have to be unique.

*name.**
Represents a list of names that identify the columns of *name*. *name* can be a table name, view name, or correlation name, and must designate a table or view named in the FROM clause. If a table is specified, it must not be an auxiliary table. The first name in the list identifies the first column of the table or view, the second name in the list identifies the second column of the table or view, and so on.

The list of names is established when the statement containing the SELECT clause is prepared. Therefore, * does not identify any columns that have been added to a table after the statement has been prepared.

SQL statements can be implicitly or explicitly rebound (prepared again). The effect of a rebind on statements that include * or *name.** is that the list of names is re-established. Therefore, the number of columns returned by the statement may change.

The number of columns in the result of SELECT is the same as the number of expressions in the operational form of the select list (that is, the list established at the time the statement is prepared), and cannot exceed 750. The result of a subquery must be a single column unless the subquery is used in an EXISTS predicate.

Hidden ROWID column in the select list: The result for SELECT * does not include any hidden ROWID columns. To be included in the result, the hidden ROWID column must be explicitly specified in the select list.

Applying the select list: Some of the results of applying the select list to R depend on whether GROUP BY or HAVING is used. The next three separate lists describe the results.

IF neither GROUP BY nor HAVING is used:

- The select list can include aggregate functions only if it includes other aggregate functions, constants, or expressions that only involve constants.
- If the select list does not include aggregate functions, it is applied to each row of R and the result contains as many rows as there are rows in R.
- If the select list includes aggregate functions, R is the source of the arguments of the functions and the result of applying the select list is one row, even when R has no rows.

If HAVING is used and GROUP BY is not used:

- Each *column-name* in expression in the select list must be specified within an aggregate function. Constants or expressions that involve only constants can also be in the select list.

If GROUP BY is used:

- Each expression in the select list must use one or more grouping expressions. Or, each *column-name* in expression must:
  - Unambiguously identify a grouping column of R.
  - Be specified within an aggregate function.
  - Be a correlated reference. (A column-name is a correlated reference if it identifies a column of a table or view identified in an outer subselect.)
- If an expression in the select list is a scalar fullselect, a correlated reference from the scalar fullselect to a group R must either identify a grouping column or be contained within an aggregate function. For example, the following query fails because the correlated reference T1.C1 || T1.C2 in the select list of the scalar fullselect does not match a grouping column from the outer subselect. (Matching the grouping expression T1.C1 || T1.C2 is not supported.)

```
SELECT MAX(T1.C2) AS X1, (SELECT T1.C1 || T1.C2 FROM T2 GROUP BY T2.C1) AS  Y1
  FROM T1
  GROUP BY  T1.C1, T1.C1 || T1.C2;
```

- You cannot use GROUP BY with a name defined using the AS clause unless the name is defined in a nested table expression. "Example 6" on page 409 demonstrates the valid use of AS and GROUP BY in a SELECT statement.

In either case, the *n*th column of the result contains the values specified by applying the *n*th expression in the operational form of the select list.

Null attributes of result columns: Result columns allow null values if they are derived from one of the following:

- Any aggregate function except COUNT or COUNT_BIG
- A column that allows null values
- A view column in an outer select list that is derived from an arithmetic expression
- An arithmetic expression in an outer select list
- An arithmetic expression that allows nulls
- A scalar function or string expression that allows null values
- A host variable that has an indicator variable, or in the case of Java, a host variable or expression whose type is able to represent a Java null value
- A result of a UNION if at least one of the corresponding items in the select list is nullable

Names of result columns: The name of a result column of a subselect is determined as follows:

- If the AS clause is specified, the name of the result column is the name specified on the AS clause.
- If the AS clause is not specified and a column list is specified in the correlation clause, the name of the result column is the corresponding name in the correlation column list.
- If neither an AS clause nor a column list in the correlation clause is specified and the result column is derived only from a single column (without any functions or operators), the result column name is the unqualified name of that column.
- All other result columns are unnamed.

Names of result columns are placed into the SQL descriptor area (SQLDA) when the DESCRIBE statement is executed. This allows an interactive SQL processor such as SPUFI or DB2 QMF to use the column names when displaying the results. The names in the SQLDA include those specified by the AS clause.

Data types of result columns: Each column of the result of SELECT acquires a data type from the expression from which it is derived. Table 49 shows the data types of result columns.

Table 49. Data types of result columns

When the expression is...	The data type of the result column is...
The name of any numeric column	The same as the data type of the column, with the same precision and scale for decimal columns.
An integer constant	INTEGER.
A decimal or floating-point constant	The same as the data type of the constant, with the same precision and scale for decimal constants. For floating-point constants, the data type is DOUBLE PRECISION.
The name of any numeric host variable	The same as the data type of the variable, with the same precision and scale for decimal variables. The result is decimal if the data type of the host variable is not an SQL data type; for example, DISPLAY SIGN LEADING SEPARATE in COBOL.
An arithmetic or string expression	The same as the data type of the result, with the same precision and scale for decimal results as described in “Expressions” on page 133.
Any function	The data type of the result of the function. For a built-in function, see Chapter 3, “Functions,” on page 189 to determine the data type of the result. For a user-defined function, the data type of the result is what was defined in the CREATE FUNCTION statement for the function.
The name of any string column	The same as the data type of the column, with the same length attribute.
The name of any string host variable	The same as the data type of the variable, with a length attribute equal to the length of the variable. The result is a varying-length character string if the data type of the host variable is not an SQL data type; for example, a NUL-terminated string in C.
A character string constant of length *n*	VARCHAR(*n*).
A graphic string constant of length *n*	VARGRAPHIC(*n*).
The name of a datetime column	The same as the data type of the column.
The name of a ROWID column	Row ID.
The name of a distinct type column	The same as the distinct type of the column, with the same length, precision, and scale attributes, if any.

For information about the CCSID of the result column, see “Rules for result data types” on page 87.

from-clause

```
             ┌─,───────────────┐
             ▼                 │
►►──FROM──────table-reference──┴──────────────────────────────────────►◄
```

The FROM clause specifies a result table, R. If a single *table-reference* is specified, R is the result of that *table-reference*. If more than one *table-reference* is specified, R consists of all possible combinations of the rows of the result of each *table-reference*. Each row of R is a row from the result of the first *table-reference* concatenated with a row from the result of the second *table-reference*, concatenated with a row from the result of the third *table-reference*, and so on. The number of rows in R is the product of the number of rows in the result of each *table-reference*. Thus, if the result of any *table-reference* is empty, R is empty.

If a *table-reference* contains a security label column, DB2 compares the security label of the user to the security label of each row. Results are returned according to the following rules:

- If the security label of the user dominates the security label of the row, DB2 returns the row.
- If the security label of the user does not dominate the security label of the row, DB2 does not return the data from that row, and DB2 does not generate an error report.

table-reference

table-reference:

```
►►──┬─single-table─────────────┬──────────────────────────────────────►◄
    ├─nested-table-exprssion───┤
    ├─table-function-reference─┤
    ├─I-table-reference────────┤
    └─joined-table─────────────┘
```

single-table:

```
►►──┬─table-name──────────────┬──┬────────────────────┬───────────────►◄
    ├─view-name───────────────┤  └─correlation-clause─┘
    └─table-locator-reference─┘
```

table-locator-reference:

```
►►──TABLE──(──table-locator-variable──LIKE──table-name──)──┬──────────────────┬──►◄
                                                           └─correlation-name─┘
```

nested-table-expression:

```
►►──┬───────┬──(fullselect)──correlation-clause─────────────────────────────►◄
    └─TABLE─┘
```

table-function-reference:

```
►►──TABLE─(function-name(─┬─────────────────────────────┬─)─┬──────────────────────────────┬─)──────►
                          │ ┌─,──────────────────────┐  │   └─table-UDF-cardinality-clause─┘
                          │ ▼                        │  │
                          └─┬─expression───────────┬─┴──┘
                            └─TABLE──transition-table-name─┘

►─correlation-clause─────────────────────────────────────────────────────────►◄
```

table-UDF-cardinality-clause:

```
►►──┬─CARDINALITY──integer-constant─────────────┬────────────────────────────►◄
    └─CARDINALITY MULTIPLIER──numeric-constant──┘
```

I-table-reference:

```
►►──FINAL TABLE──(INSERT statement)─┬────────────────────┬───────────────────►◄
                                    └─correlation-clause─┘
```

correlation-clause:

```
    ┌─AS─┐
►►──┴────┴──correlation-name──┬─────────────────────────┬────────────────────►◄
                              │    ┌─,─────────────┐    │
                              │    ▼               │    │
                              └─(───column-name────┴─)──┘
```

A *table-reference* specifies a result table:

- If a single table or view is identified, the result table is simply that table or view.
- If a table locator is identified, the host variable represents the intermediate table. The intermediate table has the same structure as the table identified in *table-name*.
- A *fullselect* in parentheses is called a *nested table expression*. If a nested table expression is specified, the result table is the result of that nested table expression. The columns of the result do not need unique names, but a column

with a non-unique name cannot be referenced. At any time, the table consists of the rows that would result if the fullselect were executed.

- An *INSERT statement* in parentheses denotes that the inserted rows are returned for the corresponding select-statement or SELECT INTO statement. The result table includes all rows that were inserted. All columns of the inserted table may be referenced in the select list. If the INSERT statement is used in the *table-reference*, the subselect can still specify the where-clause, group-by-clause, having-clause, and aggregate functions. The INSERT statement has the following restrictions:
  - An INSERT statement can appear only in the FROM clause of a top-level select-statement that is a subselect or a SELECT INTO statement.
  - A fullselect in the INSERT statement cannot contain correlated references to columns outside the fullselect of the INSERT statement.
  - If the *table-reference* includes an INSERT statement, only one *table-reference* can be specified in the FROM clause (no joins allowed).
  - The underlying base table of the INSERT statement must not have any AFTER INSERT triggers that have a dependency on the target table.
  - The INSERT statement in a select-statement makes the cursor READ ONLY, which means that UPDATE WHERE CURRENT OF and DELETE WHERE CURRENT OF cannot be used.
  - The INPUT SEQUENCE clause can be specified only if the *table-reference* is included in a select-statement that contains an INSERT statement.
  - If the INSERT statement is on a view, the view must be defined by WITH CASCADED CHECK OPTION.
- If a *function-name* is specified, the result table is the set of rows returned by the table function.
- If a *joined-table* is specified, the result table is the result of one or more join operations as explained below.

Each *table-name* or *view-name* specified in every FROM clause of the same SQL statement must identify a table or view that exists at the same DB2 subsystem. If a FROM clause is specified in a subquery of a basic predicate, a view that includes GROUP BY or HAVING must not be identified.

Each *table-locator-variable* must specify a host variable with a table locator type. The only way to assign a value to a table locator is to pass the old or new transition table of a trigger to a user-defined function or stored procedure. A table locator host variable must not have a null indicator and must not be a parameter marker. In addition, a table locator can be used only in a manipulative SQL statement.

Each *function-name*, together with the types of its arguments, must resolve to a table function that exists at the same DB2 subsystem. An algorithm called function resolution, which is described on page 129, uses the function name and the arguments to determine the exact function to use. Unless given column names in the *correlation-clause*, the column names for a table function are those specified on the RETURNS clause of the CREATE FUNCTION statement. This is analogous to the column names of a table, which are defined in the CREATE TABLE.

The *table-UDF-cardinality clause* can be specified to each user-defined table function reference within the table spec of the FROM clause in a subselect. This option indicates the expected number of rows to be returned only for the SELECT statement that contains it.

CARDINALITY *integer-constant* specifies an estimate of the expected number of rows returned by the reference to the user-defined function. The value of *integer-constant* must range from 0 to 2147483647.

The value set in the CARDINALITY field of SYSIBM SYSROUTINES for the table function name is used as the reference cardinality value. The product of the specified CARDINALITY MULTIPLIER *numeric-constant* and the reference cardinality value are used by DB2 as the expected number of rows returned by the table function reference.

In this case, the *numeric-constant* can be in the integer, decimal, or floating-point format. The value must be greater than or equal to zero. If the decimal number notation is used, the number of digits may be up to 31. An integer value is treated as a decimal number with no fraction. The maximum value allowed for a floating-point number is about 7.237E + 75. If no value has been set in the CARDINALITY field of SYSIBM.SYSROUTINES, its default value is used as the reference cardinality value. If zero is specified or the computed cardinality is less than 1, DB2 assumes that the cardinality of the reference to the user-defined table function is 1.

Only a numeric constant can follow the keyword CARDINALITY or CARDINALITY MULTIPLIER. No host variable or parameter marker is allowed in a cardinality option. Specifying a cardinality option in a table function reference does not change the corresponding CARDINALITY field in SYSIBM.SYSROUTINES. The CARDINALITY field value in SYSIBM.SYSROUTINES can be initialized by the CARDINALITY option in the CREATE FUNCTION (external table) statement when a user-defined table function is created. It can be changed by the CARDINALITY option in the ALTER FUNCTION statement or by a direct update operation to SYSIBM.SYSROUTINES.

Each *correlation-name* in a *correlation-clause* defines a designator for the immediately preceding result table (*table-name*, *view-name*, nested table expression, or *function-name* reference), which can be used to qualify references to the columns of the table. Using *column-names* to list and rename the columns is optional. A correlation name must be specified for nested table expressions and references to table functions.

If a list of *column-names* is specified in a *correlation-clause*, the number of names must be the same as the number of columns in the corresponding table, view, nested table expression, or table function. Each name must be unique and unqualified. If columns are added to an underlying table of a *table-reference*, the number of columns in the result of the *table-reference* no longer matches the number of names in its *correlation-clause*. Therefore, when a rebind of a package containing the query in question is attempted, DB2 returns an error and the rebind fails. At that point, change the *correlation-clause* of the embedded SQL statement in the application program so that the number of names matches the number of columns. Then, precompile, compile, bind, and link-edit the modified program.

An exposed name is a *correlation-name* or a table-name or view name that is not followed by a *correlation-name*. The exposed names in a FROM clause should be unique, and only exposed names should be used as qualifiers of column names. Thus, if the same table name is specified twice, at least one specification of the table name should be followed by a unique correlation name. That correlation name should be used to qualify references to columns of that instance of the table. In addition, if column names are listed for the correlation name in the FROM clause, those columns names should be used to reference the columns. For more information, see "Column name qualifiers in correlated references" on page 116.

Correlated references in table-references: In general, nested table expressions and table functions can be specified in any FROM clause. Columns from the nested table expressions and table functions can be referenced in the select list and in the rest of the fullselect using the correlation name. The scope of this correlation name is the same as correlation names for other table or view names in the FROM clause. The basic rule that applies for both these cases is that the correlated reference must be from a *table-reference* at a higher level in the hierarchy of subqueries.

Nested table expressions can be used in place of a view to avoid creating a view when general use of the view is not required. They can also be used when the desired result table is based on host variables.

For table functions, an additional capability exists. A table function can contain one or more correlated references to other tables in the same FROM clause if the referenced tables precede the reference in the left-to-right order of the tables in the FROM clause. The same capability exists for nested table expressions if the optional keyword TABLE is specified; otherwise, only references to higher levels in the hierarchy of subqueries is allowed.

A nested table expression or table function that contains correlated references to other tables in the same FROM clause:
- Cannot participate in a FULL OUTER JOIN or a RIGHT OUTER JOIN
- Can participate in LEFT OUTER JOIN or an INNER JOIN if the referenced tables precede the reference in the left-to-right order of the tables in the FROM clause

Table 50 shows some examples of valid and invalid correlated references. TABF1 and TABF2 represent table functions.

Table 50. Examples of correlated references

Subselect	Valid	Reason

`SELECT T.C1, Z.C5`
`FROM TABLE( TABF1(T.C2) ) AS Z, T`
`WHERE T.C3 = Z.C4;`
	No	`T.C2` cannot be resolved because `T` does not precede `TABF1` in FROM

`SELECT T.C1, Z.C5`
`FROM T, TABLE( TABF1(T.C2) ) AS Z`
`WHERE T.C3 = Z.C4;`
	Yes	`T` precedes `TABF1` in FROM, making `T.C2` known

`SELECT A.C1, B.C5`
`FROM TABLE( TABF2(B.C2) ) AS A,`
`     TABLE( TABF1(A.C6) ) AS B`
`WHERE A.C3 = B.C4;`
	No	`B` in `B.C2` cannot be resolved because the table function that would resolve it, `TABF1`, follows its reference in `TABF2` in FROM

`SELECT D.DEPTNO, D.DEPTNAME,`
`       EMPINFO.AVGSAL, EMPINFO.EMPCOUNT`
`FROM DEPT D,`
`     (SELECT AVG(E.SALARY) AS AVGSAL,`
`             COUNT(*) AS EMPCOUNT`
`      FROM EMP E`
`      WHERE E.WORKDEPT = D.DEPTNO)`
`      AS EMPINFO;`
	No	`DEPT` precedes nested table expression, but keyword TABLE is not specified, making `D.DEPTNO` unknown

Table 50. Examples of correlated references (continued)

Subselect	Valid	Reason

`SELECT D.DEPTNO, D.DEPTNAME,`
`       EMPINFO.AVGSAL, EMPINFO.EMPCOUNT`
`FROM DEPT D,`
`     TABLE (SELECT AVG(E.SALARY) AS AVGSAL,`
`                  COUNT(*) AS EMPCOUNT`
`            FROM EMP E`
`            WHERE E.WORKDEPT = D.DEPTNO)`
`         AS EMPINFO;`
	Yes	`DEPT` precedes nested table expression and keyword TABLE is specified, making `D.DEPTNO` known

joined-table

```
                    ┌─INNER──────────────────┐
►►──┬─table-reference─┼────────────────────────┼─JOIN──table-reference──ON──join-condition──┬──────────►◄
    │                 │             ┌─OUTER─┐ │                                              │
    │                 └─┬─LEFT──┬───┴───────┴─┘                                              │
    │                   ├─RIGHT─┤                                                            │
    │                   └─FULL──┘                                                            │
    └─(joined-table)─────────────────────────────────────────────────────────────────────────┘
```

A *joined-table* specifies a result table that is the result of either an inner equi-join or an outer join. The table is derived by applying one of the join-operators: INNER, RIGHT OUTER, LEFT OUTER, or FULL OUTER to its operands. If a join-operator is not specified, INNER is implicit. The order in which a LEFT OUTER JOIN or RIGHT OUTER JOIN is performed can affect the result.

As described in more detail under "Join operations" on page 405 an inner join combines each row of the left table with every row of the right table keeping only the rows where the join-condition is true. Thus, the result table may be missing rows from either or both of the joined tables. Outer joins include the rows produced by the inner join as well as the missing rows, depending on the type of outer join as follows:

Left outer. Includes the rows from the left table that were missing from the inner join.

Right Outer. Includes the rows from the right table that were missing from the inner join.

Full Outer. Includes the rows from both tables that were missing from the inner join.

A joined-table can be used in any context in which any form of the SELECT statement is used. Both a view and a cursor is read-only if its SELECT statement includes a joined-table.

join-condition

For INNER, LEFT OUTER, and RIGHT OUTER joins:

```
►►──search-condition──────────────────────────────────────────────►◄
```

For FULL OUTER joins:

```
   ┌─AND─────────────────────────────────────────────────┐
   ▼                                                      │
►►──full-join-expression──=──full-join-expression─────────┴──────────────────────────────────►◄
```

full-join-expression:

```
►►──┬─┬─column-name──────────┬─────────────────────────────────────────────────┬──────────────►◄
    │ │                (1)   │                                                 │
    │ └─cast-function────────┘                                                 │
    │                                              ┌──────────────────────────┐ │
    │                                              ▼                          │ │
    └─COALESCE──(──┬─column-name──────────┬───────┬─,──column-name──────────┬─┴─)─┘
                   │                (1)   │       │                  (1)    │
                   └─cast-function────────┘       └─,──cast-function────────┘
```

Notes:

1 *cast-function* must only contain a column and the casting data type must be a distinct type or the data type upon which the distinct type was based.

For INNER, LEFT OUTER, and RIGHT OUTER joins, the *join-condition* is a *search-condition* that must conform to these rules:

- With one exception, It cannot contain any subqueries. If the join-table that contains the join-condition in the associated FROM clause is composed of only INNER joins, the join-condition may contain subqueries.
- Any column that is referenced in an expression of the join-condition must be a column of one of the operand tables of the associated join operator (in the scope of the same joined-table clause).

For a FULL OUTER (or FULL) join, the *join-condition* is a search condition in which the predicates can only be combined with AND. In addition, each predicate must have the form 'expression = expression', where one expression references only columns of one of the operand tables of the associated join operator, and the other expression references only columns of the other operand table. The values of the expressions must be comparable.

Each *full-join-expression* in a FULL OUTER join must include a column name or a cast function that references a column. The COALESCE function is allowed.

For any type of join, column references in an expression of the join-condition are resolved using the rules for resolution of column name qualifiers specified in "Resolution of column name qualifiers and column names" on page 117 before any rules about which tables the columns must belong to are applied.

Join operations

A *join-condition* specifies pairings of T1 and T2, where T1 and T2 are the left and right operand tables of its associated JOIN operator. For all possible combinations of rows T1 and T2, a row of T1 is paired with a row of T2 if the join-condition is true. When a row of T1 is joined with a row of T2, a row in the result consists of the values of that row of T1 concatenated with the values of that row of T2. The execution might involve the generation of a “null row”. The null row of a table consists of a null value for each column of the table, regardless of whether the columns allow null values.

The following summarizes the results of the join operations:

- The result of T1 INNER JOIN T2 consists of their paired rows.
- The result of T1 LEFT OUTER JOIN T2 consists of their paired rows and, for each unpaired row of T1, the concatenation of that row with the null row of T2. All columns derived from T2 allow null values.
- The result of T1 RIGHT OUTER JOIN T2 consists of their paired rows and, for each unpaired row of T2, the concatenation of that row with the null row of T1. All columns derived from T1 allow null values.
- The result of T1 FULL OUTER JOIN T2 consists of their paired rows and, for each unpaired row of T1, the concatenation of that row with the null row of T2, and for each unpaired row of T2, the concatenation of that row with the null row in T1. All columns of the result table allow null values.

A join operation is part of a FROM clause; therefore, for the purpose of predicting which rows will be returned from a SELECT statement containing a join operation, assume that the join operation is performed before the other clauses in the statement.

where-clause

```
►►──WHERE──search-condition──────────────────────────────────────────────────►◄
```

The WHERE clause specifies a result table that consists of those rows of R for which the search condition is true. R is the result of the FROM clause of the subselect.

The search condition must conform to the following rules:

- Each column name must unambiguously identify a column of R or be a correlated reference. A column name is a correlated reference if it identifies a column of a table or view that is identified in an outer subselect.
- An aggregate function must not be specified unless the WHERE clause is specified in a subquery of a HAVING clause and the argument of the function is a correlated reference to a group.

Any subquery in the *search-condition* is effectively executed for each row of R and the results are used in the application of the *search-condition* to the given row of R. A subquery is actually executed for each row of R only if it includes a correlated reference. In fact, a subquery with no correlated references is executed just once, whereas a subquery with a correlated reference may have to be executed once for each row.

group-by-clause

```
              ┌─,──────────────────┐
              ▼                    │
►►──GROUP BY────grouping-expression─┴──────────────────────────────────────►◄
```

The GROUP BY clause specifies a result table that consists of a grouping of the rows of R, where R is the result of the previous clause.

grouping-expression is an expression that defines the grouping of R. The following restrictions apply to *grouping-expression*:

- If *grouping-expression* is a single column, the column name must unambiguously identify a column of R.
- The result of *grouping-expression* cannot be a LOB data type (or a distinct type that is based on a LOB) or an XML data type.
- *grouping-expression* cannot include any of the following items:
  - A correlated column
  - A host variable
  - A column function
  - Any function that is nondeterministic or that is defined to have an external action
  - A scalar fullselect
  - A CASE expression whose *searched-when-clause* contains a quantified predicate, an IN predicate using a fullselect, or an EXISTS predicate

The result of GROUP BY is a set of groups of rows. In each group of more than one row, all values of each *grouping-expression* are equal, and all rows with the same set of values of the *grouping-expression* are in the same group. For grouping, all null values for a *grouping-expression* are considered equal.

A grouping expression can be used in a search condition in a HAVING clause, in an expression in a SELECT clause, or in a sort-key expression of an ORDER BY clause. In each case, the reference specifies only one value for each group. For example, if *grouping-expression* is col1+col2, then col1+col2+3 would be an allowed expression in the select list. Associative rules for expressions do not allow the similar expression of 3+col1+col2, unless parentheses are used to ensure the corresponding expression is evaluated in the same order. Thus, 3+(col1+col2) would also be allowed in the select list. If the concatenation operator is used, *grouping-expression* must be used exactly as the expression was specified in the select list.

If a *grouping-expression* contains varying-length strings with trailing blanks, the values in the group can differ in the number of trailing blanks and might not all have the same length. In that case, a reference to *grouping-expression* still specifies only one value for each group, but the value for a group is chosen arbitrarily fro the available set of values. Thus, the actual length of the result value is unpredictable.

having-clause

```
►►──HAVING──search-condition──────────────────────────────────────────────────────►◄
```

The HAVING clause specifies a result table that consists of those groups of R for which the search-condition is true. R is the result of the previous clause. If this clause is not GROUP BY, R is considered a single group with no grouping columns.

Each *column-name* in *search-condition* must:
- Unambiguously identify a grouping column of R, or
- Be specified within an aggregate function[20], or
- Be a correlated reference. A *column-name* is a correlated reference if it identifies a column of a table or view identified in an outer subselect.

A group of R to which the search condition is applied supplies the argument for each function in the search condition, except for any function whose argument is a correlated reference.

If the search condition contains a subquery, the subquery can be thought of as being executed each time the search condition is applied to a group of R, and the results used in applying the search condition. In actuality, the subquery is executed for each group only if it contains a correlated reference. For an illustration of the difference, see Example 4 and Example 5 in “Examples of subselects” below.

A correlated reference to a group of R must either identify a grouping column or be contained within an aggregate function.

The HAVING clause must not be used in a subquery of a basic predicate. When HAVING is used without GROUP BY, any column name in the select list must appear within an aggregate function.

Examples of subselects

Example 1: Show all rows of the table DSN8810.EMP.

```
SELECT * FROM DSN8810.EMP;
```

Example 2: Show the job code, maximum salary, and minimum salary for each group of rows of DSN8810.EMP with the same job code, but only for groups with more than one row and with a maximum salary greater than 50000.

```
SELECT JOB, MAX(SALARY), MIN(SALARY)
  FROM DSN8810.EMP
  GROUP BY JOB
  HAVING COUNT(*) > 1 AND MAX(SALARY) > 50000;
```

Example 3: For each employee in department E11, get the following information from the table DSN8810.EMPPROJACT: employee number, activity number, activity start date, and activity end date. Using the CHAR function, convert the start and end dates to their USA formats. Get the needed department information from the table DSN8810.EMP.

[20] See Chapter 3, “Functions,” on page 189 for restrictions that apply to the use of aggregate functions.

```
SELECT EMPNO, ACTNO, CHAR(EMSTDATE,USA), CHAR(EMENDATE,USA)
  FROM DSN8810.EMPPROJACT
  WHERE EMPNO IN (SELECT EMPNO FROM DSN8810.EMP
                  WHERE WORKDEPT = 'E11');
```

Example 4: Show the department number and maximum departmental salary for all departments whose maximum salary is less than the average salary for all employees. (In this example, the subquery would be executed only once.)

```
SELECT WORKDEPT, MAX(SALARY)
  FROM DSN8810.EMP
  GROUP BY WORKDEPT
  HAVING MAX(SALARY) < (SELECT AVG(SALARY)
                          FROM DSN8810.EMP);
```

Example 5: Show the department number and maximum departmental salary for all departments whose maximum salary is less than the average salary for employees in all other departments. (In contrast to Example 4, the subquery in this statement, containing a correlated reference, would need to be executed for each group.)

```
SELECT WORKDEPT, MAX(SALARY)
  FROM DSN8810.EMP Q
  GROUP BY WORKDEPT
  HAVING MAX(SALARY) < (SELECT AVG(SALARY)
                          FROM DSN8810.EMP
                          WHERE NOT WORKDEPT = Q.WORKDEPT);
```

Example 6: For each group of employees hired during the same year, show the year-of-hire and current average salary. (This example demonstrates how to use the AS clause in a FROM clause to name a derived column that you want to refer to in a GROUP BY clause.)

```
SELECT HIREYEAR, AVG(SALARY)
  FROM (SELECT YEAR(HIREDATE) AS HIREYEAR, SALARY
          FROM DSN8810.EMP) AS NEWEMP
  GROUP BY HIREYEAR;
```

Example 7: For an example of how to group the results of a query by an expression in the SELECT clause without having to retype the expression, see “Example 4” on page 150 for CASE expressions.

Example 8: Get the employee number and employee name for all the employees in DSN8810.EMP. Order the results by the date of hire.

```
SELECT EMPNO, FIRSTNME, LASTNAME
  FROM DSN8810.EMP
  ORDER BY HIREDATE;
```

Example 9: Assume that an external function named ADDYEARS exists. For a given date, the function adds a given number of years and returns a new date. (The data types of the two input parameters to the function are DATE and INTEGER.) Get the employee number and employee name for all employees who have been hired within the last 5 years.

```
SELECT EMPNO, FIRSTNME, LASTNAME
  FROM DSN8810.EMP
  WHERE ADDYEARS(HIREDATE, 5) > CURRENT DATE;
```

To distinguish the different types of joins, to show nested table expressions, and to demonstrate how to combine join columns, the remaining examples use these two tables:

```
The PARTS table                       The PRODUCTS table
PART     PROD#   SUPPLIER             PROD#     PRODUCT        PRICE
=======  =====   ============         =====     ==========     =====
WIRE      10      ACWF                505       SCREWDRIVER    3.70
OIL       160     WESTERN_CHEM        30        RELAY          7.55
MAGNETS   10      BATEMAN             205       SAW            18.90
PLASTIC   30      PLASTIK_CORP        10        GENERATOR      45.75
BLADES    205     ACE_STEEL
```

Example 10: Join the tables on the PROD# column to get a table of parts with their suppliers and the products that use the parts:

```
SELECT PART, SUPPLIER, PARTS.PROD#, PRODUCT
   FROM PARTS, PRODUCTS
   WHERE PARTS.PROD# = PRODUCTS.PROD#;
```

or

```
SELECT PART, SUPPLIER, PARTS.PROD#, PRODUCT
  FROM PARTS INNER JOIN PRODUCTS
    ON PARTS.PROD# = PRODUCTS.PROD#;
```

Either one of these two statements give this result:

```
PART        SUPPLIER       PROD#     PRODUCT
=======     ============   =====     ==========
WIRE        ACWF           10        GENERATOR
MAGNETS     BATEMAN        10        GENERATOR
PLASTIC     PLASTIK_CORP   30        RELAY
BLADES      ACE_STEEL      205       SAW
```

Notice two things about the example:

- There is a part in the parts table (OIL) whose product (#160) is not listed in the products table. There is a product (SCREWDRIVER, #505) that has no parts listed in the parts table. Neither OIL nor SCREWDRIVER appears in the result of the join.

  An *outer join*, however, includes rows where the values in the joined columns do not match.
- There is explicit syntax to express that this familiar join is not an outer join but an inner join. You can use INNER JOIN in the FROM clause instead of the comma. Use ON when you explicitly join tables in the FROM clause.

You can specify more complicated join conditions to obtain different sets of results. For example, eliminate the suppliers that begin with the letter A from the table of parts, suppliers, product numbers and products:

```
SELECT PART, SUPPLIER, PARTS.PROD#, PRODUCT
  FROM PARTS INNER JOIN PRODUCTS
    ON PARTS.PROD# = PRODUCTS.PROD#
    AND SUPPLIER NOT LIKE 'A%';
```

The result of the query is all rows that do not have a supplier that begins with A:

```
PART        SUPPLIER       PROD#     PRODUCT
=======     ============   =====     ==========
MAGNETS     BATEMAN        10        GENERATOR
PLASTIC     PLASTIK_CORP   30        RELAY
```

Example 11: Join the tables on the PROD# column to get a table of all parts and products, showing the supplier information, if any.

```
SELECT PART, SUPPLIER, PARTS.PROD#, PRODUCT
  FROM PARTS FULL OUTER JOIN PRODUCTS
    ON PARTS.PROD# = PRODUCTS.PROD#;
```

The result is:

```
PART       SUPPLIER      PROD#     PRODUCT
=======    ============  =====     ==========
WIRE       ACWF          10        GENERATOR
MAGNETS    BATEMAN       10        GENERATOR
PLASTIC    PLASTIK_CORP  30        RELAY
BLADES     ACE_STEEL     205       SAW
OIL        WESTERN_CHEM  160       (null)
(null)     (null)        (null)    SCREWDRIVER
```

The clause FULL OUTER JOIN includes unmatched rows from both tables. Missing values in a row of the result table are filled with nulls.

Example 12: Join the tables on the PROD# column to get a table of all parts, showing what products, if any, the parts are used in:

```
SELECT PART, SUPPLIER, PARTS.PROD#, PRODUCT
  FROM PARTS LEFT OUTER JOIN PRODUCTS
    ON PARTS.PROD# = PRODUCTS.PROD#;
```

The result is:

```
PART       SUPPLIER      PROD#     PRODUCT
=======    ============  =====     ==========
WIRE       ACWF          10        GENERATOR
MAGNETS    BATEMAN       10        GENERATOR
PLASTIC    PLASTIK_CORP  30        RELAY
BLADES     ACE_STEEL     205       SAW
OIL        WESTERN_CHEM  160       (null)
```

The clause LEFT OUTER JOIN includes rows from the table identified before it where the values in the joined columns are not matched by values in the joined columns of the table identified after it.

Example 13: Join the tables on the PROD# column to get a table of all products, showing the parts used in that product, if any, and the supplier.

```
SELECT PART, SUPPLIER, PRODUCTS.PROD#, PRODUCT
  FROM PARTS RIGHT OUTER JOIN PRODUCTS
    ON PARTS.PROD# = PRODUCTS.PROD#;
```

The result is:

```
PART       SUPPLIER      PROD#     PRODUCT
=======    ============  =====     ===========
WIRE       ACWF          10        GENERATOR
MAGNETS    BATEMAN       10        GENERATOR
PLASTIC    PLASTIK_CORP  30        RELAY
BLADES     ACE_STEEL     205       SAW
(null)     (null)        505       SCREWDRIVER
```

The clause RIGHT OUTER JOIN includes rows from the table identified after it where the values in the joined columns are not matched by values in the joined columns of the table identified before it.

Example 14: The result of Example 11 (a full outer join) shows the product number for SCREWDRIVER as null, even though the PRODUCTS table contains a product number for it. This is because PRODUCTS.PROD# was not listed in the SELECT list of the query. Revise the query using COALESCE so that all part numbers from both tables are shown.

```
SELECT PART, SUPPLIER,
      COALESCE(PARTS.PROD#, PRODUCTS.PROD#) AS PRODNUM, PRODUCT
      FROM PARTS FULL OUTER JOIN PRODUCTS
        ON PARTS.PROD# = PRODUCTS.PROD#;
```

In the result, notice that the AS clause (AS PRODNUM), provides a name for the result of the COALESCE function:

```
PART       SUPPLIER       PRODNUM   PRODUCT
=======    ============   =======   ===========
WIRE       ACWF           10        GENERATOR
MAGNETS    BATEMAN        10        GENERATOR
PLASTIC    PLASTIK_CORP   30        RELAY
BLADES     ACE_STEEL      205       SAW
OIL        WESTERN_CHEM   160       (null)
(null)     (null)         505       SCREWDRIVER
```

Example 15: For all parts that are used in product numbers less than 200, show the part, the part supplier, the product number, and the product name. Use a nested table expression.

```
SELECT PART, SUPPLIER, PRODNUM, PRODUCT
  FROM (SELECT PART, PROD# AS PRODNUM, SUPPLIER
                FROM PARTS
                   WHERE PROD# < 200) AS PARTX
            LEFT OUTER JOIN PRODUCTS
                ON PRODNUM = PROD#;
```

The result is:

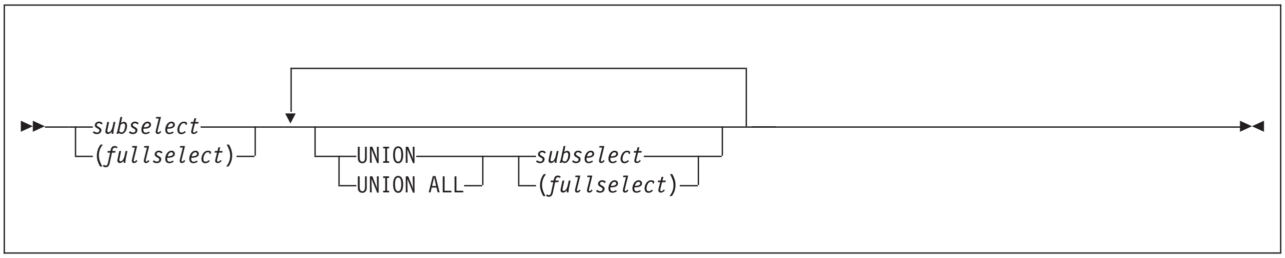
```
PART       SUPPLIER         PRODNUM     PRODUCT
=======    ============     =======     ==========
WIRE       ACWF             10          GENERATOR
MAGNETS    BATEMAN          10          GENERATOR
PLASTIC    PLASTIK_CORP     30          RELAY
OIL        WESTERN_CHEM     160         (null)
```

Example 16: Examples of statements with DISTINCT specified more than once in a subselect:

```
SELECT DISTINCT COUNT(DISTINCT A1), COUNT(A2)
  FROM T1;
```

```
SELECT COUNT(DISTINCT A))
  FROM T1
  WHERE A3 > 0
  HAVING AVG(DISTINCT A4) >1;
```

fullselect



The *fullselect* is a component of the *select-statement*, the CREATE VIEW statement, and the INSERT statement. The *fullselect* is also a component of certain predicates that, in turn, are components of a *subselect*. A subselect that is a component of a predicate is called a *subquery*.

A *fullselect* specifies a result table. If UNION is not used, the result of the fullselect is the result of the specified subselect.

UNION or **UNION ALL**

Derives a result table by combining two other result tables, R1 and R2. If UNION ALL is specified, the result consists of all rows in R1 and R2. If UNION is specified without the ALL option, the result is the set of all rows in either R1 or R2, with duplicate rows eliminated.

If the *n*th column of R1 and the *n*th column of R2 have the same result column name, the *n*th column of R has the same result column name. If the *n*th column of R1 and the *n*th column of R2 do not have the same name, the result column in R is unnamed.

Qualified column names cannot be used in the ORDER BY clause when UNION or UNION ALL is also specified.

Duplicate rows: Two rows are duplicates if each value in the first is equal to the corresponding value of the second. For determining duplicates, two null values are considered equal.

UNION and UNION ALL are associative operations. However, when UNION and UNION ALL are used in the same statement, the result depends on the order in which the operations are performed. Operations within parentheses are performed first. When the order is not specified by parentheses, operations are performed in order from left to right.

Rules for columns: R1 and R2 must have the same number of columns and the data type of the *n*th column of R1 must be compatible with the data type of the *n*th column of R2. If UNION is specified without the ALL option, R1 and R2 must not include a LOB column.

The *n*th column of the result of UNION and UNION ALL is derived from the *n*th columns of R1 and R2.

For information on the valid combinations of operand columns and the data type of the result column, see "Rules for result data types" on page 87.

Character conversion in unions and concatenations

The SQL operations that combine strings include concatenation, UNION, UNION ALL, and the IN list of an IN predicate. Within an SQL statement, concatenation combines two or more strings into a new string. Within a fullselect, UNION, UNION ALL, or the IN list of an IN predicate combine two or more string columns resulting from the subselects into results column. All such operations have the following in common:

- The choice of a result CCSID for the string or column
- The possible conversion of one or more of the component strings or columns to the result CCSID

For all such operations, the rules for those two actions are the same, as described in "Selecting the result CCSID." These rules also apply to the COALESCE scalar function.

Selecting the result CCSID

The result CCSID is selected at bind time. The result CCSID is the CCSID of one of the operands.

Two operands: When two operands are used, the result CCSID is determined by the operand types, their CCSIDs, and their relative positions in the operation. When a CCSID is X'FFFF', the result CCSID is always X'FFFF', and no character conversions take place. When neither CCSID is X'FFFF', the rules for selecting the result CCSID are identical to the ones for string comparison. See ″String comparisons″ in Chapter 3, “Functions,” on page 189.

Three or more operands:

If all the operands have the same CCSID, the result CCSID is the common CCSID.

If at least one of the CCSIDs has the value X'FFFF', the result CCSID also has the value X'FFFF'.

Otherwise, selection proceeds as follows:

1. The rules for a pair of operands are applied to the first two operands. This picks a “candidate” for the second step. The candidate is the operand that would furnish the result CCSID if just the first two operands were involved in the operation.
2. The rules are applied to the Step 1 candidate and the third operand, thereby selecting a second candidate.
3. If a fourth operand is involved, the rules are applied to the second candidate and fourth operand, to select a third candidate, and so on.

The process continues until all operands have been used. The remaining candidate is the one that furnishes the result CCSID. Whenever the rules for a pair are applied to a candidate and an operand, the candidate is considered to be the first operand.

Consider, for example, the following concatenation:

```
A CONCAT B CONCAT C
```

Here, the rules are first applied to the strings A and B. Suppose that the string selected as candidate is A. Then the rules are applied to A and C. If the string selected is again A, then A furnishes the result CCSID. Otherwise, C furnishes the result CCSID.

Character conversion of components: An operand of concatenation or the selected argument of the COALESCE scalar function is converted, if necessary, to the coded character set of the result string. Each string of an operand of UNION or UNION ALL is converted, if necessary, to the coded character set of the result column. In either case, the coded character set is the one identified by the result CCSID. Character conversion is necessary only if all of the following are true:

- The result and operand CCSIDs are different.
- Neither CCSID is X'FFFF' (neither string is defined as BIT data).
- The string is neither null nor empty.
- The SYSSTRINGS catalog table indicates that conversion is necessary.

An error occurs if a character of a string cannot be converted, SYSSTRINGS is used but contains no information about the CCSID pair, or DB2 cannot do the conversion through z/OS support for Unicode. A warning occurs if a character of a string is converted to the substitution character.

Examples of fullselects

Example 1: A query specifies the union of result tables R1 and R2. A column in R1 has the data type CHAR(10) and the subtype BIT. The corresponding column in R2 has the data type CHAR(15) and the subtype SBCS. Hence, the column in the union has the data type CHAR(15) and the subtype BIT. Values from the first column are converted to CHAR(15) by adding five trailing blanks.

Example 2: Show all the rows from DSN8810.EMP.

```
SELECT * FROM DSN8810.EMP;
```

Example 3: Using sample tables DSN8810.EMP and DSN8810.EMPROJACT, list the employee numbers of all employees for which either of the following statements are true:

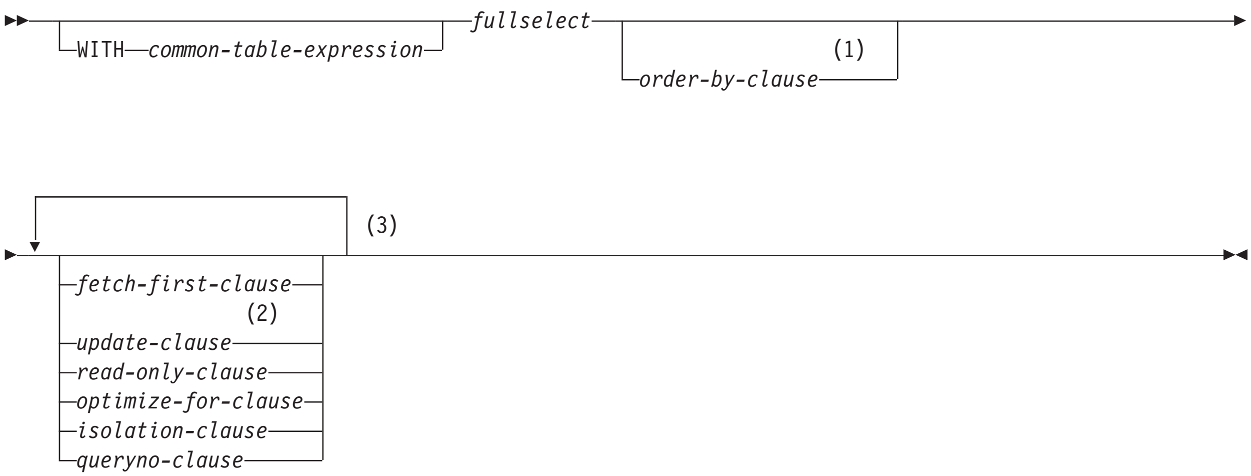
- Their department numbers begin with 'D'.
- They are assigned to projects whose project numbers begin with 'AD'.

```
SELECT EMPNO FROM DSN8810.EMP
  WHERE WORKDEPT LIKE 'D%'
  UNION
SELECT EMPNO FROM DSN8810.EMPPROJACT
  WHERE PROJNO LIKE 'AD%';
```

The result is the union of two result tables, one formed from the sample table DSN8810.EMP, the other formed from the sample table DSN8810.EMPPROJACT. The result—a one-column table—is a list of employee numbers. Because UNION, rather than UNION ALL, was used, the entries in the list are distinct. If instead UNION ALL were used, certain employee numbers would appear in the list more than once. These would be the numbers for employees in departments that begin with 'D' while their projects begin with 'AD'.

Example 4: Find the average charges for each subscriber (SNO) in the state of California during the last Friday of each month in the first quarter of 2000. Group the result according to SNO. Each MONTHnn table has columns for SNO, CHARGES, and DATE. The CUST table has columns for SNO and STATE.

select-statement



Notes:

1 If the *order-by-clause* is specified, the *update-clause* cannot be specified except when the *select-statement* is associated with an INSENSITIVE or SENSITIVE STATIC SCROLL CURSOR.

2 If the *update-clause* is specified, the *fetch-first-clause* cannot be specified.

3 The same clause must not be specified more than once.

The *select-statement* is the form of a query that can be directly specified in a DECLARE CURSOR statement, or prepared and then referenced in a DECLARE CURSOR statement. It can also be issued interactively using SPUFI causing a result table to be displayed at your terminal. In any case, the table specified by *select-statement* is the result of the fullselect.

The tables and view identified in a select statement can be at the current server or any DB2 subsystem with which the current server can establish a connection.

For local queries on DB2 UDB for z/OS or remote queries in which the server and requester are DB2 UDB for z/OS, if a table is encoded as ASCII or Unicode, the retrieved data is encoded in EBCDIC. For information on retrieving data encoded in ASCII or Unicode, see Part 6 of *DB2 Application Programming and SQL Guide*.

A select statement can implicitly or explicitly invoke user-defined functions or implicitly invoke stored procedures. This technique is known as *nesting* of SQL statements. A function or procedure is implicitly invoked in a select statement when it is invoked at a lower level. For instance, if you invoke a user-defined function from a select statement and the user-defined function invokes a stored procedure, you are implicitly invoking the stored procedure. When you execute a select statement on a table, no INSERT, UPDATE, or DELETE statement at a lower level of nesting must be executed on the same table.

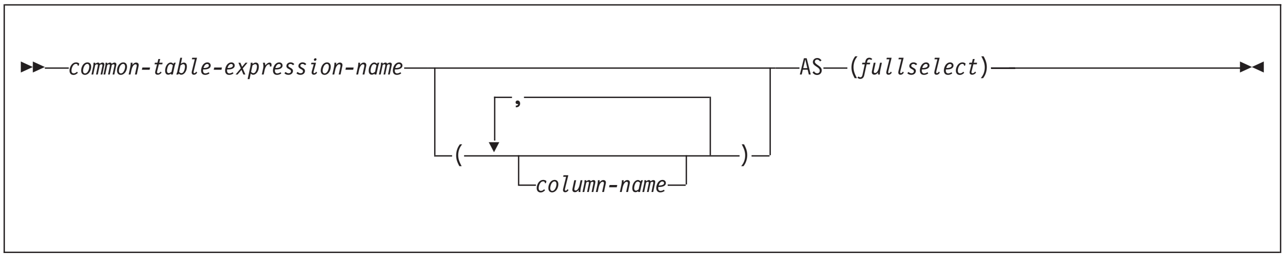
For example, suppose that you execute this SQL statement at level 1 of nesting:

```
SELECT UDF1(C1) FROM T1;
```

You cannot execute this SQL statement at a lower level of nesting:

```
INSERT INTO T1 VALUES(...);
```

common-table-expression



A *common table expression* permits defining a result table with *common-table-expression-name* that can be referenced as a table name in any FROM clause of the *fullselect* that follows. Multiple common table expressions can be specified following the single WITH keyword. Each common table expression specified can also be referenced by name in the FROM clause of subsequent common table expressions.

If a list of columns is specified, it must consist of as many names as there are columns in the result table of the fullselect. Each *column-name* must be unique and unqualified. If these column names are not specified, the names are derived from the select list of the *fullselect* used to define the common table expression.

common-table-expression-name must be an unqualified SQL identifier, and it must be different from any other *common-table-expression-name* in the same statement. If the common table expression is specified in an INSERT statement, the *common-table-expression-name* must not be the same as the table or view name that is the object of the insert. If the common table expression is specified in a CREATE VIEW statement, the *common-table-expression-name* must not be the same as the view name that is created. A common table expression *common-table-expression-name* can be specified as a table name in any FROM clause throughout the *fullselect*.

A common table expression name can only be referenced in the *select-statement*, INSERT statement, or CREATE VIEW statement that defines it.

If a *select-statement*, INSERT statement, or CREATE VIEW statement that is not contained in a trigger definition refers to a unqualified table name, the following rules are applied to determine which table is actually being referenced:

- If the unqualified name corresponds to one or more common table expression names that are specified in the *select-statement*, the name identifies the common table expression that is in the innermost scope.
- Otherwise, the name identifies a persistent table, a temporary table, or a view that is present in the default schema.

If a *select-statement*, INSERT statement, or CREATE VIEW statement that is contained in a trigger definition refers to a unqualified table name, the following rules are applied to determine which table is actually being referenced:

- If the unqualified name corresponds to one or more common table expression names that are specified in the *select-statement*, the name identifies the common table expression that is in the innermost scope.

- If the unqualified name corresponds to a transition table name, the name identifies that transition table.
- Otherwise, the name identifies a persistent table, a temporary table, or a view that is present in the default schema.

If more than one common table expression is defined in the same statement, cyclic references between the common table expressions are not permitted. A *cyclic reference* occurs when two common table expressions *dt1* and *dt2* are created such that *dt1* refers to *dt2* and *dt2* refers to *dt1*. Furthermore, a common table expression defined before cannot refer to subsequent common table expressions.

The common table expression is also optional prior to the fullselect in the CREATE VIEW and INSERT statements. However, the use of common table expressions is not allowed in a INSERT within SELECT statement.

A common table expression can be used:

- In place of a view to avoid creating the view (when general use of the view is not required and positioned updates or deletes are not used)
- When the desired result table is based on host variables
- When the same result table needs to be shared in a *fullselect*
- When the result needs to be derived using recursion

If a *fullselect* of a common table expression contains a reference to itself in a FROM clause, the common table expression is a *recursive common table expression*. Queries using recursion are useful in supporting applications such as bill of materials (BOM), reservation systems, and network planning.

The following must be true of a recursive common table expression:

- Each *fullselect* that is part of the recursion cycle must start with SELECT or SELECT ALL. Use of SELECT DISTINCT is not allowed. Furthermore, the unions must use UNION ALL.
- The column names must be specified following the *table-name* of the common table expression.
- The first *fullselect* of the first union (the initialization *fullselect*) must not include a reference to the common table expression itself in any FROM clause).
- If a column name of the common table expression is referred to in the iterative *fullselect*, the data type, length, and CCSID for the column are determined based on the initialization *fullselect*. The corresponding column in the iterative *fullselect* must have the same data type and length as the data type and length determined based on the initialization *fullselect* and the CCSID must match. However, for character string types, the length of the two data types may differ. In this case, the column in the iterative *fullselect* must have a length that would always be assignable to the length determined from the initialization *fullselect*. If a column of a recursive common table expression is not used recursively in its definition, the data type, length, and CCSID for the column are determined by applying rules associated with non-recursive queries.
- Each *fullselect* that is part of the recursion cycle must not include any aggregate functions, GROUP BY clauses, or HAVING clauses. The FROM clauses of these *fullselects* can include at most one reference to a common table expression that is part of a recursion cycle.
- Subqueries (scalar or quantified) must not be part of any recursion cycles.
- Outer join must not be part of any recursion cycles.

When developing recursive common table expressions, remember that an infinite recursion cycle (loop) can be created. Check that recursion cycles will terminate. This is especially important if the data involved is cyclic. A recursive common table expression is expected to include a predicate that will prevent an infinite loop. The recursive common table expression is expected to include :

- In the iterative *fullselect*, an integer column incremented by a constant.
- A predicate in the WHERE clause of the iterative *fullselect* in the form of ″counter_col < constant″ or ″counter_col < :hostvar″. A warning is issued if this syntax is not found.

order-by-clause

```
                  ┌─,──────────────────────┐
                  │             ┌─ASC──┐   │
►►──ORDER BY──┬───▼─sort-key──┼──────┼───┴──┬──────────────────────────────────►◄
              │               └─DESC─┘      │
              └─INPUT SEQUENCE──────────────┘
```

sort-key:

```
►►──┬─column-name─┬──────────────────────────────────────────────────────────►◄
    ├─integer─────┤
    └─expression──┘
```

The ORDER BY clause specifies an ordering of the rows of the result table.

INPUT SEQUENCE indicates that the result table reflects the input order of the rows specified in the VALUES clause of an INSERT statement. INPUT SEQUENCE ordering can be specified only when an INSERT statement is specified in a from-clause.

If a single *sort-key* is identified, the rows are ordered by the values of that *sort-key*. If more than one *sort-key* is identified, the rows are ordered by the values of the first *sort-key*, then by the values of the second *sort-key*, and so on. A *sort-key* cannot be a LOB expression.

A named column in the select list can be identified by a *sort-key* that is an integer or a column name. An unnamed column in the select list must be identified by an integer or by an expression. A column is unnamed if the AS clause is not specified in the select list and the column is derived from a constant, an expression with operators, or a function. If the fullselect includes a UNION operator, the fullselect rules on named columns apply.

column-name

Usually identifies a column of the result table. In this case, *column-name* must be the name of a named column in the select list. If the *fullselect* includes a UNION or UNION ALL, the column name cannot be qualified.

If the query is a *subselect*, the *column-name* can also identify a column name of a table, view, or nested table expression identified in the FROM clause. An error occurs if the subselect includes any of the following:

- DISTINCT in the select list
- Aggregate functions in the select list
- GROUP BY clause

integer
Must be greater than 0 and not greater than the number of columns in the result table. The integer *n* identifies the *n*th column of the result table.

expression
Specifies an expression with operators (that is, not simply a *column-name* or *integer*). The query to which ordering is applied must be a *subselect* to use this form of the *sort-key*.

The *expression* cannot include a nondeterministic function or a function with an external action. Any column name in the expression must conform to the rules described on page 420. An expression cannot be specified if DISTINCT is used in the select list of the *subselect*.

If the *subselect* is grouped, the *expression* may or may not be in the select list of the *subselect*. When *expression* is not in the select list the following rules apply:

- Each expression in the ORDER BY clause must either:
  - Use one or more grouping expressions
  - Use a column-name that either unambiguously identifies a grouping column of R or is specified within a column function.
- Each expression in the ORDER BY clause must not contain a scalar fullselect.

ASC
Uses the values of the *sort-key* in ascending order. This is the default.

DESC
Uses the values of the *sort-key* in descending order.

Ordering is performed in accordance with the comparison rules described in Chapter 2, “Language elements,” beginning on page 83. The null value is higher than all other values. If your ordering specification does not determine a complete ordering, rows with duplicate values of the last identified *sort-key*y have an arbitrary order. If you do not specify ORDER BY, the rows of the result table have an arbitrary order.

Column names in sort keys: A column name in a *sort-key* must conform to the following rules:

- If the column name is qualified, the query must be a *subselect*. The column name must unambiguously identify a column of a table, view, or nested table expression in the FROM clause of the subselect; its value is used to compute the value of the sort specification.
- If the column name is unqualified, the following two cases apply:
  - The query is a *subselect*. In this case, the column name must unambiguously identify a column of a table, view, or nested table expression in the FROM clause of the subselect. If the column name is identical to one column of the result table, its value is used to compute the value of the sort specification. If the column name is not identical to one column, it must unambiguously identify a column of a table, view, or nested table expression in the FROM clause of the fullselect.

– The query is *not* a *subselect* (that is, the query includes a UNION or UNION ALL). The column name must be identical to exactly one column of the result table; its value is used to compute the value of the sort specification.

fetch-first-clause

```
                ┌─1───────┐
►►──FETCH FIRST─┴─integer─┴──┬─ROW──┬──ONLY──────────────────────────────────►◄
                             └─ROWS─┘
```

The FETCH FIRST clause limits the number of rows that can be fetched. It improves the performance of queries with potentially large result tables when only a limited number of rows are needed. If the clause is specified, the number of rows retrieved will not exceed *n*, where *n* is the value of the integer. An attempt to fetch *n+1* rows is handled the same way as normal end of data. The value of *integer* must be positive and non-zero. The default is 1.

If the OPTIMIZE FOR clause is not specified, a default of OPTIMIZE FOR *integer* ROWS, where *integer* is the value of FETCH FIRST, is assumed. DB2 uses this value for access path optimization.

If both the FETCH FIRST clause and the ORDER BY clause are specified, the ordering is performed on the entire result table prior to returning the first *n* rows.

If the FETCH FIRST clause is used with a SELECT statement that contains an INSERT statement, all rows specified in the INSERT statement are inserted, but only the rows specified in the FETCH FIRST clause are retrieved.

update-clause

```
►►──FOR UPDATE──┬──────────────────┬──────────────────────────────────────────►◄
                └─OF──column-name──┘
```

The optional FOR UPDATE clause identifies the columns that can be updated in a later positioned UPDATE statement. Each column name must be unqualified and must identify a column of the table or view identified in the first FROM clause of the fullselect. The clause must not be specified if the result table of the fullselect is read-only. For a discussion of read-only result tables, see “DECLARE CURSOR” on page 812. The clause must also not be specified if a created temporary table is referenced in the first FROM clause of the select-statement.

If the FOR UPDATE clause is specified without a list of columns, the columns that can be updated will include all the updatable columns of the table or view that is identified in the first FROM clause of the fullselect.

The declaration of a cursor referred to in a positioned UPDATE statement need not include an UPDATE clause if the STDSQL(YES) or NOFOR option is specified when the program is precompiled. For more on the subject, see "Positioned updates of columns" on page 185.

When FOR UPDATE is used, FETCH operations referencing the cursor acquire U or X locks rather than S locks when:

- The isolation level of the statement is cursor stability.
- The isolation level of the statement is repeatable read or read stability and field U LOCK FOR RR/RS on installation panel DSNTIPI is set to get U locks.
- The isolation level of the statement is repeatable read or read stability and USE AND KEEP EXCLUSIVE LOCKS or USE AND KEEP UPDATE LOCKS is specified in the SQL statement, an X lock or a U lock, respectively, is acquired at fetch time.

No locks are acquired on declared temporary tables. For a discussion of U locks and S locks, see Part 5 (Volume 2) of *DB2 Administration Guide*.

read-only-clause

```
►►──FOR READ ONLY──────────────────────────────────────────────────────────►◄
```

The clause FOR READ ONLY indicates that the result table is read-only. Therefore, the cursor cannot be referred to in positioned UPDATE or DELETE statements.

Some result tables are read-only by nature (for example, a table based on a read-only view.) FOR READ ONLY can still be specified for such tables, but the specification has no effect.

For tables in which updates and deletes are allowed, specifying FOR READ ONLY can possibly improve the performance of FETCH operations as DB2 can do blocking and avoid exclusive locks. For example, in programs that contain dynamic SQL statements without the FOR READ ONLY or ORDER BY clause, DB2 might open cursors as if the UPDATE clause was specified.

A read-only result table must not be referred to in an UPDATE or DELETE statement, whether it is read-only by nature or specified as FOR READ ONLY.

To take advantage of the possibly improved performance of FETCH operations while guaranteeing that selected data is not modified and preventing some types of deadlocks, you can specify FOR READ ONLY in combination with the optional syntax of USE AND KEEP ... LOCKS on the *isolation-clause*.

Alternative syntax and synonyms: FOR FETCH ONLY can be specified as a synonym for FOR READ ONLY.

optimize-for-clause

```
►►──OPTIMIZE FOR──integer──┬─ROWS─┬──────────────────────────────────────────────►◄
                           └─ROW──┘
```

The OPTIMIZE FOR clause requests special optimization of the *select-statement*. The clause specifies that optimization is based on the assumption that the number of rows retrieved will not exceed *n*, where *n* is the value of the integer. If the clause is omitted, optimization is based on the assumption that all rows of the result table will be retrieved unless the FETCH FIRST clause is specified. If OPTIMIZE FOR is omitted and FETCH FIRST is specified, OPTIMIZE FOR *integer* ROWS is assumed, where *integer* is the value of FETCH FIRST.

The OPTIMIZE FOR clause does not limit the number of rows that can be fetched or affect the result in any way other than performance. In general, if you are retrieving only a few rows, use OPTIMIZE FOR 1 ROW to influence the access path that DB2 selects. For more information about using this clause, see *DB2 Application Programming and SQL Guide*.

isolation-clause

```
►►──WITH──┬─CS──────────────────┬────────────────────────────────────────────────►◄
          ├─UR──────────────────┤
          ├─RR──┬─────────────┬─┤
          │     └─lock-clause─┘ │
          └─RS──┬─────────────┬─┘
                └─lock-clause─┘
```

lock-clause:

```
├──USE AND KEEP──┬─EXCLUSIVE─┬──LOCKS──────────────────────────────────────────────┤
                 ├─UPDATE────┤
                 └─SHARE─────┘
```

The *isolation-clause* specifies the isolation level at which the statement is executed. (Isolation level does not apply to declared temporary tables because no locks are acquired.)

CS Cursor stability

UR Uncommitted read

RR Repeatable read

RR *lock-clause*
Repeatable read, using and keeping the type of lock that is specified in *lock-clause* on all accessed pages and rows

RS Read stability

RS *lock-clause*
: Read stability, using and keeping the type of lock that is specified in *lock-clause* on all accessed pages and rows

lock-clause
: Specifies the type of lock.

USE AND KEEP EXCLUSIVE LOCKS
USE AND KEEP UPDATE LOCKS
USE AND KEEP SHARE LOCKS
: Specifies that DB2 is to acquire and hold X, U, or S locks, respectively.

WITH UR can be specified only if the result table of the fullselect or the SELECT INTO statement is read-only.

In an ODBC application, the SQLSetStmtAttr function can be used to set statement attributes that interact with the *lock-clause*. If SQLSetStmtAttr is invoked with a cursor's statement handle and specifying that its SQL_ATTR_CLOSE_BEHAVIOR is SQL_CC_RELEASE (locks are to be released when the cursor is closed), then irrespective of any *lock-clause*, lock used by the cursor that are not needed to protect the integrity of changed data are released. For more information on SQLSetStmtAttr, see *DB2 ODBC Guide and Reference*.

Although requesting an UPDATE or EXCLUSIVE LOCK can reduce concurrency, it can prevent some types of deadlocks.

The **default** isolation level of the statement depends on:
- The isolation of the package or plan that the statement is bound in
- Whether the result table is read-only

Table 51 shows the default isolation level of the statement.

Table 51. Default isolation level based on the isolation level of the package or plan and whether the result table is read-only

If package isolation is:	And plan isolation is:	And the result table is:	Then the default isolation is:
RR	Any	Any	RR
RS	Any	Any	RS
CS	Any	Any	CS
UR	Any	Read-only	UR
		Not read-only	CS
Not specified	Not specified	Any	RR
	RR	Any	RR
	RS	Any	RS
	CS	Any	CS
	UR	Read-only	UR
		Not read-only	CS

A simple way to ensure that a result table is read-only is to specify FOR READ ONLY in the SQL statement.

Alternative syntax and synonyms: KEEP UPDATE LOCKS can be specified as a synonym for USE AND KEEP EXCLUSIVE LOCKS. However, KEEP UPDATE

LOCKS can be specified only if FOR UPDATE OF is specified, and it is not supported in the SELECT INTO statement.

queryno-clause

```
►►──QUERYNO──integer──────────────────────────────────────────────────────────────►◄
```

The QUERYNO clause specifies the number to be used for this SQL statement in EXPLAIN output and trace records. The number is used for the QUERYNO columns of the plan tables for the rows that contain information about this SQL statement. This number is also used in the QUERYNO column of the SYSIBM.SYSSTMT and SYSIBM.SYSPACKSTMT catalog tables.

If the clause is omitted, the number associated with the SQL statement is the statement number assigned during precompilation. Thus, if the application program is changed and then precompiled, that statement number might change.

Using the QUERYNO clause to assign unique numbers to the SQL statements in a program is helpful:

- For simplifying the use of optimization hints for access path selection
- For correlating SQL statement text with EXPLAIN output in the plan table

For information on using optimization hints, such as enabling the system for optimization hints and setting valid hint values, and for information on accessing the plan table, see Part 5 (Volume 2) of *DB2 Administration Guide*.

Examples of select statements

Example 1: Select all the rows from DSN8810.EMP.

```
SELECT * FROM DSN8810.EMP;
```

Example 2: Select all the rows from DSN8810.EMP, arranging the result table in chronological order by date of hiring.

```
SELECT * FROM DSN8810.EMP ORDER BY HIREDATE;
```

Example 3: Select the department number (WORKDEPT) and average departmental salary (SALARY) for all departments in the table DSN8810.EMP. Arrange the result table in ascending order by average departmental salary.

```
SELECT WORKDEPT, AVG(SALARY)
  FROM DSN8810.EMP
  GROUP BY WORKDEPT
  ORDER BY 2;
```

Example 4: Change various salaries, bonuses, and commissions in the table DSN8810.EMP. Confine the changes to employees in departments D11 and D21. Use positioned updates to do this with a cursor named UP_CUR. Use a FOR UPDATE clause in the cursor declaration to indicate that all updatable columns are updated. Below is the declaration for a PL/I program.

```
EXEC SQL DECLARE UP_CUR CURSOR FOR
  SELECT WORKDEPT, EMPNO, SALARY, BONUS, COMM
    FROM DSN8810.EMP
    WHERE WORKDEPT IN ('D11','D21')
    FOR UPDATE;
```

Beginning where the cursor is declared, all updatable columns would be updated. If only specific columns needed to be updated, such as only the salary column, the FOR UPDATE clause could be used to specify the salary column (FOR UPDATE OF SALARY).

Example 5: Find the maximum, minimum, and average bonus in the table DSN8810.EMP. Execute the statement with uncommitted read isolation, regardless of the value of ISOLATION with which the plan or package containing the statement is bound. Assign 13 as the query number for the SELECT statement.

```
EXEC SQL
  SELECT MAX(BONUS), MIN(BONUS), AVG(BONUS)
    INTO :MAX, :MIN, :AVG
    FROM DSN8810.EMP
    WITH UR
    QUERYNO 13;
```

If bind option EXPLAIN(YES) is specified, rows are inserted into the plan table. The value used for the QUERYNO column for these rows is 13.

Example 6: The cursor declaration shown below is in a PL/I program. In the query within the declaration, X.RMT_TAB is an alias for a table at some other DB2. Hence, when the query is used, it is processed using DRDA access. See “Distributed data” on page 18.

The declaration indicates that no positioned updates or deletes will be done with the query’s cursor. It also specifies that the access path for the query be optimized for the retrieval of at most 50 rows. Even so, the program can retrieve more than 50 rows from the result table, which consists of the entire table identified by the alias. However, when more than 50 rows are retrieved, performance could possibly degrade.

```
EXEC SQL DECLARE C1 CURSOR FOR
  SELECT * FROM X.RMT_TAB
  OPTIMIZE FOR 50 ROWS
  FOR READ ONLY;
```

The FETCH FIRST clause could be used instead of the OPTIMIZE FOR clause to ensure that only 50 rows are retrieved as in the following example:

```
EXEC SQL DECLARE C1 CURSOR FOR
  SELECT * FROM X.RMT_TAB
  FETCH FIRST 50 ROWS ONLY;
```

Example 7: Assume that table DSN8810.EMP has 1000 rows and you wish to see the first five EMP_ROWID values that were inserted into DSN8810.EMP_PHOTO_RESUME.

```
EXEC SQL DECLARE CS1 CURSOR FOR
  SELECT EMP_ROWID
    FROM FINAL TABLE (INSERT INTO DSN8810.EMP_PHOTO_RESUME (EMPNO)
                     SELECT EMPNO FROM DSN8810.EMP)
    FETCH FIRST 5 ROWS ONLY;
```

All 1000 rows are inserted into DSN8810.EMP_PHOTO_RESUME, but only the first five are returned.

Chapter 5. Statements

This chapter contains syntax diagrams, semantic descriptions, rules, and examples of the use of the SQL statements listed in Table 52.

Table 52. SQL statements

SQL statement	Function	Page
ALLOCATE CURSOR	Defines and associates a cursor with a result set locator variable	436
ALTER DATABASE	Changes the description of a database	438
ALTER FUNCTION (external)	Changes the description of a user-defined external scalar or table function	441
ALTER FUNCTION (SQL scalar)	Changes the description of an SQL scalar function	458
ALTER INDEX	Changes the description of an index	464
ALTER PROCEDURE (external)	Changes the description of an external procedure	479
ALTER PROCEDURE (SQL)	Changes the description of an SQL procedure	490
ALTER SEQUENCE	Changes the description of a sequence	496
ALTER STOGROUP	Changes the description of a storage group	501
ALTER TABLE	Changes the description of a table	504
ALTER TABLESPACE	Changes the description of a table space	545
ALTER VIEW	Regenerates a view	545
ASSOCIATE LOCATORS	Gets the result set locator value for each result set returned by a stored procedure	558
BEGIN DECLARE SECTION	Marks the beginning of a host variable declaration section	562
CALL	Calls a stored procedure	563
CLOSE	Closes a cursor	572
COMMENT	Replaces or adds a comment to the description of an object	574
COMMIT	Ends a unit of recovery and commits the database changes made by that unit of recovery	581
CONNECT	Connects the process to a server	583
CREATE ALIAS	Defines an alias	589
CREATE AUXILIARY TABLE	Defines an auxiliary table for storing LOB data	589
CREATE DATABASE	Defines a database	594
CREATE DISTINCT TYPE	Defines a distinct type (user-defined data type)	597
CREATE FUNCTION (external scalar)	Defines a user-defined external scalar function	605
CREATE FUNCTION (external table)	Defines a user-defined external table function	628
CREATE FUNCTION (sourced)	Defines a user-defined function that is based on an existing scalar or aggregate function	645
CREATE FUNCTION (SQL scalar)	Defines a user-defined SQL scalar function	657
CREATE GLOBAL TEMPORARY TABLE	Defines a created temporary table	667

Table 52. SQL statements (continued)

SQL statement	Function	Page
CREATE INDEX	Defines an index on a table	673
CREATE PROCEDURE (external)	Defines an external stored procedure	692
CREATE PROCEDURE (SQL)	Defines an SQL procedure	710
CREATE SEQUENCE	Defines a sequence	721
CREATE STOGROUP	Defines a storage group	729
CREATE SYNONYM	Defines an alternate name for a table or view	732
CREATE TABLE	Defines a table	734
CREATE TABLESPACE	Defines a table space, which includes allocating and formatting the table space	772
CREATE TRIGGER	Defines a trigger	793
CREATE VIEW	Defines a view of one or more tables or views	805
DECLARE CURSOR	Defines an SQL cursor	812
DECLARE GLOBAL TEMPORARY TABLE	Defines a declared temporary table	824
DECLARE STATEMENT	Declares names used to identify prepared SQL statements	836
DECLARE TABLE	Provides the programmer and the precompiler with a description of a table or view	837
DECLARE VARIABLE	Defines a CCSID for a host variable	840
DELETE	Deletes one or more rows from a table	843
DESCRIBE (prepared statement or TABLE)	Describes the result columns of a prepared statement or the columns of a table or view	851
DESCRIBE CURSOR	Puts information about the result set associated with a cursor into a descriptor	859
DESCRIBE INPUT	Puts information about the input parameters (markers) of a prepared statement into a descriptor	861
DESCRIBE PROCEDURE	Puts information about the result sets returned by a stored procedure into a descriptor	863
DROP	Deletes objects	866
END DECLARE SECTION	Marks the end of a host variable declaration section	880
EXECUTE	Executes a prepared SQL statement	881
EXECUTE IMMEDIATE	Prepares and executes an SQL statement	886
EXPLAIN	Obtains information about how an SQL statement would be executed	889
FETCH	Positions the cursor, returns data, or both positions the cursor and returns data	903
FREE LOCATOR	Removes the association between a LOB locator variable and its value	927
GET DIAGNOSTICS	Provides diagnostic information about the last SQL statement that was executed	928
GRANT (collection privileges)	Grants authority to create a package in a collection	944
GRANT (database privileges)	Grants privileges on a database	945

Table 52. SQL statements (continued)

SQL statement	Function	Page
GRANT (distinct type or JAR privileges)	Grants the usage privilege on a distinct type (user-defined data type) or a JAR	947
GRANT (function or procedure privileges)	Grants privileges on a user-defined function or a stored procedure	949
GRANT (package privileges)	Grants authority to bind, execute, or copy a package	954
GRANT (plan privileges)	Grants authority to bind or execute an application plan	957
GRANT (schema privileges)	Grants privileges on a schema	958
GRANT (sequence privileges)	Grants privileges on a user-defined sequence	960
GRANT (system privileges)	Grants system privileges	958
GRANT (table or view privileges)	Grants privileges on a table or view	964
GRANT (use privileges)	Grants authority to use specified buffer pools, storage groups, or table spaces	967
HOLD LOCATOR	Allows a LOB locator variable to retain its association with its value beyond a unit of work	969
INCLUDE	Inserts declarations into a source program	970
INSERT	Inserts one or more rows into a table	972
LABEL	Replaces or adds a label on the description of a table, view, alias, or column	986
LOCK TABLE	Locks a table or table space partition in shared or exclusive mode	988
OPEN	Opens a cursor	990
PREPARE	Prepares an SQL statement (with optional parameters) for execution	995
REFRESH TABLE	Refreshes the data in a materialized query table	1011
RELEASE (connection)	Places one or more connections in the release pending status	1013
RELEASE SAVEPOINT	Releases a savepoint and any subsequently set savepoints within a unit of recovery	1016
RENAME TABLE	Renames an existing table	1017
REVOKE (collection privileges)	Revokes authority to create a package in a collection	1025
REVOKE (database privileges)	Revokes privileges on a database	1026
REVOKE (distinct type or JAR privileges)	Revokes the usage privilege on a distinct type (user-defined data type) or a JAR	1029
REVOKE (function or procedure privileges)	Revokes privileges on a user-defined function or a stored procedure	1031
REVOKE (package privileges)	Revokes authority to bind, execute, or copy a package	1036
REVOKE (plan privileges)	Revokes authority to bind or execute an application plan	1038
REVOKE (schema privileges)	Revokes privileges on a schema	1039
REVOKE (sequence privileges)	Revokes privileges on a user-defined sequence	1041
REVOKE (system privileges)	Revokes system privileges	1043

Table 52. SQL statements (continued)

SQL statement	Function	Page
REVOKE (table or view privileges)	Revokes privileges on a table or view	1046
REVOKE (use privileges)	Revokes authority to use specified buffer pools, storage groups, or table spaces	1049
ROLLBACK	Ends a unit of recovery and backs out the changes to the database made by that unit of recovery, or partially rolls back the changes to a savepoint within the unit of recovery	1051
SAVEPOINT	Sets a savepoint within a unit of recovery	1054
SELECT	Specifies the SELECT statement of the cursor	1056
SELECT INTO	Specifies a result table of no more than one row and assigns the values to host variables	1057
SET CONNECTION	Establishes the database server of the process by identifying one of its existing connections	1060
SET CURRENT APPLICATION ENCODING SCHEME	Assigns a value to the CURRENT APPLICATION ENCODING SCHEME special register	1062
SET CURRENT DEGREE	Assigns a value to the CURRENT DEGREE special register	1063
SET CURRENT LOCALE LC_CTYPE	Assigns a value to the CURRENT LOCALE LC_CTYPE special register	1065
SET CURRENT MAINTAINED TABLE TYPES FOR OPTIMIZATION	Assigns a value to the CURRENT MAINTAINED TABLE TYPES FOR MAINTAINED TABLE TYPES special register	1067
SET CURRENT OPTIMIZATION HINT	Assigns a value to the CURRENT OPTIMIZATION HINT special register	1069
SET CURRENT PACKAGE PATH	Assigns a value to the CURRENT PACKAGE PATH special register	1070
SET CURRENT PACKAGESET	Assigns a value to the CURRENT PACKAGESET special register	1074
SET CURRENT PRECISION	Assigns a value to the CURRENT PRECISION special register	1076
SET CURRENT REFRESH AGE	Assigns a value to the CURRENT REFRESH AGE special register	1077
SET CURRENT RULES	Assigns a value to the CURRENT RULES special register	1079
SET CURRENT SQLID	Assigns a value to the CURRENT SQLID special register	1080
SET ENCRYPTION PASSWORD	Assign a value for the ENCRYPTION PASSWORD and ,optionally, a hint for the password	1084
SET host-variable Assignment	Assigns values to host variables	1084
SET PATH	Assigns a value to the CURRENT PATH special register	1087
SET SCHEMA	Assigns a value to the CURRENT SCHEMA special register	1090
SET transition-variable Assignment	Assigns values to transition variables	1093
SIGNAL SQLSTATE	Signals an error with a user-specified SQLSTATE and description	1140
UPDATE	Updates the values of one or more columns in one or more rows of a table	1097
VALUES	Provides a way to invoke a user-defined function from a trigger	1108
VALUES INTO	Assigns values to host variables	1109

Table 52. SQL statements (continued)

SQL statement	Function	Page
WHENEVER	Defines actions to be taken on the basis of SQL return codes	1111

How SQL statements are invoked

The SQL statements described in this chapter are classified as *executable* or *nonexecutable*. The section on invocation in the description of each statement indicates whether or not the statement is executable.

Executable statements can be invoked in the following ways:
- Embedded in an application program
- Dynamically prepared and executed
- Dynamically prepared and executed using DB2 ODBC function calls
- Issued interactively

Depending on the statement, you can use some or all of these methods. The section on invocation in the description of each statement tells you which methods can be used. See Appendix C, "Characteristics of SQL statements in DB2 UDB for z/OS," on page 1155 for a list of executable statements.

A *nonexecutable statement* can only be embedded in an application program.

In addition to the statements described in this chapter, there is one more SQL statement construct: the *select-statement*. (See "select-statement" on page 416.) It is not included in this chapter because it is used in a different way from other statements.

A select-statement can be invoked in the following ways:
- Included in DECLARE CURSOR and implicitly executed by OPEN
- Dynamically prepared, referred to in DECLARE CURSOR, and implicitly executed by OPEN
- Dynamically executed (no PREPARE required) using a DB2 ODBC function call
- Issued interactively

The first two methods are called, respectively, the *static* and the *dynamic* invocation of *select-statement*.

Embedding a statement in an application program

You can include SQL statements in a source program that will be submitted to the precompiler. Such statements are said to be *embedded* in the application program. An embedded statement can be placed anywhere in the application program where a host language statement is allowed. Each embedded statement must be preceded by a keyword (or keywords) to indicate that the statement is an SQL statement:

- In C and COBOL, each embedded statement must be preceded by the keywords EXEC SQL.
- In Java, each embedded statement must be preceded by the keywords #sql.
- In REXX, each embedded statement must be preceded by the keyword EXECSQL.

Executable statements: An executable statement embedded in an application program is executed every time a statement of the host language would be executed if specified in the same place. (Thus, for example, a statement within a loop is executed every time the loop is executed, and a statement within a conditional construct is executed only when the condition is satisfied.)

An embedded statement can contain references to host variables. A host variable referred to in this way can be used in one of two ways:

As *input*
: The current value of the host variable is used in the execution of the statement.

As *output*
: The variable is assigned a new value as a result of executing the statement.

In particular, all references to host variables in expressions and predicates are effectively replaced by current values of the variables; that is, the variables are used as input. The treatment of other references is described individually for each statement.

The successful or unsuccessful execution of the statement is indicated by setting the SQLCODE and SQLSTATE fields in the SQLCA.[21] You must therefore follow all executable statements by a test of SQLCODE or SQLSTATE. Alternatively, you can use the WHENEVER statement (which is itself nonexecutable) to change the flow of control immediately after the execution of an embedded statement.

Nonexecutable statements: An embedded nonexecutable statement is processed only by the precompiler. The statement is *never* executed, and acts as a "no-operation" if placed among executable statements of the application program. Therefore, you must not follow such statements by a test of the SQLCODE or SQLSTATE field in the SQLCA.

Dynamic preparation and execution

Your application program can dynamically build an SQL statement in the form of a character string placed in a host variable. In general, the statement is built from some data available to the application program (for example, input from a workstation). In non-Java langauages, the statement so constructed can be prepared for execution by means of the (embedded) statement PREPARE and executed by means of the (embedded) statement EXECUTE, as described in Part 6 of *DB2 Application Programming and SQL Guide*. Alternatively, you can use the (embedded) statement EXECUTE IMMEDIATE to prepare and execute a statement in one step. In Java, the statement can be prepared for execution by means of the Statement, PreparedStatement, and CallableStatement classes, and executed by means of their respective execute() methods.

The statement may also be prepared by calling the DB2 ODBC SQLPrepare function and then executed by calling the DB2 ODBC SQLExecute function. In both cases, the application does not contain an embedded PREPARE or EXECUTE statement. You can execute the statement, without preparation, by passing the statement to the DB2 ODBC SQLExecDirect function.

DB2 ODBC Guide and Reference describes the APIs supported with this interface.

[21] SQLCODE and SQLSTATE cannot be in the SQLCA when the precompiler option STDSQL(YES) is in effect. See "SQL standard language" on page 184.

A statement that is going to be prepared must not contain references to host variables. It can instead contain parameter markers. (See “Parameter markers” on page 1003 in the description of the PREPARE statement for rules concerning parameter markers.) When the prepared statement is executed, the parameter markers are effectively replaced by current values of the host variables specified in the EXECUTE statement. (See “EXECUTE” on page 881 for rules concerning this replacement.) Once prepared, a statement can be executed several times with different values of host variables.

Parameter markers are not allowed in the SQL statement prepared and executed using EXECUTE IMMEDIATE.

In non-Java languages, the successful or unsuccessful execution of the statement is indicated by the values returned in the SQLCODE and SQLSTATE fields in the SQLCA after the EXECUTE (or EXECUTE IMMEDIATE) statement. You should check the fields as described above for embedded statements. In Java, the successful or unsuccessful execution of the statement is handled by Java Exceptions.

As explained in “Authorization IDs and dynamic SQL” on page 51, the DYNAMICRULES behavior in effect determines the privilege set that is used for authorization checking when dynamic SQL statements are processed. Table 53 summarizes those privilege sets. (See Table 3 on page 51 for a list of the DYNAMICRULES bind option values that determine which behavior is in effect).

Table 53. DYANMICRULES behaviors and authorization checking

DYNAMICRULES behavior	Privilege set
Run behavior	The union of the set of privileges held by each authorization ID of the process if the dynamically prepared statement is other than an ALTER, CREATE, DROP, GRANT, RENAME, or REVOKE statement. The privileges that are held by the SQL authorization ID of the process if the dynamic SQL statement is a CREATE, GRANT, or REVOKE statement.
Bind behavior	The privileges that are held by the primary authorization ID of the owner of the package or plan.
Define behavior	The privileges that are held by the authorization ID of the stored procedure or user-defined function owner (definer).
Invoke behavior	The privileges that are held by the authorization ID of the stored procedure or user-defined function invoker. However, if the invoker is the primary authorization ID of the process or the CURRENT SQLID value, secondary authorization IDs are also checked if they are needed for the required authorization. Therefore, in that case, the privilege set is the union of the set of privileges that are held by each authorization ID.

Static invocation of a SELECT statement

You can include a SELECT statement as a part of the (nonexecutable) statement DECLARE CURSOR. Such a statement is executed every time you open the cursor by means of the (embedded) statement OPEN. After the cursor is open, you can retrieve the result table a row at a time by successive executions of the (embedded) SQL FETCH statement.

If the application is using DB2 ODBC, the SELECT statement is first prepared with the SQLPrepare function call. It is then executed with the SQLExecute function call. Data is then fetched with the SQLFetch function call. The application does not explicitly open the cursor.

The SELECT statement used in this way can contain references to host variables. These references are effectively replaced by the values that the variables have at the moment of executing OPEN.

The successful or unsuccessful execution of the SELECT statement is indicated by the values returned in the SQLCODE and SQLSTATE fields in the SQLCA after the OPEN. You should check the fields as described above for embedded statements.

If the application is using DB2 ODBC, the successful execution of the SELECT statement is indicated by the return code from the SQLExecute function call. If necessary, the application may retrieve the SQLCA by calling the SQLGetSQLCA function.

Dynamic invocation of a SELECT statement

Your application program can dynamically build a SELECT statement in the form of a character string placed in a host variable. In general, the statement is built from some data available to the application program (for example, a query obtained from a terminal). The statement so constructed can be prepared for execution by means of the (embedded) statement PREPARE, and referred to by a (nonexecutable) statement DECLARE CURSOR. The statement is then executed every time you open the cursor by means of the (embedded) statement OPEN. After the cursor is open, you can retrieve the result table a row at a time by successive executions of the (embedded) SQL FETCH statement.

The SELECT statement used in that way must not contain references to host variables. It can instead contain parameter markers. (See “Notes” in “PREPARE” on page 995 for rules concerning parameter markers.) The parameter markers are effectively replaced by the values of the host variables specified in the OPEN statement. (See “OPEN” on page 990 for rules concerning this replacement.)

The successful or unsuccessful execution of the SELECT statement is indicated by the values returned in the SQLCODE and SQLSTATE fields in the SQLCA after the OPEN. You should check the fields as described above for embedded statements.

Interactive invocation

IBM relational database management systems allow you to enter SQL statements from a terminal. DB2 UDB for z/OS provides SPUFI to prepare and execute these statements. Other products are also available. A statement entered in this way is said to be issued interactively.

A statement issued interactively must not contain parameter markers or references to host variables, because these make sense only in the context of an application program. For the same reason, there is no SQLCA involved.

Checking the execution of SQL statements

An application program that contains executable SQL statements must include one or both of the following stand-alone host variables:

- SQLCODE (SQLCOD in Fortran)
- SQLSTATE (SQLSTT in Fortran)

Or,

- An SQLCA, which can be provided by using the INCLUDE SQLCA statement

Whether you define stand-alone SQLCODE and SQLSTATE host variables or an SQLCA in your program depends on the DB2 precompiler option you choose.

If the application is using DB2 ODBC and it calls the SQLGetSQLCA function, it need only include an SQLCA. Otherwise, all notification of success or errors is specified with return codes for the various function calls.

When you specify STDSQL(YES), which indicates conformance to the SQL standard, you should not define an SQLCA. The stand-alone variable for SQLCODE must be a valid host variable in the DECLARE SECTION of a program. It can also be declared outside of the DECLARE SECTION when no variable is defined for SQLSTATE. The stand-alone variable for SQLSTATE must be declared in the DECLARE SECTION; it must not be declared as an element of a structure.

When you specify STDSQL(NO), which indicates conformance to DB2 rules, you must include an SQLCA explicitly.

SQLCODE

Regardless of whether the application program provides an SQLCA or a stand-alone variable for SQLCODE, DB2 sets SQLCODE after each SQL statement is executed. DB2 conforms to the SQL standard as follows:

- If SQLCODE = 0, execution was successful.
- If SQLCODE > 0 and not = 100, execution was successful with a warning.
- If SQLCODE = 100, "no data" was found. For example, a FETCH statement returned no data because the cursor was positioned after the last row of the result table.
- If SQLCODE < 0, execution was not successful.

The SQL standard does not define the meaning of any other specific positive or negative values of SQLCODE, and the meaning of these values is not the same in all implementations of SQL.

If the application is using DB2 ODBC, an SQLCODE is only returned if the application issues the SQLGetSQLCA function.

SQLSTATE

Regardless of whether the application program provides an SQLCA or a stand-alone variable for SQLSTATE, DB2 sets SQLSTATE after each SQL statement is executed. DB2 returns values that conform to the error specification in the SQL standard.

If the application is using DB2 ODBC, the SQLSTATE returned conforms to the ODBC Version 2.0 specification.

SQLSTATE provides application programs with common codes for common error conditions (the values of SQLSTATE are product-specific if the error or warning is product-specific). Furthermore, SQLSTATE is designed so that application programs can test for specific errors or classes of errors. The coding scheme is the same for all IBM implementations of SQL. The SQLSTATE values are based on the SQLSTATE specifications contained in the SQL standard.

Error messages and the tokens that are substituted for variables in error messages are associated with SQLCODE values, not SQLSTATE values.

ALLOCATE CURSOR

The ALLOCATE CURSOR statement defines a cursor and associates it with a result set locator variable.

Invocation

This statement can be embedded in an application program. It is an executable statement that can be dynamically prepared. It cannot be issued interactively.

Authorization

None required.

Syntax

```
►►──ALLOCATE──cursor-name──CURSOR FOR RESULT SET──rs-locator-variable──────────────────────────────►◄
```

Description

cursor-name
Names the cursor. The name must not identify a cursor that has already been declared in the source program.

CURSOR FOR RESULT SET *rs-locator-variable*
Specifies a result set locator variable that has been declared in the application program according to the rules for declaring result set locator variables.

The result set locator variable must contain a valid result set locator value, as returned by the ASSOCIATE LOCATORS or DESCRIBE PROCEDURE SQL statement. The value of the result set locator variable is used at the time the cursor is allocated. Subsequent changes to the value of the result set locator have no affect on the allocated cursor. The result set locator value must not be the same as a value used for another cursor allocated in the source program.

Notes

Dynamically prepared ALLOCATE CURSOR statements: The EXECUTE statement with the USING clause must be used to execute a dynamically prepared ALLOCATE CURSOR statement. In a dynamically prepared statement, references to host variables are represented by parameter markers (question marks). In the ALLOCATE CURSOR statement, *rs-locator-variable* is always a host variable. Thus, for a dynamically prepared ALLOCATE CURSOR statement, the USING clause of the EXECUTE statement must identify the host variable whose value is to be substituted for the parameter marker that represents *rs-locator-variable*.

You cannot prepare an ALLOCATE CURSOR statement with a statement identifier that has already been used in a DECLARE CURSOR statement. For example, the following SQL statements are invalid because the PREPARE statement uses STMT1 as an identifier for the ALLOCATE CURSOR statement and STMT1 has already been used for a DECLARE CURSOR statement.

```
DECLARE CURSOR C1 FOR STMT1;

PREPARE STMT1 FROM          INVALID
  'ALLOCATE C2 CURSOR FOR RESULT SET ?';
```

Rules for using an allocated cursor: The following rules apply when you use an allocated cursor:

- You cannot open an allocated cursor with the OPEN statement.
- You can close an allocated cursor with the CLOSE statement. Closing an allocated cursor closes the associated cursor defined in the stored procedure.
- You can allocate only one cursor to each result set.

The life of an allocated cursor: A rollback operation, an implicit close, or an explicit close destroy allocated cursors. A commit operation destroys allocated cursors that are not defined WITH HOLD by the stored procedure. Destroying an allocated cursor closes the associated cursor defined in the stored procedure.

Considerations for scrollable cursors: Following an ALLOCATE CURSOR statement, a GET DIAGNOSTICS statement can be used to get the attributes of the cursor such as the following information (for more information, see "GET DIAGNOSTICS" on page 928):

- DB2_SQL_ATTR_CURSOR_HOLD. Whether the cursor was defined with the WITH HOLD attribute.
- DB2_SQL_ATTR_CURSOR_SCROLLABLE. Scrollability of the cursor.
- DB2_SQL_ATTR_CURSOR_SENSITIVITY. Effective sensitivity of the cursor.

  The sensitivity information can be used by applications (such as an ODBC driver) to determine what type of FETCH (INSENSITIVE or SENSITIVE) to issue for a cursor defined as ASENSITIVE.
- DB2_SQL_ATTR_CURSOR_ROWSET. Whether the cursor can be used to access rowsets.
- DB2_SQL_ATTR_CURSOR_TYPE. Whether a cursor type is forward-only, static, or dynamic.

In addition, if subsystem parameter DISABSCL is set to YES, a subset of the above information is returned in the SQLCA:

- The scrollability of the cursor is in SQLWARN1.
- The sensitivity of the cursor is in SQLWARN4.
- The effective capability of the cursor is in SQLWARN5.

Example

The statement in the following example is assumed to be in a PL/I program.

Define and associate cursor C1 with the result set locator variable LOC1 and the related result set returned by the stored procedure:

```
EXEC SQL ALLOCATE C1 CURSOR FOR RESULT SET :LOC1;
```

ALTER DATABASE

The ALTER DATABASE statement changes the description of a database at the current server.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

The privilege set that is defined below must include at least one of the following:

- The DROP privilege on the database
- Ownership of the database
- DBADM or DBCTRL authority for the database
- SYSADM or SYSCTRL authority

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package. If the statement is dynamically prepared, the privilege set is the union of the privilege sets that are held by each authorization ID of the process.

Syntax

```
                                   ┌─────────────────────────────┐
                                   ↓  (1)                        │
►►──ALTER DATABASE──database-name──────┬─BUFFERPOOL──bpname──────┬┴─────────────────►◄
                                       ├─INDEXBP──bpname─────────┤
                                       ├─STOGROUP──stogroup-name─┤
                                       └─CCSID──ccsid-value──────┘
```

Notes:

1 The same clause must not be specified more than once.

Description

DATABASE *database-name*
Identifies the database to be altered. The name must identify a database that exists at the current server.

BUFFERPOOL *bpname*
Identifies the default buffer pool for the table spaces within the database. It does not apply to table spaces that already exist within the database.

If the database is a work file database, 8KB and 16KB buffer pools cannot be specified.

See “Naming conventions” on page 40 for more details about *bpname*.

INDEXBP *bpname*
Identifies the default buffer pool for the indexes within the database. It does not apply to indexes that already exist within the database. The name must identify a 4KB buffer pool. See “Naming conventions” on page 40 for more details about *bpname*.

INDEXBP cannot be specified for a work file database.

STOGROUP *stogroup-name*

Identifies the storage group to be used, as required, as a default storage group to support DASD space requirements for table spaces and indexes within the database. It does not apply to table spaces and indexes that already exist within the database.

STOGROUP cannot be specified for a work file database.

CCSID *ccsid-value*

Identifies the default CCSID for table spaces within the database. It does not apply to existing table spaces in the database. *ccsid-value* must identify a CCSID value that is compatible with the current value of the CCSID for the database. "Notes" contains a list that shows the CCSID to which a given CCSID can be altered.

CCSID cannot be specified for a work file database or a TEMP database.

Notes

Altering the CCSID: The ability to alter the default CCSID enables you to change to a CCSID that supports the Euro symbol. You can only convert between specific CCSIDs that do and do not define the Euro symbol. In most cases, the code point that supports the Euro symbol replaces an existing code point, such as the International Currency Symbol (ICS).

Changing a CCSID can be disruptive to the system and requires several steps. For each encoding scheme of a system (ASCII, EBCDIC, and Unicode), DB2 supports SBCS, DBCS, and mixed CCSIDs. Therefore, the CCSIDs for all databases and all table spaces within an encoding scheme should be altered at the same time. Otherwise, unpredictable results might occur.

The recommended method for changing the CCSID requires that the data be unloaded and reloaded. See Appendix A of *DB2 Installation Guide* for the steps needed to change the CCSID, such as running an installation CLIST to modify the CCSID data in DSNHDECP, when to drop and recreate views, and when to rebind invalidated plans and packages.

The following lists show the CCSIDs that can be converted. The second CCSID in each pair is the CCSID with the Euro symbol. The CCSID can be changed from the CCSID that does not support the Euro symbol to the CCSID that does, and vice versa. For example, if the current CCSID is 500, it can be changed to 1148.

```
EBCDIC CCSIDs
---------------
37         1140
273        1141
277        1142
278        1143
280        1144
284        1145
285        1146
297        1147
500        1148
871        1149
```

```
ASCII CCSIDs
---------------
850        858
874        4970
1250       5346
1251       5347
```

1252	5348
1253	5349
1254	5350
1255	5351
1256	5352
1257	5353

Example

Change the default buffer pool for both table spaces and indexes within database ABCDE to BP2.

```
ALTER DATABASE ABCDE
  BUFFERPOOL BP2
  INDEXBP BP2;
```

ALTER FUNCTION (external)

The ALTER FUNCTION statement changes the description of a user-defined external scalar or external table function at the current server.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

The privilege set defined below must include at least one of the following:
- Ownership of the function
- The ALTERIN privilege on the schema
- SYSADM or SYSCTRL authority

The authorization ID that matches the schema name implicitly has the ALTERIN privilege on the schema.

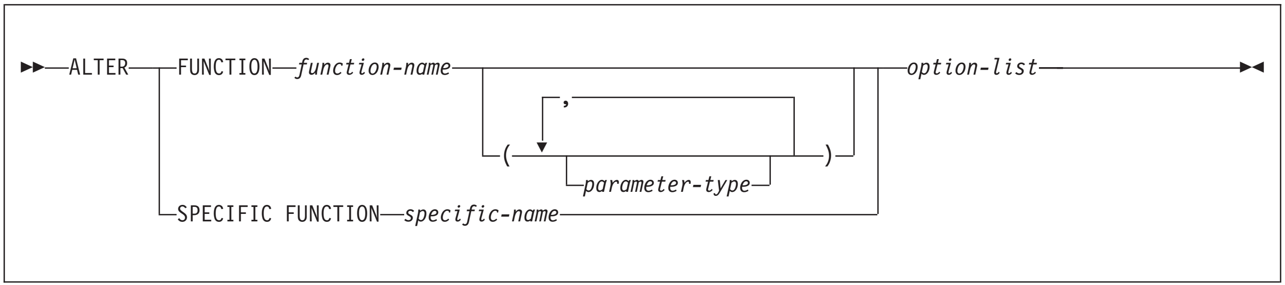
Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package.

If the statement is dynamically prepared, the privilege set is the privileges that are held by the authorization IDs of the process. The specified function name can include a schema name (a qualifier). However, if the schema name is not the same as one of these authorization IDs, one of the following conditions must be met:
- The privilege set includes SYSADM or SYSCTRL authority.
- An authorization ID of the process has the ALTERIN privilege on the schema.

If the environment in which the function is to be run is being changed, the authorization ID must have authority to use the WLM environment specified. The required authorization is obtained from an external security product, such as RACF.

For *external scalar functions,* when LANGUAGE is JAVA and a *jar-name* is specified in the EXTERNAL NAME clause, the privilege set must include USAGE on the JAR, the Java ARchive file.

Syntax



parameter-type:

```
►►──┬─data-type──┬─────────────────┬─┬──────────────────────────────────────────►◄
    │            │             (1) │ │
    │            └─AS LOCATOR──────┘ │
    └─TABLE LIKE──table-name──AS LOCATOR─┘
```

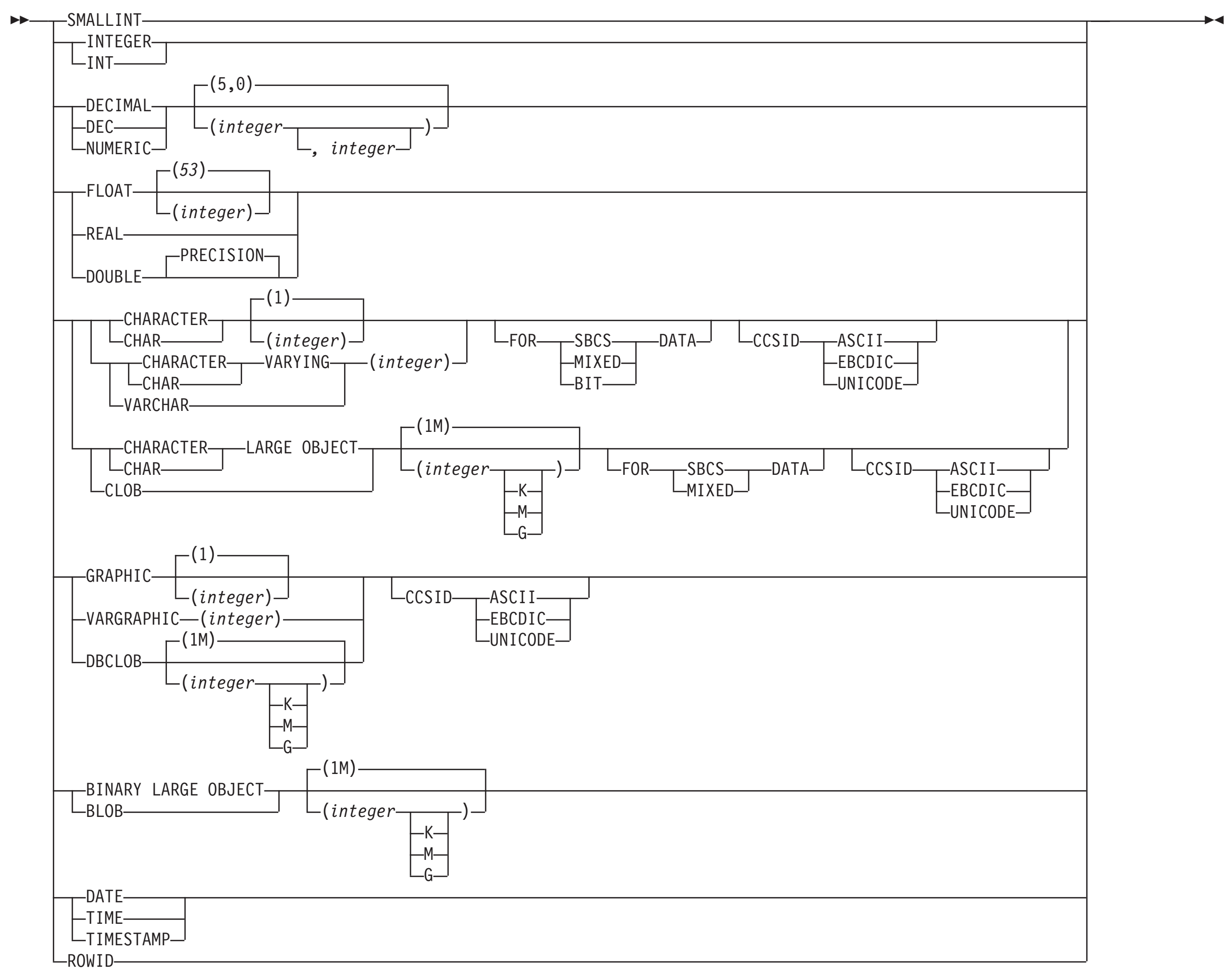
Notes:

1 AS LOCATOR can be specified only for a LOB data type or a distinct type based on a LOB data type.

data-type:

```
►►──┬─built-in-type──────┬──────────────────────────────────────────────────────►◄
    └─distinct-type-name─┘
```

built-in-type:



option-list: (Specify options in any order. Specify at least one option. Do not specify the same option more than once.)

```
                          (1)
►►──EXTERNAL NAME──┬─'string'────────┬──LANGUAGE──┬─ASSEMBLE─────────┬─────────────────────────────────►
                   └─identifier──────┘            ├─C────────────────┤
                                                  ├─COBOL────────────┤
                                                  │    (2) (3)       │
                                                  ├─JAVA─────────────┤
                                                  └─PLI──────────────┘

►─PARAMETER STYLE──┬─SQL────────────┬──┬─NOT DETERMINISTIC─┬──┬─RETURNS NULL ON NULL INPUT─┬─────────►
                   │      (2) (3)   │  └─DETERMINISTIC─────┘  └─CALLED ON NULL INPUT───────┘
                   └─JAVA───────────┘


                   (3)
►──┬─MODIFIES SQL DATA─┬──┬─NO EXTERNAL ACTION─┬──┬─NO SCRATCHPAD─────────┬──────────────────────────►
   ├─READS SQL DATA────┤  └─EXTERNAL ACTION────┘  └─SCRATCHPAD───length───┘
   ├─CONTAINS SQL──────┤
   └─NO SQL────────────┘

                              (3)                                        (4)
►──┬─NO FINAL CALL─┬──┬─ALLOW PARALLEL─────┬──┬─NO DBINFO─┬──CARDINALITY──integer──────────────────────►
   └─FINAL CALL────┘  └─DISALLOW PARALLEL──┘  └─DBINFO────┘

►──┬─NO COLLID───────────────┬──WLM ENVIRONMENT──┬─name──────────────┬──ASUTIME──┬─NO LIMIT──────┬──►
   └─COLLID──collection-id───┘                   └─(──name──,──*──)──┘           └─LIMIT──integer─┘


►─STAY RESIDENT──┬─NO──┬──PROGRAM TYPE──┬─SUB──┬──SECURITY──┬─DB2─────┬───────────────────────────►
                 └─YES─┘                └─MAIN─┘            ├─USER────┤
                                                            └─DEFINER─┘


►──┬─STOP AFTER SYSTEM DEFAULT FAILURES─┬──RUN OPTIONS──run-time-options──────────────────────────────►
   ├─STOP AFTER──integer──FAILURES──────┤
   └─CONTINUE AFTER FAILURE─────────────┘


►──┬─INHERIT SPECIAL REGISTERS─┬──STATIC DISPATCH──────────────────────────────────────────────────►◄
   └─DEFAULT SPECIAL REGISTERS─┘
```

Notes:

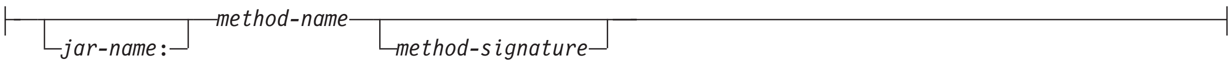
1 If LANGUAGE is JAVA, EXTERNAL NAME must be specified with a valid *external-java-routine-name*.

2 When LANGUAGE JAVA is specified, PARAMETER STYLE JAVA must also be specified. When PARAMETER STYLE JAVA is specified, LANGUAGE JAVA must also be specified.

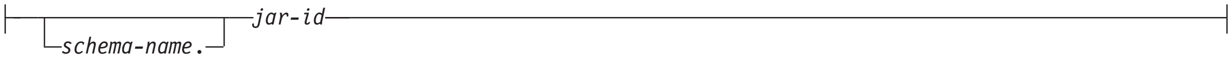
3 LANGUAGE JAVA, PARAMETER JAVA, MODIFIES SQL DATA, and ALLOW PARALLEL are not supported for *external table functions*.

4 CARDINALITY is not supported for *external scalar functions*.

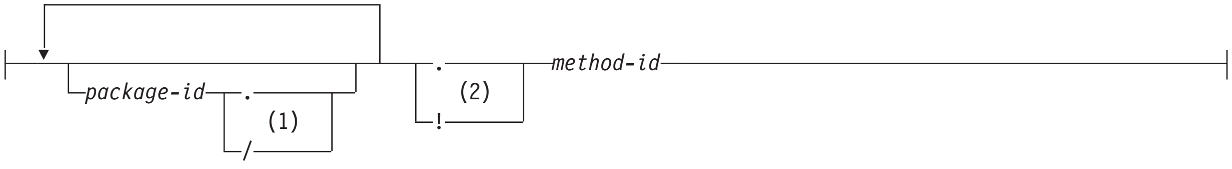
external-java-routine-name:



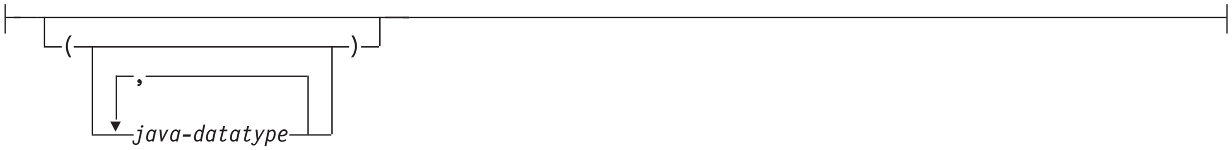
jar-name:



method-name:



method-signature:



Notes:

1 The slash (/) is supported for compatibility with previous releases of DB2 UDB for z/OS.

2 The exclamation point (!) is supported for compatibility with other products in the DB2 UDB family.

Description

One of the following three clauses identifies the function to be changed.

FUNCTION *function-name*

Identifies the external function by its function name. The name is implicitly or explicitly qualified with a schema name. If the name is not explicitly qualified, it is implicitly qualified with a schema name according to the following rules:

- If the statement is embedded in a program, the schema name is the authorization ID in the QUALIFIER bind option when the plan or package was created or last rebound. If QUALIFIER was not specified, the schema name is the owner of the plan or package.
- If the statement is prepared dynamically, the schema name is the SQL authorization ID in the CURRENT SQLID special register.

The identified function must be an external function. There must be exactly one function with *function-name* in the schema. The function can have any number of input parameters. If the schema does not contain a function with *function-name* or contains more than one function with this name, an error occurs.

FUNCTION *function-name (parameter-type,...)*

Identifies the external function by its function signature, which uniquely identifies the function.

function-name

Gives the function name of the external function. If the function name is not qualified, it is implicitly qualified with a schema name as described in the preceding description for FUNCTION *function-name*.

If *function-name()* is specified, the function that is identified must have zero parameters.

(parameter-type,...)

Identifies the number of input parameters of the function and their data types.

The data type of each parameter must match the data type that was specified in the CREATE FUNCTION statement for the parameter in the corresponding position. The number of data types and the logical concatenation of the data types are used to uniquely identify the function. Therefore, you cannot change the number of parameters or the data types of the parameters.

For data types that have a length, precision, or scale attribute, you can use a set of empty parentheses, specify a value, or accept the default values:

- Empty parentheses indicate that DB2 is to ignore the attribute when determining whether the data types match.

  FLOAT cannot be specified with empty parentheses because its parameter value indicates different data types (REAL or DOUBLE).
- If you use a specific value for a length, precision, or scale attribute, the value must exactly match the value that was specified (implicitly or explicitly) in the CREATE FUNCTION statement.

  The specific value for FLOAT(*n*) does not have to exactly match the defined value of the source function because 1<=*n*<= 21 indicates REAL and 22<=*n*<=53 indicates DOUBLE. Matching is based on whether the data type is REAL or DOUBLE.
- If length, precision, or scale is not explicitly specified and empty parentheses are not specified, the default length of the data type is implied. The implicit length must exactly match the value that was specified (implicitly or explicitly) in the CREATE FUNCTION statement.

For data types with a subtype or encoding scheme attribute, specifying the FOR *subtype* DATA clause or the CCSID clause is optional. Omission of either clause indicates that DB2 is to ignore the attribute when determining whether the data types match. If you specify either clause, it must match the value that was implicitly or explicitly specified in the CREATE FUNCTION statement.

See “CREATE FUNCTION” on page 604 for more information on the specification of the parameter list.

A function with the function signature must exist in the explicitly or implicitly specified schema; otherwise, an error occurs.

SPECIFIC FUNCTION *specific-name*

Identifies the external function by its specific name. The name is implicitly or explicitly qualified with a schema name. A function with the specific name must exist in the schema; otherwise, an error occurs.

If the specific name is not qualified, it is implicitly qualified with a schema name as described in the preceding description for FUNCTION *function-name*.

The following clauses change the description of the function that has been identified to be changed.

| **EXTERNAL NAME** *’string’* or *identifier*

Identifies the user-written code (program) that runs when the function is invoked.

If LANGUAGE is JAVA, *’string’* must be specified and enclosed in single quotation marks, with no extraneous blanks within the single quotation marks. It must specify a valid *external-java-routine-name*. If multiple *’string’*s are specified, the total length of all of them must not be greater than 1305 bytes and they must be separated by a space or a line break. Do not specify a JAR for a JAVA function for which NO SQL is in effect.

An *external-java-routine-name* contains the following parts:

jar-name

Identifies the name given to the JAR when it was installed in the database. The name contains *jar-id*, which can optionally be qualified with a schema. Examples are ″myJar″ and ″mySchema.myJar.″ The unqualified *jar-id* is implicitly qualified with a schema name according to the following rules:

- If the statement is embedded in a program, the schema name is the authorization ID in the QUALIFIER bind option when the package or plan was created or last rebound. If the QUALIFIER was not specified, the schema name is the owner of the package or plan.
- If the statement is dynamically prepared, the schema name is the SQL authorization ID in the CURRENT SQLID special register.

If *jar-name* is specified, it must exist when the ALTER FUNCTION statement is processed.

If *jar-name* is not specified, the function is loaded from the class file directly instead of being loaded from a JAR file. DB2 searches the directories in the CLASSPATH associated with the WLM Environment. Environmental variables for Java routines are specified in a data set identified in a JAVAENV DD card on the JCL used to start the address space for a WLM-managed function.

method-name

Identifies the name of the method and must not be longer than 254 bytes. Its package, class, and method ID’s are specific to Java and as such are not limited to 18 bytes. In addition, the rules for what these can contain are not necessarily the same as the rules for an SQL ordinary identifier.

package-id

Identifies the package list that the class identifier is part of. If the class is part of a package, the method name must include the complete package prefix, such as ″myPacks.UserFuncs.″ The Java virtual machine looks in the directory ″/myPacks/UserFuncs/″ for the classes.

class-id

Identifies the class identifier of the Java object.

method-id

Identifies the method identifier with the Java class to be invoked.

method-signature
Identifies a list of zero or more Java data types for the parameter list and must not be longer than 1024 bytes. Specify the *method-signature* if the user-defined function involves any input or output parameters that can be NULL. When the function being created is called, DB2 searches for a Java method with the exact *method-signature*. The number of *java-datatype* elements specified indicates how many parameters that the Java method must have.

A Java procedure can have no parameters. In this case, you code an empty set of parentheses for *method-signature*. If a Java *method-signature* is not specified, DB2 searches for a Java method with a signature derived from the default JDBC types associated with the SQL types specified in the parameter list of the ALTER FUNCTION statement.

For other values of LANGUAGE, the value must conform to the naming conventions for MVS load modules: the value must be less than or equal to 8 bytes, and it must conform to the rules for an ordinary identifier with the exception that it must not contain an underscore.

LANGUAGE
Specifies the application programming language in which the function is written. All programs must be designed to run in IBM's Language Environment® environment.

ASSEMBLE
The function is written in Assembler.

C The function is written in C or C++.

COBOL
The function is written in COBOL, including the object-oriented language extensions.

JAVA
The user-defined function is written in Java byte code and is executed in the Java Virtual Machine. If the ALTER FUNCTION statement results in changing LANGUAGE to JAVA, PARAMETER STYLE JAVA and an EXTERNAL NAME clause must be specified to provide the appropriate values. When LANGUAGE JAVA is specified, the EXTERNAL NAME clause must also be specified with a valid *external-java-routine-name* and PARAMETER STYLE must be specified with JAVA.

Do not specify LANGUAGE JAVA when SCRATCHPAD, FINAL CALL, DBINFO, PROGRAM TYPE MAIN, or RUN OPTIONS is specified. Do not specify LANGUAGE JAVA for a table function.

PLI
The function is written in PL/I.

PARAMETER STYLE
Specifies the linkage convention that the function program uses to receive input parameters from and pass return values to the invoking SQL statement.

SQL
Specifies the parameter passing convention that supports passing null values both as input and for output. The parameters that are passed between the invoking SQL statement and the function include:

- Input parameters. The first *n* parameters are the input parameters that are specified for the function.

- Result parameters. For an external scalar function, a parameter for the result of the function. For an external table function, the next *m* parameters that are specified on the RETURNS TABLE clause of the CREATE statement that defined the function.
- Input parameter indicator variables. *n* parameters for the indicator variables for the input parameters.
- Result parameter indicator variables. For an external scalar function, a parameter for the indicator variable for the result of the function that is specified on the RETURNS clause of the CREATE statement that defined the function. For an external table function, m parameters for the indicator variables of the result columns of the function that are specified on the RETURNS TABLE clause of the CREATE statement that defined the function.
- The SQLSTATE to be returned to DB2.
- The qualified name of the function.
- The specific name of the function.
- The SQL diagnostic string to be returned to DB2.
- The scratchpad, if SCRATCHPAD is specified.
- The call type. For an external scalar function, the call type is passed only if FINAL CALL is specified. The call type is always passed for an external table function.
- The DBINFO structure, if DBINFO is specified.

JAVA

Indicates that the user-defined function uses a convention for passing parameters that conforms to the Java and SQLJ specifications. If the ALTER FUNCTION statement results in changing LANGUAGE to JAVA, PARAMETER STYLE JAVA and an EXTERNAL NAME clause must be specified to provide the appropriate values.PARAMETER STYLE JAVA can be specified only if LANGUAGE is JAVA. JAVA must be specified for PARAMETER STYLE when LANGUAGE is JAVA.

Do not specify PARAMETER STYLE JAVA for a table function.

NOT DETERMINISTIC or **DETERMINISTIC**

Specifies whether the function returns the same results each time that the function is invoked with the same input arguments.

NOT DETERMINISTIC

The function might not return the same result each time that the function is invoked with the same input arguments. The function depends on some state values that affect the results. DB2 uses this information to disable the merging of views and table expressions when processing SELECT, UPDATE, DELETE, or INSERT statements that refer to this function. An example of a function that is nondeterministic is one that generates random numbers, or any function that contains SQL statements.

Some SQL functions that invoke functions that are not deterministic can receive incorrect results if the function is executed by parallel tasks. Specify the DISALLOW PARALLEL clause for these functions.

| If a view or a materialized query table definition refers to the function, the function cannot be changed to NOT DETERMINISTIC. To change the function, drop any views or materialized query tables that refer to the function first.

DETERMINISTIC

The function always returns the same result each time that the function is invoked with the same input arguments. An example of a deterministic function is a function that calculates the square root of the input. DB2 uses this information to enable the merging of views and table expressions for SELECT, UPDATE, DELETE, or INSERT statements that refer to this function. If applicable, specify DETERMINISTIC to prevent non-optimal access paths from being chosen for SQL statements that refer to this function.

DB2 does not verify that the function program is consistent with the specification of DETERMINISTIC or NOT DETERMINISTIC.

RETURNS NULL ON NULL INPUT or **CALLED ON NULL INPUT**

Specifies whether the function is called if any of the input arguments is null at execution time.

RETURNS NULL ON NULL INPUT

The function is not called if any of the input arguments is null. For an external scalar function, the result is the null value. For an external table function, the result is an empty table, which is a table with no rows.

CALLED ON NULL INPUT

The function is called regardless of whether any of the input arguments are null, making the function responsible for testing for null argument values. For an external scalar function, the function can return a null or nonnull value. For an external table function, the function can return an empty table, depending on its logic.

MODIFIES SQL DATA, **READS SQL DATA**, **CONTAINS SQL**, or **NO SQL**

Specifies which SQL statements, if any, can be executed in the function or any routine that is called from this function. The default is READS SQL DATA. For the data access classification of each statement, see Table 95 on page 1158.

MODIFIES SQL DATA

Specifies that the function can execute any SQL statement except the statements that are not supported in functions. Do not specify MODIFIES SQL DATA when ALLOW PARALLEL is in effect.

READS SQL DATA

Specifies that the function can execute SQL statements with a data access classification of READS SQL DATA, CONTAINS SQL, or NO SQL. SQL statements that do not modify SQL data can be included in the function. Statements that are not supported in any function return a different error.

CONTAINS SQL

Specifies that the function can execute only SQL statements with a data classification of CONTAINS SQL or NO SQL. SQL statements that neither read nor modify SQL data can be executed by the function. Statements that are not supported in any function return a different error.

NO SQL

Specifies that the function can execute only SQL statements with a data access classification of NO SQL. Do not specify NO SQL for a JAVA function that uses a JAR.

NO EXTERNAL ACTION or **EXTERNAL ACTION**

Specifies whether the function takes an action that changes the state of an object that DB2 does not manage. An example of an external action is sending a message or writing a record to a file.

Because DB2 uses the RRS attachment for external functions, DB2 can participate in two-phase commit with any other resource manager that uses

RRS. For resource managers that do not use RRS, there is no coordination of commit or rollback operations on non-DB2 resources.

NO EXTERNAL ACTION

The function does not take any action that changes the state of an object that DB2 does not manage. DB2 uses this information to enable the merging of views and table expressions for SELECT, UPDATE, DELETE, or INSERT statements that refer to this function. If applicable, specify NO EXTERNAL ACTION to prevent non-optimal access paths from being chosen for SQL statements that refer to this function.

EXTERNAL ACTION

The function can take an action that changes the state of an object that DB2 does not manage.

Some SQL statements that invoke functions with external actions can result in incorrect results if parallel tasks execute the function. For example, if the function sends a note for each initial call to it, one note is sent for each parallel task instead of once for the function. Specify the DISALLOW PARALLEL clause for functions that do not work correctly with parallelism.

If you specify EXTERNAL ACTION, DB2:

- Materializes the views and table expressions in SELECT, UPDATE, DELETE or INSERT statements that refer to the function. This materialization can adversely affect the access paths that are chosen for the SQL statements that refer to this function. Do not specify EXTERNAL ACTION if the function does not have an external action.
- Does not move the function from one task control block (TCB) to another between FETCH operations.
- Does not allow another function or stored procedure to use the TCB until the cursor is closed. This is also applicable for cursors declared WITH HOLD.

The only changes to resources made outside of DB2 that are under the control of commit and rollback operations are those changes made under RRS control.

| If a view or a materialized query table definition refers to the function, the function cannot be changed to EXTERNAL ACTION. To change the function, drop any views or materialized query tables that refer to the function first.

DB2 does not verify that the function program is consistent with the specification of EXTERNAL ACTION or NO EXTERNAL ACTION.

NO SCRATCHPAD or **SCRATCHPAD**

Specifies whether DB2 is to provide a scratchpad for the function. It is strongly recommended that external functions be reentrant, and a scratchpad provides an area for the function to save information from one invocation to the next.

NO SCRATCHPAD

A scratchpad is not allocated and passed to the function.

SCRATCHPAD *length*

When the function is invoked for the first time, DB2 allocates memory for a scratchpad. A scratchpad has the following characteristics:

- *length* must be between 1 and 32767. The default value is 100 bytes.
- DB2 initializes the scratchpad to all binary zeros (X'00's).

- The scope of a scratchpad is the SQL statement. For each reference to the function in an SQL statement, there is one scratchpad.

  For example, assuming that user-defined function UDFX is a scalar function that is defined with the SCRATCHPAD option, three scratchpads are allocated for the three references to UDFX in the following SQL statement:

  ```
  SELECT A, UDFX(A) FROM TABLEB
    WHERE UDFX(A) > 103 OR UDFX(A) < 19;
  ```

  For another example, assume that UDFX is a user-defined table function that is defined with the SCRATCHPAD option. Two scratchpads are allocated for the two references to function UDFX in the following SQL statement:

  ```
  SELECT *
    FROM TABLE (UDFX(A)), TABLE (UDFX(B));
  ```

  If the function is run under parallel tasks, one scratchpad is allocated for each parallel task of each reference to the function in the SQL statement. This can lead to unpredictable results. For example, if a function uses the scratchpad to count the number of times that it is invoked, the count reflects the number of invocations done by the parallel task and not the SQL statement. Specify the DISALLOW PARALLEL clause for functions that do not work correctly with parallelism.
- The scratchpad is persistent. DB2 preserves its content from one invocation of the function to the next. Any changes that the function makes to the scratchpad on one call are still there on the next call. DB2 initializes the scratchpads when it begins to execute an SQL statement. DB2 does not reset scratchpads when a correlated subquery begins to execute.
- The scratchpad can be a central point for the system resources that the function acquires. If the function acquires system resources, specify FINAL CALL to ensure that DB2 calls the function one more time so that the function can free those system resources.

Each time that the function is invoked, DB2 passes an additional argument to the function that contains the address of the scratchpad.

If you specify SCRATCHPAD, DB2:

- Does not move the function from one TCB or address space to another between FETCH operations.
- Does not allow another function or stored procedure to use the TCB until the cursor is closed. This is also applicable for cursors declared WITH HOLD.

Do not specify SCRATCHPAD when LANGUAGE JAVA is specified.

NO FINAL CALL or **FINAL CALL**

Specifies whether a *final call* is made to the function. A final call enables the function to free any system resources that it has acquired. A final call is useful when the function has been defined with the SCRATCHPAD keyword and the function acquires system resource and anchors them in the scratchpad.

The effect of NO FINAL CALL or FINAL call depends on whether the external function is a scalar function or a table function.

For an external scalar function:

NO FINAL CALL
A final call is not made to the external scalar function. The function does not receive an additional argument that specifies the type of call.

FINAL CALL
A final call is made to the external scalar function. See the following description of call types for the characteristics of a final call. When FINAL CALL is specified, the function receives an additional argument that specifies the type of call to enable the function to differentiate between a final call and another type of call. Do not specify FINAL CALL when LANGUAGE JAVA is specified.

For more information on NO FINAL CALL and FINAL CALL for external scalar functions, including the types of calls, see the description of the option for "CREATE FUNCTION (external scalar)" on page 605.

For an external table function:

NO FINAL CALL
A first and final call are not made to the external table function.

FINAL CALL
A first call and final call are made to the external table function in addition to one or more other types of calls.

For both NO FINAL CALL and FINAL CALL, the function receives an additional argument that specifies the type of call. For more information on NO FINAL CALL and FINAL CALL for external table functions, including the types of calls, see the description of the option for "CREATE FUNCTION (external table)" on page 628.

ALLOW or **DISALLOW PARALLEL**
Specifies whether, for a single reference to the function, the function can be executed in parallel. If the function is defined with MODIFIES SQL DATA, specify DISALLOW PARALLEL, not ALLOW PARALLEL.

ALLOW PARALLEL
Specifies that DB2 can consider parallelism for the function. Parallelism is not forced on the SQL statement that invokes the function or on any SQL statement in the function. Existing restrictions on parallelism apply.

See SCRATCHPAD, EXTERNAL ACTION, and FINAL CALL for considerations when specifying ALLOW PARALLEL.

DISALLOW PARALLEL
Specifies that DB2 does not consider parallelism for the function.

NO DBINFO or **DBINFO**
Specifies whether additional status information is passed to the function when it is invoked.

NO DBINFO
Additional information is not passed.

DBINFO
An additional argument is passed when the function is invoked. The argument is a structure that contains information such as the application run-time authorization ID, the schema name, the name of a table or column that the function might be inserting into or updating, and identification of the database server that invoked the function. For details about the argument and its structure, see *DB2 Application Programming and SQL Guide*.

Do not specify DBINFO when LANGUAGE JAVA is specified.

CARDINALITY *integer*

Specifies an estimate of the expected number of rows that the function returns. The number is used for optimization purposes. The value of *integer* must range from 0 to 2147483647.

If a function has an infinite cardinality—the function never returns the "end-of-table" condition and always returns a row, then a query that requires the "end-of-table" to work correctly, will need to be interrupted. Thus, avoid using such functions in queries that involve GROUP BY and ORDER BY.

Do not specify CARDINALITY for external scalar functions.

NO COLLID or **COLLID** *collection-id*

Identifies the package collection that is to be used when the function is executed. This is the package collection into which the DBRM that is associated with the function program is bound.

NO COLLID

The package collection for the function is the same as the package collection of the program that invokes the function. If a trigger invokes the function, the collection of the trigger package is used. If the invoking program does not use a package, DB2 resolves the package by using the CURRENT PACKAGE PATH special register, the CURRENT PACKAGESET special register, or the PKLIST bind option (in this order). For details about how DB2 uses these three items, see the information on package resolution in Part 5 of *DB2 Application Programming and SQL Guide*.

COLLID *collection-id*

The name of the package collection that is to be used when the function is executed.

WLM ENVIRONMENT

An SQL identifier that identifies the *name* of the WLM (workload manager) application environment in which the function is to run.

name

The WLM environment in which the function must run. If the user-defined function is nested and if the calling stored procedure or invoking user-defined function is not running in an address space associated with the specified WLM environment, DB2 routes the function request to a different address space.

(name,*)

When an SQL application program calls the function, *name*s specifies the WLM environment in which the function runs.

If another user-defined function or a stored procedure calls the function, the function runs in the same environment that the calling routine uses. In this case, authorization to run the function in the WLM environment is not checked because the authorization of the calling routine suffices.

The *name* of the WLM environment is an SQL identifier.

To change the environment in which the function is to run, you must have appropriate authority for the WLM environment. For an example of a RACF command that provides this authorization, see "Running stored procedures" on page 707.

ASUTIME

Specifies the total amount of processor time, in CPU service units, that a single invocation of the function can run. The value is unrelated to the ASUTIME column of the resource limit specification table.

When you are debugging a function, setting a limit can be helpful if the function gets caught in a loop. For information on service units, see *z/OS MVS Initialization and Tuning Guide*.

NO LIMIT

There is no limit on the service units.

LIMIT *integer*

The limit on the service units is a positive integer in the range of 1 to 2G. If the function uses more service units than the specified value, DB2 cancels the function.

STAY RESIDENT

Specifies whether the load module for the function is to remain resident in memory when the function ends.

NO

The load module is deleted from memory after the function ends. Use NO for non-reentrant functions.

YES

The load module remains resident in memory after the function ends. Use YES for reentrant functions.

PROGRAM TYPE

Specifies whether the function program runs as a main routine or a subroutine.

SUB

The function runs as a subroutine.

MAIN

The function runs as a main routine.

Do not specify PROGRAM TYPE MAIN when LANGUAGE JAVA is in effect.

SECURITY

Specifies how the function interacts with an external security product, such as RACF, to control access to non-SQL resources.

DB2

The function does not require an external security environment. If the function accesses resources that an external security product protects, the access is performed using the authorization ID associated with the WLM-established stored procedure address space.

USER

An external security environment should be established for the function. If the function accesses resources that the external security product protects, the access is performed using the primary authorization ID of the process that invoked the function.

DEFINER

An external security environment should be established for the function. If the function accesses resources that the external security product protects, the access is performed using the authorization ID of the owner of the function.

STOP AFTER SYSTEM DEFAULT FAILURES, STOP AFTER *nn* **FAILURES,** or **CONTINUE AFTER FAILURE**

Specifies whether the routine is to be put in a stopped state after some number of failures. The following options must not be specified for SQL functions or sourced functions.

STOP AFTER SYSTEM DEFAULT FAILURES

Specifies that this routine should be placed in a stopped state after the number of failures indicated by the value of field MAX ABEND COUNT on installation panel DSNTIPX.

STOP AFTER *nn* **FAILURES**

Specifies that this routine should be placed in a stopped state after *nn* failures. The value *nn* can be an integer from 1 to 32767.

CONTINUE AFTER FAILURE

Specifies that this routine should not be placed in a stopped state after any failure.

RUN OPTIONS *run-time-options*

Specifies the Language Environment run-time options to be used for the function. You must specify *run-time-options* as a character string that is no longer than 254 bytes. To replace any existing run-time options with no options, specify an empty string with RUN OPTIONS. When you specify an empty string, DB2 does not pass any run-time options to Language Environment, and Language Environment uses its installation defaults.

For a description of the Language Environment run-time options, see *z/OS Language Environment Programming Reference*.

Do not specify RUN OPTIONS when LANGUAGE JAVA is specified.

INHERIT SPECIAL REGISTERS or **DEFAULT SPECIAL REGISTERS**

Specifies how special registers are set on entry to the routine.

INHERIT SPECIAL REGISTERS

Specifies that special registers should be inherited according to the rules listed in the table for characteristics of special registers in a user-defined function in Table 27 on page 111.

DEFAULT SPECIAL REGISTERS

Specifies that special registers should be initialized to the default values, as indicated by the rules in the table for characteristics of special registers in a user-defined function in Table 27 on page 111.

STATIC DISPATCH

At function resolution time, DB2 chooses a function based on the static (or declared) types of the function parameters.

Notes

Changes are immediate: Any changes that the ALTER FUNCTION statement causes to the definition of an external function take effect immediately. The changed definition is used the next time that the function is invoked.

Invalidation of plans and packages: When an external function is altered, all the plans and packages that refer to that function are marked invalid.

Alternative syntax and synonyms: To provide compatibility with previous releases of DB2 or other products in the DB2 UDB family, DB2 supports the following keywords:

- VARIANT as a synonym for NOT DETERMINISTIC
- NOT VARIANT as a synonym for DETERMINISTIC
- NOT NULL CALL as a synonym for RETURNS NULL ON NULL INPUT
- NULL CALL as a synonym for CALLED ON NULL INPUT
- PARAMETER STYLE DB2SQL as a synonym for PARAMETER STYLE SQL

Examples

Example 1: Assume that there are two functions CENTER in the PELLOW schema. The first function has two input parameters with INTEGER and FLOAT data types, respectively. The specific name for the first function is FOCUS1. The second function has three parameters with CHAR(25), DEC(5,2), and INTEGER data types.

Using the specific name to identify the function, change the WLM environment in which the first function runs from WLMENVNAME1 to WLMENVNAME2.

```
ALTER SPECIFIC FUNCTION ENGLES.FOCUS1 WLM ENVIRONMENT WLMENVNAME2;
```

Example 2: Change the second function that is described in *Example 1* so that it is not invoked when any of the arguments are null. Use the function signature to identify the function,

```
ALTER FUNCTION ENGLES.CENTER (CHAR(25), DEC(5,2), INTEGER)
   RETURNS NULL ON NULL INPUT;
```

You can also code the ALTER FUNCTION statement without the exact values for the CHAR and DEC data types:

```
ALTER FUNCTION ENGLES.CENTER (CHAR(), DEC(), INTEGER)
   RETURNS NULL ON NULL INPUT;
```

If you use empty parentheses, DB2 is to ignore the length, precision, and scale attributes when looking for matching data types to find the function.

ALTER FUNCTION (SQL scalar)

The ALTER FUNCTION (SQL) statement changes the description of a user-defined SQL scalar function at the current server.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

The privilege set defined below must include at least one of the following:
- Ownership of the function
- The ALTERIN privilege on the schema
- SYSADM or SYSCTRL authority

The authorization ID that matches the schema name implicitly has the ALTERIN privilege on the schema.

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package.

If the statement is dynamically prepared, the privilege set is the privileges that are held by the authorization IDs of the process. The specified function name can include a schema name (a qualifier). However, if the schema name is not the same as one of these authorization IDs, one of the following conditions must be met:
- The privilege set includes SYSADM or SYSCTRL authority.
- An authorization ID of the process has the ALTERIN privilege on the schema.

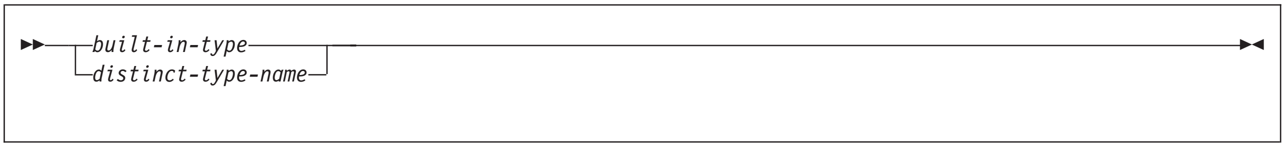
Syntax

```
►►──ALTER──┬──FUNCTION──function-name──┬─────────────────────────────┬─┬──option-list──────────►◄
           │                           │       ┌─,──────────────┐    │ │
           │                           │       ▼                │    │ │
           │                           └─(──┬──────────────────┴─)─┘ │
           │                                └─parameter-type─┘        │
           └─SPECIFIC FUNCTION──specific-name─────────────────────────┘
```

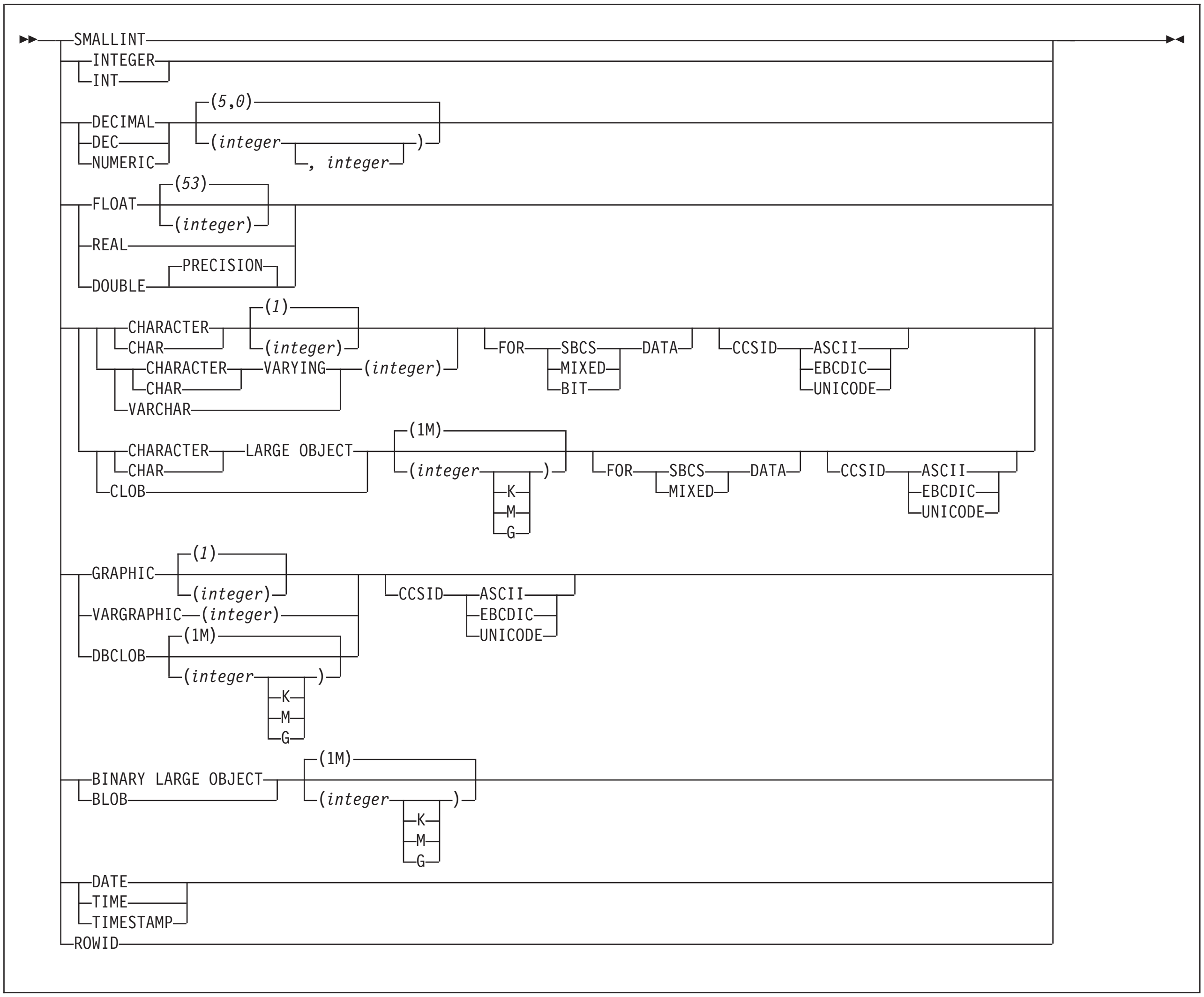
parameter-type:

```
►►──┬──data-type──┬──────────────┬──┬──────────────────────────────────────────►◄
    │             └─AS LOCATOR─┘    │
    └─TABLE LIKE──table-name──AS LOCATOR─┘
```

data-type:



built-in-type:



option-list: (Specify options in any order. Specify at least one option. Do not specify the same option more than once.)

```
►►──LANGUAGE SQL──┬─NOT DETERMINISTIC─┬──┬─EXTERNAL ACTION────┬──┬─CONTAINS SQL───┬──────────►
                  └─DETERMINISTIC─────┘  └─NO EXTERNAL ACTION─┘  └─READS SQL DATA─┘

►─STATIC DISPATCH──CALLED ON NULL INPUT──────────────────────────────────────────────────►◄
```

Description

One of the following three clauses identifies the function to be changed.

FUNCTION *function-name*

Identifies the SQL function by its function name. The name is implicitly or explicitly qualified with a schema name. If the name is not explicitly qualified, it is implicitly qualified with a schema name according to the following rules:

- If the statement is embedded in a program, the schema name is the authorization ID in the QUALIFIER bind option when the plan or package was created or last rebound. If QUALIFIER was not specified, the schema name is the owner of the plan or package.
- If the statement is prepared dynamically, the schema name is the SQL authorization ID in the CURRENT SQLID special register.

The identified function must be an SQL function. There must be exactly one function with *function-name* in the schema. The function can have any number of input parameters. If the schema does not contain a function with *function-name* or contains more than one function with this name, an error occurs.

FUNCTION *function-name (parameter-type,...)*

Identifies the SQL function by its function signature, which uniquely identifies the function.

function-name

Gives the function name of the SQL function. If the function name is not qualified, it is implicitly qualified with a schema name as described in the preceding description for FUNCTION *function-name*.

If *function-name()* is specified, the function that is identified must have zero parameters.

(parameter-type,...)

Identifies the number of input parameters of the function and the data type of each parameter. The data type of each parameter must match the data type that was specified in the CREATE FUNCTION statement for the parameter in the corresponding position. The number of data types and the logical concatenation of the data types are used to uniquely identify the function. Therefore, you cannot change the number of parameters or the data types of the parameters.

For data types that have a length, precision, or scale attribute, you can use a set of empty parentheses, specify a value, or accept the default values:

- Empty parentheses indicate that DB2 is to ignore the attribute when determining whether the data types match.

FLOAT cannot be specified with empty parentheses because its parameter value indicates different data types (REAL or DOUBLE).

- If you use a specific value for a length, precision, or scale attribute, the value must exactly match the value that was specified (implicitly or explicitly) in the CREATE FUNCTION statement.

  The specific value for FLOAT(*n*) does not have to exactly match the defined value of the source function because 1<=*n*<= 21 indicates REAL and 22<=*n*<=53 indicates DOUBLE. Matching is based on whether the data type is REAL or DOUBLE.
- If length, precision, or scale is not explicitly specified and empty parentheses are not specified, the default length of the data type is implied. The implicit length must exactly match the value that was specified (implicitly or explicitly) in the CREATE FUNCTION statement.

For data types with a subtype or encoding scheme attribute, specifying the FOR *subtype* DATA clause or the CCSID clause is optional. Omission of either clause indicates that DB2 is to ignore the attribute when determining whether the data types match. If you specify either clause, it must match the value that was implicitly or explicitly specified in the CREATE FUNCTION statement.

See “CREATE FUNCTION” on page 604 for more information on the specification of the parameter list.

A function with the function signature must exist in the explicitly or implicitly specified schema; otherwise, an error occurs.

SPECIFIC FUNCTION *function-name*

Identifies the SQL function by its specific name. The name is implicitly or explicitly qualified with a schema name. A function with the specific name must exist in the schema; otherwise, an error occurs.

If the specific name is not qualified, it is implicitly qualified with a schema name as described in the preceding description for FUNCTION *function-name*.

The following clauses change the description of the function that has been identified to be changed.

LANGUAGE SQL

Specifies the application programming language in which the stored function is written. The value of the function is written as DB2 SQL in the *expression* of the RETURN clause in the CREATE FUNCTION statement.

NOT DETERMINISTIC or **DETERMINISTIC**

Specifies whether the function returns the same results each time that the function is invoked with the same input arguments.

NOT DETERMINISTIC

The function might not return the same result each time that the function is invoked with the same input arguments. The function depends on some state values that affect the results. DB2 uses this information to disable the merging of views and table expressions when processing SELECT, UPDATE, DELETE, or INSERT statements that refer to this function. An example of a function that is not deterministic is one that generates random numbers.

NOT DETERMINISTIC must be specified explicitly or implicitly if the function program accesses a special register or invokes another nondeterministic function.

DETERMINISTIC
The function always returns the same result each time that the function is invoked with the same input arguments. An example of a deterministic function is a function that calculates the square root of the input. DB2 uses this information to enable the merging of views and table expressions for SELECT, UPDATE, DELETE, or INSERT statements that refer to this function. If applicable, specify DETERMINISTIC to prevent non-optimal access paths from being chosen for SQL statements that refer to this function.

DB2 does not verify that the function program is consistent with the specification of DETERMINISTIC or NOT DETERMINISTIC.

EXTERNAL ACTION or **NO EXTERNAL ACTION**
Specifies whether the function takes an action that changes the state of an object that DB2 does not manage. An example of an external action is sending a message or writing a record to a file.

EXTERNAL ACTION
The function can take an action that changes the state of an object that DB2 does not manage.

Some SQL statements that invoke functions with external actions can result in incorrect results if parallel tasks execute the function. For example, if the function sends a note for each initial call to it, one note is sent for each parallel task instead of once for the function. Specify the DISALLOW PARALLEL clause for functions that do not work correctly with parallelism.

If you specify EXTERNAL ACTION, then DB2:

- Materializes the views and table expressions in SELECT, UPDATE, DELETE or INSERT statements that refer to the function. This materialization can adversely affect the access paths that are chosen for the SQL statements that refer to this function. Do not specify EXTERNAL ACTION if the function does not have an external action.
- Does not move the function from one task control block (TCB) to another between FETCH operations.
- Does not allow another function or stored procedure to use the TCB until the cursor is closed. This is also applicable for cursors declared WITH HOLD.

The only changes to resources made outside of DB2 that are under the control of commit and rollback operations are those changes made under RRS control.

EXTERNAL ACTION must be specified implicitly or explicitly specified if the SQL routine body invokes a function that is defined with EXTERNAL ACTION.

NO EXTERNAL ACTION
The function does not take any action that changes the state of an object that DB2 does not manage. DB2 uses this information to enable the merging of views and table expressions for SELECT, UPDATE, DELETE, or INSERT statements that refer to this function. If applicable, specify NO

EXTERNAL ACTION to prevent non-optimal access paths from being chosen for SQL statements that refer to this function.

DB2 does not verify that the function program is consistent with the specification of EXTERNAL ACTION or NO EXTERNAL ACTION.

READS SQL DATA or **CONTAINS SQL**

Specifies which SQL statements, if any, can be executed in the function or any routine that is called from this function. The default is READS SQL DATA. For the data access classification of each statement, see Table 95 on page 1158.

READS SQL DATA

Specifies that the function can execute SQL statements with a data access classification of READS SQL DATA or CONTAINS SQL. SQL statements that do not modify SQL data can be included in the function. Statements that are not supported in any function return a different error.

CONTAINS SQL

Specifies that the function can execute only SQL statements with a data classification of CONTAINS SQL. SQL statements that neither read nor modify SQL data can be executed by the function. Statements that are not supported in any function return a different error.

STATIC DISPATCH

At function resolution time, DB2 chooses a function based on the static (or declared) types of the function parameters.

CALLED ON NULL INPUT

The function is called regardless of whether any of the input arguments are null, making the function responsible for testing for null arguments. The function can return null.

Notes

Changes are immediate: Any changes that the ALTER FUNCTION statement causes to the definition of an SQL function take effect immediately. The changed definition is used the next time that the function is invoked.

Invalidation of plans and packages: When an SQL function is altered, all the plans and packages that refer to that function are marked invalid.

Alternative syntax and synonyms: To provide compatibility with previous releases of DB2 or other products in the DB2 UDB family, DB2 supports the following keywords:

- VARIANT as a synonym for NOT DETERMINISTIC
- NOT VARIANT as a synonym for DETERMINISTIC
- NULL CALL as a synonym for CALLED ON NULL INPUT

Examples

Example 1: Modify the definition for an SQL function to indicate that the function is deterministic.

```
ALTER FUNCTION MY_UDF1 DETERMINISTIC;
```

ALTER INDEX

The ALTER INDEX statement changes the description of an index at the current server.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

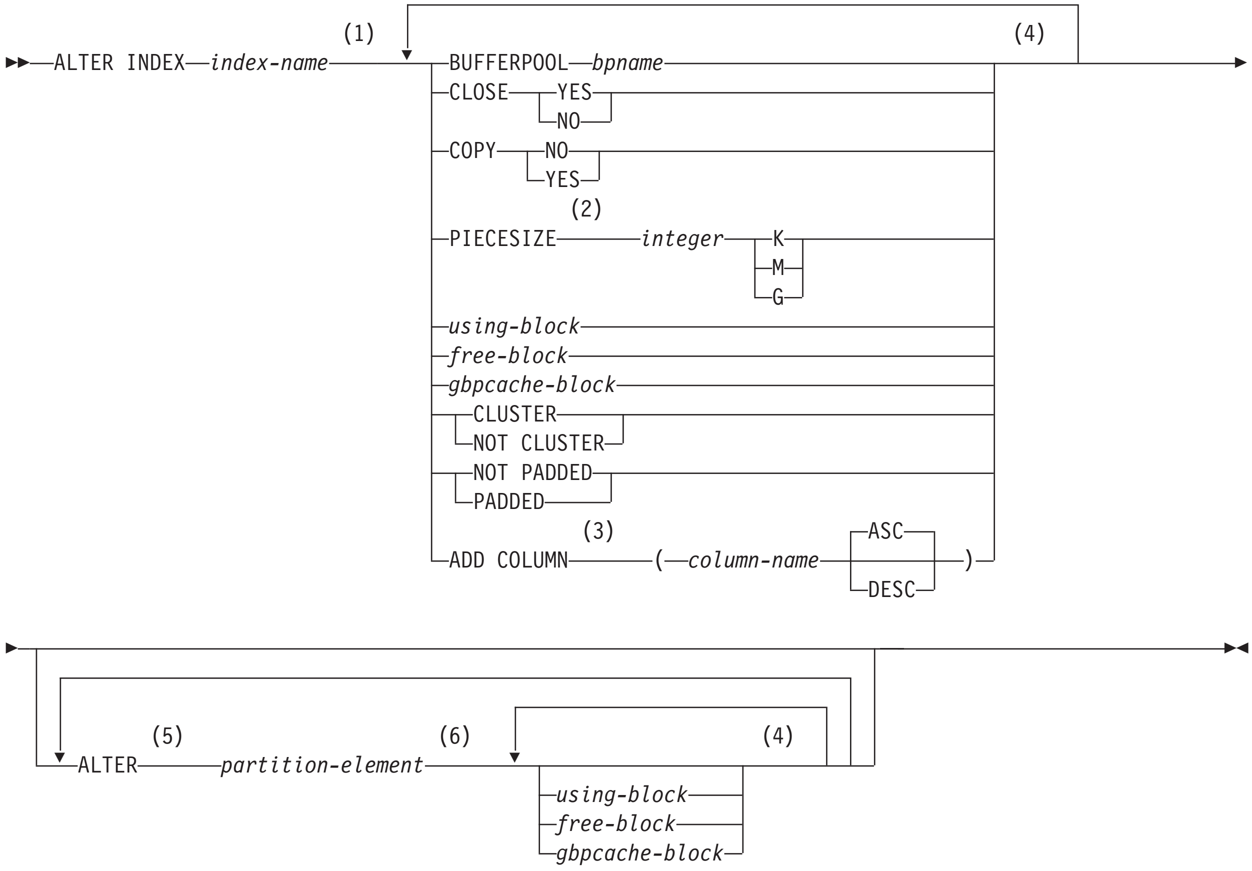
The privilege set that is defined below must include one of the following:

- Ownership of the index
- Ownership of the table on which the index is defined
- DBADM authority for the database that contains the table
- SYSADM or SYSCTRL authority

If BUFFERPOOL or USING STOGROUP is specified, additional privileges could be needed, as explained in the description of those clauses.

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package. If the statement is dynamically prepared, the privilege set is the union of the privilege sets that are held by each authorization ID of the process.

Syntax



Notes:

1 At least one clause must be specified after *index-name*. It can be from the optional list or it can be PART.

2 The PIECESIZE clause can only be specified for secondary indexes.

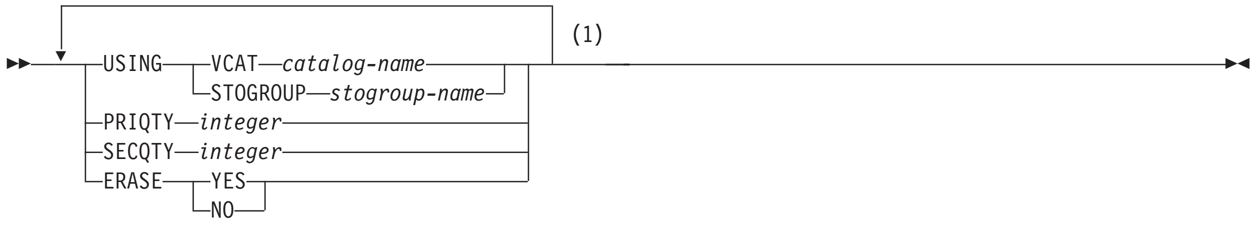
3 If ADD COLUMN and PADDED or NOT PADDED are specified, ADD COLUMN must be specified before PADDED or NOT PADDED.

4 The same clause must not be specified more than once.

5 The ALTER clause can only be specified for partitioned indexes. The ALTER clause must be specified last.

6 If *partition-element* is specified, either the ENDING clause of *partition-element*, or *using-block*, *free-block*, or *gbpcache-block* should also be specified.

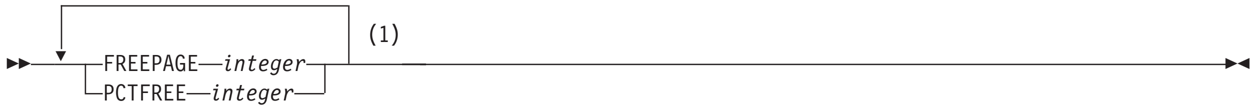
using-block:



Notes:

1 The same clause must not be specified more than once.

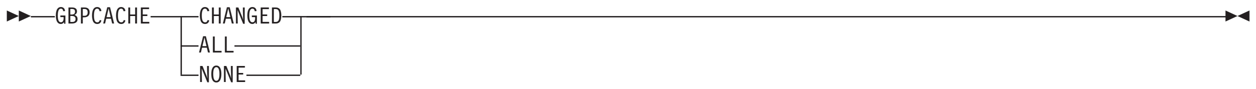
free-block:



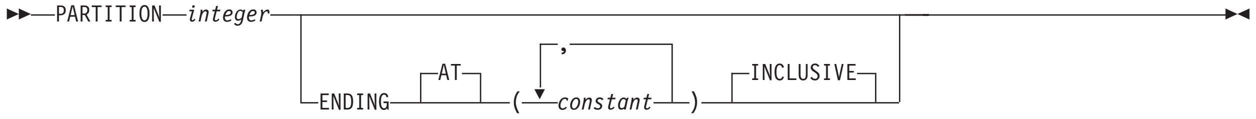
Notes:

1 The same clause must not be specified more than once.

gbpcache-block:



partition-element:



Description

index-name
Identifies the index to be altered. The name must identify a user-created index that exists at the current server. The name must not identify an index that is defined on a declared temporary table.

BUFFERPOOL *bpname*
Identifies the buffer pool to be used for the index. The *bpname* must identify an activated 4KB buffer pool, and the privilege set must include SYSADM authority,

SYSCTRL authority, or the USE privilege for the buffer pool. See “Naming conventions” on page 40 for more details about *bpname*.

The change to the description of the index takes effect the next time the data sets of the index space are opened. The data sets can be closed and reopened by a STOP DATABASE command to stop the index followed by a START DATABASE command to start the index.

In a data sharing environment, if you specify BUFFERPOOL, the index space must be in the stopped state when the ALTER INDEX statement is executed.

CLOSE

Specifies whether the data set is eligible to be closed when the index is not being used and the limit on the number of open data sets is reached. The change to the close rule takes effect the next time the data sets of the index space are opened.

YES

Eligible for closing.

NO

Not eligible for closing.

If DSMAX is reached and there are no CLOSE YES page sets to close, CLOSE NO page sets will be closed.

COPY

Indicates whether the COPY utility is allowed for the index.

NO

Does not allow full image or concurrent copies or the use of the RECOVER utility on the index.

YES

Allows full image or concurrent copies and the use the RECOVER utility on the index. For data sharing, changing COPY to YES causes additional SCA (Shared Communications Area) storage to be used until the next full or incremental image copy is taken or until COPY is set back to NO.

PIECESIZE *integer*

Specifies the maximum addressability of each piece (data set) for a secondary index.

Be aware that when you alter the PIECESIZE value, the index is placed into page set REBUILD-pending (PSRBD) status. The entire index space becomes inaccessible. You must run the REBUILD INDEX or the REORG TABLESPACE utility to remove that status.

The subsequent keyword K, M, or G, indicates the units of the value specified in *integer*.

K Indicates that the *integer* value is to be multiplied by 1 024 to specify the maximum piece size in bytes. The integer must be a power of two between 254 and 67 108 864.

M Indicates that the *integer* value is to be multiplied by 1 048 576 to specify the maximum piece size in bytes. The integer must be a power of two between 1 and 65 536.

G Indicates that the *integer* value is to be multiplied by 1 073 741 824 to specify the maximum piece size in bytes. The integer must be a power of two between 1 and 64.

Table 54 shows the valid values for piece size, which depend on the size of the table space.

Table 54. Valid values of PIECESIZE clause

K units	M units	G units	Size attribute of table space
254 K	-	-	-
512 K	-	-	-
1024 K	1 M	-	-
2048 K	2 M	-	-
4096 K	4 M	-	-
8192 K	8 M	-	-
16384 K	16 M	-	-
32768 K	32 M	-	-
65536 K	64 M	-	-
131072 K	128 M	-	-
262144 K	256 M	-	-
524288 K	512 M	-	-
1048576 K	1024 M	1 G	-
2097152 K	2048 M	2 G	-
4194304 K	4096 M	4 G	LARGE, DSSIZE 4 G (or greater)
8388608 K	8192 M	8 G	DSSIZE 8 G (or greater)
16777216 K	16384 M	16 G	DSSIZE 16 G (or greater)
33554432 K	32768 M	32 G	DSSIZE 32 G (or greater)
67108864 K	65536 M	64 G	DSSIZE 64 G

The piece size limit for partitioned table spaces with more than 254 partitions is 4096.

using-block

The components of the *using-block* are discussed below, first for nonpartitioned indexes and then for partitioned indexes.

Using block for nonpartitioned indexes

For nonpartitioned indexes, the USING clause specifies whether the data sets for the index are to be managed by the user or managed by DB2. The USING clause applies to every data set that can be used for the index.

If you specify USING, the index must be in the stopped state when the ALTER INDEX statement is executed. See “Altering storage attributes” on page 476 to determine how and when changes take effect.

VCAT *catalog-name*

Specifies a user-managed data set with a name that starts with the specified catalog name. You must specify the catalog name in the form of an SQL identifier. Thus, you must specify an alias if the name of the integrated catalog facility catalog is longer than eight characters. When the new description of the index is applied, the integrated catalog facility catalog must contain an entry for the data set the conforms to the DB2 naming conventions set forth in Part 2 (Volume 1) of *DB2 Administration Guide*.

One or more DB2 subsystems could share integrated catalog facility catalogs with the current server. To avoid the chance of having one of those subsystems attempt to assign the same name to different data sets, select a value for *catalog-name* that is not used by the other DB2 subsystems.

STOGROUP *stogroup-name*

Specifies using a DB2-managed data set that resides on a volume of the specified storage group. The stogroup name must identify a storage group that exists at the current server and the privilege set must include SYSADM authority, SYSCTRL authority, or the USE privilege for the storage group. When the new description of the index is applied, the description of the storage group must include at least one volume serial number. Each volume serial number must identify a volume that is accessible to z/OS for dynamic allocation of the data set, and all identified volumes must be of the same device type. Furthermore, the integrated catalog facility catalog used for the storage group must not contain an entry for the data set.

If you specify USING STOGROUP and the current data set is DB2-managed, omission of the PRIQTY, SECQTY, or ERASE clause is an implicit specification of the current value of the omitted clause.

If you specify USING STOGROUP to convert from user-managed data sets to DB2-managed data sets:

- Omission of the PRIQTY clause is an implicit specification of the default value. For information on how DB2 determines the default value, see “Rules for primary and secondary space allocation” on page 788.
- Omission of the SECQTY clause is an implicit specification of the default value. For information on how DB2 determines the default value, see “Rules for primary and secondary space allocation” on page 788.
- Omission of the ERASE clause is an implicit specification of ERASE NO.

PRIQTY *integer*

Specifies the minimum primary space allocation for a DB2-managed data set. This clause can be specified only if the data set is currently managed by DB2 and USING VCAT is not specified.

If PRIQTY is specified (with a value other than -1), the primary space allocation is at least *n* kilobytes, where *n* is:

12	If *integer* is less than 12
integer	If *integer* is between 12 and 4194304
4194304	If *integer* is greater than 4194304

If PRIQTY -1 is specified, DB2 uses a default value for the primary space allocation. For information on how DB2 determines the default value for primary space allocation, see “Rules for primary and secondary space allocation” on page 788.

If USING STOGROUP is specified and PRIQTY is omitted, the value of PRIQTY is its current value. (However, if the current data set is being changed from being user-managed to DB2-managed, the value is its default value. See the description of USING STOGROUP.)

If you specify PRIQTY and do not specify a value of -1, DB2 specifies the primary space allocation to access method services using the smallest multiple of 4KB not less than *n*. The allocated space can be greater than the amount of space requested by DB2. For example, it could be the smallest number of tracks that will accommodate the space requested. To more closely estimate the actual amount of storage, see the description of the DEFINE CLUSTER command in *DFSMS/MVS: Access Method Services for the Integrated Catalog*.

When determining a suitable value for PRIQTY, be aware that two of the pages of the primary space are used by DB2 for purposes other than storing index entries.

SECQTY *integer*

Specifies the minimum secondary space allocation for a DB2-managed data set. This clause can be specified only if the data set is currently managed by DB2 and USING VCAT is not specified.

If SECQTY -1 is specified, DB2 uses a default value for the secondary space allocation.

If USING STOGROUP is specified and SECQTY is omitted, the value of SECQTY is its current value. (However, if the current data set is being changed from being user-managed to DB2-managed, the value is its default value. See the description of USING STOGROUP.)

For information on the actual value that is used for secondary space allocation, whether you specify a value or DB2 uses a default value, see “Rules for primary and secondary space allocation” on page 788.

If you specify SECQTY and do not specify a value of -1, DB2 specifies the secondary space allocation to access method services using the smallest multiple of 4KB not less than *n*. The allocated space can be greater than the amount of space requested by DB2. For example, it could be the smallest number of tracks that will accommodate the space requested. To more closely estimate the actual amount of storage, see the description of the DEFINE CLUSTER command in *DFSMS/MVS: Access Method Services for the Integrated Catalog*.

ERASE

Indicates whether the DB2-managed data sets are to be erased when they are deleted during the execution of a utility or an SQL statement that drops the index. Refer to *DFSMS/MVS: Access Method Services for the Integrated Catalog* for more information.

NO

Does not erase the data sets. Operations involving data set deletion will perform better than ERASE YES. However, the data is still accessible, though not through DB2.

YES

Erases the data sets. As a security measure, DB2 overwrites all data in the data sets with zeros before they are deleted.

This clause can be specified only if the data set is currently managed by DB2 and USING VCAT is not specified. If you specify ERASE, the index must be in the stopped state when the ALTER INDEX statement is executed. See "Altering storage attributes" on page 476 to determine how and when changes take effect.

USING block for partitioned indexes:

For a partitioned index, there is an optional PARTITION clause for each partition. A *using-block* can be specified at the global level or at the partition level. A *using-block* within a PARTITION clause applies only to that partition. A *using-block* specified before any PARTITION clauses applies to every partition except those with a PARTITION clause with a *using-block*.

For DB2-managed data sets, the values of PRIQTY, SECQTY, and ERASE for each partition are given by the first of these choices that applies:

- The values of PRIQTY, SECQTY, and ERASE given in the *using-block* within the PARTITION clause for the partition. Do not use more than one *using-block* in any PARTITION clause.
- The values of PRIQTY, SECQTY, and ERASE given in a *using-block* before any PARTITION clauses
- The current values of PRIQTY, SECQTY, and ERASE

For data sets that are being changed from user-managed to DB2-managed, the values of PRIQTY, SECQTY, and ERASE for each partition are given by the first of these choices that applies:

- The values of PRIQTY, SECQTY, and ERASE given in the *using-block* within the PARTITION clause for the partition. Do not use more than one *using-block* in any PARTITION clause.
- The values of PRIQTY, SECQTY, and ERASE given in a *using-block* before any PARTITION clauses
- The default values of PRIQTY, SECQTY, and ERASE, which are:
  - PRIQTY 12
  - SECQTY 12, if PRIQTY is not specified in either *using-block*, or 10% of PRIQTY or 3 times the index page size (whichever is larger) when PRIQTY is specified
  - ERASE NO

Any partition for which USING or ERASE is specified (either explicitly at the partition level or implicitly at the global level) must be in the stopped state when the ALTER INDEX statement is executed. See "Altering storage attributes" on page 476 to determine how and when changes take effect.

VCAT *catalog-name*

Specifies a user-managed data set with a name that starts with the specified catalog name. You must specify the catalog name in the form of an SQL identifier. Thus, you must specify an alias if the name of the integrated catalog facility catalog is longer than eight characters.

If *n* is the number of the partition, the identified integrated catalog facility catalog must already contain an entry for the *n*th data set of the index, conforming to the DB2 naming convention for data sets set forth in Part 2 (Volume 1) of *DB2 Administration Guide*.

One or more DB2 subsystems could share integrated catalog facility catalogs with the current server. To avoid the chance of having one of those subsystems attempt to assign the same name to different data sets, select a value for *catalog-name* that is not used by the other DB2 subsystems.

DB2 assumes one and only one data set for each partition.

STOGROUP *stogroup-name*
If USING STOGROUP is used, *stogroup-name* must identify a storage group that exists at the current server and the privilege set must include SYSADM authority, SYSCTRL authority, or the USE privilege for the storage group.

DB2 assumes one and only one data set for each partition.

For information on the PRIQTY, SECQTY, and ERASE clauses, see the description of those clauses in the using-block for secondary indexes.

End of using-block

free-block

FREEPAGE *integer*
Specifies how often to leave a page of free space when index entries are created as the result of executing a DB2 utility. One free page is left for every *integer* pages. The value of *integer* can range from 0 to 255. The change to the description of the index or partition has no effect until it is loaded or reorganized using a DB2 utility.

PCTFREE *integer*
Determines the percentage of free space to leave in each nonleaf page and leaf page when entries are added to the index or partition as the result of executing a DB2 utility. The first entry in a page is loaded without restriction. When additional entries are placed in a nonleaf or leaf page, the percentage of free space is at least as great as *integer*.

The value of *integer* can range from 0 to 99, however, if a value greater than 10 is specified, only 10 percent of free space will be left in nonleaf pages. The change to the description of the index or partition has no effect until it is loaded or reorganized using a DB2 utility.

If the index is partitioned, the values of FREEPAGE and PCTFREE for a particular partition are given by the first of these choices that applies:

- The values of FREEPAGE and PCTFREE given in the PARTITION clause for that partition. Do not use more than one *free-block* in any PARTITION clause.
- The values given in a *free-block* before any PARTITION clauses.
- The current values of FREEPAGE and PCTFREE for that partition.

End of free-block

gbpcache-block

GBPCACHE

Specifies what index pages are written to the group buffer pool in a data sharing environment. In a non-data-sharing environment, you can specify this option, but it is ignored.

CHANGED

When there is inter-DB2 R/W interest on the index or partition, updated pages are written to the group buffer pool. When there is no inter-DB2 R/W interest, the group buffer pool is not used. Inter-DB2 R/W interest exists when more than one member in the data sharing group has the index or partition open, and at least one member has it open for update.

If the index is in a group buffer pool that is defined as GBPCACHE(NO), CHANGED is ignored and no pages are cached to the group buffer pool.

ALL

Indicates that pages are to be cached to the group buffer pool as they are read in from DASD, with one exception. When the page set is not GBP-dependent and one DB2 data sharing member has exclusive R/W interest in that page set (no other group members have any interest in the page set), no pages are cached in the group buffer pool.

If the index is in a group buffer pool that is defined as GBPCACHE(NO), ALL is ignored and no pages are cached to the group buffer pool.

NONE

Indicates that no pages are to be cached to the group buffer pool. DB2 uses the group buffer pool only for cross-invalidation.

If you specify NONE, the index or partition must not be in group buffer pool recover pending (GRECP) status.

If the index is partitioned, the value of GBPCACHE for a particular partition is given by the first of these choices that applies:

1. The value of GBPCACHE given in the PARTITION clause for that partition. Do not use more than one *gbpcache-block* in any PARTITION clause.
2. The value given in a *gbpcache-block* before any PARTITION clauses.
3. The current value of GBPCACHE for that partition.

If you specify GBPCACHE in a data sharing environment, the index or partition must be in the stopped state when the ALTER INDEX statement is executed. You cannot alter the GBPCACHE value for certain indexes on DB2 catalog tables; for more information, see "SQL statements allowed on the catalog" on page 1197.

End of gbpcache-block

CLUSTER or **NOT CLUSTER**

Specifies whether the index is the clustering index for the table.

CLUSTER

The index is used as the clustering index for the table. This change takes effect immediately. Any subsequent INSERT statements will use the new clustering index. Existing data remains clustered by the previous clustering index until the table space is reorganized.

The implicit or explicit clustering index is ignored when data is inserted into a table space that is defined with MEMBER CLUSTER. Instead of using cluster order, DB2 chooses where to locate the data based on available space. The MEMBER CLUSTER attribute affects only data that is inserted with the INSERT statement; data is always loaded and reorganized in cluster order.

Do not specify CLUSTER if the table is an auxiliary table or if CLUSTER was used already for a different index on the table.

NOT CLUSTER

The index is not used as the clustering index of the table. If the index is already defined as the clustering index, it continues to be used as the clustering index by DB2 and the REORG utility until clustering is explicitly changed by specifying CLUSTER for a different index.

Specifying NOT CLUSTER for an index that is not a clustering index is ignored.

If the index is the partitioning index for a table that uses index-controlled partitioning, the table is converted to use table-controlled partitioning. The high limit key for the last partition is set to the highest possible value for ascending key columns or the lowest possible value for descending key columns.

NOT PADDED or **PADDED**

Specifies how varying-length string columns are to be stored in the index. If the index contains no varying-length columns, this option is ignored, and a warning message is returned.

NOT PADDED

Specifies that varying-length string columns are not to be padded to their maximum length in the index. The length information for a varying-length column is stored with the key.

NOT PADDED is ignored and has no effect if the index is on an auxiliary table. Indexes on auxiliary tables are always padded.

When PADDED is changed to NOT PADDED, the index key length is recalculated with the varying-length formula (2000 - *n* - 2*m*, where *n* is the number of columns that can contain null values and *m* is the number of varying-length columns in the key). If it is possible that the index key length may exceed the maximum length (because before when it was padded, the formula 2000 - *n* was used), an error occurs.

PADDED

Specifies that varying-length string columns within the index are always padded with the default pad character to their maximum length.

When an index with at least one varying-length column is changed from PADDED to NOT PADDED, or vice versa, the index is placed in restricted REBUILD-pending status (RBDP). The index cannot be accessed until it is rebuilt from the table (REBUILD INDEX, REORG TABLESPACE, or LOAD REPLACE utility). For nonpartitioned secondary indexes (NPSIs), the index is placed in page set REBUILD-pending status (PSRBD), and the entire index must be rebuilt. In addition, plans and packages that are dependent on the table are quiesced, and dynamically cached statements that are dependent on the index are invalidated.

ADD COLUMN *column-name*

Adds *column-name* to the index. *column-name* must be unqualified, must identify a column of the table, must not be one of the existing columns of the index, and must not be a LOB column or a distinct type column based on a LOB data type. The total number of columns for the index cannot exceed 64.

For PADDED indexes, the sum of the length attributes of the columns must not be greater than 2000 - *n*, where *n* is the number of columns that can contain null values. For NOT PADDED indexes, the sum of the length attributes of the columns must not be greater than 2000 - *n* -2*m*, where *n* is the number of nullable columns and *m* is the number of varying-length columns.

The index cannot be any of the following types of indexes:

- A system-defined catalog index
- An index that enforces a primary key, unique key, or referential constraint
- A partitioning index when index-controlled partitioning is being used
- A unique index required for a ROWID column defined as GENERATED BY DEFAULT
- An auxiliary index

If the column is added to the table and that same column is added to an associated index within the same commit scope and within that commit scope no data rows were inserted, the index is left in advisory REORG-pending (AREO*) state; otherwise, the index is left in REBUILD-pending (RBDP) state.

ASC Index entries are put in ascending order by the column.

DESC Index entries are put in descending order by the column.

ALTER PARTITION *integer*
Identifies the partition of the index to be altered. For an index that has *n* partitions, you must specify an integer in the range 1 to *n*. You must not use this clause if the index is nonpartitioned. You must use this clause if the index is partitioned and you specify the ENDING AT clause.

ENDING AT(*constant,...***)**
Specifies the highest value of the index key for the identified partition of the partitioning index. In this context, highest means highest in the sorting sequences of the index columns. In a column defined as ascending (ASC), highest and lowest have their usual meanings. In a column defined as descending (DESC), the lowest actual value is highest in the sorting sequence.

You must use at least one constant after ENDING AT in each PARTITION clause. You can use as many constants as there are columns in the key. The concatenation of all the constants is the highest value of the key in the corresponding partition of the index. The length of each highest key value (also called the limit key) is the same as the length of the partitioning index

The use of constants to define key values is subject to these rules:

- The first constant corresponds to the first column of the key, the second constant to the second column, and so on. Each constant must have the same data type as its corresponding column. A hexadecimal string constant (GX) cannot be specified.
- If a key includes a ROWID column (or a column with a distinct type that is based on a ROWID data type), only the first 17 bytes of the constant that is specified for the corresponding ROWID column are considered.
- The precision and scale of a decimal constant must not be greater than the precision and scale of its corresponding column.

- If a string constant is longer or shorter than required by the length attribute of its column, the constant is either truncated or padded on the right to the required length. If the column is ascending, the padding character is X'FF'; if the column is descending, the padding character is X'00'.
- Using fewer constants than there are columns in the key has the same effect as using the highest possible values for all omitted columns for an ascending index.
- If the key exceeds 255 bytes, only the first 255 bytes are considered.
- The highest value of the key in any partition must be lower than the highest value of the key in the next partition.
- The highest value of the key in the last partition depends on how the table space was defined. For table spaces created without the LARGE or DSSIZE option, the constants you specify after ENDING AT are not enforced. The highest value of the key that can be placed in the table is the highest possible value of the key.

  For table spaces created with the LARGE or DSSIZE options, the constants you specify after ENDING AT are enforced. The value specified for the last partition is the highest value of the key that can be placed in the table. Any keys that are made invalid after the ALTER TABLE statement is executed are placed in a discard data set when you run REORG. If the last partition is in REORG-pending status, regardless of whether you changed its limiting key values, you must specify a discard data set when you run REORG.

ENDING AT must not be specified for any indexes defined on a table that uses table-controlled partitioning. Use ALTER TABLE ALTER PART to modify the partitioning boundaries for a table that uses table-controlled partitioning.

INCLUSIVE
Specifies that the specified range values are included in the data partition.

Notes

Altering storage attributes: The USING, PRIQTY, SECQTY, and ERASE clauses define the storage attributes of the index or partition. If you specify the USING or ERASE clause when altering storage attributes, the index or partition must be in the stopped state when the ALTER INDEX statement is executed. A STOP DATABASE...SPACENAM... command can be used to stop the index or partition.

If the catalog name changes, the changes take effect after you move the data and start the index or partition using the START DATABASE...SPACENAM... command. The catalog name can be implicitly or explicitly changed by the ALTER INDEX statement. The catalog name also changes when you move the data to a different device. See the procedures for moving data in Part 2 (Volume 1) of *DB2 Administration Guide*.

Changes to the secondary space allocation (SECQTY) take effect the next time DB2 extends the data set; however, the new value is not reflected in the integrated catalog until you use the REORG, RECOVER, or LOAD REPLACE utility on the index or partition. Changes to the other storage attributes take effect the next time you use the REORG, RECOVER, or LOAD REPLACE utility on the index or partition. If you change the primary space allocation parameters or erase rule, you can have the changes take effect earlier if you move the data before you start the index or partition.

Altering indexes on DB2 catalog tables: For details on altering options on catalog tables, see “SQL statements allowed on the catalog” on page 1197.

Altering limit keys: If you specify ALTER PARTITION *integer* ENDING AT to change the limit key values of a partitioning index, the plans and packages that are dependent on that index are marked INVALID and go through automatic rebind the next time they are run.

Invalidation of plans and packages: When an index is altered, all the plans and packages that refer to that index are marked invalid if one of the following conditions is true:

- A column is added to the index.
- The index is altered to be PADDED.
- The index is a partitioning index on a table that uses index-controlled partitioning, and one or more limit key values is altered.

Running utilities: You cannot execute the ALTER INDEX statement while a DB2 utility has control of the index or its associated table space.

Alternative syntax and synonyms: To provide compatibility with previous releases of DB2 or other products in the DB2 UDB family, DB2 supports the following keywords when altering the partitions of a partitioned index:

- PART can be specified as a synonym for PARTITION. In addition, the ALTER keyword that precedes PARTITION is optional. In addition, if you alter more than one partition, specifying a comma between each ALTER PARTITION *integer* clause is optional.
- VALUES can be specified as a synonym for ENDING AT.

Although these keywords are supported as alternatives, they are not the preferred syntax.

Examples

Example 1: Alter the index DSN8810.XEMP1. Indicate that DB2 is not to close the data sets that support the index when there are no current users of the index.

```
ALTER INDEX DSN8810.XEMP1
  CLOSE NO;
```

Example 2: Alter the index DSN8810.XPROJ1. Use BP1 as the buffer pool that is to be associated with the index, indicate that full image or concurrent copies on the index are allowed, and change the maximum size of each data set to 8 megabytes.

```
ALTER INDEX DSN8810.XPROJ1
  BUFFERPOOL BP1
  COPY YES
  PIECESIZE 8M;
```

Example 3: Assume that index X1 contains a least one varying-length column and is a padded index. Alter the index to a nonpadded index.

```
ALTER INDEX X1
  NOT PADDED;
```

The index is placed in restricted REBUILD-pending status (RBDP) and cannot be accessed until it is rebuilt from the table

Example 4: Alter partitioned index DSN8810.DEPT1. For partition 3, leave one page of free space for every 13 pages and 13 percent of free space per page. For partition 5, leave one page for every 25 pages and 25 percent of free space. For all the other partitions, leave one page of free space for every 6 pages and 11 percent of free space. Ensure that index pages are cached to the group buffer pool for all partitions except partition 4. For partition 4, write pages only when there is inter-DB2 R/W interest on the partition.

```
ALTER INDEX DSN8810.XDEPT1
   BUFFERPOOL BP1
   CLOSE YES
   COPY YES
   USING VCAT CATLGG
   FREEPAGE 6
   PCTFREE 11
   GBPCACHE ALL
   ALTER PARTITION 3
      USING VCAT CATLGG
      FREEPAGE 13
      PCTFREE 13,
   PARTITION 4
      USING VCAT CATLGG
      GBPCACHE CHANGED,
   PARTITION 5
      USING VCAT CATLGG
      FREEPAGE 25
      PCTFREE 25;
```

ALTER PROCEDURE (external)

The ALTER PROCEDURE statement changes the description of an external stored procedure at the current server.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

The privilege set that is defined below must include at least one of the following:
- Ownership of the stored procedure
- The ALTERIN privilege on the schema
- SYSADM or SYSCTRL authority

The authorization ID that matches the schema name implicitly has the ALTERIN privilege on the schema.

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package.

If the statement is dynamically prepared, the privilege set is the privileges that are held by the authorization IDs of the process. The specified procedure name can include a schema name (a qualifier). However, if the schema name is not the same as one of these authorization IDs, one of the following conditions must be met:
- The privilege set includes SYSADM or SYSCTRL authority.
- An authorization ID of the process has the ALTERIN privilege on the schema.

If the environment in which the stored procedure is to run is being changed, the authorization ID must have authority to use the WLM environment or DB2-established stored procedure address space. This authorization is obtained from an external security product, such as RACF.

When LANGUAGE is JAVA and a *jar-name* is specified in the EXTERNAL NAME clause, the privilege set must include USAGE on the JAR, the Java ARchive file.

Syntax

```
►►──ALTER PROCEDURE──procedure-name──option-list──────────────────────────────────────►◄
```

option-list: (Specify options in any order. Specify at least one option. Do not specify the same option more than once.)

```
                                                    (1)
►►──DYNAMIC RESULT SETS──integer──EXTERNAL NAME──┬─'string'───┬──LANGUAGE──┬─ASSEMBLE─┬──────────────►
                                                 └─identifier─┘            ├─C────────┤
                                                                           ├─COBOL────┤
                                                                           ├─JAVA─────┤
                                                                           ├─PLI──────┤
                                                                           └─REXX─────┘

►─PARAMETER STYLE──┬─SQL───────────────┬─┬─NOT DETERMINISTIC─┬──┬─MODIFIES SQL DATA─┬──────────────►
                   ├─GENERAL───────────┤ └─DETERMINISTIC─────┘  ├─READS SQL DATA────┤
                   ├─GENERAL WITH NULLS┤                        ├─CONTAINS SQL──────┤
                   └─JAVA──────────────┘                        └─NO SQL────────────┘

►─┬─NO DBINFO─┬──┬─NO COLLID──────────────┬─WLM ENVIRONMENT──┬─name─────────────┬──────────────────►
  └─DBINFO────┘  └─COLLID──collection-id─┘                  └─(──name──,──*──)─┘

►─ASUTIME──┬─NO LIMIT──────────┬─STAY RESIDENT──┬─NO──┬─PROGRAM TYPE──┬─SUB──┬─────────────────────►
           └─LIMIT──integer────┘                └─YES─┘               └─MAIN─┘

►─SECURITY──┬─DB2─────┬─RUN OPTIONS──run-time-options──COMMIT ON RETURN──┬─NO──┬───────────────────►
            ├─USER────┤                                                  └─YES─┘
            └─DEFINER─┘

►─┬─INHERIT SPECIAL REGISTERS─┬─CALLED ON NULL INPUT──┬─STOP AFTER SYSTEM DEFAULT FAILURES─┬─────►◄
  └─DEFAULT SPECIAL REGISTERS─┘                       ├─STOP AFTER──integer──FAILURES──────┤
                                                      └─CONTINUE AFTER FAILURE─────────────┘
```

Notes:

1 If LANGUAGE is JAVA, EXTERNAL NAME must be specified with a valid *external-java-routine-name*.

external-java-routine-name:

```
├──┬────────────┬──method-name──┬──────────────────┬─────────────────────────────┤
   └─jar-name:─┘                └─method-signature─┘
```

jar-name:

```
├──┬──────────────┬──jar-id──────────────────────────────────────────────────────┤
   └─schema-name,─┘
```

method-name:

```
      ┌────────────────────────┐
      ▼                        │
├──┬──────────────────────┬──┴──class-id──┬─.───┬──method-id────────────────────┤
   └─package-id──┬─.───┬──┘                │ (2) │
                 │ (1) │                   └─!───┘
                 └─/───┘
```

method-signature:

```
├──┬──────────────────────────────┬──────────────────────────────────────────────┤
   └─(──┬──────────────────────┬──)─┘
        │  ┌─,──────────────┐  │
        │  ▼                │  │
        └──┴─java-datatype──┴──┘
```

Notes:

1 The slash (/) is supported for compatibility with previous releases of DB2 UDB for z/OS.

2 The exclamation point (!) is supported for compatibility with other products in the DB2 UDB family.

Description

procedure-name

Identifies the stored procedure to be altered. The name is implicitly or explicitly qualified by a schema name. If the name is not explicitly qualified, it is implicitly qualified with a schema name according to the following rules:

- If the statement is embedded in a program, the schema name is the authorization ID in the QUALIFIER option when the plan or package was created or last rebound. If QUALIFIER was not specified, the schema name is the owner of the plan or package.
- If the statement is dynamically prepared, the schema name is the SQL authorization ID in the CURRENT SQLID special register.

DYNAMIC RESULT SETS *integer*

Specifies the maximum number of query result sets that the stored procedure can return. The value must be between 0 and 32767.

| **EXTERNAL NAME** *'string'* or *identifier*

Specifies the name of the MVS load module for the program that runs when the procedure name is specified in an SQL CALL statement.

If LANGUAGE is JAVA, *'string'* must be specified and enclosed in single quotation marks, with no extraneous blanks within the single quotation marks. It must specify a valid *external-java-routine-name*. If multiple *'string'*s are specified, the total length of all of them must not be greater than 1305 bytes and they must be separated by a space or a line break. Do not specify a JAR for a JAVA procedure for which NO SQL is in effect.

An *external-java-routine-name* contains the following parts:

jar-name

Identifies the name given to the JAR when it was installed in the database. The name contains *jar-id*, which can optionally be qualified with a schema. Examples are ″myJar″ and ″mySchema.myJar.″ The unqualified *jar-id* is implicitly qualified with a schema name according to the following rules:

- If the statement is embedded in a program, the schema name is the authorization ID in the QUALIFIER bind option when the package or plan was created or last rebound. If the QUALIFIER was not specified, the schema name is the owner of the package or plan.
- If the statement is dynamically prepared, the schema name is the SQL authorization ID in the CURRENT SQLID special register.

If *jar-name* is specified, it must exist when the ALTER PROCEDURE statement is processed.

If *jar-name* is not specified, the procedure is loaded from the class file directly instead of being loaded from a JAR file. DB2 searches the directories in the CLASSPATH associated with the WLM Environment. Environmental variables for Java routines are specified in a data set identified in a JAVAENV DD card on the JCL used to start the address space for a WLM-managed stored procedure.

method-name

Identifies the name of the method and must not be longer than 254 bytes. Its package, class, and method ID's are specific to Java and as such are not limited to 18 bytes. In addition, the rules for what these can contain are not necessarily the same as the rules for an SQL ordinary identifier.

package-id

Identifies the package list that the class identifier is part of. If the class is part of a package, the method name must include the complete package prefix, such as ″myPacks.StoredProcs.″ The Java virtual machine looks in the directory ″/myPacks/StoredProcs/″ for the classes.

class-id

Identifies the class identifier of the Java object.

method-id

Identifies the method identifier with the Java class to be invoked.

method-signature

Identifies a list of zero or more Java data types for the parameter list and must not be longer than 1024 bytes. Specify the *method-signature* if the procedure involves any input or output parameters that can be NULL. When the stored procedure being created is called, DB2 searches for a Java method with the exact *method-signature*. The number of *java-datatype* elements specified indicates how many parameters that the Java method must have.

A Java procedure can have no parameters. In this case, you code an empty set of parentheses for *method-signature*. If a Java *method-signature* is not specified, DB2 searches for a Java method with a signature derived from the default JDBC types associated with the SQL types specified in the parameter list of the ALTER PROCEDURE statement.

| For other values of LANGUAGE, the value must conform to the naming conventions for MVS load modules: the value must be less than or equal to 8 bytes, and it must conform to the rules for an ordinary identifier with the exception that it must not contain an underscore.

LANGUAGE
Specifies the application programming language in which the stored procedure is written. Assembler, C, COBOL, and PL/I programs must be designed to run in IBM's Language Environment.

ASSEMBLE
The stored procedure is written in Assembler.

C The stored procedure is written in C or C++.

COBOL
The stored procedure is written in COBOL, including the OO-COBOL language extensions.

JAVA
The stored procedure is written in Java byte code and is executed in the Java Virtual Machine. When LANGUAGE JAVA is specified, the EXTERNAL NAME clause must also be specified with a valid *external-java-routine-name* and PARAMETER STYLE must be specified with JAVA. The procedure must be a public static method of the specified Java class.

Do not specify LANGUAGE JAVA when DBINFO, PROGRAM TYPE MAIN, or RUN OPTIONS is in effect.

PLI
The stored procedure is written in PL/I.

REXX
The stored procedure is written in REXX. Do not specify LANGUAGE REXX when PARAMETER STYLE SQL is specified.

PARAMETER STYLE
Identifies the linkage convention used to pass parameters to and return values from the stored procedure. All of the linkage conventions provide arguments to the stored procedure that contain the parameters specified on the CALL statement. Some of the linkage conventions pass additional arguments to the stored procedure that provide more information to the stored procedure. For more information on linkage conventions, see *DB2 Application Programming and SQL Guide*.

SQL
Specifies that, in addition to the parameters on the CALL statement, several additional parameters are passed to the stored procedure. The following parameters are passed:

- The first *n* parameters that are specified on the CREATE PROCEDURE statement.
- *n* parameters for indicator variables for the parameters.
- The SQLSTATE to be returned.
- The qualified name of the stored procedure.
- The specific name of the stored procedure.

- The SQL diagnostic string to be returned to DB2.
- If DBINFO is specified, the DBINFO structure.

Do not specify PARAMETER STYLE SQL when LANGUAGE REXX is specified.

GENERAL

Specifies that the stored procedure uses a parameter passing mechanism where the stored procedure receives only the parameters specified on the CALL statement. Arguments to procedures defined with this parameter style cannot be null.

GENERAL WITH NULLS

Specifies that, in addition to the parameters on the CALL statement as specified in GENERAL, another argument is also passed to the stored procedure. The additional argument contains an indicator array with an element for each of the parameters on the CALL statement. In C, this is an array of short ints. The indicator array enables the stored procedure to accept or return null parameter values.

JAVA

Specifies that the stored procedure uses a parameter passing convention that conforms to the Java and SQLJ Routines specifications. PARAMETER STYLE JAVA can be specified only if LANGUAGE is JAVA. If the ALTER PROCEDURE statement results in changing LANGUAGE to JAVA, PARAMETER STYLE JAVA and an EXTERNAL NAME clause might need to be specified to provide appropriate values. JAVA must be specified for PARAMETER STYLE when LANGUAGE is JAVA.

INOUT and OUT parameters are passed as single-entry arrays. The INOUT and OUT parameters are declared in the Java method as single-element arrays of the Java type.

PARAMETER STYLE SQL cannot be used with LANGUAGE REXX.

DETERMINISTIC or **NOT DETERMINISTIC**

Specifies whether the stored procedure returns the same results each time the stored procedure is called with the same IN and INOUT arguments.

DETERMINISTIC

The stored procedure always returns the same results each time the stored procedure is called with the same IN and INOUT arguments, if the referenced data in the database has not changed.

NOT DETERMINISTIC

The stored procedure might not return the same result each time the procedure is called with the same IN and INOUT arguments, even when the referenced data in the database has not changed.

DB2 does not verify that the stored procedure code is consistent with the specification of DETERMINISTIC or NOT DETERMINISTIC.

MODIFIES SQL DATA, **READS SQL DATA**, **CONTAINS SQL**, or **NO SQL**

Specifies which SQL statements, if any, can be executed in the procedure or any routine that is called from this procedure. For the data access classification of each statement, see Table 95 on page 1158.

MODIFIES SQL DATA

Specifies that the procedure can execute any SQL statement except statements that are not supported in procedures.

READS SQL DATA
Specifies that the procedure can execute any SQL statement except statements that are not supported in procedures. Specifies that the procedure can execute statements with a data access classification of READS SQL DATA, CONTAINS SQL, or NO SQL. SQL statements that do not modify SQL data can be included in the procedure. Statements that are not supported in any procedure return a different error.

CONTAINS SQL
Specifies that the procedure can execute only SQL statements with a data classification of CONTAINS SQL or NO SQL. SQL statements that neither read nor modify SQL data can be executed by the procedure. Statements that are not supported in any procedure return a different error.

NO SQL
Specifies that the procedure can execute only SQL statements with a data access classification of NO SQL. Do not specify NO SQL for a JAVA procedure that uses a JAR.

NO DBINFO or **DBINFO**
Specifies whether additional status information is passed to the stored procedure when it is invoked.

NO DBINFO
Additional information is not passed.

DBINFO
An additional argument is passed when the stored procedure is invoked. The argument is a structure that contains information such as the application run-time authorization ID, the schema name, the name of a table or column that the procedure might be inserting into or updating, and identification of the database server that invoked the procedure. For details about the argument and its structure, see *DB2 Application Programming and SQL Guide*.

DBINFO can be specified only if PARAMETER STYLE SQL is specified.

NO COLLID or **COLLID** *collection-id*
Identifies the package collection that is to be used when the stored procedure is executed. This is the package collection into which the DBRM that is associated with the stored procedure is bound.

NO COLLID
Specifies that the package collection for the stored procedure is the same as the package collection of the calling program. If the invoking program does not use a package, DB2 resolves the package by using the CURRENT PACKAGE PATH special register, the CURRENT PACKAGESET special register, or the PKLIST bind option (in this order). For details about how DB2 uses these three items, see the information on package resolution in Part 5 of *DB2 Application Programming and SQL Guide*.

COLLID *collection-id*
Identifies the package collection that is to be used when the stored procedure is executed. It is the name of the package collection into which the DBRM associated with the stored procedure is bound.

For REXX stored procedures, *collection-id* can be DSNREXRR, DSNREXRS, DSNREXCR, or DSNREXCS.

WLM ENVIRONMENT
Identifies the WLM (workload manager) environment in which the stored

procedure is to run when the DB2 stored procedure address space is WLM-established. The *name* of the WLM environment is an SQL identifier.

name

The WLM environment in which the stored procedure must run. If another stored procedure or a user-defined function calls the stored procedure and that calling routine is running in an address space that is not associated with the specified WLM environment, DB2 routes the stored procedure request to a different address space.

(name,*)

When the stored procedure is called directly by an SQL application program, the WLM environment in which the stored procedure runs.

If another stored procedure or a user-defined function calls the stored procedure, the stored procedure runs in the same WLM environment that the calling routine uses.

To change the environment in which the procedure is to run, you must have appropriate authority for the WLM environment. For an example of a RACF command that provides this authorization, see “Running stored procedures” on page 707.

ASUTIME

Specifies the total amount of processor time, in CPU service units, that a single invocation of a stored procedure can run. The value is unrelated to the ASUTIME column in the resource limit specification table.

When you are debugging a stored procedure, setting a limit can be helpful in case the stored procedure gets caught in a loop. For information on CPU service units, see *z/OS MVS Initialization and Tuning Guide*.

NO LIMIT

There is no limit on the service units.

LIMIT *integer*

The limit on the service units is a positive *integer* in the range of 1 to 2G. If the stored procedure uses more service units than the specified value, DB2 cancels the stored procedure.

STAY RESIDENT

Specifies whether the stored procedure load module is to remain resident in memory when the stored procedure ends.

NO

The load module is deleted from memory after the stored procedure ends. Use NO for non-reentrant stored procedures.

YES

The load module remains resident in memory after the stored procedure ends.

PROGRAM TYPE

Specifies whether the stored procedure runs as a main routine or a subroutine.

SUB

The stored procedure runs as a subroutine.

Do not specify PROGRAM TYPE SUB for stored procedures with a LANGUAGE value of REXX.

MAIN

The stored procedure runs as a main routine.

Do not specify PROGRAM TYPE MAIN when LANGUAGE JAVA is in effect.

SECURITY

Specifies how the stored procedure interacts with an external security product, such as RACF, to control access to non-SQL resources.

DB2

The stored procedure does not require a special external security environment. If the stored procedure accesses resources that an external security product protects, the access is performed using the authorization ID associated with the stored procedure address space.

USER

An external security environment should be established for the stored procedure. If the stored procedure accesses resources that the external security product protects, the access is performed using the authorization ID of the user who invoked the stored procedure.

DEFINER

An external security environment should be established for the stored procedure. If the stored procedure accesses resources that the external security product protects, the access is performed using the authorization ID of the owner of the stored procedure.

RUN OPTIONS *run-time-options*

Specifies the Language Environment run-time options to be used for the stored procedure. For a REXX stored procedure, specifies the Language Environment run-time options to be passed to the REXX language interface to DB2. You must specify *run-time-options* as a character string that is no longer than 254 bytes. To replace any existing run-time options with no options, specify an empty string with RUN OPTIONS. When you specify an empty string, DB2 does not pass any run-time options to Language Environment, and Language Environment uses its installation defaults. For a description of the Language Environment run-time options, see *z/OS Language Environment Programming Reference*.

Do not specify RUN OPTIONS when LANGUAGE JAVA is specified.

COMMIT ON RETURN

Indicates whether DB2 is to commit the transaction immediately on return from the stored procedure.

NO

DB2 does not issue a commit when the stored procedure returns.

YES

DB2 issues a commit when the stored procedure returns if the following statements are true:

- The SQLCODE that is returned by the CALL statement is not negative.
- The stored procedure is not in a must abort state.

The commit operation includes the work that is performed by the calling application process and the stored procedure.

If the stored procedure returns result sets, the cursors that are associated with the result sets must have been defined WITH HOLD to be usable after the commit.

INHERIT SPECIAL REGISTERS or **DEFAULT SPECIAL REGISTERS**

Specifies how special registers are set on entry to the routine.

INHERIT SPECIAL REGISTERS
Indicates that values of special registers are inherited according to the rules listed in the table for characteristics of special registers in a stored procedure in Table 27 on page 111.

DEFAULT SPECIAL REGISTERS
Indicates that special registers are initialized to the default values, as indicated by the rules in the table for characteristics of special registers in a stored procedure in Table 27 on page 111.

CALLED ON NULL INPUT
Specifies that the procedure is to be called even if any or all of the argument values are null, which means that the procedure must be coded to test for null argument values. The procedure can return null or nonnull values.

STOP AFTER SYSTEM DEFAULT FAILURES, STOP AFTER *nn* **FAILURES,** or **CONTINUE AFTER FAILURE**
Specifies whether the routine is to be put in a stopped state after some number of failures.

STOP AFTER SYSTEM DEFAULT FAILURES
Specifies that this routine should be placed in a stopped state after the number of failures indicated by the value of field MAX ABEND COUNT on installation field DSNTIPX.

STOP AFTER *nn* **FAILURES**
Specifies that this routine should be placed in a stopped state after *nn* failures. The value *nn* can be an integer from 1 to 32767.

CONTINUE AFTER FAILURE
Specifies that this routine should not be placed in a stopped state after any failure.

Notes

Changes are immediate: Any changes that the ALTER PROCEDURE statement cause to the definition of a procedure take effect immediately. The changed definition is used the next time that the procedure is called.

Invalidation of plans and packages: When an external procedure is altered, all the plans and packages that refer to that procedure are marked invalid.

Alternative syntax and synonyms: To provide compatibility with previous releases of DB2 or other products in the DB2 UDB family, DB2 supports the following keywords:

- DYNAMIC RESULT SET, RESULT SET, and RESULT SETS as synonyms for DYNAMIC RESULT SETS
- STANDARD CALL as a synonym for DB2SQL
- SIMPLE CALL as a synonym for GENERAL
- SIMPLE CALL WITH NULLS as a synonym for GENERAL WITH NULLS
- VARIANT as a synonym for NOT DETERMINISTIC
- NOT VARIANT as a synonym for DETERMINISTIC
- NULL CALL as a synonym for CALLED ON NULL INPUT
- PARAMETER STYLE DB2SQL as a synonym for PARAMETER STYLE SQL

Example

Assume that stored procedure SYSPROC.MYPROC is currently defined to run in WLM environment PARTSA and that you have appropriate authority on that WLM environment and WLM environment PARTSEC. Change the definition of the stored procedure so that it runs in PARTSEC.

```
ALTER PROCEDURE SYSPROC.MYPROC WLM ENVIRONMENT PARTSEC;
```

ALTER PROCEDURE (SQL)

The ALTER PROCEDURE statement changes the description of an SQL procedure at the current server.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

The privilege set that is defined below must include at least one of the following:

- Ownership of the stored procedure
- The ALTERIN privilege on the schema
- SYSADM or SYSCTRL authority

The authorization ID that matches the schema name implicitly has the ALTERIN privilege on the schema.

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package.

If the statement is dynamically prepared, the privilege set is the privileges that are held by the authorization IDs of the process. The specified procedure name can include a schema name (a qualifier). However, if the schema name is not the same as one of these authorization IDs, one of the following conditions must be met:

- The privilege set includes SYSADM or SYSCTRL authority.
- An authorization ID of the process has the ALTERIN privilege on the schema.

The authorization ID used to alter the stored procedure definition must have appropriate authority for the specified environment (WLM environment or DB2-established stored procedure address space) in which the procedure is currently defined to run. This authorization is obtained from an external security product, such as RACF.

Syntax

```
►►──ALTER PROCEDURE──procedure-name──option-list───────────────────────────────────────►◄
```

option-list: (Specify options in any order. Specify at least one option. Do not specify the same option more than once.)

```
►►──DYNAMIC RESULT SETS──integer──EXTERNAL NAME──┬─'string'───┬──┬─NOT DETERMINISTIC─┬──────────────►
                                                 └─identifier─┘  └─DETERMINISTIC─────┘

►──┬─MODIFIES SQL DATA─┬──┬─NO COLLID──────────────┬──WLM ENVIRONMENT──┬─name──────────────┬────────►
   ├─READS SQL DATA────┤  └─COLLID──collection-id─┘                    └─(──name──,──*──)─┘
   └─CONTAINS SQL──────┘

►─ASUTIME──┬─NO LIMIT────────┬──STAY RESIDENT──┬─NO──┬──PROGRAM TYPE──┬─SUB──┬─────────────────────►
           └─LIMIT──integer─┘                  └─YES─┘                 └─MAIN─┘

►─SECURITY──┬─DB2─────┬──COMMIT ON RETURN──┬─NO──┬──RUN OPTIONS──run-time-options───────────────────►
            ├─USER────┤                    └─YES─┘
            └─DEFINER─┘

►──┬─INHERIT SPECIAL REGISTERS─┬──┬─STOP AFTER SYSTEM DEFAULT FAILURES─┬──────────────────────────►◄
   └─DEFAULT SPECIAL REGISTERS─┘  ├─STOP AFTER──integer──FAILURES──────┤
                                  └─CONTINUE AFTER FAILURES────────────┘
```

Description

procedure-name
: Identifies the stored procedure to be altered. The name is implicitly or explicitly qualified by a schema. If the name is not explicitly qualified, it is implicitly qualified with a schema name according to the following rules:

- If the statement is embedded in a program, the schema name is the authorization ID in the QUALIFIER bind option when the plan or package was created or last rebound. If QUALIFIER was not specified, the schema name is the owner of the plan or package.
- If the statement is dynamically prepared, the schema name is the SQL authorization ID in the CURRENT SQLID special register.

DYNAMIC RESULT SETS*integer*
: Specifies the maximum number of query result sets that the stored procedure can return. The value must be between 0 and 32767.

EXTERNAL NAME *'string'* or *identifier*
: Specifies the name of the MVS load module for the program that runs when the procedure name is specified in an SQL CALL statement. The value must conform to the naming conventions for MVS load modules: the value must be less than or equal to 8 bytes, and it must conform to the rules for an ordinary identifier with the exception that it must not contain an underscore.

NOT DETERMINISTIC or **DETERMINISTIC**
: Specifies whether the stored procedure returns the same results each time the stored procedure is called with the same IN and INOUT arguments.

DETERMINISTIC
: The stored procedure always returns the same results each time the stored procedure is called with the same IN and INOUT arguments, if the referenced data in the database has not changed.

NOT DETERMINISTIC
: The stored procedure might not return the same result each time the

procedure is called with the same IN and INOUT arguments, even when the referenced data in the database has not changed.

DB2 does not verify that the stored procedure code is consistent with the specification of DETERMINISTIC or NOT DETERMINISTIC.

MODIFIES SQL DATA, **READS SQL DATA**, or **CONTAINS SQL**

Specifies the classification of SQL statements that the procedure can execute. For the data access classification of each statement, see Table 95 on page 1158.

MODIFIES SQL DATA

Specifies that the procedure can execute any SQL statement except statements that are not supported in procedures.

READS SQL DATA

Specifies that the procedure can execute any SQL statement except statements that are not supported in procedures. Specifies that the procedure can execute statements with a data access classification of READS SQL DATA or CONTAINS SQL. SQL statements that do not modify SQL data can be included in the procedure. Statements that are not supported in any procedure return a different error.

CONTAINS SQL

Specifies that the procedure can execute only SQL statements with a data classification of CONTAINS SQL. SQL statements that neither read nor modify SQL data can be executed by the procedure. Statements that are not supported in any procedure return a different error.

NO COLLID or **COLLID** *collection-id*

Identifies the package collection that is to be used when the stored procedure is executed. This is the package collection into which the DBRM that is associated with the stored procedure is bound.

NO COLLID

Indicates that the package collection for the stored procedure is the same as the package collection of the calling program. If the invoking program does not use a package, DB2 resolves the package by using the CURRENT PACKAGE PATH special register, the CURRENT PACKAGESET special register, or the PKLIST bind option (in this order). For details about how DB2 uses these three items, see the information on package resolution in Part 5 of *DB2 Application Programming and SQL Guide*.

COLLID *collection-id*

Indicates the package collection for the stored procedure is the one specified.

WLM ENVIRONMENT

Identifies the WLM (workload manager) environment in which the stored procedure is to run when the DB2 stored procedure address space is WLM-established. The *name* of the WLM environment is an SQL identifier.

name

The WLM environment in which the stored procedure must run. If another stored procedure or a user-defined function calls the stored procedure and that calling routine is running in an address space that is not associated with the specified WLM environment, DB2 routes the stored procedure request to a different address space.

(name,*)

When an SQL application program directly calls a stored procedure, the WLM environment in which the stored procedure runs.

If another stored procedure or a user-defined function calls the stored procedure, the stored procedure runs in the same WLM environment that the calling routine uses.

To change the environment in which the stored procedure is to run, you must have appropriate authority for the WLM environment. For an example of a RACF command that provides this authorization, see “Running stored procedures” on page 707.

ASUTIME

Specifies the total amount of processor time, in CPU service units, that a single invocation of a stored procedure can run. The value is unrelated to the ASUTIME column of the resource limit specification table.

When you are debugging a stored procedure, setting a limit can be helpful in case the stored procedure gets caught in a loop. For information on service units, see *z/OS MVS Initialization and Tuning Guide*.

NO LIMIT

There is no limit on the service units.

LIMIT *integer*

The limit on the service units is a positive *integer* in the range of 1 to 2G. If the stored procedure uses more service units than the specified value, DB2 cancels the stored procedure.

STAY RESIDENT

Specifies whether the stored procedure load module is to remain resident in memory when the stored procedure ends.

NO

The load module is deleted from memory after the stored procedure ends.

YES

The load module remains resident in memory after the stored procedure ends.

PROGRAM TYPE

Specifies whether the stored procedure runs as a main routine or a subroutine.

SUB

The stored procedure runs as a subroutine.

MAIN

The stored procedure runs as a main routine.

SECURITY

Specifies how the stored procedure interacts with an external security product, such as RACF, to control access to non-SQL resources.

DB2

The stored procedure does not require a special external security environment. If the stored procedure accesses resources that an external security product protects, the access is performed using the authorization ID associated with the stored procedure address space.

USER

An external security environment should be established for the stored procedure. If the stored procedure accesses resources that the external security product protects, the access is performed using the authorization ID of the user who invoked the stored procedure.

DEFINER

An external security environment should be established for the stored procedure. If the stored procedure accesses resources that the external security product protects, the access is performed using the authorization ID of the owner of the stored procedure.

RUN OPTIONS *run-time-options*

Specifies the Language Environment run-time options to be used for the stored procedure. You must specify *run-time-options* as a character string that is no longer than 254 bytes. If you do not specify RUN OPTIONS or pass an empty string, DB2 does not pass any run-time options to Language Environment, and Language Environment uses its installation defaults.

For a description of the Language Environment run-time options, see *z/OS Language Environment Programming Reference*.

COMMIT ON RETURN

Indicates whether DB2 commits the transaction immediately on return from the stored procedure.

NO

DB2 does not issue a commit when the stored procedure returns.

YES

DB2 issues a commit when the stored procedure returns if the following statements are true:

- The SQLCODE that is returned by the CALL statement is not negative.
- The stored procedure is not in a must abort state.

The commit operation includes the work that is performed by the calling application process and the stored procedure.

If the stored procedure returns result sets, the cursors that are associated with the result sets must have been defined as WITH HOLD to be usable after the commit.

INHERIT SPECIAL REGISTERS or **DEFAULT SPECIAL REGISTERS**

Specfies how special registers are set on entry to the routine.

INHERIT SPECIAL REGISTERS

Specifies that special registers should be inherited according to the rules listed in the table for characteristics of special registers in a stored procedure in Table 27 on page 111.

DEFAULT SPECIAL REGISTERS

Specifies that special registers should be initialized to the default values, as indicated by the rules in the table for characteristics of special registers in a stored procedure in Table 27 on page 111.

STOP AFTER SYSTEM DEFAULT FAILURES, STOP AFTER *nn* **FAILURES,** or **CONTINUE AFTER FAILURE**

Specifies whether the routine is to be put in a stopped state after some number of failures.

STOP AFTER SYSTEM DEFAULT FAILURES

Specifies that this routine should be placed in a stopped state after the number of failures indicated by the value of field MAX ABEND COUNT on installation panel DSNTIPX.

STOP AFTER *nn* FAILURES
Specifies that this routine should be placed in a stopped state after *nn* failures. The value *nn* can be an integer from 1 to 32767.

CONTINUE AFTER FAILURES
Specifies that this routine should not be placed in a stopped state after any failure.

Notes

Changes are immediate: Any changes that the ALTER PROCEDURE statement cause to the definition of a procedure take effect immediately. The changed definition is used the next time that the procedure is called.

Invalidation of plans and packages: When an SQL procedure is altered, all the plans and packages that refer to that procedure are marked invalid.

Alternative syntax and synonyms: To provide compatibility with previous releases of DB2 or other products in the DB2 UDB family, DB2 supports the following keywords:

- RESULT SET, RESULT SETS, and DYNAMIC RESULT SET as synonyms for DYNAMIC RESULT SETS.
- VARIANT as a synonym for NOT DETERMINISTIC
- NOT VARIANT as a synonym for DETERMINISTIC

Example

Modify the definition for an SQL procedure so that SQL changes are committed on return from the SQL procedure and the SQL procedure runs in the WLM environment named WLMSQLP.

```
ALTER PROCEDURE UPDATE_SALARY_1
 COMMIT ON RETURN YES
 WLM ENVIRONMENT WLMSQLP;
```

ALTER SEQUENCE

The ALTER SEQUENCE statement changes the attributes of a sequence at the current server. Only future values of the sequence are affected by the ALTER SEQUENCE statement.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

The privilege set that is defined below must include at least one of the following:
- Ownership of the sequence
- The ALTER privilege for the sequence
- The ALTERIN privilege on the schema
- SYSADM or SYSCTRL authority

The authorization ID that matches the schema name implicitly has the ALTERIN privilege on the schema.

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package. If the statement is dynamically prepared, the privilege set is the privileges that are held by the SQL authorization ID of the process.

Syntax

```
                                 ┌───────────────────────────────────────────────┐
                                 ▼      (1)                                       │
►►──ALTER SEQUENCE──sequence-name───────────┬─RESTART──┬──────────────────────┬─┬─┴──────────►◄
                                            │          └─WITH──numeric-constant─┘ │
                                            ├─INCREMENT BY──numeric-constant──────┤
                                            ├─┬─NO MINVALUE──────────────────┬────┤
                                            │ └─MINVALUE──numeric-constant───┘    │
                                            ├─┬─NO MAXVALUE──────────────────┬────┤
                                            │ └─MAXVALUE──numeric-constant───┘    │
                                            ├─┬─NO CYCLE─┬────────────────────────┤
                                            │ └─CYCLE────┘                        │
                                            ├─┬─NO CACHE──────────────────┬───────┤
                                            │ └─CACHE──integer-constant───┘       │
                                            └─┬─NO ORDER─┬────────────────────────┘
                                              └─ORDER────┘
```

Notes:

1 At least one option must be specified and the same clause must not be specified more than once. Separator commas may be specified between sequence attributes when a sequence is defined.

Description

SEQUENCE *sequence-name*
Identifies the sequence. The combination of sequence name and the implicit or

explicit qualifier must identify an existing sequence at the current server. *sequence-name* must not identify a sequence that is generated by the system for an identity column.

RESTART

Restarts the sequence. If *numeric-constant* is not specified, the sequence is restarted at the value specified implicitly or explicitly as the starting value on the CREATE SEQUENCE statement that originally created the sequence.

WITH *numeric-constant*

Specifies the value at which to restart the sequence. The value can be any positive or negative value that could be assigned to the a column of the data type that is associated with the sequence without non-zero digits existing to the right of the decimal point.

If RESTART is not specified, the sequence is not restarted. Instead, it resumes with the current values in effect for all the options after the ALTER statement is issued.

After a sequence is restarted or changed to allow cycling, sequence numbers may be duplicates of values generated by the sequence previously.

INCREMENT BY *numeric-constant*

Specifies the interval between consecutive values of the sequence. The value can be any positive or negative value (including 0) that could be assigned to a column of the data type that is associated with the sequence without any non-zero digits existing to the right of the decimal point. The default is 1.

If INCREMENT BY *numeric-constant* is positive, the sequence ascends. If INCREMENT BY *numeric-constant* is negative, the sequence descends. If INCREMENT BY *numeric-constant* is 0, the sequence is treated as an ascending sequence.

The absolute value of INCREMENT BY can be greater than the difference between MAXVALUE and MINVALUE.

NO MINVALUE or **MINVALUE**

Specifies whether or not there is a minimum end point of the range of values for the sequence.

NO MINVALUE

Specifies that the minimum end point of the range of values for the sequence has not been specified explicitly. In such a case, the value for MINVALUE becomes one of the following:

- For an ascending sequence, the value is the original starting value.
- For a descending sequence, the value is the minimum of the data type that is associated with the sequence.

MINVALUE *numeric-constant*

Specifies the minimum value at which a descending sequence either cycles or stops generating values, or an ascending sequence cycles to after reaching the maximum value. The last value that is generated for a cycle of a descending sequence will be equal to or greater than this value. MINVALUE is the value to which an ascending sequence cycles to after reaching the maximum value.

The value can be any positive or negative value that could be assigned to the a column of the data type that is associated with the sequence without non-zero digits existing to the right of the decimal point. The value must be less than or equal to the maximum value.

NO MAXVALUE or **MAXVALUE**

Specifies whether or not there is a maximum end point of the range of values for the sequence.

NO MAXVALUE

Specifies either explicitly or implicitly that the minimum end point of the range of values for the sequence has not be set. In such a case, the default value for MAXVALUE becomes one of the following:

- For an ascending sequence, the value is the maximum value of the data type that is associated with the sequence
- For a descending sequence, the value is the original starting value.

If NO MAXVALUE is explicitly specified in the ALTER SEQUENCE statement, the value of the MAXVALUE column in the catalog table is reset to the maximum value of the data type associated with the sequence if the sequence is ascending or the value stored in the START column of the catalog table if the sequence is descending. Whether the sequence is ascending or descending depends on whether or not the INCREMENT BY option is reset. If it is, the new INCREMENT BY VALUE determines if the sequence is ascending or descending. If it is not explicitly reset, the value stored in the INCREMENT column of the catalog table determines if the sequence is ascending or descending.

MAXVALUE *numeric-constant*

Specifies the maximum value at which an ascending sequence either cycles or stops generating values or a descending sequence cycles to after reaching the minimum value. The last value that is generated for a cycle of an ascending sequence will be less than or equal to this value. MAXVALUE is the value to which a descending sequence cycles to after reaching the minimum value.

The value can be any positive or negative value that could be assigned to the a column of the data type that is associated with the sequence without non-zero digits existing to the right of the decimal point. The value must be greater than or equal to the minimum value.

NO CYCLE or **CYCLE**

Specifies whether or not the sequence should continue to generate values after reaching either its maximum or minimum value. The boundary of the sequence can be reached either with the next value landing exactly on the boundary condition or by overshooting it.

NO CYCLE

Specifies that the sequence cannot generate more values once the maximum or minimum value for the sequence has been reached.

CYCLE

Specifies that the sequence continue to generate values after either the maximum or minimum value has been reached. If this option is used, after an ascending sequence reaches its maximum value, it generates its minimum value. After a descending sequence reaches its minimum value, it generates its maximum value. The maximum and minimum values for the sequence defined by the MINVALUE and MAXVALUE options determine the range that is used for cycling.

When CYCLE is in effect, duplicate values can be generated by the sequence. When a sequence is defined with CYCLE, any application conversion tools for converting applications from other vendor platforms to DB2 should also explicitly specify MINVALUE, MAXVALUE, and START WITH values.

NO CACHE or **CACHE**
Specifies whether or not to keep some preallocated values in memory for faster access. This is a performance and tuning option.

NO CACHE
Specifies that values of the sequence are not to be preallocated. This option ensures that there is not a loss of values in the case of a system failure. When NO CACHE is specified, the values of the sequence are not stored in the cache. In this case, every request for a new value for the sequence results in synchronous I/O.

CACHE *integer-constant*
Specifies the maximum number of sequence values that DB2 can preallocate and keep in memory. Preallocating values in the cache reduces synchronous I/O when values are generated for the sequence. The actual number of values that DB2 caches is always the lesser of the number in effect for the CACHE option and the number of remaining values within the logical range. Thus, the CACHE value is essentially an upper limit for the size of the cache.

In the event of a system failure, all cached sequence values that have not been used in committed statements are lost (that is, they will never be used). The value specified for the CACHE option is the maximum number of sequence values that could be lost in case of system failure.

The minimum value is 2.

In a data sharing environment, you can use the CACHE and NO ORDER options to allow multiple DB2 members to cache sequence values simultaneously.

NO ORDER or **ORDER**
Specifies whether the sequence numbers must be generated in order of request.

NO ORDER
Specifies that the sequence numbers do not need to be generated in order of request.

ORDER
Specifies that the sequence numbers are generated in order of request. Specifying ORDER may disable the caching of values. There is no guarantee that values are assigned in order across the entire server unless NO CACHE is also specified. ORDER applies only to a single-application process.

In a data sharing environment, if the CACHE and NO ORDER options are in effect, multiple caches can be active simultaneously, and the requests for next value assignments from different DB2 members may not result in the assignment of values in strict numeric order. For example, if members DB2A and DB2B are using the same sequence, and DB2A gets the cache values 1 to 20 and DB2B gets the cache values 21 to 40, the actual order of values assigned would be 1,21,2 if DB2A requested for next value first, then DB2B requested, and then DB2A again requested. Therefore, to guarantee that sequence numbers are generated in strict numeric order among multiple DB2 members using the same sequence concurrently, specify the ORDER option.

Notes

Altering the attributes of a sequence: The changes to the attributes of a sequence take effect after the ALTER SEQUENCE statement is committed. If the ALTER SEQUENCE request results in an error or is rolled back, nothing is changed; however, unused cache values may be lost.

You cannot use the ALTER SEQUENCE statement to change the data type of a sequence. To change the data type, drop the sequence and recreate it.

Altering a sequence may cause unused cache values to be lost.

Alternative syntax and synonyms: To provide compatibility with previous releases of DB2 or other products in the DB2 UDB family, DB2 supports the following keywords:

- NOCACHE (single key word) as a synonym for NO CACHE
- NOCYCLE (single key word) as a synonym for NO CYCLE
- NOMINVALUE (single key word) as a synonym for NO MINVALUE
- NOMAXVALUE (single key word) as a synonym for NO MAXVALUE
- NOORDER (single key word) as a synonym for NO ORDER

Examples

Example 1: Reset a sequence to the START WITH value to generate the numbers from 1 up to the number of rows in the table:

```
ALTER SEQUENCE org_seq
  RESTART;
```

ALTER STOGROUP

The ALTER STOGROUP statement changes the description of a storage group at the current server.

Invocation

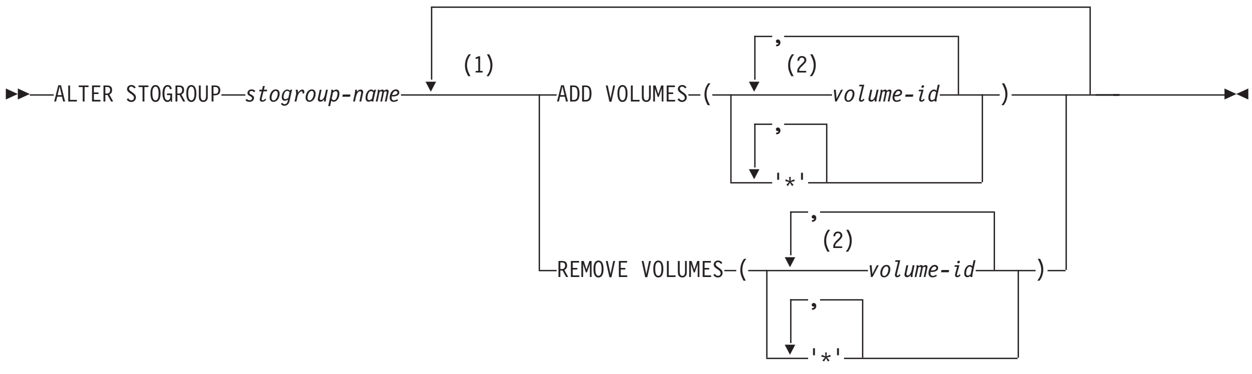
This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

The privilege set that is defined below must include one of the following:
- Ownership of the storage group
- SYSADM or SYSCTRL authority

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package. If the statement is dynamically prepared, the privilege set is the union of the privilege sets that are held by each authorization ID of the process.

Syntax



Notes:

1 The same clause must not be specified more than once.

2 The same *volume-id* must not be specified more than once in the same clause.

Description

stogroup-name
Identifies the storage group to be altered. The name must identify a storage group that exists at the current server.

ADD VOLUMES(*volume-id,...***)** or **ADD VOLUMES(***'*',...***)**
Adds volumes to the storage group. Each *volume-id* is the volume serial number of a storage volume to be added. It can have a maximum of six characters and is specified as an identifier or a string constant.

A *volume-id* must not be specified if any volume of the storage group is designated by an asterisk (*). An asterisk must not be specified if any volume of the storage group is designated by a *volume-id*.

You cannot add a volume that is already in the storage group unless you first remove it with REMOVE VOLUMES.

Asterisks are recognized only by Storage Management Subsystem (SMS). To allow SMS control over volume selection, define DB2 STOGROUPs with VOLUMES(*'*',...*. SMS usage is recommended, rather than using DB2 to allocate data to specific volumes. Having DB2 select the volume requires non-SMS usage or assigning an SMS Storage Class with guaranteed space. However, because guaranteed space reduces the benefits of SMS allocation, it is not recommended.

If you do choose to use specific volume assignments, additional manual space management must be performed. Free space must be managed for each individual volume to prevent failures during the initial allocation and extension. This process generally requires more time for space management and results in more space shortages. Guaranteed space should be used only where the space needs are relatively small and do not change.

REMOVE VOLUMES(*volume-id,...***)** or **REMOVE VOLUMES(***'*',...***)**

Removes volumes from the storage group. Each *volume-id* is the volume serial number of a storage volume to be removed. Each *volume-id* must identify a volume that is in the storage group.

The REMOVE VOLUMES clause is applied to the current list of volumes before the ADD VOLUMES clause is applied. Removing a volume from a storage group does not affect existing data, but a volume that has been removed is not used again when the storage group is used to allocate storage for table spaces or index spaces.

Asterisks are recognized only by Storage Management Subsystem (SMS). For information about using asterisks, see the above description of the ADD VOLUMES clause.

Notes

Work file databases: If the storage group altered contains data sets in a work file database, the database must be stopped and restarted for the effects of the ALTER to be recognized. To stop and restart a database, issue the following commands:

```
-STOP DATABASE(database-name)
-START DATABASE(database-name)
```

Device types: When the storage group is used at run time, an error can occur if the volumes in the storage group are of different device types, or if a volume is not available to z/OS for dynamic allocation of data sets.

When a storage group is used to extend a data set, all volumes in the storage group must be of the same device type as the volumes used when the data set was defined. Otherwise, an extend failure occurs if an attempt is made to extend the data set.

Number of volumes: There is no specific limit on the number of volumes that can be defined for a storage group. However, the maximum number of volumes that can be managed for a storage group is 133. Thus, there is no point in creating a storage group with more than 133 volumes.

z/OS imposes a limit on the number of volumes that can be allocated per data set: 59 at this writing. For the latest information on that restriction, see *DFSMS/MVS: Access Method Services for the Integrated Catalog*.

Verifying volume IDs: When processing the ADD VOLUMES or REMOVE VOLUMES clause, DB2 does not check the existence of the volumes or determine the types of devices that they identify. Later, when the storage group is used to allocate or deallocate data sets, the list of volumes is passed in the specified order to Data Facilities (DFSMSdfp™), which does the actual work. See Part 2 (Volume 1) of *DB2 Administration Guide* for more information about creating DB2 storage groups.

SMS data set management: You can have Storage Management Subsystem (SMS) manage the storage needed for the objects that the storage group supports. To do so, specify ADD VOLUMES('*') and REMOVE VOLUMES(*current-vols*) in the ALTER statement, where *current-vols* is the list of the volumes currently assigned to the storage group. SMS manages every data set created later for the storage group. SMS does not manage data sets created before the execution of the statement.

You can also specify ADD VOLUMES(*volume-id*) and REMOVE VOLUMES('*') to make the opposite change.

See Part 2 (Volume 1) of *DB2 Administration Guide* for considerations for using SMS to manage data sets.

Examples

Example 1: Alter storage group DSN8G810. Add volumes DSNV04 and DSNV05.

```
ALTER STOGROUP DSN8G810
    ADD VOLUMES (DSNV04,DSNV05);
```

Example 2: Alter storage group DSN8G810. Remove volumes DSNV04 and DSNV05.

```
ALTER STOGROUP DSN8G810
  REMOVE VOLUMES (DSNV04,DSNV05);
```

ALTER TABLE

The ALTER TABLE statement changes the description of a table at the current server.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

The privilege set that is defined below must include at least one of the following:

- The ALTER privilege on the table
- Ownership of the table
- DBADM authority for the database
- SYSADM or SYSCTRL authority

Additional privileges might be required in the following situations:

- FOREIGN KEY, DROP PRIMARY KEY, DROP FOREIGN KEY, or DROP CONSTRAINT is specified.
- The data type of a column that is added to the table is a distinct type.
- A fullselect is specified.
- A column is defined as a security label column.

See the description of the appropriate clauses for the details about these privileges.

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package. If the statement is dynamically prepared, the privilege set is the union of the privilege sets that are held by each authorization ID of the process.

Syntax

```
►►──ALTER TABLE──table-name──────────────────────────────────────────────────────►

   ┌──────────────────────────────────────────────────────────────────────┐
   ▼  (1)   (2)       (3)                                                 │
►──────────────────┬─ADD──────────┬─column-definition──────┬──────────┬──┴──────►◄
                   │              ├─unique-constraint──────┤          │
                   │              ├─referential-constraint─┤          │
                   │              ├─check-constraint───────┤          │
                   │              ├─add-partition──────────┤          │
                   │              ├─partitioning-clause────┤          │
                   │              └─RESTRICT ON DROP───────┘          │
                   ├─ALTER──┬─column-alteration────┬──────────────────┤
                   │        └─partition-alteration─┘                  │
                   ├─ROTATE──partition-rotation───────────────────────┤
                   ├─DROP──┬─PRIMARY KEY──────────────────────────────┤
                   │       ├─┬─FOREIGN KEY─┬─constraint-name─┤        │
                   │       │ ├─UNIQUE──────┤                 │        │
                   │       │ ├─CHECK───────┤                 │        │
                   │       │ └─CONSTRAINT──┘                 │        │
                   │       └─RESTRICT ON DROP────────────────┘        │
                   ├─VALIDPROC──┬─program-name─┬──────────────────────┤
                   │            └─NULL─────────┘                      │
                   ├─AUDIT──┬─NONE────┬───────────────────────────────┤
                   │        ├─CHANGES─┤                               │
                   │        └─ALL─────┘                               │
                   ├─DATA CAPTURE──┬─NONE────┬────────────────────────┤
                   │               └─CHANGES─┘                        │
                   │                     ┌─CARDINALITY─┐              │
                   ├──┬─NOT VOLATILE─┬───┴─────────────┴──────────────┤
                   │  └─VOLATILE─────┘                                │
                   │            ┌─MATERIALIZED─┐                      │
                   │      ┌─────┴──────────────┴─QUERY─┐              │
                   ├─ADD──┴────────────────────────────┴─materialized-query-definition──┤
                   │           ┌─MATERIALIZED─┐                       │
                   ├─DROP──────┴──────────────┴─QUERY─────────────────┤
                   │            ┌─MATERIALIZED─┐                      │
                   └─ALTER──────┴──────────────┴─QUERY──materialized-query-table-alteration─┘
```

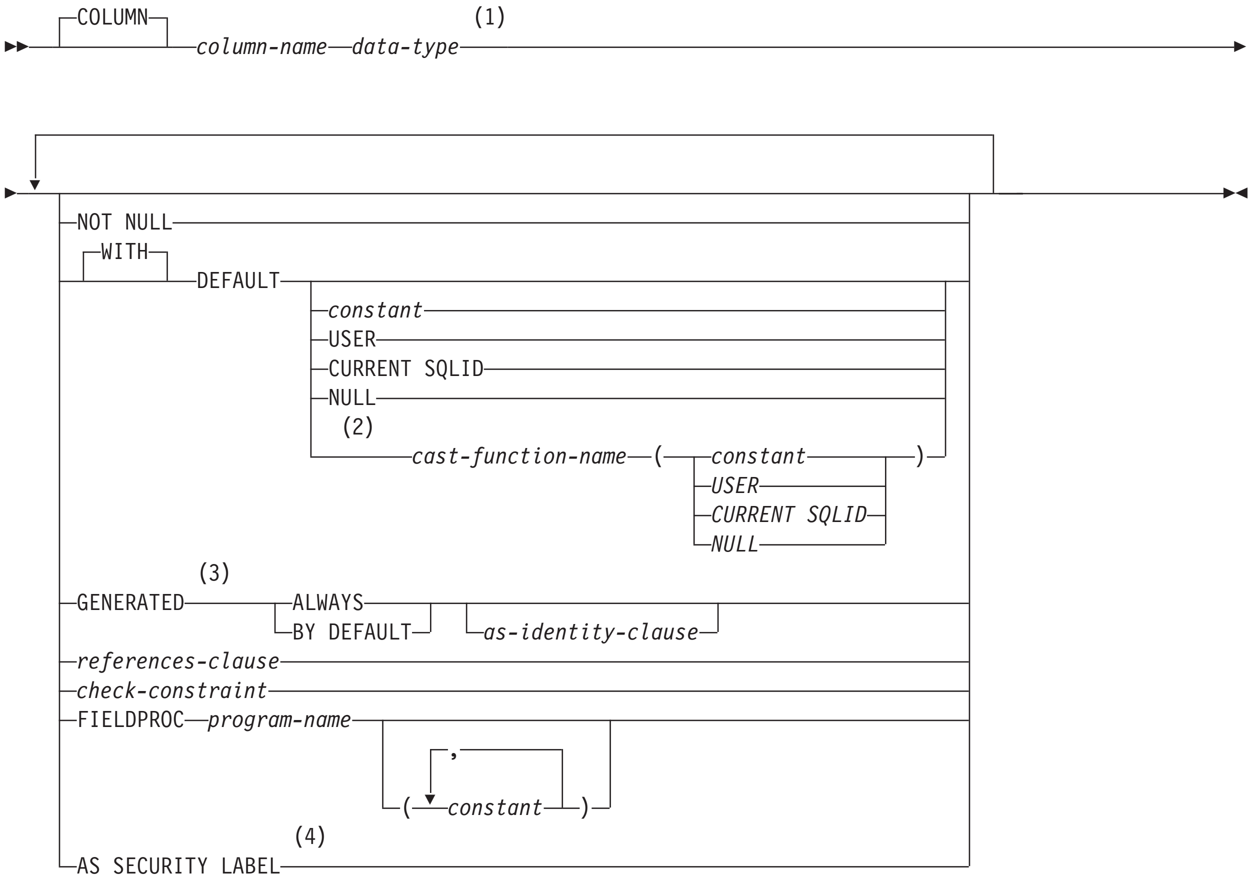
Notes:

1 The same clause must not be specified more than once, except for the ALTER COLUMN clause, which can be specified more than once. If ALTER COLUMN SET DATA TYPE is specified, it must be specified first.

2 The following clauses are mutually exclusive with each other:
- ALTER TABLE ADD PARTITION
- ALTER TABLE ALTER COLUMN
- ALTER TABLE ALTER PARTITION
- ALTER TABLE ROTATE PARTITION FIRST TO LAST

3 The ADD keyword is optional for referential-constraint or check-constraint if it is the first clause specified in the statement. Otherwise, ADD is required.

column-definition:



Notes:

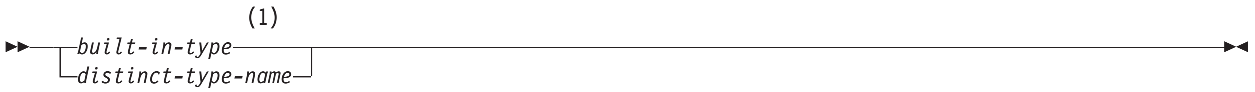
1 The same clause must not be specified more than once.

2 The cast-function-name form of the DEFAULT value can only be used with a column that is defined as a distinct type.

3 GENERATED must be specified if the column is to be an identity column. A column that has a ROWID data type (or a distinct type that is based on a ROWID data type) defaults to GENERATED ALWAYS.

4 This clause can be specified only for a CHAR(8) data type and requires that the NOT NULL WITH DEFAULT clause be specified.

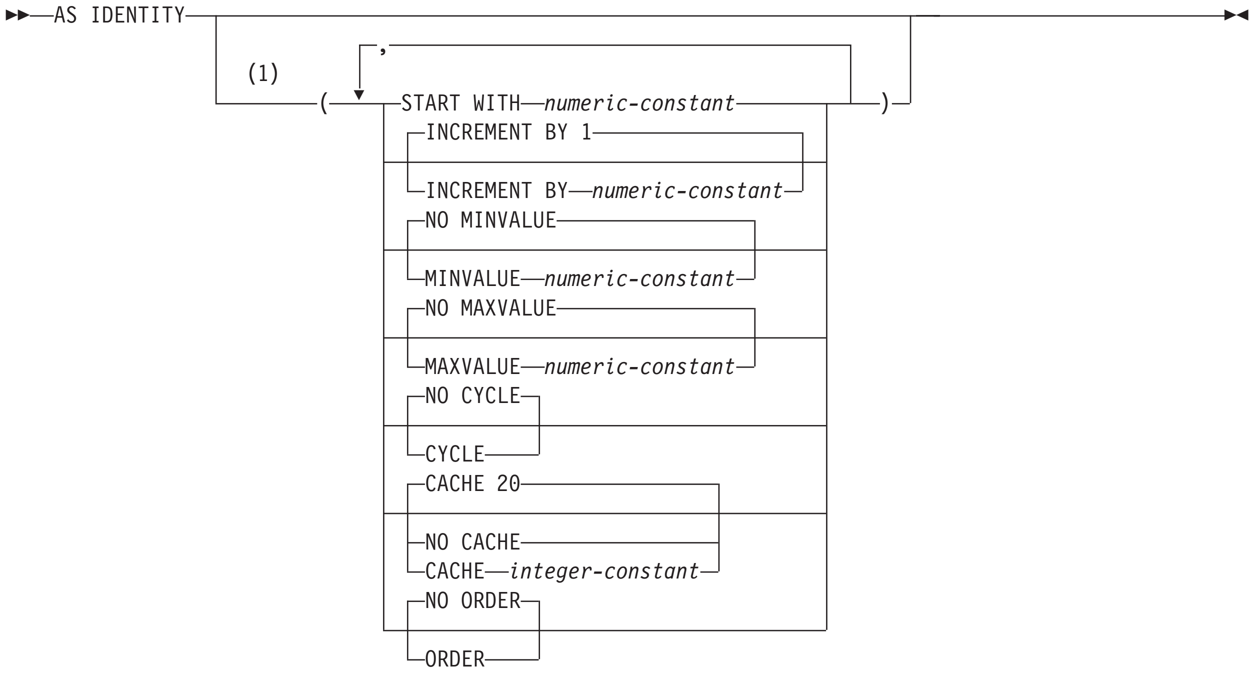
data-type:



Notes:

1 For the syntax, see “built-in-type” on page 741.

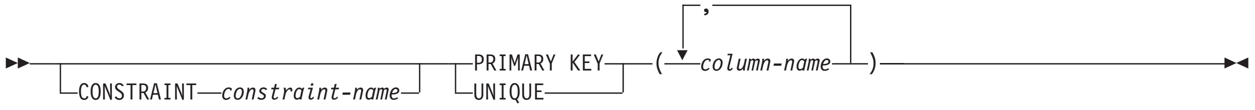
as-identity-clause:



Notes:

1 Separator commas may or may not be specified between attributes when an identity column is defined.

unique-constraint:



referential-constraint:

```
                                               (1)    ┌─,───────────┐
►►──┬──────────────────────────────┬──FOREIGN KEY─────(──▼─column-name─┴──)──references-clause──────────►◄
    └─CONSTRAINT──constraint-name──┘
```

Notes:

1 For compatibility with prior releases, when the CONSTRAINT clause (shown above) is not specified, a *constraint-name* may be specified following FOREIGN KEY.

references-clause:

```
►►──REFERENCES──table-name──┬─────────────────────────┬──┬───────────────────────────────┬──────────►
                            │    ┌─,───────────┐      │  └─ON DELETE──┬─RESTRICT──┬──────┘
                            └─(──▼─column-name─┴──)───┘               ├─NO ACTION─┤
                                                                      ├─CASCADE───┤
                                                                      └─SET NULL──┘

   ┌─ENFORCED─────┐  ┌─ENABLE QUERY OPTIMIZATION─┐
►──┼──────────────┼──┴───────────────────────────┴───────────────────────────────────────────────►◄
   └─NOT ENFORCED─┘
```

check-constraint:

```
►►──┬──────────────────────────────┬──CHECK──(check-condition)──────────────────────────────────►◄
    └─CONSTRAINT──constraint-name──┘
```

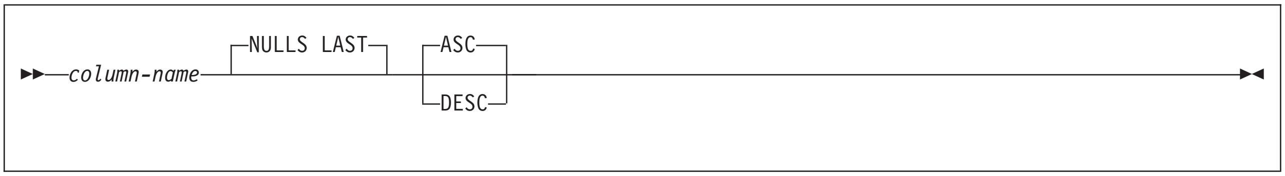
add-partition:

```
                                   ┌─,────────┐
                       ┌─AT─┐      │          │      ┌─INCLUSIVE─┐
►►──PARTITION──ENDING──┴────┴──(──▼─constant─┴──)───┴───────────┴──────────────────────────────►◄
```

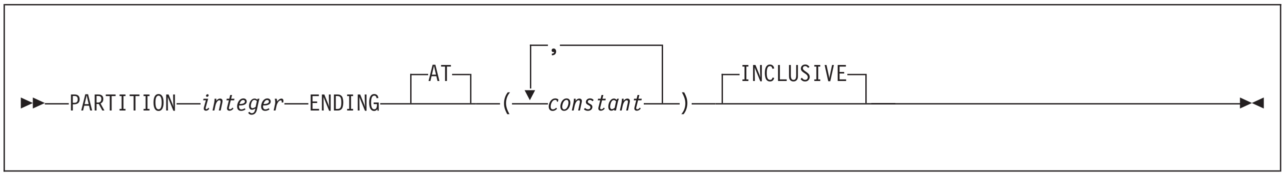
partitioning-clause:

```
                                   ┌─,────────────────────┐       ┌─,─────────────────┐
                 ┌─RANGE─┐         │                      │       │                   │
►►──PARTITION BY─┴───────┴──(──▼─partition-expression─┴──)──(──▼─partition-element─┴──)──────────►◄
```

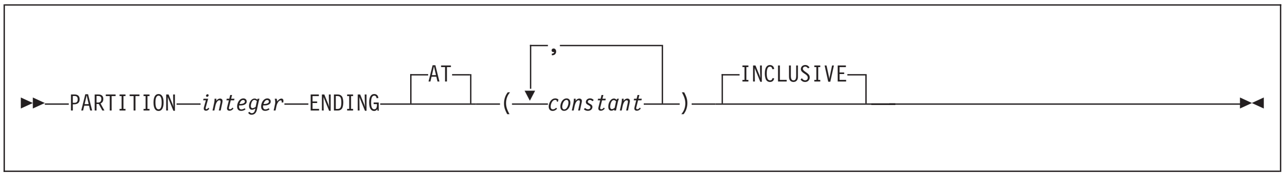
partition-expression:



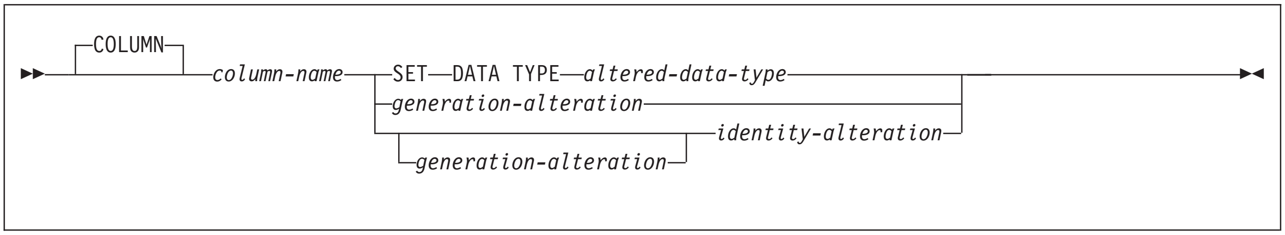
partition-element:



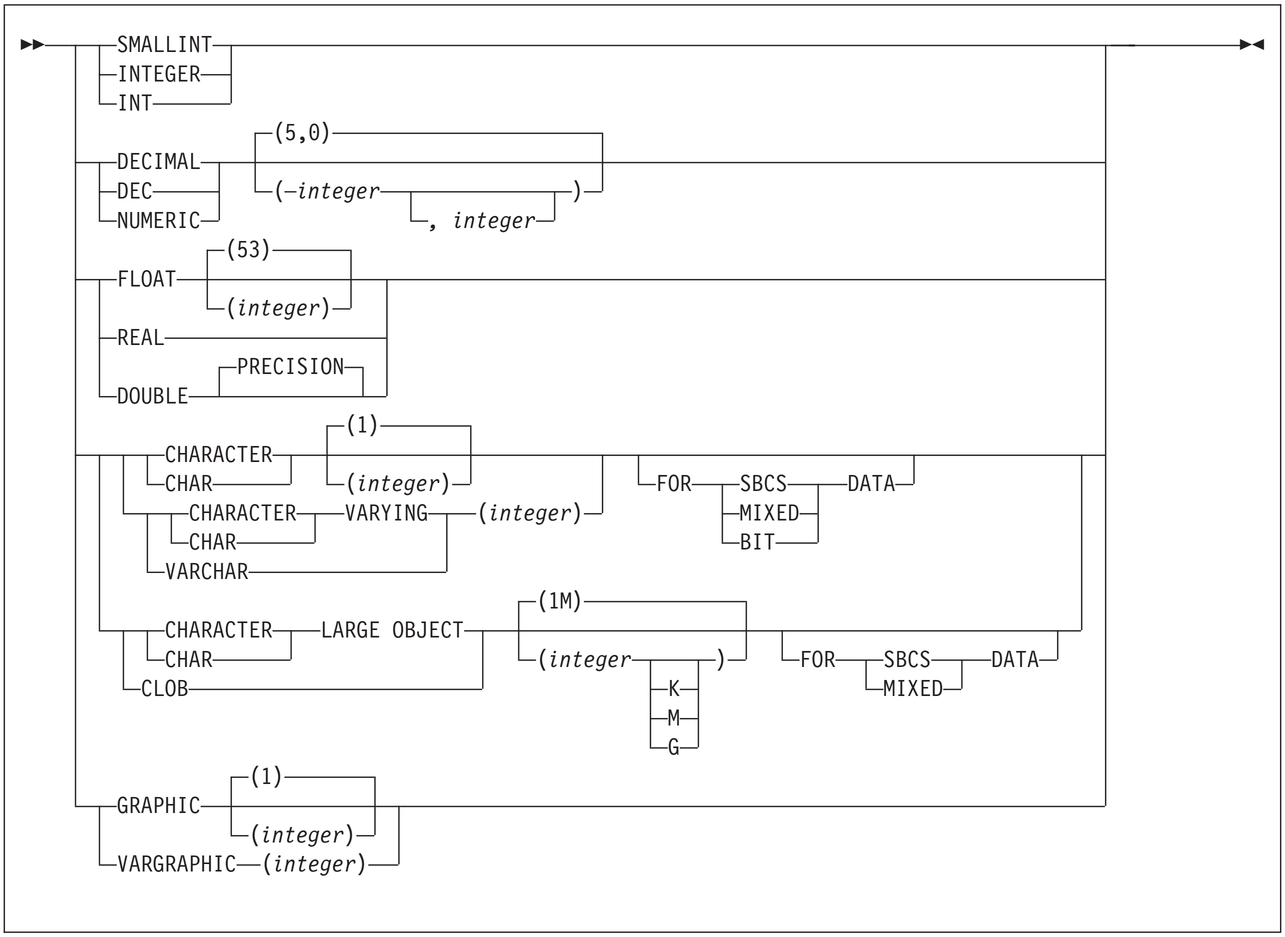
partition-alteration:



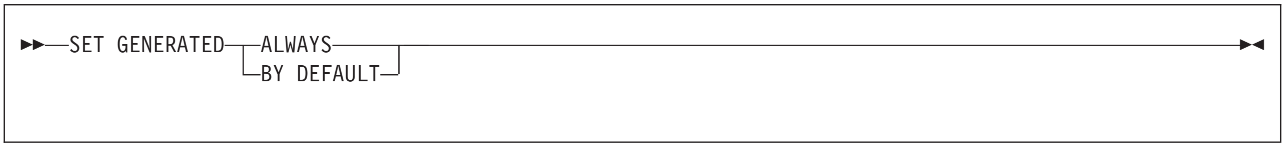
column-alteration:



altered-data-type:



generation-alteration:



identity-alteration:

```
       ┌─────────────────────────────────────────────────┐
       ↓  (1)                                            │
►►─────────┬─RESTART─┬─────────────────────────┬─────────┴──────────────────────────────────────►◄
           │         └─WITH──numeric-constant──┘  │
           ├─SET INCREMENT BY──numeric-constant───┤
           ├─SET───┬─NO MINVALUE──────────────────┤
           │       └─MINVALUE──numeric-constant─┘ │
           ├─SET───┬─NO MAXVALUE──────────────────┤
           │       └─MAXVALUE──numeric-constant─┘ │
           ├─SET───┬─NO CYCLE─┬───────────────────┤
           │       └─CYCLE────┘                   │
           ├─SET───┬─NO CACHE─────────────────────┤
           │       └─CACHE──integer-constant──┘   │
           └─SET───┬─NO ORDER─┬───────────────────┘
                   └─ORDER────┘
```

Notes:

1 At least one option must be specified and the same clause must not be specified more than once.

partition-rotation:

```
                                                       ┌─,────────┐
                                          ┌─AT─┐       ↓          │        ┌─INCLUSIVE─┐
►►──PARTITION FIRST TO LAST──ENDING───────┴────┴──(────constant───┴──)───┴───────────┴──RESET────►◄
```

materialized-query-definition:

```
►►──(──fullselect──)──refreshable-table-options──────────────────────────────────────────────►◄
```

refreshable-table-options:

```
                                            ┌──────────────────────────────────────┐
                                            ▼  (1)                                  │
►►──DATA INITIALLY DEFERRED──REFRESH DEFERRED──────┬──────────────────────────────┬─┴──────────►◄
                                                   │ ┌─MAINTAINED BY SYSTEM─┐      │
                                                   ├─┴─MAINTAINED BY USER───┴──────┤
                                                   │ ┌─ENABLE QUERY OPTIMIZATION──┐│
                                                   └─┴─DISABLE QUERY OPTIMIZATION─┴┘
```

Notes:

1 The same clause must not be specified more than once.

materialized-query-table-alteration:

```
►►──SET──refreshable-table-alteration──────────────────────────────────────────►◄
```

refreshable-table-alteration:

```
     ┌───────────────────────────────────────────┐
     ▼  (1)                                       │
►►──────┬─MAINTAINED BY──┬─SYSTEM─┬─────────────┬─┴──────────────────────────────►◄
        │                └─USER───┘             │
        └──┬─ENABLE──┬──QUERY OPTIMIZATION──────┘
           └─DISABLE─┘
```

Notes:

1 The same clause must not be specified more than once.

Description

table-name
Identifies the table to be altered. The name must identify a table that exists at the current server. The name must not identify an auxiliary table, declared temporary table, or view. If the name identifies a catalog table, DATA CAPTURE CHANGES is the only clause that can be specified. If *table-name* identifies a materialized query table, alterations are limited to either using the DROP MATERIALIZED QUERY clause, changing the materialized query table options with the ALTER MATERIALIZED QUERY clause, or using AUDIT, DATA CAPTURE, and ADD or DROP RESTRICT ON DROP clauses.

column-definition

ADD column-definition
Adds a column to the table. Except for a ROWID column and an identity column, all values of the column in existing rows are set to its default value. If

the table has *n* columns, the ordinality of the new column is *n*+1. The value of *n* cannot be greater than 749. For a dependent table, *n* cannot be greater than 748.

The column cannot be added if the increase in the total byte count of the columns exceeds the maximum row size. The maximum row size for the table is eight less than the maximum record size as described in “Maximum record size” on page 767. A column also cannot be added to a table that has an edit procedure.

If you add a LOB column and the table does not already have a ROWID column, DB2 creates a hidden ROWID column. You cannot add a LOB or ROWID column to a created temporary table. For details about adding a LOB column, such as the other objects that might be implicitly created or need to be explicitly created, see “Creating a table with LOB columns” on page 766. For more information about adding a ROWID column, see “Adding a ROWID column” on page 539.

You cannot add an identity column to a table that has an identity column or to a created temporary table. For more information about adding an identity column, see “Adding an identity column” on page 539. You cannot add a security label column to a table that has a security label column.

column-name
Is the name of the column you want to add to the table. Do not use the name of an existing column of the table. Do not qualify *column-name*.

built-in-type
Specifies the data type of the column is one of the built-in data types. See “built-in-type” on page 741 for details.

distinct-type-name
Specifies the distinct type (user-defined data type) of the column. The length and scale of the column are respectively the length and scale of the source type of the distinct type. The privilege set must implicitly or explicitly include the USAGE privilege on the distinct type.

The encoding scheme of the distinct type must be the same as the encoding scheme of the table.

If the column is to be used in the definition of the foreign key of a referential constraint, the data type of the corresponding column of the parent key must have the same distinct type.

NOT NULL
Prevents the column from containing null values. If NOT NULL is specified, the DEFAULT clause must be used to specify a nonnull default value for the column unless the column has a row ID data type or is an identity column. For a ROWID column, NOT NULL must be specified, and DEFAULT must not be specified. For an identity column, although NOT NULL can be specified, DEFAULT must not be specified.

DEFAULT
The default value assigned to the column in the absence of a value specified on INSERT or LOAD. Do not specify DEFAULT for the following types of columns because DB2 generates default values:

- A ROWID column
- An identity column (a column that is defined AS IDENTITY)
- A security label column (a column that is defined AS SECURITY LABEL)

If a value is not specified after the DEFAULT keyword, the default value depends on the data type of the column as indicated in the following table:

Data Type	Default Value
Numeric	0
Fixed-length string	Blanks
Varying-length string	A string of length 0
Date	For existing rows, a date corresponding to 1 January 0001. For added rows, CURRENT DATE.
Time	For existing rows, a time corresponding to 0 hours, 0 minutes, and 0 seconds. For added rows, CURRENT TIME.
Timestamp	For existing rows, a date corresponding to 1 January 0001, and a time corresponding to 0 hours, 0 minutes, 0 seconds, and 0 microseconds. For added rows, CURRENT TIMESTAMP.

A default value other than the one that is listed above can be specified in one of the following forms, except for a LOB column. The only form that can be specified for a LOB column is DEFAULT NULL. Unlike other varying-length strings, a LOB column can have the default value of only a zero-length string or null. Specify:
- WITH DEFAULT for a default value of an empty string
- DEFAULT NULL for a default value of null

constant

Specifies a constant as the default value for the column. The value of the constant must conform to the rules for assigning that value to the column.

A character or string constant must be short enough so that its UTF-8 representation requires no more than 1536 bytes. In addition, a hexadecimal graphic string (GX) constant cannot be specified.

USER

Specifies the value of the USER special register at the time of INSERT or LOAD as the default for the column. If USER is specified, the data type of the column must be a character string with a length greater than or equal to the length attribute of the USER special register. For existing rows, the value is that of the USER special register at the time the ALTER TABLE statement is processed.

CURRENT SQLID

Specifies the value of the SQL authorization ID of the process at the time of INSERT or LOAD as the default for the column. If CURRENT SQLID is specified, the data type of the column must be a character string with a length greater than or equal to the length attribute of the CURRENT SQLID special register. For existing rows, the value is the SQL authorization ID of the process at the time the ALTER TABLE statement is processed.

NULL

Specifies null as the default value for the column.

cast-function-name

The name of the cast function that matches the name of the distinct type for the column. A cast function can be specified only if the data type of the column is a distinct type.

The schema name of the cast function, whether it is explicitly specified or implicitly resolved through function resolution, must be the same as the explicitly or implicitly specified schema name of the distinct type.

In a given column definition:

- DEFAULT and FIELDPROC cannot both be specified.
- NOT NULL and DEFAULT NULL cannot both be specified.
- DEFAULT cannot be specified for a ROWID column or an identity column.
- Omission of NOT NULL and DEFAULT for a column other than an identity column is an implicit specification of DEFAULT NULL. For an identity column, it is an implicit specification of NOT NULL, and DB2 generates default values.

GENERATED

Indicates that DB2 generates values for the column. GENERATED is applicable only to ROWID columns and identity columns. If the data type of the column is a ROWID (or a distinct type that is based on a ROWID), the default is GENERATED ALWAYS.

ALWAYS

Indicates that DB2 will generate a value for the column when a row is inserted into the table. ALWAYS is the recommended value unless you are using data propagation.

If you specify ALWAYS, you must not specify a value for the column when a row is inserted into the table. Also, you cannot update the value of the column

BY DEFAULT

Indicates that DB2 will generate a value for the column when a row is inserted unless a value was specified for the column on the insert.

If a user-supplied value is specified for a ROWID column, DB2 uses the value only if it is a valid row ID value that was previously generated by DB2 and the column has a unique, single-column index. Until this index is created on the ROWID column, the SQL INSERT statement and the LOAD utility cannot be used to add rows to the table. If the value of special register CURRENT RULES is 'STD' when the ALTER TABLE statement is processed, DB2 implicitly creates the index on the ROWID column. The name of this index is 'I' followed by the first ten characters of the column name followed by seven randomly generated characters. If the column name is less than ten characters, DB2 adds underscore characters to the end of the name until it has ten characters. The implicitly created index has the COPY NO attribute.

For an identity column, DB2 inserts a specified value but does not verify that it is a unique value for the column unless the identity column has a unique, single-column index; without a unique index, DB2 can guarantee unique values only among the set of system-generated values.

If a user-supplied value is specified for an identity column, DB2 inserts the specified value but does not perform any special validation on that value beyond the normal validation that is performed for any column. DB2 does not check how the specified value affects the sequential properties that are defined for the identity column. DB2 can guarantees the uniqueness of values only for identity columns that are defined as GENERATED ALWAYS. To ensure the uniqueness of an identity column that is defined as GENERATED BY DEFAULT, define a unique index on the identity column.

BY DEFAULT is the recommended value only when you are using data propagation.

AS IDENTITY

Specifies that the column is an identity column for the table. A table can have only one identity column. AS IDENTITY can be specified only if the data type for the column is an exact numeric type with a scale of zero (SMALLINT, INTEGER, DECIMAL with a scale of zero, or a distinct type based on one of these types). Separator commas between identity column attribute specifications are optional when the identity column is defined.

An identity column is implicitly NOT NULL. When adding an identity column to a table, you must also specify GENERATED ALWAYS or GENERATED BY DEFAULT.

START WITH *numeric-constant*

Specifies the first value that is generated for the identity column. The value can be any positive or negative value that could be assigned to the column without non-zero digits existing to the right of the decimal point.

If a value is not explicitly specified when the identity column is defined, the default is the MINVALUE for an ascending identity column and the MAXVALUE for a descending identity column. This value is not necessarily the value that would be cycled to after reaching the maximum or minimum value for the identity column. The START WITH clause can be used to start the generation of values outside the range that is used for cycles. The range used for cycles is defined by MINVALUE and MAXVALUE.

INCREMENT BY *numeric-constant*

Specifies the interval between consecutive values of the identity column. The value can be any positive or negative value (including 0) that does not exceed the value of a large integer constant and could be assigned to the column without any non-zero digits existing to the right of the decimal point. The default is 1.

If the value is positive or zero, the sequence of values for the identity column ascends. If the value is negative, the sequence of values descends.

MINVALUE or **NO MINVALUE**

Specifies the minimum value at which a descending identity column either cycles or stops generating values or an ascending identity column cycles to after reaching the maximum value.

NO MINVALUE

Specifies that the minimum end point of the range of values for the identity column has not be set. In such a case, the default value for MINVALUE becomes one of the following:

- For an ascending identity column, the value is the START WITH value or 1 if START WITH was not specified.
- For a descending identity column, the value is the minimum value of the data type of the column.

MINVALUE *numeric-constant*

Specifies the numeric constant that is the minimum value that is generated for this identity column. This value can be any positive or negative value that could be assigned to this column without non-zero digits existing to the right of the decimal point. The value must be less than or equal to the maximum value.

MAXVALUE or **NO MAXVALUE**

Specifies the maximum value at which a ascending identity column either cycles or stops generating values or a descending identity column cycles to after reaching the minimum value.

NO MAXVALUE

Specifies that the minimum end point of the range of values for the identity column has not be set. In such a case, the default value for MAXVALUE becomes one of the following:

- For an ascending identity column, the value is the maximum value of the data type of the column.
- For a descending identity column, the value is the START WITH value or -1 if START WITH is not specified.

MAXVALUE *numeric-constant*

Specifies the numeric constant that is the maximum value that is generated for this identity column. This value can be any positive or negative value that could be assigned to this column without non-zero digits existing to the right of the decimal point. The value must be greater than or equal to the minimum value.

CYCLE or **NO CYCLE**

Specifies whether this identity column should continue to generate values after reaching either its maximum or minimum value.

NO CYCLE

Specifies that values will not be generated for the identity column after the maximum or minimum value has been reached. This is the default.

CYCLE

Specifies that values continue to be generated for this column after the maximum or minimum value has been reached. If this option is used, after an ascending identity column reaches the maximum value, it generates its minimum value. After a descending identity column reaches its minimum value, it generates its maximum value. The maximum and minimum values for the identity column determine the range that is used for cycling.

When CYCLE is in effect, duplicate values can be generated by DB2 for an identity column. However, if a unique index exists on the identity column and a non-unique value is generated for it, an error occurs.

CACHE or **NO CACHE**

Specifies whether to keep some preallocated values in memory.

Preallocating and storing values in the cache improves the performance of inserting rows into a table. The default is CACHE 20.

NO CACHE
Specifies that values for the identity column are not preallocated and stored in the cache, ensuring that values will not be lost in the case of a system failure. In this case, every request for a new value for the identity column results in synchronous I/O.

CACHE *integer-constant*
Specifies the maximum number of values of the identity column sequence that DB2 can preallocate and keep in memory.

During a system failure, all cached identity column values that are yet to be assigned might be lost and will not be used. Therefore, the value that is specified for CACHE also represents the maximum number of values for the identity column that could be lost during a system failure.

The minimum value is 2.

In a data sharing environment, you can use the CACHE and NO ORDER options to allow multiple DB2 members to cache sequence values simultaneously.

ORDER or **NO ORDER**
Specifies whether the identity column values must be generated in order of request. The default is NO ORDER.

NO ORDER
Specifies that the values do not need to be generated in order of request.

ORDER
Specifies that the values are generated in order of request. Specifying ORDER may disable the caching of values. ORDER applies only to a single-application process.

In a data sharing environment, if the CACHE and NO ORDER options are in effect, multiple caches can be active simultaneously, and the requests for identity values from different DB2 members may not result in the assignment of values in strict numeric order. For example, if members DB2A and DB2B are using the identity column, and DB2A gets the cache values 1 to 20 and DB2B gets the cache values 21 to 40, the actual order of values assigned would be 1,21,2 if DB2A requested a value first, then DB2B requested, and then DB2A again requested. Therefore, to guarantee that identity values are generated in strict numeric order among multiple DB2 members using the same identity column, specify the ORDER option.

references-clause
The *references-clause* of a *column-definition* provides a shorthand method of defining a foreign key composed of a single column. Thus, if *references-clause* is specified in the definition of column C, the effect is the same as if that *references-clause* were specified as part of a FOREIGN KEY clause in which C is the only identified column.

Do not specify *references-clause* in the definition of a LOB, ROWID column, or security label column because a LOB, ROWID, or security label column cannot be a foreign key.

check-constraint

The *check-constraint* of a *column-definition* has the same effect as specifying a check constraint in a separate ADD *check-constraint* clause. For conformance with the SQL standard, a table check constraint specified in the definition of column C should not reference any columns other than C.

Do not specify a check constraint in the definition of a LOB, ROWID, or security label column.

FIELDPROC *program-name*

Designates *program-name* as the field procedure exit routine for the column. Writing a field procedure exit routine is described in Appendix B (Volume 2) of *DB2 Administration Guide*. A field procedure can be specified only for a column with a length attribute that is not greater than 255 bytes, and the column must not be a security label column.

The field procedure encodes and decodes column values. Before a value is inserted in the column, it is passed to the field procedure for encoding. Before a value from the column is used by a program, it is passed to the field procedure for decoding. A field procedure could be used, for example, to alter the sorting sequence of values entered in the column.

The field procedure is also invoked during the processing of the ALTER TABLE statement. When so invoked, the procedure provides DB2 with the column's *field description*. The field description defines the data characteristics of the encoded values. By contrast, the information you supply for the column in the ALTER TABLE statement defines the data characteristics of the decoded values.

constant

Is a parameter that is passed to the field procedure when it is invoked. A parameter list is optional. The *n*th parameter specified in the FIELDPROC clause on ALTER TABLE corresponds to the *n*th parameter of the specified field procedure. The maximum length of the parameter list is 255 bytes, including commas but excluding insignificant blanks and the delimiting parentheses.

If you omit FIELDPROC, the column has no field procedure.

AS SECURITY LABEL

Indicates that the table is defined with multilevel security with row level granularity and specifies that the column will contain the security label values. A table can have only one security label column. To define a table with a security label column, the primary authorization ID of the statement must have a valid security label, and the RACF SECLABEL class must be active. In addition, the following conditions are also required:

- The data type of the column must be CHAR(8).
- The subtype of the column must be SBCS.
- The column does not have any field procedures, check constraints, or referential constraints.
- The column must be defined as NOT NULL and WITH DEFAULT clauses.
- The table does not have an edit procedure.
- The table is not the source table for a materialized query table.

- You are using z/OS Version 1 Release 5 or later.

For existing rows in the table, the value of the security label column defaults to the security label of the user at the time the ALTER statement is executed.

End of column-definition

unique-constraint

CONSTRAINT *constraint-name*
Names the primary key or unique key constraint. If a constraint name is not specified, a unique constraint name is generated. If a name is specified, it must be different from the names of any referential, check, primary key, or unique key constraints previously specified on the table.

PRIMARY KEY(*column-name,...***)**
Defines a primary key composed of the identified columns. Each column name must be an unqualified name that identifies a column of the table except a LOB or ROWID column, and the same column must not be identified more than once. The number of identified columns must not exceed 64. In addition, the sum of the length attributes of the columns must not be greater than 2000 -*2m*, where *m* is the number of varying-length columns in the key. The table must not have a primary key and the identified columns must be defined as NOT NULL.

The set of columns in the primary key cannot be the same as the set of columns of another unique key.

The table must have a unique index with a key that is identical to the primary key. The keys are identical only if they have the same number of columns and the *n*th column name of one is the same as the *n*th column name of the other.

The identified columns are defined as the primary key of the table. The description of the index is changed to indicate that it is a primary index. If the table has more than one unique index with a key that is identical to the primary key, the selection of the primary index is arbitrary.

UNIQUE(*column-name***,...)**
Defines a unique key composed of the identified columns with the specified *constraint-name*. If a *constraint-name* is not specified, a name is generated. Each column name must be an unqualified name that identifies a column of the table except a LOB or ROWID column, and the same column must not be identified more than once. Each identified column must be defined as NOT NULL. The number of identified columns must not exceed 64. In addition, the sum of the length attributes of the columns must not be greater than 2000 – *n* for padded indexes and 2000 - *n* - *2m* for nonpadded indexes, where *n* is the number of columns that can contain null values and *m* is the number of varying-length columns in the key.

The set of columns in the unique key cannot be the same as the set of columns of the primary key or another unique key. A unique key is a duplicate if it is the same as the primary key or a previously defined unique key. The specification of a duplicate unique key is ignored with a warning.

The table must have a unique index with a key that is identical to the unique key. The keys are identical only if they have the same number of columns and the *n*th column name of one is the same as the *n*th column name of the other.

The identified columns are defined as a unique key of the table. The description of the index is changed to indicate that it is enforcing a unique key constraint. If the table has more than one unique index with a key that is identical to the unique key, the selection of the enforcing index is arbitrary.

End of unique-constraint

referential-constraint

CONSTRAINT *constraint-name*

Names the referential constraint. If a constraint name is not specified, a unique constraint name is generated. If a name is specified, it must be different from the names of any referential, check, primary key, or unique key constraints previously specified on the table.

FOREIGN KEY (*column-name,...***) references-clause**

Specifies a referential constraint with the specified *constraint-name*.

Let T1 denote the object table of the ALTER TABLE statement.

The foreign key of the referential constraint is composed of the identified columns. Each *column-name* must be an unqualified name that identifies a column of T1 except a LOB, ROWID column, or security label column, and the same column must not be identified more than once. The number of identified columns must not exceed 64 and the sum of their length attributes must not exceed 255 minus the number of columns that allow null values. The referential constraint is a duplicate if the FOREIGN KEY and the parent table are the same as the FOREIGN KEY and parent table of an existing referential constraint on T1. The specification of a duplicate referential constraint is ignored with a warning.

End of referential-constraint

references-clause

REFERENCES *table-name (column-name,...)*

The table name specified after REFERENCES must identify a table that exists at the current server, but it must not identify a catalog table. Let T2 denote the identified parent table and let T1 denote the table being altered (T1 and T2 can be the same table).

T2 must have a unique index and the privilege set on T2 must include the ALTER or REFERENCES privilege on the parent table, or the REFERENCES privilege on the columns of the nominated parent key.

The parent key of the referential constraint is composed of the identified columns. Each *column-name* must be an unqualified name that identifies a column of T2. The identified column cannot be a LOB, ROWID, or security label column. The same column must not be identified more than once.

The list of column names in the parent key must be identical to the list of column names in a primary key or unique key in the parent table T2. The column names must be specified in the *same order* as in the primary key or unique key.

If a list of column names is not specified, then T2 must have a primary key. Omission of a list of column names is an implicit specification of the columns of the primary key for T2.

The specified foreign key must have the same number of columns as the parent key of T2 and, except for their names, default values, null attributes and check constraints, the description of the *n*th column of the foreign key must be identical to the description of the *n*th column of the nominated parent key. If the foreign key includes a column defined as a distinct type, the corresponding column of the nominated parent key must be the same distinct type. If a column of the foreign key has a field procedure, the corresponding column of the nominated parent key must have the same field procedure and an identical field description. A *field description* is a description of the encoded value as it is stored in the database for a column that has been defined to have an associated field procedure.

The table space that contains T1 must be available to DB2. If T1 is populated, its table space is placed in a check pending status. A table in a segmented table space is populated if the table is not empty. A table in an nonsegmented table space is considered populated if the table space has ever contained any records.

The referential constraint specified by the FOREIGN KEY clause defines a relationship in which T2 is the parent and T1 is the dependent. A description of the referential constraint is recorded in the catalog.

ON DELETE

The delete rule of the relationship is determined by the ON DELETE clause. For more on the concepts used here, see “Referential constraints” on page 8.

If T1 and T2 are the same table, CASCADE or NO ACTION must be specified. SET NULL must not be specified unless some column of the foreign key allows null values. Also, SET NULL must not be specified if any nullable column of the foreign key is a column of the key of a partitioning index. The default value for the rule depends on the value of the CURRENT RULES special register when the CREATE TABLE statement is processed. If the value of the register is 'DB2', the delete rule defaults to RESTRICT; if the value is 'SQL', the delete rule defaults to NO ACTION.

The delete rule applies when a row of T2 is the object of a DELETE or propagated delete operation and that row has dependents in T1. Let *p* denote such a row of T2.

- If RESTRICT or NO ACTION is specified, an error occurs and no rows are deleted.
- If CASCADE is specified, the delete operation is propagated to the dependents of *p* in T1.
- If SET NULL is specified, each nullable column of the foreign key of each dependent of *p* in T1 is set to null.

A cycle involving two or more tables must not cause a table to be delete-connected to itself. Thus, if the relationship would form a cycle:

- The referential constraint cannot be defined if each of the existing relationships that would be part of the cycle have a delete rule of CASCADE.
- CASCADE must not be specified if T2 is delete-connected to T1.

If T1 is delete-connected to T2 through multiple paths, those relationships in which T1 is a dependent and which form all or part of those paths must have the same delete rule and it must not be SET NULL. For example, assume that T1 is a dependent of T3 in a relationship with a delete rule of *r* and that one of the following is true:

- T2 and T3 are the same table.

- T2 is a descendent of T3 and the deletion of rows from T3 cascades to T2.
- T2 and T3 are both descendents of the same table and the deletion of rows from that table cascades to both T2 and T3.

In this case, the referential constraint cannot be defined when *r* is SET NULL. When *r* is other than SET NULL, the referential constraint can be defined, but the delete rule that is implicitly or explicitly specified in the FOREIGN KEY clause must be the same as *r*.

ENFORCED or **NOT ENFORCED**
Indicates whether or not the referential constraint is enforced by the database manager during normal operations, such as insert, update, or delete.

ENFORCED
Specifies that the referential constraint is enforced by the database manager during normal operations (such as insert, update, or delete) and that it is guaranteed to be correct. This is the default.

NOT ENFORCED
Specifies that the referential constraint is not enforced by the database manager during normal operations, such as insert, update, or delete. This option should only be used when the data that is stored in the table is verified to conform to the constraint by some other method than relying on the database manager.

ENABLE QUERY OPTIMIZATION
Specifies that the constraint can be used for query optimization. DB2 uses the information in query optimization using materialized query tables with the assumption that the constraint is correct. This is the default.

End of references-clause

check-constraint

CONSTRAINT *constraint-name*
Names the check constraint. If constraint-name is not specified, a unique constraint name is derived from the name of the first column in the check-condition specified in the definition of the check constraint. If a name is specified, it must be different from the names of any referential, check, primary key, or unique key constraints previously specified on the table.

CHECK (*check-condition***)**
Defines a check constraint. A check-condition can evaluate to unknown if a column that is an operand of the predicate is null. A check-condition that evaluates to unknown does not violate the check constraint. A *check-condition* is a search condition, with the following restrictions:

- It can refer only to the columns of table *table-name*; however, the columns cannot be LOB, ROWID, or security label columns (including distinct types that are based on LOB and ROWID data types).
- It can be up to 3800 bytes long, not including redundant blanks.
- It must not contain any of the following:
  - Subselects
  - Built-in or user-defined functions
  - Cast functions other than those created when the distinct type was created
  - Host variables
  - Parameter markers

  - Special registers
  - Columns that include a field procedure
  - CASE expressions
  - row expressions
  - DISTINCT predicates
  - GX literals (hexadecimal graphic string constants)
- If a check-condition refers to a LOB column (including a distinct type that is based on a LOB), the reference must occur within a LIKE predicate.
- The AND and OR logical operators can be used between predicates. The NOT logical operator cannot be used.
- The first operand of every predicate must be the column name of a column in the table.
- The second operand in the check-condition must be either a constant or a column name of a column in the table.
  - If the second operand of a predicate is a constant, and if the constant is:
    - A floating-point number, then the column data type must be floating point.
    - A decimal number, then the column data type must be either floating point or decimal.
    - An integer number, then the column data type must not be a small integer.
    - A small integer number, then the column data type must be small integer.
    - A decimal constant, then its precision must not be larger than the precision of the column.
  - If the second operand of a predicate is a column, then both columns of the predicate must have:
    - The same data type
    - Identical descriptions with the exception that the specification of the NOT NULL and DEFAULT clauses for the columns can be different, and that string columns with the same data type can have different length attributes

Effects of defining a check constraint on a populated table: When a check constraint is defined on a populated table and the value of the special register CURRENT RULES is 'DB2', the check constraint is not immediately enforced on the table. The check constraint is added to the description of the table, and the table space that contains the table is placed in a check pending status. For a description of the check pending status and the implications for utility operations, see Part 2 of *DB2 Utility Guide and Reference*.

When a check constraint is defined on a populated table and the value of the special register CURRENT RULES is 'STD', the check constraint is checked against all rows of the table. If no violations occur, the check constraint is added to the table. If any rows violate the new check constraint, an error occurs and the description of the table is unchanged.

End of check-constraint

add-partition

ADD PARTITION
Specifies that a partition is added to the table and each partitioned index on the table. The new partition is the next physical partition not being used until the maximum for the table space has been reached. ADD PARTITION must not be

specified for nonpartitioned tables. If the table uses index-controlled partitioning, it is converted to use table-controlled partitioning.

The maximum number of partitions allowed depends on how the table space was originally created. If DSSIZE was specified when the table space was created, it is non-zero in the catalog. The maximum number of partitions allowed is shown in Table 55.

Table 55. Maximum number of partitions allowed

DSSIZE	Page size 4KB	Page size 8KB	Page size 16KB	Page size 32KB
1GB-4GB	4096	4096	4096	4096
8GB	2048	4096	4096	4096
16GB	1024	2048	4096	4096
32GB	512	1024	2048	4096
64GB	256	512	1024	2048

If LARGE was specified when the table space was created, the maximum number of partitions is shown in the fourth row of Table 56. For more than 254 partitions when LARGE or DSSIZE is not specified, the maximum number of partitions is determined by the page size of the table space.

Table 56. Maximum number of partitions when DSSIZE = 0

Type of table space	Number of existing partitions	Maximum partitions
non-large	1 to 16	16
non-large	17 to 32	32
non-large	33 to 64	64
large	N/A	4096

The existing table space PRIQTY and SECQTY attributes of the previous logical partition are used for the space attributes of the new partition. For each partitioned index, the existing PRIQTY and SECQTY attributes of the previous partition are used.

To specify specific space attributes for the new partition, use additional ALTER TABLESPACE and ALTER INDEX statements.

Adding a partition is not allowed if the table is a materialized query table or a materialized query table is defined on the table. A partition cannot be added if the table space definition is incomplete because a partitioning key or partitioning index is missing.

ENDING AT*(constant, ...)*

Specifies the high key limit for the new partition. The new partition’s key limit must be higher when partitioning is ascending and lower when it is descending. Specify at least one constant after ENDING AT in the PARTITION clause. You can use as many values as there are columns in the key. The concatenation of all the constants is the highest value of the key in the corresponding partition of the index. The use of constants to define key values is subject to the following rules:

- The first constant corresponds to the first column of the key, the second constant to the second column, and so on. Each constant must have the same data type as its corresponding column. A hexadecimal graphic string constant (GX) cannot be specified.

  Using fewer constants than there are columns in the key has the same effect as using the highest or lowest values for the omitted columns, depending on whether they are ascending or descending.
- The highest value of the key in any partition must be lower than the highest value of the key in the next partition.
- The constants specified for the last partition are enforced. The value specified for the last partition is the highest value of the key that can be placed in the table. If the limit was not previously enforced, any existing key values greater than the value specified for the added partition are placed into the discard data set when REORG is run.
- The precision and scale of a decimal constant must not be greater than the precision and scale of its corresponding column.
- If a string constant is longer or shorter than required by the length attribute of its column, the constant is either truncated or padded on the right to the required length. If the column is ascending, the padding character is X'FF'. If the column is descending, the padding character is X'00'.
- If a key includes a ROWID column or a column with a distinct type that is based on a ROWID data type, then 17 bytes of the constant that is specified for the corresponding ROWID column are considered.

INCLUSIVE
Specifies that the specified range values are included in the data partition.

End of add-partition

partitioning-clause

ADD PARTITION BY RANGE
Specifies the range partitioning scheme for the table (the columns used to partition the data). When this clause is specified, the table uses table-controlled partitioning. The number of partitions specified in the ADD PARTITION BY RANGE clause has to be the same as the number of partitions defined in the table space.

This clause applies only to tables in a partitioned table space. If the table is already complete by having established either table-controlled partitioning or index-controlled partitioning, the ADD PARTITION BY RANGE clause is not allowed. If this clause is used, then the ENDING AT clause cannot be used on a subsequent CREATE INDEX statement for this table.

partition-expression
Specifies the key data over which the range is defined to determine the target data partition of the data.

column-name
Specifies the columns of the key. Each *column-name* must identify a column of the table. Do not specify more than 64 columns, the same column more than once, a LOB column, a column with a distinct type that is based on a LOB data type, or a qualified column name. The sum of length attributes of the columns must not be greater than 255 - *n*, where *n* is the number of columns that can contain null values.

NULLS LAST
Specifies that null values are treated as positive infinity for purposes of comparison.

ASC
Puts the entries in ascending order by the column. ASC is the default.

DESC
Puts the entries in descending order by the column.

partition-element
Specifies ranges for a data partitioning key and the table space where rows of the table in the range will be stored.

PARTITION *integer*
Identifies the partition to apply the boundary specified in the subsequent ENDING AT clause. It must be in the range of 1 to *n* where *n* is the number of partitions in the table.

ENDING AT*(constant, ...)*
Specifies the highest value of the partitioning key for the new partition. Specify at least one constant after ENDING AT in each PARTITION clause. You can use as many constants as there are columns in the key. The concatenation of all the constants is the highest value of the key in the corresponding partition. The length of each highest key value (the limit key) is the same as the length of the partitioning key. The use of constants to define key values is subject to the rules listed for the ENDING AT clause for a partition definition. See “list of rules” on page 525.

INCLUSIVE
Specifies that the specified range values are included in the data partition.

End of partitioning-clause

ADD RESTRICT ON DROP
Restricts dropping the table and the database and table space that contain the table.

column-alteration

ALTER COLUMN column-alteration
Alters the definition of an existing column, including the attributes of an existing identity column. Only the attributes specified are altered. Other attributes remain unchanged. Only future values of the column are affected by the changes made with an ALTER TABLE ALTER COLUMN statement.

The table being altered must not be in an incomplete state because of a missing unique index on a unique constraint (primary or unique key). A column can only be referenced once in an ALTER COLUMN clause in a single ALTER TABLE statement. However, that same column can be referenced multiple times for adding or dropping constraints in the same ALTER TABLE statement. An ALTER TABLE ALTER COLUMN statement may not be processed in the same unit of work as an INSERT, DELETE, or UPDATE statement. A column cannot be altered if the table is used in a materialized query table definition or if the table is a materialized query table.

You can modify all the attributes of an existing identity column, except for the data type of the column. To change the data type of an identity column, drop the table containing the column and recreate it.

column-name

Identifies the column to be altered. The name must not be qualified and must identify an existing column in the table being altered when the ALTER statement is processed. The column must not be part of a referential constraint or have a field procedure. The column must not be defined as a security label column. When the attributes of an identity column are altered, the column of the specified *column-name* must exist in the specified table and must have been defined with the IDENTITY attribute.

SET DATA TYPE *(altered-data-type*

Specifies the new data type of the column to be altered. For a character or CLOB column, you can also use the clause to change the definition of the subtype that is stored in the DB2 catalog and OBD.

The column cannot be an identity column. The new data type must be compatible with the existing data type of the column. The existing data type of the column cannot be a ROWID, LOB, date, time, timestamp, or distinct type. For more information on the compatibility of data types, see "Assignment and comparison" on page 74.

If the data type is a character or graphic string, the new length attribute must be at least as large as the existing length attribute of the column. If the data type is a numeric data type, the specified precision and scale must be at least as large as the existing precision and scale. If a decimal fraction is being converted to floating point, the ALTER statement will fail if there is a unique index or a unique constraint on the column.

If the specified column has a default value, the existing default value must represent a value that could be assigned to a column with the new data type in accordance with the rules for assignment. The default value is updated to reflect the new data type.

If the column is specified in a unique constraint (unique key or primary key) or unique index, the new column length must not exceed the limit on an index size. For PADDED indexes, the sum of the length attributes of the columns must not be greater than 2000-*n*, where *n* is the number of columns that can contain null values. For NOT PADDED indexes, the sum of the length attributes of the columns must not be greater than 2000-*n*-2*m*, where *n* is the number of nullable columns and *m* is the number of varying length columns.

The total byte count of columns after the alteration must not exceed the maximum row size. If the column is in the partitioning key, the new partitioning key cannot exceed 255-*n*.

Table 57 shows the numeric data type alterations that are supported for SET DATA TYPE:

Table 57. Supported numeric data type alterations for SET DATA TYPE

From/To	SMALLINT	INTEGER	DECIMAL(q,t)	FLOAT(1-21)	FLOAT(22-53)
SMALLINT	Y	Y	(q-t)>4	Y	Y
INTEGER	N	Y	(q-t)>9	N	Y
DECIMAL(p,s)	s=0; p<5	s=0; p<10	q>=p (q-t)>=(p-s)	p<7	p<16

Table 57. Supported numeric data type alterations for SET DATA TYPE (continued)

From/To	SMALLINT	INTEGER	DECIMAL(q,t)	FLOAT(1-21)	FLOAT(22-53)
FLOAT(1-21)	N	N	N	Y	Y
FLOAT(22-53)	N	N	N	N	Y

Table 58 shows the character data type alterations that are supported for SET DATA TYPE:

Table 58. Supported character data type alterations for SET DATA TYPE (x > =0).

From/To	VARCHAR(n+x)	CHAR (n+x)	GRAPHIC(n+x)	VARGRAPHIC(n+x)
VARCHAR	Y	Y	N	N
CHAR(n)	Y	Y	N	N
GRAPHIC(n)	N	N	Y	Y
VARGRAPHIC(n)	N	N	Y	Y

When columns are converted from CHAR to VARCHAR, normal assignment rules apply, which means that trailing blanks are kept instead of being stripped out. If you want varying length character strings without trailing blanks, use the STRIP function for data in the column after changing the data type to VARCHAR.

If the table being altered has an edit procedure or valid procedure, an error occurs. If a materialized query table is defined on this table or if this table is defined as being a materialized query table, then an error also occurs.

The table space that contains the table being altered is left in an advisory REORG-pending (AREO) status. If the column being altered is part of an index, an exception state may be set for the index as shown in Table 59:

Table 59. Advisory settings for ALTER COLUMN when the column is in an index

Alteration type	Exception state	Plans and packages invalidation
VARCHAR to CHAR	AREO*	Yes
VARGRAPHIC to GRAPHIC	AREO*	Yes
CHAR to VARCHAR	AREO*	Yes
GRAPHIC to VARGRAPHIC	AREO*	Yes
VARCHAR to VARCHAR	AREO* (for padded only)	No
VARGRAPHIC to VARGRAPHIC	AREO* (for padded only)	No
CHAR to CHAR	AREO*	Yes
GRAPHIC to GRAPHIC	AREO*	Yes
NUMERIC to NUMERIC	RBDP	Yes

For information on resetting advisory or restrictive exception states, see *DB2 Utility Guide and Reference*.

FOR *subtype* **DATA**
Alters the *subtype* of a character or CLOB column. This clause does not change the data. The clause only updates the definition of the subtype as it is stored in the DB2 catalog and the OBD. The length and data type that are specified must match the existing length and data type of the column; otherwise, an error occurs.

For more information on the subtype values (SBCS, MIXED, and BIT), see the subtype information under "built-in-type" on page 741.

SET GENERATED ALWAYS or BY DEFAULT
For a definition, see the description of the GENERATED attribute for defining an identity column on page 515.

RESTART WITH *numeric-constant*
Specifies that, when it is time to generate the next value for this identity column, the sequence associated with the column should restart with the specified value. This value can be any positive or negative value (including 0) that could be assigned to this column without nonzero digits existing to the right of the decimal point.

SET INCREMENT BY *numeric-constant*
For a definition, see the description of INCREMENT BY for defining an identity column on page 516.

SET MINVALUE or **NO MINVALUE**
For a definition, see the description of MINVALUE or NO MINVALUE for defining an identity column on page 516.

SET MAXVALUE or **NO MAXVALUE**
For a definition, see the description of MAXVALUE or NO MAXVALUE for defining an identity column on page 517.

SET CYCLE or **NO CYCLE**
For a definition, see the description of CYCLE or NO CYCLE for defining an identity column on page 517.

SET CACHE or **NO CACHE**
For a definition, see the description of CACHE or NO CACHE for defining an identity column on page 517.

SET ORDER or **NO ORDER**
For a definition, see the description of ORDER or NO ORDER for defining an identity column on page 518.

End of column-alteration

partition-alteration

ALTER PARTITION
Specifies that the partitioning limit key for the identified partition is to be altered. Specify ALTER PARTITION only if the table is partitioned.

This clause applies only to tables in a partitioned table space. If the table is already complete by having established either table-controlled partitioning or index-controlled partitioning, the ADD PARTITION BY RANGE clause is not allowed. If this clause is used, then the ENDING AT clause cannot be used on a subsequent CREATE INDEX statement for this table.

integer
If *integer* is specified, it must be in the range 1 to *n*, where *n* is the number of partitions in the table. Altering a partition boundary is not allowed if the table is a materialized query table or if a materialized query table is defined on this table. When this option is specified for any partition except for the last, both the identified partition and the partition following are placed in REORG-pending (REORP) status.

ENDING AT*(constant, ...)*
Specifies the highest value of the partitioning key for the identified partition.

In this context, highest means highest in the sorting sequences of the columns. In a column defined as ascending (ASC), highest and lowest have their usual meanings. In a column defined as descending (DESC) the lowest actual value is highest in the sorting sequence.

Specify at least one constant after ENDING AT in each ALTER PARTITION clause. You can use as many constants as there are columns in the key. The concatenation of all the constants is the highest value of the key in the corresponding partition. The length of each highest key value (the limit key) is the same as the length of the partitioning key. The use of constants to define key values is subject to the rules listed for the ENDING AT clause for a partition definition. See “list of rules” on page 525.

The value that is specified must not be equal to or beyond the range of the partition boundaries of the adjacent partitions.

INCLUSIVE
Specifies that the specified range values are included in the data partition.

If the table uses index-controlled partitioning, it is converted to use table-controlled partitioning. The high limit key for the last partition is set to the highest possible value for ascending key columns or the lowest possible value for descending key columns.

End of partition-alteration

rotate-partition

ROTATE PARTITION FIRST TO LAST
Specifies that the first logical partition should be rotated to become the last logical partition. This keyword must be followed by the ENDING AT clause, which specifies the new high key limit for this partition, which is now logically last. The new partitioning key value must be higher than the current high key limit if partition values are ascending. If partition values are descending, the new key limit must be lower than the current low key limit.

Rotating a partition occurs immediately. If there is a referential constraint with DELETE RESTRICT on the table, the ROTATE might fail. If the table uses index-controlled partitioning, it is converted to use table-controlled partitioning.

If the table has a security label column, the user must have a valid security label to rotate partitions. In addition, if write-down is in effect, the user must have the write-down privilege.

ENDING AT*(constant, ...)*
The ENDING AT clause specifies the new high key limit for the existing partition holding the oldest data.

In this context, highest means highest in the sorting sequences of the columns. In a column defined as ascending (ASC), highest and lowest have their usual meanings. In a column defined as descending (DESC) the lowest actual value is highest in the sorting sequence.

Specify at least one constant after ENDING AT. You can use as many constants as there are columns in the key. The concatenation of all the constants is the highest value of the key in the corresponding partition. The length of each highest key value (the limit key) is the same as the length of the partitioning key. The use of constants to define key values is subject to the rules listed for the ENDING AT clause for a partition definition. See “list of rules” on page 525.

INCLUSIVE
Specifies that the specified range values are included in the data partition.

RESET
Specifies that the existing data in the oldest partition is deleted. In a partitioned table with limit values that are in ascending sequence, ALTER TABLE ALTER PARTITION ROTATE FIRST TO LAST logically operates as if the partition with the lowest high key limit were dropped and then a new partition was added with the specified high key limit. The partition’s new key limit must be higher than any other partition in the table. For descending limit keys, the rotation operates as the partition with the highest limit values becomes the partition with the lowest limit values.

If the partition contains referential integrity parent relationships, has DATA CAPTURE logging enabled, or has a delete row trigger, then each data row in the partition must be deleted individually. If a table does not have any of these attribute settings, then the data rows are removed by deleting and redefining the underlying data sets.

SYSCOPY and SYSLGRNGX rows associated with the partition being reset are deleted. This includes the rows for the table space partition, partitioned index partitions, LOB table spaces, and auxiliary indexes.

End of rotate-partition

DROP PRIMARY KEY
Drops the definition of the primary key and all referential constraints in which the primary key is a parent key. The table must have a primary key and the privilege set must include the ALTER or REFERENCES privilege on every dependent table of the table.

The description of the primary index is changed to indicate that it is not a primary index.

DROP FOREIGN KEY *constraint-name*
Drops the referential constraint *constraint-name*. The constraint-name must identify a referential constraint in which the table is the dependent table, and the privilege set must include the ALTER or REFERENCES privilege on the parent table of that relationship, or the REFERENCES privilege on the columns of the parent table of that relationship.

DROP UNIQUE *constraint-name*
Drops the definition of the unique key constraint and all referential constraints in which the unique key is a parent key. The table must have a unique key. The privilege set must include the ALTER or REFERENCES privilege on every

dependent table of the table. The description of the enforcing index is changed to indicate that it is not enforcing a unique key constraint.

DROP CHECK *constraint-name*

Drops the check constraint *constraint-name*. The constraint-name must identify an existing check constraint defined on the table.

DROP CONSTRAINT *constraint-name*

Drops the constraint *constraint-name*. The constraint-name must identify an existing primary key, unique key, check, or referential constraint defined on the table.

DROP CONSTRAINT must not be used on the same ALTER TABLE statement as DROP PRIMARY KEY, DROP UNIQUE KEY, DROP FOREIGN KEY or DROP CHECK.

DROP RESTRICT ON DROP

Removes the restriction on dropping the table and the database and table space that contain the table.

VALIDPROC

Names a validation procedure for the table or inhibits the execution of any existing validation procedure.

program-name

Designates *program-name* as the new validation exit routine for the table. Validation exit routines are described in Appendix B (Volume 2) of *DB2 Administration Guide*.

The validation procedure can inhibit a load, insert, update, or delete operation on any row of the table. Before the operation takes place, the row is passed to the procedure. The values represented by any LOB columns in the table are not passed. On an insert or update operation, if the table has a security label column and the user does not have write-down privilege, the user's security label value is passed to the validation routine as the value of the column. After examining the row, the procedure returns a value that indicates whether the operation should proceed. A typical use is to impose restrictions on the values that can appear in various columns.

A table can have only one validation procedure at a time. When you name a new procedure, any existing procedure is no longer used. The new procedure is not used to validate existing table rows. It is used only to validate rows that are loaded, inserted, updated, or deleted after execution of the ALTER TABLE statement.

NULL

Discontinues the use of any validation routine for the table.

AUDIT

Alters the auditing attribute of the table. For information about audit trace classes, see Part 3 (Volume 1) of *DB2 Administration Guide*.

NONE

Specifies that no auditing is to be done when the table is accessed.

CHANGES

Specifies that auditing is to be done when the table is accessed during the first insert, update, or delete operation performed by each unit of recovery. However, the auditing is done only if the appropriate audit trace class is active.

ALL

Specifies that auditing is to be done when the table is accessed during the first operation of any kind performed by each unit of work of a utility or application process. However, the auditing is done only if the appropriate audit trace class is active and the access is not performed with COPY, RECOVER, REPAIR, or any stand-alone utility.

If the AUDIT attribute is changed to CHANGES or ALL, subsequent ALTER TABLE statements will be audited if the appropriate audit trace class is active.

DATA CAPTURE

Specifies whether the logging of SQL INSERT, UPDATE, and DELETE operations on the table is augmented by additional information. For guidance on intended uses of the expanded log records, see:

- The description of data propagation to IMS in *IMS DataPropagator: An Introduction*
- The instructions for using Remote Recovery Data Facility (RRDF) in *Remote Recovery Data Facility Program Description and Operations*
- The instructions for reading log records in Appendix C (Volume 2) of *DB2 Administration Guide*

NONE

Do not record additional information to the log.

CHANGES

Write additional data about SQL updates to the log. Information about the values that are represented by any LOB columns is not available.

For details about the recording of additional data for logged updates to catalog tables, see “Notes” on page 500.

VOLATILE or **NOT VOLATILE**

Specifies how DB2 is to choose access to the table.

VOLATILE

Specifies that DB2 is to use index access to the table whenever possible for SQL operations. However, be aware that list prefetch and certain other optimization techniques are disabled when VOLATILE is used.

One instance in which use of VOLATILE may be desired is for a table whose size can vary greatly. If statistics are taken when the table is empty or has only a few rows, those statistics might not be appropriate when the table has many rows. Another instance in which use of VOLATILE may be desired is for a table that contains groups of rows, as defined by the primary key on the table. All but the last column of the primary key of such a table indicate the group to which a given row belongs. The last column of the primary key is the sequence number indicating the order in which the rows are to be read from the group. VOLATILE maximizes concurrency of operations on rows within each group, since rows are usually accessed in the same order for each operation.

NOT VOLATILE

Specifies that DB2 is to base SQL access to the table on the current statistics.

CARDINALITY

An optional keyword that currently has no effect, but that is provided for DB2 family compatibility.

materialized-query-definition

ADD MATERIALIZED QUERY *materialized-query-definition*

Changes a base table to a materialized query table. Supplies a definition for a regular table to make it a materialized query table. The table specified by *table-name* and the result columns of the fullselect must not have the following characteristics:

- Be already defined as a materialized query table
- Have any primary keys, unique constraints (unique indexes), referential constraints (foreign keys), check constraints, or triggers defined
- Be referenced in the definition of another materialized query table
- Be directly or indirectly referenced in the *fullselect*
- Be in an incomplete state

If *table-name* does not meet these criteria, an error occurs.

fullselect

Defines the query on which the table is based. The columns of the existing table must meet the following characteristics:

- Have the same number of columns
- Have exactly the same column definitions
- Have the same column names in the same ordinal positions

If fullselect is specified, the owner of the table being altered must have the SELECT privilege on the tables or views referenced in the fullselect. Having SELECT privilege means that the owner has at least one of the following authorizations:

- Ownership of the tables or views referenced in the fullselect
- The SELECT privilege on the tables and views referenced in the fullselect
- SYSADM authority
- DBADM authority for the database in which the table of the fullselect reside

If the owner of the table does not have the SELECT privilege, the following authorization IDs must have SYSADM authority or DBADM authority for the database in which the tables of the fullselect reside:

- For embedded statements, the authorization ID of the owner of the plan or package
- For dynamically prepared statements, the SQL authorization ID of the process

For details about specifying *fullselect* for a materialized query table, see the definition of *fullselect* in the CREATE TABLE statement on page 762.

Altering a table to change it from a base table to a materialized query table with REFRESH DEFERRED causes any plans and packages dependent on the table to be invalidated.

refreshable-table-options

Specifies the materialized query table options for altering a regular table to a materialized query table.

DATA INITIALLY DEFERRED

Specifies that the data in the table is not validated as part of the ALTER

TABLE statement. A REFRESH TABLE statement can be used to make sure the data in the materialized query table is the same as the result of the query in which the table is based.

REFRESH DEFERRED
Specifies that the data in the table can be refreshed at any time using the REFRESH TABLE statement. The data in the table only reflects the result of the query as a snapshot at the time when the REFRESH TABLE statement is processed or as updated by the user for a user-maintained materialized query table.

MAINTAINED BY SYSTEM or **MAINTAINED BY USER**
Specifies how the data in the materialized query table is maintained.

MAINTAINED BY SYSTEM
Specifies that the data in the materialized query table *table-name* is to be maintained by the system. Only the REFRESH TABLE statement is allowed on the table.

MAINTAINED BY USER
Specifies that the data in materialized query table *table-name* is to be maintained by the user, who can use LOAD utility or the INSERT, DELETE, UPDATE, and REFRESH TABLE statements on the table.

ENABLE QUERY OPTIMIZATION or **DISABLE QUERY OPTIMIZATION**
Specifies whether this materialized query table can be used for optimization.

ENABLE QUERY OPTIMIZATION
Specifies that the materialized query table can be used for query optimization. If the fullselect specified does not satisfy the restrictions for query optimization, an error occurs. For detailed rules to satisfy query optimization, see *materialized-query-definition* in the CREATE TABLE statement on page 762.

DISABLE QUERY OPTIMIZATION
Specifies that the materialized query table cannot be used for query optimization. The table can still be queried directly.

End of materialized-query-definition

DROP MATERIALIZED QUERY
Changes a materialized query table so that it is no longer considered a materialized query table. The table specified by *table-name* must be defined as a materialized query table. The definition of columns and data of the name are not changed, but the table can no longer be used for query optimization and is no longer valid for use with the REFRESH TABLE statement.

Altering a table to change from a materialized query table to a base table with the DROP MATERIALIZED QUERY clause causes any plans and packages dependent on the table to be invalidated.

materialized-query-table-alteration

ALTER MATERIALIZED QUERY *materialized-query-table-alteration*
Changes attributes of a materialized query table. The *table-name* must identify a materialized query table.

SET *refreshable-table-alteration*
Changes how the table is maintained or whether the table can be used in query optimization.

MAINTAINED BY SYSTEM
Specifies that the data in a materialized query table *table-name* is to be maintained by the system.

MAINTAINED BY USER
Specifies that the data in the materialized query table *table-name* is to be maintained by the user.

ENABLE QUERY OPTIMIZATION
Specifies that materialized query table *table-name* can be used in query optimization. If the fullselect specified for the materialized query table does not satisfy the restrictions for automatic query optimization, an error occurs. For detailed rules to satisfy query optimization, see “CREATE TABLE” on page 734.

DISABLE QUERY OPTIMIZATION
Specifies that materialized query table *table-name*cannot be used for query optimization. The table can still be queried directly.

End of materialized-query-table-alteration

Notes

Order of processing of clauses: When there is more than one clause, they are processed in the following order: VALIDPROC, AUDIT, DATA CAPTURE, DROP clauses, ALTER clause, and ADD clauses. Within each of these stages, the order in which the user specifies the clauses is the order in which they are performed.

Altering the data type, length, precision, or scale of a column: When you change the data type, length, precision, or scale of a column, be aware of the following information about indexes, limit keys, check constraints, and invalidation:

- *Restrictions.* The ALTER TABLE statement is not allowed if any of the following conditions are true:
  - The column is referenced in a referential constraint.
  - The column has a field procedure routine.
  - The column is defined as an identity column.
  - The column is defined as an security label column
  - The table has an edit or validation routine.
  - The table is defined with DATA CAPTURE CHANGES.
  - The table is a created temporary table.
  - The table is a materialized query table or the table is referenced by a materialized query table.
  - The data type changed is not to a compatible data type.
  - The new length or data type specification could result in a loss of significance because of a shorter length or less precision in the data type.
  - For a conversion from decimal to float, a unique index or a unique constraint exists on the column.
  - The existing default value for a column cannot be assigned to the new data type.

  - Increasing the column length results in an existing index that references the column exceeding the maximum size of an index.
  - Increasing the column length results in the partitioning key using that column exceeding the maximum size for a partitioning key.
  - Table definition is incomplete because unique index for enforcing a unique constraint (primary key or unique key) is missing.
- *Indexes.*
  - If the index has a changed CHAR column, it is in advisory REORG-pending (AREO*) status.
  - If the index has a changed numeric column, it is left in REBUILD-pending (RBDP) status.
- *Length of partitioned index keys.* When a table is altered and the length of a column in the PARTITIONING KEY is changed, DB2 changes the length of the limit key (the highest key value) for a partition too. The length of the limit key is increased by the same amount that the length of the column is increased.
- *Check constraints.* If a check constraint refers to the column being altered, the length of the column is also changed in the check constraint.

When you change a column from a fixed to varying length or change the length of a varying-length column, process the ALTER TABLE statements in the same unit of work or do a reorganization between the ALTERs to avoid anomalies with the lengths and padding of individual values.

Restrictions for adding and altering columns: When using ALTER TABLE, you cannot add:
- A column to a table that has an edit procedure
- A ROWID column to a table that already has an explicitly defined ROWID column
- An identity column to a table that already has an identity column
- A security label column to a table that already has a security label column
- A LOB, ROWID, or identity column to a created temporary table
- A GRAPHIC, VARGRAPHIC, DBCLOB, or CHAR FOR MIXED DATA column, when the setting for installation option MIXED DATA is NO

You cannot alter these columns:
- A column in a table that has an edit procedure or a validation exit procedure
- A column in a materialized query table or a column in a table that has a materialized query table defined on it
- A column that is referenced in a field procedure
- A column that is referenced in a referential constraint

  However, you can change a column that is referenced in a referential constraint (either in a parent key or foreign key) using the following steps:
  1. Drop the referential constraint.
  2. Perform the alter on both the parent and child table.
  3. Recreate the referential constraint.
- A LOB column

A column can only be referenced once in an ADD COLUMN or an ALTER COLUMN clause in a single ALTER TABLE statement. However, that same column can be referenced multiple times for adding or dropping constraints in the same ALTER TABLE statement.

Because a distinct type is subject to the same restrictions as its source type, all the syntactic rules that apply to LOB and ROWID columns apply to distinct type columns that are based on LOBs and row IDs. For example, if a table has ROWID column, you cannot add a column with a distinct type that is sourced on a row ID.

Adding a column to table T only changes the description of T. If the catalog description of T is used to create a table T' and a facility such as DSN1COPY is used to effectively copy T into T', queries that refer to the added column in T' will fail because the data does not match its description. To avoid this problem, run the REORG utility against the table space of T before making the copy.

Altering the attributes of an existing identity column: Existing values for the identity column are unaffected by the ALTER TABLE statement. The changed identity column attributes affect values generated after the ALTER statement has executed. DB2 does not validate any of the existing identity column values against the new identity column attributes. For example, duplicate values might be generated even if NO CYCLE is in effect, such as when an ascending identity column altered to become a descending identity column.

Any existing values in the cache that have not yet been used may be lost. Loss of cached values can also occur if the ALTER statement returns an error or is rolled back.

Adding a ROWID column: When you add a ROWID column to an existing table, DB2 ensures that the same, unique row ID value is returned for a row whenever it is accessed. If the table already has a hidden ROWID column, DB2 also ensures that the values in the two ROWID columns are identical. If the table has a hidden ROWID column and the ROWID column that you add is defined as GENERATED BY DEFAULT, DB2 changes the hidden ROWID column to have the GENERATED BY DEFAULT attribute.

Reorganizing a table space has no effect on the values in a ROWID column.

Adding an identity column: When you add an identity column to a table that is not empty, DB2 places the table space that contains the table in the REORG pending state. When the REORG utility is subsequently run, DB2 generates the values for the identity column in all existing rows and then removes the REORG pending status. These values are guaranteed to be unique, and their order is system-determined.

Effect of adding a column on views: Adding a column to a table has no effect on existing views.

Cascaded effects of adding or altering a column: Adding a column to a table has no cascaded effects to views that reference the table. For example, adding a column to a table does not cause the column to be added to any dependent views, even if those views were created with a SELECT clause. But altering a column may cause other cascaded effects. Table 60 on page 540 lists the cascaded effect of altering the data type, precision, scale, or length of a column.

Table 60. Cascaded effect of altering a column's data type, precision, scale, or length

Operation	Effect
Alter of a column referenced by a view	If the data type, length, precision, or scale for a column is altered, all the views that are dependent on the altered table are reevaluated at alter time with the new column attributes. If errors are encountered during the view regeneration process, the ALTER TABLE statement fails. The new internal structure of each dependent view is not saved at alter time, and subsequent references to a dependent view will cause the view to be regenerated again. Use the ALTER VIEW statement to regenerate a dependent view and have the new internal structure saved.
Alter of a column referenced in the key of an index or a unique constraint (unique key or primary key)	The alter is allowed unless DECIMAL with a fraction is being converted to a floating value. In this case, the loss of precision can result in a loss of uniqueness. For numeric data type conversions, the index is placed in REBUILD-pending status. For character data type conversions, the index key columns are converted on first-write access. The index is not placed in REBUILD-pending status.
Alter of a column referenced in a package or plan	The alter is allowed. All plans and packages dependent on the table in which the column is being altered are invalidated.
Alter of a column referenced in the body of a user-defined function or procedure	Alter is allowed. If there is a package associated with the function or procedure, it is invalidated.
Alter of a column referenced in the parameter list of a user-defined function or procedure	Alter is allowed. The attributes of the existing function or procedure are unchanged. To access the new definition of the column, the function or procedure must be dropped and recreated.
Alter of a column referenced by a trigger	Alter is allowed. All trigger packages dependent on the table of the column are invalidated.
Alter of a column referenced in a CHECK constraint	Alter is allowed. The CHECK constraint is regenerated. If regeneration fails, the ALTER statement is rolled back.

Adding a partition: When you add a partition to a table, if the boundary for the last partition was not previously enforced, it is enforced after the partition is added, and the last two logical partitions are left in REORG-pending (REORP) status. If the last partition before the new one is added was in REORG-pending status, the added partition is also placed in REORG-pending status.

Rotating a partition from first to last: Running ALTER TABLE to rotate the first logical partition to become the last logical partition can be very time consuming. During the reset operation, all rows from the partition are deleted. In addition, the keys for the deleted rows are also deleted from all nonpartitioned indexes, which requires that each nonpartitioned index must be scanned.

When you rotate partitions, if the boundary for the last partition was not previously enforced, it is enforced after ROTATE FIRST TO LAST is issued, and the last two logical partitions are left in REORG-pending (REORP) status. If the last partition before ROTATE FIRST TO LAST was issued was in REORG-pending status, the last two logical partitions are left in REORG-pending status.

Effect of changes on applications: Applications might need to be changed to correspond to changes to the columns in a table. For example, if you increase the length of a column, you need to increase the length of host variables into which that column is fetched. If you change the data type of a column, you also might need to change the data type of the corresponding host variable to avoid performance degradation.

Invalidation of plans and packages: When a table is altered, all the plans, packages, and dynamic cached statements that refer to the table are invalidated if any one of the following conditions is true:

- The table is a created temporary table or a materialized query table.
- The table is changed to add or drop a materialized query definition.
- The AUDIT attribute of the table is changed.
- A DATE, TIME, or TIMESTAMP column is added and its default value for added rows is CURRENT DATE, CURRENT TIME, or CURRENT TIMESTAMP, respectively.
- A security label is added.
- The length attribute of a CHAR, VARCHAR, GRAPHIC, or VARGRAPHIC column has changed. See Table 59 on page 529.
- The column data type, precision, scale, or subtype is changed.
- The table is partitioned and a partition is added or one of the existing partitions is changed or rotated

When a referential constraint is defined with a delete rule of CASCADE or SET NULL, all plans and packages that refer to the parent table of the constraint are invalidated. Furthermore, all plans and packages that refer to tables from which deletes cascade to this parent table are also invalidated.

Altering a base table or a user-maintained materialized query table to change it to a system-maintained materialized query table causes any plans and packages dependent on the table to be invalidated because INSERT, UPDATE, and DELETE statements are not allowed on system-maintained materialized query tables. Altering a materialized query table to change it to a base table causes any plans and packages dependent on the table to be invalidated because the REFRESH TABLE statement is invalid on a base table.

Dropping constraints and check pending status: If a table space or partition is in check pending status because it contains a table with rows that violate constraints, dropping the constraints removes the check pending status.

Altering materialized query tables: The ALTER TABLE statement can be used to register an existing table at the current server as a materialized query table, change the attributes of an existing materialized query table, or change an existing materialized query table into a base table.

The isolation level at the time when a base table is first altered to become a materialized query table by the ALTER TABLE statement is the isolation level for the materialized query table

Altering a table to change it to a materialized query table with query optimization enabled makes the table eligible for use in query rewrite immediately. Therefore, pay attention to the accuracy of the data in the table. If necessary, the table should be altered to a materialized query table with query optimization disabled, and then the table should be refreshed and enabled with query optimization.

When a base table is altered into a materialized query table or a user-maintained query table is altered into a system-maintained one, the REFRESH_TIME column of the row for the table in SYSIBM.SYSVIEWS contains the current timestamp. When a system-maintained materialized query table is altered into a user-maintained materialized query table, the REFRESH_TIME column of the row for the table in SYSIBM.SYSVIEWS does not change.

The LOAD utility is not allowed on a system-maintained query table, but it is allowed on a user-maintained materialized query table.

Considerations for running utilities while altering tables: You cannot execute the ALTER TABLE statement while a utility has control of the table space that contains the table.

Capturing changes to the DB2 catalog: To have logged changes to a DB2 catalog table augmented with information for data capture, specify ALTER TABLE *xxx* DATA CAPTURE CHANGES where *xxx* is the name of a catalog table (SYSIBM.*xxx*). Data capture of catalog table changes provides the possibility of creating and managing a shadow of the catalog.

Alternative syntax and synonyms: To provide compatibility with previous releases of DB2 or other products in the DB2 UDB family, DB2 supports the following keywords:

- NOCACHE (single key word) as a synonym for NO CACHE
- NOCYCLE (single key word) as a synonym for NO CYCLE
- NOMINVALUE (single key word) as a synonym for NO MINVALUE
- NOMAXVALUE (single key word) as a synonym for NO MAXVALUE
- NOORDER (single key word) as a synonym for NO ORDER
- PART as a synonym for PARTITION
- VALUES as a synonym for ENDING AT
- DEFINITION ONLY as a synonym for WITH NO DATA
- SET MATERIALIZED QUERY AS DEFINITION ONLY as a synonym for DROP MATERIALIZED QUERY
- SET SUMMARY AS DEFINITION ONLY as a synonym for DROP MATERIALIZED QUERY
- SET MATERIALIZED QUERY AS (fullselect) as a synonym for ADD MATERIALIZED QUERY (fullselect)

- SET SUMMARY AS (fullselect) as a synonym for ADD MATERIALIZED QUERY (fullselect)

Examples

Example 1: Column DEPTNAME in table DSN8810.DEPT was created as a VARCHAR(36). Increase its length to 50 bytes. Also, add the column BLDG to the table DSN8810.DEPT. Describe the new column as a character string column that holds SBCS data.

```
ALTER TABLE DSN8810.DEPT
  ALTER COLUMN DEPTNAME SET DATA TYPE VARCHAR(50)
  ADD BLDG CHAR(3) FOR SBCS DATA;
```

Example 2: Assign a validation procedure named DSN8EAEM to the table DSN8810.EMP.

```
ALTER TABLE DSN8810.EMP
  VALIDPROC DSN8EAEM;
```

Example 3: Disassociate the current validation procedure from the table DSN8810.EMP. After the statement is executed, the table no longer has a validation procedure.

```
ALTER TABLE DSN8810.EMP
  VALIDPROC NULL;
```

Example 4: Define ADMRDEPT as the foreign key of a self-referencing constraint on DSN8810.DEPT.

```
ALTER TABLE DSN8810.DEPT
  FOREIGN KEY(ADMRDEPT) REFERENCES DSN8810.DEPT ON DELETE CASCADE;
```

Example 5: Add a check constraint to the table DSN8810.EMP which checks that the minimum salary an employee can have is $10,000.

```
ALTER TABLE DSN8810.EMP
  ADD CHECK (SALARY >= 10000);
```

Example 6: Alter the PRODINFO table to define a foreign key that references a non-primary unique key in the product version table (PRODVER_1). The columns of the unique key are VERNAME, RELNO.

```
ALTER TABLE PRODINFO
  FOREIGN KEY (PRODNAME,PRODVERNO)
    REFERENCES PRODVER_1 (VERNAME,RELNO) ON DELETE RESTRICT;
```

Example 7: Assume that table DEPT has a unique index defined on column DEPTNAME. Add a unique key constraint named KEY_DEPTNAME consisting of column DEPTNAME to the DEPT table:

```
ALTER TABLE DSN8810.DEPT
  ADD CONSTRAINT KEY_DEPTNAME UNIQUE( DEPTNAME );
```

Example 8: Register the base table TRANSCOUNT as a materialized query table. The result of the fullselect must provide a set of columns that match the columns in the existing table (same number of columns, same column definitions, and same names). So that you can maintain the table with insert, update, and delete operations as well as the REFRESH TABLE statement, define the materialized query table as user-maintained.

```
ALTER TABLE TRANSCOUNT ADD MATERIALIZED QUERY
  (SELECT ACCTID, LOCID, YEAR, COUNT(*) as cnt
   FROM TRANS
```

```
                              GROUP BY ACCTID, LOCID, YEAR )
                              DATA INITIALLY DEFERRED
                              REFRESH DEFERRED
                              MAINTAINED BY USER;
```

ALTER TABLESPACE

The ALTER TABLESPACE statement changes the description of a table space at the current server.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

The privilege set that is defined below must include at least one of the following:

- Ownership of the table space
- DBADM authority for its database
- SYSADM or SYSCTRL authority

If BUFFERPOOL or USING STOGROUP is specified, additional privileges might be required, as explained in the description of those clauses.

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package. If the statement is dynamically prepared, the privilege set is the union of the privilege sets that are held by each authorization ID of the process.

Syntax

```
                                                            ┌───────────────────────────────────────┐ (1)
>>──ALTER TABLESPACE──┬────────────────┬──table-space-name──▼─┬─BUFFERPOOL──bpname──────────────┬─┴──────────►
                      └─database-name.─┘                      ├─CCSID──ccsid-value──────────────┤
                                                              ├─┬─CLOSE YES─┬───────────────────┤
                                                              │ └─CLOSE NO──┘                   │
                                                              ├─┬─LOCKMAX SYSTEM─┬──────────────┤
                                                              │ └─LOCKMAX────────┘              │
                                                              ├─┬─LOCKSIZE ANY────────┬─────────┤
                                                              │ ├─LOCKSIZE TABLESPACE─┤         │
                                                              │ ├─LOCKSIZE TABLE──────┤         │
                                                              │ ├─LOCKSIZE PAGE───────┤         │
                                                              │ ├─LOCKSIZE ROW────────┤         │
                                                              │ └─LOCKSIZE LOB────────┘         │
                                                              ├─MAXROWS──integer────────────────┤
                                                              ├─┬─TRACKMOD YES─┬────────────────┤
                                                              │ └─TRACKMOD NO──┘                │
                                                              ├─using-block─────────────────────┤
                                                              ├─free-block──────────────────────┤
                                                              └─gbpcache-block──────────────────┘

►──┬──────────────────────────────────────────────────────────────┬──────────►◄
   │ ┌──────────────────────────────────────────────────────────┐ │
   │ │                           ┌───────────────────────┐ (1)  │ │
   └─▼─ALTER PARTITION──integer──▼─┬─using-block───────┬─┴──────┴─┘
                                   ├─free-block────────┤
                                   ├─gbpcache-block────┤
                                   ├─┬─COMPRESS YES─┬──┤
                                   │ └─COMPRESS NO──┘  │
                                   └─┬─TRACKMOD YES─┬──┘
                                     └─TRACKMOD NO──┘
```

Notes:

1 The same clause must not be specified more than once in a single ALTER TABLESPACE statement. For example, if TRACKMOD YES is specified at the table space level, it must not be specified after ALTER PARTITION.

using-block:

```
     ┌───────────────────────────────────────┐
>>───▼─┬─┬─USING VCAT──catalog-name──────┬─┬─┴──────────────────────────────────►◄
       │ └─USING STOGROUP──stogroup-name─┘ │
       ├─PRIQTY──integer───────────────────┤
       ├─SECQTY──integer───────────────────┤
       └─┬─ERASE YES─┬─────────────────────┘
         └─ERASE NO──┘
```

free-block:

```
       ┌───────────────────────┐
       ▼                       │
►►───┬─FREEPAGE──integer─┬─────┴──────────────────────────────────────────────►◄
     └─PCTFREE──integer──┘
```

gbpcache-block:

```
►►──┬─GBPCACHE CHANGED─┬──────────────────────────────────────────────────────►◄
    ├─GBPCACHE ALL─────┤
    ├─GBPCACHE SYSTEM──┤
    └─GBPCACHE NONE────┘
```

Description

database-name.table-space-name
Identifies the table space to be altered. The name must identify a table space that exists at the current server. Omission of *database-name* is an implicit specification of DSNDB04.

If you identify a table space of a work file database, the database must be in the stopped state. If you identify a partitioned table space, you can use the PARTITION clause as explained below.

BUFFERPOOL *bpname*
Identifies the buffer pool to be used for the table space. The *bpname* must identify an activated buffer pool with the same page size as the table space. See “Naming conventions” on page 40 for more details about *bpname*.

The privilege set must include SYSADM or SYSCTRL authority or the USE privilege for the buffer pool.

The change to the description of the table space takes effect the next time the data sets of the table space are opened. The data sets can be closed and reopened by a STOP DATABASE command to stop the table space followed by a START DATABASE command to start the table space.

In a data sharing environment, if you specify BUFFERPOOL, the table space must be in the stopped state when the ALTER TABLESPACE statement is executed.

CCSID *ccsid-value*
Identifies the CCSID value to be used for the table space. *ccsid-value* must identify a CCSID value that is compatible with the current value of the CCSID for the table space. See “Notes” on page 439 for a list that shows the CCSID to which a given CCSID can be changed and details about changing it.

Do not specify CCSID for a LOB table space or a table space in a TEMP database.

CLOSE
When the limit on the number of open data sets is reached, specifies the priority in which data sets are closed.

YES
Eligible for closing before CLOSE NO data sets. This is the default unless the table space is in a TEMP database.

NO
Eligible for closing after all eligible CLOSE YES data sets are closed.

For a table space in a TEMP database, DB2 uses CLOSE NO regardless of the value specified

COMPRESS
Specifies whether data compression applies to the rows of the table space or partition. Do not specify COMPRESS for a LOB table space.

YES
Specifies data compression. The rows are not compressed until the LOAD or REORG utility is run on the table in the table space or partition.

NO
Specifies no data compression. Inserted rows will not be compressed. Updated rows will be decompressed. The dictionary used for compression will be erased when the LOAD REPLACE, LOAD RESUME NO, or REORG utility is run. See Part 5 (Volume 2) of *DB2 Administration Guide* for more information about the dictionary and data compression.

LOCKMAX
Specifies the maximum number of page, row, or LOB locks an application process can hold simultaneously in the table space. If a program requests more than that number, locks are escalated. The page, row, or LOB locks are released and the intent lock on the table space or segmented table is promoted to S or X mode. If you specify LOCKMAX a for table space in a TEMP database, DB2 ignores the value because these types of locks are not used.

For an application that uses Sysplex query parallelism, a lock count is maintained on each member.

integer
Specifies the number of locks allowed before escalating, in the range 0 to 2 147 483 647.

Zero (0) indicates that the number of locks on the table or table space are not counted and escalation does not occur.

SYSTEM
Indicates that the value of field LOCKS PER TABLE(SPACE) on installation panel DSNTIPJ specifies the maximum number of page, row, or LOB locks a program can hold simultaneously in the table or table space.

If you change LOCKSIZE and omit LOCKMAX, the following results occur:

LOCKSIZE	Resultant LOCKMAX
TABLESPACE or TABLE	0
PAGE, ROW, or LOB	Unchanged
ANY	SYSTEM

If the lock size is TABLESPACE or TABLE, LOCKMAX must be omitted, or its operand must be 0.

LOCKSIZE

Specifies the size of locks used within the table space and, in some cases, also the threshold at which lock escalation occurs. Do not specify LOCKSIZE for a table space in a work file database or a TEMP database.

ANY

Specifies that DB2 can use any lock size. Currently, DB2 never chooses row locks, but reserves the right to do so.

In most cases, DB2 uses LOCKSIZE PAGE LOCKMAX SYSTEM for non-LOB table spaces and LOCKSIZE LOB LOCKMAX SYSTEM for LOB table spaces. However, when the number of locks acquired for the table space exceeds the maximum number of locks allowed for a table space (an installation parameter), the page or LOB locks are released and locking is set at the next higher level. If the table space is segmented, the next higher level is the table. If the table space is nonsegmented, the next higher level is the table space.

TABLESPACE

Specifies table space locks.

TABLE

Specifies table locks. Use TABLE only for a segmented table space.

PAGE

Specifies page locks. Do not use PAGE for a LOB table space.

ROW

Specifies row locks. Do not use ROW for a LOB table space.

LOB

Specifies LOB locks. Use LOB only for a LOB table space.

Let S denote an SQL statement that refers to a table in the table space:

- The LOCKSIZE change affects S if S is prepared and executed after the change. This includes dynamic statements and static statements that are not bound because of VALIDATE(RUN).
- If the size specified by the new LOCKSIZE is greater than the size of the old LOCKSIZE, the change affects S if S is a static statement that is executed after the change.

  The hierarchy of lock sizes, starting with the largest, is as follows:
  - table space lock
  - table lock (only for segmented table spaces)
  - page lock, row lock, and LOB lock (which are at the same level)
- In all other cases, LOCKSIZE has no effect on S until S is rebound.

LOG

Specifies whether changes to a LOB column in the table space are to be written to the log. Use LOG only for a LOB table space.

YES

Indicates that changes to a LOB column are to be written to the log. You cannot use YES if the auxiliary table in the table space stores a LOB column that is greater than 1 gigabyte in length.

When you change the value of LOG to YES, the LOB table space is placed in copy pending status.

NO

Indicates that changes to a LOB column are not to be written to the log.

LOG NO has no effect on a commit or rollback operation; the consistency of the database is maintained regardless of whether the LOB value is logged. All committed changes and changes that are rolled back reflect the expected results.

Even when LOG NO is specified, changes to system pages and to the auxiliary index are logged. During the log apply operation of the RECOVER utility, LPL recovery, or GPB recovery, all LOB values that were not logged are marked invalid and cannot be accessed by a SELECT or FETCH statement. Invalid LOB values can be updated or deleted.

MAXROWS *integer*

Specifies the maximum number of rows that DB2 will consider placing on each data page. The integer can range from 1 through 255.

The change takes effect immediately for new rows added. However, the space class settings for some pages may be incorrect and could cause unproductive page visits. It is highly recommended to reorganize the table space after altering MAXROWS.

If you specify MAXROWS, the table space must be in the stopped state when the ALTER TABLESPACE statement is executed. Do not specify MAXROWS for a LOB table space, a table space in a work file database, or the DB2 catalog table spaces that are listed under “SQL statements allowed on the catalog” on page 1197.

TRACKMOD

Specifies whether DB2 tracks modified pages in the space map pages of the table space or partition. Do not specify TRACKMOD for a LOB table space. For a table space in a TEMP database, DB2 uses TRACKMOD NO regardless of the value specified.

YES

DB2 tracks changed pages in the space map pages to improve the performance of incremental image copy. For data sharing, changing TRACKMOD to YES causes additional SCA (shared communication area) storage to be used until after the next full or incremental image copy is taken or until TRACKMOD is set back to NO.

NO

DB2 does not track changed pages in the space map pages. It uses the LRSN value in each page to determine whether a page has been changed.

free-block

FREEPAGE *integer*

Specifies how often to leave a page of free space when the table space is loaded or reorganized. One free page is left after every *integer* pages; *integer* can range from 0 to 255. FREEPAGE 0 leaves no free pages. Do not specify FREEPAGE for a LOB table space, or a table space in a work file database or a TEMP database.

If the table space is segmented, the number of pages left free must be less than the SEGSIZE value. If the number of pages to be left free is greater than or equal to the SEGSIZE value, then the number of pages is adjusted downward to one less than the SEGSIZE value.

The change to the description of the table space or partition has no effect until it is loaded or reorganized.

PCTFREE *integer*

Specifies what percentage of each page to leave as free space when the table space is loaded or reorganized. The first record on each page is loaded without restriction. When additional records are loaded, at least *integer* percent of free space is left on each page. *integer* can range from 0 to 99. Do not specify PCTFREE for a LOB table space, or a table space in a work file database or a TEMP database.

This change to the description of the table space or partition has no effect until it is loaded or reorganized.

End of free-block

using-block

USING

Specifies whether a data set for the table space or partition is managed by the user or managed by DB2. If the table space is partitioned, USING applies to the data set for the partition identified in the PARTITION clause. If the table space is not partitioned, USING applies to every data set that is eligible for the table space. (A nonpartitioned table space can have more than one data set if PRIQTY+118 ×SECQTY is at least 2 gigabytes.)

If the USING clause is specified, the table space or partition must be in the stopped state when the ALTER TABLESPACE statement is executed. See "Altering storage attributes" on page 555 to determine how and when changes take effect.

VCAT *catalog-name*

Specifies a user-managed data set with a name that starts with *catalog-name*. You must specify the catalog name in the form of an SQL identifier. Thus, you must specify an alias[22] if the name of the integrated catalog facility catalog is longer than eight characters. When the new description of the table space is applied, the integrated catalog facility catalog must contain an entry for the data set conforming to the DB2 naming conventions set forth in Part 2 (Volume 1) of *DB2 Administration Guide*.

One or more DB2 subsystems could share integrated catalog facility catalogs with the current server. To avoid the chance of having one of those subsystems attempt to assign the same name to different data sets, select a value for *catalog-name* that is not used by the other DB2 subsystems.

STOGROUP *stogroup-name*

Specifies a DB2-managed data set that resides on a volume of the identified storage group. The stogroup name must identify a storage group that exists at the current server and the privilege set must include SYSADM authority, SYSCTRL authority, or the USE privilege for the storage group. When the new description of the table space is applied, the description of the storage group must include at least one volume serial number, each volume serial number must identify a volume that is accessible to z/OS for dynamic allocation of the data set, and all identified volumes must be of the same device type. Furthermore, the integrated catalog facility catalog used for the storage group must not contain an entry for the data set.

[22] The alias of an integrated catalog facility catalog

If you specify USING STOGROUP and the current data set for the table space or partition is DB2-managed:

- Omission of the PRIQTY clause is an implicit specification of the current PRIQTY value.
- Omission of the SECQTY clause is an implicit specification of the current SECQTY value.
- Omission of the ERASE clause is an implicit specification of the current ERASE rule.

If you specify USING STOGROUP to convert from user-managed data sets to DB2-managed data sets:

- Omission of the PRIQTY clause is an implicit specification of the default value. For information on how DB2 determines the default value, see "Rules for primary and secondary space allocation" on page 788.
- Omission of the SECQTY clause is an implicit specification of the default value. For information on how DB2 determines the default value, see "Rules for primary and secondary space allocation" on page 788.
- Omission of the ERASE clause is an implicit specification of ERASE NO.

PRIQTY *integer*

Specifies the minimum primary space allocation for a DB2-managed data set of the table space or partition. This clause can be specified only if the data set is managed by DB2, and if one of the following is true:

- USING STOGROUP is specified.
- A USING clause is not specified.

If PRIQTY is specified (with a value other than -1), the primary space allocation is at least *n* kilobytes, where *n* is the value of *integer* with the following exceptions:

- For 4KB page sizes, if *integer* is less than 12, *n* is 12.
- For 8KB page sizes, if *integer* is less than 24, *n* is 24.
- For 16KB page sizes, if *integer* is less than 48, *n* is 48.
- For 32KB page sizes, if *integer* is less than 96, *n* is 96.
- For any page size, if *integer* is greater than 4194304, *n* is 4194304.

For LOB table spaces, the exceptions are:

- For 4KB pages sizes, if *integer* is less than 200, *n* is 200.
- For 8KB pages sizes, if *integer* is less than 400, *n* is 400.
- For 16KB pages sizes, if *integer* is less than 800, *n* is 800.
- For 32KB pages sizes, if *integer* is less than 1600, *n* is 1600.
- For any page size, if *integer* is greater than 4194304, *n* is 4194304.

The maximum value allowed for PRIQTY is 64GB (67108864 kilobytes).

If PRIQTY -1 is specified, DB2 uses a default value for the primary space allocation. For information on how DB2 determines the default value for primary space allocation, see "Rules for primary and secondary space allocation" on page 788.

If PRIQTY is omitted and USING STOGROUP is specified, the value of PRIQTY is its current value. (However, if the current data set is being changed from being user-managed to DB2-managed, the value is its default value. See the description of USING STOGROUP.)

If you specify PRIQTY and do not specify a value of -1, DB2 specifies the primary space allocation to access method services using the smallest multiple of *p*KB not less than *n*, where *p* is the page size of the table space. The allocated space can be greater than the amount of space requested by DB2. For example, it could be the smallest number of tracks that will accommodate the request. To more closely estimate the actual amount of storage, see the description of the DEFINE CLUSTER command in *DFSMS/MVS: Access Method Services for the Integrated Catalog*.

At least one of the volumes of the identified storage group must have enough available space for the primary quantity. Otherwise, the primary space allocation will fail.

See “Altering storage attributes” on page 555 to determine how and when changes to PRIQTY take effect.

SECQTY *integer*

Specifies the minimum secondary space allocation for a DB2-managed data set of the table space or partition. This clause can be specified only if the data set is managed by DB2, and if one of the following is true:

- USING STOGROUP is specified.
- A USING clause is not specified.

If SECQTY -1 is specified, DB2 uses a default value for the secondary space allocation.

If USING STOGROUP is specified and SECQTY is omitted, the value of SECQTY is its current value. (However, if the current data set is being changed from being user-managed to DB2-managed, the value is its default value. See the description of USING STOGROUP.)

For information on the actual value that is used for secondary space allocation, whether you specify a value or DB2 uses a default value, see “Rules for primary and secondary space allocation” on page 788.

If you specify SECQTY and do not specify a value of -1, DB2 specifies the secondary space allocation to access method services using the smallest multiple of *p*KB not less than *n*, where *p* is the page size of the table space. The allocated space can be greater than the amount of space requested by DB2. For example, it could be the smallest number of tracks that will accommodate the request. To more closely estimate the actual amount of storage, see the description of the DEFINE CLUSTER command in *DFSMS/MVS: Access Method Services for the Integrated Catalog*.

See “Altering storage attributes” on page 555 to determine how and when changes to SECQTY take effect.

ERASE

Indicates whether the DB2-managed data sets for the table space or partition are to be erased before they are deleted during the execution of a utility or an SQL statement that drops the table space.

NO

Does not erase the data sets. Operations involving data set deletion will perform better than ERASE YES. However, the data is still accessible, though not through DB2.

YES

Erases the data sets. As a security measure, DB2 overwrites all data in the data sets with zeros before they are deleted.

This clause can be specified only if the data set is managed by DB2, and if one of the following is true:
- USING STOGROUP is specified.
- A USING clause is not specified.

If you specify ERASE, the table space or partition must be in the stopped state when the ALTER TABLESPACE statement is executed. See "Altering storage attributes" on page 555 to determine how and when changes take effect.

End of using-block

gbpcache-block

GBPCACHE

In a data sharing environment, specifies what pages of the table space or partition are written to the group buffer pool in a data sharing environment. In a non-data-sharing environment, you can specify GBPCACHE for a table space other than one in a work file or TEMP database, but it is ignored. Do not specify GBPCACHE for a table space in a work file database or in a TEMP database in either environment (data sharing or not). In addition, you cannot alter the GBPCACHE value of some DB2 catalog table spaces; for a list of these table spaces, see "SQL statements allowed on the catalog" on page 1197.

CHANGED

When there is inter-DB2 R/W interest on the table space or partition, updated pages are written to the group buffer pool. When there is no inter-DB2 R/W interest, the group buffer pool is not used. Inter-DB2 R/W interest exists when more than one member in the data sharing group has the table space or partition open, and at least one member has it open for update.

If the table space is in a group buffer pool that is defined to be used only for cross-invalidation (GBPCACHE NO), CHANGED is ignored and no pages are cached to the group buffer pool.

ALL

Indicates that pages are to be cached in the group buffer pool as they are read in from DASD.

Exception: In the case of a single updating DB2 when no other DB2s have any interest in the page set, no pages are cached in the group buffer pool.

If the table space is in a group buffer pool that is defined to be used only for cross-invalidation (GBPCACHE NO), ALL is ignored and no pages are cached to the group buffer pool.

SYSTEM

Indicates that only changed system pages within the LOB table space are to be cached to the group buffer pool. A system page is a space map page or any other page that does not contain actual data values.

SYSTEM is the default for a LOB table space. Use SYSTEM only for a LOB table space.

NONE

Indicates that no pages are to be cached to the group buffer pool. DB2 uses the group buffer pool only for cross-invalidation.

If you specify NONE, the table space or partition must not be in recover pending status when the ALTER TABLESPACE statement is executed.

If you specify GBPCACHE in a data sharing environment, the table space or partition must be in the stopped state when the ALTER TABLESPACE statement is executed.

End of gbpcache-block

ALTER PARTITION *integer*

Identifies a partition of the table space. For a table space that has *n* partitions, you must specify an integer in the range 1 to *n*. You must not use this clause for a nonpartitioned table space or for a LOB table space. At least one of the following clauses must be specified:

FREEPAGE
PCTFREE
USING
PRIQTY
SECQTY
COMPRESS
ERASE
GBPCACHE
TRACKMOD

The changes specified by these clauses affect only the identified partition.

Notes

Running utilities: You cannot execute the ALTER TABLESPACE statement while a DB2 utility has control of the table space.

Altering more than one partition: To change FREEPAGE, PCTFREE, USING, PRIQTY, SECQTY, COMPRESS, ERASE, or GBPCACHE for more than one partition, you must use separate ALTER TABLESPACE statements.

Altering storage attributes: The USING, PRIQTY, SECQTY, and ERASE clauses define the storage attributes of the table space or partition. If you specify USING or ERASE when altering storage attributes, the table space or partition must be in the stopped state when the ALTER TABLESPACE statement is executed. You can use a STOP DATABASE...SPACENAM... command to stop the table space or partition.

If the catalog name changes, the changes take effect after you move the data and start the table space or partition using the START DATABASE...SPACENAM... command. The catalog name can be implicitly or explicitly changed by the ALTER TABLESPACE statement. The catalog name also changes when you move the data to a different device. See the procedures for moving data in Part 2 (Volume 1) of *DB2 Administration Guide*.

Changes to the secondary space allocation (SECQTY) take effect the next time DB2 extends the data set; however, the new value is not reflected in the integrated catalog until you use the REORG, RECOVER, or LOAD REPLACE utility on the table space or partition. The changes to the other storage attributes take effect the next time the page set is reset. For a non-LOB table space, the page set is reset when you use the REORG, RECOVER, or LOAD REPLACE utilities on the table space or partition. For a LOB table space, the page set is reset when RECOVER is run on the LOB table space or LOAD REPLACE is run on its associated base table space. If there is not enough storage to satisfy the primary space allocation, a REORG might fail. If you change the primary space allocation parameters or erase rule, you can have the changes take effect earlier if you move the data before you start the table space or partition.

Altering table spaces for DB2 catalog tables: For details on altering options on catalog tables, see “SQL statements allowed on the catalog” on page 1197.

Invalidation of plans and packages: When the SBCS CCSID attribute of a table space is altered, all the plans and packages that refer to that table space are marked invalid.

Alternative syntax and synonyms: For compatibility with previous releases of DB2, the following keywords are supported:

- You can specify the LOCKPART clause, but it has no effect. Starting with Version 8, DB2 treats all partitioned table spaces as if they were defined as LOCKPART YES. LOCKPART YES specifies the use of selective partition locking. When all the conditions for selective partition locking are met, DB2 locks only the partitions that are accessed. When the conditions for selective partition locking are not met, DB2 locks every partition of the table space.
- When altering the partitions of a partitioned table space, you can specify PART as a synonym for PARTITION. In addition, the ALTER keyword that precedes PARTITION is optional.

Examples

Example 1: Alter table space DSN8S81D in database DSN8D81A. BP2 is the buffer pool associated with the table space. PAGE is the level at which locking is to take place.

```
ALTER TABLESPACE DSN8D81A.DSN8S81D
  BUFFERPOOL BP2
  LOCKSIZE PAGE;
```

Example 2: Alter table space DSN8S81E in database DSN8D81A. The table space is partitioned. Indicate that the data sets of the table space are not to be closed when there are no current users of the table space. Also, change all of the partitions so that DB2 will use a formula to determine any secondary space allocations, and change partition 1 to use a PCTFREE value of 20.

```
ALTER TABLESPACE DSN8D81A.DSN8S81E
  CLOSE NO
  SECQTY -1
  ALTER PARTITION 1 PCTFREE 20;
```

ALTER VIEW

The ALTER VIEW statement regenerates a view using an existing view definition at the current server.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

The privilege set that is defined below must include at least one of the following:
- Ownership of the view
- SYSADM authority
- SYSCTRL authority

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package. If the statement is dynamically prepared, the privilege set is the union of the privilege sets that are held by each authorization ID of the process.

Syntax

```
►►──ALTER VIEW──view-name──REGENERATE──────────────────────────────────────────►◄
```

Description

view-name
: Identifies the view to be regenerated. The name must identify a view that exists at the current server.

REGENERATE
: Specifies that the view is to be regenerated. The view definition in the catalog is used, and existing authorizations and dependent views are retained. The catalog is updated with the regenerated view definition. If the view cannot be successfully regenerated, an error is returned.

Examples

Check the catalog to find any views that were marked with view regeneration errors during catalog migration:

```
SELECT CREATOR,NAME FROM SYSIBM.SYSTABLES
  WHERE TYPE = 'V' AND STATUS = 'R' AND TABLESTATUS = 'V';
```

Assume that the query returned MYVIEW as the name of a view with a regeneration error. Issue an ALTER VIEW statement to regenerate the view:

```
ALTER VIEW MYVIEW REGENERATE;
```

ASSOCIATE LOCATORS

The ASSOCIATE LOCATORS statement gets the result set locator value for each result set returned by a stored procedure.

Invocation

This statement can be embedded in an application program. It is an executable statement that can be dynamically prepared. It cannot be issued interactively.

Authorization

None required.

Syntax

```
                                                 ┌─,──────────────────┐
                   ┌─RESULT SET─┐                ▼                    │
►►──ASSOCIATE──────┴────────────┴──┬─LOCATOR──┬──(───rs-locator-variable─┴──)──────────────────►
                                   └─LOCATORS─┘

►─WITH PROCEDURE──┬─procedure-name─┬──────────────────────────────────────────────────────────►◄
                  └─host-variable──┘
```

Description

rs-locator-variable
Identifies a result set locator variable that has been declared according to the rules for declaring result set locator variables.

WITH PROCEDURE *procedure-name* or *host-variable*
Identifies the stored procedure that returned one or more result sets. When the ASSOCIATE LOCATORS statement is executed, the procedure name must identify a stored procedure that the requester has already invoked using the SQL CALL statement. The procedure name can be specified as a one-, two-, or three-part name. The procedure name in the ASSOCIATE LOCATORS statement must be specified the same way that it was specified on the CALL statement. For example, if a two-part procedure name was specified on the CALL statement, you must specify a two-part procedure name in the ASSOCIATE LOCATORS statement.

If a host variable is used to specify the name:

- It must be a character string variable with a length attribute that is not greater than 255.
- It must not be followed by an indicator variable.
- The value of the host variable is a specification that depends on the server. Regardless of the server, the specification must:
  - Be left justified within the host variable
  - Not contain embedded blanks
  - Be padded on the right with blanks if its length is less than that of the host variable

Notes

Assignment of locator values: If the ASSOCIATE LOCATORS statement specifies multiple locator variables, locator values are assigned to the locator variables in the order that the associated cursors are opened at runtime. Locator values are assigned to the locator variables in the same order that they would be placed in the SQLVAR entries in the SQLDA as a result of a DESCRIBE PROCEDURE statement.

Locator values are not provided for cursors that are closed when control is returned to the invoking application. If a cursor was closed and later re-opened before returning to the invoking application, the most recently executed OPEN CURSOR statement for the cursor is used to determine the order in which the locator values are returned for the procedure result sets. For example, assume procedure P1 opens three cursors A, B, C, closes cursor B and then issues another OPEN CURSOR statement for cursor B before returning to the invoking application. The locator values assigned for the following ASSOCIATE LOCATORS statement will be in the order A, C, B:

```
ASSOCIATE RESULT SET LOCATORS (:loc1, :loc2, :loc3) WITH PROCEDURE P1;--> assigns
  locators for result set cursors A, C, and B
```

More than one locator can be associated with a result set. You can issue multiple ASSOCIATE LOCATORS statements for the same stored procedure with different result set locator variables to associate multiple locators with each result set.

- If the number of result set locator variables specified in the ASSOCIATE LOCATORS statement is less than the number of result sets returned by the stored procedure, all locator variables specified in the statement are assigned a value, and a warning is issued. For example, assume procedure P1 exists and returns four result sets. Each of the following ASSOCIATE LOCATORS statement returns information on the first result set along with a warning that not enough locators were provided to obtain information about all the result sets.

```
CALL P1;
ASSOCIATE RESULT SET LOCATORS (:loc1) WITH PROCEDURE P1;-->  :loc1 is assigned
  a value for first result set, and a warning is returned
ASSOCIATE RESULT SET LOCATORS (:loc2) WITH PROCEDURE P1;-->  :loc2 is assigned
  a value for first result set, and a warning is returned
ASSOCIATE RESULT SET LOCATORS (:loc3) WITH PROCEDURE P1;-->  :loc3 is assigned
  a value for first result set, and a warning is returned
ASSOCIATE RESULT SET LOCATORS (:loc4) WITH PROCEDURE P1;-->  :loc4 is assigned
  a value for first result set, and a warning is returned
```

- If the number of result set locator variables that are listed in the ASSOCIATE LOCATORS statement is greater than the number of locators returned by the stored procedure, the extra locator variables are assigned a value of 0.

Accessing result sets from multiple CALL statements: An application can access to result sets created by multiple CALL statements. The result sets can be created by different procedure or by the same procedure invoked multiple times.

- *Invoking different procedures:* Invoking different procedures with the same name can be done either explicitly by specifying the different collections or implicitly with the use of the PACKAGE PATH. For example, to identify the different collections explicitly, specify qualified names on the CALL statement. Although both procedures are named P2, they are different procedures. After the second CALL statement, result sets from both procedures are accessible to the application.

```
CALL X.P2;
CALL Y.P2;
```

The collections for the two different procedures can also be determined implicitly from the PACKAGE PATH when unqualified procedure names are specified as part of the CALL statement. For example, assume that procedure P4 exists in collections X and Z. An application contains two CALL statements to invoke procedure P4. The references to procedure P4 in the CALL statements are unqualified. So, the PACKAGE PATH special register is used to resolve the procedure name. Procedure X.P4 is invoked for the first CALL statement and procedure Z.P4 is invoked by the second CALL statement. Following the second CALL statement, result sets from both procedures are accessible to the application.

```
SET CURRENT PACKAGE PATH = X, Y, Z;
CALL P4;
SET CURRENT PACKAGE PATH = PATH Z, Y, X;
CALL P4;
```

- *Invoking the same procedure multiple times:* If the server and requester are both Version 8 of DB2 UDB for z/OS (running in new-function mode), you can call a stored procedure multiple times within an application and at the same nesting level. Each call to the same stored procedure causes a unique instance of the stored procedure to run. If the stored procedure returns result sets, each instance of the stored procedure opens its own set of result set cursors. For more information on this situation, see "Multiple calls to the same stored procedure" on page 570.

  When a procedure is invoked multiple times in an application and there is a need to process the result sets from the different instances at the same time, be sure to use the ASSOCIATE LOCATORS statement after each CALL statement to capture the locator values returned from each invocation of the procedure. For example, assume that procedure P exists in collection Z and that an application contains two CALL statements to invoke procedure P. The PACKAGE PATH is used to determine the collection for the procedure in the first CALL statement, and the collection is explicitly specified in the second CALL statement. Result sets from both procedures can be accessible to the application following both CALL statements if the locators for the result sets produced by the first CALL statement are captured with an ASSOCIATE LOCATOR statement before invoking the procedure the second time.

```
SET CURRENT PACKAGE PATH = X, Y, Z;
CALL P3;
ASSOCIATE LOCATORS ...
CALL Z.P3;
ASSOCIATE LOCATORS ...
-- process the result sets using the locators --
```

Using host variables: If the ASSOCIATE LOCATORS statement contains host variables, the following conditions apply:

- If the statement is executed statically, the contents of the host variables are assumed to be in the encoding scheme that was specified in the ENCODING parameter when the package or plan that contains the statement was bound.
- If the statement is executed dynamically, the contents of the host variables are assumed to be in the encoding scheme that is specified in the APPLICATION ENCODING bind option.

Examples

The statements in the following examples are assumed to be in PL/I programs.

Example 1: Use result set locator variables LOC1 and LOC2 to get the result set locator values for the two result sets returned by stored procedure P1. Assume that the stored procedure is called with a one-part name from current server SITE2.

```
EXEC SQL CONNECT TO SITE2;
EXEC SQL CALL P1;
EXEC SQL ASSOCIATE RESULT SET LOCATORS (:LOC1, :LOC2)
         WITH PROCEDURE P1;
```

Example 2: Repeat the scenario in Example 1, but use a two-part name to specify an explicit schema name for the stored procedure to ensure that stored procedure P1 in schema MYSCHEMA is used.

```
EXEC SQL CONNECT TO SITE2;
EXEC SQL CALL MYSCHEMA.P1;
EXEC SQL ASSOCIATE RESULT SET LOCATORS (:LOC1, :LOC2)
         WITH PROCEDURE MYSCHEMA.P1;
```

Example 3: Use result set locator variables LOC1 and LOC2 to get the result set locator values for the two result sets that are returned by the stored procedure named by host variable HV1. Assume that host variable HV1 contains the value SITE2.MYSCHEMA.P1 and the stored procedure is called with a three-part name.

```
EXEC SQL CALL SITE2.MYSCHEMA.P1;
EXEC SQL ASSOCIATE LOCATORS (:LOC1, :LOC2)
         WITH PROCEDURE :HV1;
```

The preceding example would be invalid if host variable HV1 had contained the value MYSCHEMA.P1, a two-part name. For the example to be valid with that two-part name in host variable HV1, the current server must be the same as the location name that is specified on the CALL statement as the following statements demonstrate. This is the only condition under which the names do not have to be specified the same way and a three-part name on the CALL statement can be used with a two-part name on the ASSOCIATE LOCATORS statement.

```
EXEC SQL CONNECT TO SITE2;
EXEC SQL CALL SITE2.MYSCHEMA.P1;
EXEC SQL ASSOCIATE LOCATORS (:LOC1, :LOC2)
         WITH PROCEDURE :HV1;
```

BEGIN DECLARE SECTION

The BEGIN DECLARE SECTION statement marks the beginning of a host variable declare section.

Invocation

This statement can only be embedded in an application program. It is not an executable statement. It must not be specified in Java or REXX.

Authorization

None required.

Syntax

```
►►──BEGIN DECLARE SECTION──────────────────────────────────────────────────────►◄
```

Description

The BEGIN DECLARE SECTION statement can be coded in the application program wherever variable declarations can appear in accordance with the rules of the host language. It is used to indicate the beginning of a host variable declaration section. A host variable section ends with an END DECLARE SECTION statement, described in “END DECLARE SECTION” on page 880.

The following rules are enforced by the precompiler only if the host language is C or the STDSQL(YES) precompiler option is specified:

- A variable referred to in an SQL statement must be declared within a host variable declaration section of the source program in all host languages, other than Java and REXX. Furthermore, the declaration of each variable must appear before the first reference to the variable. Host variables are declared without the use of these statements in Java, and they are not declared at all in REXX.
- BEGIN DECLARE SECTION and END DECLARE SECTION statements must be paired and must not be nested.
- Host variable declaration sections can contain only host variable declarations, SQL INCLUDE statements that include host variable declarations, or DECLARE VARIABLE statements.

Notes

Host variable declaration sections are only required if the STDSQL(YES) option is specified or the host language is C. However, declare sections can be specified for any host language so that the source program can conform to IBM SQL. If declare sections are used, but not required, variables declared outside a declare section must not have the same name as variables declared within a declare section.

Example

```
EXEC SQL BEGIN DECLARE SECTION;

 (host variable declarations)

EXEC SQL END DECLARE SECTION;
```

CALL

The CALL statement invokes a stored procedure.

Invocation

This statement can be embedded in an application program. This statement can also be dynamically prepared, but only from an ODBC or CLI driver that supports dynamic CALL statements. IBM's ODBC and CLI drivers provide this capability.

Authorization

Invoking a stored procedure requires the EXECUTE privilege on the following:

- The stored procedure

  You do not need the EXECUTE privilege on a stored procedure that was created prior to Version 6 of DB2 UDB for z/OS.
- The stored procedure package and most packages that run under the stored procedure

  The authorization that is required for which packages is explained in detail below under "Authorization to execute packages under the stored procedure".

Authorization to execute the stored procedure

The authorization ID that must have the EXECUTE privilege on the stored procedure depends on the form of the CALL statement:

- For static SQL programs that use the syntax CALL *procedure*, the owner of the plan or package that contains the CALL statement must have one of the following:
  - – The EXECUTE privilege on the stored procedure
  - – Ownership of the stored procedure
  - – SYSADM authority
- For static SQL programs that use the syntax CALL *host variable* (ODBC applications use this form of the CALL statement), the authorization ID of the plan or package that contains the CALL statement must have one of the following:
  - – The EXECUTE privilege on the stored procedure
  - – Ownership of the stored procedure
  - – SYSADM authority

  The DYNAMICRULES behavior for the plan or package that contains the CALL statement determines both the authorization ID and the privilege set that is held by that authorization ID:

  Run behavior
  The privilege set is the union of the set of privileges held by the SQL authorization ID and each authorization ID of the process.

  Bind behavior
  The privilege set is the privileges that are held by the primary authorization ID of the owner of the package or plan.

  Define behavior
  The privilege set is the privileges that are held by the authorization ID of the owner (definer) of the stored procedure or user-defined function that issued the CALL statement.

  Invoke behavior
  The privilege set is the privileges that are held by the authorization ID of the invoker of the stored

procedure or user-defined function that issued the CALL statement. However, if the invoker is the primary authorization ID of the process or the CURRENT SQLID value, the privilege set is the union of the set of privileges that are held by each authorization ID.

For a list of the DYNAMICRULES values that specify run, bind, define, or invoke behavior, see Table 3 on page 51.

Authorization to execute packages under the stored procedure

The authorization that is required to run the stored procedure package and any packages that are used under the stored procedure apply to any form of the CALL statement as follows:

- ***Stored procedure package:*** One of the authorization IDs that are defined below under "Set of authorization IDs" must have at least one of the following on the stored procedure package:
  - The EXECUTE privilege on the package
  - Ownership of the package
  - PACKADM authority for the package's collection
  - SYSADM authority

  A PKLIST entry is not required for the stored procedure package.
- ***User-defined function packages and trigger packages:*** If a stored procedure or any application under the stored procedure invokes a user-defined function, DB2 requires only the owner (the definer) and not the invoker of the user-defined function to have EXECUTE authority on the user-defined function package. However, the authorization ID of the SQL statement that invokes the user-defined function must have EXECUTE authority on the function. Similarly, if a trigger is used under a stored procedure, DB2 does not require EXECUTE authority on the trigger package; however, the authorization ID of the SQL statement that activates the trigger must have EXECUTE authority on the trigger. For more information about the EXECUTE authority for user-defined functions, triggers, and user-defined function packages, see Part 3 of *DB2 Administration Guide*.

  PKLIST entries are not required for any user-defined function packages or trigger packages that are used under the stored procedure.
- ***Packages other than user-defined function, trigger, and stored procedure packages:*** One of the authorization IDs that are defined below under "Set of authorization IDs" must have at least one of the following on any packages other than user-defined function and trigger packages that are used under the stored procedure:
  - The EXECUTE privilege on the package
  - Ownership of the package
  - PACKADM authority for the package's collection
  - SYSADM authority

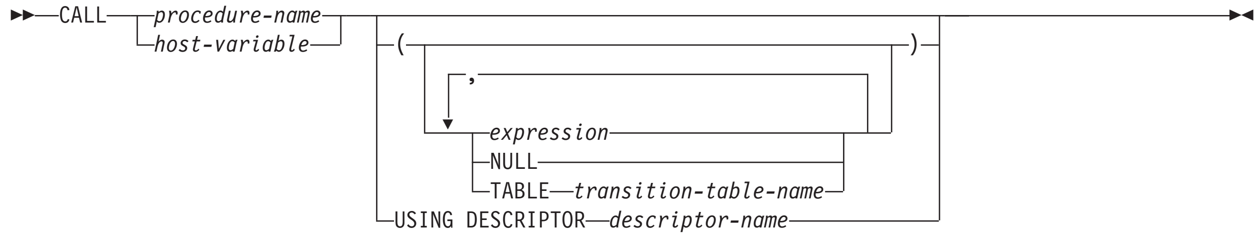
  PKLIST entries are required for any of these packages that are used under the stored procedure.

Set of authorization IDs: DB2 checks the following authorization IDs in the order in which they are listed for the required authorization to execute the stored procedure package and any packages other than user-defined function and trigger packages as described above:

- The owner (the definer) of the stored procedure

- The owner of the plan that contains the statement that invokes the package if the application is local, the application is distributed and DB2 UDB for z/OS is both the requester and the server, or the application uses Recoverable Resources Management Services attachment facility (RRSAF) and has no plan.
- The owner of the package that contains the statement that invokes the package if the application is distributed and DB2 UDB for z/OS is the server but not the requester
- The authorization ID as determined by the value of the DYNAMICRULES bind option for the plan or package that contains the CALL statement if the CALL statement is in the form of CALL *host variable*

Syntax



Description

procedure-name **or** *host-variable*

Identifies the stored procedure to call. The procedure name can be specified as a character string constant or within a host variable.

A procedure name is a qualified or unqualified name. Each part of the name must be composed of SBCS characters:

- A fully qualified procedure name is a three-part name. The first part is an SQL identifier that contains the location name that identifies the DBMS at which the procedure is stored. The second part is an SQL identifier that contains the schema name of the stored procedure. The last part is an SQL identifier that contains the name of the stored procedure. A period must separate each of the parts. Any or all of the parts can be a delimited identifier.
- A two-part procedure name has one implicit qualifier. The implicit qualifier is the location name of the current server. The two parts identify the schema name and the name of the stored procedure. A period must separate the two parts.
- An unqualified procedure name is a one-part name with two implicit qualifiers. The first implicit qualifier is the location name of the current server. The second implicit qualifier depends on the server. If the server is DB2 UDB for z/OS, the implicit qualifier is the schema name. DB2 uses the SQL path to determine the value of the schema name.
  - If the procedure name is specified as a literal on the CALL statement (CALL *procedure-name*), the SQL path is the value of the PATH bind option that is associated with the calling package or plan.

  - If a host variable is specified for the procedure name on the CALL statement (CALL *host-variable*), the SQL path is the value of the CURRENT PATH special register.

DB2 searches the schema names in the SQL path from left to right until a stored procedure with the specified schema name is found in the DB2 catalog. When a matching *schema.procedure-name* is found, the search stops only if the following conditions are true:

  - The user is authorized to call the stored procedure.
  - The number of parameters in the definition of the stored procedure matches the number of parameters specified on the CALL statement.

If the list of schemas in the SQL path is exhausted before the procedure name is resolved, an error is returned.

If a host variable is used:

- It must be a character string variable with a length attribute that is not greater than 254.
- It must not have a CLOB data type.
- It must not be followed by an indicator variable.
- The value of the host variable is a specification that depends on the server. Regardless of the server, the specification must:
  - Be left justified within the host variable
  - Not contain embedded blanks
  - Be padded on the right with blanks if its length is less than that of the host variable

  In addition, the specification can:
  - Contain upper and lowercase characters. Lowercase characters are not folded to uppercase.
  - Use a delimited identifier for any part of a three-part procedure name.

  If the server is DB2 UDB for z/OS, the specification must be a procedure name as defined above.

When the CALL statement is executed, the procedure name or specification must identify a stored procedure that exists at the server.

When the package that contains the CALL statement is bound, the stored procedure that is invoked must be created if VALIDATE(BIND) is specified. Although the stored procedure does not need to be created at bind time if VALIDATE(RUN) is specified, it must be created when the CALL statement is executed.

Parameters (*expression*, **NULL**, **TABLE transition-table-name**)

Identifies a list of values to be passed as parameters to the stored procedure. If USING DESCRIPTOR is specified, each host variable described by the identified SQLDA is a parameter, or part of an expression that is a parameter, of the CALL statement. If host structures are not specified in the CALL statement, the *n*th parameter of the CALL statement corresponds to the *n*th parameter in the stored procedure, and the number of parameters in each must be the same. Otherwise, each reference to a host structure is replaced by a reference to each of the variables contained in that host structure, and the resulting number of parameters must be the same as the number of parameters defined for the stored procedure.

However, a character FOR BIT DATA parameter cannot be passed as input for a parameter that is not defined as character FOR BIT DATA. Likewise, a character argument that is not FOR BIT DATA cannot be passed as input for a parameter that is defined as character FOR BIT DATA.

Each parameter of a stored procedure is described at the server. In addition to attributes such as data type and length, the description of each parameter indicates how the stored procedure uses it:

- IN means as an input value
- OUT means as an output value
- INOUT means both as an input and an output value

When the CALL statement is executed, the value of each of its parameters is assigned to the corresponding parameter of the stored procedure. In cases where the parameters of the CALL statement are not an exact match to the data types of the parameters of the stored procedure, each parameter specified in the CALL statement is converted to the data type of the corresponding parameter of the stored procedure at execution. The conversion occurs according to the same rules as assignment to columns. For details on the rules used to assign parameters, see "Assignment and comparison" on page 74.

Conversion can occur when precision, scale, length, encoding scheme, or CCSID differ between the parameter specified in the CALL statement and the data type of the corresponding parameter of the stored procedure. Conversion might occur for a character string parameter specified in the CALL statement when the corresponding parameter of the stored procedure has a different encoding scheme or CCSID. For example, an error occurs when the CALL statement passes mixed data that actually contains DBCS characters as input to a parameter of the stored procedure that is declared with an SBCS subtype. Likewise, an error occurs when the stored procedure returns mixed data that actually contains DBCS characters in the parameter of the CALL statement that has an SBCS subtype.

Control is passed to the stored procedure according to the calling conventions of the host language. When execution of the stored procedure is complete, the value of each parameter of the stored procedure is assigned to the corresponding parameter of the CALL statement defined as OUT or INOUT.

expression

The parameter is the result of the specified expression, which is evaluated before the stored procedure is invoked.

If *expression* is a single host variable, the corresponding parameter of the procedure can be defined as IN, INOUT, or OUT. Otherwise, the corresponding parameter of the procedure must be defined as IN. In addition, the host variable can identify a structure. Any host variable or structure that is specified must be described in the application program according to the rules for declaring host structures and variables. A reference to a host structure is replaced by a reference to each of the variables contained in the host structure.

If the result of the expression can be the null value, either the description of the procedure must allow for null parameters or the corresponding parameter of the stored procedure must be defined as OUT.

The following additional rules apply depending on how the corresponding parameter was defined in the CREATE PROCEDURE statement for the procedure:

- IN *expression* can contain references to multiple host variables. In addition to the rules stated in "Expressions" on page 133 for *expression*,

| *expression* cannot include a column name, a scalar subselect, an
| aggregate function, or a user-defined function that is sourced on an
| aggregate function.

- INOUT or OUT *expression* can only be a single host variable.

NULL
The parameter is a null value. The corresponding parameter of the procedure must be defined as IN and the description of the procedure must allow for null parameters.

TABLE transition-table-name
The parameter is a transition table, and it is passed to the procedure as a table locator. You can use the CALL statement with the TABLE clause only within the definition of the triggered action of a trigger. The name of a transition table must be specified in the CALL statement if the corresponding parameter of the procedure was defined in the TABLE LIKE clause of the CREATE PROCEDURE statement. For information about creating a trigger, see "CREATE TRIGGER" on page 793 and *DB2 Application Programming and SQL Guide*.

There is no effect on the transition table on the return from the procedure regardless of whether the parameter was defined as IN, INOUT, or OUT.

USING DESCRIPTOR *descriptor-name*
Identifies an SQLDA that contains a valid description of the host variables that are to be passed as parameters to the stored procedure. If the stored procedure has no parameters, an SQLDA is ignored.

Before the CALL statement is processed, the user must set the following fields in the SQLDA:

- SQLN to indicate the number of SQLVAR occurrences provided in the SQLDA. This number must not be less than SQLD. This field is not part of the REXX SQLDA and therefore does not need to be set for REXX programs.
- SQLDABC to indicate the number of bytes of storage allocated for the SQLDA. This number must be not be less than SQLN*44+16. This field is not part of the REXX SQLDA and therefore does not need to be set for REXX programs.
- SQLD to indicate the number of variables used in the SQLDA when processing the statement. This number must be the same as the number of parameters of the stored procedure.
- SQLVAR occurrences to indicate the attributes of the variables.

There are additional considerations for setting the fields of the SQLDA when a variable that is passed as a parameter to the stored procedure has a LOB data type or is a LOB locator. For more information, see Appendix E, "SQL descriptor area (SQLDA)," on page 1173.

The SQL CALL statement ignores distinct type information in the SQLDA. Only the base SQL type information is used to process the input and output parameters described by the SQLDA.

See "Identifying an SQLDA in C or C++" on page 1189 for how to represent *descriptor-name* in C.

Notes

Parameter assignments: When the CALL statement is executed, the value of each of its parameters is assigned with storage assignment rules to the corresponding parameter of the procedure. Control is passed to the procedure according to the calling conventions of the host language. When execution of the procedure is complete, the value of each parameter of the procedure is assigned with storage assignment rules to the corresponding parameter of the CALL statement defined as OUT or INOUT. If an error is returned by the procedure, OUT arguments are undefined and INOUT arguments are unchanged. For details on the assignment rules, see “Assignment and comparison” on page 74.

Cursors and prepared statements in procedures: All cursors opened in the called procedure that are not result set cursors are closed and all statements prepared in the called procedure are destroyed when the procedure ends.

Result sets from procedures: Any cursors specified using the WITH RETURN clause that the procedure leaves open when it returns identifies a result set. In a procedure written in Java, all cursors are implicitly defined WITH RETURN.

Errors from procedures: A procedure can return errors or warnings using a SQLSTATE-like SQL statement. Applications should be aware of the possible SQLSTATEs that can be expected when a procedure is invoked. The possible SQLSTATEs depend on how the procedure is coded. Procedures may also return SQLSTATEs such as those that begin with ’38’ or ’39’ if DB2 encounters problems executing the procedure. Applications should therefore be prepared to handle any error SQLSTATE that may result from issuing a CALL statement.

Improving performance: The capability of calling stored procedures is provided to improve the performance of DRDA distributed access (DB2 private protocol access is not supported). The capability is also useful for local operations. The server can be the local DB2. In which case, packages are still required.

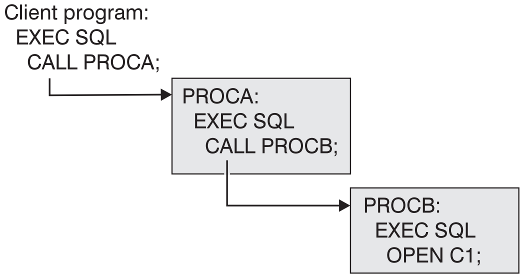
All values of all parameters are passed from the requester to the server. To improve the performance of this operation, host variables that correspond to OUT parameters and have lengths of more than a few bytes should be set to null before the CALL statement is executed.

Using the CALL statement in a trigger: When a trigger issues a CALL statement to invoke a stored procedure, the parameters that are specified in the CALL statement cannot be host variables and the USING DESCRIPTOR clause cannot be specified.

Nesting CALL statements: A program that is executing as a stored procedure, a user-defined function, or a trigger can issue a CALL statement. When a stored procedure, user-defined function, or trigger calls a stored procedure, user-defined function, or trigger, the call is considered to be nested. Stored procedures, user-defined functions, and triggers can be nested up to 16 levels deep on a single system. Nesting can occur within a single DB2 subsystem or when a stored procedure or user-defined function is invoked at a remote server.

If a stored procedure returns any query result sets, the result sets are returned to the caller of the stored procedure. If the SQL CALL statement is nested, the result sets are visible only to the program that is at the previous nesting level. For example, Figure 12 on page 570 illustrates a scenario in which a client program calls stored procedure PROCA, which in turn calls stored procedure PROCB. Only

PROCA can access any result sets that PROCB returns; the client program has no access to the query result sets. The number of query result sets that PROCB returns does not count toward the maximum number of query results that PROCA can return.



```
Client program:
  EXEC SQL
    CALL PROCA;
```

```
PROCA:
  EXEC SQL
    CALL PROCB;
```

```
PROCB:
  EXEC SQL
    OPEN C1;
```

Figure 12. Nested CALL statements

Some stored procedures cannot be nested. A stored procedure, user-defined function, or trigger cannot call a stored procedure that is defined with the COMMIT ON RETURN attribute. A stored procedure can call another stored procedure only if they execute in the same type of address space; they must both execute in a DB2-established address space or in a WLM-established address space.

Multiple calls to the same stored procedure: If the server and requester are both Version 8 of DB2 UDB for z/OS (running in new-function mode), you can call a stored procedure multiple times within an application and at the same nesting level. Each call to the same stored procedure causes a unique instance of the stored procedure to run. If the stored procedure returns result sets, each instance of the stored procedure opens its own set of result set cursors.

The application might receive a ″resource unavailable message″ if the CALL statement causes the values of the maximum number of active stored procedures or maximum number open cursors to be exceeded. The value of field MAX STORED PROCEDURES (on installation panel DSNTIPX) defines the maximum number of active stored procedures that are allowed per thread. The value of field MAX OPEN CURSORS (on installation panel DSNTIPX) defines the maximum number of open cursors (both result set cursors and regular cursors) that are allowed per thread.

If you make multiple calls to the same stored procedure within an application, be aware of the following considerations:

- A DESCRIBE PROCEDURE statement describes the last instance of the stored procedure.
- The ASSOCIATE LOCATORS statement works on the last instance of the stored procedure.
- The ALLOCATE CURSOR statement must specify a unique cursor name for a result set returned from an instance of the stored procedure. Otherwise, you will lose the data from the result sets that are returned from prior instances or calls to the stored procedure.

You should issue an ASSOCIATE LOCATORS statement (or DESCRIBE PROCEDURE statement) after each call to the stored procedure to get a unique locator value for each result set.

Using host variables: If the CALL statement contains host variables, the contents of the host variables are assumed to be in the encoding scheme that was specified in the ENCODING parameter when the package or plan that contains the statement was bound.

Examples

Example 1: A PL/I application has been precompiled on DB2 ALPHA and a package was created at DB2 BETA with the BIND subcommand. A CREATE PROCEDURE statement was issued at BETA to define the procedure SUMARIZE, which allows nulls and has two parameters. The first parameter is defined as IN and the second parameter is defined as OUT. Some of the statements that the application that runs at DB2 ALPHA might use to call stored procedure SUMARIZE include:

```
EXEC SQL CONNECT TO BETA;
V1 = 528671;
IV = -1;
EXEC SQL CALL SUMARIZE(:V1,:V2 INDICATOR :IV);
```

Example 2: Assume that stored procedure MYPROC exists and produces several result sets. An application might include statements like the following to access the result sets produced by MYPROC:

```
-- Invoke stored procedure MYPROC that returns several result sets
EXEC SQL CALL MYPROC (....);

-- Copy the locator values for the result sets into result set locator variables
EXEC SQL ASSOCIATE RESULT SET LOCATORS (:RS1, :RS2, :RS3) WITH PROCEDURE MYPROC;

-- Allocate cursors for the result set cursors
EXEC SQL ALLOCATE CSR1 CURSOR FOR RESULT SET :RS1;
EXEC SQL ALLOCATE CSR2 CURSOR FOR RESULT SET :RS2;
EXEC SQL ALLOCATE CSR3 CURSOR FOR RESULT SET :RS3;

-- Process data returned with the result set cursors
DO WHILE (SQLCODE = 0);
EXEC SQL FETCH CSR1 INTO .....
END;

EXEC SQL CLOSE CSR1;

-- do similar processing with other result sets
...
```

CLOSE

The CLOSE statement closes a cursor. If a temporary copy of a result table was created when the cursor was opened, that table is destroyed.

Invocation

This statement can only be embedded in an application program. It is an executable statement that cannot be dynamically prepared. It must not be specified in Java.

Authorization

See “DECLARE CURSOR” on page 812 for the authorization required to use a cursor.

Syntax

```
►►──CLOSE──cursor-name─────────────────────────────────────────────────────►◄
```

Description

cursor-name
Identifies the cursor to be closed. The cursor name must identify a declared cursor as explained in “DECLARE CURSOR” on page 812. When the CLOSE statement is executed, the cursor must be in the open state.

Notes

Any open cursors of an application process option are implicitly closed at the termination of a unit of work. However, explicitly closing cursors as soon as possible can improve performance. CLOSE does not cause a commit or rollback operation.

The cursor could have been allocated. See “ALLOCATE CURSOR” on page 436.

Example

A cursor is used to fetch one row at a time into the application program variables DNUM, DNAME, and MNUM. Finally, the cursor is closed. If the cursor is reopened, it is again located at the beginning of the rows to be fetched.

```
EXEC SQL DECLARE C1 CURSOR FOR
   SELECT DEPTNO, DEPTNAME, MGRNO
   FROM DSN8810.DEPT
   WHERE ADMRDEPT = 'A00'
   END-EXEC.

EXEC SQL OPEN C1 END-EXEC.

EXEC SQL FETCH C1 INTO :DNUM, :DNAME, :MNUM END-EXEC.

IF SQLCODE = 100
   PERFORM DATA-NOT-FOUND
ELSE
   PERFORM GET-REST-OF-DEPT
   UNTIL SQLCODE IS NOT EQUAL TO ZERO.

EXEC SQL CLOSE C1 END-EXEC.
```

```
GET-REST-OF-DEPT.
   EXEC SQL FETCH C1 INTO :DNUM, :DNAME, :MNUM END-EXEC.
```

COMMENT

The COMMENT statement adds or replaces comments in the descriptions of various objects in the DB2 catalog at the current server.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

For a comment on a table, view, alias, index, or column, the privilege set that is defined below must include at least one of the following:

- Ownership of the table, view, alias, or index
- DBADM authority for its database (tables and indexes only)
- SYSADM or SYSCTRL authority

For a comment on a distinct type, stored procedure, trigger, or user-defined function, the privilege set that is defined below must include at least one of the following:

- Ownership of the distinct type, stored procedure, trigger, or user-defined function
- The ALTERIN privilege on the schema (for the addition of comments)
- SYSADM or SYSCTRL authority

For a comment on a plan or package, the privilege set that is defined below must include at least one of the following:

- Ownership of the plan or package
- SYSADM or SYSCTRL authority

For a comment on a sequence, the privilege set that is defined below must include at least one of the following:

- Ownership of the sequence
- The ALTER privilege for the sequence
- The ALTERIN privilege on the schema
- SYSADM or SYSCTRL authority

The authorization ID that matches the schema name implicitly has the ALTERIN privilege on the schema.

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package. If the statement is dynamically prepared, the privilege set is determined by the DYNAMICRULES behavior in effect (run, bind, define, or invoke) and is summarized in Table 53 on page 433. (For more information on these behaviors, including a list of the DYNAMICRULES bind option values that determine them, see “Authorization IDs and dynamic SQL” on page 51.)

Syntax

```
 ►►──COMMENT ON──────────────────────────────────────────────────────────────────────────►

|►──┬─┬─ALIAS──alias-name──────────────────────────────────────┬─IS──string-constant─┬──────►◄
    │ ├─COLUMN──┬─table-name─┬─.column-name─────────────────────┤                     │
    │ │         └─view-name──┘                                 │                     │
    │ ├─DISTINCT TYPE──distinct-type-name──────────────────────┤                     │
    │ ├─┬─FUNCTION──function-name──┬───────────────────────┬─┬─┤                     │
    │ │ │                          │     ┌─,─────────────┐ │ │ │                     │
    │ │ │                          │     ▼               │ │ │ │                     │
    │ │ │                          └─(───┬───────────────┬┴─)┘ │ │                     │
    │ │ │                                └─parameter-type─┘    │ │                     │
    │ │ └─SPECIFIC FUNCTION──specific-name─────────────────────┘ │                     │
    │ ├─INDEX──index-name──────────────────────────────────────┤                     │
    │ ├─PACKAGE──collection-id.package-name──┬────────────────────┬┤                     │
    │ │                                      │ ┌─VERSION─┐        │                     │
    │ │                                      └─┴─────────┴─version-id─┘                     │
    │ ├─PLAN──plan-name────────────────────────────────────────┤                     │
    │ ├─PROCEDURE──procedure-name──────────────────────────────┤                     │
    │ ├─SEQUENCE──sequence-name────────────────────────────────┤                     │
    │ ├─TABLE──┬─table-name─┬──────────────────────────────────┤                     │
    │ │        └─view-name──┘                                  │                     │
    │ └─TRIGGER──trigger-name──────────────────────────────────┘                     │
    │                          ┌─,───────────────────────────────┐                   │
    │                          ▼                                 │                   │
    └─┬─table-name─┬──(───column-name──IS──string-constant──┴──)───────────────────┘
      └─view-name──┘
```

parameter-type

```
►►──data-type──┬────────────────┬──────────────────────────────────────────────────►◄
               │         (1)    │
               └─AS LOCATOR─────┘
```

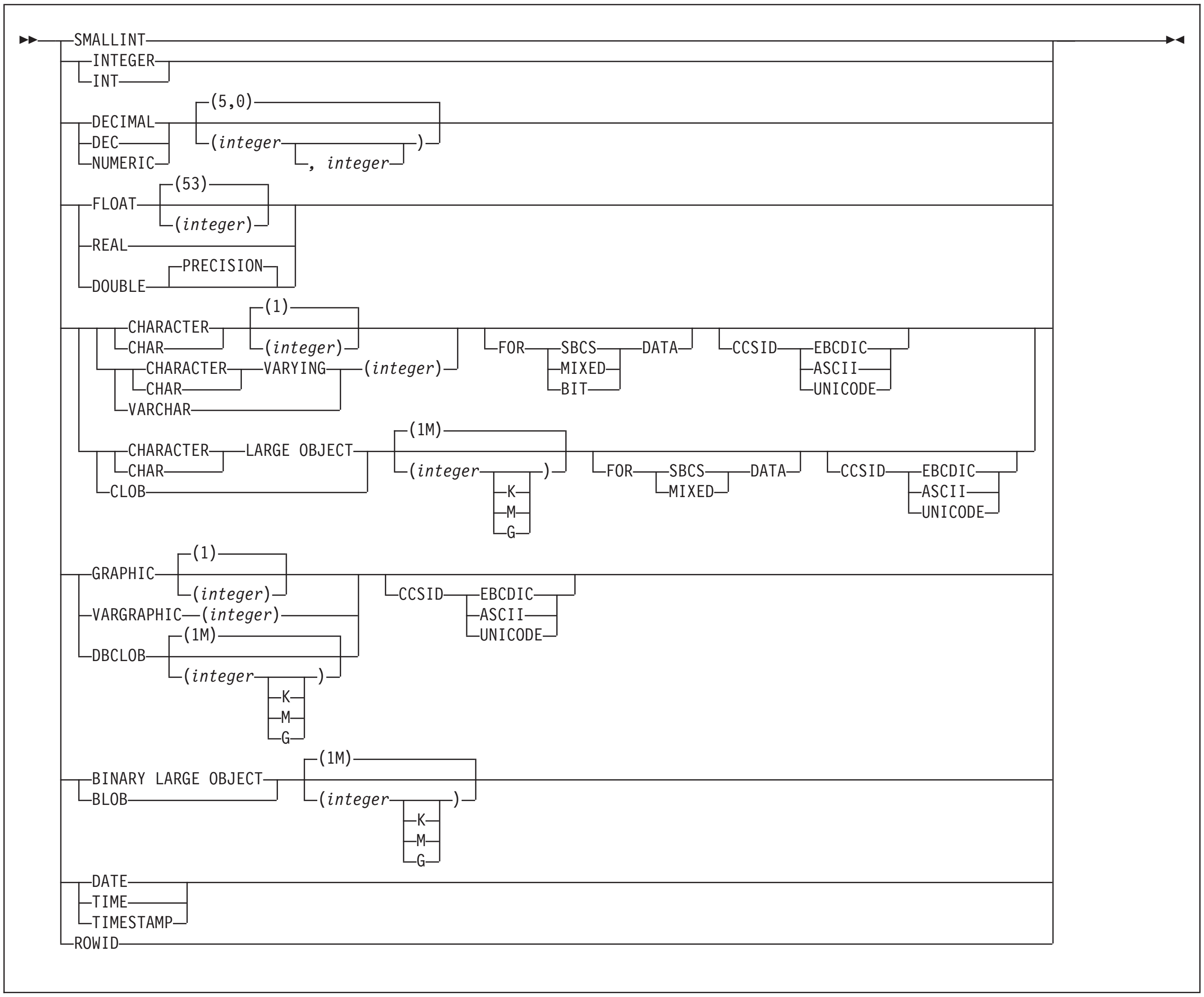
Notes:

1 AS LOCATOR can be specified only for a LOB data type or a distinct type that is based on a LOB data type.

data-type

```
►►──┬─built-in-type──────┬─────────────────────────────────────────────────────────►◄
    └─distinct-type-name─┘
```

built-in-type



Description

ALIAS *alias-name*
Identifies the alias to which the comment applies. *alias-name* must identify an alias that exists at the current server. The comment is placed in the REMARKS column of the SYSIBM.SYSTABLES catalog table for the row that describes the alias.

COLUMN *table-name.column-name* or *view-name.column-name*
Identifies the column to which the comment applies. The name must identify a column of a table or view that exists at the current server. The name must not identify a column of a declared temporary table. The comment is placed into the REMARKS column of the SYSIBM.SYSCOLUMNS catalog table, for the row that describes the column.

Do not use TABLE or COLUMN to comment on more than one column in a table or view. Give the table or view name and then, in parentheses, a list in the form:

```
column-name IS string-constant,
column-name IS string-constant,...
```

The column names must not be qualified, each name must identify a column of the specified table or view, and that table or view must exist at the current server.

DISTINCT TYPE *distinct-type-name*

Identifies the distinct type to which the comment applies. *distinct-type-name* must identify a distinct type that exists at the current server. The comment is placed in the REMARKS column of the SYSIBM.SYSDATATYPES catalog table for the row that describes the distinct type.

FUNCTION or **SPECIFIC FUNCTION**

Identifies the function to which the comment applies. The function must exist at the current server, and it must be a function that was defined with the CREATE FUNCTION statement or a cast function that was generated by a CREATE DISTINCT TYPE statement. The comment is placed in the REMARKS column of the SYSIBM.SYSROUTINES catalog table for the row that describes the function.

The function can be identified by its name, function signature, or specific name. If the function was defined with a table parameter (the LIKE TABLE was specified in the CREATE FUNCTION statement to indicate that one of the input parameters is a transition table), you must identify the function its function name, if it is unique, or with its specific name.

FUNCTION *function-name*

Identifies the function by its name. The *function-name* must identify exactly one function. The function can have any number of parameters defined for it. If there is more than one function with the specified name in the specified or implicit schema, an error is returned.

FUNCTION *function-name (parameter-type,...)*

Identifies the function by its function signature, which uniquely identifies the function. The*function-name (parameter-type,...)* must identify a function with the specified function signature. The specified parameters must match the data types in the corresponding position that were specified when the function was created. The number of data types and the logical concatenation of the data types is used to identify the specific function instance to which the comment applies. Synonyms for data types are considered a match. The rules for function resolution (and the SQL path) are not used.

If *function-name()* is specified, the function that is identified must have zero parameters.

function-name

Identifies the name of the function.

(parameter-type,...)

Identifies the parameters of the function.

If an unqualified distinct type name is specified, DB2 searches the SQL path to resolve the schema name for the distinct type.

For data types that have a length, precision, or scale attribute, use one of the following:

- Empty parenthesis indicates that the data base manager ignores the attribute when determining whether the data types match. For example, DEC() will be considered a match for a parameter of a function defined with a data type of DEC(7,2). However, FLOAT cannot be specified with empty parenthesis because its parameter value indicates a specific data type (REAL or DOUBLE).

- If a specific value for a length, precision, or scale attribute is specified, the value must exactly match the value that was specified (implicitly or explicitly) in the CREATE FUNCTION statement. If the data type is FLOAT, the precision does not have to exactly match the value that was specified because matching is based on the data type (REAL or DOUBLE).
- If length, precision, or scale is not explicitly specified, and empty parentheses are not specified, the default attributes of the data type are implied. The implicit length must exactly match the value that was specified (implicitly or explicitly) in the CREATE FUNCTION statement.

For data types with a subtype or encoding scheme attribute, specifying the FOR *subtype* DATA clause or the CCSID clause is optional. Omission of either clause indicates that DB2 ignores the attribute when determining whether the data types match. If you specify either clause, it must match the value that was implicitly or explicitly specified in the CREATE FUNCTION statement.

AS LOCATOR
Specifies that the function is defined to receive a locator for this parameter. If AS LOCATOR is specified, the data type must be a LOB or a distinct type based on a LOB.

SPECIFIC FUNCTION *specific-name*
Identifies the function by its specific name. The *specific-name* must identify a specific function that exists at the current server.

INDEX *index-name*
Identifies the index to which the comment applies. *index-name* must identify an index that exists at the current server. The comment is placed in the REMARKS column of the SYSIBM.SYSINDEXES catalog table for the row that describes the index.

PACKAGE *collection-id.package-name*
Identifies the package to which the comment applies. You must qualify the package name with a collection ID. *collection-id.package-name* must identify a package that exists at the current server. The name plus the implicitly or explicitly specified *version-id* must identify a package that exists at the current server. Omitting *version-id* is an implicit specification of the null version.

PLAN *plan-name*
Identifies the plan to which the comment applies. *plan-name* must identify a plan that exists at the current server.

PROCEDURE *procedure-name*
Identifies the stored procedure to which the comment applies. *procedure-name* must identify a stored procedure that has been defined with the CREATE PROCEDURE statement at the current server. The comment is placed in the REMARKS column of the SYSIBM.SYSROUTINES catalog table for the row that describes the stored procedure.

SEQUENCE *sequence-name*
Identifies the sequence to which the comment applies. The combination of name and implicit or explicit schema name must identify an existing sequence at the current server. If no sequence by this name exists in the explicitly or implicitly specified schema, an error occurs. *sequence-name* must not be the name of an internal sequence object that is generated by the system for an

| identity column. The comment is placed in the REMARKS column of the
| SYSIBM.SYSSEQUENCES catalog table for the row that describes the
| sequence.

TABLE *table-name* or *view-name*
Identifies the table or view to which the comment applies. *table-name* or *view-name* must identify a table, auxiliary table, or view that exists at the current server. *table-name* must not identify a declared temporary table. The comment is placed in the REMARKS column of the SYSIBM.SYSTABLES catalog table for the row that describes the table or view.

TRIGGER *trigger-name*
Identifies the trigger to which the comment applies. *trigger-name* must identify a trigger that exists at the current server. The comment is placed in the REMARKS column of the SYSIBM.SYSTRIGGERS catalog table for the row that describes the trigger.

IS *string-constant*
Introduces the comment that you want to make. *string-constant* can be any SQL character string constant of up to 254 characters.

Notes

Alternative syntax and synonyms: To provide compatibility with previous releases of DB2 or other products in the DB2 UDB family, DB2 supports DATA TYPE as a synonym for DISTINCT TYPE.

Examples

Example 1: Enter a comment on table DSN8810.EMP.

```
COMMENT ON TABLE DSN8810.EMP
  IS 'REFLECTS 1ST QTR 81 REORG';
```

Example 2: Enter a comment on view DSN8810.VDEPT.

```
COMMENT ON TABLE DSN8810.VDEPT
  IS 'VIEW OF TABLE DSN8810.DEPT';
```

Example 3: Enter a comment on the DEPTNO column of table DSN8810.DEPT.

```
COMMENT ON COLUMN DSN8810.DEPT.DEPTNO
  IS 'DEPARTMENT ID - UNIQUE';
```

Example 4: Enter comments on the two columns in table DSN8810.DEPT.

```
COMMENT ON DSN8810.DEPT
  (MGRNO IS 'EMPLOYEE NUMBER OF DEPARTMENT MANAGER',
   ADMRDEPT IS 'DEPARTMENT NUMBER OF ADMINISTERING DEPARTMENT');
```

Example 5: Assume that you are SMITH and that you created the distinct type DOCUMENT in schema SMITH. Enter comments on DOCUMENT.

```
COMMENT ON DISTINCT TYPE DOCUMENT
  IS 'CONTAINS DATE, TABLE OF CONTENTS, BODY, INDEX, and GLOSSARY';
```

Example 6: Assume that you are SMITH and you know that ATOMIC_WEIGHT is the only function with that name in schema CHEM. Enter comments on ATOMIC_WEIGHT.

```
COMMENT ON FUNCTION CHEM.ATOMIC_WEIGHT
  IS 'TAKES ATOMIC NUMBER AND GIVES ATOMIC WEIGHT';
```

Example 7: Assume that you are SMITH and that you created the function CENTER in schema SMITH. Enter comments on CENTER, using the signature to uniquely identify the function instance.

```
COMMENT ON FUNCTION CENTER (INTEGER, FLOAT)
  IS 'USES THE CHEBYCHEV METHOD';
```

Example 8: Assume that you are SMITH and that you created another function named CENTER in schema JOHNSON. You gave the function the specific name FOCUS97. Enter comments on CENTER, using the specific name to identify the function instance.

```
COMMENT ON SPECIFIC FUNCTION JOHNSON.FOCUS97
  IS 'USES THE SQUARING TECHNIQUE';
```

Example 9: Assume that you are SMITH and that stored procedure OSMOSIS is in schema BIOLOGY. Enter comments on OSMOSIS.

```
COMMENT ON PROCEDURE BIOLOGY.OSMOSIS
  IS 'CALCULATIONS THAT MODEL OSMOSIS';
```

Example 11: Assume that you are SMITH and that trigger BONUS is in your schema. Enter comments on BONUS.

```
COMMENT ON TRIGGER BONUS
  IS 'LIMITS BONUSES TO 10% OF SALARY';
```

Example 12: Provide a comment for package MYPKG, which is in collection COLLIDA.

```
COMMENT ON COLLIDA.MYPKG
  IS 'THIS IS MY PACKAGE';
```

Example 13: Provide a comment for plan MYPLAN.

```
COMMENT ON MYPLAN
  IS 'THIS IS MY PLAN';
```

COMMIT

The COMMIT statement ends a unit of recovery and commits the relational database changes that were made in that unit of recovery. If relational databases are the only recoverable resources used by the application process, COMMIT also ends the unit of work.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared. It cannot be used in the IMS or CICS environment.

Authorization

None required.

Syntax

```
           ┌─WORK─┐
►►──COMMIT─┴──────┴──────────────────────────────────────────────────────►◄
```

Description

The unit of recovery in which the statement is executed is ended and a new unit of recovery is effectively started for the process. All changes made by ALTER, COMMENT, CREATE, DELETE, DROP, EXPLAIN, GRANT, INSERT, LABEL, RENAME, REVOKE, UPDATE statements, a cursor for a SELECT statement without an INSERT statement, a subselect with an INSERT statement, and SELECT INTO with an INSERT statement executed during the unit of recovery are committed, and all savepoints that were set within the unit of recovery are released. SQL connections are ended when any of the following apply:

- The connection is in the release pending status
- The connection is not in the release pending status but it is a remote connection and:
  - The DISCONNECT(AUTOMATIC) bind option is in effect, or
  - The DISCONNECT(CONDITIONAL) bind option is in effect and an open WITH HOLD cursor is not associated with the connection.

For existing connections, all LOB locators are disassociated, except for those locators for which a HOLD LOCATOR statement has been issued without a corresponding FREE LOCATOR statement. All open cursors that were declared without the WITH HOLD option are closed. All open cursors that were declared with the WITH HOLD option are preserved, along with any SELECT statements that were prepared for those cursors. All other prepared statements are destroyed unless dynamic caching is enabled for your system. In that case, all prepared SELECT, INSERT, UPDATE, and DELETE statements that are bound with DYNAMICKEEP(YES) are kept past the commit.

Prepared statements cannot be kept past a commit if any of the following is true:

- SQL RELEASE has been issued for that site.
- Bind option DISCONNECT(AUTOMATIC) was used.

- Bind option DISCONNECT(CONDITIONAL) was used and there are no hold cursors for that site.

All implicitly acquired locks are released, except:

- Locks that are required for the cursors that were not closed
- Table and table space locks when the RELEASE parameter on the bind command was not RELEASE(COMMIT)
- LOB locks and LOB table space locks that are required for held LOB locators

For an explanation of the duration of explicitly acquired locks, see Part 5 (Volume 2) of *DB2 Administration Guide*.

All rows of every created temporary table of the application process are deleted with the exception that the rows of a created temporary table are not deleted if any program in the application process has an open WITH HOLD cursor that is dependent on that table. In addition, if RELEASE(COMMIT) is in effect, the logical work files for the created temporary tables whose rows are deleted are also deleted.

All rows of every declared temporary table of the application process are deleted with these exceptions:

- The rows of a declared temporary table that is defined with the ON COMMIT PRESERVE ROWS attribute are not deleted.
- The rows of a declared temporary table that is defined with the ON COMMIT DELETE ROWS attribute are not deleted if any program in the application process has an open WITH HOLD cursor that is dependent on that table.

Notes

Implicit commit operations: In all DB2 environments, the normal termination of a process is an implicit commit operation.

Restrictions on the use of COMMIT: The COMMIT statement cannot be used in the IMS or CICS environment. To cause a commit operation in these environments, SQL programs must use the call prescribed by their transaction manager. The effect of these commit operations on DB2 data is the same as that of the SQL COMMIT statement.

The COMMIT statement cannot be used in a stored procedure if the procedure is in the calling chain of a user-defined function or a trigger or if the caller is using a two-phase commit.

Effect of commit on special registers: Issuing a COMMIT statement may cause special registers to be re-initialized. Whether one of these special registers is affected by a commit depends on whether the special register has been explicitly set within the application process. For example, assume that the PATH special register has not been explicitly set with a SET PATH statement in the application process. After a commit, the value of PATH is re-initialized. For information on the initialization of PATH, which can take the current value of CURRENT SQLID into consideration, see “CURRENT PATH” on page 105.

Example

Commit all DB2 database changes made since the unit of recovery was started.

```
COMMIT WORK;
```

CONNECT

The CONNECT statement connects an application process to a database server. This server becomes the *current server* for the process. Refer to “Distributed data” on page 18 for complete information about connections, the current server, commit processing, and distributed and remote units of work. The CONNECT statement of DB2 UDB for z/OS is equivalent to CONNECT (Type 2) in *IBM DB2 Universal Database SQL Reference for Cross-Platform Development*.

Invocation

This statement can only be embedded within an application program. It is an executable statement that cannot be dynamically prepared. It must not be specified in Java or REXX.

Authorization

The primary authorization ID of the process or the authorization ID that is specified in this statement must be authorized to connect to the specified server. The server performs the authorization check when the statement is executed, and determines the specific authorization that is required. See Part 3 (Volume 1) of *DB2 Administration Guide* for further information.

Syntax

```
►►──CONNECT──┬──────────────────────────────────────────────┬────────────────────►◄
             ├─TO──┬─location-name─┬───┬───────────────┬────┤
             │     └─host-variable─┘   └─authorization─┘    │
             ├─RESET────────────────────────────────────────┤
             └─authorization────────────────────────────────┘
```

authorization:

```
►►──USER──host-variable──USING──host-variable────────────────────────────────────►◄
```

Description

TO *location-name* or *host-variable*
Identifies the server by the specified location name or by the location name that is contained in the host variable. If a host variable is specified:

- It must be a CHAR or VARCHAR variable with a length attribute that is not greater than 16. (A C NUL-terminated character string can be up to 17 bytes long.)
- It must not be followed by an indicator variable.
- The location name must be left-justified within the host variable and must conform to the rules for forming an ordinary identifier.
- If the length of the location name is less than the length of the host variable, it must be padded on the right with blanks.
- It must not contain lowercase characters.

When the CONNECT statement is executed:

- The location name must identify a server known to the local DB2 subsystem. Hence, the location name must be the location name of the local DB2 subsystem or it must appear in the LOCATION column of the SYSIBM.LOCATIONS table.
- The application process must not have an existing connection to the specified server, if the SQLRULES(STD) bind option is in effect.
- The application process must be in a connectable state, if the transaction is participating in a remote unit of work.

RESET

CONNECT RESET is equivalent to CONNECT TO *x* where *x* is the location name of the local DB2 subsystem.

- If the SQLRULES(DB2) bind option is in effect, CONNECT RESET establishes the local DB2 subsystem as the current SQL connection.
- If the SQLRULES(STD) bind option is in effect, CONNECT RESET establishes the local DB2 subsystem as the current SQL connection only if the connection does not exist.

authorization

Specifies an authorization ID and a password that is used to verify that the authorization ID is authorized to connect to the server. Authorization cannot be specified when the connection type is IMS or CICS. An attempt to do so causes an SQL error.

USER *host-variable*

Identifies the authorization name to use when connecting to the server. The value of *host-variable* must satisfy the following rules:

- The value must be a CHAR or VARCHAR variable with a length attribute that is not greater than 128.
- The value must be left-justified within the host variable and must conform to the rules for forming an authorization name.
- The value must not be followed by an indicator variable.
- The value must be padded on the right with blanks if the length of the authorization name is less than the length of the host variable.

For a connection to the local DB2 subsystem, a user ID that is longer than 8 characters causes an SQL error.

USING *host-variable*

Identifies the password of the authorization name to use when connecting to the server. The value of *host-variable* must satisfy the following rules:

- The value must be a CHAR or VARCHAR variable with a length attribute that is not greater than 128.
- The value must be left-justified.
- The value must not include an indicator variable.
- The value must be padded on the right with blanks if the length of the password is less than the length of the host variable.
- The value must not contain lowercase characters.

For a connection to a DB2 subsystem, a password that is longer than 8 characters causes an SQL error.

CONNECT USER/USING is equivalent to CONNECT TO *x* USER/USING where *x* is the location name of the local DB2 subsystem (which has the semantic of CONNECT RESET).

CONNECT with no operand
This form of the CONNECT statement returns information about the current server in the SQLERRP field of the SQLCA. SQLERRP returns blanks if the application process is in the unconnected state.

Executing a CONNECT with no operand has no effect on connection states.

In a remote unit of work, this form of CONNECT does not require the application process to be in a connectable state.

Notes

Successful connection: With the exception of a CONNECT with no operand statement, if execution of the CONNECT statement is successful:

- One of the following scenarios takes place in a **distributed unit of work**:
  - If the location name does not identify a server to which the application process is already connected, an SQL connection to the server is created and placed in the current and held state. The previously current SQL connection, if any, is placed in the dormant state.
  - If the location name identifies a server to which the application process is already connected, the associated SQL connection is dormant, and the SQLRULES(DB2) option is in effect, the SQL connection is placed in the current state. The previously current SQL connection, if any, is placed in the dormant state.
  - If the location name identifies a server to which the application process is already connected, the associated SQL connection is current, and the SQLRULES(DB2) option is in effect, the states of all SQL connections of the application process are unchanged.
- The following actions occur in a **remote unit of work**:
  - The application process is connected to the specified server.
  - An existing SQL connection of the application process is ended. As a result, all cursors of that SQL connection are closed, all prepared statements of that connection are destroyed, and so on.
- The location name is placed in the CURRENT SERVER special register.
- When CONNECT is used to connect back to the local DB2 subsystem, the CURRENT SQLID special register is reinitialized if the USER/USING clause is specified.
- Information about the server is placed in the SQLERRP field of the SQLCA. If the server is a DB2 Universal Database product, the information has the form *pppvvrrm*, where:
  - *ppp* is:
    ARI for DB2 Server for VSE & VM
    DSN for DB2 UDB for z/OS
    QSQ for DB2 UDB for iSeries
    SQL for DB2 UDB for LUW
  - *vv* is a two-digit version identifier such as '08'.
  - *rr* is a two-digit release identifier such as '01'.
  - *m* is a one-digit maintenance level. Values 0, 1, 2, 3, and 4 are reserved for maintenance levels in compatibility and enabling-new-function mode. Values 5, 6, 7, 8, and 9 are for maintenance levels in new-function mode.

For example, if the server is Version 8 of DB2 UDB for z/OS in new-function mode with the first level of maintenance, the value of SQLERRP is 'DSN08015'.

- Additional information about the connection is placed in the SQLERRMC field of the SQLCA. The contents are product-specific.

  Tip: Use the GET DIAGNOSTICS command, which is new in Version 8, to get detailed diagnostic information about the last SQL statement that was executed.

Unsuccessful connection: With the exception of a CONNECT with no operand statement, if execution of the CONNECT statement is unsuccessful:

- In a **distributed unit of work**, the connection state of the application process and the states of its SQL connections are unchanged unless the failure was because an authorization check failed. If this is the case, the connection is placed in the connectable and unconnected state.
- In a **remote unit of work**, the SQLERRP field of the SQLCA is set to the name of the DB2 requester module that detected the error.

  If execution of the CONNECT statement is unsuccessful because the application process is not in the connectable state, the connection state of the application process is unchanged. If execution of the CONNECT statement is unsuccessful for any other reason, CURRENT SERVER is set to blanks and the application process is placed in the connectable and unconnected state.

Authorization: If the server is a DB2 subsystem, a user is authenticated in the following way:

- DB2 invokes RACF via the RACROUTE macro with REQUEST=VERIFY to verify the password.
- If the password is verified, DB2 then invokes RACF again via the RACROUTE macro with REQUEST=AUTH, to check whether the authorization ID is allowed to use DB2 resources defined to RACF.
- DB2 then invokes the connection exit routine if one has been defined.
- The connection then has a primary authorization ID, possibly one or more secondary IDs, and an SQL ID.

If the server is a remote DB2 subsystem, the requester generates authentication tokens and sends them to the remote site in the following way:

- The SECURITY_OUT column in SYSIBM.LUNAMES for SNA or the SECURITY_OUT column in SYSIBM.IPNAMES for TCP/IP must have one of the following values:
  - ’A’ (already verified)
  - ’D’ (userid and security-sensitive data encryption; TCP/IP only)
  - ’E’ (userid, password, and security-sensitive data encryption; TCP/IP only)
  - ’P’ (password)

  When the value is ’A’, the user ID and password specified on the CONNECT is still sent.
- For SNA, the ENCRYPTPSWDS column in SYSIBM.SYSLUNAMES must be not contain ’Y’.
- The authorization ID and password are verified at the server.
- In all cases, outbound translation—as specified in SYSIBM.USERNAMES—is not done.

If a connection to the server exists and the server is not DB2 UDB for z/OS or another server that can reuse threads, the existing connection is terminated and a new connection is established using the specified USER/USING.

Distributed unit of work: In general, the following are true:

- A CONNECT statement with the TO clause and the USER/USING clause can be executed only if no current or dormant connection to the named server exists. However, if the named server is the local DB2 subsystem and the CONNECT statement is the first SQL statement that is executed after the DB2 thread is created, the CONNECT statement executes successfully.
- A CONNECT statement without the TO clause but with the USER/USING clause can be executed only if no current or dormant connection to the local DB2 subsystem exists. However, if the CONNECT statement is the first SQL statement that is executed after the DB2 thread is created, the CONNECT statement executes successfully.

Remote unit of work: If the authorization check fails, the connection is placed in the connectable and unconnected state.

Precompiler options: Regardless of whether a program is precompiled with the CONNECT(1) or CONNECT(2) option, DB2 UDB for z/OS negotiates with the remote server during the connection process to determine how to perform commits. If the remote server does not support the two-phase commit protocol, DB2 downgrades to perform one-phase commits.

Programs containing CONNECT statements that are precompiled with different CONNECT precompiler options cannot execute as part of the same application process. An error occurs when an attempt is made to execute the invalid CONNECT statement.

Host variables: If a CONNECT statement contains host variables, the contents of the host variables are assumed to be in the encoding scheme that was specified in the ENCODING parameter when the package or plan that contains the statement was bound.

Error processing: A CONNECT statement can return and indicate a successful execution even when no physical connection yet exists. DB2 delays the physical connection process, when possible, to economize on the number of messages it sends to a server. Therefore, errors in CONNECT statement processing can be reported following the next executable SQL statement, not immediately following the CONNECT statement.

Examples

Example 1: Connect an application to a DBMS. The location name is in the character-string variable *LOCNAME*, the authorization identifier is in the character-string variable *AUTHID*, and the password is in the character-string variable *PASSWORD*.

```
EXEC SQL CONNECT TO :LOCNAME USER :AUTHID USING :PASSWORD;
```

Example 2: Obtain information about the current server.

```
EXEC SQL CONNECT;
```

Example 3: Execute SQL statements in a distributed unit of work. The first CONNECT statement creates a connection to the EASTDB server. The second

CONNECT statement creates a connection to the WESTDB server, and places the SQL connection to EASTDB in the dormant state.

```
EXEC SQL CONNECT TO EASTDB;

  (execute statements referencing objects at EASTDB)

EXEC SQL CONNECT TO WESTDB;

  (execute statements referencing objects at WESTDB)
```

Example 4: Connect to a remote server with the specified user ID and password, perform work for the user, and then re-use the connection with a different user ID and password.

```
EXEC SQL CONNECT USER :AUTHID USING :PASSWORD;

  (execute SQL statements accessing data on the server)

EXEC SQL COMMIT;

  (set AUTHID and PASSWORD to new values)

EXEC SQL CONNECT USER :AUTHID USING :PASSWORD;

  (execute SQL statements accessing data on the server)
```

Example 5: Change servers in a remote unit of work. Assume that the application connected to a remote DB2 server, opened a cursor, and fetched rows from the cursor's result table. Subsequently, to connect to the local DB2 subsystem, the application executes the following statements:

```
EXEC SQL COMMIT WORK;
EXEC SQL CONNECT RESET;
```

The COMMIT is required because opening the cursor caused the application to enter the unconnectable and connected state.

If the cursor was declared with the WITH HOLD clause and was not closed with a CLOSE statement, it would still be open even after execution of the COMMIT statement. However, it would be closed with the execution of the CONNECT statement.

CREATE ALIAS

The CREATE ALIAS statement defines an alias for a table or view. The definition is recorded in the DB2 catalog at the current server. The table or view does not have to be described in that catalog.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

The privilege set that is defined below must include at least one of the following:

- The CREATEALIAS privilege
- SYSADM or SYSCTRL authority
- DBADM or DBCTRL authority on the database that contains the table, if the alias is for a table and the value of field DBADM CREATE AUTH on installation panel DSNTIPP is YES

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that held by the authorization ID of the owner of the plan or package. If the specified alias name includes a qualifier that is not the same as this authorization ID, the privilege set must include one of the following authorities:

- SYSADM or SYSCTRL authority
- DBADM or DBCTRL authority on the database that contains the table, if the alias is for a table and the value of field DBADM CREATE AUTH on installation panel DSNTIPP is YES

If the statement is dynamically prepared, the privilege set is the privileges that are held by the SQL authorization ID of the process. If the specified alias name includes a qualifier that is not the same as this authorization ID:

- The privilege set must include SYSADM or SYSCTRL authority.
- The privilege set must include DBADM or DBCTRL authority on the database that contains the table, if the alias is for a table and the value of field DBADM CREATE AUTH on installation panel DSNTIPP is YES.
- The qualifier must be the same as one of the authorization IDs of the process and the privileges that are held by that authorization ID must include the CREATEALIAS privilege. This is an exception to the rule that the privilege set is the privileges that are held by the SQL authorization ID of the process.

Syntax

```
►►──CREATE ALIAS──alias-name──FOR──┬─table-name─┬──────────────────────────────────────►◄
                                   └─view-name──┘
```

Description

alias-name
Names the alias. The name must not identify a table, view, alias, or synonym that exists at the current server.

If qualified, the name can be a two-part or three-part name. If a three-part name is used, the first part must match the value of the field DB2 LOCATION NAME on installation panel DSNTIPR at the current server. (If the current server is not the local DB2, this name is not necessarily the name in the CURRENT SERVER special register.) Whether the name is two-part or three-part, the authorization ID that qualifies the name is the owner of the alias.

If the alias name is unqualified and the statement is embedded in an application program, the owner of the alias is the authorization ID that serves as the implicit qualifier for unqualified object names. This is the authorization ID in the QUALIFIER operand when the plan or package was created or last rebound. If QUALIFIER was not used, the owner of the alias is the owner of the package or plan.

If the alias name is unqualified and the statement is dynamically prepared, the SQL authorization ID is the owner of the alias.

The owner has the privilege to drop the alias.

FOR *table-name* or *view-name*

Identifies the table or view for which the alias is defined. If a table is identified, it must not be an auxiliary table or a declared temporary table. The table or view need not exist at the time the alias is defined. If it does exist, it can be at the current server or at another server. The name must not be the same as the alias name and must not identify an alias that exists at the current server.

Notes

An alias can be defined for a table, view, or alias that is not at the current server. When so defined, the existence of the referenced object is not verified at the time the alias is created. But the object must exist when a statement that contains the alias is executed. And if that object is also an alias, it must refer to a table or view at the server where that alias is defined.

A warning occurs if an alias is defined for a table or view that is local to the current server but does not exist.

When a table is moved from one location to another, the alias for that table must be dropped and then re-created with the new location name. When an application is moved from one location to another location, aliases must exist at the new location for all tables that are referred to by the application. Aliases at the old location can be dropped if they are no longer needed.

When an application uses three-part name aliases for remote objects and DRDA access, the application program must be bound at each location that is specified in the three-part names. Also, you need to define the alias at the remote site as well as at the local site.

Example

Create an alias for a catalog table at a DB2 with location name DB2USCALABOA5281.

```
CREATE ALIAS LATABLES FOR DB2USCALABOA5281.SYSIBM.SYSTABLES;
```

CREATE AUXILIARY TABLE

The CREATE AUXILIARY TABLE statement creates an auxiliary table at the current server for storing LOB data.

Invocation

Do not use this statement if the value of special register CURRENT RULES is 'STD' when the statement is executed. When the register's value is 'STD' and a base table is created with LOB columns or altered such that LOB columns are added, DB2 automatically creates the LOB table space, auxiliary table, and index on the auxiliary table for each LOB column. DB2 chooses the names and characteristics of these objects. For more information about the names and the characteristics, see "Creating a table with LOB columns" on page 766.

This statement can be embedded in an application program or issued interactively if the value of special register CURRENT RULES is 'DB2' when the statement is executed. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

The privilege set that is defined below must include at least one of the following:

- The CREATETAB privilege for the database implicitly or explicitly specified by the IN clause
- DBADM, DBCTRL, or DBMAINT authority for the database
- SYSADM or SYSCTRL authority

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package. If the specified table name includes a qualifier that is not the same as this authorization ID, the privilege set must include SYSADM or SYSCTRL authority, DBADM authority for the database, or DBCTRL authority for the database.

If the statement is dynamically prepared, the privilege set is the privileges that are held by the SQL authorization ID of the process. However, if the specified table name includes a qualifier that is not the same as this authorization ID, the following rules apply:

1. If the privilege set includes SYSADM or SYSCTRL authority, DBADM authority for the database, or DBCTRL authority for the database, any qualifier is valid.
2. If the privilege set does not include any of the authorities listed in item 1 above, the qualifier is valid only if it is the same as one of the authorization IDs of the process and the privilege set that are held by that authorization ID includes all[23] privileges needed to create the table.

[23] Exception: The CREATETAB privilege is checked on the SQL authorization ID of the process.

Syntax

```
►►──CREATE──┬─AUXILIARY─┬──TABLE──aux-table-name──IN──┬────────────────┬──table-space-name──────────►
            └─AUX───────┘                              └─database-name.─┘

►──STORES──table-name──COLUMN──column-name──┬──────────────┬─────────────────────────────────────►◄
                                            └─PART──integer─┘
```

Description

AUXILIARY or AUX
Specifies a table that is used to store the LOB data for a LOB column (or a column with a distinct type that is based on a LOB data type).

aux-table-name
Names the auxiliary table. The name must not identify a table, view, alias, or synonym that exists at the current server.

If qualified, the name can be a two-part or three-part name. If a three-part name is used, the first part must match the value of field DB2 LOCATION NAME on installation panel DSNTIPR at the current server. (If the current server is not the local DB2, this name is not necessarily the name in the CURRENT SERVER special register.) Whether the name is two-part or three-part, the authorization ID that qualifies the name is the table's owner.

If the table name is unqualified and the statement is embedded in a program, the owner of the table is the authorization ID that serves as the implicit qualifier for unqualified object names. This is the authorization ID in the QUALIFIER operand when the plan or package was created or last rebound. If QUALIFIER was not used, the owner of the table is the owner of the package or plan.

If the table name is unqualified and the statement is dynamically prepared, the SQL authorization ID is the owner of the table.

IN *database-name.table-space-name* **or IN** *table-space-name*
Identifies the table space in which the auxiliary table is created. The name must identify an empty LOB table space that currently exists at the current server. The LOB table space must be in the same database as the associated base table.

If you specify a database and a table space, the table space must belong to the specified database. If you specify only a table space, it must belong to database DSNDB04.

STORES *table-name* **COLUMN** *column-name*
Identifies the base table and the column of that table that is to be stored in the auxiliary table. If the base table is nonpartitioned, an auxiliary table must not already exist for the specified column. If the base table is partitioned, an auxiliary table must not already exist for the specified column and specified partition.

The encoding scheme for the LOB data stored in the auxiliary table is the same as the encoding scheme for the base table. It is either ASCII, EBCDIC, or UNICODE depending on the value of the CCSID clause when the base table was created.

The auxiliary table can store a BLOB, CLOB, or DBCLOB value that is greater than 1 gigabyte in length only if the LOB table space for the auxiliary table was defined with LOG NO.

PART *integer*
Specifies the partition of the base table for which the auxiliary table is to store the specified column. You can specify PART only if the base table is defined in a partitioned table space, and no other auxiliary table exists for the same LOB column of the base table.

Notes

Determining the number of auxiliary tables to create: If the base table is nonpartitioned, you must create one LOB table space and one auxiliary table for each LOB column in the base table. If the base table is partitioned, for each LOB column, you must create one LOB table space and one auxiliary table. For example if your base table has three partitions and two LOB columns, you need to create a three LOB table spaces and three auxiliary tables for each LOB column. In other words, you need a total of six LOB table spaces and six auxiliary tables.

Example

Assume that a column named EMP_PHOTO with a data type of BLOB(110K) has been added to sample employee table DSN8810.EMP for each employee's photo. Create auxiliary table EMP_PHOTO_ATAB to store the BLOB data for the BLOB column in LOB table space DSN8D81A.PHOTOLTS.

```
CREATE AUX TABLE EMP_PHOTO_ATAB
   IN DSN8D81A.PHOTOLTS
   STORES DSN8810.EMP
   COLUMN EMP_PHOTO;
```

CREATE DATABASE

The CREATE DATABASE statement defines a DB2 database at the current server.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

The privilege set that is defined below must include at least one of the following:

- The CREATEDBA privilege
- The CREATEDBC privilege
- SYSADM or SYSCTRL authority

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package. If the statement is dynamically prepared, the privilege set is the privileges that are held by the SQL authorization ID of the process.

See "Notes" on page 596 for the authorization effect of a successful CREATE DATABASE statement.

Syntax

```
                                     .------------------------------------------------.
                                     V   (1)                                          |
>>--CREATE DATABASE--database-name-------+-BUFFERPOOL--bpname------------------------+-+----------><
                                         +-INDEXBP--bpname---------------------------+
                                         +-AS--+-WORKFILE-+--+--------------------+--+
                                         |     '-TEMP-----'  '-FOR--member-name---'  |
                                         |            .-SYSDEFLT------.              |
                                         +-STOGROUP---+-stogroup-name-+--------------+
                                         '-CCSID--+-ASCII---+------------------------'
                                                  +-EBCDIC--+
                                                  '-UNICODE-'
```

Notes:

1 The same clause must not be specified more than once.

Description

database-name
: Names the database. The name must not start with DSNDB and must not identify a database that exists at the current server. If the database is to be a work file database in a data sharing environment, DSNDB07 is an acceptable work file database name. However, only one member of a data sharing group can use DSNDB07 as the name of its work file database.

BUFFERPOOL *bpname*
: Specifies the default buffer pool name to be used for table spaces created

within the database. If the database is a work file database, 8KB and 16KB buffer pools cannot be specified. See "Naming conventions" on page 40 for more details about *bpname*.

If you omit the BUFFERPOOL clause, the buffer pool specified for user data on installation panel DSNTIP1 is used. The default value for the user data field on that panel is BP0.

INDEXBP *bpname*

Specifies the default buffer pool name to be used for the indexes created within the database. The name must identify a 4KB buffer pool. See "Naming conventions" on page 40 for more details about *bpname*. If the database is a work file database, INDEXBP cannot be specified.

If you omit the INDEXBP clause, the buffer pool specified for user indexes on installation panel DSNTIP1 is used. The default value for the user indexes field on that panel is BP0.

AS WORKFILE or **AS TEMP**

Indicates that this is a work file database or a database for declared temporary tables (a TEMP database).

AS WORKFILE

Specifies the database is a work file database. AS WORKFILE can be specified only in a data sharing environment. Only one work file database can be created for each DB2 member.

AS TEMP

Specifies the database is for declared temporary tables only. AS TEMP must be specified to create a database that will be used for declared temporary tables; otherwise, the database will not be used for declared temporary tables. Only one TEMP database can be created for each DB2 subsystem or data sharing member. A TEMP database cannot be shared between DB2 subsystems or data sharing members.

PUBLIC implicitly receives the CREATETAB privilege (without GRANT authority) to define a declared temporary table in the TEMP database. This implicit privilege is not recorded in the DB2 catalog and cannot be revoked.

FOR *member-name*

Specifies the member for which this database is to be created. Specify FOR member-name only in a data sharing environment.

If FOR *member-name* is not specified, the member is the DB2 subsystem on which the CREATE DATABASE statement is executed.

The CCSID clause is not supported for a work file database or a TEMP database. A TEMP database can contain a mixture of encoding schemes. If you specify AS WORKFILE or AS TEMP, do not use the CCSID clause.

STOGROUP *stogroup-name*

Specifies the storage group to be used, as required, as a default storage group to support DASD space requirements for table spaces and indexes within the database. The default is SYSDEFLT.

CCSID *encoding-scheme*

Specifies the default encoding scheme for data stored in the database. The default applies to table spaces created in the database. All tables stored within a table space must use the same encoding scheme.

ASCII Specifies that the data must be encoded using the ASCII CCSIDs of the server.

EBCDIC
Specifies that the data must be encoded using the EBCDIC CCSIDs of the server.

UNICODE
Specifies that the data must be encoded using the UNICODE CCSIDs of the server.

Usually, each encoding scheme requires only a single CCSID. Additional CCSIDs are needed when mixed, graphic, or UNICODE data is used.

The option defaults to the value of field DEF ENCODING SCHEME on installation panel DSNTIPF.

Do not use the CCSID clause if you specify the AS WORKFILE or AS TEMP clause.

Notes

If the statement is embedded in an application program, the owner of the plan or package is the owner of the database. If the statement is dynamically prepared, the SQL authorization ID of the process is the owner of the database.

If the owner of the database has the CREATEDBA, SYSADM, or SYSCTRL authority, the owner acquires DBADM authority for the database. DBADM authority for a database includes table privileges on all tables in that database. Thus, if a user with SYSCTRL authority creates a database, that user has table privileges on all tables in that database. This is an exception to the rule that SYSCTRL authority does not include table privileges.

If the owner of the database has the CREATEDBC privilege, but not the CREATEDBA privilege, the owner acquires DBCTRL authority for the database. In this case, no authorization ID has DBADM authority for the database until it is granted by an authorization ID with SYSADM authority.

Examples

Example 1: Create database DSN8D81P. Specify DSN8G810 as the default storage group to be used for the table spaces and indexes in the database. Specify 8KB buffer pool BP8K1 as the default buffer pool to be used for table spaces in the database, and BP2 as the default buffer pool to be used for indexes in the database.

```
CREATE DATABASE DSN8D81P
  STOGROUP DSN8G810
  BUFFERPOOL BP8K1
  INDEXBP BP2;
```

Example 2: Create database DSN8TEMP. Use the defaults for the default storage group and default buffer pool names. Specify ASCII as the default encoding scheme for data stored in the database.

```
CREATE DATABASE DSN8TEMP
  CCSID ASCII;
```

CREATE DISTINCT TYPE

The CREATE DISTINCT TYPE statement defines a distinct type, which is a data type that a user defines. A distinct type must be based on one of the built-in data types. Successful execution of the statement also generates:

- A function to cast between the distinct type and its source type
- A function to cast between the source type and its distinct type
- As appropriate, support for the use of comparison operators with the distinct type

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

The privilege set that is defined below must include at least one of the following:

- The CREATEIN privilege on the schema
- SYSADM or SYSCTRL authority

The authorization ID that matches the schema name implicitly has the CREATEIN privilege on the schema.

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package.

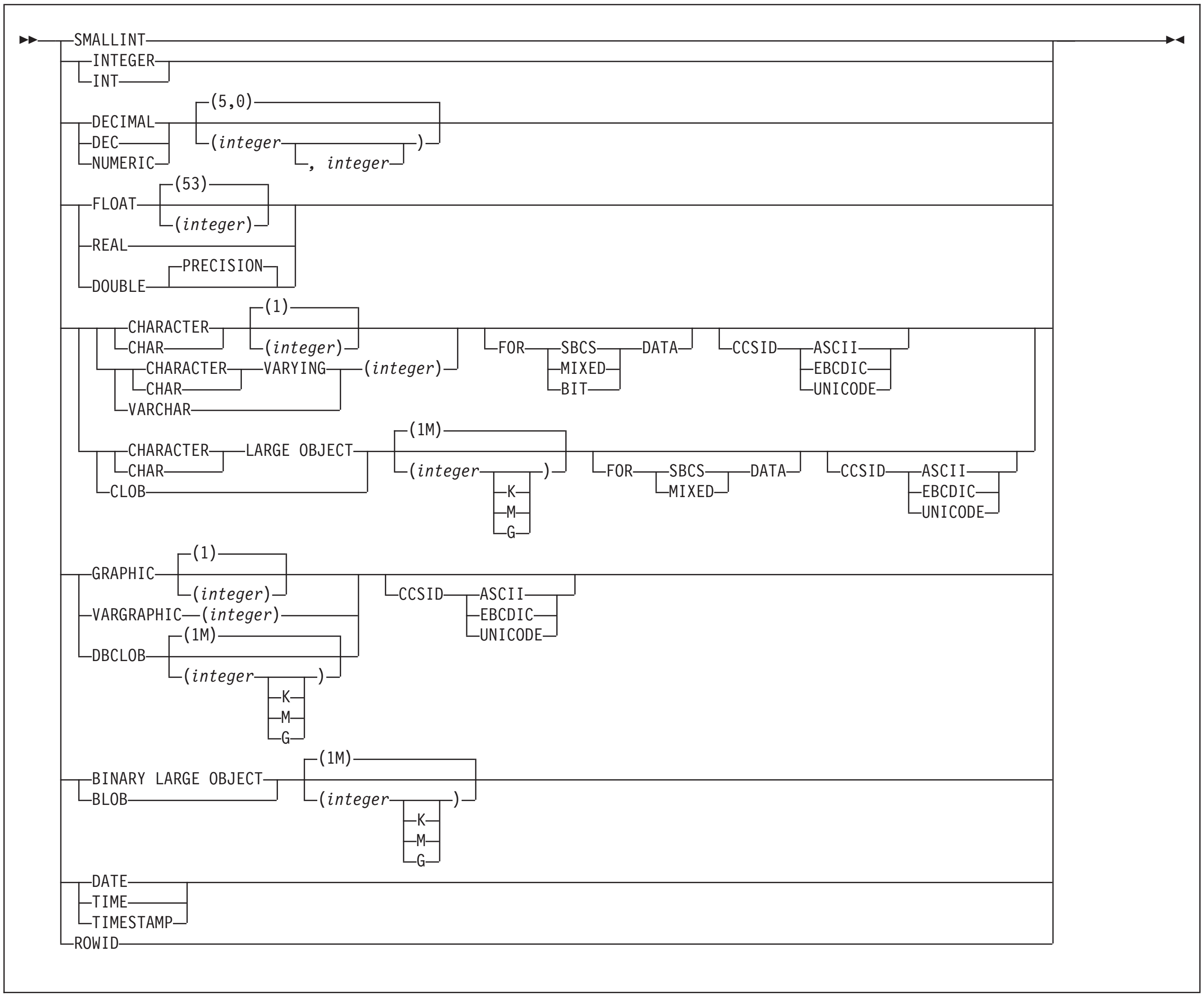
If the statement is dynamically prepared, the privilege set is the privileges that are held by the SQL authorization ID of the process. The specified distinct type name can include a schema name (a qualifier). However, if the schema name is not the same as the SQL authorization ID, one of the following conditions must be met:

- The privilege set includes SYSADM or SYSCTRL authority.
- The SQL authorization ID of the process has the CREATEIN privilege on the schema.

Syntax

```
►►──CREATE DISTINCT TYPE──distinct-type-name──AS──source-data-type──────────────────────►◄
```

source-data-type



Description

distinct-type-name

Names the distinct type. The name is implicitly or explicitly qualified by a schema name. The name, together with the implicit or explicit schema name, must not identify a distinct type that exists at the current server.

- The unqualified form of *distinct-type-name* is an SQL identifier.

  distinct-type-name must not be the name of a built-in data type, BOOLEAN, or any of following system-reserved keywords even if you specify them as delimited identifiers:

  ALL
  AND
  ANY
  BETWEEN
  DISTINCT
  EXCEPT
  EXISTS
  FALSE
  LIKE
  MATCH
  NOT
  NULL
  ONLY
  OR
  OVERLAPS
  SIMILAR
  UNIQUE
  UNKNOWN
  =
  ¬=
  <
  <=
  ¬<
  >

FOR
FROM
IN
IS
SOME
TABLE
TRUE
TYPE
>=
¬>
<>

The unqualified name is implicitly qualified with a schema name according to the following rules:

If the CREATE DISTINCT TYPE statement is embedded in a program, the schema name is the authorization ID in the QUALIFIER bind option when the plan or package was created or last rebound. If QUALIFIER was not specified, the schema name is the owner of the plan or package.

If the CREATE DISTINCT TYPE statement is dynamically prepared, the schema name is the SQL authorization ID in the CURRENT SQLID special register.

- The qualified form of *distinct-type-name* is an SQL identifier (the schema name) followed by a period and an SQL identifier.

  The schema name can be 'SYSTOOLS' if the user who executes the CREATE statement has SYSADM or SYSCTRL privilege. Otherwise, the schema name must not begin with 'SYS' unless the schema name is 'SYSADM'.

The owner of the distinct type is determined by how the CREATE DISTINCT TYPE statement is invoked:

- If the statement is embedded in a program, the owner is the authorization ID of the owner of the plan or package.
- If the statement is dynamically prepared, the owner is the SQL authorization ID in the CURRENT SQLID special register.

Although the information is not recorded in the catalog, the owner is given the USAGE privilege on the distinct type. The owner is also given the EXECUTE privilege with the GRANT option on each of the generated cast functions.

source-data-type

Specifies the data type that is used as the basis for the internal representation of the distinct type. The data type must be a built-in data type. For more information on built-in data types, see "built-in-type" on page 741.

If the distinct type is based on a character string data type, the FOR clause indicates the subtype. If you do not specify the FOR clause, the distinct type is defined with the default subtype. For ASCII or EBCDIC data, the default is SBCS when the value of field MIXED DATA on installation panel DSNTIPF is NO. The default is MIXED when the value is YES. For UNICODE character data, the default subtype is mixed.

If the distinct type is based on a string data type, the CCSID clause indicates whether the encoding scheme of the data is ASCII, EBCDIC or UNICODE. If you do not specify CCSID ASCII, CCSID EBCDIC, or UNICODE, the encoding scheme is the value of field DEF ENCODING SCHEME on installation panel DSNTIPF.

Notes

Source data types with DBCS or mixed data: When the implicit or explicit encoding scheme is ASCII or EBCDIC and the source data type is graphic or a character type is MIXED DATA, then the value of field FOR MIXED DATA on installation panel DSNTIPF must be YES; otherwise, an error occurs.

Generated cast functions: The successful execution of the CREATE DISTINCT TYPE statement causes DB2 to generate the following cast functions:

- A function to convert from the distinct type to its source data type
- A function to convert from the source data type to the distinct type
- A function to cast from a data type *A* to distinct type *DT*, where *A* is promotable to the source data type *S* of distinct type *DT*

  For some source data types, DB2 supports an additional function to convert from:
  - INTEGER to the distinct type if the source type is SMALLINT
  - VARCHAR to the distinct type if the source type is CHAR
  - VARGRAPHIC to the distinct type if the source type is GRAPHIC
  - DOUBLE to the distinct type if the source type is REAL

The cast functions are created as if the following statements were executed:

```
CREATE FUNCTION source-type-name (distinct-type-name)
   RETURNS source-type-name ...

CREATE FUNCTION distinct-type-name (source-type-name)
   RETURNS distinct-type-name ...
```

Even if you specified a length, precision, or scale for the source data type in the CREATE DISTINCT TYPE statement, the name of the cast function that converts from the distinct type to the source type is simply the name of the source data type. The data type of the value that the cast function returns includes any length, precision, or scale values that you specified for the source data type. (See Table 61 on page 601 for details.)

The name of the cast function that converts from the source type to the distinct type is the name of the distinct type. The input parameter of the cast function has the same data type as the source data type, including the length, precision, and scale.

For example, assume that a distinct type named T_SHOESIZE is created with the following statement:

```
CREATE DISTINCT TYPE CLAIRE.T_SHOESIZE AS VARCHAR(2)
```

When the statement is executed, DB2 also generates the following cast functions. VARCHAR converts from the distinct type to the source type, and T_SHOESIZE converts from the source type to the distinct type.

```
FUNCTION CLAIRE.VARCHAR (CLAIRE.T_SHOESIZE) RETURNS SYSIBM.VARCHAR (2)
FUNCTION CLAIRE.T_SHOESIZE (SYSIBM.VARCHAR (2)) RETURNS CLAIRE.T_SHOESIZE
```

Notice that function VARCHAR returns a value with a data type of VARCHAR(2) and that function T_SHOESIZE has an input parameter with a data type of VARCHAR(2).

The schema of the generated cast functions is the same as the schema of the distinct type. No other function with the same name and function signature must already exist in the database.

In the preceding example, if T_SHOESIZE had been sourced on a SMALLINT, CHAR, or GRAPHIC data type instead of a VARCHAR data type, another cast function would have been generated in addition to the two functions to cast between the distinct type and the source data type. For example, assume that T_SHOESIZE is created with this statement:

```
CREATE DISTINCT TYPE CLAIRE.T_SHOESIZE AS CHAR(2)
```

When the statement is executed, DB2 generates these cast functions:

```
FUNCTION CLAIRE.CHAR (CLAIRE.T_SHOESIZE) RETURNS SYSIBM.CHAR (2)
FUNCTION CLAIRE.T_SHOESIZE (SYSIBM.CHAR (2)) RETURNS CLAIRE.T_SHOESIZE
FUNCTION CLAIRE.T_SHOESIZE (SYSIBM.VARCHAR (2)) RETURNS CLAIRE.T_SHOESIZE
```

Notice that the third function enables the casting of a VARCHAR(2) to T_SHOESIZE. This additional function is created to enable casting a constant, such as 'AB', directly to the distinct type. Without the additional function, you would have to first cast 'AB', which has a data type of VARCHAR, to a data type of CHAR and then cast it to the distinct type.

You cannot explicitly drop a generated cast function. The cast functions that are generated for a distinct type are implicitly dropped when the distinct type is dropped with the DROP statement.

For each built-in data type that can be the source data type for a distinct type, Table 61 gives the names of the generated cast functions, the data types of the input parameters, and the data types of the values that the functions returns.

Table 61. CAST functions on distinct types

Source type name	Function name	Parameter-type	Return-type
SMALLINT	*distinct-type-name*	SMALLINT	*distinct-type-name*
	distinct-type-name	INTEGER	*distinct-type-name*
	SMALLINT	*distinct-type-name*	SMALLINT
INTEGER	*distinct-type-name*	INTEGER	*distinct-type-name*
	INTEGER	*distinct-type-name*	INTEGER
DECIMAL	*distinct-type-name*	DECIMAL (p,s)	*distinct-type-name*
	DECIMAL	*distinct-type-name*	DECIMAL (p,s)
NUMERIC	*distinct-type-name*	DECIMAL (p,s)	*distinct-type-name*
	DECIMAL	*distinct-type-name*	DECIMAL (p,s)
REAL	*distinct-type-name*	REAL	*distinct-type-name*
	distinct-type-name	DOUBLE	*distinct-type-name*
	REAL	*distinct-type-name*	REAL
FLOAT(*n*) where *n*<=21	*distinct-type-name*	REAL	*distinct-type-name*
	distinct-type-name	DOUBLE	*distinct-type-name*
	REAL	*distinct-type-name*	REAL
FLOAT(*n*) where *n*>21	*distinct-type-name*	DOUBLE	*distinct-type-name*
	DOUBLE	*distinct-type-name*	DOUBLE
FLOAT	*distinct-type-name*	DOUBLE	*distinct-type-name*
	DOUBLE	*distinct-type-name*	DOUBLE
DOUBLE	*distinct-type-name*	DOUBLE	*distinct-type-name*
	DOUBLE	*distinct-type-name*	DOUBLE
DOUBLE PRECISION	*distinct-type-name*	DOUBLE	*distinct-type-name*
	distinct-type-name	CHAR (n)	*distinct-type-name*
	CHAR	*distinct-type-name*	CHAR (n)
	distinct-type-name	VARCHAR (n)	*distinct-type-name*
	DOUBLE	*distinct-type-name*	DOUBLE

Table 61. CAST functions on distinct types (continued)

Source type name	Function name	Parameter-type	Return-type
CHAR CHARACTER	*distinct-type-name*	CHAR (n)	*distinct-type-name*
	CHAR	*distinct-type-name*	CHAR (n)
	distinct-type-name	VARCHAR (n)	*distinct-type-name*
VARCHAR CHARACTER VARYING CHAR VARYING	*distinct-type-name*	VARCHAR (n)	*distinct-type-name*
	VARCHAR	*distinct-type-name*	VARCHAR (n)
CLOB	*distinct-type-name*	CLOB (n)	*distinct-type-name*
	CLOB	*distinct-type-name*	CLOB (n)
GRAPHIC	*distinct-type-name*	GRAPHIC (n)	*distinct-type-name*
	GRAPHIC	*distinct-type-name*	GRAPHIC (n)
	distinct-type-name	VARGRAPHIC (n)	*distinct-type-name*
VARGRAPHIC	*distinct-type-name*	VARGRAPHIC (n)	*distinct-type-name*
	VARGRAPHIC	*distinct-type-name*	VARGRAPHIC (n)
DBCLOB	*distinct-type-name*	DBCLOB (n)	*distinct-type-name*
	DBCLOB	*distinct-type-name*	DBCLOB (n)
BLOB	*distinct-type-name*	BLOB (n)	*distinct-type-name*
	BLOB	*distinct-type-name*	BLOB (n)
DATE	*distinct-type-name*	DATE	*distinct-type-name*
	DATE	*distinct-type-name*	DATE
TIME	*distinct-type-name*	TIME	*distinct-type-name*
	TIME	*distinct-type-name*	TIME
TIMESTAMP	*distinct-type-name*	TIMESTAMP	*distinct-type-name*
	TIMESTAMP	*distinct-type-name*	TIMESTAMP
ROWID	*distinct-type-name*	ROWID	*distinct-type-name*
	ROWID	*distinct-type-name*	ROWID

Notes: NUMERIC and FLOAT are not recommended when creating a distinct type for a portable application. Use DECIMAL and DOUBLE (or REAL) instead.

Built-in functions: When a distinct type is defined, the built-in functions (such as AVG, MAX, and LENGTH) are not automatically supported for the distinct type. You can use a built-in function on a distinct type only after a sourced user-defined function, which is based on the built-in function, has been created for the distinct type. For information on defining sourced user-defined functions, see "CREATE FUNCTION (sourced)" on page 645.

Syntax alternatives: The WITH COMPARISONS clause, which specifies that system-generated comparison operators are to be created for comparing two instances of the distinct type, can be specified as the last clause of the statement. Use WITH COMPARISONS only if it is required for compatibility with other products in the DB2 UDB family. If the source data type is either BLOB, CLOB, or DBCLOB and WITH COMPARISONS is specified, an error occurs as in previous releases.

Examples

Example 1: Create a distinct type named SHOESIZE that is based on an INTEGER data type.

```
   CREATE DISTINCT TYPE SHOESIZE AS INTEGER;
```

The successful execution of this statement also generates two cast functions. Function INTEGER(SHOESIZE) returns a value with data type INTEGER, and function SHOESIZE(INTEGER) returns a value with distinct type SHOESIZE.

Example 2: Create a distinct type named MILES that is based on a DOUBLE data type.

```
   CREATE DISTINCT TYPE MILES AS DOUBLE;
```

The successful execution of this statement also generates two cast functions. Function DOUBLE(MILES) returns a value with data type DOUBLE, and function MILES(DOUBLE) returns a value with distinct type MILES.

CREATE FUNCTION

The CREATE FUNCTION statement registers a user-defined function with a database server. You can register four different types of functions with this statement, each of which is described separately.

- External scalar

  The function is written in a programming language and returns a scalar value. The external executable is registered with a database server along with various attributes of the function. See “CREATE FUNCTION (external scalar)” on page 605.

- External table

  The function is written in a programming language and returns a complete table. The external executable is registered with a database server along with various attributes of the function. See “CREATE FUNCTION (external table)” on page 628.

- Sourced

  The function is implemented by invoking another function (either built-in, external, SQL, or sourced) that is already registered with a database server. See “CREATE FUNCTION (sourced)” on page 645.

- SQL scalar

  The function content is specified in the RETURN clause of the CREATE FUNCTION statement. See “CREATE FUNCTION (SQL scalar)” on page 657.

CREATE FUNCTION (external scalar)

This CREATE FUNCTION statement registers a user-defined external scalar function with a database server.

A scalar function returns a single value each time it is invoked.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

The privilege set defined below must include at least one of the following:

- The CREATEIN privilege on the schema
- SYSADM or SYSCTRL authority

The authorization ID that matches the schema name implicitly has the CREATEIN privilege on the schema.

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package.

If the statement is dynamically prepared, the privilege set is the privileges that are held by the SQL authorization ID of the process. The specified function name can include a schema name (a qualifier). However, if the schema name is not the same as the SQL authorization ID, one of the following conditions must be met:

- The privilege set includes SYSADM or SYSCTRL authority.
- The SQL authorization ID of the process has the CREATEIN privilege on the schema.

Additional privileges are required if the function uses a table as a parameter, refers to a distinct type, or is to run in a WLM (workload manager) environment. These privileges are:

- The SELECT privilege on any table that is an input parameter to the function.
- The USAGE privilege on each distinct type that the function references.
- Authority to create programs in the specified WLM environment. This authorization is obtained from an external security product, such as RACF.

When LANGUAGE is JAVA and a *jar-name* is specified in the EXTERNAL NAME clause, the privilege set must include USAGE on the JAR, the Java ARchive file.

Syntax

```
►►──CREATE FUNCTION──source-data-type──(──┬─────────────────────────────┬──)──────────────►
                                          │  ┌─,─────────────────────┐  │
                                          │  ▼                       │  │
                                          └───parameter-declaration──┴──┘

          (1)
►──RETURNS──────┬──data-type2──┬──────────────────┬──────────────────────────┬──option-list──────►◄
                │              │              (2) │                          │
                │              └──AS LOCATOR──────┘                          │
                └──data-type3──CAST FROM──data-type4──┬──────────────────┬───┘
                                                      │              (2) │
                                                      └──AS LOCATOR──────┘
```

Notes:

1 This clause and the clauses that follow in the *option-list* can be specified in any order.

2 AS LOCATOR can be specified only for a LOB data type or a distinct type based on a LOB data type.

parameter-declaration:

```
►►──┬──────────────────┬──parameter-type──────────────────────────────────────────►◄
    └──parameter-name──┘
```

parameter-type:

```
►►──┬──data-type──┬──────────────────┬───────────┬────────────────────────────────►◄
    │             │              (1) │           │
    │             └──AS LOCATOR──────┘           │
    └──TABLE LIKE──┬──table-name──┬──AS LOCATOR──┘
                   └──view-name───┘
```

Notes:

1 AS LOCATOR can be specified only for a LOB data type or a distinct type based on a LOB data type.

data-type:

```
►►──┬─built-in-type──────┬──────────────────────────────────────────────────►◄
    └─distinct-type-name─┘
```

built-in-type:

```
►►──┬─SMALLINT──────────────────────────────────────────────────────────────────────────────┬──►◄
    ├─┬─INTEGER─┬───────────────────────────────────────────────────────────────────────────┤
    │ └─INT─────┘                                                                           │
    │             ┌─(5,0)──────────────────────┐                                            │
    ├─┬─DECIMAL─┬─┴─(integer─┬────────────┬─)──┴────────────────────────────────────────────┤
    │ ├─DEC─────┤            └─, integer──┘                                                 │
    │ └─NUMERIC─┘                                                                           │
    │         ┌─(53)──────┐                                                                 │
    ├─┬─FLOAT─┴─(integer)─┴─┬───────────────────────────────────────────────────────────────┤
    │ ├─REAL────────────────┤                                                               │
    │ │         ┌─PRECISION─┐│                                                              │
    │ └─DOUBLE──┴───────────┴┘                                                              │
    │                         ┌─(1)───────┐                                                   │
    ├─┬─┬─┬─┬─CHARACTER─┬─────┴─(integer)─┴──┬─┬───────────────────────┬─┬───────────────────────┬─┬─┤
    │ │ │ │ └─CHAR──────┘                    │ └─FOR─┬─SBCS──┬─DATA─┘ └─CCSID─┬─ASCII───┬─┘ │
    │ │ │ └─┬─┬─CHARACTER─┬─VARYING─┬─(integer)─┘      ├─MIXED─┤                ├─EBCDIC──┤   │
    │ │ │   │ └─CHAR──────┘         │                  └─BIT───┘                └─UNICODE─┘   │
    │ │ │   └─VARCHAR───────────────┘                                                        │
    │ │ │                                ┌─(1M)──────────────┐                                  │
    │ │ └─┬─┬─CHARACTER─┬─LARGE OBJECT─┬─┴─(integer─┬───┬─)─┴─┬───────────────────────┬─┬───────────────────────┬─┘
    │ │   │ └─CHAR──────┘              │            ├─K─┤     └─FOR─┬─SBCS──┬─DATA─┘ └─CCSID─┬─ASCII───┬─┘
    │ │   └─CLOB─────────────────────────┘            ├─M─┤           └─MIXED─┘                ├─EBCDIC──┤
    │ │                                             └─G─┘                                    └─UNICODE─┘
    │ │           ┌─(1)───────┐
    ├─┬─GRAPHIC───┴─(integer)─┴──┬─┬─────────────────────────┬────────────────────────────────┤
    │ ├─VARGRAPHIC──(integer)────┤ └─CCSID─┬─ASCII───┬─┘                                    │
    │ │         ┌─(1M)─────────────┐│        ├─EBCDIC──┤                                      │
    │ └─DBCLOB──┴─(integer─┬───┬─)─┴┘        └─UNICODE─┘                                      │
    │                      ├─K─┤                                                            │
    │                      ├─M─┤                                                            │
    │                      └─G─┘                                                            │
    │                           ┌─(1M)──────────────┐                                        │
    ├─┬─BINARY LARGE OBJECT─┬───┴─(integer─┬───┬─)─┴──────────────────────────────────────────┤
    │ └─BLOB────────────────┘              ├─K─┤                                            │
    │                                      ├─M─┤                                            │
    │                                      └─G─┘                                            │
    ├─┬─DATE──────┬─────────────────────────────────────────────────────────────────────────┤
    │ ├─TIME──────┤                                                                         │
    │ └─TIMESTAMP─┘                                                                         │
    └─ROWID─────────────────────────────────────────────────────────────────────────────────┘
```

option-list:

```
>>--+------------------------------+--+------------------------------------+---------->
    |          (1)                 |  '-PARAMETER CCSID--+-ASCII----+------'
    '-SPECIFIC--------specific-name-'                    +-EBCDIC---+
                                                         '-UNICODE--'

>--EXTERNAL--+------------------------------+--LANGUAGE--+-ASSEMBLE-+--+-PARAMETER STYLE SQL--+-->
             |                  (2)         |            +-C--------+  |                 (3)  |
             '-NAME--+-'string'-----+-------'            +-COBOL----+  '-PARAMETER STYLE JAVA-'
                     '-identifier-'                      |     (3)  |
                                                         +-JAVA-----+
                                                         '-PLI------'

  .-NOT DETERMINISTIC-.  .-FENCED-.  .-RETURNS NULL ON NULL INPUT-.  .-READS SQL DATA-----.
>-+-------------------+--+--------+--+----------------------------+--+--------------------+-->
  '-DETERMINISTIC-----'              '-CALLED ON NULL INPUT-------'  +-MODIFIES SQL DATA--+
                                                                     +-CONTAINS SQL-------+
                                                                     '-NO SQL-------------'

  .-EXTERNAL ACTION----.  .-NO SCRATCHPAD--------------.  .-NO FINAL CALL-.
>-+--------------------+--+----------------------------+--+---------------+------------------->
  '-NO EXTERNAL ACTION-'  |             .-100----.     |  '-FINAL CALL----'
                          '-SCRATCHPAD--+--------+-----'
                                        '-length-'

                       (4)  .-NO DBINFO-.  .-NO COLLID-----------------.
>-+--------------------+----+-----------+--+---------------------------+------------------->
  +-ALLOW PARALLEL-----+    '-DBINFO----'  '-COLLID--collection-id-----'
  '-DISALLOW PARALLEL--'

                                          .-ASUTIME NO LIMIT--------.  .-STAY RESIDENT NO--.
>-+-------------------------------------+-+-------------------------+--+-------------------+-->
  '-WLM ENVIRONMENT--+-name---+---------' '-ASUTIME--LIMIT--integer-'  '-STAY RESIDENT YES-'
                     '-(name)-'

  .-PROGRAM TYPE SUB--.  .-SECURITY DB2-------------.  .-STOP AFTER SYSTEM DEFAULT FAILURES-.
>-+-------------------+--+--------------------------+--+------------------------------------+-->
  '-PROGRAM TYPE MAIN-'  '-SECURITY--+-USER----+----'  +-STOP AFTER--integer--FAILURES------+
                                     '-DEFINER-'       '-CONTINUE AFTER FAILURE-------------'

                                     .-INHERIT SPECIAL REGISTERS-.  .-STATIC DISPATCH-.
>-+--------------------------------+-+---------------------------+--+-----------------+------><
  '-RUN OPTIONS--run-time-options--' '-DEFAULT SPECIAL REGISTERS-'
```

Notes:

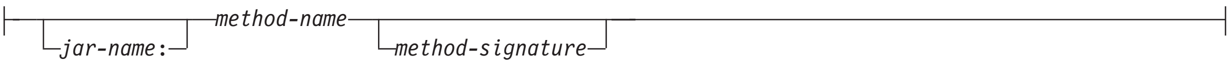
1 The clauses in the option list can be specified in any order

2 With LANGUAGE JAVA, use a valid *external-java-routine-name*.

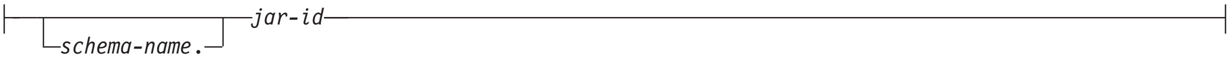
3 When either LANGUAGE JAVA or PARAMETER STYLE JAVA is specified, the other must be also be specified

4 If NOT DETERMINISTIC, EXTERNAL ACTION, SCRATCHPAD, or FINAL CALL is specified, DISALLOW PARALLEL is the default.

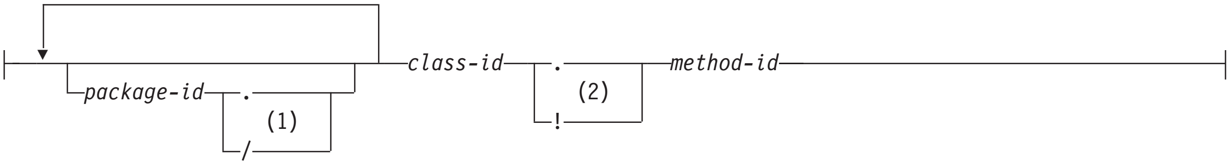
external-java-routine-name:



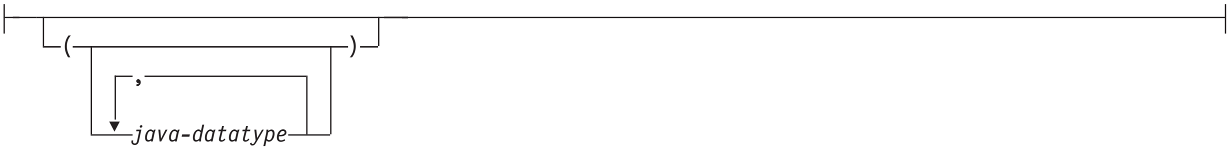
jar-name:



method-name:



method-signature:



Notes:

1 The slash (/) is supported for compatibility with previous release of DB2 UDB for z/OS.

2 The exclamation point (!) is supported for compatibility with other products in the DB2 UDB family.

Description

function-name

Names the user-defined function. The name is implicitly or explicitly qualified by a schema name. The combination of name, schema name, the number of parameters, and the data type of each parameter[24] (without regard for any length, precision, scale, subtype or encoding scheme attributes of the data type) must not identify a user-defined function that exists at the current server.

You can use the same name for more than one function if the function signature of each function is unique.

- The unqualified form of *function-name* is an SQL identifier.

  The name must not be any of the following system-reserved keywords even if you specify them as delimited identifiers:

  ```
  ALL                     LIKE                    UNIQUE
  AND                     MATCH                   UNKNOWN
  ANY                     NOT                     =
  BETWEEN                 NULL                    ¬=
  ```

[24] If the function has more than 30 parameters, only the first 30 parameters are used to determine whether the function is unique.

```
DISTINCT
EXCEPT
EXISTS
FALSE
FOR
FROM
IN
IS
ONLY
OR
OVERLAPS
SIMILAR
SOME
TABLE
TRUE
TYPE
<
<=
¬<
>
>=
¬>
<>
```

The unqualified function name is implicitly qualified with a schema name according to the following rules:

- If the statement is embedded in a program, the schema name is the authorization ID in the QUALIFIER bind option when the plan or package was created or last rebound. If QUALIFIER was not specified, the schema name is the owner of the plan or package.
- If the statement is dynamically prepared, the schema name is the SQL authorization ID in the CURRENT SQLID special register.

- The qualified form of *function-name* is an SQL identifier (the schema name) followed by a period and an SQL identifier.

  The schema name can be ’SYSTOOLS’ if the user who executes the CREATE statement has SYSADM or SYSCTRL privilege. Otherwise, the schema name must not begin with 'SYS' unless the schema name is 'SYSADM'.

The owner of the function is determined by how the CREATE FUNCTION statement is invoked:

- If the statement is embedded in a program, the owner is the authorization ID of the owner of the plan or package.
- If the statement is dynamically prepared, the owner is the SQL authorization ID in the CURRENT SQLID special register.

The owner is implicitly given the EXECUTE privilege with the GRANT option for the function.

(*parameter-declaration,...***)**

Identifies the number of input parameters of the function, and specifies the data type of each parameter. All the parameters for a function are input parameters and are nullable. There must be one entry in the list for each parameter that the function expects to receive. Although not required, you can give each parameter a name.

A function can have no parameters. In this case, you must code an empty set of parentheses, for example:

```
CREATE FUNCTION WOOFER()
```

parameter-name

Specifies the name of the input parameter. The name is an SQL identifier, and each name in the parameter list must not be the same as any other name.

data-type

Specifies the data type of the input parameter. The data type can be a built-in data type or a distinct type.

built-in-type

The data type of the input parameter is a built-in data type.

You can use the same built-in data types as for the CREATE TABLE statement. For information on the data types, see “built-in-type” on page 741.

For parameters with a character or graphic data type, the PARAMETER CCSID clause or CCSID clause indicates the encoding scheme of the parameter. If you do not specify either of these clauses, the encoding scheme is the value of field DEF ENCODING SCHEME on installation panel DSNTIPF.

distinct-type-name

The data type of the input parameter is a distinct type. Any length, precision, scale, subtype, or encoding scheme attributes for the parameter are those of the source type of the distinct type.

If you specify the name of the distinct type without a schema name, DB2 resolves the schema name by searching the schemas in the SQL path.

The implicitly or explicitly specified encoding scheme of all the parameters with a string data type must be the same—either all ASCII, all EBCDIC, or all UNICODE.

Although parameters with a character data type have an implicitly or explicitly specified subtype (BIT, SBCS, or MIXED), the function program can receive character data of any subtype. Therefore, conversion of the input data to the subtype of the parameter might occur when the function is invoked. An error occurs if mixed data that actually contains DBCS characters is used as the value for an input parameter that is declared with an SBCS subtype.

Parameters with a datetime data type or a distinct type are passed to the function as a different data type:

- A datetime type parameter is passed as a character data type, and the data is passed in ISO format.

  The encoding scheme for a datetime type parameter is the same as the implicitly or explicitly specified encoding scheme of any character or graphic string parameters. If no character or graphic string parameters are passed, the encoding scheme is the value of field DEF ENCODING SCHEME on installation panel DSNTIPF.
- A distinct type parameter is passed as the source type of the distinct type.

AS LOCATOR

Specifies that a locator to the value of the parameter is passed to the function instead of the actual value. Specify AS LOCATOR only for parameters with a LOB data type or a distinct type based on a LOB data type. Passing locators instead of values can result in fewer bytes being passed to the function, especially when the value of the parameter is very large.

The AS LOCATOR clause has no effect on determining whether data types can be promoted, nor does it affect the function signature, which is used in function resolution.

TABLE LIKE *table-name* or *view-name* **AS LOCATOR**

Specifies that the parameter is a transition table. However, when the function is invoked, the actual values in the transition table are not passed to the function. A single value is passed instead. This single value is a locator to the table, which the function uses to access the columns of the transition table. A function with a table parameter can only be invoked from the triggered action of a trigger.

The use of TABLE LIKE provides an implicit definition of the transition table. It specifies that the transition table has the same number of columns as the identified table or view. The columns have the same data type, length, precision, scale, subtype, and encoding scheme as the identified table or view, as they are described in catalog tables SYSCOLUMNS and SYSTABLESPACE. The number of columns and the attributes of those columns are determined at the time the CREATE FUNCTION statement is processed. Any subsequent changes to the number of columns in the table or the attributes of those columns do not affect the parameters of the function.

The *name* specified after TABLE LIKE must identify a table or view that exists at the current server. The name must not identify a declared temporary table. The name does not have to be the same name as the table that is associated with the transition table for the trigger. An unqualified table or view name is implicitly qualified according to the following rules:

- If the CREATE FUNCTION statement is embedded in a program, the implicit qualifier is the authorization ID in the QUALIFIER bind option when the plan or package was created or last rebound. If QUALIFIER was not used, the implicit qualifier is the owner of the plan or package.
- If the CREATE FUNCTION statement is dynamically prepared, the implicit qualifier is the SQL authorization ID in the CURRENT SQLID special register.

When the function is invoked, the corresponding columns of the transition table identified by the table locator and the table or view identified in the TABLE LIKE clause must have the same definition. The data type, length, precision, scale, and encoding scheme of these columns must match exactly. The description of the table or view at the time the CREATE FUNCTION statement was executed is used.

Additionally, a character FOR BIT DATA column of the transition table cannot be passed as input for a table parameter for which the corresponding column of the table specified at the definition is not defined as character FOR BIT DATA. (The definition occurs with the CREATE FUNCTION statement.) Likewise, a character column of the transition table that is not FOR BIT DATA cannot be passed as input for a table parameter for which the corresponding column of the table specified at the definition is defined as character FOR BIT DATA.

For more information about using table locators, see *DB2 Application Programming and SQL Guide*.

RETURNS

Identifies the output of the function. Consider this clause in conjunction with the optional CAST FROM clause.

data-type2

Specifies the data type of the output. The output parameter is nullable.

The same considerations that apply to the data type of input parameter, as described under “data-type” on page 610, apply to the data type of the output of the function.

AS LOCATOR

Specifies that the function returns a locator to the value rather than the actual value. You can specify AS LOCATOR only if the output from the function has a LOB data type or a distinct type based on a LOB data type.

data-type3 **CAST FROM** *data-type4*

Specifies the data type of the output of the function (*data-type4*) and the data type in which that output is returned to the invoking statement (*data-type3*). The two data types can be different. For example, for the following definition, the function returns a DOUBLE value, which DB2 converts to a DECIMAL value and then passes to the statement that invoked the function:

```
CREATE FUNCTION SQRT(DECIMAL(15,0))
     RETURNS DECIMAL(15,0) CAST FROM DOUBLE
     ...
```

The value of *data-type4* must not be a distinct type and must be castable to *data-type3*. The value for *data-type3* can be any built-in data type or distinct type. (For information on casting data types, see “Casting between data types” on page 71.) The encoding scheme of the parameters, if they are string data types, must be the same.

AS LOCATOR

Specifies that the function returns a locator to the value rather than the value. You can specify AS LOCATOR only if *data-type4* is a LOB data type or a distinct type based on a LOB data type.

SPECIFIC *specific-name*

Specifies a unique name for the function. The name is implicitly or explicitly qualified with a schema name. The name, including the schema name, must not identify the specific name of another function that exists at the current server.

The unqualified form of *specific-name* is an SQL identifier. The qualified form is an SQL identifier (the schema name) followed by a period and an SQL identifier.

If you do not specify a schema name, it is the same as the explicit or implicit schema name of the function name (*function-name*). If you specify a schema name, it must be the same as the explicit or implicit schema name of the function name.

If you do not specify the SPECIFIC clause, the default specific name is the name of the function. However, if the function name does not provide a unique specific name or if the function name is a single asterisk, DB2 generates a specific name in the form of:

```
SQLxxxxxxxxxxxx
```

where `'xxxxxxxxxxxx'` is a string of 12 characters that make the name unique.

The specific name is stored in the SPECIFIC column of the SYSROUTINES catalog table. The specific name can be used to uniquely identify the function in several SQL statements (such as ALTER FUNCTION, COMMENT, DROP, GRANT, and REVOKE) and must be used in DB2 commands (START FUNCTION, STOP FUNCTION, and DISPLAY FUNCTION). However, the function cannot be invoked by its specific name.

PARAMETER CCSID

Indicates whether the encoding scheme for string parameters is ASCII, EBCDIC, or UNICODE. The default encoding scheme is the value specified in the CCSID clauses of the parameter list or RETURNS clause, or in the field DEF ENCODING SCHEME on installation panel DSNTIPF.

This clause provides a convenient way to specify the encoding scheme for *all* string parameters. If individual CCSID clauses are specified for individual parameters in addition to this PARAMETER CCSID clause, the value specified in *all* of the CCSID clauses must be the same value that is specified in this clause.

This clause also specifies the encoding scheme to be used for system-generated parameters of the routine such as message tokens and DBINFO.

EXTERNAL

Specifies the program that runs when the function is invoked.

DB2 loads the load module when the function is invoked. The load module is created when the program that contains the function body is compiled and link-edited. The load module does not need to exist when the CREATE FUNCTION statement is executed. However, it must exist and be accessible by the current server when the function is invoked.

You can specify the EXTERNAL clause in one of the following ways:

```
EXTERNAL

EXTERNAL NAME PKJVSP1

EXTERNAL NAME 'PKJVSP1'
```

If you specify an external program name, you must use the NAME keyword. For example, this syntax is not valid:

```
EXTERNAL PKJVSP1
```

NAME *’string’* or *identifier*

Identifies the user-written code that implements the user-defined function.

If LANGUAGE is JAVA, *’string’* must be specified and enclosed in single quotation marks, with no extraneous blanks within the single quotation marks. It must specify a valid *external-java-routine-name*. If multiple *’string’*s are specified, the total length of all of them must not be greater than 1305 bytes and they must be separated by a space or a line break. Do not specify a JAR for a JAVA function for which NO SQL is also specified.

An *external-java-routine-name* contains the following parts:

jar-name

Identifies the name given to the JAR when it was installed in the database. The name contains *jar-id*, which can optionally be qualified with a schema. Examples are ″myJar″ and ″mySchema.myJar.″ The unqualified *jar-id* is implicitly qualified with a schema name according to the following rules:

- If the statement is embedded in a program, the schema name is the authorization ID in the QUALIFIER bind option when the package or plan was created or last rebound. If the QUALIFIER was not specified, the schema name is the owner of the package or plan.
- If the statement is dynamically prepared, the schema name is the SQL authorization ID in the CURRENT SQLID special register.

If *jar-name* is specified, it must exist when the CREATE FUNCTION statement is processed.

If *jar-name* is not specified, the function is loaded from the class file directly instead of being loaded from a JAR file. DB2 searches the directories in the CLASSPATH associated with the WLM Environment. Environmental variables for Java routines are specified in a data set identified in a JAVAENV DD card on the JCL used to start the address space for a WLM-managed function.

method-name
Identifies the name of the method and must not be longer than 254 bytes. Its package, class, and method ID's are specific to Java and as such are not limited to 18 bytes. In addition, the rules for what these can contain are not necessarily the same as the rules for an SQL ordinary identifier.

package-id
Identifies the package list that the class identifier is part of. If the class is part of a package, the method name must include the complete package prefix, such as ″myPacks.UserFuncs.″ The Java virtual machine looks in the directory ″/myPacks/UserFuncs/″ for the classes.

class-id
Identifies the class identifier of the Java object.

method-id
Identifies the method identifier with the Java class to be invoked.

method-signature
Identifies a list of zero or more Java data types for the parameter list and must not be longer than 1024 bytes. Specify the *method-signature* if the user-defined function involves any input or output parameters that can be NULL. When the function being created is called, DB2 searches for a Java method with the exact *method-signature*. The number of *java-datatype* elements specified indicates how many parameters that the Java method must have.

A Java procedure can have no parameters. In this case, you code an empty set of parentheses for *method-signature*. If a Java *method-signature* is not specified, DB2 searches for a Java method with a signature derived from the default JDBC types associated with the SQL types specified in the parameter list of the CREATE FUNCTION statement.

For other values of LANGUAGE, the name can be a string constant that is no longer than 8 characters. It must conform to the naming conventions for load modules. Alphabetical extenders for national languages can be used as the first character and as subsequent characters in the load module name.

If you do not specify the NAME clause, 'NAME *function-name*' is implicit. In this case, *function-name* must not be longer than 8 characters.

LANGUAGE
Specifies the application programming language in which the function program is written. All programs must be designed to run in IBM's Language Environment environment.

ASSEMBLE
The function is written in Assembler.

C The function is written in C or C++.

COBOL
The function is written in COBOL, including the object-oriented language extensions.

JAVA
The user-defined function is written in Java byte code and is executed in the Java Virtual Machine. When LANGUAGE JAVA is specified, the EXTERNAL NAME clause must also be specified with a valid *external-java-routine-name* and PARAMETER STYLE must be specified with JAVA.

Do not specify LANGUAGE JAVA when SCRATCHPAD, FINAL CALL, DBINFO, PROGRAM TYPE MAIN, or RUN OPTIONS is in effect.

PLI
The function is written in PL/I.

PARAMETER STYLE
Specifies the linkage convention that the function program uses to receive input parameters from and pass return values to the invoking SQL statement.

SQL
Specifies the parameter passing convention that supports passing null values both as input and for output. The parameters that are passed between the invoking SQL statement and the function include:

- *n* parameters for the input parameters that are specified for the function
- A parameter for the result of the function
- *n* parameters for the indicator variables for the input parameters
- A parameter for the indicator variable for the result
- The SQLSTATE to be returned to DB2
- The qualified name of the function
- The specific name of the function
- The SQL diagnostic string to be returned to DB2
- The scratchpad, if SCRATCHPAD is specified
- The call type, if FINAL CALL is specified
- The DBINFO structure, if DBINFO is specified

JAVA
Indicates that the user-defined function uses a convention for passing parameters that conforms to the Java and SQLJ specifications. PARAMETER STYLE JAVA can be specified only if LANGUAGE is JAVA. JAVA must be specified for PARAMETER STYLE when LANGUAGE is JAVA.

NOT DETERMINISTIC or **DETERMINISTIC**
Specifies whether the function returns the same results each time that the function is invoked with the same input arguments.

NOT DETERMINISTIC
The function might not return the same result each time that the function is invoked with the same input arguments. The function depends on some state values that affect the results. DB2 uses this information to disable the merging of views and table expressions when processing SELECT, UPDATE, DELETE, or INSERT statements that refer to this function. An example of a function that is not deterministic is one that generates random numbers, or any function that contains SQL statements.

NOT DETERMINISTIC is the default.

Some functions that are not deterministic can receive incorrect results if the function is executed by parallel tasks. Specify the DISALLOW PARALLEL clause for these functions.

DETERMINISTIC
The function always returns the same result each time that the function is invoked with the same input arguments. An example of a deterministic function is a function that calculates the square root of the input. DB2 uses this information to enable the merging of views and table expressions for SELECT, UPDATE, DELETE, or INSERT statements that refer to this function. DETERMINISTIC is not the default. If applicable, specify DETERMINISTIC to prevent non-optimal access paths from being chosen for SQL statements that refer to this function.

DB2 does not verify that the function program is consistent with the specification of DETERMINISTIC or NOT DETERMINISTIC.

FENCED
Specifies that the external function runs in an external address space to prevent the function from corrupting DB2 storage.

FENCED is the default.

RETURNS NULL ON NULL INPUT or **CALLED ON NULL INPUT**
Specifies whether the function is called if any of the input arguments is null at execution time.

RETURNS NULL ON NULL INPUT
The function is not called if any of the input arguments is null. The result is the null value. RETURNS NULL ON INPUT is the default.

CALLED ON NULL INPUT
The function is called regardless of whether any of the input arguments are null, making the function responsible for testing for null argument values. The function can return a null or nonnull value.

MODIFIES SQL DATA, **READS SQL DATA**, **CONTAINS SQL**, or **NO SQL**
Specifies which SQL statements, if any, can be executed in the function or any routine that is called from this function. The default is READS SQL DATA. For the data access classification of each statement, see Table 95 on page 1158.

MODIFIES SQL DATA
Specifies that the function can execute any SQL statement except the statements that are not supported in functions. Do not specify MODIFIES SQL DATA when ALLOW PARALLEL is in effect.

READS SQL DATA
Specifies that the function can execute SQL statements with a data access classification of READS SQL DATA, CONTAINS SQL, or NO SQL. SQL statements that do not modify SQL data can be included in the function. Statements that are not supported in any function return a different error.

CONTAINS SQL
Specifies that the function can execute only SQL statements with a data classification of CONTAINS SQL or NO SQL. SQL statements that neither read nor modify SQL data can be executed by the function. Statements that are not supported in any function return a different error.

NO SQL

Specifies that the function can execute only SQL statements with a data access classification of NO SQL. Do not specify NO SQL for a JAVA function that uses a JAR.

EXTERNAL ACTION or **NO EXTERNAL ACTION**

Specifies whether the function takes an action that changes the state of an object that DB2 does not manage. An example of an external action is sending a message or writing a record to a file.

Because DB2 uses the RRS attachment for external functions, DB2 can participate in two-phase commit with any other resource manager that uses RRS. For resource managers that do not use RRS, there is no coordination of commit or rollback operations on non-DB2 resources.

EXTERNAL ACTION

The function can take an action that changes the state of an object that DB2 does not manage.

Some SQL statements that invoke functions with external actions can result in incorrect results if parallel tasks execute the function. For example, if the function sends a note for each initial call to it, one note is sent for each parallel task instead of once for the function. Specify the DISALLOW PARALLEL clause for functions that do not work correctly with parallelism.

If you specify EXTERNAL ACTION, DB2:

- Materializes the views and table expressions in SELECT, UPDATE, DELETE or INSERT statements that refer to the function. This materialization can adversely affect the access paths that are chosen for the SQL statements that refer to this function. Do not specify EXTERNAL ACTION if the function does not have an external action.
- Does not move the function from one task control block (TCB) to another between FETCH operations.
- Does not allow another function or stored procedure to use the TCB until the cursor is closed. This is also applicable for cursors declared WITH HOLD.

The only changes to resources made outside of DB2 that are under the control of commit and rollback operations are those changes made under RRS control.

EXTERNAL ACTION is the default.

NO EXTERNAL ACTION

The function does not take any action that changes the state of an object that DB2 does not manage. DB2 uses this information to enable the merging of views and table expressions for SELECT, UPDATE, DELETE, or INSERT statements that refer to this function. NO EXTERNAL ACTION is not the default. If applicable, specify NO EXTERNAL ACTION to prevent non-optimal access paths from being chosen for SQL statements that refer to this function.

DB2 does not verify that the function program is consistent with the specification of EXTERNAL ACTION or NO EXTERNAL ACTION.

NO SCRATCHPAD or **SCRATCHPAD**

Specifies whether DB2 is to provide a scratchpad for the function. It is strongly recommended that external functions be reentrant, and a scratchpad provides an area for the function to save information from one invocation to the next.

NO SCRATCHPAD
A scratchpad is not allocated and passed to the function. NO SCRATCHPAD is the default.

SCRATCHPAD *length*
When the function is invoked for the first time, DB2 allocates memory for a scratchpad. A scratchpad has the following characteristics:

- *length* must be between 1 and 32767. The default value is 100 bytes.
- DB2 initializes the scratchpad to all binary zeros (X'00''s).
- The scope of a scratchpad is the SQL statement. For each reference to the function in an SQL statement, there is one scratchpad. For example, assuming that function UDFX was defined with the SCRATCHPAD keyword, three scratchpads are allocated for the three references to UDFX in the following SQL statement:

  ```
  SELECT A, UDFX(A) FROM TABLEB
   WHERE UDFX(A) > 103 OR UDFX(A) < 19;
  ```

  If the function is run under parallel tasks, one scratchpad is allocated for each parallel task of each reference to the function in the SQL statement. This can lead to unpredictable results. For example, if a function uses the scratchpad to count the number of times that it is invoked, the count reflects the number of invocations done by the parallel task and not the SQL statement. Specify the DISALLOW PARALLEL clause for functions that will not work correctly with parallelism.
- The scratchpad is persistent. DB2 preserves its content from one invocation of the function to the next. Any changes that the function makes to the scratchpad on one call are still there on the next call. DB2 initializes the scratchpads when it begins to execute an SQL statement. DB2 does not reset scratchpads when a correlated subquery begins to execute.
- The scratchpad can be a central point for the system resources that the function acquires. If the function acquires system resources, specify FINAL CALL to ensure that DB2 calls the function one more time so that the function can free those system resources.

Each time the function invoked, DB2 passes an additional argument to the function that contains the address of the scratchpad.

If you specify SCRATCHPAD, DB2:

- Does not move the function from one task control block (TCB) to another between FETCH operations.
- Does not allow another function or stored procedure to use the TCB until the cursor is closed. This is also applicable for cursors declared WITH HOLD.

Do not specify SCRATCHPAD when LANGUAGE JAVA is in effect.

NO FINAL CALL or **FINAL CALL**
Specifies whether a *final call* is made to the function. A final call enables the function to free any system resources that it has acquired. A final call is useful when the function has been defined with the SCRATCHPAD keyword and the function acquires system resource and anchors them in the scratchpad.

NO FINAL CALL

A final call is not made to the function. The function does not receive an additional argument that specifies the type of call. NO FINAL CALL is the default.

FINAL CALL

A final call is made to the function. To differentiate between final calls and other calls, the function receives an additional argument that specifies the type of call. The types of calls are:

Normal call

SQL arguments are passed and the function is expected to return a result.

First call

The first call to the function for this reference to the function in this SQL statement. A first call is a normal call—SQL arguments are passed and the function is expected to return a result.

Final call

The last call to the function to enable the function to free resources. A final call is not a normal call. If an error occurs, DB2 attempts to make the final call unless the function abended. A final call occurs at these times:

- *End of statement:* When the cursor is closed for cursor-oriented statements, or the execution of the statement has completed.
- *End of a parallel task:* When the function is executed by parallel tasks.
- *End of transaction:* When normal end of statement processing does not occur. For example, the logic of an application, for some reason, bypasses closing the cursor.

If a commit operation occurs while a cursor defined as WITH HOLD is open, a final call is made when the cursor is closed or the application ends. If a commit occurs at the end of a parallel task, a final call is made regardless of whether a cursor defined as WITH HOLD is open.

If a commit, rollback, or abort operation causes the final call, the function cannot issue any SQL statements when it is invoked.

Some functions that use a final call can receive incorrect results if parallel tasks execute the function. For example, if a function sends a note for each final call to it, one note is sent for each parallel task instead of once for the function. Specify the DISALLOW PARALLEL clause for functions that have inappropriate actions when executed in parallel.

Do not specify FINAL CALL when LANGUAGE JAVA is in effect.

ALLOW or **DISALLOW PARALLEL**

For a single reference to the function, specifies whether parallelism can be used when the function is invoked. Although parallelism can be used for most scalar functions, some functions such as those that depend on a single copy of the scratchpad cannot be invoked with parallel tasks. Consider these characteristics when determining which clause to use:

- If all invocations of the function are completely independent from one another, specify ALLOW PARALLEL.

- If each invocation of the function updates the scratchpad, providing values that are of interest to the next invocation, such as incrementing a counter, specify DISALLOW PARALLEL.
- If the scratchpad is used only so that some expensive initialization processing is performed a minimal number of times, specify ALLOW PARALLEL.
- If the function performs some external action that should apply to only one partition, specify DISALLOW PARALLEL.
- If the function is defined with MODIFIES SQL DATA, specify DISALLOW PARALLEL, not ALLOW PARALLEL.

ALLOW PARALLEL

Specifies that DB2 can consider parallelism for the function. Parallelism is not forced on the SQL statement that invokes the function or on any SQL statement in the function. Existing restrictions on parallelism apply.

DISALLOW PARALLEL

Specifies that DB2 does not consider parallelism for the function.

The default is DISALLOW PARALLEL, if you specify one or more of the following clauses:

- NOT DETERMINISTIC
- EXTERNAL ACTION
- FINAL CALL
- MODIFIES SQL DATA
- SCRATCHPAD

Otherwise, ALLOW PARALLEL is the default.

NO DBINFO or **DBINFO**

Specifies whether additional status information is passed to the function when it is invoked.

NO DBINFO

No additional information is passed. NO DBINFO is the default.

DBINFO

An additional argument is passed when the function is invoked. The argument is a structure that contains information such as the application run-time authorization ID, the schema name, the name of a table or column that the function might be inserting into or updating, and identification of the database server that invoked the function. For details about the argument and its structure, see *DB2 Application Programming and SQL Guide*.

Do not specify DBINFO when LANGUAGE JAVA is in effect.

NO COLLID or **COLLID** *collection-id*

Identifies the package collection that is to be used when the function is executed. This is the package collection into which the DBRM that is associated with the function program is bound.

NO COLLID

The package collection for the function is the same as the package collection of the program that invokes the function. If a trigger invokes the function, the collection of the trigger package is used. If the invoking program does not use a package, DB2 resolves the package by using the CURRENT PACKAGE PATH special register, the CURRENT PACKAGESET special register, or the PKLIST bind option (in this order). For details about how DB2 uses these three items, see the information on package resolution in Part 5 of *DB2 Application Programming and SQL Guide*.

NO COLLID is the default.

COLLID *collection-id*

The name of the package collection that is to be used when the function is executed.

WLM ENVIRONMENT

Identifies the WLM (workload manager) application environment in which the function is to run. The *name* of the WLM environment is an SQL identifier.

If you do not specify WLM ENVIRONMENT, the function runs in the WLM-established stored procedure address space that is specified at installation time. When LANGUAGE is JAVA, you must specify WLM ENVIRONMENT, and the WLM environment in which the function is to run must be Java-enabled.

name

The WLM environment in which the function must run. If another user-defined function or a stored procedure calls the function and that calling routine is running in an address space that is not associated with the WLM environment, DB2 routes the function request to a different address space.

(name,*)

When an SQL application program directly invokes the function, the WLM environment in which the function runs.

If another user-defined function or a stored procedure calls the function, the function runs in same environment that the calling routine uses. In this case, authorization to run the function in the WLM environment is not checked because the authorization of the calling routine suffices.

Users must have the appropriate authorization to execute functions in the specified WLM environment. For an example of a RACF command that provides this authorization, see "Running external functions in WLM environments" on page 625.

ASUTIME

Specifies the total amount of processor time, in CPU service units, that a single invocation of the function can run. The value is unrelated to the ASUTIME column of the resource limit specification table.

When you are debugging a function, setting a limit can be helpful if the function gets caught in a loop. For information on service units, see *z/OS MVS Initialization and Tuning Guide*.

NO LIMIT

There is no limit on the service units. NO LIMIT is the default.

LIMIT *integer*

The limit on the service units is a positive integer in the range of 1 to 2G. If the function uses more service units than the specified value, DB2 cancels the function.

STAY RESIDENT

Specifies whether the load module for the function is to remain resident in memory when the function ends.

NO
The load module is deleted from memory after the function ends. Use NO for non-reentrant functions. NO is the default.

YES
The load module remains resident in memory after the function ends. Use YES for reentrant functions.

PROGRAM TYPE
Specifies whether the function program runs as a main routine or a subroutine.

SUB
The function runs as a subroutine. With LANGUAGE JAVA, PROGRAM TYPE SUB is the only valid option. SUB is the default.

MAIN
The function runs as a main routine.

SECURITY
Specifies how the function interacts with an external security product, such as RACF, to control access to non-SQL resources.

DB2
The function does not require an external security environment. If the function accesses resources that an external security product protects, the access is performed using the authorization ID that is associated with the WLM-established stored procedure address space.

DB2 is the default.

USER
An external security environment should be established for the function. If the function accesses resources that the external security product protects, the access is performed using the primary authorization ID of the process that invoked the function.

DEFINER
An external security environment should be established for the function. If the function accesses resources that the external security product protects, the access is performed using the authorization ID of the owner of the function.

STOP AFTER SYSTEM DEFAULT FAILURES, STOP AFTER ***nn*** **FAILURES,** or **CONTINUE AFTER FAILURE**
Specifies whether the routine is to be put in a stopped state after some number of failures.

STOP AFTER SYSTEM DEFAULT FAILURES
Specifies that this routine should be placed in a stopped state after the number of failures indicated by the value of field MAX ABEND COUNT on installation panel DSNTIPX. This is the default.

STOP AFTER ***nn*** **FAILURES**
Specifies that this routine should be placed in a stopped state after *nn* failures. The value *nn* can be an integer from 1 to 32767.

CONTINUE AFTER FAILURE
Specifies that this routine should not be placed in a stopped state after any failure.

RUN OPTIONS *run-time-options*
Specifies the Language Environment run-time options to be used for the function. You must specify *run-time-options* as a character string that is no

longer than 254 bytes. If you do not specify RUN OPTIONS or pass an empty string, DB2 does not pass any run-time options to Language Environment, and Language Environment uses its installation defaults. For a description of the Language Environment run-time options, see *z/OS Language Environment Programming Reference*.

Do not specify RUN OPTIONS when LANGUAGE JAVA is in effect.

INHERIT SPECIAL REGISTERS or **DEFAULT SPECIAL REGISTERS**
Specifies how special registers are set on entry to the routine.

INHERIT SPECIAL REGISTERS
Specifies that the values of special registers are inherited according to the rules listed in the table for characteristics of special registers in a user-defined function in Table 27 on page 111.

DEFAULT SPECIAL REGISTERS
Specifies that special registers are initialized to the default values, as indicated by the rules in the table for characteristics of special registers in a user-defined function in Table 27 on page 111.

STATIC DISPATCH
At function resolution time, DB2 chooses a function based on the static (or declared) types of the function parameters. STATIC DISPATCH is the default.

Notes

Choosing data types for parameters: When you choose the data types of the input and output parameters for your function, consider the rules of promotion that can affect the values of the parameters. (See “Promotion of data types” on page 70). For example, a constant that is one of the input arguments to the function might have a built-in data type that is different from the data type that the function expects, and more significantly, might not be promotable to that expected data type. Based on the rules of promotion, using the following data types for parameters is recommended:
- INTEGER instead of SMALLINT
- DOUBLE instead of REAL
- VARCHAR instead of CHAR
- VARGRAPHIC instead of GRAPHIC

For portability of functions across platforms that are not DB2 UDB for z/OS, do not use the following data types, which might have different representations on different platforms:
- FLOAT. Use DOUBLE or REAL instead.
- NUMERIC. Use DECIMAL instead.

Specifying the encoding scheme for parameters: The implicitly or explicitly specified encoding scheme of all the parameters with a string data type (both input and output parameters) must be the same—either all ASCII or all EBCDIC.

Determining the uniqueness of functions in a schema: At the current server, the function signature of each function, which is the qualified function name combined with the number and data types of the input parameters, must be unique. If the function has more than 30 input parameters, only the data types of the first 30 are used to determine uniqueness. This means that two different schemas can each contain a function with the same name that have the same data types for all of their corresponding data types. However, a single schema must not contain multiple functions with the same name that have the same data types for all of their corresponding data types.

When determining whether corresponding data types match, DB2 does not consider any length, precision, scale, subtype or encoding scheme attributes in the comparison. DB2 considers the synonyms of data types (DECIMAL and NUMERIC, REAL and FLOAT, and DOUBLE and FLOAT) a match. Therefore, CHAR(8) and CHAR(35) are considered to be the same, as are DECIMAL(11,2), DECIMAL(4,3), and NUMERIC(4,2).

Assume that the following statements are executed to create four functions in the same schema. The second and fourth statements fail because they create functions that are duplicates of the functions that the first and third statements created.

```
CREATE FUNCTION PART (INT, CHAR(15)) ...
CREATE FUNCTION PART (INTEGER, CHAR(40)) ...

CREATE FUNCTION ANGLE (DECIMAL(12,2)) ...
CREATE FUNCTION ANGLE (DEC(10,7)) ...
```

Overriding a built-in function: Giving an external function the same name as a built-in function is not a recommended practice unless you are trying to change the functionality of the built-in function.

If you do intend to create an external function with the same name as a built-in function, be careful to maintain the uniqueness of its function signature. If your function has the same name and data types of the corresponding parameters of the built-in function but implements different logic, DB2 might choose the wrong function when the function is invoked with an unqualified function name. Thus, the application might fail, or perhaps even worse, run successfully but provide an inappropriate result.

Running external functions in WLM environments: You can use the WLM ENVIRONMENT clause to identify the address space in which a function or is to run. Using different WLM environments lets you isolate one group of programs from another. For example, you might choose to isolate programs based on security requirements and place all payroll applications in one WLM environment because those applications deal with data, such as employee salaries.

To prevent a user from defining functions in sensitive WLM environments, DB2 invokes the external security manager to determine whether the user has authorization to issue CREATE FUNCTION statements that refer to the specified WLM environment. The following example shows the RACF command that authorizes DB2 user DB2USER1 to register a function on DB2 subsystem DB2A that runs in the WLM environment named PAYROLL.

```
PERMIT DB2A.WLMENV.PAYROLL CLASS(DSNR) ID(DB2USER1)  ACCESS(READ)
```

Scrollable cursors specified with user-defined functions: A row can be fetched more than once with a scrollable cursor. Therefore, if a scrollable cursor is defined with a nondeterministic function in the select list of the cursor, a row can be fetched multiple times with different results for each fetch. Similarly, if a scrollable cursor is defined with a user-defined function with external action, the action is executed with every fetch.

Alternative syntax and synonyms: To provide compatibility with previous releases of DB2 or other products in the DB2 UDB family, DB2 supports the following keywords:

- VARIANT as a synonym for NOT DETERMINISTIC
- NOT VARIANT as a synonym for DETERMINISTIC
- NOT NULL CALL as a synonym for RETURNS NULL ON NULL INPUT

- NULL CALL as a synonym for CALLED ON NULL INPUT
- PARAMETER STYLE DB2SQL as a synonym for PARAMETER STYLE SQL

Examples

Example 1: Assume that you want to write an external function program in C that implements the following logic:

```
output = 2 * input - 4
```

The function should return a null value if and only if one of the input arguments is null. The simplest way to avoid a function call and get a null result when an input value is null is to specify RETURNS NULL ON NULL INPUT on the CREATE FUNCTION statement or allow it to be the default. Write the statement needed to register the function, using the specific name MINENULL1.

```
CREATE FUNCTION NTEST1 (SMALLINT)
   RETURNS SMALLINT
   EXTERNAL NAME 'NTESTMOD'
   SPECIFIC MINENULL1
   LANGUAGE C
   DETERMINISTIC
   NO SQL
   FENCED
   PARAMETER STYLE SQL
   RETURNS NULL ON NULL INPUT
   NO EXTERNAL ACTION;
```

Example 2: Assume that user Smith wants to register an external function named CENTER in schema SMITH. The function program will be written in C and will be reentrant. Write the statement that Smith needs to register the function, letting DB2 generate a specific name for the function.

```
CREATE FUNCTION CENTER (INTEGER, FLOAT)
   RETURNS FLOAT
   EXTERNAL NAME 'MIDDLE'
   LANGUAGE C
   DETERMINISTIC
   NO SQL
   FENCED
   PARAMETER STYLE SQL
   NO EXTERNAL ACTION
   STAY RESIDENT YES;
```

Example 3: Assume that user McBride (who has administrative authority) wants to register an external function named CENTER in the SMITH schema. McBride plans to give the function specific name FOCUS98. The function program uses a scratchpad to perform some one-time only initialization and save the results. The function program returns a value with a FLOAT data type. Write the statement McBride needs to register the function and ensure that when the function is invoked, it returns a value with a data type of DECIMAL(8,4).

```
CREATE FUNCTION SMITH.CENTER (FLOAT, FLOAT, FLOAT)
   RETURNS DECIMAL(8,4) CAST FROM FLOAT
   EXTERNAL NAME 'CMOD'
   SPECIFIC FOCUS98
   LANGUAGE C
   DETERMINISTIC
   NO SQL
   FENCED
   PARAMETER STYLE SQL
   NO EXTERNAL ACTION
   SCRATCHPAD
   NO FINAL CALL;
```

Example 4: The following example registers a Java user-defined function that returns the position of the first vowel in a string. The user-defined function is written in Java, is to be run fenced, and is the FINDVWL method of class JAVAUDFS.

```
CREATE FUNCTION FINDV (CLOB(100K))
   RETURNS INTEGER
   FENCED
   LANGUAGE JAVA
   PARAMETER STYLE JAVA
   EXTERNAL NAME 'JAVAUDFS.FINDVWL'
   NO EXTERNAL ACTION
   CALLED ON NULL INPUT
   DETERMINISTIC
   NO SQL;
```

CREATE FUNCTION (external table)

This CREATE FUNCTION statement registers a user-defined external table function with a database server.

A table function can be used in the FROM clause of a SELECT. It returns a table to the SELECT one row at a time.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

The privilege set defined below must include at least one of the following:

- The CREATEIN privilege on the schema
- SYSADM or SYSCTRL authority

The authorization ID that matches the schema name implicitly has the CREATEIN privilege on the schema.

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package.

If the statement is dynamically prepared, the privilege set is the privileges that are held by the SQL authorization ID of the process. The specified function name can include a schema name (a qualifier). However, if the schema name is not the same as the SQL authorization ID, one of the following conditions must be met:

- The privilege set includes SYSADM or SYSCTRL authority.
- The SQL authorization ID of the process has the CREATEIN privilege on the schema.

Additional privileges are required if the function uses a table as a parameter, refers to a distinct type, or is to run in a WLM (workload manager) environment. These privileges are:

- The SELECT privilege on any table that is an input parameter to the function.
- The USAGE privilege on each distinct type that the function references.
- Authority to create programs in the specified WLM environment. This authorization is obtained from an external security product, such as RACF.

Syntax

```
>>──CREATE FUNCTION──function-name──(──┬─────────────────────────────┬──)──────────────────>
                                       │  ┌─,───────────────────┐    │
                                       │  ▼                     │    │
                                       └───parameter-declaration┴────┘

                        ┌─,────────────────────────────────────────┐
              (1)       ▼                                          │
>──RETURNS TABLE──────(───column-name──data-type──┬─────────────┬──┴──)──option-list──────>◄
                                                  │        (2)  │
                                                  └─AS LOCATOR──┘
```

Notes:

1 This clause and the clauses that follow in the *option-list* can be specified in any order.

2 AS LOCATOR can be specified only for a LOB data type or a distinct type based on a LOB data type.

parameter-declaration:

```
>>──┬────────────────┬──parameter-type──────────────────────────────────────────────────>◄
    └─parameter-name─┘
```

parameter-type:

```
>>──┬─data-type──┬───────────────┬────────────┬────────────────────────────────────────>◄
    │            │          (1)  │            │
    │            └─AS LOCATOR────┘            │
    └─TABLE LIKE──┬─table-name─┬──AS LOCATOR──┘
                  └─view-name──┘
```

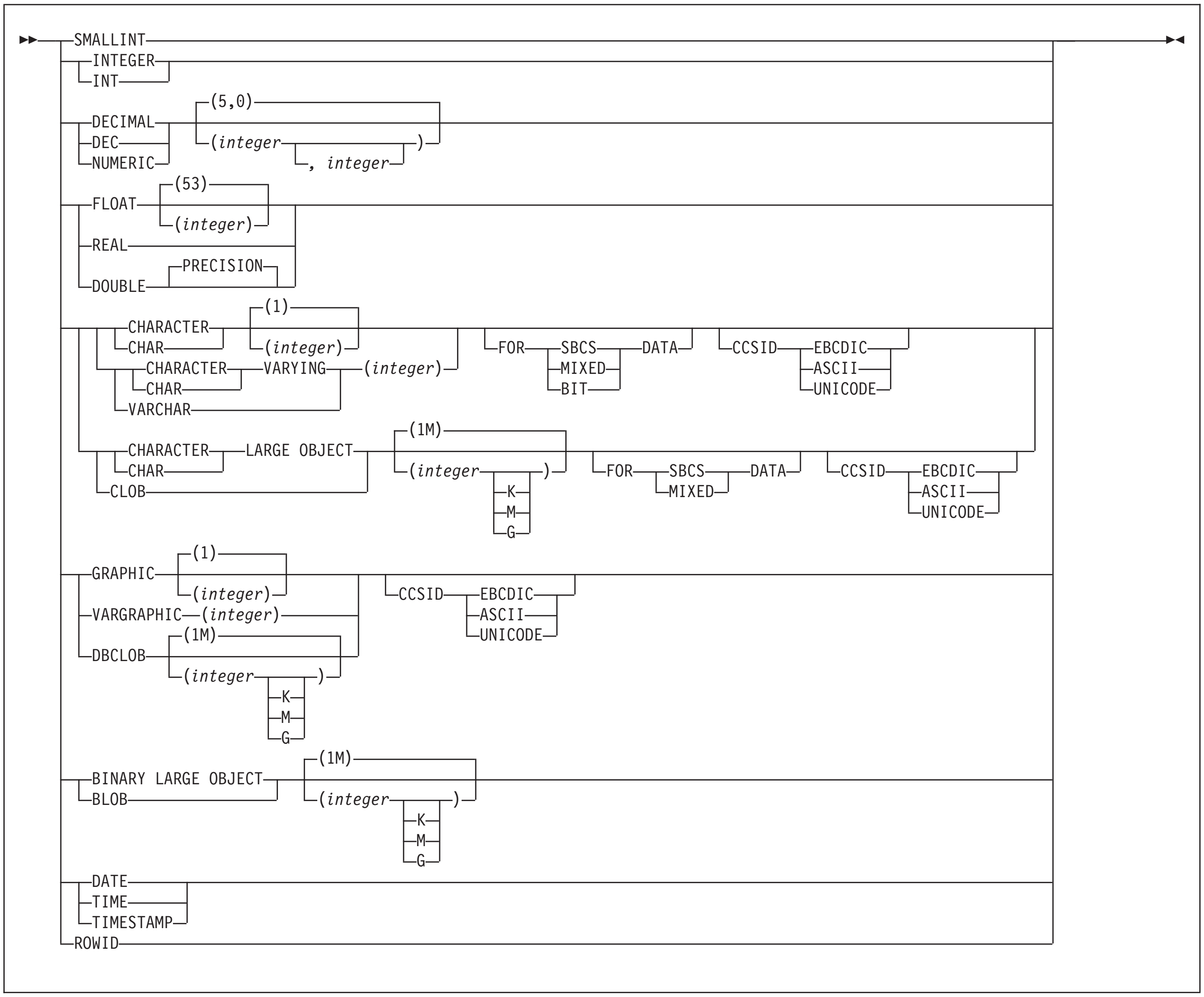
Notes:

1 AS LOCATOR can be specified only for a LOB data type or a distinct type based on a LOB data type.

data-type:

```
>>──┬─built-in-type──────┬─────────────────────────────────────────────────────────────>◄
    └─distinct-type-name─┘
```

built-in-type:



option-list:

```
►►──┬──────────────────────────────┬──┬─────────────────────────────────────┬───────────────────►
    │           (1)                │  └─PARAMETER CCSID──┬─ASCII───┬────────┘
    └─SPECIFIC────────specific-name┘                     ├─EBCDIC──┤
                                                         └─UNICODE─┘

►─EXTERNAL──┬──────────────────────────┬──LANGUAGE──┬─ASSEMBLE─┬──PARAMETER STYLE SQL──────────►
            └─NAME──┬─'string'───┬─────┘            ├─C────────┤
                    └─identifier─┘                  ├─COBOL────┤
                                                    └─PLI──────┘

   ┌─NOT DETERMINISTIC─┐  ┌─FENCED─┐  ┌─RETURNS NULL ON NULL INPUT─┐  ┌─READS SQL DATA─┐
►──┼───────────────────┼──┴────────┴──┼────────────────────────────┼──┼────────────────┼───────►
   └─DETERMINISTIC─────┘              └─CALLED ON NULL INPUT───────┘  ├─CONTAINS SQL───┤
                                                                      └─NO SQL─────────┘

   ┌─EXTERNAL ACTION────┐  ┌─NO SCRATCHPAD────────────────┐  ┌─NO FINAL CALL─┐
►──┼────────────────────┼──┼──────────────────────────────┼──┼───────────────┼──DISALLOW PARALLEL──►
   └─NO EXTERNAL ACTION─┘  │                ┌─100────┐    │  └─FINAL CALL────┘
                           └─SCRATCHPAD─────┼────────┼────┘
                                            └─length─┘

   ┌─NO DBINFO─┐                           ┌─NO COLLID─────────────┐
►──┼───────────┼──┬─────────────────────┬──┼───────────────────────┼──────────────────────────►
   └─DBINFO────┘  └─CARDINALITY─integer─┘  └─COLLID─collection-id──┘

                                      ┌─ASUTIME NO LIMIT───────┐  ┌─STAY RESIDENT NO──┐
►──┬────────────────────────────┬──┼────────────────────────┼──┼───────────────────┼───────────►
   └─WLM ENVIRONMENT──┬─name───┬┘  └─ASUTIME──LIMIT──integer─┘  └─STAY RESIDENT YES─┘
                      └─(name)─┘

   ┌─PROGRAM TYPE SUB──┐  ┌─SECURITY DB2─────────────────────────────────────────────┐
►──┼───────────────────┼──┼──────────────────────────────────────────────────────────┼──────────►
   └─PROGRAM TYPE MAIN─┘  │                          ┌─INHERIT SPECIAL REGISTERS─┐   │
                          └─SECURITY──┬─USER────┬──┼───────────────────────────┼───┘
                                      └─DEFINER─┘  └─DEFAULT SPECIAL REGISTERS─┘

                                          ┌─STATIC DISPATCH─┐  ┌─STOP AFTER SYSTEM DEFAULT FAILURES─┐
►──┬──────────────────────────────────┬──┴─────────────────┴──┼────────────────────────────────────┼──►◄
   └─RUN OPTIONS──run-time-options────┘                        ├─STOP AFTER──integer──FAILURES──────┤
                                                               └─CONTINUE AFTER FAILURE─────────────┘
```

Notes:

1 The clauses in the *option-list* can be specified in any order.

Description

function-name

Names the user-defined function. The name is implicitly or explicitly qualified by a schema name. The combination of name, schema name, the number of parameters, and the data type of each parameter[25] (without regard for any length, precision, scale, subtype or encoding scheme attributes of the data type) must not identify a user-defined function that exists at the current server.

You can use the same name for more than one function if the function signature of each function is unique.

- The unqualified form of *function-name* is an SQL identifier.

  The name must not be any of the following system-reserved keywords even if you specify them as delimited identifiers:

  ```
  ALL
  AND
  ANY
  BETWEEN
  DISTINCT
  EXCEPT
  EXISTS
  FALSE
  FOR
  FROM
  IN
  IS
  LIKE
  MATCH
  NOT
  NULL
  ONLY
  OR
  OVERLAPS
  SIMILAR
  SOME
  TABLE
  TRUE
  TYPE
  UNIQUE
  UNKNOWN
  =
  ¬=
  <
  <=
  ¬<
  >
  >=
  ¬>
  <>
  ```

  The unqualified function name is implicitly qualified with a schema name according to the following rules:

  - If the statement is embedded in a program, the schema name is the authorization ID in the QUALIFIER bind option when the plan or package was created or last rebound. If QUALIFIER was not specified, the schema name is the owner of the plan or package.
  - If the statement is dynamically prepared, the schema name is the SQL authorization ID in the CURRENT SQLID special register.

- The qualified form of *function-name* is an SQL identifier (the schema name) followed by a period and an SQL identifier.

  The schema name can be ’SYSTOOLS’ if the user who executes the CREATE statement has SYSADM or SYSCTRL privilege. Otherwise, the schema name must not begin with 'SYS' unless the schema name is 'SYSADM'.

The owner of the function is determined by how the CREATE FUNCTION statement is invoked:

- If the statement is embedded in a program, the owner is the authorization ID of the owner of the plan or package.
- If the statement is dynamically prepared, the owner is the SQL authorization ID in the CURRENT SQLID special register.

The owner is implicitly given the EXECUTE privilege with the GRANT option for the function.

(*parameter-declaration,...***)**

Identifies the number of input parameters of the function, and specifies the data type of each parameter. All the parameters for a function are input parameters and are nullable. There must be one entry in the list for each parameter that the function expects to receive. Although not required, you can give each parameter a name.

[25] If the function has more than 30 parameters, only the first 30 parameters are used to determine whether the function is unique.

A function can have no parameters. In this case, you must code an empty set of parentheses, for example:

```
CREATE FUNCTION WOOFER()
```

parameter-name

Specifies the name of the input parameter. The name is an SQL identifier, and each name in the parameter list must not be the same as any other name. The same name cannot be used for a parameter name and a column name.

data-type

Specifies the data type of the input parameter. The data type can be a built-in data type or a distinct type.

built-in-type

The data type of the input parameter is a built-in data type.

You can use the same built-in data types as for the CREATE TABLE statement. For information on the data types, see “built-in-type” on page 741.

For parameters with a character or graphic data type, the PARAMETER CCSID clause or CCSID clause indicates the encoding scheme of the parameter. If you do not specify either of these clauses, the encoding scheme is the value of field DEF ENCODING SCHEME on installation panel DSNTIPF.

distinct-type-name

The data type of the input parameter is a distinct type. Any length, precision, scale, subtype, or encoding scheme attributes for the parameter are those of the source type of the distinct type.

If you specify the name of the distinct type without a schema name, DB2 resolves the schema name by searching the schemas in the SQL path.

Although parameters with a character data type have an implicitly or explicitly specified subtype (BIT, SBCS, or MIXED), the function program can receive character data of any subtype. Therefore, conversion of the input data to the subtype of the parameter might occur when the function is invoked. An error occurs if mixed data that actually contains DBCS characters is used as the value for an input parameter that is declared with an SBCS subtype.

Parameters with a datetime data type or a distinct type are passed to the function as a different data type:

- A datetime type parameter is passed as a character data type, and the data is passed in ISO format.

  The encoding scheme for a datetime type parameter is the same as the implicitly or explicitly specified encoding scheme of any character or graphic string parameters. If no character or graphic string parameters are passed, the encoding scheme is the value of field DEF ENCODING SCHEME on installation panel DSNTIPF.
- A distinct type parameter is passed as the source type of the distinct type.

AS LOCATOR

Specifies that a locator to the value of the parameter is passed to the function instead of the actual value. Specify AS LOCATOR only for parameters with a LOB data type or a distinct type that is based on a

LOB data type. Passing locators instead of values can result in fewer bytes being passed to the function, especially when the value of the parameter is very large.

The AS LOCATOR clause has no effect on determining whether data types can be promoted, nor does it affect the function signature, which is used in function resolution.

TABLE LIKE *table-name* or *view-name* **AS LOCATOR**
Specifies that the parameter is a transition table. However, when the function is invoked, the actual values in the transition table are not passed to the function. A single value is passed instead. This single value is a locator to the table, which the function uses to access the columns of the transition table. A function with a table parameter can only be invoked from the triggered action of a trigger.

The use of TABLE LIKE provides an implicit definition of the transition table. It specifies that the transition table has the same number of columns as the identified table or view. The columns have the same data type, length, precision, scale, subtype, and encoding scheme as the identified table or view, as they are described in catalog tables SYSCOLUMNS and SYSTABLESPACE. The number of columns and the attributes of those columns are determined at the time the CREATE FUNCTION statement is processed. Any subsequent changes to the number of columns in the table or the attributes of those columns do not affect the parameters of the function.

The *name* specified after TABLE LIKE must identify a table or view that exists at the current server. The name must not identify a declared temporary table. The name does not have to be the same name as the table that is associated with the transition table for the trigger. An unqualified table or view name is implicitly qualified according to the following rules:

- If the CREATE FUNCTION statement is embedded in a program, the implicit qualifier is the authorization ID in the QUALIFIER bind option when the plan or package was created or last rebound. If QUALIFIER was not used, the implicit qualifier is the owner of the plan or package.
- If the CREATE FUNCTION statement is dynamically prepared, the implicit qualifier is the SQL authorization ID in the CURRENT SQLID special register.

When the function is invoked, the corresponding columns of the transition table identified by the table locator and the table or view identified in the TABLE LIKE clause must have the same definition. The data type, length, precision, scale, and encoding scheme of these columns must match exactly. The description of the table or view at the time the CREATE FUNCTION statement was executed is used.

Additionally, a character FOR BIT DATA column of the transition table cannot be passed as input for a table parameter for which the corresponding column of the table specified at the definition is not defined as character FOR BIT DATA. (The definition occurs with the CREATE FUNCTION statement.) Likewise, a character column of the transition table that is not FOR BIT DATA cannot be passed as input for a table parameter for which the corresponding column of the table specified at the definition is defined as character FOR BIT DATA.

For more information about using table locators, see *DB2 Application Programming and SQL Guide*.

RETURNS TABLE(*column-name data-type* **...)**

Identifies that the output of the function is a table. The parentheses that follow the keyword enclose the list of names and data types of the columns of the table.

column-name

Specifies the name of the column. The name is an SQL identifier and must be unique within the RETURNS TABLE clause for the function.

data-type

Specifies the data type of the column. The column is nullable.

AS LOCATOR

Specifies that the function returns a locator to the value rather than the actual value. You can specify AS LOCATOR only for a LOB data type or a distinct type based on a LOB data type.

SPECIFIC *specific-name*

Specifies a unique name for the function. The name is implicitly or explicitly qualified with a schema name. The name, including the schema name, must not identify the specific name of another function that exists at the current server.

The unqualified form of *specific-name* is an SQL identifier. The qualified form is an SQL identifier (the schema name) followed by a period and an SQL identifier.

If you do not specify a schema name, it is the same as the explicit or implicit schema name of the function name (*function-name*). If you specify a schema name, it must be the same as the explicit or implicit schema name of the function name.

If you do not specify the SPECIFIC clause, the default specific name is the name of the function. However, if the function name does not provide a unique specific name or if the function name is a single asterisk, DB2 generates a specific name in the form of:

```
SQLxxxxxxxxxxxx
```

where `'xxxxxxxxxxxx'` is a string of 12 characters that make the name unique.

The specific name is stored in the SPECIFIC column of the SYSROUTINES catalog table. The specific name can be used to uniquely identify the function in several SQL statements (such as ALTER FUNCTION, COMMENT, DROP, GRANT, and REVOKE) and in DB2 commands (START FUNCTION, STOP FUNCTION, and DISPLAY FUNCTION). However, the function cannot be invoked by its specific name.

PARAMETER CCSID

Indicates whether the encoding scheme for string parameters is ASCII, EBCDIC, or UNICODE. The default encoding scheme is the value specified in the CCSID clauses of the parameter list or RETURNS clause, or in the field DEF ENCODING SCHEME on installation panel DSNTIPF.

This clause provides a convenient way to specify the encoding scheme for *all* string parameters. If individual CCSID clauses are specified for individual parameters in addition to this PARAMETER CCSID clause, the value specified in *all* of the CCSID clauses must be the same value that is specified in this clause.

This clause also specifies the encoding scheme to be used for system-generated parameters of the routine such as message tokens and DBINFO.

EXTERNAL

Specifies that the function being registered is based on code that is written in an external programming language and adheres to the documented linkage conventions and interface of that language.

If you do not specify the NAME clause, 'NAME *function-name*' is implicit. In this case, *function-name* must not be longer than 8 characters.

NAME *'string'* or *identifier*

Identifies the name of the load module that contains the user-written code that implements the logic of the function.

For other values of LANGUAGE, the name can be a string constant that is no longer than 8 characters. It must conform to the naming conventions for load modules. Alphabetical extenders for national languages can be used as the first character and as subsequent characters in the load module name.

DB2 loads the load module when the function is invoked. The load module is created when the program that contains the function body is compiled and link-edited. The load module does not need to exist when the CREATE FUNCTION statement is executed. However, it must exist and be accessible by the current server when the function is invoked.

You can specify the EXTERNAL clause in one of the following ways:

```
EXTERNAL

EXTERNAL NAME PKJVSP1

EXTERNAL NAME 'PKJVSP1'
```

If you specify an external program name, you must use the NAME keyword. For example, this syntax is not valid:

```
EXTERNAL PKJVSP1
```

LANGUAGE

Specifies the application programming language in which the function program is written. All programs must be designed to run in IBM's Language Environment environment.

ASSEMBLE

The function is written in Assembler.

C The function is written in C or C++.

COBOL

The function is written in COBOL, including the object-oriented language extensions.

PLI

The function is written in PL/I.

PARAMETER STYLE SQL

Specifies the linkage convention that the function program uses to receive input parameters from and pass return values to the invoking SQL statement.

PARAMETER STYLE SQL specifies the parameter passing convention that supports passing null values both as input and for output. The parameters that are passed between the invoking SQL statement and the function include:

- *n* parameters for the input parameters that are specified for the function
- *m* parameters for the result columns of the function that are specified on the RETURNS TABLE clause
- *n* parameters for the indicator variables for the input parameters
- *m* parameters for the indicator variables of the result columns of the function that are specified on the RETURNS TABLE clause
- The SQLSTATE to be returned to DB2
- The qualified name of the function
- The specific name of the function
- The SQL diagnostic string to be returned to DB2
- The scratchpad, if SCRATCHPAD is specified
- The call type
- The DBINFO structure, if DBINFO is specified

For complete details about the structure of the parameter list that is passed, see *DB2 Application Programming and SQL Guide*.

NOT DETERMINISTIC or **DETERMINISTIC**

Specifies whether the function returns function returns the same results each time that the function is invoked with the same input arguments.

NOT DETERMINISTIC

The function might not return the same results each time that the function is invoked with the same input arguments. The function depends on some state values that affect the results. DB2 uses this information to disable the merging of views and table expressions when processing SELECT, UPDATE, DELETE, or INSERT statements that refer to this function. An example of a function that is not deterministic is one that generates random numbers, or any function that contains SQL statements.

NOT DETERMINISTIC is the default.

DETERMINISTIC

The function always returns the same result each time that the function is invoked with the same input arguments. An example of a deterministic function is a function that calculates the square root of the input. DB2 uses this information to enable the merging of views and table expressions for SELECT, UPDATE, DELETE, or INSERT statements that refer to this function. DETERMINISTIC is not the default. If applicable, specify DETERMINISTIC to prevent non-optimal access paths from being chosen for SQL statements that refer to this function.

DB2 does not verify that the function program is consistent with the specification of DETERMINISTIC or NOT DETERMINISTIC.

FENCED

Specifies that the function runs in an external address space to prevent the function from corrupting DB2 storage.

FENCED is the default.

RETURNS NULL ON NULL INPUT or **CALLED ON NULL INPUT**

Specifies whether the function is called if any of the input arguments is null at execution time.

RETURNS NULL ON NULL INPUT
The function is not called if any of the input arguments is null. The result is an empty table, which is a table with no rows. RETURNS NULL ON INPUT is the default.

CALLED ON NULL INPUT
The function is called regardless of whether any of the input arguments are null, making the function responsible for testing for null argument values. The function can return an empty table, depending on its logic.

READS SQL DATA, **CONTAINS SQL**, or **NO SQL**
Specifies which SQL statements, if any, can be executed in the function or any routine that is called from this function. The default is READS SQL DATA. For the data access classification of each statement, see Table 95 on page 1158.

READS SQL DATA
Specifies that the function can execute SQL statements with a data access classification of READS SQL DATA, CONTAINS SQL, or NO SQL. SQL statements that do not modify SQL data can be included in the function. Statements that are not supported in any function return a different error.

CONTAINS SQL
Specifies that the function can execute only SQL statements with a data classification of CONTAINS SQL or NO SQL. SQL statements that neither read nor modify SQL data can be executed by the function. Statements that are not supported in any function return a different error.

NO SQL
Specifies that the function can execute only SQL statements with a data access classification of NO SQL.

EXTERNAL ACTION or **NO EXTERNAL ACTION**
Specifies whether the function takes an action that changes the state of an object that DB2 does not manage. An example of an external action is sending a message or writing a record to a file.

Because DB2 uses the RRS attachment for functions, DB2 can participate in two-phase commit with any other resource manager that uses RRS. For resource managers that do not use RRS, there is no coordination of commit or rollback operations on non-DB2 resources.

EXTERNAL ACTION
The function can take an action that changes the state of an object that DB2 does not manage.

If you specify EXTERNAL ACTION, DB2:

- Materializes the views and table expressions in SELECT, UPDATE, DELETE or INSERT statements that refer to the function. This materialization can adversely affect the access paths that are chosen for the SQL statements that refer to this function. Do not specify EXTERNAL ACTION if the function does not have an external action.
- Does not move the function from one task control block (TCB) to another between FETCH operations.
- Does not allow another function or stored procedure to use the TCB until the cursor is closed. This is also applicable for cursors declared WITH HOLD.

The only changes to resources made outside of DB2 that are under the control of commit and rollback operations are those changes made under RRS control.

EXTERNAL ACTION is the default.

NO EXTERNAL ACTION
The function does not take any action that changes the state of an object that DB2 does not manage. DB2 uses this information to enable the merging of views and table expressions for SELECT, UPDATE, DELETE, or INSERT statements that refer to this function. NO EXTERNAL ACTION is not the default. If applicable, specify NO EXTERNAL ACTION to prevent non-optimal access paths from being chosen for SQL statements that refer to this function.

NO SCRATCHPAD or **SCRATCHPAD**
Specifies whether DB2 provides a scratchpad for the function. It is strongly recommended that functions be reentrant, and a scratchpad provides an area for the function to save information from one invocation to the next.

NO SCRATCHPAD
Specifies that a scratchpad is not allocated and passed to the function. NO SCRATCHPAD is the default.

SCRATCHPAD *length*
Specifies that when the function is invoked for the first time, DB2 allocates memory for a scratchpad. A scratchpad has the following characteristics:

- *length* must be between 1 and 32767. The default value is 100 bytes.
- DB2 initializes the scratchpad to all binary zeros (X'00''s).
- The scope of a scratchpad is the SQL statement. Each reference to the function in an SQL statement has a scratchpad. For example, assuming that function UDFX was defined with the SCRATCHPAD keyword, two scratchpads are allocated for the two references to UDFX in the following SQL statement:

```
SELECT *
FROM TABLE (UDFX(A)), TABLE (UDFX(B));
```

- The scratchpad is persistent. DB2 preserves its content from one invocation of the function to the next. Any changes that the function makes to the scratchpad on one call are still there on the next call. DB2 initializes the scratchpads when it begins to execute an SQL statement. DB2 does not reset scratchpads when a correlated subquery begins to execute.
- The scratchpad can be a central point for the system resources that the function acquires. If the function acquires system resources, specify FINAL CALL to ensure that DB2 calls the function one more time so that the function can free those system resources.

Each time the function invoked, DB2 passes an additional argument to the function that contains the address of the scratchpad.

If you specify SCRATCHPAD, DB2:

- Does not move the function from one task control block (TCB) to another between FETCH operations.
- Does not allow another function or stored procedure to use the TCB until the cursor is closed. This is also applicable for cursors declared WITH HOLD.

NO FINAL CALL or **FINAL CALL**
Specifies whether a *first call* and a *final call* are made to the function.

NO FINAL CALL
A first call and final call are not made to the function. NO FINAL CALL is the default.

FINAL CALL
A first call and final call are made to the function in addition to one or more *open*, *fetch*, or *close calls.*

The types of calls are:

First call
A *first call* occurs only if the function was defined with FINAL CALL. Before a first call, the scratchpad is set to binary zeros. Argument values are passed to the function, and the function might acquire memory or perform other one-time only resource initialization. However, the function should not return any data to DB2, but it can set return values for the SQL-state and diagnostic-message arguments.

Open call
An *open call* occurs unless the function returns an error. The scratchpad is set to binary zeros only if the function was defined with NO FINAL CALL. Argument values are passed to the function, and the function might perform any one-time initialization actions that are required. However, the function should not return any data to DB2.

Fetch call
A *fetch call* occurs unless the function returns an error during the first call or open call. Argument values are passed to the function, and DB2 expects the function to return a row of data or the end-of-table condition. If a scratchpad is also passed to the function, it remains untouched from the previous call.

Close call
A *close call* occurs unless the function returns an error during the first call, open call, or fetch call. No SQL-argument or SQL-argument-ind values are passed to the function, and if the function attempts to examine these values, unpredictable results may occur. If a scratchpad is also passed to the function, it remains untouched from the previous call.

The function should not return any data to DB2, but it can set return values for the SQL-state and diagnostic-message arguments. Also on close call, a function that is defined with NO FINAL CALL should release any system resources that it acquired. (A function that is defined with FINAL CALL should release any acquired resources on the final call.)

Final The *final call* balances the first call, and like the first call, occurs only if the function was defined with FINAL CALL. The function can set return values for the SQL-state and diagnostic-message arguments. The function should also release any system resources that it acquired. A final call occurs at these times:

- *End of statement:* When the cursor is closed for cursor-oriented statements, or the execution of the statement has completed.
- *End of transaction:* When normal end of statement processing does not occur. For example, the logic of an application, for some reason, bypasses closing the cursor.

If a commit, rollback, or abort operation causes the final call, the function cannot issue any SQL statements when it is invoked.

DISALLOW PARALLEL
Specifies that DB2 does not consider parallelism for the function.

NO DBINFO or **DBINFO**
Specifies whether additional status information is passed to the function when it is invoked.

NO DBINFO
No additional information is passed. NO DBINFO is the default.

DBINFO
An additional argument is passed when the function is invoked. The argument is a structure that contains information such as the application run-time authorization ID, the schema name, the name of a table or column that the function might be inserting into or updating, and identification of the database server that invoked the function. For details about the argument and its structure, see *DB2 Application Programming and SQL Guide*.

CARDINALITY *integer*
Specifies an estimate of the expected number of rows that the function returns. The number is used for optimization purposes. The value of *integer* must range from 0 to 2147483647.

If you do not specify CARDINALITY, DB2 assumes a finite value. The finite value is the same value that DB2 assumes for tables for which the RUNSTATS utility has not gathered statistics.

If a function has an infinite cardinality—the function never returns the “end-of-table” condition and always returns a row, then a query that requires the “end-of-table” to work correctly will need to be interrupted. Thus, avoid using such functions in queries that involve GROUP BY and ORDER BY.

NO COLLID or **COLLID** *collection-id*
Identifies the package collection that is to be used when the function is executed. This is the package collection into which the DBRM that is associated with the function program is bound.

NO COLLID
The package collection for the function is the same as the package collection of the program that invokes the function. If a trigger invokes the function, the collection of the trigger package is used. If the invoking program does not use a package, DB2 resolves the package by using the CURRENT PACKAGE PATH special register, the CURRENT PACKAGESET special register, or the PKLIST bind option (in this order). For details about how DB2 uses these three items, see the information on package resolution in Part 5 of *DB2 Application Programming and SQL Guide*.

NO COLLID is the default.

COLLID *collection-id*
The name of the package collection that is to be used when the external is executed.

WLM ENVIRONMENT
Identifies the WLM (workload manager) application environment in which the function is to run. The *name* of the WLM environment is an SQL identifier.

If you do not specify WLM ENVIRONMENT, the function runs in the WLM-established stored procedure address space that is specified at installation time.

name
The WLM environment in which the function must run. If another user-defined function or a stored procedure calls the function and that calling routine is running in an address space that is not associated with the WLM environment, DB2 routes the function request to a different address space.

(name,*)
When an SQL application program directly invokes the function, the WLM environment in which the function runs.

If another user-defined function or a stored procedure calls the function, the function runs in same environment that the calling routine uses. In this case, authorization to run the function in the WLM environment is not checked because the authorization of the calling routine suffices.

Users must have the appropriate authorization to execute functions in the specified WLM environment. For an example of a RACF command that provides this authorization, see “Running external functions in WLM environments” on page 625.

ASUTIME
Specifies the total amount of processor time, in CPU service units, that a single invocation of the function can run. The value is unrelated to the ASUTIME column of the resource limit specification table.

When you are debugging a function, setting a limit can be helpful if the function gets caught in a loop. For information on service units, see *z/OS MVS Initialization and Tuning Guide*.

NO LIMIT
There is no limit on the service units. NO LIMIT is the default.

LIMIT *integer*
The limit on the service units is a positive integer in the range of 1 to 2G. If the function uses more service units than the specified value, DB2 cancels the function.

STAY RESIDENT
Specifies whether the load module for the function is to remain resident in memory when the function ends.

NO
The load module is deleted from memory after the function ends. Use NO for non-reentrant functions. NO is the default.

YES
The load module remains resident in memory after the function ends. Use YES for reentrant functions.

PROGRAM TYPE
Specifies whether the function program runs as a main routine or a subroutine.

SUB
The function runs as a subroutine. SUB is the default.

MAIN
The function runs as a main routine.

SECURITY

Specifies how the function interacts with an external security product, such as RACF, to control access to non-SQL resources.

DB2

The function does not require an external security environment. If the function accesses resources that an external security product protects, the access is performed using the authorization ID that is associated with the WLM-established stored procedure address space.

DB2 is the default.

USER

An external security environment should be established for the function. If the function accesses resources that the external security product protects, the access is performed using the primary authorization ID of the process that invoked the function.

DEFINER

An external security environment should be established for the function. If the function accesses resources that the external security product protects, the access is performed using the authorization ID of the owner of the function.

RUN OPTIONS *run-time-options*

Specifies the Language Environment run-time options to be used for the function. You must specify *run-time-options* as a character string that is no longer than 254 bytes. If you do not specify RUN OPTIONS or pass an empty string, DB2 does not pass any run-time options to Language Environment, and Language Environment uses its installation defaults.

For a description of the Language Environment run-time options, see *z/OS Language Environment Programming Reference*.

INHERIT SPECIAL REGISTERS or **DEFAULT SPECIAL REGISTERS**

Specifies how special registers are set on entry to the routine.

INHERIT SPECIAL REGISTERS

Specifies that the values of special registers are inherited according to the rules listed in the table for characteristics of special registers in a user-defined function in Table 27 on page 111.

DEFAULT SPECIAL REGISTERS

Specifies that special registers are initialized to the default values, as indicated by the rules in the table for characteristics of special registers in a user-defined function in Table 27 on page 111.

STATIC DISPATCH

At function resolution time, DB2 chooses a function based on the static (or declared) types of the function parameters. STATIC DISPATCH is the default.

STOP AFTER SYSTEM DEFAULT FAILURES, STOP AFTER *nn* **FAILURES,** or **CONTINUE AFTER FAILURE**

Specifies whether the routine is to be put in a stopped state after some number of failures.

STOP AFTER SYSTEM DEFAULT FAILURES

Specifies that this routine should be placed in a stopped state after the number of failures indicated by the value of field MAX ABEND COUNT on installation panel DSNTIPX. This is the default.

STOP AFTER *nn* FAILURES
Specifies that this routine should be placed in a stopped state after *nn* failures. The value *nn* can be an integer from 1 to 32767.

CONTINUE AFTER FAILURE
Specifies that this routine should not be placed in a stopped state after any failure.

Notes

See "Notes" on page 624 for information about:
- Choosing data types for parameters
- Specifying the encoding scheme for parameters
- Determining the uniqueness of functions in a schema
- Overriding a built-in function
- Running external functions in WLM environments
- Specifying nondeterministic or external action functions in the definition of a scrollable cursor

Alternative syntax and synonyms: To provide compatibility with previous releases of DB2 or other products in the DB2 UDB family, DB2 supports the following keywords:
- VARIANT as a synonym for NOT DETERMINISTIC
- NOT VARIANT as a synonym for DETERMINISTIC
- NOT NULL CALL as a synonym for RETURNS NULL ON NULL INPUT
- NULL CALL as a synonym for CALLED ON NULL INPUT
- PARAMETER STYLE DB2SQL as a synonym for PARAMETER STYLE SQL

Example

The following example registers a table function written to return a row consisting of a single document identifier column for each known document in a text management system. The first parameter matches a given subject area and the second parameter contains a given string.

Within the context of a single session, the table function always returns the same table; therefore, it is defined as DETERMINISTIC. In addition, the DISALLOW PARALLEL keyword is added because table functions cannot operate in parallel.

Although the size of the output for DOCMATCH is highly variable, CARDINALITY 20 is a representative value and is specified to help DB2.

```
CREATE FUNCTION DOCMATCH (VARCHAR(30), VARCHAR(255))
                   RETURNS TABLE (DOC_ID CHAR(16))
  EXTERNAL NAME ABC
  LANGUAGE C
  PARAMETER STYLE SQL
  NO SQL
  DETERMINISTIC
  NO EXTERNAL ACTION
  FENCED
  SCRATCHPAD
  FINAL CALL
  DISALLOW PARALLEL
  CARDINALITY 20;
```

CREATE FUNCTION (sourced)

This CREATE FUNCTION statement registers a user-defined function that is based on an existing scalar or aggregate function with a database server.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

The privilege set defined below must include at least one of the following:
- The CREATEIN privilege on the schema
- SYSADM or SYSCTRL authority

The authorization ID that matches the schema name implicitly has the CREATEIN privilege on the schema.

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package.

If the statement is dynamically prepared, the privilege set is the privileges that are held by the SQL authorization ID of the process. The specified function name can include a schema name (a qualifier). However, if the schema name is not the same as the SQL authorization ID, one of the following conditions must be met:
- The privilege set includes SYSADM or SYSCTRL authority.
- The SQL authorization ID of the process has the CREATEIN privilege on the schema.

Additional privileges are required for the source function, and other privileges are also needed if the function uses a table as a parameter, or refers to a distinct type. These privileges are:
- The EXECUTE privilege for the function that the SOURCE clause references.
- The SELECT privilege on any table that is an input parameter to the function.
- The USAGE privilege on each distinct type that the function references.

Syntax

```
                                                                  (1)
>>--CREATE FUNCTION--function-name--(--+---------------------------+--)--------RETURNS--data-type2----->
                                       |  .-,-------------------.  |
                                       |  V                     |  |
                                       '----parameter-declaration-+-'

>--+------------------+--+---------------------------+--+-----------------------------------+------->
   |             (2)  |  '-SPECIFIC--specific-name-'  '-PARAMETER CCSID--+-ASCII---+-'
   '-AS LOCATOR-------'                                                  +-EBCDIC--+
                                                                         '-UNICODE-'

>--SOURCE--+-function-name--(--+---------------------+--)-+------------------------------------><
           |                   |  .-,-------------.  |    |
           |                   |  V               |  |    |
           |                   '----parameter-type-+--'    |
           '-SPECIFIC--specific-name----------------------'
```

Notes:

1 RETURNS, SPECIFIC, and SOURCE can be specified in any order.

2 AS LOCATOR can be specified only for a LOB data type or a distinct type based on a LOB data type.

parameter-declaration:

```
>>--+----------------+--parameter-type--------------------------------------------------><
    '-parameter-name-'
```

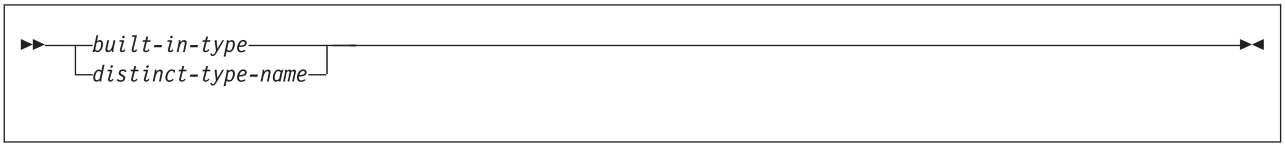
parameter-type:

```
>>--+-data-type--+------------------+--------------+-----------------------------------><
    |            |             (1)  |              |
    |            '-AS LOCATOR-------'              |
    '-TABLE LIKE--+-table-name-+--AS LOCATOR-------'
                  '-view-name--'
```

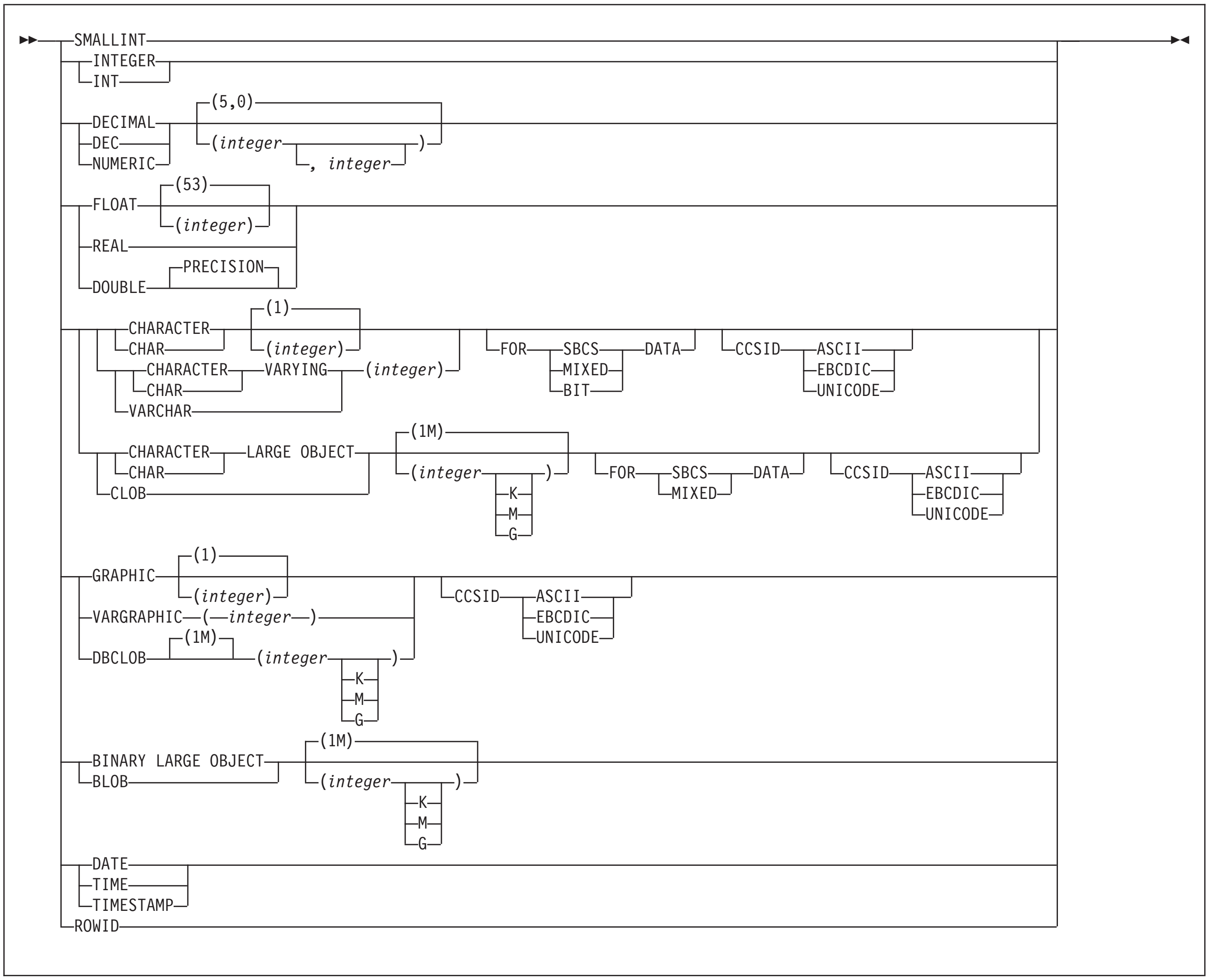
Notes:

1 AS LOCATOR can be specified only for a LOB data type or a distinct type based on a LOB data type.

data-type:



built-in-type:



Description

function-name

Names the user-defined function. The name is implicitly or explicitly qualified by a schema name. The combination of name, schema name, the number of parameters, and the data type each parameter[26] (without regard for any length, precision, scale, subtype, or encoding scheme attributes of the data type) must not identify a user-defined function that exists at the current server.

[26] If the function has more than 30 parameters, only the first 30 parameters are used to determine whether the function is unique.

If the function is sourced on an existing function to enable the use of the existing function with a distinct type, the name can be the same name as the existing function. In general, more than one function can have the same name if the function signature of each function is unique.

- The unqualified form of *function-name* is an SQL identifier.

  The name must not be any of the following system-reserved keywords even if you specify them as delimited identifiers:

  ```
  ALL
  AND
  ANY
  BETWEEN
  DISTINCT
  EXCEPT
  EXISTS
  FALSE
  FOR
  FROM
  IN
  IS
  LIKE
  MATCH
  NOT
  NULL
  ONLY
  OR
  OVERLAPS
  SIMILAR
  SOME
  TABLE
  TRUE
  TYPE
  UNIQUE
  UNKNOWN
  =
  ¬=
  <
  <=
  ¬<
  >
  >=
  ¬>
  <>
  ```

  The unqualified function name is implicitly qualified with a schema name according to the following rules:

  – If the statement is embedded in a program, the schema name is the authorization ID in the QUALIFIER bind option when the plan or package was created or last rebound. If QUALIFIER was not specified, the schema name is the owner of the plan or package.

  – If the statement is dynamically prepared, the schema name is the SQL authorization ID in the CURRENT SQLID special register.

- The qualified form of *function-name* is an SQL identifier (the schema name) followed by a period and an SQL identifier.

  The schema name can be ’SYSTOOLS’ if the user who executes the CREATE statement has SYSADM or SYSCTRL privilege. Otherwise, the schema name must not begin with 'SYS' unless the schema name is 'SYSADM'.

The owner of the function is determined by how the CREATE FUNCTION statement is invoked:

- If the statement is embedded in a program, the owner is the authorization ID of the owner of the plan or package.
- If the statement is dynamically prepared, the owner is the SQL authorization ID in the CURRENT SQLID special register.

The owner is implicitly given the EXECUTE privilege with the GRANT option for the function.

(*parameter-declaration,...***)**

Specifies the number of input parameters of the function and the data type of each parameter. All the parameters for a function are input parameters and are nullable. There must be one entry in the list for each parameter that the function expects to receive. Although not required, you can give each parameter a name.

A function can have no parameters. In this case, you must code an empty set of parentheses, for example:

```
CREATE FUNCTION WOOFER()
```

parameter-name

Specifies the name of the input parameter. The name is an SQL identifier, and each name in the parameter list must not be the same as any other name.

data-type

Specifies the data type of the input parameter. The data type can be a built-in data type or a distinct type.

built-in-type

The data type of the input parameter is a built-in data type.

You can use the same built-in data types as for the CREATE TABLE statement. For information on the data types, see “built-in-type” on page 741.

For parameters with a character or graphic data type, the PARAMETER CCSID clause or CCSID clause indicates the encoding scheme of the parameter. If you do not specify either of these clauses, the encoding scheme is the value of field DEF ENCODING SCHEME on installation panel DSNTIPF.

distinct-type-name

The data type of the input parameter is a distinct type. Any length, precision, scale, subtype, or encoding scheme attributes for the parameter are those of the source type of the distinct type.

The implicitly or explicitly specified encoding scheme of all the parameters with a string data type must be the same—either all ASCII, all EBCDIC, or all UNICODE.

Although parameters with a character data type have an implicitly or explicitly specified subtype (BIT, SBCS, or MIXED), the function program can receive character data of any subtype. Therefore, conversion of the input data to the subtype of the parameter might occur when the function is invoked.

Parameters with a datetime data type or a distinct type are passed to the function as a different data type:

- A datetime type parameter is passed as a character data type, and the data is passed in ISO format.

  The encoding scheme for a datetime type parameter is the same as the implicitly or explicitly specified encoding scheme of any character or graphic string parameters. If no character or graphic string parameters are passed, the encoding scheme is the value of field DEF ENCODING SCHEME on installation panel DSNTIPF.
- A distinct type parameter is passed as the source type of the distinct type.

You can specify any built-in data type or distinct type that matches or can be cast to the data type of the corresponding parameter of the source function (the function that is identified in the SOURCE clause). (For information on casting data types, see “Casting between data types” on page 71.) Length, precision, or scale attributes do not have be specified for data types with these attributes. When specifying data types with these attributes, follow these rules:

- An empty set of parentheses can be used to indicate that the length, precision, or scale is the same as the source function.
- If length, precision, or scale is not explicitly specified, and empty parentheses are not specified, the default values are used.

AS LOCATOR

Specifies that a locator to the value of the parameter is passed to the function instead of the actual value. Specify AS LOCATOR only for parameters with a LOB data type or a distinct type based on a LOB data type. Passing locators instead of values can result in fewer bytes being passed to the function, especially when the value of the parameter is very large.

The AS LOCATOR clause has no effect on determining whether data types can be promoted, nor does it affect the function signature, which is used in function resolution.

TABLE LIKE *table-name* or *view-name* **AS LOCATOR**

Specifies that the parameter is a transition table. However, when the function is invoked, the actual values in the transition table are not passed to the function. A single value is passed instead. This single value is a locator to the table, which the function uses to access the columns of the transition table. A function with a table parameter can only be invoked from the triggered action of a trigger.

The use of TABLE LIKE provides an implicit definition of the transition table. It specifies that the transition table has the same number of columns as the identified table or view. The columns have the same data type, length, precision, scale, subtype, and encoding scheme as the identified table or view, as they are described in catalog tables SYSCOLUMNS and SYSTABLESPACE. The number of columns and the attributes of those columns are determined at the time the CREATE FUNCTION statement is processed. Any subsequent changes to the number of columns in the table or the attributes of those columns do not affect the parameters of the function.

The *name* specified after TABLE LIKE must identify a table or view that exists at the current server. The name must not identify a declared temporary table. The name does not have to be the same name as the table that is associated with the transition table for the trigger. An unqualified table or view name is implicitly qualified according to the following rules:

- If the CREATE FUNCTION statement is embedded in a program, the implicit qualifier is the authorization ID in the QUALIFIER bind option when the plan or package was created or last rebound. If QUALIFIER was not used, the implicit qualifier is the owner of the plan or package.
- If the CREATE FUNCTION statement is dynamically prepared, the implicit qualifier is the SQL authorization ID in the CURRENT SQLID special register.

When the function is invoked, the corresponding columns of the transition table identified by the table locator and the table or view identified in the TABLE LIKE clause must have the same definition. The data type, length, precision, scale, and encoding scheme of these columns must match exactly. The description of the table or view at the time the CREATE FUNCTION statement was executed is used.

Additionally, a character FOR BIT DATA column of the transition table cannot be passed as input for a table parameter for which the corresponding column of the table specified at the definition is not defined as character FOR BIT DATA. (The definition occurs with the CREATE FUNCTION statement.) Likewise, a character column of the transition table that is not FOR BIT DATA cannot be passed as input for a table parameter for which the corresponding column of the table specified at the definition is defined as character FOR BIT DATA.

For more information about using table locators, see *DB2 Application Programming and SQL Guide*.

RETURNS

Identifies the output of the function.

data-type2

Specifies the data type of the output. The output is nullable.

You can specify any built-in data type or distinct type that can be cast to from the data type of the source function's result. (For information on casting data types, see "Casting between data types" on page 71.) For additional rules that apply to the data type that you can specify, see "Rules for creating sourced functions" on page 655.

AS LOCATOR

Specifies that the function returns a locator to the value rather than the actual value. You can specify AS LOCATOR only if the output from the function has a LOB data type or a distinct type based on a LOB data type.

SPECIFIC *specific-name*

Provides a unique name for the function. The name is implicitly or explicitly qualified with a schema name. The name, including the schema name, must not identify the specific name of another function that exists at the current server.

The unqualified form of *specific-name* is an SQL identifier. The qualified form is an SQL identifier (the schema name) followed by a period and an SQL identifier.

If you do not specify a schema name, it is the same as the explicit or implicit schema name of the function name (*function-name*). If you specify a schema name, it must be the same as the explicit or implicit schema name of the function name.

If you do not specify the SPECIFIC clause, the default specific name is the name of the function. However, if the function name does not provide a unique specific name or if the function name is a single asterisk, DB2 generates a specific name in the form of:

```
SQLxxxxxxxxxxxx
```

where `'xxxxxxxxxxxx'` is a string of 12 characters that make the name unique.

The specific name is stored in the SPECIFIC column of the SYSROUTINES catalog table. The specific name can be used to uniquely identify the function in several SQL statements (such as ALTER FUNCTION, COMMENT, DROP, GRANT, and REVOKE) and in DB2 commands (START FUNCTION, STOP FUNCTION, and DISPLAY FUNCTION). However, the function cannot be invoked by its specific name.

PARAMETER CCSID

Indicates whether the encoding scheme for string parameters is ASCII, EBCDIC, or UNICODE. The default encoding scheme is the value specified in the CCSID clauses of the parameter list or RETURNS clause, or in the field DEF ENCODING SCHEME on installation panel DSNTIPF.

This clause provides a convenient way to specify the encoding scheme for *all* string parameters. If individual CCSID clauses are specified for individual parameters in addition to this PARAMETER CCSID clause, the value specified in *all* of the CCSID clauses must be the same value that is specified in this clause.

This clause also specifies the encoding scheme to be used for system-generated parameters of the routine such as message tokens and DBINFO.

SOURCE

Specifies that the new function is being defined as a sourced function. A *sourced function* is implemented by another function (the *source function*). The source function must be a scalar or aggregate function that exists at the current server, and it must be one of the following types of functions:

- A function that was defined with a CREATE FUNCTION statement
- A cast function that was generated by a CREATE DISTINCT TYPE statement
- A built-in function

If the source function is not a built-in function, the particular function can be identified by its name, function signature, or specific name.

If the source function is a built-in function, the SOURCE clause must include a function signature for the built-in function. The source function must not be any of the built-in functions shown in Table 62 (if a particular syntax is shown, only the indicated form cannot be specified).

Table 62. Built-in functions that cannot be the source function. When listed with specific conditions, the function cannot be a source function under those conditions. Otherwise, the function cannot be a source function regardless of its arguments.

Type of function	Restricted functions

Aggregate	COUNT(*)
	COUNT_BIG(*)
	XMLAGG

Scalar function	CHAR(*datetime-expression*, *second-argument*) where *second-argument* is ISO, USA, EUR, JIS, or LOCAL COALESCE DECRYPT_BIT where second argument is DEFAULT DECRYPT_CHAR where second argument is DEFAULT DECRYPT_DB where second argument is DEFAULT GETVARIABLE where second argument is DEFAULT LOCAL MAX MIN NULLIF STRIP where multiple arguments are specified XML2CLOB XMLCONCAT XMLELEMENT XMLFOREST XMLNAMESPACES

If you base the sourced function directly or indirectly on an external scalar function, the sourced function inherits the attributes of the external scalar function. This can involve several layers of sourced functions. For example, assume that function A is sourced on function B, which in turn is sourced on function C. Function C is an external scalar function. Functions A and B inherit all of the attributes that are specified on the EXTERNAL clause of the CREATE FUNCTION statement for function C.

function-name

Identifies the function that is to be used as the source function. The source function can be defined with any number of parameters. If more than one function is defined with the specified name in the specified or implicit schema, an error is returned.

If you specify an unqualified *function-name*, DB2 searches the schemas of the SQL path. DB2 selects the first schema that has only one function with this name on which the user has EXECUTE authority. An error is returned if a function is not found or a schema has more than one function with this name.

function-name (parameter-type,...)

Identifies the function that is to be used as the source function by its function signature, which uniquely identifies the function. The*function-name (parameter-type,...)* must identify a function with the specified signature. The specified parameters must match the data types in the corresponding position that were specified when the function was created. DB2 uses the number of data types and the logical concatenation of the data types to identify the specific function instance. Synonyms for data types are considered a match.

If *function-name()* is specified, the identified function must have zero parameters.

To use a built-in function as the source function, this syntax variation must be used. You cannot use this form of the syntax if the source function was defined with a table parameter (the LIKE TABLE was specified in the CREATE FUNCTION statement to indicate that one of the input parameters is a transition table). Instead, identify the function with its function name, if unique, or with its specific name.

function-name

Identifies the function name of the source function. If you specify an unqualified name, DB2 searches the schemas of the SQL path. Otherwise, DB2 searches for the function in the specified schema.

*parameter-type***,...**

Identifies the parameters of the function.

If an unqualified distinct type name is specified, DB2 searches the SQL path to resolve the schema name for the distinct type.

Empty parentheses are allowed for some data types that are specified in this context. For data types that have a length, precision, or scale attribute, use one of the following specifications:

- Empty parentheses indicate that DB2 ignores the attribute when determining whether the data types match. For example, DEC() is considered a match for a parameter of a function that is defined with a data type of DEC(7,2). However, FLOAT cannot be specified with empty parentheses because its parameter value indicates a specific data type (REAL or DOUBLE).

- If a specific value for a length, precision, or scale attribute is specified, the value must exactly match the value that was specified (implicitly or explicitly) in the CREATE FUNCTION statement. If the data type is FLOAT, the precision does not need to exactly match the value that was specified because matching is based on the data type (REAL or DOUBLE).
- If length, precision, or scale is not explicitly specified, and empty parentheses are not specified, the default attributes of the data type are implied. The implicit length must exactly match the value that was specified (implicitly or explicitly) in the CREATE FUNCTION statement.

If you omit the FOR *subtype* DATA clause or the CCSID clause for data types with a subtype or encoding scheme attribute, DB2 is to ignore the attribute when determining whether the data types match.An exception to ignoring the attribute is FOR BIT DATA. A character FOR BIT DATA parameter of the new function cannot correspond to a parameter of the source function that is not defined as character FOR BIT DATA. Likewise, a character parameter of the new function that is not FOR BIT DATA cannot correspond to a parameter of the source function that is defined as character FOR BIT DATA.

The number of input parameters in the function that is being created must be the same as the number of parameters in the source function. If the data type of each input parameter is not the same as or castable to the corresponding parameter of the source function, an error occurs. The data type of the final result of the source function must match or be castable to the result of the sourced function.

AS LOCATOR

Specifies that the function is defined to receive a locator for this parameter. If AS LOCATOR is specified, the data type must be a LOB or distinct type that is based on a LOB.

SPECIFIC *specific-name*

Identifies the function to be used as the source function by its specific name.

If you specify an unqualified *specific-name*, DB2 searches the SQL path to locate the schema. DB2 selects the first schema that contains a function with this specific name for which the user has EXECUTE authority. DB2 returns an error if it cannot find a function with the specific name in one of the schemas in the SQL path.

If you specify a qualified *specific-name*, DB2 searches the named schema for the function. DB2 returns an error if it cannot find a function with the specific name.

Notes

Choosing data types for parameters: When you choose the data types of the input and output parameters for your function, consider the rules of promotion that can affect the values of the parameters. (See “Promotion of data types” on page 70). For example, a constant that is one of the input arguments to the function might have a built-in data type that is different from the data type that the function expects, and more significantly, might not be promotable to that expected data type. Based on the rules of promotion, we recommend using the following data types for parameters:

- INTEGER instead of SMALLINT
- DOUBLE instead of REAL
- VARCHAR instead of CHAR
- VARGRAPHIC instead of GRAPHIC

For portability of functions across platforms that are not DB2 UDB for z/OS, do not use the following data types, which might have different representations on different platforms:

- FLOAT. Use DOUBLE or REAL instead.
- NUMERIC. Use DECIMAL instead.

Specifying the encoding scheme for parameters: The implicitly or explicitly specified encoding scheme of all the parameters with a string data type (both input and output parameters) must be the same—either all ASCII, all EBCDIC, or all UNICODE.

Determining the uniqueness of functions in a schema: At the current server, the function signature of each function, which is the qualified function name combined with the number and data types of the input parameters, must be unique. This means that two different schemas can each contain a function with the same name that have the same data types for all of their corresponding data types. However, a schema must not contain two functions with the same name that have the same data types for all of their corresponding data types.

When determining whether corresponding data types match, DB2 does not consider any length, precision, scale, subtype or encoding scheme attributes in the comparison. DB2 considers the synonyms of data types (DECIMAL and NUMERIC, REAL and FLOAT, and DOUBLE and FLOAT) a match. Therefore, CHAR(8) and CHAR(35) are considered to be the same, as are DECIMAL(11,2), DECIMAL(4,3), and NUMERIC(4,2).

Assume that the following statements are executed to create four functions in the same schema. The second and fourth statements fail because they create functions that are duplicates of the functions that the first and third statements created.

```
CREATE FUNCTION PART (INT, CHAR(15)) ...
CREATE FUNCTION PART (INTEGER, CHAR(40)) ...

CREATE FUNCTION ANGLE (DECIMAL(12,2)) ...
CREATE FUNCTION ANGLE (DEC(10,7)) ...
```

Rules for creating sourced functions: For the discussion in this section, assume that the function that is being created is named NEWF and the source function is named SOURCEF. Consider the following rules when creating a sourced function:

- The unqualified names of the sourced function and source function can be different (NEWF and SOURCEF).
- The number of input parameters for NEWF and SOURCEF must be the same; otherwise, an error occurs when the CREATE FUNCTION statement is executed.
- When specifying the input parameters and output for NEWF, you can specify a value for the precision, scale, subtype, or encoding scheme for a data type with any of these attributes or use empty parentheses.

  Empty parentheses, such as VARCHAR(), indicate that the value of the attribute is the same as the attribute for the corresponding parameter of SOURCEF, or that is determined by data type promotion. If you specify any values for the attributes, DB2 checks the values against the corresponding input parameters and returned output of SOURCEF as described next.

- When the CREATE FUNCTION statement is executed, DB2 checks the input parameters of NEWF against those of SOURCEF. The data type of each input parameter of NEWF function must be either the same as, or promotable to, the data type of the corresponding parameter of SOURCEF; otherwise, an error occurs. (For information on the promotion of data types, see "Casting between data types" on page 71.)

  This checking does not guarantee that an error will not occur when NEWF is invoked. For example, an argument that matches the data type and length or precision attributes of a NEWF parameter might not be promotable if the corresponding SOURCEF parameter has a shorter length or less precision. In general, do not define the parameters of a sourced function with length or precision attributes that are greater than the attributes of the corresponding parameters of the source function.
- When the CREATE FUNCTION statement is executed, DB2 checks the data type identified in the RETURNS clause of NEWF against the data type that SOURCEF returns. The data type that SOURCEF returns must be either the same as, or promotable to, the RETURNS data type of NEWF; otherwise, an error occurs.

  This checking does not guarantee that an error will not occur when NEWF is invoked. For example, the value of a result that matches the data type and length or precision attributes of those specified for SOURCEF's result might not be promotable if the RETURNS data type of NEWF has a shorter length or less precision. Consider the possible effects of defining the RETURNS data type of a sourced function with length or precision attributes that are less than the attributes defined for the data type returned by source function.

Scrollable cursors specified with user-defined functions: A row can be fetched more than once with a scrollable cursor. Therefore, if a scrollable cursor is defined with a nondeterministic function in the select list of the cursor, a row can be fetched multiple times with different results for each fetch. Similarly, if a scrollable cursor is defined with a user-defined function with external action, the action is executed with every fetch.

Examples

Example 1: Assume that you created a distinct type HATSIZE, which you based on the built-in data type INTEGER. You want to have an AVG function to compute the average hat size of different departments. Create a sourced function that is based on built-in function AVG.

```
CREATE FUNCTION AVE (HATSIZE) RETURNS HATSIZE
   SOURCE SYSIBM.AVG (INTEGER);
```

When you created distinct type HATSIZE, two cast functions were generated, which allow HATSIZE to be cast to INTEGER for the argument and INTEGER to be cast to HATSIZE for the result of the function.

Example 2: After Smith registered the external scalar function CENTER in his schema, you decide that you want to use this function, but you want it to accept two INTEGER arguments instead of one INTEGER argument and one FLOAT argument. Create a sourced function that is based on CENTER.

```
CREATE FUNCTION MYCENTER (INTEGER, INTEGER)
   RETURNS FLOAT
   SOURCE SMITH.CENTER (INTEGER, FLOAT);
```

CREATE FUNCTION (SQL scalar)

This statement is used to define a user-defined SQL scalar function. A scalar function returns a single value each time it is invoked. Specifying a function is generally valid wherever an SQL expression is valid.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

The privilege set defined below must include at least one of the following:
- The CREATEIN privilege on the schema
- SYSADM or SYSCTRL authority

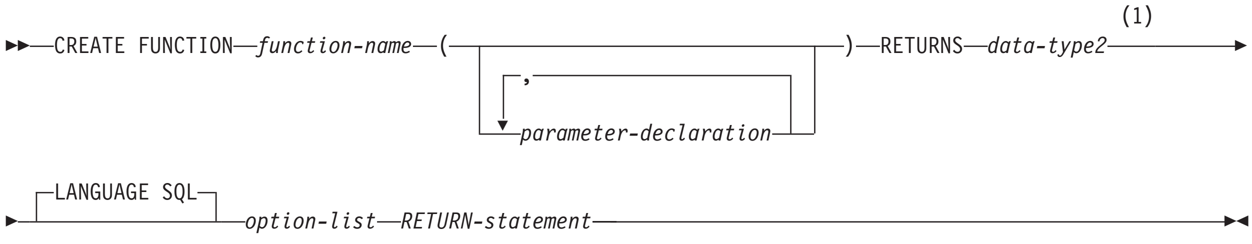
The authorization ID that matches the schema name implicitly has the CREATEIN privilege on the schema.

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package.

If the statement is dynamically prepared, the privilege set is the privileges that are held by the SQL authorization ID of the process. The specified function name can include a schema name (a qualifier). However, if the schema name is not the same as the SQL authorization ID, one of the following conditions must be met:
- The privilege set includes SYSADM or SYSCTRL authority.
- The SQL authorization ID of the process has the CREATEIN privilege on the schema.

Additional privileges are required if the function uses a table as a parameter or refers to a distinct type. These privileges are:
- The SELECT privilege on any table that is an input parameter to the function.
- The USAGE privilege on each distinct type that the function references.

Syntax



Notes:

1 The RETURNS clause, the *RETURN-statement*, and the clauses in the *option-list* can be specified in any order. However, the same clause cannot be specified more than once.

parameter-declaration:

```
                  (1)
>>──parameter-name──────data-type1──────────────────────────────────────────────────><
```

Notes:

1 Note that the *parameter-name* is required for SQL functions.

data-type:

```
>>──┬─built-in-type──────┬──────────────────────────────────────────────────────────><
    └─distinct-type-name─┘
```

built-in-type:

```
>>──┬─SMALLINT───────────────────────────────────────────────────────────────────────┬──><
    ├─┬─INTEGER─┬────────────────────────────────────────────────────────────────────┤
    │ └─INT─────┘                                                                    │
    │             ┌─(5,0)──────────────────────────┐                                 │
    ├─┬─DECIMAL─┬─┼────────────────────────────────┼─────────────────────────────────┤
    │ ├─DEC─────┤ └─(integer─┬────────────────┬─)──┘                                 │
    │ └─NUMERIC─┘            └─, integer──────┘                                      │
    │         ┌─(53)──────────────┐                                                  │
    ├─┬─FLOAT─┼───────────────────┼─┬────────────────────────────────────────────────┤
    │ │       └─(──integer──)─────┘ │                                                │
    │ ├─REAL────────────────────────┤                                                │
    │ │        ┌─PRECISION─┐        │                                                │
    │ └─DOUBLE─┴───────────┴────────┘                                                │
    │                    ┌─(1)─────────┐                                             │
    ├─┬─┬─┬─CHARACTER─┬──┼─────────────┼──────┬─┬───────────────────────┬─┬─────────────────────────┬─┬─┤
    │ │ │ └─CHAR──────┘  └─(integer)───┘      │ └─FOR─┬─SBCS──┬──DATA─┘ └─CCSID─┬─ASCII───┬───────┘ │ │
    │ │ └─┬─┬─CHARACTER─┬─VARYING─┬─(integer)─┘       ├─MIXED─┤                 ├─EBCDIC──┤         │ │
    │ │   │ └─CHAR──────┘         │                   └─BIT───┘                 └─UNICODE─┘         │ │
    │ │   └─VARCHAR─────────────┘                                                                 │ │
    │ │                                 ┌─(1M)──────────────┐                                     │ │
    │ └─┬─┬─CHARACTER─┬─LARGE OBJECT─┬──┼───────────────────┼─┬───────────────────────┬─┬─────────────────────────┬─┘ │
    │   │ └─CHAR──────┘              │  └─(integer─┬───┬─)──┘ └─FOR─┬─SBCS──┬──DATA─┘ └─CCSID─┬─ASCII───┬───────┘   │
    │   └─CLOB───────────────────────┘             ├─K─┤              └─MIXED─┘                 ├─EBCDIC──┤           │
    │                                              ├─M─┤                                        └─UNICODE─┘           │
    │                                              └─G─┘                                                              │
    │             ┌─(1)─────────┐                                                                                     │
    ├─┬─GRAPHIC───┼─────────────┼──┬─┬──────────────────────────┬─────────────────────────────────────────────────────┤
    │ │           └─(integer)───┘  │ └─CCSID─┬─ASCII───┬────────┘                                                     │
    │ ├─VARGRAPHIC──(integer)──────┤         ├─EBCDIC──┤                                                              │
    │ │          ┌─(1M)──────────┐ │         └─UNICODE─┘                                                              │
    │ └─DBCLOB───┼───────────────┼─┘                                                                                  │
    │            └─(integer─┬───┬─)┘                                                                                  │
    │                       ├─K─┤                                                                                     │
    │                       ├─M─┤                                                                                     │
    │                       └─G─┘                                                                                     │
    │                           ┌─(1M)───────────────┐                                                                │
    ├─┬─BINARY LARGE OBJECT─┬───┼────────────────────┼────────────────────────────────────────────────────────────────┤
    │ └─BLOB────────────────┘   └─(integer─┬───┬─)───┘                                                                │
    │                                      ├─K─┤                                                                      │
    │                                      ├─M─┤                                                                      │
    │                                      └─G─┘                                                                      │
    ├─┬─DATE──────┬───────────────────────────────────────────────────────────────────────────────────────────────────┤
    │ ├─TIME──────┤                                                                                                   │
    │ └─TIMESTAMP─┘                                                                                                   │
    └─ROWID───────────────────────────────────────────────────────────────────────────────────────────────────────────┘
```

option-list:

```
                              (1)                                         ┌─NOT DETERMINISTIC─┐
►►──┬──────────────────────────┬────┬────────────────────────────────────┬───┼───────────────────┼──────►
    └─SPECIFIC──specific-name──┘    └─PARAMETER CCSID──┬─ASCII───┬───────┘   └─DETERMINISTIC─────┘
                                                       ├─EBCDIC──┤
                                                       └─UNICODE─┘

   ┌─EXTERNAL ACTION────┐  ┌─READS SQL DATA─┐  ┌─STATIC DISPATCH─┐  ┌─CALLED ON NULL INPUT─┐
►──┼────────────────────┼──┼────────────────┼──┴─────────────────┴──┴──────────────────────┴──────►◄
   └─NO EXTERNAL ACTION─┘  └─CONTAINS SQL───┘
```

Notes:

1 This clause and the other clauses in the *option-list* can be specified in any order. However, the same clause cannot be specified more than once.

Description

function-name

Names the user-defined function. The name is implicitly or explicitly qualified by a schema name. The combination of name, schema name, the number of parameters, and the data type of each parameter[27] (without regard for any length, precision, scale, subtype or encoding scheme attributes of the data type) must not identify a user-defined function that exists at the current server.

You can use the same name for more than one function if the function signature of each function is unique.

- The unqualified form of *function-name* is an SQL identifier.

  The name must not be any of the following system-reserved keywords even if you specify them as delimited identifiers:

  ```
  ALL                    LIKE                   UNIQUE
  AND                    MATCH                  UNKNOWN
  ANY                    NOT                    =
  BETWEEN                NULL                   ¬=
  DISTINCT               ONLY                   <
  EXCEPT                 OR                     <=
  EXISTS                 OVERLAPS               ¬<
  FALSE                  SIMILAR                >
  FOR                    SOME                   >=
  FROM                   TABLE                  ¬>
  IN                     TRUE                   <>
  IS                     TYPE
  ```

  The unqualified function name is implicitly qualified with a schema name according to the following rules:

  – If the statement is embedded in a program, the schema name is the authorization ID in the QUALIFIER bind option when the plan or package was created or last rebound. If QUALIFIER was not specified, the schema name is the owner of the plan or package.

  – If the statement is dynamically prepared, the schema name is the SQL authorization ID in the CURRENT SQLID special register.

[27] If the function has more than 30 parameters, only the first 30 parameters are used to determine whether the function is unique.

- The qualified form of *function-name* is an SQL identifier (the schema name) followed by a period and an SQL identifier.

  The schema name can be ’SYSTOOLS’ if the user who executes the CREATE statement has SYSADM or SYSCTRL privilege. Otherwise, the schema name must not begin with 'SYS' unless the schema name is 'SYSADM'.

The owner of the function is determined by how the CREATE FUNCTION statement is invoked:

- If the statement is embedded in a program, the owner is the authorization ID of the owner of the plan or package.
- If the statement is dynamically prepared, the owner is the SQL authorization ID in the CURRENT SQLID special register.

The owner is implicitly given the EXECUTE privilege with the GRANT option for the function.

(*parameter-declaration,...***)**

Identifies the number of input parameters of the function, and specifies the name and data type of each parameter. All the parameters for a function are input parameters and are nullable. There must be one entry in the list for each parameter that the function expects to receive.

A function can have no parameters. In this case, you must code an empty set of parentheses, for example:

```
CREATE FUNCTION WOOFER()
```

parameter-name

Specifies the name of the input parameter. The name is an SQL identifier, and each name in the parameter list must not be the same as any other name.

data-type

Specifies the data type of the input parameter. The data type can be a built-in data type or a distinct type.

built-in-type

The data type of the input parameter is a built-in data type.

You can use the same built-in data types as for the CREATE TABLE statement. For information on the data types, see “built-in-type” on page 741.

For parameters with a character or graphic data type, the PARAMETER CCSID clause or CCSID clause indicates the encoding scheme of the parameter. If you do not specify either of these clauses, the encoding scheme is the value of field DEF ENCODING SCHEME on installation panel DSNTIPF.

distinct-type-name

The data type of the input parameter is a distinct type. Any length, precision, scale, subtype, or encoding scheme attributes for the parameter are those of the source type of the distinct type.

If you specify the name of the distinct type without a schema name, DB2 resolves the schema name by searching the schemas in the SQL path.

The implicitly or explicitly specified encoding scheme of all the parameters with a string data type must be the same—either all ASCII, all EBCDIC, or all UNICODE.

Although parameters with a character data type have an implicitly or explicitly specified subtype (BIT, SBCS, or MIXED), the function program can receive character data of any subtype. Therefore, conversion of the input data to the subtype of the parameter might occur when the function is invoked. An error occurs if mixed data that actually contains DBCS characters is used as the value for an input parameter that is declared with an SBCS subtype.

Parameters with a datetime data type or a distinct type are passed to the function as a different data type:

- A datetime type parameter is passed as a character data type, and the data is passed in ISO format.

  The encoding scheme for a datetime type parameter is the same as the implicitly or explicitly specified encoding scheme of any character or graphic string parameters. If no character or graphic string parameters are passed, the encoding scheme is the value of field DEF ENCODING SCHEME on installation panel DSNTIPF.
- A distinct type parameter is passed as the source type of the distinct type.

RETURNS

Identifies the output of the function. Consider this clause in conjunction with the optional CAST FROM clause.

data-type2

Specifies the data type of the output. The output is nullable.

The same considerations that apply to the data type of input parameter, as described under “data-type” on page 660, apply to the data type of the output of the function.

LANGUAGE SQL

Specifies the application programming language in which the stored function is written. The value of the function is written as DB2 SQL within the *expression* of the RETURN clause. LANGUAGE SQL is the default.

SPECIFIC *specific-name*

Specifies a unique name for the function. The name is implicitly or explicitly qualified with a schema name. The name, including the schema name, must not identify the specific name of another function that exists at the current server.

The unqualified form of *specific-name* is an SQL identifier. The qualified form is an SQL identifier (the schema name) followed by a period and an SQL identifier.

If you do not specify a schema name, it is the same as the explicit or implicit schema name of the function name (*function-name*). If you specify a schema name, it must be the same as the explicit or implicit schema name of the function name.

If you do not specify the SPECIFIC clause, the default specific name is the name of the function. However, if the function name does not provide a unique specific name or if the function name is a single asterisk, DB2 generates a specific name in the form of:

```
SQLxxxxxxxxxxxx
```

where `'xxxxxxxxxxxx'` is a string of 12 characters that make the name unique.

The specific name is stored in the SPECIFIC column of the SYSROUTINES catalog table. The specific name can be used to uniquely identify the function in several SQL statements (such as ALTER FUNCTION, COMMENT, DROP, GRANT, and REVOKE) and must be used in DB2 commands (START FUNCTION, STOP FUNCTION, and DISPLAY FUNCTION). However, the function cannot be invoked by its specific name.

PARAMETER CCSID

Indicates whether the encoding scheme for string parameters is ASCII, EBCDIC, or UNICODE. The default encoding scheme is the value specified in the CCSID clauses of the parameter list or RETURNS clause, or in the field DEF ENCODING SCHEME on installation panel DSNTIPF.

This clause provides a convenient way to specify the encoding scheme for *all* string parameters. If individual CCSID clauses are specified for individual parameters in addition to this PARAMETER CCSID clause, the value specified in *all* of the CCSID clauses must be the same value that is specified in this clause.

This clause also specifies the encoding scheme to be used for system-generated parameters of the routine such as message tokens and DBINFO.

NOT DETERMINISTIC or **DETERMINISTIC**

Specifies whether the function returns the same results each time that the function is invoked with the same input arguments.

NOT DETERMINISTIC

The function might not return the same result each time that the function is invoked with the same input arguments. The function depends on some state values that affect the results. DB2 uses this information to disable the merging of views and table expressions when processing SELECT, UPDATE, DELETE, or INSERT statements that refer to this function. An example of a function that is not deterministic is one that generates random numbers.

NOT DETERMINISTIC must be specified explicitly or implicitly if the function program accesses a special register or invokes another nondeterministic function. NOT DETERMINISTIC is the default.

DETERMINISTIC

The function always returns the same result function each time that the function is invoked with the same input arguments. An example of a deterministic function is a function that calculates the square root of the input. DB2 uses this information to enable the merging of views and table expressions for SELECT, UPDATE, DELETE, or INSERT statements that refer to this function. DETERMINISTIC is not the default. If applicable, specify DETERMINISTIC to prevent non-optimal access paths from being chosen for SQL statements that refer to this function.

DB2 does not verify that the function program is consistent with the specification of DETERMINISTIC or NOT DETERMINISTIC.

EXTERNAL ACTION or **NO EXTERNAL ACTION**

Specifies whether the function takes an action that changes the state of an object that DB2 does not manage. An example of an external action is sending a message or writing a record to a file.

EXTERNAL ACTION

The function can take an action that changes the state of an object that DB2 does not manage.

Some SQL statements that invoke functions with external actions can result in incorrect results if parallel tasks execute the function. For example, if the function sends a note for each initial call to it, one note is sent for each parallel task instead of once for the function. Specify the DISALLOW PARALLEL clause for functions that do not work correctly with parallelism.

If you specify EXTERNAL ACTION, then DB2:

- Materializes the views and table expressions in SELECT, UPDATE, DELETE or INSERT statements that refer to the function. This materialization can adversely affect the access paths that are chosen for the SQL statements that refer to this function. Do not specify EXTERNAL ACTION if the function does not have an external action.
- Does not move the function from one task control block (TCB) to another between FETCH operations.
- Does not allow another function or stored procedure to use the TCB until the cursor is closed. This is also applicable for cursors declared WITH HOLD.

The only changes to resources made outside of DB2 that are under the control of commit and rollback operations are those changes made under RRS control.

EXTERNAL ACTION must be specified implicitly or explicitly specified if the SQL routine body invokes a function that is defined with EXTERNAL ACTION. EXTERNAL ACTION is the default.

NO EXTERNAL ACTION

The function does not take any action that changes the state of an object that DB2 does not manage. DB2 uses this information to enable the merging of views and table expressions for SELECT, UPDATE, DELETE, or INSERT statements that refer to this function. NO EXTERNAL ACTION is not the default. If applicable, specify NO EXTERNAL ACTION to prevent non-optimal access paths from being chosen for SQL statements that refer to this function.

DB2 does not verify that the function program is consistent with the specification of EXTERNAL ACTION or NO EXTERNAL ACTION.

READS SQL DATA or **CONTAINS SQL**

Specifies which SQL statements, if any, can be executed in the function or any routine that is called from this function. The default is READS SQL DATA. For the data access classification of each statement, see Table 95 on page 1158.

READS SQL DATA

Specifies that the function can execute SQL statements with a data access classification of READS SQL DATA or CONTAINS SQL. SQL statements that do not modify SQL data can be included in the function. Statements that are not supported in any function return a different error.

CONTAINS SQL

Specifies that the function can execute only SQL statements with a data classification of CONTAINS SQL. SQL statements that neither read nor modify SQL data can be executed by the function. Statements that are not supported in any function return a different error.

STATIC DISPATCH
At function resolution time, DB2 chooses a function based on the static (or declared) types of the function parameters. STATIC DISPATCH is the default.

CALLED ON NULL INPUT
The function is called regardless of whether any of the input arguments are null, making the function responsible for testing for null arguments. The function can return null. CALLED ON NULL INPUT is the default.

RETURN-statement
Specifies the return value of the function. For description of the statement, see "RETURN statement" on page 1138.

Notes

Choosing data types for parameters: When you choose the data types of the input and output parameters for your function, consider the rules of promotion that can affect the values of the parameters. (See "Promotion of data types" on page 70). For example, a constant that is one of the input arguments to the function might have a built-in data type that is different from the data type that the function expects, and more significantly, might not be promotable to that expected data type. Based on the rules of promotion, using the following data types for parameters is recommended:
- INTEGER instead of SMALLINT
- DOUBLE instead of REAL
- VARCHAR instead of CHAR
- VARGRAPHIC instead of GRAPHIC

For portability of functions across platforms that are not DB2 UDB for z/OS, do not use the following data types, which might have different representations on different platforms:
- FLOAT. Use DOUBLE or REAL instead.
- NUMERIC. Use DECIMAL instead.

Specifying the encoding scheme for parameters: The implicitly or explicitly specified encoding scheme of all the parameters with a string data type (both input and output parameters) must be the same—either all ASCII or all EBCDIC.

Determining the uniqueness of functions in a schema: At the current server, the function signature of each function, which is the qualified function name combined with the number and data types of the input parameters, must be unique. If the function has more than 30 input parameters, only the data types of the first 30 are used to determine uniqueness. This means that two different schemas can each contain a function with the same name that have the same data types for all of their corresponding data types. However, a single schema must not contain multiple functions with the same name that have the same data types for all of their corresponding data types.

When determining whether corresponding data types match, DB2 does not consider any length, precision, scale, subtype or encoding scheme attributes in the comparison. DB2 considers the synonyms of data types (DECIMAL and NUMERIC, REAL and FLOAT, and DOUBLE and FLOAT) a match. Therefore, CHAR(8) and CHAR(35) are considered to be the same, as are DECIMAL(11,2), DECIMAL(4,3), and NUMERIC(4,2).

Assume that the following statements are executed to create four functions in the same schema. The second and fourth statements fail because they create functions that are duplicates of the functions that the first and third statements created.

```
CREATE FUNCTION PART (A INT, B CHAR(15)) ...
CREATE FUNCTION PART (A INTEGER, B CHAR(40)) ...

CREATE FUNCTION ANGLE (A DECIMAL(12,2)) ...
CREATE FUNCTION ANGLE (A DEC(10,7)) ...
```

Overriding a built-in function: Giving an SQL function the same name as a built-in function is not a recommended practice unless you are trying to change the functionality of the built-in function.

If you do intend to create an SQL function with the same name as a built-in function, be careful to maintain the uniqueness of its function signature. If your function has the same name and data types of the corresponding parameters of the built-in function but implements different logic, DB2 might choose the wrong function when the function is invoked with an unqualified function name. Thus, the application might fail, or perhaps even worse, run successfully but provide an inappropriate result.

Resolution of function invocations: DB2 resolves function invocations inside the body of the function according to the SQL path that is in effect for the CREATE FUNCTION statement. This SQL path does not change after the function is created.

Referencing date and time special registers: If an SQL function contains multiple references to any of the date or time special registers, all references return the same value. Further, this value is the same value returned by the register invocation in the statement that invoked the function.

Self-referencing function: The body of an SQL function (that is, the *expression* or NULL in the RETURN clause of the CREATE FUNCTION statement) cannot contain a recursive invocation of itself or to another function that invokes it, because such a function would not exist to be referenced.

Scrollable cursors specified with user-defined functions: A row can be fetched more than once with a scrollable cursor. Therefore, if a scrollable cursor is defined with a nondeterministic function in the select list of the cursor, a row can be fetched multiple times with different results for each fetch. Similarly, if a scrollable cursor is defined with a user-defined function with external action, the action is executed with every fetch.

Alternative syntax and synonyms: To provide compatibility with previous releases of DB2 or other products in the DB2 UDB family, DB2 supports the following keywords:

- VARIANT as a synonym for NOT DETERMINISTIC
- NOT VARIANT as a synonym for DETERMINISTIC
- NOT NULL CALL as a synonym for RETURNS NULL ON NULL INPUT
- NULL CALL as a synonym for CALLED ON NULL INPUT

Examples

Example 1: Define a scalar function that returns the tangent of a value using existing SIN and COS built-in functions:

```
CREATE FUNCTION TAN (X DOUBLE)
  RETURNS DOUBLE
  LANGUAGE SQL
```

```
CONTAINS SQL
NO EXTERNAL ACTION
DETERMINISTIC
RETURN SIN(X)/COS(X);
```

CREATE GLOBAL TEMPORARY TABLE

The CREATE GLOBAL TEMPORARY TABLE statement creates a description of a temporary table at the current server.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

The privilege set that is defined below must include at least one of the following:
- The CREATETMTAB system privilege
- The CREATETAB database privilege for any database
- DBADM, DBCTRL, or DBMAINT authority for any database
- SYSADM or SYSCTRL authority

Additional privileges might be required when the data type of a column is a distinct type or the LIKE clause is specified. See the description of *distinct-type* and LIKE for the details.

Privilege set: The privilege set is the same as the privilege set for the CREATE TABLE statement. See “Privilege Set” on page 721 for details.

Syntax

```
                                                         ┌─,─────────────────┐
                                                         ▼                   │
►►──CREATE GLOBAL TEMPORARY TABLE──table-name──┬─(───────column-definition───┴──)─┬────────────────►
                                               └─LIKE──┬─table-name─┬────────────┘
                                                       └─view-name──┘

►──┬──────────────────────────┬────────────────────────────────────────────────────────────────►◄
   └─CCSID──┬─ASCII───┬───────┘
            ├─EBCDIC──┤
            └─UNICODE─┘
```

column-definition:

```
►►──column-name──data-type──┬──────────┬───────────────────────────────────────────────────────►◄
                            └─NOT NULL─┘
```

data-type:

```
►►──┬─built-in-type──────┬──────────────────────────────────────────────────►◄
    └─distinct-type-name─┘
```

built-in-type:

```
►►──┬─┬─INTEGER─┬────────────────────────────────────────────┬──────────────►◄
    │ └─INT─────┘                                            │
    ├─SMALLINT───────────────────────────────────────────────┤
    │             ┌─(5,0)─────────────────────┐              │
    ├─┬─DECIMAL─┬─┼───────────────────────────┼──────────────┤
    │ ├─DEC─────┤ └─(integer─┬───────────┬─)─┘               │
    │ └─NUMERIC─┘            └─, integer─┘                   │
    │         ┌─(53)──────┐                                  │
    ├─┬─FLOAT─┼───────────┼─┬────────────────────────────────┤
    │ │       └─(integer)─┘ │                                │
    │ ├─REAL────────────────┤                                │
    │ │          ┌─PRECISION─┐                               │
    │ └─DOUBLE───┴───────────┴┘                              │
    │                  ┌─(1)───────┐                         │
    ├─┬─┬─CHARACTER─┬──┼───────────┼───────────┬─┬─────────────────────┬─┤
    │ │ └─CHAR──────┘  └─(integer)─┘           │ └─FOR─┬─SBCS──┬─DATA─┘ │
    │ └───VARCHAR──────────────────(integer)───┘       ├─MIXED─┤        │
    │     └─┬─CHARACTER─┬──VARYING─┘                   └─BIT───┘        │
    │       └─CHAR──────┘                                               │
    │                 ┌─(1)───────┐                                     │
    ├─┬───GRAPHIC─────┼───────────┼─┬───────────────────────────────────┤
    │ │               └─(integer)─┘ │                                   │
    │ └───VARGRAPHIC────(integer)───┘                                   │
    ├─DATE──────────────────────────────────────────────────────────────┤
    ├─TIME──────────────────────────────────────────────────────────────┤
    └─TIMESTAMP─────────────────────────────────────────────────────────┘
```

Description

table-name
Names the temporary table. The name, including the implicit or explicit qualifier, must not identify a table, view, alias, synonym, or temporary table that exists at the database server.

The qualification rules for *table-name* are the same as for *table-name* in the CREATE TABLE statement.

The owner acquires ALL PRIVILEGES on the table WITH GRANT OPTION and the authority to drop the table.

column-definition
Defines the attributes of a column for each instance of the table. The number of columns defined must not exceed 750. The maximum record size must not exceed 32714 bytes. The maximum row size must not exceed 32706 bytes (8 bytes less than the maximum record size).

column-name
Names the column. The name must not be qualified and must not be the same as the name of another column in the table.

data-type
Specifies the data type of the column. The data type can be a built-in data type or a distinct type.

built-in-type
Any built-in data type that can be specified for the CREATE TABLE statement with the exception that you cannot define a temporary table with a LOB or ROWID column.

For more information on and the rules that apply to the data types, see “built-in-type” on page 741.

distinct-type
Any distinct type except one that is based on a LOB or ROWID data type. The privilege set must implicitly or explicitly include the USAGE privilege on the distinct type.

NOT NULL
Specifies that the column cannot contain nulls. Omission of NOT NULL indicates that the column can contain nulls.

LIKE *table-name* **or** *view-name*
Specifies that the columns of the table have exactly the same name and description as the columns of the identified table or view. The name specified after LIKE must identify a table, view, or temporary table that exists at the current server. The privilege set must implicitly or explicitly include the SELECT privilege on the identified table or view.

This clause is similar to the LIKE clause on CREATE TABLE, but it has the following differences:

- If any column of the identified table or view has an attribute value that is not allowed for a column in a temporary table, that attribute value is ignored. The corresponding column in the new temporary table has the default value for that attribute unless otherwise indicated.

  For example, if a table with a security label column is identified in the LIKE clause, the corresponding column of the new table inherits only the data type of the security label column; none of the security label column attributes are inherited.
- If any column of the identified table or view allows a default value other than null, that default value is ignored and the corresponding column in the new temporary table has no default value. A default value other than null is not allowed for any column in a temporary table.

CCSID *encoding-scheme*
Specifies the encoding scheme for string data stored in the table.

ASCII Specifies that the data must be encoded by using the ASCII CCSIDs of the server.

An error occurs if a valid ASCII CCSID has not been specified for the installation.

EBCDIC
Specifies that data must be encoded by using the EBCDIC CCSIDs of the server.

An error occurs if a valid EBCDIC CCSID has not been specified for the installation.

UNICODE

Specifies that data must be encoded by using the CCSIDs of the server for Unicode.

An error occurs if a valid CCSID for Unicode has not been specified for the installation.

Usually, each encoding scheme requires only a single CCSID. Additional CCSIDs are needed when mixed, graphic, or Unicode data is used. An error occurs if CCSIDs have not been defined.

For the creation of temporary tables, the CCSID clause can be specified whether or not the LIKE clause is specified. If the CCSID clause is specified, the encoding scheme of the new table is the scheme that is specified in the CCSID clause. If the CCSID clause is not specified, the encoding scheme of the new table is the same as the scheme for the table specified in the LIKE clause.

Notes

Instantiation and termination: Let T be a temporary table defined at the current server and let P denote an application process:

- An empty instance of T is created as a result of the first implicit or explicit reference to T in an OPEN, SELECT INTO, INSERT, or DELETE operation that is executed by any program in P.
- Any program in P can reference T and any reference to T by a program in P is a reference to that instance of T.

  When a commit operation terminates a unit of work in P and no program in P has an open WITH HOLD cursor that is dependent on T, the commit includes the operation DELETE FROM T.
- When a rollback operation terminates a unit of work in P, the rollback includes the operation DELETE FROM T.
- When the connection to the database server at which an instance of T was created terminates, the instance of T is destroyed. However, the definition of T remains. A DROP TABLE statement must be executed to drop the definition of T.

Restrictions and extensions: Let T denote a temporary table:

- Columns of T cannot have default values other than null.
- A column of T cannot have a LOB or ROWID data type (or a distinct type based on one).
- T cannot have unique constraints, referential constraints, or check constraints.
- T cannot be defined as the parent in a referential constraint.
- T cannot be referenced in:
  - A CREATE INDEX statement.
  - A LOCK TABLE statement.
  - As the object of an UPDATE statement in which the object is T or a view of T. However, you can reference T in the WHERE clause of an UPDATE statement.
  - DB2 utility commands.
- As with all tables stored in a work file, query parallelism cannot be considered for any query that references T.

- If T is referenced in the *subselect* of a CREATE VIEW statement, you cannot specify a WITH CHECK OPTION clause in the CREATE VIEW statement.
- ALTER TABLE T is valid only if the statement is used to add a column to T. Any column that you add to T must have a default value of null.

  When you alter T, any plans and packages that refer to the table are invalidated, and DB2 automatically rebinds the plans and packages the next time they are run.
- DELETE FROM T or a *view of T* is valid only if the statement does not include a WHERE or WHERE CURRENT OF clause. In addition, DELETE FROM *view of T* is valid only if the view was created (CREATE VIEW) without the WHERE clause. A DELETE FROM statement deletes all the rows from the table or view.
- You can refer to T in the FROM clause of any subselect. If you refer to T in the first FROM clause of a select-statement, you cannot specify a FOR UPDATE clause.
- You cannot use a DROP DATABASE statement to implicitly drop T. To drop T, reference T in a DROP TABLE statement.
- A temporary table instantiated by an SQL statement using a three-part table name can be accessed by another SQL statement using the same name in the same application process for as long as the DB2 connection which established the instantiation is not terminated.
- GRANT ALL PRIVILEGES ON T is valid, but you cannot grant specific privileges on T.

  Of the ALL privileges, only the ALTER, INSERT, DELETE, and SELECT privileges can actually be used on T.
- REVOKE ALL PRIVILEGES ON T is valid, but you cannot revoke specific privileges from T.
- A COMMIT operation deletes all rows of every temporary table of the application process, but the rows of T are not deleted if any program in the application process has an open WITH HOLD cursor that is dependent on T. In addition, if RELEASE(COMMIT) is in effect and no open WITH HOLD cursors are dependent on T, all logical work files for T are also deleted.
- A ROLLBACK operation deletes all rows and all logical work files of every temporary table of the application process.
- You can reuse threads when using a temporary table, and a logical work file for a temporary table name remains available until deallocation. A new logical work file is not allocated for that temporary table name when the thread is reused.
- You can refer to T in the following statements:

  ALTER FUNCTION
  ALTER PROCEDURE
  COMMENT
  CREATE ALIAS
  CREATE FUNCTION
  CREATE PROCEDURE
  CREATE SYNONYM
  CREATE TABLE LIKE
  CREATE VIEW
  DESCRIBE TABLE
  DECLARE TABLE
  DROP TABLE
  INSERT
  LABEL
  SELECT INTO

Alternative syntax and synonyms: For compatibility with previous releases of DB2, you can specify LONG VARCHAR as a synonym for VARCHAR(*integer*) and LONG VARGRAPHIC as a synonym for VARGRAPHIC(*integer*) when defining the data type of a column. However, the use of these synonyms is not encouraged because after the statement is processed, DB2 considers a LONG VARCHAR column to be VARCHAR and a LONG VARGRAPHIC column to be VARGRAPHIC.

Examples

Example 1: Create a temporary table, CURRENTMAP. Name two columns, CODE and MEANING, both of which cannot contain nulls. CODE contains numeric data and MEANING has character data. Assuming a value of NO for the field MIXED DATA on installation panel DSNTIPF, column MEANING has a subtype of SBCS:

```
CREATE GLOBAL TEMPORARY TABLE CURRENTMAP
     (CODE INTEGER NOT NULL, MEANING VARCHAR(254) NOT NULL);
```

Example 2: Create a temporary table, EMP:

```
CREATE GLOBAL TEMPORARY TABLE EMP
     (TMPDEPTNO   CHAR(3)     NOT NULL,
      TMPDEPTNAME VARCHAR(36) NOT NULL,
      TMPMGRNO    CHAR(6)             ,
      TMPLOCATION CHAR(16)            );
```

CREATE INDEX

The CREATE INDEX statement creates a partitioning index or a secondary index and an index space at the current server. The columns included in the key of the index are columns of a table at the current server.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

The privilege set that is defined below must include at least one of the following:

- The INDEX privilege on the table
- Ownership of the table
- DBADM authority for the database that contains the table
- SYSADM or SYSCTRL authority

Additional privileges might be required, as explained in the description of the BUFFERPOOL and USING STOGROUP clauses.

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package. If the specified index name includes a qualifier that is not the same as this authorization ID, the privilege set must include SYSADM or SYSCTRL authority, or DBADM or DBCTRL authority for the database.

If the statement is dynamically prepared, the privilege set is the privileges that are held by the SQL authorization ID of the process. However, if the specified index name includes a qualifier that is not the same as this authorization ID, the following rules apply:

- If the privilege set includes SYSADM or SYSCTRL authority, or DBADM or DBCTRL authority for the database, any qualifier is valid.
- If the privilege set includes none of these authorities, the qualifier is valid only if it is the same as one of the authorization IDs of the process and the privilege set that are held by that authorization ID includes all privileges needed to create the index. This is an exception to the rule that the privilege set is the privileges that are held by the SQL authorization ID of the process.

Syntax

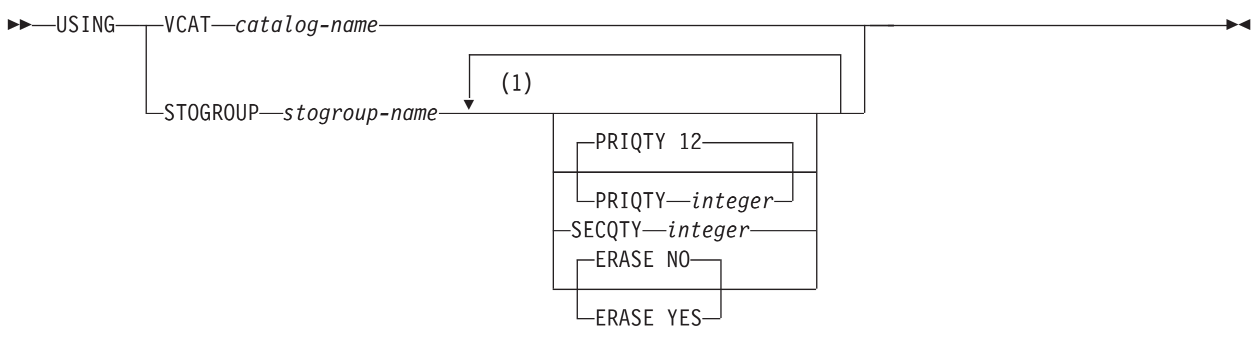
```
►►──CREATE──┬──────────────────────────┬──INDEX──index-name──ON──────────────────────────►
            └─UNIQUE──┬──────────────┬─┘
                      └─WHERE NOT NULL─┘

            ┌─,─────────────────────┐            ┌──────────────────────────────┐
            ▼             ┌─ASC──┐  │            ▼   (1)                        │
►──┬─table-name──(────column-name─┼──────┼──┴──)──┬──┬──────────────────────┬───┴────────►
   │                              └─DESC─┘        │  │ ┌─NOT CLUSTER─┐      │
   └─aux-table-name───────────────────────────────┘  ├─┴─CLUSTER─────┴──────┤
                                                      ├─PARTITIONED──────────┤
                                                      │ ┌─NOT PADDED─┐ (2)  │
                                                      ├─┴─PADDED─────┴──────┤
                                                      ├─using-block──────────┤
                                                      ├─free-block───────────┤
                                                      ├─gbpcache-block───────┤
                                                      │ ┌─DEFINE YES─┐      │
                                                      └─┴─DEFINE NO──┴──────┘

►──┬───────────────────────────────────────────────────────────────────────────┬────────►
   │                              ┌─,───────────────────────────────────────┐  │
   │                              │                ┌─────────────────────┐  │  │
   │             ┌─RANGE─┐        ▼                ▼   (1)               │  │  │
   └─PARTITION BY─┴───────┴──(────partition-element───┬──────────────────┬─┴──┴──)─┘
                                                      ├─using-block──────┤
                                                      ├─free-block───────┤
                                                      └─gbpcache-block───┘

   ┌─────────────────────────────────┐
   ▼   (1)                           │
►──┬─────────────────────────────┬───┴───────────────────────────────────────────────►◄
   ├─BUFFERPOOL──bpname──────────┤
   │ ┌─CLOSE YES─┐               │
   ├─┴─CLOSE NO──┴───────────────┤
   │ ┌─DEFER NO──┐               │
   ├─┴─DEFER YES─┴───────────────┤
   ├─PIECESIZE──integer──┬─K─┬───┤
   │                     ├─M─┤   │
   │                     └─G─┘   │
   │ ┌─COPY NO──┐                │
   └─┴─COPY YES─┴────────────────┘
```

Notes:

1 The same clause must not be specified more than once.

2 The value of field PAD INDEXES BY DEFAULT (on installation panel DSNTIPE) determines the default. When the value is NO, NOT PADDED is the default. When the value is YES, PADDED is the default. For more information, see the description of the PADDED or NOT PADDED options.

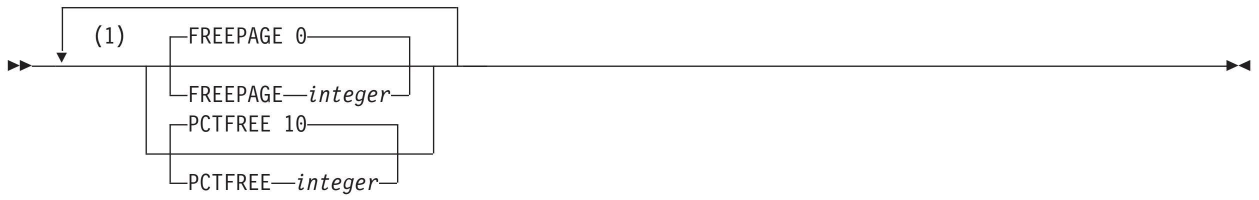
using-block:



Notes:

1 The same clause must not be specified more than once.

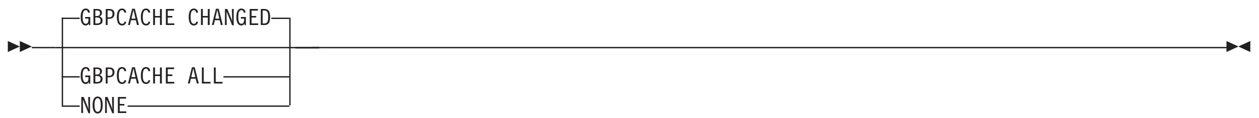
free-block:



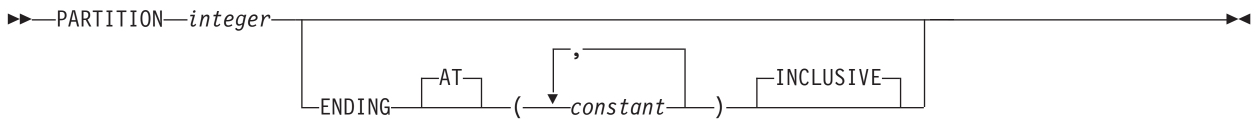
Notes:

1 The same clause must not be specified more than once.

gbpcache-block:



partition-element:



Description

UNIQUE
Prevents the table from containing two or more rows with the same value of the

index key. If any column of the key can contain null values, the meaning of “the same value” is determined by the use or omission of the option WHERE NOT NULL:

- If WHERE NOT NULL is omitted, any two null values are taken to be equal. For example, if the key is a single column, that column can contain no more than one null value.
- If WHERE NOT NULL is used, any two null values are taken to be unequal. If the key is a single column, that column can contain any number of null values, though its other values must be unique.

Unless DEFER YES is specified, the uniqueness constraint is also checked during the execution of the CREATE INDEX statement. If the table already contains rows with duplicate key values, the index is not created. Refer to Part 2 of *DB2 Application Programming and SQL Guide* for more information about using the REBUILD INDEX utility when duplicate keys exist for an index defined with UNIQUE and DEFER YES.

A table requires a unique index if you use the UNIQUE or PRIMARY KEY clause in the CREATE TABLE statement. DB2 implicitly creates those unique indexes if the CREATE TABLE statement is processed by the schema processor; otherwise, you must explicitly create them. If any of the unique indexes that must be explicitly defined do not exist, the definition of the table is incomplete, and the following rules apply:

- Let K denote a key for which a required unique index does not exist and let *n* denote the number of unique indexes that remain to be created before the definition of the table is complete. (For a new table that has no indexes, K is its primary key or any of the keys defined in the CREATE TABLE statement as UNIQUE and *n* is the number of such keys. After the definition of a table is complete, an index cannot be dropped if it is enforcing a primary key or unique key.)
- The creation of the unique index reduces *n* by one if the index key is identical to K. The keys are identical only if they have the same columns in the same order.
- If *n* is now zero, the creation of the index completes the definition of the table.
- If K is a primary key, the description of the index indicates that it is a primary index. If K is not a primary key, the description of the index indicates that it enforces the uniqueness of a key defined as UNIQUE in the CREATE TABLE statement.

A table also requires a unique index if there is a ROWID column that is defined as GENERATED BY DEFAULT.

| A unique index cannot be created on a materialized query table.

INDEX *index-name*

Names the index. The name must not identify an index that exists at the current server.

The associated index space also has a name. That name appears as a qualifier in the names of data sets defined for the index. If the data sets are managed by the user, the name is the same as the second (or only) part of *index-name*. If this identifier consists of more than eight characters, only the first eight are used. The name of the index space must be unique among the names of the index spaces and table spaces of the database for the identified table. If the data sets are defined by DB2, then DB2 derives a unique name.

The qualification rules for an index name depend on the type of table as follows:

- *Index on a base table, materialized query table, or auxiliary table.* If the index name is unqualified and the statement is embedded in an application program, the owner of the index is the authorization ID that serves as the implicit qualifier for unqualified object names. This is the authorization ID in the QUALIFIER operand when the plan or package was created or last rebound. If QUALIFIER was not used, the owner of the index is the owner of the package or plan.

  If the index name is unqualified and the statement is dynamically prepared, the SQL authorization ID is the owner of the index.
- *Index on a declared temporary table.* The qualifier, if explicitly specified, must be SESSION. If the index name is unqualified, DB2 uses SESSION as the implicit qualifier.

ON *table-name* or *aux-table-name*

Identifies the table on which the index is created. The name can identify a base table, a materialized query table, a declared temporary table, or an auxiliary table.

table-name

Identifies the base table, materialized query table, or declared temporary table on which the index is created. The name must identify a table that exists at the current server. (The name of a declared temporary table must be qualified with SESSION.) The name must not identify a created temporary table.

column-name,**...**

Specifies the columns of the index key.

Each *column-name* must identify a column of the table. Do not specify more than 64 columns, the same column more than once, or a LOB column (or a column with a distinct type that is based on a LOB data type). Do not qualify *column-name*.

| The sum of the length attributes of the columns must not be greater
| than the following limits, where *n* is the number of columns that can
| contain null values and *m* is the number of varying-length columns in
| the key:

| - 2000 - *n* for a padded, nonpartitioning index
| - 2000 - *n* - *2m* for a nonpadded, nonpartitioning index
| - 255 - *n* for a partitioning index (padded or nonpadded)

ASC Puts the index entries in ascending order by the column. ASC is the default.

DESC Puts the index entries in descending order by the column.

aux-table-name

Identifies the auxiliary table on which the index is created. The name must identify an auxiliary table that exists at the current server. If the auxiliary table already has an index, do not create another one. An auxiliary table can only have one index.

Do not specify any columns for the index key. The key value is implicitly defined as a unique 19-byte value that is system generated.

If qualified, *table-name* or *aux-table-name* can be a two-part or three-part name. If a three-part name is used, the first part must match the value of the field DB2 LOCATION NAME of installation panel DSNTIPR at the current server. (If the current server is not the local DB2, this name is not necessarily the name in the CURRENT SERVER special register.) Whether the name is two-part or three-part, the authorization ID that qualifies the name is the owner of the index.

The table space that contains the named table must be available to DB2 so that its data sets can be opened. If the table space is EA-enabled, the data sets for the index must be defined to belong to a DFSMS data class that has the extended format and addressability attributes.

CLUSTER or NOT CLUSTER
Specifies whether the index is the clustering index for the table.

CLUSTER
The index is to be used as the clustering index of the table. Do not specify CLUSTER for an index on an auxiliary table.

NOT CLUSTER
The index is not to be used as the clustering index of the table.

PARTITIONED
Specifies that the index is data partitioned (that is, partitioned according to the partitioning scheme of the underlying data). A partitioned index can be created only on a partitioned table space. The types of partitioned indexes are partitioning and secondary.

An index is considered a partitioning index if the specified index key columns match or comprise a superset of the columns specified in the partitioning key, are in the same order, and have the same ascending or descending attributes.

If PARTITION BY was not specified when the table was created, the CREATE INDEX statement must have the ENDING AT clause specified to define a partitioning index and use index-controlled partitioning. This index is created as a partitioned index even if the PARTITIONED keyword is not specified. When a partitioning index is created, if both the PARTITIONED and ENDING AT keywords are omitted, the index will be nonpartitioned. If PARTITIONED is specified, the USING block with PRIQTY and SECQTY specifications are optional. If these space parameters are not specified, default values are used.

A secondary index is any index defined on a partitioned table space that does not meet the definition of the partitioning index. For partitioned secondary indexes (data-partitioned secondary indexes), the ENDING AT clause is not allowed because the partitioning scheme of the index is predetermined by that of the underlying data. UNIQUE and UNIQUE WHERE NOT NULL are also not allowed. If a partitioned secondary index is created on a table that uses index-controlled partitioning, the table is converted to use table-controlled partitioning.

NOT PADDED or PADDED
Specifies how varying-length string columns are to be stored in the index. If the index contains no varying-length columns, this option is ignored, and a warning message is returned. Indexes that do not have varying-length string columns are always created as physically padded indexes.

NOT PADDED
Specifies that varying-length string columns are not to be padded to their maximum length in the index. The length information for a varying-length column is stored with the key.

NOT PADDED is ignored and has no effect if the index is being created on an auxiliary table. Indexes on auxiliary tables are always padded.

PADDED
Specifies that varying-length string columns within the index are always padded with the default pad character to their maximum length.

When the index contains at least one varying-length column, the default for the option depends on the value of field PAD INDEXES BY DEFAULT on installation panel DSNTIPE:

- When the value of this field is NO, which is the default for sites that newly installed Version 8, new indexes are not padded unless PADDED is specified.
- When the value of this field is YES, which is the default value for sites that migrated to Version 8, new indexes are padded unless NOT PADDED is specified.

using-block

The components of the USING clause are discussed below, first for nonpartitioned indexes and then for partitioned indexes.

Using clause for nonpartitioned indexes
For nonpartitioned indexes, the USING clause indicates whether the data sets for the index are to be managed by the user or managed by DB2. If DB2 definition is specified, the clause also gives space allocation parameters (PRIQTY and SECQTY) and an erase rule (ERASE).

If you omit USING, the data sets will be managed by DB2 on volumes listed in the default storage group of the table's database. That default storage group must exist. With no USING clause, PRIQTY, SECQTY, and ERASE assume their default values.

VCAT *catalog-name*
Specifies that the first data set for the index is managed by the user, and that following data sets, if needed, are also managed by the user.

The data sets defined for the index are linear VSAM data sets cataloged in an integrated catalog facility catalog identified by *catalog-name*. An alias[28] must be used if *catalog-name* is longer than eight characters.

Conventions for index data set names are given in Part 2 (Volume 1) of *DB2 Administration Guide*. *catalog-name* is the first qualifier for each data set name.

One or more DB2 subsystems could share integrated catalog facility catalogs with the current server. To avoid the chance of having one of those subsystems attempt to assign the same name to different data sets, select a value for *catalog-name* that is not used by the other DB2 subsystems.

STOGROUP *stogroup-name*
Specifies that DB2 will define and manage the data sets for the index. Each data set will be defined on a volume listed in the identified storage group. The values specified (or the defaults) for PRIQTY and SECQTY determine the primary and secondary allocations for the data set. If

[28] The alias of an integrated catalog facility catalog

PRIQTY+118×SECQTY is 2 gigabytes or greater, more than one data set could eventually be used, but only the first is defined during execution of this statement.

To use USING STOGROUP, the privilege set must include SYSADM authority, SYSCTRL authority, or the USE privilege for that storage group. Moreover, *stogroup-name* must identify a storage group that exists at the current server and includes in its description at least one volume serial number. The description can indicate that the choice of volumes will be left to Storage Management Subsystem (SMS). Each volume specified in the storage group must be accessible to z/OS for dynamic allocation of the data set, and all these volumes must be of the same device type.

The integrated catalog facility catalog used for the storage group must ***not*** contain an entry for the first data set of the index. If the catalog is password protected, the description of the storage group must include a valid password.

The storage group supplies the data set name. The first level qualifier is also the name of, or an alias[28] for, the integrated catalog facility catalog on which the data set is to be cataloged. The naming convention for the data set is the same as if the data set is managed by the user.

PRIQTY *integer*

Specifies the minimum primary space allocation for a DB2-managed data set. When you specify PRIQTY (with a value other than -1), the primary space allocation is at least *n* kilobytes, where *n* is:

12	If *integer* is less than 12
integer	If *integer* is between 12 and 4194304
4194304	If *integer* is greater than 4194304

If you do not specify PRIQTY or specify PRIQTY -1, DB2 uses a default value for the primary space allocation; for information on how DB2 determines the default value, see “Rules for primary and secondary space allocation” on page 788.

If you specify PRIQTY and do not specify a value of -1, DB2 specifies the primary space allocation to access method services using the smallest multiple of 4KB not less than *n*. The allocated space can be greater than the amount of space requested by DB2. For example, it could be the smallest number of tracks that will accommodate the space requested. To more closely estimate the actual amount of storage, see the description of the DEFINE CLUSTER command in *DFSMS/MVS: Access Method Services for the Integrated Catalog*.

When determining a suitable value for PRIQTY, be aware that two of the pages of the primary space are used by DB2 for purposes other than storing index entries.

SECQTY *integer*

Specifies the minimum secondary space allocation for a DB2-managed data set. If you do not specify SECQTY, DB2 uses a formula to determine a value. For information on the actual value that is used for secondary space allocation, whether you specify a value or not, see “Rules for primary and secondary space allocation” on page 788.

If you specify SECQTY and do not specify a value of -1, DB2 specifies the secondary space allocation to access method services using the smallest multiple of 4KB not less than *n*. The allocated space can be greater than the amount of space requested by DB2. For example, it could be the smallest number of tracks that will accommodate the space requested. To more closely estimate the actual amount of storage, see the description of the DEFINE CLUSTER command in *DFSMS/MVS: Access Method Services for the Integrated Catalog*.

ERASE

Indicates whether the DB2-managed data sets are to be erased when they are deleted during the execution of a utility or an SQL statement that drops the index. Refer to *DFSMS/MVS: Access Method Services for the Integrated Catalog* for more information.

NO

Does not erase the data sets. Operations involving data set deletion will perform better than ERASE YES. However, the data is still accessible, though not through DB2. This is the default.

YES

Erases the data sets. As a security measure, DB2 overwrites all data in the data sets with zeros before they are deleted.

USING clause for partitioned indexes:

If the index is partitioned, there is a PARTITION clause for each partition. Within a PARTITION clause, a USING clause is optional. If a USING clause is present, it applies to that partition in the same way that a USING clause for a secondary index applies to the entire index.

When a USING block is absent from a PARTITION clause, the USING clause parameters for the partition depend on whether a USING clause is specified before the PART clauses.

- If the USING clause is specified, it applies to every PARTITION clause that does not include a USING clause.
- If the USING clause is not specified, the following defaults apply to the partition:
  - Data sets are managed by DB2
  - The default storage group for the database is used
  - A value of 12 is used for PRIQTY and SECQTY
  - A value of NO is used for ERASE

VCAT *catalog-name*

Specifies a user-managed data set with a name that starts with the specified catalog name. You must specify an alias[28] if the name of the integrated catalog facility catalog is longer than eight characters.

If *n* is the number of the partition, the identified integrated catalog facility catalog must already contain an entry for the *n*th data set of the index, conforming to the DB2 naming convention for data sets set forth in Part 2 (Volume 1) of *DB2 Administration Guide*.

One or more DB2 subsystems could share integrated catalog facility catalogs with the current server. To avoid the chance of having one of those subsystems attempt to assign the same name to different data sets, select a value for *catalog-name* that is not used by the other DB2 subsystems.

DB2 assumes one and only one data set for each partition.

Do not specify VCAT for an index on a declared temporary table.

STOGROUP *stogroup-name*

If USING STOGROUP is used, explicitly or by default, for a partition *n*, DB2 defines the data set for the partition during the execution of the CREATE

INDEX statement, using space from the named storage group. The privilege set must include SYSADM authority, SYSCTRL authority, or the USE privilege for that storage group. The integrated catalog facility catalog used for the storage group must NOT contain an entry for the *n*th data set of the index.

stogroup-name must identify a storage group that exists at the current server and the privilege set must include SYSADM authority, SYSCTRL authority, or the USE privilege for the storage group.

If you omit PRIQTY, SECQTY, or ERASE from a USING STOGROUP clause for some partition, their values are given by the next USING STOGROUP clause that governs that partition: either a USING clause that is not in any PARTITION clause, or a default USING clause. DB2 assumes one and only one data set for each partition.

End of using-block

free-block

FREEPAGE *integer*
Specifies how often to leave a page of free space when index entries are created as the result of executing a DB2 utility or when creating an index for a table with existing rows. One free page is left for every *integer* pages. The value of *integer* can range from 0 to 255. The default is 0, leaving no free pages.

Do not specify FREEPAGE for an index on a declared temporary table.

PCTFREE *integer*
Determines the percentage of free space to leave in each nonleaf page and leaf page when entries are added to the index or index partition as the result of executing a DB2 utility or when creating an index for a table with existing rows. The first entry in a page is loaded without restriction. When additional entries are placed in a nonleaf or leaf page, the percentage of free space is at least as great as *integer*.

The value of *integer* can range from 0 to 99, however, if a value greater than 10 is specified, only 10 percent of free space will be left in nonleaf pages. The default is 10.

Do not specify PCTFREE for an index on a declared temporary table.

If the index is partitioned, the values of FREEPAGE and PCTFREE for a particular partition are given by the first of these choices that applies:

- The values of FREEPAGE and PCTFREE given in the PARTITION clause for that partition. Do not use more than one *free-block* in any PARTITION clause.
- The values given in a *free-block* that is not in any PARTITION clause.
- The default values FREEPAGE 0 and PCTFREE 10.

End of free-block

gbpcache-block

GBPCACHE
In a data sharing environment, specifies what index pages are written to the

group buffer pool. In a non-data-sharing environment, the option is ignored unless the index is on a declared temporary table. Do not specify GBPCAHCE for an index on a declared temporary table in either environment (data sharing or non-data-sharing).

CHANGED

When there is inter-DB2 R/W interest on the index or partition, updated pages are written to the group buffer pool. When there is no inter-DB2 R/W interest, the group buffer pool is not used. Inter-DB2 R/W interest exists when more than one member in the data sharing group has the index or partition open, and at least one member has it open for update. GBPCACHE CHANGED is the default.

If the index is in a group buffer pool that is defined as GBPCACHE(NO), CHANGED is ignored and no pages are cached to the group buffer pool.

ALL

Indicates that pages are to be cached in the group buffer pool as they are read in from DASD.

Exception: In the case of a single updating DB2 when no other DB2s have any interest in the page set, no pages are cached in the group buffer pool.

If the index is in a group buffer pool that is defined as GBPCACHE(NO), ALL is ignored and no pages are cached to the group buffer pool.

NONE

Indicates that no pages are to be cached to the group buffer pool. DB2 uses the group buffer pool only for cross-invalidation.

If the index is partitioned, the value of GBPCACHE for a particular partition is given by the first of these choices that applies:

1. The value of GBPCACHE given in the PARTITION clause for that partition. Do not use more than one *gbpcache-block* in any PARTITION clause.
2. The value given in a *gbpcache-block* that is not in any PARTITION clause.
3. The default value is CHANGED.

End of gbpcache-block

DEFINE

Specifies when the underlying data sets for the index are physically created.

YES

The data sets are created when the index is created (the CREATE INDEX statement is executed). YES is the default.

NO

The data sets are not created until data is inserted into the index. DEFINE NO is applicable only for DB2-managed data sets (USING STOGROUP is specified). DEFINE NO is ignored for user-managed data sets (USING VCAT is specified). DB2 uses the SPACE column in catalog table SYSINDEXPART to record the status of the data sets (undefined or allocated). DEFINE NO is also ignored if the index is being created on a table that is not empty, or on an auxiliary table.

Do not specify DEFINE NO for an index on a declared temporary table. Do not use DEFINE NO on an index if you use a program outside of DB2 to propagate data into a table on which that index is defined. The DB2 catalog stores information about whether the data sets for an index space have been allocated. If you use DEFINE NO on an index of a table and data is then propagated into the table from a program that is outside of DB2, the index space data sets are allocated, but the DB2 catalog will not reflect this fact. As a result, DB2 acts as if the data sets for the index space have not yet been allocated. The resulting inconsistency causes DB2 to deny application programs access to the data until the inconsistency is resolved.

Use DEFINE NO especially when performance of the CREATE INDEX statement is important or DASD resource is constrained.

PARTITION BY RANGE

Specifies the partitioning index for the table, which determines the partitioning scheme for the data in the table.

partition-element

Specifies the range for each partition.

PARTITION *integer*

A PARTITION clause specifies the highest value of the index key in one partition of a partitioning index. In this context, highest means highest in the sorting sequences of the index columns. In a column defined as *ascending* (ASC), highest and lowest have their usual meanings. In a column defined as *descending* (DESC), the lowest actual value is highest in the sorting sequence.

If you use CLUSTER, and the table is contained in a partitioned table space, you must use exactly one PARTITION clause for each partition (defined with NUMPARTS on CREATE TABLESPACE). If there are *p* partitions, the value of *integer* must range from 1 through *p*.

The length of the highest value of a partition (also called the limit key) is the same as the length of the partitioning index.

ENDING AT(*constant,...***)**

Specifies that this is the partitioning index and indicates how the data will be partitioned. The table space is marked complete after this partitioning index is created. You must use at least one constant after ENDING AT in each PARTITION clause. You can use as many as there are columns in the key. The concatenation of all the constants is the highest value of the key in the corresponding partition of the index unless the VALUES statement was already specified when the table or previous index was created.

The use of the constants to define key values is subject to these rules:

- The first constant corresponds to the first column of the key, the second constant to the second column, and so on. Each constant must conform to the rules for assigning that value to the column. A hexadecimal string constant (GX) cannot be specified.
- If a key includes a ROWID column (or a column with a distinct type that is based on a ROWID data type), only the first 17 bytes of the constant that is specified for the corresponding ROWID column are considered.
- The precision and scale of a decimal constant must not be greater than the precision and scale of its corresponding column.
- If a string constant is longer or shorter than required by the length attribute of its column, the constant is either truncated or padded on the right to the required length. If the column is ascending, the padding character is X'FF'; if the column is descending, the padding character is X'00'.

- Using fewer constants than there are columns in the key has the same effect as using the highest possible values for all omitted columns.
- The highest value of the key in any partition must be lower than the highest value of the key in the next partition.
- The combination of the number of table space partitions and the corresponding limit key size cannot exceed the number of partitions * (106 + limit key size in bytes) <65394.
- If the key exceeds 255 bytes, only the first 255 bytes are considered.
- The highest value of the key in the last partition depends on the type of table space. For table spaces that are not large partitioned table spaces, the constants you specify after ENDING AT are not enforced. The highest value of the key that can be placed in the table is the highest possible value of the key.

  For large partitioned table space, the constants you specify are enforced. The value specified for the last partition is the highest value of the key that can be placed in the table. Any key values greater than the value specified for the last partition are out of range.

When you define a table space with DSSIZE, you automatically give the same size to all indexes that point to that table space.

ENDING AT can be specified only if the ENDING AT clause was not specified on a previous CREATE or ALTER TABLE statement for the underlying table.

INCLUSIVE
Specifies that the specified range values are included in the data partition.

BUFFERPOOL *bpname*
Identifies the buffer pool to be used for the index. The *bpname* must identify an activated 4KB buffer pool and the privilege set must include SYSADM or SYSCTRL authority or the USE privilege for the buffer pool.

The default is the default buffer pool for indexes in the database.

See “Naming conventions” on page 40 for more details about *bpname*. See Chapter 2 of *DB2 Command Reference* for a description of active and inactive buffer pools.

CLOSE
Specifies whether or not the data set is eligible to be closed when the index is not being used and the limit on the number of open data sets is reached.

YES
Eligible for closing. This is the default unless the index is on a declared temporary table.

NO
Not eligible for closing.

If DSMAX is reached and there are no CLOSE YES page sets to close, CLOSE NO page sets will be closed.

For an index on a declared temporary table, DB2 uses CLOSE NO regardless of the value specified.

DEFER

Indicates whether the index is built during the execution of the CREATE INDEX statement. Regardless of the option specified, the description of the index and its index space is added to the catalog. If the table is empty and DEFER YES is specified, the index is neither built nor placed in a rebuild pending status. Refer to Part 2 (Volume 1) of *DB2 Administration Guide* for more information about using DEFER. Do not specify DEFER for an index on a declared temporary table or an auxiliary table.

NO

The index is built. This is the default.

YES

The index is not built. If the table is populated, the index is placed in a rebuild pending status and a warning message is issued; the index must be rebuilt by the REBUILD INDEX utility.

PIECESIZE *integer*

Specifies the maximum addressability of each piece (data set) for a secondary index. The subsequent keyword K, M, or G, indicates the units of the value specified in *integer*.

K Indicates that the *integer* value is to be multiplied by 1 024 to specify the maximum piece size in bytes. The integer must be a power of two between 254 and 67 108 864.

M Indicates that the *integer* value is to be multiplied by 1 048 576 to specify the maximum piece size in bytes. The integer must be a power of two between 1 and 65 536.

G Indicates that the *integer* value is to be multiplied by 1 073 741 824 to specify the maximum piece size in bytes. The integer must be a power of two between 1 and 64.

Table 63 on page 687 shows the valid values for piece size, which depend on the size of the table space.

Table 63. Valid values of PIECESIZE clause

K units	M units	G units	Size attribute of table space
254 K	-	-	-
512 K	-	-	-
1024 K	1 M	-	-
2048 K	2 M	-	-
4096 K	4 M	-	-
8192 K	8 M	-	-
16384 K	16 M	-	-
32768 K	32 M	-	-
65536 K	64 M	-	-
131072 K	128 M	-	-
262144 K	256 M	-	-
524288 K	512 M	-	-
1048576 K	1024 M	1 G	-
2097152 K	2048 M	2 G	-
4194304 K	4096 M	4 G	LARGE, DSSIZE 4 G (or greater)
8388608 K	8192 M	8 G	DSSIZE 8 G (or greater)
16777216 K	16384 M	16 G	DSSIZE 16 G (or greater)
33554432 K	32768 M	32 G	DSSIZE 32 G (or greater)
67108864 K	65536 M	64 G	DSSIZE 64 G

As only a specification of the maximum amount of data that a piece can hold and not the actual allocation of storage, PIECESIZE has no effect on primary and secondary space allocation.

The default for piece size is 2 G (2 GB) for indexes that are backed by table spaces that were created without the LARGE or DSSIZE option, and 4 G (4 GB) for indexes that are backed by table spaces that were created with the LARGE or DSSIZE option. For auxiliary indexes, the default is 4 G (4 GB).

Later, if you change the PIECESIZE value with the ALTER INDEX statement, be aware of the effect on the index, which is put into REBUILD-pending status.

COPY

Indicates whether the COPY utility is allowed for the index. Do not specify COPY for an index on a declared temporary table.

NO

Does not allows full image or concurrent copies or the use of the RECOVER utility on the index. NO is the default.

YES

Allows full image or concurrent copies and the use of the RECOVER utility on the index.

Notes

If DEFER NO is implicitly or explicitly specified, the CREATE INDEX statement cannot be executed while a DB2 utility has control of the table space that contains the identified table.

If the identified table already contains data and if the index build is not deferred, CREATE INDEX creates the index entries for it. If the table does not yet contain data, CREATE INDEX creates a description of the index; the index entries are created when data is inserted into the table.

There are no restrictions on the use of ASC or DESC for the columns of a parent key or foreign key. An index on a foreign key does not have to have the same ascending and descending attributes as the index of the corresponding parent key.

EBCDIC, ASCII, and UNICODE encoding schemes for an index: An index has the same encoding scheme as its associated table.

Choosing a value for PIECESIZE: To choose a value for PIECESIZE, divide the size of the secondary index by the number of data sets that you want. For example, to ensure that you have 5 data sets for the secondary index, and your index is 10 MB (and not likely to grow much), specify PIECESIZE 2 M. If your secondary index is likely to grow, choose a larger value.

Remember that 32 pieces is the limit if the underlying table space is not defined as LARGE (or as DSSIZE 4G or greater) and that the limit is 4096 for objects with greater than 254 parts.

Keep the PIECESIZE value in mind when you are choosing values for primary and secondary quantities. Ideally, the value of your primary quantity plus the secondary quantities should be evenly divisible into PIECESIZE.

Dropping an index: Partitioning indexes can only be dropped by dropping the associated table space. Secondary indexes that are not indexes on auxiliary tables can be dropped simply by dropping the indexes. An empty index on an auxiliary table can be explicitly dropped; a populated index can be dropped only by dropping other objects. For details, see “Dropping an index on an auxiliary table and an auxiliary table” on page 875.

If the index is a unique index that enforces a primary key, unique key, or referential constraint, the constraint must be dropped before the index is dropped. See “DROP” on page 866.

Use of PARTITIONED keyword: When a partitioned index is created and no additional keywords are specified, the index is nonpartitioned. If the keyword PARTITIONED is specified, the index is partitioned. The index is both data-partitioned and key-partitioned because it is defined on the partitioning columns of the table. Any index on a partitioned table space that does not meet the definition of a partitioning index is a secondary index. When a secondary index is created and no additional keywords are specified, the secondary index is nonpartitioned (NPSI). If the keyword PARTITIONED is specified, the index is a data-partitioned secondary index (DPSI).

Creating indexes on DB2 catalog tables: For details on creating indexes on catalog tables, see “SQL statements allowed on the catalog” on page 1197.

EA-enabled index data sets: If an index is created for an EA-enabled table space, the data sets for the index must be set up to belong to a DFSMS data class that has the extended format and extended addressability attributes.

Creating indexes in a data sharing environment: DB2 will not invalidate any package or plan referred to in a table on which the index is created. However, the VALID column in SYSIBM.SYSPACKAGE or SYSIBM.SYSPLAN is marked as ″A″ unless the package or plan is already invalidated and marked VALID = ″N″. See “SYSIBM.SYSPACKAGE table” on page 1269 for a description of SYSIBM.SYSPACKAGE and “SYSIBM.SYSPLAN table” on page 1284 for a description of SYSIBM.SYSPLAN.

Alternative syntax and synonyms: To provide compatibility with previous releases of DB2 or other products in the DB2 UDB family, DB2 supports the following keywords when creating a partitioned index:

- PART can be specified as a synonym for PARTITION. In addition, the PARTITION BY RANGE keywords that precede PARTITION are optional.
- VALUES can be specified as a synonym for ENDING AT.

Although these keywords are supported as alternatives, they are not the preferred syntax.

Examples

Example 1: Create a unique index, named DSN8810.XDEPT1, on table DSN8810.DEPT. Index entries are to be in ascending order by the single column DEPTNO. DB2 is to define the data sets for the index, using storage group DSN8G810. Each data set (piece) should hold 1 megabyte of data at most. Use 512 kilobytes as the primary space allocation for each data set and 64 kilobytes as the secondary space allocation. These specifications enable each data set to be extended up to 8 times before a new data set is used—512KB + (8*64KB)= 1024KB. Make the index padded.

The data sets can be closed when no one is using the index and do not need to be erased if the index is dropped.

```
CREATE UNIQUE INDEX DSN8810.XDEPT1
  ON DSN8810.DEPT
    (DEPTNO ASC)
  PADDED
  USING STOGROUP DSN8G810
    PRIQTY 512
    SECQTY 64
    ERASE NO
  BUFFERPOOL BP1
  CLOSE YES
  PIECESIZE 1 M;
```

For the above example, the underlying data sets for the index will be created immediately, which is the default (DEFINE YES). Assuming that table DSN8810.DEPT is empty, if you wanted to defer the creation of the data sets until data is first inserted into the index, you would specify DEFINE NO instead of accepting the default behavior. Specifying PADDED ensures that the varying-length character string columns in the index are padded with blanks.

Example 2: Create a cluster index, named XEMP2, on table EMP in database DSN8810. Put the entries in ascending order by column EMPNO. Let DB2 define the data sets for each partition using storage group DSN8G810. Make the primary space allocation be 36 kilobytes, and allow DB2 to use the default value for SECQTY, which for this example is 12 kilobytes (3 times 4KB). If the index is dropped, the data sets need not be erased.

There are to be 4 partitions, with index entries divided among them as follows:
 Partition 1: entries up to H99
 Partition 2: entries above H99 up to P99
 Partition 3: entries above P99 up to Z99
 Partition 4: entries above Z99

Associate the index with buffer pool BP1 and allow the data sets to be closed when no one is using the index. Enable the use of the COPY utility for full image or concurrent copies and the RECOVER utility.

```
   CREATE INDEX DSN8810.XEMP2
     ON DSN8810.EMP
       (EMPNO ASC)
     USING STOGROUP DSN8G810
       PRIQTY 36
       ERASE NO
       CLUSTER
       PARTITION BY RANGE
       (PARTITION 1 ENDING AT('H99'),
        PARTITION 2 ENDING AT('P99'),
        PARTITION 3 ENDING AT('Z99'),
        PARTITION 4 ENDING AT('999'))
     BUFFERPOOL BP1
     CLOSE YES
     COPY YES;
```

Example 3: Create a secondary index, named DSN8810.XDEPT1, on table DSN8810.DEPT. Put the entries in ascending order by column DEPTNO. Assume that the data sets are managed by the user with catalog name DSNCAT and each data set (piece) is to hold 1 gigabyte of data at most before the next data set is used.

```
  CREATE UNIQUE INDEX DSN8810.XDEPT1
    ON DSN8810.DEPT
      (DEPTNO ASC)
    USING VCAT DSNCAT
    PIECESIZE 1048576 K;
```

Example 4: Assume that a column named EMP_PHOTO with a data type of BLOB(110K) was added to the sample employee table for each employee's photo and auxiliary table EMP_PHOTO_ATAB was created in LOB table space DSN8D81A.PHOTOLTS to store the BLOB data for the column. Create an index named XPHOTO on the auxiliary table. The data sets are to be user-managed with catalog name DSNCAT.

```
  CREATE UNIQUE INDEX DSN8810.XPHOTO
     ON DSN8810.EMP_PHOTO_ATAB
     USING VCAT DSNCAT
     COPY YES;
```

In this example, no columns are specified for the key because auxiliary indexes have implicitly generated keys.

CREATE PROCEDURE

The CREATE PROCEDURE statement registers a stored procedure with a database server. You can register two different types of procedures with this statement, each of which is described separately.

- External

  The procedure is written in a programming language such as C, COBOL, or Java. The external executable is referenced by a procedure defined at the server along with various attributes of the procedure. See “CREATE PROCEDURE (external)” on page 692.
- SQL

  The procedure is written exclusively in SQL. The procedure body is defined at the current server along with various attributes of the procedure. See “CREATE PROCEDURE (SQL)” on page 710.

CREATE PROCEDURE (external)

The CREATE PROCEDURE statement defines an external stored procedure at the current server.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is specified implicitly or explicitly.

Authorization

The privilege set that is defined below must include at least one of the following:
- The CREATEIN privilege on the schema
- SYSADM or SYSCTRL authority

The authorization ID that matches the schema name implicitly has the CREATEIN privilege on the schema.

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package.

If the statement is dynamically prepared, the privilege set is the privileges that are held by the SQL authorization ID of the process. The specified procedure name can include a schema name (a qualifier). However, if the schema name is not the same as the SQL authorization ID, one of the following conditions must be met:
- The privilege set includes SYSADM or SYSCTRL authority.
- The SQL authorization ID of the process has the CREATEIN privilege on the schema.

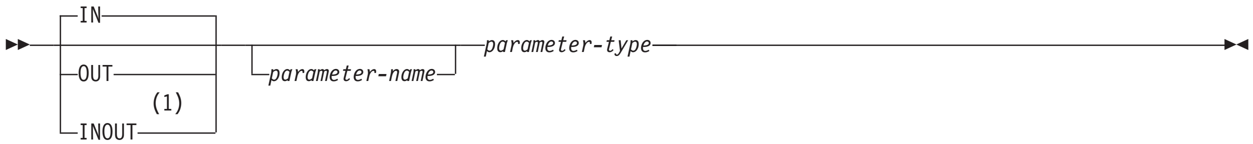
The authorization ID that is used to create the stored procedure must have authority to create programs that are to be run either in the DB2-established stored procedure address space or the specified workload manager (WLM) environment. In addition, if the stored procedure uses a distinct type as a parameter, this authorization ID must have the USAGE privilege on each distinct type that is a parameter.

When LANGUAGE is JAVA and a *jar-name* is specified in the EXTERNAL NAME clause, the privilege set must include USAGE on the JAR, the Java ARchive file.

Syntax

```
►►──CREATE PROCEDURE──procedure-name──┬──────────────────────────────┬──option-list──────────►◄
                                      │    ┌─,──────────────────┐    │
                                      │    ▼                    │    │
                                      └─(───┬───────────────────┬┴──)┘
                                            └─parameter-declaration─┘
```

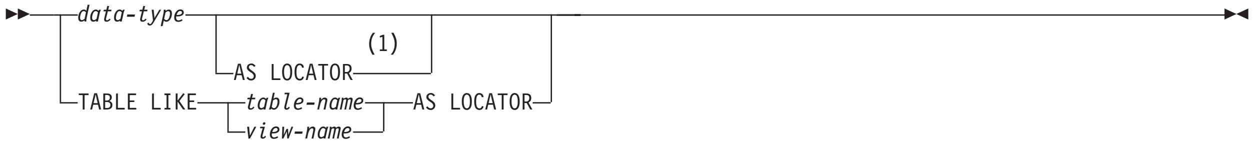
parameter-declaration:



Notes:

1 For a REXX stored procedure, only one parameter can have type OUT or INOUT. That parameter must be declared last.

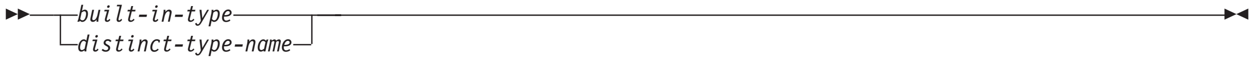
parameter-type:



Notes:

1 AS LOCATOR can be specified only for a LOB data type or a distinct type based on a LOB data type.

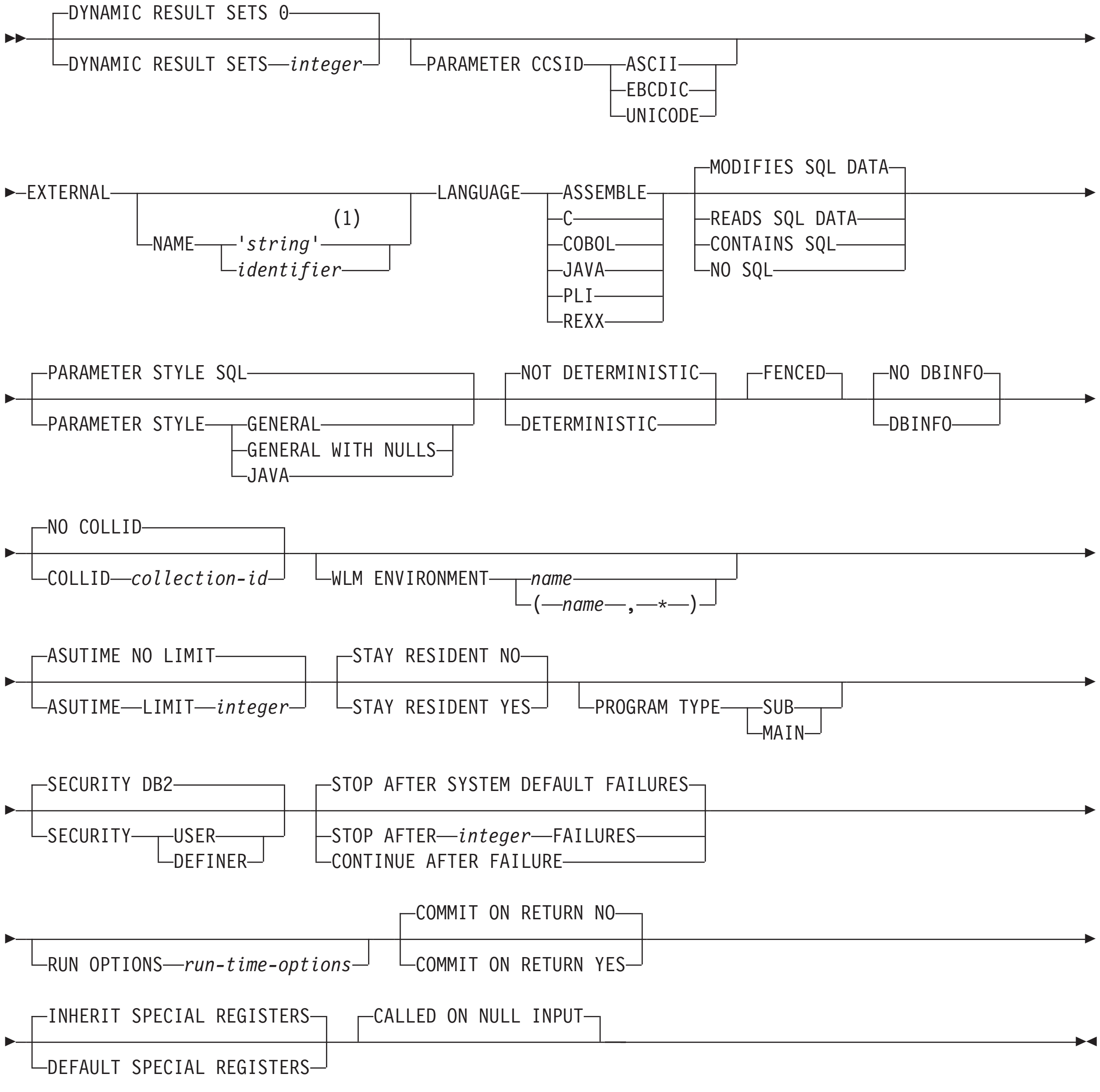
data-type:



built-in-type:

```
►►──┬─SMALLINT────────────────────────────────────────────────────────────────────────────────────────────────────┬────────────►◄
    ├─┬─INTEGER─┬─────────────────────────────────────────────────────────────────────────────────────────────────┤
    │ └─INT─────┘                                                                                                 │
    │               ┌─(5,0)───────────────────┐                                                                   │
    ├─┬─DECIMAL─┬───┼─────────────────────────┼───────────────────────────────────────────────────────────────────┤
    │ ├─DEC─────┤   └─(integer─┬──────────┬─)─┘                                                                   │
    │ └─NUMERIC─┘              └─, integer┘                                                                       │
    │           ┌─(1)───────┐                                                                                     │
    ├─┬─FLOAT───┼───────────┼─┬───────────────────────────────────────────────────────────────────────────────────┤
    │ │         └─(integer)─┘ │                                                                                   │
    │ ├─REAL──────────────────┤                                                                                   │
    │ │         ┌─PRECISION─┐ │                                                                                   │
    │ └─DOUBLE──┴───────────┴─┘                                                                                   │
    │                    ┌─(1)───────┐                                                                            │
    ├─┬─┬─┬─CHARACTER─┬──┼───────────┼──────────┬──┬──────────────────────┬──┬────────────────────┬─────────────┬─┤
    │ │ │ └─CHAR──────┘  └─(integer)─┘          │  └─FOR──┬─SBCS──┬──DATA─┘  └─CCSID──┬─ASCII───┬─┘             │ │
    │ │ └─┬─┬─CHARACTER─┬──VARYING─┬──(integer)─┘         ├─MIXED─┤                   ├─EBCDIC──┤               │ │
    │ │   │ └─CHAR──────┘          │                      └─BIT───┘                   └─UNICODE─┘               │ │
    │ │   └─VARCHAR────────────────┘                                                                            │ │
    │ │                                  ┌─(1M)─────────────┐                                                   │ │
    │ └─┬─┬─CHARACTER─┬──LARGE OBJECT─┬──┼──────────────────┼──┬──────────────────────┬──┬────────────────────┬─┘ │
    │   │ └─CHAR──────┘               │  └─(integer─┬───┬─)─┘  └─FOR──┬─SBCS──┬──DATA─┘  └─CCSID──┬─ASCII───┬─┘   │
    │   └─CLOB────────────────────────┘             ├─K─┤             └─MIXED─┘                   ├─EBCDIC──┤     │
    │                                               ├─M─┤                                         └─UNICODE─┘     │
    │                                               └─G─┘                                                         │
    │            ┌─(1)───────┐                                                                                    │
    ├─┬─GRAPHIC──┼───────────┼───────┬──┬────────────────────┬────────────────────────────────────────────────────┤
    │ │          └─(integer)─┘       │  └─CCSID──┬─ASCII───┬─┘                                                    │
    │ ├─VARGRAPHIC──(integer)────────┤           ├─EBCDIC──┤                                                      │
    │ │         ┌─(1M)─────────────┐ │           └─UNICODE─┘                                                      │
    │ └─DBCLOB──┼──────────────────┼─┘                                                                            │
    │           └─(integer─┬───┬─)─┘                                                                              │
    │                      ├─K─┤                                                                                  │
    │                      ├─M─┤                                                                                  │
    │                      └─G─┘                                                                                  │
    │                          ┌─(1M)─────────────┐                                                               │
    ├─┬─BINARY LARGE OBJECT─┬──┼──────────────────┼───────────────────────────────────────────────────────────────┤
    │ └─BLOB────────────────┘  └─(integer─┬───┬─)─┘                                                               │
    │                                     ├─K─┤                                                                   │
    │                                     ├─M─┤                                                                   │
    │                                     └─G─┘                                                                   │
    ├─┬─DATE──────┬───────────────────────────────────────────────────────────────────────────────────────────────┤
    │ ├─TIME──────┤                                                                                               │
    │ └─TIMESTAMP─┘                                                                                               │
    └─ROWID───────────────────────────────────────────────────────────────────────────────────────────────────────┘
```

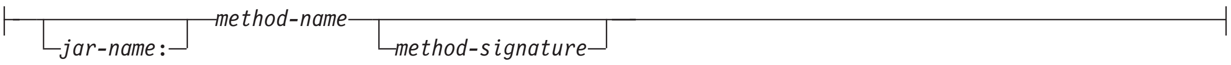
option-list: (The options can be specified in any order.)



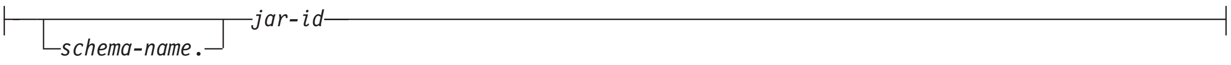
Notes:

1 With LANGUAGE JAVA, use a valid *external-java-routine-name*.

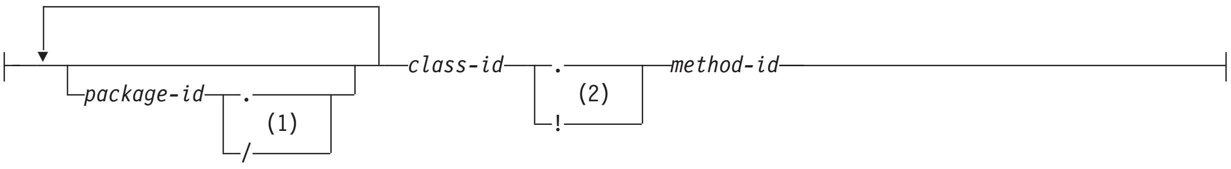
external-java-routine-name:



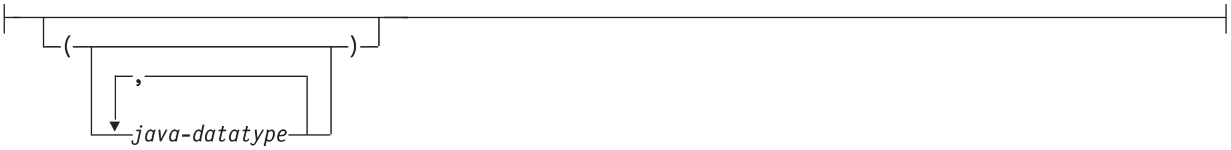
jar-name:



method-name:



method-signature:



Notes:

1 The slash (/) is supported for compatibility with previous releases of DB2 UDB for z/OS.

2 The exclamation point (!) is supported for compatibility with other products in the DB UDB family.

Description

procedure-name

Names the stored procedure. The name cannot be a single asterisk even if you specify it as a delimited identifier ("*").

The name is implicitly or explicitly qualified by a schema. The name, including the implicit or explicit qualifier, must not identify an existing stored procedure at the current server.

- The unqualified form of *procedure-name* is an SQL identifier. The unqualified name is implicitly qualified with a schema name according to the following rules:

  If the statement is embedded in a program, the schema name is the authorization ID in the QUALIFIER bind option when the plan or package was created or last rebound. If QUALIFIER was not specified, the schema name is the owner of the plan or package.

  If the statement is dynamically prepared, the schema name is the SQL authorization ID in the CURRENT SQLID special register.
- The qualified form of *procedure-name* is an SQL identifier (the schema name) followed by a period and an SQL identifier.

The schema name can be ’SYSIBM’ or ’SYSPROC’. It can also be ’SYSTOOLS’ if the user who executes the CREATE statement has SYSADM or SYSCTRL privilege. Otherwise, the schema name must not begin with 'SYS' unless the schema name is 'SYSADM'.

The owner of the procedure is determined by how the CREATE PROCEDURE statement is invoked:

- If the statement is embedded in a program, the owner is the authorization ID of the owner of the plan or package.
- If the statement is dynamically prepared, the owner is the SQL authorization ID in the CURRENT SQLID special register.

The owner is implicitly given the EXECUTE privilege with the GRANT option for the procedure.

(*parameter-declaration,...***)**

Specifies the number of parameters of the stored procedure and the data type of each parameter, and optionally, the name of each parameter. A parameter for a stored procedure can be used only for input, only for output, or for both input and output. If an error is returned by the procedure, OUT parameters are undefined and INOUT parameters are unchanged. All the parameters are nullable.

IN Identifies the parameter as an input parameter to the stored procedure. The parameter does not contain a value when the stored procedure returns control to the calling SQL application.

IN is the default.

OUT

Identifies the parameter as an output parameter that is returned by the stored procedure.

INOUT

Identifies the parameter as both an input and output parameter for the stored procedure.

parameter-name

Names the parameter.

data-type

Specifies the data type of the parameter. The data type can be a built-in data type or a distinct type.

built-in-type

The data type of the parameter is a built-in data type.

For more information on the data types, see “built-in-type” on page 741.

For parameters with a character or graphic data type, the PARAMETER CCSID clause or CCSID clause indicates the encoding scheme of the parameter. If you do not specify either of these clauses, the encoding scheme is the value of field DEF ENCODING SCHEME on installation panel DSNTIPF.

distinct-type-name

The data type of the input parameter is a distinct type. Any length, precision, scale, subtype, or encoding scheme attributes for the parameter are those of the source type of the distinct type.

If you specify the name of the distinct type without a schema name, DB2 resolves the schema name by searching the schemas in the SQL path.

Although an input parameter with a character data type has an implicitly or explicitly specified subtype (BIT, SBCS, or MIXED), the value that is actually passed in the input argument on the CALL statement can have any subtype. Therefore, conversion of the input data to the subtype of the parameter might occur when the procedure is called. With ASCII or EBCDIC, an error occurs if mixed data that actually contains DBCS characters is used as the value for an input parameter that is declared with an SBCS subtype.

Parameters with a datetime data type or a distinct type are passed to the function as a different data type:

- A datetime type parameter is passed as a character data type, and the data is passed in ISO format.

  The encoding scheme for a datetime type parameter is the same as the implicitly or explicitly specified encoding scheme of any character or graphic string parameters. If no character or graphic string parameters are passed, the encoding scheme is the value of field DEF ENCODING SCHEME on installation panel DSNTIPF.
- A distinct type parameter is passed as the source type of the distinct type.

AS LOCATOR

Specifies that a locator to the value of the parameter is passed to the procedure instead of the actual value. Specify AS LOCATOR only for parameters with a LOB data type or a distinct type based on a LOB data type. Passing locators instead of values can result in fewer bytes being passed to the procedure, especially when the value of the parameter is very large.

The AS LOCATOR clause has no effect on determining whether data types can be promoted.

TABLE LIKE *table-name* or *view-name* **AS LOCATOR**

Specifies that the parameter is a transition table. However, when the procedure is called, the actual values in the transition table are not passed to the stored procedure. A single value is passed instead. This single value is a locator to the table, which the procedure uses to access the columns of the transition table. A procedure with a table parameter can only be invoked from the triggered action of a trigger.

The use of TABLE LIKE provides an implicit definition of the transition table. It specifies that the transition table has the same number of columns as the identified table or view. The columns have the same data type, length, precision, scale, subtype, and encoding scheme as the identified table or view, as they are described in catalog tables SYSCOLUMNS and SYSTABLESPACES. The number of columns and the attributes of those columns are determined at the time the CREATE PROCEDURE statement is processed. Any subsequent changes to the number of columns in the table or the attributes of those columns do not affect the parameters of the procedure.

The *name* specified after TABLE LIKE must identify a table or view that exists at the current server. The name must not identify a declared temporary table. The name does not have to be the same name as the table that is associated with the transition table for the trigger. An unqualified table or view name is implicitly qualified according to the following rules:

- If the CREATE PROCEDURE statement is embedded in a program, the implicit qualifier is the authorization ID in the QUALIFIER bind option when the plan or package was created or last rebound. If QUALIFIER was not used, the implicit qualifier is the owner of the plan or package.
- If the CREATE PROCEDURE statement is dynamically prepared, the implicit qualifier is the SQL authorization ID in the CURRENT SQLID special register.

When the procedure is called, the corresponding columns of the transition table identified by the table locator and the table or view identified in the TABLE LIKE clause must have the same definition. The data type, length, precision, scale, and encoding scheme of these columns must match exactly. The description of the table or view at the time the CREATE PROCEDURE statement was executed is used.

Additionally, a character FOR BIT DATA column of the transition table cannot be passed as input for a table parameter for which the corresponding column of the table specified at the definition is not defined as character FOR BIT DATA. (The definition occurs with the CREATE PROCEDURE statement.) Likewise, a character column of the transition table that is not FOR BIT DATA cannot be passed as input for a table parameter for which the corresponding column of the table specified at the definition is defined as character FOR BIT DATA.

For more information about using table locators, see *DB2 Application Programming and SQL Guide*.

FENCED

Specifies that the stored procedure runs in an external address space to prevent user programs from corrupting DB2 storage.

DYNAMIC RESULT SETS *integer*

Specifies the maximum number of query result sets that the stored procedure can return. The default is DYNAMIC RESULT SETS 0, which indicates that there are no result sets. The value must be between 0 and 32767.

PARAMETER CCSID

Indicates whether the encoding scheme for string parameters is ASCII, EBCDIC, or UNICODE. The default encoding scheme is the value specified in the CCSID clauses of the parameter list or in the field DEF ENCODING SCHEME on installation panel DSNTIPF.

This clause provides a convenient way to specify the encoding scheme for *all* string parameters. If individual CCSID clauses are specified for individual parameters in addition to this PARAMETER CCSID clause, the value specified in *all* of the CCSID clauses must be the same value that is specified in this clause.

This clause also specifies the encoding scheme to be used for system-generated parameters of the routine such as message tokens and DBINFO.

EXTERNAL

Specifies that the CREATE PROCEDURE statement is being used to define a new procedure that is based on code written in an external programming language. If the NAME clause is not specified, 'NAME *procedure-name*' is assumed. The NAME clause is required for a LANGUAGE JAVA procedure because the default name is not valid for a Java procedure. In some cases, the default name will not be valid. To avoid invalid names, specify the NAME clause for the following types of procedures:

- A procedure that is defined as LANGUAGE JAVA
- A procedure that has a name that is greater than 8 bytes in length, contains an underscore, or does not conform to the rules for an ordinary identifier.

NAME *’string’* or *identifier*

Identifies the user-written code that implements the stored procedure.

If LANGUAGE is JAVA, *’string’* must be specified and enclosed in single quotation marks, with no extraneous blanks within the single quotation marks. It must specify a valid *external-java-routine-name*. If multiple *’string’*s are specified, the total length of all of them must not be greater than 1305 bytes and they must be separated by a space or a line break.

An *external-java-routine-name* contains the following parts:

jar-name

Identifies the name given to the JAR when it was installed in the database. The name contains *jar-id*, which can optionally be qualified with a schema. Examples are ″myJar″ and ″mySchema.myJar.″ The unqualified *jar-id* is implicitly qualified with a schema name according to the following rules:

- If the statement is embedded in a program, the schema name is the authorization ID in the QUALIFIER bind option when the package or plan was created or last rebound. If the QUALIFIER was not specified, the schema name is the owner of the package or plan.
- If the statement is dynamically prepared, the schema name is the SQL authorization ID in the CURRENT SQLID special register.

If *jar-name* is specified, it must exist when the CREATE PROCEDURE statement is processed. Do not specify a *jar-name* for a JAVA procedure for which NO SQL is also specified.

If *jar-name* is not specified, the procedure is loaded from the class file directly instead of being loaded from a JAR file. DB2 searches the directories in the CLASSPATH associated with the WLM Environment. Environmental variables for Java routines are specified in a data set identified in a JAVAENV DD card on the JCL used to start the address space for a WLM-managed stored procedure.

method-name

Identifies the name of the method and must not be longer than 254 bytes. Its package, class, and method ID’s are specific to Java and as such are not limited to 18 bytes. In addition, the rules for what these can contain are not necessarily the same as the rules for an SQL ordinary identifier.

package-id

Identifies the package list that the class identifier is part of. If the class is part of a package, the method name must include the complete package prefix, such as ″myPacks.StoredProcs.″ The Java virtual machine looks in the directory ″/myPacks/StoredProcs/″ for the classes.

class-id

Identifies the class identifier of the Java object.

method-id

Identifies the method identifier with the Java class to be invoked.

method-signature

Identifies a list of zero or more Java data types for the parameter list and must not be longer than 1024 bytes. Specify the *method-signature* if the procedure involves any input or output parameters that can be NULL. When the stored procedure being created is called, DB2 searches for a Java method with the exact *method-signature*. The number of *java-datatype* elements specified indicates how many parameters that the Java method must have.

A Java procedure can have no parameters. In this case, you code an empty set of parentheses for *method-signature*. If a Java *method-signature* is not specified, DB2 searches for a Java method with a signature derived from the default JDBC types associated with the SQL types specified in the parameter list of the CREATE PROCEDURE statement.

| For other values of LANGUAGE, the value must conform to the naming conventions for MVS load modules: the value must be less than or equal to 8 bytes, and it must conform to the rules for an ordinary identifier with the exception that it must not contain an underscore.

LANGUAGE

This mandatory clause is used to specify the language interface convention to which the procedure body is written. All programs must be designed to run in the server's environment. Assembler, C, COBOL, and PL/I programs must be designed to run in IBM's Language Environment.

ASSEMBLE

The stored procedure is written in Assembler.

C The stored procedure is written in C or C++.

COBOL

The stored procedure is written in COBOL, including the OO-COBOL language extensions.

JAVA

The stored procedure is written in Java byte code and is executed in the Java Virtual Machine. When LANGUAGE JAVA is specified, the EXTERNAL NAME clause must be specified with a valid *external-java-routine-name* and PARAMETER STYLE must be specified with JAVA. The procedure must be a public static method of the specified Java class.

Do not specify LANGUAGE JAVA when DBINFO, PROGRAM TYPE MAIN, or RUN OPTIONS is specified.

PLI

The stored procedure is written in PL/I.

REXX

The stored procedure is written in REXX. Do not specify LANGUAGE REXX when PARAMETER STYLE SQL is in effect. When REXX is specified, the procedure must use PARAMETER STYLE GENERAL or GENERAL WITH NULLS.

MODIFIES SQL DATA, **READS SQL DATA**, **CONTAINS SQL**, or **NO SQL**

Specifies which SQL statements, if any, can be executed in the procedure or any routine that is called from this procedure. The default is MODIFIES SQL DATA. For the data access classification of each statement, see Table 95 on page 1158.

MODIFIES SQL DATA
Specifies that the procedure can execute any SQL statement except statements that are not supported in procedures.

READS SQL DATA
Specifies that the procedure can execute any SQL statement except statements that are not supported in procedures. Specifies that the procedure can execute statements with a data access classification of READS SQL DATA, CONTAINS SQL, or NO SQL. SQL statements that do not modify SQL data can be included in the procedure. Statements that are not supported in any procedure return a different error.

CONTAINS SQL
Specifies that the procedure can execute only SQL statements with a data classification of CONTAINS SQL or NO SQL. SQL statements that neither read nor modify SQL data can be executed by the procedure. Statements that are not supported in any procedure return a different error.

NO SQL
Specifies that the procedure can execute only SQL statements with a data access classification of NO SQL. Do not specify NO SQL for a JAVA procedure that uses a JAR.

PARAMETER STYLE
Identifies the linkage convention used to pass parameters to and return values from the stored procedure. All of the linkage conventions provide arguments to the stored procedure that contain the parameters specified on the CALL statement. Some of the linkage conventions pass additional arguments to the stored procedure that provide more information to the stored procedure. For more information on linkage conventions, see *DB2 Application Programming and SQL Guide*.

SQL
Specifies that, in addition to the parameters on the CALL statement, several additional parameters are passed to the stored procedure. The following parameters are passed:

- The first *n* parameters that are specified on the CREATE PROCEDURE statement.
- *n* parameters for indicator variables for the parameters.
- The SQLSTATE to be returned.
- The qualified name of the stored procedure.
- The specific name of the stored procedure.
- The SQL diagnostic string to be returned to DB2.
- If DBINFO is specified, the DBINFO structure.

PARAMETER STYLE SQL is the default. Do not specify PARAMETER STYLE SQL when LANGUAGE REXX or LANGUAGE JAVA is in effect.

GENERAL
Specifies that the stored procedure uses a parameter passing mechanism where the stored procedure receives only the parameters specified on the CALL statement. Arguments to procedures defined with this parameter style cannot be null.

GENERAL WITH NULLS
Specifies that, in addition to the parameters on the CALL statement as specified in GENERAL, another argument is also passed to the stored procedure. The additional argument contains an indicator array with an element for each of the parameters on the CALL statement. In C, this is an

array of short ints. The indicator array enables the stored procedure to accept or return null parameter values.

JAVA
Specifies that the stored procedure uses a parameter passing convention that conforms to the Java and SQLJ Routines specifications. PARAMETER JAVA can be specified only if LANGUAGE is JAVA. JAVA must be specified for PARAMETER STYLE when LANGUAGE is JAVA.

INOUT and OUT parameters are passed as single-entry arrays. The INOUT and OUT parameters are declared in the Java method as single-element arrays of the Java type.

For REXX stored procedures (LANGUAGE REXX), GENERAL and GENERAL WITH NULLS are the only valid values for PARAMETER STYLE; therefore, specify one of these values and do not allow PARAMETER STYLE to default to SQL.

DETERMINISTIC or **NOT DETERMINISTIC**
Specifies whether the stored procedure returns the same results each time the stored procedure is called with the same IN and INOUT arguments.

DETERMINISTIC
The stored procedure always returns the same results each time the stored procedure is called with the same IN and INOUT arguments, if the referenced data in the database has not changed.

NOT DETERMINISTIC
The stored procedure might not return the same result each time the procedure is called with the same IN and INOUT arguments, even when the referenced data in the database has not changed. NOT DETERMINISTIC is the default.

DB2 does not verify that the stored procedure code is consistent with the specification of DETERMINISTIC or NOT DETERMINISTIC.

NO DBINFO or **DBINFO**
Specifies whether additional status information is passed to the stored procedure when it is invoked.

NO DBINFO
Additional information is not passed. NO DBINFO is the default.

DBINFO
An additional argument is passed when the stored procedure is invoked. The argument is a structure that contains information such as the name of the current server, the application run-time authorization ID and identification of the version and release of the database manager that invoked the procedure. For details about the argument and its structure, see *DB2 Application Programming and SQL Guide*.

DBINFO can be specified only if PARAMETER STYLE SQL is specified.

NO COLLID or **COLLID** *collection-id*
Identifies the package collection that is to be used when the stored procedure is executed. This is the package collection into which the DBRM that is associated with the stored procedure is bound.

NO COLLID
The package collection for the stored procedure is the same as the package collection of the calling program. If the invoking program does not

use a package, DB2 resolves the package by using the CURRENT PACKAGE PATH special register, the CURRENT PACKAGESET special register, or the PKLIST bind option (in this order). For details about how DB2 uses these three items, see the information on package resolution in Part 5 of *DB2 Application Programming and SQL Guide*.

NO COLLID is the default.

COLLID *collection-id*

The package collection for the stored procedure is the one specified.

For REXX stored procedures, *collection-id* can be DSNREXRR, DSNREXRS, DSNREXCR, or DSNREXCS.

WLM ENVIRONMENT

Identifies the WLM (workload manager) environment in which the stored procedure is to run when the DB2 stored procedure address space is WLM-established. The *name* of the WLM environment is an SQL identifier.

If you do not specify WLM ENVIRONMENT, the stored procedure runs in the default WLM-established stored procedure address space specified at installation time.

name

The WLM environment in which the stored procedure must run. If another stored procedure or a user-defined function calls the stored procedure and that calling routine is running in an address space that is not associated with the specified WLM environment, DB2 routes the stored procedure request to a different address space.

(name,*)

When an SQL application program directly calls a stored procedure, the WLM environment in which the stored procedure runs.

If another stored procedure or a user-defined function calls the stored procedure, the stored procedure runs in the same WLM environment that the calling routine uses.

To define a stored procedure that is to run in a specified WLM environment, you must have appropriate authority for the WLM environment. For an example of a RACF command that provides this authorization, see “Running stored procedures” on page 707.

ASUTIME

Specifies the total amount of processor time, in CPU service units, that a single invocation of a stored procedure can run. The value is unrelated to the ASUTIME column of the resource limit specification table.

When you are debugging a stored procedure, setting a limit can be helpful in case the stored procedure gets caught in a loop. For information on service units, see *z/OS MVS Initialization and Tuning Guide*.

NO LIMIT

There is no limit on the service units. NO LIMIT is the default.

LIMIT *integer*

The limit on the service units is a positive *integer* in the range of 1 to 2 G. If the stored procedure uses more service units than the specified value, DB2 cancels the stored procedure.

STAY RESIDENT

Specifies whether the stored procedure load module is to remain resident in memory when the stored procedure ends.

NO

The load module is deleted from memory after the stored procedure ends. NO is the default.

YES

The load module remains resident in memory after the stored procedure ends.

PROGRAM TYPE

Specifies whether the stored procedure runs as a main routine or a subroutine.

SUB

The stored procedure runs as a subroutine. With LANGUAGE JAVA, PROGRAM TYPE SUB is the only valid option.

MAIN

The stored procedure runs as a main routine. With LANGUAGE REXX, PROGRAM TYPE MAIN is always in effect.

The default for PROGRAM TYPE is:

- MAIN with LANGUAGE REXX
- SUB with LANGUAGE JAVA
- For other languages, the default depends on the value of the CURRENT RULES special register:
  - MAIN when the value is DB2
  - SUB when the value is STD

SECURITY

Specifies how the stored procedure interacts with an external security product, such as RACF, to control access to non-SQL resources.

DB2

The stored procedure does not require a special external security environment. If the stored procedure accesses resources that an external security product protects, the access is performed using the authorization ID associated with the stored procedure address space. DB2 is the default.

USER

An external security environment should be established for the stored procedure. If the stored procedure accesses resources that the external security product protects, the access is performed using the authorization ID of the user who invoked the stored procedure.

DEFINER

An external security environment should be established for the stored procedure. If the stored procedure accesses resources that the external security product protects, the access is performed using the authorization ID of the owner of the stored procedure.

STOP AFTER SYSTEM DEFAULT FAILURES, STOP AFTER *nn* FAILURES, or **CONTINUE AFTER FAILURE**

Specifies whether the routine is to be put in a stopped state after some number of failures.

STOP AFTER SYSTEM DEFAULT FAILURES

Specifies that this routine should be placed in a stopped state after the number of failures indicated by the value of field MAX ABEND COUNT on installation panel DSNTIPX. This is the default.

STOP AFTER *nn* **FAILURES**
Specifies that this routine should be placed in a stopped state after *nn* failures. The value *nn* can be an integer from 1 to 32767.

CONTINUE AFTER FAILURE
Specifies that this routine should not be placed in a stopped state after any failure.

RUN OPTIONS *run-time-options*
Specifies the Language Environment run-time options to be used for the stored procedure. For a REXX stored procedure, specifies the Language Environment run-time options to be passed to the REXX language interface to DB2. You must specify *run-time-options* as a character string that is no longer than 254 bytes. If you do not specify RUN OPTIONS or pass an empty string, DB2 does not pass any run-time options to Language Environment, and Language Environment uses its installation defaults.

Do not specify RUN OPTIONS when LANGUAGE JAVA is in effect.

For a description of the Language Environment run-time options, see *z/OS Language Environment Programming Reference*.

COMMIT ON RETURN
Indicates whether DB2 commits the transaction immediately on return from the stored procedure.

NO
DB2 does not issue a commit when the stored procedure returns. NO is the default.

YES
DB2 issues a commit when the stored procedure returns if the following statements are true:

- The SQLCODE that is returned by the CALL statement is not negative.
- The stored procedure is not in a must abort state.

The commit operation includes the work that is performed by the calling application process and the stored procedure.

If the stored procedure returns result sets, the cursors that are associated with the result sets must have been defined as WITH HOLD to be usable after the commit.

INHERIT SPECIAL REGISTERS or **DEFAULT SPECIAL REGISTERS**
Specifies how special registers are set on entry to the routine. The default is INHERIT SPECIAL REGISTERS.

INHERIT SPECIAL REGISTERS
Specifies that the values of special registers are inherited according to the rules listed in the table for characteristics of special registers in a stored procedure in Table 27 on page 111.

DEFAULT SPECIAL REGISTERS
Specifies that special registers are initialized to the default values, as indicated by the rules in the table for characteristics of special registers in a stored procedure in Table 27 on page 111.

CALLED ON NULL INPUT
Specifies that the procedure is to be called even if any or all argument values

are null, which means that the procedure must be coded to test for null argument values. The procedure can return null or nonnull values. CALLED ON NULL INPUT is the default.

Notes

Choosing data types for parameters: When you choose the data types of the parameters for your stored procedure, consider the rules of promotion that can affect the values of the parameters. (See "Promotion of data types" on page 70). For example, a constant that is one of the input arguments to the stored procedure might have a built-in data type that is different from the data type that the procedure expects, and more significantly, might not be promotable to that expected data type. Based on the rules of promotion, using the following data types for parameters is recommended:

- INTEGER instead of SMALLINT
- DOUBLE instead of REAL
- VARCHAR instead of CHAR
- VARGRAPHIC instead of GRAPHIC

For portability of functions across platforms that are not DB2 UDB for z/OS, do not use the following data types, which might have different representations on different platforms:

- FLOAT. Use DOUBLE or REAL instead.
- NUMERIC. Use DECIMAL instead.

Specifying the encoding scheme for parameters: The encoding scheme of all the parameters with a string data type (both input and output parameters) must be the same—either all ASCII, all EBCDIC, or all UNICODE. If you specify the encoding scheme on the individual parameters, instead of using the PARAMETER CCSID to specify it for all parameters at once or allowing the encoding scheme to default to the system value, ensure that they all agree.

Running stored procedures: You can use the WLM ENVIRONMENT clause to identify the address space in which a stored procedure is to run. Using different WLM environments lets you isolate one group of programs from another. For example, you might choose to isolate programs based on security requirements and place all payroll applications in one WLM environment because those applications deal with sensitive data, such as employee salaries.

Regardless of where the stored procedure is to run, DB2 invokes RACF to determine whether you have appropriate authorization. You must have authorization to issue CREATE PROCEDURE statements that refer to the specified WLM environment or the DB2-established stored procedure address space. For example, the following RACF command authorizes DB2 user DB2USER1 to define stored procedures on DB2 subsystem DB2A that run in the WLM environment named PAYROLL.

```
  PERMIT  DB2A.WLMENV.PAYROLL  CLASS(DSNR) ID(DB2USER1)  ACCESS(READ)
```

Similarly, the following RACF command authorizes the same user to define stored procedures that run in the DB2 stored procedure address space named DB2ASPAS.

```
  PERMIT  DB2A.WLMENV.DB2ASPAS  CLASS(DSNR) ID(DB2USER1)  ACCESS(READ)
```

Accessing result sets from nested stored procedures: When another stored procedure or a user-defined function calls a stored procedure, only the calling routine can access the result sets that the stored procedure returns. The result sets are not returned to the application that contains the outermost stored procedure or user-defined function in the sequence of nested calls.

When a stored procedure is nested, the result sets that are returned by the stored procedure are accessible only by the calling routine. The result sets are not returned to the application that contains the outermost stored procedure or user-defined function in the sequence of nested calls.

Restrictions for nested stored procedures: A stored procedure, user-defined function, or trigger cannot call a stored procedure that is defined with the COMMIT ON RETURN clause.

Alternative syntax and synonyms: To provide compatibility with previous releases of DB2 or other products in the DB2 UDB family, DB2 supports the following keywords:

- RESULT SET as a synonym for DYNAMIC RESULT SET
- RESULT SETS as a synonym for DYNAMIC RESULT SETS
- STANDARD CALL as a synonym for DB2SQL
- SIMPLE CALL as a synonym for GENERAL
- SIMPLE CALL WITH NULLS as a synonym for GENERAL WITH NULLS
- VARIANT as a synonym for NOT DETERMINISTIC
- NOT VARIANT as a synonym for DETERMINISTIC
- NULL CALL as a synonym for CALLED ON NULL INPUT
- PARAMETER STYLE DB2SQL as a synonym for PARAMETER STYLE SQL

Examples

Example 1: Create the definition for a stored procedure that is written in COBOL. The procedure accepts an assembly part number and returns the number of parts that make up the assembly, the total part cost, and a result set. The result set lists the part numbers, quantity, and unit cost of each part. Assume that the input parameter cannot contain a null value and that the procedure is to run in a WLM environment called PARTSA.

```
CREATE PROCEDURE SYSPROC.MYPROC(IN INT, OUT INT, OUT DECIMAL(7,2))
       LANGUAGE COBOL
       EXTERNAL NAME MYMODULE
       PARAMETER STYLE GENERAL
       WLM ENVIRONMENT PARTSA
       DYNAMIC RESULT SETS 1;
```

Example 2: Create the definition for the stored procedure described in Example 1, except use the linkage convention that passes more information than the parameter specified on the CALL statement. Specify Language Environment run-time options HEAP, BELOW, ALL31, and STACK.

```
CREATE PROCEDURE SYSPROC.MYPROC(IN INT, OUT INT, OUT DECIMAL(7,2))
       LANGUAGE COBOL
       EXTERNAL NAME MYMODULE
       PARAMETER STYLE SQL
       WLM ENVIRONMENT PARTSA
       DYNAMIC RESULT SETS 1
       RUN OPTIONS 'HEAP(,,ANY),BELOW(4K,,),ALL31(ON),STACK(,,ANY,)';
```

Example 3: Create the procedure definition for a stored procedure, written in Java, that is passed a part number and returns the cost of the part and the quantity that is currently available.

```
CREATE PROCEDURE PARTS_ON_HAND(IN PARTNUM INT,
                               OUT COST DECIMAL(7,2),
                               OUT QUANTITY INT)
       LANGUAGE JAVA
       EXTERNAL NAME 'PARTS.ONHAND'
       PARAMETER STYLE JAVA;
```

CREATE PROCEDURE (SQL)

The CREATE PROCEDURE statement defines an SQL procedure at the current server and specifies the source statements for the procedure.

Invocation

This statement can only be dynamically prepared, but the DYNAMICRULES run behavior must be specified implicitly or explicitly. It is intended to be processed using one of the following methods:

- JCL
- The DB2 UDB for z/OS SQL procedure processor (DSNTPSMP) (IBM DB2 Development Center uses this method.)

For more information on preparing SQL procedures for execution, see Part 6 of *DB2 Application Programming and SQL Guide*. Issuing the CREATE PROCEDURE statement from another context will result in an incomplete procedure definition even though the statement processing returns without error.

Authorization

The privilege set that is defined below must include at least one of the following:

- The CREATEIN privilege on the schema
- SYSADM or SYSCTRL authority

The authorization ID that matches the schema name implicitly has the CREATEIN privilege on the schema.

Privilege set: The privilege set is the privileges that are held by the SQL authorization ID of the process.

If the statement is dynamically prepared, the privilege set is the privileges that are held by the SQL authorization ID of the process. The specified procedure name can include a schema name (a qualifier). However, if the schema name is not the same as the SQL authorization ID, one of the following conditions must be met:

- The privilege set includes SYSADM or SYSCTRL authority.
- The SQL authorization ID of the process has the CREATEIN privilege on the schema.

The authorization ID that is used to create the stored procedure must have authority to create programs that are to be run either in the DB2-established stored procedure address space or the specified workload manager (WLM) environment.

Syntax

```
►►──CREATE PROCEDURE──procedure-name──┬───────────────────────────────────┬──LANGUAGE SQL──────►
                                      │    ┌─,─────────────────────┐    │
                                      │    ▼                       │    │
                                      └─(───┴─┬───────────────────┬┴───)─┘
                                              └─parameter-declaration─┘

►─option-list──SQL-routine-body────────────────────────────────────────────────────────────►◄
```

parameter-declaration:

```
   ┌─IN────┐
►►─┼───────┼─parameter-name──parameter-type──────────────────────────────────►◄
   ├─OUT───┤
   └─INOUT─┘
```

parameter-type:

```
►►─┬─built-in-type─────────────────────────┬──────────────────────────────────►◄
   └─TABLE LIKE──table-name──AS LOCATOR────┘
```

built-in-type:

```
►►─┬─SMALLINT───────────────────────────────────────────────────────────────────────────────────────┬──►◄
   ├─┬─INTEGER─┬────────────────────────────────────────────────────────────────────────────────────┤
   │ └─INT─────┘                                                                                    │
   │             ┌─(5,0)──────────────────────┐                                                     │
   ├─┬─DECIMAL─┬─┼────────────────────────────┼─────────────────────────────────────────────────────┤
   │ ├─DEC─────┤ └─(integer─┬─────────────┬─)─┘                                                     │
   │ └─NUMERIC─┘            └─, integer───┘                                                         │
   │          ┌─(53)──────┐                                                                         │
   ├─┬─FLOAT──┼───────────┼─┬───────────────────────────────────────────────────────────────────────┤
   │ │        └─(integer)─┘ │                                                                       │
   │ ├─REAL─────────────────┤                                                                       │
   │ │         ┌─PRECISION─┐│                                                                       │
   │ └─DOUBLE──┴───────────┴┘                                                                       │
   │                      ┌─(1)────────┐                                                            │
   ├─┬─┬─┬─CHARACTER─┬────┼────────────┼─────────┬─┬────────────────────────┬─┬─────────────────────┬─┬┤
   │ │ │ └─CHAR──────┘    └─(integer)──┘         │ └─FOR─┬─SBCS──┬─DATA─────┘ └─CCSID─┬─ASCII───┬───┘ ││
   │ │ └─┬─┬─CHARACTER─┬─VARYING─┬─(integer)─────┘       ├─MIXED─┤                    ├─EBCDIC──┤     ││
   │ │   │ └─CHAR──────┘         │                       └─BIT───┘                    └─UNICODE─┘     ││
   │ │   └─VARCHAR───────────────┘                                                                    ││
   │ │                                  ┌─(1M)──────────────┐                                         ││
   │ └─┬─┬─CHARACTER─┬─LARGE OBJECT─┬───┼───────────────────┼─┬────────────────────────┬─┬─────────────────────┬─┘│
   │   │ └─CHAR──────┘              │   └─(integer─┬───┬─)──┘ └─FOR─┬─SBCS──┬─DATA────┘ └─CCSID─┬─ASCII───┬─┘  │
   │   └─CLOB───────────────────────┘              ├─K─┤            └─MIXED─┘                   ├─EBCDIC──┤    │
   │                                               ├─M─┤                                        └─UNICODE─┘    │
   │                                               └─G─┘                                                      │
   │             ┌─(1)───────┐                                                                              │
   ├─┬─GRAPHIC───┼───────────┼──────────┬─┬──────────────────────────┬──────────────────────────────────────┤
   │ │           └─(integer)─┘          │ └─CCSID─┬─ASCII───┬────────┘                                      │
   │ ├─VARGRAPHIC──(integer)────────────┤         ├─EBCDIC──┤                                               │
   │ │         ┌─(1M)──────────────┐    │         └─UNICODE─┘                                               │
   │ └─DBCLOB──┼───────────────────┼────┘                                                                   │
   │           └─(integer─┬───┬─)──┘                                                                        │
   │                      ├─K─┤                                                                             │
   │                      ├─M─┤                                                                             │
   │                      └─G─┘                                                                             │
   │                            ┌─(1M)──────────────┐                                                       │
   ├─┬─BINARY LARGE OBJECT─┬────┼───────────────────┼───────────────────────────────────────────────────────┤
   │ └─BLOB────────────────┘    └─(integer─┬───┬─)──┘                                                       │
   │                                       ├─K─┤                                                            │
   │                                       ├─M─┤                                                            │
   │                                       └─G─┘                                                            │
   └─┬─DATE──────┬──────────────────────────────────────────────────────────────────────────────────────────┘
     ├─TIME──────┤
     └─TIMESTAMP─┘
```

option-list: (The options can be specified in any order.)

```
     ┌─DYNAMIC RESULT SETS 0─────────┐
►►───┼───────────────────────────────┼──┬─────────────────────────────────────┬──────────────────►
     └─DYNAMIC RESULT SETS──integer──┘  └─PARAMETER CCSID──┬─ASCII───┬───────┘
                                                           ├─EBCDIC──┤
                                                           └─UNICODE─┘

                                            ┌─NOT DETERMINISTIC─┐  ┌─FENCED─┐  ┌─CALLED ON NULL INPUT─┐
►──┬──────────────────────────────────┬────┼───────────────────┼──┴────────┴──┴──────────────────────┴───►
   └─EXTERNAL NAME──┬─'string'────┬──┘    └─DETERMINISTIC─────┘
                    └─identifier──┘

   ┌─MODIFIES SQL DATA─┐  ┌─NO DBINFO─┐  ┌─NO COLLID──────────────────┐
►──┼───────────────────┼──┴───────────┴──┼────────────────────────────┼───────────────────────────►
   ├─READS SQL DATA────┤                 └─COLLID──collection-id──────┘
   └─CONTAINS SQL──────┘

                                                    ┌─ASUTIME NO LIMIT──────────┐  ┌─STAY RESIDENT NO──┐
►──┬──────────────────────────────────────────┬────┼───────────────────────────┼──┼───────────────────┼──►
   └─WLM ENVIRONMENT──┬─name──────────────────┤    └─ASUTIME LIMIT──integer────┘  └─STAY RESIDENT YES─┘
                      └─(──name──,──*──)──────┘

   ┌─PROGRAM TYPE MAIN─┐  ┌─SECURITY DB2──────┐
►──┼───────────────────┼──┼───────────────────┼──┬───────────────────────────────────┬──────────────►
   └─PROGRAM TYPE SUB──┘  ├─SECURITY USER─────┤  └─RUN OPTIONS──run-time-options────┘
                          └─SECURITY DEFINER──┘

   ┌─COMMIT ON RETURN NO──┐  ┌─INHERIT SPECIAL REGISTERS─┐  ┌─STOP AFTER SYSTEM DEFAULT FAILURES─┐
►──┼──────────────────────┼──┼───────────────────────────┼──┼────────────────────────────────────┼───►◄
   └─COMMIT ON RETURN YES─┘  └─DEFAULT SPECIAL REGISTERS─┘  ├─STOP AFTER──integer──FAILURES─────┤
                                                            └─CONTINUE AFTER FAILURE─────────────┘
```

Description

procedure-name

Names the stored procedure. Although the name of an SQL procedure can be a delimited identifier, the name itself can contain only uppercase letters A through Z and digits 0 through 9 and must begin with a letter. The name of an SQL procedure cannot contain the alphabetic extenders for national languages (#, @, $).

The name is implicitly or explicitly qualified by a schema. The name, including the implicit or explicit qualifier, must not identify an existing stored procedure at the current server.

- The unqualified form of *procedure-name* is an SQL identifier. The unqualified name is implicitly qualified with a schema name according to the following rules:

  If the statement is embedded in a program, the schema name is the authorization ID in the QUALIFIER bind option when the plan or package was created or last rebound. If QUALIFIER was not specified, the schema name is the owner of the plan or package.

  If the statement is dynamically prepared, the schema name is the SQL authorization ID in the CURRENT SQLID special register.

- The qualified form of *procedure-name* is an SQL identifier (the schema name) followed by a period and an SQL identifier.

  The schema name can be ’SYSIBM’ or ’SYSPROC’. It can also be ’SYSTOOLS’ if the user who executes the CREATE statement has SYSADM or SYSCTRL privilege. Otherwise, the schema name must not begin with 'SYS' unless the schema name is 'SYSADM'.

The owner of the procedure is determined by how the CREATE PROCEDURE statement is invoked:

- If the statement is embedded in a program, the owner is the authorization ID of the owner of the plan or package.
- If the statement is dynamically prepared, the owner is the SQL authorization ID in the CURRENT SQLID special register.

The owner is implicitly given the EXECUTE privilege with the GRANT option for the procedure.

(*parameter-declaration,...***)**

Specifies the number of parameters of the stored procedure, the data type of each parameter, and the name of each parameter. A parameter for a stored procedure can be used only for input, only for output, or for both input and output. If an error is returned by the procedure, OUT parameters are undefined, and INOUT parameters are unchanged. All the parameters are nullable.

IN Identifies the parameter as an input parameter to the stored procedure. The value of the parameter on entry to the procedure is the value that is returned to the calling SQL application.

IN is the default.

OUT

Identifies the parameter as an output parameter that is returned by the stored procedure.

INOUT

Identifies the parameter as both an input and output parameter for the stored procedure.If the parameter is not set within the procedure, its input value is returned.

parameter-name

Names the parameter for use as an SQL variable. *parameter-name* is an SQL identifier.

parameter-type

Specifies the data type of the parameter.

built-in-type

The data type of the parameter is a built-in data type.

For more information on the data types, including the subtype of character data types (the FOR *subtype* DATA clause), see “built-in-type” on page 741.

For parameters with a character or graphic data type, the PARAMETER CCSID clause or CCSID clause indicates the encoding scheme of the parameter. If you do not specify either of these clauses, the encoding scheme is the value of field DEF ENCODING SCHEME on installation panel DSNTIPF.

TABLE LIKE *table-name* **AS LOCATOR**

Specifies that the parameter is a transition table. However, when the procedure is called, the actual values in the transition table are not passed to the stored procedure. A single value is passed instead. This single value is a locator to the table, which the procedure uses to access the columns of the transition table. A procedure with a table parameter can only be invoked from the triggered action of a trigger.

For more information about the TABLE LIKE clause, see "TABLE LIKE" on page 698. For more information about using table locators, see *DB2 Application Programming and SQL Guide*.

Although an input parameter with a character data type has an implicitly or explicitly specified subtype (BIT, SBCS, or MIXED), the value that is actually passed in the input parameter can have any subtype. Therefore, conversion of the input data to the subtype of the parameter might occur when the procedure is called. With ASCII or EBCDIC, an error occurs if mixed data that actually contains DBCS characters is used as the value for an input parameter that is declared with an SBCS subtype.

A parameter with a datetime data type is passed to the SQL procedure as a different data type. A datetime type parameter is passed as a character data type, and the data is passed in ISO format.

The encoding scheme for a datetime type parameter is determined as follows:

- If there are one or more parameters with a character or graphic data type, the encoding scheme of the datetime type parameter is the same as the encoding scheme of the character or graphic parameters.
- Otherwise, the encoding scheme is the value of field DEF ENCODING SCHEME on installation panel DSNTIPF.

LANGUAGE

Specifies the application programming language in which the stored procedure is written.

SQL

The stored procedure is written in DB2 SQL procedural language.

DYNAMIC RESULT SETS *integer*

Specifies the maximum number of query result sets that the stored procedure can return. The default is DYNAMIC RESULT SETS 0, which indicates that there are no result sets. The value must be between 0 and 32767.

PARAMETER CCSID

Indicates whether the encoding scheme for string parameters is ASCII, EBCDIC, or UNICODE. The default encoding scheme is the value specified in the CCSID clauses of the parameter list or in the field DEF ENCODING SCHEME on installation panel DSNTIPF.

This clause provides a convenient way to specify the encoding scheme for *all* string parameters. If individual CCSID clauses are specified for individual parameters in addition to this PARAMETER CCSID clause, the value specified in *all* of the CCSID clauses must be the same value that is specified in this clause.

This clause also specifies the encoding scheme to be used for system-generated parameters of the routine such as message tokens and DBINFO.

EXTERNAL NAME *'string'* or *identifier*

Specifies the name of the MVS load module for the program that runs when the procedure name is specified in an SQL CALL statement. The value must conform to the naming conventions for MVS load modules: the value must be less than or equal to 8 bytes, and it must conform to the rules for an ordinary identifier with the exception that it must not contain an underscore.

If you do not specify EXTERNAL NAME, EXTERNAL NAME *procedure-name* is implicit. In some cases, the default name will not be valid. To avoid invalid names, specify EXTERNAL NAME for a procedure that has a name that is greater than 8 bytes in length, contains an underscore, or does not conform to the rules for an ordinary identifier.

DETERMINISTIC or **NOT DETERMINISTIC**

Specifies whether the stored procedure returns the same results each time the stored procedure is called with the same IN and INOUT arguments.

DETERMINISTIC

The stored procedure always returns the same results each time the stored procedure is called with the same IN and INOUT arguments, if the referenced data in the database has not changed.

NOT DETERMINISTIC

The stored procedure might not return the same result each time the procedure is called with the same IN and INOUT arguments, even when the referenced data in the database has not changed. NOT DETERMINISTIC is the default.

DB2 does not verify that the stored procedure code is consistent with the specification of DETERMINISTIC or NOT DETERMINISTIC.

FENCED

Specifies that the stored procedure runs in an external address space to prevent user programs from corrupting DB2 storage.

FENCED is the default.

CALLED ON NULL INPUT

Specifies that the procedure is to be called even if any or all argument values are null, which means that the procedure must be coded to test for null argument values. The procedure can return null or nonnull values. CALLED ON NULL INPUT is the default.

MODIFIES SQL DATA, **READS SQL DATA**, or **CONTAINS SQL**

Specifies the classification of SQL statements that the procedure can execute. The default is MODIFIES SQL DATA. For the data access classification of each statement, see Table 95 on page 1158.

MODIFIES SQL DATA

Specifies that the procedure can execute any SQL statement except statements that are not supported in procedures.

READS SQL DATA

Specifies that the procedure can execute any SQL statement except statements that are not supported in procedures. Specifies that the procedure can execute statements with a data access classification of READS SQL DATA, CONTAINS SQL, or NO SQL. SQL statements that do not modify SQL data can be included in the procedure. Statements that are not supported in any procedure return a different error.

CONTAINS SQL
Specifies that the procedure can execute only SQL statements with a data classification of CONTAINS SQL. SQL statements that neither read nor modify SQL data can be executed by the procedure. Statements that are not supported in any procedure return a different error.

NO DBINFO
Specifies that no additional status information that is known by DB2 is passed to the stored procedure when it is invoked.

NO COLLID or **COLLID** *collection-id*
Identifies the package collection that is to be used when the stored procedure is executed. This is the package collection into which the DBRM that is associated with the stored procedure is bound.

NO COLLID
The package collection for the stored procedure is the same as the package collection of the calling program. If the invoking program does not use a package, DB2 resolves the package by using the CURRENT PACKAGE PATH special register, the CURRENT PACKAGESET special register, or the PKLIST bind option (in this order). For details about how DB2 uses these three items, see the information on package resolution in Part 5 of *DB2 Application Programming and SQL Guide*.

NO COLLID is the default.

COLLID *collection-id*
The package collection for the stored procedure is the one specified.

WLM ENVIRONMENT
Identifies the WLM (workload manager) environment in which the stored procedure is to run when the DB2 stored procedure address space is WLM-established. The *name* of the WLM environment is an SQL identifier.

If you do not specify WLM ENVIRONMENT, the stored procedure runs in the default WLM-established stored procedure address space specified at installation time.

name
The WLM environment in which the stored procedure must run. If another stored procedure or a user-defined function calls the stored procedure and that calling routine is running in an address space that is not associated with the specified WLM environment, DB2 routes the stored procedure request to a different address space.

(name,*)
When an SQL application program directly calls a stored procedure, the WLM environment in which the stored procedure runs.

If another stored procedure or a user-defined function calls the stored procedure, the stored procedure runs in the same WLM environment that the calling routine uses.

To define a stored procedure that is to run in a specified WLM environment, you must have appropriate authority for the WLM environment. For an example of a RACF command that provides this authorization, see “Running stored procedures” on page 707.

ASUTIME
Specifies the total amount of processor time, in CPU service units, that a single

invocation of a stored procedure can run. The value is unrelated to the ASUTIME column of the resource limit specification table.

When you are debugging a stored procedure, setting a limit can be helpful in case the stored procedure gets caught in a loop. For information on service units, see *z/OS MVS Initialization and Tuning Guide*.

NO LIMIT
There is no limit on the service units. NO LIMIT is the default.

LIMIT *integer*
The limit on the service units is a positive *integer* in the range of 1 to 2 G. If the stored procedure uses more service units than the specified value, DB2 cancels the stored procedure.

STAY RESIDENT
Specifies whether the stored procedure load module remains resident in memory when the stored procedure ends.

NO
The load module is deleted from memory after the stored procedure ends. NO is the default.

YES
The load module remains resident in memory after the stored procedure ends.

PROGRAM TYPE
Specifies whether the stored procedure runs as a main routine or a subroutine.

SUB
The stored procedure runs as a subroutine.

MAIN
The stored procedure runs as a main routine. MAIN is the default for SQL procedures.

SECURITY
Specifies how the stored procedure interacts with an external security product, such as RACF, to control access to non-SQL resources.

DB2
The stored procedure does not require a special external security environment. If the stored procedure accesses resources that an external security product protects, the access is performed using the authorization ID associated with the stored procedure address space. DB2 is the default.

USER
An external security environment should be established for the stored procedure. If the stored procedure accesses resources that the external security product protects, the access is performed using the authorization ID of the user who invoked the stored procedure.

DEFINER
An external security environment should be established for the stored procedure. If the stored procedure accesses resources that the external security product protects, the access is performed using the authorization ID of the owner of the stored procedure.

RUN OPTIONS *run-time-options*
Specifies the Language Environment run-time options to be used for the stored procedure. You must specify *run-time-options* as a character string that is no longer than 254 bytes. If you do not specify RUN OPTIONS or pass an empty

string, DB2 does not pass any run-time options to Language Environment, and Language Environment uses its installation defaults.

For a description of the Language Environment run-time options, see *z/OS Language Environment Programming Reference*.

COMMIT ON RETURN
Indicates whether DB2 commits the transaction immediately on return from the stored procedure.

NO
DB2 does not issue a commit when the stored procedure returns. NO is the default.

YES
DB2 issues a commit when the stored procedure returns if the following statements are true:

- The SQLCODE that is returned by the CALL statement is not negative.
- The stored procedure is not in a must abort state.

The commit operation includes the work that is performed by the calling application process and the stored procedure.

If the stored procedure returns result sets, the cursors that are associated with the result sets must have been defined as WITH HOLD to be usable after the commit.

INHERIT SPECIAL REGISTERS or **DEFAULT SPECIAL REGISTERS**
Specifies how special registers are set on entry to the routine. The default is INHERIT SPECIAL REGISTERS.

INHERIT SPECIAL REGISTERS
Specifies that the values of special registers are inherited, according to the rules listed in the table for characteristics of special registers in a stored procedure in Table 27 on page 111.

DEFAULT SPECIAL REGISTERS
Specifies that special registers are initialized to the default values, as indicated by the rules in the table for characteristics of special registers in a stored procedure in Table 27 on page 111.

STOP AFTER SYSTEM DEFAULT FAILURES, STOP AFTER *nn* **FAILURES,** or **CONTINUE AFTER FAILURE**
Specifies whether the routine is to be put in a stopped state after some number of failures.

STOP AFTER SYSTEM DEFAULT FAILURES
Specifies that this routine should be placed in a stopped state after the number of failures indicated by the value of field MAX ABEND COUNT on installation panel DSNTIPX. This is the default.

STOP AFTER *nn* **FAILURES**
Specifies that this routine should be placed in a stopped state after *nn* failures. The value *nn* can be an integer from 1 to 32767.

CONTINUE AFTER FAILURE
Specifies that this routine should not be placed in a stopped state after any failure.

SQL-routine-body
Specifies the statements that define the body of the SQL procedure. For information on the SQL control statements that are supported in SQL

procedures, see Chapter 6, “SQL control statements,” on page 1113. For information on the SQL statements that are allowed in SQL procedures, see “SQL statements allowed in SQL procedures” on page 1160.

Notes

Using parameters in SQL procedures: The following rules apply to the use of parameters in SQL procedures:

- If IN is specified for a parameter in an SQL procedure, the parameter can be modified within the SQL procedure body. When control returns to the caller, the original value of the IN parameter on entry to the procedure is returned to the caller.
- If OUT is specified for a parameter in an SQL procedure, the parameter can be used on the left or right side of an assignment statement in the SQL procedure body. The parameter can be checked or used to set other variables. The last value that is assigned to an OUT parameter is returned to the caller. If the parameter is not set, DB2 returns the null value to the caller.
- If INOUT is specified for a parameter in an SQL procedure, the parameter can be used on the left or right side of an assignment statement in the SQL procedure body. The first value of the parameter is determined by the caller, and the last value that is assigned to the parameter is returned to the caller.

See “Notes” on page 707 for information about:
- Choosing data types for parameters
- Specifying the encoding scheme for parameters
- Environments for running stored procedures
- Accessing result sets from nested stored procedures

Error handling in SQL procedures: You should consider the possible exceptions that can occur for each SQL statement in the body of a procedure. Any exception SQLSTATE that is not handled within the procedure using a handler within a compound statement results in the exception SQLSTATE being returned to the caller of the procedure.

Alternative syntax and synonyms: To provide compatibility with previous releases of DB2 or other products in the DB2 UDB family, DB2 supports the following keywords:
- RESULT SET and RESULT SETS as synonyms for DYNAMIC RESULT SETS
- VARIANT as a synonym for NOT DETERMINISTIC
- NOT VARIANT as a synonym for DETERMINISTIC

Examples

Example 1: Create the definition for an SQL procedure. The procedure accepts an employee number and a multiplier for a pay raise as input. The following tasks are performed in the procedure body:
- Calculate the employee's new salary.
- Update the employee table with the new salary value.

```
CREATE PROCEDURE UPDATE_SALARY_1
 (IN EMPLOYEE_NUMBER CHAR(10),
 IN RATE DECIMAL(6,2))
 LANGUAGE SQL
 MODIFIES SQL DATA
  UPDATE EMP
  SET SALARY = SALARY * RATE
  WHERE EMPNO = EMPLOYEE_NUMBER
```

Example 2: Create the definition for the SQL procedure described in example 1, but specify that the procedure has these characteristics:

- The procedure runs in a WLM environment called PARTSA.
- The same input always produces the same output.
- SQL work is committed on return to the caller.
- The Language Environment run-time options to be used when the SQL procedure executes are 'MSGFILE(OUTFILE),RPTSTG(ON),RPTOPTS(ON)'.

```
CREATE PROCEDURE UPDATE_SALARY_1
 (IN EMPLOYEE_NUMBER CHAR(10),
 IN RATE DECIMAL(6,2))
 LANGUAGE SQL
 MODIFIES SQL DATA
 WLM ENVIRONMENT PARTSA
 DETERMINISTIC
 RUN OPTIONS 'MSGFILE(OUTFILE),RPTSTG(ON),RPTOPTS(ON)'
 COMMIT ON RETURN YES
   UPDATE EMP
   SET SALARY = SALARY * RATE
   WHERE EMPNO = EMPLOYEE_NUMBER
```

For more examples of SQL procedures, see Chapter 6, “SQL control statements,” on page 1113.

CREATE SEQUENCE

The CREATE SEQUENCE statement creates a sequence at the application server.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

The privilege set that is defined below must include at least one of the following:

- The CREATEIN privilege on the schema
- SYSADM or SYSCTRL authority

The authorization ID that matches the schema name implicitly has the CREATEIN privilege on the schema.

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package.

If the statement is dynamically prepared, the privilege set is the privileges that are held by the SQL authorization ID of the process.

If the data type of the sequence is a distinct type, the privilege set must include the USAGE privilege on the distinct type.

Syntax

```
                                   ┌─────────────────────────────────────────────┐
                                   ↓          (1)                                │
►►──CREATE SEQUENCE──sequence-name──────┬─────────────────────────────────────┬──┴──────────►◄
                                        │      ┌─INTEGER───┐                  │
                                        ├─AS───┴─data-type─┴──────────────────┤
                                        ├─START WITH──numeric-constant────────┤
                                        │ ┌─INCREMENT BY 1──────────────────┐ │
                                        ├─┴─INCREMENT BY──numeric-constant──┴─┤
                                        │ ┌─NO MINVALUE─────────────┐         │
                                        ├─┴─MINVALUE──numeric-constant┴───────┤
                                        │ ┌─NO MAXVALUE─────────────┐         │
                                        ├─┴─MAXVALUE──numeric-constant┴───────┤
                                        │ ┌─NO CYCLE─┐                        │
                                        ├─┴─CYCLE────┴────────────────────────┤
                                        │ ┌─CACHE 20────────────────────┐     │
                                        ├─┼─NO CACHE────────────────────┤─────┤
                                        │ └─CACHE──integer-constant─────┘     │
                                        │ ┌─NO ORDER─┐                        │
                                        └─┴─ORDER────┴────────────────────────┘
```

Notes:

1 The same clause must not be specified more than once. Separator commas may or may not be specified between sequence attributes when a sequence is defined.

Description

SEQUENCE *sequence-name*
Names the sequence.

The combination of name and the implicit or explicit name must not identify an existing sequence at the current server, including the internal names generated by DB2 for identity names.

The unqualified form of *sequence-name* is an SQL identifier. The unqualified name is implicitly qualified with a schema name according to the following rules:

- If the CREATE SEQUENCE statement is embedded in a program, the schema name is the authorization ID in the QUALIFIER bind option when the plan or package was created or last rebound. If QUALIFIER was not specified, the schema name is the owner of the plan or package.
- If the CREATE SEQUENCE statement is dynamically prepared, the schema name is the SQL authorization ID in the CURRENT SQLID special register.

The contents of the SQL PATH are not used to determine the implicit qualifier of a sequence name.

The qualified form of *sequence-name* is a schema followed by a period and an SQL identifier. The schema name must not begin with 'SYS' unless the schema name is 'SYSADM'.

The owner of the sequence is determined by the following conditions. If the CREATE SEQUENCE statement is embedded in a program, the owner is the authorization ID of the owner of the plan or package. If the CREATE SEQUENCE statement is dynamically prepared, the owner is the SQL authorization ID contained in the CURRENT SQLID special register. The owner has the ALTER and USAGE privileges on the new sequence with the GRANT option. These privileges can be granted by the owner and cannot be revoked from the owner.

AS *data-type*
Specifies the data type to be used for the sequence value. The data type can be any exact numeric data type (SMALLINT, INTEGER, or DECIMAL with a scale of zero), or a user-defined distinct type for which the source type is an exact numeric data type with a scale of zero. The default is INTEGER.

START WITH *numeric-constant*
Specifies the first value for the sequence. The value can be any positive or negative value that could be assigned to the a column of the data type that is associated with the sequence without non-zero digits existing to the right of the decimal point.

If the START WITH key word is not explicitly specified with a value, the default is the MINVALUE for ascending sequences and MAXVALUE for descending sequences.

This value is not necessarily the value that a sequence would cycle to after reaching the maximum or minimum value of the sequence. The START WITH clause can be used to start a sequence outside the range that is used for cycles. The range used for cycles is defined by MINVALUE and MAXVALUE.

INCREMENT BY *numeric-constant*
Specifies the interval between consecutive values of the sequence. The value can be any positive or negative value (including 0) that could be assigned to a column of the data type that is associated with the sequence without any non-zero digits existing to the right of the decimal point. The default is 1.

If INCREMENT BY is positive, the sequence ascends. If INCREMENT BY is negative, the sequence descends. If INCREMENT is 0, the sequence is treated as an ascending sequence.

The absolute value of INCREMENT BY can be greater than the difference between MAXVALUE and MINVALUE.

MINVALUE or **NO MINVALUE**
Specifies the minimum value at which a descending sequence either cycles or stops generating values or an ascending sequence cycles to after reaching the maximum value. The default is NO MINVALUE.

MINVALUE *numeric-constant*
Specifies the minimum end of the range of values for the sequence. The last value that is generated for a cycle of a descending sequence will be equal to or greater than this value. MINVALUE is the value to which an ascending sequence cycles to after reaching the maximum value.

The value can be any positive or negative value that could be assigned to the a column of the data type that is associated with the sequence without non-zero digits existing to the right of the decimal point. The value must be less than or equal to the maximum value.

For the effects of defining MINVALUE and MAXVALUE with the same value, see "Defining a constant sequence" on page 726.

NO MINVALUE

Specifies that the minimum end point of the range of values for the sequence has not been specified explicitly. In such a case, the default value for MINVALUE becomes one of the following:

- For an ascending sequence, the value is the START WITH value or 1 if START WITH is not specified.
- For a descending sequence, the value is the minimum value of the data type that is associated with the sequence.

MAXVALUE or **NO MAXVALUE**

Specifies the minimum value at which an ascending sequence either cycles or stops generating values or an descending sequence cycles to after reaching the minimum value. The default is NO MAXVALUE.

MAXVALUE *numeric-constant*

Specifies the maximum end of the range of values for the sequence. The last value that is generated for a cycle of an ascending sequence will be less than or equal to this value. MAXVALUE is the value to which a descending sequence cycles to after reaching the minimum value.

The value can be any positive or negative value that could be assigned to the a column of the data type that is associated with the sequence without non-zero digits existing to the right of the decimal point. The value must be greater than or equal to the minimum value.

For the effects of defining MAXVALUE and MINVALUE with the same value, see "Defining a constant sequence" on page 726.

NO MAXVALUE

Specifies the maximum end point of the range of values for the sequence has not been specified explicitly. In such a case, the default value for MAXVALUE becomes one of the following:

- For an ascending sequence, the value is the maximum value of the data type that is associated with the sequence.
- For a descending sequence, the value is the START WITH value or -1 if START WITH is not specified.

CYCLE or **NO CYCLE**

Specifies whether or not the sequence should continue to generate values after reaching either its maximum or minimum value. The boundary of the sequence can be reached either with the next value landing exactly on the boundary condition or by overshooting it. The default is NO CYCLE.

CYCLE

Specifies that the sequence continue to generate values after either the maximum or minimum value has been reached. If this option is used, after an ascending sequence reaches its maximum value, it generates its minimum value. After a descending sequence reaches its minimum value, it generates its maximum value. The maximum and minimum values for the sequence defined by the MINVALUE and MAXVALUE options determine the range that is used for cycling.

When CYCLE is in effect, duplicate values can be generated by the sequence. When a sequence is defined with CYCLE, any application conversion tools for converting applications from other vendor platforms to DB2 should also explicitly specify MINVALUE, MAXVALUE, and START WITH values.

NO CYCLE

Specifies that the sequence cannot generate more values once the maximum or minimum value for the sequence has been reached. The NO CYCLE option (the default) can be altered to CYCLE at any time during the life of the sequence.

When the next value is being generated for a sequence if the maximum value (for an ascending sequence) or the minimum value (for a descending sequence) of the logical range of the sequence is exceeded and the NO CYCLE option is in effect, an error occurs.

CACHE or **NO CACHE**

Specifies whether or not to keep some preallocated values in memory for faster access. This is a performance and tuning option.

CACHE *integer-constant*

Specifies the maximum number of values of the sequence that DB2 can preallocate and keep in memory. Preallocating values in the cache reduces synchronous I/O when values are generated for the sequence. The actual number of values that DB2 caches is always the lesser of the number in effect for the CACHE option and the number of remaining values within the logical range. Thus, the CACHE value is essentially an upper limit for the size of the cache.

In the event of a system failure, all cached sequence values that have not been used in committed statements are lost (that is, they will never be used). The value specified for the CACHE option is the maximum number of sequence values that could be lost in case of system failure.

The minimum value is 2. The default is CACHE 20.

In a data sharing environment, you can use the CACHE and NO ORDER options to allow multiple DB2 members to cache sequence values simultaneously.

NO CACHE

Specifies that values of the sequence are not to be preallocated. This option ensures that there is not a loss of values in the case of a system failure. When NO CACHE is specified, the values of the sequence are not stored in the cache. In this case, every request for a new value for the sequence results in synchronous I/O.

ORDER or **NO ORDER**

Specifies whether the sequence numbers must be generated in order of request. The default is NO ORDER.

ORDER

Specifies that the sequence numbers are generated in order of request. Specifying ORDER may disable the caching of values. There is no guarantee that values are assigned in order across the entire server unless NO CACHE is also specified. ORDER applies only to a single-application process.

NO ORDER

Specifies that the sequence numbers do not need to be generated in order of request.

In a data sharing environment, if the CACHE and NO ORDER options are in effect, multiple caches can be active simultaneously, and the requests for next value assignments from different DB2 members may not result in the assignment of values in strict numeric order. For example, if members DB2A and DB2B are using the same sequence, and DB2A gets the cache values 1 to 20 and DB2B gets the cache values 21 to 40, the actual order of values assigned would be 1,21,2 if DB2A requested for next value first, then DB2B requested, and then DB2A again requested. Therefore, to guarantee that sequence numbers are generated in strict numeric order among multiple DB2 members using the same sequence concurrently, specify the ORDER option.

Notes

Relationship of MINVALUE and MAXVALUE: MINVALUE must not be greater than MAXVALUE. Although MINVALUE is typically less than MAXVALUE, MINVALUE can equal MAXVALUE. If START WITH were the same value as MINVALUE and MAXVALUE, the sequence would be constant. The request for the next value in a constant sequence appears to have no effect because all of the values that are generated by the sequence are in fact the same value.

Defining sequences that cycle: When you define a sequence, you can choose to have it cycle automatically or not when the maximum or minimum value for the sequence has been reached.

- Implicitly or explicitly defining a sequence with NO CYCLE causes the sequence to not cycle automatically after the boundary is reached. However, you can use the ALTER SEQUENCE statement to cycle the sequence manually. ALTER SEQUENCE allows you to restart or extend the sequence, which causes sequence values to continue to be generated.
- Explicitly defining a sequence with CYCLE causes the sequence to cycle automatically after the boundary is reached. Sequence values continue to be generated after the sequence cycles.

  When a sequence is defined to cycle automatically, the maximum or minimum value that is generated for a sequence may not be the actual MAXVALUE or MINVALUE value that is specified if the increment is a value other than 1 or -1. For example, the sequence defined with START WITH=1, INCREMENT=2, MAXVALUE=10 will generate a maximum value of 9, and will not generate the value 10.

  When a sequence is defined with CYCLE, any application conversion tools (for converting applications from other vendor platforms to DB2) should also explicitly specify MINVALUE, MAXVALUE, and START WITH.

Defining a constant sequence: You can define a sequence such that it always returns the same (or a constant) value. To create a constant sequence, use either of these techniques when defining the sequence:

- Specify an INCREMENT value of zero and a START WITH value that does not exceed MAXVALUE.
- Specify the same value for START WITH, MINVALUE, and MAXVALUE, and specify CYCLE.

A constant sequence can be used as a numeric global variable. You can use ALTER SEQUENCE to adjust the values that are generated for a constant sequence.

Consumed values of a sequence: After DB2 generates a value for a sequence, that value can be said to be ″consumed″ regardless of whether or not that value is utilized by the application or not. The value is not reused within the current cycle. A consumed value may not be utilized when the statement that caused the value to be generated fails for some reason or is rolled back after the value was generated. Generated but unused values may constitute gaps in a sequence.

Gaps in a sequence: Consecutive values in a sequence differ by the constant INCREMENT BY value specified for the sequence. However, gaps can be introduced in a sequence in situations like the following ones:

- A transaction has advanced the sequence and then rolls back.
- The SQL statement leading to the generation of the next value fails after the value was generated.
- The NEXT VALUE expression is used in the SELECT statement of a cursor in a DRDA environment where the client uses block-fetch and not all retrieved rows are fetched by the application.
- The sequence is altered and then the alteration is rolled back.
- The sequence is dropped and then the dropping is rolled back.

Values of such gaps are not available for the current cycle, unless the sequence is altered and restarted in a specific way to make them available.

A sequence is incremented independently of a transaction. Thus, a given transaction increments the sequence two times may see a gap in the two numbers that it receives if other transactions concurrently increment the same sequence. Most applications can tolerate these instances as these are not really gaps.

Duplicate sequence values: It is possible the duplicate values can be generated for a sequence. Duplicate values are most likely to occur when a sequence is defined with the CYCLE option, is defined as a constant sequence, or is altered. For example, the following situations could cause duplicate sequence values:

- A sequence is defined with the attributes START WITH=2, INCREMENT BY 2, MINVALUE=2, MAXVALUE=10, and CYCLE.
- The ALTER SEQUENCE statement is used to restart the sequence with a value that has already been generated.
- The ALTER SEQUENCE statement is used to reverse the ascending direction of a sequence by changing the INCREMENT BY value from a positive to a negative.

Using sequences: A sequence can be referenced using a *sequence reference*. A sequence reference can appear in most places that an expression can appear. A sequence reference can specify whether the value to be returned is a newly generated value or the previously generated value. A NEXT VALUE sequence expression is used to generate a new value. A PREVIOUS VALUE sequence expression is used to obtain the last assigned value of a sequence. For more information, see “Sequence reference” on page 156.

Alternative syntax and synonyms: To provide compatibility with previous releases of DB2 or other products in the DB2 UDB family, DB2 supports the following keywords:

- NOMINVALUE (single key word) as a synonym for NO MINVALUE
- NOMAXVALUE (single key word) as a synonym for NO MAXVALUE
- NOCYCLE (single key word) as a synonym for NO CYCLE
- NOCACHE (single key word) as a synonym for NO CACHE
- NOORDER (single key word) as a synonym for NO ORDER

Examples

Example 1: Create a sequence names ″org_seq″ that starts at 1 increments by 1, does not cycle, and caches 24 values at a time:

```
CREATE SEQUENCE ORDER_SEQ
   START WITH 1
   INCREMENT BY 1
   NO MAXVALUE
   NO CYCLE
   CACHE 24;
```

INCREMENT 1, NO MAXVALUE, and NO CYCLE are defaults and do not need to be specified.

Example 2: The following example shows how to create and use a sequence named ″order_seq″ in a table named ″orders″:

```
CREATE SEQUENCE ORDER_SEQ
   START WITH 1
   INCREMENT BY 1
   NO MAXVALUE
   NO CYCLE
   CACHE 20;

  INSERT INTO ORDERS (ORDERNO, CUSTNO)
    VALUES (NEXT VALUE FOR ORDER_SEQ, 123456);
```

or to update the orders:

```
UPDATE ORDERS
   SET ORDERNO = NEXT VALUE FOR ORDER_SEQ
   WHERE ORDERNO = 123456;
```

Example 3: The following example shows how to use the same sequence number as a unique key value in two separate tables by referencing the sequence number with a NEXT VALUE expression for the first row to generate the sequence value and with a PREVIOUS VALUE expression for the other rows to refer to the sequence value most recently generated.

```
INSERT INTO ORDERS (ORDERNO, CUSTNO)
   VALUES (NEXT VALUE FOR ORDER_SEQ, 123456);

   INSERT INTO LINE_ITEMS (ORDERNO, PARTNO, QUANTITY)
     VALUES (PREVIOUS VALUE FOR ORDER_SEQ, 987654);
```

If NEXT VALUE is invoked in the same statement as the PREVIOUS VALUE, then regardless of their order in the statement, PREVIOUS VALUE returns the previous (unincremented) value and NEXT VALUE returns the next value.

CREATE STOGROUP

The CREATE STOGROUP statement creates a storage group at the current server. Storage from the identified volumes can later be allocated for table spaces and index spaces.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

The privilege set that is defined below must include at least one of the following:

- The CREATESG privilege
- SYSADM or SYSCTRL authority

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package. If the statement is dynamically prepared, the privilege set is the privileges that are held by the SQL authorization ID of the process.

Syntax

```
                                                ┌─,──────────────┐
                                                │   (1)          │
►►──CREATE STOGROUP──stogroup-name──VOLUMES──(──┬─▼───volume-id──┴─┬──)──VCAT──catalog-name──────────►◄
                                                │ ┌─,──┐           │
                                                │ ▼    │           │
                                                └──'*'─┴───────────┘
```

Notes:

1 The same *volume-id* must not be specified more than once.

Description

stogroup-name
Names the storage group. The name must not identify a storage group that exists at the current server.

VOLUMES(*volume-id,...***)** or **VOLUMES(***'*',...***)**
Defines the volumes of the storage group. Each *volume-id* is a volume serial number of a storage volume. It can have a maximum of six characters and is specified as an identifier or a string constant.

Asterisks are recognized only by Storage Management Subsystem (SMS). To allow SMS control over volume selection, define DB2 STOGROUPs with VOLUMES(*'*',...*). SMS usage is recommended, rather than using DB2 to allocate data to specific volumes. Having DB2 select the volume requires non-SMS usage or assigning an SMS Storage Class with guaranteed space. However, because guaranteed space reduces the benefits of SMS allocation, it is not recommended.

If you do choose to use specific volume assignments, additional manual space management must be performed. Free space must be managed for each individual volume to prevent failures during the initial allocation and extension. This process generally requires more time for space management and results in more space shortages. Guaranteed space should be used only where the space needs are relatively small and do not change.

VCAT *catalog-name*

Identifies the integrated catalog facility catalog for the storage group. You must specify an alias[29] if the name of the integrated catalog facility catalog is longer than 8 characters.

The designated catalog is the one in which entries are placed for the data sets created by DB2 with the aid of the storage group. These are linear VSAM data sets for associated table or index spaces or for their partitions. For each such space or partition, association is made through a USING clause in a CREATE TABLESPACE, CREATE INDEX, ALTER TABLESPACE, or ALTER INDEX statement. For more on the association, see the descriptions of those statements in this chapter.

Conventions for data set names are given in Part 2 (Volume 1) of *DB2 Administration Guide*. *catalog-name* is the first qualifier for each data set name.

One or more DB2 subsystems could share integrated catalog facility catalogs with the current server. To avoid the chance of having one of those subsystems attempt to assign the same name to different data sets, select a value for *catalog-name* that is not used by the other DB2 subsystems.

Notes

Device types: When the storage group is used at run time, an error can occur if the volumes in the storage group are of different device types, or if a volume is not available to z/OS for dynamic allocation of data sets.

When a storage group is used to extend a data set, all volumes in the storage group must be of the same device type as the volumes used when the data set was defined. Otherwise, an extend failure occurs if an attempt is made to extend the data set.

Number of volumes: There is no specific limit on the number of volumes that can be defined for a storage group. However, the maximum number of volumes that can be managed for a storage group is 133. Thus, there is no point in creating a storage group with more than 133 volumes.

z/OS imposes a limit on the number of volumes that can be allocated per data set: 59 at this writing. For the latest information on that restriction, see *DFSMS/MVS: Access Method Services for the Integrated Catalog*.

Storage group owner: If the statement is embedded in an application program, the owner of the plan or package is the owner of the storage group. If the statement is dynamically prepared, the SQL authorization ID of the process is the owner of the storage group. The owner has the privilege of altering and dropping the storage group.

[29] The alias of an integrated catalog facility catalog.

Specifying volume IDs: A new storage group must have either specific volume IDs or non-specific volume IDs. You cannot create a storage group that contains a mixture of specific and non-specific volume IDs.

Verifying volume IDs: When processing the VOLUMES clause, DB2 does not check the existence of the volumes or determine the types of devices that they identify. Later, whenever the storage group is used to allocate data sets, the list of volumes is passed in the specified order to Data Facilities (DFSMSdfp), which does the actual work. See Part 2 (Volume 1) of *DB2 Administration Guide* for more information about creating DB2 storage groups.

Example

Create storage group, DSN8G810, of volumes ABC005 and DEF008. DSNCAT is the integrated catalog facility catalog name.

```
CREATE STOGROUP DSN8G810
  VOLUMES (ABC005,DEF008)
  VCAT DSNCAT;
```

CREATE SYNONYM

The CREATE SYNONYM statement defines a synonym for a table or view at the current server.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

None required.

Syntax

```
►►──CREATE SYNONYM──synonym──FOR──authorization-name.─┬─table-name─┬──────────────────────────►◄
                                                      └─view-name──┘
```

Description

synonym
Names the synonym. The name must not identify a synonym, table, view, or alias that is owned by the owner of the synonym that is being created. The owner of the synonym being created is determined by how the CREATE SYNONYM statement is invoked:

- If the statement is embedded in an application program, the owner is the authorization ID of the plan or package.
- If the statement is dynamically prepared, the owner is the SQL authorization ID in the CURRENT SQLID special register.

FOR *authorization-name.table-name* or *authorization-name.view-name*
Identifies the object to which the synonym applies. The name must consist of two parts and must identify a table, view, or alias that exists at the current server. If a table is identified, it must not be an auxiliary table or a declared temporary table. If an alias is identified, it must be an alias for a table or view at the current server and the synonym is defined for that table or view.

Notes

In cases where the statement is dynamically prepared, users with SYSADM authority can create synonyms for other users. This is done by changing the value of the CURRENT SQLID special register before issuing the CREATE SYNONYM statement. See “SET CURRENT SQLID” on page 1080 for details on changing the value of the CURRENT SQLID special register.

The authorization ID recorded as the owner of a synonym is the only authorization ID for which the synonym is defined and the only authorization ID that can be used to drop it.

If an alias is used to denote the table or view, the name of that table or view, not the alias, is recorded in the catalog as the definition of the synonym. That severs the connection between the synonym and alias, and even if the alias is dropped and redefined, the synonym is still in effect and names the original table or view.

Example

Define DEPT as a synonym for the table DSN8810.DEPT.

```
CREATE SYNONYM DEPT
  FOR DSN8810.DEPT;
```

This example does not work if the current SQL authorization ID is DSN8810.

CREATE TABLE

The CREATE TABLE statement defines a table. The definition must include its name and the names and attributes of its columns. The definition can include other attributes of the table, such as its primary key and its table space.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

The privilege set that is defined below must include at least one of the following:

- The CREATETAB privilege for the database implicitly or explicitly specified by the IN clause
- DBADM, DBCTRL, or DBMAINT authority for the database in which the table is being created
- SYSADM or SYSCTRL authority

Additional privileges might be required in the following conditions:

- The clause IN, LIKE or FOREIGN KEY is specified.
- The data type of a column is a distinct type.
- The table space is implicitly created.
- A fullselect is specified.
- A column is defined as a security label column.

See the description of the appropriate clauses for details about these privileges.

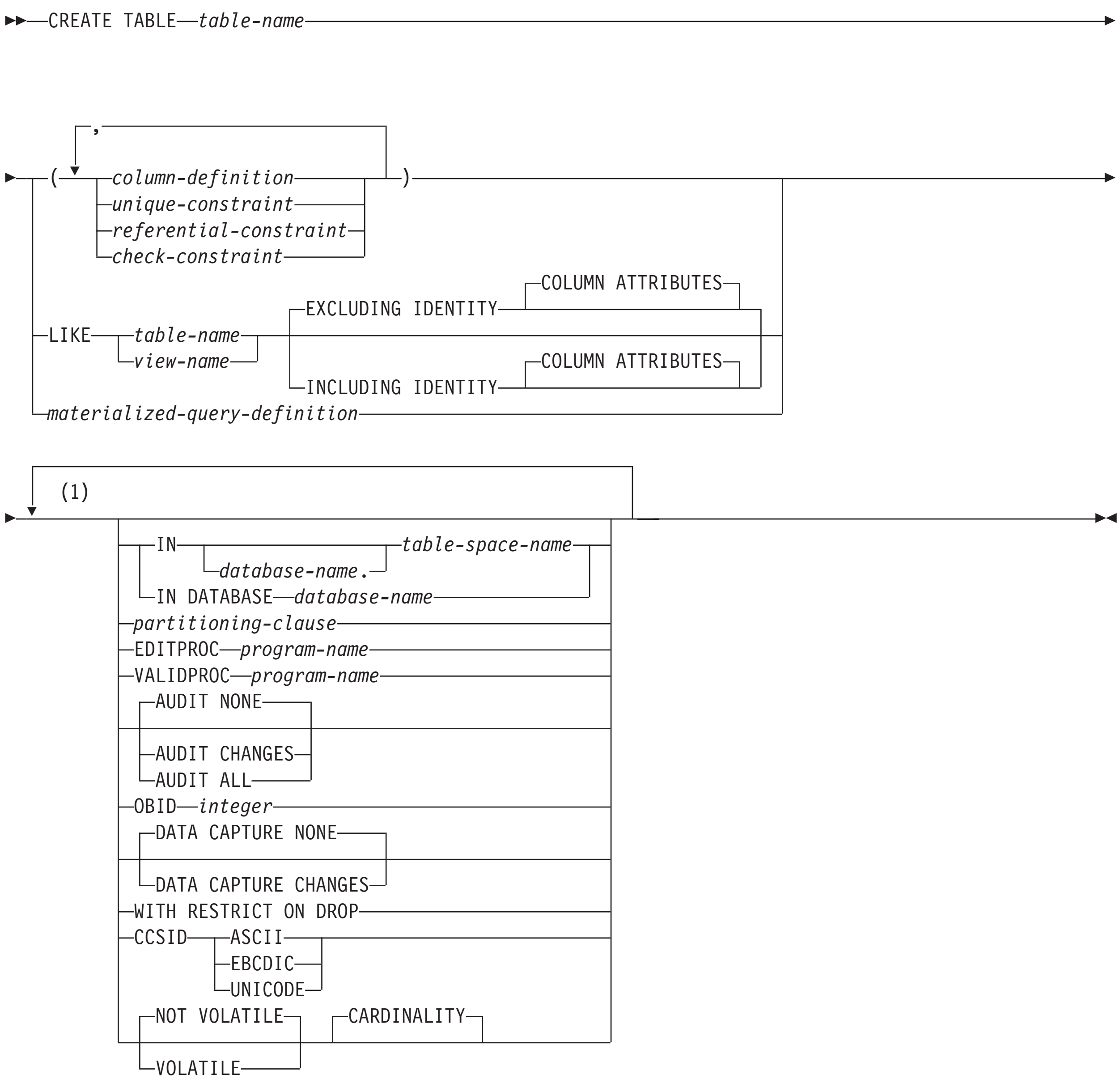
Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package.

- If the privilege set lacks SYSADM or SYSCTRL authority, DBADM authority for the database, or DBCTRL authority for the database, the qualifier (owner) of the table must be the same as the authorization ID of the owner of the plan or package.
- If the privilege set includes SYSADM or SYSCTRL authority, DBADM authority for the database, or DBCTRL authority for the database, the qualifier (owner) of the table can be any authorization ID.

If the statement is dynamically prepared, the privilege set is the privileges that are held by the SQL authorization ID of the process.

- If the privilege set lacks SYSADM or SYSCTRL authority, DBADM authority for the database, or DBCTRL authority for the database, the qualifier (owner) of the table must be the same as one of the authorization IDs of the process and the privilege set that is held by that authorization ID includes all privileges needed to create the table.
- If the privilege set includes SYSADM or SYSCTRL authority, DBADM authority for the database, or DBCTRL authority for the database, the qualifier (owner) of the table can be any authorization ID.

Syntax



```
►►──CREATE TABLE──table-name──────────────────────────────────────────────────►

        ┌─,──────────────────────────┐
        ▼                            │
►──┬─(──┬─column-definition──────────┴──)──────────────────────────────┬──────►
   │    ├─unique-constraint──────┤                                     │
   │    ├─referential-constraint─┤                                     │
   │    └─check-constraint───────┘                                     │
   │                                             ┌─COLUMN ATTRIBUTES─┐ │
   │                      ┌─EXCLUDING IDENTITY───┴───────────────────┴─┐ │
   ├─LIKE──┬─table-name─┬─┼────────────────────────────────────────────┼─┤
   │       └─view-name──┘ │                      ┌─COLUMN ATTRIBUTES─┐ │ │
   │                      └─INCLUDING IDENTITY───┴───────────────────┴─┘ │
   └─materialized-query-definition───────────────────────────────────────┘

   ┌──────────────────────────────────────────────────┐
   │ (1)                                              │
   ▼                                                  │
►─────────┬─┬─IN──┬────────────────┬─table-space-name─┬─┬──┴──────────────────►◄
          │ │     └─database-name.─┘                  │ │
          │ └─IN DATABASE──database-name──────────────┘ │
          ├─partitioning-clause─────────────────────────┤
          ├─EDITPROC──program-name──────────────────────┤
          ├─VALIDPROC──program-name─────────────────────┤
          │ ┌─AUDIT NONE────┐                           │
          ├─┼───────────────┼───────────────────────────┤
          │ ├─AUDIT CHANGES─┤                           │
          │ └─AUDIT ALL─────┘                           │
          ├─OBID──integer───────────────────────────────┤
          │ ┌─DATA CAPTURE NONE─────┐                   │
          ├─┼───────────────────────┼───────────────────┤
          │ └─DATA CAPTURE CHANGES──┘                   │
          ├─WITH RESTRICT ON DROP───────────────────────┤
          ├─CCSID──┬─ASCII───┬──────────────────────────┤
          │        ├─EBCDIC──┤                          │
          │        └─UNICODE─┘                          │
          │ ┌─NOT VOLATILE─┐  ┌─CARDINALITY─┐           │
          └─┼──────────────┼──┴─────────────┴───────────┘
            └─VOLATILE─────┘
```

Notes:

1 The same clause must not be specified more than once.

column-definition:

```
►►─column-name─data-type──────────────────────────────────────────────────────────►


   ┌────────────────────────────────────────────────────────────────┐
   ↓  (1)                                                           │
►──┴──────────┬─NOT NULL──────────────────────────────────────────┬─┴──────────►◄
              ├─column-constraint─────────────────────────────────┤
              │ ┌─WITH─┐                                          │
              ├─┴──────┴─DEFAULT─┬──────────────────────────────┬─┤
              │                  ├─constant─────────────────────┤ │
              │                  ├─USER─────────────────────────┤ │
              │                  ├─CURRENT SQLID────────────────┤ │
              │                  ├─NULL─────────────────────────┤ │
              │                  │ (2)                          │ │
              │                  └────cast-function-name─(─┬─constant──────┬─)─┘ │
              │                                            ├─USER──────────┤     │
              │                                            ├─CURRENT SQLID─┤     │
              │                                            └─NULL──────────┘     │
              │          (3)                                      │
              ├─GENERATED──────┬─ALWAYS─────┬──┬────────────────────┬─┤
              │                └─BY DEFAULT─┘  └─as-identity-clause─┘ │
              ├─FIELDPROC─program-name─┬────────────────────┬────────┤
              │                        │     ┌─,────────┐   │        │
              │                        │     ↓          │   │        │
              │                        └─(───constant───┴─)─┘        │
              │                    (4)                               │
              └─AS SECURITY LABEL────────────────────────────────────┘
```

Notes:

1 The same clause must not be specified more than once.

2 This form of the DEFAULT value can only be used with columns that are defined as a distinct type.

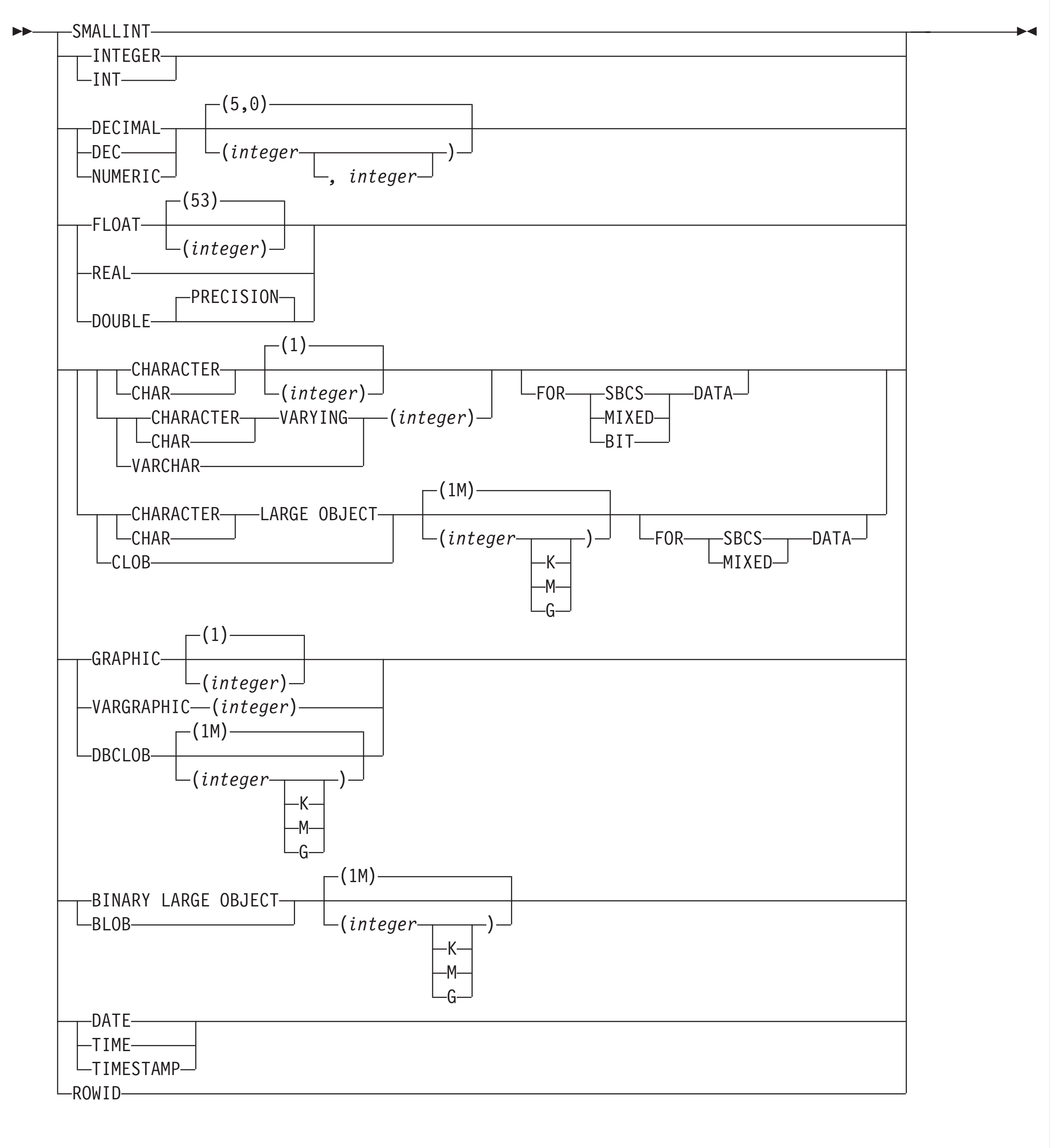
3 A column that has a ROWID data type (or a distinct type that is based on a ROWID data type) defaults to GENERATED ALWAYS.

4 This clause can be specified only for a CHAR(8) data type and requires that the NOT NULL and WITH DEFAULT clauses be specified.

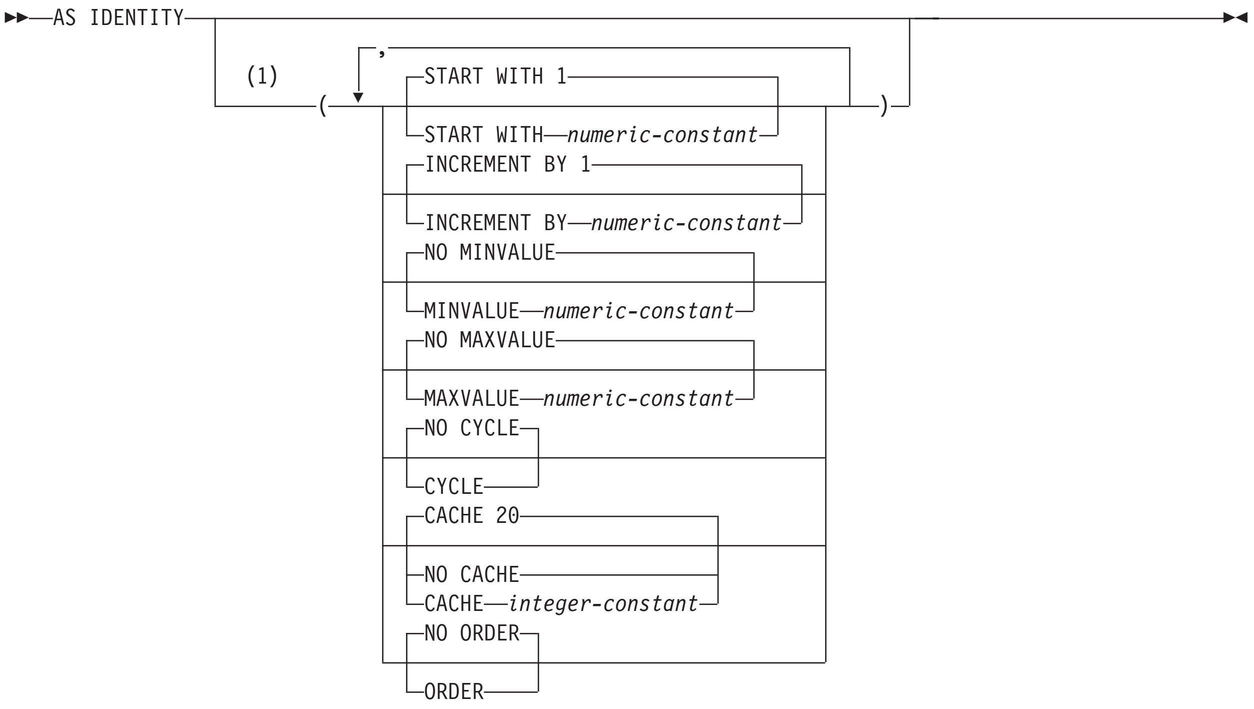
data-type:

```
►►──┬─built-in-type──────┬──────────────────────────────────────────────────────►◄
    └─distinct-type-name─┘
```

built-in-type:



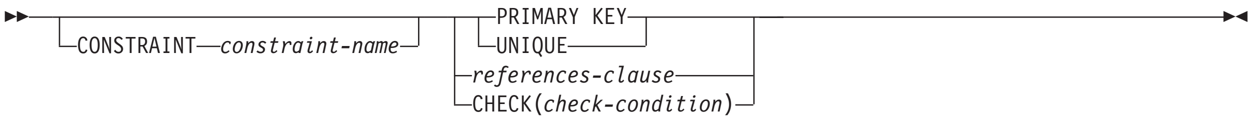
as-identity-clause:



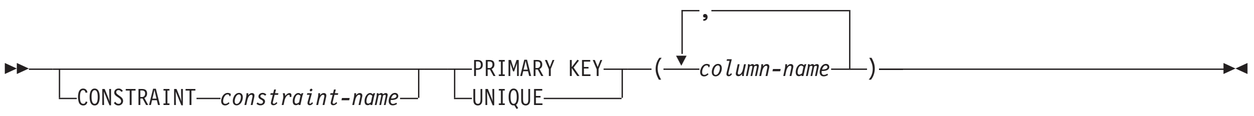
Notes:

1 Separator commas may or may not be specified between attributes when an identity column is defined.

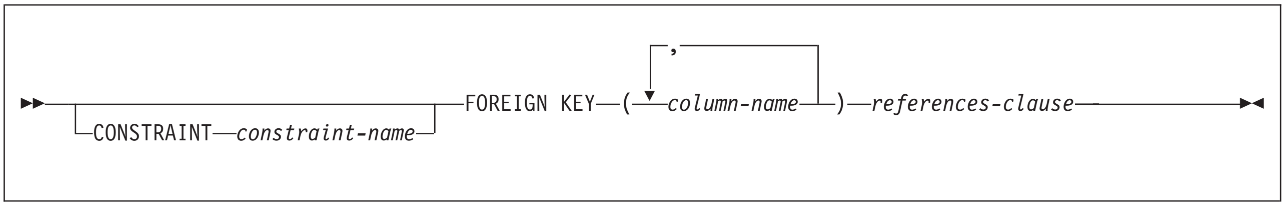
column-constraint:



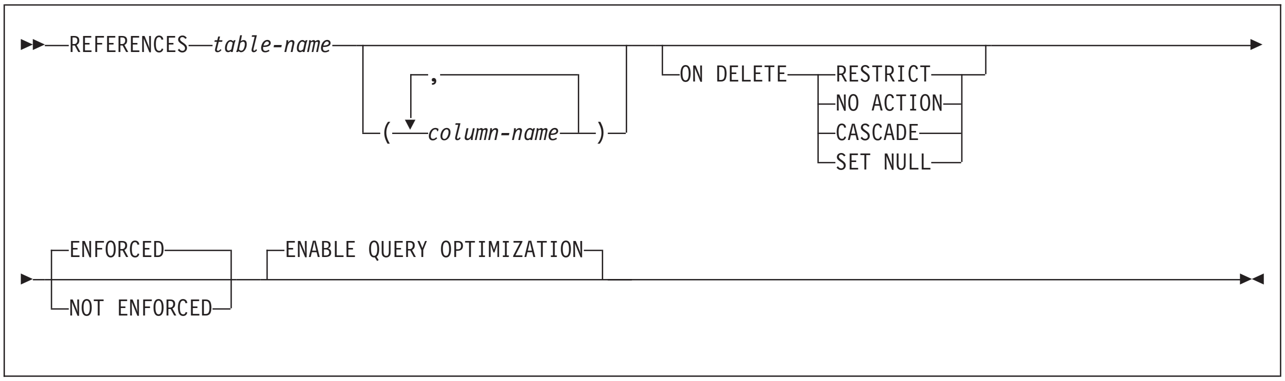
unique-constraint:



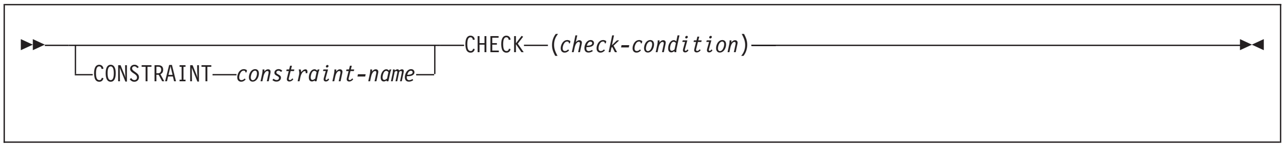
referential-constraint:



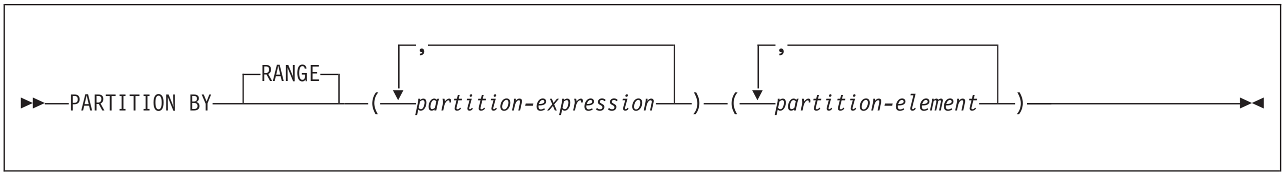
references-clause:



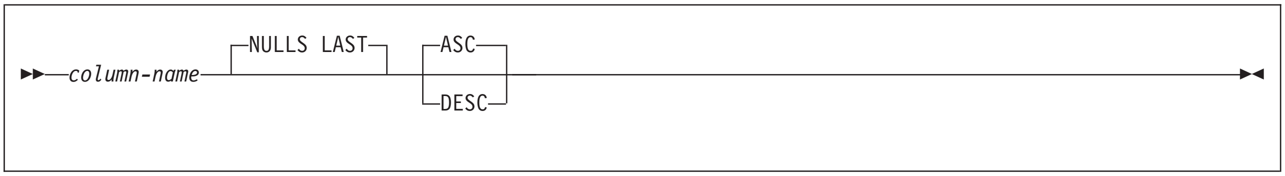
check-constraint:



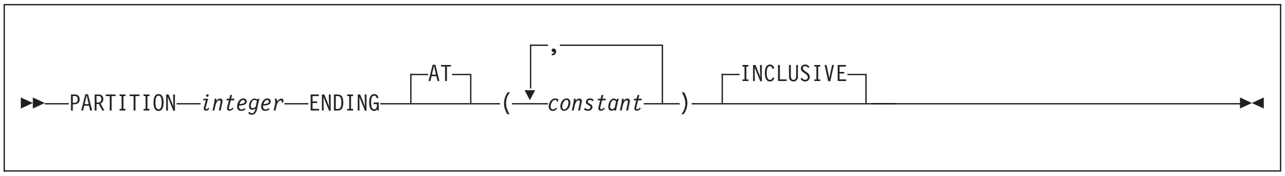
partitioning-clause:



partition-expression:



partition-element:



materialized-query-definition

```
>>─┬──────────────────────────┬─AS─(fullselect)─┬─WITH NO DATA─┬──────────────┬─┬──────────────────><
   │    ┌─,──────────┐        │                 │              └─copy-options─┘ │
   │    ▼            │        │                 └─refreshable-table-options──────┘
   └─(──┴─column-name─┴───)───┘
```

copy-options:

```
                            ┌─COLUMN ATTRIBUTES─┐                 ┌─COLUMN─┐
      ┌─EXCLUDING IDENTITY─┴───────────────────┴─┐   ┌─EXCLUDING─┴────────┴─DEFAULTS─┐
>>────┼──────────────────────────────────────────┼───┼───────────────────────────────┼──────────><
      │                     ┌─COLUMN ATTRIBUTES─┐ │   │              ┌─COLUMN─┐        │
      └─INCLUDING IDENTITY─┴───────────────────┴─┘   ├─INCLUDING─┴────────┴─DEFAULTS─┤
                                                      └─USING TYPE DEFAULTS───────────┘
```

refreshable-table-options:

```
                                            ┌──────────────────────────────────────┐
                                            ▼    (1)                               │
>>──DATA INITIALLY DEFERRED──REFRESH DEFERRED────┬──────────────────────────────────┬┴──────────><
                                                 │ ┌─MAINTAINED BY SYSTEM─┐          │
                                                 ├─┴─MAINTAINED BY USER───┘          │
                                                 │ ┌─ENABLE QUERY OPTIMIZATION──┐    │
                                                 └─┴─DISABLE QUERY OPTIMIZATION─┘────┘
```

Notes:

1 The same clause must not be specified more than once.

Description

table-name

Names the table. The name must not identify a table, view, alias, or synonym that exists at the current server.

If qualified, the name can be a two-part or three-part name. If a three-part name is used, the first part must match the value of field DB2 LOCATION NAME on installation panel DSNTIPR at the current server. (If the current server is not the local DB2, this name is not necessarily the name in the CURRENT SERVER special register.) Whether the name is two-part or three-part, the authorization ID that qualifies the name is the table's owner.

If the table name is unqualified and the statement is embedded in a program, the owner of the table is the authorization ID that serves as the implicit qualifier for unqualified object names. This is the authorization ID in the QUALIFIER operand when the plan or package was created or last rebound. If QUALIFIER was not used, the owner of the table is the owner of the package or plan.

If the table name is unqualified and the statement is dynamically prepared, the SQL authorization ID is the owner of the table.

The owner has all table privileges on the table (SELECT, UPDATE, and so on), and the authority to drop the table. All the owner's table privileges are grantable.

column-definition

Defines the attributes of a column. There must be at least one column definition.

column-name
Names a column of the table. For a dependent table, up to 749 columns can be named. For a table that is not a dependent, this number is 750. Do not qualify *column-name* and do not use the same name for more than one column of the table.

built-in-type
Specifies the data type of the column as one of the following built-in data types, and for character string data types, specifies the subtype. For more information about defining a table with a LOB column (CLOB, BLOB, or DBCLOB), see "Creating a table with LOB columns" on page 766.

SMALLINT
For a small integer.

INTEGER or **INT**
For a large integer.

DECIMAL(*integer,integer***)** or **DEC(***integer,integer***)**
DECIMAL(*integer***)** or **DEC(***integer***)**
DECIMAL or **DEC**
For a decimal number. The first integer is the precision of the number. That is, the total number of digits, which can range from 1 to 31. The second integer is the scale of the number. That is, the number of digits to the right of the decimal point, which can range from 0 to the precision of the number.

You can use DECIMAL(*p*) for DECIMAL(*p*,0) and DECIMAL for DECIMAL(5,0).

You can also use the word NUMERIC instead of DECIMAL. For example, NUMERIC(8) is equivalent to DECIMAL(8). Unlike DECIMAL, NUMERIC has no allowable abbreviation.

FLOAT(*integer***)**
FLOAT
For a floating-point number. If *integer* is between 1 and 21 inclusive, the format is single precision floating-point. If the integer is between 22 and 53 inclusive, the format is double precision floating-point.

You can use DOUBLE PRECISION or FLOAT for FLOAT(53).

REAL
For single precision floating-point.

DOUBLE or DOUBLE PRECISION
For double precision floating-point

CHARACTER(*integer***)** or **CHAR(***integer***)**

CHARACTER or **CHAR**
For a fixed-length character string of length *integer*, which can range from 1 to 255. If the length specification is omitted, a length of 1 character is assumed.

VARCHAR(*integer***)**, **CHAR VARYING(***integer***)**, or **CHARACTER VARYING(***integer***)**
For a varying-length character string of maximum length *integer*, which can range from 1 to the maximum record size minus 8 bytes. See Table 65 on page 767 to determine the maximum record size.

FOR *subtype* **DATA**
Specifies a subtype for a character string column, which is a column with a data type of CHAR, VARCHAR, or CLOB. Do not use the FOR *subtype* DATA clause with columns of any other data type (including any distinct type). *subtype* can be one of the following:

SBCS
Column holds single-byte data.

MIXED
Column holds mixed data. Do not specify MIXED if the value of field MIXED DATA on installation panel DSNTIPF is NO unless the CCSID UNICODE clause is also specified, or the table is being created in a Unicode table space or database.

BIT
Column holds BIT data. Do not specify BIT for a CLOB column.

If you do not specify the FOR clause, the column is defined with a default subtype. For ASCII or EBCDIC data:

- The default is SBCS when the value of field MIXED DATA on installation panel DSNTIPF is NO.
- The default is MIXED when the value is YES.

For Unicode data, the default subtype is MIXED.

| A security label column is always considered SBCS data, regardless of
| the encoding scheme of the table.

CLOB(*integer* [K|M|G]**), CHAR LARGE OBJECT(***integer* [K|M|G]**)**, or **CHARACTER LARGE OBJECT(***integer* [K|M|G]**)**
CLOB, CHAR LARGE OBJECT, or **CHARACTER LARGE OBJECT**
For a character large object (CLOB) string of the specified maximum length in bytes. The maximum length must be in the range of 1 to 2 147 483 647. A CLOB column has a varying-length. It cannot be referenced in certain contexts regardless of its maximum length. For more information, see “Restrictions using LOBs” on page 62.

The maximum value that can be specified for *integer* depends on whether a units indicator is also specified as shown in the following list.

integer	The maximum value for *integer* is 2 147 483 647. The maximum length of the string is *integer*.
integer K	The maximum value for *integer* is 2 097 152. The maximum length is 1024 times *integer*.
integer M	The maximum value for *integer* is 2048. The maximum length is 1 048 576 times *integer*.

integer G — The maximum value for *integer* is 2. The maximum length is 1 073 741 824 times *integer*.

If you specify a value that evaluates to 2 gigabytes (2 147 483 648), DB2 uses a value that is one byte less, or 2 147 483 647.

GRAPHIC(*integer***)**
GRAPHIC
For a fixed-length graphic string of length *integer*, which can range from 1 to 127. If the length specification is omitted, a length of 1 character is assumed.

VARGRAPHIC(*integer***)**
For a varying-length graphic string of maximum length *integer*, which must range from 1 to *n*/2, where *n* is the maximum row size minus 2 bytes.

DBCLOB(*integer* [K|M|G]**)**
DBCLOB
For a double-byte character large object (DBCLOB) string of the specified maximum length in double-byte characters. The maximum length must be in the range of 1 through 1 073 741 823. A DBCLOB column has a varying-length. It cannot be referenced in certain contexts regardless of its maximum length. For more information, see “Restrictions using LOBs” on page 62.

The meaning of *integer* K|M|G is similar to CLOB. The difference is that the number specified is the number of double-byte characters.

BLOB (*integer* [K|M|G] or **BINARY LARGE OBJECT(***integer* [K|M|G]**)**
BLOB or **BINARY LARGE OBJECT**
For a binary large object (BLOB) string of the specified maximum length in bytes. The maximum length must be in the range of 1 through 2 147 483 647. A BLOB column has a varying-length. It cannot be referenced in certain contexts regardless of its maximum length. For more information, see “Restrictions using LOBs” on page 62.

The meaning of *integer* K|M|G is the same as for CLOB.

DATE
For a date.

TIME
For a time.

TIMESTAMP
For a timestamp.

ROWID
For a row ID type.

A table can have only one ROWID column. The values in a ROWID column are unique for every row in the table and cannot be updated. You must specify NOT NULL with ROWID.

distinct-type-name
Specifies the data type of the column is a distinct type (a user-defined data type). The length, precision, and scale of the column are respectively the length, precision, and scale of the source type of the distinct type. The privilege set must implicitly or explicitly include the USAGE privilege on the distinct type.

The encoding scheme of the distinct type must be the same as the encoding scheme of the table. The subtype for the distinct type, if it has the attribute, is the subtype with which the distinct type was created.

If the column is to be used in the definition of the foreign key of a referential constraint, the data type of the corresponding column of the parent key must have the same distinct type.

NOT NULL

Prevents the column from containing null values. Omission of NOT NULL implies that the column can contain null values.

column-constraint

The *column-constraint* of a *column-definition*n provides a shorthand method of defining a constraint composed of a single column. Thus, if a *column-constraint* is specified in the definition of column C, the effect is the same as if that constraint were specified as a *unique-constraint*, *referential-constraint*, or *check-constraint* in which C is the only identified column.

CONSTRAINT *constraint-name*

Names the constraint. If a constraint name is not specified, a unique constraint name is generated. If the name is specified, it must be different from the names of any referential, check, primary key, or unique key constraints previously specified on the table.

PRIMARY KEY

Provides a shorthand method of defining a primary key composed of a single column. Thus, if PRIMARY KEY is specified in the definition of column C, the effect is the same as if the PRIMARY KEY(C) clause is specified as a separate clause.

The NOT NULL clause must be specified with this clause. PRIMARY KEY cannot be specified more than once in a column definition, and must not be specified if the UNIQUE clause is specified in the definition or if the definition is for a LOB or ROWID column (including a distinct type that is based on a ROWID data type) .

The table is marked as unavailable until its primary index is explicitly created unless the CREATE TABLE statement is processed by the schema processor. In that case, DB2 implicitly creates an index to enforce the uniqueness of the primary key and the table definition is considered complete. (For more information about implicitly created indexes, see “Implicitly created indexes” on page 769.)

UNIQUE

Provides a shorthand method of defining a unique key composed of a single column. Thus, if UNIQUE is specified in the definition of column C, the effect is the same as if the UNIQUE(C) clause is specified as a separate clause.

The NOT NULL clause must be specified with this clause. UNIQUE cannot be specified more than once in a column definition and must not be specified if the PRIMARY KEY clause is specified in the column definition or if the definition is for a LOB or ROWID column (including a distinct type that is based on a LOB or ROWID data type) .

The table is marked as unavailable until all the required indexes are explicitly created unless the CREATE TABLE statement is processed by the schema processor. In that case, DB2 implicitly creates the indexes that are required for the unique keys and the table definition is considered complete. (For more information about implicitly created indexes, see “Implicitly created indexes” on page 769.)

references-clause

The *references-clause* of a *column-definition* provides a shorthand method of defining a foreign key composed of a single column. Thus, if *references-clause* is specified in the definition of column C, the effect is the same as if that *references-clause* were specified as part of a FOREIGN KEY clause in which C is the only identified column.

Do not specify *references-clause* in the definition of a LOB, ROWID, or security label column; a LOB, ROWID, or security label column cannot be a foreign key.

CHECK *(check-condition)*

CHECK *(check-condition)* provides a shorthand method of defining a check constraint that applies to a single column. For conformance with the SQL standard, if CHECK is specified in the column definition of column C, no columns other than C should be referenced in the check condition of the check constraint. The effect is the same as if the check condition were specified as a separate clause.

DEFAULT

The default value assigned to the column in the absence of a value specified on INSERT or LOAD. Do not specify DEFAULT for the following types of columns because DB2 generates default values:

- A ROWID column (or a distinct type that is based on a ROWID)
- An identity column (a column that is defined AS IDENTITY)
- A security label column (a column that is defined AS SECURITY LABEL)

If a value is not specified after DEFAULT, the default value depends on the data type of the column, as follows:

Data Type	Default Value
Numeric	0
Fixed-length string	Blanks
Varying-length string	A string of length 0
Date	CURRENT DATE
Time	CURRENT TIME
Timestamp	CURRENT TIMESTAMP
Distinct type	The default of the source data type

A default value other than the one that is listed above can be specified in one of the following forms, except for a LOB column. The only form that can be specified for a LOB column is DEFAULT NULL. Unlike other varying-length strings, a LOB column can have the default value of only a zero-length string or null. Specify:

- WITH DEFAULT for a default value of an empty string
- DEFAULT NULL for a default value of null

Omission of NOT NULL and DEFAULT from a *column-definition*, for a column other than an identity column, is an implicit specification of DEFAULT NULL. For an identity column, it is an implicit specification of NOT NULL, and DB2 generates default values.

constant

Specifies a constant as the default value for the column. The value of the constant must conform to the rules for assigning that value to the column.

A character or graphic string constant must be short enough so that its UTF-8 representation requires no more than 1536. In addition, a hexadecimal graphic string constant (GX) cannot be specified.

USER
Specifies the value of the USER special register at the time of INSERT or LOAD as the default value for the column. If USER is specified, the data type of the column must be a character string with a length attribute greater than or equal to the length attribute of the USER special register.

CURRENT SQLID
Specifies the value of the SQL authorization ID of the process at the time of INSERT or LOAD as the default value for the column. If CURRENT SQLID is specified, the data type of the column must be a character string with a length attribute greater than or equal to the length attribute of the CURRENT SQLID special register.

NULL
Specifies null as the default value for the column. If NOT NULL is specified, DEFAULT NULL must not be specified with the same *column-definition*.

cast-function-name
The name of the cast function that matches the name of the distinct type for the column. A cast function can only be specified if the data type of the column is a distinct type.

The schema name of the cast function, whether it is explicitly specified or implicitly resolved through function resolution, must be the same as the explicitly or implicitly specified schema name of the distinct type.

constant
Specifies a constant as the argument. The constant must conform to the rules of a constant for the source type of the distinct type.

USER
Specifies the value of the USER special register at the time a row is inserted as the default for the column. The source type of the distinct type of the column must be a CHAR or VARCHAR with a length attribute that is greater than or equal to the length attribute of the USER special register.

CURRENT SQLID
Specifies the value of the CURRENT SQLID special register at the time a row is inserted as the default for the column. The source type of the distinct type of the column must be a CHAR or VARCHAR with a length attribute that is greater than or equal to the length attribute of the CURRENT SQLID special register.

NULL
Specifies the NULL value as the argument.

In a given column definition:

- DEFAULT and FIELDPROC cannot both be specified.
- NOT NULL and DEFAULT NULL cannot both be specified.

Table 64 on page 747 summarizes the effect of specifying the various combinations of the NOT NULL and DEFAULT clauses on the CREATE TABLE statement *column-description* clause.

Table 64. Effect of specifying combinations of the NOT NULL and DEFAULT clauses

If NOT NULL is:	And DEFAULT is:	The effect is:
Specified[1]	Omitted	An error occurs if a value is not provided for the column on INSERT or LOAD.
	Specified without an operand	The system defined nonnull default value is used.
	constant	The specified constant is used as the default value.
	USER	The value of the USER special register at the time of INSERT or LOAD is used as the default value.
	CURRENT SQLID	The SQL authorization ID of the process at the time of INSERT or LOAD is used as the default value.
	NULL	An error occurs during the execution of CREATE TABLE.
Omitted	Omitted	Equivalent to an implicit specification of DEFAULT NULL.
	Specified without an operand	The system defined nonnull default value is used.
	constant	The specified constant is used as the default value.
	USER	The value of the USER special register at execution time is used as the default value.
	CURRENT SQLID	The SQL authorization ID of the process is used as the default value.
	NULL	Null is used as the default value.

Note: The table does not apply to a column with a ROWID data type or to an identity column.

GENERATED

Specifies that DB2 generates values for the column. GENERATED must be specified if the column is to be considered an identity column. If the data type of the column is a ROWID (or a distinct type that is based on a ROWID), the default is GENERATED ALWAYS.

ALWAYS

Specifies that DB2 will always generate a value for the column when a row is inserted into the table. ALWAYS is the recommended value unless you are using data propagation.

BY DEFAULT

Specifies that DB2 will generate a value for the column when a row is inserted into the table unless a value is specified.

For a ROWID column, DB2 uses a specified value only if it is a valid row ID value that was previously generated by DB2 and the column has a unique, single-column index. Until this index is created on the ROWID column, the SQL INSERT statement and the LOAD utility cannot be used to add rows to the table. If the value of special register CURRENT RULES is 'STD' when the CREATE TABLE statement is processed, DB2 implicitly creates the index on the ROWID column. The name of this index is 'I' followed by the first ten characters of the column name followed by seven randomly generated characters. If the column name is less than ten characters, DB2 adds underscore characters to the end of the name until it has ten characters. The implicitly created index has the COPY NO attribute.

For an identity column, DB2 inserts a specified value but does not verify that it a unique value for the column unless the identity column has a unique, single-column index.

BY DEFAULT is the recommended value only when you are using data propagation.

AS IDENTITY

Specifies that the column is an identity column for the table. A table can have only one identity column. AS IDENTITY can be specified only if the data type for the column is an exact numeric type with a scale of zero (SMALLINT, INTEGER, DECIMAL with a scale of zero, or a distinct type based on one of these types).

An identity column is implicitly NOT NULL. An identity column cannot have a WITH DEFAULT clause.

START WITH *numeric-constant*

Specifies the first value that is generated for the identity column. The value can be any positive or negative value that could be assigned to the column without non-zero digits existing to the right of the decimal point.

If a value is not explicitly specified when the identity column is defined, the default is the MINVALUE for an ascending identity column and the MAXVALUE for a descending identity column. This value is not necessarily the value that would be cycled to after reaching the maximum or minimum value for the identity column. The START WITH clause can be used to start the generation of values outside the range that is used for cycles. The range used for cycles is defined by MINVALUE and MAXVALUE.

INCREMENT BY *numeric-constant*

Specifies the interval between consecutive values of the identity column. The value can be any positive or negative value (including 0) that does not exceed the value of a large integer constant, and could be assigned to the column without any non-zero digits existing to the right of the decimal point. The default is 1.

If this value is negative, the values for the identity column descend. If this value is 0 or positive, the values for the identity column ascend. The default is 1.

MINVALUE or **NO MINVALUE**

Specifies the minimum value at which a descending identity column either cycles or stops generating values or an ascending identity column cycles to after reaching the maximum value. The default is NO MINVALUE.

NO MINVALUE

Specifies that the minimum end point of the range of values for the identity column has not be set. In such a case, the default value for MINVALUE becomes one of the following:

- For an ascending identity column, the value is the START WITH value or 1 if START WITH is not specified.

- For a descending identity column, the value is the minimum value of the data type of the column.

MINVALUE *numeric-constant*

Specifies the numeric constant that is the minimum value that is generated for this identity column. This value can be any positive or negative value that could be assigned to this column without non-zero digits existing to the right of the decimal point. The value must be less than or equal to the maximum value.

MAXVALUE or **NO MAXVALUE**

Specifies the maximum value at which an ascending identity column either cycles or stops generating values or a descending identity column cycles to after reaching the minimum value. The default is NO MINVALUE.

NO MAXVALUE

Specifies that the minimum end point of the range of values for the identity column has not be set. In such a case, the default value for MAXVALUE becomes one of the following:

- For an ascending identity column, the value is the maximum value of the data type associated with the column.
- For a descending identity column, the value is the START WITH value -1 if START WITH is not specified.

MAXVALUE *numeric-constant*

Specifies the numeric constant that is the maximum value that is generated for this identity column. This value can be any positive or negative value that could be assigned to this column without non-zero digits existing to the right of the decimal point. The value must be greater than or equal to the minimum value.

CYCLE or **NO CYCLE**

Specifies whether this identity column should continue to generate values after reaching either its maximum or minimum value. The default is NO CYCLE.

NO CYCLE

Specifies that values will not be generated for the identity column after the maximum or minimum value has been reached.

CYCLE

Specifies that values continue to be generated for the identity column after the maximum or minimum value has been reached. If this option is used, after an ascending identity column reaches the maximum value, it generates its minimum value. After a descending identity column reaches its minimum value, it generates its maximum value. The maximum and minimum values for the identity column determine the range that is used for cycling.

When CYCLE is in effect, duplicate values can be generated by DB2 for an identity column. However, if a unique index exists on the identity column and a non-unique value is generated for it, an error occurs.

CACHE or **NO CACHE**

Specifies whether to keep some preallocated values in memory.

Preallocating and storing values in the cache improves the performance of inserting rows into a table. The default is CACHE 20.

NO CACHE
Specifies that values for the identity column are not preallocated and stored in the cache, ensuring that values will not be lost in the case of a system failure. In this case, every request for a new value for the identity column results in synchronous I/O.

In a data sharing environment, use NO CACHE if you need to guarantee that the identity values are generated in the order in which they are requested.

CACHE *integer-constant*
Specifies the maximum number of values of the identity column sequence that DB2 can preallocate and keep in memory.

During a system failure, all cached identity column values that are yet to be assigned might be lost and will not be used. Therefore, the value that is specified for CACHE also represents the maximum number of values for the identity column that could be lost during a system failure.

The minimum value is 2.

In a data sharing environment, you can use the CACHE and NO ORDER options to allow multiple DB2 members to cache sequence values simultaneously.

ORDER or **NO ORDER**
Specifies whether the identity column values must be generated in order of request. The default is NO ORDER.

NO ORDER
Specifies that the values do not need to be generated in order of request.

ORDER
Specifies that the values are generated in order of request. Specifying ORDER may disable the caching of values. ORDER applies only to a single-application process.

In a data sharing environment, if the CACHE and NO ORDER options are in effect, multiple caches can be active simultaneously, and the requests for identity values from different DB2 members may not result in the assignment of values in strict numeric order. For example, if members DB2A and DB2B are using the identity column, and DB2A gets the cache values 1 to 20 and DB2B gets the cache values 21 to 40, the actual order of values assigned would be 1,21,2 if DB2A requested a value first, then DB2B requested, and then DB2A again requested. Therefore, to guarantee that identity values are generated in strict numeric order among multiple DB2 members using the same identity column, specify the ORDER option.

FIELDPROC *program-name*
Designates *program-name* as the field procedure exit routine for the column. Writing a field procedure exit routine is described in Appendix B (Volume 2) of *DB2 Administration Guide*. A field procedure can be specified

only for a column with a length attribute that is not greater than 255 bytes, and the column must not be a security label column. For more information about string comparisons with field procedures, see "Character and graphic string comparisons" on page 84.

The field procedure encodes and decodes column values: before a value is inserted in the column, it is passed to the field procedure for encoding. Before a value from the column is used by a program, it is passed to the field procedure for decoding. A field procedure could be used, for example, to alter the sorting sequence of values entered in the column.

The field procedure is also invoked during the processing of the CREATE TABLE statement. When so invoked, the procedure provides DB2 with the column's *field description*. The field description defines the data characteristics of the encoded values. By contrast, the information you supply for the column in the CREATE TABLE statement defines the data characteristics of the decoded values.

constant
Is a parameter that is passed to the field procedure when it is invoked. A parameter list is optional. The *n*th parameter specified in the FIELDPROC clause on CREATE TABLE corresponds to the *n*th parameter of the specified field procedure. The maximum length of the parameter list is 254 bytes, including commas but excluding insignificant blanks and the delimiting parentheses.

If you omit FIELDPROC, the column has no field procedure.

AS SECURITY LABEL
Specifies that the column will contain security label values. This also indicates that the table is defined with multilevel security with row level granularity. A table can have only one security label column. To define a table with a security label column, the primary authorization ID of the statement must have a valid security label, and the RACF SECLABEL class must be active. In addition, the following conditions are also required:

- The data type of the column must be CHAR(8).
- The subtype of the column must be SBCS.
- The column must be defined with the NOT NULL and WITH DEFAULT clauses.
- No field procedures, check constraints, or referential constraints are defined on the column.
- An edit procedure is not defined on the table.
- You are using z/OS Version 1 Release 5 or later.

For information about using multilevel security, see Part 3 (Volume 1) of *DB2 Administration Guide*.

End of column-definition

unique-constraint

CONSTRAINT *constraint-name*
Names the constraint. If a constraint name is not specified, a unique constraint name is generated. If a name is specified, it must be different from the names of any referential, check, primary key, or unique key constraints previously specified on the table.

PRIMARY KEY(*column-name,...***)**
Defines a primary key composed of the identified columns. The clause must not be specified more than once and the identified columns must be defined as NOT NULL. Each *column-name* must be an unqualified name that identifies a column of the table except a LOB or ROWID column (including a distinct type that is based on a LOB or ROWID), and the same column must not be identified more than once. The number of identified columns must not exceed 64. In addition, the sum of the length attributes of the columns must not be greater than 2000 -*2m*, where *m* is the number of varying-length columns in the key.

The table is marked as unavailable until its primary index is explicitly created unless the CREATE TABLE statement is processed by the schema processor. In that case, DB2 implicitly creates an index to enforce the uniqueness of the primary key and the table definition is considered complete. (For more information about implicitly created indexes, see “Implicitly created indexes” on page 769.)

UNIQUE(*column-name***,...)**
Defines a unique key composed of the identified columns. Each *column-name* must be an unqualified name that identifies a column of the table except a LOB column, and the same column must not be identified more than once. Each identified column must be defined as NOT NULL. The number of identified columns must not exceed 64. In addition, the sum of the length attributes of the columns must not be greater than 2000 -*2m*, where *m* is the number of varying-length columns in the key.

A unique key is a duplicate if it is the same as the primary key or a previously defined unique key. The specification of a duplicate unique key is ignored with a warning.

The table is marked as unavailable until all the required indexes are explicitly created unless the CREATE TABLE statement is processed by the schema processor. In that case, DB2 implicitly creates the indexes that are required for the unique keys and the table definition is considered complete. (For more information about implicitly created indexes, see “Implicitly created indexes” on page 769.)

End of unique-constraint

referential-constraint

CONSTRAINT *constraint-name*
Names the referential constraint. If a constraint name is not specified, a unique constraint name is generated. If a name is specified, it must be different from the names of any referential, check, primary key, or unique key constraints previously specified on the table.

FOREIGN KEY (*column-name,...***) references-clause**
Each specification of the FOREIGN KEY clause defines a referential constraint .

The foreign key of the referential constraint is composed of the identified columns. Each *column-name* must be an unqualified name that identifies a column of the table except a LOB, ROWID, or security label column, and the same column must not be identified more than once. The number of identified columns must not exceed 64, and the sum of their length attributes must not exceed 255 minus the number of columns that allow null values. The referential constraint is a duplicate if the FOREIGN KEY and parent table are the same as the FOREIGN KEY and parent table of a previously defined referential constraint. The specification of a duplicate referential constraint is ignored with a warning.

End of referential-constraint

references-clause

REFERENCES *table-name (column-name,...)*

The table name specified after REFERENCES must identify a table that exists at the current server[30], but it must not identify a catalog table or a declared global temporary table. In the following discussion, let T2 denote an identified table and let T1 denote the table that you are creating (T1 and T2 cannot be the same table[30]).

T2 must have a unique index and the privilege set must include the ALTER or REFERENCES privilege on the parent table, or the REFERENCES privilege on the columns of the nominated parent key.

The parent key of the referential constraint is composed of the identified columns. Each *column-name* must be an unqualified name that identifies a column of T2. The identified column cannot be a LOB, ROWID, or security label column. The same column must not be identified more than once.

The list of column names in the parent key must be identical to the list of column names in a primary key or unique key in the parent table T2. The column names must be specified in the *same order* as in the primary key or unique key.

If a list of column names is not specified, then T2 must have a primary key. Omission of a list of column names is an implicit specification of the columns of the primary key for T2.

The specified foreign key must have the same number of columns as the parent key of T2 and, except for their names, default values, null attributes and check constraints, the description of the *n*th column of the foreign key must be identical to the description of the *n*th column of the nominated parent key. If the foreign key includes a column defined as a distinct type, the corresponding column of the nominated parent key must be the same distinct type. If a column of the foreign key has a field procedure, the corresponding column of the nominated parent key must have the same field procedure and an identical field description. A field description is a description of the encoded value as it is stored in the database for a column that has been defined to have an associated field procedure.

The referential constraint specified by a FOREIGN KEY clause defines a relationship in which T2 is the parent and T1 is the dependent. A description of the referential constraint is recorded in the catalog.

ON DELETE

The delete rule of the relationship is determined by the ON DELETE clause. For more on the concepts used here, see “Referential constraints” on page 8.

SET NULL must not be specified unless some column of the foreign key allows null values. The default value for the rule depends on the value of the CURRENT RULES special register when the CREATE TABLE statement is

[30] This restriction is relaxed when the statement is processed by the schema processor and the other table is created within the same CREATE SCHEMA.

processed. If the value of the register is 'DB2', the delete rule defaults to RESTRICT; if the value is 'STD', the delete rule defaults to NO ACTION.

The delete rule applies when a row of T2 is the object of a DELETE or propagated delete operation and that row has dependents in T1. Let *p* denote such a row of T2. Then:

- If RESTRICT or NO ACTION is specified, an error occurs and no rows are deleted.
- If CASCADE is specified, the delete operation is propagated to the dependents of *p* in T1.
- If SET NULL is specified, each nullable column of the foreign key of each dependent of *p* in T1 is set to null.

Let T3 denote a table identified in another FOREIGN KEY clause (if any) of the CREATE TABLE statement. The delete rules of the relationships involving T2 and T3 must be the same and must not be SET NULL if:

- T2 and T3 are the same table.
- T2 is a descendent of T3 and the deletion of rows from T3 cascades to T2.
- T2 and T3 are both descendents of the same table and the deletion of rows from that table cascades to both T2 and T3.

ENFORCED or **NOT ENFORCED**

Indicates whether or not the referential constraint is enforced by DB2 during normal operations, such as insert, update, or delete.

ENFORCED

Specifies that the referential constraint is enforced by the DB2 during normal operations (such as insert, update, or delete) and that it is guaranteed to be correct. This is the default.

NOT ENFORCED

Specifies that the referential constraint is not enforced by DB2 during normal operations, such as insert, update, or delete. This option should only be used when the data that is stored in the table is verified to conform to the constraint by some other method than relying on the database manager.

ENABLE QUERY OPTIMIZATION

Specifies that the constraint can be used for query optimization. DB2 uses the information in query optimization using materialized query tables with the assumption that the constraint is correct. This is the default.

End of references-clause

check-constraint

CONSTRAINT *constraint-name*

Names the check constraint. The constraint name must be different from the names of any referential, check, primary key, or unique key constraints previously specified on the table.

If constraint-name is not specified, a unique constraint name is derived from the name of the first column in the check-condition specified in the definition of the check constraint.

CHECK (*check-condition***)**

Defines a check constraint. At any time, the *check-condition* must be true or unknown for every row of the table. A *check-condition* can evaluate to unknown if a column that is an operand of the predicate is null. A *check-condition* that evaluates to unknown does not violate the check constraint. A *check-condition* is a search condition, with the following restrictions:

- It can refer only to columns of table *table-name*; however, the columns cannot be LOB, ROWID, or security label columns (including distinct types that are based on LOB and ROWID data types).
- It can be up to 3800 bytes long, not including redundant blanks.
- It must not contain any of the following:
  - Subselects
  - Built-in or user-defined functions
  - Cast functions other than those created when the distinct type was created
  - Host variables
  - Parameter markers
  - Special registers
  - Columns that include a field procedure
  - CASE expressions
  - Row expressions
  - DISTINCT predicates
  - GX literals (hexadecimal graphic string constants)
- If a check-condition refers to a LOB column (including a distinct type that is based on a LOB), the reference must occur within a LIKE predicate.
- The AND and OR logical operators can be used between predicates. The NOT logical operator cannot be used.
- The first operand of every predicate must be the column name of a column in the table.
- The second operand in the check-condition must be either a constant or a column name of a column in the table.
  - If the second operand of a predicate is a constant, and if the constant is:
    - A floating-point number, then the column data type must be floating point.
    - A decimal number, then the column data type must be either floating point or decimal.
    - An integer number, then the column data type must not be a small integer.
    - A small integer number, then the column data type must be small integer.
    - A decimal constant, then its precision must not be larger than the precision of the column.
  - If the second operand of a predicate is a column, then both columns of the predicate must have:
    - The same data type.
    - Identical descriptions with the exception that the specification of the NOT NULL and DEFAULT clauses for the columns can be different, and that string columns with the same data type can have different length attributes

End of check-constraint

LIKE *table-name* or *view-name*
Specifies that the columns of the table have exactly the same name and description as the columns of the identified table or view. The name specified after LIKE must identify a table or view that exists at the current server or a

declared temporary table. The privilege set must implicitly or explicitly include the SELECT privilege on the identified table or view. If the identified table or view contains a column with a distinct type, the USAGE privilege on the distinct type is also needed. An identified table must not be an auxiliary table. An identified view must not include a column that is an explicitly defined ROWID column (including a distinct type that is based on a ROWID) or an identity column. (For more information, see “Notes” on page 726.)

The use of LIKE is an implicit definition of *n* columns, where *n* is the number of columns in the identified table or view. The implicit definition includes all attributes of the *n* columns as they are described in SYSCOLUMNS with these exceptions:

- When a table is identified in the LIKE clause and a column in the table has a field procedure, the corresponding column of the new table has the same field procedure and the field description. However, the field procedure is not invoked during the execution of the CREATE TABLE statement. When a view is identified in the LIKE clause, none of the columns of the new table will have a field procedure. This is true even in the case that a column of a base table underlying the view has a field procedure defined.
- When a table is identified in the LIKE clause and a column in the table is an identity column, the corresponding column of the new table inherits only the data type of the identity column; none of the identity attributes of the column are inherited unless the INCLUDING IDENTITY clause is specified.
- When a table is identified in the LIKE clause and a column in the table is a security label column, the corresponding column of the new table inherits only the data type of the security label column; none of the security label attributes of the column are inherited.
- When a table is identified in the LIKE clause and the table contains a ROWID column (explicitly-defined, hidden, or both), the corresponding columns of the new table inherits the ROWID columns.
- When a view is identified in the LIKE clause, the default value that is associated with the corresponding column of the new table depends on the column of the underlying base table for the view. If the column of the base table does not have a default, the new column does not have a default. If the column of the base table has a default, the default of the new column is:
  - Null if the column of the underlying base table allows nulls.
  - The default for the data type of the underlying base table if the underlying base table does not allow nulls.

  The above defaults are chosen regardless of the current default of the base table column.
- When a table that uses table-controlled partitioning is identified in the LIKE clause, the new table does not inherit that table’s partitioning scheme. If desired, these partition boundaries can be added by specifying ALTER TABLE with the ADD PARTITION BY RANGE clause.
- The CCSID of the column is determined by the implicit or explicit CCSID clause. For more information, see the CCSID clause.

The implicit definition does not include any other attributes of the identified table or view. For example, the new table does not have a primary key or foreign key. The table is created in the table space implicitly or explicitly specified by the IN clause, and the table has any other optional clause only if the optional clause is specified.

EXCLUDING IDENTITY COLUMN ATTRIBUTES or **INCLUDING IDENTITY COLUMN ATTRIBUTES**

Specifies whether identity column attributes are inherited from the definition of the source of the result table.

EXCLUDING IDENTITY COLUMN ATTRIBUTES

Specifies that identity column attributes are not inherited from the source result table definition. This is the default.

INCLUDING IDENTITY COLUMN ATTRIBUTES

Specifies that, if available, identity column attributes (such as START WITH, INCREMENT BY, and CACHE values) are inherited from the definition of the source table. These attributes can be inherited if the element of the corresponding column in the table, view, or *fullselect* is the name of a column of a table or the name of a column of a view that directly or indirectly maps to the column name of a base table with the identity attribute. In other cases, the columns of the new temporary table do not inherit the identity attributes. The columns of the new table do not inherit the identity attributes in the following cases:

- The select list of the *fullselect* includes multiple instances of an identity column name (that is, selecting the same column more than once).
- The select list of the *fullselect* includes multiple identity columns (that is, it involves a join).
- The identity column is included in an expression in the select list.
- The *fullselect* includes a set operation (union).

WITH RESTRICT ON DROP

Indicates that the table can be dropped only by using REPAIR DBD DROP. In addition, the database and table space that contain the table can be dropped only by using REPAIR DBD DROP.

IN *database-name.table-space-name* or **IN DATABASE** *database-name*

Names the database and table space in which the table is created. Both forms are optional; the default is IN DATABASE DSNDB04.

You can name a database (with *database-name*), a table space (with *table-space-name*), or both. If you name a database, it must be described in the current server's catalog, and must not be DSNDB06 or a work file database.

If you use IN DATABASE, either explicitly or by default, a table space is implicitly created in *database-name*. The name of the table space is derived from the table name. Its other attributes are those it would have if it were created by a CREATE TABLESPACE statement with all optional clauses omitted.

If you name a table space, it must not be one that was created implicitly, be a partitioned table space that already contains a table, or be a LOB table space. If you name a partitioned table space, you cannot load or use the table until its partitioned index is created.

If you name both a database and a table space, the table space must belong to the database you name. If you name only a table space, it must belong to database DSNDB04.

To create a table space implicitly, the privilege set must have: SYSADM or SYSCTRL authority; DBADM, DBCTRL, or DBMAINT authority for the database; or the CREATETS privilege for the database. You must also have the USE privilege for the database's default buffer pool and default storage group.

If you name a table space, you must have SYSADM or SYSCTRL authority, DBADM authority for the database, or the USE privilege for the table space.

partitioning-clause

PARTITION BY RANGE

Specifies the range partitioning scheme for the table (the columns used to partition the data). When this clause is specified, the table space is complete, and it is not necessary to create a partitioned index on the table. If this clause is used, the ENDING AT clause cannot be used on a subsequent CREATE INDEX statement for this table.

If this clause is specified, the IN *database-name.table-space-name* clause is required. This clause applies only to tables in a partitioned table space.

partition-expression

Specifies the key data over which the range is defined to determine the target data partition of the data.

column-name

Specifies the columns of the key. Each *column-name* must identify a column of the table. Do not specify more than 64 columns, the same column more than once, a LOB column, a column with a distinct type that is based on a LOB data type, or a qualified column name. The sum of length attributes of the columns must not be greater than 255 - *n*, where *n* is the number of columns that can contain null values.

NULLS LAST

Specifies that null values are treated as positive infinity for purposes of comparison.

ASC

Puts the entries in ascending order by the column. ASC is the default.

DESC

Puts the entries in descending order by the column.

partition-element

Specifies ranges for a data partitioning key and the table space where rows of the table in the range will be stored.

PARTITION *integer*

integer is the physical number of a partition in the table space. A PARTITION clause must be specified for every partition of the table space. In this context, highest means highest in the sorting sequences of the columns. In a column defined as ascending (ASC), highest and lowest have their usual meanings. In a column defined as descending (DESC), the lowest actual value is highest in the sorting sequence.

ENDING AT*(constant, ...)*

constant defines the limit key for a partition boundary. Specify at least one constant after ENDING AT in each PARTITION clause. You can use as many constants as there are columns in the key. The concatenation of all the constants is the highest value of the key for ascending and the lowest for descending. The use of constants to define key values is subject to the following rules:

- The first constant corresponds to the first column of the key, the second constant to the second column, and so on. Each constant must conform to the rules for assigning that value to the column. A hexadecimal string constant (GX) cannot be specified.

Using fewer constants than there are columns in the key has the same effect as using the highest or lowest values for the omitted columns, depending on whether they are ascending or descending.

- The highest value of the key in any partition must be lower than the highest value of the key in the next partition for ascending cases.
- The constants specified for the last partition are enforced. The value specified for the last partition is the highest value of the key that can be placed in the table. Any key values greater than the value specified for the last partition are out of range.
- The precision and scale of a decimal constant must not be greater than the precision and scale of its corresponding column.
- If a string constant is longer or shorter than required by the length attribute of its column, the constant is either truncated or padded on the right to the required length. If the column is ascending, the padding character is X'FF'. If the column is descending, the padding character is X'00'.
- If a key includes a ROWID column or a column with a distinct type that is based on a ROWID data type, then 17 bytes of the constant that is specified for the corresponding ROWID column are considered.

INCLUSIVE
Specifies that the specified range values are included in the data partition.

End of partitioning-clause

EDITPROC *program-name*
Designates *program-name* as the edit routine for the table. The edit routine, which must be provided by the current server's site, is invoked during the execution of LOAD, INSERT, UPDATE, and all row retrieval operations on the table.

An edit routine receives an entire table row, and can transform that row in any way. Also, it receives a transformed row and must change the row back to its original form. For information on writing an EDITPROC exit routine, see Appendix B (Volume 2) of *DB2 Administration Guide*.

You must not specify an edit routine for a table with a LOB, ROWID, identity column, or security label column.

If you omit EDITPROC, the table has no edit procedure.

VALIDPROC *program-name*
Designates *program-name* as the validation exit routine for the table. Writing a validation exit routine is described in Appendix B (Volume 2) of *DB2 Administration Guide*.

The validation routine can inhibit a load, insert, update, or delete operation on any row of the table: before the operation takes place, the procedure is passed the row. The values represented by any LOB columns in the table are not passed. On an insert or update operation, if the table has a security label column and the user does not have write-down privilege, the user's security label value is passed to the validation routine as the value of the column. After examining the row, the procedure returns a value that indicates whether the operation should proceed. A typical use is to impose restrictions on the values that can appear in various columns.

A table can have only one validation procedure at a time. In an ALTER TABLE statement, you can designate a replacement procedure or discontinue the use of a validation procedure.

If you omit VALIDPROC, the table has no validation routine.

AUDIT

Identifies the types of access to this table that causes auditing to be performed. For information about audit trace classes, see Part 3 (Volume 1) of *DB2 Administration Guide*.

If a materialized query table is refreshed with the REFRESH TABLE statement, the auditing also occurs during the REFRESH TABLE operation. AUDIT works as usual for INSERT, UPDATE, and DELETE operations on a user-maintained materialized query table.

NONE

Specifies that no auditing is to be done when this table is accessed. This is the default.

CHANGES

Specifies that auditing is to be done when the table is accessed during the first insert, update, or delete operation performed by each unit of work. However, the auditing is done only if the appropriate audit trace class is active.

ALL

Specifies that auditing is to be done when the table is accessed during the first operation of any kind performed by each unit of work of a utility or application process. However, the auditing is done only if the appropriate audit trace class is active and the access is not performed with COPY, RECOVER, REPAIR, or any stand-alone utility.

If the table is subsequently altered with an ALTER TABLE statement, the ALTER TABLE statement is audited only if AUDIT CHANGES or AUDIT ALL is in effect and the appropriate audit trace class is active.

OBID *integer*

Identifies the OBID to be used for this table. An OBID is the identifier for an object's internal descriptor. The integer must not identify an existing or previously used OBID of the database. If you omit OBID, DB2 generates a value.

The following statement retrieves the value of OBID:

```
SELECT OBID
  FROM SYSIBM.SYSTABLES
  WHERE CREATOR = 'ccc' AND NAME = 'nnn';
```

Here, *nnn* is the table name and *ccc* is the table's creator.

DATA CAPTURE

Specifies whether the logging of SQL INSERT, UPDATE, and DELETE operations on the table is augmented by additional information. For guidance on intended uses of the expanded log records, see:

- The description of data propagation to IMS in *IMS DataPropagator: An Introduction*
- The instructions for using Remote Recovery Data Facility (RRDF) in *Remote Recovery Data Facility Program Description and Operations*
- The instructions for reading log records in Appendix C (Volume 2) of *DB2 Administration Guide*

If a materialized query table is refreshed with the REFRESH TABLE statement, the logging of the augmented information occurs during the REFRESH TABLE operation. DATA CAPTURE works as usual for INSERT, UPDATE, and DELETE operations on a user-maintained materialized query table.

NONE
Do not record additional information to the log. This is the default.

CHANGES
Write additional data about SQL updates to the log. Information about the values that are represented by any LOB columns is not available.

CCSID *encoding-scheme*
Specifies the encoding scheme for string data stored in the table. If the IN clause is specified, the value must agree with the encoding scheme that is already in use for the table space or database specified in the IN clause. The specific CCSIDs for SBCS, mixed, and graphic data are determined by the table space or database specified in the IN clause. If the IN clause is not specified, the value specified is used for the table being created as well as for the table space that DB2 implicitly creates. The specific CCSIDs for SBCS, mixed, and graphic data are determined by the default CCSIDs for the server for the specified encoding scheme. The valid values are ASCII, EBCDIC, and UNICODE.

If the CCSID clause is not specified, the encoding scheme for the table depends on the IN clause:

- If the IN clause is specified, the encoding scheme already in use for the table space or database specified in the IN clause is used.
- If the IN clause is not specified, the encoding scheme of the new table is the same as the scheme for the table that is specified in the LIKE clause.

If the CCSID clause is specified for a materialized query table, the encoding scheme specified in the clause must be the same as the scheme for the result CCSID of the fullselect. The CCSID must also be the same as the CCSID of the table space for the table being created.

VOLATILE or NOT VOLATILE
Specifies how DB2 is to choose access to the table.

VOLATILE
Specifies that index access should be used on this table whenever possible for SQL operations. However, be aware that list prefetch and certain other optimization techniques are disabled when VOLATILE is used.

One instance in which use of VOLATILE may be desired is for a table whose size can vary greatly. If statistics are taken when the table is empty or has only a few rows, those statistics might not be appropriate when the table has many rows. Another instance in which use of VOLATILE may be desired is for a table that contains groups of rows, as defined by the primary key on the table. All but the last column of the primary key of such a table indicate the group to which a given row belongs. The last column of the primary key is the sequence number indicating the order in which the rows are to be read from the group. VOLATILE maximizes concurrency of operations on rows within each group, since rows are usually accessed in the same order for each operation.

NOT VOLATILE
Specifies that SQL access to this table should be based on the current statistics. NOT VOLATILE is the default.

CARDINALITY
An optional keyword that currently has no effect, but that is provided for DB2 family compatibility.

materialized-query-definition

materialized-query-definition
Specifies that the column definitions are based on the result of a fullselect. If *materialized-query-table-options* are specified, the table is a materialized query table and the REFRESH TABLE statement can be used to populate the table with the results of the fullselect.

column-name
Names the columns in the table. If a list of column names is specified, it must consist of as many names as there are columns in the result table of the fullselect. Each *column-name* must be unique and unqualified. If a list of column names is not specified, the columns of the table inherit the names of the columns of the result table of the fullselect.

A list of column names must be specified if the result table of the fullselect has duplicate column names or an unnamed column. An unnamed column is a column derived from a constant, function, expression, or set operation that is not named using the AS clause of the select list.

AS*(fullselect)*
Specifies that the table definition is based on the column definitions from the result of a query expression. The use of AS *(fullselect)* is an implicit definition of *n* columns for the table, where *n* is the number of columns that would result from the *fullselect*. The columns of the new table are defined by the columns that result from the *fullselect*. Every select list element must have a unique name. The AS clause can be used in the select-clause to provide unique names. The implicit definition includes the column name, data type, and nullability characteristic of each of the result columns of *fullselect*.

If the fullselect is specified, for the statement that is embedded or prepared dynamically, the owner of the table being created must have the SELECT privilege on the tables or views referenced in the fullselect, or the privilege set must include SYSADM or DBADM authority for the database in which the tables of the fullselect reside. Having SELECT privilege means that the owner has at least one of the following authorizations:

- Ownership of the tables or views referenced in the fullselect
- The SELECT privilege on the tables and views referenced in the fullselect
- SYSADM authority
- DBADM authority for the database in which the tables of the fullselect reside

The rules for establishing the qualifiers for names used in the fullselect are the same as the rules used to establish the qualifiers for *table-name*.

The fullselect must not refer to host variables or include parameter markers.

When WITH NO DATA is specified, the fullselect must not:

- Reference a remote object.

- Result in a column having a ROWID data type or a distinct type based on ROWID.
- Result in a column having a BLOB, CLOB, or DBCLOB data type or a distinct type based on these data types.
- Contain PREVIOUS VALUE or a NEXT VALUE expression.
- Include an INSERT statement in the FROM clause.

When a materialized query table is defined, the column attributes, such as DEFAULT and IDENTITY, are not inherited from the fullselect. When DISABLE QUERY OPTIMIZATION is specified, the following additional restrictions apply:

- The fullselect cannot contain a reference to a created global temporary table or a declared global temporary table.
- The fullselect cannot reference another materialized query table.

When a materialized query table is defined with ENABLE QUERY OPTIMIZATION specified, the following additional restrictions apply:

- The fullselect must be a subselect.
- The subselect cannot include a function that is nondeterministic or has external actions. For example, a user-defined function that is defined with either EXTERNAL ACTION or NOT DETERMINISTIC or the RAND built-in function cannot be referenced.
- The subselect cannot contain any predicates that include subqueries.
- The subselect cannot contain
  - A nested table expression or view that requires temporary materialization
  - A join using the INNER JOIN syntax
  - An outer join
  - A special register
  - A scalar fullselect
  - A row expression predicate
  - Sideway references
- The outermost SELECT list of the subselect must not reference data that is encoded with different CCSID sets.
- If the subselect references a view, the fullselect in the view definition must satisfy the preceding restrictions.

When *fullselect* does not satisfy the restrictions, an error occurs.

WITH NO DATA

Specifies that the query is used only to define the attributes of the new a table. The table is not populated using the results of the query and the REFRESH TABLE statement cannot be used. When the WITH NO DATA clause is specified, the table is not considered a materialized query table.

The columns of the table are defined based on the definitions of the columns that result from the fullselect.

copy-options

Specifies whether identity column attributes and column defaults are inherited from the definition of the source of the result table.

EXCLUDING IDENTITY COLUMN ATTRIBUTES or **INCLUDING IDENTITY COLUMN ATTRIBUTES**

Specifies whether identity column attributes are inherited.

EXCLUDING IDENTITY COLUMN ATTRIBUTES
Specifies that identity column attributes are not inherited from the definition of the source of the result table. This is the default.

INCLUDING IDENTITY COLUMN ATTRIBUTES
Specifies that, if available, identity column attributes (such as START WITH, INCREMENT BY, and CACHE values) are inherited from the definition of the source table. These attributes can be inherited if the element of the corresponding column in the table, view, or *fullselect* is the name of a column of a table or the name of a column of a view that directly or indirectly maps to the column name of a base table with the identity attribute. In other cases, the columns of the new temporary table do not inherit the identity attributes. The columns of the new table do not inherit the identity attributes in the following cases:

- The select list of the *fullselect* includes multiple instances of an identity column name (that is, selecting the same column more than once).
- The select list of the *fullselect* includes multiple identity columns (that is, it involves a join).
- The identity column is included in an expression in the select list.
- The *fullselect* includes a set operation (union).

EXCLUDING COLUMN DEFAULTS, INCLUDING COLUMN DEFAULTS, or **USING TYPE DEFAULTS**
Specifies whether column defaults are inherited.

EXCLUDING COLUMN DEFAULTS
Specifies that the column defaults are not inherited from the definition of the source table. The default values of the column of the new table are either null or there are no default values. If the column can be null, the default is the null value. If the column cannot be null, there is no default value, and an error occurs if a value is not provided for a column on INSERT for the new table.

INCLUDING COLUMN DEFAULTS
Specifies that column defaults for each updatable column of the definition of the source table are inherited. Columns that are not updatable do not have a default defined in the corresponding column of the created table.

USING TYPE DEFAULTS
Specifies that the default values for the table depend on data type of the columns that result from *fullselect*, as follows:

Data type	Default value
Numeric	0
Fixed-length string	Blanks
Varying-length string	A string of length 0
Date	CURRENT DATE
Time	CURRENT TIME
Timestamp	CURRENT TIMESTAMP

refreshable-table-options
Specifies the options for a refreshable materialized query table.

DATA INITIALLY DEFERRED
Specifies that the data is not inserted into the materialized query table

when it is created. Use the REFRESH TABLE statement to populate the materialized query table, or use the INSERT statement to insert data into a user-maintained materialized query table.

REFRESH DEFERRED
Specifies that the data in the table can be refreshed at any time using the REFRESH TABLE statement. The data in the table only reflects the result of the query as a snapshot at the time when the REFRESH TABLE statement is processed or when it was last updated for a user-maintained materialized query table.

MAINTAINED BY SYSTEM or **MAINTAINED BY USER**
Specifies how the data in the materialized query table is maintained.

MAINTAINED BY SYSTEM
Specifies that the materialized query table is maintained by the system. Only the REFRESH statement is allowed on the table. This is the default.

MAINTAINED BY USER
Specifies that the materialized query table is maintained by the user, who can use the LOAD utility or the INSERT, DELETE, UPDATE, SELECT FOR UPDATE, or REFRESH TABLE statements on the table.

ENABLE QUERY OPTIMIZATION or **DISABLE QUERY OPTIMIZATION**
Specifies whether this materialized query table can be used for optimization.

ENABLE QUERY OPTIMIZATION
Specifies that the materialized query table can be used for query optimization. If the fullselect specified does not satisfy the restrictions for query optimization, an error occurs. This is the default.

DISABLE QUERY OPTIMIZATION
Specifies that the materialized query table cannot be used for query optimization. The table can still be queried directly.

End of materialized-query-definition

Notes

Table design: Designing tables is part of the process of database design. For information on design, see *The Official Introduction to DB2 UDB for z/OS*.

Creating a table in a segmented table space: A table cannot be created in a segmented table space if:

- The available space in the data set is less than the segment size specified for the table space, and
- The data set cannot be extended.

Creating a table with graphic and mixed data columns: You cannot create an ASCII or EBCDIC table with a GRAPHIC, VARGRAPHIC, or DBCLOB column or a CHAR, VARCHAR, or CLOB column defined as FOR MIXED DATA when the setting for installation option MIXED DATA is NO.

Creating a table with distinct type columns based on LOB and ROWID columns: Because a distinct type is subject to the same restrictions as its source type, all the syntactic rules that apply to LOB columns (CLOB, DBCLOB, and BLOB) and ROWID columns apply to distinct type columns that are based on LOBs and row IDs. For example, a table cannot have both an explicitly defined ROWID column and a column with a distinct type that is based on a row ID.

Creating a table with LOB columns: A table with a LOB column (CLOB, DBCLOB, or BLOB) must also have a ROWID column and one or more auxiliary tables. When you create the table, you can either explicitly define the ROWID column or let DB2 implicitly generate one for you. When DB2 generates the ROWID column, it is called a *hidden ROWID column*, and DB2:

- Creates the column with a name of DB2_GENERATED_ROWID_FOR_LOBS*nn* .

  DB2 appends *nn* only if the column name already exists in the table, replacing *nn* with 00 and incrementing by 1 until the name is unique within the row.
- Defines the column as GENERATED ALWAYS.
- Appends the hidden ROWID column to the end of the row after all the other explicitly defined columns.

For example, assume that DB2 generated a hidden ROWID column named DB2_GENERATED_ROWID_FOR_LOBS for table MYTABLE. The result table for a SELECT * statement for table MYTABLE would not contain that ROWID column. However, the result table for SELECT COL1, DB2_GENERATED_ROWID_FOR_LOBS would include the hidden ROWID column.

The definition of the table is marked incomplete until an auxiliary table is created in a LOB table space for each LOB column in the base table and index is created on each auxiliary table. The auxiliary table stores the actual values of a LOB column. If you create a table with a LOB column in a partitioned table space, there must be one auxiliary table defined for each partition of the base table space.

Unless DB2 implicitly creates the LOB table space, auxiliary table, and index on the auxiliary table for each LOB column in the base table, you need to create these objects using the CREATE TABLESPACE, CREATE AUXILIARY TABLE, and CREATE INDEX statements.

If the value of special register CURRENT RULES is 'STD' when the CREATE TABLE statement is processed, DB2 implicitly creates the LOB table space, auxiliary table, and index on the auxiliary table for each LOB column in the base table. DB2 chooses the names of implicitly created objects using these conventions:

LOB table space
: Name is 8 characters long, consisting of an ’L’ followed by 7 random characters.

auxiliary table
: Name is 18 characters long. The first five characters of the name are the first five characters of the name of the base table. The second five characters are the first five characters of the name of the LOB column. The last eight characters are randomly generated. If a base table name or a LOB column name is less than five characters, DB2 adds underscore characters to the name to pad it to a length of five characters.

index on the auxiliary table
: Name is 18 characters long. The first character of the name is an ’I’. The next ten characters are the first ten characters of the name

of the auxiliary table. The last seven characters are randomly generated. The index has the COPY NO attribute.

The other attributes of these implicitly created objects are those that would have been created by their respective CREATE statements with all optional clauses omitted, with the following exceptions:

- The database name is the database name of the base table.
- If the size of the LOB column is greater than 1 GB, the LOG option for the LOB table space is LOG NO.

Utility REPORT TABLESPACESET identifies the LOB table spaces that DB2 implicitly created.

Creating a table with an identity column: When a table has an identity column, DB2 can automatically generate sequential numeric values for the column as rows are inserted into the table. Thus, identity columns are ideal for primary keys. Identity columns and ROWID columns are similar in that both types of columns contain values that DB2 generates. ROWID columns are used in large object (LOB) table spaces and can be useful in direct-row access. ROWID columns contain values of the ROWID data type, which returns a 40-byte VARCHAR value that is not regularly ascending or descending. ROWID data values are therefore not well suited to many application uses, such as generating employee numbers or product numbers. For data that is not LOB data and that does not require direct-row access, identity columns are usually a better approach, because identity columns contain existing numeric data types and can be used in a wide variety of uses for which ROWID values would not be suitable.

When a table is recovered to a point-in-time, it is possible that a large gap in the generated values for the identity column might result. For example, assume a table has an identity column that has an incremental value of 1 and that the last generated value at time T1 was 100 and DB2 subsequently generates values up to 1000. Now, assume that the table space is recovered back to time T1. The generated value of the identity column for the next row that is inserted after the recovery completes will be 1001, leaving a gap from 100 to 1001 in the values of the identity column.

If you want to ensure that an identity column has unique values, create a unique index on the column.

Maximum record size: The maximum record size of a table depends on the page size of the table space and whether the EDITPROC clause is specified, as shown in Table 65. The page size of the table space is the size of its buffer, which is determined by the BUFFERPOOL clause that was explicitly or implicitly specified when the table space was created.

Table 65. Maximum record size, in bytes

EDITPROC	Page Size = 4KB	Page Size = 8KB	Page Size = 16KB	Page Size = 32KB
NO	4056	8138	16330	32714
YES	4046	8128	16320	32704

The maximum record size corresponds to the maximum length of a VARCHAR column if that column is the only column in the table.

Byte counts: The sum of the byte counts of the columns must not exceed the maximum row size of the table. The maximum row size is eight less than the maximum record size.

For columns that do not allow null values, Table 66 gives the byte counts of columns by data type. For columns that allow null values, the byte count is one more than shown in the table.

Table 66. Byte counts of columns by data type

Data Type	Byte Count
INTEGER	4
SMALLINT	2
FLOAT(*n*)	If *n* is between 1 and 21, the byte count is 4. If *n* is between 22 and 53, the byte count is 8.
DECIMAL	INTEGER(*p*/2)+1, where *p* is the precision
CHAR(*n*)	*n*
VARCHAR(*n*)	*n*+2
CLOB	6
GRAPHIC(*n*)	2*n*
VARGRAPHIC(*n*)	2*n*+2
DBCLOB	6
BLOB	6
DATE	4
TIME	3
TIMESTAMP	10
ROWID	19
distinct type	The length of the source data type upon which the distinct type was based

Creating a table with a LONG VARCHAR or LONG VARGRAPHIC column: Although the syntax LONG VARCHAR and LONG VARGRAPHIC is allowed for compatibility with previous releases of DB2, its use is not encouraged. VARCHAR(*integer*) and VARGRAPHIC(*integer*) is the recommended syntax, because after the CREATE TABLE statement is processed, DB2 considers a LONG VARCHAR column to be VARCHAR and a LONG VARGRAPHIC column to be VARGRAPHIC.

When a column is defined using the LONG VARCHAR or LONG VARGRAPHIC syntax, DB2 determines the length attribute of the column. You can use the following information, which is provided for existing applications that require the use of the LONG VARCHAR or LONGVARGRAPHIC syntax, to calculate the byte count and the character count of the column.

To calculate the byte count, use this formula:

2*(INTEGER((INTEGER((*m*-*i*-*k*)/*j*))/2))

Where:

m Is the maximum row size (8 less than the maximum record size) *i* Is the sum of the byte counts of all columns in the table that are not LONG VARCHAR or LONG VARGRAPHIC

j is the number of LONG VARCHAR and LONG VARGRAPHIC columns in the table

k k is the number of LONG VARCHAR and LONG VARGRAPHIC columns that allow nulls

To find the character count:

1. Find the byte count.
2. Subtract 2.
3. If the data type is LONG VARGRAPHIC, divide the result by 2. If the result is not an integer, drop the fractional part.

Creating a materialized query table: If the fullselect in the CREATE TABLE statement contains a SELECT *, the select list of the subselect is determined at the time the materialized query table is created. In addition, any references to user-defined functions are resolved at the same time. The isolation level at the time when the CREATE TABLE statement is executed is the isolation level for the materialized query table. After a materialized query table is created, the REFRESH_TIME column of the row for the table in the SYSIBM.SYSVIEWS catalog table contains the default timestamp.

A FIELDPROC on a materialized query table is inherited from a select item if the select item is a column that can be mapped to a column of a base table or a view directly in the subselect FROM clause. This is also true for a table created with the WITH NO DATA clause.

The materialized query table inherits a security label column if only one table in the fullselect contains a security label column and the materialized query table is not defined with the WITH NO DATA clause, and the primary authorization ID of the statement has a valid security label column. If more than one table in the fullselect contains a security label column, an error occurs.

The owner of a materialized query table has all the table privileges with the grant option on the table irrespective of whether the owner has the necessary privileges on the base tables, views, functions, and sequence expressions.

No unique attributes, default attributes, or system generated attributes are associated with a materialized query table column. No unique constraints or unique indexes can be created for materialized query tables. Thus, a materialized query table cannot be a parent table in a referential constraint.

When you are creating user-maintained materialized query tables, you should create the materialized query table with query optimization disabled and then enable the table for query optimization after it is populated. Otherwise, DB2 might rewrite queries to use the empty materialized query table, and you will not get accurate results.

Implicitly created indexes: When the PRIMARY KEY or UNIQUE clause is used in the CREATE TABLE statement and the CREATE TABLE statement is processed by the schema processor, DB2 implicitly creates the unique indexes used to enforce the uniqueness of the primary or unique keys. Each index is created as if the following CREATE INDEX statement were issued:

```
CREATE UNIQUE INDEX xxx ON table-name (column1,...)
```

Where:

- *xxx* is the name of the index that DB2 generates.
- *table-name* is the name of the table specified in the CREATE TABLE statement.
- *(column1,...)* is the list of column names that were specified in the UNIQUE or PRIMARY KEY clause of the CREATE TABLE statement.

For more information about the schema processor, see Part 2 (Volume 1) of *DB2 Administration Guide*.

Creating a table while a utility runs: You cannot use CREATE TABLE while a DB2 utility has control of the table space implicitly or explicitly specified by the IN clause.

Alternative syntax and synonyms: To provide compatibility with previous releases of DB2 or other products in the DB2 UDB family, DB2 supports the following keywords:

- NOCACHE (single key word) as a synonym for NO CACHE
- NOCYCLE (single key word) as a synonym for NO CYCLE
- NOMINVALUE (single key word) as a synonym for NO MINVALUE
- NOMAXVALUE (single key word) as a synonym for NO MAXVALUE
- NOORDER (single key word) as a synonym for NO ORDER
- PART as a synonym for PARTITION
- VALUES as a synonym for ENDING AT
- DEFINITION ONLY as a synonym for WITH NO DATA

Examples

Example 1: Create a table named DSN8810.DEPT in the table space DSN8S81D of the database DSN8D81A. Name the table's five columns DEPTNO, DEPTNAME, MGRNO, ADMRDEPT, and LOCATION, allowing only MGRNO and LOCATION to contain nulls, and designating DEPTNO as the only column in the table's primary key. All five columns hold character string data. Assuming a value of NO for the field MIXED DATA on installation panel DSNTIPF, all five columns have the subtype SBCS.

```
CREATE TABLE DSN8810.DEPT
  (DEPTNO   CHAR(3)     NOT NULL,
   DEPTNAME VARCHAR(36) NOT NULL,
   MGRNO    CHAR(6)             ,
   ADMRDEPT CHAR(3)     NOT NULL,
   LOCATION CHAR(16)            ,
   PRIMARY KEY(DEPTNO)          )
  IN DSN8D81A.DSN8S81D;
```

Example 2: Create a table named DSN8810.PROJ in an implicitly created table space of the database DSN8D81A. Assign the table a validation procedure named DSN8EAPR.

```
CREATE TABLE DSN8810.PROJ
  (PROJNO   CHAR(6)      NOT NULL,
   PROJNAME VARCHAR(24)  NOT NULL,
   DEPTNO   CHAR(3)      NOT NULL,
   RESPEMP  CHAR(6)      NOT NULL,
   PRSTAFF  DECIMAL(5,2)         ,
   PRSTDATE DATE                 ,
    PRENDATE DATE                 ,
    MAJPROJ  CHAR(6)      NOT NULL)
   IN DATABASE DSN8D81A
   VALIDPROC DSN8EAPR;
```

Example 3: Assume that table PROJECT has a non-primary unique key that consists of columns DEPTNO and RESPEMP (the department number and employee responsible for a project). Create a project activity table named ACTIVITY with a foreign key on that unique key.

```
CREATE TABLE ACTIVITY
  (PROJNO   CHAR(6)      NOT NULL,
   ACTNO    SMALLINT     NOT NULL,
   ACTDEPT  CHAR(3)      NOT NULL,
   ACTOWNER CHAR(6)      NOT NULL,
   ACSTAFF  DECIMAL(5,2)         ,
   ACSTDATE DATE         NOT NULL,
   ACENDATE DATE                 ,
   FOREIGN KEY (ACTDEPT,ACTOWNER)
      REFERENCES PROJECT (DEPTNO,RESPEMP) ON DELETE RESTRICT)
  IN DSN8D81A.DSN8S81D;
```

Example 4: Create an employee photo and resume table EMP_PHOTO_RESUME that complements the sample employee table. The table contains a photo and resume for each employee. Put the table in table space DSN8D81A.DSN8S81E. Let DB2 always generate the values for the ROWID column.

```
CREATE TABLE DSN8810.EMP_PHOTO_RESUME
  (EMPNO      CHAR(6)     NOT NULL,
   EMP_ROWID  ROWID NOT NULL GENERATED ALWAYS,
   EMP_PHOTO  BLOB(110K),
   RESUME     CLOB(5K),
   PRIMARY KEY (EMPNO))
  IN DSN8D81A.DSN8S81E
  CCSID EBCDIC;
```

Example 5: Create an EMPLOYEE table with an identity column named EMPNO. Define the identity column so that DB2 will always generate the values for the column. Use the default value, which is 1, for the first value that should be assigned and for the incremental difference between the subsequently generated consecutive numbers.

```
CREATE TABLE EMPLOYEE
  (EMPNO      INTEGER GENERATED ALWAYS AS IDENTITY,
   ID         SMALLINT,
   NAME       CHAR(30),
   SALARY     DECIMAL(5,2),
   DEPTNO     SMALLINT)
  IN DSN8D81A.DSN8S81D;
```

Example 6: Assume a very large transaction table named TRANS contains one row for each transaction processed by a company. The table is defined with many columns. Create a materialized query table for the TRANS table that contain daily summary data for the date and amount of a transaction.

```
CREATE TABLE STRANS AS
  (SELECT YEAR AS SYEAR, MONTH AS SMONTH, DAY AS SDAY, SUM(AMOUNT) AS SSUM
   FROM TRANS
   GROUP BY YEAR, MONTH, DAY)
   DATA INITIALLY DEFERRED REFRESH DEFERRED;
```

CREATE TABLESPACE

The CREATE TABLESPACE statement defines a simple, segmented, or partitioned table space at the current server.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

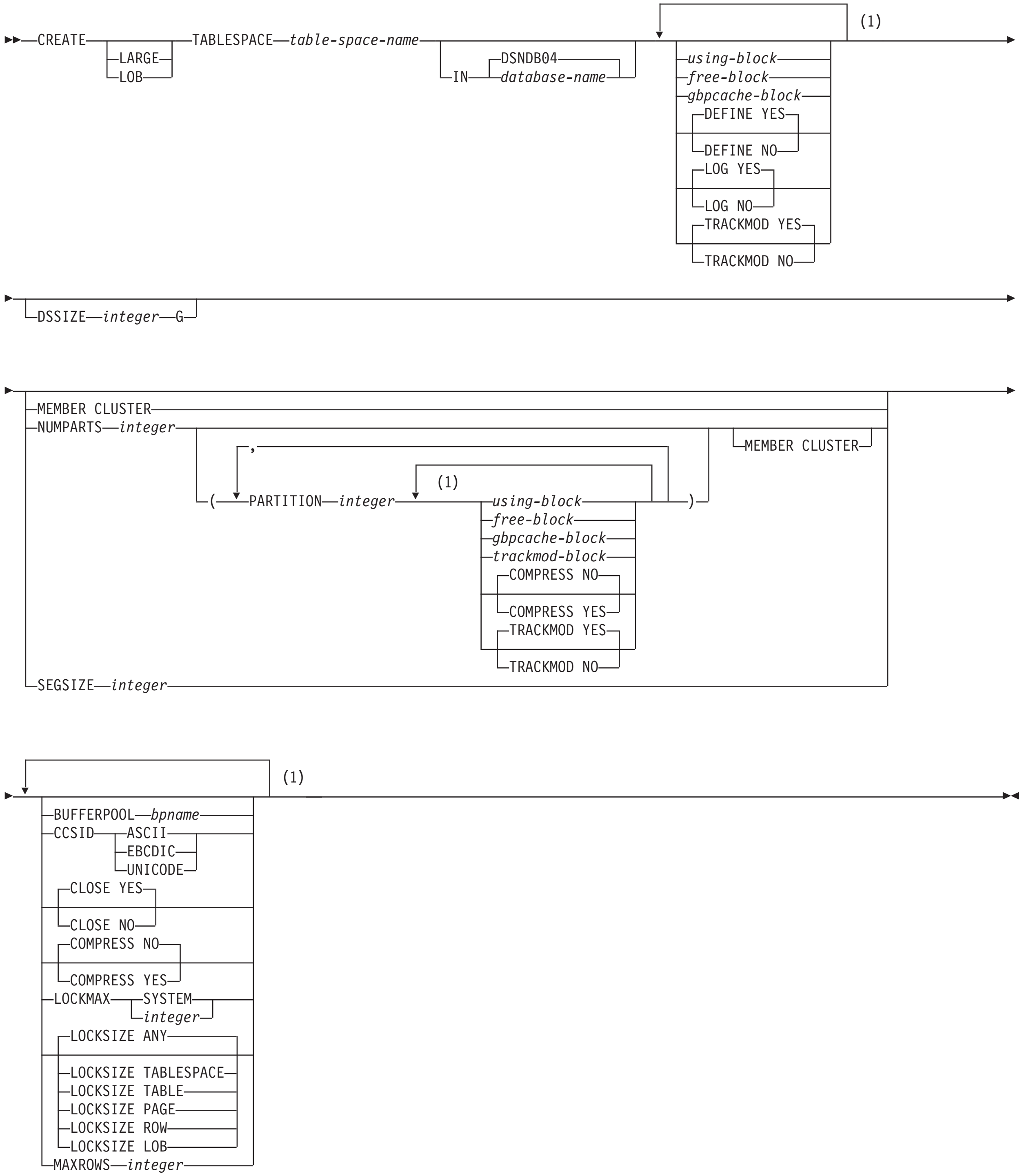
The privilege set that is defined below must include at least one of the following:

- The CREATETS privilege for the database
- DBADM, DBCTRL, or DBMAINT authority for the database
- SYSADM or SYSCTRL authority

Additional privileges might be required, as explained in the description of the BUFFERPOOL and USING STOGROUP clauses.

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package. If the statement is dynamically prepared, the privilege set is the privileges that are held by the SQL authorization ID of the process.

Syntax



Notes:

1 The same clause must not be specified more than once.

using-block:

```
>>──USING──┬─VCAT──catalog-name──────────────────────────────┬─────────────────────────><
           │                      ┌──────────────────────┐   │
           │                      ▼                      │(1)│
           └─STOGROUP──stogroup-name──┬─────────────────┬─┴───┘
                                      ├─PRIQTY──integer─┤
                                      ├─SECQTY──integer─┤
                                      │ ┌─ERASE NO──┐   │
                                      └─┴─ERASE YES─┴───┘
```

Notes:

1 The same clause must not be specified more than once.

free-block:

```
     ┌──────────────────────────┐
     ▼  ┌─FREEPAGE 0───────┐    │(1)
>>────┬─┴─FREEPAGE──integer─┴─┬─┴──────────────────────────────────────────────────><
      │ ┌─PCTFREE 5────────┐  │
      └─┴─PCTFREE──integer─┴──┘
```

Notes:

1 The same clause must not be specified more than once.

gbpcache-block:

```
    ┌─GBPCACHE CHANGED─┐
>>──┼──────────────────┼─────────────────────────────────────────────────────────><
    ├─GBPCACHE ALL─────┤
    ├─GBPCACHE SYSTEM──┤
    └─GBPCACHE NONE────┘
```

Description

LARGE
Identifies that each partition of a partitioned table space has a maximum partition size of 4 GB, which enables the table space to contain more than 64 GB of data. The preferred method to specify a maximum partition size of 4 GB and larger is the DSSIZE clause. The LARGE clause is for compatibility of releases of DB2 UDB for z/OS prior to Version 6. Do not specify LARGE if LOB or DSSIZE is specified.

LOB
Identifies the table space as LOB table space. A LOB table space is used to hold LOB values.

The LOB table space must be in the same database as its associated base table space.

table-space-name

Names the table space. The name, qualified with the *database-name* implicitly or explicitly specified by the IN clause, must not identify a table space, index space, or LOB table space that exists at the current server.

A table space that is for declared temporary tables must be in a TEMP database (a database that is defined AS TEMP). PUBLIC implicitly receives the USE privilege (without GRANT authority) on any table space created in the TEMP database. This implicit privilege is not recorded in the DB2 catalog, and it cannot be revoked.

IN *database-name*

Identifies the database in which the table space is created. The name must identify a database that exists at the current server. DSNDB06 must not be specified for any type of table space, and a work file database must not be specified for a LOB table space. If the table space is for declared temporary tables, a TEMP database (a database that is defined with AS TEMP) must be specified. The default is DSNDB04.

using-block

The components of the USING clause are discussed below, first for nonpartitioned table spaces and then for partitioned table spaces. If you omit USING, the default storage group of the database must exist.

USING clause for nonpartitioned table spaces:

For nonpartitioned table spaces, the USING clause indicates whether the data set for the table space is defined by you or by DB2. If DB2 is to define the data set, the clause also gives space allocation parameters and an erase rule.

If you omit USING, DB2 defines the data sets using the default storage group of the database and the defaults for PRIQTY, SECQTY, and ERASE.

VCAT *catalog-name*

Specifies that the first data set for the table space is managed by the user, and following data sets, if needed, are also managed by the user.

The data sets defined for the table space are linear VSAM data sets cataloged in an integrated catalog facility catalog identified by *catalog-name*. An alias[31] must be used if the catalog name is longer than eight characters.

Conventions for table space data set names are given in Part 2 (Volume 1) of *DB2 Administration Guide*. *catalog-name* is the first qualifier for each data set name.

One or more DB2 subsystems could share integrated catalog facility catalogs with the current server. To avoid the chance of having one of those subsystems attempt to assign the same name to different data sets, select a value for *catalog-name* that is not used by the other DB2 subsystems.

STOGROUP *stogroup-name*

Specifies that DB2 will define and manage the data sets for the table space. Each data set will be defined on a volume of the identified storage group. The values specified (or the defaults) for PRIQTY and SECQTY determine the primary and secondary allocations for the data set. The

[31] The alias of an integrated catalog facility catalog.

storage group supplies the name of a volume for the data set and the first-level qualifier for the data set name. The first-level qualifier is also the name of, or an alias[31] for, the integrated catalog facility catalog on which the data set is to be cataloged. The naming conventions for the data set are the same as if the data set is managed by the user. As was mentioned above for VCAT, the first-level qualifier could cause naming conflicts if the local DB2 can share integrated catalog facility catalogs with other DB2 subsystems.

stogroup-name must identify a storage group that exists at the current server. SYSADM or SYSCTRL authority, or the USE privilege on the storage group, is required.

The description of the storage group must include at least one volume serial number, or it must indicate that the choice of volumes is left to Storage Management Subsystem (SMS). If volume serial numbers appear in the description, each must identify a volume that is accessible to z/OS for dynamic allocation of the data set, and all identified volumes must be of the same device type.

The integrated catalog facility catalog used for the storage group must ***not*** contain an entry for the first data set of the table space. If the integrated catalog facility catalog is password protected, the description of the storage group must include a valid password.

PRIQTY *integer*

Specifies the minimum primary space allocation for a DB2-managed data set. When you specify PRIQTY with a value other than -1, the primary space allocation is at least *n* kilobytes, where *n* is the value of *integer* with the following exceptions:

- For 4KB page sizes, if *integer* is less than 12, *n* is 12.
- For 8KB page sizes, if *integer* is less than 24, *n* is 24.
- For 16KB page sizes, if *integer* is less than 48, *n* is 48.
- For 32KB page sizes, if *integer* is less than 96, *n* is 96.
- For any page size, if *integer* is greater than 4194304, *n* is 4194304.

For LOB table spaces, the exceptions are:

- For 4KB page sizes, if *integer* is less than 200, *n* is 200.
- For 8KB page sizes, if *integer* is less than 400, *n* is 400.
- For 16KB page sizes, if *integer* is less than 800, *n* is 800.
- For 32KB page sizes, if *integer* is less than 1600, *n* is 1600.
- For any page size, if *integer* is greater than 4194304, *n* is 4194304.

The maximum value allowed for PRIQTY is 64GB (67108864 kilobytes).

| If you do not specify PRIQTY or specify PRIQTY -1, DB2 uses a default value for the primary space allocation; for information on how DB2 determines the default value, see “Rules for primary and secondary space allocation” on page 788.

If you specify PRIQTY and do not specify a value of -1, DB2 specifies the primary space allocation to access method services using the smallest multiple of *p* KB not less than *n*, where *p* is the page size of the table space. The allocated space can be greater than the amount of space requested by DB2. For example, it could be the smallest number of tracks that will accommodate the request. The amount of storage space requested must be available on some volume in the storage group based on VSAM space allocation restrictions. Otherwise, the primary space allocation will fail. To more closely estimate the actual amount of storage, see the description of the DEFINE CLUSTER command in *DFSMS/MVS: Access Method Services for the Integrated Catalog*.

Executing this statement causes only one data set to be created. However, you might have more data than this one data set can hold. DB2 automatically defines more data sets when they are needed. Regardless of the value in PRIQTY, when a data set reaches its maximum size, DB2 creates a new one. To enable a data set to reach its maximum size without running out of extents, it is recommended that you allow DB2 to automatically choose the value of the secondary space allocations for extents.

If you do choose to explicitly specify SECQTY, to avoid wasting space, use the following formula to make sure that PRIQTY and its associated secondary extent values do not exceed the maximum size of the data set:

```
PRIQTY + (number of extents * SECQTY) <= DSSIZE (implicit or explicit)
```

SECQTY *integer*

Specifies the minimum secondary space allocation for a DB2-managed data set. If you do not specify SECQTY, DB2 uses a formula to determine a value. For information on the actual value that is used for secondary space allocation, whether you specify a value or not, see “Rules for primary and secondary space allocation” on page 788.

If you specify SECQTY and do not specify a value of -1, DB2 specifies the secondary space allocation to access method services using the smallest multiple of *p* KB not less than *n*, where *p* is the page size of the table space. The allocated space can be greater than the amount of space requested by DB2. For example, it could be the smallest number of tracks that will accommodate the request. To more closely estimate the actual amount of storage, see the description of the DEFINE CLUSTER command in *DFSMS/MVS: Access Method Services for the Integrated Catalog*.

ERASE

Indicates whether the DB2-managed data sets for the table space or partition are to be erased when they are deleted during the execution of a utility or an SQL statement that drops the table space.

NO

Does not erase the data sets. Operations involving data set deletion will perform better than ERASE YES. However, the data is still accessible, though not through DB2. This is the default.

YES

Erases the data sets. As a security measure, DB2 overwrites all data in the data sets with zeros before they are deleted.

USING clause for partitioned table spaces:

If the table space is partitioned, there is a USING clause for each partition; either one you give explicitly or one provided by default. Except as explained below, the meaning of the clause and the rules that apply to it are the same as for a nonpartitioned table space.

The USING clause for a particular partition is the first of these choices that can be found:

- A USING clause in the PARTITION clause for the partition
- A USING clause that is not in any PARTITION clause
- An implicit USING STOGROUP clause that identifies the default storage group of the database and accepts the defaults for PRIQTY, SECQTY, and ERASE

VCAT *catalog-name*

Indicates that the data set for the partition is managed by the user using the naming conventions set forth in Part 2 (Volume 1) of *DB2 Administration Guide*. As was true for the nonpartitioned case, *catalog-name* identifies the catalog for the data set and supplies the first-level qualifier for the data set name.

One or more DB2 subsystems could share integrated catalog facility catalogs with the current server. To avoid the chance of having one of those subsystems attempt to assign the same name to different data sets, select a value for *catalog-name* that is not used by the other DB2 subsystems.

DB2 assumes one and only one data set for each partition.

STOGROUP *stogroup-name*

Indicates that DB2 will create a data set for the partition with the aid of a storage group named *stogroup-name*. The data set is defined during the execution of this statement. DB2 assumes one and only one data set for each partition.

The *stogroup-name* must identify a storage group that exists at the current server and the privilege set must include SYSADM authority, SYSCTRL authority, or the USE privilege for the storage group. The integrated catalog facility catalog used for the storage group must ***not*** contain an entry for that data set.

When USING STOGROUP is specified for a partition, the defaults for PRIQTY, SECQTY, and ERASE are the values specified in the USING STOGROUP clause that is not in any PARTITION clause. If that USING STOGROUP clause is not specified, the defaults are those specified in the description of PRIQTY, SECQTY, and ERASE.

End of using-block

free-block

FREEPAGE *integer*

Specifies how often to leave a page of free space when the table space or partition is loaded or reorganized. You must specify an integer in the range 0 to 255. If you specify 0, no pages are left as free space. Otherwise, one free page is left after every *n* pages, where *n* is the specified integer. However, if the table space is segmented and the integer you specify is not less than the segment size, *n* is one less than the segment size.

If the table space is segmented, the number of pages left free must be less than the SEGSIZE value. If the number of pages to be left free is greater than or equal to the SEGSIZE value, then the number of pages is adjusted downward to one less than the SEGSIZE value.

The default is FREEPAGE 0, leaving no free pages. Do not specify FREEPAGE for a LOB table space, or a table space in a work file database or a TEMP database.

PCTFREE *integer*

Indicates what percentage of each page to leave as free space when the table is loaded or reorganized. *integer* can range from 0 to 99. The first record on each page is loaded without restriction. When additional records are loaded, at least *integer* percent of free space is left on each page.

The default is PCTFREE 5. Do not specify PCTFREE for a LOB table space, or a table space in a work file database or a TEMP database.

If the table space is partitioned, the values of FREEPAGE and PCTFREE for a particular partition are given by the first of these choices that apply:

- The values of FREEPAGE and PCTFREE given in the PARTITION clause for that partition
- The values given in a *free-block* that is not in any PARTITION clause
- The default values are FREEPAGE 0 and PCTFREE 5.

End of free-block

gbpcache-block

GBPCACHE

In a data sharing environment, specifies what pages of the table space or partition are written to the group buffer pool in a data sharing environment. In a non-data-sharing environment, you can specify GBPCACHE for a table space other than one in a work file or TEMP database, but it is ignored. Do not specify GBPCACHE for a table space in a work file or TEMP database in either environment (data sharing or non-data-sharing).

CHANGED

When there is inter-DB2 R/W interest on the table space or partition, updated pages are written to the group buffer pool. When there is no inter-DB2 R/W interest, the group buffer pool is not used. Inter-DB2 R/W interest exists when more than one member in the data sharing group has the table space or partition open, and at least one member has it open for update. GBPCACHE CHANGED is the default.

If the table space is in a group buffer pool that is defined to be used only for cross-invalidation (GBPCACHE NO), CHANGED is ignored and no pages are cached to the group buffer pool.

ALL

Indicates that pages are to be cached in the group buffer pool as they are read in from DASD.

Exception: In the case of a single updating DB2 when no other DB2s have any interest in the page set, no pages are cached in the group buffer pool.

If the table space is in a group buffer pool that is defined to be used only for cross-invalidation (GBPCACHE NO), ALL is ignored and no pages are cached to the group buffer pool.

SYSTEM

Indicates that only changed system pages within the LOB table space are to be cached to the group buffer pool. A system page is a space map page or any other page that does not contain actual data values.

This is the default for LOB table spaces. You can use SYSTEM only for a LOB table space.

NONE

Indicates that no pages are to be cached to the group buffer pool. DB2 uses the group buffer pool only for cross-invalidation.

If you specify NONE, the table space or partition must not be in recover pending status and must be in the stopped state when the CREATE TABLESPACE statement is executed.

If the table space is partitioned, the value of GBPCACHE for a particular partition is given by the first of these choices that applies:

1. The value of GBPCACHE given in the PARTITION clause for that partition. Do not use more than one *gbpcache-block* in any PARTITION clause.
2. The value given in a *gbpcache-block* that is not in any PARTITION clause.
3. The default value CHANGED.

End of gbpcache-block

DEFINE

Specifies when the underlying data sets for the table space are physically created.

YES

The data sets are created when the table space is created (the CREATE TABLESPACE statement is executed). YES is the default.

NO

The data sets are not created until data is inserted into the table space. DEFINE NO is applicable only for DB2-managed data sets (USING STOGROUP is specified). DEFINE NO is ignored for user-managed data sets (USING VCAT is specified). DB2 uses the SPACE column in catalog table SYSTABLEPART to record the status of the data sets (undefined or allocated). DEFINE NO is also ignored for a LOB table space.

Do not specify DEFINE NO for a table space in a work file database or a TEMP database; otherwise, an error occurs. DEFINE NO is not recommended if you intend to use any tools outside of DB2 to manipulate data, such as to load data, because data sets might then exist when DB2 does not expect them to exist. When DB2 encounters this inconsistent state, applications will receive an error.

LOG

Specifies whether changes to a LOB column in the table space are to be written to the log. You can use the LOG clause only for a LOB table space.

YES

Indicates that changes to a LOB column are to be written to the log. You cannot use YES if the auxiliary table in the table space stores a LOB column that is greater than 1 gigabyte in length.

YES is the default.

NO

Indicates that changes to a LOB column are not to be written to the log.

LOG NO has no effect on a commit or rollback operation; the consistency of the database is maintained regardless of whether the LOB value is logged. All committed changes and changes that are rolled back reflect the expected results.

Even when LOG NO is specified, changes to system pages and to the auxiliary index are logged. During the log apply operation of the RECOVER utility, LPL recovery, or GPB recovery, all LOB values that were not logged are marked invalid and cannot be accessed by a SELECT or FETCH statement. Invalid LOB values can be updated or deleted.

TRACKMOD

Specifies whether DB2 tracks modified pages in the space map pages of the table space or partition. Do not specify TRACKMOD for a LOB table space. For a table space in a TEMP database, DB2 uses TRACKMOD NO regardless of the value specified.

YES

DB2 tracks changed pages in the space map pages to improve the performance of incremental image copy. YES is the default unless the table space is in a TEMP database.

NO

DB2 does not track changed pages in the space map pages. It uses the LRSN value in each page to determine whether a page has been changed.

If the table space is partitioned, the value of TRACKMOD for a particular partition is given by the first of these choices that applies:

1. The value of TRACKMOD given in the PARTITION clause for that partition.
2. The value given in a *trackmod-block* that is not in any PARTITION clause.
3. The default value YES.

DSSIZE *integer* **G**

A value in gigabytes that indicates the maximum size for each partition or, for LOB table spaces, each data set. If you specify DSSIZE, you must also specify NUMPARTS or LOB.

The following values are valid:

1G	1 gigabyte
2G	2 gigabytes
4G	4 gigabytes
8G	8 gigabytes
16G	16 gigabytes
32G	32 gigabytes
64G	64 gigabytes

To specify a value greater than 4G, the following conditions must be true:

- DB2 is running with DFSMS Version 1 Release 5.
- The data sets for the table space are associated with a DFSMS data class that has been specified with extended format and extended addressability.

For all table spaces except LOB table spaces, if DSSIZE (or LARGE) is omitted, the default for the maximum size of each partition depends on the value of NUMPARTS:

If NUMPARTS is ...	Maximum partition size is...
1 to 16	4GB
17 to 32	2GB

33 to 64	1GB
65 to 254	4GB

If NUMPARTS is greater than 254, the maximum partition size depends on the page size of the table space:

If page size is ...	**Default DSSIZE is ...**
4K	4GB
8K	8GB
16K	16GB
32K	32GB

The partition size shown is not necessarily the actual number of bytes used or allocated for any one partition; it is the largest number that can be logically addressed. Each partition occupies one data set.

For LOB table spaces, if DSSIZE is not specified, the default for the maximum size of each data set is 4 GB. The maximum number of data sets is 254.

MEMBER CLUSTER

Specifies that data inserted by the INSERT statement is not clustered by the implicit clustering index (the first index) or the explicit clustering index. Instead, DB2 chooses where to locate the data in the table space based on available space.

Do not specify MEMBER CLUSTER for a LOB table space, or a table space in a work file database or a TEMP database.

NUMPARTS *integer*

Indicates that the table space is partitioned.

integer is the number of partitions, and can range from 1 to 4096 inclusive. NUMPARTS must be specified if DSSIZE is specified and LOB is omitted, or LARGE is specified.

The maximum size of each partition depends on the value specified for DSSIZE or LARGE. If DSSIZE or LARGE is not specified, the number of partitions specified determines the maximum size of each partition. For a summary of the values for the maximum size, see the description of “DSSIZE” on page 781.

The maximum number of partitions that a table space can have depends on the DSSIZE specified and the page size. The total table space size depends on how many partitions it has and DSSIZE. Page size affects table size because it affects how many partitions a table space can have. Table 67 shows a chart of maximum partitions for DSSIZE and page size and total table space size for both EA-enabled (extended addressability) and non-EA-enabled data sets. (Specifying a DSSIZE greater than 4 GB requires EA-enabled data sets.)

Table 67. Table space size given page size and partitions

Type of RID	Max number of partitions	Page size	DSSIZE	Total table space size
5-byte EA	4096	4KB	1GB	4TB
5-byte EA	4096	4KB	2GB	8TB
5-byte EA	4096	4KB	4GB	16TB
5-byte EA	2048	4KB	8GB	16TB
5-byte EA	1024	4KB	16GB	16TB
5-byte EA	512	4KB	32GB	16TB

Table 67. Table space size given page size and partitions (continued)

Type of RID	Max number of partitions	Page size	DSSIZE	Total table space size
5-byte EA	256	4KB	64GB	16TB
5-byte EA	4096	4KB	1GB	4TB
5-byte EA	4096	4KB	2GB	8TB
5-byte EA	4096	4KB	4GB	16TB
5-byte EA	4096	4KB	8GB	32TB
5-byte EA	2048	4KB	16GB	32TB
5-byte EA	1024	4KB	32GB	32TB
5-byte EA	512	4KB	64GB	32TB
5-byte EA	4096	4KB	1GB	4TB
5-byte EA	4096	4KB	2GB	8TB
5-byte EA	4096	4KB	4GB	16TB
5-byte EA	4096	4KB	8GB	32TB
5-byte EA	4096	4KB	16GB	64TB
5-byte EA	2048	4KB	32GB	64TB
5-byte EA	1024	4KB	64GB	64TB
5-byte EA	4096	4KB	1GB	4TB
5-byte EA	4096	4KB	2GB	8TB
5-byte EA	4096	4KB	4GB	16TB
5-byte EA	4096	4KB	8GB	32TB
5-byte EA	4096	4KB	16GB	64TB
5-byte EA	4096	4KB	32GB	128TB
5-byte EA	2048	4KB	64GB	128TB
5-byte (non-EA) LARGE	4096	4KB	(4GB)	16TB

If you omit NUMPARTS, the table space is not partitioned and initially occupies one data set. Do not specify NUMPARTS for a LOB table space, or a table space in a work file database or a TEMP database.

PARTITION *integer*

Specifies to which partition the following *using-block* or *free-block* applies. *integer* can range from 1 to the number of partitions given by NUMPARTS.

You can code the PARTITION clause (and any *using-block* or *free-block* that follows it) as many times as needed. If you use the same partition number more than once, only the last specification for that partition is used.

BUFFERPOOL *bpname*

Identifies the buffer pool to be used for the table space and determines the page size of the table space. For 4KB, 8KB, 16KB and 32KB page buffer pools, the page sizes are 4 KB, 8 KB, 16 KB, and 32 KB, respectively. The *bpname* must identify an activated buffer pool, and the privilege set must include SYSADM or SYSCTRL authority, or the USE privilege on the buffer pool. If the table space is to be created in a work file database, you cannot specify 8KB and 16KB buffer pools.

If you do not specify the BUFFERPOOL clause, the default buffer pool of the database is used.

See “Naming conventions” on page 40 for more details about *bpname*. See Chapter 2 of *DB2 Command Reference* for a description of active and inactive buffer pools.

LOCKSIZE

Specifies the size of locks used within the table space and, in some cases, also the threshold at which lock escalation occurs. Do not use this clause for a table space in a work file database or a TEMP database.

ANY

Specifies that DB2 can use any lock size. Currently, DB2 never chooses row locks, but reserves the right to do so.

In most cases, DB2 uses LOCKSIZE PAGE LOCKMAX SYSTEM for non-LOB table spaces and LOCKSIZE LOB LOCKMAX SYSTEM for LOB table spaces. However, when the number of locks acquired for the table space exceeds the maximum number of locks allowed for a table space (an installation parameter), the page or LOB locks are released and locking is set at the next higher level. If the table space is segmented, the next higher level is the table. If the table space is nonsegmented, the next higher level is the table space.

TABLESPACE

Specifies table space locks.

TABLE

Specifies table locks. Use TABLE only for a segmented table space.

PAGE

Specifies page locks. Do not use PAGE for a LOB table space.

ROW

Specifies row locks. Do not use ROW for a LOB table space.

LOB

Specifies LOB locks. Use LOB only for a LOB table space.

LOCKMAX

Specifies the maximum number of page, row, or LOB locks an application process can hold simultaneously in the table space. If a program requests more than that number, locks are escalated. The page, row, or LOB locks are released and the intent lock on the table space or segmented table is promoted to S or X mode. If you specify LOCKMAX for table space in a TEMP database, DB2 ignores the value because these types of locks are not used.

integer

Specifies the number of locks allowed before escalating, in the range 0 to 2 147 483 647.

Zero (0) indicates that the number of locks on the table or table space are not counted and escalation does not occur.

SYSTEM

Indicates that the value of LOCKS PER TABLE(SPACE), on installation panel DSNTIPJ, specifies the maximum number of page, row, or LOB locks a program can hold simultaneously in the table or table space.

The following table summarizes the results of specifying a LOCKSIZE value while omitting LOCKMAX.

LOCKSIZE	Resultant LOCKMAX
ANY	SYSTEM
TABLESPACE, TABLE, PAGE, ROW, or LOB	0

If the lock size is TABLESPACE or TABLE, LOCKMAX must be omitted, or its operand must be 0.

For an application that uses Sysplex query parallelism, a lock count is maintained on each member.

CLOSE

When the limit on the number of open data sets is reached, specifies the priority in which data sets are closed.

YES

Eligible for closing before CLOSE NO data sets. This is the default unless the table space is in a TEMP database.

NO

Eligible for closing after all eligible CLOSE YES data sets are closed.

For a table space in a TEMP database, DB2 uses CLOSE NO regardless of the value specified.

COMPRESS

Specifies whether data compression applies to the rows of the table space or partition. Do not specify COMPRESS for a LOB table space or a table space in a TEMP database.

For partitioned table spaces, the COMPRESS attribute for each partition is the value from the first of the following conditions that apply:

- The value specified in the COMPRESS clause in the PARTITION clause for the partition
- The value specified in the COMPRESS clause that is not in any PARTITION clause
- An implicit COMPRESS NO by default.

See Part 5 (Volume 2) of *DB2 Administration Guide* for more information about data compression.

YES

Specifies data compression. The rows are not compressed until the LOAD or REORG utility is run on the table in the table space or partition.

NO

Specifies no data compression for the table space or partition.

SEGSIZE *integer*

Indicates that the table space will be segmented. *integer* specifies how many pages are to be assigned to each segment. *integer* must be a multiple of 4 such that 4 ≤*integer* ≤64. If the SEGSIZE clause is not specified, the table space is not segmented.

SEGSIZE must be specified for a table space in a TEMP database because the table space must be segmented. Do not specify SEGSIZE for a LOB table space or a table space in work file database; neither can be segmented.

A segmented table space cannot be partitioned. Therefore, do not specify NUMPARTS if you specify SEGSIZE.

CCSID *encoding-scheme*

Specifies the encoding scheme for tables stored in the table space.

If you do not specify a CCSID when it is allowed, the default is the encoding scheme of the database in which the table space resides, except for table spaces in database DSNDB04; for table spaces in DSNDB04, the default is the value of field DEF ENCODING SCHEME on installation panel DSNTIPF.

ASCII Specifies that the data is to be encoded using ASCII CCSIDs. If the database in which the table space is to reside is already defined as ASCII, the ASCII CCSIDs associated with that database are used. Otherwise, the default ASCII CCSIDs of the server are used.

EBCDIC

Specifies that the data is to be encoded using EBCDIC CCSIDs.

UNICODE

Specifies that the data is to be encoded using the UNICODE CCSIDs of the server.

Usually, each encoding scheme requires only a single CCSID. Additional CCSIDs are needed when mixed, graphic, or Unicode data is used.

All data stored within a table space must use the same encoding scheme unless the table space is in a TEMP database.

Do not specify CCSID for a LOB table space or a table space in a TEMP database. The encoding scheme for a LOB table space is inherited from the base table space. A table space in a TEMP database does not have an associated encoding scheme because the table space can contain declared temporary tables with a mixture of encoding schemes.

MAXROWS *integer*

Specifies the maximum number of rows that DB2 will consider placing on each data page. The integer can range from 1 through 255. This value is considered for INSERT, LOAD, and REORG. For LOAD and REORG (which do not apply for a table space in the TEMP database), the PCTFREE specification is considered before MAXROWS; therefore, fewer rows might be stored than the value you specify for MAXROWS.

If you do not specify MAXROWS, the default number of rows is 255.

Do not use MAXROWS for a LOB table space or a table space in a work file database.

Notes

Simple table spaces: If neither LOB, NUMPARTS, nor SEGSIZE are specified, the table space that is created is a simple table space. See An Introduction to DB2 for z/OS for a discussion of types of table spaces.

Table spaces in a work file database: The following restrictions apply to table spaces created in a work file database:

- They can be created only when the database is explicitly stopped by the STOP DATABASE command without the SPACENAM option.
- They can be created for another member only if both the executing DB2 subsystem and the other member can access the work file data sets. That is required whether the data sets are user-managed or in a DB2 storage group.

- They cannot use 8-KB or 16-KB page sizes.(The buffer pool in which you define the table space determines the page size. For example, a table space that is defined in a 4-KB buffer pool has 4-KB page sizes.)
- The following clauses are not allowed:

DEFINE NO
FREEPAGE
GBPCACHE
LOB
LOG
LOCKSIZE
NUMPARTS
PCTFREE
SEGSIZE

Table spaces in a TEMP database (table spaces for declared temporary tables): Declared temporary tables must reside in segmented table spaces in a database that is defined AS TEMP (the TEMP database). At least one segmented table space with at least an 8-KB page size must exist in the TEMP database before a declared temporary table can be defined and used. DB2 does not implicitly create a table space for declared temporary tables. A table space for declared temporary tables can be shared. You cannot choose which table space in a TEMP database is used for a specific declared temporary table. Therefore, multiple application processes can use the same table space for their declared temporary tables.

When you create table spaces for in the TEMP database, it is recommended that you give them all the same segment size, with the same minimum primary and secondary space allocation values for the data sets, to maximize the use of all the table spaces for all declared temporary tables in all application processes.

When you create a table space in a TEMP database, the following clauses are not allowed:

CCSID
COMPRESS
DEFINE NO
DSSIZE
FREEPAGE
GBPCACHE
LARGE
LOB
LOCKSIZE
LOG
MEMBER CLUSTER
NUMPARTS
PCTFREE
TRACKMOD

Table spaces in a TEMP database (table spaces for scrollable cursors): For information on creating table spaces in a TEMP database for static scrollable cursors, see *DB2 Installation Guide*.

Creating LOB table spaces: When you create a LOB table space, the following clauses are not allowed:

CCSID
COMPRESS
FREEPAGE
LOCKSIZE TABLE
LOCKSIZE PAGE
LOCKSIZE ROW
NUMPARTS
PCTFREE
SEGSIZE
TRACKMOD

Making a partitioned table space larger: Depending on the needs of your application, you might need to increase the size of a partitioned table space to hold more data by either adding more partitions or by increasing the size of the existing partitions:

- To add more partitions, use the ALTER TABLE statement with the ADD PARTITION clause.
- To increase the size of the partitions, use the following steps:
  1. Unload the data rows from the table space, if necessary.

2. Drop the table space. The table and any indexes, views, or synonyms dependent on the table are dropped, and authorizations for the table and views are revoked.
3. Recreate the table space (specifying an appropriate value for the DSSIZE clause), the table (create the partitioning scheme for the table using either table-controlled or index-controlled partitioning), and the necessary indexes.
4. Recreate views and synonyms. Reestablish appropriate authorizations.
5. Load data into the new table.
6. Rebind the plans and packages that changed.

If you only need to redistribute the data between the existing partitions to make better use of the space within the existing table, you can use either of these two methods:

- The ALTER TABLE statement with the ALTER PARTITION clause. You can alter the partitions to specify new partition boundaries to explicitly specify how to redistribute the data. Any affected partitions are set to REORG-pending status.
- The REORG utility with the REBALANCE keyword. REBALANCE specifies that the data is evenly redistributed across the partitions that are reorganized.

Rules for primary and secondary space allocation: You can specify the primary and secondary space allocation for tables spaces and indexes or allow DB2 to choose them. Having DB2 choose the values, especially the secondary space quantity, increases the possibility of reaching the maximum data set size before running out of extents.

In the following rules that describe how allocation works, these terms are used:

PRIQTY, SECQTY
The keywords for CREATE TABLESPACE, ALTER TABLESPACE, CREATE INDEX, and ALTER INDEX.

specified-priqty
The user-specified value for PRIQTY.

specified-secqty
The user-specified value for SECQTY.

actual-priqty
The actual primary space allocation, in kilobytes.

actual-priqty-cylinders
The actual primary space allocation, in cylinders.

actual-secqty
The actual secondary space allocation, in kilobytes.

actual-secqty-cylinders
The actual secondary space allocation, in cylinders.

calculated-extent-cylinders
A value that is calculated by DB2 using a *sliding scale*. A sliding scale means that the first secondary extent allocations are smaller than later secondary allocations. For example, Figure 13 on page 789 shows the sliding scale of secondary extent allocations that DB2 uses for a 64-GB data set.

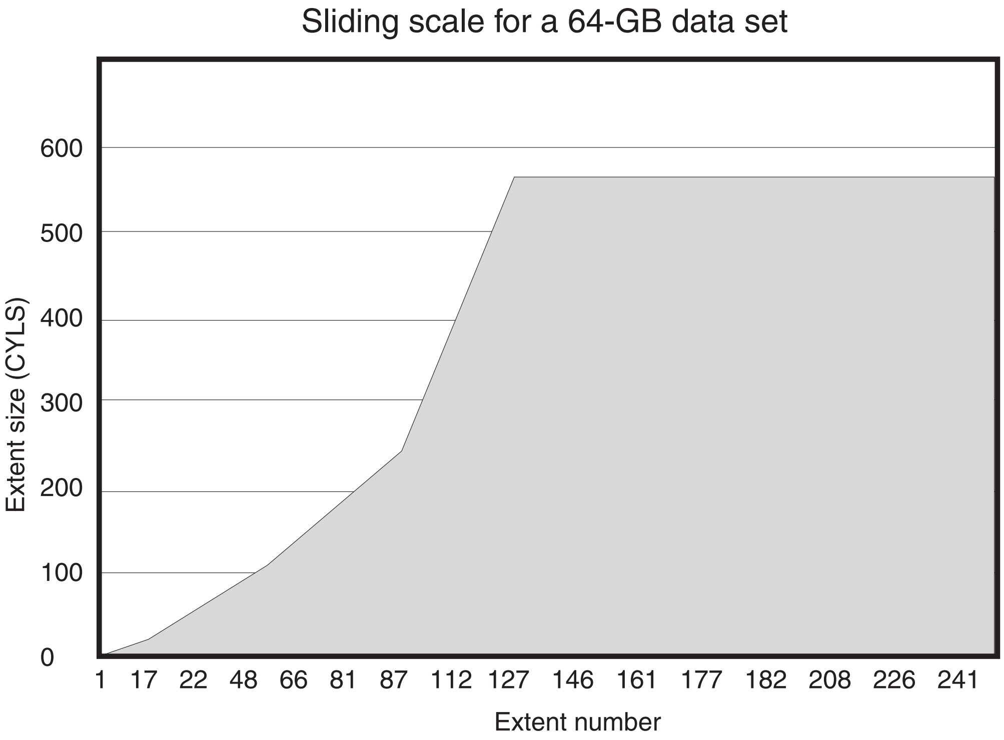


Figure 13. Sliding scale allocation of secondary extents for a 64-GB data set

The rules are:

- **Rule 1 (for primary space allocation)**

  If PRIQTY is specified and *specified-priqty* is not equal to -1, *actual-priqty* is at least *specified-priqty* KB.

  If PRIQTY is not specified or *specified-priqty* is equal to -1, *actual-priqty* is determined as follows:

  – For a table space, if the TSQTY subsystem parameter value is specified and is greater than 0, *actual-priqty* is at least the value of TSQTY.

    If the TSQTY subsystem parameter is not specified or is 0, *actual-priqty* is one cylinder for a non-LOB table space. *actual-priqty* is 10 cylinders for a LOB table space.

  – For an index, if the IXQTY subsystem parameter value is specified and is greater than 0, *actual-priqty* is at least the value of IXQTY.

    If the IXQTY subsystem parameter is not specified or is 0, *actual-priqty* is one cylinder.

- **Rule 2 (for secondary space allocation)**

  If SECQTY is not specified, the following formulas determine *actual-secqty*:

  – If the maximum size of a data set in the table space or index is less than 32 GB, the formula is:

```
actual-secqty-cylinders=
MAX(0.1*actual-priqty-cylinders, MIN(calculated-extent-cylinders, 127))
```

  – If the maximum size of a data set in the table space or index is 32 GB or greater, the formula is:

```
actual-secqty-cylinders=
MAX(0.1*actual-priqty-cylinders, MIN(calculated-extent-cylinders, 559))
```

- **Rule 3 (for secondary space allocation)**

  If SECQTY is 0, *actual-secqty* is 0.

- **Rule 4 (for secondary space allocation)**

  This is the only rule that depends on the value of subsystem parameter MGEXTSZ (field OPTIMIZE EXTENT on installation panel DSNTIP7).

  If MGEXTSZ is YES:

  - If SECQTY is specified and *specified-secqty* is not equal to -1 or 0, the following formulas determine *actual-secqty*:
    - If the maximum size of a data set in the table space or index is less 32 GB, the formula is:

      ```
      actual-secqty-cylinders=
      MAX(MIN(calculated-extent-cylinders, 127),specified-secqty-cylinders)
      ```
    - If the maximum size of a data set in the table space or index is 32 GB or greater, the formula is:

      ```
      actual-secqty-cylinders=
      MAX(MIN(calculated-extent-cylinders, 559),specified-secqty-cylinders)
      ```

  If MGEXTSZ is NO:

  - For a table space, if SECQTY is *n*, the secondary space allocation is at least *n* kilobytes, with the following exceptions:
    - If SECQTY is greater than 4194304, *n* is 4194304 kilobytes.
    - For LOB table spaces:
      - For 4KB page sizes, if *integer* is greater than 0 and less than 200, *n* is 200.
      - For 8KB page sizes, if *integer* is greater than 0 and less than 400, *n* is 400.
      - For 16KB page sizes, if *integer* is greater than 0 and less than 800, *n* is 800.
      - For 32KB page sizes, if *integer* is greater than 0 and less than 1600, *n* is 1600.
      - For any page size, if *integer* is greater than 4194304, *n* is 4194304.
  - For an index, if SECQTY is *integer*, the secondary space allocation is at least *n* kilobytes, where *n* is:

12	If SECQTY and PRIQTY are omitted
4194304	If *integer* is greater than 4194304
integer	If *integer* is not greater than 4194304

Alternative syntax and synonyms: For compatibility with previous releases of DB2, the following keywords are supported:

- You can specify the LOCKPART clause, but it has no effect. Starting with Version 8, DB2 treats all table spaces as if they were defined as LOCKPART YES. LOCKPART YES specifies the use of selective partition locking. When all the conditions for selective partition locking are met, DB2 locks only the partitions that are accessed. When the conditions for selective partition locking are not met, DB2 locks every partition of the table space.

  If you specify LOCKSIZE TABLESPACE, you must not explicitly specify LOCKPART YES.
- When creating a partitioned table space, you can specify PART as a synonym for PARTITION.

Examples

Example 1: Create table space DSN8S81D in database DSN8D81A. Let DB2 define the data sets, using storage group DSN8G810. The primary space allocation is 52 kilobytes; the secondary, 20 kilobytes. The data sets need not be erased before they are deleted.

Locking on tables in the space is to take place at the page level. Associate the table space with buffer pool BP1. The data sets can be closed when no one is using the table space.

```
CREATE TABLESPACE DSN8S81D
  IN DSN8D81A
  USING STOGROUP DSN8G810
    PRIQTY 52
    SECQTY 20
    ERASE NO
  LOCKSIZE PAGE
  BUFFERPOOL BP1
  CLOSE YES;
```

For the above example, the underlying data sets for the table space will be created immediately, which is the default (DEFINE YES). If you want to defer the creation of the data sets until data is first inserted into the table space, you would specify DEFINE NO instead of accepting the default behavior.

Example 2: Assume that a large query database application uses a table space to record historical sales data for marketing statistics. Create large table space SALESHX in database DSN8D81A for the application. Create it with 82 partitions, specifying that the data in partitions 80 through 82 is to be compressed.

Let DB2 define the data sets for all the partitions in the table space, using storage group DSN8G810. For each data set, the primary space allocation is 4000 kilobytes, and the secondary space allocation is 130 kilobytes. Except for the data set for partition 82, the data sets do not need to be erased before they are deleted.

Locking on the table is to take place at the page level. There can only be one table in a partitioned table space. Associate the table space with buffer pool BP1. The data sets cannot be closed when no one is using the table space. If there are no CLOSE YES data sets to close, DB2 may close the CLOSE NO data sets when the DSMAX is reached.

```
CREATE TABLESPACE SALESHX
  IN DSN8D81A
  USING STOGROUP DSN8G810
    PRIQTY 4000
    SECQTY 130
    ERASE NO
  NUMPARTS 82
  (PARTITION 80
    COMPRESS YES,
   PARTITION 81
    COMPRESS YES,
   PARTITION 82
    COMPRESS YES
    ERASE YES)
  LOCKSIZE PAGE
  BUFFERPOOL BP1
  CLOSE NO;
```

Example 3: Assume that a column named EMP_PHOTO with a data type of BLOB(110K) has been added to the sample employee table for each employee's photo. Create LOB table space PHOTOLTS in database DSN8D81A for the auxiliary table that will hold the BLOB data.

Let DB2 define the data sets for the table space, using storage group DSN8G810. For each data set, the primary space allocation is 3200 kilobytes, and the secondary space allocation is 1600 kilobytes. The data sets do not need to be erased before they are deleted. (Because ERASE NO is the default, the clause does not have to be explicitly specified to get the desired behavior.)

```
CREATE LOB TABLESPACE PHOTOLTS
  IN DSN8D81A
  USING STOGROUP DSN8G810
    PRIQTY 3200
    SECQTY 1600
  LOCKSIZE LOB
  BUFFERPOOL BP16K0
  GBPCACHE SYSTEM
  LOG NO
  CLOSE NO;
```

CREATE TRIGGER

The CREATE TRIGGER statement defines a trigger in a schema and builds a trigger package at the current server.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

The privilege set that is defined below must include all of the following:

- Either of these privileges:
  - The CREATEIN privilege on the schema
  - SYSADM or SYSCTRL authority
- The TRIGGER privilege on the table. The privilege set must include at least one of the following:
  - The TRIGGER privilege on the table on which the trigger is defined
  - The ALTER privilege on the table on which the trigger is defined
  - DBADM authority on the database that contains the table
  - SYSADM or SYSCTRL authority
- The SELECT privilege on the table on which the trigger is defined if any transition variables or transition tables are specified
- The SELECT privilege on any table or view to which the search condition of triggered action refers
- The necessary privileges to invoke the triggered SQL statements in the triggered action

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package.

If the statement is dynamically prepared, the privilege set is the privileges that are held by the SQL authorization ID of the process. The specified trigger name can include a schema name (a qualifier). However, if the specified name includes a schema name that is not the same as the SQL authorization ID, one of the following conditions must be met:

- The privilege set includes SYSADM or SYSCTRL authority.
- The SQL authorization ID of the process has the CREATEIN privilege on the schema.

Syntax

```
>>--CREATE TRIGGER--trigger-name--+-NO CASCADE BEFORE-+--+-INSERT------------------------+-------->
                                  '-AFTER-------------'  +-DELETE------------------------+
                                                         '-UPDATE--+------------------+--'
                                                                   |      .-,-------. |
                                                                   |      V         | |
                                                                   '-OF----column-name-+-'

>--ON--table-name--+-------------------------------------------------------------+------------->
                   |              .--------------------------------------------. |
                   |              V  (1)        .-AS-.                         | |
                   '-REFERENCING-----+-OLD------+----+--correlation-name--+----+-'
                                     |          .-AS-.                    |
                                     +-NEW------+----+--correlation-name--+
                                     |                .-AS-.              |
                                     +-OLD_TABLE------+----+--table-identifier-+
                                     |                .-AS-.              |
                                     '-NEW_TABLE------+----+--table-identifier-'

>--+-FOR EACH ROW---------------+--MODE DB2SQL--triggered-action-----------------------------><
   |                       (2)  |
   '-FOR EACH STATEMENT---------'
```

Notes:

1. The same clause must not be specified more than once. OLD TABLE and NEW TABLE must be specified only for AFTER triggers.
2. FOR EACH STATEMENT must not be specified for BEFORE triggers.

triggered-action

```
>>--+----------------------------+--SQL-trigger-body-------------------------------------------><
    '-WHEN--(search-condition)---'
```

SQL-trigger-body

```
>>--+-triggered-SQL-statement---------------------------------------+------------------------><
    |                .---------------------------------.             |
    |                V                                 |             |
    '-BEGIN ATOMIC-----triggered-SQL-statement--;------+------END----'
```

Description

trigger-name
Names the trigger. The name is implicitly or explicitly qualified by a schema. The name, including the implicit or explicit schema name, must not identify a trigger that exists at the current server.

The name is also used to create the trigger package; therefore, the name must also not identify a package that is already described in the catalog. The schema name becomes the collection-id of the trigger package.

- The unqualified form of *trigger-name* is an SQL identifier. The unqualified name is implicitly qualified with a schema name according to the following rules:

  If the statement is embedded in a program, the schema name of the trigger is the authorization ID in the QUALIFIER bind option when the plan or package was created or last rebound. If QUALIFIER was not used, the schema name of the trigger is the owner of the package or plan.

  If the statement is dynamically prepared, the schema name of the trigger is the SQL authorization ID of the process.
- The qualified form of *trigger-name* is an SQL identifier (the schema name) followed by a period and an SQL identifier. The schema name must not begin with 'SYS' unless the name is 'SYSADM', or the schema name is 'SYSTOOLS' and the user who executes the CREATE statement has SYSADM or SYSCTRL privilege. The schema name that qualifies the trigger name is the trigger's owner.

The owner of the trigger is determined by how the CREATE TRIGGER statement is invoked:

- If the statement is embedded in a program, the owner is the authorization ID of the owner of the plan or package.
- If the statement is dynamically prepared, the owner is the SQL authorization ID in the CURRENT SQLID special register.

NO CASCADE BEFORE
Specifies that the trigger is a before trigger. DB2 executes the triggered action before it applies any changes caused by an insert, delete, or update operation on the subject table. It also specifies that the triggered action does not activate other triggers because the triggered action of a before trigger cannot contain any updates.

AFTER
Specifies that the trigger is an after trigger. DB2 executes the triggered action after it applies any changes caused by an insert, delete, or update operation on the subject table.

INSERT
Specifies that the trigger is an insert trigger. DB2 executes the triggered action whenever there is an insert operation on the subject table. However, if the insert trigger is defined on PLAN_TABLE, DSN_STATEMNT_TABLE, or DSN_FUNCTION_TABLE, and the insert operation was caused by DB2 adding a row to the table, the triggered action is not to be executed.

DELETE
Specifies that the trigger is a delete trigger. DB2 executes the triggered action whenever there is a delete operation on the subject table.

UPDATE
Specifies that the trigger is an update trigger. DB2 executes the triggered action whenever there is an update operation on the subject table.

If you do not specify a list of column names, an update operation on any column of the subject table, including columns that are subsequently added with the ALTER TABLE statement, activates the triggered action.

OF *column-name,...*
Each *column-name* that you specify must be a column of the subject table and must appear in the list only once. An update operation on any of the listed columns activates the triggered action.

ON *table-name*
Identifies the subject table with which the trigger is associated. The name must identify a base table at the current server. It must not identify a materialized query table, a temporary table, an auxiliary table, an alias, a synonym, or a catalog table.

REFERENCING
Specifies the correlation names for the transition variables and the table names for the transition tables. For the rows in the subject table that are modified by the triggering SQL operation (insert, delete, or update), a correlation name identifies the columns of a specific row. *table-identifiers* identify the complete set of affected rows.

Each row that is affected by the triggering SQL operation is available to the triggered action by qualifying column names with *correlation-names* that are specified as follows:

OLD AS *correlation-name*
Specifies the correlation name that identifies the values in the row prior to the triggering SQL operation.

NEW AS *correlation-name*
Specifies the correlation name that identifies the values in the row as modified by the triggering SQL operation and by any SET statement in a before trigger that has already been executed.

The complete set of rows that are affected by the triggering operation is available to the triggered action by using *table-identifiers* that are specified as follows:

OLD_TABLE AS *table-identifier*
Specifies the name of a temporary table that identifies the values in the complete set of rows that are modified rows by the triggering SQL operation prior to any actual changes.

NEW_TABLE AS *table-identifier*
Specifies the name of a temporary table that identifies the values in the complete set of rows as modified by the triggering SQL operation and by any SET statement in a before trigger that has already been executed.

Only one OLD and one NEW *correlation-name* can be specified for a trigger. Only one OLD_TABLE and one NEW_TABLE *table-identifier* can be specified for a trigger. All of the *correlation-names* and *table-identifiers* must be unique from one another.

Table 68 on page 797 summarizes the allowable combinations of transition variables and transition tables that you can specify for the various trigger types. The OLD *correlation-name* and the OLD_TABLE *table-identifier* are valid only if the triggering event is either a delete operation or an update operation. For a delete operation, the OLD *correlation-name* captures the values of the columns in the deleted row, and the OLD_TABLE *table-identifier* captures the values in the set of deleted rows. For an update operation, the OLD *correlation-name* captures the values of the columns of a row before the update operation, and the OLD_TABLE *table-identifier* captures the values in the set of updated rows.

The NEW *correlation-name* and the NEW_TABLE *table-identifier* are valid only if the triggering event is either an insert operation or an update operation. For both operations, the NEW *correlation-name* captures the values of the columns in the inserted or updated row and the NEW_TABLE *table-identifier* captures the values in the set of inserted or updated rows. For BEFORE triggers, the values of the updated rows include the changes from any SET statements in the triggered action of BEFORE triggers.

The OLD and NEW correlation-name variables cannot be modified in an AFTER trigger.

Table 68. Allowable combinations of attributes in a trigger definition

Granularity	**Activation time**	**Triggering SQL operation**	**Transition variables allowed**	**Transition tables allowed**
FOR EACH ROW	BEFORE	DELETE	OLD	-
		INSERT	NEW	-
		UPDATE	OLD, NEW	-
	AFTER	DELETE	OLD	OLD_ TABLE
		INSERT	NEW	NEW_TABLE
		UPDATE	OLD, NEW	OLD_TABLE, NEW_TABLE
FOR EACH STATEMENT	BEFORE	DELETE	-	-
		INSERT	-	-
		UPDATE	-	-
	AFTER	DELETE	-	OLD_TABLE
		INSERT	-	NEW_TABLE
		UPDATE	-	OLD_TABLE, NEW_TABLE

A transition variable that has a character data type inherits the subtype and CCSID of the column of the subject table. During the execution of the triggered action, the transition variables are treated like host variables. Therefore, character conversion might occur.

You cannot modify a transition table; transition tables are read-only. Although a transition table does not inherit any edit or validation procedures from the subject table, it does inherit the subject table's encoding scheme and field procedures.

The scope of each *correlation-name* and each *table-identifier* is the entire trigger definition.

FOR EACH ROW

Specifies that DB2 executes the triggered action for each row of the subject table that the triggering SQL operation modifies. If the triggering SQL operation does not modify any rows, the triggered action is not executed.

FOR EACH STATEMENT

Specifies that DB2 executes the triggered action only once for the triggering SQL operation. Even if the triggering SQL operation does not modify any rows, the triggered action is executed once. Do not specify FOR EACH STATEMENT for a before trigger.

MODE DB2SQL

Specifies the mode of the trigger. MODE DB2SQL triggers are activated after all of the row operations have occurred.

triggered-action

Specifies the action to be performed when the trigger is activated. The triggered action is composed of one or more SQL statements and by an optional condition that controls whether the statements are executed.

WHEN (*search-condition***)**

Specifies a condition that evaluates to true, false, or unknown. The triggered SQL statements are executed only if the search-condition evaluates to true. If the WHEN clause is omitted, the associated SQL statements are always executed. The condition for a before trigger must not include a subselect that references the subject table.

SQL-trigger-body

Specifies an SQL statement or SQL statements that are to be executed for the triggered action.

triggered-SQL-statement

Specifies a single SQL statement that is to be executed for the triggered action.

BEGIN ATOMIC *triggered-SQL-statement,...* **END**

Specifies a list of SQL statements that are to be executed for the triggered action. The statements are executed in the order in which they are specified.

SQL processor programs, such as SPUFI and DSNTEP2, might not correctly parse SQL statements in the triggered action that are ended with semicolons. These processor programs accept multiple SQL statements, each separated with a terminator character, as input. Processor programs that use a semicolon as the SQL statement terminator can truncate a CREATE TRIGGER statement with embedded semicolons and pass only a portion of it to DB2. Therefore, you might need to change the SQL terminator character for these processor programs. For information on changing the terminator character for SPUFI and DSNTEP2, see *DB2 Application Programming and SQL Guide*.

Only certain SQL statements can be specified in the *SQL-trigger-body*. Table 69 shows the list of allowable SQL statements, which differs depending on whether the trigger is being defined as BEFORE or AFTER. An ’X’ in the table indicates that the statement is valid.

Table 69. Allowable SQL statements

	Trigger activation time	
SQL statement	**BEFORE**	**AFTER**
fullselect	X	X
CALL	X	X
SIGNAL	X	X
VALUES	X	X
SET transition variable	X	
INSERT		X
DELETE (searched)		X

Table 69. Allowable SQL statements (continued)

	Trigger activation time	
SQL statement	**BEFORE**	**AFTER**
UPDATE (searched)		X
REFRESH TABLE		X

The statements in the triggered action have these restrictions:

- They must not refer to host variables, parameter markers, undefined transition variables, or declared temporary tables.
- They must only refer to a table or view that is at the current server.
- They must only invoke a stored procedure or user-defined function that is at the current server. An invoked routine can, however, access a server other than the current server.
- They must not contain a fullselect that refers to the subject table if the trigger is defined as BEFORE.

The triggered action may refer to the values in the set of affected rows. This action is supported through the use of transition variables and transition tables.

Transition variables use the names of the columns in the subject table qualified by a specified name that identifies whether the reference is to the old value (before the update) or the new value (after the update). A transition variable can be referenced in *search-condition* or *triggered-SQL-statement* of the triggered action wherever a host variable is allowed in the statement if it were issued outside the body of a trigger.

Transition tables can be referenced in the triggered action of an after trigger. Transition tables are read-only. Transition tables also use the name of the columns of the subject table but have a name specified that allows the complete set of affected rows to be treated as a table. The name of the transition table can be referenced in *triggered-SQL-statement* of the triggered action whenever a table name is allowed in the statement if it were issued outside the body of a trigger. The name of the transition table can be specified in *search-condition* or *triggered-SQL-statement* of the triggered action whenever a column name is allowed in the statement if it were issued outside the body of a trigger.

In addition, a transition table can be passed as a parameter to a user-defined function or procedure specifying the TABLE keyword before the name of the transition table. When the function or procedure is invoked, a table locator is passed for the transition table.

A transition variable or transition table is not affected after being returned from a procedure invoked from within a triggered action regardless of whether the corresponding parameter was defined in the CREATE PROCEDURE statement as IN, INOUT, or OUT.

Notes

The implicitly created trigger package: When you create a trigger, DB2 automatically creates a trigger package with the same name as the trigger name.

The collection name of the trigger package is the schema name of the trigger, and the version identifier is the empty string. Multiple versions of a trigger package are not allowed.

Execution authorization: The user executing the triggering SQL operation does not need authority to execute a trigger package. The trigger package does not need to be in the package list for the plan that is associated with the program that contains the SQL statement.

A trigger package becomes invalid if an object or privilege on which it depends is dropped or revoked. The next time the trigger is activated, DB2 attempts to rebind the invalid trigger package. If the automatic rebind is unsuccessful, the trigger package remains invalid.

You cannot create another package from the trigger package, such as with the BIND COPY command. The only way to drop a trigger package is to drop the trigger or the subject table. Dropping the trigger drops the trigger package; dropping the subject table drops the trigger and the trigger package.

DB2 creates the trigger package with the following attributes:

- ACTION(ADD)
- CURRENTDATA(YES)
- DBPROTOCOL(DRDA)
- DEGREE(1)
- DYNAMICRULES(BIND)
- ENABLE(*)
- ENCODING(0)
- EXPLAIN(NO)
- FLAG(I)
- ISOLATION(CS)
- REOPT(NONE) and NODEFER(PREPARE)
- OWNER(authorization ID)
- QUERYOPT(1)
- PATH(path)
- RELEASE(COMMIT)
- SQLERROR(NOPACKAGE)
- QUALIFIER(authorization ID)
- VALIDATE(BIND)

The values of OWNER, QUALIFIER, and PATH are set depending on whether the CREATE TRIGGER statement is embedded in a program or issued interactively. If the statement is embedded in a program, OWNER and QUALIFIER are the owner and qualifier of the package or plan. PATH is the value from the PATH bind option. If the statement is issued interactively, both OWNER and QUALIFIER are the SQL authorization ID. PATH is the value in the CURRENT PATH special register.

Activating a trigger: Only insert, delete, or update operations can activate a trigger. The activation of a trigger can cause trigger cascading. *Trigger cascading* is the result of the activation of one trigger that executes SQL statements that cause the activation of other triggers or even the same trigger again. The triggered actions can also cause updates as a result of the original modification, which can result in the activation of additional triggers. With trigger cascading, a significant chain of triggers can be activated causing a significant change to the database as a result of a single insert, delete, or update statement.

Loading a table with the LOAD utility does not activate any triggers that are defined for the table.

Multiple triggers: Multiple triggers that have the same triggering SQL operation and activation time (BEFORE or AFTER) can be defined on a table. The triggers are activated in the order in which they were created. For example, the trigger that was created first is executed first; the trigger that was created second is executed second; and so on.

Adding columns to subject tables or tables that the triggered action references: If a column is added to a table for which a trigger is defined (the subject table), the following rules apply:

- If the trigger is an update trigger that was defined without an explicit list of column names, an update to the new column activates the trigger.
- If the SQL statements in the triggered action refer to the subject table, the new column is not accessible to the SQL statements until the trigger package is rebound.
- The OLD_TABLE and the NEW_TABLE transition tables contain the new column, but the column cannot be referenced unless the column is recreated. If the transition tables are passed to a user-defined function or a stored procedure, the user-defined function or stored procedure, the user-defined function or stored procedure must be recreated with the new definition of the table (that is, the function or procedure must be dropped and recreated), and the package for the user-defined function or stored procedure must be rebound.

If a column is added to any table to which the SQL statements in the triggered action refers, the new column is not accessible to the SQL statements until the trigger package is rebound.

Altering the attributes of a column that the triggered action references: If a column is altered in the table on which the trigger is defined on (the subject table), the alter is processed, and the dependent trigger packages are invalidated.

Adding triggers to enforce constraints: Adding a trigger on a table that already has rows does not cause the triggered action to be executed. Thus, if the trigger is designed to enforce constraints on the data in the table, the data in the existing rows might not satisfy those constraints.

Defining triggers on plan, statement, and function tables: You can create a trigger on PLAN_TABLE, DSN_STATEMNT_TABLE, or DSN_FUNCTION_TABLE. However, insert triggers that are defined on these tables are not activated when DB2 adds rows to the tables.

Renaming subject tables or tables that the triggered action references: You cannot rename a table for which a trigger is defined (the subject table). Except for the subject table, you can rename any table to which the SQL statements in the triggered action refer. After renaming such a table, drop the trigger and then re-create the trigger so that it refers to the renamed table.

Dependencies when dropping objects and revoking privileges: The following dependencies apply to a trigger:

- Dropping the subject table (the table on which the trigger is defined) causes the trigger and its package to also be dropped.

- Dropping any table, view, alias, or index that is referenced or used within the SQL statements in the triggered action causes the trigger and its package to be invalidated. Dropping a referenced synonym has no effect.
- Dropping a user-defined function that is referenced by the SQL statements in the triggered action is not allowed. An error occurs.
- Dropping a sequence that is referenced by the SQL statements in the triggered action is not allowed. An error occurs.
- Revoking a privilege on which the trigger depends causes the trigger and its package to be invalidated.

Result sets for stored procedures: If a trigger invokes a stored procedure that returns result sets, the application that activated the trigger cannot access those result sets.

Special registers: The values of the special registers are saved before a trigger is activated and are restored on return from the trigger.

Table 70 gives the rules for special registers within a trigger. Some of the special registers are applicable only to dynamic SQL. Although dynamic SQL statements are not allowed directly in the triggered SQL statements, they are allowed in a user-defined function or stored procedure that is invoked by the triggered SQL statements.

Table 70. Rules for the values of special registers in triggers

Special register	The value is ....
CURRENT DATE CURRENT TIME CURRENT TIMESTAMP	Inherited from the triggering SQL operation (delete, insert, update). All triggered SQL statements, including the SQL statements in a user-defined function or a stored procedure invoked by the trigger, inherit these values.
CURRENT PACKAGESET	Set to the schema name of the trigger
CURRENT TIMEZONE	Set to the TIMEZONE parameter
CURRENT CLIENT_ACCTNG CURRENT CLIENT_APPLNAME CURRENT CLIENT_USERID CURRENT CLIENT_WRKSTNNAME CURRENT APPLICATION ENCODING SCHEME CURRENT DEGREE CURRENT LC_CTYPE CURRENT MAINTAINED TABLE TYPES CURRENT MEMBER CURRENT OPTIMIZATION HINT CURRENT PATH CURRENT PACKAGE PATH CURRENT PRECISION CURRENT REFRESH AGE CURRENT RULES CURRENT SERVER CURRENT SQLID USER	Inherited from the triggering SQL operation (delete, insert, update)

Transaction isolation: All of the statements in the *SQL-trigger-body* run under the isolation level that was used at the time the trigger was created.

Errors binding triggers: When a CREATE TRIGGER statement is bound, the SQL statements within the triggered action may not be fully parsed. Syntax errors in those statements might not be caught until the CREATE TRIGGER statement is executed.

Errors executing triggers: Severe errors that occur during the execution of triggered SQL statements are returned with SQLCODE -901, -906, -911, and -913 and the corresponding SQLSTATE. Non-severe errors raised by a triggered SQL statement that is a SIGNAL SQLSTATE statement or that contains a RAISE_ERROR function are returned with SQLCODE -438 and the SQLSTATE that is specified in the SIGNAL SQLSTATE statement or the RAISE_ERROR condition. Other non-severe errors are returned with SQLCODE -723 and SQLSTATE 09000.

Warnings are not returned.

Limiting processor time: DB2's resource limit facility allows you to specify the maximum amount of processor time for a dynamic, manipulative SQL statement (SELECT, INSERT, UPDATE, and DELETE). The execution of a trigger is counted as part of the triggering SQL statement.

Restrictions on constants: A CREATE TRIGGER statement cannot contain a hexadecimal graphic string (GX) constant.

Alternative syntax and synonyms: To provide compatibility with previous releases of DB2 or other products in the DB2 UDB family, DB2 supports the following keywords:
- OLD TABLE as a synonym for OLD_TABLE
- NEW TABLE as a synonym for NEW_TABLE

Examples

Example 1: Create two triggers that track the number of employees that a company manages. The subject table is the EMPLOYEE table, and the triggers increment and decrement a column with the total number of employees in the COMPANY_STATS table. The tables have these columns:
  EMPLOYEE table: ID, NAME, ADDRESS, and POSITION
  COMPANY_STATS table: NBEMP, NBPRODUCT, and REVENUE

This example shows the use of transition variables in a row trigger to maintain summary data in another table.

Create the first trigger, NEW_HIRE, so that it increments the number of employees each time a new person is hired; that is, each time a new row is inserted into the EMPLOYEE table, increase the value of column NBEMP in table COMPANY_STATS by 1.

```
CREATE TRIGGER NEW_HIRE
   AFTER INSERT ON EMPLOYEE
   FOR EACH ROW MODE DB2SQL
   BEGIN ATOMIC
     UPDATE COMPANY_STATS SET NBEMP = NBEMP + 1;
   END
```

Create the second trigger, FORM_EMP, so that it decrements the number of employees each time an employee leaves the company; that is, each time a row is deleted from the table EMPLOYEE, decrease the value of column NBEMP in table COMPANY_STATS by 1.

```
   CREATE TRIGGER FORM_EMP
      AFTER DELETE ON EMPLOYEE
      FOR EACH ROW MODE DB2SQL
      BEGIN ATOMIC
        UPDATE COMPANY_STATS SET NBEMP = NBEMP - 1;
      END
```

Example 2: Create a trigger, REORDER, that invokes user-defined function ISSUE_SHIP_REQUEST to issue a shipping request whenever a parts record is updated and the on-hand quantity for the affected part is less than 10% of its maximum stocked quantity. User-defined function ISSUE_SHIP_REQUEST orders a quantity of the part that is equal to the part's maximum stocked quantity minus its on-hand quantity; the function also ensures that the request is sent to the appropriate supplier.

The parts records are in the PARTS table. Although the table has more columns, the trigger is activated only when columns ON_HAND and MAX_STOCKED are updated.

```
CREATE TRIGGER REORDER
     AFTER UPDATE OF ON_HAND, MAX_STOCKED ON PARTS
     REFERENCING NEW AS NROW
     FOR EACH ROW MODE DB2SQL
     WHEN (NROW.ON_HAND < 0.10 * NROW.MAX_STOCKED)
     BEGIN ATOMIC
       VALUES(ISSUE_SHIP_REQUEST(NROW.MAX_STOCKED - NROW.ON_HAND, NROW.PARTNO));
     END
```

Example 3: Repeat the scenario in *Example 2* except use a fullselect instead of a VALUES statement to invoke the user-defined function. This example also shows how to define the trigger as a statement trigger instead of a row trigger. For each row in the transition table that evaluates to true for the WHERE clause, a shipping request is issued for the part.

```
CREATE TRIGGER REORDER
     AFTER UPDATE OF ON_HAND, MAX_STOCKED ON PARTS
     REFERENCING NEW_TABLE AS NTABLE
     FOR EACH STATEMENT MODE DB2SQL
       BEGIN ATOMIC
         SELECT ISSUE_SHIP_REQUEST(MAX_STOCKED - ON_HAND, PARTNO)
           FROM NTABLE
         WHERE (ON_HAND < 0.10 * MAX_STOCKED);
     END
```

Example 4: Assume that table EMPLOYEE contains column SALARY. Create a trigger, SAL_ADJ, that prevents an update to an employee's salary that exceeds 20% and signals such an error. Have the error that is returned with an SQLSTATE of '75001' and a description. This example shows that the SIGNAL SQLSTATE statement is useful for restricting changes that violate business rules.

```
   CREATE TRIGGER SAL_ADJ
     AFTER UPDATE OF SALARY ON EMPLOYEE
     REFERENCING OLD AS OLD_EMP
                 NEW AS NEW_EMP
     FOR EACH ROW MODE DB2SQL
     WHEN (NEW_EMP.SALARY > (OLD_EMP.SALARY * 1.20))
       BEGIN ATOMIC
         SIGNAL SQLSTATE '75001' ('Invalid Salary Increase - Exceeds 20%');
       END
```

CREATE VIEW

The CREATE VIEW statement creates a view on tables or views at the current server.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

For every table or view identified in the *fullselect*, the privilege set that is defined below must include at least one of the following:

- The SELECT privilege on the table or view
- Ownership of the table or view
- DBADM authority for the database (tables only)
- SYSADM authority
- SYSCTRL authority (catalog tables only)

Authority requirements depend in part on the choice of the view's owner. For information on how to choose the owner, see the description of *view-name* in "Description" on page 557.

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package:

- If this privilege set includes SYSADM authority, the owner of the view can be any authorization ID. If that set includes SYSCTRL but not SYSADM authority, the following is true: the owner of the view can be any authorization ID, provided the view does not refer to user tables or views in the first FROM clause of its defining fullselect. (It could refer instead, for example, to catalog tables or views thereof.)

  If the view satisfies the rules in the preceding paragraph, and if no errors are present in the CREATE statement, the view is created, even if the owner has no privileges at all on the tables and views identified in the view's fullselect.
- If the privilege set includes DBADM authority on at least one of the databases that contains a table from which the view is created, the owner of the view can be any authorization ID if all of the following conditions are true:
  - The value of field DBADM CREATE AUTH was set to YES on panel DSNTIPP during DB2 installation.
  - The view is not based only on views.

  Note: The owner of the view must have the SELECT privilege on all tables and views in the CREATE VIEW statement, or, if the owner does not have the SELECT privilege on a table, the creator must have DBADM authority on the database that contains that table.
- If the privilege set lacks SYSADM, SYSCTRL, or DBADM authority, or if the authorization ID of the application plan or package fails to meet any of the previous conditions, the owner of the view must be the owner of the application plan or package.

If the statement is dynamically prepared, the following rules apply:

- If the SQL authorization ID of the process has SYSADM authority, the owner of the view can be any authorization ID. If that authorization ID has SYSCTRL but not SYSADM authority, the following is true: the owner of the view can be any authorization ID, provided the view does not refer to user tables or views in the first FROM clause of its defining fullselect. (It could refer instead, for example, to catalog tables or views thereof.)

  If the view satisfies the rules in the preceding paragraph, and if no errors are present in the CREATE statement, the view is created, even if the owner has no privileges at all on the tables and views identified in the view's fullselect.
- If SQL authorization ID of the process includes DBADM authority on at least one of the databases that contains a table from which the view is created, the owner of the view can be different from the SQL authorization ID if all of the following conditions are true:
  - The value of field DBADM CREATE AUTH was set to YES on panel DSNTIPP during DB2 installation.
  - The view is not based only on views.

  Note: The owner of the view must have the SELECT privilege on all tables and views in the CREATE VIEW statement, or, if the owner does not have the SELECT privilege on a table, the creator must have DBADM authority on the database that contains that table.
- If the SQL authorization ID of the process lacks SYSADM, SYSCTRL, or DBADM authority, or if the SQL authorization ID of the process fails to meet any of the previous conditions, only the authorization IDs of the process can own the view. In this case, the privilege set is the privileges that are held by the authorization ID selected for ownership.

Syntax

```
>>──CREATE VIEW──view-name──┬──────────────────────┬──┬────────────────────────────────────────┬──────────►
                            │   ┌─,───────────┐    │  │      ┌─,─────────────────────────┐     │
                            └─(─▼─column-name─┴─)─┘  └─WITH─▼─common-table-expression───┴─────┘

►──AS──fullselect──┬───────────────────────────────────────────┬──────────────────────────────────────►◄
                   │        ┌─CASCADED─┐                       │
                   └─WITH───┼──────────┼───CHECK OPTION────────┘
                            └─LOCAL────┘
```

Description

view-name
: Names the view. The name must not identify a table, view, alias, or synonym that exists at the current server.

  If qualified, the name can be a two-part or three-part name. If a three-part name is used, the first part must match the value of the field DB2 LOCATION NAME of installation panel DSNTIPR at the current server. (If the current server is not the local DB2, this name is not necessarily the name in the CURRENT SERVER special register.) In either case, the authorization ID that qualifies the name is the view's owner.

If the view name is unqualified and the statement is embedded in an application program, the owner of the view is the authorization ID that serves as the implicit qualifier for unqualified object names. This is the authorization ID of the QUALIFIER operand when the plan or package was created or last rebound. If QUALIFIER was not used, the owner of the view is the owner of the package or plan.

If the view name is unqualified and the statement is dynamically prepared, the owner of the view is the SQL authorization ID of the process.

The owner of a view always acquires the SELECT privilege on the view and the authority to drop the view. If all of the privileges that are required to create the view are held with the GRANT option before the view is created, the owner of the view receives the SELECT privilege with the GRANT option. Otherwise, the owner receives the SELECT privilege without the GRANT option. For example, assume that a view is created on a table for which the owner has the SELECT privilege with the GRANT option and the view definition also refers to a user-defined function. If the owner's EXECUTE privilege on the user-defined function is held without the GRANT option, the owner acquires the SELECT privilege on the view without the GRANT option.

The owner can also acquire INSERT, UPDATE, and DELETE privileges on the view. Acquiring these privileges is possible if the view is not "read only", which means a single table or view is identified in the first FROM clause of the fullselect. For each privilege that the owner has on the identified table or view (INSERT, UPDATE, and DELETE) before the new view is created, the owner acquires that privilege on the new view. The owner receives the privilege with the GRANT option if the privilege is held on the table or view with the GRANT option. Otherwise, the owner receives the privilege without the GRANT option.

With appropriate DB2 authority, a process can create views for those who have no authority to create the views themselves. The owner of such a view has the SELECT privilege on the view, without the GRANT option, and can drop the view.

column-name,...
Names the columns in the view. If you specify a list of column names, it must consist of as many names as there are columns in the result table of the fullselect. Each name must be unique and unqualified. If you do not specify a list of column names, the columns of the view inherit the names of the columns of the result table of the fullselect.

You must specify a list of column names if the result table of the fullselect has duplicate column names or an unnamed column (a column derived from a constant, function, or expression that was not given a name by the AS clause). For more details about unnamed columns, see the information about names of result columns under "select-clause" on page 395.

WITH *common-table-expression*
Specifies a common table expression. For an explanation of common table expression, see "common-table-expression" on page 417.

AS *fullselect*
Defines the view. At any time, the view consists of the rows that would result if the fullselect were executed.

fullselect must not refer to any declared temporary tables, host variables, or parameter markers (question marks). In addition, *fullselect* must not include an INSERT statement in the FROM clause. For an explanation of *fullselect*, see "fullselect" on page 412.

WITH ... CHECK OPTION

Specifies that every row that is inserted or updated through the view must conform to the definition of the view. A row that does not conform to the definition of the view is a row that cannot be retrieved using that view.

The CHECK OPTION clause must not be specified if the view is read-only, includes a subquery, references a function that is nondeterministic or has an external action, or if the fullselect of the view refers to a created temporary table. If the CHECK OPTION clause is specified for an updatable view that does not allow inserts, it applies to updates only.

If the CHECK OPTION clause is omitted, the definition of the view is not used in the checking of any insert or update operations that use the view. Some checking might still occur during insert or update operations if the view is directly or indirectly dependent on another view that includes the CHECK OPTION clause. Because the definition of the view is not used, rows might be inserted or updated through the view that do not conform to the definition of the view.

The difference between the two forms of the check option, CASCADED and LOCAL, is meaningful only when a view is dependent on another view. The default is CASCADED. The view on which another view is directly or indirectly defined is an *underlying view*.

CASCADED

Update and insert operations on view V must satisfy the search conditions of view V and all underlying views, regardless of whether the underlying views were defined with a check option. Furthermore, every updatable view that is directly or indirectly defined on view V inherits those search conditions (the search conditions of view V and all underlying views of V) as a constraint on insert or update operations.

LOCAL

Update and insert operations on view V must satisfy the search conditions of view V and underlying views that are defined with a check option (either WITH CASCADED CHECK OPTION or WITH LOCAL CHECK OPTION). Furthermore, every updatable view that is directly or indirectly defined on view V inherits those search conditions (the search conditions of view V and all underlying views of V that are defined with a check option) as a constraint on insert or update operations.

The LOCAL form of the CHECK option lets you update or insert rows that do not conform to the search condition of view V. You can perform these operations if the view is directly or indirectly defined on a view that was defined without a check option.

Table 71 on page 809 illustrates the effect of using the default check option, CASCADED. The information in Table 71 on page 809 is based on the following views:

- CREATE VIEW V1 AS SELECT COL1 FROM T1 WHERE COL1 > 10
- CREATE VIEW V2 AS SELECT COL1 FROM V1 WITH CASCADED CHECK OPTION
- CREATE VIEW V3 AS SELECT COL1 FROM V2 WHERE COL1 < 100

Table 71. Examples using default check option, CASCADED

SQL statement	Description of result
INSERT INTO V1 VALUES(5)	Succeeds because V1 does not have a check option and it is not dependent on any other view that has a check option.
INSERT INTO V2 VALUES(5)	Results in an error because the inserted row does not conform to the search condition of V1 which is implicitly is part of the definition of V2.
INSERT INTO V3 VALUES(5)	Results in an error because the inserted row does not conform to the search condition of V1.
INSERT INTO V3 VALUES(200)	Succeeds even though it does not conform to the definition of V3 (V3 does not have the view check option specified); it does conform to the definition of V2 (which does have the view check option specified).

The difference between CASCADED and LOCAL is shown best by example. Consider the following updatable views, where x and y represent either LOCAL or CASCADED:

V1 is defined on Table T0.
V2 is defined on V1 WITH x CHECK OPTION.
V3 is defined on V2.
V4 is defined on V3 WITH y CHECK OPTION.
V5 is defined on V4.

This example shows V1 as an *underlying view* for V2 and V2 as *dependent* on V1.

Table 72 shows the views in which search conditions are checked during an INSERT or UPDATE operation:

Table 72. Views in which search conditions are checked during INSERT and UPDATE operations

View used in INSERT or UPDATE operation	x = LOCAL
	y = LOCAL
		x = CASCADED
		y = CASCADED
			x = LOCAL
			y = CASCADED
				x = CASCADED
				y = LOCAL

V1	None	None	None	None
V2	V2	V2, V1	V2	V2, V1
V3	V2	V2, V1	V2	V2, V1
V4	V4, V2	V4, V3, V2, V1	V4, V3, V2, V1	V4, V2, V1
V5	V4, V2	V4, V3, V2, V1	V4, V3, V2, V1	V4, V2, V1

Notes

Authorization for views created for other users: When a process with appropriate authority creates a view for another user that does not have authorization for the underlying table or view, the SELECT privilege for the created view is implicitly granted to the user.

Read-only views: A view is *read-only* if one or more of the following statements is true of its definition:

- The first FROM clause identifies more than one table or view, or identifies a table function, a nested table expression, or a common table expression.
- The first SELECT clause specifies the keyword DISTINCT.

- The outer fullselect contains a GROUP BY clause.
- The outer fullselect contains a HAVING clause.
- The first SELECT clause contains an aggregate function.
- It contains a subquery such that the base object of the outer fullselect, and of the subquery, is the same table.
- The first FROM clause identifies a read-only view.
- The first FROM clause identifies a system-maintained materialized query table.
- The outer fullselect is not a subselect (contains UNION or UNION ALL).

A read-only view cannot be the object of an INSERT, UPDATE, or DELETE statement. A view that includes GROUP BY or HAVING cannot be referred to in a subquery of a basic predicate.

Hidden ROWID columns: If the definition of a view refers to a hidden ROWID column, the hidden ROWID column is included in the view only if the the hidden ROWID column is explicitly specified in the fullselect. For example, row ID column MY_ROWID would not be included in a view with this definition:

```
CREATE VIEW V1 AS SELECT * FROM MY_TABLE
```

Testing a view definition: You can test the semantics of your view definition by executing SELECT * FROM *view-name*.

The two forms of a view definition: Both the source and the operational form of a view definition are stored in the DB2 catalog. Those two forms are not necessarily equivalent because the operational form reflects the state that exists when the view is created. For example, consider the following statement:

```
   CREATE VIEW V AS SELECT * FROM S;
```

In this example, S is a synonym or alias for A.T, which is a table with columns C1, C2, and C3. The operational form of the view definition is equivalent to:

```
   SELECT C1, C2, C3 FROM A.T;
```

Adding columns to A.T using ALTER TABLE and dropping S does not affect the operational form of the view definition. Thus, if columns are added to A.T or if S is redefined, the source form of the view definition can be misleading.

View restrictions: A view definition cannot contain references to remote objects. A view definition cannot map to more than 15 base table instances. A view definition cannot reference a declared global temporary table.

Examples

Example 1: Create the view DSN8810.VPROJRE1. PROJNO, PROJNAME, PROJDEP, RESPEMP, FIRSTNME, MIDINIT, and LASTNAME are column names. The view is a join of tables and is therefore read-only.

```
   CREATE VIEW DSN8810.VPROJRE1
     (PROJNO,PROJNAME,PROJDEP,RESPEMP,
      FIRSTNME,MIDINIT,LASTNAME)
     AS SELECT ALL
     PROJNO,PROJNAME,DEPTNO,EMPNO,
     FIRSTNME,MIDINIT,LASTNAME
     FROM DSN8810.PROJ, DSN8810.EMP
     WHERE RESPEMP = EMPNO;
```

In the example, the WHERE clause refers to the column EMPNO, which is contained in one of the base tables but is not part of the view. In general, a column named in the WHERE, GROUP BY, or HAVING clause need not be part of the view.

Example 2: Create the view DSN8810.FIRSTQTR that is the UNION ALL of three fullselects, one for each month of the first quarter of 2000. The common names are SNO, CHARGES, and DATE.

```
   CREATE VIEW DSN8810.FIRSTQTR (SNO, CHARGES, DATE) AS
SELECT SNO, CHARGES, DATE
FROM MONTH1
WHERE DATE BETWEEN '01/01/2000' and '01/31/2000'
    UNION All
SELECT SNO, CHARGES, DATE
FROM MONTH2
WHERE DATE BETWEEN '02/01/2000' and '02/29/2000'
    UNION All
SELECT SNO, CHARGES, DATE
FROM MONTH3
WHERE DATE BETWEEN '03/01/2000' and '03/31/2000';
```

DECLARE CURSOR

The DECLARE CURSOR statement defines a cursor.

Invocation

This statement can only be embedded in an application program. It is not an executable statement. It must not be specified in Java.

Authorization

For each table or view identified in the SELECT statement of the cursor, the privilege set must include at least one of the following:

- The SELECT privilege
- Ownership of the object
- DBADM authority for the corresponding database (tables only)
- SYSADM authority
- SYSCTRL authority (catalog tables only)

If the SELECT statement of the cursor includes an INSERT statement, the privilege must also include at least one of the following:

- The INSERT privilege on the target of the insert
- Ownership of the target of the insert
- DBADM authority for the corresponding database (tables only)
- SYSADM authority
- SYSCTRL authority (catalog tables only)

The SELECT statement of the cursor is one of the following:

- The prepared select statement identified by *statement-name*
- The specified *select-statement*

If statement-name is specified:

- The privilege set is determined by the DYNAMICRULES behavior in effect (run, bind, define, or invoke) and is summarized in Table 53 on page 433. (For more information on these behaviors, including a list of the DYNAMICRULES bind option values that determine them, see “Authorization IDs and dynamic SQL” on page 51.)
- The authorization check is performed when the SELECT statement is prepared.
- The cursor cannot be opened unless the SELECT statement is successfully prepared.

If select-statement is specified:

- The privilege set consists of the privileges that are held by the authorization ID of the owner of the plan or package.
- If the plan or package is bound with VALIDATE(BIND), the authorization check is performed at bind time, and the bind is unsuccessful if any required privilege does not exist.
- If the plan or package is bound with VALIDATE(RUN), an authorization check is performed at bind time, but all required privileges need not exist at that time. If all privileges exist at bind time, no authorization checking is performed when the cursor is opened. If any privilege does not exist at bind time, an authorization check is performed the first time the cursor is opened within a unit of work. The OPEN is unsuccessful if any required privilege does not exist.

Syntax

```
                          ┌─NO SCROLL──────────────────────────┐
►►──DECLARE──cursor-name──┼────────────────────────────────────┼──CURSOR──────────────────────────►
                          │  ┌─ASENSITIVE─────────────┐        │
                          └──┼────────────────────────┼─SCROLL─┘
                             ├─INSENSITIVE────────────┤
                             │            ┌─DYNAMIC─┐ │
                             └─SENSITIVE──┼─────────┼─┘
                                          └─STATIC──┘

  ┌───────────────────────────────┐
  │ (1)                           │
►─▼──────┬──────────────────────┬─┴──FOR──┬─select-statement─┬──────────────────►◄
         ├─holdability──────────┤         └─statement-name───┘
         ├─returnability────────┤
         └─rowset-positioning───┘
```

Notes:

1 The same clause must not be specified more than once.

holdability:

```
     ┌─WITHOUT HOLD─┐
►►───┼──────────────┼──────────────────────────────────────►◄
     └─WITH HOLD────┘
```

returnability:

```
     ┌─WITHOUT RETURN────────────┐
►►───┼───────────────────────────┼─────────────────────────►◄
     │             ┌─TO CALLER─┐ │
     └─WITH RETURN─┼───────────┼─┘
```

rowset-positioning:

```
     ┌─WITHOUT ROWSET POSITIONING─┐
►►───┤                            ├──────────────────────────────────────────────►◄
     └─WITH ROWSET POSITIONING────┘
```

Description

cursor-name
Names the cursor. The name must not identify a cursor that has already been declared in the source program. The name is usually VARCHAR(128); however, if the cursor is defined WITH RETURN, the name is limited to VARCHAR(30).

NO SCROLL or SCROLL
Specifies whether the cursor is scrollable or not scrollable.

NO SCROLL
Specifies that the cursor is not scrollable. This is the default.

SCROLL
Specifies that the cursor is scrollable. For a scrollable cursor, whether the cursor has sensitivity to inserts, updates, or deletes depends on the cursor sensitivity option in effect for the cursor. If a sensitivity option is not specified, ASENSITIVE is the default. The sensitivity options include the following ones:

asensitivity
Specifies the desired sensitivity of the cursor to inserts, updates, or deletes that made to the rows underlying the result table. The sensitivity of the cursor determines whether DB2 can materialize the rows of the result into a temporary table.

ASENSITIVE
Specifies that the cursor should be as sensitive as possible. This is the default.

A cursor that defined as ASENSITIVE will be either insensitive or sensitive dynamic; it will not be sensitive static. For information about how the effective sensitivity of the cursor is returned to the application with the GET DIAGNOSTICS statement or in the SQLCA, see "OPEN" on page 990.

INSENSITIVE
Specifies that the cursor does not have sensitivity to inserts, updates, or deletes that are made to the rows underlying the result table. As a result, the size of the result table, the order of the rows, and the values for each row do not change after the cursor is opened. In addition, the cursor is read-only. The SELECT statement or *attribute-string* of the PREPARE statement cannot contain a FOR UPDATE clause, and the cursor cannot be used for positioned updates or deletes.

SENSITIVE
Specifies that the cursor has sensitivity to changes that are made to the database after the result table is materialized. The cursor is always sensitive to updates and deletes that are made using the cursor (that is, positioned updates and deletes using the same cursor). When the current value of a row no longer satisfies the *select-statement* or

statement-name, that row is no longer visible through the cursor. When a row of the result table is deleted from the underlying base table, the row is no longer visible through the cursor.

If DB2 cannot make changes visible to the cursor, then an error is issued at bind time for OPEN CURSOR. DB2 cannot make changes visible to the cursor when the cursor implicitly becomes read-only. Such is the case when the result table must be materialized, as when the FROM clause of the SELECT statement contains more than one table or view. The current list of conditions that result in an implicit read-only cursor can be found in “Read-only cursors” on page 819.

The default is DYNAMIC.

DYNAMIC

Specifies that the result table of the cursor is dynamic, meaning that the size of the result table may change after the cursor is opened as rows are inserted into or deleted from the underlying table, and the order of the rows may change. Rows that are inserted, deleted, or updated by statements that are executed by the same application process as the cursor are visible to the cursor immediately. Rows that are inserted, deleted, or updated by statements that are executed by other application processes are visible only after the statements are committed. If a column for an ORDER BY clause is updated via a cursor or any means outside the process, the next FETCH statement behaves as if the updated row was deleted and re-inserted into the result table at its correct location. At the time of a positioned update, the cursor is positioned before the next row of the original location and there is no current row, making the row appear to have moved.

If a SENSITIVE DYNAMIC cursor is not possible, an error is returned. For example, if a temporary table is needed (such as for processing a FETCH FIRST n ROWS ONLY clause), an error is returned. The SELECT statement of a cursor that is defined as SENSITIVE DYNAMIC cannot contain an INSERT statement.

STATIC

Specifies that the size of the result table and the order of the rows do not change after the cursor is opened. Rows inserted into the underlying table are not added to the result table regardless of how the rows are inserted. Rows in the result table do not move if columns in the ORDER BY clause are updated in rows that have already been materialized. Positioned updates and deletes are allowed if the result table is updatable. The SELECT statement of a cursor that is defined as SENSITIVE STATIC cannot contain an INSERT statement.

A STATIC cursor has visibility to changes made by *this* cursor using positioned updates or deletes. Committed changes made outside this cursor are visible with the SENSITIVE option of the FETCH statement. A FETCH SENSITIVE can result in a *hole* in the result table (that is, a difference between the result table and its underlying base table). If an updated row in the base table of a cursor no longer satisfies the predicate of its SELECT statement, an update hole occurs in the result table. If a row of a cursor was deleted in the base table, a delete hole occurs in the result table. When a FETCH SENSITIVE detects an update hole, no data is returned (a warning is issued), and the cursor is left positioned on the update hole. When a FETCH SENSITIVE detects a delete hole, no data is returned (a warning is issued), and the cursor is left positioned on the delete hole.

Updates through a cursor result in an automatic re-fetch of the row. This re-fetch means that updates can create a hole themselves. The re-fetched row also reflects changes as a result of triggers updating the same row. It is important to reflect these changes to maintain the consistency of data in the row.

Using a nondeterministic function (built-in or user-defined) in the WHERE clause of the *select-statement* or *statement-name* of a SENSITIVE STATIC cursor can cause misleading results. This situation occurs because DB2 constructs a temporary result table and retrieves rows from this table for FETCH INSENSITIVE statements. When DB2 processes a FETCH SENSITIVE statement, rows are fetched from the underlying table and predicates are re-evaluated. Using a nondeterministic function can yield a different result on each FETCH SENSITIVE of the same row, which could also result in the row no longer being considered a match.

A FETCH INSENSITIVE on a SENSITIVE STATIC SCROLL cursor is not sensitive to changes made outside the cursor, unless a previous FETCH SENSITIVE has already refreshed that row; however, positioned updates and delete changes with the cursor are visible.

STATIC cursors are insensitive to insertions.

WITHOUT HOLD or **WITH HOLD**

Specifies whether the cursor should be prevented from being closed as a consequence of a commit operation.

WITHOUT HOLD

Does not prevent the cursor from being closed as a consequence of a commit operation. This is the default.

WITH HOLD

Prevents the cursor from being closed as a consequence of a commit operation. A cursor declared with WITH HOLD is closed at commit time if one of the following is true:

- The connection associated with the cursor is in the release pending status.
- The bind option DISCONNECT(AUTOMATIC) is in effect.
- The environment is one in which the option WITH HOLD is ignored.

When WITH HOLD is specified, a commit operation commits all of the changes in the current unit of work, but releases only the locks that are not required to maintain the cursor. For example, with a non-scrollable cursor, an initial FETCH statement is needed after a COMMIT statement to position the cursor on the row that follows the row that the cursor was positioned on before the commit operation.

WITH HOLD has no effect on an INSERT statement within a SELECT statement. When a COMMIT is issued, the changes caused by the INSERT statement are committed, regardless of whether or not the cursor is declared WITH HOLD.

All cursors are implicitly closed by a connect (Type 1) or rollback operation. A cursor is also implicitly closed by a commit operation if WITH HOLD is ignored or not specified.

Cursors that are declared with WITH HOLD in CICS or in IMS non-message-driven programs will not be closed by a rollback operation if the cursor was opened in a previous unit of work and no changes have been made to the database in the current unit of work. The cursor cannot be closed because CICS and IMS do not broadcast the rollback request to DB2 for a null unit of work.

If a cursor is closed before the commit operation, the effect is the same as if the cursor was declared without the option WITH HOLD.

WITH HOLD is ignored in IMS message driven programs (MPP, IFP, and message-driven BMP). WITH HOLD maintains the cursor position in a CICS pseudo-conversational program until the end-of-task (EOT).

For details on restrictions that apply to declaring cursors with WITH HOLD, see Part 2 of *DB2 Application Programming and SQL Guide*.

WITHOUT RETURN or **WITH RETURN TO CALLER**

Specifies the intended use of the result table of the cursor. The default is WITHOUT RETURN, except in Java procedures, where the default is WITH RETURN TO CALLER.

WITHOUT RETURN

Specifies that the result table of the cursor is not intended to be used as a result set that will be returned from the program or procedure.

WITH RETURN TO CALLER

Specifies that the result table of the cursor is intended to be used as a result set that will be returned from the program or procedure to the caller. Specifying TO CALLER is optional.

WITH RETURN TO CALLER is relevant when the SQL CALL statement is used to invoke a procedure that either contains the DECLARE CURSOR statement, or directly or indirectly invokes a program or procedure that contains the DECLARE CURSOR statement. In other cases, the precompiler might accept the clause, but the clause has no effect.

When a cursor that is declared using the WITH RETURN TO CALLER clause remains open at the end of a program or procedure, that cursor defines a result set from the program or procedure. Use the CLOSE statement to close cursors that are not intended to be a result set from the program or procedure. Although DB2 will automatically close any cursors that are not declared using WITH RETURN TO CALLER, the use of the CLOSE statement is recommended to increase the portability of applications.

For non-scrollable cursors, the result set consists of all rows from the current cursor position to the end of the result table. For scrollable cursors, the result set consists of all rows of the result table.

The caller is the program or procedure that executed the SQL CALL statement that either invokes the procedure that contains the DECLARE CURSOR statement, or directly or indirectly invokes the program that contains the DECLARE CURSOR statement. For example, if the caller is a procedure, the result set is returned to the procedure. If the caller is a client application, the result set is returned to the client application.

rowset-positioning

Specifies whether multiple rows of data can be accessed as a rowset on a single FETCH statement for the cursor. The default is WITHOUT ROWSET POSITIONING.

WITHOUT ROWSET POSITIONING

Specifies that the cursor can be used only with row-positioned FETCH statements. The cursor is to return a single row for each FETCH statement and the FOR *n* ROWS clause cannot be specified on a FETCH statement for this cursor. WITHOUT ROWSET POSITIONING or single row access refers to how data is fetched from the database engine. For remote access, data may be blocked and returned to the client in blocks.

WITH ROWSET POSITIONING

Specifies that the cursor can be used with either row-positioned or rowset-positioned FETCH statements. This cursor can be used to return either a single row or multiple rows, as a rowset, with a single FETCH statement. ROWSET POSITIONING refers to how data is fetched from the database engine. For remote access, if any row qualifies, at least 1 row is returned as a rowset. The size of the rowset depends on the number of rows specified on the FETCH statement and on the number of rows that qualify. Data may be blocked and returned to the client in blocks.

select-statement

Specifies the result table of the cursor. See “select-statement” on page 416 for an explanation of *select-statement*.

The *select-statement* must not include parameter markers (except for REXX), but can include references to host variables. In host languages, other than REXX, the declarations of the host variables must precede the DECLARE CURSOR statement in the source program. In REXX, parameter markers must be used in place of host variables and the statement must be prepared.

The USING clause of the OPEN statement can be used to specify host variables that will override the values of the host variables or parameter markers that are specified as part of the statement in the DECLARE CURSOR statement.

The *select-statement* of the cursor must not contain an INSERT statement if the cursor is defined as SENSITIVE DYNAMIC or SENSITIVE STATIC.

statement-name

Identifies the prepared *select-statement* that specifies the result table of the cursor whenever the cursor is opened. The *statement-name* must not be identical to a statement name specified in another DECLARE CURSOR statement of the source program. For an explanation of prepared SELECT statements, see “PREPARE” on page 995.

The prepared *select-statement* of the cursor must not contain an INSERT statement if the cursor is defined as SENSITIVE DYNAMIC or SENSITIVE STATIC.

Notes

A cursor in the open state designates a result table and a position relative to the rows of that table. The table is the result table specified by the SELECT statement of the cursor.

Read-only cursors: If the result table is *read-only*, the cursor is *read-only*. The result table is *read-only* if one or more of the following statements is true about the SELECT statement of the cursor:

- The first FROM clause identifies or contains any of the following:
  - More than one table or view
  - A catalog table with no updatable columns
  - A read-only view
  - A nested table expression
  - A table function
  - A system-maintained materialized query table
- The first SELECT clause specifies the keyword DISTINCT, contains an aggregate function, or uses both.
- The SELECT statement of the cursor contains an INSERT statement.
- The outer subselect contains a GROUP BY clause, a HAVING clause, or both clauses
- It contains a subquery such that the base object of the outer subselect, and of the subquery, is the same table
- Any of the following operators or clauses are specified:
  - A UNION or UNION ALL operator
  - An ORDER BY clause (except when the cursor is declared as SENSITIVE STATIC scrollable)
  - A FOR READ ONLY clause
- It is executed with isolation level UR and a FOR UPDATE clause is not specified.

If the result table is not *read-only*, the cursor can be used to update or delete the underlying rows of the result table.

TEMP database requirement for static scrollable cursors: To use a static scrollable cursor, you must first create a TEMP database and table spaces in this database because a static scrollable cursor requires a temporary table for its result table while the cursor is open. DB2 chooses a table space to use for the temporary result table. Dynamic scrollable cursors do not require a declared temporary table.

Cursors in COBOL and Fortran programs: In COBOL and Fortran source programs, the DECLARE CURSOR statement must precede all statements that explicitly refer to the cursor by name. This rule does not necessarily apply to the other host languages because the precompiler provides a two-pass option for these languages. This rule applies to other host languages if the two-pass option is not used.

Cursors in REXX: If host variables are used in a DECLARE CURSOR statement within a REXX procedure, the DECLARE CURSOR statement must be the object of a PREPARE and EXECUTE.

Scope of a cursor: The scope of *cursor-name* is the source program in which it is defined; that is, the application program submitted to the precompiler. Thus, you can only refer to a cursor by statements that are precompiled with the cursor declaration. For example, a COBOL program called from another program cannot use a cursor that was opened by the calling program. Furthermore, a cursor defined in a Fortran subprogram can only be referred to in that subprogram. Cursors that specify WITH RETURN in a procedure and are left open are returned as result sets.

Although the scope of a cursor is the program in which it is declared, each package (or DBRM of a plan) created from the program includes a separate instance of the cursor, and more than one instance of the cursor can be used in the same execution of the program. For example, assume a program is precompiled with the CONNECT(2) option and its DBRM is used to create a package at location X and a package at location Y. The program contains the following SQL statements:

```
DECLARE C CURSOR FOR ...
CONNECT TO X
OPEN C
FETCH C INTO ...
CONNECT TO Y
OPEN C
FETCH C INTO ...
```

The second OPEN C statement does not cause an error because it refers to a different instance of cursor C. The same notion applies to a single location if the packages are in different collections.

A SELECT statement is evaluated at the time the cursor is opened. If the same cursor is opened, closed, and then opened again, the results may be different. If the SELECT statement of the cursor contains CURRENT DATE, CURRENT TIME or CURRENT TIMESTAMP, all references to these special registers yields the same respective datetime value on each FETCH operation. The value is determined when the cursor is opened. Multiple cursors using the same SELECT statement can be opened concurrently. They are each considered independent activities.

Blocking of data: To process data more efficiently, DB2 might block data for read-only cursors. If a cursor is not going to be used in a positioned UPDATE or positioned DELETE statement, define the cursor as FOR READ ONLY.

Positioned deletes and isolation level UR: Specify FOR UPDATE if you want to use the cursor for a positioned DELETE and the isolation level is UR because of a BIND option. In this case, the isolation level is CS.

Returning a result set from a stored procedure: A cursor that is declared in a stored procedure returns a result set when all of the following conditions are true:

- The cursor is declared with the WITH RETURN option. In a distributed environment, blocks of each result set of the cursor's data are returned with the CALL statement reply.
- The cursor is left open after exiting from the stored procedure. A cursor declared with the SCROLL option must be left positioned *before* the first row before exiting from the stored procedure.
- The cursor is declared with the WITH HOLD option if the stored procedure performs a COMMIT_ON_RETURN.

The result set is the set of all rows after the current position of the cursor after exiting the stored procedure. The result set is assumed to be read-only. If that same procedure is reinvoked, open result set cursors for a stored procedure at a given site are automatically closed by the database management system.

Scrollable cursors specified with user-defined functions: A row can be fetched more than once with a scrollable cursor. Therefore, if a scrollable cursor is defined with a nondeterministic function in the select list of the cursor, a row can be fetched multiple times with different results for each fetch. (However, the value of a nondeterministic function in the WHERE clause of a scrollable cursor is captured when the cursor is opened and remains unchanged until the cursor is closed.) Similarly, if a scrollable cursor is defined with a user-defined function with external action, the action is executed with every fetch.

Examples

The statements in the following examples are assumed to be in PL/I programs.

Example 1: Declare C1 as the cursor of a query to retrieve data from the table DSN8810.DEPT. The query itself appears in the DECLARE CURSOR statement.

```
EXEC SQL DECLARE C1 CURSOR FOR
   SELECT DEPTNO, DEPTNAME, MGRNO
   FROM DSN8810.DEPT
   WHERE ADMRDEPT = 'A00';
```

Example 2: Declare C1 as the cursor of a query to retrieve data from the table DSN8810.DEPT. Assume that the data will be updated later with a searched update and should be locked when the query executes. The query itself appears in the DECLARE CURSOR statement.

```
EXEC SQL DECLARE C1 CURSOR FOR
   SELECT DEPTNO, DEPTNAME, MGRNO
   FROM DSN8810.DEPT
   WHERE ADMRDEPT = 'A00'
   FOR READ ONLY WITH RS USE AND KEEP EXCLUSIVE LOCKS;
```

Example 3: Declare C2 as the cursor for a statement named STMT2.

```
EXEC SQL DECLARE C2 CURSOR FOR STMT2;
```

Example 4: Declare C3 as the cursor for a query to be used in positioned updates of the table DSN8810.EMP. Allow the completed updates to be committed from time to time without closing the cursor.

```
EXEC SQL DECLARE C3 CURSOR WITH HOLD FOR
  SELECT * FROM DSN8810.EMP
    FOR UPDATE OF WORKDEPT, PHONENO, JOB, EDLEVEL, SALARY;
```

Instead of specifying which columns should be updated, you could use a FOR UPDATE clause without the names of the columns to indicate that all updatable columns are updated.

Example 5: In stored procedure SP1, declare C4 as the cursor for a query of the table DSN8810.PROJ. Enable the cursor to return a result set to the caller of SP1, which performs a commit on return.

```
EXEC SQL DECLARE C4 CURSOR WITH HOLD WITH RETURN FOR
   SELECT PROJNO, PROJNAME
   FROM DSN8810.PROJ
   WHERE DEPTNO = 'A01';
```

Example 6: In the following example, the DECLARE CURSOR statement associates the cursor name C5 with the results of the SELECT and specifies that the cursor is scrollable. C5 allows positioned updates and deletes because the result table can be updated.

```
EXEC SQL DECLARE C5 SENSITIVE STATIC SCROLL CURSOR FOR
   SELECT DEPTNO, DEPTNAME, MGRNO
   FROM DSN8810.DEPT
   WHERE ADMRDEPT = 'A00';
```

Example 7: In the following example, the DECLARE CURSOR statement associates the cursor name C6 with the results of the SELECT and specifies that the cursor is scrollable.

```
EXEC SQL DECLARE C6 INSENSITIVE SCROLL CURSOR FOR
   SELECT DEPTNO, DEPTNAME, MGRNO
   FROM DSN8810.DEPT
   WHERE DEPTNO;
```

Example 8: The following example illustrates how an application program might use dynamic scrollable cursors. First create and populate a table.

```
CREATE TABLE ORDER
      (ORDERNUM  INTEGER,
       CUSTNUM   INTEGER,
       CUSTNAME  VARCHAR(20),
       ORDERDATE CHAR(8),
       ORDERAMT  DECIMAL(8,3),
       COMMENTS  VARCHAR(20));
```

Populate the table by inserting or loading about 500 rows.

```
EXEC SQL DECLARE CURSOR ORDERSCROLL
   SENSITIVE DYNAMIC SCROLL FOR
   SELECT ORDERNUM, CUSTNAME, ORDERAMT, ORDERDATE FROM ORDER
   WHERE ORDERAMT > 1000
   FOR UPDATE OF COMMENTS;
```

Open the scrollable cursor.

```
OPEN CURSOR ORDERSCROLL;
```

Fetch forward from the scrollable cursor.

```
Loop-to-fill-screen
      do 10 times
       FETCH FROM ORDERSCROLL INTO :HV1, :HV2, :HV3, :HV4;
      end
```

Fetch RELATIVE from the scrollable cursor.

```
Skip-forward-100-rows
      FETCH RELATIVE +100
       FROM ORDERSCROLL INTO :HV1, :HV2, :HV3, :HV4;
Skip-backward-50-rows
      FETCH RELATIVE -50
       FROM ORDERSCROLL INTO :HV1, :HV2, :HV3, :HV4;
```

Fetch ABSOLUTE from the scrollable cursor.

```
Re-read-the-third-row
      FETCH ABSOLUTE +3
       FROM ORDERSCROLL INTO :HV1, :HV2, :HV3, :HV4;
```

Fetch RELATIVE from scrollable cursor.

```
Read-the-third-row-from current position
      FETCH SENSITIVE RELATIVE +3
       FROM ORDERSCROLL INTO :HV1, :HV2, :HV3, :HV4;
```

Do a positioned update through the scrollable cursor.

```
Update-the-current-row
      UPDATE ORDER SET COMMENTS = "Expedite"
       WHERE CURRENT OF ORDERSCROLL;
```

Close the scrollable cursor.

```
CLOSE CURSOR ORDERSCROLL;
```

Example 9: Declare C1 as the cursor of a query to retrieve a rowset from the table DEPT. The prepared statement is MYCURSOR.

```
EXEC SQL DECLARE C1 CURSOR
   WITH ROWSET POSITIONING FOR MYCURSOR;
```

DECLARE GLOBAL TEMPORARY TABLE

The DECLARE GLOBAL TEMPORARY TABLE statement defines a declared temporary table for the current application process. The declared temporary table description does not appear in the system catalog. It is not persistent and cannot be shared with other application processes. Each application process that defines a declared temporary table of the same name has its own unique description and instance of the temporary table. When the application process terminates, the temporary table is dropped.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

None are required, unless the LIKE clause is specified when additional privileges might be required.

PUBLIC implicitly has the following privileges without GRANT authority for declared temporary tables:

- The CREATETAB privilege to define a declared temporary table in the database that is defined AS TEMP, which is the database for declared temporary tables.
- The USE privilege to use the table spaces in the database that is defined as TEMP.
- All table privileges on the table and authority to drop the table. (Table privileges for a declared temporary table cannot be granted or revoked.)

These implicit privileges are not recorded in the DB2 catalog and cannot be revoked.

Syntax

```
►►──DECLARE GLOBAL TEMPORARY TABLE──table-name──────────────────────────────────►


          ┌─,──────────────────┐
          ▼                    │
►──┬─(─────column-definition───┴─)───────────────────────────────────┬─────────►
   │                                             ┌─COLUMN ATTRIBUTES─┐ │
   │                        ┌─EXCLUDING IDENTITY─┴───────────────────┴─┐│
   ├─LIKE──┬─table-name─┬───┼──────────────────────────────────────────┼┤
   │       └─view-name──┘   │                   ┌─COLUMN ATTRIBUTES─┐  ││
   │                        └─INCLUDING IDENTITY─┴───────────────────┴─┘│
   └─AS──(fullselect)──WITH NO DATA──┬──────────────┬───────────────────┘
                                     └─copy-options─┘

   ┌─────────────────────────────────┐
   ▼  (1)                            │
►─────────────┬───────────────────────┬┴──────────────────────────────────────►◄
              ├─CCSID──┬─ASCII───┬────┤
              │        ├─EBCDIC──┤    │
              │        └─UNICODE─┘    │
              │  ┌─ON COMMIT DELETE ROWS───┐
              └──┼─────────────────────────┼┘
                 ├─ON COMMIT PRESERVE ROWS─┤
                 └─ON COMMIT DROP TABLE────┘
```

Notes:

1 The same clause must not be specified more than once.

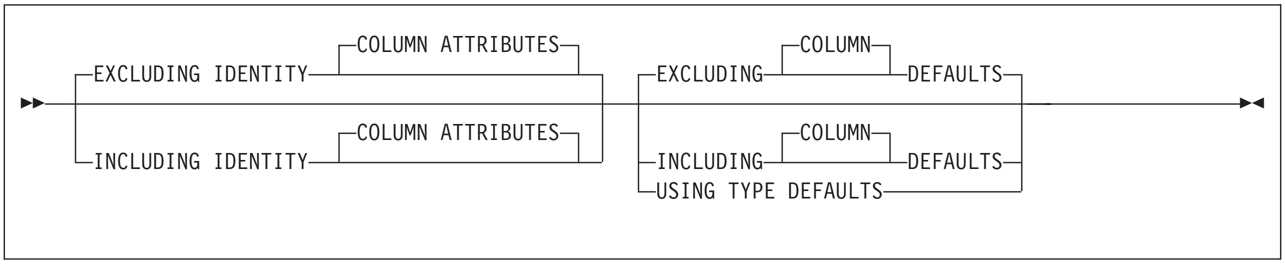
column-definition:

```
                                 ┌─────────────────────────────────────────────┐
                           (1)   ▼                                             │
►►──column-name──data-type──────────┬───────────────────────────────────────┬──┴──►◄
                                    │ ┌─WITH─┐                               │
                                    ├─┴──────┴─DEFAULT──┬────────────────┬───┤
                                    │                   ├─constant───────┤   │
                                    │                   ├─USER───────────┤   │
                                    │                   ├─CURRENT SQLID──┤   │
                                    │                   └─NULL───────────┘   │
                                    ├─GENERATED──┬─ALWAYS─────┬─┬──────────────────┬─┤
                                    │            └─BY DEFAULT─┘ └─identity-options─┘ │
                                    └─NOT NULL─────────────────────────────────────┘
```

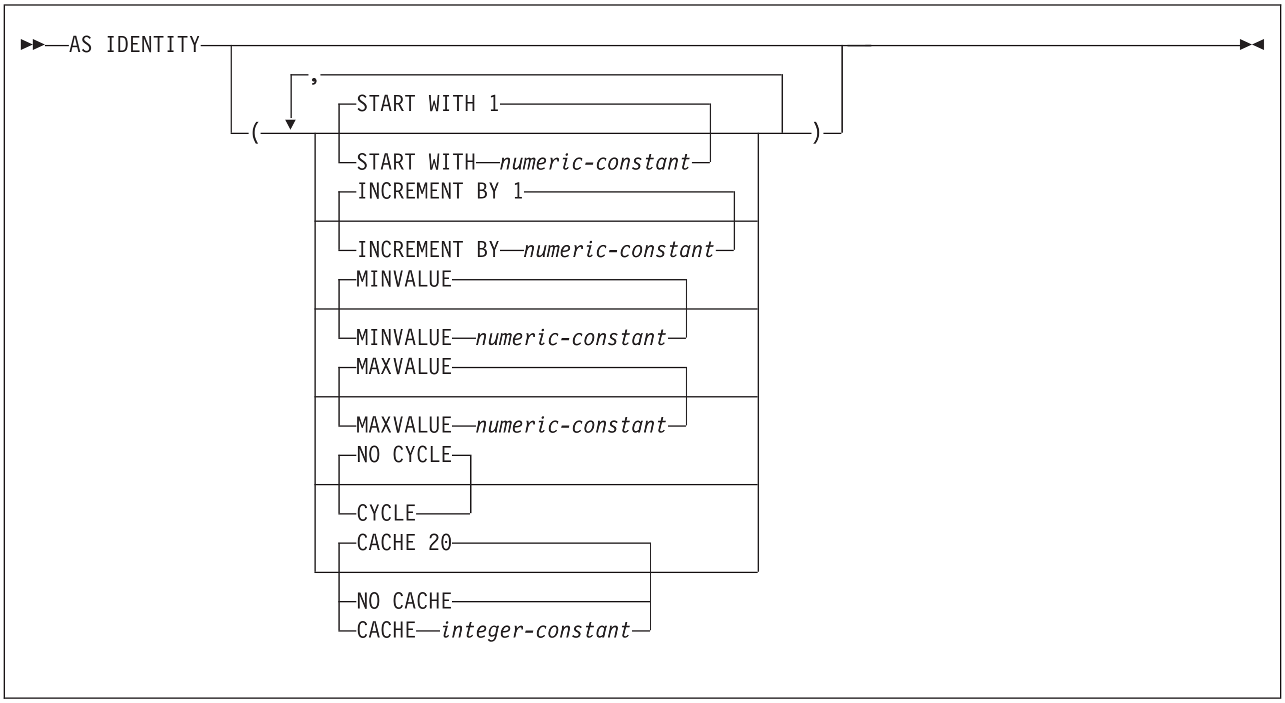
Notes:

1 The same clause must not be specified more than once.

copy-options:



identity-options:



Description

table-name
Names the temporary table. The qualifier, if specified explicitly, must be SESSION. If the qualifier is not specified, it is implicitly defined to be SESSION.

If a table, view, synonym, or alias already exists with the same name and an implicit or explicit qualifier of SESSION:

- The declared temporary table is still defined with SESSION.*table-name*. An error is not issued because the resolution of a declared temporary table name does not include the persistent and shared names in the DB2 catalog tables.
- Any references to SESSION.*table-name* will resolve to the declared temporary table rather than to any existing SESSION.*table-name* whose definition is persistent and is in the DB2 catalog tables.

column-definition
Defines the attributes of a column for each instance of the table. The number of columns defined must not exceed 750. The maximum record size must not

exceed 32714 bytes. The maximum row size must not exceed 32706 bytes (8 bytes less than the maximum record size).

column-name
Names the column. The name must not be qualified and must not be the same as the name of another column in the table.

data-type
Specifies the data type of the column. The data type can be any built-in data type that can be specified for the CREATE TABLE statement except for a LOB (BLOB, CLOB, and DBCLOB) or ROWID type. The FOR *subtype* DATA clause can be specified as part of *data-type*. For more information on the data types and the rules that apply to them, see "built-in-type" on page 741.

DEFAULT
Specifies a default value for the column. This clause must not be specified more than once in the same *column-definition*.

Omission of NOT NULL and DEFAULT from a *column-definition* is an implicit specification of DEFAULT NULL.

If DEFAULT is specified without a value after it, the default value of the column depends on the data type of the column, as follows:

Data type	Default value
Numeric	0
Fixed-length string	Blanks
Varying-length string	A string of length 0
Date	CURRENT DATE
Time	CURRENT TIME
Timestamp	CURRENT TIMESTAMP

A default value other than the one that is listed above can be specified in one of the following forms:

constant
Specifies a constant as the default value for the column. The value of the constant must conform to the rules for assigning that value to the column. A hexadecimal graphic string constant (GX) cannot be specified.

USER
Specifies the value of the USER special register at the time of INSERT or LOAD as the default value for the column. The data type of the column must be a character string with a length attribute greater than or equal to the length attribute of the USER special register.

CURRENT SQLID
Specifies the value of the SQL authorization ID of the process at the time of INSERT or LOAD as the default value for the column. The data type of the column must be a character string with a length attribute greater than or equal to the length attribute of the CURRENT SQLID special register.

NULL
Specifies null as the default value for the column. If NOT NULL was specified, DEFAULT NULL must not be specified within the same *column-definition*.

GENERATED
Specifies that DB2 generates values for the column. GENERATED must be specified if the column is to be considered an IDENTITY column.

ALWAYS
Specifies that DB2 always generates a value for the column when a row is inserted into the table.

BY DEFAULT
Specifies that DB2 generates a value for the column when a row is inserted into the table unless a value is specified. BY DEFAULT is the recommended value only when you are using data propagation.

Defining a column as GENERATED BY DEFAULT does not necessarily guarantee the uniqueness of the values. To ensure uniqueness of the values, define a unique, single-column index on the column.

AS IDENTITY
Specifies that the column is an identity column for the table. A table can have only one identity column. AS IDENTITY can be specified only if the data type for the column is an exact numeric type with a scale of zero (SMALLINT, INTEGER, DECIMAL with a scale of zero).

An identity column is implicitly NOT NULL. An identity column cannot have a DEFAULT clause. For the descriptions of the identity attributes, see the description of the AS IDENTITY clause in "CREATE TABLE" on page 734.

NOT NULL
Specifies that the column cannot contain nulls. Omission of NOT NULL indicates that the column can contain nulls.

LIKE *table-name* or *view-name*
Specifies that the columns of the table have the same name, data type, and nullability attributes as the columns of the identified table or view. If a table is identified, the column default attributes are also defined by that table. The name specified must identify a table, view, synonym, or alias that exists at the current server. The identified table must not be an auxiliary table or a declared temporary table.

The privilege set must include the SELECT privilege on the identified table or view.

This clause is similar to the LIKE clause on CREATE TABLE, but it has the following differences:

- If LIKE results in a column having a LOB data type, a ROWID data type, or distinct type, the DECLARE GLOBAL TEMPORARY TABLE statement fails.
- In addition to these data type restrictions, if any column has any other attribute value that is not allowed in a declared temporary table, that attribute value is ignored. The corresponding column in the new temporary table has the default value for that attribute unless otherwise indicated.

  For example, if a table with a security label column is identified in the LIKE clause, the corresponding column of the new table inherits only the data type of the security label column; none of the security label column attributes are inherited.

When the identified object is a table, the column name, data type, nullability, and default attributes are determined from the columns of the specified table; any identity column attributes are inherited only if the INCLUDING IDENTITY COLUMN ATTRIBUTES clause is specified.

EXCLUDING IDENTITY COLUMN ATTRIBUTES or **INCLUDING IDENTITY COLUMN ATTRIBUTES**
Specifies whether identity column attributes are inherited from the columns resulting from the *fullselect*, *table-name*, or *view-name*.

EXCLUDING IDENTITY COLUMN ATTRIBUTES
Specifies that the table does not inherit the identity attributes of the columns resulting from the *fullselect*, *table-name*, or *view-name*.

INCLUDING IDENTITY COLUMN ATTRIBUTES
Specifies that the table inherits the identity attributes, if any, of the columns resulting from the *fullselect* or *table-name*. In general, the identity attributes are copied if the element of the corresponding column in the table or*fullselect* is the name of a table column that directly or indirectly maps to the name of a base table column that is an identity column.

If the INCLUDING IDENTITY COLUMN ATTRIBUTES clause is specified with the AS fullselect clause, the columns of the new table do not inherit the identity attribute in the following cases:

- The select list of the *fullselect* includes multiple instances of an identity column name (that is, selecting the same column more than once).
- The select list of the *fullselect* includes multiple identity columns (that is, it involves a join).
- The identity column is included in an expression in the select list.
- The *fullselect* includes a set operation (union).

If INCLUDING IDENTITY COLUMN ATTRIBUTES is not specified, the new table will not have an identity column.

If the LIKE clause identifies a view, INCLUDING IDENTITY COLUMN ATTRIBUTES must not be specified.

AS *(fullselect)* **WITH NO DATA**
Specifies that the table definition is based on the column definitions from the result of a query expression. The use of AS *(fullselect)* is an implicit definition of *n* columns for the declared global temporary table, where *n* is the number of columns that would result from the *fullselect*. The columns of the new table are defined by the columns that result from the *fullselect*. Every select list element must have a unique name. The AS clause can be used in the select-clause to provide unique names. The implicit definition includes the column name, data type, and nullability characteristic of each of the result columns of *fullselect*.

WITH NO DATA indicates that the *fullselect* is not executed. You can use the INSERT INTO statement with the same *fullselect* specified in the AS clause to populate the declared temporary table with the set of rows from the result table of the *fullselect*.

The behavior of these column attributes is controlled with the INCLUDING or USING TYPE DEFAULTS clauses, which are defined below.

If *fullselect* results in a column having a LOB data type, a ROWID data type, or a distinct type, the DECLARE GLOBAL TEMPORARY statement fails.

If *fullselect* results in other column attributes that are not applicable for a declared temporary table, those attributes are ignored in the implicit definition for the declared temporary table.

The *fullselect* must not refer to host variables or include parameter markers (question marks). The outermost SELECT list of the *fullselect* must not reference data that is encoded with different CCSID sets.

EXCLUDING COLUMN DEFAULTS, INCLUDING COLUMN DEFAULTS, or **USING TYPE DEFAULTS**

Specifies whether the table inherits the default values of the columns of the fullselect.

EXCLUDING COLUMN DEFAULTS

Specifies that the table does not inherit the default values of the columns of the fullselect. The default values of the column of the new table are either null or there are no default values. If the column can be null, the default is the null value. If the column cannot be null, there is no default value, and an error occurs if a value is not provided for a column on INSERT for the new table.

INCLUDING COLUMN DEFAULTS

Specifies that the table inherits the default values of the columns of the fullselect. A default value is the value that is assigned to the column when a value is not specified on an INSERT or LOAD. Columns resulting from the fullselect that are not updatable will not have a default defined in the corresponding column of the created table.

USING TYPE DEFAULTS

Specifies that the default values for the declared temporary table depend on the data type of the columns that result from *fullselect*, as follows:

Data type	**Default value**
Numeric	0
Fixed-length string	Blanks
Varying-length string	A string of length 0
Date	CURRENT DATE
Time	CURRENT TIME
Timestamp	CURRENT TIMESTAMP

CCSID *encoding-scheme*

Specifies the encoding scheme for string data that is stored in the table. For declared temporary tables, the encoding scheme for the data cannot be specified for the table space or database, and all data in one table space or the database need not use the same encoding scheme. Because there can be only one TEMP database for all declared temporary tables for each DB2 member, there can be a mixture of encoding schemes in both the database and each table space.

For the creation of temporary tables, the CCSID clause can be specified whether or not the LIKE clause is specified. If the CCSID clause is specified, the encoding scheme of the new table is the scheme that is specified in the CCSID clause. If the CCSID clause is not specified, the encoding scheme of the new table is the same as the scheme for the table specified in the LIKE clause or as the scheme for the table identified by the AS (fullselect) clause.

ASCII Specifies that the data is encoded by using the ASCII CCSIDs of the server.

EBCDIC

Specifies that the data is encoded by using the EBCDIC CCSIDs of the server.

UNICODE

Specifies that the data is encoded by using the UNICODE CCSIDs of the server.

An error occurs if the CCSIDs for the encoding scheme have not been defined. Usually, each encoding scheme requires only a single CCSID. Additional CCSIDs are needed when mixed, graphic, or UNICODE data is used.

ON COMMIT

Specifies what happens to the table for a commit operation. The default is ON COMMIT DELETE ROWS.

DELETE ROWS

Specifies that all of the rows of the table are deleted if there is no open cursor that is defined as WITH HOLD that references the table.

PRESERVE ROWS

Specifies that all of the rows of the table are preserved. Thread reuse capability is not available to any application process or thread that contains, at its most recent commit, an active declared temporary table that was defined with the ON COMMIT PRESERVE ROWS clause.

DROP TABLE

Specifies that the table is implicitly dropped at commit if there is no open cursor that is defined as WITH HOLD that references the table. If there is an open cursor defined as WITH HOLD on the table at commit, the rows are preserved.

Notes

Instantiation, scope, and termination: For the following explanations, P denotes an application process, and T is a declared temporary table executed in P:

- An empty instance of T is created when a DECLARE GLOBAL TEMPORARY TABLE statement is executed in P.
- Any SQL statement in P can reference T, and any of those references to T in P is a reference to that same instance of T. ()

  If a DECLARE GLOBAL TEMPORARY statement is specified within a SQL procedural language compound statement, the scope of the declared temporary table is the application process and not just the compound statement. A declared temporary table cannot be defined multiple times by the same name in other compound statements in that application process, unless the table has been dropped explicitly.
- If T was declared at a remote server, the reference to T must use the same DB2 connection that was used to declare T and that connection must not have been terminated after T was declared. When the connection to the database server at which T was declared terminates, T is dropped.
- If T was defined with the ON COMMIT DELETE ROWS clause specified implicitly or explicitly, when a commit operation terminates a unit of work in P and there is no open WITH HOLD cursor in P that is dependent on T, the commit deletes all rows from T.
- If T is defined with the ON COMMIT DROP TABLE clause, when a commit operation terminates a unit of work in P and no program in P has a WITH HOLD cursor open that is dependent on T, the commit includes the operation DROP TABLE T .
- When a rollback operation terminates a unit of work or savepoint in P, and that unit of work or savepoint includes the declaration of SESSION.T, the changes to table T are undone.

  When a rollback operation terminates a unit of work or savepoint in P, and that unit of work or savepoint includes the declaration of SESSION.T, the rollback drops table T.

When a rollback operation terminates a unit of work or savepoint in P, and that unit of work or savepoint includes the drop of the declaration of declared temporary table SESSION.T, the rollback undoes the drop of table T.

- When the application process that declared T terminates, T is dropped.

Privileges: When a declared temporary table is defined, PUBLIC is implicitly granted all table privileges on the table and authority to drop the table. These implicit privileges are not recorded in the DB2 catalog and cannot be revoked. This enables any SQL statement in the application process to reference a declared temporary table that has already been defined in that application process.

Referring to a declared temporary table in other SQL statements: Many SQL statements support declared temporary tables. To refer to a declared temporary table in an SQL statement other than DECLARE GLOBAL TEMPORARY TABLE, you must qualify the table name with SESSION. You can either specify SESSION explicitly in the table name or use the QUALIFIER bind option to specify SESSION as the qualifier for all SQL statements in the plan or package.

If you use SESSION as the qualifier for a table name but the application process does not include a DECLARE GLOBAL TEMPORARY TABLE statement for the table name, DB2 assumes that you are not referring to a declared temporary table. DB2 resolves such table references to a table whose definition is persistent and appears in the DB2 catalog tables.

With the exception of the DECLARE GLOBAL TEMPORARY TABLE statement, any static SQL statement that references a declared temporary table is incrementally bound at run time. This is because the definition of the declared temporary table does not exist until the DECLARE GLOBAL TEMPORARY statement is executed in the application process that contains those SQL statements and the definition does not persist when the application process finishes running.

When a plan or package is bound, any static SQL statement (other than the DECLARE GLOBAL TEMPORARY TABLE statement) that references a *table-name* that is qualified by SESSION, regardless of whether the reference is for a declared temporary table, is not completely bound. However, the bind of the plan or package succeeds if there are no other errors. These static SQL statements are then incrementally bound at run time when the static SQL statement is issued. This is necessary because:

- The definition of the declared temporary table does not exist until the DECLARE GLOBAL TEMPORARY TABLE statement for the table is executed in the same application process that contains those SQL statements. Therefore, DB2 must wait until the plan or package is run to determine if SESSION.*table-name* refers to a base table or a declared temporary table.
- The definition of a declared temporary table does not persist after the table it is explicitly dropped (DROP statement), implicitly dropped (ON COMMIT DROP TABLE), or the application process that defined it finishes running. When the application process terminates or is re-used as a reusable application thread, the instantiated rows of the table are deleted and the definition of the declared temporary table is dropped if it has not already been explicitly or implicitly dropped.

After the plan or package is bound, any static SQL statement that refers to a *table-name* that is qualified by SESSION has a new statement status of M in the DB2 catalog table (STATUS column of SYSIBM.SYSSTMT or SYSIBM.SYSPACKSTMT).

Thread reuse: If a declared temporary table is defined in an application process that is running as a local thread, the application process or local thread that declared the table qualifies for explicit thread reuse if:

- The table was defined with the ON COMMIT DELETE ROWS attribute, which is the default.
- The table was defined with the ON COMMIT PRESERVE ROWS attribute and the table was explicitly dropped with the DROP TABLE statement before the thread's commit operation.
- The table was defined with the ON COMMIT DROP TABLE attribute. When a declared temporary table is defined with the ON COMMIT DROP TABLE and a commit occurs, the table is implicitly dropped if there are no open cursors defined with the WITH HOLD option.

When the thread is reused, the declared temporary table is dropped and its rows are destroyed. However, if you do not explicitly or implicitly drop all declared temporary tables before or when your thread performs a commit and the thread becomes idle waiting to be reused, as with all thread reuse situations, the idle thread holds resources and locks. This includes some declared temporary table resources and locks on the table spaces and the database descriptor (DBD) for the TEMP database. So, instead of using the implicit drop feature of thread reuse to drop your declared temporary tables, it is recommended that you:

- Use the DROP TABLE statement to explicitly drop your declared temporary tables before the thread performs a commit and becomes idle.
- Define the declared temporary tables with ON COMMIT DROP TABLE clause so that the tables are implicitly dropped when a commit occurs.

Explicitly dropping the tables before a commit occurs or having them implicitly dropped when the commit occurs enables you to maximize the use of declared temporary table resources and release locks when multiple threads are using declared temporary table.

Remote threads qualify for thread reuse differently than local threads. If a declared temporary table is defined (with or without ON COMMIT DELETE ROWS) in an application process that is running as a remote or DDF thread (also known as Database Access Thread or DBAT), the remote thread qualifies for thread reuse only when the declared temporary table is explicitly dropped before the thread performs a commit operation. Dropping the declared temporary table enables the remote thread to qualify for the implicit thread reuse that is supported for DDF threads via connection pooling and to become an inactive DBAT (type 1 inactive thread) or an inactive connection (type 2 inactive thread).

Parallelism support: Only I/O and CP parallelism are supported. Any query that involves a declared temporary table is limited to parallel tasks on a single CPC.

Restrictions on the use of declared temporary tables: Declared temporary tables cannot:

- Be specified in referential constraints.
- Be referenced in any SQL statements that are defined in a trigger body (CREATE TRIGGER statement). If you refer a table name that is qualified with SESSION in a trigger body, DB2 assumes that you are referring to a base table.
- Be referenced in a CREATE INDEX statement unless the schema name of the index is SESSION.

In addition, do not refer to a declared temporary table in any of the following statements.

ALTER INDEX
ALTER TABLE
COMMENT
CREATE ALIAS
CREATE FUNCTION (TABLE LIKE clause)
CREATE PROCEDURE (TABLE LIKE clause)
CREATE TRIGGER
CREATE VIEW
GRANT (table or view privileges)
LABEL
LOCK TABLE
REFRESH TABLE
RENAME TABLE
REVOKE (table or view privileges)

Declared global temporary tables and dynamic statement caching: The DB2 dynamic statement cache feature does not support dynamic SQL statements that reference declared temporary tables, even if the SQL statement also includes references to base or persistent tables. DB2 will not insert such statements into the dynamic statement cache. Instead, these dynamic statements are processed as if statement caching is not in effect. Declared temporary tables are unique and specific to an application process or DB2 thread, cannot be shared across threads, are not described in the DB2 catalog , and do not persist beyond termination of the DB2 thread or application process. These attributes prevent the use of the dynamic statement cache feature where tables and SQL statements are shared across threads or application processes.

Table space requirements in the TEMP database: DB2 stores all declared temporary tables in the TEMP database (a database that is defined as TEMP). You cannot define a declared temporary table unless a segmented table space with at least an 8-K page size exists in the TEMP database.

Alternative syntax and synonyms: To provide compatibility with previous releases, DB2 allows you to specify:

- LONG VARCHAR as a synonym for VARCHAR(*integer*) and LONG VARGRAPHIC as a synonym for VARGRAPHIC(*integer*) when defining the data type of a column.

  However, the use of these synonyms is not encouraged because after the statement is processed, DB2 considers a LONG VARCHAR column to be VARCHAR and a LONG VARGRAPHIC column to be VARGRAPHIC.
- DEFINITION ONLY as a synonym for WITH NO DATA.

Examples

Example 1: Define a declared temporary table with column definitions for an employee number, salary, commission, and bonus.

```
DECLARE GLOBAL TEMPORARY TABLE SESSION.TEMP_EMP
   (EMPNO     CHAR(6)   NOT NULL,
    SALARY    DECIMAL(9, 2),
    BONUS     DECIMAL(9, 2),
    COMM      DECIMAL(9, 2))
    CCSID EBCDIC
    ON COMMIT PRESERVE ROWS;
```

Example 2: Assume that base table USER1.EMPTAB exists and that it contains three columns, one of which is an identity column. Declare a temporary table that has the same column names and attributes (including identity attributes) as the base table.

```
DECLARE GLOBAL TEMPORARY TABLE TEMPTAB1
   LIKE USER1.EMPTAB
   INCLUDING IDENTITY
   ON COMMIT PRESERVE ROWS;
```

In the above example, DB2 uses SESSION as the implicit qualifier for TEMPTAB1.

DECLARE STATEMENT

The DECLARE STATEMENT statement is used for application program documentation. It declares names that are used to identify prepared SQL statements.

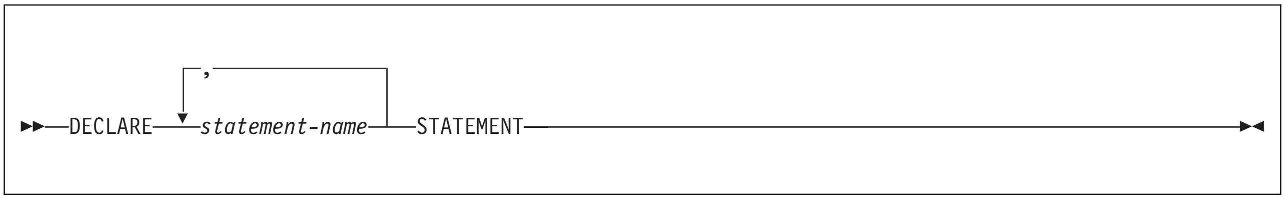
Invocation

This statement can only be embedded in an application program. It is not an executable statement.

Authorization

None required.

Syntax



Description

statement-name **STATEMENT**
: Lists one or more names that are used in your application program to identify prepared SQL statements.

Example

This example shows the use of the DECLARE STATEMENT statement in a PL/I program.

```
EXEC SQL DECLARE OBJECT_STATEMENT STATEMENT;

EXEC SQL INCLUDE SQLDA;
EXEC SQL DECLARE C1 CURSOR FOR OBJECT_STATEMENT;

( SOURCE_STATEMENT IS "SELECT DEPTNO, DEPTNAME,
  MGRNO FROM DSN8810.DEPT WHERE ADMRDEPT = 'A00'"  )

EXEC SQL PREPARE OBJECT_STATEMENT FROM SOURCE_STATEMENT;
EXEC SQL DESCRIBE OBJECT_STATEMENT INTO SQLDA;

(Examine SQLDA)

EXEC SQL OPEN C1;

DO WHILE (SQLCODE = 0);
  EXEC SQL FETCH C1 USING DESCRIPTOR SQLDA;

(Print results)

END;

EXEC SQL CLOSE C1;
```

DECLARE TABLE

The DECLARE TABLE statement is used for application program documentation. It also provides the precompiler with information used to check your embedded SQL statements. (The DCLGEN subcommand can be used to generate declarations for tables and views described in any accessible DB2 catalog. For more on DCLGEN, see Part 2 of *DB2 Application Programming and SQL Guide* and Chapter 2 of *DB2 Command Reference*.)

Invocation

This statement can only be embedded in an application program. It is not an executable statement.

Authorization

None required.

Syntax

```
►►──DECLARE──┬─table-name─┬──────────────────────────────────────────────────────►
             └─view-name──┘

          ┌─,────────────────────────────────────────────────────────────┐
          ▼                                                              │
►─TABLE(───column-name───┬─built-in-type───────┬──┬──────────────────────┬─┴─)─────►◄
                         └─distinct-type-name──┘  ├─NOT NULL─────────────┤
                                                  └─NOT NULL WITH DEFAULT┘
```

Description

table-name or *view-name*
Specifies the name of the table or view to document. If the table is defined in your application program, the description of the table in the SQL statement in which it is defined (for example, CREATE TABLE or DECLARE GLOBAL TEMPORARY TABLE statement) and the DECLARE TABLE statement must be identical.

column-name
Specifies the name of a column of the table or view.

The precompiler uses these names to check for consistency of names within your SQL statements. It also uses the data type to check for consistency of names and data types within your SQL statements.

built-in-type
Specifies the built-in data type of the column. Use one of the built-in data types. For more information on the data types, see “built-in-type” on page 741.

distinct-type-name
Specifies the distinct type (user-defined data type) of the column. An implicit or explicit schema name qualifies the name.

NOT NULL
Specifies that the column does not allow null values and does not provide a default value.

NOT NULL WITH DEFAULT
Specifies that the column does not allow null values but provides a default value.

Notes

Error handling during processing: If an error occurs during the processing of the DECLARE TABLE statement, a warning message is issued, and the precompiler continues processing your source program.

Documenting a distinct type column: Although you can specify the name of a distinct type as the data type of a column in the DECLARE TABLE statement, use the built-in data type on which the distinct type is based instead. Using the base type enables the precompiler to check the embedded SQL statements for errors; otherwise, error checking is deferred until bind time.

To determine the source data type of the distinct type, check the value of column SOURCETYPE in catalog table SYSDATATYPES.

Examples

Example 1: Declare the sample employee table, DSN8810.EMP.

```
EXEC SQL DECLARE DSN8810.EMP TABLE
  (EMPNO     CHAR(6)     NOT NULL,
   FIRSTNME  VARCHAR(12) NOT NULL,
   MIDINIT   CHAR(1)     NOT NULL,
   LASTNAME  VARCHAR(15) NOT NULL,
   WORKDEPT  CHAR(3)             ,
   PHONENO   CHAR(4)             ,
   HIREDATE  DATE                ,
   JOB       CHAR(8)             ,
   EDLEVEL   SMALLINT            ,
   SEX       CHAR(1)             ,
   BIRTHDATE DATE                ,
   SALARY    DECIMAL(9,2)        ,
   BONUS     DECIMAL(9,2)        ,
   COMM      DECIMAL(9,2)        );
```

Example 2: Assume that table CANADIAN_SALES keeps information for your company's sales in Canada. The table was created with the following definition:

```
CREATE TABLE CANADIAN_SALES
  (PRODUCT_ITEM   INTEGER,
   MONTH          INTEGER,
   YEAR           INTEGER,
   TOTAL          CANADIAN_DOLLAR);
```

CANADIAN_DOLLAR is a distinct type that was created with the following statement:

```
CREATE DISTINCT TYPE CANADIAN_DOLLAR AS DECIMAL(9,2);
```

Declare the CANADIAN_SALES table, using the source type for CANADIAN_DOLLAR instead of the distinct type name.

```
DECLARE TABLE CANADIAN_SALES
  (PRODUCT_ITEM   INTEGER,
   MONTH          INTEGER,
   YEAR           INTEGER,
   TOTAL          DECIMAL(9,2);
```

DECLARE VARIABLE

The DECLARE VARIABLE statement defines a CCSID for a host variable and the subtype of the variable. When it appears in an application program, the DECLARE VARIABLE statement causes the DB2 precompiler to tag a host variable with a specific CCSID. When the host variable appears in a SQL statement, the DB2 precompiler places this CCSID into the structures that it generates for the SQL statement.

Invocation

This statement can only be embedded in an application program. It is not an executable statement.

Authorization

None required.

Syntax

```
               ┌─,──────────────┐
                                ▼                    │                   ┌─CCSID EBCDIC──┐
►►──DECLARE───▼─host-variable─┴──VARIABLE─┬─┼───────────────┼────────────────────┬──────────────►◄
                                          │ ├─CCSID ASCII───┤  ┌─FOR SBCS DATA──┐ │
                                          │ └─CCSID UNICODE─┘  ├─FOR MIXED DATA─┤ │
                                          │                    └─FOR BIT DATA───┘ │
                                          └─CCSID──integer-constant───────────────┘
```

Description

host-variable
Identifies a character or graphic string host variable defined in the program. An indicator variable cannot be specified for the host-variable.

CCSID ASCII, EBCDIC, or UNICODE
Specifies that the appropriate default CCSID for the specified encoding scheme of the server should be used. If this clause is not specified, the CCSID of the variable is the appropriate default EBCDIC CCSID of the server.

CCSID ASCII
Specifies that the default ASCII CCSID for the type of the variable at the server should be used.

CCSID EBCDIC
Specifies that the default EBCDIC CCSID for the type of the variable at the server should be used. CCSID EBCDIC is the default if this option is not specified.

CCSID UNICODE
Specifies that the default UNICODE CCSID for the type of the variable at the server should be used.

FOR SBCS DATA, FOR MIXED DATA, or FOR BIT DATA
Specifies the type of data contained in the variable *host-variable*. The FOR clause cannot be specified when declaring a graphic host variable.

For ASCII or EBCDIC data, if this clause is not specified when declaring a character host variable, the default is FOR SBCS DATA if MIXED DATA = NO on the install panel DSNTIPF. The default is FOR MIXED DATA if MIXED DATA = YES on the install panel DSNTIPF.

For UNICODE data, the default is always FOR MIXED DATA, regardless of the setting of MIXED DATA on the install panel DSNTIPF.

FOR SBCS DATA
Specifies that the values of the host variable can contain only SBCS (single-byte character set) data.

FOR MIXED DATA
Specifies that the values of the host variable can contain both SBCS data and DBCS data.

FOR BIT DATA
Specifies that the values of the host-variable are not associated with a coded character set and, therefore, are never converted. The CCSID of a FOR BIT DATA host variable is 65535.

CCSID *integer-constant*
Specifies that the values of the host variable contain data that is encoded using CCSID *integer-constant*. If the integer is an SBCS CCSID, the host variable is SBCS data. If the integer is a mixed data CCSID, the host variable is mixed data. For character host variables, the CCSID specified must be an SBCS, mixed CCSID, or UNICODE (UTF-8) CCSID. For graphic host variables, the CCSID specified must be a DBCS or UNICODE (UTF-16) CCSID. The valid range of values for the integer is 1 - 65533.

Notes

Placement of statement: The DECLARE VARIABLE statement can be specified anywhere in an application program that SQL statements are valid with the following exception. The DECLARE VARIABLE statement must occur before an SQL statement that refers to a host variable specified in the DECLARE VARIABLE statement.

CCSID exceptions for EXECUTE IMMEDIATE or PREPARE: When the host variable appears in an SQL statement, the DB2 precompiler places the appropriate numeric CCSID into the structures it generates for the SQL statement. This placement of the CCSID occurs for any SQL statement other than the EXECUTE IMMEDIATE or PREPARE statements. The placement of the CCSID also occurs for a *host-variable* in an EXECUTE IMMEDIATE or PREPARE statement, but it does not occur for a variable in a *string-expression* in an EXECUTE IMMEDIATE or PREPARE statement.

If a PL/1 application program contains at least one DECLARE VARIABLE statement, a *string-expression* in any EXECUTE IMMEDIATE or PREPARE statement cannot be preceded by a colon. An expression that consists of just a variable name preceded by a colon is interpreted as a *host-variable*.

Specific host languages: If a DECLARE VARIABLE statement is used in an assembler source program, the ONEPASS precompiler option must not be used. If a DECLARE VARIABLE statement is used in a C, C++, or PL/I source program, the TWOPASS precompiler option must be used. For those languages, or COBOL, the host-variable definition can either precede or follow a DECLARE VARIABLE statement that refers to that variable. If a DECLARE VARIABLE statement is used in a FORTRAN source program, then the host-variable definition must precede the DECLARE VARIABLE statement.

Example

Example: Define the following host variables using PL/I data types: FRED as fixed length bit data, JEAN as fixed length UTF-8 (mixed) data, DAVE as varying length UTF-8 (mixed) data, PETE as fixed length graphic UTF-16 data, and AMBER as varying length graphic UTF-16 data.

Use the DECLARE VARIABLE statement to specify a data subtype or CCSID for these host variables: FRED as CCSID EBCDIC, JEAN as CCSID 1208 or CCSID UNICODE, DAVE as CCSID 1208 or CCSID UNICODE, PETE as CCSID 1200 or CCSID UNICODE, and AMBER as CCSID 1200 or CCSID UNICODE.

```
EXEC SQL BEGIN DECLARE SECTION;
   DCL FRED CHAR(10);
       EXEC SQL DECLARE :FRED VARIABLE CCSID EBCDIC FOR BIT DATA;
   DCL JEAN CHAR(30);
       EXEC SQL DECLARE :JEAN VARIABLE CCSID 1208;
   DCL DAVE CHAR(9) VARYING;
       EXEC SQL DECLARE :DAVE VARIABLE CCSID UNICODE;
   DCL PETE GRAPHIC(10);
       EXEC SQL DECLARE :PETE VARIABLE CCSID 1200;
   DCL AMBER VARGRAPHIC(20);
       EXEC SQL DECLARE :AMBER VARIABLE CCSID UNICODE;
EXEC SQL END DECLARE SECTION;
```

DELETE

The DELETE statement deletes rows from a table or view. The table or view can be at the current server or any DB2 subsystem with which the current server can establish a connection. Deleting a row from a view deletes the row from the table on which the view is based.

There are two forms of this statement:

- The *searched* DELETE form is used to delete one or more rows, optionally determined by a search condition.
- The *positioned* DELETE form specifies that one or more rows corresponding to the current cursor position are to be deleted.

Invocation

This statement can be embedded in an application program or issued interactively. A positioned DELETE is embedded in an application program. Both the embedded and interactive forms are executable statements that can be dynamically prepared.

Authorization

Authority requirements depend on whether the object identified in the statement is a user-defined table, a catalog table, or a view, and whether the statement is a searched DELETE and SQL standard rules are in effect:

When a table other than a catalog table is identified: The privilege set must include at least one of the following:

- The DELETE privilege on the table
- Ownership of the table
- DBADM authority on the database that contains the table
- SYSADM authority

When a catalog table is identified: The privilege set must include at least one of the following:

- DBADM authority on the catalog database
- SYSCTRL authority
- SYSADM authority

When a view is identified: The privilege set must include at least one of the following:

- The DELETE privilege on the view
- SYSADM authority

In a searched delete, the SELECT privilege is required in addition to the DELETE privilege when the option for the SQL standard is set as follows:

Searched DELETE and SQL standard rules: If SQL standard rules are in effect and the search-condition in a searched DELETE contains a reference to a column of the table or view, the privilege set must include at least one of the following:

- The SELECT privilege on the table or view
- SYSADM authority

SQL standard rules are in effect as follows:

- For static SQL statements, if the SQLRULES(STD) bind option was specified
- For dynamic SQL statements, if the CURRENT RULES special register is set to 'STD'

The owner of a view, unlike the owner of a table, might not have DELETE authority on the view (or might have DELETE authority without being able to grant it to others). The nature of the view itself can preclude its use for DELETE. For more information, see the description of authority in “CREATE VIEW” on page 805.

If a subselect is specified, the privilege set must include authority to execute the subselect. For more information about the subselect authorization rules, see “Authorization” on page 394.

If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package. If the statement is dynamically prepared, the privilege set is determined by the DYNAMICRULES behavior in effect (run, bind, define, or invoke) and is summarized in Table 53 on page 433. (For more information on these behaviors, including a list of the DYNAMICRULES bind option values that determine them, see “Authorization IDs and dynamic SQL” on page 51.)

Syntax

searched delete:

```
►►──DELETE FROM──┬─table-name─┬──┬──────────────────┬──┬─────────────────────────┬──────────────►
                 └─view-name──┘  └─correlation-name─┘  └─WHERE──search-condition─┘

►──┬──────────────────┬──┬──────────────────┬──────────────────────────────────────────────────►◄
   └─isolation-clause─┘  └─QUERYNO──integer─┘
```

positioned delete:

```
►►──DELETE FROM──┬─table-name─┬──┬──────────────────┬──WHERE CURRENT OF──cursor-name──────────►
                 └─view-name──┘  └─correlation-name─┘

►──┬──────────────────────────────────────────────┬─────────────────────────────────────────────►◄
   └─FOR ROW──┬─host-variable────┬──OF ROWSET─┘
              └─integer-constant─┘
```

isolation-clause:

```
►►──WITH──┬─RR─┬────────────────────────────────────────────────────────────────────────────────►◄
          ├─RS─┤
          └─CS─┘
```

Description

FROM *table-name* or *view-name*
Identifies the table or view from which rows are to be deleted. The name must identify a table or view that exists at the DB2 subsystem identified by the implicitly or explicitly specified location name. The name must not identify:

- An auxiliary table

- A catalog table for which deletes are not allowed
- A view of such a catalog table
- A read-only view (For a description of a read-only view, see “CREATE VIEW” on page 805.)
- A system-maintained materialized query table

In an IMS or CICS application, the DB2 subsystem that contains the identified table or view must be a remote server that supports two-phase commit.

correlation-name

Specifies an alternate name that can be used within the *search-condition* to designate the table or view. (For an explanation of correlation names, see “Correlation names” on page 114.)

WHERE

Specifies the rows to be deleted. You can omit the clause, give a search condition, or specify a cursor. For a created temporary table or a view of a created temporary table, you must omit the clause. When the clause is omitted, all the rows of the table or view are deleted.

search-condition

Is any search condition as described in Chapter 2, “Language elements,” on page 33. Each *column-name* in the search condition, other than in a subquery, must identify a column of the table or view.

The search condition is applied to each row of the table or view and the deleted rows are those for which the result of the search condition is true.

If the search condition contains a subquery, the subquery can be thought of as being executed each time the search condition is applied to a row, and the results used in applying the search condition. In actuality, a subquery with no correlated references is executed just once, whereas it is possible that a subquery with a correlated reference must be executed once for each row.

Let T2 denote the object table of a DELETE statement and let T1 denote a table that is referred to in the FROM clause of a subquery of that statement. T1 must not be a table that can be affected by the DELETE on T2. Thus, the following rules apply:

- T1 must not be a dependent of T2 in a relationship with a delete rule of CASCADE or SET NULL, unless the result of the subquery is materialized before the DELETE action is executed.
- T1 must not be a dependent of T3 in a relationship with a delete rule of CASCADE or SET NULL if deletes of T2 cascade to T3.

WHERE CURRENT OF cursor-name

Identifies the cursor to be used in the delete operation. *cursor-name* must identify a declared cursor as explained in the description of the DECLARE CURSOR statement in “DECLARE CURSOR” on page 812. If the DELETE statement is embedded in a program, the DECLARE CURSOR statement must include *select-statement* rather than *statement-name*.

The table or view named must also be named in the FROM clause of the SELECT statement of the cursor, and the result table of the cursor must be capable of being deleted. For an explanation of read-only result tables, see “Read-only cursors” on page 819. Note that the object of the DELETE statement must not be identified as the object of the subquery in the WHERE clause of the SELECT statement of the cursor.

If the cursor is ambiguous and the plan or package was bound with CURRENTDATA(NO), DB2 might return an error to the application if DELETE WHERE CURRENT OF is attempted for any of the following:

- A cursor that is using block fetching
- A cursor that is using query parallelism
- A cursor that is positioned on a row that has been modified by this or another application process

When the DELETE statement is executed, the cursor must be open and positioned on a row or rowset of the result table.

- If the cursor is positioned on a single row, that row is the one deleted, and after the deletion the cursor is positioned before the next row of its result table. If there is no next row, the cursor positioned after the last row.
- If the cursor is positioned on a rowset, all rows corresponding to the rows of the current rowset are deleted, and after the deletion the cursor is positioned before the next rowset of its result table. If there is no next rowset, the cursor positioned after the last rowset.

FOR ROW n OF ROWSET

Specifies which row of the current rowset is to be deleted. The corresponding row of the rowset is deleted, and the cursor remains positioned on the current rowset. If the rowset consists of a single row, or all other rows in the rowset have already been deleted, then the cursor is positioned before the next rowset of the result table. If there is no next rowset, the cursor is positioned after the last rowset.

host-variable or *integer-constant* is assigned to an integral value *k*. If *host-variable* is specified, it must be an exact numeric type with scale zero, must not include an indicator variable, and *k* must be in the range of 1 to 32767. The cursor must be positioned on a rowset, and the specified value must be a valid value for the set of rows most recently retrieved for the cursor.

If the specified row cannot be deleted, an error is returned. It is possible that the specified row is within the bounds of the rowset most recently requested, but the current rowset contains less than the number of rows that were implicitly or explicitly requested when that rowset was established.

If, via a positioned delete against a sensitive static cursor that specifies a particular row of the current rowset, and that row has been identified as a delete hole (that is, a row in the result table whose corresponding row has deleted from the base table), an error is returned.

If, via a positioned delete against a sensitive static cursor that specifies a particular row of the current rowset, and that row has been identified as an update hole (that is, a row in the result table whose corresponding row has been updated so that it no longer satisfies a predicate of the SELECT statement), an error is returned.

It is possible for another application process to delete a row in the base table of the SELECT statement so that the specified row of the cursor no longer has a corresponding row in the base table. An attempt to delete such a row results in an error.

If the FOR ROW n OF ROWSET clause is not specified, the current position of cursor determines the rows that are affected by the statement:

- If the cursor is positioned on a single row, that row is the one deleted. After the row is deleted, the cursor is positioned before the next row of its result table. If there is no next row, the cursor positioned after the last row.

- If the cursor is positioned on a rowset, all rows corresponding to the rows of the current rowset are deleted. After the rows are deleted, the cursor is positioned before the next rowset of its result table. If there is no next rowset, the cursor positioned after the last rowset.

isolation-clause

Specifies the isolation level used when locating the rows to be deleted by the statement.

WITH

Introduces the isolation level, which may be one of the following:

RR	Repeatable read
RS	Read stability
CS	Cursor stability

The default isolation level of the statement is the isolation level of the package or plan in which the statement is bound, with the package isolation taking precedence over the plan isolation. When a package isolation is not specified, the plan isolation is the default.

QUERYNO *integer*

Specifies the number to be used for this SQL statement in EXPLAIN output and trace records. The number is used for the QUERYNO column of the plan table for the rows that contain information about this SQL statement. This number is also used in the QUERYNO column of the SYSIBM.SYSSTMT and SYSIBM.SYSPACKSTMT catalog tables.

If the clause is omitted, the number associated with the SQL statement is the statement number assigned during precompilation. Thus, if the application program is changed and then precompiled, that statement number might change.

Using the QUERYNO clause to assign unique numbers to the SQL statements in a program is helpful:

- For simplifying the use of optimization hints for access path selection
- For correlating SQL statement text with EXPLAIN output in the plan table

For information on using optimization hints, such as enabling the system for optimization hints and setting valid hint values, and for information on accessing the plan table, see Part 5 (Volume 2) of *DB2 Administration Guide*.

Notes

Delete operation errors: If an error occurs during the execution of any delete operation, no changes are made. If an error occurs during the execution of a positioned delete, the position of the cursor is unchanged. However, it is possible for an error to make the position of the cursor invalid, in which case the cursor is closed. It is also possible for a delete operation to cause a rollback, in which case the cursor is closed.

Position of cursor: If an application process deletes a row on which any of its cursors are positioned, those cursors are positioned before the next row of the result table. Let C be a cursor that is positioned before row R (as a result of an OPEN, a DELETE through C, a DELETE through some other cursor, or a searched DELETE). In the presence of INSERT, UPDATE, and DELETE operations that affect the base table from which R is derived, the next FETCH operation referencing C does not necessarily position C on R. For example, the operation can position C on R’, where R’ is a new row that is now the next row of the result table.

Locking: Unless appropriate locks already exist, one or more exclusive locks are acquired during the execution of a successful delete operation. Until the locks are released by a commit or rollback operation, the effect of the DELETE operation can only be perceived by the application process that performed the deletion and the locks can prevent other application processes from performing operations on the table. Locks are not acquired when rows are deleted from a declared temporary table unless all the rows are deleted (DELETE FROM T). When all the rows are deleted from a declared temporary table, a segmented table lock is acquired on the pages for the table and no other table in the table space is affected.

Triggers: If the identified table or the base table of the identified view has a delete trigger, the trigger is activated. A trigger might cause other statements to be executed or return error conditions based on the deleted values.

Referential integrity: If the identified table or the base table of the identified view is a parent, the rows selected must not have any dependents in a relationship with a delete rule of RESTRICT or NO ACTION. In addition, the DELETE must not cascade to descendent rows that have dependents in a relationship with a delete rule of RESTRICT or NO ACTION.

If the delete operation is not prevented by a RESTRICT or NO ACTION delete rule, the selected rows are deleted and any rows that are dependents of the selected rows are also deleted.

- The nullable columns of foreign keys in any rows that are their dependents in a relationship governed by a delete rule of SET NULL are set to the null value.
- Any rows that are their dependents in a relationship governed by a delete rule of CASCADE are also deleted, and these rules apply, in turn, to those rows.

The only difference between NO ACTION and RESTRICT is when the referential constraint is enforced. RESTRICT (IBM SQL rules) enforces the rule immediately, and NO ACTION (SQL standard rules) enforces the rule at the end of the statement. This difference matters only in the case of a searched DELETE involving a self-referencing constraint that deletes more than one row. NO ACTION might allow the DELETE to be successful where RESTRICT (if it were allowed) would prevent it.

Check constraint: A check constraint can prevent the deletion of a row in a parent table when there are dependents in a relationship with a delete rule of SET NULL. If deleting a row in the parent table would cause a column in a dependent table to be set to null and there is a check constraint that specifies that the column must not be null, the row is not deleted.

Nesting user-defined functions or stored procedures: A DELETE statement can implicitly or explicitly refer to user-defined functions or stored procedures. This is known as *nesting* of SQL statements. A user-defined function or stored procedure that is nested within the DELETE must not access the table from which you are deleting rows.

Number of rows deleted: Except as noted below, a DELETE operation sets SQLERRD(3) to the number of deleted rows. This number does not include any rows that were deleted as a result of a CASCADE delete rule.

DELETE FROM T without a WHERE clause deletes all rows of T. If a table T is contained in a segmented table space and is not a parent table, this deletion will be performed without accessing T. The SQLERRD(3) field is set to -1. (For a complete description of the SQLCA, including exceptions to the above, see Appendix D, “SQL communication area (SQLCA),” on page 1165.

Rules for positioned DELETE with SENSITIVE STATIC scrollable cursor: When a SENSITIVE STATIC scrollable cursor has been declared, the following rules apply:

- *Delete attempt of delete holes or update holes.* If, with a positioned delete against a SENSITIVE STATIC scrollable cursor, an attempt is made to delete a row that has been identified as a delete hole (that is, a row in the result table whose corresponding row has been deleted from the base table), an error occurs.

  If an attempt is made to delete a row that has been identified as an update hole (that is, a row in the result table whose corresponding row has been updated so that it no longer satisfies the predicate of the SELECT statement), an error occurs.
- *Delete operations.* Positioned delete operations with SENSITIVE STATIC scrollable cursors perform as follows:
  1. The SELECT list items in the target row of the base table of the cursor are compared with the values in the corresponding row of the result table (that is, the result table must still agree with the base table). If the values are not identical, the delete operation is rejected and an error occurs. The operation can be attempted again after a successful FETCH SENSITIVE has occurred for the target row.
  2. The WHERE clause of the SELECT statement is re-evaluated to determine whether the current values in the base table still satisfy the search criteria. The values in the SELECT list are compared to determine that these values have not changed. If the WHERE clause evaluates as true, and the values in the SELECT list have not changed, the delete operation is allowed to proceed. Otherwise, an error occurs, the delete operation is rejected, and an update hole appears in the cursor.
  3. After the base table row is successfully deleted, the temporary result table is updated and the row is marked as a delete hole.
- *Rollback of delete holes.* Delete holes are usually permanent. Once a delete hole is identified, it remains a delete hole until the cursor is closed. However, if a positioned delete using *this* cursor actually caused the creation of the hole (that is, this cursor was used to make the changes that resulted in the hole) and the delete was subsequently rolled back, then the row is no longer considered a delete hole.
- *Result table.* Any deletes, either positioned or searched, to rows of the base table on which a SENSITIVE STATIC scrollable cursor is defined are reflected in the result table if a positioned update or positioned delete is attempted with the scrollable cursor. A SENSITIVE STATIC scrollable cursor sees these deletes when a FETCH SENSITIVE is attempted.

If the FOR ROW *n* OF ROWSET clause is not specified, the entire rowset fetched by the most recent FETCH statement that returned data for the specified cursor is deleted.

Deleting rows from a table with multilevel security: When you delete rows from a table with multilevel security, DB2 compares the security label of the user (the primary authorization ID) to the security label of the row. The delete proceeds according to the following rules:

- If the security label of the user and the security label of the row are equivalent, the row is deleted.

- If the security label of the user dominates the security label of the row, the user's write-down privilege determines the security the result of the DELETE statement:
  - – If the user has write-down privilege or write-down control is not enabled, the row is deleted.
  - – If the user does not have write-down privilege and write-down control is enabled, the row is not deleted.
- If the security label of the row dominates the security label of the user, the row is not deleted.

Other SQL statements in the same unit of work: The following statements cannot follow a DELETE statement in the same unit of work:

- An ALTER TABLE statement that changes the data type of a column (ALTER COLUMN SET DATATYPE)
- An ALTER INDEX statement that changes the padding attribute of an index with varying-length columns (PADDED to NOT PADDED or vice versa)

Examples

Assume that the statements in the examples are embedded in PL/I programs.

Example 1: From the table DSN8810.EMP delete the row on which the cursor C1 is currently positioned.

```
EXEC SQL DELETE FROM DSN8810.EMP WHERE CURRENT OF C1;
```

Example 2: From the table DSN8810.EMP, delete all rows for departments E11 and D21.

```
EXEC SQL DELETE FROM DSN8810.EMP
  WHERE WORKDEPT = 'E11' OR WORKDEPT = 'D21';
```

Example 3: From employee table X, delete the employee who has the most absences.

```
EXEC SQL DELETE FROM EMP X
  WHERE ABSENT = (SELECT MAX(ABSENT) FROM EMP Y
  WHERE X.WORKDEPT = Y.WORKDEPT);
```

Example 4: Assuming that cursor CS1 is positioned on a rowset consisting of 10 rows of table T1, delete all 10 rows in the rowset.

```
EXEC SQL DELETE FROM T1 WHERE CURRENT OF CS1;
```

Example 5: Assuming cursor CS1 is positioned on a rowset consisting of 10 rows of table T1, delete the fourth row of the rowset.

```
EXEC SQL DELETE FROM T1 WHERE CURRENT OF CS1 FOR ROW 4 OF ROWSET;
```

DESCRIBE (prepared statement or table)

The DESCRIBE statement obtains information about a prepared statement or a designated table or view. For an explanation of prepared statements, see “PREPARE” on page 995 and “DESCRIBE PROCEDURE” on page 863.

Invocation

This statement can only be embedded in an application program. It is an executable statement that cannot be dynamically prepared. It must not be specified in Java.

Authorization

None required if the statement is used for a prepared statement. When it is used instead for a table or view, the privileges that are held by the authorization ID that owns the plan or package must include at least one of the following (if there is a plan, authorization checking is done only against the plan owner):

- Ownership of the table or view
- The SELECT, INSERT, UPDATE, DELETE, or REFERENCES privilege on the object
- The ALTER or INDEX privilege on the object (tables only)
- DBADM authority over the database that contains the object (tables only)
- SYSADM or SYSCTRL authority

For an RRSAF application that does not have a plan and in which the requester and the server are DB2 UDB for z/OS systems, authorization to execute the package is performed against the primary or secondary authorization ID of the process.

See “PREPARE” on page 995 for the authorization required to create a prepared statement.

Syntax

```
                ┌─OUTPUT─┐
►►──DESCRIBE────┴────────┴──┬─statement-name──────┬──INTO──descriptor-name──┬──────────────────────┬──►◄
                            └─TABLE──host-variable─┘                        │          ┌─NAMES──┐  │
                                                                            └─USING────┼─LABELS─┼──┘
                                                                                       ├─ANY────┤
                                                                                       └─BOTH───┘
```

Description

OUTPUT
When a *statement-name* is specified, optional keyword to indicate that the describe will return information about the select list columns in a the prepared SELECT statement.

statement-name
Identifies the prepared statement. When the DESCRIBE statement is executed, the name must identify a statement that has been prepared by the application process at the current server.

TABLE *host-variable*
Identifies the table or view. The name must not identify an auxiliary table. When

the DESCRIBE statement is executed, the host variable must contain a name which identifies a table or view that exists at the current server. This variable must be a fixed- or varying-length character string with a length attribute less than 256. The name must be followed by one or more blanks if the length of the name is less than the length of the variable. It cannot contain a period as the first character and it cannot contain embedded blanks. In addition, the quotation mark is the escape character regardless of the value of the string delimiter option. An indicator variable must not be specified for the host variable.

INTO *descriptor-name*
Identifies an SQL descriptor area (SQLDA), which is described in Appendix E, “SQL descriptor area (SQLDA),” on page 1173. See “Identifying an SQLDA in C or C++” on page 1189 for how to represent *descriptor-name* in C.

For languages other than REXX: Before the DESCRIBE statement is executed, the user must set the following variable in the SQLDA and the SQLDA must be allocated.

SQLN Indicates the number of SQLVAR occurrences provided in the SQLDA. DB2 does not change this value. For techniques to determine the number of required occurrences, see “Allocating the SQLDA” on page 853.

For REXX: The SQLDA is not allocated before it is used. An SQLDA consists of a set of stem variables. There is one occurrence of variable *stem.*SQLD, followed by zero or more occurrences of a set of variables that is equivalent to an SQLVAR structure. Those variables begin with *stem.n*.

After the DESCRIBE statement is executed, all the fields in the SQLDA except SQLN are either set by DB2 or ignored. For information on the contents of the fields, see “The SQLDA contents returned after DESCRIBE” on page 854.

USING
Indicates what value to assign to each SQLNAME variable in the SQLDA. If the requested value does not exist, SQLNAME is set to a length of 0.

NAMES
Assigns the name of the column. This is the default.

LABELS
Assigns the label of the column. (Column labels are defined by the LABEL statement.)

ANY
Assigns the column label, and if the column has no label, the column name.

BOTH
Assigns both the label and name of the column. In this case, two or three occurrences of SQLVAR per column, depending on whether the result set contains distinct types, are needed to accommodate the additional information. To specify this expansion of the SQLVAR array, set SQLN to $2 \times n$ or $3 \times n$, where n is the number of columns in the object being described. For each of the columns, the first n occurrences of SQLVAR, which are the base SQLVAR entries, contain the column names. Either the second or third n occurrences of SQLVAR, which are the extended SQLVAR entries, contain the column labels. If there are no distinct types, the labels are returned in the second set of SQLVAR entries. Otherwise, the labels are returned in the third set of SQLVAR entries.

For a declared temporary table, the name of the column is assigned regardless of the value specified in the USING clause because declared temporary tables cannot have labels.

Notes

Using PREPARE INTO clause: Information about a prepared statement can also be obtained by using the INTO clause of the PREPARE statement.

Allocating the SQLDA: Before the DESCRIBE or PREPARE INTO statement is executed, the value of SQLN must be set to a value greater than or equal to zero to indicate how many occurrences of SQLVAR are provided in the SQLDA. Also, enough storage must be allocated to contain the number of occurrences that SQLN specifies. To obtain the description of the columns of the result table of a prepared SELECT statement, the number of occurrences of SQLVAR must be at least equal to the number of columns. Furthermore, if USING BOTH is specified, or if the columns include LOBs or distinct types, the number of occurrences of SQLVAR should be two or three times the number of columns. See “Determining how many SQLVAR occurrences are needed” on page 1177 for more information.

First technique: Allocate an SQLDA with enough occurrences of SQLVAR to accommodate any select list that the application will have to process. At the extreme, the number of SQLVARs could equal three times the maximum number of columns allowed in a result table. After the SQLDA is allocated, the application can use the SQLDA repeatedly.

This technique uses a large amount of storage that is never deallocated, even when most of this storage is not used for a particular select list.

Second technique: Repeat the following two steps for every processed select list:

1. Execute a DESCRIBE statement with an SQLDA that has no occurrences of SQLVAR; that is, an SQLDA for which SQLN is zero.
2. Allocate a new SQLDA with enough occurrences of SQLVAR. Use the values that are returned in SQLD and SQLCODE to determine the number of SQLVAR entries that are needed. The value of SQLD is the number of columns in the result table, which is either the required number of occurrences of SQLVAR or a fraction of the required number (see “Determining how many SQLVAR occurrences are needed” on page 1177 for details). If the SQLCODE is +236, +237, +238, or +239, the number of SQLVAR entries that is needed is two or three times the value in SQLD, depending on whether USING BOTH was specified. Set SQLN to reflect the number of SQLVAR entries that have been allocated.
3. Execute the DESCRIBE statement again, using the new SQLDA.

This technique allows better storage management than the first technique, but it doubles the number of DESCRIBE statements.

Third technique: Allocate an SQLDA that is large enough to handle most (hopefully, all) select lists but is also reasonably small. If an execution of DESCRIBE fails because SQLDA is too small, allocate a larger SQLDA and execute the DESCRIBE statement again.

For the new larger SQLDA, use the values that are returned in SQLD and SQLCODE from the failing DESCRIBE statement to calculate the number of occurrences of SQLVAR that are needed, as described in technique two.

Remember to check for SQLCODEs +236, +237, +238, and +239, which indicate whether *extended* SQLVAR entries are needed because the data includes LOBs or distinct types.

This third technique is a compromise between the first two techniques. Its effectiveness depends on a good choice of size for the original SQLDA.

The SQLDA contents returned on DESCRIBE: After a DESCRIBE statement is executed, the following list describes the contents of the SQLDA fields as they are set by DB2 or ignored. These descriptions do not necessarily apply to the uses of an SQLDA in other SQL statements (EXECUTE, OPEN, FETCH). For more on the other uses, see Appendix E, “SQL descriptor area (SQLDA),” on page 1173.

SQLDAID

DB2 sets the first 6 bytes to ’SQLDA ’ (5 letters followed by the space character) and the eighth byte to a space character. The seventh byte is set to indicate the number of SQLVAR entries that are needed to describe each column of the result table as follows:

space The value of space occurs when:

- USING BOTH was not specified and the columns being described do not include LOBs or distinct types. Each column only needs one SQLVAR entry. If the SQL standard option is yes, DB2 sets SQLCODE to warning code +236. Otherwise, SQLCODE is zero.
- USING BOTH was specified and the columns being described do not include LOBs or distinct types. Each column needs two SQLVAR entries. DB2 sets SQLD to two times the number of columns of the result table. The second set of SQLVARs is used for the labels.

2 Each column needs two SQLVAR entries. Two entries per column are required when:

- USING BOTH was not specified and the columns being described include LOBs or distinct types or both. DB2 sets the second set of SQLVAR entries with information for the LOBs or distinct types being described.
- USING BOTH was specified and the columns include LOBs but not distinct types. DB2 sets the second set of SQLVAR entries with information for the LOBs and labels for the columns being described.

3 Each column needs three SQLVAR entries. Three entries are required only when USING BOTH is specified and the columns being described include distinct types. The presence of LOB data does not matter. It is the distinct types and not the LOBs that cause the need for three SQLVAR entries per column when labels are also requested. DB2 sets the second set of SQLVAR entries with information for the distinct types (and LOBs, if any) and the third set of SQLVAR entries with the labels of the columns being described.

A REXX SQLDA does not contain this field.

SQLDABC

The length of the SQLDA in bytes. DB2 sets the value to SQLN×44+16.

A REXX SQLDA does not contain this field.

SQLD If the prepared statement is a query, DB2 sets the value to the number of columns in the object being described (the value is actually twice the number of columns in the case where USING BOTH was specified and the result table does not include LOBs or distinct types). Otherwise, if the statement is not a query, DB2 sets the value to 0.

SQLVAR

An array of field description information for the column being described. There are two types of SQLVAR entries—the base SQLVAR and the extended SQLVAR.

If the value of SQLD is 0, or is greater than the value of SQLN, no values are assigned to any occurrences of SQLVAR. If the value of SQLN was set so that there are enough SQLVAR occurrences to describe the specified columns (columns with LOBs or distinct types and a request for labels increase the number of SQLVAR entries that are needed), the values are assigned to the first *n* occurrences of SQLVAR so that the first occurrence of SQLVAR contains a description of the first column, the second occurrence of SQLVAR contains a description of the second column, and so on. This first set of SQLVAR entries are referred to as *base SQLVAR* entries. Each column always has a base SQLVAR entry.

If the DESCRIBE statement included the USING BOTH clause, or the columns being described include LOBs or distinct types, additional SQLVAR entries are needed. These additional SQLVAR entries are referred to as the *extended SQLVAR* entries. There can be up to two sets of extended SQLVAR entries for each column.

For REXX, the SQLVAR is a set of stem variables that begin with *stem.n*, instead of a structure. The REXX SQLDA uses only a base SQLVAR. The way in which DB2 assigns values to the SQLVAR variables is the same as for other languages. That is, the *stem.*1 variables describe the first column in the result table, the *stem.*2 variables describe the second column in the result table, and so on. If USING BOTH is specified, the *stem.n*+1 variables also describe the first column in the result table, the *stem.n*+2 variables also describe the second column in the result table, and so on.

The base SQLVAR:

SQLTYPE

A code that indicates the data type of the column and whether the column can contain null values. For the possible values of SQLTYPE, see Table 103 on page 1181.

SQLLEN

A length value depending on the data type of the result columns. SQLLEN is 0 for LOB data types. For the other possible values of SQLLEN, see Table 103 on page 1181.

In a REXX SQLDA, for DECIMAL or NUMERIC columns, DB2 sets the SQLPRECISION and SQLSCALE fields instead of the SQLLEN field.

SQLDATA

The CCSID of a string column. For possible values, see Table 104 on page 1182.

In a REXX SQLDA, DB2 sets the SQLCCSID field instead of the SQLDATA field.

SQLIND
Reserved.

SQLNAME
The unqualified name or label of the column, depending on the value of USING (NAMES, LABELS, ANY, or BOTH). The field is a string of length 0 if the column does not have a name or label. For more details on unnamed columns, see the discussion of the names of result columns under "select-clause" on page 395. This value is returned in the encoding scheme specified by the ENCODING bind option for the plan or package that contains the statement.

The extended SQLVAR:

SQLLONGLEN
The length attribute of a BLOB, CLOB, or DBCLOB column.

***** Reserved.

SQLDATALEN
Not Used.

SQLDATATYPE-NAME
For a distinct type, the fully qualified distinct type name. Otherwise, the value is the fully qualified name of the built-in data type.

For a label, the label for the column.

This value is returned in the encoding scheme specified by the ENCODING bind option for the plan or package that contains this statement.

The REXX SQLDA does not use the extended SQLVAR.

Performance considerations: Although DB2 does not change the value of SQLN, you might want to reset this value after the DESCRIBE statement is executed. If the contents of SQLDA from the DESCRIBE statement is used in a later FETCH statement, set SQLN to *n* (where *n* is the number of columns of the result table) before executing the FETCH statement. For details, see "Preparing the SQLDA for data retrieval."

Preparing the SQLDA for data retrievals: This note is relevant if you are applying DESCRIBE to a prepared query and you intend to use the SQLDA in the FETCH statements you employ to retrieve the result table rows. To prepare the SQLDA for that task, you must set the SQLDATA field of SQLVAR. SQLIND must be set if SQLTYPE is odd, and SQLNAME must be set when overriding the CCSID. For the meaning of those fields in that context, see Appendix E, "SQL descriptor area (SQLDA)," on page 1173.

Also, SQLN and SQLDABC should be reset (if necessary) to *n* and *n*×44+16, where *n* is the number of columns in the result table. Doing so can improve performance when the rows of the result table are fetched.

Support for extended dynamic SQL in a distributed environment: In a distributed environment where DB2 UDB for z/OS is the server and the requester supports extended dynamic SQL, such as DB2 Server for VSE & VM, a DESCRIBE statement that is executed against an SQL statement in the extended dynamic package appears to DB2 as a DESCRIBE statement against a static SQL statement in the DB2 package. A DESCRIBE statement cannot normally be issued against a static SQL statement. However, a DESCRIBE against a static SQL statement that is generated by extended dynamic SQL executes without error if the package has been rebound after field DESCRIBE FOR STATIC on installation panel DSNTIP4 has been set to YES.

YES indicates that DB2 generates an SQLDA for the DESCRIBE at bind time so that DESCRIBE requests for static SQL statements can be satisfied at execution time. For more information, see Part 3 of *DB2 Installation Guide*.

Avoiding double preparation when using REOPT(ALWAYS) or REOPT(ONCE): If bind option REOPT(ALWAYS) or REOPT(ONCE) is in effect, DESCRIBE causes the statement to be prepared if it is not already prepared. If issued before an OPEN or an EXECUTE, the DESCRIBE causes the statement to be prepared without input variables. If the statement has input variables, the statement must be prepared again when it is opened or executed. When REOPT(ONCE) is in effect, the statement is always prepared twice even if there are no input variables. Therefore, to avoid preparing statements twice, issue the DESCRIBE after the OPEN. For non-cursor statements, open and fetch processing are performed on the EXECUTE. So, if a DESCRIBE must be issued, the statement will be prepared twice.

Errors occurring on DESCRIBE: In local and remote processing, the DEFER(PREPARE) and REOPT(ALWAYS)/REOPT(ONCE) bind options can cause some errors that are normally issued during PREPARE processing to be issued on DESCRIBE.

Using host variables: If the DESCRIBE statement contains host variables, the contents of the host variables are assumed to be in the encoding scheme that was specified in the ENCODING parameter when the package or plan that contains the statement was bound.

Example

In a PL/I program, execute a DESCRIBE statement with an SQLDA that has no occurrences of SQLVAR. If SQLD is greater than zero, use the value to allocate an SQLDA with the necessary number of occurrences of SQLVAR and then execute a DESCRIBE statement using that SQLDA. This is the second technique described in “Allocating the SQLDA” on page 853.

```
EXEC SQL  BEGIN DECLARE SECTION;
  DCL  STMT1_STR   CHAR(200)  VARYING;
EXEC SQL  END DECLARE SECTION;
EXEC SQL  INCLUDE SQLDA;
EXEC SQL  DECLARE DYN_CURSOR CURSOR FOR STMT1_NAME;

... /* code to prompt user for a query, then to generate */
    /* a select-statement in the STMT1_STR           */
EXEC SQL  PREPARE STMT1_NAME FROM :STMT1_STR;

... /* code to set SQLN to zero and to allocate the SQLDA */
EXEC SQL  DESCRIBE STMT1_NAME INTO :SQLDA;

... /* code to check that SQLD is greater than zero, to set */
    /* SQLN to SQLD, then to re-allocate the SQLDA         */
EXEC SQL  DESCRIBE STMT1_NAME INTO :SQLDA;

... /* code to prepare for the use of the SQLDA            */
EXEC SQL  OPEN DYN_CURSOR;

... /* loop to fetch rows from result table                */
```

```
EXEC SQL  FETCH DYN_CURSOR USING DESCRIPTOR :SQLDA;
.
.
.
```

DESCRIBE CURSOR

The DESCRIBE CURSOR statement gets information about the result set that is associated with the cursor. The information, such as column information, is put into a descriptor. Use DESCRIBE CURSOR for result set cursors from stored procedures. The cursor must be defined with the ALLOCATE CURSOR statement.

Invocation

This statement can only be embedded in an application program. It is an executable statement that cannot be dynamically prepared.

Authorization

None required.

Syntax

```
►►──DESCRIBE CURSOR──┬─cursor-name───┬──INTO──descriptor-name────────────────────────────►◄
                     └─host-variable─┘
```

Description

cursor-name or *host-variable*

Identifies a cursor by the specified cursor-name or the cursor name contained in the host-variable. The name must identify a cursor that has already been allocated in the source program.

A cursor name is an SQL identifier.

If a host variable is used:

- It must be a character string variable with a length attribute that is not greater than 18 bytes (A C NUL-terminated character string can be up to 19 bytes).
- It must not be followed by an indicator variable.
- The cursor name must be left justified within the host variable and must not contain embedded blanks.
- If the length of the cursor name is less than the length of the host variable, it must be padded on the right with blanks.

INTO *descriptor-name*

Identifies an SQL descriptor area (SQLDA). The information returned in the SQLDA describes the columns in the result set associated with the named cursor.

The considerations for allocating and initializing the SQLDA are similar to those of a varying-list SELECT statement. For more information, see Part 6 of *DB2 Application Programming and SQL Guide*.

For REXX: The SQLDA is not allocated before it is used.

After the DESCRIBE CURSOR statement is executed, the contents of the SQLDA are the same as after a DESCRIBE for a SELECT statement, with the following exceptions:

- The first 5 bytes of the SQLDAID field are set to 'SQLRS'.

- Bytes 6 to 8 of the SQLDAID field are reserved. If the cursor is declared WITH HOLD in a stored procedure, the high-order bit of the 8th byte is set to 1.

These exceptions do not apply to a REXX SQLDA, which does not include the SQLDAID field.

Notes

Using cursors for result sets: Column names are included in the information that DESCRIBE CURSOR obtains when the statement that generates the result set is either:

- Dynamic
- Static and the value of field DESCRIBE FOR STATIC on installation panel DSNTIP4 was YES when the package or stored procedure was bound. If the value of the field was NO, the returned information includes only the data type and length of the columns.

Using host variables: If the DESCRIBE CURSOR statement contains host variables, the contents of the host variables are assumed to be in the encoding scheme that was specified in the ENCODING parameter when the package or plan that contains the statement was bound.

Examples

The statements in the following examples are assumed to be in PL/I programs.

Example 1: Place information about the result set associated with cursor C1 into the descriptor named by :sqlda1.

```
EXEC SQL DESCRIBE CURSOR C1 INTO :sqlda1
```

Example 2: Place information about the result set associated with the cursor named by :hv1 into the descriptor named by :sqlda2.

```
EXEC SQL DESCRIBE CURSOR :hv1 INTO :sqlda2
```

DESCRIBE INPUT

The DESCRIBE INPUT statement obtains information about the input parameter markers of a prepared statement. For an explanation of prepared statements, see “PREPARE” on page 995 and “DESCRIBE PROCEDURE” on page 863.

Invocation

This statement can only be embedded in an application program. It is an executable statement that cannot be dynamically prepared.

Authorization

None required if the statement is used for a prepared statement.

Syntax

```
►►──DESCRIBE INPUT──statement-name──INTO──descriptor-name──────────────────────────►◄
```

Description

statement-name
Identifies the prepared statement. When the DESCRIBE INPUT statement is executed, the name must identify a statement that has been prepared by the application process at the current server.

INTO *descriptor-name*
Identifies an SQL descriptor area (SQLDA), which is described in Appendix E, “SQL descriptor area (SQLDA),” on page 1173. See “Identifying an SQLDA in C or C++” on page 1189 for how to represent *descriptor-name* in C. The information returned in the SQLDA describes the parameter markers.

Before the DESCRIBE INPUT statement is executed, the user must set the SQLN field in the SQLDA and the SQLDA must be allocated. Considerations for initializing and allocating the SQLDA are similar to those for the DESCRIBE statement (see “DESCRIBE (prepared statement or table)” on page 851). An occurrence of an extended SQLVAR is needed for each parameter in addition to the required base SQLVAR only if the input data contains LOBs.

For REXX: The SQLDA is not allocated before it is used.

After the DESCRIBE INPUT statement is executed, all the fields in the SQLDA except SQLN are either set by DB2 or ignored. The SQLDA contents are similar to the contents returned for the DESCRIBE statement (see page 854) with these exceptions:

- In the SQLDAID, DB2 sets the value of the seventh byte only to the space character or '2'. A value of '3' is never used. The value '2' indicates that two SQLVAR entries (an occurrence of both a base SQLVAR and an extended SQLVAR) are required for each parameter because the input data contains LOBs. The seventh byte is a space character when either of the following conditions is true:
  – The input data does not contain LOBs. Only a base SQLVAR occurrence is needed for each parameter.
  – Only a base SQLVAR occurrence is needed for each column of the result, and the SQLDA is not large enough to contain the returned information.

- The SQLD field is set to the number of parameter markers being described. The value is 0 if the statement being described does not have input parameter markers.
- The SQLNAME field is not used.
- The SQLDATATYPE is set to a nullable, regardless of the usage of the parameter markers in the prepared statement.
- The SQLDATATYPE-NAME is not used if an extended SQLVAR entry is present. DESCRIBE INPUT does not return information about distinct types.

For complete information on the contents of the fields, see Appendix E, “SQL descriptor area (SQLDA),” on page 1173.

Notes

Preparing the SQLDA for OPEN or EXECUTE: This note is relevant if you are applying DESCRIBE INPUT to a prepared statement and you intend to use the SQLDA in an OPEN or EXECUTE statement. To prepare the SQLDA for that purpose:

- Set SQLDATA to a valid address.
- If SQLTYPE is odd, set SQLIND to a valid address.

For the meaning of those fields in that context, see Appendix E, “SQL descriptor area (SQLDA),” on page 1173.

Support for extended dynamic SQL in a distributed environment: Unlike the DESCRIBE statement, which can be used in a distributed environment to describe static SQL statements generated by extended dynamic SQL, you cannot describe host variables in static SQL statements that are generated by extended dynamic SQL. A DESCRIBE INPUT statement issued against such static SQL statements always fails.

For information on how the DESCRIBE statement supports extended dynamic SQL, see “Support for extended dynamic SQL in a distributed environment” on page 856.

Using host variables: If the DESCRIBE INPUT statement contains host variables, the contents of the host variables are assumed to be in the encoding scheme that was specified in the ENCODING parameter when the package or plan that contains the statement was bound.

Example

Execute a DESCRIBE INPUT statement with an SQLDA that has enough SQLVAR occurrences to describe any number of input parameters a prepared statement might have. Assume that five parameter markers at most will need to be described and that the input data does not contain LOBs.

```
     /* STMT1_STR contains INSERT statement with VALUES clause  */
   EXEC SQL  PREPARE STMT1_NAME FROM :STMT1_STR;

  ... /* code to set SQLN to 5 and to allocate the SQLDA         */
   EXEC SQL  DESCRIBE INPUT STMT1_NAME INTO :SQLDA;
  .
  .
  .
```

This example uses the first technique described in “Allocating the SQLDA” on page 853 to allocate the SQLDA.

DESCRIBE PROCEDURE

The DESCRIBE PROCEDURE statement gets information about the result sets returned by a stored procedure. The information, such as the number of result sets, is put into a descriptor.

Invocation

This statement can only be embedded in an application program. It is an executable statement that cannot be dynamically prepared.

Authorization

None required.

Syntax

```
►►──DESCRIBE PROCEDURE──┬─procedure-name─┬──INTO──descriptor-name────────────────────────────►◄
                        └─host-variable──┘
```

Description

procedure-name or *host-variable*
: Identifies the stored procedure that returned one or more result sets. When the DESCRIBE PROCEDURE statement is executed, the procedure name must identify a stored procedure that the requester has already invoked using the SQL CALL statement. The procedure name can be specified as a one, two, or three-part name. The procedure name in the DESCRIBE PROCEDURE statement must be specified the same way that it was specified on the CALL statement. For example, if a two-part procedure name was specified on the CALL statement, you must specify a two-part procedure name in the DESCRIBE PROCEDURE statement.

If a host variable is used:

- It must be a character string variable with a length attribute that is not greater than 254.
- It must not be followed by an indicator variable.
- The value of the host variable is a specification that depends on the database server. Regardless of the server, the specification must:
  - Be left justified within the host variable
  - Not contain embedded blanks
  - Be padded on the right with blanks if its length is less than that of the host variable

INTO *descriptor-name*
: Identifies an SQL descriptor area (SQLDA). The information returned in the SQLDA describes the result sets returned by the stored procedure.

Considerations for allocating and initializing the SQLDA are similar to those for DESCRIBE TABLE.

The contents of the SQLDA after executing a DESCRIBE PROCEDURE statement are:

- The first 5 bytes of the SQLDAID field are set to 'SQLPR'.

A REXX SQLDA does not contain SQLDAID.

- Bytes 6 to 8 of the SQLDAID field are reserved.
- The SQLD field is set to the total number of result sets. A value of 0 in the field indicates there are no result sets.
- There is one SQLVAR entry for each result set.
- The SQLDATA field of each SQLVAR entry is set to the result set locator value associated with the result set.

  For a REXX SQLDA, SQLLOCATOR is set to the result set locator value.
- The SQLIND field of each SQLVAR entry is set to the estimated number of rows in the result set
- The SQLNAME field is set to the name of the cursor used by the stored procedure to return the result set. This value is returned in the encoding scheme specified by the ENCODING bind option for the plan or package that contains this statement.

Notes

SQLDA information: A value of -1 in the SQLIND field indicates that an estimated number of rows in the result set is not provided. DB2 UDB for z/OS always sets SQLIND to -1.

DESCRIBE PROCEDURE does not return information about the parameters expected by the stored procedure.

Assignment of locator values: Locator values are assigned to the SQLVAR entries in the SQLDA in the order that the associated cursors are opened at run time. Locator values are not provided for cursors that are closed when control is returned to the invoking application. If a cursor was closed and later re-opened before returning to the invoking application, the most recently executed OPEN CURSOR statement for the cursor is used to determine the order in which the locator values are returned for the procedure result sets. For example, assume procedure P1 opens three cursors A, B, C, closes cursor B and then issues another OPEN CURSOR statement for cursor B before returning to the invoking application. The locator values are assigned in the order A, C, B.

Alternatively, an ASSOCIATE LOCATORS statement can be used to copy the locator values to result set locator variables.

Using host variables: If the DESCRIBE PROCEDURE statement contains host variables, the contents of the host variables are assumed to be in the encoding scheme that was specified in the ENCODING parameter when the package or plan that contains the statement was bound.

Examples

The statements in the following examples are assumed to be in PL/I programs.

Example 1: Place information about the result sets returned by stored procedure P1 into the descriptor named by SQLDA1. Assume that the stored procedure is called with a one-part name from current server SITE2.

```
EXEC SQL CONNECT TO SITE2;
EXEC SQL CALL P1;
EXEC SQL DESCRIBE PROCEDURE P1 INTO :SQLDA1;
```

Example 2: Repeat the scenario in Example 1, but use a two-part name to specify an explicit schema name for the stored procedure to ensure that stored procedure P1 in schema MYSCHEMA is used.

```
EXEC SQL CONNECT TO SITE2;
EXEC SQL CALL MYSCHEMA.P1;
EXEC SQL DESCRIBE PROCEDURE MYSCHEMA.P1 INTO :SQLDA1;
```

Example 3: Place information about the result sets returned by the stored procedure identified by host variable HV1 into the descriptor named by SQLDA2. Assume that host variable HV1 contains the value SITE2.MYSCHEMA.P1 and the stored procedure is called with a three-part name.

```
EXEC SQL CALL SITE2.MYSCHEMA.P1;
EXEC SQL DESCRIBE PROCEDURE :HV1 INTO :SQLDA2;
```

The preceding example would be invalid if host variable HV1 had contained the value MYSCHEMA.P1, a two-part name. For the example to be valid with that two-part name in host variable HV1, the current server must be the same as the location name that is specified on the CALL statement as the following statements demonstrate. This is the only condition under which the names do not have to be specified the same way and a three-part name on the CALL statement can be used with a two-part name on the DESCRIBE PROCEDURES statement.

```
EXEC SQL CONNECT TO SITE2;
EXEC SQL CALL SITE2.MYSCHEMA.P1;
EXEC SQL ASSOCIATE LOCATORS (:LOC1, :LOC2)
         WITH PROCEDURE :HV1;
```

DROP

The DROP statement removes an object at the current server. Except for storage groups, any objects that are directly or indirectly dependent on that object are deleted. Whenever an object is deleted, its description is deleted from the catalog at the current server, and any plans or packages that refer to the object are invalidated.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

To drop a table, table space, or index, the privilege set that is defined below must include at least one of the following:
- Ownership of the object (for an index, the owner is the owner of the table or index)
- DBADM authority
- SYSADM or SYSCTRL authority

To drop an alias, storage group, or view, the privilege set that is defined below must include at least one of the following:
- Ownership of the object
- SYSADM or SYSCTRL authority

To drop a database, the privilege set that is defined below must include at least one of the following:
- The DROP privilege on the database
- DBADM or DBCTRL authority for the database
- SYSADM or SYSCTRL authority

To drop a package, the privilege set that is defined below must include at least one of the following:
- Ownership of the package
- The BINDAGENT privilege granted from the package owner
- PACKADM authority for the collection or for all collections
- SYSADM or SYSCTRL authority

To drop a synonym, the privilege set that is defined below must include ownership of the synonym.

To drop a distinct type, stored procedure, trigger, user-defined function, or sequence, the privilege set that is defined below must include at least one of the following:
- Ownership of the object [32]
- The DROPIN privilege on the schema
- SYSADM or SYSCTRL authority

The authorization ID that matches the schema name implicitly has the DROPIN privilege on the schema.

[32] Not applicable for stored procedures defined in releases of DB2 UDB for z/OS prior to Version 6.

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package. If the statement is dynamically prepared, the privilege set is the union of the privilege sets that are held by each authorization ID of the process.

Syntax

```
►►──DROP──┬─ALIAS──alias-name─────────────────────────────────────────────────┬──────►◄
          ├─DATABASE──database-name───────────────────────────────────────────┤
          │                                 ┌─RESTRICT─┐                      │
          ├─DISTINCT TYPE──distinct-type-name──┴──────────┴──────────────────────┤
          │                                                    ┌─RESTRICT─┐   │
          ├──┬─FUNCTION──function-name──┬──────────────────────────┬──┴──────────┴─┬─┤
          │  │                         │      ┌─,──────────────┐  │              │ │
          │  │                         │      ▼                │  │              │ │
          │  │                         └─(──┬────────────────┬─┴─)─┘              │ │
          │  │                              └─parameter-type─┘                    │ │
          │  │                                       ┌─RESTRICT─┐                 │ │
          │  └─SPECIFIC FUNCTION──specific-name──┴──────────┴─────────────────────┘ │
          ├─INDEX──index-name─────────────────────────────────────────────────┤
          ├───PACKAGE────collection-id.package-name──┬───────────────────────────┬──┤
          │                                          │ ┌─VERSION─┐               │  │
          │                                          └─┴─────────┴──version-id──┘  │
          │                            ┌─RESTRICT─┐                           │
          ├─PROCEDURE──procedure-name──┴──────────┴───────────────────────────┤
          │                          ┌─RESTRICT─┐                             │
          ├─SEQUENCE──sequence-name──┴──────────┴─────────────────────────────┤
          ├─STOGROUP──stogroup-name───────────────────────────────────────────┤
          ├─SYNONYM──synonym──────────────────────────────────────────────────┤
          ├─TABLE──table-name─────────────────────────────────────────────────┤
          ├─TABLESPACE──┬────────────────┬─table-space-name───────────────────┤
          │             └─database-name.─┘                                    │
          ├─TRIGGER──trigger-name─────────────────────────────────────────────┤
          └─VIEW──view-name───────────────────────────────────────────────────┘
```

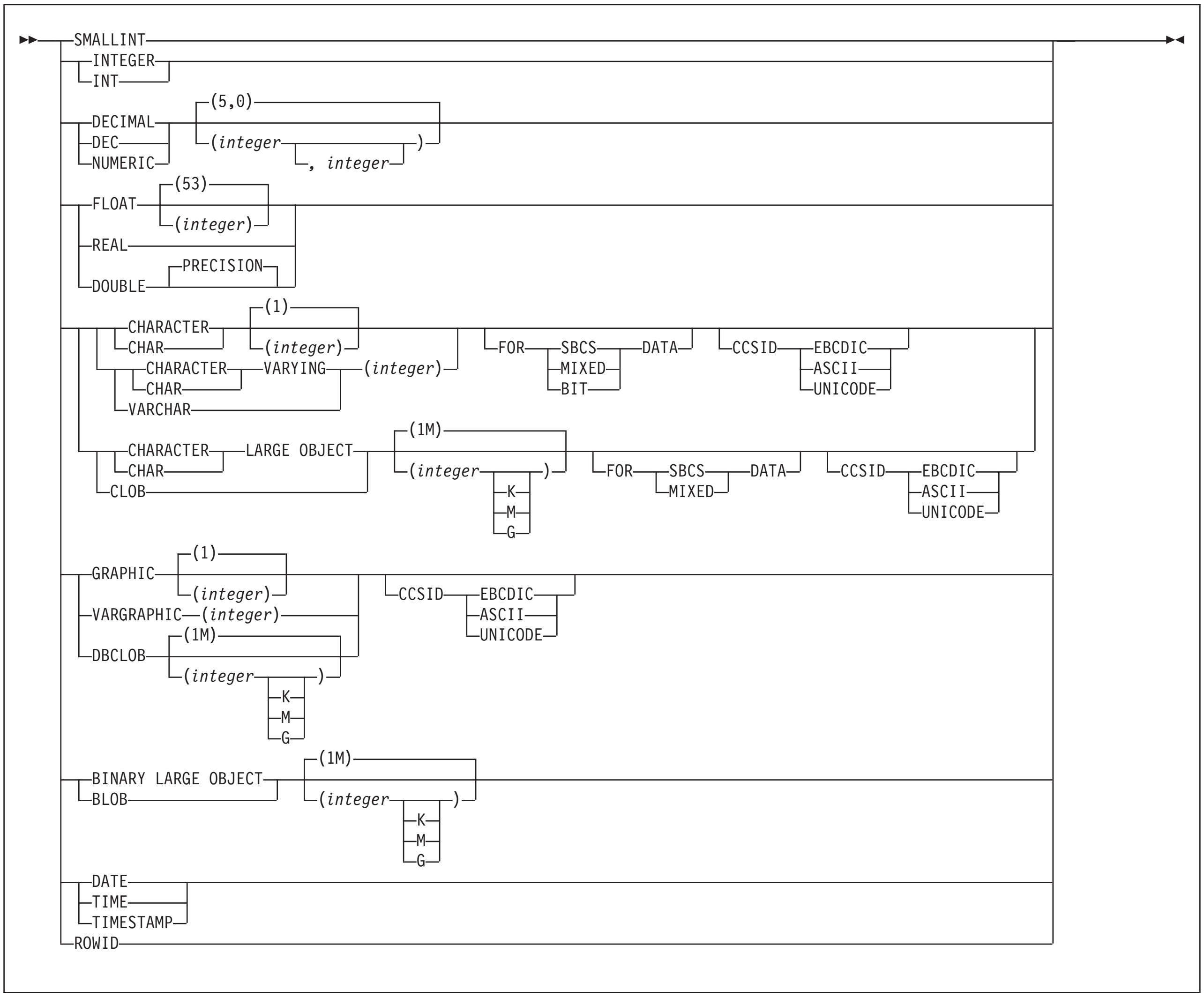
parameter type:

```
►►──data-type──┬────────────┬───────────────────────────────────────────────►◄
               └─AS LOCATOR─┘
```

data type:

```
►►──┬─built-in-type──────┬──────────────────────────────────────────────────►◄
    └─distinct-type-name─┘
```

built-in-type:



Description

ALIAS *alias-name*
Identifies the alias to be dropped. The name must identify an alias that exists at the current server. Dropping an alias has no effect on any view, materialized query table, or synonym that was defined using the alias.

DATABASE *database-name*
Identifies the database to be dropped. The name must identify a database that exists at the current server. DSNDB04 or DSNDB06 must not be specified. The privilege set must include SYSADM authority. A TEMP database can be dropped only if none of the table spaces or index spaces that it contains are actively being used.

Whenever a database is dropped, all of its table spaces, tables, index spaces, and indexes are also dropped.

DISTINCT TYPE *distinct-type-name*
Identifies the distinct type to be dropped. The name must identify a distinct type

that exists at the current server. The default keyword RESTRICT indicates that the distinct type is not dropped if any of the following dependencies exist:

- The definition of a column of a table uses the distinct type.
- The definition of an input or result parameter of a user-defined function uses the distinct type.
- The definition of a parameter of a stored procedure uses the distinct type
- A sequence exists for which the data type of the sequence is the distinct type.

Whenever a distinct type is dropped, all privileges on the distinct type are also dropped. In addition, the cast functions that were generated when the distinct type was created and the privileges on those cast functions are also dropped.

FUNCTION or SPECIFIC FUNCTION

Identifies the function to be dropped. The function must exist at the current server, and it must have been defined with the CREATE FUNCTION statement. The particular function can be identified by its name, function signature, or specific name.

Functions that are implicitly generated by the CREATE DISTINCT TYPE statement cannot be dropped using the DROP statement. They are implicitly dropped when the distinct type is dropped.

As indicated by the default keyword RESTRICT, the function is not dropped if any of the following dependencies exist:

- Another function is sourced on the function.
- A view uses the function.
- A trigger package uses the function.
- The definition of a materialized query table uses the function.

When a function is dropped, all privileges on the function are also dropped. Any plans or packages that are dependent on the function dropped are made inoperative.

FUNCTION *function-name*

Identifies the function by its name. The *function-name* must identify exactly one function. The function can have any number of parameters defined for it. If there is more than one function of the specified name in the specified or implicit schema, an error is returned.

FUNCTION *function-name (parameter-type,...)*

Identifies the function by its function signature, which uniquely identifies the function. The *function-name (parameter-type, ...)* must identify a function with the specified function signature. The specified parameters must match the data types in the corresponding position that were specified when the function was created. The number of data types, and the logical concatenation of the data types is used to identify the specific function instance which is to be dropped. Synonyms for data types are considered a match.

If the function was defined with a table parameter (the LIKE TABLE was specified in the CREATE FUNCTION statement to indicate that one of the input parameters is a transition table), the function signature cannot be used to uniquely identify the function. Instead, use one of the other syntax variations to identify the function with its function name, if unique, or its specific name.

If *function-name ()* is specified, the function identified must have zero parameters.

function-name
Identifies the name of the function.

(parameter-type,...)
Identifies the parameters of the function.

If an unqualified distinct type name is specified, DB2 searches the SQL path to resolve the schema name for the distinct type.

For data types that have a length, precision, or scale attribute, use one of the following:

- Empty parentheses indicate that the database manager ignores the attribute when determining whether the data types match. For example, DEC() will be considered a match for a parameter of a function defined with a data type of DEC(7,2). However, FLOAT cannot be specified with empty parenthesis because its parameter value indicates a specific data type (REAL or DOUBLE).
- If a specific value for a length, precision, or scale attribute is specified, the value must exactly match the value that was specified (implicitly or explicitly) in the CREATE FUNCTION statement. If the data type is FLOAT, the precision does not have to exactly match the value that was specified because matching is based on the data type (REAL or DOUBLE).
- If length, precision, or scale is not explicitly specified, and empty parentheses are not specified, the default attributes of the data type are implied. The implicit length must exactly match the value that was specified (implicitly or explicitly) in the CREATE FUNCTION statement.

For data types with a subtype or encoding scheme attribute, specifying the FOR *subtype* DATA clause or the CCSID clause is optional. Omission of either clause indicates that DB2 ignores the attribute when determining whether the data types match. If you specify either clause, it must match the value that was implicitly or explicitly specified in the CREATE FUNCTION statement.

AS LOCATOR
Specifies that the function is defined to receive a locator for this parameter. If AS LOCATOR is specified, the data type must be a LOB or a distinct type based on a LOB.

SPECIFIC FUNCTION *specific-name*
Identifies the function by its specific name. The *specific-name* must identify a specific function that exists at the current server.

INDEX *index-name*
Identifies the index to be dropped. The name must identify a user-defined index that exists at the current server but must not identify a populated index on an auxiliary table. (For details on dropping user-defined indexes on catalog tables, see “SQL statements allowed on the catalog” on page 1197.) A populated index on an auxiliary table can only be dropped by dropping the base table.

If the index that is dropped was created by specifying the ENDING AT clause to define partition boundaries, the table is converted to use table-controlled partitioning. The high limit key for the last partition is set to the highest possible value for ascending key columns or the lowest possible value for descending key columns.

Whenever an index is directly or indirectly dropped, its index space is also dropped. The name of a dropped index space cannot be reused until a commit operation is performed.

If the index is a unique index used to enforce a unique constraint (primary or unique key), the unique constraint must be dropped before the index can be dropped. In addition, if a unique constraint supports a referential constraint, the index cannot be dropped unless the referential constraint is dropped.

However, a unique index (for a unique key only) can be dropped without first dropping the unique key constraint if the unique key was created in a release of DB2 before Version 7 and if the unique key constraint has no associated referential constraints. For information about dropping constraints, see “ALTER TABLE” on page 504.

If a unique index is dropped and that index was defined on a ROWID column that is defined as GENERATED BY DEFAULT, the table can still be used, but rows cannot be inserted into that table.

If an empty index on an auxiliary table is dropped, the base table is marked incomplete.

PACKAGE *collection-id.package-name*

Identifies the package version to be dropped. The name plus the implicitly or explicitly specified *version-id* must identify a package version that exists at the current server. Omission of the *version-id* is an implicit specification of the null version. The name must not identify a trigger package. A trigger package can only be dropped by dropping the associated trigger or subject table.

Whenever the last or only version of a package is dropped, all privileges on the package are dropped and all plans that are dependent on the execute privilege of the package are invalidated.

VERSION *version-id*

version-id is the version identifier that was assigned to the package’s DBRM when the DBRM was created. If *version-id* is not specified, a null string is used as the version identifier.

Delimit the version identifier when it:
- Is generated by the VERSION(AUTO) precompiler option
- Begins with a digit
- Contains lowercase or mixed-case letters

For more on version identifiers, see the information on preparing an application program for execution in Part 5 of *DB2 Application Programming and SQL Guide*.

PROCEDURE *procedure-name*

Identifies the stored procedure to be dropped. The name must identify a stored procedure that has been defined with the CREATE PROCEDURE statement at the current server. For dropping a procedure with a schema name 'SYSIBM', the privilege set must include SYSADM or SYSCTRL authority.

When a procedure is directly or indirectly dropped, all privileges on the procedure are also dropped. In addition, any plans or packages that are dependent on the procedure are marked invalid.

SEQUENCE *sequence-name*

Identifies the sequence to be dropped. The name must identify an existing sequence at the current server. If no sequence by this name exists in the explicitly or implicitly specified schema, an error occurs.

sequence-name must not be the name of an internal sequence object that is generated by the system for an identity column. Sequences generated by the system for identity columns cannot be dropped with the DROP SEQUENCE statement. A sequence object for an identity column is implicitly dropped when the table containing the identify column is dropped.

The default keyword RESTRICT indicates that the sequence is not dropped if any of the following dependencies exist:

- A trigger that uses the sequence in a NEXT VALUE or PREVIOUS VALUE expression exists.
- An inline SQL function that uses the sequences in a NEXT VALUE or PREVIOUS VALUE expression exists.

Whenever a sequence is dropped, all privileges on the sequence are also dropped, and the plans and packages that refer to the sequence are invalidated. Dropping a sequence, even if the drop process is rolled back, results in the loss of the still-unassigned cache values for the sequence.

STOGROUP *stogroup-name*

Identifies the storage group to be dropped. The name must identify a storage group that exists at the current server but not a storage group that is used by any table space or index space.

For information on the effect of dropping the default storage group of a database, see “Dropping a default storage group” on page 874.

SYNONYM *synonym*

Identifies the synonym to be dropped. In a static DROP SYNONYM statement, the name must identify a synonym that is owned by the owner of the plan or package. In a dynamic DROP SYNONYM statement, the name must identify a synonym that is owned by the SQL authorization ID. Thus, using interactive SQL, a user with SYSADM authority can drop any synonym by first setting CURRENT SQLID to the owner of the synonym.

Dropping a synonym has no effect on any view, materialized query table, or alias that was defined using the synonym, nor does it invalidate any plans or packages that use such views, materialized query tables, or aliases.

TABLE *table-name*

Identifies the table to be dropped. The name must identify a table that exists at the current server but must not identify a catalog table, a table in a partitioned table space, or a populated auxiliary table. A table in a partitioned table space can only be dropped by dropping the table space. A populated auxiliary table can only be dropped by dropping the associated base table.

Whenever a table is directly or indirectly dropped, all privileges on the table, all referential constraints in which the table is a parent or dependent, and all synonyms, views, and indexes defined on the table are also dropped. If the table space for the table was implicitly created, it is also dropped.

Whenever a table is directly or indirectly dropped, all materialized query tables defined on the table are also dropped. Whenever a materialized query table is directly or indirectly dropped, all privileges on the materialized query table and all synonyms, views, and indexes that are defined on the materialized query table are also dropped. Any alias defined on the materialized query table is not dropped. Any plans or packages that are dependent on the dropped materialized query table are marked invalid.

If a table with LOB columns is dropped, the auxiliary tables associated with the table and the indexes on the auxiliary tables are also dropped. Any LOB table spaces that were implicitly created for the auxiliary tables are also dropped.

If an empty auxiliary table is dropped, the definition of the base table is marked incomplete.

If the table has a security label column, the primary authorization ID of the DROP statement must have a valid security label, and the RACF SECLABEL class must be active.

TABLESPACE *database-name.table-space-name*

Identifies the table space to be dropped. The name must identify a table space that exists at the current server. The database name must not be DSNDB06. Omission of the database name is an implicit specification of DSNDB04.

Whenever a table space is directly or indirectly dropped, all the tables in the table space are also dropped. The name of a dropped table space cannot be reused until a commit operation is performed.

A table space in a TEMP database can be dropped only if it does not contain an active declared temporary table. A LOB table space can be dropped only if it does not contain an auxiliary table.

Whenever a base table space that contains tables with LOB columns is dropped, all the auxiliary tables and indexes on those auxiliary tables that are associated with the base table space are also dropped.

TRIGGER *trigger-name*

Identifies the trigger to be dropped. The name must identify a trigger that exists at the current server.

Whenever a trigger is directly or indirectly dropped, all privileges on the trigger are also dropped and the associated trigger package is freed. The name of that trigger package is the same as the trigger name and the collection ID is the schema name.

VIEW *view-name*

Identifies the view to be dropped. The name must identify a view that exists at the current server.

Whenever a view is directly or indirectly dropped, all privileges on the view and all synonyms and views that are defined on the view are also dropped. Whenever a view is directly or indirectly dropped, all materialized query tables defined on the view are also dropped.

Notes

Restrictions on DROP: DROP is subject to these restrictions:

- DROP DATABASE cannot be performed while a DB2 utility has control of any part of the database.
- DROP INDEX cannot be performed while a DB2 utility has control of the index or its associated table space.
- DROP PACKAGE or DROP TRIGGER (which implicitly drops the trigger package) cannot be performed while the package or trigger package is in use by an application. For applications that are bound with RELEASE(COMMIT), you can drop the package or trigger package at a commit point. For applications that

are bound with RELEASE(DEALLOCATE), you can drop the package or trigger package only when the application's thread is deallocated.

- DROP TABLE cannot be performed while a DB2 utility has control of the table space that contains the table.
- DROP TABLESPACE cannot be performed while a DB2 utility has control of the table space.

In a data sharing environment, the following restrictions also apply:

- If any member has an active resource limit specification table (RLST) you cannot drop the database or table space that contains the table, the table itself, or any index on the table.
- If the member executing the drop cannot access the DB2-managed data sets, only the catalog and directory entries for those data sets are removed.

Objects that have certain dependencies cannot be dropped. For information on these restrictions, see Table 74 on page 877.

Recreating objects: After an index or table space is dropped, a commit must be performed before the object can be recreated with the same name. If a table that was created without an IN clause (thereby causing a table space to be implicitly created) is dropped, a table cannot be recreated with the same name until a commit is performed.

Dropping a parent table: DROP is not DELETE and therefore does not involve delete rules.

Dropping a default storage group: If you drop the default storage group of a database, the database no longer has a legitimate default. You must then specify USING in any statement that creates a table space or index in the database. You must do this until you either:

- Create another storage group with the same name using the CREATE STOGROUP statement, or
- Designate another default storage group for the database using the ALTER DATABASE statement.

Dropping a table space or index: To drop a table space or index, the size of the buffer pool associated with the table space or index must not be zero.

Dropping a table space in a work file database: If one member of a data sharing group drops a table space in a work file database, or an entire work file database, that belongs to another member, DB2-managed data sets that the executing member cannot access are not dropped. However, the catalog and directory entries for those data sets are removed.

Dropping resource limit facility (governor) indexes, tables, and table spaces: While the RLST is active, you cannot issue a DROP DATABASE, DROP INDEX, DROP TABLE, or DROP TABLESPACE statement for an object associated with an RLST that is active on any member of a data sharing group. See Part 5 (Volume 2) of *DB2 Administration Guide* for details.

Dropping a temporary table: To drop a created temporary table or a declared temporary table, use the DROP TABLE statement.

Dropping a materialized query table: To drop a materialized query table, use the DROP TABLE statement.

Dropping an alias: Dropping a table or view does not drop its aliases. To drop an alias, use the DROP ALIAS statement.

Dropping an index on an auxiliary table and an auxiliary table: You can explicitly drop an empty index on an auxiliary table with the DROP INDEX statement. An empty or populated index on an auxiliary table is implicitly dropped when:

- The auxiliary table is empty and it is explicitly dropped (empty indexes only).
- The associated base table for the auxiliary table is dropped.
- The base table space that contains the associated base table is dropped.

You can explicitly drop an empty auxiliary table with the DROP TABLE statement. An empty or populated auxiliary table is implicitly dropped when:

- The associated base table for the auxiliary table is dropped.
- The base table space that contains the associated base table is dropped.

Table 73 shows which DROP statements implicitly or explicitly cause an auxiliary table and the index on that table to be dropped, as indicated by the 'D' in the column.

Table 73. Effect of various DROP statements on auxiliary tables and indexes

	Auxiliary table		**Index on auxiliary table**	
Statement	**Populated**	**Empty**	**Populated**	**Empty**
DROP TABLESPACE (base table space)	D	D	D	D
DROP TABLE (base table)	D	D	D	D
DROP TABLE (auxiliary table)		D		D
DROP INDEX (index on auxiliary table)				D

Note: D indicates that the table or index is dropped.

Dropping a migrated index or table space: Here, “migration” means migrated by the Hierarchical Storage Manager (DFSMShsm™). DB2 does not wait for any recall of the migrated data sets. Hence, recall is not a factor in the time it takes to execute the statement.

Deleting SYSLGRNG records for dropped table spaces: After dropping a table space, you cannot delete the associated records. If you want to remove the records, you must quiesce the table space, and then run the MODIFY RECOVERY utility *before* dropping the table space. If you delete the SYSLGRNG records and drop the table space, you cannot reclaim the table space.

Dependencies when dropping objects: Whenever an object is directly or indirectly dropped, other objects that depend on the dropped object might also be dropped. (The catalog stores information about the dependencies of objects on each other.) The following semantics determine what happens to a dependent object when the object that it depends on (the underlying object) is dropped:

Cascade (D) Dropping the underlying object causes the dependent object to be dropped. However, if the dependent object cannot be dropped because it has a restrict dependency on another object, the drop of the underlying object fails.

Restrict (D) The underlying object cannot be dropped if a dependent object exists.

Inoperative (O)
Dropping the underlying object causes the dependent object to become inoperative.

Invalidation (V)
Dropping the underlying object causes the dependent object to become invalidated.

For objects that directly depend on others, Table 74 on page 877 uses the letter abbreviations above to summarize what happens to a dependent object when its underlying object is specified in a DROP statement. Additional objects can be indirectly affected, too.

To determine the indirect effects of a DROP statement, assess what happens to the dependent object and whether the dependent object has objects that depend on it. For example, assume that view B is defined on table A and view C is defined on view B. In Table 74 on page 877, the 'D' in the VIEW column of the DROP TABLE row indicates that view B is dropped when table A is dropped. Next, because view C is dependent on view B, check the VIEW column for DROP VIEW. The 'D' in the column indicates that view C will be dropped, too.

Table 74. Effect of dropping objects that have dependencies

	Type of object													
DROP statement	**ALIAS**	**DATABASE**	**DISTINCT TYPE**	**FUNCTION**	**INDEX**	**PACKAGE**[1]	**PROCEDURE**	**SEQUENCE**	**STOGROUP**	**SYNONYM**	**TABLE**	**TABLESPACE**	**TRIGGER**	**VIEW**
DROP ALIAS						V								
DROP DATABASE					D[2]						D	D		D
DROP DISTINCT TYPE				R[3]			R[4]				R			
DROP FUNCTION				R[5]		O							R	R
DROP INDEX[2,6]						V							V	
DROP PACKAGE[7]														
DROP PROCEDURE						O							R	
DROP SEQUENCE				R[13]		V							R	
DROP STOGROUP					R[8]							R[8]		
DROP SYNONYM														
DROP TABLE[9,10]					D	V				D			D[11]	D
DROP TABLESPACE[12]					D	V					D			
DROP TRIGGER														
DROP VIEW						V				D				D

Table 74. Effect of dropping objects that have dependencies (continued)

	Type of object													
DROP statement	**ALIAS**	**DATABASE**	**DISTINCT TYPE**	**FUNCTION**	**INDEX**	**PACKAGE[1]**	**PROCEDURE**	**SEQUENCE**	**STOGROUP**	**SYNONYM**	**TABLE**	**TABLESPACE**	**TRIGGER**	**VIEW**

Legend:

D Dependent object is dropped.
O Dependent object is made inoperative.
V Dependent object is invalidated.
R DROP statement fails.

Notes:

1. The PACKAGE column represents packages for user-defined functions, procedures, and triggers, as well as other packages. The PACKAGE column also applies for plans.
2. The index space associated with the index is dropped.
3. If a function is dependent on the distinct type being dropped, the distinct type cannot be dropped unless the function is one of the cast functions that was created for the distinct type.
4. If the definition of a parameter of a stored procedure uses the distinct type, the distinct type cannot be dropped.
5. If other user-defined functions are sourced on the user-defined function being dropped, the function cannot be dropped.
6. An index on an auxiliary table cannot be explicitly dropped.
7. A trigger package cannot be explicitly dropped with DROP PACKAGE. A trigger package is implicitly dropped when the associated trigger or subject table is dropped.
8. A storage group cannot be dropped if it is used by any table space or index space.
9. An auxiliary table cannot be explicitly dropped with DROP TABLE. An auxiliary table is implicitly dropped when the associated base table is dropped.
10. If an implicit table space was created when the table was created, the table space is also dropped.
11. When a subject table is dropped, the associated trigger and trigger package are also dropped.
12. A LOB table space cannot be dropped until the base table with the LOB columns is dropped. A table space in a TEMP database cannot be dropped if it contains an active declared temporary table.
13. This restriction is only for SQL functions.

Alternative syntax and synonyms: To provide compatibility with previous releases of DB2 or other products in the DB2 UDB family, DB2 supports the following keywords:

- DATA TYPE as a synonym for DISTINCT TYPE
- PROGRAM as a synonym for PACKAGE

Examples

Example 1: Drop table DSN8810.DEPT.

```
DROP TABLE DSN8810.DEPT;
```

Example 2: Drop table space DSN8S81D in database DSN8D81A.

```
DROP TABLESPACE DSN8D81A.DSN8S81D;
```

Example 3: Drop the view DSN8810.VPROJRE1:

```
DROP VIEW DSN8810.VPROJRE1;
```

Example 4: Drop the package DSN8CC0 with the version identifier VERSZZZZ. The package is in the collection DSN8CC61. Use the version identifier to distinguish the package to be dropped from another package with the same name in the same collection.

```
DROP PACKAGE DSN8CC61.DSN8CC0 VERSION VERSZZZZ;
```

Example 5: Drop the package DSN8CC0 with the version identifier "1994-07-14-09.56.30.196952". When a version identifier is generated by the VERSION(AUTO) precompiler option, delimit the version identifier.

```
DROP PACKAGE DSN8CC61.DSN8CC0 VERSION "1994-07-14-09.56.30.196952";
```

Example 6: Drop the distinct type DOCUMENT, if it is not currently in use:

```
DROP DISTINCT TYPE DOCUMENT;
```

Example 7: Assume that you are SMITH and that ATOMIC_WEIGHT is the only function with that name in schema CHEM. Drop ATOMIC_WEIGHT.

```
DROP FUNCTION CHEM.ATOMIC_WEIGHT;
```

Example 8: Assume that you are SMITH and that you created the function CENTER in schema SMITH. Drop CENTER, using the function signature to identify the function instance to be dropped.

```
DROP FUNCTION CENTER(INTEGER, FLOAT);
```

Example 9: Assume that you are SMITH and that you created another function named CENTER, which you gave the specific name FOCUS97, in schema JOHNSON. Drop CENTER, using the specific name to identify the function instance to be dropped.

```
DROP SPECIFIC FUNCTION JOHNSON.FOCUS97;
```

Example 10: Assume that you are SMITH and that stored procedure OSMOSIS is in schema BIOLOGY. Drop OSMOSIS.

```
DROP PROCEDURE BIOLOGY.OSMOSIS;
```

Example 11: Assume that you are SMITH and that trigger BONUS is in your schema. Drop BONUS.

```
DROP TRIGGER BONUS;
```

END DECLARE SECTION

The END DECLARE SECTION statement marks the end of an SQL declare section.

Invocation

This statement can only be embedded in an application program. It is not an executable statement. It must not be specified in Java or REXX.

Authorization

None required.

Syntax

```
►►──END DECLARE SECTION─────────────────────────────────────────────────────►◄
```

Description

The END DECLARE SECTION statement can be coded in the application program wherever declarations can appear in accordance with the rules of the host language. It is used to indicate the end of an SQL declare section. An SQL declare section starts with a BEGIN DECLARE SECTION statement described in "BEGIN DECLARE SECTION" on page 562.

The following rules are enforced by the precompiler only if the host language is C or the STDSQL(YES) precompiler option is specified:

- A variable referred to in an SQL statement must be declared within an SQL declare section of the source program.
- BEGIN DECLARE SECTION and END DECLARE SECTION statements must be paired and must not be nested.
- SQL declare sections can contain only host variable declarations, SQL INCLUDE statements that include host variable declarations, or DECLARE VARIABLE statements.

Notes

SQL declare sections are only required if the STDSQL(YES) option is specified or the host language is C. However, SQL declare sections can be specified for any host language so that the source program can conform to IBM SQL. If SQL declare sections are used, but not required, variables declared outside an SQL declare section should not have the same name as variables declared within an SQL declare section.

Example

```
EXEC SQL BEGIN DECLARE SECTION;

 (host variable declarations)

EXEC SQL END DECLARE SECTION;
```

EXECUTE

The EXECUTE statement executes a prepared SQL statement.

Invocation

This statement can only be embedded in an application program. It is an executable statement that cannot be dynamically prepared. It must not be specified in Java.

Authorization

See "PREPARE" on page 995 for the authorization required to create a prepared statement.

Syntax

```
►►──EXECUTE──statement-name──┬──────────────────────────────────────┬──────────────►◄
                             │         ┌─,─────────────┐            │
                             │         ▼               │            │
                             ├─USING────host-variable──┴────────────┤
                             ├─USING DESCRIPTOR──descriptor-name────┤
                             │                             (1)      │
                             └─┤ multiple-row-insert ├──────────────┘
```

Notes:

1 This option can be specified only when *statement-name* refers to a dynamic INSERT statement that was prepared with FOR MULTIPLE ROWS, specified as part of the ATTRIBUTES clause on the PREPARE statement.

multiple-row-insert:

```
              ┌─,─────────────────────┐                                      (1)
              ▼                       │
►►──┬─USING─────┬─host-variable-array─┬─┴──┬──┬─────────────────────────────────────┬──────►◄
    │           └─host-variable───────┘    │  └─FOR──┬─host-variable────┬──ROWS──┘
    └─USING DESCRIPTOR──descriptor-name────┘         └─integer-constant─┘
```

Notes:

1 The FOR n ROWS clause can only be specified for a dynamic statement that contains only a single multiple-row INSERT statement.

Description

statement-name
Identifies the prepared statement to be executed. *statement-name* must identify a statement that was previously prepared within the unit of work and the prepared statement must not be a SELECT statement.

USING
Introduces a list of host variables whose values are substituted for the parameter markers (question marks) in the prepared statement. (For an explanation of parameter markers, see "PREPARE" on page 995.) If the

prepared statement includes parameter markers, you must include USING in the EXECUTE statement. USING is ignored if there are no parameter markers.

For more on the substitution of values for parameter markers, see “Parameter marker replacement” on page 884.

host-variable,...
Identifies structures or variables that must be described in the application program in accordance with the rules for declaring host structures and variables. A reference to a structure is replaced by a reference to each of its variables. The number of variables must be the same as the number of parameter markers in the prepared statement. The *n*th variable supplies the value for the *n*th parameter marker in the prepared statement.

USING DESCRIPTOR *descriptor-name*
Identifies an SQLDA that contains a valid description of the input host variables.

Before the EXECUTE statement is processed, the user must set the following fields in the SQLDA:

- SQLN to indicate the number of SQLVAR occurrences provided in the SQLDA

  A REXX SQLDA does not contain this field.
- SQLABC to indicate the number of bytes of storage allocated for the SQLDA.
- SQLD to indicate the number of variables used in the SQLDA when processing the statement
- SQLVAR occurrences to indicate the attributes of the variables

The SQLDA must have enough storage to contain all SQLVAR occurrences. If an SQLVAR entry includes a LOB or a distinct type based on a LOB, there must be additional SQLVAR entries for each parameter. For more information on the SQLDA, which includes a description of the SQLVAR and an explanation on how to determine the number of SQLVAR occurrences, see Appendix E, “SQL descriptor area (SQLDA),” on page 1173.

SQLD must be set to a value greater than or equal to zero and less than or equal to SQLN. It must be the same as the number of parameter markers in the prepared statement. The *n*th variable described by the SQLDA corresponds to the *n*th parameter marker in the prepared statement.

See “Identifying an SQLDA in C or C++” on page 1189 for how to represent *descriptor-name* in C.

multiple-row-insert
The prepared statement must be an INSERT statement for which the FOR MULTIPLE ROWS clause was specified as part of the ATTRIBUTES clause on the PREPARE statement.

USING *host-variable-array* **or** *host-variable*
Identifies for each column involved in the INSERT statement a *host-variable-array* or *host-variable* that contains the data to be inserted. The number of columns implicitly or explicitly specified in the INSERT statement must be less than or equal to the total number of *host-variable-array*s or the number of host-variables specified.

host-variable-array
Identifies a host-variable array that must be defined in the application

program in accordance with the rules for declaring an array. The number of rows to be inserted must be less than or equal to the dimension of each *host-variable-array*.

An optional indicator array can be specified for a *host-variable-array*. It should be specified if the SQLTYPE of any SQLVAR occurrence indicates that the value for the column is null. The number or elements in the indicator array must be greater than or equal to the number of rows being inserted.

host-variable

Identifies a variable that must be described in the application program in accordance with the rules for declaring host variables.

USING DESCRIPTOR *descriptor-name*

Identifies an SQLDA that must contain a valid description of the host variable arrays or host variables containing the values to be inserted.

The SQLDA must have enough storage to contain a SQLVAR for each target column for which values are provided, plus an additional SQLVAR entry for the number of rows. DB2 generates code to fill in the required information for this extra SQLVAR. Each SQLVAR occurrence describes a host variable, host variable array, or buffer that contains the values for a column of the target table. The last SQLVAR occurrence contains the number of rows to be inserted. For example, if the INSERT statement is providing values for 5 columns of the target table, then 6 SQLVAR entries must be provided. If any value is a LOB, twice as many SQLVAR entries must be provided, and SQLN must be set to that number. Thus, if the INSERT statement is providing values for 5 columns of the target table, and some of the values to be inserted are LOBs, then 12 SQLVAR entries must be provided.

Before the dynamic multiple-row INSERT is processed, you must set the following fields in the SQLDA:

- SQLN to indicate the number of SQLVAR occurrences provided in the SQLDA.
- SQLABC to indicate the number of bytes of storage allocated for the SQLDA.
- SQLD to indicate the number of variables used in the SQLDA that provide values for columns that are the target of the INSERT, plus one.
- SQLVAR occurrences to indicate the attributes of an element of the host variable array for the SQLVAR entries that correspond to values provided for the target columns of the INSERT. Within each SQLVAR:
  - SQLTYPE indicates the data type of the elements of the host variable array.
  - SQLDATA field points to the corresponding host variable array.
  - The length fields (SQLLEN and SQLLONGLEN) are set to indicate the length of a single element of the array.
- SQLNAME - The SQLNAME field is described under “Field descriptions of an occurrence of a base SQLVAR” on page 1177 for usage in FETCH, OPEN, INSERT, and EXECUTE. Specifically, the fifth and sixth bytes must contain a flag field, and the seventh and eighth bytes must contain a binary small integer (halfword) containing the dimension of the host-variable array and, if specified, corresponding indicator array.

The SQLVAR entry for the number of rows must also contain a flag value. See “Field descriptions of an occurrence of a base SQLVAR” on page 1177 for more information.

You set the SQLDATA and SQLIND pointers to the beginning of the corresponding arrays. SQLD must be set to a value greater than or equal to zero and less than or equal to SQLN.

FOR *host-variable* or *integer-constant* **ROWS**

Specifies the number of rows to be inserted. The values inserted are specified in the USING clause.

host-variable or *integer-constant* is assigned to an integral value *k*. If *host-variable* is specified, it must be an exact numeric type with a scale of zero and must not include an indicator variable. Furthermore, *k* must be in the range 0<k<=32767.

FOR n ROWS cannot be specified on the EXECUTE statement if the statement being processed is a dynamic INSERT statement that included a FOR n ROWS clause. If host-variable arrays were provided, and the FOR n ROWS clause was not specified as part of the EXECUTE statement or the INSERT statement, an error is returned.

Notes

DB2 can stop the execution of a prepared SQL statement if the statement is taking too much processor time to finish. When this happens, an error occurs. The application that issued the statement is not terminated; it is allowed to issue another SQL statement.

Parameter marker replacement: Before the prepared statement is executed, each parameter marker in the statement is effectively replaced by its corresponding host variable. The replacement is an assignment operation in which the source is the value of the host variable and the target is a variable within DB2. The assignment rules are those described for assignment to a column in "Assignment and comparison" on page 74. For a typed parameter marker, the attributes of the target variable are those specified by the CAST specification. For an untyped parameter marker, the attributes of the target variable are determined according to the context of the parameter marker. For the rules that affect parameter markers, see "Parameter markers" on page 1003.

Let V denote a host variable that corresponds to parameter marker P. The value of V is assigned to the target variable for P in accordance with the rules for assigning a value to a column:

- V must be compatible with the target.
- If V is a string, its length must not be greater than the length attribute of the target.
- If V is a number, the absolute value of its integral part must not be greater than the maximum absolute value of the integral part of the target.
- If the attributes of V are not identical to the attributes of the target, the value is converted to conform to the attributes of the target.
- If the target cannot contain nulls, V must not be null.

When the prepared statement is executed, the value used in place of P is the value of the target variable for P. For example, if V is CHAR(6) and the target is CHAR(8), the value used in place of P is the value of V padded on the right with two blanks.

Errors occurring on EXECUTE: In local and remote processing, the DEFER(PREPARE) and REOPT(ALWAYS)/REOPT(ONCE) bind options can cause some errors that are normally issued during PREPARE processing to be issued on EXECUTE.

Examples

Example 1: In this example, an INSERT statement with parameter markers is prepared and executed. S1 is a structure that corresponds to the format of DSN8810.DEPT.

```
EXEC SQL PREPARE DEPT_INSERT FROM
  'INSERT INTO DSN8810.DEPT VALUES(?,?,?,?)';

(Check for successful execution and read values into S1)

EXEC SQL EXECUTE DEPT_INSERT USING :S1;
```

Example 2: Assume that the IWH.PROGPARM table has 9 columns. Prepare and execute a dynamic INSERT statement that inserts 5 rows of data into the IWH.PROGPARM table. The values to be inserted are provided in arrays, where all the values for a column are provided in an host-variable-array with the EXECUTE statement.

```
STMT = 'INSERT INTO IWH.PROGPARM  (IWHID, UPDATE_BY,UPDATE_TS,NAME,
                                   SHORT_DESCRIPTION, ORDERNO, PARMDATA,
                                   PARMDATALONG, VWPROGKEY)

VALUES ( ? , ? , ? , ? , ? , ? , ? , ? , ? )';

ATTRVAR = 'FOR MULTIPLE ROWS';

EXEC SQL PREPARE INS_STMT ATTRIBUTES :ATTRVAR FROM :STMT;

NROWS = 5;

EXEC SQL EXECUTE INS_STMT FOR :NROWS ROWS
           USING :V1, :V2, :V3, :V4, :V5, :V6, :V7, :V8, :V9;
```

In this example, each host variable in the USING clause represents an array of values for the corresponding column of the target of the INSERT statement.

EXECUTE IMMEDIATE

The EXECUTE IMMEDIATE statement:

- Prepares an executable form of an SQL statement from a string form of the statement
- Executes the SQL statement
- Destroys the executable form

EXECUTE IMMEDIATE combines the basic functions of the PREPARE and EXECUTE statements. It can be used to prepare and execute an SQL statement that contains neither host variables nor parameter markers.

Invocation

This statement can only be embedded in an application program. It is an executable statement that cannot be dynamically prepared. It must not be specified in Java.

Authorization

The authorization rules are those defined for the dynamic preparation of the SQL statement specified by EXECUTE IMMEDIATE. For example, see “INSERT” on page 972 for the authorization rules that apply when an INSERT statement is executed using EXECUTE IMMEDIATE.

Syntax

```
►►──EXECUTE IMMEDIATE──┬─host-variable─────┬──────────────────────────────────────►◄
                       └─string-expression─┘
```

Description

host-variable
For languages other than PL/I, *host-variable* must be specified. It must identify a host variable that is described in the application program in accordance with the rules for declaring character or graphic string variables. If the source string is over 32KB in length, the *host-variable* must be a CLOB or DBCLOB variable. The maximum source length is 2MB although the host variable can be declared larger than 2MB. An indicator variable must not be specified. In Assembler language, C, and COBOL, the host variable must be a varying-length string variable. In C, it must not be a NUL-terminated string.

In PL/I, if the source program includes at least one DECLARE VARIABLE statement, the host variable (preceded by a colon) is considered a *host-variable* and must be a varying-length string variable. The host variable may be either a fixed-length or varying-length string variable if the source program does not include any DECLARE VARIABLE statements. It is then considered a *string-expression*. When a *string-expression* is used, the precompiler-generated structures for it use an EBCDIC CCSID and an informational message is issued.

string-expression
string-expression is any PL/I expression that yields a string. If the source program does not include any DECLARE VARIABLE statements, an optional colon can precede the *string-expression*. The colon introduces PL/I syntax.

Therefore, host variables within a *string-expression* that includes operators or functions should not be preceded with a colon. However, if the source program includes at least one DECLARE VARIABLE statement, a *string-expression* cannot be preceded by a colon and an expression that consists of just a variable name preceded by a colon is interpreted as a *host-variable,* not as a *string-expression*. The precompiler-generated structures for a *string-expression* use an EBCDIC CCSID.

Notes

Allowable SQL statements: The value of the identified host variable or the specified *string-expression* is called the *statement string*.

The statement string must be one of the following SQL statements:

ALTER
COMMENT
COMMIT
CREATE
DELETE
DROP
EXPLAIN
GRANT
INSERT
LABEL
LOCK TABLE
REFRESH
RENAME
REVOKE
ROLLBACK
SET CURRENT DEGREE
SET CURRENT LOCALE LC_CTYPE
SET CURRENT OPTIMIZATION HINT
SET CURRENT MATERIALIZED QUERY TABLE
SET CURRENT PRECISION
SET CURRENT REFRESH AGE
SET CURRENT RULES
SET CURRENT SQLID
SET PATH
UPDATE

The statement string must not include parameter markers or references to host variables, must not begin with EXEC SQL, and must not terminate with END-EXEC or a semicolon.

Errors and error handling: When an EXECUTE IMMEDIATE statement is executed, the specified statement string is parsed and checked for errors. If the SQL statement is invalid, it is not executed and the error condition that prevents its execution is reported in the SQLCA. If the SQL statement is valid, but an error occurs during its execution, that error condition is reported in the SQLCA.

DB2 can stop the execution of a prepared SQL statement if the statement is taking too much CPU time to finish. When this happens an error occurs. The application that issued the statement is not terminated; it is allowed to issue another SQL statement.

Performance considerations: If the same SQL statement is to be executed more than once, it is more efficient to use the PREPARE and EXECUTE statements rather than the EXECUTE IMMEDIATE statement.

Examples

Example 1: In this PL/I example, the EXECUTE IMMEDIATE statement is used to execute a DELETE statement in which the rows to be deleted are determined by a search-condition specified by the value of PREDS.

```
EXEC SQL EXECUTE IMMEDIATE 'DELETE FROM DSN8810.DEPT
  WHERE' || PREDS;
```

Example 2: Use C to execute the SQL statement in the host variable Qstring.

```
EXEC SQL INCLUDE SQLCA;
void main ()
  {
   EXEC SQL BEGINDECLARE SECTION;

   char Qstring[100M =
     "INSERT INTO WORK_TABLE SELECT * FROM EMPPROJACT WHERE ACTNO >= 100";
   EXEC SQL END DECLARE SECTION;
  .
  .
  .
   EXEC SQL EXECUTE IMMEDIATE :Qstring;

   return;
  }
```

EXPLAIN

The information about this statement is Product-sensitive Programming Interface and Associated Guidance Information, as defined in “Notices” on page 1369.

The EXPLAIN statement obtains information about access path selection for an *explainable statement*. A statement is explainable if it is a SELECT or INSERT statement, or the searched form of an UPDATE or DELETE statement. The information obtained is placed in a user-supplied *plan table*.

Optionally, EXPLAIN can also obtain and place information in two additional tables. A user-supplied *statement table* can be populated with information about the estimated cost of executing the explainable statement. A user-supplied *function table* can be populated with information about how DB2 resolves the user-defined functions that are referred to in the explainable statement.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

The authorization rules are those defined for the SQL statement specified in the EXPLAIN statement. For example, see the description of the DELETE statement for the authorization rules that apply when a DELETE statement is explained.

If the EXPLAIN statement is embedded in an application program, the authorization rules that apply are those defined for embedding the specified SQL statement in an application program. In addition, the authorization ID of the owner of the plan or package must also have one of the following characteristics:

- Be the owner of a plan table named PLAN_TABLE
- Have an alias on a plan table named *owner*.PLAN_TABLE and have SELECT and INSERT privileges on the table

If the EXPLAIN statement is dynamically prepared, the authorization rules that apply are those defined for dynamically preparing the specified SQL statement. In addition, the SQL authorization ID of the process must also have one of the following characteristics:

- Be the owner of a plan table named PLAN_TABLE
- Have an alias on a plan table named *owner*.PLAN_TABLE and have SELECT and INSERT privileges on the table

The authorization rules are different if the STMTCACHE keyword is specified to have a cached statement explained. The application process must have SYSADM authority or the authority that is required to share the cached statement. For more information about the authority to use the dynamic statement cache, see Part 6 of *DB2 Application Programming and SQL Guide*.

Syntax

```
►►──EXPLAIN──┬──┬─PLAN─┬──┬─────────────────────┬─FOR──explainable-sql-statement─┬──────────►◄
             │  └─ALL──┘  └─SET QUERYNO=integer─┘                                 │
             └─STMTCACHE──┬─STMTID──────┬─id-host-variable───┬────────────────────┘
                          │             └─integer-constant───┘ │
                          └─STMTTOKEN───┬─token-host-variable─┬┘
                                        └─string-constant─────┘
```

Description

PLAN
Inserts one row into the plan table for each step used in executing *explainable-sql-statement*. The steps for enforcing referential constraints are not included. See "Creating a plan table" on page 892 and Table 75 on page 893 for the format and column descriptions of the plan table.

If a statement table exists, a row that provides a cost estimate of processing the explainable statement is inserted into the statement table. See "Creating a statement table" on page 898 and Table 76 on page 899 for the format and column descriptions of the statement table.

If a function table exists, one row is inserted into the function table for each user-defined function that is referred to by the explainable statement. See "Creating a function table" on page 900 and Table 77 on page 901 for the format and column descriptions of the function table.

ALL
Has the same effect as PLAN.

SET QUERYNO = *integer*
Associates *integer* with *explainable-sql-statement*. The column QUERYNO is given the value *integer* in every row inserted into the plan table, statement table, or function table by the EXPLAIN statement. If QUERYNO is not specified, DB2 itself assigns a number. For an embedded EXPLAIN statement, the number is the statement number that was assigned by the precompiler and placed in the DBRM.

FOR *explainable-sql-statement*
Specifies the SQL statement to be explained. *explainable-sql-statement* can be any explainable SQL statement. If EXPLAIN is embedded in a program, the statement can contain references to host variables. If EXPLAIN is dynamically prepared, the statement can contain parameter markers. Host variables that appear in the statement must be defined in the statement's program.

The statement must refer to objects at the current server.

explainable-sql-statement must not contain a QUERYNO clause. To specify the value of the QUERYNO column in plan table for the statement being explained, use the SET QUERYNO = clause of the EXPLAIN statement.

explainable-sql-statement cannot be a statement-name or a host-variable. To use EXPLAIN to get information about dynamic SQL statements, you must prepare the entire EXPLAIN statement dynamically.

To obtain information about an explainable SQL statement that references a declared temporary table, the EXPLAIN statement must be executed in the same application process in which the table was declared. For static EXPLAIN statements, the information is not obtained at bind-time but at run-time when the EXPLAIN statement is incrementally bound.

STMTCACHE STMTID *id-host-variable* or *integer-constant*

Specifies that the cached statement with the specified statement ID is to be explained. The value contained *id-host-variable* or specified by *integer-constant* identifies the statement ID. The statement ID is an integer that uniquely identifies a statement that has been cached in the dynamic statement cache. The statement ID of a cached statement can be retrieved through IFI monitor facilities from IFCID 316 or 124. Some diagnostic trace records, such as 173, 196, and 337, also show the statement ID.

For every row that the EXPLAIN statement inserts into the plan table, statement table, or function table, the QUERYNO column contains the value of the statement ID.

STMTCACHE STMTOKEN *id-host-variable* or *integer-constant*

Specifies that the cached statements with the specified statement token are to be explained. The value contained in *token-host-variable* or specified by *string-constant* identifies the statement token. The statement token must be a character string that is no longer than 240 bytes. The application program that originally prepares and inserts a statement into the cache associates a statement token with the cached statement. The program can make this association with the RRSAF SET_ID function, or the sqleseti API if the program is connected remotely.

For every row that the EXPLAIN statement inserts into the plan table, statement table, or function table, the STMTTOKEN column contains the value of the statement token, and the QUERYNO column contains the value of the statement ID for the cached statement with the statement token.

Notes

Output from EXPLAIN: Output from EXPLAIN is one or more rows of data inserted into the plan table. Rows are also inserted into the statement table and function table if the tables exist. The plan table must be created before the EXPLAIN statement is executed. Unless you need the information that the statement table or function table provides, it is not necessary to create either table to use EXPLAIN. The tables have the following names:

plan table	*userid*.PLAN_TABLE
statement table	*userid*.DSN_STATEMNT_TABLE
function table	*userid*.DSN_FUNCTION_TABLE

where *userid* is:

- The owner of the plan or package if the EXPLAIN statement is embedded in a plan or package.
- The SQL authorization ID of the process if the statement is dynamically prepared.

For information on using the plan table and the statement table, see Part 5 (Volume 2) of *DB2 Administration Guide*. For information on using the function table, see Part 3 of *DB2 Application Programming and SQL Guide*.

Output from BIND or REBIND: DB2 can also add rows to a plan table, statement table, and function table when a plan or package is bound or rebound. This addition of rows occurs when the BIND or REBIND subcommand is executed with the EXPLAIN(YES) option in effect. The option requires that rows be added for every explainable statement in the plan or package being bound. For a plan, these do not include statements in the packages that can be used with the plan. For either a package or plan, they do not include explainable statements within EXPLAIN statements nor do they include explainable statements that refer to declared temporary tables, which are incrementally bound at run time.

The plan table must exist when the BIND or REBIND subcommand is executed. Unless you need the information that the statement table or function table provides, neither table has to exist. Only the tables that exist receive new rows. The tables have the following names:

plan table	*userid*.PLAN_TABLE
statement table	*userid*.DSN_STATEMNT_TABLE
function table	*userid*.DSN_FUNCTION_TABLE

where *userid* is the owner of the plan or package.

Creating a plan table: To create a plan table, execute the following SQL statement:

```
CREATE TABLE userid.PLAN_TABLE
       (QUERYNO            INTEGER        NOT NULL,
        QBLOCKNO           SMALLINT       NOT NULL,
        APPLNAME           CHAR(8)        NOT NULL,
        PROGNAME           VARCHAR(128)   NOT NULL,
        PLANNO             SMALLINT       NOT NULL,
        METHOD             SMALLINT       NOT NULL,
        CREATOR            VARCHAR(128)   NOT NULL,
        TNAME              VARCHAR(128)   NOT NULL,
        TABNO              SMALLINT       NOT NULL,
        ACCESSTYPE         CHAR(2)        NOT NULL,
        MATCHCOLS          SMALLINT       NOT NULL,
        ACCESSCREATOR      VARCHAR(128)   NOT NULL,
        ACCESSNAME         VARCHAR(128)   NOT NULL,
        INDEXONLY          CHAR(1)        NOT NULL,
        SORTN_UNIQ         CHAR(1)        NOT NULL,
        SORTN_JOIN         CHAR(1)        NOT NULL,
        SORTN_ORDERBY      CHAR(1)        NOT NULL,
        SORTN_GROUPBY      CHAR(1)        NOT NULL,
        SORTC_UNIQ         CHAR(1)        NOT NULL,
        SORTC_JOIN         CHAR(1)        NOT NULL,
        SORTC_ORDERBY      CHAR(1)        NOT NULL,
        SORTC_GROUPBY      CHAR(1)        NOT NULL,
        TSLOCKMODE         CHAR(3)        NOT NULL,
        TIMESTAMP          CHAR(16)       NOT NULL,
        REMARKS            VARCHAR(762)   NOT NULL,
        PREFETCH           CHAR(1)        ,
        COLUMN_FN_EVAL     CHAR(1)        ,
        MIXOPSEQ           SMALLINT       ,
        VERSION            VARCHAR(64)    ,
        COLLID             VARCHAR(128)   ,
        ACCESS_DEGREE      SMALLINT       ,
        ACCESS_PGROUP_ID   SMALLINT       ,
        JOIN_DEGREE        SMALLINT       ,
        JOIN_PGROUP_ID     SMALLINT       ,
        SORTC_PGROUP_ID    SMALLINT       ,
        SORTN_PGROUP_ID    SMALLINT       ,
        PARALLELISM_MODE   CHAR(1)        ,
        MERGE_JOIN_COLS    SMALLINT       ,
        CORRELATION_NAME   VARCHAR(128)   ,
        PAGE_RANGE         CHAR(1)        NOT NULL WITH DEFAULT,
        JOIN_TYPE          CHAR(1)        NOT NULL WITH DEFAULT,
        GROUP_MEMBER       CHAR(8)        NOT NULL WITH DEFAULT,
        IBM_SERVICE_DATA   VARCHAR(254)   FOR BIT DATA NOT NULL WITH DEFAULT,
        WHEN_OPTIMIZE      CHAR(1)        NOT NULL WITH DEFAULT,
        QBLOCK_TYPE        CHAR(6)        NOT NULL WITH DEFAULT,
        BIND_TIME          TIMESTAMP      NOT NULL WITH DEFAULT,
        OPTHINT            VARCHAR(128)   NOT NULL WITH DEFAULT,
     HINT_USED           VARCHAR(128)   NOT NULL WITH DEFAULT,
     PRIMARY_ACCESSTYPE  CHAR(1)        NOT NULL WITH DEFAULT,
     PARENT_QBLOCKNO     SMALLINT       NOT NULL WITH DEFAULT,
     TABLE_TYPE          CHAR(1)        ,
     TABLE_ENCODE        CHAR(1)        NOT NULL WITH DEFAULT,
     TABLE_SCCSID        SMALLINT       NOT NULL WITH DEFAULT,
     TABLE_MCCSID        SMALLINT       NOT NULL WITH DEFAULT,
     TABLE_DCCSID        SMALLINT       NOT NULL WITH DEFAULT,
     ROUTINE_ID          INTEGER        NOT NULL WITH DEFAULT,
     CTEREF              SMALLINT       NOT NULL WITH DEFAULT,
     STMTTOKEN           VARCHAR(240))
IN database-name.table-space-name
CCSID EBCDOC;
```

where *database-name.table-space-name* identifies a database and table space you have authorization to use.

Plan table column descriptions: Table 75 explains the columns in PLAN_TABLE. The explanations apply both to rows resulting from the execution of an EXPLAIN statement and to rows resulting from a bind or rebind.

Each row in a plan table describes a step in the execution of a query or subquery in an explainable statement. The column values for the row identify, among other things, the query or subquery, the tables involved, and the method used to carry out the step.

Table 75. Descriptions of columns in PLAN_TABLE

Column Name	Description
QUERYNO	A number intended to identify the statement being explained. For a row produced by an EXPLAIN statement, specify the number in the QUERYNO clause. For a row produced by non-EXPLAIN statements, specify the number using the QUERYNO clause, which is an optional part of the SELECT, INSERT, UPDATE and DELETE statement syntax. Otherwise, DB2 assigns a number based on the line number of the SQL statement in the source program. When the values of QUERYNO are based on the statement number in the source program, values greater than 32767 are reported as 0. However, in a very long program, the value is not guaranteed to be unique. If QUERYNO is not unique, the value of TIMESTAMP is unique.
QBLOCKNO	A number that identifies each query block within a query. The value of the numbers are not in any particular order, nor are they necessarily consecutive.
APPLNAME	The name of the application plan for the row. Applies only to embedded EXPLAIN statements executed from a plan or to statements explained when binding a plan. Blank if not applicable.
PROGNAME	The name of the program or package containing the statement being explained. Applies only to embedded EXPLAIN statements and to statements explained as the result of binding a plan or package. Blank if not applicable.
PLANNO	The number of the step in which the query indicated in QBLOCKNO was processed. This column indicates the order in which the steps were executed.

Table 75. Descriptions of columns in PLAN_TABLE (continued)

Column Name	Description
METHOD	A number (0, 1, 2, 3, or 4) that indicates the join method used for the step: **0** First table accessed, continuation of previous table accessed, or not used. **1** *Nested loop* join. For each row of the present composite table, matching rows of a new table are found and joined. **2** *Merge scan* join. The present composite table and the new table are scanned in the order of the join columns, and matching rows are joined. **3** Sorts needed by ORDER BY, GROUP BY, SELECT DISTINCT, UNION, a quantified predicate, or an IN predicate. This step does not access a new table. **4** *Hybrid* join. The current composite table is scanned in the order of the join-column rows of the new table. The new table is accessed using list prefetch.
CREATOR	The creator of the new table accessed in this step, blank if METHOD is 3.
TNAME	The name of a table, materialized query table, created or declared temporary table, materialized view, or materialized table expression. The value is blank if METHOD is 3. The column can also contain the name of a table in the form DSNWFQB(*qblockno*). DSNWFQB(*qblockno*) is used to represent the intermediate result of a UNION ALL or an outer join that is materialized. If a view is merged, the name of the view does not appear.
TABNO	Values are for IBM use only.
ACCESSTYPE	The method of accessing the new table: **I** By an index (identified in ACCESSCREATOR and ACCESSNAME) **I1** By a one-fetch index scan **M** By a multiple index scan (followed by MX, MI, or MU) **MI** By an intersection of multiple indexes **MU** By a union of multiple indexes **MX** By an index scan on the index named in ACCESSNAME **N** By an index scan when the matching predicate contains the IN keyword **R** By a table space scan **RW** By a work file scan of the result of a materialized user-defined table function **T** By a sparse index (star join work files) **V** By buffers for an INSERT statement within a SELECT **blank** Not applicable to the current row
MATCHCOLS	For ACCESSTYPE I, I1, N, or MX, the number of index keys used in an index scan; otherwise, 0.
ACCESSCREATOR	For ACCESSTYPE I, I1, N, or MX, the creator of the index; otherwise, blank.
ACCESSNAME	For ACCESSTYPE I, I1, N, or MX, the name of the index; otherwise, blank.
INDEXONLY	Whether access to an index alone is enough to carry out the step, or whether data too must be accessed. Y=Yes; N=No. For exceptions, see Part 5 (Volume 2) of *DB2 Administration Guide*.
SORTN_UNIQ	Whether the new table is sorted to remove duplicate rows. Y=Yes; N=No.
SORTN_JOIN	Whether the new table is sorted for join method 2 or 4. Y=Yes; N=No.
SORTN_ORDERBY	Whether the new table is sorted for ORDER BY. Y=Yes; N=No.
SORTN_GROUPBY	Whether the new table is sorted for GROUP BY. Y=Yes; N=No.
SORTC_UNIQ	Whether the composite table is sorted to remove duplicate rows. Y=Yes; N=No.
SORTC_JOIN	Whether the composite table is sorted for join method 1, 2 or 4. Y=Yes; N=No.
SORTC_ORDERBY	Whether the composite table is sorted for an ORDER BY clause or a quantified predicate. Y=Yes; N=No.

Table 75. Descriptions of columns in PLAN_TABLE (continued)

Column Name	Description
SORTC_GROUPBY	Whether the composite table is sorted for a GROUP BY clause. Y=Yes; N=No.
TSLOCKMODE	An indication of the mode of lock to be acquired on either the new table, or its table space or table space partitions. If the isolation can be determined at bind time, the values are: **IS** Intent share lock **IX** Intent exclusive lock **S** Share lock **U** Update lock **X** Exclusive lock **SIX** Share with intent exclusive lock **N** UR isolation; no lock If the isolation cannot be determined at bind time, then the lock mode determined by the isolation at run time is shown by the following values. **NS** For UR isolation, no lock; for CS, RS, or RR, an S lock. **NIS** For UR isolation, no lock; for CS, RS, or RR, an IS lock. **NSS** For UR isolation, no lock; for CS or RS, an IS lock; for RR, an S lock. **SS** For UR, CS, or RS isolation, an IS lock; for RR, an S lock. The data in this column is right justified. For example, IX appears as a blank followed by I followed by X. If the column contains a blank, then no lock is acquired.
TIMESTAMP	Usually, the time at which the row is processed, to the last .01 second. If necessary, DB2 adds .01 second to the value to ensure that rows for two successive queries have different values.
REMARKS	A field into which you can insert any character string of 762 or fewer characters.
PREFETCH	Whether data pages are to be read in advance by prefetch. S = pure sequential prefetch; L = prefetch through a page list; D = optimizer expects dynamic prefetch; blank = unknown or no prefetch.
COLUMN_FN_EVAL	When an SQL aggregate function is evaluated. R = while the data is being read from the table or index; S = while performing a sort to satisfy a GROUP BY clause; blank = after data retrieval and after any sorts.
MIXOPSEQ	The sequence number of a step in a multiple index operation. **1, 2, ... n** For the steps of the multiple index procedure (ACCESSTYPE is MX, MI, or MU.) **0** For any other rows (ACCESSTYPE is I, I1, M, N, R, or blank.)
VERSION	The version identifier for the package. Applies only to an embedded EXPLAIN statement executed from a package or to a statement that is explained when binding a package. Blank if not applicable.
COLLID	The collection ID for the package. Applies only to an embedded EXPLAIN statement that is executed from a package or to a statement that is explained when binding a package. Blank if not applicable. The value DSNDYNAMICSQLCACHE indicates that the row is for a cached statement.
Note: The following nine columns, from ACCESS_DEGREE through CORRELATION_NAME, contain the null value if the plan or package was bound using a plan table with fewer than 43 columns. Otherwise, each of them can contain null if the method it refers to does not apply.	
ACCESS_DEGREE	The number of parallel tasks or operations activated by a query. This value is determined at bind time; the actual number of parallel operations used at execution time could be different. This column contains 0 if there is a host variable.
ACCESS_PGROUP_ID	The identifier of the parallel group for accessing the new table. A parallel group is a set of consecutive operations, executed in parallel, that have the same number of parallel tasks. This value is determined at bind time; it could change at execution time.

Table 75. Descriptions of columns in PLAN_TABLE (continued)

Column Name	Description
JOIN_DEGREE	The number of parallel operations or tasks used in joining the composite table with the new table. This value is determined at bind time and can be 0 if there is a host variable. The actual number of parallel operations or tasks used at execution time could be different.
JOIN_PGROUP_ID	The identifier of the parallel group for joining the composite table with the new table. This value is determined at bind time; it could change at execution time.
SORTC_PGROUP_ID	The parallel group identifier for the parallel sort of the composite table.
SORTN_PGROUP_ID	The parallel group identifier for the parallel sort of the new table.
PARALLELISM_MODE	The kind of parallelism, if any, that is used at bind time: **I** Query I/O parallelism **C** Query CP parallelism **X** Sysplex query parallelism
MERGE_JOIN_COLS	The number of columns that are joined during a merge scan join (Method=2).
CORRELATION_NAME	The correlation name of a table or view that is specified in the statement. If there is no correlation name, then the column is blank.
PAGE_RANGE	Whether the table qualifies for page range screening, so that plans scan only the partitions that are needed. Y = Yes; blank = No.
JOIN_TYPE	The type of join: **F** FULL OUTER JOIN **L** LEFT OUTER JOIN **S** STAR JOIN **blank** INNER JOIN or no join RIGHT OUTER JOIN converts to a LEFT OUTER JOIN when you use it, so that JOIN_TYPE contains L.
GROUP_MEMBER	The member name of the DB2 that executed EXPLAIN. The column is blank if the DB2 subsystem was not in a data sharing environment when EXPLAIN was executed.
IBM_SERVICE_DATA	Values are for IBM use only.
WHEN_OPTIMIZE	When the access path was determined: **blank** At bind time, using a default filter factor for any host variables, parameter markers, or special registers. **B** At bind time, using a default filter factor for any host variables, parameter markers, or special registers; however, the statement is reoptimized at run time using input variable values for input host variables, parameter markers, or special registers. The bind option REOPT(ALWAYS) or REOPT(ONCE) must be specified for reoptimization to occur. **R** At run time, using input variables for any host variables, parameter markers, or special registers. The bind option REOPT(ALWAYS) or REOPT(ONCE) must be specified for this to occur.

Table 75. Descriptions of columns in PLAN_TABLE (continued)

Column Name	Description
QBLOCK_TYPE	For each query block, an indication of the type of SQL operation performed. For the outermost query, this column identifies the statement type. Possible values: **SELECT** SELECT **INSERT** INSERT **UPDATE** UPDATE **DELETE** DELETE **SELUPD** SELECT with FOR UPDATE OF **DELCUR** DELETE WHERE CURRENT OF CURSOR **UPDCUR** UPDATE WHERE CURRENT OF CURSOR **CORSUB** Correlated subselect or fullselect **NCOSUB** Noncorrelated subselect or fullselect **TABLEX** Table expression **TRIGGR** WHEN clause on CREATE TRIGGER **UNION** UNION **UNIONA** UNION ALL **TRIGGR** Trigger WHEN clause
BIND_TIME	The time at which the plan or package for this statement or query block was bound. For static SQL statements, this is a full-precision timestamp value. For dynamic SQL statements, this is the value contained in the TIMESTAMP column of PLAN_TABLE appended by 4 zeroes.
OPTHINT	A string that you use to identify this row as an optimization hint for DB2. DB2 uses this row as input when choosing an access path.
HINT_USED	If DB2 used one of your optimization hints, it puts the identifier for that hint (the value in OPTHINT) in this column.
PRIMARY_ACCESSTYPE	Indicates whether direct row access will be attempted first: **D** DB2 will try to use direct row access. If DB2 cannot use direct row access at run time, it uses the access path described in the ACCESSTYPE column of PLAN_TABLE. **blank** DB2 will not try to use direct row access.
PARENT_QBLOCKNO	A number that indicates the QBLOCKNO of the parent query block.
TABLE_TYPE	The type of new table: **B** Buffers for an INSERT statement within a SELECT **C** Common table expression **F** Table function **M** Materialized query table **Q** Temporary intermediate result table (not materialized). For the name of a view or nested table expression, a value of Q indicates that the materializaition was virtual and not actual. Materialization can be virtual when the view or nested table expression definition contains a UNION ALL that is not distributed. **RB** Recursive common table expression **T** Table **W** Work file The value of the column is null if the query uses GROUP BY, ORDER BY, or DISTINCT, which requires an implicit sort.
TABLE_ENCODE	The encoding scheme of the table. If the table has a single CCSID set, possible values are: **A** ASCII **E** EBCDIC **U** Unicode M is the value of the column when the table contains muliple CCSID set, the value of the column is M.

Table 75. Descriptions of columns in PLAN_TABLE (continued)

Column Name	Description
TABLE_SCCSID	The SBCS CCSID value of the table. If column TABLE_ENCODE is M, the value is 0.
TABLE_MCCSID	The mixed CCSID value of the table. If column TABLE_ENCODE is M, the value is 0
TABLE_DCCSID	The DBCS CCSID value of the table. If column TABLE_ENCODE is M, the value is 0.
ROUTINE_ID	Values are for IBM use only.
CTEREF	If the referenced table is a common table expression, the value is the top-level query block number.
STMTTOKEN	User-specified statement token.

Plan table creation options: A plan table can have a format with fewer columns than those shown in the foregoing CREATE statement. A plan table must include one of the following sets of columns:

- All the columns up to and including REMARKS (COLCOUNT = 25)
- All the columns up to and including MIXOPSEQ (COLCOUNT = 28)
- All the columns up to and including COLLID (COLCOUNT = 30)
- All the columns up to and including JOIN_PGROUP_ID (COLCOUNT = 34)
- All the columns up to and including IBM_SERVICE_DATA (COLCOUNT = 43)
- All the columns up to and including BIND_TIME (COLCOUNT = 46)
- All the columns up to and including PRIMARY_ACCESSTYPE (COLCOUNT = 49)
- All the columns up to and including TABLE_TYPE (COLCOUNT = 51)
- All the columns shown in the CREATE statement (COLCOUNT = 58)

Whichever set of columns you choose, the columns must appear in the order in which the CREATE statement indicates. You can add columns to an existing plan table with the ALTER TABLE statement only if the modified table satisfies one of the allowed sets of columns. For example, you cannot add column PREFETCH by itself, but must add columns PREFETCH, COLUMN_FN_EVAL, and MIXOPSEQ. If you add any NOT NULL columns, give them the NOT NULL WITH DEFAULT attribute.

When using the 58-column format for the plan table, remember that many columns (PROGNAME, COLLID, CREATOR, TNAME, ACCESSCREATOR, ACCESSNAME, CORRELATION_NAME) must be defined as VARCHAR(128). In previous releases of DB2, these columns were smaller.

Missing columns are ignored when rows are added to a plan table.

Plan table migration: You can migrate existing plan tables to subsequent releases or fall back to prior releases. If you fall back to a prior release, the extra columns are simply ignored when EXPLAIN is executed. If you migrate to a subsequent release, the missing columns are likewise ignored.

Creating a statement table: To create a statement table, execute the following SQL statement:

```
CREATE TABLE userid.DSN_STATEMNT_TABLE
       (QUERYNO            INTEGER        NOT NULL WITH DEFAULT,
        APPLNAME           CHAR(8)        NOT NULL WITH DEFAULT,
        PROGNAME           VARCHAR(128)   NOT NULL WITH DEFAULT,
        COLLID             VARCHAR(128)   NOT NULL WITH DEFAULT,
        GROUP_MEMBER       CHAR(8)        NOT NULL WITH DEFAULT,
        EXPLAIN_TIME       TIMESTAMP      NOT NULL WITH DEFAULT,
        STMT_TYPE          CHAR(6)        NOT NULL WITH DEFAULT,
        COST_CATEGORY       CHAR(1)        NOT NULL WITH DEFAULT,
        PROCMS              INTEGER        NOT NULL WITH DEFAULT,
        PROCSU              INTEGER        NOT NULL WITH DEFAULT,
        REASON              VARCHAR(254)   NOT NULL WITH DEFAULT.
        STMT_ENCODE         CHAR(1)        NOT NULL WITH DEFAULT)
   IN database-name.table-space-name
   CCSID EBCDIC;
```

where *database-name.table-space-name* identifies a database and table space you have authorization to use.

Statement table column descriptions: Table 76 explains the columns in DSN_STATEMNT_TABLE. The explanations apply both to rows resulting from the execution of an EXPLAIN statement and to rows resulting from a bind or rebind.

Each row in the table provides a cost estimate, in service units and milliseconds, of processing an explainable statement.

Notice that the first five columns of the table are the same as the first five columns of PLAN_TABLE and DSN_FUNCTION_TABLE.

Table 76. Descriptions of columns in DSN_STATEMNT_TABLE

Column name	Description
QUERYNO	A number intended to identify the statement being explained. See the description of the QUERYNO column in Table 75 on page 893 for more information. If QUERYNO is not unique, the value of EXPLAIN_TIME is unique.
APPLNAME	The name of the application plan for the row, or blank. See the description of the APPLNAME column in Table 75 on page 893 for more information.
PROGNAME	The name of the program or package containing the statement being explained, or blank. See the description of the PROGNAME column in Table 75 on page 893 for more information.
COLLID	The collection ID for the package, blank, or DSNDYNAMICSQLCACHE. When the row in the table is for a cached statement, the value of the column is DSNDYNAMICSQLCACHE. See the description of the COLLID column in Table 75 on page 893 for more information.
GROUP_MEMBER	The member name of the DB2 that executed EXPLAIN, or blank. See the description of the GROUP_MEMBER column in Table 75 on page 893 for more information.
EXPLAIN_TIME	The time at which the statement is processed. This time is the same as the BIND_TIME column in PLAN_TABLE.
STMT_TYPE	The type of statement being explained. Possible values are: SELECT SELECT INSERT INSERT UPDATE UPDATE DELETE DELETE SELUPD SELECT with FOR UPDATE DELCUR DELETE WHERE CURRENT OF CURSOR UPDCUR UPDATE WHERE CURRENT OF CURSOR

Table 76. Descriptions of columns in DSN_STATEMNT_TABLE (continued)

Column name	Description
COST_CATEGORY	Indicates if DB2 was forced to use default values when making its estimates. Possible values: A Indicates that DB2 had enough information to make a cost estimate without using default values. B Indicates that some condition exists for which DB2 was forced to use default values. See the values in REASON to determine why DB2 was unable to put this estimate in cost category A.
PROCMS	The estimated processor cost, in milliseconds, for the SQL statement. The estimate is rounded up to the next integer value. The maximum value for this cost is 2147483647 milliseconds, which is equivalent to approximately 24.8 days. If the estimated value exceeds this maximum, the maximum value is reported.
PROCSU	The estimated processor cost, in service units, for the SQL statement. The estimate is rounded up to the next integer value. The maximum value for this cost is 2147483647 service units. If the estimated value exceeds this maximum, the maximum value is reported.
REASON	A string that indicates the reasons for putting an estimate into cost category B. HOST VARIABLES The statement uses host variables, parameter markers, or special registers. TABLE CARDINALITY The cardinality statistics are missing for one or more of the tables used in the statement. UDF The statement uses user-defined functions. TRIGGERS Triggers are defined on the target table of an INSERT, UPDATE, or DELETE statement. REFERENTIAL CONSTRAINTS Referential constraints of the type CASCADE or SET NULL exist on the target table of a DELETE statement.
STMT_ENCODE	Encoding scheme of the statement. If the statement represents a single CCSID set, the possible values are: **A** ASCII **E** EBCDIC **U** Unicode If the statement has multiple CCSID sets, the value is M.

Creating a function table: To create a function table, execute the following SQL statement:

```
CREATE TABLE DSN_FUNCTION_TABLE
       (QUERYNO            INTEGER        NOT NULL WITH DEFAULT,
        QBLOCKNO           INTEGER        NOT NULL WITH DEFAULT,
        APPLNAME           CHAR(8)        NOT NULL WITH DEFAULT,
        PROGNAME           VARCHAR(128)   NOT NULL WITH DEFAULT,
        COLLID             VARCHAR(128)   NOT NULL WITH DEFAULT,
        GROUP_MEMBER       CHAR(8)        NOT NULL WITH DEFAULT,
        EXPLAIN_TIME       TIMESTAMP      NOT NULL WITH DEFAULT,
        SCHEMA_NAME        VARCHAR(128)   NOT NULL WITH DEFAULT,
        FUNCTION_NAME      VARCHAR(128)   NOT NULL WITH DEFAULT,
        SPEC_FUNC_NAME      VARCHAR(128)   NOT NULL WITH DEFAULT,
        FUNCTION_TYPE       CHAR(2)        NOT NULL WITH DEFAULT,
        VIEW_CREATOR        VARCHAR(128)   NOT NULL WITH DEFAULT,
        VIEW_NAME           VARCHAR(128)   NOT NULL WITH DEFAULT,
        PATH                VARCHAR(2048)  NOT NULL WITH DEFAULT,
        FUNCTION_TEXT       VARCHAR(1500)  NOT NULL WITH DEFAULT)
   IN database-name.table-space-name
   CCSID EBCDIC;
```

where *database-name.table-space-name* identifies a database and table space you have authorization to use. The table space in which you create DSN_FUNCTION_TABLE must have an 8K page size or greater.

Function table column descriptions: Table 77 explains the columns in DSN_FUNCTION_TABLE. The explanations apply both to rows resulting from the execution of an EXPLAIN statement and to rows resulting from a bind or rebind.

For each user-defined function that is referred to by the explainable statement, each row in the function table describes how DB2 resolved the function reference.

Notice that the first five columns of the table are the same as the first five columns of PLAN_TABLE and DSN_STATEMNT_TABLE.

Table 77. Descriptions of columns in DSN_FUNCTION_TABLE

Column name	Description
QUERYNO	A number intended to identify the statement being explained. See the description of the QUERYNO column in Table 75 on page 893 for more information. If QUERYNO is not unique, the value of EXPLAIN_TIME is unique.
APPLNAME	The name of the application plan for the row, or blank. See the description of the APPLNAME column in Table 75 on page 893 for more information.
PROGNAME	The name of the program or package containing the statement being explained, or blank. See the description of the PROGNAME column in Table 75 on page 893 for more information.
COLLID	The collection ID for the package, or DSNDYNAMICSQLCACHE. When the row in the table is for a cached statement, the value of the column is DSNDYNAMICSQLCACHE. See the description of the COLLID column in Table 75 on page 893 for more information.
GROUP_MEMBER	The member name of the DB2 that executed EXPLAIN, or blank. See the description of the GROUP_MEMBER column in Table 75 on page 893 for more information.
EXPLAIN_TIME	The time at which the statement is processed. This time is the same as the BIND_TIME column in PLAN_TABLE.
SCHEMA_NAME	The schema name of the function invoked in the explained statement.
FUNCTION_NAME	The name of the function invoked in the explained statement.
SPEC_FUNC_ID	The specific name of the function invoked in the explained statement.
FUNCTION_TYPE	The type of function invoked in the explained statement. Possible values are: S Scalar function T Table function

Table 77. Descriptions of columns in DSN_FUNCTION_TABLE (continued)

Column name	Description
VIEW_CREATOR	If the function specified in the FUNCTION_NAME column is referenced in a view definition, the creator of the view. Otherwise, blank.
VIEW_NAME	If the function specified in the FUNCTION_NAME column is referenced in a view definition, the name of the view. Otherwise, blank.
PATH	The value of the SQL path that was used to resolve the schema name of the function.
FUNCTION_TEXT	The text of the function reference (the function name and parameters). If the function reference is over 100 bytes, this column contains the first 100 bytes. For functions specified in infix notation, FUNCTION_TEXT contains only the function name. For example, for a function named /, which overloads the SQL divide operator, if the function reference is A/B, FUNCTION_TEXT contains only /.

Examples

Example 1: Determine the steps required to execute the query 'SELECT X.ACTNO...'. Assume that no set of rows in the PLAN_TABLE has the value 13 for the QUERYNO column.

```
EXPLAIN PLAN SET QUERYNO = 13
FOR SELECT X.ACTNO, X.PROJNO, X.EMPNO, Y.JOB, Y.EDLEVEL
    FROM DSN8810.EMPPROJACT X, DSN8810.EMP Y
       WHERE X.EMPNO = Y.EMPNO
          AND X.EMPTIME > 0.5
          AND (Y.JOB = 'DESIGNER' OR Y.EDLEVEL >= 12)
       ORDER BY X.ACTNO, X.PROJNO;
```

Example 2: Retrieve the information returned in Example 1. Assume that a statement table exists, so also retrieve the estimated cost of processing the query. Use the following query, which joins the plan table and the statement table.

```
SELECT * FROM PLAN_TABLE A, DSN_STATEMNT_TABLE B
  WHERE A.QUERYNO = 13 and B.QUERYNO = 13
  ORDER BY A.QBLOCKNO, A.PLANNO, A.MIXOPSEQ;
```

Example 3: Have the cached statement with statement ID 124 explained. Assume that host variable SID contains 124.

```
EXPLAIN STMTCACHE STMTID :SID;
```

Example 4: Assume that you want to use the plan table that was created by ADMF001 and your authorization ID is SYSADM. If you have an alias on ADMF001.PLAN_TABLE (CREATE ALIAS SYSADM.PLAN_TABLE FOR ADMF001.PLAN_TABLE) and sufficient INSERT and SELECT privileges on the table, the following EXPLAIN statement will execute and ADMF001.PLAN_TABLE will be populated.

```
EXPLAIN PLAN SET QUERYNO = 101
  FOR SELECT * FROM DSN8810.EMP;
```

FETCH

The FETCH statement positions a cursor on a row of its result table. It can return zero, one, or multiple rows and assigns the values of the rows to host variables if there is a target specification.

There are two forms of this statement

- **Single row fetch:** positions the cursor and, optionally, retrieves data from a single row of the result table.
- **Multiple row fetch:** positions the cursor on zero or more rows of the result table and, optionally, returns data if there is a target specification.

Invocation

This statement can only be embedded in an application program. It is an executable statement that cannot be dynamically prepared. Multiple row fetch is not supported in REXX, Fortran[33], or SQL Procedure applications.

Authorization

See “DECLARE CURSOR” on page 812 for an explanation of the authorization required to use a cursor.

Syntax

```
                                                          ┌─FROM─┐
►►──FETCH──┬─────────────────┬──┤ fetch-orientation ├──┴──────┴──cursor-name──────────────────►
           │             (1) │
           ├─INSENSITIVE─────┤
           │            (2)  │
           └─SENSITIVE───────┘

►──┬───────────────────────────┬──────────────────────────────────────────────────────────────►◄
   ├──┤ single-row-fetch ├─────┤
   └──┤ multiple-row-fetch ├───┘
```

Notes:

1 The default depends on the sensitivity of the cursor. If INSENSITIVE is specified on the DECLARE CURSOR, then the default is INSENSITIVE and if SENSITIVE is specified on the DECLARE CURSOR, then the default is SENSITIVE.

2 If INSENSITIVE or SENSITIVE is specified, *single-row-fetch* or *multiple-row-fetch* must be specified.

[33] ASSEMBLER and other languages are supported, but this support is limited to statements that allow USING DESCRIPTOR. The precompiler does not recognize host-variable-arrays except in C/C++, COBOL, and PL/I.

fetch-orientation

fetch-orientation:

```
           (1)
├──┬─BEFORE──────────────────┬─────────────────────────────────────────────────────────────┤
   │      (1)                │
   ├─AFTER───────────────────┤
   ├─┤ row-positioned ├──────┤
   └─┤ rowset-positioned ├───┘
```

row-positioned:

```
   ┌─NEXT─────────────────────────┐
├──┼──────────────────────────────┼──────────────────────────────────────────────────────────┤
   ├─PRIOR────────────────────────┤
   ├─FIRST────────────────────────┤
   ├─LAST─────────────────────────┤
   ├─CURRENT──────────────────────┤
   ├─ABSOLUTE──┬─host-variable────┬┤
   │           └─integer-constant─┘│
   └─RELATIVE──┬─host-variable────┬┘
               └─integer-constant─┘
```

rowset-positioned:

```
├──┬─NEXT ROWSET────────────────────────────────────────────────┬──────────────────────────────────────┤
   ├─PRIOR ROWSET───────────────────────────────────────────────┤
   ├─FIRST ROWSET───────────────────────────────────────────────┤
   ├─LAST ROWSET────────────────────────────────────────────────┤
   ├─CURRENT ROWSET─────────────────────────────────────────────┤
   └─ROWSET STARTING AT──┬─ABSOLUTE─┬──┬─host-variable────┬─────┘
                         └─RELATIVE─┘  └─integer-constant─┘
```

Notes:

1 If BEFORE or AFTER is specified, SENSITIVE, INSENSITIVE, single-row-fetch, or multiple-row-fetch must not be specified.

fetch-type

single-row-fetch:

```
                                                 (1)
├──┬─────────────────────────────────────────┬──────────────────────────────────────────────────────┤
   │          ┌─,──────────────┐             │
   │          ▼                │             │
   ├─INTO───host-variable──────┴─────────────┤
   └─INTO DESCRIPTOR descriptor-name─────────┘
```

multiple-row-fetch:

```
                                                 (2)
├──┬──────────────────────────────────────┬─────┬─────────────────────────────────────────┬──────────┤
   └─FOR──┬─host-variable─────┬──ROWS─────┘     │          ┌─,──────────────────────┐      │
          └─integer-constant──┘                 │          ▼                        │      │
                                                ├─INTO───host-variable-array────────┴──────┤
                                                └─INTO DESCRIPTOR descriptor-name──────────┘
```

Notes:

1 For single-row-fetch, a host-variable-array can be specified instead of a host variable and the descriptior can describe host-variable-arrays. In either case, data is returned only for the first entry of the host-variable-array.

2 This clause is optional. If this clause is not specified and either a rowset size has not been established yet or a row positioned FETCH statement was the last type of FETCH statement issued for this cursor, the rowset size is implicitly one. If the last FETCH statement issued for this cursor was a rowset positioned FETCH statement and this clause is not specified, the rowset size is the same size as the previous rowset positioned FETCH.

Description

INSENSITIVE

Returns the row from the result table as it is. If the row has been previously fetched with a FETCH SENSITIVE, it reflects changes made outside this cursor before the FETCH SENSITIVE statement was issued. Positioned updates and deletes are reflected with FETCH INSENSITIVE if the same cursor was used for the positioned update or delete.

INSENSITIVE can only be specified for cursors declared as INSENSITIVE or SENSITIVE STATIC (or if the cursor is declared as ASENSITIVE and DB2 defaults to INSENSITIVE). Otherwise, if the cursor is declared as SENSITIVE DYNAMIC (or if the cursor is declared as ASENSITIVE and DB2 defaults to SENSITIVE DYNAMIC), an error occurs and the FETCH statement has no effect. For an INSENSITIVE cursor, specifying INSENSITIVE is optional because it is the default.

SENSITIVE

Updates the fetched row in the result table from the corresponding row in the base table of the cursor's SELECT statement and returns the current values. Thus, it reflects changes made outside this cursor. SENSITIVE can only be specified for a sensitive cursor. Otherwise, if the cursor is insensitive, an error occurs and the FETCH statement has no effect. For a SENSITIVE cursor, specifying SENSITIVE is optional because it is the default.

When the cursor is declared as SENSITIVE STATIC and a FETCH SENSITIVE is requested, the following steps are taken:

1. DB2 retrieves the row of the database that corresponds to the row of the result table that is about to be fetched.
2. If the corresponding row has been deleted, a ″delete hole″ occurs in the result table, a warning is issued, the cursor is repositioned on the ″hole″, and no data is fetched. (DB2 marks a row in the result table as a ″delete hole″ when the corresponding row in the database is deleted.)
3. If the corresponding row has not been deleted, the predicate of the underlying SELECT statement is re-evaluated. If the row no longer satisfies the predicate, an ″update hole″ occurs in the result table, a warning is issued, the cursor is repositioned on the ″hole,″ and no data is fetched. (DB2 marks a row in the result table as an ″update hole″ when an update to the corresponding row in the database causes the row to no longer qualify for the result table.)
4. If the corresponding row does not result in a delete or an update hole in the result table, the cursor is repositioned on the row of the result table and the data is fetched.

AFTER

Positions the cursor after the last row of the result table. Values are not assigned to host variables. The number of rows of the result table are returned in the SQLERRD1 and SQLERRD2 fields of the SQLCA for cursors with an effective sensitivity of INSENSITIVE or SENSITIVE STATIC.

BEFORE

Positions the cursor before the first row of the result table. Values are not assigned to host variables.

row-positioned

Positioning of the cursor with row-positioned fetch orientations NEXT, PRIOR, and RELATIVE is done in relation to the current cursor position. Following a successful row-positioned FETCH statement, the cursor is positioned on a single row of data. If the cursor is enabled for rowsets, positioning is performed relative to the first row of the current rowset, and the cursor is positioned on a rowset consisting of a single row.

NEXT

Positions the cursor on the next row or rows of the result table relative to the current cursor position, and returns data if a target is specified. NEXT is the only row-positioned fetch operation that can be explicitly specified for cursors that are defined as NO SCROLL. NEXT is the default if no other cursor positioning is specified. If a specified row reflects a hole, a warning is issued and data values are not assigned to host variables for that row.

Table 78 on page 907 lists situations for different cursor positions and the results when NEXT is used.

Table 78. Results when NEXT is used with different cursor positions

Current state of the cursor	Result of FETCH NEXT
Before the first row	Cursor is positioned on the first row (1) and data is returned if requested.
On the last row or after the last row	A warning occurs, values are not assigned to host variables, and the cursor is positioned after the last row.
Before a hole	For a SENSITIVE STATIC cursor, a warning occurs for a delete hole or an update hole, values are not assigned to host variables, and the cursor is positioned on the hole.
Unknown	An error occurs, values are not assigned to host variables, and the cursor position remains unknown.

Note:

(1)This row is not applicable in the case of a forward-only cursor (that is when NO SCROLL was specified implicitly or explicitly).

PRIOR

Positions the cursor on the previous row or rows of the result table relative to the current cursor position, and returns data if a target is specified. If a specified row reflects a hole, a warning is issued, and data values are not assigned to host variables for that row.

Table 79 lists situations for different cursor positions and the results when PRIOR is used.

Table 79. Results when PRIOR is used with different cursor positions

Current state of the cursor	Result of FETCH PRIOR
Before the first row or on the first row	A warning occurs, values are not assigned to host variables, and the cursor is positioned before the first row.
After a hole	For a SENSITIVE STATIC cursor, a warning occurs for a delete hole or an update hole, values are not assigned to host variables, and the cursor is positioned on the hole.
After the last row	Cursor is positioned on the last row.
Unknown	An error occurs, values are not assigned to host variables, and the cursor position remains unknown.

FIRST

Positions the cursor on the first row of the result table, and returns data if a target is specified. For a SENSITIVE STATIC cursor, if the first row of the result table is a hole, a warning occurs for a delete hole or an update hole and values are not assigned to host variables.

LAST

Positions the cursor on the last row of the result table, and returns data if a target is specified. The number of rows of the result table is returned in the SQLERRD1 and SQLERRD2 fields of the SQLCA for an insensitive or sensitive static cursor. For a SENSITIVE STATIC cursor, if the last row of the result table is a hole, a warning occurs for a delete hole or an update hole and values are not assigned to host variables.

CURRENT

The cursor position is not changed, data is returned if a target is specified. If the cursor was positioned on a rowset of more than one row, then the cursor position is on the first row of the rowset.

Table 80 lists situations in which errors occur with CURRENT.

Table 80. Situations in which errors occur with CURRENT

Current state of the cursor	Result of FETCH CURRENT
Before the first row or after the last row	A warning occurs, values are not assigned to host variables.
On a hole	For a SENSITIVE STATIC or a SENSITIVE DYNAMIC cursor, a warning occurs for a delete hole or an update hole, values are not assigned to host variables, and the cursor is positioned on the hole. A hole is detected for a SENSITIVE DYNAMIC cursor when the current row is deleted or updated so that it no longer meets the selection criterion, and a FETCH CURRENT or a FETCH RELATIVE +0 is executed without repositioning the cursor.
Unknown	An error occurs, values are not assigned to host variables, and the cursor position remains unknown.

ABSOLUTE

host-variable or *integer-constant* is assigned to an integral value *k*. If a *host-variable* is specified, it must be an exact numeric type with zero scale and must not include an indicator variable. The possible data types for the host variable are DECIMAL(*n*,0) or integer. The DECIMAL data type is limited to DECIMAL(18,0). An *integer-constant* can be up to 31 digits, depending on the application language.

If *k*=0, the cursor is positioned before the first row of the result table. Otherwise, ABSOLUTE positions the cursor to row *k* of the result table if *k*>0, or to *k* rows from the bottom of the table if *k*<0. For example, ″ABSOLUTE -1″ is the same as ″LAST″.

Data is returned if the specified position is within the rows of the result table, and a target is specified.

If an absolute position is specified that is before the first row or after the last row of the result table, a warning occurs, values are not assigned to host variables, and the cursor is positioned either before the first row or after the last row. If the resulting cursor position is after the last row for INSENSITIVE and SENSITIVE STATIC scrollable cursors, the number of rows of the result table are returned in the SQLERRD1 and SQLERRD2 fields of the SQLCA. If row *k* of the result table is a hole, a warning occurs and values are not assigned to host variables.

FETCH ABSOLUTE 0 results in positioning before the first row and a warning is issued. FETCH BEFORE results in positioning before the first row and no warning is issued.

Table 81 lists some synonymous specifications.

Table 81. Synonymous scroll specifications for ABSOLUTE

Specification	Alternative
ABSOLUTE 0 (but with a warning)	BEFORE (without a warning)
ABSOLUTE +1	FIRST
ABSOLUTE -1	LAST
ABSOLUTE -*m*, 0<m≤*n*	ABSOLUTE *n*+1-*m*
ABSOLUTE *n*	LAST
ABSOLUTE -*n*	FIRST
ABSOLUTE *x* (with a warning)	AFTER (without a warning)
ABSOLUTE -*x* (with a warning)	BEFORE (without a warning)

Note:

Assume: 0<=*m*<=*n*<*x* Where, *n* is the number of rows in the result table.

RELATIVE

host-variable or *integer-constant* is assigned to an integral value *k*. If a *host-variable* is specified, it must be an exact numeric type with zero scale and must not include an indicator variable. The possible data types for the host variable are DECIMAL(*n*,0) or integer. The DECIMAL data type is limited to DECIMAL(18,0). An *integer-constant* can be up to 31 digits, depending on the application language.

Data is returned if the specified position is within the rows of the result table, and a target is specified.

RELATIVE positions the cursor to the row in the result table that is either *k* rows after the current row if *k*>0, or ABS*(k)* rows before the current row if *k*<0. For example, ″RELATIVE -1″ is the same as ″PRIOR″. If *k*=0, the position of the cursor does not change (that is, ″RELATIVE 0″ is the same as ″CURRENT″).

If a relative position is specified that results in positioning before the first row or after the last row, a warning is issued, values are not assigned to host variables, and the cursor is positioned either before the first row or after the last row. If the resulting cursor position is after the last row for INSENSITIVE and SENSITIVE STATIC scrollable cursors, the number of rows of the result table is returned in the SQLERRD1 and SQLERRD2 fields of the SQLCA. If the cursor is positioned on a hole and RELATIVE 0 is specified or if the target row is a hole, a warning occurs and values are not assigned to host variables. If the cursor position is unknown and RELATIVE 0 is specified, an error occurs.

Table 82 lists some synonymous specifications.

Table 82. Synonymous Scroll Specifications for RELATIVE

Specification	Alternative
RELATIVE +1	NEXT
RELATIVE -1	PRIOR
RELATIVE 0	CURRENT
RELATIVE +r (with a warning)	AFTER (without a warning)
RELATIVE -r (with a warning)	BEFORE (without a warning)

Note:

r has to be large enough to position the cursor beyond either end of the result table.

rowset-positioned

Positioning of the cursor with rowset-positioned fetch orientations NEXT ROWSET, PRIOR ROWSET, and ROWSET STARTING AT RELATIVE is done in relation to the current rowset. The number of rows in the rowset is determined either explicitly or implicitly. The FOR *n* ROWS clause in the multiple-row-fetch clause is used to explicitly specify the size of the rowset. Following a successful rowset-positioned FETCH statement, the cursor is positioned on all rows of the rowset.

A rowset-positioned fetch orientation must not be specified if the current cursor position is not defined to access rowsets. NEXT ROWSET is the only rowset-positioned fetch orientation that can be specified for cursors that are defined as NO SCROLL.

If a row of the rowset reflects a hole, a warning is returned, data values are not assigned to host variable arrays for that row (that is, the corresponding positions in the target host variable arrays are untouched), and -3 is returned in all provided indicator variables for that row. If a hole is detected, and at least one indicator variable is not provided, an error occurs.

NEXT ROWSET

Positions the cursor on the next rowset of the result table relative to the current cursor position, and returns data if a target is specified. The next rowset is logically obtained by fetching the row that follows the current rowset and fetching additional rows until the number of rows that is specified implicitly or explicitly in the FOR n ROWS clause is obtained or the last row of the result table is reached.

If a row of the rowset reflects a hole, the following actions occur:

- A warning is returned.
- Data values are not assigned to the host-variable-arrays for that row (that is, the corresponding positions in the target host-variable-arrays are untouched).
- A value of -3 is returned in all of the indicator variables that are provided for the row.

If a hole is detected and at least one indicator variable is not provided, an error is returned.

If the cursor is not positioned because of a prior error, values are not assigned to the host-variable-array, and an error is returned. If a row of the rowset would be after the last row of the result table, values are not assigned to host-variable-arrays for that row and any subsequent requested rows of the rowset, and a warning is returned.

NEXT ROWSET is the only rowset positioned fetch orientation that can be explicitly be specified for cursors that are defined as NO SCROLL.

PRIOR ROWSET

Positions the cursor on the previous rowset of the result table relative to the current position, and returns data if a target is specified.

The prior rowset is logically obtained by fetching the row that follows the current rowset and fetching additional rows until the number of rows that is specified implicitly or explicitly in the FOR n ROWS clause is obtained or the last row of the result table is reached.

If a row would be before the first row of the result table, the cursor is positioned on a partial rowset that consists of only those rows that are prior to the current position of the cursor starting with the first row of the result table, and a warning is returned. Values are not assigned to the host-variable-arrays for the rows in the rowset for which the warning is returned.

Although the rowset is logically obtained by fetching backwards from before the current rowset, the data is returned to the application starting with the first row of the rowset, to the end of the rowset.

If a row of the rowset reflects a hole, the following actions occur:
- A warning is returned.
- Data values are not assigned to the host-variable-arrays for that row (that is, the corresponding positions in the target host-variable-arrays are untouched).
- A value of -3 is returned in all of the indicator variables that are provided for the row.

If a hole is detected and at least one indicator variable is not provided, an error is returned.

If the cursor is not positioned because of a prior error, values are not assigned to the host-variable-array, and an error is returned.

FIRST ROWSET

Positions the cursor on the first rowset of the result table, and returns data if a target is specified.

If a row of the rowset reflects a hole, the following actions occur:
- A warning is returned.
- Data values are not assigned to the host-variable-arrays for that row (that is, the corresponding positions in the target host-variable-arrays are untouched).
- A value of -3 is returned in all of the indicator variables that are provided for the row.

If a hole is detected and at least one indicator variable is not provided, an error is returned.

If the result table contains fewer rows than specified implicitly or explicitly in the FOR *n* ROWS clause, values are not assigned to host-variable-arrays after the last row of the result table, and a warning is returned.

LAST ROWSET

Positions the cursor on the last rowset of the result table and returns data if a target is specified. The last rowset is logically obtained by fetching the last row of the result table and fetching prior rows until the number of rows in the rowset is obtained or the first row of the result table is reached.

Although the rowset is logically obtained by fetching backwards from the bottom of the result table, the data is returned to the application starting with the first row of the rowset, to the end of the rowset, which is also the end of the result table.

If a row of the rowset reflects a hole, the following actions occur:

- A warning is returned.
- Data values are not assigned to the host-variable-arrays for that row (that is, the corresponding positions in the target host-variable-arrays are untouched).
- A value of -3 is returned in all of the indicator variables that are provided for the row.

If a hole is detected and at least one indicator variable is not provided, an error is returned.

If the result table contains fewer rows than specified implicitly or explicitly in the FOR *n* ROWS clause, the last rowset is the same as the first rowset, values are not assigned to host-variable-arrays after the last row of the result table, and a warning is returned.

CURRENT ROWSET

If the FOR *n* ROWS clause specifies a number different from the number of rows specified implicitly or explicitly in the FOR *n* ROWS clause on the most recent FETCH statement for this cursor, the cursor is repositioned on the specified number of rows, starting with the first row of the current rowset. Otherwise, the position of the cursor on the current rowset is unchanged. Data is returned if a target is specified.

With isolation level UR or a sensitive dynamic scrollable cursor, it is possible that different rows will be returned than the FETCH that established the most recent rowset cursor position. This can occur while refetching the first row of the rowset when it is determined to not be there anymore. In this case, fetching continues moving forward to get the first row of data for the rowset. This can also occur when changes have been made to other rows in the current rowset such that they no longer exist or have been logically moved within (or out of) the result table of the cursor.

If the cursor is not positioned because of a prior error, values are not assigned to the host-variable-array, and an error occurs.

If the current rowset contains fewer rows than specified implicitly or explicitly in the FOR *n* ROWS clause, values are not assigned to host-variable-arrays after the last row, and a warning is returned.

ROWSET STARTING AT ABSOLUTE or **RELATIVE** *host-variable* or *integer-constant*

Positions the cursor on the rowset beginning at the row of the result table that is indicated by the ABSOLUTE or RELATIVE specification, and returns data if a target is specified.

host-variable or *integer-constant* is assigned to an integral value *k*. If *host-variable* is specified, it must be an exact numeric type with scale zero, and must not include an indicator variable. The possible data types for the host variable are DECIMAL(n,0) or integer, where the DECIMAL data type is limited to DECIMAL(18,0). If a constant is specified, the value must be an integer.

If a row of the result table would be after the last row or before the first row of the result table, values are not assigned to host-variable-arrays for that row and a warning is returned.

ABSOLUTE

If k=0, an error occurs. If k>0, the first row of the rowset is row k. If k<0, the rowset is positioned on the ABS(k) rows from the bottom of the result table. Assume that ABS(k) is equal to the number of rows for the rowset and that there are enough row to return a complete rowset:

- FETCH ROWSET STARTING AT ABSOLUTE -k is the same as FETCH LAST ROWSET.
- FETCH ROWSET STARTING AT ABSOLUTE 1 is the same as FETCH FIRST ROWSET.

RELATIVE

If k=0 and the FOR *n* ROWS clause does not specify a number different from the number most recently specified implicitly or explicitly for this cursor, then the position of the cursor does not change (that is, ″RELATIVE ROWSET 0″ is the same as ″CURRENT ROWSET″). If k=0 and the FOR *n* ROWS clause specifies a number different from the number most recently specified implicitly or explicitly for this cursor, then the cursor is repositioned on the specified number of rows, starting with the first row of the current rowset. Otherwise, RELATIVE repositions the cursor so that the first row of the new rowset cursor position is on the row in the result table that is either k rows after the first row of the current rowset cursor position if k>0, or ABS(k) rows before the first row of the current rowset cursor position if k<0. Assume that ABS(k) is equal to the number of rows for the resulting rowset

- FETCH ROWSET STARTING AT RELATIVE -k is the same as FETCH PRIOR ROWSET.
- FETCH ROWSET STARTING AT RELATIVE k is the same as FETCH NEXT ROWSET.
- FETCH ROWSET STARTING AT RELATIVE 0 is the same as FETCH CURRENT ROWSET.

When ROWSET STARTING AT RELATIVE -n is specified and there are not enough rows between the current position of the cursor and the beginning of the result table to return a complete rowset:

- A warning is returned.
- Values are not assigned to the host-variable-arrays.
- The cursor position remains unchanged.

If a row of the rowset reflects a hole, If a row of the rowset reflects a hole, the following actions occur:

- A warning is returned.
- Data values are not assigned to the host-variable-arrays for that row (that is, the corresponding positions in the target host-variable-arrays are untouched).
- A value of -3 is returned in all of the indicator variables that are provided for the row.

If a hole is detected and at least one indicator variable is not provided, an error is returned. If a row of the rowset is unknown, values are not assigned to host variable arrays for that row, and an error is returned. If a row of the rowset would be after the last row or before the first row of the result table, values are not assigned to host-variable-arrays for that row, and a warning is returned.

cursor-name

Identifies the cursor to be used in the fetch operation. The cursor name must identify a declared cursor, as explained in the description of the DECLARE CURSOR statement in “DECLARE CURSOR” on page 812, or an allocated cursor, as explained in “ALLOCATE CURSOR” on page 436. When the FETCH statement is executed, the cursor must be in the open state.

If a single-row-fetch or multiple-row-fetch clause is not specified, the cursor position is adjusted as specified, but no data is returned to the user.

single-row-fetch

When *single-row-fetch* is specified, SENSITIVE or INSENSITIVE can be specified though there is a default. The default depends on the sensitivity of the cursor. If the sensitivity of the cursor is INSENSITIVE, then the default is INSENSITIVE. If the effective sensitivity of the cursor is SENSITIVE DYNAMIC or SENSITIVE STATIC, then the default is SENSITIVE. The single-row-fetch or multiple-row-fetch clause must not be specified when the FETCH BEFORE or FETCH AFTER option is specified. They are required when FETCH BEFORE or FETCH AFTER is not specified. If an individual fetch operation causes the cursor to be positioned or to remain positioned on a row if there is a target specification, the values of the result table are assigned to host variables as specified by the single-fetch-clause.

INTO *host-variable,...*

Specifies a list of host variables. Each *host-variable* must identify a structure or variable that is described in the application program in accordance with the rules for declaring host structures and variables. A reference to a structure is replaced by a reference to each of its variables. The first value in the result row is assigned to the first host variable, the second value to the second host variable, and so on.

INTO DESCRIPTOR *descriptor-name*

Identifies an SQLDA that contains a valid description of the host output variables. Result values from the associated SELECT statement are returned to the application program in the output host variables.

Before the FETCH statement is processed, you must set the following fields in the SQLDA:

- SQLN to indicate the number of SQLVAR occurrences provided in the SQLDA

  A REXX SQLDA does not contain this field.
- SQLABC to indicate the number of bytes of storage allocated in the SQLDA
- SQLD to indicate the number of variables used in the SQLDA when processing the statement
- SQLVAR occurrences to indicate the attributes of the variables

The SQLDA must have enough storage to contain all SQLVAR occurrences. Each SQLVAR occurrence describes a host variable or buffer into which a value in the result table is to be assigned. If LOBs are present in the results, there must be additional SQLVAR entries for each column of the result table. If the result table contains only base types and distinct types, multiple SQLVAR entries are not needed for each column. However, extra SQLVAR entries are needed for distinct types as well as for LOBs in

DESCRIBE and PREPARE INTO statements. For more information on the SQLDA, which includes a description of the SQLVAR and an explanation on how to determine the number of SQLVAR occurrences, see Appendix E, "SQL descriptor area (SQLDA)," on page 1173.

SQLD must be set to a value greater than or equal to zero and less than or equal to SQLN.

See "Identifying an SQLDA in C or C++" on page 1189 for how to represent *descriptor-name* in C.

multiple-row-fetch

Retrieves multiple rows of data from the result table of a query. The FOR *n* ROWS clause of the FETCH statement controls how many rows are returned on a single FETCH statement. The fetch orientation determines whether the resulting cursor position (for example, on a single row, rowset, before, or after the result table). Fetching stops when an error is returned, all requested rows are fetched, or the end of data condition is reached.

Fetching multiple rows of data can be done with scrollable or non-scrollable cursors. The operations used to define, open, and close a cursor used for fetching multiple rows of data are the same as for those used for single row FETCH statements.

If the BEFORE or AFTER option is specified, neither single-row-fetch or multiple-row-fetch can be specified.

FOR *host-variable* or *integer-constant* **ROWS**

host-variable or *integer-constant* is assigned to an integral value *k*. If a host variable is specified, it must be an exact numeric type with a scale of zero and must not include an indicator variable. Furthermore, *k* must be in the range, 0<k<=32767.

This clause must not be specified if a row-positioned fetch-orientation clause was specified. This clause must also not be specified for a cursor that is defined without rowset access.

If a rowset fetch orientation is specified and this clause is not specified, the number of rows in the resulting rowset is determined as follows;

- If the most recent FETCH statement for this cursor was a rowset-positioned FETCH, the number of rows of the rowset is implicitly determined by the number of rows that was most recently specified (implicitly or explicitly) for this cursor.
- When the most recent FETCH statement for this cursor was either FETCH BEFORE or FETCH AFTER and the most recent FETCH statement for this cursor prior to that was a rowset-positioned FETCH, the number of rows of the rowset is implicitly determined by the number of rows that were most recently specified (implicitly or explicitly) for this cursor.
- Otherwise, the rowset consists of a single row.

For result set cursors, the number of rows for a rowset cursor position, established in the procedure that defined the rowset, is not inherited by the caller when the rowset is returned. Use the FOR *n* ROWS clause on the first rowset FETCH statement for the result set in the calling program to establish the number of rows for the cursor. Otherwise, the rowset consists of a single row.

The cursor is positioned on the row or rowset that is specified by the orientation clause (for example, NEXT ROWSET), and those rows are fetched if a target is specified. After the cursor is positioned on the first row being fetched, the next k-1 rows are fetched. Fetching moves forward from the cursor position in the result table and continues until the end of data condition is returned, k-1 rows have been fetched, or an assignment error is returned.

The resulting cursor position depends on the fetch orientation that is specified:

- For a row-positioned fetch orientation, the cursor is positioned at the last row successfully retrieved.
- For a rowset-positioned fetch orientation, the cursor is positioned on all the rows retrieved.

The values from each individual fetch are placed in data areas that are described in the INTO or USING clause. If a target specification is provided for a rowset-positioned FETCH, the host variable arrays must be specified as the target specification, and the arrays must be defined with a dimension of 1 or greater. The target specification must be defined as an array for a rowset-positioned FETCH even if the number of rows that is specified implicitly or explicitly is one. See ″Considerations for an SQLCA with a FETCH Statement on Page 21″ .

INTO *host-variable-array*

Identifies for each column of the result table a host-variable-array to receive the data that is retrieved with this FETCH statement. If the number of host-variable-arrays is less than the number of columns of the result table, the SQLWARN3 field of the SQLCA is set to 'W'. No warning is given if there are more host-variable-arrays than the number of columns in the result table.

Each host-variable-array must be defined in the application program in accordance with the rules for declaring an array. A host-variable-array is used to return the values for a column of the result table. The number of rows to be fetched must be less than or equal to the dimension of each of the host-variable-arrays.

An optional indicator array can be specified for a host-variable-array. It should be specified if the SQLTYPE of any SQLVAR occurrence indicates that the column of the result table is nullable. Additionally, if an operation may result in null values, such as an UPDATE operation that results in a hole, is performed in the application, an indicator array should be specified. Otherwise an error occurs if null values are encountered. The indicators are returned as small integers.

INTO DESCRIPTOR *descriptor-name*

Identifies an SQLDA that must contain a valid description of zero or more host-variable-arrays or buffers into which the values for a column of the result table are to be returned.

Before the FETCH statement is processed, you must set the following fields in the SQLDA:

- SQLN to indicate the number of SQLVAR occurrences provided in the SQLDA.
- SQLABC to indicate the number of bytes of storage allocated for the SQLDA.

- SQLD to indicate the number of variables used in the SQLDA when processing the statement.
- SQLVAR occurrences to indicate the attributes of an element of the host-variable-array. Within each SQLVAR representng an array:
  - SQLTYPE indicates the data type of the elements of the host-variable-array.
  - SQLDATA field points to the first element of the host-variable-array.
  - The length fields (SQLLEN and SQLLONGLEN) are set to indicate the maximum length of a single element of the array.
  - SQLNAME - The length of SQLNAME must be set to 8, and the first two bytes of the data portion of SQLNAME must be initialized to X'0000'. The fifth and sixth bytes must contain a flag field and the seventh and eighth bytes must be initialized to a binary small integer (half word) representation of the dimension of the host-variable-array, and the corresponding indicator array, if one is specified.

  The SQLVAR entry for the number of rows must also contain a flag value. The number of rows to be fetched must be less than or equal to the dimension of each of the host variable arrays.

You set the SQLDATA and SQLIND pointers to the beginning of the corresponding arrays. The SQLDA must have enough storage to contain all SQLVAR occurrences. Each SQLVAR occurrence describes a host-variable-array or buffer into which the values for a column in the result table are to be returned. If any column of the result table is a LOB, two SQLVAR entries must be provided for each SQLVAR, and SQLN must be set to two times the number of SQLVARS. SQLD must be set to a value greater than or equal to zero and less than or equal to SQLN.

Notes

Assignment to host variables: The *n*th variable identified by the INTO clause or described in the SQLDA corresponds to the *n*th column of the result table of the cursor. The data type of a host variable must be compatible with its corresponding value. If the value is numeric, the variable must have the capacity to represent the whole part of the value. For a datetime value, the variable must be a character string variable of a minimum length as defined in "String representations of datetime values" on page 65. If the value is null, an indicator variable must be specified.

Assignments are made in sequence through the list. Each assignment to a variable is made according to the rules described in Chapter 2, "Language elements," on page 33. If the number of variables is less than the number of values in the row, the SQLWARN3 field of the SQLCA is set to W. There is no warning if there are more variables than the number of result columns. If the value is null, an indicator variable must be provided. If an assignment error occurs, the value is not assigned to the variable and no more values are assigned to variables. Any values that have already been assigned to variables remain assigned.

Normally, you use LOB locators to assign and retrieve data from LOB columns. However, because of compatibility rules, you can also use LOB locators to assign data to host variables with CHAR, VARCHAR, GRAPHIC, or VARGRAPHIC data types. For more information on using locators, see Part 2 of *DB2 Application Programming and SQL Guide*.

Result column evaluation considerations: If an error occurs as the result of an arithmetic expression in the SELECT list of an outer SELECT statement (division by zero, or overflow) or a numeric conversion error occurs, the result is the null value. As in any other case of a null value, an indicator variable must be provided and the main variable is unchanged. In this case, however, the indicator variable is set to -2. Processing of the statement continues as if the error had not occurred. (However, this error causes a positive SQLCODE.) If you do not provide an indicator variable, a negative value is returned in the SQLCODE field of the SQLCA. Processing of the statement terminates when the error is encountered. No value is assigned to the host variable or to later variables, though any values that have already been assigned to variables remain assigned.

If the specified host variable is not large enough to contain the result, a warning is returned and W is assigned to SQLWARN1 in the SQLCA. The actual length of the result is returned in the indicator variable associated with the host-variable, if an indicator is provided. It is possible that a warning may not be returned on a FETCH operation. This occurs as a result of optimizations, such as the use of system temporary tables or blocking. It is also possible that the returned warning applies to a previously fetched row. When a datetime value is returned, the length of the variable must be large enough to store the complete value. Otherwise, a warning or an error is returned.

Cursor positioning: An open cursor has three possible positions:
- Before a row
- On a row or rowset
- After the last row

When a scrollable or non-scrollable cursor is opened, it is positioned before the first row in the result table. If a cursor is on a row, that row is called the current row of the cursor. If a cursor is on a rowset, the rows are called the current rowset of the cursor.

A cursor referred to in an UPDATE or DELETE statement must be positioned on a row or rowset. A cursor can only be on a row or rowset as a result of a FETCH statement.

If the cursor was declared SENSITIVE STATIC SCROLL, a row may be a *hole*, from which no values may be fetched, updated, or deleted. Holes do not exist with DYNAMIC SCROLL cursors because there is no temporary result table. For information about holes in the result table of a cursor, see Part 2 of *DB2 Application Programming and SQL Guide*.

For scrollable cursors, the cursor position after an error varies depending on the type of error:
- When an operation is attempted against an update or delete hole, or when an update or delete hole is detected, the cursor is positioned on the hole.
- When a FETCH operation is attempted past the end of file, the cursor is positioned after the last row.
- When a FETCH operation is attempted before the beginning of file, the cursor is positioned before the first row.
- When an error causes the cursor position to be invalid such as when a single row positioned update or positioned delete error occurs that causes a rollback, the cursor is closed.

Cursor position after exception condition: If an error occurs during the execution of a fetch operation, the position of the cursor and the result of any later fetch is unpredictable. It is possible for an error to occur that makes the position of the cursor invalid, in which case the cursor is closed.

If an individual fetch operation specifies a destination that is outside the range of the cursor, a warning is issued (except for FETCH BEFORE or FETCH AFTER), the cursor is positioned before or after the result table, and values are not assigned to host variables.

Concurrency and scrollability: The current row of a cursor cannot be updated or deleted by another application process if it is locked. Unless it is already locked because it was inserted or updated by the application process during the current unit of work, the current row of a cursor is not locked if:

- The isolation level is UR, or
- The isolation level is CS, and
  - The result table of the cursor is read-only
  - The bind option CURRENTDATA(NO) is in effect

A dynamic scrollable cursor is useful when it is more important to the application to see updated rows and newly inserted rows and there is no need to see deleted rows. The isolation level of CS should be used for maximum concurrency with dynamic scrollable cursors. Specifying an isolation level of RR or RS severely restricts the update of the table, thus defeating the purpose of a SENSITIVE DYNAMIC scrollable cursor. If the application needs a constant result table, a SENSITIVE STATIC scrollable cursor with an isolation level of CS should be used.

Sensitivity of SENSITIVE STATIC SCROLL cursors to database changes: When SENSITIVE STATIC SCROLL has been declared, the following rules apply:

- For the result of an update operation to be visible within a cursor after ″open,″ the update operation must be a positioned update executed against the cursor, or a FETCH SENSITIVE in a STATIC cursor must be executed against a row which has been updated by some other means (that is, a searched update, committed updates of others, or an update with another cursor in the same process).
- Another process can update the base table of the SELECT statement so that the current values no longer satisfy the WHERE clause. In this case, an ″update hole″ effectively exists during the time the values in the base table do not satisfy the WHERE clause, and the row is no longer accessible through the cursor. When an attempt is made to fetch a row that has been identified as an update hole, no values are returned, and a warning is issued.

  Under SENSITIVE STATIC SCROLL cursors, update holes are only identified during positioned update, positioned delete, and FETCH SENSITIVE operations. Each positioned update, positioned delete, and FETCH SENSITIVE operation does the necessary tests to determine if an update hole exists.
- For the result of a delete operation to be visible within a SENSITIVE STATIC SCROLL cursor, the delete operation must be a positioned delete executed against the cursor or a FETCH SENSITIVE in a STATIC cursor must be executed against a row that has been deleted by some other means (that is, a searched delete, committed deletes of others, or a delete with another cursor in the same process).
- Another process, or the even the same process, may delete a row in the base table of the SELECT statement so that a row of the cursor no longer has a corresponding row in the base table. In this case, a ″delete hole″ effectively exists, and that row is no longer accessible through the cursor. When an attempt is made to fetch a row that has been identified as a delete hole, no values are returned, and a warning is issued.

Under SENSITIVE STATIC SCROLL cursors, delete holes are identified during positioned update, positioned delete, and FETCH SENSITIVE operations.

- Inserts into the base table or tables of SENSITIVE STATIC SCROLL cursors are not seen after the cursor is opened.

LOB locators: When information is retrieved into LOB locators and it is not necessary to retain the locator across FETCH statements, it is a good practice to issue a FREE LOCATOR statement before issuing another FETCH statement because locator resources are limited.

Isolation level considerations: The isolation level of the statement (specified implicitly or explicitly) can affect the result of a rowset-positioned FETCH statement. This is possible when changes are made to the tables underlying the cursor when isolation level UR is used with a dynamic scrollable cursor, or with other isolation levels when rows have been added by the application fetching from the cursor. These situations can occur with the following fetch orientations:

PRIOR ROWSET
With a dynamic scrollable cursor and isolation level UR, the content of a prior rowset can be affected by other activity within the table. It is possible that a row that previously qualified for the cursor, and was included as a member of the ″prior″ rowset, has since been deleted or modified before it is actually returned as part of the rowset for the current statement. To avoid this behavior, use an isolation level other than UR.

CURRENT ROWSET
With a dynamic scrollable cursor, additional rows can be added between rows that form the rowset that was returned to the user. With isolation level RR, these rows can only be added by the application fetching from the cursor. For isolation levels other than RR, other applications can insert rows that can affect the results of a subsequent FETCH CURRENT ROWSET. To avoid this behavior, use a static scrollable cursor instead of a dynamic scrollable cursor.

LAST ROWSET
With a dynamic scrollable cursor and isolation level UR, the content of the last rowset can be affected by other activity within the table. It is possible that a row that previously qualified for the cursor, and was included as a member of the ″last″ rowset, has since been deleted or modified before it is actually returned as part of the rowset for the current statement. To avoid this behavior, use an isolation level other than UR.

ROWSET STARTING AT RELATIVE *-n* (where *-n* is a negative number)
With a dynamic scrollable cursor and isolation level UR, the content of a prior rowset can be affected by other activity within the table. It is possible that a row that previously qualified for the cursor, and was included as a member of the ″prior″ rowset, has since been deleted or modified before it is actually returned as part of the rowset for the current statement. To avoid this behavior, use an isolation level other than UR.

Row positioned and rowset positioned FETCH statement interaction: Table 83 on page 921 demonstrates the interaction between row positioned and rowset positioned FETCH statements. The table is based on the following assumptions:

- TABLE T1 has 15 rows
- CURSOR CS1 is declared as follows:

```
DECLARE CS1 SCROLL CURSOR WITH ROWSET POSITIONING FOR
SELECT * FROM T1;
```

- An OPEN CURSOR statement has been successfully executed for CURSOR CS1 and the FETCH statements in the table are executed in the order that they appear in the table.

Table 83. Interaction between row positioned and rowset positioned FETCH statements

FETCH Statement	**Cursor Position**
FETCH FIRST	Cursor is positioned on row 1.
FETCH FIRST ROWSET	Cursor is positioned on a rowset of size 1, consisting of row 1.
FETCH FIRST ROWSET FOR 5 ROWS	Cursor is positioned on a rowset of size 5, consisting of rows 1, 2, 3, 4, and 5.
FETCH CURRENT ROWSET	Cursor is positioned on a rowset of size 5, consisting of rows 1, 2, 3, 4, and 5.
FETCH CURRENT	Cursor is positioned on row 1
FETCH FIRST ROWSET FOR 5 ROWS	Cursor is positioned on a rowset of size 5, consisting of rows 1, 2, 3, 4, and 5.
FETCH **or** FETCH NEXT	Cursor is positioned on row 2.
FETCH NEXT ROWSET	Cursor is positioned on a rowset of size 1, consisting of row 3.
FETCH NEXT ROWSET FOR 3 ROWS	Cursor is positioned on a rowset of size 3, consisting of rows 4,5, and 6.
FETCH NEXT ROWSET	Cursor is positioned on a rowset of size 3, consisting of rows 7,8, and 9.
FETCH LAST	Cursor is positioned on row 15.
FETCH LAST ROWSET FOR 2 ROWS	Cursor is positioned on a rowset of size 2, consisting of rows 14 and 15.
FETCH PRIOR ROWSET	Cursor is positioned on a rowset of size 2, consisting of rows 12 and 13.
FETCH ABSOLUTE 2	Cursor is positioned on row 2.
FETCH ROWSET STARTING AT ABSOLUTE 2 FOR 3 ROWS	Cursor is positioned on a rowset of size 3, consisting of rows 2, 3, and 4.
FETCH RELATIVE 2	Cursor is positioned on row 4.
FETCH ROWSET STARTING AT ABSOLUTE 2 FOR 4 ROWS	Cursor is positioned on a rowset of size 4, consisting of rows 2, 3, 4, and 5.
FETCH RELATIVE -1	Cursor is positioned on row 1.
FETCH ROWSET STARTING AT ABSOLUTE 3 FOR 2 ROWS	Cursor is positioned on a rowset of size 2, consisting of rows 3 and 4.
FETCH ROWSET STARTING AT RELATIVE 4	Cursor is positioned on a rowset of size 2, consisting of rows 7 and 8.
FETCH PRIOR	Cursor is positioned on row 6.
FETCH ROWSET STARTING AT ABSOLUTE 13 FOR 5 ROWS	Cursor is positioned on a rowset of size 3, consisting of rows 13, 14, and 15.
FETCH FIRST ROWSET	Cursor is positioned on a rowset of size 5, consisting of rows 1, 2, 3, 4, and 5. **Note:** Even though the previous FETCH statement returned only 3 rows because EOF was encountered, DB2 will remember that 5 rows were requested by the previous FETCH statement.

Considerations for using the FOR n ROWS clause with the FETCH FIRST n ROWS ONLY clause: A clause specifying the desired number of rows can be specified in the SELECT statement of a cursor or the FETCH statement for a cursor, or both. However, these clauses have different effects:

- In the SELECT statement, a FETCH FIRST *n* ROWS ONLY clause controls the maximum number of rows that can be accessed with the cursor. When a FETCH statement attempts to retrieve a row beyond the number specified in the FETCH FIRST n ROWS ONLY clause of the SELECT statement, an end-of-data condition occurs.
- In a FETCH statement, a FOR *n* ROWS clause controls the number of rows that are returned for a single FETCH statement.

Both of these clauses can be specified.

Diagnostics information for rowset positioned FETCH statements: A single FETCH statement from a rowset cursor might encounter multiple conditions. These conditions can be errors or warnings. If a warning occurs during the fetch of a row, processing continues. If a non-terminating error (such as a bind out error) occurs during the fetch of a row, processing continues. Use the GET DIAGNOSTICS statement to obtain information about all of the conditions that are encountered for one of these FETCH statements. See “GET DIAGNOSTICS” on page 928 for more information.

The SQLCA returns some information about errors and warnings that are found while fetching from a rowset cursor. Processing stops when the end of data is encountered, or when a terminating error occurs. The specific error or end-of-data condition is returned as a result of the fetch from the rowset cursor. After each FETCH statement from a rowset cursor, information is returned to the program through the SQLCA. The SQLCA is set as follows:

- SQLCODE contains the SQLCODE.
- SQLSTATE contains the SQLSTATE.
- SQLERRD1 and SQLERRD2 contain the number of rows of the result table if a row of the requested rowset is after the last row of the result table for an insensitive or sensitive static cursor.
- SQLERRD3 contains the actual number of rows returned. If SQLERRD3 is less than the number of rows requested, then an error or end-of-data condition occurred.
- SQLWARN flags are set to represent all the warnings that were accumulated while processing the FETCH statement.

Consider the following examples, where 10 rows are fetched with a single FETCH statement.

- **Example 1:** Assume that an error is detected on the 5th row. SQLERRD3 is set to 4 for the 4 returned rows, SQLSTATE is set to 22003, and SQLCODE is set to -802. This information is also available from the GET DIAGNOSTICS statement (the information that is returned is generated from connected server, which may differ across different servers). For example:

  ```
  GET DIAGNOSTICS :num_rows = ROW_COUNT, :num_cond = NUMBER;
  ```

  would result in

  ```
  num_rows = 4 and num_cond = 1 (1 condition).
  GET DIAGNOSTICS CONDITION 1 :sqlstate = RETURNED_SQLSTATE,
  :sqlcode = DB2_RETURNED_SQLCODE, :row_num = DB2_ROW_NUMBER;
  ```

would result in

```
sqlstate = 22003, sqlcode = -802, and row_num = 5.
```

- **Example 2:** Assume that an end-of-data condition is detected on the 6th row and that the cursor does not have immediate sensitivity to updates. SQLERRD3 is set to 5 for the 5 returned rows, SQLSTATE is set to 02000, and SQLCODE is set to +100. This information is also available from the GET DIAGNOSTICS statement, for example:

  ```
  GET DIAGNOSTICS :num_rows = ROW_COUNT, :num_cond = NUMBER;
  ```

  would result in

  ```
  num_rows = 5 and num_cond = 1 (1 condition).
  GET DIAGNOSTICS CONDITION 1 :sqlstate = RETURNED_SQLSTATE,
  :sqlcode = DB2_RETURNED_SQLCODE, :row_num = DB2_ROW_NUMBER;
  ```

  would result in

  ```
  sqlstate = 02000, sqlcode = 100, and row_num = 6.
  ```

- **Example 3:** Assume that an end-of-data condition is detected on the 6th row and that the cursor is sensitive to inserted rows. SQLERRD3 is set to 5 for the 5 returned rows, SQLSTATE is set to 02000, and SQLCODE is set to +100. Assume that after the FETCH, 1 more row is inserted into the table. If an additional FETCH statement is executed, an end-of-data condition is detected after the new row has been fetched. SQLERRD3 is set to 1 for the 1 returned row, SQLSTATE is set to 02000, and SQLCODE is set to +100.

In some cases, DB2 returns a warning if indicator variables are provided, or an error if indicator variables are not provided. These errors can be thought of as data mapping errors that result in a warning if indicator variables are provided.

- If indicator variables are provided, DB2 returns all rows to the user, marking the errors in the indicator variables. The SQLCODE and SQLSTATE contain the warning from the last data mapping error. The GET DIAGNOSTICS statement can be used to retrieve information about all the data mapping errors that have occurred.
- If some or no indicator variables are provided, all rows are returned as above until the first data mapping error that does not have indicator variables is detected. The rows successfully fetched are returned and the SQLSTATE, SQLCODE, and SQLWARN flags are set, if necessary. (The SQLCODE may be 0 or a positive value).

It is possible, if a data mapping error occurs, for the positioning of the cursor to be successful. In this case, the cursor is positioned on the rowset that encountered the data mapping error.

Consider the following examples, which try to fetch 10 rows with a single FETCH statement.

- **Example 1:** Assume that indicators have been provided for values returned for column 1, but not for column 2. The 5th row has a data mapping error (+802) for column 1, and the 7th row has a data mapping error for column 2 (-802 is returned because an indicator was not provided for column 2). SQLERRD3 is set to 6 for the 6 returned rows, SQLSTATE and SQLCODE are set to the error from the 7th row fetched. The indicator variable for the 5th row column 1 indicates that a data mapping error was found. This information is also available from the GET DIAGNOSTICS statement, for example:

  ```
  GET DIAGNOSTICS :num_rows = ROW_COUNT, :num_cond = NUMBER;
  ```

would result in

```
num_rows = 6 and num_cond = 2 (2 conditions).
GET DIAGNOSTICS CONDITION 1 :sqlstate = RETURNED_SQLSTATE,
:sqlcode = DB2_RETURNED_SQLCODE, :row_num = DB2_ROW_NUMBER;
```

would result in

```
sqlstate = 01519, sqlcode = +802, and row_num = 5.
GET DIAGNOSTICS CONDITION 2 :sqlstate = RETURNED_SQLSTATE,
:sqlcode = DB2_RETURNED_SQLCODE, :row_num = DB2_ROW_NUMBER;
```

would result in

```
sqlstate = 22003, sqlcode = -802, and row_num = 7.
```

The resulting cursor position is unknown.

- **Example 2:** Assume that null indicators are provided, that rows 3 and 5 are holes, and that data exists for the other requested rows. SQLERRD3 is set to 10 to reflect that 10 fetches were completed and that information has been returned for the 10 requested rows. Eight rows actually contain data. For two rows, indicator variables are set to indicate no data was returned for those rows. SQLSTATE is set to 02502, SQLCODE is set to +222, and all null indicators for rows 3 and 5 are set to -3 to indicate that a hole was detected. This information is also available from the GET DIAGNOSTICS statement, for example:

```
GET DIAGNOSTICS :num_rows = ROW_COUNT, :num_cond = NUMBER;
```

would result in

```
num_rows = 10 and num_cond = 2 (2 conditions).
GET DIAGNOSTICS CONDITION 1 :sqlstate = RETURNED_SQLSTATE,
:sqlcode = DB2_RETURNED_SQLCODE, :row_num = DB2_ROW_NUMBER;
```

would result in

```
sqlstate = 02502, sqlcode = +222, and row_num = 3.
GET DIAGNOSTICS CONDITION 2 :sqlstate = RETURNED_SQLSTATE,
:sqlcode = DB2_RETURNED_SQLCODE, :row_num = DB2_ROW_NUMBER;
```

would result in

```
sqlstate = 02502, sqlcode = +222, and row_num = 5.
```

If a null indicator was not provided for any variable in a row that was a hole, an error occurs.

SQLCA usage summary: For multiple-row-fetch, the fields of the **SQLCA** are set as follows:

Condition		Action: Resulting Values Stored in the SQLCA Fields		
Errors	**DATA**	**SQLSTATE**	**SQLCODE**	**SQLERRD3**
No[1]	Return all requested rows	00000	0	# rows requested
No[1]	Return data for subset of requested rows, End of Data	02000	+100	#rows

Condition		Action: Resulting Values Stored in the SQLCA Fields		
Errors	DATA	SQLSTATE	SQLCODE	SQLERRD3
No[1]	Return all requested rows	sqlstate(2)	sqlcode(2)	#rows requested
Yes[1]	Return successfully fetched rows	sqlstate(3)	sqlcode(3)	#rows
Yes[1]	Return successfully fetched rows	sqlstate(4)	sqlcode(4)	#rows

Notes:

1. SQLWARN flags may be set in all cases, even if there are no other warnings or errors indicated. The warning flags are an accumulation of all warning flags set while processing the multiple-row-fetch.
2. sqlcode is the last positive SQLCODE, and sqlstate is the corresponding SQLSTATE value.
3. Database Server detected error. sqlcode is the first negative SQLCODE encountered, sqlstate is the corresponding SQLSTATE value.
4. Client detected error. sqlcode is the first negative SQLCODE encountered, sqlstate is one of the following SQLSTATEs: 22002, 22008, 22509, 22518, or 55021.

Providing indicator variables for error conditions: If an error occurs as the result of an arithmetic expression in the SELECT list of an outer SELECT statement (division by zero or overflow) or a numeric conversion error occurs, the result is the null value. As in any other case of a null value, an indicator variable must be provided and the main variable is unchanged. In this case, however, the indicator variable is set to -2. Processing of the statement continues as if the error had not occurred. (However, this error causes a positive SQLCODE.)

If you do not provide an indicator variable, a negative value is returned in the SQLCODE field of the SQLCA. Processing of the statement terminates when the error is encountered. No value is assigned to the host variable or to later variables, though any values that have already been assigned to variables remain assigned. Additionally, a -3 is returned in all indicators provided by the application when a hole was detected for the row on a rowset positioned FETCH, and values were not returned for the row. Processing of the statement terminates if a hole is detected and at least one indicator variable was not provided by the application.

Alternative syntax and synonyms: USING DESCRIPTOR can be specified as a synonym for INTO DESCRIPTOR.

Example

Example 1: The FETCH statement fetches the results of the SELECT statement into the application program variables DNUM, DNAME, and MNUM. When no more rows remain to be fetched, the not found condition is returned.

```
EXEC SQL DECLARE C1 CURSOR FOR
  SELECT DEPTNO, DEPTNAME, MGRNO FROM DSN8810.DEPT
  WHERE ADMRDEPT = 'A00';
 EXEC SQL OPEN C1;
 DO WHILE (SQLCODE = 0);
  EXEC SQL FETCH C1 INTO :DNUM, :DNAME, :MNUM;
 END;
 EXEC SQL CLOSE C1;
```

Example 2: For an example of FETCH statements with a dynamic scrollable cursor, see “Example 8” on page 822.

Example 3: Fetch the last 5 rows of the result table C1 using cursor C1:

```
FETCH ROWSET STARTING AT ABSOLUTE -5
   FROM C1 FOR 5 ROWS INTO DESCRIPTOR :MYDESCR;
```

Example 4: Fetch 6 rows starting at row 10 for cursor CURS1, and fetch the data into three host-variable-arrays:

```
FETCH ROWSET STARTING AT ABSOLUTE 10
   FROM CURS1 FOR 6 ROWS
   INTO :hav1, :hva2, :hva3;
```

Alternatively, a descriptor could have been specified in an INTO DESCRIPTOR clause where the information in the SQLDA reflects the data types of the host-variable-arrays:

```
FETCH ROWSET STARTING AT ABSOLUTE 10
   FROM CURS1 FOR 6 ROWS
   INTO DESCRIPTOR descriptor-name;
```

FREE LOCATOR

The FREE LOCATOR statement removes the association between a LOB locator variable and its value.

Invocation

This statement can only be embedded in an application program. It cannot be issued interactively. It is an executable statement that can be dynamically prepared. However, the EXECUTE statement with the USING clause must be used to execute the prepared statement. FREE LOCATOR cannot be used with the EXECUTE IMMEDIATE statement. It must not be specified in Java.

Authorization

None required.

Syntax

```
                   ┌─,─────────────┐
                   ▼               │
►►──FREE LOCATOR────host-variable──┴──────────────────────────────────────────►◄
```

Description

host-variable, ...

Identifies one or more locator variables that must be declared in accordance with the rules for declaring locator variables. The locator variable type must be a binary large object locator, a character large object locator, or a double-byte character large object locator.

The *host-variable* must currently have a locator assigned to it. That is, a locator must have been assigned during this unit of work (by a FETCH, SELECT INTO, assignment statement, SET *host-variable* statement, or VALUES INTO statement) and must not subsequently have been freed (by a FREE LOCATOR statement); otherwise, an error is returned.

If more than one locator is specified and an error is returned on one of the locators, it is possible that some locators have been freed and others have not been freed.

Example

Assume that the employee table contains columns RESUME, HISTORY, and PICTURE and that locators have been established in a program to represent the column values. Free the CLOB locator variables LOCRES and LOCHIST, and the BLOB locator variable LOCPIC.

```
EXEC SQL FREE LOCATOR :LOCRES, :LOCHIST, :LOCPIC
```

GET DIAGNOSTICS

The GET DIAGNOSTICS statement provides diagnostic information about the last SQL statement (other than a GET DIAGNOSTICS statement) that was executed. This diagnostic information is gathered as the previous SQL statement is executed. Some of the information available through the GET DIAGNOSTICS statement is also available in the SQLCA.

Invocation

This statement can only be embedded in an application program. It is an executable statement that cannot be dynamically prepared.

Authorization

None required.

Syntax

```
►►──GET DIAGNOSTICS──┬─┤ statement-information ├─┬──────────────────────────────────────────►◄
                     ├─┤ condition-information ├─┤
                     └─┤ combined-information ├──┘
```

statement-information:

statement-information:

```
      ┌─,──────────────────────────────────────────────────────┐
      ▼                                                        │
├──┬──host-variable1──=──┤ statement-information-item-name ├──┴─┬──────────────────────────────┤
   └─host-variable1──=──DB2_GET_DIAGNOSTICS_DIAGNOSTICS──────────┘
```

statement-information-item-name:

```
    ┌─,─────────────────────────────────┐
    ▼                                   │
├────┬─DB2_LAST_ROW───────────────────┬─┴──────────────────────────────────────────────────────┤
     ├─DB2_NUMBER_PARAMETER_MARKERS───┤
     ├─DB2_NUMBER_RESULT_SETS─────────┤
     ├─DB2_RETURN_STATUS──────────────┤
     ├─DB2_SQL_ATTR_CURSOR_HOLD───────┤
     ├─DB2_SQL_ATTR_CURSOR_ROWSET─────┤
     ├─DB2_SQL_ATTR_CURSOR_SCROLLABLE─┤
     ├─DB2_SQL_ATTR_CURSOR_SENSITIVITY┤
     ├─DB2_SQL_ATTR_CURSOR_TYPE───────┤
     ├─MORE───────────────────────────┤
     ├─NUMBER─────────────────────────┤
     └─ROW_COUNT──────────────────────┘
```

condition-information:

condition-information:

```
├──CONDITION──┬─host-variable2─┬──────────────────────────────────────────────────────────►
              └─integer────────┘


   ┌─,─────────────────────────────────────────────────────────┐
   ▼                                                           │
►──host-variable3── =──┬─┤ condition-information-item-name  ├─┬─┴──────────────────────────┤
                       └─┤ connection-information-item-name ├─┘
```

condition-information-item-name:

```
├──┬─CATALOG_NAME────────────────┬──────────────────────────────────────────────────────┤
   ├─CONDITION_NUMBER────────────┤
   ├─CURSOR_NAME─────────────────┤
   ├─DB2_ERROR_CODE1─────────────┤
   ├─DB2_ERROR_CODE2─────────────┤
   ├─DB2_ERROR_CODE3─────────────┤
   ├─DB2_ERROR_CODE4─────────────┤
   ├─DB2_INTERNAL_ERROR_POINTER──┤
   ├─DB2_MESSAGE_ID──────────────┤
   ├─DB2_MODULE_DETECTING_ERROR──┤
   ├─DB2_ORDINAL_TOKEN_n─────────┤
   ├─DB2_REASON_CODE─────────────┤
   ├─DB2_RETURNED_SQLCODE────────┤
   ├─DB2_ROW_NUMBER──────────────┤
   ├─DB2_SQLERRD_SET─────────────┤
   ├─DB2_SQLERRD1────────────────┤
   ├─DB2_SQLERRD2────────────────┤
   ├─DB2_SQLERRD3────────────────┤
   ├─DB2_SQLERRD4────────────────┤
   ├─DB2_SQLERRD5────────────────┤
   ├─DB2_SQLERRD6────────────────┤
   ├─DB2_TOKEN_COUNT─────────────┤
   ├─MESSAGE_TEXT────────────────┤
   ├─RETURNED_SQLSTATE───────────┤
   └─SERVER_NAME─────────────────┘
```

connection-information-item-name:

```
├──┬─DB2_AUTHENTICATION_TYPE─┬──────────────────────────────────────────────────────────┤
   ├─DB2_AUTHORIZATION_ID────┤
   ├─DB2_CONNECTION_STATE────┤
   ├─DB2_CONNECTION_STATUS───┤
   ├─DB2_ENCRYPTION_TYPE─────┤
   ├─DB2_SERVER_CLASS_NAME───┤
   └─DB2_PRODUCT_ID──────────┘
```

combined-information:

combined-information:

```
                                ┌─,──────────────────────────────────────┐
                                ▼              (1)                       │
├──host-variable4──=──ALL───────┬──STATEMENT─────────────────────────────┴──────────────────────┤
                                │                      (2)           │
                                └──┬─CONDITION──┬─────────────────────┘
                                   └─CONNECTION─┘      ├─host-variable5─┤
                                                       └─integer────────┘
```

Notes:

1 STATEMENT can only be specified once.

2 CONDITION and CONNECTION can only be specified once if host-variable5 or integer is not also specified.

Description

Diagnostic information is provided in three main areas: statement information, condition information, and combined information. After the execution of an SQL statement, information about the execution of the statement is provided as statement information, and at least one instance of condition information is provided. The number of instances of the condition information is indicated by the NUMBER item that is available in the statement information. Combined information contains a text representation of all the information gathered about the execution of the SQL statement.

The diagnostic information that is provided is specific to the server. If you are connected to a server other than DB2 UDB for z/OS, see that product's documentation for the diagnostic information that is returned.

statement-information
Provides information about the last SQL statement executed.

host-variable1
Identifies a variable described in the program in accordance with the rules for declaring host variables. The data type of the host variable must be the data type as specified in "Data types for GET DIAGNOSTICS items" on page 938.

The host variable is assigned the value of the specified statement information item. If the value is truncated when assigning it to the host variable, a warning is returned and the GET_DIAGNOSTICS_DIAGNOSTICS item of the diagnostics area is updated with the details of this condition. If a DIAGNOSTICS item is not set, then the host variable is set to a default value, based on its data type: 0 for an exact numeric field, an empty string for a VARCHAR field, and blanks for a CHAR field.

DB2_GET_DIAGNOSTICS_DIAGNOSTICS
Contains textual information about errors or warnings that may have occurred in the execution of the GET DIAGNOSTICS statement. The format of the information is similar to what would be returned by a GET DIAGNOSTICS :hv = ALL statement.

statement-information-item-name:

DB2_LAST_ROW
For a multiple-row FETCH statement, contains a value of +100 if the last row currently in the table is in the set of rows that have been fetched. For cursors that are not sensitive to updates, there would be no need to do a subsequent FETCH, because the result would be an end-of-data indication. For cursors that are sensitive to updates, a subsequent FETCH may return more data if a row had been inserted before the FETCH was executed. For statements other than multiple-row FETCH statements, or for multiple-row FETCH statements that do not contain the last row, this variable contains the value 0.

DB2_NUMBER_PARAMETER_MARKERS
For a PREPARE statement, contains the number of parameter markers in the prepared statement. Otherwise, or if the server only returns an SQLCA, the value zero is returned.

DB2_NUMBER_RESULT_SETS
For a CALL statement, contains the actual number of result sets returned by the procedure. Otherwise, or if the server only returns an SQLCA, the value zero is returned.

DB2_NUMBER_ROWS
If the previous SQL statement was an OPEN or a FETCH that caused the size of the result table to be unknown, returns the number of rows in the result table. For SENSITIVE DYNAMIC cursors, this value can be thought of as an approximation because rows that are inserted and deleted will affect the next retrieval of this value. If the previous SQL statement was a PREPARE statement, returns the estimated number of rows in the result table for the prepared statement. Otherwise, or if the server only returns an SQLCA, the value zero is returned.

DB2_RETURN_STATUS
Identifies the status value returned from the stored procedure associated with the previously executed SQL statement, provided that the statement was a CALL statement that invoked a procedure that returns a status. . Otherwise, or if the server only returns an SQLCA, the value zero is returned.

DB2_SQL_ATTR_CURSOR_HOLD
For an ALLOCATE or OPEN statement, indicates whether a cursor can be held open across multiple units of work.

- N indicates that this cursor does not remain open across multiple units of work.
- Y indicates that this cursor remains open across multiple units of work.

Otherwise, a blank is returned.

DB2_SQL_ATTR_CURSOR_ROWSET
For an ALLOCATE or OPEN statement, indicates whether or not a cursor can be accesses using rowset positioning.

- N indicates that this cursor supports only row positioned operations.
- Y indicates that this cursor supports rowset positioned operations.

Otherwise, a blank is returned.

DB2_SQL_ATTR_CURSOR_SCROLLABLE
For an ALLOCATE or OPEN statement, indicates whether or not a cursor can be scrolled forward and backward.

- N indicates that this cursor is not scrollable.

- Y indicates that this cursor is scrollable.

Otherwise, a blank is returned.

DB2_SQL_ATTR_CURSOR_SENSITIVITY
For an ALLOCATE or OPEN statement, indicates whether or not a cursor does or does not show updates to cursor rows made by other connections.

- I indicates insensitive.
- S indicates sensitive.

Otherwise, a blank is returned.

DB2_SQL_ATTR_CURSOR_TYPE
For an ALLOCATE or OPEN statement, indicates the type of cursor, whether a cursor type is forward-only, static, or dynamic.

- F indicates a forward cursor.
- D indicates a dynamic cursor.
- S indicates a static cursor.

Otherwise, a blank is returned.

MORE
Indicates whether some of the warning and errors from the previous SQL statement were stored or discarded.

- N indicates that all the warnings and errors from the previous SQL statement are stored in the diagnostic area.
- Y indicates that some of the warnings and errors from the previous SQL statement were discarded because the amount of storage needed to record warnings and errors exceeded 65535 bytes.

NUMBER
Returns the number of errors and warnings detected by the execution of the previous SQL statement, other than a GET DIAGNOSTICS statement, that have been stored in the diagnostics area. If the previous SQL statement returned an SQLSTATE of 00000 or no previous SQL statement has been executed, the number returned is one.

The GET DIAGNOSTICS statement itself may return information via the SQLSTATE parameter, but does not modify the previous contents of the diagnostics area, except for the DB2_GET_DIAGNOSTICS_DIAGNOSTICS item.

ROW_COUNT
Identifies the number of rows associated with the previous SQL statement that was executed.

If the previous SQL statement is a DELETE, INSERT, or UPDATE statement, ROW_COUNT identifies the number of rows deleted, inserted, or updated by that statement, excluding rows affected by either triggers or referential integrity constraints.

If the previous SQL statement is a multiple-row FETCH, ROW_COUNT identifies the number of rows fetched.

A value of -1 indicates a mass delete from a table in a segmented table space.

Otherwise, or if the server only returns an SQLCA, the value zero is returned.

condition-information

Assigns the values of the specified condition information to the associated host variables. The host variable specified must be of the data type that is compatible with the data type of the specified diagnostic-ID or an error occurs. If the value of the condition is truncated when assigning it to the host variable, an error occurs. If an indicator variable was provided, the length of the value is returned in the indicator variable.

If a DIAGNOSTICS item is not set, then the host variable is set to a default value, based on the data type of the item. The specific value will be 0 for a numeric field, an empty string for a VARCHAR field, and blanks for a CHAR field.

host-variable2 or **integer**

Identifies the diagnostic for which information is requested. Each diagnostic that occurs while executing an SQL statement is assigned an integer. The value 1 indicates the first diagnostic, 2 indicates the second diagnostic, and so on. If the value is 1, the diagnostic information that is retrieved corresponds to the condition that is indicated by the SQLSTATE value actually returned by the execution of the previous SQL statement (other than a GET DIAGNOSTICS statement). The host variable specified must be a numeric data type or an error occurs. An indicator variable is not allowed for this host variable. If a value is specified that is less than or equal to zero or greater than the number of available diagnostics, an error occurs.

host-variable3

Identifies a variable described in the program in accordance with the rules for declaring host variables. The data type of the host variable must be the data type as specified in “Data types for GET DIAGNOSTICS items” on page 938 for the indicated condition-information item.

condition-information-item-name

CATALOG_NAME

If the returned SQLSTATE is any one of the following values, the constraint that caused the error is a referential, check, or unique constraint. The location (RDB) name of the server that generated the condition is returned.

- Class 09 (Triggered Action Exception),
- Class 23 (Integrity Constraint Violation)
- Class 27 (Triggered Data Change Violation)
- 40002 (Transaction Rollback - Integrity Constraint Violation)
- 40004 (Transaction Rollback - Triggered Action Exception)

If the returned SQLSTATE is class 42 (Syntax Error or Access Rule Violation), the server name of the table that caused the error is returned.

If the returned SQLSTATE is class 44 (WITH CHECK OPTION Violation), the server name of the view that caused the error is returned.

Otherwise, the empty string is returned.

The actual server name may be different than the server name specified, either implicitly or explicitly, on the CONNECT statement because of the use of aliases or synonyms.

CONDITION_NUMBER

Returns the number of the diagnostic returned.

CURSOR_NAME
If the returned SQLSTATE is class 24 (Invalid Cursor State), the name of the cursor is returned. Otherwise, the empty string is returned.

DB2_ERROR_CODE1[34]
Returns an internal error code. Otherwise, or if the server only returns an SQLCA, the value 0 is returned.

DB2_ERROR_CODE2[35]
Returns an internal error code. Otherwise, or if the server only returns an SQLCA, the value 0 is returned.

DB2_ERROR_CODE3[36]
Returns an internal error code. Otherwise, or if the server only returns an SQLCA, the value 0 is returned.

DB2_ERROR_CODE4[37]
Returns an internal error code. Otherwise, or if the server only returns an SQLCA, the value 0 is returned.

DB2_INTERNAL_ERROR_POINTER
For some errors, this is a negative value that is an internal error pointer. Otherwise, the value 0 is returned.

DB2_MESSAGE_ID
Corresponds to the message that is contained in the MESSAGE_TEXT diagnostic item (for example, DSNT102I or DSNU180I).

DB2_MODULE_DETECTING_ERROR
Returns an identifier indicating which module detected the error. For a SIGNAL statement that is issued from a routine, the value ’ROUTINE’ is returned. Otherwise, the string ’DSN   ’ is returned.

DB2_ORDINAL_TOKEN_n
Returns the *n*th token. *n* must be a value from 1 to 100. For example, DB2_ORDINAL_TOKEN_1 would return the value of the first token, DB2_ORDINAL_TOKEN_2 the second token, and so on. A numeric value for a token is converted to characters before being returned. If there is no value for the token, or if the server only returns an SQLCA, an empty string is returned.

DB2_REASON_CODE
Contains the reason code for errors that have a reason code token in the message text. Otherwise, the value zero is returned.

DB2_RETURNED_SQLCODE
Returns the SQLCODE for the specified diagnostic.

DB2_ROW_NUMBER
Returns the number of the row where the condition was encountered, when such information is available and applicable.

DB2_SQLERRD_SET
A value of Y indicates that the DB2_SQLERRD1 through DB2_SQLERRD items might be set. These items are set only when communicating with a

[34] SQLERRD1

[35] SQLERRD2

[36] SQLERRD3

[37] SQLERRD4

server that returns the SQLCA SQL communications area and not the new diagnositics area. Otherwise, a blank is returned.

DB2_SQLERRD1
Returns the value of sqlerrd(1) from the SQLCA that is returned by the server. Otherwise, the value zero is returned.

DB2_SQLERRD2
Returns the value of sqlerrd(2) from the SQLCA that is returned by the server. Otherwise, the value zero is returned.

DB2_SQLERRD3
Returns the value of sqlerrd(3) from the SQLCA that is returned by the server. Otherwise, the value zero is returned.

DB2_SQLERRD4
Returns the value of sqlerrd(4) from the SQLCA that is returned by the server. Otherwise, the value zero is returned.

DB2_SQLERRD5
Returns the value of sqlerrd(5) from the SQLCA that is returned by the server. Otherwise, the value zero is returned.

DB2_SQLERRD6
Returns the value of sqlerrd(6) from the SQLCA that is returned by the server. Otherwise, the value zero is returned.

DB2_TOKEN_COUNT
Returns the number of tokens available for the specified diagnostic ID.

MESSAGE_TEXT
Returns the message text that is associated with the SQLCODE. This is the short text, including substituted tokens. The message text does not contain the message number.

RETURNED_SQLSTATE
Returns the SQLSTATE for the specified diagnostic.

SERVER_NAME
If the previous SQL statement is a CONNECT, DISCONNECT, or SET CONNECTION statement, returns the name of the server specified in the previous statement is returned. Otherwise, the name of the server where the statement executes is returned.

connection-information-item-name
Provides information about the last SQL statement executed if it was a CONNECT statement.

DB2_AUTHENTICATION_TYPE
Contains an authentication type value of:

- ‘S’ for a server authentication
- ‘C’ for client authentication
- Otherwise, or if the server only returns an SQLCA, a blank is returned

DB2_AUTHORIZATION_ID
Authorization ID used by connected server. Because of user ID translation and authorization exits, the local user ID may not be the authorized ID used by the server.

DB2_CONNECTION_STATE
Contains the connection state:

- -1 if the connection is unconnected

- 1 if the connection is connected

Otherwise, or if the server only returns an SQLCA, the value zero is returned.

DB2_CONNECTION_STATUS
Contains a value of:

- 1 if committable updates can be performed on the connection for this unit of work
- 2 if no committable updates can be performed on the connection for this unit of work

Otherwise, or if the server only returns an SQLCA, the value zero is returned.

DB2_SERVER_CLASS_NAME
For a CONNECT or SET CONNECTION statement, contains one of the following values:

- QAS for DB2 UDB foriSeries™
- QDB2 for DB2 UDB for OS/390 and z/OS
- QDB2/2 for DB2 UDB for OS/2
- QDB2/6000 for DB2 UDB for AIX®
- QDB2/6000 PE for DB2 UDB for AIX Parallel Edition
- QDB2/AIX64 for DB2 UDB for AIX 64-bit
- QDB2/HPUX for DB2 UDB for HP-UX
- QDB2/HP64 for DB2 UDB for HP-UX 64-bit
- QDB2/LINUX for DB2 UDB for Linux
- QDB2/LINUX390 for DB2 UDB for Linux
- QDB2/LINUXIA64 for DB2 UDB for Linux
- QDB2/LINUXPPC for DB2 UDB for Linux
- QDB2/LINUXPPC64 for DB2 UDB for Linux
- QDB2/LINUXZ64 for DB2 UDB for Linux
- QDB2/NT for DB2 UDB for NT
- QDB2/NT64 for DB2 UDB for NT 64-bit
- QDB2/PTX for DB2 UDB for NUMA-Q
- QDB2/SCO for DB2 UDB for SCO UnixWare
- QDB2/SGI for DB2 UDB for Silicon Graphics
- QDB2/SNI for DB2 UDB for Siemens Nixdorf
- QDB2/SUN for DB2 UDB for SUN Solaris
- QDB2/SUN64 for DB2 UDB for SUN Solaris 64-bit
- QDB2/Windows 95 for DB2 UDB for Windows® 95 or Windows 98
- QSQLDS/VM for DB2 for VM and VSE
- QSQLDS/VSE for DB2 for VM and VSE

Otherwise, the empty string is returned.

DB2_ENCRYPTION_TYPE
The level of encryption for the connection:

- A indicates only the authentication tokens (authid and password) are encrypted.
- D indicates all data is encrypted for the connection.

- Otherwise, a blank is returned.

DB2_PRODUCT_ID

Returns a product signature. If the application server is an IBM relational database product, the form is *pppvvrrm*, where:

- *ppp* identifies the product as follows:
  - ARI for DB2 Server for VSE & VM
  - DSN for DB2 UDB for z/OS
  - QSQ for DB2 UDB for iSeries
  - SQL for all other DB2 UDB products
- *vv* is a two-digit version identifier such as ’08’
- *rr* is a two-digit release identifier such as ‘01’
- *m* is a one-digit maintenance level identifier such as ‘5’ (Values 0, 1, 2, 3, and 4 are for maintenance levels in compatibility and enabling-new-function mode. Values 5, 6, 7, 8, and 9 are for maintenance levels in new-function mode.)

For example, if the application server is Version 8 of DB2 UDB for z/OS in new-function mode with the latest maintenance, the value would be ‘DSN08015’.

combined-information

Provides a text representation of all the information gathered about the execution of the SQL statement.

ALL

Indicates that all diagnostic items that are set for the last SQL statement executed are to be combined into one string. The format of the string is a semicolon separated list of all of the available diagnostic information in the form: <item-name>[(<condition-number>)]=<value-converted-to-character>;... as shown in the following example:

```
NUMBER=1;RETURNED_SQLSTATE=02000;DB2_RETURNED_SQLCODE=+100;
```

host-variable4

Identifies a variable described in the program in accordance with the rules for declaring host variables. The data type of the host variable must be VARCHAR. If the length of *host-variable4* is not sufficient to hold the full returned diagnostic string, the string is truncated, a warning is returned, and the GET_DIAGNOSTICS_DIAGNOSITICS item of the diagnostics area is updated with the details of this condition.

STATEMENT

Indicates that all statement-information-item-name diagnostic items that are set for the last SQL statement executed should be combined into one string. The format is the same as described for the ALL option.

CONDITION

Indicates that all condition-information-item-name diagnostic items that are set for the last SQL statement executed should be combined into one string. If *host-variable5* or integer is supplied after CONDITION, the format is the same as described above for the ALL option. If *host-variable5* or integer is not supplied, the format includes a condition number entry at the beginning of the information for that condition in the form:

CONDITION_NUMBER=X;<item-name>=<value-converted-to-character>;... where X is the number of the condition, as shown in the following example:

```
CONDITION_NUMBER=1;RETURNED_SQLSTATE=02000;RETURNED_SQLCODE=100;
   CONDITION_NUMBER=2;RETURNED_SQLSTATE=01004;
```

CONNECTION
Indicates that all connection-information-item-name diagnostic items that are set for the last SQL statement executed should be combined into one string. If *host-variable5* or integer is supplied after CONNECTION, the format is the same as described for the ALL option. If *host-variable5* or integer is not supplied, then the format includes a condition number entry at the beginning of the information for that condition in the form:

CONNECTION_NUMBER=X;<item-name>=<value-converted-to-character>;... where X is the number of the condition, as shown in the following example:

```
CONNECTION_NUMBER=1;CONNECTION_NAME=SVL1;DB2_PRODUCT_ID=DSN08010;
```

host-variable5 or *integer*
Identifies the diagnostic for which ALL CONDITION or ALL CONNECTION information is requested. The host variable specified must be a numeric data type or an error occurs. An indicator variable is not allowed for this host variable or an error occurs. If a value is specified that is less than or equal to zero or greater than the number of available diagnostics, an error occurs.

Notes

The GET DIAGNOSTICS statement does not change the contents of the diagnostics area (SQLCA). If an SQLSTATE or SQLCODE special variable is declared in the SQL procedure, these are set to the SQLSTATE or SQLCODE returned from issuing the GET DIAGNOSTICS statement. The SQLSTATE and SQLCODE values from before the GET DIAGNOSTICS statement was issued are still available in the diagnostics area by issuing a GET DIAGNOSTICS for RETURNED_SQLSTATE and DB2_RETURNED_SQLCODE.

Data types for GET DIAGNOSTICS items

Table 84. Data types for GET DIAGNOSTICS items

Item	Data type
Statement Information	
DB2_GET_DIAGNOSTICS_DIAGNOSTICS	VARCHAR(32672)
DB2_LAST_ROW	INTEGER
DB2_NUMBER_PARAMETER_MARKERS	INTEGER
DB2_NUMBER_RESULT_SETS	INTEGER
DB2_NUMBER_ROWS	DECIMAL(31,0)
DB2_RETURN_STATUS	INTEGER
DB2_SQL_ATTR_CURSOR_HOLD	CHAR(1)
DB2_SQL_ATTR_CURSOR_ROWSET	CHAR(1)
DB2_SQL_ATTR_CURSOR_SCROLLABLE	CHAR(1)
DB2_SQL_ATTR_CURSOR_SENSITIVITY	CHAR(1)
DB2_SQL_ATTR_CURSOR_TYPE	CHAR(1)
MORE	CHAR(1)
NUMBER	INTEGER
ROW_COUNT	DECIMAL(31,0)
Condition Information	

Table 84. Data types for GET DIAGNOSTICS items (continued)

Item	Data type
CATALOG NAME	VARCHAR(128)
CONDITION_NUMBER	INTEGER
CURSOR_NAME	VARCHAR(128)
DB2_ERROR_CODE1	INTEGER
DB2_ERROR_CODE2	INTEGER
DB2_ERROR_CODE3	INTEGER
DB2_ERROR_CODE4	INTEGER
DB2_INTERNAL_ERROR_POINTER	INTEGER
DB2_MESSAGE_ID	CHAR(10)
DB2_MODULE_DETECTING_ERROR	CHAR(8)
DB2_ORDINAL_TOKEN_n	VARCHAR(515)
DB2_REASON_CODE	INTEGER
DB2_RETURNED_SQLCODE	INTEGER
DB2_ROW_NUMBER	DECIMAL(31,0)
DB2_TOKEN_COUNT	INTEGER
MESSAGE_TEXT	VARCHAR(32672)
RETURNED_SQLSTATE	CHAR(5)
SERVER_NAME	VARCHAR(128)
Connection Information	
DB2_AUTHENTICATION_TYPE	CHAR(1)
DB2_AUTHORIZATION_ID	VARCHAR(128)
DB2_CONNECTION_STATE	INTEGER
DB2_CONNECTION_STATUS	INTEGER
DB2_ENCRYPTION_TYPE	CHAR(1)
DB2_PRODUCT_ID	VARCHAR(8)
DB2_SERVER_CLASS_NAMED	CHAR(128)
Combined Information	
ALL	VARCHAR(32672)

DRDA considerations The GET DIAGNOSTICS statement is supported from a DB2 UDB for z/OS Version 8 client, regardless of the level of the server (a DB2 UDB for z/OS Version 7 or a DB2 UDB for Windows Version 7, for example). When connected to servers that do not support the Open Group Version 3 DRDA standard, a subset of diagnostic information is generated based on the returned SQLCA. The condition contains the following information:

- The DB2_RETURNED_SQLCODE is set based on the SQLCODE.
- The RETURNED_SQLSTATE is set based on the SQLSTATE.
- The DB2_GET_DIAGNOSTICS_DIAGNOSTICS item contains the information from the SQLCA that came from the server.

Only if you are using multi-row fetch or insert is there a need to have the extended diagnostic information that is provided by servers that support the Open Group Version 3 DRDA standard.

Alternative syntax and synonyms: To provide compatibility with previous releases of DB2 or other products in the DB2 UDB family, DB2 supports the following keywords:

- RETURN_STATUS as a synonym for DB2_RETURN_STATUS
- EXCEPTION as a synonym for CONDITION

Examples

Example 1: In an application, use the GET DIAGNOSTICS statement to determine how many rows were updated.

```
long rcount;
EXEC SQL UPDATE T1 SET C1 = C1 + 1;
EXEC SQL GET DIAGNOSTICS :rcount = ROW_COUNT;
```

After execution of this code segment, rcount will contain the number of rows that were updated.

Example 2: In an application, use the GET DIAGNOSTICS statement to handle multiple SQL Errors.

```
long numerrors, counter;
char retsqlstate[5];
long hva[5];
EXEC SQL INSERT INTO T1 FOR 5 ROWS VALUES (:hva) NOT ATOMIC
  CONTINUE ON SQLEXCEPTION;
EXEC SQL GET DIAGNOSTICS :numerrors = NUMBER;
for ( i=1;i < numerrors;i++)
  {
  EXEC SQL GET DIAGNOSTICS CONDITION :i :retsqlstate = RETURNED_SQLSTATE;
```

Execution of this code segment sets and prints retsqlstate with the SQLSTATE for each error that was encountered in the previous SQL statement.

Example 3: Retrieve information about a connection.

```
EXEC SQL GET DIAGNOSTICS :HV_PRODUCT_ID = DB2_PRODUCT_ID;
```

Example 4: Use the GET DIAGNOSTICS statement to retrieve information that is similar to what is returned in the SQLCA:

```
EXEC SQL GET DIAGNOSTICS CONDITION 1
     :dasqlcode   = DB2_RETURNED_SQLCODE,
     :datokencnt  = DB2_TOKEN_COUNT,
     :datoken1    = DB2_ORDINAL_TOKEN_1,
     :datoken2    = DB2_ORDINAL_TOKEN_2,
     :datoken3    = DB2_ORDINAL_TOKEN_3,
     :datoken4    = DB2_ORDINAL_TOKEN_4,
     :datoken5    = DB2_ORDINAL_TOKEN_5,
     :dasqlerrd1b = DB2_MESSAGE_ID,
     :damsgtext   = MESSAGE_TEXT,
     :dasqlerrp   = DB2_MODULE_DETECTING_ERROR,
     :dasqlstate  = RETURNED_SQLSTATE;
```

GRANT

The GRANT statement grants privileges to authorization IDs. There is a separate form of the statement for each of these classes of privilege:

- Collection
- Database
- Distinct type
- Function or stored procedure
- Package
- Plan
- Schema
- Sequence
- System
- Table or view
- Use

The applicable objects are always at the current server. The grants are recorded in the current server's catalog.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

If the authorization mechanism was not activated when the DB2 subsystem was installed, an error condition occurs.

Authorization

To grant a privilege P, the privilege set must include one of the following:

- The privilege P WITH GRANT OPTION
- Ownership of the object on which P is a privilege
- SYSADM authority

The presence of SYSCTRL authority in the privilege set allows the granting of all authorities except:

- DBADM on databases
- DELETE, INSERT, SELECT, and UPDATE on user tables or views
- EXECUTE on plans, packages, functions, or stored procedures
- PACKADM on collections
- SYSADM authority

Except for views, the GRANT option for privileges on a table is also inherent in DBADM authority for its database, provided DBADM authority was acquired with the GRANT option. See "CREATE VIEW" on page 805 for a description of the rules that apply to views.

If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package. If the statement is dynamically prepared, the privilege set is the privileges that are held by the SQL authorization ID of the process.

Syntax

```
                                                 ┌─,──────────────────────┐
                                                 ▼                        │
►►──GRANT──authorization-specification──TO───┬─authorization-name──────┴──────────────────►
                                             ├─PUBLIC──────────────────┤
                                             └─PUBLIC AT ALL LOCATIONS─┘

►──┬───────────────────┬──────────────────────────────────────────────────────────────────►◄
   └─WITH GRANT OPTION─┘
```

Description

authorization-specification
Specifies one or more privileges for the class of privilege. The same privilege must not be specified more than once.

TO
Specifies to what authorization IDs the privileges are granted.

authorization-name,...
Lists one or more authorization IDs.

The value of CURRENT RULES determines whether you can use the ID of the GRANT statement itself (to grant privileges to yourself). When CURRENT RULES is:

DB2
You cannot use the ID of the GRANT statement.

STD
You can use the ID of the GRANT statement.

PUBLIC
Grants the privileges to all users at the current server, including database requesters using DRDA access.

PUBLIC AT ALL LOCATIONS
Grants the privileges to all users in the network. Applies to table privileges only, excluding ALTER, INDEX, REFERENCES, and TRIGGER.

PUBLIC AT ALL LOCATIONS applies to DB2 private protocol access only.

WITH GRANT OPTION
Allows the named users to grant the privileges to others. Granting an administrative authority with this option allows the user to specifically grant any privilege belonging to that authority. If you omit WITH GRANT OPTION, the named users cannot grant the privileges to others unless they have that authority from some other source.

GRANT authority cannot be passed to PUBLIC or to PUBLIC AT ALL LOCATIONS. When WITH GRANT OPTION is used with either of these, a warning is issued, and the named privileges are granted, but without GRANT authority.

Notes

For more on DB2 privileges, read Part 3 (Volume 1) of *DB2 Administration Guide*.

A *grant* is the granting of a specific privilege by a specific grantor to a specific grantee. The grantor for a given GRANT statement is the authorization ID for the privilege set; that is, the SQL authorization ID of the process or the authorization ID of the owner of the plan or package. The grantee, as recorded in the catalog, is an authorization ID, PUBLIC, or PUBLIC*, where PUBLIC* denotes PUBLIC AT ALL LOCATIONS.

Duplicate grants from the same grantor are not recorded in the catalog. Otherwise, the result of executing a GRANT statement is recorded as one or more grants in the current server's catalog.

If more than one privilege or *authorization-name* is specified after the TO keyword and one of the grants is in error, execution of the statement is stopped and no grants are made. The status of the privilege or privileges granted is recorded in the catalog for each *authorization-name*.

Different grantors can grant the same privilege to a single grantee. The grantee retains that privilege as long as one or more of those grants are recorded in the catalog. Privileges that imply other privileges are also termed *authorities*. Grants are removed from the catalog by executing SQL REVOKE statements.

Whenever a grant is made for a database, distinct type, package, plan, schema, stored procedure, table, trigger, user-defined function, view, or USE privilege for an object that does not exist, an SQL return code is issued and the grant is not made.

PUBLIC AT ALL LOCATIONS: PUBLIC AT ALL LOCATIONS can continue to be specified as an alternative to PUBLIC as in prior releases. PUBLIC AT ALL LOCATIONS was introduced and was intended for use only with DB2 private protocol access.

GRANT (collection privileges)

This form of the GRANT statement grants privileges on collections.

Syntax

```
                                                ┌─,──────────────┐          ┌─,──────────────────┐
                                                ▼                │          ▼                    │
►►──GRANT──┬─CREATE──┬──┬─ON─┬──COLLECTION──┬──collection-id─┴──┬──TO──┬─authorization-name─┴──────►
           └─PACKADM─┘  └─IN─┘              └─*─────────────────┘      └─PUBLIC─────────────┘

►──┬───────────────────┬──────────────────────────────────────────────────────────────────────────►◄
   └─WITH GRANT OPTION─┘
```

Description

CREATE IN

Grants the privilege to use the BIND subcommand to create packages in the designated collections.

The word ON can be used instead of IN.

PACKADM ON

Grants package administrator authority for the designated collections.

The word IN can be used instead of ON.

COLLECTION *collection-id,...*

Identifies the collections on which the specified privilege is granted. The collections do not have to exist.

COLLECTION *

Indicates that the specified privilege is granted on all collections including those that do not currently exist.

TO

Refer to “GRANT” on page 941 for a description of the TO clause.

WITH GRANT OPTION

Refer to “GRANT” on page 941 for a description of the WITH GRANT OPTION clause.

Example

Grant the privilege to create new packages in collections QAACLONE and DSN8CC61 to CLARK.

```
GRANT CREATE IN COLLECTION QAACLONE, DSN8CC61 TO CLARK;
```

GRANT (database privileges)

This form of the GRANT statement grants privileges on databases.

Syntax

```
            ┌─,──────────────┐                 ┌─,───────────────┐      ┌─,────────────────────────┐
            ▼                │                 ▼                 │      ▼                          │
►►──GRANT─────┬─DBADM──────┬─┴──ON DATABASE─────database-name────┴──TO─────┬─authorization-name─┬─┴──────────►
              ├─DBCTRL─────┤                                                └─PUBLIC─────────────┘
              ├─DBMAINT────┤
              ├─CREATETAB──┤
              ├─CREATETS───┤
              ├─DISPLAYDB──┤
              ├─DROP───────┤
              ├─IMAGCOPY───┤
              ├─LOAD───────┤
              ├─RECOVERDB──┤
              ├─REORG──────┤
              ├─REPAIR─────┤
              ├─STARTDB────┤
              ├─STATS──────┤
              └─STOPDB─────┘

►──┬───────────────────┬──────────────────────────────────────────────────────────────────────────────►◄
   └─WITH GRANT OPTION─┘
```

Description

Each keyword listed grants the privilege described, but only as it applies to or within the databases named in the statement.

DBADM
Grants the database administrator authority.

DBCTRL
Grants the database control authority.

DBMAINT
Grants the database maintenance authority.

CREATETAB
Grants the privilege to create new tables. For a TEMP database, PUBLIC implicitly has the CREATETAB privilege (without GRANT authority) to define declared temporary tables; this privilege is not recorded in the DB2 catalog, and it cannot be revoked.

CREATETS
Grants the privilege to create new table spaces.

DISPLAYDB
Grants the privilege to issue the DISPLAY DATABASE command.

DROP
Grants the privilege to issue the DROP or ALTER DATABASE statements for the designated databases.

IMAGCOPY
Grants the privilege to run the COPY, MERGECOPY, and QUIESCE utilities against table spaces of the specified databases, and to run the MODIFY utility.

LOAD
Grants the privilege to use the LOAD utility to load tables.

RECOVERDB
Grants the privilege to use the RECOVER and REPORT utilities to recover table spaces and indexes.

REORG
Grants the privilege to use the REORG utility to reorganize table spaces and indexes.

REPAIR
Grants the privilege to use the REPAIR and DIAGNOSE utilities.

STARTDB
Grants the privilege to issue the START DATABASE command.

STATS
Grants the privilege to use the RUNSTATS utility to update statistics, and the CHECK utility to test whether indexes are consistent with the data they index.

STOPDB
Grants the privilege to issue the STOP DATABASE command.

ON DATABASE *database-name,...*
Identifies databases on which privileges are to be granted. For each named database, the grantor must have all the specified privileges with the GRANT option. Each name must identify a database that exists at the current server. DSNDB01 must not be identified; however, a grant of a privilege on DSNDB06 implies the granting of the same privilege on DSNDB01 for utility operations only.

TO
Refer to “GRANT” on page 941 for a description of the TO clause.

WITH GRANT OPTION
Refer to “GRANT” on page 941 for a description of the WITH GRANT OPTION clause.

Examples

Example 1: Grant drop privileges on database DSN8D81A to user PEREZ.

```
GRANT DROP
  ON DATABASE DSN8D81A
  TO PEREZ;
```

Example 2: Grant repair privileges on database DSN8D81A to all local users.

```
GRANT REPAIR
  ON DATABASE DSN8D81A
  TO PUBLIC;
```

Example 3: Grant authority to create new tables and load tables in database DSN8D81A to users WALKER, PIANKA, and FUJIMOTO, and give them grant privileges.

```
GRANT CREATETAB,LOAD
  ON DATABASE DSN8D81A
  TO WALKER,PIANKA,FUJIMOTO
  WITH GRANT OPTION;
```

GRANT (distinct type or JAR privileges)

This form of the GRANT statement grants the privilege to use distinct types (user-defined data types) or JARs.

Syntax

```
                                         ┌─,─────────────────────┐             ┌─,──────────────────────┐
►►──GRANT──USAGE ON──┬─DISTINCT TYPE───▼─distinct-type-name─┴─┬──TO───▼─┬─authorization-name─┬─┴──────────►
                     │           ┌─,──────┐                   │          └─PUBLIC─────────────┘
                     └─JAR───▼─jar-name─┴───────────────────┘

►─┬───────────────────┬──────────────────────────────────────────────────────────────────────────────►◄
  └─WITH GRANT OPTION─┘
```

Description

USAGE
Grants the privilege to use the distinct type in tables, functions procedures, or CAST expressions, or the privilege to use the JAR.

DISTINCT TYPE *distinct-type-name*
Identifies the distinct type. The name, including the implicit or explicit schema name, must identify a unique distinct type that exists at the current server. If you do not explicitly qualify the distinct type name, it is implicitly qualified with a schema name according to the following rules:

- If the statement is embedded in a program, the schema name is the authorization ID in the QUALIFIER option when the plan or package was created or last rebound. If QUALIFIER was not used, the schema name is the owner of the plan or package.
- If the statement is dynamically prepared, the schema name is the SQL authorization ID in the CURRENT SQLID special register.

JAR *jar-name*
Identifies the JAR. The name, including the implicit or explicit schema name, must identify a unique JAR that exists at the current server. If you do not explicitly qualify the JAR name, it is implicitly qualified with a schema name according to the following rules:

- If the statement is embedded in a program, the schema name is the authorization ID in the QUALIFIER option when the plan or package was created or last rebound. If QUALIFIER was not used, the schema name is the owner of the plan or package.
- If the statement is dynamically prepared, the schema name is the SQL authorization ID in the CURRENT SQLID special register.

TO
Refer to “GRANT” on page 941 for a description of the TO clause.

WITH GRANT OPTION
Refer to “GRANT” on page 941 for a description of the WITH GRANT OPTION clause.

Notes

Alternative syntax and synonyms: To provide compatibility with previous releases of DB2 or other products in the DB2 UDB family, DB2 supports DATA TYPE as a synonym for DISTINCT TYPE.

Examples

Example 1: Grant the USAGE privilege on distinct type SHOE_SIZE to user JONES. This GRANT statement does not give JONES the privilege to execute the cast functions that are associated with the distinct type SHOE_SIZE.

```
GRANT USAGE ON DISTINCT TYPE SHOE_SIZE TO JONES;
```

Example 2: Grant the USAGE privilege on distinct type US_DOLLAR to all users at the current server.

```
GRANT USAGE ON DISTINCT TYPE US_DOLLAR TO PUBLIC;
```

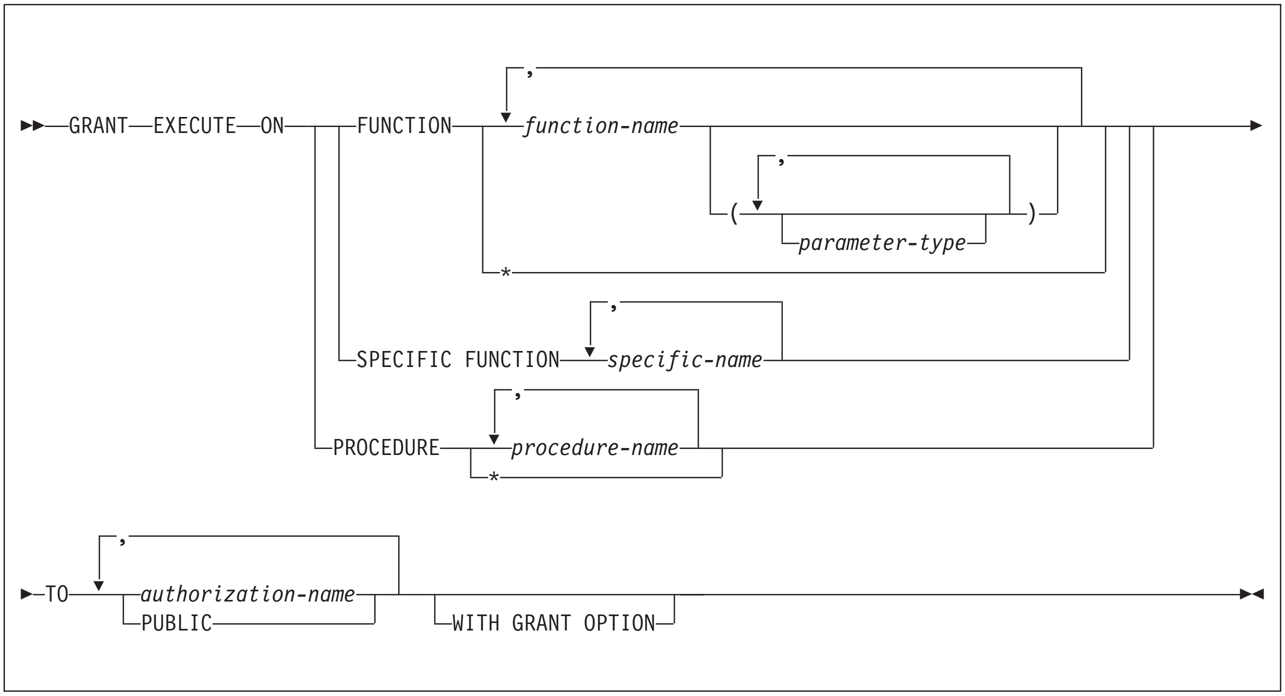
Example 3: Grant the USAGE privilege on distinct type CANADIAN_DOLLAR to the administrative assistant (ADMIN_A), and give this user the ability to grant the USAGE privilege on the distinct type to others. The administrative assistant cannot grant the privilege to execute the cast functions that are associated with the distinct type CANADIAN_DOLLAR because WITH GRANT OPTION does not give the administrative assistant the EXECUTE authority on these cast functions.

```
GRANT USAGE ON DISTINCT TYPE CANADIAN_DOLLAR TO ADMIN_A
      WITH GRANT OPTION;
```

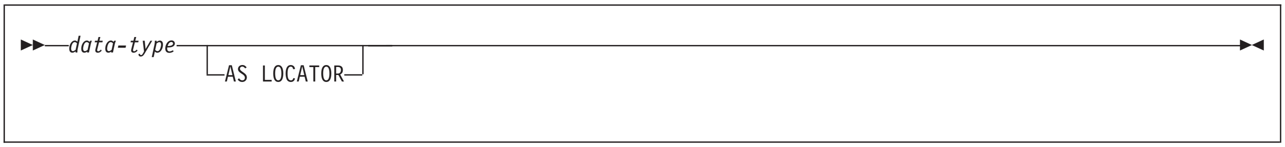
GRANT (function or procedure privileges)

This form of the GRANT statement grants privileges on user-defined functions, cast functions that are generated for distinct types, and stored procedures.

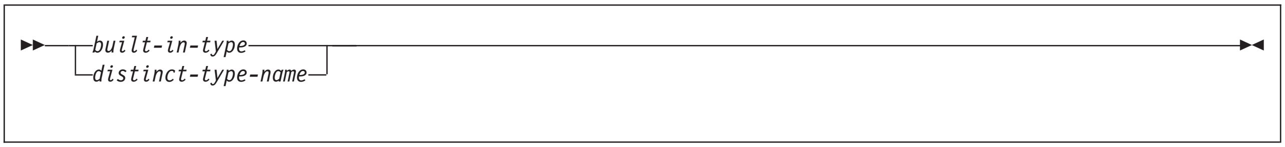
Syntax



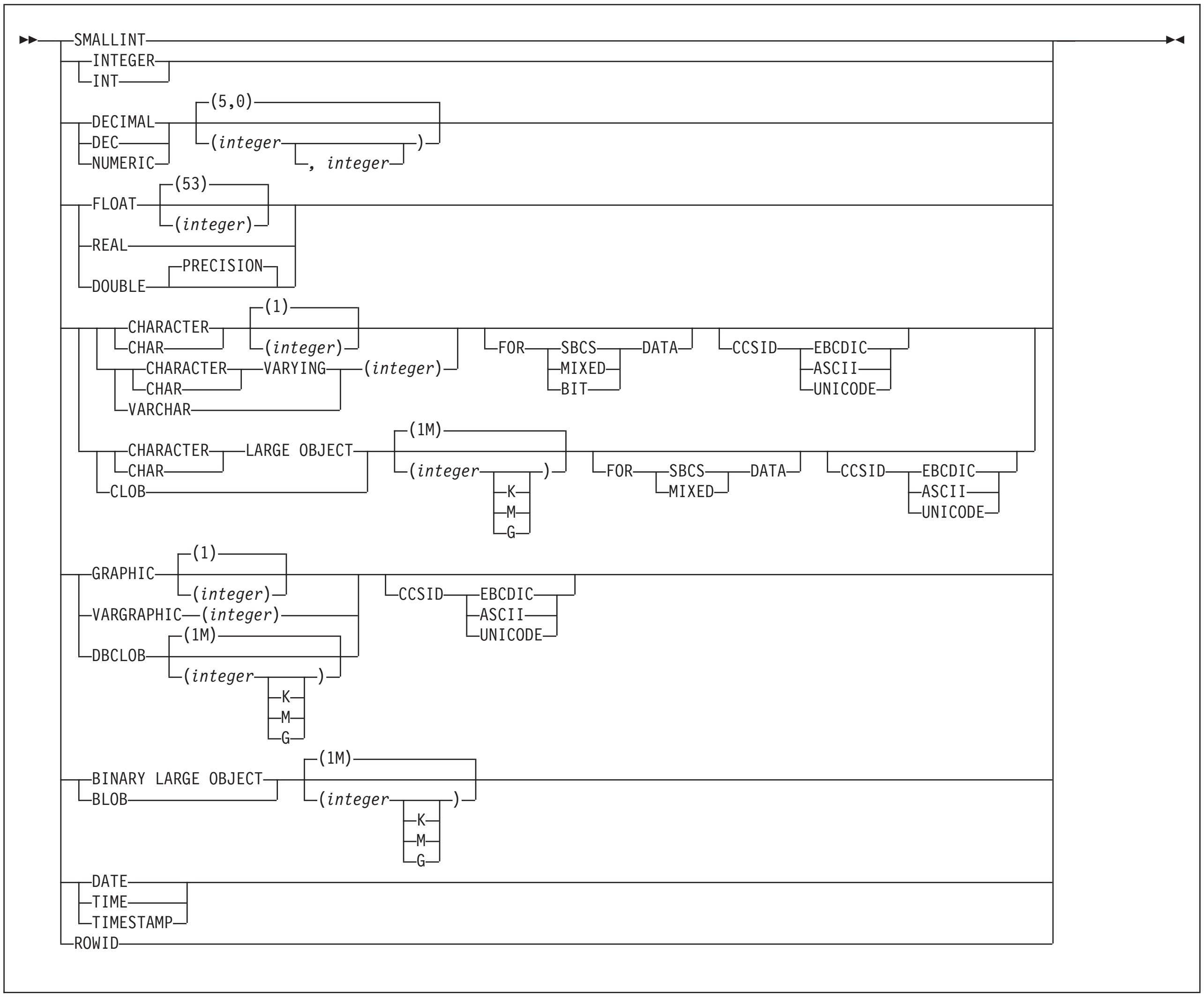
parameter type:



data type:



built-in-type:



Description

EXECUTE
Grants the privilege to run the identified user-defined function, cast function that was generated for a distinct type, or stored procedure.

FUNCTION or SPECIFIC FUNCTION
Identifies the function on which the privilege is granted. The function must exist at the current server, and it must be a function that was defined with the CREATE FUNCTION statement or a cast function that was generated by a CREATE DISTINCT TYPE statement. The function can be identified by name, function signature, or specific name.

If the function was defined with a table parameter (the LIKE TABLE was specified in the CREATE FUNCTION statement to indicate that one of the input parameters is a transition table), the function signature cannot be used to identify the function. Instead, identify the function with its function name, if unique, or with its specific name.

FUNCTION *function-name*

Identifies the function by its name. The *function-name* must identify exactly one function. The function can have any number of parameters defined for it. If there is more than one function of the specified name in the specified or implicit schema, an error is returned.

If you do not explicitly qualify the function name with a schema name, the function name is implicitly qualified with a schema name according to the following rules:

- If the statement is embedded in a program, the schema name is the authorization ID in the QUALIFIER option when the plan or package was created or last rebound. If QUALIFIER was not used, the schema name is the owner of the plan or package.
- If the statement is dynamically prepared, the schema name is the SQL authorization ID in the CURRENT SQLID special register.

An * can be specified for a qualified or unqualified *function-name*. An * (or *schema-name*.*) indicates that the privilege is granted on all the functions in the schema including those that do not currently exist. Specifying an * does not affect any EXECUTE privileges that are already granted on a function.

FUNCTION *function-name (parameter-type,...)*

Identifies the function by its function signature, which uniquely identifies the function. The *function-name (parameter-type, ...)* must identify a function with the specified function signature. The specified parameters must match the data types in the corresponding position that were specified when the function was created. The number of data types, and the logical concatenation of the data types is used to identify the specific function instance on which the privilege is to be granted. Synonyms for data types are considered a match.

If *function-name ()* is specified, the function identified must have zero parameters.

function-name

Identifies the name of the function. If you do not explicitly qualify the function name with a schema name, the function name is implicitly qualified with a schema name as described in the preceding description for FUNCTION *function-name*.

(parameter-type,...)

Identifies the parameters of the function.

If an unqualified distinct type name is specified, DB2 searches the SQL path to resolve the schema name for the distinct type.

For data types that have a length, precision, or scale attribute, use one of the following:

- Empty parentheses indicate that the database manager ignores the attribute when determining whether the data types match. For example, DEC() will be considered a match for a parameter of a function defined with a data type of DEC(7,2). However, FLOAT cannot be specified with empty parenthesis because its parameter value indicates a specific data type (REAL or DOUBLE).
- If a specific value for a length, precision, or scale attribute is specified, the value must exactly match the value that was specified (implicitly or explicitly) in the CREATE FUNCTION statement. If the

data type is FLOAT, the precision does not have to exactly match the value that was specified because matching is based on the data type (REAL or DOUBLE).

- If length, precision, or scale is not explicitly specified, and empty parentheses are not specified, the default attributes of the data type are implied. The implicit length must exactly match the value that was specified (implicitly or explicitly) in the CREATE FUNCTION statement.

For data types with a subtype or encoding scheme attribute, specifying the FOR *subtype* DATA clause or the CCSID clause is optional. Omission of either clause indicates that DB2 ignores the attribute when determining whether the data types match. If you specify either clause, it must match the value that was implicitly or explicitly specified in the CREATE FUNCTION statement.

AS LOCATOR
Specifies that the function is defined to receive a locator for this parameter. If AS LOCATOR is specified, the data type must be a LOB or a distinct type based on a LOB.

SPECIFIC FUNCTION *specific-name*
Identifies the function by its specific name. The *specific-name* must identify a specific function that exists at the current server.

PROCEDURE *procedure-name*
Identifies a stored procedure that is defined at the current server. If you do not explicitly qualify the procedure name with a schema name, the procedure name is implicitly qualified with a schema name according to the following rules:

- If the statement is embedded in a program, the schema name is the authorization ID in the QUALIFIER option when the plan or package was created or last rebound. If QUALIFIER was not used, the schema name is the owner of the plan or package.
- If the statement is dynamically prepared, the schema name is the SQL authorization ID in the CURRENT SQLID special register.

An * can be specified for a qualified or unqualified *procedure-name*. An * (or *schema-name*.*) indicates that the privilege is granted on all the stored procedures in the schema including those that do not currently exist. Specifying an * does not affect any EXECUTE privileges that are already granted on a stored procedure.

TO
Refer to “GRANT” on page 941 for a description of the TO clause.

WITH GRANT OPTION
Refer to “GRANT” on page 941 for a description of the WITH GRANT OPTION clause.

Examples

Example 1: Grant the EXECUTE privilege on function CALC_SALARY to user JONES. Assume that there is only one function in the schema with function name CALC_SALARY.

```
GRANT EXECUTE ON FUNCTION CALC_SALARY TO JONES;
```

Example 2: Grant the EXECUTE privilege on procedure VACATION_ACCR to all users at the current server.

```
GRANT EXECUTE ON PROCEDURE VACATION_ACCR TO PUBLIC;
```

Example 3: Grant the EXECUTE privilege on function DEPT_TOTALS to the administrative assistant and give the assistant the ability to grant the EXECUTE privilege on this function to others. The function has the specific name DEPT85_TOT. Assume that the schema has more than one function that is named DEPT_TOTALS.

```
GRANT EXECUTE ON SPECIFIC FUNCTION DEPT85_TOT TO ADMIN_A
      WITH GRANT OPTION;
```

Example 4: Grant the EXECUTE privilege on function NEW_DEPT_HIRES to HR (Human Resources). The function has two input parameters with data types of INTEGER and CHAR(10), respectively. Assume that the schema has more than one function that is named NEW_DEPT_HIRES.

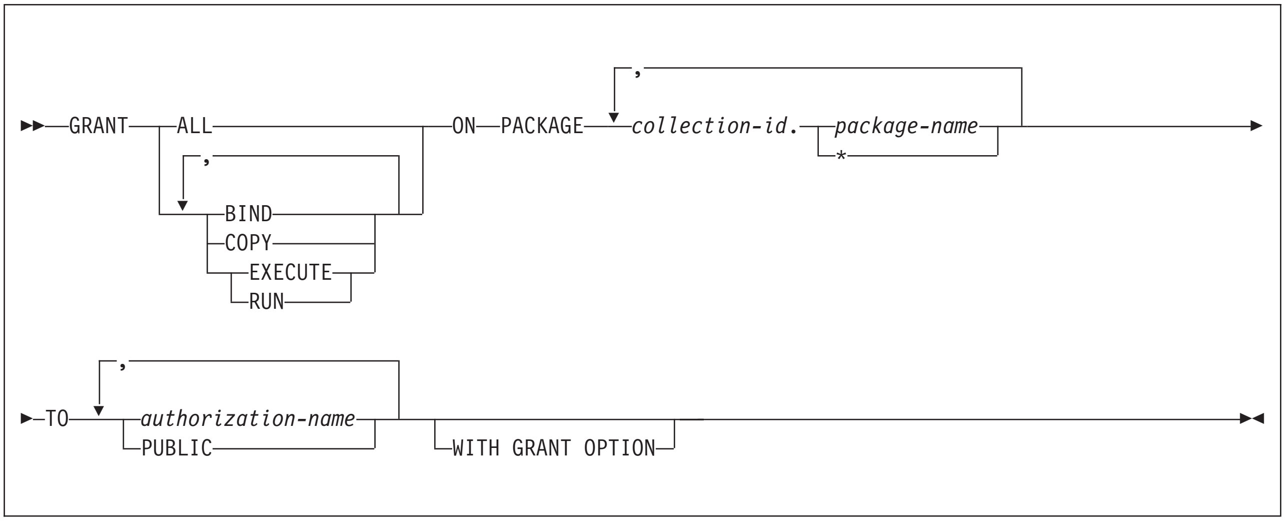
```
GRANT EXECUTE ON FUNCTION NEW_DEPT_HIRES (INTEGER, CHAR(10))
      TO HR;
```

You can also code the CHAR(10) data type as CHAR().

GRANT (package privileges)

This form of the GRANT statement grants privileges on packages.

Syntax



Description

BIND
Grants the privilege to use the BIND and REBIND subcommands for the designated packages.

The BIND package privilege can also be used to allow a user to add a new version of an existing package. For details on the authorization required to create new packages and new versions of existing packages, see “Notes” on page 955.

COPY
Grants the privilege to use the COPY option of the BIND subcommand for the designated packages.

EXECUTE
Grants the privilege to run application programs that use the designated packages and to specify the packages following PKLIST for the BIND PLAN and REBIND PLAN commands. RUN is an alternate name for the same privilege.

ALL
Grants all package privileges for which you have GRANT authority for the packages named in the ON clause.

ON PACKAGE *collection-id.package-name,...*
Identifies packages for which you are granting privileges. The granting of a package privilege applies to all versions of a package. The list can simultaneously contain items of the following two forms:

- *collection-id.package-name* explicitly identifies a single package. The name must identify a package that exists at the current server.
- *collection-id.** applies to every package in the indicated collection. This includes packages that currently exist and future packages. The grant applies

to a collection at the current server, but the *collection-id* does not have to identify a collection that exists when the grant is made.

To grant a privilege in this form requires PACKADM with the WITH GRANT OPTION over the collection or all collections, SYSADM, or SYSCTRL authority. Because of this fact, WITH GRANT OPTION, if included in the statement, is ignored for grants of this form, but not for grants for specific packages.

TO
Refer to “GRANT” on page 941 for a description of the TO clause.

WITH GRANT OPTION
Refer to “GRANT” on page 941 for a description of the WITH GRANT OPTION clause.

Notes

The authorization required to add a new package or a new version of an existing package depends on the value of field BIND NEW PACKAGE on installation panel DSNTIPP. The default value is BINDADD.

If the value of BIND NEW PACKAGE is BINDADD, the primary authorization ID must have one of the following to add a new package or a new version of an existing package to a collection:

- The BINDADD system privilege and either the CREATE IN privilege or PACKADM authority for the collection or for all collections
- SYSADM or SYSCTRL authority

If the value of BIND NEW PACKAGE is BIND, the primary authorization ID must have one of the following to add a new package or a new version of an existing package to a collection:

- The BINDADD system privilege and either the CREATE IN privilege or PACKADM authority for the collection or for all collections
- SYSADM or SYSCTRL authority
- PACKADM authority for the collection or for all collections
- Users with the BIND package privilege can also add a new version of an existing package

Notes

Alternative syntax and synonyms: To provide compatibility with previous releases of DB2 or other products in the DB2 UDB family, DB2 supports specifying PROGRAM as a synonym for PACKAGE.

Examples

Example 1: Grant the privilege to copy all packages in collection DSN8CC61 to LEWIS.

```
GRANT COPY ON PACKAGE DSN8CC61.* TO LEWIS;
```

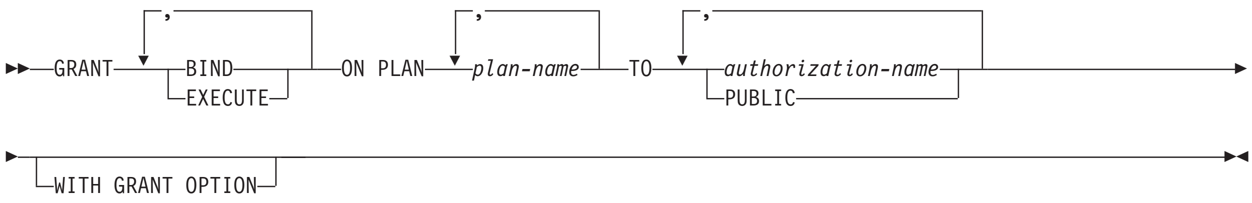
Example 2: You have the BIND privilege with GRANT authority over the package CLCT1.PKG1. You have the EXECUTE privilege with GRANT authority over the package CLCT2.PKG2. You have no other privileges with GRANT authority over any package in the collections CLCT1 AND CLCT2. Hence, the following statement, when executed by you, grants LEWIS the BIND privilege on CLCT1.PKG1 and the EXECUTE privilege on CLCT2.PKG2, and makes no other grant. The privileges granted include no GRANT authority.

```
GRANT ALL ON PACKAGE CLCT1.PKG1, CLCT2.PKG2 TO JONES;
```

GRANT (plan privileges)

This form of the GRANT statement grants privileges on plans.

Syntax



Description

BIND
Grants the privilege to use the BIND, REBIND, and FREE subcommands for the identified plans. (The authority to create new plans using BIND ADD is a system privilege.)

EXECUTE
Grants the privilege to run programs that use the identified plans.

ON PLAN *plan-name,...*
Identifies the application plans on which the privileges are granted. For each identified plan, you must have all specified privileges with the GRANT option.

TO
Refer to “GRANT” on page 941 for a description of the TO clause.

WITH GRANT OPTION
Refer to “GRANT” on page 941 for a description of the WITH GRANT OPTION clause.

Examples

Example 1: Grant the privilege to bind plan DSN8IP81 to user JONES.

```
GRANT BIND ON PLAN DSN8IP81 TO JONES;
```

Example 2: Grant privileges to bind and execute plan DSN8CP81 to all users at the current server.

```
GRANT BIND,EXECUTE ON PLAN DSN8CP81 TO PUBLIC;
```

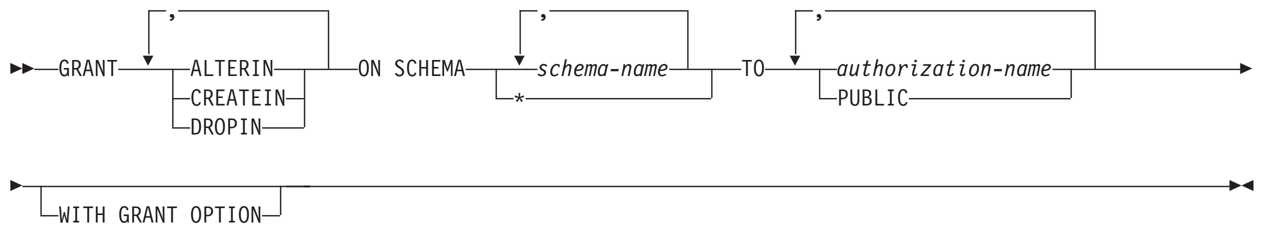
Example 3: Grant the privilege to execute plan DSN8CP81 to users ADAMSON and BROWN with grant option.

```
GRANT EXECUTE ON PLAN DSN8CP81 TO ADAMSON,BROWN WITH GRANT OPTION;
```

GRANT (schema privileges)

This form of the GRANT statement grants privileges on schemas.

Syntax



Description

ALTERIN
Grants the privilege to alter stored procedures and user-defined functions, or specify a comment for distinct types, cast functions that are generated for distinct types, stored procedures, triggers, and user-defined functions in the designated schemas.

CREATEIN
Grants the privilege to create distinct types, stored procedures, triggers, and user-defined functions in the designated schemas.

DROPIN
Grants the privilege to drop distinct types, stored procedures, triggers, and user-defined functions in the designated schemas.

SCHEMA *schema-name*
Identifies the schemas on which the privilege is granted. The schemas do not need to exist when the privilege is granted.

SCHEMA *
Indicates that the specified privilege is granted on all schemas including those that do not currently exist.

TO
Refer to “GRANT” on page 941 for a description of the TO clause.

WITH GRANT OPTION
Refer to “GRANT” on page 941 for a description of the WITH GRANT OPTION clause.

Examples

Example 1: Grant the CREATEIN privilege on schema T_SCORES to user JONES.

```
GRANT CREATEIN ON SCHEMA T_SCORES TO JONES;
```

Example 2: Grant the CREATEIN privilege on schema VAC to all users at the current server.

```
GRANT CREATEIN ON SCHEMA VAC TO PUBLIC;
```

Example 3: Grant the ALTERIN privilege on schema DEPT to the administrative assistant and give the grantee the ability to grant ALTERIN privileges on this schema to others.

```
GRANT ALTERIN ON SCHEMA DEPT TO ADMIN_A
      WITH GRANT OPTION;
```

Example 4: Grant the CREATEIN, ALTERIN, and DROPIN privileges on schemas NEW_HIRE, PROMO, and RESIGN to HR (Human Resources).

```
GRANT CREATEIN, ALTERIN, DROPIN ON SCHEMA NEW_HIRE, PROMO, RESIGN TO HR;
```

GRANT (sequence privileges)

This form of the GRANT statement grants privileges on a user-defined sequence.

Syntax

```
         ┌─,──────────┐                  ┌─,─────────────┐       ┌─,───────────────────────┐
         ▼            │                  ▼               │       ▼                         │
►►─GRANT───┬─ALTER──────┬─┴───ON SEQUENCE───sequence-name─┴──TO───┬─authorization-name─┬─┴──────►
           │      (1)   │                                          └─PUBLIC─────────────┘
           └─USAGE──────┘

►─┬──────────────────┬──────────────────────────────────────────────────────────────────────►◄
  └─WITH GRANT OPTION─┘
```

Notes:

1 The keyword SELECT is an alternative keyword for USAGE.

Description

ALTER
Grants the privilege to alter a sequence or record a comment on a sequence.

USAGE
Grants the USAGE privilege to use a sequence. This privilege is needed when the NEXT VALUE or PREVIOUS VALUE expression is invoked for a sequence name.

SEQUENCE *sequence-name*
Identifies the sequence. The name, including the implicit or explicit schema qualifier, must uniquely identify an existing sequence at the current server. If no sequence by this name exists in the explicitly or implicitly specified schema, an error occurs. *sequence-name* must not be the name of an internal sequence object that is generated by the system for an identity column.

TO
Refer to “GRANT” on page 941 for a description of the TO clause.

WITH GRANT OPTION
Refer to “GRANT” on page 941 for a description of the WITH GRANT OPTION clause.

Examples

Grant USAGE privilege on sequence MYNUM to user JONES.

```
GRANT USAGE
  ON SEQUENCE MYNUM
  TO JONES;
```

GRANT (system privileges)

This form of the GRANT statement grants system privileges.

Syntax

```
            ┌─,──────────────┐        ┌─,───────────────────┐
            ▼                │        ▼                     │
►►──GRANT───┬─ARCHIVE──────┬─┴──TO────┬─authorization-name─┬─┴──┬───────────────────┬──────────────►◄
            ├─BINDADD──────┤          └─PUBLIC─────────────┘    └─WITH GRANT OPTION─┘
            ├─BINDAGENT────┤
            ├─BSDS─────────┤
            ├─CREATEALIAS──┤
            ├─CREATEDBA────┤
            ├─CREATEDBC────┤
            ├─CREATESG─────┤
            ├─CREATETMTAB──┤
            ├─DISPLAY──────┤
            ├─MONITOR1─────┤
            ├─MONITOR2─────┤
            ├─RECOVER──────┤
            ├─STOPALL──────┤
            ├─STOSPACE─────┤
            ├─SYSADM───────┤
            ├─SYSCTRL──────┤
            ├─SYSOPR───────┤
            └─TRACE────────┘
```

Description

ARCHIVE
Grants the privilege to use the ARCHIVE LOG and SET LOG commands.

BINDADD
Grants the privilege to create plans and packages by using the BIND subcommand with the ADD option.

BINDAGENT
Grants the privilege to issue the BIND, FREE PACKAGE, or REBIND subcommands for plans and packages and the DROP PACKAGE statement on behalf of the grantor. The privilege also allows the holder to copy and replace plans and packages on behalf of the grantor.

A warning is issued if WITH GRANT OPTION is specified when granting this privilege.

BSDS
Grants the privilege to issue the RECOVER BSDS command.

CREATEALIAS
Grants the privilege to use the CREATE ALIAS statement.

CREATEDBA
Grants the privilege to issue the CREATE DATABASE statement and acquire DBADM authority over those databases.

CREATEDBC
Grants the privilege to issue the CREATE DATABASE statement and acquire DBCTRL authority over those databases.

CREATESG
Grants the privilege to create new storage groups.

CREATETMTAB
Grants the privilege to use the CREATE GLOBAL TEMPORARY TABLE statement.

DISPLAY
Grants the privilege to use the following commands:

- The DISPLAY ARCHIVE command for archive log information
- The DISPLAY BUFFERPOOL command for the status of buffer pools
- The DISPLAY DATABASE command for the status of all databases
- The DISPLAY LOCATION command for statistics about threads with a distributed relationship
- The DISPLAY LOG command for log information, including the status of the offload task
- The DISPLAY THREAD command for information on active threads within DB2
- The DISPLAY TRACE command for a list of active traces

MONITOR1
Grants the privilege to obtain IFC data classified as serviceability data, statistics, accounting, and other performance data that does not contain potentially secure data.

MONITOR2
Grants the privilege to obtain IFC data classified as containing potentially sensitive data such as SQL statement text and audit data. Users with MONITOR2 privileges have MONITOR1 privileges.

RECOVER
Grants the privilege to issue the RECOVER INDOUBT command.

STOPALL
Grants the privilege to issue the STOP DB2 command.

STOSPACE
Grants the privilege to use the STOSPACE utility.

SYSADM
Grants all DB2 privileges except for a few reserved for installation SYSADM authority. The privileges the user possesses are all grantable, including the SYSADM authority itself. The privileges the user lacks restrict what the user can do with the directory and the catalog. Using WITH GRANT OPTION when granting SYSADM is redundant but valid. For more on SYSADM and install SYSADM authority, see Part 3 (Volume 1) of *DB2 Administration Guide*.

SYSCTRL
Grants the system control authority, which allows the user to have most of the privileges of a system administrator but excludes the privileges to read or change user data. Using WITH GRANT OPTION when granting SYSCTRL is redundant but valid. For more information on SYSCTRL authority, see Part 3 (Volume 1) of *DB2 Administration Guide*.

SYSOPR
Grants the privilege to have system operator authority.

TRACE
Grants the privilege to issue the MODIFY TRACE, START TRACE, and STOP TRACE commands.

TO
Refer to “GRANT” on page 941 for a description of the TO clause.

WITH GRANT OPTION
If you grant the SYSADM or SYSCTRL system privilege, WITH GRANT OPTION is valid but unnecessary. It is unnecessary because whoever is granted SYSADM or SYSCTRL has that authority and all the privileges it implies, with the GRANT option.

Examples

Example 1: Grant DISPLAY privileges to user LUTZ.

```
GRANT DISPLAY
  TO LUTZ;
```

Example 2: Grant BSDS and RECOVER privileges to users PARKER and SETRIGHT, with the WITH GRANT OPTION.

```
GRANT BSDS,RECOVER
  TO PARKER,SETRIGHT
  WITH GRANT OPTION;
```

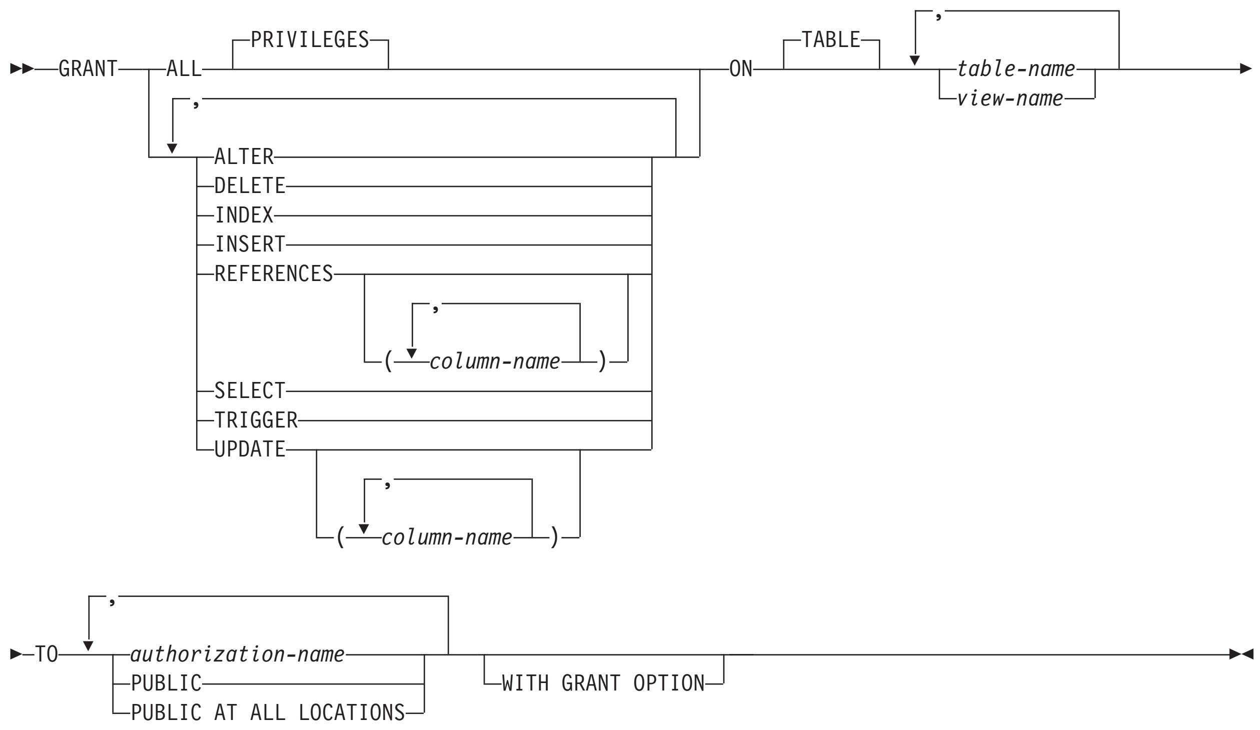
Example 3: Grant TRACE privileges to all local users.

```
GRANT TRACE
  TO PUBLIC;
```

GRANT (table or view privileges)

This form of the GRANT statement grants privileges on tables and views.

Syntax



Description

ALL or **ALL PRIVILEGES**

Grants all table or view privileges for which you have GRANT authority, for the tables and views named in the ON clause. Does not include ALTER, INDEX, REFERENCES, or TRIGGER for a grant to PUBLIC AT ALL LOCATIONS.

If you do not use ALL, you must use one or more of the keywords in the following list. For each keyword that you use, you must have GRANT authority for that privilege on every table or view identified in the ON clause.

ALTER

Grants the privilege to alter the specified table or create a trigger on the specified table. ALTER cannot be granted to PUBLIC AT ALL LOCATIONS. Nor can it be used if the statement identifies an auxiliary table or a view.

DELETE

Grants the privilege to delete rows in the specified table or view. DELETE cannot be granted on an auxiliary table.

INDEX

Grants the privilege to create an index on the specified table. INDEX cannot be granted to PUBLIC AT ALL LOCATIONS nor can it be granted on a view.

INSERT
Grants the privilege to insert rows into the specified table or view. INSERT cannot be granted on an auxiliary table.

REFERENCES
Grants the privilege to add a referential constraint in which the specified table is a parent. If a list of column names is not specified or if REFERENCES is granted via the specification of ALL PRIVILEGES, the grantee can define referential constraints using all columns of the table as a parent key, even those added later via the ALTER TABLE statement. This privilege cannot be granted on a view or auxiliary table. REFERENCES cannot be granted to PUBLIC AT ALL LOCATIONS.

REFERENCES(*column-name,...***)**
Grants the privilege to add or drop a referential constraint in which the specified table is a parent using only those columns that are specified in the column list as a parent key. Each *column-name* must be an unqualified name that identifies a column of the table identified in the ON clause. This privilege cannot be granted on a view or auxiliary table. REFERENCES cannot be granted to PUBLIC AT ALL LOCATIONS.

SELECT
Grants the privilege to create a view or read data from the specified table or view. SELECT cannot be granted on an auxiliary table.

TRIGGER
Grants the privilege to create a trigger on the specified table. TRIGGER cannot be granted to PUBLIC AT ALL LOCATIONS nor can it be granted on an auxiliary table or a view.

UPDATE
Grants the privilege to update rows in the specified table or view. UPDATE cannot be granted on an auxiliary table.

UPDATE(*column-name,...***)**
Grants the privilege to update only the columns named. Each *column-name* must be the unqualified name of a column of every table or view identified in the ON clause. Each *column-name* must not identify a column of an auxiliary table.

ON *table-name* **or** *view-name*
Specifies the tables or views on which you are granting the privileges. The list can be a list of table names or view names, or a combination of the two. A declared temporary table must not be identified.

If you use GRANT ALL, then for each named table or view, the privilege set (described in “Authorization” in “GRANT” on page 941) must include at least one privilege with the GRANT option.

TO
Refer to “GRANT” on page 941 for a description of the TO clause.

WITH GRANT OPTION
Refer to “GRANT” on page 941 for a description of the WITH GRANT OPTION clause.

Notes

The REFERENCES privilege does not replace the ALTER privilege. It was added to conform to the SQL standard. To define a foreign key that references a parent table, you must have either the REFERENCES or the ALTER privilege, or both.

For a created temporary table or a view of a created temporary table, only ALL or ALL PRIVILEGES can be granted. Specific table or view privileges cannot be granted. In addition, only the ALTER, DELETE, INSERT, and SELECT privileges apply to a created temporary table.

For a declared temporary table, no privileges can be granted. When a declared temporary table is defined, PUBLIC implicitly receives all table privileges (without GRANT authority) for the table. These privileges are not recorded in the DB2 catalog, and they cannot be revoked.

For an auxiliary table, only the INDEX privilege can be granted. DELETE, INSERT, SELECT, and UPDATE privileges on the base table that is associated with the auxiliary table extend to the auxiliary table.

PUBLIC AT ALL LOCATIONS: PUBLIC AT ALL LOCATIONS can continue to be specified as an alternative to PUBLIC as in prior releases. PUBLIC AT ALL LOCATIONS was introduced and was intended for use only with DB2 private protocol access.

Examples

Example 1: Grant SELECT privileges on table DSN8810.EMP to user PULASKI.

```
GRANT SELECT ON DSN8810.EMP TO PULASKI;
```

Example 2: Grant UPDATE privileges on columns EMPNO and WORKDEPT in table DSN8810.EMP to all users at the current server.

```
GRANT UPDATE (EMPNO,WORKDEPT) ON TABLE DSN8810.EMP TO PUBLIC;
```

Example 3: Grant all privileges on table DSN8810.EMP to users KWAN and THOMPSON, with the WITH GRANT OPTION.

```
GRANT ALL ON TABLE DSN8810.EMP TO KWAN,THOMPSON WITH GRANT OPTION;
```

Example 4: Grant the SELECT and UPDATE privileges on the table DSN8810.DEPT to every user in the network.

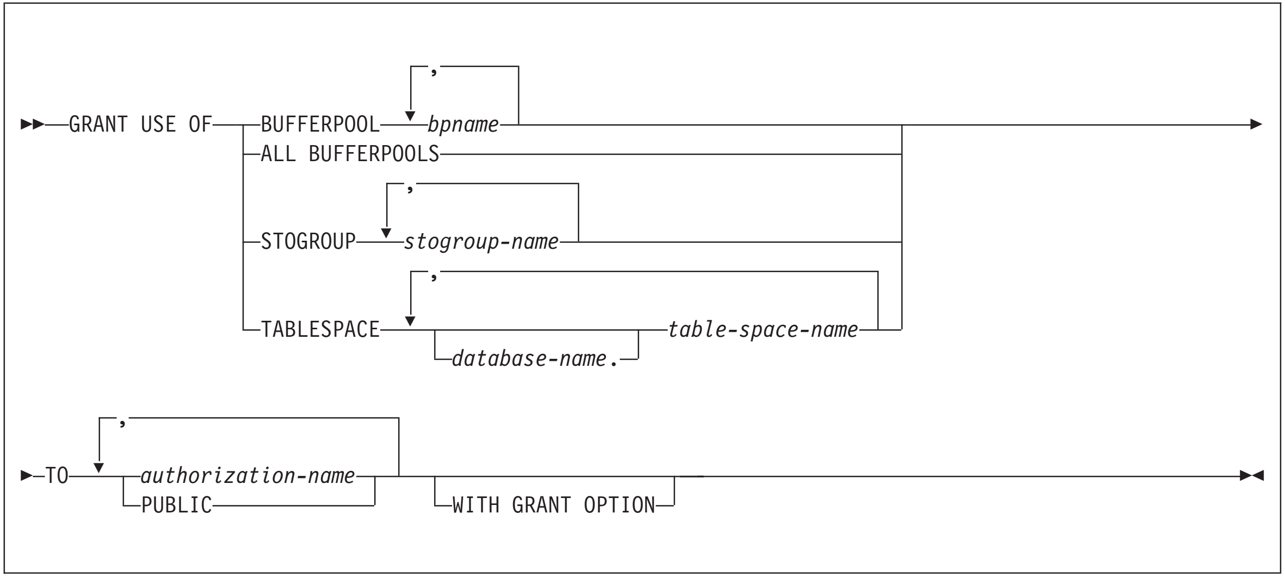
```
GRANT SELECT, UPDATE ON TABLE DSN8810.DEPT
  TO PUBLIC AT ALL LOCATIONS;
```

Even with this grant, it is possible that some network users do not have access to the table at all, or to any other object at the table’s subsystem. Controlling access to the subsystem involves the communications databases at the subsystems in the network. The tables for the communication databases are described in Appendix F, “DB2 catalog tables,” on page 1191. Controlling access is described in Part 3 (Volume 1) of *DB2 Administration Guide*.

GRANT (use privileges)

This form of the GRANT statement grants authority to use particular buffer pools, storage groups, or table spaces.

Syntax



Description

BUFFERPOOL *bpname,...*
Grants the privilege to refer to any of the identified buffer pools in a CREATE INDEX, CREATE TABLESPACE, ALTER INDEX, or ALTER TABLESPACE statement. See “Naming conventions” on page 40 for more details about *bpname*.

ALL BUFFERPOOLS
Grants the privilege to refer to any buffer pool in a CREATE INDEX, CREATE TABLESPACE, ALTER INDEX, or ALTER TABLESPACE statement.

STOGROUP *stogroup-name,...*
Grants the privilege to refer to any of the identified storage groups in a CREATE INDEX, CREATE TABLESPACE, ALTER INDEX, or ALTER TABLESPACE statement.

TABLESPACE *database-name***.***table-space-name,...*
Grants the privilege to refer to any of the identified table spaces in a CREATE TABLE statement. The default for *database-name* is DSNDB04.

You cannot grant the privilege for tables spaces that are for declared temporary tables (table spaces in the TEMP database). For these table spaces, PUBLIC implicitly has the TABLESPACE privilege (without GRANT authority); this privilege is not recorded in the DB2 catalog, and it cannot be revoked.

TO
Refer to “GRANT” on page 941 for a description of the TO clause.

WITH GRANT OPTION
Refer to “GRANT” on page 941 for a description of the WITH GRANT OPTION clause.

Notes

You can grant privileges for only one type of object with each statement. Thus, you can grant the use of several table spaces with one statement, but not the use of a table space and a storage group. For each object you identify, you must have the USE privilege with GRANT authority.

Examples

Example 1: Grant authority to use buffer pools BP1 and BP2 to user MARINO.

```
GRANT USE OF BUFFERPOOL BP1,BP2
  TO MARINO;
```

Example 2: Grant to all local users the authority to use table space DSN8S81D in database DSN8D81A.

```
GRANT USE OF TABLESPACE
  DSN8D81A.DSN8S81D
  TO PUBLIC;
```

HOLD LOCATOR

The HOLD LOCATOR statement allows a LOB locator variable to retain its association with a value beyond a unit of work.

Invocation

This statement can only be embedded in an application program. It cannot be issued interactively. It is an executable statement that can be dynamically prepared. However, the EXECUTE statement with the USING clause must be used to execute the prepared statement. HOLD LOCATOR cannot be used with the EXECUTE IMMEDIATE statement.

Authorization

None required.

Syntax

```
                    ┌─,─────────────┐
                    ▼               │
►►──HOLD LOCATOR────host-variable───┴─────────────────────────────────────►◄
```

Description

host-variable, ...
: Identifies one or more locator variables that must be declared in accordance with the rules for declaring locator variables. The locator variable type must be a binary large object locator, a character large object locator, or a double-byte character large object locator.

The *host-variable* must currently have a locator assigned to it. That is, a locator must have been assigned during this unit of work (by a FETCH, SELECT INTO, assignment statement, SET *host-variable* statement, or VALUES INTO statement); otherwise, an error is returned.

If more than one locator is specified and an error is returned on one of the locators, it is possible that some locators have been held and others have not been held.

Notes

A host-variable LOB locator variable that has the hold property is freed (has its association between it and its value removed) when:

- The SQL FREE LOCATOR statement is executed for the locator variable.
- The SQL ROLLBACK statement is executed.
- The SQL session is terminated.

Example

Assume that the employee table contains columns RESUME, HISTORY, and PICTURE and that locators have been established in a program to represent the values represented by the columns. Give the CLOB locator variables LOCRES and LOCHIST, and the BLOB locator variable LOCPIC the hold property.

```
EXEC SQL HOLD LOCATOR :LOCRES, :LOCHIST, :LOCPIC
```

INCLUDE

The INCLUDE statement inserts application code, including declarations and statements, into a source program.

Invocation

This statement can only be embedded in an application program. It is not an executable statement. It must not be specified in Java or REXX.

Authorization

None required.

Syntax

```
►►──INCLUDE──┬─SQLCA───────┬──────────────────────────────────────────────────►◄
             ├─SQLDA───────┤
             └─member-name─┘
```

Description

SQLCA
Indicates that the description of an SQL communication area (SQLCA) is to be included. INCLUDE SQLCA must not be specified more than once in the same application program. In COBOL, INCLUDE SQLCA must be specified in the Working-Storage Section or the Linkage Section. INCLUDE SQLCA must not be specified if the program is precompiled with the STDSQL(YES) option.

For a description of the SQLCA, see Appendix D, "SQL communication area (SQLCA)," on page 1165.

SQLDA
Indicates that the description of an SQL descriptor area (SQLDA) is to be included. It must not be specified in a Fortran. For a description of the SQLDA, see Appendix E, "SQL descriptor area (SQLDA)," on page 1173.

member-name
Names a member of the partitioned data set to be the library input when your application program is precompiled. It must be an SQL identifier.

The member can contain any host language source statements and any SQL statements other than an INCLUDE statement. In COBOL, INCLUDE *member-name* must not be specified in other than the Data Division or the Procedure Division.

Notes

When your application program is precompiled, the INCLUDE statement is replaced by source statements. Thus, the INCLUDE statement must be specified at a point in your application program where the resulting source statements are acceptable to the compiler.

The INCLUDE statement cannot refer to source statements that themselves contain INCLUDE statements.

The declarations that are generated by DCLGEN can be used in an application program by specifying the same member in the INCLUDE statement as in the DCLGEN LIBRARY parameter.

Example

Include an SQL communications area in a PL/I program.

```
EXEC SQL INCLUDE SQLCA;
```

INSERT

The INSERT statement inserts rows into a table or view. The table or view can be at the current server or any DB2 subsystem with which the current server can establish a connection. Inserting a row into a view also inserts the row into the table on which the view is based.

There are three forms of this statement:

- The INSERT via VALUES form is used to insert a single row into the table or view using the values provided or referenced.
- The INSERT via SELECT form is used to insert one or more rows into the table or view using values from other tables, or views, or both.
- The INSERT via FOR *n* ROWS form is used to insert multiple rows into the table or view using values provided from *host-variable arrays*.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

Authority requirements depend on whether the object identified in the statement is a user-defined table, a catalog table for which inserts are allowed, or a view:

When a user-defined table is identified: The privilege set must include at least one of the following:

- The INSERT privilege on the table
- Ownership of the table
- DBADM authority on the database that contains the table
- SYSADM authority

When a catalog table is identified: The privilege set must include at least one of the following:

- DBADM authority on the catalog database
- SYSCTRL authority
- SYSADM authority

When a view is identified: The privilege set must include at least one of the following:

- The INSERT privilege on the view
- SYSADM authority

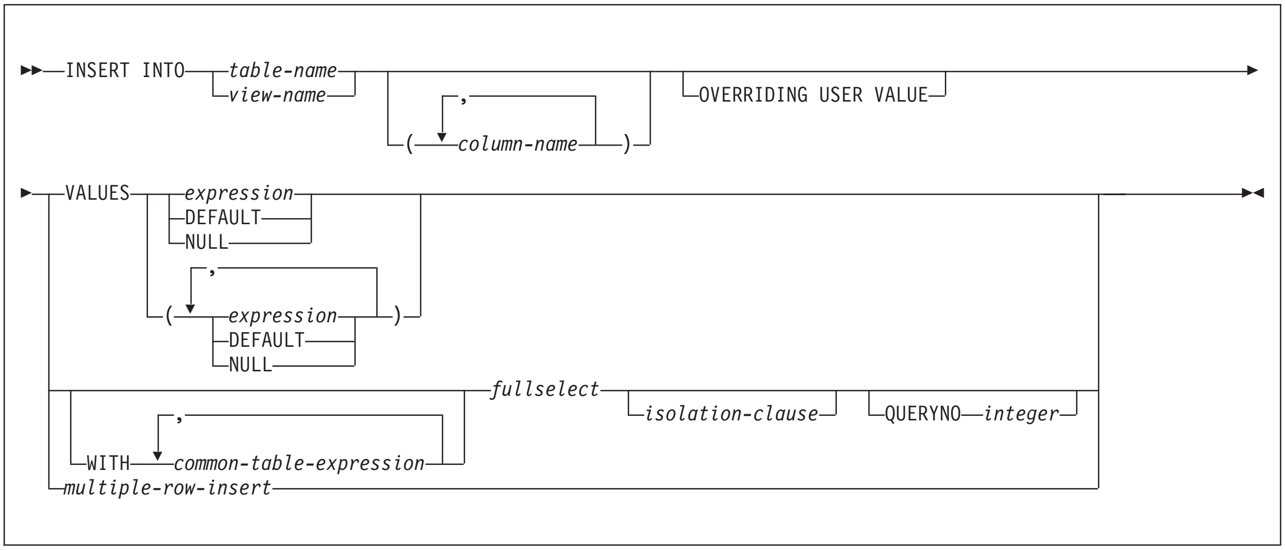
The owner of a view, unlike the owner of a table, might not have INSERT authority on the view (or can have INSERT authority without being able to grant it to others). The nature of the view itself can preclude its use for INSERT. For more information, see the discussion of authority in “CREATE VIEW” on page 805.

If the INSERT statement is embedded in a SELECT statement, the privilege set must include the SELECT privilege on the table or view.

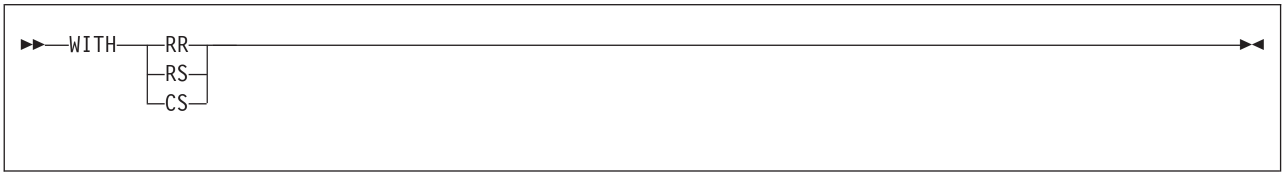
If a fullselect is specified, the privilege set must include authority to execute the fullselect. For more information about the authorization rules, see “Authorization” on page 394.

If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package. If the statement is dynamically prepared, the privilege set is determined by the DYNAMICRULES behavior in effect (run, bind, define, or invoke) and is summarized in Table 53 on page 433. (For more information on these behaviors, including a list of the DYNAMICRULES bind option values that determine them, see "Authorization IDs and dynamic SQL" on page 51.)

Syntax



isolation-clause:



multiple-row-insert:

```
►►──VALUES──┬──┬─expression──────────┬───────────┬──┬─────────────────────────────────────────┬──►
            │  ├─host-variable-array─┤           │  │                                   (1)   │
            │  ├─NULL────────────────┤           │  └─FOR──┬─host-variable────┬──ROWS─────────┘
            │  └─DEFAULT─────────────┘           │         └─integer-constant─┘
            │      ┌─,────────────────────────┐  │
            │      ▼                          │  │
            └─(──────┬─expression──────────┬──┴─)┘
                     ├─host-variable-array─┤
                     ├─NULL────────────────┤
                     └─DEFAULT─────────────┘

   ┌─ATOMIC──────────────────────────────────────┐
►──┼─────────────────────────────────────────────┴──────────────────────────────────────────►◄
   │                                       (2)   │
   └─NOT ATOMIC CONTINUE ON SQLEXCEPTION──────────┘
```

Notes:

1 The FOR *n* ROWS clause must be specified for a static multiple-row-insert. However, this clause must not be specified for a dynamic INSERT statement. For a dynamic statement, the FOR *n* ROWS clause is specified on the EXECUTE statement.

2 The ATOMIC or NOT ATOMIC CONTINUE ON SQLEXCEPTION clauses may be specified for a static multiple-row-insert. However, this clause must not be specified for a dynamic INSERT statement. For a dynamic statement, the ATOMIC or NOT ATOMIC CONTINUE ON SQLEXCEPTION clause is specified as an attribute on the PREPARE statement.

Description

INTO *table-name* or *view-name*

Identifies the object of the INSERT statement. The name must identify a table or view that exists at the DB2 subsystem identified by the implicitly or explicitly specified location name. The name must not identify:

- An auxiliary table
- A catalog table for which inserts are not allowed
- A view of such a catalog table
- A read-only view. (For a description of a read-only view, see "CREATE VIEW" on page 805.)
- A system-maintained materialized query table

In an IMS or CICS application, the DB2 subsystem that contains the identified table or view must be a remote server that supports two-phase commit.

column-name,...

Specifies the columns for which insert values are provided. Each name must identify a column of the table or view. The columns can be identified in any order, but the same column must not be identified more than once. A view column that cannot accept insert values must not be identified. If the object of the INSERT statement is a view with such columns, a list of column names must be specified, and the list must not identify these columns. If a qualifier is specified, it must be valid (that is, the table name must be the table or view name specified after the INTO keyword, and if a qualifier is specified for the table name, it must match the default qualifier).

Omission of the column list is an implicit specification of a list in which every column of the table or view is identified in left-to-right order. This list is established when the statement is prepared and therefore does not include columns that were added to the table after the statement was prepared.

The effect of a rebind on INSERT statements that do not include a column list is that the implicit list of names is re-established. Therefore, the number of columns into which data is inserted can change and cause an error.

OVERRIDING USER VALUE

Specifies that the value specified in the VALUES clause or produced by a fullselect for a column that is defined as GENERATED ALWAYS is ignored. Instead, a system-generated value is inserted, overriding the user-specified value.

Specify OVERRIDING USER VALUE only if the insert involves a column defined as GENERATED ALWAYS, such as a ROWID column or an identity column.

VALUES

Specifies one new row in the form of a list of values. Each host variable in the clause must identify a host structure or variable that is declared in the program in accordance with the rules for declaring host structures and variables. A reference to a structure is replaced by a reference to each of its variables.

The number of values in the VALUES clause must equal the number of names in the implicit or explicit column list. The first value is inserted in the first column in the list, the second value in the second column, and so on. If more than one value is specified, the list of values must be enclosed in parentheses.

expression

Any expression of the type described in “Expressions” on page 133. The expression must not include a column name. If *expression* is a single host variable, the host variable can identify a structure. Any host variable or structure that is specified must be described in the application program according to the rules for declaring host structures and variables.

DEFAULT

The default value assigned to the column. If the column is a ROWID column or an identity column, DB2 will generate a unique value for the column. You can specify DEFAULT only for columns that have an assigned default value, ROWID columns, and identity columns.

For information on default values of data types, see the description of the DEFAULT clause for “CREATE TABLE” on page 734.

NULL

Specifies the null value as the value of the column. Specify NULL only for nullable columns.

For a ROWID or an identity column that was defined as GENERATED ALWAYS, you must specify DEFAULT unless you specify the OVERRIDING USER VALUE clause to indicate that any user-specified value will be ignored and a unique system-generated value will be inserted.

For a ROWID or identity column that is defined as GENERATED BY DEFAULT, you can specify a value. However, a value can be inserted into ROWID column defined BY DEFAULT only if a single-column unique index is defined on the

ROWID column and the specified value is a valid row ID value that was previously generated by DB2. When a value is inserted into an identity column defined BY DEFAULT, DB2 does not verify that the specified value is a unique value for the column unless the identity column has a single-column unique index.

WITH *common-table-expression*
Specifies a common table expression. For an explanation of common table expression, see “common-table-expression” on page 417.

fullselect
Specifies a set of new rows in the form of the result table of a fullselect. If the result table is empty, SQLCODE is set to +100, and SQLSTATE is set to '02000'.

(For an explanation of fullselect, see “fullselect” on page 412.)

When the base object of the INSERT and the base object of the fullselect or any subquery of the fullselect are the same table, the fullselect is evaluated completely before any rows are inserted.

The number of columns in the result table must equal the number of names in the column list. The value of the first column of the result is inserted in the first column in the list, the second value in the second column, and so on. Any values that are produced for a ROWID or identity column must conform to the rules that are described for those columns under the VALUES clause.

If the object table is self-referencing, the fullselect must not return more than one row.

isolation-clause
Specifies the isolation level that is used when the fullselect is executed.

WITH
Introduces the isolation level, which may be one of the following:

RR	Repeatable read
RS	Read stability
CS	Cursor stability

The default isolation level of the statement is the isolation level of the package or plan in which the statement is bound, with the package isolation taking precedence over the plan isolation. When a package isolation is not specified, the plan isolation is the default.

QUERYNO *integer*
Specifies the number to be used for this SQL statement in EXPLAIN output and trace records. The number is used for the QUERYNO column of the plan table for the rows that contain information about this SQL statement. This number is also used in the QUERYNO column of the SYSIBM.SYSSTMT and SYSIBM.SYSPACKSTMT catalog tables.

If the clause is omitted, the number associated with the SQL statement is the statement number assigned during precompilation. Thus, if the application program is changed and then precompiled, that statement number might change.

Using the QUERYNO clause to assign unique numbers to the SQL statements in a program is helpful:

- For simplifying the use of optimization hints for access path selection
- For correlating SQL statement text with EXPLAIN output in the plan table

For information on using optimization hints, such as enabling the system for optimization hints and setting valid hint values, and for information on accessing the plan table, see Part 5 (Volume 2) of *DB2 Administration Guide*.

multiple-row-insert

VALUES

Specifies the items for the rows to be inserted. The number of items in the VALUES clause must equal the number of names in the implicit or explicit column list. The first item in the list provides the value (or values) for the first column in the list. The second item in the list provides the value (or values) for the second column, and so on.

expression

Any expression of the type described in “Expressions” on page 133. The expression must not include a column name. For each row that is inserted, the corresponding column is assigned the value of the expression.

host-variable-array

Each host-variable array must be defined in the application program in accordance with the rules for declaring an array. A host-variable array contains the data for a column of table that is a target of the INSERT. The number of rows to be inserted must be less than or equal to the dimension of each of the host-variable arrays.

An optional indicator array can be specified for each host-variable array. It should be specified if the SQLTYPE of any SQLVAR occurrence indicates that the SQLVAR is nullable. The indicators must be small integers. The indicator array must be large enough to contain an indicator for each row of input data.

DEFAULT

Specifies that the default value is assigned to the column. For each row inserted, the corresponding column is assigned its default value. DEFAULT can be specified only for columns that have a default value. For information on default values of data types, see the description of the DEFAULT clause for “CREATE TABLE” on page 734.

NULL

Specifies the null value as the value of the column in each row inserted. For each row inserted, the corresponding column is assigned the NULL value. Specify NULL only for nullable columns.

FOR *host-variable* or *integer-constant* **ROWS**

Specifies the number of rows to be inserted. For a dynamic INSERT statement, this clause can be specified on the EXECUTE statement. For more information, see “EXECUTE” on page 881. However, this clause is required when a dynamic SELECT statement contains more than one multiple-row INSERT statement.

host-variable or *integer-constant* is assigned to an integral value *k*. If *host-variable* is specified, it must be an exact numeric type with scale zero, and must not include an indicator variable. Furthermore, *k* must be in the range, 0<k<=32767. *k* rows are inserted into the target table from the specified host-variable array.

If a parameter marker is specified in this clause, a value must be provided with the USING clause of the associated EXECUTE or OPEN statement.

ATOMIC or **NOT ATOMIC CONTINUE ON SQLEXCEPTION**
Specifies whether all of the rows should be inserted as an atomic operation or not.

ATOMIC
Specifies that if the insert for any row fails, all changes made to the database by any of the inserts, including changes made by successful inserts, are undone. This is the default.

NOT ATOMIC CONTINUE ON SQLEXCEPTION
Specifies that, regardless of the failure of any particular insert of a row, the INSERT statement will not undo any changes made to the database by the successful inserts of other rows from the host-variable arrays, and inserting will be attempted for subsequent rows. However, the minimum level of atomicity is at least that of a single insert (that is, it is not possible for a partial insert to complete), including any triggers that may have been executed as a result of the INSERT statement.

This clause is only valid for a static INSERT statement. This clause must also not be specified if the INSERT statement is contained within a SELECT statement. For a dynamic INSERT statement, specify the clause on the PREPARE statement. For more information, see “PREPARE” on page 995.

Notes

Insert rules: Insert values must satisfy the following rules. If they do not, or if any other errors occur during the execution of the INSERT statement, no rows are inserted and the position of the cursors are not changed.

- *Default values*. The value inserted in any column that is not in the column list is the default value of the column. Columns without a default value must be included in the column list. Similarly, if you insert into a view, the default value is inserted into any column of the base table that is not included in the view. Hence, all columns of the base table that are not in the view must have a default value.
- *Length*. If the insert value of a column is a number, the column must be a numeric column with the capacity to represent the integral part of the number. If the insert value of a column is a string, the column must be either a string column with a length attribute at least as great as the length of the string, or a datetime column if the string represents a date, time, or timestamp.
- *Assignment*. Insert values are assigned to columns in accordance with the assignment rules described in Chapter 2, “Language elements,” on page 33.
- *Uniqueness constraints*. If the identified table or the base table of the identified view has one or more unique indexes, each row inserted into the table must conform to the constraints imposed by those indexes.
- *Referential constraints*. Each nonnull insert value of a foreign key must be equal to some value of the parent key of the parent table in the relationship.
- *Check constraints*. The identified table or the base table of the identified view might have one or more check constraints. Each row inserted must conform to the conditions imposed by those constraints. Thus, each check condition must be true or unknown.
- *Field and validation procedures*. If the identified table or the base table of the identified view has a field or validation procedure, each row inserted must conform to the constraints imposed by that procedure.
- *Views and the WITH CHECK OPTION*. For views defined with WITH CHECK OPTION, each row you insert into the view must conform to the definition of the view. If the view you name is dependent on other views whose definitions include

WITH CHECK OPTION, the inserted rows must also conform to the definitions of those views. For an explanation of the rules governing this situation, see “CREATE VIEW” on page 805.

For views that are not defined with WITH CHECK OPTION, you can insert rows that do not conform to the definition of the view. Those rows cannot appear in the view but are inserted into the base table of the view.

- *Omitting the column list*. When you omit the column list, you must specify a value for every column that was present in the table when the INSERT statement was bound or (for dynamic execution) prepared.
- *Triggers*. An INSERT statement might cause triggers to be activated. A trigger might cause other statements to be executed or raise error conditions based on the insert values.

  When triggers are processed for an INSERT statement that inserts multiple rows depends on the atomicity option that was specified for the INSERT statement:

  – **ATOMIC**. The inserts are processed as a single statement. Any statement level triggers fire once for the statement, and the transition tables will include all of the rows that were inserted.

  – **NOT ATOMIC CONTINUE ON SQLEXCEPTION**. The inserts are processed separately. Any statement level triggers are processed for each row that is inserted, and the transition tables include the individual row that is inserted. When errors are encountered with this option in effect, processing continues, and some of the specified rows will not be inserted. In this case, if an insert trigger is defined on the underlying base table, the trigger transition table will only include rows that were successfully inserted.

Number of rows inserted: Normally, after an INSERT statement completes execution, the value of SQLERRD(3) in the SQLCA is the number of rows inserted. (For a complete description of the SQLCA, including exceptions to the above statement, see Appendix D, “SQL communication area (SQLCA),” on page 1165.) The value in SQLERRD(3) does not include the number of rows that were inserted as the result of a trigger.

Nesting user-defined functions or stored procedures: An INSERT statement can implicitly or explicitly refer to user-defined functions or stored procedures. This is known as *nesting* of SQL statements. A user-defined function or stored procedure that is nested within the INSERT must not access the table into which you are inserting values.

Locking: Unless appropriate locks already exist, one or more exclusive locks are acquired at the execution of a successful INSERT statement. Until a commit or rollback operation releases the locks, only the application process that performed the insert can access the inserted row. If LOBs are not inserted into the row, application processes that are running with uncommitted read can also access the inserted row. The locks can also prevent other application processes from performing operations on the table. However, application processes that are running with uncommitted read can access locked pages and rows.

Locks are not acquired on declared temporary tables.

Inserting rows into a table with multilevel security : When you insert rows into a table with multilevel security, DB2 determines the value for the security label column of the row according to the following rules:

- If the user (the primary authorization ID) has write-down privilege or write-down control is not enabled, the user can set the security label for the row to any valid security label. The value that is specified must be assignable to a column that is defined as CHAR(8) FOR SBCS DATA NOT NULL. If the user does not specify a value for the security label or specifies DEFAULT, the security label of the row becomes the same as the security label of the user.

- If the user does not have write-down privilege and write-down control is enabled, the security label of the row becomes the same as the security label of the user.

Inserting a row into catalog table SYSIBM.SYSSTRINGS: If the object table is SYSIBM.SYSSTRINGS, only certain values can be specified, as described in Appendix B (Volume 2) of *DB2 Administration Guide*.

Datetime representation when using datetime registers: As explained under "Datetime special registers" on page 98, when two or more datetime registers are implicitly or explicitly specified in a single SQL statement, they represent the same point in time. This is also true when multiple rows are inserted.

Diagnostics information for a multiple-row INSERT statement: A single multiple-row INSERT statement might encounter multiple conditions. These conditions can be errors or warnings. Use the GET DIAGNOSTICS statement to obtain information about all of the conditions that are encountered for one of these INSERT statements. See "GET DIAGNOSTICS" on page 928 for more information.

If a warning occurs during the execution of an insert of a row, processing continues.

When NOT ATOMIC CONTINUE ON SQLEXCEPTION is specified and an error occurs during the execution of an insert of a row, the inserts are processed independently. This means that if one or more errors occur during the execution of an insert of a row, processing continues. The row that was being inserted at the time of the error is not inserted. Execution continues with the next row to be inserted, and any other changes made during the execution of the multiple-row INSERT statement are not backed out. However, the insert of an individual row is an atomic action.

When multiple errors or warnings occur with a non-atomic INSERT statement, diagnostic information for each row is available using the GET DIAGNOSTICS statement. The SQLSTATE and SQLCODE reflect a summary of what happened during the INSERT statement:

- **SQLSTATE 01659, SQLCODE +252.** All rows were inserted, but one or more warnings occurred.
- **SQLSTATE 22529, SQLCODE -253.** At least one row was successfully inserted, but one or more errors occurred. Some warnings may also have occurred.
- **SQLSTATE 22530, SQLCODE -254.** No row was inserted. One or more errors occurred while trying to insert multiple rows of data.
- **SQLSTATE 429BI, SQLCODE -20252.** More errors occurred that DB2 is capable of recording. Statement processing is terminated.

When ATOMIC is in effect, if an insert value violates any constraints or if any other error occurs during the execution of an insert of a row, all changes made during the execution of the multiple-row INSERT statement are backed out. The SQLCA reflects the last warning encountered.

After an INSERT statement that inserts multiple rows of data, both atomic and non-atomic, information is returned to the program through the SQLCA. The SQLCA is set as follows:

- SQLCODE contains the SQLCODE.
- SQLSTATE contains the SQLSTATE.
- SQLERRD3 contains the number of rows actually inserted. SQLERRD3 is the number of rows inserted, if this is less than the number of rows requested, then an error occurred.
- SQLWARN flags are set if they were set during any single insert operation.

The SQLCA is used to return information on errors and warnings found during a multiple-row insert. If indicator arrays are provided, the indicator variable values are used to determine if the value from the host-variable array, or NULL, will be used. The SQLSTATE contains the warning from the last data mapping error.

Considerations for specifying the number of rows for a dynamic multiple-row INSERT statement: Be aware of these considerations when specifying the number of rows to be inserted with a dynamic multiple-row INSERT statement that uses host-variable arrays:

- The FOR n ROWS clause can be specified as part of an INSERT statement or as part of an EXECUTE statement, but not both
- In the INSERT statement, you can specify a numeric constant in the FOR n ROWS clause to indicate the number of rows to be inserted or specify a parameter marker to indicate that the number of rows will be specified with the associated EXECUTE or OPEN statement. A multiple-row INSERT statement that is contained within a SELECT statement must include a FOR n ROWS clause.
- In an EXECUTE statement, when a dynamic INSERT statement is not contained within a SELECT statement, the number of rows can be specified with either the FOR n ROWS clause or the USING clause of the EXECUTE statement:
  - If the INSERT statement did not contain a FOR n ROWS clause, a value for the number of rows to be inserted can be specified in the FOR n ROWS clause of the EXECUTE statement with a numeric constant or host variable.
  - If a parameter marker was specified as part of a FOR n ROWS clause in the INSERT statement, a value for the number of rows must be specified with the USING clause of the EXECUTE statement.
- In an OPEN statement, when a dynamic SELECT statement contains one or more INSERT statements that have FOR n ROWS clauses with parameter markers, the values for the number of rows to be inserted (that is, the values for the parameter markers) must be specified with the USING clause of the OPEN statement.

DRDA considerations for a multiple-row INSERT statement: DB2 UDB for z/OS limits the size of user data and control information to 10M (except for LOBs, which are processed in a different data stream) for a single multiple-row INSERT statement using host-variable arrays.

Multiple-row insert and fetch statements are supported by any requester or server that supports the DRDA Version 3 protocols. If an attempt is made to issue a multiple-row INSERT or FETCH statement on a server that does not support DRDA Version 3 protocols, an error occurs.

When a multiple-row INSERT statement is executed at a DB2 for z/OS requester, the number of rows being inserted at the requester might not be known in some cases. These cases include:

- The FOR ’n’ ROWS clause contains a literal value for ’n’ for either a static or dynamic INSERT statement.

- Host variables are specified on the USING clause of an EXECUTE statement for a dynamic INSERT statement.

In either case, if the number of rows that is being inserted is not known, the requester may flow more data than is required to the server. The number of rows that is actually inserted will be correct because the server knows the correct number of rows to insert. However, performance can be adversely affected. Consider the following scenario:

```
...

long serial_num [10];
struct {
short len;
char data [18];
}name [20]
...
EXEC SQL INSERT INTO T1 VALUES (:serial_num, :name) FOR 5 ROWS
```

At the requester, when this statement is executed, the number of rows being inserted, 5, is not known. As a result, the requester will flow 10 values for serial_num and 10 values for name to the server (because the maximum number of rows that can be inserted without error is 10, which is the size of the smallest host-variable array).

Use the following programming techniques to avoid or minimize problems:

- Avoid using literal values for ’n’ in the FOR ’n’ ROWS clause of INSERT statements. For static INSERT statements, this technique ensures that the value for ’n’ will be known at the requester.
- For dynamic INSERT statements, use the USING DESCRIPTOR clause instead of the USING *host-variables* clause on the EXECUTE statement. If a USING DESCRIPTOR clause is used on the EXECUTE statement, the value for ’n’ must be indicated in the DESCRIPTOR.
- If neither of the above methods can be used:
  - Declare your host-variable arrays as small as possible, or indicate that the size of your host-variable arrays are the size of ’n’ in your descriptor. This avoids sending large numbers of host-variable-array entries that will not be used to the server.
  - Ensure that varying length string arrays are initialized to a length of 0 (zero). This minimizes the amount of data that is sent to the server.
  - Ensure that decimal host-variable arrays are initialized to valid values. This avoids a negative SQLCODE from being returned if the requester encounters invalid decimal data.

Other SQL statements in the same unit of work: The following statements cannot follow an INSERT statement in the same unit of work:

- An ALTER TABLE statement that changes the data type of a column (ALTER COLUMN SET DATATYPE)
- An ALTER INDEX statement that changes the padding attribute of an index with varying-length columns (PADDED to NOT PADDED or vice versa)

Examples

Example 1: Insert values into sample table DSN8810.EMP.

```
INSERT INTO DSN8810.EMP
  VALUES ('000205','MARY','T','SMITH','D11','2866',
           '1981-08-10','ANALYST',16,'F','1956-05-22',
          16345,500,2300);
```

Example 2: Assume that SMITH.TEMPEMPL is a created temporary table. Populate the table with data from sample table DSN8810.EMP.

```
INSERT INTO SMITH.TEMPEMPL
  SELECT *
  FROM DSN8810.EMP;
```

Example 3: Assume that SESSION.TEMPEMPL is a declared temporary table. Populate the table with data from department D11 in sample table DSN8810.EMP.

```
INSERT INTO SESSION.TEMPEMPL
  SELECT *
  FROM DSN8810.EMP
  WHERE WORKDEPT='D11';
```

Example 4: Insert a row into sample table DSN8810.EMP_PHOTO_RESUME. Set the value for column EMPNO to the value in host variable HV_ENUM. Let the value for column EMP_ROWID be generated because it was defined with a row ID data type and with clause GENERATED ALWAYS.

```
INSERT INTO DSN8810.EMP_PHOTO_RESUME(EMPNO, EMP_ROWID)
  VALUES (:HV_ENUM, DEFAULT);
```

You can only insert user-specified values into ROWID columns that are defined as GENERATED BY DEFAULT and not as GENERATED ALWAYS. Therefore, in the above example, if you were to try to insert a value into EMP_ROWID instead of specifying DEFAULT, the statement would fail unless you also specify OVERRIDING USER VALUE. For columns that are defined as GENERATED ALWAYS, the OVERRIDING USER VALUE clause causes DB2 to ignore any user-specified value and generate a value instead.

For example, assume that you want to copy the rows in DSN8810.EMP_PHOTO_RESUME to another table that has a similar definition (both tables have a ROWID columns defined as GENERATED ALWAYS). For the following INSERT statement, the OVERRIDING USER VALUE clause causes DB2 to ignore the EMP_ROWID column values from DSN8810.EMP_PHOTO_RESUME and generate values for the corresponding ROWID column in B.EMP_PHOTO_RESUME.

```
INSERT INTO B.EMP_PHOTO_RESUME
  OVERRIDING USER VALUE
  SELECT * FROM DSN8810.EMP_PHOTO_RESUME;
```

Example 5: Assume that the T1 table has one column. Insert a variable (:hv) number of rows of data into the T1 table. The values to be inserted are provided in a host-variable array (:hva).

```
EXEC SQL INSERT INTO T1 FOR :hv ROWS VALUES (:hva:hvind) ATOMIC;
```

In this example, :hva represents the host-variable array and :hvind represents the array of indicator variables.

Example 6: Assume that the T2 table has 2 columns, C1 is a SMALL INTEGER column, and C2 is an INTEGER column. Insert 10 rows of data into the T2 table. The values to be inserted are provided in host-variable arrays :hva1 (an array of INTEGERS) and :hva2 (an array of DECIMAL(15,0) values). The data values for :hva1 and :hva2 are represented in Table 85 on page 984:

Table 85. Data values for :hva1 and :hva2

Array entry	:hva1	:hva2
1	1	32768
2	-12	90000
3	79	2
4	32768	19
5	8	36
6	5	24
7	400	36
8	73	4000000000
9	-200	2000000000
10	35	88

```
EXEC SQL INSERT INTO T2 (C1, C2)
  FOR 10 ROWS VALUES (:hva1:hvind1, :hva2:hvind2)
  NOT ATOMIC CONTINUE ON SQLEXCEPTION;
```

After execution of the INSERT statement, the following information will be in the SQLCA:

```
SQLCODE = 0
SQLSTATE = 0
SQLERRD3 = 8
```

Although an attempt was made to insert 10 rows, only 8 rows of data were inserted. Processing continued after the first failed insert because NOT ATOMIC CONTINUE ON SQLEXCEPTION was specified. You can use the GET DIAGNOSTICS statement to find further information, for example:

```
GET DIAGNOSTICS :num_rows = ROW_COUNT, :num_cond = NUMBER;
```

The result of this statement is num_rows = 8 and num_cond = 2 (2 conditions).

```
GET DIAGNOSTICS CONDITION 2 :sqlstate = RETURNED_SQLSTATE,
                            :sqlcode = DB2_RETURNED_SQLCODE,
                            :row_num = DB2_ROW_NUMBER;
```

The result of this statement is sqlstate = 22003, sqlcode = -302, and row_num = 4.

```
GET DIAGNOSTICS CONDITION 1 :sqlstate = RETURNED_SQLSTATE,
                            :sqlcode = DB2_RETURNED_SQLCODE,
                            :row_num = DB2_ROW_NUMBER;
```

The result of this statement is sqlstate = 22003, sqlcode = -302, and row_num = 8.

Example 7: Assume the above table T2 with two columns. C1 is a SMALL INTEGER column, and C2 is an INTEGER column. Insert 8 rows of data into the T2 table. The values to be inserted are provided in host-variable arrays :hva1 (an array of INTEGERS) and :hva2 (an array of DECIMAL(15,0) values.) The data values for :hva1 and :hva2 are represented in Table 85.

```
EXEC SQL INSERT INTO T2 (C1, C2)
  FOR 8 ROWS VALUES (:hva1:hvind1, :hva2:hvind2)
  NOT ATOMIC CONTINUE ON SQLEXCEPTION;
```

After execution of the INSERT statement, the following information will be in the SQLCA:

```
SQLCODE = -302
SQLSTATE = 22003
SQLERRD3 = 6
```

Although an attempt was made to insert 8 rows, only 6 rows of data were inserted. Processing continued after the first failed insert because NOT ATOMIC CONTINUE ON SQLEXCEPTION was specified. You can use the GET DIAGNOSTICS statement to find further information, for example:

```
GET DIAGNOSTICS :num_rows = ROW_COUNT, :num_cond = NUMBER;
```

The result of this statement is num_rows = 68 and num_cond = 2 (2 conditions).

```
GET DIAGNOSTICS CONDITION 2 :sqlstate = RETURNED_SQLSTATE,
                            :sqlcode = DB2_RETURNED_SQLCODE,
                            :row_num = DB2_ROW_NUMBER;
```

The result of this statement is sqlstate = 22003, sqlcode = -302, and row_num = 4.

```
GET DIAGNOSTICS CONDITION 1 :sqlstate = RETURNED_SQLSTATE,
                            :sqlcode = DB2_RETURNED_SQLCODE,
                            :row_num = DB2_ROW_NUMBER;
```

The result of this statement is sqlstate = 22003, sqlcode = -302, and row_num = 8.

Example 8: Assume that table T1 has two columns. Insert a variable number (:hvn) or rows into T1. The values to be inserted are in host-variable arrays :hva and :hvb. In this example, the INSERT statement is contained within the SELECT statement of cursor CS1. The SELECT statement makes use of two other input host variables (:hv1 and :hv2) in the WHERE clause. Either a static or dynamic INSERT statement can be used.

```
Static INSERT statement:

DECLARE CS1 CURSOR WITH ROWSET POSITIONING FOR
   SELECT *
      FROM FINAL TABLE
         (INSERT INTO T1 VALUES (:hva, :hvb) FOR :hvn ROWS)
      WHERE C1 > :hv1 AND C2 < :hv2;
OPEN CS1;

Dynamic INSERT statement:
PREPARE INSSTMT FROM
   'SELECT *
       FROM FINAL TABLE
          (INSERT INTO T1 VALUES ( ? , ? ) FOR ? ROWS)
       WHERE C1 > ? AND C2 < ?';
DECLARE CS1 CURSOR WITH ROWSET POSITIONING FOR :INSSTMT;
OPEN CS1 USING :hva, :hvb, :hvn, :hv1, :hv2; (or OPEN CS1 USING DESCRIPTOR ...)
```

If the host-variable arrays for the multiple-row INSERT statement were to be specified using a descriptor, that descriptor (SQLDA) would have to describe all input host variables in the statement, and the order of the entries in the SQLDA should be the same as the order of the order of the host variables, host-variable arrays, and values for the FOR n ROWS clauses in the statement. For example, given the statement above, the SQLVAR entries in the descriptor must be assigned in the following order: :hvn, :hva, :hvb, :hv1, hv2. In addition, the SQLVAR entries for host-variable arrays must be tagged in the SQLDA as column arrays (by specifying a special value in part of the SQLNAME field for a host variable), and the SQLVAR entry for the number of rows value must be tagged in the SQLDA (by specifying another special value in part of the SQLNAME field for the host variable).

LABEL

The LABEL statement adds or replaces labels in the descriptions of tables, views, aliases, or columns in the catalog at the current server.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

The privilege set that is defined below must include at least one of the following:
- Ownership of the table, view, or alias
- DBADM authority for its database (tables only)
- SYSADM or SYSCTRL authority

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package. If the statement is dynamically prepared, the privilege set is determined by the DYNAMICRULES behavior in effect (run, bind, define, or invoke) and is summarized in Table 53 on page 433. (For more details on these behaviors, including a list of the DYNAMICRULES bind option values that determine them, see “Authorization IDs and dynamic SQL” on page 51.)

Syntax

```
►►──LABEL ON──┬──┬─TABLE──┬─table-name─┬───────────┬─IS─string-constant─┬─────────────►◄
              │  │        └─view-name──┘           │                    │
              │  ├─ALIAS─alias-name────────────────┤                    │
              │  └─COLUMN──┬─table-name.column-name─┤                    │
              │            └─view-name.column-name──┘                    │
              │                   ┌─,────────────────────────────┐       │
              │                   ▼                              │       │
              └─┬─table-name─┬──(───column-name─IS─string-constant─┴─)────┘
                └─view-name──┘
```

Description

TABLE *table-name* or *view-name*
: Identifies the table or view to which the label applies. The name must identify a table or view that exists at the current server. *table-name* must not identify a declared temporary table. The label is placed into the LABEL column of the SYSIBM.SYSTABLES catalog table for the row that describes the table or view.

ALIAS *alias-name*
: Identifies the alias to which the label applies. The name must identify an alias that exists at the current server. The label is placed in the LABEL column of the SYSIBM.SYSTABLES catalog table for the row that describes the alias.

COLUMN *table-name.column-name* or *view-name.column-name*
: Identifies the column to which the label applies. The name must identify a column of a table or view that exists at the current server. The name must not

identify a column of a declared temporary table. The label is placed in the LABEL column of the SYSIBM.SYSCOLUMNS catalog table in the row that describes the column.

Do not use TABLE or COLUMN to define a label for more than one column in a table or view. Give the table or view name and then, in parentheses, a list in the form:

```
column-name IS string-constant,
column-name IS string-constant,...
```

See Example 2 below.

The column names must not be qualified, each name must identify a column of the specified table or view, and that table or view must exist at the current server.

IS Introduces the label you want to provide.

string-constant
Can be any SQL character string constant of up to 30 bytes in length.

Examples

Example 1: Enter a label on the DEPTNO column of table DSN8810.DEPT.

```
LABEL ON COLUMN DSN8810.DEPT.DEPTNO
  IS 'DEPARTMENT NUMBER';
```

Example 2: Enter labels on two columns in table DSN8810.DEPT.

```
LABEL ON DSN8810.DEPT
 (MGRNO IS 'MANAGER'S EMPLOYEE NUMBER',
  ADMRDEPT IS 'ADMINISTERING DEPARTMENT');
```

LOCK TABLE

The LOCK TABLE statement requests a lock on a table or table space at the current server. The lock is not acquired if the process already holds an appropriate lock.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

The privilege set that is defined below must include at least one of the following:

- The SELECT privilege on the identified table
- Ownership of the table
- DBADM authority for the database
- SYSADM or SYSCTRL authority

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package. If the statement is dynamically prepared, the privilege set is determined by the DYNAMICRULES behavior in effect (run, bind, define, or invoke) and is summarized in Table 53 on page 433. (For more details on these behaviors, including a list of the DYNAMICRULES bind option values that determine them, see “Authorization IDs and dynamic SQL” on page 51.)

Syntax

```
►►──LOCK TABLE──table-name──┬────────────────────────┬──IN──┬─SHARE─────┬──MODE──────────────────────────►◄
                            └─PARTITION──integer─┘         └─EXCLUSIVE─┘
```

Description

table-name
: Identifies the table to be locked. The name must identify a table that exists at the current server. It must not identify a view, a temporary table (created or declared), or a catalog table. The lock might or might not apply exclusively to the table. The effect of locking an auxiliary table is to lock the LOB table space that contains the auxiliary table.

PARTITION *integer*
: Identifies the partition of a partitioned table space to lock. The table identified by *table-name* must belong to a partitioned table space. The value specified for *integer* must be an integer that is no greater than the number of partitions in the table space.

IN SHARE MODE
: For a lock on a table that is not an auxiliary table, requests the acquisition of a lock that prevents other processes from executing anything but read-only operations on the table. For a lock on a LOB table space, IN SHARE mode requests a lock that prevents storage from being reallocated. When a LOB table space is locked, other processes can delete LOBs or update them to a null

value, but they cannot insert LOBs with a nonnull value. The type of lock that the process holds after execution of the statement depends on what lock, if any, the process already holds.

IN EXCLUSIVE MODE
Requests the acquisition of an exclusive lock for the application process. Until the lock is released, it prevents concurrent processes from executing any operations on the table. However, unless the lock is on a LOB table space, concurrent processes that are running at an isolation level of uncommitted read (UR) can execute read-only operations on the table.

Notes

Releasing locks: If LOCK TABLE is a static SQL statement, the RELEASE option of bind determines when DB2 releases a lock. For RELEASE(COMMIT), DB2 releases the lock at the next commit point. For RELEASE(DEALLOCATE), DB2 releases the lock when the plan is deallocated (the application ends).

If LOCK TABLE is a dynamic SQL statement, DB2 uses RELEASE(COMMIT) and releases the lock at the next commit point, *unless* the table or table space is referenced by cached dynamic statements. Caching allows DB2 to keep prepared statements in memory past commit points. In this case, DB2 holds the lock until deallocation or until the commit after the prepared statements are freed from memory. Under some conditions, if a lock is held past a commit point, DB2 demotes the lock state of a segmented table or a nonsegmented table space to an intent lock at the commit point.

For more information on using LOCK TABLE (such as the size and duration of locks), and on locking in general, see Part 4 of *DB2 Application Programming and SQL Guide* or Part 5 (Volume 2) of *DB2 Administration Guide*.

Syntax alternatives and synonyms: For compatibility with previous releases of DB2, PART can be specified as a synonym for PARTITION.

Example

Obtain a lock on the sample table named DSN8810.EMP, which resides in a partitioned table space. The lock obtained applies to every partition and prevents other application programs from either reading or updating the table.

```
LOCK TABLE DSN8810.EMP IN EXCLUSIVE MODE;
```

OPEN

The OPEN statement opens a cursor so that it can be used to process rows from its result table.

Invocation

This statement can only be embedded in an application program. It is an executable statement that cannot be dynamically prepared. It must not be specified in Java.

Authorization

See “DECLARE CURSOR” on page 812 for the authorization required to use a cursor.

Syntax

```
►►──OPEN──cursor-name──┬──────────────────────────────────────┬──────────────►◄
                       │        ┌─,──────────────┐            │
                       │        ▼                │            │
                       ├─USING───host-variable───┴────────────┤
                       └─USING DESCRIPTOR──descriptor-name────┘
```

Description

cursor-name
Identifies the cursor to be opened. The *cursor-name* must identify a declared cursor as explained in “DECLARE CURSOR” on page 812. When the OPEN statement is executed, the cursor must be in the closed state.

The SELECT statement of the cursor is either:

- The *select-statement* specified in the DECLARE CURSOR statement, or
- The prepared *select-statement* identified by the *statement-name* specified in the DECLARE CURSOR statement. If the statement has not been successfully prepared, or is not a *select-statement*, the cursor cannot be successfully opened.

The result table of the cursor is derived by evaluating the SELECT statement. The evaluation uses the current values of any special registers or PREVIOUS VALUE expressions specified in the SELECT statement and the current values of any host variables specified in the SELECT statement or the USING clause of the OPEN statement. The rows of the result table can be derived during the execution of the OPEN statement and a temporary copy of a result table can be created to hold them. They can be derived during the execution of later FETCH statements. In either case, the cursor is placed in the open state and positioned before the first row of its result table. If the table is empty the position of the cursor is effectively “after the last row.” DB2 does not indicate an empty table when the OPEN statement is executed. But it does indicate that condition, on the first execution of FETCH, by returning values of +100 for SQLCODE and '02000' for SQLSTATE.

USING
Introduces a list of host variables whose values are substituted for the

parameter markers (question marks) or host variables in the statement of the cursor, depending on the declaration of the cursor:

- If the DECLARE CURSOR statement included *statement-name*, the statement was prepared with a PREPARE statement. The host variables specified in the USING clause of the OPEN statement replace any parameter markers in the prepared statement. This reflects the typical use of the USING clause of the OPEN statement For an explanation of parameter marker replacement, see “PREPARE” on page 995.

  If the prepared statement includes parameter markers, you must use USING. If the prepared statement does not include parameter markers, USING is ignored.
- If the DECLARE CURSOR statement included *select-statement* and the SELECT statement included host variables, the USING clause of the OPEN statement can be used to specify host variables that are to override the values that were specified when the cursor was defined. In this case, the OPEN statement is executed as if each host variable in the SELECT statement were a parameter marker except that the attributes of the target variable are the same as the host variables in the SELECT statement. The effect is to override the values of the host variables in the SELECT statement of the cursor with the values of the host variables specified in the USING clause. The overriding value is always the value of the main variable because indicator variables are ignored in this context without warning.

host-variable,...

Identifies host structures or variables that must be described in the application program in accordance with the rules for declaring host structures and variables. When the statement is executed, a reference to a structure is replaced by a reference to each of its variables. The number of variables must be the same as the number of parameter markers in the prepared statement. The *n*th variable corresponds to the *n*th parameter marker in the prepared statement. Where appropriate, locator variables can be provided as the source of values for parameter markers.

DESCRIPTOR *descriptor-name*

Identifies an SQLDA that contains a valid description of the input host variables.

Before the OPEN statement is processed, the user must set the following fields in the SQLDA:

- SQLN to indicate the number of SQLVAR occurrences provided in the SQLDA

  A REXX SQLDA does not contain this field.
- SQLABC to indicate the number of bytes of storage allocated for the SQLDA
- SQLD to indicate the number of variables used in the SQLDA when processing the statement
- SQLVAR occurrences to indicate the attributes of the variables

The SQLDA must have enough storage to contain all SQLVAR occurrences. If LOBs or distinct types are present in the result table, there must be additional SQLVAR entries for each input host variable. For more information on the SQLDA, which includes a description of the SQLVAR and an explanation on how to determine the number of SQLVAR occurrences, see Appendix E, “SQL descriptor area (SQLDA),” on page 1173.

SQLD must be set to a value greater than or equal to zero and less than or equal to SQLN. It must be the same as the number of parameter markers in the prepared statement.

See “Identifying an SQLDA in C or C++” on page 1189 for how to represent *descriptor-name* in C.

Notes

Errors occurring on OPEN: In local and remote processing, the DEFER(PREPARE) and REOPT(ALWAYS)/REOPT(ONCE) bind options can cause some SQL statements to receive “delayed” errors. For example, an OPEN statement might receive an SQLCODE that normally occurs during PREPARE processing. Or a FETCH statement might receive an SQLCODE that normally occurs at OPEN time.

Closed state of cursors: All cursors in an application process are in the closed state when:
- The application process is started.
- A new unit of work is started for the application process unless the WITH HOLD option has been used in the DECLARE CURSOR statement.
- The application was precompiled with the CONNECT(1) option (which implicitly closes any open cursors).

A cursor can also be in the closed state because:
- A CLOSE statement was executed.
- An error was detected that made the position of the cursor unpredictable.

To retrieve rows from the result table of a cursor, you must execute a FETCH statement when the cursor is open. The only way to change the state of a cursor from closed to open is to execute an OPEN statement.

Effect of a temporary copy of a result table: DB2 can process a cursor in two different ways:
- It can create a temporary copy of the result table during the execution of the OPEN statement. You can specify INSENSITIVE SCROLL on the cursor to force the use of a a temporary copy of the result table.
- It can derive the result table rows as they are needed during the execution of later FETCH statements.

If the result table is not read-only, DB2 uses the latter method. If the result table is read-only, either method could be used. The results produced by these two methods could differ in the following respects:

When a temporary copy of the result table is used: An error can occur that would otherwise not occur until some later FETCH statement. INSERT statements that are executed while the cursor is open cannot affect the result table once all the rows have been materialized in the temporary copy of the result table. For a scrollable insensitive cursor, UPDATE and DELETE statements that are executed while the cursor is open cannot affect the result table. For a scrollable sensitive static cursor, UPDATE and DELETE statements can affect the result table if the rows are subsequently fetched with sensitive FETCH statements.

When a temporary copy of the result table is not used: INSERT, UPDATE, and DELETE statements that are executed while the cursor is open can affect the result table if they are issued from the same application process. The effect of such operations is not always predictable.

For example, if cursor C is positioned on a row of its result table defined as SELECT * FROM T, and you insert a row into T, the effect of that insert on the result table is not predictable because its rows are not ordered. A later FETCH C might or might not retrieve the new row of T. To avoid these changes, you can specify INSENSITIVE SCROLL for the cursor to force the use of a temporary copy of the result table.

Parameter marker replacement: Before the OPEN statement is executed, each parameter marker in the query is effectively replaced by its corresponding host variable. The replacement is an assignment operation in which the source is the value of the host variable and the target is a variable within DB2. The assignment rules are those described for assignment to a column in “Assignment and comparison” on page 74. For a typed parameter marker, the attributes of the target variable are those specified by the CAST specification. For an untyped parameter marker, the attributes of the target variable are determined according to the context of the parameter marker. For the rules that affect parameter markers, see “Parameter markers” on page 1003.

Let V denote a host variable that corresponds to parameter marker P. The value of V is assigned to the target variable for P in accordance with the rules for assigning a value to a column:

- V must be compatible with the target.
- If V is a string, its length (excluding trailing blanks) must not be greater than the length attribute of the target.
- If V is a number, the absolute value of its integral part must not be greater than the maximum absolute value of the integral part of the target.
- If the attributes of V are not identical to the attributes of the target, the value is converted to conform to the attributes of the target.
- If the target cannot contain nulls, V must not be null.

When the SELECT statement of the cursor is evaluated, each parameter marker in the statement is effectively replaced by the value of its corresponding host variable. For example, if V is CHAR(6) and the target is CHAR(8), the value used in place of P is the value of V padded on the right with two blanks. For more on the process of replacement, see “Parameter marker replacement.”

Considerations for scrollable cursors: Following an OPEN *cursor* statement, a GET DIAGNOSTICS statement can be used to get the attributes of the cursor such as the following information (for more information, see “GET DIAGNOSTICS” on page 928):

- DB2_SQL_ATTR_CURSOR _HOLD. Whether the cursor was defined with the WITH HOLD attribute.
- DB2_SQL_ATTR_CURSOR_SCROLLABLE. Scrollability of the cursor.
- DB2_SQL_ATTR_CURSOR_SENSITIVITY. Effective sensitivity of the cursor.

  The sensitivity information can be used by applications (such as an ODBC driver) to determine what type of FETCH (INSENSITIVE or SENSITIVE) to issue for a cursor defined as ASENSITIVE.

- DB2_SQL_ATTR_CURSOR_ROWSET. Whether the cursor can be used to access rowsets.
- DB2_SQL_ATTR_CURSOR_TYPE. Whether a cursor type is forward-only, static, or dynamic.

In addition, if subsystem parameter DISABSCL is set to YES, a subset of the above information is returned in the SQLCA:

- The scrollability of the cursor is in SQLWARN1.
- The sensitivity of the cursor is in SQLWARN4.
- The effective capability of the cursor is in SQLWARN5.

Number of rows inserted: If the SELECT statement of the cursor contains an INSERT statement, the OPEN operation sets SQLERRD(3) to the number of rows inserted.

Materialization of the rows of the result table and NEXT VALUE expressions: If the rows of the result table of a cursor are materialized when the cursor is opened and the SELECT statement of the cursor contains NEXT VALUE expressions, the expressions are processed when the cursor is opened. Otherwise, the NEXT VALUE expressions are evaluated as the rows of the result table are retrieved.

Example

The OPEN statement in the following example places the cursor at the beginning of the rows to be fetched.

```
EXEC SQL DECLARE C1 CURSOR FOR
  SELECT DEPTNO, DEPTNAME, MGRNO FROM DSN8810.DEPT
  WHERE ADMRDEPT = 'A00';
EXEC SQL OPEN C1;
 DO WHILE (SQLCODE = 0);
  EXEC SQL FETCH C1 INTO :DNUM, :DNAME, :MNUM;
END;
 EXEC SQL CLOSE C1;
```

PREPARE

The PREPARE statement creates an executable SQL statement from a string form of the statement. The character-string form is called a *statement string*. The executable form is called a *prepared statement*.

Invocation

This statement can only be embedded in an application program. It is an executable statement that cannot be dynamically prepared. It must not be specified in Java.

Authorization

The authorization rules are those defined for the dynamic preparation of the SQL statement specified by the PREPARE statement. For example, see Chapter 4, “Queries,” on page 393 for the authorization rules that apply when a SELECT statement is prepared.

Syntax

```
►►──PREPARE──statement-name──┬─────────────────────────────────────────────────┬──────────────►
                             └─INTO──descriptor-name──┬─────────────────────┬──┘
                                                      │         ┌─NAMES──┐  │
                                                      └─USING───┼─LABELS─┼──┘
                                                                ├─ANY────┤
                                                                └─BOTH───┘

►──┬──┬──────────────────────────────────────┬──FROM──host-variable──┬──────────────────────►◄
   │  │                                 (1)  │                       │
   │  └─ATTRIBUTES──attr-host-variable───────┘                       │
   │                             (2)                                 │
   └─FROM──string-expression─────────────────────────────────────────┘
```

Notes:

1 *attr-host-variable* must be a string host variable and the content must conform to the rules for attribute-string. The ATTRIBUTES clause can only be specified before *host-variable*.

2 *string-expression* is only supported for PLI.

attribute-string

```
   ┌─────────────────────────────────────────────────────┐
   ↓   (1)                                               │
►►─────────┬──┬─ASENSITIVE──────────────┬──────────────┬─┴───────────────────────────────────────────────►◄
           │  ├─INSENSITIVE─────────────┤              │
           │  │           ┌─DYNAMIC─┐   │              │
           │  └─SENSITIVE─┤         ├───┘              │
           │              └─STATIC──┘                  │
           ├──┬─NO SCROLL─┬────────────────────────────┤
           │  └─SCROLL────┘                            │
           ├─holdability───────────────────────────────┤
           ├─returnability─────────────────────────────┤
           ├─rowset-positioning────────────────────────┤
           ├─fetch-first-clause────────────────────────┤
           ├──┬─read-only-clause─┬─────────────────────┤
           │  └─update-clause────┘                     │
           ├─optimize-clause───────────────────────────┤
           ├─isolation-clause──────────────────────────┤
           │                         (2)               │
           ├──┬─FOR MULTIPLE ROWS─┬────────────────────┤
           │  └─FOR SINGLE ROW────┘                    │
           │                                       (3) │
           └──┬─ATOMIC─────────────────────────────┬───┘
              └─NOT ATOMIC CONTINUE ON SQLEXCEPTION─┘
```

Notes:

1 The same clause must not be specified more than once. If the options are not specified, their defaults are whatever was specified for the corresponding option in an associated DECLARE CURSOR or INSERT statement.

2 The FOR SINGLE ROW or FOR MULTIPLE ROWS clause must only be specified for an INSERT statement.

3 The ATOMIC or NOT ATOMIC CONTINUE ON SQLEXCEPTION clause must only be specified for an INSERT statement.

holdability:

```
►►──┬─WITHOUT HOLD─┬──────────────────────────────────────────────────────────────►◄
    └─WITH HOLD────┘
```

returnability:

```
►►──┬─WITHOUT RETURN─────────────┬────────────────────────────────────────────────►◄
    │              ┌─TO CALLER─┐ │
    └─WITH RETURN──┴───────────┴─┘
```

rowset-positioning:

```
►►──┬─WITHOUT ROWSET POSITIONING─┬──────────────────────────────────────────────────────────►◄
    └─WITH ROWSET POSITIONING────┘
```

Description

statement-name
Names the prepared statement. If the name identifies an existing prepared statement, that prepared statement is destroyed. The name must not identify a prepared statement that is the SELECT statement of an open cursor.

INTO
If you use INTO, and the PREPARE statement is successfully executed, information about the prepared statement is placed in the SQLDA specified by the descriptor name. Thus, the PREPARE statement:

```
EXEC SQL PREPARE S1 INTO :SQLDA FROM :V1;
```

is equivalent to:

```
EXEC SQL PREPARE S1 FROM :V1;
EXEC SQL DESCRIBE S1 INTO :SQLDA;
```

descriptor-name
Identifies the SQLDA. For languages other than REXX, SQLN must be set to indicate the number of SQLVAR occurrences. See “DESCRIBE (prepared statement or table)” on page 851 and Appendix E, “SQL descriptor area (SQLDA),” on page 1173 for information about how to determine the number of SQLVAR occurrences to use and for an explanation of the information that is placed in the SQLDA.

See “Identifying an SQLDA in C or C++” on page 1189 for how to represent *descriptor-name* in C.

USING
Indicates what value to assign to each SQLNAME variable in the SQLDA when INTO is used. If the requested value does not exist, SQLNAME is set to length 0.

NAMES
Assigns the name of the column. This is the default.

LABELS
Assigns the label of the column. (Column labels are defined by the LABEL statement.)

ANY
Assigns the column label, and, if the column has no label, the column name.

BOTH
Assigns both the label and name of the column. In this case, two or three occurrences of SQLVAR per column, depending on whether the result table contains distinct types, are needed to accommodate the additional information. To specify this expansion of the SQLVAR array, set SQLN to 2×*n* or 3×*n*, where *n* is the number of columns in the object being described. For each of the columns, the first *n* occurrences

of SQLVAR, which are the base SQLVAR entries, contain the column names. Either the second or third *n* occurrences of SQLVAR, which are the extended SQLVAR entries, contain the column labels. If there are no distinct types, the labels are returned in the second set of SQLVAR entries. Otherwise, the labels are returned in the third set of SQLVAR entries.

A REXX SQLDA does not include the SQLN field, so you do not need to set SQLN for REXX programs.

ATTRIBUTES *attr-host-variable*

Specifies the attributes for this cursor that are in effect if a corresponding attribute has not been specified as part of the associated SELECT statement. If attributes are specified in the SELECT statement, they are used instead of the corresponding attributes specified on the PREPARE statement. In turn, if attributes are specified in the PREPARE statement, they are used instead of the corresponding attributes specified on a DECLARE CURSOR statement.

attr-host-variable must identify a host variable that is described in the program in accordance with the rules for declaring string variables. *attr-host-variable* must be a string variable (either fixed-length or varying-length) that has a length attribute that does not exceed the maximum length of a CHAR or VARCHAR. Leading and trailing blanks are removed from the value of the host variable. The host variable must contain a valid *attribute-string*.

An indicator variable can be used to indicate whether or not attributes are actually provided on the PREPARE statement. Thus, applications can use the same PREPARE statement regardless of whether attributes need to be specified or not.

The options that can be specified as part of the *attribute-string* are as follows:

ASENSITIVE, INSENSITIVE, SENSITIVE STATIC, or **SENSITIVE DYNAMIC**

Specifies the desired sensitivity of the cursor to inserts, updates, or deletes that made to the rows underlying the result table. The sensitivity of the cursor determines whether DB2 can materialize the rows of the result into a temporary table. The default is ASENSITIVE.

ASENSITIVE

Specifies that the cursor should be as sensitive as possible. A cursor that defined as ASENSITIVE will be either insensitive or sensitive dynamic; it will not be sensitive static. For information about how the effective sensitivity of the cursor is returned to the application with the GET DIAGNOSTICS statement or in the SQLCA, see “OPEN” on page 990.

INSENSITIVE

Specifies that the cursor does not have sensitivity to inserts, updates, or deletes that are made to the rows underlying the result table. As a result, the size of the result table, the order of the rows, and the values for each row do not change after the cursor is opened. In addition, the cursor is read-only. The SELECT statement or *attribute-string* of the PREPARE statement cannot contain a FOR UPDATE clause, and the cursor cannot be used for positioned updates or deletes.

[38] The scrollability and sensitivity of the cursor are independent and do not have to be specified together. Thus, the cursor might be defined as SCROLL INSENSITIVE, but the PREPARE statement might specify SENSITIVE STATIC as an override for the sensitivity.

SENSITIVE

Specifies that the cursor has sensitivity to changes made to the database after the result table is materialized. The cursor is always sensitive to updates and deletes made using the cursor (that is, positioned updates and deletes using the same cursor). When the current value of a row no longer satisfies the *select-statement* or *statement-name*, that row is no longer visible through the cursor. When a row of the result table is deleted from the underlying base table, the row is no longer visible through the cursor.

In addition, the cursor has sensitivity to changes made to values outside the cursor (that is, by other cursors or committed changes by other application processes). If DB2 can not make changes made outside the cursor visible to the cursor, an error is issued at OPEN CURSOR. Whether the cursor is sensitive to changes made outside this cursor depends on whether DYNAMIC or STATIC is in effect for the cursor and whether SENSITIVE or INSENSITIVE FETCH statements are used.

Whether the cursor is sensitive to newly inserted rows depends on whether DYNAMIC or STATIC is in effect for the cursor. The default is DYNAMIC.

STATIC

Specifies that the order of the rows and size of the result table is static. The size of the result table does not grow after the cursor is opened and the rows are materialized. The order of the rows is established as the result table is materialized. Rows that are inserted into the underlying table are not added to the result table of the cursor regardless of how the rows were inserted. Rows in the result table do not move if columns in the ORDER BY clause are updated in rows that have already been materialized.

Whether the changes that are made outside the cursor are visible to the cursor depends on the type of FETCH that is used with a SENSITIVE STATIC cursor. For more information, see “Considerations for FETCH statements used with a sensitive static cursor” on page 1007.

Using a nondeterministic function (built-in or user-defined) in the WHERE clause of *select-statement* or *statement-name* of a SENSITIVE STATIC cursor can cause misleading results. This occurs because DB2 constructs a temporary result table and retrieves rows from this table for INSENSITIVE FETCH statements. When DB2 processes a SENSITIVE FETCH statement, rows are fetched from the underlying table and predicates are re-evaluated if they contain non-correlated subqueries. Using a nondeterministic function can yield a different result for the re-evaluated query causing the row to no longer be considered a match.

The associated SELECT statement cannot contain an INSERT statement.

If SENSITIVE STATIC is specified and a sensitive static cursor is not possible, then an error is returned.

SENSITIVE DYNAMIC

Specifies that the result table of the cursor is dynamic in that the size of the result table can change after the cursor is opened as rows are inserted into or deleted from the underlying table, and the order of the rows can change. Inserts, deletes, and updates that are made by the same application process are immediately visible. Inserts, deletes, and updates that are made by other application processes are visible after they are committed.

All FETCH statements for sensitive dynamic cursors are sensitive to changes made by this cursor, changes made by other cursors in the same application process, and committed changes made by other application processes.

The associated SELECT statement cannot contain an INSERT statement.

If a SENSITIVE DYNAMIC cursor is not possible, an error is returned, an error is returned.

If ASENSITIVE, INSENSITIVE, SENSITIVE STATIC, or SENSITIVE DYNAMIC is specified as part of the ATTRIBUTES clause, SCROLL must be specified.

SCROLL or **NO SCROLL**

Specifies whether the cursor is scrollable.

SCROLL

Specifies that the cursor is scrollable.

NO SCROLL

Specifies that the cursor is not scrollable.

WITHOUT RETURN or WITH RETURN TO CALLER

Specifies the intended use of the result table of the cursor.

WITHOUT RETURN

Specifies that the result table of the cursor is not intended to be used as a result set that will be returned from the program or procedure.

WITH RETURN TO CALLER

Specifies that the result table of the cursor is intended to be used as a result set that will be returned from the program or procedure to the caller. Specifying TO CALLER is optional.

When a cursor that is declared using the WITH RETURN TO CALLER clause remains open at the end of a program or procedure, that cursor defines a result set from the program or procedure. Use the CLOSE statement to close cursors that are not intended to be a result set from the program or procedure. Although DB2 will automatically close any cursors that are not declared using WITH RETURN TO CALLER, the use of the CLOSE statement is recommended to increase the portability of applications. (For Java external procedures, all cursors are implicitly declared WITH RETURN TO CALLER.)

For non-scrollable cursors, the result set consists of all rows from the current cursor position to the end of the result table. For scrollable cursors, the result set consists of all rows of the result table.

The caller is the program or procedure that executed the SQL CALL statement that either invokes a procedure that contains the DECLARE CURSOR statement, or directly or indirectly invokes a program that contains the DECLARE CURSOR statement. For example, if the caller is a procedure, the result set is returned to the procedure. If the caller is a client application, the result set is returned to the client application.

rowset-positioning

Specifies whether rows of data can be accessed as a rowset on a single FETCH statement for this cursor.

WITHOUT ROWSET POSITIONING

Specifies that the cursor can only be used with row positioned FETCH statements.

WITH ROWSET POSITIONING

Specifies that this cursor can be used with rowset positioned or row positioned FETCH statements

fetch-first-clause

Limits the number of rows that can be fetched. It improves the performance of queries with potentially large result sets when only a limited number of rows are needed. If the clause is specified, the number of rows retrieved will not exceed *n*, where *n* is the value of the integer. An attempt to fetch n+1 rows is handled the same way as normal end of date. The value of integer must be positive and non-zero. The default is 1.

If the OPTIMIZE FOR clause is not specified, a default of ″OPTIMIZE FOR integer ROWS″ is assumed. If both the FETCH FIRST and OPTIMIZE FOR clauses are specified, the lower of the integer values from these clauses is used to influence optimization and the communications buffer size.

read-only-clause

Declares that the result table is read-only and therefore the cursor cannot be referred to in positioned UPDATE and DELETE statements.

update-clause

Identifies the columns that can updated in a later positioned UPDATE statement. Each column must be unqualified and must identify a column of the table or view identified in the first FROM clause of the fullselect. The clause must not be specified if the result table of the fullselect is read-only. The clause must also not be specified if a created temporary table is referenced in the first FROM clause of the select-statement.

If the clause is specified without a list of columns, the columns that can be updated include all the updatable columns of the table or view that is identified in the first FROM clause of the fullselect.

optimize-clause

Requests special optimization of the *select-statement*. If the clause is omitted, optimization is based on the assumption that all rows of the result table will be retrieved. If the clause is specified, optimization is based on the assumption that the number of rows retrieved will not exceed *n*, where *n* is the value of the integer. The clause does not limit the number of rows that can be fetched or affect the result in any way other than performance.

isolation-clause

Specifies the isolation level at which the statement is executed and, for *select-statement*, the type of locks that are acquired. See “isolation-clause” on page 423.

FOR SINGLE ROW or **FOR MULTIPLE ROWS**

Specifies whether a variable number of rows of data will be provided for a dynamic INSERT statement.

FOR SINGLE ROW

Specifies that multiple rows of data cannot be provided with host variable arrays on an EXECUTE statement for the statement being prepared. FOR SINGLE ROW must only be specified for an INSERT statement.

FOR MULTIPLE ROWS
Specifies that multiple rows of data can be provided with host variable arrays on an EXECUTE statement for the statement being prepared. FOR MULTIPLE ROWS must only be specified for an INSERT statement.

ATOMIC or **NOT ATOMIC CONTINUE ON SQLEXCEPTION**
Specifies whether all of the rows should be inserted as an atomic operation or not and can only be specified for dynamic INSERT statements.

ATOMIC
Specifies that if the insert for any row fails, all changes made to the database by any of the inserts, including changes made by successful inserts, are undone. This is the default.

NOT ATOMIC CONTINUE ON SQLEXCEPTION
Specifies that, regardless of the failure of any particular insert of a row, the INSERT statement will not undo any changes made to the database by the successful inserts of other rows from the host variable arrays, and inserting will be attempted for subsequent rows. However, the minimum level of atomicity is at least that of a single insert (that is, it is not possible for a partial insert to complete), including any triggers that may have been executed as a result of the INSERT statement.

FROM
Specifies the statement string. The statement string is the value of the specified *string-expression* or the identified *host-variable*.

host-variable
Must identify a host variable that is described in the application program in accordance with the rules for declaring string variables. If the source string is over 32KB in length, the *host-variable* must be a CLOB or DBCLOB variable. The maximum source string length is 2MB although the host variable can be declared larger than 2MB. An indicator variable must not be specified. In COBOL and Assembler language, the host variable must be a varying-length string variable. In C, the host variable must not be a NUL-terminated string.

In PL/I, if the source program includes at least one DECLARE VARIABLE statement, the host variable (preceded by a colon) is considered a *host-variable* and must be a varying-length string variable. The host variable may be either a fixed-length or varying-length string variable if the source program does not include any DECLARE VARIABLE statements. It is then considered a *string-expression*. When a *string-expression* is used, the precompiler-generated structures for it use an EBCDIC CCSID and an informational message is issued.

string-expression
string-expression is any PL/I expression that yields a string. If the source program does not include any DECLARE VARIABLE statements, an optional colon can precede the *string-expression*. The colon introduces PL/I syntax. Therefore, host variables within a *string-expression* that includes operators or functions should not be preceded with a colon. However, if the source program includes at least one DECLARE VARIABLE statement, a *string-expression* cannot be preceded by a colon and an expression that

consists of just a variable name preceded by a colon is interpreted as a *host-variable,* not as a *string-expression.*

The ATTRIBUTES clause cannot be specified following *string-expression*.

The precompiler-generated structures for a *string-expression* use an EBCDIC CCSID.

Notes

Rules for statement strings: The statement string must be one of the following SQL statements:

- ALLOCATE CURSOR
- ALTER
- ASSOCIATE LOCATORS
- COMMENT
- COMMIT
- CREATE
- DELETE
- DROP
- EXPLAIN
- FREE LOCATOR
- GRANT
- HOLD LOCATOR
- LABEL
- LOCK TABLE
- RENAME
- REFRESH TABLE
- REVOKE ROLLBACK
- select-statement
- SET CURRENT APPLICATION ENCODING SCHEME
- SET CURRENT DEGREE
- SET CURRENT MAINTAINED TABLE TYPES
- SET CURRENT OPTIMIZATION HINT
- SET CURRENT PRECISION
- SET CURRENT REFRESH AGE
- SET CURRENT RULES
- SET CURRENT SQLID
- SET PATH
- SIGNAL SQLSTATE
- UPDATE

The statement string must not:

- Begin with EXEC SQL and end with a statement terminator
- Include references to host variables
- Include comments

Parameter markers: Although a statement string cannot include references to host variables, it can include *parameter markers*. The parameter markers are replaced by the values of host variables when the prepared statement is executed. A parameter marker is a question mark (?) that appears where a host variable could appear if the statement string were a static SQL statement. For an explanation of how parameter markers are replaced by values, see “EXECUTE” on page 881, “OPEN” on page 990, and Part 6 of *DB2 Application Programming and SQL Guide*.

The two types of parameter markers are typed and untyped:

Typed parameter marker

A parameter marker that is specified with its target data type. A typed parameter marker has the general form:

```
CAST(? AS data-type)
```

This invocation of a CAST specification is a “promise” that the data type of the parameter at run time will be of the data type that is specified or some data type that is assignable to the specified data type. For example, in the following UPDATE statement, the value of the argument of the TRANSLATE function will be provided at run time:

```
UPDATE EMPLOYEE
  SET LASTNAME = TRANSLATE(CAST(? AS VARCHAR(12)))
 WHERE EMPNO = ?
```

The data type of the value that is provided for the TRANSLATE function will either be VARCHAR(12), or some data type that can be converted to VARCHAR(12). For more information, refer to “Assignment and comparison” on page 74.

Untyped parameter marker

A parameter marker that is specified without its target data type. An untyped parameter marker has the form of a single question mark. The context in which the parameter marker appears determines its data type. For example, in the above UPDATE statement, the data type of the untyped parameter marker in the predicate is the same as the data type of the EMPNO column.

Typed parameter markers can be used in dynamic SQL statements wherever a host variable is supported and the data type is based on the promise made in the CAST specification.

Untyped parameters markers can be used in dynamic SQL statements in selected locations where host variables are supported. Table 86 shows these locations and the resulting data type of the parameter. The table groups the locations into expressions, predicates, and functions to help show where untyped parameter markers are allowed.

Table 86. Untyped parameter marker usage

Location of untyped parameter marker	Data type (or error if not supported)
Expressions (including select list, CASE, and VALUES)	
Alone in a select list. For example: `SELECT ?`	Error
Both operands of a single arithmetic operator, after considering operator precedence and the order of operation rules. Includes cases such as: `? + ? + 10`	Error

Table 86. Untyped parameter marker usage (continued)

Location of untyped parameter marker	Data type (or error if not supported)
One operand of a single operator in an arithmetic expression (except datetime arithmetic expressions). Includes cases such as: `? + ? * 10`	The data type of the other operand
Any operand of a datetime expression. For example: `'timecol + ?' or '? - datecol'`	Error
Labeled duration in a datetime expression	Error
Both operands of a CONCAT operator	Error
One operand of a CONCAT operator when the other operand is any character data type except CLOB	If the other operand is CHAR(*n*) or VARCHAR(*n*), where n is less than 128, the data type is VARCHAR(255 - *n*). In all other cases, the data type is VARCHAR(255).
One operand of a CONCAT operator when the other operand is any graphic data type except DBCLOB	If the other operand is GRAPHIC(*n*) or VARGRAPHIC(*n*), where n is less than 64, the data type is VARGRAPHIC(127 - *n*). In all other cases, the data type is VARGRAPHIC(127).
One operand of a CONCAT operator when the other operand is a LOB string	The data type of the other operand (the LOB string)
The value on the right-hand side of a SET clause in an UPDATE statement	The data type of the column or, if the column is defined as a distinct type, the source data type of the distinct type
The *expression* following the CASE keyword in a simple CASE expression	Error
Any or all *expressions* following the WHEN keyword in a simple CASE expression	The result of applying the “Rules for result data types” on page 87 to the expression following CASE and the expressions following WHEN that are not untyped parameter markers
A *result-expression* in any CASE expression when all the other *result-expression*s are either NULL or untyped parameter markers.	Error
A *result-expression* in any CASE expression when at least one other *result-expression* is neither NULL nor an untyped parameter marker.	The result of applying the “Rules for result data types” on page 87 to all the *result-expression*s that are not NULL or untyped parameter markers
Alone as a column-expression in a single-row VALUES clause that is not within an INSERT statement	Error
Alone as a column-expression in a single-row VALUES clause within an INSERT statement	The data type of the column or, if the column is defined as a distinct type, the source data type of the distinct type
Predicates	
Both operands of a comparison operator	Error

Table 86. Untyped parameter marker usage (continued)

Location of untyped parameter marker	Data type (or error if not supported)
One operand of a comparison operator when the other operand is not an untyped parameter marker	The data type of the other operand. If the operand has a datetime data type, the result of DESCRIBE INPUT will show the data type as CHAR(255) although DB2 uses the datetime data type in any comparisons.
All the operands of a BETWEEN predicate	Error
Two operands of a BETWEEN predicate (either the first and second, or the first and third)	The data type of the operand that is not a parameter marker
Only one operand of a BETWEEN predicate	The result of applying the "Rules for result data types" on page 87 on the other operands that are not parameter markers
All the operands of an IN predicate, for example, `? IN (?,?,?)`	Error
The first and second operands of an IN predicate, for example, `? IN (?,A,B)`	The result of applying the "Rules for result data types" on page 87 on the operands in the IN list that are not parameter markers
The first operand of an IN predicate and zero or more operands of the IN list except for the first operand of the IN list, for example, `? IN (A,?,B,?)`	The result of applying the "Rules for result data types" on page 87 on the operands in the IN list that are not parameter markers
The first operand of an IN predicate when the right-hand side is a fullselect of fullselect, for example, `? IN (fullselect)`	The data type of the selected column
Any or all operands of the IN list of the IN predicate and the first operand of the IN predicate is not an untyped parameter marker, for example, `A IN (?,A,?)`	The data type of the first operand (the operand on the left-hand side of the IN list)
All the operands of a LIKE predicate	The first and second operands (*match-expression* and *pattern-expression*) are VARCHAR(4000). The third operand (*escape-expression*) is VARCHAR(1).
The first operand (the *match-expression*) when at least one other operand (the *pattern-expression* or *escape-expression*) is not an untyped parameter marker.	VARCHAR(4000), VARGRAPHIC(2000), or BLOB(4000), depending on the data type of the first operand that is not an untyped parameter marker
The second operand (the *pattern-expression*) when at least one other operand (the *match-expression* or *escape-expression*) is not an untyped parameter marker. When the pattern specified in a LIKE predicate is a parameter marker and a fixed-length character host variable is used to replace the parameter marker, specify a value for the host variable that is the correct length. If you do not specify the correct length, the select does not return the intended results.	VARCHAR(4000), VARGRAPHIC(2000), or BLOB(4000), depending on the data type of the first operand that in not an untyped parameter marker.
The third operand (the *escape-expression*) when at least one other operand (the *match-expression* or *pattern-expression*) is not an untyped parameter marker	CHAR(1), GRAPHIC(1), or BLOB(1), depending on the data type of the first operand that in not an untyped parameter marker
Operand of a NULL predicate	Error

Table 86. Untyped parameter marker usage (continued)

Location of untyped parameter marker	Data type (or error if not supported)
Functions	
All operands of COALESCE or NULLIF	Error
Any operand of COALESCE or NULLIF when at least one other operand is not an untyped parameter marker	The result of applying the "Rules for result data types" on page 87 on the operands that are not untyped parameter markers, the data type of the other operand
Both operands of POSSTR	VARCHAR(4000) for both operands
One operand of POSSTR when the other operand is a character data type	VARCHAR(4000)
One operand of POSSTR when the other operand is a graphic data type	VARGRAPHIC(2000)
One operand of POSSTR when the other operand is a BLOB	BLOB(4000)
First operand of SUBSTR	VARCHAR(4000)
Second or third operand of SUBSTR	INTEGER
One operand of TIMESTAMP	TIME
First operand of TIMESTAMP_FORMAT	VARCHAR(255)
First operand of TRANSLATE	Error
Second or third operand of TRANSLATE	VARCHAR(4000) or VARGRAPHIC(2000), depending on whether the data type of the first operand is character or graphic
Fourth operand of TRANSLATE	VARCHAR(1) or VARGRAPHIC(1), depending on whether the data type of the first operand is character or graphic
First operand of VARCHAR_FORMAT	TIMESTAMP
Unary minus	DOUBLE PRECISION
Unary plus	DOUBLE PRECISION
Operand of any built-in scalar function (except those that are described above in this table for COALESCE, NULLIF, POSSTR, SUBSTR, TIMESTAMP, TIMESTAMP_FORMAT, TRANSLATE, and VARCHAR_FORMAT)	Error
Operand of a built-in aggregate function	Error
Operand of a user-defined scalar function, user-defined aggregate function, or user-defined table function	The data type of the corresponding parameter in the function instance
Other	
FOR *n* ROWS clause of an INSERT statement	Integer

Considerations for FETCH statements used with a sensitive static cursor: Whether changes made outside the cursor are visible to the cursor depends on the type of FETCH that is used with a SENSITIVE STATIC cursor:

- A SENSITIVE FETCH is sensitive to all updates and deletes that are made by this cursor (including changes made by triggers) and committed updates and deletes by all other application processes because every fetched row is retrieved from the underlying base table and not a temporary table. This is the default type of FETCH statement for a SENSITIVE cursor.

Changes that are made to the underlying data using this cursor result in an automatic refresh of the row. The changes that are made using this type of cursor can result in holes in the result table of the cursor. In addition, re-fetching rows (fetching rows that have already been retrieved) can result in holes in the result table. If a sensitive FETCH is issued to re-fetch a row and the row no longer qualifies for the search condition of the query, it results in a ″delete hole″ or an ″update hole″. In this case, no data is returned, and the cursor is left positioned on the hole.

- An INSENSITIVE FETCH is not sensitive to updates and deletes that are made outside this cursor; however, it is sensitive to all updates and deletes that are made by this cursor. Changes that made with triggers are not visible with an INSENSITIVE FETCH until the content of the rows are updated in the result table with a SENSITIVE FETCH statement. If an application does not want to be sensitive to changes that are made outside this cursor (that is, the application does not want to see changes made either with another cursor or by another application process), INSENSITIVE can be explicitly specified as part of the FETCH statement for a SENSITIVE STATIC cursor. This type of FETCH is useful for refreshing data in user data buffers. For more information, see "INSENSITIVE" on page 905.

Error checking: When a PREPARE statement is executed, the statement string is parsed and checked for errors. If the statement string is invalid, a prepared statement is not created and the error condition that prevents its creation is reported in the SQLCA.

In local and remote processing, the DEFER(PREPARE) and REOPT(ALWAYS)/REOPT(ONCE) bind options can cause some SQL statements to receive "delayed" errors. For example, DESCRIBE, EXECUTE, and OPEN might receive an SQLCODE that normally occurs during PREPARE processing.

Reference and execution rules: Prepared statements can be referred to in the following kinds of statements, with the following restrictions shown:

In...	The prepared statement...
DESCRIBE	has no restrictions
DECLARE CURSOR	must be SELECT when the cursor is opened
EXECUTE	must *not* be SELECT

A prepared statement can be executed many times. Indeed, if a prepared statement is not executed more than once and does not contain parameter markers, it is more efficient to use the EXECUTE IMMEDIATE statement rather than the PREPARE and EXECUTE statements.

Prepared statement persistence: All prepared statements created by a unit of work are destroyed when the unit of work is terminated, with the following exceptions:

- A SELECT statement whose cursor is declared with the option WITH HOLD persists over the execution of a commit operation if the cursor is open when the commit operation is executed.

- SELECT, INSERT, UPDATE, and DELETE statements that are bound with KEEPDYNAMIC(YES) are kept past the commit operation if your system is enabled for dynamic statement caching, and none of the following are true:
  - SQL RELEASE has been issued for the site
  - Bind option DISCONNECT(AUTOMATIC) was used
  - Bind option DISCONNECT(CONDITIONAL) was used and there are no hold cursors for the site

Scope of a statement name: The scope of a *statement-name* is the same as the scope of a *cursor-name*. See "DECLARE CURSOR" on page 812 for more information about the scope of a *cursor-name*.

Preparation with PREPARE INTO and REOPT bind option: If bind option REOPT(ALWAYS) or REOPT(ONCE) is in effect, PREPARE INTO is equivalent to a PREPARE and a DESCRIBE being performed. If a statement has input variables, the DESCRIBE causes the statement to be prepared with default values, and the statement must be prepared again when it is opened or executed. When REOPT(ONCE) is in effect, the statement is always prepared twice even if there are no input variables. Therefore, to avoid having a statement prepared twice, avoid using PREPARE INTO when REOPT(ALWAYS) or REOPT(ONCE) is in effect.

Relationship of cursor attributes on PREPARE statements and SELECT or DECLARE CURSOR statements: Cursor attributes that are specified as part of the *select-statement* are used instead of any corresponding options that specified with the ATTRIBUTES clause on PREPARE. Attributes that are specified as part of the ATTRIBUTES clause of PREPARE take precedence over any corresponding option that is specified with the DECLARE CURSOR statement. The order for using cursor attributes is as follows:

- SELECT (highest priority)
- PREPARE statement ATTRIBUTES clause
- DECLARE CURSOR (lowest priority)

For example, assume that host variable MYQ has been set to the following SELECT statement:

```
SELECT WORKDEPT, EMPNO, SALARY, BONUS, COMM
     FROM EMP
    WHERE WORKDEPT IN ('D11', 'D21')
    FOR UPDATE OF SALARY, BONUS, COMM
```

If the following PREPARE statement were issued, then the FOR UPDATE clause specified as part of the SELECT statement would be used instead of the FOR READ ONLY clause specified with the ATTRIBUTES clause as part of the PREPARE statement. Thus, the cursor would be updatable.

```
attrstring = 'FOR READ ONLY';
EXEC SQL PREPARE stmt1 ATTRIBUTES :attrstring FROM :MYQ;
```

Examples

Example 1: In this PL/I example, an INSERT statement with parameter markers is prepared and executed. Before execution, values for the parameter markers are read into the host variables S1, S2, S3, S4, and S5.

```
EXEC SQL PREPARE DEPT_INSERT FROM
  'INSERT INTO DSN8810.DEPT VALUES(?,?,?,?,?)';
```

```
(Check for successful execution and read values into host variables)

EXEC SQL EXECUTE DEPT_INSERT USING :S1, :S2, :S3, :S4, :S5;
```

Example 2: Prepare a dynamic SELECT statement specifying the attributes of the cursor with a host variable on the PREPARE statement. Assume that the text of the SELECT statement is in a variable named stmttxt, and that the desired attributes of the cursor are in a variable named attrvar.

```
EXEC SQL DECLARE mycursor CURSOR FOR mystmt;
EXEC SQL PREPARE mystmt ATTRIBUTES :attrvar
            FROM :stmttxt;
EXEC SQL DESCRIBE mystmt INTO :mysqlda;
EXEC SQL OPEN mycursor;
EXEC SQL FETCH FROM mycursor USING DESCRIPTOR :mysqlda;
```

REFRESH TABLE

The REFRESH TABLE statement refreshes the data in a materialized query table. The statement deletes all rows in the materialized query table, executes the fullselect in the table definition to recalculate the data from the tables specified in the fullselect, inserts the calculated result into the materialized query table, and updates the catalog for the refresh timestamp and cardinality of the table. The table can exist at the current server or at any DB2 subsystem with which the current server can establish a connection.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

The privilege set for REFRESH TABLE must include at least one of the following authorities:

- Ownership of the materialized query table
- DBADM or DBCTRL authority on the database that contains the materialized query table
- SYSADM or SYSCTRL authority

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package. If the statements dynamically prepared, the privilege set is determined by the DYNAMICRULES behavior in effect (run, bind, define, or invoke). For more information on these behaviors, including a list of the DYNAMICRULES bind option values, see “Authorization IDs and dynamic SQL” on page 51.

Syntax

```
►►──REFRESH TABLE──table-name──┬─────────────────────┬──────────────────────────────────►◄
                               └─QUERYNO──integer─┘
```

Description

table-name
: Identifies the table to be refreshed. The name must identify a materialized query table. REFRESH TABLE evaluates the fullselect in the *materialized-query-definition* clause to refresh the table. The isolation level for the fullselect is the isolation level of the materialized query table recorded when CREATE TABLE or ALTER TABLE was issued.

QUERYNO *integer*
: Specifies the number to be used for this SQL statement in EXPLAIN output and trace records. The number is used for the QUERYNO column of the plan table for the rows that contain information about this SQL statement. This number is also used in the QUERYNO column of the SYSIBM.SYSSTMT and SYSIBM.SYSPACKSTMT catalog tables.

If the clause is omitted, the number associated with the SQL statement is the statement number assigned during precompilation. Thus, if the application program is changed and then precompiled, that statement number might change.

Notes

Automatic query rewrite using materialized query tables is not attempted for the fullselect in the materialized query table definition during the processing of REFRESH TABLE statement.

After successful execution of a REFRESH TABLE statement, the SQLCA field SQLERRD(3) will contain the number of rows inserted into the materialized query table.

The EXPLAIN output for REFRESH TABLE *table-name* is the same as the EXPLAIN output for INSERT INTO *table-name fullselect* where *fullselect* is from the materialized query table definition.

The REFRESH TABLE statement is supported over DRDA protocol, but not supported over DB2 private protocol.

If the materialized query table has a security label column, the REFRESH TABLE statement does not do any checking for multilevel security with row-level granularity when it deletes and repopulates the data in the table by executing the fullselect. Instead, DB2 performs the checking for multilevel security with row-level granularity when the materialized query table is exploited in automatic query rewrite or is used directly.

Example

Issue a statement to refresh the content of a materialized query table that is named SALESCOUNT. The statement recalculates the data from the fullselect that was used to define SALESCOUNT and refreshes the content of SALESCOUNT with the recalculated results.

```
REFRESH TABLE SALESCOUNT;
```

RELEASE (connection)

The RELEASE (connection) statement places one or more connections in the release pending state.

Invocation

This statement can only be embedded in an application program. It is an executable statement that cannot be dynamically prepared. It must not be specified in Java or REXX.

Authorization

None required.

Syntax

```
►►──RELEASE──┬─location-name─┬───────────────────────────────────────────────►◄
             ├─host-variable─┤
             ├─CURRENT───────┤
             │     ┌─SQL─┐   │
             ├─ALL─┴─────┴───┤
             └─ALL PRIVATE───┘
```

Description

location-name or *host-variable*
: Identifies an SQL connection or a DB2 private connection by the specified location name or the location name contained in the host variable. If a host variable is specified:

- It must be a character string variable with a length attribute that is not greater than 16. (A C NUL-terminated character string can be up to 17 bytes.)
- It must not be followed by an indicator variable.
- The location name must be left-justified within the host variable and must conform to the rules for forming an ordinary location identifier.
- If the length of the location name is less than the length of the host variable, it must be padded on the right with blanks.

The specified location name or the location name contained in the host variable must identify an existing SQL connection or DB2 private connection of the application process.

CURRENT
Identifies the current SQL connection of the application process. The application process must be in the connected state.

ALL or **ALL SQL**
Identifies all existing connections (including local, SQL, and DB2 private connections) of the application process. An error or warning does not occur if no connections exist when the statement is executed.

ALL PRIVATE
Identifies all existing DB2 private connections of the application process. An error or warning does not occur if no DB2 private connections exist when the statement is executed.

If the RELEASE (connection) statement is successful, each identified connection is placed in the release-pending state and, therefore, will be ended during the next commit operation. If the RELEASE (connection) statement is unsuccessful, the connection state of the application process and the states of its connections are unchanged.

Notes

RELEASE and CONNECT (Type 1): Using CONNECT (Type 1) semantics does not prevent using RELEASE (connection).

Scope of RELEASE: RELEASE (connection) does not close cursors, does not release any resources, and does not prevent further use of the connection.

Resource considerations for remote connections: Resources are required to create and maintain remote connections. Thus, a remote connection that is not going to be reused should be in the release pending status and one that is going to be reused should not be in the release pending status. Remote connections can also be ended during a commit operation as a result of the DISCONNECT(AUTOMATIC) or DISCONNECT(CONDITIONAL) bind option.

If the current SQL connection is in the release pending status when a commit operation is performed, the connection is ended and the application process is in the unconnected state. In this case, the next executed SQL statement should be CONNECT or SET CONNECTION.

Connection states: ROLLBACK does not reset the state of a connection from release pending to held.

If the current SQL connection is in the release pending state when a commit operation is performed, the connection is ended and the application process is in the unconnected state. In this case, the next executed SQL statement must be CONNECT or SET CONNECTION.

For further information, see “When a connection is ended” on page 22.

Location names CURRENT and ALL: A database server named CURRENT or ALL can only be identified by a host variable or a delimited identifier. A connection in the release pending state is ended during a commit operation even though it has an open cursor defined with WITH HOLD.

Encoding scheme of a host variable: If the RELEASE statement contains host variables, the contents of the host variables are assumed to be in the encoding scheme that was specified in the ENCODING parameter when the package or plan that contains the statement was bound.

Examples

Example 1: The SQL connection to TOROLAB1 is not needed in the next unit of work. The following statement causes it to be ended during the next commit operation:

```
EXEC SQL RELEASE TOROLAB1;
```

Example 2: The current SQL connection is not needed in the next unit of work. The following statement causes it to be ended during the next commit operation:

```
EXEC SQL RELEASE CURRENT;
```

Example 3: The first phase of an application involves explicit CONNECTs to remote servers and the second phase involves the use of DB2 private protocol access with the local DB2 subsystem as the server. None of the existing connections are needed in the second phase and their existence could prevent the allocation of DB2 private connections. Accordingly, the following statement is executed before the commit operation that separates the two phases:

```
EXEC SQL RELEASE ALL SQL;
```

Example 4: The first phase of an application involves the use of DB2 private protocol access with the local DB2 subsystem as the server and the second phase involves explicit CONNECTs to remote servers. The existence of the DB2 private connections allocated during the first phase could cause a CONNECT operation to fail. Accordingly, the following statement is executed before the commit operation that separates the two phases:

```
EXEC SQL RELEASE ALL PRIVATE;
```

RELEASE SAVEPOINT

The RELEASE SAVEPOINT statement releases the identified savepoint and any subsequently established savepoints within a unit of recovery.

Invocation

This statement can be imbedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

None required.

Syntax

```
           ┌─TO─┐
►►──RELEASE──┴────┴──SAVEPOINT──savepoint-name──────────────────────────────────►◄
```

Description

savepoint-name
Identifies the savepoint to release. If the named savepoint does not exist, an error occurs. The named savepoint and all the savepoints that were subsequently established in the unit of recovery are released. After a savepoint is released, it is no longer maintained and rollback to the savepoint is no longer possible.

Notes

Savepoint names: The name of the savepoint that was released can be reused in another SAVEPOINT statement, regardless of whether the UNIQUE keyword was specified on an earlier SAVEPOINT statement that specified this same savepoint name.

Example

Assume that a main routine sets savepoint A and then invokes a subroutine that sets savepoints B and C. When control returns to the main routine, release savepoint A and any subsequently set savepoints. Savepoints B and C, which were set by the subroutine, are released in addition to A.

```
⋮
   RELEASE SAVEPOINT A;
```

RENAME

The RENAME statement renames an existing table.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

Authorization

The privilege set that is defined below must include at least one of the following:
- Ownership of the table
- DBADM, DBCTRL, or DBMAINT authority for the database that contains the table
- SYSADM or SYSCTRL authority

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges held by the authorization ID of the owner of the plan or package. If the statement is dynamically prepared, the privilege set is the union of the privilege sets that are held by each authorization ID of the process.

Syntax

```
             ┌─TABLE─┐
►►──RENAME───┴───────┴──table-name──TO──new-table-identifier──────────────────────────────►◄
```

Description

table-name
: Identifies the existing table that is to be renamed. The name, including the implicit or explicit qualifier, must identify a table that exists at the current server. The name must not identify a declared temporary table, a catalog table, an active RLST table, a materialized query table, a table with a trigger defined on it, a view, or a synonym. If you specify a three-part name or alias for the source table, the source table must exist at the current server. If any view definitions or materialized query table definitions currently refer to the source table, an error occurs.

new-table-identifier
: Specifies the new name for the table without a qualifier. The qualifier of the *source-table-name* is used to qualify the new name for the table. The qualified name must *not* identify a table, view, alias, or synonym that already exists at the current server.

Notes

Effects of the statement: The specified table is renamed to the new name. All privileges and indexes on the table are preserved.

Invalidation of plans and packages: When any table except an auxiliary table is renamed, plans and packages that refer to that table are invalidated. When an auxiliary table is renamed, plans and packages that refer to the auxiliary table are not invalidated.

Considerations for aliases: If an alias name is specified for *table-name*, the table must exist at the current server, and the table that is identified by the alias is renamed. The name of the alias is not changed and continues to refer to the old table name after the rename.

Changing the name of an alias with the RENAME statement is not supported. To change the name to which an alias refers, you must drop the alias and then recreate it.

Transfer of authorization, referential integrity constraints, and indexes: *All* authorizations associated with the source table name are *transferred* to the new (target) table name. The authorization catalog tables are updated appropriately.

Referential integrity constraints involving the source table are updated to refer to the new table. The catalog tables are updated appropriately.

Indexes defined over the source table are *transferred* to the new table. The index catalog tables are updated appropriately.

Object identifier: Renamed tables keep the same object identifier (OBID) as the original table.

Renaming registration tables: If an application registration table or object registration table is specified as the source table for RENAME, then once RENAME completes, it is as if that table had been dropped. There is no ART (application registration table) or ORT (object registration table) once the ART or ORT table has been renamed.

Catalog table updates: Entries in the following catalog tables are updated to reflect the new table name:
- SYSAUXRELS
- SYSCHECKS
- SYSCHECKS2
- SYSCHECKDEP
- SYSCOLAUTH
- SYSCOLDIST
- SYSCOLDIST_HIST
- SYSCOLDISTSTATS
- SYSCOLSTATS
- SYSCOLUMNS
- SYSCOLUMNS_HIST
- SYSCONSTDEP
- SYSFIELDS
- SYSFOREIGNKEYS
- SYSINDEXES
- SYSINDEXES_HIST
- SYSKEYCOLUSE
- SYSPLANDEP
- SYSPACKDEP
- SYSRELS
- SYSSEQUENCESDEP

- SYSSYNONYMS
- SYSTABAUTH
- SYSTABCONST
- SYSTABLES
- SYSTABLES_HIST
- SYSTABSTATS
- SYSTABSTATS_HIST

Entries in SYSSTMT and SYSPACKSTMT are not updated.

Examples

Example 1: Change the name of the EMP table to EMPLOYEE:

```
RENAME TABLE EMP TO EMPLOYEE;
```

Example 2: Change the name of the EMP_USA_HIS2002:

```
RENAME TABLE EMP_USA_HIS2002 TO EMPLOYEE_UNITEDSTATES_HISTORY2002;
```

REVOKE

The REVOKE statement revokes privileges from authorization IDs. There is a separate form of the statement for each of these classes of privilege:

- Collection
- Database
- Distinct type
- Function or stored procedure
- Package
- Plan
- Schema
- Sequence
- System
- Table or view
- Use

The applicable objects are always at the current server.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.

If the authorization mechanism was not activated when the DB2 subsystem was installed, an error condition occurs.

Authorization

If the BY clause is not specified, the authorization ID of the statement must have granted at least one of the specified privileges to every *authorization-name* specified in the FROM clause (including PUBLIC, if specified). If the BY clause is specified, the authorization ID of the statement must have SYSADM or SYSCTRL authority.

If the statement is embedded in an application program, the authorization ID of the statement is the authorization ID of the owner of the plan or package. If the statement is dynamically prepared, the authorization ID of the statement is the SQL authorization ID of the process.

Syntax

```
                                              ┌─,──────────────────────┐
                                              ▼                        │
►►──REVOKE──authorization-specification──FROM────┬─authorization-name───┬─┴──────────────────────►
                                                 ├─PUBLIC───────────────┤
                                                 └─PUBLIC AT ALL LOCATIONS─┘

                                          (1)
                                 ┌─RESTRICT──────┐
►──┬─────────────────────────────┬────┴───────────────┴─────────────────────────────►◄
   │             ┌─,──────────────────┐    │
   │             ▼                    │    │
   └─BY──────┬─────authorization-name─┴─┬──┘
             └─ALL──────────────────────┘
```

Notes:

1 The RESTRICT clause is the default only for the forms of the REVOKE statement that allow it.

Description

authorization-specification
Specifies one or more privileges for the class of privilege. The same privilege must not be specified more than once.

FROM
Specifies from what authorization IDs the privileges are revoked.

authorization-name,...
Lists one or more authorization IDs. Do not use the same authorization ID more than once.

The value of CURRENT RULES determines if you can use the ID of the REVOKE statement itself (to revoke privileges from yourself). When CURRENT RULES is:

DB2
You cannot use the ID of the REVOKE statement.

STD
You can use the ID of the REVOKE statement.

PUBLIC
Revokes a grant of privileges to PUBLIC.

PUBLIC AT ALL LOCATIONS
Revokes a grant of privileges to PUBLIC AT ALL LOCATIONS.

BY
Lists grantors who have granted privileges and revokes each named privilege that was explicitly granted to some named user by one of the named grantors. Only an authorization ID with SYSADM or SYSCTRL authority can use BY, even if the authorization ID names only itself in the BY clause.

authorization-name,...
Lists one or more authorization IDs of users who were the grantors of the privileges named. Do not use the same authorization ID more than once. Each grantor listed must have explicitly granted some named privilege to all named users.

ALL
Revokes each named privilege from all named users who were explicitly granted the privilege, regardless of who granted it.

RESTRICT
Prevents the named privilege from being revoked when certain conditions apply. RESTRICT is the default only for the forms of the REVOKE statement that allow it. These forms are revoking the USAGE privilege on distinct types, the EXECUTE privilege on user-defined functions and stored procedures, and the USAGE privilege on sequences.

Notes

Revoked privileges: The privileges revoked from an authorization ID are those that are identified in the statement and which were granted to the authorization ID by the authorization ID of the statement. Other privileges can be revoked as the result of a cascade revoke. For more on DB2 privileges, see Part 3 (Volume 1) of *DB2 Administration Guide*.

Cascade revoke: Revoking a privilege from a user can also cause that privilege to be revoked from other users. This is called a *cascade revoke*. The following rules must be true for privilege P' to be revoked from U3 when U1 revokes privilege P from U2:

- P and P' are the same privilege.
- U2 granted privilege P' to U3.
- No one granted privilege P to U2 prior to the grant by U1.
- U2 does not have installation SYSADM authority.

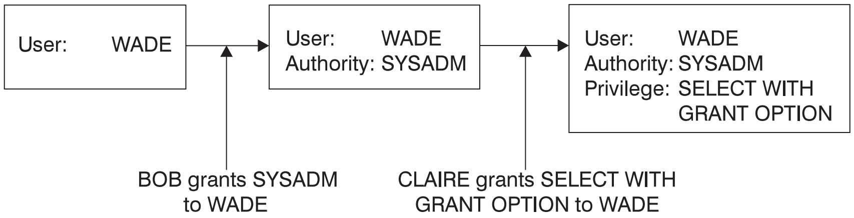
The rules also apply to the implicit grants that are made as a result of a CREATE VIEW statement.

Cascade revoke does not occur under any of the following conditions:

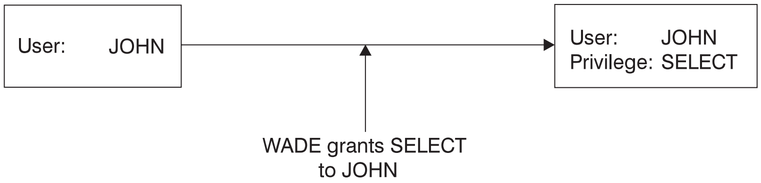
- The privilege was granted by a current install SYSADM.
- The privilege is the USAGE privilege on a distinct type and the revokee owns any of these items:
  - A user-defined function or stored procedure that uses the distinct type
  - A table that has a column that uses the distinct type
  - A sequence whose data type is the distinct type
- The privilege is the USAGE privilege on a sequence and the revokee owns any of these items:
  - A trigger that has a NEXT VALUE or PREVIOUS VALUE expression that specifies the sequence
  - An inline SQL function that has a NEXT VALUE or PREVIOUS VALUE expression in the function body that specifies the sequence
- The privilege is the EXECUTE privilege on a user-defined function and the revokee owns any of these items:
  - A user-defined function that is sourced on the function
  - A view that uses the function
  - A trigger package that uses the function
  - A table that uses the function in a check constraint or a user-defined default type
- The privilege is the EXECUTE privilege on a stored procedure and the revokee owns any of these items:
  - A trigger package that refers to the stored procedure in a CALL statement.

Refer to the diagrams for the following example:

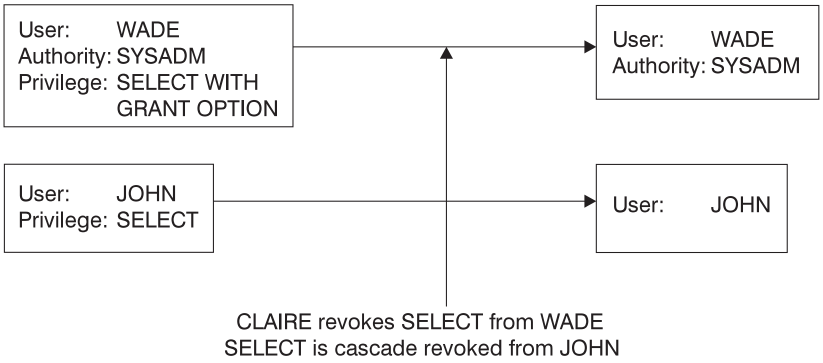
1. Suppose BOB grants SYSADM authority to WADE. Later, CLAIRE grants the SELECT privilege on a table with the WITH GRANT OPTION to WADE.


User: WADE
User: WADE
Authority: SYSADM
User: WADE
Authority: SYSADM
Privilege: SELECT WITH GRANT OPTION
BOB grants SYSADM to WADE
CLAIRE grants SELECT WITH GRANT OPTION to WADE

2. WADE grants the SELECT privilege to JOHN on the same table.



3. When CLAIRE revokes the SELECT privilege on the table from WADE, the SELECT privilege on that table is also revoked from JOHN.


User: WADE
Authority: SYSADM
Privilege: SELECT WITH GRANT OPTION
User: WADE
Authority: SYSADM
User: JOHN
Privilege: SELECT
User: JOHN
CLAIRE revokes SELECT from WADE
SELECT is cascade revoked from JOHN

The grant from WADE to JOHN is removed because WADE had not been granted the SELECT privilege from any other source before CLAIRE made the grant. The SYSADM authority granted to WADE from BOB does not affect the cascade revoke. For more on SYSADM and install SYSADM authority, see Part 3 (Volume 1) of *DB2 Administration Guide*. For another example of cascading revokes, see Part 3 (Volume 1) of *DB2 Administration Guide*.

Revoking a SELECT privilege that was exercised to create a view or materialized query table causes the view to be dropped, unless the owner of the view was directly granted the SELECT privilege from another source before the view was created. Revoking a SYSADM privilege that was required to create a view causes the view to be dropped. For details on when SYSADM authority is required to create a view, see *Authorization* in “CREATE VIEW” on page 805.

[39] Dependencies on stored procedures can be checked only if the procedure name is specified as a literal and not via a host variable in the CALL statement.

Invalidation of plans and packages: A revoke or cascaded revoke of any privilege, excluding the EXECUTE privilege on a user-defined function, that was exercised to create a plan or package makes the plan or package invalid when the revokee no longer holds the privilege from any other source. Corresponding authorization caches are cleared even if the revokee has the privilege from any other source. [39]

Inoperative plans and packages: A revoke or cascaded revoke of the EXECUTE privilege on a user-defined function that was exercised to create a plan or package makes the plan or package inoperative and causes the corresponding authorization caches to be cleared when the revokee no longer holds the privilege from any other source.[39]

Privileges belonging to an authority: You can revoke an administrative authority, but you cannot separately revoke the specific privileges inherent in that administrative authority.

Let P be a privilege inherent in authority X. A user with authority X can also have privilege P as a result of an explicit grant of P. In this case:

- If X is revoked, the user still has privilege P.
- If P is revoked, the user still has the privilege because it is inherent in X.

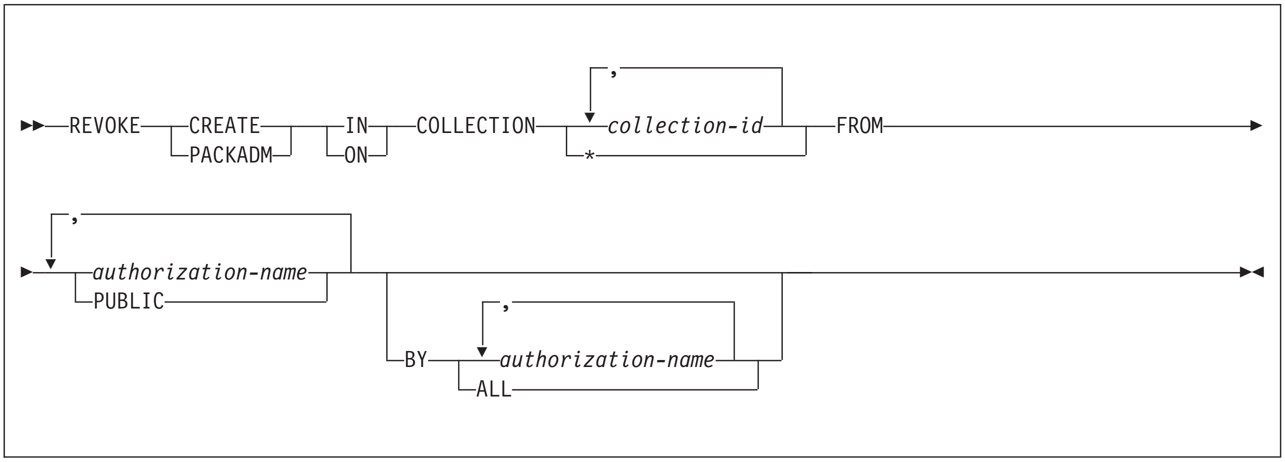
Ownership privileges: The privileges inherent in the ownership of an object cannot be revoked.

PUBLIC AT ALL LOCATIONS: PUBLIC AT ALL LOCATIONS can continue to be specified as an alternative to PUBLIC as in prior releases. PUBLIC AT ALL LOCATIONS was introduced and was intended for use only with DB2 private protocol access.

REVOKE (collection privileges)

This form of the REVOKE statement revokes privileges on collections.

Syntax



Description

CREATE IN
Revokes the privilege to use the BIND subcommand to create packages in the designated collections.

The word ON can be used instead of IN.

PACKADM ON
Revokes the package administrator authority for the designated collections.

The word IN can be used instead of ON.

COLLECTION *collection-id,...*
Identifies the collections on which the specified privilege is revoked. For each identified collection, you (or the indicated grantors) must have granted the specified privilege on that collection to all identified users (including PUBLIC if specified). The same collection must not be identified more than once.

COLLECTION *
Indicates that the specified privilege on COLLECTION * is revoked. You (or the indicated grantors) must have granted the specified privilege on COLLECTION * to all identified users (including PUBLIC if specified). Privileges granted on specific collections are not affected.

FROM
Refer to “REVOKE” on page 1020 for a description of the FROM clause.

BY
Refer to “REVOKE” on page 1020 for a description of the BY clause.

Example

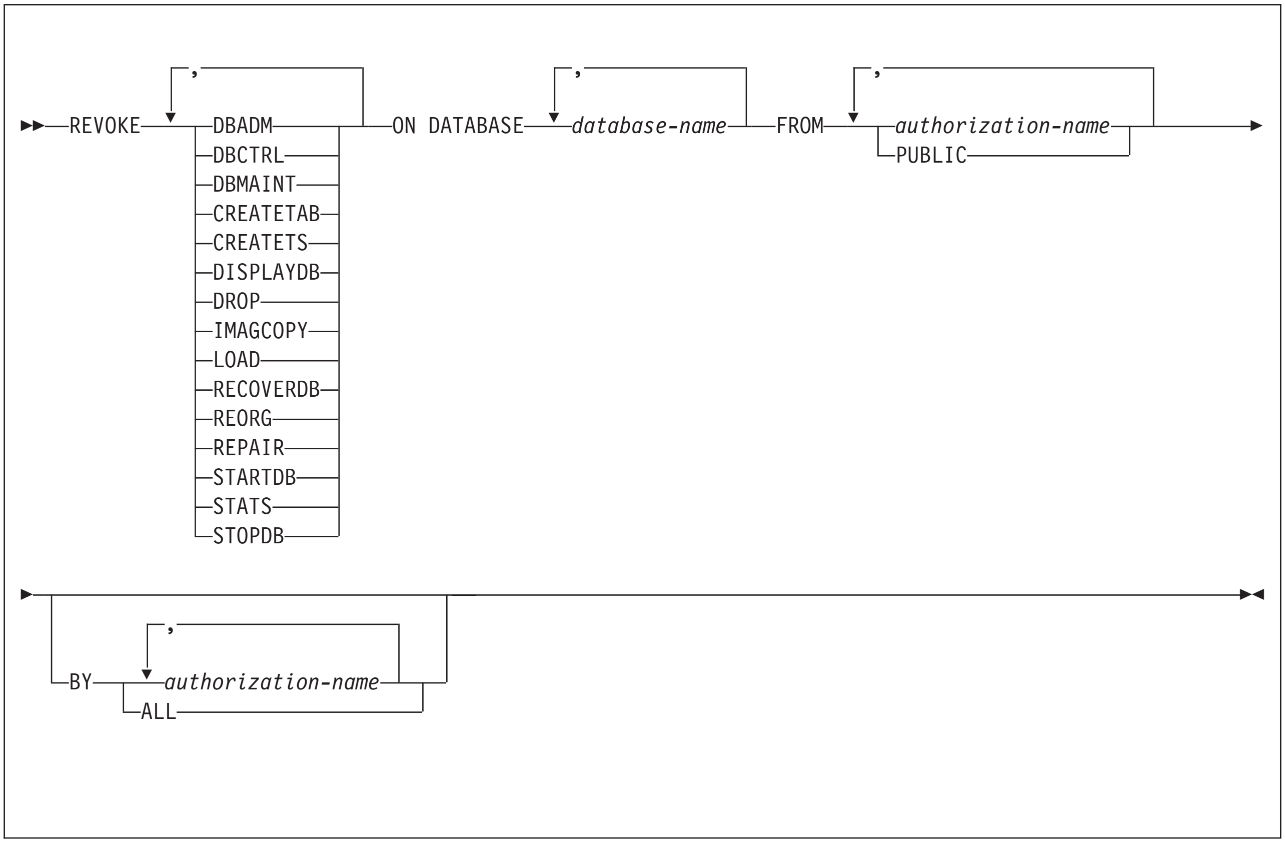
Revoke the privilege to create new packages in collections QAACLONE and DSN8CC61 from CLARK.

```
REVOKE CREATE IN COLLECTION QAACLONE, DSN8CC61 FROM CLARK;
```

REVOKE (database privileges)

This form of the REVOKE statement revokes database privileges.

Syntax



```
            ┌─,────────────┐               ┌─,─────────────┐         ┌─,────────────────────┐
            ▼              │               ▼               │         ▼                      │
►►──REVOKE────┬─DBADM──────┬─┴──ON DATABASE────database-name──┴──FROM────┬─authorization-name─┬─┴──────────►
              ├─DBCTRL─────┤                                             └─PUBLIC─────────────┘
              ├─DBMAINT────┤
              ├─CREATETAB──┤
              ├─CREATETS───┤
              ├─DISPLAYDB──┤
              ├─DROP───────┤
              ├─IMAGCOPY───┤
              ├─LOAD───────┤
              ├─RECOVERDB──┤
              ├─REORG──────┤
              ├─REPAIR─────┤
              ├─STARTDB────┤
              ├─STATS──────┤
              └─STOPDB─────┘

►──┬───────────────────────────────────────┬──────────────────────────────────────────────────►◄
   │            ┌─,──────────────────┐     │
   │            ▼                    │     │
   └─BY──────┬────authorization-name─┴─┬───┘
             └─ALL─────────────────────┘
```

Description

Each keyword listed revokes the privilege described, but only as it applies to or within the databases named in the statement.

DBADM
Revokes the database administrator authority.

DBCTRL
Revokes the database control authority.

DBMAINT
Revokes the database maintenance authority.

CREATETAB
Revokes the privilege to create new tables. For a TEMP database, you cannot revoke the privilege from PUBLIC. When a TEMP database is created, PUBLIC implicitly receives the CREATETAB privilege (without GRANT authority); this privilege is not recorded in the DB2 catalog, and it cannot be revoked.

CREATETS
Revokes the privilege to create new table spaces.

DISPLAYDB
Revokes the privilege to issue the DISPLAY DATABASE command.

DROP
Revokes the privilege to issue the DROP or ALTER statements in the specified databases.

IMAGCOPY
Revokes the privilege to run the COPY, MERGECOPY, and QUIESCE utilities against table spaces of the specified databases, and to run the MODIFY utility.

LOAD
Revokes the privilege to use the LOAD utility to load tables.

RECOVERDB
Revokes the privilege to use the RECOVER and REPORT utilities to recover table spaces and indexes.

REORG
Revokes the privilege to use the REORG utility to reorganize table spaces and indexes.

REPAIR
Revokes the privilege to use the REPAIR and DIAGNOSE utilities.

STARTDB
Revokes the privilege to issue the START DATABASE command.

STATS
Revokes the privilege to use the RUNSTATS utility to update statistics, and the CHECK utility to test whether indexes are consistent with the data they index.

STOPDB
Revokes the privilege to issue the STOP DATABASE command.

ON DATABASE *database-name,...*
Identifies databases on which you are revoking the privileges. For each database you identify, you (or the indicated grantors) must have granted at least one of the specified privileges on that database to all identified users (including PUBLIC, if specified). The same database must not be identified more than once.

FROM
Refer to “REVOKE” on page 1020 for a description of the FROM clause.

BY
Refer to “REVOKE” on page 1020 for a description of the BY clause.

Examples

Example 1: Revoke drop privileges on database DSN8D81A from user PEREZ.

```
REVOKE DROP
  ON DATABASE DSN8D81A
  FROM PEREZ;
```

Example 2: Revoke repair privileges on database DSN8D81A from all local users. (Grants to specific users will not be affected.)

```
REVOKE REPAIR
  ON DATABASE DSN8D81A
  FROM PUBLIC;
```

Example 3: Revoke authority to create new tables and load tables in database DSN8D81A from users WALKER, PIANKA, and FUJIMOTO.

```
REVOKE CREATETAB,LOAD
  ON DATABASE DSN8D81A
  FROM WALKER,PIANKA,FUJIMOTO;
```

REVOKE (distinct type or JAR privileges)

This form of the REVOKE statement revokes the privilege to use distinct types (user-defined data types) or JARs.

Syntax

```
                                    ┌─,──────────────────┐                ┌─,──────────────────────┐
>>──REVOKE──USAGE ON──┬─DISTINCT TYPE───▼─distinct-type-name─┴──┬──FROM───▼─┬─authorization-name─┬─┴──────>
                      │             ┌─,───────┐                 │           └─PUBLIC─────────────┘
                      └─JAR───────▼─jar-name─┴─────────────────┘

                                        ┌─RESTRICT─┐
>──┬──────────────────────────────────┬─┴──────────┴──────────────────────────────────────────────────><
   │          ┌─,──────────────────┐   │
   └─BY───┬─▼─authorization-name─┴─┬─┘
          └─ALL────────────────────┘
```

Description

USAGE
Revokes the privilege to use the distinct type in tables, functions procedures, or CAST expressions, or the privilege to use the JAR.

DISTINCT TYPE *distinct-type-name*
Identifies a distinct type. The name, including the implicit or explicit schema qualifier, must identify a unique distinct type that exists at the current server. If you specify an unqualified name, the name is implicitly qualified with a schema name according to the following rules:

- If the statement is embedded in a program, the schema name is the authorization ID in the QUALIFIER option when the plan or package was created or last rebound. If QUALIFIER was not used, the schema name is the owner of the plan or package.
- If the statement is dynamically prepared, the schema name is the SQL authorization ID in the CURRENT SQLID special register.

JAR *jar-name*
Identifies the JAR. The name, including the implicit or explicit schema name, must identify a unique JAR that exists at the current server. If you do not explicitly qualify the JAR name, it is implicitly qualified with a schema name according to the following rules:

- If the statement is embedded in a program, the schema name is the authorization ID in the QUALIFIER option when the plan or package was created or last rebound. If QUALIFIER was not used, the schema name is the owner of the plan or package.
- If the statement is dynamically prepared, the schema name is the SQL authorization ID in the CURRENT SQLID special register.

FROM
Refer to “REVOKE” on page 1020 for a description of the FROM clause.

BY
Refer to “REVOKE” on page 1020 for a description of the BY clause.

RESTRICT
Prevents the USAGE privilege from being revoked on a distinct type or JAR if any of the following conditions exist and the revokee does not have the USAGE privilege from another source:

- The revokee owns a function or stored procedure that uses the distinct type or references the JAR.
- The revokee owns a table that has a column that uses the distinct type.
- A sequence exists for which the data type of the sequence is the distinct type.

Notes

Alternative syntax and synonyms: To provide compatibility with previous releases of DB2 or other products in the DB2 UDB family, DB2 supports DATA TYPE as a synonym for DISTINCT TYPE.

Examples

Example 1: Revoke the USAGE privilege on distinct type SHOESIZE from user JONES.

```
REVOKE USAGE ON DISTINCT TYPE SHOESIZE FROM JONES;
```

Example 2: Revoke the USAGE privilege on distinct type US_DOLLAR from all users at the current server except for those who have been specifically granted USAGE and not through PUBLIC.

```
REVOKE USAGE ON DISTINCT TYPE US_DOLLAR FROM PUBLIC;
```

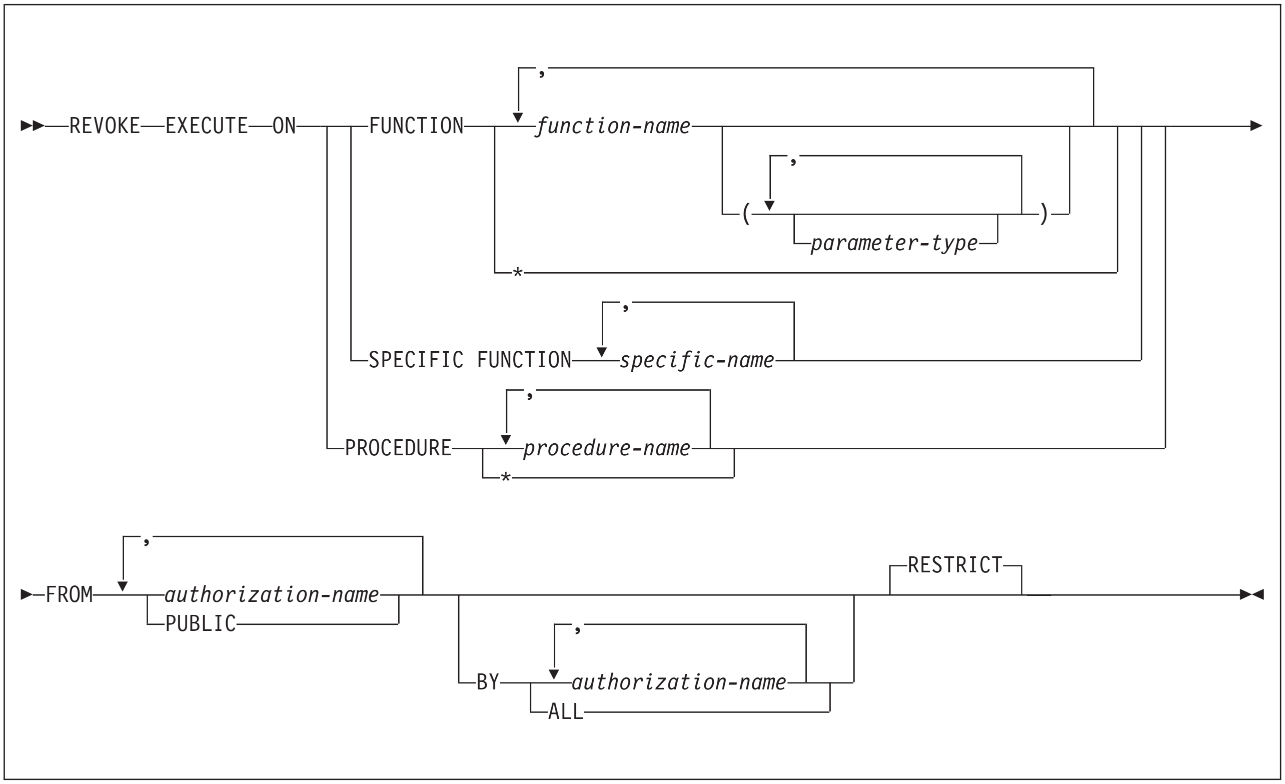
Example 3: Revoke the USAGE privilege on distinct type CANADIAN_DOLLARS from the administrative assistant (ADMIN_A).

```
REVOKE USAGE ON DISTINCT TYPE CANADIAN_DOLLARS
      FROM ADMIN_A;
```

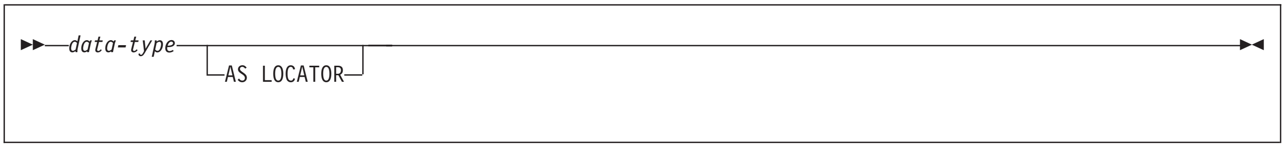
REVOKE (function or procedure privileges)

This form of the REVOKE statement revokes privileges on user-defined functions, cast functions that were generated for distinct types, and stored procedures.

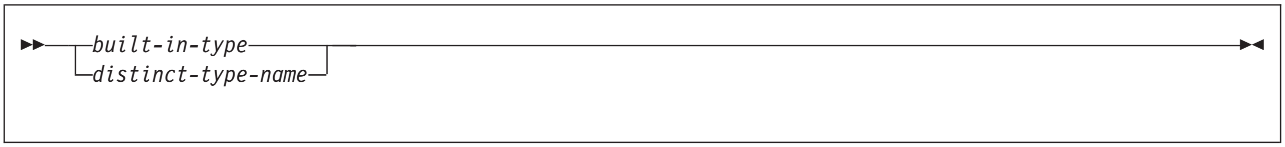
Syntax



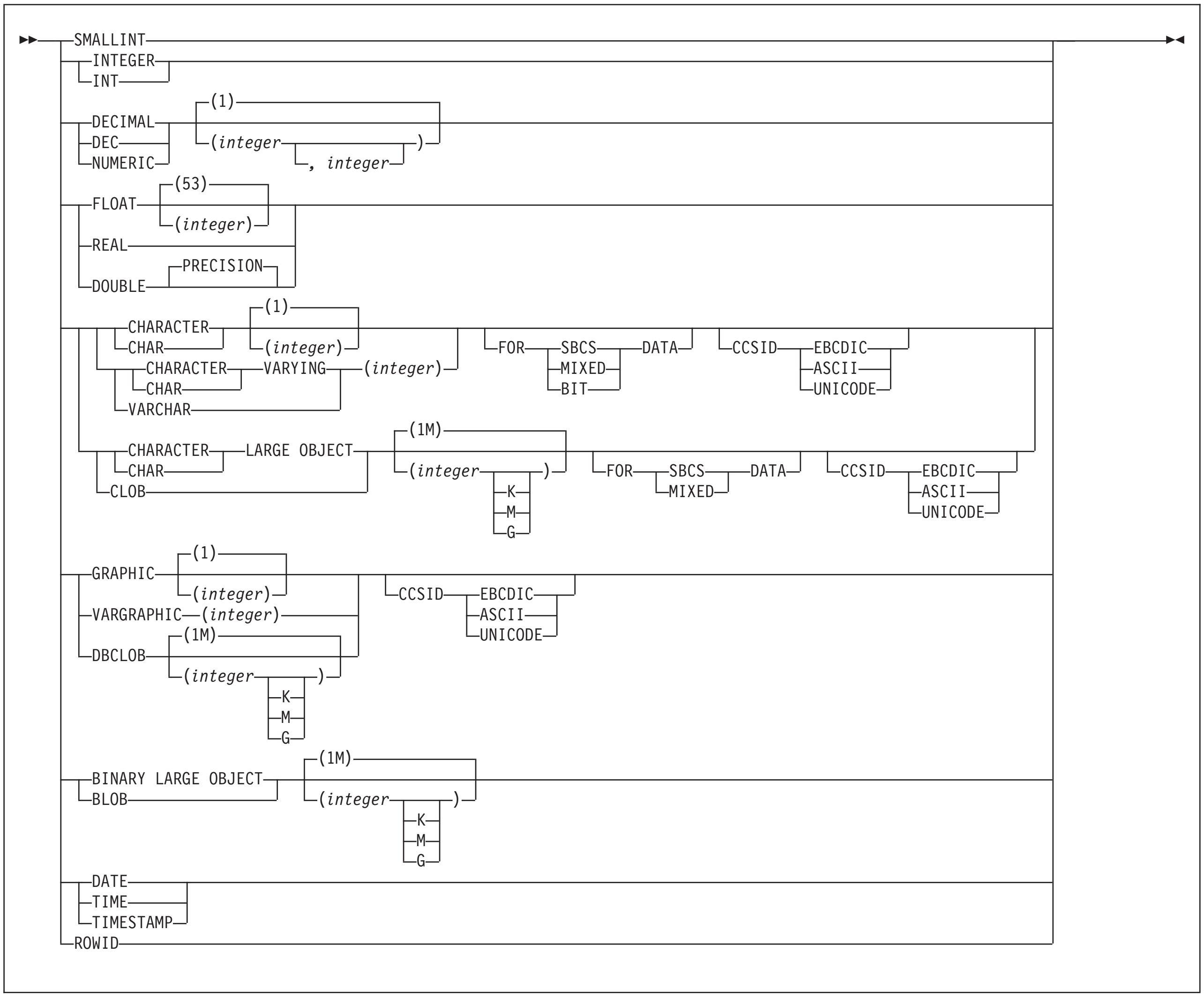
parameter type:



data type:



built-in-type:



Description

EXECUTE
Revokes the privilege to run the identified user-defined function, cast function that was generated for a distinct type, or stored procedure.

FUNCTION or **SPECIFIC FUNCTION**
Identifies the function from which the privilege is revoked. The function must exist at the current server, and it must be a function that was defined with the CREATE FUNCTION statement or a cast function that was generated by a CREATE DISTINCT TYPE statement. The function can be identified by name, function signature, or specific name.

If the function was defined with a table parameter (the LIKE TABLE was specified in the CREATE FUNCTION statement to indicate that one of the input parameters is a transition table), the function signature cannot be used to identify the function. Instead, identify the function with its function name, if unique, or with its specific name.

FUNCTION *function-name*

Identifies the function by its name. The *function-name* must identify exactly one function. The function can have any number of parameters defined for it. If there is more than one function of the specified name in the specified or implicit schema, an error is returned.

If you do not explicitly qualify the function name with a schema name, the function name is implicitly qualified with a schema name according to the following rules:

- If the statement is embedded in a program, the schema name is the authorization ID in the QUALIFIER option when the plan or package was created or last rebound. If QUALIFIER was not used, the schema name is the owner of the plan or package.
- If the statement is dynamically prepared, the schema name is the SQL authorization ID in the CURRENT SQLID special register.

An * can be specified for a qualified or unqualified *function-name*. An * (or *schema-name*.*) indicates that the privilege is revoked for all the functions in the schema. You (or the indicated grantors) must have granted the privilege on FUNCTION * to all identified users (including PUBLIC if specified). Privileges granted on specific functions are not affected.

FUNCTION *function-name (parameter-type,...)*

Identifies the function by its function signature, which uniquely identifies the function. The *function-name (parameter-type, ...)* must identify a function with the specified function signature. The specified parameters must match the data types in the corresponding position that were specified when the function was created. The number of data types, and the logical concatenation of the data types is used to identify the specific function instance on which the privilege is to be granted. Synonyms for data types are considered a match.

If *function-name ()* is specified, the function identified must have zero parameters.

function-name

Identifies the name of the function. If you do not explicitly qualify the function name with a schema name, the function name is implicitly qualified with a schema name as described in the preceding description for FUNCTION *function-name*.

(parameter-type,...)

Identifies the parameters of the function.

If an unqualified distinct type name is specified, DB2 searches the SQL path to resolve the schema name for the distinct type.

For data types that have a length, precision, or scale attribute, use one of the following:

- Empty parentheses indicate that the database manager ignores the attribute when determining whether the data types match. For example, DEC() will be considered a match for a parameter of a function defined with a data type of DEC(7,2). However, FLOAT cannot be specified with empty parenthesis because its parameter value indicates a specific data type (REAL or DOUBLE).
- If a specific value for a length, precision, or scale attribute is specified, the value must exactly match the value that was specified (implicitly or explicitly) in the CREATE FUNCTION statement. If the

data type is FLOAT, the precision does not have to exactly match the value that was specified because matching is based on the data type (REAL or DOUBLE).

- If length, precision, or scale is not explicitly specified, and empty parentheses are not specified, the default attributes of the data type are implied. The implicit length must exactly match the value that was specified (implicitly or explicitly) in the CREATE FUNCTION statement.

For data types with a subtype or encoding scheme attribute, specifying the FOR *subtype* DATA clause or the CCSID clause is optional. Omission of either clause indicates that DB2 ignores the attribute when determining whether the data types match. If you specify either clause, it must match the value that was implicitly or explicitly specified in the CREATE FUNCTION statement.

AS LOCATOR
Specifies that the function is defined to receive a locator for this parameter. If AS LOCATOR is specified, the data type must be a LOB or a distinct type based on a LOB.

SPECIFIC FUNCTION *specific-name*
Identifies the function by its specific name. The *specific-name* must identify a specific function that exists at the current server.

PROCEDURE *procedure-name*
Identifies a stored procedure that is defined at the current server. If you do not explicitly qualify the procedure name with a schema name, the procedure name is implicitly qualified with a schema name according to the following rules:

- If the statement is embedded in a program, the schema name is the authorization ID in the QUALIFIER option when the plan or package was created or last rebound. If QUALIFIER was not used, the schema name is the owner of the plan or package.
- If the statement is dynamically prepared, the schema name is the SQL authorization ID in the CURRENT SQLID special register.

An * can be specified for a qualified or unqualified *procedure-name*. An * (or *schema-name*.*) indicates that the privilege is revoked for all the procedures in the schema. You (or the indicated grantors) must have granted the privilege on PROCEDURE * to all identified users (including PUBLIC if specified). Privileges granted on specific procedures are not affected.

FROM
Refer to “REVOKE” on page 1020 for a description of the FROM clause.

BY
Refer to “REVOKE” on page 1020 for a description of the BY clause.

RESTRICT
Prevents the EXECUTE privilege from being revoked on a user-defined function or stored procedure if the revokee owns any of the following objects and does not have the EXECUTE privilege from another source:

- A function that is sourced on the function
- A view that uses the function
- A trigger package that uses the function or stored procedure
- A table that uses the function in a check constraint or user-defined default clause

| - A materialized query table whose fullselect uses the function

Examples

Example 1: Revoke the EXECUTE privilege on function CALC_SALARY for user JONES. Assume that there is only one function in the schema with function CALC_SALARY.

```
REVOKE EXECUTE ON FUNCTION CALC_SALARY FROM JONES;
```

Example 2: Revoke the EXECUTE privilege on procedure VACATION_ACCR from all users at the current server.

```
REVOKE EXECUTE ON PROCEDURE VACATION_ACCR FROM PUBLIC;
```

Example 3: Revoke the privilege of the administrative assistant to grant EXECUTE privileges on function DEPT_TOTAL to other users. The administrative assistant will still have the EXECUTE privilege on function DEPT_TOTALS.

```
REVOKE EXECUTE ON FUNCTION DEPT_TOTALS
      FROM ADMIN_A;
```

Example 4: Revoke the EXECUTE privilege on function NEW_DEPT_HIRES for HR (Human Resources). The function has two input parameters with data types of INTEGER and CHAR(10), respectively. Assume that the schema has more than one function that is named NEW_DEPT_HIRES.

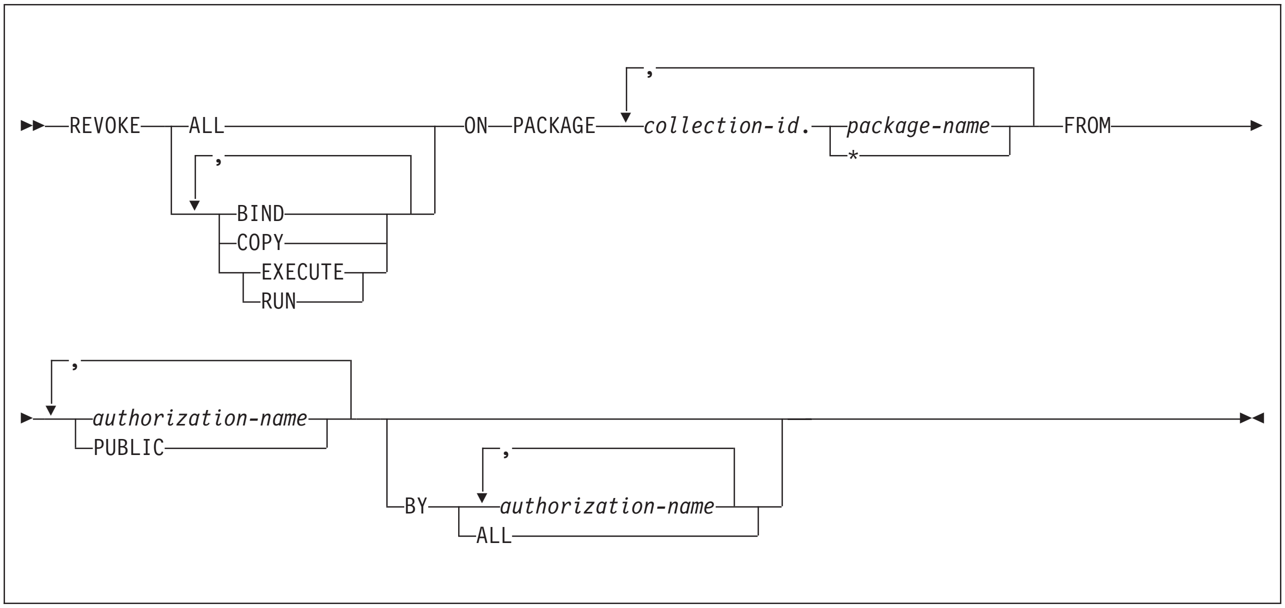
```
REVOKE EXECUTE ON FUNCTION NEW_DEPT_HIRES (INTEGER, CHAR(10))
      FROM HR;
```

You can also code the CHAR(10) data type as CHAR().

REVOKE (package privileges)

This form of the REVOKE statement revokes privileges on packages.

Syntax



Description

BIND
Revokes the privilege to use the BIND and REBIND subcommands for the designated packages. In addition, if the value of field BIND NEW PACKAGE on installation panel DSNTIPP is BIND, the additional BIND privilege of adding new versions of packages is revoked. (For details, see “Notes” on page 955 for “GRANT (package privileges)” on page 954.)

COPY
Revokes the privilege to use the COPY option of the BIND subcommand for the designated packages.

EXECUTE
Revokes the privilege to run application programs that use the designated packages and to specify the packages following PKLIST for the BIND PLAN and REBIND PLAN commands. RUN is an alternate name for the same privilege.

ALL
Revokes all package privileges for which you have authority for the packages named in the ON clause.

ON PACKAGE *collection-id.package-name,...*
Identifies packages for which you are revoking privileges. The revoking of a package privilege applies to all versions of that package. For each package that you identify, you (or the indicated grantors) must have granted at least one of the specified privileges on that package to all identified users (including PUBLIC, if specified). An authorization ID with PACKADM authority over the collection or all collections, SYSADM, or SYSCTRL authority can specify all packages in the collection by using * for *package-name*. The same package must not be specified more than once.

FROM
Refer to “REVOKE” on page 1020 for a description of the FROM clause.

BY
Refer to “REVOKE” on page 1020 for a description of the BY clause.

Notes

Alternative syntax and synonyms: To provide compatibility with previous releases of DB2 or other products in the DB2 UDB family, DB2 supports specifying PROGRAM as a synonym for PACKAGE.

Example

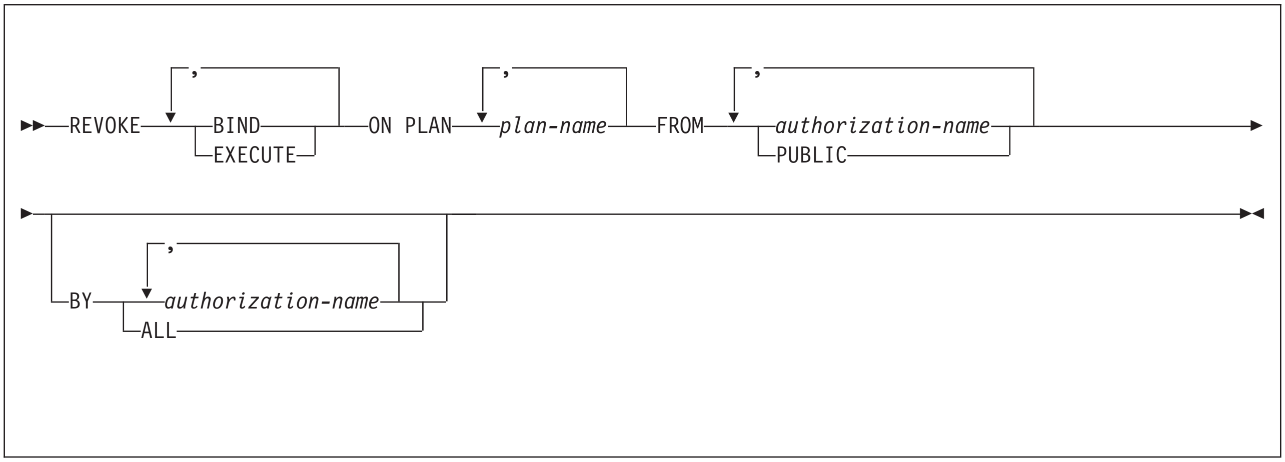
Revoke the privilege to copy all packages in collection DSN8CC61 from LEWIS.

```
REVOKE COPY ON PACKAGE DSN8CC61.* FROM LEWIS;
```

REVOKE (plan privileges)

This form of the REVOKE statement revokes privileges on application plans.

Syntax



Description

BIND
Revokes the privilege to use the BIND, REBIND, and FREE subcommands for the identified plans.

EXECUTE
Revokes the privilege to run application programs that use the identified plans.

ON PLAN *plan-name,...*
Identifies application plans for which you are revoking privileges. For each plan that you identify, you (or the indicated grantors) must have granted at least one of the specified privileges on that plan to all identified users (including PUBLIC, if specified). The same plan must not be specified more than once.

FROM
Refer to “REVOKE” on page 1020 for a description of the FROM clause.

BY
Refer to “REVOKE” on page 1020 for a description of the BY clause.

Examples

Example 1: Revoke authority to bind plan DSN8IP81 from user JONES.

```
REVOKE BIND ON PLAN DSN8IP81 FROM JONES;
```

Example 2: Revoke authority previously granted to all users at the current server to bind and execute plan DSN8CP81. (Grants to specific users will not be affected.)

```
REVOKE BIND,EXECUTE ON PLAN DSN8CP81 FROM PUBLIC;
```

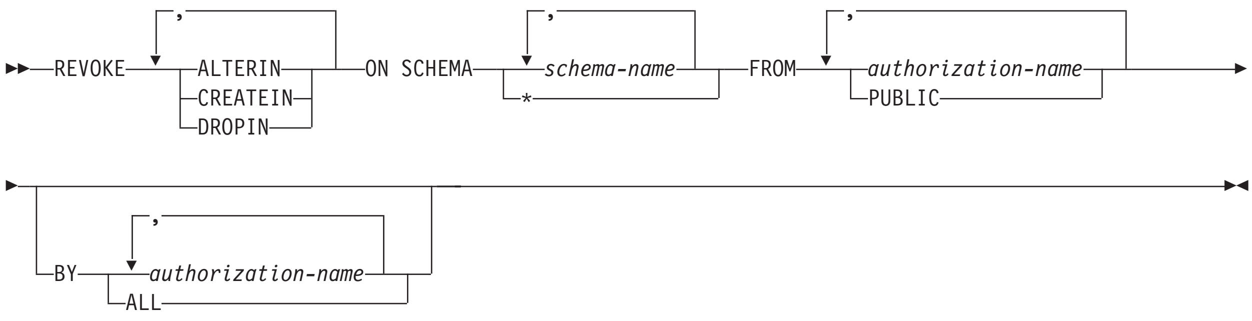
Example 3: Revoke authority to execute plan DSN8CP81 from users ADAMSON and BROWN.

```
REVOKE EXECUTE ON PLAN DSN8CP81 FROM ADAMSON,BROWN;
```

REVOKE (schema privileges)

This form of the REVOKE statement revokes privileges on schemas.

Syntax



Description

ALTERIN
Revokes the privilege to alter stored procedures and user-defined functions, or specify a comment for distinct types, cast functions that are generated for distinct types, stored procedures, triggers, and user-defined functions in the designated schemas.

CREATEIN
Revokes the privilege to create distinct types, stored procedures, triggers, and user-defined functions in the designated schemas.

DROPIN
Revokes the privilege to drop distinct types, stored procedures, triggers, and user-defined functions in the designated schemas.

SCHEMA *schema-name*
Identifies the schema on which the privilege is revoked.

SCHEMA *
Indicates that the specified privilege on all schemas is revoked. You (or the indicated grantors) must have previously granted the specified privilege on SCHEMA * to all identified users (including PUBLIC if specified). Privileges granted on specific schemas are not affected.

FROM
Refer to "REVOKE" on page 1020 for a description of the FROM clause.

BY
Refer to "REVOKE" on page 1020 for a description of the BY clause.

Examples

Example 1: Revoke the CREATEIN privilege on schema T_SCORES from user JONES.

```
REVOKE CREATEIN ON SCHEMA T_SCORES FROM JONES;
```

Example 2: Revoke the CREATEIN privilege on schema VAC from all users at the current server.

```
REVOKE CREATEIN ON SCHEMA VAC FROM PUBLIC;
```

Example 3: Revoke the ALTERIN privilege on schema DEPT from the administrative assistant.

```
REVOKE ALTERIN ON SCHEMA DEPT FROM ADMIN_A;
```

Example 4: Revoke the ALTERIN and DROPIN privileges on schemas NEW_HIRE, PROMO, and RESIGN from HR (Human Resources).

```
REVOKE ALTERIN, DROPIN ON SCHEMA NEW_HIRE, PROMO, RESIGN FROM HR;
```

REVOKE (sequence privileges)

This form of the REVOKE statement revokes the privileges on a user-defined sequence.

Syntax

```
            ┌─,───────────┐              ┌─,─────────────┐      ┌─,─────────────────────┐
            ▼             │              ▼               │      ▼                       │
►►──REVOKE────┬─ALTER──┬──┴──ON SEQUENCE───sequence-name─┴──FROM──┬─authorization-name─┬─┴───────►
              │   (1)  │                                          └─PUBLIC─────────────┘
              └─USAGE──┘

                                   ┌─RESTRICT─┐
►──┬─────────────────────────────┬─┴──────────┴──────────────────────────────────────────────────►◄
   │         ┌─,──────────────┐  │
   │         ▼                │  │
   └─BY───┬─authorization-name─┴┬┘
          └─ALL─────────────────┘
```

Notes:

1 The keyword SELECT is an alternative keyword for USAGE.

Description

ALTER
Revokes the privilege to alter a sequence or record a comment on a sequence.

USAGE
Revokes the USAGE privilege to use a sequence. This privilege is needed when the NEXT VALUE or PREVIOUS VALUE expression is invoked for a sequence name.

SEQUENCE *sequence-name*
Identifies the sequence. The name, including the implicit or explicit schema qualifier, must uniquely identify an existing sequence at the current server. If no sequence by this name exists in the explicitly or implicitly specified schema, an error occurs. *sequence-name* must not be the name of an internal sequence object that is generated by the system for an identity column.

FROM
Refer to “REVOKE” on page 1020 for a description of the FROM clause.

BY
Refer to “REVOKE” on page 1020 for a description of the BY clause.

RESTRICT
Prevents the USAGE privilege from being revoked on a sequence if the revokee owns one of the following objects and does not have the USAGE privilege from another source:

- A trigger that specifies the sequence in a NEXT VALUE or PREVIOUS VALUE expression
- An inline SQL function that specifies the sequence in a NEXT VALUE or PREVIOUS VALUE expression

Examples

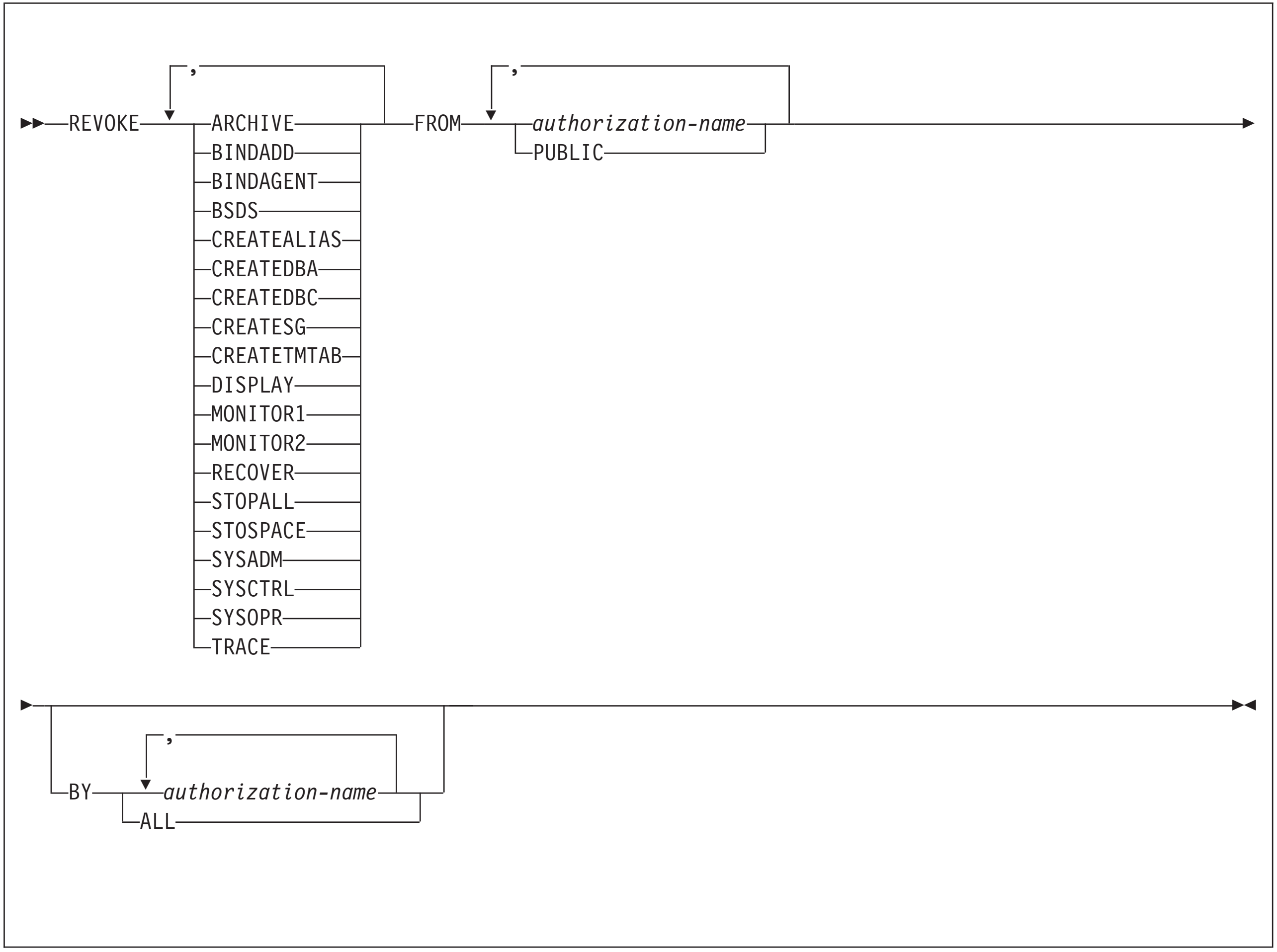
Revoke USAGE privilege on sequence MYNUM to user JONES.

```
REVOKE USAGE
  ON SEQUENCE MYNUM
  FROM JONES;
```

REVOKE (system privileges)

This form of the REVOKE statement revokes system privileges.

Syntax



Description

ARCHIVE
Revokes the privilege to use the ARCHIVE LOG command.

BINDADD
Revokes the privilege to create plans and packages using the BIND subcommand with the ADD option.

BINDAGENT
Revokes the privilege to issue the BIND, FREE PACKAGE, or REBIND subcommands for plans and packages and the DROP PACKAGE statement on behalf of the grantor. The privilege also allows the holder to copy and replace plans and packages on behalf of the grantor.

A revoke of this privilege does not cascade.

BSDS
Revokes the privilege to issue the RECOVER BSDS command.

CREATEALIAS
Revokes the privilege to use the CREATE ALIAS statement.

CREATEDBA
Revokes the privilege to issue the CREATE DATABASE statement and acquire DBADM authority over those databases.

CREATEDBC
Revokes the privilege to issue the CREATE DATABASE statement and acquire DBCTRL authority over those databases.

CREATESG
Revokes the privilege to create new storage groups.

CREATETMTAB
Revokes the privilege to use the CREATE GLOBAL TEMPORARY TABLE statement.

DISPLAY
Revokes the privilege to use the following commands:

- The DISPLAY ARCHIVE command for archive log information
- The DISPLAY BUFFERPOOL command for the status of buffer pools
- The DISPLAY DATABASE command for the status of all databases
- The DISPLAY FUNCTION SPECIFIC command for statistics about accessed external user-defined functions
- The DISPLAY LOCATION command for statistics about threads with a distributed relationship
- The DISPLAY PROCEDURE command for statistics about accessed stored procedures
- The DISPLAY THREAD command for information on active threads with in DB2
- The DISPLAY TRACE command for a list of active traces

MONITOR1
Revokes the privilege to obtain IFC data classified as serviceability data, statistics, accounting, and other performance data that does not contain potentially secure data.

MONITOR2
Revokes the privilege to obtain IFC data classified as containing potentially sensitive data such as SQL statement text and audit data. (Having the MONITOR2 privilege also implies having MONITOR1 privileges, however, revoking the MONITOR2 privilege does not cause the revoke of an explicitly granted MONITOR1 privilege.)

RECOVER
Revokes the privilege to issue the RECOVER INDOUBT command.

STOPALL
Revokes the privilege to use the STOP DB2 command.

STOSPACE
Revokes the privilege to use the STOSPACE utility.

SYSADM
Revokes the system administrator authority.

SYSCTRL
Revokes the system control authority.

SYSOPR
Revokes the system operator authority.

TRACE
Revokes the privilege to use the MODIFY TRACE, START TRACE, and STOP TRACE commands.

FROM
Refer to “REVOKE” on page 1020 for a description of the FROM clause.

BY
Refer to “REVOKE” on page 1020 for a description of the BY clause.

Examples

Example 1: Revoke DISPLAY privileges from user LUTZ.

```
REVOKE DISPLAY
  FROM LUTZ;
```

Example 2: Revoke BSDS and RECOVER privileges from users PARKER and SETRIGHT.

```
REVOKE BSDS,RECOVER
  FROM PARKER,SETRIGHT;
```

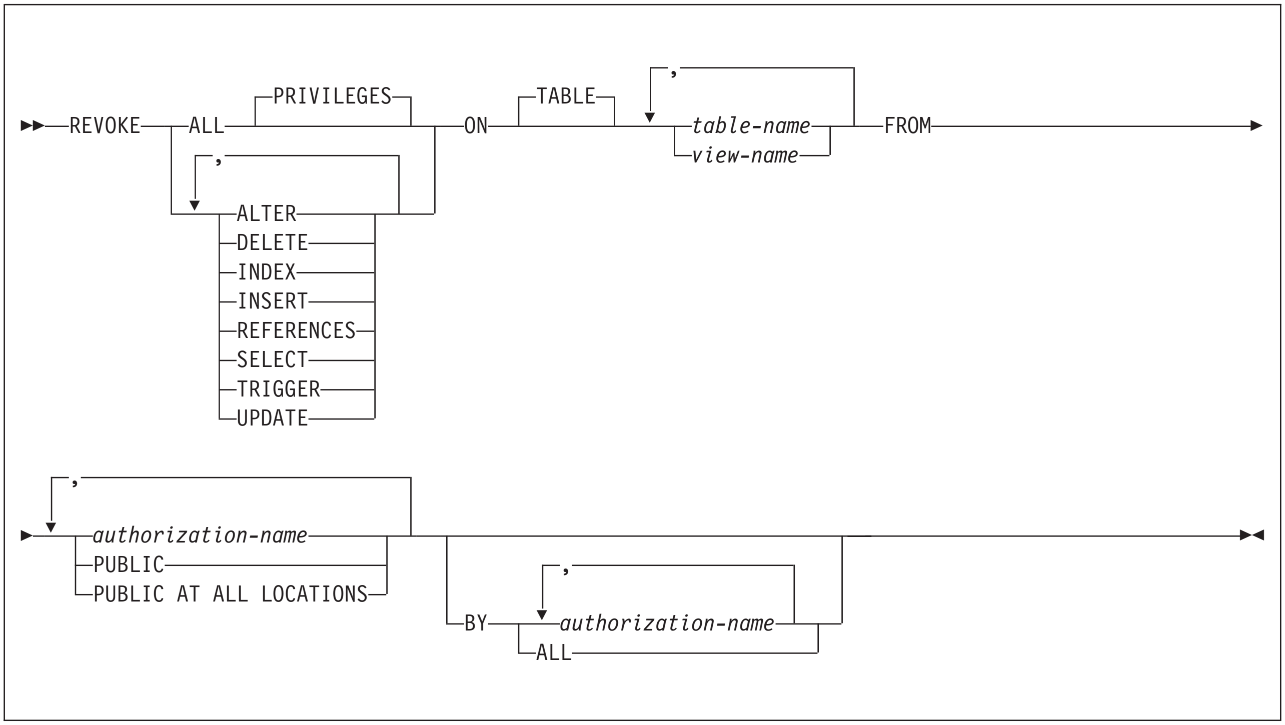
Example 3: Revoke TRACE privileges previously granted to all local users. (Grants to specific users will not be affected.)

```
REVOKE TRACE
  FROM PUBLIC;
```

REVOKE (table or view privileges)

This form of the REVOKE statement revokes privileges on one or more tables or views.

Syntax



Description

ALL or **ALL PRIVILEGES**
If you specify ALL, the authorization ID of the statement must have granted a least one privilege on each identified table or view to each *authorization-name*. The privilege revoked from an authorization ID are those privileges on the table or view that the authorization ID of the statement granted to the authorization ID.

If you do not use ALL, you must use one or more of the keywords listed below. Each keyword revokes the privilege described, but only as it applies to the tables or views named in the ON clause.

ALTER
Revokes the privilege to alter the specified table or create a trigger on the specified table.

DELETE
Revokes the privilege to delete rows in the specified table or view.

INDEX
Revokes he privilege to create an index on the specified table.

INSERT
Revokes the privilege to insert rows into the specified table or view.

REFERENCES
Revokes the privilege to define and drop referential constraints. Although you

can use a list of column names with the GRANT statement, you cannot use a list of column names with REVOKE; the privilege is revoked for all columns.

SELECT
Revokes the privilege to create a view or read data from the specified table or view. A view or a materialized query table is dropped when the SELECT privilege that was used to create it is revoked, unless the owner of the view or materialized query table was directly granted the SELECT privilege from another source before the view or materialized query table was created.

TRIGGER
Revokes the privilege to create a trigger on the specified table.

UPDATE
Revokes the privilege to update rows in the specified table or view. A list of column names can be used only with GRANT, not with REVOKE.

ON *table-name* **or** *view-name*
Names one or more tables or views on which you are revoking the privileges. The list can consist of table names, view names, or a combination of the two. A table or view must not be identified more than once, and a declared temporary table must not be identified.

FROM
Refer to "REVOKE" on page 1020 for a description of the FROM clause.

BY
If you omit BY, you must have granted each named privilege to each of the named users. More precisely, each privilege must have been granted to each user by a GRANT statement whose authorization ID is also the authorization ID of your REVOKE statement. Each of these grants is then revoked. (No single privilege need be granted on all tables and views.)

If BY is specified, each named grantor must satisfy the above requirement. In that case, the authorization ID of the statement need not satisfy the requirement unless it is one of the named grantors.

Refer to "REVOKE" on page 1020 for a description of the BY clause.

Notes

For a created temporary table or a view of a created temporary table, only ALL or ALL PRIVILEGES can be revoked. Specific table or view privileges cannot be revoked.

For a declared temporary table, no privileges can be revoked because none can be granted. When a declared temporary table is defined, PUBLIC implicitly receives all table privileges (without GRANT authority) for the table. These privileges are not recorded in the DB2 catalog.

PUBLIC AT ALL LOCATIONS: PUBLIC AT ALL LOCATIONS can continue to be specified as an alternative to PUBLIC as in prior releases. PUBLIC AT ALL LOCATIONS was introduced and was intended for use only with DB2 private protocol access.

Examples

Example 1: Revoke SELECT privileges on table DSN8810.EMP from user PULASKI.

```
REVOKE SELECT ON TABLE DSN8810.EMP FROM PULASKI;
```

Example 2: Revoke update privileges on table DSN8810.EMP previously granted to all local DB2 users. (Grants to specific users are not affected.)

```
REVOKE UPDATE ON TABLE DSN8810.EMP FROM PUBLIC;
```

Example 3: Revoke all privileges on table DSN8810.EMP from users KWAN and THOMPSON.

```
REVOKE ALL ON TABLE DSN8810.EMP FROM KWAN,THOMPSON;
```

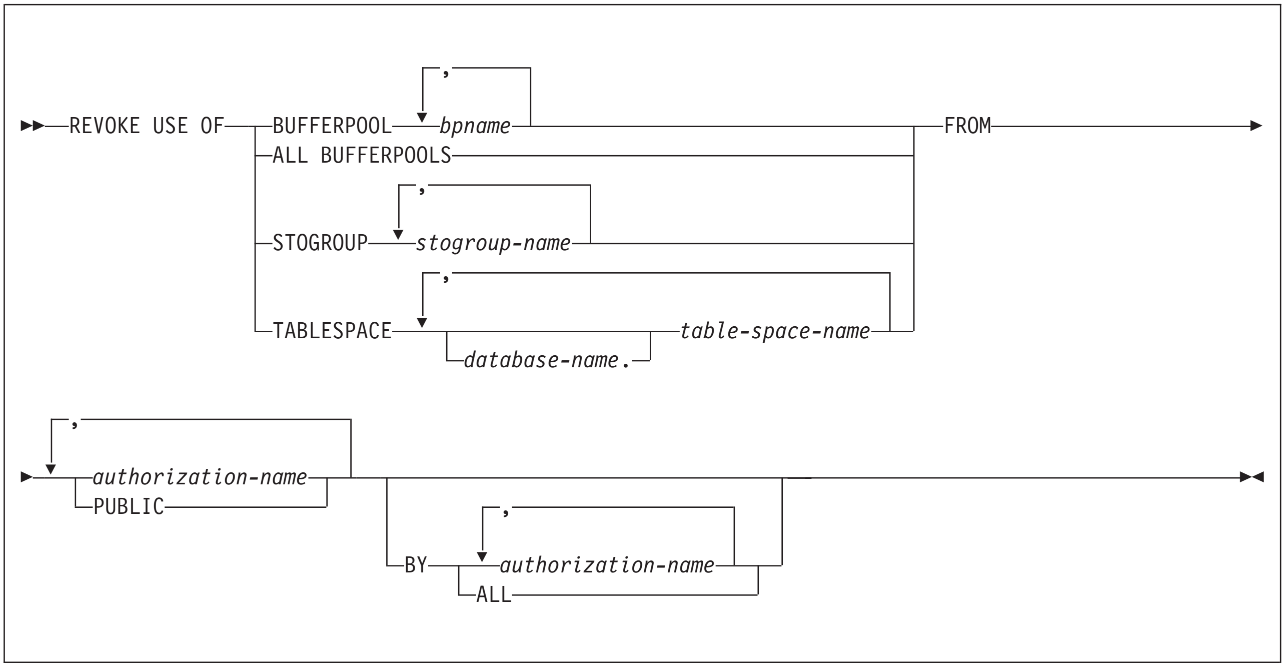
Example 4: Revoke the grant of SELECT and UPDATE privileges on the table DSN8810.DEPT to every user in the network. Doing so does not affect users who obtained these privileges from some other grant.

```
REVOKE SELECT, UPDATE ON TABLE DSN8810.DEPT
  FROM PUBLIC AT ALL LOCATIONS;
```

REVOKE (use privileges)

This form of the REVOKE statement revokes authority to use particular buffer pools, storage groups, or table spaces.

Syntax



Description

BUFFERPOOL *bpname,...*
Revokes the privilege to refer to any of the identified buffer pools in a CREATE INDEX, CREATE TABLESPACE, ALTER INDEX, or ALTER TABLESPACE statement. See “Naming conventions” on page 40 for more details about *bpname*.

ALL BUFFERPOOLS
Revokes the privilege to refer to any buffer pool in a CREATE INDEX, CREATE TABLESPACE, ALTER INDEX, or ALTER TABLESPACE statement.

STOGROUP *stogroup-name,...*
Revokes the privilege to refer to any of the identified storage groups in a CREATE INDEX, CREATE TABLESPACE, ALTER INDEX, or ALTER TABLESPACE statement.

TABLESPACE *database-name***.***table-space-name,...*
Revokes the privilege to refer to any of the specified table spaces in a CREATE TABLE statement. The default *database-name* is DSNDB04.

For table spaces in a TEMP database, which are for declared temporary tables, you cannot revoke the privilege from PUBLIC. When a table space is created in the TEMP database, PUBLIC implicitly receives the TABLESPACE privilege (without GRANT authority); this privilege is not recorded in the DB2 catalog, and it cannot be revoked.

FROM
Refer to “REVOKE” on page 1020 for a description of the FROM clause.

BY
Refer to “REVOKE” on page 1020 for a description of the BY clause.

Notes

You can revoke privileges for only one type of object with each statement. Thus you can revoke the use of several table spaces with one statement, but not the use of a table space and a storage group.

For each object you name, you (or the indicated grantors) must have granted the USE privilege on that object to all identified users (including PUBLIC, if specified). The same object must not be identified more than once.

Revoking the privilege USE OF ALL BUFFERPOOLS does not cascade to all other privileges that can be granted under that privilege. A user with the privilege USE OF ALL BUFFERPOOLS WITH GRANT OPTION can make two types of grants:

- GRANT USE OF ALL BUFFERPOOLS TO *userid*. This privilege is revoked when the original user’s privilege is revoked.
- GRANT USE OF BUFFERPOOL BP*n* TO *userid*. This privilege is *not revoked* when the original user’s privilege is revoked.

Examples

Example 1: Revoke authority to use buffer pool BP2 from user MARINO.

```
REVOKE USE OF BUFFERPOOL BP2
  FROM MARINO;
```

Example 2: Revoke a grant of the USE privilege on the table space DSN8S81D in the database DSN8D81A. The grant is to PUBLIC, that is, to everyone at the local DB2 subsystem. (Grants to specific users are not affected.)

```
REVOKE USE OF TABLESPACE DSN8D81A.DSN8S81D
  FROM PUBLIC;
```

ROLLBACK

The ROLLBACK statement can be used to either:

- End a unit of recovery and back out all the relational database changes that were made by that unit of recovery. If relational databases are the only recoverable resources used by the application process, ROLLBACK also ends the unit of work.
- Back out only the changes made after a savepoint was set within the unit of recovery without ending the unit of recovery. Rolling back to a savepoint enables selected changes to be undone.

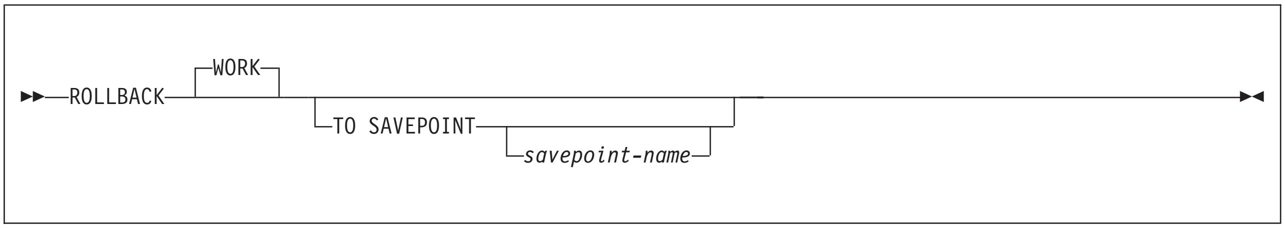
Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared. It can be used in the IMS or CICS environment only if the TO SAVEPOINT clause is specified.

Authorization

None required.

Syntax



Description

When ROLLBACK is used without the SAVEPOINT clause, the unit of recovery in which the ROLLBACK statement is executed is ended and a new unit of recovery is effectively started. All changes made by ALTER, COMMENT, CREATE, DELETE, DROP, EXPLAIN, GRANT, INSERT, LABEL, REFRESH TABLE, RENAME, REVOKE, UPDATE, subselect with INSERT, and SELECT INTO with INSERT statements executed during the unit of recovery are backed out.

ROLLBACK without the TO SAVEPOINT clause also causes the following to occur:

- All locks implicitly acquired during the unit of recovery are released. See “LOCK TABLE” on page 988 for an explanation of the duration of explicitly acquired locks.
- All cursors are closed, all prepared statements are destroyed, and any cursors associated with the prepared statements are invalidated.
- All rows and all logical work files of every created temporary table of the application process are deleted. (All the rows of a declared temporary table are not implicitly deleted. As with base tables, any changes made to a declared temporary table during the unit of recovery are undone to restore the table to its state at the last commit.)
- All LOB locators, including those that are held, are freed.

TO SAVEPOINT

Specifies that the unit of recovery is not to be ended and that only a partial rollback (to a savepoint) is to be performed. If a savepoint name is not specified, rollback is to the last active savepoint. For example, if in a unit of recovery, savepoints A, B, and C are set in that order and then C is released, ROLLBACK TO SAVEPOINT causes a rollback to savepoint B.

savepoint-name
Identifies the savepoint to which to roll back. If the named savepoint does not exist, an error occurs.

All database changes (including changes made to a declared temporary tables but excluding changes made to created temporary tables) that were made after the savepoint was set are backed out. Changes that are made to created temporary tables are not logged and are not backed out; a warning is issued instead. (A warning is also issued when a created temporary table is changed and there is an active savepoint.)

In addition, none of the following items are backed out:
- The opening or closing of cursors
- Changes in cursor positioning
- The acquisition and release of locks
- The caching of the rolled back statements

Any savepoints that are set after the one to which rollback is performed are released. The savepoint to which rollback is performed is not released.

ROLLBACK with or without the TO SAVEPOINT clause has no effect on connections.

Notes

The following information applies only to rolling back all changes in the unit of recovery (the ROLLBACK statement without the TO SAVEPOINT clause):

- *Stored procedures.* The ROLLBACK statement cannot be used if the procedure is in the calling chain of a user-defined function or a trigger or if DB2 is not the commit coordinator.
- *IMS or CICS.* Using a ROLLBACK to SAVEPOINT statement in an IMS or CICS environment only rolls back DB2 resources. Any other recoverable resources updated in the environment are not rolled back. To do a rollback operation in these environments, SQL programs must use the call prescribed by their transaction manager. The effect of these rollback operations on DB2 data is the same as that of the SQL ROLLBACK statement.

  A rollback operation in an IMS or CICS environment might handle the closing of cursors that were declared with the WITH hold option differently than the SQL ROLLBACK statement does. If an application requests a rollback operation from CICS or IMS, but no work has been performed in DB2 since the last commit point, the rollback request will not be broadcast to DB2. If the application had opened cursors using the WITH HOLD option in a previous unit of work, the cursors will not be closed, and any prepared statements associated with those cursors will not be destroyed.
- *Implicit rollback operations:* In all DB2 environments, the abend of a process is an implicit rollback operation.

Examples

Example 1: Roll back all DB2 database changes made since the unit of recovery was started.

```
ROLLBACK WORK;
```

Example 2: After a unit of recovery started, assume that three savepoints A, B, and C were set and that C was released:

```
...
SAVEPOINT A ON ROLLBACK RETAIN CURSORS;
...
SAVEPOINT B ON ROLLBACK RETAIN CURSORS;
...
SAVEPOINT C ON ROLLBACK RETAIN CURSORS;
...
RELEASE SAVEPOINT C;
...
```

Roll back all DB2 database changes only to savepoint A:

```
ROLLBACK WORK TO SAVEPOINT A;
```

If a savepoint name was not specified (that is, `ROLLBACK WORK TO SAVEPOINT`), the rollback would be to the last active savepoint that was set, which is B.

SAVEPOINT

The SAVEPOINT statement sets a savepoint within a unit of recovery to identify a point in time within the unit of recovery to which relational database changes can be rolled back.

Invocation

This statement can be imbedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

None required.

Syntax

```
                                                          (1)
►►──SAVEPOINT──savepoint-name──┬────────┬──ON ROLLBACK RETAIN CURSORS──────────────►
                               └─UNIQUE─┘

                          (1)
►─┬─ON ROLLBACK RETAIN LOCKS────┬─────────────────────────────────────────────────►◄
  └─────────────────────────────┘
```

Notes:

1 These clauses can be specified in either order.

Description

savepoint-name
Names the savepoint. *savepoint-name* must not begin with 'SYS'.

UNIQUE
Specifies that the application program cannot reuse the savepoint name within the unit of recovery. An error occurs if a savepoint with the same name as *savepoint-name* already exists within the unit of recovery.

Omitting UNIQUE indicates that the application can reuse the savepoint name within the unit of recovery. If *svpt-name* identifies a savepoint that already exists within the unit of recovery and the savepoint was not created with the UNIQUE option, the existing savepoint is destroyed and a new savepoint is created. Destroying a savepoint to reuse its name for another savepoint is not the same as releasing the savepoint. Reusing a savepoint name destroys only one savepoint. Releasing a savepoint with the RELEASE SAVEPOINT statement releases the savepoint and all savepoints that have been subsequently set.

ON ROLLBACK RETAIN CURSORS
Specifies that any cursors that are opened after the savepoint is set are not tracked, and thus, are not closed upon rollback to the savepoint. Although these cursors remain open after rollback to the savepoint, they might not be usable. For example, if rolling back to the savepoint causes the insertion of a row on which the cursor is positioned to be rolled back, using the cursor to update or delete the row results in an error.

ON ROLLBACK RETAIN LOCKS
Specifies that any locks that are acquired after the savepoint is set are not tracked, and thus, are not released on rollback to the savepoint.

Example

Assume that you want to set three savepoints at various points in a unit of recovery. Name the first savepoint A and allow the savepoint name to be reused. Name the second savepoint B and do not allow the name to be reused. Because you no longer need savepoint A when you are ready to set the third savepoint, reuse A as the name of the savepoint.

```
   SAVEPOINT A ON ROLLBACK RETAIN CURSORS;

⋮
   SAVEPOINT B UNIQUE ON ROLLBACK RETAIN CURSORS;

⋮
   SAVEPOINT A ON ROLLBACK RETAIN CURSORS;
```

SELECT

For a description of the SELECT statement, see “select-statement” on page 416.

SELECT INTO

The SELECT INTO statement produces a result table that contains at most one row, and assigns the values in that row to host variables. If the table is empty, the statement assigns +100 to SQLCODE, '02000' to SQLSTATE, and does not assign values to the host variables. The tables or views identified in the statement can exist at the current server or at any DB2 subsystem with which the current server can establish a connection.

Invocation

This statement can only be embedded in an application program. It is an executable statement that cannot be dynamically prepared.

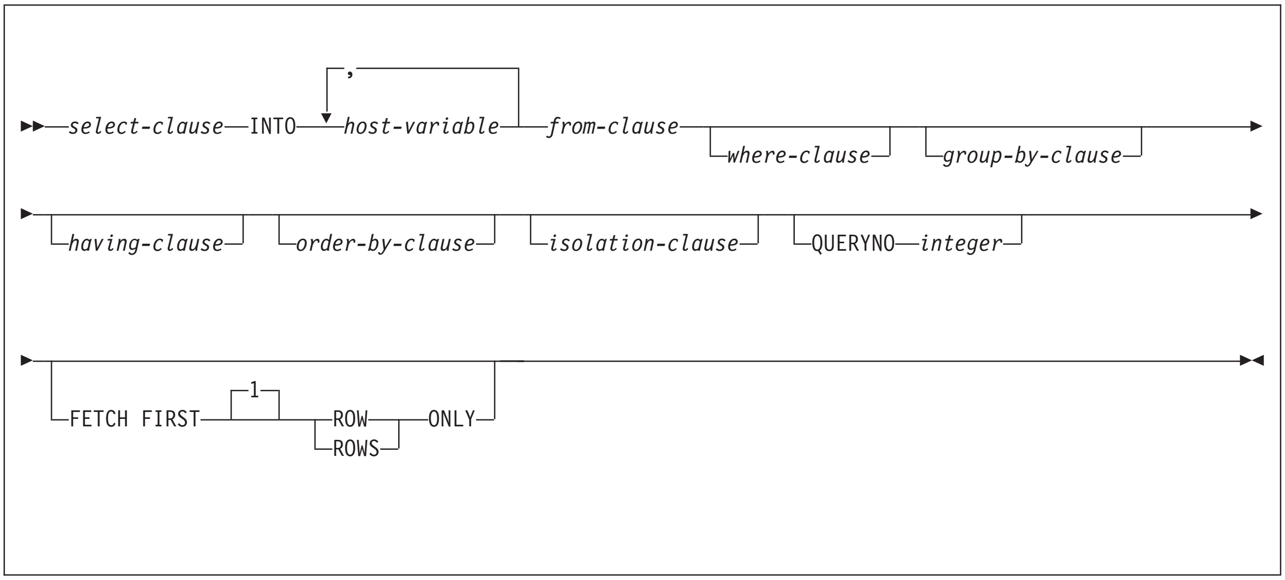
Authorization

The privileges that are held by the authorization ID of the owner of the plan or package must include at least one of the following for every table and view identified in the statement:

- The SELECT privilege on the table or view
- Ownership of the table or view
- DBADM authority for the database (tables only)
- SYSADM authority
- SYSCTRL authority (catalog tables only)

If the SELECT INTO statement includes an INSERT statement, the privilege set must also include at least the INSERT privilege on the table or view.

Syntax



Description

The table is derived by evaluating the *isolation-clause*, *from-clause*, *where-clause*, *group-by-clause*, *having-clause*, *order-by-clause*, and the *select-clause*, in this order. See Chapter 4, “Queries,” on page 393 for a description of these clauses.

INTO *host-variable,...*
Each *host-variable* must identify a structure or variable that is described in the

program in accordance with the rules for declaring host structures and variables. In the operational form of the INTO clause, a reference to a structure is replaced by a reference to each of its host variables.

The first value in the result row is assigned to the first variable in the list, the second value to the second variable, and so on. If the number of host variables is less than the number of column values, the value W is assigned to the SQLWARN3 field of the SQLCA. (See Appendix D, "SQL communication area (SQLCA)," on page 1165.)

The data type of a variable must be compatible with the value assigned to it. If the value is numeric, the variable must have the capacity to represent the integral part of the value. For a date or time value, the variable must be a character string variable of a minimum length as defined in Chapter 2, "Language elements," on page 33. If the value is null, an indicator variable must be specified.

Each assignment to a variable is made according to the rules described in Chapter 2, "Language elements," on page 33. Assignments are made in sequence through the list.

If an error occurs as the result of an arithmetic expression in the SELECT list of a SELECT INTO statement (division by zero or overflow) or a numeric conversion error occurs, the result is the null value. As in any other case of a null value, an indicator variable must be provided and the main variable is unchanged. In this case, however, the indicator variable is set to -2. Processing of the statement continues as if the error had not occurred. (However, this error causes a positive SQLCODE.) If you do not provide an indicator variable, a negative value is returned in the SQLCODE field of the SQLCA. Processing of the statement terminates when the error is encountered.

If an error occurs, no value is assigned to the host variable or to later variables, though any values that have already been assigned to variables remain assigned.

If an error occurs because the result table has more than one row, values may or may not be assigned to the host variables. If values are assigned to the host variables, the row that is the source of the values is undefined and not predictable.

isolation-clause
Specifies the isolation level at which the statement is executed and, optionally, the type of locks that are acquired.

QUERYNO *integer*
Specifies the number to be used for this SQL statement in EXPLAIN output and trace records. The number is used for the QUERYNO columns of the plan tables for the rows that contain information about this SQL statement. This number is also used in the QUERYNO column of the SYSIBM.SYSSTMT and SYSIBM.SYSPACKSTMT catalog tables.

If the clause is omitted, the number associated with the SQL statement is the statement number assigned during precompilation. Thus, if the application program is changed and then precompiled, that statement number might change.

Using the QUERYNO clause to assign unique numbers to the SQL statements in a program is helpful:

- For simplifying the use of optimization hints for access path selection
- For correlating SQL statement text with EXPLAIN output in the plan table

For information on using optimization hints, such as enabling the system for optimization hints and setting valid hint values, and for information on accessing the plan table, see Part 5 (Volume 2) of *DB2 Administration Guide*.

FETCH FIRST ROW ONLY *integer*

The FETCH FIRST ROW ONLY clause can be used in the SELECT INTO statement when the query can result in more than a single row. The clause indicates that only one row should be retrieved regardless of how many rows might be in the result table. When a number is explicitly specified, it must be 1.

Using the FETCH FIRST ROW ONLY clause to explicitly limit the result table to a single row provides a way for the SELECT INTO statement to be used with a query that returns more than a single row. Using the clause helps you to avoid using a cursor when you know that you want to retrieve only one row. To influence which row is returned, you can use the *order-by-clause*. When you specify *order-by-clause*, the rows of the result are ordered and then the first row is returned. If the FETCH FIRST ROW ONLY clause is not specified and the result table contains more than a single row, an error occurs.

Notes

Number of rows inserted: If the SELECT INTO statement of the cursor contains an INSERT statement, the SELECT INTO operation sets SQLERRD(3) to the number of rows inserted.

Using locators: Normally, you use LOB locators to assign and retrieve data from LOB columns. However, because of compatibility rules, you can also use LOB locators to assign data to host variables with CHAR, VARCHAR, GRAPHIC, or VARGRAPHIC data types. For more information on using locators, see Part 2 of *DB2 Application Programming and SQL Guide*.

Examples

Example 1: Put the maximum salary in DSN8810.EMP into the host variable MAXSALRY.

```
EXEC SQL SELECT MAX(SALARY)
  INTO :MAXSALRY
  FROM DSN8810.EMP;
```

Example 2: Put the row for employee 528671, from DSN8810.EMP, into the host structure EMPREC.

```
EXEC SQL SELECT * INTO :EMPREC
  FROM DSN8810.EMP
  WHERE EMPNO = '528671'
END-EXEC.
```

Example 3: Put the row for employee 528671, from DSN8810.EMP, into the host structure EMPREC. Assume that the row will be updated later and should be locked when the query executes.

```
EXEC SQL SELECT * INTO :EMPREC
  FROM DSN8810.EMP
  WHERE EMPNO = '528671'
  WITH RS USE AND KEEP EXCLUSIVE LOCKS
END-EXEC.
```

SET CONNECTION

The SET CONNECTION statement establishes the database server of the process by identifying one of its existing connections.

Invocation

This statement can only be embedded in an application program. It is an executable statement that cannot be dynamically prepared. It must not be specified in Java or REXX.

Authorization

None required.

Syntax

```
►►──SET CONNECTION──┬─location-name─┬──────────────────────────────────────────────►◄
                    └─host-variable─┘
```

Description

location-name or *host-variable*

Identifies the SQL connection by the specified location name or the location name contained in the host variable. If a host variable is specified:

- It must be a character string variable with a length attribute that is not greater than 16. (A C NUL-terminated character string can be up to 17 bytes.)
- It must not be followed by an indicator variable.
- The location name must be left-justified within the host variable and must conform to the rules for forming an ordinary location identifier.
- If the length of the location name is less than the length of the host variable, it must be padded on the right with blanks.

Let S denote the specified location name or the location name contained in the host variable. S must identify an existing SQL connection of the application process. If S identifies the current SQL connection, the state of S and all other connections of the application process are unchanged. The following rules apply when S identifies a dormant SQL connection.

If the SET CONNECTION statement is successful:

- SQL connection S is placed in the current state.
- S is placed in the CURRENT SERVER special register.
- Information about server S is placed in the SQLERRP field of the SQLCA. If the server is an IBM product, the information has the form *pppvvrrm*, where:
  - *ppp* is:

    ARI for DB2 Server for VSE & VM
    DSN for DB2 UDB for z/OS
    QSQ for DB2 UDB for iSeries
    SQL for all other DB2 UDB products
  - *vv* is a two-digit version identifier such as '08'.
  - *rr* is a two-digit release identifier such as '01'.

  - *m* is a one-digit maintenance level such as '5' (Values 0, 1, 2, 3, and 4 are for maintenance levels in compatibility and enabling-new-function mode. Values 5, 6, 7, 8, and 9 are for maintenance levels in new-function mode.)

  For example, if the server is Version 8 of DB2 UDB for z/OS in new-function mode with the latest maintenance, the value of SQLERRP is 'DSN08015'.
- Any previously current SQL connection is placed in the dormant state.

If the SET CONNECTION statement is unsuccessful, the connection state of the application process and the states of its SQL connections are unchanged.

Notes

The use of CONNECT (Type 1) statements does not prevent the use of SET CONNECTION, but the statement either fails or does nothing because dormant SQL connections do not exist. The SQLRULES(DB2) bind option does not prevent the use of SET CONNECTION, but the statement is unnecessary because CONNECT (Type 2) statements can be used instead. Use the SET CONNECTION statement to conform to the SQL standard.

When an SQL connection is used, made dormant, and then restored to the current state in the same unit of work, the status of locks, cursors, and prepared statements for that SQL connection reflects its last use by the application process.

If the SET CONNECTION statement contains host variables, the contents of the host variables are assumed to be in the encoding scheme that was specified in the ENCODING parameter when the package or plan that contains the statement was bound.

Example

Execute SQL statements at TOROLAB1, execute SQL statements at TOROLAB2, and then execute more SQL statements at TOROLAB1.

```
EXEC SQL CONNECT TO TOROLAB1;

  (execute statements referencing objects at TOROLAB1)

EXEC SQL CONNECT TO TOROLAB2;

  (execute statements referencing objects at TOROLAB2)

EXEC SQL SET CONNECTION TOROLAB1;

  (execute statements referencing objects at TOROLAB1)
```

The first CONNECT statement creates the TOROLAB1 connection, the second CONNECT statement places it in the dormant state, and the SET CONNECTION statement returns it to the current state.

SET CURRENT APPLICATION ENCODING SCHEME

The SET CURRENT APPLICATION ENCODING SCHEME statement assigns a value to the CURRENT APPLICATION ENCODING SCHEME special register. This special register allows users to control which encoding scheme will be used for dynamic SQL statements after the SET statement has been executed.

Invocation

This statement can be embedded only in an application program. It is an executable statement that cannot be dynamically prepared.

Authorization

None required.

Syntax

```
                   ┌─APPLICATION─┐                    ┌─=─┐
►►──SET CURRENT────┴─────────────┴───ENCODING SCHEME──┴───┴───────────────►

►──┬─string-constant─┬──────────────────────────────────────────────────►◄
   └─host-variable───┘
```

Description

string-constant
: A character string constant that represents a valid encoding scheme (ASCII, EBCDIC, UNICODE, or a character representation of a number between 1 and 65533).

host variable
: A variable with a data type of CHAR or VARCHAR. The value of *host-variable* must not be null and must represent a valid encoding scheme or a character representation of a number between 1 and 65533). An associated indicator variable must not be provided.

  The value must:
  - Be left justified within the host variable
  - Be padded on the right with blanks if its length is less than that of the host variable

Examples

The following examples set the CURRENT APPLICATION ENCODING SCHEME special register to 'EBCDIC' (in the second example, Host variable HV1 = 'EBCDIC').

```
EXEC SQL SET CURRENT APPLICATION ENCODING SCHEME = 'EBCDIC';
EXEC SQL SET CURRENT ENCODING SCHEME  = :HV1;
```

SET CURRENT DEGREE

The SET CURRENT DEGREE statement assigns a value to the CURRENT DEGREE special register.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

None required.

Syntax

```
►►──SET CURRENT DEGREE──=──┬─string-constant─┬────────────────────────────────────────►◄
                           └─host-variable───┘
```

Description

The value of CURRENT DEGREE is replaced by the value of the string constant or host variable. The value must be a character string that is not longer than 3 bytes and the value must be 'ANY', '1', or '1 '.

Notes

If the value of CURRENT DEGREE is '1' when a query is dynamically prepared, the execution of that query will not use parallel operations. If the value of CURRENT DEGREE is 'ANY' when a query is dynamically prepared, the execution of that query can involve parallel operations.

The initial value of CURRENT DEGREE is determined by the value of field CURRENT DEGREE on installation panel DSNTIP4. The default for the initial value is 1 unless your installation has changed it to be ANY by modifying the value in that field.

For distributed applications, the default value at the server is used unless the requesting application issues the SQL statement SET CURRENT DEGREE. For requests using DRDA, the SET CURRENT DEGREE statement must be within the scope of the CONNECT statement.

The value specified in the SET CURRENT DEGREE statement remains in effect until it is changed by the execution of another SET CURRENT DEGREE statement or until deallocation of the application process. For applications that connect to DB2 using the call attachment facility, the value of register CURRENT DEGREE can be requested to remain in effect for a longer duration. For more information, see the description of the call attachment facility CONNECT statement in Part 6 of *DB2 Application Programming and SQL Guide*.

Examples

Example 1: The following statement inhibits parallel operations:

```
SET CURRENT DEGREE = '1';
```

Example 2: The following statement allows parallel operations:

```
SET CURRENT DEGREE = 'ANY';
```

SET CURRENT LOCALE LC_CTYPE

The SET CURRENT LOCALE LC_CTYPE statement assigns a value to the CURRENT LOCALE LC_CTYPE special register. The special register allows control over the LC_CTYPE locale for statements that use a built-in function that refers to a locale, such as LCASE, UCASE, and TRANSLATE (with a single argument).

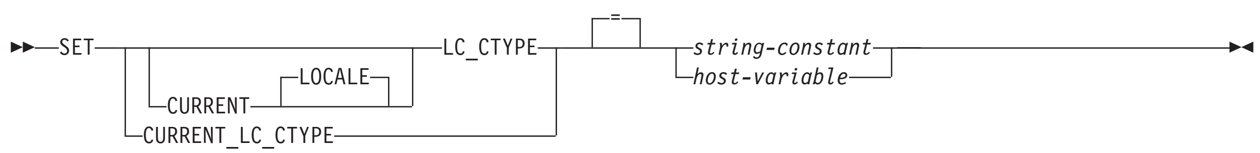
Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

None required.

Syntax



Description

The value of CURRENT LOCALE LC_CTYPE is replaced by the string constant or host variable specified. The value must be a CHAR or VARCHAR character string that is no longer than 50 bytes.

The value of CURRENT LOCALE LC_CTYPE is replaced by the value specified. The value must not be longer than 50 bytes and must be a valid locale.

string-constant
: A character string constant that must not be longer than 50 bytes and must represent a valid locale.

host-variable
: A variable with a data type of CHAR or VARCHAR and a length that is not longer than 50 bytes. The value of *host-variable* must not be null and must represent a valid locale. If the host variable has an associated indicator variable, the value of the indicator variable must not indicate a null value.

  The locale must:
  - Be left justified within the host variable
  - Be padded on the right with blanks if its length is less than that of the host variable

A locale can be specified in uppercase characters, lowercase characters, or a combination of the two. For information on locales and their naming conventions, see *z/OS C/C++ Programming Guide*. Some examples of locales include:

Fr_BE
Fr_FR@EURO
En_US
Ja_JP

Examples

Example 1: Set the CURRENT LOCALE LC_CTYPE special register to the locale ’En_US’.

```
   EXEC SQL SET CURRENT LOCALE LC_CTYPE = 'En_US';
```

Example 2: Set the CURRENT LOCALE LC_CTYPE special register to the value of host variable HV1, which contains ’Fr_FR@EURO’.

```
   EXEC SQL SET CURRENT LOCALE LC_CTYPE = :HV1;
```

SET CURRENT MAINTAINED TABLE TYPES FOR OPTIMIZATION

The SET CURRENT MAINTAINED TABLE TYPES FOR OPTIMIZATION statement changes the value of the CURRENT MAINTAINED TABLE TYPES FOR OPTIMIZATION special register.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

None required.

Syntax

```
                              ┌─TABLE─┐         ┌─FOR OPTIMIZATION─┐  ┌─=─┐
►►──SET CURRENT MAINTAINED──┴───────┴──TYPES──┴──────────────────┴──┴───┴──┬─ALL───────────┬──────►◄
                                                                          ├─NONE──────────┤
                                                                          ├─SYSTEM────────┤
                                                                          ├─USER──────────┤
                                                                          └─host-variable─┘
```

Description

The value indicates which materialized query tables that are enabled for optimization are considered when optimizing the processing of dynamic SQL queries.

ALL
Indicates that all materialized query tables will be considered.

NONE
Indicates that no materialized query tables will be considered.

SYSTEM
Indicates that only system-maintained materialized query tables that are refresh deferred will be considered.

USER
Indicates that only user-maintained materialized query tables that are refresh deferred will be considered.

host-variable
A variable of type CHAR or VARCHAR. The length of the contents of *host-variable* must not exceed 255 bytes. It cannot be set to null. If *host-variable* has an associated indicator variable, the value of that indicator variable must not indicate a null value.

The characters of *host-variable* must be left justified. The content of the host variable must be a string that would match what can be specified as keywords for the special register in the exact case intended as there is no conversion to uppercase characters.

Notes

The initial value of the CURRENT MAINTAINED TABLE TYPES FOR OPTIMIZATION special register is determined by the value on the CURRENT MAINT TYPES field on installation panel DSNTIP8. The default value of the field is SYSTEM.

The CURRENT REFRESH AGE special register needs to be set to a value other than zero in order for the specified types of objects to be considered for optimizing the processing of dynamic SQL queries.

The CURRENT MAINTAINED TABLE TYPES FOR OPTIMIZATION special register affects dynamic statement cache matching.

Examples

Example 1: The following statement sets the CURRENT MAINTAINED TABLE TYPES FOR OPTIMIZATION special register:

```
SET CURRENT MAINTAINED TABLE TYPES ALL;
```

Example 2: The following example retrieves the current value of the CURRENT MAINTAINED TABLE TYPES FOR OPTIMIZATION special register into the host variable called CURMAINTYPES.

```
EXEC SQL VALUES (CURRENT MAINTAINED TABLE TYPES) INTO :CURMAINTYPES;
```

The value would be ALL if set by the previous example.

Example 3: The following example resets the CURRENT MAINTAINED TABLE TYPES FOR OPTIMIZATION special register so that no materialized query tables can be considered to optimize the processing of dynamic SQL queries.

```
SET CURRENT MAINTAINED TABLE TYPES NONE;
```

SET CURRENT OPTIMIZATION HINT

The SET CURRENT OPTIMIZATION HINT statement assigns a value to the CURRENT OPTIMIZATION HINT special register.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

None required.

Syntax

```
►►──SET CURRENT OPTIMIZATION HINT──=──┬─string-constant─┬──────────────────────────────────────►◄
                                      └─host-variable───┘
```

Description

The value of special register CURRENT OPTIMIZATION HINT is replaced by the value of the string constant or host variable. The value must be a character string that is not longer than 128 bytes.

Notes

The initial value of the CURRENT OPTIMIZATION HINT special register is set to the value that was used for the OPTHINT bind option. The OPTHINT bind option specifies whether optimization hints are used in determining the access path of static statements and identifies which user-defined hint (rows in the authid.PLAN_TABLE) is used. Therefore, if the SET CURRENT OPTIMIZATION HINT statement is not executed to change the value of the special register, DB2 uses the same optimization hint for dynamic statements that it uses for static statements. The default of OPTHINT for BIND PLAN and BIND PACKAGE is all blanks. An empty string or all blanks indicate that DB2 uses normal optimization techniques and ignores optimization hints. DB2 does not use optimization hints for dynamic SQL if dynamic statement caching is enabled.

Example

Example 1: Assume that string constant 'NOHYB' identifies a user-defined optimization hint in authid.PLAN_TABLE. Set the CURRENT OPTIMIZATION HINT special register so that DB2 uses this optimization hint to generate the access path for dynamic statements.

```
SET CURRENT OPTIMIZATION HINT = 'NOHYB';
```

If you set the register this way, DB2 validates and considers information in the rows in authid.PLAN_TABLE where the value in the OPTHINT column matches ’NOHYB’ for dynamic SQL statements.

Example 2: Clear the CURRENT OPTIMIZATION HINT special register by specifying an empty string.

```
SET CURRENT OPTIMIZATION HINT = '';
```

SET CURRENT PACKAGE PATH

The SET CURRENT PACKAGE PATH assigns a value to the CURRENT PACKAGE PATH special register.

Invocation

This statement can be embedded only in an application program. It is an executable statement that cannot be dynamically prepared.

Authorization

None required.

Syntax

```
                                       ┌─,──────────────────────────┐
                              ┌─=─┐    ▼                            │
►►──SET CURRENT PACKAGE PATH──┴───┴────┬─collection-id───────────┬──┴──────────────────────────►◄
                                       │     (1)                 │
                                       ├─USER────────────────────┤
                                       │                      (1)│
                                       ├─CURRENT PACKAGE PATH────┤
                                       │              (1)        │
                                       ├─CURRENT PATH────────────┤
                                       ├─host-variable───────────┤
                                       └─string-constant─────────┘
```

Notes:

1 USER, CURRENT PACKAGE PATH, and CURRENT PATH can be specified only once on the right side of the statement.

Description

The value of CURRENT PACKAGE PATH is replaced by the values specified.

collection-id
Identifies a collection. *collection-id* must not be a delimited identifier that is empty or contains only blanks.

USER
Specifies the value of the USER special register.

CURRENT PACKAGE PATH
Specifies the value of the CURRENT PACKAGE PATH special register before the execution of the SET CURRENT PACKAGE PATH.

CURRENT PATH
Specifies the value of the CURRENT PATH special register.

host-variable
Specifies a host variable that contains one or more collection IDs, separated by commas. The host variable must:

- Have a data type of CHAR or VARCHAR. The actual length of the contents of the host variable must not exceed the maximum length of the CURRENT PACKAGE PATH special register.

- Not be the null value if an indicator variable is provided.
- Contain an empty or blank string, or one or more collection IDs that are separated by commas.
- Be padded on the right with blanks if the host variable is fixed-length, or if the actual length of the host variable is longer than the content.
- Not contain a delimited identifier that is empty or contains only blanks.

string-constant

Specifies a string constant that contains one or more collection IDs, separated by commas. The string constant must:

- Have a length that does not exceed the maximum length of the CURRENT PACKAGE PATH special register.
- Contain an empty or blank string, or one or more collection IDs separated by commas.
- Not contain a delimited identifier that is empty or contains only blanks.

Notes

Contents of host variable or string constant: The contents of a host variable or string constant are interpreted as a list of collection IDs if the value contains at least one comma. If multiple collection IDs are specified, they must be separated by commas. Each collection ID in the list must conform to the rules for forming an ordinary identifier or be specified as a delimited identifier.

Checking for the existence of collections: No validation that the collections exist is made at the time that the CURRENT PACKAGE PATH special register is set. For example, a collection ID that is misspelled is not detected, which could affect the way subsequent SQL operates. At package execution time, authorization to the specific package is checked, and if this authorization check fails, an error is issued.

Resulting contents of the special register: The special register string is built by taking each collection ID specified and removing trailing blanks, delimiting with double quotation marks, doubling any double quotation marks within the collection ID as necessary, and then separating each collection ID by a comma. If the same collection ID appears more than once in the list, the first occurrence of the collection is used. The length of the resulting list cannot exceed the length of the special register. For example, assume that the following statements are issued:

```
SET CURRENT PACKAGE PATH = MYPKGS, "ABC E", SYSIBM
SET :HVPKLIST = CURRENT PACKAGE PATH
```

These statements result in the value of the host variable being set to: ″MYPKGS″, ″ABC E″, ″SYSIBM″.

A collection ID that does not conform to the rules for an ordinary identifier must be specified as a delimited collection ID and must not be specified within a host variable or string constant.

Considerations for keywords: A difference exists between specifying a single keyword, such as USER, as a single keyword or as a delimited identifier. To indicate that the current value of a special register that is specified as a single keyword should be used in the package path, specify the name of the special register as a keyword. If you specify the name of the special register as a delimited identifier, it is interpreted as a collection ID of that value. For example, assume that the current value of the USER special register is SMITH and that the following statement is issued:

```
SET CURRENT PACKAGE PATH = SYSIBM, USER, "USER"
```

The result is that the value of the CURRENT PACKAGE PATH special register is set to: ″SYSIBM, ″SMITH″, ″USER″.

Specifying a collection ID in an SQL procedure: Because a host variable (SQL variable) in an SQL procedure does not begin with a colon, DB2 uses the following rules to determine whether a value that is specified in a SET PACKAGE PATH = *name* statement is a variable or a collection ID:

- If *name* is the same as a parameter or SQL variable in the SQL procedure, DB2 uses *name* as a parameter or SQL variable and assigns the value in *name* to the package path.
- If *name* is not the same as a parameter or SQL variable in the SQL procedure, DB2 uses *name* as a collection ID and assigns and the value in *name* is the package path.

DRDA classification: The SET CURRENT PACKAGE PATH statement is executed by the database server and, therefore, is classified as a non-local SET statement in DRDA. The SET CURRENT PACKAGE PATH statement requires a new level of DRDA support. If SET CURRENT PACKAGE PATH is issued when connected to the local server, the SET CURRENT PACKAGE PATH special register at the local server is set. Otherwise, when SET CURRENT PACKAGE PATH is issued when connected to a remote server, the SET CURRENT PACKAGE PATH special register at the remote server is set.

Examples

Example 1: Set the CURRENT PACKAGE PATH special register to the list of collections COLL4 and COLL5, where :hvar1 contains the value COLL4,COLL5:

```
   SET CURRENT PACKAGE PATH :hvar1;
```

The value of CURRENT PACKAGE PATH is set to the following two collection IDs: ″COLL4″,″COLL5″.

Example 2: Set the CURRENT PACKAGE PATH special register to the list of collections: COLL1, COLL#2, COLL3, COLL4, and COLL5, where :hvar1 contains the value COLL4,COLL5:

```
  SET CURRENT PACKAGE PATH = "COLL1","COLL#2","COLL3", :hvar1;
```

The value of CURRENT PACKAGE PATH is set to the following five collection IDs: ″COLL1,″COLL#2″,″COLL3″,″COLL4″,″COLL5″.

Example 3: Clear the CURRENT PACKAGE PATH special register.

```
  SET CURRENT PACKAGE PATH = ' ';
```

Example 4: In preparation of calling a stored procedure that is named SUMARIZE, temporarily add two collections, COLL_PROD1″ and ″COLL_PROD2, to the end of the CURRENT PACKAGE PATH special register (the values of the collections are in host variables :prodcoll1 and prodcoll2, respectively). Because the stored procedure SUMARIZE is not defined with a COLLID value and is defined with INHERIT SPECIAL REGISTERS, the stored procedure will inherit the value of CURRENT PACKAGE PATH. When the stored procedure returns, set the value of the CURRENT PACKAGE PATH special register back to its original value.

```
SET :oldCPP = CURRENT PACKAGE PATH;
SET CURRENT PACKAGE PATH = CURRENT PACKAGE PATH, :prodcoll1, :prodcoll2;
CALL SUMARIZE(:V1,:V2);
SET CURRENT PACKAGE PATH = :oldCPP;
```

SET CURRENT PACKAGESET

The SET CURRENT PACKAGESET statement assigns a value to the CURRENT PACKAGESET special register.

Invocation

This statement can only be embedded in an application program. It is an executable statement that cannot be dynamically prepared.

Authorization

None required.

Syntax

```
►►──SET CURRENT PACKAGESET──=──┬─USER────────────┬──────────────────────────────────────────►◄
                               ├─string-constant─┤
                               └─host-variable───┘
```

Description

The value of CURRENT PACKAGESET is replaced by the value of the USER special register, *string-constant*, or *host-variable*. The value specified by *string-constant* or *host-variable* must be a character string that is not longer than 128 bytes.

Notes

Selection of plan elements: A *plan element* is a DBRM that has been bound into the plan or a package that is implicitly or explicitly identified in the package list of the plan. Plan elements contain the control structures used to execute certain SQL statements.

Since a plan can have many elements, one of the first steps involved in the execution of an SQL statement that requires a control structure is the selection of the plan element that contains its control structure. The information used by DB2 to select plan elements includes the value of CURRENT PACKAGESET.

SET CURRENT PACKAGESET is used to specify the collection ID of a package that exists at the current server. SET CURRENT PACKAGESET is optional and should not be used without an understanding of the following rules for selecting a plan element.

If the CURRENT PACKAGESET special register is an empty string, DB2 searches for a DBRM or a package in one of these sequences:

At the local location (if CURRENT SERVER is blank or explicitly names that location), the order is:

1. All DBRMs bound directly to the plan
2. All packages that have already been allocated for the application process
3. All unallocated packages explicitly named in, and all collections completely included in, the package list of the plan. The order of search is the order those packages are named in the package list.

At a remote location, the order is:

1. All packages that have already been allocated for the application process at that location
2. All unallocated packages explicitly named in, and all collections completely included in, the package list of the plan, whose locations match the value of CURRENT SERVER. The order of search is the order those packages are named in the package list.

If the special register CURRENT PACKAGESET is set, DB2 skips the check for programs that are part of the plan and uses the value of CURRENT PACKAGESET as the collection. For example, if CURRENT PACKAGESET contains COL5, then DB2 uses COL5.PROG1.*timestamp* for the search. For additional information, see Part 4 of *DB2 Application Programming and SQL Guide*.

DRDA classification: SET CURRENT PACKAGESET is executed by the requester and is therefore classified as a local SET statement in DRDA.

CURRENT PACKAGESET special register with stored procedures and user-defined functions: The initial value of the CURRENT PACKAGESET special register in a stored procedure or user-defined function is the value of the COLLID parameter with which the stored procedure or user-defined function was defined. If the routine was defined without a value for the COLLID parameter, the value of the special register is inherited from the calling program. A stored procedure or user-defined function can use the SET CURRENT PACKAGESET statement to change the value of the special register. This allows the routine to select the version of the DB2 package that is used to process the SQL statements in a called routine that is not defined with a COLLID value.

When control returns from the stored procedure to the calling program, the special register CURRENT PACKAGESET is restored to the value it contained before the stored procedure was called.

Examples

Example 1: Limit the plan element selection to packages in the PERSONNEL collection at the current server.

```
EXEC SQL SET CURRENT PACKAGESET = 'PERSONNEL';
```

Example 2: Eliminate collections as a factor in plan element selection.

```
EXEC SQL SET CURRENT PACKAGESET = '';
```

SET CURRENT PRECISION

The SET SCHEMA statement assigns a value to the CURRENT SCHEMA special register. If the package is bound with the DYNAMICRULES BIND option, this statement does not affect the qualifier used for unqualified database object references. [40]

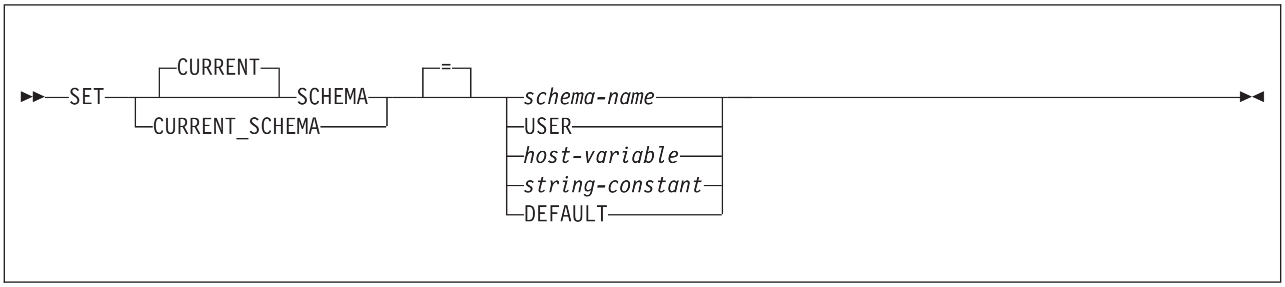
Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

None required.

Syntax



Description

This statement replaces the value of the CURRENT PRECISION special register with the value of the string constant or host variable. The value must be a character string 5 bytes in length. The value must be 'DEC15,' 'DEC31,' or 'Dpp.s', where 'pp' is either 15 or 31 and 's' is a number between 1 and 9. If the form 'Dpp.s'is used, 'pp' represents the precision that will be used with the rules that are used for DEC15 or DEC31, and 's' represents the minimum divide scale to use for division operations. The separator used in the form 'Dpp.s' may be either the '.'or the ',' character, regardless of the setting of the default decimal point. An error occurs if any other values are specified.

Example

Set the CURRENT PRECISION special register so that subsequent statements that are prepared use DEC15 rules for decimal arithmetic.

```
EXEC SQL SET CURRENT PRECISION = 'DEC15';
```

[40] **Affect of DYNAMICRULES bind option**:
RUN
BIND
DEFINEBIND
DEFINERUN
INVOKEBIND
INVOKERUN

SET CURRENT REFRESH AGE

The SET CURRENT REFRESH AGE statement changes the value of the CURRENT REFRESH AGE special register.

The CURRENT REFRESH AGE value corresponding to ANY (99 999 999 999 999) cannot be used in timestamp arithmetic operations because the result would be outside the valid range of dates.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

None required.

Syntax

```
                                  ┌─=─┐
►►──SET CURRENT REFRESH AGE───────┴───┴───┬─numeric-constant─┬──────────────────────────────────────►◄
                                          ├─ANY──────────────┤
                                          └─host-variable────┘
```

Description

numeric-constant
A DECIMAL(20,6) value representing a timestamp duration. The value must be 0 or 99 999 999 999 999, the microseconds of which is ignored and thus can be any value.

0 Indicates that query optimization using materialized query tables will not be attempted.

99999999999999
Indicates that any materialized query tables identified by the CURRENT MAINTAINED TABLE TYPES FOR OPTIMIZATION special register may be used to optimize the processing of a query. This value represents 9999 years, 99 months, 99 days, 99 hours, 99 minutes, and 99 seconds.

ANY
Shorthand for 99999999999999.

host-variable
A variable of type DECIMAL(20,6) or other type that is assignable to DECIMAL(20,6). It cannot be set to null. If *host-variable* has an associated indicator variable, the value of that indicator variable must not indicate a null value. The value of *host-variable* must be 0 or 99 999 999 999 999, the microseconds of which is ignored and thus can be any value.

Notes

Materialized query tables created or altered with DISABLE QUERY OPTIMIZATION specified are not eligible for automatic query rewrite. Thus, they are not affected by the setting of this special register.

Setting the CURRENT REFRESH AGE special register to a value other than zero should be done with caution. Allowing a materialized query table that may not represent the values of the underlying base table to be used to optimize the processing of a query may produce results that do not accurately represent the data in the underlying table. This situation may be acceptable when you know the underlying data has not changed or you are willing to accept the degree of error in the results based on your knowledge of the data.

Examples

Example: Set the CURRENT REFRESH AGE special register to 99 999 999 999 999 to indicate that any materialized query tables identified by the CURRENT MAINTAINED TABLE TYPES FOR OPTIMIZATION special register may be used to optimize the processing of a query.

```
SET CURRENT REFRESH AGE ANY;
```

SET CURRENT RULES

The SET CURRENT RULES statement assigns a value to the CURRENT RULES special register.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

None required.

Syntax

```
►►──SET CURRENT RULES──=──┬─string-constant─┬─────────────────────────────────────────────►◄
                          └─host-variable───┘
```

Description

This statement replaces the value of the CURRENT RULES special register with the value of the string constant or host variable. The value must be a character string that is 3 bytes in length, and the value must be 'DB2' or 'STD'. An error occurs if any other values are specified.

Notes

For the effect of the values 'DB2' and 'STD' on the execution of certain SQL statements, see “CURRENT RULES” on page 107.

Example

Set the SQL rules to be followed to DB2.

```
EXEC SQL SET CURRENT RULES = 'DB2';
```

SET CURRENT SQLID

The SET CURRENT SQLID statement assigns a value to the CURRENT SQLID special register.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared. The value to which special register CURRENT SQLID is set is used as the SQL authorization ID and the implicit qualifier for dynamic SQL statements only if DYNAMICRULES run behavior is in effect. The CURRENT SQLID value is ignored for the other DYNAMICRULES behaviors.

Authorization

If any of the authorization IDs of the process has SYSADM authority, CURRENT SQLID can be set to any value. Otherwise, the specified value must be equal to one of the authorization IDs of the application process. This rule always applies, even when SET CURRENT SQLID is a static statement.

Syntax

```
►►──SET CURRENT SQLID──=──┬─USER────────────┬──────────────────────────────────────►◄
                          ├─string-constant─┤
                          └─host-variable───┘
```

Description

The value of CURRENT SQLID is replaced by the value of USER, *string-constant*, or *host-variable*. The value specified by a *string-constant* or *host-variable* must be a character string that is not longer than 8 bytes. Unless some authorization ID of the process has SYSADM authority, the value must be equal to one of the authorization IDs of the process.

Notes

Effect on authorization IDs: SET CURRENT SQLID does not change the primary authorization ID of the process.

If the SET CURRENT SQLID statement is executed in a stored procedure or user-defined function package that has a dynamic SQL behavior other than run behavior, the SET CURRENT SQLID statement does not affect the authorization ID that is used for dynamic SQL statements in the package. The dynamic SQL behavior determines the authorization ID. For more information, see the discussion of DYNAMICRULES in Chapter 2 of *DB2 Command Reference*.

Effect on special register CURRENT PATH: When the value of the PATH special register depends on the value of the CURRENT SQLID special register, any changes to the CURRENT SQLID special register are not reflected in the value of the PATH special register until a commit operation is performed or a SET PATH statement is issued to change the SQL path to use the new value of the CURRENT SQLID.

DRDA classification: SET CURRENT SQLID is executed by the database server and is therefore classified as a non-local SET statement in DRDA.

Examples

Example 1: Set the CURRENT SQLID to the primary authorization ID.

```
SET CURRENT SQLID = USER;
```

Example 2: Assume that the value of CURRENT SQLID is ’Jane’ and that the default value of the PATH special register was established using that value (that is, the value of PATH is ″SYSIBM″, ″SYSFUN″, ″SYSPROC″, ″Jane″). Change the value of the CURRENT SQLID special register to ’John’.

```
SET CURRENT SQLID = 'JOHN';
```

To change the SQL path to use the updated CURRENT SQLID value of ’John’, issue a SET PATH statement to change the value of the PATH special register. Alternatively, a commit would cause PATH to be re-initialized. Otherwise, the path remains ″SYSIBM″, ″SYSFUN″, ″SYSPROC″, ″Jane″), which may cause unqualified object names to resolve to ’Jane’ when you want them to resolve to ″John″.

SET ENCRYPTION PASSWORD

The SET ENCRYPTION PASSWORD statement sets the value of the encryption password and, optionally, the password hint. The encryption and decryption built-in functions use this password and password hint for data encryption unless the functions are invoked with an explicitly specified password and hint. The password is not tied to DB2 authentication and is used only for data encryption.

This statement is not under transaction control.

Invocation

The statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

No authorization is required to execute this statement.

Syntax

```
                                ┌─=─┐
►►──SET ENCRYPTION PASSWORD─────┴───┴──┬─password-host-variable─┬────────────────────────►
                                       └─password-string-const──┘

►──┬──────────────────────────────────────────────┬─────────────────────────────────────►◄
   │              ┌─=─┐                           │
   └─WITH HINT────┴───┴──┬─hint-host-variable─┬───┘
                         └─hint-string-const──┘
```

Description

password-host-variable
: A variable of type CHAR or VARCHAR. The length of *host-variable* must be between 6 and 127 bytes, or 0 reset to no value. The value cannot be null. Specify all characters in the exact case that is intended because there is no conversion to uppercase characters.

password-string-const
: A character string constant. The length of the constant must be between 6 and 127 bytes, or 0 reset to no value. The value cannot be NULL. Specify all characters in the exact case that is intended because there is no conversion to uppercase characters.

WITH HINT
: Indicates that a password hint is specified. A password hint is a value that helps you remember a data encryption password (for example, 'Ocean' as a hint to remember the password 'Pacific'). If a password hint is specified, the hint is used for the encryption function. You can use the GETHINT function to subsequently retrieve the hint for an encrypted value. If a password hint is not specified, no hint is embedded in data that is encrypted with the encryption function.

password-host-variable
A variable of type CHAR or VARCHAR. The length of *host-variable* can be up to 32 bytes, or 0 reset to no value. If the value is null or an empty string, no hint is embedded into data that is encrypted with the encryption function.

password-string-const
A character string constant. The length of the constant can be up to 32 bytes. If the value is NULL or an empty string, no hint is embedded into data that is encrypted with the encryption function.

Notes

The initial value of the ENCRYPTION PASSWORD is the empty string (’’).

Normal DB2 mechanisms are used to transmit the host variable or constant to the database server.

For more information about using this statement, see “ENCRYPT_TDES” on page 253 and “DECRYPT_BIT, DECRYPT_CHAR, and DECRYPT_DB” on page 246..

Examples

Example 1: Set the ENCRYPTION PASSWORD to the value in :hv1. Do not specify a hint for the password.

```
SET ENCRYPTION PASSWORD = :hv1
```

Example 2: Set the ENCRYPTION PASSWORD to the value in :hv1. Specify the value in :hv2 as the hint for the password.

```
SET ENCRYPTION PASSWORD = :hv1 WITH HINT :hv2
```

SET host-variable assignment

The SET host-variable assignment statement assigns values, either of expressions or NULL values, to host variables.

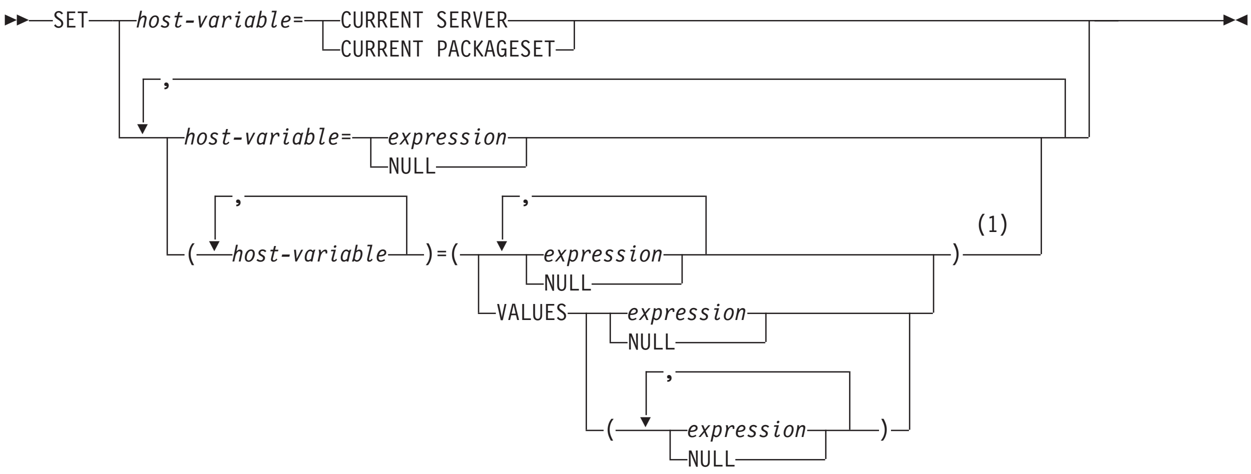
Invocation

This statement can be embedded only in an application program. It is an executable statement that cannot by dynamically prepared.

Authorization

The privileges that are held by the current authorization ID must include those required to execute any of the expressions.

Syntax



Notes:

1 The number of *expression*s and NULL keywords must match the number of *host-variable*s.

Description

host-variable

Identifies one or more host variables or transition variables that are used to receive the corresponding *expression* or NULL value on the right side of the statement.

For the triggered action of a CREATE TRIGGER statement, use the SET *transition-variable* instead.

The value to be assigned to each *host-variable* can be specified immediately following the item reference, for example, *host-variable = expression, host-variable=expression.* Or, sets of parentheses can be used to specify all the *host-variable*s and then all the values, for example, *(host-variable, host-variable) = (expression, expression)*.

host-variable

Identifies one or more host variables that are used to receive the corresponding *expression* or NULL value on the right side of the statement.

Each host variable must be defined in the program as described under the rules for declaring host variables. A parameter marker must not be specified in place of *host-variable*.

The value to be assigned to each *host-variable* can be specified immediately following the host variable, for example, *host-variable = expression, host-variable =expression.* Or, sets of parentheses can be used to specify all the *host-variable*s and then all the values, for example, *(host-variable, host-variable) = (expression, expression)*.

expression

Specifies the value to be assigned to the corresponding *host-variable*. The expression is any expression of the type described in “Expressions” on page 133, except it cannot contain a reference to CURRENT PACKAGE PATH or to *local* special registers (CURRENT SERVER or CURRENT PACKAGESET).

All expressions are evaluated before any result is assigned to a host variable. If an expression refers to a host variable that is used in the host variable list, the value of the variable in the expression is the value of the variable prior to any assignments.

Each assignment to a host variable is made according to the assignment rules described in “Assignment and comparison” on page 74. Assignments are made in sequence through the list. When the *host-variable*s are enclosed within parentheses, for example, *(host-variable, host-variable, ...) = (expression, expression, ...)*, the first value is assigned to the first host variable in the list, the second value to the second host variable in the list, and so on.

NULL

Specifies the null value and can only be specified for host variables that have an associated indicator variable.

VALUES

Specifies the value to be assigned to the corresponding host variable. When more than one value is specified, the values must be enclosed in parentheses. Each value can be an expression or NULL, as described above. The following syntax is equivalent:

- *(host-variable, host-variable) = (VALUES(expression, NULL))*
- *(host-variable, host-variable) = (expression, NULL)*

Local special registers and the CURRENT PACKAGE PATH special register can be referenced only in a VALUES host-variable statement that results in the assignment of a single host variable and not those that result in setting more than one value.

Notes

The default encoding scheme for the data is the value in the bind option ENCODING, which is the option for application encoding.

Normally, you use LOB locators to assign and retrieve data from LOB columns. However, because of compatibility rules, you can also use LOB locators to assign data to host variables with CHAR, VARCHAR, GRAPHIC, or VARGRAPHIC data types. For more information on using locators, see Part 2 of *DB2 Application Programming and SQL Guide*.

Examples

Example 1: Set the host variable HVL to the value of the CURRENT PATH special register.

```
SET :HVL = CURRENT PATH;
```

Example 2: Set the host variable PATH to the contents of the SQL PATH special register, the host variable XTIME to the local time at the current server, and the host variable MEM to the current member of the data sharing environment.

```
SET :SERVER = CURRENT PATH,
    :XTIME = CURRENT TIME,
    :MEM = CURRENT MEMBER;
```

Example 3: Set the host variable DETAILS to a portion of a LOB value, using a LOB expression with a LOB locator to refer the extracted portion of the value.

```
SET :DETAILS = SUBSTR(:LOCATOR,1,35);
```

Example 4: Set host variable HV1 to the results of external function CALC_SALARY and host variable HV2 to the value of special register CURRENT PATH. Use an indicator value with HV1 in case CALC_SALARY returns a null value.

```
SET (:HV1:IND1, :HV2) =
    (CALC_SALARY(:HV3, :HF4), CURRENT PATH);
```

SET PATH

The SET PATH statement assigns a value to the CURRENT PATH special register.

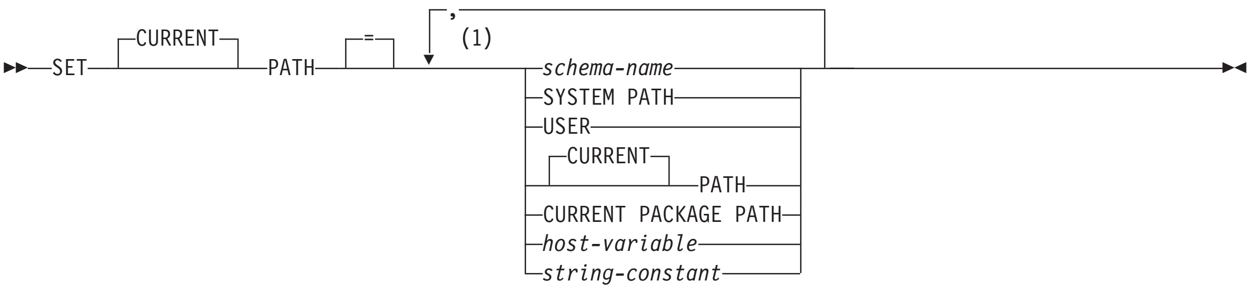
Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

None required.

Syntax



Notes:

1 SYSTEM PATH, USER and CURRENT PATH can be specified only once each.

Description

The value of PATH is replaced by the values specified.

schema-name
Identifies a schema. DB2 does not verify that the schema exists. For example, a schema name that is misspelled is not detected, which could affect the way subsequent SQL operates.

SYSTEM PATH
Specifies the schema names "SYSIBM", "SYSFUN"[41], "SYSPROC".

USER
Specifies the value of the USER special register.

PATH
Specifies the value of the CURRENT PATH special register before the execution of this statement.

CURRENT PACKAGE PATH
Specifies the value of the CURRENT PACKAGE PATH special register.

[41] SYSFUN is a schema used for additional functions shipped on other servers in the DB2 product family. Although DB2 UDB for z/OS does not use the SYSFUN schema, it can be useful to have SYSFUN in the path when doing distributed processing that involves a server that uses the SYSFUN schema.

host-variable

A variable with a data type of CHAR or VARCHAR. The value of *host-variable* must not be null and must represent a valid schema name.

The schema name must:

- Be left justified within the host variable
- Be padded on the right with blanks if its length is less than that of the host variable

string-constant

A character string constant that represents a valid schema name.

If the schema name specified in *string-constant* will also be specified in other SQL statements and the schema name does not conform to the rules for ordinary identifiers, the schema name must be specified as a delimited identifier in the other SQL statements.

Notes

Restrictions on SET PATH: These restrictions apply to the SET PATH statement:

- If the same schema name appears more than once in the path, the first occurrence of the name is used and a warning is issued.
- The length of the CURRENT PATH special register limits the number of schema names that can be specified. DB2 builds the string for the special register by taking each schema name specified and removing any trailing blanks from it, adding two delimiters around it, and adding one comma after each schema name except the last one. The length of the resulting string cannot exceed 2048 bytes.

Specifying SYSIBM and SYSPROC: Schemas SYSIBM and SYSPROC do not need to be specified in the special register. If either of these schemas is not explicitly specified in the CURRENT PATH special register, the schema is implicitly assumed at the front of the SQL path; if both are not specified, they are assumed in the order of SYSIBM, SYSPROC (see “SQL path” on page 46 for an example). Only the schemas that are explicitly specified in the CURRENT PATH register are included in the 254 byte limit.

To avoid having SYSIBM or SYSPROC implicitly added to the front of the SQL path, explicitly specify them in the path when setting the value of the register. If you specify them at the end of the path, DB2 will check all the other schemas in the path first.

Specifying USER versus ″USER″: There is a difference between specifying USER with and without escape characters. To indicate that the value of the USER special register should be used in the SQL path, specify the keyword USER. If you specify USER is as a delimited identifier instead (for example, ″USER″), it is interpreted as a schema name of ’USER’. For example, assume that the current value of the USER special register is SMITH and that the following statement is issued:

```
SET PATH = SYSIBM, SYSPROC, USER, "USER"
```

The result is that the value of the SQL path is set to: SYSIBM, SYSPROC, SMITH, USER.

Specifying a schema name in an SQL procedure: Because a host variable (SQL variable) in an SQL procedure does not begin with a colon, DB2 uses the following rules to determine whether a value that is specified in a SET PATH=*name* statement is a variable or a *schema-name*:

- If *name* is the same as a parameter or SQL variable in the SQL procedure, DB2 uses *name* as a parameter or SQL variable and assigns the value in *name* to PATH.
- If *name* is not the same as a parameter or SQL variable in the SQL procedure, DB2 uses *name* as a *schema-name* and assigns the value *name* to PATH.

The use of the path to resolve object names: For information on when the SQL path is used to resolve unqualified data type, function, and procedure names and when the CURRENT PATH special register provides the SQL path, see “SQL path” on page 46.

DRDA classification: The SET PATH statement is executed by the database server and, therefore, is classified as a non-local SET statement in DRDA.

Alternative syntax and synonyms: For compatibility with previous releases of DB2 or other products in the DB2 UDB family, DB2 supports CURRENT FUNCTION PATH or CURRENT_PATH as a synonym for CURRENT PATH. CURRENT_PATH is consistent with the SQL standard name of the special register.

Examples

Example 1: Set the CURRENT PATH special register to the list of schemas: ″SCHEMA1″, ″SCHEMA#2″, ″SYSIBM″.

```
SET PATH = SCHEMA1,"SCHEMA#2", SYSIBM;
```

When the special register provides the SQL path, SYSPROC which was not explicitly specified in the special register, is implicitly assumed at the front of the SQL path, making the effective value of the path:

```
SYSPROC, SCHEMA1, SCHEMA#2, SYSIBM
```

Example 2: Add schema SMITH and SYSPROC to the value of the CURRENT PATH special register that was set in Example 1.

```
SET PATH = CURRENT PATH, SMITH, SYSPROC;
```

The value of the special register becomes:

```
SCHEMA1, SCHEMA#2, SYSIBM, SMITH, SYSPROC
```

SET SCHEMA

The SET SCHEMA statement assigns a value to the CURRENT SCHEMA special register. If the package is bound with the DYNAMICRULES BIND option, this statement does not affect the qualifier that is used for unqualified database object references.

Invocation

This statement can be embedded in an application program or issued interactively. It is an executable statement that can be dynamically prepared.

Authorization

None required.

Syntax

```
           ┌─CURRENT─┐                 ┌─=─┐
►►──SET────┴─────────┴─────SCHEMA──┬───┴───┴───┬─schema-name─────┬──────────────────────────────────────►◄
           └─CURRENT_SCHEMA────────┘           ├─USER────────────┤
                                               ├─host-variable───┤
                                               ├─string-constant─┤
                                               └─DEFAULT─────────┘
```

Description

schema-name
: Identifies a schema. No validation that the schema exists is made at the time the CURRENT SCHEMA is set. For example, if a schema name is misspelled, it could affect the way subsequent SQL operates.

USER
: Specifies the value of the USER special register.

host-variable
: Specifies a host variable that contains a schema name. The content is not folded to uppercase.

The host variable must:

- Be a CHAR, VARCHAR, GRAPHIC, or VARGRAPHIC variable. The actual length of the contents of the *host-variable* must not exceed the length of a schema name.
- Not be set to null. If *host-variable* has an associated indicator variable, the value of that indicator variable must not indicate a null value.
- Include a schema name that is left justified and conforms to the rules for forming an ordinary identifier or delimited identifier. If the identifier is delimited, it must not be empty or contain only blanks.
- Be padded on the right with blanks if the host variable is fixed length.
- Not contain USER or DEFAULT.

string-constant
: Specifies a string constant that contains a schema name. The content is not folded to uppercase.

The string constant must:

- Have a length that does not exceed the maximum length of a schema name.
- Include a schema name that is left justified and conforms to the rules for forming an ordinary identifier or delimited identifier. If the identifier is delimited, it must not be empty or contain only blanks.
- Not contain USER or DEFAULT.

DEFAULT
Specifies that CURRENT SCHEMA is to be set to its initial value, as if it had never been explicitly set during the application process. For information about the initial value of CURRENT SCHEMA, see “CURRENT SCHEMA” on page 108.

Notes

Considerations for keywords: There is a difference between specifying a single keyword (such as USER or DEFAULT) as a single keyword or as a delimited identifier. To indicate that the current value of the USER special register should be used for setting the current schema, specify USER as a keyword. To indicate that the special register should be set to its default value, specify DEFAULT as a keyword. If USER or DEFAULT is specified as a delimited identifier instead (for example, ″USER″), it is interpreted as a schema name of that value (″USER″).

Transaction considerations: The SET SCHEMA statement is not a commitable operation. ROLLBACK has no effect on CURRENT SCHEMA.

Usage of the assigned value: The value of the CURRENT SCHEMA special register, as set by this statement, is used as the schema name in all dynamic SQL statements. The QUALIFIER bind option specifies the schema name for use as the qualifier for unqualified database object names in static SQL statements.

Impact on other special registers: Setting the CURRENT SCHEMA special register does not affect any other special register. Therefore, the CURRENT SCHEMA is not be included in the SQL path that is used to resolve the schema name for unqualified references to function, procedures and user-defined types in dynamic SQL statements. To include the current schema value in the SQL path, whenever the SET SCHEMA statement is issued, also issue the SET PATH statement including the schema name from the SET SCHEMA statement.

Examples

Example 1: The following statement sets the CURRENT SCHEMA special register.

```
EXEC SQL SET SCHEMA RICK;
```

Example 2: The following example retrieves the current value of the CURRENT SCHEMA special register into the host variable called CURSCHEMA.

```
EXEC SQL SELECT CURRENT SCHEMA INTO :CURSCHEMA
   FROM SYSIBM.SYSDUMMY;
```

The value of the host variable is RICK.

Example 3: Set the implicit qualifier to ABC, but change the id that will be used for authorization checking to XYZ.

```
SET SCHEMA = 'ABC';
SET CURRENT SQLID =  'XYZ';
SELECT * FROM T1;
```

In this example, T1 is interpreted as ABC.T1, but the authorization to reference this table will be checked against user XYZ.

Example 4: Assume that the statements in Example 3 have just been processed. The values of the CURRENT SQLID and CURRENT SCHEMA special registers now contain different values, and all CREATE statements are prohibited. The DEFAULT keyword can be used in a SET SCHEMA statement to reset the value of the CURRENT SCHEMA special register so that it will have the same value as CURRENT SQLID. After issuing such a statement, CREATE statements will be allowed. The following statement sets the value of the CURRENT SCHEMA special register to the same value as in CURRENT SCHEMA:

```
SET SCHEMA = DEFAULT;
```

SET transition-variable assignment

The SET transition-variable assignment statement assigns values, either of expressions or NULL values, to transition variables.

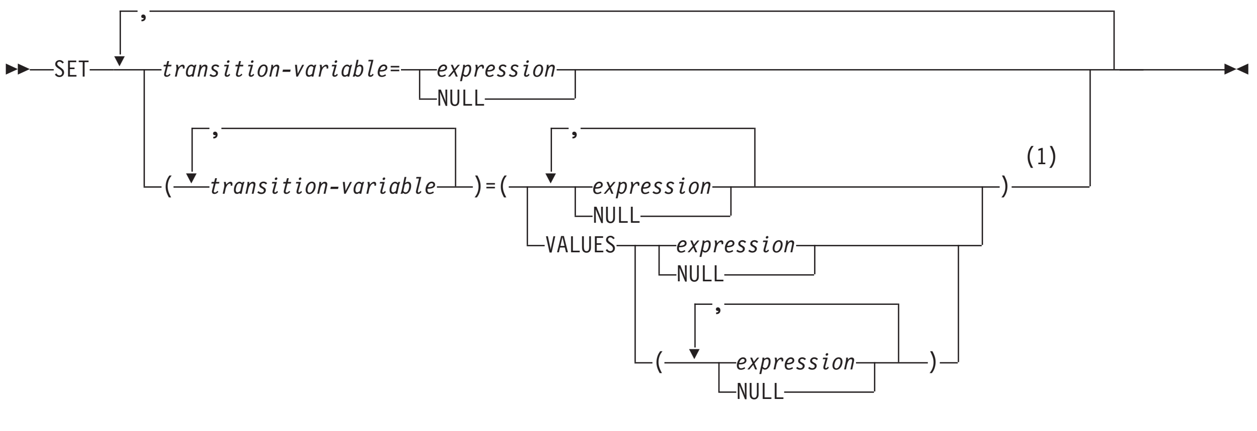
Invocation

This statement can be used as a triggered SQL statement in the triggered action of a before trigger whose granularity is FOR EACH ROW.

Authorization

The privileges that are held by the current authorization ID must include those required to execute any of the expressions or assignments to transition variables.

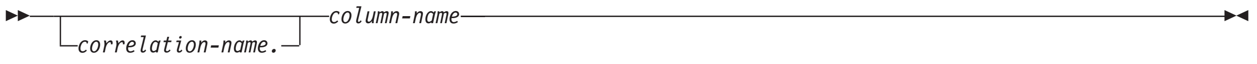
Syntax



Notes:

1 The number of *expression*s and NULL keywords must match the number of *transition-variable*s.

transition-variable:



Description

transition-variable

Identifies a column in the set of affected rows for the trigger that is used to used to receive the corresponding *expression* or NULL value on the right side of the statement.

The value to be assigned to each *transition-variable* can be specified immediately following the transition variable, for example, *transition-variable = expression, transition-variable=expression.* Or, sets of parentheses can be used to specify all the *transition-variable*s and then all the values, for example, *(transition-variable, transition-variable) = (expression, expression)*.

correlation-name

Identifies the correlation name given for referencing the NEW transition variables. The name must match the correlation name specified following NEW in the REFERENCING clause of the CREATE TRIGGER statement.

If OLD is not specified in the REFERENCING clause, *correlation-name* defaults to the correlation name following NEW.

column-name

Identifies the column to be updated. The name must identify a column of the subject table. The name can identify an identity column that is defined as GENERATED BY DEFAULT but not one defined as GENERATED ALWAYS. You must not specify the same column more than once.

The effect of a SET *transition-variable* statement is equivalent to the effect of an SQL UPDATE statement.

expression

Specifies the value to be assigned to the corresponding *transition-variable*. The expression is any expression of the type described in “Expressions” on page 133. A reference to a *local special register* is the value of that special register at the *server* when the trigger body is activated. If the expression contains a scalar fullselect, the scalar fullselect cannot reference columns of the triggering table. The expression cannot include a column function except when it occurs within a scalar fullselect.

An expression can contain references to OLD and NEW transition variables that are qualified with a correlation name.

All expressions are evaluated before any result is assigned to a transition variable. If an expression refers to a transition variable that is used in the list of transition variables, the value of the variable in the expression is the value of the variable prior to any assignments.

Each assignment to a transition variable column is made according to the assignment rules described in “Assignment and comparison” on page 74. Assignments are made in sequence through the list. When the *transition-variable*s are enclosed within parentheses, for example, *(transition-variable, transition-variable, ...) = (expression, expression, ...)*, the first value is assigned to the first transition variable in the list, the second value to the second transition variable in the list, and so on.

NULL

Specifies the null value and can only be specified for nullable transition variables.

VALUES

Specifies the value to be assigned to the corresponding transition variable. When more than one value is specified, the values must be enclosed in parentheses. Each value can be an expression or NULL, as described above. The following syntax is equivalent:

- *(transition-variable, transition-variable) = (VALUES(expression, NULL))*
- *(transition-variable, transition-variable) = (expression, NULL)*

Examples

Example 1: Assume that you want to create a before trigger that sets the salary and commission columns to default values for newly inserted rows in the EMPLOYEE table and that you will define the trigger only with NEW in the REFERENCING clause. Write the SET transition-variable statement that assigns the default values to the SALARY and COMMISSION columns.

```
SET (SALARY, COMMISSION) = (50000, 8000);
```

Example 2: Assume that you want to create a before trigger that detects any commission increases greater than 10% for updated rows in the EMPLOYEE table and limits the commission increase to 10%. You will define the trigger with both OLD and NEW in the REFERENCING clause. Write the SET transition-variable statement that limits an increase to the COMMISSION column to 10% .

```
SET NEWROW.COMMISSION = 1.1 * OLDROW.COMMISSION;
```

SIGNAL SQLSTATE

The SIGNAL SQLSTATE statement is used to signal an error. It causes an error to be returned with the specified SQLSTATE and error description. For a description of the statement, see “SIGNAL statement” on page 1140.

UPDATE

The UPDATE statement updates the values of specified columns in rows of a table or view. Updating a row of a view updates a row of the table on which the view is based. The table or view can exist at the current server or at any DB2 subsystem with which the current server can establish a connection.

There are two forms of this statement:

- The *searched* UPDATE form is used to update one or more rows optionally determined by a search condition.
- The *positioned* UPDATE form specifies that one or more rows corresponding to the current cursor position are to be updated.

Invocation

This statement can be embedded in an application program or issued interactively. A positioned UPDATE can be embedded in an application program. Both forms are executable statements that can be dynamically prepared.

Authorization

Authority requirements depend on whether the object identified in the statement is a user-defined table, a catalog table for which updates are allowed, or a view, and whether SQL standard rules are in effect:

When a user-defined table is identified: The privilege set must include at least one of the following:

- The UPDATE privilege on the table
- The UPDATE privilege on each column to be updated
- Ownership of the table
- DBADM authority on the database that contains the table
- SYSADM authority

When a catalog table is identified: The privilege set must include at least one of the following:

- The UPDATE privilege on each column to be updated
- DBADM authority on the catalog database
- SYSCTRL authority
- SYSADM authority

When a view is identified: The privilege set must include at least one of the following:

- The UPDATE privilege on the view
- The UPDATE privilege on each column to be updated
- SYSADM authority

When SQL standard rules are in effect: If SQL standard rules are in effect and an expression in the SET clause contains a reference to a column of the table or view, or if the search-condition in a searched UPDATE contains a reference to a column of the table or view, the privilege set must include at least one of the following:

- The SELECT privilege on the table or view
- SYSADM authority

SQL standard rules are in effect as follows:

- For static SQL statements, if the SQLRULES(STD) bind option was specified
- For dynamic SQL statements, if the CURRENT RULES special register is set to 'STD'

The owner of a view, unlike the owner of a table, might not have UPDATE authority on the view (or might have UPDATE authority without being able to grant it to others). The nature of the view itself can preclude its use for UPDATE. For more information, see the discussion of authority in “CREATE VIEW” on page 805.

If a fullselect is specified, the privilege set must include authority to execute the fullselect. For more information about the authorization rules, see “Authorization” on page 394.

Privilege set: If the statement is embedded in an application program, the privilege set is the privileges that are held by the authorization ID of the owner of the plan or package. If the statement is dynamically prepared, the privilege set is determined by the DYNAMICRULES behavior in effect (run, bind, define, or invoke) and is summarized in Table 53 on page 433. (For more information on these behaviors, including a list of the DYNAMICRULES bind option values that determine them, see “Authorization IDs and dynamic SQL” on page 51).

Syntax

searched update:

```
►►──UPDATE──┬─table-name─┬──┬──────────────────┬──SET──assignment-clause──────────────►
            └─view-name──┘  └─correlation-name─┘

►──┬──────────────────────────┬──┬──────────────────┬──┬─────────────────┬──────────►◄
   └─WHERE──search-condition──┘  └─isolation-clause─┘  └─QUERYNO──integer─┘
```

positioned update:

```
►►──UPDATE──┬─table-name─┬──┬──────────────────┬──SET──assignment-clause──────────────►
            └─view-name──┘  └─correlation-name─┘

►─WHERE CURRENT OF──cursor-name──┬──────────────────────────────────────────┬───────►◄
                                 └─FOR ROW──┬─host-variable─────┬──OF ROWSET─┘
                                            └─integer-constant──┘
```

assignment clause:

```
     ┌─,──────────────────────────────────────────────────┐
     ▼                                                    │
►►──┬─column-name=─┬─expression──────────┬────────────────┬┴──────────────────────►◄
    │              ├─NULL────────────────┤                │
    │              └─(scalar-fullselect)─┘                │
    │    ┌─,────────────┐         ┌─,─────────────────────┐   │
    │    ▼              │         ▼ (1)                   │   │
    └─(──┴─column-name──┴─)──=──(─┬────────┬─expression─┬─┴─┬─)─┘
                                  │        └─NULL───────┘   │
                                  │                 (2)     │
                                  └─row-fullselect──────────┘
```

Notes:

1 The number of *expressions* and NULL keywords must match the number of *column-names*.

2 The number of columns in the select list must match the number of *column-names*.

isolation-clause:

```
►►──WITH──┬─RR─┬─────────────────────────────────────────────────────►◄
          ├─RS─┤
          └─CS─┘
```

Description

table-name or *view-name*

Identifies the object of the UPDATE statement. The name must identify a table or view that exists at the DB2 subsystem identified by the implicitly or explicitly specified location name. The name must not identify:

- An auxiliary table
- A created temporary table or a view of a created temporary table
- A catalog table with no updatable columns or a view of a catalog table with no updatable columns
- A read-only view. (For a description of a read-only view, see “CREATE VIEW” on page 805.)
- A system-maintained materialized query table

In an IMS or CICS application, the DB2 subsystem that contains the identified table or view must be a remote server that supports two-phase commit.

A catalog table or a view of a catalog table can be identified if every column identified in the SET clause is an updatable column. If a column of a catalog table is updatable, then its description in Appendix F, “DB2 catalog tables,” on page 1191 indicates that the column can be updated. If the object table is SYSIBM.SYSSTRINGS, any column other than IBMREQD can be updated, but the rows selected for update must be rows provided by the user (the value of the IBMREQD column is N) and only certain values can be specified as explained in Appendix B (Volume 2) of *DB2 Administration Guide*.

correlation-name

Can be used within *search-condition* or *assignment-clause* to designate the table or view. (For an explanation of *correlation-name*, see "Correlation names" on page 114.)

SET

Introduces a list of one or more column names and the values to be assigned to the columns.

column-name

Identifies a column to be updated. *column-name* must identify a column of the specified table or view, but must not identify a ROWID column, an identity column that is defined as GENERATED ALWAYS, or a view column that is derived from a scalar function, constant, or expression. The same column must not be specified more than once.

For a positioned update, allowable column names can be further restricted to those in a certain list. This list appears in the FOR UPDATE clause of the SELECT statement for the associated cursor. The clause can be omitted using the conditions described in "Positioned updates of columns" on page 185.

A view column derived from the same column as another column of the view can be updated, but both columns cannot be updated in the same UPDATE statement.

expression

Indicates the new value of the column. The *expression* is any expression of the type described in "Expressions" on page 133. It must not include an aggregate function.

A *column-name* in an expression must identify a column of the table or view. For each row that is updated, the value of the column in the expression is the value of the column in the row before the row is updated.

NULL

Specifies the null value as the new value of the column. Specify NULL only for nullable columns.

scalar-fullselect

Specifies a fullselect that returns a single row with a single column. The column value is assigned to the corresponding *column-name*. If the fullselect returns no rows, the null value is assigned; an error occurs if the column to be updated is not nullable. An error also occurs if there is more than one row in the result.

For a positioned update, if the table or view that is the object of the UPDATE statement is used in the fullselect, the column from the instance of the table or view in the fullselect cannot be the same as *column-name*, the column being updated.

The fullselect must not contain a GROUP BY or HAVING clause. If the fullselect refers to columns to be updated, the value of such a column in the fullselect is the value of the column in the row before the row is updated.

row-fullselect

Specifies a fullselect that returns a single row. The column values are assigned to each of the corresponding *column-names*. If the fullselect returns no rows, the null value is assigned to each column; an error occurs if any column to be updated is not nullable. An error also occurs if there is more than one row in the result.

For a positioned update, if the table or view that is the object of the UPDATE statement is used in the fullselect, a column from the instance of the table or view in the fullselect cannot be the same as *column-name*, a column being updated.

The fullselect must not contain a GROUP BY or HAVING clause. If the fullselect refers to columns to be updated, the value of such a column in the fullselect is the value of the column in the row before the row is updated.

WHERE

Specifies the rows to be updated. You can omit the clause, give a search condition, or specify a cursor. If you omit the clause, all rows of the table or view are updated.

search-condition

Is any search condition described in Chapter 2, “Language elements,” on page 33. Each *column-name* in the search condition, other than in a subquery, must identify a column of the table or view.

The search condition is applied to each row of the table or view and the updated rows are those for which the result of the *search-condition* is true. If the unique key or primary key is a parent key, the constraints are effectively checked at the end of the operation.

If the search condition contains a subquery, the subquery can be thought of as being executed each time the search condition is applied to a row, and the results used in applying the search condition. In actuality, a subquery with no correlated references is executed just once, whereas it is possible that a subquery with a correlated reference must be executed once for each row.

WHERE CURRENT OF cursor-name

Identifies the cursor to be used in the update operation. *cursor-name* must identify a declared cursor as explained in the description of the DECLARE CURSOR statement in “DECLARE CURSOR” on page 812. If the UPDATE statement is embedded in a program, the DECLARE CURSOR statement must include *select-statement* rather than *statement-name*.

The object of the UPDATE statement must also be identified in the FROM clause of the SELECT statement of the cursor. The columns to be updated can be identified in the FOR UPDATE clause of that SELECT statement though they do not have to be identified. If the columns are not specified, the columns that can be updated include all the updatable columns of the table or view that is identified in the first FROM clause of the fullselect.

The result table of the cursor must not be read-only. For an explanation of read-only result tables, see “Read-only cursors” on page 819. Note that the object of the UPDATE statement must not be identified as the object of the subquery in the WHERE clause of the SELECT statement of the cursor.

When the UPDATE statement is executed, the cursor must be open and positioned on a row or rowset of the result table.

- If the cursor is positioned on a single row, that row is the one updated.
- If the cursor is positioned on a rowset, all rows corresponding to the rows of the current rowset are updated.

FOR ROW n OF ROWSET

Specifies which row of the current rowset is to be updated. The corresponding row of the rowset is updated, and the cursor remains positioned on the current rowset.

host-variable or *integer-constant* is assigned to an integral value *k*. If *host-variable* is specified, it must be an exact numeric type with scale zero, must not include an indicator variable, and *k* must be in the range of 1 to 32767.

The cursor must be positioned on a rowset, and the specified value must be a valid value for the set of rows most recently retrieved for the cursor. If the specified row cannot be updated, an error is returned. It is possible that the specified row is within the bounds of the rowset most recently requested, but the current rowset contains less than the number of rows that were implicitly or explicitly requested when that rowset was established.

If this clause is not specified, the cursor position determines the rows that will be affected. If the cursor is positioned on a single row, that row is the one updated. In the case where the most recent FETCH statement returned multiple rows of data (but not as a rowset), this position would be on the last row of data that was returned. If the cursor is positioned on a rowset, all rows corresponding to the current rowset are updated. The cursor position remains unchanged.

It is possible for another application process to update a row in the base table of the SELECT statement so that the specified row of the cursor no longer has a corresponding row in the base table. An attempt to update such a row results in an error.

isolation-clause

Specifies the isolation level used when locating the rows to be updated by the statement.

WITH

Introduces the isolation level, which may be one of the following:

RR	Repeatable read
RS	Read stability
CS	Cursor stability

The default isolation level of the statement is the isolation level of the package or plan in which the statement is bound, with the package isolation taking precedence over the plan isolation. When a package isolation is not specified, the plan isolation is the default.

QUERYNO *integer*

Specifies the number to be used for this SQL statement in EXPLAIN output and trace records. The number is used for the QUERYNO column of the plan table for the rows that contain information about this SQL statement. This number is also used in the QUERYNO column of the SYSIBM.SYSSTMT and SYSIBM.SYSPACKSTMT catalog tables.

If the clause is omitted, the number associated with the SQL statement is the statement number assigned during precompilation. Thus, if the application program is changed and then precompiled, that statement number might change.

Using the QUERYNO clause to assign unique numbers to the SQL statements in a program is helpful:

- For simplifying the use of optimization hints for access path selection
- For correlating SQL statement text with EXPLAIN output in the plan table

For information on using optimization hints, such as enabling the system for optimization hints and setting valid hint values, and for information on accessing the plan table, see Part 5 (Volume 2) of *DB2 Administration Guide*.

Notes

Update rules: Update values must satisfy the following rules. If they do not, or if other errors occur during the execution of the UPDATE statement, no rows are updated and the position of the cursors are not changed.

- *Assignment*. Update values are assigned to columns using the assignment rules described in Chapter 2, "Language elements," on page 33.
- *Validity*. Updates must obey the following rules. If they do not, or if any other errors occur during the execution of the UPDATE statement, no rows are updated.
  - *Subselects:* The row-fullselect and scalar-fullselect must return no more than one row.
  - *Unique constraints and unique indexes:* If the identified table (or base table of the identified view) has any unique indexes or unique constraints, each row that is updated in the table must conform to the limitations that are imposed by those indexes and constraints.

    All uniqueness checks are effectively made at the end of the statement. In the case of a multi-row update, this validation occurs after all the rows are updated.
  - *Check constraints:* If the identified table (or base table of the identified view) has any check constraints, each check constraint must be true or unknown for each row that is updated in the table.

    All checks constraints are effectively validated at the end of the statement. In the case of a multi-row update, this validation occurs after all the rows are updated.
  - *Views and the WITH CHECK OPTION*. For views defined with WITH CHECK OPTION, an updated row must conform to the definition of the view. If the view you name is dependent on other views whose definitions include WITH CHECK OPTION, the updated rows must also conform to the definitions of those views. For an explanation of the rules governing this situation, see "CREATE VIEW" on page 805.

    For views that are not defined with WITH CHECK OPTION, you can change the rows so that they no longer conform to the definition of the view. Such rows are updated in the base table of the view and no longer appear in the view.
  - *Field and validation procedures*. The updated rows must conform to any constraints imposed by any field or validation procedures on the identified table (or on the base table of the identified view).
- *Referential constraints*. The value of the parent key in a parent row must not be changed. If the update value produces a foreign key that is nonnull, the foreign key must be equal to some value of the parent key of the parent table of the relationship.

  All referential constraints are effectively checked at the end of the statement. In the case of a multi-row update, this validation occurs after all the rows are updated.
- *Triggers*. An UPDATE statement might cause triggers to be activated. A trigger might cause other statements to be executed or raise error conditions based on the update values.

Number of rows updated: Normally, after an UPDATE statement completes execution, the value of SQLERRD(3) in the SQLCA is the number of rows updated. (For a complete description of the SQLCA, including exceptions to the preceding sentence, see Appendix D, "SQL communication area (SQLCA)," on page 1165.)

Nesting user-defined functions or stored procedures: An UPDATE statement can implicitly or explicitly refer to user-defined functions or stored procedures. This is known as *nesting* of SQL statements. A user-defined function or stored procedure that is nested within the UPDATE must not access the table being updated.

Locking: Unless appropriate locks already exist, one or more exclusive locks are acquired by the execution of a successful UPDATE statement. Until a commit or rollback operation releases the locks, only the application process that performed the insert can access the updated row. If LOBs are not updated, application processes that are running with uncommitted read can also access the updated row. The locks can also prevent other application processes from performing operations on the table. However, application processes that are running with uncommitted read can access locked pages and rows.

Locks are not acquired on declared temporary tables.

Datetime representation when using datetime registers: As explained under "Datetime special registers" on page 98, when two or more datetime registers are implicitly or explicitly specified in a single SQL statement, they represent the same point in time. This is also true when multiple rows are updated.

Rules for positioned UPDATE with a SENSITIVE STATIC scrollable cursor: When a SENSITIVE STATIC scrollable cursor has been declared, the following rules apply:

- *Update attempt of delete holes.* If, with a positioned update against a SENSITIVE STATIC scrollable cursor, an attempt is made to update a row that has been identified as a delete hole, an error occurs.
- *Update operations.* Positioned update operations with SENSITIVE STATIC scrollable cursors perform as follows:
  1. The SELECT list items in the target row of the base table of the cursor are compared with the values in the corresponding row of the result table (that is, the result table must still agree with the base table). If the values are not identical, then the update operation is rejected, and an error occurs. The operation may be attempted again after a successful FETCH SENSITIVE has occurred for the target row.
  2. The WHERE clause of the SELECT statement is re-evaluated to determine whether the current values in the base table still satisfy the search criteria. The values in the SELECT list are compared to determine that these values have not changed. If the WHERE clause evaluates as true, and the values in the SELECT have not changed, the update operation is allowed to proceed. Otherwise, the update operation is rejected, an error occurs, and an *update hole* appears in the cursor.
- *Update of update holes.* Update holes are not permanent. It is possible for another process, or a searched update in the same process, to update an update hole row so that it is no longer an update hole. Update holes become visible with a FETCH SENSITIVE for positioned updates and positioned deletes.
- *Result table.* After the base table is updated, the row is re-evaluated and updated in the temporary result table. At this time, it is possible that the positioned update changed the data such that the row does not qualify the search condition, in which case the row is marked as an update hole for subsequent FETCH operations.

Updating rows in a table with multilevel security: When you update rows in a table with multilevel security, DB2 compares the security label of the user (the primary authorization ID) to the security label of the row. The update proceeds according to the following rules:

- If the security label of the user and the security label of the row are equivalent, the row is updated and the value of the security label is determined by whether the user has write-down privilege:
  - If the user has write-down privilege or write-down control is not enabled, the user can set the security label of the row to any valid security label. The value that is specified for the security label column must be assignable to a column that is defined as CHAR(8) FOR SBCS DATA NOT NULL.
  - If the user does not have write-down privilege and write-down control is enabled, the security label of the row is set to the value of the security label of the user.
- If the security label of the user dominates the security label of the row, the result of the UPDATE statement is determined by whether the user has write-down privilege:
  - If the user has write-down privilege or write-down control is not enabled, the row is updated and the user can set the security label of the row to any valid security label.
  - If the user does not have write-down privilege and write-down control is enabled, the row is not updated.
- If the security label of the row dominates the security label of the user, the row is not updated.

Other SQL statements in the same unit of work: The following statements cannot follow an UPDATE statement in the same unit of work:

- An ALTER TABLE statement that changes the data type of a column (ALTER COLUMN SET DATATYPE)
- An ALTER INDEX statement that changes the padding attribute of an index with varying-length columns (PADDED to NOT PADDED or vice versa)

Examples

The following nine examples refer to the sample table DSN8810.EMP.

Example 1: Change employee 000190’s telephone number to 3565 in DSN8810.EMP.

```
UPDATE DSN8810.EMP
  SET PHONENO='3565'
  WHERE EMPNO='000190';
```

Example 2: Give each member of department D11 a 100-dollar raise.

```
UPDATE DSN8810.EMP
  SET SALARY = SALARY + 100
  WHERE WORKDEPT = 'D11';
```

Example 3: Employee 000250 is going on a leave of absence. Set the employee’s pay values (SALARY, BONUS, and COMMISSION) to null.

```
UPDATE DSN8810.EMP
  SET SALARY = NULL, BONUS = NULL, COMM = NULL
  WHERE EMPNO='000250';
```

Alternatively, the statement could also be written as follows:

```
UPDATE DSN8810.EMP
  SET (SALARY, BONUS, COMM) = (NULL, NULL, NULL)
  WHERE EMPNO='000250';
```

Example 4: Assume that a column named PROJSIZE has been added to DSN8810.EMP. The column records the number of projects for which the employee's department has responsibility. For each employee in department E21, update PROJSIZE with the number of projects for which the department is responsible.

```
UPDATE DSN8810.EMP
  SET PROJSIZE = (SELECT COUNT(*)
                  FROM DSN8810.PROJ
                  WHERE DEPTNO = 'E21')
  WHERE WORKDEPT = 'E21';
```

Example 5: Double the salary of the employee represented by the row on which the cursor C1 is positioned.

```
EXEC SQL UPDATE DSN8810.EMP
  SET SALARY = 2 * SALARY
  WHERE CURRENT OF C1;
```

Example 6: Assume that employee table EMP1 was created with the following statement:

```
CREATE TABLE EMP1
  (EMP_ROWID    ROWID GENERATED ALWAYS,
   EMPNO        CHAR(6),
   NAME         CHAR(30),
   SALARY       DECIMAL(9,2),
   PICTURE      BLOB(250K),
   RESUME       CLOB(32K));
```

Assume that host variable HV_EMP_ROWID contains the value of the ROWID column for employee with employee number '350000'. Using that ROWID value to identify the employee and user-defined function UPDATE_RESUME, increase the employee's salary by $1000 and update that employee's resume.

```
EXEC SQL UPDATE EMP1
  SET SALARY = SALARY + 1000,
      RESUME = UPDATE_RESUME(:HV_RESUME)
  WHERE EMP_ROWID = :HV_EMP_ROWID;
```

Example 7: In employee table X, give each employee whose salary is below average a salary increase of 10%.

```
EXEC SQL UPDATE EMP X
  SET SALARY = 1.10 * SALARY
  WHERE SALARY < (SELECT AVG(SALARY) FROM EMP Y
  WHERE X.JOBCODE = Y.JOBCODE);
```

Example 8: Raise the salary of the employees in department 'E11' whose salary is below average to the average salary.

```
EXEC SQL UPDATE EMP T1
  SET SALARY = (SELECT AVG(T2.SALARY) FROM EMP T2)
  WHERE WORKDEPT = 'E11' AND
        SALARY < (SELECT AVG(T3.SALARY) FROM EMP T3);
```

Example 9: Give the employees in department 'E11' a bonus equal to 10% of their salary.

```
EXEC SQL
  DECLARE C1 CURSOR FOR
    SELECT BONUS
```

```
      FROM DSN8710.EMP
      WHERE WORKDEPT = 'E12'
      FOR UPDATE OF BONUS;

  EXEC SQL
    UPDATE DSN8710.EMP
      SET BONUS = ( SELECT .10 * SALARY FROM DSN8710.EMP Y
                    WHERE EMPNO = Y.EMPNO )
      WHERE CURRENT OF C1;
```

Example 10: Assuming that cursor CS1 is positioned on a rowset consisting of 10 rows in table T1, update all 10 rows in the rowset.

```
EXEC SQL UPDATE T1 SET C1 = 5 WHERE CURRENT OF CS1;
```

Example 11: Assuming that cursor CS1 is positioned on a rowset consisting of 10 rows in table T1, update the fourth row of the rowset.

```
short ind1, ind2;

int n, updt_value;

stmt = 'UPDATE T1 SET C1 = ? WHERE CURRENT OF CS1 FOR ROW ? OF ROWSET'

ind1 = 0;

ind2 = 0;

n = 4;

updt_value = 5;

...

strcpy(my_sqlda.sqldaid,"SQLDA");

my_sqlda.sqln = 2;

my_sqlda.sqld = 2;

my_sqlda.sqlvar[0].sqltype = 497;
my_sqlda.sqlvar[0].sqllen = 4;
my_sqlda.sqlvar[0].sqldata = (int *) &updt_value;
my_sqlda.sqlvar[0].sqlind = (short *) &ind1;

my_sqlda.sqlvar[1].sqltype = 497;
my_sqlda.sqlvar[1].sqllen = 4;
my_sqlda.sqlvar[1].sqldata = (int *) &n;
my_sqlda.sqlvar[1].sqlind = (short *) &ind2;

EXEC SQL PREPARE S1 FROM :stmt;

EXEC SQL EXECUTE S1 USING DESCRIPTOR :my_sqlda;
```

VALUES

The VALUES statement provides a method for invoking a user-defined function from a trigger. Transition variables and transition tables can be passed to the user-defined function.

Invocation

This statement can only be used in the triggered action of a trigger.

Authorization

Authorization is required for any expressions that are used in the statement. For more information, see “Expressions” on page 133.

Syntax

```
►►──VALUES──┬─expression─────────────┬──────────────────────────────────────────►◄
            │   ┌─,──────────────┐   │
            │   ▼                │   │
            └─(───expression─────┴─)─┘
```

Description

VALUES

Specifies one or more expressions. If more than one expression is specified, the expressions must be enclosed within parentheses.

expression

Any expression of the type described in “Expressions” on page 133. The expression must not contain a host variable.

The expressions are evaluated, but the resulting values are discarded and are not assigned to any output variables.

If a user-defined function is specified as part of an expression, the user-defined function is invoked. If a negative SQLCODE is returned when the function is invoked, DB2 stops executing the trigger and rolls back any triggered actions that were performed.

Example

Example: Create an after trigger EMPISRT1 that invokes user-defined function NEWEMP when the trigger is activated. An insert operation on table EMP activates the trigger. Pass transition variables for the new employee number, last name, and first name to the user-defined function.

```
CREATE TRIGGER EMPISRT1
   AFTER INSERT ON EMP
   REFERENCING NEW AS N
   FOR EACH ROW
   MODE DB2SQL
   BEGIN ATOMIC
      VALUES(NEWEMP(N.EMPNO, N.LASTNAME, N.FIRSTNAME));
   END
```

VALUES INTO

The VALUES INTO statement assigns one or more values to host variables.

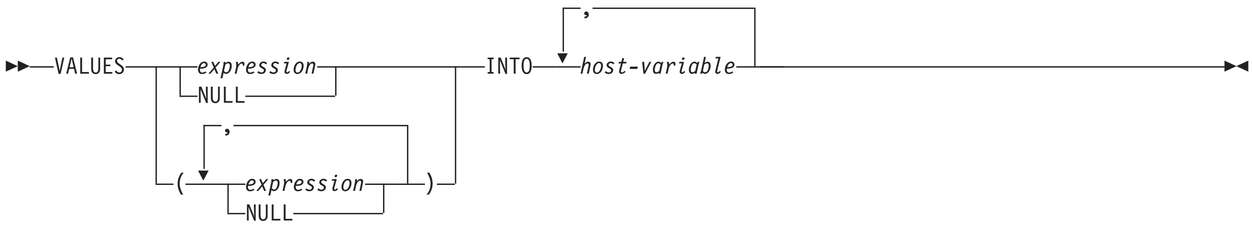
Invocation

This statement can only be embedded in an application program. It is an executable statement that cannot be dynamically prepared.

Authorization

Authorization is required for any expressions that are used in the statement. For more information, see "Expressions" on page 133

Syntax



Description

VALUES
Introduces one or more values. If more than one value is specified, the list of values must be enclosed within parentheses.

expression
Any expression of the type described in "Expressions" on page 133. The expression must not include a column name.

NULL
The null value. NULL can only be specified for host variables that have an associated indicator variable.

INTO
Introduces one or more host variables. The values that are specified in the VALUES clause are assigned to these host variables. The first value specified is assigned to the first host variable, the second value to the second host variable, and so on. Each assignment is made according to the rules described in "Assignment and comparison" on page 74. Assignments are made in sequence through the list. If there are fewer host variables than values, the value 'W' is assigned to the SQLWARN3 field of the SQLCA. (See Appendix D, "SQL communication area (SQLCA)," on page 1165.)

host-variable
Identifies a variable that is described in the program according to the rules for declaring host variables.

Notes

The default encoding scheme for the data is the value in the bind option ENCODING, which is the option for application encoding.

If an error occurs, no value is assigned to any host variable. However, if LOB values are involved, there is a possibility that the corresponding host variable was modified, but the variable's contents are unpredictable.

Local special registers and CURRENT PACKAGE PATH special register can be referenced only in a VALUES INTO statement that results in the assignment of a single host variable and not those that result in setting more than one value.

Normally, you use LOB locators to assign and retrieve data from LOB columns. However, because of compatibility rules, you can also use LOB locators to assign data to host variables with CHAR, VARCHAR, GRAPHIC, or VARGRAPHIC data types. For more information on using locators, see Part 2 of *DB2 Application Programming and SQL Guide*.

Examples

Example 1: Assign the value of the CURRENT PATH special register to host variable HV1.

```
EXEC SQL VALUES(CURRENT PATH)
         INTO :HV1;
```

Example 2: Assign the value of the CURRENT MEMBER special register to host variable MEM.

```
EXEC SQL VALUES(CURRENT MEMBER)
         INTO :MEM;
```

Example 3: Assume that LOB locator LOB1 is associated with a CLOB value. Assign a portion of the CLOB value to host variable DETAILS using the LOB locator.

```
EXEC SQL VALUES (SUBSTR(:LOB1,1,35))
         INTO :DETAILS;
```

WHENEVER

The WHENEVER statement specifies the host language statement to be executed when a specified exception condition occurs.

Invocation

This statement can only be embedded in an application program. It is not an executable statement. It must not be specified in Java or REXX.

Authorization

None required.

Syntax

```
►►──WHENEVER──┬─NOT FOUND──┬──┬─CONTINUE──────────────────────┬────────────────►◄
              ├─SQLERROR───┤  └─┬─GOTO──┬──┬───┬──host-label─┘
              └─SQLWARNING─┘    └─GO TO─┘  └─:─┘
```

Description

The NOT FOUND, SQLERROR, or SQLWARNING clause is used to identify the type of exception condition.

NOT FOUND
Identifies any condition that results in an SQLCODE of +100 (equivalently, an SQLSTATE code of '02000').

SQLERROR
Identifies any condition that results in a negative SQLCODE.

SQLWARNING
Identifies any condition that results in a warning condition (SQLWARN0 is W), or that results in a positive SQLCODE other than +100.

The CONTINUE or GO TO clause specifies the next statement to be executed when the identified type of exception condition exists.

CONTINUE
Specifies the next sequential statement of the source program.

GOTO or **GO TO** *host-label*
Specifies the statement identified by *host-label*. For *host-label*, substitute a single token, optionally preceded by a colon. The form of the token depends on the host language. In COBOL, for example, it can be *section-name* or an unqualified *paragraph-name*.

Notes

There are three types of WHENEVER statements:

- WHENEVER NOT FOUND
- WHENEVER SQLERROR
- WHENEVER SQLWARNING

Every executable SQL statement in an application program is within the scope of one implicit or explicit WHENEVER statement of each type. The scope of a

WHENEVER statement is related to the listing sequence of the statements in the application program, not their execution sequence.

An SQL statement is within the scope of the last WHENEVER statement of each type that is specified before that SQL statement in the source program. If a WHENEVER statement of some type is not specified before an SQL statement, that SQL statement is within the scope of an implicit WHENEVER statement of that type in which CONTINUE is specified. If a WHENEVER statement is specified in a Fortran subprogram, its scope is that subprogram, not the source program.

Examples

The following statements can be embedded in a COBOL program.

Example 1: Go to the label HANDLER for any statement that produces an error.

```
EXEC SQL WHENEVER SQLERROR GOTO HANDLER END-EXEC.
```

Example 2: Continue processing for any statement that produces a warning.

```
EXEC SQL WHENEVER SQLWARNING CONTINUE END-EXEC.
```

Example 3: Go to the label ENDDATA for any statement that does not return.

```
EXEC SQL WHENEVER NOT FOUND GO TO ENDDATA END-EXEC.
```

Chapter 6. SQL control statements

Control statements are SQL statements that allow SQL to be used in a manner similar to writing a program in a structured programming language. SQL control statements provide the capability to control the logic flow, declare and set variables, and handle warnings and exceptions. Some SQL control statements include other nested SQL statements.

SQL-control-statement:

```
►►──┬─assignment-statement─────┬──────────────────────────────────────────►◄
    ├─CALL statement───────────┤
    ├─CASE statement───────────┤
    ├─compound-statement───────┤
    ├─GET DIAGNOSTICS statement┤
    ├─GOTO statement───────────┤
    ├─IF statement─────────────┤
    ├─ITERATE statement────────┤
    ├─LEAVE statement──────────┤
    ├─LOOP statement───────────┤
    ├─REPEAT statement─────────┤
    ├─RESIGNAL statement───────┤
    ├─RETURN statement─────────┤
    ├─SIGNAL statement─────────┤
    └─WHILE statement──────────┘
```

Control statements are supported in SQL procedures. SQL procedures are created by specifying LANGUAGE SQL and an SQL routine body on the CREATE PROCEDURE statement. The SQL routine body must be a single SQL statement which may be an SQL control statement.

The remainder of this chapter contains a description of the control statements including syntax diagrams, semantic descriptions, usage notes, and examples of the use of the statements that constitute the SQL routine body. In addition, you can find information about referencing SQL parameters and variables in “References to SQL parameters and SQL variables” on page 1114.

The two common elements that are used in describing specific SQL control statements are:

- SQL control statements as described above
- “SQL-procedure-statement” on page 1115

For information on each of the SQL control statements, see these topics:

- “assignment-statement” on page 1116
- “CALL statement” on page 1118
- “CASE statement” on page 1120
- “compound-statement” on page 1122
- “GET DIAGNOSTICS statement” on page 1127
- “GOTO statement” on page 1128
- “IF statement” on page 1130
- “ITERATE statement” on page 1131
- “LEAVE statement” on page 1132

- "LOOP statement" on page 1133
- "REPEAT statement" on page 1134
- "RESIGNAL statement" on page 1135
- "RETURN statement" on page 1138
- "SIGNAL statement" on page 1140
- "WHILE statement" on page 1143

References to SQL parameters and SQL variables

The name of an SQL parameter or SQL variable in an SQL routine can be the same as the name of a column in a table or view that the SQL routine references. Names that are the same should be explicitly qualified. Qualifying a name clearly indicates whether the name refers to a column, SQL variable, or SQL parameter.

If the name is not qualified, the following rules describe whether the name refers to the column, the SQL variable, or the SQL parameter:

- The name is checked first as an SQL variable name and then as an SQL parameter name.
- If an SQL variable or SQL parameter by that name is not found, the name is assumed to be a column name.

The name of an SQL variable or SQL parameter in an SQL routine can be the name of an identifier that is used in certain SQL statements. If the name is not qualified, the following rules describe whether the name refers to the identifier, the SQL variable, or the SQL parameter:

- In the SET PATH statement, the name is checked as an SQL variable name or an SQL parameter name. If an SQL variable or SQL parameter by that name is not found, the name is assumed to be an identifier.
- In the CONNECT statement, the name is used as an identifier.

SQL-procedure-statement

An SQL control statement may allow multiple SQL statements to be specified within the SQL control statement. These statements are defined as SQL procedure statements.

Syntax

```
►►──┬─────────┬──┬─SQL-control-statement─┬──────────────────────────────────────────►◄
    └─label:──┘  └─SQL-statement─────────┘
```

Description

label
: Specifies a label for the statement. A label is an SQL ordinary identifier that is 1 to 64 bytes in length. The label must be unique within the procedure.

SQL-control-statement
: Specifies an SQL statement that provides the capability to control logic flow, declare and set variables, and handle warnings and exceptions, as defined in this chapter. Control statements are supported in SQL procedures.

SQL-statement
: Specifies an SQL statement as listed in Table 96 on page 1161. These statements are described in Chapter 5, “Statements,” on page 427.

Notes

Comments: Comments can be included within the body of an SQL procedure. A comment begins with /* and ends with */. The following rules apply:

- The beginning characters /* must be on the same line.
- The ending characters */ must be on the same line.
- Comments can be started wherever a space is valid.
- Comments can be continued to the next line.

assignment-statement

The assignment statement assigns a value to an output parameter or to an SQL variable.

Syntax

```
►►──SET──┬─SQL-parameter-name─┬──=──┬─expression─┬──────────────────────────────────────────────────►◄
         └─SQL-variable-name──┘     └─NULL───────┘
```

Description

SQL-parameter-name
Identifies the parameter that is the assignment target. The parameter must be specified in *parameter-declaration* in the CREATE PROCEDURE statement and must be defined as OUT or INOUT.

SQL-variable-name
Identifies the SQL variable that is the assignment target. SQL variables can be declared in a compound-statement and must be declared before it is used. For information on declaring SQL variables, see “compound-statement” on page 1122.

expression **or NULL**
Specifies the expression or value that is the assignment source. See “Expressions” on page 133 for information on expressions.

Notes

Assignment rules: Assignment statements in SQL procedures must conform to the SQL assignment rules. For example, the data type of the target and source must be compatible. See “Assignment and comparison” on page 74 for assignment rules.

If an assignment statement is the only statement in the procedure body, the statement cannot end with a semicolon. Otherwise, the statement must end with a semicolon.

When a string is assigned to a fixed-length variable and the length of the string is less than the length attribute of the target, the string is padded on the right with the necessary number of single-byte or double-byte blanks. When a string is assigned to a variable and the string is longer than the length attribute of the variable, a warning SQLSTATE is set and the value is truncated.

The ENCODING bind option is not used during processing of assignments to string variables. For example, assume that the system does not use mixed or DBCS, and the system EBCDIC SBCS CCSID is 37. Character conversion will not occur on assignment even if CCSID 500 is specified for the ENCODING bind parameter for the package for the procedure.

If truncation of the whole part of a number occurs on assignment to a numeric variable, a warning SQLCODE is set and the value is truncated.

Assignments involving SQL parameters: An IN parameter can appear on the left or right side of an assignment statement. When control returns to the caller, the original value of an IN parameter is passed to the caller. An OUT parameter can also appear on the left or right side of an assignment statement. When control returns to the caller, the last value that is assigned to an OUT parameter is returned to the caller. For an INOUT parameter, the first value of the parameter is determined by the caller, and the last value that is assigned to the parameter is returned to the caller.

Examples

Increase the SQL variable p_salary by 10 percent.

```
SET p_salary = p_salary + (p_salary * .10)
```

Set SQL variable p_salary to the null value.

```
SET p_salary = NULL
```

Set SQL variable midinit to the first character of SQL variable midname.

```
SET midinit = SUBSTR(midname,1,1)
```

CALL statement

The CALL statement invokes a stored procedure.

Syntax

```
►►──CALL──procedure-name──arugment-list──────────────────────────────────►◄
```

argument-list:

```
►►─┬──────────────────────────────────────┬─────────────────────────────►◄
   │        ┌─,──────────────────────┐    │
   │        ▼                        │    │
   └─(──────┬─SQL-variable-name───┬──┴─)─┘
            ├─SQL-parameter-name──┤
            ├─expression──────────┤
            └─NULL────────────────┘
```

Description

procedure-name
: Identifies the stored procedure to call. The procedure name must identify a stored procedure that exists at the current server.

argument-list
: Identifies a list of values to be passed as parameters to the stored procedure. The number of parameters must be the same as the number of parameters defined for the stored procedure. See "CALL" on page 563 for more information.

  Control is passed to the stored procedure according to the calling conventions for SQL procedures. When execution of the stored procedure is complete, the value of each parameter of the stored procedure is assigned to the corresponding parameter of the CALL statement defined as OUT or INOUT.

  SQL-variable-name
  : Specifies an SQL variable as an argument to the stored procedure. For an explanation of references to SQL variables, see "References to SQL parameters and SQL variables" on page 1114.

  SQL-parameter-name
  : Specifies an SQL parameter as an argument to the stored procedure. For an explanation of references to SQL parameters, see "References to SQL parameters and SQL variables" on page 1114.

  expression
  : The parameter is the result of the specified *expression*, which is evaluated before the stored procedure is invoked. If *expression* is a single *SQL-parameter-name* or *SQL-variable-name*, the corresponding parameter of the procedure can be defined as IN, INOUT, or OUT. Otherwise, the corresponding parameter of the procedure must be defined as IN. If the result of the *expression* can be the null value, either the description of the procedure must allow for null parameters or the corresponding parameter of the stored procedure must be defined as OUT.

The following additional rules apply depending on how the corresponding parameter was defined in the CREATE PROCEDURE statement for the procedure:

- IN *expression* can contain references to multiple SQL parameters or variables. In addition to the rules stated in “Expressions” on page 133 for *expression*, *expression* cannot include a column name, an aggregate function, or a user-defined function that is sourced on an aggregate function.
- INOUT or OUT *expression* can only be a single SQL parameter or variable.

NULL
The parameter is a null value. The corresponding parameter of the procedure must be defined as IN and the description of the procedure must allow for null parameters.

Notes

If a CALL statement is the only statement in the procedure body, the statement cannot end with a semicolon. Otherwise, the statement must end with a semicolon.

See “CALL” on page 563 for more information on the SQL CALL statement.

Examples

Call stored procedure proc1 and pass SQL variables as parameters.

```
CALL proc1(v_empno, v_salary)
```

CASE statement

The CASE statement selects an execution path based on the evaluation of one or more conditions. A CASE statement operates in the same way as a CASE expression, which is discussed in “CASE expressions” on page 148.

Syntax

```
►►──CASE──┬─simple-case-statement-when-clause───┬──┬────────────────────────────────────┬──►
          └─searched-case-statement-when-clause─┘  │       ┌──────────────────────────┐ │
                                                   │       ▼                          │ │
                                                   └─ELSE────SQL-procedure-statement──;─┴─┘

►──END CASE──────────────────────────────────────────────────────────────────────────────►◄
```

simple-case-statement-when-clause:

```
                  ┌────────────────────────────────────────────────────────────┐
                  │                            ┌──────────────────────────────┐ │
                  ▼                            ▼                              │ │
►►──expression────WHEN──expression──THEN────SQL-procedure-statement──;────────┴─┴──────►◄
```

searched-case-statement-when-clause:

```
    ┌────────────────────────────────────────────────────────────────┐
    │                                 ┌──────────────────────────────┐ │
    ▼                                 ▼                              │ │
►►────WHEN──search-condition──THEN────SQL-procedure-statement──;─────┴─┴──────►◄
```

Description

CASE
Begins a *case-expression*.

simple-case-statement-when-clause
Specifies the *expression* prior to the first WHEN keyword that is tested for equality with the value of each *expression* that follows the WHEN keyword, and the result to be executed when those expressions are equal. If the comparison is true, the THEN statement is executed. If the result is unknown or false, processing continues to the next expression or the ELSE statement.

The data type of the *expression* prior to the first WHEN keyword must be comparable to the data types of each *expression* that follows the WHEN keywords.

searched-case-statement-when-clause
Specifies the *search-condition* that is applied to each row or group of table data presented for evaluation, and the result when that condition is true. If the search

condition is true, the THEN statement is executed. If the condition is unknown or false, processing continues to the next search condition or the ELSE statement.

SQL-procedure-statement
Specifies a statement that follows the THEN and ELSE keyword. The statement specifies the result of a *searched-case-statement-when-clause* or a *simple-case-statement-when-clause* that is true, or the result if no case is true. The statement must be one of the statements listed under "SQL-procedure-statement" on page 1115.

search-condition
Specifies a condition that is true, false, or unknown about a row or group of table data. The search condition cannot contain a subselect.

END CASE
Ends a *case-statement*.

Notes

If none of the conditions specified in the WHEN are true and an ELSE is not specified, an error is issued when the statement executes, and the execution of the CASE statement is terminated.

CASE statements that use a simple case statement WHEN clause can be nested up to three levels. CASE statements that use a searched statement WHEN clause have no limit to the number of nesting levels.

If a CASE statement is the only statement in the procedure body, the statement cannot end with a semicolon. Otherwise, the statement must end with a semicolon.

Ensure that your CASE statement covers all possible execution conditions.

Examples

Use a simple case statement WHEN clause to update column DEPTNAME in table DEPT, depending on the value of SQL variable v_workdept.

```
CASE v_workdept
 WHEN 'A00'
  THEN UPDATE DEPT SET
   DEPTNAME = 'DATA ACCESS 1';
 WHEN 'B01'
  THEN UPDATE DEPT SET
   DEPTNAME = 'DATA ACCESS 2';
 ELSE UPDATE DEPT SET
   DEPTNAME = 'DATA ACCESS 3';
END CASE
```

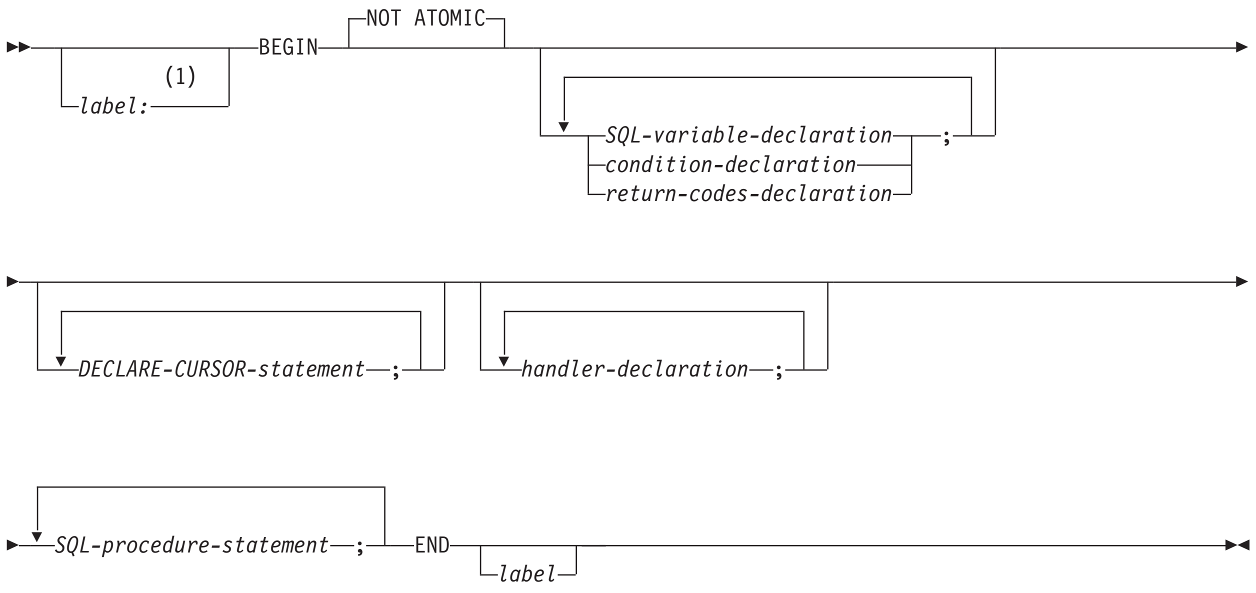
Use a searched case statement WHEN clause to update column DEPTNAME in table DEPT, depending on the value of SQL variable v_workdept.

```
CASE
 WHEN v_workdept < 'B01'
  THEN UPDATE DEPT SET
   DEPTNAME = 'DATA ACCESS 1';
 WHEN v_workdept < 'C01'
  THEN UPDATE DEPT SET
   DEPTNAME = 'DATA ACCESS 2';
 ELSE UPDATE DEPT SET
   DEPTNAME = 'DATA ACCESS 3';
END CASE
```

compound-statement

A compound statement contains a group of statements and declarations for SQL variables, cursors, and condition handlers.

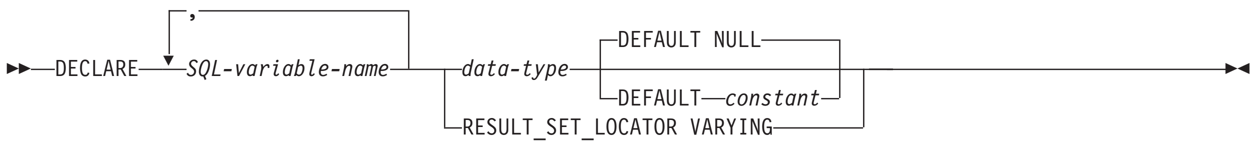
Syntax



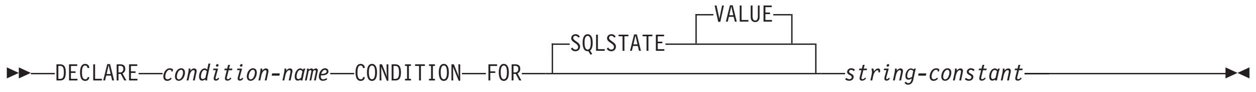
Notes:

1 Only one *label:* can be specified for each *SQL-procedure-statement*. If an ending label is specified for this beginning label, the labels must be the same.

SQL-variable-declaration:



condition-declaration:



return-codes-declaration:

```
                                  ┌─DEFAULT '00000'───┐
►►──DECLARE──┬─SQLSTATE──CHAR(5)─┼───────────────────┼─┬──────────────────────────────────────►◄
             │                    └─DEFAULT──constant─┘ │
             │                  ┌─DEFAULT 0─────────┐   │
             └─SQLCODE──INTEGER─┼───────────────────┼───┘
                                └─DEFAULT──constant─┘
```

handler-declaration:

```
►►──DECLARE──┬─CONTINUE─┬──HANDLER──FOR──┬─specific-condition-value─┬──SQL-procedure-statement────►◄
             └─EXIT─────┘                └─general-condition-value──┘
```

specific-condition-value:

```
       ┌─,────────────────────────────────────┐
       │              ┌─VALUE─┐               │
       ▼              │       │               │
►►─────┬─SQLSTATE─────┴───────┴────string─┬───┴───────────────────────────────────────────────►◄
       └─condition-name───────────────────┘
```

general-condition-value:

```
►►──┬─SQLEXCEPTION─┬──────────────────────────────────────────────────────────────────────────►◄
    ├─SQLWARNING───┤
    └─NOT FOUND────┘
```

Description

label
Defines the label for the code block. If the beginning label is specified, it can be used to qualify SQL variables declared in the compound statement and can also be specified on a LEAVE statement. If the ending label is specified, it must be the same as the beginning label.

NOT ATOMIC
NOT ATOMIC indicates that an error within the compound statement does not cause the compound statement to be rolled back.

SQL-variable-declaration
Declares a variable that is local to the compound statement.

SQL-variable-name
A qualified or unqualified name that designates a variable in an SQL procedure body. The unqualified form of an SQL variable name is an SQL identifier of 1 to 64 bytes. If the SQL variable is a delimited identifier, the

contents of the delimited identifier must conform to the rules for ordinary identifiers. The qualified form is an SQL procedure statement label followed by a period (.) and an SQL identifier.

DB2 folds all SQL variable names to uppercase. SQL variable names should not be the same as column names. If an SQL statement contains an SQL variable or parameter and a column reference with the same name, DB2 interprets the name as an SQL variable or parameter name. To refer to the column, qualify the column name with the table name. Further, to avoid ambiguous variable references and to ensure compatibility with other DB2 platforms, qualify the SQL variable or parameter name with the label of the SQL procedure statement.

data-type

Specifies the data type and length of the variable. SQL variables follow the same rules for default lengths and maximum lengths as SQL procedure parameters. See “CREATE PROCEDURE (SQL)” on page 710 for a description of SQL data types and lengths.

DEFAULT *constant* **or NULL**

Defines the default for the SQL variable. The variable is initialized when the SQL procedure is called. If a default value is not specified, the variable is initialized to NULL.

RESULT_SET_LOCATOR VARYING

Specifies the data type for a result set locator variable.

condition-declaration

Declares a condition name and corresponding SQLSTATE value.

condition-name

Specifies the name of the condition. The condition name is an SQL identifier that must be unique within the procedure body and can be referenced only within the compound statement in which it is declared.

FOR SQLSTATE *string-constant*

Specifies the SQLSTATE that is associated with the condition. The string must be specified as five characters enclosed in single quotes, and cannot be '00000'.

return-codes-declaration

Declares special variables called SQLSTATE and SQLCODE that are set automatically to the value returned after processing an SQL statement. Both the SQLSTATE and SQLCODE variables can be declared only in the outermost compound statement of the SQL procedure. Assignment to these variables is not prohibited; however, assignment is ignored by exception handlers, and processing the next SQL statement replaces the assigned value.

DECLARE-CURSOR-statement

Declares a cursor. Each cursor in the procedure body must have a unique name. An OPEN statement must be specified to open the cursor, and a FETCH statement can be specified to read rows. The cursor can be referenced only from within the compound statement. For more information on declaring a cursor, see “DECLARE CURSOR” on page 812.

handler-declaration

Specifies a set of statements to execute when an exception or completion condition occurs in the compound statement. *SQL-procedure-statement* is the set of statements that execute when the handler receives control. See “SQL-procedure-statement” on page 1115 for information on *SQL-procedure-statement*.

A handler is active only within the compound statement in which it is declared.

The actions that a handler can perform are:

CONTINUE
After the handler is invoked successfully, control is returned to the SQL statement that follows the statement that raised the exception. If the error that raised the exception is an IF, CASE, WHILE, or REPEAT statement, control returns to the statement that follows END IF, END CASE, END WHILE, or END REPEAT.

EXIT
After the handler is invoked successfully, control is returned to the end of the compound statement.

The conditions that can cause the handler to gain control are:

SQLSTATE *string*
Specifies an SQLSTATE for which the handler is invoked. The SQLSTATE cannot be '00000'.

condition-name
Specifies a condition name for which the handler is invoked. The condition name must be previously defined in a condition declaration.

SQLEXCEPTION
Specifies that the handler is invoked when an SQLEXCEPTION occurs. An SQLEXCEPTION is an SQLSTATE in which the class code is a value other than "00", "01", or "02". For more information on SQLSTATE values, see Appendix C of *DB2 Messages and Codes*.

SQLWARNING
Specifies that the handler is invoked when an SQLWARNING occurs. An SQLWARNING is an SQLSTATE value with a class code of "01".

NOT FOUND
Specifies that the handler is invoked when a NOT FOUND condition occurs. NOT FOUND corresponds to an SQLSTATE value with a class code of "02".

Notes

The order of statements in a compound statement must be:
1. SQL variable, condition declarations, and return codes declarations
2. Cursor declarations
3. Handler declarations
4. SQL procedure statements

Compound statements cannot be nested.

Unlike host variables, SQL variables are not preceded by colons when they are used in SQL statements.

The following rules apply to handlers:
- A handler declaration that contains SQLEXCEPTION, SQLWARNING, or NOT FOUND cannot contain additional SQLSTATE or condition names.
- Handler declarations within the same compound statement cannot contain duplicate conditions.

- A handler declaration cannot contain the same condition code or SQLSTATE value more than once, and cannot contain an SQLSTATE value and a condition name that represent the same SQLSTATE value.
- A handler is activated when it is the most appropriate handler for an exception or completion condition.
- If there is no handler for an SQL error, the error is passed to the caller in the SQLCA.
- A handler cannot be activated by an assignment statement that assigns a value to SQLSTATE.

The following rules and recommendations apply to the SQLCODE and SQLSTATE special variables:

- A null value cannot be assigned to SQLSTATE or SQLCODE.
- The SQLSTATE and SQLCODE variable values should be saved immediately to temporary variables if there is any intention to use the values. If a handler exists for SQLSTATE, this assignment must be done as the first statement to be processed in the handler to avoid having the value replaced by the next SQL procedure statement. If the condition raised by the SQL statement is handled, the value is changed by the first SQL statement contained in the handler.

If a compound statement is the only statement in the procedure body, the statement cannot end with a semicolon. Otherwise, the statement must end with a semicolon.

Examples

Create a procedure body with a compound statement that performs the following actions:

- Declares SQL variables, a condition for SQLSTATE '02000', a handler for the condition, and a cursor
- Opens the cursor, fetches a row, and closes the cursor

```
CREATE PROCEDURE PROC1(OUT NOROWS INT) LANGUAGE SQL
BEGIN
 DECLARE v_firstnme VARCHAR(12);
 DECLARE v_midinit CHAR(1);
 DECLARE v_lastname VARCHAR(15);
 DECLARE v_edlevel SMALLINT;
 DECLARE v_salary DECIMAL(9,2);
 DECLARE at_end INT DEFAULT 0;
 DECLARE not_found
  CONDITION FOR '02000';
 DECLARE c1 CURSOR FOR
  SELECT FIRSTNME, MIDINIT, LASTNAME,
   EDLEVEL, SALARY
  FROM EMP;
 DECLARE CONTINUE HANDLER FOR not_found SET NOROWS=1;
 OPEN c1;
 FETCH c1 INTO v_firstnme, v_midinit,
  v_lastname, v_edlevel, v_salary;
 CLOSE c1;
END
```

GET DIAGNOSTICS statement

The GET DIAGNOSTICS statement obtains information about the previous SQL statement that was executed. See “GET DIAGNOSTICS” on page 928.

When you need to specify a variable in a GET DIAGNOSTICS statement that is used within an SQL procedure, you would use either *SQL-variable-name* or *SQL-parameter-name*. In an embedded GET DIAGNOSTICS statement, you would use a *host-variable*. You can replace the instances of *host-variable* in the description of “GET DIAGNOSTICS” on page 928 with *SQL-variable-name* or *SQL-parameter-name*.

GOTO statement

The GOTO statement is used to branch to a user-defined label within an SQL procedure.

Syntax

```
►►──GOTO──label──────────────────────────────────────────────────────────────►◄
```

Description

label
Specifies a labelled statement at which processing is to continue.

The labelled statement and the GOTO statement must be in the same scope. The following rules apply to the scope:

- If the GOTO statement is defined in a compound statement, *label* must be defined inside the same compound statement. *label* cannot be in a nested compound statement.
- If the GOTO statement is defined in a handler, *label* must be defined in the same handler and follow the other scope rules.
- If the GOTO statement is defined outside of a handler, *label* must not be defined within a handler.

If *label* is not defined within a scope that the GOTO statement can reach, an error is returned.

A label name cannot be the same as the name of the SQL procedure in which the label is used.

Notes

Use the GOTO statement sparingly. Because the GOTO statement interferes with the normal sequence of processing, it makes an SQL procedure more difficult to read and maintain. Before using a GOTO statement, determine whether some other statement, such as an IF statement or LEAVE statement, can be used instead.

Examples

Use a GOTO statement to transfer control to the end of a compound statement if the value of an SQL variable is less than 600.

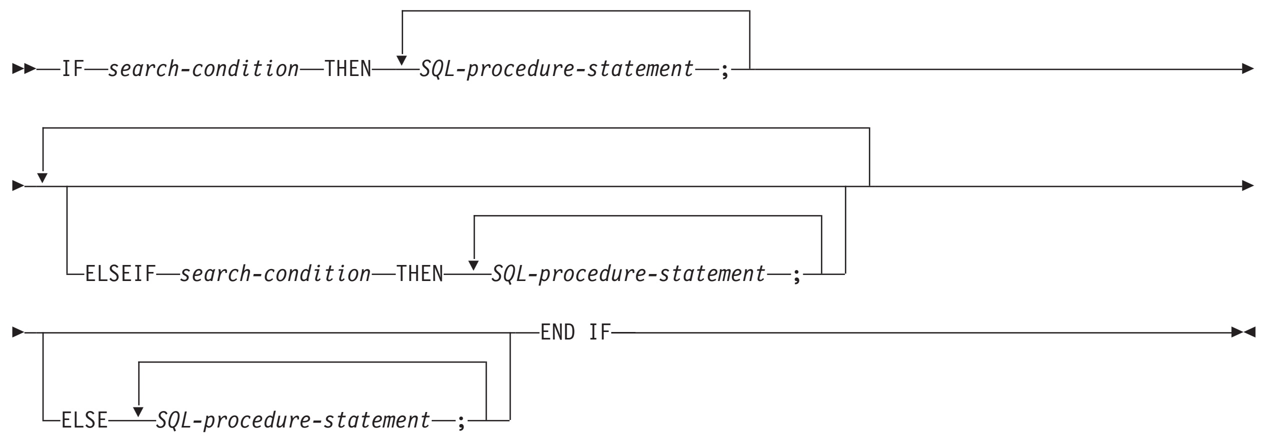
```
BEGIN
 DECLARE new_salary DECIMAL(9,2);
 DECLARE service DECIMAL(8,2);
 SELECT SALARY, CURRENT_DATE - HIREDATE
  INTO new_salary, service
 FROM EMP
WHERE EMPNO = v_empno;
IF service < 600
 THEN GOTO EXIT;
END IF;
IF rating = 1
 THEN SET new_salary =
  new_salary + (new_salary * .10);
ELSEIF rating = 2
```

```
 THEN SET new_salary =
  new_salary + (new_salary * .05);
END IF;
UPDATE EMP
SET SALARY = new_salary
WHERE EMPNO = v_empno;
EXIT: SET return_parm = service;
END
```

IF statement

The IF statement selects an execution path based on the evaluation of a condition.

Syntax



Description

search-condition
: Specifies the condition for which an SQL statement should be invoked. If the condition is unknown or false, processing continues to the next search condition until either a condition is true or processing reaches the ELSE clause.

SQL-procedure-statement
: Specifies the statement to be invoked if the preceding *search-condition* is true. If no *search-condition* evaluates to true, then the *SQL-procedure-statement* following the ELSE keyword is invoked. The statement must be one of the statements listed under “SQL-procedure-statement” on page 1115.

Examples

Assign a value to the SQL variable new_salary based on the value of SQL variable rating.

```
IF rating = 1
 THEN SET new_salary =
  new_salary + (new_salary * .10);
 ELSEIF rating = 2
  THEN SET new_salary =
   new_salary + (new_salary * .05);
 ELSE SET new_salary =
  new_salary + (new_salary * .02);
END IF
```

ITERATE statement

The ITERATE statement causes the flow of control to return to the beginning of a labelled loop.

Syntax

```
►►──ITERATE──label───────────────────────────────────────────────────────────►◄
```

Description

label
Specifies the label of the FOR, LOOP, REPEAT, or WHILE statement to which the flow of control is passed.

Examples

This example uses a cursor to return information for a new department. If the not_found condition handler is invoked, the flow of control passes out of the loop. If the value of v_dept is ’D11’, an ITERATE statement causes the flow of control to be passed back to the top of the LOOP statement. Otherwise, a new row is inserted into the table.

```
CREATE PROCEDURE ITERATOR ()
  LANGUAGE SQL
  MODIFIES SQL DATA
  BEGIN
    DECLARE v_dept CHAR(3);
    DECLARE v_deptname VARCHAR(29);
    DECLARE v_admdept CHAR(3);
    DECLARE at_end INTEGER DEFAULT 0;
    DECLARE not_found CONDITION FOR SQLSTATE '02000';
    DECLARE c1 CURSOR FOR
      SELECT deptno,deptname,admrdept
        FROM department
        ORDER BY deptno;
    DECLARE CONTINUE HANDLER FOR not_found
    SET at_end = 1;
    OPEN c1;
    ins_loop:
    LOOP
      FETCH c1 INTO v_dept, v_deptname, v_admdept;
      IF at_end = 1 THEN
        LEAVE ins_loop;
      ELSEIF v_dept = 'D11' THEN
        ITERATE ins_loop;
      END IF;
      INSERT INTO department (deptno,deptname,admrdept)
                     VALUES('NEW', v_deptname, v_admdept);
    END LOOP;
    CLOSE c1;
  END
```

LEAVE statement

The LEAVE statement transfers program control out of a loop or a compound statement.

Syntax

```
►►──LEAVE──label──────────────────────────────────────────────────────────────►◄
```

Description

label
Specifies the label of the compound statement or loop to exit.

A label name cannot be the same as the name of the SQL procedure in which the label is used.

Notes

When a LEAVE statement transfers control out of a compound statement, all open cursors in the compound statement, except cursors that are used to return result sets, are closed.

If a LEAVE statement is the only statement in the procedure body, the statement cannot end with a semicolon. Otherwise, the statement must end with a semicolon.

Examples

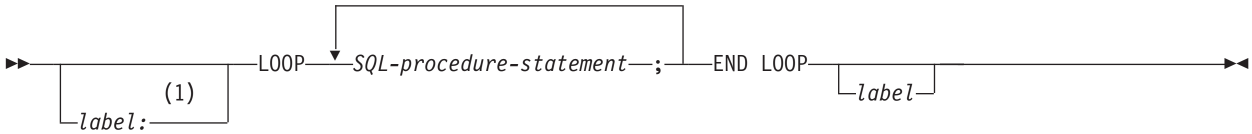
Use a LEAVE statement to transfer control out of a LOOP statement when a negative SQLCODE occurs.

```
ftch_loop: LOOP
 FETCH c1 INTO
  v_firstnme, v_midinit,
  v_lastname, v_edlevel, v_salary;
 IF SQLCODE=100 THEN LEAVE ftch_loop;
 END IF;
END LOOP
```

LOOP statement

The LOOP statement executes a statement or group of statements multiple times.

Syntax



Notes:

1 Only one *label:* can be specified for each *SQL-procedure-statement*. If an ending label is specified for this beginning label, the labels must be the same.

Description

label
: Specifies the label for the LOOP statement. If the ending label is specified, the beginning label must be specified, and the two must match.

A label name cannot be the same as the name of the SQL procedure in which the label is used.

SQL-procedure-statement
: Specifies the statements to be executed in the loop. The statement must be one of the statements listed under “SQL-procedure-statement” on page 1115.

Notes

If a LOOP statement is the only statement in the procedure body, the statement cannot end with a semicolon. Otherwise, the statement must end with a semicolon.

Examples

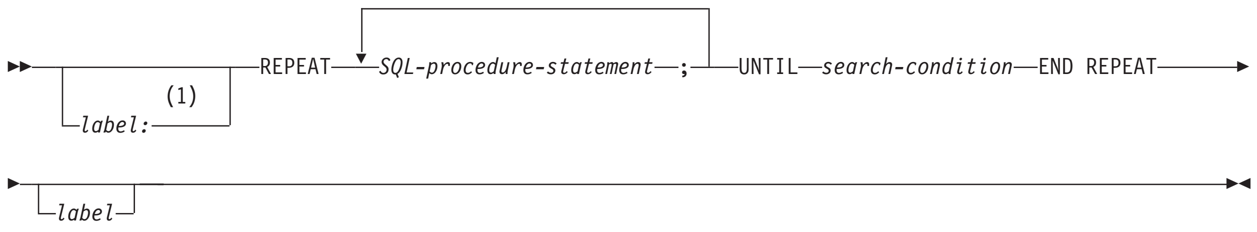
Use a LOOP statement to fetch rows from a table.

```
ftch_loop: LOOP
 FETCH c1 INTO
  v_firstnme, v_midinit,
  v_lastname, v_edlevel, v_salary;
 IF SQLCODE<>0 THEN SET badsql=1;
 END IF;
END LOOP
```

REPEAT statement

The REPEAT statement executes a statement or group of statements until a search condition is true.

Syntax



Notes:

1 Only one *label:* can be specified for each *SQL-procedure-statement*. If an ending label is specified for this beginning label, the labels must be the same.

Description

label
Specifies the label for the REPEAT statement. If the ending label is specified, the beginning label must be specified, and the two must match.

A label name cannot be the same as the name of the SQL procedure in which the label is used.

SQL-procedure-statement
Specifies the statements to be executed. The statement must be one of the statements listed under “SQL-procedure-statement” on page 1115.

search-condition
Specifies a condition that is evaluated after each execution of the SQL procedure statement. If the condition is true, the SQL procedure statement is not executed again.

Notes

If a REPEAT statement is the only statement in the procedure body, the statement cannot end with a semicolon. Otherwise, the statement must end with a semicolon.

Examples

Use a REPEAT statement to fetch rows from a table.

```
fetch_loop:
REPEAT
 FETCH c1 INTO
  v_firstnme, v_midinit, v_lastname;
UNTIL
    SQLCODE <> 0
END REPEAT fetch_loop
```

RESIGNAL statement

The RESIGNAL statement is used within a handler to return an error or warning condition. It causes an error or warning to be returned with the specified SQLSTATE, along with optional message text.

Syntax

```
►►──RESIGNAL──┬────────────────────────────────────────────────────────────────────────────┬──────►◄
              │               ┌─VALUE─┐                                                    │
              └─┬─SQLSTATE──────┴───────┴─┬─sqlstate-string-constant─┬─┬──┬────────────────────┬─┘
                │                         └─variable-name────────────┘ │  └─signal-information─┘
                └─condition-name───────────────────────────────────────┘
```

signal-information:

```
►►──SET──MESSAGE_TEXT──=──diagnostic-string-expression──────────────────────────────────────────►◄
```

Description

SQLSTATE VALUE
Specifies the SQLSTATE that will be returned. Any valid SQLSTATE value can be used. It must be a character string constant with exactly five characters that follow the rules for SQLSTATEs:

- Each character must be from the set of digits ('0' through '9') or non-accented upper case letter ('A' through 'Z').
- The SQLSTATE class (the first two characters) cannot be '00' because it represents successful completion.

If the SQLSTATE does not conform to these rules, an error occurs.

sqlstate-string-constant
A character string constant with a length of five bytes that is a valid SQLSTATE value.

variable-name
Identifies an SQL variable that must be declared within the *compound-statement*. The SQL variable must have a length of five bytes and have a valid SQLSTATE value.

condition-name
Specifies the name of the condition that will be returned. *condition-name* must be declared within the *compound-statement*.

SET MESSAGE_TEXT
Specifies a string that describes the error or warning. The string is returned in the SQLERRMC field of the SQLCA or with the GET DIAGNOSTICS statement.

diagnostic-string-expression
An expression with a data type of CHAR or VARCHAR that returns a character string of up to 1000 bytes that describes the error or warning condition. A string that is longer than 70 bytes is truncated without warning

in the SQLCA. For information on how to obtain the complete message text, see "GET DIAGNOSTICS" on page 928.

Notes

While any valid SQLSTATE value can be used in the RESIGNAL statement, programmers should define new SQLSTATEs based on ranges reserved for applications. This practice prevents the unintentional use of an SQLSTATE value that might be defined by the database manager in a future release.

If the RESIGNAL statement is issued without an SQLSTATE clause or a *condition-name*, the RESIGNAL statement must be in a handler and the identical condition that activated the handler is returned. The SQLSTATE, SQLCODE, and the SQLCA associated with the condition are unchanged.

If an SQLSTATE clause or a *condition-name* was specified, the SQLCODE returned is based on the SQLSTATE value as follows:

- If the specified SQLSTATE class is either '01' or '02', a warning or not-found message is returned, and the SQLCODE is set to +438.
- Otherwise, an exception is returned and the SQLCODE is set to -438.

The other fields of the SQLCA are set as follows:

- SQLERRDx fields are set to zero.
- SQLWARNx fields are set to blank.
- SQLERRMC is set to the first 70 bytes of MESSAGE_TEXT.
- SQLERRML is set to the length of SQLERRMC.
- SQLERRP is set to ROUTINE.

When the SQLSTATE or condition indicates that an exception is returned (an SQLSTATE class other than '01' or '02'), the exception is not handled, and control is immediately returned to the end of the compound statement.

When the SQLSTATE or condition indicates that a warning (SQLSTATE class '02') is returned, the warning is not handled, and processing continues with the next statement.

When the SQLSTATE or condition indicates that a not-found condition (SQLSTATE class '02') is returned, the not-found condition is not handled, and processing continues with the next statement.

Examples

The following example detects a division by zero error. The IF statement uses a SIGNAL statement to invoke the overflow condition handler. The condition handler uses a RESIGNAL statement to return a different SQLSTATE to the client application.

```
CREATE PROCEDURE divide (  IN numerator INTEGER,
                                  IN denominator INTEGER,
                                  OUT divide_result INTEGER)
 LANGUAGE SQL
 CONTAINS SQL
BEGIN
   DECLARE overflow CONDITION for SQLSTATE '22003' ;
     DECLARE CONTINUE HANDLER FOR overflow
     RESIGNAL SQLSTATE '22375';
   IF denominator = 0 THEN
   SIGNAL overflow;
```

```
ELSE
  SET divide_result = numerator / denominator;
END IF;
END
```

RETURN statement

The RETURN statement is used to return from the routine. For SQL functions, it returns the result of the function. For an SQL procedure, it optionally returns an integer status value.

Syntax

```
►►──RETURN──┬────────────┬──────────────────────────────────────────────►◄
            ├─expression─┤
            └─NULL───────┘
```

Description

expression
: Specifies a value that is returned from the routine.

- If the routine is a function, *expression* must be specified and the value of *expression* must conform to the SQL assignment rules as described in “Assignment and comparison” on page 74. If the value is being assigned to a string variable, storage assignment rules apply.
- If the routine is a procedure, the data type of *expression* must be INTEGER. If *expression* evaluates to the null value, a value of 0 is returned.

The *expression* cannot include a column name or a host variable. See “Expressions” on page 133 for information on expressions. The *expression* cannot contain a scalar fullselect.

NULL
: The null value is returned from the SQL function. NULL is not allowed in SQL procedures.

Notes

When a RETURN statement is not used within an SQL procedure: If a RETURN statement was not used to return from a procedure or if a value is not specified on the RETURN statement, one of the following values is set:

- If the procedure returns with an SQLCODE that is greater or equal to zero, the return status is set to a value of 0.
- If the procedure returns with an SQLCODE that is less than zero, the return status is set to a value of -1.

When a RETURN statement is used within an SQL procedure: If a RETURN statement with a specified return value was used to return from a procedure, the SQLCODE, SQLSTATE, and message length in the SQLCA are initialized to zeros and the message text is set to blanks. An error is not returned to the caller.

When the value is returned: When a value is returned from a procedure, the caller may access the value using one of the following methods:

- The GET DIAGNOSTICS statement to retrieve the RETURN_STATUS when the SQL procedure was called from another SQL procedure.
- The parameter bound for the return value parameter marker in the escape clause CALL syntax (?=CALL...) in a CLI application.

- Directly from the SQLCA returned from processing the CALL of an SQL procedure by retrieving the value of SQLERRD(0). When the SQLCODE is less than zero, the sqlerrd(0) value is not set. The application should assume a return status value of -1.

Examples

Use a RETURN statement to return from an SQL procedure with a status value of zero if successful or -200 if not successful.

```
BEGIN
       . . .
           GOTO FAIL;
       . . .
SUCCESS: RETURN 0;
   FAIL: RETURN -200;
END
```

SIGNAL statement

The SIGNAL statement is used to return an error or warning condition. It causes an error or warning to be returned with the specified SQLSTATE, along with optional message text.

Syntax

```
                      ┌─VALUE─┐                             (1)
►►─SIGNAL───┬─SQLSTATE─┴───────┴─┬─sqlstate-string-constant─┬─┬──────────────────────────►
            │                    └─variable-name────────────┘ │
            │                  (2)                            │
            └─condition-name──────────────────────────────────┘

►─┬───────────────────────────┬─────────────────────────────────────────────────────────►◄
  │                        (3)│
  └─signal-information────────┘
```

Notes:

1 The SQLSTATE variation must be used within a trigger body.

2 *condition-name* must not be specified within a trigger body.

3 *signal-information* must be specified within a trigger body

signal-information:

```
►►──┬─SET─MESSAGE_TEXT─=──diagnostic-string-expression─┬─────────────────────────────────►◄
    └─(diagnostic-string-expression)───────────────────┘
```

Description

SQLSTATE VALUE
Specifies the SQLSTATE that will be returned. Any valid SQLSTATE value can be used. It must be a character string constant with exactly five characters that follow the rules for SQLSTATEs:

- Each character must be from the set of digits ('0' through '9') or non-accented upper case letter ('A' through 'Z').
- The SQLSTATE class (the first two characters) cannot be '00' because it represents successful completion.

If the SQLSTATE does not conform to these rules, an error occurs.

sqlstate-string-constant
A character string constant with a length of five bytes that is a valid SQLSTATE value.

variable-name
Identifies an SQL variable that must be declared within the *compound-statement*. The SQL variable must have a length of five bytes and have a valid SQLSTATE value.

condition-name
Specifies the name of the condition that will be returned. *condition-name* must be declared within the *compound-statement*.

SET MESSAGE_TEXT
Specifies a string that describes the error or warning. The string is returned in the SQLERRMC field of the SQLCA or with the GET DIAGNOSTICS statement.

diagnostic-string-expression
An expression with a data type of CHAR or VARCHAR that returns a character string of up to 1000 bytes that describes the error or warning condition. A string that is longer than 70 bytes is truncated without warning in the SQLCA. For information on how to obtain the complete message text, see “GET DIAGNOSTICS” on page 928.

(diagnostic-string-expression)
An expression with a data type of CHAR or VARCHAR that returns a character string of up to 1000 bytes that describes the error or warning condition. A string that is longer than 70 bytes is truncated without warning in the SQLCA. For information on how to obtain the complete message text, see “GET DIAGNOSTICS” on page 928.

Within the triggered action of a CREATE TRIGGER statement, the message text can be specified using only these variations:

```
SIGNAL SQLSTATE sqlstate-string-constant
    SET MESSAGE_TEXT = diagnostic-string-expression

SIGNAL SQLSTATE sqlstate-string-constant
   (diagnostic-string-expression)
```

Notes

While any valid SQLSTATE value can be used in the SIGNAL statement, programmers should define new SQLSTATEs based on ranges reserved for applications. This practice prevents the unintentional use of an SQLSTATE value that might be defined by the database manager in a future release.

If a SIGNAL statement is issued, the SQLCODE that is returned is based on the SQLSTATE as follows:

- If the specified SQLSTATE class is either ’01’ or ’02’, a warning or not- found message is returned, and the SQLCODE is set to +438.
- Otherwise, an exception is returned and the SQLCODE is set to -438.

The other fields of the SQLCA are set as follows:

- SQLERRDx fields are set to zero.
- SQLWARNx fields are set to blank.
- SQLERRMC is set to the first 70 bytes of MESSAGE_TEXT.
- SQLERRML is set to the length of SQLERRMC.
- SQLERRP is set to ROUTINE.

When the SQLSTATE or condition indicates that an exception (an SQLSTATE class other than ’01’ or ’02’) is returned, one of the following actions occurs:

- If a handler exists for the specified SQLSTATE, condition, or SQLEXCEPTION, the exception is handled, and control is transferred to that handler.
- Otherwise, the exception is not handled, and control is immediately returned to the end of the compound statement.

When the SQLSTATE or condition indicates that a warning (SQLSTATE class ’01’) is returned, one of the following actions occurs:

- If an active handler exists for the specified SQLSTATE, condition, or SQLWARNING, the warning is handled, and control is transferred to that handler.
- Otherwise, the warning is not handled, and processing continues with the next statement.

When the SQLSTATE or condition indicates that a not-found condition (SQLSTATE class ’02’) is returned, one of the following actions occurs:

- If an active handler exists for the specified SQLSTATE, condition, or not-found condition, the not-found condition is handled, and control is transferred to that handler.
- Otherwise, the not-found condition is not handled, and processing continues with the next statement.

When the SIGNAL statement is issued in a handler, no active handler exists.

Examples

Example 1: The following example shows an SQL procedure for an order system that signals an application error when a customer number is not known to the application. The ORDERS table includes a foreign key to the CUSTOMER table, requiring that the CUSTNO exist before an order can be inserted.

```
CREATE PROCEDURE SUBMIT ORDER
            (IN ONUM INTEGER, IN CNUM INTEGER,
             IN PNUM INTEGER, IN QNUM INTEGER)
 LANGUAGE SQL
 SPECIFIC SUBMIT_ORDER
 MODIFIES SQL DATA
BEGIN
   DECLARE EXIT HANDLER FOR SQLSTATE VALUE '23503'
     SIGNAL SQLSTATE '75002'
         SET MESSAGE_TEXT = 'Customer number is not known';
   INSERT INTO ORDERS (ORDERNO, CUSTNO, PARTNO, QUANTITY)
      VALUES (ONUM, CNUM, PNUM, QNUM);
END
```

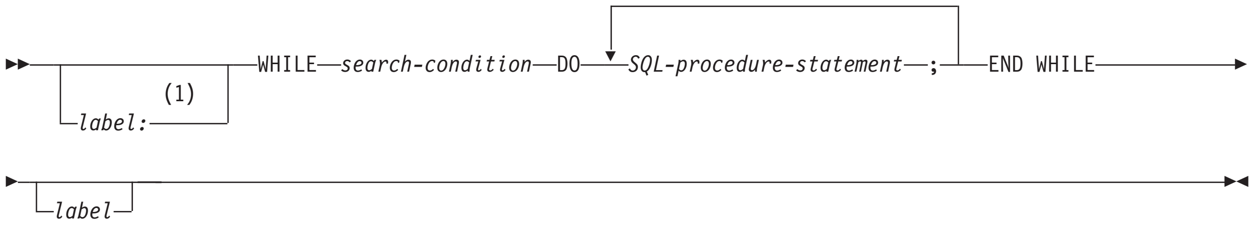
Example 2: The following example shows a trigger for an order system that allows orders to be recorded in an ORDERS table (ORDERNO, CUSTNO, PARTNO, QUANTITY) only if there is sufficient stock in the PARTS tables. When there is insufficient stock for an order, SQLSTATE ’75001’ is returned along with an appropriate error description.

```
  CREATE TRIGGER CK_AVAIL
        NO CASCADE BEFORE INSERT ON ORDERS
        REFERENCING NEW AS NEW_ORDER
        FOR EACH ROW MODE DB2SQL
        WHEN (NEW_ORDER.QUANTITY > (SELECT ON_HAND FROM PARTS
                                    WHERE NEW_ORDER.PARTNO = PARTS.PARTNO))
          BEGIN ATOMIC
            SIGNAL SQLSTATE '75001' ('Insufficient stock for order');
          END
```

WHILE statement

The WHILE statement repeats the execution of a statement or group of statements while a specified condition is true.

Syntax



Notes:

1 Only one *label:* can be specified for each *SQL-procedure-statement*. If an ending label is specified for this beginning label, the labels must be the same.

Description

label
: Specifies the label for the WHILE statement. If the ending label is specified, it must be the same as the beginning label.

A label name cannot be the same as the name of the SQL procedure in which the label is used.

search-condition
: Specifies a condition that is evaluated before each execution of the loop. If the condition is true, the SQL procedure statement in the loop is executed.

SQL-procedure-statement
: Specifies the statements to be executed in the loop. The statement must be one of the statements listed under "SQL-procedure-statement" on page 1115.

Notes

If a WHILE statement is the only statement in the procedure body, the statement cannot end with a semicolon. Otherwise, the statement must end with a semicolon.

Examples

Use a WHILE statement to fetch rows from a table while SQL variable at_end, which indicates whether the end of the table has been reached, is 0.

```
WHILE at_end = 0 DO
 FETCH c1 INTO
  v_firstnme, v_midinit,
  v_lastname, v_edlevel, v_salary;
 IF SQLCODE=100 THEN SET at_end=1;
 END IF;
END WHILE
```

Appendix A. Limits in DB2 UDB for z/OS

System storage limits might preclude the limits specified in this section. The limit for items not that are not specified below is limited by system storage.

Table 87 shows the length limits for identifiers.

Table 87. Identifier length limits. The term byte in this table means the number of bytes for the UTF-8 representation unless noted otherwise.

Item	Limit
External-java-routine-name	1305 bytes
Name of an alias, auxiliary table, collection, constraint, correlation, cursor (except for DECLARE CURSOR WITH RETURN or the EXEC SQL utility), distinct type (both parts of two-part name), function (both parts of two-part name), host identifier, index, JARs, parameter, procedure, schema, sequence, specific, statement, storage group, savepoint, SQL condition, SQL label, SQL parameter, SQL variable, synonym, table, trigger, view, XML attribute name, XML element name	128 bytes
Name of an authorization ID	8 bytes
Name of a version	64 bytes
Name of a column	30 bytes
Name of cursor that is created with DECLARE CURSOR WITH RETURN	30 bytes
Name of cursor that is created with the EXEC SQL utility	8 bytes
Name of a location	16 bytes
Name of buffer pool name, catalog, database, plan, program, table space	8 bytes
Name of package	8 bytes (Only 8 EBCDIC characters are used for packages that are created with the BIND PACKAGE command. 128 bytes can be used for packages that are created as a result of the CREATE TRIGGER statement.)

Table 88 shows the minimum and maximum limits for numeric values.

Table 88. Numeric limits

Item	Limit
Smallest SMALLINT value	-32768
Largest SMALLINT value	32767
Smallest INTEGER value	-2147483648
Largest INTEGER value	2147483647
Smallest REAL value	About -7.2×10^{75}
Largest REAL value	About 7.2×10^{75}
Smallest positive REAL value	About 5.4×10^{-79}
Largest negative REAL value	About -5.4×10^{-79}
Smallest FLOAT value	About -7.2×10^{75}
Largest FLOAT value	About 7.2×10^{75}

Table 88. Numeric limits (continued)

Item	Limit
Smallest positive FLOAT value	About 5.4×10^{-79}
Largest negative FLOAT value	About -5.4×10^{-79}
Smallest DECIMAL value	$1 - 10^{31}$
Largest DECIMAL value	$10^{31} - 1$
Largest decimal precision	31

Table 89 shows the length limits for strings.

Table 89. String length limits

Item	Limit
Maximum length of CHAR	255 bytes
Maximum length of GRAPHIC	127 double-byte characters
Maximum length[1] of VARCHAR	4046 bytes for 4-KB pages 8128 bytes for 8-KB pages 16320 bytes for 16-KB pages 32704 bytes for 32-KB pages
Maximum length[1] of VARGRAPHIC	2023 double-byte characters for 4-KB pages 4064 double-byte characters for 8-KB pages 8160 double-byte characters for 16-KB pages 16352 double-byte characters for 32-KB pages
Maximum length of CLOB	2 147 483 647 bytes (2 GB - 1 byte)
Maximum length of DBCLOB	1 073 741 823 double-byte characters
Maximum length of BLOB	2 147 483 647 bytes (2 GB - 1 byte)
Maximum length of a character constant	32704 UTF-8 bytes
Maximum length of a hexadecimal character constant	32704 hexadecimal digits
Maximum length of a graphic string constant	32704 UTF-8 bytes
Maximum length of a hexadecimal graphic string constant	32704 hexadecimal digits
Maximum length of a concatenated character string	2 147 483 647 bytes (2 GB - 1 byte)
Maximum length of a concatenated graphic string	1 073 741 824 double-byte characters
Maximum length of a concatenated binary string	2 147 483 647 bytes (2 GB - 1 byte)

Note:

1. The maximum length can be achieved only if the column is the only column in the table. Otherwise, the maximum length depends on the amount of space remaining on a page.

Table 90 shows the minimum and maximum limits for datetime values.

Table 90. Datetime limits

Item	Limit
Smallest DATE value (shown in ISO format)	0001-01-01
Largest DATE value (shown in ISO format)	9999-12-31
Smallest TIME value (shown in ISO format)	00.00.00
Largest TIME value (shown in ISO format)	24.00.00
Smallest TIMESTAMP value	0001-01-01-00.00.00.000000

Table 90. Datetime limits (continued)

Item	Limit
Largest TIMESTAMP value	9999-12-31-24.00.00.000000

Table 91 shows the DB2 limits on SQL statements.

Table 91. DB2 limits on SQL statements

Item	Limit
Maximum number of columns that are in a table or view (the value depends on the complexity of the CREATE VIEW statement) or columns returned by a table function.	750 or fewer 749 if the table is a dependent
Maximum number of base tables in a view, SELECT, UPDATE, INSERT, or DELETE	225
Maximum row and record sizes for a table	See “Maximum record size” on page 767 under CREATE TABLE
Maximum number of volume IDs in a storage group	133
Maximum number of partitions in a partitioned table space or partitioned index	64 for table spaces that are not defined with LARGE or a DSSIZE greater than 2 GB. 4096, depending on what is specified for DDSIZE or LARGE and the page size.
Maximum size of a partition (table space or index)	For table spaces that are not defined with LARGE or a DSSIZE greater than 2 GB: 4 GB, for 1 to 16 partitions 2 GB, for 17 to 32 partitions 1 GB, for 33 to 64 partitions For table spaces that are defined with LARGE: 4 GB, for 1 to 4096 partitions For table spaces that are defined with a DSSIZE greater than 2 GB: 64 GB, depending on the page size (1 to 256 partitions for 4-KB, 1 to 512 partitions for 16-KB, 1 to 1024 partitions for 32-KB, and 1 to 2048 for 32-KB)
Maximum size of a DBRM entry	131072 bytes
Maximum length of an index key	Partitioning index: 255-*n* Nonpartitioning index that is padded: 2000-*n* Nonpartitioning index that is not padded: 2000-*n*-2m Where *n* is the number of columns in the key that allow nulls and *m* is the number of varying-length columns in the key
Maximum number of bytes used in the partitioning of a partitioned index	255 (This maximum limit is subject to additional limitations, depending on the number of partitions in the table space. The number of partitions * (106 + limit key size) must be less than 65394.)
Maximum number of columns in an index key	64
Maximum number of tables in a FROM clause	225 or fewer, depending on the complexity of the statement
Maximum number of subqueries in a statement	224

Table 91. DB2 limits on SQL statements (continued)

Item	Limit
Maximum total length of host and indicator variables pointed to in an SQLDA	32767 bytes 2 147 483 647 bytes (2 GB - 1 byte) for a LOB, subject to the limitations that are imposed by the application environment and host language
Longest host variable used for insert or update	32704 bytes for a non-LOB 2 147 483 647 bytes (2 GB - 1 byte) for a LOB, subject to the limitations that are imposed by the application environment and host language
| Longest SQL statement	2 097 152 bytes
Maximum number of elements in a select list	750 or fewer, depending on whether the select list includes a hidden ROWID column or is for the result table of static scrollable cursor[1]
Maximum number of predicates in a WHERE or HAVING clause	Limited by storage
Maximum total length of columns of a query operation requiring a sort key (SELECT DISTINCT, ORDER BY, GROUP BY, UNION without the ALL keyword, and the DISTINCT keyword for aggregate functions)	4000 bytes
| Maximum length of a sort key	16000 bytes
Maximum length of a check constraint	3800 bytes
Maximum number of bytes that can be passed in a single parameter of an SQL CALL statement	32765 bytes for a non-LOB 2 147 483 647 bytes (2 GB - 1 byte) for a LOB, subject to the limitations imposed by the application environment and host language
Maximum number of stored procedures, triggers, and user-defined functions that an SQL statement can implicitly or explicitly reference	16 nesting levels
| Maximum length of the SQL path	2048 bytes

Note:

1. If the scrollable cursor is read-only, the maximum number is 749 less the number of columns in the ORDER BY that are not in the select list. If the scrollable cursor is not read-only, the maximum number is 747.

Table 92 shows the DB2 system limits.

Table 92. DB2 system limits

Item	Limit
Maximum number of concurrent DB2 or application agents	Limited by the EDM pool size, buffer pool size, and the amount of storage that is used by each DB2 or application agent
| Largest table or table space	128 terabytes (TB)
| Largest simple or segmented table space	64 GB
Largest log space	2^{48}
Largest active log data set	4 GB -1 byte
Largest archive log data set	4 GB -1 byte
Maximum number of active log copies	2

Table 92. DB2 system limits (continued)

Item	Limit
Maximum number of archive log copies	2
Maximum number of active log data sets (each copy)	93
Maximum number of archive log volumes (each copy)	10000
Maximum number of databases accessible to an application or end user	Limited by system storage and EDM pool size
Largest EDM pool	The installation parameter maximum depends on available space
Maximum number of databases	65217
Maximum number of rows per page	255 for all table spaces except catalog and directory tables spaces, which have a maximum of 127
Maximum simple or segmented data set size	2 GB
Maximum partitioned data set size	See item “maximum size of a partition” in Table 91 on page 1147
Maximum LOB data set size	64 GB
Maximum number of rows that can be inserted with a single INSERT statement	32767 rows

Appendix B. Reserved schema names and reserved words

There are restrictions on the use of certain names that are used by the database manager. In some cases, names are reserved and cannot be used by application programs. In other cases, certain names are not recommended for use by application programs though not prevented by the database manager.

Reserved schema names

In general, for distinct types, user-defined functions, stored procedures, sequences, and triggers, schema names that begin with the prefix SYS are reserved. The schema name for these objects cannot begin with SYS with these exceptions:

- SYSADM. The schema name can be SYSADM for all these objects.
- SYSIBM. The schema name can be SYSIBM for procedures.
- SYSPROC. The schema name can be SYSPROC for procedures.
- SYSTOOLS. The schema name can be SYSTOOLS for distinct types, user-defined functions, procedures, and triggers if the user who executes the CREATE statement has the SYSADM or SYSCTRL privilege.

It is also recommended not to use SESSION name as a schema name.

Reserved words

Table 93 on page 1152 lists the words that cannot be used as ordinary identifiers in some contexts because they might be interpreted as SQL keywords. For example, ALL cannot be a column name in a SELECT statement. Each word, however, can be used as a delimited identifier in contexts where it otherwise cannot be used as an ordinary identifier. For example, if the quotation mark (") is the escape character that begins and ends delimited identifiers, “ALL” can appear as a column name in a SELECT statement. In addition, some sections of this book might indicate words that cannot be used in the specific context that is being described.

Table 93. SQL reserved words

ADD
AFTER
ALL
ALLOCATE
ALLOW
ALTER
AND
ANY
AS
ASENSITIVE[2]
ASSOCIATE
ASUTIME
AUDIT
AUX
AUXILIARY
BEFORE
BEGIN
BETWEEN
BUFFERPOOL
BY
CALL
CAPTURE
CASCADED
CASE
CAST
CCSID
CHAR
CHARACTER
CHECK
CLOSE
CLUSTER
COLLECTION
COLLID
COLUMN
COMMENT
COMMIT
CONCAT
CONDITION
CONNECT
CONNECTION
CONSTRAINT
CONTAINS
CONTINUE
CREATE
CURRENT
CURRENT_DATE
CURRENT_LC_CTYPE
CURRENT_PATH
CURRENT_TIME
CURRENT_TIMESTAMP
CURSOR
DATA
DATABASE
DAY
DAYS
DBINFO
DECLARE
DEFAULT
DELETE
DESCRIPTOR
DETERMINISTIC
DISALLOW
DISTINCT
DO
DOUBLE
DROP
DSSIZE
DYNAMIC
EDITPROC
ELSE
ELSEIF
ENCODING
ENCRYPTION[2]
END
ENDING[2]
END-EXEC[1]
ERASE
ESCAPE
EXCEPT
EXCEPTION[2]
EXECUTE
EXISTS
EXIT
EXPLAIN
EXTERNAL
FENCED
FETCH
FIELDPROC
FINAL
FOR
FREE
FROM
FULL
FUNCTION
GENERATED
GET
GLOBAL
GO
GOTO
GRANT
GROUP
HANDLER
HAVING
HOLD[2]
HOUR
HOURS
IF
IMMEDIATE
IN
INCLUSIVE[2]
INDEX
INHERIT
INNER
INOUT
INSENSITIVE
INSERT
INTO
IS
ISOBID
ITERATE[2]
JAR
JOIN
KEY
LABEL
LANGUAGE
LC_CTYPE
LEAVE
LEFT
LIKE
LOCAL
LOCALE
LOCATOR
LOCATORS
LOCK
LOCKMAX
LOCKSIZE
LONG
LOOP
MAINTAINED[2]
MATERIALIZED[2]
MICROSECOND
MICROSECONDS
MINUTE
MINUTES
MODIFIES
MONTH
MONTHS
NEXTVAL[2]
NO
NONE[2]
NOT
NULL
NULLS
NUMPARTS
OBID
OF
ON
OPEN
OPTIMIZATION
OPTIMIZE
OR
ORDER
OUT
OUTER
PACKAGE
PARAMETER
PART
PADDED[2]
PARTITION[2]
PARTITIONED[2]
PARTITIONING[2]
PATH
PIECESIZE
PLAN
PRECISION
PREPARE
PREVVAL[2]
PRIQTY
PRIVILEGES
PROCEDURE
PROGRAM
PSID
QUERY[2]
QUERYNO
READS
REFERENCES
REFRESH[2]
RESIGNAL[2]
RELEASE
RENAME
REPEAT
RESTRICT
RESULT
RESULT_SET_LOCATOR
RETURN
RETURNS
REVOKE
RIGHT
ROLLBACK
ROWSET[2]
RUN
SAVEPOINT
SCHEMA
SCRATCHPAD
SECOND
SECONDS
SECQTY[2]
SECURITY[2]
SEQUENCE[2]
SELECT
SENSITIVE
SET
SIGNAL[2]
SIMPLE
SOME
SOURCE
SPECIFIC
STANDARD
STATIC
STAY
STOGROUP
STORES
STYLE
SUMMARY[2]
SYNONYM
SYSFUN
SYSIBM
SYSPROC
SYSTEM
TABLE
TABLESPACE
THEN
TO
TRIGGER
UNDO
UNION
UNIQUE
UNTIL
UPDATE
USER
USING
VALIDPROC
VALUE[2]
VALUES
VARIABLE[2]
VARIANT
VCAT
VIEW
VOLATILE[2]
VOLUMES
WHEN
WHENEVER
WHERE
WHILE
WITH
WLM
XMLELEMENT[2]
YEAR
YEARS

Note: [1] COBOL only
Note: [2] New reserved word for Version 8.

IBM SQL has additional reserved words that DB2 UDB for z/OS does not enforce. Therefore, we suggest that you do not use these additional reserved words as ordinary identifiers in names that have a continuing use. See *IBM DB2 Universal Database SQL Reference for Cross-Platform Development* for a list of the words.

Appendix C. Characteristics of SQL statements in DB2 UDB for z/OS

Actions allowed on SQL statements

Table 94 shows whether a specific DB2 statement can be executed, prepared interactively or dynamically, or processed by the requester, the server, or the precompiler. The letter **Y** means *yes*.

Table 94. Actions allowed on SQL statements in DB2 UDB for z/OS

SQL statement	Executable	Interactively or dynamically prepared	Processed by		
			Requesting system	Server	Precompiler
ALLOCATE CURSOR[1]	Y	Y	Y		
ALTER[2]	Y	Y		Y	
ASSOCIATE LOCATORS[1]	Y	Y	Y		
BEGIN DECLARE SECTION					Y
CALL[1]	Y			Y	
CLOSE	Y			Y	
COMMENT	Y	Y		Y	
COMMIT[8]	Y	Y		Y	
CONNECT	Y		Y		
CREATE[2]	Y	Y		Y	
DECLARE CURSOR					Y
DECLARE GLOBAL TEMPORARY TABLE	Y	Y		Y	
DECLARE STATEMENT					Y
DECLARE TABLE					Y
DELETE	Y	Y		Y	
DESCRIBE prepared statement or table	Y			Y	
DESCRIBE CURSOR	Y		Y		
DESCRIBE INPUT	Y			Y	
DESCRIBE PROCEDURE	Y		Y		
DROP[2]	Y	Y		Y	
END DECLARE SECTION					Y
EXECUTE	Y			Y	
EXECUTE IMMEDIATE	Y			Y	
EXPLAIN	Y	Y		Y	
FETCH	Y			Y	
FREE LOCATOR[1]	Y	Y		Y	
GET DIAGNOSTICS	Y			Y	
GRANT[2]	Y	Y		Y	
HOLD LOCATOR[1]	Y	Y		Y	

Table 94. Actions allowed on SQL statements in DB2 UDB for z/OS (continued)

			Processed by		
SQL statement	Executable	Interactively or dynamically prepared	Requesting system	Server	Precompiler
INCLUDE					Y
INSERT	Y	Y		Y	
LABEL	Y	Y		Y	
LOCK TABLE	Y	Y		Y	
OPEN	Y			Y	
PREPARE	Y			Y[4]	
REFRESH TABLE	Y	Y		Y	
RELEASE connection	Y		Y		
RELEASE SAVEPOINT	Y	Y		Y	
RENAME[2]	Y	Y		Y	
REVOKE[2]	Y	Y		Y	
ROLLBACK[8]	Y	Y		Y	
SAVEPOINT	Y	Y		Y	
SELECT INTO	Y			Y	
SET CONNECTION	Y		Y		
SET CURRENT APPLICATION ENCODING SCHEME	Y		Y		
SET CURRENT DEGREE	Y	Y		Y	
SET CURRENT LC_CTYPE	Y	Y		Y	
SET CURRENT MAINTAINED TABLE TYPES FOR OPTIMIZATION	Y	Y		Y	
SET CURRENT OPTIMIZATION HINT	Y	Y		Y	
SET CURRENT PACKAGE PATH	Y		Y		
SET CURRENT PACKAGESET	Y			Y	
SET CURRENT PRECISION	Y	Y		Y	
SET CURRENT REFRESH AGE	Y	Y		Y	
SET CURRENT RULES	Y	Y		Y	
SET CURRENT SQLID[5]	Y	Y		Y	
SET *host-variable* = CURRENT APPLICATION ENCODING SCHEME	Y	Y	Y		
SET *host-variable* = CURRENT DATE	Y			Y	
SET *host-variable* = CURRENT DEGREE	Y			Y	
SET *host-variable* = CURRENT MEMBER	Y			Y	
SET *host-variable* = CURRENT PACKAGESET	Y		Y		

Table 94. Actions allowed on SQL statements in DB2 UDB for z/OS (continued)

SQL statement	Executable	Interactively or dynamically prepared	Processed by		
			Requesting system	Server	Precompiler
SET *host-variable* = CURRENT PATH	Y			Y	
SET *host-variable* = CURRENT QUERY OPTIMIZATION LEVEL	Y			Y	
SET *host-variable* = CURRENT SERVER	Y		Y		
SET *host-variable* = CURRENT SQLID	Y			Y	
SET *host-variable* = CURRENT TIME	Y			Y	
SET *host-variable* = CURRENT TIMESTAMP	Y			Y	
SET *host-variable* = CURRENT TIMEZONE	Y			Y	
SET PATH	Y	Y		Y	
SET SCHEMA	Y	Y		Y	
SET *transition-variable* = CURRENT DATE	Y			Y	
SET *transition-variable* = CURRENT DEGREE	Y			Y	
SET *transition-variable* = CURRENT PATH	Y			Y	
SET *transition-variable* = CURRENT QUERY OPTIMIZATION LEVEL	Y			Y	
SET *transition-variable* = CURRENT SQLID	Y			Y	
SET *transition-variable* = CURRENT TIME	Y			Y	
SET *transition-variable* = CURRENT TIMESTAMP	Y			Y	
SET *transition-variable* = CURRENT TIMEZONE	Y			Y	
SIGNAL SQLSTATE[6]	Y			Y	
UPDATE	Y	Y		Y	
VALUES[6]	Y			Y	
VALUES INTO[7]	Y			Y	
WHENEVER					Y

Table 94. Actions allowed on SQL statements in DB2 UDB for z/OS (continued)

SQL statement	Executable	Interactively or dynamically prepared	Processed by		
			Requesting system	Server	Precompiler

Notes:

1. The statement can be dynamically prepared. It cannot be issued dynamically.
2. The statement can be dynamically prepared only if DYNAMICRULES run behavior is implicitly or explicitly specified.
3. The statement can be dynamically prepared, but only from an ODBC or CLI driver that supports dynamic CALL statements.
4. The requesting system processes the PREPARE statement when the statement being prepared is ALLOCATE CURSOR or ASSOCIATE LOCATORS.
5. The value to which special register CURRENT SQLID is set is used as the SQL authorization ID and the implicit qualifier for dynamic SQL statements only when DYNAMICRULES run behavior is in effect. The CURRENT SQLID value is ignored for the other DYNAMICRULES behaviors.
6. This statement can be used only in the triggered action of a trigger.
7. Local special registers can be referenced in a VALUES INTO statement if it results in the assignment of a single host-variable, not if it results in setting more than one value.
8. Some processing also occurs at the requester.

SQL statements allowed in external functions and stored procedures

Table 95 shows which SQL statements in an external stored procedure or in an external user-defined function can execute. Whether the statements can be executed depends on the level of SQL data access with which the stored procedure or external function is defined (NO SQL, CONTAINS SQL, READS SQL DATA, or MODIFIES SQL DATA). The letter **Y** means *yes*.

In general, if an executable SQL statement is encountered in a stored procedure or function defined as NO SQL, SQLSTATE 38001 is returned. If the routine is defined to allow some level of SQL access, SQL statements that are not supported in any context return SQLSTATE 38003. SQL statements not allowed for routines defined as CONTAINS SQL return SQLSTATE 38004, and SQL statements not allowed for READS SQL DATA return SQL STATE 38002.

Table 95. SQL statements in external user-defined functions and stored procedures

SQL statement	Level of SQL access			
	NO SQL	CONTAINS SQL	READS SQL DATA	MODIFIES SQL DATA
ALLOCATE CURSOR			**Y**	**Y**
ALTER				**Y**
ASSOCIATE LOCATORS			**Y**	**Y**
BEGIN DECLARE SECTION	**Y**[1]	**Y**	**Y**	**Y**
CALL		**Y**[2]	**Y**[2]	**Y**[2]
CLOSE			**Y**	**Y**
COMMENT				**Y**
COMMIT[3]		**Y**	**Y**	**Y**
CONNECT		**Y**	**Y**	**Y**
CREATE				**Y**

Table 95. SQL statements in external user-defined functions and stored procedures (continued)

	Level of SQL access			
SQL statement	**NO SQL**	**CONTAINS SQL**	**READS SQL DATA**	**MODIFIES SQL DATA**
DECLARE CURSOR	**Y**[1]	**Y**	**Y**	**Y**
DECLARE GLOBAL TEMPORARY TABLE				**Y**
DECLARE STATEMENT	**Y**[1]	**Y**	**Y**	**Y**
DECLARE TABLE	**Y**[1]	**Y**	**Y**	**Y**
DELETE				**Y**
DESCRIBE			**Y**	**Y**
DESCRIBE CURSOR			**Y**	**Y**
DESCRIBE INPUT			**Y**	**Y**
DESCRIBE PROCEDURE			**Y**	**Y**
DROP				**Y**
END DECLARE SECTION	**Y**[1]	**Y**	**Y**	**Y**
EXECUTE		**Y**[4]	**Y**[4]	**Y**
EXECUTE IMMEDIATE		**Y**[4]	**Y**[4]	**Y**
EXPLAIN				**Y**
FETCH			**Y**	**Y**
FREE LOCATOR		**Y**	**Y**	**Y**
GET DIAGNOSTICS		**Y**	**Y**	**Y**
GRANT				**Y**
HOLD LOCATOR		**Y**	**Y**	**Y**
INCLUDE	**Y**[1]	**Y**	**Y**	**Y**
INSERT				**Y**
LABEL				**Y**
LOCK TABLE		**Y**	**Y**	**Y**
OPEN			**Y**	**Y**
PREPARE		**Y**	**Y**	**Y**
REFRESH TABLE				**Y**
RELEASE connection		**Y**	**Y**	**Y**
RELEASE SAVEPOINT[6]				**Y**
REVOKE				**Y**
ROLLBACK[6, 7, 8]		**Y**	**Y**	**Y**
ROLLBACK TO SAVEPOINT[6, 7, 8]				**Y**
SAVEPOINT[6]				**Y**
SELECT			**Y**[9]	**Y**
SELECT INTO			**Y**	**Y**
SET CONNECTION		**Y**	**Y**	**Y**
SET host-variable Assignment		**Y**[5]	**Y**	**Y**

Table 95. SQL statements in external user-defined functions and stored procedures (continued)

	Level of SQL access			
SQL statement	**NO SQL**	**CONTAINS SQL**	**READS SQL DATA**	**MODIFIES SQL DATA**
SET special register		**Y**	**Y**	**Y**
SET transition-variable Assignment		**Y**[5]	**Y**	**Y**
SIGNAL SQLSTATE		**Y**	**Y**	**Y**
UPDATE				**Y**
VALUES			**Y**	**Y**
VALUES INTO		**Y**[5]	**Y**	**Y**
WHENEVER	**Y**[1]	**Y**	**Y**	**Y**

Notes:

1. Although the SQL option implies that no SQL statements can be specified, non-executable statements are not restricted.
2. The stored procedure that is called must have the same or more restrictive level of SQL data access than the current level in effect. For example, a routine defined as MODIFIES SQL DATA can call a stored procedure defined as MODIFIES SQL DATA, READS SQL DATA, or CONTAINS SQL. A routine defined as CONTAINS SQL can only call a procedure defined as CONTAINS SQL.
3. The COMMIT statement cannot be executed in a user-defined function. The COMMIT statement cannot be executed in a stored procedure if the procedure is in the calling chain of a user-defined function or trigger.
4. The statement specified for the EXECUTE statement must be a statement that is allowed for the particular level of SQL data access in effect. For example, if the level in effect is READS SQL DATA, the statement must not be an INSERT, UPDATE, or DELETE.
5. The statement is supported only if it does not contain a subquery or query-expression.
6. RELEASE SAVEPOINT, SAVEPOINT, and ROLLBACK (with the TO SAVEPOINT clause) cannot be executed from a user-defined function.
7. If the ROLLBACK statement (without the TO SAVEPOINT clause) is executed in a user-defined function, an error is returned to the calling program, and the application is placed in a *must rollback* state.
8. The ROLLBACK statement (without the TO SAVEPOINT clause) cannot be executed in a stored procedure if the procedure is in the calling chain of a user-defined function or trigger.
9. If the SELECT statement contains an INSERT in its FROM clause (INSERT within SELECT), the SQL level of access must be MODIFIES SQL DATA.

SQL statements allowed in SQL procedures

Table 96 on page 1161 lists the statements that are valid in an SQL procedure body, in addition to SQL procedure statements. The table lists the statements that can be used as the only statement in the SQL procedure and as the statements that can be nested in a compound statement. An SQL statement can be executed in an SQL procedure depending on whether MODIFIES SQL DATA, CONTAINS SQL, or READS SQL DATA is specified in the stored procedure definition. See Table 95 on page 1158 for a list of SQL statements that can be executed for each of these parameter values.

Table 96. Valid SQL statements in an SQL procedure body

	SQL statement is...	
SQL statement	**The only statement in the procedure**	**Nested in a compound statement**
ALLOCATE CURSOR		Y
ALTER DATABASE	Y	Y
ALTER FUNCTION	Y	Y
ALTER INDEX	Y	Y
ALTER PROCEDURE	Y	Y
ALTER SEQUENCE	Y	Y
ALTER STOGROUP	Y	Y
ALTER TABLE	Y	Y
ALTER TABLESPACE	Y	Y
ALTER VIEW	Y	Y
ASSOCIATE LOCATORS		Y
BEGIN DECLARE SECTION		
CALL		Y
CLOSE		Y
COMMENT	Y	Y
COMMIT[1]	Y	Y
CONNECT	Y	Y
CREATE ALIAS	Y	Y
CREATE DATABASE	Y	Y
CREATE DISTINCT TYPE	Y	Y
CREATE FUNCTION[2]	Y	Y
CREATE GLOBAL TEMPORARY TABLE	Y	Y
CREATE INDEX	Y	Y
CREATE PROCEDURE[2]	Y	Y
CREATE SEQUENCE	Y	Y
CREATE STOGROUP	Y	Y
CREATE SYNONYM	Y	Y
CREATE TABLE	Y	Y
CREATE TABLESPACE	Y	Y
CREATE TRIGGER		
CREATE VIEW	Y	Y
DECLARE CURSOR		Y
DECLARE GLOBAL TEMPORARY TABLE	Y	Y
DECLARE STATEMENT		
DECLARE TABLE		
DELETE	Y	Y
DESCRIBE prepared statement or table		

Table 96. Valid SQL statements in an SQL procedure body (continued)

SQL statement	SQL statement is... The only statement in the procedure	Nested in a compound statement
DESCRIBE CURSOR		
DESCRIBE INPUT		
DESCRIBE PROCEDURE		
DROP	**Y**	**Y**
END DECLARE SECTION		
EXECUTE		**Y**
EXECUTE IMMEDIATE	**Y**	**Y**
EXPLAIN		
FETCH		**Y**
FREE LOCATOR		
GET DIAGNOSTICS	**Y**	**Y**
GRANT	**Y**	**Y**
HOLD LOCATOR		
INCLUDE		
INSERT	**Y**	**Y**
LABEL	**Y**	**Y**
LOCK TABLE	**Y**	**Y**
OPEN		**Y**
PREPARE FROM		**Y**
REFRESH TABLE	**Y**	**Y**
RELEASE connection	**Y**	**Y**
RELEASE SAVEPOINT	**Y**	**Y**
RENAME	**Y**	**Y**
REVOKE	**Y**	**Y**
ROLLBACK[1]	**Y**	**Y**
ROLLBACK TO SAVEPOINT[1]	**Y**	**Y**
SAVEPOINT	**Y**	**Y**
SELECT		
SELECT INTO	**Y**	**Y**
SET CONNECTION	**Y**	**Y**
SET host-variable Assignment[3]		
SET special register[3, 4]	**Y**	**Y**
SET transition-variable Assignment[3]		
SIGNAL SQLSTATE		
UPDATE	**Y**	**Y**
VALUES		
VALUES INTO	**Y**	**Y**

Table 96. Valid SQL statements in an SQL procedure body (continued)

	SQL statement is...	
SQL statement	**The only statement in the procedure**	**Nested in a compound statement**
WHENEVER		

Notes:

1. The COMMIT statement and the ROLLBACK statement (without the TO SAVEPOINT clause) cannot be executed in a stored procedure if the procedure is in the calling chain of a user-defined function or trigger
2. CREATE FUNCTION with LANGUAGE SQL (specified either implicitly or explicitly) and CREATE PROCEDURE with LANGUAGE SQL are not allowed within the body of an SQL procedure.
3. SET host-variable assignment, SET transition-variable assignment, and SET special register are the SQL SET statements that are described in Chapter 5 ″Statements″ on page 427, not the SQL procedure assignment statement that is described in “assignment-statement” on page 1116.
4. The SET SCHEMA statement cannot be executed within a SQL procedure.

Appendix D. SQL communication area (SQLCA)

An SQLCA is a structure or collection of variables that is updated after each SQL statement executes. An application program that contains executable SQL statements must provide exactly one SQLCA. There are three exceptions:

- A program that is precompiled with the STDSQL(YES) option must not provide an SQLCA
- In some cases (as discussed below in In Fortran), a Fortran program must provide more than one SQLCA.
- A Java program where a SQLCA is not applicable.

In all host languages except REXX (and Java where the SQLCA is not applicable), the SQL INCLUDE statement can be used to provide the declaration of the SQLCA.

In COBOL and assembler: The name of the storage area must be SQLCA.

In PL/I, and C: The name of the structure must be SQLCA. Every executable SQL statement must be within the scope of its declaration.

Unless noted otherwise, *C* is used to represent C/370™ and C/C++ programming languages.

In Fortran: The name of the COMMON area for the INTEGER variables of the SQLCA must be SQLCA1; the name of the COMMON area for the CHARACTER variables must be SQLCA2. An SQLCA definition is required for every subprogram that contains SQL statements. One is also needed for the main program if it contains SQL statements.

In REXX: DB2 generates the SQLCA automatically. A REXX procedure cannot use the INCLUDE statement. The REXX SQLCA has a somewhat different format from SQLCAs for the other languages. See "The REXX SQLCA" on page 1170 for more information on the REXX SQLCA.

Description of SQLCA fields

The names in Table 97 are those provided by the SQL INCLUDE statement. For the most part, COBOL, C, PL/I, and assembler use the same names, and Fortran names are different. However, there is one instance where C, PL/I, and assembler names differ from COBOL.

Table 97. Fields of SQLCA

assembler, COBOL, or PL/I Name	C Name	Fortran Name	Data type	Purpose
SQLCAID	sqlcaid	Not used.	CHAR(8)	An "eye catcher" for storage dumps, containing the text 'SQLCA'.
SQLCABC	sqlcabc	Not used.	INTEGER	Contains the length of the SQLCA: 136.

Table 97. Fields of SQLCA (continued)

assembler, COBOL, or PL/I Name	C Name	Fortran Name	Data type	Purpose
SQLCODE (See note 1)	SQLCODE	SQLCOD	INTEGER	Contains the SQL return code. (See note 2) **Code** **Means** 0 Successful execution (though there might have been warning messages). positive Successful execution, but with a warning condition or other information. negative Error condition.
SQLERRML (See note 3)	sqlerrml (See note 3)	SQLTXL	SMALLINT	Length indicator for SQLERRMC, in the range 0 through 70. 0 means that the value of SQLERRMC is not pertinent.
SQLERRMC (See note 3)	sqlerrmc (See note 3)	SQLTXT	VARCHAR(70)	Contains one or more tokens, separated by X'FF', that are substituted for variables in the descriptions of error conditions. It may contain truncated tokens. A message length of 70 bytes indicates a possible truncation.
SQLERRP	sqlerrp	SQLERP	CHAR(8)	Provides a product signature and, in the case of an error, diagnostic information such as the name of the module that detected the error. In all cases, the first three characters are 'DSN' for DB2 UDB for z/OS.
SQLERRD(1)	sqlerrd[0]	SQLERR(1)	INTEGER	For a sensitive static cursor, contains the number of rows in a result table when the cursor position is after the last row (that is, when SQLCODE is equal to +100). SQLERRD(1) can also contain an internal error code.
SQLERRD(2)	sqlerrd[1]	SQLERR(2)	INTEGER	For a sensitive static cursor, contains the number of rows in a result table when the cursor position is after the last row (that is, when SQLCODE is equal to +100). SQLERRD(2) can also contain an internal error code.
SQLERRD(3)	sqlerrd[2]	SQLERR(3)	INTEGER	Contains the number of rows affected after INSERT, UPDATE, and DELETE (but not rows deleted as a result of CASCADE delete). For the OPEN of a cursor for a SELECT with INSERT or for a SELECT INTO, SQLERRD(3) contains the number of rows inserted by the embedded INSERT. Set to 0 if the SQL statement fails, indicating that all changes made in executing the statement were canceled. Set to -1 for a mass delete from a table in a segmented table space. For rowset-oriented FETCH statements, contains the number of rows returned in the rowset. For SQLCODES -911 and -913, SQLERRD(3) contains the reason code for the timeout or deadlock. After successful execution of the REFRESH TABLE statement, SQLERRD(3) contains the number of rows inserted into the materialized query table.

Table 97. Fields of SQLCA (continued)

assembler, COBOL, or PL/I Name	C Name	Fortran Name	Data type	Purpose
SQLERRD(4)	sqlerrd[3]	SQLERR(4)	INTEGER	Generally, contains timerons, a short floating-point value that indicates a rough relative estimate of resources required (See note 4). It does not reflect an estimate of the time required. When preparing a dynamically defined SQL statement, you can use this field as an indicator of the relative cost of the prepared SQL statement. For a particular statement, this number can vary with changes to the statistics in the catalog. It is also subject to change between releases of DB2 UDB for z/OS.
SQLERRD(5)	sqlerrd[4]	SQLERR(5)	INTEGER	Contains the position or column of a syntax error for a PREPARE or EXECUTE IMMEDIATE statement.
SQLERRD(6)	sqlerrd[5]	SQLERR(6)	INTEGER	Contains an internal error code.
SQLWARN0	SQLWARN0	SQLWRN(0)	CHAR(1)	Contains a blank if no other indicator is set to a warning condition (that is, no other indicator contains a W or Z). Contains a W if at least one other indicator contains a W or Z.
SQLWARN1	SQLWARN1	SQLWRN(1)	CHAR(1)	Contains a W if the value of a string column was truncated when assigned to a host variable. Contains an N for non-scrollable cursors and S for scrollable cursors after the OPEN CURSOR or ALLOCATE CURSOR statement. If subsystem parameter DISABSCL is set to YES, the field will not be set to N for non-scrollable cursors.
SQLWARN2	SQLWARN2	SQLWRN(2)	CHAR(1)	Contains a W if null values were eliminated from the argument of an aggregate function; not necessarily set to W for the MIN function because its results are not dependent on the elimination of null values.
SQLWARN3	SQLWARN3	SQLWRN(3)	CHAR(1)	Contains a W if the number of result columns is larger than the number of host variables. Contains a Z if fewer locators were provided in the ASSOCIATE LOCATORS statement than the stored procedure returned.
SQLWARN4	SQLWARN4	SQLWRN(4)	CHAR(1)	Contains a W if a prepared UPDATE or DELETE statement does not include a WHERE clause. For a scrollable cursor, contains a D for sensitive dynamic cursors, I for insensitive cursors, and S for sensitive static cursors after the OPEN CURSOR or ALLOCATE CURSOR statement; blank if cursor is not scrollable. If subsystem parameter DISABSCL is set to YES, the field will not be set to N for non-scrollable cursors.
SQLWARN5	SQLWARN5	SQLWRN(5)	CHAR(1)	Contains a W if the SQL statement was not executed because it is not a valid SQL statement in DB2 UDB for z/OS. Contains a character value of 1 (read only), 2 (read and delete), or 4 (read, delete, and update) to reflect capability of the cursor after the OPEN CURSOR or ALLOCATE CURSOR statement. If subsystem parameter DISABSCL is set to YES, the field will not be set to N for non-scrollable cursors.
SQLWARN6	SQLWARN6	SQLWRN(6)	CHAR(1)	Contains a W if the addition of a month or year duration to a DATE or TIMESTAMP value results in an invalid day (for example, June 31). Indicates that the value of the day was changed to the last day of the month to make the result valid.

Table 97. Fields of SQLCA (continued)

assembler, COBOL, or PL/I Name	C Name	Fortran Name	Data type	Purpose
SQLWARN7	SQLWARN7	SQLWRN(7)	CHAR(1)	Contains a W if one or more nonzero digits were eliminated from the fractional part of a number used as the operand of a decimal multiply or divide operation.
SQLWARN8	SQLWARN8	SQLWRX(1)	CHAR(1)	Contains a W if a character that could not be converted was replaced with a substitute character.
SQLWARN9	SQLWARN9	SQLWRX(2)	CHAR(1)	Contains a W if arithmetic exceptions were ignored during COUNT or COUNT_BIG processing. Contains a Z if the stored procedure returned multiple result sets.
SQLWARNA	SQLWARNA	SQLWRX(3)	CHAR(1)	Contains a W if at least one character field of the SQLCA or the SQLDA names or labels is invalid due to a character conversion error.
SQLSTATE	sqlstate	SQLSTT	CHAR(5)	Contains a return code for the outcome of the most recent execution of an SQL statement (See note 5).

Note:

1. With the precompiler option STDSQL(YES) in effect, SQLCODE is replaced by SQLCADE in SQLCA.
2. For the specific meanings of SQL return codes, see Part 1 of *DB2 Messages and Codes*
3. In COBOL, SQLERRM includes SQLERRML and SQLERRMC. In PL/I and C, the varying-length string SQLERRM is equivalent to SQLERRML prefixed to SQLERRMC. In assembler, the storage area SQLERRM is equivalent to SQLERRML and SQLERRMC. See the examples for the various host languages in "The included SQLCA."
4. The use of timerons may require special handling because they are floating-point values in an INTEGER array. In PL/I, for example, you could first copy the value into a BIN FIXED(31) based variable that coincides with a BIN FLOAT(24) variable.
5. For a description of SQLSTATE values, see Appendix C of *DB2 Messages and Codes*

The included SQLCA

The description of the SQLCA that is given by INCLUDE SQLCA is shown for each of the host languages.

assembler:

```
SQLCA    DS   0F
SQLCAID  DS   CL8        ID
SQLCABC  DS   F          BYTE COUNT
SQLCODE  DS   F          RETURN CODE
SQLERRM  DS   H,CL70     ERR MSG PARMS
SQLERRP  DS   CL8        IMPL-DEPENDENT
SQLERRD  DS   6F
SQLWARN  DS   0C         WARNING FLAGS
SQLWARN0 DS   C'W' IF ANY
SQLWARN1 DS   C'W' = WARNING
SQLWARN2 DS   C'W' = WARNING
SQLWARN3 DS   C'W' = WARNING
SQLWARN4 DS   C'W' = WARNING
SQLWARN5 DS   C'W' = WARNING
SQLWARN6 DS   C'W' = WARNING
SQLWARN7 DS   C'W' = WARNING
SQLEXT   DS   0CL8
SQLWARN8 DS   C
SQLWARN9 DS   C
SQLWARNA DS   C
SQLSTATE DS   CL5
```

C

```
#ifndef SQLCODE
struct sqlca
{
       unsigned char  sqlcaid[8];
       long           sqlcabc;
       long           sqlcode;
       short          sqlerrml;
       unsigned char  sqlerrmc[70];
       unsigned char  sqlerrp[8];
       long           sqlerrd[6];
       unsigned char  sqlwarn[11];
       unsigned char  sqlstate[5];
};
#define  SQLCODE   sqlca.sqlcode
#define  SQLWARN0  sqlca.sqlwarn[0]
#define  SQLWARN1  sqlca.sqlwarn[1]
#define  SQLWARN2  sqlca.sqlwarn[2]
#define  SQLWARN3  sqlca.sqlwarn[3]
#define  SQLWARN4  sqlca.sqlwarn[4]
#define  SQLWARN5  sqlca.sqlwarn[5]
#define  SQLWARN6  sqlca.sqlwarn[6]
#define  SQLWARN7  sqlca.sqlwarn[7]
#define  SQLWARN8  sqlca.sqlwarn[8]
#define  SQLWARN9  sqlca.sqlwarn[9]
#define  SQLWARNA  sqlca.sqlwarn[10]
#define  SQLSTATE  sqlca.sqlstate
#endif
struct sqlca sqlca;
```

COBOL:

```
01 SQLCA.
   05 SQLCAID      PIC X(8).
   05 SQLCABC      PIC S9(9) COMP-4.
   05 SQLCODE      PIC S9(9) COMP-4.
   05 SQLERRM.
      49 SQLERRML  PIC S9(4) COMP-4.
      49 SQLERRMC  PIC X(70).
   05 SQLERRP      PIC X(8).
   05 SQLERRD      OCCURS 6 TIMES
                   PIC S9(9) COMP-4.
   05 SQLWARN.
      10 SQLWARN0  PIC X.
      10 SQLWARN1  PIC X.
      10 SQLWARN2  PIC X.
      10 SQLWARN3  PIC X.
      10 SQLWARN4  PIC X.
      10 SQLWARN5  PIC X.
      10 SQLWARN6  PIC X.
      10 SQLWARN7  PIC X.
   05 SQLEXT.
      10 SQLWARN8  PIC X.
      10 SQLWARN9  PIC X.
      10 SQLWARNA  PIC X.
      10 SQLSTATE  PIC X(5).
```

Fortran:

```
*
*     THE SQL COMMUNICATIONS AREA
*
      INTEGER     SQLCOD,
     C            SQLERR(6),
     C            SQLTXL*2
      COMMON /SQLCA1/SQLCOD, SQLERR,SQLTXL
      CHARACTER        SQLERP*8,
     C                 SQLWRN(0:7)*1,
     C                 SQLTXT*70,
     C                 SQLEXT*8,
     C                 SQLWRX(1:3)*1,
     C                 SQLSTT*5
      COMMON /SQLCA2/SQLERP,SQLWRN,SQLTXT,SQLWRX,
     C               SQLSTT
      EQUIVALENCE (SQLWRX,SQLEXT)
*
```

PL/I:

```
DECLARE
  1 SQLCA,
    2 SQLCAID CHAR(8),
    2 SQLCABC FIXED(31) BINARY,
    2 SQLCODE FIXED(31) BINARY,
    2 SQLERRM CHAR(70) VAR,
    2 SQLERRP CHAR(8),
    2 SQLERRD(6) FIXED(31) BINARY,
    2 SQLWARN,
      3 SQLWARN0 CHAR(1),
      3 SQLWARN1 CHAR(1),
      3 SQLWARN2 CHAR(1),
      3 SQLWARN3 CHAR(1),
      3 SQLWARN4 CHAR(1),
      3 SQLWARN5 CHAR(1),
      3 SQLWARN6 CHAR(1),
      3 SQLWARN7 CHAR(1),
    2 SQLEXT,
      3 SQLWARN8 CHAR(1),
      3 SQLWARN9 CHAR(1),
      3 SQLWARNA CHAR(1),
      3 SQLSTATE CHAR(5);
```

The REXX SQLCA

The REXX SQLCA consists of a set of variables, rather than a structure. DB2 makes the SQLCA available to your application automatically. Table 98 lists the variables in a REXX SQLCA.

Table 98. Variables in a REXX SQLCA

Variable	Contents
SQLCODE	Contains the SQL return code.
SQLERRMC	Contains one or more tokens, separated by X'FF', that are substituted for variables in the descriptions of error conditions. It may contain truncated tokens. A message length of 70 bytes indicates a possible truncation.
SQLERRP	Provides a product signature and, in the case of an error, diagnostic information such as the name of the module that detected the error. For DB2 UDB for z/OS, the product signature is 'DSN'.

Table 98. Variables in a REXX SQLCA (continued)

Variable	Contents
SQLERRD.1	For a sensitive static cursor, contains the number of rows in a result table when the cursor position is after the last row (that is, when SQLCODE is equal to +100). SQLERRD(1) can also contain an internal error code.
SQLERRD.2	For a sensitive static cursor, contains the number of rows in a result table when the cursor position is after the last row (that is, when SQLCODE is equal to +100). SQLERRD(2) can also contain an internal error code.
SQLERRD.3	Contains the number of rows affected after INSERT, UPDATE, and DELETE (but not rows deleted as a result of CASCADE delete). For the OPEN of a cursor for a SELECT with INSERT or for a SELECT INTO, SQLERRD(3) contains the number of rows inserted by the embedded INSERT. Set to 0 if the SQL statement fails, indicating that all changes made in executing the statement were canceled. Set to -1 for a mass delete from a table in a segmented table space. For SQLCODE -911 or -913, SQLERRD.3 can also contain the reason code for a timeout or deadlock. After successful execution of the REFRESH TABLE statement, SQLERRD(3) contains the number of rows inserted into the materialized query table.
SQLERRD.4	Generally, contains timerons, a short floating-point value that indicates a rough relative estimate of resources required. This value does not reflect an estimate of the time required to execute the SQL statement. After you prepare an SQL statement, you can use this field as an indicator of the relative cost of the prepared SQL statement. For a particular statement, this number can vary with changes to the statistics in the catalog. This value is subject to change between releases of DB2 UDB for z/OS.
SQLERRD.5	Contains the position or column of a syntax error for a PREPARE or EXECUTE IMMEDIATE statement.
SQLERRD.6	Contains an internal error code.
SQLWARN.0	Contains a blank if no other indicator is set to a warning condition (that is, no other indicator contains a W or Z). Contains a W if at least one other indicator contains a W or Z.
SQLWARN.1	Contains a W if the value of a string column was truncated when assigned to a host variable.Contains an N for non-scrollable cursors and S for scrollable cursors after the OPEN CURSOR or ALLOCATE CURSOR statement.
SQLWARN.2	Contains a W if null values were eliminated from the argument of an aggregate function; not necessarily set to W for the MIN function because its results are not dependent on the elimination of null values.
SQLWARN.3	Contains a W if the number of result columns is larger than the number of host variables. Contains Z if the ASSOCIATE LOCATORS statement contains fewer locators than the stored procedure returned.
SQLWARN.4	Contains a W if a prepared UPDATE or DELETE statement does not include a WHERE clause. For a scrollable cursor, contains a D for sensitive dynamic cursors, I for insensitive cursors, and S for sensitive static cursors after the OPEN CURSOR or ALLOCATE CURSOR statement; otherwise, blank if cursor is not scrollable.
SQLWARN.5	Contains a W if the SQL statement was not executed because it is not a valid SQL statement in DB2 UDB for z/OS. Contains a character value of 1 (read only), 2 (read and delete), or 4 (read, delete, and update) to reflect capability of the cursor after the OPEN CURSOR or ALLOCATE CURSOR statement.
SQLWARN.6	Contains a W if the addition of a month or year duration to a DATE or TIMESTAMP value results in an invalid day (for example, June 31). Indicates that the value of the day was changed to the last day of the month to make the result valid.

Table 98. Variables in a REXX SQLCA (continued)

Variable	Contents
SQLWARN.7	Contains a W if one or more nonzero digits were eliminated from the fractional part of a number that was used as the operand of a decimal multiply or divide operation.
SQLWARN.8	Contains a W if a character that could not be converted was replaced with a substitute character.
SQLWARN.9	Contains a W if arithmetic exceptions were ignored during COUNT or COUNT_BIG processing. Contains a Z if the stored procedure returned multiple result sets.
SQLWARN.10	Contains a W if at least one character field of the SQLCA is invalid due to a character conversion error.
SQLSTATE	Contains a return code for the outcome of the most recent execution of an SQL statement.

Appendix E. SQL descriptor area (SQLDA)

An SQLDA is a collection of variables that is required for execution of the SQL DESCRIBE statement, and can be optionally used by the PREPARE, OPEN, FETCH, EXECUTE, and CALL statements. An SQLDA can be used in a DESCRIBE or PREPARE INTO statement, modified with the addresses of host variables, and then reused in a FETCH statement.

The meaning of the information in an SQLDA depends on the context in which it is used. For DESCRIBE and PREPARE INTO, DB2 sets the fields in the SQLDA to provide information to the application program. For OPEN, EXECUTE, FETCH, and CALL, the application program sets the fields in the SQLDA to provide DB2 with information:

DESCRIBE *statement-name* or PREPARE INTO

With the exception of SQLN, DB2 sets fields of the SQLDA to provide information to an application program about a prepared statement. Each SQLVAR occurrence describes a column of the result table.

DESCRIBE TABLE

With the exception of SQLN, DB2 sets fields of the SQLDA to provide information to an application program about the columns of a table or view. Each SQLVAR occurrence describes a column of the specified table or view.

DESCRIBE CURSOR

With the exception of SQLN, DB2 sets fields of the SQLDA to provide information to an application program about the result set that is associated with the specified cursor. Each SQLVAR occurrence describes a column of the result set.

DESCRIBE INPUT

With the exception of SQLN, DB2 sets fields of the SQLDA to provide information to an application program about the input parameter markers of a prepared statement. Each SQLVAR occurrence describes an input parameter marker.

DESCRIBE PROCEDURE

With the exception of SQLN, DB2 sets fields of the SQLDA to provide information to an application program about the result sets returned by the specified stored procedure. Each SQLVAR occurrence describes a returned result set.

OPEN, EXECUTE, FETCH, and CALL

The application program sets fields of the SQLDA to provide information about host variables or output buffers in the application program to DB2. Each SQLVAR occurrence describes a host variable or output buffer.

- For OPEN and EXECUTE, each SQLVAR occurrence describes an input value that is substituted for a parameter marker in the associated SQL statement that was previously prepared.
- For FETCH, each SQLVAR occurrence describes a host variable or buffer in the application program that is to be used to contain an output value from a row of the result.
- For CALL, each SQLVAR occurrence describes a host variable that corresponds to a parameter in the parameter list for the stored procedure.

For information on the way to use the SQLDA, see *DB2 Application Programming and SQL Guide*.

The following sections discuss the fields of the SQLDA and the format of the SQLDA for each language. Because the fields and format of the SQLDA for REXX is somewhat different from the SQLDAs for other languages, the REXX SQLDA is discussed separately.

Field descriptions

An SQLDA consists of four variables, a header, and an arbitrary number of occurrences of a sequence of variables collectively named SQLVAR. In DESCRIBE and PREPARE INTO, each occurrence of the SQLVAR describes the column of a table. In FETCH, OPEN, EXECUTE, and CALL, each occurrence describes a host variable.

The next section describes the SQLDA header, and “SQLVAR entries” on page 1175 describes the SQLVAR and how to determine how many SQLVAR entries to allocate in an SQLDA.

The SQLDA Header

Table 99 describes the fields in the SQLDA header.

Table 99. Fields of the SQLDA header

C name assembler, COBOL or PL/I name	**Data type**	**Usage in DESCRIBE[1] and PREPARE INTO**	**Usage in FETCH,INSERT, OPEN, EXECUTE, and CALL**
sqldaid SQLDAID	CHAR(8)	An “eye catcher” for storage dumps, containing the text 'SQLDA '. The 7th byte of the field is a flag that can be used to determine if more than one SQLVAR entry is needed for each column. For details, see “Determining how many SQLVAR occurrences are needed” on page 1177. For DESCRIBE CURSOR, the field is set to 'SQLRS'. If the cursor is declared WITH HOLD in a stored procedure, the high-order bit of the 8th byte is set to 1. For DESCRIBE PROCEDURE, it is set to 'SQLPR'.	A plus sign (+) in the 6th byte indicates that SQLNAME contains an overriding CCSID. A '2' in the 7th byte indicates the two SQLVAR entries were allocated for each column or parameter. A '3' in the 7th byte indicates that three SQLVAR entries were allocated for each column or parameter. Although three entries are never needed on input to DB2, an SQLDA with three entries might be used when the SQLDA was initialized by a DESCRIBE or PREPARE INTO with a USING BOTH clause. Otherwise, SQLDAID is not used.
sqldabc SQLDABC	INTEGER	Length of the SQLDA, equal to SQLN×44+16.	Length of the SQLDA, greater than or equal to SQLN×44+16.

Table 99. Fields of the SQLDA header (continued)

C name assembler, COBOL or PL/I name	Data type	Usage in DESCRIBE[1] and PREPARE INTO	Usage in FETCH,INSERT, OPEN, EXECUTE, and CALL
sqln SQLN	SMALLINT	Unchanged by DB2. The field must be set to a value greater than or equal to zero before the statement is executed. The field indicates the total number of occurrences of SQLVAR. At the very least, the number should be: • For DESCRIBE INPUT, the number of parameter markers to be described. • For other DESCRIBEs or PREPARE INTO: the number of columns of the result, or a multiple of the columns of the result when there are multiple sets of SQLVAR entries because column labels are returned in addition to column names.	Total number of occurrences of SQLVAR provided in the SQLDA. SQLN must be set to a value greater than or equal to zero.
sqld SQLD	SMALLINT	The number of columns described by occurrences of SQLVAR. Double that number if USING BOTH appears in the DESCRIBE or PREPARE INTO statement. Contains a 0 if the statement string is not a query. For DESCRIBE PROCEDURE, the number of result sets returned by the stored procedure. Contains a 0 if no result sets are returned.	The number of host variables described by occurrences of SQLVAR.

Notes:

1. The third column of this table represents several forms of the DESCRIBE statement:
   - For DESCRIBE *output* and PREPARE INTO, the column pertains to columns of the result table.
   - For DESCRIBE CURSOR, the column pertains to a result set associated with a cursor.
   - For DESCRIBE INPUT, the column pertains to parameter markers.
   - For DESCRIBE PROCEDURE, the column pertains to the result sets returned by the stored procedure.

SQLVAR entries

For each column or host variable described by the SQLDA, there are two types of SQLVAR entries:

Base SQLVAR entry
The base SQLVAR entry is always present. The fields of this entry contain the base information about the column or host variable such as data type code, length attribute (except for LOBs), column name (or label), host variable address, and indicator variable address.

Extended SQLVAR entry
The extended SQLVAR entry is needed (for each column) if the result

includes any LOB or distinct type[42] columns. For distinct types, the extended SQLVAR contains the distinct type name. For LOBs, the extended SQLVAR contains the length attribute of the host variable and a pointer to the buffer that contains the actual length. If locators are used to represent LOBs, an extended SQLVAR is not necessary.

The extended SQLVAR entry is also needed for each column when the USING BOTH clause was specified, which indicates that both columns names and labels are returned. (DESCRIBE *output* is the only statement with the USING BOTH clause).

The fields in the extended SQLVAR that return LOB and distinct type information do not overlap, and the fields that return LOB and label information do not overlap. Depending on the combination of labels, LOBs and distinct types, more than one extended SQLVAR entry per column may be required to return the information. See "Determining how many SQLVAR occurrences are needed" on page 1177.

Table 100 shows how to map the base and extended SQLVAR entries. For an SQLDA that contains both base and extended SQLVAR entries, the base SQLVAR entries are in the first block, followed by a block of extended SQLVAR entries, which if necessary, are followed by a second block of extended SQLVAR entries. In each block, the number of occurrences of the SQLVAR entry is equal to the value in SQLD[43] even though many of the extended SQLVAR entries might be unused.

Table 100. Contents of SQLVAR arrays

					Set of SQLVAR entries		
LOBs	**Distinct types[1]**	**7th byte of SQLDAID**	**SQLD**	**Minimum for SQLN[2]**	**First set (Base)**	**Second set (Extended)**	**Third set (Extended)**
USING BOTH clause not specified:							
No	No	Space	*n*	*n*	Column names or labels	Not Used	Not Used
Yes[3]	Yes[3]	2	*n*	*2n*	Column names or labels	LOBs, distinct types, or both	Not used
USING BOTH clause was specified:							
No	No	Space	*2n*	*2n*	Column names	Labels	Not used
Yes	No	2	*n*	*2n*	Column names	LOBs and labels	Not used
No	Yes	3	*n*	*3n*	Column names	Distinct types	Labels
Yes	Yes	3	*n*	*3n*	Column names	LOBs and distinct types	Labels

Notes:

1. DESCRIBE INPUT does not return information about distinct types.
2. The number of columns or host variables that the SQLDA describes.
3. Either LOBs, distinct types, or both are present.
4. Here, the 7th byte is set to a space and SQLD is set to two times the number of columns in the result. For all other values of the 7th byte for USING BOTH, SQLD is set to the number of columns in the result, and the 7th byte can be used to determine how many SQLVAR entries are needed for each column of the result.

[42] DESCRIBE INPUT does not return information about distinct types.

[43] When an extended SQLVAR entry is present for each column for *labels* (and there are no LOB or distinct type columns in the result),

Determining how many SQLVAR occurrences are needed

The number of SQLVAR occurrences needed depends on the statement that the SQLDA was provided for and the data types of the columns or parameters being described. See the "*Minimum Number of SQLVARs Needed*" column in Table 100 on page 1176.

If the USING BOTH clause was not specified for the statement and neither LOBs nor distinct types are present in the result, only one SQLVAR entry (a base entry) is needed for each column. The 7th byte of SQLDAID is set to a space. The SQLD is set to the number of columns in the result and represents the number of SQLVAR occurrences needed. If an insufficient number of SQLVAR occurrences were provided, DB2 returns a +236 warning in SQLCODE if the standards option was set. Otherwise, SQLCODE is zero.

If USING BOTH is specified and neither LOBs nor distinct types are present in the result, an extended SQLVAR entry per column is needed for the labels in addition to the base SQLVAR entry. The 7th byte of the SQLDAID is set to space. SQLD is set to the twice the number of columns in the result and represents the combined number of base and extended SQLVAR occurrences needed.

If LOBs, distinct types, or both are present in the results, one extended SQLVAR entry is needed per column in addition to the base SQLVAR entry with one exception. The exception is that when the USING BOTH clause is specified and distinct types are present in the results, two extended SQLVAR entries per column are needed. When a **sufficient number of SQLVAR entries are provided in the SQLDA** for both the base and extended SQLVARs, information for the LOBs and distinct types is returned. The 7th byte of SQLDAID is set to the number of SQLVAR entries that were used for each column:

2 Two SQLVAR entries per column (a base and an extended)
3 Three SQLVAR entries per column (a base and two extended)

SQLD is set to the number of columns in the result. Therefore, the value of the 7th byte of SQLDAID multiplied by the value of SQLD is the total number SQLVAR entries that were provided.

Otherwise, when an **insufficient number of SQLVAR entries have been provided** when LOBs or distinct types are present, DB2 indicates that by returning one of the following warnings in SQLCODE. DB2 also sets the 7th byte of SQLDAID to indicate how many SQLVAR entries are needed for each column of the result.

+237 There are insufficient SQLVAR entries to describe the data, and the data includes distinct types. In this case, there were enough *base* SQLVAR entries to describe the data, so the *base* SQLVAR entries are set. However, sufficient *extended* SQLVAR entries were not provided so the distinct type names are not returned.

+238 There are insufficient SQLVAR entries to describe the data, and the data includes LOBs. In this case no information is returned in the SQLVAR entries.

+239 There are insufficient SQLVAR entries to describe the data, and the data includes distinct types. There weren't even enough *base* SQLVAR entries. In this case no information is returned in the SQLVAR entries.

Field descriptions of an occurrence of a base SQLVAR

Table 101 on page 1178 describes the contents of the fields of a base SQLVAR.

Table 101. Fields in an occurrence of a base SQLVAR

C name assembler COBOL, or PL/I name	Data type	Usage in DESCRIBE[1] and PREPARE INTO	Usage in FETCH, INSERT, OPEN, EXECUTE, and CALL
sqltype SQLTYPE	SMALLINT	Indicates the data type of the column or parameter and whether it can contain null values. For a description of the type codes, see Table 103 on page 1181. For a distinct type, the data type on which the distinct type was based is placed in this field. The base SQLVAR provides no indication that this is part of the description of a distinct type.	Indicates the data type of the host variable and whether an indicator variable is provided. Host variables for datetime values must be character string variables. For FETCH, a datetime type code means a fixed-length character string. For a description of the type codes, see “SQLTYPE and SQLLEN” on page 1181.
sqllen SQLLEN	SMALLINT	The length attribute of the column or parameter. For datetime data, the length of the string representation of the value. See “SQLTYPE and SQLLEN” on page 1181 for a description of allowable values. For LOBs, the value is 0 regardless of the length attribute of the LOB. Field SQLLONGLEN in the extended SQLVAR contains the length attribute.	The length attribute of the host variable. See “SQLTYPE and SQLLEN” on page 1181 for a description of allowable values. For LOBs, the value is 0 regardless of the length attribute of the LOB. Field SQLLONGLEN in the extended SQLVAR contains the length attribute.
sqldata SQLDATA	pointer	For string columns or parameters, SQLDATA contains `X'0000zzzz'`, where *zzzz* is the associated CCSID. For character strings, SQLDATA can alternatively contain X'FFFF', which indicates bit data. Not used for other types of data. For datetime columns, SQLDATA can contain the CCSID of the string representation of the datetime value. For DESCRIBE PROCEDURE, the result set locator value associated with the result set.	Contains the address of the host variable.
sqlind SQLIND	pointer	Reserved For DESCRIBE PROCEDURE, it is set to -1.	Contains the address of an associated indicator variable, if SQLTYPE is odd. Otherwise, the field is not used.

Table 101. Fields in an occurrence of a base SQLVAR (continued)

C name assembler COBOL, or PL/I name	Data type	Usage in DESCRIBE[1] and PREPARE INTO	Usage in FETCH, INSERT, OPEN, EXECUTE, and CALL
sqlname SQLNAME	VARCHAR(30)	Contains the unqualified name or label of the column, or a string of length zero if the name or label does not exist. For more information about column names, see "Names of result columns" on page 397. For DESCRIBE PROCEDURE, SQLNAME contains the cursor name used by the stored procedure to return the result set. The values for SQLNAME appear in the order the cursors were opened by the stored procedure. For DESCRIBE INPUT, SQLNAME is not used.	Can contain CCSID and/or host-variable-array dimension information. DB2 interprets the third and fourth byte of the data portion of SQLNAME as the CCSID of the host variable if all of the following are true: • The 6th byte of SQLDAID is '+' (x'4E') • SQLTYPE indicates the host variable is a string variable • The length of SQLNAME is 8 • The first two bytes of the data portion of SQLNAME are X'0000'. For FETCH, OPEN, INSERT, and EXECUTE, DB2 interprets the fifth through eighth bytes of the data portion of SQLNAME as a binary integer that represents the dimension of the host-variable-array, and corresponding indicator-array if one is specified, if all of the following are true: • The length of SQLNAME is 8 • The first two bytes of the data portion of SQLNAME are X'0000'.

Notes:

1. The third column of this table represents several forms of the DESCRIBE statement.
   - For DESCRIBE *output* and PREPARE INTO, the column pertains to columns of the result table.
   - For DESCRIBE CURSOR, the column pertains to a result set associated with a cursor.
   - For DESCRIBE INPUT, the column pertains to parameter markers.
   - For DESCRIBE PROCEDURE, the column pertains to the result sets returned by the stored procedure.

Field descriptions of an occurrence of an extended SQLVAR

Table 102 describes the contents of the fields of an extended SQLVAR entry.

Table 102. Fields in an occurrence of an extended SQLVAR

C name assembler, COBOL, or PL/I name	Data type	Usage in DESCRIBE[1] and PREPARE INTO	Usage in FETCH, OPEN, EXECUTE, and CALL
len.sqllonglen SQLLONGL SQLLONGLEN	INTEGER	The length attribute of a LOB (BLOB, CLOB, or DBCLOB) column.	The length attribute of a LOB (BLOB, CLOB, or DBCLOB) host variable. DB2 ignores the SQLLEN field in the base SQLVAR for these data types. The length attribute indicates the number of bytes for a BLOB or CLOB, and the number of characters for a DBCLOB.
*	INTEGER	Reserved.	Reserved.

Table 102. Fields in an occurrence of an extended SQLVAR (continued)

C name assembler, COBOL, or PL/I name	Data type	Usage in DESCRIBE[1] and PREPARE INTO	Usage in FETCH, OPEN, EXECUTE, and CALL
sqldatalen SQLDATAL SQLDATALEN	pointer	Not used.	Used only for LOB (BLOB, CLOB, and DBCLOB) host variables. If the value of the field is null, the actual length of the LOB is stored in the 4 bytes immediately before the start of the data, and SQLDATA points to the first byte of the field length. The actual length indicates the number of bytes for a BLOB or CLOB, and the number of characters for a DBCLOB. If the value of the field is not null, the field contains a pointer to a 4-byte long buffer that contains the actual length *in bytes* (even for DBCLOBs) of the data in the buffer pointed to from the SQLDATA field in the matching base SQLVAR. Regardless of whether this field is used, field SQLLONGLEN must be set.
sqldatatype_name SQLTNAME SQLDATATYPE-NAME	VARCHAR(30)	A SQLTNAME field of the extended SQLVAR is set to one of the following : • For a distinct type column, the database manager sets this field to the fully qualified distinct type name. If the qualified name is longer than 30 bytes, it is truncated. To get the entire value, use the GET DIAGNOSTICS statement (see “GET DIAGNOSTICS” on page 928.) • For a label, the database manager sets this field to label. In the case that both a distinct type name and a label need to be returned in extended SQLVAR entries (USING BOTH has been specified), the distinct type name is returned in the first extended SQLVAR entry and the label in the second extended SQLVAR entry.	Not used.

Notes:

1. The third column of this table represents several forms of the DESCRIBE statement.
   - For DESCRIBE *output* and PREPARE INTO, the column pertains to columns of the result table.
   - For DESCRIBE CURSOR, the column pertains to a result set associated with a cursor.
   - For DESCRIBE INPUT, the column pertains to parameter markers.
   - For DESCRIBE PROCEDURE, the column pertains to the result sets returned by the stored procedure.

SQLTYPE and SQLLEN

Table 103 shows the values that may appear in the SQLTYPE and SQLLEN fields of the SQLDA. In DESCRIBE and PREPARE INTO, an even value of SQLTYPE means the column does not allow nulls, and an odd value means the column does allow nulls. In FETCH, OPEN, EXECUTE, and CALL, an even value of SQLTYPE means no indicator variable is provided, and an odd value means that SQLIND contains the address of an indicator variable.

Table 103. SQLTYPE and SQLLEN values for DESCRIBE, PREPARE INTO, FETCH, OPEN, EXECUTE, and CALL

	For DESCRIBE and PREPARE INTO		For FETCH, OPEN, EXECUTE, and CALL	
SQLTYPE	Column or parameter data type	SQLLEN	Host variable data type	SQLLEN
384/385	date	10 [1]	fixed-length character string representation of a date	length attribute of the host variable
388/389	time	8 [2]	fixed-length character string representation of a time	length attribute of the host variable
392/393	timestamp	26	fixed-length character string representation of a timestamp	length attribute of the host variable
400/401	N/A	N/A	NUL-terminated graphic string	length attribute of the host variable
404/405	BLOB	0 [3]	BLOB	Not used. [3]
408/409	CLOB	0 [3]	CLOB	Not used. [3]
412/413	DBCLOB	0 [3]	DBCLOB	Not used. [3]
448/449	varying-length character string	length attribute of the column	varying-length character string	length attribute of the host variable
452/453	fixed-length character string	length attribute of the column	fixed-length character string	length attribute of the host variable
456/457	long varying-length character string	length attribute of the column	long varying-length character string	length attribute of the host variable
460/461	N/A	N/A	NUL-terminated character string	length attribute of the host variable
464/465	varying-length graphic string	length attribute of the column	varying-length graphic string	length attribute of the host variable
468/469	fixed-length graphic string	length attribute of the column	fixed-length graphic string	length attribute of the host variable
472/473	long varying-length graphic string	length attribute of the column	long graphic string	length attribute of the host variable
480/481	floating point	4 for single precision, 8 for double precision	floating point	4 for single precision, 8 for double precision
484/485	packed decimal	precision in byte 1; scale in byte 2	packed decimal	precision in byte 1; scale in byte 2
496/497	large integer	4	large integer	4
500/501	small integer	2	small integer	2
504/505	N/A	N/A	DISPLAY SIGN LEADING SEPARATE	precision in byte 1; scale in byte 2

Table 103. SQLTYPE and SQLLEN values for DESCRIBE, PREPARE INTO, FETCH, OPEN, EXECUTE, and CALL (continued)

	For DESCRIBE and PREPARE INTO		For FETCH, OPEN, EXECUTE, and CALL	
SQLTYPE	**Column or parameter data type**	**SQLLEN**	**Host variable data type**	**SQLLEN**

Notes:

1. BIGINT is supported by other DB2 platforms..

SQLDATA

Table 104 identifies the CCSID values that appear in the SQLDATA field when the SQLVAR element describes a string column.

Table 104. CCSID values for SQLDATA

Data type	Subtype	Bytes 1 and 2	Bytes 3 and 4
Character	SBCS data	X'0000'	CCSID
Character	mixed data	X'0000'	CCSID
Character	BIT data	X'0000'	X'FFFF'
Graphic	N/A	X'0000'	CCSID
Any other data type	N/A	N/A	N/A

Unrecognized and unsupported SQLTYPES

The values that appear in the SQLTYPE field of the SQLDA are dependent on the level of data type support available at the sender as well as at the receiver of the data. This support is particularly important as new data types are added to the product.

New data types may or may not be supported by the sender or receiver of the data and may or may not be recognized by the sender or reciver of the data. Depending on the situation, the new data type may be returned, or a compatible data type that is agreed to by both the sender and the receiver of the data may be returned or an error may occur.

When the sender and receiver agree to use a compatible data type, Table 105 indicates the mapping that takes place. This mapping takes place when at least one of the sender or receiver does not support the data type provided. The unsupported data type can be provided by either the application or the database manager.

Table 105. Compatible data types for unsupported data types

Data type	Compatible data type
BIGINT	DECIMAL(19,0) (1)
ROWID	VARCHAR(40) FOR BIT DATA

Notes:

1. BIGINT is supported by other DB2 platforms.

Note that no indication is given in the SQLDA that the data type is substituted.

The included SQLDA

The description of the SQLDA that is given by INCLUDE SQLDA is shown below. Only assembler, C, C++, COBOL[44], and PL/I C are supported.

[44] Excluding OS/VS COBOL

assembler:

```
SQLTRIPL EQU    C'3'
SQLDOUBL EQU    C'2'
SQLSINGL EQU    C' '
*
         SQLSECT SAVE
*
SQLDA    DSECT
SQLDAID  DS    CL8      ID
SQLDABC  DS    F        BYTE COUNT
SQLN     DS    H        COUNT SQLVAR/SQLVAR2 ENTRIES
SQLD     DS    H        COUNT VARS (TWICE IF USING BOTH)
*
SQLVAR   DS    0F       BEGIN VARS
SQLVARN  DSECT ,        NTH VARIABLE
SQLTYPE  DS    H        DATA TYPE CODE
SQLLEN   DS    0H       LENGTH
SQLPRCSN DS    X        DEC PRECISION
SQLSCALE DS    X        DEC SCALE
SQLDATA  DS    A        ADDR OF VAR
SQLIND   DS    A        ADDR OF IND
SQLNAME  DS    H,CL30   DESCRIBE NAME
SQLVSIZ  EQU   *-SQLDATA
SQLSIZV  EQU   *-SQLVARN
*
SQLDA    DSECT
SQLVAR2  DS     0F      BEGIN EXTENDED FIELDS OF VARS
SQLVAR2N DSECT  ,       EXTENDED FIELDS OF NTH VARIABLE
SQLLONGL DS     F       LENGTH
SQLRSVDL DS     F       RESERVED
SQLDATAL DS     A       ADDR OF LENGTH IN BYTES
SQLTNAME DS     H,CL30  DESCRIBE NAME
*
         SQLSECT RESTORE
```

In the above declaration, SQLSECT SAVE is a macro invocation that remembers the current CSECT name. SQLSECT RESTORE is a macro invocation that continues that CSECT.

C and C++:

```
#ifndef  SQLDASIZE                /* Permit duplicate Includes      */
 /**/
 struct sqlvar
        { short  sqltype;
          short  sqllen;
          char  *sqldata;
          short *sqlind;
          struct sqlname
                { short  length;
                  char   data[30];
                } sqlname;
        };
 /**/
 struct sqlvar2
        { struct
                { long   sqllonglen;
         unsigned long   reserved;
                } len;
          char  *sqldatalen;
          struct sqldistinct_type
                { short  length;
                  char   data[30];
                } sqldatatype_name;
        };
 /**/
 struct sqlda
        { char   sqldaid[8];
          long   sqldabc;
          short  sqln;
          short  sqld;
          struct sqlvar sqlvar[1];
    };
 /**/
/*********************************************************************/
/* Macros for using the sqlvar2 fields.                              */
/*********************************************************************/
 /**/
/*********************************************************************/
/*   '2' in the 7th byte of sqldaid indicates a doubled number of    */
/*       sqlvar entries.                                             */
/*   '3' in the 7th byte of sqldaid indicates a tripled number of    */
/*       sqlvar entries.                                             */
/*********************************************************************/
#define   SQLDOUBLED  '2'
#define   SQLTRIPLED  '3'
#define   SQLSINGLED  ' '
 /**/
```

```
/*********************************************************************/
/* GETSQLDOUBLED(daptr) returns 1 if the SQLDA pointed to by         */
/* daptr has been doubled, or 0 if it has not been doubled.          */
/*********************************************************************/
#define GETSQLDOUBLED(daptr) \
    (((daptr)->sqldaid[6] == ( char) SQLDOUBLED) ? \
    (1)         : \
    (0)           )
 /**/
/*********************************************************************/
/* GETSQLTRIPLED(daptr) returns 1 if the SQLDA pointed to by         */
/* daptr has been tripled, or 0 if it has not been tripled.          */
/*********************************************************************/
#define GETSQLTRIPLED(daptr) \
    (((daptr)->sqldaid[6] == ( char) SQLTRIPLED) ? \
    (1)         : \
    (0)           )
 /**/
/*********************************************************************/
/* SETSQLDOUBLED(daptr, SQLDOUBLED) sets the 7th byte of sqldaid     */
/* to '2'.                                                           */
/* SETSQLDOUBLED(daptr, SQLSINGLED) sets the 7th byte of sqldaid     */
/* to be a ' '.                                                      */
/*********************************************************************/
#define SETSQLDOUBLED(daptr, newvalue) \
    (((daptr)->sqldaid[6] = (newvalue)))
 /**/
/*********************************************************************/
/* SETSQLTRIPLED(daptr) sets the 7th byte of sqldaid                 */
/* to '3'.                                                           */
/*********************************************************************/
#define SETSQLTRIPLED(daptr) \
    (((daptr)->sqldaid[6] = (SQLTRIPLED)))
 /**/
/*********************************************************************/
/* GETSQLDALONGLEN(daptr,n) returns the data length of the nth       */
/* entry in the sqlda pointed to by daptr. Use this only if the      */
/* sqlda was doubled or tripled and the nth SQLVAR entry has a       */
/* LOB datatype.                                                     */
/*********************************************************************/
#define GETSQLDALONGLEN(daptr,n)    (    \
    (long) (((struct sqlvar2 *) &((daptr);->sqlvar[(n) + \
           ((daptr)->sqld)])) \
            ->len.sqllonglen))
 /**/
```

```
/*********************************************************************/
/* SETSQLDALONGLEN(daptr,n,len) sets the sqllonglen field of the     */
/* sqlda pointed to by daptr to len for the nth entry. Use this only */
/* if the sqlda was doubled or tripled and the nth SQLVAR entry has  */
/* a LOB datatype.                                                   */
/*********************************************************************/
#define SETSQLDALONGLEN(daptr,n,length)  { \
    struct sqlvar2     *var2ptr; \
    var2ptr = (struct sqlvar2 *) \
        &((daptr);->sqlvar[(n) + ((daptr)->sqld)]); \
    var2ptr->len.sqllonglen  =  (long ) (length); \
    }
 /**/
/*********************************************************************/
/* GETSQLDALENPTR(daptr,n) returns a pointer to the data length for  */
/* the nth entry in the sqlda pointed to by daptr. Unlike the inline */
/* value (union sql8bytelen len), which is 8 bytes, the sqldatalen   */
/* pointer field returns a pointer to a long (4 byte) integer.       */
/* If the SQLDATALEN pointer is zero, a NULL pointer is be returned. */
/*                                                                   */
/* NOTE: Use this only if the sqlda has been doubled or tripled.     */
/*********************************************************************/
#define GETSQLDALENPTR(daptr,n) (   \
    (((struct sqlvar2 *) &(daptr);->sqlvar[(n) + (daptr)->sqld]) \
                           ->sqldatalen == NULL) ? \
    ((long *) NULL ) : \
    ((long *) ((struct sqlvar2 *) \
        &(daptr);->sqlvar[(n) + (daptr)->sqld]) \
                                    ->sqldatalen ) )
 /**/
/*********************************************************************/
/* SETSQLDALENPTR(daptr,n,ptr) sets a pointer to the data length for */
/* the nth entry in the sqlda pointed to by daptr.                   */
/* Use this only if the sqlda has been doubled or tripled.           */
/*********************************************************************/
#define SETSQLDALENPTR(daptr,n,ptr)  {  \
    struct sqlvar2 *var2ptr;    \
    var2ptr = (struct sqlvar2 *) \
        &((daptr);->sqlvar[(n) + ((daptr)->sqld)]); \
    var2ptr->sqldatalen  = (char *) ptr; \
    }
 /**/
#define SQLDASIZE(n) \
   ( sizeof(struct sqlda) + ((n)-1) * sizeof(struct sqlvar) )
#endif /* SQLDASIZE */
```

COBOL (IBM COBOL and VS COBOL II only):

```
01 SQLDA.
   05 SQLDAID PIC X(8).
   05 SQLDABC PIC S9(9) BINARY.
   05 SQLN    PIC S9(4) BINARY.
   05 SQLD    PIC S9(4) BINARY.
   05 SQLVAR  OCCURS 0 TO 750 TIMES DEPENDING ON SQLN.
      10 SQLVAR1.
         15 SQLTYPE PIC S9(4) BINARY.
         15 SQLLEN  PIC S9(4) BINARY.
         15 FILLER  REDEFINES SQLLEN.
            20 SQLPRECISION   PIC X.
            20 SQLSCALE       PIC X.
         15 SQLDATA POINTER.
         15 SQLIND  POINTER.
         15 SQLNAME.
            49 SQLNAMEL PIC S9(4) BINARY.
            49 SQLNAMEC PIC X(30).
      10 SQLVAR2 REDEFINES SQLVAR1.
         15 SQLVAR2-RESERVED-1 PIC S9(9) BINARY.
         15 SQLLONGLEN         REDEFINES SQLVAR2-RESERVED-1
                               PIC S9(9) BINARY.
         15 SQLVAR2-RESERVED-2 PIC S9(9) BINARY.
         15 SQLDATALEN         POINTER.
         15 SQLDATATYPE-NAME.
             20 SQLDATATYPE-NAMEL PIC S9(4) BINARY.
             20 SQLDATATYPE-NAMEC PIC X(30).
```

PL/I:

```
DECLARE
  1 SQLDA BASED(SQLDAPTR),
    2 SQLDAID CHAR(8),
    2 SQLDABC FIXED(31) BINARY,
    2 SQLN    FIXED(15) BINARY,
    2 SQLD    FIXED(15) BINARY,
    2 SQLVAR(SQLSIZE REFER(SQLN)),
      3 SQLTYPE  FIXED(15) BINARY,
      3 SQLLEN   FIXED(15) BINARY,
      3 SQLDATA  POINTER,
      3 SQLIND   POINTER,
      3 SQLNAME  CHAR(30)  VAR;
 /* */
DECLARE
  1 SQLDA2 BASED(SQLDAPTR),
    2 SQLDAID2 CHAR(8),
    2 SQLDABC2 FIXED(31) BINARY,
    2 SQLN2    FIXED(15) BINARY,
    2 SQLD2    FIXED(15) BINARY,
    2 SQLVAR2(SQLSIZE REFER(SQLN2)),
      3 SQLBIGLEN,
        4 SQLLONGL FIXED(31) BINARY,
        4 SQLRSVDL FIXED(31) BINARY,
      3 SQLDATAL POINTER,
      3 SQLTNAME CHAR(30) VAR;
 /* */
DECLARE SQLSIZE    FIXED(15) BINARY;
DECLARE SQLDAPTR   POINTER;
DECLARE SQLTRIPLED CHAR(1)   INITIAL('3');
DECLARE SQLDOUBLED CHAR(1)   INITIAL('2');
DECLARE SQLSINGLED CHAR(1)   INITIAL(' ');
```

Identifying an SQLDA in C or C++

A *descriptor-name* can be specified in the CALL, DESCRIBE, EXECUTE, FETCH, and OPEN statements. When the host application is written in C or C++, *descriptor-name* can be a pointer variable with pointer notation.

For example, *descriptor-name* could be declared as

```
sqlda *outsqlda;
```

Afterwords, it could be used in a statement like the following:

```
EXEC SQL DESCRIBE STMT1 INTO DESCRIPTOR :*outsqlda;
```

The REXX SQLDA

A REXX SQLDA consists of a set of REXX variables with a common stem. The stem must be a REXX variable name that contains no periods and is the same as the value of *descriptor-name* that you specify when you use the SQLDA in an SQL statement. DB2 does not support the INCLUDE SQLDA statement in REXX.

Table 106 shows the variable names in a REXX SQLDA. The values in the second column of the table are values that DB2 inserts into the SQLDA when the statement executes. Except where noted otherwise, the values in the third column of the table are values that the application must put in the SQLDA before the statement executes.

Table 106. Fields of a REXX SQLDA

Variable name	Usage in DESCRIBE and PREPARE INTO	Usage in FETCH, OPEN, EXECUTE, and CALL
stem.SQLD	The number of columns that are described in the SQLDA. Double that number if USING BOTH appears in the DESCRIBE or PREPARE INTO statement. Contains a 0 if the statement string is not a query. For DESCRIBE PROCEDURE, the number of result sets returned by the stored procedure. Contains a 0 if no result sets are returned.	The number of host variables that are used by the SQL statement.
Each SQLDA contains *stem*.SQLD of the following variables. Therefore, 1<=*n*<=*stem*.SQLD. There is one occurrence of each variable for each column of the result table or host variable that is described by the SQLDA. This set of variables is equivalent to the SQLVAR structure in SQLDAs for other languages.		
stem.n.SQLTYPE	Indicates the data type of the column or parameter and whether it can contain null values. For a description of the type codes, see “SQLTYPE and SQLLEN” on page 1181. For a distinct type, the data type on which the distinct type was based is placed in this field. The base SQLVAR provides no indication that this is part of the description of a distinct type.	Indicates the data type of the host variable and whether an indicator variable is provided. Host variables for datetime values must be character string variables. For FETCH, a datetime type code means a fixed-length character string. For a description of the type codes, see “SQLTYPE and SQLLEN” on page 1181.

Table 106. Fields of a REXX SQLDA (continued)

Variable name	Usage in DESCRIBE and PREPARE INTO	Usage in FETCH, OPEN, EXECUTE, and CALL
stem.n.SQLLEN	For a column other than a DECIMAL or NUMERIC column, the length attribute of the column or parameter. For datetime data, the length of the string representation of the value. See “SQLTYPE and SQLLEN” on page 1181 for a description of allowable values.	For a host variable that does not have a decimal data type, the length attribute of the host variable. See “SQLTYPE and SQLLEN” on page 1181 for a description of allowable values.
stem.n.SQLLEN.SQLPRECISION	For a DECIMAL or NUMERIC column, the precision of the column or parameter.	For a host variable with a decimal data type, the precision of the host variable.
stem.n.SQLLEN.SQLSCALE	For a DECIMAL or NUMERIC column, the scale of the column or parameter.	For a host variable with a decimal data type, the scale of the host variable.
stem.n.SQLCCSID	For a string column or parameter, the CCSID of the column or parameter.	For a string host variable, the CCSID of the host variable.
stem.n.SQLLOCATOR	For DESCRIBE PROCEDURE, the value of a result set locator.	Not used.
stem.n.SQLDATA	Not used.	Before EXECUTE or OPEN, contains the value of an input host variable. The application must supply this value. After FETCH, contains the values of an output host variable.
stem.n.SQLIND	Not used.	Before EXECUTE or OPEN, contains a negative number to indicate that the input host variable in *stem.n*.SQLDATA is null. The application must supply this value. After FETCH, contains a negative number if the value of the output host variable in *stem.n*.SQLDATA is null.
stem.n.SQLNAME	The name of the *n*th column in the result table. For DESCRIBE PROCEDURE, contains the cursor name that is used by the stored procedure to return the result set. The values for SQLNAME appear in the order that the cursors were opened by the stored procedure.	Not used.

Appendix F. DB2 catalog tables

DB2 UDB for z/OS maintains a set of tables (in database DSNDB06) called the DB2 catalog. This appendix describes that catalog by describing the columns of each catalog table.

The catalog tables describe such things as table spaces, tables, columns, indexes, privileges, application plans, and packages. Authorized users can query the catalog; however, it is primarily intended for use by DB2 and is therefore subject to change. All catalog tables are qualified by SYSIBM. Do not use this qualifier for user-defined tables.

The catalog tables are updated by DB2 during normal operations in response to certain SQL statements, commands, and utilities.

Use as a programming interface

Not all catalog table columns are part of the general-use programming interface. Whether a column is part of this interface is indicated in a column labeled “Use” in the table that describes the column. The values that “Use” can assume are as follows:

Value	Meaning
G	Column is part of the general-use programming interface
S	Column is part of the product-sensitive interface
I	Column is for internal use only
N	Column is not used

For columns for which “Use” is N or I, the name of the column and its description do not appear in the column’s explanation.

Release dependency indicators

Some objects depend on functions in particular releases of DB2. If you are running on a release of DB2 and fall back to a previous release, an object that depends on the more recent release becomes frozen. The object is marked with a release dependency indicator and is unavailable until remigration. The release dependency indicator, which is listed in the IBMREQD column of the catalog tables, shows the release of DB2 upon which the objects depends. Release dependency indicators in IBMREQD are defined by the following values:

Value	Meaning
B	Version 1R3 dependency indicator, not from the machine-readable material (MRM) tape
C	Version 2R1 dependency indicator, not from MRM tape
D	Version 2R2 dependency indicator, not from MRM tape
E	Version 2R3 dependency indicator, not from MRM tape
F	Version 3R1 dependency indicator, not from MRM tape
G	Version 4 dependency indicator, not from MRM tape
H	Version 5 dependency indicator, not from MRM tape
I	Version 6 dependency indicator, not from MRM tape
J	Version 6 dependency indicator, not from MRM tape
K	Version 7 dependency indicator, not from MRM tape
L	Version 8 dependency indicator, not from MRM tape
N	Not from MRM tape, no dependency

Table spaces and indexes

Table 107 shows to what table spaces the catalog tables are assigned, and what indexes they have. The pages that follow describe the columns in each table arranged alphabetically by table name. The indexes are in ascending order, except where noted.

Table 107. Tables spaces and indexes for the catalog tables

TABLE SPACE DSNDB06. ...	TABLE SYSIBM. ...	Page	INDEX SYSIBM. ...	INDEX FIELDS
SYSCOPY	SYSCOPY	1235	DSNUCH01	DBNAME.TSNAME.START_RBA.[1] TIMESTAMP[1]
			DSNUCX01	DSNAME
SYSDBASE	SYSCOLAUTH	1221	DSNACX01	CREATOR.TNAME.COLNAME
	SYSCOLUMNS	1226	DSNDCX01	TBCREATOR.TBNAME.NAME
			DSNDCX02	TYPESCHEMA.TYPENAME
	SYSFIELDS	1246		
	SYSFOREIGNKEYS	1247	DSNDRH01	CREATOR.TBNAME.RELNAME
	SYSINDEXES	1248	DSNDXX01	CREATOR.NAME
			DSNDXX02	DBNAME.INDEXSPACE
			DSNDXX03	TBCREATOR.TBNAME.CREATOR. NAME
			DSNDXX04	INDEXTYPE
	SYSINDEXPART	1253	DSNDRX01	IXCREATOR.IXNAME.PARTITION
			DSNDRX02	STORNAME
	SYSKEYS	1266	DSNDKX01	IXCREATOR.IXNAME.COLNAME
	SYSRELS	1291	DSNDLX01	REFTBCREATOR.REFTBNAME
			DSNDLX02	CREATOR.TBNAME
	SYSSYNONYMS	1314	DSNDYX01	CREATOR.NAME
	SYSTABAUTH	1315	DSNATX01	GRANTOR
			DSNATX02	GRANTEE.TCREATOR.TTNAME. GRANTEETYPE.UPDATECOLS. ALTERAUTH.DELETEAUTH. INDEXAUTH.INSERTAUTH. SELECTAUTH.UPDATEAUTH. CAPTUREAUTH.REFERENCESAUTH. REFCOLS.TRIGGERAUTH
			DSNATX03	GRANTEE.GRANTEETYPE.COLLID CONTOKEN
			DSNATX04	TCREATOR.TTNAME
	SYSTABLEPART	1318	DSNDPX01	DBNAME.TSNAME.PARTITION
			DSNDPX02	STORNAME
			DSNDPX03	DBNAME.TSNAME.LOGICAL_PART
	SYSTABLES	1324	DSNDTX01	CREATOR.NAME
			DSNDTX02	DBID.OBID.CREATOR.NAME
			DSNDTX03	TBCREATOR.TBNAME
	SYSTABLESPACE	1328	DSNDSX01	DBNAME.NAME
SYSDBAUT	SYSDATABASE	1239	DSNDDH01	NAME
			DSNDDX02	GROUP_MEMBER

Table 107. Tables spaces and indexes for the catalog tables (continued)

TABLE SPACE DSNDB06. ...	TABLE SYSIBM. ...	Page	INDEX SYSIBM. ...	INDEX FIELDS
	SYSDBAUTH	1242	DSNADH01	GRANTEE.NAME
			DSNADX01	GRANTOR.NAME
SYSDDF	IPLIST	1208	DSNDUX01	LINKNAME.IPADDR
	IPNAMES	1211	DSNFPX01	LINKNAME
	LOCATIONS	1211	DSNFCX01	LOCATION
	LULIST	1212	DSNFLX01	LINKNAME.LUNAME
			DSNFLX02	LUNAME
	LUMODES	1213	DSNFMX01	LUNAME.MODENAME
	LUNAMES	1214	DSNFNX01	LUNAME
	MODESELECT	1216	DSNFDX01	LUNAME.AUTHID[1].PLANNAME[1]
	USERNAMES	1342	DSNFEX01	TYPE.AUTHID[1].LINKNAME[1]
SYSEBCDC	SYSDUMMY1	1245		
SYSGPAUT	SYSRESAUTH	1292	DSNAGH01	GRANTEE.QUALIFIER. NAME.OBTYPE
			DSNAGX01	GRANTOR.QUALIFIER. NAME.OBTYPE
SYSGROUP	SYSSTOGROUP	1311	DSNSSH01	NAME
	SYSVOLUMES	1341		
SYSGRTNS	SYSROUTINES_OPTS	1301	DSNROX01	SCHEMA.ROUTINENAME. BUILDDATE.BUILDTIME
	SYSROUTINES_SRC	1302	DSNRSX01	ROUTINENAME
			DSNRSX02	SCHEMA.ROUTINENAME. BUILDDATE. SEQNO
SYSHIST	SYSCOLDIST_HIST	1224	DSNHFX01	TBOWNER.TBNAME. NAME.STATSTIME
	SYSCOLUMNS_HIST	1232	DSNHEX01	TBCREATOR.TBNAME. NAME.STATSTIME
	SYSINDEXES_HIST	1252	DSNHHX01	TBCREATOR.TBNAME. NAME.STATSTIME
			DSNHHX02	CREATOR.NAME
	SYSINDEXPART_HIST	1256	DSNHGX01	IXCREATOR.IXNAME. PARTITION.STATSTIME
	SYSINDEXSTATS_HIST		DSNHIX01	OWNER.NAME. PARTITION.STATSTIME
	SYSLOBSTATS_HIST	1268	DSNHJX01	DBNAME.NAME.STATSTIME
	SYSTABLEPART_HIST	1322	DSNHCX01	DBNAME.TSNAME. PARTITION.STATSNAME
	SYSTABLES_HIST	1331	DSNHDX01	CREATOR.NAME.STATSTIME
	SYSTABSTATS_HIST	1333	DSNHBX01	OWNER.NAME. PARTITION.STATSTIME

Table 107. Tables spaces and indexes for the catalog tables (continued)

TABLE SPACE	TABLE		INDEX	
DSNDB06. ...	SYSIBM. ...	Page	SYSIBM. ...	INDEX FIELDS
SYSJAVA	SYSJARCONTENTS	1261	DSNJCX01	JARSCHEMA.JAR_ID
	SYSJAROBJECTS	1263	DSNJOX01	JARSCHEMA.JAR_ID
	SYSJAVAOPTS	1264	DSNJVX01	JARSCHEMA.JAR_ID
SYSJAUXA LOB	SYSJARDATA	1262	DSNJDX01	JAR_DATA
SYSJAUXB LOB	SYSJARCLASS_SOURCE	1260	DSNJSX01	CLASS_SOURCE
SYSOBJ	SYSAUXRELS	1217	DSNOXX01	TBOWNER.TBNAME
			DSNOXX02	AUXTBOWNER.AUXTBNAME
	SYSCONSTDEP	1234	DSNCCX01	BSCHEMA.BNAME.BTYPE
			DSNCCX02	DTBCREATOR.DTBNAME
	SYSDATATYPES	1241	DSNODX01	SCHEMA.NAME
			DSNODX02	DATATYPEID[1]
	SYSKEYCOLUSE	1265	DSNCUX01	TBCREATOR.TBNAME. CONSTNAME.COLSEQ.
	SYSPARMS	1281	DSNOPX01	SCHEMA.SPECIFICNAME. ROUTINETYPE.ROWTYPE ORDINAL
			DSNOPX02	TYPESCHEMA.TYPENAME. ROUTINETYPE.CAST_FUNCTION. OWNER.SCHEMA.SPECIFICNAME
			DSNOPX03	TYPESCHEMA.TYPENAME
	SYSROUTINEAUTH	1293	DSNOAX01	GRANTOR.SCHEMA. SPECIFICNAME.ROUTINETYPE. GRANTEETYPE.EXECUTEAUTH
			DSNOAX02	GRANTEE.SCHEMA.SPECIFICNAME. ROUTINETYPE.GRANTEETYPE. EXECUTEAUTH.GRANTEDTS
			DSNOAX03	SCHEMA.SPECIFICNAME ROUTINETYPE
	SYSROUTINES	1294	DSNOFX01	NAME.PARM_COUNT. ROUTINETYPE.PARM_SIGNATURE. SCHEMA.PARM1.PARM2.PARM3. PARM4.PARM5.PARM6.PARM7. PARM8.PARM9.PARM10.PARM11. PARM12.PARM13.PARM14.PARM15. PARM16.PARM17.PARM18.PARM19. PARM20.PARM21.PARM22.PARM23. PARM24.PARM25.PARM26.PARM27. PARM28.PARM29.PARM30
			DSNOFX02	SCHEMA.SPECIFICNAME. ROUTINETYPE
			DSNOFX03	NAME.SCHEMA.CAST_FUNCTION. PARM_COUNT.PARM_SIGNATURE. PARM1
			DSNOFX04	ROUTINE_ID[1]
			DSNOFX05	SOURCESCHEMA.SOURCESPECIFIC. ROUTINETYPE
			DSNOFX06	SCHEMA.NAME.ROUTINETYPE. PARM_COUNT

Table 107. Tables spaces and indexes for the catalog tables (continued)

TABLE SPACE	TABLE		INDEX	
DSNDB06. ...	SYSIBM. ...	Page	SYSIBM. ...	INDEX FIELDS
			DSNOFX07	NAME.PARM_COUNT. ROUTINETYPE. SCHEMA. PARM_SIGNATURE. PARM1.PARM2.PARM3. PARM4.PARM5.PARM6.PARM7. PARM8.PARM9.PARM10.PARM11. PARM12.PARM13.PARM14.PARM15. PARM16.PARM17.PARM18.PARM19. PARM20.PARM21.PARM22.PARM23. PARM24.PARM25.PARM26.PARM27. PARM28.PARM29.PARM30
			DSNOFX08	JARSCHEMA. JAR_ID
	SYSSCHEMAAUTH	1303	DSNSKX01	GRANTEE.SCHEMANAME
			DSNSKX02	GRANTOR
	SYSTABCONST	1317	DSNCNX01	TBCREATOR.TBNAME.CONSTNAME
	SYSTABCONST		DSNCNX02	IXOWNER IXNAME
	SYSTRIGGERS	1334	DSNOTX01	SCHEMA.NAME.SEQNO
			DSNOTX02	TBOWNER.TBNAME
			DSNOTX03	SCHEMA.TRIGNAME
SYSPKAGE	SYSPACKAGE	1269	DSNKKX01	LOCATION.COLLID.NAME. VERSION
			DSNKKX02	LOCATION.COLLID.NAME. CONTOKEN
	SYSPACKAUTH	1275	DSNKAX01	GRANTOR.LOCATION.COLLID.NAME
			DSNKAX02	GRANTEE.LOCATION.COLLID. NAME.BINDAUTH.COPYAUTH. EXECUTEAUTH
			DSNKAX03	LOCATION.COLLID.NAME
	SYSPACKDEP	1276	DSNKDX01	DLOCATION.DCOLLID.DNAME. DCONTOKEN
			DSNKDX02	BQUALIFIER.BNAME.BTYPE
			DSNKDX03	BQUALIFIER.BNAME.BTYPE. DTYPE
	SYSPACKLIST	1277	DSNKLX01	LOCATION.COLLID.NAME
			DSNKLX02	PLANNAME.SEQNO.LOCATION. COLLID.NAME
	SYSPACKSTMT	1278	DSNKSX01	LOCATION.COLLID.NAME. CONTOKEN.SEQNO
	SYSPKSYSTEM	1283	DSNKYX01	LOCATION.COLLID.NAME. CONTOKEN.SYSTEM.ENABLE
	SYSPLSYSTEM	1290	DSNKPX01	NAME.SYSTEM.ENABLE
SYSPLAN	SYSDBRM	1244		
	SYSPLAN	1284	DSNPPH01	NAME
	SYSPLANAUTH	1288	DSNAPH01	GRANTEE.NAME.EXECUTEAUTH
			DSNAPX01	GRANTOR
	SYSPLANDEP	1289	DSNGGX01	BCREATOR.BNAME.BTYPE
	SYSSTMT	1308		

Table 107. Tables spaces and indexes for the catalog tables (continued)

TABLE SPACE DSNDB06. ...	TABLE SYSIBM. ...	Page	INDEX SYSIBM. ...	INDEX FIELDS
SYSSEQ	SYSSEQUENCES	1305	DSNSQX01	SCHEMA.NAME
			DSNSQX02	SEQUENCEID[1]
SYSSEQ2	SYSSEQUENCEAUTH	1304	DSNWCX01	SCHEMA.NAME
			DSNWCX02	GRANTOR.SCHEMA.NAME
			DSNWCX03	GRANTEE.SCHEMA.NAME
	SYSSEQUENCESDEP	1307	DSNSRX01	DCREATOR.DNAME.DCOLNAME
			DSNSRX02	BSCHEMA.BNAME.DTYPE
SYSSTATS	SYSCOLDIST	1222	DSNTNX01	TBOWNER.TBNAME.NAME
	SYSCOLDISTSTATS	1223	DSNTPX01	TBOWNER.TBNAME.NAME PARTITION
	SYSCOLSTATS	1225	DSNTCX01	TBOWNER.TBNAME.NAME PARTITION
	SYSINDEXSTATS	1258	DSNTXX01	OWNER.NAME.PARTITION
	SYSLOBSTATS	1267	DSNLNX01	DBNAME.NAME
	SYSTABSTATS	1332	DSNTTX01	OWNER.NAME.PARTITION
SYSSTR	SYSSTRINGS	1312	DSNSSX01	OUTCCSID.INCCSID.IBMREQD
	SYSCHECKS	1219	DSNSCX01	TBOWNER.TBNAME.CHECKNAME
	SYSCHECKS2	1220	DSNCHX01	TBOWNER.TBNAME.CHECKNAME
	SYSCHECKDEP	1218	DSNSDX01	TBOWNER.TBNAME.CHECKNAME COLNAME
SYSUSER	SYSUSERAUTH	1335	DSNAUH01	GRANTEE GRANTEDTS
			DSNAUX02	GRANTOR
SYSVIEWS	SYSVIEWDEP	1338	DSNGGX02	BCREATOR.BNAME.BTYPE
			DSNGGX03	BSCHEMA.BNAME.BTYPE
			DSNGGX04	BCREATOR.BNAME.BTYPE.DTYPE
	SYSVIEWS	1339	DSNVVX01	CREATOR.NAME.SEQNO.TYPE

Note:

1. Index field is in descending order

Catalog table space buffer pools

Increasing the lengths of some catalog table columns causes many catalog table rows to exceed BP0 4K page size maximum. In these cases, the table spaces that contain these tables are moved to an appropriately sized buffer pool during Enabling New Function Mode processing. The catalog table spaces that are listed in Table 108 on page 1197 change buffer pools as part of Enabling New Function Mode processing.

Table 108. Catalog table spaces that are moved as part of Enabling New Function Mode processing

Table space name	Buffer pool	Buffer pool page size
SYSDBASE	BP8K0	8K
SYSGRTNS	BP8K0	8K
SYSHIST	BP8K0	8K
SYSOBJ	BK8K0	8K
SYSSTR	BP8K0	8K
SYSSTATS	BP16K0	16K
SYSVIEWS	BP8K0	8K

SQL statements allowed on the catalog

The SQL statements listed in Table 109 can be used to change the value of certain options for existing catalog indexes and table spaces, and to add indexes to any of the catalog tables.

Table 109. SQL statements that can be used to change existing catalog indexes and table spaces, and to add indexes to any of the catalog tables

SQL statement	Index	Allowable clauses and usage notes
ALTER INDEX	IBM-defined	Only these clauses are allowed: CLOSE COPY FREEPAGE GBPCACHE NOT PADDED PADDED PCTFREE PIECESIZE You cannot alter the GBPCACHE value for indexes DSNDXX01, DSNDXX02, and DSNDXX03, which are on catalog table SYSIBM.SYSINDEXES.
ALTER TABLE		The only clause allowed is DATA CAPTURE CHANGES.

Table 109. SQL statements that can be used to change existing catalog indexes and table spaces, and to add indexes to any of the catalog tables (continued)

SQL statement	Index	Allowable clauses and usage notes
ALTER TABLESPACE		Only these clauses are allowed: CLOSE FREEPAGE GBPCACHE LOCKMAX MAXROWS PCTFREE TRACKMOD You cannot alter the GBPCACHE or MAXROWS value of some catalog table spaces. Do not specify GBPCACHE for the following table spaces: • DSNDB06.SYSDBASE • DSNDB06.SYSDBAUT • DSNDB06.SYSPKAGE • DSNDB06.SYSPLAN • DSNDB06.SYSUSER (exception: the attribute can be altered if authorization includes installation SYSADM authority.) Do not specify MAXROWS or the LOCKSIZE keyword for the following table spaces: • DSNDB06.SYSDBASE • DSNDB06.SYSDBAUT • DSNDB06.SYSGROUP • DSNDB06.SYSPLAN • DSNDB06.SYSVIEWS You can specify the LOCKSIZE keyword on the ALTER TABLESPACE statement for any catalog table spaces that are not LOB table spaces and that do not contain links.
CREATE INDEX	User-created	All clauses are allowed, except for: CLOSE YES CLUSTER UNIQUE DEFER YES (only on tables SYSINDEXES, SYSINDEXPART, and SYSKEYS) The only value allowed for BUFFERPOOL is BP0. You can create up to 100 indexes on the catalog.
ALTER INDEX	User-created	All clauses are allowed, except for BUFFERPOOL.
DROP INDEX	User-created	The statement has no clauses.

Reorganizing the catalog

The REORG TABLESPACE utility can be run on all the table spaces in the catalog database (DSNDB06) to reclaim unused or wasted space, which can affect

performance. The utility observes the PCTFREE and FREEPAGE values specified in the ALTER INDEX statement for all the catalog indexes and the following table spaces:
- DSNDB06.SYSCOPY
- DSNDB06.SYSDDF
- DSNDB06.SYSGPAUT
- DSNDB06.SYSGRTNS
- DSNDB06.SYSHIST
- DSNDB06.SYSJAVA
- DSNDB06.SYSJAUXA
- DSNDB06.SYSJAUXB
- DSNDB06.SYSOBJ
- DSNDB06.SYSPKAGE
- DSNDB06.SYSSEQ
- DSNDB06.SYSEQ2
- DSNDB06.SYSSTR
- DSNDB06.SYSSTATS
- DSNDB06.SYSUSER
- DSNDB01.SCT02
- DSNDB01.SPT01

For details on running REORG TABLESPACE, see *DB2 Utility Guide and Reference*.

New and changed catalog tables

Descriptions of the following catalog tables have been added:
- SYSIBM.IPLIST
- SYSIBM.SYSSEQUENCEAUTH

The tables that are listed in Table 110 have new or revised columns, column values, or column descriptions to support the new function in DB2 Version 8:

Table 110. Tables with new or revised columns, column values, or column descriptions to support DB2 Version 8

Table name	New column	Revised column
IPNAMES		SECURITY_OUT LINKNAME
LOCATIONS	DBALIAS	LOCATION LINKNAME PORT TPN
LULIST		LINKNAME LUNAME
LUMODES		LUNAME MODENAME
LUNAMES		LUNAME SYSMODENAME
MODESELECT		AUTHID PLANNAME LUNAME MODENAME
SYSAUXRELS		TBOWNER TBNAME COLNAME AUXTBOWNER AUXTBNAME
SYSCHECKDEP		TBOWNER TBNAME COLNAME
SYSCHECKS		TBOWNER CREATOR TBNAME CHECKCONDITION
SYSCHECKS2		TBOWNER TBNAME PATHSCHEMAS
SYSCOLAUTH		GRANTOR GRANTEE CREATOR TNAME COLNAME LOCATION COLLID CONTOKEN
SYSCOLDIST		TBOWNER TBNAME NAME COLVALUE TYPE COLGROUPNO

Table 110. Tables with new or revised columns, column values, or column descriptions to support DB2 Version 8 (continued)

Table name	New column	Revised column
SYSCOLDIST_HIST		TBOWNER TBNAME NAME COLVALUE TYPE COLGROUPNO
SYSCOLDISTSTATS		TBOWNER TBNAME NAME COLVALUE TYPE COLGROUPNO
SYSCOLSTATS	STATS_FORMAT	HIGHKEY HIGH2KEY LOWKEY LOW2KEY TBOWNER TBNAME NAME
SYSCOLUMNS	STATS_FORMAT PARTKEY_COLSEQ PARTKEY_ORDERING ALTEREDTS CCSID HIDDEN	NAME TBNAME TBCREATOR HIGH2KEY LOW2KEY REMARKS FOREIGNKEY LABEL DEFAULTVALUE TYPESCHEMA TYPENAME
SYSCOLUMNS_HIST	STATS_FORMAT	NAME TBNAME TBCREATOR HIGH2KEY LOW2KEY
SYSCONSTDEP		BNAME BSCHEMA DTBNAME DTBCREATOR
SYSCOPY	OLDEST_VERSION LOGICAL_PART	ICTYPE STYPE
SYSDATABASE		NAME CREATOR STGROUP CREATEDBY GROUP_MEMBER
SYSDATATYPES		SCHEMA OWNER NAME CREATEDBY SOURCESCHEMA SOURCETYPE REMARKS
SYSDBAUTH		GRANTOR GRANTEE NAME

Table 110. Tables with new or revised columns, column values, or column descriptions to support DB2 Version 8 (continued)

Table name	New column	Revised column
SYSDBRM		NAME PDSNAME PLNAME PLCREATOR VERSION
SYSFIELDS		TBCREATOR TBNAME NAME FLDTYPE FLDPROC PARMLIST
SYSFOREIGNKEYS		CREATOR TBNAME RELNAME COLNAME
SYSINDEXES	PADDED VERSION OLDEST_VERSION CURRENT_VERSION RELCREATED AVGKEYLEN	NAME CREATOR TBNAME TBCREATOR DBNAME INDEXSPACE CREATEDBY INDEXTYPE REMARKS
SYSINDEXES_HIST	AVGKEYLEN	NAME CREATOR TBNAME TBCREATOR
SYSINDEXPART	OLDEST_VERSION CREATEDTS AVGKEYLEN	IXNAME IXCREATOR PQTY SQTY STORNAME VCATNAME LIMITKEY
SYSINDEXPART_HIST	AVGKEYLEN	IXNAME IXCREATOR PQTY SECQTYI
SYSINDEXSTATS		OWNER NAME
SYSINDEXSTATS_HIST		OWNER NAME
SYSJARCONTENTS		JARSCHEMA JAR_ID CLASS
SYSJAROBJECTS		JARSCHEMA JAR_ID OWNER PATH
SYSJAVAOPTS		JARSCHEMA JAR_ID BUILDSCHEMA BUILDNAME BUILDOWNER DBRMLIB HPJCOMPILE_OPTS BIND_OPTS PROJECT_LIB

Table 110. Tables with new or revised columns, column values, or column descriptions to support DB2 Version 8 (continued)

Table name	New column	Revised column
SYSKEYCOLUSE		TBCREATOR TBNAME COLNAME
SYSKEYS		IXNAME IXCREATOR COLNAME
SYSLOBSTATS		DBNAME NAME
SYSLOBSTATS_HIST		DBNAME NAME
SYSPACKAGE	REMARKS	LOCATION COLLID NAME CONTOKEN OWNER CREATOR QUALIFIER VERSION PDSNAME GROUP_MEMBER REOPTVAR PATHSCHEMAS OPTHINT
SYSPACKAUTH		GRANTOR GRANTEE LOCATION COLLID NAME
SYSPACKDEP		BNAME BQUALIFIER BTYPE DLOCATION DCOLLID DNAME DCONTOKEN DOWNER
SYSPACKLIST		PLANNAME LOCATION COLLID NAME
SYSPACKSTMT		LOCATION COLLID NAME CONTOKEN VERSION STMT ISOLATION
SYSPARMS		SCHEMA OWNER NAME SPECIFICNAME PARMNAME ROWTYPE ORDINAL TYPESCHEMA TYPENAME CCSID

Table 110. Tables with new or revised columns, column values, or column descriptions to support DB2 Version 8 (continued)

Table name	New column	Revised column
SYSPKSYSTEM		LOCATION COLLID NAME CONTOKEN SYSTEM CNAME
SYSPLAN	REMARKS	NAME CREATOR BOUNDBY QUALIFIER CURRENTSERVER GROUP_MEMBER REOPTVAR PATHSCHEMAS OPTHINT
SYSPLANAUTH		GRANTOR GRANTEE NAME
SYSPLANDEP		BNAME BCREATOR BTYPE DNAME
SYSPLSYSTEM		NAME SYSTEM CNAME
SYSRELS	ENFORCED CHECKEXISTINGDATA	CREATOR TBNAME RELNAME REFTBNAME REFTBCREATOR IXOWNER IXNAME
SYSRESAUTH		GRANTOR GRANTEE QUALIFIER NAME
SYSROUTINEAUTH		GRANTOR GRANTEE SCHEMA SPECIFICNAME COLLID CONTOKEN
SYSROUTINES	NUM_DEP_MQTS MAX_FAILURE PARAMETER_CCSID	SCHEMA OWNER NAME CREATEDBY SPECIFICNAME LANGUAGE COLLID SOURCESCHEMA SOURCESPECIFIC EXTERNAL_NAME WLM_ENVIRONMENT RUNOPTS REMARKS JAVA_SIGNATURE CLASS JARSCHEMA JAR_ID

Table 110. Tables with new or revised columns, column values, or column descriptions to support DB2 Version 8 (continued)

Table name	New column	Revised column
SYSROUTINES_OPTS	DEBUG_MODE	SCHEMA ROUTINENAME BUILDSCHEMA BUILDNAME BUILDOWNER PRECOMPILE_OPTS COMPILE_OPTS PRELINK_OPTS BIND_OPTS SOURCEDSN
SYSROUTINES_SRC		SCHEMA ROUTINENAME CREATESTMT
SYSSCHEMAAUTH		GRANTOR GRANTEE SCHEMANAME
SYSSEQUENCES	PRECISION RESTARTWITH	SCHEMA OWNER NAME SEQTYPE SEQUENCEID CREATEDBY CYCLE CACHE ORDER CREATEDTS ALTEREDTS REMARKS
SYSSEQUENCESDEP	DTYPE BSCHEMA BNAME DSCHEMA	BSEQUENCEID DCREATOR DNAME DCOLNAME
SYSSTMT		NAME PLNAME PLCREATOR TEXT ISOLATION
SYSSTOGROUP	SPACEF	NAME CREATOR VCATNAME CREATEDBY
SYSSTRINGS		TRANSPROC
SYSSYNONYMS		NAME CREATOR VCATNAME TBNAME TBCREATOR CREATEDBY
SYSTABAUTH		GRANTOR GRANTEE DBNAME SCREATOR STNAME TCREATOR TTNAME GRANTEELOCATION LOCATION COLLID CONTOKEN

Table 110. Tables with new or revised columns, column values, or column descriptions to support DB2 Version 8 (continued)

Table name	New column	Revised column
SYSTABCONST		TBCREATOR TBNAME CREATOR IXOWNER IXNAME
SYSTABLEPART	LOGICAL_PART LIMITKEY_INTERNAL OLDEST_VERSION CREATEDTS AVGROWLEN	TSNAME DBNAME IXNAME IXCREATOR PQTY SQTY STORNAME VCATNAME LIMITKEY CHECKRID5B
SYSTABLEPART_HIST	AVGROWLEN	TSNAME DBNAME PQTY SECQTYI
SYSTABLES	NUM_DEP_MQTS VERSION PARTKEYCOLNUM SPLIT_ROWS SECURITY_LABEL	NAME CREATOR TYPE DBNAME TSNAME EDPROC VALPROC REMARKS PARENTS CHILDREN KEYCOLUMNS STATUS LABEL CHECKFLAG CREATEDBY LOCATION TBCREATOR TBNAME CHECKS CHECKRID5B ENCODING_SCHEME TABLESTATUS
SYSTABLES_HIST		NAME CREATOR DBNAME TSNAME
SYSTABLESPACE	OLDEST_VERSION CURRENT_VERSION AVGROWLEN SPACEF	NAME CREATOR DBNAME CREATEDBY
SYSTABSTATS		DBNAME TSNAME OWNER NAME
SYSTABSTATS_HIST		DBNAME TSNAME OWNER NAME

Table 110. Tables with new or revised columns, column values, or column descriptions to support DB2 Version 8 (continued)

Table name	New column	Revised column
SYSTRIGGERS		NAME SCHEMA OWNER CREATEDBY TBNAME TBOWNER TEXT REMARKS TRIGNAME
SYSUSERAUTH		GRANTOR GRANTEE
SYSVIEWDEP		BNAME BCREATOR BTYPE DNAME DCREATOR BSCHEMA DTYPE
SYSVIEWS	REFRESH ENABLE MAINTENANCE REFRESH_TIME ISOLATION SIGNATURE APP_ENCODING_CCSID	NAME CREATOR TEXT PATHSCHEMAS TYPE
SYSVOLUMES		SGNAME SGCREATOR VOLID
USERNAMES		AUTHID LINKNAME NEWAUTHID PASSWORD

SYSIBM.IPLIST table

Allows multiple IP addresses to be specified for a given LOCATION. Insert rows into this table when you want to define a remote DB2 data sharing group. The same value for the IPADDR column cannot appear in both the SYSIBM IPNAMES table and the SYSIBM.IPLIST table. Rows in this table can be inserted, updated, and deleted.

Column name	Data type	Description	Use
LINKNAME	VARCHAR(24) NOT NULL	This column is associated with the value specified in the LINKNAME column in the SYSIBM.LOCATIONS table and the SYSIBM.IPNAMES table. The values of the other columns in the SYSIBM.IPNAMES table apply to the server identified by the LINKNAME column in this row.	G
IPADDR	VARCHAR(254) NOT NULL	This column contains the IP address or domain name of a remote TCP/IP host of the server. If WLM Domain Name Server workload balancing is used, this column must contain the member specific domain name. If Dynamic VIPA workload balancing is used, this column must contain the member specific Dynamic VIPA address. The IPADDR column must be specified as follows: • If IPADDR contains a left justified character string containing four numeric values delimited by decimal points, DB2 assumes the value is an IP address in dotted decimal format. For example, ’123.456.78.91’ would be interpreted as a dotted decimal IP address. • All other values are interpreted as a TCP/IP gethostbyname socket call. TCP/IP domain names are not case sensitive.	G
IBMREQD	CHAR(1) NOT NULL WITH DEFAULT 'N'	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G

SYSIBM.IPNAMES table

Defines the remote DRDA servers DB2 can access using TCP/IP. Rows in this table can be inserted, updated, and deleted.

Column name	Data type	Description	Use
LINKNAME	VARCHAR(24) NOT NULL	The value specified in this column must match the value specified in the LINKNAME column of the associated row in SYSIBM.LOCATIONS.	G
SECURITY_OUT	CHAR(1) NOT NULL WITH DEFAULT 'A'	This column defines the DRDA security option that is used when local DB2 SQL applications connect to any remote server associated with this TCP/IP host: A The option is “already verified”. Outbound connection requests contain an authorization ID and no password. The authorization ID used for an outbound request is either the DB2 user’s authorization ID or a translated ID, depending upon the value of the USERNAMES column. The authorization ID is not encrypted when it is sent to the partner. For encryption, see ’D’. D The option is “userid and security-sensitive data encryption”. Outbound connection requests contain an authorization ID and no password. The authorization ID used for an outbound request is either the DB2 user’s authorization ID or a translated ID, depending upon the value of the USERNAMES column. This option indicates that the userid and security-sensitive data are to be encrypted. For non-encryption, see ’A’. E The option is “userid, password, and security-sensitive data encryption”. Outbound connection requests contain an authorization ID and a password. The password is obtained from the SYSIBM.USERNAMES table. The USERNAMES column must specify ’O’. This option indicates that the userid, password, and security-sensitive data are to be encrypted. For non-security-sensitive data encryption, see ’P’. P The option is “password”. Outbound connection requests contain an authorization ID and a password. The password is obtained from the SYSIBM.USERNAMES table. The USERNAMES column must specify ’O’. This option indicates that the userid and the password are to be encrypted if the server supports encryption. Otherwise, the userid and the password are sent to the partner in clear text. For security-sensitive data encryption, see ’E’. R The option is “RACF PassTicket”. Outbound connection requests contain a userid and a RACF PassTicket. The value specified in the LINKNAME column is used as the RACF PassTicket application name for the remote server. The authorization ID used for an outbound request is either the DB2 user’s authorization ID or a translated ID, depending upon the value of the USERNAMES column. The authorization ID is not encrypted when it is sent to the partner.	G

Column name	Data type	Description	Use
USERNAMES	CHAR(1) NOT NULL WITH DEFAULT	This column controls outbound authorization ID translation. Outbound translation is performed when an authorization ID is sent by DB2 to a remote server. O An outbound ID is subject to translation. Rows in the SYSIBM.USERNAMES table are used to perform ID translation. No translation or "come from" checking is performed on inbound IDs. blank No translation occurs.	G
IBMREQD	CHAR(1) NOT NULL WITH DEFAULT 'N'	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see "Release dependency indicators" on page 1191.	G
IPADDR	VARCHAR(254) NOT NULL WITH DEFAULT	This column contains the IP address or domain name of a remote TCP/IP host. The IPADDR column must be specified as follows: • If the IPADDR contains a left justified character string containing four numeric values delimited by decimal points, DB2 assumes the value is an IP address in dotted decimal format. For example, '123.456.78.91' would be interpreted as a dotted decimal IP address. • All other values are interpreted as a TCP/IP domain name, which can be resolved by the TCP/IP gethostbyname socket call. TCP/IP domain names are not case sensitive.	G

SYSIBM.LOCATIONS table

Contains a row for every accessible remote server. The row associates a LOCATION name with the TCP/IP or SNA network attributes for the remote server. Requesters are not defined in this table. Rows in this table can be inserted, updated, and deleted.

Column name	Data type	Description	Use
LOCATION	VARCHAR(128) NOT NULL	A unique location name for the accessible server. This is the name by which the remote server is known to local DB2 SQL applications.	G
LINKNAME	VARCHAR(24) NOT NULL	Identifies the VTAM® or TCP/IP attributes associated with this location. For any LINKNAME specified, one or both of the following statements must be true: • A row exists in SYSIBM.LUNAMES whose LUNAME matches the value specified in the SYSIBM.LOCATIONS LINKNAME column. This row specifies the VTAM communication attributes for the remote location. • A row exists in SYSIBM.IPNAMES whose LINKNAME matches the value specified in the SYSIBM.LOCATIONS LINKNAME column. This row specifies the TCP/IP communication attributes for the remote location.	G
IBMREQD	CHAR(1) NOT NULL WITH DEFAULT 'N'	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
PORT	VARCHAR(96) NOT NULL WITH DEFAULT	TCP/IP is used for outbound DRDA connections when the following statement is true: • A row exists in SYSIBM.IPNAMES, where the LINKNAME column matches the value specified in the SYSIBM.LOCATIONS LINKNAME column. If the above mentioned row is found, the value of the PORT column is interpreted as follows: • If PORT is blank, the default DRDA port (446) is used. • If PORT is nonblank, the value specified for PORT can take one of two forms: – If the value in PORT is left justified with 1-5 numeric characters, the value is assumed to be the TCP/IP port number of the remote database server. – Any other value is assumed to be a TCP/IP service name, which can be converted to a TCP/IP port number using the TCP/IP getservbyname socket call. TCP/IP service names are not case sensitive.	G
TPN	VARCHAR(192) NOT NULL WITH DEFAULT	Used only when the local DB2 begins an SNA conversation with another server. When used, TPN indicates the SNA LU 6.2 transaction program name (TPN) that will allocate the conversation. A length of zero for the column indicates the default TPN. For DRDA conversations, this is the DRDA default, which is X'07F6C4C2'. For DB2 private protocol conversations, this column is not used. When the server is DB2 Server for VSE & VM, TPN should contain the resource ID of that machine.	G
DBALIAS	VARCHAR(128) NOT NULL	Database alias. The name associated with the server. This name is used to access a remote database server. If DBALIAS is blank, the location name is used to access the remote database server. This column does not change the name of any database objects sent to the remote site that contains the location qualifier.	G

SYSIBM.LULIST table

Allows multiple LU names to be specified for a given LOCATION. Insert rows into this table when you want to define a remote DB2 data sharing group. The same value for LUNAME column cannot appear in both the SYSIBM.LUNAMES table and the SYSIBM.LULIST table. Rows in this table can be inserted, updated, and deleted.

Column name	Data type	Description	Use
LINKNAME	VARCHAR(24) NOT NULL	The value of the LINKNAME column in the SYSIBM.LOCATIONS table with which this row is associated. This is also the value of the LUNAME column in the SYSIBM.LUNAMES table. The values of the other columns in the SYSIBM.LUNAMES row apply to the LU identified by the LUNAME column in this row of SYSIBM.LULIST.	G
LUNAME	VARCHAR(24) NOT NULL	The VTAM® logical unit name (LUNAME) of the remote database system. This LUNAME must not exist in the LUNAME column of SYSIBM.LUNAMES.	G
IBMREQD	CHAR(1) NOT NULL WITH DEFAULT 'N'	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G

SYSIBM.LUMODES table

Each row of the table provides VTAM with conversation limits for a specific combination of LUNAME and MODENAME. The table is accessed only during the initial conversation limit negotiation between DB2 and a remote LU. This negotiation is called *change-number-of-sessions* (CNOS) processing. Rows in this table can be inserted, updated, and deleted.

Column name	Data type	Description	Use
LUNAME	VARCHAR(24) NOT NULL	LU name of the server involved in the CNOS processing.	G
MODENAME	VARCHAR(24) NOT NULL	Name of a logon mode description in the VTAM logon mode table.	G
CONVLIMIT	SMALLINT NOT NULL	Maximum number of active conversations between the local DB2 and the other system for this mode. Used to override the number in the DSESLIM parameter of the VTAM APPL definition statement for this mode.	G
IBMREQD	CHAR(1) NOT NULL WITH DEFAULT 'N'	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G

SYSIBM.LUNAMES table

The table must contain a row for each remote SNA client or server that communicates with DB2. Rows in this table can be inserted, updated, and deleted.

Column name	Data type	Description	Use
LUNAME	VARCHAR(24) NOT NULL	Name of the LU for one or more accessible systems. A blank string indicates the row applies to clients whose LU name is not specifically defined in this table. All other column values for a given row in this table are for clients and servers associated with the row's LU name.	G
SYSMODENAME	VARCHAR(24) NOT NULL WITH DEFAULT	Mode used to establish inter-system conversations. A blank indicates the default mode IBMDB2LM (DB2 private protocol access and for collecting sysplex balancing information from remote data sharing groups). If private protocols are used to access a remote DB2 LU or if the remote LU is a member of a DB2 data sharing group, use a separate mode other than the default mode.	G
SECURITY_IN	CHAR(1) NOT NULL WITH DEFAULT 'A'	This column defines the security options that are accepted by this DB2 when an SNA client connects to DB2: V The option is “verify”. An incoming connection request must include one of the following: a userid and password, a userid and RACF PassTicket, or a Kerberos security ticket. A The option is “already verified”. A request does not need a password, although a password is checked if it is sent. With this option, an incoming connection request is accepted if it includes any of the following: a userid, a userid and password, a userid and RACF PassTicket, or a Kerberos security ticket. If the USERNAMES column contains 'I' or 'B', RACF is not invoked to validate incoming connection requests that contain only a userid.	G
SECURITY_OUT	CHAR(1) NOT NULL WITH DEFAULT 'A'	This column defines the security option that is used when local DB2 SQL applications connect to any remote server associated with this LUNAME: A The option is “already verified”. Outbound connection requests contain an authorization ID and no password. The authorization ID used for an outbound request is either the DB2 user's authorization ID or a translated ID, depending upon the value of the USERNAMES column. R The option is “RACF PassTicket”. Outbound connection requests contain a userid and a RACF PassTicket. The server's LU name is used as the RACF PassTicket application name. The authorization ID used for an outbound request is either the DB2 user's authorization ID or a translated ID, depending upon the value of the USERNAMES column. P The option is “password”. Outbound connection requests contain an authorization ID and a password. The password is obtained from the SYSIBM.USERNAMES table or RACF, depending upon the value specified in the ENCRYPTPWDS column. The USERNAMES column must specify 'B' or 'O'.	G

Column name	Data type	Description	Use
ENCRYPTPSWDS	CHAR(1) NOT NULL WITH DEFAULT 'N'	This column only applies to DB2 UDB for z/OS partners. It is provided to support connectivity to prior releases of DB2 that are unable to support RACF PassTickets. For connections between DB2 Version 5 and later, we recommend using the SECURITY_OUT='R' option instead of the ENCRYPTPSWDS='Y' option. N No, passwords are not in internal RACF encrypted format. This is the default. Y Yes for outbound requests, the encrypted password is extracted from RACF and sent to the server. For inbound requests, the password is treated as encrypted.	G
MODESELECT	CHAR(1) NOT NULL WITH DEFAULT 'N'	Whether to use the SYBIBM.MODESELECT table: N Use default modes: IBMDB2LM (for DB2 private protocol) and IBMRDB (for DRDA). Y Searches SYSIBM.MODESELECT for appropriate mode name.	G
USERNAMES	CHAR(1) NOT NULL WITH DEFAULT	This column controls inbound and outbound authorization ID translation, and “come from” checking. Inbound translation and “come from” checking are performed when an authorization ID is received from a remote client. Outbound translation is performed when an authorization ID is sent by DB2 to a remote server. When I, O, or B is specified in this column, rows in the SYSIBM.USERNAMES table are used to perform ID translation. I An inbound ID is subject to translation and “come from” checking. No translation is performed on outbound IDs. O No translation or “come from” checking is performed on inbound IDs. An outbound ID is subject to translation. B An inbound ID is subject to translation and “come from” checking. An outbound ID is subject to translation. blank No translation occurs.	G
GENERIC	CHAR(1) NOT NULL WITH DEFAULT 'N'	Indicates whether DB2 should use its real LU name or generic LU name to identify itself to the partner LU, which is identified by this row. N The real VTAM LU name of this DB2 subsystem Y The VTAM generic LU name of this DB2 subsystem	G
IBMREQD	CHAR(1) NOT NULL WITH DEFAULT 'N'	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G

SYSIBM.MODESELECT table

Associates a mode name with any conversation created to support an outgoing SQL request. Each row represents one or more combinations of LUNAME, authorization ID, and application plan name. Rows in this table can be inserted, updated, and deleted.

Column name	Data type	Description	Use
AUTHID	VARCHAR(128) NOT NULL WITH DEFAULT	Authorization ID of the SQL request. Blank (the default) indicates that the MODENAME specified for the row is to apply to all authorization IDs.	G
PLANNAME	VARCHAR(24) NOT NULL WITH DEFAULT	Plan name associated with the SQL request. Blank (the default) indicates that the MODENAME specified for the row is to apply to all plan names.	G
LUNAME	VARCHAR(24) NOT NULL	LU name associated with the SQL request.	G
MODENAME	VARCHAR(24) NOT NULL	Name of the logon mode in the VTAM logon mode table to be used in support of the outgoing SQL request. If blank, IBMDB2LM is used for DB2 private protocol connections and IBMRDB is used for DRDA connections.	G
IBMREQD	CHAR(1) NOT NULL WITH DEFAULT 'N'	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G

SYSIBM.SYSAUXRELS table

Contains one row for each auxiliary table created for a LOB column. A base table space that is partitioned must have one auxiliary table for each partition of each LOB column.

Column name	Data type	Description	Use
TBOWNER	VARCHAR(128) NOT NULL	Authorization ID of the owner of the base table.	G
TBNAME	VARCHAR(128) NOT NULL	Name of the base table.	G
COLNAME	VARCHAR(128) NOT NULL	Name of the LOB column in the base table.	G
PARTITION	SMALLINT NOT NULL	Partition number if the base table space is partitioned. Otherwise, the value is 0.	G
AUXTBOWNER	VARCHAR(128) NOT NULL	Authorization ID of the owner of the auxiliary table.	G
AUXTBNAME	VARCHAR(128) NOT NULL	Name of the auxiliary table.	G
AUXRELOBID	INTEGER NOT NULL	Internal identifier of the relationship between the base table and the auxiliary table.	S
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G

SYSIBM.SYSCHECKDEP table

Contains one row for each reference to a column in a check constraint.

Column name	Data type	Description	Use
TBOWNER	VARCHAR(128) NOT NULL	Authorization ID of the owner of the table on which the check constraint is defined.	G
TBNAME	VARCHAR(128) NOT NULL	Name of the table on which the check constraint is defined.	G
CHECKNAME	VARCHAR(128) NOT NULL	Name of the check constraint.	G
COLNAME	VARCHAR(128) NOT NULL	Name of the column that the check constraint refers to.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G

SYSIBM.SYSCHECKS table

Contains one row for each check constraint.

Column name	Data type	Description	Use
TBOWNER	VARCHAR(128) NOT NULL	Authorization ID of the owner of the table on which the check constraint is defined.	G
CREATOR	VARCHAR(128) NOT NULL	Authorization ID of the creator of the check constraint.	G
DBID	SMALLINT NOT NULL	Internal identifier of the database for the check constraint.	S
OBID	SMALLINT NOT NULL	Internal identifier of the check constraint.	S
TIMESTAMP	TIMESTAMP NOT NULL	Time when the check constraint was created.	G
RBA	CHAR(6) FOR BIT DATA NOT NULL WITH DEFAULT	The log RBA when the check constraint was created.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
TBNAME	VARCHAR(128) NOT NULL	Name of the table on which the check constraint is defined.	G
CHECKNAME	VARCHAR(128) NOT NULL	Table check constraint name.	G
CHECKCONDITION	VARCHAR(7400) NOT NULL	Text of the table check constraint.	G

SYSIBM.SYSCHECKS2 table

Contains one row for each table check constraint for catalog tables created in or after Version 7. Check constraints for catalog tables created before Version 7 are not included in this table.

Column name	Data type	Description	Use
TBOWNER	VARCHAR(128) NOT NULL	Authorization ID of the owner of the table on which the check constraint is defined.	G
TBNAME	VARCHAR(128) NOT NULL	Name of the table on which the check constraint is defined.	G
CHECKNAME	VARCHAR(128) NOT NULL	Check constraint name.	G
PATHSCHEMAS	VARCHAR(2048) NOT NULL	SQL path at the time the check constraint was created. The path is used to resolve unqualified cast function names that are used in the constraint definition.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G

SYSIBM.SYSCOLAUTH table

Records the UPDATE or REFERENCES privileges that are held by users on individual columns of a table or view.

Column name	Data type	Description	Use
GRANTOR	VARCHAR(128) NOT NULL	Authorization ID of the user who granted the privileges. Could also be PUBLIC or PUBLIC followed by an asterisk[45].	G
GRANTEE	VARCHAR(128) NOT NULL	Authorization ID of the user who holds the privilege or the name of an application plan or package that uses the privilege. PUBLIC for a grant to PUBLIC. PUBLIC followed by an asterisk for a grant to PUBLIC AT ALL LOCATIONS.	G
GRANTEETYPE	CHAR(1) NOT NULL	Type of grantee: blank An authorization ID P An application plan or a package. The grantee is a package if COLLID is not blank.	G
CREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the table or view on which the update privilege is held.	G
TNAME	VARCHAR(128) NOT NULL	Name of the table or view.	G
	CHAR(12) NOT NULL	Internal use only	I
	CHAR(6) NOT NULL	Not used	N
	CHAR(8) NOT NULL	Not used	N
COLNAME	VARCHAR(128) NOT NULL	Name of the column to which the UPDATE privilege applies.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
	VARCHAR(128) NOT NULL WITH DEFAULT	Not used	N
COLLID	VARCHAR(128) NOT NULL WITH DEFAULT	If GRANTEE is a package, its collection name. Otherwise, the value is blank.	G
CONTOKEN	CHAR(8) NOT NULL WITH DEFAULT FOR BIT DATA	If GRANTEE is a package, the consistency token of the DBRM from which the package was derived. Otherwise, the value is blank.	S
PRIVILEGE	CHAR(1) NOT NULL WITH DEFAULT	Indicates which privilege this row describes: R Row pertains to the REFERENCES privilege. blank Row pertains to the UPDATE privilege.	G
GRANTEDTS	TIMESTAMP NOT NULL WITH DEFAULT	Time when the GRANT statement was executed.	G

[45] PUBLIC followed by an asterisk (PUBLIC*) denotes PUBLIC AT ALL LOCATIONS. For the conditions where GRANTOR can be PUBLIC or PUBLIC*, see Part 3 (Volume 1) of *DB2 Administration Guide*.

SYSIBM.SYSCOLDIST table

Contains one or more rows for the first key column of an index key. Rows in this table can be inserted, updated, and deleted.

Column name	Data type	Description	Use
	SMALLINT NOT NULL	Not used	N
STATSTIME	TIMESTAMP NOT NULL WITH DEFAULT	If RUNSTATS updated the statistics, the date and time when the last invocation of RUNSTATS updated the statistics.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
TBOWNER	VARCHAR(128) NOT NULL	Authorization ID of the owner of the table that contains the column.	G
TBNAME	VARCHAR(128) NOT NULL	Name of the table that contains the column.	G
NAME	VARCHAR(128) NOT NULL	Name of the column. If NUMCOLUMNS is greater than 1, this name identifies the first column name of the set of columns associated with the statistics.	G
COLVALUE	VARCHAR(2000) NOT NULL WITH DEFAULT FOR BIT DATA	Contains the data of a frequently occurring value. Statistics are not collected for an index on a ROWID column. If the value has a non-character data type, the data might not be printable.	S
TYPE	CHAR(1) NOT NULL WITH DEFAULT 'F'	The type of statistics gathered: C Cardinality F Frequent value N Non-padded frequent value	G
CARDF	FLOAT NOT NULL WITH DEFAULT -1	Number of distinct values for the column group. This number is valid only for TYPE C statistics.	S
COLGROUPCOLNO	VARCHAR(254) NOT NULL WITH DEFAULT FOR BIT DATA	Identifies the set of columns associated with the statistics. If the statistics are only associated with a single column, the field contains a zero length. Otherwise, the field is an array of SMALLINT column numbers with a dimension equal to the value in NUMCOLUMNS. This is an updatable column.	S
NUMCOLUMNS	SMALLINT NOT NULL WITH DEFAULT 1	Identifies the number of columns associated with the statistics.	G
FREQUENCYF	FLOAT NOT NULL WITH DEFAULT -1	Gives the percentage of rows in the table with the value specified in COLVALUE when the number is multiplied by 100. For example, a value of 1 indicates 100%. A value of .153 indicates 15.3%. Statistics are not collected for an index on a ROWID column.	G

SYSIBM.SYSCOLDISTSTATS table

Contains zero or more rows per partition for the first key column of a partitioning index or a data-partitioned secondary index (DPSI). Rows are inserted when RUNSTATS scans index partitions of the partitioning index. No row is inserted if the index is a secondary index. Rows in this table can be inserted, updated, and deleted.

Column name	Data type	Description	Use
	SMALLINT NOT NULL	Not used	N
STATSTIME	TIMESTAMP NOT NULL WITH DEFAULT	If RUNSTATS updated the statistics, the date and time when the last invocation of RUNSTATS updated the statistics.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see "Release dependency indicators" on page 1191.	G
PARTITION	SMALLINT NOT NULL	Partition number for the table space that contains the table in which the column is defined.	G
TBOWNER	VARCHAR(128) NOT NULL	Authorization ID of the owner of the table that contains the column.	G
TBNAME	VARCHAR(128) NOT NULL	Name of the table that contains the column.	G
NAME	VARCHAR(128) NOT NULL	Name of the column. If NUMCOLUMNS is greater than 1, this name identifies the first column name of the set of columns associated with the statistics.	G
COLVALUE	VARCHAR(2000) NOT NULL WITH DEFAULT FOR BIT DATA	Contains the data of a frequently occurring value. Statistics are not collected for an index on a ROWID column. If the value has a non-character data type, the data may not be printable.	S
TYPE	CHAR(1) NOT NULL WITH DEFAULT 'F'	The type of statistics gathered: C Cardinality F Frequent value N Non-padded frequent value	G
CARDF	FLOAT NOT NULL WITH DEFAULT -1	Number of distinct values for the column group. This number is valid only for TYPE C statistics.	S
COLGROUPCOLNO	VARCHAR(254) NOT NULL WITH DEFAULT FOR BIT DATA	Identifies the set of columns associated with the statistics. If the statistics are only associated with a single column, the field contains a zero length. Otherwise, the field is an array of SMALLINT column numbers with a dimension equal to the value in NUMCOLUMNS. This is an updatable column.	S
NUMCOLUMNS	SMALLINT NOT NULL WITH DEFAULT 1	Identifies the number of columns associated with the statistics.	G
FREQUENCYF	FLOAT NOT NULL WITH DEFAULT -1	Gives the percentage of rows in the table with the value specified in COLVALUE when the number is multiplied by 100. For example, a value of 1 indicates 100%. A value of .153 indicates 15.3%. Statistics are not collected for an index on a ROWID column.	G
	VARCHAR(1000) NOT NULL WITH DEFAULT FOR BIT DATA	Internal use only	I

SYSIBM.SYSCOLDIST_HIST table

Contains rows from SYSCOLDIST. Rows are added or changed in this table when RUNSTATS collects history statistics. Rows in this table can also be inserted, updated, and deleted.

Column name	Data type	Description	Use
STATSTIME	TIMESTAMP NOT NULL	If RUNSTATS updated the statistics, the date and time when the last invocation of RUNSTATS updated the statistics.	G
TBOWNER	VARCHAR(128) NOT NULL	Authorization ID of the owner of the table that contains the column.	G
TBNAME	VARCHAR(128) NOT NULL	Name of the table that contains the column.	G
NAME	VARCHAR(128) NOT NULL	Name of the column. If NUMCOLUMNS is greater than 1, this name identifies the first column name of the set of columns associated with the statistics.	G
COLVALUE	VARCHAR(2000) NOT NULL WITH DEFAULT FOR BIT DATA	Contains the data of a frequently occurring value. Statistics are not collected for an index on a ROWID column. If the value has a non-character data type, the data might not be printable.	S
TYPE	CHAR(1) NOT NULL WITH DEFAULT 'F'	The type of statistics gathered: **C** Cardinality **F** Frequent value **N** Non-padded frequent value	G
CARDF	FLOAT(8) NOT NULL WITH DEFAULT -1	Number of distinct values for the column group. This number is valid only for TYPE C statistics. The value is -1 if statistics have not been gathered.	S
COLGROUPCOLNO	VARCHAR(254) NOT NULL WITH DEFAULT FOR BIT DATA	Identifies the set of columns associated with the statistics. If the statistics are only associated with a single column, the field contains a zero length. Otherwise, the field is an array of SMALLINT column numbers with a dimension equal to the value in NUMCOLUMNS.	S
NUMCOLUMNS	SMALLINT NOT NULL WITH DEFAULT 1	Identifies the number of columns associated with the statistics.	G
FREQUENCYF	FLOAT(8) NOT NULL DEFAULT -1	Gives the percentage of rows in the table with the value specified in COLVALUE when the number is multiplied by 100. For example, a value of 1 indicates 100%. A value of .153 indicates 15.3%. Statistics are not collected for an index on a ROWID column. The value is -1 if statistics have not been gathered.	G
IBMREQD	CHAR(1) NOT NULL DEFAULT 'N'	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G

SYSIBM.SYSCOLSTATS table

Contains partition statistics for selected columns. For each column, a row exists for each partition in the table. Rows are inserted when RUNSTATS collects either indexed column statistics or non-indexed column statistics for a partitioned table space. No row is inserted if the table space is nonpartitioned. Rows in this table can be inserted, updated, and deleted.

Column name	Data type	Description	Use
HIGHKEY	VARCHAR(2000) NOT NULL WITH DEFAULT FOR BIT DATA	Highest value of the column within the partition. Blank if statistics have not been gathered or the column is an indicator column. If the column has a non-character data type, the data might not be printable.	S
HIGH2KEY	VARCHAR(2000) NOT NULL WITH DEFAULT FOR BIT DATA	Second highest value of the column within the partition. Blank if statistics have not been gathered or the column is an indicator column. If the column has a non-character data type, the data might not be printable.	S
LOWKEY	VARCHAR(2000) NOT NULL WITH DEFAULT FOR BIT DATA	Lowest value of the column within the partition. Blank if statistics have not been gathered or the column is an indicator column. If the column has a non-character data type, the data might not be printable.	S
LOW2KEY	VARCHAR(2000) NOT NULL WITH DEFAULT FOR BIT DATA	Second lowest value of the column within the partition. Blank if statistics have not been gathered or the column is an indicator column. If the column has a non-character data type, the data might not be printable.	S
	INTEGER NOT NULL	Number of distinct column values in the partition.	S
STATSTIME	TIMESTAMP NOT NULL	If RUNSTATS updated the statistics, the date and time when the last invocation of RUNSTATS updated the statistics. If the value is '0001-01-02.00.00.00.000000', which indicates that an ALTER TABLE statement was executed to change the length of a VARCHAR column, RUNSTATS should be run to update the statistics before they are used.	G
IBMREQD	CHAR(1) NOT NULL	Whether the row came from the basic machine-readable material (MRM) tape: N No Y Yes	G
PARTITION	SMALLINT NOT NULL	Partition number for the table space that contains the table in which the column is defined.	G
TBOWNER	VARCHAR(128) NOT NULL	Authorization ID of the owner of the table that contains the column.	G
TBNAME	VARCHAR(128) NOT NULL	Name of the table that contains the column.	G
NAME	VARCHAR(128) NOT NULL	Name of the column.	G
COLCARDDATA	VARCHAR(1000) NOT NULL WITH DEFAULT FOR BIT DATA	Internal use only	I
STATS_FORMAT	CHAR(1) NOT NULL WITH DEFAULT	The type of statistics gathered: blank Statistics have not been collected or varchar column statistical values are padded. N Varchar column statistical values are not padded. This is an updatable column.	G

SYSIBM.SYSCOLUMNS table

Contains one row for every column of each table and view.

Column name	Data type	Description	Use
NAME	VARCHAR(128) NOT NULL	Name of the column.	G
TBNAME	VARCHAR(128) NOT NULL	Name of the table or view which contains the column.	G
TBCREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the table or view that contains the column.	G
COLNO	SMALLINT NOT NULL	Numeric place of the column in the table or view; for example 4 (out of 10). An additional row with column number 0 is inserted into SYSCOLUMNS if the definition of the table is incomplete (all required unique indexes have not been created).	G
COLTYPE	CHAR(8) NOT NULL	The type of the column specified in the definition of the column: INTEGER Large integer SMALLINT Small integer FLOAT Floating-point CHAR Fixed-length character string VARCHAR Varying-length character string LONGVAR Varying-length character string DECIMAL Decimal GRAPHIC Fixed-length graphic string VARG Varying-length graphic string LONGVARG Varying-length graphic string DATE Date TIME Time TIMESTMP Timestamp BLOB Binary large object CLOB Character large object DBCLOB Double-byte character large object ROWID Row ID data type DISTINCT Distinct type	G
LENGTH	SMALLINT NOT NULL	Length attribute of the column or, in the case of a decimal column, its precision. The number does not include the internal prefixes that are used to record the actual length and null state, where applicable. INTEGER 4 SMALLINT 2 FLOAT 4 or 8 CHAR Length of string VARCHAR Maximum length of string LONGVAR Maximum length of string DECIMAL Precision of number GRAPHIC Number of DBCS characters VARG Maximum number of DBCS characters LONGVARG Maximum number of DBCS characters DATE 4 TIME 3 TIMESTMP 10 BLOB 4 - The length of the field that is stored in the base table. The maximum length of the LOB column is found in LENGTH2. CLOB 4 - The length of the field that is stored in the base table. The maximum length of the CLOB column is found in LENGTH2. DBCLOB 4 - The length of the field that is stored in the base table. The maximum length of the DBCLOB column is found in LENGTH2. ROWID 17 - The maximum length of the stored portion of the identifier. DISTINCT The length of the source data type.	G

Column name	Data type	Description	Use
SCALE	SMALLINT NOT NULL	Scale of decimal data. Zero if not a decimal column.	G
NULLS	CHAR(1) NOT NULL	Whether the column can contain null values: N No Y Yes The value can be N for a view column that is derived from an expression or a function. Nevertheless, such a column allows nulls when an outer select list refers to it.	G
	INTEGER NOT NULL	Not used	N
HIGH2KEY	VARCHAR(2000) NOT NULL WITH DEFAULT FOR BIT DATA	Second highest value of the column. Blank if statistics have not been gathered, or the column is an indicator column or a column of an auxiliary table. If the column has a non-character data type, the data might not be printable. This is an updatable column.	S
LOW2KEY	VARCHAR(2000) NOT NULL WITH DEFAULT FOR BIT DATA	Second lowest value of the column. Blank if statistics have not been gathered, or the column is an indicator column or a column of an auxiliary table. If the column has a non-character data type, the data might not be printable. This is an updatable column.	S
UPDATES	CHAR(1) NOT NULL	Whether the column can be updated: N No Y Yes The value is N if the column is: • Derived from a function or expression • A column with a row ID data type (or a distinct type based on a row ID type) The value is Y if the column is a read-only view.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
REMARKS	VARCHAR(762) NOT NULL	A character string provided by the user with the COMMENT statement.	G

<table>
<tr><th>Column name</th><th>Data type</th><th>Description</th><th>Use</th></tr>
<tr><td>DEFAULT</td><td>CHAR(1)
NOT NULL</td><td>
<p>The contents of this column are meaningful only if the TYPE column for the associated SYSTABLES row indicates that this is for a table (T) or a created temporary table (G).</p>
<p>Default indicator:</p>
<table>
<tr><td>A</td><td>The column has a row ID data type (COLTYPE=’ROWID’) and the GENERATED ALWAYS attribute.</td></tr>
<tr><td>B</td><td><p>The column has a default value that depends on the data type of the column.</p>
<table>
<tr><th>Data type</th><th>Default Value</th></tr>
<tr><td>Numeric</td><td>0</td></tr>
<tr><td>Fixed-length string</td><td>Blanks</td></tr>
<tr><td>Varying-length string</td><td>A string length of 0</td></tr>
<tr><td>Date</td><td>The current date</td></tr>
<tr><td>Time</td><td>The current time</td></tr>
<tr><td>Timestamp</td><td>The current timestamp</td></tr>
</table></td></tr>
<tr><td>D</td><td>The column has a row ID data type (COLTYPE=’ROWID’) and the GENERATED BY DEFAULT attribute.</td></tr>
<tr><td>I</td><td>The column is defined with the AS IDENTITY and GENERATED ALWAYS attributes.</td></tr>
<tr><td>J</td><td>The column is defined with the AS IDENTITY and GENERATED BY DEFAULT attributes.</td></tr>
<tr><td>L</td><td>The column is defined with the AS SECURITY LABEL attribute.</td></tr>
<tr><td>N</td><td>The column has no default value.</td></tr>
<tr><td>S</td><td>The column has a default value that is the value of the SQL authorization ID of the process at the time a default value is used.</td></tr>
<tr><td>U</td><td>The column has a default value that is the value of the USER special register at the time a default value is used.</td></tr>
<tr><td>Y</td><td><p>If the NULLS column is Y, the column has a default value of null.</p>
<p>If the NULLS column is N, the default value depends on the data type of the column.</p>
<table>
<tr><th>Data type</th><th>Default Value</th></tr>
<tr><td>Numeric</td><td>0</td></tr>
<tr><td>Fixed-length string</td><td>Blanks</td></tr>
<tr><td>Varying-length string</td><td>A string length of 0</td></tr>
<tr><td>Date</td><td>The current date</td></tr>
<tr><td>Time</td><td>The current time</td></tr>
<tr><td>Timestamp</td><td>The current timestamp</td></tr>
</table></td></tr>
</table>
</td><td>G</td></tr>
</table>

Column name	Data type	Description	Use
DEFAULT (continued)	CHAR(1) NOT NULL	The contents of this column are meaningful only if the TYPE column for the associated SYSTABLES row indicates that this is for a table (T) or a created temporary table (G). Default indicator: 1 The column has a default value that is the string constant found in the DEFAULTVALUE column of this table row. 2 The column has a default value that is the floating-point constant found in the DEFAULTVALUE column of this table row. 3 The column has a default value that is the decimal constant found in the DEFAULTVALUE column of this table row. 4 The column has a default value that is the integer constant found in the DEFAULTVALUE column of this table row. 5 The column has a default value that is the hex character string found in the DEFAULTVALUE column of this table row. 6 The column has a default value that is the UX string found in the DEFAULTVALUE column of this table row. 7 The column has a graphic data type and has a default value that is the character string constant found in the DEFAULTVALUE column of this table row.	G
KEYSEQ	SMALLINT NOT NULL	The column's numeric position within the table's primary key. The value is 0 if it is not part of a primary key.	G
FOREIGNKEY	CHAR(1) NOT NULL	Applies to character or CLOB columns, where it indicates the subtype of the data: **B** BIT data **M** MIXED data **S** SBCS data **blank** Indicates one of the following subtypes: • MIXED data if the encoding scheme is UNICODE, or if the encoding scheme is not UNICODE and the value of MIXED DATA on installation panel DSNTIPS is YES • SBCS data if the encoding scheme is not UNICODE and the value of MIXED DATA on the installation panel DSNTIPS is NO. For views defined prior to Version 7, subtype information is not available and the default (MIXED or SBCS) is used.	G
FLDPROC	CHAR(1) NOT NULL	Whether the column has a field procedure: N No Y Yes blank The column is for a view defined prior to Version 7. Views defined after Version 7 contain Y or N.	G
LABEL	VARCHAR(90) NOT NULL	The column label provided by the user with a LABEL statement; otherwise, the value is an empty string.	G

Column name	Data type	Description	Use
STATSTIME	TIMESTAMP NOT NULL WITH DEFAULT	If RUNSTATS updated the statistics, the date and time when the last invocation of RUNSTATS updated the statistics. The default value is '0001-01-01.00.00.00.000000'. If the value is '0001-01-02.00.00.00.000000', which indicates that an ALTER TABLE statement was executed to change the length of a VARCHAR column, RUNSTATS should be run to update the statistics before they are used. This is an updatable column.	G
DEFAULTVALUE	VARCHAR(1536) NOT NULL WITH DEFAULT	This field is meaningful only if the column being described is for a table (the TYPE column of the associated SYSTABLES row is T for table or G for created temporary table). When the DEFAULT column is 1, 2, 3, 4, 5, 6, or 7, this field contains the default value of the column. If the default value is a string constant or a hexadecimal constant (DEFAULT is 1, 5, 6, or 7, respectively), the value is stored without delimiters. If the default value is a numeric constant (DEFAULT is 2, 3, or 4), the value is stored as specified by the user, including sign and decimal point representation, as appropriate for the constant. When the DEFAULT column is S or U and the default value was specified when a new column was defined with the ALTER TABLE statement, this field contains the value of the CURRENT SQLID or USER special register at the time the ALTER TABLE statement was executed. Remember that this default value applies only to rows that existed before the ALTER TABLE statement was executed. When the DEFAULT column is L and the column was added as a new column with the ALTER TABLE statement, this field contains the security label of the user at the time the ALTER TABLE statement was executed. Remember that this default value applies only to rows that existed before the ALTER TABLE statement was executed.	G
COLCARDF	FLOAT NOT NULL WITH DEFAULT	Estimated number of distinct values in the column. For an indicator column, this is the number of LOBs that are not null and have a length greater than zero. The value is -1 if statistics have not been gathered. The value is -2 for the first column of an index of an auxiliary table. This is an updatable column.	S
COLSTATUS	CHAR(1) NOT NULL WITH DEFAULT	Indicates the status of the definition of a column: I The definition is incomplete because a LOB table space, auxiliary table, or index on an auxiliary table has not been created for the column. blank The definition is complete.	G
LENGTH2	INTEGER NOT NULL WITH DEFAULT	Maximum length of the data retrieved from the column. Possible values are: 0 Not a LOB or ROWID column 40 For a ROWID column, the length of the returned value 1 to 2 147 483 647 bytes For a LOB column, the maximum length	G
DATATYPEID	INTEGER NOT NULL WITH DEFAULT	For a built-in data type, the internal ID of the built-in type. For a distinct type, the internal ID of the distinct type. If the column was created prior to Version 6, the value is 0.	S
SOURCETYPEID	INTEGER NOT NULL WITH DEFAULT	For a built-in data type, 0. For a distinct type, the internal ID of the built-in data type upon which the distinct type is based. If the column was created prior to Version 6, the value is 0.	S
TYPESCHEMA	VARCHAR(128) NOT NULL WITH DEFAULT 'SYSIBM'	If COLTYPE is 'DISTINCT', the schema of the distinct type. Otherwise, the value is 'SYSIBM'.	G

Column name	Data type	Description	Use
TYPENAME	VARCHAR(128) NOT NULL WITH DEFAULT	If COLTYPE is 'DISTINCT', the name of the distinct type. Otherwise, the value is the same as the value of the COLTYPE column. TYPENAME is set only for columns created in Version 6 or later. The value for columns created earlier is not filled in.	G
CREATEDTS	TIMESTAMP NOT NULL WITH DEFAULT	Timestamp when the column was created. The value is '0001-01-01.00.00.00.000000' if the column was created prior to migration to Version 6.	G
STATS_FORMAT	CHAR(1) NOT NULL WITH DEFAULT	The type of statistics gathered: blank Statistics have not been collected or varchar column statistical values are padded. N Varchar column statistical values are not padded. This is an updatable column.	G
PARTKEY_COLSEQ	SMALLINT NOT NULL WITH DEFAULT	The column's numeric position within the table's partitioning key. The value is 0 if it is not part of the partitioning key. This column is applicable only if the table uses table-controlled partitioning.	G
PARTKEY_ORDERING	CHAR(1) NOT NULL WITH DEFAULT	Order of the column in the partitioning key: A Ascending D Descending blank Column is not used as part of a partitioning key This column is applicable only if the table uses table-controlled partitioning.	G
ALTEREDTS	TIMESTAMP NOT NULL WITH DEFAULT	Timestamp when alter occurred.	G
CCSID	INTEGER NOT NULL WITH DEFAULT	CCSID of the column. 0 if the object was created prior to Version 8 or is not a string column	G
HIDDEN	INTEGER NOT NULL WITH DEFAULT	Indicates whether the column is hidden: P Partially hidden. The column is hidden from SELECT *. N Not hidden. The column is visible to all SQL statements. blank Not hidden. The column is visible to all SQL statements.	G

SYSIBM.SYSCOLUMNS_HIST table

Contains rows from SYSCOLUMNS. Rows are added or changed in this table when RUNSTATS collects history statistics. Rows in this table can also be inserted, updated, and deleted.

Column name	Data type	Description	Use
NAME	VARCHAR(128) NOT NULL	Name of the column.	G
TBNAME	VARCHAR(128) NOT NULL	Name of the table or view that contains the column.	G
TBCREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the table or view that contains the column.	G
COLNO	SMALLINT NOT NULL	Numeric place of the column in the table or view. For example 4 (out of 10).	G
COLTYPE	CHAR(8) NOT NULL	The type of the column specified in the definition of the column: INTEGER Large integer SMALLINT Small integer FLOAT Floating-point CHAR Fixed-length character string VARCHAR Varying-length character string LONGVAR Varying-length character string DECIMAL Decimal GRAPHIC Fixed-length graphic string VARG Varying-length graphic string LONGVARG Varying-length graphic string DATE Date TIME Time TIMESTMP Timestamp BLOB Binary large object CLOB Character large object DBCLOB Double-byte character large object ROWID Row ID data type DISTINCT Distinct type	G
LENGTH	SMALLINT NOT NULL	Length attribute of the column or, in the case of a decimal column, its precision. The number does not include the internal prefixes that are used to record the actual length and null state, where applicable. INTEGER 4 SMALLINT 2 FLOAT 4 or 8 CHAR Length of string VARCHAR Maximum length of string LONGVAR Maximum length of string DECIMAL Precision of number GRAPHIC Number of DBCS characters VARG Maximum number of DBCS characters LONGVARG Maximum number of DBCS characters DATE 4 TIME 3 TIMESTMP 10 BLOB 4 - The length of the field that is stored in the base table. The maximum length of the LOB column is found in LENGTH2. CLOB 4 - The length of the field that is stored in the base table. The maximum length of the CLOB	G
LENGTH2	INTEGER NOT NULL	Maximum length of the data retrieved from the column. Possible values are: **0** Not a LOB or ROWID column **40** For a ROWID column, the length of the returned value **1 to 2 147 483 647 bytes** For a LOB column, the maximum length	G

Column name	Data type	Description	Use
NULLS	CHAR(1) NOT NULL	Whether the column can contain null values: **N** No **Y** Yes	G
HIGH2KEY	VARCHAR(2000) NOT NULL WITH DEFAULT FOR BIT DATA	Second highest value of the column. Blank if statistics have not been gathered, or the column is an indicator column or a column of an auxiliary table. If the column has a non-character data type, the data might not be printable.	S
LOW2KEY	VARCHAR(2000) NOT NULL WITH DEFAULT FOR BIT DATA	Second lowest value of the column. Blank if statistics have not been gathered, or the column is an indicator column or a column of an auxiliary table. If the column has a non-character data type, the data might not be printable.	S
STATSTIME	TIMESTAMP NOT NULL	If RUNSTATS updated the statistics, the date and time when the last invocation of RUNSTATS updated the statistics. The default value is ’0001-01-01.00.00.00.000000’. If the value is ’0001-01-02.00.00.00.000000’, which indicates that an ALTER TABLE statement was executed to change the length of a VARCHAR column, RUNSTATS should be run to update the statistics before they are used.	G
COLCARDF	FLOAT(8) NOT NULL WITH DEFAULT -1	Estimated number of distinct values in the column. For an indicator column, this is the number of LOBs that are not null and have a length greater than zero. The value is -1 if statistics have not been gathered. The value is -2 for the first column of an index of an auxiliary table.	S
IBMREQD	CHAR(1) NOT NULL DEFAULT ’N’	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
STATS_FORMAT	CHAR(1) NOT NULL WITH DEFAULT	The type of statistics gathered: blank Statistics have not been collected or varchar column statistical values are padded. N Varchar column statistical values are not padded. This is an updatable column.	G

SYSIBM.SYSCONSTDEP table

Records dependencies on check constraints or user-defined defaults for a column.

Column name	Data type	Description	Use
BNAME	VARCHAR(128) NOT NULL	Name of the object on which the dependency exists.	G
BSCHEMA	VARCHAR(128) NOT NULL	Schema of the object on which the dependency exists.	G
BTYPE	CHAR(1) NOT NULL	Type of object on which the dependency exists: F Function instance	G
DTBNAME	VARCHAR(128) NOT NULL	Name of the table to which the dependency applies.	G
DTBCREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the table to which the dependency applies.	G
DCONSTNAME	VARCHAR(128) NOT NULL	If DTYPE = 'C', the unqualified name of the check constraint. If DTYPE = 'D', a column name.	G
DTYPE	CHAR(1) NOT NULL	Type of object: C Check constraint D User-defined default constant	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G

SYSIBM.SYSCOPY table

Contains information needed for recovery.

Column name	Data type	Description	Use
DBNAME	CHAR(8) NOT NULL	Name of the database.	G
TSNAME	CHAR(8) NOT NULL	Name of the target table space or index space.	G
DSNUM	INTEGER NOT NULL	Data set number within the table space. For partitioned table spaces, this value corresponds to the partition number for a single partition copy, or 0 for a copy of an entire partitioned table space or index space.	G
ICTYPE	CHAR(1) NOT NULL	Type of operation: A ALTER B REBUILD INDEX D CHECK DATA LOG(NO) (no log records for the range are available for RECOVER utility) F COPY FULL YES I COPY FULL NO P RECOVER TOCOPY or RECOVER TORBA (partial recovery point) Q QUIESCE R LOAD REPLACE LOG(YES) S LOAD REPLACE LOG(NO) V REPAIR VERSIONS utility W REORG LOG(NO) X REORG LOG(YES) Y LOAD LOG(NO) Z LOAD LOG(YES) T TERM UTILITY command (terminated utility)	G
	CHAR(6) NOT NULL	Not used	N
START_RBA	CHAR(6) NOT NULL WITH DEFAULT FOR BIT DATA	A 48-bit positive integer that contains the LRSN of a point in the DB2 recovery log. (The LRSN is the RBA in a non-data-sharing environment.) • For ICTYPE I or F, the starting point for all updates since the image copy was taken • For ICTYPE P, the point after the log-apply phase of point-in-time recovery • For ICTYPE Q, the point after all data sets have been successfully quiesced • For ICTYPE R or S, the end of the log before the start of the LOAD utility and before any data is changed • For ICTYPE T, the end of the log when the utility is terminated • For other values of ICTYPE, the end of the log before the start of the RELOAD phase of the LOAD or REORG utility.	G
FILESEQNO	INTEGER NOT NULL	Tape file sequence number of the copy.	G
DEVTYPE	CHAR(8) NOT NULL	Device type the copy is on.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
DSNAME	CHAR(44) NOT NULL	For ICTYPE='P' (RECOVER TOCOPY only), 'I', or 'F', DSNAME contains the data set name. Otherwise, DSNAME contains the name of the database and table space or index space in the form, *database-name.space-name*, or DSNAME is blank for any row migrated from a DB2 release prior to Version 4.	G
	CHAR(6) NOT NULL	Not used	N

Column name	Data type	Description	Use
SHRLEVEL	CHAR(1) NOT NULL	SHRLEVEL parameter on COPY (for ICTYPE F or I only): C Change R Reference blank Does not describe an image copy or was migrated from Version 1 Release 1 of DB2.	G
DSVOLSER	VARCHAR(1784) NOT NULL	The volume serial numbers of the data set. A list of 6-byte numbers separated by commas. Blank if the data set is cataloged.	G
TIMESTAMP	TIMESTAMP NOT NULL WITH DEFAULT	The date and time when the row was inserted. This is the date and time recorded in ICDATE and ICTIME. The use of TIMESTAMP is recommended over that of ICDATE and ICTIME, because the latter two columns may not be supported in later DB2 releases. For the COPYTOCOPY utility, this value is the date and time when the row was inserted for the primary local site or primary recovery site copy.	G
ICBACKUP	CHAR(2) NOT NULL WITH DEFAULT	Specifies the type of image copy contained in the data set: blank LOCALSITE primary copy (first data set named with COPYDDN) LB LOCALSITE backup copy (second data set named with COPYDDN) RP RECOVERYSITE primary copy (first data set named with RECOVERYDDN) RB RECOVERYSITE backup copy (second data set named with RECOVERYDDN)	G
ICUNIT	CHAR(1) NOT NULL WITH DEFAULT	Indicates the media that the image copy data set is stored on: D DASD T Tape blank Medium is neither tape nor DASD, the image copy is from a DB2 release prior to Version 2 Release 3, or ICTYPE is not 'I' or 'F'.	G

Column name	Data type	Description	Use
STYPE	CHAR(1) NOT NULL WITH DEFAULT	When ICTYPE=A, the values are: A A partition was added to a table. C A column was added to a table and an index in different commit scopes. N An index was altered to not padded P An index was altered to padded R A table was altered to rotate partitions. V A column in a table was altered for a numeric data type change and the column is in an index. When ICTYPE=F, the values are: A ADD PARTITION execution C DFSMS concurrent copy R ROTATE FIRST TO LAST S LOAD REPLACE(NO) V ALTER INDEX NOT PADDED W REORG LOG(NO) X REORG LOG(YES) blank DB2 image copy The MERGECOPY utility, when used to merge an embedded copy with subsequent incremental copies, also produces a record that contains ICTYPE=F and the STYPE of the original image copy (R, S, W, or X). When ICTYPE=P and the operation is RECOVER TORBA LOGONLY, the value is L. When ICTYPE=Q and option WRITE(YES) is in effect when the quiesce point is taken, the value is W. When ICTYPE=R, S, W, or X and the operation is resetting REORG pending status, the value is A. When ICTYPE=T, this field indicates which COPY utility was terminated by the TERM UTILITY command or the START DATABASE command with the ACCESS(FORCE) option. The values are: F COPY FULL YES I COPY FULL NO For other values of ICTYPE, the value is blank.	G
PIT_RBA	CHAR(6) NOT NULL WITH DEFAULT FOR BIT DATA	When ICTYPE=P, this field contains the LRSN for the point in the DB2 log. (The LRSN is the RBA in a non-data-sharing environment). For other ICTYPEs, this field is X'000000000000'. When ICTYPE=P, this field indicates the stop location of a point-in-time recovery. If a record contains ICTYPE=P and PIT_RBA=X'000000000000', the copy pending status is active and a full image copy is required. If such a record is encountered during fallback processing of RECOVER, the recover job fails, and a point-in-time recovery is required. PIT_RBA can be zero if the point-in-time recovery is completed by the fall-back processing of RECOVER, or if ICTYPE=P from a prior release of DB2.	G
GROUP_MEMBER	CHAR(8) NOT NULL WITH DEFAULT	The DB2 data sharing member name of the DB2 subsystem that performed the operation. This column is blank if the DB2 subsystem was not in a DB2 data sharing environment at the time the operation was performed.	G
OTYPE	CHAR(1) NOT NULL WITH DEFAULT 'T'	Type of object that the recovery information is for: I Index space T Table space	G

Column name	Data type	Description	Use
LOWDSNUM	INTEGER NOT NULL WITH DEFAULT	Partition number of the lowest partition in the range for SYSCOPY records created for REORG and LOAD REPLACE for resetting a REORG pending status. Version number of an index for SYSCOPY records created for a COPY (ICTYPE=F) of an index space (OTYPE=I). (An index is versioned when a VARCHAR column in the index key is lengthened.) The column is valid only for these uses.	G
HIGHDSNUM	INTEGER NOT NULL WITH DEFAULT	Partition number of the highest partition in the range. This column is valid only for SYSCOPY records created for REORG and LOAD REPLACE for resetting REORG pending status.	G
COPYPAGESF	FLOAT(8) NOT NULL WITH DEFAULT -1	Number of pages written to the copy data set. For inline copies, this number might include pages appearing more than once in the copy data set.	G
NPAGESF	FLOAT(8) NOT NULL WITH DEFAULT -1	The number of pages in the table space or index at the time of COPY. This number might include preformatted pages that are not actually copied.	G
CPAGESF	FLOAT(8) NOT NULL WITH DEFAULT -1	Total number of changed pages.	G
JOBNAME	CHAR(8) NOT NULL WITH DEFAULT	Job name of the utility.	G
AUTHID	CHAR(8) NOT NULL WITH DEFAULT	Authorization ID of the utility.	G
OLDEST_VERSION	SMALLINT NOT NULL WITH DEFAULT	When ICTYPE= B, F, I, S, W, or X, the version number of the oldest format of data for an object. For other values of ICTYPE, the value is -1.	G
LOGICAL_PART	INTEGER NOT NULL WITH DEFAULT	Logical partition number.	G

SYSIBM.SYSDATABASE table

Contains one row for each database, except for database DSNDB01.

Column name	Data type	Description	Use
NAME	VARCHAR(24) NOT NULL	Database name.	G
CREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the database.	G
STGROUP	VARCHAR(128) NOT NULL	Name of the default storage group of the database; blank for a system database.	G
BPOOL	CHAR(8) NOT NULL	Name of the default buffer pool of the table space; blank for a system table space.	G
DBID	SMALLINT NOT NULL	Internal identifier of the database. If there were 32511 databases or more when this database was created, the DBID is a negative number.	S
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see "Release dependency indicators" on page 1191.	G
CREATEDBY	VARCHAR(128) NOT NULL WITH DEFAULT	Primary authorization ID of the user who created the database.	G
	CHAR(1) NOT NULL WITH DEFAULT	Not used	N
	TIMESTAMP NOT NULL WITH DEFAULT	Not used	N
TYPE	CHAR(1) NOT NULL WITH DEFAULT	Type of database: blank Not a work file database or a TEMP database. T A TEMP database. The database was created with the AS TEMP clause, which indicates it is used for declared temporary tables. W A work file database. The database is DSNDB07, or it was created with the WORKFILE clause and used as a work file database by a member of a DB2 data sharing group.	G
GROUP_MEMBER	VARCHAR(24) NOT NULL WITH DEFAULT	The DB2 data sharing member name of the DB2 subsystem that uses this work file database. This column is blank if the work file database was not created in a DB2 data sharing environment, or if the database is not a work file database as indicated by the TYPE column.	G
CREATEDTS	TIMESTAMP NOT NULL WITH DEFAULT	Time when the CREATE statement was executed for the database. For DSNDB04 and DSNDB06, the value is '1985-04-01.00.00.00.000000'.	G
ALTEREDTS	TIMESTAMP NOT NULL WITH DEFAULT	Time when the most recent ALTER DATABASE statement was applied. If no ALTER DATABASE statement has been applied, ALTEREDTS has the value of CREATEDTS.	G
ENCODING_SCHEME	CHAR(1) NOT NULL WITH DEFAULT 'E'	Default encoding scheme for the database: E EBCDIC A ASCII U UNICODE blank For DSNDB04, a work file database, and a TEMP database.	G
SBCS_CCSID	INTEGER NOT NULL WITH DEFAULT	Default SBCS CCSID for the database. For a TEMP database, a work file database, or a database created in a DB2 release prior to Version 5, the value is 0.	G
DBCS_CCSID	INTEGER NOT NULL WITH DEFAULT	Default DBCS CCSID for the database. For a TEMP database, a work file database, or a database created in a DB2 release prior to Version 5, the value is 0.	G

Column name	Data type	Description	Use
MIXED_CCSID	INTEGER NOT NULL WITH DEFAULT	Default mixed CCSID for the database. For a TEMP database, a work file database, or a database created in a DB2 release prior to Version 5, the value is 0.	G
INDEXBP	CHAR(8) NOT NULL WITH DEFAULT 'BP0'	Name of the default buffer pool for indexes.	G

SYSIBM.SYSDATATYPES table

Contains one row for each distinct type defined to the system.

Column name	Data type	Description	Use
SCHEMA	VARCHAR(128) NOT NULL	Schema of the distinct type.	G
OWNER	VARCHAR(128) NOT NULL	Owner of the distinct type.	G
NAME	VARCHAR(128) NOT NULL	Name of the distinct type.	G
CREATEDBY	VARCHAR(128) NOT NULL	Authorization ID under which the distinct type was created.	G
SOURCESCHEMA	VARCHAR(128) NOT NULL	Schema of the source data type.	G
SOURCETYPE	VARCHAR(128) NOT NULL	Name of the source type.	G
METATYPE	CHAR(1) NOT NULL	The class of data type: T Distinct type	G
DATATYPEID	INTEGER NOT NULL	Internal identifier of the distinct type.	S
SOURCETYPEID	INTEGER NOT NULL	Internal ID of the built-in data type upon which the distinct type is based.	S
LENGTH	INTEGER NOT NULL	Maximum length or precision of a distinct type that is based on the IBM-defined DECIMAL data type.	G
SCALE	SMALLINT NOT NULL	Scale for a distinct type that is based on the IBM-defined DECIMAL type. For all other distinct types, the value is 0.	G
SUBTYPE	CHAR(1) NOT NULL	Subtype of the distinct type, which is based on the subtype of the source type: B The subtype is FOR BIT DATA. S The subtype is FOR SBCS DATA. M The subtype is FOR MIXED DATA. blank The source type is not a character type.	G
CREATEDTS	TIMESTAMP NOT NULL	Time when the distinct type was created.	G
ENCODING_SCHEME	CHAR(1) NOT NULL	Encoding scheme of the distinct type: A ASCII E EBCDIC U UNICODE	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
REMARKS	VARCHAR(762) NOT NULL	A character string provided by the user with the COMMENT statement.	G

SYSIBM.SYSDBAUTH table

Records the privileges that are held by users over databases.

Column name	Data type	Description	Use
GRANTOR	VARCHAR(128) NOT NULL	Authorization ID of the user who granted the privileges. Could also be PUBLIC or PUBLIC followed by an asterisk.[46]	G
GRANTEE	VARCHAR(128) NOT NULL	Application ID of the user who holds the privilege. Could also be PUBLIC for a grant to PUBLIC.	G
NAME	VARCHAR(24) NOT NULL	Database name.	G
	CHAR(12) NOT NULL	Internal use only	I
	CHAR(6) NOT NULL	Not used	N
	CHAR(8) NOT NULL	Not used	N
	CHAR(1) NOT NULL	Not used	N
AUTHHOWGOT	CHAR(1) NOT NULL	Authorization level of the user from whom the privileges were received. This authorization level is not necessarily the highest authorization level of the grantor. blank Not applicable C DBCTL D DBADM L SYSCTRL M DBMAINT S SYSADM	G
CREATETABAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can create tables within the database: blank Privilege is not held G Privilege held with the GRANT option Y Privilege is held without the GRANT option	G
CREATETSAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can create table spaces within the database: blank Privilege is not held G Privilege held with the GRANT option Y Privilege is held without the GRANT option	G
DBADMAUTH	CHAR(1) NOT NULL	Whether the GRANTEE has DBADM authority over the database: blank Privilege is not held G Privilege held with the GRANT option Y Privilege is held without the GRANT option	G
DBCTRLAUTH	CHAR(1) NOT NULL	Whether the GRANTEE has DBCTRL authority over the database: blank Privilege is not held G Privilege held with the GRANT option Y Privilege is held without the GRANT option	G
DBMAINTAUTH	CHAR(1) NOT NULL	Whether the GRANTEE has DBMAINT authority over the database: blank Privilege is not held G Privilege held with the GRANT option Y Privilege is held without the GRANT option	G
DISPLAYDBAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can issue the DISPLAY command for the database: blank Privilege is not held G Privilege held with the GRANT option Y Privilege is held without the GRANT option	G

[46] PUBLIC followed by an asterisk (PUBLIC*) denotes PUBLIC AT ALL LOCATIONS. For the conditions where GRANTOR can be PUBLIC or PUBLIC*, see Part 3 (Volume 1) of *DB2 Administration Guide*.

Column name	Data type	Description	Use
DROPAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can issue the ALTER DATABASE and DROP DATABASE statement: blank Privilege is not held G Privilege held with the GRANT option Y Privilege is held without the GRANT option	G
IMAGCOPYAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can use the COPY, MERGECOPY, MODIFY, and QUIESCE utilities on the database: blank Privilege is not held G Privilege held with the GRANT option Y Privilege is held without the GRANT option	G
LOADAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can use the LOAD utility to load tables in the database: blank Privilege is not held G Privilege held with the GRANT option Y Privilege is held without the GRANT option	G
REORGAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can use the REORG utility to reorganize table spaces and indexes in the database: blank Privilege is not held G Privilege held with the GRANT option Y Privilege is held without the GRANT option	G
RECOVERDBAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can use the RECOVER and REPORT utilities on table spaces in the database: blank Privilege is not held G Privilege held with the GRANT option Y Privilege is held without the GRANT option	G
REPAIRAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can use the DIAGNOSE and REPAIR utilities on table spaces and indexes in the database: blank Privilege is not held G Privilege held with the GRANT option Y Privilege is held without the GRANT option	G
STARTDBAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can use the START command against the database: blank Privilege is not held G Privilege held with the GRANT option Y Privilege is held without the GRANT option	G
STATSAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can use the CHECK and RUNSTATS utilities against the database: blank Privilege is not held G Privilege held with the GRANT option Y Privilege is held without the GRANT option	G
STOPAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can issue the STOP command against the database: blank Privilege is not held G Privilege held with the GRANT option Y Privilege is held without the GRANT option	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
GRANTEDTS	TIMESTAMP NOT NULL WITH DEFAULT	Time when the GRANT statement was executed.	G

SYSIBM.SYSDBRM table

Contains one row for each DBRM of each application plan.

Column name	Data type	Description	Use
NAME	VARCHAR(24) NOT NULL	Name of the DBRM.	G
TIMESTAMP	CHAR(8) NOT NULL WITH DEFAULT FOR BIT DATA	Consistency token.	S
PDSNAME	CHAR(132) NOT NULL	Name of the partitioned data set of which the DBRM is a member.	G
PLNAME	VARCHAR(24) NOT NULL	Name of the application plan of which this DBRM is a part.	G
PLCREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the application plan.	G
	CHAR(8) NOT NULL	Not used	N
	CHAR(6) NOT NULL	Not used	N
QUOTE	CHAR(1) NOT NULL	SQL string delimiter for the SQL statements in the DBRM: N Apostrophe Y Quotation mark	G
COMMA	CHAR(1) NOT NULL	Decimal point representation for SQL statements in the DBRM: N Period Y Comma	G
HOSTLANG	CHAR(1) NOT NULL	The host language used: B Assembler language C OS/VS COBOL D C F Fortran P PL/I 2 VS COBOL II or IBM COBOL Release 1 (formerly called COBOL/370) 3 IBM COBOL (Release 2 or subsequent releases) 4 C++	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
CHARSET	CHAR(1) NOT NULL WITH DEFAULT	Indicates whether the system CCSID for SBCS data was 290 (Katakana) when the program was precompiled: A No K Yes	G
MIXED	CHAR(1) NOT NULL WITH DEFAULT	Indicates if mixed data was in effect when the application program was precompiled (for more on when mixed data is in effect, see “Character strings” on page 58): N No Y Yes	G
DEC31	CHAR(1) NOT NULL WITH DEFAULT	Indicates whether DEC31 was in effect when the program was precompiled (for more on when DEC31 is in effect, see “Arithmetic with two decimal operands” on page 135): blank No Y Yes	G
VERSION	VARCHAR(122) NOT NULL WITH DEFAULT	Version identifier for the DBRM.	G
PRECOMPTS	TIMESTAMP NOT NULL WITH DEFAULT	Time when the DBRM was precompiled.	G

SYSIBM.SYSDUMMY1 table

Contains one row. The table is used for SQL statements in which a table reference is required, but the contents of the table are not important. (Unlike the other catalog tables, which reside in Unicode table spaces, SYSIBM.SYSDUMMY1 resides in table space SYSEBCDC, which is an EBCDIC table space.).

Column name	Data type	Description	Use
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G

SYSIBM.FIELDS table

Contains one row for every column that has a field procedure.

Column name	Data type	Description	Use
TBCREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the table that contains the column.	G
TBNAME	VARCHAR(128) NOT NULL	Name of the table that contains the column.	G
COLNO	SMALLINT NOT NULL	Numeric place of this column in the table.	G
NAME	VARCHAR(128) NOT NULL	Name of the column.	G
FLDTYPE	VARCHAR(24) NOT NULL	Data type of the encoded values in the field [47]: INTEGER Large integer SMALLINT Small integer FLOAT Floating-point CHAR Fixed-length character string VARCHAR Varying-length character string DECIMAL Decimal GRAPHIC Fixed-length graphic string VARG Varying-length graphic string	G
LENGTH	SMALLINT NOT NULL	The length attribute of the field; or, for a decimal field, its precision[47]. The number does not include the internal prefixes that can be used to record actual length and null state. INTEGER 4 SMALLINT 2 FLOAT 8 CHAR Length of string VARCHAR Maximum length of string DECIMAL Precision of number GRAPHIC Number of DBCS characters VARG Maximum number of DBCS characters	G
SCALE	SMALLINT NOT NULL	Scale if FLDTYPE is DECIMAL; otherwise, the value is 0.	G
FLDPROC	VARCHAR(24) NOT NULL	For a row describing a field procedure, the name of the procedure[47].	G
WORKAREA	SMALLINT NOT NULL	For a row describing a field procedure, the size, in bytes, of the work area required for the encoding and decoding of the procedure[47].	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
EXITPARML	SMALLINT NOT NULL	For a row describing a field procedure, the length of the field procedure parameter value block[47].	G
PARMLIST	VARCHAR(735) NOT NULL	For a row describing a field procedure, the parameter list following FIELDPROC in the statement that created the column, with insignificant blanks removed[47].	G
EXITPARM	VARCHAR(1530) NOT NULL WITH DEFAULT FOR BIT DATA	For a row describing a field procedure, the parameter value block of the field procedure (the control block passed to the field procedure when it is invoked)[47].	G

[47] Some columns might contain statistical values from a prior release.

SYSIBM.SYSFOREIGNKEYS table

Contains one row for every column of every foreign key.

Column name	Data type	Description	Use
CREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the table that contains the column.	G
TBNAME	VARCHAR(128) NOT NULL	Name of the table that contains the column.	G
RELNAME	VARCHAR(128) NOT NULL	Constraint name for the constraint for which the column is part of the foreign key.	G
COLNAME	VARCHAR(128) NOT NULL	Name of the column.	G
COLNO	SMALLINT NOT NULL	Numeric place of the column in its table.	G
COLSEQ	SMALLINT NOT NULL	Numeric place of the column in the foreign key.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G

SYSIBM.SYSINDEXES table

Contains one row for every index.

Column name	Data type	Description	Use
NAME	VARCHAR(128) NOT NULL	Name of the index.	G
CREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the index.	G
TBNAME	VARCHAR(128) NOT NULL	Name of the table on which the index is defined.	G
TBCREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the table.	G
UNIQUERULE	CHAR(1) NOT NULL	Whether the index is unique: D No (duplicates are allowed) U Yes P Yes, and it is a primary index (As in prior releases of DB2, a value of P is used for primary keys that are used to enforce a referential constraint.) C Yes, and it is an index used to enforce UNIQUE constraint N Yes, and it is defined with UNIQUE WHERE NOT NULL R Yes, and it is an index used to enforce the uniqueness of a non-primary parent key G Yes, and it is an index used to enforce the uniqueness of values in a column defined as ROWID GENERATED BY DEFAULT.	G
COLCOUNT	SMALLINT NOT NULL	The number of columns in the key.	G
CLUSTERING	CHAR(1) NOT NULL	Whether CLUSTER was specified when the index was created: N No Y Yes	G
CLUSTERED	CHAR(1) NOT NULL	Whether the table is actually clustered by the index: N A significant number of rows are not in clustering order, or statistics have not been gathered. Y Most of the rows are in clustering order. blank Not applicable. This is an updatable column that can also be changed by the RUNSTATS utility.	G
DBID	SMALLINT NOT NULL	Internal identifier of the database.	S
OBID	SMALLINT NOT NULL	Internal identifier of the index fan set descriptor.	S
ISOBID	SMALLINT NOT NULL	Internal identifier of the index page set descriptor.	S
DBNAME	VARCHAR(24) NOT NULL	Name of the database that contains the index.	G
INDEXSPACE	VARCHAR(24) NOT NULL	Name of the index space.	G
	INTEGER NOT NULL	Not used	N
	INTEGER NOT NULL	Not used	N
NLEAF	INTEGER NOT NULL	Number of active leaf pages in the index. The value is -1 if statistics have not been gathered. This is an updatable column.	S
NLEVELS	SMALLINT NOT NULL	Number of levels in the index tree. If the index is partitioned, it is the maximum of the number of levels in the index tree for all the partitions. The value is -1 if statistics have not been gathered. This is an updatable column.	S

Column name	Data type	Description	Use
BPOOL	CHAR(8) NOT NULL	Name of the buffer pool used for the index.	G
PGSIZE	SMALLINT NOT NULL	Size, in bytes, of the leaf pages in the index: 256, 512, 1024, 2048, or 4096	G
ERASERULE	CHAR(1) NOT NULL	Whether the data sets are erased when dropped. The value is meaningless if the index is partitioned: N No Y Yes	G
	VARCHAR(24) NOT NULL	Not used	N
CLOSERULE	CHAR(1) NOT NULL	Whether the data sets are candidates for closure when the limit on the number of open data sets is reached: N No Y Yes	G
SPACE	INTEGER NOT NULL	Number of kilobytes of DASD storage allocated to the index, as determined by the last execution of the STOSPACE utility. The value is 0 if the index is not related to a storage group, or if STOSPACE has not been run. If the index space is partitioned, the value is the total kilobytes of DASD storage allocated to all partitions that are defined in a storage group.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
CLUSTERRATIO	SMALLINT NOT NULL WITH DEFAULT	Percentage of rows that are in clustering order. For a partitioning index, it is the weighted average of all index partitions in terms of the number of rows in the partition. The value is 0 if statistics have not been gathered. The value is -2 if the index is for an auxiliary table. This is an updatable column.	S
CREATEDBY	VARCHAR(128) NOT NULL WITH DEFAULT	Primary authorization ID of the user who created the index.	G
	SMALLINT NOT NULL	Internal use only	I
	SMALLINT NOT NULL	Not used	N
STATSTIME	TIMESTAMP NOT NULL WITH DEFAULT	If RUNSTATS updated the statistics, the date and time when the last invocation of RUNSTATS updated the statistics. The default value is '0001-01-01.00.00.00.000000'. This is an updatable column.	G
INDEXTYPE	CHAR(1) NOT NULL WITH DEFAULT	The index type: 2 Type 2 index blank Type 1 index D Data-partitioned secondary index P Partitioning index (index that is on a table that uses table-controlled partitioning)	G
FIRSTKEYCARDF	FLOAT NOT NULL WITH DEFAULT -1	Number of distinct values of the first key column. This number is an estimate if updated while collecting statistics on a single partition. The value is -1 if statistics have not been gathered. This is an updatable column.	S
FULLKEYCARDF	FLOAT NOT NULL WITH DEFAULT -1	Number of distinct values of the key. The value is -1 if statistics have not been gathered. This is an updatable column.	S
CREATEDTS	TIMESTAMP NOT NULL WITH DEFAULT	Time when the CREATE statement was executed for the index. If the index was created in a DB2 release prior to Version 5, the value is '0001-01-01.00.00.00.000000'.	G

Column name	Data type	Description	Use
ALTEREDTS	TIMESTAMP NOT NULL WITH DEFAULT	Time when the most recent ALTER INDEX statement was executed for the index. If no ALTER INDEX statement has been applied, ALTEREDTS has the value of CREATEDTS. If the index was created in a DB2 release prior to Version 5, the value is '0001-01-01.00.00.00.000000'.	G
PIECESIZE	INTEGER NOT NULL WITH DEFAULT	Maximum size of a data set in kilobytes for secondary indexes. A value of zero (0) indicates that the index is a partitioning index or that the index was created in a DB2 release prior to Version 5.	G
COPY	CHAR(1) NOT NULL WITH DEFAULT 'N'	Whether COPY YES was specified for the index, which indicates if the index can be copied and if SYSIBM.SYSLGRNX recording is enabled for the index. N No Y Yes	G
COPYLRSN	CHAR(6) NOT NULL WITH DEFAULT X'000000000000' FOR BIT DATA	The value can be either an RBA or LRSN. (LRSN is only for data sharing.) If the index is currently defined as COPY YES, the value is the RBA or LRSN when the index was created with COPY YES or altered to COPY YES, not the current RBA or LRSN. If the index is currently defined as COPY NO, the value is set to X'000000000000' if the index was created with COPY NO; otherwise, if the index was altered to COPY NO, the value in COPYLRSN is not changed when the index is altered to COPY NO.	G
CLUSTERRATIOF	FLOAT NOT NULL WITH DEFAULT	When multiplied by 100, the value of the column is the percentage of rows that are in clustering order. For example, a value of .9125 indicates 91.25%. For a partitioning index, it is the weighted average of all index partitions in terms of the number of rows in the partition. The value is 0 if statistics have not been gathered. The value is -2 if the index is for an auxiliary table. This is an updatable column.	G
SPACEF	FLOAT(8) NOT NULL WITH DEFAULT -1	Kilobytes of DASD storage. The value is -1 if statistics have not been gathered. This is an updatable column.	G
REMARKS	VARCHAR(762) NOT NULL WITH DEFAULT	A character field string provided by the user with the COMMENT statement.	G
PADDED	CHAR(1) NOT NULL WITH DEFAULT	Indicates whether keys within the index are padded for varying-length column data: Y The index contains varying-length character or graphic data and is PADDED (the varying-length columns are padded to their maximum length). N The index contains varying-length character or graphic data and is NOT PADDED (the varying-length columns are not padded to their maximum length). Index-only access to all column data is possible. blank The index does not contain varying-length character or graphic data. The value is blank for indexes that have been created or altered prior to Version 8.	G
VERSION	SMALLINT NOT NULL WITH DEFAULT	The version of the data row format for this index. A value of zero indicates that a version-creating alter has never occurred against this index.	G
OLDEST_VERSION	SMALLINT NOT NULL WITH DEFAULT	The version number describing the oldest format of data in the index space and any image copies of the index.	G
CURRENT_VERSION	SMALLINT NOT NULL WITH DEFAULT	The version number describing the newest format of data in the index space. A zero indicates that the index space has never had versioning. After the version number reaches the maximum value, the number will wrap back to one.	G
RELCREATED	CHAR(1) NOT NULL WITH DEFAULT	Release of DB2 that was used to create the object, blank for indexes created before Version 8. For all other values, see “Release dependency indicators” on page 1191.	G

Column name	Data type	Description	Use
AVGKEYLEN	INTEGER NOT NULL WITH DEFAULT -1	Average length of keys within the index. The value is -1 if statistics have not been gathered.	G

SYSIBM.SYSINDEXES_HIST table

Contains rows from SYSINDEXES. Rows are added or changed in this table when RUNSTATS collects history statistics. Rows in this table can also be inserted, updated, and deleted.

Column name	Data type	Description	Use
NAME	VARCHAR(128) NOT NULL	Name of the index.	G
CREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the index.	G
TBNAME	VARCHAR(128) NOT NULL	Name of the table on which the index is defined.	G
TBCREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the table.	G
CLUSTERING	CHAR(1) NOT NULL	Whether CLUSTER was specified when the index was created: **N** No **Y** Yes	G
NLEAF	INTEGER NOT NULL WITH DEFAULT -1	Number of active leaf pages in the index. The value is -1 if statistics have not been gathered.	S
NLEVELS	SMALLINT NOT NULL WITH DEFAULT -1	Number of levels in the index tree. If the index is partitioned, it is the maximum of the number of levels in the index tree for all the partitions. The value is -1 if statistics have not been gathered.	S
STATSTIME	TIMESTAMP NOT NULL	If RUNSTATS updated the statistics, the date and time when the last invocation of RUNSTATS updated the statistics. The default value is '0001-01-01.00.00.00.000000'.	G
FIRSTKEYCARDF	FLOAT(8) NOT NULL WITH DEFAULT -1	Number of distinct values of the first key column. This number is an estimate if updated while collecting statistics on a single partition. The value is -1 if statistics have not been gathered.	S
FULLKEYCARDF	FLOAT(8) NOT NULL WITH DEFAULT -1	Number of distinct values of the key. The value is -1 if statistics have not been gathered.	S
CLUSTERRATIOF	FLOAT(8) NOT NULL	Percentage of rows that are in clustering order. For a partitioning index, it is the weighted average of all index partitions in terms of the number of rows in the partition. The value is 0 if statistics have not been gathered. The value is -2 if the index is for an auxiliary table.	G
SPACEF	FLOAT(8) NOT NULL WITH DEFAULT -1	Number of kilobytes of DASD storage allocated to the index space partition. The value is -1 if statistics have not been gathered.	G
IBMREQD	CHAR(1) NOT NULL WITH DEFAULT 'N'	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see "Release dependency indicators" on page 1191.	G
AVGKEYLEN	INTEGER NOT NULL WITH DEFAULT -1	Average length of keys within the index. The value is -1 if statistics have not been gathered.	G

SYSIBM.SYSINDEXPART table

Contains one row for each nonpartitioned secondary index (NPSI) and one row for each partition of a partitioning index or a data-partitioned secondary index (DPSI).

Column name	Data type	Description	Use
PARTITION	SMALLINT NOT NULL	Partition number; Zero if index is not partitioned.	G
IXNAME	VARCHAR(128) NOT NULL	Name of the index.	G
IXCREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the index.	G
PQTY	INTEGER NOT NULL	For user-managed data sets, the value is the primary space allocation in units of 4KB storage blocks or -1. For user-specified values of PRIQTY other than -1, the value is set to the primary space allocation only if RUNSTATS INDEX with UPDATE(ALL) or UPDATE(SPACE) is executed; otherwise, the value is zero. PQTY is based on a value of PRIQTY in the appropriate CREATE or ALTER INDEX statement. Unlike PQTY, however, PRIQTY asks for space in 1KB units. A value of -1 indicates that either of the following cases is true: • PRIQTY was not specified for a CREATE INDEX statement or for any subsequent ALTER INDEX statements. • -1 was the most recently specified value for PRIQTY, either on the CREATE INDEX statement or a subsequent ALTER INDEX statement.	G
SQTY	SMALLINT NOT NULL	For user-managed data sets, the value is the secondary space allocation in units of 4KB storage blocks or -1. For user-specified values of SECQTY other than -1, the value is set to the secondary space allocation only if RUNSTATS INDEX with UPDATE(ALL) or UPDATE(SPACE) is executed; otherwise, the value is zero. SQTY is based on a value of SECQTY in the appropriate CREATE or ALTER INDEX statement. Unlike SQTY, however, SECQTY asks for space in 1KB units. A value of -1 indicates that either of the following cases is true: • SECQTY was not specified for a CREATE INDEX statement or for any subsequent ALTER INDEX statements. • -1 was the most recently specified value for SECQTY, either on the CREATE INDEX statement or a subsequent ALTER INDEX statement. If the value does not fit into the column, the value of the column is 0. See the description of column SECQTYI.	G
STORTYPE	CHAR(1) NOT NULL	Type of storage allocation: E Explicit, and STORNAME names an integrated catalog facility catalog I Implicit, and STORNAME names a storage group	G
STORNAME	VARCHAR(128) NOT NULL	Name of storage group or integrated catalog facility catalog used for space allocation.	G
VCATNAME	VARCHAR(24) NOT NULL	Name of integrated catalog facility catalog used for space allocation.	G
	INTEGER NOT NULL	Not used	N
	INTEGER NOT NULL	Not used	N

Column name	Data type	Description	Use
LEAFDIST	INTEGER NOT NULL	100 times the average number of leaf pages between successive active leaf pages of the index. The value is -1 if statistics have not been gathered.	S
	INTEGER NOT NULL	Not used	S
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
LIMITKEY	VARCHAR(512) NOT NULL WITH DEFAULT FOR BIT DATA	The high value of the limit key of the partition in an internal format. Zero if the index is not partitioned or for a data-partitioned secondary index (DPSI). If any column of the key has a field procedure, the internal format is the encoded form of the value.	S
FREEPAGE	SMALLINT NOT NULL	Number of pages that are loaded before a page is left as free space.	G
PCTFREE	SMALLINT NOT NULL	Percentage of each leaf or nonleaf page that is left as free space.	G
SPACE	INTEGER NOT NULL WITH DEFAULT	Number of kilobytes of DASD storage allocated to the index space partition, as determined by the last execution of the STOSPACE utility. The value is 0 if STOSPACE or RUNSTATS has not been run. The value is updated by STOSPACE if the index is related to a storage group. The value is updated by RUNSTATS if the utility is executed as RUNSTATS INDEX with UPDATE(ALL) or UPDATE(SPACE). The value is -1 if the index was defined with the DEFINE NO clause, which defers the physical creation of the data sets until data is first inserted into the index, and data has yet to be inserted into the index.	G
STATSTIME	TIMESTAMP NOT NULL WITH DEFAULT	If RUNSTATS updated the statistics, the date and time when the last invocation of RUNSTATS updated the statistics. The default value is '0001-01-01.00.00.00.000000'.	G
	CHAR(1) NOT NULL	Not used	N
GBPCACHE	CHAR(1) NOT NULL WITH DEFAULT	Group buffer pool cache option specified for this index or index partition. blank Only changed pages are cached in the group buffer pool. A Changed and unchanged pages are cached in the group buffer pool. N No data is cached in the group buffer pool.	G
FAROFFPOSF	FLOAT NOT NULL WITH DEFAULT -1	Number of referred to rows far from optimal position because of an insert into a full page. The value is -1 if statistics have not been gathered. The column is not applicable for an index on an auxiliary table.	S
NEAROFFPOSF	FLOAT NOT NULL WITH DEFAULT -1	Number of referred to rows near, but not at optimal position, because of an insert into a full page. Not applicable for an index on an auxiliary table.	S
CARDF	FLOAT NOT NULL WITH DEFAULT -1	Number of keys in the index that refer to data rows or LOBs. The value is -1 if statistics have not been gathered.	S
SECQTYI	INTEGER NOT NULL WITH DEFAULT	Secondary space allocation in units of 4KB storage. For user-managed data sets, the value is the secondary space allocation in units of 4KB blocks if RUNSTATS INDEX with UPDATE(SPACE) or UPDATE(ALL) is executed; otherwise, the value is zero.	G
IPREFIX	CHAR(1) NOT NULL WITH DEFAULT 'I'	The first character of the instance qualifier for this index’s data set name. 'I' or 'J' are the only valid characters for this field. The default is 'I'.	G

Column name	Data type	Description	Use
ALTEREDTS	TIMESTAMP NOT NULL WITH DEFAULT	Time when the most recent ALTER INDEX statement was executed for the index. If no ALTER INDEX statement has been applied, the value is '0001-01-01.00.00.00.000000'.	G
SPACEF	FLOAT(8) NOT NULL WITH DEFAULT -1	Kilobytes of DASD storage. The value is -1 if statistics have not been gathered. This is an updatable column.	G
DSNUM	INTEGER NOT NULL WITH DEFAULT -1	Number of data sets. The value is -1 if statistics have not been gathered. This is an updatable column.	G
EXTENTS	INTEGER NOT NULL WITH DEFAULT -1	Number of data set extents. The value is -1 if statistics have not been gathered. This is an updatable column. This value is only for the last DSNUM for the object.	G
PSEUDO_DEL_ENTRIES	INTEGER NOT NULL WITH DEFAULT -1	Number of psuedo deleted entries (entries that are logically deleted but still physically present in the index). For a non-unique index, value is the number of RIDs that are pseudo deleted. For a unique index, the value is the number of keys and RIDs that are pseudo deleted. The value is -1 if statistics have not been gathered. This is an updatable column.	G
LEAFNEAR	INTEGER NOT NULL WITH DEFAULT -1	Number of leaf pages physically near previous leaf page for successive active leaf pages. The value is -1 if statistics have not been gathered. This is an updatable column.	S
LEAFFAR	INTEGER NOT NULL WITH DEFAULT -1	Number of leaf pages located physically far away from previous leaf pages for successive (active leaf) pages accessed in an index scan. The value is -1 if statistics have not been gathered. This is an updatable column.	S
OLDEST_VERSION	SMALLINT NOT NULL WITH DEFAULT	The version number describing the oldest format of data in the index part and any image copies of the index part.	G
CREATEDTS	TIMESTAMP NOT NULL WITH DEFAULT -1	Time when the partition was created.	G
AVGKEYLEN	INTEGER NOT NULL WITH DEFAULT -1	Average length of keys within the index. The value is -1 if statistics have not been gathered.	G

SYSIBM.SYSINDEXPART_HIST table

Contains rows from SYSINDEXPART. Rows are added or changed in this table when RUNSTATS collects history statistics. Rows in this table can also be inserted, updated, and deleted.

Column name	Data type	Description	Use
PARTITION	SMALLINT NOT NULL	Partition number. Zero if index is not partitioned.	G
IXNAME	VARCHAR(128) NOT NULL	Name of the index.	G
IXCREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the index.	G
PQTY	INTEGER NOT NULL	For user-managed data sets, the value is the primary space allocation in units of 4KB storage blocks or -1. For user-specified values of PRIQTY other than -1, the value is set to the primary space allocation only if RUNSTATS INDEX with UPDATE(ALL) or UPDATE(SPACE) is executed; otherwise, the value is zero. PQTY is based on a value of PRIQTY in the appropriate CREATE or ALTER INDEX statement. Unlike PQTY, however, PRIQTY asks for space in 1KB units. A value of -1 indicates that either of the following cases is true: • PRIQTY was not specified for a CREATE INDEX statement or for any subsequent ALTER INDEX statements. • -1 was the most recently specified value for PRIQTY, either on the CREATE INDEX statement or a subsequent ALTER INDEX statement. If a storage group is not used, the value is 0.	G
SECQTYI	INTEGER NOT NULL	For user-managed data sets, the value is the secondary space allocation in units of 4KB storage blocks or -1. For user-specified values of SECQTY other than -1, the value is set to the secondary space allocation only if RUNSTATS INDEX with UPDATE(ALL) or UPDATE(SPACE) is executed; otherwise, the value is zero. SQTY is based on a value of SECQTY in the appropriate CREATE or ALTER INDEX statement. Unlike SQTY, however, SECQTY asks for space in 1KB units. A value of -1 indicates that either of the following cases is true: • SECQTY was not specified for a CREATE INDEX statement or for any subsequent ALTER INDEX statements. • -1 was the most recently specified value for SECQTY, either on the CREATE INDEX statement or a subsequent ALTER INDEX statement. If a storage group is not used, the value is 0.	G
LEAFDIST	INTEGER NOT NULL WITH DEFAULT -1	100 times the average number of leaf pages between successive active leaf pages of the index. The value is -1 if statistics have not been gathered.	S
SPACEF	FLOAT(8) NOT NULL WITH DEFAULT -1	Number of kilobytes of DASD storage allocated to the index space partition. The value is -1 if statistics have not been gathered.	G
STATSTIME	TIMESTAMP NOT NULL	If RUNSTATS updated the statistics, the date and time when the last invocation of RUNSTATS updated the statistics. The default value is ’0001-01-01.00.00.00.000000’.	G
FAROFFPOSF	FLOAT(8) NOT NULL WITH DEFAULT -1	Number of referred to rows far from optimal position because of an insert into a full page. The value is -1 if statistics have not been gathered. The column is not applicable for an index on an auxiliary table.	S

Column name	Data type	Description	Use
NEAROFFPOSF	FLOAT(8) NOT NULL WITH DEFAULT -1	Number of referred to rows near, but not at optimal position, because of an insert into a full page. Not applicable for an index on an auxiliary table. The value is -1 if statistics have not been gathered.	S
CARDF	FLOAT(8) NOT NULL WITH DEFAULT -1	Number of keys in the index that refer to data rows or LOBs. The value is -1 if statistics have not been gathered.	S
EXTENTS	INTEGER NOT NULL WITH DEFAULT -1	Number of data set extents. The value is -1 if statistics have not been gathered. This value is only for the last DSNUM for the object.	G
PSEUDO_DEL_ENTRIES	INTEGER NOT NULL WITH DEFAULT -1	Number of psuedo deleted entries. The value is -1 if statistics have not been gathered.	G
DSNUM	INTEGER NOT NULL WITH DEFAULT -1	Data set number within the table space. For partitioned index spaces, this value corresponds to the partition number for a single partition copy, or 0 for a copy of an entire partitioned index space. The value is -1 if statistics have not been gathered.	G
IBMREQD	CHAR(1) NOT NULL WITH DEFAULT 'N'	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see "Release dependency indicators" on page 1191.	G
LEAFNEAR	INTEGER NOT NULL WITH DEFAULT -1	Number of leaf pages physically near previous leaf page for successive active leaf pages. The value is -1 if statistics have not been gathered. This is an updatable column.	S
LEAFFAR	INTEGER NOT NULL WITH DEFAULT -1	Number of leaf pages located physically far away from previous leaf pages for successive (active leaf) pages accessed in an index scan. The value is -1 if statistics have not been gathered. This is an updatable column.	S
AVGKEYLEN	INTEGER NOT NULL WITH DEFAULT -1	Average length of keys within the index. The value is -1 if statistics have not been gathered.	G

SYSIBM.SYSINDEXSTATS table

| Contains one row for each partition of a partitioning index or a data-partitioned secondary index (DPSI). Rows in this table can be inserted, updated, and deleted.

Column name	Data type	Description	Use
FIRSTKEYCARD	INTEGER NOT NULL	For the index partition, number of distinct values of the first key column.	S
FULLKEYCARD	INTEGER NOT NULL	For the index partition, number of distinct values of the key.	S
NLEAF	INTEGER NOT NULL	Number of active leaf pages in the index partition.	S
NLEVELS	SMALLINT NOT NULL	Number of levels in the index tree.	S
	SMALLINT NOT NULL	Not used	N
	SMALLINT NOT NULL	Not used	N
CLUSTERRATIO	SMALLINT NOT NULL	For the index partition, the percentage of rows that are in clustering order. The value is 0 if statistics have not been gathered.	N
STATSTIME	TIMESTAMP NOT NULL	If RUNSTATS updated the statistics, the date and time when the last invocation of RUNSTATS updated the statistics. The default value is '0001-01-01.00.00.00.000000'.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
PARTITION	SMALLINT NOT NULL	Partition number of the index.	G
| OWNER	VARCHAR(128) NOT NULL	Authorization ID of the owner of the index.	G
| NAME	VARCHAR(128) NOT NULL	Name of the index.	G
KEYCOUNT	INTEGER NOT NULL	Total number of rows in the partition.	S
FIRSTKEYCARDF	FLOAT NOT NULL WITH DEFAULT -1	For the index partition, number of distinct values of the first key column.	S
FULLKEYCARDF	FLOAT NOT NULL WITH DEFAULT -1	For the index partition, number of distinct values of the key.	S
KEYCOUNTF	FLOAT WITH DEFAULT -1	Total number of rows in the partition.	S
CLUSTERRATIOF	FLOAT NOT NULL WITH DEFAULT	For the index partition, the value, when multiplied by 100, is the percentage of rows that are in clustering order. For example, a value of .9125 indicates 91.25%. The value is 0 if statistics have not been gathered.	G
|	VARCHAR(1000) NOT NULL WITH DEFAULT FOR BIT DATA	Internal use only	I

SYSIBM.SYSINDEXSTATS_HIST table

Contains rows from SYSINDEXSTATS. Rows are added or changed in this table when RUNSTATS collects history statistics. Rows in this table can also be inserted, updated, and deleted.

Column name	Data type	Description	Use
NLEAF	INTEGER NOT NULL WITH DEFAULT -1	Number of active leaf pages in the index partition. The value is -1 if statistics have not been gathered.	S
NLEVELS	SMALLINT NOT NULL WITH DEFAULT -1	Number of levels in the index tree. The value is -1 if statistics have not been gathered.	S
STATSTIME	TIMESTAMP NOT NULL	If RUNSTATS updated the statistics, the date and time when the last invocation of RUNSTATS updated the statistics. The default value is '0001-01-01.00.00.00.000000'.	G
PARTITION	SMALLINT NOT NULL	Partition number of the index.	G
OWNER	VARCHAR(128) NOT NULL	Authorization ID of the owner of the index.	G
NAME	VARCHAR(128) NOT NULL	Name of the index.	G
FIRSTKEYCARDF	FLOAT(8) NOT NULL WITH DEFAULT -1	For the index partition, number of distinct values of the first key column. The value is -1 if statistics have not been gathered.	S
FULLKEYCARDF	FLOAT(8) NOT NULL WITH DEFAULT -1	For the index partition, number of distinct values of the key. The value is -1 if statistics have not been gathered.	S
KEYCOUNTF	FLOAT(8) NOT NULL WITH DEFAULT -1	Total number of rows in the partition. The value is -1 if statistics have not been gathered.	S
CLUSTERRATIOF	FLOAT(8) NOT NULL	For the index partition, the value, when multiplied by 100, is the percentage of rows that are in clustering order. For example, a value of indicates 91.25%. The value is 0 if statistics have not been gathered.	G
IBMREQD	CHAR(1) NOT NULL WITH DEFAULT 'N'	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see "Release dependency indicators" on page 1191.	G

SYSIBM.SYSJARCLASS_SOURCE table

Auxiliary table for SYSIBM.SYSJARCONTENTS.

Column name	Data type	Description	Use
CLASS_SOURCE	CLOB(10M) NOT NULL	The contents of the class in the JAR file.	G

SYSIBM.SYSJARCONTENTS table

Contains Java class source for installed JAR.

Column name	Data type	Description	Use
JARSCHEMA	VARCHAR(128) NOT NULL	The schema of the JAR file.	G
JAR_ID	VARCHAR(128) NOT NULL	The name of the JAR file.	G
CLASS	VARCHAR(384) NOT NULL	The class name contained in the JAR file.	G
CLASS_SOURCE_ROWID	ROWID NOT NULL GENERATED ALWAYS	ID used to support CLOB data type.	G
CLASS_SOURCE	CLOB(10M) NOT NULL	The contents of the class in the JAR file.	G
IBMREQD	CHAR(1) NOT NULL WITH DEFAULT 'N'	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G

SYSIBM.SYSJARDATA table

Auxiliary table for SYSIBM.SYSJAROBJECTS.

Column name	Data type	Description	Use
JAR_DATA	BLOB(100M) NOT NULL	The contents of the JAR file.	G

SYSIBM.SYSJAROBJECTS table

Contains binary large object representing the installed JAR.

Column name	Data type	Description	Use
JARSCHEMA	VARCHAR(128) NOT NULL	The schema of the JAR file.	G
JAR_ID	VARCHAR(128) NOT NULL	The name of the JAR file.	G
OWNER	VARCHAR(128) NOT NULL	Authorization ID of the owner of the JAR object.	G
JAR_DATA_ROWID	ROWID NOT NULL GENERATED ALWAYS	ID used to support BLOB data type.	G
JAR_DATA	BLOB(100M) NOT NULL	The contents of the JAR file. This is an updatable column.	G
PATH	VARCHAR(2048) NOT NULL	The JAR's class resolution path. This is an updatable column.	G
CREATEDTS	TIMESTAMP NOT NULL	Time when the JAR object was created.	G
ALTEREDTS	TIMESTAMP NOT NULL	Time when the JAR object was altered.	G
IBMREQD	CHAR(1) NOT NULL WITH DEFAULT 'N'	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see "Release dependency indicators" on page 1191.	G

SYSIBM.SYSJAVAOPTS table

Contains build options used during INSTALL_JAR.

Column name	Data type	Description	Use
JARSCHEMA	VARCHAR(128) NOT NULL	The schema of the JAR file.	G
JAR_ID	VARCHAR(128) NOT NULL	The name of the JAR file.	G
BUILDSCHEMA	VARCHAR(128) NOT NULL	Schema name for BUILDNAME.	G
BUILDNAME	VARCHAR(128) NOT NULL	Procedure used to create the routine.	G
BUILDOWNER	VARCHAR(128) NOT NULL	Authorization ID used to create the routine.	G
DBRMLIB	VARCHAR(256) NOT NULL	PDS name where DBRM is located.	G
HPJCOMPILE_OPTS	VARCHAR(512) NOT NULL	HPJ compile options used to install the routine.	G
BIND_OPTS	VARCHAR(2048) NOT NULL	Bind options used to install the routine.	G
POBJECT_LIB	VARCHAR(256) NOT NULL	PDSE name where program object is located.	G
IBMREQD	CHAR(1) NOT NULL WITH DEFAULT 'N'	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see "Release dependency indicators" on page 1191.	G

SYSIBM.SYSKEYCOLUSE table

Contains a row for every column in a unique constraint (primary key or unique key) from the SYSIBM.SYSTABCONST table.

Column name	Data type	Description	Use
CONSTNAME	VARCHAR(128) NOT NULL	Name of the constraint.	G
TBCREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the table on which the constraint is defined.	G
TBNAME	VARCHAR(128) NOT NULL	Name of the table on which the constraint is defined.	G
COLNAME	VARCHAR(128) NOT NULL	Name of the column	G
COLSEQ	SMALLINT NOT NULL	Numeric position of the column in the key (the first position in the key is 1).	G
COLNO	SMALLINT NOT NULL	Numeric position of the column in the table on which the constraint is defined.	G
IBMREQD	CHAR(1) NOT NULL WITH DEFAULT 'N'	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see "Release dependency indicators" on page 1191.	G

SYSIBM.SYSKEYS table

Contains one row for each column of an index key.

Column name	Data type	Description	Use
IXNAME	VARCHAR(128) NOT NULL	Name of the index.	G
IXCREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the index.	G
COLNAME	VARCHAR(128) NOT NULL	Name of the column of the key.	G
COLNO	SMALLINT NOT NULL	Numeric position of the column in the table; for example, 4 (out of 10).	G
COLSEQ	SMALLINT NOT NULL	Numeric position of the column in the key; for example, 4 (out of 4).	G
ORDERING	CHAR(1) NOT NULL	Order of the column in the key: A Ascending D Descending	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G

SYSIBM.SYSLOBSTATS table

Contains one row for each LOB table space.

Column name	Data type	Description	Use
STATSTIME	TIMESTAMP NOT NULL	Timestamp of RUNSTATS statistics update.	G
AVGSIZE	INTEGER NOT NULL	Average size of a LOB, measured in bytes, in the LOB table space.	S
FREESPACE	INTEGER NOT NULL	Number of kilobytes of available space in the LOB table space.	S
ORGRATIO	DECIMAL(5,2) NOT NULL	Ratio of organization in the LOB table space. A value of 1 indicates perfect organization of the LOB table space. The greater the value exceeds 1, the more disorganized the LOB table space.	S
DBNAME	VARCHAR(24) NOT NULL	Name of the database that contains the LOB table space named in NAME.	G
NAME	VARCHAR(24) NOT NULL	Name of the LOB table space.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G

SYSIBM.SYSLOBSTATS_HIST table

Contains rows from SYSLOBSTATS. Rows are added or changed in this table when RUNSTATS collects history statistics. Rows in this table can also be inserted, updated, and deleted.

Column name	Data type	Description	Use
STATSTIME	TIMESTAMP NOT NULL	Timestamp of RUNSTATS statistics update.	G
FREESPACE	INTEGER NOT NULL	Number of pages of free space in the LOB table space.	S
ORGRATIO	DECIMAL(5,2) NOT NULL	Ratio of organization in the LOB table space. A value of 1 indicates perfect organization of the LOB table space. The greater the value exceeds 1, the more disorganized the LOB table space.	S
DBNAME	VARCHAR(24) NOT NULL	Name of the database that contains the LOB table space named in NAME.	G
NAME	VARCHAR(24) NOT NULL	Name of the LOB table space.	G
IBMREQD	CHAR(1) NOT NULL WITH DEFAULT 'N'	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see "Release dependency indicators" on page 1191.	G

SYSIBM.SYSPACKAGE table

Contains a row for every package.

Column name	Data type	Description	Use
LOCATION	VARCHAR(128) NOT NULL	Always contains blanks	S
COLLID	VARCHAR(128) NOT NULL	Name of the package collection. For a trigger package, it is the schema name of the trigger.	G
NAME	VARCHAR(128) NOT NULL	Name of the package.	G
CONTOKEN	CHAR(8) NOT NULL WITH DEFAULT FOR BIT DATA	Consistency token for the package. For a package derived from a DB2 DBRM, this is either: • The “level” as specified by the LEVEL option when the package’s program was precompiled • The timestamp indicating when the package’s program was precompiled, in an internal format.	S
OWNER	VARCHAR(128) NOT NULL	Authorization ID of the package owner. For a trigger package, the value is the authorization ID of the owner of the trigger, which is set to the current authorization ID (the plan or package owner for static CREATE TRIGGER statement; the current SQLID for a dynamic CREATE TRIGGER statement).	G
CREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the creator of the package version. For a trigger package, the value is determined differently. For dynamic SQL, it is the primary authorization ID of the user who issued the CREATE TRIGGER statement. For static SQL, it is the authorization ID of the plan or package owner.	G
TIMESTAMP	TIMESTAMP NOT NULL	Timestamp indicating when the package was created.	G
BINDTIME	TIMESTAMP NOT NULL	Timestamp indicating when the package was last bound.	G
QUALIFIER	VARCHAR(128) NOT NULL	Implicit qualifier for the unqualified table, view, index, and alias names in the static SQL statements of the package.	G
PKSIZE	INTEGER NOT NULL	Size of the base section[48] of the package, in bytes.	G
AVGSIZE	INTEGER NOT NULL	Average size, in bytes, of those sections[48] of the plan that contain SQL statements processed at bind time.	G
SYSENTRIES	SMALLINT NOT NULL	Number of enabled or disabled entries for this package in SYSIBM.SYSPKSYSTEM. A value of 0 if all types of connections are enabled.	G
VALID	CHAR(1) NOT NULL	Whether the package is valid: A An ALTER statement changed the description of the table or base table of a view referred to by the package. For a CREATE INDEX statement involving data sharing, VALID is also marked as ″A″. The changes do not invalidate the package. H An ALTER TABLE statement changed the description of the table or base table of a view referred to by the package. For releases of DB2 prior to V5R1, the change invalidates the package. N No Y Yes	G

[48] Packages are divided into *sections*. The base section of the package must be in the EDM pool during the entire time the package is executing. Other sections of the package, corresponding roughly to sets of related SQL statements, are brought into the pool as needed.

Column name	Data type	Description	Use
OPERATIVE	CHAR(1) NOT NULL	Whether the package can be allocated: N No; an explicit BIND or REBIND is required before the package can be allocated. Y Yes	G
VALIDATE	CHAR(1) NOT NULL	Whether validity checking can be deferred until run time: B All checking must be performed at bind time. R Validation is done at run time for tables, views, and privileges that do not exist at bind time.	G
ISOLATION	CHAR(1) NOT NULL	Isolation level when the package was last bound or rebound R RR (repeatable read) S CS (cursor stability) T RS (read stability) U UR (uncommitted read) blank Not specified, and therefore at the level specified for the plan executing the package	G
RELEASE	CHAR(1) NOT NULL	The value used for RELEASE when the package was last bound or rebound: C Value used was COMMIT. D Value used was DEALLOCATE. blank Not specified, and therefore the value specified for the plan executing the package.	G
EXPLAIN	CHAR(1) NOT NULL	EXPLAIN option specified for the package; that is, whether information on the package's statements was added to the owner of the PLAN_TABLE table: N No Y Yes	G
QUOTE	CHAR(1) NOT NULL	SQL string delimiter for SQL statements in the package: N Apostrophe Y Quotation mark	G
COMMA	CHAR(1) NOT NULL	Decimal point representation for SQL statements in package: N Period Y Comma	G
HOSTLANG	CHAR(1) NOT NULL	Host language for the package's DBRM: B Assembler language C OS/VS COBOL D C F Fortran P PL/I 2 VS COBOL II or IBM COBOL Release 1 (formerly called COBOL/370™) 3 IBM COBOL (Release 2 or subsequent releases) 4 C++ blank For remotely bound packages, or trigger packages (TYPE='T')	G
CHARSET	CHAR(1) NOT NULL	Indicates whether the system CCSID for SBCS data was 290 (Katakana) when the program was precompiled: K Yes A No	G
MIXED	CHAR(1) NOT NULL	Indicates if mixed data was in effect when the package's program was precompiled (for more on when mixed data is in effect, see "Character strings" on page 58): N No Y Yes	G
DEC31	CHAR(1) NOT NULL	Indicates whether DEC31 was in effect when the package's program was precompiled (for more on when DEC31 is in effect, see "Arithmetic with two decimal operands" on page 135): N No Y Yes	G

Column name	Data type	Description	Use
DEFERPREP	CHAR(1) NOT NULL	Indicates the CURRENTDATA option when the package was bound or rebound: A Data currency is required for all cursors. Inhibit blocking for all cursors. B Data currency is not required for ambiguous cursors. C Data currency is required for ambiguous cursors. blank The package was created before the CURRENTDATA option was available.	G
SQLERROR	CHAR(1) NOT NULL	Indicates the SQLERROR option on the most recent subcommand that bound or rebound the package: C CONTINUE N NOPACKAGE	G
REMOTE	CHAR(1) NOT NULL	Source of the package: C Package was created by BIND COPY. D Package was created by BIND COPY with the OPTIONS(COMMAND) option. K The package was copied from a package that was originally bound on behalf of a remote requester. L The package was copied with the OPTIONS(COMMAND) option from a package that was originally bound on behalf of a remote requester. N Package was locally bound from a DBRM. Y Package was bound on behalf of a remote requester.	G
PCTIMESTAMP	TIMESTAMP NOT NULL	Date and time the application program was precompiled, or 0001-01-01-00.00.00.000000 if the LEVEL precompiler option was used, or if the package came from a non-DB2 location.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
VERSION	VARCHAR(122) NOT NULL	Version identifier for the package. The value is blank for a trigger package (TYPE='T').	G
PDSNAME	VARCHAR(132) NOT NULL	For a locally bound package, the name of the PDS (library) in which the package’s DBRM is a member. For a locally copied package, the value in SYSPACKAGE.PDSNAME for the source package. Otherwise, the product signature of the bind requester followed by one of the following: • The requester’s location name if the product is DB2 • Otherwise, the requester’s LU name enclosed in angle brackets; for example, “<LUSQLDS>”.	G
DEGREE	CHAR(3) NOT NULL WITH DEFAULT	The DEGREE option used when the package was last bound: ANY DEGREE(ANY) 1 or blank DEGREE(1). Blank if the package was migrated.	G
GROUP_MEMBER	VARCHAR(24) NOT NULL WITH DEFAULT	The DB2 data sharing member name of the DB2 subsystem that performed the most recent bind. This column is blank if the DB2 subsystem was not in a DB2 data sharing environment when the bind was performed.	G

Column name	Data type	Description	Use
DYNAMICRULES	CHAR(1) NOT NULL WITH DEFAULT	The DYNAMICRULES option used when the package was last bound: B BIND. Dynamic SQL statements are executed with DYNAMICRULES bind behavior. D DEFINEBIND. When the package is run under an active stored procedure or user-defined function, dynamic SQL statements in the package are executed with DYNAMICRULES define behavior. When the package is not run under an active stored procedure or user-defined function, dynamic SQL statements in the package are executed with DYNAMICRULES bind behavior. E DEFINERUN. When the package is run under an active stored procedure or user-defined function, dynamic SQL statements in the package are executed with DYNAMICRULES define behavior. When the package is not run under an active stored procedure or user-defined function, dynamic SQL statements in the package are executed with DYNAMICRULES run behavior. H INVOKEBIND. When the package is run under an active stored procedure or user-defined function, dynamic SQL statements in the package are executed with DYNAMICRULES invoke behavior. When the package is not run under an active stored procedure or user-defined function, dynamic SQL statements in the package are executed with DYNAMICRULES bind behavior. I INVOKERUN. When the package is run under an active stored procedure or user-defined function, dynamic SQL statements in the package are executed with DYNAMICRULES invoke behavior. When the package is not run under an active stored procedure or user-defined function, dynamic SQL statements in the package are executed with DYNAMICRULES run behavior. R RUN. Dynamic SQL statements are executed with DYNAMICRULES run behavior. blank DYNAMICRULES is not specified for the package. The package uses the DYNAMICRULES value of the plan to which the package is appended at execution time. For a description of the DYNAMICRULES behaviors, see “Authorization IDs and dynamic SQL” on page 51.	G
REOPTVAR	CHAR(1) NOT NULL WITH DEFAULT 'N'	Whether the access path is determined again at execution time using input variable values: N Bind option REOPT(NONE) indicates that the access path is determined at bind time. Y Bind option REOPT(ALWAYS) indicates that the access path is determined at execution time for SQL statements with variable values. 1 Bind option REOPT(ONCE) indicates that the access path is determined only once at execution time, using the first set of input variable values, regardless of how many times the same statement is executed.	G

Column name	Data type	Description	Use
DEFERPREPARE	CHAR(1) NOT NULL WITH DEFAULT	Whether PREPARE processing is deferred until OPEN is executed: N Bind option NODEFER(PREPARE) indicates that PREPARE processing is not deferred until OPEN is executed. Y Bind option DEFER(PREPARE) indicates that PREPARE processing is deferred until OPEN is executed. blank Bind option not specified for the package. It is inherited from the plan.	G
KEEPDYNAMIC	CHAR(1) NOT NULL WITH DEFAULT 'N'	Whether prepared dynamic statements are to be purged at each commit point: N The bind option is KEEPDYNAMIC(NO). Prepared dynamic SQL statements are destroyed at commit. Y The bind option is KEEPDYNAMIC(YES). Prepared dynamic SQL statements are kept past commit.	G
| PATHSCHEMAS	VARCHAR(2048) NOT NULL WITH DEFAULT	SQL path specified on the BIND or REBIND command that bound the package. The path is used to resolve unqualified data type, function, and stored procedure names used in certain contexts. If the PATH bind option was not specified, the value in the column is a zero length string; however, DB2 uses a default SQL path of: SYSIBM, SYSFUN, SYSPROC, *package qualifier*.	G
TYPE	CHAR(1) NOT NULL WITH DEFAULT	Type of package. Identifies how the package was created: blank BIND PACKAGE command created the package. T CREATE TRIGGER statement created the package, and the package is a trigger package.	G
DBPROTOCOL	CHAR(1) NOT NULL WITH DEFAULT 'P'	Whether remote access for SQL with three-part names is implemented with DRDA or DB2 private protocol access: D DRDA P DB2 private protocol	G
FUNCTIONTS	TIMESTAMP NOT NULL WITH DEFAULT	Timestamp when the function was resolved. Set by the BIND and REBIND commands, but not by AUTOBIND.	G
| OPTHINT	VARCHAR(128) NOT NULL WITH DEFAULT	Value of the OPTHINT bind option. Identifies rows in the authid.PLAN_TABLE to be used as input to the optimizer. Contains blanks if no rows in the authid.PLAN_TABLE are to be used as input.	G
ENCODING_CCSID	INTEGER NOT NULL WITH DEFAULT	The CCSID corresponding to the encoding scheme or CCSID as specified for the bind option ENCODING. The Encoding Scheme specified on the bind command: ccsid The specified or derived CCSID. 0 The default CCSID as specified on panel DSNTIPF at installation time. Used when the package was bound prior to Version 7.	G
IMMEDWRITE	CHAR(1) NOT NULL WITH DEFAULT	Indicates when writes of updated group buffer pool dependent pages are to be done. This option is only applicable for data sharing environments. N Bind option IMMEDWRITE(NO) indicates normal write activity is done. Y Bind option IMMEDWRITE(YES) indicates that immediate writes are done for updated group buffer pool dependent pages. 1 Bind option IMMEDWRITE(PH1) indicates that updated group buffer pool dependent pages are written at or before phase 1 commit. blank A migrated package.	G
RELBOUND	CHAR(1) NOT NULL WITH DEFAULT	The release when the package was bound or rebound. blank Bound prior to Version 7 K Bound on Version 7	G
|	CHAR(1)	Not used.	N

Column name	Data type	Description	Use
REMARKS	VARCHAR(550) NOT NULL WITH DEFAULT	A character string provided by the user with the COMMENT statement.	G

SYSIBM.SYSPACKAUTH table

Records the privileges that are held by users over packages.

Column name	Data type	Description	Use
GRANTOR	VARCHAR(128) NOT NULL	Authorization ID of the user who granted the privilege. Could also be PUBLIC or PUBLIC followed by an asterisk[49].	G
GRANTEE	VARCHAR(128) NOT NULL	Authorization ID of the user who holds the privileges, the name of a plan that uses the privileges or PUBLIC for a grant to PUBLIC.	G
LOCATION	VARCHAR(128) NOT NULL	Always contains blanks	S
COLLID	VARCHAR(128) NOT NULL	Collection name for the package or packages on which the privilege was granted.	G
NAME	VARCHAR(128) NOT NULL	Name of the package on which the privileges are held. An asterisk (*) if the privileges are held on all packages in a collection.	G
	CHAR(8) NOT NULL WITH DEFAULT FOR BIT DATA	Not used	N
TIMESTAMP	TIMESTAMP NOT NULL	Timestamp indicating when the privilege was granted.	G
GRANTEETYPE	CHAR(1) NOT NULL	Type of grantee: blank An authorization ID P An application plan	G
AUTHHOWGOT	CHAR(1) NOT NULL	Authorization level of the user from whom the privileges were received. This authorization level is not necessarily the highest authorization level of the grantor. blank Not applicable A PACKADM (on collection *) C DBCTL D DBADM L SYSCTRL M DBMAINT P PACKADM (on a specific collection) S SYSADM	G
BINDAUTH	CHAR(1) NOT NULL	Whether GRANTEE can use the BIND and REBIND subcommands against the package: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G
COPYAUTH	CHAR(1) NOT NULL	Whether GRANTEE can COPY the package: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G
EXECUTEAUTH	CHAR(1) NOT NULL	Whether GRANTEE can execute the package: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G

[49] PUBLIC followed by an asterisk (PUBLIC*) denotes PUBLIC AT ALL LOCATIONS. For the conditions where GRANTOR can be PUBLIC or PUBLIC*, see Part 3 (Volume 1) of *DB2 Administration Guide*.

SYSIBM.SYSPACKDEP table

Records the dependencies of packages on local tables, views, synonyms, table spaces, indexes, aliases, functions, and stored procedures.

Column name	Data type	Description	Use
BNAME	VARCHAR(128) NOT NULL	The name of an object that a package depends on.	G
BQUALIFIER	VARCHAR(128) NOT NULL	The value of the column depends on the type of object: • If BNAME identifies a table space (BTYPE is R), the value is the name of its database. • If BNAME identifies user-defined function, a cast function, a stored procedure, or a sequence (BTYPE is F, O, or Q), the value is the schema name. • Otherwise, the value is the authorization ID of the owner of BNAME.	G
BTYPE	CHAR(1) NOT NULL	Type of object identified by BNAME and BQUALIFIER: A Alias F User-defined function or cast function I Index M Materialized query table O Stored procedure P Partitioned table space if it is defined as LARGE or with the DSSIZE parm Q Sequence object R Table space S Synonym T Table V View	G
DLOCATION	VARCHAR(128) NOT NULL	Always contains blanks	S
DCOLLID	VARCHAR(128) NOT NULL	Name of the package collection.	G
DNAME	VARCHAR(128) NOT NULL	Name of the package.	G
DCONTOKEN	CHAR(8) NOT NULL WITH DEFAULT FOR BIT DATA	Consistency token for the package. This is either: • The “level” as specified by the LEVEL option when the package’s program was precompiled • The timestamp indicating when the package’s program was precompiled, in an internal format.	S
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
DOWNER	VARCHAR(128) NOT NULL WITH DEFAULT	Owner of the package.	G
DTYPE	CHAR(1) NOT NULL WITH DEFAULT	Type of package: T Trigger package blank Not a trigger package	G

SYSIBM.SYSPACKLIST table

Contains one or more rows for every local application plan bound with a package list. Each row represents a unique entry in the plan's package list.

Column name	Data type	Description	Use
PLANNAME	VARCHAR(24) NOT NULL	Name of the application plan.	G
SEQNO	SMALLINT NOT NULL	Sequence number of the entry in the package list.	G
LOCATION	VARCHAR(128) NOT NULL	Location of the package. Blank if this is local. An asterisk (*) indicates location to be determined at run time.	G
COLLID	VARCHAR(128) NOT NULL	Collection name for the package. An asterisk (*) indicates that the collection name is determined at run time.	G
NAME	VARCHAR(128) NOT NULL	Name of the package. An asterisk (*) indicates an entire collection.	G
TIMESTAMP	TIMESTAMP NOT NULL	Timestamp indicating when the row was created.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see "Release dependency indicators" on page 1191.	G

SYSIBM.SYSPACKSTMT table

Contains one or more rows for each statement in a package.

Column name	Data type	Description	Use
LOCATION	VARCHAR(128) NOT NULL	Always contains blanks	S
COLLID	VARCHAR(128) NOT NULL	Name of the package collection.	G
NAME	VARCHAR(128) NOT NULL	Name of the package.	G
CONTOKEN	CHAR(8) NOT NULL FOR BIT DATA	Consistency token for the package. This is either: • The "level" as specified by the LEVEL option when the package's program was precompiled • The timestamp indicating when the package's program was precompiled, in an internal format	S
SEQNO	SMALLINT NOT NULL	Sequence number of the row with respect to a statement in the package[50]. The numbering starts with 0.	G
STMTNO	SMALLINT NOT NULL	The statement number of the statement in the source program. A statement number greater than 32767 is stored as zero[51] or as a negative number[51]. If the value is zero, see STMTNOI for the statement number.	G
SECTNO	SMALLINT NOT NULL	The section number of the statement.[51]	G
BINDERROR	CHAR(1) NOT NULL	Whether an SQL error was detected at bind time: N No Y Yes	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see "Release dependency indicators" on page 1191.	G
VERSION	VARCHAR(122) NOT NULL	Version identifier for the package.	G
STMT	CHAR(3500) NOT NULL WITH DEFAULT FOR BIT DATA	All or a portion of the text for the SQL statement that the row represents.	S
ISOLATION	CHAR(1) NOT NULL WITH DEFAULT	Isolation level for the SQL statement: R RR (repeatable read) T RS (read stability) S CS (cursor stability) U UR (uncommitted read) L RS isolation, with a *lock-clause* X RR isolation, with a *lock-clause* blank The WITH clause was not specified on this statement. The isolation level is recorded in SYSPACKAGE.ISOLATION and in SYSPLAN.ISOLATION.	G

[50] Rows in which the value of SEQNO, STMTNO, and SECTNO are zero are for internal use.

[51] To convert a negative STMTNO to a meaningful statement number that corresponds to your precompile output, add 65536 to it. For example, -26472 is equivalent to +39064 (-26472 + 65536).

Column name	Data type	Description	Use
STATUS	CHAR(1) NOT NULL WITH DEFAULT	Status of binding the statement: A Distributed - statement uses DB2 private protocol access. The statement will be parsed and executed at the server using defaults for input variables during access path selection. B Distributed - statement uses DB2 private protocol access. The statement will be parsed and executed at the server using values for input variables during access path selection. C Compiled - statement was bound successfully using defaults for input variables during access path selection. D Distributed - statement references a remote object using DB2 private protocol access (a three-part name), but DB2 will implicitly use DRDA access instead because the statement was bound with bind option DBPROTOCOL(DRDA). This option allows the use of three-part names with DRDA access, but it requires that the package be bound at the target remote site. E Explain - statement is an SQL EXPLAIN statement. The explain is done at bind time using defaults for input variables during access path selection. F Parsed - statement did not bind successfully and VALIDATE(RUN) was used. The statement will be rebound at execution time using values for input variables during access path selection. G Compiled - statement bound successfully, but REOPT is specified. The statement will be rebound at execution time using values for input variables during access path selection. H Parsed - statement is either a data definition statement or a statement that did not bind successfully and VALIDATE(RUN) was used. The statement will be rebound at execution time using defaults for input variables during access path selection. Data manipulation statements use defaults for input variables during access path selection. I Indefinite - statement is dynamic. The statement will be bound at execution time using defaults for input variables during access path selection. J Indefinite - statement is dynamic. The statement will be bound at execution time using values for input variables during access path selection. K Control - CALL statement. L Bad - the statement has some allowable error. The bind continues but the statement cannot be executed. M Parsed - statement references a table that is qualified with SESSION and was not bound because the table reference could be for a declared temporary table that will not be defined until the package or plan is run. The SQL statement will be rebound at execution time using values for input variables during access path selection. blank The statement is non-executable, or was bound in a DB2 release prior to Version 5.	S
ACCESSPATH	CHAR(1) NOT NULL WITH DEFAULT	For static statements, indicates if the access path for the statement is based on user-specified optimization hints. A value of 'H' indicates that optimization hints were used. A blank value indicates that the access path was determined without the use of optimization hints, or that there is no access path associated with the statement. For dynamic statements, the value is blank.	G

Column name	Data type	Description	Use
STMTNOI	INTEGER NOT NULL WITH DEFAULT	If the value of STMTNO is zero, the column contains the statement number of the statement in the source program. If both STMTNO and STMTNOI are zero, the statement number is greater than 32767.	G
SECTNOI	INTEGER NOT NULL WITH DEFAULT	The section number of the statement.	G
EXPLAINABLE	CHAR(1) NOT NULL WITH DEFAULT	Contains one of the following values: Y Indicates that the SQL statement can be used with the EXPLAIN function and may have rows describing its access path in the userid.PLAN_TABLE. N Indicates that the SQL statement does not have any rows describing its access path in the userid.PLAN_TABLE. blank Indicates that the SQL statement was bound prior to Version 7.	G
QUERYNO	INTEGER NOT NULL WITH DEFAULT –1	The query number of the SQL statement in the source program. SQL statements bound prior to Version 7 have a default value of –1. Statements bound in Version 7 or later use the value specified on the QUERYNO clause on SELECT, UPDATE, INSERT, DELETE, EXPLAIN, DECLARE CURSOR, or REFRESH TABLE statements. If the QUERYNO clause is not specified, the query number is set to the statement number.	G

SYSIBM.SYSPARMS table

Contains a row for each parameter of a routine or multiple rows for table parameters (one for each column of the table).

Column name	Data type	Description	Use
SCHEMA	VARCHAR(128) NOT NULL	Schema of the routine.	G
OWNER	VARCHAR(128) NOT NULL	Owner of the routine.	G
NAME	VARCHAR(128) NOT NULL	Name of the routine.	G
SPECIFICNAME	VARCHAR(128) NOT NULL	Specific name of the routine.	G
ROUTINETYPE	CHAR(1) NOT NULL	Type of routine: F User-defined function or cast function P Stored procedure	G
CAST_FUNCTION	CHAR(1) NOT NULL	Whether the routine is a cast function: N Not a cast function Y A cast function The only way to get a value of Y is if a user creates a distinct type when DB2 implicitly generates cast functions for the distinct type.	G
PARMNAME	VARCHAR(128) NOT NULL	Name of the parameter.	G
ROUTINEID	INTEGER NOT NULL	Internal identifier of the routine.	S
ROWTYPE	CHAR(1) NOT NULL	The following values indicate the type of parameter described by this row: P Input parameter. O Output parameter; not applicable for functions B Both an input and an output parameter; not applicable for functions R Result before casting; not applicable for stored procedures C Result after casting; not applicable for stored procedures S Input parameter of the underlying built-in source function. For a sourced function and a given ORDINAL value: • The row with ROWTYPE = P describes the input parameter of the user-defined function (identified by ROUTINEID). • The row with ROWTYPE = S describes the corresponding input parameter of the built-in function that is the underlying source function (identified by the SOURCESCHEMA and SOURCESPECIFIC values). A value of 'X' indicates that the row is not used to describe a particular parameter of the routine. Instead, the row is used to record a CCSID for the encoding scheme specified in a PARAMETER CCSID clause for a function or procedure that was created prior to Version 8 (new function mode). For functions and procedures created with Version 8 or later releases, this information is recorded in the PARAMETER_CCSID clause of SYSROUTINES.	G

Column name	Data type	Description	Use
ORDINAL	SMALLINT NOT NULL	If ROWTYPE is B, O, P, or S, the value is the ordinal number of the parameter within the routine signature. If ROWTYPE is C or R, the value depends on the type of function: • For a scalar function, the value is 0. • For a table function, the value is the ordinal number of the column of the output table. If ROWTYPE is X, the value is 0.	G
TYPESCHEMA	VARCHAR(128) NOT NULL	Schema of the data type of the parameter.	G
TYPENAME	VARCHAR(128) NOT NULL	Name of the data type of the parameter.	G
DATATYPEID	INTEGER NOT NULL	For a built-in data type, the internal ID of the built-in type. For a distinct type, the internal ID of the distinct type.	S
SOURCETYPEID	INTEGER NOT NULL	For a built-in data type, 0. For a distinct type, the internal ID of the built-in data type upon which the distinct type is based.	S
LOCATOR	CHAR(1) NOT NULL	Indicates whether a locator to a value, instead of the actual value, is to be passed or returned when the routine is called: N The actual value is to be passed. Y A locator to a value is to be passed	G
TABLE	CHAR(1) NOT NULL	The data type of a column for a table parameter: N This is not a table parameter. Y This is a table parameter.	G
TABLE_COLNO	SMALLINT NOT NULL	For table parameters, the column number of the table. Otherwise, the value is 0.	G
LENGTH	INTEGER NOT NULL	Length attribute of the parameter, or in the case of a decimal parameter, its precision.	G
SCALE	SMALLINT NOT NULL	Scale of the data type of the parameter.	G
SUBTYPE	CHAR(1) NOT NULL	If the data type is a distinct type, the subtype of the distinct type, which is based on the subtype of its source type: B The subtype is FOR BIT DATA. S The subtype is FOR SBCS DATA. M The subtype is FOR MIXED DATA. blank The source type is not a character type.	G
CCSID	INTEGER NOT NULL	CCSID of the data type for character, graphic, date, time, and timestamp data types. When ROWTYPE is X and ORDINAL is 0, the CCSID column is the CCSID for all string parameters.	G
CAST_FUNCTION_ID	INTEGER NOT NULL	Internal function ID of the function used to cast the argument, if this function is sourced on another function, or result. Otherwise, the value is 0. Not applicable for stored procedures.	S
ENCODING_SCHEME	CHAR(1) NOT NULL	Encoding scheme of the parameter: A ASCII E EBCDIC U UNICODE blank The source type is not a character, graphic, or datetime type.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G

SYSIBM.SYSPKSYSTEM table

Contains zero or more rows for every package. Each row for a given package represents one or more connections to an environment in which the package could be executed.

Column name	Data type	Description	Use
LOCATION	VARCHAR(128) NOT NULL	Always contains blanks	S
COLLID	VARCHAR(128) NOT NULL	Name of the package collection.	G
NAME	VARCHAR(128) NOT NULL	Name of the package.	G
CONTOKEN	CHAR(8) NOT NULL WITH DEFAULT FOR BIT DATA	Consistency token for the package. This is either: • The “level” as specified by the LEVEL option when the package’s program was precompiled • The timestamp indicating when the package’s program was precompiled, in an internal format.	S
SYSTEM	VARCHAR(24) NOT NULL	Environment. Values can be: BATCH TSO batch CICS Customer Information Control System DB2CALL DB2 call attachment facility DLIBATCH DLI batch support facility IMSBMP IMS BMP region IMSMPP IMS MPP and IFP region REMOTE remote server	G
ENABLE	CHAR(1) NOT NULL	Indicates whether the connections represented by the row are enabled or disabled: N Disabled Y Enabled	G
CNAME	VARCHAR(60) NOT NULL	Identifies the connection or connections to which the row applies. Interpretation depends on the environment specified by SYSTEM. Values can be: • Blank if SYSTEM=BATCH or SYSTEM=DB2CALL • The LU name for a database server if SYSTEM=REMOTE • Either the requester’s location (if the product is DB2) or the requester’s LU name enclosed in angle brackets if SYSTEM=REMOTE. • The name of a single connection if SYSTEM has any other value. CNAME can also be blank when SYSTEM is not equal to BATCH or DB2CALL. When this is so, the row applies to all servers or connections for the indicated environment.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G

SYSIBM.SYSPLAN table

Contains one row for each application plan.

Column name	Data type	Description	Use
NAME	VARCHAR(24) NOT NULL	Name of the application plan.	G
CREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the application plan.	G
	CHAR(6) NOT NULL	Not used	N
VALIDATE	CHAR(1) NOT NULL	Whether validity checking can be deferred until run time: B All checking must be performed during BIND. R Validation is done at run time for tables, views, and privileges that do not exist at bind time.	G
ISOLATION	CHAR(1) NOT NULL	Isolation level for the plan: R RR (repeatable read) T RS (read stability) S CS (cursor stability) U UR (uncommitted read)	G
VALID	CHAR(1) NOT NULL	Whether the application plan is valid: A An ALTER TABLE statement changed the description of the table or base table of a view that is referred to by the application plan. For a CREATE INDEX statement involving data sharing, VALID is also marked as ″A″. The changes do not invalidate the plan. H An ALTER TABLE statement changed the description of the table or base table of a view that is referred to by the application plan. For releases of DB2 prior to Version 5, the change invalidates the application plan. N No Y Yes	G
OPERATIVE	CHAR(1) NOT NULL	Whether the application plan can be allocated: N No; an explicit BIND or REBIND is required before the plan can be allocated Y Yes	G
	CHAR(8) NOT NULL	Not used	N
PLSIZE	INTEGER NOT NULL	Size of the base section [52] of the plan, in bytes.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
AVGSIZE	INTEGER NOT NULL	Average size, in bytes, of those sections[52] of the plan that contain SQL statements processed at bind time.	G
ACQUIRE	CHAR(1) NOT NULL	When resources are acquired: A At allocation U At first use	G
RELEASE	CHAR(1) NOT NULL	When resources are released: C At commit D At deallocation	G
	CHAR(1) NOT NULL	Not used	N
	CHAR(1) NOT NULL	Not used	N

[52] Plans are divided into *sections*. The base section of the plan must be in the EDM pool during the entire time the application program is executing. Other sections of the plan, corresponding roughly to sets of related SQL statements, are brought into the pool as needed.

Column name	Data type	Description	Use
	CHAR(1) NOT NULL	Not used	N
EXPLAN	CHAR(1) NOT NULL	EXPLAIN option specified for the plan; that is, whether information on the plan's statements was added to the owner's PLAN_TABLE table: N No Y Yes	G
EXPREDICATE	CHAR(1) NOT NULL	Indicates the CURRENTDATA option when the plan was bound or rebound: B Data currency is not required for ambiguous cursors. Allow blocking for ambiguous cursors. C Data currency is required for ambiguous cursors. Inhibit blocking for ambiguous cursors. N Blocking is inhibited for ambiguous cursors, but the plan was created before the CURRENTDATA option was available.	G
BOUNDBY	VARCHAR(128) NOT NULL WITH DEFAULT	Primary authorization ID of the binder of the plan.	G
QUALIFIER	VARCHAR(128) NOT NULL WITH DEFAULT	Implicit qualifier for the unqualified table, view, index, and alias names in the static SQL statements of the plan.	G
CACHESIZE	SMALLINT NOT NULL WITH DEFAULT	Size, in bytes, of the cache to be acquired for the plan. A value of zero indicates that no cache is used.	G
PLENTRIES	SMALLINT NOT NULL WITH DEFAULT	Number of package list entries for the plan. The negative of that number if there are rows for the plan in SYSIBM.SYPACKLIST but the plan was bound in a prior release after fall back.	G
DEFERPREP	CHAR(1) NOT NULL WITH DEFAULT	Whether the package was last bound with the DEFER(PREPARE) option: N No Y Yes	G
CURRENTSERVER	VARCHAR(128) NOT NULL WITH DEFAULT	Location name specified with the CURRENTSERVER option when the plan was last bound. Blank if none was specified, implying that the first server is the local DB2 subsystem.	G
SYSENTRIES	SMALLINT NOT NULL WITH DEFAULT	Number of rows associated with the plan in SYSIBM.SYSPLSYSTEM. The negative of that number if such rows exist but the plan was bound in a prior release after fall back. A negative value or zero means that all connections are enabled.	G
DEGREE	CHAR(3) NOT NULL WITH DEFAULT	The DEGREE option used when the plan was last bound: ANY DEGREE(ANY) 1 or blank DEGREE(1). Blank if the plan was migrated.	G
SQLRULES	CHAR(1) NOT NULL WITH DEFAULT	The SQLRULES option used when the plan was last bound: D or blank SQLRULES(DB2) S SQLRULES(STD) blank A migrated plan	G
DISCONNECT	CHAR(1) NOT NULL WITH DEFAULT	The DISCONNECT option used when the plan was last bound: E or blank DISCONNECT(EXPLICIT) (EXPLICIT) A DISCONNECT(AUTOMATIC) (AUTOMATIC) C DISCONNECT(CONDITIONAL) (CONDITIONAL) blank A migrated plan	G
GROUP_MEMBER	VARCHAR(24) NOT NULL WITH DEFAULT	The DB2 data sharing member name of the DB2 subsystem that performed the most recent bind. This column is blank if the DB2 subsystem was not in a DB2 data sharing environment when the bind was performed.	G

Column name	Data type	Description	Use
DYNAMICRULES	CHAR(1) NOT NULL WITH DEFAULT	The DYNAMICRULES option used when the plan was last bound: B BIND. Dynamic SQL statements are executed with DYNAMICRULES bind behavior. blank RUN. Dynamic SQL statements in the plan are executed with DYNAMICRULES run behavior.	G
BOUNDTS	TIMESTAMP NOT NULL WITH DEFAULT	Time when the plan was bound.	G
REOPTVAR	CHAR(1) NOT NULL WITH DEFAULT 'N'	Whether the access path is determined again at execution time using input variable values: N Bind option REOPT(NONE) indicates that the access path is determined at bind time. Y Bind option REOPT(ALWAYS) indicates that the access path is determined at execution time for SQL statements with variable values. 1 Bind option REOPT(ONCE) indicates that the access path is determined only once at execution time, using the first set of input variable values, regardless of how many times the same statement is executed.	G
KEEPDYNAMIC	CHAR(1) NOT NULL WITH DEFAULT 'N'	Whether prepared dynamic statements are to be purged at each commit point: N The bind option is KEEPDYNAMIC(NO). Prepared dynamic SQL statements are destroyed at commit or rollback. Y The bind option is KEEPDYNAMIC(YES). Prepared dynamic SQL statements are kept past commit or rollback.	G
PATHSCHEMAS	VARCHAR(2048) NOT NULL WITH DEFAULT	SQL path specified on the BIND or REBIND command that bound the plan. The path is used to resolve unqualified data type, function, and stored procedure names used in certain contexts. If the PATH bind option was not specified, the value in the column is a zero length string; however, DB2 uses a default SQL path of: SYSIBM, SYSFUN, SYSPROC, *plan qualifier*.	G
DBPROTOCOL	CHAR(1) NOT NULL WITH DEFAULT 'P'	Whether remote access for SQL with three-part names is implemented with DRDA or DB2 private protocol access: D DRDA P DB2 private protocol	G
FUNCTIONTS	TIMESTAMP NOT NULL WITH DEFAULT	Timestamp when the function was resolved. Set by the BIND and REBIND commands, but not by AUTOBIND.	G
OPTHINT	VARCHAR(128) NOT NULL WITH DEFAULT	Value of the OPTHINT bind option. Identifies rows in the authid.PLAN_TABLE to be used as input to the optimizer. Contains blanks if no rows in the authid.PLAN_TABLE are to be used as input.	G
ENCODING_CCSID	INTEGER NOT NULL WITH DEFAULT	The CCSID corresponding to the encoding scheme or CCSID as specified for the bind option ENCODING. The Encoding Scheme specified on the bind command: ccsid The specified or derived CCSID. 0 The default CCSID as specified on panel DSNTIPF at installation time. Used when the plan was bound prior to Version 7	G

Column name	Data type	Description	Use
IMMEDWRITE	CHAR(1) NOT NULL WITH DEFAULT	Indicates when writes of updated group buffer pool dependent pages are to be done. This option is only applicable for data sharing environments. N Bind option IMMEDWRITE(NO) indicates normal write activity is done. Y Bind option IMMEDWRITE(YES) indicates that immediate writes are done for updated group buffer pool dependent pages. 1 Bind option IMMEDWRITE(PH1) indicates that updated group buffer pool dependent pages are written at or before phase 1 commit. blank A migrated package.	G
RELBOUND	CHAR(1) NOT NULL WITH DEFAULT	The release when the package was bound or rebound. blank Bound prior to Version 7 K Bound on Version 7	G
	CHAR(1)	Not used.	N
REMARKS	VARCHAR(762) NOT NULL WITH DEFAULT	A character string provided by the user with the COMMENT statement.	G

SYSIBM.SYSPLANAUTH table

Records the privileges that are held by users over application plans.

Column name	Data type	Description	Use
GRANTOR	VARCHAR(128) NOT NULL	Authorization ID of the user who granted the privileges.	G
GRANTEE	VARCHAR(128) NOT NULL	Authorization ID of the user who holds the privileges. Could also be PUBLIC for a grant to PUBLIC.	G
NAME	VARCHAR(24) NOT NULL	Name of the application plan on which the privileges are held.	G
	CHAR(12) NOT NULL	Internal use only	I
	CHAR(6) NOT NULL	Not used	N
	CHAR(8) NOT NULL	Not used	N
	CHAR(1) NOT NULL	Not used	N
AUTHHOWGOT	CHAR(1) NOT NULL	Authorization level of the user from whom the privileges were received. This authorization level is not necessarily the highest authorization level of the grantor. blank Not applicable C DBCTL D DBADM L SYSCTRL M DBMAINT S SYSADM	G
BINDAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can use the BIND, REBIND, or FREE subcommands against the plan: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G
EXECUTEAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can run application programs that use the application plan: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
GRANTEDTS	TIMESTAMP NOT NULL WITH DEFAULT	Time when the GRANT statement was executed.	G

SYSIBM.SYSPLANDEP table

Records the dependencies of plans on tables, views, aliases, synonyms, table spaces, indexes, functions, and stored procedures.

Column name	Data type	Description	Use
BNAME	VARCHAR(128) NOT NULL	The name of an object the plan depends on.	G
BCREATOR	VARCHAR(128) NOT NULL	If BNAME is a table space, its database. Otherwise, the authorization ID of the owner of BNAME.	G
BTYPE	CHAR(1) NOT NULL	Type of object identified by BNAME: A Alias F User-defined function or cast function I Index M Materialized query table O Stored procedure P Partitioned table space if it is defined as LARGE or with the DSSIZE parm Q Sequence object R Table space S Synonym T Table V View	G
DNAME	VARCHAR(24) NOT NULL	Name of the plan.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G

SYSIBM.SYSPLSYSTEM table

Contains zero or more rows for every plan. Each row for a given plan represents one or more connections to an environment in which the plan could be used.

Column name	Data type	Description	Use
NAME	VARCHAR(24) NOT NULL	Name of the plan.	G
SYSTEM	VARCHAR(24) NOT NULL	Environment. Values can be: BATCH TSO batch DB2CALL DB2 call attachment facility CICS Customer Information Control System DLIBATCH DLI batch support facility IMSBMP IMS BMP region IMSMPP IMS MPP or IFP region	G
ENABLE	CHAR(1) NOT NULL	Indicates whether the connections represented by the row are enabled or disabled: N Disabled Y Enabled	G
CNAME	VARCHAR(60) NOT NULL	Identifies the connection or connections to which the row applies. Interpretation depends on the environment specified by SYSTEM. Values can be: • Blank if SYSTEM=BATCH or SYSTEM=DB2CALL • The name of a single connection if SYSTEM has any other value CNAME can also be blank when SYSTEM is not equal to BATCH or DB2CALL. When this is so, the row applies to all connections for the indicated environment.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G

SYSIBM.SYSRELS table

Contains one row for every referential constraint.

Column name	Data type	Description	Use
CREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the dependent table of the referential constraint.	G
TBNAME	VARCHAR(128) NOT NULL	Name of the dependent table of the referential constraint.	G
RELNAME	VARCHAR(128) NOT NULL	Constraint name.	G
REFTBNAME	VARCHAR(128) NOT NULL	Name of the parent table of the referential constraint.	G
REFTBCREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the parent table.	G
COLCOUNT	SMALLINT NOT NULL	Number of columns in the foreign key.	G
DELETERULE	CHAR(1) NOT NULL	Type of delete rule for the referential constraint: A NO ACTION C CASCADE N SET NULL R RESTRICT	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
RELOBID1	SMALLINT NOT NULL WITH DEFAULT	Internal identifier of the constraint with respect to the database that contains the parent table.	S
RELOBID2	SMALLINT NOT NULL WITH DEFAULT	Internal identifier of the constraint with respect to the database that contains the dependent table.	S
TIMESTAMP	TIMESTAMP NOT NULL WITH DEFAULT	Date and time the constraint was defined. If the constraint is between catalog tables prior to DB2 Version 2 Release 3, the value is '1985-04-01-00.00.00.000000.'.	G
IXOWNER	VARCHAR(128) NOT NULL WITH DEFAULT	Owner of unique non-primary index used for the parent key. '99999999' if the enforcing index has been dropped. Blank if the enforcing index is a primary index.	G
IXNAME	VARCHAR(128) NOT NULL WITH DEFAULT	Name of unique non-primary index used for a parent key. '99999999' if the enforcing index has been dropped. Blank if the enforcing index is a primary index.	G
ENFORCED	CHAR(1) NOT NULL WITH DEFAULT ’Y”	Enforced by the system or not: Y Enforced by the system N Not enforced by the system (trusted)	G
CHECKEXISTINGDATA	CHAR(1) NOT NULL WITH DEFAULT	Option for checking existing data: I Immediately check existing data. If ENFORCED = ’Y’, this column will have a value of ’I’. N Never check existing data. If ENFORECED = ’N’, this column will have a value of ’N’.	G

SYSIBM.SYSRESAUTH table

Records CREATE IN and PACKADM ON privileges for collections; USAGE privileges for distinct types; and USE privileges for buffer pools, storage groups, and table spaces.

Column name	Data type	Description	Use
GRANTOR	VARCHAR(128) NOT NULL	Authorization ID of the user who granted the privilege.	G
GRANTEE	VARCHAR(128) NOT NULL	Authorization ID of the user who holds the privilege. Could also be PUBLIC for a grant to PUBLIC.	G
QUALIFIER	VARCHAR(128) NOT NULL	Qualifier of the table space (the database name) if the privilege is for a table space (OBTYPE='R'). The schema name of the distinct type if the privilege is for a distinct type (OBTYPE='D'). The schema name of the JAR if the privilege is for a JAR (OBTYPE='J'). The value is PACKADM if the privilege is for a collection (OBTYPE='C') and the authority held is PACKADM. Otherwise, the value is blank.	G
NAME	VARCHAR(128) NOT NULL	Name of the buffer pool, collection, DB2 storage group, distinct type, or table space. Could also be ALL when USE OF ALL BUFFERPOOLS is granted.	G
	CHAR(1) NOT NULL	Internal use only	I
AUTHHOWGOT	CHAR(1) NOT NULL	Authorization level of the user from whom the privileges were received. This authorization level is not necessarily the highest authorization level of the grantor. blank Not applicable C DBCTL D DBADM L SYSCTRL M DBMAINT S SYSADM P PACKADM (on a specific collection) A PACKADM (on collection *)	G
OBTYPE	CHAR(1) NOT NULL	Type of object: B Buffer pool C Collection D Distinct type R Table space S Storage group J JAR (Java ARchieve file)	G
	CHAR(12) NOT NULL	Internal use only	I
	CHAR(6) NOT NULL	Not used	N
	CHAR(8) NOT NULL	Not used	N
USEAUTH	CHAR(1) NOT NULL	Whether the privilege is held with the GRANT option: G Privilege is held with the GRANT option Y Privilege is held without the GRANT option The authority held is PACKADM when the OBTYPE is C (a collection) and QUALIFIER is PACKADM. The authority held is CREATE IN when the OBTYPE is C and QUALIFIER is blank.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see "Release dependency indicators" on page 1191.	G
GRANTEDTS	TIMESTAMP NOT NULL WITH DEFAULT	Time when the GRANT statement was executed.	G

SYSIBM.SYSROUTINEAUTH table

Records the privileges that are held by users on routines. (A routine can be a user-defined function, cast function, or stored procedure.)

Column name	Data type	Description	Use
GRANTOR	VARCHAR(128) NOT NULL	Authorization ID of the user who granted the privilege.	G
GRANTEE	VARCHAR(128) NOT NULL	Authorization ID of the user who holds the privilege or the name of a plan or package that uses the privilege. Can also be PUBLIC for a grant to PUBLIC.	G
SCHEMA	VARCHAR(128) NOT NULL	Schema of the routine	G
SPECIFICNAME	VARCHAR(128) NOT NULL	Specific name of the routine. An asterisk (*) if the privilege is held on all routines in the schema.	G
GRANTEDTS	TIMESTAMP NOT NULL	Time when the GRANT statement was executed.	G
ROUTINETYPE	CHAR(1) NOT NULL	Type of routine: F User-defined function or cast function P Stored procedure	G
GRANTEETYPE	CHAR(1) NOT NULL	Type of grantee: blank An authorization ID P An application plan or package. The grantee is a package if COLLID is not blank. R Internal use only	G
AUTHHOWGOT	CHAR(1) NOT NULL	Authorization level of the user from whom the privileges were received. This authorization level is not necessarily the highest authorization level of the grantor. This field is also used to indicate that the privilege was held on all schemas by the grantor. blank Not applicable 1 Grantor had privilege on schema.* at time of grant L SYSCTRL S SYSADM	G
EXECUTEAUTH	CHAR(1) NOT NULL	Whether GRANTEE can execute the routine: Y Privilege is held without GRANT option. G Privilege is held with GRANT option.	G
COLLID	VARCHAR(128) NOT NULL	If the GRANTEE is a package, its collection name. Otherwise, the value is blank.	G
CONTOKEN	CHAR(8) NOT NULL WITH DEFAULT FOR BIT DATA	If the GRANTEE is a package, the consistency token of the DBRM from which the package was derived. Otherwise, the value is blank.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G

SYSIBM.SYSROUTINES table

Contains a row for every routine. (A routine can be a user-defined function, cast function, or stored procedure.)

Column name	Data type	Description	Use
SCHEMA	VARCHAR(128) NOT NULL	Schema of the routine.	G
OWNER	VARCHAR(128) NOT NULL	Owner of the routine.	G
NAME	VARCHAR(128) NOT NULL	Name of the routine.	G
ROUTINETYPE	CHAR(1) NOT NULL	Type of routine: F User-defined function or cast function P Stored procedure	G
CREATEDBY	VARCHAR(128) NOT NULL	Authorization ID under which the routine was created.	G
SPECIFICNAME	VARCHAR(128) NOT NULL	Specific name of the routine.	G
ROUTINEID	INTEGER NOT NULL	Internal identifier of the routine.	S
RETURN_TYPE	INTEGER NOT NULL	Internal identifier of the result data type of the function. The column contains a -2 if the function is a table function.	S
ORIGIN	CHAR(1) NOT NULL	Origin of the routine: E External user-defined function (external table or external scalar) or stored procedure Q SQL function S System-generated function U Sourced on user-defined function or built-in function	G
FUNCTION_TYPE	CHAR(1) NOT NULL	Type of function: C Aggregate function S Scalar function T Table function blank For a stored procedure (ROUTINETYPE = 'P')	G
PARM_COUNT	SMALLINT NOT NULL	Number of parameters for the routine.	G
LANGUAGE	VARCHAR(24) NOT NULL	Implementation language of the routine: ASSEMBLE C COBOL COMPJAVA JAVA PLI REXX SQL blank ROUTINETYPE = 'F' and ORIGIN is not 'E' or not ’Q’.	G
COLLID	VARCHAR(128) NOT NULL	Name of the package collection to be used when the routine is executed. A blank value indicates the package collection is the same as the package collection of the program that invoked the routine.	G
SOURCESCHEMA	VARCHAR(128) NOT NULL	If ORIGIN is 'U' and ROUTINETYPE is 'F', the schema of the source user-defined function (’SYSIBM’ for a source built-in function). Otherwise, the value is blank.	G
SOURCESPECIFIC	VARCHAR(128) NOT NULL	If ORIGIN is 'U' and ROUTINETYPE is 'F', the specific name of the source user-defined function or source built-in function name. Otherwise, the value is blank.	G

Column name	Data type	Description	Use
DETERMINISTIC	CHAR(1) NOT NULL	The deterministic option of an external function or a stored procedure: N Indeterminate (results may differ with a given set of input values). Y Deterministic (results are consistent). blank ROUTINETYPE='F' and ORIGIN is not 'E' or not ’Q’ (the routine is a function, but not an external function or an SQL function).	G
EXTERNAL_ACTION	CHAR(1) NOT NULL	The external action option of an external function or SQL function: N Function has no side effects. E Function has external side effects so that the number of invocations is important. blank ORIGIN is not 'E' or 'Q' for the function (ROUTINETYPE='F'), or it is a stored procedure (ROUTINETYPE='P').	G
NULL_CALL	CHAR(1) NOT NULL	The CALLED ON NOT NULL INPUT option of an external function or stored procedure: N The routine is not called if any parameter has a NULL value. Y The routine is called if any parameter has a NULL value. blank ROUTINETYPE='F' and ORIGIN is not 'E' (the routine is a function, but not an external function).	G
CAST_FUNCTION	CHAR(1) NOT NULL	Whether the routine is a cast function: N The routine is not a cast function. Y The routine is a cast function. blank ORIGIN is not 'E' for the function (ROUTINETYPE='F'), or it is a stored procedure (ROUTINETYPE='P'). A cast function is generated by DB2 for a CREATE DISTINCT TYPE statement,	G
SCRATCHPAD	CHAR(1) NOT NULL	The SCRATCHPAD option of an external function: N This function does not have a SCRATCHPAD. Y This function has a SCRATCHPAD. blank ORIGIN is not 'E' for the function (ROUTINETYPE='F'), or it is a stored procedure (ROUTINETYPE='P').	G
SCRATCHPAD_LENGTH	INTEGER NOT NULL	Length of the scratchpad if the ORIGIN is 'E' for the function (ROUTINETYPE='F') and NO SCRATCHPAD is not specified. Otherwise, the value is 0.	G
FINAL_CALL	CHAR(1) NOT NULL	The FINAL CALL option of an external function: N A final call will not be made to the function. Y A final call will be made to the function. blank ORIGIN is not 'E' for the function (ROUTINETYPE='F'), or it is a stored procedure (ROUTINETYPE='P').	G
PARALLEL	CHAR(1) NOT NULL	The PARALLEL option of an external function: A This function can be invoked by parallel tasks. D This function cannot be invoked by parallel tasks. blank ORIGIN is not 'E' for the function (ROUTINETYPE='F'), or it is a stored procedure (ROUTINETYPE='P').	G

Column name	Data type	Description	Use
PARAMETER_STYLE	CHAR(1) NOT NULL	The PARAMETER STYLE option of an external function or stored procedure: D DB2SQL. All parameters are passed to the external function or stored procedure according to the DB2SQL standard convention. G GENERAL. All parameters are passed to the stored procedure according to the GENERAL standard convention. N GENERAL CALL WITH NULLS. All parameters are passed to the stored procedure according to the GENERAL WITH NULLS convention. J JAVA. All parameters are passed to the function or procedure according to the conventions for JAVA and SQLJ specifications. blank The column is blank if the ORIGIN is not 'E' or if LANGUAGE is SQL.	G
FENCED	CHAR(1) NOT NULL	**Y** Indicates that this routine runs separately the DB2 address space. All user-defined routines run in the DB2 address space. **blank** ORIGIN is 'Q' .	G
SQL_DATA_ACCESS	CHAR(1) NOT NULL	The SQL statements that are allowed in an external function, SQL function, or stored procedure: C CONTAINS SQL: Only SQL that does not read or modify data is allowed. M MODIFIES SQL DATA: All SQL is allowed, including SQL that reads or modifies data. N NO SQL: SQL is not allowed. R READS SQL DATA: Only SQL that reads data is allowed. blank Not applicable.	G
DBINFO	CHAR(1) NOT NULL	The DBINFO option of an external function or stored procedure: N No, the DBINFO parameter will not be passed to the external function or stored procedure. Y Yes, the DBINFO parameter will be passed to the external function or stored procedure. blank ORIGIN is not 'E'.	G
STAYRESIDENT	CHAR(1) NOT NULL	The STAYRESIDENT option of the routine, which determines whether the routine is to be deleted from memory when the routine ends. N The load module is to be deleted from memory after the routine terminates. Y The load module is to remain resident in memory after the routine terminates. blank ORIGIN is not 'E'.	G
ASUTIME	INTEGER NOT NULL	Number of CPU service units permitted for any single invocation of this routine. If ASUTIME is zero, the number of CPU service units is unlimited. The column is blank if ROUTINETYPE = 'F' and ORIGIN is not 'E'. If a routine consumes more CPU service units than the ASUTIME value allows, DB2 cancels the routine.	G
WLM_ENVIRONMENT	VARCHAR(54) NOT NULL	Name of the WLM environment to be used to run this routine. The column is blank if ROUTINETYPE = 'F' and ORIGIN is not 'E'. If the ROUTINETYPE = 'P', the value might be blank. Blank causes the stored procedure to be run in the DB2 stored procedure address space.	G

Column name	Data type	Description	Use
WLM_ENV_FOR_NESTED	CHAR(1) NOT NULL	For nested routine calls, indicates whether the address space of the calling stored procedure or user-defined function is used to run the nested stored procedure or user-defined function: N The nested stored procedure or user-defined function runs in an address space other than the specified WLM environment if the calling stored procedure or user-defined function is not running in the specified WLM environment. 'WLM ENVIRONMENT name' was specified. Y The nested stored procedure or user-defined function runs in the environment used by the calling stored procedure or user-defined function. 'WLM ENVIRONMENT(name,*)' was specified. blank WLM_ENVIRONMENT is blank. The column is blank if ROUTINETYPE = 'F' and ORIGIN is not 'E'.	G
PROGRAM_TYPE	CHAR(1) NOT NULL	Indicates whether the routine runs as a Language Environment main routine or a subroutine: M The routine runs as a main routine. S The routine runs as a subroutine. blank ORIGIN is not 'E'.	G
EXTERNAL_SECURITY	CHAR(1) NOT NULL	Specifies the authorization ID to be used if the routine accesses resources protected by an external security product: D DB2 - The authorization ID associated with the WLM-established stored procedure address space. U USER - The authorization ID of the SQL user that invoked the routine. C DEFINER - The authorization ID of the owner of the routine. blank ORIGIN is not 'E'.	G
COMMIT_ON_RETURN	CHAR(1) NOT NULL	If ROUTINETYPE = 'P', whether the transaction is always to be committed immediately on successful return (non-negative SQLCODE) from this stored procedure: N The unit of work is to continue. Y The unit of work is to be committed immediately. If ROUTINETYPE = 'F', the value is blank.	G
RESULT_SETS	SMALLINT NOT NULL	If ROUTINETYPE = 'P', the maximum number of ad hoc result sets that this stored procedure can return. If no ad hoc result sets exist or ROUTINETYPE = 'F', the value is zero.	G
LOBCOLUMNS	SMALLINT NOT NULL	If ORIGIN = 'E' or 'Q', the number of LOB columns found in the parameter list for this user-defined function. If no LOB columns are found in the parameter list or ORIGIN is not 'E' or not 'Q', the value is 0.	I
CREATEDTS	TIMESTAMP NOT NULL	Time when the CREATE statement was executed for this routine.	G
ALTEREDTS	TIMESTAMP NOT NULL	Time when the last ALTER statement was executed for this routine.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
PARM1	SMALLINT NOT NULL	Internal use only	I
PARM2	SMALLINT NOT NULL	Internal use only	I
PARM3	SMALLINT NOT NULL	Internal use only	I
PARM4	SMALLINT NOT NULL	Internal use only	I

Column name	Data type	Description	Use
PARM5	SMALLINT NOT NULL	Internal use only	I
PARM6	SMALLINT NOT NULL	Internal use only	I
PARM7	SMALLINT NOT NULL	Internal use only	I
PARM8	SMALLINT NOT NULL	Internal use only	I
PARM9	SMALLINT NOT NULL	Internal use only	I
PARM10	SMALLINT NOT NULL	Internal use only	I
PARM11	SMALLINT NOT NULL	Internal use only	I
PARM12	SMALLINT NOT NULL	Internal use only	I
PARM13	SMALLINT NOT NULL	Internal use only	I
PARM14	SMALLINT NOT NULL	Internal use only	I
PARM15	SMALLINT NOT NULL	Internal use only	I
PARM16	SMALLINT NOT NULL	Internal use only	I
PARM17	SMALLINT NOT NULL	Internal use only	I
PARM18	SMALLINT NOT NULL	Internal use only	I
PARM19	SMALLINT NOT NULL	Internal use only	I
PARM20	SMALLINT NOT NULL	Internal use only	I
PARM21	SMALLINT NOT NULL	Internal use only	I
PARM22	SMALLINT NOT NULL	Internal use only	I
PARM23	SMALLINT NOT NULL	Internal use only	I
PARM24	SMALLINT NOT NULL	Internal use only	I
PARM25	SMALLINT NOT NULL	Internal use only	I
PARM26	SMALLINT NOT NULL	Internal use only	I
PARM27	SMALLINT NOT NULL	Internal use only	I
PARM28	SMALLINT NOT NULL	Internal use only	I
PARM29	SMALLINT NOT NULL	Internal use only	I
PARM30	SMALLINT NOT NULL	Internal use only	I

Column name	Data type	Description	Use
IOS_PER_INVOC	FLOAT NOT NULL WITH DEFAULT -1	Estimated number of I/Os that required to execute the routine. The value is -1 if the estimated number is not known.	S
INSTS_PER_INVOC	FLOAT NOT NULL WITH DEFAULT -1	Estimated number of machine instructions that required to execute the routine. The value is -1 if the estimated number is not known.	S
INITIAL_IOS	FLOAT NOT NULL WITH DEFAULT -1	Estimated number of I/O's that are performed the first time or the last time the routine is invoked. The value is -1 if the estimated number is not known.	S
INITIAL_INSTS	FLOAT NOT NULL WITH DEFAULT -1	Estimated number of machine instructions that are performed the first time or the last time the routine is invoked. The value is -1 if the estimated number is not known.	S
CARDINALITY	FLOAT NOT NULL WITH DEFAULT -1	The predicted cardinality of the routine, -1 to trigger DB2's use of the default value (10,000).	S
RESULT_COLS	SMALLINT NOT NULL DEFAULT 1	For a table function, the number of columns in the result table. Otherwise, the value is 1.	S
EXTERNAL_NAME	VARCHAR(762) NOT NULL	The path/module/function that DB2 should load to execute the routine. The column is blank if ROUTINETYPE = 'F' and ORIGIN is not 'E'.	G
PARM_SIGNATURE	VARCHAR(150) NOT NULL WITH DEFAULT FOR BIT DATA	Internal use only	I
RUNOPTS	VARCHAR(762) NOT NULL	The Language Environment run-time options to be used for this routine. An empty string indicates that the installation default Language Environment run-time options are to be used. The column is blank if ROUTINETYPE = 'F' and ORIGIN is not 'E'.	G
REMARKS	VARCHAR(762) NOT NULL	A character string provided by the user with the COMMENT statement.	G
JAVA_SIGNATURE	VARCHAR(3072) NOT NULL WITH DEFAULT	The signature of the jar file. blank When PARAMETER STYLE is not JAVA. The column is also blank if ROUTINETYPE = 'F' and ORIGIN is not 'E'.	G
CLASS	VARCHAR(384) NOT NULL WITH DEFAULT	The class name contained in the jar file. blank When PARAMETER STYLE is not JAVA. The column is also blank if ROUTINETYPE = 'F' and ORIGIN is not 'E'.	G
JARSCHEMA	VARCHAR(128) NOT NULL WITH DEFAULT	The schema of the jar file. blank When PARAMETER STYLE is not JAVA. The column is also blank if ROUTINETYPE = 'F' and ORIGIN is not 'E'.	G
JAR_ID	VARCHAR(128) NOT NULL WITH DEFAULT	The name of the jar file. blank When PARAMETER STYLE is not JAVA. The column is also blank if ROUTINETYPE = 'F' and ORIGIN is not 'E'.	G
SPECIAL_REGS	CHAR(1) NOT NULL WITH DEFAULT 'I'	The SPECIAL REGISTER option for a routine. I INHERIT SPECIAL REGISTERS D DEFAULT SPECIAL REGISTERS blank ROUTINETYPE = 'F' and ORIGIN is not 'E' or not 'Q'.	G
NUM_DEP_MQTS	SMALLINT NOT NULL WITH DEFAULT	Number of dependent materialized query tables. The value is 0 if the row does not describe a user-defined table function, or if no materialized query tables are defined on the table function.	G
MAX_FAILURE	SMALLINT NOT NULL WITH DEFAULT -1	Allowable failures for this routine (0-255). If zero is specified, the routine will never be stopped. If no value is specified for this routine, the default will be -1 to indicate that the DB2 installation parameter (STORMXAB) will be used.	G

Column name	Data type	Description	Use
PARAMETER_CCSID	INTEGER NOT NULL WITH DEFAULT	A CCSID that specifies how character, graphic, date, time, and timestamp data types for system generated parameters to the routine such as message tokens and DBINFO should be passed. The value is dependent on the encoding scheme specified implicitly or explicitly for the PARAMETER CCSID clause defined at the system for that encoding scheme. The following list describes the CCSID for each encoding scheme: **ASCII** If mixed data is allowed, this CCSID is for mixed ASCII data, SBCS data uses the corresponding SBCS CCSID, and graphic data uses the corresponding DBCS CCSID. Otherwise, this CCSID is for SBCS ASCII data. **EBCDIC** If mixed data is allowed, this CCSID is for mixed EBCDIC data, SBCS data uses the corresponding SBCS CCSID, and graphic data uses the corresponding DBCS CCSID. Otherwise, this is the CCSID for SBCS EBCDIC data. **UNICODE** This CCSID is for mixed data (1208). A value of zero means that the CCSIDs used are those CCSIDs for the encoding scheme of other string or datetime parameters in the parameter list or RETURNS clause CCSID clauses, or the value in the DEF ENCODING SCHEME on installation panel DSNTIPF.	G

SYSIBM.SYSROUTINES_OPTS table

Contains a row for each generated routine, such as one created by DB2 UDB for z/OS Procedure Processor DSNTPSMP, that records the build options for the routine. Rows in this table can be inserted, updated, and deleted.

Column name	Data type	Description	Use
SCHEMA	VARCHAR(128) NOT NULL	Schema of the routine.	G
ROUTINENAME	VARCHAR(128) NOT NULL	Name of the routine.	G
BUILDDATE	DATE NOT NULL WITH DEFAULT	Date the routine was built	G
BUILDTIME	TIME NOT NULL WITH DEFAULT	Time the routine was built	G
BUILDSTATUS	CHAR(1) NOT NULL WITH DEFAULT 'C'	Whether this version of the routine's options is the current version	G
BUILDSCHEMA	VARCHAR(128) NOT NULL	Schema name for BUILDNAME.	G
BUILDNAME	VARCHAR(128) NOT NULL	Procedure used to create the routine.	G
BUILDOWNER	VARCHAR(128) NOT NULL	Authorization ID used to create the routine.	G
IBMREQD	CHAR(1) NOT NULL WITH DEFAULT 'N'	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see "Release dependency indicators" on page 1191.	G
PRECOMPILE_OPTS	VARCHAR(765) NOT NULL WITH DEFAULT	Precompiler options used to build the routine.	G
COMPILE_OPTS	VARCHAR(765) NOT NULL WITH DEFAULT	Compiler options used to build the routine.	G
PRELINK_OPTS	VARCHAR(765) NOT NULL WITH DEFAULT	Prelink-edit options used to build the routine.	G
LINK_OPTS	VARCHAR(765) NOT NULL WITH DEFAULT	Link-edit options used to build the routine.	G
BIND_OPTS	VARCHAR(3072) NOT NULL WITH DEFAULT	Bind options used to build the routine.	G
SOURCEDSN	VARCHAR(765) NOT NULL WITH DEFAULT	Name of the source data set.	G
DEBUG_MODE	CHAR(1) NOT NULL	Debugging is on or off for this object. 0 Debugging is off. Default and value on migration are both 0. 1 Debugging is on.	G

SYSIBM.SYSROUTINES_SRC table

Contains source for generated routines, such as those created by DB2 UDB for z/OS Procedure Processor DSNTPSMP. Rows in this table can be inserted, updated, and deleted.

Column name	Data type	Description	Use
SCHEMA	VARCHAR(128) NOT NULL	Schema of the routine.	G
ROUTINENAME	VARCHAR(128) NOT NULL	Name of the routine.	G
BUILDDATE	DATE NOT NULL WITH DEFAULT	Date the routine was built	G
BUILDTIME	TIME NOT NULL WITH DEFAULT	Time the routine was built	G
BUILDSTATUS	CHAR(1) NOT NULL WITH DEFAULT ’C’	Whether this version of the routine’s source is the current version	G
SEQNO	INTEGER NOT NULL	Number of the source statement piece in CREATESTMT.	G
IBMREQD	CHAR(1) NOT NULL WITH DEFAULT ’N’	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
CREATESTMT	VARCHAR(7500) NOT NULL	Routine source statement.	G

SYSIBM.SYSSCHEMAAUTH table

Contains one or more rows for each user that is granted a privilege on a particular schema in the database.

Column name	Data type	Description	Use
GRANTOR	VARCHAR(128) NOT NULL	Authorization ID of the user who granted the privileges or SYSADM.	G
GRANTEE	VARCHAR(128) NOT NULL	Authorization ID of the user or group who holds the privileges. Can also be PUBLIC for a grant to PUBLIC.	G
SCHEMANAME	VARCHAR(128) NOT NULL	Name of the schema or '*' for all schemas.	G
AUTHHOWGOT	CHAR(1) NOT NULL	Authorization level of the user from whom the privileges were received. This authorization level is not necessarily the highest authorization level of the grantor. This field is also used to indicate that the privilege was held on all schemas by the grantor. 1 Grantor had privilege on all schemas at time of grant L SYSCTRL S SYSADM	G
CREATEINAUTH	CHAR(1) NOT NULL	Indicates whether grantee holds CREATEIN privilege on the schema: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G
ALTERINAUTH	CHAR(1) NOT NULL	Indicates whether grantee holds ALTERIN privilege on the schema: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G
DROPINAUTH	CHAR(1) NOT NULL	Indicates whether grantee holds DROPIN privilege on the schema: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G
GRANTEDTS	TIMESTAMP NOT NULL	Time when the GRANT statement was executed.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see "Release dependency indicators" on page 1191.	G

SYSIBM.SYSSEQUENCEAUTH table

Records the privileges that are held by users over sequences.

Column name	Data type	Description	Use
GRANTOR	VARCHAR(128) NOT NULL	Authorization ID of the user who granted the privileges.	G
GRANTEE	VARCHAR(128) NOT NULL	Authorization ID of the user or group that holds the privileges or the name of an application plan or package that uses the privileges. PUBLIC for a grant to PUBLIC.	G
SCHEMA	VARCHAR(128) NOT NULL	Schema of the sequence.	G
NAME	VARCHAR(128) NOT NULL	Name of the sequence.	G
GRANTEETYPE	CHAR(1) NOT NULL	Type of grantee: blank An authorization ID. P An application plan or package. The grantee is a package if COLLID is not blank. R Internal use only.	G
AUTHHOWGOT	CHAR(1) NOT NULL	Authorization level of the user from whom the privileges were received. This authorization level is not necessarily the highest authorization level of the grantor: L SYSCTRL S SYSADM blank Not applicable	G
ALTERAUTH	CHAR(1) NOT NULL	Indicates whether grantee holds ALTER privilege on the sequence: blank Privilege is not held. G Privilege is held with the GRANT option. Y Privilege is held without the GRANT option.	G
USEAUTH	CHAR(1) NOT NULL	Indicates whether grantee holds USAGE privilege on the sequence: blank Privilege is not held. G Privilege is held with the GRANT option. Y Privilege is held without the GRANT option.	G
COLLID	VARCHAR(128) NOT NULL	If the GRANTEE is a package, its collection name. Otherwise, a string of length zero.	G
CONTOKEN	CHAR(8) NOT NULL FOR BIT DATA	If the GRANTEE is a package, the consistency token of the DBRM from which the package was derived. Otherwise, blank.	G
GRANTEDTS	TIMESTAMP NOT NULL	Time when the GRANT statement was executed.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see "Release dependency indicators" on page 1191.	G

SYSIBM.SYSSEQUENCES table

Contains one row for each identity column or user-defined sequence.

Column name	Data type	Description	Use
SCHEMA	VARCHAR(128) NOT NULL	Schema of the sequence. For an identity column, the value of TBCREATOR from the SYSCOLUMNS entry for the column.	G
OWNER	VARCHAR(128) NOT NULL	Owner of the sequence. For an identity column, the value of TBCREATOR from the SYSCOLUMNS entry for the column.	G
NAME	VARCHAR(128) NOT NULL	Name of the identity column or sequence. (The name for an identity is generated by DB2.)	G
SEQTYPE	CHAR(1) NOT NULL	Type of sequence object: **I** An identity column **S** A user-defined sequence	G
SEQUENCEID	INTEGER NOT NULL	Internal identifier of the identity column or sequence.	G
CREATEDBY	VARCHAR(128) NOT NULL	Authorization ID under which the identity column or sequence was created.	G
INCREMENT	DECIMAL(31,0) NOT NULL	Increment value (positive or negative, within INTEGER scope).	G
START	DECIMAL(31,0) NOT NULL	Start value.	G
MAXVALUE	DECIMAL(31,0) NOT NULL	Maximum value allowed for the identity column or sequence.	G
MINVALUE	DECIMAL(31,0) NOT NULL	Minimum value allowed for the identity column or sequence.	G
CYCLE	CHAR(1) NOT NULL	Whether cycling will occur when a boundary is reached: **N** No **Y** Yes, cycling will occur	G
CACHE	INTEGER NOT NULL	Number of sequence values to preallocate in memory for faster access. A value of 0 indicates that values are not to be preallocated.	G
ORDER	CHAR(1) NOT NULL	Whether the values must be generated in order: **Y** Yes **N** No	G
DATATYPEID	INTEGER NOT NULL	For a built-in data type, the internal ID of the built-in type. For a distinct type, the internal ID of the distinct type.	S
SOURCETYPEID	INTEGER NOT NULL	For a built-in data type, 0. For a distinct type, the internal ID of the built-in data type upon which the distinct type is based.	S
CREATEDTS	TIMESTAMP NOT NULL	Timestamp when the identity column or sequence was created.	G
ALTEREDTS	TIMESTAMP NOT NULL	Timestamp when the last ALTER statement was executed for this identity column or sequence.	G
MAXASSIGNEDVAL	DECIMAL(31,0)	Last possible assigned value. Initialized to null when the object is created. Updated each time the next chunk of *n* values is cached, where *n* is the value for CACHE.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
REMARKS	VARCHAR(762) NOT NULL	Character string provided by user with the COMMENT statement. The value is blank for an identity column.	G
PRECISION	SMALLINT NOT NULL WITH DEFAULT	The precision defined for asequence with a decimal or numeric type. Value is 5 for SMALLINT, 10 for INTEGER, or the actual precision specified by the user for the decimal data type. The value is 0 for rows created prior to Version 8.	G

Column name	Data type	Description	Use
RESTARTWITH	DECIMAL(31,0) NULLABLE WITH DEFAULT	The RESTART WITH value specified for a sequence during ALTER or NULL. The RESTART WITH value is reset to NULL during the first value generation after the ALTER. The value is NULL if no ALTER with RESTART WITH has happened.	G

SYSIBM.SYSSEQUENCESDEP table

Records the dependencies of identity columns and sequences.

Column name	Data type	Description	Use
BSEQUENCEID	INTEGER NOT NULL	Internal identifier of the identity column or sequence.	G
DCREATOR	VARCHAR(128) NOT NULL	The owner of the object that is dependent on this identity column or sequence.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see "Release dependency indicators" on page 1191.	G
DNAME	VARCHAR(128) NOT NULL	Name of the object that is dependent on this identity column or sequence.	G
DCOLNAME	VARCHAR(128) NOT NULL	Name of the identity column. Blank for SQL function rows.	G
DTYPE	CHAR(1) NOT NULL WITH DEFAULT 'I'	The type of object that is dependent on this sequence: **F** SQL function **I** Identity column **blank** Represents an identity column created prior to Version 8	G
BSCHEMA	VARCHAR(129) NOT NULL WITH DEFAULT	The schema name of the sequence, will be a string of length zero for an object created prior to Version 8.	G
BNAME	VARCHAR(128) NOT NULL WITH DEFAULT	The sequence name (generated by DB2 for an identity column), will be a string of length zero for an object created prior to Version 8.	G
DSCHEMA	VARCHAR(128) NOT NULL WITH DEFAULT	The qualifier of the object that is dependent on this sequence, will be a string of length zero for an object created prior to Version 8.	G

SYSIBM.SYSSTMT table

Contains one or more rows for each SQL statement of each DBRM.

Column name	Data type	Description	Use
NAME	VARCHAR(24) NOT NULL	Name of the DBRM.	G
PLNAME	VARCHAR(24) NOT NULL	Name of the application plan.	G
PLCREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the application plan.	G
SEQNO	SMALLINT NOT NULL	Sequence number of this row with respect to a statement of the DBRM[53]. The numbering starts with zero.	G
STMTNO	SMALLINT NOT NULL	The statement number of the statement in the source program. A statement number greater than 32767 is stored as zero. If the value is zero, see STMTNOI for the statement number.[53]	G
SECTNO	SMALLINT NOT NULL	The section number of the statement.[53]	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
TEXT	VARCHAR(3800) NOT NULL WITH DEFAULT FOR BIT DATA	Text or portion of the text of the SQL statement.	S
ISOLATION	CHAR(1) NOT NULL WITH DEFAULT	Isolation level for the SQL statement: R RR (repeatable read) T RS (read stability) S CS (cursor stability) U UR (uncommitted read) L RS isolation, with a *lock-clause* X RR isolation, with a *lock-clause* blank The WITH clause was not specified on this statement. The isolation level is recorded in SYSPACKAGE.ISOLATION and in SYSPLAN.ISOLATION.	G

[53] Rows in which the values of SEQNO, STMTNO, and SECTNO are zero are for internal use.

Column name	Data type	Description	Use
STATUS	CHAR(1) NOT NULL WITH DEFAULT	Status of binding the statement: A Distributed - statement uses DB2 private protocol access. The statement will be parsed and executed at the server using defaults for input variables during access path selection. B Distributed - statement uses DB2 private protocol access. The statement will be parsed and executed at the server using values for input variables during access path selection. C Compiled - statement was bound successfully using defaults for input variables during access path selection. D Distributed - statement references a remote object using DB2 private protocol access (a three-part name), but DB2 will implicitly use DRDA access instead because the statement was bound with bind option DBPROTOCOL(DRDA). This option allows the use of three-part names with DRDA access, but it requires that the package be bound at the target remote site. E Explain - statement is an SQL EXPLAIN statement. The explain is done at bind time using defaults for input variables during access path selection. F Parsed - statement did not bind successfully and VALIDATE(RUN) was used. The statement will be rebound at execution time using values for input variables during access path selection. G Compiled - statement bound successfully, but REOPT is specified. The statement will be rebound at execution time using values for input variables during access path selection. H Parsed - statement is either a data definition statement or a statement that did not bind successfully and VALIDATE(RUN) was used. The statement will be rebound at execution time using defaults for input variables during access path selection. Data manipulation statements use defaults for input variables during access path selection. I Indefinite - statement is dynamic. The statement will be bound at execution time using defaults for input variables during access path selection. J Indefinite - statement is dynamic. The statement will be bound at execution time using values for input variables during access path selection. K Control - CALL statement. L Bad - the statement has some allowable error. The bind continues but the statement cannot be executed. M Parsed - statement references a table that is qualified with SESSION and was not bound because the table reference could be for a declared temporary table that will not be defined until the package or plan is run. The SQL statement will be rebound at execution time using values for input variables during access path selection. blank The statement is non-executable, or was bound in a DB2 release prior to Version 5.	S
ACCESSPATH	CHAR(1) NOT NULL WITH DEFAULT	For static statements, indicates if the access path for the statement is based on user-specified optimization hints. A value of 'H' indicates that optimization hints were used. A blank value indicates that the access path was determined without the use of optimization hints, or that there is no access path associated with the statement. For dynamic statements, the value is blank.	G

Column name	Data type	Description	Use
STMTNOI	INTEGER NOT NULL WITH DEFAULT	If the value of STMTNOI is zero, the column contains the statement number of the statement in the source program. If both STMTNO and STMTNOI are zero, the statement number is greater than 32767.	G
SECTNOI	INTEGER NOT NULL WITH DEFAULT	The section number of the statement.	G
EXPLAINABLE	CHAR(1) NOT NULL WITH DEFAULT	Contains one of the following values: Y Indicates that the SQL statement can be used with the EXPLAIN function and may have rows describing its access path in the userid.PLAN_TABLE. N Indicates that the SQL statement does not have any rows describing its access path in the usid.PLAN_TABLE. blank Indicates that the SQL statement was bound prior to Version 7.	G
QUERYNO	INTEGER NOT NULL WITH DEFAULT –1	The query number of the SQL statement in the source program. SQL statements bound prior to Version 7 have a default value of –1. Statements bound in Version 7 or later use the value specified on the QUERYNO clause on SELECT, UPDATE, INSERT, DELETE, EXPLAIN, and DECLARE CURSOR statements. If the QUERYNO clause is not specified, the query number is set to the statement number.	G

SYSIBM.SYSSTOGROUP table

Contains one row for each storage group.

Column name	Data type	Description	Use
NAME	VARCHAR(128) NOT NULL	Name of the storage group.	G
CREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the storage group.	G
VCATNAME	VARCHAR(24) NOT NULL	Name of the integrated catalog facility catalog.	G
	VARCHAR(24) NOT NULL	Not used	N
SPACE	INTEGER NOT NULL	Number of kilobytes of DASD storage allocated to the storage group as determined by the last execution of the STOSPACE utility.	G
	CHAR(5) NOT NULL	Not used	N
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
CREATEDBY	VARCHAR(128) NOT NULL WITH DEFAULT	Primary authorization ID of the user who created the storage group.	G
STATSTIME	TIMESTAMP NOT NULL WITH DEFAULT	If the STOSPACE utility was executed for the storage group, date and time when STOSPACE was last executed.	G
CREATEDTS	TIMESTAMP NOT NULL WITH DEFAULT	Time when the CREATE statement was executed for the storage group.	G
ALTEREDTS	TIMESTAMP NOT NULL WITH DEFAULT	Time when the most recent ALTER STOGROUP statement was executed for the storage group. If no ALTER STOGROUP statement has been applied, ALTEREDTS has the value of CREATEDTS.	G
SPACEF	FLOAT NOT NULL WITH DEFAULT	Kilobytes of DASD storage for the storage group. The value is -1 if statistics have not been gathered. This is an updatable column.	

SYSIBM.SYSSTRINGS table

Contains information about character conversion. Each row describes a conversion from one coded character set to another.

Also refer to z/OS C/C++ Programming Guide for information on the additional conversions that are supported.

Column name	Data type	Description	Use
INCCSID	INTEGER NOT NULL	The source CCSID for the character conversion represented by this row.	G
OUTCCSID	INTEGER NOT NULL	The target CCSID for the character conversion represented by this row.	G
TRANSTYPE	CHAR(2) NOT NULL	Indicates the nature of the conversion. Values can be: GG GRAPHIC to GRAPHIC MM EBCDIC MIXED to EBCDIC MIXED MS EBCDIC MIXED to SBCS PM ASCII MIXED to EBCDIC MIXED PS ASCII MIXED to SBCS SM SBCS to EBCDIC MIXED SS SBCS to SBCS MP EBCDIC MIXED to ASCII MIXED PP ASCII MIXED to ASCII MIXED SP SBCS to ASCII MIXED	G
ERRORBYTE	CHAR(1) FOR BIT DATA (Nulls are allowed)	The byte used in the conversion table as an error byte. Null indicates the absence of an error byte.	S
SUBBYTE	CHAR(1) FOR BIT DATA (Nulls are allowed)	The byte used in the conversion table as a substitution character. Null indicates the absence of a substitution character.	S
TRANSPROC	VARCHAR(24) NOT NULL WITH DEFAULT	The name of a module or blanks. If IBMREQD is 'N', a nonblank value is the name of a conversion procedure provided by the user. If IBMREQD is 'Y', a nonblank value is the name of a DB2 module that contains DBCS conversion tables. The first five characters of the name of a user-provided conversion procedure must not be 'DSNXV'; these characters are used to distinguish user-provided conversion procedures from DB2 modules that contain DBCS conversion tables.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see "Release dependency indicators" on page 1191.	G
TRANSTAB	VARCHAR(256) FOR BIT DATA NOT NULL WITH DEFAULT	Either a conversion table or an empty string.	S

Each row in the table must have a unique combination of values for its INCCSID, OUTCCSID, and IBMREQD columns. Rows for which the value of IBMREQD is N can be deleted, inserted, and updated subject to this uniqueness constraint and to the constraints imposed by a VALIDPROC defined on the table. An inserted row could have values for the INCCSID and OUTCCSID columns that match those of a row for which the value of IBMREQD is Y. DB2 then uses the information in the inserted row instead of the information in the IBM-supplied row. Rows for which the value of IBMREQD is Y cannot be deleted, inserted, or updated. For information about the use of inserted rows for character conversion, see Appendix C of *DB2 Installation Guide*.

DB2 has two methods for character conversions and applies them in the following order:

1. Conversions specified by the various combinations of the INCCSID and OUTCCSID columns in the SYSIBM.SYSSTRINGS catalog table.
2. Conversions provided by z/OS support for Unicode. For more information, see z/OS Support for Unicode: Using Conversion Services.

If neither of these methods can be used for a particular character conversion, DB2 returns an error.

SYSIBM.SYSSYNONYMS table

Contains one row for each synonym of a table or view.

Column name	Data type	Description	Use
NAME	VARCHAR(128) NOT NULL	Synonym for the table or view.	G
CREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the synonym.	G
TBNAME	VARCHAR(128) NOT NULL	Name of the table or view.	G
TBCREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the table or view.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
CREATEDBY	VARCHAR(128) NOT NULL WITH DEFAULT	Primary authorization ID of the user who created the synonym.	G
CREATEDTS	TIMESTAMP NOT NULL WITH DEFAULT	Time when the CREATE statement was executed for the synonym. The value is '0001-01.01.00.00.00.000000' for synonyms created in a DB2 release prior to Version 5.	G

SYSIBM.SYSTABAUTH table

Records the privileges that users hold on tables and views.

Column name	Data type	Description	Use
GRANTOR	VARCHAR(128) NOT NULL	Authorization ID of the user who granted the privileges. Could also be PUBLIC, or PUBLIC followed by an asterisk.[54]	G
GRANTEE	VARCHAR(128) NOT NULL	Authorization ID of the user who holds the privileges or the name of an application plan or package that uses the privileges. PUBLIC for a grant to PUBLIC. PUBLIC followed by an asterisk for a grant to PUBLIC AT ALL LOCATIONS.	G
GRANTEETYPE	CHAR(1) NOT NULL	Type of grantee: blank An authorization ID P An application plan or a package. The grantee is a package if COLLID is not blank.	G
DBNAME	VARCHAR(24) NOT NULL	If the privileges were received from a user with DBADM, DBCTRL, or DBMAINT authority, DBNAME is the name of the database on which the GRANTOR has that authority. Otherwise, DBNAME is blank.	G
SCREATOR	VARCHAR(128) NOT NULL	If the row of SYSIBM.SYSTABAUTH was created as a result of a CREATE VIEW statement, SCREATOR is the authorization ID of the owner of a table or view referred to in the CREATE VIEW statement. Otherwise, SCREATOR is the same as TCREATOR.	G
STNAME	VARCHAR(128) NOT NULL	If the row of SYSIBM.SYSTABAUTH was created as a result of a CREATE TABLE statement or a materialized query table, STNAME is the name of a table or view referred to in the fullselect of the CREATE TABLE statement.	G
TCREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the table or view.	G
TTNAME	VARCHAR(128) NOT NULL	Name of the table or view.	G
AUTHHOWGOT	CHAR(1) NOT NULL	Authorization level of the user from whom the privileges were received. This authorization level is not necessarily the highest authorization level of the grantor. blank Not applicable C DBCTL D DBADM L SYSCTRL M DBMAINT S SYSADM	G
	CHAR(12) NOT NULL	Internal use only	I
	CHAR(6) NOT NULL	Not used	N
	CHAR(8) NOT NULL	Not used	N
UPDATECOLS	CHAR(1) NOT NULL	The value of this column is blank if the value of UPDATEAUTH applies uniformly to all columns of the table or view. The value is an asterisk (*) if the value of UPDATEAUTH applies to some columns but not to others. In this case, rows will exist in SYSIBM.SYSCOLAUTH with matching timestamps and PRIVILEGE = blank. These rows list the columns on which update privileges have been granted.	G
ALTERAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can alter the table: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G

[54] PUBLIC followed by an asterisk (PUBLIC*) denotes PUBLIC AT ALL LOCATIONS. For the conditions where GRANTOR can be PUBLIC or PUBLIC*, see Part 3 (Volume 1) of *DB2 Administration Guide*.

Column name	Data type	Description	Use
DELETEAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can delete rows from the table or view: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G
INDEXAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can create indexes on the table: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G
INSERTAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can insert rows into the table or view: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G
SELECTAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can select rows from the table or view: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G
UPDATEAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can update rows of the table or view: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see "Release dependency indicators" on page 1191.	G
	VARCHAR(128) NOT NULL WITH DEFAULT	Not used	N
	VARCHAR(128) NOT NULL WITH DEFAULT	Not used	N
COLLID	VARCHAR(128) NOT NULL WITH DEFAULT	If the GRANTEE is a package, its collection name. Otherwise, the value is blank.	G
CONTOKEN	CHAR(8) NOT NULL WITH DEFAULT FOR BIT DATA	If the GRANTEE is a package, the consistency token of the DBRM from which the package was derived. Otherwise, the value is blank.	S
	CHAR(1) NOT NULL WITH DEFAULT	Not used	N
REFERENCESAUTH	CHAR(1) NOT NULL WITH DEFAULT	Whether the GRANTEE can create or drop referential constraints in which the table is a parent. blank Privilege is not held G Privilege held with the GRANT option Y Privilege held without the GRANT option	G
REFCOLS	CHAR(1) NOT NULL WITH DEFAULT	The value of this column is blank if the value of REFERENCESAUTH applies uniformly to all columns of the table. The value is an asterisk(*) if the value of REFERENCESAUTH applies to some columns but not to others. In this case, rows will exist in SYSIBM.SYSCOLAUTH with PRIVILEGE = R and matching timestamps that list the columns on which reference privileges have been granted.	G
GRANTEDTS	TIMESTAMP NOT NULL WITH DEFAULT	Time when the GRANT statement was executed.	G
TRIGGERAUTH	CHAR(1) NOT NULL WITH DEFAULT	Whether the GRANTEE can create triggers in which the table is named as the subject table: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G

SYSIBM.SYSTABCONST table

Contains one row for each unique constraint (primary key or unique key) created in DB2 for OS/390 Version 7 or later.

Column name	Data type	Description	Use
CONSTNAME	VARCHAR(128) NOT NULL	Name of the constraint.	G
TBCREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the table on which the constraint is defined.	G
TBNAME	VARCHAR(128) NOT NULL	Name of the table on which the constraint is defined.	G
CREATOR	VARCHAR(128) NOT NULL	Authorization ID under which the constraint was created.	G
TYPE	CHAR(1) NOT NULL	Type of constraint: **P** Primary key **U** Unique key	G
IXOWNER	VARCHAR(128) NOT NULL	Owner of the index enforcing the constraint or blank if index has not been created yet.	G
IXNAME	VARCHAR(128) NOT NULL	Name of the index enforcing the constraint or blank if index has not been created yet.	G
CREATEDTS	TIMESTAMP NOT NULL	Time when the statement to create the constraint was executed.	G
IBMREQD	CHAR(1) NOT NULL WITH DEFAULT 'N'	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
COLCOUNT	SMALLINT NOT NULL	Number of columns in the constraint.	G

SYSIBM.SYSTABLEPART table

Contains one row for each nonpartitioned table space and one row for each partition of a partitioned table space.

Column name	Data type	Description	Use
PARTITION	SMALLINT NOT NULL	Partition number; 0 if table space is not partitioned.	G
TSNAME	VARCHAR(24) NOT NULL	Name of the table space.	G
DBNAME	VARCHAR(24) NOT NULL	Name of the database that contains the table space.	G
IXNAME	VARCHAR(128) NOT NULL	Name of the partitioning index. This column is blank unless this is a table that uses index-controlled partitioning.	G
IXCREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the partitioning index. This column is blank unless this is a table that uses index-controlled partitioning.	G
PQTY	INTEGER NOT NULL	For user-managed data sets, the value is the primary space allocation in units of 4KB storage blocks or -1. For user-specified values of PRIQTY other than -1, the value is set to the primary space allocation only if RUNSTATS TABLESPACE with UPDATE(ALL) or UPDATE(SPACE) is executed; otherwise, the value is zero. PQTY is based on a value of PRIQTY in the appropriate CREATE or ALTER TABLESPACE statement. Unlike PQTY, however, PRIQTY asks for space in 1KB units. A value of -1 indicates that either of the following cases is true: • PRIQTY was not specified for a CREATE TABLESPACE statement or for any subsequent ALTER TABLESPACE statements. • -1 was the most recently specified value for PRIQTY, either on the CREATE TABLESPACE statement or a subsequent ALTER TABLESPACE statement.	G
SQTY	SMALLINT NOT NULL	For user-managed data sets, the value is the secondary space allocation in units of 4KB storage blocks or -1. For user-specified values of SECQTY other than -1, the value is set to the secondary space allocation only if RUNSTATS TABLESPACE with UPDATE(ALL) or UPDATE(SPACE) is executed; otherwise, the value is zero. SQTY is based on a value of SECQTY in the appropriate CREATE or ALTER TABLESPACE statement. Unlike SQTY, however, SECQTY asks for space in 1KB units. A value of -1 indicates that either of the following cases is true: • SECQTY was not specified for a CREATE TABLESPACE statement or for any subsequent ALTER TABLESPACE statements. • -1 was the most recently specified value for SECQTY, either on the CREATE TABLESPACE statement or a subsequent ALTER TABLESPACE statement. If the value does not fit into the column, the value of the column is 0. See the description of column SECQTYI.	G
STORTYPE	CHAR(1) NOT NULL	Type of storage allocation: E Explicit (storage group not used) I Implicit (storage group used)	G
STORNAME	VARCHAR(128) NOT NULL	Name of storage group used for space allocation. Blank if storage group not used.	G

Column name	Data type	Description	Use
VCATNAME	VARCHAR(24) NOT NULL	Name of integrated catalog facility catalog used for space allocation.	G
CARD	INTEGER NOT NULL	Number of rows in the table space or partition or, if the table space is a LOB table space, the number of LOBs in the table space. The value is 2 147 483 647 if the number of rows is greater than or equal to 2 147 483 647. The value is -1 if statistics have not been gathered.	G
FARINDREF	INTEGER NOT NULL	Number of rows that have been relocated far from their original page. The value is -1 if statistics have not been gathered. Not applicable if the table space is a LOB table space.	S
NEARINDREF	INTEGER NOT NULL	Number of rows that have been relocated near their original page. The value is -1 if statistics have not been gathered. Not applicable if the table space is a LOB table space.	S
PERCACTIVE	SMALLINT NOT NULL	Percentage of space occupied by rows of data from active tables. The value is -1 if statistics have not been gathered. The value is -2 if the table space is a LOB table space.	S
PERCDROP	SMALLINT NOT NULL	Percentage of space occupied by rows of dropped tables. The value is -1 if statistics have not been gathered. The value is 0 for segmented table spaces. Not applicable if the table is an auxiliary table.	S
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
LIMITKEY	VARCHAR(765) NOT NULL	The high value of the partition in external format. If the table space was converted from index-controlled partitioning to table-controlled partitioning, the value is the highest possible value for an ascending key, or the lowest possible value for a descending key. If the table space is not partitioned, the value is 0.	G
FREEPAGE	SMALLINT NOT NULL	Number of pages loaded before a page is left as free space.	G
PCTFREE	SMALLINT NOT NULL	Percentage of each page left as free space.	G
CHECKFLAG	CHAR(1) NOT NULL WITH DEFAULT	C The table space partition is in a check pending status and there are rows in the table that can violate referential constraints, check constraints, or both. blank The table space is not a partition, or does not contain rows that may violate referential constraints, check constraints, or both.	G
	CHAR(4) NOT NULL WITH DEFAULT FOR BIT DATA	Not used	N
SPACE	INTEGER NOT NULL WITH DEFAULT	Number of kilobytes of DASD storage allocated to the table space partition, as determined by the last execution of the STOSPACE utility or RUNSTATS utility. The value is 0 if STOSPACE or RUNSTATS has not been run. The value is updated by STOSPACE if the table space is related to a storage group. The value is updated by RUNSTATS if the utility is executed as RUNSTATS TABLESPACE with UPDATE(ALL) or UPDATE(SPACE). The value is -1 if the table space was defined with the DEFINE NO clause, which defers the physical creation of the data sets until data is first inserted into one of the partitions, and data has yet to be inserted.	G

Column name	Data type	Description	Use
COMPRESS	CHAR(1) NOT NULL WITH DEFAULT	Indicates the following: • For a table space partition, whether the COMPRESS attribute for the partition is YES. • For a nonpartitioned table space, whether the COMPRESS attribute is YES for the table space. Values for the column can be: Y Compression is defined for the table space blank No compression	G
PAGESAVE	SMALLINT NOT NULL WITH DEFAULT	Percentage of pages saved in the table space or partition as a result of defining the table space with COMPRESS YES or other compression routines. For example, a value of 25 indicates a savings of 25 percent, so that the pages required are only 75 percent of what would be required without data compression. The calculation includes overhead bytes for each row, the bytes required for dictionary, and the bytes required for the current FREEPAGE and PCTFREE specification for the table space or partition. This calculation is based on an average row length, and the result varies depending on the actual lengths of the rows. The value is 0 if there are no savings from using data compression, or if statistics have not been gathered. The value can be negative, if for example, data compression causes an increase in the number of pages in the data set.	S
STATSTIME	TIMESTAMP NOT NULL WITH DEFAULT	If RUNSTATS updated the statistics, the date and time when the last invocation of RUNSTATS updated the statistics. The default value is '0001-01-01.00.00.00.000000'.	G
GBPCACHE	CHAR(1) NOT NULL WITH DEFAULT	Group buffer pool cache option specified for this table space or table space partition. A Changed and unchanged pages are cached in the group buffer pool. N No data is cached in the group buffer pool. S Only changed system pages, such as space map pages that do not contain actual data values, are cached in the group buffer pool. blank Only changed pages are cached in the group buffer pool.	G
CHECKRID5B	CHAR(5) NOT NULL WITH DEFAULT FOR BIT DATA	Blank if the table or partition is not in a check pending status (CHECKFLAG is blank), or if the table space is not partitioned. Otherwise, the RID of the first row of the table space partition that can violate referential constraints, check constraints, or both; or the value is X'0000000000', indicating that any row can violate referential constraints.	S
TRACKMOD	CHAR(1) NOT NULL WITH DEFAULT	Whether to track the page modifications in the space map pages: N No blank Yes	G
EPOCH	INTEGER NOT NULL WITH DEFAULT	A number that is incremented whenever an operation that changes the location of rows in a table occurs.	G
SECQTYI	INTEGER NOT NULL WITH DEFAULT	Secondary space allocation in units of 4KB storage. For user-managed data sets, the value is the secondary space allocation in units of 4KB blocks if RUNSTATS TABLESPACE with UPDATE(SPACE) or UPDATE(ALL) is executed; otherwise, the value is zero.	G
CARDF	FLOAT NOT NULL WITH DEFAULT -1	Number of rows in the table space or partition, or if the table space is a LOB table space, the number of LOBs in the table space. The value is -1 if statistics have not been gathered.	G
IPREFIX	CHAR(1) NOT NULL WITH DEFAULT 'I'	The first character of the instance qualifier for the data set name for the table space or partition. 'I' or 'J' are the only valid characters for this field. The default is 'I'.	G

Column name	Data type	Description	Use
ALTEREDTS	TIMESTAMP NOT NULL WITH DEFAULT	Time when the most recent ALTER TABLESPACE statement was executed for the table space or partition. If no ALTER TABLESPACE statement has been applied, the value is '0001-01-01.00.00.00.000000'.	G
SPACEF	FLOAT(8) NOT NULL WITH DEFAULT -1	Kilobytes of DASD storage. The value is -1 if statistics have not been gathered. This is an updatable column.	G
DSNUM	INTEGER NOT NULL WITH DEFAULT -1	Number of data sets. The value is -1 if statistics have not been gathered. This is an updatable column.	G
EXTENTS	INTEGER NOT NULL WITH DEFAULT -1	Number of data set extents. The value is -1 if statistics have not been gathered. This is an updatable column. This value is only for the last DSNUM for the object.	G
LOGICAL_PART	SMALLINT NOT NULL WITH DEFAULT	The logical partition (logical ascending or descending order) for table spaces created wtih either table-controlled partitioning or index-controlled partitioning. The physical partition number is kept in column PART and is zero for partitioned table spaces created prior to Version 8 and for nonpartitioned table spaces.	G
LIMITKEY_INTERNAL	VARCHAR(512) NOT NULL WITH DEFAULT FOR BIT DATA	The highest value of the limit key of the partition in an internal format. If the uses index-controlled partitioning instead of table-controlled partitioning or the table is not partitioned, the value is 0. If the table space was converted from index-controlled partitioning to table-controlled partitioning, the value is the highest possible value for an ascending key, or the lowest possible value for a descending key.. If any column of the key has a field procedure, the internal format is the encoded form of the value.	G
OLDEST_VERSION	SMALLINT NOT NULL WITH DEFAULT	The version number of the oldest format of data in the table part and any image copies at the part level.	G
CREATEDTS	TIMESTAMP NOT NULL WITH DEFAULT	Time when the partition was created.	G
AVGROWLEN	INTEGER NOT NULL WITH DEFAULT -1	Average length of rows for the tables in the table space or part. If the table space or part is compressed, the value is the compressed row length. If the table space or part is not compressed, the value is the uncompressed row length. The value is -1 if statistics have not been gathered.	G

SYSIBM.SYSTABLEPART_HIST table

Contains rows from SYSTABLEPART. Rows are added or changed in this table when RUNSTATS collects history statistics. Rows in this table can also be inserted, updated, and deleted.

Column name	Data type	Description	Use
PARTITION	SMALLINT NOT NULL	Partition number. 0 if table space is not partitioned.	G
TSNAME	VARCHAR(24) NOT NULL	Name of the table space.	G
DBNAME	VARCHAR(24) NOT NULL	Name of the database that contains the table space.	G
PQTY	INTEGER NOT NULL	For user-managed data sets, the value is the primary space allocation in units of 4KB storage blocks or -1. For user-specified values of PRIQTY other than -1, the value is set to the primary space allocation only if RUNSTATS TABLESPACE with UPDATE(ALL) or UPDATE(SPACE) is executed; otherwise, the value is zero. PQTY is based on a value of PRIQTY in the appropriate CREATE or ALTER TABLESPACE statement. Unlike PQTY, however, PRIQTY asks for space in 1KB units. A value of -1 indicates that either of the following cases is true: • PRIQTY was not specified for a CREATE TABLESPACE statement or for any subsequent ALTER TABLESPACE statements. • -1 was the most recently specified value for PRIQTY, either on the CREATE TABLESPACE statement or a subsequent ALTER TABLESPACE statement. If a storage group is not used, the value is 0.	G
SECQTYI	INTEGER NOT NULL	For user-managed data sets, the value is the secondary space allocation in units of 4KB storage blocks or -1. For user-specified values of SECQTY other than -1, the value is set to the secondary space allocation only if RUNSTATS TABLESPACE with UPDATE(ALL) or UPDATE(SPACE) is executed; otherwise, the value is zero. SQTY is based on a value of SECQTY in the appropriate CREATE or ALTER TABLESPACE statement. Unlike SQTY, however, SECQTY asks for space in 1KB units. A value of -1 indicates that either of the following cases is true: • SECQTY was not specified for a CREATE TABLESPACE statement or for any subsequent ALTER TABLESPACE statements. • -1 was the most recently specified value for SECQTY, either on the CREATE TABLESPACE statement or a subsequent ALTER TABLESPACE statement. If a storage group is not used, the value is 0.	G
FARINDREF	INTEGER NOT NULL WITH DEFAULT -1	Number of rows that have been relocated far from their original page. The value is -1 if statistics have not been gathered. Not applicable if the table space is a LOB table space.	S
NEARINDREF	INTEGER NOT NULL WITH DEFAULT -1	Number of rows that have been relocated near their original page. The value is -1 if statistics have not been gathered. Not applicable if the table space is a LOB table space.	S
PERCACTIVE	SMALLINT NOT NULL WITH DEFAULT -1	Percentage of space occupied by rows of data from active tables. The value is -1 if statistics have not been gathered. The value is -2 if the table space is a LOB table space.	S

Column name	Data type	Description	Use
PERCDROP	SMALLINT NOT NULL WITH DEFAULT -1	Percentage of space occupied by rows of dropped tables. The value is -1 if statistics have not been gathered. The value is 0 for segmented table spaces. Not applicable if the table is an auxiliary table.	S
SPACEF	FLOAT(8) NOT NULL WITH DEFAULT -1	Number of kilobytes of DASD storage allocated to the table space partition. The value is -1 if statistics have not been gathered.	G
PAGESAVE	SMALLINT NOT NULL	Percentage of pages saved in the table space or partition as a result of defining the table space with COMPRESS YES or other compression routines. For example, a value of 25 indicates a savings of 25 percent, so that the pages required are only 75 percent of what would be required without data compression. The calculation includes overhead bytes for each row, the bytes required for dictionary, and the bytes required for the current FREEPAGE and PCTFREE specification for the table space or partition. This calculation is based on an average row length, and the result varies depending on the actual lengths of the rows. The value is 0 if there are no savings from using data compression, or if statistics have not been gathered. The value can be negative, if for example, data compression causes an increase in the number of pages in the data set.	S
STATSTIME	TIMESTAMP NOT NULL	If RUNSTATS updated the statistics, the date and time when the last invocation of RUNSTATS updated the statistics. The default value is ’0001-01-01.00.00.00.000000’.	G
CARDF	FLOAT(8) NOT NULL WITH DEFAULT -1	Number of rows in the table space or partition, or if the table space is a LOB table space, the number of LOBS in the table space. The value is -1 if statistics have not been gathered.	S
EXTENTS	INTEGER NOT NULL WITH DEFAULT -1	Number of data set extents. The value is -1 if statistics have not been gathered. This value is only for the last DSNUM for the object.	G
DSNUM	INTEGER NOT NULL WITH DEFAULT -1	Data set number within the table space. For partitioned table spaces, this value corresponds to the partition number for a single partition copy, or 0 for a copy of an entire partitioned table space or index space. The value is -1 if statistics have not been gathered.	G
IBMREQD	CHAR(1) NOT NULL WITH DEFAULT ’N’	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
AVGROWLEN	INTEGER NOT NULL WITH DEFAULT -1	Average length of rows for the tables in the table space or part. If the table space or part is compressed, the value is the compressed row length. If the table space or part is not compressed, the value is the uncompressed row length. The value is -1 if statistics have not been gathered.	G

SYSIBM.SYSTABLES table

Contains one row for each table, view, or alias.

Column name	Data type	Description	Use
NAME	VARCHAR(128) NOT NULL	Name of the table, view, or alias.	G
CREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the table, view, or alias.	G
TYPE	CHAR(1) NOT NULL	Type of object: A Alias G Created global temporary table M Materialized query table T Table V View X Auxiliary table	G
DBNAME	VARCHAR(24) NOT NULL	For a table, or a view of tables, the name of the database that contains the table space named in TSNAME. For a created temporary table, an alias, or a view of a view, the value is DSNDB06.	G
TSNAME	VARCHAR(24) NOT NULL	For a table, or a view of one table, the name of the table space that contains the table. For a view of more than one table, the name of a table space that contains one of the tables. For a created temporary table, the value is SYSPKAGE. Although SYSPKAGE is used as the value, created temporary tables are not stored in the SYSPKAGE table space. For a view of a view, the value is SYSVIEWS. For an alias, it is SYSDBAUT.	G
DBID	SMALLINT NOT NULL	Internal identifier of the database; 0 if the row describes a view, alias, or created temporary table.	S
OBID	SMALLINT NOT NULL	Internal identifier of the table; 0 if the row describes a view, an alias, or a created temporary table.	S
COLCOUNT	SMALLINT NOT NULL	Number of columns in the table or view. The value is 0 if the row describes an alias.	G
EDPROC	VARCHAR(24) NOT NULL	Name of the edit procedure; blank if the row describes a view or alias or a table without an edit procedure.	G
VALPROC	VARCHAR(24) NOT NULL	Name of the validation procedure; blank if the row describes a view or alias or a table without a validation procedure.	G
CLUSTERTYPE	CHAR(1) NOT NULL	Whether RESTRICT ON DROP applies: blank No Y Yes. Neither the table nor any table space or database that contains the table can be dropped.	G
	INTEGER NOT NULL	Not used	N
	INTEGER NOT NULL	Not used	N
NPAGES	INTEGER NOT NULL	Total number of pages on which rows of the table appear. The value is -1 if statistics have not been gathered, or the row describes a view, an alias, a created temporary table, or an auxiliary table. This is an updatable column.	S
PCTPAGES	SMALLINT NOT NULL	Percentage of active table space pages that contain rows of the table. A page is termed active if it is formatted for rows, regardless of whether it contains any. If the table space is segmented, the percentage is based on the number of active pages in the set of segments assigned to the table. The value is -1 if statistics have not been gathered, or the row describes a view, alias, created temporary table, or auxiliary table. This is an updatable column.	S
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G

Column name	Data type	Description	Use
REMARKS	VARCHAR(762) NOT NULL	A character string provided by the user with the COMMENT statement.	G
PARENTS	SMALLINT NOT NULL	Number of relationships in which the table is a dependent. The value is 0 if the row describes a view, an alias, a created temporary table, or a materialized query table.	G
CHILDREN	SMALLINT NOT NULL	Number of relationships in which the table is a parent. The value is 0 if the row describes a view, an alias, a created temporary table, or a materialized query table.	G
KEYCOLUMNS	SMALLINT NOT NULL	Number of columns in the table's primary key. The value is 0 if the row describes a view, an alias, or a created temporary table.	G
RECLENGTH	SMALLINT NOT NULL	For user tables, the maximum length of any record in the table. Length is 8+N+L, where: • The number 8 accounts for the header (6 bytes) and the ID map entry (2 bytes). • N is 10 if the table has an edit procedure, or 0 otherwise. • L is the sum of the maximum column lengths. In determining a column's maximum length, take into account whether the column allows nulls and the data type of the column. If the column can contain nulls and is not a LOB or ROWID column, add 1 byte for a null indicator. Use 4 bytes for the length of a LOB column and 19 bytes for the length of a ROWID column. If the column has a varying-length data type (for example, VARCHAR, CLOB, or BLOB), add 2 bytes for a length indicator. For more information on column lengths, see "Data types" on page 55. The value is 0 if the row describes a view, alias, or auxiliary table. For maximum row and record sizes, see "Maximum record size" on page 767.	G
STATUS	CHAR(1) NOT NULL	Indicates the status of the table definition: I The definition of the table is incomplete. The TABLESTATUS column indicates the reason for the table definition being incomplete. R An error occurred when an attempt was made to regenerate the internal representation of the view. X The table has a primary index and the table definition is complete. blank The table has no primary index, the table is a catalog table, or the row describes a view or alias. The definition of the table, view, or alias is complete.	G
KEYOBID	SMALLINT NOT NULL	Internal DB2 identifier of the index that enforces uniqueness of the table's primary key; 0 if not applicable.	S
LABEL	VARCHAR(90) NOT NULL	The label as given by a LABEL statement; otherwise, the value is an empty string.	G
CHECKFLAG	CHAR(1) NOT NULL WITH DEFAULT	C The table space that contains the table is in a check pending status and there are rows in the table that can violate referential constraints, check constraints, or both. R The table is a materialized query table that may contain inconsistent data. blank The table contains no rows that violate referential constraints, check constraints, or both; or the row describes a view, alias, or created temporary table.	G
	CHAR(4) NOT NULL WITH DEFAULT FOR BIT DATA	Not used	N

Column name	Data type	Description	Use
AUDITING	CHAR(1) NOT NULL WITH DEFAULT	Value of the audit option: A AUDIT ALL C AUDIT CHANGE blank AUDIT NONE, or the row describes a view, an alias, or a created temporary table.	G
CREATEDBY	VARCHAR(128) NOT NULL WITH DEFAULT	Primary authorization ID of the user who created the table, view, or alias.	G
LOCATION	VARCHAR(128) NOT NULL WITH DEFAULT	Location name of the object of an alias. Blank for a table, a view, or for an alias that was not defined with a three-part object name.	G
TBCREATOR	VARCHAR(128) NOT NULL WITH DEFAULT	For an alias, the authorization ID of the owner of the referred to table or view; blank otherwise.	G
TBNAME	VARCHAR(128) NOT NULL WITH DEFAULT	For an alias, the name for the referred to table or view; blank otherwise.	G
CREATEDTS	TIMESTAMP NOT NULL WITH DEFAULT	Time when the CREATE statement was executed for the table, view, or alias	G
ALTEREDTS	TIMESTAMP NOT NULL WITH DEFAULT	For a table, the time when the latest ALTER TABLE statement was applied. If no ALTER TABLE statement has been applied, or if the row is for a view or alias, ALTEREDTS has the value of CREATEDTS.	G
DATACAPTURE	CHAR(1) NOT NULL WITH DEFAULT	Records the value of the DATA CAPTURE option for a table: blank No Y Yes For a created temporary table, DATACAPTURE is always blank.	G
RBA1	CHAR(6) NOT NULL WITH DEFAULT FOR BIT DATA	The log RBA when the table was created. Otherwise, RBA1 is X'000000000000', indicating that the log RBA is not known, or that the object is a view, an alias, or a created temporary table. In a data sharing environment, RBA1 is the LRSN (Log Record Sequence Number) value.	S
RBA2	CHAR(6) NOT NULL WITH DEFAULT FOR BIT DATA	The log RBA when the table was last altered. Otherwise, RBA2 is X'000000000000' indicating that the log RBA is not known, or that the object is a view, an alias, or a created temporary table. RBA1 will equal RBA2 if the table has not been altered. In a data sharing environment, RBA2 is the LRSN (Log Record Sequence Number) value.	S
PCTROWCOMP	SMALLINT NOT NULL WITH DEFAULT	Percentage of rows compressed within the total number of active rows in the table. This includes any row in a table space that is defined with COMPRESS YES. The value is -1 if statistics have not been gathered, or the row describes a view, alias, created temporary table, or auxiliary table. This is an updatable column.	S
STATSTIME	TIMESTAMP NOT NULL WITH DEFAULT	If RUNSTATS updated the statistics, the date and time when the last invocation of RUNSTATS updated the statistics. The default value is '0001-01-01.00.00.00.000000'. For a created temporary table, the value of STATSTIME is always the default value. This is an updatable column.	G
CHECKS	SMALLINT NOT NULL WITH DEFAULT	Number of check constraints defined on the table. The value is 0 if the row describes a view, an alias, a created temporary table, or a materialized query table,or if no constraints are defined on the table.	G
CARDF	FLOAT NOT NULL WITH DEFAULT -1	Total number of rows in the table or total number of LOBs in an auxiliary table. The value is -1 if statistics have not been gathered or the row describes a view, alias, or created temporary table. This is an updatable column.	S

Column name	Data type	Description	Use
CHECKRID5B	CHAR(5) NOT NULL WITH DEFAULT FOR BIT DATA	Blank if the table or partition is not in a check pending status (CHECKFLAG is blank), if the table space is not partitioned, or if the table is a created temporary table. Otherwise, the RID of the first row of the table space partition that can violate referential constraints, check constraints, or both; or the value is X'0000000000', indicating that any row can violate referential constraints.	S
ENCODING_SCHEME	CHAR(1) NOT NULL WITH DEFAULT 'E'	Encoding scheme for tables, views, and local aliases: E EBCDIC A ASCII M Multiple CCSID set or multiple encoding schemes U UNICODE blank For remote aliases The value is 'E' for tables in non work file databases and blank for tables in work file databases created prior to Version 5 or the default database, DSNDB04.	G
TABLESTATUS	VARCHAR(30) NOT NULL WITH DEFAULT	Indicates the reason for an incomplete table definition: L Definition is incomplete because an auxiliary table or auxiliary index has not been defined for a LOB column. P Definition is incomplete because the table lacks a primary index. R Definition is incomplete because the table lacks a required index on a row ID. U Definition is incomplete because the table lacks a required index on a unique key. V An error occurred when an attempt was made to regenerate the internal representation of the view. blank Definition is complete.	G
NPAGESF	FLOAT(8) NOT NULL WITH DEFAULT -1	Number of pages used by the table. The value is -1 if statistics have not been gathered. This is an updatable column.	G
SPACEF	FLOAT(8) NOT NULL WITH DEFAULT -1	Kilobytes of DASD storage. The value is -1 if statistics have not been gathered. This is an updatable column.	G
AVGROWLEN	INTEGER NOT NULL WITH DEFAULT -1	Average length of rows for the tables in the table space. If the table space is compressed, the value is the compressed row length. If the table space is not compressed, the value is the uncompressed row length. The value is -1 if statistics have no t been gathered.	G
RELCREATED	CHAR(1) NOT NULL WITH DEFAULT	Release of DB2 that was used to create the object: blank Created prior to Version 7 K Created on Version 7	G
NUM_DEP_MQTS	SMALLINT NOT NULL WITH DEFAULT	Number of dependent materialized query tables. The value is zero if the row describes an alias or a created temporary table, or if no materialized query tables are defined on the table.	G
VERSION	SMALLINT NOT NULL WITH DEFAULT	The version of the data row format for this table. A value of zero indicates that a version-creating alter operation has never occurred against this table.	G
PARTKEYCOLNUM	SMALLINT NOT NULL WITH DEFAULT	The number of columns in the partitioning key. This value is zero for tables that do not have partitioning or use index-controlled partitioning. The value is non-zero for tables that use table-controlled partitioning.	G
SPLIT_ROWS	CHAR(16) NOT NULL WITH DEFAULT	Value is blank, except for VOLATILE tables, which will have 'Y' in the field to indicate to DB2 to use index access on this table whenever possible.	G
SECURITY_LABEL	CHAR(1) NOT NULL	This column is only meaningful if the TYPE column is a T (for table) or M (for materialized query table). The value indicates whether the table has multilevel security: **Blank** The table does not have multilevel security. **R** The table has multilevel security with row granularity.	

SYSIBM.SYSTABLESPACE table

Contains one row for each table space.

Column name	Data type	Description	Use
NAME	VARCHAR(24) NOT NULL	Name of the table space.	G
CREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the table space.	G
DBNAME	VARCHAR(24) NOT NULL	Name of the database that contains the table space.	G
DBID	SMALLINT NOT NULL	Internal identifier of the database which contains the table space.	S
OBID	SMALLINT NOT NULL	Internal identifier of the table space file descriptor.	S
PSID	SMALLINT NOT NULL	Internal identifier of the table space page set descriptor.	S
BPOOL	CHAR(8) NOT NULL	Name of the buffer pool used for the table space.	G
PARTITIONS	SMALLINT NOT NULL	Number of partitions of the table space; 0 if the table space is not partitioned.	G
LOCKRULE	CHAR(1) NOT NULL	Lock size of the table space: A Any L Large object (LOB) P Page R Row S Table space T Table	G
PGSIZE	SMALLINT NOT NULL	Size of pages in the table space in kilobytes.	G
ERASERULE	CHAR(1) NOT NULL	Whether the data sets are to be erased when dropped. The value is meaningless if the table space is partitioned. N No erase Y Erase	G
STATUS	CHAR(1) NOT NULL	Availability status of the table space: A Available C Definition is incomplete because the table space does not use table-controlled partitioning and a partitioning index has not been created. P Table space is in a check pending status. S Table space is in a check pending status with the scope less than the entire table space. T Definition is incomplete because no table has been created.	G
IMPLICIT	CHAR(1) NOT NULL	Whether the table space was created implicitly: N No Y Yes	G
NTABLES	SMALLINT NOT NULL	Number of tables defined in the table space.	G
NACTIVE	INTEGER NOT NULL	Number of active pages in the table space. A page is termed active if it is formatted for rows, even if it currently contains none. The value is 0 if statistics have not been gathered. This is an updatable column.	S
	VARCHAR(24) NOT NULL	Not used	N
CLOSERULE	CHAR(1) NOT NULL	Whether the data sets are candidates for closure when the limit on the number of open data sets is reached. N No Y Yes	G

Column name	Data type	Description	Use
SPACE	INTEGER NOT NULL	Number of kilobytes of DASD storage allocated to the table space, as determined by the last execution of the STOSPACE utility. The value is 0 if the table space is not related to a storage group, or if STOSPACE has not been run. If the table space is partitioned, the value is the total kilobytes of DASD storage allocated to all partitions that are storage group defined.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
	VARCHAR(54) NOT NULL	Internal use only	I
	VARCHAR(24) NOT NULL	Internal use only	I
SEGSIZE	SMALLINT NOT NULL WITH DEFAULT	Number of pages in each segment of a segmented table space. The value is 0 if the table space is not segmented.	G
CREATEDBY	VARCHAR(128) NOT NULL WITH DEFAULT	Primary authorization ID of the user who created the table space.	G
STATSTIME	TIMESTAMP NOT NULL WITH DEFAULT	If RUNSTATS updated the statistics, the date and time when the last invocation of RUNSTATS updated the statistics. The default value is '0001-01-01.00.00.00.000000'. This is an updatable column.	G
LOCKMAX	INTEGER	The maximum number of locks per user to acquire for the table or table space before escalating to the next locking level. 0 Lock escalation does not occur. n n, where n > 0, is the maximum number of locks (row, page, or LOB locks for the table or table space) an application process can acquire before lock escalation occurs. -1 Represents LOCKMAX SYSTEM. The value of field LOCKS PER TABLE(SPACE) on installation panel DSNTIPJ determines lock escalation. If the value of the field is 0, lock escalation does not occur. If the value is n, where n > 0, lock escalation occurs as it does for LOCKMAX n.	G
TYPE	CHAR(1) NOT NULL WITH DEFAULT	The type of table space: blank The table space was created without any of the following options: DSSIZE, LARGE, LOB, and MEMBER CLUSTER. I The table space was defined with the MEMBER CLUSTER option and is not greater than 64 gigabytes. K The table space was defined with the MEMBER CLUSTER option and can be greater than 64 gigabytes. L The table space can be greater than 64 gigabytes. O The table space was defined with the LOB option (the table space is a LOB table space).	G
CREATEDTS	TIMESTAMP NOT NULL WITH DEFAULT	Time when the CREATE statement was executed for the table space. If the table space was created in a DB2 release prior to Version 5, the value is '0001-01-01.00.00.00.000000'.	G
ALTEREDTS	TIMESTAMP NOT NULL WITH DEFAULT	Time when the most recent ALTER TABLESPACE statement was executed for the table space. If no ALTER TABLESPACE statement has been applied, ALTEREDTS has the value of CREATEDTS. If the index was created in a DB2 release prior to Version 5, the value is '0001-01-01.00.00.00.000000'.	G

Column name	Data type	Description	Use
ENCODING_SCHEME	CHAR(1) NOT NULL WITH DEFAULT 'E'	Default encoding scheme for the table space: E EBCDIC A ASCII U UNICODE blank For tables spaces in a work file database or a TEMP database (a database that was created AS TEMP, which is for declared temporary tables.) The value is 'E' for tables in non work file databases and blank for tables in work file databases created prior to Version 5 or the default database, DSNDB04.	G
SBCS_CCSID	INTEGER NOT NULL WITH DEFAULT	Default SBCS CCSID for the table space. For a table space in a work file database, a TEMP database, or a database created in a DB2 release prior to Version 5, the value is 0.	G
DBCS_CCSID	INTEGER NOT NULL WITH DEFAULT	Default DBCS CCSID for the table space. For a table space in a work file database, a TEMP database, or a database created in a DB2 release prior to Version 5, the value is 0.	G
MIXED_CCSID	INTEGER NOT NULL WITH DEFAULT	Default mixed CCSID for the table space. For a table space in a work file database, a TEMP database, or a database created in a DB2 release prior to Version 5, the value is 0.	G
MAXROWS	SMALLINT NOT NULL DEFAULT 255	The maximum number of rows that DB2 will place on a data page. The default value is 255. For a LOB table space, the value is 0 to indicate that the column is not applicable.	G
	CHAR(1) NOT NULL WITH DEFAULT	Not used	N
LOG	CHAR(1) NOT NULL WITH DEFAULT 'Y'	Whether the changes to a table space are to be logged. N No, only applies to LOB table spaces Y Yes	G
NACTIVEF	FLOAT NOT NULL WITH DEFAULT -1	Number of active pages in the table space. A page is termed active if it is formatted for rows, even if it currently contains none. The value is -1 if statistics have not been gathered. This is an updatable column.	S
DSSIZE	INTEGER NOT NULL WITH DEFAULT	Maximum size of a data set in kilobytes.	G
OLDEST_VERSION	SMALLINT NOT NULL WITH DEFAULT	The version number of the oldest format of data in the table space and any image copies.	G
CURRENT_VERSION	SMALLINT NOT NULL WITH DEFAULT	The version number describing the newest format of data in the table space. A zero indicates that the table space has never had versioning. After the version number reaches the maximum value, the number wraps back to one.	G
AVGROWLEN	INTEGER NOT NULL WITH DEFAULT -1	Average length of rows for the tables in the table space or part. If the table space or part is compressed, the value is the compressed row length. If the table space or part is not compressed, the value is the uncompressed row length. The value is -1 if statistics have not been gathered.	G
SPACEF	FLOAT NOT NULL WITH DEFAULT	Kilobytes of DASD storage for the storage group. The value is -1 if statistics have not been gathered. This is an updatable column.	

SYSIBM.SYSTABLES_HIST table

Contains rows from SYSTABLES. Rows are added or changed in this table when RUNSTATS collects history statistics. Rows in this table can also be inserted, updated, and deleted.

Column name	Data type	Description	Use
NAME	VARCHAR(128) NOT NULL	Name of the table, view, or alias.	G
CREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the table, view, or alias.	G
DBNAME	VARCHAR(24) NOT NULL	For a table, or a view of tables, the name of the database that contains the table space named in TSNAME. For a temporary table, an alias, or a view of a view, the value is DSNDB06.	G
TSNAME	VARCHAR(24) NOT NULL	For a table, or a view of one table, the name of the table space that contains the table. For a view of more than one table, the name of a table space that contains one of the tables. For a temporary table, the value is SYSPKAGE. For a view of a view, the value is SYSVIEWS. For an alias, it is SYSDBAUT.	G
COLCOUNT	SMALLINT NOT NULL	Number of columns in the table or view. The value is 0 if the row describes an alias.	G
PCTPAGES	SMALLINT NOT NULL WITH DEFAULT -1	Percentage of active table space pages that contain rows of the table. A page is termed active if it is formatted for rows, regardless of whether it contains any. If the table space is segmented, the percentage is based on the number of active pages in the set of segments assigned to the table. The value is -1 if statistics have not been gathered, or the row describes a view, alias, temporary table, or auxiliary table.	S
PCTROWCOMP	SMALLINT NOT NULL WITH DEFAULT -1	Percentage of rows compressed within the total number of active rows in the table. This includes any row in a table space that is defined with COMPRESS YES. The value is -1 if statistics have not been gathered, or the row describes a view, alias, temporary table, or auxiliary table.	G
STATSTIME	TIMESTAMP NOT NULL	If RUNSTATS updated the statistics, the date and time when the last invocation of RUNSTATS updated the statistics. The default value is ’0001-01-01.00.00.00.000000’. For a temporary table, the value of STATSTIME is always the default value.	G
CARDF	FLOAT(8) NOT NULL WITH DEFAULT -1	Total number of rows in the table or total number of LOBs in an auxiliary table. The value is -1 if statistics have not been gathered or the row describes a view, alias, or temporary table.	S
NPAGESF	FLOAT(8) NOT NULL WITH DEFAULT -1	Total number of pages on which rows of the partition appear. The value is -1 if statistics have not been gathered.	S
AVGROWLEN	INTEGER NOT NULL WITH DEFAULT -1	Average row length of the table specified in the table space. The value is -1 if statistics have not been gathered.	G
SPACEF	FLOAT(8) NOT NULL WITH DEFAULT -1	Kilobytes of DASD storage. The value is -1 if statistics have not been gathered. This is an updatable column.	G
IBMREQD	CHAR(1) NOT NULL WITH DEFAULT ’N’	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G

SYSIBM.SYSTABSTATS table

Contains one row for each partition of a partitioned table space. Rows in this table can be inserted, updated, and deleted.

Column name	Data type	Description	Use
CARD	INTEGER NOT NULL	Total number of rows in the partition.	S
NPAGES	INTEGER NOT NULL	Total number of pages on which rows of the partition appear.	S
PCTPAGES	SMALLINT NOT NULL	Percentage of total active pages in the partition that contain rows of the table.	S
NACTIVE	INTEGER NOT NULL	Number of active pages in the partition.	S
PCTROWCOMP	SMALLINT NOT NULL	Percentage of rows compressed within the total number of active rows in the partition. This includes any row in a table space that is defined with COMPRESS YES.	S
STATSTIME	TIMESTAMP NOT NULL	If RUNSTATS updated the statistics, the date and time when the last invocation of RUNSTATS updated the statistics.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
DBNAME	VARCHAR(24) NOT NULL	Database that contains the table space named in TSNAME.	G
TSNAME	VARCHAR(24) NOT NULL	Table space that contains the table.	G
PARTITION	SMALLINT NOT NULL	Partition number of the table space that contains the table.	G
OWNER	VARCHAR(128) NOT NULL	Authorization ID of the owner of the table.	G
NAME	VARCHAR(128) NOT NULL	Name of the table.	G
CARDF	FLOAT NOT NULL WITH DEFAULT -1	Total number of rows in the partition.	S

SYSIBM.SYSTABSTATS_HIST table

Contains rows from SYSTABSTATS. Rows are added or changed in this table when RUNSTATS collects history statistics. Rows in this table can also be inserted, updated, and deleted.

Column name	Data type	Description	Use
NPAGES	INTEGER NOT NULL	Total number of pages on which rows of the partition appear.	S
STATSTIME	TIMESTAMP NOT NULL	If RUNSTATS updated the statistics, the date and time when the last invocation of RUNSTATS updated the statistics.	G
DBNAME	VARCHAR(24) NOT NULL	Database that contains the table space named in TSNAME.	G
TSNAME	VARCHAR(24) NOT NULL	Table space that contains the table.	G
PARTITION	SMALLINT NOT NULL	Partition number of the table space that contains the table.	G
OWNER	VARCHAR(128) NOT NULL	Authorization ID of the owner of the table.	G
NAME	VARCHAR(128) NOT NULL	Name of the table.	G
CARDF	FLOAT(8) NOT NULL WITH DEFAULT -1	Total number of rows in the partition. The value is -1 if statistics have not been gathered.	S
IBMREQD	CHAR(1) NOT NULL WITH DEFAULT 'N'	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G

SYSIBM.SYSTRIGGERS table

Contains one row for each trigger.

Column name	Data type	Description	Use
NAME	VARCHAR(128) NOT NULL	Name of the trigger and trigger package.	G
SCHEMA	VARCHAR(128) NOT NULL	Schema of the trigger. This implicit or explicit qualifier for the trigger name is also used for the collection ID of the trigger package.	G
SEQNO	SMALLINT NOT NULL	Sequence number of this row; the first portion of the trigger definition is in row 1, and successive rows have increasing SEQNO values.	G
DBID	SMALLINT NOT NULL	Internal identifier of the database for the trigger.	G
OBID	SMALLINT NOT NULL	Internal identifier of the trigger.	G
OWNER	VARCHAR(128) NOT NULL	Authorization ID of the owner of the trigger. The value is set to the current authorization ID (the plan or packge owner for static CREATE TRIGGER statement; the current SQLID for a dynamic CREATE TRIGGER statement).	G
CREATEDBY	VARCHAR(128) NOT NULL	Authorization ID of the owner of the trigger. The value is set to the current authorization ID (the plan or packge owner for static CREATE TRIGGER statement; the current SQLID for a dynamic CREATE TRIGGER statement).	G
TBNAME	VARCHAR(128) NOT NULL	Name of the table to which this trigger applies.	G
TBOWNER	VARCHAR(128) NOT NULL	Qualifier of the name of the table to which this trigger applies.	G
TRIGTIME	CHAR(1) NOT NULL	Time when triggered actions are applied to the base table, relative to the event that activated the trigger: B Trigger is applied before the event. A Trigger is applied after the event.	G
TRIGEVENT	CHAR(1) NOT NULL	Operation that activates the trigger: I Insert D Delete U Update	G
GRANULARITY	CHAR(1) NOT NULL	Trigger is executed once per: S Statement R Row	G
CREATEDTS	TIMESTAMP NOT NULL	Time when the CREATE statement was executed for this trigger. The time value is used in resolving functions, distinct types, and stored procedures. It is also used to order the execution of multiple triggers.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
TEXT	VARCHAR(6000) NOT NULL	Full text of the CREATE TRIGGER statement.	G
REMARKS	VARCHAR(762) NOT NULL	A character string provided by the user with the COMMENT statement.	G
TRIGNAME	VARCHAR(128) NOT NULL	Unused	G

SYSIBM.SYSUSERAUTH table

Records the system privileges that are held by users.

Column name	Data type	Description	Use
GRANTOR	VARCHAR(128) NOT NULL	Authorization ID of the user who granted the privileges.	G
GRANTEE	VARCHAR(128) NOT NULL	Authorization ID of the user that holds the privilege. Could also be PUBLIC for a grant to PUBLIC.	G
	CHAR(12) NOT NULL	Internal use only	I
	CHAR(6) NOT NULL	Not used	N
	CHAR(8) NOT NULL	Not used	N
	CHAR(1) NOT NULL	Not used	N
AUTHHOWGOT	CHAR(1) NOT NULL	Authorization level of the user from whom the privileges were received. This authorization level is not necessarily the highest authorization level of the grantor. blank Not applicable C DBCTL D DBADM L SYSCTRL M DBMAINT S SYSADM	G
	CHAR(1) NOT NULL	Not used	N
BINDADDAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can use the BIND subcommand with the ADD option: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G
BSDSAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can issue the RECOVER BSDS command: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G
CREATEDBAAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can create databases and automatically receive DBADM authority over the new databases: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G
CREATEDBCAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can execute the CREATE DATABASE statement to create new databases and automatically receive DBCTRL authority over the new databases: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G
CREATESGAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can execute the CREATE STOGROUP statement to create new storage groups: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G
DISPLAYAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can use the DISPLAY commands: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G

Column name	Data type	Description	Use
RECOVERAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can use the RECOVER INDOUBT command: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G
STOPALLAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can use the STOP command: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G
STOSPACEAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can use the STOSPACE utility: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G
SYSADMAUTH	CHAR(1) NOT NULL	Whether the GRANTEE has system administration authority: blank Privilege is not held G Privilege was granted with the GRANT option Y Privilege was granted without the GRANT option GRANTEE has the privilege with the GRANT option for a value of either Y or G.	G
SYSOPRAUTH	CHAR(1) NOT NULL	Whether the GRANTEE has system operator authority: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G
TRACEAUTH	CHAR(1) NOT NULL	Whether the GRANTEE can issue the START TRACE and STOP TRACE commands: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
MON1AUTH	CHAR(1) NOT NULL WITH DEFAULT	Whether the GRANTEE can obtain IFC serviceability data: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G
MON2AUTH	CHAR(1) NOT NULL WITH DEFAULT	Whether the GRANTEE can obtain IFC data: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G
CREATEALIASAUTH	CHAR(1) NOT NULL WITH DEFAULT	Whether the GRANTEE can execute the CREATE ALIAS statement: blank Privilege is not held G Privilege held with the GRANT option Y Privilege held without the GRANT option	G
SYSCTRLAUTH	CHAR(1) NOT NULL WITH DEFAULT	Whether the GRANTEE has SYSCTRL authority: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option GRANTEE has the privilege with the GRANT option for a value of either Y or G.	G
BINDAGENTAUTH	CHAR(1) NOT NULL WITH DEFAULT	Whether the GRANTEE has BINDAGENT privilege: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option See “GRANT (system privileges)” on page 961 for a description of the BINDAGENT privilege.	G

Column name	Data type	Description	Use
ARCHIVEAUTH	CHAR(1) NOT NULL WITH DEFAULT	Whether the GRANTEE is privileged to use the ARCHIVE LOG command: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G
	CHAR(1) NOT NULL WITH DEFAULT	Not used	N
	CHAR(1) NOT NULL WITH DEFAULT	Not used	N
GRANTEDTS	TIMESTAMP NOT NULL WITH DEFAULT	Time when the GRANT statement was executed. The value is '1985-04-01.00.00.00.000000' for the one installation row.	G
CREATETMTABAUTH	CHAR(1) NOT NULL WITH DEFAULT	Whether the GRANTEE has CREATETMTABAUTH privilege: blank Privilege is not held G Privilege is held with the GRANT option Y Privilege is held without the GRANT option	G

SYSIBM.SYSVIEWDEP table

Records the dependencies of views on tables, functions, and other views.

Column name	Data type	Description	Use
BNAME	VARCHAR(128) NOT NULL	Name of the object on which the view is dependent. If the object type is a function (BTYPE='F'), the name is the specific name of the function.	G
BCREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of BNAME. For functions, it is the schema name of the BNAME.	G
BTYPE	CHAR(1) NOT NULL	Type of object: F Function M Materialized query table T Table V View	G
DNAME	VARCHAR(128) NOT NULL	Name of the view.	G
DCREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the view.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G
BSCHEMA	VARCHAR(128) NOT NULL WITH DEFAULT	Schema of BNAME.	G
DTYPE	CHAR(1) NOT NULL	Type of table: F SQL function M Materialized query table V View	G

SYSIBM.SYSVIEWS table

Contains one or more rows for each view, materialized query table, or user-defined SQL function.

Column name	Data type	Description	Use
NAME	VARCHAR(128) NOT NULL	Name of the object.	G
CREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the object.	G
SEQNO	SMALLINT NOT NULL	Sequence number of this row; the first portion of the view is on row one and successive rows have increasing values of SEQNO.	G
CHECK	CHAR(1) NOT NULL	Whether the WITH CHECK OPTION clause was specified in the CREATE VIEW statement: N No C Yes with the *cascaded* semantic Y Yes with the *local* semantic The value is N if the view has no WHERE clause, or the object is not a view.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see "Release dependency indicators" on page 1191.	G
TEXT	VARCHAR(1500) NOT NULL	Text or portion of the text of the statement that was used to create the object.	G
PATHSCHEMAS	VARCHAR(2048) NOT NULL WITH DEFAULT	SQL path at the time the object was defined. The path is used to resolve unqualified data type and function names used in the object definition.	G
RELCREATED	CHAR(1) NOT NULL WITH DEFAULT	Release of DB2 that was used to create the object: blank Created prior to Version 7. K Created on Version 7	G
TYPE	CHAR(1) NOT NULL	Type of table: F SQL function M Materialized query table V View	G
REFRESH	CHAR(1) NOT NULL WITH DEFAULT	Refresh mode: D A materialized query table with a deferred refresh mode blank Not a materialized query table	G
ENABLE	CHAR(1) NOT NULL WITH DEFAULT	Indicates whether query optimization is enabled: Y Enabled N Disabled blank Not a materialized query table	G
MAINTENANCE	CHAR(1) NOT NULL WITH DEFAULT	Maintenance mode: S For a REFRESH = D, a materialized query table that is maintained by the system. U For a REFRESH = D, a materialized query table that is maintained by the user. blank Not a materialized query table.	G
REFRESH_TIME	TIMESTAMP NOT NULL WITH DEFAULT	For REFRESH = D and Maintenacne = S, the timestampl of the REFRESH TABLE statement that last refreshed the data. Otherwise, this is the default timestamp ('0001-01-01.00.00.00.000000').	G
ISOLATION	CHAR(1) NOT NULL WITH DEFAULT	Isolation level when the materialized query table is created or altered from a base table: R RR (repeatable read) S CS (cursor stability) T RS (read stability) U UR (uncommitted read) blank Not a materialized query table	G

Column name	Data type	Description	Use
SIGNATURE	VARCHAR(1024) NOT NULL WITH DEFAULT FOR BIT DATA	Contains an internal description. Used for materialized query tables.	G
APP_ENCODING_CCSID	INTEGER NOT NULL WITH DEFAULT	CCSID of the current application encoding scheme at the time the object was created. For objects created prior to Version 8 of DB2, the value is 0.	G

SYSIBM.SYSVOLUMES table

Contains one row for each volume of each storage group.

Column name	Data type	Description	Use
SGNAME	VARCHAR(128) NOT NULL	Name of the storage group.	G
SGCREATOR	VARCHAR(128) NOT NULL	Authorization ID of the owner of the storage group.	G
VOLID	VARCHAR(18) NOT NULL	Serial number of the volume or * if SMS-managed.	G
IBMREQD	CHAR(1) NOT NULL	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G

SYSIBM.USERNAMES table

Each row in the table is used to carry out one of the following operations:

- Outbound ID translation
- Inbound ID translation and “come from” checking

Rows in this table can be inserted, updated, and deleted.

Column name	Data type	Description	Use
TYPE	CHAR(1) NOT NULL	How the row is to be used: O For outbound translation. I For inbound translation and “come from” checking.	G
AUTHID	VARCHAR(128) NOT NULL WITH DEFAULT	Authorization ID to be translated. Applies to any authorization ID if blank.	G
LINKNAME	VARCHAR(24) NOT NULL	Identifies the VTAM or TCP/IP network locations associated with this row. A blank value in this column indicates this name translation rule applies to any TCP/IP or SNA partner. If a nonblank LINKNAME is specified, one or both of the following statements must be true: • A row exists in SYSIBM.LUNAMES whose LUNAME matches the value specified in the SYSIBM.USERNAMES LINKNAME column. This row specifies the VTAM site associated with this name translation rule. • A row exists in SYSIBM.IPNAMES whose LINKNAME matches the value specified in the SYSIBM.USERNAMES LINKNAME column. This row specifies the TCP/IP host associated with this name translation rule. Inbound name translation and “come from” checking are not performed for TCP/IP clients.	G
NEWAUTHID	VARCHAR(128) NOT NULL WITH DEFAULT	Translated value of AUTHID. Blank specifies no translation.	G
PASSWORD	VARCHAR(24) NOT NULL WITH DEFAULT	Password to accompany an outbound request, if passwords are not encrypted. If passwords are encrypted, or the row is for inbound requests, the column is not used.	G
IBMREQD	CHAR(1) NOT NULL WITH DEFAULT 'N'	A value of Y indicates that the row came from the basic machine-readable material (MRM) tape. For all other values, see “Release dependency indicators” on page 1191.	G

Appendix G. Using the catalog in database design

The information in this chapter is General-use Programming Interface and Associated Guidance Information, as defined in “Notices” on page 1369.

Retrieving information from the catalog, using SQL statements, can be helpful in designing your relational database. Appendix D of *DB2 SQL Reference* lists all the DB2 catalog tables and the information stored in them.

The information in the catalog is vital to normal DB2 operation. As the examples in this chapter show, you can *retrieve* catalog information, but *changing* it can have serious consequences. Therefore you cannot execute INSERT or DELETE statements that affect the catalog, and only a limited number of columns exist that you can update. Exceptions to these restrictions are the SYSIBM.SYSSTRINGS, SYSIBM.SYSCOLDIST, and SYSIBM.SYSCOLDISTSTATS catalog tables, into which you can insert rows and proceed to update and delete rows.

To execute the following examples, you need at least the SELECT privilege on the appropriate catalog tables. Be careful when querying the DB2 catalog because some catalog queries can result in long table space scans.

Retrieving catalog information about DB2 storage groups

SYSIBM.SYSSTOGROUP and SYSIBM.SYSVOLUMES contain information about DB2 storage groups and the volumes in those storage groups. The following query shows what volumes are in a DB2 storage group, how much space is used, and when that space was last calculated.

```
SELECT SGNAME,VOLID,SPACE,SPCDATE
  FROM SYSIBM.SYSVOLUMES,SYSIBM.SYSSTOGROUP
  WHERE SGNAME=NAME
  ORDER BY SGNAME;
```

Retrieving catalog information about a table

SYSIBM.SYSTABLES contains a row for every table, view, and alias in your DB2 system. Each row tells you whether the object is a table, a view, or an alias, its name, who created it, what database it belongs to, what table space it belongs to, and other information. SYSTABLES also has a REMARKS column in which you can store your own information about the table in question. See “Adding and retrieving comments” on page 1349 for more information about how to do this.

The following statement displays all the information for the project activity sample table:

```
SELECT *
  FROM SYSIBM.SYSTABLES
  WHERE NAME = 'PROJACT'
  AND CREATOR = 'DSN8810';
```

Retrieving catalog information about partition order

The LOGICAL_PART column in SYSIBM.SYSTABLEPART contains information for key order or logical partition order.

The following statement displays information on partition order in ascending limit value order:

```
SELECT LIMITKEY, PARTITION
  FROM SYSIBM.SYSTABLEPART
  ORDER BY LOGICAL_PART;
```

Retrieving catalog information about aliases

SYSIBM.SYSTABLES describes the aliases you create. It has three columns used only for aliases:

- LOCATION contains your subsystem's location name for the remote system, if the object on which the alias is defined resides at a remote subsystem.
- TBCREATOR contains the owner of the table or view.
- TBNAME contains the name of the table or the view.

These sample user-defined functions make it easy to find information about aliases. See *DB2 SQL Reference* for more information.

- TABLE_NAME returns the name of a table, view, or undefined object found after resolving aliases for a user-specified object.
- TABLE_SCHEMA returns the schema name of a table, view, or undefined object found after resolving aliases for a user-specified object.
- TABLE_LOCATION returns the location name of a table, view, or undefined object found after resolving aliases for a user-specified object.

The NAME and CREATOR columns of SYSTABLES contain the name and owner of the alias, and three other columns contain the following information for aliases:

- TYPE is A.
- DBNAME is DSNDB06.
- TSNAME is SYSDBAUT.

If similar tables at different locations have names with the same second and third parts, you can retrieve the aliases for them with a query like this one:

```
SELECT LOCATION, CREATOR, NAME
  FROM SYSIBM.SYSTABLES
    WHERE TBCREATOR='DSN8810' AND TBNAME='EMP'
      AND TYPE='A';
```

Retrieving catalog information about columns

SYSIBM.SYSCOLUMNS has one row for each column of every table and view. Query it, for example, if you cannot remember the column names of a table or view.

The following statement retrieves information about columns in the sample department table:

```
SELECT NAME, TBNAME, COLTYPE, LENGTH, NULLS, DEFAULT
  FROM SYSIBM.SYSCOLUMNS
  WHERE TBNAME='DEPT'
  AND TBCREATOR = 'DSN8810';
```

The result is shown below; for each column, the following information about each column is given:

- The column name
- The name of the table that contains it
- Its data type
- Its length attribute
- Whether it allows nulls
- Whether it allows default values

```
NAME      TBNAME  COLTYPE         LENGTH  NULLS  DEFAULT
DEPTNO    DEPT    CHAR                 3    N       N
DEPTNAME  DEPT    VARCHAR             36    N       N
MGRNO     DEPT    CHAR                 6    Y       N
ADMRDEPT  DEPT    CHAR                 3    N       N
```

For LOB columns, the LENGTH column shows the length of the pointer to the LOB. For an example of a query showing the actual LOB length, see “Retrieving catalog information about LOBs” on page 1347.

Retrieving catalog information about indexes

SYSIBM.SYSINDEXES contains a row for every index, including indexes on catalog tables. The following example retrieves a row about an index named XEMPL2.

```
SELECT *
  FROM SYSIBM.SYSINDEXES
  WHERE NAME = 'XEMPL2'
  AND CREATOR = 'DSN8810';
```

A table can have more than one index. To display information about all the indexes of a table, enter a statement like this one:

```
SELECT *
  FROM SYSIBM.SYSINDEXES
  WHERE TBNAME = 'EMP'
  AND TBCREATOR = 'DSN8810';
```

Retrieving catalog information about views

For every view you create, DB2 stores descriptive information in several catalog tables. The following actions occur in the catalog after the execution of CREATE VIEW:

- A row is inserted into SYSIBM.SYSTABLES.
- A row is inserted into SYSIBM.SYSTABAUTH to record the owner’s privileges on the view.
- For each column of the view, a row is inserted into SYSIBM.SYSCOLUMNS.
- One or more rows are inserted into the SYSIBM.SYSVIEWS table to record the text of the CREATE VIEW statement.
- For each table or view on which the view is dependent, a row is inserted into SYSIBM.SYSVIEWDEP to record the dependency.
- A row is inserted into SYSIBM.SYSVTREE, and possibly into SYSIBM.SYSVLTREE, to record the parse tree of the view (an internal representation of its logic).

Users might want a view of one or more of those tables, containing information about their own tables and views.

Retrieving catalog information about authorizations

SYSIBM.SYSTABAUTH contains information about the privileges held by authorization IDs over tables and views. Query it to learn who can access your data. The following query retrieves the names of all users who have been granted access to the DSN8810.DEPT table.

```
SELECT GRANTEE
  FROM SYSIBM.SYSTABAUTH
  WHERE TTNAME = 'DEPT'
    AND GRANTEETYPE <> 'P'
    AND TCREATOR = 'DSN8810';
```

GRANTEE is the name of the column that contains authorization IDs for users of tables. TTNAME and TCREATOR specify the DSN8810.DEPT table. The clause GRANTEETYPE <> ’P’ ensures that you retrieve the names only of users (not application plans or packages) that have authority to access the table.

Retrieving catalog information about parent keys

SYSIBM.SYSCOLUMNS identifies columns of a parent key in column KEYSEQ; a nonzero value indicates the place of a column in the parent key. To retrieve the creator, database, and names of the columns in the parent key of the sample project activity table using SQL statements, execute:

```
SELECT TBCREATOR, TBNAME, NAME, KEYSEQ
  FROM SYSIBM.SYSCOLUMNS
  WHERE TBCREATOR = 'DSN8810'
  AND TBNAME = 'PROJACT'
  AND KEYSEQ > 0
    ORDER BY KEYSEQ;
```

SYSIBM.SYSINDEXES identifies the primary index of a table by the value P in column UNIQUERULE. To find the name, creator, database, and index space of the primary index on the project activity table, execute:

```
SELECT TBCREATOR, TBNAME, NAME, CREATOR, DBNAME, INDEXSPACE
  FROM SYSIBM.SYSINDEXES
  WHERE TBCREATOR = 'DSN8810'
  AND TBNAME = 'PROJACT'
  AND UNIQUERULE = 'P';
```

Note: It is not always possible to retrieve information about unique keys created before Version 7. Information can be retrieved for unique keys created in Version 7 and for unique keys created before Version 7 if they are not involved in referential integrity.

Retrieving catalog information about foreign keys

SYSIBM.SYSRELS contains information about referential constraints, and each constraint is uniquely identified by the creator and name of the dependent table and the constraint name (RELNAME). SYSIBM.SYSFOREIGNKEYS contains information about the columns of the foreign key that defines the constraint. To retrieve the constraint name, column names, and parent table names for every relationship in which the project table is a dependent, execute:

```
SELECT A.CREATOR, A.TBNAME, A.RELNAME, B.COLNAME, B.COLSEQ,
     A.REFTBCREATOR, A.REFTBNAME
  FROM SYSIBM.SYSRELS A, SYSIBM.SYSFOREIGNKEYS B
  WHERE A.CREATOR = 'DSN8810'
  AND B.CREATOR = 'DSN8810'
  AND A.TBNAME = 'PROJ'
  AND B.TBNAME = 'PROJ'
  AND A.RELNAME = B.RELNAME
    ORDER BY A.RELNAME, B.COLSEQ;
```

You can use the same tables to find information about the foreign keys of tables to which the project table is a parent, as follows:

```
SELECT A.RELNAME, A.CREATOR, A.TBNAME, B.COLNAME, B.COLNO
  FROM SYSIBM.SYSRELS A, SYSIBM.SYSFOREIGNKEYS B
  WHERE A.REFTBCREATOR = 'DSN8810'
  AND A.REFTBNAME = 'PROJ'
  AND A.RELNAME = B.RELNAME
    ORDER BY A.RELNAME, B.COLNO;
```

Retrieving catalog information about check pending

SYSIBM.SYSTABLESPACE indicates that a table space is in check-pending status by a value in column STATUS: P if the entire table space has that status, S if the status has a scope of less than the entire space. To list all table spaces whose use is restricted for *any* reason, issue this command:

```
-DISPLAY DATABASE (*) SPACENAM(*) RESTRICT
```

To retrieve the names of table spaces in check-pending status only, with the names of the tables they contain, execute:

```
SELECT A.DBNAME, A.NAME, B.CREATOR, B.NAME
  FROM SYSIBM.SYSTABLESPACE A, SYSIBM.SYSTABLES B
  WHERE A.DBNAME = B.DBNAME
  AND A.NAME = B.TSNAME
  AND (A.STATUS = 'P' OR A.STATUS = 'S')
    ORDER BY 1, 2, 3, 4;
```

Retrieving catalog information about check constraints

Information about check constraints is stored in the DB2 catalog in:

- SYSIBM.SYSCHECKS, which contains one row for each check constraint defined on a table
- SYSIBM.SYSCHECKDEP, which contains one row for each reference to a column in a check constraint

The following query shows all check constraints on all tables named SIMPDEPT and SIMPEMPL in order by column name within table owner. It shows the name, authorization ID of the creator, and text for each constraint. A constraint that uses more than one column name appears more than once in the result.

```
CREATE TABLE SIMPDEPT
  (DEPTNO   CHAR(3) NOT NULL,
   DEPTNAME VARCHAR(12) CONSTRAINT CC1 CHECK (DEPTNAME IS NOT NULL),
   MGRNO    CHAR(6),
   MGRNAME  CHAR(6));
```

```
SELECT A.TBOWNER, A.TBNAME, B.COLNAME,
A.CHECKNAME, A.CREATOR, A.CHECKCONDITION
FROM SYSIBM.SYSCHECKS A, SYSIBM.SYSCHECKDEP B
WHERE A.TBOWNER = B.TBOWNER
  AND A.TBNAME = B.TBNAME
  AND B.TBNAME = 'SIMPDEPT'
  AND A.CHECKNAME = B.CHECKNAME
  ORDER BY TBOWNER, TBNAME, COLNAME;
```

Retrieving catalog information about LOBs

SYSIBM.SYSAUXRELS contains information about the relationship between a base table and an auxiliary table. For example, this query returns information about the name of the LOB columns for the employee table and its associated auxiliary table owner and name:

```
SELECT COLNAME, PARTITION, AUXTBOWNER, AUXTBNAME
   FROM SYSIBM.SYSAUXRELS
   WHERE TBNAME = 'EMP' AND TBOWNER = 'DSN8810';
```

Information about the length of a LOB is in the LENGTH2 column of SYSCOLUMNS. You can query information about the length of the column as it is returned to an application with the following query:

```
SELECT NAME, TBNAME, COLTYPE, LENGTH2, NULLS, DEFAULT
  FROM SYSIBM.SYSCOLUMNS
  WHERE TBNAME='DEPT'
  AND TBCREATOR = 'DSN8810';
```

Retrieving catalog information about user-defined functions and stored procedures

SYSIBM.SYSROUTINES describes user-defined functions and stored procedures. You can use this example to find packages with stored procedure that were created prior to Version 6 and then migrated to SYSIBM.SYSROUTINES:

```
SELECT SCHEMA, NAME FROM SYSIBM.SYSROUTINES
   WHERE ROUTINETYPE = 'P';
```

You can use this query to retrieve information about user-defined functions:

```
SELECT SCHEME, NAME, FUNCTION_TYPE, PARM_COUNT FROM SYSIBM.SYSROUTINES
   WHERE ROUTINETYPE='F';
```

Stored procedures created before Version 6 have different authorization requirements than those created in Version 6. See *DB2 Application Programming and SQL Guide* for more information.

Retrieving catalog information about triggers

SYSIBM.SYSTRIGGERS contains information about the triggers defined in your databases. To find all the triggers defined on a particular table, their characteristics, and to determine the order they are fired in, issue this query:

```
SELECT DISTINCT SCHEMA, NAME, TRIGTIME, TRIGEVENT, GRANULARITY, CREADEDTS
   FROM SYSIBM.SYSTRIGGERS
   WHERE TBNAME = 'EMP' AND TBOWNER = 'DSN8810';
```

Issue this query to retrieve the text of a particular trigger:

```
SELECT TEXT, SEQNO
   FROM SYSIBM.SYSTRIGGERS
   WHERE SCHEMA = schema_name
      AND NAME = trigger_name
   ORDER BY SEQNO;
```

Or to determine triggers that must be rebound because they are invalidated after objects are dropped or altered, issue this query:

```
SELECT COLLID, NAME
   FROM SYSIBM.SYSPACKAGE
   WHERE TYPE = 'T'
      AND (VALID = 'N' OR OPERATIVE = 'N');
```

Retrieving catalog information about sequences

SYSIBM.SYSSEQUENCES and SYSIBM.SYSSEQUENCEAUTH contains information about sequences. To retrieve the attributes of a sequence, issue this query:

```
SELECT *
  FROM SYSIBM.SYSSEQUENCES
  WHERE NAME = 'MYSEQ' AND SCHEMA = 'USER1B';
```

Issue this query to determine the privileges that user USER1B has on sequences:

```
SELECT GRANTOR, NAME, DATEGRANTED, ALTERAUTH, USEAUTH
  FROM SYSIBM.SEQUENCEAUTH
  WHERE GRANTEE = 'USER1B';
```

Adding and retrieving comments

After you create a table, view, index, or alias, you can provide explanatory information about it for future reference—information such as the purpose of the table, who uses it, and anything unusual about it. You can store a comment about the table or the view as a whole, and you can also include a comment for *each column*. You can also create comments on packages, plans, distinct types, triggers, stored procedures, and user-defined functions. A comment must not exceed 762 bytes.

A comment is especially useful if your names do not clearly indicate the contents of columns or tables. In that case, use a comment to describe the specific contents of the column or table.

Below are two examples of COMMENT:

```
COMMENT ON TABLE DSN8810.EMP IS
  'Employee table. Each row in this table represents one
   employee of the company.';
```

```
COMMENT ON COLUMN DSN8810.PROJ.PRSTDATE IS
  'Estimated project start date. The format is DATE.';
```

After you execute a COMMENT statement, your comments are stored in the REMARKS column of SYSIBM.SYSTABLES or SYSIBM.SYSCOLUMNS. (Any comment that is already present in the row is replaced by the new one.) The next two examples retrieve the comments that are added by the previous COMMENT statements.

```
SELECT REMARKS
  FROM SYSIBM.SYSTABLES
  WHERE NAME = 'EMP'
  AND CREATOR = 'DSN8810';
```

```
SELECT REMARKS
  FROM SYSIBM.SYSCOLUMNS
  WHERE NAME = 'PRSTDATE' AND TBNAME = 'PROJ'
  AND TBCREATOR = 'DSN8810';
```

Verifying the accuracy of the database definition

You can use the catalog to verify the accuracy of your database definition. After you have created the objects in your database, display selected information from the catalog to check that no errors are in your CREATE statements. By examining the catalog tables, you can verify that your tables are in the correct table space, your table spaces are in the correct storage group, and so on.

Appendix H. Sample user-defined functions

This appendix describes the sample user-defined functions that are provided with DB2. You can use the functions in the following ways:

- In your applications just as you would use other user-defined functions. Use the functions only if installation job DSNTEJ2U, which prepares the functions for use, has been run. Because the external programs that implement the logic of the sample functions are written in C and C++, the installation job requires that your site has IBM C/C++ for OS/390. For information on installation job DSNTEJ2U, see *DB2 Installation Guide*.
- As examples to help you define and implement your own user-defined functions. Data set *prefix*.SDSNSAMP contains the code for the sample functions.

Table 111 lists the sample user-defined functions. The detailed descriptions of the functions that follow the table include their external program names and specific names. The functions are in schema DSN8. The functions are defined to treat all string parameters, both input and output, as EBCDIC-encoded data.

Table 111. DB2 sample user-defined functions

Function Name	Description	Page
ALTDATE	Returns the current date or a user-specified date in a user-specified format	1352
ALTTIME	Returns the current time or a user-specified time in a user-specified format	1355
CURRENCY	Returns a floating-point number as a currency value	1357
DAYNAME	Returns the name of the day of the week on which a date in ISO format falls	1359
MONTHNAME	Returns the name of the month in which a date in ISO format falls	1360
TABLE_LOCATION	Returns the location name of a table or view after resolving any aliases	1361
TABLE_NAME	Returns the unqualified name of a table or view after resolving any aliases	1363
TABLE_SCHEMA	Returns the schema name of a table or view after resolving any aliases	1365
WEATHER	Shows how to use a user-defined table function to make non-relational data available for SQL manipulation	1367

ALTDATE

```
►►──ALTDATE(──┬───────────────────────────┬─output-format─)──────────────────────────────►◄
              └─input-date, input-format,─┘
```

The schema is DSN8.

The ALTDATE function returns the current date in one of the following formats or converts a user-specified date from one format to another:

```
D MONTH YY    D MONTH YYYY    DD MONTH YY    DD MONTH YYYY
D.M.YY        D.M.YYYY        DD.MM.YY       DD.MM.YYYY
D-M-YY        D-M-YYYY        DD-MM-YY       DD-MM-YYYY
D/M/YY        D/M/YYYY        DD/MM/YY       DD/MM/YYYY
M/D/YY        M/D/YYYY        MM/DD/YY       MM/DD/YYYY
YY/M/D        YYYY/M/D        YY/MM/DD       YYYY/MM/DD
YY.M.D        YYYY.M.D        YY.MM.DD       YYYY.MM.DD
              YYYY-M-D                       YYYY-MM-DD
              YYYY-D-XX                      YYYY-DD-XX
              YYYY-XX-D                      YYYY-XX-DD

where:

D:     Suppress leading zero if the day is less than 10
DD:    Retain leading zero if the day is less than 10
M:     Suppress leading zero if the month is less than 10
MM:    Retain leading zero if the month is less than 10
MONTH: Use English-language name of month
XX:    Use a capital Roman numeral for month
YY:    Use a year format without century
YYYY:  Use a year format with century
```

The ALTDATE function demonstrates how you can create an overloaded function—a function name for which there are multiple function instances. Each instance supports a different parameter list enabling you to group related but distinct functions in a single user-defined function. The ALTDATE function has two forms.

Form 1: ALTDATE(*output-format*)

This form of the function converts the current date into the specified format.

output-format

A character string that matches one of the 34 date formats that are shown above. The character string must have a data type of VARCHAR and an actual length that is not greater than 13 bytes.

The result of the function has a VARCHAR data type and an actual length that is not greater than 17 bytes.

Form 2: ALTDATE(*input-date, input-format, output-format*)

This form of the function converts a date (*input-date*) in one user-specified format (*input-format*) into another format (*output-format*).

input-date

The argument must be a date or a character string representation of a date in the format specified by *input-format*. The character string must have a data type of VARCHAR and an actual length that is not greater than 17 bytes.

input-format
A character string that matches one of the 34 date formats that are shown above. The character string must have a data type of VARCHAR and an actual length that is not greater than 13 bytes.

output-format
A character string that matches one of the 34 date formats that are shown above. The character string must have a data type of VARCHAR and an actual length that is not greater than 13 bytes.

The result of the function has a VARCHAR data type and an actual length that is not greater than 17 bytes.

Table 112 shows the external and specific names for the two forms of the function, which are based on the input to the function.

Table 112. External program and specific names for ALTDATE

Conversion type	Input arguments	External name	Specific name
Current date	*Output-format* (VARCHAR)	DSN8DUAD	DSN8.DSN8DUADV
User-specified date	*Input-date* (VARCHAR) *Input-format* (VARCHAR) *Output-format* (VARCHAR)	DSN8DUCD	DSN8.DSN8DUCDVVV
	Input-date (DATE) *Input-format* (VARCHAR) *Output-format* (VARCHAR)	DSN8DUCD	DSN8.DSN8DUCDDVV

Example 1: Convert the current date into format ’DD MONTH YY’, a format that will include any leading zero for the month, the name of the month in English, and the year without the two digits for the century.

```
VALUES DSN8.ALTDATE( 'DD MONTH YY' );
```

Example 2: Convert the current date into format ’D.M.YYYY’, a format that will suppress any leading zero for the day or month and include the year with the century.

```
VALUES DSN8.ALTDATE( 'D.M.YYYY' );
```

Example 3: Convert the current date into format ’YYYY-XX-DD’, a format that will include the century, the month of the year as a roman numeral, and the day of the month with any leading zero.

```
VALUES DSN8.ALTDATE( 'YYYY-XX-DD' );
```

Example 4: Convert a date in the format of ’DD MONTH YYYY’ to a date in the format of ’YYYY/MM/DD’.

```
 VALUES DSN8.ALTDATE( '11 November 1918',
                      'DD MONTH YYYY',
                      'YYYY/MM/DD' );
```

The result of the above example is `1918/11/18`.

Example 5: Convert the date that employee 000130 was hired, a date in ISO format, into the format of ’D.M.YY’.

```
SELECT  FIRSTNME || ' '
     || LASTNAME || ' was hired on '
     || DSN8.ALTDATE( HIREDATE,
                        'YYYY-MM-DD',
                        'D.M.YY' )
   FROM  EMP
  WHERE  EMPNO  = '000130';
```

Assuming that the HIREDATE is 1971-07-28, the above example returns: `DELORES QUINTANA was hired on 28.7.71`.

ALTTIME

```
►►──ALTTIME(──┬──────────────────────────┬──output-format──)──────────────────────────────►◄
              └──input-time, input-format,──┘
```

The schema is DSN8.

The ALTTIME function returns the current time in one of the following formats or converts a user-specified time from one of the formats to another:

```
H:MM AM/PM          HH:MM AM/PM
HH:MM:SS AM/PM      HH:MM:SS
H.MM                HH.MM
H.MM.SS             HH.MM.SS

where:

H:      Suppress leading zero if the hour is less than 10
HH:     Retain leading zero if the hour is less than 10
M:      Suppress leading zero if the minute is less than 10
MM:     Retain leading zero if the minute is less than 10
AM/PM:  Return time in 12-hour clock format, else 24-hour
```

The ALTTIME function demonstrates how you can create an overloaded function—a function name for which there are multiple function instances. Each instance supports a different parameter list enabling you to group related but distinct functions in a single user-defined function. The ALTIME function has two forms.

Form 1: ALTTIME(*output-format*)

This form of the function converts the current time into the specified format.

output-format

A character string that matches one of the 8 time formats that are shown above. The character string must have a data type of VARCHAR and an actual length that is not greater than 14 bytes.

The result of the function has a VARCHAR data type and an actual length that is not greater than 11 bytes.

Form 2: ALTTIME(*input-time, input-format, output-format*)

This form of the function converts a time (*input-date*) in one user-specified format (*input-format*) into another format (*output-format*).

input-time

The argument must be a time or a character string representation of a time in the format specified by *input-format*. A character string argument must have a data type of VARCHAR and an actual length that is not greater than 11 bytes.

input-format

A character string that matches one of the 8 time formats that are shown above. The character string must have a data type of VARCHAR and an actual length that is not greater than 14 bytes.

output-format

A character string that matches one of the 8 time formats that are shown above. The character string must have a data type of VARCHAR and an actual length that is not greater than 14 bytes.

The result of the function has a VARCHAR data type and an actual length that is not greater than 11 bytes.

Table 113 shows the external program and specific names for the two forms of the function, which are based on the input to the function.

Table 113. External and specific names for ALTTIME

Conversion type	Input arguments	External name	Specific name
Current time	*Output-format* (VARCHAR)	DSN8DUAT	DSN8.DSN8DUATV
User-specified time	*Input-time* (VARCHAR) *Input-format* (VARCHAR) *Output-format* (VARCHAR)	DSN8DUCT	DSN8.DSN8DUCTVVV
	Input-date (TIME) *Input-format* (VARCHAR) *Output-format* (VARCHAR)	DSN8DUCT	DSN8.DSN8DUCTTVV

Example 1: Convert the current time into a 12-hour clock format without seconds, ’H.MM AM/PM’.

```
VALUES DSN8.ALTTIME( 'H:MM AM/PM' );
```

Example 2: Convert the current time into a 24-hour clock format without seconds, ’HH.MM’.

```
VALUES DSN8.ALTTIME( 'HH.MM' );
```

Example 3: Convert the current time into a 24-hour clock format with seconds, ’HH.MM.SS’.

```
VALUES DSN8.ALTTIME( 'HH.MM.SS' );
```

Example 4: Convert ’00:00:00’, a time in 24-hour clock format with seconds, to a time in 12-hour clock format without seconds.

```
VALUES DSN8.ALTTIME( '00:00:00','HH:MM:SS','HH:MM AM/PM' );
```

The function returns `12:00 AM`.

Example 5: Convert ’00:00:00’, a time in 24-hour clock format with seconds, to a time in 12-hour clock format without seconds and without any leading zero on the hour.

```
VALUES DSN8.ALTTIME( '06.42.37','HH.MM.SS','H:MM AM/PM' );
```

The function returns `6:42 AM`.

CURRENCY

```
►►──CURRENCY(──input-amount, currency-symbol──┬──────────────────────────┬──)────────────────────►◄
                                              └─, credit/debit-indicator─┘
```

The schema is DSN8.

The CURRENCY function returns a value that is formatted as an amount with a user-specified currency symbol and, if specified, one of three symbols that indicate debit or credit.

input-amount
An expression that specifies the value to be formatted. The expression must be a floating-point value.

currency-symbol
A character string that specifies the currency symbol. The string must have a data type of VARCHAR and an actual length that is not greater than 2 bytes.

credit/debit-indicator
A character string that specifies the symbol that is included with the result to indicate whether the value is negative or positive. The string must have a data type of VARCHAR and an actual length that is not greater than 5 bytes. If *credit/debit-indicator* is not specified or is the value null, the result is formatted without an indicator symbol. You can specify the following symbols:

CR/DB
Bank style. Negative input values are appended with "DB"; positive input values are appended with "CR".

+/-
Arithmetic style. Negative input values are prefixed with a minus sign "-"; positive values are formatted without symbols.

(/)
Accounting style. Negative input values are enclosed in parentheses "( )"; positive values are formatted without symbols.

The result of the function is a character string with a data type of VARCHAR and an actual length that is not greater than 19 bytes.

The CURRENCY function uses the C language functions *strfmon* to facilitate formatting of money amounts and *setlocale* to initialize strfmon for local conventions. If setlocale fails, the CURRENCY function returns an error.

Table 114 shows the external program and specific names for CURRENCY. The specific names differ depending on the input to the function.

Table 114. External program and specific names for CURRENCY

Input arguments	External name	Specific name
input-amount *currency-symbol*	DSN8DUCY	DSN8.DSN8DUCYFV
input-amount *currency-symbol* *credit/debit-indicator*	DSN8DUCY	DSN8.DSN8DUCYFVV

Example 1: Express -1234.56 as an amount in US dollars, using the bank style debit/credit indicator to indicate whether the value is negative or positive.

```
VALUES DSN8.CURRENCY( -1234.56,'$','CR/DB' );
```

The result of the function is `$1,234.56 DB`.

Example 2: Express -1234.56 as an amount in Deutsche marks, using the accounting style debit/credit indicator to indicate whether the value is negative or positive.

```
VALUES DSN8.CURRENCY( -1234.56,'DM','(/)' );
```

The result of the function is `(DM 1,234.56)`.

Example 3: Express -1234.56 as an amount in Canadian dollars, using the accounting style debit/credit indicator to indicate whether the value is negative or positive.

```
VALUES DSN8.CURRENCY( -1234.56,'CD','+/-' );
```

The result of the function is `-CD 1,234.56`.

DAYNAME

```
▶▶──DAYNAME(input-date)──────────────────────────────────────────────────────────▶◀
```

The schema is DSN8.

The DAYNAME function returns the name of the weekday on which a given date falls. The name is returned in English.

input-date
: A valid date or valid character string representation of a date. A character string representation The string must have a data type of VARCHAR and an actual length that is not greater than 10 bytes. The date must be in ISO format.

The result of the function is a character string with a data type of VARCHAR and an actual length that is not greater than 9 bytes.

The DAYNAME function uses the IBM C++ class *IDate*.

Table 115 shows the external and specific names for DAYNAME. The specific names differ depending on the data type of the input argument.

Table 115. External and specific names for DAYNAME

Input arguments	External name	Specific name
input-date (VARCHAR)	DSN8EUDN	DSN8.DSN8EUDNV
input-date (DATE)	DSN8EUDN	DSN8.DSN8EUDND

Example 1: For the current date, find the day of the week.

```
VALUES DSN8.DAYNAME( CURRENT DATE );
```

Example 2: Find the day of the week on which leap year falls in the year 2000.

```
VALUES DSN8.DAYNAME( '2000-02-29' );
```

The result of the function is `Tuesday`.

Example 3: Find the day of the week on which Delores Quintana, employee number 000130, was hired.

```
SELECT  FIRSTNME || ' '
    ||  LASTNAME || ' was hired on '
    ||  DSN8.DAYNAME( HIREDATE ) || ', '
    ||  CHAR( HIREDATE )
  FROM  EMP
 WHERE  EMPNO  = '000130';
```

The result of the function is `DELORES QUINTANA was hired on Wednesday, 1971-07-28`.

MONTHNAME

```
►►──MONTHNAME(input-date)─────────────────────────────────────────────────────────────►◄
```

The schema is DSN8.

The MONTHNAME function returns the calendar name of the month in which a given date falls. The name is returned in English.

input-date
A valid date or valid character string representation of a date. A character string representation must have a data type of VARCHAR and an actual length that is no greater than 10 bytes. The date must be in ISO format.

The result of the function is a character string with a data type of VARCHAR and an actual length that is not greater than 9 bytes.

The MONTHNAME function uses the IBM C++ class *IDate*.

Table 116 shows the external and specific names for MONTHNAME. The specific names differ depending on the data type of the input argument.

Table 116. External and specific names for MONTHNAME

Input arguments	External name	Specific name
input-date (VARCHAR)	DSN8EUMN	DSN8.DSN8EUMNV
input-date (DATE)	DSN8EUMN	DSN8.DSN8EUMND

Example 1: For the current date, find the name of the month.

```
VALUES DSN8.MONTHNAME( CURRENT DATE );
```

Example 2: Find the month of the year in which Delores Quintana, employee number 000130, was hired.

```
SELECT  FIRSTNME || ' '
     || LASTNAME || ' was hired in the month of '
     || DSN8.MONTHNAME( HIREDATE )
     || CHAR( HIREDATE )
  FROM  EMP
 WHERE  EMPNO  = '000130';
```

The result of the function is `DELORES QUINTANA was hired in the month of July`.

TABLE_LOCATION

```
►►──TABLE_LOCATION(─object-name──┬─────────────────────────────────────────┬─)──────────────────►◄
                                 └─, object-schema──┬─────────────────────┬─┘
                                                    └─, location-name─────┘
```

The schema is DSN8.

The TABLE_LOCATION function searches for an object and returns the location name of the object after any alias chains have been resolved. The starting point of the resolution is the object that is specified by *object-name* and, if specified, *object-schema* and *location-name*. If the starting point does not refer to an alias, the location name of the starting point is returned. The resulting name can be of a table, view, or undefined object. The function returns a blank if there is no location name.

object-name
: A character expression that specifies the unqualified name to be resolved. The unqualified name is usually of an existing alias. *object-name* must have a data type of VARCHAR and an actual length that is no greater than 18 bytes.

object-schema
: A character expression that represents the schema that is used to qualify the value specified in *object-name* before resolution. *object-schema* must have a data type of VARCHAR and an actual length that is no greater than 8 bytes.

If *object-schema* is not specified or is null, the default schema is used for the qualifier.

location-name
: A character expression that represents the location that is used to qualify the value specified in *object-name* before resolution. *location-name* must have a data type of VARCHAR and an actual length that is no greater than 16 bytes.

If *location-name* is not specified or is null, the location name is equivalent to "any".

The result of the function has a data type of VARCHAR and an actual length that is no greater than 16 bytes. If *object-name* can be null, the result can be null; if *object-name* is null, the result is the null value.

Table 117 shows the external and specific names for TABLE_LOCATION. The specific names differ depending on the number of input arguments to the function.

Table 117. External and specific names for TABLE_LOCATION

Input arguments	External name	Specific name
object-name (VARCHAR)	DSN8DUTI	DSN8.DSN8DUTILV
object-name (VARCHAR) *object-schema* (VARCHAR)	DSN8DUTI	DSN8.DSN8DUTILVV
object-name (VARCHAR) *object-schema* (VARCHAR) *location name* (VARCHAR)	DSN8DUTI	DSN8.DSN8DUTILVVV

Example: Assume that:

- DSN8.ALIAS_RS_SYSTABLES is an alias of SYSIBM.SYSTABLES at location name REMOTE_SITE.
- The current SQLID is DSN8.

Use TABLE_LOCATION to find the location name where the base object for ALIAS_OF_SYSTABLES resides.

```
VALUES DSN8.TABLE_LOCATION( 'ALIAS_RS_SYSTABLES' );
```

The result of the function is `REMOTE_SITE`.

TABLE_NAME

```
►►──TABLE_NAME(─object-name──┬───────────────────────────────────────┬─)──────────────────────────►◄
                             └─, object-schema──┬───────────────────┬┘
                                                └─, location-name───┘
```

The schema is DSN8.

The TABLE_NAME function searches for an object and returns the unqualified name of the object after any alias chains have been resolved. The starting point of the resolution is the object that is specified by *object-name* and, if specified, *object-schema* and *location name*. If the starting point does not refer to an alias, the unqualified name of the starting point is returned. The resulting name can be of a table, view, or undefined object.

object-name
: A character expression that specifies the unqualified name to be resolved. The unqualified name is usually of an existing alias. *object-name* must have a data type of VARCHAR and an actual length that is no greater than 18 bytes.

object-schema
: A character expression that represents the schema that is used to qualify the value specified in *object-name* before resolution. *object-schema* must have a data type of VARCHAR and an actual length that is no greater than 8 bytes.

If *object-schema* is not specified or is null, the default schema is used for the qualifier.

location-name
: A character expression that represents the location that is used to qualify the value specified in *object-name* before resolution. *location-name* must have a data type of VARCHAR and an actual length than is no greater than 16 bytes.

If *location-name* is not specified or is null, the location name is equivalent to “any”.

The result of the function has a data type of VARCHAR and an actual length that is no greater than 18 bytes. If *object-name* can be null, the result can be null; if *object-name* is null, the result is the null value.

Table 118 shows the external and specific names for TABLE_NAME. The specific names differ depending on the number of input arguments to the function.

Table 118. External and specific names for TABLE_NAME

Input arguments	External name	Specific name
object-name (VARCHAR)	DSN8DUTI	DSN8.DSN8DUTINV
object-name (VARCHAR) *object-schema* (VARCHAR)	DSN8DUTI	DSN8.DSN8DUTINVV
object-name (VARCHAR) *object-schema* (VARCHAR) *location name* (VARCHAR)	DSN8DUTI	DSN8.DSN8DUTINVVV

Example: Assume that:

- DSN8.VIEW_OF_SYSTABLES is a view of SYSIBM.SYSTABLES.
- DSN8.ALIAS_OF_VIEW is an alias of DSN8.VIEW_OF_SYSTABLES.
- The current SQLID is DSN8.

Use TABLE_NAME to find the name of the base object for ALIAS_OF_VIEW.

```
VALUES DSN8.TABLE_NAME( 'ALIAS_OF_SYSVIEW' );
```

The result of the function is `VIEW_OF_SYSTABLES`.

TABLE_SCHEMA

```
►►──TABLE_SCHEMA(─object-name──┬──────────────────────────────────────┬─)──────────────────►◄
                               └─, object-schema──┬──────────────────┬┘
                                                  └─, location-name──┘
```

The schema is DSN8.

The TABLE_SCHEMA function searches for an object and returns the schema name of the object after any synonyms or alias chains have been resolved. The starting point of the resolution is the object that is specified by *objectname* and *objectschema*. If the starting point does not refer to an alias or synonym, the schema name of the starting point is returned. The resulting schema name can be of a table, view, or undefined object.

object-name
: A character expression that specifies the unqualified name to be resolved. The unqualified name is usually of an existing alias. *object-name* must have a data type of VARCHAR and an actual length that is no greater than 18 bytes.

object-schema
: A character expression that represents the schema that is used to qualify the value specified in *object-name* before resolution. *object-schema* must have a data type of VARCHAR and an actual length that is no greater than 8 bytes.

  If *object-schema* is not specified or is null, the default schema is used for the qualifier.

location-name
: A character expression that represents the location that is used to qualify the value specified in *object-name* before resolution. *location-name* must have a data type of VARCHAR (and an actual length that is no greater than 16 bytes.

  If *location-name* is not specified or is null, the location name is equivalent to "any".

The result of the function has a data type of VARCHAR and an actual length that is no greater than 8 bytes. If *object-name* can be null, the result can be null; if *object-name* is null, the result is the null value.

Table 119 shows the external and specific names for TABLE_SCHEMA. The specific names differ depending on the number of input arguments.

Table 119. External and specific names for function TABLE_SCHEMA

Input arguments	External name	Specific name
object-name (VARCHAR)	DSN8DUTI	DSN8.DSN8DUTISV
object-name (VARCHAR) *object-schema* (VARCHAR)	DSN8DUTI	DSN8.DSN8DUTISVV
object-name (VARCHAR) *object-schema* (VARCHAR) *location-name* (VARCHAR)	DSN8DUTI	DSN8.DSN8DUTISVVV

Example: Assume that:

- DSN8.ALIAS_OF_SYSTABLES is an alias of SYSIBM.SYSTABLES.
- The current SQLID is DSN8.

Find the name of the schema of the base table for ALIAS_OF_SYSTABLES.

```
VALUES DSN8.TABLE_SCHEMA( 'ALIAS_OF_SYSTABLES' );
```

The result of the function is SYSIBM.

WEATHER

```
►►──WEATHER(input-data-set-name)──RETURNS TABLE(──┬─name-of-city────────────────┬─)──────────────────►◄
                                                  ├─temperature-in-fahrenheit───┤
                                                  ├─percent-humidity────────────┤
                                                  ├─wind-direction──────────────┤
                                                  ├─wind-velocity───────────────┤
                                                  ├─barometer───────────────────┤
                                                  └─forecast────────────────────┘
```

The schema is DSN8.

Unlike the other sample user-defined functions, which are scalar functions, WEATHER is a table function. WEATHER shows how to use a table function to make non-relational data available to a client for manipulation by SQL. The WEATHER function is provided primarily to help you design and implement table functions.

The WEATHER function returns information from a TSO data set as a DB2 table. The TSO data set contains sample weather statistics for various cities in the United States. The statistics are returned to the client with a row for each city and a column for each statistic.

input-data-set-name
The name of the TSO data set that contains sample weather statistics. The name is a character string with a data type of VARCHAR and an actual length that is not greater than 44 bytes.

The result of the function is a DB2 table with the following columns. Each column can be null.

name-of-city	VARCHAR(30)
temperature-in-Fahrenheit	INTEGER
percent-humidity	INTEGER
wind-direction	VARCHAR(5)
wind-velocity	INTEGER
barometer	FLOAT
forecast	VARCHAR(25)

The external program name for the function is DSN8DUWF, and the specific name is DSN8.DSN8DUWF.

Example: Find the name of and the forecast for the cities that have a temperature less than 25 degrees.

```
SELECT CITY, FORECAST
  FROM TABLE(DSN8.WEATHER('prefix.SDSNIVPD(DSN8LWC)')) AS W
  WHERE TEMP_IN_F < 25
  ORDER BY CITY;
```

This example returns:

```
Bessemer, MI     Slight chance of snow
Cheyenne, WY     Continued cooling
Helena, MT       Heavy snow
Pierre, SD       Continued cold
```

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Glossary

The following terms and abbreviations are defined as they are used in the DB2 library.

A

abend. Abnormal end of task.

abend reason code. A 4-byte hexadecimal code that uniquely identifies a problem with DB2. A complete list of DB2 abend reason codes and their explanations is contained in *DB2 Messages and Codes*.

abnormal end of task (abend). Termination of a task, job, or subsystem because of an error condition that recovery facilities cannot resolve during execution.

access method services. The facility that is used to define and reproduce VSAM key-sequenced data sets.

access path. The path that is used to locate data that is specified in SQL statements. An access path can be indexed or sequential.

active log. The portion of the DB2 log to which log records are written as they are generated. The active log always contains the most recent log records, whereas the archive log holds those records that are older and no longer fit on the active log.

active member state. A state of a member of a data sharing group. The cross-system coupling facility identifies each active member with a group and associates the member with a particular task, address space, and z/OS system. A member that is not active has either a failed member state or a quiesced member state.

address space. A range of virtual storage pages that is identified by a number (ASID) and a collection of segment and page tables that map the virtual pages to real pages of the computer's memory.

address space connection. The result of connecting an allied address space to DB2. Each address space that contains a task that is connected to DB2 has exactly one address space connection, even though more than one task control block (TCB) can be present. See also *allied address space* and *task control block*.

address space identifier (ASID). A unique system-assigned identifier for and address space.

administrative authority. A set of related privileges that DB2 defines. When you grant one of the administrative authorities to a person's ID, the person has all of the privileges that are associated with that administrative authority.

after trigger. A trigger that is defined with the trigger activation time AFTER.

agent. As used in DB2, the structure that associates all processes that are involved in a DB2 unit of work. An *allied agent* is generally synonymous with an *allied thread*. *System agents* are units of work that process tasks that are independent of the allied agent, such as prefetch processing, deferred writes, and service tasks.

alias. An alternative name that can be used in SQL statements to refer to a table or view in the same or a remote DB2 subsystem.

allied address space. An area of storage that is external to DB2 and that is connected to DB2. An allied address space is capable of requesting DB2 services.

allied thread. A thread that originates at the local DB2 subsystem and that can access data at a remote DB2 subsystem.

allocated cursor. A cursor that is defined for stored procedure result sets by using the SQL ALLOCATE CURSOR statement.

already verified. An LU 6.2 security option that allows DB2 to provide the user's verified authorization ID when allocating a conversation. With this option, the user is not validated by the partner DB2 subsystem.

ambiguous cursor. A database cursor that is in a plan or package that contains either PREPARE or EXECUTE IMMEDIATE SQL statements, and for which the following statements are true: the cursor is not defined with the FOR READ ONLY clause or the FOR UPDATE OF clause; the cursor is not defined on a read-only result table; the cursor is not the target of a WHERE CURRENT clause on an SQL UPDATE or DELETE statement.

American National Standards Institute (ANSI). An organization consisting of producers, consumers, and general interest groups, that establishes the procedures by which accredited organizations create and maintain voluntary industry standards in the United States.

ANSI. American National Standards Institute.

APAR. Authorized program analysis report.

APAR fix corrective service. A temporary correction of an IBM software defect. The correction is temporary, because it is usually replaced at a later date by a more permanent correction, such as a program temporary fix (PTF).

APF. Authorized program facility.

API. Application programming interface.

APPL. A VTAM network definition statement that is used to define DB2 to VTAM as an application program that uses SNA LU 6.2 protocols.

application. A program or set of programs that performs a task; for example, a payroll application.

application-directed connection. A connection that an application manages using the SQL CONNECT statement.

application plan. The control structure that is produced during the bind process. DB2 uses the application plan to process SQL statements that it encounters during statement execution.

application process. The unit to which resources and locks are allocated. An application process involves the execution of one or more programs.

application programming interface (API). A functional interface that is supplied by the operating system or by a separately orderable licensed program that allows an application program that is written in a high-level language to use specific data or functions of the operating system or licensed program.

application requester. The component on a remote system that generates DRDA requests for data on behalf of an application. An application requester accesses a DB2 database server using the DRDA application-directed protocol.

application server. The target of a request from a remote application. In the DB2 environment, the application server function is provided by the distributed data facility and is used to access DB2 data from remote applications.

archive log. The portion of the DB2 log that contains log records that have been copied from the active log.

ASCII. An encoding scheme that is used to represent strings in many environments, typically on PCs and workstations. Contrast with *EBCDIC* and *Unicode*.

| **ASID.** Address space identifier.

attachment facility. An interface between DB2 and TSO, IMS, CICS, or batch address spaces. An attachment facility allows application programs to access DB2.

attribute. A characteristic of an entity. For example, in database design, the phone number of an employee is one of that employee's attributes.

authorization ID. A string that can be verified for connection to DB2 and to which a set of privileges is allowed. It can represent an individual, an organizational group, or a function, but DB2 does not determine this representation.

authorized program analysis report (APAR). A report of a problem that is caused by a suspected defect in a current release of an IBM supplied program.

authorized program facility (APF). A facility that permits the identification of programs that are authorized to use restricted functions.

| **automatic query rewrite.** A process that examines an
| SQL statement that refers to one or more base tables,
| and, if appropriate, rewrites the query so that it performs
| better. This process can also determine whether to
| rewrite a query so that it refers to one or more
| materialized query tables that are derived from the
| source tables.

auxiliary index. An index on an auxiliary table in which each index entry refers to a LOB.

auxiliary table. A table that stores columns outside the table in which they are defined. Contrast with *base table*.

B

backout. The process of undoing uncommitted changes that an application process made. This might be necessary in the event of a failure on the part of an application process, or as a result of a deadlock situation.

backward log recovery. The fourth and final phase of restart processing during which DB2 scans the log in a backward direction to apply UNDO log records for all aborted changes.

base table. (1) A table that is created by the SQL CREATE TABLE statement and that holds persistent data. Contrast with *result table* and *temporary table*.

(2) A table containing a LOB column definition. The actual LOB column data is not stored with the base table. The base table contains a row identifier for each row and an indicator column for each of its LOB columns. Contrast with *auxiliary table*.

base table space. A table space that contains base tables.

basic predicate. A predicate that compares two values.

basic sequential access method (BSAM). An access method for storing or retrieving data blocks in a continuous sequence, using either a sequential-access or a direct-access device.

| **batch message processing program.** In IMS, an
| application program that can perform batch-type
| processing online and can access the IMS input and
| output message queues.

before trigger. A trigger that is defined with the trigger activation time BEFORE.

binary integer. A basic data type that can be further classified as small integer or large integer.

binary large object (BLOB). A sequence of bytes where the size of the value ranges from 0 bytes to 2 GB−1. Such a string does not have an associated CCSID.

binary string. A sequence of bytes that is not associated with a CCSID. For example, the BLOB data type is a binary string.

bind. The process by which the output from the SQL precompiler is converted to a usable control structure, often called an access plan, application plan, or package. During this process, access paths to the data are selected and some authorization checking is performed. The types of bind are:

> **automatic bind**. (More correctly, *automatic rebind*) A process by which SQL statements are bound automatically (without a user issuing a BIND command) when an application process begins execution and the bound application plan or package it requires is not valid.
> **dynamic bind**. A process by which SQL statements are bound as they are entered.
> **incremental bind**. A process by which SQL statements are bound during the execution of an application process.
> **static bind**. A process by which SQL statements are bound after they have been precompiled. All static SQL statements are prepared for execution at the same time.

bit data. Data that is character type CHAR or VARCHAR and is not associated with a coded character set.

BLOB. Binary large object.

block fetch. A capability in which DB2 can retrieve, or fetch, a large set of rows together. Using block fetch can significantly reduce the number of messages that are being sent across the network. Block fetch applies only to cursors that do not update data.

BMP. Batch Message Processing (IMS). See *batch message processing program*.

bootstrap data set (BSDS). A VSAM data set that contains name and status information for DB2, as well as RBA range specifications, for all active and archive log data sets. It also contains passwords for the DB2 directory and catalog, and lists of conditional restart and checkpoint records.

BSAM. Basic sequential access method.

BSDS. Bootstrap data set.

buffer pool. Main storage that is reserved to satisfy the buffering requirements for one or more table spaces or indexes.

built-in data type. A data type that IBM supplies. Among the built-in data types for DB2 UDB for z/OS are string, numeric, ROWID, and datetime. Contrast with *distinct type*.

built-in function. A function that DB2 supplies. Contrast with *user-defined function*.

business dimension. A category of data, such as products or time periods, that an organization might want to analyze.

C

cache structure. A coupling facility structure that stores data that can be available to all members of a Sysplex. A DB2 data sharing group uses cache structures as group buffer pools.

CAF. Call attachment facility.

call attachment facility (CAF). A DB2 attachment facility for application programs that run in TSO or z/OS batch. The CAF is an alternative to the DSN command processor and provides greater control over the execution environment.

call-level interface (CLI). A callable application programming interface (API) for database access, which is an alternative to using embedded SQL. In contrast to embedded SQL, DB2 ODBC (which is based on the CLI architecture) does not require the user to precompile or bind applications, but instead provides a standard set of functions to process SQL statements and related services at run time.

cascade delete. The way in which DB2 enforces referential constraints when it deletes all descendent rows of a deleted parent row.

CASE expression. An expression that is selected based on the evaluation of one or more conditions.

cast function. A function that is used to convert instances of a (source) data type into instances of a different (target) data type. In general, a cast function has the name of the target data type. It has one single argument whose type is the source data type; its return type is the target data type.

castout. The DB2 process of writing changed pages from a group buffer pool to disk.

castout owner. The DB2 member that is responsible for casting out a particular page set or partition.

catalog. In DB2, a collection of tables that contains descriptions of objects such as tables, views, and indexes.

catalog table. Any table in the DB2 catalog.

CCSID. Coded character set identifier.

CDB. Communications database.

CDRA. Character Data Representation Architecture.

CEC. Central electronic complex. See *central processor complex*.

central electronic complex (CEC). See *central processor complex*.

central processor (CP). The part of the computer that contains the sequencing and processing facilities for instruction execution, initial program load, and other machine operations.

central processor complex (CPC). A physical collection of hardware (such as an ES/3090™) that consists of main storage, one or more central processors, timers, and channels.

CFRM. Coupling facility resource management.

CFRM policy. A declaration by a z/OS administrator regarding the allocation rules for a coupling facility structure.

character conversion. The process of changing characters from one encoding scheme to another.

Character Data Representation Architecture (CDRA). An architecture that is used to achieve consistent representation, processing, and interchange of string data.

character large object (CLOB). A sequence of bytes representing single-byte characters or a mixture of single- and double-byte characters where the size of the value can be up to 2 GB−1. In general, character large object values are used whenever a character string might exceed the limits of the VARCHAR type.

character set. A defined set of characters.

character string. A sequence of bytes that represent bit data, single-byte characters, or a mixture of single-byte and multibyte characters.

check constraint. A user-defined constraint that specifies the values that specific columns of a base table can contain.

check integrity. The condition that exists when each row in a table conforms to the check constraints that are defined on that table. Maintaining check integrity requires DB2 to enforce check constraints on operations that add or change data.

check pending. A state of a table space or partition that prevents its use by some utilities and by some SQL statements because of rows that violate referential constraints, check constraints, or both.

checkpoint. A point at which DB2 records internal status information on the DB2 log; the recovery process uses this information if DB2 abnormally terminates.

child lock. For explicit hierarchical locking, a lock that is held on either a table, page, row, or a large object (LOB). Each child lock has a parent lock. See also *parent lock*.

CI. Control interval.

CICS. Represents (in this publication): CICS Transaction Server for z/OS: Customer Information Control System Transaction Server for z/OS.

CICS attachment facility. A DB2 subcomponent that uses the z/OS subsystem interface (SSI) and cross-storage linkage to process requests from CICS to DB2 and to coordinate resource commitment.

CIDF. Control interval definition field.

claim. A notification to DB2 that an object is being accessed. Claims prevent drains from occurring until the claim is released, which usually occurs at a commit point. Contrast with *drain*.

claim class. A specific type of object access that can be one of the following isolation levels:
Cursor stability (CS)
Repeatable read (RR)
Write

claim count. A count of the number of agents that are accessing an object.

class of service. A VTAM term for a list of routes through a network, arranged in an order of preference for their use.

class word. A single word that indicates the nature of a data attribute. For example, the class word PROJ indicates that the attribute identifies a project.

clause. In SQL, a distinct part of a statement, such as a SELECT clause or a WHERE clause.

CLI. Call- level interface.

client. See *requester*.

CLIST. Command list. A language for performing TSO tasks.

CLOB. Character large object.

closed application. An application that requires exclusive use of certain statements on certain DB2 objects, so that the objects are managed solely through the application's external interface.

CLPA. Create link pack area.

clustering index. An index that determines how rows are physically ordered (*clustered*) in a table space. If a clustering index on a partitioned table is not a partitioning index, the rows are ordered in cluster sequence within each data partition instead of spanning partitions. Prior to Version 8 of DB2 UDB for z/OS, the partitioning index was required to be the clustering index.

coded character set. A set of unambiguous rules that establish a character set and the one-to-one relationships between the characters of the set and their coded representations.

coded character set identifier (CCSID). A 16-bit number that uniquely identifies a coded representation of graphic characters. It designates an encoding scheme identifier and one or more pairs consisting of a character set identifier and an associated code page identifier.

code page. (1) A set of assignments of characters to code points. In EBCDIC, for example, the character 'A' is assigned code point X'C1' (2) , and character 'B' is assigned code point X'C2'. Within a code page, each code point has only one specific meaning.

code point. In CDRA, a unique bit pattern that represents a character in a code page.

coexistence. During migration, the period of time in which two releases exist in the same data sharing group.

cold start. A process by which DB2 restarts without processing any log records. Contrast with *warm start*.

collection. A group of packages that have the same qualifier.

column. The vertical component of a table. A column has a name and a particular data type (for example, character, decimal, or integer).

column function. An operation that derives its result by using values from one or more rows. Contrast with *scalar function*.

"come from" checking. An LU 6.2 security option that defines a list of authorization IDs that are allowed to connect to DB2 from a partner LU.

command. A DB2 operator command or a DSN subcommand. A command is distinct from an SQL statement.

command prefix. A one- to eight-character command identifier. The command prefix distinguishes the command as belonging to an application or subsystem rather than to MVS.

command recognition character (CRC). A character that permits a z/OS console operator or an IMS subsystem user to route DB2 commands to specific DB2 subsystems.

command scope. The scope of command operation in a data sharing group. If a command has *member scope*, the command displays information only from the one member or affects only non-shared resources that are owned locally by that member. If a command has *group scope*, the command displays information from all members, affects non-shared resources that are owned locally by all members, displays information on sharable resources, or affects sharable resources.

commit. The operation that ends a unit of work by releasing locks so that the database changes that are made by that unit of work can be perceived by other processes.

commit point. A point in time when data is considered consistent.

committed phase. The second phase of the multisite update process that requests all participants to commit the effects of the logical unit of work.

common service area (CSA). In z/OS, a part of the common area that contains data areas that are addressable by all address spaces.

communications database (CDB). A set of tables in the DB2 catalog that are used to establish conversations with remote database management systems.

comparison operator. A token (such as =, >, or <) that is used to specify a relationship between two values.

composite key. An ordered set of key columns of the same table.

compression dictionary. The dictionary that controls the process of compression and decompression. This dictionary is created from the data in the table space or table space partition.

concurrency. The shared use of resources by more than one application process at the same time.

conditional restart. A DB2 restart that is directed by a user-defined conditional restart control record (CRCR).

connection. In SNA, the existence of a communication path between two partner LUs that allows information to be exchanged (for example, two DB2 subsystems that are connected and communicating by way of a conversation).

connection context. In SQLJ, a Java object that represents a connection to a data source.

connection declaration clause. In SQLJ, a statement that declares a connection to a data source.

connection handle. The data object containing information that is associated with a connection that DB2 ODBC manages. This includes general status information, transaction status, and diagnostic information.

connection ID. An identifier that is supplied by the attachment facility and that is associated with a specific address space connection.

consistency token. A timestamp that is used to generate the version identifier for an application. See also *version*.

constant. A language element that specifies an unchanging value. Constants are classified as string constants or numeric constants. Contrast with *variable*.

constraint. A rule that limits the values that can be inserted, deleted, or updated in a table. See *referential constraint*, *check constraint*, and *unique constraint*.

context. The application's logical connection to the data source and associated internal DB2 ODBC connection information that allows the application to direct its operations to a data source. A DB2 ODBC context represents a DB2 thread.

contracting conversion. A process that occurs when the length of a converted string is smaller than that of the source string. For example, this process occurs when an EBCDIC mixed-data string that contains DBCS characters is converted to ASCII mixed data; the converted string is shorter because of the removal of the shift codes.

control interval (CI). A fixed-length area or disk in which VSAM stores records and creates distributed free space. Also, in a key-sequenced data set or file, the set of records that an entry in the sequence-set index record points to. The control interval is the unit of information that VSAM transmits to or from disk. A control interval always includes an integral number of physical records.

control interval definition field (CIDF). In VSAM, a field that is located in the 4 bytes at the end of each control interval; it describes the free space, if any, in the control interval.

conversation. Communication, which is based on LU 6.2 or Advanced Program-to-Program Communication (APPC), between an application and a remote transaction program over an SNA logical unit-to-logical unit (LU-LU) session that allows communication while processing a transaction.

coordinator. The system component that coordinates the commit or rollback of a unit of work that includes work that is done on one or more other systems.

copy pool. A named set of SMS storage groups that contains data that is to be copied collectively. A copy pool is an SMS construct that lets you define which storage groups are to be copied by using FlashCopy® functions. HSM determines which volumes belong to a copy pool.

copy target. A named set of SMS storage groups that are to be used as containers for copy pool volume copies. A copy target is an SMS construct that lets you define which storage groups are to be used as containers for volumes that are copied by using FlashCopy functions.

copy version. A point-in-time FlashCopy copy that is managed by HSM. Each copy pool has a version parameter that specifies how many copy versions are maintained on disk.

correlated columns. A relationship between the value of one column and the value of another column.

correlated subquery. A subquery (part of a WHERE or HAVING clause) that is applied to a row or group of rows of a table or view that is named in an outer subselect statement.

correlation ID. An identifier that is associated with a specific thread. In TSO, it is either an authorization ID or the job name.

correlation name. An identifier that designates a table, a view, or individual rows of a table or view within a single SQL statement. It can be defined in any FROM clause or in the first clause of an UPDATE or DELETE statement.

cost category. A category into which DB2 places cost estimates for SQL statements at the time the statement is bound. A cost estimate can be placed in either of the following cost categories:

- A: Indicates that DB2 had enough information to make a cost estimate without using default values.
- B: Indicates that some condition exists for which DB2 was forced to use default values for its estimate.

The cost category is externalized in the COST_CATEGORY column of the DSN_STATEMNT_TABLE when a statement is explained.

coupling facility. A special PR/SM™ LPAR logical partition that runs the coupling facility control program and provides high-speed caching, list processing, and locking functions in a Parallel Sysplex®.

coupling facility resource management. A component of z/OS that provides the services to manage coupling facility resources in a Parallel Sysplex. This management includes the enforcement of CFRM policies to ensure that the coupling facility and structure requirements are satisfied.

CP. Central processor.

CPC. Central processor complex.

C++ member. A data object or function in a structure, union, or class.

C++ member function. An operator or function that is declared as a member of a class. A member function has access to the private and protected data members and to the member functions of objects in its class. Member functions are also called methods.

C++ object. (1) A region of storage. An object is created when a variable is defined or a new function is invoked. (2) An instance of a class.

CRC. Command recognition character.

CRCR. Conditional restart control record. See also *conditional restart*.

create link pack area (CLPA). An option that is used during IPL to initialize the link pack pageable area.

created temporary table. A table that holds temporary data and is defined with the SQL statement CREATE GLOBAL TEMPORARY TABLE. Information about created temporary tables is stored in the DB2 catalog, so this kind of table is persistent and can be shared across application processes. Contrast with *declared temporary table*. See also *temporary table*.

cross-memory linkage. A method for invoking a program in a different address space. The invocation is synchronous with respect to the caller.

cross-system coupling facility (XCF). A component of z/OS that provides functions to support cooperation between authorized programs that run within a Sysplex.

cross-system extended services (XES). A set of z/OS services that allow multiple instances of an application or subsystem, running on different systems in a Sysplex environment, to implement high-performance, high-availability data sharing by using a coupling facility.

CS. Cursor stability.

CSA. Common service area.

CT. Cursor table.

current data. Data within a host structure that is current with (identical to) the data within the base table.

current SQL ID. An ID that, at a single point in time, holds the privileges that are exercised when certain dynamic SQL statements run. The current SQL ID can be a primary authorization ID or a secondary authorization ID.

current status rebuild. The second phase of restart processing during which the status of the subsystem is reconstructed from information on the log.

cursor. A named control structure that an application program uses to point to a single row or multiple rows within some ordered set of rows of a result table. A cursor can be used to retrieve, update, or delete rows from a result table.

cursor sensitivity. The degree to which database updates are visible to the subsequent FETCH statements in a cursor. A cursor can be sensitive to changes that are made with positioned update and delete statements specifying the name of that cursor. A cursor can also be sensitive to changes that are made with searched update or delete statements, or with cursors other than this cursor. These changes can be made by this application process or by another application process.

cursor stability (CS). The isolation level that provides maximum concurrency without the ability to read uncommitted data. With cursor stability, a unit of work holds locks only on its uncommitted changes and on the current row of each of its cursors.

cursor table (CT). The copy of the skeleton cursor table that is used by an executing application process.

cycle. A set of tables that can be ordered so that each table is a descendent of the one before it, and the first table is a descendent of the last table. A self-referencing table is a cycle with a single member.

D

DAD. See *Document access definition.*

disk. A direct-access storage device that records data magnetically.

database. A collection of tables, or a collection of table spaces and index spaces.

database access thread. A thread that accesses data at the local subsystem on behalf of a remote subsystem.

database administrator (DBA). An individual who is responsible for designing, developing, operating, safeguarding, maintaining, and using a database.

database alias. The name of the target server if different from the location name. The database alias name is used to provide the name of the database server as it is known to the network. When a database alias name is defined, the location name is used by the application to reference the server, but the database alias name is used to identify the database server to be accessed. Any fully qualified object names within any

SQL statements are not modified and are sent unchanged to the database server.

database descriptor (DBD). An internal representation of a DB2 database definition, which reflects the data definition that is in the DB2 catalog. The objects that are defined in a database descriptor are table spaces, tables, indexes, index spaces, relationships, check constraints, and triggers. A DBD also contains information about accessing tables in the database.

database exception status. An indication that something is wrong with a database. All members of a data sharing group must know and share the exception status of databases.

database identifier (DBID). An internal identifier of the database.

database management system (DBMS). A software system that controls the creation, organization, and modification of a database and the access to the data that is stored within it.

database request module (DBRM). A data set member that is created by the DB2 precompiler and that contains information about SQL statements. DBRMs are used in the bind process.

database server. The target of a request from a local application or an intermediate database server. In the DB2 environment, the database server function is provided by the distributed data facility to access DB2 data from local applications, or from a remote database server that acts as an intermediate database server.

data currency. The state in which data that is retrieved into a host variable in your program is a copy of data in the base table.

data definition name (ddname). The name of a data definition (DD) statement that corresponds to a data control block containing the same name.

data dictionary. A repository of information about an organization's application programs, databases, logical data models, users, and authorizations. A data dictionary can be manual or automated.

data-driven business rules. Constraints on particular data values that exist as a result of requirements of the business.

Data Language/I (DL/I). The IMS data manipulation language; a common high-level interface between a user application and IMS.

data mart. A small data warehouse that applies to a single department or team. See also *data warehouse*.

data mining. The process of collecting critical business information from a data warehouse, correlating it, and uncovering associations, patterns, and trends.

data partition. A VSAM data set that is contained within a partitioned table space.

data-partitioned secondary index (DPSI). A secondary index that is partitioned. The index is partitioned according to the underlying data.

data sharing. The ability of two or more DB2 subsystems to directly access and change a single set of data.

data sharing group. A collection of one or more DB2 subsystems that directly access and change the same data while maintaining data integrity.

data sharing member. A DB2 subsystem that is assigned by XCF services to a data sharing group.

data source. A local or remote relational or non-relational data manager that is capable of supporting data access via an ODBC driver that supports the ODBC APIs. In the case of DB2 UDB for z/OS, the data sources are always relational database managers.

data space. In releases prior to DB2 UDB for z/OS, Version 8, a range of up to 2 GB of contiguous virtual storage addresses that a program can directly manipulate. Unlike an address space, a data space can hold only data; it does not contain common areas, system data, or programs.

data type. An attribute of columns, literals, host variables, special registers, and the results of functions and expressions.

data warehouse. A system that provides critical business information to an organization. The data warehouse system cleanses the data for accuracy and currency, and then presents the data to decision makers so that they can interpret and use it effectively and efficiently.

date. A three-part value that designates a day, month, and year.

date duration. A decimal integer that represents a number of years, months, and days.

datetime value. A value of the data type DATE, TIME, or TIMESTAMP.

DBA. Database administrator.

DBCLOB. Double-byte character large object.

DBCS. Double-byte character set.

DBD. Database descriptor.

DBID. Database identifier.

DBMS. Database management system.

DBRM. Database request module.

DB2 catalog. Tables that are maintained by DB2 and contain descriptions of DB2 objects, such as tables, views, and indexes.

DB2 command. An instruction to the DB2 subsystem that a user enters to start or stop DB2, to display information on current users, to start or stop databases, to display information on the status of databases, and so on.

DB2 for VSE & VM. The IBM DB2 relational database management system for the VSE and VM operating systems.

DB2I. DB2 Interactive.

DB2 Interactive (DB2I). The DB2 facility that provides for the execution of SQL statements, DB2 (operator) commands, programmer commands, and utility invocation.

DB2I Kanji Feature. The tape that contains the panels and jobs that allow a site to display DB2I panels in Kanji.

DB2 PM. DB2 Performance Monitor.

DB2 thread. The DB2 structure that describes an application's connection, traces its progress, processes resource functions, and delimits its accessibility to DB2 resources and services.

DCLGEN. Declarations generator.

DDF. Distributed data facility.

ddname. Data definition name.

deadlock. Unresolvable contention for the use of a resource, such as a table or an index.

declarations generator (DCLGEN). A subcomponent of DB2 that generates SQL table declarations and COBOL, C, or PL/I data structure declarations that conform to the table. The declarations are generated from DB2 system catalog information. DCLGEN is also a DSN subcommand.

declared temporary table. A table that holds temporary data and is defined with the SQL statement DECLARE GLOBAL TEMPORARY TABLE. Information about declared temporary tables is not stored in the DB2 catalog, so this kind of table is not persistent and can be used only by the application process that issued the DECLARE statement. Contrast with *created temporary table*. See also *temporary table*.

default value. A predetermined value, attribute, or option that is assumed when no other is explicitly specified.

deferred embedded SQL. SQL statements that are neither fully static nor fully dynamic. Like static statements, they are embedded within an application, but like dynamic statements, they are prepared during the execution of the application.

deferred write. The process of asynchronously writing changed data pages to disk.

degree of parallelism. The number of concurrently executed operations that are initiated to process a query.

delete-connected. A table that is a dependent of table P or a dependent of a table to which delete operations from table P cascade.

delete hole. The location on which a cursor is positioned when a row in a result table is refetched and the row no longer exists on the base table, because another cursor deleted the row between the time the cursor first included the row in the result table and the time the cursor tried to refetch it.

delete rule. The rule that tells DB2 what to do to a dependent row when a parent row is deleted. For each relationship, the rule might be CASCADE, RESTRICT, SET NULL, or NO ACTION.

delete trigger. A trigger that is defined with the triggering SQL operation DELETE.

delimited identifier. A sequence of characters that are enclosed within double quotation marks ("). The sequence must consist of a letter followed by zero or more characters, each of which is a letter, digit, or the underscore character (_).

delimiter token. A string constant, a delimited identifier, an operator symbol, or any of the special characters that are shown in DB2 syntax diagrams.

denormalization. A key step in the task of building a physical relational database design. Denormalization is the intentional duplication of columns in multiple tables, and the consequence is increased data redundancy. Denormalization is sometimes necessary to minimize performance problems. Contrast with *normalization*.

dependent. An object (row, table, or table space) that has at least one parent. The object is also said to be a dependent (row, table, or table space) of its parent. See also *parent row*, *parent table*, *parent table space*.

dependent row. A row that contains a foreign key that matches the value of a primary key in the parent row.

dependent table. A table that is a dependent in at least one referential constraint.

DES-based authenticator. An authenticator that is generated using the DES algorithm.

descendent. An object that is a dependent of an object or is the dependent of a descendent of an object.

descendent row. A row that is dependent on another row, or a row that is a descendent of a dependent row.

descendent table. A table that is a dependent of another table, or a table that is a descendent of a dependent table.

deterministic function. A user-defined function whose result is dependent on the values of the input arguments. That is, successive invocations with the same input values produce the same answer. Sometimes referred to as a *not-variant* function. Contrast this with an *nondeterministic function* (sometimes called a *variant function*), which might not always produce the same result for the same inputs.

DFP. Data Facility Product (in z/OS).

DFSMS. Data Facility Storage Management Subsystem (in z/OS). Also called *Storage Management Subsystem (SMS)*.

DFSMSdss™. The data set services (dss) component of DFSMS (in z/OS).

DFSMShsm. The hierarchical storage manager (hsm) component of DFSMS (in z/OS).

dimension. A data category such as time, products, or markets. The elements of a dimension are referred to as members. Dimensions offer a very concise, intuitive way of organizing and selecting data for retrieval, exploration, and analysis. See also *dimension table*.

dimension table. The representation of a dimension in a star schema. Each row in a dimension table represents all of the attributes for a particular member of the dimension. See also *dimension*, *star schema*, and *star join*.

directory. The DB2 system database that contains internal objects such as database descriptors and skeleton cursor tables.

distinct type. A user-defined data type that is internally represented as an existing type (its source type), but is considered to be a separate and incompatible type for semantic purposes.

distributed data. Data that resides on a DBMS other than the local system.

distributed data facility (DDF). A set of DB2 components through which DB2 communicates with another relational database management system.

Distributed Relational Database Architecture (DRDA). A connection protocol for distributed relational database processing that is used by IBM's relational database products. DRDA includes protocols for communication between an application and a remote relational database management system, and for communication between relational database management systems. See also *DRDA access.*

DL/I. Data Language/I.

DNS. Domain name server.

document access definition (DAD). Used to define the indexing scheme for an XML column or the mapping scheme of an XML collection. It can be used to enable an XML Extender column of an XML collection, which is XML formatted.

domain. The set of valid values for an attribute.

domain name. The name by which TCP/IP applications refer to a TCP/IP host within a TCP/IP network.

domain name server (DNS). A special TCP/IP network server that manages a distributed directory that is used to map TCP/IP host names to IP addresses.

double-byte character large object (DBCLOB). A sequence of bytes representing double-byte characters where the size of the values can be up to 2 GB. In general, DBCLOB values are used whenever a double-byte character string might exceed the limits of the VARGRAPHIC type.

double-byte character set (DBCS). A set of characters, which are used by national languages such as Japanese and Chinese, that have more symbols than can be represented by a single byte. Each character is 2 bytes in length. Contrast with *single-byte character set* and *multibyte character set*.

double-precision floating point number. A 64-bit approximate representation of a real number.

downstream. The set of nodes in the syncpoint tree that is connected to the local DBMS as a participant in the execution of a two-phase commit.

DPSI. Data-partitioned secondary index.

drain. The act of acquiring a locked resource by quiescing access to that object.

drain lock. A lock on a claim class that prevents a claim from occurring.

DRDA. Distributed Relational Database Architecture.

DRDA access. An open method of accessing distributed data that you can use to can connect to another database server to execute packages that were previously bound at the server location. You use the

SQL CONNECT statement or an SQL statement with a three-part name to identify the server. Contrast with *private protocol access*.

DSN. (1) The default DB2 subsystem name. (2) The name of the TSO command processor of DB2. (3) The first three characters of DB2 module and macro names.

duration. A number that represents an interval of time. See also *date duration*, *labeled duration*, and *time duration*.

dynamic cursor. A named control structure that an application program uses to change the size of the result table and the order of its rows after the cursor is opened. Contrast with *static cursor.*

dynamic dump. A dump that is issued during the execution of a program, usually under the control of that program.

dynamic SQL. SQL statements that are prepared and executed within an application program while the program is executing. In dynamic SQL, the SQL source is contained in host language variables rather than being coded into the application program. The SQL statement can change several times during the application program's execution.

dynamic statement cache pool. A cache, located above the 2-GB storage line, that holds dynamic statements.

E

EA-enabled table space. A table space or index space that is enabled for extended addressability and that contains individual partitions (or pieces, for LOB table spaces) that are greater than 4 GB.

EB. See *exabyte*.

EBCDIC. Extended binary coded decimal interchange code. An encoding scheme that is used to represent character data in the z/OS, VM, VSE, and iSeries environments. Contrast with *ASCII* and *Unicode*.

e-business. The transformation of key business processes through the use of Internet technologies.

EDM pool. A pool of main storage that is used for database descriptors, application plans, authorization cache, application packages.

EID. Event identifier.

embedded SQL. SQL statements that are coded within an application program. See *static SQL*.

enclave. In Language Environment , an independent collection of routines, one of which is designated as the main routine. An enclave is similar to a program or run unit.

encoding scheme. A set of rules to represent character data (ASCII, EBCDIC, or Unicode).

entity. A significant object of interest to an organization.

enumerated list. A set of DB2 objects that are defined with a LISTDEF utility control statement in which pattern-matching characters (*, %, _ or ?) are not used.

environment. A collection of names of logical and physical resources that are used to support the performance of a function.

environment handle. In DB2 ODBC, the data object that contains global information regarding the state of the application. An environment handle must be allocated before a connection handle can be allocated. Only one environment handle can be allocated per application.

EOM. End of memory.

EOT. End of task.

equijoin. A join operation in which the join-condition has the form *expression* = *expression*.

error page range. A range of pages that are considered to be physically damaged. DB2 does not allow users to access any pages that fall within this range.

escape character. The symbol that is used to enclose an SQL delimited identifier. The escape character is the double quotation mark ("), except in COBOL applications, where the user assigns the symbol, which is either a double quotation mark or an apostrophe (').

ESDS. Entry sequenced data set.

ESMT. External subsystem module table (in IMS).

EUR. IBM European Standards.

exabyte. For processor, real and virtual storage capacities and channel volume:
1 152 921 504 606 846 976 bytes or 2^{60}.

exception table. A table that holds rows that violate referential constraints or check constraints that the CHECK DATA utility finds.

exclusive lock. A lock that prevents concurrently executing application processes from reading or changing data. Contrast with *share lock*.

executable statement. An SQL statement that can be embedded in an application program, dynamically prepared and executed, or issued interactively.

execution context. In SQLJ, a Java object that can be used to control the execution of SQL statements.

exit routine. A user-written (or IBM-provided default) program that receives control from DB2 to perform specific functions. Exit routines run as extensions of DB2.

expanding conversion. A process that occurs when the length of a converted string is greater than that of the source string. For example, this process occurs when an ASCII mixed-data string that contains DBCS characters is converted to an EBCDIC mixed-data string; the converted string is longer because of the addition of shift codes.

explicit hierarchical locking. Locking that is used to make the parent-child relationship between resources known to IRLM. This kind of locking avoids global locking overhead when no inter-DB2 interest exists on a resource.

exposed name. A correlation name or a table or view name for which a correlation name is not specified. Names that are specified in a FROM clause are exposed or non-exposed.

expression. An operand or a collection of operators and operands that yields a single value.

extended recovery facility (XRF). A facility that minimizes the effect of failures in z/OS, VTAM , the host processor, or high-availability applications during sessions between high-availability applications and designated terminals. This facility provides an alternative subsystem to take over sessions from the failing subsystem.

Extensible Markup Language (XML). A standard metalanguage for defining markup languages that is a subset of Standardized General Markup Language (SGML). The less complex nature of XML makes it easier to write applications that handle document types, to author and manage structured information, and to transmit and share structured information across diverse computing environments.

external function. A function for which the body is written in a programming language that takes scalar argument values and produces a scalar result for each invocation. Contrast with *sourced function*, *built-in function*, and *SQL function*.

external procedure. A user-written application program that can be invoked with the SQL CALL statement, which is written in a programming language. Contrast with *SQL procedure*.

external routine. A user-defined function or stored procedure that is based on code that is written in an external programming language.

external subsystem module table (ESMT). In IMS, the table that specifies which attachment modules must be loaded.

F

failed member state. A state of a member of a data sharing group. When a member fails, the XCF permanently records the failed member state. This state usually means that the member's task, address space, or z/OS system terminated before the state changed from active to quiesced.

fallback. The process of returning to a previous release of DB2 after attempting or completing migration to a current release.

false global lock contention. A contention indication from the coupling facility when multiple lock names are hashed to the same indicator and when no real contention exists.

fan set. A direct physical access path to data, which is provided by an index, hash, or link; a fan set is the means by which the data manager supports the ordering of data.

federated database. The combination of a DB2 Universal Database server (in Linux, UNIX®, and Windows environments) and multiple data sources to which the server sends queries. In a federated database system, a client application can use a single SQL statement to join data that is distributed across multiple database management systems and can view the data as if it were local.

fetch orientation. The specification of the desired placement of the cursor as part of a FETCH statement (for example, BEFORE, AFTER, NEXT, PRIOR, CURRENT, FIRST, LAST, ABSOLUTE, and RELATIVE).

field procedure. A user-written exit routine that is designed to receive a single value and transform (encode or decode) it in any way the user can specify.

filter factor. A number between zero and one that estimates the proportion of rows in a table for which a predicate is true.

fixed-length string. A character or graphic string whose length is specified and cannot be changed. Contrast with *varying-length string*.

FlashCopy. A function on the IBM Enterprise Storage Server® that can create a point-in-time copy of data while an application is running.

foreign key. A column or set of columns in a dependent table of a constraint relationship. The key must have the same number of columns, with the same descriptions, as the primary key of the parent table. Each foreign key value must either match a parent key value in the related parent table or be null.

| **forest.** An ordered set of subtrees of XML nodes.

forget. In a two-phase commit operation, (1) the vote that is sent to the prepare phase when the participant has not modified any data. The forget vote allows a participant to release locks and forget about the logical unit of work. This is also referred to as the read-only vote. (2) The response to the *committed* request in the second phase of the operation.

forward log recovery. The third phase of restart processing during which DB2 processes the log in a forward direction to apply all REDO log records.

free space. The total amount of unused space in a page; that is, the space that is not used to store records or control information is free space.

full outer join. The result of a join operation that includes the matched rows of both tables that are being joined and preserves the unmatched rows of both tables. See also *join*.

fullselect. A subselect, a values-clause, or a number of both that are combined by set operators. *Fullselect* specifies a result table. If UNION is not used, the result of the fullselect is the result of the specified subselect.

| **fully escaped mapping.** A mapping from an SQL identifier to an XML name when the SQL identifier is a column name.

function. A mapping, which is embodied as a program (the function body) that is invocable by means of zero or more input values (arguments) to a single value (the result). See also *column function* and *scalar function*.

Functions can be user-defined, built-in, or generated by DB2. (See also *built-in function*, *cast function*, *external function*, *sourced function*, *SQL function*, and *user-defined function*.)

function definer. The authorization ID of the owner of the schema of the function that is specified in the CREATE FUNCTION statement.

function implementer. The authorization ID of the owner of the function program and function package.

function package. A package that results from binding the DBRM for a function program.

function package owner. The authorization ID of the user who binds the function program's DBRM into a function package.

function resolution. The process, internal to the DBMS, by which a function invocation is bound to a particular function instance. This process uses the function name, the data types of the arguments, and a list of the applicable schema names (called the *SQL path*) to make the selection. This process is sometimes called *function selection*.

function selection. See *function resolution*.

function signature. The logical concatenation of a fully qualified function name with the data types of all of its parameters.

G

GB. Gigabyte (1 073 741 824 bytes).

GBP. Group buffer pool.

GBP-dependent. The status of a page set or page set partition that is dependent on the group buffer pool. Either read/write interest is active among DB2 subsystems for this page set, or the page set has changed pages in the group buffer pool that have not yet been cast out to disk.

generalized trace facility (GTF). A z/OS service program that records significant system events such as I/O interrupts, SVC interrupts, program interrupts, or external interrupts.

generic resource name. A name that VTAM uses to represent several application programs that provide the same function in order to handle session distribution and balancing in a Sysplex environment.

getpage. An operation in which DB2 accesses a data page.

global lock. A lock that provides concurrency control within and among DB2 subsystems. The scope of the lock is across all DB2 subsystems of a data sharing group.

global lock contention. Conflicts on locking requests between different DB2 members of a data sharing group when those members are trying to serialize shared resources.

governor. See *resource limit facility*.

graphic string. A sequence of DBCS characters.

gross lock. The *shared*, *update*, or *exclusive* mode locks on a table, partition, or table space.

group buffer pool (GBP). A coupling facility cache structure that is used by a data sharing group to cache data and to ensure that the data is consistent for all members.

group buffer pool duplexing. The ability to write data to two instances of a group buffer pool structure: a *primary group buffer pool* and a *secondary group buffer pool*. z/OS publications refer to these instances as the "old" (for primary) and "new" (for secondary) structures.

group level. The release level of a data sharing group, which is established when the first member migrates to a new release.

group name. The z/OS XCF identifier for a data sharing group.

group restart. A restart of at least one member of a data sharing group after the loss of either locks or the shared communications area.

GTF. Generalized trace facility.

H

handle. In DB2 ODBC, a variable that refers to a data structure and associated resources. See also *statement handle*, *connection handle*, and *environment handle*.

help panel. A screen of information that presents tutorial text to assist a user at the workstation or terminal.

heuristic damage. The inconsistency in data between one or more participants that results when a heuristic decision to resolve an indoubt LUW at one or more participants differs from the decision that is recorded at the coordinator.

heuristic decision. A decision that forces indoubt resolution at a participant by means other than automatic resynchronization between coordinator and participant.

| **hole.** A row of the result table that cannot be accessed because of a delete or an update that has been performed on the row. See also *delete hole* and *update hole*.

home address space. The area of storage that z/OS currently recognizes as *dispatched*.

host. The set of programs and resources that are available on a given TCP/IP instance.

host expression. A Java variable or expression that is referenced by SQL clauses in an SQLJ application program.

host identifier. A name that is declared in the host program.

host language. A programming language in which you can embed SQL statements.

host program. An application program that is written in a host language and that contains embedded SQL statements.

host structure. In an application program, a structure that is referenced by embedded SQL statements.

host variable. In an application program, an application variable that is referenced by embedded SQL statements.

| **host variable array.** An array of elements, each of which corresponds to a value for a column. The dimension of the array determines the maximum number of rows for which the array can be used.

HSM. Hierarchical storage manager.

HTML. Hypertext Markup Language, a standard method for presenting Web data to users.

HTTP. Hypertext Transfer Protocol, a communication protocol that the Web uses.

I

ICF. Integrated catalog facility.

IDCAMS. An IBM program that is used to process access method services commands. It can be invoked as a job or jobstep, from a TSO terminal, or from within a user’s application program.

IDCAMS LISTCAT. A facility for obtaining information that is contained in the access method services catalog.

identify. A request that an attachment service program in an address space that is separate from DB2 issues thorough the z/OS subsystem interface to inform DB2 of its existence and to initiate the process of becoming connected to DB2.

identity column. A column that provides a way for DB2 to automatically generate a numeric value for each row. The generated values are unique if cycling is not used. Identity columns are defined with the AS IDENTITY clause. Uniqueness of values can be ensured by defining a unique index that contains only the identity column. A table can have no more than one identity column.

IFCID. Instrumentation facility component identifier.

IFI. Instrumentation facility interface.

IFI call. An invocation of the instrumentation facility interface (IFI) by means of one of its defined functions.

IFP. IMS Fast Path.

image copy. An exact reproduction of all or part of a table space. DB2 provides utility programs to make full image copies (to copy the entire table space) or incremental image copies (to copy only those pages that have been modified since the last image copy).

implied forget. In the presumed-abort protocol, an implied response of *forget* to the second-phase *committed* request from the coordinator. The response is implied when the participant responds to any subsequent request from the coordinator.

IMS. Information Management System.

IMS attachment facility. A DB2 subcomponent that uses z/OS subsystem interface (SSI) protocols and cross-memory linkage to process requests from IMS to DB2 and to coordinate resource commitment.

IMS DB. Information Management System Database.

IMS TM. Information Management System Transaction Manager.

in-abort. A status of a unit of recovery. If DB2 fails after a unit of recovery begins to be rolled back, but before the process is completed, DB2 continues to back out the changes during restart.

in-commit. A status of a unit of recovery. If DB2 fails after beginning its phase 2 commit processing, it "knows," when restarted, that changes made to data are consistent. Such units of recovery are termed *in-commit*.

independent. An object (row, table, or table space) that is neither a parent nor a dependent of another object.

index. A set of pointers that are logically ordered by the values of a key. Indexes can provide faster access to data and can enforce uniqueness on the rows in a table.

index-controlled partitioning. A type of partitioning in which partition boundaries for a partitioned table are controlled by values that are specified on the CREATE INDEX statement. Partition limits are saved in the LIMITKEY column of the SYSIBM.SYSINDEXPART catalog table.

index key. The set of columns in a table that is used to determine the order of index entries.

index partition. A VSAM data set that is contained within a partitioning index space.

index space. A page set that is used to store the entries of one index.

indicator column. A 4-byte value that is stored in a base table in place of a LOB column.

indicator variable. A variable that is used to represent the null value in an application program. If the value for the selected column is null, a negative value is placed in the indicator variable.

indoubt. A status of a unit of recovery. If DB2 fails after it has finished its phase 1 commit processing and before it has started phase 2, only the commit coordinator knows if an individual unit of recovery is to be committed or rolled back. At emergency restart, if DB2 lacks the information it needs to make this decision, the status of the unit of recovery is *indoubt* until DB2 obtains this information from the coordinator. More than one unit of recovery can be indoubt at restart.

indoubt resolution. The process of resolving the status of an indoubt logical unit of work to either the committed or the rollback state.

inflight. A status of a unit of recovery. If DB2 fails before its unit of recovery completes phase 1 of the commit process, it merely backs out the updates of its unit of recovery at restart. These units of recovery are termed *inflight*.

inheritance. The passing downstream of class resources or attributes from a parent class in the class hierarchy to a child class.

initialization file. For DB2 ODBC applications, a file containing values that can be set to adjust the performance of the database manager.

inline copy. A copy that is produced by the LOAD or REORG utility. The data set that the inline copy produces is logically equivalent to a full image copy that is produced by running the COPY utility with read-only access (SHRLEVEL REFERENCE).

inner join. The result of a join operation that includes only the matched rows of both tables that are being joined. See also *join*.

inoperative package. A package that cannot be used because one or more user-defined functions or procedures that the package depends on were dropped. Such a package must be explicitly rebound. Contrast with *invalid package.*

insensitive cursor. A cursor that is not sensitive to inserts, updates, or deletes that are made to the underlying rows of a result table after the result table has been materialized.

insert trigger. A trigger that is defined with the triggering SQL operation INSERT.

install. The process of preparing a DB2 subsystem to operate as a z/OS subsystem.

installation verification scenario. A sequence of operations that exercises the main DB2 functions and tests whether DB2 was correctly installed.

instrumentation facility component identifier (IFCID). A value that names and identifies a trace record of an event that can be traced. As a parameter on the START TRACE and MODIFY TRACE commands, it specifies that the corresponding event is to be traced.

instrumentation facility interface (IFI). A programming interface that enables programs to obtain online trace data about DB2, to submit DB2 commands, and to pass data to DB2.

Interactive System Productivity Facility (ISPF). An IBM licensed program that provides interactive dialog services in a z/OS environment.

inter-DB2 R/W interest. A property of data in a table space, index, or partition that has been opened by more than one member of a data sharing group and that has been opened for writing by at least one of those members.

intermediate database server. The target of a request from a local application or a remote application requester that is forwarded to another database server. In the DB2 environment, the remote request is forwarded transparently to another database server if the object that is referenced by a three-part name does not reference the local location.

internationalization. The support for an encoding scheme that is able to represent the code points of characters from many different geographies and languages. To support all geographies, the Unicode standard requires more than 1 byte to represent a single character. See also *Unicode*.

internal resource lock manager (IRLM). A z/OS subsystem that DB2 uses to control communication and database locking.

International Organization for Standardization. An international body charged with creating standards to facilitate the exchange of goods and services as well as cooperation in intellectual, scientific, technological, and economic activity.

invalid package. A package that depends on an object (other than a user-defined function) that is dropped. Such a package is implicitly rebound on invocation. Contrast with *inoperative package.*

invariant character set. (1) A character set, such as the syntactic character set, whose code point assignments do not change from code page to code page. (2) A minimum set of characters that is available as part of all character sets.

IP address. A 4-byte value that uniquely identifies a TCP/IP host.

IRLM. Internal resource lock manager.

ISO. International Organization for Standardization.

isolation level. The degree to which a unit of work is isolated from the updating operations of other units of work. See also *cursor stability*, *read stability*, *repeatable read*, and *uncommitted read*.

ISPF. Interactive System Productivity Facility.

ISPF/PDF. Interactive System Productivity Facility/Program Development Facility.

iterator. In SQLJ, an object that contains the result set of a query. An iterator is equivalent to a cursor in other host languages.

iterator declaration clause. In SQLJ, a statement that generates an iterator declaration class. An iterator is an object of an iterator declaration class.

J

Japanese Industrial Standard. An encoding scheme that is used to process Japanese characters.

JAR. Java Archive.

Java Archive (JAR). A file format that is used for aggregating many files into a single file.

JCL. Job control language.

JDBC. A Sun Microsystems database application programming interface (API) for Java that allows programs to access database management systems by using callable SQL. JDBC does not require the use of an SQL preprocessor. In addition, JDBC provides an architecture that lets users add modules called *database drivers*, which link the application to their choice of database management systems at run time.

JES. Job Entry Subsystem.

JIS. Japanese Industrial Standard.

job control language (JCL). A control language that is used to identify a job to an operating system and to describe the job's requirements.

Job Entry Subsystem (JES). An IBM licensed program that receives jobs into the system and processes all output data that is produced by the jobs.

join. A relational operation that allows retrieval of data from two or more tables based on matching column values. See also *equijoin, full outer join, inner join, left outer join, outer join, and right outer join*.

K

KB. Kilobyte (1024 bytes).

Kerberos. A network authentication protocol that is designed to provide strong authentication for client/server applications by using secret-key cryptography.

Kerberos ticket. A transparent application mechanism that transmits the identity of an initiating principal to its target. A simple ticket contains the principal's identity, a session key, a timestamp, and other information, which is sealed using the target's secret key.

key. A column or an ordered collection of columns that is identified in the description of a table, index, or referential constraint. The same column can be part of more than one key.

key-sequenced data set (KSDS). A VSAM file or data set whose records are loaded in key sequence and controlled by an index.

keyword. In SQL, a name that identifies an option that is used in an SQL statement.

KSDS. Key-sequenced data set.

L

labeled duration. A number that represents a duration of years, months, days, hours, minutes, seconds, or microseconds.

large object (LOB). A sequence of bytes representing bit data, single-byte characters, double-byte characters, or a mixture of single- and double-byte characters. A LOB can be up to 2 GB−1 byte in length. See also *BLOB*, *CLOB*, and *DBCLOB*.

last agent optimization. An optimized commit flow for either presumed-nothing or presumed-abort protocols in which the last agent, or final participant, becomes the commit coordinator. This flow saves at least one message.

latch. A DB2 internal mechanism for controlling concurrent events or the use of system resources.

LCID. Log control interval definition.

LDS. Linear data set.

leaf page. A page that contains pairs of keys and RIDs and that points to actual data. Contrast with *nonleaf page*.

left outer join. The result of a join operation that includes the matched rows of both tables that are being joined, and that preserves the unmatched rows of the first table. See also *join*.

limit key. The highest value of the index key for a partition.

linear data set (LDS). A VSAM data set that contains data but no control information. A linear data set can be accessed as a byte-addressable string in virtual storage.

linkage editor. A computer program for creating load modules from one or more object modules or load modules by resolving cross references among the modules and, if necessary, adjusting addresses.

link-edit. The action of creating a loadable computer program using a linkage editor.

list. A type of object, which DB2 utilities can process, that identifies multiple table spaces, multiple index spaces, or both. A list is defined with the LISTDEF utility control statement.

list structure. A coupling facility structure that lets data be shared and manipulated as elements of a queue.

LLE. Load list element.

L-lock. Logical lock.

load list element. A z/OS control block that controls the loading and deleting of a particular load module based on entry point names.

load module. A program unit that is suitable for loading into main storage for execution. The output of a linkage editor.

LOB. Large object.

LOB locator. A mechanism that allows an application program to manipulate a large object value in the database system. A LOB locator is a fullword integer value that represents a single LOB value. An application program retrieves a LOB locator into a host variable and can then apply SQL operations to the associated LOB value using the locator.

LOB lock. A lock on a LOB value.

LOB table space. A table space in an auxiliary table that contains all the data for a particular LOB column in the related base table.

local. A way of referring to any object that the local DB2 subsystem maintains. A *local table*, for example, is a table that is maintained by the local DB2 subsystem. Contrast with *remote*.

locale. The definition of a subset of a user's environment that combines a CCSID and characters that are defined for a specific language and country.

local lock. A lock that provides intra-DB2 concurrency control, but not inter-DB2 concurrency control; that is, its scope is a single DB2.

local subsystem. The unique relational DBMS to which the user or application program is directly connected (in the case of DB2, by one of the DB2 attachment facilities).

location. The unique name of a database server. An application uses the location name to access a DB2 database server. A database alias can be used to override the location name when accessing a remote server.

location alias. Another name by which a database server identifies itself in the network. Applications can use this name to access a DB2 database server.

lock. A means of controlling concurrent events or access to data. DB2 locking is performed by the IRLM.

lock duration. The interval over which a DB2 lock is held.

lock escalation. The promotion of a lock from a row, page, or LOB lock to a table space lock because the number of page locks that are concurrently held on a given resource exceeds a preset limit.

locking. The process by which the integrity of data is ensured. Locking prevents concurrent users from accessing inconsistent data.

lock mode. A representation for the type of access that concurrently running programs can have to a resource that a DB2 lock is holding.

lock object. The resource that is controlled by a DB2 lock.

lock promotion. The process of changing the size or mode of a DB2 lock to a higher, more restrictive level.

lock size. The amount of data that is controlled by a DB2 lock on table data; the value can be a row, a page, a LOB, a partition, a table, or a table space.

lock structure. A coupling facility data structure that is composed of a series of lock entries to support shared and exclusive locking for logical resources.

log. A collection of records that describe the events that occur during DB2 execution and that indicate their sequence. The information thus recorded is used for recovery in the event of a failure during DB2 execution.

| **log control interval definition.** A suffix of the physical log record that tells how record segments are placed in the physical control interval.

logical claim. A claim on a logical partition of a nonpartitioning index.

logical data modeling. The process of documenting the comprehensive business information requirements in an accurate and consistent format. Data modeling is the first task of designing a database.

logical drain. A drain on a logical partition of a nonpartitioning index.

logical index partition. The set of all keys that reference the same data partition.

logical lock (L-lock). The lock type that transactions use to control intra- and inter-DB2 data concurrency between transactions. Contrast with *physical lock (P-lock)*.

logically complete. A state in which the concurrent copy process is finished with the initialization of the target objects that are being copied. The target objects are available for update.

logical page list (LPL). A list of pages that are in error and that cannot be referenced by applications until the pages are recovered. The page is in *logical error* because the actual media (coupling facility or disk) might not contain any errors. Usually a connection to the media has been lost.

logical partition. A set of key or RID pairs in a nonpartitioning index that are associated with a particular partition.

logical recovery pending (LRECP). The state in which the data and the index keys that reference the data are inconsistent.

logical unit (LU). An access point through which an application program accesses the SNA network in order to communicate with another application program.

logical unit of work (LUW). The processing that a program performs between synchronization points.

logical unit of work identifier (LUWID). A name that uniquely identifies a thread within a network. This name consists of a fully-qualified LU network name, an LUW instance number, and an LUW sequence number.

log initialization. The first phase of restart processing during which DB2 attempts to locate the current end of the log.

log record header (LRH). A prefix, in every logical record, that contains control information.

log record sequence number (LRSN). A unique identifier for a log record that is associated with a data sharing member. DB2 uses the LRSN for recovery in the data sharing environment.

log truncation. A process by which an explicit starting RBA is established. This RBA is the point at which the next byte of log data is to be written.

LPL. Logical page list.

LRECP. Logical recovery pending.

LRH. Log record header.

LRSN. Log record sequence number.

LU. Logical unit.

LU name. Logical unit name, which is the name by which VTAM refers to a node in a network. Contrast with *location name*.

LUW. Logical unit of work.

LUWID. Logical unit of work identifier.

M

mapping table. A table that the REORG utility uses to map the associations of the RIDs of data records in the original copy and in the shadow copy. This table is created by the user.

mass delete. The deletion of all rows of a table.

master terminal. The IMS logical terminal that has complete control of IMS resources during online operations.

master terminal operator (MTO). See *master terminal.*

materialize. (1) The process of putting rows from a view or nested table expression into a work file for additional processing by a query.

(2) The placement of a LOB value into contiguous storage. Because LOB values can be very large, DB2 avoids materializing LOB data until doing so becomes absolutely necessary.

| **materialized query table.** A table that is used to contain information that is derived and can be summarized from one or more source tables.

MB. Megabyte (1 048 576 bytes).

MBCS. Multibyte character set. UTF-8 is an example of an MBCS. Characters in UTF-8 can range from 1 to 4 bytes in DB2.

member name. The z/OS XCF identifier for a particular DB2 subsystem in a data sharing group.

menu. A displayed list of available functions for selection by the operator. A menu is sometimes called a *menu panel*.

| **metalanguage.** A language that is used to create other specialized languages.

migration. The process of converting a subsystem with a previous release of DB2 to an updated or current release. In this process, you can acquire the functions of the updated or current release without losing the data that you created on the previous release.

mixed data string. A character string that can contain both single-byte and double-byte characters.

MLPA. Modified link pack area.

MODEENT. A VTAM macro instruction that associates a logon mode name with a set of parameters representing session protocols. A set of MODEENT macro instructions defines a logon mode table.

modeling database. A DB2 database that you create on your workstation that you use to model a DB2 UDB for z/OS subsystem, which can then be evaluated by the Index Advisor.

mode name. A VTAM name for the collection of physical and logical characteristics and attributes of a session.

modify locks. An L-lock or P-lock with a MODIFY attribute. A list of these active locks is kept at all times in the coupling facility lock structure. If the requesting DB2 subsystem fails, that DB2 subsystem's modify locks are converted to retained locks.

MPP. Message processing program (in IMS).

MTO. Master terminal operator.

multibyte character set (MBCS). A character set that represents single characters with more than a single byte. Contrast with *single-byte character set* and *double-byte character set*. See also *Unicode*.

multidimensional analysis. The process of assessing and evaluating an enterprise on more than one level.

Multiple Virtual Storage. An element of the z/OS operating system. This element is also called the Base Control Program (BCP).

multisite update. Distributed relational database processing in which data is updated in more than one location within a single unit of work.

multithreading. Multiple TCBs that are executing one copy of DB2 ODBC code concurrently (sharing a processor) or in parallel (on separate central processors).

must-complete. A state during DB2 processing in which the entire operation must be completed to maintain data integrity.

mutex. Pthread mutual exclusion; a lock. A Pthread mutex variable is used as a locking mechanism to allow serialization of critical sections of code by temporarily blocking the execution of all but one thread.

| **MVS.** See *Multiple Virtual Storage*.

N

negotiable lock. A lock whose mode can be downgraded, by agreement among contending users, to be compatible to all. A physical lock is an example of a negotiable lock.

nested table expression. A fullselect in a FROM clause (surrounded by parentheses).

network identifier (NID). The network ID that is assigned by IMS or CICS, or if the connection type is RRSAF, the RRS unit of recovery ID (URID).

NID. Network identifier.

nonleaf page. A page that contains keys and page numbers of other pages in the index (either leaf or nonleaf pages). Nonleaf pages never point to actual data.

nonpartitioned index. An index that is not physically partitioned. Both partitioning indexes and secondary indexes can be nonpartitioned.

nonscrollable cursor. A cursor that can be moved only in a forward direction. Nonscrollable cursors are sometimes called forward-only cursors or serial cursors.

normalization. A key step in the task of building a logical relational database design. Normalization helps you avoid redundancies and inconsistencies in your data. An entity is normalized if it meets a set of constraints for a particular normal form (first normal form, second normal form, and so on). Contrast with *denormalization*.

nondeterministic function. A user-defined function whose result is not solely dependent on the values of the input arguments. That is, successive invocations with the same argument values can produce a different answer. this type of function is sometimes called a *variant* function. Contrast this with a *deterministic function* (sometimes called a *not-variant function*), which always produces the same result for the same inputs.

not-variant function. See *deterministic function*.

NPSI. See *nonpartitioned secondary index.*

NRE. Network recovery element.

NUL. The null character ('\0'), which is represented by the value X'00'. In C, this character denotes the end of a string.

null. A special value that indicates the absence of information.

NULLIF. A scalar function that evaluates two passed expressions, returning either NULL if the arguments are equal or the value of the first argument if they are not.

null-terminated host variable. A varying-length host variable in which the end of the data is indicated by a null terminator.

null terminator. In C, the value that indicates the end of a string. For EBCDIC, ASCII, and Unicode UTF-8 strings, the null terminator is a single-byte value (X'00'). For Unicode UCS-2 (wide) strings, the null terminator is a double-byte value (X'0000').

O

OASN (origin application schedule number). In IMS, a 4-byte number that is assigned sequentially to each IMS schedule since the last cold start of IMS. The OASN is used as an identifier for a unit of work. In an 8-byte format, the first 4 bytes contain the schedule number and the last 4 bytes contain the number of IMS sync points (*commit points*) during the current schedule. The OASN is part of the NID for an IMS connection.

ODBC. Open Database Connectivity.

ODBC driver. A dynamically-linked library (DLL) that implements ODBC function calls and interacts with a data source.

OBID. Data object identifier.

Open Database Connectivity (ODBC). A Microsoft database application programming interface (API) for C that allows access to database management systems by using callable SQL. ODBC does not require the use of an SQL preprocessor. In addition, ODBC provides an architecture that lets users add modules called *database drivers*, which link the application to their choice of database management systems at run time. This means that applications no longer need to be directly linked to the modules of all the database management systems that are supported.

ordinary identifier. An uppercase letter followed by zero or more characters, each of which is an uppercase letter, a digit, or the underscore character. An ordinary identifier must not be a reserved word.

ordinary token. A numeric constant, an ordinary identifier, a host identifier, or a keyword.

originating task. In a parallel group, the primary agent that receives data from other execution units (referred to as *parallel tasks*) that are executing portions of the query in parallel.

OS/390. Operating System/390.

OS/390 OpenEdition® Distributed Computing Environment (OS/390 OE DCE). A set of technologies that are provided by the Open Software Foundation to implement distributed computing.

outer join. The result of a join operation that includes the matched rows of both tables that are being joined and preserves some or all of the unmatched rows of the tables that are being joined. See also *join.*

overloaded function. A function name for which multiple function instances exist.

P

package. An object containing a set of SQL statements that have been statically bound and that is available for processing. A package is sometimes also called an *application package*.

package list. An ordered list of package names that may be used to extend an application plan.

package name. The name of an object that is created by a BIND PACKAGE or REBIND PACKAGE command. The object is a bound version of a database request module (DBRM). The name consists of a location name, a collection ID, a package ID, and a version ID.

page. A unit of storage within a table space (4 KB, 8 KB, 16 KB, or 32 KB) or index space (4 KB). In a table space, a page contains one or more rows of a table. In a LOB table space, a LOB value can span more than one page, but no more than one LOB value is stored on a page.

page set. Another way to refer to a table space or index space. Each page set consists of a collection of VSAM data sets.

page set recovery pending (PSRCP). A restrictive state of an index space. In this case, the entire page set must be recovered. Recovery of a logical part is prohibited.

panel. A predefined display image that defines the locations and characteristics of display fields on a display surface (for example, a *menu panel*).

parallel complex. A cluster of machines that work together to handle multiple transactions and applications.

parallel group. A set of consecutive operations that execute in parallel and that have the same number of parallel tasks.

parallel I/O processing. A form of I/O processing in which DB2 initiates multiple concurrent requests for a single user query and performs I/O processing concurrently (in *parallel*) on multiple data partitions.

parallelism assistant. In Sysplex query parallelism, a DB2 subsystem that helps to process parts of a parallel query that originates on another DB2 subsystem in the data sharing group.

parallelism coordinator. In Sysplex query parallelism, the DB2 subsystem from which the parallel query originates.

Parallel Sysplex. A set of z/OS systems that communicate and cooperate with each other through certain multisystem hardware components and software services to process customer workloads.

parallel task. The execution unit that is dynamically created to process a query in parallel. A parallel task is implemented by a z/OS service request block.

parameter marker. A question mark (?) that appears in a statement string of a dynamic SQL statement. The question mark can appear where a host variable could appear if the statement string were a static SQL statement.

parameter-name. An SQL identifier that designates a parameter in an SQL procedure or an SQL function.

parent key. A primary key or unique key in the parent table of a referential constraint. The values of a parent key determine the valid values of the foreign key in the referential constraint.

parent lock. For explicit hierarchical locking, a lock that is held on a resource that might have child locks that are lower in the hierarchy. A parent lock is usually the table space lock or the partition intent lock. See also *child lock*.

parent row. A row whose primary key value is the foreign key value of a dependent row.

parent table. A table whose primary key is referenced by the foreign key of a dependent table.

parent table space. A table space that contains a parent table. A table space containing a dependent of that table is a dependent table space.

participant. An entity other than the commit coordinator that takes part in the commit process. The term participant is synonymous with *agent* in SNA.

partition. A portion of a page set. Each partition corresponds to a single, independently extendable data set. Partitions can be extended to a maximum size of 1, 2, or 4 GB, depending on the number of partitions in the partitioned page set. All partitions of a given page set have the same maximum size.

partitioned data set (PDS). A data set in disk storage that is divided into partitions, which are called members. Each partition can contain a program, part of a program, or data. The term partitioned data set is synonymous with program library.

partitioned index. An index that is physically partitioned. Both partitioning indexes and secondary indexes can be partitioned.

partitioned page set. A partitioned table space or an index space. Header pages, space map pages, data pages, and index pages reference data only within the scope of the partition.

partitioned table space. A table space that is subdivided into parts (based on index key range), each of which can be processed independently by utilities.

partitioning index. An index in which the leftmost columns are the partitioning columns of the table. The index can be partitioned or nonpartitioned.

partition pruning. The removal from consideration of inapplicable partitions through setting up predicates in a query on a partitioned table to access only certain partitions to satisfy the query.

partner logical unit. An access point in the SNA network that is connected to the local DB2 subsystem by way of a VTAM conversation.

path. See *SQL path*.

PCT. Program control table (in CICS).

PDS. Partitioned data set.

piece. A data set of a nonpartitioned page set.

physical claim. A claim on an entire nonpartitioning index.

physical consistency. The state of a page that is not in a partially changed state.

physical drain. A drain on an entire nonpartitioning index.

physical lock (P-lock). A type of lock that DB2 acquires to provide consistency of data that is cached in different DB2 subsystems. Physical locks are used only in data sharing environments. Contrast with *logical lock (L-lock)*.

physical lock contention. Conflicting states of the requesters for a physical lock. See also *negotiable lock*.

physically complete. The state in which the concurrent copy process is completed and the output data set has been created.

plan. See *application plan*.

plan allocation. The process of allocating DB2 resources to a plan in preparation for execution.

plan member. The bound copy of a DBRM that is identified in the member clause.

plan name. The name of an application plan.

plan segmentation. The dividing of each plan into sections. When a section is needed, it is independently brought into the EDM pool.

P-lock. Physical lock.

PLT. Program list table (in CICS).

point of consistency. A time when all recoverable data that an application accesses is consistent with other data. The term point of consistency is synonymous with *sync point* or *commit point*.

policy. See *CFRM policy*.

Portable Operating System Interface (POSIX). The IEEE operating system interface standard, which defines the Pthread standard of threading. See also *Pthread*.

POSIX. Portable Operating System Interface.

postponed abort UR. A unit of recovery that was inflight or in-abort, was interrupted by system failure or cancellation, and did not complete backout during restart.

PPT. (1) Processing program table (in CICS). (2) Program properties table (in z/OS).

precision. In SQL, the total number of digits in a decimal number (called the *size* in the C language). In the C language, the number of digits to the right of the decimal point (called the *scale* in SQL). The DB2 library uses the SQL terms.

precompilation. A processing of application programs containing SQL statements that takes place before compilation. SQL statements are replaced with statements that are recognized by the host language compiler. Output from this precompilation includes source code that can be submitted to the compiler and the database request module (DBRM) that is input to the bind process.

predicate. An element of a search condition that expresses or implies a comparison operation.

prefix. A code at the beginning of a message or record.

preformat. The process of preparing a VSAM ESDS for DB2 use, by writing specific data patterns.

prepare. The first phase of a two-phase commit process in which all participants are requested to prepare for commit.

prepared SQL statement. A named object that is the executable form of an SQL statement that has been processed by the PREPARE statement.

presumed-abort. An optimization of the presumed-nothing two-phase commit protocol that reduces the number of recovery log records, the duration of state maintenance, and the number of messages between coordinator and participant. The optimization also modifies the indoubt resolution responsibility.

presumed-nothing. The standard two-phase commit protocol that defines coordinator and participant responsibilities, relative to logical unit of work states, recovery logging, and indoubt resolution.

primary authorization ID. The authorization ID that is used to identify the application process to DB2.

primary group buffer pool. For a duplexed group buffer pool, the structure that is used to maintain the coherency of cached data. This structure is used for page registration and cross-invalidation. The z/OS equivalent is *old* structure. Compare with *secondary group buffer pool*.

primary index. An index that enforces the uniqueness of a primary key.

primary key. In a relational database, a unique, nonnull key that is part of the definition of a table. A table cannot be defined as a parent unless it has a unique key or primary key.

principal. An entity that can communicate securely with another entity. In Kerberos, principals are represented as entries in the Kerberos registry database and include users, servers, computers, and others.

principal name. The name by which a principal is known to the DCE security services.

private connection. A communications connection that is specific to DB2.

private protocol access. A method of accessing distributed data by which you can direct a query to another DB2 system. Contrast with *DRDA access*.

private protocol connection. A DB2 private connection of the application process. See also *private connection*.

privilege. The capability of performing a specific function, sometimes on a specific object. The types of privileges are:

> **explicit privileges**, which have names and are held as the result of SQL GRANT and REVOKE statements. For example, the SELECT privilege.
>
> **implicit privileges**, which accompany the ownership of an object, such as the privilege to drop a synonym that one owns, or the holding of an authority, such as the privilege of SYSADM authority to terminate any utility job.

privilege set. For the installation SYSADM ID, the set of all possible privileges. For any other authorization ID, the set of all privileges that are recorded for that ID in the DB2 catalog.

process. In DB2, the unit to which DB2 allocates resources and locks. Sometimes called an *application process*, a process involves the execution of one or more programs. The execution of an SQL statement is always associated with some process. The means of initiating and terminating a process are dependent on the environment.

program. A single, compilable collection of executable statements in a programming language.

program temporary fix (PTF). A solution or bypass of a problem that is diagnosed as a result of a defect in a current unaltered release of a licensed program. An authorized program analysis report (APAR) fix is corrective service for an existing problem. A PTF is preventive service for problems that might be encountered by other users of the product. A PTF is *temporary*, because a permanent fix is usually not incorporated into the product until its next release.

protected conversation. A VTAM conversation that supports two-phase commit flows.

PSRCP. Page set recovery pending.

PTF. Program temporary fix.

Pthread. The POSIX threading standard model for splitting an application into subtasks. The Pthread standard includes functions for creating threads, terminating threads, synchronizing threads through locking, and other thread control facilities.

Q

QMF™. Query Management Facility.

QSAM. Queued sequential access method.

query. A component of certain SQL statements that specifies a result table.

query block. The part of a query that is represented by one of the FROM clauses. Each FROM clause can have multiple query blocks, depending on DB2's internal processing of the query.

query CP parallelism. Parallel execution of a single query, which is accomplished by using multiple tasks. See also *Sysplex query parallelism*.

query I/O parallelism. Parallel access of data, which is accomplished by triggering multiple I/O requests within a single query.

queued sequential access method (QSAM). An extended version of the basic sequential access method (BSAM). When this method is used, a queue of data blocks is formed. Input data blocks await processing, and output data blocks await transfer to auxiliary storage or to an output device.

quiesce point. A point at which data is consistent as a result of running the DB2 QUIESCE utility.

quiesced member state. A state of a member of a data sharing group. An active member becomes quiesced when a STOP DB2 command takes effect without a failure. If the member's task, address space, or z/OS system fails before the command takes effect, the member state is failed.

R

RACF. Resource Access Control Facility, which is a component of the z/OS Security Server.

RAMAC®. IBM family of enterprise disk storage system products.

RBA. Relative byte address.

RCT. Resource control table (in CICS attachment facility).

RDB. Relational database.

RDBMS. Relational database management system.

RDBNAM. Relational database name.

RDF. Record definition field.

read stability (RS). An isolation level that is similar to repeatable read but does not completely isolate an application process from all other concurrently executing application processes. Under level RS, an application that issues the same query more than once might read additional rows that were inserted and committed by a concurrently executing application process.

rebind. The creation of a new application plan for an application program that has been bound previously. If, for example, you have added an index for a table that your application accesses, you must rebind the application in order to take advantage of that index.

rebuild. The process of reallocating a coupling facility structure. For the shared communications area (SCA) and lock structure, the structure is repopulated; for the group buffer pool, changed pages are usually cast out to disk, and the new structure is populated only with changed pages that were not successfully cast out.

RECFM. Record format.

record. The storage representation of a row or other data.

record identifier (RID). A unique identifier that DB2 uses internally to identify a row of data in a table. Compare with *row ID*.

record identifier (RID) pool. An area of main storage that is used for sorting record identifiers during list-prefetch processing.

record length. The sum of the length of all the columns in a table, which is the length of the data as it is physically stored in the database. Records can be fixed length or varying length, depending on how the columns are defined. If all columns are fixed-length columns, the record is a fixed-length record. If one or more columns are varying-length columns, the record is a varying-length column.

Recoverable Resource Manager Services attachment facility (RRSAF). A DB2 subcomponent that uses Resource Recovery Services to coordinate resource commitment between DB2 and all other resource managers that also use RRS in a z/OS system.

recovery. The process of rebuilding databases after a system failure.

recovery log. A collection of records that describes the events that occur during DB2 execution and indicates their sequence. The recorded information is used for recovery in the event of a failure during DB2 execution.

recovery manager. (1) A subcomponent that supplies coordination services that control the interaction of DB2 resource managers during commit, abort, checkpoint, and restart processes. The recovery manager also supports the recovery mechanisms of other subsystems (for example, IMS) by acting as a participant in the other subsystem's process for protecting data that has reached a point of consistency. (2) A coordinator or a participant (or both), in the execution of a two-phase commit, that can access a recovery log that maintains the state of the logical unit of work and names the immediate upstream coordinator and downstream participants.

recovery pending (RECP). A condition that prevents SQL access to a table space that needs to be recovered.

recovery token. An identifier for an element that is used in recovery (for example, NID or URID).

RECP. Recovery pending.

redo. A state of a unit of recovery that indicates that changes are to be reapplied to the disk media to ensure data integrity.

reentrant. Executable code that can reside in storage as one shared copy for all threads. Reentrant code is not self-modifying and provides separate storage areas for each thread. Reentrancy is a compiler and operating system concept, and reentrancy alone is not enough to guarantee logically consistent results when multithreading. See also *threadsafe*.

referential constraint. The requirement that nonnull values of a designated foreign key are valid only if they equal values of the primary key of a designated table.

referential integrity. The state of a database in which all values of all foreign keys are valid. Maintaining referential integrity requires the enforcement of referential constraints on all operations that change the data in a table on which the referential constraints are defined.

referential structure. A set of tables and relationships that includes at least one table and, for every table in the set, all the relationships in which that table participates and all the tables to which it is related.

| **refresh age.** The time duration between the current time and the time during which a materialized query table was last refreshed.

registry. See *registry database*.

registry database. A database of security information about principals, groups, organizations, accounts, and security policies.

relational database (RDB). A database that can be perceived as a set of tables and manipulated in accordance with the relational model of data.

relational database management system (RDBMS). A collection of hardware and software that organizes and provides access to a relational database.

relational database name (RDBNAM). A unique identifier for an RDBMS within a network. In DB2, this must be the value in the LOCATION column of table SYSIBM.LOCATIONS in the CDB. DB2 publications refer to the name of another RDBMS as a LOCATION value or a location name.

relationship. A defined connection between the rows of a table or the rows of two tables. A relationship is the internal representation of a referential constraint.

relative byte address (RBA). The offset of a data record or control interval from the beginning of the storage space that is allocated to the data set or file to which it belongs.

remigration. The process of returning to a current release of DB2 following a fallback to a previous release. This procedure constitutes another migration process.

remote. Any object that is maintained by a remote DB2 subsystem (that is, by a DB2 subsystem other than the local one). A *remote view*, for example, is a view that is maintained by a remote DB2 subsystem. Contrast with *local.*

remote attach request. A request by a remote location to attach to the local DB2 subsystem. Specifically, the request that is sent is an SNA Function Management Header 5.

remote subsystem. Any relational DBMS, except the *local subsystem*, with which the user or application can communicate. The subsystem need not be remote in any physical sense, and might even operate on the same processor under the same z/OS system.

reoptimization. The DB2 process of reconsidering the access path of an SQL statement at run time; during reoptimization, DB2 uses the values of host variables, parameter markers, or special registers.

REORG pending (REORP). A condition that restricts SQL access and most utility access to an object that must be reorganized.

REORP. REORG pending.

repeatable read (RR). The isolation level that provides maximum protection from other executing application programs. When an application program executes with repeatable read protection, rows that the program references cannot be changed by other programs until the program reaches a commit point.

repeating group. A situation in which an entity includes multiple attributes that are inherently the same. The presence of a repeating group violates the requirement of first normal form. In an entity that satisfies the requirement of first normal form, each attribute is independent and unique in its meaning and its name. See also *normalization*.

replay detection mechanism. A method that allows a principal to detect whether a request is a valid request from a source that can be trusted or whether an untrustworthy entity has captured information from a previous exchange and is replaying the information exchange to gain access to the principal.

request commit. The vote that is submitted to the prepare phase if the participant has modified data and is prepared to commit or roll back.

requester. The source of a request to access data at a remote server. In the DB2 environment, the requester function is provided by the distributed data facility.

resource. The object of a lock or claim, which could be a table space, an index space, a data partition, an index partition, or a logical partition.

resource allocation. The part of plan allocation that deals specifically with the database resources.

resource control table (RCT). A construct of the CICS attachment facility, created by site-provided macro parameters, that defines authorization and access attributes for transactions or transaction groups.

resource definition online. A CICS feature that you use to define CICS resources online without assembling tables.

resource limit facility (RLF). A portion of DB2 code that prevents dynamic manipulative SQL statements from exceeding specified time limits. The resource limit facility is sometimes called the governor.

resource limit specification table (RLST). A site-defined table that specifies the limits to be enforced by the resource limit facility.

resource manager. (1) A function that is responsible for managing a particular resource and that guarantees the consistency of all updates made to recoverable resources within a logical unit of work. The resource that is being managed can be physical (for example, disk or main storage) or logical (for example, a particular type of system service). (2) A participant, in the execution of a two-phase commit, that has recoverable resources that could have been modified. The resource manager has access to a recovery log so that it can commit or roll back the effects of the logical unit of work to the recoverable resources.

restart pending (RESTP). A restrictive state of a page set or partition that indicates that restart (backout) work needs to be performed on the object. All access to the page set or partition is denied except for access by the:
- RECOVER POSTPONED command
- Automatic online backout (which DB2 invokes after restart if the system parameter LBACKOUT=AUTO)

RESTP. Restart pending.

result set. The set of rows that a stored procedure returns to a client application.

result set locator. A 4-byte value that DB2 uses to uniquely identify a query result set that a stored procedure returns.

result table. The set of rows that are specified by a SELECT statement.

retained lock. A MODIFY lock that a DB2 subsystem was holding at the time of a subsystem failure. The lock is retained in the coupling facility lock structure across a DB2 failure.

RID. Record identifier.

RID pool. Record identifier pool.

right outer join. The result of a join operation that includes the matched rows of both tables that are being joined and preserves the unmatched rows of the second join operand. See also *join*.

RLF. Resource limit facility.

RLST. Resource limit specification table.

RMID. Resource manager identifier.

RO. Read-only access.

rollback. The process of restoring data that was changed by SQL statements to the state at its last commit point. All locks are freed. Contrast with *commit*.

root page. The index page that is at the highest level (or the beginning point) in an index.

routine. A term that refers to either a user-defined function or a stored procedure.

row. The horizontal component of a table. A row consists of a sequence of values, one for each column of the table.

ROWID. Row identifier.

row identifier (ROWID). A value that uniquely identifies a row. This value is stored with the row and never changes.

row lock. A lock on a single row of data.

rowset. A set of rows for which a cursor position is established.

rowset cursor. A cursor that is defined so that one or more rows can be returned as a rowset for a single FETCH statement, and the cursor is positioned on the set of rows that is fetched.

rowset-positioned access. The ability to retrieve multiple rows from a single FETCH statement.

row-positioned access. The ability to retrieve a single row from a single FETCH statement.

row trigger. A trigger that is defined with the trigger granularity FOR EACH ROW.

RRE. Residual recovery entry (in IMS).

RRSAF. Recoverable Resource Manager Services attachment facility.

RS. Read stability.

RTT. Resource translation table.

RURE. Restart URE.

S

savepoint. A named entity that represents the state of data and schemas at a particular point in time within a unit of work. SQL statements exist to set a savepoint, release a savepoint, and restore data and schemas to the state that the savepoint represents. The restoration of data and schemas to a savepoint is usually referred to as *rolling back to a savepoint*.

SBCS. Single-byte character set.

SCA. Shared communications area.

scalar function. An SQL operation that produces a single value from another value and is expressed as a function name, followed by a list of arguments that are enclosed in parentheses. Contrast with *column function*.

scale. In SQL, the number of digits to the right of the decimal point (called the *precision* in the C language). The DB2 library uses the SQL definition.

schema. (1) The organization or structure of a database. (2) A logical grouping for user-defined functions, distinct types, triggers, and stored procedures. When an object of one of these types is created, it is assigned to one schema, which is determined by the name of the object. For example, the following statement creates a distinct type T in schema C:

```
CREATE DISTINCT TYPE C.T ...
```

scrollability. The ability to use a cursor to fetch in either a forward or backward direction. The FETCH statement supports multiple fetch orientations to indicate the new position of the cursor. See also *fetch orientation*.

scrollable cursor. A cursor that can be moved in both a forward and a backward direction.

SDWA. System diagnostic work area.

search condition. A criterion for selecting rows from a table. A search condition consists of one or more predicates.

secondary authorization ID. An authorization ID that has been associated with a primary authorization ID by an authorization exit routine.

secondary group buffer pool. For a duplexed group buffer pool, the structure that is used to back up changed pages that are written to the primary group buffer pool. No page registration or cross-invalidation occurs using the secondary group buffer pool. The z/OS equivalent is *new* structure.

secondary index. A nonpartitioning index on a partitioned table.

section. The segment of a plan or package that contains the executable structures for a single SQL statement. For most SQL statements, one section in the plan exists for each SQL statement in the source program. However, for cursor-related statements, the DECLARE, OPEN, FETCH, and CLOSE statements reference the same section because they each refer to the SELECT statement that is named in the DECLARE CURSOR statement. SQL statements such as COMMIT, ROLLBACK, and some SET statements do not use a section.

segment. A group of pages that holds rows of a single table. See also *segmented table space*.

segmented table space. A table space that is divided into equal-sized groups of pages called segments. Segments are assigned to tables so that rows of different tables are never stored in the same segment.

self-referencing constraint. A referential constraint that defines a relationship in which a table is a dependent of itself.

self-referencing table. A table with a self-referencing constraint.

sensitive cursor. A cursor that is sensitive to changes that are made to the database after the result table has been materialized.

sequence. A user-defined object that generates a sequence of numeric values according to user specifications.

sequential data set. A non-DB2 data set whose records are organized on the basis of their successive physical positions, such as on magnetic tape. Several of the DB2 database utilities require sequential data sets.

sequential prefetch. A mechanism that triggers consecutive asynchronous I/O operations. Pages are fetched before they are required, and several pages are read with a single I/O operation.

serial cursor. A cursor that can be moved only in a forward direction.

serialized profile. A Java object that contains SQL statements and descriptions of host variables. The SQLJ translator produces a serialized profile for each connection context.

server. The target of a request from a remote requester. In the DB2 environment, the server function is provided by the distributed data facility, which is used to access DB2 data from remote applications.

server-side programming. A method for adding DB2 data into dynamic Web pages.

service class. An eight-character identifier that is used by the z/OS Workload Manager to associate user performance goals with a particular DDF thread or stored procedure. A service class is also used to classify work on parallelism assistants.

service request block. A unit of work that is scheduled to execute in another address space.

session. A link between two nodes in a VTAM network.

session protocols. The available set of SNA communication requests and responses.

shared communications area (SCA). A coupling facility list structure that a DB2 data sharing group uses for inter-DB2 communication.

share lock. A lock that prevents concurrently executing application processes from changing data, but not from reading data. Contrast with *exclusive lock*.

shift-in character. A special control character (X'0F') that is used in EBCDIC systems to denote that the subsequent bytes represent SBCS characters. See also *shift-out character*.

shift-out character. A special control character (X'0E') that is used in EBCDIC systems to denote that the subsequent bytes, up to the next shift-in control character, represent DBCS characters. See also *shift-in character*.

sign-on. A request that is made on behalf of an individual CICS or IMS application process by an attachment facility to enable DB2 to verify that it is authorized to use DB2 resources.

simple page set. A nonpartitioned page set. A simple page set initially consists of a single data set (page set piece). If and when that data set is extended to 2 GB, another data set is created, and so on, up to a total of 32 data sets. DB2 considers the data sets to be a single contiguous linear address space containing a maximum of 64 GB. Data is stored in the next available location within this address space without regard to any partitioning scheme.

simple table space. A table space that is neither partitioned nor segmented.

single-byte character set (SBCS). A set of characters in which each character is represented by a single byte. Contrast with *double-byte character set* or *multibyte character set*.

single-precision floating point number. A 32-bit approximate representation of a real number.

size. In the C language, the total number of digits in a decimal number (called the *precision* in SQL). The DB2 library uses the SQL term.

SMF. System Management Facilities.

SMP/E. System Modification Program/Extended.

SMS. Storage Management Subsystem.

SNA. Systems Network Architecture.

SNA network. The part of a network that conforms to the formats and protocols of Systems Network Architecture (SNA).

socket. A callable TCP/IP programming interface that TCP/IP network applications use to communicate with remote TCP/IP partners.

sourced function. A function that is implemented by another built-in or user-defined function that is already known to the database manager. This function can be a scalar function or a column (aggregating) function; it returns a single value from a set of values (for example, MAX or AVG). Contrast with *built-in function, external function,* and *SQL function*.

source program. A set of host language statements and SQL statements that is processed by an SQL precompiler.

| **source table.** A table that can be a base table, a view,
| a table expression, or a user-defined table function.

source type. An existing type that DB2 uses to internally represent a distinct type.

space. A sequence of one or more blank characters.

special register. A storage area that DB2 defines for an application process to use for storing information that can be referenced in SQL statements. Examples of special registers are USER and CURRENT DATE.

specific function name. A particular user-defined function that is known to the database manager by its specific name. Many specific user-defined functions can have the same function name. When a user-defined function is defined to the database, every function is assigned a specific name that is unique within its schema. Either the user can provide this name, or a default name is used.

SPUFI. SQL Processor Using File Input.

SQL. Structured Query Language.

SQL authorization ID (SQL ID). The authorization ID that is used for checking dynamic SQL statements in some situations.

SQLCA. SQL communication area.

SQL communication area (SQLCA). A structure that is used to provide an application program with information about the execution of its SQL statements.

SQL connection. An association between an application process and a local or remote application server or database server.

SQLDA. SQL descriptor area.

SQL descriptor area (SQLDA). A structure that describes input variables, output variables, or the columns of a result table.

SQL escape character. The symbol that is used to enclose an SQL delimited identifier. This symbol is the double quotation mark ("). See also *escape character*.

SQL function. A user-defined function in which the CREATE FUNCTION statement contains the source code. The source code is a single SQL expression that evaluates to a single value. The SQL user-defined function can return only one parameter.

SQL ID. SQL authorization ID.

SQLJ. Structured Query Language (SQL) that is embedded in the Java programming language.

SQL path. An ordered list of schema names that are used in the resolution of unqualified references to user-defined functions, distinct types, and stored procedures. In dynamic SQL, the current path is found in the CURRENT PATH special register. In static SQL, it is defined in the PATH bind option.

SQL procedure. A user-written program that can be invoked with the SQL CALL statement. Contrast with *external procedure*.

SQL processing conversation. Any conversation that requires access of DB2 data, either through an application or by dynamic query requests.

SQL Processor Using File Input (SPUFI). A facility of the TSO attachment subcomponent that enables the DB2I user to execute SQL statements without embedding them in an application program.

SQL return code. Either SQLCODE or SQLSTATE.

SQL routine. A user-defined function or stored procedure that is based on code that is written in SQL.

SQL statement coprocessor. An alternative to the DB2 precompiler that lets the user process SQL statements at compile time. The user invokes an SQL statement coprocessor by specifying a compiler option.

SQL string delimiter. A symbol that is used to enclose an SQL string constant. The SQL string delimiter is the apostrophe ('), except in COBOL applications, where the user assigns the symbol, which is either an apostrophe or a double quotation mark (").

SRB. Service request block.

SSI. Subsystem interface (in z/OS).

SSM. Subsystem member (in IMS).

stand-alone. An attribute of a program that means that it is capable of executing separately from DB2, without using DB2 services.

star join. A method of joining a dimension column of a fact table to the key column of the corresponding dimension table. See also *join*, *dimension*, and *star schema*.

star schema. The combination of a fact table (which contains most of the data) and a number of dimension tables. See also *star join*, *dimension*, and *dimension table*.

statement handle. In DB2 ODBC, the data object that contains information about an SQL statement that is managed by DB2 ODBC. This includes information such as dynamic arguments, bindings for dynamic arguments and columns, cursor information, result values, and status information. Each statement handle is associated with the connection handle.

statement string. For a dynamic SQL statement, the character string form of the statement.

statement trigger. A trigger that is defined with the trigger granularity FOR EACH STATEMENT.

static cursor. A named control structure that does not change the size of the result table or the order of its rows after an application opens the cursor. Contrast with *dynamic cursor.*

static SQL. SQL statements, embedded within a program, that are prepared during the program preparation process (before the program is executed). After being prepared, the SQL statement does not change (although values of host variables that are specified by the statement might change).

storage group. A named set of disks on which DB2 data can be stored.

stored procedure. A user-written application program that can be invoked through the use of the SQL CALL statement.

string. See *character string* or *graphic string*.

strong typing. A process that guarantees that only user-defined functions and operations that are defined on a distinct type can be applied to that type. For example, you cannot directly compare two currency types, such as Canadian dollars and U.S. dollars. But you can provide a user-defined function to convert one currency to the other and then do the comparison.

structure. (1) A name that refers collectively to different types of DB2 objects, such as tables, databases, views, indexes, and table spaces. (2) A construct that uses z/OS to map and manage storage on a coupling facility. See also *cache structure*, *list structure*, or *lock structure*.

Structured Query Language (SQL). A standardized language for defining and manipulating data in a relational database.

structure owner. In relation to group buffer pools, the DB2 member that is responsible for the following activities:

- Coordinating rebuild, checkpoint, and damage assessment processing
- Monitoring the group buffer pool threshold and notifying castout owners when the threshold has been reached

subcomponent. A group of closely related DB2 modules that work together to provide a general function.

subject table. The table for which a trigger is created. When the defined triggering event occurs on this table, the trigger is activated.

subpage. The unit into which a physical index page can be divided.

subquery. A SELECT statement within the WHERE or HAVING clause of another SQL statement; a nested SQL statement.

subselect. That form of a query that does not include an ORDER BY clause, an UPDATE clause, or UNION operators.

substitution character. A unique character that is substituted during character conversion for any characters in the source program that do not have a match in the target coding representation.

subsystem. A distinct instance of a relational database management system (RDBMS).

surrogate pair. A coded representation for a single character that consists of a sequence of two 16-bit code units, in which the first value of the pair is a high-surrogate code unit in the range U+D800 through U+DBFF, and the second value is a low-surrogate code unit in the range U+DC00 through U+DFFF. Surrogate pairs provide an extension mechanism for encoding 917 476 characters without requiring the use of 32-bit characters.

SVC dump. A dump that is issued when a z/OS or a DB2 functional recovery routine detects an error.

sync point. See *commit point*.

syncpoint tree. The tree of recovery managers and resource managers that are involved in a logical unit of work, starting with the recovery manager, that make the final commit decision.

synonym. In SQL, an alternative name for a table or view. Synonyms can be used to refer only to objects at the subsystem in which the synonym is defined.

syntactic character set. A set of 81 graphic characters that are registered in the IBM registry as character set 00640. This set was originally recommended to the programming language community to be used for syntactic purposes toward maximizing portability and interchangeability across systems and country boundaries. It is contained in most of the primary registered character sets, with a few exceptions. See also *invariant character set*.

Sysplex. See *Parallel Sysplex*.

Sysplex query parallelism. Parallel execution of a single query that is accomplished by using multiple tasks on more than one DB2 subsystem. See also *query CP parallelism*.

system administrator. The person at a computer installation who designs, controls, and manages the use of the computer system.

system agent. A work request that DB2 creates internally such as prefetch processing, deferred writes, and service tasks.

system conversation. The conversation that two DB2 subsystems must establish to process system messages before any distributed processing can begin.

system diagnostic work area (SDWA). The data that is recorded in a SYS1.LOGREC entry that describes a program or hardware error.

system-directed connection. A connection that a relational DBMS manages by processing SQL statements with three-part names.

System Modification Program/Extended (SMP/E). A z/OS tool for making software changes in programming systems (such as DB2) and for controlling those changes.

Systems Network Architecture (SNA). The description of the logical structure, formats, protocols, and operational sequences for transmitting information through and controlling the configuration and operation of networks.

SYS1.DUMPxx data set. A data set that contains a system dump (in z/OS).

SYS1.LOGREC. A service aid that contains important information about program and hardware errors (in z/OS).

T

table. A named data object consisting of a specific number of columns and some number of unordered rows. See also *base table* or *temporary table*.

table-controlled partitioning. A type of partitioning in which partition boundaries for a partitioned table are controlled by values that are defined in the CREATE TABLE statement. Partition limits are saved in the LIMITKEY_INTERNAL column of the SYSIBM.SYSTABLEPART catalog table.

table function. A function that receives a set of arguments and returns a table to the SQL statement that references the function. A table function can be referenced only in the FROM clause of a subselect.

table locator. A mechanism that allows access to trigger transition tables in the FROM clause of SELECT statements, in the subselect of INSERT statements, or from within user-defined functions. A table locator is a fullword integer value that represents a transition table.

table space. A page set that is used to store the records in one or more tables.

table space set. A set of table spaces and partitions that should be recovered together for one of these reasons:
- Each of them contains a table that is a parent or descendent of a table in one of the others.
- The set contains a base table and associated auxiliary tables.

A table space set can contain both types of relationships.

task control block (TCB). A z/OS control block that is used to communicate information about tasks within an address space that are connected to DB2. See also *address space connection*.

TB. Terabyte (1 099 511 627 776 bytes).

TCB. Task control block (in z/OS).

TCP/IP. A network communication protocol that computer systems use to exchange information across telecommunication links.

TCP/IP port. A 2-byte value that identifies an end user or a TCP/IP network application within a TCP/IP host.

template. A DB2 utilities output data set descriptor that is used for dynamic allocation. A template is defined by the TEMPLATE utility control statement.

temporary table. A table that holds temporary data. Temporary tables are useful for holding or sorting intermediate results from queries that contain a large number of rows. The two types of temporary table, which are created by different SQL statements, are the created temporary table and the declared temporary table. Contrast with *result table*. See also *created temporary table* and *declared temporary table*.

Terminal Monitor Program (TMP). A program that provides an interface between terminal users and command processors and has access to many system services (in z/OS).

thread. The DB2 structure that describes an application's connection, traces its progress, processes resource functions, and delimits its accessibility to DB2 resources and services. Most DB2 functions execute under a thread structure. See also *allied thread* and *database access thread*.

threadsafe. A characteristic of code that allows multithreading both by providing private storage areas for each thread, and by properly serializing shared (global) storage areas.

three-part name. The full name of a table, view, or alias. It consists of a location name, authorization ID, and an object name, separated by a period.

time. A three-part value that designates a time of day in hours, minutes, and seconds.

time duration. A decimal integer that represents a number of hours, minutes, and seconds.

timeout. Abnormal termination of either the DB2 subsystem or of an application because of the unavailability of resources. Installation specifications are set to determine both the amount of time DB2 is to wait for IRLM services after starting, and the amount of time IRLM is to wait if a resource that an application requests is unavailable. If either of these time specifications is exceeded, a timeout is declared.

Time-Sharing Option (TSO). An option in MVS that provides interactive time sharing from remote terminals.

timestamp. A seven-part value that consists of a date and time. The timestamp is expressed in years, months, days, hours, minutes, seconds, and microseconds.

TMP. Terminal Monitor Program.

to-do. A state of a unit of recovery that indicates that the unit of recovery's changes to recoverable DB2 resources are indoubt and must either be applied to the disk media or backed out, as determined by the commit coordinator.

trace. A DB2 facility that provides the ability to monitor and collect DB2 monitoring, auditing, performance, accounting, statistics, and serviceability (global) data.

transaction lock. A lock that is used to control concurrent execution of SQL statements.

transaction program name. In SNA LU 6.2 conversations, the name of the program at the remote logical unit that is to be the other half of the conversation.

transient XML data type. A data type for XML values that exists only during query processing.

transition table. A temporary table that contains all the affected rows of the subject table in their state before or after the triggering event occurs. Triggered SQL statements in the trigger definition can reference the table of changed rows in the old state or the new state.

transition variable. A variable that contains a column value of the affected row of the subject table in its state before or after the triggering event occurs. Triggered SQL statements in the trigger definition can reference the set of old values or the set of new values.

tree structure. A data structure that represents entities in nodes, with a most one parent node for each node, and with only one root node.

trigger. A set of SQL statements that are stored in a DB2 database and executed when a certain event occurs in a DB2 table.

trigger activation. The process that occurs when the trigger event that is defined in a trigger definition is executed. Trigger activation consists of the evaluation of the triggered action condition and conditional execution of the triggered SQL statements.

trigger activation time. An indication in the trigger definition of whether the trigger should be activated before or after the triggered event.

trigger body. The set of SQL statements that is executed when a trigger is activated and its triggered action condition evaluates to true. A trigger body is also called *triggered SQL statements*.

trigger cascading. The process that occurs when the triggered action of a trigger causes the activation of another trigger.

triggered action. The SQL logic that is performed when a trigger is activated. The triggered action consists of an optional triggered action condition and a set of triggered SQL statements that are executed only if the condition evaluates to true.

triggered action condition. An optional part of the triggered action. This Boolean condition appears as a WHEN clause and specifies a condition that DB2 evaluates to determine if the triggered SQL statements should be executed.

triggered SQL statements. The set of SQL statements that is executed when a trigger is activated and its triggered action condition evaluates to true. Triggered SQL statements are also called the *trigger body*.

trigger granularity. A characteristic of a trigger, which determines whether the trigger is activated:
- Only once for the triggering SQL statement
- Once for each row that the SQL statement modifies

triggering event. The specified operation in a trigger definition that causes the activation of that trigger. The triggering event is comprised of a triggering operation (INSERT, UPDATE, or DELETE) and a subject table on which the operation is performed.

triggering SQL operation. The SQL operation that causes a trigger to be activated when performed on the subject table.

trigger package. A package that is created when a CREATE TRIGGER statement is executed. The package is executed when the trigger is activated.

TSO. Time-Sharing Option.

TSO attachment facility. A DB2 facility consisting of the DSN command processor and DB2I. Applications that are not written for the CICS or IMS environments can run under the TSO attachment facility.

typed parameter marker. A parameter marker that is specified along with its target data type. It has the general form:

```
CAST(? AS data-type)
```

type 1 indexes. Indexes that were created by a release of DB2 before DB2 Version 4 or that are specified as type 1 indexes in Version 4. Contrast with *type 2 indexes*. As of Version 8, type 1 indexes are no longer supported.

type 2 indexes. Indexes that are created on a release of DB2 after Version 7 or that are specified as type 2 indexes in Version 4 or later.

U

UCS-2. Universal Character Set, coded in 2 octets, which means that characters are represented in 16-bits per character.

UDF. User-defined function.

UDT. User-defined data type. In DB2 UDB for z/OS, the term *distinct type* is used instead of user-defined data type. See *distinct type*.

uncommitted read (UR). The isolation level that allows an application to read uncommitted data.

underlying view. The view on which another view is directly or indirectly defined.

undo. A state of a unit of recovery that indicates that the changes that the unit of recovery made to recoverable DB2 resources must be backed out.

Unicode. A standard that parallels the ISO-10646 standard. Several implementations of the Unicode standard exist, all of which have the ability to represent a large percentage of the characters that are contained in the many scripts that are used throughout the world.

uniform resource locator (URL). A Web address, which offers a way of naming and locating specific items on the Web.

union. An SQL operation that combines the results of two SELECT statements. Unions are often used to merge lists of values that are obtained from several tables.

unique constraint. An SQL rule that no two values in a primary key, or in the key of a unique index, can be the same.

unique index. An index that ensures that no identical key values are stored in a column or a set of columns in a table.

unit of recovery. A recoverable sequence of operations within a single resource manager, such as an instance of DB2. Contrast with *unit of work*.

unit of recovery identifier (URID). The LOGRBA of the first log record for a unit of recovery. The URID also appears in all subsequent log records for that unit of recovery.

unit of work. A recoverable sequence of operations within an application process. At any time, an application process is a single unit of work, but the life of an application process can involve many units of work as a result of commit or rollback operations. In a *multisite update* operation, a single unit of work can include several *units of recovery*. Contrast with *unit of recovery*.

Universal Unique Identifier (UUID). An identifier that is immutable and unique across time and space (in z/OS).

unlock. The act of releasing an object or system resource that was previously locked and returning it to general availability within DB2.

untyped parameter marker. A parameter marker that is specified without its target data type. It has the form of a single question mark (?).

updatability. The ability of a cursor to perform positioned updates and deletes. The updatability of a cursor can be influenced by the SELECT statement and the cursor sensitivity option that is specified on the DECLARE CURSOR statement.

update hole. The location on which a cursor is positioned when a row in a result table is fetched again and the new values no longer satisfy the search condition. DB2 marks a row in the result table as an update hole when an update to the corresponding row in the database causes that row to no longer qualify for the result table.

update trigger. A trigger that is defined with the triggering SQL operation UPDATE.

upstream. The node in the syncpoint tree that is responsible, in addition to other recovery or resource managers, for coordinating the execution of a two-phase commit.

UR. Uncommitted read.

URE. Unit of recovery element.

URID . Unit of recovery identifier.

URL. Uniform resource locator.

user-defined data type (UDT). See *distinct type*.

user-defined function (UDF). A function that is defined to DB2 by using the CREATE FUNCTION statement and that can be referenced thereafter in SQL statements. A user-defined function can be an *external function,* a *sourced function,* or an *SQL function.* Contrast with *built-in function*.

user view. In logical data modeling, a model or representation of critical information that the business requires.

UTF-8. Unicode Transformation Format, 8-bit encoding form, which is designed for ease of use with existing ASCII-based systems. The CCSID value for data in UTF-8 format is 1208. DB2 UDB for z/OS supports UTF-8 in mixed data fields.

UTF-16. Unicode Transformation Format, 16-bit encoding form, which is designed to provide code values for over a million characters and a superset of UCS-2. The CCSID value for data in UTF-16 format is 1200. DB2 UDB for z/OS supports UTF-16 in graphic data fields.

UUID. Universal Unique Identifier.

V

value. The smallest unit of data that is manipulated in SQL.

variable. A data element that specifies a value that can be changed. A COBOL elementary data item is an example of a variable. Contrast with *constant*.

variant function. See *nondeterministic function*.

varying-length string. A character or graphic string whose length varies within set limits. Contrast with *fixed-length string*.

version. A member of a set of similar programs, DBRMs, packages, or LOBs.

> **A version of a program** is the source code that is produced by precompiling the program. The program version is identified by the program name and a timestamp (consistency token).
>
> **A version of a DBRM** is the DBRM that is produced by precompiling a program. The DBRM version is identified by the same program name and timestamp as a corresponding program version.
>
> **A version of a package** is the result of binding a DBRM within a particular database system. The package version is identified by the same program name and consistency token as the DBRM.
>
> **A version of a LOB** is a copy of a LOB value at a point in time. The version number for a LOB is stored in the auxiliary index entry for the LOB.

view. An alternative representation of data from one or more tables. A view can include all or some of the columns that are contained in tables on which it is defined.

view check option. An option that specifies whether every row that is inserted or updated through a view must conform to the definition of that view. A view check option can be specified with the WITH CASCADED

CHECK OPTION, WITH CHECK OPTION, or WITH LOCAL CHECK OPTION clauses of the CREATE VIEW statement.

Virtual Storage Access Method (VSAM). An access method for direct or sequential processing of fixed- and varying-length records on disk devices. The records in a VSAM data set or file can be organized in logical sequence by a key field (key sequence), in the physical sequence in which they are written on the data set or file (entry-sequence), or by relative-record number (in z/OS).

Virtual Telecommunications Access Method (VTAM). An IBM licensed program that controls communication and the flow of data in an SNA network (in z/OS).

| **volatile table.** A table for which SQL operations choose index access whenever possible.

VSAM. Virtual Storage Access Method.

VTAM. Virtual Telecommunication Access Method (in z/OS).

W

warm start. The normal DB2 restart process, which involves reading and processing log records so that data that is under the control of DB2 is consistent. Contrast with *cold start*.

WLM application environment. A z/OS Workload Manager attribute that is associated with one or more stored procedures. The WLM application environment determines the address space in which a given DB2 stored procedure runs.

write to operator (WTO). An optional user-coded service that allows a message to be written to the system console operator informing the operator of errors and unusual system conditions that might need to be corrected (in z/OS).

WTO. Write to operator.

WTOR. Write to operator (WTO) with reply.

X

XCF. See *cross-system coupling facility*.

XES. See *cross-system extended services*.

| **XML.** See *Extensible Markup Language*.

| **XML attribute.** A name-value pair within a tagged XML element that modifies certain features of the element.

| **XML element.** A logical structure in an XML document that is delimited by a start and an end tag.

| **XML node.** The smallest unit of valid, complete structure in a document. For example, a node can represent an element, an attribute, or a text string.

| **XML publishing functions.** Functions that return XML values from SQL values.

X/Open. An independent, worldwide open systems organization that is supported by most of the world’s largest information systems suppliers, user organizations, and software companies. X/Open's goal is to increase the portability of applications by combining existing and emerging standards.

XRF. Extended recovery facility.

Z

| **z/OS.** An operating system for the eServer™ product line that supports 64-bit real and virtual storage.

z/OS Distributed Computing Environment (z/OS DCE). A set of technologies that are provided by the Open Software Foundation to implement distributed computing.

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- *z/OS DCE Messages and Codes*, SC24-5912
- *z/OS Information Roadmap*, SA22-7500
- *z/OS Introduction and Release Guide*, GA22-7502
- *z/OS JES2 Initialization and Tuning Guide*, SA22-7532
- *z/OS JES3 Initialization and Tuning Guide*, SA22-7549
- *z/OS Language Environment Concepts Guide*, SA22-7567
- *z/OS Language Environment Customization*, SA22-7564
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- *z/OS MVS JCL Reference*, SA22-7597
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- *z/OS MVS Recovery and Reconfiguration Guide*, SA22-7623
- *z/OS MVS Routing and Descriptor Codes*, SA22-7624
- *z/OS MVS Setting Up a Sysplex*, SA22-7625
- *z/OS MVS System Codes* SA22-7626
- *z/OS MVS System Commands*, SA22-7627
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- *z/OS Planning for Multilevel Security*, SA22-7509
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- *z/OS Security Server RACF Macros and Interfaces*, SA22-7682
- *z/OS Security Server RACF Security Administrator's Guide*, SA22-7683
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- *z/OS Support for Unicode: Using Conversion Services*, SA22-7649
- *z/OS TSO/E CLISTs*, SA22-7781
- *z/OS TSO/E Command Reference*, SA22-7782
- *z/OS TSO/E Customization*, SA22-7783
- *z/OS TSO/E Messages*, SA22-7786
- *z/OS TSO/E Programming Guide*, SA22-7788
- *z/OS TSO/E Programming Services*, SA22-7789
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- *z/OS TSO/E User's Guide*, SA22-7794
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