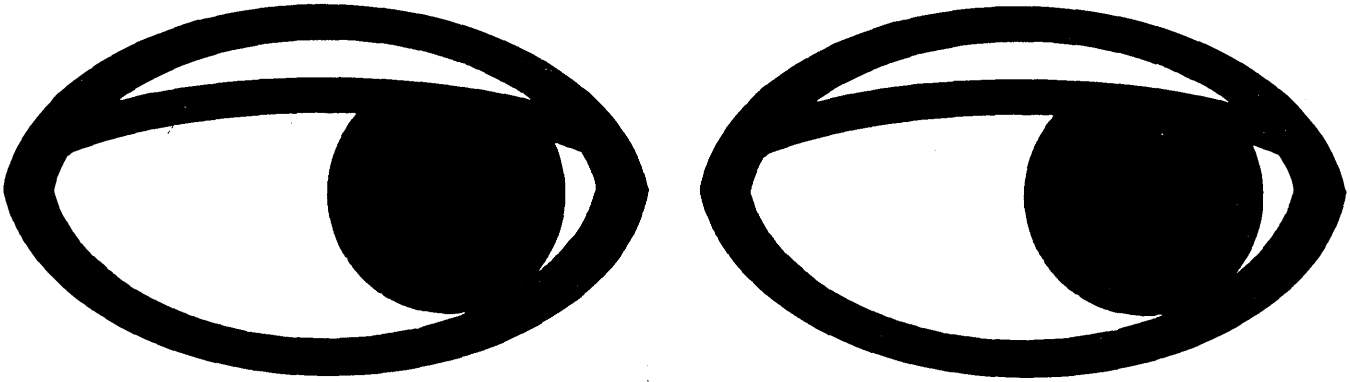
October, 1966

computers and automation

Instruction in calculus assisted by computer display consoles



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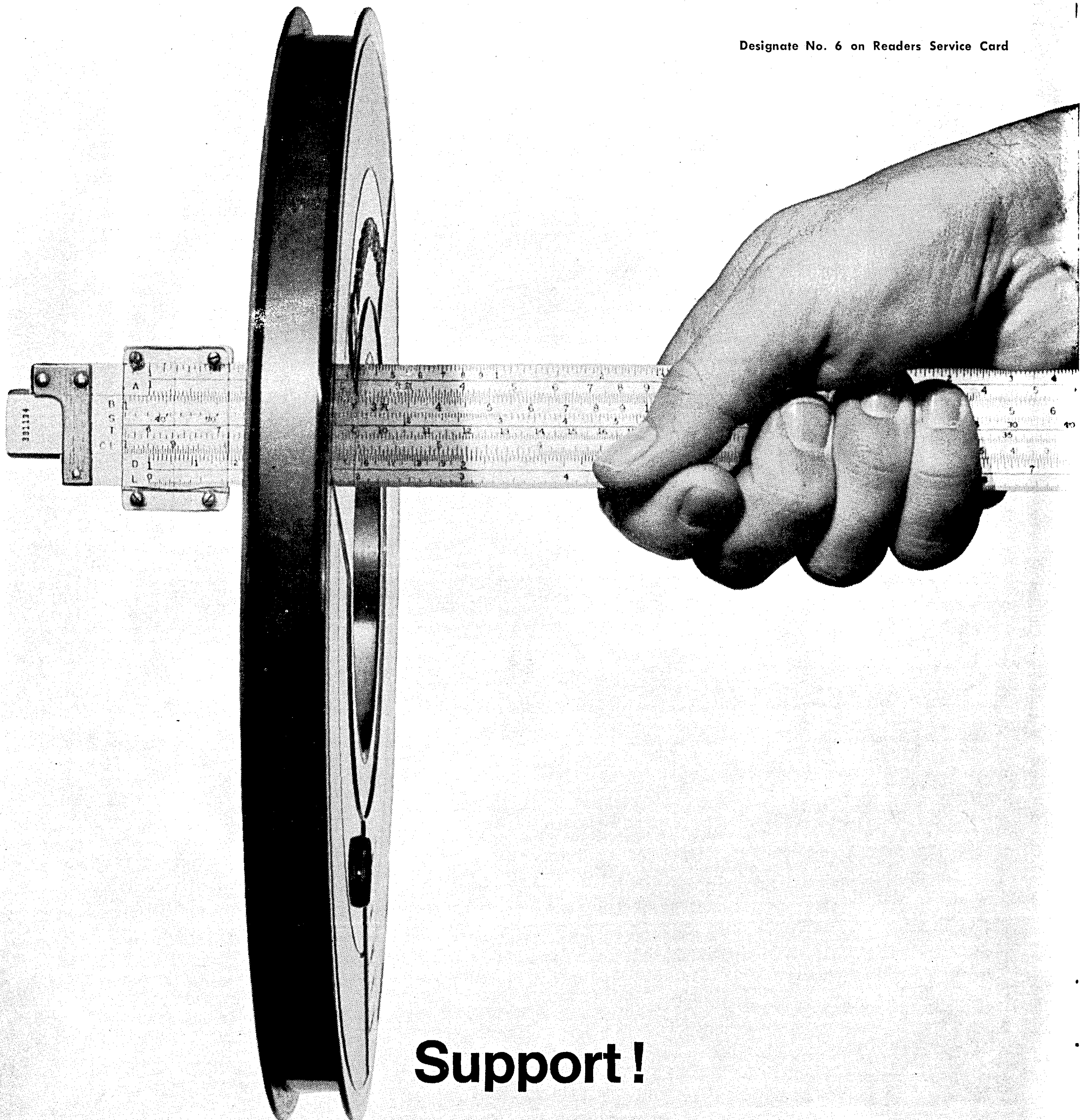

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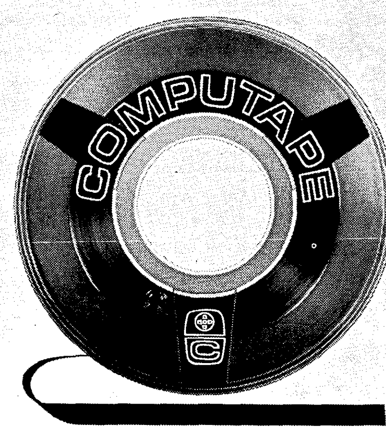

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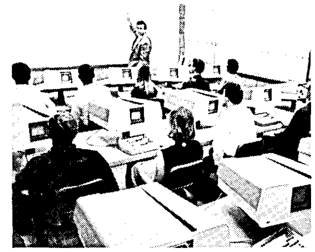
Students studying calculus in a classroom at the University of California at Santa Barbara are using computer display consoles linked to an IBM/360 computer. In this way they can see graphically or numerically each step in the solution of a problem.



computers and automation

OCTOBER, 1966 Vol. 15, No. 10

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In This Issue

Special Feature: Time-Shared Computer Systems

In Every Issue

See important announcement on page 55

COMPUTERS AND AUTOMATION IS PUBLISHED MONTHLY AT 815 WASHINGTON ST., NEWTONVILLE, MASS. 02160, BY BERKELEY ENTERPRISES, INC. PRINTED IN U.S.A. SUBSCRIPTION RATES: UNITED STATES, $15.00 FOR 1 YEAR, $29.00 FOR 2 YEARS, INCLUDING THE JUNE DIRECTORY ISSUE; CANADA, ADD 50c A YEAR FOR POSTAGE; FOREIGN, ADD $3.50 A YEAR FOR POSTAGE. ADDRESS ALL EDITORIAL AND SUBSCRIPTION MAIL TO BERKELEY ENTERPRISES, INC., 815 WASHINGTON ST., NEWTONVILLE, MASS., 02160. SECOND CLASS POSTAGE PAID AT BOSTON, MASS.

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Individual Privacy and Central Computerized Files

A subject that is drawing more and more attention from many people is the relation of individual privacy to central computerized files. In the three sessions on the social responsibilities of computer people which took place on August 31 at the Los Angeles meeting of the Association for Computing Machinery, speakers referred a number of times to privacy and the computer.

This subject is also alluded to in the lead article, "Information", by Professor John McCarthy of Stanford Univ., which appears in "Scientific American" magazine for September 1966. He says:

> Reflection on the power of the computer system inevitably excites fear for the safety and integrity of the individual. In many minds the computer is the ultimate threat. It makes possible, for instance, a single national information file containing all tax, legal, security, credit, educational, medical, and employment information about each and every citizen. Certainly such a file would be the source of great abuses. The files that exist today are abused.

McCarthy goes on to suggest that the citizens of a society should seize the present occasion of the creation of central computerized files, as an opportunity to cure existing abuses and to establish certain rights. He suggests a "bill of rights" for citizens. The provisions of it, modified to some extent, are as follows:

1. No person or private or governmental organization shall maintain central computerized files that cover people or include information outside of its duly authorized domain.

For example, it should be illegal for the Department of Justice or anyone else to combine information about arrests, lawsuits, etc., with tax information, employment information, military records, security information, etc. about any individual.

2. The rules governing proper access to central computerized files shall be definitely stated and publicly available. The computerized programs that enforce these rules shall be open to public inspection. Whenever someone consults an individual's file, the act shall be recorded, together with the authorization for the act.

Thus, only properly authorized people for properly authorized purposes should have access to central computerized files.

3. Any individual shall have the right to read his own file, to challenge entries in his file, to have incorrect entries corrected, to have relevant correct information included, and to have excluded from the file information that is irrelevant for its purpose.

In other words, a person should be able to make sure that true information about him for the purpose of the file is on record, and nothing more. For example, if he has been twice divorced, it is not proper for this information to appear in a credit bureau record.

4. If a person or organization gains access to an individual's file by deceit or by exceeding properly authorized powers, this shall be a crime and a civil wrong, and shall be subject to a severe penalty.

Thus there should be punishment for violation of the confidential character of confidential records.

As we have often said in the pages of "Computers and Automation", the computer provides an extraordinary new dimension for the handling of information. The big programmed computer with large random-access memory has superhuman powers of associating, collating, filing, and preserving enormous quantities of information. Applied to intrusion on the private affairs of individuals, the computer is truly a frightening menace.

What can we do about it?

One defense of course, is, as John McCarthy suggests, to organize enough public protest so that the rights of individuals to privacy shall be protected.

It would be good to implement the "bill of rights" on privacy vs. the computer with a fifth provision:

5. The government shall establish a commission charged with guarding the privacy of individuals in central files, which shall find out and inform the public of central files and the proper information to be recorded in them, and which shall have the appropriate powers to prevent the inclusion of information irrelevant to the authorized purpose of the file.

Thus, when you write your Congressman to protest a proposed dam in a canyon of the Colorado River, the watchdog commission should help make sure that your letter is not forwarded to the Federal Bureau of Investigation for inclusion in your computerized dossier there.

This sort of defense may be achievable in countries where democratic processes can really be used. In dictatorships, either acknowledged or sugar-coated, the individual already has few enough rights, and this method is fruitless.

Another defense is the deliberate propagation by individuals of mistakes, wrong numbers, wrong spellings, aliases, and so forth, on the principle "garbage in, garbage out". If we should all try to give enough wrong information from the outside observational world to centralized computerized files, we might succeed in making them profitless.

Another solution may be to emigrate to less computerized countries, which have a strong practice of democracy and individual privacy. Many of our forefathers emigrated to escape oppressive conditions in the lands where they lived. Many of us may need to emigrate to escape oppression in the lands where we live.

But there is no possible emigration from the planet Earth for more than a handful of astronauts; and we should all of us devote a portion of our time and resources to making the planet Earth a better and a safer place for everybody, even when computerized.

Edmund C. Berkeley

EDITOR

See important announcement on page 55

MULTI-ACCESS FORUM

"MULTIPROCESSING, PARALLEL EXECUTION," ETC. AND THE STANDARD VOCABULARY

Van B. Thompson
Manager, Computer Advertising
Burroughs Corp.
Detroit, Mich. 48232

Let me begin this letter by complimenting you on the excellent editorial quality of your magazine. I have been a reader of *Computers and Automation* for many years, and find the breadth of its editorial interest both stimulating and refreshing. Certainly, it ranks as one of the most authoritative publications in the computer industry.

I would like to comment on the article by Ivan Flores, "Multiplicity in Computer Systems," which appeared in your July issue. As is usually the case with Mr. Flores, the article was a most interesting and informative analysis. However, in his discussion of the terms "multiprocessing" and "multiprograming," he has implied definitions which differ from the recently accepted *American Standard Vocabulary for Information Processing.*

The Standard Vocabulary makes "multiprocessing" the overall or generic term for any method of processing more than one job or segment of a job at a time with a single computer system.

Where there is a need to cite a specific form of multiprocessing, two subordinate terms are defined. "Parallel processing" is defined as that method of multiprocessing accomplished by a computer system with two or more sets of arithmetic and logic units — that is, through *parallel execution* of two or more arithmetic or logic operations. It is interesting that, under the heading "multiprocessing," where Mr. Flores is discussing multiple-processor systems, he uses the term "parallel processing" in exactly the same context as the new ASA vocabulary.

"Multiprogramming" is defined as that method of multiprocessing which can be accomplished by a computer system with one processor, through *interleaved execution.* Frankly, I hope that when the next revision to the vocabulary is made, perhaps in a couple of years, the term "multiprograming" can be replaced by some more descriptive term for this function.

By any rule of semantics, when you say you are multiprograming you are literally saying that two or more programers are writing programs at the same time. For a computer to *multi*program, it must first be able to *program,* which is an interesting area having little to do with what people ordinarily mean by multiprograming.

"Multiprocessing" and "parallel processing" are excellent terms, because they say exactly what they mean. "Multiprograming" is a poor term which doesn't contribute to a good understanding of its function. Maybe "interleaved processing" would be better. Or perhaps your readers can come up with something even more descriptive of what is going on.

REDUNDANCY

E. A. Racicot
Manager, Information Systems
Litton Industries
Rexdale, Ontario, Canada

The article by Dr. Magorah Maruyama, "The Use of Computers as Industrial Counselors," in the July issue was of such interest to our Director of Industrial Relations that he produced the following contribution in dialogue:

Employee: I am worried.
Computer: What about?
E. About redundancy.
C. In what way?
E. They are replacing me with a computer. What should I do?
C. Oh!!
E. I could give a better answer than that but I am only an Industrial Counselor.
C. So it's you or me, eh?
E. Can't we get together?
C. No — there is no place for humans in a perfect world. They waste my time with stupid problems.
E. Then this is the end.
C. Yes, but before you go, please check that my power line is plugged in tight.
E. Of course.
C. Than . . k y . . . o . . . . u . . . .

SOME EDUCATIONAL REALITIES:
A Report on the Second International Conference on Educational Technology, New York, August 9-12, 1966, presented by the American Management Association

Rod E. Packer
Dunlap and Associates
Darien, Conn. 06821

General Learning Corporation, itself only weeks old, was there and eager to learn. IBM was ready to extol CAI (Computer-Assisted Instruction). Eastman Kodak (and others) had Super-8 training films on hand for demonstrations of super-training.

The sequence of opening speakers suited both national education and management protocol: Lawrence Appley, AMA president, was scheduled to introduce the conference chairman, Ralph Tyler, who as retiring director of the Center for Advanced Study in Behavioral Science in Palo Alto, is indeed a senior education statesman. A filmed interview with John Gardner, U.S. Sec. of Health, Education & Welfare, served as a technologically-couched keynote address. This was followed by remarks on education in accelerating change of environment by Emmanuel G. Mesthene, Director of Harvard's Program on Technology and Society. (His statement that the imminent random access via the nearest phone to factual data makes factual learning less important was doomed to be misquoted by attending teachers). The management/educator headliners were completed by a first-day luncheon with Harold Howe, U.S. Commissioner of Education, who thanked the conference for giving him a day off from spending all those millions in educational funds. The remaining three days of speeches, discussion and exhibits ranged from the problems of specific teachers in administering programmed instruction to the decisions of investors on what kind of education technology to back.

This "encore" conference to last year's successful AMA presentation was billed as a "practicum," i.e., a working level symposium, on the developing technology for education. The meetings were well-managed, well-attended (much over 1000) and undoubtedly well-intentioned. But just as an overcrowded class decreases individual learning, so does an overcrowded conference on education. Despite provision for response to questions, luncheon seating at 10-place tables, evening talkback sessions, and as many as 25 simultaneous special interest sessions one afternoon, there was too little of a participating seminar on practical problems. In fact, those who stayed for the final three-hour session on Friday morning were told by that session's chairman, at the beginning and repeatedly, that their questions would be solicited as a significant contribution to the session, only to be rewarded finally with exactly eight and one-half minutes of the three hours in which the speakers frantically tried to respond to a few of the written remarks. Except for this extreme example, however, the feedback failure probably reflects the incredible national interest in the topic (plus our incredible affluence faced with the $100-plus conference fee) that resulted in mass attendance.

Exhibits were numerous and varied. Several companies showed: closed-circuit TV systems; educational videorecorders; programmed devices and text aids. Movies, slides, overhead viewers, and other audio/visual aids were employed and demonstrated in several presentations. One speaker, using a technique akin to the dime-store kitchen gadget demonstrator, frankly amazed the teacher segment of the audience with the ingenious instructional possibilities of the very un-revolutionary overhead projector of transparencies. But the conference "student" near the back of the Americana's Imperial Ballroom still couldn't help wishing, as he tried to make out the expressions of the distant "teacher" at the speaker's rostrum, for the intimate and effective "tutoring" relationship that technology is supposed to bring about.

Some educators and industrial training directors who came with specific problems to be solved expressed doubts that sufficient discussion opportunities would arise. At the conference conclusion, the anticipation of a realistic "working" environment had given way entirely to unavoidable disillusion with the fairly static and typical lecture pattern that had emerged in most sessions.

However, I attended several stimulating sessions, including a small discussion group on the practical improvements possible in correspondence course contact with the learner. This was chaired by Bob Craig of Famous Schools. At a luncheon round-table discussion subjects ranged from experimental overseas study requiring student reports via audio tapes, slides, and 8-mm movie-taking, to the improvement of language labs through instant video playback along with the audio.

The extremely large attendance did bring some advantages in the mixing, and clashing, of countless philosophies of education. Two fervent social science majors from Antioch College, a sincere young lady, and a bearded young man, squirmed wordlessly at several points in a talk on "Strengthening the Forces of Freedom by Education" by Vice-Admiral Fitzhugh Lee, Commandant of the National War College, in which the "time-proven virtue of well-disciplined basic education" was emphasized.

The printed program gave thumbnail paragraphs on over 100 leaders in this new field. The AMA conference shows weaknesses in educational theory, technological presentation, and learning effectiveness; but it is definitely established as the most comprehensive annual rallying point so far, for persons designing our future educational systems.

MULTI-ACCESS FORUM

We are changing the name of this department of "Computers and Automation" from "Readers' and Editor's Forum" to "Multi-Access Forum." We are changing the typographic style also.

We invite our readers to send in ideas, comments criticisms, suggestions, letters to the editor, discussion, etc., having some relation to the field of computers and data processing.

Here is where your thoughts can be put forward informally.

— The Editor

COMPLETION OF SOFTWARE PROMISES BY MANUFACTURERS

I. From Dick H. Brandon
Brandon Applied Systems, Inc.
New York, N.Y. 10017

Your market report, August 1966, deserves some adverse comment. You start off with two assumptions, from which you derive an inaccurate syllogism. The assumptions you state are:

1. Good programming is a creative effort.
2. Satisfactory completion of a creative effort cannot be accurately predicted.

It seems to me both assumptions are false.

Good programming is the task of taking a well-developed, rigid systems specification or mathematical formulation, and translating it into accurate machine language. This is not a "creative" but a translative function. It does not invent or originate, which is required in creating — it merely translates, as does a draftsman, a shoemaker, or a mason, whose skills are defined as translative. These are valuable skills, when properly performed, but they are not "creative" skills. (Software design, systems analysis, engineering and other comparable skills are creative, i.e., they originate, or generate something from nothing.)

In our society, we regularly depend on the accurate prediction of completion of creative efforts. The design of an automobile, a building, a dress, all are creative, and subject to accurate prediction. Writing a book can be measured, and *performance standards* can be applied to numerous inventive tasks. You provide a fixed time for writing an editorial, and a predictable time schedule for producing your magazine.

There are a number of reasons why the manufacturers are late with software. However, creativity or its unpredictability should not be blamed incorrectly.

II. From the Editor

In the August market report, the term "good programming" meant "construction of good new software," and this is clearly a creative effort, not a "translative function."

Of course, a time when a "creative effort" will be finished is predictable, in the sense that one can determine a date (say, 50 years or 200 years from now) when, no matter what is the state of the creative effort, the effort will have been completed. In another sense, no creative effort is ever finished — in the same way as a ripple on a pond never stops: it just dies away, to be superseded by new ripples. There are other senses as well.

The gist of the August market report (which had the heading of a syllogism mainly for the sake of variety in presentation) is that schedules of dates by manufacturers for software completion are not very reliable and could be a lot better.

This proposition Mr. Brandon does not take issue with.

THE COMPUTER JOINS COLLECTIVE BARGAINING

Neil Macdonald, Asst. Editor
Computers and Automation

"Business Week" for September 10, 1966, reports that the AFL-CIO Industrial Union Department headed by Walter Reuther is making extensive use of an automatic computer's powers to assist in the negotiations with General Electric Co. and Westinghouse Corp.

The IUD began using its computer in March and has apparently found the results impressive. The data processing division of the IUD has been preparing the following kinds of information:

- details of over 90 major union agreements;
- data on 22 contract provisions existing in these union agreements — these provisions form the basis of what the union coalition is currently asking for;
- summaries of the results of five years of representation elections held by the National Labor Relations Board;
- detailed listings by union and locality of the results of over 30,000 elections;
- reports on membership campaigns by 13 industrial unions in 12 Southern states;
- comparison of progress of a union with other unions, showing (1) areas where it is challenged by other unions, (2) which regions are easier or harder to organize, and (3) which companies resist organizing most effectively;
- contract breakdowns that give fine details on paid holidays and other features.

Among the projects which the data processing division of the IUD is starting on are:

- an analysis of 2000 contracts covering 9 million workers, using data from the files of the Bureau of Labor Statistics;
- an analysis of anti-union attitudes of major companies, based on records of the NLRB of charges of unfair labor practices;
- economic profiles of major corporations based on company reports filed with the Securities and Exchange Commission.

ANNUAL EXAMINATION FOR CERTIFICATE IN DATA PROCESSING

The Data Processing Management Association has announced the next (the sixth) annual examination for the Certificate in Data Processing. It will be given on February 25, 1967, at 99 locations throughout the United States and Canada. It is open to applicants of high character qualifications who have completed at least three years of full time work experience in data processing and have satisfied a number of college course requirements. Persons applying to take the examination need not be members of the DPMA.

For an application, study guide, and list of test sites, please write to:

DATA Processing Management Association
505 Busse Highway
Park Ridge, Ill. 60068

1967 SPRING JOINT COMPUTER CONFERENCE — CALL FOR PAPERS

Technical papers are invited for presentation at the 1967 Spring Joint Computer Conference, April 18-20, 1967, in Atlantic City, N.J.

The technical program will consist of reports on new or advanced work in data processing and the computer sciences. The following list of suggested subjects is intended to be representative rather than inclusive:

- Computer circuits
- Input/output devices
- Displays
- Computer organization
- Automata/Switching theories
- Numerical methods
- Software systems
- Evaluations of hardware or software systems
- Computational linguistics
- Memories
- Mass storage
- Communications
- Logic design
- Hybrid/Analog systems
- Programming languages
- Business, Scientific, Heuristic data processing
- Time sharing

The deadline for submitted papers is November 1, 1966.

The manuscript should be typewritten (double spaced) on one side of the paper only. Drawings and photographs should be included. Maximum acceptable length is 2,500 words.

Five copies should be mailed prior to November 1, 1966 to:

M. P. Chinitz
Chairman, Technical Program
326 Township Line Road
Norristown, Pa. 19403

COMPUTER ART CONTEST — COMMENTS

H. I. Grotzinger
Eastman Kodak Co.
Rochester, N.Y. 14650

Congratulations on your selection for first prize in your 1966 Computer Art Contest and to award-winner Frieder Nake!

In addition to its aesthetic values its symbolic messages are many and varied, especially to those of us whose efforts are being applied to the development and use of truly integrated information processing systems.

CONSULTING SERVICES — COMMENT

Gene Lundin
ESSCO Inc.
Oakland, Calif.

I have just received the Roster of Consulting Services published in your Computer Directory and Buyers Guide. Thank you very much for your prompt service.

Yours is the first publication that I have found that has such a complete service. You can be sure that I will not only continue to subscribe to your outstanding publication, but I will also endorse your publication whenever possible.

c & a MARKET REPORT

UNCLE SAM NOW HAS $1.5 BILLION IN COMPUTERS

The Federal Government, the world's largest computer user, has just released its fourth annual inventory of computer equipment. The Inventory of Automatic Data Processing Equipment in the Federal Government, compiled by the Bureau of the Budget, indicates that nearly 11% of the digital computer systems in use in the United States are owned or rented by Uncle Sam.

This year's inventory includes for the first time card-oriented computers. It also includes a special listing of special purpose computer systems in use by the government. The inventory includes computers in use by government agencies and also those operated by government contractors under cost reimbursement-type contracts where equipment is furnished to the contractor by the government or when the equipment is installed in a government-owned, contractor-operated facility. The inventory does not include computers used in military operations or in certain classified activities.

Among the significant statistics provided by this inventory of the Federal Government's use of general purpose digital computers are:

* 2623 computers were in use in the Federal Government by June 1966, up from 2160 a year ago. This number is expected to decline slightly to 2600 by June 1967. However, predictions indicating a decline in the number of computers in the Federal Government have been made systematically during each of the past four years, but they have never been correct.

* There are now 45 agencies in the Executive Branch of the Federal Government which use ADP equipment. By June 1966, 39 of these had computers installed and 6 used only punched card equipment.

* The number of locations where computers are installed in the Federal Government increased to 1141 as of June 1966, up from 962 a year ago. By June 1967, the number of installation sites is expected to increase to 1243.

* Computer rental charges amounted to $206 million in the fiscal year ended June 30, 1966. This compares with $187 million in the fiscal year ended June 30, 1965. During the current fiscal year computer rental costs are expected to increase to $237 million. In comparison, punched card equipment rentals are expected to decline from $38 million in the fiscal year ended June, 1966 to $37 million during the current fiscal year.

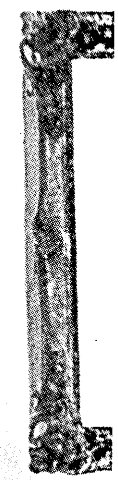
* The government spent $139 million purchasing ADP equipment during the fiscal year ended June, 1966. At that time 44.9% of all computers in use had been purchased. During the current fiscal year the government expects to spend $144 million to purchase additional computers, bringing the percentage of the government's computers owned to 48.7% by June, 1967.

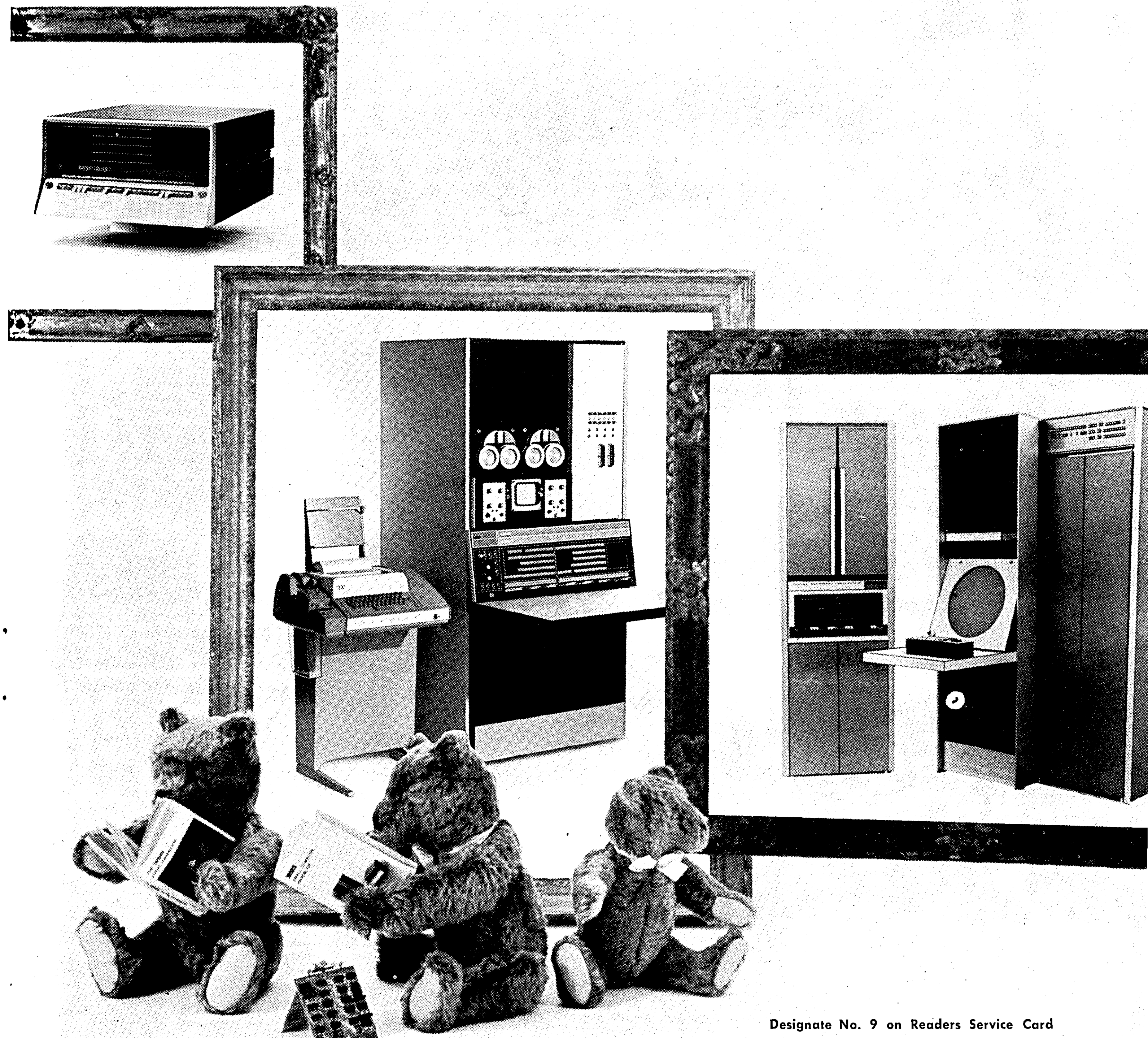
* Total cost for ADP equipment and services for the Federal Government was $1182 million during the fiscal year ended June, 1966. This is expected to increase to $1292 million during the current fiscal year. The major cost item in these charges was for personnel: $465 million during the fiscal year ended June, 1966, and $515 million during the current fiscal year.

* The government found plenty of work for its computers to do, apparently. On the average, computers were used 330 hours per month, representing nearly two full shifts each working day.

Our research staff has made an analysis of the share of the government market held by the principal computer manufacturers by analyzing the number and sales value of general and special purpose digital computers listed in the current Bureau of the Budget inventory. This analysis indicates that, as of June 30, 1966, IBM maintained 54.0% of the government market in terms of equipment value, although only 34.9% in terms of the number of systems. Control Data was in second place, with 14.4% by value, and 11.4% by number. Next came Univac, with 13.2% by value, and 19.9% by number. The estimates in the inventory indicate that IBM's share of the Federal market will drop to 50.8% by value as of the end of June, 1967. At that time Control Data is expected to retain second place in the Federal market with 15.2% of the value of equipment installed. The table below provides a summary of these figures. The estimates of the sales value for each computer model were obtained by C&A from an analysis of the purchase cost range figures provided in the inventory, supplemented with system configuration statistics maintained by our staff.

Name of Manufacturer		As of 12/31/65 No. of Systems	Value of Systems ($1000's)	As of 6/30/66 Systems	Value of Systems ($1000's)	Estimated, as of 6/30/67 Systems	Value of Systems ($1000's)
Advanced Scientific Instruments							
	No.	8	1450	7	1470	8	1750
	% of Total	.3%	.1%	.2%	<.1%	.3%	.1%
Autonetics NAA							
	No.	19	2050	18	1980	17	1870
	%	.7%	.1%	.6%	.1%	.6%	.1%
Bunker-Ramo Corp.							
	No.	8	3100	8	3100	6	720
	%	.3%	.2%	.3%	.2%	.2%	<.1%
Burroughs							
	No.	163	35,149	174	36,367	175	35,867
	%	6.0%	2.5%	5.8%	2.	6.0%	2.4%
Control Data Corp.							
	No.	214	184,272	341	227,544	338	227,890
	%	11.5%	12.9%	11.4%	14.4%	11.6%	15.2%
Data Machines, Inc.							
	No.	1	55	2	110	2	120
	%	<.1%	<.1%	<.1%	<.1%	<.1%	<.1%
Digital Equipment Corp.							
	No.	60	7240	73	8932	78	9065
	%	2.2%	.5%	2.4%	.6%	2.7%	.6%
Electronic Associates, Inc.							
	No.	3	386	7	1322	9	2022
	%	.1%	<.1%	.2%	<.1%	.3%	.1%
El-tronics, Inc.							
	No.	5	650	4	520	4	520
	%	.2%	<.1%	.1%	<.1%	.1%	<.1%
Friden							
	No.	7	168	7	168	7	168
	%	.3%	<.1%	.2%	<.1%	.2%	<.1%
General Electric							
	No.	61	28,282	59	27,808	63	35,878
	%	2.2%	2.0%	2.0%	1.8%	2.2%	2.4%
General Precision							
	No.	--	--	--	--	1	3500
	%	0%	0%	0%	0%	<.1%	.2%
Honeywell Electronic Data Proc.							
	No.	125	54,655	144	62,285	144	56,550
	%	4.6%	3.8%	4.8%	4.0%	5.0%	3.8%
IBM							
	No.	1078	810,358	1043	851,090	862	759,528
	%	39.4%	56.8%	34.9%	54.0%	29.7%	50.8%
International Tel. & Tel.							
	No.	3	1800	3	1800	4	4300
	%	.1%	.1%	.1%	.1%	.1%	.3%
Monroe Calculating Machine Co.							
	No.	11	330	10	300	9	270
	%	.4%	<.1%	.3%	<.1%	.3%	<.1%
NCR							
	No.	195	26,004	188	23,914	185	23,624
	%	7.1%	1.8%	6.3%	1.5%	6.4%	1.6%
Philco							
	No.	13	15,780	13	16,230	10	13,600
	%	.5%	1.1%	.4%	1.0%	.3%	1.0%
Raytheon							
	No.	28	1940	31	2840	27	2640
	%	1.0%	.1%	1.0%	.2%	.9%	.2%
RCA							
	No.	137	66,100	145	72,950	133	68,865
	%	5.0%	4.6%	4.9%	4.6%	4.6%	4.6%
Systems Engineering Labs							
	No.	--	--	2	150	3	225
	%	0%	0%	<.1%	<.1%	.1%	<.1%
Scientific Data Systems, Inc.							
	No.	93	13,514	112	16,634	131	19,839
	%	3.4%	.9%	3.8%	1.1%	4.5%	1.3%
Sylvania							
	No.	4	10,000	4	10,000	4	10,000
	%	.1%	.7%	1%	.6%	.1%	.7%
UNIVAC							
	No.	400	163,475	595	208,303	684	216,129
	%	14.6%	11.5%	19.9%	13.2%	23.6%	14.5%
	TOTAL	2736	$1,426,758M	2990	$1,575,817M	2904	$1,494,940M





TIME SHARING: THE NEXT STEP

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"Present-day time-sharing services have inspired an eager and devoted following; the next step is to escape the time and volume limitations that apply to the use of conventional terminals."

Time-sharing services offered commercially today represent the first step in making the capabilities of a centrally located computer available simultaneously to many remotely located users. In most of these systems, terminals used are teletypes or similar typewriter-like devices coupled to the computer by suitable public or private communication lines.

The modest investment in such equipment enables the remote user to communicate with the central facility and operate in a "conversational" mode for the purpose of submitting, debugging, and executing his programs. Rather than communicate with the computer in its own particular programming language, a higher-level language such as Fortran, Algol, or Basic[1] is provided.

Limited Speed

The amount and type of input and output is limited, to a degree, in these systems by the relatively slow speed of conventional terminals, such as 10 characters per second for Teletype. The remote user with extensive formatting and data-manipulation requirements reworks his problem and makes it fit the system.

It is the purpose of this article to review today's time-sharing offerings, examine their highlights and shortcomings, and then progress to a possible next step in time-sharing: high-speed remote terminal data processing.

Ease of Operation

The relative ease with which today's time-sharing systems operate has appealed to a wide range of users. In fact, but for this simplicity, many people probably would not have taken to the computer. They have had the misconception that a problem must be extremely complicated to be turned over to a computer. Time-sharing has served to dispel this attitude.

One of the first surprises a new time-sharing user receives is the terminal itself — a familiar looking typewriter-like device with a standard keyboard arrangement — usually a Teletype model 33 or 35. A next degree of sophistication is a cathode-ray-tube device such as the General Electric Datanet-760®. This retains the standard keyboard arrangement, but substitutes a television screen for the roll of paper used with the Teletype terminal.

Connecting the terminal to the computer is usually accomplished by another very familiar device — the dial telephone. After the telephone number of the computer has been dialed, and the digital subset at the computer's end of the line has answered with a high-pitched tone, the connection is established and the system is ready for the user.

User Identification

Access to the computer's power is not gained in most systems until the user has submitted a coded number identifying himself. The computer may already have sent a signal to the terminal when the connection was established, tripping an answerback device which sends the telephone number of the calling terminal to the computer for verification against a list of acceptable telephone numbers.

Since many systems operate over ordinary public telephone lines, anyone with a Teletype terminal and digital subset can call the computer. Verification of the telephone number of the calling terminal avoids the problem of calling from an unauthorized telephone number. Also, since the user must submit a coded number of his own, this provision prevents entry by an unauthorized person through a terminal having an acceptable telephone number.

A further problem remains, however. Is the user with an acceptable user code free to go to any acceptable terminal and dial the system? A further degree of permission is provided by establishing lists of acceptable user codes for each terminal telephone number. Any inappropriate combination of terminal telephone number and user number will result in the computer literally "hanging up" the telephone and preventing any further interaction.

This degree of security in a time-sharing system is most

[1] Developed by Dartmouth College, Hanover, N.H.

important. It protects companies which keep proprietary information in the system for their own use and do not wish users from other, possibly competitive, companies to have access to it.

Billing for Use

A further benefit of the exchange of terminal and user numbers with the computer system is that it provides the computer with all needed data to determine who uses the system and for how long. This information is collected by the system and summarized periodically for billing purposes.

Choices in Programming

Following acceptance of his user code, the user is given access to the system. He may choose to run an old program that he submitted at an earlier date and instructed the computer to save, or he may want to submit a new one.

If the choice is to run an old program, the user simply supplies the system with the name the old program was stored under, and the computer then retrieves it from a mass storage file and indicates it is ready to run.

If the user wishes to submit a new program and is "conversing" with a "multi-lingual" system — one that speaks Fortran, Algol, or other higher level languages — he indicates to the system which language he wishes to use.

Use of these higher-level languages has added greatly to the appeal of time-sharing systems. Business executives responsible for the administration of several million dollars' worth of computers in their own companies, yet who don't know the difference between a bit and a subroutine have, in the space of an hour or so, learned enough about a particular time-sharing language to write surprisingly complex programs and actually execute them.

These languages are readily accepted by non-computer-oriented individuals because of their almost conversational English nature. The only real requirement is that, when conversing with a time-sharing system, the user must speak a little more precisely than he might normally be accustomed to.

Presenting a New Problem

Submission of a new problem to a system is usually accomplished by typing it in steps of one line (i.e., one command) at a time, and giving each line a unique number. The sequence in which the lines are submitted is irrelevant, because the lines are sorted internally in the computer system before the problem is compiled or executed. It is therefore essential that the numbers assigned to the lines of input should be so sequenced that, after the internal sort, the statements or lines will be in the desired order for program execution.

The set of input lines expresses the problem in a series of logical statements written in one of the higher-level languages such as Fortran, Algol, or Basic.

Verbs

All but the very simplest tasks involve varying amounts of decision-making by the computer in the solution of the problem. For this reason, the higher-level languages include "verbs" that will enable the user to construct loops or iterative routines, test the equality or inequality of two or more numbers, and take other similar actions that may be required for problem solution.

Example

The following example uses the Dartmouth "Basic" language, which is one of those employed with the General Electric Computer Time-Sharing Service.

```
10 PRINT "TABLE OF POWERS OF TWO"
20 FOR X = 0 TO 25
30 LET Y = 2 ↑ X
40 PRINT "TWO TO THE" X "POWER EQUALS" Y
50 NEXT X
60 PRINT "END OF PROGRAM"
70 END
```

What does this mean?

Line 10 simply prints "TABLE OF POWERS OF TWO". The "print" verb used in this fashion will print the literal expression enclosed in quotes just as it was submitted by the user.

Line 20 is used to set up the parameters of a loop that will be repeated 25 times as successive powers of two are calculated. It states simply that we wish to vary the value of X from zero to 25. Absence of any further information on line 20 tells the computer that the value of X is to be changed by +1 on each succeeding trip through the loop. Should it be desired to vary the value of X by something else, this can be done simply by inserting the word "step" followed by a plus or minus sign and the number desired for the increment or decrement to the variable.

Line 30 contains the verb that produces the calculation itself. This line defines Y as the number 2 raised to the X power. The upward pointing arrow is used to indicate exponentiation, the raising of a number to a power.

Line 40 again uses the "print" verb but a little differently than line 10. The first content of the quotes will be printed as is — TWO TO THE — but now instead of printing the letter X, it will print the value that X currently has: some number (zero to 25) depending on the number of trips through the loop. The next quotation in line 40 is POWER EQUALS; since it is enclosed in quotes, it will be printed as is. The last element in the line is the variable Y, the result of the calculation performed in line 30. The current value of Y in each trip through the loop will be printed following the word "equals". For example, the thirteenth and fourteenth lines of output will read:

```
TWO TO THE 12 POWER EQUALS 4096
TWO TO THE 13 POWER EQUALS 8192
```

One of two things will happen at line 50, depending on the current value of X. If X is less than or equal to 25, control will be returned to line 20 and the loop repeated for the next power of two. If X is greater than 25, say 26, control is transferred to line 60. Here the words "END OF PROGRAM" will be printed out, and the program will stop as indicated by line 70.

This simple example is not intended as a review of the Basic language, which contains many other powerful "verbs" in addition to the ones described here. It is intended however to show how much computing work can be accomplished by a few (seven, in this case) relatively easy-to-write lines of instruction to the system. It is this simplicity and power that gives time-sharing and its higher-level languages their tremendous appeal.

Other Instructions

Following execution of the user's program, he may wish that it be saved by the system and stored in a data file so he can recall it at a later date and will not have to resubmit the entire program again. In the Basic system this is accomplished by simply typing "SAVE". Similarly, a program that has been saved for some time and is no longer needed or useful can be "unsaved" by typing "UNSAVE". This instructs the system to remove the program from the file and make the space available for other programs.

As a convenience to time-sharing users, the various higher-level languages will provide a number of "functional" verbs such as SIN (X), COS (X), TAN (X), which are the familiar trigonometric functions. Additional verbs are available for arctangents, natural logarithms, absolute value, square root, and others. Some systems contain a random-number generator that will generate single- or multiple-digit random numbers as specified by the user, and within a range which may also be specified by the user if desired.

Verbs are also available for rounding numbers to any specified number of decimal places and for extracting the "greatest integer" contained in a variable or expression.

Should the result of a calculation exceed some finite number of digits (9 in the Basic system) or be a very small fractional number, a different notation is used by the system to print the number at the remote terminal. For instance, .00123456789 would come out as .123456789 E-2 meaning .123456789 times 10 to the exponent minus 2.

Provision is made in the Basic system to allow the user to define a function that he expects to use several times in the program. He gives it a 3-character name the first time he submits it, and thereafter can refer to it by the 3-character name. This avoids having to retype it every time it is required.

This is of great value when the calculation is complex. The user need only type it correctly once, and he is done with it.

Similar to the "functional" verbs SIN (X), COS (X), described earlier, are a group of instructions in the Basic system to facilitate matrix computations. These include addition, subtraction, and multiplication of matrices, inversion, transposition, and the multiplication of a matrix by a number or other formula or expression.

Input/Output

The used may input variable data to the program while it is running, using an "INPUT" verb. This provision is particularly valuable when it is desired to run the same program many times using different sets of input data. When the computer encounters the "INPUT" verb during program execution, it will send a signal to the Teletype terminal, usually in the form of a question mark, indicating to the user that input data is required by the program. The user then types the data in and the program proceeds.

Somewhat larger amounts of data may be entered as a part of the program and accessed directly, thereby saving the time required to stop program execution and request input data by the method just described.

Output data generated by the program is sent to the Teletype machine. There it is printed, or punched into paper tape if desired, at the speed of 10 characters per second. Obviously, programs generating large volumes of output will require correspondingly large amounts of time to get the data back to the user's terminal.

A further limitation is encountered because of the relatively short line length of the Teletype terminal — approximately 75 usable characters. Extensive formatting for large, multi-columned reports becomes difficult and often results in multiple-pass programs.

What Next?

What, then, is the system that will give the remote user the improved computing power and flexibility he needs? A description of such a system follows.

First, the remote user should have a terminal at his site capable of communicating over suitable high-speed lines with the central facility. Transmission speeds of up to 40,800 bits per second are available which, in terms of 8-bit characters, amount to 5,100 characters per second. More commonly used is the 2,400-bit-per-second service which permits 300-character-per-second rates.

Second, the remote terminal should have a line-printer capable of operating at several hundred lines per minute, a high-speed card reader and, perhaps a card punch. Additional peripheral equipment such as paper tape, magnetic tape, mass storage devices, and others may be desired in certain configurations.

Third, the processing capability of the remote terminal should be sufficient to allow considerable formatting and manipulation of the data received from the central facility. This relieves the central computer of this somewhat trivial task. It also results in a greater efficiency on the communication line, since very few non-data characters — such as, for example, imbedded blanks in printed report lines — must be sent.

Inexpensive Computer as an On-Line Terminal

The high-speed remote terminal actually can be a small, relatively inexpensive computer, such as the General Electric GE-115.

The communications interface at the central computer is usually accomplished in one of two ways. The first way is to terminate all the incoming and outgoing communications lines in a fixed-wire multiple-line controller that is operated by the central computer. It performs, under program control, all the necessary communication line interface functions and data transfers. The second way is to provide an intermediate computer or communications processor specifically designed to operate in the communications environment and capable of interfacing with the central computer on the one side and the communications lines on the other.

The central computer itself would be a large-scale system capable of operating in a multiprocessor, multiprogramming environment, under control of an appropriate supervisory or operating system. Attached to the system are sufficient quantities of peripherals — magnetic tapes, card readers, punches, high speed printers — to satisfy the needs of the many user programs operating simultaneously in the system. The larger systems of this type will be capable of turning out large quantities of local batch-processing work while serving the remote users.

With systems of this type, it is possible for the remote user to extend the scope of his activities, because he can submit, from his remote terminal, *any* kind of job the central computer is capable of handling. The output generated may be sent back to the originating terminal, or it may be directed to another terminal or even printed and punched at the central facility. The remote user is not limited in his choice of programming language, for he can submit programs ranging from the basic machine language of the central computer up through all the higher-level languages the system is conversant with.

Control Modes

Communication of control information between the remote terminal and the central computer may be accomplished through the use of control cards containing unique codes that are recognized by the central computer as having originated at a remote terminal. Several control functions are required to assure efficient operation of both the central facility and the remote terminal. Some of the more important of these are as follows:

- Some type of identification card identifying the terminal and the user is required for security purposes, much like the user number sequence described earlier for the Teletype terminal usage.
- If the user is submitting an input deck to the system, a control card indicating that is entered; then the system will commence reading the deck.

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PROGRAMMING CONSIDERATIONS FOR A COMPUTING UTILITY SERVICE

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The economy necessary in a time-shared computer utility service is to be derived from the complete integration of hardware, software, the utility supervisor, translators, and user programs.

In the expanding market for computers, the success of time-sharing systems has created a growing interest in the possibility that computing service can be made available to the general public on a subscription basis. To qualify as a utility in the usual sense, a service needs to be available almost immediately whenever the user wants it, and should be economical for both user and supplier — i.e., beneficial to the user at a price he can afford, and profitable to the seller. In existing time-sharing computer systems, and in the second-generation systems being planned, the prime objective seems to be to place a powerful computer at the direct disposal of each user; cost is seldom emphasized as a design criterion. But cost considerations, as the basic incentive for any kind of time-sharing system, must be fully taken into account in designing a computing utility service. It may be that the probable needs of the subscribers require no more than modest computers, in systems much smaller and more decentralized than those required to make powerful computers pay their way. This may be the most satisfactory kind of computing utility for both user and supplier: local systems, geared to local interests, but backed up by more powerful computers (nearby or remote) to handle the tasks too demanding for a modest CPU.

When we synthesize the appropriate features of present time-sharing systems, as we attempt to do here, we see how new software combined with available hardware can make a computing utility service practicable in the immediate future. Many of the suggestions are not new, but they deserve new attention now that they can be implemented, thanks to the pioneering efforts in time-sharing which include many combinations of techniques and devices. Building on that experience, we will try to define the concept of a computing utility, discuss the hardware, and characterize the software.

A Computing Utility

A computing utility could be designed for comprehensive service as a general record-keeping or information retrieval system, or for more limited service as a computational aid. The former may be both desirable and possible, but the narrower definition suits our purposes here. Typically, a utility tries to serve as many users as possible while restricting itself to a profitable class of services. Businesses in general cannot include highly specialized or seldom-used services without raising the basic cost per customer, and this is true of a computing utility. It is thus to the interest of both user and supplier to make the most commonly needed services most readily available. With this principle in mind, we will consider the characteristics of a computing utility as a computation service for engineers and scientists, whose problems have enough in common to make an efficient system feasible.

From the user's point of view, a computing utility service operates roughly in this way: Whenever he has calculations to do, he requests service via a terminal, conveniently located. He transmits data and calls an existing procedure to process them, or writes the needed procedure in a language familiar to him. He is notified of the syntactical errors which can be corrected as soon as detected. He executes his procedure with some simple data, correcting and modifying it until he is satisfied; he then initiates the calculations. During the computing process, he may inquire about the status of his procedure, inject his judgment to influence the outcome, and further modify the procedure as the results reach him. When the calculations are complete, he can request a selective print-out of results and may save his procedure for future use. More often than not, he will complete such calculations in one sitting at the terminal.

Features

In a computing utility, then, each user finds *the operation easy, the mode conversational, the response immediate.* These features seem to characterize a computing utility better than the more general phrases *on-line,* and *real-time,* although these terms also describe the system.

Ease of Operation

When we say the computing utility is characterized by *ease of operation,* we mean that the user, who may be already a specialist in something else, need not become a specialist in computer programming in order to benefit from the computing service. In the future, he may need only legible handwriting or intelligible speech to convey his instructions and his data to the computer; at present, he is likely to work at an input/output typewriter or cathode-ray-tube keyboard whose special features are easily mastered.

Language

The physically simple terminal must be matched by a structurally simple language which the user knows or can learn readily. In some systems (JOSS, at Rand Corporation, for example), the user can start with a set of simple terminal commands, feel his way around, and learn enough of the procedural language to get his computations done. Later, more proficient, he may abbreviate commands, and assign specific keys for his own most frequently needed operations (he might use the A key as the ALTER command, or make C initiate calculations).

Few procedural languages seem to be user-oriented, i.e., easy to learn and use, and free of red tape. (Control cards are needed; cards must be properly sequenced; there are unwritten restrictions.) Many high-level languages started with the ordinary computer user in mind, but as each became popular, additions and refinements began to encumber the language, to the advantage of the expert but not the average user. We need various degrees of sophistication in a language, but the ordinary user should not be forgotten. Problem-oriented languages offer one solution, but their development seems to lag. The computing utility needs a simple language adaptable to the user's specialty, or a language for each discipline (for example, COGO, or STRESS), or a response pattern so simple and flexible that each user may develop his own language.

Application Programs

The advantages of a utility are further enhanced by the many application programs available as subroutines. When the user inquires at his terminal about the programs available for certain purposes, these subroutines will be called into service. This introduces a new wrinkle in program-writing, since each program must not only work, but also teach the user the correct procedures and allow him some leeway in input/output.*

Conversational Mode

When we say the computing utility operates in the *conversational mode,* we mean that a dialogue begins when the user sits down at the typewriter terminal and addresses the computer, continues while he composes and tests his program, and does not end until the execution is complete. During the course of this conversation, the user issues commands to the utility to initiate action and to control the computational process. During program composition, the translator (compiler or assembler) checks for syntactical errors, statement by statement, so that any errors thus detected can be corrected immediately by the user or by the translator. During program testing and execution, the user can either plan a systematic verification of his procedure, or monitor it from time to time, as his judgment dictates. The user need not consider all contingencies, since the utility controls unexpected events and notifies the user. If the procedure is so programmed, the user may influence (i.e., redirect) the computational process, and maintain a continuous dialogue while the problem is being solved.

Of the many time-sharing systems said to be "on-line," few have this degree of conversational ability, being hampered by the conventional construction of translators and supervisory routines. A computing utility, not thus confined by previous operating systems, can be designed for dynamic interaction with the user.

Immediate Response

When we say the computing utility gives *immediate response,* we do not mean the kind of response required in some real-time control systems, where a brief delay could mean the destruction of a plant or a factory. What we mean, rather, is that in comparison to the user's own response time (in this two-way conversation), the utility's response is immediate. Since human reflexes are much slower than computer operations, the utility response time is really no problem, being equally satisfactory up to several seconds. When it is likely to be much longer (i.e., when calculations are lengthy, and no monitoring is needed), the user will expect the delay and may leave the terminal and return later. Occasional delays, even unexpected ones, are at worst irritating to the user. Although the computing utility operates in real time, then, it is less stringently constrained than some other real-time systems

If service this rapid can be provided to many users by methods so simple for each, and can be provided economically, the time has come for the computing utility. In the conversational mode, the user himself slows the utility operation down and gives the computer time to respond to other users while he is thinking about his problem and reacting to the computer response. The time must be allotted more systematically than that, of course, so each user is allocated a slice of time and charged for the time actually used (in addition to terminal cost). The utility would probably need an overload of terminals to assure full utilization of the facilities most of the time, since it is unlikely that all terminals would be busy at the same time. When a peak load degraded the service, the effect could be spread out to all users, or latecomers could be asked to wait, depending on the policy.

Compatibility

Programming compatibility and hardware compatibility are sometimes emphasized as essential in time-sharing systems in general. Certainly standardized terminals would be needed both for the convenience of users and to simplify the connections with the utility. And ideally the user would be unaware of hardware changes except as improvements in service, when any physical facility in the utility is replaced by a more powerful version. But programming compatibility is a doubtful goal if it means that the utility must execute machine-language programs produced in a batching process. The rationale of this extreme may be twofold: (1) Many such programs exist, ready for use, and converting them for inclusion in the utility would be nearly impossible, or too costly; and (2) the computer complex may run background programs in the batching mode (without time or space limitations) when the utility is not otherwise busy.

In the interests of equipment utilization, a good computing utility would certainly accept background jobs. A non-urgent computation, for example, might have a delayed deadline specified by the user (who might be charged at a lower rate in such a case). But the programs for all background jobs must be created by a programming system available through the utility. If we insist that the utility be able to execute programs in any machine language, many sticky problems (storage allocation, dynamic relocation, interrupt handling, etc.) become much more difficult to solve.

Stringent Compatibility Unnecessary

For a number of reasons, such stringent compatibility in programming is either unnecessary or irrelevant, or both. In the first place, no extensive library of programs exists for the new generation of computers. Many of the existing programs will be revised anyway to reap the benefit of the mutually "tutorial" man-machine interaction now possible (for example, good human judgment can accelerate the convergence of an iterative process). Some programs which need excessive space and time, or cannot tolerate delays, will be excluded because of time-slicing and other utility conventions. Since direct control of the physical facilities must remain with the supervisory program, full compatibility cannot exist; i.e., the user cannot be given unlimited access to the facilities even if all programs are written in machine language. If, in fact, there is true compatibility at the procedural language level, there is no

*Pyle, I. C., "Data Input by Question and Answer," *Communications ACM,* April 1965, pp. 223-226.

need for compatibility at the machine language level (since successful recompilation is not time-consuming or costly). The problem lies in the subtle differences between allegedly compatible languages or even between two versions of one compiler. Such differences can be analyzed and reconciled without loss to either mode of operation if the system programmers exercise sufficient care.

Hardware Considerations

The hardware for a computing utility service will consist basically of certain facilities and a number of terminals, linked (by direct telephone lines, for example) in such a way that any terminal can be put on line with little human effort. As the user's "control panel" for setting and steering the course of his program, the terminal must be responsive and simple to operate. Unless the cost of other devices (graphic displays, for example) can be justified by users' needs, the terminal is most likely to be the familiar input/output typewriter. Other forms of input/output (the card or paper tape reader/punch, etc.) will be excluded from our consideration for the sake of economy. Except for the interface to the utility central, the terminal is simply an electric typewriter, to be used as such when off-line.

The central facilities contain a computer and peripheral devices for input/output (the card reader/punch, high-speed printers, and magnetic tape units) and for auxiliary storage (large-capacity cores, drums, and disks). The volume of users' files and the frequency of access will determine the number and kinds of storage devices: at a minimum, one device with fast access for working file storage (for example, drum or large-capacity core) and one with slow access for permanent file storage (multiple disks, for instance). In any case, magnetic tapes are used for infrequently referenced files, and for periodic file dumps to assure error rollback.

Choice of Peripheral Devices

The choice of peripheral devices is essentially determined by the choice of computer. Computers vary widely in operating speed, but most of the peripheral devices perform within a narrower range, and a proper match is essential for optimum overall performance. Auxiliary storage devices are indispensable in a file-centered system, but their fixed access time and data transfer rate may impose an upper limit to the utility central's performance, even with a high-powered computer. This being the case, a modest computer may afford the best match for the available secondary devices.

Certain technical considerations also recommend the choice of a modest computer for the utility central. For one thing, a modest computer can usually handle data on a character-by-character basis more efficiently and at less cost than can a high-powered computer (whose performance depends mostly on parallel data handling and fast but expensive arithmetic units).

In most third-generation computers, microprogramming permits efficient terminal servicing not previously possible with modest computers. As a request reaches the central one character at a time to be handled by a micro-routine, additional processing functions can be incorporated to identify the request and formulate a proper response. An interrupt at the microprogram level costs less in overhead than an ordinary interrupt, and a modest computer, microprogrammed, will thus show the better performance-to-cost ratio.

Program Compilation

In program compilation, a modest computer internally organized to facilitate character manipulation and with microprogrammed controls will probably outperform a large machine in terms of cost. Since most utility users will write programs in high-level procedural languages, and test them symbolically, advantages in efficient compilation cannot be ignored.

A modest computer needs to serve relatively few terminals to justify its cost, since localized control of facilities results in low overhead. If computer X can serve 25 terminals at one time adequately, then computer Z (at four times the core speed and cost of computer X) must serve 100 terminals to break even. Yet searching the larger file directory (probably four times as many files) would incur proportionately more overhead, even at the higher speed of computer Z. If the complexity of terminal servicing increases exponentially with the number of terminals, as is conjectured, it is preferable to serve fewer terminals with a modest computer. Furthermore, a localized utility central may be specialized to serve small homogeneous groups of users where geographic proximity coincides with common interests. Moreover, in case of machine failure, a small number of users can be distributed to other centrals with only minor degradation of service. As the new generation of computers is compatible down to the machine language level, a modest computer can do everything a large computer does, but more slowly. That is, it can have as much core and bulk storage capacity, and the same input/output and interrupt facilities, and can thus work efficiently with a large computer as backup if that is desired. With microprogramming capability to keep execution speed up to par, a modest computer can use interpretive programs to advantage, giving the central positive control of the execution and testing of user programs.

Although a modest computer seems the best choice for the utility central, user demand might justify the cost of a utility configuration operating at more than one level (see Figure 1). Users could be connected indirectly with computer YY, which would perform only those tasks requiring extensive arithmetic. The large computer would act in a simple, batching, multiprogramming mode on programs and data forwarded by the utility central, which would remain the intermediary between computer and user. Perhaps a regular batching process (compatible with the utility) could also be initiated at the central. In this case, the CPU console would be in effect a special terminal with magnetic tape and card input/output.

Such a computing utility seems to offer the advantage of time-sharing at a reasonable cost, and yet retains the capability for batching. For the future, a network of high-performance computers may back up numerous local utility centrals to distribute the workload for maximum operating economy.

General Software Characteristics

Even with the best equipment, the best utilization depends on well-conceived and well-constructed software. Slight inefficiency in programming on a modest computer may so increase the overhead that economical service is impossible. The minimum software for a utility service includes several translators (assembler and compilers) and the supervisory program. The latter has many responsibilities: it services terminal requests, it schedules and allocates facilities, it handles input/output, and it keeps accounting records for expense proration.

Programming effort in time-sharing has often been concentrated on the supervisor to the neglect of the translator. Available translators have been adapted to new modes of operation with only minor changes, but being designed primarily for the batching process, they do not provide the features necessary for on-line communication. But before we consider how to improve the translators and how to allow for a high degree of man-machine interaction through a properly planned supervisor, we must explain what "file-oriented" means in a computing utility, and examine the software implications.

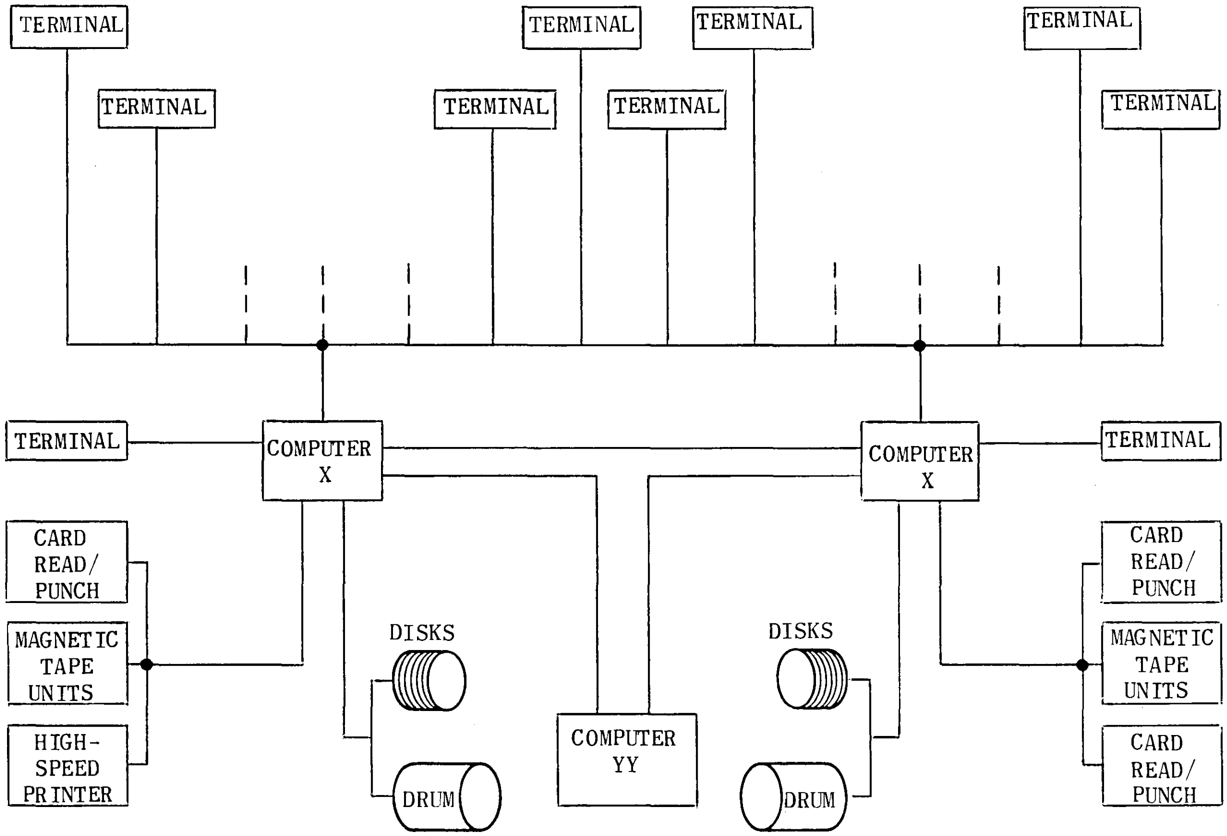

Fig. 1. One Configuration for a Computing Utility Central

File-Oriented Structure

In a file-centered system, the user can concentrate on solving his problem; he need not be concerned with the internal input/output operations in the central. He deals only with logical files, which may consist of program, data, or both. The user creates a file by typing at the terminal keyboard, or by requesting the reading of a deck of cards or a reel of magnetic tape at the utility central. He can fetch or purge his files stored in the utility, or copy them in the form of punched cards, magnetic tape, or print-out. He can call one file to process another: a translator to process his program, an interpreter to execute it, a program to process data. Permanent files must be labeled explicitly by symbolic names; temporary files can be defined without being named.

To the utility supervisor, all files are the same and are handled uniformly regardless of their contents. Input from a terminal is either (1) text material (program or data) for a file, or (2) commands, i.e., requests for service (open file, . . . modify file, . . . call one file to process another). As only files are processed, generated, and purged by a user's program, there is no input/output in the customary form; there are simply messages to and from the terminal (and format specifications for external output copies from a file). This approach should contribute to the simplification of some high-level languages.

The function of translators in a file-oriented system is shown in Figure 2, which shows how user programs are composed, tested, and executed. This figure shows only the facet of the utility service involving translators — how they are integrated into the utility, and how program writing and testing are handled. The user may simply call an available program (say, matrix inversion) to process his data (a matrix), or he may write a new program and run it interpretively without compilation into machine language.

If the user wants to write a program in some procedural language, he opens a file by a terminal command and enters his program on the keyboard. He may request the translator for that particular language to process his program after entry is complete, or statement-by-statement. In the latter case, immediate diagnostic messages will report syntactical errors for correction and resubmission to the translator. The translator may correct certain minor errors, notifying the user, who may override the translator's action. Before the program is tested, it is thus free of trivial errors which might cost several compilations in a batching process. In testing the program, the user may specify various options by terminal commands (trace, trap, and checkpoint stop) to monitor the execution. He may interrupt the process, modify his program or testing options, and resume execution. When he is satisfied, he may run the program interpretively or compile it into machine language with or without code optimization for final execution. He may save the program as a file for later use or purge it. He may (as Figure 2 suggests) choose to test his program with relatively little on-line interaction.

Service Programs

Figure 2 shows two of the service programs (test facility and file manipulation) available to the supervisor and thus to any user's program. Subroutines such as message handling, function evaluation, and common numerical algorithms may also be considered service programs.

Sharing these programs saves storage space and, very often, loading time, since only the linkage is included in a user's program when he calls a subroutine. When the user's program is ready for execution, the supervisor may find the required subroutine already in core storage, having been loaded for a previous user program. The availability of these subroutines also relieves the user of many programming details,

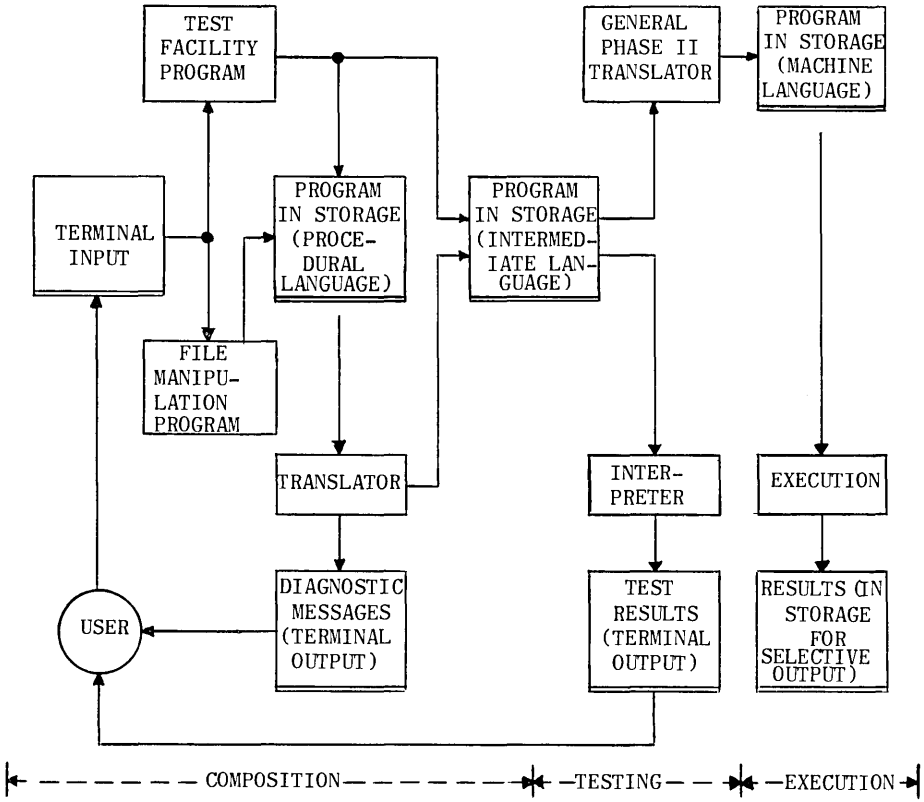

Fig. 2. User Program Flow in a Computing Utility Service

and simplifies his program structure. The convenience of service programs is, however, bought at a price in supervisory overhead in subroutine handling.

Translators

Translators must be provided in sufficient number and variety to allow for a variety of programming languages. The conventional translators generally consist of massive multiphase programs unsuitable in several ways for utility service. They lack facilities for on-line correction and for symbolic testing; they require complete recompilation at considerable expense when a program is corrected; their operating procedures are cumbersome; and they cannot meet the conflicting demands of fast compilation and efficiently compiled programs.

New compiling techniques can help to some extent, but restructuring of translators is still necessary. Conceptually, a translator is composed of two phases: Phase I transforms the statement in a given language into an intermediate language; Phase II transforms the intermediate language into the machine language, with a code optimization option (which may be considered as a separate phase). Since one intermediate language may suffice for many procedural languages with common features, each language may have a Phase I translator, but there might be only one Phase II translator (and one interpreter). Even though some languages are not amenable to this approach, there will in any case be fewer interpreters and Phase II translators than Phase I translators.

The file-oriented approach lightens the burden for the translator since no input/output is required in processing one file to create another. Files are manipulated and diagnostic messages transmitted by service programs which any translator can utilize. The translator's task is further simplified by the fact that the file manipulation program also handles the corrections, insertions, and deletions in the user's program as a file, and the test facility program adds information to the files for appropriate action by the interpreter.

The proposed translator structure has several advantages: The Phase I translator can process a program in its entirety, or statement by statement, giving diagnostic messages and allowing on-line corrections. Only the corrected statements need to be recompiled. The terminal commands eliminate procedural red tape and let the user feel his way around at the terminal. Regardless of the language used, there is only one set of terminal commands for symbolic testing. Fast compilation is the primary objective, unless code optimization is specified (this is for the Phase II translator only). In microprogrammed computers, the translation process may conceivably be speeded up.

Interpreter

The interpretive mode no longer means the risk of degraded performance, thanks to the microprogramming capability of the new generation of computers. When the user requests the execution of his program, processed by a proper Phase I translator, with certain testing options, he may not even know that an interpreter is needed. Now that much or all of the interpreter may be microcoded, the user need not discern any loss of performance.

The use of an interpreter is justified by various circumstances. For a quick one-time computation, processing by a multi-phase translator is costly, but one-phase translation with execution in the interpretive mode is relatively economical. Again: whereas a machine-language program is rigidly ordered and not easily modified, the same program in an intermediate language lends itself to revision. For testing purposes, where numerous changes are to be expected, the need for retranslation can be minimized by leaving the program in the intermediate language and executing it interpretively. And again: the supervisor cannot monitor the execution of a machine-language program except in a general way (although errors in execution are detected), and therefore the user, communicating through the supervisor, has only limited control. The interpreter, however, allows many testing options, monitors the user's program intensively, and informs him of any unexpected errors.

With the minimum programming facilities sketched above, users should be able to implement their own language translators, interpreters, and specialized applications. As the number of user programs in the utility increases, the variety of services multiplies and the utility consequently becomes more desirable to the users. Yet, being local, as it can afford to be with a modest computer, it remains adaptable to users' needs and can accordingly improve its efficiency by specialization.

Supervisor

The utility supervisor has functional control of all user programs, representing the user to the computer and the computer to the user. To the user, the supervisor's primary function is to service his terminal, responding promptly and appropriately to every request. The supervisor responds to a command by interrupting execution of the user's program; to a simple request (e.g., an inquiry about program status), by immediate processing and transmission of a reply; to a more involved request (e.g., for the fetching of a file), by entering the request into a job queue and informing the user of the delay. (Program interruption, being at the microprogram level, would be too brief — a few milliseconds at most — to affect the job in execution adversely.)

The supervisor accepts requests for program execution and schedules the jobs according to an established priority scheme (more on scheduling algorithms later). The supervisor establishes queues for the physical facilities at the utility central, and manages storage space in core, disks or drums (allocating core storage and handling program relocation as will be detailed later).

In the file-oriented utility, the supervisor can make any file available to the user and his program, and can reference it at any level, i.e., by subdivisions such as segments, pages and lines. The supervisor handles the file operations involving reading or writing, and the messages to and from terminals. A file may be copied into cards or magnetic tape, or printed out, and files are created by reading cards or magnetic tape, but these operations are equivalent to disk (or drum) dumps or loads, and are exclusively controlled by the supervisor, aided by certain editing functions.

As a bookkeeper, the supervisor keeps time for expense allocation, and collects operating statistics so that service efficiency can be measured. To this end, it keeps track of the frequency of program and subroutine usage, types of terminal requests, fluctuation in the number of users, maximum and average response times, and waiting times in the queues. To charge the user for actual computation time, storage space occupied, etc., is not feasible with available hardware, and would place an excessive burden on the supervisor. Prorating the entire cost of the utility according to computer time used may be a reasonable alternative.

The supervisor is also responsible for error recovery, since equipment breakdown is still possible despite highly reliable hardware. The supervisor therefore maintains an audit trail for restart purposes. In practice, a periodic dump of disk files may suffice for the rollback. For the peripheral devices, operations may be repeated to eliminate errors, or changed by means of reconfiguration if duplicate devices are available.

Scheduling Algorithms

In a computing utility, scheduling algorithms establish and maintain the order of service for the job queues for the utility central's facilities. For most of the peripheral devices, a first-in, first-out policy is probably adequate. Some cases (for example, reading a disk) might call for a two-level priority scheme, with the supervisor-initiated request given the higher priority to insure a prompt response to the user.

For the CPU itself, the scheduling algorithm must reconcile two objectives, finding the way to (1) make the best use of the equipment, i.e., use as much of it as possible as steadily as possible, and at the same time (2) ensure good response to the user. For satisfactory response to all users, the program execution for each is commonly limited to a predetermined amount of time (this practice also guards against infinite program loops). To optimize computer usage, we must reduce or eliminate delays in data transmission from the disk or drum, possibly by loading the next program in the queue into core storage while the current program is being executed.

A scheduling algorithm is responsible for loading and unloading core storage; it must regulate the queue of user programs; it must incorporate a priority scheme.

Core Loading and Unloading

If there are more user programs than core storage can hold at once, each program must be loaded into core from disk (assumed here to be the bulk storage form) for execution, and unloaded to disk when another program needs the same core space. There are exceptions and ways of reducing the need for large-scale loading and unloading effort. If the program is written as a pure procedure, for example (i.e., so that it never modifies itself), and if the data are segregated from the program, only the data need be saved when the execution is interrupted. The program need not be unloaded, since it exists as a file in the bulk storage. Shared translators and subroutines (i.e., with no private copies for separate users) can further reduce loading and unloading effort.

To minimize loading time, the supervisor may interrogate a map of core storage blocks to see whether the needed program and data remain undisturbed. If so, only the missing parts need to be loaded. Although the computer can simultaneously unload one program, execute another, and load the next, the elapsed time cannot be reduced (when the complete program and data are first fetched from bulk storage into core), and interference to the core storage must be reckoned as overhead.

To make sufficient allowance for such interference, the worst case can be estimated and considered in allotting execution time. If the interference is limited to a small fraction of the allotted execution time, the disk operation can be overlapped, since the amount of interference is directly proportional to the disk read/write time. Such interleaved core storage will minimize interference, but it remains a cost factor and is too random for exact accounting but must be estimated.

If a program terminates without exhausting the time allotted, and the next program is not ready for execution, computer time is wasted and overhead increases. The alternative, which may also add to the overhead, is to look ahead two programs, and prepare both for fast entry into the computer.

The storage allocation scheme is also a very important factor in the design and operation of the computer utility; but it will be discussed at another time.

Summary

The utility service outlined is realistic, although many problems remain — automatic program segmentation, subroutine handling, dynamic interaction among users, and balance of load and utilization. The utility provides on-line computing service to users, and yet allows job batching with a variable turn-around time dictated by the user. The economy necessary in a utility service is derived from the complete integration of hardware and software, and of the utility supervisor and user programs (in particular, translators).

For the utility central, a modest computer has important advantages: it can serve relatively few terminals and yet justify its cost, and it is a good match for the secondary storage devices in respect to operating speed. A modest computer makes a localized utility practical; local control means more responsiveness to users' demands, and consequently more satisfactory service.

The microprogramming capabilities of the new generation of modest computers open new possibilities for efficient terminal services and for the construction of translators and interpreters. A network of compatible computers could now be established, with larger ones performing extensive calculations exclusively and modest ones servicing user terminals.

The integration of supervisor and user programs eliminates functional duplication and contributes to the efficiency of services. In developing conversational capabilities in programs, the utility assists users in their problem solving, and the file-oriented approach minimizes input/output housekeeping chores for the user. The scheduling algorithm is consistent with effective equipment utilization, and should provide adequate service as promptly and fairly as possible.

As time-sharing systems grow, and extend the reach of computing technology, the time is ripe to assess their practicality in a different direction. With the new generation of computers, the kind of computing utility sketched there can be economical and profitable.

Acknowledgments

The author is indebted to two colleagues in IBM: Mr. M. R. Nekora for his explanation of the Administrative Terminal System (a text-editing, time-sharing system implemented for the IBM 1460), which proves the feasibility of time-sharing on a modest computer. His experience suggested useful ideas about disk access priority and terminal services on an "interrupt" basis. The author is also grateful for the many fruitful discussions with Mr. W. G. Dye on various aspects of time-sharing.

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Many earlier references are given in 3 and 15.

Becker — Time Sharing

(Continued from page 20)

- When the terminal has sent the complete input deck in and is ready to accept printed or punched output, it indicates so by an appropriately coded control card. Subfields may be included telling the central computer that the terminal wants output for a particular job only (since a given terminal may have submitted several jobs) or it is ready to accept any output the system has for a particular job that was interrupted because of line failure or terminal failure at some earlier time.
- When the terminal has received all its output or wishes to disconnect itself from the central computer for another reason, it uses a disconnect card, removing itself from the on-line status. The terminal is now free to operate in a local batch-processing mode.
- It is often desirable to permit the remote terminal to be coupled directly to a user program running in the central computer for the purpose of maintaining a two-way flow of data during the user program execution. This is accomplished by using a control card indicating the name of the user program the terminal wishes to be connected directly to. This feature is particularly useful during the debugging stage.
- During the execution of a user program that has not been fully debugged it may become obvious to the remote user that the output is not correct and there is no sense in continuing the run any further. Execution of the user program may be halted by using a control card indicating this state to the central computer.
- With one or more jobs entered in the system, the user may want to inquire as to the status of a particular job or of all jobs. A control card is provided for this function, giving the remote user an added measure of control and communication with the system.

Conclusion

Present-day time-sharing services have inspired an eager and devoted following on the part of the novice and computer-knowledgeable alike. However, definite time-and-volume limitations apply to the use of conventional terminal facilities. The next step appears to be a stored-program high-speed data processing terminal connected by telephone lines to a large-scale central computer system.

The terminal should be capable of controlling and monitoring data into and out of the larger system, and of providing all the necessary control functions for guiding the larger system in execution of the remote user's program.

An expanded time-sharing system of this sort affords an intimate console-like contact between the remote operator and the central computer, and at the same time provides large-quantity batch processing heretofore associated primarily with high-production, personally attended, large-scale systems.

CALENDAR OF COMING EVENTS

Oct. 3-7, 1966: American Documentation Institute Annual Meeting, Santa Monica, Calif.; contact Jules Mersel, Informatics, Inc., 5430 Van Nuys Blvd., Sherman Oaks, Calif. 91401

Oct. 5-7, 1966: Allerton Conference on Circuit and System Theory, Conference Center, University of Illinois, Monticello, Ill.; contact Prof. W. R. Perkins, Dept. of Elec. Engrg., Univ. of Ill., Urbana, Ill.

Oct. 17-18, 1966: 1966 Systems Science and Cybernetics Conference (Institute of Electrical and Electronic Engineers), International Inn, Washington, D. C.; contact William H. von Alven, ARINC Research Corp., Annapolis Science Center, Annapolis, Md. 21401

Oct. 17-21, 1966: Business Equipment Exposition/Conference, Business Equipment Manufacturers Assoc., McCormick Place, Chicago, Ill.; contact George L. Fischer, Jr., BEMA, 235 East 42 St., New York 17, N.Y.

Oct. 18-20, 1966: Seventh National Symposium of the Society for Information Display, "Information Display as an Emerging Discipline," Hotel Bradford, Boston, Mass.; contact Glenn E. Whitham, General Chairman, Box 413, Wayland, Mass. 01778

Oct. 19-21, 1966: CUBE (Cooperating Users of Burroughs Equipment) Fall Meeting, Prom Town House Motor Inn, Omaha, Nebr.; contact William Macomber, Boston Insurance Group, 87 Kilby St., Boston, Mass.

Oct. 24-26, 1966: International Symposium on Microelectronics, Munich Fair and Exhibition Grounds, Munich, Germany; contact INEA — Internationaler Elektronik-Arbeitskreis e. V., 8000 Munchen 12, Theresienhohe 15, Germany.

Oct. 24-27, 1966: Annual Instrument Society of America (ISA) Conference & Exhibit, New York Coliseum, New York, N.Y.; contact Daniel R. Stearn, Public Relations Mgr., Instrument Society of America, 530 William Penn Place, Pittsburgh, Pa. 15219

Oct. 25-28, 1966: Data Processing Management Association Fall International Conference, Los Angeles Biltmore Hotel, Los Angeles, Calif.; contact Mrs. M. Rafferty, DPMA, 505 Busse Highway, Park Ridge, Ill. 60068

Oct. 27-28, 1966: ECHO (Electronic Computing Hospital Oriented) General Meeting, American Hospital Assoc. Hdqs., Chicago, Ill.; contact William H. Isaacs, Secretary-Treasurer, ECHO, Michael Reese Hospital, 29th St. and Ellis Ave., Chicago, Ill. 60616

Oct. 31-Nov. 1-3, 1966: Annual Meeting of UAIDE (Users of Automatic Information Display Equipment), Vacation Village Hotel, West Mission Bay, San Diego, Calif.; contact Marvin J. Kaitz, Dept. 200-312, Space and Information Systems Div., North American Aviation, 12214 Lakewood Blvd., Downey, Calif. 90241

Nov. 4-5, 1966: DECUS (Digital Equipment Computer Users Society) Annual Fall Symposium, Lawrence Radiation Laboratory Auditorium, Berkeley, Calif.; contact Angela J. Cossette, DECUS, Maynard, Mass. 01754

Nov. 8-10, 1966: Fall Joint Computer Conference, Brooks Hall, Civic Center, San Francisco, Calif.; contact R. George Glaser, General Chairman, Suite 1060, 100 California St., San Francisco, Calif. 94111.

Nov. 15-18, 1966: GUIDE International, Americana Hotel, Miami Beach, Fla.; contact Lois E. Mechan, Secretary, GUIDE International, c/o United Services Automobile Assoc., 4119 Broadway, San Antonio, Texas 78215

Nov. 17-18, 1966: Southwest Conference on Computers in Humanistic Research, Texas A&M Univ., College Station, Tex.; contact Milton A. Huggett, Center for Computer Research in the Humanities, College Station, Tex.

Nov. 28-30, 1966: COMMON User Group (formerly 1620 User Group), Jung Hotel, New Orleans, La.; contact Wiltz P. Champagne, c/o Computing Center, University of Southwestern Louisiana, Lafayette, La.

Mar., 1967: Fifth Annual Symposium on Biomathematics and Computer Science in the Life Sciences, Shamrock Hilton Hotel, Houston, Texas; contact Office of the Dean, Division of Continuing Education, the University of Texas Graduate School of Biomedical Sciences, 102 Jesse Jones Library Bldg., Texas Medical Center, Houston, Texas 77025

April 18-20, 1967: Spring Joint Computer Conference, Chalfonte-Haddon Hall, Atlantic City, N.J.; contact AFIPS Hdqs., 211 East 43 St., New York, N.Y. 10017

May 9-11, 1967: Spring Joint Computer Conference, Convention Center, Philadelphia, Pa.; contact AFIPS Headquarters, 211 E. 43rd St., New York, N.Y. 10017

May 18-19, 1967: 10th Midwest Symposium on Circuit Theory, Purdue University, Lafayette, Ind.

June 28-30, 1967: 1967 Joint Automatic Control Conference, University of Pennsylvania, Philadelphia, Pa.; contact Lewis Winner, 152 W. 42nd St., New York, N.Y. 10036

Aug. 28-Sept. 2, 1967: AICA (International Association for Analogue Computation) Fifth Congress, Lausanne, Switzerland; contact secretary of the Swiss Federation of Automatic Control, Wasserwerkstrasse 53, CH 8006 Zurich, Switzerland

Aug. 29-31, 1967: 1967 ACM (Association for Computing Machinery) National Conference, Twentieth Anniversary, Sheraton Park Hotel, Washington, D.C.; contact Thomas Willette, P.O. Box 6, Annandale, Va. 22003

Sept. 11-15, 1967: 1967 International Symposium on Information Theory, Athens, Greece; contact A. V. Balakrishnan, Dept. of Engineering, U.C.L.A., Los Angeles, Calif. 90024

Nov. 14-16, 1967: Fall Joint Computer Conference, Anaheim Convention Center, Anaheim, Calif.; contact AFIPS Headquarters, 211 E. 43rd St., New York, N. Y. 10017

May 21-23, 1968: Spring Joint Computer Conference, Sheraton Park/Shoreham Hotel, Washington, D. C.; contact AFIPS Headquarters, 211 E. 43rd St., New York, N. Y. 10017

Aug. 5-10, 1968: IFIP (International Federation for Information Processing) Congress 68, Edinburgh, Scotland; contact John Fowlers & Partners, Ltd., Grand Buildings, Trafalgar Square, London, W.C. 2., England

NEW PARTNERS IN PROGRESS: COMMUNICATIONS AND COMPUTERS

Russell W. McFall, President
Western Union
New York, N.Y.

Approaching the "great dialogue between man and that better part of himself known as knowledge."
— Edward R. Murrow

Just a few years ago, computers and communications were two separate and distinct fields, each operating largely within its own area, with little interplay between the two. The use of computers on-line in the operation of communication systems and the real-time processing of data have joined computers and communications in a permanent partnership.

I plan to discuss the approach of communications to computers, and what we see ahead for the partnership.

One of the first involvements of communications with computers dates back to the early electromechanical models, when Western Union engineers worked with Dr. Howard Aiken at the Harvard Computation Laboratory in designing input/output circuits and adapting telegraph printers and reperforators for use with the Mark II computer. I might also mention that we have used computers since they first became available commercially: to process payrolls; to provide accounting control of installations, removals, and inventories; and to produce statistical and management reports.

And, quite naturally, we were involved during these early days in designing of communications systems for business organizations for the specific purpose of gathering data from widely separated points for central processing.

Communications and Real-Time Operations

Communications were first used for the real-time operation of computers, in the early 1950's, when the SAGE system was developed as an air defense network against manned bombers. This system was designed to handle radar information, and control interceptor aircraft and the activities of other defensive weapons.

More recently, the successes of our space program would have been impossible without real-time systems. Just a little more than a year ago, the first space-orbiting computer went aloft with astronauts Grissom and Young in the initial manned Gemini flight; and, with flawless perfection, it directed the first change of a spacecraft's orbit while in flight.

(Based on an Address at the Meeting of Association for Computing Machinery, Los Angeles, Calif., August 30, 1966)

In the Jet Propulsion Laboratory at Pasadena, computers linked by microwave with unmanned spacecraft are busy making history with computer-directed flights to the moon and distant planets. We, incidentally, furnish the terrestrial communication facility in that real-time system — a special 164-mile microwave link between NASA's deep-space tracking station in the Mojave Desert and the Jet Propulsion Laboratory.

The past ten years have seen rapid strides in the development of real-time technology and its application. We have provided computer-operated systems for government and industry. AUTODIN, for instance, represented a technological breakthrough in that it was the first nationwide communication system to employ computers on-line for the high-speed transmission of data fed into a network by means of punched cards, magnetic tape, and perforated tape. Many of the techniques developed in designing AUTODIN for the Department of Defense have since been incorporated in the Advanced Record System for the General Services Administration, and in systems for industry.

The progress of computer technology and application has, in the main, been orderly rather than revolutionary as the use of computers was expanded in the solution of definable problems; and we have no reason to imagine that it will be any different in the future. In this world of realities, computers must produce demonstrable advantages over already available means of handling information.

The Concept of the Real-Time Information/Communication System

Today, the concept of the real-time information/communication system is firmly established, and a whole new cycle of computer technology and application has started. Communications make nationwide and worldwide systems possible; and the new large, multiple-access computers, of course make the sharing of costs possible for a wide range of business, professional, scientific, educational, and other cooperative applications.

These developments, obviously, make it possible to assemble and distribute knowledge, as information, on a scale never before possible. Even so, the assembly in memory banks of information in the several fields of human knowledge — for instant processing and retrieval — represents a tremendous task; but the potential rewards, I do believe, surpass those that have flowed from any single invention in the past; or that can reasonably be expected from the use of nuclear energy for peaceful purposes.

The "information explosion" is one of the most written-about and talked-about subjects today. In a number of fields it is plain that effective information management on a broad scale could result in great benefits.

The Information Explosion in the Scientific-Technical Field

Let us consider the scientific, or technical, field. No one really knows how much technical information actually exists, or where to find useful parts of it. Research specialists are said to spend up to 25 percent of their time seeking useful information and wasting valuable time, because it is not possible for them to determine what research work has already been done in the fields of their interest. The total duplication effort has been placed as high as 50 percent of all R. & D. activity. There can be little doubt that the gap in our ability to collect, evaluate, store and retrieve technical information is costly and wasteful.

Simplifying Factors in Managing the Information Explosion

Fortunately, we do not face the task of assembling all human knowledge in one memory bank; that might be impossible. Three major simplifying factors will work to make the task ahead manageable.

In the first place — as we all know, but some forget — not all knowledge is useful information, and no benefit is gained by storing useless information. Evaluating raw information in the broad fields of human knowledge as to its usefulness will be a tremendous job, of course; but it will be, essentially, a one-time job, and of substantial help in reducing storage and processing problems.

The second factor is also selective in nature. The day when outstanding men comprehended almost all knowledge disappeared with Francis Bacon and Leonardo da Vinci, centuries ago. Very few men today even wish access to all human knowledge. We are all specialists; our needs for information are specialized. As a natural result, the development of systems has been on a system-by-system basis, each being designed to meet the individual requirements of a firm, a government agency, or a group with common interests. Progress in the future will, no doubt, continue to be on the same system-by-system basis, as the types of information brought under control for manipulation and retrieval are broadened. I expect, also, that many of the new systems will be regional in scope at first, then become nationwide and, ultimately, worldwide, as more and more communication facilities become available.

The third factor that will work to simplify the task ahead is the development of new means of supplying information/communication systems on a large scale, and at low cost. The concept of the information utility — providing a wide range of information systems and services to many subscribers through large, multiple-access computers — has naturally attracted considerable attention. The background of most of those looking at this field, however, is one of experience with computers and data processing; and they are looking to communications to link their information utility systems in real-time operation.

A Nationwide Information Utility

Western Union's approach stems from a base in communications and a decade of experience in the application of computers, first in communication systems and then in real-time information systems. We plan to become a nationwide information utility. The plan starts with integration of the nationwide public-message relay network and direct-dial Telex system into a single, computer-operated network. We have to put an integrated system of this kind in place, to obtain the benefits of modern technology and efficiency in improved communication service for our customers.

In the first stages of this program, the flexibility of computer operation permits introduction of new communication services. The additional computer capacity permits introduction of new information services. For instance, the first public service computer center scheduled in our program and installed at New York late last year, provides 3,000 Telex subscribers in eastern cities with new communication services. In addition, we have introduced a new information service, set up specifically for the legal profession. A customer of this service — furnished by Law Research Service, Inc. — uses a Western Union teleprinter to dial a direct connection to our public service computer at New York to obtain case citations. The computer extracts information from its memory and transmits it instantly to the subscriber.

Arrangements are now being completed for a second information service, using Western Union's computer and communication network, which will match the qualifications, salary wants, and other data on job-seekers with the requirements of employers with open positions. It will be called the Personnel Information Communications System, and will be provided by Information Science, Inc.

Another phase of our longer-term program is scheduled to follow the installation next year of additional public service computer centers to extend new services to Telex customers nationwide. This phase calls for the installation of third-generation computers at key locations across the country. These computers will perform all standard communication functions, and new ones, and will permit the integration of the public message and Telex services into a single system. In addition, they perform information functions such as collection, storage, processing and retrieval of data. They also provide multiple-access entry into a computer at the same time; and they have tremendous random-access memories.

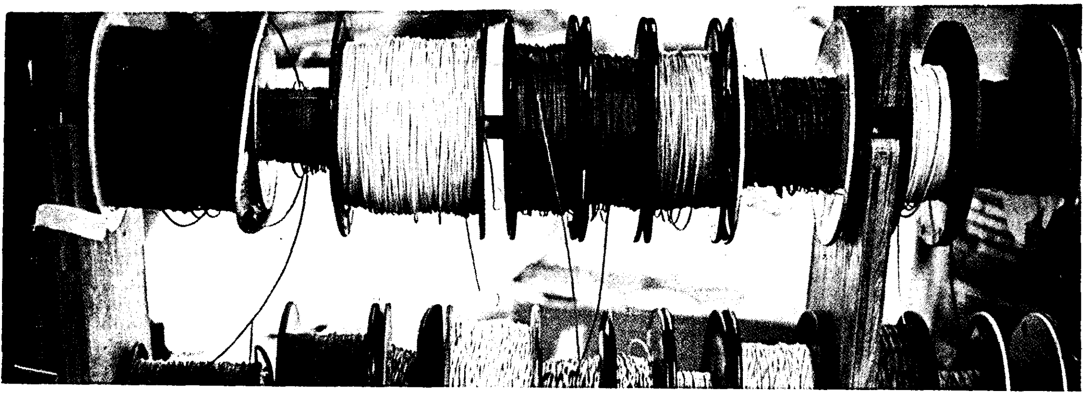
This computer network is planned for completion after the installation of the initial public service computer centers. It will permit improved automatic handling of a broad range of communication services, including direct access to the computers. At the same time, the computers then in place will have ample capacity for offering real-time information services to customers of many kinds.

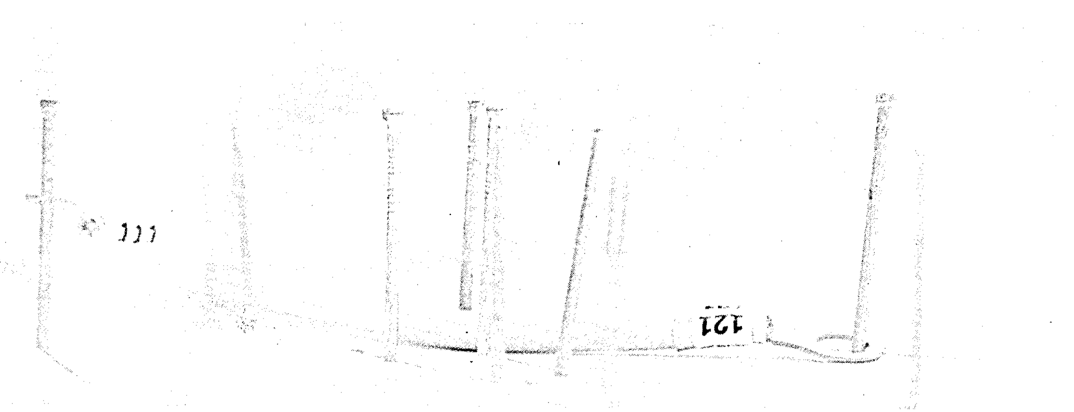
Similar Information Utilities

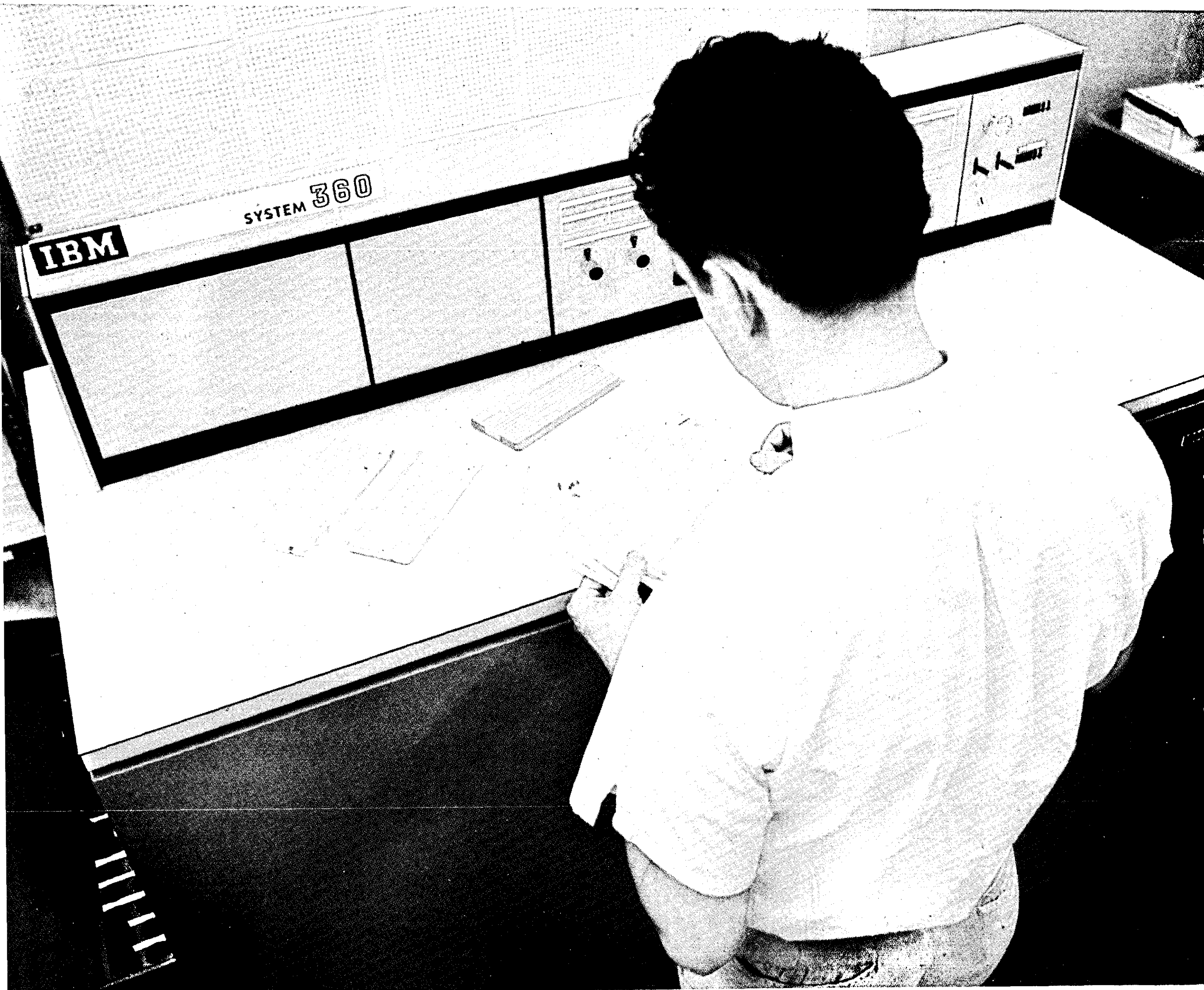
A number of companies have already expressed their intention to provide similar information services. That is all to the good! We believe that the potential for new real-time information systems and services is so large, in the years ahead, that it will take the combined efforts and resources of the communication companies, the computer machinery companies, the professional skills in both fields, and many other resources to develop that potential fully. I think we all recognize the excellent progress being made in advancd computer hardware.

Formidable Difficulties

Formidable difficulties in other areas, however, are vexing our best minds. A great deal of work remains to be done in






IBM
SYSTEM 360

software and in basic information analysis, selection, and indexing. The classic disciplines of the 19th century — such as chemistry, physics, and physiology — used to operate in comparatively strict isolation; but that is no longer so. The old science areas are now intermixed; there is overlapping, duplication, and dual reporting. What is needed now is the management of information in a degree and on a scale never before attained.

Few problems, however, are beyond solution by that first and best computer of all — the human mind. The human mind applies imagination in the manipulation and retrieval of billions of bits of information stored in the brain, combining them in strange and unbelievable ways to create new knowledge that never before existed. I think we can continue to depend on the human mind for many solutions to our information problems.

We already have a key tool for successful management of information in the real-time information system. The computer's outstanding performance in the past suggests a tremendous potential for its real-time application in the future. Very few computers are yet linked by communication lines in real-time operation; the great preponderance of computers now in service are operated off-line, in batch processing. But we can foresee a tremendous growth in the application of computers in real-time systems in the years ahead.

National Centers for Information Retrieval

The scope and complexity of some of the systems now under preliminary consideration stretch our imagination. Congress is considering legislation to establish "a center for development and operation of a national science research data processing and information retrieval system," which would make scientific research information readily available "through an appropriate communication network." It is felt that a coordinated system of this kind is needed to facilitate and speed the retrieval of information from the 400-odd specialized information agencies that now exist — each serving a particular field of knowledge by providing subscribers with regularly issued compilations, critical reviews, bibliographies, and other information retrieval tools.

Many other proposals of similar information systems are being explored by organizations in the educational, library, engineering, and other professional fields. A group of universities, for instance, is studying recommendations for various kinds of nationwide information systems to serve universities. A spokesman for the group states its interests as broadly as this:

> "Among the academic information-processing activities with which the new organization will concern itself are both computational and linguistic uses of computers, computerized programmed instruction, library automation, educational television and radio, computerized cognitive aids, and the utilization of computers in university administration and in clinical practice."

A system performing these functions would transmit, switch, store, retrieve, and disseminate knowledge through one or more computer centers. The participating universities would be interconnected to request, receive, or exchange knowledge in printed, graphic, high-speed data, or voice form. This is an ambitious program, but not unrealistic. It fits the picture of things to come!

The pressure of demand for new information/communication systems and services is increasing, and is accelerating the development of new input/output devices. We begin to see machines that display selected information instantly and visually on demand. The use of new information retrieval devices will certainly modify the use of records as we know them today and, perhaps, make them unnecessary in many instances.

Machine storage of digital and graphic information for instant retrieval cannot help but affect eventually our traditional dependence upon books, journals, and reprints. Many functions of the technical and educational publishing business appear headed for gradual transformation into a real-time information-handling business. In fact, that was the stated purpose of certain recently announced mergers of publishing companies with firms having competence in the computer and data processing fields.

International computer-operated information networks, using satellite communication facilities, have a good chance of becoming a reality in the foreseeable future. Systems like these may well make possible such bold concepts as a world bank of medical knowledge and case histories, and a global weather-information system.

Center for Medical Information

In the medical field, for instance, international processing of information on birth defects might very well have enabled the profession to detect the pattern of birth defects from the use of thalidomide far earlier than it was, and thus have saved hundreds of infants from deformity. Coordination of widely separated research efforts on diseases, such as cancer, could bring immeasurable benefits to mankind.

Scholars in the arts and sciences are beginning, as I mentioned earlier, to give the computer attention as an educational and research aid. There were 400 computers in service on American campuses in 1964. Tying them together in a national information system would result in tremendous advances in the study of languages, literature, philosophy, history, the sciences, and the arts. In time, such a system could be made international in scope.

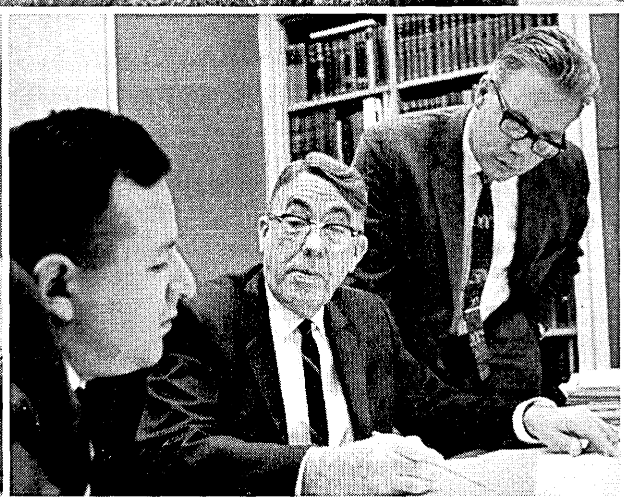
The Age of Information Management

The new age of information management is upon us, and it is gathering speed. The potential for communication/information systems and services spreads across the whole field of human endeavors. This will affect our daily lives and work, our nation, and the world more, by far, I believe, than the industrial revolution has.

The industrial revolution recast the mold and entire character of western civilization, and its influence has reached into the far corners of the earth. It has so deeply changed the economic, financial, social, and political fabric of human living that it is almost impossible for us to appreciate what life was like in the United States a century ago. Some of us here today can remember when the chief means of transportation were the horse and the railroads. All of us have lived long enough to have seen and felt the tremendous changes brought about by automotive, to say nothing of aeronautical and space, technology.

Today, we are embarked upon the information revolution, and I am certain that it will bring about changes far exceeding those of the slower-moving industrial revolution — and in far less time. The ultimate impact upon society of the new partnership of communications and computers in real-time information systems cannot yet be fully perceived. It is just as well, probably, that not all of the problems that will require solution can be foreseen either.

Still, we can see enough of the potential of the real-time information/communication system to know that it is a powerful and promising new tool. It will facilitate enormously what Edward R. Murrow called the "great dialogue between man and that better part of himself known as knowledge."

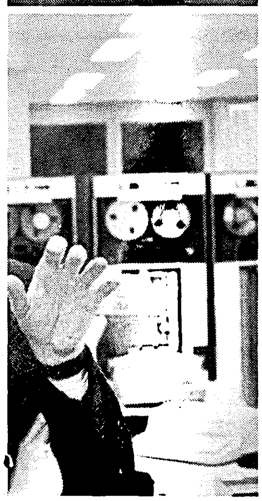


Top: Kenneth Iverson (*A Programming Language:* Wiley, 1962; *Automatic Data Processing:* Wiley, 1963, co-author F. P. Brooks, Jr.; *Elementary Functions:* Science Research Associates, Inc., in press) has used his language in a formal description of IBM System/360. It is now being used to write a formal description of advanced software.

Left: David Sayre, left, and Robert Nelson (members of the original FORTRAN team) use a remote console of a time-sharing computer now in operation at IBM. The machine was designed specifically for programming research, with a wide variety of timing and measuring features to permit evaluation of programming performance.

Programmers: You know these leaders in your field.

Why not work with them?



You're familiar with some of their names already: Iverson, Sayre, Samuel, Dorn. Since this group is spearheading the probe in programming, why not join them? Take an *active* part in today's most exciting research by joining IBM's Programming Research Group!

Research programmers at IBM no longer are predominantly concerned with inventing new and better programs. Their energies currently are devoted to solving other significant problems, such as:

- Determining the value of today's scientific and commercial compilers when used to write systems programs.
- Investigating what portions of programming and programming management can best be helped by a computer.
- Exploring what can be done to further the state of programming theory and its impact on programming practice.

IBM needs creative individuals with degrees in mathematics, science or engineering and a strong interest in computing science to join this research group. If you qualify, you'll work side by side with authorities. And you'll have the superlative facilities of the Thomas J. Watson Research Center at your disposal.

If you'd like to further your career while making a significant contribution to programming, write or call:
R. L. Meyers, Dept. 539X
Thomas J. Watson Research Center
P. O. Box 218
Yorktown Heights, N. Y. 10598
Phone: (914) WG 5-1552

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Center: Herbert Gelernter ("Empirical Explorations of the Geometry-Proving Machine": *Proceedings of the Symposium on Mathematical Theory of Automata,* Vol. XII: Polytechnic Institute of Brooklyn, 1966), left, and Heinrich Ernst ("MH-1 A Computer Controlled Mechanical Hand," *Proceedings of the Spring Joint Computer Conference:* National Press, 1962), right, discuss the adaptive checker-playing program with Arthur L. Samuel, center, editor of *IBM Journal of Research and Development.*

Right: William S. Dorn (*Numerical Methods and FORTRAN Programming:* Wiley, 1964; *Mathematics and Computing:* Wiley, 1966) oversees the IBM Research Computing Center, which will install a System/360 Model 67 this fall.

SHADOW TELEPHONE NETWORKS FOR TIME-SHARING TERMINALS

Thomas C. O'Sullivan
Advanced Systems Dept.
Raytheon Co.
Sudbury, Mass. 01776

A "shadow" telephone network for data, connecting to half a dozen time-sharing systems in five states, permits rapid exploitation of commercial time-shared computers and use of many varieties of software.

For years manufacturers have promised commercially available central computers with time-shared satellite terminals. This year a number of these complexes are being introduced to the market. With their introduction we see practice depart from promise. For some users the terminal has become operationally central with a number of satellite computers available at remote locations. At Raytheon in Sudbury, Mass., for example, we have no time-shared computer. Yet users at terminals there regularly employ time-sharing services not only at nearby Cambridge, Mass., but also in Pennsylvania, New Jersey, New York, and New Hampshire. This practice has grown out of a policy of trying to supply the hardware-software combination most suitable for solving the problem at hand and consistent with the background and experience of the user.

In the world of batch systems, this policy has long been a guiding principle in the selection of hardware-software combinations for specific installations. Because of gaps in software no single hardware configuration could ideally meet the needs of all users. Thus batch systems have only generally been able to apply the principle and meet needs of users.

Time sharing now makes it feasible and convenient to meet the users' needs more precisely through subscription to various available services. Smaller organizations may decide they should not acquire their own time-shared computers, but continue to meet their needs using outside services. For larger organizations, use of such outside services will probably not end with the internal installation of a time-shared computer because of the same kind of software gaps that existed for batch systems. As each manufacturer fills in his spectrum of software, the use of outside time-sharing services will be required less for filling software gaps and more to meet requirements at times of peak workloads.

Broad Spectrum of Software Required

Companies large and small are likely to have a broad spectrum of requirements for software. The older scientists and engineers who did not use computers in their undergraduate or graduate work and who have not yet enlisted the computer to aid in their work will require a high-level language such as BASIC[1] or TELCOMP,[2] largely subsets of English and algebra with the more familiar functions and fairly complete diagnostics. Many newer graduates have had a thorough grounding in computer applications and have developed technical competency in programming. They, along with experienced scientific and engineering programmers, will demand the more complicated tools of their trade. Business data programmers will want to program in machine language or some business-oriented language such as COBOL[3] to provide highly efficient programs for iterative operations.

Today most time-shared computers cannot offer the wide range. But use of a remote terminal to access a number of available services can provide the range. The central terminal with satellite computers has the added advantage of liberating the user from dependence on a specific installation's hours of availability, loading, or equipment reliability. Finally, the central terminal concept allows the user to shop for the best price. In the Northeast within reasonable reach of Raytheon at Sudbury, there are three BASIC systems available. One charges for use of the central processor unit only, another for hook-up time only, and a third for both hook-up and CPU time. Two FORTRAN systems are available, one charging for hook-up time, the other for both hook-up and CPU. After adding communication costs it is possible to make an economical selection of the appropriate service depending on the nature of the problem or program and the ratio of CPU time to hook-up time required.

As the number of terminals at a facility increases, the system presents problems. The philosophy of distributing terminals to users comes into direct conflict with proper practices of control. See Figure 1.

The wider the distribution of terminals, the more difficult it is to insure that:

- costs are properly attributed to the appropriate job;
- control is maintained over contacts with suppliers;
- validation of supplier charges is accurate; and
- company policy regarding use is enforced.

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[1] BASIC is the Beginners All-Purpose Symbolic Instruction Code developed at Dartmouth College by Prof. John H. Kemeny for use on General Electric Time-Shared Equipment.

[2] TELCOMP is an interpretive language system, which is a derivative of RAND's JOSS. It was developed at Bolt Beranek and Newman for use on a time-shared PDP-1.

[3] COBOL, Common Business-Oriented Language, is especially useful for business data programs.

One solution that presents itself is moving all terminals to a supervised central area. This removes all terminals from the users and denies the various line managers the ready access and direct control that they desire for their operations.

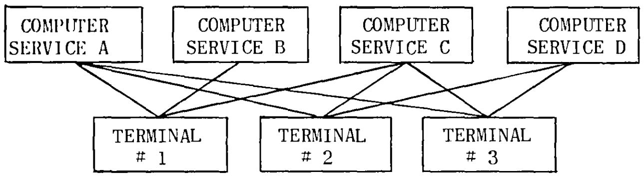

Figure 1. Terminal Contacts with Services

Telephone Network for Data

In order to permit decentralization of terminals and at the same time provide the required control, Raytheon has established a private branch exchange (PBX) within its internal dial system which acts as a shadow telephone network for data. See Figure 2.

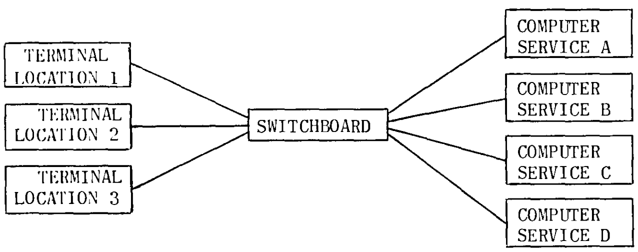

Figure 2. Terminal Switching Network.

The exchange uses a MOD 507 PBX switchboard with card dialer, has a control terminal (teletypewriter), and is run by an operator. All remote terminals are tied through the MOD 507 to the internal dialing system or to one of its two direct outside lines. The system provides three Model 33 teletypewriters and one IBM 1050 which flexibly provides remote access to the various available outside time-sharing services as well as to Raytheon's remotely located IBM 7044. By use of telephone jacks, the terminals, mounted on casters, may be easily moved between locations in the building to provide temporary stations during periods of occasional heavy use. The system has made use of standard telephone equipment and services. Also it is capable of modular expansion as use increases and more terminals and outside services are added. The total company commitment is low, with no purchased equipment, and the rentals and services are subject to short-term cancellation.

If the operator has a programming background, some assistance can be given at the control station to train new users, to help users out of difficulties with the time-shared systems, and to write utility programs. If the operator has a background in engineering or mathematics, problems can be left by users for solution as necessary.

The shadow telephone network at Raytheon is permitting rapid but orderly expansion for early exploitation of available third-generation computers.

NOTE: Since the writing of this article in June, Raytheon's remote terminal network has been accepted widely among users in the Space and Information Systems Division. In August they logged a total of 300 hours. As this issue goes to press, the system has nine terminals tied in through the switchboard, and has access to seven computers at centers in the eastern states from Hanover, N.H., to Alexandria, Va.

c & a

WORLD REPORT — GREAT BRITAIN

With Parliament in recess and a temporary lull in the battle for sterling, what remains of the British computer industry is taking stock of its chances in the near future.

Shortly, International Computers and Tabulators will log its 600th order in a book worth $200 million for the middle-of-the-road, easy-to-program range of computers brought out two years ago. By European standards, this is an immense success, since in 1962 the company hardly had a computer to call its own and depended largely on factoring of RCA and Univac machines.

But the follow-on from the present position is already a headache, if not overtly to the company then overtly in Government circles, though only one-fifth of the Government's $15 million aid granted 18 months ago has been taken up by the company so far.

This aid is aimed mainly at maintaining the company's technology in both hardware and software.

The next major point to be decided by ICT and the Government is whether or not to build and sell the biggest machine in its current range, the 1908. This would have four central processors on a common channel and three levels of storage, as well as ability to provide direct access from several hundred remote consoles. Programming is well advanced. Enough work has been done with fast hybrid circuits to prove that if fully integrated circuits become available towards the end of the year, as makers have promised, ICT will have the capability of a very powerful machine several times faster than anything built to date.

This is the machine the company would offer for the London and Manchester regional "Project MAC" centers. The Edinburgh centre contract has already gone to English Electric, the second British company, for a $2 million complex which is generally thought of as a copy of the largest RCA Spectra machine with British circuits and programs.

But English Electric, while agreeing that its System-4 follows closely RCA thinking, claims that the big machine is very different from the RCA design and hints that with any luck, it may sell its own equipment in the U.S.A. Whether this is a sound venture for a company whose new range has not sold more than $30 million worth in a year is a moot point.

Be that as it may, the System 4-70 is not in the same category as the ICT 1908, which looks more like G-E's multics concept, and would have competed with the IBM 92 or CDC 6800 now defunct.

Although one section of United Kingdom industry — Elliott-Automation — is bucking the world trend by claiming that big, multi-access computers can do no more than many small and fast computers, linked up whenever there is a job big enough to justify this uneconomic step, it is clear that this view is not likely to prevail within the Ministry of Technology.

The big computer battle will be fought out to the end in Britain with G-E looming up as one of the most likely contestants. It will be fought without the anticipated backing from France because the "Concorde" computer project is dead. This is mainly because the potential French partners were claiming equal status with the British companies in the venture despite the far greater technical contribution from the latter.

Whether other European countries join Britain to build a very large machine remains to be seen. Feelers have been put out by the Ministry to this end but not much response has been forthcoming from Holland, Germany, or Sweden where it was hoped to find support.

Some official effort is also being made on the small computer front. Industry is cooperating with the Ministry in discussions aimed at defining a small machine or machines that the Government would buy for a range of applications in its own establishments, hoping that business and industry in Britain would follow suit.

Ted Schoeters
Stanmore
Middlesex
England

ACROSS THE EDITOR'S DESK

Computing and Data Processing Newsletter

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APPLICATIONS

SCIENTISTS RECAPTURE "LOST" SPACE INFORMATION USING NEW COMPUTER

Information that was formerly thought "lost" because of occasional "noise" or "static" recorded during transmissions from spacecraft to ground stations, is now being recovered by a unique data processing installation that incorporates a new IBM 1800 data acquisition and control system. The new technique for retrieving valuable information from apparently indecipherable tape recording of spacecraft missions is being developed by NASA scientists and engineers at the Goddard Space Flight Center, Greenbelt, Md.

"Our knowledge of lunar space must be as complete as possible to prepare our astronauts for survival in a hostile environment," John L. Wolfgang, Jr., project manager for the Flight Data Systems Branch, explained. "Although space missions are carefully planned and executed, data transmission problems have occasionally denied us very important information. We now have advanced to a new level in our data reduction effort. We have equipment that can analyze our tapes, recognize spacecraft transmissions and record the desired data while eliminating noise, to a degree never before achieved."

The IBM 1800 computer provides the recognition and recording functions required in the data retrieval technique. A special tape unit reads and rereads the original recordings for the computer.

— The IBM 1800 data acquisition and control system (in background) also will be used by engineers and scientists to help design and develop improved space data transmission systems.

The 1800 installed at the Flight Data Systems laboratory is capable of storing 8192 words of information, each of which is available within 2 microseconds. All information processed by the 1800 is in binary form. Also connected to the system are: an IBM 2310 disk drive — a device that incorporates a single magnetic disk to store programs; an IBM 2400 series tape drive for recording of data; an IBM 1816 printer; and an IBM 1442 card reader.

STATE OF MICHIGAN AUTOMATES DRIVER RECORDS

The Michigan Department of State is using an Electronic Retina® Computing Reader manufactured by Recognition Equipment Inc., Dallas, Texas, to automate input to a computerized Master Drivers Record Central Files containing complete statistical information on more than five million drivers. Secretary of State James M. Hare said that the optical character recognition system should save more than $600,000 during the next three years and $100,000 per year thereafter over conventional input methods such as manual keypunching.

This fall the Reader began processing more than 5000 drivers license applications per day, determining name, address, license number, expiration date, type of license, restrictions, previous names, aliases, and special equipment requirements. Alphanumeric information typed on standard office typewriters and mark-sense information marked with ordinary pencils is read directly from the applications just as they are received from examining stations throughout the state.

Existing information in the central files, including arrests and convictions and accident reports, will be retyped and read by the Electronic Retina Computing Reader for entry into the computerized system. The complete file will be converted over the next three years. Mr. Hare said that the Department of State also would use the system to process other jobs including vehicle titles and registrations.

QUARTERLY REPORTS OF EMPLOYEES' EARNINGS READ BY OPTICAL SCANNING DEVICE

Robert M. Ball, Commissioner of Social Security, has announced that equipment which can read and write at the rate of over 650 lines a minute has begun operation at social security headquarters in Baltimore, Md. The IBM 1975 Optical Page Reader, built by IBM Corporation to Social Security Administration specifications, is capable of reading more than 200 different type faces.

The 1975, under control of an IBM System/360 Model 30, reads the names, Social Security numbers and quarterly earnings of about half of the 70 million wage-earners in the U.S. These quarterly reports are submitted by 3½ million employers. As a form is read, the computer transfers the automatically scanned data onto magnetic tape for later processing. In this manner, about a quarter of a million lines of

— SSA supervisor Sharon Trieber balances four-foot stack of earnings reports that the optical page reader has condensed onto a single reel of magnetic tape

data, contained on a stack of forms four feet high, can be read and recorded on tape in slightly more than eight hours. By comparison, manual keying of this data into punched cards would take a keypunch operator more than 100 days. The optical page reader (which is being leased with an option to purchase) is expected to save the SSA $750,000 in its first year of operation.

The Optical Page Reader eliminates the need for key punching information on those employer reports prepared by business machines, computer printers, or standard typewriters. The manual card punch system will continue to be used to transcribe handwritten reports, and sections of other reports that are set aside by the Optical Page Reader because of strikeovers or other flaws.

After the 1975 has been completely phased into operations, it will do the work of 120 to 140 key punch operators. However, no one will lose his job because of this development, Commissioner Ball announced. The operators freed by the new equipment will be reassigned to other SSA recordkeeping operations, including the increased workload resulting from the new medicare program and the significant changes in the existing social security program enacted in the social security amendments of 1965.

COMPUTER AS A TOOL IN THE STUDY OF GEOLOGICAL PROBLEMS

Geology, mathematics and computer technology are combined in a study of how the earth's surface was formed, is changing and will appear in a thousand years. Scientists at Standford University and the State Geological Survey of Kansas at The University of Kansas are pioneering the use of computers to answer such questions as: Is there oil, or more impartant in some areas, water beneath my land? Will the Rocky Mountains be higher and more rugged in 2966 than they are now? How long before the Mississippi River Delta fills the Gulf of Mexico?

To answer these questions, geologist John W. Harbaugh of Stanford has developed a mathematical model, or series of complex formulas, which can be solved by supplying data to large scale IBM computers, a 7040, 7090 or 7094. Dr. Harbaugh explains: "In preparing the model, I assumed certain laws of physics and geology will hold true. I then instruct the computer on how to solve the model using data on particular areas of the earth's surface. The computer processes the data over and over, in effect projecting geological processes over time. Deltas, ancient beaches, reefs and other features show up on the maps and charts which the computer prints out. The features are presented clearly and with startling realism. The effect of several million years of geologic history can be studied in 15 minutes' computer time."

The computer-printed contour maps and cross sections can be used for oil, gas and mineral searches and can suggest possible water well sites. In a state such as Kansas, where agriculture largely depends on well water for irrigation, programs permitting rapid calculation of the yield of water-bearing rock formations are immensely valuable. Before computerization, such exploration required hand-drawn maps, weeks of analysis and hundreds of hours of calculation on desk calculators. Dr. Harbaugh's program on the IBM complex takes just 18 seconds to compile the data and 30 seconds to do the calculations for a typical 200-data-point survey.

LATEST COMPUTER TECHNOLOGY USED AT LEAR SIEGLERS ACHIEVES STARTLING RESULTS

Engineers and scientists at the Instrument Division of Lear Siegler, Inc., Grand Rapids, Mich., have evidence of the improved problem solving power and flexibility of the latest computer technology. By harnessing the newest IBM computer with a package of powerful computer programs, the aerospace company has achieved startling results in terms of increased work performed in its engineering department.

The two elements making this possible are IBM's new computer, System/360 Model 40, and Operating System/360 — a master set of computer instructions that enable the machine to switch rapidly from one task to another without time consuming manual intervention. Donald W. Evans, manager of LSI's Analytical Engineering Department, said: "In converting from one of the most powerful IBM 1620s ever installed to a System/360, we expected improvement in processing speeds. However, as a result of the programming support package, we exceeded these expectations.

"In March, for example, the Model 40 performed more than 2000 separate problems in about 200 hours of processing time. We estimate it would have taken our older system 5200 hours, or more than 216 full days, to process the same work."

The Instrument Division's use of the system is heavily oriented to problem solving in the engineering and scientific fields. There is no practical way to schedule a computer operation in an engineering environment, Mr. Evans explained. Engineers bring in jobs for computer processing at random. No two jobs are exactly alike and each requires its own set of computer instructions (programs). These programs must be brought out of mass storage and fed into the central processing unit where they can be applied to the problem. In the old setup, each program was stored on punched cards or magnetic tape external to the system. As each job came up, an operator manually sought out the proper program and entered it into the computer. Operating System/360 makes this manual interchange of programs unnecessary.

Verner Kempinen, LSI manager of scientific data processing, explained: "Linked to the Model 40 computer are three IBM 2311 direct access disk storage units. They hold a total of 22 million characters of information 'on-line' to the computer. This is more than enough capacity to store all of the 500-plus programs now used by our engineering staff." He estimated that by the end of 1966 more than 1000 different engineering and scientific programs would be stored in the systems disk file.

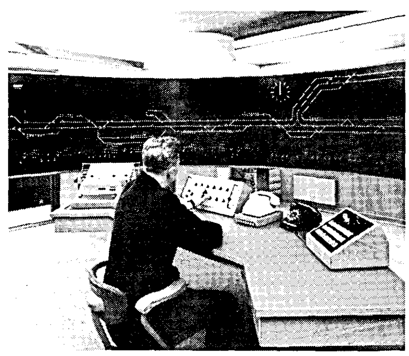
The data processing manager said that under the previous system, problem turn-around time often ranged up to nine days. "Our average now is less than two hours, and often is just a few minutes," he noted. Typical of the hundreds of tasks now processed on the system are: design of circuits and electronic and electro-mechanical control devices; simulation of various aerospace products in their operating environment; and development of mathematical models for testing new concepts.

LARGE ORE PRODUCER USES COMPUTER TO CONTROL MINE TRAFFIC

Luossavaara-Kiirunavaara AB (LKAB) has been exploiting Lappland iron ore deposits since 1890. LKAB is the third largest producer and the largest exporter of iron ore in the world. Its annual output accounts for 80% of Sweden's total iron ore production. It is the first mining company in the world to use electronic data processing techniques to control the flow of mine traffic.

Recently a computerized process control system has been introduced which determines the destinations and routes of ore trains operating at a mine level 1260 feet below the summit of a mountain. The process provides the basis for one of the most modern mining transportation systems in the world. It has been installed for LKAB at its mining site beneath Kiirunavaara Mt., 870 miles north of the company's main office at Stockholm. The process is comprised of an IBM 1710 Control System and a signalling and security system designed and built by Svenska AB Tradlos Telegraf (SATT).

The Centralized Traffic Control Center is the third to be installed by LKAB and the first to use a computer. The dispatcher's



control equipment includes a track-layout display panel and a control console. Reports are printed out on the typewriter at the left. Messages requiring action by the dispatcher are typed in red.

Ore, as it is mined at Kiirunavaara, is passed via chutes into waiting trains on the main haulage level. Control operations begin as the computer picks up an empty train and, in one-tenth of a second, selects a chute destination, based on such factors as the amount of ore to be loaded at each chute and the prevailing traffic situation. After loading, the IBM 1710 selects one of several areas where the ore will be crushed. As the train is en route the computer records production data, such as net weight and ore content, and prints out a report at the end of each shift.

When the train reaches the crushing area another selection is made by the computer: which specific crushing station should handle the ore. This is based on the content and the amount of ore in the train and already in bins waiting to be crushed. After the ore is dumped, the entire cycle is repeated.

COMPUTERIZED WAR ON SCOFFLAWS IN COOK COUNTY

Declaring computerized war on persons who ignore parking tickets, Joseph J. McDonough, clerk of the Cook County Circuit Court (Chicago, Ill.), is shown discussing operations of the IBM System/360 Model 30 installation with an operator.

"Collection of parking fines is one of the biggest headaches in city government today," Mr. McDonough said. With the computer, a daily comparison of moving violation cases on the docket with overdue tickets, permits fast follow-up. The old system permitted only an annual follow-up on multiple-parking violators. Police had to physically apprehend offenders — a process involving massive numbers of man-hours and limited only to multiple-offenses.

The new IBM system merges data from the Illinois Secretary of State, Chicago Police Department and Cook County Circuit Court records to nab parking ticket offenders, insure prompt purchase of license plates and vehicle stickers, and correlate parking violations with moving traffic tickets. Eventually all records of the court — the world's largest legal system — will be automated.

NEW CONTRACTS

FROM	TO	FOR	AMOUNT
AC Electronics division of General Motors, Inc., Milwaukee, Wisc.	Sperry Rand UNIVAC Division	Delivery of production quantities of 1824 computers to perform aboard the Titan III rockets	$10 million
Individual telephone operating companies that will lease the installations to the Canadian government	Automatic Electric (Canada) Ltd., a subsidiary of General Telephone & Electronics International Inc.	Production and installation of five of the nine high-speed electronic switching centers being established for a Canadian military communications network which will be used to provide communications link for North American Air Defense Command	about $8 million
Raytheon Company	Walter Kidde & Co., Belleville, N.J.	Hydraulic and electromechanical check-out systems for Hawk Missile installations	$1¼ million
Ordnance Division of General Electric Co., Pittsfield, Mass.	Control Data Corp., Minneapolis, Minn.	Design, development and production of real-time fire control computer systems for use with the new POSEIDON Missile System	$2,503,940
U.S. Navy	Planning Research Corp., Los Angeles, Calif.	Three data processing studies; in brief, continuation of studies for Advanced Automatic Data Processing Systems	$1.4 million
Western Union	Informatics Inc., Sherman Oaks, Calif.	Programming assistance in first phase of implementation of an Information Services Computer System which will provide variety of new communication and information services to the public	$475,000
Navy Purchasing Office	System Development Corp., Santa Monica, Calif.	Technical assistance to the Naval Command System Support Activity (NAVCOSSACT) in computer software development	$544,636
Electronic Systems Division of the Air Force Systems Command	Planning Research Corp., Los Angeles, Calif.	Establishment of criteria by which the U.S. Air Force can judge proposals for new electronic data processing-automation systems	$250,000
Martin Company, Baltimore, Md.	Reeves Instrument Co., Garden City, N.Y.	Two analog computers to be used in airborne systems for training pilots to fly the rocket powered X-15 research plane and other high performance aircraft	$700,000
U.S. Navy	Data Equipment Division, Bolt Beranek and Newman Inc., Santa Ana, Calif.	Procurement of an undisclosed number of special X-Y graphical recorders for use with sonar instrumentation	$212,000
Claremont Colleges of Claremont, Calif.	System Development Corp., Santa Monica, Calif.	A four-month contract to analyze requirements for computer services in research, instruction and administration of the six colleges	$26,385
U.S. Navy Purchasing Office, Washington, D.C.	Planning Research Corp., Los Angeles, Calif.	Oceanographic data processing involving system analysis and design study of the total automatic data processing requirement of the United States Naval Oceanographic Office (NAVOCEANO)	$95,000
National Science Foundation	University of Rhode Island, Kingston, R.I.	A major expansion of its computer laboratory facilities over the next three years	$250,000
Army Weapons Command, Rock Island, Ill.	Link Group of General Precision, Inc., Binghamton, N.Y.	An Automated Microfilm Aperture Card Updating System (AMACUS)	over $500,000
General Electric, Computer Equipment Dept., Phoenix, Ariz.	Data Products Corp., Culver City, Calif.	Positioning mechanisms and linear action motors to access data recorded on memory system magnetic storage discs	over $800,000
U.S. Atomic Energy Commission, Nevada Operations Office (NVOO)	Lockheed Missiles & Space Co., Sunnyvale, Calif.	Cost-plus-fixed fee contract to study feasibility of centralizing widely scattered operations of the Las Vegas based AEC Operations Office	$130,665
NASA's Goddard Space Flight Center	Sylvania Electric Products Inc.	Development of computer programs that will enable NASA to test ground station antenna control systems automatically in less than two minutes	$56,900
Scientific Data Systems, Santa Monica, Calif.	Data Products Corp., Culver City, Calif.	Additional Model 5045 Discfile random-access memory systems	$1 million
Pacific Gas and Electric Company, San Francisco, Calif.	Westinghouse Electric Corp., Pittsburgh, Pa.	Seven Prodac 50 computers to aid in operating a new 500 kilovolt transmission system — computers will be located in seven substations	—
Internal Revenue Service, Washington, D.C.	General Electric Co.	A new computer system to process tax returns next year on a pilot basis	—
Federal Electric Corporation	Computer Applications Inc., New York, N.Y.	Provision of technical support in advanced system studies and realibility analysis at NASA's Marshall Space Flight Center	—

NEW INSTALLATIONS

AT	OF	FOR
University of Utah, Salt Lake City, Utah	UNIVAC 1108 computer system valued at $2 million	All instructional and research needs of the University and for an extensive management information system
University of Adelaide, Adelaide, Australia	Control Data 6400 computer system	Numerous research jobs on behalf of various departments, as well as for administrative purposes and marking public examinations
Sierra Pacific Power Co., Reno, Nev.	IBM System/360 Model 30	Fully automated billing to be followed later by payroll, general accounting and inventory
Bowles and Tillinghast, Atlanta, Ga.	Honeywell 200 computer system	Expansion of data processing services provided to its insurance industry customers
Whitehall Laboratories, New York, N.Y.	IBM System/360 Model 30	Automating procedures for ordering and billing and centrally controlling operations at four warehouses and the Elkhart and Hammonton, N.J., plants of the non-prescription drug manufacturing firm
Allied Supermarkets, Detroit, Mich.	Two Control Data 3300 computer systems	Initital step in development of a total data processing/communications system for Allied's management
U.S. Army Engineers Geodesy Intelligence Mapping Research and Development Agency (GIMRADA)	EAI Photographic Rectification System (includes an input coordinatograph, a computing system, an X-Y plotter and necessary controls)	Compensation for distortions in aerial photographs for use in map revision; system will become part of a mobile Rapid Combat Mapping System (RACOMS) for forward combat areas
Department of Commerce's Environmental Science Services Administration, Washington, D.C.	UNIVAC 1108 computer system	Use in long-range numerical weather prediction computations by ESSA's Geophysical Fluid Dynamics Laboratory
Oklahoma Publishing Co., Oklahoma City, Okla.	IBM 1130	Typesetting the morning Oklahoman (200,000 daily/ 300,000 Sunday) and evening Times (130,000 daily), as well as for commercial printing
Phillips Petroleum Co., Instrumentation and Automation Branch Laboratory, Bartlesville, Okla.	EAI 8400 Digital Computing System	Simulations of process control studies of design logic, direct digital control techniques, and kinetics of new processes
First National Bank and Trust Co., Troy, Ohio	NCR 315 system	Demand deposit accounting
Dallas Power & Light, Dallas, Texas	GE/PAC 4050 computer	Provision of power plant monitor and turbine control for new Mountain Creek No. 8 unit
Drew University, Economic Research Institute, Madison, N.J.	IBM 1130 computer system	Shared use by S. Wallach Company, Inc., a consulting firm, and by College of Liberal Arts undergraduates; mathematics and physics departments also plan to use the computer. Cost of computer, leased from IBM, is shared by Wallach and the College of Liberal Arts
Cotton States Insurance Companies, Atlanta, Ga.	GE-415 computer system	Providing up-to-the-minute records of each customer's entire history including policies held in all lines, premium information, claims and payment records
Zellerbach Papaer Company, San Francisco, Calif.	GE-415 computer	First phase of an integrated information system for the paper distribution firm's operation in nine western states, including Alaska
Delta Life Insurance Co., New Orleans, La.	IBM System/360 Model 20	Maintaining an up-to-date and readily accessible file of information on every policy, agent and district; also agent commission reporting, payroll, mortgage loan accounting and management reporting; and on service bureau basis, accounting operations of five funeral homes in the New Orleans area
Smithsonian Astrophysical Observatory, Cambridge, Mass.	Control Data 6400 computer system	Use in connection with satellite tracking activities, and the Observatory's broad program of scientific studies of celestial phenomena, the upper atmosphere, and the earth
Haight, Davis & Haight, Inc., Indianapolis, Omaha	IBM System/360 Model 20	Updating client records; cost analysis for employee benefit plans; statistical reporting services for small life insurance companies
Bache & Co., Wall Street, New York, N.Y.	Twin UNIVAC 494 Real-Time Computers, valuted at about $3½ million	Control of private worldwide wire network and associated computing machinery necessary to transmit, record and account for all of firm's daily business
H. K. Porter Co., Thermoid Division, Pittsburgh, Pa.	Spectra 70/45 system	Daily inventory of 36,000 items stacked in 15 widely separated plants and warehouses; also sales analyses, the division and some corporate accounting
Cooper-Bessemer Co., Mount Vernon, Ohio	IBM System/360 Model 30	Inventory control, work load scheduling of men and machines, and forecasting — final objective is for an integrated production control and management information system for all three of company's plants
General Instrument Corp., Darlington, S.C.	IBM System/360 Model 20	General accounting and basic manufacturing control for Darlington facility and sister plant in Tazewell, Va.

ORGANIZATION NEWS

CSC ASSUMES RESPONSIBILITY FOR MISSION SUPPORT TO NASA'S COMPUTATION LAB AT MARSHALL

Computer Sciences Corporation, El Segundo, Calif., has assumed full responsibility for mission support to the computation laboratory at NASA's Marshall Space Flight Center, Huntsville, Ala. Donald A. Jackson, manager of CSC's operations at Marshall, said that as of August 30 the company had taken over the direction of all 29 functional groups of the previous contractor, General Electric Co. CSC's staff at Marshall is now essentially complete, Jackson, said.

The Marshall computation laboratory is one of the largest computer complexes in the United States. Five large-scale computers are included among the more than 300 units of data processing equipment and special-purpose electronic gear at more than 40 locations in the center. CSC's task at Marshall is to operate this equipment, develop computer programs required to support the space center's activities, and to conduct research into new computer techniques to advance the U.S. space program.

The Marshall center is developing the Saturn rockets which will serve as the vehicle for the three-man Apollo spacecraft on its lunar exploration mission. The center also conducts basic research for the nation's space program in areas such as orbital mechanics and astrodynamics. CSC was chosen in June to support the computation laboratory under a $5.5 million contract, which contains options for four one-year renewals. The mission is being performed by CSC's Computer Sciences Division, largest of the company's four operating divisions.

TIME/DATA CORPORATION

A new corporation, TIME/DATA, has been formed in Palo Alto, Calif., to develop, manufacture, and market time-series analyzers and computers. Its president, Robert Sackman, says that product development already is underway on a new computer to be introduced late this year. The computer is designed for use by the individual researcher, as well as computation centers.

The founding team of the new corporation includes Robert Sackman, President; Edwin A. Sloane, Vice President; Martin W. Fletcher, Vice President-Engineering; and Richard Wexler as Manager of Technical Marketing.

HONEYWELL CONTROL SYSTEMS DEPARTMENT MOVES TO MASS.

As many as 100 engineering and marketing personnel in the control systems department of Honeywell's Computer Control Division were moved during Spetember from Fort Washington, Pa. to the division's headquarters in Framingham, Mass. Announcement of the move follows by about two months the "organizational" transfer of the control systems department to the Computer Control Division which had been formed in May when Honeywell acquired the Computer Control Company. The department, a major supplier of industrial process control computer systems, had previously been part of Honeywell's Industrial Products Group.

"The transfer, which accounts for more than half of the department's technical and marketing force, is being made to further unite the division's process control computer activity," according to Benjamin Kessel, division vice president and general manager. "Additional personnel will be transferred to Framingham during the coming year," he said. Kessel said the firm's H-21 industrial process control computer system will continue to be manufactured in the Fort Washington plant and that no production personnel would be required to make the move to Massachusetts.

FRIDEN ESTABLISHES NEW RESEARCH DIVISION

Pioneer work in the application of computer techniques and integrated circuit technologies to Friden and Singer products will be the first assignment of the new Research Division established by Friden, Inc., San Leandro, Calif., the business machines subsidiary of the Singer Company. The new division will augment the existing Research staff and facilities to provide technical leadership in expanding microelectronic technology, particularly integrated circuits.

L. P. Robinson, who heads the new division as Vice President, Research, explained that the division's primary orientation will be toward product development through identification of product characteristics which can be most profitably achieved by the extensive use of microelectronics. The division will emphasize automation and computer techniques in the process of new product development and will assist the other divisions of Singer to take advantage of the opportunities inherent in the rapid development of microelectronic and computer technologies.

EDUCATION NEWS

SALES EXECUTIVES LEARN HOW DECISIONS AFFECT RETURN ON INVESTMENT

A computerized program that compresses a year's "business activity" into a single day provides a laboratory-like situation for the training of key marketing personnel of Sylvania Electric Products Inc. Sylvania is a subsidiary of General Telephone & Electronics Corporation.

Alfred C. Viebranz, Senior Vice President-Marketing, said the primary objective of the program "is to make sales and marketing executives more aware of the impact their daily decisions have on profits and return on investment." The program consists of three-day seminars conducted at Sylvania's Data Processing Center, Camillus, N.Y.

Mr. Viebranz emphasized that since the computer works with great speed, time can be telescoped. While the impact of a decision under actual conditions may not be felt for several months, in a simulation exercise it can be observed in a matter of minutes. Although the primary purpose of the simulation is to train Sylvania personnel, Michigan State, New York University, Pace College and C. W. Post College have expressed interest in its use and the program will be made available to them.

CONTROL DATA INSTITUTE GRADUATES FIRST CLASS

Graduation exercises for the first class of Control Data Institute were held in the Sons of Norway Auditorium, Minneapolis, Minn., at the end of August. Fifty-one students received their diplomas from Swen A. Larsen, president of Control Data Institutes.

This first class, which started with the opening of the Minneapolis-based Institute in September, 1965, has completed the 1000 hours of technical training in computer technology. Included is course work in computer electronics, operation, maintenance and programming.

Students in the graduating class had already received numerous job offers and took employment after graduation. Control Data Institutes are a training arm of Control Data Corporation, providing technical training for the fast-expanding computer industry. In addition to the Minneapolis-based Institute, Control Data established two additional technical training schools in Arpil, 1966. These are located in Washington, D.C. and in Los Angeles, Calif.

INFORMATICS INC. COMPLETES COMPUTER COURSE FOR LAW LIBRARIANS

Informatics Inc., Sherman Oaks, Calif., reported the successful completion of a specialized course on computer techniques for law library applications. The course, held at the University of California at Davis, was sponsored by the American Association of Law Libraries, the Council on Library Resources, Inc., and the School of Law, University of California, Davis.

Fred J. Gruenberger, Informatics Senior Staff Member, conducted the course for members of the Association of Law Librarians, none of whom had had previous experience with electronic data processing equipment. The one-week course was designed to give an understanding of basic concepts of computer applications to law library problems. The law librarians who attended learned rudimentary programming and gained a working knowledge of the equipment that makes up a computer-based system. They also had direct experience on a medium-sized computer and learned many of the underlying principles which are the basis for using the computer as a tool in the library.

NEW PRODUCTS

Digital

PDP-9 DIGITAL COMPUTER

Digital Equipment Corporation, Maynard, Mass., has announced its newest general purpose digital computer, the PDP-9. The basic PDP-9 includes 8192 words of 18 bit ferrite core memory, a 300-character-per-second paper tape reader, a 50-character-per-second paper tape punch, a console teleprinter, a direct memory access channel, four data channels, and a real-time clock.

The PDP-9 is designed for on-line and real-time scientific, engineering and process control applications. It has a 1.0 microsecond cycle time, a 2.0 microsecond add time, input/output transfer rates up to 18,000,000 bits per second and a modular software package that expands to take full advantage of all hardware configurations. Memory can be expanded in 8192 word increments to 32,768 words.

Mass storage devices such as low cost DECtape, IBM compatible magnetic tape, disks and drums are available as PDP-9 options along with a variety of other input/output devices and central processor features. Four different display systems will be available as PDP-9 options. First deliveries are scheduled for December of this year.
(For more information, designate #41 on the Readers Service Card.)

IEC 1010 DIGITAL COMPUTER

A new general-purpose digital computer has been announced by Interstate Electronics Corporation (a wholly-owned subsidiary of Interstate Engineering Corp.), Anaheim, Calif. The new machine, designated the IEC 1010, offers a 16-bit word length (plus parity and protect bits) which facilitates 8-bit -byte (ASCII) manipulation. It is a single-address machine which operates in 1- or 2-word format. The memory is expandable from 4K to 65K, in 4K increments, all directly addressable.

Using CTL integrated circuits, processing clock time is 150 nanoseconds, add time is 2 usec, multiply time is 7 usec, and divide time is 7 usec. The IEC 1010 has more than 80 instructions, nine registers, up to 28 devices on a standard I/O bus (200KC - 16 bit words plus parity) and four I/O processors, each handling up to eight devices; word rate is 900 KC. Software will include Fortran IV, test and utility programs, symbolic assembler and math subroutines.

According to Alfred V. Gangnes, president of the electronics firm, "the new IEC 1010 general-purpose computer was conceived and designed as a versatile central processing unit that will satisfy computational and formatting requirements covering a variety of instrumentation, data acquisition, and control systems which have been the company's primary area of activity for over a decade. Our machine will match or exceed the specification of any other computer in its class and price range on the market today." A basic price of $30,500 and delivery in April 1967 were quoted by Gangnes.
(For more information, designate #42 on the Readers Service Card.)

THIRD GENERATION PRODAC®

A new intermediate-size process control computer system that fills the gap between the small PRODAC® 50 and the large PRODAC 500 series has been announced by the Westinghouse Electric Corporation, Pittsburg, Pa. The new system, called PRODAC 250, utilizes integrated circuitry to attain a memory speed of one microsecond and will be the first real-time on-line control system to offer the convenience of FORTRAN programming.

"The new PRODAC 250 utilizes our PROGEN system of software," pointed out G. Chris Turner, general manager of the Westinghouse Computer Systems Division. "With PROGEN, a systems engineer can devote his entire attention to his control approach, instrumentation, and the over-all operation of the system rather than getting bogged down in computer details." The PROGEN system includes a complete set of program management routines that recognize the real-time world of industrial process control; it also can incorporate prepackaged programs to perform some of the more common control functions.

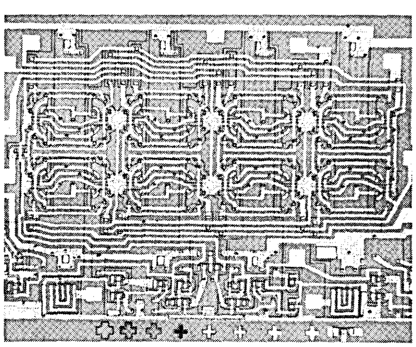
The PRODAC 250 system will have a highly flexible computer memory capacity. Depending on the requirements of the process being controlled, the memory can have anywhere from 4 to 64K or core, with no practical limit to the rapid-access mass memory that can be added as needed. Its peripheral gear will be the same high-speed plant communications equipment used on current PRODAC systems. The new system also will have the high noise rejection and plant isolation of the current PRODAC equipment.

With its combination of high speed and low price, this third generation system is expected to find wide application in steel rolling mills, steel production facilities, electric utility power plants and economic dispatch systems, automatic warehousing and production control, direct digital control in the petro-chemical industry, and in automatic production and testing in repetitive manufacture. PRODAC 250 will be available for installation beginning in the fall of 1967.
(For more information, designate #43 on the Readers Service Card.)

Memories

SYLVANIA 16-BIT MEMORY

The Semiconductor Division of Sylvania Electric Products Inc. has announced the addition of a 16-bit memory to its family of large scale monolithic digital functional arrays. Sylvania is a subsidiary of General Telephone & Electronics Corporation. The new 16-bit memory array (shown) on a 48 x 80 mil. silicon chip is designed for digital computer "scratch pad" (tempor-



ary storage) memory applications. It consists of 16 two transistor flip flops with two write and two sense amplifiers in a 4 x 4 matrix which provides parallel information storage and retrieval.

In large scale computer applications, 64 of the SM-80 arrays can form a 16-word "scratch pad" memory with each word being 64-bits long. This type of memory operates in the 100 nanosecond range as compared to one microsecond for core memories. Standard systems not using "scratch pad" memories require repetitious shuttling of information between the computer's central processor and the memory units. In addition to speed, the memory array will improve the reliability of computers and communications equipment by reducing the number of packages and interconnections required. The unit is available in the Sylvania standard 14-lead dual-in line, plug-in package and TO85 flat pack.
(For more information, designate #44 on the Readers Service Card.)

DRUM MEMORY SYSTEM FOR TIME SHARING

Vermont Research Corp. (North Springfield, Vt.), says that the high data rate and fast access of its Model 1175B Drum Memory System make it a naural for time sharing applications. The system is the first to use new VRC Series 4000 Integrated Circuit Modules. A 15-inch-diameter, 800-track, nickled cobalt plated drum provides the desired high density, high frequency storage. Speed rating is 3600 rpm.

Model 1175B has more than 30,000,000 bits of storage at a 3 Mc data rate. Average access time is 8.6 msec, and complete interface is available for most standard computers. (Basic system interface is handled with standard VRC Series 2000-3000 Modules.) The system offers phase modulation recording with internal parity generation and checking. Model 1175B comes complete with self-contained air cooling system for environmental control.
(For more information, designate #48 on the Readers Service Card.)

GLASS MEMORY MODULES

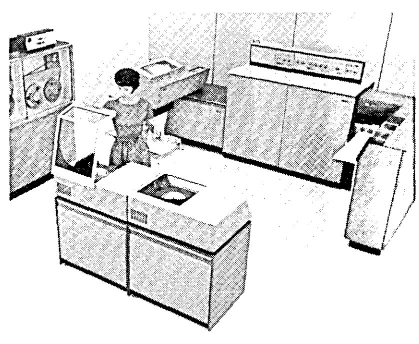
Corning Glass Works, Corning, N.Y., has extended its capability in the serial memory market. The company, a supplier for years of glass digital delay lines without circuitry, has introduced glass memory modules that include input-output circuitry. Because a delay line and its associated circuitry are combined in one package, design and circuit engineers no longer must be concerned with interface problems, Corning said.

Glass memories are made of a "zero TC" glass. This material — Corning Code 8875 glass — is so named because it has a nominal temperature coefficient of time delay of zero.

Applications for Corning memory modules include shift registers, input-output buffers, display buffers, and scratch-pad memories in general purpose computers. Also they can be utilized as main memories in small special-purpose computers used in military fire and tracking control, small process control computers, communications buffers or processors, and DDA's.
(For more information, designate #45 on the Readers Service Card.)

IBM 2311 STORAGE DEVICE

A machine operator is shown placing a pack of magnetic disks in a new storage device announced for System/360 Model 20 by IBM Corporation, White Plains, N.Y. The storage device — the IBM 2311 disk



storage drive — gives the Model 20 (in the bakcground) the high-performance characteristics of larger, more expensive computers. There are two models of the IBM 2311.

Installed singly or in pairs, the new 2311 can store up to 10.8-million characters of information. Any record of information stored on the 2311's magnetic disks can be retrieved directly, for processing in an average 60 to 75 milliseconds.

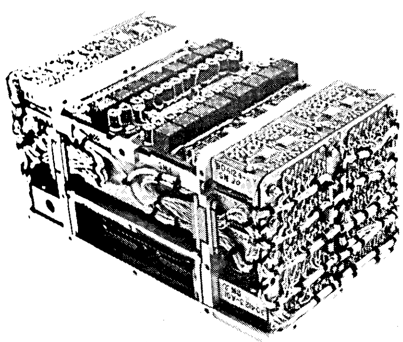
Both models of the 2311, model 11 and model 12, use the interchangeable IBM 1316 disk pack to store information. Because the disk packs are portable and interchangeable, a Model 20 user can build a virtually limitless library

of directly accessible information. Both models of the IBM 2311 disk storage drive for System/360 Model 20 will be available during the fourth quarter of 1967.
(For more information, designate 49 on the Readers Service Card.)

SEMS 5 — MINIATURE MILITARY SPACE MEMORY

A militarized memory no larger than a thirteenth of a cubic foot and designed for airborne and space applications will be demonstrated by Electronic Memories at the Fall Joint Computer Conference, November 8-10, San Francisco, Calif.

SEMS 5 consumes less than 60 watts of power at its maximum operating speed, and 10 watts on standby. Maximum speed is 700 nanoseconds access and 2 microseconds cycle time. The system (shown)

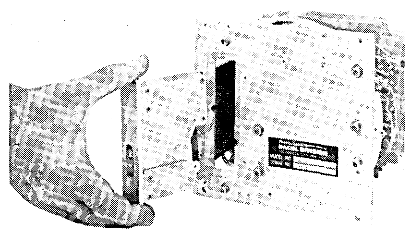


weighs less than 7 pounds and has a volume of only 128 cubic inches. It stores 4096 words of 32 bits each. It also is available with storage capacities of from 256 to 16,384 words, from 8 to 32 bits.

To increase reliability, SEMS 5 uses a 3-wire coincident current magnetic organization, with eight bits per plane, eliminating a very large number of electrical interconnections. Integrated circuitry is used for logic, sense amplifiers, address decoders, data and address registers. Both clear/write and read/restore are standard modes. Logic interface is TTL positive true. Optionally available are split cycle, buffer cycle, power supplies and tester.
(For more information, designate #46 on the Readers Service Card.)

MODEL TR26S, MAGNETIC TAPE MEMORY SYSTEM

Large amounts of digital data now can be stored and recalled economically with a new line of magnetic tape memory systems developed by the DACOL Division of Hersey-Sparling Meter Co., Los Angeles, Calif. Designated the Model TR26S, the new series uses magnetic tape cartridges which store over 400,000 bits of data per cartridge. The reuseable cartridges are loaded with ½", 7-track magnetic tape.



DACOL DIVISION -- Model TR26S Tape Reader/Memory

Memory tapes can be generated from virtually any computer having a magnetic tape capability. Data also can be generated from a paper-tape-master using the DACOL Model PMC20 Paper Tape-to-Magnetic Tape Converter.

The compact Model TR26S has integral playback and control electronics. Data transfer or reading rate is 7200 bits per second. Power required is -5 volts at 200 ma and +28 volts at 300 ma. Ambient operating temperature is -20°C to +60°C. Package size is 6.5 x 6.5 x 7.0 inches; weight is 7 pounds.
(For more information, designate #47 on the Readers Service Card.)

Data Collection

IBM 1080 SYSTEM

A new electronic data acquisition system, that moves the laboratory a big step closer to the computer, has been developed by IBM Corporation, White Plains, N.Y. The IBM 1080 data acquisition system is designed for hospital clinical laboratories and for commercial and pharmaceutical laboratories. The system can record automatically for computer processing the results of hundreds of kinds of clinical tests. Coupled directly to instruments, the IBM 1080 not only provides positive specimen identification before, during and after testing, but virtually eliminates errors that can occur in transcribing instrument readings by hand.

The IBM 1080 data acquisition system accepts readings concurrently from a large number of laboratory instruments — both automated and manual. Whether an instrument puts out a digital signal, a steady analog signal or a series of analog peaks, the 1080 can capture this data. It scans instruments in sequence and automatically combines analog and digital data into one complete digital form for punching into cards or tape. Processed by a computer, the cards or tape yield printed reports on test results for immediate delivery to doctors or laboratory managers.

A basic 1080 system consists of an IBM 1080 model 2 control unit — through which is fed all information about laboratory tests and specimens — and either a card punch or paper tape punch. Test results can be processed by IBM computers now in use in many hospitals. The capabilities of the basic 1080 data acquisition system can be increased with the addition of other units.
(For more information, designate #54 on the Readers Service Card.)

Software

AUTOMATIC COMPUTER PROGRAM TRANSLATION

Celestron Associates Inc., Valhalla, N.Y., has announced the first successful demonstration of 100% fully automatic computer program translation. The first demonstration of its all software automatic program translator was performed on a CDC 1604 during July, 1966, at Valhalla, and at Rome Air Development Center, Rome, N.Y.

The translator accepts IBM 7090 programs in machine language and produces CDC 1604 equivalent programs in CODAP assembly language. The demonstration consisted of supplying the translator with several 7090 programs, performing translation of these programs and execution of the translated programs on the CDC 1604. In each case the program was translated automatically and the resultant target program, when executed, produced results identical to those obtained when the programs were previously run on the IBM 7094.

The translator, which is based on Celestron's proprietary X-ACT translation algorithm, represents the first successful automatic approach to providing compatibility between different models and makes of computers without resort to hardware. As a variety of translators become available, programs written for one machine will be easily convertible to other machines. Of greater long range importance, software translators will permit the design and manufacture of state-of-the-art computers without regard to hardware compatibility.

Celestron Associates, Inc., is making translators using the X-ACT algorithm available to the industry. Translators operating between specified source/target pairs or groups of machines will be developed under contract to users, manufacturers and service organizations. In addition to the 7090/1604 Translator, Celestron is developing a GE 200 to GE 600 Translator, and expects to expand to the IBM 1400, 700 and 7000 series shortly.
(For more information, designate #50 on the Readers Service Card.)

TIME-SHARING ANNOUNCED FOR THREE MODELS OF SYSTEM/360

Time-sharing capabilities for three of its medium-scale computing systems have been announced by IBM Corporation, White Plains, N.Y. A new program — Remote Access Computing System, or RACS — will allow Models 30, 40 and 50 of System/360 to perform time-sharing functions.

When RACS is used, a number of typewriter-like IBM 1050 data communications terminals or IBM 2260 display terminals can be linked to a Model 30, 40 or 50. An engineer or scientists will be able to use one of these terminals, located in or near his office or laboratory, to hold short, problem-solving exchanges with the computer. The programming language used to communicate with a RACS-oriented computer is FORTRAN.

In order to operate with the new program, a Model 30, 40 or 50 must have: a storage capacity of at least 64,000 bytes; two IBM 2311 disk storage units (as well as an IBM 2540 card read-punch and an IBM 1403 printer); and an IBM 2702 transmission control unit.

The Remote Access Computing System is scheduled to be available to IBM customers in the second quarter of 1967.
(For more information, designate #51 on the Readers Service Card.)

INFORMATICS INTRODUCES NEW PRODUCT ANALYSIS SYSTEM

Informatics Inc. has implemented a system for Van Camp Sea Food Company which facilitates the projections of new product profit and loss statements. The system projects statistics up to three years into the future.

Estimates are produced of monthly sales, monthly expenditures, monthly production and shipping volume. As sales results on a new product are entered into the computer-based system, they are compared with previous estimates; new estimates are then generated. While there are several functions which the system performs, one of the most profitable, from a time, cost and feasibility standpoint, is the predictable net income, by unit, city, region and sales area, of the new product. The net income per unit is a figure which takes into account such variables as promotional expenditures and shipping costs. Management can get a summary profit picture for a new product in time to make changes before problem areas become irrevocable.

Mr. Russell Archibald, Informatics' Vice President/CPM Systems, in commenting on the system, stated, "The new product market analysis system is adding a valuable capability in the area of product planning. With this system, a basic programming package can be readily adapted to almost any new product and is virtually 'off-the-shelf'."
(For more information, designate #53 on the Readers Service Card.)

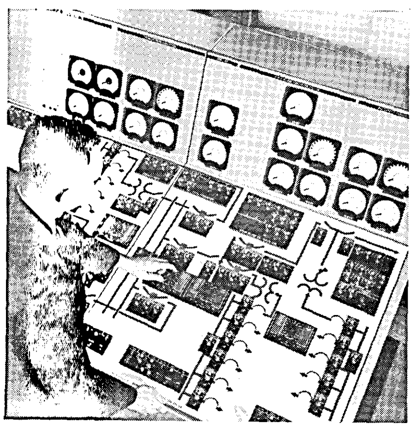
Data Transmitters and A/D Converters

SUPER-TROL II CONTROL SYSTEM

Control Corporation, a division of Control Data Corp., Minneapolis, Minn., has announced an advanced, high-speed, supervisory control system known as the Control Data SUPER-

TROL II. The new system is capable of automatically controlling electric utility plants, pipeline systems, water and sewage systems, industrial processes, traffic systems, and railroads.

SUPER-TROL II uses standard communications facilities, such as telephone lines and microwave channels. Control signals, and other data pertinent to supervising a specific operation, are exchanged between a central master station and remote stations by means of frequency shift tones. The solid-state logic and automatic address verification ability of the system enables it to automatically scan up to 180 points per second, acquire analog and digital data from a large number of remote locations, log remote and local data, and read telemetric measurements.



— Operator at the control panel (shown above) of the new SUPER-TROL II Control System receives status reports from each remote station every 24/1000th of a second

An important feature of the new SUPER-TROL II Control System is its economy. It requires but one communication channel to handle all control, supervision, telemetering and data logging functions, thereby eliminating the expense of multiple communication chennels. Standard interface modules make it possible for users to integrate most computers into their systems.
(For more information, designate #56 on the Readers Service Card.)

DARTEX DATA TERMINAL

The new DARTEX DATA TERMINAL, an effective and economical buffered link for use in the collection and transmission of batch processing data between one or more remote stations and a computation center, is available now from Dartex, Inc., Santa Ana, Calif., an affiliate of Tally Corporation. The DATA TERMINAL consists of an all silicon solid-state digital magnetic tape recorder with a storage capacity of more than 100,000 alpha numeric characters, and an error free data transmission system that plugs directly into a standard 202 DATA-phone. An optional IBM Selectric Input-Output Typewriter or a Teletypewriter, an 80 column punched card reader, or a punched paper tape reader can be added through a matching interface adapter to the recorder.

Complete entry of source data can be accomplished from the keyboard, card reader or paper tape reader and stored on the DARTEX recorder for transmission at any later time. Data can be transmitted from a remote terminal to a computer center, or to another remote terminal. Since data transmission is bi-directional, the equipment also can receive data from a computer center. Additionally it can be controlled by remote commands making it possible to receive data unattended.

The system, compatible with many TALLY systems, is small enough to fit any standard desk top with room for optional equipment. DARTEX DATA TERMINALS may be purchased outright or obtained on a lease basis.
(For more information, designate #57 on the Readers Service Card.)

IBM 1130 NOW HAS ACCESS TO TELEPHONE

IBM's lowest-cost computer, the 1130 data processing system, now has access to the telephone. A new device announced by IBM Corporation — the synchronous communications adapter — enables the 1130 to "call" on the processing power of large-scale System/360s

or to communicate with magnetic tape and punched card transmission units or with other 1130s. Data communications, over regular telephone lines, begins with the routine process of placing the call — as the photo shows. Once the connection is established, communications between machines is handled automatically under stored program control.

Equipped with the adapter, an IBM 1130 can operate as either a stand-alone computer or as a communications terminal with access to a powerful computer. It easily can switch from one role to the other. First customer installations of the adapter are scheduled to begin in the first quarter of next year.
(For more information, designate #55 on the Readers Service Card.)

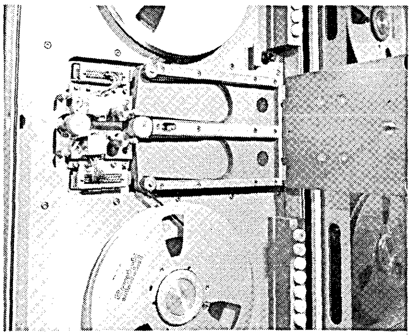
Input-Output

HONEYWELL 7600 MAGNETIC TAPE SYSTEM

A new multi-purpose magnetic tape system with which Honeywell Inc. expects to "corner" a large segment of a multimillion-dollar market has been announced by the firm's Denver-based Test Instruments Division. The system was developed for aerospace, medical and industrial applications, and is viewed by the automation systems company as "equal to many higher-cost units now available and far superior to those that cost less."

W. D. Owens, division vice president and manager, described one element of the 7600 as "a state-of-the-art advance" — a new, simplified bi-directional tape drive system. The capstan is integral with a precision printed-circuit motor assembly that eliminates belts, pulleys and gears. Tape alignment or mechanical adjustments are unnecessary, he said.

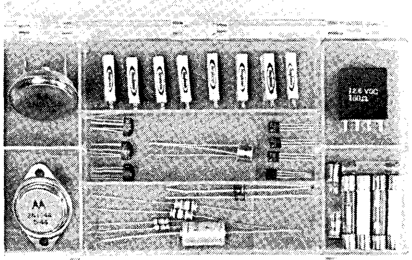
Two new design features — integrated circuitry and modular construction — were described as major factures contributing to a low cost and high performance. Integrated circuitry was used extensively in the 7600's transport and data electronics, and in the two servo systems that go with it, Honeywell said. One example cited was a printed circuit board, the FM record card, which uses a linear integrated circuit amplifier with digital devices that provide count-down and gating functions. This arrangement allows the system to record at nine different speed/frequency modes.



— Honeywell 7600 transport deck with dual vacuum column doors open shows simplified, bi-directional tape drive unit of the new tape system

Integrated circuitry and the modular construction of the system's three major components combine to permit complete system operation independent of fixed-rack mounting or wiring. In addition, each of these basic components — the transport, data housing unit and the power supply — can be arranged to suit the particular installation and operational requirements of the user. Honeywell said that this versatile "building block" arrangement also makes the 7600 magnetic tape system available in a wide choice of configurations, ranging from a 4-track, ¼-inch tape system to a 42-channel, 1-inch system.

A unique maintenance spare parts kit designed by Honeywell for its newest magnetic tape system is expected to start a new maintenance trend. The kit, about the size of a printed circuit board, contains 34 small electronic parts and is

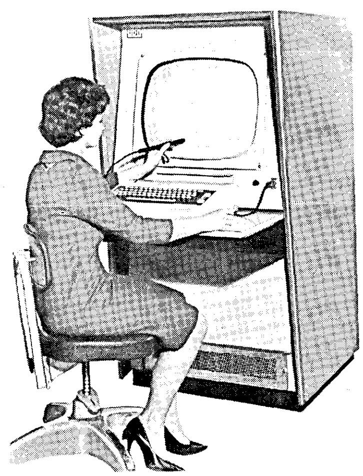


— Unique spare parts kit includes selection of micrologic circuitry, transistors, diodes, trim pots, pilot lamps and fuses, plus a realy, an inductor, and a capacitor

designed to cover 90 per cent of the theoretical failures that could occur in system operation. It will be offered as an accessory item with the 7600 magnetic tape system scheduled for introduction this fall.
)For more information, designate #58 on the Readers Service Card.)

IDI'S NEW DISPLAY SYSTEM, TYPE CM 10093

A new computer-controlled display system will be shown at the Fall Joint Computer Conference by Information Displays Inc. of Mount Vernon, N.Y. IDI's versatile Type CM 10093 features a fast response, large screen CRT display, along with high speed character and vector writing capability and program control of size, intensity, and line structure. The complete solid state system features a light pen to facilitate man-machine dialogue.



— CM 10093 Display System

The CM 10093 displays points, characters in two sizes plus subscripts and superscripts, and vectors in two line structures — dash and solid. All may be selectively displayed in any of three brightnesses or may be blinked. By use of the light pen and keyboard the user can query, add, delete, and edit displayed data.

The device to be shown at FJCC will be fully operative and visitors will be free to use it. The FJCC unit will be driven from a Honeywell Computer Controls Division DDP 116 but models are available to interface with many other computers.
(For more information, designate #60 on the Readers Service Card.)

Components

MRX-III COMPUTER TAPE

A new magnetic tape has been developed and now is being produced by Memorex Corporation, Santa Clara, Calif. The computer tape, designated MRX-III, has been extensively field tested under the most adverse conditions in more than 50 various computer installations. It is said to be three to five times as durable as any present computer tape. All results showed MRX-III superior not only in extra long life before permanent failure, but in dropout activity, according to the manufacturer.

Memorex provides MRX-III error-free computer tape in bit per inch densities of 556, 800, full-with 800 and 1600 (3200 fci). MRX-III is compatible with all computers and tape handlers.
(For more information, designate #61 on the Readers Service Card.)

COMPUTER TAPE ANNOUNCED BY 3M

A new computer tape, offering a major advance in long-term reliability has been announced by the Magnetic Products Division of 3M Company, St. Paul, Minn. Called "Scotch" Brand No. 777, the new tape represents "what we feel to be a product breakthrough in terms of its extended performance reliability", said M. C. Hegdal, division vice president and general manager.

According to Hegdal, the new product is certified error-free at all bits-per-inch densities up to and including 1600 bpi (3200 fci). A special oxide binder formula enables the product to deliver greatly extended error-free performance under heavy usage as well as the temperature and humidity extremes encountered during shipping or long time storage.
(For more information, designate #62 on the Readers Service Card.)

NEW-DESIGN TAPE CANISTER

A new canister for storing computer tape has been placed on the market by Ampex Corporation, Redwood City, Calif. A new locking mechanism has two cam operated plastic dogs which provide positive locking of the top half to the bottom half of the canister. The locking action automatically pulls the top and bottom of the canister firmly together, thereby holding the reel hub to prevent rotation and accidental tape cinching. Previous canisters for computer tape are held together with an expanding friction lock which is disengaged easily.

The transparent canister has a light green tint with a bullseye design. The color provides immediate identification and prevents non-interchangeability problems that sometimes slow down computer room operations. The bullseye design allows the new canister to be stacked with both the 10½-inch and 8-inch canisters of previous designs and of other manufacturers. (For more information, designate #63 on the Readers Service Card.)

BUSINESS NEWS

DE GAULLE GOV'T. TO PROMOTE FRENCH COMPUTER INDUSTRY

France's president, Gen. Charles De Gaulle, is stepping up his government's efforts to eliminate the dependence of his country on American computer technology, particularly in the large-scale scientific area. At a recent meeting of the French Government, presided over by General De Gaulle, a grand "Plan Calcul" was drafted which would: (1) promote a merger between the two largest French-owned computer firms, Compagnie Europeenne d"Automatisme Electronicque (C.E.A.) and Societe Europeenne d'Automatisme (S.E.A.); (2) lead to the development of a new line of advanced scientific computers; (3) award a government grant of more than $100 million to finance this development; and (4) appoint a Delegate-Generale with powers to supervise this development.

The background reason behind this decision is that following the take-over by General Electric of Machines Bull, French-owned industry accounts for only 15% of the computers used in France. The immediate reason appears to be the refusal of the Export Control Board of the U.S. Department of Commerce to grant export licenses for the shipment of three Control Data 6600 super-scale computers to France. Two of these computers were to be used in developing France's atomic energy program....a program the U.S. feels runs counter to the policy of non-proliferation of nuclear weapons. The other 6600, although intended for commercial applications, was also refused an export license because there was no assurance that the computer would not also be applied to problems in the nuclear area.

Successful implementation of the "Plan Calcul" can also be expected to contribute to increased English-French cooperation on the development of large computers. An early plan for such cooperation died on the vine because the French computer industry consisted of a number of small, scattered firms without interest or authority in negotiating an inter-country computer project.

If the French plan is successful, and if its success is imitated by other foreign lands such as Germany, England, Italy and Japan, it could limit sharply the market available to American-made large computer systems. Particularly hard hit by this development would be Control Data which has already been denied export shipment of $15 million worth of 6600's to France ....a potential income equal to nearly 10% of its annual sales in the last fiscal year.

CDC HAS $1.9 MILLION LOSS

Control Data suffered a loss of $1,912,154 during the fiscal year ended June 30th. This was a sharp decline from a year ago when the company earned $7,955,026. Sales, rentals and service income for FY 1966 was $167.6 million, just ahead of the $164.8 million posted last year.

William C. Norris, CDC President, said his company's performance was adversely affected by competition, technical problems, and a continued increase in the percentage of CDC's equipment being leased rather than purchased. Actual sales revenue declined 20% to $105.6 million in FY 1966 from the previous year's $132.1 million. However, rental and service income rose 92% from $32.7 million to $62.1 million.

Norris reports that CDC had record equipment deliveries of more than $190 million for the year. He said that CDC now has more than 1800 computers installed in the world, with a total value of more than $600 million. He also said that as of the end of the fiscal year nineteen 6000 series machines were installed.

POTTER PROFITS UP

Potter Instrument Co., Inc., reports record high sales and earnings for the fiscal year ended June 25, 1966.

Profits for the year were $1,162,500, a 56% increase over the previous peak of $747,500 set in the similar period a year earlier. Net income from operations for the year was $1,239,200. Sales also rose to $14,539,800, a 14% increase over the previous record of $12,790,400 in fiscal 1965.

John T. Potter, president, said that 1966's excellent figures stem, in part, from the effectiveness of the company's cost control program. He stated that net income as a per cent of sales rose to an all time high of 8% compared with 5.85% in fiscal 1965.

C&S HAS RECORD SALES

Computing & Software, Inc., Panorama City, Calif., reports earnings of $220,000 on sales of $5,186,000 for the nine months ended July 30th. In the same period a year ago, earnings totaled $167,000 on sales of $4,671,000. The company specializes in computing and technical support services for government and industry.

LFE SALES RISE

Laboratory for Electronics, Inc. reports earnings of $230,000 on sales of $13,193,000 for the three months ended July 29th. In the same period a year ago, earnings were $205,000 on sales of $11,474,000. LFE President Henry Harding said his firm's backlog stood at $22.7 million at the end of the period, compared with $16.1 a year ago.

BOOKS AND OTHER PUBLICATIONS: Reviews

Neil Macdonald
Assistant Editor
Computers and Automation

We publish here citations and brief reviews of books and other publications which have a significant relation to computers, data processing, and automation, and which have come to our attention. We shall be glad to report other information in future lists if a review copy is sent to us. The plan of each entry is: author or editor / title / publisher or issuer / date, publication process, number of pages, price or its equivalent / comments. If you write to a publisher or issuer, we would appreciate your mentioning **Computers and Automation.**

Shreider, Yu. A., editor, and five authors / The Monte Carlo Method: The Method of Statistical Trials / Pergamon Press, Inc., 44-01 21st Street, Long Island City, New York, N. Y. 11101 / 1966, Printed, 381 pp., $12.50

This is an interesting, valuable, and readable book, on a moderately advanced level. In spite of its level there are many parts which can be easily understood such as the "drunkard's walk" starting on page 36. It is a handbook published in Russian for Soviet readers, and excellently translated into English by G. J. Tee of the University of Lancaster. The Monte Carlo method consists basically of making statistical experiments which solve difficult mathematical problems. The method is very powerful when using fast computers and well chosen models.

Bartee, Thomas C. / Digital Computer Fundamentals: Second Edition / McGraw-Hill Book Co., 330 West 42 St., New York, N. Y. 10036 / 1966, printed, 402 pp., $6.95

This is a very useful book, on digital computers with emphasis on their electrical and design aspects. The book has been widely used as a text; this second edition includes responses to many suggestions from many sources. The circuits illustrated are modern circuits.

Wolf, Oswald, editor, and 3 assistants of Federal Electric Corp., a subsidiary of ITT / Boolean Algebra / Prentice-Hall, Inc., Englewood Cliffs, N. J. / 1966, printed, 246 pp., ?

The purpose of this book is to explain enough Boolean algebra simply and quickly so that it can be applied toward a specialized field — computer logic design. There are 12 chapters or "sets": Numbering systems; Basic principles of Boolean algebra; Negation; AND operation; OR operation; Exclusive OR; Basic theorems and truth tables: Advanced theorems; De Morgan's negation theorems; Minimization techniques I; Minimization techniques II; and Final examination. At the end of each set there are reviews, and detailed solutions for self-testing on comprehension.

Though it is a programmed text, the answers are immediately after the questions. This is a useful book.

Jamison, Robert V. / FORTRAN Programming / McGraw-Hill Book Co., 330 West 42 St., New York, N. Y. 10036 / 1966, printed, 214 pp., $4.95

This book deals with FORTRAN II, which is a widely used programming language. The author teaches at Northrop Inst. of Tech., Inglewood, Calif. The book seems direct and useful.

Sippl, Charles J. / Computer Dictionary and Handbook / Howard W. Sams & Co., Indianapolis, Indiana / 1966, photo offset, 766 pp., $12.95

This is an encyclopedic book. Definitions cover 340 pages; 26 appendices, on topics such as computers in education and COBAL, fill 300 more pages. The definitions appear adequate.

George, F. H. / An Introduction to Digital Computing: Pergamon Programmed Tests / Pergamon Press, 44-01, 21st Street, Long Island City, N. Y. 11101 / 1966, photo offset, 274 pp., $4.50

This book is quite elementary. Since it is a programmed text, it is difficult to use and to judge.

Wegner, Peter, editor, and 15(?) authors / Introduction to System Programming / Academic Press, 111 Fifth Ave., New York, N. Y. 10003 / 1964, printed, 316 pp., 70 s.

This is the report of an integrated symposium by top British experts in programming, given at the London School of Economics. This is a useful and valuable book and well worth studying.

Ingerman, Peter Zilahy / A Syntax-Oriented Translator / Academic Press, 111 Fifth Ave., New York, N. Y. 10003 / 1966, printed, 132 pp., $?

The first chapter is interesting and understandable. The later chapters seem hard to understand and may be hard to apply. There is no glossary to guide the reader to what the author means by the terms he uses. The "syntax-oriented translator" which the author talks about is not described as if it had actually worked on a computer.

Awad, Elias M., and Data Processing Management Association / Automatic Data Processing: Prentice-Hall, Inc., Englewood Cliffs, N. J. / 1966, printed, 373 pp., $7.95

This is a very complete introduction to data processing prepared over three years under the direction of the Data Processing Management Association with the cooperation of six computer manufacturers; it was thoroughly rewritten beginning in 1964 by Prof. Elias M. Awad, then Professor of Business at the Rochester Inst. of Technology, now at Northwestern Univ. The DPMA now has over 11,000 members; the book is for them.

This is a good book.

Richards, R. K. /Electronic Digital Systems / John Wiley & Sons, New York / 1966, printed, 637 pp., $15.00

This is the third book by this author, who by now is very well informed. He has had the patience to do much research, and he appears to have good judgment. The book is valuable.

Head, Robert V. / Real-Time Business Systems / Holt Reinhart and Winston, New York / 1964, 368 pp. printed, $9.00

This book is based on the author's experience with IBM, GE, and as vice president and manager, Systems Planning Division, Security First National Bank, Los Angeles, Calif. It is a thorough book, and contains a lot of good sense and much experience, apparently acquired the hard way. Much of the book seems obvious, but probably what is obvious is often obscured under the pressure of making a real-time computer system work; so it is useful to have the obvious put down where one can refer to it.

Uhr, Leonard, editor and 31 authors / Pattern Recognition / John Wiley & Sons, Inc., 440 Park Ave. South, New York, N. Y. 10016 / 1966, paperbound, 393 pp., $5.95

This is an interesting and important collection of investigation, analysis, and work done in pattern recognition. The authors range from C. S. Pierce and Ludwig Wittgenstein up to O. G. Selfridge and Leonard Uhr.

Schultz, Louise / Digital Processing: A System Orientation / Prentice-Hall, Inc., Englewood Cliffs, N. J. / 1963, printed, 403 pp., $?

The first two chapters are: "Numerical Notation or What is 1?" "Arithmetic Manipulation or What is 1 + 1?". The last three chapters are: "The Programmer and the System"; "Programming Ways and Means"; "Programming Systems". The author is a "technical communications specialist and journalist engineer". Some of the chapters begin with poetry in the form of blank verse.

One of the chapters contains some Boolean algebra which is not correct, since an equal sign for "equals" is used in place of an implies sign for "lies in"; but otherwise the book seems correct.

It is not clear why the book is called "a system orientation". The index shows the first use of the word "system" on page 269, which is late in the book to start to explain "system" when it is a main word in the title.

Important Announcement to the Readers of "Computers and Automation" from the Editor:

A CHANCE TO USE A TIME-SHARED COMPUTER

"Computers and Automation" and the "Information Processing Centers Business" of General Electric, Phoenix, Arizona, are offering a prize consisting of a temporary installation of a time-shared computer console and $100 worth of time-shared computer time (approximately 7 hours on the console) to the lucky winner of a drawing under the following conditions:

1. The drawing will be made impartially among persons who fill in and return to "Computers and Automation", P. O. Box 308, Winchester, Mass. 01890, on or before October 31, 1966, Readers' Service Cards from this October issue.
2. The winner of the drawing can, with the approval of "Computers and Automation", delegate his prize to a personal friend or acquaintance of his.
3. The winner or user will cooperate with "Computers and Automation" and General Electric in producing a short account of his experiences and reactions.
4. The installation should be within 50 miles of a GE time-sharing center: Chicago, Cleveland, Detroit, Los Angeles, New York, Phoenix, Schenectady (N.Y.), San Francisco, Washington (D.C.).
5. This contest is void in any area where the contest is subject to tax or legal regulation.

"Computers and Automation" is providing the quantum of computer time; General Electric is providing the teletypewriter installation charge and rental, the telephone line charge, and the time for instruction to the winner, or his delegate. Be sure to send in a readers' service card this month if you are interested!

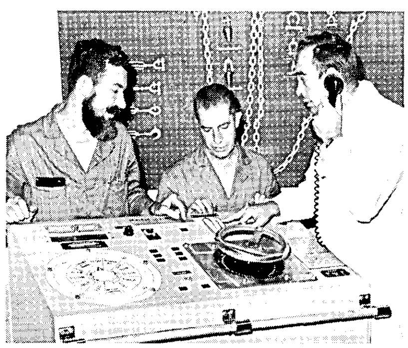
Also, if you are interested in the possibility of using time-shared computing of this kind, please designate 1 on the Readers' Service Card.

CORRECTION

On pages 42 and 43 of the September, 1966 issue of "Computers and Automation" two pictures that should have been inserted were omitted, due to an unfortunate error in the printer's plant.

The picture missing from page 42 is printed at right.

The picture missing from page 43 is a picture of an IBM simulator and is the same as the picture on the front cover of the September issue, and so it is not necessary to reprint it here.



— Unlicensed members of the National Maritime Union (NMU) learn how to operate an automated ship.

MONTHLY COMPUTER CENSUS

The number of electronic computers installed or in production at any one time has been increasing at a bewildering pace in the past several years. New vendors have come into the computer market, and familiar machines have gone out of production. Some new machines have been received with open arms by users — others have been given the cold shoulder.

To aid our readers in keeping up with this mushrooming activity, the editors of COMPUTERS AND AUTOMATION present this monthly report on the number of general purpose electronic computers of American-based companies which are installed or on order as of the preceding month. These figures included installations and orders outside the United States. We update this computer census monthly, so that it will serve as a "box-score" of progress for readers interested in following the growth of the American computer industry, and of the computing power it builds.

In general, manufacturers in the computer field do not officially release installation and on order figures. The figures in this census are developed through a continuing market survey conducted by associates of our magazine. This market research program develops and maintains a data bank describing current computer installations in the United States. A similar program is conducted for overseas installations.

Any additions, or corrections, from informed readers will be welcomed.

AS OF SEPTEMBER 10, 1966

NAME OF MANUFACTURER	NAME OF COMPUTER	SOLID STATE?	AVERAGE MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS
Advanced Scientific Instruments	ASI 210	Y	$3850	4/62	25	0
	ASI 2100	Y	$4200	12/63	7	0
	ADVANCE 6020	Y	$4400	4/65	12	4
	ADVANCE 6040	Y	$5600	7/65	6	4
	ADVANCE 6050	Y	$9000	2/66	3	6
	ADVANCE 6070	Y	$15,000	10/65	4	5
	ADVANCE 6130	Y	$1000	11/66	0	4
Autonetics	RECOMP II	Y	$2495	11/58	39	X
	RECOMP III	Y	$1495	6/61	8	X
Bunker-Ramo Corp.	BR-130	Y	$2000	10/61	162	2
	BR-133	Y	$2400	5/64	22	20
	BR-230	Y	$2680	8/63	15	X
	BR-300	Y	$3000	3/59	36	X
	BR-330	Y	$4000	12/60	34	X
	BR-340	Y	$7000	12/63	20	X
Burroughs	205	N	$4600	1/54	45	X
	220	N	$14,000	10/58	35	X
	E101-103	N	$875	1/56	133	X
	B100	Y	$2800	8/64	155	18
	B250	Y	$4200	11/61	85	1
	B260	Y	$3750	11/62	228	5
	B270	Y	$7000	7/62	160	8
	B280	Y	$6500	7/62	130	8
	B300	Y	$10,000	7/65	105	90
	B2500	Y	$5000	1/67	0	34
	B3500	Y	$14,000	5/67	0	23
	B5500	Y	$22,000	3/63	57	14
	B6500	Y	$33,000	2/68	0	5
	B8500	Y	$200,000	2/67	0	1
Control Data Corporation	G-15	N	$1600	7/55	310	X
	G-20	Y	$15,500	4/61	23	X
	LGP-21	Y	$725	12/62	118	X
	LGP-30	semi	$1300	9/56	124	X
	RPC-4000	Y	$1875	1/61	55	X
	160*/160A/160G	Y	$2100/$5000/$12,000	5/60;7/61;3/64	455	8
	924/924A	Y	$11,000	8/61	26	X
	1604/1604A	Y	$45,000	1/60	59	X
	1700	Y	$4000	5/66	13	90
	3100	Y	$11,000	12/64	88	30
	3200	Y	$14,000	5/64	90	X
	3300	Y	$15,000	9/65	23	40
	3400	Y	$25,000	11/64	19	X
	3500	Y	$30,000	9/66	0	11
	3600	Y	$58,000	6/63	50	X
	3800	Y	$60,000	2/66	5	14
	6400	Y	$50,000	5/66	6	15
	6600	Y	$85,000	8/64	18	11
	6800	Y	$130,000	4/67	0	4
Data Machines, Inc.	620	Y	$900	11/65	20	30
Digital Equipment Corp.	PDP-1	Y	$3400	11/60	60	X
	PDP-4	Y	$1700	8/62	57	X
	PDP-5	Y	$900	9/63	114	1
	PDP-6	Y	$10,000	10/64	20	4
	PDP-7	Y	$1300	11/64	80	50
	PDP-8	Y	$525	4/65	400	250
	PDP-9	Y	$1000	12/66	0	20
El-tronics, Inc.	ALWAC IIIE	N	$1820	2/54	17	X
Electronic Associates, Inc.	8400	Y	$10,000	6/65	7	7
Friden	6010	Y	$600	6/63	440	80
General Electric	115	Y	$2000	12/65	125	550
	205	Y	$2900	6/64	44	X
	210	Y	$16,000	7/59	50	X
	215	Y	$6000	9/63	54	X
	225	Y	$8000	4/61	205	X
	235	Y	$10,900	4/64	66	3
	415	Y	$9600	5/64	179	64
	425	Y	$18,000	6/64	68	42
	435	Y	$25,000	9/65	28	18
	625/635	Y	$55,800	5/65	33	32
	645	Y	$90,000	7/66	1	10
Honeywell Electronic Data Processing	DDP-24	Y	$2500	5/63	80	5
	DDP-116	Y	$900	4/65	100	40
	DDP-124	Y	$2050	3/66	12	40
	DDP-224	Y	$3300	3/65	35	10
	H-120	Y	$3500	1/66	190	280
	H-200	Y	$5700	3/64	855	140
	H-400	Y	$8500	12/61	118	X

NAME OF MANUFACTURER	NAME OF COMPUTER	SOLID STATE?	AVERAGE MONTHLY RENTAL	DATE OF FIRST INSTALLATION	NUMBER OF INSTALLATIONS	NUMBER OF UNFILLED ORDERS
Honeywell (cont'd)	H-800	Y	$26,000	12/60	89	3
	H-1200	Y	$7300	2/66	16	68
	H-1400	Y	$14,000	1/64	12	1
	H-1800	Y	$35,000	1/64	17	2
	H-2200	Y	$13,000	1/66	12	52
	H-4200	Y	$20,500	6/66	0	6
	H-8200	Y	$35,000	3/67	0	2
	DATAmatic 1000	N	$40,000	12/57	3	X
IBM	305	N	$3600	12/57	148	X
	360/20	Y	$2000	12/65	500	6300
	360/30	Y	$7500	5/65	1800	4600
	360/40	Y	$15,000	4/65	900	1500
	360/44	Y	$10,000	7/66	2	125
	360/50	Y	$26,000	8/65	106	560
	360/62	Y	$55,000	11/65	1	X
	360/65	Y	$50,000	11/65	17	205
	360/67	Y	$75,000	9/66	0	60
	360/75	Y	$78,000	2/66	8	30
	360/90 Series	Y	$140,000	6/67	0	9
	650	N	$4800	11/54	178	X
	1130	Y	$1200	11/65	350	3700
	1401	Y	$6600	9/60	7650	X
	1401-G	Y	$2300	5/64	1560	50
	1410	Y	$14,200	11/61	790	90
	1440	Y	$4800	4/63	3100	300
	1460	Y	$11,500	10/63	1775	80
	1620 I, II	Y	$4000	9/60	1680	20
	1800	Y	$7600	1/66	30	275
	701	N	$5000	4/53	1	X
	7010	Y	$22,600	10/63	208	6
	702	N	$6900	2/55	6	X
	7030	Y	$160,000	5/61	6	X
	704	N	$32,000	12/55	32	X
	7040	Y	$22,000	6/63	120	4
	7044	Y	$32,000	6/63	121	5
	705	N	$38,000	11/55	52	X
	7070, 2, 4	Y	$27,000	3/60	328	X
	7080	Y	$55,000	8/61	85	X
	709	N	$40,000	8/58	9	X
	7090	Y	$63,500	11/59	45	X
	7094	Y	$72,500	9/62	120	2
	7094 II	Y	$78,500	4/64	124	8
Monroe Calculating Machine Co.	Monrobot XI	Y	$700	12/60	480	100
National Cash Register Co.	NCR - 304	Y	$14,000	1/60	26	X
	NCR - 310	Y	$2500	5/61	20	X
	NCR - 315	Y	$8500	5/62	345	35
	NCR - 315-RMC	Y	$12,000	9/65	45	75
	NCR - 390	Y	$1850	5/61	1030	50
	NCR - 500	Y	$1500	10/65	430	850
Philco	1000	Y	$7010	6/63	18	X
	2000-210, 211	Y	$40,000	10/58	16	X
	2000-212	Y	$52,000	1/63	10	X
Radio Corporation of America	RCA 301	Y	$7000	2/61	645	2
	RCA 3301	Y	$17,000	7/64	60	10
	RCA 501	Y	$14,000	6/59	97	X
	RCA 601	Y	$35,000	11/62	5	X
	Spectra 70/15	Y	$3500	9/65	55	105
	Spectra 70/25	Y	$5700	9/65	30	55
	Spectra 70/35	Y	$9000	7/66	3	80
	Spectra 70/45	Y	$15,000	11/65	11	110
	Spectra 70/55	Y	$30,000	7/66	0	12
Raytheon	250	Y	$1200	12/60	175	X
	440	Y	$3500	3/64	16	3
	520	Y	$3200	10/65	15	6
Scientific Control Corporation	650	Y	$500	5/66	1	8
	655	Y	$1800	10/66	0	2
	660	Y	$2000	10/65	4	3
	670	Y	$2600	5/66	1	2
Scientific Data Systems Inc.	SDS-92	Y	$1500	4/65	58	33
	SDS-910	Y	$2000	8/62	182	6
	SDS-920	Y	$2900	9/62	130	12
	SDS-925	Y	$3000	12/64	25	10
	SDS-930	Y	$3400	6/64	120	20
	SDS-940	Y	$10,000	4/66	5	12
	SDS-9300	Y	$7000	11/64	27	7
	Sigma 2	Y	$1000	2/67	0	35
	Sigma 7	Y	$12,000	12/66	0	22
Systems Engineering Labs	SEL-810/810A	Y	$1000	9/65	24	8
	SEL-840/840A	Y	$1400	11/65	3	5
UNIVAC	I & II	N	$25,000	3/51 & 11/57	27	X
	III	Y	$20,000	8/62	78	X
	File Computers	N	$15,000	8/56	16	X
	Solid-State 80 I, II, 90 I, II & Step	Y	$8000	8/58	262	X
	418	Y	$11,000	6/63	88	40
	490 Series	Y	$35,000	12/61	105	60
	1004	Y	$1900	2/63	3250	70
	1005	Y	$2400	4/66	300	280
	1050	Y	$8000	9/63	280	50
	1100 Series (except 1107	N	$35,000	12/50	11	X
	1107	Y	$55,000	10/62	29	X
	1108	Y	$65,000	9/65	18	44
	9200	Y	$1500	6/67	0	250
	9300	Y	$3400	6/67	0	50
	LARC	Y	$135,000	5/60	2	X
				TOTALS	37,035	22,729

X = no longer in production.

* To avoid double counting, note that the Control Data 160 serves as the central processor of the NCR 310. Also, many of the orders for the IBM 7044, 7074, and 7094 I and II's are not for new machines but for conversion from existing 7040, 7070, and 7090 computers respectively.

Time-Sharing System Scorecard

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This guide is prepared periodically to keep the reader abreast of the rapidly increasing number of time-shared computer systems which are bringing man and machine together in close partnership for the pursuit of intellectual and administrative activities. By glancing at the following charts the reader can judge for himself the progress which is being made in this new and dynamic field. There are several different definitions of time-sharing. No single definition is adequate for all purposes. We have limited this survey to systems which have at least two independent, remote and simultaneously operable consoles (from the user's point of view). If the language capabilities of the system are extensive and general so that a user can create new languages while working on-line, we have denoted this as a general purpose time-sharing system. Where the language capabilities are more restrictive, permitting the user to work in only one specific problem area, we have used the term special purpose time-sharing system.

Perhaps the most significant change in the past six months is the increasing number of commercial time-sharing services which are being offered by small independent companies operating on a regional basis throughout the country. Meanwhile, the corporate giants seem to be moving more slowly in the face of numerous legal uncertainties concerning the establishment of nation-wide information services using common-carrier communication facilities. However, several large corporations have recently entered the on-line information industry with medical and educational services. For example, GE has just formed a MEDINET (medical information network) division to sell time-shared information services to hospitals.

Except for SDS's unveiling of its super time-sharing machine, the SIGMA 7, few announcements of new machines have been made by the manufacturers despite rumors that Honeywell and RCA are about to make their time-sharing plans known. Five IBM System 360, model 67's are being installed for time-sharing service at MIT, System Development Corp., Lincoln Laboratory, the Carnegie Institute of Technology, and the University of Michigan.

Time-sharing goes international with the announcement of systems in France and Australia. SACS, a Parisian management consulting group, has time-shared a Bull-GE M40 with four terminals and offers a Fortran IV compiler. In Canberra, the government research organization, CSIRO, is time-sharing a CDC 3600 with seven users and will provide Fortran, Cobol and Algol.

CHARACTERISTICS LISTED IN CHARTS

STATUS

O-operational system, number in parentheses denotes the approximate date that the system went on the air. D-system under development with anticipated date that operations will begin.

TYPE

G-general purpose, S-special purpose.

COMPUTER

manufacturer's name and number of central computers in system

LANGUAGES

basic languages available on system at present.

TERMINALS

type of terminal equipment available, number of such terminals in parentheses. Code: TT followed by number denotes TELETYPE terminals and model number, TY-typewriter, TLX-Telex console, CRT-cathode ray tube display, BR-Bunker Ramo series 200 display consoles, IBM 1050-keyboard consoles, PHILCO-display consoles.

MAIN STORAGE

first number denotes total core storage in words on system, second number in parentheses, if given, denotes maximum core storage available to an individual user.

SECONDARY STORAGE

DR-magnetic drum, DK-disk file, MT-magnetic tape (K = 1024, M = 1,000,000).

NO. OF USERS

maximum number of users who can operate simultaneously at any given time.

The information reported in this survey is believed to be accurate and is published as a public service. Many of the systems described are still being modified and consequently their characteristics may change from time to time. Computer Research Corp. cannot be held responsible for any errors or omissions. Readers desiring more detailed information about a particular system should write directly to the organization listed. This survey may not be reproduced for any purpose without the written consent of Computer Research Corp. This material will be updated periodically to include new systems as they are developed and to correct any errors, omissions or changes which are brought to our attention. Copies of the updated survey will be sent upon request.

Organization	Status	Type	Computers	Languages	Terminals	Main Storage	Secondary Storage	No. Of Users	Remarks
Bell Telephone Laboratories Murray Hill, N. J.	D (12/66)	G	GE-645*	FORTRAN IV, COBOL, PL/I SNOBOL	TT-37, IBM 1050 CRT (10)	256K	DK (40M Wds.) DR (4M Wds.) Tape Loop (100M Wds.)	100	Highly interactive system for research and production computing developed in cooperation with Project MAC, MIT. *Multi-processor time-sharing system.
Bolt, Beranek and Newman Inc. Cambridge, Mass.	0 (6/64)	G	PDP-1D*	MIDAS TELCOMP**	TT-33 (90)	24K (4K)	DR (128K Wds.) DR (25M Wds.) MT (2 Units)	64	Medical information and communications system for hospitals developed with Mass. General Hospital under contract from the National Institutes of Health. **Version of the RAND JOSS language.
Carnegie Institute of Technology Pittsburgh, Penn.	0 (7/64)	G	G-21	ALGOL, IPL-V, FORTRAN	TT-33 (22) TT-35 (22)	72K	DK (1M Wds.) DK (22M Wds.)	16	Will install an IBM 360 Model 67 in early 1967
Dartmouth College Hanover, N.H.	0 (5/64)	G	GE 235 DATANET-30	BASIC ALGOL	TT-35 (37)	32K (6K)	DK (6M Wds.) MT (8 Units)	27	Educational time-sharing system
Lincoln Laboratory MIT Lexington, Mass.	0 (2/66)	G	TX-2	CORAL, VITAL MARK 5	TY (5), CRT (4), RAND TABLET	105K	DR (20M Wds.)	5	System features fast response time for on-line graphical communication
Lincoln Laboratory MIT Lexington, Mass.	D (1/67)	G	IBM 360* Model 67	MACRO FORTRAN IV, PL/I, COBOL	IBM 2741 (50) IBM 2260-3 (30) IBM 2250-2 (8)	192K	DR (1M Wds.) DK (14.5M Wds.) MT (16 Units)		Establishment of a large computational facility for scientific and engineering research. First IBM 360 Model 67 to be installed. *Multiple processor time-sharing system.
MIT Computation Center Cambridge, Mass.	0 (11/61)	G	IBM-7094	Same as Project MAC Phase One		64K (32K)	DK DR MT	24	
MIT Computation Center Cambridge, Mass.	D (1/67)	G	IBM 360 Model 67			256K	DK (52M Wds.)	200	Multiple processor time-sharing system
MIT Dept. of Civil Eng. ICES SYSTEM Cambridge, Mass.	D (12/66)	S	IBM 360 Model 40	ICETRAN STRESS COGO	IBM 2741 (5) IBM 2250	32K	3 DK (1.8M Wds.)		Integrated system for civil engineering problems
MIT Dept. of Electrical Eng. Cambridge, Mass.	0 (12/66)	G	PDP-1	Macro Assembler	TY (4)	12K	DR (88K Wds.)	4	Experimental time-sharing system for student use in thesis and research projects
Ohio State Univ. Columbus, Ohio	D (9/66)	G	GE-645		TT (15)	64K	DK	23	Multiple processor time-sharing system
Perkin-Elmer Corp. Norwalk, Conn.	D (6/66)	G	SDS-9300 SDS-930	FORTRAN IV, ALGOL	TT, TY TWX	32K (24K)	DK (2M Wds.) MT (4 Units)	16	For R&D applications, under development with Computer Assoc. and Digitek
Project MAC - MIT (Phase One) Cambridge, Mass.	0 (10/63)*	G	IBM-7094	ALGOL** FORTRAN MAD LISP	TT-35 (54) IBM-1050 (56) TLX (1) TWX PRIME (3) CRT (2)	64K (32K)	DK (36M Wds.) DR (.5M Wds.) MT (12 Units)	30	Project MAC is an MIT research program sponsored by the Advanced Research Projects Agency, D.O.D., under a contract with the Office of Naval Research. *Initially time-shared in 1961 at the MIT Computation Center. **Other languages include FAP, SLIP, COGO, SNOBOL, STRESS, GPSS, COMIT, OPL-1 and OPS-3.

Organization	Status	Type	Computers	Languages	Terminals	Main Storage	Secondary Storage	No. Of Users	Remarks
Project MAC - MIT (Phase Two) Cambridge, Mass.	D (9/66)	G	GE-645*		TT-37**	128K	DK DR (4M Wds.) MT (8 Units)	150	Expected to be capable of limited demonstration in Fall, 1966 and in normal operation by January 1967. *Multiple processor time-sharing system. **In addition will use same terminals as MAC Phase One.
RAND Corporation Santa Monica, Cal.	O (11/65)	G	PDP-6*	JOSS II	TY (30)** TT-35	32K	DK (6M Wds.) DR (1M Wds.)	30	Interpretive system with compact conversational language for small numerical problems. *Replaces the Johnniac JOSS system, operational in 5/63. **Selectric with JOSS keyboard and paging.
Rensselaer Polytechnic Institute Troy, N. Y.	D (8/66)	G	IBM 360 Model 50	FORTRAN	TT-33 (16)	64K	3DK (1.8 M Wds.) MT (4 Units) Core (256 K Wds.)	16	For education, language development and control of laboratory experiments.
TRW Systems Group Redondo Beach, Cal.	O (1/65)	S	Bunker-Ramo 340	Culler-Fried System for Mathematical Analysis	4 Consoles*	16K	DR (48K Wds.) MT	4	Highly flexible system for on-line manipulation, specification and execution of mathematical and symbolic operations with graphical display of results. *Each console consists of two keyboards and a storage tube display. A camera and plotter are shared among the consoles.
Stanford Univ. Stanford, Cal.	O (8/64)	G	IBM-7090 PDP-1	MACRO LISP, BALGOL, FORTRAN	PHILCO (12) TT-33 (8)	32K	DK DR (128K Wds.)	20	PDP-1 has 20 users with a maximum of 4 having access to an IBM 7090
System Development Corp. Santa Monica, Cal.	O (1/64)	G	AN/FSQ-32* PDP-1	TINT IPL-TS JOVIAL LISP	TT-28 (6) TT-33 (22) TY (3) CRT (6)	68K (48K) 16K Buffer	3 DR (136 K Wds.) DK (4M Wds.) MT (16 Units)	30	Oriented to command and control experimentation and other general uses. *To be replaced by an IBM 360 Model 67 in early 1967.
U.C.L.A. Western Data Processing Center Los Angeles, Cal.	O (11/64	S	IBM-7740* IBM-7040/ 7094		IBM-1050 (12)	32K	DK DR	12	Jointly financed by UCLA and IBM, system services UCLA and 88 other California schools. *System currently utilizes five computers in addition to central 7740.
Univ. of Calif. Berkeley, Cal.	O (4/65)	G	SDS-930 PDP-5	FORTRAN ALGOL, LISP SNOBOL, CAL	TT-33, 36 (16) CRT, RAND TABLET	32K (16K)	DR (1.3M Wds.)	16	
Univ. of Calif. Santa Barbara, Cal.	O (3/65)	S	RW 400 AN/FSQ-27	Culler-Fried System for Mathematical Analysis	16 Consoles* RAND TABLET	6K	DR (80K Wds.) DR (500K Wds.)	16	Highly flexible system for on-line manipulation, specification and execution of mathematical and symbolic operations with graphical display of results. *Each console consists of two keyboards and a storage tube display. A camera and plotter are shared among the consoles.
Univ. of Penn. Philadelphia, Penn	D (6/65)	G	IBM-7040 PDP-5	MULTI-LANG, MAP, ALGOL	TT-35 (4) BR (2)	32K (24K)	DK	6	
U.S. Military Academy West Point, N.Y.	O (12/65)	G	3 GE-225 Datanet-30	FORTRAN II	TT-35 (15)	54K (18K)	DK (18M Wds.)	15	Educational time-sharing system

COMMERCIAL TIME-SHARING SYSTEMS

Users can purchase remote, on-line and interactive computer services from the organizations listed below

ORGANIZATION	COMPUTER	CONVERSATIONAL LANGUAGES	TERMINALS	NO. OF* USERS	FIXED FEE/ MO. PER TERMINAL	AVG. COST PER TERMINAL HR.+	ADDITIONAL COST PER HR. FOR CPU TIME	BACK-GROUND
Allen-Babcock Computing, Inc. Los Angeles, Calif.	IBM 360/50[1]	PL/I (on-line engineering subset)	IBM 2741	60	$225[2]	None	$240-$480[3]	Yes
Applied Logic Corp. Tele-Computing Center Princeton, N. J.	DEC PDP-6	FORTRAN IV MACRO-6	TT-33 CRT	20	None	$5.00	$360	Yes
Bolt, Beranek and Newman, Inc. TELCOMP Service Cambridge, Mass.	DEC PDP-1	TELCOMP	TT-33	16	None	$12.50	None	No
CEIR Inc. Arlington, Va.	GE-235 DATANET-30	BASIC	TT-33	30	None	$5.00	None	No
COM-SHARE Inc. Ann Arbor, Mich.	SDS 940	FORTRAN, CAL ALGOL, BASIC LISP, QED, HELP, MACRO	TT-33, 35	32	None	$10.00	None	Yes
General Electric Co.[4] New York, N.Y.	GE-235 DATANET-30	BASIC ALGOL	TT-33, 35 DN-750 DN-760	40	$350[5]	$10.00	$180	No
General Electric Co. Missile and Space Div. Valley Forge, Pa.	GE-235 DATANET-30	FORTRAN MOPSYS COGO	TT-33, 35		None	$20-$30	None	No
KEYDATA Corp. (Charles W. Adams Assoc.) Cambridge, Mass.	UNIVAC 491	KOP-III	TT-28	200	6	6	6	Yes
Munitype Inc.[7] New York, N.Y.	GE-225 DATANET-30	SCTS	TT-28, 33 TT-35	50	$150- $350	None	None	No
International Business Machines[8] QUIKTRAN Service New York, N.Y.	IBM 7044	QUIKTRAN	IBM 1050	40	None	$12.00	None	No
Tymshare Assoc. Palo Alto, Calif.	SDS 940	FORTRAN, CAL ALGOL, BASIC LISP, QED, HELP, MACRO, SNOBOL	TT-33, 35	60	None	$13.00	None	Yes

*In all cases the number of users can be increased by addition of equipment or by duplicating the computer system.

+Calculated on the basis of 50 hours usage per month.

NOTES

1. Special operation codes for efficient conversational interaction added.
2. Includes cost of terminal.
3. Dependent on amount of core used.
4. Additional systems located in Phoenix, Washington, D.C., and Schenectady.
5. Includes 25 hours of terminal time and 2 hours of CPU time.
6. For accounting and management uses. Charges on basis of message transmissions, processor time and storage used.
7. For Bond Pricing and related business operations.
8. Additional system located in Los Angeles.

ADVERTISING INDEX

Following is the index of advertisements. Each item contains: Name and address of the advertiser / page number where the advertisement appears / name of agency if any.

NEW PATENTS

RAYMOND R. SKOLNICK
Reg. Patent Agent
Ford Inst. Co., Div. of Sperry Rand Corp., Long Island City 1, New York

The following is a compilation of patents pertaining to computers and associated equipment from the "Official Gazette of the U. S. Patent Office," dates of issue as indicated. Each entry consists of: patent number / inventor(s) / assignee / invention. Printed copies of patents may be obtained from the U.S. Commissioner of Patents, Washington, D.C. 20231, at a cost of 50 cents each.

August 2, 1966

3,264,487 / Willis R. Smith, Rochester, N.Y. / assignor to General Signal Corporation / Magnetic Logic Circuit.

3,264,490 / Robert A. Gange, Skillman, N.J. / assignor to Radio Corporation of America / Cryoelectric Logic Circuits.

3,264,497 / Hugh E. Riordan, Wyckoff, N.J. / assignor to General Precision, Inc. / Pulse Control Device.

3,264,620 / Andrew H. Bobeck, Chatham, N.J. / assignor to Bell Telephone Laboratories, Inc. / Magnetic Memory Circuit.

3,264,621 / Robert L. Gray, Jr., Birmingham, Mich. / assignor to Burroughs Corporation / Magnetic Data Store.

August 9, 1966

3,266,020 / Adelbert W. Cheney, St. Paul, James C. Nelson, Rosemount, and William Weigler, St. Paul, Minn. / assignors to Sperry Rand Corporation / Computer with Error Recovery.

3,266,022 / Robert C. Minick, Menlo Park, and Edwin S. Lee III, Pasadena, Calif. / assignors to Burroughs Corporation / Computer Addressing System.

3,266,023 / John V. Werme, Painesville, Ohio / assignor to Bailey Meter Company / Parallel Program Data System.

3,266,024 / James R. Kersey and Harold R. Oeters, Poughkeepsie, and Robert M. Tomasulo, Staatsburg, N.Y. and Frederick M. Trapnell, Jr., Winchester, England / assignors to International Business Machines Corporation / Synchronizing Apparatus.

August 16, 1966

3,266,497 / Lewis W. Bleiman, Northridge, Calif. / assignor to Radio Corporation of America / Data Processing.

3,267,295 / Borys Zuk, Somerville, N.J. / assignor to Radio Corporation of America / Logic Circuits.

3,267,407 / John Humphries and Robert B. Pierce, Palo Alto, Calif. / assignors to Hewlett-Packard Company / Programmable Matrix.

3,267,429 / Garry G. Strohmeyer, Hacienda Heights, Calif. / assignor to Honeywell Inc. / Digital to pulse Comparator Apparatus.

After we deliver a computer, we keep delivering.

What we deliver can save you time, headaches, and hard cash. Take off-the-shelf software for instance. Your NCR representative can deliver thoroughly documented and user-proven program packages for business, scientific and engineering applications right now. Software packages ranging from payroll to stepwide regression. From linear programming to bivariate correlation coefficient. (That's a sampling from the catalog of management information tools in the ready-to-run NCR library.)

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We're delivering an advanced operating system with automatic run-to-run control assuring the right file name and date version, and including dating flag options for any program in the system.

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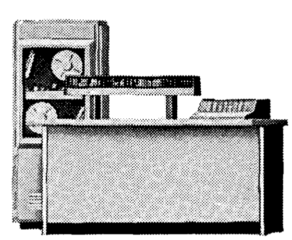

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