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NOTES

1. John Vincent is presently an Assistant Professor of Sociology at the University of Minnesota and is an instructor in the statistics/methods sequence.
2. Due to space limitations, extensive labeling of output is not available on MISS. This limitation is minimized, however, by supplying or constructing code books for the data sets.
3. This limitation on the size of the raw data matrix does not apply to files residing on disk storage. In other words, a large data file might be stored on the disk, but only 700 elements from that file could be analyzed at any one time.
4. In a hardware configuration offering more disk storage area than our hardware system permits, these space limitations of MISS could easily be lifted.

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OMNI-SHRIMP: An interpretive language which mimics OMNITAB*

G. SCOTT HARRIS, JAMES M. SWANSON, and JOANNE L. DUERR

University of Texas, Austin, Texas 78712

A description of OMNITAB, an interpretive language, is provided along with a discussion of its use. The major attributes of SHRIMP (an interactive mathematical package developed at the University of Texas) are pointed out in detail and its use and relationship to OMNITAB defined. An example is included to show SHRIMP compatibility with OMNITAB.

OMNITAB is an interpretive language developed by the National Bureau of Standards for use in statistical and mathematical problems in research. The OMNITAB language is easy to learn because it resembles English, and only a small portion of the language is necessary for the beginner.

Two successful applications of OMNITAB in the classroom have been described in the literature. A paper by Swanson, Harris, and Ledlow (1973) gives a description of an application for teaching undergraduate statistics to students completely unfamiliar with both statistical concepts and the computer. Furthermore, Swanson, Riederer, and Weekly (1973) describe an application in a graduate course for teaching matrix methods in applied statistics.

HISTORICAL BACKGROUND

The University of Texas has a long-standing involvement in academic computing. This involvement led to the development of a large academic Computation Center, independent of administrative computing, comprised of a Control Data 6400 and a Control Data 6600 together with Texas's own dual operating system. Appended to this are two high-speed remote terminals, 15 medium-speed remote terminals, and 64 Teletype

lines, soon to be doubled.

There is a good reason for mentioning these figures. They indicate a growing trend in a university such as Texas (with 40,000 students) to make available a new form of computing: time-shared interactive instruction. The OMNITAB and SHRIMP systems illustrate the use of facilities such as these in a new way.

Previously, academic computing has been heavily weighted toward numerical methods in mathematics and the physical sciences. In recent years, however, academic computing has been developing interactive tutorial systems, such as CLIC at Texas, for student drill work. Now there is another use of the computer which lies between the page-flipping drill sessions and the mastery of a complex computer language.

An example of this kind of application is the OMNITAB system. Originally used for research when developed by the National Bureau of Standards, it has a number of features which fill this gap. First, it resembles English and is easy for the beginner to master with the positive feedback of early success. Second, it is a true procedural language, placing the power of the computer under the user's control (see Hogben, Peavy, & Varner, 1971). Third, when using the modifications of the University of Texas, a user receives immediate feedback on his every directive and even on instructions given by a professor (see Harris, 1971).

These features have made OMNITAB extremely

*Reprints may be obtained from G. Scott Harris, Computation Center, University of Texas, Austin, Texas 78712.

```

1-OMNITAB COMPATIBILITY
2-SMALL SIZE
3-DYNAMIC WORKSHEET STORAGE
4-CENTRALIZED INPUT/OUTPUT
5-USER COMMANDS EASILY ADDED
6-TEACHING MODIFICATIONS INCLUDED
7-SYSTEM DEPENDENT FUNCTIONS
  FLOWCHARTED, DOCUMENTED
8-DESIGNED FOR INTERACTIVE USE
  FROM TTY OR CRT.  DUPLICATES
  INTERACTION ON OUTPUT FILE

```

Fig. 1. SHRIMP features.

popular at Texas. So popular, in fact, that we must replace it for interactive teaching use! Briefly, this turn of events proceeded as follows: OMNITAB was procured from the National Bureau of Standards and installed at Texas. It was then modified to be interactive, with a smaller worksheet. Its use went from 0 to 1000 jobs per month in the first year. Then it was modified further as a teaching tool in work sponsored by the Project C-BE (Computer-Based Education) to allow OMNITAB to be externally initialized, such as by an instructor, and to facilitate certain printing formats on Teletype. As a result, OMNITAB is also now in use for teaching 1200 business students, 200 psychology students, and many others in library sciences and similar areas. James Swanson has developed a set of 20 laboratories using OMNITAB for self-paced instruction in statistics.

All of this means that the number of OMNITAB users on our system has grown quite large, placing a load on our system because of the size of OMNITAB. We have made most of the modifications which can be made easily to convert OMNITAB into a teaching tool, and yet it is still large. Several copies at once in our machine is a load. This is something we already knew, of course. For, in spite of the fact that approximately 50 universities now run OMNITAB, we have had many requests for information from places that simply could not run so large a program.

The University of Texas is not only committed to its own immediate needs, of course, but is also concerned with transporting and sharing solutions to computing problems with other sites. As a member of the CONDUIT network, the University of Texas intends that the system will not only solve our own problem but be transportable to solve the same problem at other sites. CONDUIT consists of the computers of Oregon State, North Carolina, Dartmouth, and the Universities of Iowa and Texas. CONDUIT serves a consortium of 100 schools and 275,000 students. It can do this because each member school of CONDUIT is also involved in a local network, as Texas is in the Southwest with over 22 other schools. The SHRIMP system will be available through the CONDUIT Coordinator at the University of Texas.

SHRIMP FEATURES

SHRIMP is an interactive mathematical package

```

INTERACTIVE MATH PACKAGE, V1
*INFORMATIVE MESSAGE
MEMORY USED: 7168-REMAINING:25600
SET THESE GRADES IN COLM 1
89 98 87 78 76
SUM COL 1 AND PUT IN COL 2
DIVIDE COLL 2 BY 5.0 AND PUT MEAN IN 3
PRINT COLS 1 2 3

```

COLUMN	1	COLUMN	2	COLUMN	3
	89.00		428.0		85.60
	98.00		428.0		85.60
	87.00		428.0		85.60
	78.00		428.0		85.60
	76.00		428.0		85.60

```

STOP

```

Fig. 2. A simple SHRIMP program.

```

NOTE THE FOLLOWING NUMBERS HAVE BEEN
NOTE ENTERED INTO THE WORKSHEET
NOTE CALCULATE AND PRINT THEIR MEAN
NOTE USING LOWER LEVEL COMMANDS
SET NUMS IN COL 1
98 89 78 87 67
PRINT COL 1
STOP
NOTE THERE IS NO MORE ON TAPE A
STOP

```

Fig. 3. A simple instructor file.

```

HELLO. THE SHRIMP SYSTEM IS BEING
PREPARED FOR YOUR USE. AFTER YOU HEAR
A BELL, TYPE
      READ TAPE A
AND YOU WILL RECEIVE SOME INSTRUCTIONS.
(CHE BELL INDICATES WHEN THE SYSTEM IS
READY TO ACCEPT YOUR TYPING.)

```

Fig. 4. Beginning instructions.

```

INTERACTIVE MATH PACKAGE, V1
*INFORMATIVE MESSAGE
MEMORY USED: 7168-REMAINING:25600
READ TAPE A
THE FOLLOWING NUMBERS HAVE BEEN
ENTERED INTO THE WORKSHEET.
CALCULATE AND PRINT THEIR MEAN
USING LOWER LEVEL COMMANDS.

```

COLUMN	1
98.00	
89.00	
78.00	
87.00	
67.00	

```

SUM COL 1 AND PUT IN COL 2
DIVIDE COL 2 BY 5.0 AND PUT IN 3
ABRIDGE PRINT ROW 1 OF COL 3
83.80
STOP

```

Fig. 5. A simple SHRIMP program using an instructor file.

developed at the University of Texas (see Fig. 1). It is intended to be as easy to use and as powerful as OMNITAB and yet to be efficient enough in terms of size and other factors to be competitive in a time-sharing

environment. Furthermore, SHRIMP is intended to be transportable. These goals are not achieved at the expense of optimum performance, however, but rather by functionalizing and centralizing access to certain machine-dependent features which are available at most sites.

The major attributes of SHRIMP are as follows: (1) A subset of OMNITAB may be executed on SHRIMP. Thus, a student not only learns to use the computer, he also acquires a valuable research tool useful later at approximately 50 universities. (2) SHRIMP is small. Using overlays, it currently executes in 7000 (decimal) words of memory on a CDC 6600. (3) The worksheet storage is variable, allowing optimum use of memory. (4) All input and output is in a centralized routine, allowing easy local adaptation. (5) User commands may be easily added. A local site may write a new command without detailed knowledge of SHRIMP structure and input/output. (6) The teaching modifications made at Texas are included in SHRIMP. (7) System dependent functions (one necessary, two optional) have flow charts provided for easy local implementation. (8) SHRIMP output is designed for Teletype use. A duplicate of all that transpires on the Teletype or CRT is produced on the output file for the student's and instructor's later use.

A SIMPLE SHRIMP PROGRAM

The SHRIMP language resembles simple English sentences, beginning with verbs, directing the manipulation of a worksheet inside the computer of rows and columns (see Fig. 2). The figure illustrates one such trivial program. (Note that all examples in this paper are kept trivial for the sake of clarity, but many powerful higher level features are to be found in SHRIMP, just as in OMNITAB.) A SHRIMP command occurs on a single line. Only the first word and the numbers matter in general, the other words being the user's mnemonics. Literal number values are indicated by the use of the decimal point, other values being interpreted as column numbers or row numbers or some other quantity appropriate to the command.

AN INSTRUCTOR FILE

The teaching modifications made to OMNITAB are also in SHRIMP (see Fig. 3). This file was previously constructed by an instructor and placed on an auxiliary file (in this case named "A"). It consists of instructions to the student and data for him to analyze. The command "READ TAPE A" on the part of the student transfers control to this file. The command "STOP" on

```
INTERACTIVE MATH PACKAGE, V1
*INFORMATIVE MESSAGE
MEMORY USED:7168-REMAINING:25600
READ TAPE A
```

OMNITAB 0 -- AN INTRODUCTION TO THE OMNITAB LANGUAGE

THE OMNITAB LANGUAGE ALLOWS YOU TO USE SIMPLE ENGLISH SENTENCES TO PROGRAM A COMPUTER. THIS LAB EXERCISE WILL SHOW YOU HOW TO USE OMNITAB INSTEAD OF A DESK CALCULATOR OR PAPER AND PENCIL TO PERFORM THE NUMERICAL CALCULATIONS WHICH YOU ENCOUNTER IN A STATISTICS CLASS.

OMNITAB OPERATES ON A WORKSHEET PRINCIPLE. THE WORKSHEET IS USED JUST AS A SHEET OF PAPER TO HOLD NUMBERS

THE OMNITAB WORKSHEET

```
-----
-          COL 1    COL 2          .    . COL 20-
-ROW 1      -      -
-ROW 22     -      -
- .
- .
-ROW 50
-----
```

INSTEAD OF WRITING NUMBERS DOWN IN A COLUMN ON A SHEET OF PAPER, THE COMMAND SET IS USED TO PUT DATA INTO THE WORKSHEET.

FOR EXAMPLE: SET THE FOLLOWING NUMBERS INTO COL 1
 123.45 118.92101 101.0 139.947 109.666667
 WOULD PUT FIVE NUMBERS INTO COL 1 OF THE WORKSHEET.
 (NOTE THAT THE DATA (NUMBERS) ARE SEPARATED BY SPACES.)

Fig. 6. A complete teaching laboratory session as used in OMNITAB and SHRIMP.

THE COMMAND PRINT IS USED TO GET DATA OUT OF THE WORKSHEET

FOR EXAMPLE: PRINT COL 1

WOULD PRINT THE FIVE NUMBERS IN COL 1.

***** HERE IS A SAMPLE PROGRAM DEMONSTRATING THE OMNITAB
 ***** COMMANDS -SET- AND -PRINT-. JUST COPY THE PROGRAM
 ***** TO GET EXPERIENCE WITH THE SYSTEM

SET THE FOLLOWING NUMBERS IN COL 1

123.45 118.92101 101.0 139.947 109.666667

PRINT COL 1

(NOTE: AFTER YOU FINISH THE EXAMPLE PROGRAM, ENTER

READ TAPE A

AND YOU WILL RECEIVE SOME MORE INSTRUCTIONS.)

SET COL 1

123.45 118.92101 101.0 139.947 109.666667

PRINT COL 1

COLUMN 1

123.4

118.9

101.0

139.9

109.7

READ TAPE A

NOW PUT FIVE MORE NUMBERS (YOU CHOOSE THEM) INTO COL 2.

USE THE SET COMMAND JUST AS BEFORE.

AFTER YOU GET THE NUMBERS IN COL 2, YOU CAN USE ONE OF THESE
 COMMANDS: ADD, SUB, MULT, DIV.

FOR EXAMPLE: ADD COL 1 TO COL 2 AND PUT RESULT IN COL 3

SUB COL 1 FROM COL 2 AND PUT INTO COL 3

MULT COL 1 BY COL 2 AND PUT PRODUCT IN COL 3

DIV COL 1 BY COL 2 AND PUT RESULT INTO COL 3

ARE ALL OMNITAB COMMANDS. NOTE THAT YOU MUST SPECIFY A COL
 WHERE THE RESULT OF AN OPERATION CAN BE STORED.

***** TRY ONE OF THESE COMMANDS (ADD, SUB, MULT, OR DIV).

AFTER THAT, PRINT OUT COLS 1, 2, AND 3 TO SEE WHAT

HAPPENED. TO ACCOMPLISH THIS MULTI-COLUMN PRINT, ENTER:

PRINT COLS 1, 2, AND 3

(REMEMBER, AFTER YOU FINISH THIS PART OF THE LAB, ENTER

READ TAPE A TO CONTINUE TO THE NEXT PART OF THIS LAB.)

SET COL 2

1 2 3 4 5

ADD COL 1 TO COL 2 AND PUT ANS IN COL 3

PRINT COLS 1 2 3

COLUMN 1 COLUMN 2 COLUMN 3

123.4 1.000 124.4

118.9 2.000 120.9

101.0 3.000 104.0

139.9 4.000 143.9

109.7 5.000 114.7

READ TAPE A

PLEASE TYPE STOP TO END THIS LAB.

THEN REMOVE THE TELETYPE OUTPUT AND TAKE IT WITH YOU.

GOODBYE.

STOP

this file does not totally stop SHRIMP, but rather transfers control back to the student.

BEGINNING INSTRUCTIONS

When executing SHRIMP in the student lab mode, these instructions are printed to the student as he begins (see Fig. 4).

A SIMPLE SHRIMP PROGRAM USING THE INSTRUCTOR FILE

Using SHRIMP and the previous instructor file, we have performed this trivial laboratory (see Fig. 5). Note that we transferred control of SHRIMP to Tape A using the "READ TAPE A" command, received instructions, and control was returned to us.

AN OMNITAB LABORATORY (OMNILAB) PERFORMED WITH SHRIMP

This example is included to show SHRIMP compatibility with OMNITAB and to acquaint you with further features of the teaching facilities and the OMNITAB language (see Fig. 6).

SHRIMP DYNAMIC WORKSHEET

If your computer can grant changes in memory size to a running program, SHRIMP can optimize its size through the dimension command (see Fig. 7). Note that when the product of rows and columns necessitates a change in size SHRIMP issues a message indicating current memory consumption.

SHRIMP COMMAND ADDING PROCEDURE

SHRIMP has functions which take care of all input/output, parsing of commands, and worksheet access (see Fig. 8). The user may write a new command using the arguments placed in common by the parser and access the worksheet through the cell function, which can store or retrieve any particular row and column. The command goes in a simple data table.

```
INTERACTIVE MATH PACKAGE, V1
* INFORMATIVE MESSAGE
MEMORY USED: 7168-REMAINING:25600
DIMENSION WORKSHEET 100 ROWS, 100 COLS
* INFORMATIVE MESSAGE
MEMORY USED:17088-REMAINING:15680
DIMENSION 10 ROWS 1000 COLS
DIMENSION 10 ROWS BY 10 COLS
* INFORMATIVE MESSAGE
MEMORY USED:7168-REMAINING:25600
DIMENSION 10 ROWS BY 2500 COLS
*INFORMATIVE MESSAGE
MEMORY USED:32128-REMAINING: 640
STOP
```

Fig. 7. SHRIMP dynamic worksheet feature.

```
1-INSERT COMMAND IN DATA TABLE
2-ADD NAME IN 1 OF 2 CALLING ROUTINES
3-WRITE SUBROUTINE USING
  A-ARGUMENTS PREPARED IN COMMON BY
    SHRIMP PARSE
  B-SHRIMP CELL FUNCTION TO ACCESS
    WORKSHEET
  C-SHRIMP OUTPUT FUNCTION TO PRINT
```

Fig. 8. SHRIMP command adding procedure.

```
SCN--NECESSARY--FLOWCHARTS PROVIDED
  FOR ASSEMBLY LANGUAGE COMMAND
  SCANNER

MEMORY--OPTIONAL--LOCAL FUNCTION TO
  CHANGE AMOUNT OF MEMORY DURING
  EXECUTION FOR DYNAMIC WORKSHEET

MODTTY--OPTIONAL--LOCAL FUNCTION TO
  DETERMINE INTERACTIVE OR BATCH
  MODE OF OPERATION
```

Fig. 9. SHRIMP system dependent functions.

SYSTEM DEPENDENT FUNCTIONS

SHRIMP's transportability comes not through clumsy code, but through documentation and centralization of system dependent functions (see Fig. 9). Complete flow charts are provided for the necessary command scanner. The optional dynamic worksheet storage requires a function to obtain and release memory. And the optional batch mode requires a function which indicates an interactive terminal situation. The latter two options may be locked out of SHRIMP by setting a variable in common.

CONCLUSION

The SHRIMP system offers an exciting possibility in computer access. Response to its inception and requests for copies are already coming in. The combination of easy learning and procedural power open many alternative uses. We at Texas welcome your suggestions for commands and applications. Once again, requests for SHRIMP information should be directed to George Culp, CONDUIT Curriculum Coordinator, Computation Center, University of Texas, Austin, Texas 78712.

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