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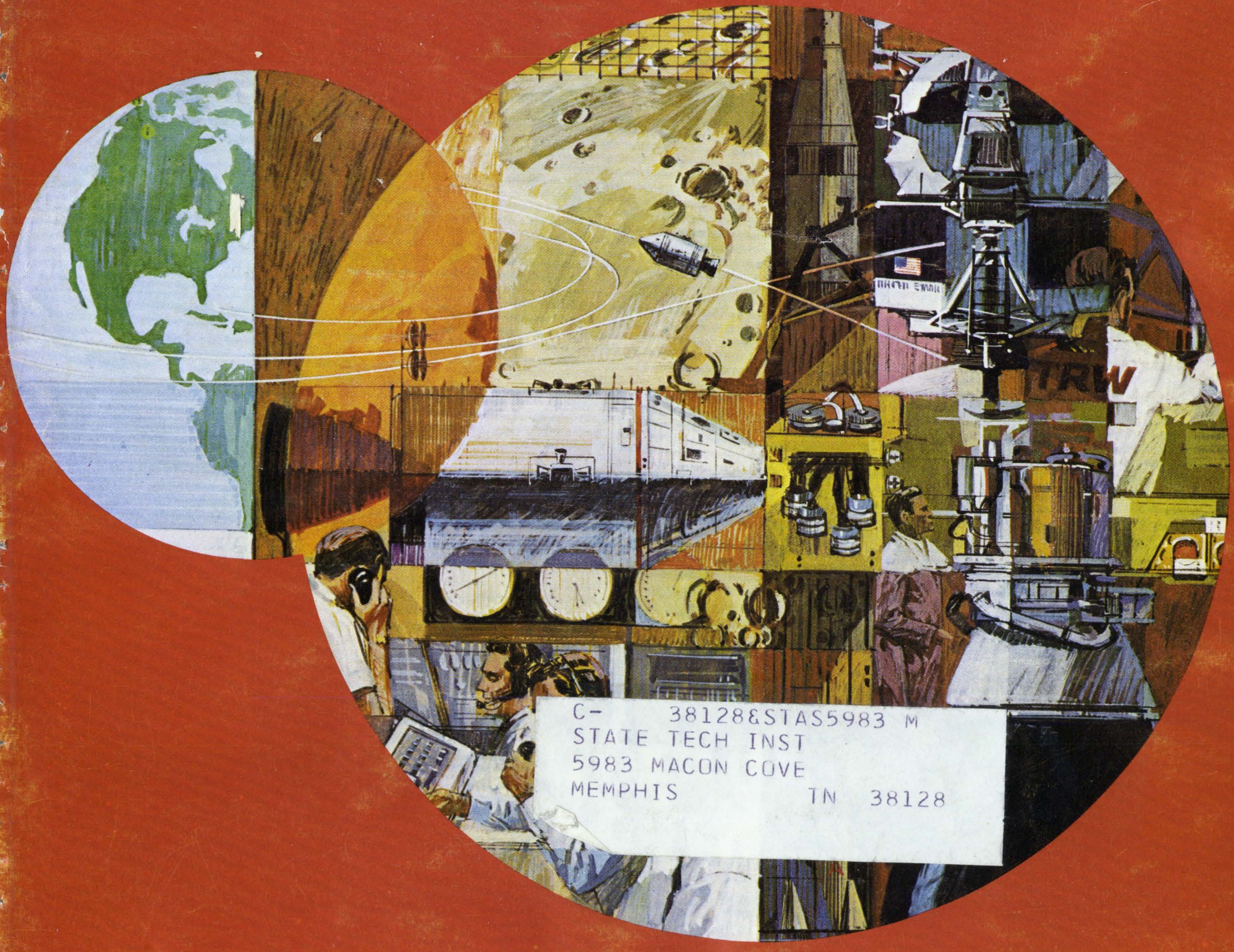

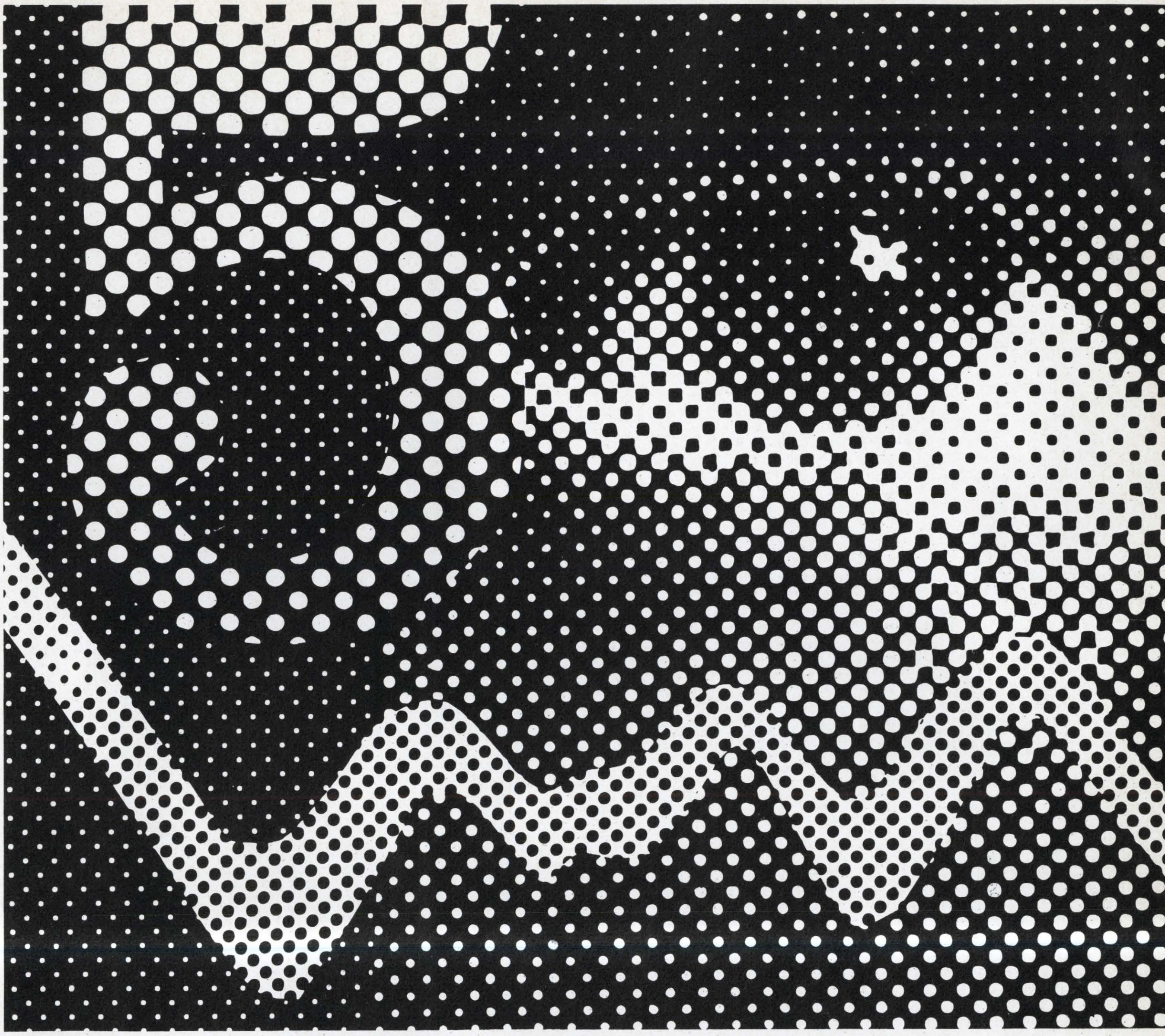

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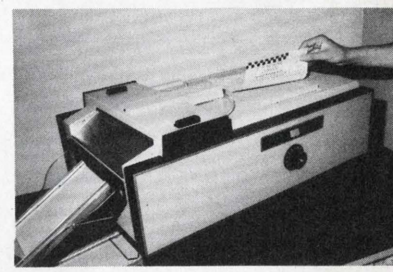

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FIGURE I

EQUIVALENT TRANSPORTATION MATRIX

	b	4	5	12	13	13	14	15	15	18	18	24	25	29	32	33	45	47		
a	i \ T	4	8	8	2	4	7	3	5	4	3	8	4	1	8	8	6	8	S′ai	Lai
2	6	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0	1
4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0	1
8	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0	1
10	5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0	2
10	9	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0	2
11	4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0	1
11	6	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0	1
11	5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0	1
20	8	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0	1
23	7	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0	1
23	2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0	1
23	1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0	1
31	4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0	1
33	3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0	1
34	8	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0	1
	Sai	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	UiT	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		

TABLE I

SCHEDULE OF LOADINGS

LOADING POINT *(i)*	LOADING DATE *(a)*	DELIVERY POINT *(j)*
1	9/23	4
2	9/04 9/23	8 8
3	10/03	6
4	9/11 10/01	8 8
5	9/10 9/10 9/11	2 4 5
6	9/02 9/11	4 7
7	9/23	1
8	9/08 9/15 10/04	3 8 8
9	9/10 9/10	3 4

FIGURE II

Maximize

$$X_{4,1} + X_{4,2} + X_{6,1} + X_{6,2} + X_{7,1} + X_{7,2} \cdots + X_{15,9} + X_{15,10} = z$$

Subject to:

$$X_{4,1} + X_{4,2} + S'ai_1 = 2$$

$$X_{6,1} + X_{6,2} + S'ai_2 = 1$$

$$\vdots$$

$$\cdots + X_{15,9} + X_{15,10} + S'ai_{15} = 1$$

$$X_{4,1} + X_{6,1} + X_{7,1} \cdots + Sbj_1 = 1$$

$$X_{4,2} + X_{6,2} + X_{7,2} \cdots + Sbj_2 = 1$$

$$\vdots$$

$$X_{13,12} + Sbj_{12} = 1$$

An Algorithem for Rapid Reassignment of Motor Freight Carriers

William S. Hipp

Supervisor
Seismic Applications
Houston Data Center
Control Data Corporation

SYNOPSIS: An algorithm is proposed for rapid solution of a carrier reassignment problem. Given a shipment schedule, the reassignment problem is: find the minimum number of carriers needed to complete the schedule, where reassignment of a carrier after completion of its initial assignment is allowed.

TABLE II

DISTANCES IN TIME EQUIVALENTS

(tij)

i \ j	1	2	3	4	5	6	7	8
1	6	2	6	2	5	5	2	1
2	7	2	7	2	6	5	3	1
3	12	6	12	16	11	12	15	16
4	6	2	6	3	5	6	3	1
5	6	3	5		4	6	3	1
6	6	2	6	2	5	6	3	1
7	6	2	6	2	5	5	2	1
8	10	13	10	13	9	18	13	13
9	5	8	5	8	4	15	8	8

TABLE III

SCHEDULE OF ARRIVALS

DELIVERY POINT *(j)*	ARRIVAL DATE *(b)*
1	9/29
2	9/13
3	9/15 9/18
4	9/04 9/13 9/18 9/25
5	9/15
6	10/15
7	9/14
8	9/05 9/12 9/24 10/02 10/13 10/17

TABLE IV

a	*i*	*Lai*	*b*	*j*	*Ubj*
2	6	1	4	4	1
4	2	1	5	8	1
8	8	1	12	8	1
10	5	2	13	2	1
10	9	2	13	4	1
11	4	1	14	7	1
11	6	1	15	3	1
11	5	1	15	5	1
20	8	1	18	4	1
23	7	1	18	3	1
23	2	1	24	8	1
23	1	1	25	4	1
31	4	1	29	1	1
33	3	1	32	8	1
34	4	1	33	8	1
			45	6	1
			47	8	1

■ ***Introduction.*** This paper outlines a direct computational procedure for extremely rapid solution of the reassignment problem in which it is desired to minimize the number of carriers required to meet a fixed schedule. The method takes advantage of a unique formulation of the problem presented by Dantzig and Fulkerson and originally intended for resolution by the simplex algorithm.

Development of practicable scheduling models for use in small and medium size computers has been hindered in many instances by storage limitations where special transportation codes are involved, or by time considerations where linear programming systems are used. The procedure described here provides a solution time which must be considered instantaneous in terms of conventional techniques. Significantly, program requirements are minimal allowing maximum utilization of core for the problem matrix.

The Problem. Assume a schedule of product movement such that we have a number of loading points (i) at which carriers are to be loaded for deliveries at points (j), Table I. Distances in units of time between all shipping and receiving points are known (these may include corresponding loading and unloading times), Table II. All carriers are considered to be interchangeable so that complete freedom of movement exists between all loading and receiving points. The schedule of product movement is expressed in unit carrier loads so that each delivery must be followed by a return to some loading point. The problem is to determine a pattern of carrier assignment such that the given schedule of product movement may be accomplished with the minimum number of carriers.

Formulation. From Tables I and II determine a schedule of arrival times as shown in Table III. Ordering the loading and delivery schedules by date, we derive Table IV where

L_{ai} = the number of carriers loading at i at time a

U_{bj} = the number of carriers unloading at j at time b

and defining

X_{aibj} = the number of carriers *reassigned* from delivery point j at time b for reloading at point i at time a.

We now construct a rectangular array of spaces, each row being identified by a unique combination of loading point and date, and, similarly, each column by delivery point and date as in Figure I. The inequalities

(1) $\sum_{a,i} X_{aibj} \leq U_{bj}$

(2) $\sum_{b,j} X_{aibj} \leq L_{ai}$

where

(3) $X_{aibj} \geq 0$

are satisfied for all possible schedules since the total number of reassignments from j at b can never be greater than the total number of carriers, U_{bj}, unloading at j at time b. Nor can the total number of reassignments to i at a exceed the number of carriers loading at i at time a. In each case, however, it can be less.

An equivalent transportation problem can now be generated by the introduction of non-negative slack variables, S_{ai} and S_{bj}, representing, respectively, the number of carriers which initiate their individual schedules at time a and loading point i, and end their individual schedules at delivery point j and time b. Rewriting (1) and (2) in the form of equalities we have

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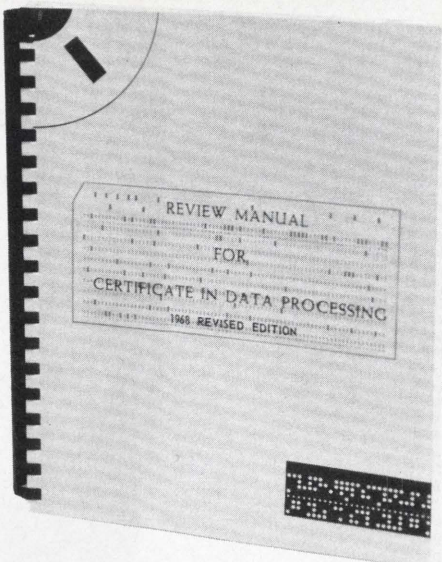

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(4) $\sum_{a,i} X_{aibj} + S_{bj} = U_{bj}, \quad S_{bj} \geq 0$

(5) $\sum_{b,j} X_{aibj} + S_{ai} = L_{ai}, \quad S_{ai} \geq 0$

Any carrier loading at point i, time a, must ultimately make a delivery at some point j, time b. Therefore,

$$\sum_{a,i} L_{ai} = \sum_{b,j} U_{bj}.$$

Since

$$\sum_{a,i} S_{ai} + Z = \sum_{a,i} L_{ai}, \quad Z \geq 0$$

$$\sum_{b,j} S_{bj} + Z = \sum_{b,j} U_{bj} \quad Z \geq 0$$

where

$$Z = \sum_{a,i} \sum_{b,j} X_{aibj}$$

it can be seen that to minimize the slacks, S_{ai} and S_{bj}, is to maximize the number of reassignments, X_{aibj}, thus minimizing the number of carriers required.

The blank spaces in the equivalent transportation matrix formed by the example problem in Figure I denote the area of physically permissible reassignments. That is, those X_{aibj} couples where

$$T_{ij} \leq a - b$$

When this condition is not met, the corresponding X_{aibj} variables are constrained to zero and need not enter into solution.

Thus, we have outlined a construction of the scheduling, or reassignment, problem which may be expanded in the fashion of a classical transportation set and solved as a linear programming problem. Using the coordinates of the X_{aibj} squares in Figure I for vector identification and tagging slacks by row and column numbers, the set may be expanded as in Figure II.

Solution of the sample problem obtained with a standard linear programming code is shown in Figure III. Since seventeen movements were specified and eight reassignments made, nine carriers will be required.

The simplex algorithm has the advantage of being extremely simple to apply, particularly when the problem is of transportation type. The difficulty is that as the transportation equivalent becomes larger the size of the linear form increases exponentially and, thus, the time required for solution. A 50 (i,j) x 50 (b,j) transportation equivalent easily expands to a linear form on the order of nine hundred variables and eighty constraint rows. A rather large linear programming problem

	b	4	5	12	13	13	14	15	15	18	18	24	25	29	32	33	45	47		
a	i \ T	4	8	8	2	4	7	3	5	4	3	8	4	1	8	8	6	8	S'ai	Lai
2	6	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1	0
4	2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1	0
8	8	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1	0
10	5	1	1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0	0
10	9	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	2	0
11	4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1	0
11	6	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1	0
11	5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1	0
20	8	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1	0
23	7	x	x	x	x	x	1	x	x	x	x	x	x	x	x	x	x	x	0	0
23	2	x	x	x	x	1	x	x	x	x	x	x	x	x	x	x	x	x	0	0
23	1	x	x	1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0	0
31	4	x	x	x	x	x	x	x	1	x	x	x	x	x	x	x	x	x	0	0
33	3	x	x	x	x	x	x	1	x	x	x	x	x	x	x	x	x	x	0	0
34	8	x	x	x	1	x	x	x	x	x	x	x	x	x	x	x	x	x	0	0
	Sbj	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1		
	Ubj	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		

FIGURE III
L/P SOLUTION

	b	4	5	12	13	13	14	15	15	18	18	24	25	29	32	33	45	47		
a	i \ T	4	8	8	2	4	7	3	5	4	3	8	4	1	8	8	6	8	S'ai	Lai
2	6	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1	0
4	2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1	0
8	8	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1	0
10	5	1	1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0	0
10	9	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	2	0
11	4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1	0
11	6	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1	0
11	5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1	0
20	8	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1	0
23	7	x	x	x	x	x	x	x	1	x	x	x	x	x	x	x	x	x	0	0
23	2	x	x	1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0	0
23	1	x	x	x	1	x	x	x	x	x	x	x	x	x	x	x	x	x	0	0
31	4	x	x	x	x	x	x	x	x	x	x	1	x	x	x	x	x	x	0	0
33	3	x	x	x	x	x	x	x	x	x	1	x	x	x	x	x	x	x	0	0
34	8	x	x	x	x	1	x	x	x	x	x	x	x	x	x	x	x	x	0	0
	Sbj	0	0	0	0	0	1	1	1	0	0	0	1	1	1	1	1	1		
	Ubj	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		

FIGURE IV
SAMPLE SOLUTION

for a relatively small scheduling system.

The Method. An interesting, and in this case most pertinent, feature of the linear system described above is that the relative cost coefficients of all objective function variables equal one.

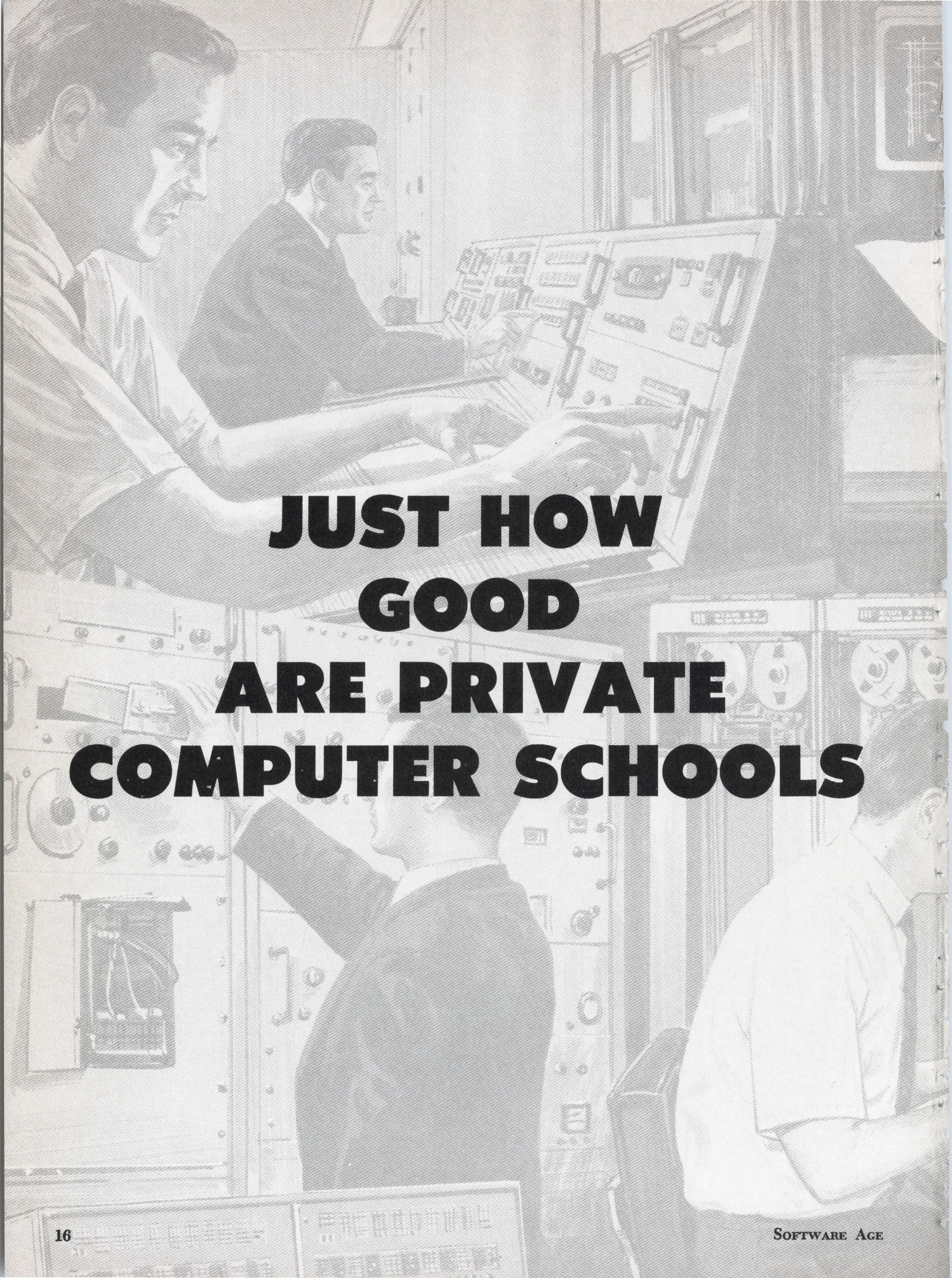
In a linear system where all relative cost coefficients of objective function variables equal unity, the basis for an optimum solution will always be one which contains the maximum number of elements.

Further, it can be shown that

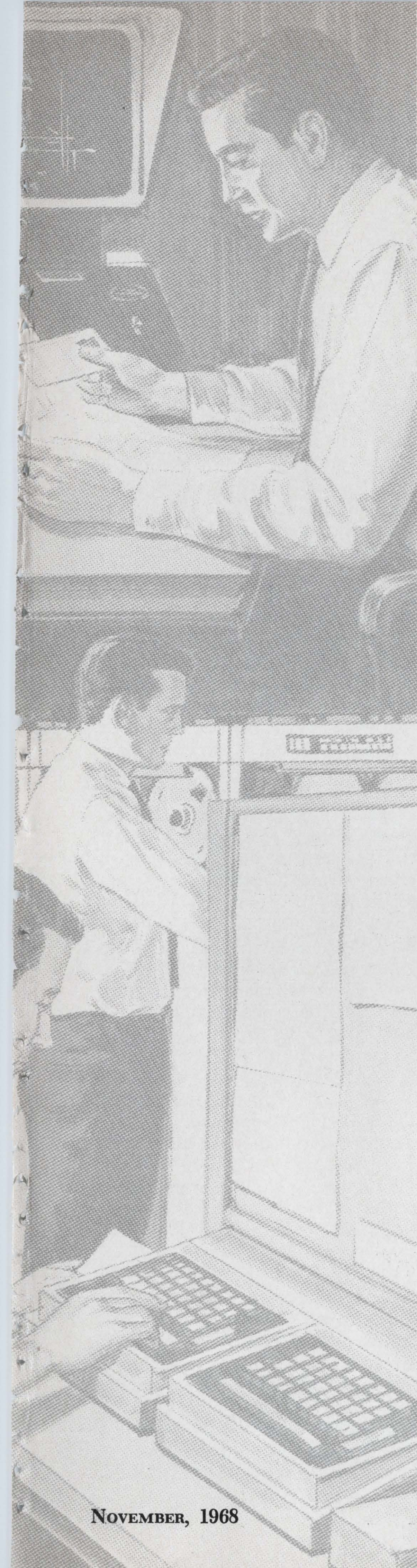
The elements comprising such a basis will always be those present in linear combination (constraints) with the fewest number of other elements.

Scanning the expanded form to ascertain a basis meeting this condition is a rather inconvenient way to avoid the rigors of simplex computation. Instead, it is possible to select the appropriate variables directly from the equivalent transportation set represented in Figure I. It can be seen that the linear combinations generated in the constraint rows for any X_{aibj} will always be directly proportional to the number of permissible reassignments in the row (a,i) and column (b,j). Therefore, by alternately selecting variables in those rows and columns containing the fewest permissible reassignments we can proceed directly to an optimum solution.

Given the problem shown in Figure I, first ask if there are any rows with only one permissible reassignment. There are none. Next ask the same question for all columns. Column twelve contains only one permissible reassignment at $X_{13,12}$. Assign the value of L_{ai13} or S_{bj12}, whichever is smaller. Column thirteen also contains one permissible reassignment at $X_{13,13}$. Since L_{ai13} is now zero, no further reassignments may be made in this row. Repeating the process for the condition of n permissible reassignments, n = 1,2,...,m, where m equals the maximum number of permissible X_{aibj}'s in any row or column (or until all possible assignments have been made) we arrive at the solution in Figure IV. The two solutions will differ only among selection of degenerate variables. ■



JUST HOW GOOD ARE PRIVATE COMPUTER SCHOOLS



W. Roger Moore

Systems Analyst
Information Systems Sales and Service
General Electric Company
Cleveland, Ohio

During the past few years I have experienced and have been able to observe many things in the field of private computer education. I've seen the strong and weak points of curriculum; the qualifications of instructors; the honesty and credibility of sales and advertising; and, in fact, nearly all of the good and bad things encountered today by students of these schools. All these things are part of the total picture that the public seldom ever sees.

As a former Director of Education of one of these schools, I've been asked the question, from time to time, "Just how good are these computer schools?" For that reason, I submit this paper outlining my own personal views and observations on the matter.

■ Education is a very marketable item (particularly when it has to do with computers). The trouble is, many people that get lured into thinking they can make it in this field, can't afford to lose $700 to $1800 of their hard earned money. The missing ingredient in the computer school business seems to be either honesty or quality and sometimes both.

The terms "Data Processor", "EDP", "Tab operation", "Machine Accounting", and "control panel wiring" are quickly becoming a part of the past—if you don't believe it, just look at the Sunday want ads. The fact remains, though, that many private computer schools teach them today as the main part of their course. The reasons are obvious when you look at the rental costs of the various equipment involved. It's much less expensive to rent a couple of tabulating machines with a pile of control panels than it is to rent a computer. Additionally, it's quite impressive to the unsuspecting student to see all those wired panels and to think that some day he might be able to wire them. Of course, what he doesn't realize is that the demand for such knowledge is almost nil. It's like offering a TV repair course, with some television repair theory, but having only radios to work with. Of course then, any attempts to advertise the course as being a TV repair course would be misleading.

Advertising of this kind unfortunately is used by many of these computer schools, but in addition they usually promise high salary jobs with a minimum amount of time and effort required of the student. This would be fine if it were true, but most likely it will take eight to ten years before the student will attain those kind of earnings, unless he has some practical experience and college to go along with this computer education.

Schools are also quick to advertise excerpts from Time Magazine, the Wall Street Journal, and others. These excerpts usually emphasize the shortage or great need for *qualified* people in the computer field. The schools seem to imply that a student need merely to complete the prescribed course and he will fulfill the qualifications sought after by the employers. This is not necessarily true. For one thing, the employer usually has a certain draft classification in mind, and in most cases he is looking for some college education in the persons background. Usually he's not interested in hiring women because of shift work, or plant location, or total hours or manual labor. In many cases he simply isn't willing to take a chance with the person because of the multitude of unqualified private computer school graduates that have knocked at his or his friend's door.

After the misleading ad, a high pressure salesman may take over with his many gimmicks and angles. There could be only a couple of students signed up for this class but the salesman might say to his prospect "there's only one seat left . . . it could be taken at any time" and if the prospect is at all interested, he will sign.

Sometimes an aptitude test is given by the salesman either in the home or at the school. Here the salesman has a lot to gain if he can get his prospect through the test. The test is usually the IBM programmer's aptitude test or some watered down version of it. The standard test has 80 questions divided into three parts, each part being timed. The test is a very good one if administered properly, especially the first two parts. However, sometimes extra help or time is given, or the prospect is allowed to study the test before taking it, or is even permitted to retake it after going over his mistakes. If the prospect still fails, correct answers are sometimes filled in afterwards and arithmetic errors intentionally made in the students' favor. The most common practice used is the giving of higher letter grades than the scores warrant.

The salesman can easily get away with this too, since it would be almost impossible for the average individual to tie in a letter grade to his score without being able to first look it up. What makes this true are the facts that 1) the taker is not expected to finish the test, and 2) the score he receives on each part and the total must be compared against statistical results to obtain a meaningful grade (a straight percentile grade would not be significant).

Of course now, the watered down version, in effect, would produce the same end results. The prospect would most certainly not fail it. At any rate it's at this point that the great injustice really begins, because the person is led to believe that he has abilities of which he does not.

The only protection that one might take against this type of thing

NCR Los Angeles invites you to join the fast moving Century Series team

NCR, creator of the sophisticated and fast-selling Century Series computer systems, offers you immediate opportunity to work in new-generation technology. Join the men responsible for the industry's most advanced developments in high-speed thin-film memories, monolithic integrated circuitry, disc memory innovation, and automated production techniques. NCR Electronics Division is the largest commercial computer manufacturing facility in Southern California and one of the most advanced in the world. Benefits include a thoroughly professional environment, an excellent salary, non-defense stability, and fully paid life, hospital and medical plans for you and your dependents. Look into NCR now and accelerate your career.

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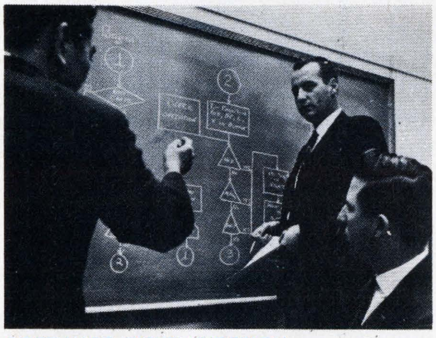
SYSTEMS ANALYSIS ENGINEERS

Analysis and development of advanced systems specifications; consultation on systems design, hardware configuration, software trade-offs; analysis of competitive systems. Prefer applicants with BS degrees and 3-5 years' experience and ability to write and test functional specifications in such areas as very-high-speed memories, disc files, drum files, central processors employing large-scale integration, communications and time-sharing systems.



SOFTWARE SYSTEMS DESIGN

Develop operating, executive, utility and on-line systems for third- and fourth-generation advanced systems. Positions require a business or science degree and large-scale file computer or software development experience.

ENGINEERS

ELECTRONIC DEVELOPMENT ENGINEERS

Specification, design, checkout and documentation of digital and digital/analog equipment for use with on-line data processing and data communications systems. Requires BSEE and five years' related experience.

INDUSTRIAL ENGINEERS

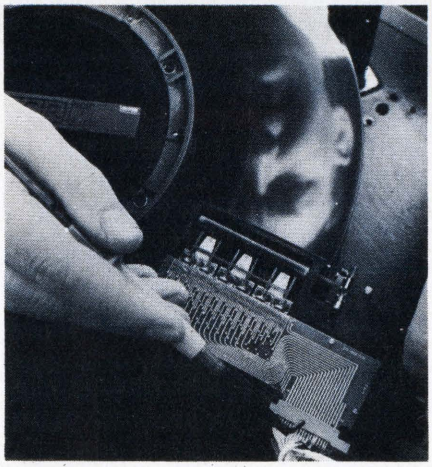
Will develop manufacturing machining processes for various projects. Will be responsible for capital equipment analysis, fabrication tooling and initial production. Positions require BSIE and heavy mechanical/industrial engineering experience.

CIRCUIT DESIGN ENGINEERS

Will design and develop digital and analog semiconductor circuits, including discrete, integrated and hybrid types. Requires a BS/MSEE and two years' related experience.

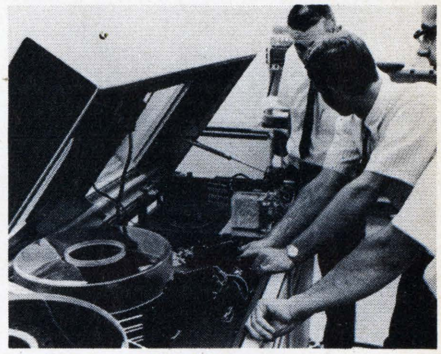
MAGNETIC HEAD DESIGN ENGINEER

Will design and develop flying magnetic recording heads and the required prototype tooling. Requires BS or MS in EE, ME or physics plus three years' applicable experience. Knowledge of ferrite machining technology and ferrite heads desirable.



MATERIALS & PROCESS ENGINEERS

Will evaluate and select metallic or non-metallic materials, develop chemical or metallurgical processes, or prepare specifications for computer equipment. Requires BS or MS and 2 years' applicable experience.



CHEMICAL ENGINEERS

Positions are available for college trained engineers to assume responsibility for film plating, organic finish analysis, and production plating process functions. Successful candidates will possess a BS degree in chemical engineering, a knowledge of organic coatings, the ability to develop and direct a process laboratory, and 3 to 5 years' experience in electroplating of magnetic thin film materials or chemical process analysis.

RESEARCH ENGINEERS

Will be engaged in feasibility model development, or integrated circuit memory or high speed magnetic memory circuit design.

Requires scientific and/or engineering degree and adaptability to a multiplicity of applied research projects.

ARRANGE NOW FOR INTERVIEW AT FJCC

Confidential interviews will be held at the St. Francis Hotel during the Fall Joint Computer Conference in San Francisco, Dec. 9-11. To schedule an appointment, submit detailed resume including salary history to Steve Williams at the Division.

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would be to take the legitimate aptitude tests provided by the various computer manufacturers and have them administered by completely impartial parties such as high school guidance counsellors or the state employment service. This would establish one's qualifications, however, be careful. Some people are simply better test takers than others. The grade may not truly indicate a potential ability or lack of ability in computer programming.

One seriously considering this field as a future occupation should take the aforementioned into consideration and ask himself the following questions:

Do I have—
- a willingness toward change?
- an eagerness to learn and try new things
- an aptitude for using my mind?
- a determination to see the job through?
- the ability to think logically?

Am I an organizer?
Did I like algebra or especially geometry in school?
Do I like to solve problems?

If in most cases the answers were yes, and a better than average* aptitude exists, then one should most certainly pursue his ambition to become a programmer. If there are still doubts as to qualifications and just whether the person will even like this field, he might consider an inexpensive correspondence course before plunging headlong into it. This just might give him enough basic background for further education in the field or enough even to get him hired as a trainee programmer. At any rate, many "qualified" individuals are truly needed.

At this point it might be a good idea to take a look at just what these schools have or don't have to offer. Factors that should be considered are: facilities, curriculum, lab, faculty, reputation, student materials, placement, and costs.

Facilities. If a person were to visit these schools he most probably

** A poor or average grade, if truly indicative of aptitude, is not encouraging. A person with this kind of aptitude should look in other occupational directions since he must, in order to succeed in this field, be better than average. This profession, just like the medical profession, demands quality people. There is virtually little or no room for those who are not exceptional or at least better than average.*

would find some to be very luxurious with tropical plants, wall-to-wall carpeting, and offices with big beautiful walnut desks. On the other hand, he might find just the opposite. Don't be fooled by outward appearance, however. It often is an indicator that just the opposite exists regarding the quality of courses offered by the school. The key is to look for moderation but don't stop there.

Curriculum. A thorough investigation into the contents of the curriculum is an absolute necessity to the interested individual. He should, however, first find out as much as he can about the field before investigating the various curricula. He should start by looking in the newspaper want ads and the professional data processing magazines. He should talk to computer manufacturing representatives and members of local professional organizations like the Data Processing Managers Association (DPMA). In essence, he would find out as much as he possibly can about what kind of experience and knowledge is being sought after by the computer users. Armed with this knowledge he can go ahead now and make an intelligent analysis and comparison.

The curricula vary from school to school about as much as the physical locations and facilities do, but basically they should contain the following:

1. A short, but thorough introduction to data processing and computers (this should take no longer than from 2 to 4 hours).
2. A good strong presentation of computer logic and the language being taught (preferably COBOL).
3. A generous amount of lab time (at least one half of the course).
4. A sufficient amount of hands-on computer experience (at least five minutes per student per lab hour).
5. A minimum coverage of at least 10 sessions on disc and tape with at least one session per peripheral of hands-on experience.
6. A minimum of 5 case problems for students to program having at least 900 source language instructions all totaled.

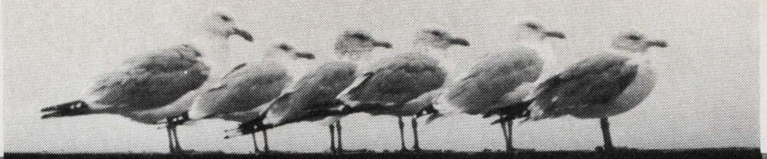
Many schools, however, offer inferior courses and therefore, the buyer should beware. He should beware of:

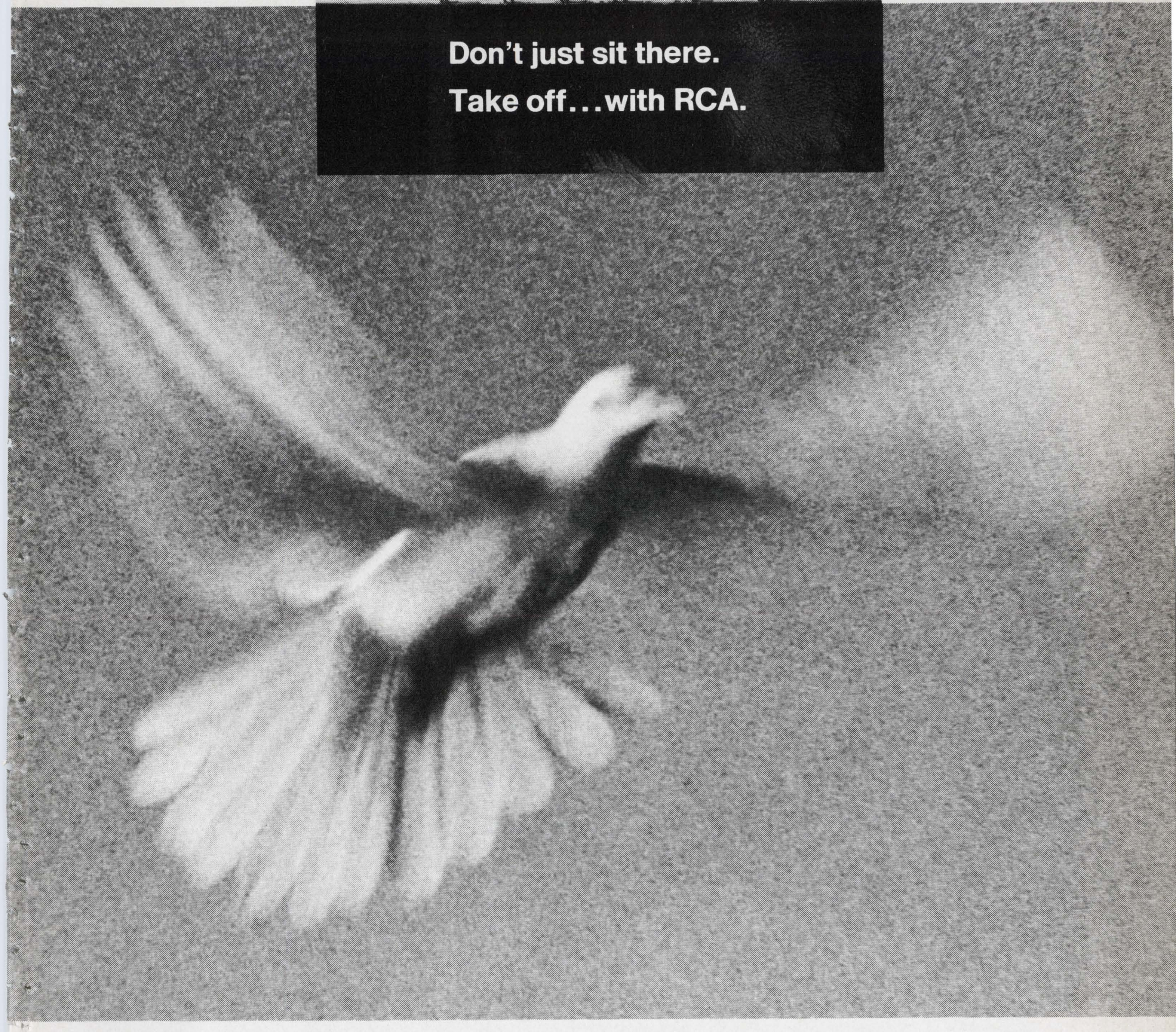
1. out-dated computer languages and techniques
2. obsolete equipment
3. unnecessary time spent on unit record equipment like keypunches, verifiers, reproducers, interpreters, and the like
4. lack of provisions for spending a reasonable amount of time on the computer, on discs, and on tape
5. the use of educational computers in place of full scale electronic computers
6. the use of small scale desk top computers or bookkeeping machines in place of the real thing
7. false implications that practical experience or lab includes program assembly and machine debugging

Lab. When choosing a computer education just keep in mind that hands on experience when learning how to program is perhaps the most important single factor that should be considered. Most students don't really learn programming until they've run and debugged their own programs on the equipment. So it should be of prime importance that the school either have its own computer or have liberal use of someone else's computer.

Also, I cannot emphasize enough the fact that COBOL should be stressed since it is offered by most computer manufacturers and is being used by more and more computer users every day. Actual experience on disc and tape should also be stressed. Monitoring systems, supervising systems, and operating systems should in addition be covered fully.

Faculty. The instructors in all of these schools are nearly always qualified to teach the courses offered. If they weren't, a school would very quickly get a bad reputation and wouldn't be able to hold its students. There are two very good ways that this can be checked; first through the Better Business Bureau, and second through the school's graduates. A school with nothing to hide or be ashamed of will usually be glad to give out several names




Don't just sit there.
Take off...with RCA.

of successful graduates to interested individuals.

Reputation. Some very interesting questions that could be asked of these graduates, besides questions concerning instructor programming and teaching abilities, might go as follows:

1. How many students do you know that failed this school's computer course?
2. Were all the graduates from your class qualified to become programmers?
3. How honest were the salesmen or counsellors in presenting the true facts?
4. Did the school stand behind all of their promises?
5. Were there any students in your class that shouldn't have been there?
6. Did the school make an honest effort to place all qualified graduates?
7. Of those that were placed, did their employers recognize this school's computer course as being of any value?

By all means, while talking to school officials or the schools' graduates, an interested person should find out all about lab time and lab facilities. As mentioned before, this is the most important part of the course. He wouldn't want to pass up this opportunity.

Student Materials. An examination of student materials can sometimes be revealing. If the manuals are standard (being written and published by the computer manufacturer), then probably they will suffice. However, many schools compile their own manuals taking what they want from each official publication. Sometimes this is satisfactory, however, most manuals take from one to two years to put together and publish, thus allowing technology to pass them up. In these cases, more often than not, there is a tendency to over simplify or to be very basic. These specially produced manuals will very often emphasize unit record operations and control panel wiring instead of computer programming. Very often this is an indication of the kind of course that's going to be taught.

Placement. Most of these schools offer a placement service which is usually free. A salesman may mislead prospective students into be-

lieving that this service guarantees them a job when they graduate. This, of course is not true and besides that, these kinds of promises are prohibited by law in many states.

The fact remains, that if a student does not end up near the top of his class, irrespective of the school he attends, he should not expect much in the way of placement. He should just remember that the employer still has the choice in the matter and more often than not will only want to talk to the top people in the class.

Buying an education won't buy him a future. He must earn it; through hard work whether it be in school or on the job. He must continually prove his abilities by performance. It matters not whether it be to an instructor or the employer. He must have fortitude and patience for the sake of learning.

If a prospective student keeps these things in mind, he won't be led astray by the false claims. He won't fall into the trap that may lead to a huge financial waste.

Costs. Courses generally run about $2.50 to $3.50 per actual hour. It's well worth it if the ability is there and the school is reputable and their courses are up-to-date. Much caution is necessary as you probably realize by now.

Take a Good Hard Look. Should we be concerned? My answer is a very emphatic yes! But what can we do about it? How can we force these schools to do a better job? Well, there are several ways. We could do it through legislation, or competition, or accreditation, or pressure from the business community, or by educating the general public and the students in high school; educating them in data processing and programming.

The high schools have really fallen short in this respect. They should have been teaching programming for the past five years. This is where the upgrading must begin.

Some schools are now recognizing this fact. Altoona Area School District in Pennsylvania has been teaching for some time now with a powerful GE 225 Pennsylvania Time-sharing System. The Cleveland Board of Education in Ohio has also gotten into computer education along with several other school districts in the Cleveland area. Other

Can there be this kind of excitement in programming?

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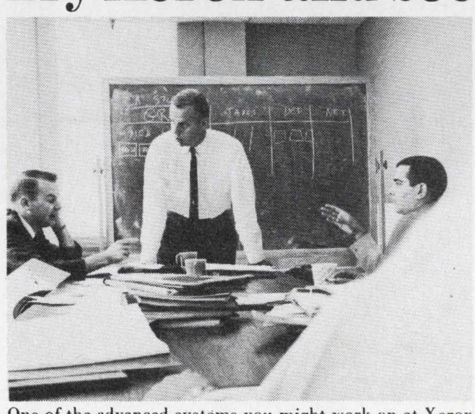

One of the advanced systems you might work on at Xerox is EBS . . . Equipment Billing System. Here, Bud Seiph, EBS Manager, leads discussion of new systems approaches.

You hear the rapids before you see them —a distant, almost subsonic roar . . . feel the stream pick up speed . . . then a rush through a smooth, narrow chute—and you're in white water! The dangerous thrust of foam-masked rocks, the sweeping power of fast, broken water and the nimble response of the light canoe to your stroke—this is wild, wet excitement of white water canoeing*.

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All this exposure does more than make you a better programmer. It can be the groundwork for several lines of advancement. As a programming specialist. A systems analyst. A functional specialist in one of the areas you've become acquainted with . . . and into management.

If you've a Bachelor's degree and/or experience with IBM 360 series systems using COBOL, the Univac 1108 using FORTRAN or COBOL, or IBM 7000 series using COBOL or AUTOCODER, we'd like to show you the kind of excitement that goes hand-in-hand with programming at Xerox. These openings are in Rochester, New York. Please send your resume to M. H. Hartigan, Dept. MZ-69-M1, Xerox Corporation, P.O. Box 1995, Rochester, N.Y. 14603.

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*Rochester is less than a 2-hour drive from some of the finest canoeing in the northeast.

schools scattered around the country are also beginning to act. I take my hat off to them all, for this is the right direction.

Some institutions of higher learning have done outstandingly well in computer education during the past five to ten years. Case Institute of Technology, among others, offers a very, very excellent course of study in computer science, but for the most part, colleges, universities, and technical institutes that teach computer programming have fairly weak coverage of the subject. As you can see, this whole situation creates quite an educational gap and that's the reason why so many of these private data processing schools have sprung up lately.

The future isn't all that bad, however. Those high schools, colleges, and universities with weak programs in computer education have made great strides in the past couple of years. Strength in their programs looks to be only a year to two years away. This should be good news to both the interested individual and the industry.

The industry will continue to increase the demand for qualified people but, this demand will be met only if the high schools and colleges continue updating and strengthening their computer courses and if, as a result of this, the private computer schools either upgrade or cease to exist.

So, if you were to ask me today, "Just How Good are Private Computer Schools?", I'd have to say, for the most part, not so good. Remember though, there is good and bad in everything and so with enough caution one can separate them and get a good computer education. ■

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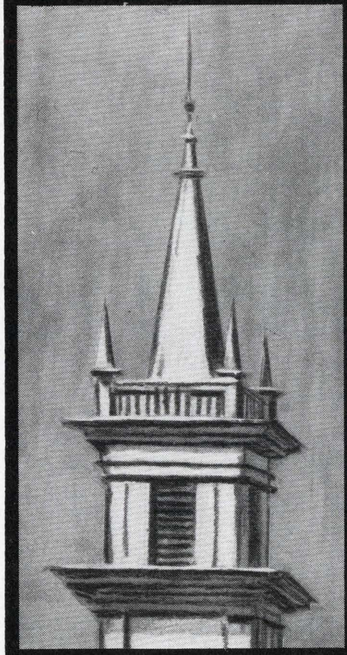
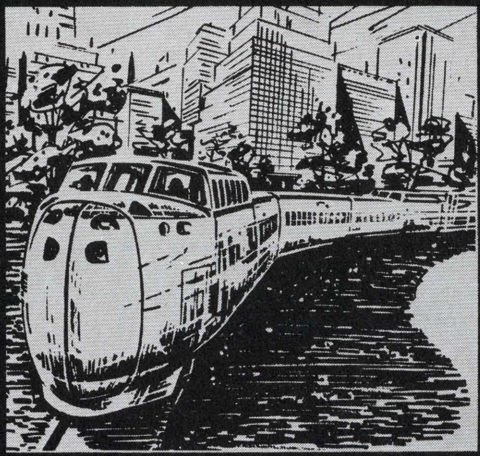
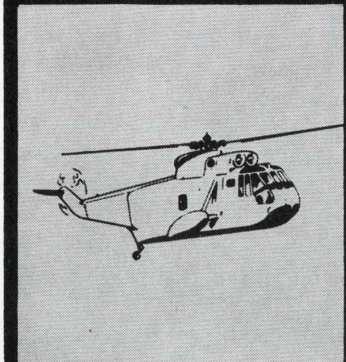
Send your resume in confidence, stating salary requirements, to Mr. Leo J. Shalvoy, Professional Employment—or—deposit your resume in our lock box at the Software Age Resume Center in San Francisco during the FJCC.







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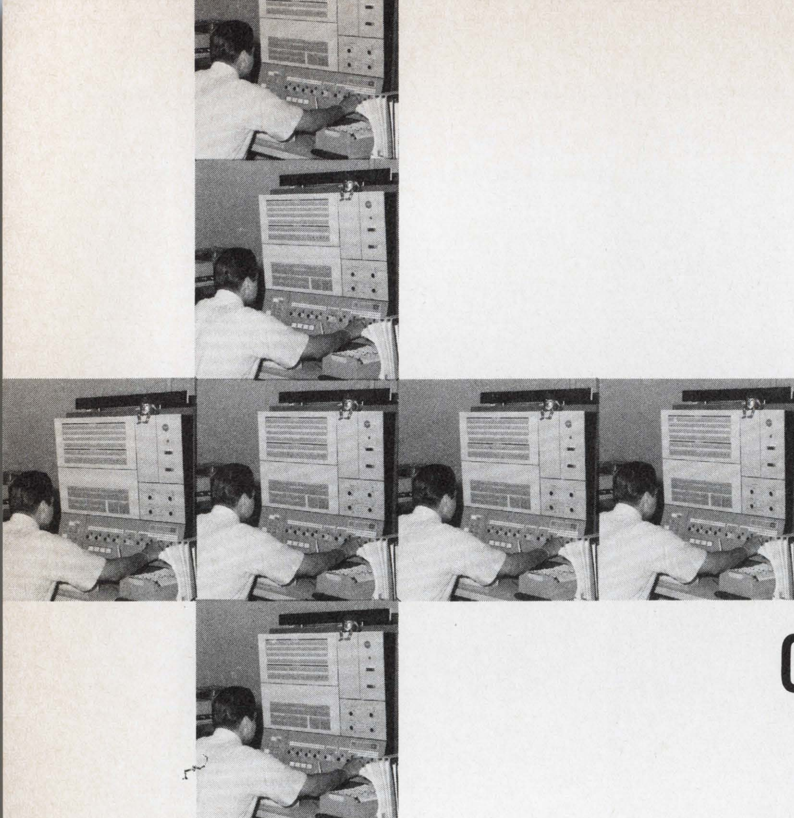
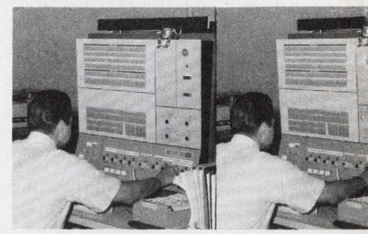


MIDDLE MANAGEMENT SEMINARS SOLVE COMMUNICATION PROBLEMS

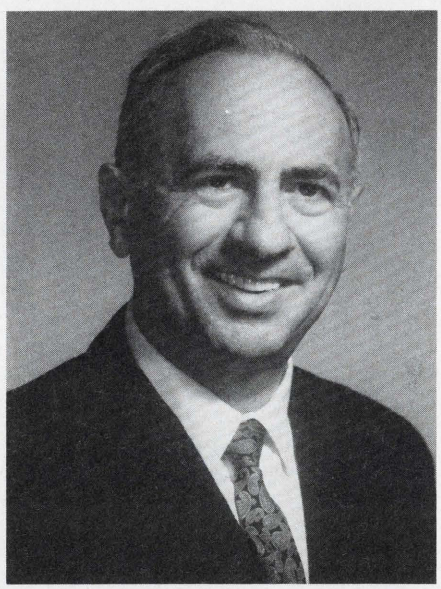


■ The communication barrier that exists between middle management and data processing personnel is one of the greatest problems in today's modern business world.

This barrier is responsible for such problems as duplication of large amounts of data processing work, wasted efforts among key employees, failure to find more uses and techniques to develop applications for a computer and a hesitancy among management personnel to approach data processing personnel about potential projects.

Charron–Williams College in Miami, Florida found that many companies are aware of this communication gap but are not taking the proper steps to teach management personnel about the operation of data processing systems.

Realizing the need for management to have an understanding of the computer and its programming, the college organized a data processing course for management. The course is designed to give management an overview of Data Processing Procedures. Lectures include principles of flow charting, studies in computer hardware, system analysis, concepts of computer programs, programming languages and case studies of computer applications.



Mr. Irving Goldstein has been President of Charron–Williams College for 19 years. He has simultaneously served as President of the Florida School of Medical Technology in Miami. On the Board of Directors of the Business University of Tampa and the Tampa Technical Institute—he is president of the Florida Association of Private Schools and is a board member of many national school associations as well as civic and fraternal organizations. Since his graduation from Columbia University, he has been involved in private school education for the past 25 years.

Charron–Williams, which is the oldest and largest business college in South Florida, having been founded in 1940, is not a newcomer to the field of data processing. The college has been offering courses in data processing for nearly 10 years. Graduates of the courses are qualified to write computer programs. Approximately 100 students a year complete this program and are placed in various companies.

It was from a number of graduates that officials at Charron–Williams received reports about the lack of communication between management and data processing personnel.

What are computerized companies doing to break down this communication barrier?

"Companies aren't sure where to turn for the basic training required," according to George Gjertsen, Data Processing Director at Charron–Williams. "They generally seek the training from one of four areas—the computer manufacturer, the manager of data processing at the company, the company training staff or a qualified person in the company's data processing department.

"Experience has indicated, however, that there are problems blocking effective training in all of these areas."

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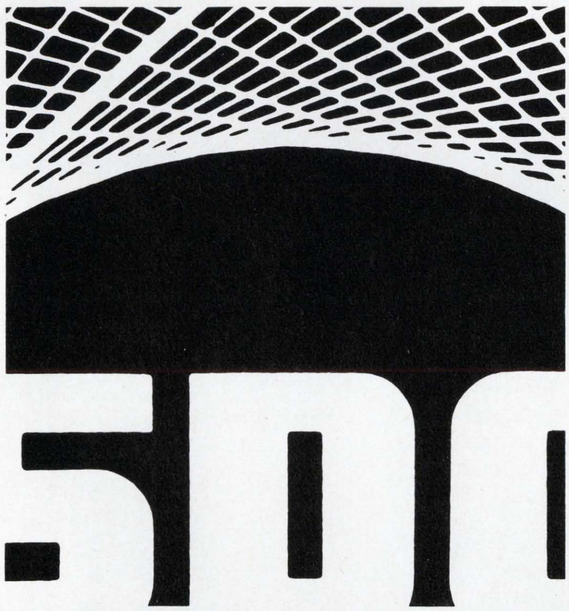

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Gjertsen pointed out these various problems and explained why management personnel cannot be properly trained in the basic concepts of data processing by employing any of the four methods.

1. The computer manufacturer conducts periodic seminars, but they are usually held in another city from the company that is interested in training. The classes are formal and extremely large, which discourages questions from class members. There also is an inclination to use data processing terms without first defining them. The material is presented in a form that most non-data processing personnel are unable to comprehend.

2. The data processing manager at a company often will provide more confusion than training for management personnel. He has the tendency to speak the language that he knows and lives and uses such terms as "asynchronous processing, bytes, bits and something he calls an interrupt system." He also is involved with many complex problems since his department is the hub supporting the flow of data throughout the company. He is usually too busy and preoccupied to conduct training sessions for management.

3. Using a qualified person from the data processing department usually results in creating problems within his department. As one of the key persons involved in operating the computer, his absence from the department would prevent the company from realizing the maximum utility of its computer.

4. The training staff within an organibation is not equipped to teach data processing because the subject matter requires someone who is well-grounded through experience to answer questions that arise.

Gjertsen said another alternative open to a company is to employ a man with teaching experience and a thorough data processing background for the training of management personnel.

"The main objection to this method," he explained, "is that the company must increase its payroll. It also means that a company's com-

puter equipment would become tied up if it were used for demonstration purposes in the teaching of management personnel."

He feels that the unique program Charron–Williams College has initiated is proving to be the most effective method of eliminating the communication gap between middle management and data processing personnel. The college has developed an approach to informal management training that is both inexpensive and complete for a participating company.

Gjertsen conducts the data processing seminar at Charron–Williams on a one day a week basis covering a 16-week period. Each session, which runs three hours, covers a specific phase of data processing from the structure of the punch card code through accounting controls, principles of unit record systems and computers.

Sessions are held in the college's computer room which contains IBM unit record equipment and an IBM 360 computer used for demonstrations.

Gjertsen, who has a thorough background in data processing, uses the feedback approach to teaching. Participants in the seminar, which is limited to 20 persons, are encouraged to ask questions as the material is presented during the lectures. This gives management personnel the opportunity to fully understand each point as it is covered. Before any terminology is used, Gjertsen presents a complete definition of it. Sessions are conducted around a conference table, and the students work simple problems together to illustrate principles covered in the lectures.

Management personnel enrolled in this first seminar offered by the college began to generate ideas for application to the data processing systems in their companies by the time the course was half-completed. Twelve of the participants in this initial seminar are supervisors of their respective departments at Pan American Airways In Miami. The departments they represent are supply, engineering, production control, quality assurance, production and accounting.

"We're looking for this course to bring certain management people up to a level of understanding that will enable them to make better use of

the data processing department," according to John Stearns, supervisor of research and development, maintenance administration, for Pan American in Miami. "When they have this understanding, they will be able to derive the full advantages from data processing.

"We want to continue an education program along this line to break down the communication barrier between management and data processing. In speaking to a programmer, you have to be able to explain what you want."

Stearns said that it is essential for management to learn how to use the data processing department effectively in order to make the best possible improvements in the function of a company.

"The most important points that management should understand are the types of jobs that can be done on a computer, the costs involved in using a computer, the time element of developing a system to be used on a computer and a complete understanding of what a system is," he said.

Richard Howell, data processing manager at Pan American in Miami, said that he has already observed some results from the seminar at Charron–Williams.

"They are beginning to understand why certain projects cannot be done feasibly by electronic data processing," he said. "Before they started the course, most of them couldn't even talk about a job that they wanted.

"This course seems to be giving them an idea of what we are doing and a chance to talk our language. I am now able to pin them down better on what kind of job they want to have us do in data processing."

The following are comments from some of the Pan American employees taking the course at Charron–Williams.

William A. Snider, supervisor of inventory control: "I've been able to learn what the limits and capabilities of data processing are, and this helps me to communicate with the manager of data processing in a logical manner. The course has helped me to ask more intelligent questions. It's an excellent course because it starts with the basics and then moves up. Before you can understand computers, you have to learn the background."

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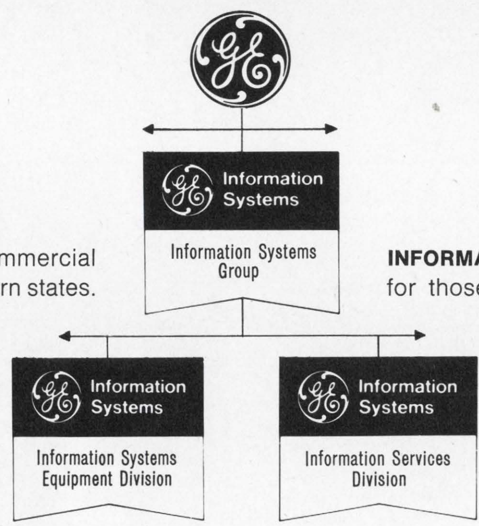

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John D. Mosure, supervisor of production personnel administration: "In addition to giving us an understanding of what data processing is all about, we are also learning what problems there are in that area.

"I used to have the tendency to think that data processing could handle everything that came up. You can save a lot of time and tribulation when you have a knowledge and understanding of just what they can and can't do. It helps all of us to work faster and more effectively."

Irving Goldstein, president of Charron–Williams, said that the college has been receiving inquiries from both large and small companies in regard to the data processing seminar.

"The number of inquiries indicates that companies are aware and concerned about the lack of communication between middle management and data processing personnel," Goldstein said. "We feel that the program we have developed will be filling a great need in this area." ■

AN AUTOMATIC TEST SYSTEM BASED UPON PATTERN RECOGNITION DISPLAYS

FIGURE 1

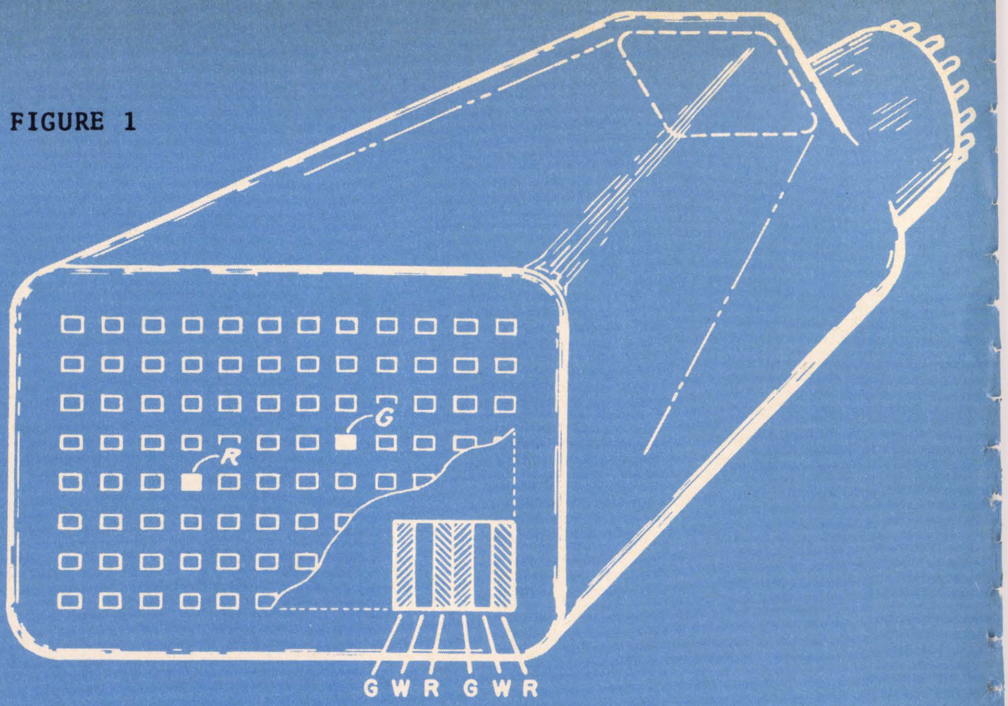


Fig. 1. A matrix of 8 X 12 or 96 data points is presented in real-time on a color cathode ray tube. One of the data points registers a high value and therefore appears in red; another data point registers a low value and appears in green. The other 94 points are within tolerance and therefore appear white. The sketch in the corner shows in greater detail the vertical line structure of the target screen on which the colors are produced for the different data points. An optical port is shown at the rear of the CRT envelope where a camera may be positioned for taking color photographs of the rear of the target screen.

David M. Goodman
New York University

ABSTRACT: Employing a large number of optical and electrical input signals, an automatic test system is proposed which rapidly samples a plurality of test data from an operating ensemble and which then displays the data block format so that interpretation is made on the basis of pattern recognition. The display is via a cathode ray tube which is operated in a TV mode so that the displayed test data can be continuously and rapidly up-dated. By means of rear ports in the cathode ray tube it is shown how failure patterns can be recorded on film and preserved to make the test system self-programming, thereby overcoming one of the major obstacles in presently conceived automatic test systems.

I. Introduction

The techniques of automation have been employed by the electronics industry at an ever increasing rate, beginning in the early 1950's. These techniques have been used with varying degrees of success to solve the information handling problem in command and control, missile launch, surveillance, and fire control systems to name a few. These techniques have also been applied in an attempt to provide adequate maintenance for these types of systems. The nature of these prior efforts is well documented.*

A new test technique described in Volume II of these lecture notes, makes use of optical fibres for transmitting test data in optical form; a vidicon for scanning the optical test data; and a cathode ray tube for displaying in real-time the results of test. Presented herein are proposed test systems which take advantage of and are in accordance with this advanced technique. The first arrangement pertains to an electronic assembly containing 96 test points. The data from these test points is displayed for analysis in such a manner that a fault anywhere in the assembly is detected and pinpointed at a single glance.

* *"Automation In Electronic Equipment," N.Y.U. Press, 32 Washington Place, New York, New York 10003.*

FIGURE 2

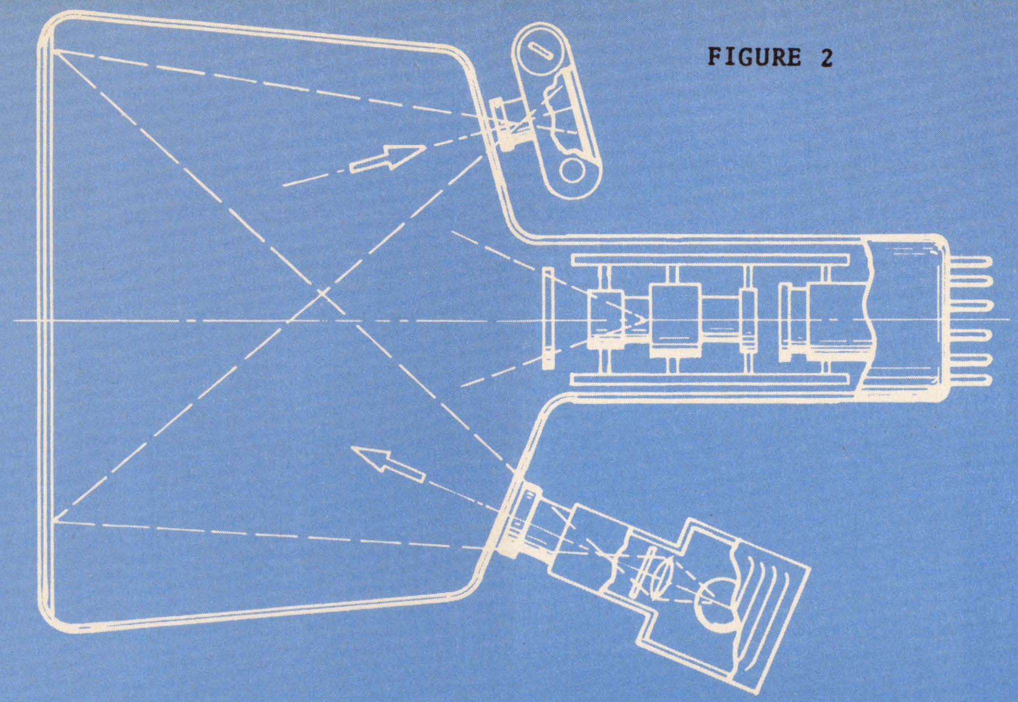


Fig. 2. A sectional view of a cathode ray tube with two separate optical ports provided at the rear of the tube envelope. Adjacent the upper port is a camera for taking pictures of the rear of the target screen. Adjacent the lower port is an optical projector for casting an image on the target screen. The projected image is viewed from the front of the CRT. And for this purpose, the target screen is made translucent.

The test system then is expanded so that a larger collection of test data can be displayed, stored, and interpreted.

Accordingly, it is an object of this test system

(1) to provide real-time matrix type displays which present a large quantity of test data in multi-color easy-to-interpret patterns;

(2) to provide in conjunction with the matrix display a film strip record-keeping device which operates to retain test data which is generated when the system under test develops a malfunction or out-of-tolerance condition; and

(3) to provide in photographic and handbook form an information storage facility which contains a library of pre-recorded failure patterns representative of specific malfunctions that may occur in the system under test.

In order to set the stage for the detailed explanation of how these objectives are achieved, some of the terms which will be used in the description are now defined. These definitions should be reviewed by the reader for they set in perspective the logistic packages which typically are encountered in maintenance activities, and it is towards a maintenance type display that this test system is oriented.

II. Definitions

Piece-part. A separately identifiable component such as a resistor, or vacuum tube. In micro-electronics a chip, or flat pack.

Major Piece-part. A component of substantial size and cost such as a high power transmitting tube.

Sub-assembly. A combination of piece-part physically located on a common chassis or carrier board. In micro-electronics, a replaceable card containing a plurality of flat packs or the like.

Assembly. A combination of piece-parts, major piece-parts, and sub-assemblies arranged electrically and mechanically in such a manner that the entire unit functions as a whole. The assembly generally is a replaceable unit.

Equipment. A combination of assemblies designed to perform a given function. An example is a radar, sonar, or communications transmitter or receiver.

System. A combination of equipments arranged so that a plurality of functions are grouped together to achieve an end result. An example is a radar fire control system; or an air traffic control system.

Major System. A combination of systems arranged as in Sage; or in Dew Line; or Nike–Zeus; or Apollo; etc.

Module. Any sub-assembly, assembly, or equipment which is packaged so as to be removed and tested as an entity.

Unit Under Test (UUT). A generic expression applying to any of the foregoing definitions.

(PUT)—Piece-part under test
(MUT)—Module under test
(EUT)—Equipment under test
(SUT)—System under test

Test System (TS). Combinations of any of the foregoing UUT, PUT, MUT, EUT, and SUT with special circuits for achieving the test functions. The test system may be external or built-in. In this paper, they also generate the displays for pattern recognition.

III. The Matrix Display

To describe one form the Test System may take, an illustrative example is chosen which has 96 electronic components in an assembly, each of which can fail without causing the failure of any of the others. The assembly is designed with one test point available for each component, and when the circuit is energized a voltage is obtained from each test point. These voltages are attenuated or amplified so that they all measure 1 volt dc for a normal functional assembly. The 96 voltages are sampled sequentially by a scanning device which feeds into circuitry to compare these 96 samples to their nominal value of 1 volt. A display is then generated in which the test data derived from the 96 test points is presented as luminous spots in the form of an 8 x 12 matrix of white dots. As long as the assembly is energized, and there is no failure, the appearance of the 8 x 12 matrix of white dots remains uniform and unchanged.

The circuits which measure the sampled data operate to route the 96 test voltages into five different channels according to the magnitude of the test voltage. The channels are divided into voltage levels of 0–0.7, 0.7–0.9, 0.9–1.1, 1.1–1.3 and over 1.3. By definition, a normal test voltage is in the range 0.9–1.1 volts. A low-marginal voltage is in the range 0.7–0.9 volts; a high-marginal voltage is in the range 1.1–1.3 volts. One failure voltage (low) is less than 0.7 volts; and the other failure voltage (high) is greater than 1.3 volts.

The five channels feed into selection networks which control the color of the dots generated on the display. Typically, a test voltage in channel 1 generates a red dot; channel 2, an orange dot; channel 3, a white dot; channel 4, a yellow dot;

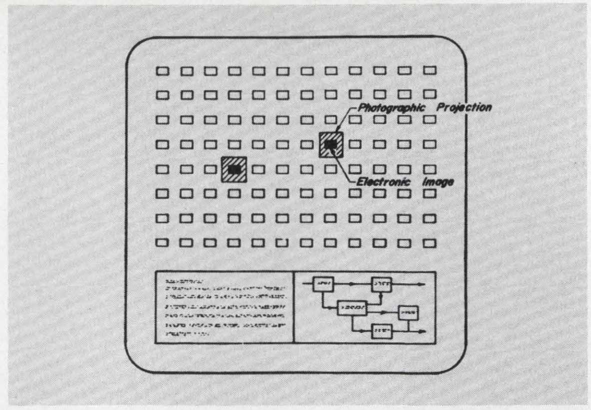


Fig. 3. Another matrix of 96 data points in which the real-time data is compared by an operator to data previously stored on film chips. Two of the data points are out-of-tolerance. The automatic information retrieval system has selected the proper mal-function chip, which fact is confirmed by the photographic projection properly overlaying the electronic real-time image. In the lower half of the CRT there is projected from the same film chip some text and schematic drawings which contain appropriate instructions for the operator.

and channel 5, a green dot. These color dots are clustered together for each of the 96 test points in the 8 x 12 matrix. What this display means to an observer thus becomes evident. Suppose test point 37 has changed color; it is because the test voltage is not normal and it takes but a brief inspection to determine from the actual color of the test point if the drift is marginal, or if the component has failed. The color also reveals whether the drift is high or low, or if the failure is open circuit or short circuit. These relationships are tabulated here for convenience.

Channel	*Voltage Range*	*Color*	*Significance*
1	0.–0.7	Red	"Short" Circuit
2	0.7–0.9	Orange	Marginal-low
3	0.9–1.1	White	Normal
4	1.1–1.3	Yellow	Marginal-high
5	>1.3	Green	"Open" Circuit

IV. The Test System

A closed circuit television chain is used to generate the display. A rectangular raster is scanned at a 60 cycle rate in a standard 525 line format so that each of the 96 test points is measured in sequence and the results displayed 60 times each second. In other words, the voltage from test point 37 is examined every 16.6 milliseconds; and the dot on the matrix corresponding to this test point is energized once every 16.6 milliseconds. If the voltage is normal the dot remains white. If the voltage is not normal it will be routed into the proper one of the other four channels and the dot will appear as red, orange, yellow, or green. If the voltage drifts through more than one range, then the color of the displayed test point will drift accordingly. If the voltage varies rapidly, as in an intermittent condition, then the dot will flicker in color.

Thus, once attracted by an off-normal color the observer can determine after a few seconds of examination if this is an intermittent condition; if it is a drift; or if it is a failure.

A. Failure Diagnosis

When a fault appears the observer refers to a previously prepared handbook of test point abnormalities, looks at the entry for test point 37, and finds the diagnosis for the color condition he just observed. This diagnosis can be made in less than a minute, the time it takes to find the entry, if the handbook is complete. To achieve these rapid results the handbook of test point abnormalities obviously was prepared in advance. To do this for 96 individual test points is not very difficult. But suppose, as is often the case, that failures of components do not occur singly but in combinations. Now failure patterns have to be derived for the handbook that take into account the various combinations and permutations of the 96 voltages derived from the test points. Even for only 96 test voltages this can become an excessive burden, especially since each voltage can take on five different effective values. A more practical method of preparing the handbook is to predict, from the design, the most probable failures and to generate from these (either by calculation or experimentation) a series of different failure patterns. These patterns, representing multiple malfunctions, also become part of the handbook. When a complex failure occurs, the observer has to match these patterns with those actually displayed. This matching process will take a little more time in the case of multiple malfunction than it did in the case of a single abnormality. But after a history of learning on a display of this sort it can safely be assumed that the observer's skill will increase to the point where he will recognize certain patterns for the often repeated failures; he will not have to refer to the handbook; and so diagnosis again becomes almost instantaneous.

Using the foregoing arrangement it is conceivable, even likely, that on occasion a failure pattern will be generated for which there is no equivalent in the handbook. It is necessary in this situation to trouble shoot the test assembly using any technique then available under the circumstances that prevail. After the failure is thus tracked down, the failure pattern and this new-found diagnosis is entered into the handbook. Except for this last step of entering the information in the handbook, this procedure is equivalent to ordinary present day maintenance procedures. And even with respect to this last step, it should be noted that when a technician traces down a fault new to him he stores the information in his mind so that if the failure is repeated he need not go through all the steps of re-tracing the fault.

B. Self Programming

To supplement the handbook and to achieve results similar to that inherent in a thought proc-

ess, a camera unit is positioned to take photographs of the cathode ray tube as illustrated in Figure 2.

In a properly functioning assembly, the 96 test points create an 8 x 12 matrix of white dots which are uniform in disposition as has been stated. For this normal condition there is no need to take any pictures. The information is repetitive and redundant. But when a test point varies from normal, thereby generating a different color, it becomes desirable to record the event and the time of occurrence. Accordingly, a photo-cell detector responsive to the drift or failure colors is positioned to face the display screen. The detector is energized when a non-normal color is displayed thereby to open the shutter of the camera. Preferably the shutter stays open for one full raster scanning cycle, in this case 1/60 second. In so doing the camera records

(1) the last cycle of information (due to the persistence of the phosphors in the CRT) and

(2) the data displayed in the 1/60 of a second following the opening of the shutter and

(3) either clock time or running time, or both.

The shutter is then closed and the film is advanced. If the non-normal condition persists, the camera is again activated, etc. It is thus that the camera takes a series of pictures in color which yields a permanent history of performance of the 96 component assembly.

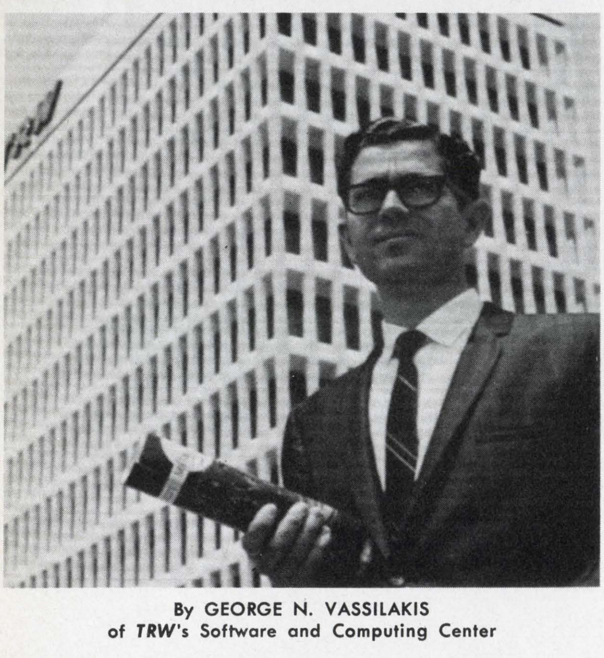
By repeating this process of photographing the display, a handbook is soon compiled which contains the pattern for each possible drift and failure mode. Each new diagnosis which is entered into the handbook should be complete and accurate since the electronic post-mortem examinations can be carried out carefully and with precision.

C. Failure Reporting

It is a further advantage of the camera arrangement just described that a filmed record has been made showing the status of events for the scanning cycle that preceded the actual failure. This record often will suffice to determine the sequence of stages that the assembly went through as it reached the failure mode. This type of failure identification is best used so that re-design or retrofit of the assembly under test can be better accomplished. Not only will the actual failure be recorded but the original stresses which brought about this condition will be part of the record. In other words, the instant arrangement can provide a good failure reporting system for it identifies the failed component as well as the cause of failure, which may originate with some other component. Additionally, if a given failure is not catastrophic but is due to gradual deterioration process then the observer of the display will see the onset of drift, he can anticipate the failure, and he can take

TROUBLE-TRAN PRESENTS

XTRAN'S ADVENTURES IN FORTRAN



By GEORGE N. VASSILAKIS
of *TRW*'s Software and Computing Center

PROBLEM OF THE MONTH

```
X=F(3.)                REAL FUNCTIØN F(A)
Y=FPRIME(3.)           F=A*A
Z=X+Y                  RETURN
.                      ENTRY FPRIME(A)
END                    FPRIME=2.*A
                       RETURN
                       END
```

What is the value of Z? Why?

ANSWER TO LAST MONTH'S PROBLEM

The key to last month's problem was to count the storage that was required by the labeled CØMMØN in the following three statements:

```
CØMMØN/R/R(5)
CØMMØN/X/X/X/Y/Y/Z
CØMMØN/W/W(10)
```

First let us look at the second statement. FORTRAN permits the same symbol as the name of a variable and the name of a labeled CØMMØN block. The name of a block may appear in more than one place and the compiler will link all the pieces together.

The first X in statement CØMMØN/X/X/X/Y/Y/Z is the name of the block X. The second X is the variable X. The third X is the second appearance of block X. The first Y is the variable Y in block X. The second Y is the block Y. Z is a variable in block Y.

Statement CØMMØN/X/X/X/Y/Y/Z may be replaced by the following two statements:

```
CØMMØN/X/X,Y
CØMMØN/Y/Z
```

The total storage needed depends on the machine and the loader.

1. IBM—7094
   $6 + 2 + 2 + 10 = 20$
   At load time, every labeled CØMMØN block is assigned to the nearest even location in memory.
2. CDC—6600
   $5 + 2 + 1 + 10 = 18$
   No problems here.
3. IBM System/360
   $6 + 2 + 2 + 10 = 20$
   Labeled CØMMØN blocks must start at double-word boundaries.

P. S. New material is urgently needed for this column.

XTRAN

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corrective action in advance of the failure itself. For this purpose, the handbook also is prepared to contain instructions specifying corrective action that may be taken under these circumstances.

D. Information-Retrieval and Self-Test

The next step in the development of this Test System is to provide the observer with mechanical assistance in sorting through the different failure patterns in his handbook. To aid in this information-retrieval process, each of the 96 points in the 8 x 12 matrix is provided with a circuit controlling relay. Thus, test point 37 has its associated relay 37. This relay is energized only when one of the four non-normal voltages appear at the test point. This relay functions to select the failure cards which are punched with a hole at position 37. These cards may be of the type conventionally used in machine accounting systems, or they may be designed specifically for the Test System. In either case, the details of punching, collating, and sorting are believed sufficiently well known so that this brief reference thereto suffices for the purposes now at hand. Position 37 is punched on four cards, with one card and one hole corresponding to each of the four non-normal voltages. When relay 37 is energized all the cards with a hole at position 37 are sorted from the deck. The cards are then sorted as a consequence of the test voltage being in either of channels 1, 2, 4, or 5. Likewise if test points other than 37 were off normal, their cards too would be removed from the deck; and there would be a further selection which takes into account the passage of the test signal through channels 1, 2, 4, or 5. Written, typed or printed on each card is a description of the component which caused the drift (or malfunction) together with a description of the adjustment (or repair) which is to be made. Additionally, each card carries a first photographic film transparency with this same descriptive information; and a second photographic transparency which contains the multi-color drift or failure pattern.

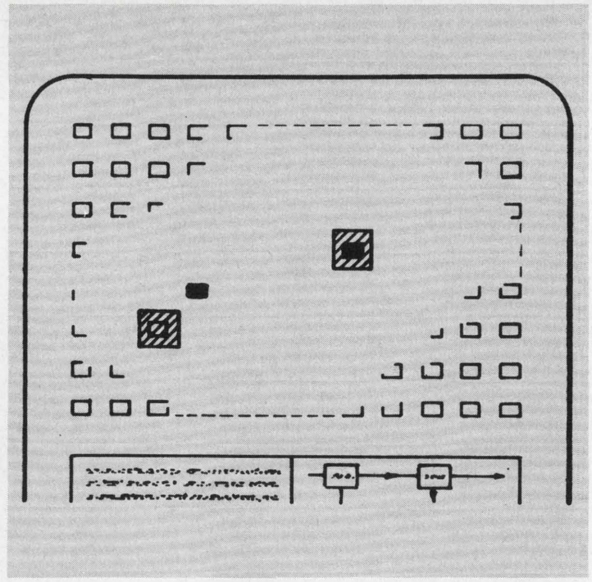


Fig. 4. An example of the failure of the information retrieval system to select the proper malfunction chip. Note that one of the out-of-tolerance data points and the photographic overlay are not in proper register.

In response to the operation of the photocell detector, a transport mechanism inserts the appropriate failure card 37 (due to operation of relay 37) into the optical projector which is positioned towards the rear of the display CRT as illustrated in Figure 2. The information on the photographic transparency thus is projected onto the rear face of the CRT. Therefore, the operator who is observing the real-time test data also sees the descriptive information together with the failure pattern stored on the two film transparencies. On one section of the CRT set aside for the projection of the first transparency, there appears the English language instruction or description of malfunction. An aural or visible alarm or message may accompany this projection of the data to make sure that the observer's attention has been drawn to the display. Simultaneously, the failure pattern recorded on the second transparency is projected for viewing by the observer. In this case, however, the failure pattern recorded on the film is not projected on a special portion of the CRT but is projected to be super-imposed over the 8 x 12 matrix of test points as illustrated in Figure 3.

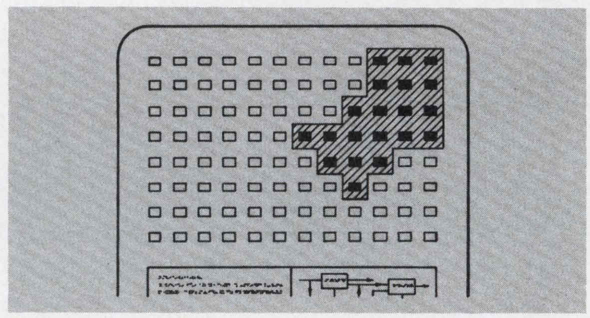
This is done so that the observer can match the failure pattern generated by the test system with that stored on the film, thereby to verify that the proper failure card has been selected. This visual comparison is made on the basis of (1) dot positions in the matrix and (2) the color of the dot at each position. This is a form of self-test of the Test System which can be "eyeballed" by the observer with relative ease.

When a complex fault occurs involving more than a single component a number of relays will

be energized. To retrieve the proper failure card a series of card sorting operations commence. The first pass selects all possible faults associated with one of the non-normal test points. The second pass takes into consideration all possible faults collected from the first pass, and selects only those cards which have a fault associated with the second non-normal test point. This selection process continues until only the failure card remains whose pattern matches that generated by the assembly under test. The two photographic transparencies on that card then are projected for viewing by the observer. This is illustrated in Figure 4 where the concept of pattern recognition is clearly revealed.

V. Summary of the Test System

The observer so far has been given a test system in which any drift, intermittent, or failure in the assembly under test shows up as a "color flag" in a matrix of white dots which are displayed on a television-like receiver. To determine the significance of this "flag" the observer may rely on his memory, may refer to his handbook, or he may read the information from the display screen itself. Perhaps most important,



he knows that the matrix-like failure pattern in his handbook is also projected on the face of the CRT to overlay that generated by the electron beam in real-time. This gives him the opportunity to confirm immediately that the failure card that was selected by the automatic information-retrieval sub-system does in fact yield the failure pattern generated by the faulty assembly. If the two patterns do not match, as illustrated in Figure 5, the observer, is put on notice that either of two conditions prevail.

First: the retrieval sub-system or some other unit of the Test System may not be functioning properly. And, this may be verified by exercising a special sub-routine in the information-retrieval unit. Second: the Test System may be functioning properly but there may not be a suitable failure card in the library. This is equivalent to a "program-stop," type of condition which probably is inherent in any automatic physical system which is designed to make logic decisions. Fortunately, this mis-match of the test patterns should be the exception rather than the rule in a well instrumented system and the possibility of its happening should not detract from the already described substantial gainful results.

(Continued next month)

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new products

The AIMS-V Translator is a unique software package that accepts unstructured input prepared on the AIMS-V SHORTHAND COBOL notational specification sheets and yields output of a complete COBOL source program. The COBOL programs that are generated have common formats regardless of the parameters of the specific system. Therefore, better program documentation is available than with previous COBOL programs. A savings of at least 50 per cent program coding time and keypunch time can be realized when using AIMS-V in comparison to straight COBOL. It is operational on the IBM 360-30 and up for $15,000 including on-site training and fully documented.

For more information, circle No. 52 on the Reader Service Card

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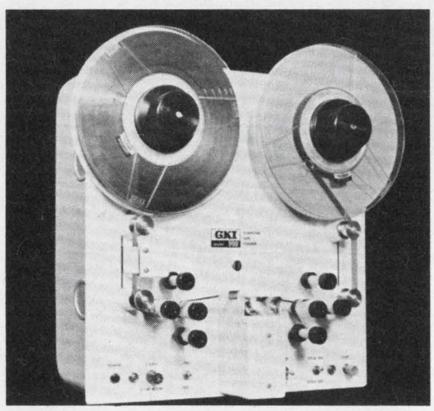

General Kinetics Incorporated announces the availability of a new brochure on the Model 999 Computer Tape Cleaner.

This new brochure describes the unique means for removing error causing dirt from magnetic tape. The GKI Model 999 Computer Tape Cleaner has these outstanding features:

Cleans computer magnetic tape automatically, highest efficiency cleaning process, economical for all sizes of computer installations.

For more information, circle No. 53 on the Reader Service Card

* * *

Automated Systems Inc., of Olympia, Washington has developed a new software package called LOG-IN (Log-Inventory) which is a punched-card-to-computer-system for the timber industry, written in COBOL and operated on any Honeywell series 200 computer.

The package records, classifies and summarizes truck-ticket log records and provides management with reports for accounting, inventory, and analysis of log production from each tract.

The minimum configuration (on a series 200 computer) is 32K core memory, five mag tape units, a card reader, and a 132 print position line printer.

An 11-page booklet is available at a cost of $1.00.

For more information, circle No. 54 on the Reader Service Card

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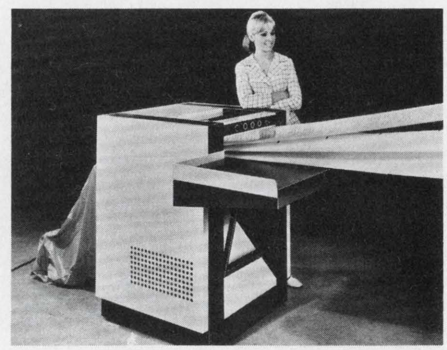


The powerful Shredmaster Conveyor-400 is a clean, efficient way to destroy obsolete computer print-outs (in either batch or continuous forms), IBM cards and tab cards. With its fast moving conveyor belt feed, it can shred up to 2500 pounds of paper per hour. It can also destroy books, magazines, plastic cards, aluminum duplicating plates, even entire files of old records while the contents are still in their file folders.

The Conveyor-400 is completely mobile on heavy duty casters which allow the machine to be moved to areas where needed and eliminates moving large amounts of paper to the machine. The shreds are caught in a large, dust-free disposable plastic bag at the rear of the machine.

For more information, circle No. 55 on the Reader Service Card

* * *

Programming Sciences Corporation announced recently that SSTPAC, a stand alone diagnostic monitor system, written for the IBM System/360, is now available for distribution. SSTPAC will provide full on-line diagnostic services for any device capable of operating with a System/360.

Originally developed for use with alphanumeric CRT display terminals, SSTPAC has been generalized for use with disk or tape drivers, printers, plotters, optical or film scanners, audio response units and all other System/360 compatible devices.

For more information, circle No. 56 on the Reader Service Card

* * *

The first of several optional special features of the MARK IV File Management System has been announced by Informatics Inc.

The new feature, Table Lookup, according to C. Gordon Utt, MARK IV Marketing Manager, operates as an integral part of MARK IV. It allows a reduction in file size through the use of codes which are automatically translated by MARK IV to produce attractive reports. The previous time consuming task of creating tables and retrieval techniques for processing this type of information is greatly simplified by this special feature.

MARK IV, a proprietary software product of Informatics, is a general purpose file management system now in use with IBM System/360 software in over 60 installations in North and South America, Europe, Africa and Asia.

For more information, circle No. 57 on the Reader Service Card

* * *

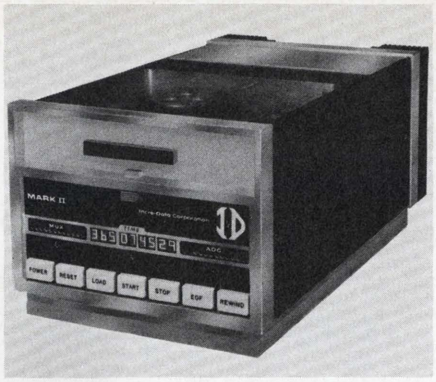
The Incre-Data Mark II data acquisition system utilizes IBM-compatible magnetic tape cartridges to completely eliminate digital playback conversion. It can be cartridge-loaded and programmed in the field. The solid state system has five basic components: programmable data formater/controller, analog and digital multiplexer, analog to digital converter, digital clock, magnetic tape recorder.

Data format handles up to 144 individual digital characters. Systems control is achieved with a 400-pin patchable connector.

High-speed analog multiplexer sequentially samples 20 differential or 40 single-ended inputs, with single scan, continual scan or start/stop scan rates.

Digital clock correlates all input data. Front panel decimal display shows days, hours, minutes and seconds. Clock can be used to drive external controls or remote displays. Pre-set and start/stop controls provide start/stop synchronization with external time standard.

Incremental magnetic tape recorder is 7-track and compatible with IBM NRZI



at densities of 200 and 556 BPI, and records at speeds up to 2,000 characters per second synchronous speeds and up to 1,000 characters per second asynchronous. Recorder uses a self-threading single speed cartridge for quick and easy loading or reloading; each cartridge holds 1,000 feet of 1.5 mil mylar tape wound on a removable 6″ diameter reel. All recorder controls can be mounted remotely.

It measures 6½″ high, 7¾″ wide, 13⅜″ long; weighs approximately 29 pounds. Standard power is +28 volts dc at 4 amps; optional power converters are +12 volts dc, and 60 Hz, 400 Hz, 115 volts.

For more information, circle No. 58 on the Reader Service Card

* * *

Single laboratory analyst operates the new OMEGA Data Reduction System recently introduced by Beckman Instruments, Inc., Fullerton, California. The new system provides laboratory analysts in a wide range of industries with exclusive use of an Olivetti Underwood computer in their laboratories for time-saving analyses. Now in use with liquid scintillation instrumentation, the new system is also adaptable for use with fluorometers, infrared and ultraviolet spectrophotometers, atomic absorption analyzers, electrochemical equipment. The computing module is the Olivetti Underwood Programma 101 desktop-size computer.

For more information, circle No. 59 on the Reader Service Card

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The 101 desktop computer by Olivetti Underwood Corporation. New desktop-size computer is programmable for use in a wide range of businesses, schools, laboratories and hospitals. It is little larger than a typewriter, yet it can "write", store, and run programs calling for as many as 120 mathematical steps and instantly print out results on paper tape. The 101 sells outright for $3,850.

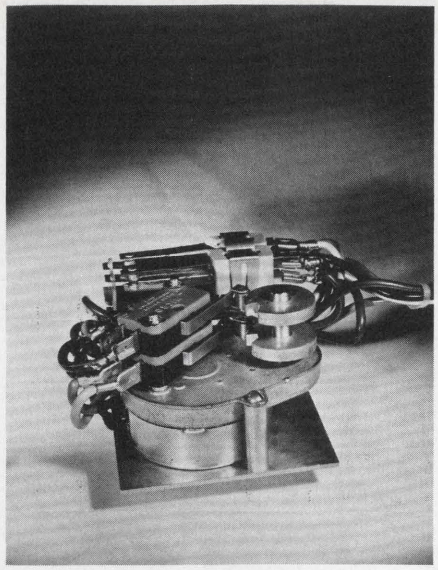
For more information, circle No. 60 on the Reader Service Card

* * *

A time delay relay for use in temperature control and regulation applications has been unveiled by the Industrial Timing Division of Sessions here. Sessions is a subsidiary of Consolidated Electronics Industries Corporation.

Sessions has been granted preliminary patent authorizations.

The device enables a compressor to operate independent of a timer and is



believed to be the only electro-mechanical device of its type on the market.

The standard 115-volt, 60-cycle package utilizes split adjustable cams and Sessions' high reliability S-2000 series synchronous motor. The electrical no-back motor is patented by Sessions and is known for its ability to withstand high static loads. Torque rating is 30 oz. in. @ one rpm.

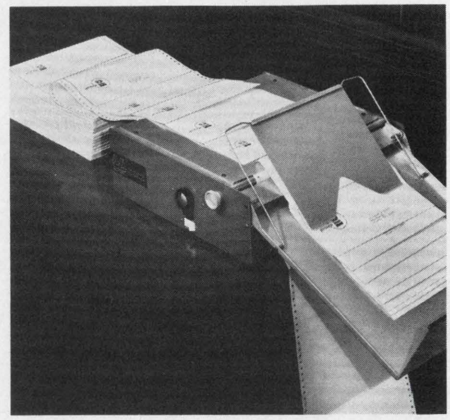
The device incorporates a 3½x2½x3" package with a variety of mountings available. It provides time delay relay in case of power failure with automatic set and restart characteristics. The device to be controlled remains activated as long as the thermostat is energized.

For more information, circle No. 61 on the Reader Service Card

* * *

A new type continuous envelope using a radically different method of affixing conventional envelopes to carrier strips has been developed by Moore Business Forms, Inc. The new product, called "Mooremailer," offers many unique features heretofore unavailable in a continuous envelope. In the Mooremailer, regular correspondence envelopes are affixed to a carrier strip by four glue spots positioned under the envelope flaps. These spots are not visible when the flap is sealed, making each envelope appear as individually addressed instead of mass addressed.

Developed especially for use in computer-driven printers and other writing equipment, the unique edge-to-edge position of the envelopes keeps non-printing time to a minimum. The low profile flap allows greater printer address area and minimizes the possibility of ribbon shadow or character omission.



When feeding, envelopes lie perfectly flat with no loose edges or overlapping flaps, to cause smudging or spotty impressions, when run on high speed printers, tabulating machines, electronic accounting machines and typewriters with pin feed devices.

For more information, circle No. 62 on the Reader Service Card

* * *

The Graphics & Instrument Division of Electronic Associates has introduced a new series of X-Y recorders.

The first in this line of plotters is the OEM-17 X-Y recorder, a new concept in plotter design for the original equipment manufacturer.

The OEM-17 plotter employs a highly reliable, low cost design using a DC servo system. It offers flexibility in size and interface to accommodate various system requirements. The plotter is available with its own power supply or can be supplied with power from the system.

Some features of the OEM-17 include: a 17" x 17" plotting surface; sealed feedback potentiometers; a magnetic paper-hold system; a disposable fibre-tip pen writing system; and static accuracy of ±0.2% of full scale.

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