MARCH 1976

NASA CR- 144770

MDC G6210

FINAL REPORT
A METHODOLOGY FOR PRODUCING RELIABLE SOFTWARE

VOLUME II

MCDONNELL DOUGLAS ASTRONAUTICS COMPANY

MCDONNELL DOUGLAS CORPORATION

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A METHODOLOGY FOR PRODUCING RELIABLE SOFTWARE

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PREFACE

This report was prepared for Mr. Evmenios Damon, Mission Operations Computing Division, NASA Goddard Space Flight Center under Contract Number NAS 5-20781.

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APPENDIX A

AUTOMATED VERIFICATION TOOLS

CONTENTS

A.1 INTRODUCTION

The purpose of this task is to investigate the existence, availability, and applicability of automated verification tools. A comparative analysis is made and relative merits are evaluated. In addition, recommendations regarding development of new tools or modification of existing tools for NASA applications are discussed.

In the course of this investigation eight automated verification tools were tested. Two difficulties were present from the outset. The first was the availability of certain tools for purposes of a comparative analysis. Researchers were reluctant to release their tools for an evaluation over which they had no control. Thus some better known tools such as PACE and RXVP were not included in the study. Secondly, due to the diversity of tool functions, capabilities and machine implementations, a suitable test bed for comparison had to be found. This was accomplished by using the same source program for testing the tools and adopting common units of measurement for timing statistics. These units of measurement are:

(1) the time required to compile the test program

(2) the time required to execute the test program

Thus, if a particular tool was tested on machine X, the timing statistics are relative to the normal compile and execution times of the program on machine X.

A.2 DESCRIPTIONS OF THE AUTOMATED TOOLS TESTED

A.2.1 Automatic Test Data Generator (ATDG)

TRW
Houston, Texas

Implementations: UNIVAC

ATDG examines a FORTRAN source program to determine the values of program variables required to produce optimal test cases. A report is produced upon completion of a path analysis for each program or subroutine. The report is presented in six sections:

Section I:	FORTRAN source code listing and corresponding segment numbers. (A segment is a set of contiguous source lines with no branch points).
Section II:	Static error analysis. Checks are made for infinite loops, unreachable code, and set/use violations.
Section III:	Segment number reference for symbols in set/use statements.
Section IV:	List of program paths
Section V:	List of program paths with branch expression values which affect execution.
Section VI:	Skeleton listing of each program path.

Exhibit Reference: A

Test results:

The exhibit shows the ATDG reports produced for FORTRAN program HSMAIN and one subroutine.

The output from the ATDG static error analysis (sections II and III) is interesting only when errors are uncovered in the element being analyzed. Of the six elements, only the main program (HSMAIN) had any detectable errors. The only errors which may require some explanation are those related to unreachable code:

a) ATDG says that the transfer 67-69 (and consequently 69-70 and 70-50) cannot be reached. An attempt was made to verify this. The transfer 67-69 is executed if L-N+1=0 (i.e., if L=N+1); since L=N is set at segment 59 and L is decremented at segment 62, it appears that L can never be greater than N. (The reader is encouraged to examine the code and locate these transfers).

b) ATDG says that the transfer 96-97 (and consequently 97-113) cannot be reached. Since NVEC=4 is set at segment 1 and is not altered until segment 105, it appears that NVEC.EQ.0 will in fact always be false at segment 96.

The final data generation output of ATDG is most useful if the transfers in the element are dependent upon integer switch variables, especially if these are inputs to the element or are set to a constant. It does very badly if switching is based upon dimensioned variables, since it does not interpret the value of the dimensions. When processing DO loops, it iterates the loop only as many times as are necessary to execute all transfers within the range of DO (i.e., the indexes on the DO statement are disregarded). Since the elements in this program perform much of the transfers based upon the value of A(I,J) and all contain a large number of DO loops, much of the data generation information is difficult to interpret. To assist the reader in understanding the reports, the following test cases have been derived for subroutine COMPIT:

a) By looking at Section VI, we know that the inputs which affect branching are N, L, SIGMA, A, and RHO. These are the values which will constitute a test case; all other inputs are arbitrary.

b) The listing (section I) shows that the key feature of the routine is the loop from segment 2 to 36. The path 1 in Section V shows that the loop (i.e., segment 36) is exercised 3 times, therefore M-L=2. We can thus assume that L=1 and N=4 will be alright since, in segment 1, M=N-1=3 would then be set.

c) It appears that, after deriving a setting for L and N, the only other constraints to set are those on B1 and D (i.e., since these are the branches shown in output V that are not dependent upon L and N). Section V shows that the first time through the loop, the conditions B1.GE.0 and D.NE.0 must be true; the second loop, B1.LT.0 and D.NE.0 must be true; the third loop B1.GE.0 and D.NE.0 must be true. Further, D cannot be negative, so change all D.NE.0 to D.GT.0. Then, the conditions for Path 1 can be satisfied by:

First Loop

$D = SQRT(B1^2 + B2^2 + B3^2) > 0$ true if $B1 \neq 0$

$B1 = A(1,1)(A(1,1)-SIGMA)+A(1,2)A(2,1)+RHO > 0$

true if A(1,1)=1.0, SIGMA=.5, A(1,2)=A(2,1)=RHO=0.0

Second Loop

$D > 0$ true if $B1 \neq 0$

$B1=A(2,2)(A(2,2)-SIGMA)+A(2,3)A(3,2)+RHO < 0$

true if A(2,2)=.1, SIGMA=.5, A(2,3)=A(3,2)=RHO=0.0

Third Loop

D>0 true if B1≠0

B1=A(3,3)(A(3,3)-SIGMA)+A(3,4)A(4,3)+RHO·0

true if A(3,3)=1.0, SIGMA=.5, A(3,4)=A(4,3)=RHO=0.0

Then inputs for Path 2 can easily be derived as:

N=2, A(1,1)=A(1,2)=A(2,1)=RHO=0.0, SIGMA=.5

A.2.2 FORTUNE

CAPEX
Phoenix, Arizona

Implementations: IBM, CDC

FORTUNE is used for FORTRAN source level optimization and execution analysis. Statistics gathered during program execution provide:

(1) the exact number of times each statement was executed,

(2) the estimated total execution time for each statement,

(3) the number of IF statement true paths taken,

(4) a summary of the estimated time and percentage of time spent within each program module.

Standard preprocessor/postprocessor organization is used. Timing information is gathered by analyzing each source statement, estimating the execution time for each statement, and then multiplying the estimated time by the number of executions. Estimates are obtained as follows:

(1) a basic cost fcr each statement type (DO, GOTO, etc.),

(2) a further incremental cost for each operation in arithmetic statements, each argument in subroutine entries, and invocation of intrinsic functions.

Estimates are relative to a base value of 2 for a GOTO statement. Library subroutine times are based on published values. Timings are not estimated for I/O statements.

Exhibit Reference: B

Test results:

The exhibit shows the results of instrumenting an entire FORTRAN program. Note the use of an annotated source listing for reporting data.

A.2.3 NBS Analyzer

Gordon Lyon
Rona Stillman
Institute of Computer Sciences and Technology
National Bureau of Standards
Washington, D.C. 20234

Implementations: UNIVAC

The NBS Analyzer is a simple static and dynamic tool for use with FORTRAN programs. Static analysis consists of a summary of source statements by FORTRAN type (i.e., GOTO, DO, FORMAT, etc.). To obtain dynamic statistics, a preprocessor divides the source program into segments. A segment is defined as a set of contiguous instructions containing no transfer of control statements. Thus a new segment is defined upon encountering a GOTO, IF, DO, etc. statement. Assignment of segments continues across subroutine boundaries; that is, a main program and any attendant subroutines are treated as a single program. Dynamic statistics consist of a matrix containing execution counts for each segment of the instrumented FORTRAN program.

Exhibit Reference: C

Test results

Exhibit pages 1C through 15C show the segment assignments for a FORTRAN program with five subroutines. Page 16C contains the Local Analysis for the program. Dynamic execution counts are contained on page 17C.

A.2.4 Program Evaluator and Tester (PET)

McDonnell Douglas Automation Company
Huntington Beach, California

Implementations: IBM,CDC,GE, Honeywell

PET is an automated aid used in debugging, testing and documentation of FORTRAN programs. Standard preprocessor/postprocessor organization is used. Run time statistics include:

(1) the number of times each statement was executed

(2) the number of times each branch of a program was executed. This includes branch counts for logical and arithmetic IF conditions, plus computed and assigned GOTO's branching histories.

(3) the minimum and maximum values attained by an assignment statement variable or DO loop parameter.

(4) the first and last values attained by an assignment statement variable or DO loop parameter.

(5) relative subroutine execution timings.

All of the above except (1) and (2) are optional, and may be activated via an option card. For each subprogram, a one page syntactic and operational profile is written by the postprocessor. For each program, four one page reports are written: a syntactic and operational profile, a subprogram operational summary, a subprogram execution summary and a subprogram timing summary.

Exhibit Reference: D,E

Test results:

The exhibit shows the results of instrumenting an entire FORTRAN program. Exhibit D reflects a run with full instrumentation, while Exhibit E shows the same program executed with minimal instrumentation. Note the expanded use of the annotated source listing for displaying dynamic execution statistics.

A.2.5 PFORT Verifier

A. D. Hall
B. G. Ryder
Bell Laboratories
Murray Hill, New Jersey

Implementations: IBM, CDC, Honeywell, Burroughs, Others

The PFORT Verifier checks a FORTRAN source program for adherence to PFORT, a portable subset of ANS FORTRAN. Subprogram communication is checked through common argument lists. Debugging and documentation aids include subprogram cross reference giving type, usage and attributes of each identifier with a list of statements in which it occurs. Also provided is a summary by subprogram listing argument attributes, common blocks used, subprograms called, and the calling subprograms. PFORT is written in PFORT.

Exhibit Reference: F

Test results:

Exhibit pages 1F through 6F illustrate the results obtained after scanning subprogram IMVEC. Exhibit page 7F is the summary report for the entire program.

A.2.6 Problem Program Evaluator (PPE)

Boole and Babbage
Sunnyvale, California

Implementations: IBM

PPE is a performance measurement tool residing in the same region as a problem program to be measured. The executing program is sampled at regular intervals by the PPE Extractor and the sample data is stored on a disk or tape for later analysis by the PPE Analyzer. Measurements include:

(1) percent of time the program is actively executing,

(2) percent of time the program is waiting for I/O to complete,

(3) percent of time the program is waiting for non-I/O events to complete,

(4) how the I/O is distributed among the problem program's data sets,

(5) percent of time the problem program is executing SVC's (Supervisor Calls),

(6) where in the program the various activities and waits occurred.

Note that PEE performs analysis on load modules, and is therefore independent of the programming language used.

Exhibit Reference: G

Test results:

The exhibit displays the results of a PPE extractor and analyzer run for a COBOL program. Since the PPE Code Activity Report is rather complicated, the significant portions of the report are explained below:

1. Distribution of Activity (Excluding DSOW Wait)

   The "Sample Boundary" referred to is the entire region specified. Samples taken, above and below the sample boundaries, are those in OS routines which cannot be related back to the problem program. "Active" is defined as that percentage of activity when instructions are being executed within the area. "Wait" is that activity when the CPU must wait for some event associated with an activity within the area before it can resume processing -- not including I/O wait that can be associated with a data set; examples are OPEN, CLOSE, LINK and LOAD.

2. Distribution of DSOW Wait

This section gives a comparison, on a percentage basis, of the number of DSOW samples associated with each data set for which there is a DD statement. Data sets showing a high percentage of activity should be examined for opportunities to reduce this amount.

3. Module Map (Excluding Wait)

This section provides a list of each module sampled by the extractor in the order in which they were encountered; the starting and ending addresses for each module, relative to the beginning of the OS region; and the percentage of active samples for each module.

4. Study Report

This section is the most important part of the report. It provides information as to how the CPU time was distributed throughout the program. The "Code Execution Frequency" subreport lists the percentage of time "Active" samples were taken in each interval of the program. An interval is a number of contiguous bytes (usually 32) used for grouping extractor results. Therefore, each interval shown on the report represents several machine instructions. The starting and ending location shown for each interval represent their addresses relative to the beginning of the module.

For convenience, the 10 Most Frequently Executed Intervals are listed separately. The value of this report is that it allows the Programmer to concentrate his effort of optimizing the source code on those areas of the program where the most time is being consumed. For those intervals having a high percentage, the corresponding source statements should be examined, in an attempt to improve the coding.

A drawback of PPE is the necessity of consulting a source program load map to associate timing statistics. An alternate approach is taken by FORTUNE, in which timing values are reported directly on the source program listing. PET also provides similar statistics on a more summarized basis per subprogram. An advantage over most other performance measurement tools is PPE's ability to measure programs of any source language on IBM.

A.2.7 FORTRAN Structuring Engine (SFORTRAN)

Caine, Farber and Gordon, Inc.
Pasadena, California

Implementations: IBM

The FORTRAN Structuring Engine produces a SFORTRAN source program and listing from a FORTRAN source program. SFORTRAN is a highly structured superset of FORTRAN. A SFORTRAN to FORTRAN preprocessor is available to allow compilation and execution of SFORTRAN programs. The SFORTRAN program listing is designed to easily identify blocks of code and thus obtain a picture of the overall logical structure of the program.

Exhibit Reference: H

Test results:

Probably the best produce of this type on the market today, in terms of structuring a given FORTRAN program. Note that even if the preprocessor is never used to execute the SFORTRAN representation of a particular FORTRAN program, the SFORTRAN listing can be an invaluable aid in determining what is going on in a large and complicated program.

The Structuring Engine has serious practical limitations to go along with its sophisticated output, however, since a 1000K load module size makes it rather machine dependent. Also, the number of SFORTRAN lines starts to go up extremely fast as the number of branch points in the FORTRAN program increases.

A.2.8 DISSECT Symbolic Evaluation System

McDonnell Douglas Automation Company
Huntington Beach, California

Implementations: PDP-10

DISSECT is a symbolic evaluation system that is used to analyze programs written in ANSI FORTRAN.

When a program path is executed by running the program on a given input, the correctness of the path for that input can be determined by examining the effects of the calculations carried out by the path. If the path is executed "symbolically" rather than with actual data, it may be possible to use a single execution to illustrate its correctness on a large subset of the input domain rather than on just a single value. Symbolic execution of a program is carried out by given dummy symbolic values rather than actual numeric (string, logical, etc.) values to all or some of the input variables of the program. An expression in the program involving variables with symbolic values is evaluated by substituting the current symbolic values of the variables into the expression. The resulting expression is then simplified algebraically. All operators having only actual as opposed to symbolic operands are evaluated in the normal way. The resulting expression is the symbolic value of the original expression.

The DISSECT system operates on two input files and produces an output file. One of the input files contains a FORTRAN program to be analyzed and the other contains the DISSECT commands which tell the system what kind of symbolic evaluation analysis to carry out. The output file contains the results of the analysis.

The command file for a DISSECT analysis is divided into a number of cases. The program in the input file is processed completely for each case. Each case has a section for a text description of the part of the program to be analyzed by the case. This text is not processed by the system and is considered to be the specification for the case. The rest of a case contains commands which identify the part of the program which corresponds to the case, commands which assign (symbolic) values to variables and commands which specify what output is to be generated.

The output file which is generated by a DISSECT analysis is also divided into cases. Each output case contains the case specifications and commands as well as the output generated by the system for that case. The user can check the validity of his program by comparing case specifications with system output for cases.

A program path is a possible flow of control through the program. A path is feasible if at least one element of the program's input domain causes that path to be executed. In general, a complete set of DISSECT cases for a program should "cover" the program in some sence. One approach is to analyze each feasible path (up to some number of iterations of loops). Complex programs having many paths can be divided into segments and analyzed using separate cases.

Exhibit Reference: I

Test Results:

The first page of the exhibit contains a program called INTERP, where DISSECT was used to verify that the program agreed with its specifications. The INTERP routine is written so that the number of points NTERMS used in the interpolation process may be less than the number of points available (NPTS). The first segment of the routine, lines 1-25, decides which points to use. It involves choosing a value for I1. The points X(I1), X(I1+1), ..., X(I1+n-1) in the program correspond to the points $x_1, x_2, \ldots, x_n$ in the documented formulae (n=min {NPTS, NTERMS}). The documentation states that x_1 (i.e., X(I1)) "is chosen so that x_1 and x_n straddle x". "If the value of x is too close to the lower or upper limit of the values of x_i, the corresponding value of x_1 or x_n is set equal to the limiting value".

It was decided to examine the paths through this section of code for NPTS = 1 and 2 (the limiting cases) and also for NPTS = 3 and NPTS = 4. Exhibit pages 2I-33I contain the system output for these four cases, which cause DISSECT to analyze all paths in the program up to statement 28 for NPTS = 1, 2, 3 and 4.

This is a large number of paths but it was found that the output for each was easy to read and that it was easy to determine if the program was correct for the case.

The second segment of DISSECT, lines 26-33 is supposed to compute the following values of Δ and Δ_i.

$$\Delta = \frac{x - x_1}{x_2 - x_1} \qquad \Delta_i = \frac{x_i - x_1}{x_2 - x_1}$$

The verification of this segment is contained in Cases 5 and 6 on exhibit pages 33I and 34I.

The Case 6 command ASSIGN I1 = "11" ensures that the output for Case 6 will use the symbol I1 to stand for I1 rather than the value it may have as the result of earlier calculations.

Symbolic output for code in the third segment, lines 34 through 48, appears in Cases 7 and 8 on exhibit pages 35I and 36I.

The final segment of the program, lines 49 through 60, is supposed to compute the formula:

$$Y(x) = a_1 + \sum_{j=2}^{n} \{a_j \prod_{i=1}^{j-1} (- _i)\}.$$

Symbolic output for this segment appears in Cases 9 and 10 on exhibit pages 36I and 37I (the program uses the variable YØUT to represent the value y(x)).

A.2.9 JOYCE

McDonnell Douglas Automation Company
Huntington Beach, California

Implementations: CDC

JOYCE is a program designed to aid the programmer both in checkout and documentation. It accepts as primary input FORTRAN source decks in the form of card decks or CDC compile files. The source decks are edited producing tables of referenced symbols (variables, subroutines, and I/O files) and flowlists (microfilm FORTRAN listings with all transfers indicated by arrows to the right of the listing and all DO loops indicated by brackets on the left). Also available are cross-reference lists for variables, subroutines, and I/O references. The above edit information may be combined with definitions and mathematical symbols, input on data cards, to yield a completely cross-referenced program glossary. This glossary may be listed on microfilm in a variety of formats on a program and/or subroutine level sorted on FORTRAN and/or mathematical symbol or in any of several special modes (e.g. by storage location). All operating modes require only a few easily punched free-format control cards. JOYCE is written entirely in FORTRAN IV.

Exhibit Reference: J

Test results:

Exhibit pages 1J through 10J show the flowlist for the test program and its subroutines, produced on microfilm. All transfers are indicated by arrows to the right of the statement text, and all DO loops are indicated by brackets to the left.

Exhibit pages 11J through 24J contain the symbol cross references in alphabetical order. A description is given for each use of a symbol name, together with an analysis of the symbol's use in a subroutine. This output may optionally appear on a printer.

Entries under the Subroutine Usage heading include:

(1) Subroutine name in which the symbol is used

(2) A code indicating how the symbol is used. A complete list of usage codes is contained on Exhibit page 44J. The most frequent codes appearing in this example are:

M - the symbol is modified
W - working variable
I - input variable
O - output variable

(3) Symbol Type (real, integer, etc.)

(4) Variable name within the subroutine

(5) Dimension, if symbol is an array

The Cross Reference Matrix is on Exhibit pages 44J through 46J. This matrix is a summary of the information in the cross reference discussed earlier. This output appeared on the system printer.

A.2.10 DAVE

Lloyd Fosdick and Leon Osterweil
Dept. of Computer Science
University of Colorado
Boulder, Colorado

Implementations: CDC, IBM

DAVE is a system used to detect the existence of a wide variety of errors in ANSI Standard FORTRAN programs. Common programming errors that DAVE will detect include:

(1) misspelled variables

(2) transposed variables

(3) failure to initialize

(4) misspelled lables

Under mild restrictions, DAVE can guarantee that certain types of errors are absent.

DAVE does not attempt to positively identify the exact nature of every error in a program. Instead, the program is probed for suspicious and elusive constructs, thus confronting the programmer directly with various subleties and suspicious aspects of the program. The programmer must then use the messages and warnings produced by DAVE to improve his program.

DAVE is written in highly portable FORTRAN.

Exhibit Reference: K

Test results:

Exhibit pages 1K through 13K show the program listing for test program UNSEIG and its five subroutines. Page 14K illustrates the Call Graph Table, which lists the external calls for the main program and each subroutine.

The remainder of the Exhibit shows various warning messages for the main program and each subroutine.

REFERENCES

NBS Analyzer

1. G. Lyon and R. B. Stillman. A FORTRAN Analyzer. NBS Technical Note 849, Institute for Computer Sciences and Technology, National Bureau of Standards, Washington, D.C., October 1974.

PET

1. L. G. Stucki. A Prototype Automatic Testing Tool. Paper Number MDAC WD 1985, 1972.

2. L. G. Stucki. Automatic Generation of Self-Metric Software. Paper No. MDAC WD 2144, 1973.

3. C. B. Boettcher. Program Evaluator and Tester, CDC Users Manual. McDonnell Douglas Automation Company, Document Number M2085074, 1974.

PFORT

1. B. G. Ryder. The PFORT Verifier. Software Practice and Experience. Volume 4, Number 4, October - December 1974, pp. 359-378.

2. B. G.Ryder. The PFORT Verifier - User's Guide. Computing Science Technical Report #12, Bell Laboratories, Murray Hill, N.J.

3. A. D. Hall and B. G. Ryder. The PFORT Verifier - Installation and Maintenance. Bell Laboratories, Murray Hill, New Jersey, unpublished.

DISSECT

1. L. G. Stucki and W. E. Howden. Final Report - A Methodology for Effective Test Case Selection, Phase III. McDonnell Douglas paper number G6211, March 1976.

DAVE

1. L. D. Fosdick and L. J. Osterweil. DAVE - A FORTRAN Program Analysis System. Computer Science and Statistics: 8th Annual Symposium on the Interface, Los Angeles, February 1975.

A.3 TIMING STATISTICS

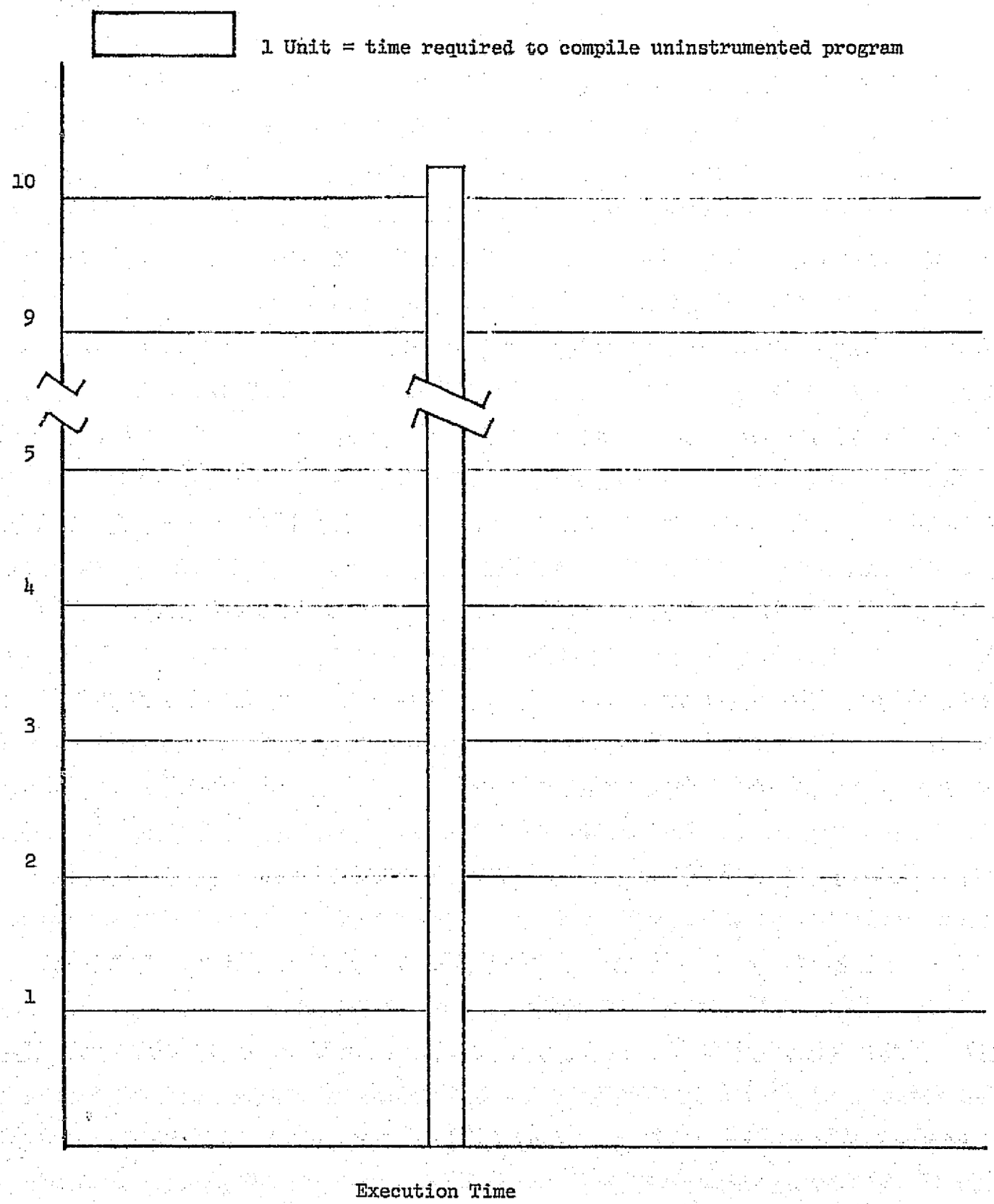
The following pages contain timing statistics for each of the tools tested to date. Two common units of measurement have been established to give some basis of comparison for all tools tested. These units of measurement are :

(1) the time required to compile the uninstrumented source program

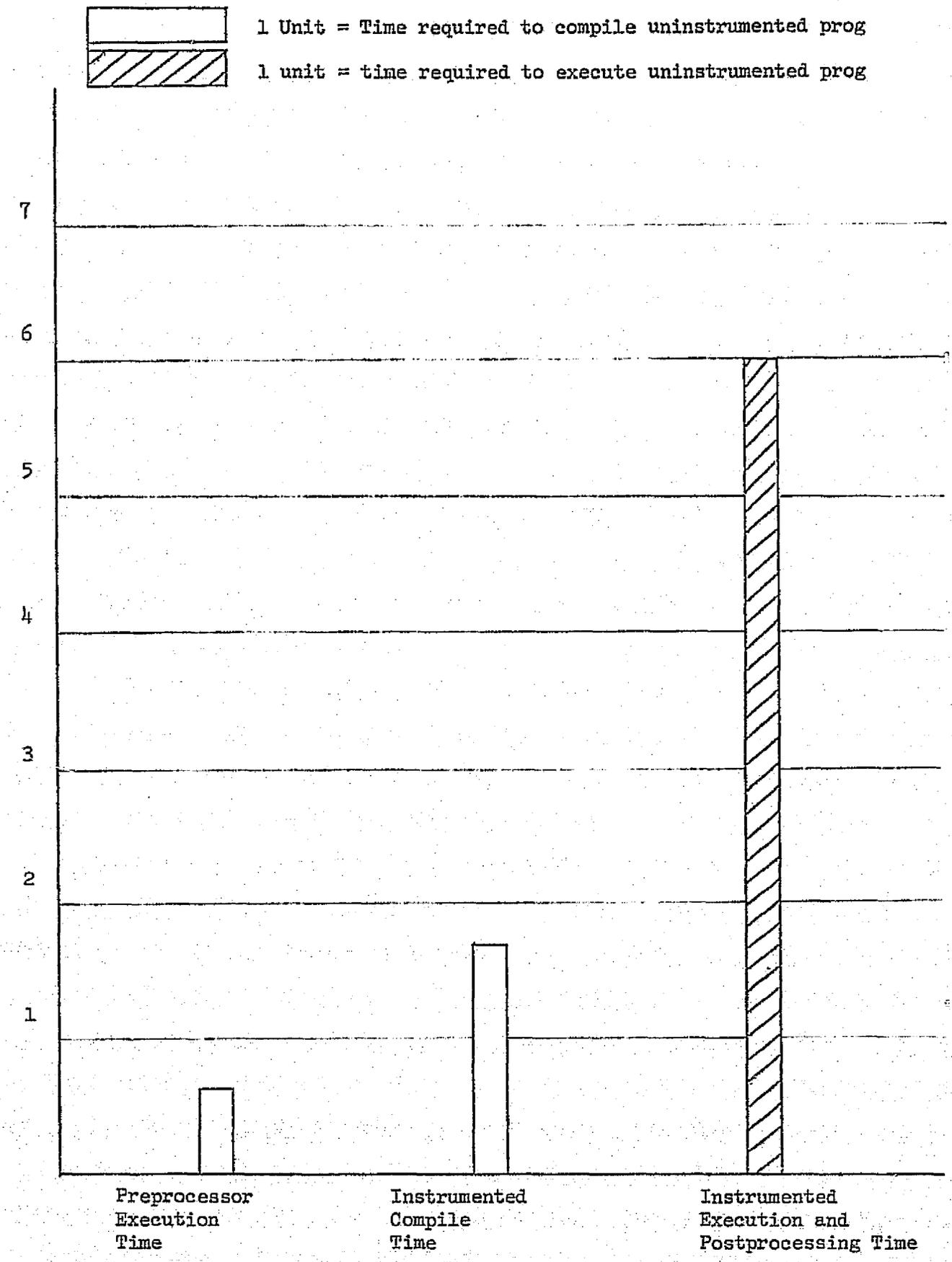
(2) the time required to execute the uninstrumented program.

Thus, if a particular tool was tested on machine X, the timing statistics are relative to the normal compile and execution times of the program on machine X.

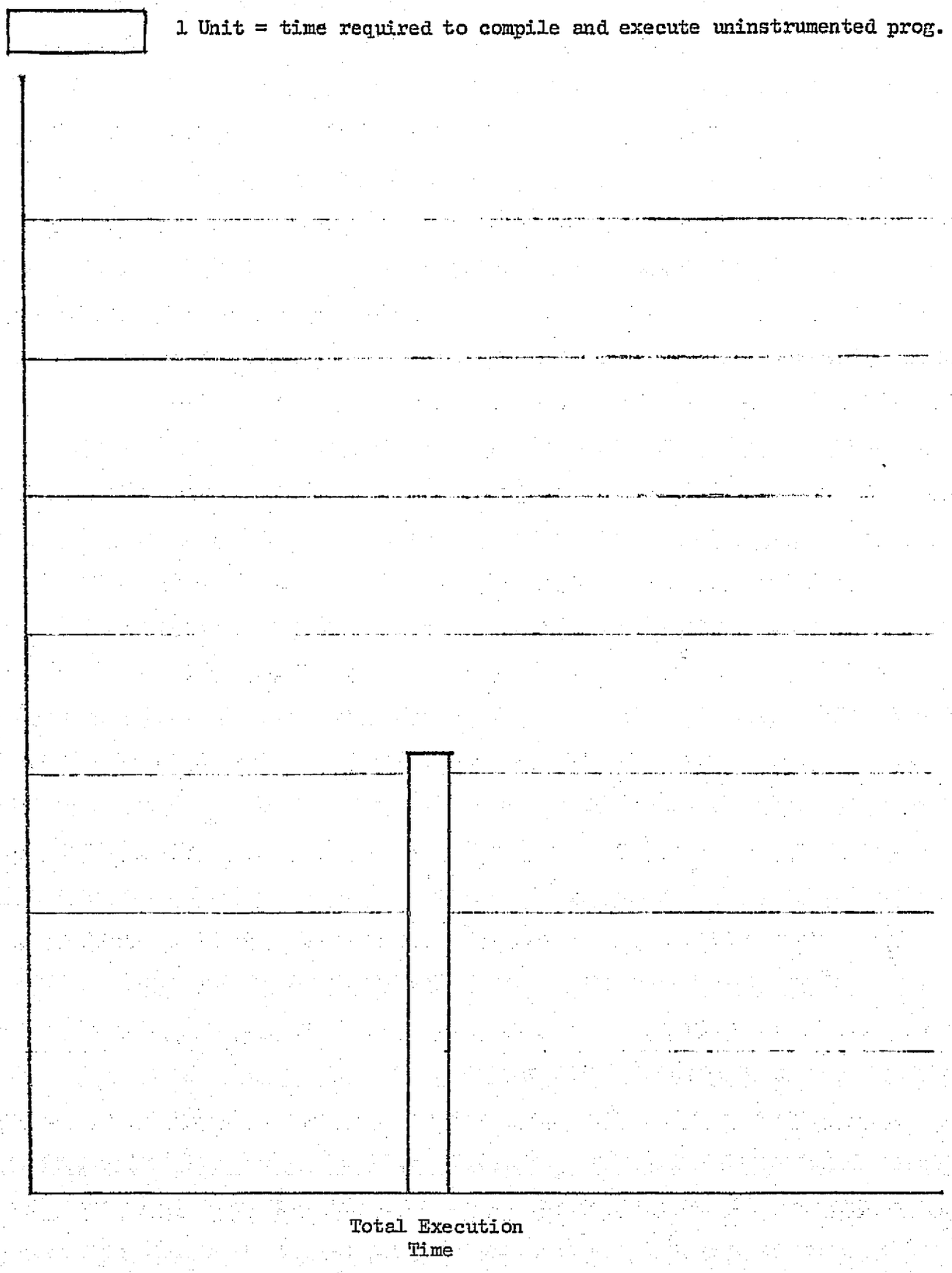
In addition, the same test program is used for different tools whenever possible.


1 Unit = time required to compile uninstrumented program
10
9
5
4
3
2
1
Execution Time

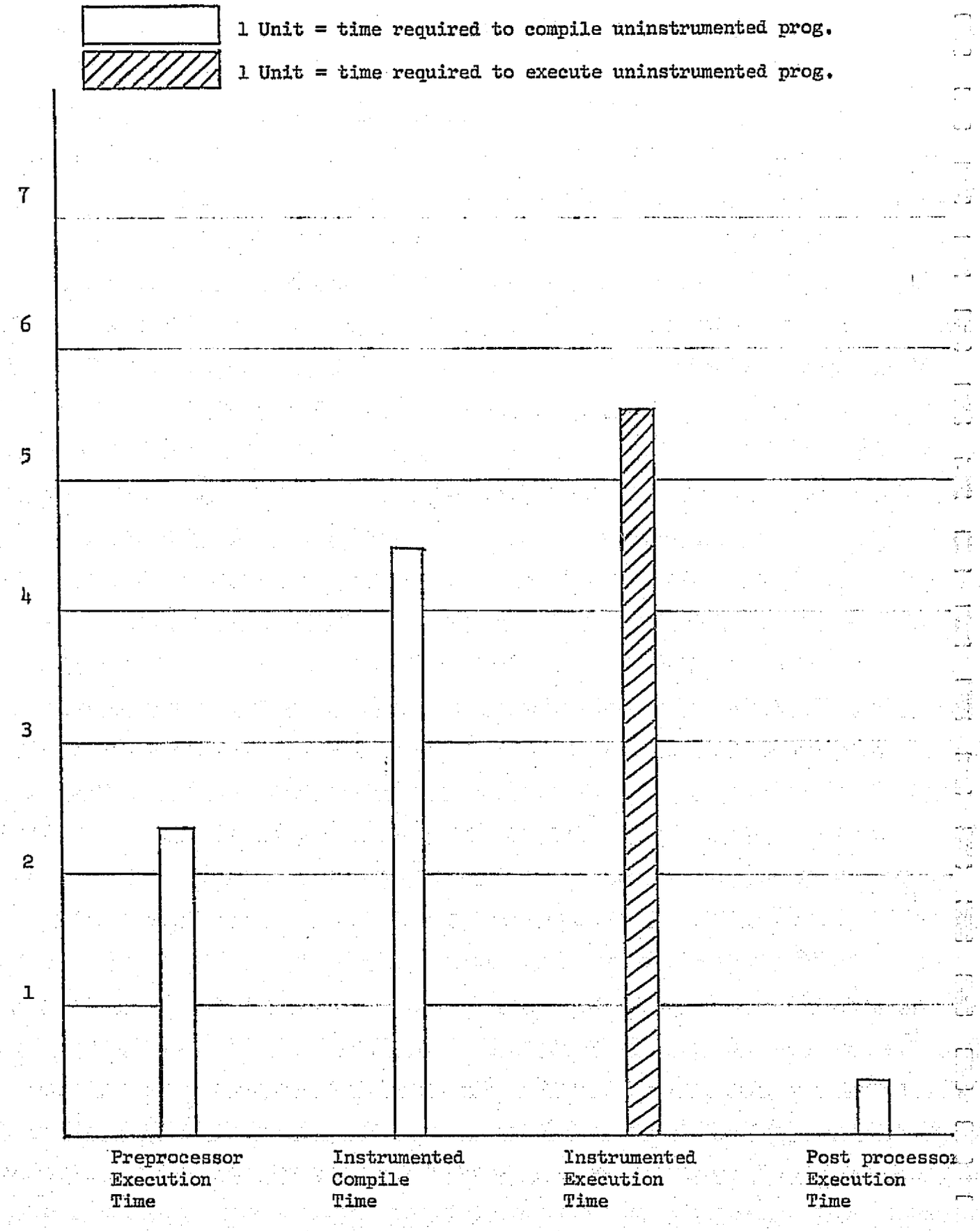
ATDG


1 Unit = Time required to compile uninstrumented prog
1 unit = time required to execute uninstrumented prog
7
6
5
4
3
2
1
Preprocessor Execution Time
Instrumented Compile Time
Instrumented Execution and Postprocessing Time

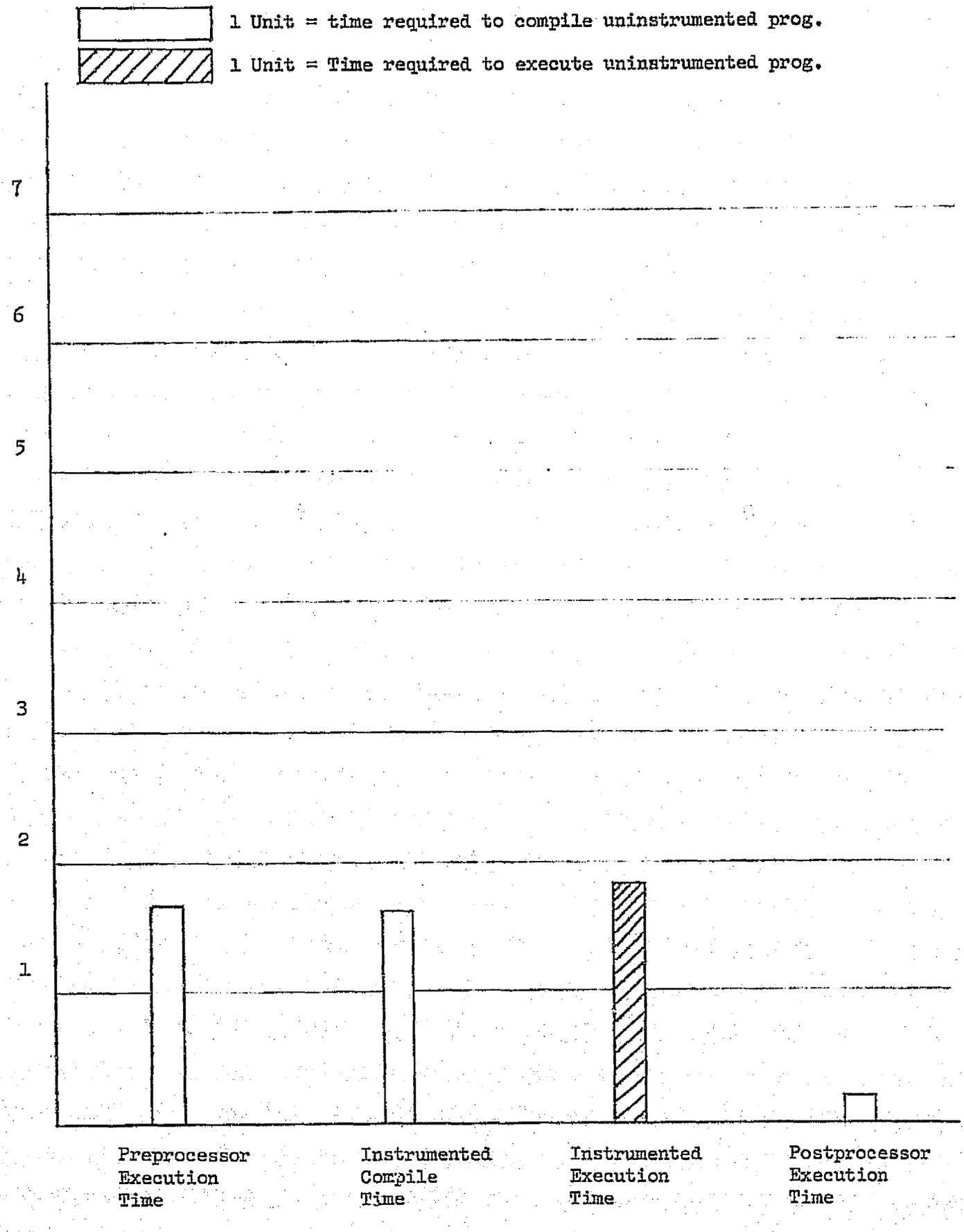
FORTUNE



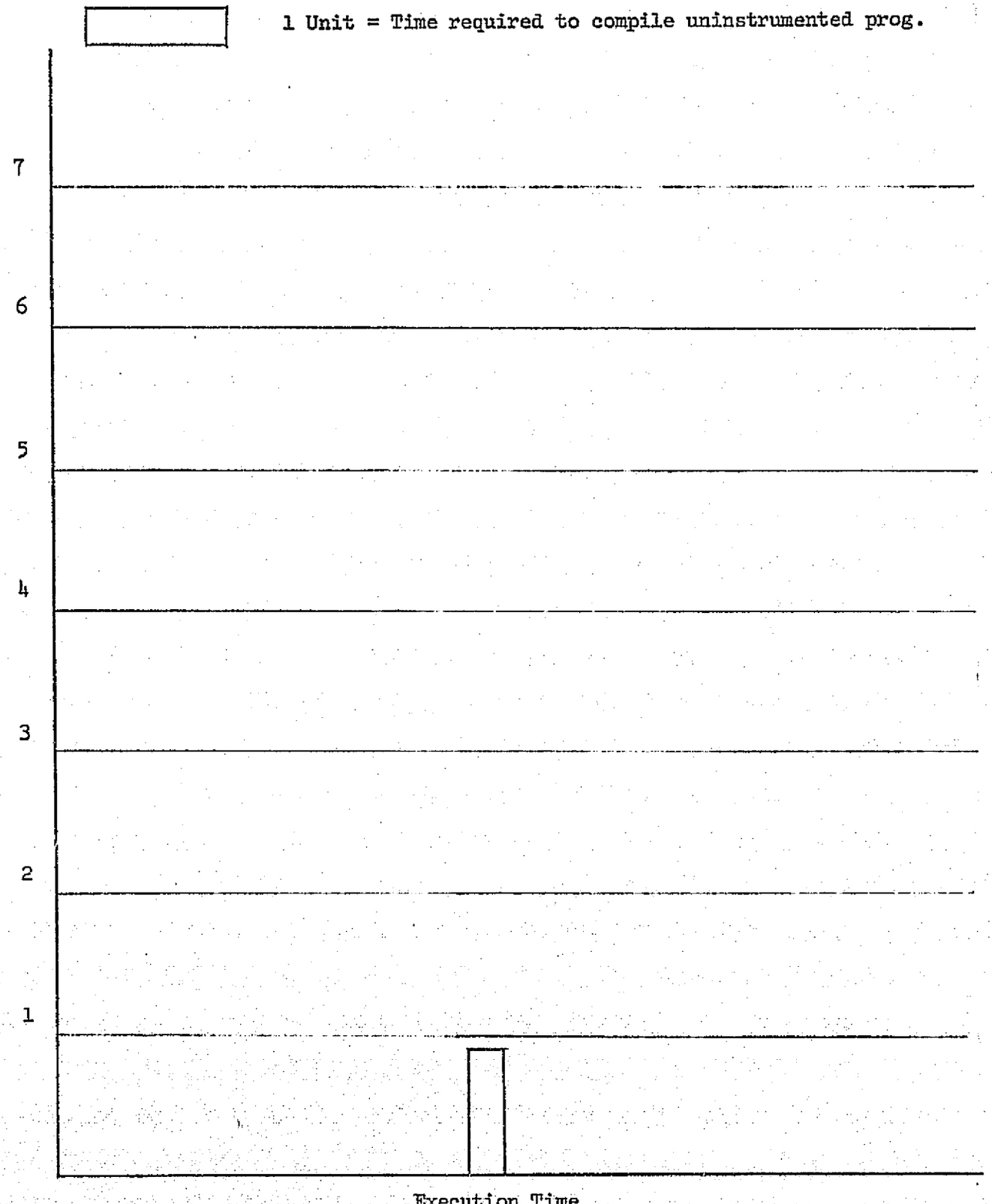
NBS ANALYZER



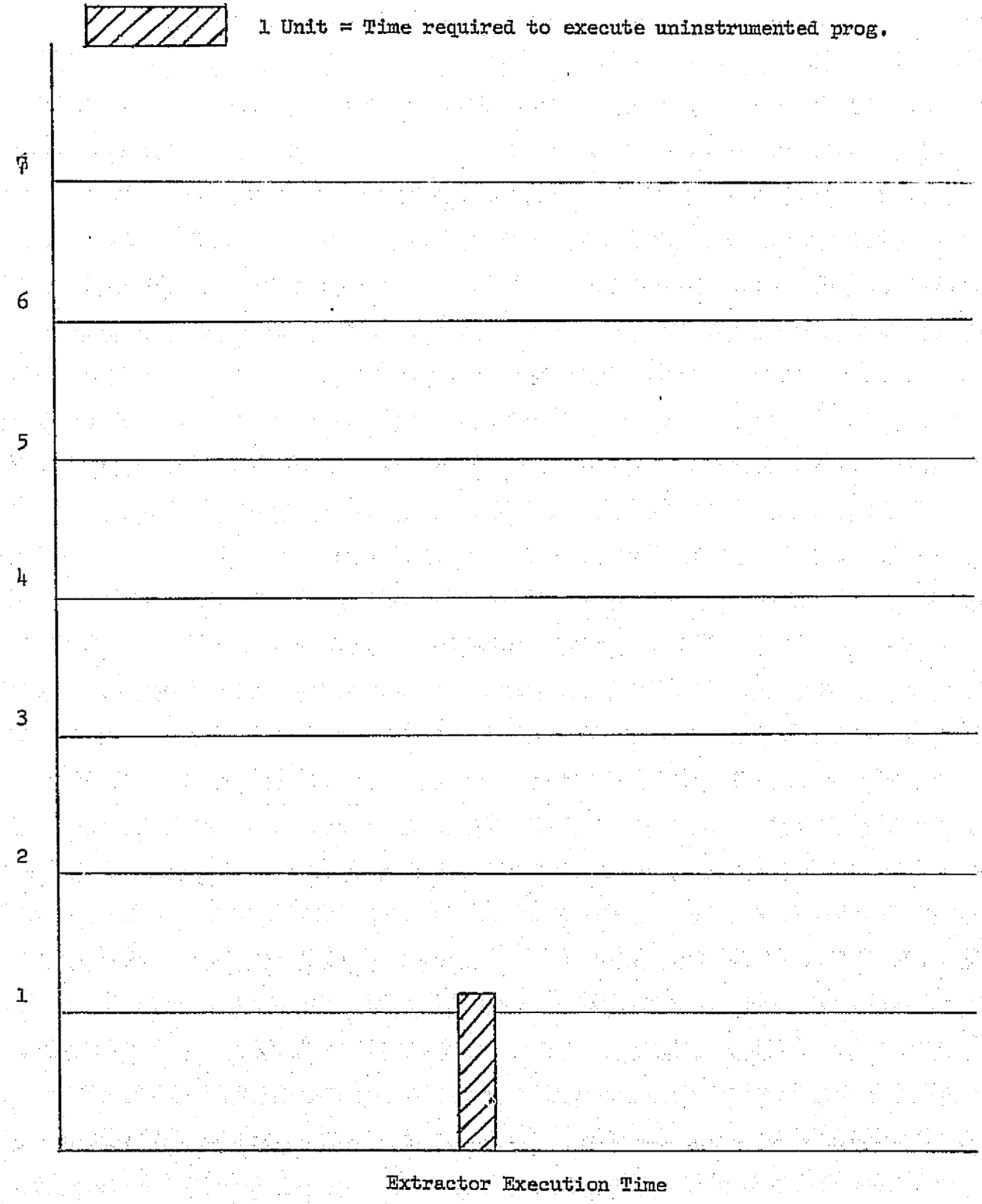
PET
(Full Instrumentation)

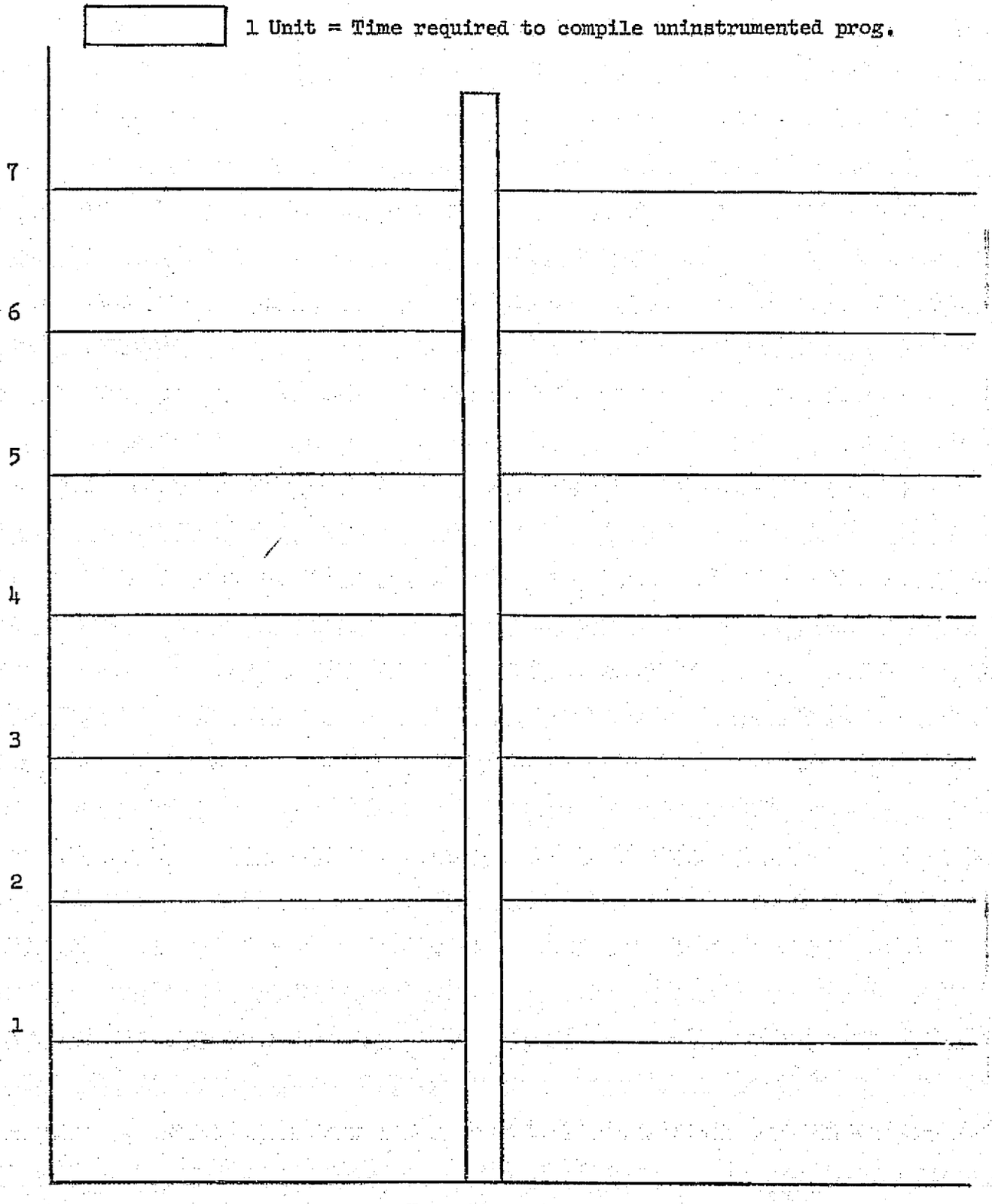


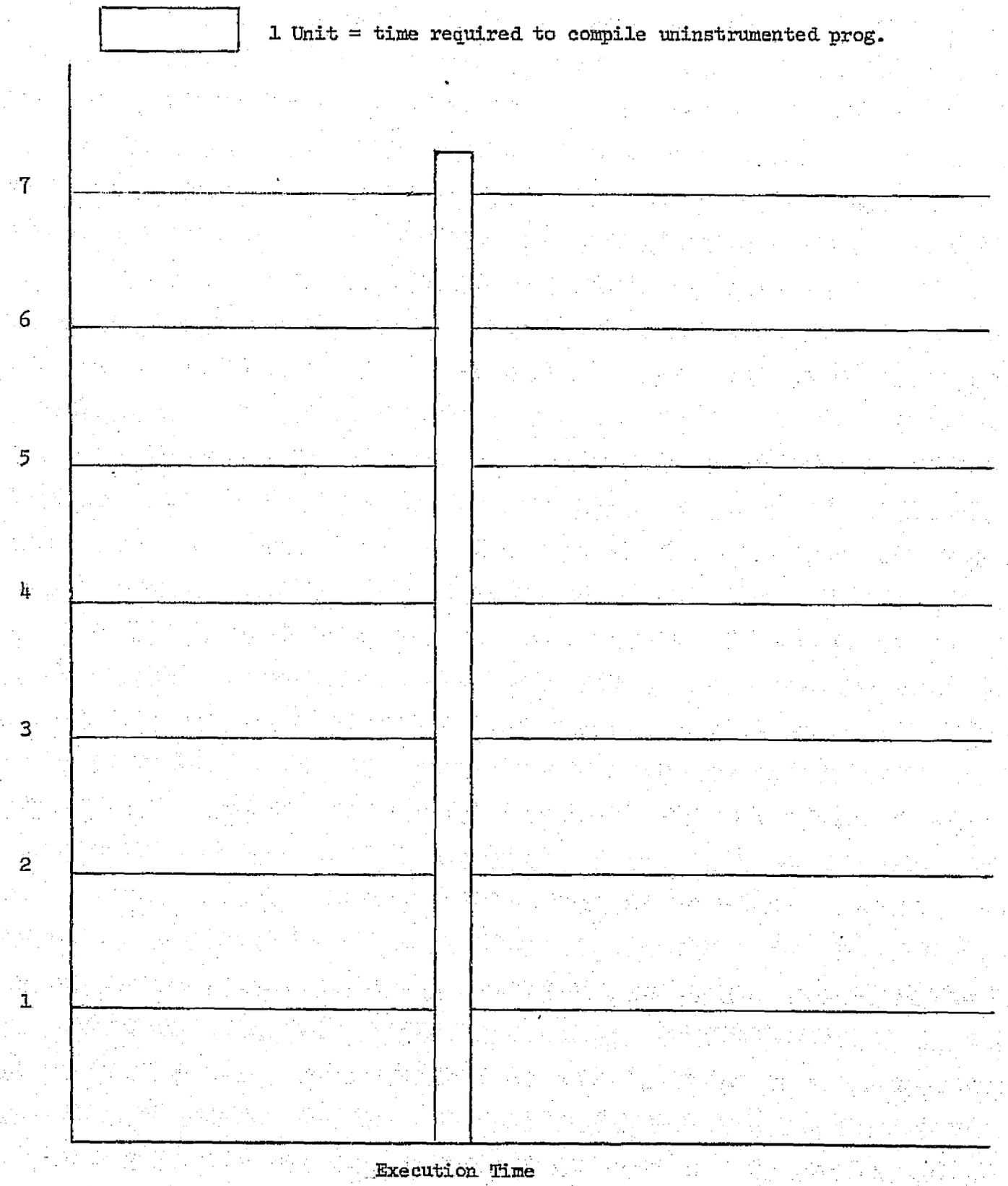
PET
(Minimal Instrumentation)


1 Unit = Time required to compile uninstrumented prog.
7
6
5
4
3
2
1
Execution Time

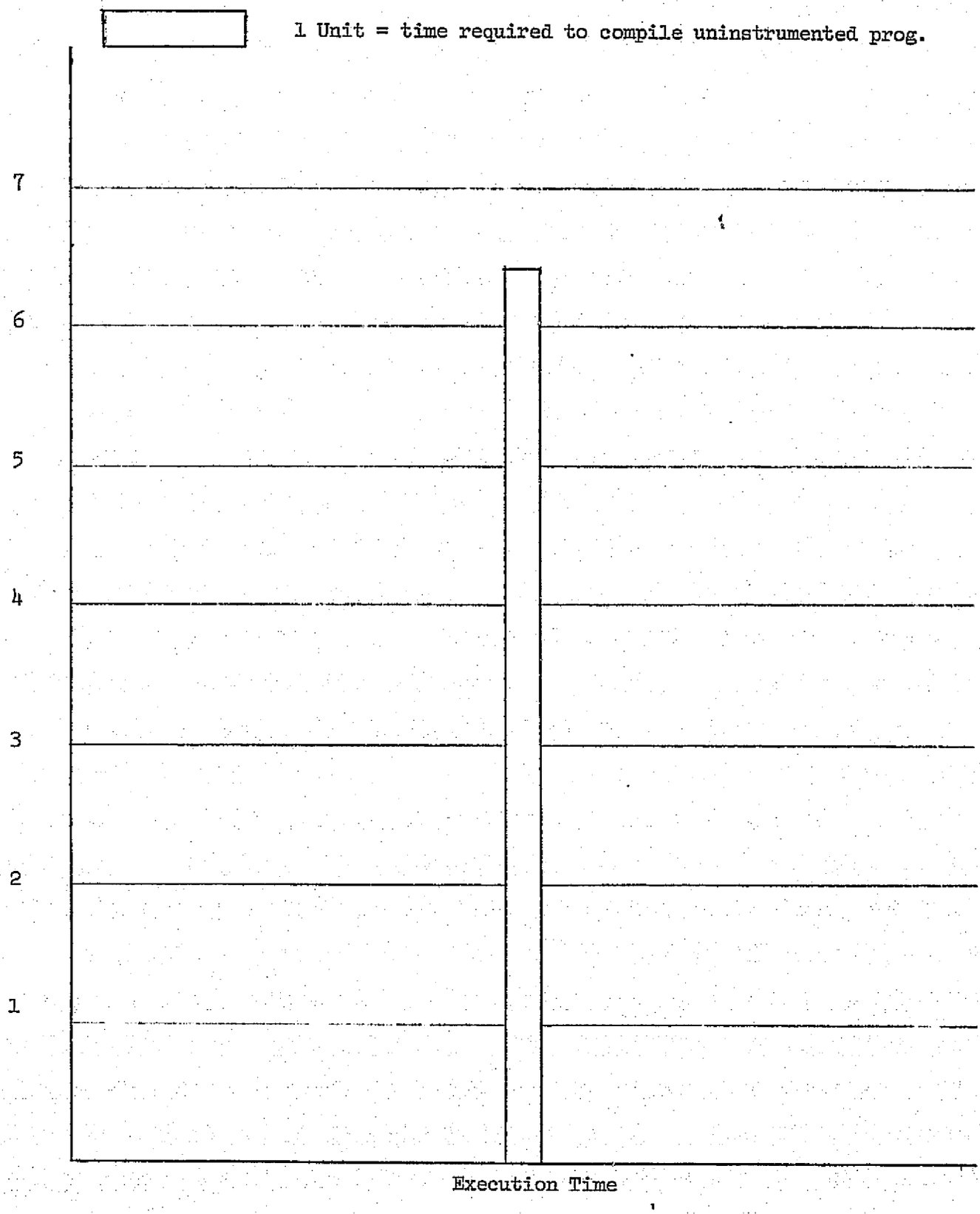
PFORT


1 Unit = Time required to execute uninstrumented prog.
7
6
5
4
3
2
1
Extractor Execution Time
PPE

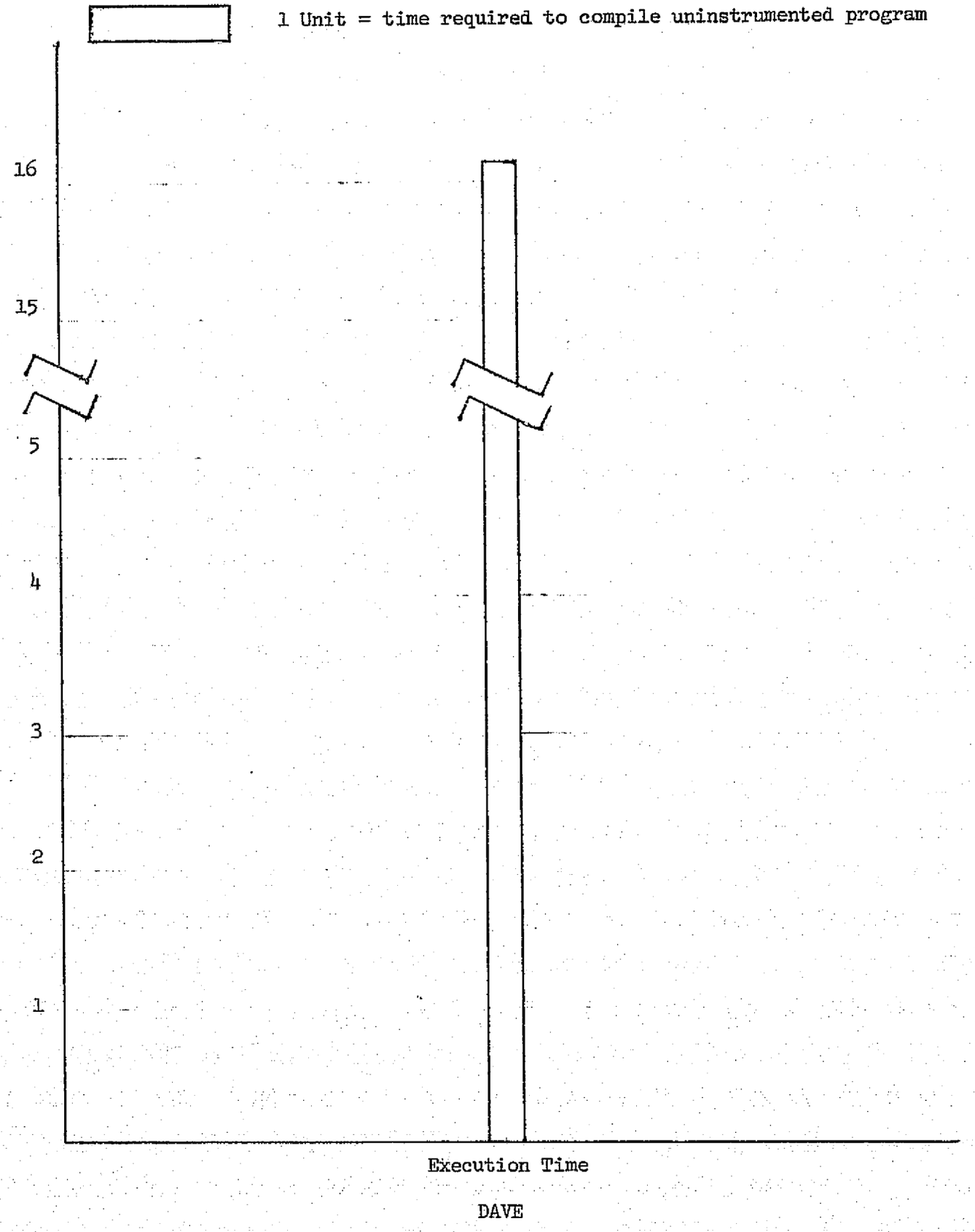

1 Unit = Time required to compile uninstrumented prog.
7
6
5
4
3
2
1
Execution Time
SFORTRAN


1 Unit = time required to compile uninstrumented prog.
7
6
5
4
3
2
1
Execution Time

DISSECT


1 Unit = time required to compile uninstrumented prog.
7
6
5
4
3
2
1
Execution Time

JOYCE


1 Unit = time required to compile uninstrumented program
16
15
5
4
3
2
1
Execution Time
DAVE

A.4 COMPUTER GENERATED OUTPUT FROM THE TEST RUNS

A. Automatic Test Data Generator (ATDG)

B. FORTUNE

C. NBS Analyzer

D. Program Evaluator and Tester (PET) - full instrumentation

E. Program Evaluator and Tester (PET) - minimal instrumentation

F. PFORT Verifier

G. Problem Program Evaluator (PPE)

H. FORTRAN Structuring Engine (SFORTRAN)

I. DISSECT Symbolic Evaluation System

J. JOYCE

K. DAVE

HSMAIN

```
:D,U 14.
:SE UPPER ASSUMED
: 14.01-06/02-16:54-(0,1)
:IT
:
```

SEGMENT NUMBERS	FORTRAN STATEMENTS
0	ELEMENT HSPAIN
0	DIMENSION A(10,10),VEC(8), EIGVEC(4,4), INT *(10),CC(10),SS(10)
0	DIMENSION Z(10),D(10,10),BB(10,10)
1	NMAX = 10
1	NN = 4
1	NVEC = 4
1	N=NN
1	K=N-2
2	DO1J=1,K
2	K1=J+1
2	K2=J+2
2	GREAT= ABS(A(K1,J))
2	MAX=K1
3	DO2I=K2,N
3	AB= ABS(A(I,J))
3, 4	IF (GREAT.GE.AB) GO TO 2
5	3 GREAT=AB
5	MAX=I
6	2 CONTINUE
7	INT(J)=MAX
7, 8	IF (MAX.EQ.K1) GO TO 5
9	4 DO6L=J,N
9	E=A(K1,L)
9	A(K1,L)=A(MAX,L)
10	6 A(MAX,L)=E
11	DO7L=1,N
11	E=A(L,K1)
11	A(L,K1)=A(L,MAX)
12	7 A(L,MAX)=E
13	5 DO8I=K2,N
13, 14	IF (A(I,J).EQ.0.) GO TO 8
15	A(I,J)=-A(I,J)/A(K1,J)
16	DO11M=K1,N
17	11 A(I,M)=A(I,M)+A(I,J)*A(K1,M)
18	8 CONTINUE
19	DO 2000 M=K2,N
19, 20	IF (A(M,J).EQ.0.) GO TO 2000
21	10 DO 2001 I=1,N
22	2001 A(I,K1)=A(I,K1)-A(I,M)*A(M,J)
23	2000 CONTINUE
24	1 CONTINUE
25	DO 105 I=1,N
26	DO 105 J=1,N
27	105 D(I,J)=A(I,J)
28	DO 106 I=3,N

```
      28                L=I-2
      29                DO 106 J=1,L
      30            106 A(I,J)=0.0
      31                K1=N+1
      31                R=0.0
      31                C=0.0
      32                DO33I=1,N
      32                R=R+ ABS(A(I,I))
      33             33 C=C+ ABS(A(I,N))
      34                DO34I=2,N
      34                RS=0.0
      34                CS=0.0
      34                L=I-1
      35                DO35J=L,N
      35                RS=RS+ ABS(A(I,J))
      35                K1J=K1-J
      35                K1I=K1-I
      36             35 CS=CS+ ABS(A(K1J,K1I))
      37,   38          IF (RS.LE.R) GO TO 36
      39             37 R=RS
      40,   41       36 IF (CS.LE.C) GO TO 34
      42             44 C=CS
      43             34 CONTINUE
      44                IJK=1
      44,   45          IF (R.GE.C) GO TO 54
      46             53 DELTA=R*1.0E-11
      46                DEL=R/17.1829
      46                GO TO 153
      47             54 DELTA=C*1.0E-11
      47                DEL=C/17.1829
      48            153 DO 107 I=1,N
      49            107 A(I,I)=A(I,I)-DEL
      50,   51       55 IF (N.NE.1) GO TO 48
      52             47 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,1)
      53                GO TO 76
      54,   55       48 IF (N.NE.2) GO TO 80
      56             49 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,2)
      57                GO TO 76
      58             80 AR1=0.0
      58                AR3=0.0
      58                AR4=0.0
      59             61 L=N
      60                DO56 I=2,N
      60                N2I=N+2-I
      60,   61          IF( ABS(A(N2I,N2I-1)).LT.DELTA)GO TO 57
      62             56 L=L-1
      63,   64       57 IF (L.NE.N) GO TO 59
      65             58 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,1)
      66                N=N-1
      66                GO TO 48
      67,   68       59 IF ((L-N+1).NE.0) GO TO 75
      69             60 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,2)
      70                N=N-2
      70                GO TO 55
      71             75 B=A(N-1,N-1)+A(N,N)
      71                C=A(N-1,N-1)*A(N,N)-A(N,N-1)*A(N-1,N)
      71                C1=A(N-1,N-1)-A(N,N)
```

```
      DISC=C1*C1+4.0*A(N,N-1)*A(N-1,N)
      IF (DISC.GE.0.) GO TO 63
   62 R1=0.5*B
      R2=.5* SQRT( ABS(DISC))
      ANUM=(R1-AR3)*(R1-AR3)+(R2-AR4)*(R2-AR4)
      DENOM=AR3*AR3+AR4*AR4
      IF (DENOM.NE.0.) GO TO 200
  201 RHO=0.0
      SIGMA=0.0
      GO TO 203
  200 RHO=C
      SIGMA=S
  203 AR3=R1
      AR4=R2
      CALL COMPIT(A,NMAX,L,N,RHO,SIGMA)
      GO TO 61
   63 IF (B.GE.0.) GO TO 65
   64 R1=.5*(B- SQRT(DISC))
      GO TO 66
   65 R1=.5*(B+ SQRT(DISC))
      IF (R1.NE.0.) GO TO 66
   83 R2=0.0
      GO TO 64
   66 R2=C/R1
   84 IF( ABS(A(N,N)-R1).GE. ABS(A(N,N)-R2))GO TO
     *68
   67 AR2=R1
      GO TO 69
   68 AR2=R2
   69 IF (AR1.NE.0.) GO TO 71
   72 SHIFT=0.0
      GO TO 73
   71 SHIFT=AR2
   73 AR1=AR2
      CALL REALIT(A,NMAX,L,N,SHIFT,CC,SS)
      GO TO 61
   76 IF (NVEC.EQ.0) GO TO 600
  550 SMALL=DELTA*1.0E-30
      NUM=0
      JI=1
      NM=NN+NN
  513 C1=VEC(JI)
      C2=VEC(JI+1)
      NUM=NUM+1
      DO 570 I=1,NN
      DO 570 J=1,NN
  570 A(I,J)=D(I,J)
      IF (C2.NE.0.) GO TO 561
      CALL RVEC(A,NMAX,INT,C1,SMALL,NN,NUM,EIGVEC,
     *NVEC,CC,SS)
      JI=JI+2
      IF(NVEC.EQ.NUM)GO TO 600
      GO TO 513
  561 CALL IMVEC(A,NMAX,INT,C1,C2,SMALL,NN,NUM,EIG
     *VEC,NVEC,CC,SS,Z,BB)
      JI=JI+4
      IF(NVEC.EQ.NUM)GO TO 600
```

```
    112                 GO TO 513
    113           600   CONTINUE
    113                 WRITE(6,700) (VEC(I),I=1,NN)
    114                 DO 20 I=1,NN
    115           20    WRITE(6,700) (EIGVEC(I,J),J=1,NN)
      0           700   FORMAT(1H ,5E20.8 / 5E20.8)
    116                 STOP
      0                 END


 SEGMENT
 NUMBERS                FORTRAN STATEMENTS

    0           ELEMENT EOF
CAR:181
OF:181
:
INES:181 FIELDATA


SRKPT PRINTS
```

```
***STATIC ERROR ANALYSIS FOR ELEMENT HSMAIN***

***CHECK FOR INFINITE LOOPS

   NO INFINITE LOOPS HAVE BEEN DETECTED

***CHECK FOR UNREACHABLE CODE

   ERROR - THE FOLLOWING BRANCHES CANNOT BE EXECUTED
     67-  69,  69-  70,  70-  50,  96-  97,  97- 113,

***CHECK SET/USE OF INTERNAL SYMBOLS

    A       IS USED IN THE FOLLOWING SEGMENTS WITHOUT HAVING BEEN SET
        2   3   9  13  15  17  19  22  27
    SET SEGMENTS/  10  12  30  52  56  65  69  77  94
                  102 105 109
    USE SEGMENTS/   2   3   9  11  13  15  17  19  22
                   27  32  33  35  36  49  52  56  60
                   65  69  71  77  86  94 105 109


    ANUM    IS SET  IN THE FOLLOWING SEGMENTS BUT NEVER USED
       73


    NM      IS SET  IN THE FOLLOWING SEGMENTS BUT NEVER USED
       98


   NO VIOLATIONS HAVE BEEN DETECTED FOR THE FOLLOWING SYMBOLS
    AB       AR1      AR2      AR3      AR4      B        BB
    C        CC       CS       C1       C2       D        DEL
    DELTA    DENOM    DISC     E        EIGVEC   GREAT    I
    IJK      INT      J        JI       K        K1       K1I
    K1J      K2       L        M        MAX      N        NMAX
    NN       NUM      NVEC     N2I      P        RHO      RS
    R1       R2       SHIFT    SIGMA    SMALL    SS       VEC
    Z

STATIC ERROR ANALYSIS IS COMPLETE.
```

II

```
.0,0 11.
ISE UPPER ASSUMED
 I4.01-06/03-19:28-(0,1)
IIT


I**CHECK SET/USE OF INTERNAL SYMBOLS

  P R O C E S S   S Y M B O L  A
    NO SET VIOLATIONS HAVE BEEN DETECTED
    A      IS USED IN THE FOLLOWING SEGMENTS WITHOUT HAVING BEEN SET
        2   3   9  13  15  17  19  22  27
    SET SEGMENTS/  10  12  30  52  56  65  69  77  94
                  102 105 109
    USE SEGMENTS/   2   3   9  11  13  15  17  19  22
                   27  32  33  35  36  49  52  56  60
                   65  69  71  77  86  94 105 109

  P R O C E S S   S Y M B O L  AB
    NO SET VIOLATIONS HAVE BEEN DETECTED
    NO USE VIOLATIONS HAVE BEEN DETECTED
    SET SEGMENTS/   3
    USE SEGMENTS/   3   5

  P R O C E S S   S Y M B O L  ANUM
    ANUM   IS SET  IN THE FOLLOWING SEGMENTS BUT NEVER USED
       73

  P R O C E S S   S Y M B O L  AR1
    NO SET VIOLATIONS HAVE BEEN DETECTED
    NO USE VIOLATIONS HAVE BEEN DETECTED
    SET SEGMENTS/  58  94
    USE SEGMENTS/  90

  P R O C E S S   S Y M B O L  AR2
    NO SET VIOLATIONS HAVE BEEN DETECTED
    NO USE VIOLATIONS HAVE BEEN DETECTED
    SET SEGMENTS/  88  89
    USE SEGMENTS/  93  94

  P R O C E S S   S Y M B O L  AR3
    NO SET VIOLATIONS HAVE BEEN DETECTED
    NO USE VIOLATIONS HAVE BEEN DETECTED
    SET SEGMENTS/  58  77
    USE SEGMENTS/  73

  P R O C E S S   S Y M B O L  AR4
    NO SET VIOLATIONS HAVE BEEN DETECTED
    NO USE VIOLATIONS HAVE BEEN DETECTED
    SET SEGMENTS/  58  77
    USE SEGMENTS/  73

  P R O C E S S   S Y M B O L  B
    NO SET VIOLATIONS HAVE BEEN DETECTED
    NO USE VIOLATIONS HAVE BEEN DETECTED
    SET SEGMENTS/  71
```

USE SEGMENTS/ 75 76 79 81 82

PROCESS SYMBOL BB
NO SET VIOLATIONS HAVE BEEN DETECTED
NO USE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/ 109
USE SEGMENTS/ 109

PROCESS SYMBOL C
NO SET VIOLATIONS HAVE BEEN DETECTED
NO USE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/ 31 42 71
USE SEGMENTS/ 33 40 44 47 76 85

PROCESS SYMBOL CC
NO SET VIOLATIONS HAVE BEEN DETECTED
NO USE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/ 94 105 109
USE SEGMENTS/ 94 105 109

PROCESS SYMBOL CS
NO SET VIOLATIONS HAVE BEEN DETECTED
NO USE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/ 34
USE SEGMENTS/ 36 40 42

PROCESS SYMBOL C1
NO SET VIOLATIONS HAVE BEEN DETECTED
NO USE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/ 71 99 105 109
USE SEGMENTS/ 71 105 109

PROCESS SYMBOL C2
NO SET VIOLATIONS HAVE BEEN DETECTED
NO USE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/ 99 109
USE SEGMENTS/ 103 109

PROCESS SYMBOL D
NO SET VIOLATIONS HAVE BEEN DETECTED
NO USE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/ 27
USE SEGMENTS/ 102

PROCESS SYMBOL DEL
NO SET VIOLATIONS HAVE BEEN DETECTED
NO USE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/ 46 47 52 56 65 69
USE SEGMENTS/ 49 52 56 65 69

PROCESS SYMBOL DELTA
NO SET VIOLATIONS HAVE BEEN DETECTED
NO USE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/ 46 47
USE SEGMENTS/ 60 98

PROCESS SYMBOL DENOM

```
NO SET VIOLATIONS HAVE BEEN DETECTED
NO JSE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/  73
USE SEGMENTS/  73

P R O C E S S   S Y M B O L  DISC
NO SET VIOLATIONS HAVE BEEN DETECTED
NO JSE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/  71
USE SEGMENTS/  71  73  81  82

P R O C E S S   S Y M B O L  E
NO SET VIOLATIONS HAVE BEEN DETECTED
NO JSE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/   9  11
USE SEGMENTS/  10  12

P R O C E S S   S Y M B O L  EIGVEC
NO SET VIOLATIONS HAVE BEEN DETECTED
NO JSE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/ 105 109
USE SEGMENTS/ 105 109 115

P R O C E S S   S Y M B O L  GREAT
NO SET VIOLATIONS HAVE BEEN DETECTED
NO JSE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/   2   5
USE SEGMENTS/   3

P R O C E S S   S Y M B O L  I
NO SET VIOLATIONS HAVE BEEN DETECTED
NO JSE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/   3  13  21  25  28  32  34  48  60
                100 114
USE SEGMENTS/   3   5  13  15  17  22  27  28  30
                 32  33  34  35  49  60 102 113 115

P R O C E S S   S Y M B O L  IJK
NO SET VIOLATIONS HAVE BEEN DETECTED
NO JSE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/  44  52  56  65  69
USE SEGMENTS/  52  56  65  69

P R O C E S S   S Y M B O L  INT
NO SET VIOLATIONS HAVE BEEN DETECTED
NO JSE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/   7 105 109
USE SEGMENTS/ 105 109

P R O C E S S   S Y M B O L  J
NO SET VIOLATIONS HAVE BEEN DETECTED
NO JSE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/   2  25  29  35 101
USE SEGMENTS/   2   3   7   9  13  15  17  19  22
                27  30  35 102 115

P R O C E S S   S Y M B O L  JI
```

NO SET VIOLATIONS HAVE BEEN DETECTED
NO JSE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/ 98
USE SEGMENTS/ 99 106 110

PROCESS SYMBOL K
NO SET VIOLATIONS HAVE BEEN DETECTED
NO JSE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/ 1
USE SEGMENTS/ 2

PROCESS SYMBOL K1
NO SET VIOLATIONS HAVE BEEN DETECTED
NO JSE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/ 2 31
USE SEGMENTS/ 2 7 9 11 15 15 17 22 35

PROCESS SYMBOL K1I
NO SET VIOLATIONS HAVE BEEN DETECTED
NO JSE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/ 35
USE SEGMENTS/ 36

PROCESS SYMBOL K1J
NO SET VIOLATIONS HAVE BEEN DETECTED
NO JSE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/ 35
USE SEGMENTS/ 36

PROCESS SYMBOL K2
NO SET VIOLATIONS HAVE BEEN DETECTED
NO JSE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/ 2
USE SEGMENTS/ 3 13 19

PROCESS SYMBOL L
NO SET VIOLATIONS HAVE BEEN DETECTED
NO JSE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/ 9 11 28 34 59 77 94
USE SEGMENTS/ 9 10 11 12 29 35 62 63 67
77 94

PROCESS SYMBOL M
NO SET VIOLATIONS HAVE BEEN DETECTED
NO JSE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/ 16 19
JSE SEGMENTS/ 17 19 22

PROCESS SYMBOL MAX
NO SET VIOLATIONS HAVE BEEN DETECTED
NO JSE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/ 2 5
JSE SEGMENTS/ 7 9 10 11 12

PROCESS SYMBOL N
NO SET VIOLATIONS HAVE BEEN DETECTED

NO JSE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/ 1 52 56 65 69 77 94
USE SEGMENTS/ 1 3 9 11 13 16 19 21 25
26 28 31 32 33 34 35 48 50
52 54 56 59 60 63 65 66 67
69 70 71 77 86 94

PROCESS SYMBOL NM
NM IS SET IN THE FOLLOWING SEGMENTS BUT NEVER USED
98

PROCESS SYMBOL NMAX
NO SET VIOLATIONS HAVE BEEN DETECTED
NO USE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/ 1 52 56 65 69 77 94 105 109

USE SEGMENTS/ 52 56 65 69 77 94 105 109

PROCESS SYMBOL NN
NO SET VIOLATIONS HAVE BEEN DETECTED
NO JSE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/ 1 105 109
USE SEGMENTS/ 1 98 100 101 105 109 113 114 115

PROCESS SYMBOL NUM
NO SET VIOLATIONS HAVE BEEN DETECTED
NO USE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/ 98 105 109
USE SEGMENTS/ 99 105 106 109 110

PROCESS SYMBOL NVEC
NO SET VIOLATIONS HAVE BEEN DETECTED
NO USE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/ 1 105 109
USE SEGMENTS/ 96 105 106 109 110

PROCESS SYMBOL N2I
NO SET VIOLATIONS HAVE BEEN DETECTED
NO JSE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/ 60
USE SEGMENTS/ 60

PROCESS SYMBOL R
NO SET VIOLATIONS HAVE BEEN DETECTED
NO JSE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/ 31 39
JSE SEGMENTS/ 32 37 44 46

PROCESS SYMBOL RHO
NO SET VIOLATIONS HAVE BEEN DETECTED
NO JSE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/ 75 75 77
JSE SEGMENTS/ 77

PROCESS SYMBOL RS
NO SET VIOLATIONS HAVE BEEN DETECTED

```
NO USE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/  34
USE SEGMENTS/  35  37  39

PROCESS  SYMBOL  R1
NO SET VIOLATIONS HAVE BEEN DETECTED
NO USE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/  73  81  82
USE SEGMENTS/  73  77  82  85  86  88

PROCESS  SYMBOL  R2
NO SET VIOLATIONS HAVE BEEN DETECTED
NO USE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/  73  84  85
USE SEGMENTS/  73  77  86  89

PROCESS  SYMBOL  SHIFT
NO SET VIOLATIONS HAVE BEEN DETECTED
NO USE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/  92  93  94
USE SEGMENTS/  94

PROCESS  SYMBOL  SIGMA
NO SET VIOLATIONS HAVE BEEN DETECTED
NO USE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/  75  76  77
USE SEGMENTS/  77

PROCESS  SYMBOL  SMALL
NO SET VIOLATIONS HAVE BEEN DETECTED
NO USE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/  98 105 109
USE SEGMENTS/ 105 109

PROCESS  SYMBOL  SS
NO SET VIOLATIONS HAVE BEEN DETECTED
NO USE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/  94 105 109
USE SEGMENTS/  94 105 109

PROCESS  SYMBOL  VEC
NO SET VIOLATIONS HAVE BEEN DETECTED
NO USE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/  52  56  65  69
USE SEGMENTS/  52  56  65  69  99 113

PROCESS  SYMBOL  Z
NO SET VIOLATIONS HAVE BEEN DETECTED
NO USE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/ 109
USE SEGMENTS/ 109
SCAN:331
EOF:331
D:
LINES:331 FIELDATA
```

IV

PATH NUMBER 1

```
                    NUMBER OF BRANCHES IN NETWORK =  157
            NUMBER OF BRANCHES PREVIOUSLY TRAVERSED =    5
NUMBER OF NEW BRANCHES TRAVERSED BY CURRENT PATH =  145
                  TOTAL NUMBER OF BRANCHES TRAVERSED =  150
 (TOTAL # TRAVERSED)/(TOTAL BRANCHES) PERCENTAGE =   95
            (NEW BRANCH)/(TOTAL BRANCH) PERCENTAGE =   92
```

OPTIMAL PATH OF SEGMENTS - -

```
  1 -  2 -  3 -  4 -  6 -  3 -  5 -  6 -  7 -  8 -
 13 - 14 - 18 - 13 - 15 - 16 - 17 - 16 - 17 - 18 -
 19 - 20 - 23 - 19 - 21 - 22 - 21 - 22 - 23 - 24 -
  2 -  3 -  4 -  6 -  7 -  9 - 10 -  9 - 10 - 11 -
 12 - 11 - 12 - 13 - 14 - 18 - 19 - 20 - 23 - 24 -
 25 - 26 - 27 - 26 - 27 - 25 - 26 - 27 - 28 - 29 -
 30 - 29 - 30 - 28 - 29 - 30 - 31 - 32 - 33 - 32 -
 33 - 34 - 35 - 36 - 35 - 36 - 37 - 38 - 40 - 41 -
 43 - 34 - 35 - 36 - 37 - 39 - 40 - 42 - 43 - 44 -
 45 - 47 - 48 - 49 - 48 - 49 - 50 - 51 - 54 - 55 -
 58 - 59 - 60 - 61 - 63 - 64 - 67 - 68 - 71 - 72 -
 79 - 80 - 82 - 83 - 85 - 86 - 87 - 89 - 90 - 91 -
 93 - 94 - 95 - 59 - 60 - 62 - 60 - 62 - 63 - 65 -
 66 - 54 - 55 - 58 - 59 - 60 - 61 - 63 - 64 - 67 -
 68 - 71 - 73 - 74 - 76 - 77 - 78 - 59 - 60 - 61 -
 63 - 64 - 67 - 68 - 71 - 73 - 75 - 77 - 78 - 59 -
 60 - 61 - 63 - 64 - 67 - 68 - 71 - 72 - 79 - 81 -
 85 - 86 - 88 - 90 - 92 - 94 - 95 - 59 - 60 - 61 -
 63 - 64 - 67 - 68 - 71 - 72 - 79 - 80 - 82 - 84 -
 86 - 88 - 90 - 92 - 94 - 95 - 59 - 60 - 61 - 63 -
 65 - 66 - 54 - 56 - 57 - 96 - 90 - 99 -100 -101 -
102 -101 -102 -100 -101 -102 -103 -104 -109 -110 -
112 - 99 -100 -101 -102 -103 -105 -106 -108 - 99 -
100 -101 -102 -103 -105 -106 -107 -113 -114 -115 -
114 -115 -116 -
```

PATH NUMBER 2

```
                    NUMBER OF BRANCHES IN NETWORK =  157
            NUMBER OF BRANCHES PREVIOUSLY TRAVERSED =  150
NUMBER OF NEW BRANCHES TRAVERSED BY CURRENT PATH =    7
                  TOTAL NUMBER OF BRANCHES TRAVERSED =  157
 (TOTAL # TRAVERSED)/(TOTAL BRANCHES) PERCENTAGE =  100
            (NEW BRANCH)/(TOTAL BRANCH) PERCENTAGE =    4
```

OPTIMAL PATH OF SEGMENTS - -

```
  1 -  2 -  3 -  4 -  6 -  7 -  8 - 13 - 14 - 18 -
 19 - 20 - 23 - 24 - 25 - 26 - 27 - 28 - 29 - 30 -
 31 - 32 - 33 - 34 - 35 - 36 - 37 - 38 - 40 - 41 -
 43 - 44 - 46 - 48 - 49 - 50 - 52 - 53 - 96 - 98 -
 99 -100 -101 -102 -103 -104 -109 -110 -111 -113 -
114 -115 -116 -
```

IF ALL WENT WELL, YOUR PATHS ARE COMPLETED (IF ERRORS
OCCURRED, FIN AND CALL AN ATDS PROGRAMMER - YOU CAN RESTART LATER).
YOU ARE READY TO PROCEED WITH THE GENERATION OF DATA.
RESPOND WITH : $RUN .DATAGEN

V

```
+++ P A T H   N U M B E R   1
  1 -  2 -  3 -  4 -  6 -  3 -  5 -  6 -  7 -  8 -
 13 - 14 - 18 - 13 - 15 - 16 - 17 - 16 - 17 - 18 -
 19 - 20 - 23 - 19 - 21 - 22 - 21 - 22 - 23 - 24 -
  2 -  3 -  4 -  6 -  7 -  9 - 10 -  9 - 10 - 11 -
 12 - 11 - 12 - 13 - 14 - 18 - 19 - 20 - 23 - 24 -
 25 - 26 - 27 - 26 - 27 - 25 - 26 - 27 - 28 - 29 -
 30 - 29 - 30 - 28 - 29 - 30 - 31 - 32 - 33 - 32 -
 33 - 34 - 35 - 36 - 35 - 36 - 37 - 38 - 40 - 41 -
 43 - 34 - 35 - 36 - 37 - 39 - 40 - 42 - 43 - 44 -
 45 - 47 - 48 - 49 - 48 - 49 - 50 - 51 - 54 - 55 -
 58 - 59 - 60 - 61 - 63 - 64 - 67 - 68 - 71 - 72 -
 79 - 80 - 82 - 83 - 85 - 86 - 87 - 89 - 90 - 91 -
 93 - 94 - 95 - 59 - 60 - 62 - 60 - 62 - 63 - 65 -
 66 - 54 - 55 - 58 - 59 - 60 - 61 - 63 - 64 - 67 -
 68 - 71 - 73 - 74 - 76 - 77 - 78 - 59 - 60 - 61 -
 63 - 64 - 67 - 68 - 71 - 73 - 75 - 77 - 78 - 59 -
 60 - 61 - 63 - 64 - 67 - 68 - 71 - 72 - 79 - 81 -
 85 - 86 - 88 - 90 - 92 - 94 - 95 - 59 - 60 - 61 -
 63 - 64 - 67 - 68 - 71 - 72 - 79 - 80 - 82 - 84 -
 86 - 88 - 90 - 92 - 94 - 95 - 59 - 60 - 61 - 63 -
 65 - 66 - 54 - 56 - 57 - 96 - 98 - 99 -100 -101 -
102 -101 -102 -100 -101 -102 -103 -104 -109 -110 -
112 - 99 -100 -101 -102 -103 -105 -106 -108 - 99 -
100 -101 -102 -103 -105 -106 -107 -113 -114 -115 -
114 -115 -116 -
+++ BRANCH EXPRESSIONS WHICH AFFECT EXECUTION

    BRANCH EXPRESSION                CONDITION
    +++++++++++++++++                +++++++++
    GREAT.GE.AB                      TRUE
    I-N                              <=ZERO
    GREAT.GE.AB                      FALSE
    I-N                              > ZERO
    MAX.EQ.K1                        TRUE
    A(I,J).EQ.0.                     TRUE
    I-N                              <=ZERO
    A(I,J).EQ.0.                     FALSE
    M-N                              <=ZERO
    M-N                              > ZERO
    I-N                              > ZERO
    A(M,J).EQ.0.                     TRUE
    M-N                              <=ZERO
    A(M,J).EQ.0.                     FALSE
    I-N                              <=ZERO
    I-N                              > ZERO
    M-N                              > ZERO
    J-K                              <=ZERO
    GREAT.GE.AB                      TRUE
    I-N                              > ZERO
    MAX.EQ.K1                        FALSE
    L-N                              <=ZERO
    L-N                              > ZERO
    L-N                              <=ZERO
    L-N                              > ZERO
    A(I,J).EQ.0.                     TRUE
    I-N                              > ZERO
    A(M,J).EQ.0.                     TRUE
    M-N                              > ZERO
    J-K                              > ZERO
    J-N                              <=ZERO
```

J-N	> ZERO
&I-N	<=ZERO
J-N	> ZERO
&I-N	> ZERO
J-L	<=ZERO
J-L	> ZERO
&I-N	<=ZERO
J-L	> ZERO
&I-N	> ZERO
I-N	<=ZERO
I-N	> ZERO
J-N	<=ZERO
J-N	> ZERO
RS.LE.R	TRUE
CS.LE.C	TRUE
I-N	<=ZERO
J-N	> ZERO
RS.LE.R	FALSE
CS.LE.C	FALSE
I-N	> ZERO
R.GE.C	TRUE
I-N	<=ZERO
I-N	> ZERO
N.NE.1	TRUE
N.NE.2	TRUE
ABS(A(N2I,N2I-1)).LT.DELTA	TRUE
L.NE.N	TRUE
(L-N+1).NE.0	TRUE
DISC.GE.0.	TRUE
B.GE.0.	TRUE
R1.NE.0.	TRUE
ABS(A(N,N)-R1).GE.ABS(A(N,N)-R2)	TRUE
AR1.NE.0.	TRUE
ABS(A(N2I,N2I-1)).LT.DELTA	FALSE
I-N	<=ZERO
ABS(A(N2I,N2I-1)).LT.DELTA	FALSE
I-N	> ZERO
L.NE.N	FALSE
N.NE.2	TRUE
ABS(A(N2I,N2I-1)).LT.DELTA	TRUE
L.NE.N	TRUE
(L-N+1).NE.0	TRUE
DISC.GE.0.	FALSE
DENOM.NE.0.	TRUE
ABS(A(N2I,N2I-1)).LT.DELTA	TRUE
L.NE.N	TRUE
(L-N+1).NE.0	TRUE
DISC.GE.0.	FALSE
DENOM.NE.0.	FALSE
ABS(A(N2I,N2I-1)).LT.DELTA	TRUE
L.NE.N	TRUE
(L-N+1).NE.0	TRUE
DISC.GE.0.	TRUE
B.GE.0.	FALSE
ABS(A(N,N)-R1).GE.ABS(A(N,N)-R2)	FALSE
AR1.NE.0.	FALSE
ABS(A(N2I,N2I-1)).LT.DELTA	TRUE
L.NE.N	TRUE
(L-N+1).NE.0	TRUE
DISC.GE.0.	TRUE
B.GE.0.	TRUE
R1.NE.0.	FALSE
ABS(A(N,N)-R1).GE.ABS(A(N,N)-R2)	FALSE

V

AR1.NE.0.	FALSE
ABS(A(N2I+N2I-1)).LT.DELTA	TRUE
L.NE.N	FALSE
N.NE.2	FALSE
NVEC.EQ.0	FALSE
J-NN	<=ZERO
J-NN	> ZERO
&I-NN	<=ZERO
J-NN	> ZERO
&I-NN	> ZERO
C2.NE.0.	TRUE
NVEC.EQ.NUM	FALSE
J-NN	> ZERO
&I-NN	> ZERO
C2.NE.0.	FALSE
NVEC.EQ.NUM	FALSE
J-NN	> ZERO
&I-NN	> ZERO
C2.NE.0.	FALSE
NVEC.EQ.NUM	TRUE
I-NN	<=ZERO
I-NN	> ZERO

V

*** P A T H N U M B E R 2

1 - 2 - 3 - 4 - 6 - 7 - 8 - 13 - 14 - 18 -
19 - 20 - 23 - 24 - 25 - 26 - 27 - 28 - 29 - 30 -
31 - 32 - 33 - 34 - 35 - 36 - 37 - 38 - 40 - 41 -
43 - 44 - 46 - 48 - 49 - 50 - 52 - 53 - 96 - 98 -
99 -100 -101 -102 -103 -104 -109 -110 -111 -113 -
114 -115 -116 -

*** BRANCH EXPRESSIONS WHICH AFFECT EXECUTION

BRANCH EXPRESSION	CONDITION
++++++++++++++++++	+++++++++
GREAT.GE.AB	TRUE
I-N	> ZERO
MAX.EQ.K1	TRUE
A(I,J).EQ.0.	TRUE
I-N	> ZERO
A(M,J).EQ.0.	TRUE
M-N	> ZERO
J-K	> ZERO
J-N	> ZERO
&I-N	> ZERO
J-L	> ZERO
&I-N	> ZERO
I-N	> ZERO
J-N	> ZERO
RS.LE.R	TRUE
CS.LE.C	TRUE
I-N	> ZERO
R.GE.C	FALSE
I-N	> ZERO
N.NE.1	FALSE
NVEC.EQ.0	FALSE
J-NN	> ZERO
&I-NN	> ZERO
C2.NE.0.	TRUE
NVEC.EQ.NUM	TRUE
I-NN	> ZERO

SKLTON END OF JOB

```
:D,R 9.
:AD-ONLY MODE
:SE UPPER ASSUMED
) 14.01-06/03-19:05-(D,)
)IT
:
*** INPUT VARIABLES WHICH AFFECT BRANCHING
VEC     A
*** OTHER INPUT VARIABLES
EIGVEC Z        BB      ABS     CC      SS
*** VARIABLES WHICH ARE COMPUTED
I       JI      A       NMAX    C1      SMALL   NN      NUM
EIGVEC NVEC     CC      SS      J       C2      Z       BB
MM      DEL     VEC     IJK     N       N2I     L       SHIFT
ER1     AR2     R2      R1      DISC    C       B       RHO
SIGMA   AR4     AR3     DENOM   ANUM    DELTA   R       CS
KII     KIJ     RS      K1      D       M       E       AB
MAX     GREAT   K2      K
*** SKELETON LISTING OF THE CANDIDATE PATH FOR HSMAIN
SEG 1   SEG 2   STATEMENT
                        .
                        .
   1                    NN = 4
   1                    NVEC = 4
   1                    N=NN
   1                    K=N-2
   2                    DO1J=1,K
   2                    K1=J+1
   2                    K2=J+2
   2                    GREAT= ABS(A(K1,J))
   2                    MAX=K1
   3                    DO2I=K2,N
   3                    AB= ABS(A(I,J))
   3        4           IF (GREAT.GE.AB) GO TO 2
                        .
   5                    MAX=I
   6                  2 CONTINUE
   7                    INT(J)=MAX
   7        8           IF (MAX.EQ.K1) GO TO 5
   9                  4 DO6L=J,N
   9                    E=A(K1,L)
                        .
  10                  6 A(MAX,L)=E
  11                    DO7L=1,N
  11                    E=A(L,K1)
                        .
  12                  7 A(L,MAX)=E
  13                  5 DO8I=K2,N
  13       14           IF (A(I,J).EQ.0.) GO TO 8
  15                    A(I,J)=-A(I,J)/A(K1,J)
  16                    DO11M=K1,N
  17                 11 A(I,M)=A(I,M)+A(I,J)*A(K1,M)
  18                  8 CONTINUE
  19                    DO 2000 M=K2,N
  19       20           IF (A(M,J).EQ.0.) GO TO 2000
  21                 10 DO 2001 I=1,N
  22               2001 A(I,K1)=A(I,K1)-A(I,M)*A(M,J)
```

```
      2000 CONTINUE
         1 CONTINUE
           DO 105 I=1,N
           DO 105 J=1,N
       105 D(I,J)=A(I,J)
           DO 106 I=3,N
           L=I-2
           DO 106 J=1,L
       106 A(I,J)=0.0
           K1=N+1
           R=0.0
           C=0.0
           DO33I=1,N
           R=R+ ABS(A(1,I))
        33 C=C+ ABS(A(I,N))
           DO34I=2,N
           RS=0.0
           CS=0.0
           L=I-1
           DO35J=L,N
           RS=RS+ ABS(A(I,J))
           K1J=K1-J
           K1I=K1-I
        35 CS=CS+ ABS(A(K1J,K1I))
     38    IF (RS.LE.R) GO TO 36
        37 R=RS
     41 36 IF (CS.LE.C) GO TO 34
        44 C=CS
        34 CONTINUE
           .
     45    IF (R.GE.C) GO TO 54
           .
           .
        54 DELTA=C*1.0E-11
           DEL=C/17.1829
       153 DO 107 I=1,N
       107 A(I,I)=A(I,I)-DEL
     51 55 IF (N.NE.1) GO TO 46
           .
           .
     55 48 IF (N.NE.2) GO TO 80
        49 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,2)
           GO TO 76
        80 AR1=0.0
           AR3=0.0
           AR4=0.0
        61 L=N
           DO56 I=2,N
           N2I=N+2-I
     61    IF( ABS(A(N2I,N2I-1)).LT.DELTA)GO TO 57
        56 L=L-1
     64 57 IF (L.NE.N) GO TO 59
        58 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,1)
           N=N-1
           GO TO 48
     68 59 IF ((L-N+1).NE.0) GO TO 75
           .
```

```
                    .
      75 B=A(N-1,N-1)+A(N,N)
         C=A(N-1,N-1)*A(N,N)-A(N,N-1)*A(N-1,N)
         C1=A(N-1,N-1)-A(N,N)
         DISC=C1*C1+4.0*A(N,N-1)*A(N-1,N)
   72    IF (DISC.GE.0.) GO TO 63
                    .
                    .
         DENOM=AR3*AR3+AR4*AR4
   74    IF (DENOM.NE.0.) GO TO 200
                    .
                    .
         GO TO 203
  200 RHO=C
                    .
  203 AR3=R1
                    .
         CALL COMPIT(A,NMAX,L,N,RHO,SIGMA)
         GO TO 61
   80     63 IF (B.GE.0.) GO TO 65
          64 R1=.5*(B- SQRT(DISC))
             GO TO 66
          65 R1=.5*(B+ SQRT(DISC))
   83        IF (R1.NE.0.) GO TO 66
          83 R2=0.0
             GO TO 84
          66 R2=C/R1
   87     84 IF( ABS(A(N,N)-R1).GE. ABS(A(N,N)-R2))GO TO 68
                    .
             GO TO 69
          68 AR2=R2
   91     69 IF (AR1.NE.0.) GO TO 71
                    .
             GO TO 73
          71 SHIFT=AR2
          73 AR1=AR2
             CALL REALIT(A,NMAX,L,N,SHIFT,CC,SS)
             GO TO 61
   97     76 IF (NVEC.EQ.0) GO TO 600
                    .
         NUM=0
         JI=1
                    .
  513 C1=VEC(JI)
         C2=VEC(JI+1)
         NUM=NUM+1
         DO 570 I=1,NN
         DO 570 J=1,NN
  570 A(I,J)=D(I,J)
  104    IF (C2.NE.0.) GO TO 561
         CALL RVEC(A,NMAX,INT,C1,SMALL,NN,NUM,EIGVEC,NVEC,CC,SS)
         JI=JI+2
  107    IF(NVEC.EQ.NUM)GO TO 600
         GO TO 513
  561 CALL IMVEC(A,NMAX,INT,C1,C2,SMALL,NN,NUM,EIGVEC,NVEC,CC,S
         JI=JI+4
  111    IF(NVEC.EQ.NUM)GO TO 600
```

```
 112                    GO TO 513
 113              600 CONTINUE
                      .
 114                    DO 20 I=1,NN
 115              20    WRITE(6,700) (EIGVEC(I,J),J=I,NN)
*** INPUT VARIABLES WHICH AFFECT BRANCHING
VEC     A
*** OTHER INPUT VARIABLES
EIGVEC CC       SS      Z       BB
*** VARIABLES WHICH ARE COMPUTED
I       JI      A       NMAX    C1      C2      SMALL   NN
NUM     EIGVEC NVEC     CC      SS      Z       BB      J
VM      DEL     VEC     IJK     N       DELTA   CS      K11
K1J     RS      L       C       R       K1      D       M
Z6      MAX     GREAT   K2      K
*** SKELETON LISTING OF THE CANDIDATE PATH FOR HSMAIN
SEG 1   SEG 2   STATEMENT
                      .
                      .
   1                  NN = 4
   1                  NVEC = 4
   1                  N=NN
   1                  K=N-2
   2                  DO1J=1,K
   2                  K1=J+1
   2                  K2=J+2
   2                  GREAT= ABS(A(K1,J))
   2                  MAX=K1
   3                  DO2I=K2,N
   3                  AB= ABS(A(I,J))
   3       4          IF (GREAT.GE.AB) GO TO 2
                      .
                      .
   6                2 CONTINUE
   7                  INT(J)=MAX
   7       8          IF (MAX.EQ.K1) GO TO 5
                      .
                      .
  13                5 DO8I=K2,N
  13      14          IF (A(I,J).EQ.0.) GO TO 8
                      .
                      .
  18                8 CONTINUE
  19                  DO 2000 M=K2,N
  19      20          IF (A(M,J).EQ.0.) GO TO 2000
                      .
                      .
  23             2000 CONTINUE
  24                1 CONTINUE
  25                  DO 105 I=1,N
  26                  DO 105 J=1,N
  27              105 D(I,J)=A(I,J)
  28                  DO 106 I=3,N
  28                  L=I-2
  29                  DO 106 J=1,L
  30              106 A(I,J)=0.0
  31                  K1=N+1
```

```
      R=0.0
      C=0.0
      DO33I=1,N
      R=R+ ABS(A(1,I))
   33 C=C+ ABS(A(I,N))
      DO34I=2,N
      RS=0.0
      CS=0.0
      L=I-1
      DO35J=L,N
      RS=RS+ ABS(A(I,J))
      K1J=K1-J
      K1I=K1-I
   35 CS=CS+ ABS(A(K1J,K1I))
   38    IF (RS.LE.R) GO TO 36
                    .
   41 36 IF (CS.LE.C) GO TO 34
                    .
      34 CONTINUE
                    .
   45    IF (R.GE.C) GO TO 54
                    .
                    .
      GO TO 153
                    .
                    .
  153 DO 107 I=1,N
  107 A(I,I)=A(I,I)-DEL
   51  55 IF (N.NE.1) GO TO 48
       47 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,1)
          GO TO 76
                    .
                    .
   97  76 IF (NVEC.EQ.0) GO TO 600
                    .
          NUM=0
          JI=1
                    .
                    .
          C2=VEC(JI+1)
          NUM=NUM+1
          DO 570 I=1,NN
          DO 570 J=1,NN
  570 A(I,J)=D(I,J)
  104     IF (C2.NE.0.) GO TO 561
                    .
                    .
  561 CALL IMVEC(A,NMAX,INT,C1,C2,SMALL,NN,NUM,EIGVEC,NVEC,CC,S
                    .                                        Z,BB)
  111     IF(NVEC.EQ.NUM)GO TO 600
                    .
  600 CONTINUE
                    .
          DO 20 I=1,NN
   20     WRITE(6,700) (EIGVEC(I,J),J=1,NN)
CAN:277
OF:277
```

COMPIT

```
C,J 14.
SE UPPER ASSUMED
 14.01-06/04-14:00-(0,1)
IT
```

SEGMENT NUMBERS			FORTRAN STATEMENTS
			ELEMENT COMPIT
3			SUBROUTINE COMPIT(A,NMAX,L,N,RHO,SIGMA)
3			DIMENSION A(NMAX,NMAX)
1			M=N-1
2			DO 1 I=L,M
2,	3		IF (I.NE.L) GO TO 3
4		2	B1=A(L,L)*(A(L,L)-SIGMA)+A(L,L+1)*A(L+1,L)+R
			*HO
4			B2=A(L+1,L)*(A(L,L)+A(L+1,L+1)-SIGMA)
4			B3=A(L+1,L)*A(L+2,L+1)
4			A(L+2,L)=0.0
4			GO TO 6
5		3	B1=A(I,I-1)
5			B2=A(I+1,I-1)
5,	6		IF (I.EQ.M) GO TO 5
7		4	B3=A(I+2,I-1)
7			GO TO 6
8		5	B3=0.0
9		6	D=SQRT(B1*B1+B2*B2+B3*B3)
9,	10		IF (B1.GE.0.) GO TO 8
11		7	D=-D
12,	13	8	IF (D.EQ.0.) GO TO 1
14		9	C1=B2/(D+B1)
14			C2=B3/(D+B1)
14			E=2.0/(1.0+C1*C1+C2*C2)
15			DO 10 K=I,N
15,	16		IF (I.EQ.M) GO TO 12
17		11	G=E*(A(I,K)+C1*A(I+1,K)+C2*A(I+2,K))
17			A(I,K)=A(I,K)-G
17			A(I+1,K)=A(I+1,K)-C1*G
17			A(I+2,K)=A(I+2,K)-C2*G
17			GO TO 10
18		12	G=E*(A(I,K)+C1*A(I+1,K))
18			A(I,K)=A(I,K)-G
18			A(I+1,K)=A(I+1,K)-C1*G
19		10	CONTINUE
20,	21		IF (I.EQ.L) GO TO 14
22		13	A(I,I-1)=-D
22			A(I+1,I-1)=0.0
22,	23		IF (I.EQ.M) GO TO 14
24		15	A(I+2,I-1)=0.0
25		14	J=I+2
25,	26		IF (J.LE.N) GO TO 17
27		16	J=N
28		17	DO 18 K=L,J
28,	29		IF (I.EQ.M) GO TO 20

```
   30              19 G=E*(A(K,I)+C1*A(K,I+1)+C2*A(K,I+2))
   30                 A(K,I)=A(K,I)-G
   30                 A(K,I+1)=A(K,I+1)-C1*G
   30                 A(K,I+2)=A(K,I+2)-C2*G
   30                 GO TO 18
   31              20 G=E*(A(K,I)+C1*A(K,I+1))
   31                 A(K,I)=A(K,I)-G
   31                 A(K,I+1)=A(K,I+1)-C1*G
   32              18 CONTINUE
   33                 J=I+3
   33,   34           IF (J.GT.N) GO TO 1
   35              21 G=E*C2*A(I+3,I+2)
   35                 A(I+3,I)=-G
   35                 A(I+3,I+1)=-C1*G
   35                 A(I+3,I+2)=A(I+3,I+2)-C2*G
   36               1 CONTINUE
   37                 RETURN
    0                 END


SEGMENT
 NUMBERS              FORTRAN STATEMENTS

    0         ELEMENT EOF
CAN:77
OF:77

INES:77 FIELDATA
```

```
***STATIC ERROR ANALYSIS FOR ELEMENT COMPIT***

***CHECK FOR INFINITE LOOPS

   NO INFINITE LOOPS HAVE BEEN DETECTED

***CHECK FOR UNREACHABLE CODE

   NO UNREACHABLE CODE HAS BEEN DETECTED

***CHECK SET/USE OF INTERNAL SYMBOLS

   NO VIOLATIONS HAVE BEEN DETECTED FOR THE FOLLOWING SYMBOLS
   B1       B2       B3       C1       C2       D        E
    G        I        J        K        M

STATIC ERROR ANALYSIS IS COMPLETE.
```

III

```
D.J 11.
SE UPPER ASSUMED
 14.01-06/04-14:01-(0,1)
IT


**CHECK SET/USE OF INTERNAL SYMBOLS

 P R O C E S S   S Y M B O L  B1
    NO SET VIOLATIONS HAVE BEEN DETECTED
    NO USE VIOLATIONS HAVE BEEN DETECTED
    SET SEGMENTS/   4   5
    USE SEGMENTS/   9  14

 P R O C E S S   S Y M B O L  B2
    NO SET VIOLATIONS HAVE BEEN DETECTED
    NO USE VIOLATIONS HAVE BEEN DETECTED
    SET SEGMENTS/   4   5
    USE SEGMENTS/   9  14

 P R O C E S S   S Y M B O L  B3
    NO SET VIOLATIONS HAVE BEEN DETECTED
    NO USE VIOLATIONS HAVE BEEN DETECTED
    SET SEGMENTS/   4   7   8
    USE SEGMENTS/   9  14

 P R O C E S S   S Y M B O L  C1
    NO SET VIOLATIONS HAVE BEEN DETECTED
    NO USE VIOLATIONS HAVE BEEN DETECTED
    SET SEGMENTS/  14
    USE SEGMENTS/  14  17  18  30  31  35

 P R O C E S S   S Y M B O L  C2
    NO SET VIOLATIONS HAVE BEEN DETECTED
    NO USE VIOLATIONS HAVE BEEN DETECTED
    SET SEGMENTS/  14
    USE SEGMENTS/  14  17  30  35

 P R O C E S S   S Y M B O L  D
    NO SET VIOLATIONS HAVE BEEN DETECTED
    NO USE VIOLATIONS HAVE BEEN DETECTED
    SET SEGMENTS/   9
    USE SEGMENTS/  11  12  14  22

 P R O C E S S   S Y M B O L  E
    NO SET VIOLATIONS HAVE BEEN DETECTED
    NO USE VIOLATIONS HAVE BEEN DETECTED
    SET SEGMENTS/  14
    USE SEGMENTS/  17  18  30  31  35

 P R O C E S S   S Y M B O L  G
    NO SET VIOLATIONS HAVE BEEN DETECTED
    NO USE VIOLATIONS HAVE BEEN DETECTED
    SET SEGMENTS/  17  18  30  31  35
    USE SEGMENTS/  17  18  30  31  35
```

III

```
PROCESS SYMBOL I
NO SET VIOLATIONS HAVE BEEN DETECTED
NO USE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/   2
USE SEGMENTS/   2   5   7  15  17  18  20  22  24
               25  28  30  31  33  35

PROCESS SYMBOL J
NO SET VIOLATIONS HAVE BEEN DETECTED
NO USE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/  25  27  33
USE SEGMENTS/  25  28  33

PROCESS SYMBOL K
NO SET VIOLATIONS HAVE BEEN DETECTED
NO USE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/  15  28
USE SEGMENTS/  17  18  30  31

PROCESS SYMBOL M
NO SET VIOLATIONS HAVE BEEN DETECTED
NO USE VIOLATIONS HAVE BEEN DETECTED
SET SEGMENTS/   1
USE SEGMENTS/   2   5  15  22  28
A:76
F:76

NES:76 FIELDATA
```

IV

PATH NUMBER 1

NUMBER OF BRANCHES IN NETWORK =	49
NUMBER OF BRANCHES PREVIOUSLY TRAVERSED =	0
NUMBER OF NEW BRANCHES TRAVERSED BY CURRENT PATH =	46
TOTAL NUMBER OF BRANCHES TRAVERSED =	46
(TOTAL # TRAVERSED)/(TOTAL BRANCHES) PERCENTAGE =	93
(NEW BRANCH)/(TOTAL BRANCH) PERCENTAGE =	93

OPTIMAL PATH OF SEGMENTS - -

1 - 2 - 4 - 9 - 10 - 12 - 14 - 15 - 17 - 19 -
15 - 17 - 19 - 20 - 21 - 25 - 26 - 28 - 30 - 32 -
28 - 30 - 32 - 33 - 35 - 36 - 2 - 3 - 5 - 7 -
9 - 11 - 12 - 14 - 15 - 17 - 19 - 20 - 22 - 24 -
25 - 26 - 28 - 30 - 32 - 33 - 34 - 36 - 2 - 3 -
5 - 6 - 8 - 9 - 10 - 12 - 14 - 15 - 16 - 18 -
19 - 20 - 22 - 23 - 25 - 27 - 28 - 29 - 31 - 32 -
33 - 34 - 36 - 37 -

PATH NUMBER 2

NUMBER OF BRANCHES IN NETWORK =	49
NUMBER OF BRANCHES PREVIOUSLY TRAVERSED =	46
NUMBER OF NEW BRANCHES TRAVERSED BY CURRENT PATH =	3
TOTAL NUMBER OF BRANCHES TRAVERSED =	49
(TOTAL # TRAVERSED)/(TOTAL BRANCHES) PERCENTAGE =	100
(NEW BRANCH)/(TOTAL BRANCH) PERCENTAGE =	6

OPTIMAL PATH OF SEGMENTS - -

1 - 2 - 4 - 9 - 10 - 12 - 13 - 36 - 37 -

```
+++ P A T H   N U M B E R   1
  1 -  2 -  4 -  9 - 10 - 12 - 14 - 15 - 17 - 19 -
 15 - 17 - 19 - 20 - 21 - 25 - 26 - 28 - 30 - 32 -
 28 - 30 - 32 - 33 - 35 - 36 -  2 -  3 -  5 -  7 -
  9 - 11 - 12 - 14 - 15 - 17 - 19 - 20 - 22 - 24 -
 25 - 26 - 28 - 30 - 32 - 33 - 34 - 36 -  2 -  3 -
  5 -  6 -  8 -  9 - 10 - 12 - 14 - 15 - 16 - 18 -
 19 - 20 - 22 - 23 - 25 - 27 - 28 - 29 - 31 - 32 -
 33 - 34 - 36 - 37 -
+++ BRANCH EXPRESSIONS WHICH AFFECT EXECUTION

    BRANCH EXPRESSION                 CONDITION
    +++++++++++++++++                 +++++++++
    I.NE.L                            FALSE
    B1.GE.0.                          TRUE
    D.EQ.0.                           FALSE
    I.EQ.M                            FALSE
    K-N                               <=ZERO
    I.EQ.M                            FALSE
    K-N                               > ZERO
    I.EQ.L                            TRUE
    J.LE.N                            TRUE
    I.EQ.M                            FALSE
    K-J                               <=ZERO
    I.EQ.M                            FALSE
    K-J                               > ZERO
    J.GT.N                            FALSE
    I-M                               <=ZERO
    I.NE.L                            TRUE
    I.EQ.M                            FALSE
    B1.GE.0.                          FALSE
    D.EQ.0.                           FALSE
    I.EQ.M                            FALSE
    K-N                               > ZERO
    I.EQ.L                            FALSE
    I.EQ.M                            FALSE
    J.LE.N                            TRUE
    I.EQ.M                            FALSE
    K-J                               > ZERO
    J.GT.N                            TRUE
    I-M                               <=ZERO
    I.NE.L                            TRUE
    I.EQ.M                            TRUE
    B1.GE.0.                          TRUE
    D.EQ.0.                           FALSE
    I.EQ.M                            TRUE
    K-N                               > ZERO
    I.EQ.L                            FALSE
    I.EQ.M                            TRUE
    J.LE.N                            FALSE
    I.EQ.M                            TRUE
    K-J                               > ZERO
    J.GT.N                            TRUE
    I-M                               > ZERO


+++ P A T H   N U M B E R   2
  1 -  2 -  4 -  9 - 10 - 12 - 13 - 36 - 37 -
+++ BRANCH EXPRESSIONS WHICH AFFECT EXECUTION

    BRANCH EXPRESSION                 CONDITION
    +++++++++++++++++                 +++++++++
    I.NE.L                            FALSE
    B1.GE.0.                          TRUE
    D.EQ.0.                           TRUE
    I-M                               > ZERO
```

V

VI

```
BED.R  9.
READ-ONLY MODE
CASE UPPER ASSUMED
ED 14.01-06/07-15:44-(0,)
EDIT
0:
1*** INPUT VARIABLES WHICH AFFECT BRANCHING
 N       L       SIGMA   A       RHO
0*** OTHER INPUT VARIABLES
0*** VARIABLES WHICH ARE COMPUTED
 J       A       G       K       E       C2      C1      D
 B3      B2      B1      I       M
1*** SKELETON LISTING OF THE CANDIDATE PATH FOR COMPIT
 SEG 1  SEG 2  STATEMENT
                        .
                        .
    1                   M=N-1
    2                   DO 1 I=L,M
    2       3           IF (I.NE.L) GO TO  3
    4                 2 B1=A(L,L)*(A(L,L)-SIGMA)+A(L,L+1)*A(L+1,L)+RHO
    4                   B2=A(L+1,L)*(A(L,L)+A(L+1,L+1)-SIGMA)
    4                   B3=A(L+1,L)*A(L+2,L+1)
    4                   A(L+2,L)=0.0
    4                   GO TO 6
    5                 3 B1=A(I,I-1)
    5                   B2=A(I+1,I-1)
    5       6           IF (I.EQ.M) GO TO 5
    7                 4 B3=A(I+2,I-1)
    7                   GO TO 6
    8                 5 B3=0.0
    9                 6 D= SQRT(B1*B1+B2*B2+B3*B3)
    9      10           IF (B1.GE.0.) GO TO 8
   11                 7 D=-D
   12      13         8 IF (0.EQ.0.) GO TO 1
   14                 9 C1=B2/(D+B1)
   14                   C2=B3/(D+B1)
   14                   E=2.0/(1.0+C1*C1+C2*C2)
   15                   DO 10 K=1,N
   15      16           IF (I.EQ.M) GO TO 12
   17                11 G=E*(A(I,K)+C1*A(I+1,K)+C2*A(I+2,K))
   17                   A(I,K)=A(I,K)-G
   17                   A(I+1,K)=A(I+1,K)-C1*G
   17                   A(I+2,K)=A(I+2,K)-C2*G
   17                   GO TO 10
   18                12 G=E*(A(I,K)+C1*A(I+1,K))
                        .
                        .
   19                10 CONTINUE
   20      21           IF (I.EQ.L) GO TO 14
                        .
                        .
   22      23           IF (I.EQ.M) GO TO 14
   24                15 A(I+2,I-1)=0.0
   25                14 J=I*2
   25      26           IF (J.LE.N) GO TO 17
   27                16 J=N
   28                17 DO 18 K=L,J
```

30.A

```
      IF (I.EQ.M) GO TO 20
   19 G=E*(A(K,I)+C1*A(K,I+1)+C2*A(K,I+2))
      A(K,I)=A(K,I)-G
      A(K,I+1)=A(K,I+1)-C1*G
      A(K,I+2)=A(K,I+2)-C2*G
      GO TO 18
   20 G=E*(A(K,I)+C1*A(K,I+1))

   18 CONTINUE
      J=I+3
      IF (J.GT.N) GO TO 1
   21 G=E*C2*A(I+3,I+2)

      A(I+3,I+1)=-C1*G
      A(I+3,I+2)=A(I+3,I+2)-C2*G
    1 CONTINUE
      RETURN
1*** INPUT VARIABLES WHICH AFFECT BRANCHING
  N     SIGMA  RHO    A      L
0*** OTHER INPUT VARIABLES
0*** VARIABLES WHICH ARE COMPUTED
  D       A       B3      B2      B1      I       M
1*** SKELETON LISTING OF THE CANDIDATE PATH FOR COMPIT
 SEG 1  SEG 2  STATEMENT

      M=N-1
      DO 1 I=L,M
      IF (I.NE.L) GO TO 3
    2 B1=A(L,L)*(A(L,L)-SIGMA)+A(L,L+1)*A(L+1,L)+RHO
      B2=A(L+1,L)*(A(L,L)+A(L+1,L+1)-SIGMA)
      B3=A(L+1,L)*A(L+2,L+1)

      GO TO 6

    6 D=SQRT(B1*B1+B2*B2+B3*B3)
      IF (B1.GE.0.) GO TO 8

    8 IF (D.EQ.0.) GO TO 1

    1 CONTINUE
      RETURN
```

*** C A P I F O R T U N E E X E C U T I O N P R O F I L E L I S T I N G *** VERSION DATE 1/26/73.

STATEMENTS	*** FORTUNE FOR IBM/360 ***	EXECUTIONS	TIME	TRUE	PAGE 1
	C FOR DESCRIPTION OF METHOD USED IN THIS PROGRAM, SEE **THE QR				
	C TRANSFORMATION** BY FRANCIS, COMPUTER JOURNAL, VOL. 4 PP, 265,272				
	C START HERE TO PRODUCE UPPER HESSENBURG MATRIX				
	DIMENSION A(10,10),VEC(8), EIGVEC(4,4), INT(10),CC(10),SS(10)				
	DIMENSION Z(10),D(10,10),BB(10,10)				
	DATA A / 0.1,5.8,1.9,3.2,6*0.0,2.8,3.9,0.7,0.1,6*0.0,				
	Z 6.2,3.5,0.6,1.2,6*0.0,9.9,6.2,1.7,3.8 /				
	NMAX = 10	1	2		
	NN = 4	1	2		
	NVEC = 4	1	2		
	N=NN	1	2		
	K=N-2	1	5		
	DO1 J=1,K	1	18		
	K1=J+1	2	10		
	K2=J+2	2	10		
	GREAT= ABS(A(K1,J))	2	24		
	MAX=K1	2	4		
	DO2 I=K2,N	2	27		
	AB= ABS(A(I,J))	3	36		
	IF (GREAT.GE.AB) GO TO 2	3	19	2	
3	GREAT=AB	1	2		
	MAX=I	1	2		
2	CONTINUE	3			
	C INT(J) GIVES INFORMATION ABOUT INTERCHANGES				
	INT(J)=MAX	2	8		
	IF (MAX.EQ.K1) GO TO 5	2	12	1	
4	DO6 L=J,N	1	27		
	E=A(K1,L)	3	21		
	A(K1,L)=A(MAX,L)	3	33		
6	A(MAX,L)=E	3	21		
	DO7 L=1,N	1	36		
	E=A(L,K1)	4	28		
	A(L,K1)=A(L,MAX)	4	44		
7	A(L,MAX)=E	4	28		
	C INTERCHANGE DONE				
5	DO8 I=K2,N	2	27		
	IF (A(I,J).EQ.0.) GO TO 8	3	27	**0*	
	A(I,J)=-A(I,J)/A(K1,J)	3	78		
	DO11 M=K1,N	3	72		
11	A(I,M)=A(I,M)+A(I,J)*A(K1,M)	8	216		
8	CONTINUE	3			
	C LEFT MULT. DONE				
	DO 2000 M=K2,N	2	27		
	IF (A(M,J).EQ.0.) GO TO 2000	3	27	**0*	
10	DO 2001 I=1,N	3	108		
2001	A(I,K1)=A(I,K1)-A(I,M)*A(M,J)	12	324		
2000	CONTINUE	3			
1	CONTINUE	2			
	C RIGHT MULT. DONE				
	C HESSENBURG MATRIX NOW FORMED AS A(I,J), MULTIPLIERS STORED WITH IT				
	DO 105 I=1,N	1	36		
	DO 105 J=1,N	4	144		
105	D(I,J)=A(I,J)	16	176		

```
C PUT APPROPRIATE ZEROS WHERE MULTIPLIERS WERE STORED                    1        18
      DO 106 I=3,N                                                       2        10
      L=I-2                                                              2        27
      DO 106 J=1,L                                                       3        21
  106 A(I,J)=0.0                                                         1         5
      K1=N+1                                                             1         2
      R=0.0                                                              1         2
      C=0.0                                                              1        36
      DO 33 I=1,N                                                        4        56
      R=R+ ABS(A(I,I))                                                   4        56
   33 C=C+ ABS(A(I,N))                                                   1        27
      DO 34 I=2,N                                                        3         6
      RS=0.0                                                             3         6
      CS=0.0                                                             3        15
      L=I-1                                                              3        81
      DO 35 J=L,N                                                        9       126
      RS=RS+ ABS(A(I,J))                                                 9        45
      K1J=K1-J                                                           9        45
      K1I=K1-I                                                           9       126
   35 CS=CS+ ABS(A(K1J,K1I))                                             3        21         3
      IF (RS.LE.R) GO TO 36                                            **0*
   37 R=RS                                                             3        19         2
   36 IF (CS.LE.C) GO TO 34                                            1         2
   44 C=CS                                                             3
   34 CONTINUE                                                         1         2
      IJK=1                                                            1         7         1
      IF (R.GE.C) GO TO 54
C DELTA IS CRITERION FOR STOPPING AN ITERATION                        **0*
   53 DELTA=R*1.0E-11                                                 **0*
C DEL IS ARBITRARY SHIFT                                              **0*
      DEL=R/17.1429                                                    1         9
      GO TO 153                                                        1        10
   54 DELTA=C*1.0E-11
      DEL=C/17.1429
C     DELTA COMPUTED                                                   1        36
C PRODUCE A-PI, ITERATE ON THIS TO BREAK UP EIGENVALUES OF EQUAL MODULUS 8        56
  153 DO 107 I=1,N                                                     1         7         1
  107 A(I,I)=A(I,I)-DEL
   55 IF (N.NE.1) GO TO 48
C SUBROUTINE CALCEV CALCULATES EIGENVALUES OF 1X1 OR 2X2 MATRICES.
C PI AS ADDED BACK IN CALCEV                                          **0*
   47 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,1)                            **0*
      GO TO 76                                                         3        19         2
   48 IF (N.NE.2) GO TO 80                                             1        21
   49 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,2)                              1         2
      GO TO 76
C QR TRANSFORMATION STARTS HERE
C INITIALIZE FOR DETERMINING SUBSEQUENT SHIFTS                         2         4
   80 AR1=0.0                                                          2         4
      AR3=0.0                                                          2         4
      AR4=0.0
C RE-ENTER AFTER REALIT OR COMPIT SUBROUTINES CALLED
C SELECT FIRST ((ZERO)) SUB-DIAGONAL ELEMENT FROM BOTTOM               9        18
   61 L=N                                                              9       180
      DO 56 I=2,N
```

```
      N2I=N+2-I                                                    20      140
      IF( ABS(A(N2I,N2I-1)).LT.DELTA)GO TO 57                      20      344        2
   54 L=I-1                                                        18       90
C VALUE OF L SELECTED
   57 IF (L.NE.N) GO TO 59                                          9       59        7
   58 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,1)                           2       42
      N=N-1                                                         2       10
      GO TO 48                                                      2        4
   59 IF ((L-N+1).NE.0) GO TO 75                                    7       84        7
   60 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,2)                         **0*
      N=N-2                                                       **0*
      GO TO 55                                                    **0*
C DETERMINE EIGENVALUES OF 2X2 MATRIX -- ROW 1 = A(N-1,N-1)   A(N-1,N)
C                                        ROW 2 = A(N,N-1)     A(N,N)
C AND BASE SHIFT ON THESE
   75 B=A(N-1,N-1)+A(N,N)                                           7      133
      C=A(N-1,N-1)*A(N,N)-A(N,N-1)*A(N-1,N)                         7      294
      C1=A(N-1,N-1)-A(N,N)                                          7      133
      DISC=C1*C1+4.0*A(N,N-1)*A(N-1,N)                              7      224
      IF (DISC.GE.0.) GO TO 63                                      7       49        7
   62 R1=0.5*B                                                    **0*
      R2=.5* SQRT( ABS(DISC))                                     **0*
      ANUM=(R1-AR3)*(R1-AR3)+(R2-AR4)*(R2-AR4)                    **0*
      DENOM=AR3*AR3+AR4*AR4                                       **0*
      IF (DENOM.NE.0.) GO TO 200                                  **0*
  201 RHO=0.0                                                     **0*
      SIGMA=0.0                                                   **0*
      GO TO 203                                                   **0*
  200 RHO=C                                                       **0*
      SIGMA=B                                                     **0*
  203 AR1=R1                                                      **0*
      AR2=R2                                                      **0*
      CALL COMPIT(A,NMAX,L,N,RHO,SIGMA)                           **0*
      GO TO 61                                                    **0*
   63 IF (B.GE.0.) GO TO 65                                         7       35      **0*
   64 R1=.5*(B- SQRT(DISC))                                         7      497
      GO TO 66                                                      7       14
   65 R1=.5*(B+ SQRT(DISC))                                       **0*
      IF (R1.NE.0.) GO TO 66                                      **0*
   83 R2=0.0                                                      **0*
      GO TO 84                                                    **0*
   66 R2=C/R1                                                       7       70
C     ROOTS OF 2*2 MATRIX FOUND
   84 IF( ABS(A(N,N)-R1).GE. ABS(A(N,N)-R2))GO TO 68                7      209        3
   67 AR=R1                                                         4        8
      GO TO 69                                                      4        8
   68 AR=R2                                                         3        6
   69 IF (AR1.NE.0.) GO TO 71                                       7       45        5
   72 SHIFT=0.0                                                     2        4
      GO TO 73                                                      2        4
   71 SHIFT=AR2                                                     5       10
   73 AR1=AR2                                                       7       14
      CALL REALIT(A,NMAX,L,N,SHIFT,CC,6S)                           7      147
      GO TO 61                                                      7       14
C ARE VECTORS NEEDED
```

```
     76 IF (NVEC.EQ.0) GO TO 600                                    1        5    **0*
C INVERSE ITERATION IS USED FOR EIGENVECTORS
    550 SMALL=DELTA*1.0E-30                                         1        9
        NUM=0                                                       1        2
        JI=1                                                        1        2
        NN=NN+NN                                                    1        5
C C1 IS REAL PART OF EIGENVALUE
    513 C1=VEC(JI)                                                  4       16
C C2 IS COMPLEX PART OF EIGENVALUE
        C2=VEC(JI+1)                                                4       28
        NUM=NUM+1                                                   4       20
C REPLACE HESSENBURG MATRIX AND MULTIPLIERS
        DO 570 I=1,NN                                               4      144
        DO 570 J=1,NN                                              16      576
    570 A(I,J)=D(I,J)                                              64      704
        IF (C2.NE.0.) GO TO 561                                     4       20    **0*
        CALL RVEC(A,NMAX,INT,C1,SMALL,NN,NUM,EIGVEC,NVEC,CC,SS)     4      124
        JI=JI+2                                                     4       20
        IF(NVEC.EQ.NUM)GO TO 600                                    4       22       1
        GO TO 513                                                   3        6
    561 CALL IMVEC(A,NMAX,INT,C1,C2,SMALL,NN,NUM,EIGVEC,NVEC,CC,SS,Z,BB)  **0*
C NEXT STATEMENT IGNORES CONJUGATE COMPLEX EIGENVALUES
        JI=JI+1                                                   **0*
        IF(NVEC.EQ.NUM)GO TO 600                                  **0*
        GO TO 513                                                 **0*
    600 CONTINUE                                                    1
        WRITE(6,700) (VEC(I),I=1,NN)                                1      144
        DO 20 I=1,NN                                                1       36
   20   WRITE(6,700) (EIGVEC(I,J),J=1,NN)                           4      664
  700   FORMAT(1H ,5E20.8 / 5E20.8)
        END
```

```
      SUBROUTINE CALCEV(A,NMAX,DEL,VEC,IJK,N,M)                          3      132
      DIMENSION A(NMAX,NMAX),VEC(1)
      IF (M.NE.1) GO TO 2                                                3       17        1
    1 AI=0.0                                                             2        4
      A(N,M)=A(N,M)+DEL                                                  2       28
C STORE EIGENVALUES IN VEC
      VEC(IJK)=A(N,N)                                                    2       18
      VEC(IJK+1)=AI                                                      2       14
      IJK=IJK+2                                                          2       10
      RETURN                                                             2        4
    2 B=A(N-1,N-1)+A(N,N)                                                1       19
      C=A(N-1,N-1)*A(N,N)-A(N,N-1)*A(N-1,N)                              1       42
      C1=A(N-1,N-1)-A(N,N)                                               1       19
      DISC=C1*C1+4.0*A(N,N-1)*A(N-1,N)                                   1       32
      IF (DISC.LT.0.) GO TO 9                                            1        5      **0*
    4 AI=0.0                                                             1        2
      IF (B.GE.0.) GO TO 6                                               1        7        1
      R1=0.5*(B- SQRT(DISC))                                            **0*
      GO TO 7                                                           **0*
    6 R1=0.5*(B+ SQRT(DISC))                                             1       71
      IF(R1.NE.0.) GO TO 7                                               1        7        1
   10 R2=0.0                                                            **0*
      GO TO 11                                                          **0*
    7 R2=C/R1                                                            1       10
   11 R1=R1+DEL                                                          1        5
      R2=R2+DEL                                                          1        5
      VEC(IJK)=R2                                                        1        4
      VEC(IJK+1)=AI                                                      1        7
      VEC(IJK+2)=R1                                                      1        7
      VEC(IJK+3)=AI                                                      1        7
      GO TO 8                                                            1        2
    9 R1=0.5*B                                                          **0*
      AI=-.5* SQRT( ABS(DISC))                                          **0*
      R1=R1+DEL                                                         **0*
      VEC(IJK)=R1                                                       **0*
      VEC(IJK+1)=-AI                                                    **0*
      VEC(IJK+2)=R1                                                     **0*
      VEC(IJK+3)=AI                                                     **0*
    8 IJK=IJK+4                                                          1        5
      RETURN                                                             1        2
      END
```

```
      SUBROUTINE REALIT(A,NMAX,L,N,SHIFT,C,S)                    7      308
      DIMENSION A(NMAX,NMAX),C(1),S(1)
      IF (SHIFT.EQ.0.) GO TO 2                                   7       39       2
    1 DO3 I=L,N                                                  5      162
    3 A(I,I)=A(I,I)-SHIFT                                       18      252
    2 M=N-1                                                      7       35
      DO4 I=L,M                                                  7      162
      DENOM=SQRT(A(I,I)**2+A(I+1,I)**2)                         18     3312
      IF (DENOM.GT.0.) GO TO 10                                 18      126      18
   11 C(I)=1.0                                                 **0*
      S(I)=0.0                                                 **0*
      GO TO 4                                                  **0*
   10 C(I)=A(I,I)/DENOM                                        18      288
      S(I)=A(I+1,I)/DENOM                                      18      342
      A(I,I)=DENOM                                             18      126
   12 I1=I+1                                                   18       90
      DO 35 J=I1,N                                             18      297
      F=A(I,J)                                                 33      231
      A(I,J)=A(I+1,J)*S(I)+F*C(I)                              33      957
      A(I+1,J)=A(I+1,J)*C(I)-F*S(I)                            33     1056
   35 CONTINUE                                                 33
    4 CONTINUE                                                 18
C     TRIANGULAR MATRIX FORMED
      DO5 J=L,M                                                7      162
      DO4 I=L,J                                                18      297
      F=A(I,J)                                                 33      231
      A(I,J)=A(I,J+1)*S(J)+F*C(J)                              33      957
    6 A(I,J+1)=A(I,J+1)*C(J)-F*S(J)                            33     1056
      A(J+1,J)=A(J+1,J+1)*S(J)                                 18      450
    5 A(J+1,J+1)=A(J+1,J+1)*C(J)                               18      504
C     TRANSFORMATION COMPLETED
      IF (SHIFT.EQ.0.) RETURN                                  7       39       2
    7 DO9 I=L,N                                                5      162
    9 A(I,I)=A(I,I)+SHIFT                                      18      252
    8 RETURN                                                   5       10
      END
```

```
      SUBROUTINE COMPIT(A,NMAX,L,N,RHO,SIGMA)                          **0*
      DIMENSION A(NMAX,NMAX)
C HOUSEHOLDER TYPE MATRICES USED INSTEAD OF ROTATIONS(SEE FRANCIS PAPER)
      M=N-1                                                            **0*
      DO 1 I=L,M                                                       **0*
      IF (I.NE.L) GO TO 3                                              **0*
    2 B1=A(L,L)*(A(L,L)-SIGMA)+A(L,L+1)*A(L+1,L)+RHO                   **0*
      B2=A(L+1,L)*(A(L,L)+A(L+1,L+1)-SIGMA)                            **0*
      B3=A(L+1,L)*A(L+2,L+1)                                           **0*
      A(L+2,L)=0.0                                                     **0*
      GO TO 6                                                          **0*
    3 B1=A(I,I-1)                                                      **0*
      B2=A(I+1,I-1)                                                    **0*
      IF (I.EQ.M) GO TO 5                                              **0*
    4 B3=A(I+2,I-1)                                                    **0*
      GO TO 6                                                          **0*
    5 B3=0.0                                                           **0*
    6 D=SQRT(B1*B1+B2*B2+B3*B3)                                        **0*
      IF (B1.GE.0.) GO TO 8                                            **0*
    7 D=-D                                                             **0*
    8 IF (D.EQ.0.) GO TO 1                                             **0*
    9 C1=B2/(D+B1)                                                     **0*
      C2=B3/(D+B1)                                                     **0*
      E=2.0/(1.0+C1*C1+C2*C2)                                          **0*
      DO 10 K=I,N                                                      **0*
      IF (I.EQ.M) GO TO 12                                             **0*
   11 G=E*(A(I,K)+C1*A(I+1,K)+C2*A(I+2,K))                             **0*
      A(I,K)=A(I,K)-G                                                  **0*
      A(I+1,K)=A(I+1,K)-C1*G                                           **0*
      A(I+2,K)=A(I+2,K)-C2*G                                           **0*
      GO TO 10                                                         **0*
   12 G=E*(A(I,K)+C1*A(I+1,K))                                         **0*
      A(I,K)=A(I,K)-G                                                  **0*
      A(I+1,K)=A(I+1,K)-C1*G                                           **0*
   10 CONTINUE                                                         **0*
      IF (I.EQ.L) GO TO 14                                             **0*
   13 A(I,I-1)=-D                                                      **0*
      A(I+1,I-1)=0.0                                                   **0*
      IF (I.EQ.M) GO TO 16                                             **0*
   15 A(I+2,I-1)=0.0                                                   **0*
C     ROW OPERATION COMPLETED
   14 J=I+2                                                            **0*
      IF (J.LE.N) GO TO 17                                             **0*
   16 J=N                                                              **0*
   17 DO 18 K=L,J                                                      **0*
      IF (I.EQ.M) GO TO 20                                             **0*
   19 G=E*(A(K,I)+C1*A(K,I+1)+C2*A(K,I+2))                             **0*
      A(K,I)=A(K,I)-G                                                  **0*
      A(K,I+1)=A(K,I+1)-C1*G                                           **0*
      A(K,I+2)=A(K,I+2)-C2*G                                           **0*
      GO TO 18                                                         **0*
   20 G=E*(A(K,I)+C1*A(K,I+1))                                         **0*
      A(K,I)=A(K,I)-G                                                  **0*
      A(K,I+1)=A(K,I+1)-C1*G                                           **0*
   18 CONTINUE                                                         **0*
```

```
      J=I+3                                                    **0*
      IF (J.GT.N) GO TO 1                                      **0*
   21 G=F*C2*A(I+3,I+2)                                        **0*
      A(I+3,I)=-G                                              **0*
      A(I+3,I+1)=-C1*G                                         **0*
      A(I+3,I+2)=A(I+3,I+2)-C2*G                               **0*
C     COLUMN OPERATION COMPLETED
    1 CONTINUE                                                 **0*
      RETURN                                                   **0*
      END
```

		EXECUTIONS	TIME	TRUE
	SUBROUTINE RVEC(A,NMAX,INT,C1,SMALL,N,NUM,EIGVEC,NVEC,INTER,Y)	4	216	
	DIMENSION A(NMAX,NMAX),INTER(1),Y(1),INT(1),EIGVEC(NMAX,NMAX)			
	DO1 I=1,N	4	144	
1	A(I,I)=A(I,I)-C1	16	224	
	DO2 I=2,N	4	106	
	IF(ABS(A(I-1,I-1)).GE. ABS(A(I,I-1)))GO TO 4	12	384	6
3	INTER(I)=I	6	24	
	J=I-1	6	30	
	DO5 K=J,N	6	162	
	B=A(I-1,K)	18	162	
	A(I-1,K)=A(I,K)	18	252	
5	A(I,K)=B	18	126	
	GO TO 6	6	12	
4	INTER(I)=I-1	6	42	
6	IF (A(I,I-1).EQ.0.) GO TO 2	12	144	**0*
	C=-A(I,I-1)/A(I-1,I-1)	12	348	
	A(I,I-1)=C	12	108	
	DO 8 K=I,N	12	216	
8	A(I,K)=A(I,K)+C*A(I-1,K)	24	600	
2	CONTINUE	12		
C	TRIANGULAR MATRIX FORMED			
	DO9 I=1,N	4	144	
	IF(ABS(A(I,I)).GE.SMALL)GO TO 9	16	256	16
10	A(I,I)=SMALL	**0*		
9	CONTINUE	16		
C	NORMALISED ((EIGENVECTOR)) OF HESSENBURG MATRIX OBTAINED FOR RHS = 1			
	DO 5555 I=1,N	4	144	
5555	Y(I)=1.0	16	64	
	DO 8888 JJ,JJ=1,4	4	144	
7777	Y(N)=Y(N)/A(N,N)	16	288	
	B=Y(N)	16	64	
	DO11 I=2,N	16	432	
	E=0.0	48	96	
	M=N+1-I	48	336	
	DO12 J=2,I	48	864	
	L=N+J-I	96	672	
12	E=E+Y(L)*A(M,L)	96	1536	
	Y(M)=(Y(M)-E)/A(M,M)	48	1008	
	IF(ABS(B).GE. ABS(Y(M)))GO TO 11	48	856	20
13	B=Y(M)	28	112	
11	CONTINUE	48		
	DO14 I=1,N	16	576	
14	Y(I)=Y(I)/B	64	896	
	IF(JJJJ.EQ.4)GO TO 6666	16	88	4
	DO15 I=2,N	12	324	
	IF (INTER(I).NE.I) GO TO 15	36	288	18
16	B=Y(I)	18	72	
	Y(I)=Y(I-1)	18	162	
	Y(I-1)=B	18	126	
15	Y(I)=Y(I)+A(I,I-1)*Y(I-1)	36	900	
8888	CONTINUE	12		
C	EIGENVECTOR OF HESSENBURG MATRIX OBTAINED (NOT NORMALIZED)			
6666	M=N-1	4	20	
	DO21 I=2,M	4	72	
	J=N+1-I	8	56	

STATE /S	*** FORTUNE FOR IBM/360 ***	EXECUTIONS	TIME	TRUE	P	10
	L=J+1	8	40			
	DO20 K=L,N	8	108			
20	Y(K)=Y(K)-Y(J)*A(K,J=1)	12	264			
	LL=INT(N-I)	8	160			
	IF (J.EQ.LL) GO TO 21	8	48	4		
19	B=Y(J)	4	16			
	Y(J)=Y(LL)	4	24			
	Y(LL)=B	4	16			
21	CONTINUE	8				
C	UNNORMALIZED EIGENVECTOR OF ORIGINAL MATRIX OBTAINED					
	B=0.0	4	8			
	DO22 I=1,N	4	144			
	IF(ABS(B).GE. ABS(Y(I)))GO TO 22	16	288	8		
23	B=Y(I)	8	32			
22	CONTINUE	16				
	DO24 I=1,N	4	144			
24	Y(I)=Y(I)/B	16	224			
C	NORMALIZED EIGENVECTOR OBTAINED					
C	PUT Y(I) (REAL EIGENVECTOR) IN EIGVECT(NUMOFEV,I)					
	DO 100 I=1,N	4	144			
100	EIGVEC(NUM,I)=Y(I)	16	144			
	RETURN	4	8			
	END					

```
      SUBROUTINE IMVEC(A,NMAX,INT,C1,AMU,SMALL,N,NUM,EIGVEC,NVEC,INTER,
     1Y,Z,B)                                                            **0*
      DIMENSION A(NMAX,NMAX),INTER(1),Y(1),Z(1),INT(1),B(NMAX,NMAX),
     1EIGVEC(NMAX,NMAX)
      DO50 I=1,N                                                        **0*
      DO50 J=1,N                                                        **0*
   50 B(I,J)=0.0                                                        **0*
      DO1 I=1,N                                                         **0*
      A(I,I)=A(I,I)-C1                                                  **0*
    1 B(I,I)=B(I,I)-AMU                                                 **0*
      DO2 I=2,N                                                         **0*
      C=A(I-1,I-1)*A(I-1,I-1)+B(I-1,I-1)*B(I-1,I-1)                     **0*
      D=A(I,I-1)*A(I,I-1)+B(I,I-1)*B(I,I-1)                             **0*
      IF (C.GE.D) GO TO 4                                               **0*
    3 INTER(I)=I                                                        **0*
      G=C                                                               **0*
      C=D                                                               **0*
      D=G                                                               **0*
      J=I-1                                                             **0*
      DO5 K=J,N                                                         **0*
      G=A(I-1,K)                                                        **0*
      A(I-1,K)=A(I,K)                                                   **0*
      A(I,K)=G                                                          **0*
      G=B(I-1,K)                                                        **0*
      B(I-1,K)=B(I,K)                                                   **0*
    5 B(I,K)=G                                                          **0*
      GO TO 6                                                           **0*
    4 INTER(I)=I-1                                                      **0*
    6 IF (D.EQ.0.) GO TO 2                                              **0*
    7 G=A(I,I-1)                                                        **0*
      A(I,I-1)=-(G*A(I-1,I-1)+B(I,I-1)*B(I-1,I-1))/C                    **0*
      B(I,I-1)=-(B(I,I-1)*A(I-1,I-1)-G*B(I-1,I-1))/C                    **0*
      DO8 K=I,N                                                         **0*
      A(I,K)=A(I,K)+A(I,I-1)*A(I-1,K)-B(I,I-1)*B(I-1,K)                 **0*
    8 B(I,K)=B(I,K)+B(I,I-1)*A(I-1,K)+A(I,I-1)*B(I-1,K)                 **0*
    2 CONTINUE                                                          **0*
C     TRIANGULAR MATRIX FORMED
      DO9 I=1,N                                                         **0*
      C=A(I,I)*A(I,I)+B(I,I)*B(I,I)                                     **0*
      IF (C.GE.SMALL) GO TO 9                                           **0*
      A(I,I)= SQRT(SMALL)                                               **0*
      B(I,I)=0.0                                                        **0*
    9 CONTINUE                                                          **0*
      DO 1111 I=1,N                                                     **0*
      Y(I)=1.0                                                          **0*
 1111 Z(I)=0.0                                                          **0*
      DO 8888 JJ=1,4                                                    **0*
      C=A(N,N)*A(N,N)+B(N,N)*B(N,N)                                     **0*
      G=Y(N)                                                            **0*
      Y(N)=(G*A(N,N)+Z(N)*B(N,N))/C                                     **0*
      Z(N)=(Z(N)*A(N,N)-G*B(N,N))/C                                     **0*
      DO17 I=2,N                                                        **0*
      E=0.0                                                             **0*
      F=0.0                                                             **0*
      H=N+1-I                                                           **0*
```

```
      DO18 J=2,I                                                    **0*
      L=N+J-I                                                       **0*
      E=F+Y(L)*A(M,L)-Z(L)*B(M,L)                                   **0*
   18 F=F+Y(L)*B(M,L)+Z(L)*A(M,L)                                   **0*
      D=A(M,M)*A(M,M)+B(M,M)*B(M,M)                                 **0*
      G=Y(M)                                                        **0*
      Y(M)=((G-E)*A(M,M)+(Z(M)-F)*B(M,M))/D                         **0*
   17 Z(M)=((Z(M)-F)*A(M,M)-(G-E)*B(M,M))/D                         **0*
      E=0.0                                                         **0*
      DO51 I=1,N                                                    **0*
      F=Y(I)*Y(I)+Z(I)*Z(I)                                         **0*
      IF (E.GE.F) GO TO 51                                          **0*
   52 F=F                                                           **0*
      L=I                                                           **0*
   51 CONTINUE                                                      **0*
      A1=Y(L)                                                       **0*
      A2=Z(L)                                                       **0*
      DO14 I=1,N                                                    **0*
      G=Y(I)                                                        **0*
      Y(I)=(G*A1+Z(I)*A2)/E                                         **0*
   14 Z(I)=(Z(I)*A1-G*A2)/E                                         **0*
      IF(JJJ.EQ.4) GO TO 6666                                       **0*
      DO15 I=2,N                                                    **0*
      IF (INTER(I).NE.I) GO TO 30                                   **0*
   16 G=Y(I)                                                        **0*
      Y(I)=Y(I-1)                                                   **0*
      Y(I-1)=G                                                      **0*
      G=Z(I)                                                        **0*
      Z(I)=Z(I-1)                                                   **0*
      Z(I-1)=G                                                      **0*
   30 Y(I)=Y(I)+A(I,I-1)*Y(I-1)-B(I,I-1)*Z(I-1)                     **0*
   15 Z(I)=Z(I)+B(I,I-1)*Y(I-1)+A(I,I-1)*Z(I-1)                     **0*
 8888 CONTINUE                                                      **0*
C     EIGENVECTOR OF HESSENBURG MATRIX OBTAINED
 6666 M=N-1                                                         **0*
      DO21 I=2,M                                                    **0*
      J=N+1-I                                                       **0*
      L=J+1                                                         **0*
      DO20 K=L,N                                                    **0*
      Y(K)=Y(K)-Y(J)*A(K,J-1)+Z(J)*B(K,J-1)                         **0*
   20 Z(K)=Z(K)-Z(J)*A(K,J-1)-Y(J)*B(K,J-1)                         **0*
      LL=INT(N-I)                                                   **0*
      IF (J.EQ.LL) GO TO 21                                         **0*
   19 G=Y(J)                                                        **0*
      Y(J)=Y(LL)                                                    **0*
      Y(LL)=G                                                       **0*
      G=Z(J)                                                        **0*
      Z(J)=Z(LL)                                                    **0*
      Z(LL)=G                                                       **0*
   21 CONTINUE                                                      **0*
C     UNNORMALIZED EIGENVECTOR OBTAINED
      E=0.0                                                         **0*
      DO22 I=1,N                                                    **0*
      F=Y(I)*Y(I)+Z(I)*Z(I)                                         **0*
      IF (E.GE.F) GO TO 22                                          **0*
```

```
   23 F=F                                                        **0*
      L=T                                                        **0*
   22 CONTINUE                                                   **0*
      A1=Y(L)                                                    **0*
      A2=Z(L)                                                    **0*
      DO24 I=1,N                                                 **0*
      G=Y(I)                                                     **0*
      Y(I)=(G*A1+Z(I)*A2)/E                                      **0*
   24 Z(I)=(Z(I)*A1-G*A2)/E                                      **0*
C     NORMALIZED EIGENVECTOR OBTAINED
C PUT Y(I) (REAL PART) IN EIGVECT(NUMOFEV,I)
      DO 100 I=1,N                                               **0*
  100 EIGVEC(NUM,I)=Y(I)                                         **0*
      NUM=NUM+1                                                  **0*
C PUT Z(I) (COMPLEX PART) IN EIGVECT(NUMOFEV,I)
      DO 101 I=1,N                                               **0*
  101 EIGVEC(NUM,I)=Z(I)                                         **0*
      RETURN                                                     **0*
      END
```

*** PROGRAM SUMMARY -

ROUTINE	TIME	PERCENT
MAIN	8054	22.3
CALCEV	485	1.3
REALIT	11903	32.9
COMPIT	0	0.0
RVEC	15710	43.5
IMVEC	0	0.0
	36152	

```
FORTRAN FREQUENCIES, OCT73, N1.


C FOR DESCRIPTION OF METHOD USED IN THIS PROGRAM, SEE **THE QR
C TRANSFORMATION** BY FRANCIS, COMPUTER JOURNAL, VOL. 4 PP. 265,332
C START HERE TO PRODUCE UPPER HESSENBURG MATRIX
      DIMENSION A(10,10),VEC(3), EIGVEC(4,4),  INT(10),CC(10),SS(10)
      DIMENSION Z(10),D(10,10),BB(10,10)
      DATA A / 0.1,5.8,1.9,3.2,6*0.0,2.8,3.9,0.7,0.1,6*0.0,
     Z         6.2,3.5,0.6,1.2,6*0.0,0.9,6.2,1.7,3.8,66*0.0/
C*************************** SEGMENT     1 ****************************
      N AA = 10
      NN = 4
      NVEC = 4
      N=NN
      K=N-2
      DO1J=1,K
C*************************** SEGMENT     2 ****************************
      K1=J+1
      K2=J+2
      GREAT= ABS(A(K1,J))
      MAX=K1
      DO21=K2,N
C*************************** SEGMENT     3 ****************************
      AB= ABS(A(I,J))
C*********************** SEGMENTS     4 THRU     5 **********************
      IF (GREAT.GE.AB) GO TO 2
C*************************** SEGMENT     6 ****************************
    3 GREAT=AB
      MAX=I
C*************************** SEGMENT     7 ****************************
    2 CONTINUE
C INT(I) GIVES INFORMATION ABOUT INTERCHANGES
C*************************** SEGMENT     8 ****************************
      INT(J)=MAX
C*********************** SEGMENTS     9 THRU    10 **********************
      IF (MAX.EQ.K1) GO TO 5
C*************************** SEGMENT    11 ****************************
    4 DO6L=J,N
C*************************** SEGMENT    12 ****************************
      F=A(K1,L)
      A(K1,L)=A(MAX,L)
C*************************** SEGMENT    13 ****************************
    6 A(MAX,L)=F
C*************************** SEGMENT    14 ****************************
      DO7L=1,N
C*************************** SEGMENT    15 ****************************
      F=A(L,K1)
      A(L,K1)=A(L,MAX)
C*************************** SEGMENT    16 ****************************
    7 A(L,MAX)=F
C     INTERCHANGE DONE
C*************************** SEGMENT    17 ****************************
    5 DO8I=K2,N
C*********************** SEGMENTS    18 THRU    19 **********************
      IF (A(I,J).EQ.0.) GO TO 8
C*************************** SEGMENT    20 ****************************
```

```
      A(I,J)=-A(I,J)/A(K1,J)
      DO11M=K1,N
C*************************** SEGMENT    21 ****************************
   11 A(I,M)=A(I,M)+A(I,J)*A(K1,M)
C*************************** SEGMENT    22 ****************************
    8 CONTINUE
C     LEFT MULT. DONE
C*************************** SEGMENT    23 ****************************
      DO 2000 M=K2,N
C********************** SEGMENTS    24 THRU    25 **********************
      IF (A(M,J).EQ.0.) GO TO 2000
C*************************** SEGMENT    26 ****************************
   10 DO 2001 I=1,N
C*************************** SEGMENT    27 ****************************
 2001 A(I,K1)=A(I,K1)-A(I,M)*A(M,J)
C*************************** SEGMENT    28 ****************************
 2000 CONTINUE
C*************************** SEGMENT    29 ****************************
    1 CONTINUE
C     RIGHT MULT. DONE
C HESSENBURG MATRIX NOW FORMED AS A(I,J). MULTIPLIERS STORED WITH IT
C*************************** SEGMENT    30 ****************************
      DO 105 I=1,N
C*************************** SEGMENT    31 ****************************
      DO 105 J=1,N
C*************************** SEGMENT    32 ****************************
  105 D(I,J)=A(I,J)
C PUT APPROPRIATE ZEROS WHERE MULTIPLIERS WERE STORED
C*************************** SEGMENT    33 ****************************
      DO 106 I=3,N
C*************************** SEGMENT    34 ****************************
      L=I-2
      DO 106 J=1,L
C*************************** SEGMENT    35 ****************************
  106 A(I,J)=0.0
C*************************** SEGMENT    36 ****************************
      K1=K1
      R=0.0
      C=0.0
      DO3 I=1,N
C*************************** SEGMENT    37 ****************************
      R=R+ ABS(A(I,I))
C*************************** SEGMENT    38 ****************************
    3 C=C+ ABS(A(I,N))
C*************************** SEGMENT    39 ****************************
      DO35 I=2,N
C*************************** SEGMENT    40 ****************************
      RS=0.0
      CS=0.0
      L=I-1
      DO35 J=L,N
C*************************** SEGMENT    41 ****************************
      RS=RS+ ABS(A(I,J))
      K1J=N-J
      K1I=N-I
C*************************** SEGMENT    42 ****************************
   35 CS=CS+ ABS(A(K1J,K1I))
C********************** SEGMENTS    43 THRU    44 **********************
```

```
      IF (RS.LE.R) GO TO 36
C*************************** SEGMENT    45 ****************************
   37 R=RS
C********************** SEGMENTS    46 THRU    47 **********************
   36 IF (CS.LE.C) GO TO 34
C*************************** SEGMENT    48 ****************************
   44 C=CS
C*************************** SEGMENT    49 ****************************
   34 CONTINUE
C*************************** SEGMENT    50 ****************************
      IJK=1
C********************** SEGMENTS    51 THRU    52 **********************
      IF (R.GL.C) GO TO 54
C DELTA IS CRITERION FOR STOPPING AN ITERATION
C*************************** SEGMENT    53 ****************************
   53 DELTA=R*1.0E-11
C DEL IS ARBITRARY SHIFT
      DEL=R/17.1829
      GO TO 153
C*************************** SEGMENT    54 ****************************
   54 DELTA=C*1.0E-11
      DEL=C/17.1529
C     DELTA COMPUTED
C PRODUCE A-PI, ITERATE ON THIS TO BREAK UP EIGENVALUES OF EQUAL MODULUS
C*************************** SEGMENT    55 ****************************
  153 DO 107 I=1,N
C*************************** SEGMENT    56 ****************************
  107 A(I,I)=A(I,I)-DEL
C********************** SEGMENTS    57 THRU    58 **********************
   55 IF (R.GE.1) GO TO 48
C SUBROUTINE CALCEV CALCULATES EIGENVALUES OF 1X1 OR 2X2 MATRICES.
C PI IS ADDED BACK IN CALCEV
C*************************** SEGMENT    59 ****************************
   47 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,1)
      GO TO 76
C********************** SEGMENTS    60 THRU    61 **********************
   48 IF (N.NE.2) GO TO 80
C*************************** SEGMENT    62 ****************************
   49 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,2)
      GO TO 76
C OR TRANSFORMATION STARTS HERE
C INITIALIZE FOR DETERMINING SUBSEQUENT SHIFTS
C*************************** SEGMENT    63 ****************************
   80 AR1=0.0
      AR3=0.0
      AR4=0.0
C RE-ENTER AFTER REALIT OR COMPIT SUBROUTINES CALLED
C SELECT FIRST ((ZERO)) SUB-DIAGONAL ELEMENT FROM BOTTOM
C*************************** SEGMENT    64 ****************************
   61 L=N
      DO56 I=2,N
C*************************** SEGMENT    65 ****************************
      N2I=N+2-I
C********************** SEGMENTS    66 THRU    67 **********************
      IF( ABS(A(N2I,N2I-1)).LT.DELTA)GO TO 57
C*************************** SEGMENT    68 ****************************
   56 L=L-1
C VALUE OF L SELECTED
```

```
C********************** SEGMENTS    69 THRU    70 **********************
   57 IF (L.NE.N) GO TO 59
C*************************** SEGMENT    71 ***************************
   58 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,1)
      N=N-1
      GO TO 48
C********************** SEGMENTS    72 THRU    73 **********************
   59 IF ((L-N+1).NE.0) GO TO 75
C*************************** SEGMENT    74 ***************************
   60 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,2)
      N=N-2
      GO TO 55
C DETERMINE EIGENVALUES OF 2X2 MATRIX -- ROW 1 = A(N-1,N-1)   A(N-1,N)
C                                        ROW 2 = A(N,N-1)     A(N,N)
C AND BASE SHIFT ON THESE
C*************************** SEGMENT    75 ***************************
   75 B=A(N-1,N-1)+A(N,N)
      C=A(N-1,N-1)*A(N,N)-A(N,N-1)*A(N-1,N)
      C1=A(N-1,N-1)-A(N,N)
      DISC=C1*C1+4.0*A(N,N-1)*A(N-1,N)
C********************** SEGMENTS    76 THRU    77 **********************
      IF (DISC.GE.0.) GO TO 63
C*************************** SEGMENT    78 ***************************
   62 R1=0.5*B
      R2=.5* SQRT( ABS(DISC))
      ANUM=(R1-AR3)*(R1-AR3)+(R2-AR4)*(R2-AR4)
      DENOM=AR3*AR3+AR4*AR4
C********************** SEGMENTS    79 THRU    80 **********************
      IF (DENOM.NE.0.) GO TO 200
C*************************** SEGMENT    81 ***************************
  201 RHO=0.0
      SIGMA=0.0
      GO TO 203
C*************************** SEGMENT    82 ***************************
  200 RHO=C
      SIGMA=B
C*************************** SEGMENT    83 ***************************
  203 AR3=1.
      AR4=2
      CALL COMPIT(A,NMAX,L,N,RHO,SIGMA)
      GO TO 61
C********************** SEGMENTS    84 THRU    85 **********************
   63 IF (B.GE.0.) GO TO 65
C*************************** SEGMENT    86 ***************************
   64 R1=.5*(B- SQRT(DISC))
      GO TO 66
C*************************** SEGMENT    87 ***************************
   65 R1=.5*(B+ SQRT(DISC))
C********************** SEGMENTS    88 THRU    89 **********************
      IF (R1.NE.0.) GO TO 66
C*************************** SEGMENT    90 ***************************
   83 R2=0.0
      GO TO 84
C*************************** SEGMENT    91 ***************************
   66 R2=C/R1
C     ROOTS OF 2*2 MATRIX FOUND
C********************** SEGMENTS    92 THRU    93 **********************
   84 IF( ABS(A(N,N)-R1).GE. ABS(A(N,N)-R2))GO TO 68
```

```
C*************************** SEGMENT    94 ****************************
   67 AR2=P1
      GO TO 69
C*************************** SEGMENT    95 ****************************
   68 AR2=P2
C********************** SEGMENTS    96 THRU    97 **********************
   69 IF (AR1.NE.0.) GO TO 71
C*************************** SEGMENT    98 ****************************
   72 SHIFT=0.0
      GO TO 73
C*************************** SEGMENT    99 ****************************
   71 SHIFT=AR2
C*************************** SEGMENT   100 ****************************
   73 AR1=AR2
      CALL REALIT(A,NMAX,L,N,SHIFT,CC,SS)
      GO TO 61
C ARE VECTORS NEEDED
C********************** SEGMENTS   101 THRU   102 **********************
   76 IF (IVEC.EQ.0) GO TO 600
C INVERSE ITERATION IS USED FOR EIGENVECTORS
C*************************** SEGMENT   103 ****************************
  550 SMALL=DELTA*1.0E-30
      NUM=0
      JI=1
      NM=NN+NN
C C1 IS REAL PART OF EIGENVALUE
C*************************** SEGMENT   104 ****************************
  513 C1=VEC(JI)
C C2 IS COMPLEX PART OF EIGENVALUE
      C2=VEC(JI+1)
      NUM=NUM+1
C REPLACE HESSENBURG MATRIX AND MULTIPLIERS
      DO 570 I=1,NN
C*************************** SEGMENT   105 ****************************
      DO 570 J=1,NN
C*************************** SEGMENT   106 ****************************
  570 A(I,J)=G(I,J)
C********************** SEGMENTS   107 THRU   108 **********************
      IF (C2.NE.0.) GO TO 561
C*************************** SEGMENT   109 ****************************
      CALL RVEC(A,NMAX,INT,C1,SMALL,NN,NUM,EIGVEC,NVEC,CC,SS)
      JI=JI+2
C********************** SEGMENTS   110 THRU   111 **********************
      IF(NVEC.EQ.NUM)GO TO 600
C*************************** SEGMENT   112 ****************************
      GO TO 513
C*************************** SEGMENT   113 ****************************
  561 CALL INVEC(A,NMAX,INT,C1,C2,SMALL,NN,NUM,EIGVEC,NVEC,CC,SS,Z,BB)
C NEXT STATEMENT IGNORES CONJUGATE COMPLEX EIGENVALUES
      JI=JI+4
C********************** SEGMENTS   114 THRU   115 **********************
      IF(NVEC.EQ.NUM)GO TO 600
C*************************** SEGMENT   116 ****************************
      GO TO 513
C*************************** SEGMENT   117 ****************************
  600 CONTINUE
      WRITE(6,700) (VEC(I),I=1,NN)
      DO 2  I=1,N
```

```
C********************************* SEGMENT   118 ****************************
20    WRITE(6,700) (EIGVEC(I,J),J=1,NN)
700   FORMAT(1H ,5E20.8 / 5E20.8)
      END

END PASS1, VALUE=     193
      SUBROUTINE CALCEV(A,NMAX,DEL,VEC,IJK,N,M)
      DIMENSION A(NMAX,NMAX),VEC(1)
C********************** SEGMENTS   119 THRU   120 **********************
      IF (M.NE.1) GO TO 2
C********************************* SEGMENT   121 ****************************
    1 AI=0.0
      A(N,N)=A(N,N)+DEL
C STORE EIGENVALUES IN VEC
      VEC(IJK)=A(N,N)
      VEC(IJK+1)=AI
      IJK=IJK+2
      RETURN
C********************************* SEGMENT   122 ****************************
    2 C=A(N-1,N-1)+A(N,N)
      C=A(N-1,N-1)*A(N,N)-A(N,N-1)*A(N-1,N)
      C1=A(N-1,N-1)-A(N,N)
      DISC=C1*C1+4.0*A(N,N-1)*A(N-1,N)
C********************** SEGMENTS   123 THRU   124 **********************
      IF (DISC.LT.0.) GO TO 9
C********************************* SEGMENT   125 ****************************
    4 AI=0.0
C********************** SEGMENTS   126 THRU   127 **********************
      IF (C.GE.0.) GO TO 6
C********************************* SEGMENT   128 ****************************
      R1=0.5*(B- SQRT(DISC))
      GO TO 7
C********************************* SEGMENT   129 ****************************
    6 R1=0.5*(B+ SQRT(DISC))
C********************** SEGMENTS   130 THRU   131 **********************
      IF(R1.NE.0.) GO TO 7
C********************************* SEGMENT   132 ****************************
   10 R2=0.0
      GO TO 11
C********************************* SEGMENT   133 ****************************
    7 R2=C/R1
C********************************* SEGMENT   134 ****************************
   11 R1=R1+DEL
      R2=R2+DEL
      VEC(IJK)=R2
      VEC(IJK+1)=AI
      VEC(IJK+2)=R1
      VEC(IJK+3)=AI
      GO TO 8
C********************************* SEGMENT   135 ****************************
    9 R1=0.5*B
      AI=-.5* SQRT( ABS(DISC))
      R1=R1+DEL
      VEC(IJK)=R1
      VEC(IJK+1)=-AI
      VEC(IJK+2)=R1
      VEC(IJK+3)=AI
C********************************* SEGMENT   136 ****************************
```

```
    8 IJK=IJK+4
      RETURN
      END

END PASS1, VALUE=      41
      SUBROUTINE REALIT(A,NMAX,L,N,SHIFT,C,S)
      DIMENSION A(NMAX,NMAX),C(1),S(1)
C*********************** SEGMENTS   137 THRU   138 **********************
      IF (SHIFT.EQ.0.) GO TO 2
C*************************** SEGMENT   139 ******************************
    1 DO3 I=L,N
C*************************** SEGMENT   140 ******************************
    3 A(I,I)=A(I,I)-SHIFT
C*************************** SEGMENT   141 ******************************
    2 M=N-1
      DO4 I=L,M
C*************************** SEGMENT   142 ******************************
      DENOM= SQRT(A(I,I)**2+A(I+1,I)**2)
C*********************** SEGMENTS   143 THRU   144 **********************
      IF (DENOM.GT.0.) GO TO 10
C*************************** SEGMENT   145 ******************************
   11 C(I)=1.0
      S(I)=0.0
      GO TO 4
C*************************** SEGMENT   146 ******************************
   10 C(I)=A(I,I)/DENOM
      S(I)=A(I+1,I)/DENOM
      A(I,I)=DENOM
C*************************** SEGMENT   147 ******************************
   12 I1=I+1
      DO 35 J=I1,N
C*************************** SEGMENT   148 ******************************
      F=A(I,J)
      A(I,J)=A(I+1,J)*S(I)+F*C(I)
      A(I+1,J)=A(I+1,J)*C(I)-F*S(I)
C*************************** SEGMENT   149 ******************************
   35 CONTINUE
C*************************** SEGMENT   150 ******************************
    4 CONTINUE
C     TRIANGULAR MATRIX FORMED
C*************************** SEGMENT   151 ******************************
      DO5 I=L,M
C*************************** SEGMENT   152 ******************************
      DO6 I=L,J
C*************************** SEGMENT   153 ******************************
      F=A(I,J)
      A(I,J)=A(I,J+1)*S(J)+F*C(J)
C*************************** SEGMENT   154 ******************************
    6 A(I,J+1)=A(I,J+1)*C(J)-F*S(J)
C*************************** SEGMENT   155 ******************************
      A(J+1,J)=A(J+1,J+1)*S(J)
C*************************** SEGMENT   156 ******************************
    5 A(J+1,J+1)=A(J+1,J+1)*C(J)
C     TRANSFORMATION COMPLETED
C*********************** SEGMENTS   157 THRU   158 **********************
      IF (SHIFT.LT.0.) RETURN
C*************************** SEGMENT   159 ******************************
    7 DO9 I=L,N
```


7C

```
C********************************* SEGMENT   160 ******************************
    9 A(I,I)=A(I,I)+SHIFT
C********************************* SEGMENT   161 ******************************
    8 RETURN
      END

END PASS1, VALUE=      36
      SUBROUTINE COMPIT(A,NMAX,L,N,RHO,SIGMA)
      DIMENSION A(NMAX,NMAX)
C HOUSEHOLDER TYPE MATRICES USED INSTEAD OF ROTATIONS(SEE FRANCIS PAPER)
C********************************* SEGMENT   162 ******************************
      M=N-1
      DO 1 I=L,M
C********************** SEGMENTS   163 THRU   164 **********************
      IF (I.NE.L) GO TO  3
C********************************* SEGMENT   165 ******************************
    2 B1=A(L,L)*(A(L,L)-SIGMA)+A(L,L+1)*A(L+1,L)+RHO
      B2=A(L+1,L)*(A(L,L)+A(L+1,L+1)-SIGMA)
      B3=A(L+1,L)*A(L+2,L+1)
      A(L+2,L)=0.0
      GO TO 6
C********************************* SEGMENT   166 ******************************
    3 B1=A(I,I-1)
      B2=A(I+1,I-1)
C********************** SEGMENTS   167 THRU   168 **********************
      IF (I.EQ.M) GO TO 5
C********************************* SEGMENT   169 ******************************
    4 B3=A(I+2,I-1)
      GO TO 6
C********************************* SEGMENT   170 ******************************
    5 B3=0.0
C********************************* SEGMENT   171 ******************************
    6 D= SQRT(B1*B1+B2*B2+B3*B3)
C********************** SEGMENTS   172 THRU   173 **********************
      IF (B1.GE.0.) GO TO 8
C********************************* SEGMENT   174 ******************************
    7 D=-D
C********************** SEGMENTS   175 THRU   176 **********************
    8 IF (D.EQ.0.) GO TO 1
C********************************* SEGMENT   177 ******************************
    9 C1=B2/(D+B1)
      C2=B3/(D+B1)
      E=2.0/(1.0+C1*C1+C2*C2)
      DO 10 K=I,N
C********************** SEGMENTS   178 THRU   179 **********************
      IF (I.EQ.M) GO TO 12
C********************************* SEGMENT   180 ******************************
   11 G=E*(A(I,K)+C1*A(I+1,K)+C2*A(I+2,K))
      A(I,K)=A(I,K)-G
      A(I+1,K)=A(I+1,K)-C1*G
      A(I+2,K)=A(I+2,K)-C2*G
      GO TO 10
C********************************* SEGMENT   181 ******************************
   12 G=E*(A(I,K)+C1*A(I+1,K))
      A(I,K)=A(I,K)-G
      A(I+1,K)=A(I+1,K)-C1*G
C********************************* SEGMENT   182 ******************************
   10 CONTINUE
```

```
C********************** SEGMENTS   183 THRU   184 **********************
      IF (I.EQ.L) GO TO 14
C************************** SEGMENT   185 ****************************
   13 A(I,I-1)=-D
      A(I+1,I-1)=0.0
C********************** SEGMENTS   186 THRU   187 **********************
      IF (I.EQ.M) GO TO 14
C************************** SEGMENT   188 ****************************
   15 A(I+2,I-1)=0.0
C     ROW OPERATION COMPLETED
C************************** SEGMENT   189 ****************************
   14 J=I+2
C********************** SEGMENTS   190 THRU   191 **********************
      IF (J.LE.N) GO TO 17
C************************** SEGMENT   192 ****************************
   16 J=N
C************************** SEGMENT   193 ****************************
   17 DO 18 K=L,J
C********************** SEGMENTS   194 THRU   195 **********************
      IF (I.EQ.M) GO TO 20
C************************** SEGMENT   196 ****************************
   19 G=E*(A(K,I)+C1*A(K,I+1)+C2*A(K,I+2))
      A(K,I)=A(K,I)-G
      A(K,I+1)=A(K,I+1)-C1*G
      A(K,I+2)=A(K,I+2)-C2*G
      GO TO 18
C************************** SEGMENT   197 ****************************
   20 G=E*(A(K,I)+C1*A(K,I+1))
      A(K,I)=A(K,I)-G
      A(K,I+1)=A(K,I+1)-C1*G
C************************** SEGMENT   198 ****************************
   18 CONTINUE
C************************** SEGMENT   199 ****************************
      J=I+3
C********************** SEGMENTS   200 THRU   201 **********************
      IF (J.GT.N) GO TO 1
C************************** SEGMENT   202 ****************************
   21 G=E*C2*A(I+3,I+2)
      A(I+3,I)=-G
      A(I+3,I+1)=-C1*G
      A(I+3,I+2)=A(I+3,I+2)-C2*G
C     COLUMN OPERATION COMPLETED
C************************** SEGMENT   203 ****************************
    1 CONTINUE
C************************** SEGMENT   204 ****************************
      RETURN
      END

END PASS1, VALUE=      65
      SUBROUTINE RVEC(A,NMAX,I,T,C1,SMALL,N,NUM,EIGVEC,NVEC,INTER,Y)
      DIMENSION A(NMAX,NMAX),INTER(1),Y(1),INT(1),EIGVEC(NMAX,NMAX)
C************************** SEGMENT   205 ****************************
      DO1 I=1,N
C************************** SEGMENT   206 ****************************
    1 A(I,I)=A(I,I)-C1
C************************** SEGMENT   207 ****************************
      DO2 I=2,N
C********************** SEGMENTS   208 THRU   209 **********************
```

```
      IF( ABS(A(I-1,I-1)).GE. ABS(A(I,I-1)))GO TO 4
C*************************** SEGMENT   210 ****************************
    3 INTER(I)=I
      J=I-1
      DO5 K=J,N
C*************************** SEGMENT   211 ****************************
      B=A(I-1,K)
      A(I-1,K)=A(I,K)
C*************************** SEGMENT   212 ****************************
    5 A(I,K)=B
C*************************** SEGMENT   213 ****************************
      GO TO 6
C*************************** SEGMENT   214 ****************************
    4 INTER(I)=I-1
C********************** SEGMENTS   215 THRU   216 **********************
    6 IF (A(I,I-1).EQ.0.) GO TO 2
C*************************** SEGMENT   217 ****************************
      C=-A(I,I-1)/A(I-1,I-1)
      A(I,I-1)=C
      DO 8 K=I,N
C*************************** SEGMENT   218 ****************************
    8 A(I,K)=A(I,K)+C*A(I-1,K)
C*************************** SEGMENT   219 ****************************
    2 CONTINUE
C     TRIANGULAR MATRIX FORMED
C*************************** SEGMENT   220 ****************************
      DO9 I=1,N
C********************** SEGMENTS   221 THRU   222 **********************
      IF( ABS(A(I,I)).GE.SMALL)GO TO 9
C*************************** SEGMENT   223 ****************************
   10 A(I,I)=SMALL
C*************************** SEGMENT   224 ****************************
    9 CONTINUE
C NORMALISED ((EIGENVECTOR)) OF HESSENBURG MATRIX OBTAINED FOR RHS = 1
C*************************** SEGMENT   225 ****************************
      DO 5555 I=1,N
C*************************** SEGMENT   226 ****************************
 5555 Y(I)=1.0
C*************************** SEGMENT   227 ****************************
      DO 7777 JJJJ=1,4
C*************************** SEGMENT   228 ****************************
 7777 Y(N)=Y(N)/A(N,N)
      E=Y(N)
      DO11 I=2,N
C*************************** SEGMENT   229 ****************************
      F=0.0
      M=N+1-I
      DO12 J=2,I
C*************************** SEGMENT   230 ****************************
      L=N+J-I
C*************************** SEGMENT   231 ****************************
   12 F=F+Y(L)*A(M,L)
C*************************** SEGMENT   232 ****************************
      Y(M)=(Y(M)-F)/A(M,M)
C********************** SEGMENTS   233 THRU   234 **********************
      IF( ABS(E).GE. ABS(Y(M)))GO TO 11
C*************************** SEGMENT   235 ****************************
   13 E=Y(M)
```

```
C*************************** SEGMENT   236 ***************************
   11 CONTINUE
C*************************** SEGMENT   237 ***************************
      DO14 I=1,N
C*************************** SEGMENT   238 ***************************
   14 Y(I)=Y(I)/B
C********** SEGMENTS   239 THRU   240 **********
      IF(JJJJ.EQ.4)GO TO 6666
C*************************** SEGMENT   241 ***************************
      DO15 I=2,N
C********** SEGMENTS   242 THRU   243 **********
      IF (INTER(I).NE.I) GO TO 15
C*************************** SEGMENT   244 ***************************
   16 B=Y(I)
      Y(I)=Y(I-1)
      Y(I-1)=B
C*************************** SEGMENT   245 ***************************
   15 Y(I)=Y(I)+A(I,I-1)*Y(I-1)
C*************************** SEGMENT   246 ***************************
 6888 CONTINUE
C EIGENVECTOR OF HESSENBURG MATRIX OBTAINED (NOT NORMALIZED)
C*************************** SEGMENT   247 ***************************
 6666 J=N-1
      DO21 I=2,M
C*************************** SEGMENT   248 ***************************
      J=N+1-I
      L=J+1
      DO20 K=L,N
C*************************** SEGMENT   249 ***************************
   20 Y(K)=Y(K)-Y(J)*A(K,J-1)
C*************************** SEGMENT   250 ***************************
      LL=INT(N-I)
C********** SEGMENTS   251 THRU   252 **********
      IF (J.EQ.LL) GO TO 21
C*************************** SEGMENT   253 ***************************
   19 B=Y(J)
      Y(J)=Y(LL)
      Y(LL)=B
C*************************** SEGMENT   254 ***************************
   21 CONTINUE
C UNNORMALIZED EIGENVECTOR OF ORIGINAL MATRIX OBTAINED
C*************************** SEGMENT   255 ***************************
      B=0.0
      DO23 I=1,N
C********** SEGMENTS   256 THRU   257 **********
      IF( ABS(B).GE. ABS(Y(I)))GO TO 22
C*************************** SEGMENT   258 ***************************
   23 B=Y(I)
C*************************** SEGMENT   259 ***************************
   22 CONTINUE
C*************************** SEGMENT   260 ***************************
      DO24 I=1,N
C*************************** SEGMENT   261 ***************************
   24 Y(I)=Y(I)/B
C     NORMALIZED EIGENVECTOR OBTAINED
C PUT Y(I) (REAL EIGENVECTOR) IN EIGVECT(NUMOFEV,I)
C*************************** SEGMENT   262 ***************************
      DO 100 I=1,N
```

```
C************************** SEGMENT   263 ****************************
  100 EIGVEC(NUM,I)=Y(I)
C************************** SEGMENT   264 ****************************
      RETURN
      END

END PASS1, VALUE=      78
      SUBROUTINE IMVEC(A,NMAX,INT,C1,AMU,SMALL,N,NUM,EIGVEC,NVEC,INTER,
     1Y,Z,P)
      DIMENSION A(NMAX,NMAX),INTER(1),Y(1),Z(1),INT(1),B(NMAX,NMAX),
     1EIGVEC(NMAX,NMAX)
C************************** SEGMENT   265 ****************************
      DO50 I=1,N
C************************** SEGMENT   266 ****************************
      DO50 J=1,N
C************************** SEGMENT   267 ****************************
   50 B(I,J)=0.0
C************************** SEGMENT   268 ****************************
      DO1 I=1,N
C************************** SEGMENT   269 ****************************
      A(I,I)=A(I,I)-C1
C************************** SEGMENT   270 ****************************
    1 B(I,I)=B(I,I)-AMU
C************************** SEGMENT   271 ****************************
      DO2 I=2,N
C************************** SEGMENT   272 ****************************
      C=A(I-1,I-1)*A(I-1,I-1)+B(I-1,I-1)*B(I-1,I-1)
      D=A(I,I-1)*A(I,I-1)+B(I,I-1)*B(I,I-1)
C********************** SEGMENTS   273 THRU   274 **********************
      IF (C,GE,D) GO TO 4
C************************** SEGMENT   275 ****************************
    3 INT(I)=I
      E=C
      C=D
      D=G
      J=I-1
      DO5 K=J,N
C************************** SEGMENT   276 ****************************
      G=A(I-1,K)
      A(I-1,K)=A(I,K)
      A(I,K)=G
      G=B(I-1,K)
      B(I-1,K)=B(I,K)
C************************** SEGMENT   277 ****************************
    5 B(I,K)=G
C************************** SEGMENT   278 ****************************
      GO TO 6
C************************** SEGMENT   279 ****************************
    4 INT(I)=I-1
C********************** SEGMENTS   280 THRU   281 **********************
    6 IF (D,EQ,0.) GO TO 2
C************************** SEGMENT   282 ****************************
    7 C=A(I,I-1)
      A(I,I-1)=(G*A(I-1,I-1)+D*B(I-1,I-1))/C
      B(I,I-1)=(D*A(I,I-1)+A(I-1,I-1)-G*B(I-1,I-1))/C
      DO8 K=I,N
C************************** SEGMENT   283 ****************************
      A(I,K)=A(I,K)+A(I,I-1)*A(I-1,K)-B(I,I-1)*B(I-1,K)
```

12C

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C*************************** SEGMENT   284 ****************************
    8  B(I,K)=B(I,K)+B(I,I-1)*A(I-1,K)+A(I,I-1)*B(I-1,K)
C*************************** SEGMENT   285 ****************************
    2 CONTINUE
C     TRIANGULAR MATRIX FORMED
C*************************** SEGMENT   286 ****************************
      DO 9 I=1,N
C*************************** SEGMENT   287 ****************************
      C=A(I,I)+A(I,I)+B(I,I)+B(I,I)
C********************** SEGMENTS   288 THRU   289 **********************
      IF (C.GE.SMALL) GO TO 9
C*************************** SEGMENT   290 ****************************
      A(I,I)= SQRT(SMALL)
      B(I,I)=0.0
C*************************** SEGMENT   291 ****************************
    9 CONTINUE
C*************************** SEGMENT   292 ****************************
      DO 1111 I=1,N
C*************************** SEGMENT   293 ****************************
      Y(I)=1.0
C*************************** SEGMENT   294 ****************************
 1111 Z(I)=0.0
C*************************** SEGMENT   295 ****************************
      DO 5000 JJJ=1,4
C*************************** SEGMENT   296 ****************************
      C=A(N,N)+A(N,N)+B(N,N)*B(N,N)
      G=Y(N)
      Y(N)=(G+A(N,N)+Z(N)*B(N,N))/C
      Z(N)=(Z(N)+A(N,N)-G*B(N,N))/C
      DO 17 I=2,N
C*************************** SEGMENT   297 ****************************
      E=0.0
      F=0.0
      M=N+1-I
      DO 18 J=2,I
C*************************** SEGMENT   298 ****************************
      L=N+J-I
      E=E+Y(L)*A(M,L)-Z(L)*B(M,L)
C*************************** SEGMENT   299 ****************************
   18 F=F+Y(L)*B(M,L)+Z(L)*A(M,L)
C*************************** SEGMENT   300 ****************************
      D=A(M,M)+A(M,M)+B(M,M)*B(M,M)
      G=Y(M)
      Y(M)=((G-E)*A(M,M)+(Z(M)-F)*B(M,M))/D
C*************************** SEGMENT   301 ****************************
   17 Z(M)=((Z(M)-F)*A(M,M)-(G-E)*B(M,M))/D
C*************************** SEGMENT   302 ****************************
      E=0.0
      DO 51 I=1,N
C*************************** SEGMENT   303 ****************************
      E=Y(I)*Y(I)+Z(I)*Z(I)
C********************** SEGMENTS   304 THRU   305 **********************
      IF (E.GT.E) GO TO 51
C*************************** SEGMENT   306 ****************************
   52 E=E
      L=I
C*************************** SEGMENT   307 ****************************
   51 CONTINUE
```

130

```
C********************************* SEGMENT   308 ****************************
      A1=Y(L)
      A2=Z(L)
      DO14 I=1,N
C********************************* SEGMENT   309 ****************************
      G=Y(I)
      Y(I)=(G*A1+Z(I)+A2)/F
C********************************* SEGMENT   310 ****************************
   14 Z(I)=(Z(I)*A1-G*A2)/F
C********************************* SEGMENTS  311 THRU   312 ********************
      IF(JJJ.EQ.4) GO TO 6666
C********************************* SEGMENT   313 ****************************
      DO15 I=2,N
C********************************* SEGMENTS  314 THRU   315 ********************
      IF (INTLP(I).NE.1) GO TO 30
C********************************* SEGMENT   316 ****************************
   16 G=Y(I)
      Y(I)=Y(I-1)
      Y(I-1)=G
      G=Z(I)
      Z(I)=Z(I-1)
      Z(I-1)=G
C********************************* SEGMENT   317 ****************************
   30 Y(I)=Y(I)+A(I,I-1)*Y(I-1)-B(I,I-1)*Z(I-1)
C********************************* SEGMENT   318 ****************************
   15 Z(I)=Z(I)+B(I,I-1)*Y(I-1)+A(I,I-1)*Z(I-1)
C********************************* SEGMENT   319 ****************************
 6688 CONTINUE
C     EIGENVECTOR OF HESSENBERG MATRIX OBTAINED
C********************************* SEGMENT   320 ****************************
 6666 KEN=1
      DO21 I=2,N
C********************************* SEGMENT   321 ****************************
      J=N+1-I
      L=J+1
      DO20 K=L,N
C********************************* SEGMENT   322 ****************************
      Y(K)=Y(K)-Y(J)*A(K,J-1)+Z(J)*B(K,J-1)
C********************************* SEGMENT   323 ****************************
   20 Z(K)=Z(K)-Z(J)*A(K,J-1)-Y(J)*B(K,J-1)
C********************************* SEGMENT   324 ****************************
      LL=INT(N-1)
C********************************* SEGMENTS  325 THRU   326 ********************
      IF (J.EQ.LL) GO TO 21
C********************************* SEGMENT   327 ****************************
   19 G=Y(J)
      Y(J)=Y(LL)
      Y(LL)=G
      G=Z(J)
      Z(J)=Z(LL)
      Z(LL)=G
C********************************* SEGMENT   328 ****************************
   21 CONTINUE
C     ORTHONORMALIZED EIGENVECTOR OBTAINED
C********************************* SEGMENT   329 ****************************
      KEN=1
      DO22 I=1,N
C********************************* SEGMENT   330 ****************************
```

14C

```
      F=Y(I)*Y(I)+Z(I)*Z(I)
C********************** SEGMENTS   331 THRU   332 **********************
      IF (E.GE.F) GO TO 22
C*************************** SEGMENT   333 ****************************
   23 E=F
      L=I
C*************************** SEGMENT   334 ****************************
   22 CONTINUE
C*************************** SEGMENT   335 ****************************
      A1=Y(L)
      A2=Z(L)
      DO24 I=1,N
C*************************** SEGMENT   336 ****************************
      G=Y(I)
      Y(I)=(G*A1+Z(I)*A2)/E
C*************************** SEGMENT   337 ****************************
   24 Z(I)=(Z(I)*A1-G*A2)/E
C     NORMALIZED EIGENVECTOR OBTAINED
C PUT Y(I) (REAL PART) IN EIGVECT(NUMOFEV,I)
C*************************** SEGMENT   338 ****************************
      DO 100 I=1,N
C*************************** SEGMENT   339 ****************************
  100 EIGVEC(NUM,I)=Y(I)
C*************************** SEGMENT   340 ****************************
      NUM=NUM+1
C PUT Z(I) (COMPLEX PART) IN EIGVECT(NUMOFEV,I)
      DO 101 I=1,N
C*************************** SEGMENT   341 ****************************
  101 EIGVEC(NUM,I)=Z(I)
C*************************** SEGMENT   342 ****************************
      RETURN
      END

END PASS1 VALUE=     127
```

LOCAL ANALYSIS--

COUNT			CODE
177	OCCURRENCES OF	<ASSIGNMENT> X=...	36
112	OCCURRENCES OF	<ASSIGNMENT> X(..)=..	36
8	OCCURRENCES OF	CALL X(...)	38
23	OCCURRENCES OF	CONTINUE	55
1	OCCURRENCES OF	DATA /../	11
6	OCCURRENCES OF	DIMENSION X(..),...	18
1	OCCURRENCES OF	DIMENSION X(..)	18
65	OCCURRENCES OF	DO	37
6	OCCURRENCES OF	END	56
1	OCCURRENCES OF	FORMAT	41
76	OCCURRENCES OF	GOTO X	59
55	OCCURRENCES OF	IF(<IF>)<STATEMENT> ALSO IF(<SWITCH>)...	45

<STATEMENT> DATA FOR BOOLEAN IF ABF--
50 OCCURRENCES OF CODE 59 <STATEMENT>S.
1 OCCURRENCES OF CODE 61 <STATEMENT>S.
0 ILL FORMED <STATEMENT>S AND
0 IMPROPER <STATEMENT>S.

7	OCCURRENCES OF	RETURN	61
5	OCCURRENCES OF	SUBROUTINE X(..)	01
2	OCCURRENCES OF	WRITE (..)(	42
98	OCCURRENCES OF	COMMENTS	
595	OCCURRENCES OF	STATEMENTS	
158	OCCURRENCES OF	LABELED STATEMENTS	

SEGMENT EXECUTION FREQUENCIES

X	0	1	2	3	4	5	6	7	8	9
0	-------	1	2	3	3	2	1	3	2	2
10	1	1	3	3	1	4	4	2	3	0
20	3	8	3	2	3	0	3	12	3	2
30	1	4	16	1	2	3	1	4	4	1
40	3	9	9	3	3	0	3	2	1	3
50	1	1	1	0	1	1	4	1	1	0
60	3	2	1	2	9	20	20	2	18	9
70	7	2	7	7	0	7	7	7	0	0
80	0	0	0	0	7	0	7	0	0	0
90	0	7	7	3	4	3	7	5	2	5
100	7	1	0	1	4	16	64	4	0	4
110	4	1	3	0	0	0	0	1	4	3
120	1	2	1	1	0	1	1	1	0	1
130	1	1	0	1	1	0	1	7	2	5
140	18	7	18	18	18	0	18	18	33	33
150	18	7	18	33	33	18	18	7	2	5
160	18	5	0	0	0	0	0	0	0	0
170	0	0	0	0	0	0	0	0	0	0
180	0	0	0	0	0	0	0	0	0	0
190	0	0	0	0	0	0	0	0	0	0
200	0	0	0	0	0	4	16	4	12	6
210	6	18	18	6	6	12	0	12	24	12
220	4	16	16	0	16	4	16	4	16	48
230	96	96	48	48	20	28	48	16	64	16
240	4	12	36	18	18	36	12	4	8	12
250	8	8	4	4	8	4	16	8	8	16
260	4	16	4	16	4	0	0	0	0	0
270	0	0	0	0	0	0	0	0	0	0
280	0	0	0	0	0	0	0	0	0	0
290	0	0	0	0	0	0	0	0	0	0
300	0	0	0	0	0	0	0	0	0	0
310	0	0	0	0	0	0	0	0	0	0
320	0	0	0	0	0	0	0	0	0	0
330	0	0	0	0	0	0	0	0	0	0
340	0	0	0							

OF :

```
STATEMENT
NUMBER    PROGRAM LISTING (LEADING N INDICATES CONVERSION WARNINGS)                COUNT          SPECIFIC EXECUTION DATA

  1N      PROGRAM UNSEIG(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT)
  2 C FOR DESCRIPTION OF METHOD USED IN THIS PROGRAM, SEE **THE QR
  3 C TRANSFORMATION** BY FRANCIS, COMPUTER JOURNAL, VOL. 4 PP. 265,332
  4 C START HERE TO PRODUCE UPPER HESSENBURG MATRIX
  5       DIMENSION A(10,10),VEC(8),EIGVEC(4,4),INT(10),CC(10),SS(10)
  6       DIMENSION Z(10),D(10,10),BB(10,10)
          DATA A / 0.1,5.8,1.9,3.2,6*0.0,2.8,3.9,0.7,0.1,6*0.0,
  8      X         6.2,3.5,0.6,1.2,6*0.0,9.9,6.2,1.7,3.8        /
  9       NMAX = 10                                                               1
 10       NN = 4                                                                  1
 11       NVEC = 4                                                                1
 12       N=NN                                                                    1 MIN=              4 MAX=              4
                                                                                    FIRST=           4 LAST=             4
 13       K=N-2                                                                   1 MIN=              2 MAX=              2
                                                                                    FIRST=           2 LAST=             2
 14       DO1J=1,K                                                                1 MIN1=             2 MAX1=             2
 15       K1=J+1                                                                  2 MIN=              2 MAX=              3
                                                                                    FIRST=           2 LAST=             3
 16       K2=J+2                                                                  2 MIN=              3 MAX=              4
                                                                                    FIRST=           3 LAST=             4
 17       GREAT= ABS(A(K1,J))                                                     2 MIN=  .9392687E+00 MAX=  .5800000E+01
                                                                                    FIRST=  .58000E+01 LAST=  .93927E+00
 18       MAX=K1                                                                  2 MIN=              2 MAX=              3
                                                                                    FIRST=           2 LAST=             3
 19       DO2I=K2,N                                                               2 MIN1=             3 MAX1=             4
                                                                                    MIN2=            4 MAX2=             4
 20       AB= ABS(A(I,J))                                                         3 MIN=  .1900000E+01 MAX=  .3200000E+01
                                                                                    FIRST=  .19000E+01 LAST=  .20819E+01
 21       IF (GREAT.GE.AB) GO TO 2                                                3 TRUE              2 FALSE             1
 22     3 GREAT=AB                                                                1 MIN=  .2081926E+01 MAX=  .2081926E+01
                                                                                    FIRST=  .20819E+01 LAST=  .20819E+01
 23       MAX=I                                                                   1 MIN=              4 MAX=              4
                                                                                    FIRST=           4 LAST=             4
 24     2 CONTINUE                                                                3
 25 C INT(I) GIVES INFORMATION ABOUT INTERCHANGES
 26       INT(J)=MAX                                                              2 MIN=              2 MAX=              4
                                                                                    FIRST=           2 LAST=             4
 27       IF (MAX.EQ.K1) GO TO 5                                                  2 TRUE              1 FALSE             1
 28     4 DO6L=J,N                                                                1 MIN1=             2 MAX1=             2
                                                                                    MIN2=            4 MAX2=             4
 29       E=A(K1,L)                                                               3 MIN= -.9392687E+00 MAX= -.3310345E+00
                                                                                    FIRST= -.93927E+00 LAST=  -.33103E+00
 30       A(K1,L)=A(MAX,L)                                                        3 MIN= -.2081926E+01 MAX=  .3793103E+00
                                                                                    FIRST= -.20819E+01 LAST=  .37931E+00
 31     6 A(MAX,L)=E                                                              3 MIN= -.9392687E+00 MAX= -.3310345E+00
                                                                                    FIRST= -.93927E+00 LAST=  -.33103E+00
 32       DO7L=1,N                                                                1 MIN1=             4 MAX1=             4
 33       E=A(L,K1)                                                               4 MIN= -.7310345E+00 MAX=  .6200000E+01
                                                                                    FIRST=  .62000E+01 LAST=  -.54655E+00
 34       A(L,K1)=A(L,MAX)                                                        4 MIN= -.3310345E+00 MAX=  .9900000E+01
                                                                                    FIRST=  .99000E+01 LAST=  -.33103E+00
 35     7 A(L,MAX)=E                                                              4 MIN= -.7310345E+00 MAX=  .6200000E+01
                                                                                    FIRST=  .62000E+01 LAST=  -.54655E+00
 36 C     INTERCHANGE DONE
 37     5 DO8I=K2,N                                                               2 MIN1=             3 MAX1=             4
                                                                                    MIN2=            4 MAX2=             4
```

STATEMENT NUMBER	PROGRAM LISTING (LEADING N INDICATES CONVERSION WARNINGS)	COUNT	SPECIFIC EXECUTION DATA
38	IF (A(I,J).EQ.0.) GO TO 8	3	TRUE 0 FALSE 3
39	A(I,J)=-A(I,J)/A(K1,J)	3	MIN= -.5517241E+00 MAX= -.3275862E+00 FIRST= -.32759E+00 LAST= -.45115E+00
40	DO11M=K1,N	3	MIN1= 2 MAX1= 3 MIN2= 4 MAX2= 4
41	11 A(I,M)=A(I,M)+A(I,J)*A(K1,M)	8	MIN= -.2051724E+01 MAX= .3793103E+00 FIRST= -.57759E+00 LAST= -.21674E+00
42	8 CONTINUE	3	
43 C	LEFT MULT. DONE		
44	DO 2000 M=K2,N	2	MIN1= 3 MAX1= 4 MIN2= 4 MAX2= 4
45	IF (A(M,J).EQ.0.) GO TO 2000	3	TRUE 0 FALSE 3
46	10 DO 2001 I=1,M	3	MIN1= 4 MAX1= 4
47	2001 A(I,K1)=A(I,K1)-A(I,M)*A(M,J)	12	MIN= -.2291201E+01 MAX= .1269715E+02 FIRST= .48310E+01 LAST= -.59995E+00
48	2000 CONTINUE	3	
49	1 CONTINUE	2	
50 C	RIGHT MULT. DONE		
51 C	HESSENBURG MATRIX NOW FORMED AS A(I,J). MULTIPLIERS STORED WITH IT		
52	DO 105 I=1,N	1	MIN1= 4 MAX1= 4
53	DO 105 J=1,N	4	MIN1= 4 MAX1= 4
54	105 D(I,J)=A(I,J)	16	MIN= -.2081926E+01 MAX= .1269715E+02 FIRST= .10000E+00 LAST= -.21674E+00
55 C	PUT APPROPRIATE ZEROS WHERE MULTIPLIERS WERE STORED		
56	DO 106 I=3,N	1	MIN1= 4 MAX1= 4
57	L=I-2	2	MIN= 1 MAX= 2 FIRST= 1 LAST= 2
58	DO 106 J=1,L	2	MIN1= 1 MAX1= 2
59	106 A(I,J)=0.0	3	
60	K1=N+1	1	MIN= 5 MAX= 5 FIRST= 5 LAST= 5
61	R=0.0	1	
62	C=0.0	1	
63	DO33I=1,N	1	MIN1= 4 MAX1= 4
64	R=R+ ABS(A(I,I))	4	MIN= .1000000E+00 MAX= .2929026E+02 FIRST= .10000E+00 LAST= .29290E+02
65	33 C=C+ ABS(A(I,N))	4	MIN= .6200000E+01 MAX= .1064778E+02 FIRST= .62000E+01 LAST= .10648E+02
66	DO34I=2,N	1	MIN1= 4 MAX1= 4
67	RS=0.0	3	
68	CS=0.0	3	
69	L=I-1	3	MIN= 1 MAX= 3 FIRST= 1 LAST= 3
70	DO35J=L,N	3	MIN1= 1 MAX1= 3 MIN2= 4 MAX2= 4
71	RS=RS+ ABS(A(I,J))	9	MIN= .5999461E+00 MAX= .2554628E+02 FIRST= .58000E+01 LAST= .81669E+00
72	K1J=K1-J	9	MIN= 1 MAX= 4 FIRST= 4 LAST= 1
73	K1I=K1-I	9	MIN= 1 MAX= 3 FIRST= 3 LAST= 1
74	35 CS=CS+ ABS(A(K1J,K1I))	9	MIN= .5999461E+00 MAX= .2112564E+02 FIRST= .59995E+00 LAST= .59000E+01
75	IF (RS.LE.R) GO TO 36	3	TRUE 2 FALSE 0
76	37 R=RS	0	
77	36 IF (CS.LE.C) GO TO 34	3	TRUE 2 FALSE 1
78	99 C=CS	1	MIN= .2112564E+02 MAX= .2112564E+02

```
STATEMENT
NUMBER    PROGRAM LISTING (LEADING H INDICATES CONVERSION WARNINGS)                    COUNT        SPECIFIC EXECUTION DATA

 79     34 CONTINUE                                                                    3
 80          IJK=1                                                                     1
 81          IF (R.GE.C) GO TO 54                                                      1 TRUE              1 FALSE             0
 82  C DELTA IS CRITERION FOR STOPPING AN ITERATION
 83     53 DELTA=R*1.0E-11                                                    *        0
 84  C DEL IS ARBITRARY SHIFT
 85          DEL=R/17.1829                                                 *        0
 86          GO TO 153                                                     *        0
 87     54 DELTA=C*1.0E-11                                                            1 MIN=  .2112564E-09 MAX=  .2112564E-09
                                                                                        FIRST=  .21126E-09 LAST=   .21126E-09
 88          DEL=C/17.1829                                                             1 MIN=  .1229457E+01 MAX=  .1229457E+01
                                                                                        FIRST=  .12295E+01 LAST=   .12295E+01
 89  C       DELTA COMPUTED
 90  C PRODUCE A-PI, ITERATE ON THIS TO BREAK UP EIGENVALUES OF EQUAL MODULUS
 91    153 DO 107 I=1,N                                                            1 MIN1=             4 MAX1=             4
 92    107 A(I,I)=A(I,I)-DEL                                                       4 MIN= -.1446200E+01 MAX=  .7237784E+01
                                                                                        FIRST= -.11295E+01 LAST=  -.14462E+01
 93     55 IF (N.NE.1) GO TO 48                                                    1 TRUE              1 FALSE             0
 94  C SUBROUTINE CALCEV CALCULATES EIGENVALUES OF 1X1 OR 2X2 MATRICES.
 95  C PI IS ADDED BACK IN CALCEV
 96     47 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,1)                                *        0
 97          GO TO 76                                                         *        0
 98     48 IF (N.NE.2) GO TO 60                                                    3 TRUE              2 FALSE             1
 99     49 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,2)                                     1
100          GO TO 76                                                              1
101  C QR TRANSFORMATION STARTS HERE
102  C INITIALIZE FOR DETERMINING SUBSEQUENT SHIFTS
103     60 AR1=0.0                                                                 2
104          AR3=0.0                                                               2
105          AR4=0.0                                                               2
106  C RE-ENTER AFTER REALIT OR COMPIT SUBROUTINES CALLED
107  C SELECT FIRST ((ZERO)) SUB-DIAGONAL ELEMENT FROM BOTTOM
108     61 L=N                                                                     9 MIN=              3 MAX=              4
                                                                                        FIRST=             4 LAST=             3
109          DO56 I=2,N                                                            9 MIN1=             3 MAX1=             4
110          N2I=N+2-I                                                            20 MIN=              2 MAX=              4
                                                                                        FIRST=             4 LAST=             3
111          IF( ABS(A(N2I,N2I-1)).LT.DELTA)GO TO 57                              20 TRUE             2 FALSE            18
112     56 L=L-1                                                                  18 MIN=              1 MAX=              3
                                                                                        FIRST=             3 LAST=             1
113  C VALUE OF L SELECTED
114     57 IF (L.NE.N) GO TO 59                                                    9 TRUE              7 FALSE             2
115     58 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,1)                                     2
116          N=N-1                                                                 2 MIN=              2 MAX=              3
                                                                                        FIRST=             3 LAST=             2
117          GO TO 48                                                              2
118     59 IF ((L-N+1).NE.0) GO TO 75                                              7 TRUE              7 FALSE             0
119     60 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,2)                                *        0
120          N=N-2                                                             *        0
121          GO TO 55                                                          *        0
```

```
STATEMENT
NUMBER    PROGRAM LISTING (LEADING N INDICATES CONVERSION WARNINGS)                    COUNT        SPECIFIC EXECUTION DATA

122 C DETERMINE EIGENVALUES OF 2X2 MATRIX -- ROW 1 = A(N-1,N-1)   A(N-1,N)
123 C                                        ROW 2 = A(N,N-1)     A(N,N)
124 C AND BASE SHIFT ON THESE
125      75 B=A(N-1,N-1)+A(N,N)                                                       7 MIN= -.5384725E+01 MAX= -.3040462E-02
                                                                                      FIRST= -.26262E+01 LAST=  -.49193E+01
126         C=A(N-1,N-1)*A(N,N)-A(N,N-1)*A(N-1,N)                                    7 MIN= -.8740759E+01 MAX=  .1267871E+01
                                                                                      FIRST=  .12679E+01 LAST=  -.81379E+01
127         C1=A(N-1,N-1)-A(N,N)                                                     7 MIN= -.8004470E+01 MAX=  .2654877E+01
                                                                                      FIRST=  .26624E+00 LAST=  -.75333E+01
128         DISC=C1*C1+4.0*A(N,N-1)*A(N-1,N)                                         7 MIN=  .1825211E+01 MAX=  .6395829E+02
                                                                                      FIRST=  .18252E+01 LAST=   .56751E+02
129         IF (DISC.GE.0.) GO TO 63                                                 7 TRUE          7 FALSE          0
130      62 R1=0.5*B                                                          *      0
131         R2=.5* SQRT( ABS(DISC))                                           *      0
132         ANUM=(R1-AR3)*(R1-AR3)+(R2-AR4)*(R2-AR4)                          *      0
133         DENOM=AR3*AR3+AR4*AR4                                             *      0
134         IF (DENOM.NE.0.) GO TO 200                                        *      0
135     201 RHO=0.0                                                           *      0
136         SIGMA=0.0                                                         *      0
137         GO TO 203                                                         *      0
138     200 RHO=C                                                             *      0
139         SIGMA=B                                                           *      0
140     203 AR3=R1                                                            *      0
141         AR4=R2                                                            *      0
142         CALL COMPIT(A,NMAX,L,N,RHO,SIGMA)                                 *      0
143         GO TO 61                                                          *      0
144      63 IF (B.GE.0.) GO TO 65                                                    7 TRUE          0 FALSE          7
145      64 R1=.5*(B- SQRT(DISC))                                                    7 MIN= -.6691059E+01 MAX= -.1328918E+01
                                                                                      FIRST= -.19886E+01 LAST=  -.62263E+01
146         GO TO 66                                                                 7
147      65 R1=.5*(B+ SQRT(DISC))                                             *      0
148         IF (R1.NE.0.) GO TO 66                                            *      0
149      83 R2=0.0                                                            *      0
150         GO TO 84                                                          *      0
151      66 R2=C/R1                                                                  7 MIN= -.6375759E+00 MAX=  .1325918E+01
                                                                                      FIRST= -.63758E+00 LAST=   .13070E+01
152 C       ROOTS OF 2*2 MATRIX FOUND
153      84 IF( ABS(A(N,N)-R1).GE. ABS(A(N,N)-R2))GO TO 68                           7 TRUE          3 FALSE          4
154      67 AR2=R1                                                                   4 MIN= -.1988580E+01 MAX= -.1328918E+01
                                                                                      FIRST= -.19886E+01 LAST=  -.13290E+01
155         GO TO 69                                                                 4
156      68 AR2=R2                                                                   3 MIN=  .1301875E+01 MAX=  .1307015E+01
                                                                                      FIRST=  .13019E+01 LAST=   .13070E+01
157      69 IF (AR1.NE.0.) GO TO 71                                                  7 TRUE          5 FALSE          2
158      72 SHIFT=0.0                                                                2
159         GO TO 73                                                                 2
160      71 SHIFT=AR2                                                                5 MIN= -.1337816E+01 MAX=  .1307015E+01
                                                                                      FIRST= -.13378E+01 LAST=   .13070E+01
161      73 AR1=AR2                                                                  7 MIN= -.1988580E+01 MAX=  .1307015E+01
                                                                                      FIRST= -.19886E+01 LAST=   .13070E+01
162         CALL REALIT(A,NMAX,L,N,SHIFT,CC,SS)                                      7
163         GO TO 61                                                                 7
164 C ARE VECTORS NEEDED
```

STATEMENT NUMBER	PROGRAM LISTING (LEADING N INDICATES CONVERSION WARNINGS)		COUNT	SPECIFIC EXECUTION DATA
165	76 IF (NVEC.EQ.0) GO TO 600		1	TRUE 0 FALSE 1
166	C INVERSE ITERATION IS USED FOR EIGENVECTORS			
167	550 SMALL=DELTA*1.0E-30		1	MIN= .2112564E-39 MAX= .2112564E-39 FIRST= .21126E-39 LAST= .21126E-39
168	NUM=0		1	
169	JI=1		1	
170	NM=NN+NN		1	MIN= 8 MAX= 8 FIRST= 8 LAST= 8
171	C C1 IS REAL PART OF EIGENVALUE			
172	513 C1=VEC(JI)		4	MIN= -.5247020E+01 MAX= .1121005E+02 FIRST= -.99502E-01 LAST= .11210E+02
173	C C2 IS COMPLEX PART OF EIGENVALUE			
174	C2=VEC(JI+1)		4	MIN= 0. MAX= 0. FIRST= 0. LAST= 0.
175	NUM=NUM+1		4	MIN= 1 MAX= 4 FIRST= 1 LAST= 4
176	C REPLACE HESSENBURG MATRIX AND MULTIPLIERS			
177	DO 570 I=1,NN		4	MIN1= 4 MAX1= 4
178	DO 570 J=1,NN		16	MIN1= 4 MAX1= 4
179	570 A(I,J)=D(I,J)		64	MIN= -.2081926E+01 MAX= .1269715E+02 FIRST= .10000E+00 LAST= -.21674E+00
180	IF (C2.NE.0.) GO TO 561		4	TRUE 0 FALSE 4
181	CALL RVEC(A,NMAX,INT,C1,SMALL,NN,NUM,EIGVEC,NVEC,CC,SS)		4	
182	JI=JI+2		4	MIN= 3 MAX= 9 FIRST= 3 LAST= 9
183	IF(NVEC.EQ.NUM)GO TO 600		4	TRUE 1 FALSE 3
184	GO TO 513		3	
185	561 CALL IMVEC(A,NMAX,INT,C1,C2,SMALL,NN,NUM,EIGVEC,NVEC,CC,SS,Z,BB)	*	0	
186	C NEXT STATEMENT IGNORES CONJUGATE COMPLEX EIGENVALUES			
187	JI=JI+4	*	0	
188	IF(NVEC.EQ.NUM)GO TO 600	*	0	
189	GO TO 513	*	0	
190	600 CONTINUE		1	
191	END		1	

PROGRAM EVALUATOR AND TESTER REPORT

FOR SUBROUTINE UNSEIG

SYNTACTIC PROFILE

TOTAL NUMBER OF SOURCE STATEMENTS 190

TYPE OF STATEMENT	NUMBER	PERCENT OF TOTAL
EXECUTABLE SOURCE	156	82.1
NONEXECUTABLE SOURCE	4	2.1
COMMENT	30	15.8
NONSTANDARD	1	.5
BRANCH	58	N/A
CALL	8	N/A
UNFORMATTED I/O	0	N/A
FORMATTED I/O	0	N/A
ASSERTION DIRECTIVES	0	N/A

OPERATIONAL PROFILE

TOTAL EXECUTION COUNT 560

TYPE OF STATEMENT	NO EXECUTED	PERCENT EXECUTED
EXECUTABLE SOURCE	125	80.1
BRANCH	35	60.3
CALL	4	50.0
UNFORMATTED I/O	0	100.0
FORMATTED I/O	0	100.0

```
STATEMENT
NUMBER    PROGRAM LISTING (LEADING H INDICATES CONVERSION WARNINGS)                    COUNT        SPECIFIC EXECUTION DATA

    1         SUBROUTINE CALCEV(A,NMAX,DEL,VEC,IJK,N,M)
    2         DIMENSION A(NMAX,NMAX),VEC(1)
    3         IF (M.NE.1) GO TO 2                                                    3 TRUE              1 FALSE             2
    4       1 AI=0.0                                                                 2
    5         A(N,N)=A(N,N)+DEL                                                      2 MIN= -.9950155E-0' MAX=  .2536472E+01
                                                                                       FIRST= -.99502E-01 LAST=   .25365E+01
    6 C STORE EIGENVALUES IN VEC
    7         VEC(IJK)=A(N,N)                                                        2 MIN= -.9950155E-01 MAX=  .2536472E+01
                                                                                       FIRST= -.99502E-01 LAST=   .25365E+01
    8         VEC(IJK+1)=AI                                                          2 MIN= 0.            MAX= 0.
                                                                                       FIRST= 0.          LAST=  0.
    9         IJK=IJK+2                                                              2 MIN=             3 MAX=            5
                                                                                       FIRST=             3 LAST=           5
   10         RETURN                                                                 2
   11       2 B=A(N-1,N-1)+A(N,N)                                                    1 MIN=  .3504115E+01 MAX=  .3504115E+01
                                                                                       FIRST=  .35041E+01 LAST=   .35041E+01
   12         C=A(N-1,N-1)*A(N,N)-A(N,N-1)*A(N-1,N)                                  1 MIN= -.6463907E+02 MAX= -.6463907E+02
                                                                                       FIRST= -.64639E+02 LAST=  -.64639E+02
   13         C1=A(N-1,N-1)-A(N,N)                                                   1 MIN=  .1681400E+02 MAX=  .1681400E+02
                                                                                       FIRST=  .16814E+02 LAST=   .16814E+02
   14         DISC=C1*C1+4.0*A(N,N-1)*A(N-1,N)                                       1 MIN=  .2708351E+03 MAX=  .2708351E+03
                                                                                       FIRST=  .27084E+03 LAST=   .27084E+03
   15         IF (DISC.LT.0.) GO TO 9                                                1 TRUE              0 FALSE             1
   16       4 AI=0.0                                                                 1
   17         IF (B.GE.0.) GO TO 6                                                   1 TRUE              1 FALSE             0
   18         R1=0.5*(B- SQRT(DISC))                                           *     0
   19         GO TO 7                                                          *     0
   20       6 R1=0.5*(B+ SQRT(DISC))                                                 1 MIN=  .9980592E+01 MAX=  .9980592E+01
                                                                                       FIRST=  .99806E+01 LAST=   .99806E+01
   21         IF(R1.NE.0.) GO TO 7                                                   1 TRUE              1 FALSE             0
   22      10 R2=0.0                                                           *     0
   23         GO TO 11                                                         *     0
   24       7 R2=C/R1                                                                1 MIN= -.6476477E+01 MAX= -.6476477E+01
                                                                                       FIRST= -.64765E+01 LAST=  -.64765E+01
   25      11 R1=R1+DEL                                                             1 MIN=  .1121005E+02 MAX=  .1121005E+02
                                                                                       FIRST=  .11210E+02 LAST=   .11210E+02
   26         R2=R2+DEL                                                             1 MIN= -.5247020E+01 MAX= -.5247020E+01
                                                                                       FIRST= -.52470E+01 LAST=  -.52470E+01
   27         VEC(IJK)=R2                                                           1 MIN= -.5247020E+01 MAX= -.5247020E+01
                                                                                       FIRST= -.52470E+01 LAST=  -.52470E+01
   28         VEC(IJK+1)=AI                                                         1 MIN= 0.            MAX= 0.
                                                                                       FIRST= 0.          LAST=  0.
   29         VEC(IJK+2)=R1                                                         1 MIN=  .1121005E+02 MAX=  .1121005E+02
                                                                                       FIRST=  .11210E+02 LAST=   .11210E+02
   30         VEC(IJK+3)=AI                                                         1 MIN= 0.            MAX= 0.
                                                                                       FIRST= 0.          LAST=  0.
   31         GO TO 8                                                               1
   32       9 R1=0.5*B                                                       *     0
   33         AI=-.5* SQRT( ABS(DISC))                                         *     0
   34         R1=R1+DEL                                                        *     0
   35         VEC(IJK)=R1                                                      *     0
   36         VEC(IJK+1)=-AI                                                   *     0
   37         VEC(IJK+2)=R1                                                    *     0
```

STATEMENT NUMBER	PROGRAM LISTING (LEADING N INDICATES CONVERSION WARNINGS)	COUNT	SPECIFIC EXECUTION DATA
38	VEC(IJK+3)=AI	0	
39	8 IJK=IJK+4	1	MIN= 9 MAX= 9 FIRST= 9 LAST= 9
40	RETURN	1	
41	END		

PROGRAM EVALUATOR AND TESTER REPORT
FOR SUBROUTINE CALCEV

SYNTACTIC PROFILE

TOTAL NUMBER OF SOURCE STATEMENTS 41

TYPE OF STATEMENT	NUMBER	PERCENT OF TOTAL
EXECUTABLE SOURCE	37	90.2
NONEXECUTABLE SOURCE	3	7.3
COMMENT	1	2.4
NONSTANDARD	0	0.0
BRANCH	11	N/A
CALL	0	N/A
UNFORMATTED I/O	0	N/A
FORMATTED I/O	0	N/A
ASSERTION DIRECTIVES	0	N/A

OPERATIONAL PROFILE

TOTAL EXECUTION COUNT 34

TYPE OF STATEMENT	NO EXECUTED	PERCENT EXECUTED
EXECUTABLE SOURCE	26	70.3
BRANCH	6	54.5
CALL	0	100.0
UNFORMATTED I/O	0	100.0
FORMATTED I/O	0	100.0

```
STATEMENT
NUMBER    PROGRAM LISTING (LEADING N INDICATES CONVERSION WARNINGS)
```

COUNT / SPECIFIC EXECUTION DATA

```
  1       SUBROUTINE REALIT(A,NMAX,L,N,SHIFT,C,S)
  2       DIMENSION A(NMAX,NMAX),C(1),S(1)
  3       IF (SHIFT.EQ.0.) GO TO 2
  4     1 DO3 I=L,N
  5     3 A(I,I)=A(I,I)-SHIFT
  6     2 M=N-1
  7       DO9 I=L,M
  8       DENOM= SQRT(A(I,I)**2+A(I+1,I)**2)
  9       IF (DENOM.GT.0.) GO TO 10
 10    11 C(I)=1.0
 11       S(I)=0.0
 12       GO TO 4
 13    10 C(I)=A(I,I)/DENOM
 14       S(I)=A(I+1,I)/DENOM
 15       A(I,I)=DENOM
 16    12 I1=I+1
 17       DO 35 J=I1,N
 18       F=A(I,J)
 19       A(I,J)=A(I+1,J)*S(I)+F*C(I)
 20       A(I+1,J)=A(I+1,J)*C(I)-F*S(I)
 21    35 CONTINUE
 22     4 CONTINUE
 23 C     TRIANGULAR MATRIX FORMED
 24       DO5 J=L,M
 25       DO6 I=L,J
 26       F=A(I,J)
 27       A(I,J)=A(I,J+1)*S(J)+F*C(J)
 28     6 A(I,J+1)=A(I,J+1)*C(J)-F*S(J)
 29       A(J+1,J)=A(J+1,J+1)*S(J)
 30     5 A(J+1,J+1)=A(J+1,J+1)*C(J)
 31 C     TRANSFORMATION COMPLETED
 32       IF (SHIFT.EQ.0.) RETURN
 33     7 DO9 I=L,N
 34     9 A(I,I)=A(I,I)+SHIFT
 35     8 RETURN
```

```
                                                  7 TRUE              2 FALSE             5
                                                  5 MIN1=             1 MAX1=             1
                                                    MIN2=             3 MAX2=             4
                                                 18 MIN= -.8000932E+01 MAX=  .1173958E+02
                                                    FIRST=  .52505E+01 LAST= -.25864E-06
                                                  7 MIN=              2 MAX=              3
                                                    FIRST=            3 LAST=             2
                                                  7 MIN1=             1 MAX1=             1
                                                    MIN2=             2 MAX2=             3
                                                 18 MIN=  .1456132E+01 MAX=  .1260434E+02
                                                    FIRST=  .59089E+01 LAST=  .79883E+01
                                                 18 TRUE             18 FALSE            0
                                                  0
                                                  0
                                                  0
                                                 18 MIN= -.1000000E+01 MAX=  .9967086E+00
                                                    FIRST= -.19114E+00 LAST= -.10000E+01
                                                 18 MIN= -.4120136E+00 MAX=  .9815621E+00
                                                    FIRST=  .98156E+00 LAST= -.62647E-07
                                                 18 MIN=  .1456132E+01 MAX=  .1260434E+02
                                                    FIRST=  .59089E+01 LAST=  .79883E+01
                                                 18 MIN=             2 MAX=              4
                                                    FIRST=           2 LAST=             3
                                                 18 MIN1=            2 MAX1=             4
                                                    MIN2=             3 MAX2=             4
                                                 33 MIN= -.1394996E+02 MAX=  .1405885E+02
                                                    FIRST=  .10293E+02 LAST= -.49720E+01
                                                 33 MIN= -.1345768E+02 MAX=  .1393676E+02
                                                    FIRST=  .51369E+01 LAST=  .49720E+01
                                                 33 MIN= -.1394996E+02 MAX=  .3435814E+01
                                                    FIRST= -.11487E+02 LAST= -.52838E-07
                                                 33
                                                 18
                                                  7 MIN1=             1 MAX1=             1
                                                    MIN2=             2 MAX2=             3
                                                 18 MIN1=            1 MAX1=             1
                                                    MIN2=             1 MAX2=             3
                                                 33 MIN= -.1411128E+02 MAX=  .1260434E+02
                                                    FIRST=  .59089E+01 LAST=  .79620E+01
                                                 33 MIN= -.7961958E+01 MAX=  .1405885E+02
                                                    FIRST=  .39127E+01 LAST= -.79620E+01
                                                 33 MIN= -.1411128E+02 MAX=  .1346203E+02
                                                    FIRST= -.67819E+01 LAST= -.49720E+01
                                                 18 MIN= -.4605441E+00 MAX=  .1145868E+02
                                                    FIRST=  .11459E+02 LAST=  .33101E-14
                                                 18 MIN= -.2653969E+01 MAX=  .7961958E+01
                                                    FIRST= -.22314E+01 LAST=  .52838E-07
                                                  7 TRUE              2 FALSE             5
                                                  5 MIN1=             1 MAX1=             1
                                                    MIN2=             3 MAX2=             4
                                                 18 MIN= -.6925412E+01 MAX=  .1041062E+02
                                                    FIRST=  .69542E+01 LAST=  .13070E+01
                                                  5
```

****
* *
* PROGRAM EVALUATOR AND TESTER REPORT *
* *
* FOR SUBROUTINE REALIT *
* *
****

SYNTACTIC PROFILE

TOTAL NUMBER OF SOURCE STATEMENTS 36

TYPE OF STATEMENT	NUMBER	PERCENT OF TOTAL
EXECUTABLE SOURCE	31	86.1
NONEXECUTABLE SOURCE	3	8.3
COMMENT	2	5.6
NONSTANDARD	0	0.0
BRANCH	7	N/A
CALL	0	N/A
UNFORMATTED I/O	0	N/A
FORMATTED I/O	0	N/A
ASSERTION DIRECTIVES	0	N/A

OPERATIONAL PROFILE

TOTAL EXECUTION COUNT 515

TYPE OF STATEMENT	NO EXECUTED	PERCENT EXECUTED
EXECUTABLE SOURCE	28	90.3
BRANCH	5	71.4
CALL	0	100.0
UNFORMATTED I/O	0	100.0
FORMATTED I/O	0	100.0

STATEMENT NUMBER	PROGRAM LISTING (LEADING N INDICATES CONVERSION WARNINGS)	COUNT	SPECIFIC EXECUTION DATA
1	SUBROUTINE COMPIT(A,NMAX,L,N,RHO,SIGMA)		
2	DIMENSION A(NMAX,NMAX)		
3	C HOUSEHOLDER TYPE MATRICES USED INSTEAD OF ROTATIONS(SEE FRANCIS PAPER)		
4	M=N-1	*	0
5	DO 1 I=L,M	*	0
6	IF (I.NE.L) GO TO 3	*	0
7	2 B1=A(L,L)*(A(L,L)-SIGMA)+A(L,L+1)*A(L+1,L)+RHO	*	0
8	B2=A(L+1,L)*(A(L,L)+A(L+1,L+1)-SIGMA)	*	0
9	B3=A(L+1,L)*A(L+2,L+1)	*	0
10	A(L+2,L)=0.0	*	0
11	GO TO 6	*	0
12	3 B1=A(I,I-1)	*	0
13	B2=A(I+1,I-1)	*	0
14	IF (I.EQ.M) GO TO 5	*	0
15	4 B3=A(I+2,I-1)	*	0
16	GO TO 6	*	0
17	5 B3=0.0	*	0
18	6 D= SQRT(B1*B1+B2*B2+B3*B3)	*	0
19	IF (B1.GE.0.) GO TO 8	*	0
20	7 D=-D	*	0
21	8 IF (D.EQ.0.) GO TO 1	*	0
22	9 C1=B2/(D+B1)	*	0
23	C2=B3/(D+B1)	*	0
24	E=2.0/(1.0+C1*C1+C2*C2)	*	0
25	DO 10 K=I,N	*	0
26	IF (I.EQ.M) GO TO 12	*	0
27	11 G=E*(A(I,K)+C1*A(I+1,K)+C2*A(I+2,K))	*	0
28	A(I,K)=A(I,K)-G	*	0
29	A(I+1,K)=A(I+1,K)-C1*G	*	0
30	A(I+2,K)=A(I+2,K)-C2*G	*	0
31	GO TO 10	*	0
32	12 G=E*(A(I,K)+C1*A(I+1,K))	*	0
33	A(I,K)=A(I,K)-G	*	0
34	A(I+1,K)=A(I+1,K)-C1*G	*	0
35	10 CONTINUE	*	0
36	IF (I.EQ.L) GO TO 14	*	0
37	13 A(I,I-1)=-D	*	0
38	A(I+1,I-1)=0.0	*	0
39	IF (I.EQ.M) GO TO 14	*	0
40	15 A(I+2,I-1)=0.0	*	0
41	C ROW OPERATION COMPLETED		
42	14 J=I+2	*	0
43	IF (J.LE.N) GO TO 17	*	0
44	16 J=N	*	0
45	17 DO 18 K=L,J	*	0
46	IF (I.EQ.M) GO TO 20	*	0
47	19 G=E*(A(K,I)+C1*A(K,I+1)+C2*A(K,I+2))	*	0
48	A(K,I)=A(K,I)-G	*	0
49	A(K,I+1)=A(K,I+1)-C1*G	*	0
50	A(K,I+2)=A(K,I+2)-C2*G	*	0
51	GO TO 18	*	0
52	20 G=E*(A(K,I)+C1*A(K,I+1))	*	0
53	A(K,I)=A(K,I)-G	*	0
54	A(K,I+1)=A(K,I+1)-C1*G	*	0
55	18 CONTINUE	*	0
56	J=I+3	*	0

STATEMENT NUMBER	PROGRAM LISTING (LEADING N INDICATES CONVERSION WARNINGS)	COUNT	SPECIFIC EXECUTION DATA
57	IF (J.GT.N) GO TO 1	*	0
58	21 G=E*C2*A(I+3,I+2)	*	0
59	A(I+3,I)=-G	*	0
60	A(I+3,I+1)=-C1*G	*	0
61	A(I+3,I+2)=A(I+3,I+2)-C2*G	*	0
62 C	COLUMN OPERATION COMPLETED		
63	1 CONTINUE	*	0
64	RETURN	*	0
65	END		

```
**************************************
*                                    *
* PROGRAM EVALUATOR AND TESTER REPORT *
*                                    *
*        FOR SUBROUTINE COMPIT       *
*                                    *
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SYNTACTIC PROFILE

TOTAL NUMBER OF SOURCE STATEMENTS 65

TYPE OF STATEMENT	NUMBER	PERCENT OF TOTAL
EXECUTABLE SOURCE	59	90.8
NONEXECUTABLE SOURCE	3	4.6
COMMENT	3	4.6
NONSTANDARD	0	0.0
BRANCH	24	N/A
CALL	0	N/A
UNFORMATTED I/O	0	N/A
FORMATTED I/O	0	N/A
ASSERTION DIRECTIVES	0	N/A

THIS SUBROUTINE WAS NOT EXECUTED

14D

STATEMENT NUMBER	PROGRAM LISTING (LEADING N INDICATES CONVERSION WARNINGS)	COUNT	SPECIFIC EXECUTION DATA
1	SUBROUTINE RVEC(A,NMAX,INT,C1,SMALL,N,NUM,EIGVEC,NVEC,INTER,Y)		
2	DIMENSION A(NMAX,NMAX),INTER(1),Y(1),INT(1),EIGVEC(NMAX,NMAX)		
3	DO1 I=1,N	4	MIN1= 4 MAX1= 4
4	1 A(I,I)=A(I,I)-C1	16	MIN= -.1142679E+02 MAX= .1371426E+02
			FIRST= .19950E+00 LAST= -.11427E+02
5	DO2 I=2,N	4	MIN1= 4 MAX1= 4
6	IF(ABS(A(I-1,I-1)).GE. ABS(A(I,I-1)))GO TO 4	12	TRUE 6 FALSE 6
7	3 INTER(I)=I	6	MIN= 2 MAX= 4
			FIRST= 2 LAST= 4
8	J=I-1	6	MIN= 1 MAX= 3
			FIRST= 1 LAST= 3
9	DO5 K=J,N	6	MIN1= 1 MAX1= 3
			MIN2= 4 MAX2= 4
10	B=A(I-1,K)	18	MIN= -.3365121E+01 MAX= .1269715E+02
			FIRST= .19950E+00 LAST= .46004E+01
11	A(I-1,K)=A(I,K)	18	MIN= -.1142679E+02 MAX= .1371426E+02
			FIRST= .58000E+01 LAST= -.11427E+02
12	5 A(I,K)=B	18	MIN= -.3365121E+01 MAX= .1269715E+02
			FIRST= .19950E+00 LAST= .46004E+01
13	GO TO 6	6	
14	4 INTER(I)=I-1	6	MIN= 1 MAX= 3
			FIRST= 2 LAST= 2
15	6 IF (A(I,I-1).EQ.0.) GO TO 2	12	TRUE 0 FALSE 12
16	C=-A(I,I-1)/A(I-1,I-1)	12	MIN= -.9218999E+00 MAX= .7913944E+00
			FIRST= -.34397E-01 LAST= .40259E+00
17	A(I,I-1)=C	12	MIN= -.9218999E+00 MAX= .7913944E+00
			FIRST= -.34397E-01 LAST= .40259E+00
18	DO 8 K=I,N	12	MIN1= 2 MAX1= 4
			MIN2= 4 MAX2= 4
19	8 A(I,K)=A(I,K)+C*A(I-1,K)	24	MIN= -.3365121E+01 MAX= .1596498E+02
			FIRST= .99984E+01 LAST= .10311E-09
20	2 CONTINUE	12	
21	C TRIANGULAR MATRIX FORMED		
22	DO9 I=1,N	4	MIN1= 4 MAX1= 4
23	IF(ABS(A(I,I)).GE.SMALL)GO TO 9	16	TRUE 16 FALSE 0
24	10 A(I,I)=SMALL *	0	
25	9 CONTINUE	16	
26	C NORMALISED ((EIGENVECTOR)) OF HESSENBURG MATRIX OBTAINED FOR RHS = I		
27	DO 5555 I=1,N	4	MIN1= 4 MAX1= 4
28	5555 Y(I)=1.0	16	
29	DO 8888 JJJJ=1,4	4	
30	7777 Y(N)=Y(N)/A(N,N)	16	MIN= -.3574285E+14 MAX= .1330028E+13
			FIRST= -.35743E+14 LAST= .87749E+10
31	B=Y(N)	16	MIN= -.3574285E+14 MAX= .1330028E+13
			FIRST= -.35743E+14 LAST= .87749E+10
32	DO11 I=2,N	16	MIN1= 4 MAX1= 4
33	E=0.0	48	
34	M=N+1-I	48	MIN= 1 MAX= 3
			FIRST= 3 LAST= 1
35	DO12 J=2,I	48	MIN1= 2 MAX1= 4
36	L=N+J-I	96	MIN= 2 MAX= 4
			FIRST= 4 LAST= 4
37	12 E=E+Y(L)*A(M,L)	96	MIN= -.1304838E+15 MAX= .1661351E+15
			FIRST= -.19119E+14 LAST= .71225E+13
38	Y(M)=(Y(M)-E)/A(M,M)	48	MIN= -.8752668E+13 MAX= .3305043E+14
			FIRST= .69849E+13 LAST= .64109E+12

STATEMENT NUMBER	PROGRAM LISTING (LEADING N INDICATES CONVERSION WARNINGS)	COUNT	SPECIFIC EXECUTION DATA
39	IF(ABS(B).GE. ABS(Y(M)))GO TO 11	48	TRUE 20 FALSE 28
40	10 B=Y(M)	28	MIN= -.8752668E+13 MAX= .7828595E+13 FIRST= .78286E+13 LAST= .89285E+12
41	11 CONTINUE	48	
42	DO14 I=1,N	16	MIN1= 4 MAX1= 4
43	14 Y(I)=Y(I)/B	64	MIN= -.8944238E+00 MAX= .1000000E+01 FIRST= .13794E+00 LAST= .98280E-02
44	IF(JJJJ.EQ.4)GO TO 6666	16	TRUE 4 FALSE 12
45	DO15 I=2,N	12	MIN1= 4 MAX1= 4
46	IF (INTER(I).NE.I) GO TO 15	36	TRUE 18 FALSE 18
47	16 B=Y(I)	18	MIN= -.3651198E+00 MAX= .1000000E+01 FIRST= -.36512E+00 LAST= .98280E-02
48	Y(I)=Y(I-1)	18	MIN= -.1301137E+01 MAX= .1000000E+01 FIRST= .19794E+00 LAST= .90086E+00
49	Y(I-1)=B	18	MIN= -.3651198E+00 MAX= .1000000E+01 FIRST= -.36512E+00 LAST= .98280E-02
50	15 Y(I)=Y(I)+A(I,I-1)*Y(I-1)	36	MIN= -.1312023E+01 MAX= .1374845E+01 FIRST= .21050E+00 LAST= .90481E+00
51	8888 CONTINUE	12	
52	C EIGENVECTOR OF HESSENBURG MATRIX OBTAINED (NOT NORMALIZED)		
53	6666 M=N-1	4	MIN= 3 MAX= 3 FIRST= 3 LAST= 3
54	DO21 I=2,M	4	MIN1= 3 MAX1= 3
55	J=N+1-I	8	MIN= 2 MAX= 3 FIRST= 3 LAST= 2
56	L=J+1	8	MIN= 3 MAX= 4 FIRST= 4 LAST= 3
57	DO20 K=L,N	8	MIN1= 3 MAX1= 4 MIN2= 4 MAX2= 4
58	20 Y(K)=Y(K)-Y(J)*A(K,J-1)	12	MIN= -.3968651E+00 MAX= .9118357E+00 FIRST= .91184E+00 LAST= .36454E+00
59	LL=INT(N-I)	8	MIN= 2 MAX= 4 FIRST= 4 LAST= 2
60	IF (J.EQ.LL) GO TO 21	8	TRUE 4 FALSE 4
61	19 B=Y(J)	4	MIN= -.8944238E+00 MAX= -.1364325E+00 FIRST= -.19542E+00 LAST= -.18719E+00
62	Y(J)=Y(LL)	4	MIN= -.2086210E+00 MAX= .9118357E+00 FIRST= .91184E+00 LAST= -.74622E-01
63	Y(LL)=B	4	MIN= -.8944238E+00 MAX= -.1364325E+00 FIRST= -.19542E+00 LAST= -.18719E+00
64	21 CONTINUE	8	
65	C UNNORMALIZED EIGENVECTOR OF ORIGINAL MATRIX OBTAINED		
66	B=0.0	4	
67	DO22 I=1,N	4	MIN1= 4 MAX1= 4
68	IF(ABS(B).GE. ABS(Y(I)))GO TO 22	16	TRUE 8 FALSE 8
69	23 B=Y(I)	8	MIN= -.3651198E+00 MAX= .1000000E+01 FIRST= .19794E+00 LAST= .10000E+01
70	22 CONTINUE	16	
71	DO24 I=1,N	4	MIN1= 4 MAX1= 4
72	24 Y(I)=Y(I)/B	16	MIN= -.5009484E+00 MAX= .1000000E+01 FIRST= .24986E+00 LAST= .36454E+00
73	C NORMALIZED EIGENVECTOR OBTAINED		

STATEMENT NUMBER	PROGRAM LISTING (LEADING N INDICATES CONVERSION WARNINGS)	COUNT	SPECIFIC EXECUTION DATA
74	C PUT Y(I) (REAL EIGENVECTOR) IN EIGVEC(NUMOFEV,I)		
75	DO 100 I=1,N	4	MIN1= 4 MAX1= 4
76	100 EIGVEC(NUM,I)=Y(I)	16	MIN= -.5009484E+00 MAX= .1000000E+01 FIRST= .24986E+00 LAST= .36454E+00
77	RETURN	4	
78	END		

****
* *
* PROGRAM EVALUATOR AND TESTER REPORT *
* *
* FOR SUBROUTINE AVEC *
* *
****

SYNTACTIC PROFILE

TOTAL NUMBER OF SOURCE STATEMENTS 78

TYPE OF STATEMENT	NUMBER	PERCENT OF TOTAL
EXECUTABLE SOURCE	69	88.5
NONEXECUTABLE SOURCE	3	3.8
COMMENT	6	7.7
NONSTANDARD	0	0.0
BRANCH	17	N/A
CALL	0	N/A
UNFORMATTED I/O	0	N/A
FORMATTED I/O	0	N/A
ASSERTION DIRECTIVES	0	N/A

OPERATIONAL PROFILE

TOTAL EXECUTION COUNT 1238

TYPE OF STATEMENT	NO EXECUTED	PERCENT EXECUTED
EXECUTABLE SOURCE	68	98.6
BRANCH	15	88.2
CALL	0	100.0
UNFORMATTED I/O	0	100.0
FORMATTED I/O	0	100.0

STATEMENT NUMBER	PROGRAM LISTING (LEADING N INDICATES CONVERSION WARNINGS)	COUNT	SPECIFIC EXECUTION DATA
	SUBROUTINE IMVEC(A,NMAX,INT,C1,AMU,SMALL,N,NUM,EIGVEC,NVEC,INTER,		
2	1Y,Z,B)		
	DIMENSION A(NMAX,NMAX),INTER(1),Y(1),Z(1),INT(1),B(NMAX,NMAX),		
4	1EIGVEC(NMAX,NMAX)		
5	DO50 I=1,N	*	0
6	DO50 J=1,N	*	0
7	50 B(I,J)=0.0	*	0
8	DO1 I=1,N	*	0
9	A(I,I)=A(I,I)-C1	*	0
10	1 B(I,I)=B(I,I)-AMU	*	0
11	DO2 I=2,N	*	0
12	C=A(I-1,I-1)*A(I-1,I-1)+B(I-1,I-1)*B(I-1,I-1)	*	0
13	D=A(I,I-1)*A(I,I-1)+B(I,I-1)*B(I,I-1)	*	0
14	IF (C.GE.D) GO TO 4	*	0
15	3 INTER(I)=I	*	0
16	G=C	*	0
17	C=D	*	0
18	D=G	*	0
19	J=I-1	*	0
20	DO5 K=J,N	*	0
21	G=A(I-1,K)	*	0
22	A(I-1,K)=A(I,K)	*	0
23	A(I,K)=G	*	0
24	G=B(I-1,K)	*	0
25	B(I-1,K)=B(I,K)	*	0
26	5 B(I,K)=G	*	0
27	GO TO 6	*	0
28	4 INTER(I)=I-1	*	0
29	6 IF (D.EQ.0.) GO TO 2	*	0
30	7 G=A(I,I-1)	*	0
31	A(I,I-1)=-(G*A(I-1,I-1)+B(I,I-1)*B(I-1,I-1))/C	*	0
32	B(I,I-1)=-(B(I,I-1)*A(I-1,I-1)-G*B(I-1,I-1))/C	*	0
33	DO8 K=I,N	*	0
34	A(I,K)=A(I,K)+A(I,I-1)*A(I-1,K)-B(I,I-1)*B(I-1,K)	*	0
35	8 B(I,K)=B(I,K)+B(I,I-1)*A(I-1,K)+A(I,I-1)*B(I-1,K)	*	0
36	2 CONTINUE	*	0
37 C	TRIANGULAR MATRIX FORMED		
38	DO9 I=1,N	*	0
39	C=A(I,I)*A(I,I)+B(I,I)*B(I,I)	*	0
40	IF (C.GE.SMALL) GO TO 9	*	0
41	A(I,I)= SQRT(SMALL)	*	0
42	B(I,I)=0.0	*	0
43	9 CONTINUE	*	0
44	DO 1111 I=1,N	*	0
45	Y(I)=1.0	*	0
46	1111 Z(I)=0.0	*	0
47	DO 8888 JJJ=1,N	*	0
48	C=A(N,N)*A(N,N)+B(N,N)*B(N,N)	*	0
49	G=Y(N)	*	0
50	Y(N)=(G*A(N,N)+Z(N)*B(N,N))/C	*	0
51	Z(N)=(Z(N)*A(N,N)-G*B(N,N))/C	*	0
52	DO17 I=2,N	*	0
53	E=0.0	*	0
54	F=0.0	*	0
55	M=N+1-I	*	0
56	DO18 J=2,I	*	0

STATEMENT NUMBER		PROGRAM LISTING (LEADING H INDICATES CONVERSION WARNINGS)	COUNT	SPECIFIC EXECUTION DATA
57		L=N+J-I	*	0
58		E=E+Y(L)*A(M,L)-Z(L)*B(M,L)	*	0
59	18	F=F+Y(L)*B(M,L)+Z(L)*A(M,L)	*	0
60		D=A(M,M)*A(M,M)+B(M,M)*B(M,M)	*	0
61		G=Y(M)	*	0
62		Y(M)=((G-E)*A(M,M)+(Z(M)-F)*B(M,M))/D	*	0
63	17	Z(M)=((Z(M)-F)*A(M,M)-(G-E)*B(M,M))/D	*	0
64		E=0.0	*	0
65		DO51 I=1,N	*	0
66		F=Y(I)*Y(I)+Z(I)*Z(I)	*	0
67		IF (E.GE.F) GO TO 51	*	0
68	52	E=F	*	0
69		L=I	*	0
70	51	CONTINUE	*	0
71		A1=Y(L)	*	0
72		A2=Z(L)	*	0
73		DO14 I=1,N	*	0
74		G=Y(I)	*	0
75		Y(I)=(G*A1+Z(I)*A2)/E	*	0
76	14	Z(I)=(Z(I)*A1-G*A2)/E	*	0
77		IF(JJJ.EQ.4) GO TO 6666	*	0
78		DO15 I=2,N	*	0
79		IF (INTER(I).NE.I) GO TO 30	*	0
80	16	G=Y(I)	*	0
81		Y(I)=Y(I-1)	*	0
82		Y(I-1)=G	*	0
83		G=Z(I)	*	0
84		Z(I)=Z(I-1)	*	0
85		Z(I-1)=G	*	0
86	30	Y(I)=Y(I)+A(I,I-1)*Y(I-1)-B(I,I-1)*Z(I-1)	*	0
87	15	Z(I)=Z(I)+B(I,I-1)*Y(I-1)+A(I,I-1)*Z(I-1)	*	0
88	8888	CONTINUE	*	0
89	C	EIGENVECTOR OF HESSENBURG MATRIX OBTAINED		
90	6666	M=N-1	*	0
91		DO21 I=2,M	*	0
92		J=N+1-I	*	0
93		L=J+1	*	0
94		DO20 K=L,N	*	0
95		Y(K)=Y(K)-Y(J)*A(K,J-1)+Z(J)*B(K,J-1)	*	0
96	20	Z(K)=Z(K)-Z(J)*A(K,J-1)-Y(J)*B(K,J-1)	*	0
97		LL=INT(N-I)	*	0
98		IF (J.EQ.LL) GO TO 21	*	0
99	19	G=Y(J)	*	0
100		Y(J)=Y(LL)	*	0
101		Y(LL)=G	*	0
102		G=Z(J)	*	0
103		Z(J)=Z(LL)	*	0
104		Z(LL)=G	*	0
105	21	CONTINUE	*	0
106	C	UNNORMALIZED EIGENVECTOR OBTAINED		
107		E=0.0	*	0
108		DO22 I=1,N	*	0
109		F=Y(I)*Y(I)+Z(I)*Z(I)	*	0
110		IF (E.GE.F) GO TO 22	*	0
111	23	E=F	*	0
112		L=I	*	0

STATEMENT NUMBER	PROGRAM LISTING (LEADING N INDICATES CONVERSION WARNINGS)	COUNT	SPECIFIC EXECUTION DATA
113	22 CONTINUE	*	0
114	A1=Y(L)	*	0
115	A2=Z(L)	*	0
116	DO24 I=1,N	*	0
117	G=Y(I)	*	0
118	Y(I)=(G*A1+Z(I)*A2)/E	*	0
119	24 Z(I)=(Z(I)*A1-G*A2)/E	*	0
120	C NORMALIZED EIGENVECTOR OBTAINED		
121	C PUT Y(I) (REAL PART) IN EIGVECT(NUMOFEV,I)		
122	DO 100 I=1,N	*	0
123	100 EIGVEC(NUM,I)=Y(I)	*	0
124	NUM=NUM+1	*	0
125	C PUT Z(I) (COMPLEX PART) IN EIGVECT(NUMOFEV,I)		
126	DO 101 I=1,N	*	0
127	101 EIGVEC(NUM,I)=Z(I)	*	0
128	RETURN	*	0
129	END		

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*                                    *
* PROGRAM EVALUATOR AND TESTER REPORT *
*                                    *
*        FOR SUBROUTINE IMVEC        *
*                                    *
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SYNTACTIC PROFILE

TOTAL NUMBER OF SOURCE STATEMENTS 127

TYPE OF STATEMENT	NUMBER	PERCENT OF TOTAL
EXECUTABLE SOURCE	118	92.9
NONEXECUTABLE SOURCE	3	2.4
COMMENT	6	4.7
NONSTANDARD	0	0.0
BRANCH	17	N/A
CALL	0	N/A
UNFORMATTED I/O	0	N/A
FORMATTED I/O	0	N/A
ASSERTION DIRECTIVES	0	N/A

THIS SUBROUTINE WAS NOT EXECUTED

PROGRAM EVALUATOR AND TESTER REPORT

FOR PROGRAM UNSEIG

SYNTACTIC PROFILE

TOTAL NUMBER OF SOURCE STATEMENTS 537

TYPE OF STATEMENT	NUMBER	PERCENT OF TOTAL
EXECUTABLE SOURCE	470	87.5
NONEXECUTABLE SOURCE	19	3.5
COMMENT	48	8.9
NONSTANDARD	1	.2
BRANCH	134	N/A
CALL	8	N/A
UNFORMATTED I/O	0	N/A
FORMATTED I/O	0	N/A
ASSERTION DIRECTIVES	0	N/A

OPERATIONAL PROFILE

TOTAL EXECUTION COUNT 2347

TYPE OF STATEMENT	NO EXECUTED	PERCENT EXECUTED
EXECUTABLE SOURCE	247	52.6
BRANCH	61	45.5
CALL	4	50.0
UNFORMATTED I/O	0	100.0
FORMATTED I/O	0	100.0

PROGRAM EVALUATOR AND TESTER REPORT

SUBROUTINE OPERATIONAL SUMMARY

SUBROUTINE NAME	NO OF STATEMENTS EXECUTED	PERCENT EXECUTED	NO OF CALLS EXECUTED	PERCENT EXECUTED	NO OF BRANCHES EXECUTED	PERCENT EXECUTED
UNSEIG	125	80.1	4	50.0	35	60.3
CALCEV	26	70.3	0	100.0	6	54.5
REALIT	28	90.3	0	100.0	5	71.4
RVEC	68	98.6	0	100.0	15	88.2
PROGRAM	247	52.6	4	50.0	61	45.5

SUBROUTINES NOT EXECUTED

COMPIT
IMVEC

24D

PROGRAM EVALUATOR AND TESTER REPORT

SUBROUTINE EXECUTION SUMMARY

SUBROUTINE NAME	NUMBER TIMES ENTERED	TOTAL EXECUTION COUNT	TOTAL CALL COUNT	PERCENT OF TOTAL EXECUTIONS	TOTAL BRANCH COUNT	PERCENT OF TOTAL EXECUTIONS	TOTAL I/O COUNT	PERCENT OF TOTAL EXECUTIONS
UNSEIG	1	560	14	2.50	121	21.61	0	0.00
CALCEV	3	34	0	0.00	7	20.59	0	0.00
REALIT	7	515	0	0.00	32	6.21	0	0.00
RVEC	4	1238	0	0.00	170	13.73	0	0.00

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* *
* PROGRAM EVALUATOR AND TESTER REPORT *
* *
* SUBROUTINE TIMING SUMMARY *
* *
****

TOTAL EXECUTION TIME FOR THIS CASE .042 SEC

TOTAL TIME IN MONITORED ROUTINES .038 SEC

TOTAL TIME IN OTHER ROUTINES .004 SEC

DETAILED SUBROUTINE TIME MONITORING

SUBROUTINE NAME	TIME RELATIVE TO MAXIMUM SUBROUTINE EXECUTION TIME (* = TWO PERCENT)	ACTUAL TIME IN SECONDS	PERCENT OF TOTAL MONITORED TIME
UNSEIG	**********	.017	44.74
CALCEV	***	.001	2.63
REALIT	********	.008	21.05
AVEC	**********	.012	31.58

TOTAL TIME IN POSTPROCESSOR 1.667 SEC

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STATEMENT
NUMBER    PROGRAM LISTING (LEADING N INDICATES CONVERSION WARNINGS)                    COUNT        SPECIFIC EXECUTION DATA

  1N      PROGRAM UNSEIG(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT)
  2 C FOR DESCRIPTION OF METHOD USED IN THIS PROGRAM, SEE **THE QR
  3 C TRANSFORMATION** BY FRANCIS, COMPUTER JOURNAL, VOL. 4 PP. 265,332
  4 C START HERE TO PRODUCE UPPER HESSENBURG MATRIX
  5       DIMENSION A(10,10),VEC(8),EIGVEC(4,4),INT(10),CC(10),SS(10)
  6       DIMENSION Z(10),D(10,10),BB(10,10)
          DATA A / 0.1,5.8,1.9,3.2,6*0.0,2.8,3.9,0.7,0.1,6*0.0,
  8      X         6.2,3.5,0.6,1.2,6*0.0,9.9,6.2,1.7,3.8        /
  9       NMAX = 10                                                                    1
 10       NN = 4                                                                       1
 11       NVEC = 4                                                                     1
 12       N=NN                                                                         1
 13       K=N-2                                                                        1
 14       DO1J=1,K                                                                     1
 15       K1=J+1                                                                       2
 16       K2=J+2                                                                       2
 17       GREAT= ABS(A(K1,J))                                                          2
 18       MAX=K1                                                                       2
 19       DO2I=K2,N                                                                    2
 20       AB= ABS(A(I,J))                                                              3
 21       IF (GREAT.GE.AB) GO TO 2                                                     3 TRUE        2 FALSE        1
 22     3 GREAT=AB                                                                     1
 23       MAX=I                                                                        1
 24     2 CONTINUE                                                                     3
 25 C INT(I) GIVES INFORMATION ABOUT INTERCHANGES
 26       INT(J)=MAX                                                                   2
 27       IF (MAX.EQ.K1) GO TO 5                                                       2 TRUE        1 FALSE        1
 28     4 DO6L=J,N                                                                     1
 29       E=A(K1,L)                                                                    3
 30       A(K1,L)=A(MAX,L)                                                             3
 31     6 A(MAX,L)=E                                                                   3
 32       DO7L=1,N                                                                     1
 33       E=A(L,K1)                                                                    4
 34       A(L,K1)=A(L,MAX)                                                             4
 35     7 A(L,MAX)=E                                                                   4
 36 C     INTERCHANGE DONE
 37     5 DO8I=K2,N                                                                    2
 38       IF (A(I,J).EQ.0.) GO TO 8                                                    3 TRUE        0 FALSE        3
 39       A(I,J)=-A(I,J)/A(K1,J)                                                       3
 40       DO11M=K1,N                                                                   3
 41    11 A(I,M)=A(I,M)+A(I,J)*A(K1,M)                                                 8
 42     8 CONTINUE                                                                     3
 43 C     LEFT MULT. DONE
 44       DO 2000 M=K2,N                                                               2
 45       IF (A(M,J).EQ.0.) GO TO 2000                                                 3 TRUE        0 FALSE        3
 46    10 DO 2001 I=1,N                                                                3
 47  2001 A(I,K1)=A(I,K1)-A(I,M)*A(M,J)                                                12
 48  2000 CONTINUE                                                                     3
 49     1 CONTINUE                                                                     2
 50 C     RIGHT MULT. DONE
 51 C HESSENBURG MATRIX NOW FORMED AS A(I,J). MULTIPLIERS STORED WITH IT
 52       DO 105 I=1,N                                                                 1
 53       DO 105 J=1,N                                                                 4
```

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STATEMENT
NUMBER    PROGRAM LISTING (LEADING N INDICATES CONVERSION WARNINGS)                    COUNT        SPECIFIC EXECUTION DATA
 54   105 D(I,J)=A(I,J)                                                                 16
 55 C PUT APPROPRIATE ZEROS WHERE MULTIPLIERS WERE STORED
 56       DO 106 I=3,N                                                                  1
 57       L=I-2                                                                         2
 58       DO 106 J=1,L                                                                  2
 59   106 A(I,J)=0.0                                                                    3
 60       K1=N+1                                                                        1
 61       R=0.0                                                                         1
 62       C=0.0                                                                         1
 63       DO33I=1,N                                                                     1
 64       R=R+ ABS(A(I,I))                                                              4
 65    33 C=C+ ABS(A(I,N))                                                              4
 66       DO34I=2,N                                                                     1
 67       RS=0.0                                                                        3
 68       CS=0.0                                                                        3
 69       L=I-1                                                                         3
 70       DO35J=L,N                                                                     3
 71       RS=RS+ ABS(A(I,J))                                                            9
 72       K1J=K1-J                                                                      9
 73       K1I=K1-I                                                                      9
 74    35 CS=CS+ ABS(A(K1J,K1I))                                                        9
 75       IF (RS.LE.R) GO TO 36                                                         3 TRUE       3 FALSE      0
 76    37 R=RS                                                                  *      0
 77    36 IF (CS.LE.C) GO TO 34                                                      3 TRUE       2 FALSE      1
 78    44 C=CS                                                                       1
 79    34 CONTINUE                                                                   3
 80       IJK=1                                                                      1
 81       IF (R.GE.C) GO TO 54                                                       1 TRUE       1 FALSE      0
 82 C DELTA IS CRITERION FOR STOPPING AN ITERATION
 83    53 DELTA=R*1.0E-11                                                    *      0
 84 C DEL IS ARBITRARY SHIFT
 85       DEL=R/17.1829                                                      *      0
 86       GO TO 153                                                          *      0
 87    54 DELTA=C*1.0E-11                                                            1
 88       DEL=C/17.1829                                                              1
 89 C     DELTA COMPUTED
 90 C PRODUCE A-PI, ITERATE ON THIS TO BREAK UP EIGENVALUES OF EQUAL MODULUS
 91   153 DO 107 I=1,N                                                               1
 92   107 A(I,I)=A(I,I)-DEL                                                          4
 93    55 IF (N.NE.1) GO TO 48                                                       1 TRUE       1 FALSE      0
 94 C SUBROUTINE CALCEV CALCULATES EIGENVALUES OF 1X1 OR 2X2 MATRICES.
 95 C PI IS ADDED BACK IN CALCEV
 96    47 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,1)                                 *      0
 97       GO TO 76                                                            *      0
 98    48 IF (N.NE.2) GO TO 80                                                       3 TRUE       2 FALSE      1
 99    49 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,2)                                        1
100       GO TO 76                                                                   1
101 C OR TRANSFORMATION STARTS HERE
102 C INITIALIZE FOR DETERMINING SUBSEQUENT SHIFTS
103    80 AR1=0.0                                                                    2
104       AR3=0.0                                                                    2
```

STATEMENT NUMBER	PROGRAM LISTING (LEADING N INDICATES CONVERSION WARNINGS)		COUNT	SPECIFIC EXECUTION DATA
105	AR4=0.0		2	
106	C RE-ENTER AFTER REALIT OR COMPIT SUBROUTINES CALLED			
107	C SELECT FIRST ((ZERO)) SUB-DIAGONAL ELEMENT FROM BOTTOM			
108	61 L=N		9	
109	DO56 I=2,N		9	
110	N2I=N+2-I		20	
111	IF(ABS(A(N2I,N2I-1)).LT.DELTA)GO TO 57		20	TRUE 2 FALSE 18
112	56 L=L-1		18	
113	C VALUE OF L SELECTED			
114	57 IF (L.NE.N) GO TO 59		9	TRUE 7 FALSE 2
115	58 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,1)		2	
116	N=N-1		2	
117	GO TO 48		2	
118	59 IF ((L-N+1).NE.0) GO TO 75		7	TRUE 7 FALSE 0
119	60 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,2)	*	0	
120	N=N-2	*	0	
121	GO TO 55	*	0	
122	C DETERMINE EIGENVALUES OF 2X2 MATRIX -- ROW 1 = A(N-1,N-1) A(N-1,N)			
123	C ROW 2 = A(N,N-1) A(N,N)			
124	C AND BASE SHIFT ON THESE			
125	75 B=A(N-1,N-1)+A(N,N)		7	
126	C=A(N-1,N-1)*A(N,N)-A(N,N-1)*A(N-1,N)		7	
127	C1=A(N-1,N-1)-A(N,N)		7	
128	DISC=C1*C1+4.0*A(N,N-1)*A(N-1,N)		7	
129	IF (DISC.GE.0.) GO TO 63		7	TRUE 7 FALSE 0
130	62 R1=0.5*B	*	0	
131	R2=.5* SQRT(ABS(DISC))	*	0	
132	ANUM=(R1-AR3)*(R1-AR3)+(R2-AR4)*(R2-AR4)	*	0	
133	DENOM=AR3*AR3+AR4*AR4	*	0	
134	IF (DENOM.NE.0.) GO TO 200	*	0	
135	201 RHO=0.0	*	0	
136	SIGMA=0.0	*	0	
137	GO TO 203	*	0	
138	200 RHO=C	*	0	
139	SIGMA=B	*	0	
140	203 AR3=R1	*	0	
141	AR4=R2	*	0	
142	CALL COMPIT(A,NMAX,L,N,RHO,SIGMA)	*	0	
143	GO TO 61	*	0	
144	63 IF (B.GE.0.) GO TO 65		7	TRUE 0 FALSE 7
145	64 R1=.5*(B- SQRT(DISC))		7	
146	GO TO 66		7	
147	65 R1=.5*(B+ SQRT(DISC))	*	0	
148	IF (R1.NE.0.) GO TO 66	*	0	
149	83 R2=0.0	*	0	
150	GO TO 84	*	0	
151	66 R2=C/R1		7	
152	C ROOTS OF 2*2 MATRIX FOUND			
153	84 IF(ABS(A(N,N)-R1).GE. ABS(A(N,N)-R2))GO TO 68		7	TRUE 3 FALSE 4
154	67 AR2=R1		4	
155	GO TO 69		4	

```
STATEMENT
NUMBER   PROGRAM LISTING (LEADING N INDICATES CONVERSION WARNINGS)                    COUNT        SPECIFIC EXECUTION DATA
     68 AR2=R2                                                                        3
     69 IF (AR1.NE.0.) GO TO 71                                                       7 TRUE       5 FALSE      2
     72 SHIFT=0.0                                                                     2
        GO TO 73                                                                      2
     71 SHIFT=AR2                                                                     5
     73 AR1=AR2                                                                       7
        CALL REALIT(A,NMAX,L,N,SHIFT,CC,SS)                                           7
        GO TO 61                                                                      7
C ARE VECTORS NEEDED
     76 IF (NVEC.EQ.0) GO TO 600                                                      1 TRUE       0 FALSE      1
C INVERSE ITERATION IS USED FOR EIGENVECTORS
    550 SMALL=DELTA*1.0E-30                                                           1
        NUM=0                                                                         1
        JI=1                                                                          1
        NM=NN+NN                                                                      1
C C1 IS REAL PART OF EIGENVALUE
    513 C1=VEC(JI)                                                                    4
C C2 IS COMPLEX PART OF EIGENVALUE
        C2=VEC(JI+1)                                                                  4
        NUM=NUM+1                                                                     4
C REPLACE HESSENBURG MATRIX AND MULTIPLIERS
        DO 570 I=1,NN                                                                 4
        DO 570 J=1,NN                                                                16
    570 A(I,J)=D(I,J)                                                                64
        IF (C2.NE.0.) GO TO 561                                                       4 TRUE       0 FALSE      4
        CALL RVEC(A,NMAX,INT,C1,SMALL,NN,NUM,EIGVEC,NVEC,CC,SS)                       4
        JI=JI+2                                                                       4
        IF(NVEC.EQ.NUM)GO TO 600                                                      4 TRUE       1 FALSE      3
        GO TO 513                                                                     3
    561 CALL IMVEC(A,NMAX,INT,C1,C2,SMALL,NN,NUM,EIGVEC,NVEC,CC,SS,Z,BB)          *   0
C NEXT STATEMENT IGNORES CONJUGATE COMPLEX EIGENVALUES
        JI=JI+4                                                                   *   0
        IF(NVEC.EQ.NUM)GO TO 600                                                  *   0
        GO TO 513                                                                 *   0
    600 CONTINUE                                                                      1
        END                                                                           1
```

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*                                    *
* PROGRAM EVALUATOR AND TESTER REPORT *
*                                    *
*        FOR SUBROUTINE UNSEIG       *
*                                    *
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SYNTACTIC PROFILE

TOTAL NUMBER OF SOURCE STATEMENTS 190

TYPE OF STATEMENT	NUMBER	PERCENT OF TOTAL
EXECUTABLE SOURCE	156	82.1
NONEXECUTABLE SOURCE	4	2.1
COMMENT	30	15.8
NONSTANDARD	1	.5
BRANCH	58	N/A
CALL	8	N/A
UNFORMATTED I/O	0	N/A
FORMATTED I/O	0	N/A
ASSERTION DIRECTIVES	0	N/A

OPERATIONAL PROFILE

TOTAL EXECUTION COUNT 560

TYPE OF STATEMENT	NO EXECUTED	PERCENT EXECUTED
EXECUTABLE SOURCE	125	80.1
BRANCH	35	60.3
CALL	4	50.0
UNFORMATTED I/O	0	100.0
FORMATTED I/O	0	100.0

STATEMENT NUMBER	PROGRAM LISTING (LEADING N INDICATES CONVERSION WARNINGS)		COUNT	SPECIFIC EXECUTION DATA
1	SUBROUTINE CALCEV(A,NMAX,DEL,VEC,IJK,N,M)			
2	DIMENSION A(NMAX,NMAX),VEC(1)			
3	IF (M.NE.1) GO TO 2		3	TRUE 1 FALSE 2
4	1 AI=0.0		2	
5	A(N,N)=A(N,N)+DEL		2	
6	C STORE EIGENVALUES IN VEC			
7	VEC(IJK)=A(N,N)		2	
8	VEC(IJK+1)=AI		2	
9	IJK=IJK+2		2	
10	RETURN		2	
11	2 B=A(N-1,N-1)+A(N,N)		1	
12	C=A(N-1,N-1)*A(N,N)-A(N,N-1)*A(N-1,N)		1	
13	C1=A(N-1,N-1)-A(N,N)		1	
14	DISC=C1*C1+4.0*A(N,N-1)*A(N-1,N)		1	
15	IF (DISC.LT.0.) GO TO 9		1	TRUE 0 FALSE 1
16	4 AI=0.0		1	
17	IF (B.GE.0.) GO TO 6		1	TRUE 1 FALSE 0
18	R1=0.5*(B- SQRT(DISC))	*	0	
19	GO TO 7	*	0	
20	6 R1=0.5*(B+ SQRT(DISC))		1	
21	IF(R1.NE.0.) GO TO 7		1	TRUE 1 FALSE 0
22	10 R2=0.0	*	0	
23	GO TO 11	*	0	
24	7 R2=C/R1		1	
25	11 R1=R1+DEL		1	
26	R2=R2+DEL		1	
27	VEC(IJK)=R2		1	
28	VEC(IJK+1)=AI		1	
29	VEC(IJK+2)=R1		1	
30	VEC(IJK+3)=AI		1	
31	GO TO 8		1	
32	9 R1=0.5*B	*	0	
33	AI=-.5* SQRT(ABS(DISC))	*	0	
34	R1=R1+DEL	*	0	
35	VEC(IJK)=R1	*	0	
36	VEC(IJK+1)=-AI	*	0	
37	VEC(IJK+2)=R1	*	0	
38	VEC(IJK+3)=AI	*	0	
39	8 IJK=IJK+4		1	
40	RETURN		1	
41	END			

PROGRAM EVALUATOR AND TESTER REPORT
FOR SUBROUTINE CALCEV

SYNTACTIC PROFILE

TOTAL NUMBER OF SOURCE STATEMENTS 41

TYPE OF STATEMENT	NUMBER	PERCENT OF TOTAL
EXECUTABLE SOURCE	37	90.2
NONEXECUTABLE SOURCE	3	7.3
COMMENT	1	2.4
NONSTANDARD	0	0.0
BRANCH	11	N/A
CALL	0	N/A
UNFORMATTED I/O	0	N/A
FORMATTED I/O	0	N/A
ASSERTION DIRECTIVES	0	N/A

OPERATIONAL PROFILE

TOTAL EXECUTION COUNT 39

TYPE OF STATEMENT	NO EXECUTED	PERCENT EXECUTED
EXECUTABLE SOURCE	26	70.3
BRANCH	6	54.5
CALL	0	100.0
UNFORMATTED I/O	0	100.0
FORMATTED I/O	0	100.0

```
STATEMENT
NUMBER    PROGRAM LISTING (LEADING N INDICATES CONVERSION WARNINGS)                    COUNT        SPECIFIC EXECUTION DATA

      1       SUBROUTINE REALIT(A,NMAX,L,N,SHIFT,C,S)
      2       DIMENSION A(NMAX,NMAX),C(1),S(1)
      3       IF (SHIFT.EQ.0.) GO TO 2                                                    7 TRUE          2 FALSE         5
      4     1 DO3 I=L,N                                                                   5
      5     3 A(I,I)=A(I,I)-SHIFT                                                       18
      6     2 M=N-1                                                                      7
      7       DO4 I=L,M                                                                  7
      8       DENOM= SQRT(A(I,I)**2+A(I+1,I)**2)                                        18
      9       IF (DENOM.GT.0.) GO TO 10                                                 18 TRUE          18 FALSE        0
     10    11 C(I)=1.0                                                          *         0
     11       S(I)=0.0                                                          *         0
     12       GO TO 4                                                           *         0
     13    10 C(I)=A(I,I)/DENOM                                                         18
     14       S(I)=A(I+1,I)/DENOM                                                       18
     15       A(I,I)=DENOM                                                              18
     16    12 I1=I+1                                                                    18
     17       DO 35 J=I1,N                                                              18
     18       F=A(I,J)                                                                  33
     19       A(I,J)=A(I+1,J)*S(I)+F*C(I)                                               33
     20       A(I+1,J)=A(I+1,J)*C(I)-F*S(I)                                             33
     21    35 CONTINUE                                                                  33
     22     4 CONTINUE                                                                  18
     23 C     TRIANGULAR MATRIX FORMED
     24       DO5 J=L,M                                                                 7
     25       DO6 I=L,J                                                                 18
     26       F=A(I,J)                                                                  33
     27       A(I,J)=A(I,J+1)*S(J)+F*C(J)                                               33
     28     6 A(I,J+1)=A(I,J+1)*C(J)-F*S(J)                                             33
     29       A(J+1,J)=A(J+1,I,J+1)*S(J)                                                18
     30     5 A(J+1,J+1)=A(J+1,J+1)*C(J)                                                18
     31 C     TRANSFORMATION COMPLETED
     32       IF (SHIFT.EQ.0.) RETURN                                                   7 TRUE          2 FALSE         5
     33     7 DO9 I=L,N                                                                 5
     34     9 A(I,I)=A(I,I)+SHIFT                                                       18
     35     8 RETURN                                                                    5
     36       END
```

PROGRAM EVALUATOR AND TESTER REPORT
FOR SUBROUTINE REALIT

SYNTACTIC PROFILE

TOTAL NUMBER OF SOURCE STATEMENTS 36

TYPE OF STATEMENT	NUMBER	PERCENT OF TOTAL
EXECUTABLE SOURCE	31	86.1
NONEXECUTABLE SOURCE	3	8.3
COMMENT	2	5.6
NONSTANDARD	0	0.0
BRANCH	7	N/A
CALL	0	N/A
UNFORMATTED I/O	0	N/A
FORMATTED I/O	0	N/A
ASSERTION DIRECTIVES	0	N/A

OPERATIONAL PROFILE

TOTAL EXECUTION COUNT 515

TYPE OF STATEMENT	NO EXECUTED	PERCENT EXECUTED
EXECUTABLE SOURCE	28	90.3
BRANCH	5	71.4
CALL	0	100.0
UNFORMATTED I/O	0	100.0
FORMATTED I/O	0	100.0

STATEMENT NUMBER	PROGRAM LISTING (LEADING N INDICATES CONVERSION WARNINGS)	COUNT	SPECIFIC EXECUTION DATA
1	SUBROUTINE COMPIT(A,NMAX,L,N,RHO,SIGMA)		
2	DIMENSION A(NMAX,NMAX)		
3	C HOUSEHOLDER TYPE MATRICES USED INSTEAD OF ROTATIONS(SEE FRANCIS PAPER)		
4	M=N-1	*	0
5	DO 1 I=L,M	*	0
6	IF (I.NE.L) GO TO 3	*	0
7	2 B1=A(L,L)*(A(L,L)-SIGMA)+A(L,L+1)*A(L+1,L)+RHO	*	0
8	B2=A(L+1,L)*(A(L,L)+A(L+1,L+1)-SIGMA)	*	0
9	B3=A(L+1,L)*A(L+2,L+1)	*	0
10	A(L+2,L)=0.0	*	0
11	GO TO 6	*	0
12	3 B1=A(I,I-1)	*	0
13	B2=A(I+1,I-1)	*	0
14	IF (I.EQ.M) GO TO 5	*	0
15	4 B3=A(I+2,I-1)	*	0
16	GO TO 6	*	0
17	5 B3=0.0	*	0
18	6 D= SQRT(B1*B1+B2*B2+B3*B3)	*	0
19	IF (B1.GE.0.) GO TO 8	*	0
20	7 D=-D	*	0
21	8 IF (D.EQ.0.) GO TO 1	*	0
22	9 C1=B2/(D+B1)	*	0
23	C2=B3/(D+B1)	*	0
24	E=2.0/(1.0+C1*C1+C2*C2)	*	0
25	DO 10 K=I,N	*	0
26	IF (I.EQ.M) GO TO 12	*	0
27	11 G=E*(A(I,K)+C1*A(I+1,K)+C2*A(I+2,K))	*	0
28	A(I,K)=A(I,K)-G	*	0
29	A(I+1,K)=A(I+1,K)-C1*G	*	0
30	A(I+2,K)=A(I+2,K)-C2*G	*	0
31	GO TO 10	*	0
32	12 G=E*(A(I,K)+C1*A(I+1,K))	*	0
33	A(I,K)=A(I,K)-G	*	0
34	A(I+1,K)=A(I+1,K)-C1*G	*	0
35	10 CONTINUE	*	0
36	IF (I.EQ.L) GO TO 14	*	0
37	13 A(I,I-1)=-D	*	0
38	A(I+1,I-1)=0.0	*	0
39	IF (I.EQ.M) GO TO 14	*	0
40	15 A(I+2,I-1)=0.0	*	0
41	C ROW OPERATION COMPLETED		
42	14 J=I+2	*	0
43	IF (J.LE.N) GO TO 17	*	0
44	16 J=N	*	0
45	17 DO 18 K=L,J	*	0
46	IF (I.EQ.M) GO TO 20	*	0
47	19 G=E*(A(K,I)+C1*A(K,I+1)+C2*A(K,I+2))	*	0
48	A(K,I)=A(K,I)-G	*	0
49	A(K,I+1)=A(K,I+1)-C1*G	*	0
50	A(K,I+2)=A(K,I+2)-C2*G	*	0
51	GO TO 18	*	0
52	20 G=E*(A(K,I)+C1*A(K,I+1))	*	0
53	A(K,I)=A(K,I)-G	*	0
54	A(K,I+1)=A(K,I+1)-C1*G	*	0
55	18 CONTINUE	*	0
56	J=I+3	*	0

```
STATEMENT
NUMBER    PROGRAM LISTING (LEADING N INDICATES CONVERSION WARNINGS)          COUNT        SPECIFIC EXECUTION DATA
      57        IF (J.GT.N) GO TO 1                                          *      0
      58     21 G=E*C2*A(I+3,I+2)                                            *      0
      59        A(I+3,I)=-G                                                  *      0
      60        A(I+3,I+1)=-C1*G                                             *      0
      61        A(I+3,I+2)=A(I+3,I+2)-C2*G                                   *      0
      62 C      COLUMN OPERATION COMPLETED
      63      1 CONTINUE                                                     *      0
      64        RETURN                                                       *      0
      65        END
```

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* *
* PROGRAM EVALUATOR AND TESTER REPORT *
* *
* FOR SUBROUTINE COMPIT *
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SYNTACTIC PROFILE

TOTAL NUMBER OF SOURCE STATEMENTS 65

TYPE OF STATEMENT	NUMBER	PERCENT OF TOTAL
EXECUTABLE SOURCE	59	90.8
NONEXECUTABLE SOURCE	3	4.6
COMMENT	3	4.6
NONSTANDARD	0	0.0
BRANCH	24	N/A
CALL	0	N/A
UNFORMATTED I/O	0	N/A
FORMATTED I/O	0	N/A
ASSERTION DIRECTIVES	0	N/A

THIS SUBROUTINE WAS NOT EXECUTED

STATEMENT NUMBER	PROGRAM LISTING (LEADING N INDICATES CONVERSION WARNINGS)	COUNT	SPECIFIC EXECUTION DATA
1	SUBROUTINE AVEC(A,NMAX,INT,C),SMALL,N,NUM,EIGVEC,NVEC,INTER,Y)		
2	DIMENSION A(NMAX,NMAX),INTER(1),Y(1),INT(1),EIGVEC(NMAX,NMAX)		
3	DO1 I=1,N	4	
4	1 A(I,I)=A(I,I)-C1	16	
5	DO2 I=2,N	4	
6	IF(ABS(A(I-1,I-1)).GE. ABS(A(1,I-1)))GO TO 4	12	TRUE 6 FALSE 6
7	3 INTER(I)=I	6	
8	J=I-1	6	
9	DO5 K=J,N	6	
10	B=A(I-1,K)	18	
11	A(I-1,K)=A(I,K)	18	
12	5 A(I,K)=B	18	
13	GO TO 6	6	
14	4 INTER(I)=I-1	6	
15	6 IF (A(I,I-1).EQ.0.) GO TO 2	12	TRUE 0 FALSE 12
16	C=-A(I,I-1)/A(I-1,I-1)	12	
17	A(I,I-1)=C	12	
18	DO 8 K=I,N	12	
19	8 A(I,K)=A(I,K)+C*A(I-1,K)	24	
20	2 CONTINUE	12	
21	C - TRIANGULAR MATRIX FORMED		
22	DO9 I=1,N	4	
23	IF(ABS(A(I,I)).GE.SMALL)GO TO 9	16	TRUE 16 FALSE 0
24	10 A(I,I)=SMALL	0	
25	9 CONTINUE	16	
26	C NORMALISED ((EIGENVECTOR)) OF HESSENBURG MATRIX OBTAINED FOR RHS = 1		
27	DO 5555 I=1,N	4	
28	5555 Y(I)=1.0	16	
29	DO 8888 JJJJ=1,4	4	
30	7777 Y(N)=Y(N)/A(N,N)	16	
31	B=Y(N)	16	
32	DO11 I=2,N	16	
33	E=0.0	48	
34	M=N+1-I	48	
35	DO12 J=2,I	48	
36	L=N+J-I	96	
37	12 E=E+Y(L)*A(M,L)	96	
38	Y(M)=(Y(M)-E)/A(M,M)	48	
39	IF(ABS(B).GE. ABS(Y(M)))GO TO 11	48	TRUE 20 FALSE 28
40	13 B=Y(M)	28	
41	11 CONTINUE	48	
42	DO14 I=1,N	16	
43	14 Y(I)=Y(I)/B	64	
44	IF(JJJJ.EQ.4)GO TO 6666	16	TRUE 4 FALSE 12
45	DO15 I=2,N	12	
46	IF (INTER(I).NE.I) GO TO 15	36	TRUE 18 FALSE 18
47	16 B=Y(I)	18	
48	Y(I)=Y(I-1)	18	
49	Y(I-1)=B	18	
50	15 Y(I)=Y(I)+A(I,I-1)*Y(I-1)	36	
51	8888 CONTINUE	12	

STATEMENT NUMBER	PROGRAM LISTING (LEADING N INDICATES CONVERSION WARNINGS)	COUNT	SPECIFIC EXECUTION DATA
52	C EIGENVECTOR OF HESSENBURG MATRIX OBTAINED (NOT NORMALIZED)		
53	6666 M=N-1	4	
54	DO21 I=2,M	4	
55	J=N+1-I	8	
56	L=J+1	8	
57	DO20 K=L,N	8	
58	20 Y(K)=Y(K)-Y(J)*A(K,J-1)	12	
59	LL=INT(N-I)	8	
60	IF (J.EQ.LL) GO TO 21	8	TRUE 4 FALSE 4
61	19 B=Y(J)	4	
62	Y(J)=Y(LL)	4	
63	Y(LL)=B	4	
64	21 CONTINUE	8	
65	C UNNORMALIZED EIGENVECTOR OF ORIGINAL MATRIX OBTAINED		
66	B=0.0	4	
67	DO22 I=1,N	4	
68	IF(ABS(B).GE. ABS(Y(I)))GO TO 22	16	TRUE 8 FALSE 8
69	23 B=Y(I)	8	
70	22 CONTINUE	16	
71	DO24 I=1,N	4	
72	24 Y(I)=Y(I)/B	16	
73	C NORMALIZED EIGENVECTOR OBTAINED		
74	C PUT Y(I) (REAL EIGENVECTOR) IN EIGVECT(NUMOFEV,I)		
75	DO 100 I=1,N	4	
76	100 EIGVEC(NUM,I)=Y(I)	16	
77	RETURN	4	
78	END		

****
* *
* PROGRAM EVALUATOR AND TESTER REPORT *
* *
* FOR SUBROUTINE RVEC *
* *
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SYNTACTIC PROFILE

TOTAL NUMBER OF SOURCE STATEMENTS 78

TYPE OF STATEMENT	NUMBER	PERCENT OF TOTAL
EXECUTABLE SOURCE	69	88.5
NONEXECUTABLE SOURCE	3	3.8
COMMENT	6	7.7
NONSTANDARD	0	0.0
BRANCH	17	N/A
CALL	0	N/A
UNFORMATTED I/O	0	N/A
FORMATTED I/O	0	N/A
ASSERTION DIRECTIVES	0	N/A

OPERATIONAL PROFILE

TOTAL EXECUTION COUNT 1238

TYPE OF STATEMENT	NO EXECUTED	PERCENT EXECUTED
EXECUTABLE SOURCE	68	98.6
BRANCH	15	88.2
CALL	0	100.0
UNFORMATTED I/O	0	100.0
FORMATTED I/O	0	100.0

STATEMENT NUMBER	PROGRAM LISTING (LEADING N INDICATES CONVERSION WARNINGS)	COUNT	SPECIFIC EXECUTION DATA
	SUBROUTINE IMVEC(A,NMAX,INT,C1,AMU,SMALL,N,NUM,EIGVEC,NVEC,INTER,		
2	1Y,Z,B)		
	DIMENSION A(NMAX,NMAX),INTER(1),Y(1),Z(1),INT(1),B(NMAX,NMAX),		
4	1EIGVEC(NMAX,NMAX)		
5	DO50 I=1,N	* 0	
6	DO50 J=1,N	* 0	
7	50 B(I,J)=0.0	* 0	
8	DO1 I=1,N	* 0	
9	A(I,I)=A(I,I)-C1	* 0	
10	1 B(I,I)=B(I,I)-AMU	* 0	
11	DO2 I=2,N	* 0	
12	C=A(I-1,I-1)*A(I-1,I-1)+B(I-1,I-1)*B(I-1,I-1)	* 0	
13	D=A(I,I-1)*A(I,I-1)+B(I,I-1)*B(I,I-1)	* 0	
14	IF (C.GE.D) GO TO 4	* 0	
15	3 INTER(I)=I	* 0	
16	G=C	* 0	
17	C=D	* 0	
18	D=G	* 0	
19	J=I-1	* 0	
20	DO5 K=J,N	* 0	
21	G=A(I-1,K)	* 0	
22	A(I-1,K)=A(I,K)	* 0	
23	A(I,K)=G	* 0	
24	G=B(I-1,K)	* 0	
25	B(I-1,K)=B(I,K)	* 0	
26	5 B(I,K)=G	* 0	
27	GO TO 6	* 0	
28	4 INTER(I)=I-1	* 0	
29	6 IF (D.EQ.0.) GO TO 2	* 0	
30	7 G=A(I,I-1)	* 0	
31	A(I,I-1)=-(G*A(I-1,I-1)+B(I,I-1)*B(I-1,I-1))/C	* 0	
32	B(I,I-1)=-(B(I,I-1)*A(I-1,I-1)-G*B(I-1,I-1))/C	* 0	
33	DO8 K=I,N	* 0	
34	A(I,K)=A(I,K)+A(I,I-1)*A(I-1,K)-B(I,I-1)*B(I-1,K)	* 0	
35	8 B(I,K)=B(I,K)+B(I,I-1)*A(I-1,K)+A(I,I-1)*B(I-1,K)	* 0	
36	2 CONTINUE	* 0	
37 C	TRIANGULAR MATRIX FORMED		
38	DO9 I=1,N	* 0	
39	C=A(I,I)*A(I,I)+B(I,I)*B(I,I)	* 0	
40	IF (C.GE.SMALL) GO TO 9	* 0	
41	A(I,I)= SQRT(SMALL)	* 0	
42	B(I,I)=0.0	* 0	
43	9 CONTINUE	* 0	
44	DO 1111 I=1,N	* 0	
45	Y(I)=1.0	* 0	
46	1111 Z(I)=0.0	* 0	
47	DO 8888 JJJ=1,4	* 0	
48	C=A(N,N)*A(N,N)+B(N,N)*B(N,N)	* 0	
49	G=Y(N)	* 0	
50	Y(N)=(G*A(N,N)+Z(N)*B(N,N))/C	* 0	
51	Z(N)=(Z(N)*A(N,N)-G*B(N,N))/C	* 0	
52	DO17 I=2,N	* 0	
53	E=0.0	* 0	
54	F=0.0	* 0	
55	M=N+1-I	* 0	
56	DO18 J=2,I	* 0	

STATEMENT NUMBER	PROGRAM LISTING (LEADING N INDICATES CONVERSION WARNINGS)	COUNT	SPECIFIC EXECUTION DATA
	L=N+J-I	* 0	
	E=E+Y(L)*A(M,L)-Z(L)*B(M,L)	* 0	
18	F=F+Y(L)*B(M,L)+Z(L)*A(M,L)	* 0	
	D=A(M,M)*A(M,M)+B(M,M)*B(M,M)	* 0	
	G=Y(M)	* 0	
	Y(M)=((G-E)*A(M,M)+(Z(M)-F)*B(M,M))/D	* 0	
17	Z(M)=((Z(M)-F)*A(M,M)-(G-E)*B(M,M))/D	* 0	
	E=0.0	* 0	
	DO51 I=1,N	* 0	
	F=Y(I)*Y(I)+Z(I)*Z(I)	* 0	
	IF (E.GE.F) GO TO 51	* 0	
52	E=F	* 0	
	L=I	* 0	
51	CONTINUE	* 0	
	A1=Y(L)	* 0	
	A2=Z(L)	* 0	
	DO14 I=1,N	* 0	
	G=Y(I)	* 0	
	Y(I)=(G*A1+Z(I)*A2)/E	* 0	
14	Z(I)=(Z(I)*A1-G*A2)/E	* 0	
	IF(JJJ.EQ.4) GO TO 6666	* 0	
	DO15 I=2,M	* 0	
	IF (INTER(I).NE.1) GO TO 30	* 0	
16	G=Y(I)	* 0	
	Y(I)=Y(I-1)	* 0	
	Y(I-1)=G	* 0	
	G=Z(I)	* 0	
	Z(I)=Z(I-1)	* 0	
	Z(I-1)=G	* 0	
30	Y(I)=Y(I)+A(I,I-1)*Y(I-1)-B(I,I-1)*Z(I-1)	* 0	
15	Z(I)=Z(I)+B(I,I-1)*Y(I-1)+A(I,I-1)*Z(I-1)	* 0	
8888	CONTINUE	* 0	
C	EIGENVECTOR OF HESSENBURG MATRIX OBTAINED		
6666	M=N-1	* 0	
	DO21 I=2,M	* 0	
	J=N+1-I	* 0	
	L=J+1	* 0	
	DO20 K=L,N	* 0	
	Y(K)=Y(K)-Y(J)*A(K,J-1)+Z(J)*B(K,J-1)	* 0	
20	Z(K)=Z(K)-Z(J)*A(K,J-1)-Y(J)*B(K,J-1)	* 0	
	LL=INT(N-I)	* 0	
	IF (J.EQ.LL) GO TO 21	* 0	
19	G=Y(J)	* 0	
	Y(J)=Y(LL)	* 0	
	Y(LL)=G	* 0	
	G=Z(J)	* 0	
	Z(J)=Z(LL)	* 0	
	Z(LL)=G	* 0	
21	CONTINUE	* 0	
C	UNNORMALIZED EIGENVECTOR OBTAINED		
	E=0.0	* 0	
	DO22 I=1,N	* 0	
	F=Y(I)*Y(I)+Z(I)*Z(I)	* 0	
	IF (E.GE.F) GO TO 22	* 0	
23	E=F	* 0	
	L=I	* 0	

STATEMENT NUMBER	PROGRAM LISTING (LEADING N INDICATES CONVERSION WARNINGS)	COUNT	SPECIFIC EXECUTION DATA
113	22 CONTINUE	* 0	
114	A1=Y(L)	* 0	
115	A2=Z(L)	* 0	
116	DO24 I=1,N	* 0	
117	G=Y(I)	* 0	
118	Y(I)=(G*A1+Z(I)*A2)/E	* 0	
119	24 Z(I)=(Z(I)*A1-G*A2)/E	* 0	
120 C	NORMALIZED EIGENVECTOR OBTAINED		
121 C PUT	Y(I) (REAL PART) IN EIGVECT(NUMOFEV,I)		
122	DO 100 I=1,N	* 0	
123	100 EIGVEC(NUM,I)=Y(I)	* 0	
124	NUM=NUM+1	* 0	
125 C PUT	Z(I) (COMPLEX PART) IN EIGVECT(NUMOFEV,I)		
126	DO 101 I=1,N	* 0	
127	101 EIGVEC(NUM,I)=Z(I)	* 0	
128	RETURN	* 0	
129	END		

****
* *
* PROGRAM EVALUATOR AND TESTER REPORT *
* *
* FOR SUBROUTINE IMVEC *
* *
****

SYNTACTIC PROFILE

TOTAL NUMBER OF SOURCE STATEMENTS 127

TYPE OF STATEMENT	NUMBER	PERCENT OF TOTAL
EXECUTABLE SOURCE	118	92.9
NONEXECUTABLE SOURCE	3	2.4
COMMENT	6	4.7
NONSTANDARD	0	0.0
BRANCH	17	N/A
CALL	0	N/A
UNFORMATTED I/O	0	N/A
FORMATTED I/O	0	N/A
ASSERTION DIRECTIVES	0	N/A

THIS SUBROUTINE WAS NOT EXECUTED

****
* *
* PROGRAM EVALUATOR AND TESTER REPORT *
* *
* FOR PROGRAM UNSEIG *
* *
****

SYNTACTIC PROFILE

TOTAL NUMBER OF SOURCE STATEMENTS 537

TYPE OF STATEMENT	NUMBER	PERCENT OF TOTAL
EXECUTABLE SOURCE	470	87.5
NONEXECUTABLE SOURCE	19	3.5
COMMENT	48	8.9
NONSTANDARD	1	.2
BRANCH	134	N/A
CALL	8	N/A
UNFORMATTED I/O	0	N/A
FORMATTED I/O	0	N/A
ASSERTION DIRECTIVES	0	N/A

OPERATIONAL PROFILE

TOTAL EXECUTION COUNT 2347

TYPE OF STATEMENT	NO EXECUTED	PERCENT EXECUTED
EXECUTABLE SOURCE	247	52.6
BRANCH	61	45.5
CALL	4	50.0
UNFORMATTED I/O	0	100.0
FORMATTED I/O	0	100.0

PROGRAM EVALUATOR AND TESTER REPORT

SUBROUTINE OPERATIONAL SUMMARY

SUBROUTINE NAME	NO OF STATEMENTS EXECUTED	PERCENT EXECUTED	NO OF CALLS EXECUTED	PERCENT EXECUTED	NO OF BRANCHES EXECUTED	PERCENT EXECUTED
UNSEIG	125	80.1	4	50.0	35	60.3
CALCEV	26	70.3	0	100.0	6	54.5
REALIT	28	90.3	0	100.0	5	71.4
AVEC	68	98.6	0	100.0	15	88.2
PROGRAM	247	52.6	4	50.0	61	45.5

SUBROUTINES NOT EXECUTED

COMPIT
IMVEC

****
* *
* PROGRAM EVALUATOR AND TESTER REPORT *
* *
* SUBROUTINE EXECUTION SUMMARY *
* *
****

SUBROUTINE NAME	NUMBER TIMES ENTERED	TOTAL EXECUTION COUNT	TOTAL CALL COUNT	PERCENT OF TOTAL EXECUTIONS	TOTAL BRANCH COUNT	PERCENT OF TOTAL EXECUTIONS	TOTAL I/O COUNT	PERCENT OF TOTAL EXECUTIONS
UNSEIG	1	560	14	2.50	121	21.61	0	0.00
CALCEV	3	34	0	0.00	7	20.59	0	0.00
REALIT	7	515	0	0.00	32	6.21	0	0.00
RVEC	4	1236	0	0.00	170	13.73	0	0.00

PROGRAM EVALUATOR AND TESTER REPORT

SUBROUTINE TIMING SUMMARY

TOTAL EXECUTION TIME FOR THIS CASE .013 SEC

TOTAL TIME IN POSTPROCESSOR 1.260 SEC

ABBREVIATIONS USED IN THE FORTRAN VERIFIER SYMBOL TABLES FOLLOWING THE PROGRAM UNIT LISTINGS

TYPE KEY	USAGE KEY	ATTRIBUTE KEY
COLUMN 1.	COLUMNS 1 AND 2.	COLUMN 1.
E EXPLICITLY TYPED	FA ARITHMETIC-STATEMENT-FUNCTION ARGUMENT	C IN COMMON
COLUMN 2.	FN FUNCTION	COLUMN 2.
I INTEGER	E EXTERNAL(FUNCTION OR SUBROUTINE)	E IN AN EQUIVALENCE STATEMENT
R REAL	GT ASSIGNED GOTO VARIABLE	COLUMN 3.
D DOUBLE PRECISION	IF INTRINSIC FUNCTION	A DUMMY ARGUMENT
C COMPLEX	SN SUBROUTINE	COLUMN 4.
L LOGICAL	V VARIABLE	S VALUE SET BY PROGRAM UNIT
H HOLLERITH		COLUMNS 5 AND 6.
		S SCALAR
		AX ARRAY WITH X DIMENSIONS

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FORTRAN VERIFIER LISTING OF THE PROGRAM UNIT          04/15/75          15:46:34

      C FOR DESCRIPTION OF METHOD USED IN THIS PROGRAM, SEE **THE QR
      C TRANSFORMATION** BY FRANCIS, COMPUTER JOURNAL, VOL. 4 PP. 265,332
      C START HERE TO PRODUCE UPPER HESSENBERG MATRIX
    1       DIMENSION A(10,10),VEC(8), EIGVEC(4,4),  INT(10),CC(10),SS(10)
    2       DIMENSION Z(10),D(10,10),BE(10,10)
    3       DATA A / 0.1,5.8,1,9,3,2,6*0,0,2,8,3.9,0.7,0.1,6*0,0,
    3      Z         6.2,3.5,0,6,1.2,6*0,0,9,9,6.2,1,7,3,8          /

*** MISSING DECLARATORS OR DATA-ITEMS


*** ILLEGAL PUNCTUATION IN DATA STMT

    4           NMAX = 10
    5           NN = 4
    6           NVEC = 4
    7           N=NN
    8           K=N-2
    9           DO1J=1,K
   10           K1=J+1
   11           K2=J+2
   12           GREAT= ABS(A(K1,J))
   13           MAX=K1
   14           DO2I=K2,N
   15           AB= ABS(A(I,J))
   16           IF (GREAT.GE.AB) GO TO 2
   17         3 GREAT=AB
   18           MAX=I
   19         2 CONTINUE
      C INT(I) GIVES INFORMATION ABOUT INTERCHANGES
   20           INT(J)=MAX
   21           IF (MAX.EQ.K1) GO TO 5
   22         4 DO6L=J,N
   23           E=A(K1,L)
   24           A(K1,L)=A(MAX,L)
   25         6 A(MAX,L)=E
   26           DO7L=1,N
   27           E=A(L,K1)
   28           A(L,K1)=A(L,MAX)
   29         7 A(L,MAX)=E
      C       INTERCHANGE DONE
   30         5 DO8I=K2,N
   31           IF (A(I,J).EQ.0.) GO TO 8
   32           A(I,J)=-A(I,J)/A(K1,J)
   33           DO11M=K1,N
   34        11 A(I,M)=A(I,M)+A(I,J)*A(K1,M)
   35         8 CONTINUE
      C       LEFT MULT, DONE
   36           DO 2000 M=K2,N
   37           IF (A(M,J).EQ.0.) GO TO 2000
   38        10 DO 2001 I=1,N
   39      2001 A(I,K1)=A(I,K1)-A(I,M)*A(M,J)
   40      2000 CONTINUE
   41         1 CONTINUE
      C       IGHT   T. L
      C HESSENBURG MATRIX NOW FORMED AS A(I,J), MULTIPLIERS STORED WITH IT
```

```
      DO 105 J=1,N
  105 D(I,J)=A(I,J)
C PUT APPROPRIATE ZEROS WHERE MULTIPLIERS WERE STORED
      DO 106 I=3,N
      L=I-2
      DO 106 J=1,L
  106 A(I,J)=0.0
      K1=N+1
      R=0.0
      C=0.0
      DO33I=1,N
      R=R+ ABS(A(I,I))
   33 C=C+ ABS(A(I,N))
      DO34I=2,N
      RS=0.0
      CS=0.0
      L=I-1
      DO35J=L,N
      RS=RS+ ABS(A(I,J))
      K1J=K1-J
      K1I=K1-I
   35 CS=CS+ ABS(A(K1J,K1I))
      IF (RS.LE.R) GO TO 36
   37 R=RS
   36 IF (CS.LE.C) GO TO 34
   44 C=CS
   34 CONTINUE
      IJK=1
      IF (R.GE.C) GO TO 54
C DELTA IS CRITERION FOR STOPPING AN ITERATION
   53 DELTA=R*1.0E-11
C DEL IS ARBITRARY SHIFT
      DEL=R/17.1829
      GO TO 153
   54 DELTA=C*1.0E-11
      DEL=C/17.1829
C     DELTA COMPUTED
C PRODUCE A-PI, ITERATE ON THIS TO BREAK UP EIGENVALUES OF EQUAL MODULUS
  153 DO 107 I=1,N
  107 A(I,I)=A(I,I)-DEL
   55 IF (N.NE.1) GO TO 48
C SUBROUTINE CALCEV CALCULATES EIGENVALUES OF 1X1 OR 2X2 MATRICES.
C PI IS ADDED BACK IN CALCEV
   47 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,1)
      GO TO 76
   48 IF (N.NE.2) GO TO 60
   49 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,2)
      GO TO 76
C QR TRANSFORMATION STARTS HERE
C INITIALIZE FOR DETERMINING SUBSEQUENT SHIFTS
   60 AR1=0.0
      AR3=0.0
      AR4=0.0
C RE-ENTER AFTER REALIT OR COMPIT SUBROUTINES CALLED
C SELECT FIRST ((ZERO)) SUB-DIAGONAL ELEMENT FROM BOTTOM
   61 L=N
      DO56 I=2,N
      N2I=N+2-I
      IF( ABS(A(N2I,N2I-1)).LT.DELTA)GO TO 57
   56 L=L+1
C VALUE OF L SELECTED
   57 IF (L.NE.N) GO TO 59
   58 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,1)
      N=N-1
```

```
      IF (IL*N+1),NE.0) GO TO 75
   60 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,2)
      N=N-2
      GO TO 55
C DETERMINE EIGENVALUES OF 2X2 MATRIX == ROW 1 = A(N-1,N-1)   A(N-1,N)
C                                       ROW 2 = A(N,N-1)     A(N,N)
C AND BASE SHIFT ON THESE
   75 B=A(N-1,N-1)+A(N,N)
      C=A(N-1,N-1)*A(N,N)-A(N,N-1)*A(N-1,N)
      C1=A(N-1,N-1)-A(N,N)
      DISC=C1*C1+4.0*A(N,N-1)*A(N-1,N)
      IF (DISC.GE.0.) GO TO 63
   62 R1=0.5*B
      R2=.5* SQRT( ABS(DISC))
      ANUM=(R1-AR3)*(R1-AR3)+(R2-AR4)*(R2-AR4)
      DENOM=AR3*AR3+AR4*AR4
      IF (DENOM.NE.0.) GO TO 200
  201 RHO=0.0
      SIGMA=0.0
      GO TO 203
  200 RHO=C
      SIGMA=B
  203 AR3=R1
      AR4=R2
      CALL COMPIT(A,NMAX,L,N,RHO,SIGMA)
      GO TO 61
   63 IF (B.GE.0.) GO TO 65
   64 R1=.5*(B- SQRT(DISC))
      GO TO 66
   65 R1=.5*(B+ SQRT(DISC))
      IF (R1.NE.0.) GO TO 66
   83 R2=0.0
      GO TO 84
   66 R2=C/R1
C     ROOTS OF 2*2 MATRIX FOUND
   84 IF( ABS(A(N,N)-R1).GE. ABS(A(N,N)-R2))GO TO 68
   67 AR2=R1
      GO TO 69
   68 AR2=R2
   69 IF (AR1.NE.0.) GO TO 71
   72 SHIFT=0.0
      GO TO 73
   71 SHIFT=AR2
   73 AR1=AR2
      CALL REALIT(A,NMAX,L,N,SHIFT,CC,SS)
      GO TO 61
C ARE VECTORS NEEDED
   76 IF (NVEC.EQ.0) GO TO 600
C INVERSE ITERATION IS USED FOR EIGENVECTORS
  550 SMALL=DELTA*1.0E-30
      NUM=0
      JI=1
      NM=NN+NN
C C1 IS REAL PART OF EIGENVALUE
  513 C1=VEC(JI)
C C2 IS COMPLEX PART OF EIGENVALUE
      C2=VEC(JI+1)
      NUM=NUM+1
C REPLACE HESSENBURG MATRIX AND MULTIPLIERS
      DO 570 I=1,NN
      DO 570 J=1,NN
  570 A(I,J)=D(I,J)
      IF (C2.NE.0.) GO TO 561
      CALL RVEC(A,NMAX,INT,C1,SMALL,NN,NUM,EIGVEC,NVEC,CC,SS)
      JI=
      IF(NVEC.EQ.NUM)GO TO 600
```

```
      561 CALL IMVEC(A,NMAX,INT,C1,C2,SMALL,NN,NUM,EIGVEC,NVEC,CC,SS,Z,BB)
C NEXT STATEMENT IGNORES CONJUGATE COMPLEX EIGENVALUES
          JI=JI+4
          IF(NVEC.EQ.NUM)GO TO 600
          GO TO 513
      600 CONTINUE
          WRITE(6,700) (VEC(I),I=1,NN)
          DO 20 I=1,NN
   20     WRITE(6,700) (EIGVEC(I,J),J=1,NN)
  700     FORMAT(1H ,5E20.8 / 5E20.8)
          END
```

*** P-U NOT SAVED FOR PASS2 PROCESSING

PROGRAM UNIT *MAIN

NAME	TYPE	USE	ATTRIBUTES	REFERENCES
ABS	R	IF		12 15 53 54 60 63 90 106 127
AB	R	V	SS	15 16 17
ANUM	R	V	SS	107
AR1	R	V	SS	84 131 135
AR2	R	V	SS	128 130 134 135
AR3	R	V	SS	85 107 108 115
AR4	R	V	SS	86 107 108 116
A	R	V	SA2	1 3 12 15 23 24 25 27 28 29 31 32 34 37 39 44 48 53 54 60 63 77 79 82 90 93 97 100 101 102 103 117 127 136 148 150 154
BB	R	V	A2	2 154
B	R	V	SS	100 105 114 119 120 122
CALCEV		SN		79 82 93 97
CC	R	V	A1	1 136 150 154
COMPIT		SN		117
CS	R	V	SS	57 63 66 67
C1	R	V	SS	102 103 143 150 154
C2	R	V	SS	144 149 154
C	R	V	SS	51 54 66 67 70 74 75 101 113 126
DELTA	R	V	SS	71 74 90 139
DEL	R	V	SS	72 75 77 79 82 93 97
DENOM	R	V	SS	108 109
DISC	R	V	SS	103 104 106 120 122
D	R	V	SA2	2 44 148
EIGVEC	R	V	A2	1 150 154 161
E	R	V	SS	23 25 27 29
GREAT	R	V	SS	12 16 17
IJK	I	V	SS	69 79 82 93 97
IMVEC		SN		154
INT	I	V	SA1	1 20 150 154
I	I	V	SS	14 15 18 30 31 32 34 38 39 42 44 45 46 48 52 53 54 55 58 60 62 76 77 88 89 146 148 159 160 161
JI	I	V	SS	141 143 144 151 155
J	I	V	SS	9 10 11 12 15 20 22 31 32 34 37 39 43 44 47 48 59 60 61 147 148 161
K11	I	V	SS	62 63
K1J	I	V	SS	61 63
K1	I	V	SS	10 12 13 21 23 24 27 28 32 33 34 39 49 61 62
K2	I	V	SS	11 14 30 36
K	I	V	SS	8 9
L	I	V	SS	22 23 24 25 26 27 28 29 46 47 58 59 87 91 92 96 117 136
MAX	I	V	SS	13 18 20 21 24 25 28 29
M	I	V	SS	33 34 36 37 39
NMAX	I	V	SS	4 79 82 93 97 117 136 150 154
NN	I	V	SS	5 7 142 146 147 150 154 159

NUM	I	V	SS	140	145	150	152	154	156		
NVEC	I	V	SS	6	138	150	152	154	156		
N2I	I	V	SS	89	90						
N	I	V	SS	7	8	14	22	26	30	33	36
				38	42	43	45	49	52	54	55
				59	76	78	79	81	82	87	88
				89	92	93	94	96	97	98	100
				101	102	103	117	127	136		
REALIT		SN		136							
RHO	R	V	SS	110	113	117					
RS	R	V	SS	56	60	64	65				
RVEC		SN		150							
R1	R	V	SS	105	107	115	120	122	123	126	127
				128							
R2	R	V	SS	106	107	116	124	126	127	130	
R	R	V	SS	50	53	64	65	70	71	72	
SHIFT	R	V	SS	132	134	136					
SIGMA	R	V	SS	111	114	117					
SMALL	R	V	SS	139	150	154					
SQRT	ER	FN		106	120	122					
SS	R	V	A1	1	136	150	154				
VEC	R	V	A1	1	79	82	93	97	143	144	159
Z	R	V	A1	2	154						
105				42	43	44					
106				45	47	48					
107				76	77						
10				38							
11				33	34						
153				73	76						
1				9	41						
2000				36	37	40					
2001				38	39						
200				109	113						
201				110							
203				112	115						
20				160	161						
2				14	16	19					
33				52	54						
34				55	66	68					
35				59	63						
36				64	66						
37				65							
3				17							
44				67							
47				79							
48				78	81	95					
49				82							
4				22							
513				143	153	157					
53				71							
54				70	74						
550				139							
55				78	99						
561				149	154						
56				88	91						
570				146	147	148					
57				90	92						
58				93							
59				92	96						
5				21	30						
600				138	152	156	158				
60				97							
61				87	118	137					
62				105							

```
64                  126
65                  119   122
66                  121   123   126
67                  128
68                  127   130
69                  129   131
6                    22    25
700                 159   161   162
71                  131   134
72                  132
73                  133   135
75                   96   190
76                   80    83   138
7                    26    29
80                   81    84
83                  124
84                  125   127
8                    30    31    35

*** ILLEGAL LAST EXECUTABLE STMT
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FORTRAN VERIFIER LISTING OF THE PROGRAM UNIT 04/15/75 15.46.58.

```
1           SUBROUTINE CALCEV(A,NMAX,DEL,VEC,IJK,N,M)
2           DIMENSION A(NMAX,NMAX),VEC(1)
3           IF (M.NE.1) GO TO 2
4         1 AI=0.0
5           A(N,N)=A(N,N)+DEL
        C STORE EIGENVALUES IN VEC
6           VEC(IJK)=A(N,N)
7           VEC(IJK+1)=AI
8           IJK=IJK+2
9           RETURN
10        2 B=A(N-1,N-1)+A(N,N)
11          C=A(N-1,N-1)*A(N,N)-A(N,N-1)*A(N-1,N)
12          C1=A(N-1,N-1)-A(N,N)
13          DISC=C1*C1+4.0*A(N,N-1)*A(N-1,N)
14          IF (DISC.LT.0.) GO TO 9
15        4 AI=0.0
16          IF (B.GE.0.) GO TO 6
17          R1=0.5*(B- SQRT(DISC))
18          GO TO 7
19        6 R1=0.5*(B+ SQRT(DISC))
20          IF(R1.NE.0.) GO TO 7
21       10 R2=0.0
22          GO TO 11
23        7 R2=C/R1
24       11 R1=R1+DEL
25          R2=R2+DEL
26          VEC(IJK)=R2
27          VEC(IJK+1)=AI
28          VEC(IJK+2)=R1
29          VEC(IJK+3)=AI
30          GO TO 8
31        9 R1=0.5*B
32          AI=.5* SQRT( ABS(DISC))
33          R1=R1+DEL
34          VEC(IJK)=R1
35          VEC(IJK+1)=-AI
36          VEC(IJK+2)=R1
37          VEC(IJK+3)=AI
38        8 IJK=IJK+4
39          RETURN
40          END
```

PROGRAM UNIT CALCEV

ARGUMENTS A NMAX DEL VEC IJK N M

NAME	TYPE	USE	ATTRIBUTES	REFERENCES							
ABS	R	IF		32							
A1	R	V	SS	4	7	15	27	29	32	35	37
A	R	V	ASA2	1	2	5	6	10	11	12	13
B	R	V	SS	10	16	17	19	31			
C1	R	V	SS	12	13						
C	R	V	SS	11	23						
DEL	R	V	A S	1	5	24	25	33			
DISC	R	V	SS	13	14	17	19	32			
IJK	I	V	ASS	1	6	7	8	26	27	28	29
				34	35	36	37	39			
M	I	V	A S	1	3						
NMAX	I	V	A S	1	2						
N	I	V	A S	1	5	6	10	11	12	13	
R1	R	V	SS	17	19	20	23	24	28	31	33
				34	36						
R2	R	V	SS	21	23	25	26				
SQRT	ER	FN		17	19	32					
VEC	R	V	ASA1	1	2	6	7	26	27	28	29
				34	35	36	37				
10				21							
11				22	24						
1				4							
2				3	10						
4				15							
6				16	19						
7				18	20	23					
8				30	38						
9				14	31						

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FORTRAN VERIFIER LISTING OF THE PROGRAM UNIT 04/15/75 15:46:59

```
      1          SUBROUTINE REALIT(A,NMAX,L,N,SHIFT,C,S)
      2          DIMENSION A(NMAX,NMAX),C(1),S(1)
      3          IF (SHIFT.EQ.0.) GO TO 2
      4        1 DO3 I=L,N
      5        3 A(I,I)=A(I,I)-SHIFT
      6        2 M=N-1
      7          DO4 I=L,M
      8          DENOM= SQRT(A(I,I)**2+A(I+1,I)**2)
      9          IF (DENOM.GT.0.) GO TO 10
     10       11 C(I)=1.0
     11          S(I)=0.0
     12          GO TO 4
     13       10 C(I)=A(I,I)/DENOM
     14          S(I)=A(I+1,I)/DENOM
     15          A(I,I)=DENOM
     16       12 I1=I+1
     17          DO 35 J=I1,N
     18          F=A(I,J)
     19          A(I,J)=A(I+1,J)*S(I)+F*C(I)
     20          A(I+1,J)=A(I+1,J)*C(I)-F*S(I)
     21       35 CONTINUE
     22        4 CONTINUE
               C    TRIANGULAR MATRIX FORMED
     23          DO5 J=L,M
     24          DO6 I=L,J
     25          F=A(I,J)
     26          A(I,J)=A(I,J+1)*S(J)+F*C(J)
     27        6 A(I,J+1)=A(I,J+1)*C(J)-F*S(J)
     28          A(J+1,J)=A(J+1,J+1)*S(J)
     29        5 A(J+1,J+1)=A(J+1,J+1)*C(J)
               C    TRANSFORMATION COMPLETED
     30          IF (SHIFT.EQ.0.) RETURN
     31        7 DO9 I=L,N
     32        9 A(I,I)=A(I,I)+SHIFT
     33        8 RETURN
     34          END
```

PROGRAM UNIT REALIT

ARGUMENTS A NMAX L N SHIFT C S

NAME	TYPE	USE	ATTRIBUTES	REFERENCES							
A	R	V	ASA2	1	2	5	8	13	14	15	18
				19	20	25	26	27	28	29	32
C	R	V	ASA1	1	2	10	13	19	20	26	27
				29							
DENOM	R	V	SS	8	9	13	14	15			
F	R	V	SS	18	19	20	25	26	27		
I1	I	V	SS	16	17						
I	I	V	SS	4	5	7	8	10	11	13	14
				15	16	18	19	20	24	25	26
				27	31	32					
J	I	V	SS	17	18	19	20	23	24	25	26
				27	28	29					
L	I	V	A S	1	4	7	23	24	31		
M	I	V	SS	6	7	23					
NMAX	I	V	A S	1	2						
N	I	V	A S	1	4	6	17	31			
SHIFT	R	V	A S	1	3	5	30	32			
SORT	ER	FN		8							
S	R	V	ASA1	1	2	11	14	19	20	26	27
				28							
10				9	13						
11				10							
12				16							
1				4							
2				3	6						
35				17	21						
3				4	5						
4				7	12	22					
5				23	29						
6				24	27						
7				31							
8				33							
9				31	32						

FORTRAN VERIFIER LISTING OF THE PROGRAM UNIT 04/15/75 15:47:00

```
      SUBROUTINE COMPIT(A,NMAX,L,N,RHO,SIGMA)
      DIMENSION A(NMAX,NMAX)
C HOUSEHOLDER TYPE MATRICES USED INSTEAD OF ROTATIONS(SEE FRANCIS PAPER)
      M=N-1
      DO 1 I=L,M
      IF (I.NE.L) GO TO 3
    2 B1=A(L,L)*(A(L,L)-SIGMA)+A(L,L+1)*A(L+1,L)+RHO
      B2=A(L+1,L)*(A(L,L)+A(L+1,L+1)-SIGMA)
      B3=A(L+1,L)*A(L+2,L+1)
      A(L+2,L)=0.0
      GO TO 6
    3 B1=A(I,I-1)
      B2=A(I+1,I-1)
      IF (I.EQ.M) GO TO 5
    4 B3=A(I+2,I-1)
      GO TO 6
    5 B3=0.0
    6 D= SQRT(B1*B1+B2*B2+B3*B3)
      IF (B1.GE.0.) GO TO 8
    7 D=-D
    8 IF (D.EQ.0.) GO TO 1
    9 C1=B2/(D+B1)
      C2=B3/(D+B1)
      E=2.0/(1.0+C1*C1+C2*C2)
      DO 10 K=I,N
      IF (I.EQ.M) GO TO 12
   11 G=E*(A(I,K)+C1*A(I+1,K)+C2*A(I+2,K))
      A(I,K)=A(I,K)-G
      A(I+1,K)=A(I+1,K)-C1*G
      A(I+2,K)=A(I+2,K)-C2*G
      GO TO 10
   12 G=E*(A(I,K)+C1*A(I+1,K))
      A(I,K)=A(I,K)-G
      A(I+1,K)=A(I+1,K)-C1*G
   10 CONTINUE
      IF (I.EQ.L) GO TO 14
   13 A(I,I-1)=D
      A(I+1,I-1)=0.0
      IF (I.EQ.M) GO TO 14
   15 A(I+2,I-1)=0.0
C     ROW OPERATION COMPLETED
   14 J=I+2
      IF (J.LE.N) GO TO 17
   16 J=N
   17 DO 18 K=L,J
      IF (I.EQ.M) GO TO 20
   19 G=E*(A(K,I)+C1*A(K,I+1)+C2*A(K,I+2))
      A(K,I)=A(K,I)-G
      A(K,I+1)=A(K,I+1)-C1*G
      A(K,I+2)=A(K,I+2)-C2*G
      GO TO 18
   20 G=E*(A(K,I)+C1*A(K,I+1))
      A(K,I)=A(K,I)-G
      A(K,I+1)=A(K,I+1)-C1*G
   18 CONTINUE
      J=I+3
      IF (J.GT.N) GO TO 1
   21 G=E*C2*A(I+3,I+2)
      A(I+3,I)=-G
      A(I+3,I+1)=-C1*G
```

```
      C     COLUMN OPERATION COMPLETED
    1 CONTINUE
      RETURN
      END
```

14F

PROGRAM UNIT COMPIT

ARGUMENTS A NMAX L N RHO SIGMA

NAME	TYPE	USE	ATTRIBUTES	REFERENCES
A	R	V	ASAR	1 2 6 7 8 9 11 12
				14 26 27 28 29 31 32 33
				36 37 39 45 46 47 48 50
				51 52 56 57 58 59
B1	R	V	SS	6 11 17 18 21 22
B2	R	V	SS	7 12 17 21
B3	R	V	SS	8 14 16 17 22
C1	R	V	SS	21 23 26 28 31 33 45 47
				50 52 58
C2	R	V	SS	22 23 26 29 45 48 56 59
D	R	V	SS	17 19 20 21 22 36
E	R	V	SS	23 26 31 45 50 56
G	R	V	SS	26 27 28 29 31 32 33 45
				46 47 48 50 51 52 56 57
				58 59
I	I	V	SS	4 5 11 12 13 14 24 25
				26 27 28 29 31 32 33 35
				36 37 38 39 40 44 45 46
				47 48 50 51 52 54 56 57
				58 59
J	I	V	SS	40 41 42 43 54 55
K	I	V	SS	24 26 27 28 29 31 32 33
				43 45 46 47 48 50 51 52
L	I	V	A S	1 4 5 6 7 8 9 35
				43
M	I	V	SS	3 4 13 25 38 44
NMAX	I	V	A S	1 2
N	I	V	A S	1 3 24 41 42 55
RHO	R	V	A S	1 6
SIGMA	R	V	A S	1 6 7
SORT	ER	FN		17
10				24 30 34
11				26
12				25 31
13				36
14				35 38 40
15				39
16				42
17				41 43
18				43 49 53
19				45
1				4 20 55 60
20				44 50
21				56
2				6
3				5 11
4				14
5				13 16
6				10 15 17
7				19
8				18 20
9				21

FORTRAN VERIFIER LISTING OF THE PROGRAM UNIT 04/15/75 15;47,01.

```
      1          SUBROUTINE RVEC(A,NMAX,INT,C1,SMALL,N,NUM,EIGVEC,NVEC,INTER,Y)
      2          DIMENSION A(NMAX,NMAX),INTER(1),Y(1),INT(1),EIGVEC(NMAX,NMAX)
      3            DO1 I=1,N
      4          1 A(I,I)=A(I,I)-C1
      5            DO2 I=2,N
      6            IF( ABS(A(I-1,I-1)),GE, ABS(A(I,I-1)))GO TO 4
      7          3 INTER(I)=I
      8            J=I-1
      9            DO5 K=J,N
     10            B=A(I-1,K)
     11            A(I-1,K)=A(I,K)
     12          5 A(I,K)=B
     13            GO TO 6
     14          4 INTER(I)=I-1
     15          6 IF (A(I,I-1),EQ.0.) GO TO 2
     16            C=-A(I,I-1)/A(I-1,I-1)
     17            A(I,I-1)=C
     18            DO 8 K=I,N
     19          8 A(I,K)=A(I,K)+C*A(I-1,K)
     20          2 CONTINUE
                C     TRIANGULAR MATRIX FORMED
     21            DO9 I=1,N
     22            IF( ABS(A(I,I)).GE.SMALL)GO TO 9
     23         10 A(I,I)=SMALL
     24          9 CONTINUE
                C NORMALISED ((EIGENVECTOR)) OF HESSENBURG MATRIX OBTAINED FOR RHS = 1
     25            DO 5555 I=1,N
     26       5555 Y(I)=1.0
     27            DO 8888 JJJ=1,4
     28       7777 Y(N)=Y(N)/A(N,N)
     29            B=Y(N)
     30            DO11 I=2,N
     31            E=0.0
     32            N=N-1
     33            DO12 J=2,I
     34            L=N+J-1
     35         12 E=E+Y(L)*A(M,L)
     36            Y(M)=(Y(M)-E)/A(M,M)
     37            IF( ABS(B).GE. ABS(Y(M)))GO TO 11
     38         13 B=Y(M)
     39         11 CONTINUE
     40            DO14 I=1,N
     41         14 Y(I)=Y(I)/B
     42            IF(JJJ.EQ.4)GO TO 6666
     43            DO15 I=2,N
     44            IF (INTER(I).NE.I) GO TO 15
     45         16 B=Y(I)
     46            Y(I)=Y(I-1)
     47            Y(I-1)=B
     48         15 Y(I)=Y(I)+A(I,I-1)*Y(I-1)
     49       8888 CONTINUE
                C EIGENVECTOR OF HESSENBURG MATRIX OBTAINED (NOT NORMALIZED)
     50       6666 M=N-1
     51            DO21 I=2,M
     52            J=N+1-I
     53            L=J+1
     54            DO20 K=L,N
     55         20 Y(K)=Y(K)-Y(J)*A(K,J-1)
     56                 RINT  )
```

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*** ILLEGAL SYNTAX OF SUBSCRIPT
      57            IF (J.EQ.LL) GO TO 21
      58         19 B=Y(J)
      59            Y(J)=Y(LL)
      60            Y(LL)=B
      61         21 CONTINUE
               C UNNORMALIZED EIGENVECTOR OF ORIGINAL MATRIX OBTAINED
      62            B=0.0
      63            DO22 I=1,N
      64            IF( ABS(B).GE. ABS(Y(I)))GO TO 22
      65         23 B=Y(I)
      66         22 CONTINUE
      67            DO24 I=1,N
      68         24 Y(I)=Y(I)/B
               C     NORMALIZED EIGENVECTOR OBTAINED
               C PUT Y(I) (REAL EIGENVECTOR) IN EIGVEC(NUMOFEV,I)
      69            DO 100 I=1,N
      70        100 EIGVEC(NUM,I)=Y(I)
      71            RETURN
      72            END
```


(7F)

PROGRAM UNIT RVEC

ARGUMENTS A NMAX INT G1 SHALL N NUM EIGVEC NVEC
INTER Y

NAME	TYPE	USE	ATTRIBUTES	REFERENCES
ABS	R	IF		6 22 37 64
A	R	V	ASA2	1 2 4 6 10 11 12 15 16 17 19 22 23 28 35 36 48 55
B	R	V	SS	10 12 29 37 38 41 45 47 58 60 62 64 65 68
C1	R	V	A S	1 4
C	R	V	SS	16 17 19
EIGVEC	R	V	ASA2	1 2 70
E	R	V	SS	31 35 36
INTER	I	V	ASA1	1 2 7 14 44
INT	I	V	A A1	1 2 56
I	I	V	SS	3 4 5 6 7 8 10 11 12 14 15 16 17 18 19 21 22 23 25 26 30 32 33 34 40 41 43 44 45 46 47 48 51 52 63 64 65 67 68 69 70
JJJJ	I	V	SS	27 42
J	I	V	SS	8 9 33 34 52 53 55 57 58 59
K	I	V	SS	9 10 11 12 18 19 54 55
LL	I	V	SS	56 57 59 60
L	I	V	SS	34 35 53 54
M	I	V	SS	32 35 36 37 38 50 51
NMAX	I	V	A S	1 2
NUM	I	V	A S	1 70
NVEC	I	V	A S	1
N	I	V	A S	1 3 5 9 18 21 25 28 29 30 32 34 40 43 50 52 54 56 63 67 69
SHALL	R	V	A S	1 22 23
Y	R	V	ASA1	1 2 26 28 29 35 36 37 38 41 45 46 47 48 55 58 59 60 64 65 68 70
100				69 70
10				23
11				30 37 39
12				33 35
13				38
14				40 41
15				43 44 48
16				45
19				58
1				3 4
20				54 55
21				51 57 61
22				63 64 66
23				65
24				67 68
3				5 15 20
5				7
4				6 14

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```
5                    9   12
6666                42   50
6                   13   15
7777                28
8888                27   49
8                   18   19
9                   21   22   24
```

FORTRAN VERIFIER LISTING OF THE PROGRAM UNIT 04/15/75 15.47.03.

```
1          SUBROUTINE INVEC(A,NMAX,INT,C1,AHU,SMALL,N,NUM,EIGVEC,NVEC,INTER,
1         1Y,Z,B)
2          DIMENSION A(NMAX,NMAX),INTER(1),Y(1),Z(1),INT(1),B(NMAX,NMAX),
2         1EIGVEC(NMAX,NMAX)
3          DO50 I=1,N
4          DO50 J=1,N
5        50 B(I,J)=0.0
6          DO1 I=1,N
7          A(I,I)=A(I,I)-C1
8        1 B(I,I)=B(I,I)-AHU
9          DO2 I=2,N
10         C=A(I-1,I-1)*A(I-1,I-1)+B(I-1,I-1)*B(I-1,I-1)
11         D=A(I,I-1)*A(I,I-1)+B(I,I-1)*B(I,I-1)
12         IF (C.GE.D) GO TO 4
13       3 INTER(I)=I
14         G=C
15         C=D
16         D=G
17         J=I-1
18         DO5 K=J,N
19         G=A(I-1,K)
20         A(I-1,K)=A(I,K)
21         A(I,K)=G
22         G=B(I-1,K)
23         B(I-1,K)=B(I,K)
24       5 B(I,K)=G
25         GO TO 6
26       4 INTER(I)=I-1
27       6 IF (D.EQ.0.) GO TO 2
28       7 G=A(I,I-1)
29         A(I,I-1)=-(G*A(I-1,I-1)+B(I,I-1)*B(I-1,I-1))/C
30         B(I,I-1)=-(B(I,I-1)*A(I-1,I-1)-G*B(I-1,I-1))/C
31         DO8 K=I,N
32         A(I,K)=A(I,K)+A(I,I-1)*A(I-1,K)-B(I,I-1)*B(I-1,K)
33       8  B(I,K)=B(I,K)+B(I,I-1)*A(I-1,K)+A(I,I-1)*B(I-1,K)
34       2 CONTINUE
C          TRIANGULAR MATRIX FORMED
35         DO9 I=1,N
36         C=A(I,I)*A(I,I)+B(I,I)*B(I,I)
37         IF (C.GE.SMALL) GO TO 9
38         A(I,I)= SQRT(SMALL)
39         B(I,I)=0.0
40       9 CONTINUE
41         DO 1111 I=1,N
42         Y(I)=1.0
43      1111 Z(I)=0.0
44         DO 8888 JJJ=1,4
45         C=A(N,N)*A(N,N)+B(N,N)*B(N,N)
46         G=Y(N)
47         Y(N)=(G*A(N,N)+Z(N)*B(N,N))/C
48         Z(N)=(Z(N)*A(N,N)-G*B(N,N))/C
49         DO17 I=2,N
50         E=0.0
51         F=0.0
52         M=N-I+1
53         DO18 J=2,I
54         L=N+J-I
55         E=E+Y(L)*A(M,L)-Z(L)*B(M,L)
56      18 F=F+Y(L)*B(M,L)+Z(L)*A(M,L)
57         D=A(M,M)*A(M,M)+B(M,M)*B(M,M)
```

2 OF

```
      58
      59          Y(M)=((G-E)*A(M,M)+(Z(M)*F)*B(N,M))/D
      60       17 Z(M)=((Z(M)-F)*A(M,M)*(G-E)*B(N,M))/D
      61          E=0.0
      62          DO51 I=1,N
      63          F=Y(I)*Y(I)+Z(I)*Z(I)
      64          IF (E.GE.F) GO TO 51
      65       52 E=F
      66          L=I
      67       51 CONTINUE
      68          A1=Y(L)
      69          A2=Z(L)
      70          DO14 I=1,N
      71          G=Y(I)
      72          Y(I)=(G*A1+Z(I)*A2)/E
      73       14 Z(I)=(Z(I)*A1-G*A2)/E
      74          IF(JJJ.EQ.4) GO TO 6666
      75          DO15 I=2,N
      76          IF (INTER(I).NE.1) GO TO 30
      77       16 G=Y(I)
      78          Y(I)=Y(I-1)
      79          Y(I-1)=G
      80          G=Z(I)
      81          Z(I)=Z(I-1)
      82          Z(I-1)=G
      83       30 Y(I)=Y(I)+A(I,I-1)*Y(I-1)+B(I,I-1)*Z(I-1)
      84       15 Z(I)=Z(I)+B(I,I-1)*Y(I-1)+A(I,I-1)*Z(I-1)
      85     8888 CONTINUE
             C    EIGENVECTOR OF HESSENBURG MATRIX OBTAINED
      86     6666 N=N-1
      87          DO21 I=2,N
      88          J=N+1-I
      89          L=J+1
      90          DO20 K=1,N
      91          Y(K)=Y(K)-Y(J)*A(K,J-1)+Z(J)*B(K,J-1)
      92       20 Z(K)=Z(K)-Z(J)*A(K,J-1)-Y(J)*B(K,J-1)
      93          LL=INT(N-I)

*** ILLEGAL SYNTAX OF SUBSCRIPT

      94          IF (J.EQ.LL) GO TO 21
      95       19 G=Y(J)
      96          Y(J)=Y(LL)
      97          Y(LL)=G
      98          G=Z(J)
      99          Z(J)=Z(LL)
     100          Z(LL)=G
     101       21 CONTINUE
             C    UNNORMALIZED EIGENVECTOR OBTAINED
     102          E=0.0
     103          DO22 I=1,N
     104          F=Y(I)*Y(I)+Z(I)*Z(I)
     105          IF (E.GE.F) GO TO 22
     106       23 E=F
     107          L=I
     108       22 CONTINUE
     109          A1=Y(L)
     110          A2=Z(L)
     111          DO24 I=1,N
     112          G=Y(I)
     113          Y(I)=(G*A1+Z(I)*A2)/E
     114       24 Z(I)=(Z(I)*A1-G*A2)/E
             C    NORMALIZED EIGENVECTOR OBTAINED
```

```
      DO 100 I=1,N
  100 EIGVEC(NUM,I)=Y(I)
      NUM=NUM+1
C PUT Z(I) (COMPLEX PART) IN EIGVEC(NUMOFEV,I)
      DO 101 I=1,N
  101 EIGVEC(NUM,I)=Z(I)
      RETURN
      END
```

22F

PROGRAM UNIT IMVEC

ARGUMENTS A NMAX INT C1 AHU SMALL N NUM EIGVEC
NVEC INTER Y Z B

NAME	TYPE	USE	ATTRIBUTES	REFERENCES
AHU	R	V	A S	1 8
A1	R	V	SS	68 72 73 109 113 114
A2	R	V	SS	69 72 73 110 113 114
A	R	V	ASA2	1 2 7 10 11 19 20 21
				28 29 30 32 33 36 38 45
				47 48 55 56 57 59 60 83
				84 91 92
B	R	V	ASA2	1 2 5 8 10 11 22 23
				24 29 30 32 33 36 39 45
				47 48 55 56 57 59 60 83
				84 91 92
C1	R	V	A S	1 7
C	R	V	SS	10 12 14 15 29 30 36 37
				45 47 48
D	R	V	SS	11 12 15 16 27 57 59 60
EIGVEC	R	V	ASA2	1 2 116 119
E	R	V	SS	50 55 59 60 61 64 65 72
				73 102 105 106 113 114
F	R	V	SS	51 56 59 60 63 64 65 104
				105 106
G	R	V	SS	14 16 19 21 22 24 28 29
				30 46 47 48 58 59 60 71
				72 73 77 79 80 82 95 97
				98 100 112 113 114
INTER	I	V	ASA1	1 2 13 26 76
INT	I	V	A A1	1 2 93
I	I	V	SS	3 5 6 7 8 9 10 11
				13 17 19 20 21 22 23 24
				26 28 29 30 31 32 33 35
				36 38 39 41 42 43 49 52
				53 54 62 63 66 70 71 72
				73 75 76 77 78 79 80 81
				82 83 84 87 88 103 104 107
				111 112 113 114 115 116 118 119
JJJ	I	V	SS	44 74
J	I	V	SS	4 5 17 18 53 54 88 89
				91 92 94 95 96 98 99
K	I	V	SS	18 19 20 21 22 23 24 31
				32 33 90 91 92
LL	I	V	SS	93 94 96 97 99 100
L	I	V	SS	54 55 56 66 68 69 89 90
				107 109 110
M	I	V	SS	52 55 56 57 58 59 60 86
				87
NMAX	I	V	A S	1 2
NUM	I	V	ASS	1 116 117 119
NVEC	I	V	A S	1
N	I	V	A S	1 3 4 6 9 18 31 35
				41 45 46 47 48 49 52 54
				62 70 75 86 88 90 93 103
				111 115 118
SMALL	R	V	A S	1 37 38

23F

	R	V	ASA1								
				1	2	42	46	47	55	56	58
				59	63	68	71	72	77	78	79
				83	84	91	92	95	96	97	104
				109	112	113	116				

Z	R	V	ASA1								
				1	2	43	47	48	55	56	59
				60	63	69	72	73	80	81	82
				83	84	91	92	98	99	100	104
				110	113	114	119				
100				115	116						
101				118	119						
1111				41	43						
14				70	73						
15				75	84						
16				77							
17				49	60						
18				53	56						
19				95							
1				6	8						
20				90	92						
21				87	94	101					
22				103	105	108					
23				106							
24				111	114						
2				9	27	34					
30				76	83						
3				13							
4				12	26						
50				3	4	5					
51				62	64	67					
52				65							
5				18	24						
6666				74	86						
6				25	27						
7				28							
8888				44	85						
8				31	33						
9				35	37	40					

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*** MISSING MAIN PGM

CALCEV

ARGUMENT ATTRIBUTES *RSA *I*S *R*S *RSA *ISS *I*S
*I*S
CALLS SUBPROGRAMS SQRT

COMPIT

ARGUMENT ATTRIBUTES *RSA *I*S *I*S *I*S *R*S *R*S
CALLS SUBPROGRAMS SQRT

IMVEC

ARGUMENT ATTRIBUTES *RSA *I*S *I*A *R*S *R*S *R*S
*I*S *ISS *RSA *I*S *ISA *RSA
*RSA *RSA
CALLS SUBPROGRAMS SQRT

REALIT

ARGUMENT ATTRIBUTES *RSA *I*S *I*S *I*S *R*S *RSA
*RSA
CALLS SUBPROGRAMS SQRT

RVEC

ARGUMENT ATTRIBUTES *RSA *I*S *I*A *R*S *R*S *I*S
*I*S *RSA *I*S *ISA *RSA

SQRT

ARGUMENT ATTRIBUTES *R*S
CALLED BY SUBPROGRAMS IMVEC COMPIT REALIT CALCEV

25F

1

```
00001          IDENTIFICATION DIVISION.
00002          PROGRAM-ID. AVSIM.
00003          ENVIRONMENT DIVISION.
00004          INPUT-OUTPUT SECTION.
00005          FILE-CONTROL.
00006              SELECT  COB     ASSIGN  TO  UT-S-SYS001.
00007              SELECT  AVS     ASSIGN  TO  UT-S-SYS002.
00008              SELECT  RPT     ASSIGN  TO  UT-S-SYS004.
00009          DATA DIVISION.
00010          FILE SECTION.
00011          FD  COB.
00012          01  COBR                        PIC X(80).
00013          FD  AVS.
00014          01  AVSR.
00015                  10  FILLER              PIC X(04).
00016                  10  AVSR-1              PIC X(06).
00017                  10  FILLER              PIC X(02).
00018                  10  AVSR-2              PIC X(68).
00019          FD  RPT.
00020          01  RPTR.
00021              05  RPTR80                  PIC X(80).
00022              05  RPTR53                  PIC X(53).
00023          WORKING-STORAGE SECTION.
00024          77  CTRL                        PIC X(01).
00025          77  CNTR1                       PIC 9(06)   VALUE 99.
00026          77  CNTR2                       PIC 9(03)   VALUE ZEROS.
00027          77  CNTR3                       PIC 9(05)   VALUE ZEROS.
00028          01  SUMM-FLAG                   PIC X(01)   VALUE SPACE.
00029          01  RPTWS.
00030              05  FILLER                  PIC X(01).
00031              05  LINE-NO                 PIC X(05)   VALUE SPACES.
00032              05  FILLER                  PIC X(01)   VALUE SPACES.
00033              05  RPTWS-1                 PIC X(01).
00034              05  COBX.
00035                  07 COBX-3.
00036                      10  COBX-1         PIC X(01).
00037                      10  COBX-2         PIC X(01).
00038                      10  FILLER         PIC X(01).
00039                  07 COBX-77.
00040                      10  FILLER         PIC X(76).
00041                      10  COBX-80        PIC X(01).
00042              05  AVSX.
00043                  10  AVSX-1             PIC X(06).
00044                  10  FILLER             PIC X(03).
00045                  10  AVSX-2             PIC X(71).
00046          01  RPTWSX  REDEFINES   RPTWS.
00047              05  RPTWSX80                PIC X(80).
00048              05  FILLER                  PIC X(06).
00049              05  RPTWSX53                PIC X(53).
```

```
00050            05  FILLER                  PIC X(29).
00051        01  HDR1.
00052            05  FILLER                  PIC X(72)   VALUE SPACES.
00053            05  FILLER                  PIC X(29)   VALUE
00054                'DATE 01/31/75            PAGE '.
00055            05  PGE                     PIC ZZZ9.
00056        01  HDR2.
00057            05  FILLER                  PIC X(82)   VALUE SPACES.
00058            05  FILLER                  PIC X(09)   VALUE 'EXECUTION'.
00059        01  HDR3.
00060            05  FILLER                  PIC X(09)   VALUE SPACES.
00061            05  FILLER                  PIC X(48)   VALUE
00062                '          ANNOTATED PROGRAM LISTING                '.
00063            05  FILLER                  PIC X(41)   VALUE
00064                '                COUNT          '.
00065            05  FILLER                  PIC X(23)   VALUE
00066                'SPECIFIC EXECUTION DATA'.
00067        01  BLINE                       PIC X(01).
00068        PROCEDURE DIVISION.
00069            OPEN INPUT  COB AVS.
00070            OPEN OUTPUT RPT.
00071            WRITE RPTR FROM BLINE AFTER POSITIONING 0 LINES.
00072            MOVE SPACES TO CTRL.
00073            MOVE 'X'  TO CTRL.
00074        MC10.
00075            READ COB INTO COBX  AT END GO TO MC20.
00076            READ AVS AT END GO TO MC20.
00077            IF  CTRL = 'X'  AND  SUMM-FLAG = SPACE
00078                MOVE SPACE TO AVSX
00079                MOVE AVSR-1  TO  AVSX-1
00080                MOVE AVSR-2  TO  AVSX-2
00081                       ELSE
00082                MOVE AVSR TO AVSX.
00083            MOVE SPACES TO RPTWS-1.
00084            IF  COBX-1  =  'C'  MOVE SPACE TO COBX-1.
00085            IF  COBX-1  =  'X'  MOVE  'C'  TO COBX-1.
00086            IF  COBX-1  =  '*'
00087                MOVE '1'  TO  SUMM-FLAG
00088                MOVE SPACE TO COBX-1
00089                ADD 01  TO  CNTR2
00090                MOVE CNTR2  TO  PGE
00091                WRITE RPTR  FROM HDR1   AFTER POSITIONING 0 LINES
00092                WRITE RPTR  FROM BLINE  AFTER POSITIONING 1 LINES
00093                MOVE 00 TO CNTR1
00094                GO TO MC10.
00095            IF  COBX-1  =  'E'
00096                MOVE ' '  TO  SUMM-FLAG
00097                MOVE SPACE TO COBX-1
00098                ADD 01  TO  CNTR2
00099                MOVE CNTR2  TO  PGE
00100                WRITE RPTR  FROM HDR1   AFTER POSITIONING 0 LINES
00101                WRITE RPTR  FROM HDR2   AFTER POSITIONING 1 LINES
```

```
00102                 WRITE RPTR  FROM BLINE  AFTER POSITIONING 1 LINES
00103                 MOVE 00 TO CNTR1
00104                 MOVE 00  TO  CNTR3
00105                 GO TO MC10.
00106           IF  CNTR1   GREATER   THAN  52
00107                 ADD 01  TO  CNTR2
00108                 MOVE CNTR2  TO  PGE
00109                 WRITE RPTR  FROM HDR1   AFTER POSITIONING 0 LINES
00110                 WRITE RPTR  FROM HDR2   AFTER POSITIONING 2 LINES
00111                 WRITE RPTR  FROM HDR3   AFTER POSITIONING 1 LINES
00112                 WRITE RPTR  FROM BLINE  AFTER POSITIONING 1 LINES
00113                 MOVE 00  TO CNTR1.
00114           ADD 01  TO  CNTR1.
00115           IF  COBX-1 = 'K'
00116                 MOVE SPACE  TO COBX-1
00117                 MOVE SPACE  TO LINE-NO
00118                       ELSE
00119                 ADD 001 TO CNTR3
00120                 MOVE CNTR3  TO LINE-NO.
00121           IF  SUMM-FLAG  =  '1'
00122                 MOVE SPACE  TO  LINE-NO
00123                 WRITE RPTR  FROM  RPTWS AFTER POSITIONING 1 LINES
00124                 GO TO MC10.
00125           IF  CTRL = 'X' GO TO MC15.
00126           IF  COBX-2 NOT = SPACES AND SUMM-FLAG NOT = '1'
00127                 MOVE COBX-3 TO LINE-NO
00128                 MOVE SPACES TO COBX-3
00129                     ELSE
00130                 MOVE SPACES TO LINE-NO.
00131           IF  COBX-80 NOT = SPACES MOVE 'C' TO RPTWS-1.
00132     MC15.
00133           MOVE SPACE TO COBX-80.
00134           MOVE RPTWSX80  TO  RPTR80.
00135           MOVE RPTWSX53  TO  RPTR53.
00136           WRITE RPTR AFTER POSITIONING 1 LINES.
00137           GO TO MC10.
00138     MC20.
00139           CLOSE COB AVS RPT.
00140           GOBACK.
```

CONDENSED LISTING

69	OPEN	0007DC	70	OPEN	000826	71	WRITE	00086A
72	MOVE	0008BE	73	MOVE	0008C2	75	READ	0008C6
75	GO	0008EC	76	READ	0008F2	76	GO	000912
77	IF	000918	78	MOVE	00092C	79	MOVE	000936
80	MOVE	00093C	82	MOVE	000952	83	MOVE	000958
84	IF	00095C	84	MOVE	000966	85	IF	00096A
85	MOVE	000974	86	IF	000978	87	MOVE	000982
88	MOVE	000986	89	ADD	00098A	90	MOVE	0009A0
91	WRITE	0009BB	92	WRITE	000A0C	93	MOVE	000A60
94	GO	000A66	95	IF	000A6C	96	MOVE	000A76
97	MOVE	000A7A	98	ADD	000A7E	99	MOVE	000A94
100	WRITE	000AAC	101	WRITE	000B00	102	WRITE	000B54
103	MOVE	000BA8	104	MOVE	000BAE	105	GO	000BB4
106	IF	000BBA	107	ADD	000BCC	108	MOVE	000BE2
109	WRITE	000BFA	110	WRITE	000C4E	111	WRITE	000CA2
112	WRITE	000CF6	113	MOVE	000D4A	114	ADD	000D50
115	IF	000D66	116	MOVE	000D70	117	MOVE	000D74
119	ADD	000D84	120	MOVE	000D9A	121	IF	000DA0
122	MOVE	000DAA	123	WRITE	000DB4	124	GO	000DFE
125	IF	000E04	125	GO	000E0E	126	IF	000E14
127	MOVE	000E28	128	MOVE	000E38	130	MOVE	000E48
131	IF	000E52	131	MOVE	000E5C	133	MOVE	000E60
134	MOVE	000E64	135	MOVE	000E6A	136	WRITE	000E70
137	GO	000EB4	139	CLOSE	000EBA	140	GOBACK	000FBA

A PROPRIETARY PROGRAM OF
BOOLE AND BABBAGE, INC.
18990 HOMESTEAD ROAD
CUPERTINO, CALIFORNIA 95014
408-255-1200

ANALYSIS NAME=
LOCATION=

REPORT DATE 17 JAN 75
REPORT TIME 15.24.08
ANALYSIS RUN NUMBER=

EXTRACTOR DATA SETS

DATA SET NAME	FT04F001
JOB NAME	AVSXX
STEP NAME	PPEXTRCT
CONTROL MODULE NAME	MAIN
EXTRACTION	
DATE	17 JAN 75
START TIME	15.23.33
END TIME	15.23.39
REGION BOUNDS(ABSOLUTE)	
FWA	295800
LWA	2B1000
SAMPLE BOUNDS	
FWA	000000
LWA	01B800
SAMPLE INTERVAL (MS)	16
SAMPLE COUNTS	
BELOW FWA	0
IN BOUNDS	60
ABOVE LWA	94
DSOW WAIT	157
SAMPLE INTERRUPTS	
INCLUDING WAIT	311
EXCLUDING WAIT	104
TOTAL INTERRUPTS	318
CONFIGURATION ID	
EXTRACTOR ID	PPEPL2.1
EXTRACTOR SERIAL NO.	0
WEIGHTING FACTOR	1
STUDY CRITERIA	
START TIME	15.23.33
END TIME	15.23.39

* * * * *

DISTRIBUTION OF ACTIVITY (EXCLUDING DSOW WAIT)

	ACTIVE	WAIT	TOTAL
BELOW LOWER SAMPLE BOUNDARY	0.0	0.0	0.0
WITHIN SAMPLE BOUNDARIES	9.00	10.29	19.29
ABOVE UPPER SAMPLE BOUNDARY	24.44	5.79	30.23
TOTAL	33.44	16.08	49.52

* * * * *

DG

DISTRIBUTION OF DSnW WAIT

DATA SET NAME	PERCENT OF ACTIVITY
SYSARFND	0,0
SYSOUT	0,0
SYS001	6,75
SYS002	9,97
SYS004	33,76
TOTAL	50,48

* * * * *

MODULE MAP (EXCLUDING WAIT)

MODULE NAME	FIRST BYTE ADDRESS	LAST BYTE ADDRESS	PERCENT OF RUN TIME	MODULES WITH OVERLAYS	MODULES FOR WHICH REPORTS ARE PROVIDED
MAIN	001E58	003800	26,92		X
IGG019AR	164EF0	165000	0,0		
IGG019AQ	165058	165100	0,0		

* * * * *

STUDY REPORT FOR MODULE MAIN

A. BOUNDS FOR THE STUDY REPORT

LOWER BOUND = 000000
UPPER BOUND = 01B800

NUMBER OF BYTES PER UNIT INTERVAL = 32, 00020(HEX)

* * * * *

B. DISTRIBUTION OF EXECUTED INSTRUCTIONS (EXCLUDING WAIT)

	ACTIVE	WAIT	TOTAL
BELOW LOWER STUDY BOUNDARY	0.0	0.0	0.0
WITHIN STUDY BOUNDARIES	26.92	0.0	26.92
ABOVE UPPER STUDY BOUNDARY	0.0	0.0	0.0
TOTAL	26.92	0.0	26.92

* * * * *

C. PERCENTAGE OF TIME SPENT EXECUTING SVC'S = 24.04

* * * * *

D. THE MOST FREQUENTLY EXECUTED INTERVALS (EXCLUDING WAIT)

STARTING LOCATION	ENDING LOCATION	PERCENT OF RUN TIME
000F40	000F5F	10.58
000820	00083F	6.73
000840	00085F	6.73
0008F0	0008FF	0.96
000880	00088F	0.96
001140	00115F	0.96

* * * * *

E. CODE EXECUTION FREQUENCY FOR EACH INTERVAL (EXCLUDING WAIT)

STARTING LOCATION	ENDING LOCATION	INTERVAL PERCENT	CUMULATIVE PERCENT	HISTOGRAM - PERCENT OF TIME (EACH * = 0.3 PERCENT) .0 3.0 6.0 9.0 12.0 15.0
000000	00081F	0.0	0.0	*
000820	00083F	6.73	6.73	**********
000840	00085F	6.73	13.46	**********
000860	00087F	0.0	13.46	*
0008F0	0008FF	0.96	14.42	****
000900	00089F	0.0	14.42	*
000880	00088F	0.96	15.38	****

STARTING LOCATION	ENDING LOCATION	INTERVAL PERCENT	CUMULATIVE PERCENT	HISTOGRAM - PERCENT OF TIME (EACH * = 0.3 PERCENT) .0 3.0 6.0 9.0 12.0 15.0
.000BC0	000F3F	0.0	15.38	-
000F40	000F5F	10.58	25.96	**********************************
.000F60	00113F	0.0	25.96	-
001140	00115F	0.96	26.92	***
.001160	018800	0.0	26.92	-

. THE INTERVAL SIZE CONSISTS OF MORE THAN ONE UNIT INTERVAL.

* * * * *

FORTRAN PROGRAM INPUT


```
LINE
NUMBER
     1      C..... REF:  UCLA DEMO 14.0
     2      C FOR DESCRIPTION OF METHOD USED IN THIS PROGRAM, SEE **THE QR
     3      C TRANSFORMATION** BY FRANCIS, COMPUTER JOURNAL, VOL. 4 PP. 265,332
     4      C START HERE TO PRODUCE UPPER HESSENBURG MATRIX
     5            DIMENSION A(10,10),VEC(8), EIGVEC(4,4),  INT(10),CC(10),SS(10)
     6            DIMENSION Z(10),D(10,10),BB(10,10)
     7            DATA A / 0.1,5.8,1.9,3.2,6*0.0,2.8,3.9,0.7,0.1,6*0.0,
     8           Z         6.2,3.5,0.6,1.2,6*0.0,9.9,6.2,1.7,3.8       /
     9            NMAX = 10
    10            NN = 4
    11            NVEC = 4
    12            N=NN
    13            K=N-2
    14            DO1J=1,K
    15            K1=J+1
    16            K2=J+2
    17            GREAT= ABS(A(K1,J))
    18            MAX=K1
    19            DO2I=K2,N
    20            AB= ABS(A(I,J))
    21            IF (GREAT.GE.AB) GO TO 2
    22          3 GREAT=AB
    23            MAX=I
    24          2 CONTINUE
    25      C INT(I) GIVES INFORMATION ABOUT INTERCHANGES
    26            INT(J)=MAX
    27            IF (MAX.EQ.K1) GO TO 5
    28          4 DO6L=J,N
    29            E=A(K1,L)
    30            A(K1,L)=A(MAX,L)
    31          6 A(MAX,L)=E
    32            DO7L=1,N
    33            E=A(L,K1)
    34            A(L,K1)=A(L,MAX)
    35          7 A(L,MAX)=E
    36      C     INTERCHANGE DONE
    37          5 DO8I=K2,N
    38            IF (A(I,J).EQ.0.) GO TO 8
    39            A(I,J)=-A(I,J)/A(K1,J)
    40            DO11M=K1,N
    41         11 A(I,M)=A(I,M)+A(I,J)*A(K1,M)
    42          8 CONTINUE
    43      C     LEFT MULT. DONE
    44            DO 2000 M=K2,N
    45            IF (A(M,J).EQ.0.) GO TO 2000
    46         10 DO 2001 I=1,N
    47       2001 A(I,K1)=A(I,K1)-A(I,M)*A(M,J)
    48       2000 CONTINUE
    49          1 CONTINUE
    50      C     RIGHT MULT. DONE
    51      C HESSENBURG MATRIX NOW FORMED AS A(I,J). MULTIPLIERS STORED WITH IT
    52            DO 105 I=1,N
```

FORTRAN PROGRAM INPUT

```
LINE
NUMBER      INPUT FORTRAN STATEMENT

   53           DO 105 J=1,N
   54       105 D(I,J)=A(I,J)
   55     C PUT APPROPRIATE ZEROS WHERE MULTIPLIERS WERE STORED
   56           DO 106 I=3,N
   57           L=I-2
   58           DO 106 J=1,L
   59       106 A(I,J)=0.0
   60           K1=N+1
   61           R=0.0
   62           C=0.0
   63           DO33I=1,N
   64           R=R+ ABS(A(1,I))
   65        33 C=C+ ABS(A(I,N))
   66           DO34I=2,N
   67           RS=0.0
   68           CS=0.0
   69           L=I-1
   70           DO35J=L,N
   71           RS=RS+ ABS(A(I,J))
   72           K1J=K1-J
   73           K1I=K1-I
   74        35 CS=CS+ ABS(A(K1J,K1I))
   75           IF (RS.LE.R) GO TO 36
   76        37 R=RS
   77        36 IF (CS.LE.C) GO TO 34
   78        44 C=CS
   79        34 CONTINUE
   80           IJK=1
   81           IF (R.GE.C) GO TO 54
   82     C DELTA IS CRITERION FOR STOPPING AN ITERATION
   83        53 DELTA=R*1.0E-11
   84     C DEL IS ARBITRARY SHIFT
   85           DEL=R/17.1829
   86           GO TO 153
   87        54 DELTA=C*1.0E-11
   88           DEL=C/17.1829
   89     C     DELTA COMPUTED
   90     C PRODUCE A-PI, ITERATE ON THIS TO BREAK UP EIGENVALUES OF EQUAL MODULUS
   91       153 DO 107 I=1,N
   92       107 A(I,I)=A(I,I)-DEL
   93        55 IF (N.NE.1) GO TO 48
   94     C SUBROUTINE CALCEV CALCULATES EIGENVALUES OF 1X1 OR 2X2 MATRICES,
   95     C PI IS ADDED BACK IN CALCEV
   96        47 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,1)
   97           GO TO 76
   98        48 IF (N.NE.2) GO TO 80
   99        49 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,2)
  100           GO TO 76
  101     C QR TRANSFORMATION STARTS HERE
  102     C INITIALIZE FOR DETERMINING SUBSEQUENT SHIFTS
  103        80 AR1=0.0
  104           AR3=0.0
```

FORTRAN PROGRAM INPUT

```
LINE
NUMBER                    INPUT FORTRAN STATEMENT

  105          AR4=0.0
  106      C RE-ENTER AFTER REALIT OR COMPIT SUBROUTINES CALLED
  107      C SELECT FIRST ((ZERO)) SUB-DIAGONAL ELEMENT FROM BOTTOM
  108         61 L=N
  109            DO56 I=2,N
  110            N2I=N+2-I
  111            IF( ABS(A(N2I,N2I-1)).LT.DELTA)GO TO 57
  112         56 L=L-1
  113      C VALUE OF L SELECTED
  114         57 IF (L.NE.N) GO TO 59
  115         58 CALL CALCEV(A,NMAX,CEL,VEC,IJK,N,1)
  116            N=N-1
  117            GO TO 48
  118         59 IF ((L-N+1).NE.0) GO TO 75
  119         60 CALL CALCEV(A,NMAX,CEL,VEC,IJK,N,2)
  120            N=N-2
  121            GO TO 55
  122      C DETERMINE EIGENVALUES OF 2X2 MATRIX -- ROW 1 = A(N-1,N-1)   A(N-1,N)
  123      C                                       ROW 2 = A(N,N-1)     A(N,N)
  124      C AND BASE SHIFT ON THESE
  125         75 B=A(N-1,N-1)+A(N,N)
  126            C=A(N-1,N-1)*A(N,N)-A(N,N-1)*A(N-1,N)
  127            C1=A(N-1,N-1)-A(N,N)
  128            DISC=C1*C1+4.0*A(N,N-1)*A(N-1,N)
  129            IF (DISC.GE.0.) GO TO 63
  130         62 R1=0.5*B
  131            R2=.5* SQRT( ABS(DISC))
  132            ANUM=(R1-AR3)*(R1-AR3)+(R2-AR4)*(R2-AR4)
  133            DENOM=AR3*AR3+AR4*AR4
  134            IF (DENOM.NE.0.) GO TO 200
  135        201 RHO=0.0
  136            SIGMA=0.0
  137            GO TO 203
  138        200 RHO=C
  139            SIGMA=B
  140        203 AR3=R1
  141            AR4=R2
  142            CALL COMPIT(A,NMAX,L,N,RHO,SIGMA)
  143            GO TO 61
  144         63 IF (B.GE.0.) GO TO 65
  145         64 R1=.5*(B- SQRT(DISC))
  146            GO TO 66
  147         65 R1=.5*(B+ SQRT(DISC))
  148            IF (R1.NE.0.) GO TO 66
  149         83 R2=0.0
  150            GO TO 84
  151         66 R2=C/R1
  152      C     ROOTS OF 2*2 MATRIX FOUND
  153         84 IF( ABS(A(N,N)-R1).GE. ABS(A(N,N)-R2))GO TO 68
  154         67 AR2=R1
  155            GO TO 69
  156         68 AR2=R2
```

FORTRAN PROGRAM INPLT

```
LINE
NUMBER                                  INPUT FORTRAN STATEMENT

  157        69 IF (AR1.NE.0.) GO TO 71
  158        72 SHIFT=0.0
  159           GO TO 73
  160        71 SHIFT=AR2
  161        73 AR1=AR2
  162           CALL REALIT(A,NMAX,L,N,SHIFT,CC,SS)
  163           GO TO 61
  164     C ARE VECTORS NEEDED
  165        76 IF (NVEC.EQ.0) GO TO 600
  166     C INVERSE ITERATION IS USED FOR EIGENVECTORS
  167       550 SMALL=DELTA*1.0E-30
  168           NUM=0
  169           JI=1
  170           NN=NN+NN
  171     C C1 IS REAL PART OF EIGENVALUE
  172       513 C1=VEC(JI)
  173     C C2 IS COMPLEX PART OF EIGENVALUE
  174           C2=VEC(JI+1)
  175           NUM=NUM+1
  176     C REPLACE HESSENBURG MATRIX AND MULTIPLIERS
  177           DO 570 I=1,NN
  178           DO 570 J=1,NN
  179       570 A(I,J)=B(I,J)
  180           IF (C2.NE.0.) GO TO 561
  181           CALL RVEC(A,NMAX,INT,C1,SMALL,NN,NUM,EIGVEC,NVEC,CC,SS)
  182           JI=JI+2
  183           IF(NVEC.EQ.NUM)GO TO 600
  184           GO TO 513
  185       561 CALL IRVEC(A,NMAX,INT,C1,C2,SMALL,NN,NUM,EIGVEC,NVEC,CC,SS,Z,BB)
  186     C NEXT STATEMENT IGNORES CONJUGATE COMPLEX EIGENVALUES
  187           JI=JI+4
  188           IF(NVEC.EQ.NUM)GO TO 600
  189           GO TO 513
  190       600 CONTINUE
  191           WRITE(6,700) (VEC(I),I=1,NN)
  192           DO 20 I=1,NN
  193        20 WRITE(6,700) (EIGVEC(I,J),J=1,NN)
  194       700 FORMAT(1H ,5E20.8 / 5E20.8)
  195           END
AFR1044    LINE NUMBER  193        *** NO RETURN OR STOP FOLLOWING LAST STATEMENT ***
```

STRUCTURED SFORTRAN PROGRAM

```
INPUT  OUTPUT  NEST
 LINE   LINE   LEVEL                    OUTPUT SFORTRAN STATEMENT

            1          C     ************************          ENTRY ************************
            2          C     ..... REF:  UCLA DEMO 14.0
            3          C      FOR DESCRIPTION OF METHOD USED IN THIS PROGRAM, SEE **THE QR
            4          C      TRANSFORMATION** BY FRANCIS, COMPUTER JOURNAL, VOL. 4 PP. 265,332
            5          C      START HERE TO PRODUCE UPPER HESSENBURG MATRIX
      5     6                   DIMENSION A(10,10),VEC(8), EIGVEC(4,4), INT(10),CC(10),SS(10)
      6     7                   DIMENSION Z(10),E(10,10),BB(10,10)
      7     8                   DATA A / 0.1,5.8,1.9,3.2,6*0.0,2.8,3.9,0.7,0.1,6*0.0, 6.2,3.5,
            9                1          0.6,1.2,6*0.0,9.9,6.2,1.7,3.8 /
           10          C     ************************ LOGIC START ***************************
      9    11                   NMAX = 10
     10    12                   NN = 4
     11    13                   NVEC = 4
     12    14                   N=NN
     13    15                   K=N-2
     14    16                   DO FOR J=1,K
     15    17         1           K1=J+1
     16    18         1           K2=J+2
     17    19         1           GREAT= ABS(A(K1,J))
     18    20         1           MAX=K1
     19    21         1           DO FOR I=K2,N
     20    22         2              AB= ABS(A(I,J))
     21    23         2              IF (GREAT.LT.AB)
     22    24         3                 GREAT=AB
     23    25         3                 MAX=I
           26         2              END IF
           27         1           END DO FOR
           28         1     C                 INT(I) GIVES INFORMATION ABOUT INTERCHANGES
     26    29         1           INT(J)=MAX
     27    30         1           IF (MAX.NE.K1)
     28    31         2              DO FOR L=J,N
     29    32         3                 E=A(K1,L)
     30    33         3                 A(K1,L)=A(MAX,L)
     31    34         3                 A(MAX,L)=E
           35         2              END DO FOR
           36         2              DO FOR L=1,N
     33    37         3                 E=A(L,K1)
```

STRUCTURED SFORTRAN PROGRAM

```
 INPUT  OUTPUT  NEST
 LINE   LINE    LEVEL                    OUTPUT SFORTRAN STATEMENT
   34     38      3          |     |   A(L,K1)=A(L,MAX)
   35     39      3          |     |   A(L,MAX)=E
          40      2          |     |END DO EOR
          41      1          |   END IF
          42      1    C     |                                    INTERCHANGE DONE
   37     43      1          |DO EOR I=K2,N
   38     44      2          |   IF (A(I,J).NE.0.)
   39     45      3          |      A(I,J)=-A(I,J)/A(K1,J)
   40     46      3          |      DO EOR M=K1,N
   41     47      4          |         A(I,M)=A(I,M)+A(I,J)*A(K1,M)
          48      3          |      END DO EOR
          49      2          |   END IF
          50      1          |END DO EOR
          51      1    C     |                                    LEFT MULT. DONE
   44     52      1          |DO EOR M=K2,N
   45     53      2          |   IF (A(M,J).NE.0.)
   46     54      3          |      DO EOR I=1,N
   47     55      4          |         A(I,K1)=A(I,K1)-A(I,M)*A(M,J)
          56      3          |      END DO EOR
          57      2          |   END IF
          58      1          |END DO EOR
          59                 |END DO EOR
          60          C      | RIGHT MULT. DONE
          61          C      HESSENBURG MATRIX NOW FORMED AS A(I,J). MULTIPLIERS STORED WITH IT
   52     62                 |DO EOR I=1,N
   53     63      1          |   DO EOR J=1,A
   54     64      2          |      B(I,J)=A(I,J)
          65      1          |END DO EOR
```

STRUCTURED SFORTRAN PROGRAM

```
INPUT  OUTPUT  NEST
 LINE   LINE  LEVEL   OUTPUT SFORTRAN STATEMENT
                      |
                      |
       66             |END DO FOR
                      |
       67         C   |        PUT APPROPRIATE ZEROS WHERE MULTIPLIERS WERE STORED
  56   68             |DO FOR I=3,N
  57   69         1   |   L=I-2
                      |   |
  58   70         1   |   |DO FOR J=1,L
  59   71         2   |   |   A(I,J)=0.0
       72         1   |   |END DO FOR
                      |   |
       73             |END DO FOR
                      |
  60   74             | K1=N+1
  61   75             | R=0.0
  62   76             | C=0.0
                      |
  63   77             |DO FOR I=1,N
  64   78         1   |   R=R+ ABS(A(1,I))
  65   79         1   |   C=C+ ABS(A(I,N))
       80             |END DO FOR
                      |
  66   81             |DO FOR I=2,N
  67   82         1   |   RS=0.0
  68   83         1   |   CS=0.0
  69   84         1   |   L=I-1
                      |   |
  70   85         1   |   |DO FOR J=L,N
  71   86         2   |   |   RS=RS+ ABS(A(I,J))
  72   87         2   |   |   K1J=K1-J
  73   88         2   |   |   K1I=K1-I
  74   89         2   |   |   CS=CS+ ABS(A(K1J,K1I))
       90         1   |   |END DO FOR
                      |   |
  75   91         1   |   IE (RS.GT.R)
  76   92         2   |      R=RS
       93         1   |   END IE
  77   94         1   |   IE (CS.GT.C)
  78   95         2   |      C=CS
```

STRUCTURED SFORTRAN PROGRAM

```
INPUT  OUTPUT  NEST
 LINE   LINE   LEVEL                    OUTPUT SFORTRAN STATEMENT
                 96      1              |   END IF
                 97                     |END DO FOR
                                        |
   80            98                     |IJK=1
   81            99                     |IF (R.LT.C)
                100      1    C         |                  DELTA IS CRITERION FOR STOPPING AN ITERATION
   83           101      1              |   DELTA=R*1.0E-11
                102      1    C         |                                    DEL IS ARBITRARY SHIFT
   85           103      1              |   DEL=R/17.1829
                104                     |ELSE
   87           105      1              |   DELTA=C*1.0E-11
   88           106      1              |   DEL=C/17.1829
                107                     |END IF
                                        |
                108           C         |DELTA COMPUTED
                109           C         |PRODUCE A-PI, ITERATE ON THIS TO BREAK UP EIGENVALUES OF EQUAL MODULUS
   91           110                     |DO FOR I=1,N
   92           111      1              |   A(I,I)=A(I,I)-DEL
                112                     |END DO FOR
                                        |
                                        |
                113             113     |DO FOREVER
   93           114      1              |   IF (N.EQ.1)
                115      2    C         |SUBROUTINE CALCEV CALCULATES EIGENVALUES OF 1X1 OR 2X2 MATRICES.
                116      2    C         |PI IS ADDED BACK IN CALCEV
   96           117      2              |      CALL CALCEV(A,NMAX,DEL,VEC,IJK,R,1)
                118      2              |      UNDO 113
                                        |<------
                119      1              |   ELSE
                                        |   |
                120      2      120     |   |DO FOREVER
   98           121      3              |   |   IF (N.EQ.2)
   99           122      4              |   |      CALL CALCEV(A,NMAX,DEL,VEC,IJK,R,2)
                123      4              |   |      UNDO 113
                                        |   |<----------
                124      3              |   |   END IF
                125      3    C         |   |            OR TRANSFORMATION STARTS HERE
                126      3    C         |   |            INITIALIZE FOR DETERMINING SUBSEQUENT SHIFTS
  103           127      3              |   |   AR1=0.0
  104           128      3              |   |   AR3=0.0
  105           129      3              |   |   AR4=0.0
                                        |   |   |
                130      3              |   |   |DO FOREVER
                131      4    C         |   |   |RE-ENTER AFTER REALIT OR COMPIT SUBROUTINES CALLED
                132      4    C         |   |   |SELECT FIRST ((ZERO)) SUB-DIAGONAL ELEMENT FROM BOTTOM
  108           133      4              |   |   |   L=N
```

STRUCTURED SFORTRAN PROGRAM

INPUT LINE	OUTPUT LINE	NEST LEVEL		OUTPUT SFORTRAN STATEMENT
109	134	4		DO ECR I=2,N
110	135	5		N2I=N+2-I
111	136	5		UNDO IE (ABS(A(N2I,N2I-1)).LT.DELTA)
				<---
112	137	5		L=L-1
	138	4		END DO FOR
	139	4	C	VALUE OF L SELECTED
114	140	4		UNDO IE (L.EQ.N)
				<---
118	141	4		UNDO 120 IE ((L-N+1).EQ.0)
				<------
	142	4	C	DETERMINE EIGENVALUES OF 2X2 MATRIX -- ROW 1 = A(N-1,N-1) A(N-1,N)
	143	4	C	ROW 2 = A(N,N-1) A(N,N)
	144	4	C	AND BASE SHIFT ON THESE
125	145	4		B=A(N-1,N-1)+A(N,N)
126	146	4		C=A(N-1,N-1)*A(N,N)-A(N,N-1)*A(N-1,N)
127	147	4		C1=A(N-1,N-1)-A(N,N)
128	148	4		DISC=C1*C1+4.0*A(N,N-1)*A(N-1,N)
129	149	4		IE (DISC.GE.0.)
144	150	5		IE (B.GE.0.)
147	151	6		R1=.5*(B+ SQRT(DISC))
148	152	6		IE (R1.EQ.0.)
149	153			R2=0.0
	154			ELSE
151	155	7		R2=C/R1
	156	6		END IE
	157	5		ELSE
145	158	6		R1=.5*(B- SQRT(DISC))
151	159	6		R2=C/R1
	160	5		END IE
	161	5	C	ROOTS OF 2*2 MATRIX FOUND
153	162	5		IE (ABS(A(N,N)-R1).LT. ABS(A(N,N)-R2))
154	163	6		AR2=R1
	164	5		ELSE
156	165	6		AR2=R2
	166	5		END IE
157	167	5		IE (AR1.EQ.0.)
158	168	6		SHIFT=0.0
	169	5		ELSE
160	170	6		SHIFT=AR2
	171	5		END IE
161	172	5		AR1=AR2
162	173	5		CALL REALIT(A,NMAX,L,N,SHIFT,CC,SS)
	174	4		ELSE
130	175	5		R1=0.5*B
131	176	5		R2=.5* SQRT(ABS(DISC))
132	177	5		ANUM=(R1-AR3)*(R1-AR3)+(R2-AR4)*(R2-AR4)
133	178	5		DENOM=AR3*AR3+AR4*AR4

STRUCTURED SFORTRAN PROGRAM

INPUT LINE	OUTPUT LINE	NEST LEVEL	OUTPUT SFORTRAN STATEMENT
134	179	5	IF (DENOM.EQ.0.)
135	180	6	RHO=0.0
136	181	6	SIGMA=0.0
	182	5	ELSE
138	183	6	RHO=C
139	184	6	SIGMA=B
	185	5	END IF
140	186	5	AR3=R1
141	187	5	AR4=R2
142	188	5	CALL COMPIT(A,NMAX,L,N,RHO,SIGMA)
	189	4	END IF
	190	3	END DO FOREVER
115	191	3	CALL CALCEV(A,NMAX,DEL,VEC,IJK,N-1)
116	192	3	N=N-1
	193	2	END DO FOREVER
	194	1	END IF
119	195	1	CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,2)
120	196	1	N=N-2
	197		END DO FOREVER
	198	C	ARE VECTORS NEEDED
165	199		IF (NVEC.NE.0)
	200	1 C	INVERSE ITERATION IS USED FOR EIGENVECTORS
167	201	1	SMALL=DELTA*1.0E-30
168	202	1	NUM=0
169	203	1	JI=1
170	204	1	NP=NN+NN
	205	1	DO FOREVER
	206	2 C	C1 IS REAL PART OF EIGENVALUE
172	207	2	C1=VEC(JI)
	208	2 C	C2 IS COMPLEX PART OF EIGENVALUE
174	209	2	C2=VEC(JI+1)
175	210	2	NUM=NUM+1
	211	2 C	REPLACE HESSENBURG MATRIX AND MULTIPLIERS
177	212	2	DO FOR I=1,NN
178	213	3	DO FOR J=1,NN
179	214	4	A(I,J)=D(I,J)
	215	3	END DO FOR
	216	2	END DO FOR

STRUCTURED SFORTRAN PROGRAM

```
 INPUT   OUTPUT   NEST
  LINE    LINE   LEVEL                         OUTPUT SFORTRAN STATEMENT

                                  |  1                                                            1 |
  180     217      2              |  IF (C2.NE.C.)                                                  |
  185     218      3              |     CALL IMVEC(A,NMAX,INT,C1,C2,SMALL,NN,NUM,EIGVEC,NVEC,       |
          219               1     |           CC,SS,Z,BB)                                           |
          220      3   C          |       NEXT STATEMENT IGNORES CONJUGATE COMPLEX EIGENVALUES      |
  187     221      3              |     JI=JI+4                                                     |
  188     222      3              |     UNDO IF (NVEC.EQ.NUM)                                       |
                                 <-------                                                           |
          223      2              |  ELSE                                                           |
  181     224      3              |     CALL RVEC(A,NMAX,INT,C1,SMALL,NN,NUM,EIGVEC,NVEC,CC,        |
          225               1     |           SS)                                                   |
  182     226      3              |     JI=JI+2                                                     |
  183     227      3              |     UNDO IF (NVEC.EQ.NUM)                                       |
                                 <-------                                                           |
          228      2              |  END IF                                                         |
          229      1              |END DO FOREVER                                                   |
                                  |-----------------------------------------------------------------|

          230                    END IF
  191     231                    WRITE (6, 90010) (VEC(I),I=1,NN)

                                 |------------------------------------------------------------------|
  192     232                    |DO FOR I=1,NN                                                     |
  193     233      1             |   WRITE (6, 90010) (EIGVEC(I,J),J=1,NN)                          |
          234                    |END DO FOR                                                        |
                                 |------------------------------------------------------------------|

          235                    STOP
```

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STRUCTURED SFORTRAN PROGRAM

INPUT LINE	OUTPUT LINE	NEST LEVEL	OUTPUT SFORTRAN STATEMENT
	236		C ********** FORMAT STATEMENTS **********
194	237		90010 FORMAT (1H ,5E20.8 / 5E20.8)
	238		C ********** END PROGRAM UNIT **********
	239		END

12H

FORMAT CROSS_REFERENCE TABLE

FORMAT STATEMENT NUMBER	LOCATION	REFERENCES		
90010	237	231	233	

FORTRAN PROGRAM INPUT

LINE NUMBER	INPUT FORTRAN STATEMENT
1	C..... REF: UCLA DEMO 14.1
2	SUBROUTINE CALCEV(A,NMAX,DEL,VEC,IJK,N,M)
3	DIMENSION A(NMAX,NMAX),VEC(1)
4	IF (M.NE.1) GO TO 2
5	1 AI=0.0
6	A(N,N)=A(N,N)+DEL
7	C STORE EIGENVALUES IN VEC
8	VEC(IJK)=A(N,N)
9	VEC(IJK+1)=AI
10	IJK=IJK+2
11	RETURN
12	2 B=A(N-1,N-1)+A(N,N)
13	C=A(N-1,N-1)*A(N,N)-A(N,N-1)*A(N-1,N)
14	C1=A(N-1,N-1)-A(N,N)
15	DISC=C1*C1+4.0*A(N,N-1)*A(N-1,N)
16	IF (DISC.LT.0.) GO TO 9
17	4 AI=0.0
18	IF (B.GE.0.) GO TO 6
19	R1=0.5*(B- SQRT(DISC))
20	GO TO 7
21	6 R1=0.5*(B+ SQRT(DISC))
22	IF(R1.NE.0.) GO TO 7
23	10 R2=0.0
24	GO TO 11
25	7 R2=C/R1
26	11 R1=R1+DEL
27	R2=R2+DEL
28	VEC(IJK)=R2
29	VEC(IJK+1)=AI
30	VEC(IJK+2)=R1
31	VEC(IJK+3)=AI
32	GO TO 8
33	9 R1=0.5*B
34	AI=-.5* SQRT(ABS(DISC))
35	R1=R1+DEL
36	VEC(IJK)=R1
37	VEC(IJK+1)=-AI
38	VEC(IJK+2)=R1
39	VEC(IJK+3)=AI
40	8 IJK=IJK+4
41	RETURN
42	END

14 H

STRUCTURED SFORTRAN PROGRAM

INPUT LINE	OUTPUT LINE	NEST LEVEL	OUTPUT SFORTRAN STATEMENT
	1		C ********** CALCEV ENTRY **********
	2		C ..... REF: UCLA DEMO 14.1
2	3		SUBROUTINE CALCEV(A,NMAX,DEL,VEC,IJK,N,M)
3	4		DIMENSION A(NMAX,NMAX),VEC(1)
	5		C ********** LOGIC START **********
4	6		IF (M.EQ.1)
5	7	1	AI=0.0
6	8	1	A(N,N)=A(N,N)+DEL
	9	1	C STORE EIGENVALUES IN VEC
8	10	1	VEC(IJK)=A(N,N)
9	11	1	VEC(IJK+1)=AI
10	12	1	IJK=IJK+2
11	13	1	RETURN
			<----------
	14		END IF
12	15		B=A(N-1,N-1)+A(N,N)
13	16		C=A(N-1,N-1)*A(N,N)-A(N,N-1)*A(N-1,N)
14	17		C1=A(N-1,N-1)-A(N,N)
15	18		DISC=C1*C1+4.0*A(N,N-1)*A(N-1,N)
16	19		IF (DISC.GE.0.)
17	20	1	AI=0.0
18	21	1	IF (B.GE.0.)
21	22	2	R1=0.5*(B+ SQRT(DISC))
22	23	2	IF (R1.EQ.0.)
23	24	3	R2=0.0
	25	2	ELSE
25	26	3	R2=C/R1
	27	2	END IF
	28	1	ELSE
19	29	2	R1=0.5*(B- SQRT(DISC))
25	30	2	R2=C/R1
	31	1	END IF
26	32	1	R1=R1+DEL
27	33	1	R2=R2+DEL
28	34	1	VEC(IJK)=R2
29	35	1	VEC(IJK+1)=AI
30	36	1	VEC(IJK+2)=R1
31	37	1	VEC(IJK+3)=AI
	38		ELSE
33	39	1	R1=0.5*B
34	40	1	AI=-.5* SQRT(ABS(DISC))
35	41	1	R1=R1+DEL
36	42	1	VEC(IJK)=R1
37	43	1	VEC(IJK+1)=-AI
38	44	1	VEC(IJK+2)=R1
39	45	1	VEC(IJK+3)=AI
	46		END IF
40	47		IJK=IJK+4
41	48		RETURN

STRUCTURED SFORTRAN PROGRAM

INPUT LINE	OUTPUT LINE	NEST LEVEL	OUTPUT SFORTRAN STATEMENT
	49		C ********** END PROGRAM UNIT **********
	50		END

H 9/1

FORTRAN PROGRAM INPUT

LINE NUMBER	INPUT FORTRAN STATEMENT
1	C..... REF: UCLA DEMO 14.2
2	SUBROUTINE REALIT(A,NMAX,L,N,SHIFT,C,S)
3	DIMENSION A(NMAX,NMAX),C(1),S(1)
4	IF (SHIFT.EQ.0.) GO TO 2
5	1 DO3 I=L,N
6	3 A(I,I)=A(I,I)-SHIFT
7	2 M=N-1
8	DO4 I=L,M
9	DENOM= SQRT(A(I,I)**2+A(I+1,I)**2)
10	IF (DENOM.GT.0.) GO TO 10
11	11 C(I)=1.0
12	S(I)=0.0
13	GO TO 4
14	10 C(I)=A(I,I)/DENOM
15	S(I)=A(I+1,I)/DENOM
16	A(I,I)=DENOM
17	12 I1=I+1
18	DO 35 J=I1,N
19	F=A(I,J)
20	A(I,J)=A(I+1,J)*S(I)+F*C(I)
21	A(I+1,J)=A(I+1,J)*C(I)-F*S(I)
22	35 CONTINUE
23	4 CONTINUE
24	C TRIANGULAR MATRIX FORMED
25	DO5 J=L,M
26	DO6 I=L,J
27	F=A(I,J)
28	A(I,J)=A(I,J+1)*S(J)+F*C(J)
29	6 A(I,J+1)=A(I,J+1)*C(J)-F*S(J)
30	A(J+1,J)=A(J+1,J+1)*S(J)
31	5 A(J+1,J+1)=A(J+1,J+1)*C(J)
32	C TRANSFORMATION COMPLETED
33	IF (SHIFT.EQ.0.) RETURN
34	7 DO9 I=L,N
35	9 A(I,I)=A(I,I)+SHIFT
36	8 RETURN
37	END

STRUCTURED SFORTRAN PROGRAM

```
INPUT  OUTPUT  NEST
 LINE   LINE   LEVEL                    OUTPUT SFORTRAN STATEMENT

       1              C     ********** ****** REALIT   ENTRY **********************
       2              C                                          ***** REF:  UCLA DEMO 14.2
  2    3                    SUBROUTINE REALIT(A,NMAX,L,N,SHIFT,C,S)
  3    4                      DIMENSION A(NMAX,NMAX),C(1),S(1)
       5              C     ********** ********** LOGIC START **************************
  4    6                      IF (SHIFT.NE.0.)
                              |
  5    7         1           |DO FOR I=L,N
  6    8         2           |   A(I,I)=A(I,I)-SHIFT
       9         1           |END DO FOR
                              |
      10                     END IF
  7   11                     M=N-1
                              |
  8   12                     |DO FOR I=L,M
  9   13         1           |   DENOM= SQRT(A(I,I)**2+A(I+1,I)**2)
 10   14         1           |   IF (DENOM.GT.0.)
 14   15         2           |       C(I)=A(I,I)/DENOM
 15   16         2           |       S(I)=A(I+1,I)/DENOM
 16   17         2           |       A(I,I)=DENOM
 17   18         2           |       II=I+1
                              |       |
 18   19         2           |       |DO FOR J=II,N
 19   20         3           |       |   F=A(I,J)
 20   21         3           |       |   A(I,J)=A(I+1,J)*S(I)+F*C(I)
 21   22         3           |       |   A(I+1,J)=A(I+1,J)*C(I)-F*S(I)
      23         2           |       |END DO FOR
                              |       |
      24         1           |   ELSE
 11   25         2           |       C(I)=1.,C
 12   26         2           |       S(I)=0.0
      27         1           |   END IF
      28                     |END DO FOR
                              |
      29              C      |                    TRIANGULAR MATRIX FORMED
 25   30                     |DO FOR J=L,M
                              |   |
 26   31         1           |   |DO FOR I=L,J
 27   32         2           |   |   F=A(I,J)
 28   33         2           |   |   A(I,J)=A(I,J+1)*S(J)+F*C(J)
```

STRUCTURED SFORTRAN PROGRAM

```
 INPUT  OUTPUT  NEST
 LINE    LINE   LEVEL                      OUTPUT SFORTRAN STATEMENT

  29      34      2               |  |     A(I,J+1)=A(I,J+1)*C(J)-F*S(J)             | |
          35      1               |  |END DO FOR                                     | |
                                  |  |-----------------------------------------------| |
                                  |                                                    |
  30      36      1               |    A(J+1,J)=A(J+1,J+1)*S(J)                        |
  31      37      1               |    A(J+1,J+1)=A(J+1,J+1)*C(J)                      |
          38                      |END DO FOR                                          |
                                  |----------------------------------------------------|

          39             C                                 TRANSFORMATION COMPLETED
  33      40                       IF (SHIFT.EQ.0.)
  33      41      1                    RETURN
                         <--------------
          42                       END IF

                                  |                                                    |
  34      43                      |DO FOR I=L,N                                        |
  35      44      1               |    A(I,I)=A(I,I)+SHIFT                             |
          45                      |END DO FOR                                          |
                                  |----------------------------------------------------|

  36      46                       RETURN
                         <---------
          47             C     ************************ END PROGRAM UNIT ************************

          48                   END
```


H 61

FORTRAN PROGRAM INPUT

LINE NUMBER	INPUT FORTRAN STATEMENT
1	C..... REF: UCLA DEMO 14.3
2	SUBROUTINE COMPIT(A,NMAX,L,N,RHO,SIGMA)
3	DIMENSION A(NMAX,NMAX)
4	C HOUSEHOLDER TYPE MATRICES USED INSTEAD OF ROTATIONS(SEE FRANCIS PAPER)
5	M=N-1
6	DO 1 I=L,M
7	IF (I.NE.L) GO TO 3
8	2 B1=A(L,L)*(A(L,L)-SIGMA)+A(L,L+1)*A(L+1,L)+RHO
9	B2=A(L+1,L)*(A(L,L)+A(L+1,L+1)-SIGMA)
10	B3=A(L+1,L)*A(L+2,L+1)
11	A(L+2,L)=0.0
12	GO TO 6
13	3 B1=A(I,I-1)
14	B2=A(I+1,I-1)
15	IF (I.EQ.M) GO TO 5
16	4 B3=A(I+2,I-1)
17	GO TO 6
18	5 B3=0.0
19	6 D= SQRT(B1*B1+B2*B2+B3*B3)
20	IF (B1.GE.0.) GO TO 8
21	7 D=-D
22	8 IF (D.EQ.0.) GO TO 1
23	9 C1=B2/(D+B1)
24	C2=B3/(D+B1)
25	E=2.0/(1.0+C1*C1+C2*C2)
26	DO 10 K=I,N
27	IF (I.EQ.M) GO TO 12
28	11 G=E*(A(I,K)+C1*A(I+1,K)+C2*A(I+2,K))
29	A(I,K)=A(I,K)-G
30	A(I+1,K)=A(I+1,K)-C1*G
31	A(I+2,K)=A(I+2,K)-C2*G
32	GO TO 10
33	12 G=E*(A(I,K)+C1*A(I+1,K))
34	A(I,K)=A(I,K)-G
35	A(I+1,K)=A(I+1,K)-C1*G
36	10 CONTINUE
37	IF (I.EQ.L) GO TO 14
38	13 A(I,I-1)=-D
39	A(I+1,I-1)=0.0
40	IF (I.EQ.M) GO TO 14
41	15 A(I+2,I-1)=0.0
42	C ROW OPERATION COMPLETED
43	14 J=I+2
44	IF (J.LE.N) GO TO 17
45	16 J=N
46	17 DO 18 K=L,J
47	IF (I.EQ.M) GO TO 20
48	19 G=E*(A(K,I)+C1*A(K,I+1)+C2*A(K,I+2))
49	A(K,I)=A(K,I)-G
50	A(K,I+1)=A(K,I+1)-C1*G
51	A(K,I+2)=A(K,I+2)-C2*G
52	GO TO 18

FORTRAN PROGRAM INPUT

LINE NUMBER	INPUT FORTRAN STATEMENT
53	20 G=E*(A(K,I)+C1*A(K,I+1))
54	A(K,I)=A(K,I)-G
55	A(K,I+1)=A(K,I+1)-C1*G
56	18 CONTINUE
57	J=I+3
58	IF (J.GT.N) GO TO 1
59	21 G=E*C2*A(I+3,I+2)
60	A(I+3,I)=-G
61	A(I+3,I+1)=-C1*G
62	A(I+3,I+2)=A(I+3,I+2)-C2*G
63	C COLUMN OPERATION COMPLETED
64	1 CONTINUE
65	RETURN
66	END

STRUCTURED SFORTRAN PROGRAM

```
 INPUT  OUTPUT  NEST
  LINE   LINE   LEVEL                    OUTPUT SFORTRAN STATEMENT

              1          C     ********************** COMPIT   ENTRY **************************
              2          C                                                ..... REF:  UCLA DEMO 14.3
         2    3               SUBROUTINE COMPIT(A,NMAX,L,N,RHO,SIGMA)
         3    4                  DIMENSION A(NMAX,NMAX)
              5          C     ********************** LOGIC START ****************************
              6          C HOUSEHOLDER TYPE MATRICES USED INSTEAD OF ROTATIONS(SEE FRANCIS PAPER)
         5    7                  M=N-1
         6    8                  DO FOR I=L,M
         7    9        1            IF (I.NE.L)
        13   10        2               B1=A(I,I-1)
        14   11        2               B2=A(I+1,I-1)
        15   12        2               IF (I.NE.M)
        16   13        3                  B3=A(I+2,I-1)
             14        2               ELSE
        18   15        3                  B3=0.0
             16        2               END IF
             17        1            ELSE
         8   18        2               B1=A(L,L)*(A(L,L)-SIGMA)+A(L,L+1)*A(L+1,L)+RHO
         9   19        2               B2=A(L+1,L)*(A(L,L)+A(L+1,L+1)-SIGMA)
        10   20        2               B3=A(L+1,L)*A(L+2,L+1)
        11   21        2               A(L+2,L)=0.0
             22        1            END IF
        19   23        1            D= SQRT(B1*B1+B2*B2+B3*B3)
        20   24        1            IF (B1.LT.0.)
        21   25        2               D=-D
             26        1            END IF
        22   27        1            IF (D.NE.0.)
        23   28        2               C1=B2/(D+B1)
        24   29        2               C2=B3/(D+B1)
        25   30        2               E=2.0/(1.0+C1*C1+C2*C2)
        26   31        2               DO FOR K=I,N
        27   32        3                  IF (I.NE.M)
        28   33        4                     G=E*(A(I,K)+C1*A(I+1,K)+C2*A(I+2,K))
        29   34        4                     A(I,K)=A(I,K)-G
        30   35        4                     A(I+1,K)=A(I+1,K)-C1*G
        31   36        4                     A(I+2,K)=A(I+2,K)-C2*G
             37        3                  ELSE
        33   38        4                     G=E*(A(I,K)+C1*A(I+1,K))
        34   39        4                     A(I,K)=A(I,K)-G
        35   40        4                     A(I+1,K)=A(I+1,K)-C1*G
             41        3                  END IF
             42        2               END DO FOR
        37   43        2               IF (I.NE.L)
```

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STRUCTURED SFORTRAN PROGRAM

```
 INPUT  OUTPUT  NEST
  LINE   LINE  LEVEL                    OUTPUT SFORTRAN STATEMENT

    38     44     3              A(I,I-1)=-D
    39     45     3              A(I+1,I-1)=0.0
    40     46     3              IF (I.NE.M)
    41     47     4                  A(I+2,I-1)=0.0
           48     3              END IF
           49     2          END IF
           50     2    C                          ROW OPERATION COMPLETED
    43     51     2          J=I+2
    44     52     2          IF (J.GT.N)
    45     53     3              J=N
           54     2          END IF

    46     55     2          DO EOR K=L,J
    47     56     3              IF (I.NE.M)
    48     57     4                  G=E*(A(K,I)+C1*A(K,I+1)+C2*A(K,I+2))
    49     58     4                  A(K,I)=A(K,I)-G
    50     59     4                  A(K,I+1)=A(K,I+1)-C1*G
    51     60     4                  A(K,I+2)=A(K,I+2)-C2*G
           61     3              ELSE
    53     62     4                  G=E*(A(K,I)+C1*A(K,I+1))
    54     63     4                  A(K,I)=A(K,I)-G
    55     64     4                  A(K,I+1)=A(K,I+1)-C1*G
           65     3              END IF
           66     2          END DO EOR

    57     67     2          J=I+3
    58     68     2          IF (J.LE.N)
    59     69     3              G=E*C2*A(I+3,I+2)
    60     70     3              A(I+3,I)=-G
    61     71     3              A(I+3,I+1)=-C1*G
    62     72     3              A(I+3,I+2)=A(I+3,I+2)-C2*G
           73     2          END IF
           74     1      END IF
           75         END DO EOR

    65     76                RETURN
                       <--------
           77         C     ********** END PROGRAM UNIT **********
           78               END
```

2/3 H

FORTRAN PROGRAM INPUT

```
LINE
NUMBER      INPUT FORTRAN STATEMENT

    1      C..... REF:  UCLA DEMO 14.4
    2            SUBROUTINE RVEC(A,NMAX,INT,C1,SMALL,N,NUM,EIGVEC,NVEC,INTER,Y)
    3            DIMENSION A(NMAX,NMAX),INTER(1),Y(1),INT(1),EIGVEC(NMAX,NMAX)
    4            DO1 I=1,N
    5          1 A(I,I)=A(I,I)-C1
    6            DO2 I=2,N
    7            IF( ABS(A(I-1,I-1)).GE. ABS(A(I,I-1)))GO TO 4
    8          3 INTER(I)=I
    9            J=I-1
   10            DO5 K=J,N
   11            B=A(I-1,K)
   12            A(I-1,K)=A(I,K)
   13          5 A(I,K)=B
   14            GO TO 6
   15          4 INTER(I)=I-1
   16          6 IF (A(I,I-1).EQ.0.) GO TO 2
   17            C=-A(I,I-1)/A(I-1,I-1)
   18            A(I,I-1)=C
   19            DO 8 K=1,N
   20          8 A(I,K)=A(I,K)+C*A(I-1,K)
   21          2 CONTINUE
   22      C     TRIANGULAR MATRIX FORMED
   23            DO9 I=1,N
   24            IF( ABS(A(I,I)).GE.SMALL)GO TO 9
   25         10 A(I,I)=SMALL
   26          9 CONTINUE
   27      C NORMALISED ((EIGENVECTOR)) OF HESSENBURG MATRIX OBTAINED FOR RHS = 1
   28            DO 5555 I=1,N
   29       5555 Y(I)=1.0
   30            DO 8888 JJJJ=1,4
   31       7777 Y(N)=Y(N)/A(N,N)
   32            B=Y(N)
   33            DO11 I=2,N
   34            E=0.0
   35            M=N+1-I
   36            DO12 J=2,I
   37            L=N+J-I
   38         12 E=E+Y(L)*A(M,L)
   39            Y(M)=(Y(M)-E)/A(M,M)
   40            IF( ABS(B).GE. ABS(Y(M)))GO TO 11
   41         13 B=Y(M)
   42         11 CONTINUE
   43            DO14 I=1,N
   44         14 Y(I)=Y(I)/B
   45            IF(JJJJ.EQ.4)GO TO 6666
   46            DO15 I=2,N
   47            IF (INTER(I).NE.I) GO TO 15
   48         16 B=Y(I)
   49            Y(I)=Y(I-1)
   50            Y(I-1)=B
   51         15 Y(I)=Y(I)+A(I,I-1)*Y(I-1)
   52       8888 CONTINUE
```

24 H

FORTRAN PROGRAM INPUT

LINE NUMBER	INPUT FORTRAN STATEMENT
53	C EIGENVECTOR OF HESSENBURG MATRIX OBTAINED (NOT NORMALIZED)
54	6666 M=N-1
55	DO21 I=2,M
56	J=N+1-I
57	L=J+1
58	DO20 K=L,N
59	20 Y(K)=Y(K)-Y(J)*A(K,J-1)
60	LL=IRT(N-I)
61	IF (J.EQ.LL) GO TO 21
62	19 B=Y(J)
63	Y(J)=Y(LL)
64	Y(LL)=B
65	21 CONTINUE
66	C UNNORMALIZED EIGENVECTOR OF ORIGINAL MATRIX OBTAINED
67	B=0.0
68	DO22 I=1,N
69	IF(ABS(B).GE. ABS(Y(I)))GO TO 22
70	23 B=Y(I)
71	22 CONTINUE
72	DO24 I=1,N
73	24 Y(I)=Y(I)/B
74	C NORMALIZED EIGENVECTOR OBTAINED
75	C PUT Y(I) (REAL EIGENVECTOR) IN EIGVECT(NUMOFEV,I)
76	DO 100 I=1,N
77	100 EIGVEC(NUM,I)=Y(I)
78	RETURN
79	END

STRUCTURED SFORTRAN PROGRAM

```
 INPUT  OUTPUT  NEST
 LINE   LINE    LEVEL                    OUTPUT SFORTRAN STATEMENT

        1               C     ********************** RVEC     ENTRY **************************
        2               C                                                  ..... REF:  UCLA DEMO 14.4
   2    3                     SUBROUTINE RVEC(A,NMAX,INT,C1,SMALL,N,NUM,EIGVEC,NVEC,INTER,Y)
   3    4                       DIMENSION A(NMAX,NMAX),INTER(1),Y(1),INT(1),EIGVEC(NMAX,NMAX)

        5               C     ************************ LOGIC START ****************************

   4    6                     DO FOR I=1,N
   5    7          1              A(I,I)=A(I,I)-C1
        8                     END DO FOR

        9                     DO FOR I=2,N
   7   10          1              IF ( ABS(A(I-1,I-1)).LT. ABS(A(I,I-1)))
   8   11          2                  INTER(I)=I
   9   12          2                  J=I-1
  10   13          2                  DO FOR K=J,N
  11   14          3                      B=A(I-1,K)
  12   15          3                      A(I-1,K)=A(I,K)
  13   16          3                      A(I,K)=B
       17          2                  END DO FOR
       18          1              ELSE
  15   19          2                  INTER(I)=I-1
       20          1              END IF
  16   21          1              IF (A(I,I-1).NE.0.)
  17   22          2                  C=-A(I,I-1)/A(I-1,I-1)
  18   23          2                  A(I,I-1)=C
  19   24          2                  DO FOR K=I,N
  20   25          3                      A(I,K)=A(I,K)+C*A(I-1,K)
       26          2                  END DO FOR
       27          1              END IF
       28                    END DO FOR

       29               C                                  TRIANGULAR MATRIX FORMED
  23   30                    DO FOR I=1,N
  24   31          1              IF ( ABS(A(I,I)).LT.SMALL)
```

26H

STRUCTURED SFORTRAN PROGRAM

INPUT LINE	OUTPUT LINE	NEST LEVEL	OUTPUT SFORTRAN STATEMENT
25	32	2	A(I,I)=SMALL
	33	1	END IF
	34		END DO EOR
	35		C NORMALISED ((EIGENVECTOR)) OF HESSENBURG MATRIX OBTAINED FOR RHS = 1
28	36		DO EOR I=1,N
29	37	1	Y(I)=1.0
	38		END DO EOR
30	39		DO EOR JJJJ=1,4
31	40	1	Y(N)=Y(N)/A(N,N)
32	41	1	B=Y(N)
33	42	1	DO EOR I=2,N
34	43	2	E=0.0
35	44	2	M=N+1-I
36	45	2	DO EOR J=2,I
37	46	3	L=N+J-I
38	47	3	E=E+Y(L)*A(M,L)
	48	2	END DO EOR
39	49	2	Y(M)=(Y(M)-E)/A(M,M)
40	50	2	IF (ABS(B).LT. ABS(Y(M)))
41	51	3	B=Y(M)
	52	2	END IF
	53	1	END DO EOR
43	54	1	DO EOR I=1,N
44	55	2	Y(I)=Y(I)/B
	56	1	END DO EOR
45	57	1	UNDO IF (JJJJ.EQ.4)
46	58	1	DO EOR I=2,N
47	59	2	IF (INTER(I).EQ.I)
48	60	3	B=Y(I)

STRUCTURED SFORTRAN PROGRAM

INPUT LINE	OUTPUT LINE	NEST LEVEL	OUTPUT SFORTRAN STATEMENT
49	61	3	Y(I)=Y(I-1)
50	62	3	Y(I-1)=B
	63	2	END IF
51	64	2	Y(I)=Y(I)+A(I,I-1)*Y(I-1)
	65	1	END DO FOR
	66		END DO FOR
	67	C	EIGENVECTOR OF HESSENBURG MATRIX OBTAINED (NOT NORMALIZED)
54	68		M=N-1
55	69		DO FOR I=2,M
56	70	1	J=N+1-I
57	71	1	L=J+1
58	72	1	DO FOR K=L,N
59	73	2	Y(K)=Y(K)-Y(J)*A(K,J-1)
	74	1	END DO FOR
60	75	1	LL=INT(N-I)
61	76	1	IF (J.NE.LL)
62	77	2	B=Y(J)
63	78	2	Y(J)=Y(LL)
64	79	2	Y(LL)=B
	80	1	END IF
	81		END DO FOR
	82	C	UNNORMALIZED EIGENVECTOR OF ORIGINAL MATRIX OBTAINED
67	83		B=0.0
68	84		DO FOR I=1,N
69	85	1	IF (ABS(B).LT.ABS(Y(I)))
70	86	2	B=Y(I)
	87	1	END IF
	88		END DO FOR
72	89		DO FOR I=1,N
73	90	1	Y(I)=Y(I)/B
	91		END DO FOR

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STRUCTURED SFORTRAN PROGRAM

```
 INPUT   OUTPUT   NEST
 LINE     LINE    LEVEL                     OUTPUT SFORTRAN STATEMENT

           92          C                   NORMALIZED EIGENVECTOR OBTAINED
           93          C               PUT Y(I) (REAL EIGENVECTOR) IN EIGVECT(NUMOFEV,I)
  76       94                  |DO FOR I=1,N
  77       95      1           |    EIGVEC(NUM,I)=Y(I)
           96                  |END DO FOR

  78       97                   RETURN
                        <---------
           98          C      ************************ END PROGRAM UNIT ************************

           99                 END
```


29H

FORTRAN PROGRAM INPUT

```
LINE
NUMBER      INPUT FORTRAN STATEMENT

    1      C..... REF:  UCLA DEMO 14.5
    2            SUBROUTINE IMVEC(A,NMAX,INT,C1,AMU,SMALL,N,NUM,EIGVEC,NVEC,INTER,
    3           1Y,Z,B)
    4            DIMENSION A(NMAX,NMAX),INTER(1),Y(1),Z(1),INT(1),B(NMAX,NMAX),
    5           1EIGVEC(NMAX,NMAX)
    6            DO50 I=1,N
    7            DO50 J=1,N
    8           50 B(I,J)=0.0
    9            DO1 I=1,N
   10            A(I,I)=A(I,I)-C1
   11          1 B(I,I)=B(I,I)-AMU
   12            DO2 I=2,N
   13            C=A(I-1,I-1)*A(I-1,I-1)+B(I-1,I-1)*B(I-1,I-1)
   14            D=A(I,I-1)*A(I,I-1)+B(I,I-1)*B(I,I-1)
   15            IF (C.GE.D) GO TO 4
   16          3 INTER(I)=I
   17            G=C
   18            C=D
   19            D=G
   20            J=I-1
   21            DO5 K=J,N
   22            G=A(I-1,K)
   23            A(I-1,K)=A(I,K)
   24            A(I,K)=G
   25            G=B(I-1,K)
   26            B(I-1,K)=B(I,K)
   27          5 B(I,K)=G
   28            GO TO 6
   29          4 INTER(I)=I-1
   30          6 IF (D.EQ.0.) GO TO 2
   31          7 G=A(I,I-1)
   32            A(I,I-1)=-(G*A(I-1,I-1)+B(I,I-1)*B(I-1,I-1))/C
   33            B(I,I-1)=-(B(I,I-1)*A(I-1,I-1)-G*B(I-1,I-1))/C
   34            DO8 K=I,N
   35            A(I,K)=A(I,K)+A(I,I-1)*A(I-1,K)-B(I,I-1)*B(I-1,K)
   36          8  B(I,K)=B(I,K)+B(I,I-1)*A(I-1,K)+A(I?I-1)*B(I-1,K)
   37          2 CONTINUE
   38      C     TRIANGULAR MATRIX FORMED
   39            DO9 I=1,N
   40            C=A(I,I)*A(I,I)+B(I,I)*B(I,I)
   41            IF (C.GE.SMALL) GO TO 9
   42            A(I,I)= SQRT(SMALL)
   43            B(I,I)=0.0
   44          9 CONTINUE
   45            DO 1111 I=1,N
   46            Y(I)=1.0
   47         1111 Z(I)=0.0
   48            DO 8888 JJJ=1,4
   49            C=A(N,N)*A(N,N)+B(N,N)*B(N,N)
   50            G=Y(N)
   51            Y(N)=(G*A(N,N)+Z(N)*B(N,N))/C
   52            Z(N)=(Z(N)*A(N,N)-G*B(N,N))/C
```

30H

FORTRAN PROGRAM INPUT

```
LINE
NUMBER          INPUT FORTRAN STATEMENT
   53           DO17 I=2,N
   54           E=0.0
   55           F=0.0
   56           M=N+1-I
   57           DO18 J=2,I
   58           L=M+J-I
   59           E=E+Y(L)*A(M,L)-Z(L)*B(M,L)
   60        18 F=F+Y(L)*B(M,L)+Z(L)*A(M,L)
   61           D=A(M,M)*A(M,M)+B(M,M)*B(M,M)
   62           G=Y(M)
   63           Y(M)=((G-E)*A(M,M)+(Z(M)-F)*B(M,M))/D
   64        17 Z(M)=((Z(M)-F)*A(M,M)-(G-E)*B(M,M))/D
   65           E=0.0
   66           DO51 I=1,N
   67           F=Y(I)*Y(I)+Z(I)*Z(I)
   68           IF (E.GE.F) GO TO 51
   69        52 E=F
   70           L=I
   71        51 CONTINUE
   72           A1=Y(L)
   73           A2=Z(L)
   74           DO14 I=1,N
   75           G=Y(I)
   76           Y(I)=(G*A1+Z(I)*A2)/E
   77        14 Z(I)=(Z(I)*A1-G*A2)/E
   78           IF(JJJ.EQ.4) GO TO 6666
   79           DO15 I=2,N
   80           IF (INTER(I).NE.I) GO TO 30
   81        16 G=Y(I)
   82           Y(I)=Y(I-1)
   83           Y(I-1)=G
   84           G=Z(I)
   85           Z(I)=Z(I-1)
   86           Z(I-1)=G
   87        30 Y(I)=Y(I)+A(I,I-1)*Y(I-1)-B(I,I-1)*Z(I-1)
   88        15 Z(I)=Z(I)+B(I,I-1)*Y(I-1)+A(I,I-1)*Z(I-1)
   89      8888 CONTINUE
   90         C     EIGENVECTOR OF HESSENBURG MATRIX OBTAINED
   91      6666 M=N-1
   92           DO21 I=2,M
   93           J=N+1-I
   94           L=J+1
   95           DO20 K=L,N
   96           Y(K)=Y(K)-Y(J)*A(K,J-1)+Z(J)*B(K,J-1)
   97        20 Z(K)=Z(K)-Z(J)*A(K,J-1)-Y(J)*B(K,J-1)
   98           LL=INT(N-I)
   99           IF (J.EQ.LL) GO TO 21
  100        19 G=Y(J)
  101           Y(J)=Y(LL)
  102           Y(LL)=G
  103           G=Z(J)
  104           Z(J)=Z(LL)
```

FORTRAN PROGRAM INPUT

```
LINE
NUMBER                          INPUT FORTRAN STATEMENT

  105           Z(LL)=G
  106        21 CONTINUE
  107     C     UNNORMALIZED EIGENVECTOR OBTAINED
  108           E=0.0
  109           DO22 I=1,N
  110           F=Y(I)*Y(I)+Z(I)*Z(I)
  111           IF (E.GE.F) GO TO 22
  112        23 E=F
  113           L=I
  114        22 CONTINUE
  115           A1=Y(L)
  116           A2=Z(L)
  117           DO24 I=1,N
  118           G=Y(I)
  119           Y(I)=(G*A1+Z(I)*A2)/E
  120        24 Z(I)=(Z(I)*A1-G*A2)/E
  121     C     NORMALIZED EIGENVECTOR OBTAINED
  122     C PUT Y(I) (REAL PART) IN EIGVECT(NUMOFEV,I)
  123           DO 100 I=1,N
  124       100 EIGVEC(NUM,I)=Y(I)
  125           NUM=NUM+1
  126     C PUT Z(I) (COMPLEX PART) IN EIGVECT(NUMOFEV,I)
  127           DO 101 I=1,N
  128       101 EIGVEC(NUM,I)=Z(I)
  129           RETURN
  130           END
```

STRUCTURED SFORTRAN PROGRAM

INPUT LINE	OUTPUT LINE	NEST LEVEL	OUTPUT SFORTRAN STATEMENT
	1		C ********** IMVEC ENTRY **********
	2		C ..... REF: UCLA DEMO 14.5
2	3		SUBROUTINE IMVEC(A,NMAX,INT,C1,AMU,SMALL,N,NUM,EIGVEC,NVEC,INTER,
	4		1 Y,Z,B)
4	5		DIMENSION A(NMAX,NMAX),INTER(1),Y(1),Z(1),INT(1),B(NMAX,NMAX),
	6		1 EIGVEC(NMAX,NMAX)
	7		C ********** LOGIC START **********
6	8		DO FOR I=1,N
7	9	1	DO FOR J=1,N
8	10	2	B(I,J)=0.0
	11	1	END DO FOR
	12		END DO FOR
9	13		DO FOR I=1,N
10	14	1	A(I,I)=A(I,I)-C1
11	15	1	B(I,I)=B(I,I)-AMU
	16		END DO FOR
12	17		DO FOR I=2,N
13	18	1	C=A(I-1,I-1)*A(I-1,I-1)+B(I-1,I-1)*B(I-1,I-1)
14	19	1	D=A(I,I-1)*A(I,I-1)+B(I,I-1)*B(I,I-1)
15	20	1	IF (C.LT.D)
16	21	2	INTER(I)=I
17	22	2	G=C
18	23	2	C=D
19	24	2	D=G
20	25	2	J=I-1
21	26	2	DO FOR K=J,N
22	27	3	G=A(I-1,K)
23	28	3	A(I-1,K)=A(I,K)
24	29	3	A(I,K)=G
25	30	3	G=B(I-1,K)
26	31	3	B(I-1,K)=B(I,K)
27	32	3	B(I,K)=G
	33	2	END DO FOR

STRUCTURED SFORTRAN PROGRAM

INPUT LINE	OUTPUT LINE	NEST LEVEL	OUTPUT SFORTRAN STATEMENT
	34	1	ELSE
29	35	2	INTER(I)=I-1
	36	1	END IF
30	37	1	IF (D.NE.0.)
31	38	2	G=A(I,I-1)
32	39	2	A(I,I-1)=-(G*A(I-1,I-1)+B(I,I-1)*B(I-1,I-1))/C
33	40	2	B(I,I-1)=-(B(I,I-1)*A(I-1,I-1)-G*B(I-1,I-1))/C
34	41	2	DO FOR K=I,N
35	42	3	A(I,K)=A(I,K)+A(I,I-1)*A(I-1,K)-B(I,I-1)*B(I-1,K)
36	43	3	B(I,K)=B(I,K)+B(I,I-1)*A(I-1,K)+A(I?I-1)*B(I-1,K)
	44	2	END DO FOR
	45	1	END IF
	46		END DO FOR
	47	C	TRIANGULAR MATRIX FORMED
39	48		DO FOR I=1,N
40	49	1	C=A(I,I)*A(I,I)+B(I,I)*B(I,I)
41	50	1	IF (C.LT.SMALL)
42	51	2	A(I,I)= SQRT(SMALL)
43	52	2	B(I,I)=C.0
	53	1	END IF
	54		END DO FOR
45	55		DO FOR I=1,N
46	56	1	Y(I)=1.0
47	57	1	Z(I)=0.0
	58		END DO FOR
48	59		DO FOR JJJ=1,4
49	60	1	C=A(N,N)*A(N,N)+B(N,N)*B(N,N)
50	61	1	G=Y(N)
51	62	1	Y(N)=(G*A(N,N)+Z(N)*B(N,N))/C
52	63	1	Z(N)=(Z(N)*A(N,N)-G*B(N,N))/C
53	64	1	DO FOR I=2,N
54	65	2	E=0.0

34H

STRUCTURED SFORTRAN PROGRAM

INPUT LINE	OUTPUT LINE	NEST LEVEL	OUTPUT SFORTRAN STATEMENT
55	66	2	F=0.0
56	67	2	N=N+1-I
57	68	2	DO FOR J=2,I
58	69	3	L=N+J-1
59	70	3	E=E+Y(L)*A(M,L)-Z(L)*B(M,L)
60	71	3	F=F+Y(L)*B(M,L)+Z(L)*A(M,L)
	72	2	END DO FOR
61	73	2	C=A(M,M)*A(M,M)+B(M,M)*B(M,M)
62	74	2	G=Y(M)
63	75	2	Y(M)=((G-E)*A(M,M)+(Z(M)-F)*B(M,M))/C
64	76	2	Z(M)=((Z(M)-F)*A(M,M)-(G-E)*B(M,M))/C
	77	1	END DO FOR
65	78	1	E=0.0
66	79	1	DO FOR I=1,N
67	80	2	F=Y(I)*Y(I)+Z(I)*Z(I)
68	81	2	IF (E.LT.F)
69	82	3	E=F
70	83	3	L=I
	84	2	END IF
	85	1	END DO FOR
72	86	1	A1=Y(L)
73	87	1	A2=Z(L)
74	88	1	DO FOR I=1,N
75	89	2	G=Y(I)
76	90	2	Y(I)=(G*A1+Z(I)*A2)/E
77	91	2	Z(I)=(Z(I)*A1-G*A2)/E
	92	1	END DO FOR
78	93	1	UNDO IF (JJJ.EQ.4)
79	94	1	DO FOR I=2,N
83	95	2	IF (INTER(I).EQ.I)
81	96	3	G=Y(I)
82	97	3	Y(I)=Y(I-1)
83	98	3	Y(I-1)=G
84	99	3	G=Z(I)
85	100	3	Z(I)=Z(I-1)

STRUCTURED SFORTRAN PROGRAM

```
 INPUT  OUTPUT  NEST
 LINE   LINE    LEVEL                    OUTPUT SFORTRAN STATEMENT
   86     101      3                          Z(I-1)=G
          102      2                      END IF
   87     103      2                      Y(I)=Y(I)+A(I,I-1)*Y(I-1)-B(I,I-1)*Z(I-1)
   88     104      2                      Z(I)=Z(I)+B(I,I-1)*Y(I-1)+A(I,I-1)*Z(I-1)
          105      1                  END DO FOR
          106                     END DO FOR
          107              C                        EIGENVECTOR OF HESSENBURG MATRIX OBTAINED
   91     108                     M=N-1
   92     109                     DO FOR I=2,M
   93     110      1                  J=N+1-I
   94     111      1                  L=J+1
   95     112      1                  DO FOR K=L,M
   96     113      2                      Y(K)=Y(K)-Y(J)*A(K,J-1)+Z(J)*B(K,J-1)
   97     114      2                      Z(K)=Z(K)-Z(J)*A(K,J-1)-Y(J)*B(K,J-1)
          115      1                  END DO FOR
   98     116      1                  LL=INT(N-I)
   99     117      1                  IF (J.NE.LL)
  100     118      2                      G=Y(J)
  101     119      2                      Y(J)=Y(LL)
  102     120      2                      Y(LL)=G
  103     121      2                      G=Z(J)
  104     122      2                      Z(J)=Z(LL)
  105     123      2                      Z(LL)=G
          124      1                  END IF
          125                     END DO FOR
          126              C                        UNNORMALIZED EIGENVECTOR OBTAINED
  108     127                     E=0.0
  109     128                     DO FOR I=1,N
  110     129      1                  F=Y(I)*Y(I)+Z(I)*Z(I)
  111     130      1                  IF (E.LT.F)
  112     131      2                      E=F
  113     132      2                      L=I
          133      1                  END IF
          134                     END DO FOR
  115     135                     A1=Y(L)
  116     136                     A2=Z(L)
```

STRUCTURED SFORTRAN PROGRAM

INPUT LINE	OUTPUT LINE	NEST LEVEL		OUTPUT SFORTRAN STATEMENT
117	137			DO FOR I=1,N
118	138	1		G=Y(I)
119	139	1		Y(I)=(G*A1+Z(I)*A2)/E
120	140	1		Z(I)=(Z(I)*A1-G*A2)/E
	141			END DO FOR
	142		C	NORMALIZED EIGENVECTOR OBTAINED
	143		C	PUT Y(I) (REAL PART) IN EIGVECT(NUMOFEV,I)
123	144			DO FOR I=1,N
124	145	1		EIGVEC(NUM,I)=Y(I)
	146			END DO FOR
125	147			NUM=NUM+1
	148		C	PUT Z(I) (COMPLEX PART) IN EIGVECT(NUMOFEV,I)
127	149			DO FOR I=1,N
128	150	1		EIGVEC(NUM,I)=Z(I)
	151			END DO FOR
129	152			RETURN
	153		C	********** END PROGRAM UNIT **********
	154			END

H2/3

```
      SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT) #0
      DOUBLE PRECISION DELTAX, DELTA, A, PROD, SUM  #1
      DIMENSION X(1), Y(1)                          #2
      DIMENSION DELTA(10), A(10)                    #3
                                                    #4
        SEARCH FOR APPROPRIATE VALUE OF X(I)        #5
C                                                   #6
   11 DO 19 I=1, NPTS                               #7
      IF (XIN - X(I)) 13, 17, 19                    #8
   13 II = I - NTERMS/2                             #9
      IF (II) 15, 15, 21                            #10
   15 II = 1                                        #11
      GO TO 21                                      #12
   17 YOUT = Y(I)                                   #13
   18 GO TO 61                                      #14
   19 CONTINUE                                      #15
      II = NPTS - NTERMS + 1                        #16
   21 I2 = II + NTERMS - 1                          #18
      IF (NPTS - I2) 23, 31, 31                     #19
   23 I2 = NPTS                                     #20
      II = I2 - NTERMS + 1                          #21
   25 IF (II) 26, 26, 31                            #22
   26 II = 1                                        #23
   27 NTERMS = I2 - II + 1                          #24
C                                                   #25
C       EVALUATE DEVIATIONS DELTA                   #26
C                                                   #27
   31 DENOM = X(II+1) - X(II)                       #28
      DELTAX = (XIN - X(II)) / DENOM                #29
      DO 35 I=1, NTERMS                             #30
      IX = II + I - 1                               #31
      DELTA(I) = (X(IX) - X(II)) / DENOM            #32
   35 CONTINUE                                      #32.1
C                                                   #33
C       ACCUMULATE COEFFICIENTS A                   #34
C                                                   #35
   40 A(1) = Y(II)                                  #36
   41 DO 50 K=2, NTERMS                             #37
      PROD = 1.                                     #38
      SUM = 0.                                      #39
      IMAX = K - 1                                  #40
      IXMAX = II + IMAX                             #41
      DO 49 I=1, IMAX                               #42
      J = K - I                                     #43
      PROD = PROD * (DELTA(K) - DELTA(J))           #44
   49 SUM = SUM - A(J)/PROD                         #45
      A(K) = SUM + Y(IXMAX)/PROD                    #46
   50 CONTINUE                                      #47
C                                                   #48
C       ACCUMULATE SUM OF EXPANSION                 #49
C                                                   #50
   51 SUM = A(1)                                    #51
      DO 57 J=2, NTERMS                             #52
      PROD = 1.                                     #53
      IMAX = J - 1                                  #54
      DO 56 I=1, IMAX                               #55
   56 PROD = PROD * (DELTAX - DELTA(I))             #56
   57 SUM = SUM + A(J)*PROD                         #57
   60 YOUT = SUM                                    #58
   61 RETURN                                        #59
      END                                           #60
```

TESTCASE Output File ((1 15) (INTERP . OUT)) --date--

Program file: ((1 15) (INTERP . F4))
Analysis commands file: ((1 15) (INTERP . ACF))

ANALYSIS OF INTERP

Global Commands:

```
MAXPATHS 300;
MAXLENGTH 300;
DEFAULT LOOP ANY CONSISTENT(1-10);
DEFAULT SELECT ANY CONSISTENT;
PATH; PREDICATES;
```

Case 1 ==========

ANALYSIS OF SECTION OF CODE THAT DETERMINES X1.
CHECK FOR NPTS=1 CASE.

Case Commands:

```
OUTPUT I1, NTERMS;
SELECT ALL;
7 ASSIGN NPTS=1;
28 HALT;
```

Case 1.1 ----------

PATH: 8-12 18-24

PREDICATES:

```
    :1  0        SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
    :7  8        XIN - X(1) .LT. 0
    :9  10       1 - (NTERMS/2) .LE. 0
    :13 19       1 - ((1 + NTERMS) - 1) .LT. 0
    :16 22       1 + 1 - NTERMS .LE. 0
```

OUTPUT:

Final Values

```
    :18 28       I1 = 1
                 NTERMS = 1
```

Case 1.2 ----------

PATH: 8-12 18-22

```
PREDICATES:
     :1  3          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .LT. 0
     :9  10         1 - (NTERMS/2) .LE. 0
     :13 15         1 - ((1 + NTERMS) - 1) .LT. 0
     :16 22         1 + 1 - NTERMS .GT. 0

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :16 28         I1 = 1 + 1 - NTERMS
                    NTERMS = NTERMS


Case 1.3 ----------------------------------------------------------


PATH:  0-12 18-19

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .LT. 0
     :9  10         1 - (NTERMS/2) .LE. 0
     :13 19         1 - ((1 + NTERMS) - 1) .GE. 0

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :13 28         I1 = 1
                    NTERMS = NTERMS


Case 1.4 ----------------------------------------------------------


PATH:  0-10 18-24

PREDICATES:
     :1  2          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .LT. 0
     :9  10         1 - (NTERMS/2) .GT. 0
     :11 19         1 - ((1 - (NTERMS/2) + NTERMS) - 1) .LT. 0
     :14 22         1 + 1 - NTERMS .LE. 0

OUTPUT:

  Final Values
     :16 28         I1 = 1
                    NTERMS = 1


Case 1.5 ----------------------------------------------------------
```

```
PATH:  0-10 18-22

PREDICATES:
     :1  8          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .LT. 0
     :9  10         1 - (NTERMS/2) .GT. 0
     :11 19         1 - ((1 - (NTERMS/2) + NTERMS) - 1) .LT. 0
     :14 22         1 + 1 - NTERMS .GT. 0

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :14 28         I1 = 1 + 1 - NTERMS
                    NTERMS = NTERMS


Case 1.6 ----------------------------------------------------------


PATH:  0-10 18-19

PREDICATES:
     :1  8          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .LT. 0
     :9  10         1 - (NTERMS/2) .GT. 0
     :11 19         1 - ((1 - (NTERMS/2) + NTERMS) - 1) .GE. 0

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :11 22         I1 = 1 - (NTERMS/2)
                    NTERMS = NTERMS


Case 1.7 ----------------------------------------------------------


PATH:  0-8 13-14 59

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .EQ. 0

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
59       NOTE: Reference to unitialized variable I1

  Final Values
     :10 59         I1 = I1
                    NTERMS = NTERMS


Case 1.8 ----------------------------------------------------------
```

```
PATH:  0-8 15 7 16-24

PREDICATES:
     :1  8          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :13 19         1 - ((1 + 1 - NTERMS + NTERMS) - 1) .LT. 0
     :16 22         1 + 1 - NTERMS .LE. 0

OUTPUT:

  Final Values
     :13 28         I1 = 1
                    NTERMS = 1


Case 1.9 ----------------------------------------------------------


PATH:  0-8 15 7 16-22

PREDICATES:
     :1  8          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :13 19         1 - ((1 + 1 - NTERMS + NTERMS) - 1) .LT. 0
     :16 22         1 + 1 - NTERMS .GT. 0

OUTPUT:
     :1  8          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :16 28         I1 = 1 + 1 - NTERMS
                    NTERMS = NTERMS


Case 1.10 ---------------------------------------------------------


PATH:  0-8 15 7 16-18

PREDICATES:
     :1  8          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :13 19         1 - ((1 + 1 - NTERMS + NTERMS) - 1) .GE. 0

OUTPUT:
     :1  8          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :13 28         I1 = 1 + 1 - NTERMS
                    NTERMS = NTERMS


Case 2 ------------------------------------------------------------

AS IN CASE 1, CHECK FOR NPTS=2
```

```
Case Commands:

OUTPUT I1, NTERMS;
SELECT ALL;
CONSISTENCY;
7 ASSIGN NPTS=2;
28 HALT;


Case 2.1 ------------------------------------------------------


PATH:  0-12 18-24

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .LT. 0
     :9  10         1 - (NTERMS/2) .LE. 0
     :13 19         2 - ((1 + NTERMS) - 1) .LT. 0
     :16 22         1 + 2 - NTERMS .LE. 0
     :18 28   CONSISTENCY:  OK

OUTPUT:

  Final Values
     :18 28         I1 = 1
                    NTERMS = 2


Case 2.2 ------------------------------------------------------


PATH:  0-12 18-22

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .LT. 0
     :9  10         1 - (NTERMS/2) .LE. 0
     :13 19         2 - ((1 + NTERMS) - 1) .LT. 0
     :16 22         1 + 2 - NTERMS .GT. 0
     :16 28   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :18 28         I1 = 1 + 2 - NTERMS
                    NTERMS = NTERMS


Case 2.3 ------------------------------------------------------


PATH:  0-12 18-19

PREDICATES:
```

```
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .LT. 0
     :9  10         1 - (NTERMS/2) .LE. 0
     :13 19         2 - ((1 + NTERMS) - 1) .GE. 0
     :13 28   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :13 28         I1 = 1
                    NTERMS = NTERMS


Case 2.4 ------------------------------------------------------


PATH:  8-10 10-24

PREDICATES:
     :1  8          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .LT. 0
     :9  10         1 - (NTERMS/2) .GT. 0
     :11 19         2 - ((1 - (NTERMS/2) + NTERMS) - 1) .LT. 0
     :14 22         1 + 2 - NTERMS .LE. 0
     :16 28   CONSISTENCY:  OK

OUTPUT:

  Final Values
     :16 28         I1 = 1
                    NTERMS = 2


Case 2.5 ------------------------------------------------------


PATH:  8-10 10-22

PREDICATES:
     :1  8          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .LT. 0
     :9  10         1 - (NTERMS/2) .GT. 0
     :11 19         2 - ((1 - (NTERMS/2) + NTERMS) - 1) .LT. 0
     :14 22         1 + 2 - NTERMS .GT. 0
     :14 28   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :14 28         I1 = 1 + 2 - NTERMS
                    NTERMS = NTERMS


Case 2.6 ------------------------------------------------------
```

```
PATH:  8-10 13-19

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .LT. 0
     :9  10         1 - (NTERMS/2) .GT. 0
     :11 19         2 - ((1 - (NTERMS/2) + NTERMS) - 1) .GE. 0
     :11 28   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :11 28         I1 = 1 - (NTERMS/2)
                    NTERMS = NTERMS


Case 2.7 ----------------------------------------------------------


PATH:  8-8 13-14 59

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .EQ. 0
     :13 59   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
59        NOTE: Reference to unitialized variable I1

  Final Values
     :10 59         I1 = I1
                    NTERMS = NTERMS


Case 2.8 ----------------------------------------------------------


PATH:  8-8 15 7-12 18-24

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .LT. 0
     :13 10         2 - (NTERMS/2) .LE. 0
     :17 19         2 - ((1 + NTERMS) - 1) .LT. 0
     :20 22         1 + 2 - NTERMS .LE. 0
     :22 28   CONSISTENCY:  OK

OUTPUT:

  Final Values
     :22 28         I1 = 1
                    NTERMS = 2
```

```
Case 2.9 ----------------------------------------------------------

PATH:  0-8 15 7-12 18-22

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .LT. 0
     :13 10         2 - (NTERMS/2) .LE. 0
     :17 19         2 - ((1 + NTERMS) - 1) .LT. 0
     :20 22         1 + 2 - NTERMS .GT. 0
     :20 28   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :22 28         I1 = 1 + 2 - NTERMS
                    NTERMS = NTERMS


Case 2.10 ---------------------------------------------------------

PATH:  0-8 15 7-12 18-19

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .LT. 0
     :13 10         2 - (NTERMS/2) .LE. 0
     :17 19         2 - ((1 + NTERMS) - 1) .GE. 0
     :17 28   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :17 28         I1 = 1
                    NTERMS = NTERMS


Case 2.11 ---------------------------------------------------------

PATH:  0-8 15 7-10 18-24

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .LT. 0
     :13 10         2 - (NTERMS/2) .GT. 0
     :15 19         2 - ((2 - (NTERMS/2) + NTERMS) - 1) .LT. 0
     :18 22         1 + 2 - NTERMS .LE. 0
     :20 28   CONSISTENCY:  OK
```

```
OUTPUT:

  Final Values
     :20 20          I1 = 1
                     NTERMS = 2


Case 2.12 ------------------------------------------------------


PATH:  0-8 15 7-10 18-22

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .LT. 0
     :13 10         2 - (NTERMS/2) .GT. 0
     :15 19         2 - ((2 - (NTERMS/2) + NTERMS) - 1) .LT. 0
     :18 22         1 + 2 - NTERMS .GT. 0
     :13 20   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :18 20          I1 = 1 + 2 - NTERMS
                     NTERMS = NTERMS


Case 2.13 ------------------------------------------------------


PATH:  0-6 15 7-10 18-19

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .LT. 0
     :13 10         2 - (NTERMS/2) .GT. 0
     :15 19         2 - ((2 - (NTERMS/2) + NTERMS) - 1) .GE. 0
     :15 20   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :15 20          I1 = 2 - (NTERMS/2)
                     NTERMS = NTERMS


Case 2.14 ------------------------------------------------------


PATH:  0-8 15 7-8 13-14 59

PREDICATES:
```

```
     :1  8          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .EQ. 0
     :14 59   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
59       NOTE: Reference to uninitialized variable I1

  Final Values
     :14 59         I1 = I1
                    NTERMS = NTERMS


Case 2.15 ------------------------------------------------------------


PATH:  0-8 15 7-8 15 7 16-24

PREDICATES:
     :1  8          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .GT. 0
     :17 19         2 - ((1 + 2 - NTERMS + NTERMS) - 1) .LT. 0
     :20 22         1 + 2 - NTERMS .LE. 0
     :22 28   CONSISTENCY:  OK

OUTPUT:

  Final Values
     :22 28         I1 = 1
                    NTERMS = 2


Case 2.16 ------------------------------------------------------------


PATH:  0-8 15 7-8 15 7 16-22

PREDICATES:
     :1  8          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .GT. 0
     :17 19         2 - ((1 + 2 - NTERMS + NTERMS) - 1) .LT. 0
     :20 22         1 + 2 - NTERMS .GT. 0
     :20 28   CONSISTENCY:  OK

OUTPUT:
     :1  8          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :20 28         I1 = 1 + 2 - NTERMS
                    NTERMS = NTERMS


Case 2.17 ------------------------------------------------------------
```

```
PATH:  0-8 15 7-8 16 7 16-19

PREDICATES:
     :1  8          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .GT. 0
     :17 19         2 - ((1 + 2 - NTERMS + NTERMS) - 1) .GE. 0
     :17 28   CONSISTENCY:  OK

OUTPUT:
     :1  8          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :17 28         I1 = 1 + 2 - NTERMS
                    NTERMS = NTERMS


Case 3 ==========================================================

AS IN CASE 1, CHECK FOR NPTS=3.

Case Commands:

OUTPUT I1, NTERMS;
SELECT ALL;
CONSISTENCY;
7 ASSIGN NPTS=3;
23 HALT;


Case 3.1 ----------------------------------------------------


PATH:  0-12 18-24

PREDICATES:
     :1  8          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .LT. 0
     :9  10         1 - (NTERMS/2) .LE. 0
     :13 19         3 - ((1 + NTERMS) - 1) .LT. 0
     :16 22         1 + 3 - NTERMS .LE. 0
     :18 28   CONSISTENCY:  OK

OUTPUT:

  Final Values
     :18 28         I1 = 1
                    NTERMS = 3


Case 3.2 ----------------------------------------------------


PATH:  0-12 18-22

PREDICATES:
```

```
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .LT. 0
     :9  10         1 - (NTERMS/2) .LE. 3
     :13 19         3 - ((1 + NTERMS) - 1) .LT. 0
     :16 22         1 + 3 - NTERMS .GT. 0
     :16 28   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :16 28         I1 = 1 + 3 - NTERMS
                    NTERMS = NTERMS


Case 3.3 ------------------------------------------------------------

PATH:  0-12 18-19

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .LT. 0
     :9  10         1 - (NTERMS/2) .LE. 0
     :13 19         3 - ((1 + NTERMS) - 1) .GE. 0
     :13 28   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :13 28         I1 = 1
                    NTERMS = NTERMS


Case 3.4 ------------------------------------------------------------

PATH:  0-10 18-24

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .LT. 0
     :9  10         1 - (NTERMS/2) .GT. 0
     :11 19         3 - ((1 - (NTERMS/2) + NTERMS) - 1) .LT. 0
     :14 22         1 + 3 - NTERMS .LE. 0
     :16 28   CONSISTENCY:  OK

OUTPUT:

  Final Values
     :16 28         I1 = 1
                    NTERMS = 3


Case 3.5 ------------------------------------------------------------
```

```
PATH:  0-10 18-22

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .LT. 0
     :9  10         1 - (NTERMS/2) .GT. 0
     :11 19         3 - ((1 - (NTERMS/2) + NTERMS) - 1) .LT. 0
     :14 22         1 + 3 - NTERMS .GT. 0
     :14 28   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :14 28         I1 = 1 + 3 - NTERMS
                    NTERMS = NTERMS


Case 3.6 ------------------------------------------------------


PATH:  0-10 18-19

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .LT. 0
     :9  10         1 - (NTERMS/2) .GT. 0
     :11 19         3 - ((1 - (NTERMS/2) + NTERMS) - 1) .GE. 0
     :11 28   CONSISTENCY:  OK

OUTPUT:
     :1  8          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :11 28         I1 = 1 - (NTERMS/2)
                    NTERMS = NTERMS


Case 3.7 ------------------------------------------------------


PATH:  0-8 13-14 59

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .EQ. 0
     :13 59   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
59       NOTE: Reference to unitialized variable I1

  Final Values
     :13 59         I1 = I1
                    NTERMS = NTERMS
```

```
Case 3.8 ------------------------------------------------------

PATH:  0-8 15 7-12 18-24

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .LT. 0
     :13 10         2 - (NTERMS/2) .LE. 0
     :17 19         3 - ((1 + NTERMS) - 1) .LT. 0
     :20 22         1 + 3 - NTERMS .LE. 0
     :22 28   CONSISTENCY:  OK

OUTPUT:

  Final Values
     :22 28         11 = 1
                    NTERMS = 3


Case 3.9 ------------------------------------------------------

PATH:  0-8 15 7-12 18-22

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .LT. 0
     :13 10         2 - (NTERMS/2) .LE. 0
     :17 19         3 - ((1 + NTERMS) - 1) .LT. 0
     :20 22         1 + 3 - NTERMS .GT. 0
     :20 28   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :20 28         11 = 1 + 3 - NTERMS
                    NTERMS = NTERMS


Case 3.10 -----------------------------------------------------

PATH:  0-8 15 7-12 18-19

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .LT. 0
     :13 10         2 - (NTERMS/2) .LE. 0
     :17 19         3 - ((1 + NTERMS) - 1) .GE. 0
     :17 28   CONSISTENCY:  OK
```

```
OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :17 28         I1 = 1
                    NTERMS = NTERMS

Case 3.11 ------------------------------------------------------

PATH:  0-8 15 7-10 18-24

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .LT. 0
     :13 10         2 - (NTERMS/2) .GT. 0
     :15 19         3 - ((2 - (NTERMS/2) + NTERMS) - 1) .LT. 0
     :18 22         1 + 3 - NTERMS .LE. 0
     :23 28   CONSISTENCY:  OK

OUTPUT:

  Final Values
     :23 28         I1 = 1
                    NTERMS = 3

Case 3.12 ------------------------------------------------------

PATH:  0-8 15 7-10 18-22

PREDICATES:
     :1  8          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .LT. 0
     :13 10         2 - (NTERMS/2) .GT. 0
     :15 19         3 - ((2 - (NTERMS/2) + NTERMS) - 1) .LT. 0
     :18 22         1 + 3 - NTERMS .GT. 0
     :18 28   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :18 28         I1 = 1 + 3 - NTERMS
                    NTERMS = NTERMS

Case 3.13 ------------------------------------------------------

PATH:  0-8 15 7-10 18-19
```

```
PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .LT. 0
     :13 10         2 - (NTERMS/2) .GT. 0
     :15 19         3 - ((2 - (NTERMS/2) + NTERMS) - 1) .GE. 0
     :15 28   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :15 28         I1 = 2 - (NTERMS/2)
                    NTERMS = NTERMS


Case 3.14 ------------------------------------------------------

PATH:  0-8 15 7-8 13-14 59

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .EQ. 0
     :14 59   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
59       NOTE: Reference to unitialized variable I1

  Final Values
     :14 59         I1 = I1
                    NTERMS = NTERMS


Case 3.15 ------------------------------------------------------

PATH:  0-8 15 7-8 15 7-12 18-24

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .GT. 0
     :15 8          XIN - X(3) .LT. 0
     :17 10         3 - (NTERMS/2) .LE. 0
     :21 19         3 - ((1 + NTERMS) - 1) .LT. 0
     :24 22         1 + 3 - NTERMS .LE. 0
     :26 28   CONSISTENCY:  OK

OUTPUT:

  Final Values
     :26 28         I1 = 1
                    NTERMS = 3
```

```
Case 3.16 ------------------------------------------------------

PATH:  3-8 15 7-8 15 7-12 18-22

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .GT. 0
     :15 8          XIN - X(3) .LT. 0
     :17 18         3 - (NTERMS/2) .LE. 0
     :21 19         3 - ((1 + NTERMS) - 1) .LT. 0
     :24 22         1 + 3 - NTERMS .GT. 0
     :24 28   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :24 28         I1 = 1 + 3 - NTERMS
                    NTERMS = NTERMS

Case 3.17 ------------------------------------------------------

PATH:  0-8 15 7-8 15 7-12 18-19

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .GT. 0
     :15 8          XIN - X(3) .LT. 0
     :17 18         3 - (NTERMS/2) .LE. 0
     :21 19         3 - ((1 + NTERMS) - 1) .GE. 0
     :21 28   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :21 28         I1 = 1
                    NTERMS = NTERMS

Case 3.18 ------------------------------------------------------

PATH:  0-8 15 7-8 15 7-10 18-24

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .GT. 0
     :15 8          XIN - X(3) .LT. 0
     :17 18         3 - (NTERMS/2) .GT. 0
```

```
      :19 19          3 - ((3 - (NTERMS/2) + NTERMS) - 1) .LT. 0
      :22 22          1 + 3 - NTERMS .LE. 3
      :24 28    CONSISTENCY:  OK

OUTPUT:

  Final Values
      :24 28          I1 = 1
                      NTERMS = 3


Case 3.19 ------------------------------------------------------------


PATH:  0-8 15 7-8 15 7-10 18-22

PREDICATES:
      :1  0           SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
      :7  8           XIN - X(1) .GT. 0
      :11 8           XIN - X(2) .GT. 0
      :15 8           XIN - X(3) .LT. 0
      :17 10          3 - (NTERMS/2) .GT. 0
      :19 19          3 - ((3 - (NTERMS/2) + NTERMS) - 1) .LT. 0
      :22 22          1 + 3 - NTERMS .GT. 0
      :22 28    CONSISTENCY:  OK

OUTPUT:
      :1  0           SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
      :22 28          I1 = 1 + 3 - NTERMS
                      NTERMS = NTERMS


Case 3.20 ------------------------------------------------------------


PATH:  0-8 15 7-8 15 7-10 18-19

PREDICATES:
      :1  0           SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
      :7  8           XIN - X(1) .GT. 0
      :11 8           XIN - X(2) .GT. 0
      :15 8           XIN - X(3) .LT. 0
      :17 10          3 - (NTERMS/2) .GT. 0
      :19 19          3 - ((3 - (NTERMS/2) + NTERMS) - 1) .GE. 0
      :19 28    CONSISTENCY:  OK

OUTPUT:
      :1  2           SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
      :19 28          I1 = 3 - (NTERMS/2)
                      NTERMS = NTERMS
```

```
Case 3.21 ------------------------------------------------------

PATH:  0-8 15 7-8 15 7-8 13-14 59

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .GT. 0
     :15 8          XIN - X(3) .EQ. 0
     :13 59   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
59       NOTE: Reference to unitialized variable I1

  Final Values
     :13 59         I1 = I1
                    NTERMS = NTERMS


Case 3.22 ------------------------------------------------------

PATH:  0-8 15 7-8 15 7-8 15 7 16-24

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .GT. 0
     :15 8          XIN - X(3) .GT. 0
     :21 19         3 - ((1 + 3 - NTERMS + NTERMS) - 1) .LT. 0
     :24 22         1 + 3 - NTERMS .LE. 0
     :26 28   CONSISTENCY:  OK

OUTPUT:

  Final Values
     :26 28         I1 = 1
                    NTERMS = 3


Case 3.23 ------------------------------------------------------

PATH:  0-8 15 7-8 15 7-8 15 7 16-22

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .GT. 0
     :15 8          XIN - X(3) .GT. 0
     :21 19         3 - ((1 + 3 - NTERMS + NTERMS) - 1) .LT. 0
     :24 22         1 + 3 - NTERMS .GT. 0
     :24 28   CONSISTENCY:  OK
```

```
OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :24 28         I1 = 1 + 3 - NTERMS
                    NTERMS = NTERMS


Case 3.24 ------------------------------------------------------------


PATH:  0-8 15 7-8 15 7-8 15 7 16-19

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .GT. 0
     :15 8          XIN - X(3) .GT. 0
     :21 19         3 - ((1 + 3 - NTERMS + NTERMS) - 1) .GE. 0
     :21 28   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :21 28         I1 = 1 + 3 - NTERMS
                    NTERMS = NTERMS


Case 4 ===========================================================

AS IN CASE 1, CHECK FOR NPTS=4.

Case Commands:

OUTPUT I1, NTERMS;
SELECT ALL;
CONSISTENCY;
7 ASSIGN NPTS=4;
28 HALT;


Case 4.1 ---------------------------------------------------------


PATH:  0-12 18-24

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .LT. 0
     :9  10         1 - (NTERMS/2) .LE. 0
     :13 19         4 - ((1 + NTERMS) - 1) .LT. 0
     :16 22         1 + 4 - NTERMS .LE. 0
     :18 28   CONSISTENCY:  OK
```

```
OUTPUT:

  Final Values
     :18 28          I1 = 1
                     NTERMS = 4


Case 4.2 ------------------------------------------------------


PATH:  0-12 18-22

PREDICATES:
     :1  0           SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8           XIN - X(1) .LT. 0
     :9  10          1 - (NTERMS/2) .LE. 0
     :13 19          4 - ((1 + NTERMS) - 1) .LT. 0
     :16 22          1 + 4 - NTERMS .GT. 0
     :16 28    CONSISTENCY:  OK

OUTPUT:
     :1  0           SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :16 28          I1 = 1 + 4 - NTERMS
                     NTERMS = NTERMS


Case 4.3 ------------------------------------------------------


PATH:  0-12 18-19

PREDICATES:
     :1  0           SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8           XIN - X(1) .LT. 0
     :9  10          1 - (NTERMS/2) .LE. 0
     :13 19          4 - ((1 + NTERMS) - 1) .GE. 0
     :13 28    CONSISTENCY:  OK

OUTPUT:
     :1  0           SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :13 28          I1 = 1
                     NTERMS = NTERMS


Case 4.4 ------------------------------------------------------


PATH:  0-10 18-24

PREDICATES:
     :1  0           SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8           XIN - X(1) .LT. 0
```

```
     :9  10          1 - (NTERMS/2) .GT. 0
     :11 19          4 - ((1 - (NTERMS/2) + NTERMS) - 1) .LT. 0
     :14 22          1 + 4 - NTERMS .LE. 0
     :16 28    CONSISTENCY:  OK

OUTPUT:

  Final Values
     :16 28          I1 = 1
                     NTERMS = 4


Case 4.5 ------------------------------------------------------------


PATH:  8-10 18-22

PREDICATES:
     :1  8           SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8           XIN - X(1) .LT. 0
     :9  10          1 - (NTERMS/2) .GT. 0
     :11 19          4 - ((1 - (NTERMS/2) + NTERMS) - 1) .LT. 0
     :14 22          1 + 4 - NTERMS .GT. 0
     :14 28    CONSISTENCY:  OK

OUTPUT:
     :1  8           SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :14 28          I1 = 1 + 4 - NTERMS
                     NTERMS = NTERMS


Case 4.6 ------------------------------------------------------------


PATH:  8-10 18-19

PREDICATES:
     :1  8           SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8           XIN - X(1) .LT. 0
     :9  10          1 - (NTERMS/2) .GT. 0
     :11 19          4 - ((1 - (NTERMS/2) + NTERMS) - 1) .GE. 0
     :11 28    CONSISTENCY:  OK

OUTPUT:
     :1  8           SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :11 28          I1 = 1 - (NTERMS/2)
                     NTERMS = NTERMS


Case 4.7 ------------------------------------------------------------
```

```
PATH:  0-8 13-14 59

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .EQ. 0
     :10 59   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
59       NOTE: Reference to unitialized variable I1

  Final Values
     :10 59         I1 = I1
                    NTERMS = NTERMS


Case 4.8 ------------------------------------------------------


PATH:  0-8 15 7-12 18-24

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .LT. 0
     :13 18         2 - (NTERMS/2) .LE. 0
     :17 19         4 - ((1 + NTERMS) - 1) .LT. 0
     :20 22         1 + 4 - NTERMS .LE. 0
     :22 28   CONSISTENCY:  OK

OUTPUT:

  Final Values
     :22 28         I1 = 1
                    NTERMS = 4


Case 4.9 ------------------------------------------------------


PATH:  0-8 15 7-12 18-22

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .LT. 0
     :13 18         2 - (NTERMS/2) .LE. 0
     :17 19         4 - ((1 + NTERMS) - 1) .LT. 0
     :20 22         1 + 4 - NTERMS .GT. 0
     :20 28   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :20 28         I1 = 1 + 4 - NTERMS
```

```
                    NTERMS = NTERMS

Case 4.10 ------------------------------------------------------------

PATH:  0-8 15 7-12 18-19

PREDICATES:
     :1  8          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .LT. 0
     :13 10         2 - (NTERMS/2) .LE. 0
     :17 19         4 - ((1 + NTERMS) - 1) .GE. 0
     :17 28   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :17 28         I1 = 1
                    NTERMS = NTERMS


Case 4.11 ------------------------------------------------------------

PATH:  0-8 15 7-10 18-24

PREDICATES:
     :1  8          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .LT. 0
     :13 10         2 - (NTERMS/2) .GT. 0
     :15 19         4 - ((2 - (NTERMS/2) + NTERMS) - 1) .LT. 0
     :18 22         1 + 4 - NTERMS .LE. 0
     :20 28   CONSISTENCY:  OK

OUTPUT:

  Final Values
     :20 28         I1 = 1
                    NTERMS = 4


Case 4.12 ------------------------------------------------------------

PATH:  0-8 15 7-10 18-22

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .LT. 0
     :13 10         2 - (NTERMS/2) .GT. 0
     :15 19         4 - ((2 - (NTERMS/2) + NTERMS) - 1) .LT. 0
```

```
     :18 22          1 + 4 - NTERMS .GT. 0
     :18 23    CONSISTENCY:  OK

OUTPUT:
     :1  8           SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :18 28          I1 = 1 + 4 - NTERMS
                     NTERMS = NTERMS


Case 4.13 ------------------------------------------------------


PATH:  0-8 15 7-10 18-19

PREDICATES:
     :1  8           SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8           XIN - X(1) .GT. 0
     :11 8           XIN - X(2) .LT. 0
     :13 10          2 - (NTERMS/2) .GT. 0
     :15 19          4 - ((2 - (NTERMS/2) + NTERMS) - 1) .GE. 0
     :15 28    CONSISTENCY:  OK

OUTPUT:
     :1  8           SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :15 28          I1 = 2 - (NTERMS/2)
                     NTERMS = NTERMS


Case 4.14 ------------------------------------------------------


PATH:  0-8 15 7-8 13-14 59

PREDICATES:
     :1  8           SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8           XIN - X(1) .GT. 0
     :11 8           XIN - X(2) .EQ. 0
     :14 59    CONSISTENCY:  OK

OUTPUT:
     :1  8           SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
59       NOTE: Reference to unitialized variable I1

  Final Values
     :14 59          I1 = I1
                     NTERMS = NTERMS


Case 4.15 ------------------------------------------------------


PATH:  0-8 15 7-8 15 7-12 18-24
```

```
PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .GT. 0
     :15 8          XIN - X(3) .LT. 0
     :17 18         3 - (NTERMS/2) .LE. 0
     :21 19         4 - ((1 + NTERMS) - 1) .LT. 0
     :24 22         1 + 4 - NTERMS .LE. 0
     :26 28   CONSISTENCY:  OK

OUTPUT:

  Final Values
     :26 28         I1 = 1
                    NTERMS = 4


Case 4.16 ------------------------------------------------------------

PATH:  0-8 15 7-8 15 7-12 18-22

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .GT. 0
     :15 8          XIN - X(3) .LT. 0
     :17 18         3 - (NTERMS/2) .LE. 0
     :21 19         4 - ((1 + NTERMS) - 1) .LT. 0
     :24 22         1 + 4 - NTERMS .GT. 0
     :24 28   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :24 28         I1 = 1 + 4 - NTERMS
                    NTERMS = NTERMS


Case 4.17 ------------------------------------------------------------

PATH:  0-8 15 7-8 15 7-12 18-19

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .GT. 0
     :15 8          XIN - X(3) .LT. 0
     :17 18         3 - (NTERMS/2) .LE. 0
     :21 19         4 - ((1 + NTERMS) - 1) .GE. 0
     :21 28   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
```

```
  Final Values
     :21 28          I1 = 1
                     NTERMS = NTERMS


Case 4.18 ------------------------------------------------------------


PATH:  0-8 15 7-8 15 7-10 18-24

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .GT. 0
     :15 8          XIN - X(3) .LT. 0
     :17 10         3 - (NTERMS/2) .GT. 0
     :19 19         4 - ((3 - (NTERMS/2) + NTERMS) - 1) .LT. 0
     :22 22         1 + 4 - NTERMS .LE. 0
     :24 28   CONSISTENCY:  OK

OUTPUT:

  Final Values
     :24 28          I1 = 1
                     NTERMS = 4


Case 4.19 ------------------------------------------------------------


PATH:  0-8 15 7-8 15 7-10 18-22

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .GT. 0
     :15 8          XIN - X(3) .LT. 0
     :17 10         3 - (NTERMS/2) .GT. 0
     :19 19         4 - ((3 - (NTERMS/2) + NTERMS) - 1) .LT. 0
     :22 22         1 + 4 - NTERMS .GT. 0
     :22 28   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :22 28          I1 = 1 + 4 - NTERMS
                     NTERMS = NTERMS


Case 4.20 ------------------------------------------------------------


PATH:  0-8 15 7-8 15 7-10 18-19

PREDICATES:
```

```
      :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
      :7  8          XIN - X(1) .GT. 0
      :11 8          XIN - X(2) .GT. 0
      :15 8          XIN - X(3) .LT. 0
      :17 10         3 - (NTERMS/2) .GT. 0
      :19 19         4 - ((3 - (NTERMS/2) + NTERMS) - 1) .GE. 0
      :19 28   CONSISTENCY:  OK

OUTPUT:
      :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
      :19 28         I1 = 3 - (NTERMS/2)
                     NTERMS = NTERMS


Case 4.21 ------------------------------------------------------------


PATH:  0-8 15 7-8 15 7-8 13-14 59

PREDICATES:
      :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
      :7  8          XIN - X(1) .GT. 0
      :11 8          XIN - X(2) .GT. 0
      :15 8          XIN - X(3) .EQ. 0
      :18 59   CONSISTENCY:  OK

OUTPUT:
      :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
59        NOTE: Reference to unitialized variable I1

  Final Values
      :18 59         I1 = I1
                     NTERMS = NTERMS


Case 4.22 ------------------------------------------------------------


PATH:  0-8 15 7-8 15 7-8 15 7-12 18-24

PREDICATES:
      :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
      :7  8          XIN - X(1) .GT. 0
      :11 8          XIN - X(2) .GT. 0
      :15 8          XIN - X(3) .GT. 0
      :19 8          XIN - X(4) .LT. 0
      :21 10         4 - (NTERMS/2) .LE. 0
      :25 19         4 - ((1 + NTERMS) - 1) .LT. 0
      :28 22         1 + 4 - NTERMS .LE. 0
      :30 28   CONSISTENCY:  OK

OUTPUT:

  Final Values
```

```
     :30 23          I1 = 1
                     NTERMS = 4


Case 4.23 ------------------------------------------------------


PATH:  0-8 15 7-8 15 7-8 15 7-12 18-22

PREDICATES:
     :1  0           SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8           XIN - X(1) .GT. 0
     :11 8           XIN - X(2) .GT. 0
     :15 8           XIN - X(3) .GT. 0
     :19 8           XIN - X(4) .LT. 0
     :21 10          4 - (NTERMS/2) .LE. 0
     :25 19          4 - ((1 + NTERMS) - 1) .LT. 0
     :28 22          1 + 4 - NTERMS .GT. 0
     :28 28   CONSISTENCY:  OK

OUTPUT:
     :1  0           SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :28 28          I1 = 1 + 4 - NTERMS
                     NTERMS = NTERMS


Case 4.24 ------------------------------------------------------


PATH:  0-8 15 7-8 15 7-8 15 7-12 18-19

PREDICATES:
     :1  0           SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8           XIN - X(1) .GT. 0
     :11 8           XIN - X(2) .GT. 0
     :15 8           XIN - X(3) .GT. 0
     :19 8           XIN - X(4) .LT. 0
     :21 10          4 - (NTERMS/2) .LE. 0
     :25 19          4 - ((1 + NTERMS) - 1) .GE. 0
     :25 28   CONSISTENCY:  OK

OUTPUT:
     :1  0           SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :25 28          I1 = 1
                     NTERMS = NTERMS


Case 4.25 ------------------------------------------------------


PATH:  0-8 15 7-8 15 7-8 15 7-10 18-24
```

```
PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .GT. 0
     :15 8          XIN - X(3) .GT. 0
     :19 8          XIN - X(4) .LT. 0
     :21 10         4 - (NTERMS/2) .GT. 0
     :23 19         4 - ((4 - (NTERMS/2) + NTERMS) - 1) .LT. 0
     :26 22         1 + 4 - NTERMS .LE. 0
     :28 28   CONSISTENCY:  OK

OUTPUT:

  Final Values
     :28 28         I1 = 1
                    NTERMS = 4


Case 4.26 ------------------------------------------------------


PATH:  0-8 15 7-8 15 7-8 15 7-10 18-22

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .GT. 0
     :15 8          XIN - X(3) .GT. 0
     :19 8          XIN - X(4) .LT. 0
     :21 10         4 - (NTERMS/2) .GT. 0
     :23 19         4 - ((4 - (NTERMS/2) + NTERMS) - 1) .LT. 0
     :26 22         1 + 4 - NTERMS .GT. 0
     :26 28   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :26 28         I1 = 1 + 4 - NTERMS
                    NTERMS = NTERMS


Case 4.27 ------------------------------------------------------


PATH:  0-8 15 7-8 15 7-8 15 7-10 18-19

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .GT. 0
     :15 8          XIN - X(3) .GT. 0
     :19 8          XIN - X(4) .LT. 0
     :21 10         4 - (NTERMS/2) .GT. 0
     :23 19         4 - ((4 - (NTERMS/2) + NTERMS) - 1) .GE. 0
     :23 28   CONSISTENCY:  OK
```

```
OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :23 28         I1 = 4 - (NTERMS/2)
                    NTERMS = NTERMS


Case 4.23 ------------------------------------------------------------


PATH:  0-8 15 7-8 15 7-8 15 7-8 13-14 59

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .GT. 0
     :15 8          XIN - X(3) .GT. 0
     :19 8          XIN - X(4) .EQ. 0
     :22 59   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
59       NOTE: Reference to unitialized variable I1

  Final Values
     :22 59         I1 = I1
                    NTERMS = NTERMS


Case 4.29 ------------------------------------------------------------


PATH:  0-8 15 7-8 15 7-8 15 7-8 15 7 16-24

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .GT. 0
     :15 8          XIN - X(3) .GT. 0
     :19 8          XIN - X(4) .GT. 0
     :25 19         4 - ((1 + 4 - NTERMS + NTERMS) - 1) .LT. 0
     :28 22         1 + 4 - NTERMS .LE. 0
     :32 28   CONSISTENCY:  OK

OUTPUT:

  Final Values
     :30 28         I1 = 1
                    NTERMS = 4


Case 4.30 ------------------------------------------------------------


PATH:  0-8 15 7-8 15 7-8 15 7-8 15 7 16-22
```

```
PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .GT. 0
     :15 8          XIN - X(3) .GT. 0
     :19 8          XIN - X(4) .GT. 0
     :25 19         4 - ((1 + 4 - NTERMS + NTERMS) - 1) .LT. 0
     :28 22         1 + 4 - NTERMS .GT. 0
     :28 28   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :28 28         I1 = 1 + 4 - NTERMS
                    NTERMS = NTERMS


Case 4.31 ------------------------------------------------------------


PATH:  0-8 15 7-8 15 7-8 15 7-8 15 7 16-19

PREDICATES:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :7  8          XIN - X(1) .GT. 0
     :11 8          XIN - X(2) .GT. 0
     :15 8          XIN - X(3) .GT. 0
     :19 8          XIN - X(4) .GT. 0
     :25 19         4 - ((1 + 4 - NTERMS + NTERMS) - 1) .GE. 0
     :25 28   CONSISTENCY:  OK

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)

  Final Values
     :25 28         I1 = 1 + 4 - NTERMS
                    NTERMS = NTERMS


Case 5 ===========================================================

ANALYSIS OF THE PART OF THE CODE THAT SETS UP DELTA (DELTAX)
AND DELTA(I).  SET NTERMS TO 1.

Case Commands:

OUTPUT DELTAX, DELTA;
7 SKIP 28;
28 ASSIGN NTERMS=1;
28 ASSIGN I1="I1";
36 HALT;


Case 5.1 ------------------------------------------------------------
```

```
PATH:  0-3 28-32.1 38

PREDICATES:

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :6  28         ** ASSIGN I1 = I1

  Final Values
     :14 38         DELTAX = (XIN - X(I1))/(X(1 + I1) - X(I1))

                    DELTA(1) = (X((1 + I1) - 1) - X(I1))/(X(1 +
                           I1) - X(I1))
```

Case 6 ==========

AS IN CASE 5, NTERMS=4.

Case Commands:

```
OUTPUT DELTAX, DELTA;
7 SKIP 28;
28 ASSIGN NTERMS=4;
28 ASSIGN I1="I1";
38 HALT;
```

Case 6.1 ----------

```
PATH:  0-3 28-32.1 38-32.1 38-32.1 38-32.1 38

PREDICATES:

OUTPUT:
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :6  28         ** ASSIGN I1 = I1

  Final Values
     :29 38         DELTAX = (XIN - X(I1))/(X(1 + I1) - X(I1))

                    DELTA(4) = (X((4 + I1) - 1) - X(I1))/(X(1 +
                           I1) - X(I1))
                    DELTA(3) = (X((3 + I1) - 1) - X(I1))/(X(1 +
                           I1) - X(I1))
                    DELTA(2) = (X((2 + I1) - 1) - X(I1))/(X(1 +
                           I1) - X(I1))
                    DELTA(1) = (X((1 + I1) - 1) - X(I1))/(X(1 +
                           I1) - X(I1))
```

Case 7 ==========

ANALYSIS THE PART OF THE CODE USED TO GENERATE THE COEFFICIENTS.
POLYNOMI DEGREE 1. NTERMS=2.
IN THIS WE GET THE RECURSIVE FORMULA TO COMPARE WITH THE
DOCUMENT BY ASSIGNING A TO SYMBOLIC A.

Case Com s:

```
7 SKIP 3
36 ASSIG  1="I1";
36 OUTPUT  (1);
37 ASSIG  ="A";
38 ASSIG  ERMS=2;
36 ASSIG  LTA="DELTA";
46 OUTPUT  );
47 ASSIG  ="A";
51 HALT;
```

Case 7.1 ----------

PATH: 8- 30-45 42 46-47 37

PREDICATE :

OUTPUT:

```
     :1          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :5          ** ASSIGN I1 = I1
     :7          ** ASSIGN DELTA = DELTA($I)
     :8          A(1) = Y(I1)
     :9          ** ASSIGN A = A($I)
     :21         A(2) = -A(1)/(DELTA(2) - DELTA(1)) + (Y(1 +
                        I1)/(DELTA(2) - DELTA(1)))
```

Case 8 ==========

AS IN CAS 7 EXCEPT POLYNOMIAL OF DEGREE 2. NTERMS=3.

Case Comma s:

```
7 SKIP 3
36 ASSIG  1="I1";
36 OUTPUT  1);
37 ASSIGN  ="A";
38 ASSIG  ERMS=3;
36 ASSIG  LTA="DELTA";
46 OUTPUT  K);
47 ASSIGN  ="A";
51 HALT;
```


Case 8.1 ----------

PATH: 0-3 36-45 42 46-47 37-45 42-45 42 46-47 37

PREDICATES:

OUTPUT:

```
     :1  0          SUBROUTINE INTERP(X, Y, NPTS, NTERMS, XIN, YOUT)
     :5  36         ** ASSIGN I1 = I1
     :7  36         ** ASSIGN DELTA = DELTA($I)
     :8  36         A(1) = Y(I1)
     :9  37         ** ASSIGN A = A($I):9
     :21 43         A(2) = -A(1):9/(DELTA(2) - DELTA(1)) + (Y(I1 +
                         I1)/(DELTA(2) - DELTA(1)))
     :22 47         ** ASSIGN A = A($I):22
     :41 46         A(3) = -A(2):22/(DELTA(3) - DELTA(2)) - (A(1):22/((
                         DELTA(2) - DELTA(2))*(DELTA(3) - DELTA(1))))
                          + (Y(2 + I1)/((DELTA(3) - DELTA(2))*(
                         DELTA(3) - DELTA(1))))
```

Case 9 ==========

ANALYSIS OF PART OF PROGRAM THAT USES COEFFICIENTS FROM CASES 7 AND 8 TO CALCULATE OUTPUTT VALUE OF YOUT. AS IN CASE 7, POLYNOMIAL OF DEGREE 1. NTERMS=2.

Case Commands:

```
OUTPUT YOUT;
7 SKIP 51;
51 ASSIGN NTERMS=2;
51 ASSIGN A="A";
51 ASSIGN DELTAX="DELTAX";
51 ASSIGN DELTA="DELTA";
```

Case 9.1 ----------

PATH: 0-3 51-56 55 57 52 58-59

PREDICATES:

OUTPUT:

```
     :6  51         ** ASSIGN A = A($I)
     :7  51         ** ASSIGN DELTAX = DELTAX
     :8  51         ** ASSIGN DELTA = DELTA($I)

  Final Values
     :21 59         YOUT = A(1) + A(2)*(DELTAX - DELTA(1))
```

Case 10 ==========

AS IN CASE 9 EXCEPT POLYNOMIAL OF DEGREE 2. NTERMS=3.

Case Commands:

```
OUTPUT YOUT;
7 SKIP 51;
51 ASSIGN NTERMS=3;
51 ASSIGN A="A";
51 ASSIGN DELTAX="DELTAX";
51 ASSIGN DELTA="DELTA";


Case 13.1 ------------------------------------------------------------


PATH:  0-3 51-53 55 57 52-50 55-56 55 57 52 53-59

PREDICATES:

OUTPUT:
     :6  51          ** ASSIGN A = A($I)
     :7  51          ** ASSIGN DELTAX = DELTAX
     :8  51          ** ASSIGN DELTA = DELTA($I)

  Final Values
     :33 59          YOUT = A(1) + A(2)*(DELTAX - DELTA(1)) + A(3)*(
                            DELTAX - DELTA(1))*(DELTAX - DELTA(2))
```

```
      C FO  DESCRIPTION OF METHOD USED IN THIS PROGRAM, SEE **THE QR
      C TRANSFORMATION** BY FRANCIS, COMPUTER JOURNAL, VOL. 4 PP. 265,332
      C START HERE TO PRODUCE UPPER HESSENBURG MATRIX
            DIMENSION A(NMAX,NMAX),INT(1),VEC(1),D(NMAX,NMAX),EIGVEC(NMAX,NMAX
           1)
            N=NN
            K=N-2
            DO1J=1,K
            K1=J+1
            K2=J+2
            GREAT= ABS(A(K1,J))
            MAX=K1
            DO2I=K2,N
            AB= ABS(A(I,J))
            IF (GREAT.GE.AB) GO TO 2
          3 GREAT=AB
            MAX=I
          2 CONTINUE
      C INT(I) GIVES INFORMATION ABOUT INTERCHANGES
            INT(J)=MAX
            IF (MAX.EQ.K1) GO TO 5
          4 DO6L=J,N
            E=A(K1,L)
            A(K1,L)=A(MAX,L)
          6 A(MAX,L)=E
            DO7L=1,N
            E=A(L,K1)
            A(L,K1)=A(L,MAX)
          7 A(L,MAX)=E
      C     INTERCHANGE DONE
          5 DO8I=K2,N
            IF (A(I,J).EQ.0.) GO TO 8
            A(I,J)=-A(I,J)/A(K1,J)
            DO11M=K1,N
         11 A(I,M)=A(I,M)+A(I,J)*A(K1,M)
          8 CONTINUE
      C     LEFT MULT. DONE
            DO 2000 M=K2,N
            IF (A(M,J).EQ.0.) GO TO 2000
         10 DO 2001 I=1,N
       2001 A(I,K1)=A(I,K1)-A(I,M)*A(M,J)
       2000 CONTINUE
          1 CONTINUE
      C     RIGHT MULT. DONE
      C HESSENBURG MATRIX NOW FORMED AS A(I,J). MULTIPLIERS STORED WITH IT
            DO 105 I=1,N
            DO 105 J=1,N
        105 D(I,J)=A(I,J)
      C PUT APPROPRIATE ZEROS WHERE MULTIPLIERS WERE STORED
            DO 106 I=3,N
            L=I-2
            DO 106 J=1,L
        106 A(I,J)=0.0
            K1=N-1
            R=0.0
            C=0.0
            DO33I=1,N
            R=R+ ABS(A(I,I))
         33 C=C+ ABS(A(I,N))
            DO34I=2,N
            RS=0.0
            CS=0.0
            L=I-1
            DO35J=L,N
            RS=RS+ ABS(A(I,J))
            K1J=K1-J
            K1I=K1-I
         35 CS=CS+ ABS(A(K1J,K1I))
            IF (RS.LE.R) GO TO 36
         37 R=RS
         36 IF (CS.LE.C) GO TO 34
         44 C=CS
```


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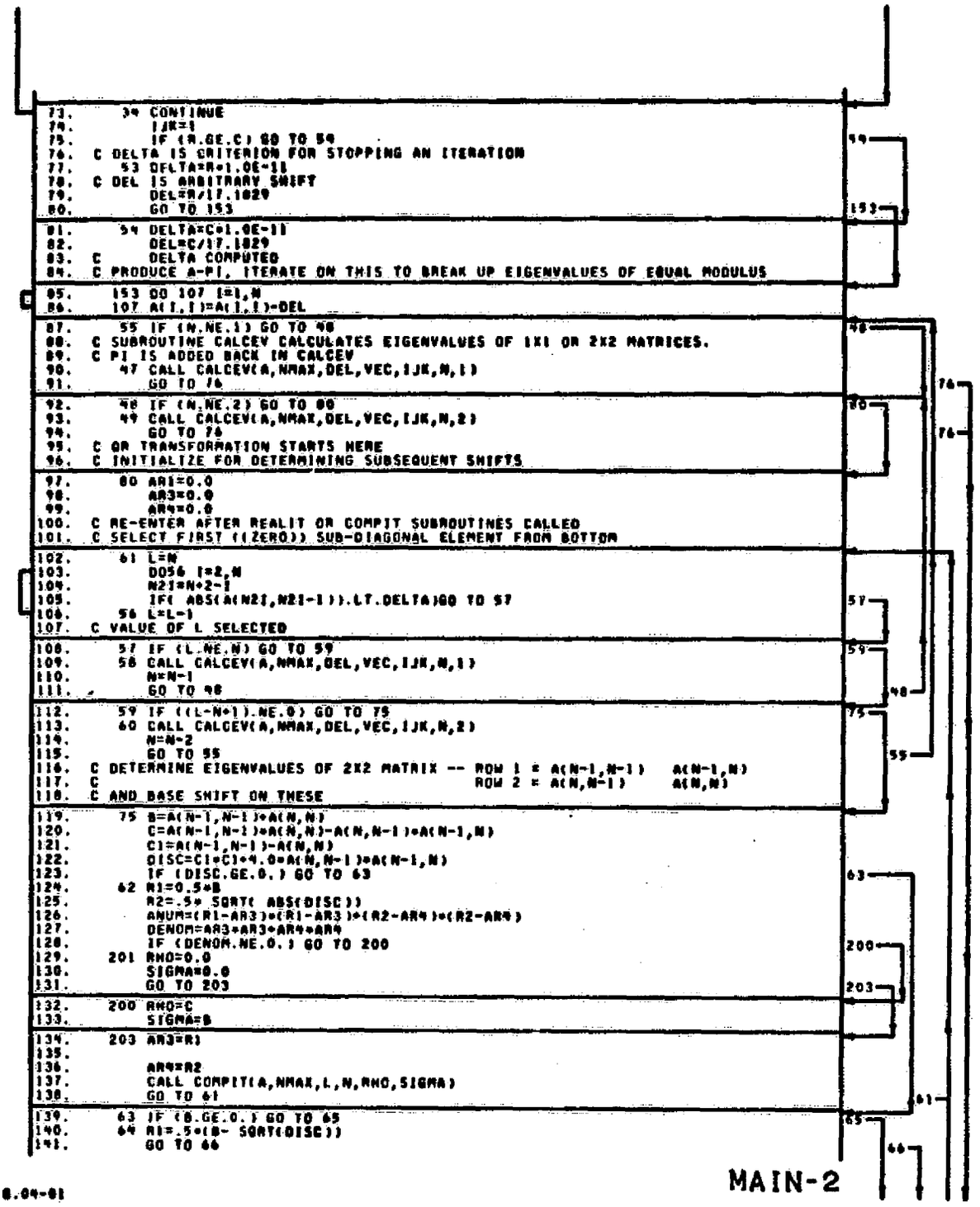
```
 73.      34 CONTINUE
 74.         IJK=1
 75.         IF (N.GE.C) GO TO 54
 76.   C DELTA IS CRITERION FOR STOPPING AN ITERATION
 77.      53 DELTA=B*1.0E-11
 78.   C DEL IS ARBITRARY SHIFT
 79.         DEL=B/17.1029
 80.         GO TO 153
 81.      54 DELTA=C*1.0E-11
 82.         DEL=C/17.1029
 83.   C     DELTA COMPUTED
 84.   C PRODUCE A-PI, ITERATE ON THIS TO BREAK UP EIGENVALUES OF EQUAL MODULUS
 85.     153 DO 107 I=1,N
 86.     107 A(I,I)=A(I,I)-DEL
 87.      55 IF (N.NE.1) GO TO 48
 88.   C SUBROUTINE CALCEV CALCULATES EIGENVALUES OF 1X1 OR 2X2 MATRICES.
 89.   C PI IS ADDED BACK IN CALCEV
 90.      47 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,1)
 91.         GO TO 76
 92.      48 IF (N.NE.2) GO TO 80
 93.      49 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,2)
 94.         GO TO 76
 95.   C QR TRANSFORMATION STARTS HERE
 96.   C INITIALIZE FOR DETERMINING SUBSEQUENT SHIFTS
 97.      80 AR1=0.0
 98.         AR3=0.0
 99.         AR4=0.0
100.   C RE-ENTER AFTER REALIT OR COMPIT SUBROUTINES CALLED
101.   C SELECT FIRST ((ZERO)) SUB-DIAGONAL ELEMENT FROM BOTTOM
102.      61 L=N
103.         DO56 I=2,N
104.         N2I=N+2-I
105.         IF( ABS(A(N2I,N2I-1)).LT.DELTA)GO TO 57
106.      56 L=L-1
107.   C VALUE OF L SELECTED
108.      57 IF (L.NE.N) GO TO 59
109.      58 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,1)
110.         N=N-1
111.         GO TO 48
112.      59 IF ((L-N+1).NE.0) GO TO 75
113.      60 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,2)
114.         N=N-2
115.         GO TO 55
116.   C DETERMINE EIGENVALUES OF 2X2 MATRIX -- ROW 1 = A(N-1,N-1)   A(N-1,N)
117.   C                                        ROW 2 = A(N,N-1)     A(N,N)
118.   C AND BASE SHIFT ON THESE
119.      75 B=A(N-1,N-1)+A(N,N)
120.         C=A(N-1,N-1)*A(N,N)-A(N,N-1)*A(N-1,N)
121.         C1=A(N-1,N-1)-A(N,N)
122.         DISC=C1*C1+4.0*A(N,N-1)*A(N-1,N)
123.         IF (DISC.GE.0.) GO TO 63
124.      62 R1=0.5*B
125.         R2=.5* SQRT( ABS(DISC))
126.         ANUM=(R1-AR3)*(R1-AR3)*(R2-AR4)*(R2-AR4)
127.         DENOM=AR3+AR3+AR4+AR4
128.         IF (DENOM.NE.0.) GO TO 200
129.     201 RHO=0.0
130.         SIGMA=0.0
131.         GO TO 203
132.     200 RHO=C
133.         SIGMA=B
134.     203 AR3=R1
135.
136.         AR4=R2
137.         CALL COMPIT(A,NMAX,L,N,RHO,SIGMA)
138.         GO TO 61
139.      63 IF (B.GE.0.) GO TO 65
140.      64 R1=.5*(B- SQRT(DISC))
141.         GO TO 66
```



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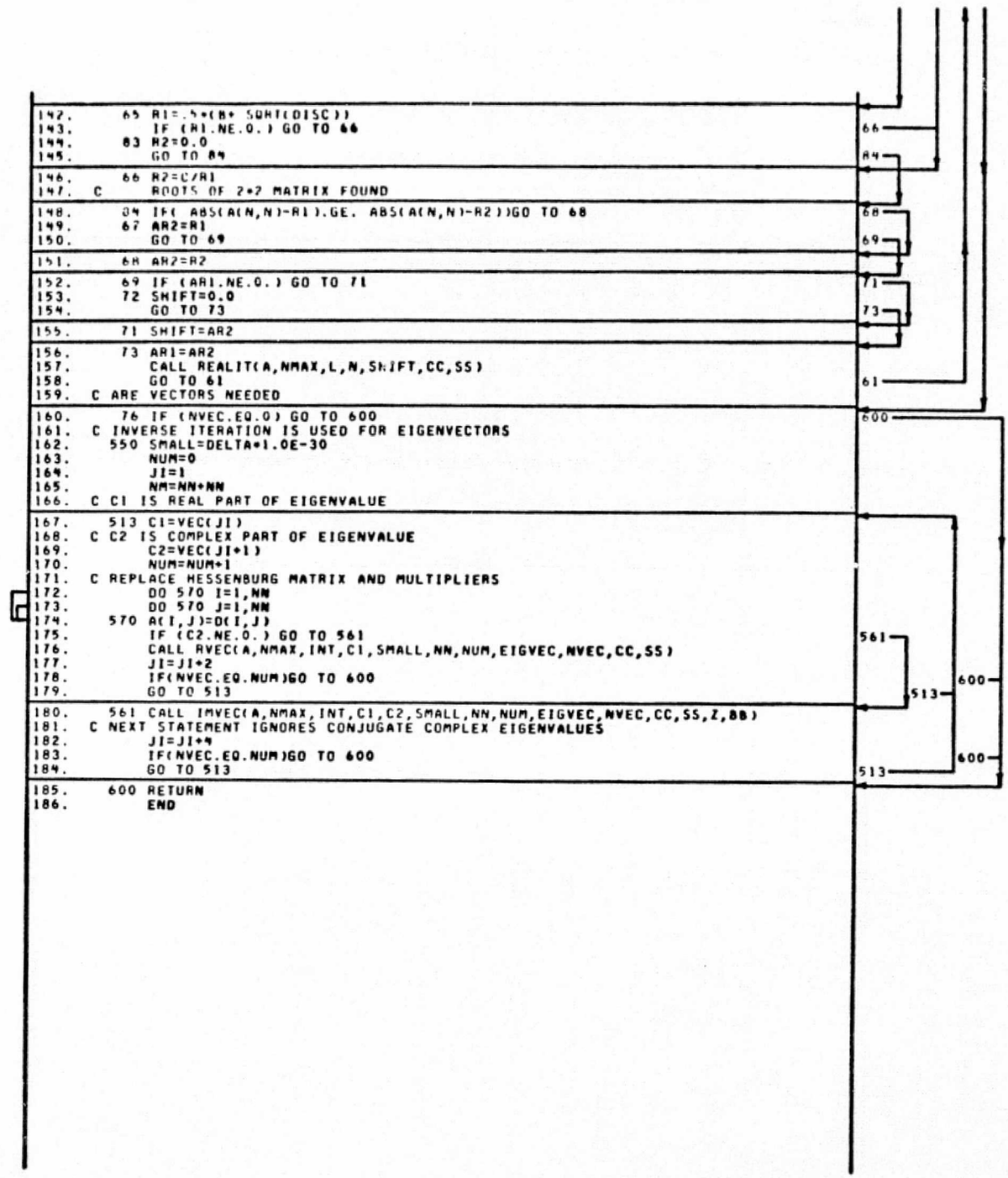
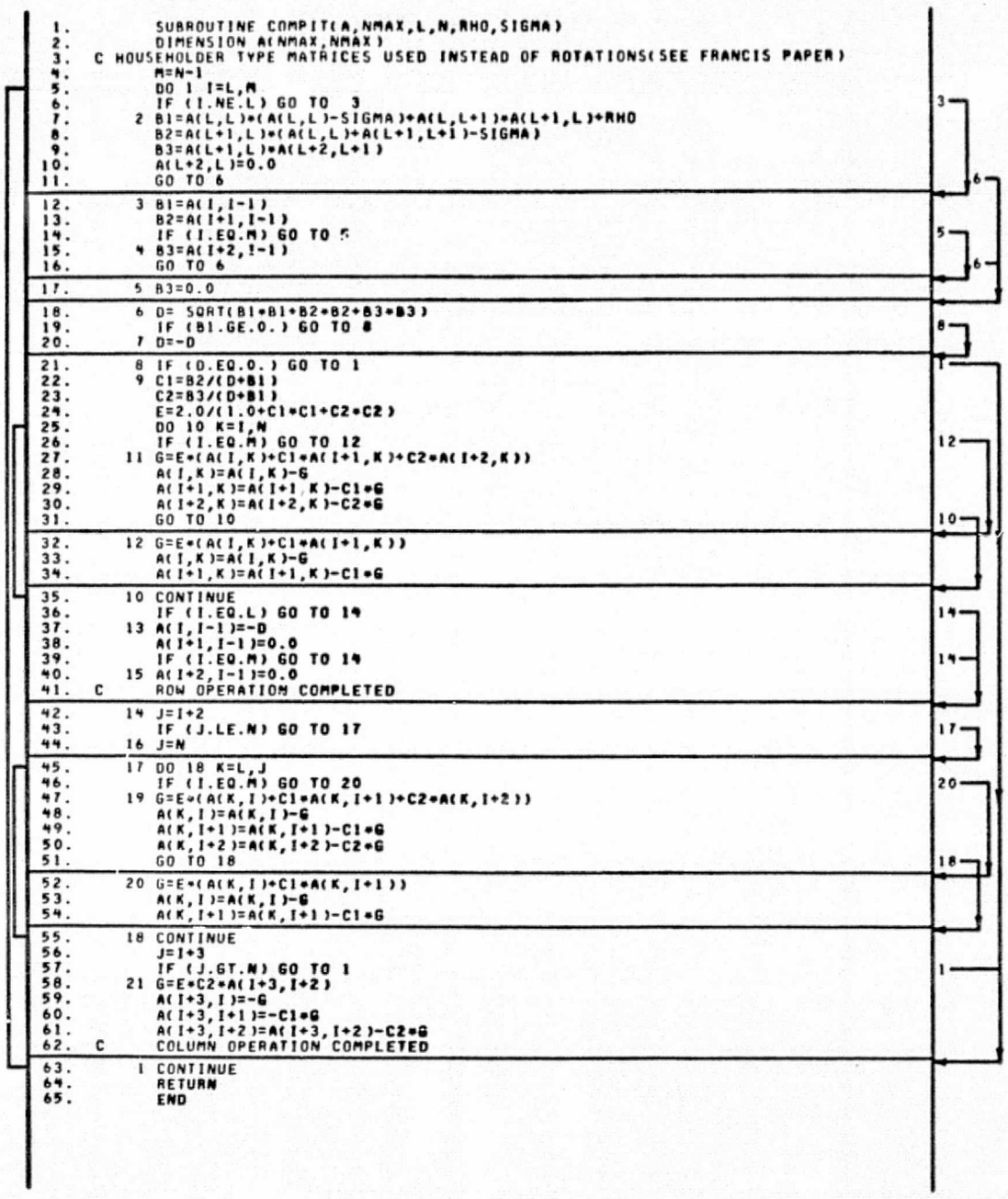
MAIN-2



```
142.      65 R1=.5*(B+ SQRT(DISC))
143.         IF (R1.NE.0.) GO TO 66
144.      83 R2=0.0
145.         GO TO 84
146.      66 R2=C/R1
147.   C     ROOTS OF 2*2 MATRIX FOUND
148.      84 IF( ABS(A(N,N)-R1).GE. ABS(A(N,N)-R2))GO TO 68
149.      67 AR2=R1
150.         GO TO 69
151.      68 AR2=R2
152.      69 IF (AR1.NE.0.) GO TO 71
153.      72 SHIFT=0.0
154.         GO TO 73
155.      71 SHIFT=AR2
156.      73 AR1=AR2
157.         CALL REALIT(A,NMAX,L,N,SHIFT,CC,SS)
158.         GO TO 61
159.   C ARE VECTORS NEEDED
160.      76 IF (NVEC.EQ.0) GO TO 600
161.   C INVERSE ITERATION IS USED FOR EIGENVECTORS
162.     550 SMALL=DELTA*1.0E-30
163.         NUM=0
164.         JI=1
165.         NM=NN+NN
166.   C C1 IS REAL PART OF EIGENVALUE
167.     513 C1=VEC(JI)
168.   C C2 IS COMPLEX PART OF EIGENVALUE
169.         C2=VEC(JI+1)
170.         NUM=NUM+1
171.   C REPLACE HESSENBURG MATRIX AND MULTIPLIERS
172.         DO 570 I=1,NN
173.         DO 570 J=1,NN
174.     570 A(I,J)=D(I,J)
175.         IF (C2.NE.0.) GO TO 561
176.         CALL RVEC(A,NMAX,INT,C1,SMALL,NN,NUM,EIGVEC,NVEC,CC,SS)
177.         JI=JI+2
178.         IF(NVEC.EQ.NUM)GO TO 600
179.         GO TO 513
180.     561 CALL IMVEC(A,NMAX,INT,C1,C2,SMALL,NN,NUM,EIGVEC,NVEC,CC,SS,Z,BB)
181.   C NEXT STATEMENT IGNORES CONJUGATE COMPLEX EIGENVALUES
182.         JI=JI+1
183.         IF(NVEC.EQ.NUM)GO TO 600
184.         GO TO 513
185.     600 RETURN
186.         END
```

```
 1.          SUBROUTINE CALCEV(A,NMAX,DEL,VEC,IJK,N,M)
 2.          DIMENSION A(NMAX,NMAX),VEC(1)
 3.          IF (M.NE.1) GO TO 2
 4.        1 AI=0.0
 5.          A(N,N)=A(N,N)+DEL
 6.    C STORE EIGENVALUES IN VEC
 7.          VEC(IJK)=A(N,N)
 8.          VEC(IJK+1)=AI
 9.          IJK=IJK+2
10.          RETURN
11.        2 B=A(N-1,N-1)+A(N,N)
12.          C=A(N-1,N-1)*A(N,N)-A(N,N-1)*A(N-1,N)
13.          C1=A(N-1,N-1)-A(N,N)
14.          DISC=C1*C1+4.0*A(N,N-1)*A(N-1,N)
15.          IF (DISC.LT.0.) GO TO 9
16.        4 AI=0.0
17.          IF (B.GE.0.) GO TO 6
18.          R1=0.5*(B- SQRT(DISC))
19.          GO TO 7
20.        6 R1=0.5*(B+ SQRT(DISC))
21.          IF(R1 .NE.0.) GO TO 7
22.       10 R2=0.
23.          GO TO 11
24.        7 R2=C/R1
25.       11 R1=R1+DEL
26.          R2=R2+DEL
27.          VEC(IJK)=R2
28.          VEC(IJK+1)=AI
29.          VEC(IJK+2)=R1
30.          VEC(IJK+3)=AI
31.          GO TO 8
32.        9 R1=0.5*B
33.          AI=-.5* SQRT( ABS(DISC))
34.          R1=R1+DEL
35.          VEC(IJK)=R1
36.          VEC(IJK+1)=-AI
37.          VEC(IJK+2)=R1
38.          VEC(IJK+3)=AI
39.        8 IJK=IJK+4
40.          RETURN
41.          END
```

```
      SUBROUTINE REALIT(A,NMAX,L,N,SHIFT,C,S)
      DIMENSION A(NMAX,NMAX),C(1),S(1)
      IF (SHIFT.EQ.0.) GO TO 2
    1 DO3 I=L,N
    3 A(I,I)=A(I,I)-SHIFT
    2 M=N-1
      DO4 I=L,M
      DENOM= SQRT(A(I,I)**2+A(I+1,I)**2)
      IF (DENOM.GT.0.) GO TO 10
   11 C(I)=1.0
      S(I)=0.0
      GO TO 4
   10 C(I)=A(I,I)/DENOM
      S(I)=A(I+1,I)/DENOM
      A(I,I)=DENOM
   12 I1=I+1
      DO 35 J=I1,N
      F=A(I,J)
      A(I,J)=A(I+1,J)*S(I)+F*C(I)
      A(I+1,J)=A(I+1,J)*C(I)-F*S(I)
   35 CONTINUE
    4 CONTINUE
C     TRIANGULAR MATRIX FORMED
      DO5 J=L,M
      DO6 I=L,J
      F=A(I,J)
      A(I,J)=A(I,J+1)*S(J)+F*C(J)
    6 A(I,J+1)=A(I,J+1)*C(J)-F*S(J)
      A(J+1,J)=A(J+1,J+1)*S(J)
    5 A(J+1,J+1)=A(J+1,J+1)*C(J)
C     TRANSFORMATION COMPLETED
      IF (SHIFT.EQ.0.) RETURN
    7 DO9 I=L,N
    9 A(I,I)=A(I,I)+SHIFT
    8 RETURN
      END
```



```
 1.          SUBROUTINE COMPIT(A,NMAX,L,N,RHO,SIGMA)
 2.          DIMENSION A(NMAX,NMAX)
 3.    C HOUSEHOLDER TYPE MATRICES USED INSTEAD OF ROTATIONS(SEE FRANCIS PAPER)
 4.          M=N-1
 5.          DO 1 I=L,M
 6.          IF (I.NE.L) GO TO  3
 7.        2 B1=A(L,L)*(A(L,L)-SIGMA)+A(L,L+1)*A(L+1,L)+RHO
 8.          B2=A(L+1,L)*(A(L,L)+A(L+1,L+1)-SIGMA)
 9.          B3=A(L+1,L)*A(L+2,L+1)
10.          A(L+2,L)=0.0
11.          GO TO 6
12.        3 B1=A(I,I-1)
13.          B2=A(I+1,I-1)
14.          IF (I.EQ.M) GO TO 5
15.        4 B3=A(I+2,I-1)
16.          GO TO 6
17.        5 B3=0.0
18.        6 D= SQRT(B1*B1+B2*B2+B3*B3)
19.          IF (B1.GE.0.) GO TO 8
20.        7 D=-D
21.        8 IF (D.EQ.0.) GO TO 1
22.        9 C1=B2/(D+B1)
23.          C2=B3/(D+B1)
24.          E=2.0/(1.0+C1*C1+C2*C2)
25.          DO 10 K=I,N
26.          IF (I.EQ.M) GO TO 12
27.       11 G=E*(A(I,K)+C1*A(I+1,K)+C2*A(I+2,K))
28.          A(I,K)=A(I,K)-G
29.          A(I+1,K)=A(I+1,K)-C1*G
30.          A(I+2,K)=A(I+2,K)-C2*G
31.          GO TO 10
32.       12 G=E*(A(I,K)+C1*A(I+1,K))
33.          A(I,K)=A(I,K)-G
34.          A(I+1,K)=A(I+1,K)-C1*G
35.       10 CONTINUE
36.          IF (I.EQ.L) GO TO 14
37.       13 A(I,I-1)=-D
38.          A(I+1,I-1)=0.0
39.          IF (I.EQ.M) GO TO 14
40.       15 A(I+2,I-1)=0.0
41.    C     ROW OPERATION COMPLETED
42.       14 J=I+2
43.          IF (J.LE.N) GO TO 17
44.       16 J=N
45.       17 DO 18 K=L,J
46.          IF (I.EQ.M) GO TO 20
47.       19 G=E*(A(K,I)+C1*A(K,I+1)+C2*A(K,I+2))
48.          A(K,I)=A(K,I)-G
49.          A(K,I+1)=A(K,I+1)-C1*G
50.          A(K,I+2)=A(K,I+2)-C2*G
51.          GO TO 18
52.       20 G=E*(A(K,I)+C1*A(K,I+1))
53.          A(K,I)=A(K,I)-G
54.          A(K,I+1)=A(K,I+1)-C1*G
55.       18 CONTINUE
56.          J=I+3
57.          IF (J.GT.N) GO TO 1
58.       21 G=E*C2*A(I+3,I+2)
59.          A(I+3,I)=-G
60.          A(I+3,I+1)=-C1*G
61.          A(I+3,I+2)=A(I+3,I+2)-C2*G
62.    C     COLUMN OPERATION COMPLETED
63.        1 CONTINUE
64.          RETURN
65.          END
```

```
      SUBROUTINE RVEC(A,NMAX,INT,C1,SMALL,N,NUM,EIGVEC,NVEC,INTER,Y)
      DIMENSION A(NMAX,NMAX),INTER(1),Y(1),INT(1),EIGVEC(NMAX,NMAX)
      DO1 I=1,N
    1 A(I,I)=A(I,I)-C1
      DO2 I=2,N
      IF( ABS(A(I-1,I-1)).GE. ABS(A(I,I-1)))GO TO 9
    3 INTER(I)=I
      J=I-1
      DO5 K=J,N
      B=A(I-1,K)
      A(I-1,K)=A(I,K)
    5 A(I,K)=B
      GO TO 6
      INTER(I)=I-1
      IF (A(I,I-1).EQ.0.) GO TO 2
      C=-A(I,I-1)/A(I-1,I-1)
      A(I,I-1)=C
      DO 8 K=I,N
    8 A(I,K)=A(I,K)+C*A(I-1,K)
    2 CONTINUE
C     TRIANGULAR MATRIX FORMED
      DO9 I=1,N
      IF( ABS(A(I,I)).GE.SMALL)GO TO 9
   10 A(I,I)=SMALL
    9 CONTINUE
C NORMALISED ((EIGENVECTOR)) OF HESSENBURG MATRIX OBTAINED FOR RHS = 1
      DO 5555 I=1,N
 5555 Y(I)=1.0
      DO 8888 JJJJ=1,9
 7777 Y(N)=Y(N)/A(N,N)
      B=Y(N)
      DO11 I=2,N
      E=0.0
      M=N+1-I
      DO12 J=2,I
      L=N+J-I
   12 E=E+Y(L)*A(M,L)
      Y(M)=(Y(M)-E)/A(M,M)
      IF( ABS(B).GE. ABS(Y(M)))GO TO 11
   13 B=Y(M)
   11 CONTINUE
      DO19 I=1,N
   19 Y(I)=Y(I)/B
      IF(JJJJ.EQ.9)GO TO 6666
      DO15 I=2,N
      IF (INTER(I).NE.I) GO TO 15
   16 B=Y(I)
      Y(I)=Y(I-1)
      Y(I-1)=B
   15 Y(I)=Y(I)+A(I,I-1)*Y(I-1)
 8888 CONTINUE
C EIGENVECTOR OF HESSENBURG MATRIX OBTAINED (NOT NORMALIZED)
 6666 M=N-1
      DO21 I=2,M
      J=N+1-I
      L=J+1
      DO20 K=L,N
   20 Y(K)=Y(K)-Y(J)*A(K,J-1)
      LL=INT(N-I)
      IF (J.EQ.LL) GO TO 21
   19 B=Y(J)
      Y(J)=Y(LL)
      Y(LL)=B
   21 CONTINUE
C UNNORMALIZED EIGENVECTOR OF ORIGINAL MATRIX OBTAINED
      B=0.0
      DO22 I=1,N
      IF( ABS(B).GE. ABS(Y(I)))GO TO 22
   23 B=Y(I)
   22 CONTINUE
      DO24 I=1,N
```

RVEC-1

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```
72.       24 Y(I)=Y(I)/B
73.   C      NORMALIZED EIGENVECTOR OBTAINED
74.   C PUT Y(I) (REAL EIGENVECTOR) IN EIGVECT(NUMOFEV,I)
75.        DO 100 I=1,N
76.      100 EIGVEC(NUM,I)=Y(I)
77.        RETURN
78.        END
```

RVEC-2

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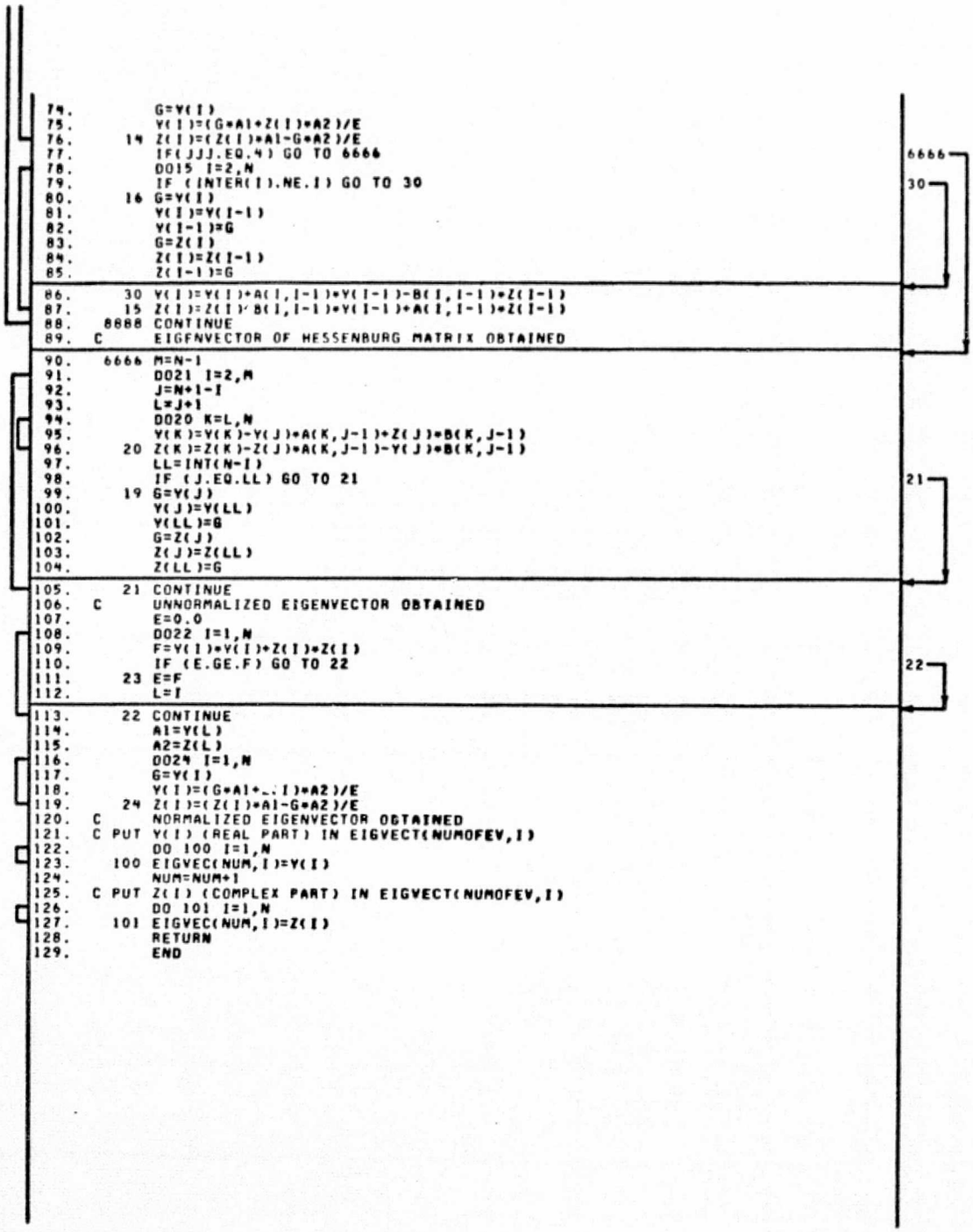
```
      SUBROUTINE IMVEC(A,NMAX,INT,C1,AMU,SMALL,N,NUM,EIGVEC,NVEC,INTER,
     1V,Z,B)
      DIMENSION A(NMAX,NMAX),INTER(1),Y(1),Z(1),INT(1),B(NMAX,NMAX),
     1EIGVEC(NMAX,NMAX)
      DO50 I=1,N
      DO50 J=1,N
   50 B(I,J)=0.0
      DO1 I=1,N
      A(I,I)=A(I,I)-C1
    1 B(I,I)=B(I,I)-AMU
      DO2 I=2,N
      C=A(I-1,I-1)*A(I-1,I-1)+B(I-1,I-1)*B(I-1,I-1)
      D=A(I,I-1)*A(I,I-1)+B(I,I-1)*B(I,I-1)
      IF (C.GE.D) GO TO 4
    3 INTER(I)=I
      G=C
      C=D
      D=G
      J=I-1
      DO5 K=J,N
      G=A(I-1,K)
      A(I-1,K)=A(I,K)
      A(I,K)=G
      G=B(I-1,K)
      B(I-1,K)=B(I,K)
    5 B(I,K)=G
      GO TO 6
    4 INTER(I)=I-1
    6 IF (D.EQ.0.) GO TO 2
    7 G=A(I,I-1)
      A(I,I-1)=-(G*A(I-1,I-1)+B(I,I-1)*B(I-1,I-1))/D
      B(I,I-1)=-(B(I,I-1)*A(I-1,I-1)-G*B(I-1,I-1))/D
      DO8 K=I,N
      A(I,K)=A(I,K)+A(I,I-1)*A(I-1,K)-B(I,I-1)*B(I-1,K)
    8 B(I,K)=B(I,K)+B(I,I-1)*A(I-1,K)+A(I,I-1)*B(I-1,K)
    2 CONTINUE
C     TRIANGULAR MATRIX FORMED
      DO9 I=1,N
      C=A(I,I)*A(I,I)+B(I,I)*B(I,I)
      IF (C.GE.SMALL) GO TO 9
      A(I,I)= SQRT(SMALL)
      B(I,I)=0.0
    9 CONTINUE
      DO 1111 I=1,N
      Y(I)=1.0
 1111 Z(I)=0.0
      DO 8888 JJJ=1,9
      C=A(N,N)*A(N,N)+B(N,N)*B(N,N)
      G=Y(N)
      Y(N)=(G*A(N,N)+Z(N)*B(N,N))/C
      Z(N)=(Z(N)*A(N,N)-G*B(N,N))/C
      DO17 I=2,N
      E=0.0
      F=0.0
      M=N+1-I
      DO18 J=2,I
      L=N+J-I
      E=E+Y(L)*A(M,L)-Z(L)*B(M,L)
   18 F=F+Y(L)*B(M,L)+Z(L)*A(M,L)
      D=A(M,M)*A(M,M)+B(M,M)*B(M,M)
      G=Y(M)
      Y(M)=((G-E)*A(M,M)+(Z(M)-F)*B(M,M))/D
   17 Z(M)=((Z(M)-F)*A(M,M)-(G-E)*B(M,M))/D
      E=0.0
      DO51 I=1,N
      F=Y(I)*Y(I)+Z(I)*Z(I)
      IF (E.GE.F) GO TO 51
   52 E=F
      L=I
   51 CONTINUE
      A1=Y(L)
      A2=Z(L)
      DO19 I=1,N
```




```
      G=Y(I)
      Y(I)=(G*A1+Z(I)*A2)/E
   14 Z(I)=(Z(I)*A1-G*A2)/E
      IF(JJJ.EQ.4) GO TO 6666
      DO15 I=2,N
      IF (INTER(I).NE.I) GO TO 30
   16 G=Y(I)
      Y(I)=Y(I-1)
      Y(I-1)=G
      G=Z(I)
      Z(I)=Z(I-1)
      Z(I-1)=G
   30 Y(I)=Y(I)+A(I,I-1)*Y(I-1)-B(I,I-1)*Z(I-1)
   15 Z(I)=Z(I)+B(I,I-1)*Y(I-1)+A(I,I-1)*Z(I-1)
 8888 CONTINUE
C     EIGENVECTOR OF HESSENBURG MATRIX OBTAINED
 6666 M=N-1
      DO21 I=2,M
      J=N+1-I
      L=J+1
      DO20 K=L,N
      Y(K)=Y(K)-Y(J)*A(K,J-1)+Z(J)*B(K,J-1)
   20 Z(K)=Z(K)-Z(J)*A(K,J-1)-Y(J)*B(K,J-1)
      LL=INT(N-I)
      IF (J.EQ.LL) GO TO 21
   19 G=Y(J)
      Y(J)=Y(LL)
      Y(LL)=G
      G=Z(J)
      Z(J)=Z(LL)
      Z(LL)=G
   21 CONTINUE
C     UNNORMALIZED EIGENVECTOR OBTAINED
      E=0.0
      DO22 I=1,N
      F=Y(I)*Y(I)+Z(I)*Z(I)
      IF (E.GE.F) GO TO 22
   23 E=F
      L=I
   22 CONTINUE
      A1=Y(L)
      A2=Z(L)
      DO24 I=1,N
      G=Y(I)
      Y(I)=(G*A1+..I)*A2)/E
   24 Z(I)=(Z(I)*A1-G*A2)/E
C     NORMALIZED EIGENVECTOR OBTAINED
C PUT Y(I) (REAL PART) IN EIGVECT(NUMOFEV,I)
      DO 100 I=1,N
  100 EIGVEC(NUM,I)=Y(I)
      NUM=NUM+1
C PUT Z(I) (COMPLEX PART) IN EIGVECT(NUMOFEV,I)
      DO 101 I=1,N
  101 EIGVEC(NUM,I)=Z(I)
      RETURN
      END
```

FORTRAN SYMBOL	MATH SYMBOL	DESCRIPTION	SUBROUTINE	U	TYPE	USAGE VAR	DIM
A		Argument 1 to subprogram CALCEV.	CALCEV	M	REAL	A	(NMAX,NMAX
A		Argument 1 to subprogram COMPIT.	COMPIT	M	REAL	A	(NMAX,NMAX
A		Argument 1 to subprogram IMVEC.	IMVEC	M	REAL	A	(NMAX,NMAX
A		Local variable in subprogram MAIN.	MAIN	M	REAL	A	(NMAX,NMAX
			CALCEV/1	M	REAL	A	(NMAX,NMAX
			COMPIT/1	M	REAL	A	(NMAX,NMAX
			IMVEC/1	M	REAL	A	(NMAX,NMAX
			REALIT/1	M	REAL	A	(NMAX,NMAX
			RVEC/1	M	REAL	A	(NMAX,NMAX
A		Argument 1 to subprogram REALIT.	REALIT	M	REAL	A	(NMAX,NMAX
A		Argument 1 to subprogram RVEC.	RVEC	M	REAL	A	(NMAX,NMAX
AMU		Argument 5 to subprogram IMVEC.	IMVEC	I	REAL	AMU	

FORTRAN SYMBOL	MATH SYMBOL	DESCRIPTION	SUBROUTINE USAGE SUBR	U	TYPE	VAR	DIM
B		Argument 14 to subprogram IMVEC.	IMVEC	M	REAL	B	(NMAX,NMAX
BB		Local variable in subprogram MAIN.	MAIN	I	REAL	BB	
			IMVEC/14	M	REAL	B	(NMAX,NMAX

FORTRAN SYMBOL	MATH SYMBOL	DESCRIPTION	SUBROUTINE USAGE SUBR	U	TYPE	VAR	DIM
C		Argument 6 to subprogram REALIT.	REALIT	M	REAL	C	(1)
CALCEV		Subprogram external name.	CALCEV	E		CALCEV	
			MAIN	S		CALCEV	
CC		Local variable in subprogram MAIN.	MAIN	I	REAL	CC	
			IMVEC/11	M	INTE	INTER	(1)
			REALIT/6	M	REAL	C	(1)
			RVEC/10	M	INTE	INTER	(1)
COMPIT		Subprogram external name.	COMPIT	E		COMPIT	
			MAIN	S		COMPIT	
C1		Argument 4 to subprogram IMVEC.	IMVEC	I	REAL	C1	
C1		Local variable in subprogram MAIN.	MAIN	W	REAL	C1	
			IMVEC/4	I	REAL	C1	
			RVEC/4	I	REAL	C1	
C1		Argument 4 to subprogram RVEC.	RVEC	I	REAL	C1	
C2		Local variable in subprogram MAIN.	MAIN	W	REAL	C2	
			IMVEC/5	I	REAL	AMU	

FORTRAN SYMBOL	MATH SYMBOL	DESCRIPTION	SUBROUTINE USAGE SUBR	U	TYPE	VAR	DIM
DEL		Argument 3 to subprogram CALCEV.	CALCEV	I	REAL	DEL	
DEL		Local variable in subprogram MAIN.	MAIN	W	REAL	DEL	
			CALCEV/3	I	REAL	DEL	

FORTRAN SYMBOL	MATH SYMBOL	DESCRIPTION	SUBROUTINE USAGE			
			SUBR	D	TYPE	VAR DIM
EIGVEC		Argument 9 to subprogram IMVEC.	IMVEC	O	REAL	EIGVEC(NMAX,NMAX
EIGVEC		Local variable in subprogram MAIN.	MAIN	I	REAL	EIGVEC(NMAX,NMAX
			IMVEC/9	O	REAL	EIGVEC(NMAX,NMAX
			RVEC/8	O	REAL	EIGVEC(NMAX,NMAX
EIGVEC		Argument 8 to subprogram RVEC.	RVEC	O	REAL	EIGVEC(NMAX,NMAX

FORTRAN SYMBOL	MATH SYMBOL	DESCRIPTION	SUBROUTINE USAGE SUBR	U	TYPE	VAR	DIM
IJK		Argument 5 to subprogram CALCEV.	CALCEV	M	INTE	IJK	
IJK		Local variable in subprogram MAIN.	MAIN	W	INTE	IJK	
			CALCEV/5	M	INTE	IJK	
IMVEC		Subprogram external name.	IMVEC	E		IMVEC	
			MAIN	S		IMVEC	
INT		Argument 3 to subprogram IMVEC.	IMVEC	I	INTE	INT	(1)
INT		Local variable in subprogram MAIN.	MAIN	W	INTE	INT	(1)
			IMVEC/3	I	INTE	INT	(1)
			RVEC/3	I	INTE	INT	(1)
INT		Argument 3 to subprogram RVEC.	RVEC	I	INTE	INT	(1)
INTER		Argument 11 to subprogram IMVEC.	IMVEC	M	INTE	INTER	(1)
INTER		Argument 10 to subprogram RVEC.	RVEC	M	INTE	INTER	(1)

FORTRAN SYMBOL	MATH SYMBOL	DESCRIPTION	SUBROUTINE USAGE SUBR U TYPE VAR DIM
L		Argument 3 to subprogram COMPIT.	COMPIT I INTE L
L		Local variable in subprogram MAIN.	MAIN W INTE L COMPIT/3 I INTE L REALIT/3 I INTE L
L		Argument 3 to subprogram REALIT.	REALIT I INTE L

FORTRAN SYMBOL	MATH SYMBOL	DESCRIPTION	SUBROUTINE SUBR	USAGE D TYPE	VAR	DIM
M		Argument 7 to subprogram CALCEV.	CALCEV	I	INTE	M

FORTRAN SYMBOL	MATH SYMBOL	DESCRIPTION	SUBROUTINE USAGE SUBR	U	TYPE	VAR	DIM
N		Argument 6 to subprogram CALCEV.	CALCEV	I	INTE	N	
N		Argument 4 to subprogram COMPIT.	COMPIT	I	INTE	N	
N		Argument 7 to subprogram IMVEC.	IMVEC	I	INTE	N	
N		Local variable in subprogram MAIN.	MAIN	W	INTE	N	
			CALCEV/6	I	INTE	N	
			COMPIT/4	I	INTE	N	
			REALIT/4	I	INTE	N	
N		Argument 4 to subprogram REALIT.	REALIT	I	INTE	N	
N		Argument 6 to subprogram RVEC.	RVEC	I	INTE	N	
NMAX		Argument 2 to subprogram CALCEV.	CALCEV	I	INTE	NMAX	
NMAX		Argument 2 to subprogram COMPIT.	COMPIT	I	INTE	NMAX	
NMAX		Argument 2 to subprogram IMVEC.	IMVEC	I	INTE	NMAX	
NMAX		Local variable in subprogram MAIN.	MAIN	I	INTE	NMAX	
			CALCEV/2	I	INTE	NMAX	
			COMPIT/2	I	INTE	NMAX	
			IMVEC/2	I	INTE	NMAX	
			REALIT/2	I	INTE	NMAX	
			RVEC/2	I	INTE	NMAX	
NMAX		Argument 2 to subprogram REALIT.	REALIT	I	INTE	NMAX	
NMAX		Argument 2 to subprogram RVEC.	RVEC	I	INTE	NMAX	
NN		Local variable in subprogram MAIN.	MAIN	I	INTE	NN	
			IMVEC/7	I	INTE	N	
			RVEC/6	I	INTE	N	
NUM		Argument 8 to subprogram IMVEC.	IMVEC	M	INTE	NUM	
NUM		Local variable in subprogram MAIN.	MAIN	W	INTE	NUM	
			IMVEC/8	M	INTE	NUM	
			RVEC/7	I	INTE	NUM	
NUM		Argument 7 to subprogram RVEC.	RVEC	I	INTE	NUM	

FORTRAN SYMBOL	MATH SYMBOL	DESCRIPTION	SUBROUTINE SUBR	U	TYPE	USAGE VAR	DIM
REALIT		Subprogram external name.	MAIN	S		REALIT	
			REALIT	E		REALIT	
RHO		Argument 5 to subprogram COMPIT.	COMPIT	I	REAL	RHO	
RHO		Local variable in subprogram MAIN.	MAIN	W	REAL	RHO	
			COMPIT/5	I	REAL	RHO	
RVEC		Subprogram external name.	MAIN	S		RVEC	
			RVEC	E		RVEC	

FORTRAN SYMBOL	MATH SYMBOL	DESCRIPTION	SUBROUTINE USAGE SUBR	U	TYPE	VAR	DIM
S		Argument 7 to subprogram REALIT.	REALIT	M	REAL	S	(1)
SHIFT		Local variable in subprogram MAIN.	MAIN	W	REAL	SHIFT	
			REALIT/5	I	REAL	SHIFT	
SHIFT		Argument 5 to subprogram REALIT.	REALIT	I	REAL	SHIFT	
SIGMA		Argument 6 to subprogram COMPIT.	COMPIT	I	REAL	SIGMA	
SIGMA		Local variable in subprogram MAIN.	MAIN	W	REAL	SIGMA	
			COMPIT/6	I	REAL	SIGMA	
SMALL		Argument 6 to subprogram IMVEC.	IMVEC	I	REAL	SMALL	
SMALL		Local variable in subprogram MAIN.	MAIN	W	REAL	SMALL	
			IMVEC/6	I	REAL	SMALL	
			RVEC/5	I	REAL	SMALL	
SMALL		Argument 5 to subprogram RVEC.	RVEC	I	REAL	SMALL	
SQRT		*LIBRARY/SYSTEM* non-user-supplied routine.	CALCEV	F		SQRT	
			COMPIT	F		SQRT	
			IMVEC	F		SQRT	
			MAIN	F		SQRT	
			REALIT	F		SQRT	
SS		Local variable in subprogram MAIN.	MAIN	I	REAL	SS	
			IMVEC/12	M	REAL	Y	(1)
			REALIT/7	M	REAL	S	(1)
			RVEC/11	M	REAL	Y	(1)

FORTRAN SYMBOL	MATH SYMBOL	DESCRIPTION	SUBROUTINE	I/O	TYPE	USAGE VAR	USAGE DIM
VEC		Argument 4 to subprogram CALCEV.	CALCEV	O	REAL	VEC	(1)
VEC		Local variable in subprogram MAIN.	MAIN	I	REAL	VEC	(1)
			CALCEV/4	O	REAL	VEC	(1)

FORTRAN SYMBOL	MATH SYMBOL	DESCRIPTION	SUBROUTINE USAGE SUBR	U	TYPE	VAR	DIM
Y		Argument 12 to subprogram IMVEC.	IMVEC	M	REAL	Y	(1)
Y		Argument 11 to subprogram RVEC.	RVEC	M	REAL	Y	(1)

FORTRAN SYMBOL	MATH SYMBOL	DESCRIPTION	SUBROUTINE	USAGE		
			SUBR	U	TYPE	VAR	DIM
Z		Argument 13 to subprogram IMVEC.	IMVEC	A	REAL	Z	(1)
Z		Local variable in subprogram MAIN.	MAIN	I	REAL	Z	
			IMVEC/13	A	REAL	Z	(1)

SUBROUTINE MAIN

GLOSSARY FOR SUBROUTINE MAIN

FORTRAN SYMBOL	MATH SYMBOL	DESCRIPTION
A		Working real local array, dimensioned (NMAX,NMAX). This symbol appears in the following calls - COMPIT argument # 1, ABS argument # 1, CALCEV argument # 1, RVEC argument # 1, IMVEC argument # 1, REALIT argument # 1.
AB		Working real local variable.
ANUM		Real local variable which is calculated but not used.
AR1		Working real local variable.
AR2		Working real local variable.
AR3		Working real local variable.
AR4		Working real local variable.
B		Working real local variable.
BB		Real local variable which is not explicitly calculated. This symbol appears in the following calls - IMVEC argument #14.
C		Working real local variable.
CALCEV		Called subroutine.
CC		Real local variable which is not explicitly calculated. This symbol appears in the following calls - RVEC argument #10, IMVEC argument #11, REALIT argument # 6.
COMPIT		Called subroutine.
CS		Working real local variable.
C1		Working real local variable. This symbol appears in the following calls - IMVEC argument # 4, RVEC argument # 4.
C2		Working real local variable. This symbol appears in the following calls - IMVEC argument # 5.
D		Working real local array, dimensioned (NMAX,NMAX).
DEL		Working real local variable. This symbol appears in the following calls - CALCEV argument # 3.
DELTA		Working real local variable.
DENOM		Working real local variable.
DISC		Working real local variable. This symbol appears in the following calls - ABS argument # 1, SQRT argument # 1.
E		Working real local variable.
EIGVEC		Real local array, dimensioned (NMAX,NMAX), which is not explicitly calculated. This symbol appears in the following calls - IMVEC argument # 9, RVEC argument # 8.
GREAT		Working real local variable.
I		Working integer local variable.
IJK		Working integer local variable. This symbol appears in the following calls - CALCEV argument # 5.
IMVEC		Called subroutine.
INT		Working integer local array, dimensioned (1). This symbol appears in the following calls - IMVEC argument # 3, RVEC argument # 3.
J		Working integer local variable.
JI		Working integer local variable.
K		Working integer local variable.

GLOSSARY FOR SUBROUTINE MAIN

FORTRAN SYMBOL	MATH SYMBOL	DESCRIPTION
K1		Working integer local variable.
K11		Working integer local variable.
K1J		Working integer local variable.
K2		Working integer local variable.
L		Working integer local variable. This symbol appears in the following calls - COMPIT argument # 3, REALIT argument # 3.
M		Working integer local variable.
MAX		Working integer local variable.
N		Working integer local variable. This symbol appears in the following calls - REALIT argument # 4, CALCEV argument # 6, COMPIT argument # 4.
NM		Integer local variable which is calculated but not used.
NMAX		Integer local variable which is not explicitly calculated. This symbol appears in the following calls - IMVEC argument # 2, CALCEV argument # 2, COMPIT argument # 2, REALIT argument # 2, RVEC argument # 2.
NN		Integer local variable which is not explicitly calculated. This symbol appears in the following calls - IMVEC argument # 7, RVEC argument # 6.
NUM		Working integer local variable. This symbol appears in the following calls - IMVEC argument # 8, RVEC argument # 7.
NVEC		Integer local variable which is not explicitly calculated. This symbol appears in the following calls - IMVEC argument #10, RVEC argument # 9.
N2I		Working integer local variable.
R		Working real local variable.
REALIT		Called subroutine.
RHO		Working real local variable. This symbol appears in the following calls - COMPIT argument # 5.
RS		Working real local variable.
RVEC		Called subroutine.
R1		Working real local variable.
R2		Working real local variable.
SHIFT		Working real local variable. This symbol appears in the following calls - REALIT argument # 5.
SIGMA		Working real local variable. This symbol appears in the following calls - COMPIT argument # 6.
SMALL		Working real local variable. This symbol appears in the following calls - IMVEC argument # 6, RVEC argument # 5.
SQRT		Function reference.
SS		Real local variable which is not explicitly calculated. This symbol appears in the following calls - RVEC argument #11, IMVEC argument #12, REALIT argument # 7.
VEC		Real local array, dimensioned (1), which is not explicitly calculated. This symbol appears in the following calls - CALCEV argument # 4.

GLOSSARY FOR SUBROUTINE MAIN

FORTRAN SYMBOL	MATH SYMBOL	DESCRIPTION
Z		Real local variable which is not explicitly calculated. This symbol appears in the following calls - IMVEC argument #13.

SUBROUTINE CALCEV

GLOSSARY FOR SUBROUTINE CALCEV

FORTRAN SYMBOL	MATH SYMBOL	DESCRIPTION
A		*MODIFIED* real argument no. 1, dimensioned (NMAX,NMAX).
AI		Working real local variable.
B		Working real local variable.
C		Working real local variable.
CALCEV		Subprogram entry point.
CI		Working real local variable.
DEL		*INPUT* real argument no. 3.
DISC		Working real local variable. This symbol appears in the following calls - ABS argument # 1, SQRT argument # 1.
IJK		*MODIFIED* integer argument no. 5.
M		*INPUT* integer argument no. 7.
N		*INPUT* integer argument no. 6.
NMAX		*INPUT* integer argument no. 2.
RI		Working real local variable.
R2		Working real local variable.
SQRT		Function reference.
VEC		*OUTPUT* real argument no. 4, dimensioned (1).

SUBROUTINE REALIT

GLOSSARY FOR SUBROUTINE REALIT

FORTRAN SYMBOL	MATH SYMBOL	DESCRIPTION
A		*MODIFIED* real argument no. 1, dimensioned (NMAX,NMAX).
C		*MODIFIED* real argument no. 6, dimensioned (1).
DENOM		Working real local variable.
F		Working real local variable.
I		Working integer local variable.
II		Working integer local variable.
J		Working integer local variable.
L		*INPUT* integer argument no. 3.
M		Working integer local variable.
N		*INPUT* integer argument no. 4.
NMAX		*INPUT* integer argument no. 2.
REALIT		Subprogram entry point.
S		*MODIFIED* real argument no. 7, dimensioned (1).
SHIFT		*INPUT* real argument no. 5.
SQRT		Function reference.

SUBROUTINE COMPIT

GLOSSARY FOR SUBROUTINE COMPIT

FORTRAN SYMBOL	MATH SYMBOL	DESCRIPTION
A		*MODIFIED* real argument no. 1, dimensioned (NMAX,NMAX).
B1		Working real local variable.
B2		Working real local variable.
B3		Working real local variable.
COMPIT		Subprogram entry point.
C1		Working real local variable.
C2		Working real local variable.
D		Working real local variable.
E		Working real local variable.
G		Working real local variable.
I		Working integer local variable.
J		Working integer local variable.
K		Working integer local variable.
L		*INPUT* integer argument no. 3.
M		Working integer local variable.
N		*INPUT* integer argument no. 4.
NMAX		*INPUT* integer argument no. 2.
RHO		*INPUT* real argument no. 5.
SIGMA		*INPUT* real argument no. 6.
SQRT		Function reference.

SUBROUTINE RVEC

GLOSSARY FOR SUBROUTINE RVEC

FORTRAN SYMBOL	MATH SYMBOL	DESCRIPTION
A		*MODIFIED* real argument no. 1, dimensioned (NMAX,NMAX). This symbol appears in the following calls - ABS argument # 1.
B		Working real local variable. This symbol appears in the following calls - ABS argument # 1.
C		Working real local variable.
C1		*INPUT* real argument no. 4.
E		Working real local variable.
EIGVEC		*OUTPUT* real argument no. 8, dimensioned (NMAX,NMAX).
I		Working integer local variable.
INT		*INPUT* integer argument no. 3, dimensioned (1).
INTER		*MODIFIED* integer argument no.10, dimensioned (1).
J		Working integer local variable.
JJJJ		Working integer local variable.
K		Working integer local variable.
L		Working integer local variable.
LL		Working integer local variable.
M		Working integer local variable.
N		*INPUT* integer argument no. 6.
NMAX		*INPUT* integer argument no. 2.
NUM		*INPUT* integer argument no. 7.
RVEC		Subprogram entry point.
SMALL		*INPUT* real argument no. 5.
Y		*MODIFIED* real argument no.11, dimensioned (1). This symbol appears in the following calls - ABS argument # 1.

SUBROUTINE IMVEC

GLOSSARY FOR SUBROUTINE IMVEC

FORTRAN SYMBOL	MATH SYMBOL	DESCRIPTION
A		*MODIFIED* real argument no. 1, dimensioned (NMAX,NMAX).
AMU		*INPUT* real argument no. 5.
A1		Working real local variable.
A2		Working real local variable.
B		*MODIFIED* real argument no.14, dimensioned (NMAX,NMAX).
C		Working real local variable.
C1		*INPUT* real argument no. 4.
D		Working real local variable.
E		Working real local variable.
EIGVEC		*OUTPUT* real argument no. 9, dimensioned (NMAX,NMAX).
F		Working real local variable.
G		Working real local variable.
I		Working integer local variable.
IMVEC		Subprogram entry point.
INT		*INPUT* integer argument no. 3, dimensioned (1).
INTER		*MODIFIED* integer argument no.11, dimensioned (1).
J		Working integer local variable.
JJJ		Working integer local variable.
K		Working integer local variable.
L		Working integer local variable.
LL		Working integer local variable.
M		Working integer local variable.
N		*INPUT* integer argument no. 7.
NMAX		*INPUT* integer argument no. 2.
NUM		*MODIFIED* integer argument no. 8.
SMALL		*INPUT* real argument no. 6. This symbol appears in the following calls - SQRT argument # 1.
SQRT		Function reference.
Y		*MODIFIED* real argument no.12, dimensioned (1).
Z		*MODIFIED* real argument no.13, dimensioned (1).

SUBROUTINE CALCEV

Inputs:

A DEL IJK M N NMAX

Outputs:

A IJK VEC

Subroutines Called:

SQRT

SUBROUTINE REALIT

Inputs:

A C L N NMAX S SHIFT

Outputs:

A C S

Subroutines Called:

SQRT

SUBROUTINE REALIT

Inputs:

A C L N NMAX S SHIFT

Outputs:

A C S

Subroutines Called:

SQRT

SUBROUTINE COMPIT

Inputs:

A L N NMAX RHO SIGMA

Outputs:

A

Subroutines Called:

SQRT

SUBROUTINE RVEC

Inputs:

A	C1	INT	INTER	N	NMAX	NUM	SMALL	Y

Outputs:

A	EIGVEC	INTER	Y

Subroutines Called:

SUBROUTINE IMVEC

Inputs:

A AMU B C1 INT INTER N NMAX NUM SMALL Y Z

Outputs:

A B EIGVEC INTER NUM Y Z

Subroutines Called:

SQRT

Inputs:

Outputs:

Subroutines Called:

CALCEV COMPIT IMVEC REALIT RVEC SQRT

THE FOLLOWING IS A LIST OF THE USAGE CODES WHICH MAY APPEAR IN THE CROSS-REFERENCE MATRIX. EACH APPEARANCE OF A USAGE CODE INDICATES HOW THE SYMBOL TO THE LEFT IS USED IN THE SUBROUTINE LISTED ABOVE.

A ARITHMETIC STATEMENT FUNCTION

C CONSTANT - APPEARS IN DATA STATEMENT AND IS USED BUT VALUE IS NOT RE-CALCULATED.

D DATA - APPEARS IN DATA STATEMENT BUT IS NOT USED.

E SUBROUTINE ENTRY POINT.

F FUNCTION REFERENCE.

I FOR VARIABLE - INPUT, USED BUT NOT RE-CALCULATED.
FOR I/O FILE - USED IN READ STATEMENT.

M FOR VARIABLE - MODIFIED, BOTH USED AND RE-CALCULATED, APPLIES TO COMMON VARIABLES AND ARGUMENTS.
FOR I/O FILE - BOTH READ AND WRITTEN.

O FOR VARIABLE - OUTPUT, VALUE IS CALCULATED BUT NOT USED.
FOR I/O FILE - USED IN ENDFILE, PRINT, PUNCH, AND/OR WRITE STATEMENT.
FOR FUNCTION NAME - FUNCTION ENTRY POINT (FUNCTION VALUE IS OUTPUT).

P I/O FILE POSITIONED - BACKSPACE OR REWIND.

S SUBROUTINE CALL

W WORKING VARIABLE - BOTH CALCULATED AND USED, APPLIES TO LOCAL VARIABLES ONLY.

(INTEGER) ARGUMENT NUMBER, THE VARIABLE AT LEFT APPEARS AS THE I-TH ARGUMENT IN A CALL TO THE ABOVE SUBR.

* ARGUMENT NUMBERS, TWO OR MORE INTEGERS (ARGUMENT NUMBERS, SEE ABOVE) BELONG HERE SO THE USER HAS TO CONSULT THE PROGRAM GLOSSARY TO SEE WHAT THEY ARE.

* THE COMMON BLOCK ON THE LEFT APPEARS IN THE SUBROUTINE ABOVE, AT LEAST ONE ELEMENT OF THE COMMON BLOCK IS USED IN SOME MANNER.

- CROSS REFERENCE MATRIX -

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SYMBOL	STORE	LOC	C	C	I	M	R	R	
SHIFT	/MAIN	/(*)				W	5		
SIGMA	/MAIN	/(*)		6		W			
SMALL	/MAIN	/(*)			6	W		5	
SS	/MAIN	/(*)			12	I	7	11	
VEC	/MAIN	/(*)	4			I			
Z	/MAIN	/(*)			13	I			
A	/REALIT	/(ARG 1)					M		
C	/REALIT	/(ARG 6)					M		
L	/REALIT	/(ARG 3)					I		
N	/REALIT	/(ARG 4)					I		
NMAX	/REALIT	/(ARG 2)					I		
REALIT	/REALIT	/($)				S	E		
S	/REALIT	/(ARG 7)					M		
SHIFT	/REALIT	/(ARG 5)					I		
A	/RVEC	/(ARG 1)						M	
C1	/RVEC	/(ARG 4)						I	
EIGVEC	/RVEC	/(ARG 8)						O	
INT	/RVEC	/(ARG 3)						I	
INTER	/RVEC	/(ARG10)						M	
N	/RVEC	/(ARG 6)						I	
NMAX	/RVEC	/(ARG 2)						I	
NUM	/RVEC	/(ARG 7)						I	
RVEC	/RVEC	/($)				S		E	
SMALL	/RVEC	/(ARG 5)						I	
Y	/RVEC	/(ARG11)						M	
SQRT	/SQRT	/($)	F	F	F	F	F		

* CROSS REFERENCE MATRIX *

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SYMBOL	STORE	LOC	C	C	I	M	R	R		
A	/CALCEV/	(ARG 1)	M							
CALCEV	/CALCEV/	($)	E			S				
DEL	/CALCEV/	(ARG 3)	I							
IJK	/CALCEV/	(ARG 5)	M							
M	/CALCEV/	(ARG 7)	I							
N	/CALCEV/	(ARG 6)	I							
NMAX	/CALCEV/	(ARG 2)	I							
VEC	/CALCEV/	(ARG 4)	O							
A	/COMPIT/	(ARG 1)		I						
COMPIT	/COMPIT/	($)		E		S				
L	/COMPIT/	(ARG 3)		I						
N	/COMPIT/	(ARG 4)		I						
NMAX	/COMPIT/	(ARG 2)		I						
RHO	/COMPIT/	(ARG 5)		I						
SIGMA	/COMPIT/	(ARG 6)		I						
A	/IMVEC	/(ARG 1)			M					
AMU	/IMVEC	/(ARG 5)			I					
B	/IMVEC	/(ARG14)			M					
C1	/IMVEC	/(ARG 4)			I					
EIGVEC	/IMVEC	/(ARG 9)			O					
IMVEC	/IMVEC	/($)			E	S				
INT	/IMVEC	/(ARG 3)			I					
INTER	/IMVEC	/(ARG11)			M					
N	/IMVEC	/(ARG 7)			I					
NMAX	/IMVEC	/(ARG 2)			I					
NUM	/IMVEC	/(ARG 8)			M					
SMALL	/IMVEC	/(ARG 6)			I					
Y	/IMVEC	/(ARG12)			M					
Z	/IMVEC	/(ARG13)			M					
A	/MAIN	/(*)	1	1	1	W	1	1		
BB	/MAIN	/(*)			14	I				
CC	/MAIN	/(*)			11	I	6	10		
C1	/MAIN	/(*)			4	W		4		
C2	/MAIN	/(*)			5	W				
DEL	/MAIN	/(*)	3			W				
EIGVEC	/MAIN	/(*)			9	I		8		
IJK	/MAIN	/(*)	5			W				
INT	/MAIN	/(*)			3	W		3		
L	/MAIN	/(*)		3		W	3			
N	/MAIN	/(*)	6	4		W	4			
NMAX	/MAIN	/(*)	2	2	2	I	2	2		
NN	/MAIN	/(*)			7	I		6		
NUM	/MAIN	/(*)			8	W		7		
NVEC	/MAIN	/(*)			10	I		9		
RHO	/MAIN	/(*)		5		W				

SOURCE PROGRAM LISTING

$ IN THE LABEL FIELD INDICATES THE EXPANSION
OF THE LOGICAL IF STATEMENT ON THE PREVIOUS LINE

```
LINE STMT BLOCK       SOURCE

   1    1    1          SUBROUTINE UNSEIG(A,NMAX,NN,NVEC,VEC,EIGVEC,INT,CC,SS,Z,D,BB)
   2    0    0    C FOR DESCRIPTION OF METHOD USED IN THIS PROGRAM, SEE **THE QR
   3    0    0    C TRANSFORMATION** BY FRANCIS, COMPUTER JOURNAL, VOL. 4 PP. 265,332
   4    0    0    C START HERE TO PRODUCE UPPER HESSENBURG MATRIX
   5    2    1          DIMENSION A(NMAX,NMAX),INT(1),VEC(1),D(NMAX,NMAX),EIGVEC(NMAX,NMAX
   6    2    1         C)
   7    3    2          N=NN
   8    4    3          K=N-2
   9    5    4          DO1J=1,K
  10    6    5          K1=J+1
  11    7    6          K2=J+2
  12    8    7          GREAT= ABS(A(K1,J))
  13    9    8          MAX=K1
  14   10    9          DO2I=K2,N
  15   11   10          AB= ABS(A(I,J))
  16   12   11          IF (GREAT.GE.AB)
  16   13   12         $ GO TO 2
  17   14   13        3 GREAT=AB
  18   15   14          MAX=I
  19   16   15        2 CONTINUE
  20    0    0    C INT(I) GIVES INFORMATION ABOUT INTERCHANGES
  21   17   16          INT(J)=MAX
  22   18   17          IF (MAX.EQ.K1)
  22   19   18         $ GO TO 5
  23   20   19        4 DO6L=J,N
  24   21   20          E=A(K1,L)
  25   22   21          A(K1,L)=A(MAX,L)
  26   23   22        6 A(MAX,L)=E
  27   24   23          DO7L=1,N
  28   25   24          E=A(L,K1)
  29   26   25          A(L,K1)=A(L,MAX)
  30   27   26        7 A(L,MAX)=E
  31    0    0    C     INTERCHANGE DONE
  32   28   27        5 DO8I=K2,N
  33   29   28          IF (A(I,J).EQ.0.)
  33   30   29         $ GO TO 8
  34   31   30          A(I,J)=-A(I,J)/A(K1,J)
  35   32   31          DO1IM=K1,N
  36   33   32       11 A(I,M)=A(I,M)+A(I,J)*A(K1,M)
  37   34   33        8 CONTINUE
  38    0    0    C     LEFT MULT. DONE
  39   35   34          DO 2000 M=K2,N
  40   36   35          IF (A(M,J).EQ.0.)
  40   37   36         $ GO TO 2000
  41   38   37       10 DO 2001 I=1,N
  42   39   38     2001 A(I,K1)=A(I,K1)-A(I,M)*A(M,J)
  43   40   39     2000 CONTINUE
  44   41   40        1 CONTINUE
  45    0    0    C     RIGHT MULT. DONE
```

```
   46    0    0  C HESSENBURG MATRIX NOW FORMED AS A(I,J). MULTIPLIERS STORED WITH IT
   47   42   41        DO 105 I=1,N
   48   43   42        DO 105 J=1,N
   49   44   43    105 D(I,J)=A(I,J)
   50    0    0  C PUT APPROPRIATE ZEROS WHERE MULTIPLIERS WERE STORED
   51   45   44        DO 106 I=3,N
   52   46   45        L=I-2
   53   47   46        DO 106 J=1,L
   54   48   47    106 A(I,J)=0.0
   55   49   48        K1=N+1
   56   50   49        R=0.0
   57   51   50        C=0.0
   58   52   51        DO33I=1,N
   59   53   52        R=R+ ABS(A(1,I))
   60   54   53     33 C=C+ ABS(A(I,N))
   61   55   54        DO34I=2,N
   62   56   55        RS=0.0
   63   57   56        CS=0.0
   64   58   57        L=I-1
   65   59   58        DO35J=L,N
   66   60   59        RS=RS+ ABS(A(I,J))
   67   61   60        K1J=K1-J
   68   62   61        K1I=K1-I
   69   63   62     35 CS=CS+ ABS(A(K1J,K1I))
   70   64   63        IF (RS,LE,R)
   70   65   64       $ GO TO 36
   71   66   65     37 R=RS
   72   67   66     36 IF (CS,LE,C)
   72   68   67       $ GO TO 34
   73   69   68     44 C=CS
   74   70   69     34 CONTINUE
   75   71   70        IJK=1
   76   72   71        IF (R,GE,C)
   76   73   72       $ GO TO 54
   77    0    0  C DELTA IS CRITERION FOR STOPPING AN ITERATION
   78   74   73     53 DELTA=R*1.0E-11
   79    0    0  C DEL IS ARBITRARY SHIFT
   80   75   74        DEL=R/17.1829
   81   76   75        GO TO 153
   82   77   76     54 DELTA=C*1.0E-11
   83   78   77        DEL=C/17.1829
   84    0    0  C      DELTA COMPUTED
   85    0    0  C PRODUCE A-PI, ITERATE ON THIS TO BREAK UP EIGENVALUES OF EQUAL MODULUS
   86   79   78    153 DO 107 I=1,N
   87   80   79    107 A(I,I)=A(I,I)-DEL
   88   81   80     55 IF (N,NE,1)
   88   82   81       $ GO TO 48
   89    0    0  C SUBROUTINE CALCEV CALCULATES EIGENVALUES OF 1X1 OR 2X2 MATRICES.
   90    0    0  C PI IS ADDED BACK IN CALCEV
   91   83   82     47 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,1)
   92   84   83        GO TO 76
   93   85   84     48 IF (N,NE,2)
   93   86   85       $ GO TO 80
   94   87   86     49 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,2)
   95   88   87        GO TO 76
   96    0    0  C QR TRANSFORMATION STARTS HERE
   97    0    0  C INITIALIZE FOR DETERMINING SUBSEQUENT SHIFTS
   98   89   88     80 AR1=0.0
   99   90   89        AR3=0.0
  100   91   90        AR4=0.0
  101    0    0  C RE-ENTER AFTER REALIT OR COMPIT SUBROUTINES CALLED
  102    0    0  C SELECT FIRST (ZERO), SUB-DIAGONAL ELEMENT FROM BOTTOM
```

```
103   92   91      61 L=N
104   93   92         DO56 I=2,N
105   94   93         N2I=N+2-I
106   95   94         IF( ABS(A(N2I,N2I-1)).LT.DELTA)
106   96   95        $GO TO 57
107   97   96      56 L=L-1
108    0    0   C VALUE OF L SELECTED
109   98   97      57 IF (L.NE.N)
109   99   98        $ GO TO 59
110  100   99      58 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,1)
111  101  100         N=N-1
112  102  101         GO TO 48
113  103  102      59 IF ((L-N+1).NE.0)
113  104  103        $ GO TO 75
114  105  104      60 CALL CALCEV(A,NMAX,DEL,VEC,IJK,N,2)
115  106  105         N=N-2
116  107  106         GO TO 55
117    0    0   C DETERMINE EIGENVALUES OF 2X2 MATRIX -- ROW 1 = A(N-1,N-1)   A(N-1,N)
118    0    0   C                                       ROW 2 = A(N,N-1)     A(N,N)
119    0    0   C AND BASE SHIFT ON THESE
120  108  107      75 B=A(N-1,N-1)+A(N,N)
121  109  108         C=A(N-1,N-1)*A(N,N)-A(N,N-1)*A(N-1,N)
122  110  109         C1=A(N-1,N-1)-A(N,N)
123  111  110         DISC=C1*C1+4.0*A(N,N-1)*A(N-1,N)
124  112  111         IF (DISC.GE.0.)
124  113  112        $ GO TO 63
125  114  113      62 R1=0.5*B
126  115  114         R2=.5* SQRT( ABS(DISC))
127  116  115         ANUM=(R1-AR3)*(R1-AR3)+(R2-AR4)*(R2-AR4)
128  117  116         DENOM=AR3*AR3+AR4*AR4
129  118  117         IF (DENOM.NE.0.)
129  119  118        $ GO TO 200
130  120  119     201 RHO=0.0
131  121  120         SIGMA=0.0
132  122  121         GO TO 203
133  123  122     200 RHO=C
134  124  123         SIGMA=B
135  125  124     203 AR3=R1
136  126  125         AR4=R2
137  127  126     .   CALL COMPIT(A,NMAX,L,N,RHO,SIGMA)
138  128  127         GO TO 61
139  129  128      63 IF (B.GE.0.)
139  130  129        $ GO TO 65
140  131  130      64 R1=.5*(B- SQRT(DISC))
141  132  131         GO TO 66
142  133  132      65 R1=.5*(B+ SQRT(DISC))
143  134  133         IF (R1.NE.0.)
143  135  134        $ GO TO 66
144  136  135      83 R2=0.0
145  137  136         GO TO 84
146  138  137      66 R2=C/R1
147    0    0   C     ROOTS OF 2*2 MATRIX FOUND
148  139  138      84 IF( ABS(A(N,N)-R1).GE. ABS(A(N,N)-R2))
148  140  139        $GO TO 68
149  141  140      67 AR2=R1
150  142  141         GO TO 69
151  143  142      68 AR2=R2
152  144  143      69 IF (AR1.NE.0.)
152  145  144        $ GO TO 71
153  146  145      72 SHIFT=0.0
154  147  146         GO TO 73
155  148  147      71 SHIFT=AR2
```

```
156   149   148      73 AR1=AR2
157   150   149         CALL REALIT(A,NMAX,L,N,SHIFT,CC,SS)
158   151   150         GO TO 61
159     0     0   C ARE VECTORS NEEDED
160   152   151      76 IF (NVEC.EQ.0)
160   153   152        $ GO TO 600
161     0     0   C INVERSE ITERATION IS USED FOR EIGENVECTORS
162   154   153     550 SMALL=DELTA*1.0E-30
163   155   154         NUM=0
164   156   155         JI=1
165   157   156         NM=NN+NN
166     0     0   C C1 IS REAL PART OF EIGENVALUE
167   158   157     513 C1=VEC(JI)
168     0     0   C C2 IS COMPLEX PART OF EIGENVALUE
169   159   158         C2=VEC(JI+1)
170   160   159         NUM=NUM+1
171     0     0   C REPLACE HESSENBURG MATRIX AND MULTIPLIERS
172   161   160         DO 570 I=1,NN
173   162   161         DO 570 J=1,NN
174   163   162     570 A(I,J)=D(I,J)
175   164   163         IF (C2.NE.0.)
175   165   164        $ GO TO 561
176   166   165         CALL RVEC(A,NMAX,INT,C1,SMALL,NN,NUM,EIGVEC,NVEC,CC,SS)
177   167   166         JI=JI+2
178   168   167         IF(NVEC.EQ.NUM)
178   169   168        $GO TO 600
179   170   169         GO TO 513
180   171   170     561 CALL IMVEC(A,NMAX,INT,C1,C2,SMALL,NN,NUM,EIGVEC,NVEC,CC,SS,Z,BB)
181     0     0   C NEXT STATEMENT IGNORES CONJUGATE COMPLEX EIGENVALUES
182   172   171         JI=JI+4
183   173   172         IF(NVEC.EQ.NUM)
183   174   173        $GO TO 600
184   175   174         GO TO 513
185   176   175     600 RETURN
186   177     1         END
```

SOURCE PROGRAM LISTING

$ IN THE LABEL FIELD INDICATES THE EXPANSION
OF THE LOGICAL IF STATEMENT ON THE PREVIOUS LINE

```
LINE STMT BLOCK       SOURCE

 187    1    1         SUBROUTINE CALCEV(A,NMAX,DEL,VEC,IJK,N,M)
 188    2    1         DIMENSION A(NMAX,NMAX),VEC(1)
 189    3    2         IF (M.NE.1)
 189    4    3        $ GO TO 2
 190    5    4       1 AI=0.0
 191    6    5         A(N,N)=A(N,N)+DEL
 192    0    0   C STORE EIGENVALUES IN VEC
 193    7    6         VEC(IJK)=A(N,N)
 194    8    7         VEC(IJK+1)=AI
 195    9    8         IJK=IJK+2
 196   10    9         RETURN
 197   11   10       2 B=A(N-1,N-1)+A(N,N)
 198   12   11         C=A(N-1,N-1)*A(N,N)-A(N,N-1)*A(N-1,N)
 199   13   12         C1=A(N-1,N-1)-A(N,N)
 200   14   13         DISC=C1*C1+4.0*A(N,N-1)*A(N-1,N)
 201   15   14         IF (DISC.LT.0.)
 201   16   15        $ GO TO 9
 202   17   16       4 AI=0.0
 203   18   17         IF (B.GE.0.)
 203   19   18        $ GO TO 6
 204   20   19         R1=0.5*(B- SQRT(DISC))
 205   21   20         GO TO 7
 206   22   21       6 R1=0.5*(B+ SQRT(DISC))
 207   23   22         IF(R1.NE.0.)
 207   24   23        $ GO TO 7
 208   25   24      10 R2=0.0
 209   26   25         GO TO 11
 210   27   26       7 R2=C/R1
 211   28   27      11 R1=R1+DEL
 212   29   28         R2=R2+DEL
 213   30   29         VEC(IJK)=R2
 214   31   30         VEC(IJK+1)=AI
 215   32   31         VEC(IJK+2)=R1
 216   33   32         VEC(IJK+3)=AI
 217   34   33         GO TO 8
 218   35   34       9 R1=0.5*B
 219   36   35         AI=-.5* SQRT( ABS(DISC))
 220   37   36         R1=R1+DEL
 221   38   37         VEC(IJK)=R1
 222   39   38         VEC(IJK+1)=-AI
 223   40   39         VEC(IJK+2)=R1
 224   41   40         VEC(IJK+3)=AI
 225   42   41       8 IJK=IJK+4
 226   43   42         RETURN
 227   44    1         END
```

ORIGINAL PAGE IS
OF POOR QUALITY

5K

SOURCE PROGRAM LISTING

$ IN THE LABEL FIELD INDICATES THE EXPANSION
OF THE LOGICAL IF STATEMENT ON THE PREVIOUS LINE

```
LINE STMT BLOCK       SOURCE

 228    1    1          SUBROUTINE REALIT(A,NMAX,L,N,SHIFT,C,S)
 229    2    1          DIMENSION A(NMAX,NMAX),C(1),S(1)
 230    3    2          IF (SHIFT.EQ.0.)
 230    4    3         $ GO TO 2
 231    5    4        1 DO3 I=L,N
 232    6    5        3 A(I,I)=A(I,I)-SHIFT
 233    7    6        2 M=N-1
 234    8    7          DO4 I=L,M
 235    9    8          DENOM= SQRT(A(I,I)**2+A(I+1,I)**2)
 236   10    9          IF (DENOM.GT.0.)
 236   11   10         $ GO TO 10
 237   12   11       11 C(I)=1.0
 238   13   12          S(I)=0.0
 239   14   13          GO TO 4
 240   15   14       10 C(I)=A(I,I)/DENOM
 241   16   15          S(I)=A(I+1,I)/DENOM
 242   17   16          A(I,I)=DENOM
 243   18   17       12 I1=I+1
 244   19   18          DO 35 J=I1,N
 245   20   19          F=A(I,J)
 246   21   20          A(I,J)=A(I+1,J)*S(I)+F*C(I)
 247   22   21          A(I+1,J)=A(I+1,J)*C(I)-F*S(I)
 248   23   22     35   CONTINUE
 249   24   23        4 CONTINUE
 250    0    0  C       TRIANGULAR MATRIX FORMED
 251   25   24          DO5 J=L,M
 252   26   25          DO6 I=L,J
 253   27   26          F=A(I,J)
 254   28   27          A(I,J)=A(I,J+1)*S(J)+F*C(J)
 255   29   28        6 A(I,J+1)=A(I,J+1)*C(J)-F*S(J)
 256   30   29          A(J+1,J)=A(J+1,J+1)*S(J)
 257   31   30        5 A(J+1,J+1)=A(J+1,J+1)*C(J)
 258    0    0  C       TRANSFORMATION COMPLETED
 259   32   31          IF (SHIFT.EQ.0.)
 259   33   32         $ RETURN
 260   34   33        7 DO9 I=L,N
 261   35   34        9 A(I,I)=A(I,I)+SHIFT
 262   36   35        8 RETURN
 263   37    1          END
```

6K

SOURCE PROGRAM LISTING

$ IN THE LABEL FIELD INDICATES THE EXPANSION
OF THE LOGICAL IF STATEMENT ON THE PREVIOUS LINE

```
LINE STMT BLOCK       SOURCE

 264    1    1         SUBROUTINE COMPIT(A,NMAX,L,N,RHO,SIGMA)
 265    2    1         DIMENSION A(NMAX,NMAX)
 266    0    0   C HOUSEHOLDER TYPE MATRICES USED INSTEAD OF ROTATIONS(SEE FRANCIS PAPER)
 267    3    2         M=N-1
 268    4    3         DO 1 I=L,M
 269    5    4         IF (I.NE.L)
 269    6    5        $ GO TO  3
 270    7    6       2 B1=A(L,L)*(A(L,L)-SIGMA)+A(L,L+1)*A(L+1,L)+RHO
 271    8    7         B2=A(L+1,L)*(A(L,L)+A(L+1,L+1)-SIGMA)
 272    9    8         B3=A(L+1,L)*A(L+2,L+1)
 273   10    9         A(L+2,L)=0.0
 274   11   10         GO TO 6
 275   12   11       3 B1=A(I,I-1)
 276   13   12         B2=A(I+1,I-1)
 277   14   13         IF (I.EQ.M)
 277   15   14        $ GO TO 5
 278   16   15       4 B3=A(I+2,I-1)
 279   17   16         GO TO 6
 280   18   17       5 B3=0.0
 281   19   18       6 D= SQRT(B1*B1+B2*B2+B3*B3)
 282   20   19         IF (B1.GE.0.)
 282   21   20        $ GO TO 8
 283   22   21       7 D=-D
 284   23   22       8 IF (D.EQ.0.)
 284   24   23        $ GO TO 1
 285   25   24       9 C1=B2/(D+B1)
 286   26   25         C2=B3/(D+B1)
 287   27   26         E=2.0/(1.0+C1*C1+C2*C2)
 288   28   27         DO 10 K=I,N
 289   29   28         IF (I.EQ.M)
 289   30   29        $ GO TO 12
 290   31   30      11 G=E*(A(I,K)+C1*A(I+1,K)+C2*A(I+2,K))
 291   32   31         A(I,K)=A(I,K)-G
 292   33   32         A(I+1,K)=A(I+1,K)-C1*G
 293   34   33         A(I+2,K)=A(I+2,K)-C2*G
 294   35   34         GO TO 10
 295   36   35      12 G=E*(A(I,K)+C1*A(I+1,K))
 296   37   36         A(I,K)=A(I,K)-G
 297   38   37         A(I+1,K)=A(I+1,K)-C1*G
 298   39   38      10 CONTINUE
 299   40   39         IF (I.EQ.L)
 299   41   40        $ GO TO 14
 300   42   41      13 A(I,I-1)=-D
 301   43   42         A(I+1,I-1)=0.0
 302   44   43         IF (I.EQ.M)
 302   45   44        $ GO TO 14
 303   46   45      15 A(I+2,I-1)=0.0
 304    0    0   C     ROW OPERATION COMPLETED
 305   47   46      14 J=I+2
```

```
306   48   47          IF (J.LE.N)
306   49   48        $ GO TO 17
307   50   49     16 J=N
308   51   50     17 DO 18 K=L,J
309   52   51          IF (I.EQ.M)
309   53   52        $ GO TO 20
310   54   53     19 G=E*(A(K,I)+C1*A(K,I+1)+C2*A(K,I+2))
311   55   54          A(K,I)=A(K,I)-G
312   56   55          A(K,I+1)=A(K,I+1)-C1*G
313   57   56          A(K,I+2)=A(K,I+2)-C2*G
314   58   57          GO TO 18
315   59   58     20 G=E*(A(K,I)+C1*A(K,I+1))
316   60   59          A(K,I)=A(K,I)-G
317   61   60          A(K,I+1)=A(K,I+1)-C1*G
318   62   61     18 CONTINUE
319   63   62          J=I+3
320   64   63          IF (J.GT.N)
320   65   64        $ GO TO 1
321   66   65     21 G=E*C2*A(I+3,I+2)
322   67   66          A(I+3,I)=-G
323   68   67          A(I+3,I+1)=-C1*G
324   69   68          A(I+3,I+2)=A(I+3,I+2)-C2*G
325    0    0  C       COLUMN OPERATION COMPLETED
326   70   69      1 CONTINUE
327   71   70          RETURN
328   72    1          END
```

SOURCE PROGRAM LISTING

$ IN THE LABEL FIELD INDICATES THE EXPANSION
OF THE LOGICAL IF STATEMENT ON THE PREVIOUS LINE

```
LINE STMT BLOCK       SOURCE

 329    1    1         SUBROUTINE RVEC(A,NMAX,INT,C1,SMALL,N,NUM,EIGVEC,NVEC,INTER,Y)
 330    2    1         DIMENSION A(NMAX,NMAX),INTER(1),Y(1),INT(1),EIGVEC(NMAX,NMAX)
 331    3    2         DO1 I=1,N
 332    4    3       1 A(I,I)=A(I,I)-C1
 333    5    4         DO2 I=2,N
 334    6    5         IF( ABS(A(I-1,I-1)).GE. ABS(A(I,I-1)))
 334    7    6        $GO TO 4
 335    8    7       3 INTER(I)=I
 336    9    8         J=I-1
 337   10    9         DO5 K=J,N
 338   11   10         B=A(I-1,K)
 339   12   11         A(I-1,K)=A(I,K)
 340   13   12       5 A(I,K)=B
 341   14   13         GO TO 6
 342   15   14       4 INTER(I)=I-1
 343   16   15       6 IF (A(I,I-1).EQ.0.)
 343   17   16        $ GO TO 2
 344   18   17         C=-A(I,I-1)/A(I-1,I-1)
 345   19   18         A(I,I-1)=C
 346   20   19         DO 8 K=I,N
 347   21   20       8 A(I,K)=A(I,K)+C*A(I-1,K)
 348   22   21       2 CONTINUE
 349    0    0  C      TRIANGULAR MATRIX FORMED
 350   23   22         DO9 I=1,N
 351   24   23         IF( ABS(A(I,I)).GE.SMALL)
 351   25   24        $GO TO 9
 352   26   25      10 A(I,I)=SMALL
 353   27   26       9 CONTINUE
 354    0    0  C NORMALISED ((EIGENVECTOR)) OF HESSENBURG MATRIX OBTAINED FOR RHS = 1
 355   28   27   ..    DO 5555 I=1,N
 356   29   28    5555 Y(I)=1.0
 357   30   29         DO 8888 JJJJ=1,4
 358   31   30    7777 Y(N)=Y(N)/A(N,N)
 359   32   31         B=Y(N)
 360   33   32         DO11 I=2,N
 361   34   33         E=0.0
 362   35   34         M=N+1-I
 363   36   35         DO12 J=2,I
 364   37   36         L=N+J-I
 365   38   37      12 E=E+Y(L)*A(M,L)
 366   39   38         Y(M)=(Y(M)-E)/A(M,M)
 367   40   39         IF( ABS(B).GE. ABS(Y(M)))
 367   41   40        $GO TO 11
 368   42   41      13 B=Y(M)
 369   43   42      11 CONTINUE
 370   44   43         DO14 I=1,N
 371   45   44      14 Y(I)=Y(I)/B
 372   46   45         IF(JJJJ.EQ.4)
 372   47   46        $GO TO 6666
```

```
      DO15 I=2,N
      IF (INTER(I).NE.I)
     $ GO TO 15
   16 B=Y(I)
      Y(I)=Y(I-1)
      Y(I-1)=B
   15 Y(I)=Y(I)+A(I,I-1)*Y(I-1)
 8888 CONTINUE
C EIGENVECTOR OF HESSENBURG MATRIX OBTAINED (NOT NORMALIZED)
 6666 M=N-1
      DO21 I=2,M
      J=N+1-I
      L=J+1
      DO20 K=L,N
   20 Y(K)=Y(K)-Y(J)*A(K,J-1)
      LL=INT(N-I)
      IF (J.EQ.LL)
     $ GO TO 21
   19 B=Y(J)
      Y(J)=Y(LL)
      Y(LL)=B
   21 CONTINUE
C UNNORMALIZED EIGENVECTOR OF ORIGINAL MATRIX OBTAINED
      B=0.0
      DO22 I=1,N
      IF( ABS(B).GE. ABS(Y(I)))
     $GO TO 22
   23 B=Y(I)
   22 CONTINUE
      DO24 I=1,N
   24 Y(I)=Y(I)/B
C     NORMALIZED EIGENVECTOR OBTAINED
C PUT Y(I) (REAL EIGENVECTOR) IN EIGVECT(NUMOFEV,I)
      DO 100 I=1,N
  100 EIGVEC(NUM,I)=Y(I)
      RETURN
      END
```

SOURCE PROGRAM LISTING

$ IN THE LABEL FIELD INDICATES THE EXPANSION
OF THE LOGICAL IF STATEMENT ON THE PREVIOUS LINE

```
LINE STMT BLOCK       SOURCE

 407    1    1         SUBROUTINE IMVEC(A,NMAX,INT,C1,AMU,SMALL,N,NUM,EIGVEC,NVEC,INTER,
 408    1    1        CY,Z,B)
 409    2    1         DIMENSION A(NMAX,NMAX),INTER(1),Y(1),Z(1),INT(1),B(NMAX,NMAX),
 410    2    1        CEIGVEC(NMAX,NMAX)
 411    3    2         DO50 I=1,N
 412    4    3         DO50 J=1,N
 413    5    4      50 B(I,J)=0.0
 414    6    5         DO1 I=1,N
 415    7    6         A(I,I)=A(I,I)-C1
 416    8    7       1 B(I,I)=B(I,I)-AMU
 417    9    8         DO2 I=2,N
 418   10    9         C=A(I-1,I-1)*A(I-1,I-1)+B(I-1,I-1)*B(I-1,I-1)
 419   11   10         D=A(I,I-1)*A(I,I-1)+B(I,I-1)*B(I,I-1)
 420   12   11         IF (C.GE.D)
 420   13   12        $ GO TO 4
 421   14   13       3 INTER(I)=I
 422   15   14         G=C
 423   16   15         C=D
 424   17   16         D=G
 425   18   17         J=I-1
 426   19   18         DO5 K=J,N
 427   20   19         G=A(I-1,K)
 428   21   20         A(I-1,K)=A(I,K)
 429   22   21         A(I,K)=G
 430   23   22         G=B(I-1,K)
 431   24   23         B(I-1,K)=B(I,K)
 432   25   24       5 B(I,K)=G
 433   26   25         GO TO 6
 434   27   26       4 INTER(I)=I-1
 435   28   27       6 IF (D.EQ.0.)
 435   29   28        $ GO TO 2
 436   30   29       7 G=A(I,I-1)
 437   31   30         A(I,I-1)=-(G*A(I-1,I-1)+B(I,I-1)*B(I-1,I-1))/C
 438   32   31         B(I,I-1)=-(B(I,I-1)*A(I-1,I-1)-G*B(I-1,I-1))/C
 439   33   32         DO8 K=I,N
 440   34   33         A(I,K)=A(I,K)+A(I,I-1)*A(I-1,K)-B(I,I-1)*B(I-1,K)
 441   35   34       8 B(I,K)=B(I,K)+B(I,I-1)*A(I-1,K)+A(I,I-1)*B(I-1,K)
 442   36   35       2 CONTINUE
 443    0    0  C      TRIANGULAR MATRIX FORMED
 444   37   36         DO9 I=1,N
 445   38   37         C=A(I,I)*A(I,I)+B(I,I)*B(I,I)
 446   39   38         IF (C.GE.SMALL)
 446   40   39        $ GO TO 9
 447   41   40         A(I,I)= SQRT(SMALL)
 448   42   41         B(I,I)=0.0
 449   43   42       9 CONTINUE
 450   44   43         DO 1111 I=1,N
 451   45   44         Y(I)=1.0
 452   46   45    1111 Z(I)=0.0
```

ORIGINAL PAGE IS
OF POOR QUALITY

```
453   47   46          DO 8888 JJJ=1,4
454   48   47          C=A(N,N)*A(N,N)+B(N,N)*B(N,N)
455   49   48          G=Y(N)
456   50   49          Y(N)=(G*A(N,N)+Z(N)*B(N,N))/C
457   51   50          Z(N)=(Z(N)*A(N,N)-G*B(N,N))/C
458   52   51          DO17 I=2,N
459   53   52          E=0.0
460   54   53          F=0.0
461   55   54          M=N+1-I
462   56   55          DO18 J=2,I
463   57   56          L=N+J-I
464   58   57          E=E+Y(L)*A(M,L)-Z(L)*B(M,L)
465   59   58       18 F=F+Y(L)*B(M,L)+Z(L)*A(M,L)
466   60   59          D=A(M,M)*A(M,M)+B(M,M)*B(M,M)
467   61   60          G=Y(M)
468   62   61          Y(M)=((G-E)*A(M,M)+(Z(M)-F)*B(M,M))/D
469   63   62       17 Z(M)=((Z(M)-F)*A(M,M)-(G-E)*B(M,M))/D
470   64   63          E=0.0
471   65   64          DO51 I=1,N
472   66   65          F=Y(I)*Y(I)+Z(I)*Z(I)
473   67   66          IF (E.GE.F)
473   68   67         $ GO TO 51
474   69   68       52 E=F
475   70   69          L=I
476   71   70       51 CONTINUE
477   72   71          A1=Y(L)
478   73   72          A2=Z(L)
479   74   73          DO14 I=1,N
480   75   74          G=Y(I)
481   76   75          Y(I)=(G*A1+Z(I)*A2)/E
482   77   76       14 Z(I)=(Z(I)*A1-G*A2)/E
483   78   77          IF(JJJ.EQ.4)
483   79   78         $ GO TO 6666
484   80   79          DO15 I=2,N
485   81   80          IF (INTER(I).NE.I)
485   82   81         $ GO TO 30
486   83   82       16 G=Y(I)
487   84   83          Y(I)=Y(I-1)
488   85   84          Y(I-1)=G
489   86   85          G=Z(I)
490   87   86          Z(I)=Z(I-1)
491   88   87          Z(I-1)=G
492   89   88       30 Y(I)=Y(I)+A(I,I-1)*Y(I-1)-B(I,I-1)*Z(I-1)
493   90   89       15 Z(I)=Z(I)+B(I,I-1)*Y(I-1)+A(I,I-1)*Z(I-1)
494   91   90     8888 CONTINUE
495    0    0        C     EIGENVECTOR OF HESSENBURG MATRIX OBTAINED
496   92   91     6666 M=N-1
497   93   92          DO21 I=2,M
498   94   93          J=N+1-I
499   95   94          L=J+1
500   96   95          DO20 K=L,N
501   97   96          Y(K)=Y(K)-Y(J)*A(K,J-1)+Z(J)*B(K,J-1)
502   98   97       20 Z(K)=Z(K)-Z(J)*A(K,J-1)-Y(J)*B(K,J-1)
503   99   98          LL=INT(N-I)
504  100   99          IF (J.EQ.LL)
504  101  100         $ GO TO 21
505  102  101       19 G=Y(J)
506  103  102          Y(J)=Y(LL)
507  104  103          Y(LL)=G
508  105  104          G=Z(J)
509  106  105          Z(J)=Z(LL)
510  107  106          Z(LL)=G
```

12K

```
      21 CONTINUE
C        UNNORMALIZED EIGENVECTOR OBTAINED
         E=0.0
         DO22 I=1,N
         F=Y(I)*Y(I)+Z(I)*Z(I)
         IF (E.GE.F)
        $ GO TO 22
      23 E=F
         L=I
      22 CONTINUE
         A1=Y(L)
         A2=Z(L)
         DO24 I=1,N
         G=Y(I)
         Y(I)=(G*A1+Z(I)*A2)/E
      24 Z(I)=(Z(I)*A1-G*A2)/E
C        NORMALIZED EIGENVECTOR OBTAINED
C PUT Y(I) (REAL PART) IN EIGVECT(NUMOFEV,I)
         DO 100 I=1,N
     100 EIGVEC(NUM,I)=Y(I)
         NUM=NUM+1
C PUT Z(I) (COMPLEX PART) IN EIGVECT(NUMOFEV,I)
         DO 101 I=1,N
     101 EIGVEC(NUM,I)=Z(I)
         RETURN
         END
```

```
                CALL GRAPH TABLE ENTRIES

     SUBPROGRAM NAME=    UNSEIG
     PROCESSED AS ITEM NUMBER            1   IN THE INPUT FILE
     NUMBER OF EXTERNAL CALLS=           5
     NAMES OF CALLED
            IMVEC
           CALCEV
           COMPIT
           REALIT
             RVEC
     NUMBER OF CALLERS=          0

     SUBPROGRAM NAME=    CALCEV
     PROCESSED AS ITEM NUMBER            2   IN THE INPUT FILE
     NUMBER OF EXTERNAL CALLS=           0
     NAMES OF CALLERS
           UNSEIG

     SUBPROGRAM NAME=    COMPIT
     PROCESSED AS ITEM NUMBER            4   IN THE INPUT FILE
     NUMBER OF EXTERNAL CALLS=           0
     NAMES OF CALLERS
           UNSEIG

     SUBPROGRAM NAME=    REALIT
     PROCESSED AS ITEM NUMBER            3   IN THE INPUT FILE
     NUMBER OF EXTERNAL CALLS=           0
     NAMES OF CALLERS
           UNSEIG

     SUBPROGRAM NAME=      RVEC
     PROCESSED AS ITEM NUMBER            5   IN THE INPUT FILE
     NUMBER OF EXTERNAL CALLS=           0
     NAMES OF CALLERS
           UNSEIG

     SUBPROGRAM NAME=     IMVEC
     PROCESSED AS ITEM NUMBER            6   IN THE INPUT FILE
     NUMBER OF EXTERNAL CALLS=           0
     NAMES OF CALLERS
           UNSEIG
     NEXT LEAF IS FILE ENTRY NUMBER            2
     NEXT LEAF IS FILE ENTRY NUMBER            3
     NEXT LEAF IS FILE ENTRY NUMBER            4
     NEXT LEAF IS FILE ENTRY NUMBER            5
     NEXT LEAF IS FILE ENTRY NUMBER            6
     NEXT LEAF IS FILE ENTRY NUMBER            1

     PHASE1 COMPLETE

     PHASE2 COMPLETE
     ********************************************************************
     ********************************************************************

               DIAGNOSTICS FOR PROGRAM UNIT      CALCEV


     ********* NO ERRORS
```

14K

****

DIAGNOSTICS FOR PROGRAM UNIT REALIT

********* NO ERRORS

****
****

DIAGNOSTICS FOR PROGRAM UNIT COMPIT

********* NO ERRORS

****
****

DIAGNOSTICS FOR PROGRAM UNIT RVEC

********* NO ERRORS

****
****

DIAGNOSTICS FOR PROGRAM UNIT IMVEC

********* NO ERRORS

****
****

DIAGNOSTICS FOR PROGRAM UNIT UNSEIG

********* NO ERRORS

****
****

DIAGNOSTICS FOR PROGRAM UNIT CALCEV

****
*****WARNING NO. 27

THE LOCAL VARIABLE NAMED C IS ASSIGNED A VALUE IN
BLOCK 11 AND IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT
USE OR IS NOT SUBSEQUENTLY USED AS INPUT, ON SOME PATHS.
ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS
11 12 13 14 15 34 35 36 37 38
39 40 41 42

****

```
**********************************************************************
**********************************************************************

          DIAGNOSTICS FOR PROGRAM UNIT      REALIT

********** NO WARNINGS

**********************************************************************
**********************************************************************

          DIAGNOSTICS FOR PROGRAM UNIT      COMPIT

********** NO WARNINGS

**********************************************************************
**********************************************************************

          DIAGNOSTICS FOR PROGRAM UNIT        RVEC



**********************************************************************
*****WARNING   NO. 19

     A VARIABLE IN A PARAMETER LIST IS USED FOR NEITHER INPUT NOR
     OUTPUT.

    NAME OF VARIABLE          NVEC
**********************************************************************
**********************************************************************
**********************************************************************

          DIAGNOSTICS FOR PROGRAM UNIT       IMVEC



**********************************************************************
*****WARNING   NO. 19

     A VARIABLE IN A PARAMETER LIST IS USED FOR NEITHER INPUT NOR
     OUTPUT.

    NAME OF VARIABLE          NVEC
**********************************************************************


**********************************************************************
*****WARNING   NO. 27

     THE LOCAL VARIABLE NAMED       C IS ASSIGNED A VALUE IN
     BLOCK   15 AND IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT
     USE OR IS NOT SUBSEQUENTLY USED AS INPUT, ON SOME PATHS.
     ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS
    15    16    17    18    19    20    21    22    23    24
   25    27    28    35    36    37
**********
```

```
**********************************************************************
*****WARNING   NO. 27

     THE LOCAL VARIABLE NAMED       L IS ASSIGNED A VALUE IN
     BLOCK  114 AND IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT
     USE OR IS NOT SUBSEQUENTLY USED AS INPUT, ON SOME PATHS.
     ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS
   114   115   110   111   113   114
**********************************************************************
**********************************************************************
**********************************************************************

          DIAGNOSTICS FOR PROGRAM UNIT      UNSEIG



**********************************************************************
*****WARNING   NO. 16 STATEMENT NO.  150  BASIC BLOCK NO.  149

     CORRESPONDING ARGUMENTS IN THE PARAMETER LISTS ARE OF
     DIFFERENT DIMENSIONALITY.

                    CALLING SUBPROGRAM  CALLED SUBPROGRAM
                           UNSEIG              REALIT
   ARGUMENT POSITION          6                   6
NUMBER OF DIMENSIONS          0                   1
    NAME OF ARGUMENT            CC                  C
    KIND OF ARGUMENT          IDENTIFIER
         INPUT CLASS                        NON INPUT
        OUTPUT CLASS                       STR.OUTPUT
**********************************************************************


**********************************************************************
*****WARNING   NO. 16 STATEMENT NO.  150  BASIC BLOCK NO.  149

     CORRESPONDING ARGUMENTS IN THE PARAMETER LISTS ARE OF
     DIFFERENT DIMENSIONALITY.

                    CALLING SUBPROGRAM  CALLED SUBPROGRAM
                           UNSEIG              REALIT
   ARGUMENT POSITION          7                   7
NUMBER OF DIMENSIONS          0                   1
    NAME OF ARGUMENT            SS                  S
    KIND OF ARGUMENT          IDENTIFIER
         INPUT CLASS                        NON INPUT
        OUTPUT CLASS                       STR.OUTPUT
**********************************************************************


**********************************************************************
*****WARNING   NO. 10 STATEMENT NO.  166  BASIC BLOCK NO.  165

     CORRESPONDING ARGUMENTS IN THE PARAMETER LISTS ARE OF
     DIFFERENT DATA TYPES.

                    CALLING SUBPROGRAM  CALLED SUBPROGRAM
                           UNSEIG              RVEC
   ARGUMENT POSITION          10                  10
```

```
          DATA TYPE              REAL              INTEGER
    NAME OF ARGUMENT              CC                 INTER
    KIND OF ARGUMENT          IDENTIFIER
         INPUT CLASS                             NON INPUT
        OUTPUT CLASS                            STR.OUTPUT
**************************************************************


**************************************************************
*****WARNING   NO. 16 STATEMENT NO.  166  BASIC BLOCK NO.  165

     CORRESPONDING ARGUMENTS IN THE PARAMETER LISTS ARE OF
     DIFFERENT DIMENSIONALITY.

                    CALLING SUBPROGRAM  CALLED SUBPROGRAM
                           UNSEIG              RVEC
   ARGUMENT POSITION        10                 10
NUMBER OF DIMENSIONS         0                  1
    NAME OF ARGUMENT           CC              INTER
    KIND OF ARGUMENT       IDENTIFIER
         INPUT CLASS                        NON INPUT
        OUTPUT CLASS                       STR.OUTPUT
**************************************************************


**************************************************************
*****WARNING   NO. 16 STATEMENT NO.  166  BASIC BLOCK NO.  165

     CORRESPONDING ARGUMENTS IN THE PARAMETER LISTS ARE OF
     DIFFERENT DIMENSIONALITY.

                    CALLING SUBPROGRAM  CALLED SUBPROGRAM
                           UNSEIG              RVEC
   ARGUMENT POSITION        11                 11
NUMBER OF DIMENSIONS         0                  1
    NAME OF ARGUMENT           SS                 Y
    KIND OF ARGUMENT       IDENTIFIER
         INPUT CLASS                        NON INPUT
        OUTPUT CLASS                       STR.OUTPUT
**************************************************************


**************************************************************
*****WARNING   NO. 10 STATEMENT NO.  171  BASIC BLOCK NO.  170

     CORRESPONDING ARGUMENTS IN THE PARAMETER LISTS ARE OF
     DIFFERENT DATA TYPES.

                    CALLING SUBPROGRAM  CALLED SUBPROGRAM
                           UNSEIG              IMVEC
   ARGUMENT POSITION        11                 11
          DATA TYPE          REAL             INTEGER
    NAME OF ARGUMENT          CC                INTER
    KIND OF ARGUMENT       IDENTIFIER
         INPUT CLASS                        NON INPUT
        OUTPUT CLASS                       STR.OUTPUT
**************************************************************


**************************************************************
*****WARNING   NO. 16 STATEMENT NO.  171  BASIC BLOCK NO.  170
```

18K

CORRESPONDING ARGUMENTS IN THE PARAMETER LISTS ARE OF
DIFFERENT DIMENSIONALITY.

	CALLING SUBPROGRAM UNSEIG	CALLED SUBPROGRAM IMVEC
ARGUMENT POSITION	11	11
NUMBER OF DIMENSIONS	0	1
NAME OF ARGUMENT	CC	INTER
KIND OF ARGUMENT	IDENTIFIER	
INPUT CLASS		NON INPUT
OUTPUT CLASS		STR.OUTPUT

****

****
*****WARNING NO. 16 STATEMENT NO. 171 BASIC BLOCK NO. 170

CORRESPONDING ARGUMENTS IN THE PARAMETER LISTS ARE OF
DIFFERENT DIMENSIONALITY.

	CALLING SUBPROGRAM UNSEIG	CALLED SUBPROGRAM IMVEC
ARGUMENT POSITION	12	12
NUMBER OF DIMENSIONS	0	1
NAME OF ARGUMENT	SS	Y
KIND OF ARGUMENT	IDENTIFIER	
INPUT CLASS		NON INPUT
OUTPUT CLASS		STR.OUTPUT

****

****
*****WARNING NO. 16 STATEMENT NO. 171 BASIC BLOCK NO. 170

CORRESPONDING ARGUMENTS IN THE PARAMETER LISTS ARE OF
DIFFERENT DIMENSIONALITY.

	CALLING SUBPROGRAM UNSEIG	CALLED SUBPROGRAM IMVEC
ARGUMENT POSITION	13	13
NUMBER OF DIMENSIONS	0	1
NAME OF ARGUMENT	Z	Z
KIND OF ARGUMENT	IDENTIFIER	
INPUT CLASS		NON INPUT
OUTPUT CLASS		STR.OUTPUT

****

****
*****WARNING NO. 16 STATEMENT NO. 171 BASIC BLOCK NO. 170

CORRESPONDING ARGUMENTS IN THE PARAMETER LISTS ARE OF
DIFFERENT DIMENSIONALITY.

	CALLING SUBPROGRAM UNSEIG	CALLED SUBPROGRAM IMVEC
ARGUMENT POSITION	14	14
NUMBER OF DIMENSIONS	0	2
NAME OF ARGUMENT	BB	B
KIND OF ARGUMENT	IDENTIFIER	
INPUT CLASS		NON INPUT
OUTPUT CLASS		STR.OUTPUT

****

****
*****WARNING NO. 27

THE LOCAL VARIABLE NAMED GREAT IS ASSIGNED A VALUE IN
BLOCK 13 AND IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT
USE OR IS NOT SUBSEQUENTLY USED AS INPUT, ON SOME PATHS.
ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS

13	14	15	16	17	18	27	28	29	33
34	35	36	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54	55
56	57	58	59	60	61	62	63	64	66
67	69	70	71	72	76	77	78	79	80
81	84	86	87	151	152	175			

****

****
*****WARNING NO. 27

THE LOCAL VARIABLE NAMED MAX IS ASSIGNED A VALUE IN
BLOCK 14 AND IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT
USE OR IS NOT SUBSEQUENTLY USED AS INPUT, ON SOME PATHS.
ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS

14	15	10	11	13	14

****

****
*****WARNING NO. 27

THE LOCAL VARIABLE NAMED C IS ASSIGNED A VALUE IN
BLOCK 108 AND IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT
USE OR IS NOT SUBSEQUENTLY USED AS INPUT, ON SOME PATHS.
ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS

108	109	110	111	112	128	129	132	133	135
136	138	139	142	143	144	147	148	149	150
91	92	93	94	95	97	98	102	103	107
108									

****

****
*****WARNING NO. 27

THE LOCAL VARIABLE NAMED DELTA IS ASSIGNED A VALUE IN
BLOCK 76 AND IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT
USE OR IS NOT SUBSEQUENTLY USED AS INPUT, ON SOME PATHS.
ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS

76	77	78	79	80	81	84	86	87	151
152	175								

****

****
*****WARNING NO. 27

THE LOCAL VARIABLE NAMED AR1 IS ASSIGNED A VALUE IN
BLOCK 148 AND IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT
USE OR IS NOT SUBSEQUENTLY USED AS INPUT, ON SOME PATHS.

ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS
148 149 150 91 92 93 94 95 97 98
102 104 105 106 80 81 84 85 88

****

****
*****WARNING NO. 27

THE LOCAL VARIABLE NAMED AR3 IS ASSIGNED A VALUE IN
BLOCK 124 AND IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT
USE OR IS NOT SUBSEQUENTLY USED AS INPUT, ON SOME PATHS.
ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS
124 125 126 127 91 92 93 94 95 97
98 102 104 105 106 80 81 84 85 88
89

****

****
*****WARNING NO. 27

THE LOCAL VARIABLE NAMED AR4 IS ASSIGNED A VALUE IN
BLOCK 125 AND IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT
USE OR IS NOT SUBSEQUENTLY USED AS INPUT, ON SOME PATHS.
ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS
125 126 127 91 92 93 94 95 97 98
102 104 105 106 80 81 84 85 88 89
90

****

****
*****WARNING NO. 27

THE LOCAL VARIABLE NAMED ANUM IS ASSIGNED A VALUE IN
BLOCK 115 AND IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT
USE OR IS NOT SUBSEQUENTLY USED AS INPUT, ON ALL PATHS.
ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS
115 116 117 118 122 123 124 125 126 127
91 92 93 94 95 97 98 102 103 107
108 109 110 111 113 114 115

****

****
*****WARNING NO. 27

THE LOCAL VARIABLE NAMED RHO IS ASSIGNED A VALUE IN
BLOCK 122 AND IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT
USE OR IS NOT SUBSEQUENTLY USED AS INPUT, ON SOME PATHS.
ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS
122 123 124 125 126 127 91 92 93 94
95 97 98 102 103 107 108 109 110 111
113 114 115 116 117 118 122

****

****
*****WARNING NO. 27

THE LOCAL VARIABLE NAMED SIGMA IS ASSIGNED A VALUE IN

BLOCK 123 AND IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT
USE OR IS NOT SUBSEQUENTLY USED AS INPUT, ON SOME PATHS.
ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS
123 124 125 126 127 91 92 93 94 95
97 98 102 103 107 108 109 110 111 113
114 115 116 117 118 122 123

****

****
*****WARNING NO. 27

THE LOCAL VARIABLE NAMED JI IS ASSIGNED A VALUE IN
BLOCK 171 AND IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT
USE OR IS NOT SUBSEQUENTLY USED AS INPUT, ON SOME PATHS.
ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS
171 172 173 175
****

****
*****WARNING NO. 27

THE LOCAL VARIABLE NAMED NM IS ASSIGNED A VALUE IN
BLOCK 156 AND IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT
USE OR IS NOT SUBSEQUENTLY USED AS INPUT, ON ALL PATHS.
ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS
156 157 158 159 160 161 162 163 164 170
171 172 173 175
****

****
*****MESSAGE NO. 37

SUBPROGRAM UNSEIG IS NEVER CALLED.
****
****
****

DIAGNOSTICS FOR PROGRAM UNIT CALCEV

****
*****MESSAGE NO. 42

AN ELEMENT OF THE COMMON OR PARAMETER ARRAY NAMED VEC
IS ASSIGNED A VALUE IN BLOCK 39 AND SOME ELEMENT OF THE
ARRAY IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT USE OF
THE ARRAY ON SOME PATHS.
ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS
39 40
****

CLASSIFICATION OF PARAMETER AND COMMON VARIABLES

SUBROUTINE CALCEV

PARAMETERS/ENTRIES

ORDER NAME INPUT CLASS OUTPUT CLASS

22K

1	A	STRICT	OUTPUT
2	NMAX	STRICT	NON
3	DEL	STRICT	NON
4	VEC	NON	STRICT
5	IJK	STRICT	STRICT
6	N	STRICT	NON
7	M	STRICT	NON

****
****

DIAGNOSTICS FOR PROGRAM UNIT REALIT

****
*****MESSAGE NO. 42

AN ELEMENT OF THE COMMON OR PARAMETER ARRAY NAMED C
IS ASSIGNED A VALUE IN BLOCK 11 AND SOME ELEMENT OF THE
ARRAY IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT USE OF
THE ARRAY ON SOME PATHS.
ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS
11 12 13 23 8 9 10 14
****

****
*****MESSAGE NO. 42

AN ELEMENT OF THE COMMON OR PARAMETER ARRAY NAMED S
IS ASSIGNED A VALUE IN BLOCK 12 AND SOME ELEMENT OF THE
ARRAY IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT USE OF
THE ARRAY ON SOME PATHS.
ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS
12 13 23 8 9 10 14 15
****

CLASSIFICATION OF PARAMETER AND COMMON VARIABLES

SUBROUTINE REALIT

PARAMETERS/ENTRIES

ORDER	NAME	INPUT CLASS	OUTPUT CLASS
1	A	STRICT	STRICT
2	NMAX	STRICT	NON
3	L	STRICT	NON
4	N	STRICT	NON
5	SHIFT	STRICT	NON
6	C	NON	STRICT
7	S	NON	STRICT

****
****

DIAGNOSTICS FOR PROGRAM UNIT COMPIT

****
*****MESSAGE NO. 42

AN ELEMENT OF THE COMMON OR PARAMETER ARRAY NAMED A
IS ASSIGNED A VALUE IN BLOCK 66 AND SOME ELEMENT OF THE
ARRAY IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT USE OF
THE ARRAY ON SOME PATHS.
ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS
66 67

****

CLASSIFICATION OF PARAMETER AND COMMON VARIABLES

SUBROUTINE COMPIT

PARAMETERS/ENTRIES

ORDER	NAME	INPUT CLASS	OUTPUT CLASS
1	A	STRICT	OUTPUT
2	NMAX	STRICT	NON
3	L	STRICT	NON
4	N	STRICT	NON
5	RHO	INPUT	NON
6	SIGMA	INPUT	NON

****
****

DIAGNOSTICS FOR PROGRAM UNIT RVEC

****
*****MESSAGE NO. 42

AN ELEMENT OF THE COMMON OR PARAMETER ARRAY NAMED A
IS ASSIGNED A VALUE IN BLOCK 11 AND SOME ELEMENT OF THE
ARRAY IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT USE OF
THE ARRAY ON SOME PATHS.
ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS
11 12

****

****
*****MESSAGE NO. 42

AN ELEMENT OF THE COMMON OR PARAMETER ARRAY NAMED EIGVEC
IS ASSIGNED A VALUE IN BLOCK 77 AND SOME ELEMENT OF THE
ARRAY IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT USE OF
THE ARRAY ON SOME PATHS.
ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS
77 77

****

****
*****MESSAGE NO. 42

AN ELEMENT OF THE COMMON OR PARAMETER ARRAY NAMED INTER
IS ASSIGNED A VALUE IN BLOCK 14 AND SOME ELEMENT OF THE
ARRAY IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT USE OF
THE ARRAY ON SOME PATHS.
ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS
14 15 16 21 5 6 14

****

24K

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**********************************************************************
*****MESSAGE   NO. 42

     AN ELEMENT OF THE COMMON OR PARAMETER ARRAY NAMED       Y
     IS ASSIGNED A VALUE IN BLOCK   65 AND SOME ELEMENT OF THE
     ARRAY IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT USE OF
     THE ARRAY ON SOME PATHS.
     ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS
    65    66
**********************************************************************

            CLASSIFICATION OF PARAMETER AND COMMON VARIABLES

                      SUBROUTINE        RVEC

                     PARAMETERS/ENTRIES
     ORDER          NAME          INPUT CLASS          OUTPUT CLASS
        1              A            STRICT               STRICT
        2           NMAX            STRICT               NON
        3            INT            STRICT               NON
        4             C1            STRICT               NON
        5          SMALL            STRICT               NON
        6              N            STRICT               NON
        7            NUM            STRICT               NON
        8         EIGVEC            NON                  STRICT
        9           NVEC            NON                  NON
       10          INTER            NON                  STRICT
       11              Y            NON                  STRICT
**********************************************************************
**********************************************************************

          DIAGNOSTICS FOR PROGRAM UNIT       IMVEC



**********************************************************************
*****MESSAGE   NO. 42

     AN ELEMENT OF THE COMMON OR PARAMETER ARRAY NAMED       A
     IS ASSIGNED A VALUE IN BLOCK   20 AND SOME ELEMENT OF THE
     ARRAY IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT USE OF
     THE ARRAY ON SOME PATHS.
     ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS
    20    21
**********************************************************************


**********************************************************************
*****MESSAGE   NO. 42

     AN ELEMENT OF THE COMMON OR PARAMETER ARRAY NAMED  EIGVEC
     IS ASSIGNED A VALUE IN BLOCK  126 AND SOME ELEMENT OF THE
     ARRAY IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT USE OF
     THE ARRAY ON SOME PATHS.
     ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS
   126   126
**********************************************************************
```

25K

****
*****MESSAGE NO. 42

AN ELEMENT OF THE COMMON OR PARAMETER ARRAY NAMED INTER
IS ASSIGNED A VALUE IN BLOCK 26 AND SOME ELEMENT OF THE
ARRAY IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT USE OF
THE ARRAY ON SOME PATHS.
ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS
26 27 28 35 9 10 11 12 26
****

****
*****MESSAGE NO. 42

AN ELEMENT OF THE COMMON OR PARAMETER ARRAY NAMED Y
IS ASSIGNED A VALUE IN BLOCK 102 AND SOME ELEMENT OF THE
ARRAY IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT USE OF
THE ARRAY ON SOME PATHS.
ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS
102 103
****

****
*****MESSAGE NO. 42

AN ELEMENT OF THE COMMON OR PARAMETER ARRAY NAMED Z
IS ASSIGNED A VALUE IN BLOCK 105 AND SOME ELEMENT OF THE
ARRAY IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT USE OF
THE ARRAY ON SOME PATHS.
ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS
105 106
****

****
*****MESSAGE NO. 42

AN ELEMENT OF THE COMMON OR PARAMETER ARRAY NAMED B
IS ASSIGNED A VALUE IN BLOCK 23 AND SOME ELEMENT OF THE
ARRAY IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT USE OF
THE ARRAY ON SOME PATHS.
ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS
23 24
****

CLASSIFICATION OF PARAMETER AND COMMON VARIABLES

SUBROUTINE IMVEC

PARAMETERS/ENTRIES

ORDER	NAME	INPUT CLASS	OUTPUT CLASS
1	A	STRICT	STRICT
2	NMAX	STRICT	NON
3	INT	STRICT	NON
4	C1	STRICT	NON
5	AMU	STRICT	NON
6	SMALL	STRICT	NON
7	N	STRICT	NON
8	NUM	STRICT	STRICT
9	EIGVEC	NON	STRICT

10	NVEC	NON	NON
11	INTER	NON	STRICT
12	Y	NON	STRICT
13	Z	NON	STRICT
14	B	NON	STRICT

****

DIAGNOSTICS FOR PROGRAM UNIT UNSEIG

****

*****MESSAGE NO. 42

AN ELEMENT OF THE COMMON OR PARAMETER ARRAY NAMED A
IS ASSIGNED A VALUE IN BLOCK 162 AND SOME ELEMENT OF THE
ARRAY IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT USE OF
THE ARRAY ON SOME PATHS.
ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS
162 162

****

*****MESSAGE NO. 42

AN ELEMENT OF THE COMMON OR PARAMETER ARRAY NAMED INT
IS ASSIGNED A VALUE IN BLOCK 16 AND SOME ELEMENT OF THE
ARRAY IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT USE OF
THE ARRAY ON SOME PATHS.
ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS
16 17 18 27 28 29 33 34 35 36
39 40 5 6 7 8 9 10 11 12
15 16

****

*****MESSAGE NO. 42

AN ELEMENT OF THE COMMON OR PARAMETER ARRAY NAMED D
IS ASSIGNED A VALUE IN BLOCK 43 AND SOME ELEMENT OF THE
ARRAY IS ASSIGNED A VALUE THEREAFTER BEFORE ANY INPUT USE OF
THE ARRAY ON SOME PATHS.
ONE SUCH PATH, INDICATED BY BASIC BLOCK NUMBERS, IS
43 43

****

CLASSIFICATION OF PARAMETER AND COMMON VARIABLES

SUBROUTINE UNSEIG

PARAMETERS/ENTRIES

ORDER	NAME	INPUT CLASS	OUTPUT CLASS
1	A	STRICT	STRICT
2	NMAX	STRICT	NON
3	NN	STRICT	NON
4	NVEC	STRICT	NON
5	VEC	NON	STRICT
6	EIGVEC	NON	OUTPUT

7	INT	NON	STRICT
8	CC	NON	OUTPUT
9	SS	NON	OUTPUT
10	Z	NON	OUTPUT
11	D	NON	STRICT
12	BB	NON	OUTPUT

TOOL	IMPLEMENTATIONS	SOURCE LANGUAGES ACCEPTED	STATIC / DYNAMIC	
ATDG NASA-HOUSTON HOUSTON,TEXAS	UNIVAC	FORTRAN	STATIC	
FORTUNE CAPEX PHOENIX,ARIZONA	IBM CDC	FORTRAN	STATIC	
NBS ANALYZER NBS WASHINGTON,D.C.	UNIVAC	FORTRAN	STATIC DYNAMIC	
PET MCDONNELL- DOUGLAS HUNTINGTON BEACH CALIFORNIA	IBM CDC HONEYWELL G.E. UNIVAC	FORTRAN	STATIC DYNAMIC	DE
PFORT BELL LAB MURRAY HILL NEW JERSEY	IBM CDC BURROUGHS HONEYWELL OTHERS	FORTRAN	STATIC	
PPE BOOLE AND BABBAGE SUNNYVALE CALIFORNIA	IBM	ALL	DYNAMIC	
STRUCTURING ENGINE (SFORTRAN) CANE,FARBER, GORDON,INC. PASADENA CALIFORNIA	IBM	FORTRAN	STATIC	
DISSECT MCDONNELL- DOUGLAS HUNTINGTON BEACH CALIFORNIA	PDP10	FORTRAN	STATIC	

FOLDOUT FRAME /

IC / DYNAMIC	OPERATING COST 1-LOW 5-HIGH	EASE OF USE 1-EASY 5-DIFF.	FEATURES	LIMITATIONS
STATIC	4	3	.DETERMINES VALUES OF PROGRAM VARIABLES TO PRODUCE OPTIMAL TEST CASES	.DIFFICULT TO INTERPRET OUTPUT
STATIC	2	1	.EXACT STMT EXECUTION COUNTS .ESTIMATED EXEC TIME FOR EACH STATEMENT .NUMBER OF IF STATEMENT TRUE PATHS TAKEN .SUBROUTINE EXECUTION TIMINGS	.NO LONGER ACTIVELY SUPPORTED
STATIC DYNAMIC	1	2	.SUMMARY OF SOURCE STATEMENTS BY FORTRAN TYPE .EXECUTION COUNTS FOR PROGRAM SEGMENTS	
STATIC DYNAMIC	2 - 3 DEPENDING ON OPTIONS	1	.EXACT STMT EXECUTION COUNTS .IF STATEMENT TRUE AND FALSE BRANCH COUNTS .MINIMUM/MAXIMUM VALUES ATTAINED BY PROGRAM VARIABLES .FIRST AND LAST VALUES ATTAINED BY PROGRAM VARIABLES .RELATIVE SUBROUTINE EXEC TIMINGS	
STATIC	1	2	.CHECKS SOURCE PROGRAM FOR ADHERENCE TO A PORTABLE SUBSET OF ANS FORTRAN .SUBPROGRAM COMMUNICATION CHECKED THROUGH COMMON & ARGUMENT LISTS .SUBPROGRAM CROSS REFERENCE OF ID TYPE,USAGE AND ATTRIBUTES	
DYNAMIC	1	2	.SAMPLES EXECUTING PROGRAM AT REGULAR INTERVALS TO OBTAIN PERFORMANCE STATISTICS .MEASURES I/O WAIT TIME .MEASURES TIME SPENT EXECUTING SVC'S	. PERFORMANCE STATISTICS ARE NOT REPORTED AT SOURCE STMT. LEVEL
STATIC	5	1	.PRODUCES A STRUCTURED FORTRAN PROGRAM AND LISTING FROM FORTRAN SOURCE .PREPROCESSOR AVAILABLE TO TRANSLATE STRUCTURED PROGRAM INTO FORTRAN FOR COMPILATION	. 1000K LOAD MODULE . CAN PRODUCE EXCESSIVELY LARGE STRUCTURED PROGRAMS
STATIC	4	3	.TESTS PROGRAMS INFORMALLY BY COMPUTING VALUES OF PROGRAM VARIABLES ALONG SELECTED PATHS .ALLOWS SYMBOLIC EXECUTION OF PROGRAMS	.SOME USER TIME REQUIRED TO SET UP TEST CASES

TION A.5 SUMMARY OF TEST RESULTS

FOLDOUT FRAME 1 29K

TOOL	IMPLEMENTATIONS	SOURCE LANGUAGES ACCEPTED	STATIC / DYNAMIC	OPERATING 1-LOW 2-HIGH
JOYCE MCDONNELL-DOUGLAS HUNTINGTON BEACH CALIFORNIA	CDC	FORTRAN	STATIC	2
DAVE COMP. SCIENCE DEPT. UNIV. OF COLORADO BOULDER, COLORADO	IBM CDC	FORTRAN	STATIC	5

MIC	OPERATING COST 1-LOW 2-HIGH	EASE OF USE 1-EASY 5-DIFF.	FEATURES	LIMITATIONS
	2	2	.CHECKOUT AND DOCUMENTATION AID .MICROFILM FLOWLIST WITH ALL TRANSFERS INDICATED BY ARROWS AND ALL DO LOOPS INDICATED BY BRACKETS .COMPLETE CROSS-REFERENCED PROGRAM GLOSSARY	
	5	2	.CHECKS FOR A WIDE VARIETY OF SOURCE ERRORS .ISSUES WARNING MESSAGES FOR POSSIBLE ERRORS	.REDUNDANT OUTPUT MESSAGES

SUMMARY OF TEST RESULTS (Continued)

FOLDOUT FRAME 2

A.6 RECOMMENDATIONS

A knowledge of currently available automated verification tools should be part of the software designers repertoire of techniques and procedures for developing reliable software. These tools can impact the software life cycle at five points:

(1) During program development to insure program specifications and standards are met.

(2) In formal acceptance testing as a record of acceptance standards.

(3) As a debugging aid

(4) As an integral part of program documentation

(5) As a performance measurement tool aimed at improving program efficiency.

The following guidelines are recommended when considering an automated verification tool for use at GSFC.

(1) Select the tool early in the software development cycle and have it installed at GSFC. Unforeseen delays often occur when installing tools at the users site.

(2) Care must be taken to select a tool that is easy for the applications programmer to use. Clear and consise documentation must be readily available for the users.

(3) The use of an automated verification tool must supplement, and not replace, good desk checking procedures and well designed test plans.

(4) In most cases, the application of an automated verification tool increases machine costs. Many available tools are very powerful and can be misused by applying them to classes of problems that can be solved by simpler means.

The following are recommendations for the use of the tools involved in this study by GSFC.

PFORT is representative of a class of automated verification tools known as standards auditors. This tool checks FORTRAN programs for machine transferability, and can be especially valuable at GSFC when verifying that vendor programs coming into GSFC adhere to a prescribed set of standards.

PPE (Problem Program Evaluator) is currently in use at GSFC. Its approach to execution monitoring by interrupting running programs at preset time intervals is unique. PPE is a well established proven tool of considerable use in performance measurement applications.

The SFORT structuring engine is considered impractical at this time for use at GSFC due to extreme system resource requirements (1000K load module and high execution time).

The three execution analyzers (NBS Analyzer, FORTUNE and PET) can be grouped together functionally. FORTUNE is no longer actively supported. PET (Program Evaluator and Tester), although more costly than the NBS Analyzer, has been operating on IBM 360/370 computers since 1972 and offers powerful capabilities. Where cost is a major factor, the NBS Analyzer (not available on IBM) might be considered. In all other cases PET is recommended.

ATDG (Automatic Test Data Generator) and the DISSECT Symbolic Evaluation System can best be thought of as representative tools from current research into the field of program testing and proving. More research and development is required to fully realize tools of this kind and apply them toward a formal demonstration of program correctness. The usefulness of ATDG and DISSECT to GSFC at this time is doubtful, due to programmer time required to invoke the tool and interpret the output to draw meaningful conclusions about program correctness. However, continued refinement and development of these techniques warrant additional support.

JOYCE and DAVE have proven to be valuable documentation and checkout aids. JOYCE, however, is not currently available on IBM and therefore could not be installed at GSFC at this time.