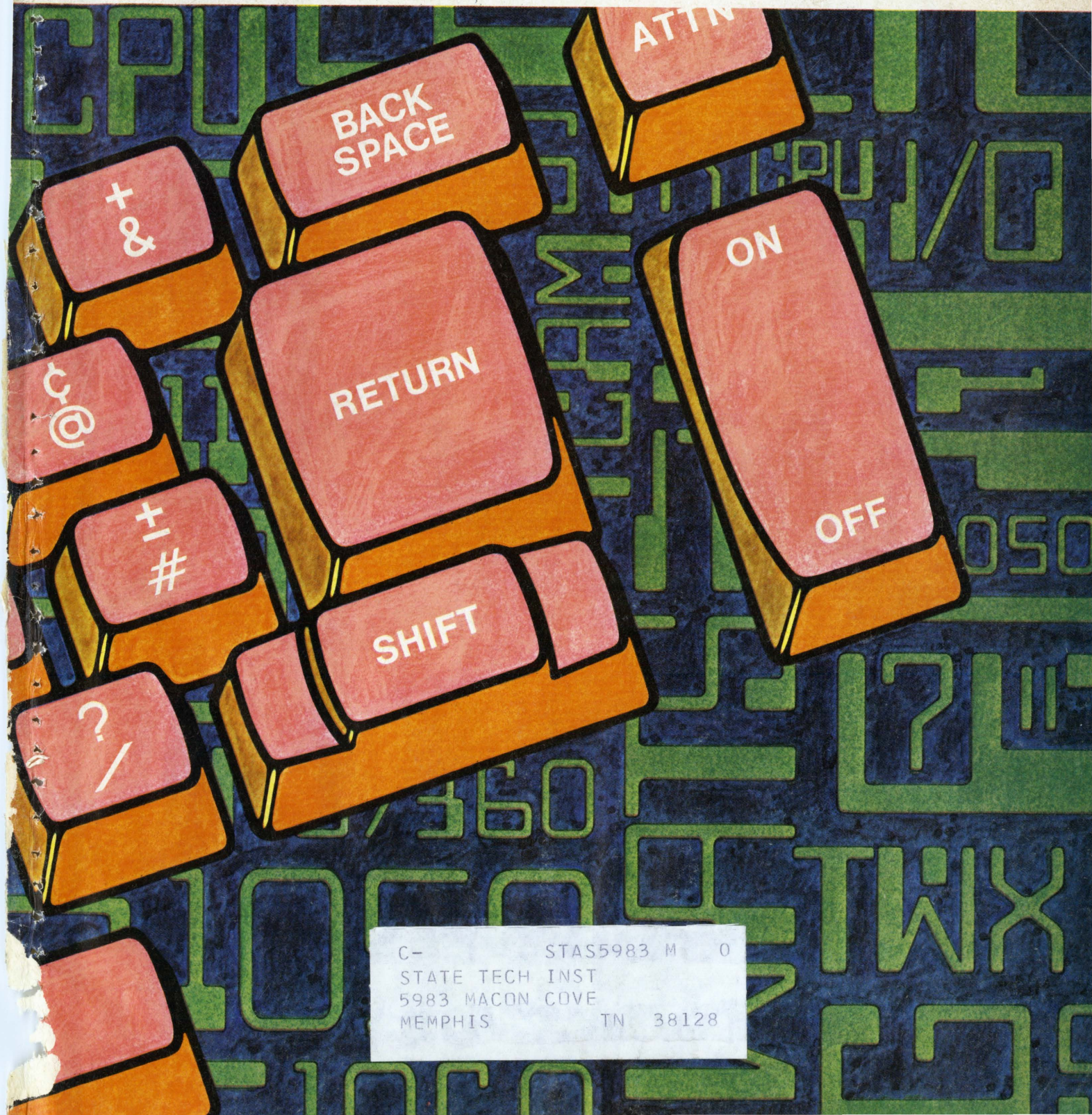
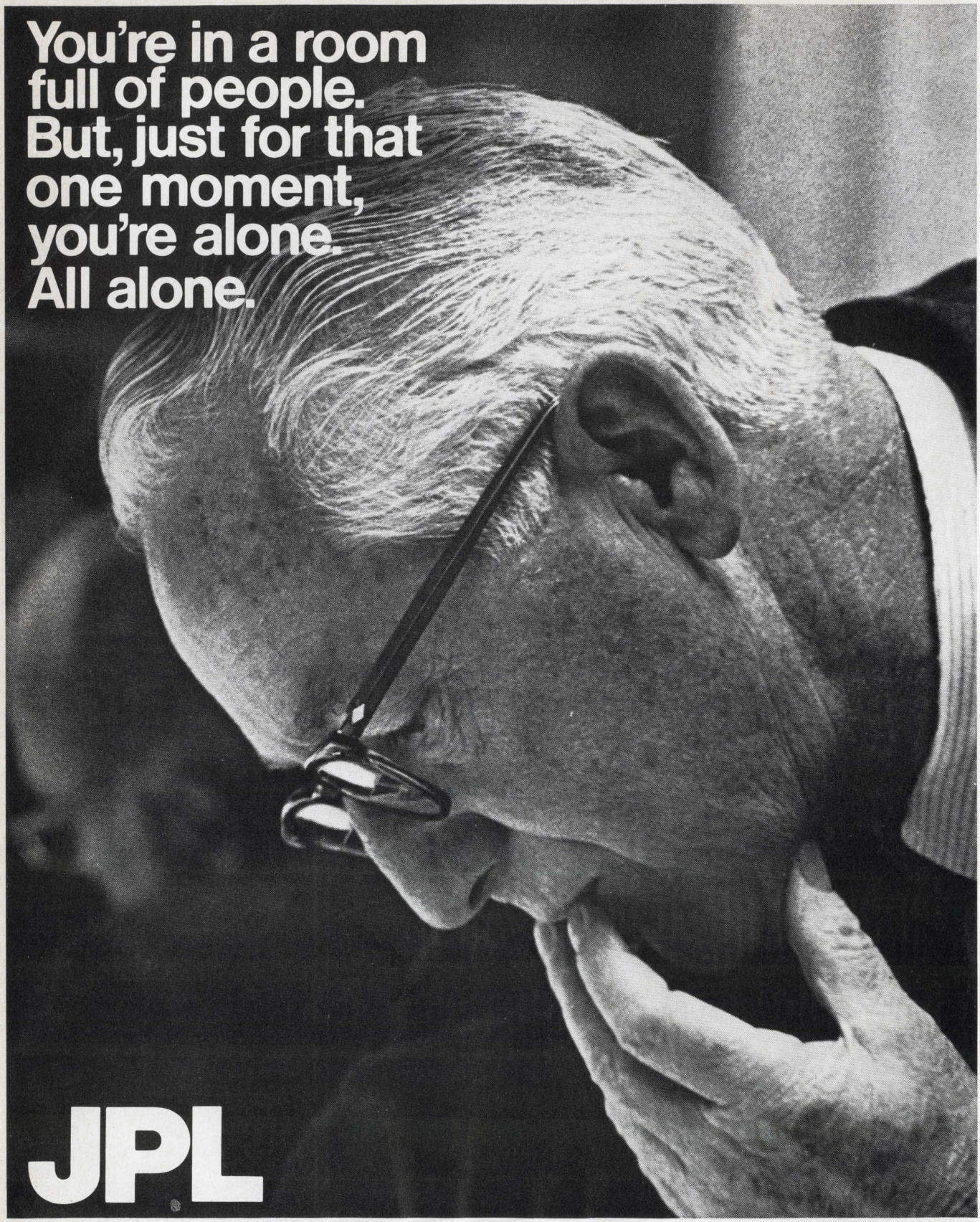
software age

JANUARY 1970





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Publisher's Page

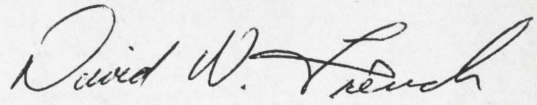
We marked the end of the decade with the beginning of SOFTWARE AGE's free program listings campaign (pages 32–34). Indications are that it is going to be a successful and informative presentation. Hundreds of programs have been submitted during the first week of the campaign, and the inquiries and requests for additional listing forms certainly indicate that this industry feels the need for the service and has every intention of contributing—mightily. The first publication of the listings will be in the February issue. The semi-annual summaries will be published during the months of the Joint Computer Conferences.

Many SOFTWARE AGE readers will see the listings for the first time during COMPSO 70 in Chicago. The COMPSO exposition is focused on the software and peripheral facets of the computer industry and should contribute to the easing of some of the incredible logistics associated with over attendance and under exposure at the Spring and Fall Joint Computer Conferences. SOFTWARE AGE staff members will report on the Chicago exhibition with a projection to the third COMPSO regional convention in Los Angeles during April. The Spring Joint/Atlantic City—COMPSO/Los Angeles debate has made *polarization* more than a word with SOFTWARE staffers.

The introduction of a letters column in this issue is an indication of the volume of mail we receive. SOFTWARE AGE will continue to publish representative samples and whenever we have the opportunity, opposite points of view will be well represented. Reader commentary both governs and directs all responsive media. We welcome and encourage it.

During the first quarter of 1970, thousands of you will receive SOFTWARE's reader qualification forms. While we have made them as brief and straight-forward as possible, they do require a few moments to complete. Your cooperation and time will be appreciated by S/A and certainly by the much-maligned and unheralded heroines of publishing—the circulation department. The information you include on the forms represents the input documentation of the magazine and you are the source. We rely on your assistance and we will certainly continue to appreciate it.

Ambitious programs are only that without capable people to nurse them through to a successful fruition. In recent weeks we have added Bruce H. Dutton, Walter Schaw, John Antil and Philip Servus. Bruce has been Associate Publisher, Publisher and Sales Manager of magazines such as "Marine Products," "Advertising Age," "Advertising & Sales Promotion" and will contribute in and through S/A to examine some of the practices and questions this industry must face-up-to regarding the marketing and purchasing of software and services. Phil Servus has joined us in sales and service and will be located in our suburban Philadelphia office. John was with 3M's sales department prior to joining S/A in sales and service. Wally Schaw has been managing editor of a publishing group of 10 newspapers, Assistant Secretary of the American Foundry Society, Assistant Publisher of "Modern Casting" magazine and has directed many in-depth and supervisory studies of computer applications. He will be directing much of his effort toward statistical research in and with S/A's more than 125,000 subscribers.



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LETTERS

Dear Sir:

In reference to Lt. Colonel Edwin G. Hudspeth's article "Use of Mathematics to Perform Bit Manipulation and Reduce Storage Requirements in Remote Terminal Operations" in the November issue of *Software Age*, I submit the following suggestion for improvement.

Rather than divide by powers of 2, one logical AND one compare would determine if a document contains information concerning any combination of key word bits. This technique will save an enormous amount of computer time when compared to the technique described in the above article.

Would you please forward this suggestion to Lt. Colonel Hudspeth.

Sincerely yours,
CHARLES E. CLOUSE
Houston, Texas

Dear Sir:

Thank you for Mr. Clouse's letter of December 2. I agree wholeheartedly with him. I had written our document search program in two versions, one using a mathematical search (dividing by powers of 2) and one using the logical AND operation. I only covered the mathematical one in the article since I felt this technique could be used in BASIC or any other language that didn't have the logical operators.

For your readers information, to use the logical AND operation, you must first set up an inquiry word. If you wanted to search for all documents containing the subjects represented by keyword numbers 2, 5, 8, 29, and 31, the inquiry word would be $2^2+2^5+2^8+2^{29}+2^{31}$. We could then use FORTRAN statement CALL AND(X,Y,Z) where X was our inquiry word, Y was our data word and the result of the logical AND operation was stored in Z. In terms of Boolean logic, Z would be the intersection of the bits in X and Y. If the document covered the five keywords previously mentioned Z would be equal to X and a simple comparison would show this.

Since there are more keywords in the ASI system than the number of bits in a word, each document is represented by three data words and therefore a search requires three inquiry words. To speed up the process, as soon as it was found that any one inquiry word wasn't equal to its intersection with the appropriate data word, that document was rejected.

I appreciate Mr. Clouse's comments and thank him for them.

Sincerely,
EDWIN G. HUDSPETH
Lt. Colonel, USAF

Dear Sir:

Most of the suggestions of Arline Walter and Marilyn Bohl in "From Better to Best Tips for Good Programming," *Software Age*, November, 1969, are accepted good programming practice. However, I believe suggestion G in "Efficiency in Compilation/Execution" is sufficiently misleading so as to merit further explanation. The authors suggest the use of label arrays to aid in compile-time storage conservation and to help minimize the number of internal procedures. What the authors fail to mention is that if PL/1 GO TO statements are coded as shown in their example, then the execution time for each GO TO is increased by an order of magnitude relative to similar forms of the GO TO statement. The reason for this is that the elements of the label array in the authors' example may assume the value of labels defined in enclosing blocks. Thus a test at execution-time is necessary to determine if the value of the array element is a local label. If a label array (rather than a single label variable) is to be used, then execution speed would be improved by the coding shown below. Of course, the significance of the improvement depends upon the amount of processing to be performed between the GO TO statements.

```
DCL L(4) LABEL(L1,L2,L3,L4)
         INIT(L1,L2,L3,L4);
         .
         .
         .
         I=2;
         GO TO L3;
L2:      .
         .
         .
         I=4;
L3:      .
         .
         GO TO L(I);
L4:
```

Obviously, the compile-time advantage cited by the authors is lost. There is also more labor in preparing the DECLARE statement. Certainly the form of coding used by the authors is convenient in use, and hopefully the efficiency of the PL/1 object code for that form will be improved in the future, perhaps by the restriction of that form's array element values to local labels only.

Sincerely,
LAWRENCE SCHUTTE
West Lafayette, Indiana

Dear Sir:

The November, 1969 issue of *Software Age* contains an article starting on page 47 entitled "PL/1 Programming Aids from Better to Best Tips for Good Programming" by Arline B. Walter and Marlyn Bohl.

As a teacher of information systems and coordinator of our basic programming course which teaches our School of Business students the PL/1 language, I request your permission to reproduce copies of the above mentioned article for our faculty (20 copies). Your cooperation will be appreciated in this matter. Reproduction will be done by Xerox. If additional copies could be made, I would use them in my advanced systems (undergraduate and graduate) courses next quarter (probably an additional 30–40 copies). Obviously due credit would be given the authors and your publication. Probably if we could use the article in class also, I would have our secretaries mimeograph it.

Sincerely yours,
LLOYD J. BUCKWELL
Bowling Green, Ohio

Editor's comment: We will be including a Letters to the Editor column every month, so let's hear from you on the Editorial content of *Software Age*.

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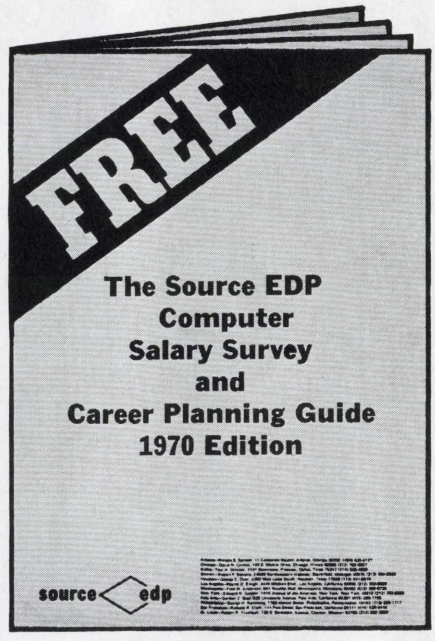

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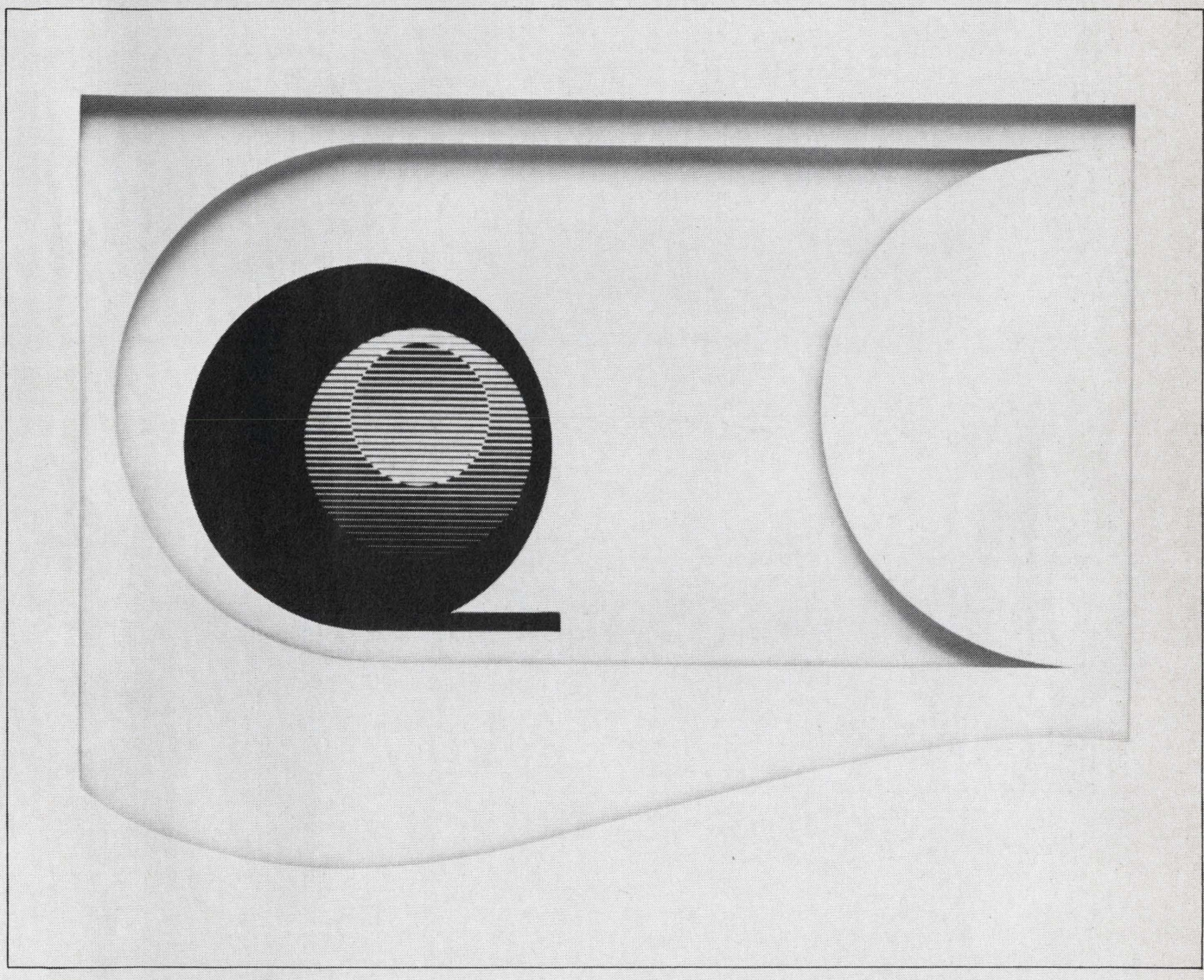

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A TIMELY R

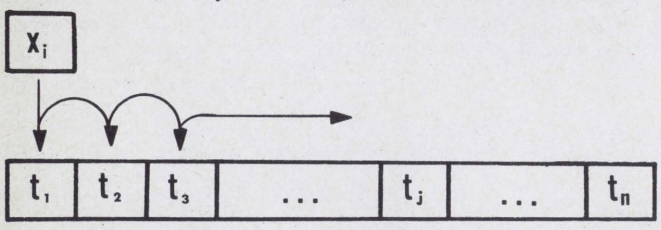
by
Frank Morris
Corporate Systems Consultant
Bristol Myers Co.

During the past decade the programming world has advanced from a subculture of octal bit-manipulating enthusiasts to a sophisticated mass of higher language conversationalists. As teleprocessing demands faster response systems, the tools of the assembly and machine language program are being re-applied to improve the throughput efficiency.

In this article four searching techniques will be described and analyzed. The author/Mr. Morris has omitted data-self-addressing because this powerful method is generally applicable to editing procedures rather than to table look-up operations. The logic flowcharts are in general form and the weighting factors used in the comparisons represent instruction timings from several computers.

Sequential Search

This is the most commonly used method of table look-up. The internal table ($t_1 \rightarrow t_n$) is sorted and the record value (x_1) is random (i.e. unsorted). In its simplest form the search proceeds from the beginning (t_1) and compares each table item (t_j) until the record value (x_i) is either located or until it is determined that x_i is not in the table. This may be pictured as: (see above)



SEQUENTIAL SEARCH

With a table sorted in ascending order as long as x_i is greater than the table value the search continues until the end of the table. If a less-than ($t_j > x_i$) or end-of-table

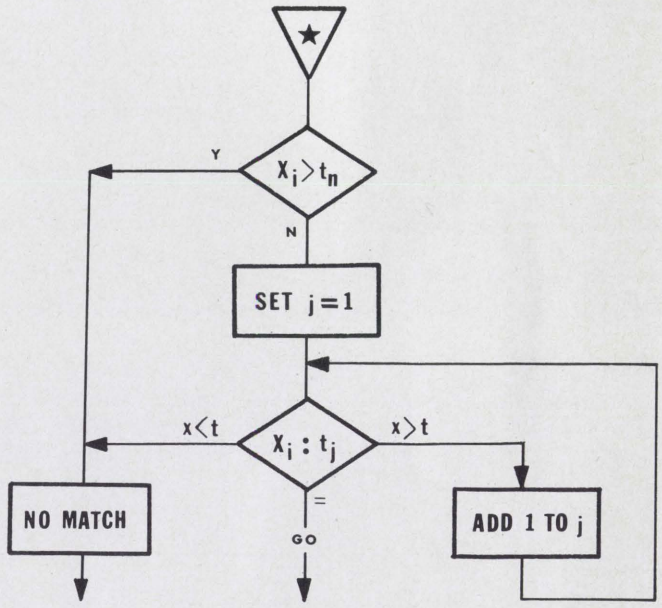


Figure 1

SEARCH

ES:

EVIEW

Mr. Morris has been an EDP Consultant for Touche Ross, a Project Leader at Allied Chemical and an EDP Officer in the Air Force. He has a BA in Economics (1961) and an MS in Mathematics and Statistics (1966) from Rutgers University. Mr. Morris is currently working as a Corporate Systems Consultant for the Bristol–Myers Co.

($x_i > t_n$) condition occurs, we have a no-match situation ($x_i \neq t_1 \rightarrow t_n$) and an appropriate *error* path is executed. The logic of the sequential search is given in fig. 1.

Each new x_i is checked from the beginning of the table since these values are assumed to be unsorted. The end-table ($x_i > t_n$) is placed first in order to remove it from the major loop ($x > t$). If an "increment-compare-branch" or tally type instruction is available, it may be used instead of the "Add 1 to j" instruction and obviate the need for a separate end-table check.

Effectiveness

With a sequenced table and random input the average number of compares executed will be $(n + 1)/2$ (n being the number of table items). But in analyzing a method we must consider the overhead involved. The overhead consists of add, subtract, branching and set-up instructions utilized in the loop. The timing chart below relates the number of instructions executed for 100 x values which will match each table item. The weighting factors establish a rough equivalency between the different instructions and a 5 character compare instruction.

TIMING CHART—SEQUENTIAL SEARCH

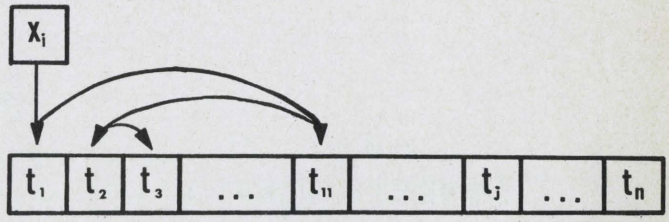
	Major Compare	Add 1	End Table	Set Up
No. Exec.	5050	4950	100	100
Weight	5050	2475	100	25

Total for 100 x_i = 7650
Avg. Equiv. Time = 76.5

Space requirements for storage in core are only the table size and about 8 instructions. Its wide use denotes the ease of forethought and programming involved. In regard to flexibility the table is normally modified and then re-entered into core. A separate program for adding, deleting and modifying would resemble a standard update routine.

Spaced Sequential Search

This variation on the simple sequential reflects in its procedure a better attempt at dealing with the low probability of a given x_i matching a given table value. The procedure is changed in that that t_j is increased by a larger value and then decreased on a less-than condition. This may be pictured as:



SPACED SEQ. SEARCH

The logic (fig. 2) is similar to the sequential but with the addition of a sub-counter (g). On a greater-than condition the normal g value of 10 is added to j causing jumps of 10 in the table. On the first less-than condition we regress 9 items and then move forward one item at a time.

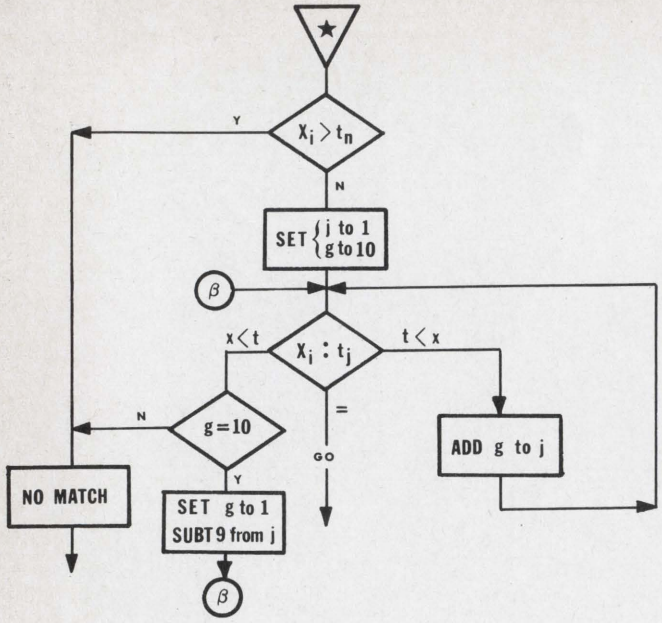


Figure 2

TIMING CHART—SPACED SEQUENTIAL

	Major Compare	Add 1	End Table	Set Up	Aux. Add/ Subt	Aux. Compare	Aux. Set Up
No. Exec.	1090	990	100	200	90	90	90
Weight	1090	495	100	50	45	45	45

Total for 100 x_i = 1870
Avg. Equiv. Time = 18.7

Effectiveness

By spacing the compares significant time is saved. With the same table size (n = 100) and 100 matching x_i, the timing chart below renders an average equivalency compare rate of 18.7. The sequential search rate was 76.5.

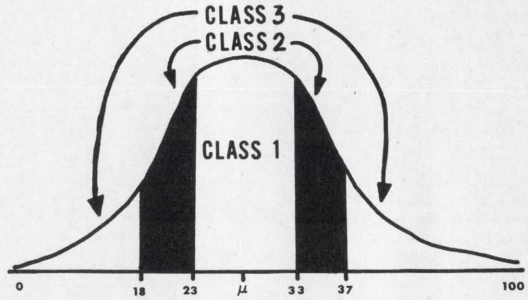
The amount of the increment g can be varied in order to find the most efficient value for a given table. For evenly distributed x values n/10 is generally a suitable g increment.

The core storage requirement has increased by four instruction lengths. The flexibility of the table in respect to modification is the same as in the use of the sequential search.

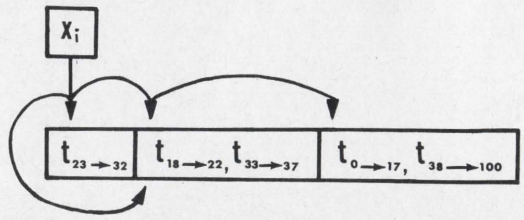
Probability Search

A third variety of the simple sequential pattern is to arrange the table values into an expected frequency array. The adequacy of the array depends on the efforts made in the probability analysis. There are several ways to accomplish this analysis. Some data will fit into a standard pattern and statistical tables can be utilized. In instances where rougher approximations will suffice, the pattern of expected matches can be determined by consulting relevant sources. If we were doing sales analysis, the table information might originate from volume figures in the sales department. Another way is to empirically accumulate data by placing counters after the equal-to condition in the search logic.

Many types of tables are conducive to normal curve analysis. In a theoretical actuarial application our table is the age range of potential policy holders. The problem is to match an age and then extract insurance data from the table. The range of ages is from 0 to 100 years and the average age (X) is computed to be 28 years. From samplings of computer requests, the standard deviations (s) is computed at 4.3 years. These derived statistics, X and s, are used as approximations for the population parameters μ and σ. From a "Table of Areas of the Normal Curve" we select an interval for our first comparison class. If we select 28 $\pm$ 5 years as our class, we are using a 1.162σ interval. From the Normal Curve table we find that this will circumscribe about 75% of the expected input. Our next class is conveniently a 1σ range outside the limits of our first class (i.e., 18–22.9 and 33–37.9 years). This second class will account for 22½% of the expected x values. The remainder of the ages can be placed in a third class. The chart below pictures the distribution and the pattern of the search.



PROBABILITY SEARCH



Since the probability search is a customized technique the program is difficult to relate as a generalized concept. For a specific size and number of classes, a specific number of modification loops are required. For the given example a simple loop is adequate since all possible age values in the range 0 to 100 are included in the table. Only the end-table compare provides a no-match route. The logic for this example is rendered in fig. 3.

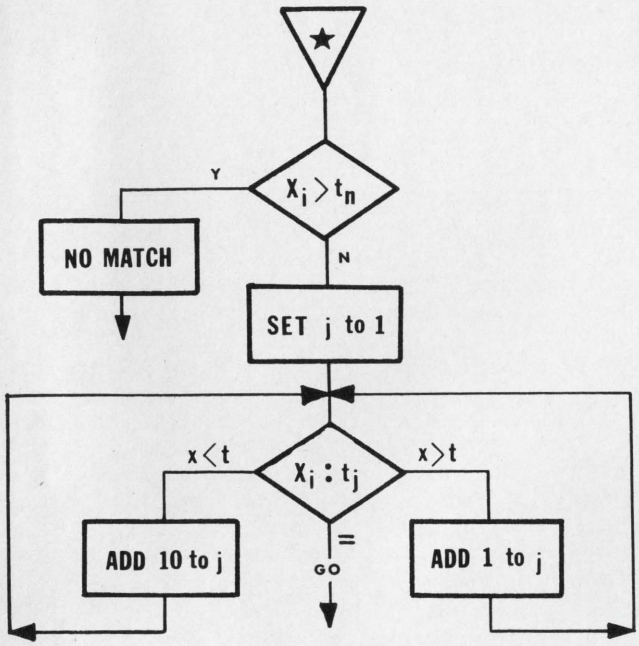


Figure 3

The less-than "Add 10 to j" saves extra compares on 12½% of the x values (0–22). In following the logic it is obvious that we are double-checking some values (e.g., if $x_i > 32$, it is therefore > 18–22). However to avoid this redundancy, another compare (end-class-1) would have to be inserted in the major loop. In doing this we would increase our overhead on 75% of the x values by 5 compares and only alleviate the double-checking of the 18–22 range (11¼%). Though not efficient in this instance, the attempt at perfect efficiency should be pursued to produce the best results. In other distributions, especially those with numerous classes, it is often better to use an index and search each class separately.

Effectiveness

For a table distributed as in our example, the timing chart below shows a great saving over both the simple and the spaced sequential techniques. The sequential and spaced required an average of 76.5 and 18.7 equivalent compares respectively.

The probability technique may not always produce such exceptional results. With bi-modal and flat-topped distributions the results will be less impressive.

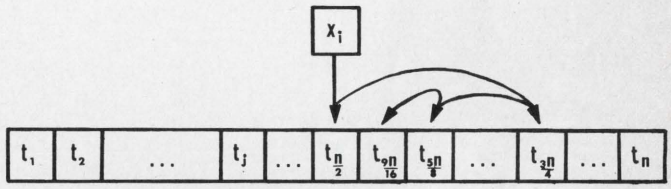
In our example the routine required 10 instructions, two more than the sequential. This is a variable figure dependent on the complexity of the class structure. Flexibility in the general case is a little more difficult since new table items must be placed in the proper class rather than merely sorted into the table sequence.

Binary Search

The name binary is given to this technique because the maximum number of requisite comparisons is expressed as a power of 2. For a table size less than 2^n, the number of compares will be n or less. Some table sizes and compare rates are:

Table Size (t_n)	Maximum Compares
8– 15 ($<2^4$)	4
16– 31 ($<2^5$)	5
32– 63 ($<2^6$)	6
64–127 ($<2^7$)	7
128–255 ($<2^8$)	8

The binary, like the preceding techniques, utilizes a sorted table. The first comparison is made against the center item in the table. If $x_i > t_j$, the next compare will be in the center of the right half of the table. Subsequent hi–lo results move the compare to the center of the remaining relevant portion of the table. This can be pictured as:



BINARY SEARCH

The logic of a binary search can be accomplished by using a divide instruction or through the use of an index. Since a divide is generally one of the most time consuming instructions, the index is preferable. The logic is shown in fig. 4.

The end-table check is not necessary since the number of compares is used for control. In the flowchart the index (1_k) provides for a table size up to 127 items. To locate item 99 the following items would be compared: 64, 96, 112, 104, 100, 98 and 99. The binary search may be used

TIMING CHART—PROBABILITY SEARCH

	Major Compare	Add 1	End Table	Set Up	Aux. Add/ Subt
No. Exec.	757.3	660.5	100	100	13.3
Weight	757.3	330.2	100	25	6.7

Total for 100 x_i = 1219
Avg. Equiv. Time = 12.2

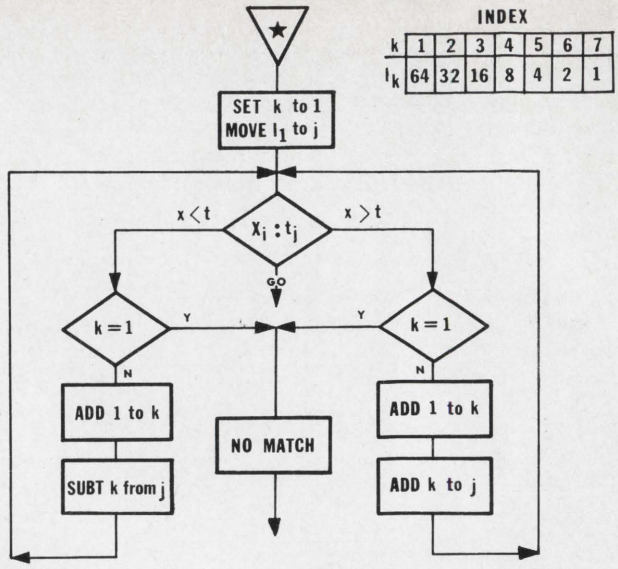


Figure 4

for tables not fitting exactly a power of 2. The starting point is still the center, but an additional 1 is often needed in the index.

TIMING CHART—BINARY SEARCH

	Major Compare	Add 1	Set Up	Aux. Add/ Subt	Aux. Compare
No. Exec.	581	481	200	481	481
Weight	581	240.5	50	240.5	240.5

Total Time for 100 x_i = 1353
Avg. Equiv. Time = 13.5

Effectiveness

The timing chart below is for a binary search on a table with 100 items. The first compare is against the 50th item.

This technique is more efficient than the sequential and the spaced. It falls behind the probability search in our example, but would be better than many probability applications. The greatest advantage of the binary search is that a maximum time for an x_i is far less than in any of the other approaches. Our timing has been for the average x_i. The figures below are for the "worst case" maximums. For most searches the worst case is one at the end of the table.

TIMING—MAX. COMPARES FOR AN X VALUE

Search Type	Equivalent Compares
Sequential	181.2
Spaced Seq.	37.2
Probability	180.4
Binary	18.0

There are 13 instructions in the flowchart for the binary search. Space required for the table is an item longer at times to provide for easier manipulation at the end of the table. If the index is placed before or after the table, the table size can be changed without program modification.

A variation, on the straight binary, is useful for larger tables. The table is divided into groups representing some characteristic of the data (e.g., the first digit). The proper group is determined and the binary loop is modified to reference the group. This variation is best when the group sizes are similar. In situations where core is available and time is critical, the search loop can be written out fully.

Concordance Analyzer of Cobol and Fortran Source Programs

by Norman D. Peterson

In modifying or diagnosing a program, a suitable cross-reference listing is often desired. Here is a self-contained and unusually short Cobol program for producing such an index for either a Cobol or Fortran source program. If the program begins with a header for an IDENTIFICATION DIVISION, Cobol will be assumed. Otherwise the program will be treated as Fortran. The program includes Fortran comment cards in the indexing process, but assumes that these do not contain any information in positions 2 through 6.

The cross-reference program, illustrated in the accompanying figures, contains its own sort and presents for each statement number, variable, Cobol verb, procedure name, and literal, not only the location where each is encountered, but also the full context of each line in which it appears. For this reason, the resultant listing has been referred to as a concordance index rather than as merely a cross reference.

In the accompanying figures, the IDENTIFICATION and ENVIRONMENT divisions have been left for the user to add. The program has been implemented and tested on a CDC 6400 computer, and is in fully operational, although not necessarily final, form. Only a basic form of the program is presented, not only for the sake of brevity, but also so that the reader might be free to embellish the program according to his own needs.

After brief experience with the program, the reader will most likely wish to make refinements in format and editing. As with a typical concordance or keyword-in-context index, it will of course produce a considerable amount of chaff. Although the user can ignore irrelevant entries, it may be more convenient if modifications for chaff reduction are tailored to the needs of the user. In addition, to locate lines in their original sequence, it is assumed that they are numbered sequentially for identification. Relative location for Cobol programs is generally provided by the content of positions 1 through 6. However, especially for Fortran programs, the reader may wish to build in automatic line numbering in positions 73 through 80.

COBOL CODING FORM — CONTROL DATA CORPORATION — PAGE 1

```
DATA DIVISION.
FILE SECTION.
FD  CARD-INPUT-FILE
    LABEL RECORDS OMITTED
    RECORD CONTAINS 80 CHARACTERS
    BLOCK CONTAINS 1 RECORD
    DATA RECORD IS CARD-INPUT-RECORD.
01  CARD-INPUT-RECORD.
    02  STRING-OF-CHARACTERS.
        03 CHAR OCCURS 80 TIMES  PICTURE IS X.

FD  OUTPUT-REPORT
    BLOCK CONTAINS 1 RECORD
    RECORD CONTAINS 132 CHARACTERS
    LABEL RECORDS OMITTED
    DATA RECORD IS PRINT-LINE.
01  PRINT-LINE.
    02  CCC-OF-PRINT-LINE  PICTURE X.
    02  FILLER             PICTURE X(131).
```

COBOL CODING FORM — CONTROL DATA CORPORATION — PAGE 2

```
FD  GENERATED-PRINT-FILE
    BLOCK CONTAINS 1 RECORD
    RECORD CONTAINS 132 CHARACTERS
    LABEL RECORDS OMITTED
    DATA RECORD IS GENERATED-PRINT-LINE.
01  GENERATED-PRINT-LINE.
    02  CCC          PICTURE X.
    02  KEY-PHRASE.
        03 CHAR2 OCCURS 49 TIMES  PICTURE X.
    02  GAP          PICTURE XX.
    02  COBOL-LINE   PICTURE X(80).

FD  SORTED-PRINT-FILE
    BLOCK CONTAINS 1 RECORD
    RECORD CONTAINS 132 CHARACTERS
    LABEL RECORDS OMITTED
    DATA RECORD IS SORTED-PRINT-RECORD.
01  SORTED-PRINT-RECORD.
    02  CARRIAGE-CONTROL-CHARACTER  PICTURE X.
    02  KEY-PHRASE2   PICTURE X(49).
    02  FILLER        PICTURE XX.
    02  COBOL-LINEX   PICTURE X(80).
```

COBOL CODING FORM — CONTROL DATA CORPORATION — PAGE 3

```
SD  SORTING-FILE
    DATA RECORD IS SORTING-RECORD.
01  SORTING-RECORD.
    02  CCCY          PICTURE X .
    02  KEY-PHRASE3   PICTURE X(49).
    02  FILLER        PICTURE XX.
    02  COBOL-LINEY   PICTURE X(80).

WORKING-STORAGE SECTION.
77  I             PICTURE 9 COMPUTATIONAL-1 VALUE IS ZERO.
77  J             PICTURE 9 COMPUTATIONAL-1 VALUE IS ZERO.
77  ONE           PICTURE 9 COMPUTATIONAL-1 VALUE IS 1.
77  INITIAL-I     PICTURE 9 COMPUTATIONAL-1 VALUE IS 7.
77  FROM-INDEX    PICTURE 9 COMPUTATIONAL-1 VALUE IS ZERO.
77  TO-INDEX      PICTURE 9 COMPUTATIONAL-1 VALUE IS ZERO.
77  CHAR-OPTION PICTURE X.
```

COBOL CODING FORM — CONTROL DATA CORPORATION — PAGE 4

```
PROCEDURE DIVISION.
PROGRAM-INITIALIZATION.
    OPEN INPUT CARD-INPUT-FILE.
    OPEN OUTPUT GENERATED-PRINT-FILE.
    MOVE SPACES TO GAP.
    READ CARD-INPUT-FILE
        AT END GO TO END-OF-INPUT.
    IF CHAR (8)  IS NOT EQUAL TO 'I'  GO TO ASSUME-FORTRAN.
    IF CHAR (9)  IS NOT EQUAL TO 'D'  GO TO ASSUME-FORTRAN.
    IF CHAR (10) IS NOT EQUAL TO 'E'  GO TO ASSUME-FORTRAN.
    IF CHAR (11) IS NOT EQUAL TO 'N'  GO TO ASSUME-FORTRAN.
    IF CHAR (12) IS NOT EQUAL TO 'T'  GO TO ASSUME-FORTRAN.
ASSUME-COBOL-INPUT.
    MOVE SPACE TO CHAR-OPTION.
    GO TO PROCESS-FIRST-CARD.
ASSUME-FORTRAN.
    MOVE '-' TO CHAR-OPTION.
    MOVE 0 TO INITIAL-I.
    GO TO PROCESS-FIRST-CARD.
READ-SOURCE-PROG-STATMT.
    READ CARD-INPUT-FILE
        AT END GO TO END-OF-INPUT.
```

COBOL CODING FORM — CONTROL DATA CORPORATION — PAGE 5

```
PROCESS-FIRST-CARD.
    MOVE CARD-INPUT-RECORD TO COBOL-LINE.
    MOVE INITIAL-I TO I.
    IF INITIAL-I IS EQUAL TO 0, MOVE SPACE TO CHAR (6).
    COMPUTE J = I + 1.
SCAN-1.
    IF J IS EQUAL TO 73, GO TO READ-SOURCE-PROG-STATMT.
    IF I IS EQUAL TO INITIAL-I                  GO TO SCAN-2.
    IF CHAR (I) IS EQUAL TO ' '                 GO TO SCAN-2.
    IF CHAR (I) IS EQUAL TO '.'                 GO TO SCAN-2.
    IF CHAR (I) IS EQUAL TO ','                 GO TO SCAN-2.
    IF CHAR (I) IS EQUAL TO '('                 GO TO SCAN-2.
    IF CHAR (I) IS EQUAL TO ')'                 GO TO SCAN-2.
    IF CHAR (I) IS EQUAL TO '='                 GO TO SCAN-2.
    IF CHAR (I) IS EQUAL TO '/'                 GO TO SCAN-2.
    IF CHAR (I) IS EQUAL TO '*'                 GO TO SCAN-2.
    IF CHAR (I) IS EQUAL TO '+'                 GO TO SCAN-2.
    IF CHAR (I) IS EQUAL TO CHAR-OPTION, GO TO SCAN-2.
RETURN-POINT.
    ADD ONE TO I.
    ADD ONE TO J.
    GO TO SCAN-1.
```

COBOL CODING FORM — CONTROL DATA CORPORATION — PAGE 6

```
SCAN-2.
    IF CHAR (J) IS EQUAL TO ' '   GO TO RETURN-POINT.
    IF CHAR (J) IS EQUAL TO '.'   GO TO RETURN-POINT.
    IF CHAR (J) IS EQUAL TO ','   GO TO RETURN-POINT.
    IF CHAR (J) IS EQUAL TO '('   GO TO RETURN-POINT.
    IF CHAR (J) IS EQUAL TO ')'   GO TO RETURN-POINT.
    IF CHAR (J) IS EQUAL TO '='   GO TO RETURN-POINT.
    IF CHAR (J) IS EQUAL TO '/'   GO TO RETURN-POINT.
    IF CHAR (J) IS EQUAL TO '*'   GO TO RETURN-POINT.
    IF CHAR (J) IS EQUAL TO '+'   GO TO RETURN-POINT.
    IF CHAR (J) IS EQUAL TO CHAR-OPTION, GO TO RETURN-POINT.
    MOVE J TO FROM-INDEX.
    MOVE ONE TO TO-INDEX.
    MOVE SPACES TO KEY-PHRASE.
BUILD-KEY-PHRASE.
    IF FROM-INDEX IS EQUAL TO 73, GO TO WRITE-OUTPUT.
    IF   TO-INDEX IS EQUAL TO 50, GO TO WRITE-OUTPUT.
    MOVE CHAR (FROM-INDEX)  TO  CHAR2 (TO-INDEX).
    ADD ONE TO  FROM-INDEX.
    ADD ONE TO    TO-INDEX.
    GO TO BUILD-KEY-PHRASE.
```

COBOL CODING FORM — CONTROL DATA CORPORATION — PAGE 7

```
WRITE-OUTPUT.
    WRITE GENERATED-PRINT-LINE.
    GO TO RETURN-POINT.
END-OF-INPUT.
    CLOSE CARD-INPUT-FILE.
    CLOSE GENERATED-PRINT-FILE.
SORTING-OF-PRINT-LINES.
    SORT  SORTING-FILE ON ASCENDING KEY
                KEY-PHRASE3 OF SORTING-RECORD
                    USING  GENERATED-PRINT-FILE
                        GIVING SORTED-PRINT-FILE.
    OPEN INPUT SORTED-PRINT-FILE.
    CLOSE SORTED-PRINT-FILE.
    OPEN INPUT SORTED-PRINT-FILE.
    OPEN OUTPUT OUTPUT-REPORT.
PRINT-OUT-SORTED-INDEX.
    READ SORTED-PRINT-FILE  AT END GO TO END-OF-PRINTING.
    MOVE SPACE TO CARRIAGE-CONTROL-CHARACTER.
    WRITE PRINT-LINE FROM SORTED-PRINT-RECORD.
    GO TO PRINT-OUT-SORTED-INDEX.
END-OF-PRINTING.
    CLOSE SORTED-PRINT-FILE.
    CLOSE OUTPUT-REPORT.
STOP RUN.
```

conference countdown

JANUARY, 1970

12–16 Data Transmission Facilities exhibition, London, England. Contact: U.S. Dept. of Commerce (BIC-942), Washington, D.C.

14–16 1970 International Conference on System Sciences (IEEE), Honolulu, Hawaii. Contact: Dr. Richard Jones, 2565 The Mall, University of Hawaii, Honolulu, Hawaii 96822.

19–21 Computer Software and Peripherals Show and Conference, Eastern Region, New York, N.Y. Contact: Show World, Inc., 37 West 39th St., New York, N.Y. 10018.

FEBRUARY

10–11 The National Security Industrial Association Conference on "The Application of Computers to Training," Washington, D. C. Contact: Paul Newman, Headquarters NSIA, Department ACT, Suite 700, Union Trust Building, 740 15th Street, N.W., Washington, D. C. 20005.

16–19 Annual Computer-Aided Circuit Analysis and Design Institute, Tampa, Fla. Contact: Dr. George Zobrist, Department of Electrical Engineering, University of South Florida, Tampa, Fla. 33620.

17–19 Computer Software and Peripherals Show and Conference, Midwestern Region, Chicago, Ill. Contact: Show World, Inc. 37 West 39th St., New York, N. Y. 10018.

19–20 ADAPSO's 28th Management Conference, Los Angeles, Calif. Contact: ADAPSO, 551 Fifth Avenue, New York, N. Y. 10017.

23–25 Data Processing Supplies Association, Winter General Meeting, New Orleans, La. Contact: DPSA, 1116 Summer St., P.O. Box 1333, Stamford, Conn. 06904.

27–28 National Association of Computer Assisted Analysts (NACAA) Multiposium, Los Angeles, Calif. Contact: NACAA, Multiposium, Mary Bragg, P.O. Box 2802, Fullerton, Calif. 92633.

MARCH

23–25 INFO–EXPO–70, Washington, D.C. Contact: Paul Zurkowski, Information Industry Association, 1025 15th St. N.W., Washington, D.C. 20005.

23–26 IEEE International Convention and Exhibition, New York, N.Y. Contact: IEEE, 345 E. 47th St., New York, N.Y. 10017.

25 QUEST—Symposium Exposition of Time-Sharing Systems & Techniques, Los Angeles, Calif. Contact: Merrill Goulding, 4612 W. Jefferson, Los Angeles, Calif. 90016.

APRIL

3 Computer Graphic Workshop, Association for Computer Machinery, Rosslyn, Va. Contact: Spec. Int. Group for Graphics, Box 933, Blair Station, Silver Spring, Md. 20910.

7– 9 Computer Software and Peripherals Show and Conference, Western Region, Los Angeles, Calif. Contact: Show World, Inc., 37 West 39th St., New York, N.Y. 10018.

new products

Memory Raster Displays

Applied Digital Data Systems, Inc., Hauppauge, New York, has announced a new series of readout devices that permit ordinary TV monitors to display computer generated or sequential data. The Memory Raster Displays (MRD) are devices that will accept data from a computer, a keyboard, magnetic tape, or any other sequential source and display the data on an ordinary 525-line TV Monitor at remote locations which are linked to the source by a single coaxial cable.

All model MRDS accept serial data, character by character, store the data in their refresh memories, convert it into a composite video signal, and display it on ordinary TV monitors. During operation, the MRD'S sequentially insert each character into a dynamic shift register memory location corresponding to the next available character position on the screen.

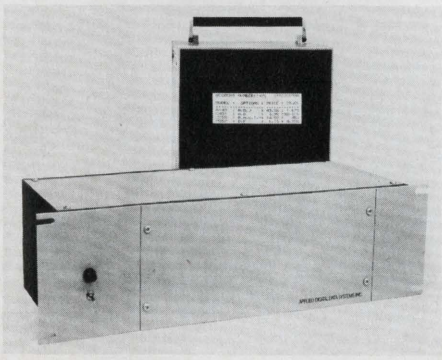
The MRD-100 displays BCD numeric data on TV Monitors in 2, 4, or 8 lines with 32 characters per line; or in 4 or 8 lines with 16 characters per line.

The MRD-200 displays ASC11 alphanumeric data in from 32 to 1024 character positions in 1, 2, 4, 8 or 16 lines with either 32 or 64 character per lien.

The MRD-500 can be read from as well as written into. It also has random access capability and is thus ideal for custom-designed display systems.

Controls on the MRD-100 and MRD-200 include the ability to select a display line, and to advance to the character position where the next character will be entered. Optional features include: a control for blinking any character or characters on the screen; a coursor symbol for tracking the location of the next character to be entered; and an erase command for erasing all or part of the screen.

For more information, circle No. 20 on the Reader Service Card



Telecommunication Information Management Executive

Shaw Systems Associates Inc., of Houston, Texas, has developed a generalized communication system of modular design, called TIME (Telecommunication Information Management Executive). The modularity of design and flexibility of adaptation of the system is said to allow the user to economically and quickly keep abreast of management's increasing requirements. TIME can start out as a system for simple inquiry to and can gradually be expanded until it becomes a comprehensive management information system.

Modularity of TIME is accomplished through several major system design criteria, including:

File Independence—the Number and organization technique of the files supported by TIME is a user specified variable.

Terminal Device Independence—Any teleprocessing unit supported by IBM BTAM (7770, 2260, 1050, 2780, etc.) may be supported by the TIME system in one partition.

Application independence—Application modules can be written in high or low level languages. They may be added by the user as the need arises.

Standard IOCS—No specialized IOCS modules are a part of the system. All input/output functions are accomplished at the get/put or read/write level.

The TIME system is compatible with both IBM DOS/360 and OS/360. Processing modules may be either transient or core resident as desired. Memory requirements vary with the number and type of terminals, the number and type of application files being accessed and the nature of actual processing taking place. The system has been implemented on an IBM system 360 with multiple terminal devices and applications in less than 32 K of memory.

For more information, circle No. 21 on the Reader Service Card

Generalized Read and Simulate Program

Control Data, Minneapolis, Minn. has announced two new software packages for use with its 915 Page Reader Systems. GRASP (Generalized Read and Simulate Program) is said to give OCR users higher throughput capabilities that are somewhat faster and more efficient than similarly designed programs. GRASP was designed to read documents, validate and format the input data contained on the documents, and write the output on magnetic tape at maximum throughput rates. It

uses a series of typed parameters to recognize the documents read by the 915 Page Reader, which define the physical document format, control characters and output format.

The second software package, Keypunch Simulator Program, obtains data from pages typed in the standard font of the American National Standards Institute (ANSI) and converts the data into punched card images that are recorded on magnetic tape. The Keypunch Simulator Program is capable of verifying and justifying the typed input data, filling in blanks in the data and providing for the duplication of character positions from a previous record.

For more information, circle No. 22 on the Reader Service Card

CASPER

A new conversion system, CASPER, has been developed by Computer Advisory Services, Inc., Los Angeles, Calif., a software subsidiary of Columbia Picture Industries. CASPER is a software package which will translate IBM 1400 programs to COBOL, on a large time-sharing computer. CASPER is on a time-sharing system to permit more thorough logic evaluation, translation and checkout than previously achieved by batch processing methods. The pricing schedule depends on the volume of work and on the degree of completion required by the customer. One hundred percent conversion on small orders will be handled for 59¢ per IBM 1400 Autocoder or SPS source statement, where the client assumes responsibility for file conversions, system integration and final checkout.

For more information, circle No. 23 on the Reader Service Card

VICOM

Software Methods, Inc., New York, N. Y. has recently developed a general purpose on-line file management system, VICOM, which was designed to be used by personnel with limited or no prior data processing experience. The minimum configuration for the VICOM system is 32,000 bytes main memory, 3 magnetic tapes and 1 disk. VICOM's capabilities include: file generation, file maintenance, data retrieval and report generation.

The VICOM system can be used for the application of statistical methods, the analysis of historical data, and to fulfill the requirements of an automated set of tools for research, analysis, forecasting and planning.

A security system is also provided to restrict user access to the data files. The mechanism for modifying the security imposed upon the file is also considered a non-programmer language which, like the entire system, may be called for execution by a terminal CRT or off-line device attached to the system. Through the implementation of efficient, non-programming tools, the VICOM System is readily available to the user for the modification of data, modification of data characteristics and for its meaningful output presentation.

For more information, circle No. 24 on the Reader Service Card

New Command Language

PDA Systems, Inc., River Vale, New Jersey, has a new command Language, BAL-FIX, which was designed to enable programmers to perform interactive debugging of BAL programs on any IBM 360 computer.

With BAL-FIX the programmer can interrupt the execution of his program at predetermined locations and selectively display the contents of registers, control words, and core locations. On the basis of this analysis, he can continue execution to the next program interrupt point and modify the contents of any register control word or core location, or he can program additional interruptions.

Facility with BAL-FIX is quickly and easily achieved via extensive, built-in, interactive features. For example, each BAL-FIX command has a range of error messages associated with it and the appropriate message is typed out on the console whenever a sytax error is made in a command, or when an unrecognizable command is entered.

BAL-FIX is completely compatible with the DOS supervisor. The package comes as a card deck ready to be loaded into the system library. Only one additional card is required at the beginning of the deck for a problem program. This card includes the parameters which allow the pre-setting of up to 10 program interrupts at any desired locations in the program.

For more information, circle No. 25 on the Reader Service Card

Magnetic Tape Unit

Stromberg DatagraphiX, Inc., a subsidiary of General Dynamics, San Diego, Calif., has a new Magnetic Tape Unit on the market. The new tape unit, the F512, enables the DatagraphiX 4360 Micromation Recorder to accept 9-channel 1600 bpi phase-encoded magnetic tape input in addition to 9-channel 800 bpi and 7-channel 800 and 556 bpi NRZI-encoded tape.

When the F512 is integrated with the DatagraphiX 4360, the recorder translates the output from a digital computer to alphanumerics at 30,000 characters a second and displays them on a CHARACTRON$_{tm}$ shaped Beam Tube. The readable text, in page format is then photographed onto film at the rate of 7,000 lines a minute.

For more information, circle No. 26 on the Reader Service Card

Management Service System

Webster Computer Corporation, Danbury, Conn. has announced Measurement Service System (MSS) a computer software system designed to help computer users gain greater throughput from IBM System/360 computers. The system will operate on any IBM System/360 computer using DOS.

MSS allows a user to account for the instruction execution time for each program running in each partition of memory. MSS records the Start, Stop, Wait, Super-

visor, and Problem Partition 7 times for each program run through the computer. MSS also indicates Idle time by partition, Abnormal Termination codes, Test or Production run indications and several other types of relevant data.

MSS does not disrupt the normal data processing operations, alter the logic, nor degrade the execution of the DOS Supervisor. The detail data gathered each day is subsequently analyzed by using a group of special data reduction programs. Then the output from these programs provides valuable information relative to the control of computer operations and configuration analysis. Optimization of scheduling is achieved through use of the output from the automatically created Daily Log.

Following a customer's use of MSS a senior systems analyst of Webster Computer Corporation will analyze and review the results with the customer to aid him in developing improvements in the operation of his installation and gaining programming efficiencies.

For more information, circle No. 27 on the Reader Service Card

Surveying Calculation Software

Call-A-Computer, Minneapolis, Minnesota, has added a 12 program package to the library available to its time-sharing subscribers. The new package is designed to solve standard surveying problems and includes the following programs, as well as six others:

TRAVR$, which determines the X and Y coordinates for a closed loop transverse through the use of distances and deflection angles. TRAVR$ also calculates and adjusts for errors in the traverse, calculates the bearings between the points, calculates the area of the traverse, and adds or subtracts arc segments to the traverse.

PTTRV$, which determines the X and Y coordinates from any number of side shots and calculates the bearing and the length of the line needed to close a partial traverse.

TANDIS$, which finds the distance and bearing between pairs of coordinate points.

COARE$ which determines the area bounded by a set of coordinate points and adds or subtracts arc segments from the area.

NTSKI$ which computes the coordinates of an unknown point given the bearings from two known points, and calculates the distance from each of the known points to the unknown point. And NTKS2$, which computes the coordinates of an unknown point given the bearing from one known point to the unknown point and the distance from another known point to the unknown point. It also calculates the unknown bearing and the unknown distance.

On a time-sharing computer these programs are able to calculate the solutions in less than 10 minutes whereas formerly 3 to 4 hours were required to perform the calculations by hand.

For more information, circle No. 28 on the Reader Service Card

New Graphics Output System

California Computer Products, Inc., Anaheim, Calif., has a new, high speed, high resolution, Graphics Output System, the 900/1670. The off-line COM system can draw at the rate of 500,000 increments/

sec. and it can print at the rate of 5,000 lines/min. depending upon the size and variation of software generated type fonts. There are several options which are available for the system, including: a form projector with 16 program selectable forms; a high speed character generator which increases the average printing rate by 100%; cameras for 16mm or 35mm sprocketed or unsprocketed microfilm; and a 105mm microfiche camera.

The system is composed of a Model 900 Controller, a stored program device, the Model 937 Magnetic Tape unit, providing up to 30,000 byte/sec. input to the controller, and the Model 1670 microfilm printer/plotter, featuring a programmable raster of 16,384 x 16,384 positions, plot resolution. The system has 30 levels of intensity which are under program control and which allow the system to achieve twenty usable line widths, and lines and dots are produced in the incremental dot writing technique.

For more information, circle No. 29 on the Reader Service Card

Microfilm Printer/Plotter

Graphics System Division of Computer Industries, Inc., has announced a new, versatile Computer Output Microfilm (COM) Printer/Plotter system. It features modular construction and a long list of options that can be purchased when they are needed.

The new system, microfilm Model the 300–3, prints and plots at speeds up to 200 pages a minute. It accepts almost any tape format via a unique patchboard panel and code plug system. It can record on either roll or microfiche formats with a new Multiformat camera that handles 16, 35 or 105 mm films. (There is a variety of other cameras available that can be used without system modification.) The 300–3 has an optional hard copy module that allows for paper and film output to occur simultaneously, and it also has a magnetic tape input capability that handles 7-track (556 or 800 BPI with odd or even parity), and 9-track (800 or 1600 BPI with even parity).

The 300–3 has the standard reread capability and optional retrieval coding. It is provided with forms projection and a special error void capability. Some additional optional features include: frame butting, additional character sets and many special selectors (recorded length, line length, print delay, cod control and frames required. The 300–3 also has an audible error alarm optionally available.

For more information, circle No. 30 on the Reader Service Card

Two New Program Packages from IBM

IBM has announced two new program packages which will extend time-sharing capabilities to a wide range of System 360s.

One package, Time-Sharing Option (TSO) was designed for the users of System/360 Models 50, 65, 75, 85, and 195. It provides for time-sharing concurrent with batch processing and allows terminal users to select from any language supported for the Operating System, including Assembler, FORTRAN, COBOL, ALGOL, PL/I and RPG, as well as ITF BASIC and an interactive subset of PL/I, two new program products. TSO also enables the terminal user to interact with any application program.

The second new package announced by IBM is the Interactive Terminal Facility (ITF) for users of Models 25, 30, 40, 50, 65, 75, 85 and 195. ITF provides two of the conversational programming languages offered under TSO: BASIC and an interactive subset of PL/I. ITF can run under the Disk Operating System on a Model 25 with 49,152 bytes of main storage. For concurrent time-sharing and batch processing under DOS/360, a Model 30 or larger with at least 65,536 bytes is required. Under OS/360, a 131,072 byte main memory is required.

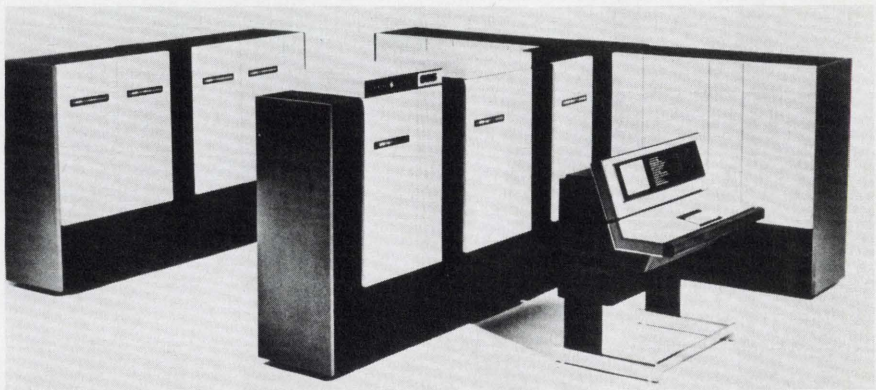
For more information, circle No. 31 on the Reader Service Card

New Computer from GE

General Electric Co., New York, has announced a powerful new computer, the GE-655, in an attempt to capture a bigger portion of the large-scale computer market. The GE-655 is upward compatible with the existing GE-600 line of large-scale information systems. The system is capable of multiprogramming, multiprocessing and executing the 3 dimensions of data processing concurrently—local batch processing, remote batch processing and time-sharing. Some of the features of the 655 include: a memory cycle of one-half a microsecond, 10 new instructions, character handling improvements and a time register with higher resolution to complement the faster internal speed of the machine.

Each GE-655 memory module contains 65,536 words and each controller can handle one or two modules. A system can accommodate up to two controllers for a total capacity of 262,144 words –f core memory.

For more information, circle No. 32 on the Reader Service Card



New System from RCA

RCA Information Systems, New York, has announced a new time-shared information storage and retrieval system, which is said to allow more than 100 data processing users at different locations to concurrently use the full resources of the Spectra 70/61 remote computing system.

The new system, User Language/1 (UL/1) is a generalized Data Base Management System which processes requests from many on-line users simultaneously. The functions that can be performed by the system include: file creation and updating; file structure revision; on-line inquiry response; interactive browsing; and the on-line initiation of more complex operations.

The system provides user-oriented facilities for non-programmers and at the same time more experienced users have access to the abilities to handle more advanced applications. UL/1 has two report generators, one which permits a high degree of layout and format flexibility to meet users' need and the other which minimizes user action to produce the required output.

The system uses normal English language and arithmetic notation in an attempt to simplify typical requirements for input and output data base manipulations.

The system can be used interactively, from remote teletypes and video date terminals, and also from a remote high speed batch data terminal and from local card readers for handling batch processing.

For more information, circle No. 33 on the Reader Service Card

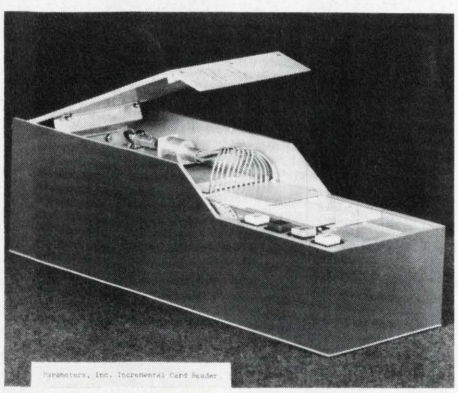
Incremental Card Reader

Parameters, Inc., a subsidiary of Global Industries, Inc., Belleville, New Jersey, has developed an incremental card reader that programs test equipment, chemical processes, food processes, batching machinery and mini-computers.

The DS-80 is complete and self-contained with interface, modular circuitry, and performance features that are compatible with most computers and data systems. On command, the DS-80 reads Hollerith coded data, a column at a time, up to speeds of 80 columns a second.

The DS-80 features: a single-step function with return to start from any column; an automatic feed and return; sync/output with read conrol; and 3 speed which are deermined by applicaion. All of the control functions are programmable from remote locations.

The DS-80 works by reading the card opto-electronically. In this process a phototransistor array senses light through the punched holes in the card. For maximum reliability during this process the light is channeled to each row through individual fiber optics from a common source.



For more information, circle No. 34 on the Reader Service Card

Optical Bar Code Reader

A Medical Folder is an item which contains patient medical information and is identified by a unique number. There is a Medical Information system that controls the folder's whereabouts and completion status. In order for the system to work it is necessary to accurately identify the folder at certain checkpoints within the working environment, and then reliably route the information to a central control.

Cambridge Information Systems, Inc., Cambridge, Mass., has developed a low-cost Optcal Bar Code Reader (OR) to work in conjuncton with the Automated Medical Record Locator System, a medical information system. The OR is used as a direct input device to automatically identify the medical folder and transmit the information to a digital computer. OR's can be placed at various strategic locations. Then, when a Medical Folder is passed over an OR in the network the computer is notified of the folder number and its whereabouts. Although the OR was designed to be used as in input terminal in an On-Line system is can also function off-line driving a paper tape punch.

The Optical Bar Code Reader contains mechanical, optical and electronic components. The folder is mechanically guided over an optical reading unit by a conveyor-like device which maintains code pattern alignment. The optical units are an adaptation of a commercial shaft encoder and the electronic portion of the decoder is a simple, compact unit which feeds the four-track (4 bit) code to relays suitable for interfacing with a telephone teletype modem.

For more information, circle No. 35 on the Reader Service Card

New Interactive Management Information System

A new interactive Management Information System has been announced by Meta-Language Products, Inc., New York, N. Y. The new system is MUSE$_{tm}$ (Machine-User Symbiotic Environment) and it has been specifically designed for creative decision-making and the solving of non-routine problems by management and corporate planners who are not skilled in ways to communicate with a computer.

The 3 main features of the system: 1) a natural English language; 2) a simple data loading/updating procedure; and 3) an automatic report generator; provide the users the way to communicate for interaction with and processing form a large common data base. All the user has to do is ask questions, give commands, or develop applications dialogues in an unstructured natural manner. The System provides interactive error detection, full line-editing and a system-maintained dictionary with definitions, to aid the user in developing dialogues.

Upon installation the system contains 250 basic dictionary entries. To this the user adds words of his own terminology—from 3,000 to 25,000 words, depending on the machine—through data loading and idiomatic equivalences.

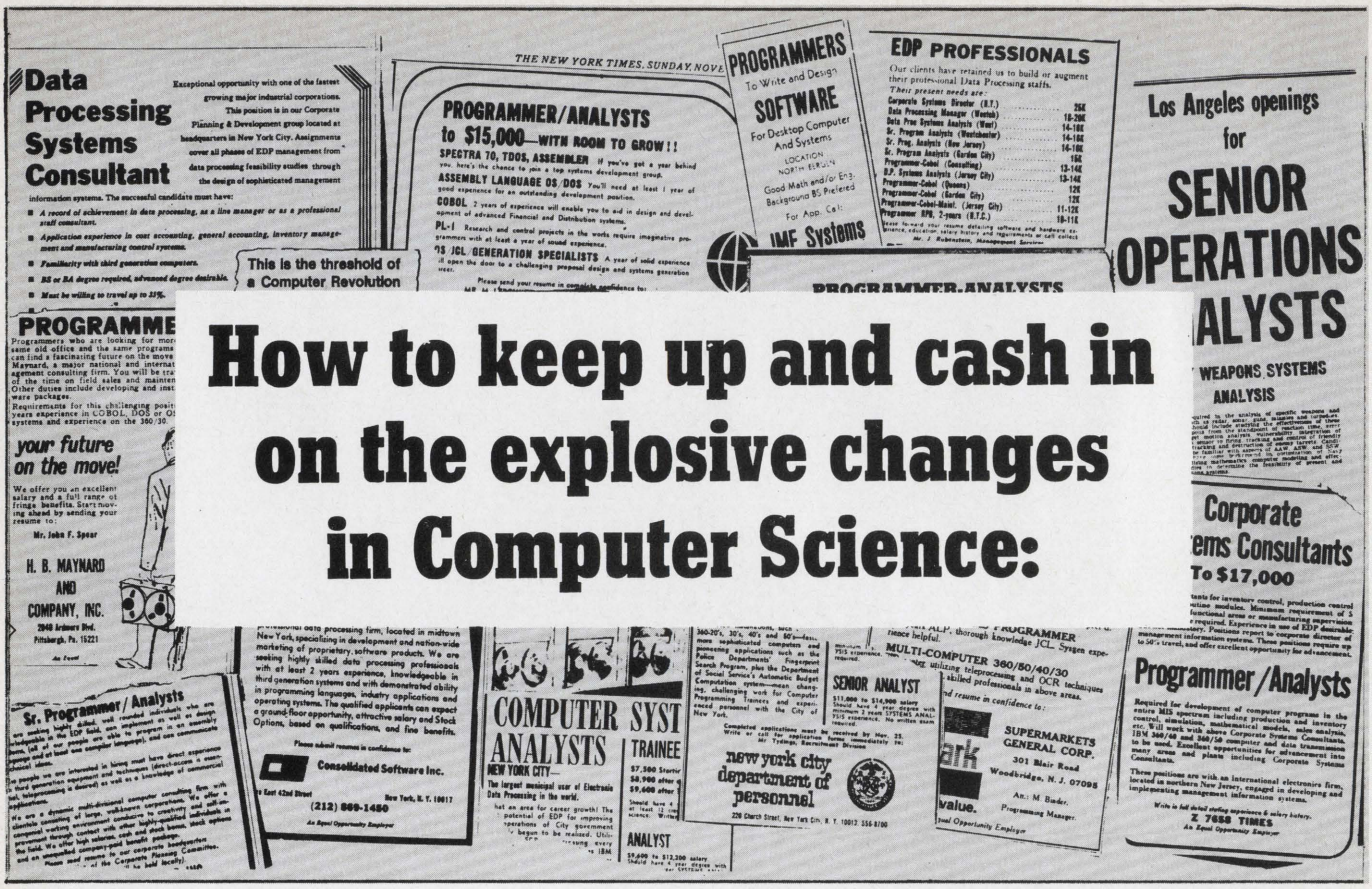
MUSE$_{tm}$ has been implemented on the XDS-940 and conversion to other computers, including the CDC 3300, PDP-10 and GE-635, will begin in February. Other machines that are being studied for MUSE implementation include the XDS-Sigma 7, RCA Spectra 70/46 and the UNIVAC 1108.

For more information, circle No. 36 on the Reader Service Card

New Plotting Software from Houston Instrument

Houston Instrument, a Division of Bausch & Lomb has added plotting software to its line of computer applications. TRIDEM$_{tm}$ a three-dimensional software package, offers wide versatility in plotting a gridded array in three-dimensional space. Some of the features of the software package include the representation of stereo pairs, full hidden line capabilities and exact approximation of curvilinear. TRIDEM$_{tm}$ was written in basic FORTRAN 1V and requires only 3500 words of core. It can be installed on almost any computer system. When the system is installed the user communicates with it by supplying parameters to the six basic FORTRAN subroutine entry points within the system.

For more information, circle No. 37 on the Reader Service Card



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Line Control and Terminal Management IN OS/360— a proposed control system

Robert M. Winick
IBM Corporation
Systems Development Division
Research Triangle Park, North Carolina

This article presents some of the problems and peculiarities of controlling the hardware in a telecommunications environment. Because of the wide diversity of terminals comprising a teleprocessing network and the innumerable ways that software facilities can be combined to produce a total real-time control system, a set of programming functions rather than an integrated software package is proposed. Emphasis placed upon the line control and terminal discipline required to manage the remote stations. The set of functions described will provide control for both start–stop and binary synchronous hardware.*

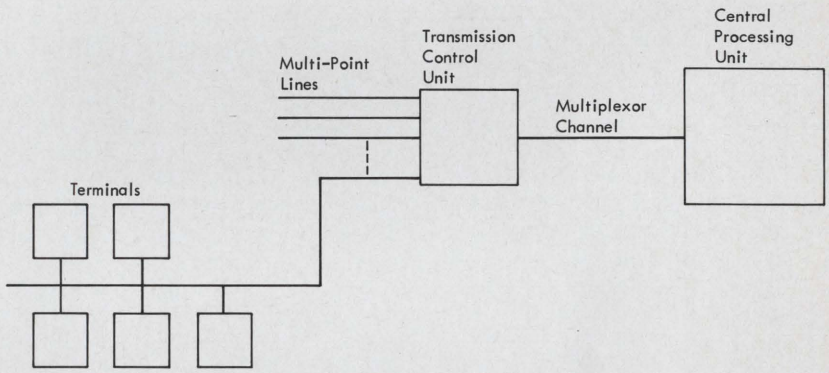

Figure 1. Multipoint Leased Line Configuration

The job of any input–output control system is to regulate the data flow between the external devices and the central processor. The most efficient control system is generally the one which handles the largest volume of data in the least amount of processor time with the smallest requirement of central processor storage. In a telecommunications environment, core and execution time are only two of the resources whose management is critical to the efficient operation of the control system. In most networks, one or more terminals and their data sets are attached to a communications line which, in turn, attaches to a data set and then to a transmission control unit. Several control units multiplex to an IBM System/360 computer. Thus the combined costs of the hardware required to attach a far-flung network of terminals to a central processor is often as expensive as—indeed, often more expensive than—the rental cost of the computer itself. Therefore, the control system must provide optimal operation of the telecommunication lines and terminals.

Various problems encountered in the design of a control system for a telecommunications environment are described in this article. Because of the high number of variables involved in any specific system, a total solution is not proposed, but rather a set of functions which, by selective combination, can provide a software package tailored to the installation's unique requirements. Both start–stop and binary synchronous communication, and three types of communication lines—point-to-point switched—are considered.

Start–Stop Multipoint Lines

Of the three types of communication lines, multipoint leased lines provide the greatest centralized control of traffic. A terminal may neither accept nor enter messages until "invited" to by the host computer. This operation is essential if there is to be organized communication between the central processor and the several stations sharing the same line. Prior to each operation, all terminals on the line could be de-selected and placed into control mode. Each terminal can now recognize only its unique polling or addressing sequence. A terminal that recognizes its addressing characters responds negatively—i.e., it cannot accept a message—or responds positively, and is thus selected and enters text mode. A terminal that responds negatively to its addressing sequence is indicating either a hardware failure, a procedural malfunction such as the terminal being placed off-line or a remote printer being out of paper, or, in a buffered terminal, that data is being entered into the buffer. This negative response is treated as an error condition by the control system.

Unlike addressing which occurs only when the central processor has traffic

* Since this article was written, many of the concepts have been incorporated into newly announced IBM telecommunication software support for Operating System/360 known as TCAM (Telecommunications Access Method).

for that terminal, polling of each terminal to solicit messages from that station occurs at specified times. When a terminal recognizes its polling characters and responds positively, it becomes selected, enters text mode, and transmits a message to the central processor.

The squence of polling the terminals on a line is controlled by an "invitation list" for that line. The invitation list contains the terminals that are to be polled, and the order in which they are to be polled. Any terminal may be repeated in the list two or more times. Assuming the installation does not limit the maximum number of messages that may be entered at any one time by a terminal, a station which has responded positively to a poll may be continuously re-polled until it has entered all of its messages. No other terminal may enter messages during this period. More often than not, a station will not have a message ready to transmit when it is polled, and a negative response will be automatically generated.

When the negative response is received by the computer, the control system will perform one of three functions, depending upon which transmission priority has been selected for that line by the installation. The next terminal in the list will be polled, or traffic from the output queue will be transmitted to the stations, or the pointers to the list will be reset and an optional delay taken before the next polling pass is made. If "send priority" (i.e., the central processor's sending operations have higher priority than its receiving operations) was chosen, all messages from the output queue will be sent to the appropriate terminals on the line. Polling will then resume with the current entry in the invitation list.

If "equal priority" (i.e., the central processor's sending operations have equal priority with its receiving operations) was selected, polling will resume with the current terminal in the list until the list is exhausted. At that time all messages from the output queue will be transmitted. An optional delay may be invoked at the end of the list which must complete before the next pass is made through the invitation list.

If "receive priority" is used (i.e., the central processor's receiving operations have priority over its sending operations), the delay determines the period of time during which outgoing traffic will be sent to the terminals on that line. If the pass through the invitation list was productive—i.e., one or more messages were received from terminals on the line—the optional delay is not invoked at the end of the pass. Only if the pass through the list was unproductive is the delay put into effect. Thus, traffic incoming to the central processor is not unduly delayed and, in the absence of incoming messages, unproductive polling is diminished.

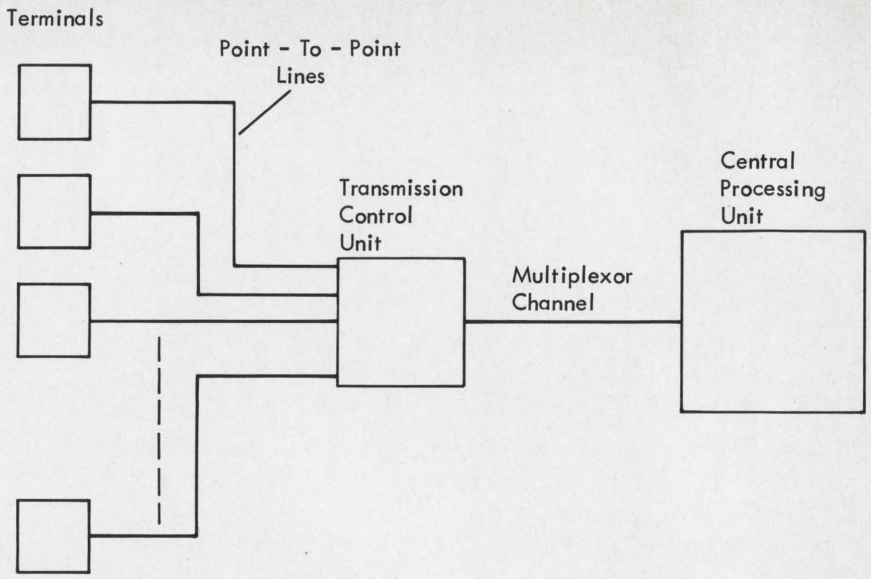

Figure 2. Point-to-Point Leased Line Configuration

A hardware feature common to IBM System/360 multiplexor channels removes the burden of handling unproductive polling from the control system. Called "autopoll," the facility allows negative responses from polling sequences to be handled completely in the multiplexor channel. The channel then restarts the polling operation with address pointers incremented to the next entry in the invitation list. When the end of the list is encountered, the channel program instructs the channel to reset to the beginning of the list. Thus, the only time the control system need be aware that polling is in progress is when a message is elicited from a station. The autopoll feature imposes its very rigid format upon the design of the invitation list. By using this design for both autopoll and programmed poll, minimal work is required for the control system to change between one and the other.

The use of polling and addressing sequences for teletypes and terminals such as 1060's and 2740's enables a specific station on the line to be chosen to communicate with the control program. An additional capability is available with terminals such as 1030's and 1050's. A particular component of the terminal being selected may be specified. For example, a card reader of a 1050 may be polled for input to the central processor and, subsequently, the printer may be addressed for output.

An important characteristic of multipoint-terminal systems is the centralization of terminal control in the host computer. Both the direction and duration of traffic can be strictly governed by the control system. Since the system knows with whom it is in contact at all times, terminal identification is redundant. Message security and data privacy can be assured.

Start–Stop Contention (Leased) Lines

A scheme less costly than multipoint terminal control is provided by contention terminals. There is no hardware in the control units to allow de-selection of terminals or selection of a specified station. As a result, the central processor has no method of informing a remote location whether it is to accept a message or enter a message. All stations on a contention or point-to-point line are always in a selected state. The control system must therefore always be prepared to receive data from these remote stations unless it is transmitting an outgoing message to them.

Since the control system has no facility for organizing the control of traffic to and from these terminals, the installation must provide solutions to many of the inherent problems. When a remote station is entering a message, it does not know whether another terminal is also keying in a message. When the control system is transmitting a message, it does not know whether a remote terminal has just decided to enter a message. Furthermore, the remote stations are always in a selected state causing all messages sent from the central processor to be received at all stations on the line.

A method available to the control system for helping to regulate point-to-point traffic includes issuing a "prepare" command to the channel. When a message is being entered from a remote station, the "prepare" can be chained to a "sense" command which

would set a program switch inhibiting the control system from attempting to send any messages out at the time. If traffic should be initiated from the central processor just prior to the switch being set, two-way traffic on the line would cause a hardware error which could be corrected in the error-recovery procedures for the control system.

Message integrity cannot automatically be ensured by the control system. The installation must take steps to verify and acknowledge messages incoming to the processor. Data security can be assured only if the user restricts each point-to-point line to a single station.

Start–Stop Contention (Switched) Lines

Dial lines often provide many users with an economical alternative to leased tele-processing lines. Customers may set up terminals such as 2740's or 1050's with dial features or teletypes AT&T 33/35 (TWX) which operate on switched-connection telephone lines. Once contact between the terminal and the processor is established, the 2740's and TWX's are controlled as point-to-point, the 1050's as multi-point terminals. When the processor initiates contact, the control system knows the terminal dialed; but when the remote station initiates the call, a means for the caller to identify himself is often desirable. TWX, for example, has an optional hardware facility for the caller to send an identification sequence. The control system also can allow the operator at the remote location to include in the header of his messages an identification of the calling station.

The control system permits great flexibility in the method of establishing the call, and in the frequency of the calls. For any switched line, either the remote location, or the processor, or both, may initiate contact. The processor could be directed to call when there is at least one message for a remote terminal, or at a predetermined time of day, or at a specified interval after the previous call. One or more telephone lines could be set up at an installation for establishing a call. Thus during periods of heavy traffic when one line is busy, an alternate line could be obtained.

The control system supports the WATS (Wide Area Telephone Service) bands of common carrier lines. The tariff on each WATS band is determined by the territory covered by the band. Thus the control system will utilize the least expensive band possible to call a remote location. Only if that band is busy will a line in the next band be used by the control system to contact the specified terminal. If no lines are available for the processor to call a switched connection terminal, a request is queued for the first of the lines. When that line becomes free, the desired connection may then be made.

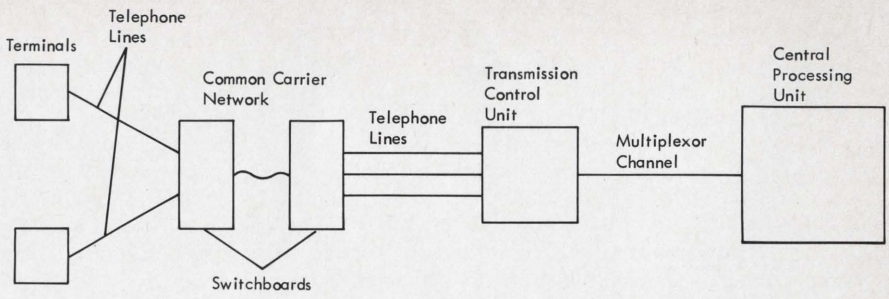

Figure 3. Point-to-Point Switched Line Configuration

Buffered Terminals

All the above-mentioned terminal types have the one following important characteristic: When a station is selected and entering a message to or receiving a message from the processor, a physical data path is established from the particular I/O component at the terminal to the central processor. This path is maintained until the entire message has been transmitted.

In contrast to this, terminals such as 2740 Model II, 1130, 2780 and remote S/360 Model 20 can operate to take advantage of its hardware buffer. When the terminal initiates a message, the first "block" of the message is entered by the I/O component into the station's buffer. When the station is subsequently selected, a path can be established between the control unit (buffer) and the processor. The data rate on the communication line is far greater than could be achieved with a non-buffered terminal where the transmission rate was determined by a card reader or a printer. The terminal is then de-selected while the I/O unit is entering the next "block" of the message into the buffer. In a multipoint configuration, this interval permits all other "ready" terminals on the line, each in turn, to be selected to enter or to accept the next "blocks" of their messages.

During the data transfer between the I/O unit and the buffer, if an input error is encountered, the data is re-entered to the buffer. No "line time" is required for this operation since the station is not ready and will not yet respond affirmatively to its poll. On output from the buffer to the I/O unit, corrections of output errors are possible off-line in a similar fashion. Thus a benefit of buffering data at the terminal site is that the central processor and communication line are freed of the responsibility of re-sending (or re-receiving) message data to correct *terminal* I/O errors. Of course, errors arising during transmission between the terminals and central processor rather than during the inputting or outputting of data, will still require a retransmission.

Thus multipoint buffered terminals present several new problems for the control system. A transmission, which had been previously equated with a complete message, can now indicate a message block. Control information in the processor must be defined for each buffered terminal through which all the separate message blocks originating at that site may be logically chained to each other.

A scheme must also be devised whereby the control system knows precisely when to return to each station to select it again. If it returns too soon, a "not ready" response will be generated by the terminal. Processor time will have been lost constructing the channel program and, in the case of output operations where messages are queued on a disk, disk time will have been wasted reading a message block. (The message block must be discarded and subsequently re-read from the disk since to retain it would mean tieing up the processor buffers until the terminal was ready.) If the control system returns to select the line too late, valuable line time will have been lost.

A scheme for determining when a station may be selected again requires the installation to define a data rate (in characters per second) to describe the data speed between each I/O unit and the terminal's buffer. For output messages, the control system can take the product of this rate and the number of characters in the current message block as the time that must elapse before the terminal can again be selected. For input messages from the terminal, no approximation can be made, since an undetermined amount of characters will comprise each message block. Since the processor work involved in incrementing an invitation list to the next entry is minimal, the inability to predict the precise time to re-poll a terminal for the next message block is not at all serious.

Two of the three types of priority management are reasonable for buffered terminals. In equal priority, a complete pass is first made through the invitation list. If the autopoll feature is in use, all of the active terminals on the line are polled to permit each in turn to enter a message block. If a programmed poll is employed, only these terminals not currently engaged in accepting data from the processor or not held up in a delay interval will be polled. Thus each terminal in the list is invited to enter a message block.

When all of the terminals in the invitation list have been handled, those stations not involved in entering messages and for which outgoing traffic has been queued will be selected, one after the other, and sent a message block. The interval that must elapse for each station before it can again be selected is then calculated as the product of the data rate of the output component of the terminal and the number of characters in the message block.

The only difference between equal and send priority is that the latter does not require output traffic for terminals to wait until the end of the invitation list is reached. At the end of receipt of a message block or negative response to a poll, an outgoing block of data will be sent to each station that can accept it.

These problems discussed for buffered terminals via multipoint environment are not found in point-to-point or switched networks since contact with only one station at a time is possible.

Device Characteristics

Most of the terminals that can operate as buffered stations are handled by binary-synchronous (BSC) line control rather than start–stop. Although the types of terminals that can be mixed on the same line are limited for start–stop communication, most binary synchronous types may be mixed on a line. Moreover, one or more BSC terminal types can call the computer over the same set of dial lines. This ever-increasing family of compatible tele-processing stations, if it is to find full support for its terminal compatibility, requires that the control system provide a language to describe the functional characteristics of its member terminals. Thus, a station is not defined or handled by the name of the device; rather, once the name of a device is given, its characteristics are looked up and all future references made to these characteristics. For example, the device is described to the control system in terms of its buffer size, ITB requirement, transmission code, etc. Thus, the channel program generation and terminal control may be organized simply and succinctly for all of the terminals comprising the functionally compatible set.

Additionally, the inclusion of an unsupported device is not a major effort if the device can be defined to the control system in terms of functional characteristics already supported. The language provided to the user could map his functional definitions into a string of bits describing the station to the control system.

Line Control Considerations

Coordination of data transfer between the host computer and remote terminals is maintained by use of line-control characters before, during, and after each message. If a message is switched between two like terminals, the control characters in the incoming data stream may be left unchanged when the message is outputted to its destination. For example, text entered from a 1050 is delimited by Ⓓ and Ⓒ, and segmented into blocks by Ⓑ. If the message is forwarded to a 2740 with station control feature, the line control may be left intact. Moreover, the segmented blocks of the message may be of varying size. The "variable format" facility of the control system allows this retention of line control in the incoming messages.

If, however, the message is destined for, say an 1130 station, the control characters must be deleted by the control system when the message arrives at the CPU. "STX" and "EBT" codes must be inserted by the control system to delimit each block when the message is prepared for transmission to the 1130. The last block, however, must be delimited by "STX" and "ETX," and the entire message ended with an "EOT." The inclusion of control characters appropriate to the destination station is further complicated by the need to reblock the segment blocks into units to best meet the requirements of the destination station. Since only one block size may be specified for a given terminal or component, all messages to that destination will be blocked to the same size. The block size for a station may be altered on a per-message or per-application basis. This "fixed format" facility of the control system could remove the awesome task of blocking the message segments and handling line control from the user of the telecommunications system.

Akin to the manipulation of line-control characters is the handling of format-control characters. This could provide for the movement and positioning of the I/O components at the remote stations. Characters such as "new line," "carriage return," "line feed," "tabulation," etc., interspersed in the message text allow a great flexibility in control of the tele-processing components. A macro-instruction facility can allow the user to insert or delete specified format characters from his message.

There are, of course, numerous other functions associated with line and terminal management. An effective discipline for the I/O control relies heavily upon the techniques by which messages are queued, buffer space is allocated in the host computer, and processing functions are available to serve the diversity of applications. Unfortunately, these topics are beyond the scope of this article. I have, however, explained the methods by which a proposed control system could manage start–stop and BSC lines, buffered and non-buffered terminals, point-to-point, dial, and multipoint networks. Perhaps the most significant test of the above-mentioned techniques is their adaptability to specific installations. If, through simple definition of macro-statements and selection of functions, the user can tailor the proposed control system to monitor his tele-processing network so that he achieves maximum utilization of his communication lines in a minimum of main storage and with a minimum of processor time, the test of the system will be proved.

ROBERT M. WINICK

The author is a staff programmer in telecommunications in IBM's Systems Development Division laboratory at Research Triangle Park, N. C. He helped design and implement basic and queued telecommunication access methods (OS/BTAM and OS/QTAM). At present, he is coordinating the development of an advanced telecommunication access method (OS/TCAM).
Mr. Winick has a B.A. in mathematics from Columbia University.

financial currents

Computer System Architects, Inc. has been formed in Cambridge, Massachusetts to supply system-architectural needs to companies developing computer-based products. The principals in the company are John Thron, President; Robert Tomlin, Vice President–Research; and Robert F. Morse, Vice President–Operations.

* * *

Computers Unlimited, Inc. has opened its first computer center in Rochester, N. Y., to offer time-sharing, batch processing and programming services to EDP users in Upstate New York. The new center is equipped with an IBM 360/67 computer, and the peripheral equipment that is specially designed for time-sharing.

* * *

Bradford Computer & Systems, Inc., New York, has announced a five-year agreement with International Paper Co. to continue to manage and operate IP's corporate computer data center in New York City. Bradford Computer Systems will also provide systems design and other consulting services to International Paper.

* * *

International Systems Associates, Ltd., New York, has announced the formation of two new divisions **ISA Forms, Inc.,** and **J. Carlton's, Inc.,** both of New York. ISA Forms, Inc., will market a complete range of business forms, computer tapes and disks, ribbons and punch cards; and J. Carlton's, Inc. will utilize recent ISA advances in mail order data processing technology to market "new and unusual" items that range in price from $3 to $300.

* * *

Levin–Townsend Service Corp. (LTS), New York, and **Sigma Data Computer Corporation,** Bethesda, Maryland have jointly announced an agreement, whereby LTS will participate in the marketing of Sigma Data's Inquiry and Reporting System throughout the United States and Canada. Sigma Data is engaged in the application of advanced computer analysis and software techniques for government and industry and LTS, a subsidiary of Levin–Townsend Computer Corporation, is currently engaged in the marketing of several software packages, as well as providing consulting, programming, education and data center services.

* * *

Show World, Inc., New York owners and managers of COMPSO, the three regional Computer Software and Peripherals Shows and Conferences, has merged with and into **Computer Expositions, Inc.,** a publicly owned company. Both companies specialize in trade show management in many fields, and will continue to serve business and data processing management through the new organization.

* * *

A group of highly specialized problem solvers formerly with IBM have joined forces to form **CORSTAR** Business Computing Company. CORSTAR will be based in White Plains, N. Y., and will provide the capability of creating customized Management Information Systems and their related Databanks. John F. Sitar is the President of the new company.

* * *

Alphanumeric, Inc. (OTC), Lake Success, N. Y., and **Alphatext Systems, Ltd.,** a Canadian corporation, announced the formation of a jointly-owned Ottawa-based Canadian company called Alphanumeric Textran, Ltd. Alphanumeric is a supplier of computerized services and equipment for the printing, publishing and data processing industries. Alphatext Systems is an Ottawa-based firm which offers computerized text processing services.

* * *

J. Roy Morris, President of **Cybermatics, Inc.,** (OTC), the Fort Lee, New Jersey based computer services company, and Sal Carci, President of **Carci Computab Systems Inc.,** (OTC), Hauppauge, New York, a computer business forms company, announced an agreement in principle for the merger of Carci Computab into Cybermatics. Carci Computab manufactures and sells continuous, single and multi-copy business forms used in computer systems, whereas Cybermatics is an independent software company serving as a general systems contractor and supplier of on-line systems and computer based services.

* * *

Access Systems, Inc., Paramus, New Jersey, has announced that the company will change its name to AXICOM SYSTEMS, INC. Axicom offers time-sharing capabilities and services to the business and scientific community of the Northeastern United States, with the UNIVAC 1108 and an Exec 8 operating system. Clients of Axicom are offered the choice of real-time, demand or batch processing capabilities.

* * *

Computer Transceiver Systems, Inc. (CTSI), Upper Saddle River, N. J., has entered into a field service agreement with **Honeywell, Inc.** According to the agreement, Honeywell will provide a complete range of maintenance and repair facilities for CTSI's products line. CTSI is currently producing the Executport 300, a lightweight thermal-page-printing data transceiver. The 27-pound unit is completely self-contained in a portable carrying case. In addition to the Execuport 300, CTSI is developing several other related products in the data communications field.

* * *

Automatic Data Processing, Inc. (ADP), Clifton, New Jersey, a national computer services company, has reached an agreement in principle to acquire **Electronic Data Service, Inc.** (EDS), a Chicago-based data processing service firm; has agreed to acquire **MSM Computer Service** of New York City; and has completed the acquisition of **Tamcor, Inc.,** a New York City data processing firm. Electronic Data Service, Inc., provides payroll, accounts receivable and a broad range of commercial data processing services to 175 customer firms in the Chicago area. EDS's computer center will now serve as a base for marketing ADP's payroll and other commercial data processing services in the Chicago area.

* * *

Scientific Resources Corp., (NYSE), Philadelphia, has announced a joint development program and marketing agreement with **Globe Universal Sciences, Inc.** (Private), Midland, Texas. Under the agreement the new seismic software developed by Globe will be marketed excusively by Scientific Resources. Globe is an integrated earth sciences company operating in the United States, Canada and Alaska's Northern Slope, and Scientific Resources Corporation is a computer technology company in the information industry and a developer of total computer systems for industry, government and management.

Drexel Data Systems, Conshohocken, Pa., has announced a merger agreement with **Ventura-Data Corp.** of Conshohocken, Pa., whereby the company becomes an operating division of VDC. Drexel Data Systems is a data processing software and consulting firm in all phases of EDP, including programming, systems, planning, communications and control.

* * *

A new management consulting firm, **Decision Sciences Corporation,** Jenkintown, Pa. has been formed to specialize in decision support systems used to aid management decision-making in government, business and industry. The President of the new company is Donald F. Blumbert, formerly Vice President of Computer Sciences Corporation.

* * *

Calculator-Computer Leasing Corporation (CCLC) of Pittsburgh has acquired **Caribe Data Processing, Inc.** (CDP), a computer service in San Juan, Puerto Rico. The Chairman of CCLC said that the purchase was made with cash and CCLC stock, and included a computer programming school, Royal Computer Institute, also located in San Juan. CDP develops computer programs for payrolls, inventory control, accounts receivable and bookkeeping functions, and markets a complete computer service for these functions.

* * *

Comress, Inc., Washington, D. C. has announced the acquisition of an 80% interest in **Complex Systems, Inc.,** of New York City. Complex Systems specializes in the development of custom tele-processing computer systems for financial institutions and organizations and Comress, Inc. is a computer software and consulting firm.

* * *

National Data Processing Corporation, Cedar Rapids, Iowa has changed the name of the company to Network Data Processing Corporation and the company has opened executive Headquarters in Oak Brook, Illinois.

* * *

Systems Engineering Laboratories, Inc., Fort Lauderdale, Fla. and **Spectral Dynamics Corporation** of San Diego have jointly announced that they have reached an agreement in principle under which Systems will offer to exchange ⅝ths of a share of its common stock for each share of Spectral Dynamics common stock. Systems, is a manufacturer of digital computers and systems utilizing them. Systems markets its computers, systems and other products through direct sales and service locations throughout the United States and Canada. Spectral Dynamics is a designer and manufacturer of electronic instruments used in vibration and acoustic analysis, data acquisition and structural design and of custom systems using these instruments.

* * *

Delta Computer Corporation, Baton Rouge, La., has filed a registration statement with the Securities and Exchange Commission covering the proposed sale of 200,000 shares of Common Stock. Delta Computer provides general data processing services for commercial, industrial, financial, governmental and educational institutions.

* * *

Last year several major U. S. and Canadian organizations banded together to create the "Optical Character Recognition User Association". To eshablish a common denominator, only users of one manufacturer's optical equipment were invited to join the Association. However, in a two-day session just completed, the organization has decided to open its doors to all OCR Users.

* * *

Factsystem, Inc. has announced licensing of its total management information system to **Data Power, Inc.** The Factsystem software package is designed to make comprehensive processing service available to a full spectrum of small and medium-sized businesses, in addition to the larger organization conventionally employing automated processing.

* * *

Fabri-Tek, Inc., has acquired the Connector Division of **National Connector Corporation** in an agreement signed by officials of both companies. The division will be integrated into Fabri-Tek's total marketing strategy as a supplier to the computer industry and will be operated within the company's management structure. Fabri-Tek is a leading manufacturer of computer memory components and systems, special use computers, educational computer trainers and instructional programs and printed circuit boards.

* * *

Control Data Corp. has announced that it has acquired all of the outstanding stock of the **Precision Data Company, Ltd.,** of Toronto, Canada, in exchange for 33,268 shares of Control Data Common stock. Precision Data is engaged in the manufacture and sale of tabulating cards, disk packs, magnetic tape, and other products related to the computer business. It also manufactures and sells a magnetic tape cleaner. Control Data also provides a

broad range of other computer systems, peripheral products, services and business supplies to the data processing industry. CDC's product line of business supplies includes tabulating cards, business cards, business forms, disk packs, computer printer ribbons and certified magnetic tape.

* * *

Control Data Corp. and **Biomedical Computer Services, Inc.** have entered into an agreement to cooperate in the development and implementation of total systems capabilities in the health care field. Under terms of the agreement, Biomedical Computer Services of St. Paul will develop a total integrated system design including applications and problem-solving techniques for the administration and operation of hospitals, physicians' offices, clinics, extended care facilities and other allied health care services. Control Data will develop operating systems and related software and communications capability for medical utilities employing CDC 6000 series computer systems.

* * *

Ticket Reservation Systems, Inc. has announced that it has acquired the business and assets of **Terminal Applications Corporation,** a wholly-owned subsidiary of Control Data Corporation Terminal Applications Corp. is engaged in developing a range of application services via terminals over a national communications network. An Example of one of the first services to be offered by Terminal Applications Corp. will be a computerized fare construction and automatic ticketing service for the airline industry. TRS' electronic box offices are located in banks, department stores, super-markets, travel agencies and other retail establishments, offering customers reserved seat tickets for a variety of theatrical, entertainment and sports attractions in the United States, Canada and Great Britain.

* * *

University Computing Company, Dallas, Texas and LTV Aerospace Corp. have annouced that negotiations have proceeded for the acquisition by UCC of half the 71 percent stock of **Computer Technology Inc.,** which is held by LTVAC. UCC is a multinational computing services firm with operations throughout the United States, and CT performs computer services for Ling–Temco–Vought, Inc., parent of LTVAC, and certain of its subsidiaries, including LTVAC. The agreement provides for a three-year period in which UCC will furnish corporate, financial, marketing and operating management advice and consultation relating to the operations of CT.

World Computer Corporation, Dallas, Texas, has announced that they will acquire National Communications Corporation, also of Dallas, Texas. NCC furnishes engineering, installation, maintenance and related services to the telecommunications industry including telephone companies and equipment manufacturers. World Computer Corporation presently offers customers computer software services, teleprocessing capabilities, equipment leasing and brokering, engineering design and development, and hardware systems manufacturing and marketing.

* * *

Recognition Equipment Incorporated, Dallas, Texas, and **Data Craft Corporation,** Fort Lauderdale, have announced that they have reached an agreement in principle under which Recognition Equipment will acquire 889,430 shares of Datacraft common stock and warrants to purchase an additional 499,169 shares of Datacraft common stock in exchange for the issuance to Datacraft of 142,309 shares of Recognition Equipment common stock. Recognition Equipment Incorporated is a manufacturer of optical character recognition equipment, and Datacraft Corporation is a manufacturer of digital computers and magnetic core memory systems.

* * *

Computer Complex, Inc., Houston, Texas and **Com-Share, Inc.,** Ann Arbor, Michigan, have agreed in principle to merge the two companies with 1.5 shares of Computer Complex, Inc. common stock to be issued for each share of Com-Share, Inc. common stock. Under the terms of the agreement, the time-sharing operations of Computer Complex will be merged into COM-Share which will operate as a wholly-owned subsidiary of Computer Complex, Inc. Com-Share, Inc. provides time-sharing service in 34 cities in the United States and Canada. Computer Complex provides time-sharing service in 18 cities. The combined companies will provide increased national time-sharing coverage since the companies do not operate in the same areas to any substantial extent at this time.

* * *

Ennis Business Forms, Inc., Texas, has concluded the acquisition agreements of UP Corp., a New York City-based business forms company and for Hospital Data Systems, Inc., a Massachusetts firm specializing in hospital systems. Ennis will now warehouse its continuous and other stock forms for sale in the New York City

area, and equipment is being installed there to produce continuous forms and specialty short-run business forms. Hospital Data Systems, Worchester, Mass., designs and manufactures a highly sophisticated line of hospital forms and systems under the trade name COPAC —Computer Oriented Patient Accounting Control.

* * *

Computer Image Productions, Denver, Colorado, has been formed as a division of Computer Image Corporation to produce educational and industrial films and tapes utilizing the Scanimate and Animac Computers developed by the company. Computer Image Corporation is a leader in computer animation for television, motion pictures, educational and industrial films and videotapes.

* * *

Computer Sciences Corporation, Los Angeles, Calif. has formed a Development Division to develop the future computer-based systems which the company will market as proprietary products. The new division will also be responsible for developing the advanced systems software which the company supplies to computer manufacturers and major users of computers.

Data Products Corporation, Los Angeles, Calif. has formed a Discfile Division to manufacture large disk store memories for computerized data storage and retrieval system. The new division will be responsible for line production of the new 6040 Discfile being marketed to the mainframe computer industry and the System/7000 Large Disc Store being sold with interface equipment and engineering services by the Corporation's systems division to the end user market. Data Products is a producer of peripheral electronic computer equipment, including line printers, core memory systems, card readers and punches, tape cleaners and testers. In addition, the corporation develops and manufactures data transmission and telecommunications equipment for commercial, industrial and military applications.

* * *

Republic Corporation, Los Angeles, Calif., has opened its new computer service center, managed by System Development Corp. (SDC). The center uses an IBM 360/65 computer and its major customers include large data processing users seeking to supplement their own data processing requirements. Additional services incorporating remote terminals for specific applications will be offered in the next few months.

* * *

Computer Publications, Inc. has changed its name "to more accurately define its multifunction research, advisory, and publications activities". The company will be known as Computer + Technology Information, Inc. Computer + Technology Information, Inc. has also announced the formation of a new division: Technology Research Bureau (TRB).

* * *

Transamerica Computer Company, San Francisco, has agreed in principle, to acquire Toronto-based Scientific/Commercial Research Services Limited (SCORE). SCORE provides system design and computer programming services for a wide variety of applications, including information retrieval, computerized typesetting, library cataloging, and audience measurement and analysis. Transamerica Computer, which provides a wide range of services in the computer industry, is a wholly-owned subsidiary of diversified Transamerica Corporation.

* * *

Caelus Memories, Inc., a wholly owned subsidiary of Electronic Memories and Magnetics, has formed a Canadian sales subsidiary, Caelus Canada Limited. The new Canadian subsidiary will be structured after Caelus' domestic marketing organization.

* * *

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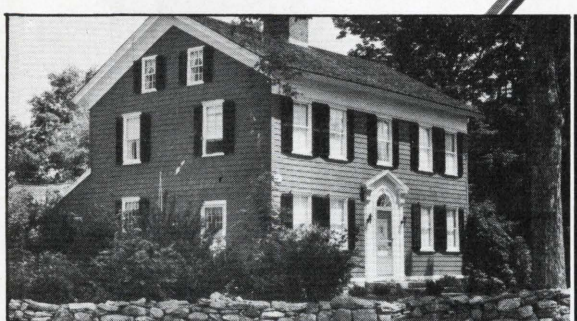

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All listings will be re-published in semi-annual summary issues of SOFTWARE AGE during the months of the S.J.C.C. and F.J.C.C.

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GROUPING . . . . . Listings will be grouped according to keyword, title, mainframe application and compatability, industry, etc. As listings grow, more categories and definitions will be added.

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This program is: Utility ☐ Systems ☐ Scientific ☐ Applications ☐ Engineering ☐ Management ☐ Other ☐

Title: | Number of Programs (if more than one)

Description: (Use reverse side if necessary)

Hardware Configuration:

Programming Language: | Documentation Provided:

On-Site Support/Debugging Available? Yes ☐ No ☐ Hours ☐ Guaranteed? Yes ☐ No ☐

Patent No. Copyrighted? Yes ☐ No ☐ | Number of Programs Distributed

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Broker Wanted ☐

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Description: (Use reverse side if necessary)

Hardware Configuration:

Programming Language: | Documentation Provided:

On-Site Support/Debugging Available? Yes ☐ No ☐ Hours ☐ Guaranteed? Yes ☐ No ☐

Patent No. Copyrighted? Yes ☐ No ☐ | Number of Programs Distributed

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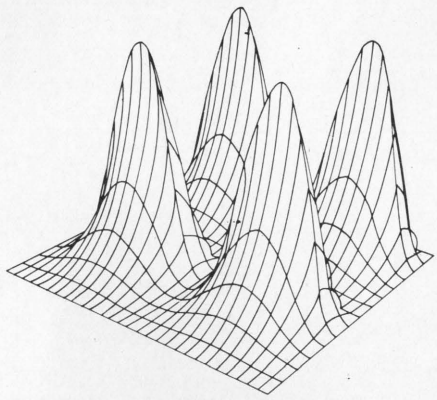
New Plotting Software

TRIDEM*

3-dimensional perspectives, stereos and isometrics

Written in FORTRAN, the TRIDEM package expands a plotting system's capability to provide 3-dimensional, perspective or stereo plots of any data which can be expressed as a function of two variables or in XYZ coordinates. You can make machine tool design plots from many angles... create complex energy spectrums for isotope study... produce frequency and impedance curves... do optical studies... or vibration analyses... or provide insights and correlations on any subject rather than spend long hours in scrutiny of numbers on a conventional graph.

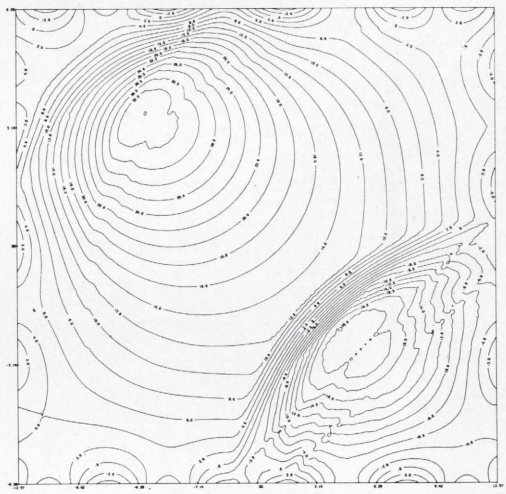


- Use with any standard plotting system.
- FORTRAN compiler and minimum core required.
- Lease price is $2500 total for the first three years, renewable for $100 per 3 year period thereafter.
- Complete programming documentation provided.
- Full maintenance and updating included.

CØNTØUR-PLØT*

30 times faster than hand drawn maps

The CONTOUR-PLOT system is a verb-orientated, inherently logical and flexible programming system to produce complex, fully-annotated contour diagrams of high graphic quality comparable to carefully hand-drawn maps—at a speed 30 times greater. An outstanding feature is the ability to manipulate surfaces stored within the system. Intersections, unions and other arithmetic operations are now possible with this contouring package. Surfaces are stored in the system and can be assessed at will. Applications include onshore and offshore geophysical studies for nuclear, radiation and thermal analyses; communication, aerospace, meteorology and other gridded data studies.



- FORTRAN IV language
- Use with Houston Instrument or any standard plotting system
- Lease Price:

Basic	$8500.
Multiple Surface Option	$2000.
Isometric Option	$1000.
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Profile Plot Option	$ 500.

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The CONTOUR-PLOT package works in conjunction with the TRIDEM* package to produce 3-dimensional contour plots. Send for brochures.*

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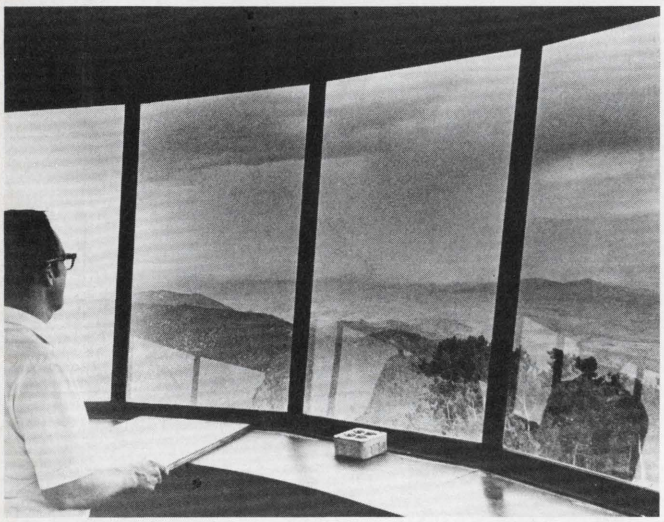

Scientists at Langmuir Laboratory, which is just west of Socorro, New Mexico, are trying to determine the causes of thunderstorms and the associated lightning and rain. The Laboratory, which is supported primarily by the National Science Foundation, sits atop a 10,600-foot peak in the Magdalena Mountains where thunderstorms occur almost daily during the summer and autumn.

Information from the cumulonimbus (thundercloud) clouds is obtained and fed into an IBM System/360 Model 44. In the brief course of a lightning bolt, the IBM system shows what all the sensing devices record. Readings include temperature, pressure, water content, heat energy, electrical energy, thunder intensity and several other scientific measurements.

There are several methods being used by the scientists to obtain further information from the thunderheads. One specialist fires instrumented rockets into the thunderheads to measure the electrical fields inside the storms. The tips of the rockets contain delicate miniaturized electronic measuring devices and transmitters which broadcast the readings back for processing.

Another group at Langmuir has stretched a thick 7,000 foot steel cable between two mountain peaks. Lightning attracted to the cable is analyzed by the system. Scientists also use the cable coupled with a 100-thousand volt electrical generator to induce electrical changes in thunderclouds—by forcing man-made electrical charges into the clouds.

Several scientists, using a long tube held aloft by air pressure and a balloon, blast electrically-charged smoke particles into the bases of the clouds. By experimenting, they hope to learn how the electrical properties of clouds alter or hasten the formation of water drops.

Some scientists gather information by sending up instruments on huge helium balloons; others fly through storm cells in instrumented airplanes. One scientist flies through thunderclouds gathering air samples. By examining radon—a radioactive gas emitted from the earth—he and his associates are tracing air currents associated with the storms. Other data gathering devices include a closed circuit television network showing the appearance of storms overhead from different locations, radar to observe the rain that follows lightning, sensitive ammeters that measure the Saint-Elmo fire currents that flow into the air under thunder storms, acoustical recorders for studying the nature of thunder, and dozens of other sophisticated devices designed and built by the scientists to measure storm properties.

The scientists at Langmuir say that the computer analysis of the noise of the thunderclaps analyzed by the computer represent only one-fourth of one percent of the total energy released in the electrical discharge.

These studies continue and it is hoped that a comprehensive knowledge of thunderstorms —and the tornadoes associated with large thunderstorms—might someday enable man to control tornadoes and hurricanes.

Doctors of the University of Florida's J. Hillis Miller Medical Center are using the computer to simplify the job of diagnosing thyroid disease. Information is supplied by the patient and fed into an IBM 2741 terminal which connects, via a telephone line to an IBM System/360 Model 50 located at the University's computing center. The computer processes the data in less than a second, comparing the patient's condition with known diagnostic findings on 2,000 thyroid cases. A complete report, listing diagnostic probabilities figured mathematically and a conclusion, is printed back on the terminal within two to three minutes. When the data is not sufficient for diagnosis, the computer suggests additional laboratory tests to increase the probability of obtaining a proper diagnosis while the patient is still in the hospital. The reports are also checked by specialists who have found them accurate in

95 percent of all cases.

The computer facilitation of thyroid condition diagnoses is important because the thyroid has such a profound effect on the health and energy of the human body. Essentially the thyroid accumulates the body's scarce supply of iodine and synthesizes the substance into the hormone thyroxin. An insufficient supply of thyroxin, a condition called hypothyroidism, causes the body's machinery to slow down. Symptoms of hypothyroidism may include low body temperature, weakness, fatigue, poor appetite, and sometimes, weight gain. An excessive secretion of thyroxin, hyperthyroidism, causes physiological overactivity that can lead to severe strains on vital organs. The symptoms of hyperthyroidism include irritability, nervousness, warm feelings, frequent perspirations and heart palpitations during minor exertions.

Diagnosis is particularly important because effective treatments are so readily available. Physicians may administer synthetic thyroxin when the hormone is deficient or, for hyperthyroidism, they can surgically remove part of the overactive gland or inhibit it by radiation.

Fitzgerald, the radiation physics instructor who developed the computer program, says that although excellent tests are available to measure the body's thyroxin quantity and its circulatory action, diagnosis of thyroid disease has proven difficult because only one of many classic symptoms may be apparent in individual cases.

Bud Goode, a Los Angeles sports writer is using a computer's electronic analysis to aid him in writing a year-round sports column.

Each week Goode feeds huge amounts of statistical data on the previous week-end's football games from a UNIVAC 1004 remote input station in Los Angeles, to a UNIVAC 1108 computer in the Univac Information Services Division network of data processing centers. The computer compares the data with previous statistics on a team's performances and calculates the current effectiveness of a team on a wide variety of points.

For example, Michigan came into the Rose Bowl a slightly better team than the University of Southern California, the computer indicated, because of a superior running game, 280 yards per game on the ground compared to 216. However, the computer also noted that Southern Cal had allowed only 96 yards per game rushing.

According to the computer analysis the pass interception is football's most important play and is responsible for most upsets and furthermore, the computer notes that a team which picks off one more interception than its opponent will win 80 percent of its games.

Also, according to the computer

- Passing is more important than running in professional football, but running is more important than passing in collegiate games.
- The most decisive statistic for a pro team's standing is the number of opponent points scored per pass attempt. This measures the ability of the defensive secondary.
- During the 1969 pro football season, offense has proven to be about five percent more important than defense.
- The most important statistic in measuring a quarterback's ability is average yards per pass.

In spite of the incredible scrutiny of the variables by the computer some other factors continue to have a deciding influence. For example, in April the computer selected the New York Mets to win the National League's Eastern Division; however, in August the machine indicated that the odds were almost 100 to 1 against the New York Mets becoming the world champs.

The National Pet Registration Center in Gillette, New Jersey is attempting to prevent the tremendous numbers of "dog disappearances" that are occurring throughout the United States. Sal La Manna, head of the Registration Center, believes that about 50 percent of the two million dogs that disappeared last year were victims of dognappers who sell stolen dogs to laboratories and hospitals for use in research. La Manna's organization tattoos the dogs with the owner's social security number and registers these numbers on a UNIVAC 9200-11 computer at the Capital Data Processing Corp., Montclair, N. J. The computer also keeps an extensive information system on the traffic in lost and stolen dogs.

La Manna's system has registered about 10,000 dogs since it was started in 1968. Each dog receives a tag showing it has been tattooed and the owner is given decals for display at his home, telling potential dognappers that the animal has been marked with a permanent identification number.

La Manna has also notified state attorney generals, police departments, dog pounds, humane societies and the 1,500 laboratories across the country that use dogs as subjects of the dog registration system. The penalty for dognapping and transporting a stolen dog across state lines is a Federal Penalty of a $5000 fine and/or five years in prison.

Besides tracking down dogs that are registered, the computer also contains confidential information on many dog dealers, including the areas in which they operate; descriptions and license numbers of the vehicles they use; and whether or not they have been involved in dognapping. Also in the computer's memory are the names and addresses of all labs using dogs in their experiments and information on known locations of dog auctions.

A person anywhere in the country can request the computer's help. A woman in San Francisco recently notified the police that her beagle was missing. Although the dog wasn't registered at the National Pet Registration Center the computer provided the name of the dealer who operated in the area. The dealer, as it turned out, had the beagle.

The Ohio River Valley Water Sanitation Commission (ORSANCO) is using a computer in Cincinnati to analyze hourly water quality readings from the 981-mile-long Ohio River. Pipes, like the one shown, draw river samples and channel the water to one of the 27 monitoring stations along the river and its tributaries. Electronic devices at the stations constantly analyze the water for dissolved oxygen, temperature, pH, conductivity, oxygen reduction, potential chloride and solar radiation intensity. Data recorded at each station is then transmitted by telemeter to the ORSANCO headquarters office at Cincinnati and fed into the IBM 1130 computer.

The objective of ORSANCO is to assist the states in eliminating pollution from the river and its tributaries. When the agency was created in 1948, less than one percent of the 3.6-million people on the Ohio river were served by sewerage treatment facilities. Now there are operating facilities that serve 99.5 percent of the population. Along with the improvements in the quality of the water, the Ohio River has become a major source of recreation. Water skiing, boating and swimming have become very popular and fish are more plentiful in the river than in previous years.

In the picture a technician reviews a computer-generated report which pinpoints the sources of pollution through an identification of the condition that exists, and where along the river the condition was first detected.

TROUBLE-TRAN PRESENTS XTRAN'S ADVENTURES IN FORTRAN

By GEORGE N. VASSILAKIS

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TROUBLE-TRAN'S Objectives:

1. To have fun.
2. To promote USA Standard FORTRAN by pointing out differences and inconsistencies of existing FORTRAN Compilers.
3. To alert programmers to the physical limitations of hardware.

PROBLEM OF THE MONTH

Problem 21: Factorials Revisited

Write a program (in any language) to compute and print the exact value of 100 factorial. The answer has 158 digits and its magnitude is approximately 9.33×10^{157}.

If your answer is postmarked prior to February 10, 1970, you will be eligible for one of five $10 prizes. Winners will be selected by a random number algorithm.

NOTE: This problem will be a good exercise for the scientific programmer who rarely gets the opportunity to work with extended precision other than FORTRAN's double precision. It will also give everyone the opportunity to think about limitations imposed by hardware.

Answer to Problem 19:

According to mail received thus far, problem 19 was the most interesting problem ever published in this column. A good indication of this is the variety of solutions I have received. I had expected to see a few FORTRAN solutions, one or two PL/1 solutions and maybe (just maybe) a COBOL solution. Instead, I have received solutions on practically every machine and language you can imagine. Would you believe a Flexowriter solution? Is this programming?

About 60% of the solutions received thus far are in FORTRAN. The non-FORTRAN solutions are dominated by PL/1. In general, this problem was rather simple for those languages and systems which operate in the interpretive mode. In a time-sharing environment, all one has to do at execution time is to get a hold of the source file and list it. The problem becomes much more difficult in a batch processing environment where the source file is not available at execution time.

Most FORTRAN solutions had used DATA statements to fill an array with hollerith information which, when printed with proper formats, generated an identical copy of the source program. Some FORTRAN users avoided the DATA statement but found other ways to initialize arrays with the needed hollerith strings.

J. B. Heidebrecht of TRW submitted a rather puzzling solution (CDC-6500 FORTRAN) which was printing the source program out of an array in labeled COMMON without putting anything into it. As it turned out, this array overlapped the compilers input buffer which contained the source of the latest compilation. Other FORTRAN solutions ranged from a few statements to 400 statements!

The best FORTRAN solution was submitted by E. Roberts of MIT–Lincoln Labs. As you see, his FORMAT statement will output the entire source program.

```
      WRITE(6,100)
      STOP
100   FORMAT(6X,12HWRITE(6,100)/6X,4HSTOP/
     . 42H   100 FORMAT(6X,12HWRITE(6,100)/6X,4HSTOP/      ,2(/5X,67H.
     . 42H   100 FORMAT(6X,12HWRITE(6,100)/6X,4HSTOP/      ,2(/5X,67H.
     . )/T48,2H)/T1,5X2(21H.)/T48,2H)/T1,5X2(21H)/
     . T62,10H)/6X3HEND)T1,5X2(28H.T62,10H)/6X3HEND)T1,5X2(29H)/
       6X3HEND)
      END
```

PL/1 solutions were similar to FORTRAN. COBOL solutions were lengthy but they did the job thanks to the PICTURE definition. IBM 360 Assembly Langauge programmers did a fine job. Congratulatins to H. B. Hoyle, College of William and Mary, who surprised me with a solution which consists of 30 hexadecimal constants and the END card. According to J. R. Mashey of State College, Pennsylvania, this problem was a snap for SNOBOL4. His solution was on three cards. COMPASS programmers had an easy job, because the assembler's input buffer was available to them at execution time. A 5-Card SIMSCRIPT II solution by R. Villanueva of Simulation Associates was rather interesting because the first three cards were identical and cards 4 and 5 were also the same. APL, LISP and ADPAC solutions were very interesting.

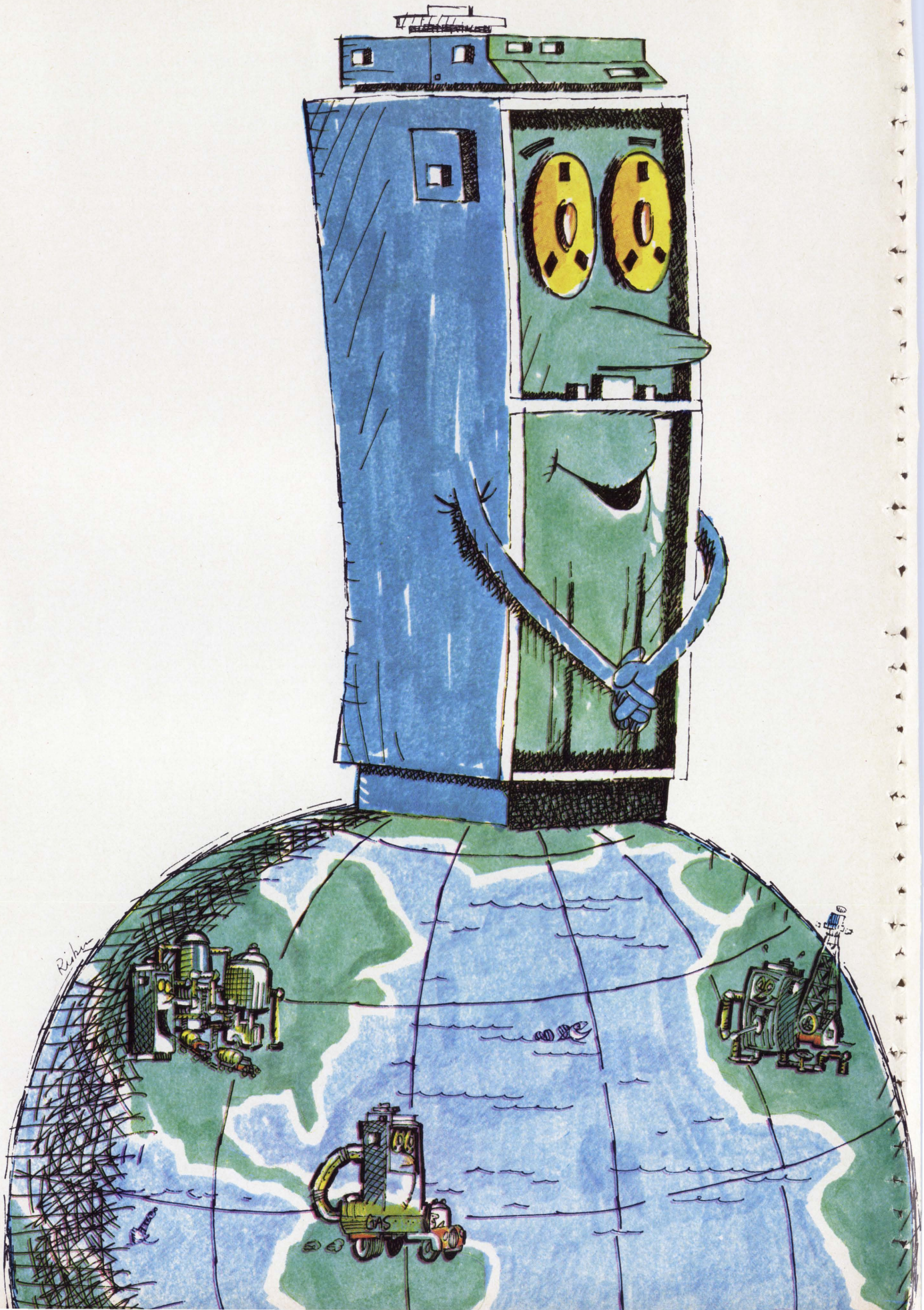
Users of small machines such as IBM 1401, IBM 1620, Honeywell 200, etc. submitted one card programs which print themselves when the card is read and the program is started.

Another interesting solution was submitted by J. J. Saffert of Lawrence, Kansas. He used "Hull's Hypothetical Computer" simulated on a GE-635. This is defined in a book "Introduction to Computing" by T. E. Hull.

Surprisingly enough, I have not seen any ALGOL solutions but I'm still hoping.

P. S.: Winners of this problem will be published next month.

XTRAN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