C/C++ Productivity Tools for OS/390

Performance Analyzer

Note!

Before using this information and the product it supports, be sure to read the general information under **Notices**.

Edition notice (November 2000)

This edition applies to C/C++ Productivity Tools fo OS/390 Release 1.0, program number 5655-B85 and to all subsequent releases and modifications until otherwise indicated in new editions. Consult the latest edition of the applicable system bibliography for current information on these products.

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Contents

Chapter 1. The Performance Analyzer for OS/390

The Performance Analyzer helps you understand and improve the performance of your C/C++ programs. It traces the execution of a program and creates a trace file which contains data that can be examined in several diagrams at the workstation. Sometimes this tracing is also referred to as *profiling*. With the trace information, you can improve the performance of a program, examine a sequence of calls leading up to an exception, and understand the execution flow when a program runs.

The Performance Analyzer can complement other application development tools by helping you understand aspects of the program that would otherwise be difficult to visualize. For instance, with the Performance Analyzer you can:

- **Time and tune programs**
  The Performance Analyzer records the time stamp of each trace event. As a result, the trace file contains a detailed record of when your program called and exited each traced function. The trace data also shows how long each function ran, which helps you identify code that you may want to tune.
- **Diagnose program abends**
  The Performance Analyzer provides a complete history of events leading up to the point where a program abends.
- **Trace multithreaded programs**
  After tracing a multithreaded program, you can examine the individual threads to identify their function usage.
- **Trace multiple processes**
  When your POSIX programs use the fork and spawn functions to create new processes, you can still view the events in the different processes because a separate trace file is created for each process.

The Performance Analzyer performs function tracing on a program. Function tracing records information about each function call and return made during the execution of the program.

Performance Analyzer components
The Performance Analyzer has two components:

- **Host component**
  Traces your host program's execution and creates a binary trace file containing the trace data that was collected. You then download this file to the workstation for analysis.
- **Workstation component**
  Allows you to analyze the trace file that you have created on the host. You can take advantage of graphical and textual diagrams to assist you with the analysis of the trace data.

RELATED CONCEPTS

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Function trace"Function trace" on page 14
Call frequency counting"Call frequency counting" on page 13
Multiple process support"Multiple process support" on page 16

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RELATED REFERENCES

Run-time option for program tracing “Run-time option for program tracing” on page 62
Run-time environment variables for program tracing “Run-time environment variables for program tracing” on page 64
Limitations when creating a trace“Limitations when creating a trace” on page 59

Performance Analyzer product files

Host Data Sets

The host component runs from a data set, CBC.SCTVMOD, which contains the following members:

- **CEEEVPRF**
  Alias for the Performance Analyzer module
- **CTVMSGE**
  English messages
- **CTVMSGK**
  Kanji messages
- **CTVMSGT**
  Message table
- **CTVPFILE**
  Performance Analyzer module
- **ICTVMSGT**
  Alias for the message table

OS/390 Version 2 Release 4 and subsequent releases ship the dataset. To use the Performance Analyzer product dataset you must purchase and enable the OS/390 C/C++ Compiler with Debug feature in OS/390.The installation program adds an entry to the IFAPRDxx parmlib member with the feature name “C/C++/DEBUG” to enable this feature in OS/390. You must also apply the latest service to FMIDs, H24P111 and J24P112. See *OS/390 Planning for Installation* and *OS/390 MVS Initialization and Tuning Guide* or contact your system programmer for more information about enabling OS/390 features and applying service to this data set.

To run the Performance Analyzer on the host system, the CBC.SCTVMOD data set must be included in the OS/390 modules’ search path. To do this, your system programmer can add it to the Link Pack Area, you can add it to your STEPLIB DD statement in your JCL, or you can use the export command in the OS/390 shell to add it to your STEPLIB before you run your program.

RELATED CONCEPTS

The Performance Analyzer for OS/390“Chapter 1. The Performance Analyzer for OS/390” on page 1

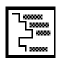
RELATED TASKS

Creating a trace file“Creating a trace file” on page 28
Starting the Performance Analyzer to analyze a trace file“Starting the Performance Analyzer to analyze a trace file” on page 38

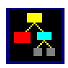
Chapter 2. Diagrams for analyzing a trace file

Diagrams for analyzing a trace file

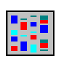
The Performance Analyzer provides several diagrams in which you can view and analyze the data contained in your trace file. Each diagram presents a different view of the trace data to give you an overall idea of how your program performs. The following list contains the names of the diagrams, the icons used to represent them, and a brief description of each; more detailed introductions to the diagrams and their uses are included in the related topics below.



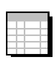
Call Nesting
The Call Nesting diagram shows the trace file as a sequential series of function calls and returns. This diagram helps in diagnosing problems with critical sections, sequencing protocols, thread delays, and crashes.



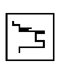
Dynamic Call Graph
The Dynamic Call Graph diagram is a two-dimensional graphical representation of your program's execution. It shows the relative importance (in terms of execution time) of program components, and the call hierarchy.



Execution Density
The Execution Density diagram shows your program in terms of execution time. It shows trace data chronologically from top to bottom as thin horizontal lines of various colors in columns assigned to each traced function.



Statistics
The Statistics diagram is a textual report of cumulative information about your program's execution. It provides summary and detailed statistics on execution time and event generation for each component type: function, class, and executable.



Time Line
The Time Line diagram shows function calls and returns in chronological order along a vertical line. A function call is represented by a short horizontal line to the right, and a function return is represented by a short horizontal line to the left. The horizontal lines are connected by vertical lines whose length is proportional to the amount of time that elapsed between the respective events.

RELATED CONCEPTS

Call Nesting Diagram"Call Nesting diagram" on page 6
Dynamic Call Graph Diagram"Dynamic Call Graph diagram" on page 6
Execution Density Diagram"Execution Density diagram" on page 8
Statistics Diagram
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RELATED TASKS

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Call Nesting diagram

The Call Nesting diagram shows the trace file as a series of function calls and returns, arranged vertically. Use this diagram to diagnose problems with critical sections, sequencing protocols, program crashes, or thread delays.

Trace Data

The trace data shown by the Call Nesting diagram includes the following elements:

- The functions that were called during program execution
- The order in which the functions were called and in which they returned
- The nesting of function calls (the call stack) at any point during program execution
- The points at which control switched from one thread to another during program execution

Uses

Use the Call Nesting diagram to perform the following tasks:

- Examine the specific elements of trace data listed above.
- See the interactions among the threads.
- Get a better understanding of the program’s flow.
- View and create annotations of trace file events.

RELATED CONCEPTS

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RELATED TASKS

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Filtering Events by Thread“Filtering events by thread” on page 48
Correlating Events between Diagrams“Correlating events between diagrams” on page 39
Recognizing Call Sequence Patterns“Recognizing call sequence patterns” on page 51
Viewing Thread Interactions in a Multithreaded Program“Viewing thread interactions in a multithreaded program” on page 54

Dynamic Call Graph diagram

The Dynamic Call Graph diagram is a two-dimensional graphical representation of your program’s execution. It shows the relative importance in terms of execution time of the different components, and the call hierarchy.

Trace Data

The trace data shown by the Dynamic Call Graph diagram includes the following elements:

- The functions, classes, or executables (components) that ran during program execution
- The calls that were made from one component to another
- The call hierarchy
- The caller, the callee, and the number of times a call was made between each pair of components
- The relative importance of each call between components in terms of the number of calls made between components
- The relative importance of each component in terms of execution time and time on stack

You can show trace data for one type of component at a time:

- When you choose to show information on functions, the following trace data is available for each function that ran:
  - Function name
  - Compile unit
  - Object file (workstation programs) or Compile unit (host programs)
  - Executable name
  - Execution time
  - Number of calls
  - Time on stack
- When you choose to show information on classes (possible only if your trace file contains class information), the following trace data is available for each class whose code was executed:
  - Class name
  - Names of member functions and their associated statistics
  - Execution time
  - Number of calls to the member functions in the class
- When you choose to show information on executables, the following trace data is available for each executable that ran:
  - Executable name
  - Functions in the executable, and their associated statistics
  - Execution time
  - Number of calls

Uses

Use the Dynamic Call Graph diagram to perform the following tasks:

- Examine the specific types of trace data listed above.
- Get an overall view of your program and its flow.
- See the relative importance in terms of execution time of program components.
- See where time is spent in your program.
- See your program's call hierarchy.

RELATED CONCEPTS

Diagrams for Analyzing a Trace File“Diagrams for analyzing a trace file” on page 5

RELATED TASKS

Opening a Trace File in a Diagram“Opening a trace file in a diagram” on page 38
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Filtering Nodes and Arcs in the Dynamic Call Graph Diagram“Filtering nodes and arcs in the Dynamic Call Graph diagram” on page 50
Enlarging or Reducing a Diagram“Enlarging or reducing a diagram” on page 39

Execution Density diagram

The Execution Density diagram shows the trace data chronologically from top to bottom, as follows:

- Each vertical column represents a function (or collapsed group of functions if you have included group information in the diagram).
- Each horizontal line represents a time slice.
- The color of each horizontal line represents the percentage of execution time spent in the given function for that time slice. (Only included threads, functions, and groups are used in calculating this percentage.)

  For instance, in the default setting, functions executing more than 50% of a given time slice are represented by a red horizontal line drawn in the appropriate column at the vertical location corresponding to that time slice.

Trace Data

The trace data shown by the Execution Density diagram includes the following elements:

- The percentage of execution time spent in every traced function or group of functions for each time slice
- The total time, start time, and end time for a selected range of time

You can also show information on collections of functions, called *groups*. That is, you can define groups of functions that are meaningful to you using the **Options > Work with groups...** dialog, and can then optionally select a subset of the groups to include in the diagram using the **View > Include groups...** dialog. You can toggle the showing of group information on or off by repeatedly selecting the **View > Group filter** option.

Uses

Use the Execution Density diagram to perform the following tasks:

- Get an overview of what functions were the most active at various stages of your program’s execution.
- Spot execution trends.

RELATED CONCEPTS

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Function Groups“Function groups” on page 19

RELATED TASKS

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Filtering Events by Function“Filtering events by function” on page 47
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Statistics diagram

The Statistics diagram gives you a textual report of execution time by function (or group of functions, if you include group information in the diagram), class (if your trace file contains class information), or executable. Use this information to find hot spots in the overall program execution.

Trace Data

The trace data shown by the Statistics diagram consists of summary and detailed information.

The summary information shown by the Statistics diagram can include the following elements:

- Executable name
- Trace file description (if a description was entered when the file was created)
- Execution date
- Execution time
- Number of executables generating events
- Number of classes generating events
- Number of functions generating events
- Number of threads generating events
- Total number of events
- Total number of annotations
- Number of user events
- Maximum call nest depth
- Number of trace buffer flushes
- Total trace time excluding overhead
- Trace overhead
- Indication of whether time is task (CPU) time, or real (clock) time

  Note: Data for classes is shown only if your trace file contains class information. The default class C_Function always exists, however.

Detailed information is shown for each component traced. Depending upon whether you are viewing information on functions, classes, or executables, the information shown by the Statistics diagram can include the following elements:

- Percent of total execution time spent in the component
- Percent of the total execution time that the component was on the call stack
- Number of times the component was called
- Cumulative execution time spent in the component
- Cumulative execution time that the component was on the call stack
- Execution time for the shortest call to the component
- Execution time for the longest call to the component
- Average execution time for a call to the component

You can also show information on collections of functions, called *groups*. That is, you can define groups of functions that are meaningful to you using the **Options >**

Work with groups... dialog, and can then optionally select a subset of the groups to include in the diagram using the **View > Include groups...** dialog. If **View > Details on** is set to **Functions**, you can toggle the showing of group information on or off by repeatedly selecting the **View > Group filter** option.

Uses

Use the Statistics diagram to perform the following tasks:

- Quickly determine which components are consuming the largest amount of execution time. These components are likely to be ones for which performance tuning would prove most beneficial.
- Determine which of your functions are good candidates for inlining. If a function has a small average execution time and is called often, it is a good candidate for inlining.
- Analyze your algorithms by comparing the number of calls that were made to a particular component with the number of calls that you expected, in order to isolate possible inefficiencies.
- Determine which of several algorithms performs better by comparing the statistics recorded in a trace file generated separately for each different version of the algorithm.

RELATED CONCEPTS

Diagrams for Analyzing a Trace File“Diagrams for analyzing a trace file” on page 5
Function Groups“Function groups” on page 19

RELATED TASKS

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Viewing Class Activity“Viewing class activity” on page 51
Selecting Functions to Inline“Selecting functions to inline” on page 53

Time Line diagram

The Time Line diagram shows the sequence of nested function calls and returns, with a vertical distance between events that is proportional to the amount of time that elapsed between the respective events. It provides a direct and natural presentation of the chronological relationships of events. The Time Line diagram also shows when the flow of execution switches from one thread to another by means of a dashed horizontal line.

Trace Data

The trace data shown by the Time Line diagram includes the following elements:

- The functions that were called during program execution
- The order in which the functions were called and in which they returned
- The time at which the functions were called and at which they returned, and the time that elapsed between events
- The nesting of function calls (the call stack) at any point during program execution
- The points at which control switched from one thread to another during program execution

Uses

Use the Time Line diagram to perform the following tasks:

- Examine the specific elements of trace data listed above.
- See the interactions among various threads.
- Get a better understanding of a program's flow.
- Determine the elapsed time between two events.

RELATED CONCEPTS

Diagrams for Analyzing a Trace File"Diagrams for analyzing a trace file" on page 5

RELATED TASKS

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Chapter 3. Trace file generation

Call frequency counting

During function tracing, instead of collecting all tracing data, you can limit the information collected by the Performance Analyzer to the following:

- The functions that each function calls and how many times it calls them
- A count of the number of times each function is called

This data provides information about the call relationships between functions and indicates which functions are being called most frequently. You can use this information to analyze your program and to fine tune its performance.

When you specify FUNCTION=COUNTS as a suboption of the **PROFILE** run-time option, call frequency data is written to a trace file. After you download this file to the workstation, you can display the file graphically using the Dynamic Call Graph diagram and the Statistics diagram. No other diagrams display call frequency information.

Note: Call Frequency Counting does not provide call timing information nor does it include a chronological list of events that occur during the execution of the program (function calls, function returns, thread creation, thread switches). This reduces the size of the trace file, making it more manageable and easier to analyze.

A sample call frequency counting trace file called CallFrequency.trc is available in the 390ProductivityTools\samples directory.

RELATED CONCEPTS

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Trace events“Trace events” on page 14
Overhead time“Overhead time” on page 16

RELATED TASKS

Collecting call frequency data “Collecting call frequency data” on page 33
Downloading the trace files from the host“Downloading the trace file from the host” on page 37

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Run-time option for program tracing“Run-time option for program tracing” on page 62
Run-time environment variables for program tracing“Run-time environment variables for program tracing” on page 64

Time stamps

During function tracing, the Performance Analyzer collects time stamp data. A time stamp is a number representing a point in time. At each trace event during the execution of a program, the Performance Analyzer records a time stamp, representing the precise time that the trace event occurred. By comparing the time stamps of two trace events, the elapsed time between the two trace events can be determined. Use the time stamp data associated with the trace events to analyze your program's performance, such as identifying performance bottlenecks.

Note: Time stamps are not collected when Call Frequency Counting is specified.

RELATED CONCEPTS

Trace events"Trace events"
Function trace"Function trace"
Overhead time"Overhead time" on page 16
Call frequency counting"Call frequency counting" on page 13

Trace events

To enable your program to be traced, compile it using the TEST(HOOK) and NOGONUMBER compile options. NOGONUMBER is optional, however it will significantly reduce the load module size. If the module is going to be both traced and debugged then do not specify NOGONUMBER. The Test(HOOK) option enables the compiler to generate hooks in the code at the following points:

- Function entry
- Function exit
- Before a function call
- After a function call

The Performance Analyzer uses these points in the code as trace events. A hook in the code enables the Performance Analyzer to get control and record various information about the event such as the time of the event and the thread and function associated with the event. By default, each event is recorded in chronological order.

By default, the first event in the trace will be a call to a dummy function called __PROGRAM__. This event represents the program start time. The last event in the trace will be the return from the __PROGRAM__ function and represents the program end time. The _PROGRAM_ events are not included in traces created with delay tracing and traces of Webserver applications.

Note: When Call Frequency Counting is specified, the events are not recorded. The only processing that is done for a trace event in this case is incrementing the call counter for the function and recording call frequency data.

RELATED CONCEPTS

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Function trace"Function trace"
Overhead time"Overhead time" on page 16
Call frequency counting"Call frequency counting" on page 13
Delay tracing"Delay tracing" on page 17

Function trace

The Performance Analzyer performs function tracing, during which information is recorded about the function calls and returns made during the execution of the program.

To enable your program to be traced, compile it using the TEST(HOOK) and NOGONUMBER compile options. These options enable the compiler to generate hooks in the code at the following points:

- Function entry
- Function exit
- Before a function call
- After a function call

The Performance Analyzer uses these points in the code as trace events. A hook in the code enables the Performance Analyzer to get control and record the time of the event. These hooks call a small monitoring function that creates a time stamp on each event. The monitoring function also determines which function the trace event is for and the module that the function is in. By comparing the time stamps of the function entry and the function exit events, the Performance Analyzer determines the time taken to execute the function.

By default, the first event in the trace will be a call to a dummy function called __PROGRAM__. This event represents the program start time, which may be different than the time that the first hook is encountered in the program. There is a corresponding function call return event at the end of the trace that represents the program end time. The _PROGRAM_ events are not included in traces created with delay tracing and traces of Webserver applications. The execution time of the __PROGRAM__ function and module represents the time spent during the execution of the program when there are no functions containing hooks on the stack. The __PROGRAM__ execution time will be more significant when not all of the program source files are compiled with TEST(HOOK).

Use Function trace files to accomplish the following objectives:

- Identify costly or time-consuming functions
- Show logic flow (useful for constructors and destructors)
- Identify potential inline functions
- Determine which functions of a DLL are being called
- Track library calls
- Verify all built-in functions are used
- Track function calls among threads
- Track class interaction
- Track module interaction

RELATED CONCEPTS

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Trace events“Trace events” on page 14
Overhead time“Overhead time” on page 16
Call frequency counting“Call frequency counting” on page 13
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RELATED TASKS

Creating a trace file“Creating a trace file” on page 28

RELATED REFERENCES

Limitations when creating a trace“Limitations when creating a trace” on page 59
Run-time option for program tracing“Run-time option for program tracing” on page 62

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Run-time environment variables for program tracing“Run-time environment variables for program tracing” on page 64
Call nesting diagram“Call Nesting diagram” on page 6
Dynamic call graph diagram“Dynamic Call Graph diagram” on page 6
Execution density diagram“Execution Density diagram” on page 8
Statistics diagram“Statistics diagram” on page 9
Time line diagram“Time Line diagram” on page 10

Overhead time

Function Tracing
Whenever the Performance Analyzer logs an event for function tracing, it adds overhead to the normal execution time of your program. This increases the overall execution time of your program. The monitoring function calculates the overhead time on each event. The Performance Analyzer compensates for this overhead time by adjusting the timestamp for the event. It subtracts the overhead time from the event’s timestamp. This adjustment ensures that your program’s true execution performance is reported as accurately as possible.

When tracing is turned off, the monitoring function will not be executed, even if the code contains hooks. However, when hooks are placed in the code, the code size increases. This, along with the small amount of time to execute the hook instructions, may affect the performance of your program, even when tracing is turned off. When you have finished using the Performance Analyzer to tune your program, rebuild it without generating hooks by compiling it without the TEST(HOOK) option. This will improve the execution performance of your program.

RELATED CONCEPTS

Trace events“Trace events” on page 14
Function trace“Function trace” on page 14
Time stamps“Time stamps” on page 13

Multiple process support

Use the Performance Analyzer to trace a single-process program or to trace a program that uses the fork or spawn function to create new processes. A separate trace file with a unique name is generated for each process created by the program. If the process is the result of a fork or spawn call, the name of the trace file for the process has the ID of the process (PID) appended to it.

The names of process and program trace files are based on the value of the __PROF_FILE_NAME environment variable.

RELATED CONCEPTS

Function trace“Function trace” on page 14

RELATED TASKS

Creating a trace file“Creating a trace file” on page 28

RELATED REFERENCES

Sample trace file names from tracing a multiprocess program“Sample trace file names from tracing a multiprocess program” on page 76
Run-time environment variables for program tracing“Run-time environment variables for program tracing” on page 64

Delay tracing

Instead of tracing the entire execution of a program, you can trace portions of the execution by using delay tracing. With delay tracing, you delay the start of tracing until after the program has started executing. It allows you to dynamically start and stop tracing one or more times during the execution of the program. Each time you stop tracing, a new trace file is created containing the data collected since the last time tracing was started. If tracing is not stopped manually, tracing will continue until the program being traced terminates.

To use delay tracing, include the DELAY option in the sub-option string passed on the PROFILE run-time option. To start or stop tracing, a SIGPROF signal is sent to the process on which the program is running, using the OS/390 UNIX System Services command kill. The same command is used for both starting and stopping tracing.

Note: Since the OS/390 UNIX System Services kill command is used, delay tracing can only be performed from the OS/390 UNIX System Services shell.

RELATED CONCEPTS

Time stamps“Time stamps” on page 13
Function trace“Function trace” on page 14
Overhead time“Overhead time” on page 16
Call frequency counting“Call frequency counting” on page 13

Chapter 4. Trace file viewing and analysis

Function groups

You can create arbitrary collections of functions, called *groups*, and then analyze performance data for one or more selected groups only, instead of analyzing data for all of the functions in your program.

For example, you could create a group called *storage*, assign all storage-related functions to that group, and then analyze only the storage group to understand how much time your program is spending in storage-management activities.

You can create multiple group definitions and save them in a grouping file for later recall, and can create multiple grouping files.

You can view performance information by groups in several diagrams.

In any diagram that supports grouping, select **Collapse group** to combine all of the functions in a group into a single entry. This option is available from the **View**, **Selected**, or selected item pop-up menu when the diagram is showing group information and a function in one of the groups shown is selected.

You can likewise select **Expand group** to restore a collapsed group to its component entries, one per function. This option is available from the **View**, **Selected**, or selected item pop-up menu when the diagram is showing group information and a collapsed group is selected.

RELATED CONCEPTS

Execution Density Diagram"Execution Density diagram" on page 8
Statistics Diagram"Statistics diagram" on page 9

RELATED TASKS

Filtering Events by Group"Filtering events by group" on page 48

Pattern recognition

Loops in your program cause the same sequence of calls and returns to be repeated in the trace. The Performance Analyzer lets you combine like sequences in the Call Nesting diagram by using pattern recognition. The pattern recognition facility looks at a single thread and indicates patterns of calls and returns using curved arcs that show the number of repetitions of each pattern to the right.

This technique reduces the amount of screen space the diagram uses, and therefore shortens the number of pages you must scroll through to look at your trace file.

If you see a pattern repeated numerous times, for workstation programs you can group the functions in the pattern together with *pragma alloc_text* statements to limit the number of page swaps between calls, and thus improve performance. For host programs, group all of the functions in the pattern in one source file, close to each other, to limit the number of page swaps.

Pattern recognition can only be used when you include a single thread for analysis, and there are no collapsed functions in the diagram.

RELATED CONCEPTS

Call Nesting Diagram“Call Nesting diagram” on page 6

RELATED TASKS

Recognizing Call Sequence Patterns“Recognizing call sequence patterns” on page 51
Filtering Events by Thread“Filtering events by thread” on page 48

Diagram filters

There are several techniques for filtering the trace file to reduce the amount of trace data shown in a diagram, or for isolating interesting or problematic areas in a diagram.

Some techniques have associated tasks that need to be performed in order to apply a filter; such tasks are indicated in the related topics below. Other techniques involve a straightforward manipulation of the objects shown in a diagram’s display. The following list contains filtering techniques that you can use in each of the diagrams.

Call Nesting diagram

In this diagram, you can filter data in the following ways:

- Selecting specific functions or specific threads to include. The Performance Analyzer shows trace information only for those functions or threads selected.
- Selecting a time or time range to view.
- Collapsing calls so that all calls and returns subordinate to a calling function are hidden.

Dynamic Call Graph diagram

In this diagram, you can filter data in the following ways:

- Selecting specific threads to include. The Performance Analyzer shows trace information only for those threads selected.
- Removing nodes in the call path to or from a selected node.
- Hiding arcs.
- Hiding selected nodes.
- Creating a subgraph to work with. Doing so cleans up the diagram by deleting hidden nodes, repositioning remaining nodes, and centering the diagram.
- Zooming in.
- Showing data by function, class (only if your trace file contains class information), or executable by selecting from the **View > Nodes of** menu.
- Specifying that only nodes meeting selected criteria of number of calls, percent of execution time, percent of time on stack, execution time, or time on stack are shown.
- Specifying that only arcs meeting a criterion of number of calls are shown.

Execution Density diagram

In this diagram, you can filter data in the following ways:

- Selecting specific functions or threads to include. The Performance Analyzer shows trace information only for those functions or threads selected.
- Selecting specific groups of functions to include. The Performance Analyzer shows trace information only for those groups selected.
- Scaling the diagram to increase the number of pages shown.
- Zooming in.
- Selecting a time or time range to view.

Statistics diagram

In this diagram, you can filter data in the following ways:

- Selecting specific threads to include. The Performance Analyzer shows trace information only for those threads selected.
- Selecting specific groups of functions to include. The Performance Analyzer shows trace information only for those groups selected.
- Showing data by function, class (only if your trace file contains class information), or executable by selecting from the **View > Details on** menu.

Time Line diagram

In this diagram, you can filter data in the following ways:

- Scaling the diagram to increase the number of pages shown.
- Zooming in.
- Selecting a time or time range to view.

RELATED CONCEPTS

Diagrams for Analyzing a Trace File“Diagrams for analyzing a trace file” on page 5
Function Groups“Function groups” on page 19

RELATED TASKS

Filtering Events by Function“Filtering events by function” on page 47
Filtering Events by Thread“Filtering events by thread” on page 48
Filtering Events by Group“Filtering events by group” on page 48
Filtering Events by Component Type“Filtering events by component type” on page 47

Correlation

One diagram cannot show everything of interest within a trace file. Some events are easier to find in one diagram, but the information in another is more meaningful; in such cases it is helpful to find the event in one diagram and then locate that same event in one or more of the other open diagrams. Correlation allows you to do so.

The Performance Analyzer provides three diagrams whose events can be correlated between any two of them, or between all three: Call Nesting, Execution Density, and Time Line. You can correlate the diagrams based on a specific time or event, or on a range of time or events. You can also correlate (in one direction) from a function in the Statistics diagram to a call to that same function in the Call Nesting diagram; the call located is the one that used the most time of all calls to the function.

For example, use the Call Nesting diagram to identify the order and names of functions called, and then correlate to the Time Line diagram to find out how long the functions took to run. Or you can use the Execution Density diagram to see general patterns that lead up to a certain point, and then correlate to the Call Nesting diagram to see the exact order of the function calls.

Note that it is possible to correlate events between two instances of the same diagram, which could prove useful, for example, if each is scaled differently.

RELATED CONCEPTS

Call Nesting Diagram
"Call Nesting diagram" on page 6Execution Density Diagram
"Execution Density diagram" on page 8Statistics Diagram
"Statistics diagram" on page 9Time Line Diagram"Time Line diagram" on page 10

RELATED TASKS

Correlating Events between Diagrams"Correlating events between diagrams" on page 39

Chapter 5. Tips for using the Performance Analyzer to understand your program

Use a combination of diagrams to understand your program

The Performance Analyzer allows you to open a trace file in several diagrams, and to open multiple views of the same diagram simultaneously. Sometimes opening a trace file in two or more diagrams can help you understand a program better.

For instance, if you do not want to wade through code listings to determine how the code works, use the Dynamic Call Graph diagram, and the Call Nesting and Time Line diagrams in conjunction with each another to get a better understanding of the program's flow.

In the Call Nesting diagram you can see the order in which functions are called and return, and in the Time Line diagram you can see the timing of the calls and returns.

The Dynamic Call Graph diagram shows all of the program's threads, the relative consumption of execution time by the different functions, and the call hierarchy.

RELATED CONCEPTS

Diagrams for Analyzing a Trace File"Diagrams for analyzing a trace file" on page 5

RELATED TASKS

Opening a Trace File in a Diagram"Opening a trace file in a diagram" on page 38
Correlating Events between Diagrams"Correlating events between diagrams" on page 39
Seeing Details by Combining the Zoom and Correlation Features"Seeing details by combining the zoom and correlation features" on page 40

Annotate your trace file

An annotation is a bookmark or reminder that you can place in the trace file after it is created. In the Call Nesting diagram, select **Edit > Annotate...** to insert notes or reminders next to any function you highlight.

Workstation Programs Only: The following information is applicable to workstation programs only.

Chapter 6. Preparing your program for analysis

Compiling your program

Specify the following compile options:

- TEST(HOOK)
  Generates the following hooks in your code:
  - Function entry and exit
  - Before function call and after function call
- NOGONUMBER
  NOGONUMBER is optional. However, if it is specified, NOGONUMBER significantly reduces the size of the load module produced because no line number tables are generated in the code. Line number tables are required debugging, not for tracing. If the module is going to be both traced and debugged do not specify NOGONUMBER.
- OPT(1) or OPT(2)
  Optimization will improve the performance of the application.

Note: For C programs compiled with NOOPT, specify the TEST option as TEST(HOOK,PATH,NOLINE,NOBLOCK,NOSYM).

You can build executables and DLLs from multiple compilation units (object files). You can specify the TEST(HOOK) compile option for only those compilation units that you want to trace. When your executable or DLL is running, the Performance Analyzer only captures trace information for those compilation units built with TEST(HOOK).

For example, if you use the TEST(HOOK) option when compiling both the caller function A and the called function B, the Performance Analyzer sees hooks in the following order:

1. Function A entry hook
2. Before function B call hook
3. Function B entry hook
4. Function B exit hook
5. After function B call hook
6. Function A exit hook

In the example, if function B calls a third function C in another DLL which was compiled with NOTEST, then the Performance Analyzer sees hooks in the following order:

1. Function A entry hook
2. Before function B call hook
3. Function B entry hook
4. Before function C call hook
5. After function C call hook
6. Function B exit hook
7. After function B call hook
8. Function A exit hook

Note that no hooks are available for entry and exit of function C.

Although the hooks exist, you can reduce the overhead time of tracing and, therefore, the overall program execution time by setting the environment variable __PROF_HOOKS to BEFORE_AFTER or to ENTRY_EXIT. This reduces the number of hooks that Performance Analyzer processes. If you set __PROF_HOOKS to ALL, the Performance Analyzer processes all hooks.

Note: Do not compile the program with the NOEXECOPS compile option because it will prevent the processing of run-time options and therefore the invocation of the Performance Analyzer.

Refer to the OS/390 C/C++ User's Guide for more information on compiling programs.

RELATED CONCEPTS

Function trace"Function trace" on page 14

RELATED TASKS

Setting environment variables for Performance Analyzer"Setting environment variables for Performance Analyzer"
Setting run-time option PROFILE for Performance Analyzer"Setting run-time option PROFILE for Performance Analyzer" on page 27
Creating a trace file"Creating a trace file" on page 28

RELATED REFERENCES

Run-time option for program tracing "Run-time option for program tracing" on page 62
Run-time environment variables for program tracing"Run-time environment variables for program tracing" on page 64
Sample JCL for creating trace files"Sample JCL for creating trace files" on page 72
Sample TSO commands for creating trace files"Sample TSO commands for creating trace files" on page 75
Sample Unix system service commands for creating trace files"Sample Unix system service commands for creating trace files" on page 74

Setting environment variables for Performance Analyzer

The following environment variables allow you to control the trace data that is created by the Performance Analyzer.

You can set these environment variables before executing your program for tracing:

- **__PROF_APPEND_PID = YES|NO** specifies whether the process identifier (PID) is appended to the trace file name.
- **__PROF_FILE_NAME=*filename* s**pecifies the name of the trace file to be generated.
- **__PROF_HOOKS = ALL|ENTRY_EXIT|BEFORE_AFTER** identifies the type of hooks that are to be processed.
- **__PROF_WEBSERVER=NO|YES** indicates whether tracing is to be performed in a Lotus Domino Go Webserver environment.

The following samples are available for setting the environment variables:

- Sample JCL for creating trace files“Sample JCL for creating trace files” on page 72
- Sample Unix system service commands for creating trace files“Sample Unix system service commands for creating trace files” on page 74
- Sample TSO Commands for creating trace files“Sample TSO commands for creating trace files” on page 75

Refer to the *OS/390 C/C++ Programming Guide* and *OS/390 UNIX System Services User’s Guide* for more information on environment variables. These books are available through the OS/390 C/C++ Library page.

RELATED CONCEPTS

Function trace“Function trace” on page 14

RELATED TASKS

Compiling your program“Compiling your program” on page 25
Setting run-time option PROFILE for Performance Analyzer“Setting run-time option PROFILE for Performance Analyzer”
Creating a trace file“Creating a trace file” on page 28

RELATED REFERENCES

Run-time environment variables for program tracing“Run-time environment variables for program tracing” on page 64

Setting run-time option PROFILE for Performance Analyzer

To enable the tracing of a program during its execution, set the Language Environment run-time option, PROFILE, using the following syntax:

`PROFile(ON,'string')`

You specify tracing details with the *string* suboption.

The following samples are available for setting the Language Environment run-time option, PROFILE:

- Sample JCL for creating trace files“Sample JCL for creating trace files” on page 72
- Sample Unix system service commands for creating trace files“Sample Unix system service commands for creating trace files” on page 74
- Sample TSO Commands for creating trace files“Sample TSO commands for creating trace files” on page 75

Note: Do not compile the program with the NOEXECOPS compile option because it will prevent the processing of run-time options and therefore the invocation of the Performance Analyzer.

Refer to the *Language Environment for OS/390* and *VM Programming Reference* for more information on run-time options.

RELATED CONCEPTS

Function trace“Function trace” on page 14

RELATED TASKS

Compiling your program“Compiling your program” on page 25
Setting environment variables for Performance Analyzer“Setting environment variables for Performance Analyzer” on page 26
Creating a trace file“Creating a trace file”
Specifying trace file name“Specifying trace file name” on page 35

RELATED REFERENCES

Run-time option for program tracing“Run-time option for program tracing” on page 62
Run-time environment variables for program tracing“Run-time environment variables for program tracing” on page 64

Creating a trace file

When you run a program, the Performance Analyzer is started by setting the run-time option, PROFILE(ON,’string’). You must complete the following steps before running your program:

1. Compile your program with TEST(HOOK), NOGONUMBER.
2. Set the desired Performance Analyzer environment variables.
3. Add the Performance Analzyer product dataset called CBC.SCTVMOD to the STEPLIB of the program if it has not been installed in the link pack area (LPA).
4. Set the run-time option, PROFILE(ON,’*string*’).

The program can run under any of the following environments:

- OS/390 batch
- TSO
- OS/390 UNIX shell

Refer to the *OS/390 C/C++ User’s Guide* for more information on compiling and running your applications.

RELATED CONCEPTS

Function trace“Function trace” on page 14
Performance Analyzer product files“Performance Analyzer product files” on page 2

RELATED TASKS

Compiling your program“Compiling your program” on page 25
Setting environment variables for Performance Analyzer“Setting environment variables for Performance Analyzer” on page 26
Setting run-time option PROFILE for Performance Analyzer“Setting run-time option PROFILE for Performance Analyzer” on page 27

RELATED REFERENCES

Run-time option for program tracing“Run-time option for program tracing” on page 62
Run-time environment variables for program tracing“Run-time environment variables for program tracing” on page 64
Sample JCL for creating trace files“Sample JCL for creating trace files” on page 72
Sample Unix system service commands for creating trace files“Sample Unix system

service commands for creating trace files” on page 74
Sample TSO Commands for creating trace files“Sample TSO commands for creating trace files” on page 75

Chapter 7. Starting and exiting the Performance Analyzer

Starting the Performance Analyzer

You can start the Performance Analyzer in any of the following ways:

- By double-clicking on its icon
- By entering the Performance Analyzer command on a command line

RELATED TASKS

Starting the Performance Analyzer from a Command Line“Starting the Performance Analyzer from a command line”
Exiting the Performance Analyzer“Exiting the Performance Analyzer”

Starting the Performance Analyzer from a command line

You can start the Performance Analyzer from a command line, a command (CMD) file, or a batch (BAT) file.

To start the Performance Analyzer use the following command:

```
ianalyze [/x]
```

Where /x represents any number of Performance Analyzer invocation parameters documented in the related reference material indicated below.

You can invoke the Performance Analyzer with the Performance Analyzer - Window Manager window shown by issuing the command without invocation parameters. By issuing the command with the appropriate invocation parameters, you can invoke the Performance Analyzer so that it immediately begins to trace an executable or opens an existing trace file in one or more trace file analysis diagrams.

RELATED CONCEPTS

Diagrams for Analyzing a Trace File“Diagrams for analyzing a trace file” on page 5

RELATED TASKS

Opening a Trace File in a Diagram“Opening a trace file in a diagram” on page 38

RELATED REFERENCES

Performance Analyzer Invocation Parameters“Performance Analyzer invocation parameters” on page 60

Exiting the Performance Analyzer

To exit the Performance Analyzer, do the following:

1. Select **Exit the Performance Analyzer** from one of the following menus:
   - **File** menu in the Performance Analyzer - Window Manager window
   - **Trace file** menu in any of the diagrams
2. Select **Yes** if necessary.

Select **Options > Quick exit** in the Performance Analyzer - Window Manager window to cause the application to exit immediately without confirmation each time you select **Exit the Performance Analyzer**.

Chapter 8. Controlling what data is collected in the trace file

Collecting call frequency data

By default, the Performance Analyzer collects and records all tracing data, including timing, call count, and call relationship information for each function traced. It also records a chronological list of the events that occur during the trace. To collect only a count of the number of times each function is called and the functions each function calls, you must specify the following suboption in the **PROFILE** run-time option:

FUNCTION=COUNTS

For example:

PROFILE (ON, 'FUNCTION=COUNTS')

This capability of the Performance Analyzer is called call frequency counting.

To view the call frequency information collected with this suboption, make the trace file generated as a result of this suboption accessible on the workstation by using NFS or by downloading it. You can then display the file graphically on the workstation with the following diagrams:

Diagram	Information available	Information not available
Dynamic Call Graph	• Call counts on arcs and information windows • Call Frequency Data • Colour-coded arcs	• *Execution time* and *Time on Stack* values and percentages on information windows • Scaled node sizes • Colour-coded nodes
Statistics	• Number of calls column • Partial summary section, which includes the number of executables, classes, functions, and threads plus call depth for each thread	The following columns: • % of Execution • % on Stack • Execution time • Time on stack • Minimum Call • Maximum Call • Average Call

Note: Call Frequency Counting does not provide call timing information nor does it include a chronological list of events that occur during the execution of the program (function calls, function returns, thread creation, thread switches). This reduces the size of the trace file, making it more manageable and easier to analyze.

A sample call frequency counting trace file called CallFrequency.trc is available in the 390ProductivityTools\samples directory.

RELATED CONCEPTS

Function trace"Function trace" on page 14
Call frequency counting"Call frequency counting" on page 13

RELATED TASKS

Compiling your program“Compiling your program” on page 25
Creating a trace file“Creating a trace file” on page 28

RELATED REFERENCES

Run-time option for program trace“Run-time option for program tracing” on page 62

Tracing a specific DLL

To trace a specific DLL, compile the files that make up the DLL with the TEST(HOOK) and NOGONUMBER options. Do not use the TEST(HOOK) option when compiling any other code that calls the DLL; otherwise, when you perform the trace, you would get trace data for the other code. Perform the trace as you would do normally by setting the PROFILE run-time option and executing the program that calls the DLL.

RELATED CONCEPTS

Function trace“Function trace” on page 14

RELATED TASKS

Compiling your program“Compiling your program” on page 25
Creating a trace file“Creating a trace file” on page 28

Tracing a Webserver application

To trace a Lotus Domino Go Webserver application, do the following:

1. Compile the application code using the TEST(HOOK) and NOGONUMBER compile options. NOGONUMBER is optional and will significantly reduce the load module size. If the module is going to be both traced and debugged, do not specify NOGONUMBER.
2. Start the Lotus Domino Go Webserver with tracing turned on by doing the following:
   a. Set the Performance Analyzer environment variable __PROF_WEBSERVER=YES
   b. Set the Performance Analyzer environment variable __PROF_FILE_NAME to the desired name for the trace file.
   c. Set the Performance Analyzer environment variable __PROF_HOOKS if desired.
   d. Add the Performance Analyzer product dataset called CBC.SCTVMOD to the STEPLIB.
   e. Set the run-time option, PROFILE(ON,’string’)
   f. Start the Lotus Domino Go Webserver in the environment where the previous steps were done.
3. Run the Webserver application.
4. Stop tracing and create a trace file by sending the SIGPROF signal to the Lotus Domino Go Webserver with the OS/390 Unix System Services kill command. For example, issue the following command from another OS/390 Unix System Services shell session: kill -s PROF *webspid* where *webspid* is the process ID of the Lotus Domino Go Webserver.

Note: To trace another Webserver application, you must stop then restart the Lotus Domino Go Webserver with tracing turned on again.

RELATED CONCEPTS

Function trace“Function trace” on page 14

RELATED TASKS

Compiling your program“Compiling your program” on page 25
Creating a trace file“Creating a trace file” on page 28

Specifying trace file name

Use the __PROF_FILE_NAME environment variable to name a trace file. Set this environment variable before you run your program for tracing.

If you do not set the __PROF_FILE_NAME environment variable, the Performance Analyzer generates a default name for the trace file. Default trace file names are explained in Run-Time Environment Variables for Program Trace.

Note: If the program is executing in the OS/390 UNIX System Services shell or executing with the POSIX(ON) run-time option, then by default, the process ID will be appended to the trace file name. If you do not want the process ID to be appended to the trace file name, specify the environment variable __PROF_APPEND_PID=no.

RELATED CONCEPTS

Function trace“Function trace” on page 14

RELATED TASKS

Setting environment variables for Performance Analyzer“Setting environment variables for Performance Analyzer” on page 26

RELATED REFERENCES

Run-time environment variables for program tracing“Run-time environment variables for program tracing” on page 64

Performing delay tracing

The default tracing behavior of Performance Analyzer is to start tracing as soon as your program begins executing and to stop tracing when your program terminates. With delay tracing, you delay the start of tracing until after your program has started executing. Then you can stop and restart tracing any number of times, with a new trace file being created each time tracing is stopped. The trace file contains the trace data collected only since the last start command.

To perform delay tracing, specify the DELAY option in the PROFILE run-time option string sub-option. For example, you can use the export command in the UNIX System Services (USS) shell to set the run-time option before executing the program to be traced:

export _CEE_RUNOPTS=“PROFILE(ON,’DELAY’)”

Then start the program to be traced as you normally do.

Starting the trace

To start tracing the program, use the kill -s PROF command from the USS shell. This will send a SIGPROF signal to the Performance Analyzer, indicating that tracing is to be started. If the program was started as a background job, specify the job number on the kill command. For example:

kill -s PROF %n

where n is the job number. If the program was not started as a background job, determine the ID of the process the program is running in using the USS ps command. Then specify the process ID on the kill command. For example:

kill -s PROF nnnnnnnn

where nnnnnnnn is the process ID. For the syntax of the kill and ps commands, please refer to the OS/390 UNIX System Services Command Reference.

Stopping the trace

To stop tracing, issue the same kill -s PROF command as you did to start tracing. Each time you issue the kill -s PROF command, it alternately turns tracing on or off. When tracing is turned off, a trace file is created for that particular tracing session. If tracing is not turned off using a kill -s PROF command, tracing will continue until the program terminates, at which time a trace file will be created.

The trace files created during a particular execution of the program are given unique names by appending a integral sequence number to the second and subsequent trace file names. For example, if the environment variables __PROF_FILE_NAME=testpgm.trc and __PROF_APPEND_PID=NO are set and three trace sequences are issued during the program execution, the following files are produced:

- testpgm.trc
- testpgm.trc.2
- testpgm.trc.3

Unless the value of __PROF_FILE_NAME is changed, these files will be overwritten the next time the program is traced.

Note: Since the OS/390 UNIX System Services kill command is used, delay tracing can only be performed from the OS/390 UNIX System Services shell.

RELATED CONCEPTS

Function trace“Function trace” on page 14

RELATED TASKS

Compiling your program“Compiling your program” on page 25
Creating a trace file“Creating a trace file” on page 28

Chapter 9. Viewing your trace file in a diagram

Downloading the trace file from the host

After creating a trace file, you can view the data contained in it by using the workstation component of Performance Analyzer. However, the trace file created on the host must be accessible on the workstation to view the data. You can use a remote file access program like Network File System (NFS) to access the binary trace file on the host, or you can physically download the file to the workstation as a binary file.

Example
The following example shows you how to use FTP to download a trace file *userid*/sample.trc to a file called newsamp.trc in the directory c:\pa\traces.

1. Create this directory on your workstation:
```
[C:\]md pa
[C:\]md pa\traces
```
2. Make that your current directory:
```
[C:\]cd pa\traces
```
3. Logon to FTP:

   [C:\pa\traces]ftp *system*
   Name (*system*):*userid*
   Password: **********

   This message appears:
```
230userid is logged on. Working directory is "userid".
```
4. Transfer the file in *binary*:
```
ftp>binary
ftp>get sample.trc newsamp.trc
```
   Note: You may need to change the trace file names due to differences in host and workstation file naming conventions. To rename files when transferring them from the host, specify the new file name in the **get** command. In the example, sample.trc is transferred and renamed to newsamp.trc at the workstation.
5. Logoff from FTP:
```
ftp>bye
```

RELATED CONCEPTS

Function trace“Function trace” on page 14

RELATED TASKS

Compiling your program“Compiling your program” on page 25
Setting environment variables for Performance Analyzer“Setting environment variables for Performance Analyzer” on page 26
Setting run-time option PROFILE for Performance Analyzer“Setting run-time option PROFILE for Performance Analyzer” on page 27
Creating a trace file“Creating a trace file” on page 28

Starting the Performance Analyzer to analyze a trace file

Once you have downloaded the trace file, you can analyze your data from your workstation. After you start the Performance Analyzer on your workstation, follow these steps:

1. In the Performance Analyzer Window Manager window, select **Analyze Trace**.
2. In the Analyze Trace window, specify the trace file name in the dialog box; or search for the trace file by clicking the **Find** button.
3. Select the appropriate diagrams to view the data.
4. Click the **OK** button.

RELATED CONCEPTS

Function trace“Function trace” on page 14

RELATED TASKS

Creating a trace file“Creating a trace file” on page 28
Downloading the trace file from the host“Downloading the trace file from the host” on page 37

Opening a trace file in a diagram

To open a trace file in a Performance Analyzer diagram when the Performance Analyzer is already running, use one of the following methods:

- Click the **Analyze Trace...** push button in the Performance Analyzer - Window Manager window, and then, in the Analyze Trace window, enter a trace file name and select one or more of the diagram check boxes.
- Double-click the file name or icon of a trace file in the Performance Analyzer - Window Manager window, then select one of the diagram check boxes in the Analyze Trace window and click **OK**.
- Click mouse button 2 on the file name or icon of a trace file in the Performance Analyzer - Window Manager window, then select a diagram from the trace file pop-up menu.
- From the **Trace file** menu of an open diagram, select **Open as** and then select a diagram from the cascaded menu.
- From any open diagram, click the appropriate button in the tool bar.

To immediately open a trace file in one or more Performance Analyzer diagrams when starting the Performance Analyzer from the command line, see the related procedure indicated below.

RELATED TASKS

Starting the Performance Analyzer from a Command Line“Starting the Performance Analyzer from a command line” on page 31

Chapter 10. Navigating the trace view

Correlating events between diagrams

To correlate events between the Call Nesting, Execution Density, or Time Line diagrams, complete these steps:

1. Open the trace file in the diagrams between which you want to correlate events.
2. Highlight the event range of interest in one of the diagrams by taking these steps:
   a. Click and hold mouse button 1 on the first event.
   b. Drag the pointer to the last event.
   c. Release the mouse button.
3. Select **Options > Correlation...** in the highlighted diagram. The Correlation window appears.
4. In the Correlation window, click the names of one or more diagrams to which you want to correlate, or click the **Select all** push button to correlate to all of the diagrams listed.
5. Click **OK**.

To correlate from a function in the Statistics diagram to the instance of the call to that same function in the Call Nesting diagram that used the most time of all calls to that function, complete these steps:

1. Open the trace file in the Statistics and Call Nesting Diagrams.
2. Highlight a single function in the Statistics diagram.
3. Select **Options > Correlation...** in the Statistics diagram. The Correlation window appears.
4. In the Correlation window, click the names of one or more diagrams to which you want to correlate, or click the **Select all** push button to correlate to all of the diagrams listed.
5. Click **OK**.

RELATED CONCEPTS

Correlation“Correlation” on page 21

RELATED TASKS

Opening a Trace File in a Diagram“Opening a trace file in a diagram” on page 38
Seeing Details by Combining the Zoom and Correlation Features“Seeing details by combining the zoom and correlation features” on page 40

Enlarging or reducing a diagram

The Dynamic Call Graph, Execution Density, and Time Line diagrams have zooming capabilities that allow you to enlarge (**Zoom in**) or reduce (**Zoom out**) the size of the diagram in order to focus on the area that is of most interest.

To enlarge the region of a diagram that is of most interest, follow these steps:

1. Highlight the area that you want to enlarge.

2. Select **View > Zoom in**.
3. Scroll until you see the area you highlighted.
4. Continue alternately selecting **Zoom in** and scrolling to the highlighted area until the diagram is enlarged to the degree you want.
5. If you zoom in too far, select **View > Zoom out** to quickly back out one step.

A quick way to zoom in on an area of interest in the Execution Density or Time Line diagram is to use the **Zoom to selected range** option in the **View** menu. It also provides an easy way to restore the diagram to full scale. To quickly restore the diagram to full scale after it has been reduced, follow these steps:

1. Select **Edit > Select all**.
2. Select **View > Zoom to selected range**.

A quick way to navigate and to zoom in or out in the Dynamic Call Graph diagram is to use the **Overview** feature. When you select **View > Overview**, a miniature version of the Dynamic Call Graph diagram appears in the Overview window, and a small gray box in the window highlights the area of the diagram that is currently in view. Use the gray box as follows:

- To change the area of the diagram that is currently in view, click and hold mouse button 1 inside the gray box, and then move the box until the desired area is in view.
- To resize the area shown in the diagram, grab and move the sides of the gray box with the mouse until the area shown has the desired size.

To restore the Dynamic Call Graph diagram to the original view and size, select **View > Re-lay graph**.

RELATED CONCEPTS

Diagrams for Analyzing a Trace File“Diagrams for analyzing a trace file” on page 5

RELATED TASKS

Opening a Trace File in a Diagram“Opening a trace file in a diagram” on page 38
Seeing Details by Combining the Zoom and Correlation Features“Seeing details by combining the zoom and correlation features”

Seeing details by combining the zoom and correlation features

A useful technique for examining specific areas of the Execution Density and Time Line diagrams is to use the zoom and correlation features together. Zooming sometimes forces the highlighted region off the page; correlation can help you quickly find it again.

To use this technique, complete these steps:

1. Open your trace file in the Execution Density or Time Line diagram.
2. Open another diagram that allows correlation (Call Nesting, Execution Density, or Time Line).
3. Highlight the area that you want to zoom in on (enlarge) in the first diagram.
4. Correlate the first diagram to the second.
5. In the first diagram, select **View > Zoom in** as many times as you want.
   If you zoom in too far, select **View > Zoom out** to quickly back out one step.
6. Correlate the second diagram to the first.

The region you originally highlighted is now back in view.

RELATED CONCEPTS

Diagrams for Analyzing a Trace File“Diagrams for analyzing a trace file” on page 5
Correlation“Correlation” on page 21

RELATED TASKS

Opening a Trace File in a Diagram“Opening a trace file in a diagram” on page 38
Correlating Events between Diagrams“Correlating events between diagrams” on page 39
Enlarging or Reducing a Diagram“Enlarging or reducing a diagram” on page 39

Viewing a specific time or range of time

You can view trace data for a specific time or range of time in the following diagrams:

- Call Nesting
- Execution Density
- Time Line

To view a specific time in one of these diagrams, complete these steps:

1. Select **Edit > Select Time...**. The Select Time window appears.
2. Click the appropriate radio button to select the desired unit of time.
3. Use the arrows in the spin button if you want to change the time already shown.
4. Click the appropriate push button to continue.

To view a specific range of time in one of these diagrams, complete these steps:

1. Select **Edit > Select Time Range...**. The Select Time Range window appears.
2. Select the start time:
   a. Click the appropriate radio button to select the desired unit of time.
   b. In the **Start Time** group box, use the spin button arrows to select the time at which you want the highlight to start.
3. Select the end time:
   a. Click the appropriate radio button to select the desired unit of time.
   b. In the **End Time** group box, use the spin button arrows to select the time at which you want the highlight to end.
4. Click the appropriate push button to continue.

Chapter 11. Searching for trace data in a diagram

Warning: Temporary Level 2 Header

Finding a specific annotation

An *annotation* is a bookmark or comment that you can place in the trace file after the trace file is created. Annotations are saved to the trace file so that you can see them at a later time. You can search for an annotation in the Call Nesting diagram.

To search for an annotation, complete these steps:

1. Select **Edit > Find.**
2. Select **Annotation...** from the cascaded menu. The Find Annotation window appears.
3. Follow the directions in the dialog window to get a list of all annotations.

   You can enter an asterisk (*) with a few characters of the annotation in the **Find** entry field, as follows:

   - Use an asterisk (*) to represent zero or more arbitrary characters. For example, enter:
     - * to show a list of all annotations
     - *b** to show all annotations, regardless of length, that begin with the character *b*
     - **b* to show all annotations that end with the character *b*
   - Use a question mark (?) to represent a single arbitrary character. For example, enter *?b** to show all annotations that start with any character and have the character *b* as their second character.
4. Click the appropriate push button to continue.
5. If more than one annotation matches your search criteria, select the desired annotation in the list box, and click **OK**.

The search for the annotation begins at the currently selected annotation, user event, or function (or the first such instance in the currently selected range). The search continues until the annotation is found or the end of the diagram is reached. If the annotation is found, it is highlighted; if it is not found, a message box to that effect appears.

RELATED TASKS

Adding, Changing, or Deleting Annotations“Adding, changing, or deleting annotations” on page 53

Finding a specific function call or return

You can search for a function call or return in the following diagrams:

- Call Nesting
- Execution Density
- Time Line

To search for a function call or return in one of these diagrams, complete the following steps:

1. Open the Find Function window:
   - In the Call Nesting or Time Line diagrams, select **Edit > Find > Function...**.
   - In the Execution Density diagram, select **Edit > Find function...**.
2. Enter the function name in the **Find** entry field. You can use wildcard characters (* and ?) in the entry field, as follows:
   - Use an asterisk (*) to represent zero or more arbitrary characters. For example, enter:
     – * to show a list of all function names
     – *b** to show all function names, regardless of length, that begin with the character *b*
     – **b* to show all function names that end with the character *b*
   - Use a question mark (?) to represent a single arbitrary character. For example, enter *?b** to show all function names that start with any character and have the character *b* as their second character.

     Wildcards are especially useful when you are searching for a fully qualified function name (for example, *myClass::function[parameter]*).
3. Be sure the **Case sensitive** box is checked if you want to enable case-sensitive searching.
4. Select the thread that you want searched.
5. Click the appropriate radio button to search for occurrences of when the function:
   - Was called
   - Returned
   - Was either called, or returned
6. Click the appropriate push button to continue.
7. If more than one function matches your search criteria, select the desired function in the list box, and click **OK**.
8. Select **Edit > Find next** to find the next occurrence of the function call or return.

The search for the function begins at the currently selected function, annotation (Call Nesting only), or user event (or the first such instance in the currently selected range). The search continues until the function is found or the end of the diagram is reached. If the function is found, it is highlighted; if it is not found, a message box to that effect appears.

Finding trace data for a specific function

You can search for trace data for a specific function in the following diagrams:

- Dynamic Call Graph
- Statistics

To search for a function in one of these diagrams, complete the following steps:

1. Make sure trace data for functions is shown in the diagram. See the Filter Events by Component Type topic for instructions.
2. Select **Options > Find...**. The Find Function window appears.
3. Enter the function name in the **Find** entry field. You can use wildcard characters (* and ?) in the entry field, as follows:
   - Use an asterisk (*) to represent zero or more arbitrary characters. For example, enter:

– * to show a list of all function names
– *b** to show all function names, regardless of length, that begin with the character *b*
– **b* to show all function names that end with the character *b*

- Use a question mark (?) to represent a single arbitrary character. For example, enter *?b** to show all function names that start with any character and have the character *b* as their second character.

  Wildcards are especially useful when you are searching for a fully qualified function name (for example, *myClass:: function[parameter]*).

4. Be sure the **Case sensitive** box is checked if you want to enable case-sensitive searching.
5. Click the appropriate push button to continue.
6. If more than one function matches your search criteria, click the desired function in the list box, and click **OK**.

The function is highlighted when found.

RELATED TASKS

Filtering Events by Component Type“Filtering events by component type” on page 47

Finding trace data for a specific class

You can search for trace data for a specific class in the following diagrams:

- Dynamic Call Graph
- Statistics

This is possible only if your trace file contains class information.

To search for a class in one of these diagrams, complete these steps:

1. Make sure trace data for classes is shown in the diagram:
   - In the Dynamic Call Graph diagram, select **View > Nodes of > Classes**.
   - In the Statistics diagram, select **View > Details on > Classes**.
2. Select **Options > Find...**. The Find Class window appears.
3. Enter the class name in the **Find** entry field. You can use wildcard characters (* and ?) in the entry field, as follows:
   - Use an asterisk (*) to represent zero or more arbitrary characters. For example, enter:
     – * to show a list of all class names.
     – *b** to show all class names, regardless of length, that begin with the character *b*.
     – **b* to show all class names that end with the character *b*.
   - Use a question mark (?) to represent a single arbitrary character. For example, enter *?b** to show all class names that start with any character and have the character *b* as their second character.
4. Be sure the **Case sensitive** box is checked if you want to enable case-sensitive searching.
5. Click the appropriate push button to continue.
6. If more than one class name matches your search criteria, click the desired class name in the list box, and click **OK**.

The class is highlighted when found.

RELATED TASKS
Opening a Trace File in a Diagram"Opening a trace file in a diagram" on page 38

Finding trace data for a specific executable

You can search for trace data for a specific executable in the following diagrams:

- Dynamic Call Graph
- Statistics

To search for an executable in one of these diagrams, complete these steps:

1. Make sure trace data for executables is shown in the diagram:
   - In the Dynamic Call Graph diagram, select **View > Nodes of > Executables**.
   - In the Statistics diagram, select **View > Details on > Executables**.
2. Select **Options > Find...**. The Find Executable window appears.
3. Enter the executable name in the **Find** entry field. You can use wildcard characters (* and ?) in the entry field, as follows:
   - Use an asterisk (*) to represent zero or more arbitrary characters. For example, enter:
     - * to show a list of all executable names.
     - *b** to show all executable names, regardless of length, that begin with the character *b*.
     - **b* to show all executable names that end with the character *b*.
   - Use a question mark (?) to represent a single arbitrary character. For example, enter *?b** to show all executable names that start with any character and have the character *b* as their second character.
4. Be sure the **Case sensitive** box is checked if you want to enable case-sensitive searching.
5. Click the appropriate push button to continue.
6. If more than one executable matches your search criteria, click the desired executable in the list box, and click **OK**.

The executable is highlighted when found.

RELATED TASKS
Opening a Trace File in a Diagram"Opening a trace file in a diagram" on page 38

Chapter 12. Controlling what data is shown in the diagrams

Filtering events by component type

You can show trace data for a specific component type in the following diagrams:
- Statistics
- Dynamic Call Graph

To show trace data for a specific component type in the Statistics or Dynamic Call Graph diagram, complete the following steps:
1. Open the trace file in one of the diagrams.
2. Select **View > Details on** in the Statistics diagram or **View > Nodes of** in the Dynamic Call Graph diagram.
3. Select the component type for which you want to show data:
   - Select **Functions** to show data on functions.
   - Select **Classes** to show data on classes (only possible if your trace file contains class information).
   - Select **Executables** to show data on executables.

A mark is shown next to the component type that is currently selected.

RELATED TASKS

Opening a Trace File in a Diagram“Opening a trace file in a diagram” on page 38

Filtering events by function

Filters allow you to temporarily reduce the amount of trace data shown in a diagram, or to isolate interesting or problematic areas. There are several techniques for filtering the trace data.

You can filter events by function in the following diagrams:
- Call Nesting
- Execution Density

To filter specific functions from one of these diagrams, complete these steps:
1. Select **View > Include functions...**. The Include Functions window appears.
2. Scroll the list to find the function or functions you want to filter from the diagram’s display.
3. Click each function you want to remove so that it is no longer highlighted.
4. Click the appropriate push button to continue.

To include specific functions in one of these diagrams, complete these steps:
1. Select **View > Include functions...**. The Include Functions window appears.
2. Click the **Deselect all** push button.
3. Scroll the list to find the function or functions you want shown.
4. Select each function you want shown.
5. Click the appropriate push button to continue.

To include all functions in one of these diagrams, complete these steps:

1. Select **View > Include functions...**. The Include Functions window appears.
2. Click the **Select all** push button.
3. Click the appropriate push button to continue.

In the Execution Density diagram, only those functions selected are shown. In the Call Nesting diagram, each selected function and any function in its call stack are shown.

RELATED TASKS

Opening a Trace File in a Diagram"Opening a trace file in a diagram" on page 38

Filtering events by thread

Filters allow you to temporarily reduce the amount of trace data shown in a diagram. There are several techniques for filtering the trace file and isolating interesting or problematic areas.

When you apply a thread filter, only the data from the selected threads is processed and displayed in the diagram. You can filter events by thread in the following diagrams:

- Call Nesting
- Execution Density
- Dynamic Call Graph
- Statistics

To filter events by thread, complete these steps:

1. Open the trace file in one of the diagrams listed above.
2. Select **View > Include threads...**. The Include Threads dialog appears.
3. Select the thread or threads for which you want to see trace information in one of the following ways:
   - Select specific threads by highlighting them with the mouse.
   - Click the **Select all** push button to highlight all threads.
4. Click the **OK** push button.

RELATED TASKS

Opening a Trace File in a Diagram"Opening a trace file in a diagram" on page 38

Filtering events by group

Filters allow you to temporarily reduce the amount of trace data shown in a diagram, or to isolate interesting or problematic areas. There are several techniques for filtering the trace data.

You can filter events by function group in the following diagrams:

- Execution Density
- Statistics

To define one or more groups of functions that can be analyzed as a whole in one of the diagrams that supports groups, complete the following steps:

1. Select **Options > Work with groups...**.

2. On the Grouping File page of the Work with Groups window, define a grouping file by entering a file name and optional description in the appropriate fields.
3. On the Group Names page of the Work with Groups window, enter a group name and optional description in the appropriate fields. Click **Add**. Repeat this step for as many groups of functions as you want to define in the grouping file.
4. On the Group Definition page of the Work with Groups window, add functions to a group by completing the following steps:
   a. Select the group you want to add functions to from the **Group Name** drop-down combination box.
   b. Enter a search string in the **Filter Mask** entry field that matches the function names you want to add to the group. Use * as a wildcard to match zero or more characters, or ? as a wildcard to match any single character.
   c. Select the appropriate check boxes to indicate whether you want to select functions that currently belong to no group, to exactly one group, or to more than one group.
   d. Be sure the **Case sensitive** box is checked if you want to enable case-sensitive searching.
   e. Click **Filter** to see the function names that match your search criteria.
   f. In the **Available Functions** container, highlight the functions you want to add to the group, and click **Add**.

   Repeat this step for each group of functions you want to define in the grouping file.

   Note that if you add a function to more than one group, and are showing group information in a diagram, the function appears once for each group it belongs to that is included in the diagram.
5. When you are finished defining groups and their functions, select the **Save grouping file on OK** check box in the Work with Groups window, and click **OK**. (If you just click **OK** without having saved your changes to a grouping file, the defined groups remain in effect for the current trace file in the current Performance Analyzer session only.)

To indicate which collection of function groups you want to analyze, complete these steps:
1. Select **Options > Work with groups...**.
2. On the Grouping File page of the Work with Groups window, click **Find...**.
3. Select a grouping file from the files found, and click **OK**.
4. Click **Open**.

To include specific groups in one of the diagrams that supports groups, complete these steps:
1. Select **View > Include groups...**. The Include Groups window appears.
2. Click the **Deselect all** push button.
3. Scroll the list to find the groups you want.
4. Select each group you want to include.
5. Click the appropriate push button to continue.
6. To view groups in a diagram, you must be viewing functions in that diagram:
   - In the Statistics diagram, select **View > Details on > Functions** if you are not currently viewing functions.

To view group information in a diagram after having removed it from the diagram, select **View > Group filter**. A mark appears next to the option to indicate that it is in effect.

To remove group information from a diagram that is showing group information, select **View > Group filter**. The mark next to the option is removed to indicate that it is not in effect.

RELATED CONCEPTS

Function Groups“Function groups” on page 19
Execution Density Diagram“Execution Density diagram” on page 8
Statistics Diagram“Statistics diagram” on page 9

Filtering nodes and arcs in the Dynamic Call Graph diagram

To define a specific cross section of nodes that you want shown in the Dynamic Call Graph diagram, complete these steps:

1. Select **View > Filters > Nodes...**. The Nodes Filter window appears.
2. Select the check boxes for the desired filter criteria, and fill in the corresponding values by which you want to filter the nodes.
3. Click the **And** radio button to show the nodes that meet the values for all the selected criteria. Alternatively, click the **Or** radio button to show the nodes that meet the values of at least one of the selected criteria.
4. Select one or more compile units in which you want to search for nodes that meet the filter criteria.
5. Click the **OK** push button to apply the filters and close the Nodes Filter window. (The **Apply** push button applies the filters but leaves the Nodes Filter window open.)

   The nodes that meet the filter criteria are shown and the nodes that do not meet the criteria are hidden.

To define a specific cross section of arcs that you want shown in the Dynamic Call Graph diagram, complete these steps:

1. Select **View > Filters > Arcs...**. The Arcs Filter window appears.
2. Select the check box for the **Number of Calls** criterion, and fill in the corresponding values by which you want to filter the arcs.
3. Select one or more compile units in which you want to search for arcs that meet the filter criterion.
4. Click the **OK** push button to apply the filter and close the Arcs Filter window. (The **Apply** push button applies the filter but leaves the Arcs Filter window open.)

   The arcs that meet the filter criterion are shown and the arcs that do not meet the criterion are hidden.

At any time, you can restore nodes or arcs that were hidden as a result of the filtering by bringing up the appropriate filter window again, clearing the check boxes, and clicking **OK**. Alternatively, you can select the **Restore graph** or **Restore subgraph** option, as appropriate, from the **View** menu.

RELATED CONCEPTS

Dynamic Call Graph Diagram“Dynamic Call Graph diagram” on page 6

RELATED TASKS

Opening a Trace File in a Diagram“Opening a trace file in a diagram” on page 38

Recognizing call sequence patterns

The Performance Analyzer lets you combine like sequences of calls and returns in the Call Nesting diagram, by using a pattern recognition facility.

To recognize patterns in the Call Nesting Diagram, complete these steps:

1. If any calls in the diagram are collapsed (indicated by a plus (+) sign next to the function name), return to the diagram and expand them by selecting **View > Expand all**.
2. Select **View > Include threads...**.
3. Select a single thread for which you want to see patterns by highlighting it with the mouse.
4. Select the **Use pattern recognition** check box.
5. Click **OK**.

The Call Nesting diagram indicates patterns with curved lines that show the number of repetitions on the right.

RELATED CONCEPTS

Pattern Recognition“Pattern recognition” on page 19
Call Nesting Diagram“Call Nesting diagram” on page 6

RELATED TASKS

Filtering Events by Thread“Filtering events by thread” on page 48

Viewing class activity

If you are analyzing a trace file that contains class information, you can view class activity in a Dynamic Call Graph or Statistics diagram. For example, you might want to view class activity to do one of the following:

- Discern patterns more easily. Viewing class details in a Dynamic Call Graph diagram condenses the data shown because activity in all functions defined for a class is combined, which simplifies observing patterns.
- Identify the function that consumes the most time. Viewing class details in a Statistics diagram shows you how long a particular process (group of functions) takes to run, which helps you reduce the number of functions that you must look at when trying to identify the one consuming the most time.

To view a Dynamic Call Graph or Statistics diagram by class, do the following:

1. Create a trace file.
2. Open the trace file in a Dynamic Call Graph or Statistics diagram.
3. In the Dynamic Call Graph diagram, select **View > Nodes of > Classes**. Each node then represents the data for every member function contained in that class.

   In the Statistics diagram, select **View > Details on > Classes**. The Summary and Details panes then provide statistics about the classes used in your executable.

RELATED TASKS

Opening a Trace File in a Diagram“Opening a trace file in a diagram” on page 38

Chapter 13. Analyzing your trace file

Adding, changing, or deleting annotations

An annotation is a bookmark or comment that you can place in the trace file after it is created. You can add, change, or delete annotations in the Call Nesting diagram. The Performance Analyzer saves the annotations to the trace file so you can see them later.

To add or change an annotation, complete these steps:

1. Select the function in which you want to add or change the comment.
2. Select **Edit** > **Annotate...**.
3. Type the comment in the window. The comment is limited to 64 characters.
4. Click the appropriate push button to continue.

To delete an annotation, complete these steps:

1. Select the comment you want to remove.
2. Select **Edit** > **Annotate...**.
3. Click **Remove**.

RELATED TASKS

Finding a Specific Annotation“Finding a specific annotation” on page 43

Determining the elapsed time between two events

To determine the elapsed time between two events, complete these steps:

1. Create a trace file.
2. Open the trace file in the Time Line diagram.
3. Highlight the area between the two events in the Time Line diagram. To highlight an area:
   a. Click and hold mouse button 1 on the first event.
   b. While holding mouse button 1, drag the pointer to the second event.
   c. Release the mouse button.
4. Check the status area of the Time Line diagram for the elapsed time between events. Elapsed time is shown at the beginning of the line labeled **Selected region**.

RELATED CONCEPTS

Time Line Diagram“Time Line diagram” on page 10

RELATED TASKS

Opening a Trace File in a Diagram“Opening a trace file in a diagram” on page 38

Selecting functions to inline

Your trace file can help you determine which functions to inline. To do this, complete these steps:

1. Use the *OPT* compiler option.

2. Create a trace file and view it in the Statistics diagram. If an inlined function appears in the Statistics diagram, the compiler chose not to inline it.
3. Look for functions in the Statistics diagram that were called frequently and had small average execution times. These functions could be good candidates for inlining.

Although inlining functions improves the performance of your application, it also increases the size of your executable.

RELATED TASKS

Opening a Trace File in a Diagram“Opening a trace file in a diagram” on page 38

Viewing thread interactions in a multithreaded program

To view thread interactions in a multithreaded program, complete these steps:

1. Create a trace file.
2. Open the trace file in a Call Nesting or Time Line diagram.
3. Scroll through the diagram using the vertical scroll bar. Look for horizontal dashed lines, which indicate that your program has switched from one thread to another.

   Doing so allows you to see the flow of execution across threads, and could be helpful in identifying timing problems.

RELATED CONCEPTS

Correlation“Correlation” on page 21
Call Nesting Diagram“Call Nesting diagram” on page 6
Time Line Diagram“Time Line diagram” on page 10

RELATED TASKS

Opening a Trace File in a Diagram“Opening a trace file in a diagram” on page 38

Chapter 14. Tracing applications in a CICS environment

Initial setup

To use the Performance Analyzer to trace the performance of C/C++ applications and DLLs in the CICS environment, do the following:

1. Install the Debug Tool on OS/390, and perform the CICS setup for the Debug Tool including the DTCN setup. For DTCN setup, refer to the *Debug Tool User's Guide and Reference*.
2. Install the Performance Analyzer on OS/390, and merge the Performance Analyzer CSD CBC.SCTVJCL(CTVCCSD) into the CSD defined in the CICS startup job.

   To run the Performace Analyzer on the host system, the run-time libraries for Debug Tool and Performance Analyzer must be included in the DFHRPL section of the CICS startup job. You should also include the libraries that contain the user programs and DLLs.

   ```
   //DFHRPL DD DISP=SHR,DSN=USER1.PROG1.LOAD // USER PROGRAM LIBRARY 1
   //       DD DISP=SHR,DSN=USER1.PROG2.LOAD // USER PROGRAM LIBRARY 2
   //       DD DISP=SHR,DSN=CBC.SCTVMOD // Performace Analyzer RUNTIME LIBRARY
   //       DD DISP=SHR,DSN=DTOOL.DEBUG.VISUAL.SEQAMOD // DEBUG TOOL RUNTIME LIBRARY
   ```

   Start the CICS region (for example, IYKC54), and logon to CICS using the following command:
   `logon applid(IYKC54)`
3. Create a VSAM RRDS dataset using the sample JCL CBC.SCTVJCL(CTVSJCL) with the appropriate modifications for your site. This dataset is used by the Performance Analyzer to save some temporary trace data before the trace data is written to a sequential trace dataset (allocated in the next step). The size of the dataset should be big enough to contain the trace data. The size of the trace data depends on the application and the tracing options.
4. After Performance Analyzer finishes collecting the trace data, it is dumped into a sequential dataset. Allocate a sequential dataset using the sample JCL CBC.SCTVJCL(CTVSJCL) . The size of the dataset should be big enough to contain the trace data. The size of the trace data depends on the application and the tracing options.
5. Install CICS RDO definitions for the work dataset allocated in step 3 and also for the sequential dataset allocated in step 4. The sample RDO definitions are given in CBC.SCTVJCL(CTVSCSD).

RELATED TASKS

Creating a C/C++ executable“Creating a C/C++ executable” on page 56
Creating a trace for a C/C++ executable“Creating a trace for a C/C++ executable” on page 56
Analyzing the trace“Analyzing the trace” on page 57

Creating a C/C++ executable

The following steps show you how to create a C/C++ executable that you can analyze using the Performance Analyzer:

1. To include Performance Analyzer hooks in the CICS executable, use the **TEST(HOOK) NOGONUMBER** compiler options.
2. CICS does not support setting environment variables or LE run-time options at run time using the export command. You have to either compile the LE run-time options with the user application, or use the Debug Tool Control utility (DTCN) to set the LE run-time options at the run time. Performance Analyzer uses LE run-time options to determine if the application is to be traced or not.

   a. To compile LE run-time options with the CICS C/C++ executable, insert the **#pragma runopts** compiler directive in your main program source file to set run-time Performance Analyzer options and environment variables for tracing.

   ```
   #pragma runopts(PROFILE(ON) ENVAR(__PROF_FILE_NAME=PATR))
   ```

   b. If you don't compile LE run-time options into the executable, use the Debug Tool Control utility(DTCN) as explained in CBC.SCTVJCL(CTVSREAD)

   Note that the Performace Analyzer trace file name for a CICS program is not the physical file name as it is in OS/390 UNIX System Services. It is the CICS Resource Definition name (for example, PATR) for a physical file (for example, USER1.PA.PATR). The value for __PROF_FILE_NAME should be exactly the same as the TDQueue name defined in step 5 of the Initial Setup.

   Specifying the environment variable __PROF_FILE_NAME is optional. The default value for __PROF_FILE_NAME is PATR.

RELATED TASKS

Initial setup"Initial setup" on page 55
Creating a trace for a C/C++ executable"Creating a trace for a C/C++ executable"
Analyzing the trace"Analyzing the trace" on page 57

Creating a trace for a C/C++ executable

The following steps show you how to create a trace file for a C/C++ executable:

1. Define the program and a transaction to CICS using RDO:

   ```
   CEDA DEFINE PROGRAM(HELLO) GROUP(GROUP1)
   CEDA DEFINE TRANS(HLLO) PROGRAM(HELLO) GROUP(GROUP1)

   CEDA INSTALL PROGRAM(HELLO) GROUP(GROUP1)
   CEDA INSTALL TRANS(HLLO) GROUP(GROUP1)
   ```

2. If the C/C++ executable does not have the Performace Analyzer LE runtime options compiled in, use DTCN to define the Performace Analyzer LE runtime options for the transaction HLLO as described in CBC.SCTVJCL(CTVSREAD). Otherwise, skip to the next step.
3. Run the transaction from the CICS console by typing the name of the transaction.

If the trace created by the Performance Analyzer is too big and you get a space abend, you may need to reallocate the two datasets that were allocated during the initial setup with a larger size and then trace the program again.

RELATED TASKS

Initial setup“Initial setup” on page 55
Analyzing the trace“Analyzing the trace”

Analyzing the trace

Follow these steps to analyze the trace:

1. After the transaction has finished running, close and disable the open files:

   ```
   CEMT SET FILE(PATRWORK) CLOSED DISABLED
   CEMT SET TDQUEUE(PATRWORK) CLOSED DISABLED
   ```
2. Use ftp to download the binary trace dataset (e.g. USER.PA.PATR) in a temporary directory on the workstation.
3. Launch the Performance Analyzer from your workstation.
4. Open the trace file that you downloaded in step 2.

RELATED TASKS

Creating a C/C++ executable“Creating a C/C++ executable” on page 56
Creating a trace for a C/C++ executable“Creating a trace for a C/C++ executable” on page 56

Chapter 15. Reference

Limitations when analyzing trace data

Note the following limitations when using the Performance Analyzer:

- The Performance Analyzer runs only on Windows 95, Windows NT, or Windows 2000. It does not run on Windows 3.1x or Windows for Workgroups, even with the Win32s extension.
- The pattern recognition feature in the Call Nesting diagram has the following limitations:
  - The Performance Analyzer only searches for patterns in the first 32,768 events in the selected thread.
  - The maximum number of patterns for which the Performance Analyzer searches is 8191.

  If the Performance Analyzer reaches either of these limits, it stops searching for patterns.
- The Dynamic Call Graph diagram cannot analyze trace files that have more than 7000 functions.
- If you minimize the Overview window in the Dynamic Call Graph diagram, it does not appear in the list of open applications.

Limitations when creating a trace

When creating a trace with the Performance Analyzer on OS/390, the following limitations apply:

- The Performance Analyzer can trace C/C++ applications that have multiple threads. However, it cannot accurately determine when the processor switches active threads. It can determine only the following points because they are the points where the Performance Analyzer gets control:
  - When a thread is created
  - When a function is called or returns within a thread
  - When a thread terminates

  Consequently, thread switches are recorded only at function call and return points.
- Because an OS/390 system can have multiple processors, threads can execute concurrently. For a particular function call in one thread, the Performance Analyzer calculates the function's execution time independent of the execution time calculations for functions running in other threads. On an OS/390 system with a single processor, this may result in the reporting of function execution time that is larger than the actual execution time. Another consequence of this method of function execution time calculation for a multithread application is that the data in the Statistics diagram may show a total execution time for all functions exceeding the total execution time for the program.
- Because of the overhead time required for tracing, the program takes longer to execute when it is tracing. This overhead time is factored out in the Performance Analyzer data.

- When tracing multithreaded applications with TASK time, the source code for the parent thread must be compiled with the TEST(HOOK) option in order for the child threads to be traced.
- The time period between the time a C++ exception is thrown and the time the next method is called will be charged to the method that throws the exception. A consequence of this is that time spent in a method that catches the exception but does not call any other methods or functions will not be charged to that method but to the method that threw the exception.
- When you compile your program with the TEST(HOOK) option, tracing hooks are inserted into your program. This increases your program's size, and because time is required to execute the hook instructions, the program runs slower even when tracing is turned off. For this reason, it is recommended that you rebuild your program without the TEST(HOOK) option after you have finished using the Performance Analyzer to trace and tune your program.

RELATED CONCEPTS

Function trace"Function trace" on page 14

RELATED TASKS

Creating a trace file"Creating a trace file" on page 28
Compiling your program"Compiling your program" on page 25

RELATED REFERENCES

Run-time option for program tracing"Run-time option for program tracing" on page 62

Performance Analyzer invocation parameters

When you start the Performance Analyzer from a command line, a command (CMD) file, or a batch (BAT) file, you can control which of the following initial actions the Performance Analyzer takes:

- Show the Performance Analyzer - Window Manager window
- Open an existing trace file (in one or more diagrams)

This is accomplished by specifying the appropriate invocation parameters, as described below.

Show the Performance Analyzer - Window Manager window

To start the Performance Analyzer and show the Performance Analyzer - Window Manager window, use the following command:

```
ianalyze
```

Open an Existing Trace File

To start the Performance Analyzer and open an existing trace file in one or more trace file analysis diagrams, use the following command:

`ianalyze /x myprog.trc`

Where:

/x Represents one or more of the following options. If you have already created a trace file, these options cause the trace file to be shown in their

respective diagrams. You can quickly open the diagrams by entering one or more of these options in your startup command.

/cn Shows the trace file in the Call Nesting diagram.
/ed Shows the trace file in the Execution Density diagram.
/cg Shows the trace file in the Dynamic Call Graph diagram.
/ss Shows the trace file in the Statistics diagram.
/tl Shows the trace file in the Time Line diagram.

myprog
Represents a trace file name.

For example, if you want to show the *myprog*.trc trace file in both the Call Nesting and Execution Density diagrams, enter the command:

`ianalyze /cn /ed myprog.trc`

RELATED CONCEPTS

Diagrams for Analyzing a Trace File“Diagrams for analyzing a trace file” on page 5

RELATED TASKS

Opening a Trace File in a Diagram“Opening a trace file in a diagram” on page 38

Tracing programs that have interlanguage calls

The Performance Analyzer does not trace calls to functions written in languages other than C and C++.

If your C or C++ application makes an interlanguage call, and the __PROF_HOOKS environment variable was set to ALL or BEFORE_AFTER, the called function is displayed with name Unknown_Function_xxxxxxxx in the Performance Analyzer trace diagrams, where xxxxxxxx is the hex offset within the module of the function entry point. . If __PROF_HOOKS was set to ENTRY_EXIT, the interlanguage function call does not appear in the function trace diagrams.

If the non-C/C++ function in turn calls a C or C++ function, the called C or C++ function appears in the function trace if it was compiled with TEST(HOOK) *and* __PROF_HOOKS was set to ALL or ENTRY_EXIT.

In the class views of the Performance Analyzer diagrams, C function calls are included in a class called C_Function and calls to routines of programming languages other than C++ are included in a class called Unknown_Language.

RELATED CONCEPTS

Function trace“Function trace” on page 14

RELATED TASKS

Creating a trace file“Creating a trace file” on page 28
Compiling your program“Compiling your program” on page 25

RELATED REFERENCES

Run-time option for program tracing“Run-time option for program tracing”
Run-time environment variables for program tracing“Run-time environment variables for program tracing” on page 64

Run-time option for program tracing

To enable the tracing of a program during its execution, you must set the Language Environment run-time option, PROFILE, which has the following syntax:

```
PROFILE(ON|OFF,'string')
```

or

```
PROF (ON|OFF,'string')
```

The PROFILE run-time option has two suboptions:

- ON|OFF switch to turn on or off the trace for program execution
- ’*string*’ to specify the type of tracing to be performed

Suboption ON|OFF

Specify ON to activate the Performance Analyzer tracing. Specify OFF if you do *not* want the Performance Analyzer to take any trace. You *must* specify the ON|OFF suboption.

Suboption*String*

The suboption *string* consists of a list of parameters enclosed in either single or double quotation marks. The parameters are separated by commas (,), and can occur in any order in the *string*. They can also be in any case or mixed case because all values are converted to uppercase before being processed. The parameters are provided in the following table:

Parameters	Abbreviation	Default	Description
FUNCTION=ALL or **FUNCTION=COUNTS**	**F=A** or **F=C**	**F=A**	FUNCTION=ALL counts how many times each function is called, records what functions are called by each function and how many times they are called, provides total execution and stack times for each function, and records event data (every function call/return, thread creation and time of that event). FUNCTION=COUNTS collect a count of the number of times each function is called and what functions are called by each function and how many times they were called.. **Note**: The TASK|REAL suboption is ignored if FUNCTION=COUNTS is specified.
TASK | REAL	**T** | **R**	**T**	Specifies the type of time used during tracing. Specify TASK for CPU time or REAL for elapsed time. **Note**: This suboption is ignored if FUNCTION=COUNTS is specified.

Parameters	Abbreviation	Default	Description
DELAY | NODELAY	**D | N**	**N**	NODELAY specifies that tracing starts when the program begins execution. DELAY specifies that tracing starts when the Performance Analyzer receives the SIGPROF signal sent by the **kill -s PROF** command.

Note:

- Invalid parameters result in a warning message.
- Defaults are used for unspecified parameters.
- If conflicting parameters in the suboption *string* are specified, the last one is used. For example, if the suboption *string* is “REAL, FUNCTION=COUNTS, TASK, FUNCTION=ALL”, the Performance Analyzer will use TASK and FUNCTION=ALL.

Multiple Specifications of PROFILE Options

Because run-time options can be specified a number of ways, multiple PROFILE settings may exist when the program executes. The *whole* suboption string is used as a single value. If the suboption string (including a null string) is specified in the run-time option, the whole suboption string is used. If not, the suboption string from #pragma runopts is used. If no suboption string is specified in #pragma runopts, the suboption string in the installation defaults is used. If the installation defaults do not have a PROFILE suboption string, then the default parameters (which are FUNCTION=ALL, and TASK) are used. The IBM supplied installation default for the PROFILE run-time option is PROFILE(OFF,“”)

Note: When a suboption *string* is used, the Performance Analyzer fills in missing parameters in the string with defaults. For example if neither TASK nor REAL was specified in the suboption string, the Performance Analyzer uses TASK as the type of time when tracing.

Examples

1. **Installation Default:** PROFILE(OFF,’FUNCTION=COUNTS,REAL’)
   Program Code: #pragma runopts(prof(on))
   Specified Run-time PROFILE Option: None
   PROFILE Option Used for Tracing:
   PROFILE(ON,’FUNCTION=COUNTS,REAL’)
   Suboption String Used for Tracing:FUNCTION=COUNTS,REAL
2. **Installation Default:** PROFILE(ON,’FUNCTION=COUNTS,REAL’)
   Program Code: #pragma runopts(prof(off,’function’))
   Specified Run-time PROFILE Option: prof(on)
   PROFILE Option Used for Tracing: PROFILE(ON,’FUNCTION’)
   Suboptions String Used for Tracing: FUNCTION=ALL,TASK
3. **Installation Default:** PROFILE(OFF,’FUNCTION=COUNTS’)
   Program Code: No #pragma runopts was specified
   Specified Run-time PROFILE Option: prof(on)
   PROFILE Option Used for Tracing: PROFILE(ON,’FUNCTION=COUNTS’)
   Suboption String Used for Tracing: FUNCTION=COUNTS,TASK
4. **Installation Default:** PROFILE(OFF,“’’)
   Program Code: #pragma runopts(prof(on,’f=c,real’))
   Specified Run-time PROFILE Option: prof(on,’task’)
   PROFILE Option Used for Tracing: PROFILE(ON,’TASK’)
   Suboption String Used for Tracing: FUNCTION=ALL,TASK

5. **Installation Default:** PROFILE(ON,'FUNCTION=COUNTS')
Program Code: #pragma runopts(prof(off,'function=counts,real'))
Specified Run-time PROFILE Option: prof(on,"'')
PROFILE Option Used for Tracing: PROFILE(ON,"'')
Suboption String Used for Tracing: FUNCTION=ALL,TASK

Refer to the Language Environment for OS/390 and VM Programming Reference for more information on run-time options.

RELATED CONCEPTS

Function trace"Function trace" on page 14
Call frequency counting"Call frequency counting" on page 13
Delay tracing"Delay tracing" on page 17

RELATED TASKS

Setting run-time option PROFILE for Performance Analyzer"Setting run-time option PROFILE for Performance Analyzer" on page 27
Specifying trace file name"Specifying trace file name" on page 35
Creating a trace file"Creating a trace file" on page 28
Collecting call frequency data"Collecting call frequency data" on page 33
Performing delay tracing"Performing delay tracing" on page 35

RELATED REFERENCES

Run-time environment variables for program tracing"Run-time environment variables for program tracing"
Sample JCL for creating trace files"Sample JCL for creating trace files" on page 72
Sample TSO Commands for creating trace files"Sample TSO commands for creating trace files" on page 75
Sample Unix system service commands for creating trace files"Sample Unix system service commands for creating trace files" on page 74

Run-time environment variables for program tracing

Before tracing a program during its execution, the following environment variables can be set:

__PROF_APPEND_PID=YES|NO

Default: __PROF_APPEND_PID=YES

Description:

Use this environment variable to control whether the ID of the process, where the program that is being traced is running, is appended to the trace file name. This environment variable is only used when the program is executing in OS/390 UNIX System Services or the POSIX(ON) run-time option is specified.

- YES **-** causes the process ID to be appended to the trace file name. This is useful for identifying different traces of the same program without having to change the trace file name specified with the __PROF_FILE_NAME environment variable. For example, if __PROF_FILE_NAME=testpgm.trc is set, then the resulting trace file name will be **testpgm.trc.*nnnnnnnn*** where ***nnnnnnnn*** is the process ID.

• NO - causes the process ID not to be appended to the trace file name.

Note: For some applications that create new processes, process ID's may be appended to the trace file names irregardless of the setting of this environment variable.

__PROF_FILE_NAME=filename

Default:

The filename is name.trc, where name is the name of the executable or DLL which has the first main function is used as the name. If no main function is encountered, the name of the first executable or DLL encountered is used as the name.

When tracing an OS/390 UNIX System Services (formerly known as OpenEdition) application in the OS/390 UNIX shell, the file is written to the current directory.

When tracing an OS/390 batch or TSO application, the trace data is written to a sequential data set. A high level qualifier may be added to the file name, depending on the configuration of your system.

Description:

Use this environment variable to specify the name of the output trace file(s) created by the Performance Analyzer.

- **HFS output file**
  When you are tracing an OS/390 UNIX application, you can specify a file name for the output trace file. If you want to write the file to a directory other than the current directory, specify a path with filename, for example, __PROF_FILE_NAME=/u/smith/trace.trc.
- **Output to sequential data set**
  If you want to force the output file to an OS/390 sequential data set, you can prefix filename with double slashes (//), for example __PROF_FILE_NAME=//smith.trace. The filename is prefixed with the *userid* as the high-level qualifier. You can specify a fully qualified filename by adding single quotation marks (') around the filename, for example __PROF_FILE_NAME=//'smith.trace'.

Examples of Generated Trace Files When __PROF_APPEND_PID=NO Is Set

__PROF_FILE_NAME=	**Generated Trace File For Program Running Under**	
	OS/390 Batch/TSO	**OS/390 UNIX**
trace.ftrc	Sequential data set *USERID*.TRACE.TRC	HFS file ./trace.trc
trace	Sequential data set *USERID*.TRACE	HFS file ./trace
'test.trace.trc'	Sequential data set TEST.TRACE.TRC	HFS file ./'test.trace.trc'
/u/smith/test/trace.trc	HFS file /u/smith/test/trace.trc	HFS file /u/smith/test/trace.trc

//test.trace.trc	Sequential data set *USERID*.TEST.TRACE.TRC	Sequential data set *USERID*.TEST.TRACE.TRC
//'first.test.trace.trc'	Sequential data set FIRST.TEST.TRACE.TRC	Sequential data set FIRST.TEST.TRACE.TRC
./trace.trc	HFS file ./trace.trc	HFS file ./trace.trc

__PROF_WEBSERVER=NO|YES

Default: __PROF_WEBSERVER=NO

Description:
To trace the application running in a Lotus Domino Go Webserver environment, this variable must be se to YES. Otherwise, set this variable to NO.

__PROF_HOOKS=ALL|ENTRY_EXIT|BEFORE_AFTER

Default: __PROF_HOOKS=ALL

Description:

Use this environment variable to control which hooks are processed for function calls.

- **ENTRY_EXIT**
  Trace data is only collected at entry and exit points of a function. Exercise caution when specifying **ENTRY_EXIT** because you may lose some trace information. For example, if you specified **ENTRY_EXIT**, and function B in another file was called, unless the function B's file was built with TEST(HOOK), there would be no trace record indicating that function B was ever executed. This would be conspicuous if a whole DLL is built without theTEST(HOOK) compile option because none of the calls to the DLL would be recorded.
- **BEFORE_AFTER**
  Trace data is collected before and after a function call.
- **ALL**
  Events are processed before and after a function call and also at the entry and exit points of a function. If all files of a program are compiled with TEST(HOOK), then tracing the program will be faster when you specify **BEFORE_AFTER** instead of **ALL** because fewer hooks are processed. However, the main function does not appear in the trace data because nothing calls it.

Refer to the OS/390 C/C++ Programming Guide and the OS/390 UNIX System Services User's Guide for more information on environment variables.

RELATED CONCEPTS

Function trace"Function trace" on page 14
Call frequency counting"Call frequency counting" on page 13

RELATED TASKS

Setting environment variables for Performance Analyzer"Setting environment variables for Performance Analyzer" on page 26
Collecting call frequency data"Collecting call frequency data" on page 33
Creating a trace file"Creating a trace file" on page 28

RELATED REFERENCES

Sample JCL for creating trace files"Sample JCL for creating trace files" on page 72
Sample TSO Commands for creating trace files"Sample TSO commands for creating trace files" on page 75
Sample Unix system service commands for creating trace files"Sample Unix system service commands for creating trace files" on page 74

Troubleshooting Performance Analyzer problems

No Trace File Created

By default, the Performance Analyzer creates the trace file as *xxxxxx*.trc, where *xxxxxx* is the name of the module in which the first main function is found. If the Performance Analyzer cannot find the main function, it creates a file named module_name.trc, where module_name is the name of the first executable or DLL encountered.

If you specified the environment variable __PROF_FILE_NAME, then the trace file will be created with the name you specified. If you cannot find the file, check the following:

- The PROFILE run-time option must be turned on.
- If your application is running with run-time option POSIX(ON), your trace file may be stored as an HFS file.
- If your application creates other processes with the fork or spawn functions, the names of the trace files created for the different processes of the application will have the process ID's appended to the name that was specified with __PROF_FILE_NAME.
- If your application is running with run-time option POSIX(ON) or in OS/390 UNIX System Services, and you did not set the environment variable __PROF_APPEND_PID=NO, the Performance Analyzer appends the process ID to the trace file name.
- Your program must be compiled with the TEST(HOOK) option.
- Check for Performance Analyzer error messages in stdout or stderr.
- If an OS/390 UNIX kill command was used to stop the *process*, no trace files will be generated.
- If the operator used a cancel command to stop the *process*, no trace files will be generated.

ianalyze Not Found - Workstation Error

Ensure that the workstation part of the Performance Analyzer was installed properly. For more details on installing it on the workstation, see Installing and Getting Started with OS/390 C/C++ Productivity Tools for Windows NT.

Error Reading the Trace File - Workstation Error

If you are using the **ianalyze** command to display a graph, the following message may appear:

```
28104E: Error reading trace file,"trace file name"
```

it means that the trace file cannot be displayed. The cause of the error may be one or more of the situations described in the following table:

Situation	Response
The trace file was downloaded from the host machine as a text file instead of a binary file.	Download the file again as a binary file.
The version of the Performance Analyzer's host component is different from the version of the workstation component.	Ensure that both the host and workstation components of Performance Analyzer are at the most recent service level.
The workstation is out of storage.	Close other programs that are running and use the ianalyze command again.

29104E: No events were logged in trace file error - Workstation Error

You cannot open the Call Nesting, Time Line, or Execution Density diagrams with a trace file generated by specifying the call frequency counting sub-option FUNCTION=COUNTS. Only the Dynamic Call Graph diagram and Statistics diagram show call frequency information.

34002E: Error number 100 occured - Workstation Error

This error message is issued when a diagram cannot be displayed because the data in the trace file includes a thread call depth of greater than 512. The Call Nesting, Execution Density, and Time Line diagrams do not support thread call depths greater than 512.

Loading Help Error - Workstation Error

When the Performance Analyzer is invoked at the workstation to analyze a trace file, the following error message may appear: "Failed to load Help Manager. IPTPW10.HLP must be in your HELP and DPATH environment variables" The cause of the error is usually a user HELP variable setting that does not include %HELP%. The installation of OS/390 C/C++ Productivity Tools sets a system HELP environment variable to include the path containing the required file. If you have specified a user HELP variable, add %HELP% at the end of your path specifications. Note: The DPATH environment variable does not need to be set.

RELATED CONCEPTS

Function trace"Function trace" on page 14
Call frequency counting"Call frequency counting" on page 13

RELATED TASKS

Creating a trace file"Creating a trace file" on page 28
Collecting call frequency data"Collecting call frequency data" on page 33

RELATED REFERENCES

Performance Analyzer error messages on the host"Performance Analyzer error messages on the host" on page 69
Run-time option for program tracing"Run-time option for program tracing" on page 62
Run-time environment variables for program tracing"Run-time environment

variables for program tracing" on page 64
Limitations when creating a trace"Limitations when creating a trace" on page 59

Performance Analyzer error messages on the host

These are error messages that the Performance Analyzer generates during tracing:

CTV0001
Cannot allocate memory.

Explanation:

The Performance Analyzer is unable to acquire some heap storage and cannot continue.

Programmer Response:

Run the program with a larger storage region.

CTV0002
Invalid value specified for environment variable%1. The default value %2 is used.

Explanation:

%1 is the environment variable name and %2 is the default environment variable value. An invalid value was specified for the indicated environment variable. The default value is used instead. Tracing continues.

Programmer Response:

Ensure that the environment variable is set to the desired value and try again.

CTV0004
Cannot create data space.

Explanation:

Data space creation failed. Data spaces might not be supported by the system. Data space support is required to run the Performance Analyzer. Tracing is discontinued.

Programmer Response:

Contact your systems administrator to determine whether or not data spaces are supported on your system.

CTV0005
Cannot release storage.

Explanation:

A failure occurred while trying to release data space or address space storage. If this condition continues, a storage shortage may occur.

Programmer Response:

Try tracing again. If this message continues to reappear, notify your systems administrator of this problem.

CTV0006
Cannot initialize Performance Analyzer for "DELAY" tracing.

Explanation:

A failure occurred while initializing the Performance Analyzer for "DELAY" tracing. Tracing cannot be started.

Programmer Response:

Try tracing again. If this message continues to reappear, contact your IBM representative to report the problem.

CTV0007

Tracing cannot continue due to a Performance Analyzer internal error.

Explanation:

The Performance Analyzer has encountered inconsistent data and cannot continue processing the data. If a trace file is generated, it is incomplete.

Programmer Response:

Try tracing again. If this message continues to reappear, contact your IBM representative to report this problem.

CTV0008

No tracing data is available because tracing was not activated.

Explanation:

The "DELAY" option was specified but tracing was not started with a "kill -s PROF" command. No trace data was produced and therefore no trace file is created.

Programmer Response:

If you specify the "DELAY" option, you must start tracing by sending the "SIGPROF" signal with the "kill" command to the process which is running the application program to be traced. Try tracing again and issue the "kill -s PROF" command to start tracing.

CTV0009

Cannot open iconv table.

Explanation:

A failure occurred trying to open the iconv conversion table of the Language Environment Run-Time Library. Tracing is stopped and no trace file is created.

Programmer Response:

Try tracing again. If this message continues to reappear, contact your systems administrator to ensure that the Language Environment run time is installed properly and available to your program.

CTV0010

Cannot open the trace file %1.

Explanation:

%1 is the trace file name. The specified trace file cannot be opened for writing. Tracing is stopped and no trace file is created.

Programmer Response:

Ensure that space is available in the file system or volume and that you have the correct permissions to create the file.

CTV0011

Cannot write to the trace file.

Explanation:

A failure occurred writing to the Performance Analyzer trace file. Tracing is stopped and the trace file is incomplete.

Programmer Response:

Ensure that the file system or volume is operational and not full, then try tracing again. If this message continues to reappear, contact your IBM representative to report the problem.

CTV0012

Cannot convert string to ASCII.

Explanation:

A failure occurred doing code page conversion using the iconv functions of the Language Environment Run-Time Library. Tracing is stopped and the Performance Analyzer trace is incomplete.

Programmer Response:

Try tracing again. If this message continues to reappear, contact your systems administrator to ensure that the Language Environment run time is installed properly and available to your program

CTV0013

Cannot read from data space.

Explanation:

Reading from a data space failed. Tracing continues but the Performance Analyzer trace is incomplete. A serious system problem may exist.

Programmer Response:

If this message continues to be reappear, a serious system problem may exist. Contact your systems administrator to ensure that data space support is operational. Try tracing again. If the problem persists, contact your IBM representative to report the problem.

CTV0015

%1 is an invalid Performance Analyzer option and is ignored.

Explanation:

%1 is the invalid option that was specified. An invalid Performance Analyzer option was specified. The option is ignored and tracing continues.

Programmer Response:

Specify valid Performance Analyzer options in the “PROFILE” run-time option and try again.

CTV0016

The %1 feature of OS/390 is not enabled. Contact your system programmer.

Explanation:

%1 is the name of the OS/390 feature. This feature of OS/390 is not enabled at your installation. This feature is required in order to use the Performance Analyzer. Your system programmer can contact IBM OS/390 service to have this element enabled.

Programmer Response:

Contact your system programmer to have this feature enabled.

CTV0017

No tracing data is available because no hooks were encountered.

Explanation:

No tracing hooks were found in the program code. The program cannot be traced.

Programmer Response:

Compile the program code with the TEST(HOOK) option and try tracing again.

CTV0018

Cannot write to data space.

Explanation:

Writing to a data space failed. Tracing continues but is incomplete. A serious system problem may exist.

Programmer Response:

If this message continues to reappear, a serious system problem may exist. Contact your systems administrator to ensure that data space support is operational. Try tracing again. If the problem persists, contact your IBM representative to report the problem.

CTV0019

Data space is full and it cannot be extended.

Explanation:

Extending a data space failed. Tracing continues but is incomplete. A serious system problem may exist.

Programmer Response:

If this message continues to reappear, a serious system problem may exist. Contact your systems administrator to ensure that data space support is operational. Try tracing again. If the problem persists, contact your IBM representative to report the problem.

RELATED CONCEPTS

Function trace“Function trace” on page 14

RELATED TASKS

Creating a trace file“Creating a trace file” on page 28

RELATED REFERENCES

Troubleshooting Performance Analyzer problems“Troubleshooting Performance Analyzer problems” on page 67

Sample JCL for creating trace files

You can customize this sample JCL to execute your program and turn on the Performance Analyzer for function tracing. The JCL compiles, binds, and traces the sample program CBC3GDC1 that comes with the OS/390 C/C++ Compiler.

```
//PROFFUNC JOB 1,'PP5647-A01',MSGLEVEL=(1,1),MSGCLASS=A
//  SET #CPP=CBC
//  SET #PA=CBC
//  SET #LE=CEE
//PROC JCLLIB ORDER=(&#CPP..SCBCPRC,
//   &#LE..SCEEPROC)
//*----------------------------------------------------------------------
//* PROFFUNC - OS/390 C/C++ Performance Analyzer Sample JCL For
//*            Function Level Trace
//*
//* COPYRIGHT:
//*  LICENSED MATERIALS - PROPERTY OF IBM.
//*
//*  5647-A01
//*  (C) COPYRIGHT IBM CORP. 1997,1999 ALL RIGHTS RESERVED
//*  US GOVERNMENT USERS RESTRICTED RIGHTS - USE,
//*  DUPLICATION OR DISCLOSURE RESTRICTED BY GSA
//*  ADP SCHEDULE CONTRACT WITH IBM CORP.
//*
//* INSTRUCTIONS:
//*   Before submitting this job, the JCL must be customized
//*   for your installation.  The following changes need to be
//*   made:
//*
//*    1. Update the JOB card with the installation specific
//*       parameters.
//*    2. If you chose to use a different prefix than the IBM supplied
//*       one for the C/C++ Compiler, please change the value of CBC
//*       to your chosen prefix on the // SET #CPP=CBC statement.
//*    3. If you chose to use a different prefix than the IBM supplied
//*       one for the C/C++ Host Performance Analyzer, please change
//*       the value of CBC to your chosen prefix on the // SET #PA=CBC
//*       statement.
//*    4. If you chose to use a different prefix than the IBM supplied
//*       one for the Language Environment, please change the value
//*       of CEE to your chosen prefix on the // SET #LE=CEE
//*       statement.
//*    5. If you have installed Kanji Messages for the C/C++ Compiler
//*       on your system and want to enable it, uncomment the CRUN
//*       line.
//*    6. You may have to change the unit TUNIT='VIO' to your
//*       locally-defined esoteric name.
//*
//* REQUIRED ENVIRONMENT:
//*    1. C/C++ Compiler and Language Environment must be installed on
//*       the system prior to execution of this JCL.
//*
//* INPUT:
//*    1. Input data set: CBC.SCBCSAM(CBC3GDC1).
//*
//* OUTPUT:
//*    1. Return code of zero for all steps.
//*    2. Function trace file yourid.CBC3GDC1.FUNCTION.TRC is
//*       generated.
//*    3. Output from the program:
//*     res_add =11.87655
//*     res_sub =0.34
//*     res_mul =-1.4814000
//*     res_div =1.12079927338782
//*-----------------------------------------------------------------
//PROFTST EXEC EDCCBG,
//         CPARM='OPTFILE(DD:OPTION)',
//         TUNIT='VIO',
//         LIBPRFX=&#LE.,
//         LNGPRFX=&#CPP.,
//*        CRUN='NATLANG(JPN)',
//         INFILE=&#CPP..SCBCSAM(CBC3GDC1),
```

```
//        OUTFILE='&&GSET(GO),DISP=(NEW,PASS),SPACE=(TRK,(7,7,1))',
//   GPARM='PROFILE(ON,"FUNC=A,T")),ENVAR("_CEE_ENVFILE=DD:MYVARS")/'
//OPTION DD *
LIST
TEST(HOOK)
NOGONUMBER
OPT(1)
/*
//BIND.SYSLMOD  DD  DSNAME=&OUTFILE,UNIT=&TUNIT.
//GO.MYVARS   DD *
__PROF_FILE_NAME=CBC3GDC1.FUNCTION.TRC
__PROF_HOOKS=ALL
/*
//GO.STEPLIB  DD
//            DD  DSN=&#PA..SCTVMOD,DISP=SHR
//*                ========> END OF JOB PROFFUNC <========
```

RELATED CONCEPTS

Function trace“Function trace” on page 14

RELATED TASKS

Compiling your program“Compiling your program” on page 25
Setting environment variables for Performance Analyzer“Setting environment variables for Performance Analyzer” on page 26
Setting run-time option PROFILE for Performance Analyzer“Setting run-time option PROFILE for Performance Analyzer” on page 27

RELATED REFERENCES

Sample TSO Commands for creating trace files“Sample TSO commands for creating trace files” on page 75
Sample Unix system service commands for creating trace files“Sample Unix system service commands for creating trace files”
Sample trace file names from tracing a multiprocess program“Sample trace file names from tracing a multiprocess program” on page 76

Sample Unix system service commands for creating trace files

Here are some examples of OS/390 UNIX shell commands used to compile and execute a program and turn on the Performance Analyzer for function tracing.

Compile and Bind C Programs for Tracing
Use the **c89** command to compile and bind test.c:

```
c89 -o ./test -0 -Wc,"TEST(HOOK),NOGONUMBER" test.c
```

Compile and Bind C++ Programs for Tracing
Use the **c++** command to compile and bind test.cxx:

```
c++ -o ./test -0 -Wc,"TEST(HOOK),NOGONUMBER" test.cxx
```

Set Run-Time PROFILE Option and Environment Variables
Use the export command for setting run-time options and environment variables, for example:

```
export _CEE_RUNOPTS="PROFILE(ON,'FUNCTION=ALL,REAL')"
export __PROF_FILE_NAME=./test.trc
```

Set the STEPLIB environment variable so that Language Environment can find the Performance Analyzer module (only required if it is not included in the Link Pack Area):

```
export STEPLIB=CBC.SCTVMOD:$STEPLIB
```

Execute Your Program and Start Performance Analyzer
Start your program as follows, and the Performance Analyzer tracing will begin at the same time:

```
test
```

Turn off tracing after running your program by setting the _CEE_RUNOPTS environment variable as follows:

```
export _CEE_RUNOPTS="PROFILE(OFF)"
```

Note: If tracing is not turned off in this way, any other program that is executed in the current shell will be traced, including some OS/390 UNIX shell commands.

Refer to the *OS/390 UNIX System Services Command Reference* for more information on the use of the OS/390 UNIX commands.

RELATED CONCEPTS

Function trace“Function trace” on page 14

RELATED TASKS

Compiling your program“Compiling your program” on page 25
Setting environment variables for Performance Analyzer“Setting environment variables for Performance Analyzer” on page 26
Setting run-time option PROFILE for Performance Analyzer“Setting run-time option PROFILE for Performance Analyzer” on page 27

RELATED REFERENCES

Sample JCL for creating trace files“Sample JCL for creating trace files” on page 72
Sample TSO Commands for creating trace files“Sample TSO commands for creating trace files”
Sample trace file names from tracing a multiprocess program“Sample trace file names from tracing a multiprocess program” on page 76

Sample TSO commands for creating trace files

Here are some examples of TSO commands used to compile and execute your program and turn on the Performance Analyzer for function tracing.

Compile and Bind C Programs for Tracing
Use the following to compile and bind your C program:

```
cc testprof.c(testcpgm) (test(hook) nogonumber search('cee.sceeh.+') obj(testpgm.obj(testcpgm))
cxxbind obj(testpgm.obj(testcpgm)) load(testpgm.load(testcpgm))
```

Compile and Bind C++ Programs for Tracing
Use the following to compile and bind your C++ program:

```
cxx testprof.cpp(testcpp) (test(hook) nogonumber lsearch(testprof.hpp)
          se('cbc.sclbh.+','cee.sceeh.+') obj(testpgm.obj(testcpp))
```

```
cxxbind obj(testpgm.obj(testcpp)) load(testpgm.load(testcpp))
```

Set Run-Time PROFILE Option and Environment Variables and Run Your Program

You use the following to set run-time options and environment variables and run your program. In this case, the program being executed is testpgm.load(testprof).

```
tsolib act dsname('CBC.SCTVMOD')
call testpgm(testprof) 'PROFILE(ON,"F=A,R"),ENVAR(__PROF_FILE_NAME=testprof.trace)/'
```

Refer to the *OS/390 C/C++ User’s Guide* for more information on compiling and running your applications.

RELATED CONCEPTS

Function trace“Function trace” on page 14

RELATED TASKS

Compiling your program“Compiling your program” on page 25
Setting environment variables for Performance Analyzer“Setting environment variables for Performance Analyzer” on page 26
Setting run-time option PROFILE for Performance Analyzer“Setting run-time option PROFILE for Performance Analyzer” on page 27

RELATED REFERENCES

Sample JCL for creating trace files“Sample JCL for creating trace files” on page 72
Sample Unix system service commands for creating trace files“Sample Unix system service commands for creating trace files” on page 74
Sample trace file names from tracing a multiprocess program“Sample trace file names from tracing a multiprocess program”

Sample trace file names from tracing a multiprocess program

In this example, program prog1 calls the fork function and the resulting child process calls the exec function to execute program prog2:

```
/* prog1.c */

int main()

{                                /* start of program              */

/* ...some code...*/

if ((pid = fork()) < 0) {
    perror("fork failed");
    exit(2);
    }

if (pid == (pid_t)0) {        /* CHILD process                 */
    execl("./prog2", NULL);
    perror("The execl() call must have failed");
    exit(255);                /* return failure to parent      */
    }

else  {                       /* PARENT  process               */
    pid = wait(&c_status);
          if (WIFEXITED(c_status)) {
             printf("\nchild exited with code %d\n",WEXITSTATUS(c_status));
             }
          else
```

```
            puts("\nchild did not exit successfully\n");
        }
exit(0);
}
```

Output Trace Files Default Names

If __PROF_FILE_NAME is not set, the following trace files are produced:

- prog1.trc.11111111 - parent process (PID=11111111)
- prog1.trc.22222222 - child process (PID=22222222)
- prog2.trc.22222222 if __PROF_APPEND_PID is not set or is set to YES or prog2.trc if __PROF_APPEND_PID=NO is set (PID=22222222)

Note:

1. Because the __PROF_FILE_NAME environment variable was not set, the trace file is named after the program that contains the main function, prog1, and the default file extension, .trc, is added.
2. With the fork function a new process is created, and to distinguish the trace file for the second process from the first one, the process ID (PID) number is appended at the end of each trace file's name, irregardless of the value of the environment variable __PROF_APPEND_PID.
3. When the exec function is executed, a new trace file is created for the process (which happens to be the child process in this case) up to that point of the execution. For the example above, this trace file has the name prog1.trc.22222222.
4. The exec function replaces the current process image with a new process image to run program prog2, without changing the PID number. Because program prog2 contains the main function, prog2 is used as the file name, with the default file name extension .trc appended to the name. The PID is appended to the trace file name depending on the value of the environment variable __PROF_APPEND_PID. prog2.trc or prog2.trc.22222222 will contain the trace data for program2 only.

Output Trace Files That Are Explicitly Named

If __PROF_FILE_NAME=prog1.trace is specified, the following trace files are produced:

- prog1.trace.11111112 - parent process (PID=11111112)
- prog1.trace.22222223 - child process (PID=22222223)
- prog1.trace if __PROF_APPEND_PID=NO is set (PID=22222223)

Note:

1. Because the __PROF_FILE_NAME environment variable is set to prog1.trace, the prog1.trace is used for all processes, including the process that executes the prog2 program.
2. With the fork function a new process is created and to distinguish the trace file for the second process from the first one, the process ID (PID) number is appended at the end of each trace file's name, irregardless of the value of the environment variable __PROF_APPEND_PID.

3. When the exec function is executed, a new trace file is created for the process (which happens to be the child process in this case) up to that point of the execution. For the example above, this trace file has the name prog1.trace.22222223.
4. The exec function replaces the current process image with a new process image to run program prog2, without changing the PID number. The PID is appended to the trace file name depending on the value of the environment variable __PROF_APPEND_PID. The consequence of not settting __PROF_APPEND_PID or setting it to YES, when __PROF_FILE_NAME is specified, is that the trace file for program prog2 will overwrite the trace file for the child process up until the exec function call. For the example above, if __PROF_APPEND_PID is not set or is set to YES, both trace files will have the name prog1.trace.22222223. In this case, it is recommended that __PROF_APPEND_PID=NO be set so no data is lost.

RELATED CONCEPTS

Function trace“Function trace” on page 14
Multiple process support“Multiple process support” on page 16

RELATED TASKS

Setting environment variables for Performance Analyzer“Setting environment variables for Performance Analyzer” on page 26

RELATED REFERENCES

Sample JCL for creating trace files“Sample JCL for creating trace files” on page 72
Sample TSO commands for creating trace files“Sample TSO commands for creating trace files” on page 75
Sample Unix system service commands for creating trace files“Sample Unix system service commands for creating trace files” on page 74

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