MULTICS SYSTEM-PROGRAMMERS' MANUAL

SECTION BY.6.00 PAGE 1

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Identification

Library Procedures Used by the Interactive Debugging Aids D. B. Wagner

<u>Purpose</u>

Section BY.6 describes a collection of procedures used in the implementation of the interactive debugging aids described in BX.10.00 - .04, and as such constitutes the bulk of a design specification for the debugging aids.

The diagram of figure 1 shows the interaction among the procedures described and their intended use in the debugging aids. It is to be hoped that these procedures will be useful in other areas as well, particularly in the construction of an interactive "desk calculator" command.

Expression Evaluation

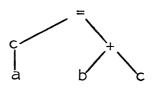
The user will see the debugging aids primarily in terms of the expression language, so that expression-evaluation is the most sensitive area of the implementation. Such issues as the order in which symbol tables are searched (e.g., which <u>a</u> will be found when there exist more than one <u>a</u>) and the points where extra blanks may occur seem minor, but have a great effect upon the user - they determine the "personality" of the debugging aids.

The work of expression-evaluation is done by three procedures -<u>parse</u>, <u>evaluate</u>, and <u>setvalue</u> (described in BY.6.03, BY.6.04 and BY.6.05 respectively). <u>parse</u> performs the syntactic analysis, yielding a tree-representation of an expression. <u>Evaluate</u> and <u>setvalue</u> perform, respectively, the two kinds of semantic expression-analysis, the so-called "right-hand-side" and "left-hand-side" evaluations, named for the two sides of an assignment statement. <u>Evaluate</u> finds the value of an expression, and <u>setvalue</u> sets the value of an expression.

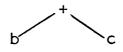
For example if the request

set $c(a) = b_{+}c$

(meaning set the contents of location \underline{a} to the result of adding \underline{b} and \underline{c} together) is typed to probe, the following action takes place. <u>Parse</u> is called by <u>probe</u>. It produces a tree-representation of the given expression as follows:



Then <u>probe</u> gives the "right-hand" subtree



to <u>evaluate</u>, which looks up <u>b</u> and <u>c</u> in the symbol table, adds their current values together, and returns the result. This result and the "left-hand" subtree

are given to <u>setvalue</u>, which actually changes the contents of location <u>a</u>.

Handling of Symbol Tables

The standard format for the "segment symbol table" is specified in Section BD.1. What is important about this standard format is that it allows considerable latitude to the designer of a translator in the area of descriptions of symbols, but rigidly legislates enough about the symbol table to make it possible for a standard subroutine to search a table for a given symbol-name without reference to what translator produced the table.

Since many translators (including PL/I and the standard assembler) use block-structuring to determine the "scope" of symbols, the symbol-table format allows for tree-structuring. The scheme used allows for tree-structuring at a higher level as well: so that all the individual symbol tables known to the debugger are treated as subtrees of a single tree called the Combined Symbol Table. Two procedures are provided for maintenance of the Combined Symbol Table: find_table and lose_table (described in BY.6.02). Find_table locates the symbol table for a specified segment and makes it a part of the combined Symbol Table (makes the symbol table "known"). Lose_table eliminates the symbol table (makes the symbol table "unknown").

The procedure Search_tables (described in BY.6.02) is used by <u>evaluate</u> and <u>setvalue</u> to search the Combined Symbol Table. It starts at a specified point and searches up and down in the tree according to certain rules which are discussed in BY.6.01.

<u>The Request Dispatcher</u>

The Request Dispatcher described in BY.6.01 does most of the work of reading and recognizing requests for the debugging

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aids, and in this respect bears some resemblance to the Shell. It also handles the <u>if</u>, <u>else</u>, <u>do</u>, and <u>end</u> requests, common to all of the debugging programs, which provide conditional and replication facilities.

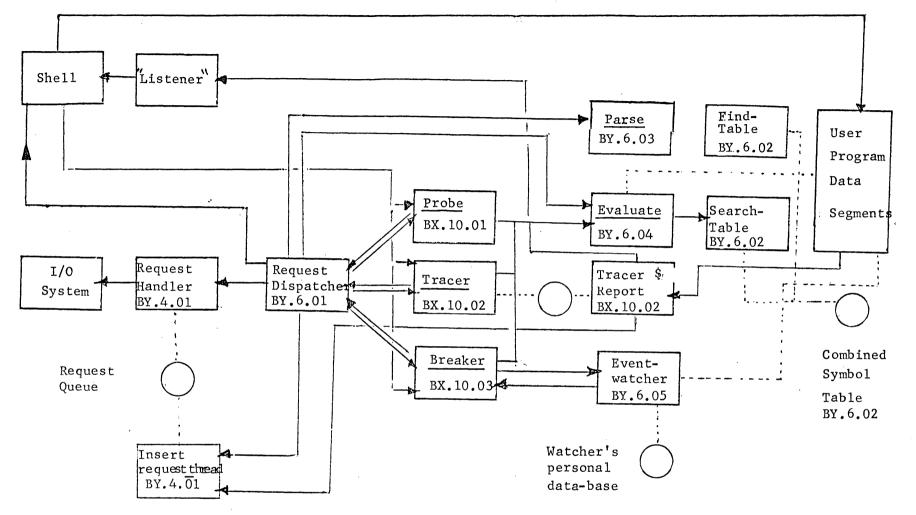
To use the Request Dispatcher, an interactive program calls the entry dispatch_request with a list of expected request names and a corresponding list of procedure entry points telling what procedure is to perform each type of request. The Dispatcher calls the Request Handler (see BY.4.01) to obtain one request line, extracts the request name (the first identifier on the line) and looks it up among the request names given in the call. If the request name is found there, dispatch_request calls the routine specified to perform the request. When this routine returns, dispatch_request returns to its caller.

If the request name is not found in the given list, it may be one of the special control requests <u>if</u>, <u>else</u>, <u>do</u>, and <u>end</u>. If it is, the appropriate action is taken (this involves fiddling with the Request Queue, see BY.4.01). If not, the request is either a command or an error. The line is given to the Shell, which attempts to interpret it as a command.

<u>The Watchers</u>

The "watchers" are the routines used by the <u>breaker</u> command to arrange for notification upon the occurence of events of interest to the user. Their use bears a family resemblance to the use of the <u>on</u> and <u>signal</u> statements in PL/I: a call to a watcher specifies an event to be watched for and gives an action to be performed when the event occurs, the "action" in this case being simply a call to a procedure with a single "identification" argument plus any arguments necessary to describe the event completely.

Not very much can be said about the watchers right now since not very much is known about the System fault and interrupt handling machinery.



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