PROFILER for NATURAL

NATURAL Quality Assurance and Testing Tool

Product Overview

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What is a Profiler?

A profiler is a tool that monitors the execution of a set of objects. Its function is similar to a doctor's stethoscope, allowing you to monitor what is happening as your application runs. A profiler produces statistics that show:

- How often each object is executed
- How often each statement is executed within each object
- What objects and statements are not executed
- How much CPU time and database elapsed time each object consumes
- How much CPU time and database elapsed time each statement consumes within each object

Now, a simple-to-use and effective profiler is available for the NATURAL environment. **PROFILER for NATURAL** from Treehouse Software, Inc. (TSI) enables you to pinpoint problem objects and statements while the system is being developed.

PROFILER Answers Important Questions

Are you sure that your application has been thoroughly tested? PROFILER will ensure that each application has been tested 100%.

Studies have shown that less than four percent of the statements in an object generally account for more than half of its execution time. Do you know which four percent these are? With PROFILER, you will.

Do you know which objects and which statements in your applications are causing unnecessary processing delays and response time problems? PROFILER will help you find them quickly and easily.

Are you using the most efficient solution to your programming problem? PROFILER will allow you to evaluate the performance impact of different options.

Benefits of PROFILER for NATURAL

PROFILER for NATURAL offers many benefits to an organization, helping in performance analysis, debugging, application testing, quality assurance, education, and evaluation.

Performance Analysis

PROFILER identifies:

- Problem objects and statements
- Inefficient code
- Poor application structure and design
- Expensive database access methods
- Excessive CPU usage

Debugging

PROFILER will:

- Reveal object and statement execution counts
- Identify object statements in the order they were executed
- Display object and statement CPU time usage
- Indicate object and statement database access elapsed time

Application Testing

PROFILER will:

- Reveal untested objects
- Identify unexecuted code
- Highlight weaknesses in test data and procedures
- Enable the site to thoroughly test applications, resulting in lower maintenance and support requirements

Quality Assurance

PROFILER will:

- Indicate the percentage of an application that has been tested
- Display the percentage of an object that has been tested
- Reveal untested objects
- Identify untested statements

Education and Evaluation

PROFILER will:

- Provide insight for both experienced and novice programmers into NATURAL internals necessary for application performance optimization
- Help evaluate NATURAL statement efficiencies
- Assess the impact of new functions, code modifications, database changes, etc.

Using PROFILER

PROFILER is a powerful product, able to handle hundreds of users running thousands of objects. Each session may be used to accumulate statistics for just one user and one NATURAL object, or for many users of a large application. PROFILER can handle the largest and most complex applications.

Summary statistics from profiling sessions can be browsed on-line or on a batch report. These can be sorted by libraries or objects, CPU time used, database elapsed time, or statement execution counts. These statistics indicate which objects and statements have not been properly tested by showing execution counts and the percentage of statements or objects which have been executed.

Individual objects can be listed to display the following execution statistics:

- The number of times the statement has been executed
- The total CPU time spent executing the statement
- The average CPU time spent executing the statement
- For statements initiating database calls, the total and average elapsed time

By identifying inefficient NATURAL statements, expensive database calls, and inappropriate use of NATURAL program structures, PROFILER provides information which can help to reduce CPU requirements, minimize the amount of database processing, and improve end-user response times.

By allowing sites to test their applications more thoroughly, PROFILER helps to avoid costly production downtime and reduce application maintenance costs. For example, the following report shows that there are 52 objects in library PAYTEST and that six objects (or 11.54 percent) were tested while profile session PAYROLL was active. The remaining 46 objects need to be tested before being placed into production. The objects that have not been tested are listed, along with the number of executable statements in the object.

```
PRO0096: 'S'elect Object to see its Source Code Listing Report.

                          Summary Report for Session
   2004-12-31 11:38        Session PAYROLL                 USER24   PAYTEST
   QA Report:     52 Objects in PAYTEST_              View Executed
     of which      6 (  11.54% ) were Executed.         Objects? N
   Objects NOT Executed starting.. ________ types.. _____     Page 1__ of 2

   S          T Exec¦ S          T Exec¦ S          T Exec¦ S          T Exec
   e          y utbl¦ e          y utbl¦ e          y utbl¦ e          y utbl
   l  Object  p Stmt¦ l  Object  p Stmt¦ l  Object  p Stmt¦ l  Object  p Stmt
   _ CITYTAXL L    1¦ _ FICAM    M    9¦ _ LIFEINSS S    3¦ _ PAY0120M M    3
   _ CITYTAXM M    9¦ _ FICAP    P   14¦ _ PAYBATCH P   10¦ _ PAY0120P P   30
   _ CITYTAXP P   13¦ _ FICAS    S    3¦ _ PAYEMPL  L    0¦ _ PAY0120T M    2
   _ CITYTAXS S    3¦ _ KAH0100M M    2¦ _ PAYKH    P   30¦ _ PAY0130P P   28
   _ CITYTX2L L    0¦ _ KAH0100P P   26¦ _ PAYL     L    0¦ _ PAY0130T M    2
   _ FEDTAXL  L    1¦ _ KAH1080  P  874¦ _ PAYLOCL  L    0¦ _ PAY0140M M    2
   _ FEDTAXM  M    9¦ _ KHBIBM   M    2¦ _ PAYROLLG C    1¦ _ PAY0140P P   25
   _ FEDTAXP  P   15¦ _ LIFEINSL L    1¦ _ PAY0100T M    2¦ _ PAY0140T M    2
   _ FEDTAXS  S    3¦ _ LIFEINSM M    6¦ _ PAY0110P P   27¦ _ PENSIONL L    0
   _ FICAL    L    1¦ _ LIFEINSP P   13¦ _ PAY0110T M    2¦ _ PENSIONM M    6

 Enter-PF1---PF2---PF3---PF4---PF5---PF6---PF7---PF8---PF9---PF10--PF11--PF12---
       Help        End                    Up    Down  Sourc             Exit
```

Background Monitoring Facility

Normally, users manually activate PROFILER at the start of a testing session and deactivate PROFILER at the end of testing. Although PROFILER activation and deactivation are very simple, some sites may prefer a more automated approach. The PROFILER Background Monitoring facility allows a profiling session to be automatically activated for one or more users at LOGON to a NATURAL library.

The password-controlled Background Monitoring facility allows authorized users to cause a profiling session to be automatically activated for themselves or others based on library or object masks, NATURAL object types, and date and time.

Use of the Background Monitoring facility is optional and does not prevent users from manually activating profiling sessions.

Introduction to Reporting

The PROFILER Reporting facility allows a user to display the statistics that have been calculated during an active profile or trace session. PROFILER retrieves these statistics from the PROFILER repository. Reports that display these statistics may be obtained on-line or in batch.

Statement Execution Count Summary Report

After profile statistcis for a session have been collected, summary reports can be viewed. In the example below, the 'Statement Execution Count Summary Report' lists all of the objects executed during a profile session. It indicates the number of times each object was executed, the total number of statements executed, the number of executable statements within the object, and the percentage of executable statements within each object which actually executed during profiling.

```
PRO0096: 'S'elect Object to see its Source Code Listing Report.

                          Summary Report for Session
   2004-12-31 11:38            Session PAYROLL                    USER24   PAYTEST
     Report Format S  Sort Order OBJ  Types _____      QA? N   Page 1__ of 1
     Start Library ________     Start Object ________  View/Amend Thresholds N
             Total Stmt Execs             2263

                                                    Exec   %Exec      % Graph of
   S                     T                 Total   Exec  utbl    -utbl   Executable
   E                     y        Run       Stmt   utbl  Stmt    Stmts   Statements
   l Library   Object    p       Count      Execs   Stmt  Exec     Exec   Executed
   _ PAYLIB    PAY0010P  P           3        114     45    40   100.00   **********
   _ PAYLIB    PAY0900M  M           1        110     55    12    21.83   **
   _ PAYLIB    PAY0120P  P           2         99     50    27    54.92   *****
   _ PAYLIB    PAY0030P  P           4         83     33     1     3.05
   _ PAYLIB    PAY0550P  P           1         76     25    15    60.27   ******
   _ PAYLIB    PAY1105M  M           1         54     97    42    43.32   ****
   _ PAYLIB    PAY0080M  M           2         23     15    11    73.35   *******




 Enter-PF1---PF2---PF3---PF4---PF5---PF6---PF7---PF8---PF9---PF10--PF11--PF12---
       Help  User  End   Stmts CPU   Dbase Up    Down  Sourc Left  Right Exit
```

Quality Assurance personnel can use this report to identify objects that have been fully tested and those that require additional testing. Site standards should require that 100 percent of the executable statements in an object must be tested before being placed in production. This report indicates that only the program, PAY0010P, has been adequately tested. The others require additional testing.

Other summary report formats can be easily accessed using the PF keys. To view all of the information available on a given report, it may be necessary to scroll left, right, up or down using additional PF keys.

Application Quality Assurance Report

The Application Quality Assurance (QA) Report begins with a summary of statistics for the application library:

```
 04-12-31                    *** PROFILER for NATURAL ***                USER24
 11:38:00                       Application QA Report                    PROLIB
 Session: PAYTEST                                                        Page
1

        Library: PAYLIB




            Total Objects Reported:         162
            Total Objects Executed:         117
            Percentage of Objects Executed: 72.22









                                                                         REP
APP
Enter-PF1---PF2---PF3---PF4---PF5---PF6---PF7---PF8---PF9---PF10--PF11--PF12--
-
      HELP        END                             +                      EXIT
```

This page shows that 117 objects in the application library (PAYLIB) being profiled were executed during the session. The remaining 45 need to be tested before being placed into production.

The summary shown above reports the application components that have been executed. To view the extent to which the individual components have been tested, the site would refer to the second page (and following pages) of the report.

The following page of the report lists the objects contained in the application library and provides a variety of statistics about each object. This information will indicate which components of the application need to be tested further.

```
END OF REPORT
 04-12-31                 *** PROFILER for NATURAL ***                 USER24
 11:38:00                    Application QA Report                     PROLIB
 Session: PAYTEST                                                      Page   2

       Statistics for Library:  PAYLIB
                                                 Excutbl     %Excutbl
                      O  Run       Excutbl      Stmts       Stmts
 User-ID   Program    T  Count     Stmts        Exec        Exec      Inconsistencies
 --------  --------   -  --------  -------  ----------- --------  ------------------------------
---
 USER37    PAY0010P   P         3       54           45     83.3
 USER37    PAY0020P   P         1       30           12     40.0  cataloged since last
activation
 USER37    PAY0030N   N         2      114           50     43.9
 USER37    PAY0040M   M         4        2            2    100.0
 USER37    PAY0050P   P         1       76           76    100.0
           PAY0060S   S                110
 USER37    PAY0070P   P         2       23           15     65.2



 ------------------------------------------------------------------------------------------
---
                                                                       REP APP
Enter-PF1---PF2---PF3---PF4---PF5---PF6---PF7---PF8---PF9---PF10--PF11--PF12---
      HELP        END                       -                 <     >    EXIT
```

This example indicates that the subroutine PAY0060S has not been tested, and that map PAY0040M and program PAY0050P have been 100% tested. The report also indicates that the timestamps on the object code and the date of the statistics collected for the program PAY0020P are inconsistent, indicating that the program was re-STOWed after statistics collection began.

Database/Work File Loops Report

The following Database/Work File Loops Report indicates the number of times each object has been tested, the number of database and work file loops contained in the object, the number of database/work file loops which have been executed, and more.

```
PRO0096: 'S'elect Object to see its Source Code Listing Report.

                          Summary Report for Session
   2004-12-31 11:38        Session PAYROLL                  USER24   PAYTEST
     Report Format F  Sort Order OBJ  Types _____      QA? N   Page 1__ of 1
     Start Library ________     Start Object _________  View/Amend Thresholds N
             Total Stmt Execs            2263

   S                    T              Total   DB/WF  %DB/WF   DB/WF  %DB/WF
   e                    y       Run    DB/WF   Loops   Loops  Bodies  Bodies
   l Library   Object   p     Count    Loops    Exec    Exec    Exec    Exec
   _ PAYLIB   PAY0010P P         3       12       6   50.00       3   25.00
   _ PAYLIB   PAY0020P P         1        9       9  100.00       9  100.00
   _ PAYLIB   PAY0003P P         2       18       9   50.00       6   33.33
   _ PAYLIB   PAY0040P P         4        4       4  100.00       2   50.00
   _ PAYLIB   PAY0051M M         1        4       4  100.00       2   50.00
   _ PAYLIB   PAY0060M M         1        6
   _ PAYLIB   PAY0070M M         2        8       8  100.00       4   50.00



 Enter-PF1---PF2---PF3---PF4---PF5---PF6---PF7---PF8---PF9---PF10--PF11--PF12---
       Help  User  End   Stmts CPU   Dbase Up    Down  Sourc Left  Right Exit
```

This report is useful for determining if all of the database and work file accesses contained in an object have been tested, helping to highlight weaknesses in test data and procedures. For example, the report above indicates that all loops in objects PAY0020P, PAY0040P, PAY0051M, and PAY0070M have been tested, but only 50 percent of the loops in objects PAY0010P and PAY0003P have been tested.

Source Code Listing Report

The Source Code Listing Report for an object displays a listing of the NATURAL source code for the object, along with statistics about its execution.

```
PRO0101: Statements shown: Executed, Un-executed and Non-Executable.
  2004-06-28 16:48 Profile Session PAYROLL           Object Profiled by TBF1
    Execs Total CPU Avg CPU > ____ ....+....1....+....2... PAY0110P Lib PAYTEST
       30    32.122   1.071   0370 READ EMPLOYEES BY NAME STARTING FROM 'A'
 <D'base   323.120  10.771 >
       30     2.264   0.075   0380   ADD 1 TO #I
       30     3.043   0.101   0390   MOVE PERSONNEL-ID TO #ID(#I)
       30     4.446   0.148   0400   COMPRESS FIRST-NAME MIDDLE-INIT NAME INTO #
       30     3.770   0.126   0410   MOVE DEPT TO #DEPT(#I)
       30     4.116   0.137   0420   MOVE JOB-TITLE TO #TITLE(#I)
       30     3.362   0.112   0430   IF #I = 10
        3     0.171   0.057   0440     PERFORM INPUT-MAP
        2     0.120   0.060   0450     RESET #I
                              0460   END-IF
       29     2.071   0.071   0470 END-READ
                            > 0480 IF #I < 10
                            > 0490   PERFORM INPUT-MAP
                            > 0500   RESET #I
                              0510 END-IF
                              0520   DEFINE SUBROUTINE INPUT-MAP
        3     0.168   0.056   0530   REPEAT
        3     4.646   1.549   0540     INPUT USING MAP 'PAY0110M'
        3     0.590   0.197   0550     DECIDE ON FIRST *PF-KEY
  PF1 ?     PF2 COPY  PF3 QUIT  PF4 SCAN  PF5 SC=   PF6 SHOW    Page   3 of 4
```

The NATURAL source code for program PAY0100P in library PAYTEST is listed with statistics for each executable statement. If an executable statement has not executed, it is marked with a ">" immediately to the left of the source code line number. In the example above, lines 0480 through 0500 have not been executed. Non-executable statements, such as comments and continuation lines, appear in the report listing, but they have no statistics and are not marked with a ">".

The Source Code Listing report also shows which NATURAL statements in an object consumed the most CPU time (line 0540 in the example above) and which statements spent the most time accessing the database (in the example above, line 0370 is the only statement that accessed the database). This can help the programmer pinpoint performance "hot spots" in an object or evaluate the performance impact of different algorithms.

The SHOW command (PF6) allows the statements displayed to be limited to any combination of executed statements, un-executed statements, and non-executable statements.

Enhanced Reporting Facility

In addition to its many standard reports, PROFILER also includes an Enhanced Reporting facility, which allows statistics for multiple sessions, User-IDs, libraries, objects, and object types to be merged on PROFILER Enhanced Reports.

Consider a site where a team of users tests the same application. Each user tests a specific function or component of the application and uses a separate PROFILER session. Using the Enhanced Reporting facility, the team members can merge their statistics on one report to show that the entire application has been fully tested.

The following Enhanced CPU Time Summary Report was generated from PROFILER statistics gathered by all users of the PAYTEST library.

```
04-12-31                *** PROFILER for NATURAL ***                  USER24
 11:38:00              Enhanced CPU Time Summary Report               PROLIB
 Report Parameter Name: PAYROLL-GROUP                                 Page 1
 Combined
        Starting Library/Program: PAYLIB   PAY0140P    Sort Order: CPU
 S
 e                        O  Run       CPU                    Catalog
 l  Library   Program     T  Count     Time (msec)    %CPU    Timestamp
 -  --------  --------    -  --------  -------------  ------  --------------------
 _  PAYLIB    PAY0140P    P         9        38.7200   35.22  99-12-10 13:04:15
 _  PAYLIB    PAY0110P    P         8        15.4240   14.03  99-12-23 10:38:18
 _  PAYLIB    PAY0140M    M        57        11.0720   10.07  99-12-10 13:03:40
 _  PAYLIB    PAY0130P    P         6        10.8800    9.90  99-12-10 13:04:11
 _  PAYLIB    PAY0100P    P        27         6.9760    6.34  99-12-25 09:37:26
 _  PAYLIB    PAY0120P    P        21         5.5680    5.06  99-12-10 13:04:06
 _  PAYLIB    PAY0130M    M        17         4.9280    4.48  99-12-10 13:03:34
 _  PAYLIB    PAY0110M    M        13         3.3280    3.03  99-12-10 13:03:19
 _  PAYLIB    PAY0120M    M        11         2.9440    2.68  99-10-15 11:57:04
 _  PAYLIB    PAY0125M    M        10         2.4960    2.27  99-12-10 13:03:31
 ------------------------------------------------------------------------------
Enter-PF1---PF2---PF3---PF4---PF5---PF6---PF7---PF8---PF9---PF10--PF11--PF12---
      HELP  PARM  END   STMT  CPU   DAT          +                      EXIT
```

Note that although this example shows all users' statistics for a particular library/object/timestamp combined into one line of the report, it is also possible to view these statistics broken down by individual User-IDs.

Many other enhanced report formats exist, and there are a number of options that enable the contents of the reports to be filtered to contain only the desired information. Users may also code their own reports, based on the statistics collected by PROFILER. As a result, PROFILER provides unlimited reporting capabilities.

Trace Subsystem

PROFILER includes a powerful Trace Subsystem, which monitors the order of execution of object statements within an application and generates a Trace Source Code Listing Report.

The following screen is an example of detailed information gathered by a tracing session.

```
2004-12-31 11:38     Report on Trace Session PAYROLL TRACE    USER24   PAYTEST

       Lines 1 to 15 of 2045  +....3....+....4....+....  PAYROLL  Lib PAYTEST
  0050 FETCH 'PAY0100P'
       ....+....1....+....2....+....3....+....4....+....  PAY0100P Lib PAYTEST
  0050 INCLUDE PAY0100C
       ....+....1....+....2....+....3....+....4....+....  PAY0100C Lib PAYTEST
C 0010 SET KEY PF1  = PGM NAMED 'HELP'
       ....+....1....+....2....+....3....+....4....+....  PAY0100P Lib PAYTEST
  0060 REPEAT
  0070   INPUT USING MAP 'PAY0100M'
       ....+....1....+....2....+....3....+....4....+....  PAY0100M Lib PAYTEST
  0012 INPUT          (     IP=OFF       HE='PAY0100H'     )
  0058 END
       ....+....1....+....2....+....3....+....4....+....  PAY0100P Lib PAYTEST
  0080   DECIDE ON FIRST *PF-KEY
  0110     VALUE 'ENTR'
  0120       PERFORM INPUT-CHECK
  1320 IF #VALUE = ' '
  1330   REINPUT 'Please enter a Value.'  MARK *#VALUE ALARM
  1370 END-IF
  0070   INPUT USING MAP 'PAY0100M'
       ....+....1....+....2....+....3....+....4....+....  PAY0100M Lib PAYTEST
  0012 INPUT          (     IP=OFF       HE='PAY0100H'     )

  Start from Line _____ and/or Scan for _____________________________  pf1 Help
```

The report above shows the flow of execution for a sample Payroll application.

- The user executes the program PAYROLL, which has its first executable statement at line number (0050).
- PAYROLL fetches the program PAY0100P.
- The PAY0100P program has its first executable statement at line number (0050), which is an INCLUDE of the copycode PAY0100C.
- PAY0100C contains a SET KEY statement. It returns control to PAY0100P.
- PAY0100P resumes execution at statement (0060). Statement (0070) executes the map PAY0100M, which inputs data from the user and returns control to PAY0100P.
- PAY0100P resumes at statement (0080), which is a DECIDE statement. Based on the next statement executed in PAY0100P, statement (0110), the user appeared to press the Enter key, which causes PAY0100P to perform the subroutine INPUT-CHECK, and so on.

Being able to follow the flow of execution in this way can be very helpful when attempting to diagnose an object failure or when attempting to determine how a particular application's components interact with each other.

Technical Summary

When installed and activated in a NATURAL environment, PROFILER for NATURAL gets control at the start of every NATURAL statement execution. As execution of each statement occurs for the libraries/objects selected for profiling, PROFILER accumulates statistics for CPU time and the number of times the statement has executed. For NATURAL statements resulting in database calls, the elapsed time spent accessing the database is also accumulated.

When a different object is executed, or when one object calls another, the statistics are stored on an ADABAS file, along with details stored from previous executions of the same object by the same user during the same profiling session. At any time, PROFILER results can be displayed on-line, and reports can be generated in batch.

PROFILER supports up to 255 concurrent active profiling sessions. Each session may be used to accumulate statistics for one or more users running objects in one or more libraries. PROFILER collects statistics for up to 2,018 executable statements in a single object, and monitors up to 44 database accessing statements in each object. This makes PROFILER suitable for use with a site's largest and most complex NATURAL applications.

The layout of the PROFILER Enhanced Reporting File is provided to facilitate the development of site-specific reports which display PROFILER statistics in any desired format.

PROFILER operates in the following environments:

MVS	**VM**
TSO	CMS
Batch	NATURAL
CICS	ADABAS
COM-PLETE/TPF	
NATURAL	
ADABAS, VSAM, or DB2	

Documentation and Installation

PROFILER documentation is contained in a single reference manual, which is fully indexed. The manual is distributed on the TSI Documentation CD-ROM. A hard copy of the manual is available upon request.

PROFILER includes a special program (PRFVRFY) to help verify that PROFILER has been properly installed, NATURAL is properly configured, the PROFILER modules are in place, the proper statistics files are installed and accessible to PROFILER, etc. It then mimics a profiling session, verifying that statistics can be collected and stored in the files. PRFVRFY provides diagnostic messages, which identify possible installation problems and suggest how to resolve them.

Customer Support

TSI provides support for PROFILER and its other products from its headquarters in Pennsylvania 24 hours a day, 7 days a week. Up-to-date support information can also be accessed from the TSI Web site on-line support area (www.treehouse.com/support.html). TSI affiliates provide first level support for the sites in their territory, communicating with TSI as needed to solve customer problems.

PROFILER users have direct input to the product developers. User questions are answered quickly, problems are discussed directly, and change enhancement requests are reviewed and implemented in a timely manner. A technical representative is available to assist in the setup and operation of PROFILER during installation.

Summary

- PROFILER enables a site to see substantial dollar savings by thoroughly testing applications, resulting in the ability to avoid costly production downtime and reduce application maintenance and support requirements.
- PROFILER shows how often a NATURAL object is executed and the CPU time and database time the object consumes.
- PROFILER shows how often each statement in a NATURAL object is executed, the CPU time for each statement, the elapsed time for each database accessing statement (e.g., FIND and READ statements), as well as each statement that was not executed.
- PROFILER provides a variety of easy-to-read, in-depth reports of object execution activity and resource usage.
- PROFILER can be activated/deactivated manually, and includes a Background Monitoring facility to automatically collect the desired statistics.
- The PROFILER interface is written in NATURAL, so it is familiar and easy to use. The data accumulator is written in Assembler, so it is fast and efficient.
- PROFILER can handle the largest NATURAL applications and hundreds of concurrent users.
- PROFILER is designed to minimize the impact of its overhead on the systems being profiled.
- PROFILER is the perfect complement to TSI's TRIM and other performance monitoring tools.
- PROFILER is also a perfect complement to TSI's Change Management product, N2O, as PROFILER helps a site to confirm that code has been fully tested before migration to the production environment.

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