As Cool as Ice: Data Mining the RACF Database and RACF Audit Data

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Data Mining Your RACF Data

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Data Mining Your RACF Data

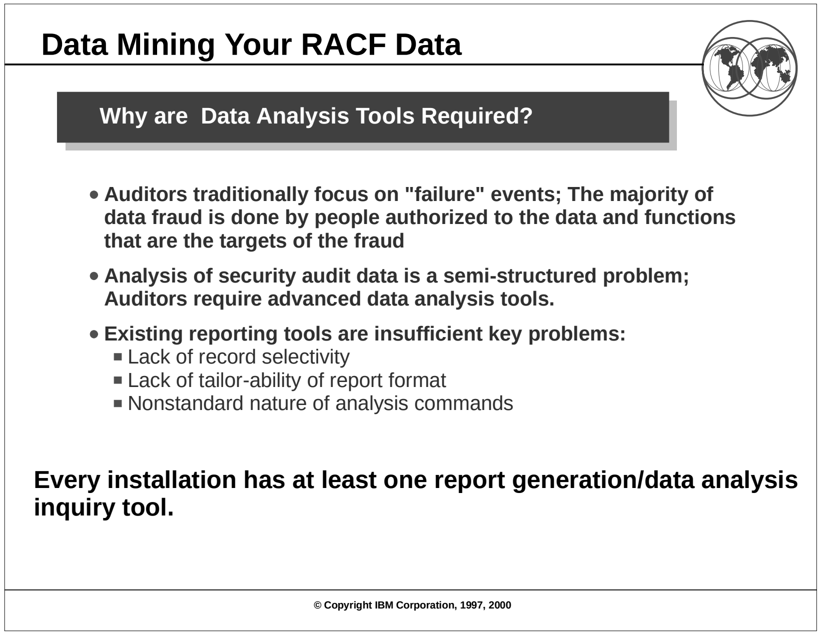
Agenda

- **What is Data Mining and how does it relate to RACF?**
  - What is auditing?
  - Why are analysis tools required?
  - What is data mining?
- **A four step approach:**
  - Understand the data and tools at our disposal
  - Formulating a search
  - Selecting the right tool
  - Refining the search

Data Mining Your RACF Data

What is Auditing?

- **Verification of compliance with the Installation Security Policy, by examining:**
  - Procedures and policies
  - Access rules
  - Physical access
  - User identification
  - Event data
    - **Looking at both successful (allowed) and unsuccessful (denied) events, looking for patterns**
  - Etc.



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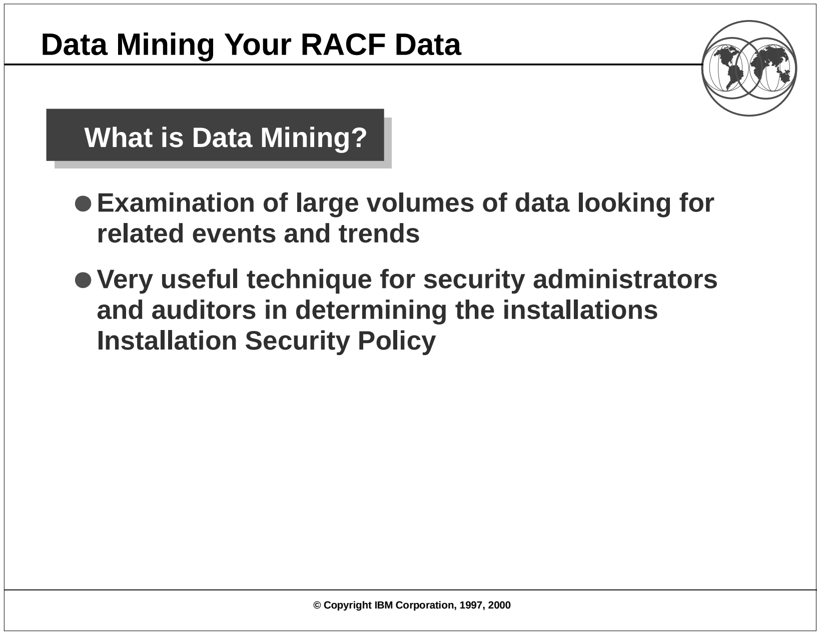
Why are Data Analysis Tools Required?

- **Auditors traditionally focus on "failure" events; The majority of data fraud is done by people authorized to the data and functions that are the targets of the fraud**
- **Analysis of security audit data is a semi-structured problem; Auditors require advanced data analysis tools.**
- **Existing reporting tools are insufficient key problems:**
  - Lack of record selectivity
  - Lack of tailor-ability of report format
  - Nonstandard nature of analysis commands

Every installation has at least one report generation/data analysis inquiry tool.



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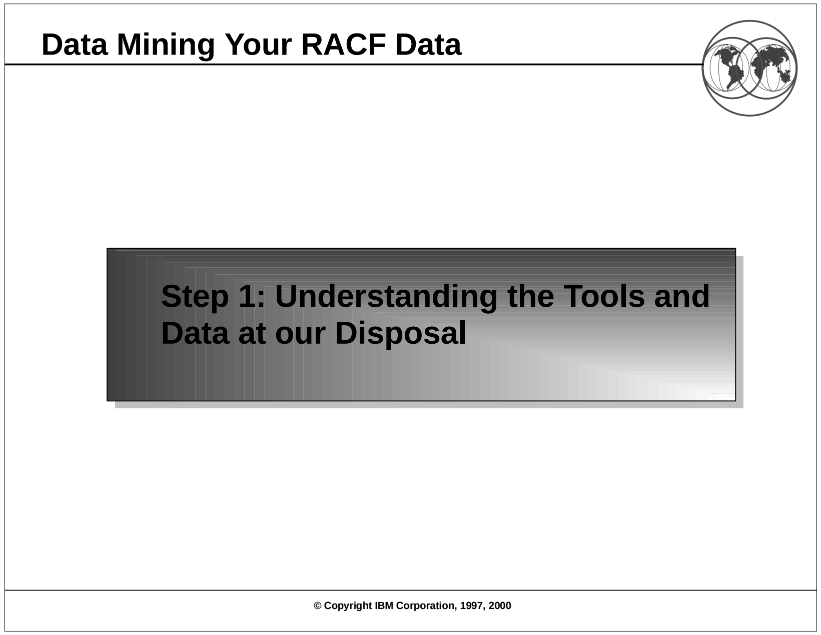
What is Data Mining?

- **Examination of large volumes of data looking for related events and trends**
- **Very useful technique for security administrators and auditors in determining the installations Installation Security Policy**



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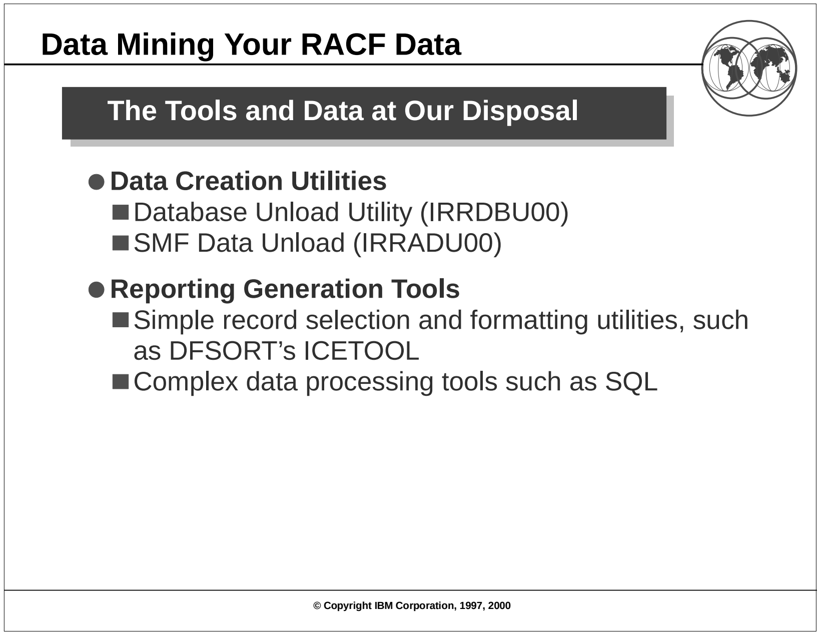
Step 1: Understanding the Tools and Data at our Disposal



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The Tools and Data at Our Disposal

- **Data Creation Utilities**
  - Database Unload Utility (IRRDBU00)
  - SMF Data Unload (IRRADU00)
- **Reporting Generation Tools**
  - Simple record selection and formatting utilities, such as DFSORT's ICETOOL
  - Complex data processing tools such as SQL

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What is the RACF Database Unload Utility?

- **Creates a flat, relational representation of the RACF database, suitable for a DBMS load utility**
- **Conventions used in unloading the data:**
  - All fields unloaded, with the exception of encrypted and "reserved for IBM" fields
  - Fields decoded and presented in a readable format
    - **Example: UACC is output as "READ," "UPDATE," "ALTER," or "CONTROL" rather than as a binary field**
  - One record type per segment and per repeat group
    - **Identified by a 4 byte record type**
  - Each record contains a "name" field which identifies the profile being described

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IRRDBU00 Record Formats: Example

- **Records which define user IDs look like:**

Record ID	User ID	Created	Owner	ADSP	Special	Operations	Revoked	GRPACC	PWD INT
0200	MARKN	1997-07-03	SYSADMIN	NO	YES	YES	NO	NO	030 ...
0200	SMITH	1996-04-25	IBMUSER	NO	YES	YES	YES	NO	030 ...
0200	WOLENSKY	1997-03-03	MARKN	NO	NO	NO	NO	NO	030 ...

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IRRDBU00 Invocation

- **If your database is split, can process all parts or each part separately**
- **Uses the enhanced generic naming (EGN) setting and class descriptor table (CDT) from the execution system.**
- Sample JCL

```
//USERX     JOB  Job card. . .
//UNLOAD    EXEC PGM=IRRDBU00,PARM=NOLOCK
//INDD1     DD   DISP=SHR, DSN=SYS1.RACFDB.PART1.COPY
//OUTDD     DD   DISP=SHR, DSN=SYS1.RACFDB.FLATFILE
//SYSPRINT  DD   SYSOUT=*
```

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When to Use IRRDBU00

- **When you want to create tailored reports on your RACF user, group, and access control definitions**
- **When you want to perform a detailed analysis of the contents of the RACF database**
- **When working with an off-loaded copy of the RACF data is OK**

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RACF SMF Data Unload Utility (IRRADU00)

What is the SMF Data Unload Utility?

- **A RACF utility that translates the security relevant audit information into a set of records that can be imported to a relational data base management system, such as SQL/DS, DB2 or SAS.**
  - One record type per event type
  - Processes SMF type 30, 80, 81, and 83 records
- **Primary users are the system auditor and security administrator**
- **Requires READ authority to the SMF data**

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How is the Utility Invoked?

- **Invoked as exits to the SMF Dump Utility (IFASMFDP)**
  - RACF SMF Data Unload modules invoked through the **USER2** and **USER3** exit points
  - IFASMFDP can be used to provide data, time, system ID, and record type selection

```
//USERX    JOB   Job Card...
//UNLOAD   EXEC  PGM=IFASMFDP
//DUMPIN   DD    DISP=SHR,DSN=USER01.SMFDATA
//DUMPOUT  DD    DUMMY
//OUTDD    DD    DISP=SHR,DSN=USER01.SMFDATA.IRRRID00
//SYSPRINT DD    SYSOUT=*
//ADUPRINT DD    SYSOUT=*
//SYSIN    DD    *
     USER2(IRRADU00)  USER3(IRRADU86)
     DATE (99001,99123)
     START (0800)
     END(1700)
     SID(SYS1)
/*
```

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What Does the Utility Produce?

- **Relational representation of the security relevant audit data, suitable for export to a relation data base management system (RDBMS) or browsing**
- **One record type per event code**

ACCESS	Resource access
ADDSD	ADDSD command
ADDUSER	ADDUSER Command
CONNECT	Connect a user to a group
DELRES	Delete resource
DELVOL	Delete volume
DEFINE	Define resource
JOBINIT	Job initiation
RENAMEDS	Rename dataset
.....	Etc.

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What Does the Utility Produce (Continued)?

- **All data decoded**
- **Commands translated into command text format**
- **Event code qualifiers decoded into meaningful eight byte values**

INVPSWD	Not valid password
INVTERM	Not valid terminal
NASECL	Not authorized to SECLABEL
NJENAUTH	NJE job not authorized
.....	Etc.

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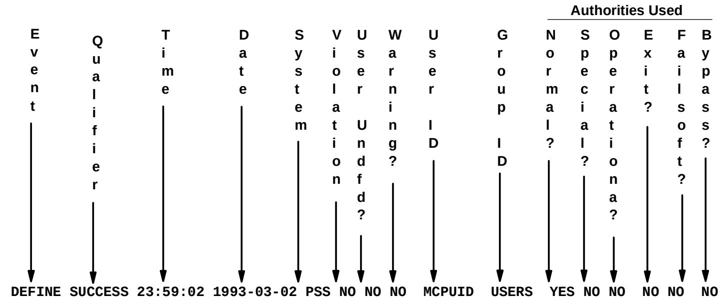
Record Formats

- All records of a specific event code are identical
- Base portion of all Type 80-based records are identical



```
DEFINE SUCCESS 23:59:02 1993-03-02 PSS NO NO NO  MCPUID  USERS  YES NO NO  NO NO  NO
ACCESS SUCCESS 23:59:03 1993-03-02 PSS NO NO NO  SYSUSER TASKS  NO  NO YES NO NO  NO
DELRES SUCCESS 23:59:04 1993-03-02 PSS NO NO NO  MCPUID  USERS  YES NO NO  NO NO  NO
ACCESS SUCCESS 23:59:04 1993-03-02 PSS NO NO NO  MCPUID  USERS  NO  NO YES NO NO  NO
ACCESS SUCCESS 23:59:05 1993-03-02 PSS NO NO NO  MCPUID  USERS  NO  NO YES NO NO  NO
```

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When to Use IRRADU00

- When you have complex selection criteria
- When you want to create tailored reports
- When you want to look at trends of events

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Step 2: Formulating a Query

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What are you Looking For?

- The first step in formulating a query is to identify what you are looking for
  - "I'm need to find all users who have an extraordinary RACF global authority (SPECIAL, OPERATIONS, or AUDITOR)"
  - "I want to find all failed logon attempts when the user ID changes but the terminal name does not"

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What are you Looking For?

- **Step two is to find the location (record type and name or offset) that helps answer your question.**
  - "I'm looking for all user IDs which have an extraordinary global authority (SPECIAL, OPERATIONS, or AUDITOR)
    - USBD_NAME (column 6-13) in the USER BASIC DATA record (type 0200)
    - USBD_SPECIAL (column 40-43) in USER BASIC DATA
    - USBD_OPER (columns 45-58) in USER BASIC DATA
    - USBD_AUDITOR (columns 386-389) in USER BASIC DATA
    - Find all records where either USBD_SPECIAL, USBD_OPER, or USBD_AUDITOR is set to "YES "

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What are you Looking For?...

- **Another example...**
  - "I want to find all failed logon attempts when the user ID changes but the terminal name does not"
    - INIT_EVENT_TYPE (column 1-8) is "JOBINIT "
    - INIT_EVENT_QUAL (column 10-17) is "INVPSWD"
    - Count the number of times that each terminal (INIT_TERM column 171-178 in JOBINIT record) is used

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Step 3: Selecting the Analysis Tool

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Selecting the Data Analysis Tool

- **The number of separate record types and the complexity of the selection criteria determine what type of data analysis tool is required**
  - When only a single record type is involved and the selection criteria is simple (equality, non-equality, greater than, less than, counting, simple pattern matching) a simple reporting tool such as ICETOOL may be used.
  - When multiple record types or complex selection criteria are required, then a more powerful analysis tool such as a relational data base manager (e.g. DB2, SQL/DS) is used.
- **Most queries are fall into single record/simple criteria**

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Using the DFSORT™ ICETOOL Utility

- IBM's DFSORT product contains a simple yet powerful report generation tool, ICETOOL.
- ICETOOL adds an easy-to-use reporting facility to DFSORT'S powerful record selection and ordering capabilities.
- ICETOOL can easily be used with RACF's SMF unload utility (IRRADU00) and database unload utility (IRRDBU00) output.
- 30+ sample reports are shipped in the RACFICE package on the RACF web page (http://www.ibm.com/s390/racf/).

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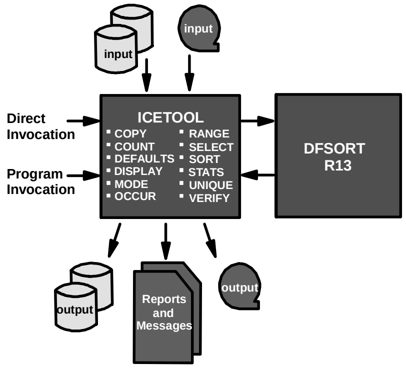
DFSORT's ICETOOL Utility



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RACFICE and ICETOOL

- All of the RACFICE Reports are created using only 3 of the 15 ICETOOL operators:
  - **SORT/COPY**
    - Record ordering and selection
  - **DISPLAY**
    - Select input fields, create report and column headers, and specify output report format
  - **OCCURS**
    - Counts occurrences of values
    - Can be used to report counts over a specified threshold value

Data Mining Your RACF Data

Selecting Records Using DFSORT

- Records are included in a report using DFSORT's INCLUDE statement:

```
INCLUDE COND=((start,length,type,eval,value,AND|OR,
             start,length,type....)
```

- `start` is the starting position
- `length` is the length of the string being compared
- `type` describes the data type
  - "CH" indicates character
  - "SS" indicates substring
- `eval` is the type of comparison
  - "EQ" is equal
  - "NE" is not equal
  - "LT" is less than
  - "LE" is less than or equal to
  - "GT is greater than
  - "GE is greater than or equal to

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Sample RACFICE Report: SORT Keywords

```
SORT FIELDS=(10,8,CH,A)
INCLUDE COND=((44,1,CH,EQ,C’Y’,OR,
               49,1,CH,EQ,C’Y’,OR,
               390,1,CH,EQ,C’Y’),AND,
               5,4,CH,EQ,C’0200’)
OPTION   VLSHRT
```

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Sample RACFICE Report: ICETOOL Keywords

```
**********************************************************************
* Name: UGLB                                                         *
*                                                                    *
* Find all of the user IDs which have extraordinary RACF privileges, *
* such as SPECIAL, OPERATIONS, and AUDITOR at the global level.      *
**********************************************************************
 SORT    FROM(DBUDATA) TO(TEMP0001) USING(RACF)
 DISPLAY FROM(TEMP0001) LIST(PRINT) -
        PAGE -
        TITLE(’User IDs With Extraordinary Global Authorities’) -
        DATE(YMD/) -
        TIME(12:)  -
        BLANK -
        ON(10,8,CH)  HEADER(’User ID’) -
        ON(79,20,CH) HEADER(’User Name’) -
        ON(44,4,CH)  HEADER(’Special’) -
        ON(49,4,CH)  HEADER(’Operations’) -
        ON(390,4,CH) HEADER(’Auditor’)
```

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Sample RACFICE Report : JCL

```
//MARKNICE JOB ’M.NELSON P385’,NOTIFY=&SYSUID,CLASS=A,
//         REGION=0M,MSGCLASS=H
//*-----------------------------------------------------------------
//UNLOAD    EXEC PGM=IRRDBU00,PARM=NOLOCKINPUT
//SYSPRINT  DD SYSOUT=*
//INDD1     DD DISP=SHR,DSN=RACFDRVR.RACF260
//OUTDD     DD DISP=(NEW,PASS),SPACE=(CYL,(5,1)),UNIT=SYSALLDA,
//          LRECL=5096,RECFM=VB,BLKSIZE=0,DSN=USER01.IRRDBU00
//*-----------------------------------------------------------------
//REPORT    EXEC PGM=ICETOOL
//TOOLMSG   DD DUMMY
//PRINT     DD SYSOUT=*
//DFSMSG    DD DUMMY
//DBUDATA   DD DISP=(SHR,DELETE),DSN=USER01.IRRDBU00
//TEMP0001  DD DISP=(NEW,DELETE),SPACE=(CYL,(5,1,0)),UNIT=SYSALLDA
//TOOLIN    DD *
 <icetool control statements>
//RACFCNTL  DD *
 <sort keywords>
```

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Sample RACFICE Report : Output

```
- 1 -       User IDs With Extraordinary Global Authorities        98/12/29

User ID    User Name              Special   Operations   Auditor
--------   --------------------   -------   ----------   -------
GLBAUDIT   ####################   NO        NO           YES
GLBOPER    ####################   NO        YES          NO
GLBSPEC    ####################   YES       NO           NO
IBMUSER                           YES       YES          YES
MARKN      ####################   YES       YES          YES
SPECUSR    ####################   YES       YES          YES
UAUDR$Y    AUDITOR                NO        NO           YES
UOPER$Y    OPERATIONS             NO        YES          NO
USPEC$Y    SPECIAL                YES       NO           NO
```

Data Mining Your RACF Data

Another Sample ICETOOL Report: Sort Keywords

```
INCLUDE COND=(5,8,CH,EQ,C’JOBINIT’,AND,
              14,8,CH,EQ,C’INVPSWD’)

 OPTION  VLSHRT
```

Data Mining Your RACF Data

Another RACFICE Report: ICETOOL Keywords

```
**********************************************************************
* Name: TRMF                                                         *
*                                                                    *
* Find all of the terminals from which an excessive number of        *
* logons with incorrect passwords have been attempted.               *
*                                                                    *
* The ICETOOL "HIGHER(x)" keyword is used to set the failure         *
* threshold.                                                         *
**********************************************************************
 COPY    FROM(ADUDATA) TO(TEMP0001) USING(RACF)
 OCCURS  FROM(TEMP0001) LIST(PRINT) -
         PAGE -

         TITLE(’TRMF: Terminals with Excessive Incorrect Passwords’)-
         DATE(YMD/) -
         TIME(12:)  -
         BLANK -
         ON(175,8,CH) HEADER(’Terminal ID’) -
         ON(VALCNT)   HEADER(’Number of Incorrect Passwords’) -
         HIGHER(3)
```

Data Mining Your RACF Data

Another RACFICE Report: Output

```
- 1 -        TRMF: Terminals with Excessive Incorrect Passwords        00/03/24

Terminal ID   Number of Incorrect Passwords
-----------   -----------------------------
P4622212                                  7
P4622600                                  9
TERM0001                                  4
```

Data Mining Your RACF Data

Using the "substring" Conditional Test

- **DFSORT release 13 introduced the substring ("SS") comparison test, which indicates that a record is included if the selected value appears anywhere within the specified field**
  ```
  INCLUDE COND=(10,44,CH,SS,"*")
  ```
  - selects any record in which the character "*" appears within columns 10 to 53
- **Consider this example:**
  ```
  INCLUDE COND=(5,4,CH,EQ,C’0500’,AND,
                266,4,CH,EQ,C’NO  ’,AND,
                   (10,249,SS,EQ,C’*’,OR,
                    10,249,SS,EQ,C’%’,OR,
                    10,249,SS,EQ,C’&’))
  ```
  - Which finds all general resource profiles (record type ’0500’) which are not generic (record offset 266 contains ’NO’) but have a generic character in the name (the "SS" operands)

Data Mining Your RACF Data

Using DFSORT Symbols

- DFSORT release 14 introduced the DFSORT SYMBOL, which can be used to replace fields (and constants) in DFSORT and ICETOOL statements with easy-to-read labels
  - **USBD_OPER** could be used as a symbol for **44,1,CH**
- RACFICE contains DFSORT symbols for all of the IRRADU00 and IRRDBU00 fields.
- Using these symbols, you could specify these DFSORT statements:

```
SORT FIELDS=(USBD_NAME,A)
INCLUDE COND=(GRBD_RECORD_TYPE,EQ,C’0500’,AND,
              GRBD_GENERIC,EQ,C’NO  ’,AND,
                 (GRBD_NAME,SS,EQ,C’*’,OR,
                  GRBD_NAME,SS,EQ,C’%’,OR,
                  GRBD_NAME,SS,EQ,C’&’))
```

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A Sample SQL Query

- As an alternative, a relational database manager such as DB2 can be used. RDBMs are most useful for complex selection criteria which span record types.
- Find all of the data set accesses made to data sets whose name begins with "PAYROLL." that were made before 8:00 AM and after 4:59 PM. Ignore all of the requests made by the user OPERBKUP.

```
SELECT
     *
FROM
     USER01.ACCESS
WHERE
     (HOUR(SMF80_TIME_WRITTEN)<8 OR HOUR(SMF80_TIME_WRITTEN)>16)
     AND
     SMF80_EVT_USER_ID^= ’OPERBKUP’
     AND
     ACC_RES_NAME LIKE ’PAYROLL.%’
     ;
```

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Step 4: Refining the Search

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Refining the Search

- **No matter what analysis tool is used, your results fall into one of four categories:**
  - Too much data ("over inclusion")
    - Add additional selection criteria
  - Too little data ("inadvertent exclusion")
    - Remove or lessen criteria
  - The wrong data ("creates confusion")
    - Specify the right criteria
  - The correct data ("right conclusion")
- **Executing against known test data is essential!**

Data Mining Your RACF Data

Additional Material

Data Mining Your RACF Data

What Samples are Shipped With RACF?

- **Sample JCL for:**
  - IRRDBU00
  - IRRADU00
- **Sample SQL create tablespace and create table statements for IRRDBU00 and IRRADU00**
- **DBMS Load Utility control statements for DB2 Load Utility for IRRDBU00 and IRRADU00**
- **Sample queries for IRRADU00 and IRRDBU00 output**
- **30+ ICETOOL reports in ’SYS1.SAMPLIB(IRRICE)’**

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What Reports does RACFICE Contain?

- **Users who have extraordinary global/goup RACF attributes**
- **Discrete data set/general resource profiles which contain generic characters**
- **Users who have more than 20 group connections**
- **Count of user/group/data set/general resource (by class) profiles**
- **User IDs with group privileges above USE**
- **Data set standard and general resources with a UACC of other than NONE**
- **Data set standard and conditional access lists with ID(*) of other than NONE**
- **General resource standard and conditional access lists with ID(*) of other than NONE**
- **Users who have explicit RRSF associations defined**
- **User IDs with an OMVS segment**
- **OS/390 UNIX super users (UID of zero)**
- **OS/390 UNIX UIDs which are used more than once**
- **HLQs with excessive generic profiles**
- **HLQs with excessive fully-qualified generic profiles**
- **User profiles defined in the past 90 days**

Data Mining Your RACF Data

What Reports does RACFICE Contain?...

- **Events associated with a specific user**
- **User IDs with excessive incorrect passwords**
- **Terminals with excessive incorrect passwords**
- **Accesses allowed due to WARNING mode profiles**
- **Accesses allowed because the user has OPERATIONS**
- **Users who are using Automatic Command Direction**
- **Users who are directing command explicitly**
- **User who log on with LOGON BY**
- **RACLINK audit records**
- **Users who are using password synchronization**
- **Access violations**

Data Mining Your RACF Data

Where are These Utilities Documented?

- **RACF Database Unload Utility (IRRDBU00)**
  - RACF Security Administrator’s Guide
  - RACF Macros and Interfaces
- **RACF SMF Data Unload Utility (IRRADU00)**
  - RACF Auditor’s Guide and RACF Macros and Interfaces
- **DFSORT ICETOOL Utility**
  - DFSORT Application Programming Guide

Data Mining Your RACF Data

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- **What is Data Mining and how does it relate to RACF?**
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  - Why are advanced analysis tools required?
  - What is data mining?
- **A four step approach:**
  - Understand the data and tools at our disposal
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