computers
and automation

Computers and Medicine

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Letters To The Editor

Computers and Education

Your March, 1969 issue which dealt with "Computers in Education" was interesting and well done. However, I find it incredible that you could devote almost an entire issue to this topic and not include any of the work being directed by public school systems. Our own project in Michigan (INDICOM — Waterford Township School District) and the Philadelphia Project (GROW) have literally tens of thousands of hours of pupil experience with Computer Assisted Instruction. In addition, many hours of curriculum materials have been planned and prepared.

It would seem that there is far too great a tendency to think of the public school environment as it was and not as it is. I do not see any possibility of Computer Assisted Instruction being imposed from the outside. I also believe that the experience base from which to devise the strategy and to make the instructional decisions necessary is most prevalent within public school systems. This is not intended to minimize the value or the necessity of university and other involvement in improving public school curriculum. However, I believe that it will be done much more effectively and efficiently if it is done within a public school setting.

I do not believe the analogy used by one of your authors in comparing the possible growth of CAI with that of automobiles and color television is appropriate. In the case of CAI it will not be the user (student) that promotes it but rather the professional. For this reason it is imperative that classroom teachers be totally involved in the development of Computer Assisted Instruction.

As a personal aside, it often becomes difficult as Director of an operating project to have to reconcile much of what is being written about CAI with reality. One of my co-workers once said, "I wish the people who write about CAI would find out more about it". This does not apply to the authors in the above mentioned issue, but it might well apply to the field generally.

Thank you and keep up the good work.

DR. JOHN PAGEN
Director, INDICOM Project
Waterford Township School District
1325 Crescent Lake Rd.
Pontiac, Mich. 48054

Ed. Note — *Thank you very much for your comments. We would be most interested in having you prepare an arti-*

cle *for us on computers in public school systems. Would you be able to write such an article and submit it to us for possible publication?*

We were very favorably impressed with the article on Computers and Education on page 16 of the March issue of *Computers and Automation.* We would like to make copies of this fine article available to several other members within our organization who have an interest in the use of the computer in educational institutions.

I, therefore, would like to request permission to reprint a limited number of copies of this article. Naturally, if we were granted this permission, we would credit *Computers and Automation* as being the copyrighted source of the article.

Thank you for your consideration.

RONALD S. KURTZER
Industry Marketing — Education
Honeywell EDP
60 Walnut St.
Wellesley Hills, Mass. 02181

Ed. Note — *Permission was granted to reprint a limited number of copies.*

Teaching Machine Language

I read with interest your editorial, "Machine Language, and Learning It", in your February issue.

Because my company is concerned with on-line process control, I would be most interested in further information regarding the book you mentioned in your editorial, *The Elements of Digital Computer Programming.* Could you please tell me the name and address and price of this book?

We feel that a lack of good instructional material for programming in Australia will result in a number of inquiries about the book in this country, especially since the material concentrates on machine language which is of particular use in I/O process routines.

We find your magazine most informative and interesting, and look forward to future issues.

PETER M. SIGAL
Applications Engineer
Hawker De Havilland Australia Pty. Ltd.
P.O. Box 78
Lidcombe, N.S.W., Australia 2141

Ed. Note — *The book* The Elements of Digital Computer Programming *was written by Edwin D. Reilly, Jr., and Francis D. Federighi, and is published*

computers
and automation

Special Feature:

Computers and Medicine

Regular Features

Editorial

C&A Worldwide

Jobs and Careers in Data Processing

Ideas: Spotlight

Multi-Access Forum

The front cover picture shows a computer-produced profile of an emotionally disturbed patient at the Institute of Living, a psychiatric hospital in Hartford, Connecticut. The computerized information system used by the hospital is described on page 46 in this issue.

NOTICE

*D ON YOUR ADDRESS IMPRINT MEANS THAT YOUR SUBSCRIPTION INCLUDES THE COMPUTER DIRECTORY. *N MEANS THAT YOUR PRESENT SUBSCRIPTION DOES NOT INCLUDE THE COMPUTER DIRECTORY. SEE PAGE 59.

Departments

C.a EDITORIAL

Computers and Medicine

This is the first issue of *Computers and Automation* which has a special concentration on the field of "Computers and Medicine". This field of application for computers will doubtless become one of the most important. The 1968 Computer Directory of *Computers and Automation* reported about 135 applications of computers in medicine and in hospitals. This figure is likely to rise steadily from year to year. Yet as short a time as ten years ago, few computer people would have expected this development.

Why has the change happened? There are several reasons:

- *Medical Knowledge.* A very large quantity of medical knowledge now exists, and much of it is very new. It is difficult to apply large quantities of knowledge through the small memories of human beings. So this condition calls for application of computers to retrieve information.

In this issue, Dr. James Boyle in his article on "Automated Diagnosis" points out some of the problems of setting up an information retrieval system in the specific area of medical diagnosis. A lack of knowledge about the "art" of diagnosis; the inconsistency in the observations of two doctors viewing the same patient under the same circumstances; the opposition of patients to "robot" diagnosis; and the unclearness and at times inaccuracy of a doctor's notes about his patients, particularly when they are read by another person, — are some of the barriers that need to be overcome to develop practical, useful, information retrieval systems in this area. But these problems are not considered to be insuperable. As Dr. Boyle comments: "The day may not be far off when the diagnostic computer with its wide range of diagnostic programs is merely another familiar machine in the doctor's office or outpatient clinic."

- *Speed.* The time to apply medical knowledge is short. When a human being is suffering from an illness, the illness will often not wait beyond a few days, sometimes a few hours, sometimes a few minutes, for the appropriate action. This condition calls for the application of computers in real time.

It was this call that inspired the automation of the Milwaukee Blood Bank described in Robert T. Stelloh's article, "An Automated Blood Bank System for the Milwaukee Blood Center". This application illustrates the significant role computers can play in preserving human life, in this case, because of the increase in speed with which the right kind of blood can get to the right patient at the right time.

- *Greater Efficiency from · Larger Systems.* Joining clever and trained human beings — doctors, nurses, hospital administrators, etc. — with computers into good systems can lead to far greater efficiency in the care of patients and a substantial saving in the cost of hospital administration.

These larger systems are more complicated, harder to operate well, and they call for a wide range of applications of computers. But success is being achieved in their development, as shown by the system described by Dr. Herbert Haessler in his contribution to this issue, "Recent Developments in Automating Medical History". Here medical histories of patients are obtained through the patient's use of a computer terminal. The results have been very satisfactory, and patient response has been very favorable.

- *Fruitful Careers.* In the field of computers and medicine, there is an excellent chance to apply computers in novel ways to achieve novel and important results in the field of increasing health and saving life.

Here is a good new field not only for computer people, but for medical people as well, to explore, experiment, innovate, and create, in building their own careers and reputation with successes. Howard Runck's article, "Computer Planning for Hospitals" reports on the enthusiasm of nursing personnel participating in the planning of a hospital computer system in Los Angeles County, and indicates the exciting possibilities in this area.

- *Social Importance.* Of all the fields of application of computers, surely here is one with a very large degree of social implications, social value, and social importance.

Recently a computer professional (a friend of mine) resigned from a large electronics firm in the Boston area with much military business, in order to go to work in the medical field in Michigan, where he could devote his knowledge of computers to medical applications — to advancing life instead of shortening it.

Here is "voting with the feet" to apply computers to socially useful ends.

Of course, humanity is faced with a population explosion. But how much better, more humane, and less wasteful it is to use methods of birth control and birth avoidance to adjust the number of human beings to the resources of the Earth for supporting them — instead of applying famine, disease, and war. How much better it is to use computers and medicine so that human life which has been born can be preserved and made healthy.

The staff of *Computers and Automation* is pleased to be able to focus this issue on "Computers and Medicine".

Edmund C. Berkeley
Editor

by Holden Day Inc., 500 Sansome St., San Francisco, Calif. The address of the MOHAC Users' Group address (discussed in the editorial) is MUG, Box 2675, Schenectady, N.Y. 12309.

Social Responsibility

Although my original intention was to insure that I receive no more than one issue of your magazine per month, I would now request that you cancel and forward a refund in full.

This action has been prompted by C&A's continued emphasis upon what Mr. Berkeley considers to be the "Social Responsibilities of Computer People". I and all other computer professionals with whom I am acquainted are perfectly capable of recognizing my social responsibilities. Fortunately, I subscribe to far better publications than C&A to assist me in recognizing and evaluating these responsibilities, since I consider C&A's editorial policy for the most part to be heavily weighted to the left of center. From now on, I intend to turn to other publications for my technical reading.

RONALD B. AYRES
New Floyd Rd.
Mounted Route
Rome, N.Y. 13440

Ed. Note — *A refund in full is being sent as you request.*

Computer Training

The article by Swen Larsen, "Computer Training in Private Schools", in your March, 1968 issue has been utilized by our school as part of our philosophy. The copy we have has become somewhat moth-eaten over the months. I wonder if we could obtain another copy of this article.

Your publication is a welcome addition each month, and is read by several people here at the institute. Keep up the good work!

SCOTT FERRIS
Director of Faculty
Computer Programming Institute
of Delaware-Kansas City, Inc.
4949 Johnson Drive
Shawnee Mission, Kansas 66205

Ed. Note — *Thank you for your kind letter. We are pleased to send you an additional copy of Mr. Larsen's article.*

Definition of Terms

In their article describing NCAR's case study of time-sharing vs. instant batch processing (March, 1969), Adams and Cohen say that they "tried to avoid the so-called 'Hawthorne Effect', where

people who are being studied change their behavior as a result of being studied".

In various studies of problems related to Computer Assisted Instruction I have encountered reference to this "Hawthorne Effect" without sufficient explanation. Isn't the effect to which Adams and Cohen refer more aptly related to Heisenberg's uncertainty principle? If so, what is the Hawthorne effect? I have been led to believe that it is used to describe situations where students using CAI exhibit initial improvement which then wanes as the novelty of CAI wears off (also called the "novelty effect").

Can you give me a more precise explanation of the differences between these three terms as related to CAI: The Hawthorne effect, Heisenberg's uncertainty principle, and the novelty effect?

Thank you.

NATHAN RELLES
Univac Educ. Systems Programming
P.O. Box 3525
St. Paul, Minn. 55101

Ed. Note — *The Hawthorne effect refers to a study conducted at the Hawthorne plant of Western Electric Co. in the 1930's. This study showed that personal factors (in this case personal attention given to the group of production workers) had as much effect on quantity of production as any other factor, such as lighting, comfortable work spaces, etc. The results were reported in a classic book* Management and the Worker *by F. J. Roethlisberger and W. J. Dickson, Harvard University Press, 1939.*

Heisenberg's uncertainty principle, also called Heisenberg's indeterminacy principle, belongs to quantum physics. It is the postulate of quantum mechanics that asserts that "in the simultaneous determination of the values of two canonically conjugated variables (such as the velocity and position of an electron), the product of the smallest possible uncertainties in their value is of the order of Planck's constant h" (which is a unit of action). To understand such a statement as this it is necessary to know quantum physics, and since I do not know that subject, all I can do is quote you the definition of the principle and suggest that you look up the subject.

I am sorry I do not have a definition of the "novelty effect". Maybe you can find a definition of it in the papers and articles which use the term, or from the authors who wrote them.

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You have to be a little careful when you tell our new film recorder, FR-80, what to do. Because there are so many things it might do.

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NEW PATENTS

Raymond R. Skolnick
Patent Manager
Ford Instrument Co.
Div. of Sperry Rand Corp.
Long Island City, N.Y. 11101

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.

February 18, 1969

3,428,951 / Edward Lindell, Woodland Hills, Calif. / Ampex Corporation, Culver City, Calif., a corporation of California / Memory addressing apparatus.

3,428,954 / Charles Antoine Marius David, Charenton, France / Societe Industrielle Bull-General Electric (Societe Anonyme), Paris, France / Element for resistive permanent memory.

3,428,955 / Shintaro Oshima, Musashino-shi, and Tetsusaburo Kamibayashi, Kitaadachi-gun, Saitama-ken, Japan / Kokusai Denshin Denwa Kabushiki Kaisha (also known as Kokusai Denshin Denwa Co., Ltd.) Chiyodaku, Tokyo-to, Japan, a joint-stock company of Japan / Woven wire memory matrix.

3,428,956 / Andrew H. Bobeck, Chatham, N. J. / Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York / Rotational mode memory circuit having flux closure paths.

3,428,957 / David Rodney Hadden, Jr., Cold Spring Harbor, N. Y. / The United States of America as represented by the Secretary of the Army / Data storage device using sonic wave propagation.

3,428,958 / Harry Putterman, Elizabeth, N. J. / General Precision Systems Inc., a corporation of Delaware / Non-destructive read-out memory and constant current driver.

February 25, 1969

3,430,213 / Kenneth R. Shoulders, Woodside, Calif. / Stanford Research Institute, Menlo Park, Calif., a corporation of California / Data storage and logic device.

CLASSIFIED

ADVERTISEMENTS

AS WE GO TO PRESS

MORE THAN 40,000 VISITORS JAMMED
THE EXHIBIT AREA AT THE SPRING
JOINT COMPUTER CONFERENCE in Bos-
ton May 14-16. Only 20,000 were
expected. This, combined with a
lack of hotel space, exhibit
space, and parking space, will
probably insure that SJCC will
not be held in Boston again — at
least not until improved facili-
ties are available.

Only 4500 of the required 8000
hotel rooms were available, and
some of those were so far away
that Conference attendees became
Boston commuters. This, in turn,
created traffic and parking prob-
lems. Exhibit space available
was reportedly about half that
needed; 127 companies that wanted
exhibit space were turned down,
and the amount of space assigned
to exhibitors left many dissatis-
fied. Workmen, carpenters, and
decorators were also in short sup-
ply. Even the lease caused prob-
lems. The computer convention was
scheduled to begin moving in five
hours before a prior show ended.

THE MERGER OF XEROX CORP. AND SCI-
ENTIFIC DATA SYSTEMS WAS APPROVED
on May 15 by stockholders of both
firms. SDS will function as a
largely independent, wholly-owned
subsidiary of Xerox. Max Palevsky,
SDS president and chief executive
officer, will become a member of
the Xerox board and chairman of
its executive committee. Arthur
Rock, SDS chairman; Dan L. McGurk,
executive vice president; and San-
ford Kaplan, senior vice president
of administration, will also be on
the Xerox board.

Xerox stockholders also approved
a 3-for-1 stock split made possi-
ble by an increase in authorized
common shares from 30,000,000 to
90,000,000 with no change in par
value. The merger agreement pro-
vides that SDS stockholders re-
ceive one share of the old Xerox
stock for every two shares of SDS.
With the stock split, SDS share-
holders get three Xerox for every
two SDS shares.

At the same time that the mer-
ger was announced, Computer Access,
a division of Computer Sharing Inc.
(which is a subsidiary of Scienti-
fic Resources Corp.) announced that
it has leased the SDS 940 computer
equipment operated by Scientific
Data Systems in El Segundo, Calif.
The take-over was to "take place
immediately". Computer Access,
with headquarters at Bala-Cynwyd,

Pennsylvania, is planning to oper-
ate at the SDS facility until they
acquire a permanent location of
their own.

THE HOUSE GOVERNMENT OPERATIONS
COMMITTEE HAS APPROVED A BILL TO
ALLOW THE DEVELOPMENT OF A COMPUTER
SYSTEM FOR CONGRESS. The bill,
H.R. 10791, was sponsored by Rep.
Jack Brooks, D-Tex. "The executive
branch can no longer prepare the
budget submitted to Congress each
year without the use of computers,"
Brooks said. "The complexity of
the budget and the vital importance
of Congress' maintaining control
over federal expenditures make the
use of computers by the Congress
an absolute necessity."

Under the bill, the Comptroller
General and Director of the Budget
Bureau would develop a computer
system to support the budget and
appropriations cycle for use in
the Federal Government.

A PETITION REQUESTING THE CIVIL
AERONAUTICS BOARD TO DISAPPROVE
AN AGREEMENT FOR A "COMMON AUTO-
MATED RESERVATION SYSTEM" for air-
lines and travel agents has been
filed by Telemax Corp. of Fairfield,
N.J. The proposed agreement is be-
tween the Air Traffic Conference of
America, an association of sched-
uled domestic air carriers and Atar
Computer Systems, Inc., a new com-
pany whose reservation system is
reportedly not yet operational.

Telemax alleges that the agree-
ment between the two companies
would grant Atar an absolute mon-
oply on automated domestic reser-
vation services for travel agents
and commercial firms. The petition
further alleges that the agreement
would sanction a concerted boycott
by the airlines against Telemax and
any other Atar competitor that pro-
vides services and equipment simi-
lar to those provided by Atar.
Telemax was the first company to
develop a fully computerized instan-
taneous reservation system for the
travel industry. Its system cur-
rently has over 1000 subscribers in
all 50 states.

The petition requests that the
Board disapprove the agreement be-
tween the Air Traffic Conference and
Atar or, in the alternative, order
a formal hearing in which Telemax
be given the opportunity to present
evidence and cross-examine witnesses.

c.a

MULTI-ACCESS FORUM

THE RELEVANCE OF COMPUTER "THINKING" — DISCUSSION

I. To the Editor from Dr. B. L. Schwartz
The Mitre Corp.
Westgate Research Park
McLean, Va. 22101

Continuing the discussion of the question of computer "thinking", treated (again!) in the Multi-Access Forum for March, I feel obliged to observe that the three questions you raise in your rebuttal to Mr. Shaw and Mr. Blessing are excellent; but your three answers are inadequate.

1. What is thinking?

You observe that the usual meaning derives from the pre-computer period, when it clearly and unambiguously referred to an animate activity. Thus, before the computer age, thinking was something that could be done only by a living being. Yet just three sentences later, you declare that "it is not scientifically honest to change this definition". But you then immediately *do* proceed to change it by a purely arbitrary extension of the term to try to make it apply to something it did not previously apply to. Regardless of whether the reader agrees with or disagrees with your answer, he cannot be persuaded by such an argument.

2. Does a computer think?

You treat this point by setting up a straw man: programmed computer ("thinking") vs. nonprogrammed computer ("nonthinking", and by your own admission, nonexistent!). But the question is not whether the computer is programmed or not, but whether the program is the product of "thinking". What people mean when they use the word "computer" in question 2 is not: "programmed computer", but rather "programmable computer", a hardware entity. Thus again, your argument misses the point of the question.

The comparison with programmed humans is entirely spurious. Humans are indeed conditioned (although I would hardly call it "programmed") by their years of interactions with the outside world. But this conditioning does not lead to each situation having a single well-defined (if unanticipated) response, as it does with a programmed computer. It is precisely because humans are not fully predictable, because when they do have choices they can think out which they prefer in any situation, that they differ from machines.

3. Is it worthwhile to decide whether computers think or do not think?

What is or is not worthwhile is a matter of individual judgement. I fully acknowledge your right to weigh the factors, reach your own conclusion, and present arguments in its favor for others to consider. Having read your conclusion and its supporting argument, I remain unconvinced. On the contrary, I feel it is important to terminate the nonproductive effort spent in arguing such unanswerable questions, so that the energy can be directed into more fruitful channels. If you feel that such arguments have been fruitful, I would be happy to learn of any specific examples of their fruits.

II. To the Editor from Sam Bisignano
1115-H University Village
Michigan State Univ.
East Lansing, Mich. 48823

In the March 1969 issue of *Computers and Automation* you cunningly answered the three questions:

1) What is thinking?
2) Does a computer think?
3) Is it worthwhile to decide whether computers think or do not think?

I sincerely believe that the manner in which you interpret "think" is a suitable restriction of the word, cleverly done, to allow the performances of a computer to fall into this category. I agree with you that computers, just as human beings and many animals, "can take in problems, mentally work out sensible solutions, and apply these solutions in situations", but is this all there is to thinking? If so, then for any brilliant human mind, one could find a computer capable of superseding the thoughts and decisions this human might have. However, is there a computer capable of composing music, for example, more beautiful than Beethoven's Ninth Symphony? Not yet; I know!

I do appreciate the achievements of computers today and in the future, but we should not conceive of a computer as possessing a superhuman mind. If we do, and if it be true and we allow this superhuman mind to succeed our mind's creativity, then possibly some day an IBM or an SDS computer will be editor of *Computers and Automation* (a tentative title), and will publish an article such as: "Is it worthwhile to decide whether humans think or do not think?", in the "eyes" of a computer.

III. From a Pastoral Letter from
The Rt. Rev. Robert L. DeWitt
Bishop, Diocese of Pennsylvania
202 West Rittenhouse Square
Philadelphia, Pa. 19103

As yet not widely known or understood is the fact of cybernation — the control of systems involving the interaction of automation machines and computers. Highly sophisticated production and processing systems are now being designed which can outperform the most exceptional human capacity. They can perform the most complicated tasks faster and more precisely than can humans; and they do not receive wages, vacations or fringe benefits, nor do they tire or retire. They can detect their own errors and those of others, make judgments, remember, search their memories for programmed data and for the new implications of data acquired. The potentialities of cybernation systems are virtually unlimited and their application is not limited simply to mechanical tasks but reaches up into the level of at least middle management.

What this adds up to is simply that the time is near at hand when machines will do as creditable a job of original thinking as do most middle level people holding responsible positions today. Work, as we have traditionally known and understood it, may exist only for an elite minority of highly trained and highly specialized people. For the majority of us, there will be no work as work. Obviously our attitudes towards work, leisure, play and social responsibility must change radically between now and the time soon coming.

IV. From Henry Jean, Vice Pres. and Gen'l Mgr.
Christopher Douglas Associates
801 Second Ave.
New York, N.Y. 10017

In regard to your discussion on computer thinking, we would like to report on a system we have developed. This system of programs can make the computer associate ideas.

The system brings about the association of concepts regardless of the actual words the operator uses.

The person using the system doesn't have to know anything about computers or programming to operate this system; all he must be able to do is read and write English.

The user simply types out his question, and the computer answers. If the question is too inexact, or too improperly phrased, the computer will tell the user he is a little off the mark.

A thesaurus of acceptable terminology will, however, give the user exactly the right words if he wants to use the thesaurus. It can be either a separate printed document, or the user can ask the computer to show him the right sections of the thesaurus.

If the user elects not to use the thesaurus, the computer will continue to respond until the subject is narrowed sufficiently. Then the desired kind of answer will come out automatically.

We expect the system to be especially useful to those who need frequent access to the computer but who do not like being forced to read many feet of printout paper to locate the answers they want.

If, for example, we apply this system to a large personnel operation, the expense of the system can be credited against the cost of the time the personnel executive now spends sweating out his latest statements, analyses, and search skills. Also, the system will save two to three times the cost of specialized programming and gives him the reports and programs he needs within hours or days instead of weeks.

The manager or technician, whoever uses the system, is free to do very nearly as he likes regardless of his computer programmers and operators.

The system can be used to automate with one computer, in a time-sharing mode, all the normal business operations that ordinarily require separate computers or specialized programming.

This system translates into logical or mathematical form the concepts that the user types into the machine in English. The relative values expressed by the mathematical statements form the limits within which the computer relates or matches the data sought.

We have applied well-developed military command-and-control computer methods to business and commercial problems in developing the system.

We also took advantage of multi-dimensional concepts to help the computer locate different groups of data that are analogous though not necessarily identical.

The user can get anything out of the system he wants, provided it's in there to begin with.

This system will tell you everything it knows or as little as you like, right down to a one-figure or two-figure answer.

We would like to invite your readers to investigate the extent to which this system in their opinion really demonstrates functions ordinarily considered to be thinking functions.

V. From the Editor

In reply to Mr. Bisignano, personally I look forward to the day when a computer will be editor of *Computers and Automation,* and will produce much better editorials and discussion than the present editor is capable of. I do believe, however, that such a day is distant, probably on the order of 20 to 40 years away.

In reply to Dr. Schwartz, of course, as soon as thinking is defined as an activity which can only be done by living beings, then by logic a computer does not think, since (1) a computer is a machine and (2) a machine is not living. But the day may come when living machines are made either by human beings or by other living machines. Until then, however, the argument is settled by the definition.

In order to make thinking done by machines to be not fully predictable, all that is needed is to include in a computer a source of random events or numbers, such as a cosmic ray counter. Then the "thinking" done by a computer is no longer predictable.

Of course there are large areas of thinking done by human beings in which so far computers have not been programmed to perform successfully. Examples include: driving a school bus; understanding spoken language; composing a "good" symphony; interviewing people about a news event and writing a report on it; etc. For a number of years such areas of thinking will remain the province of human beings. One of the big barriers, for example, that I see to programming such work on a computer is: enabling a machine to "observe" an environment and interpret what it perceives in that environment as objects or events that can be named as language names them. I am not even sure how to program a computer to recognize a red traffic light at any of a thousand street intersections — something which most human beings who drive a car can do "without thinking", i.e., without using more than a small part of their minds. □

THE SPECIAL INTEREST COMMITTEE ON SOCIAL IMPLICATIONS OF COMPUTERS OF THE ASSOCIATION FOR COMPUTING MACHINERY — DISCUSSION, PART 2

I. A letter to Robert M. Shapiro from
Bernard A. Galler, Pres.
Association for Computing Machinery
211 East 43 St.
New York, N.Y.

In response to your letter of March 3, 1969 published in Multi-Access Forum in the April issue of *Computers and Automation,* it came as a complete surprise to Jean Sammet (the chairman of our Committee on Special Interest Committees and Groups) and the Headquarters staff, as well as myself, to hear that you are the secretary of SICSIC with a mailing list of 100 names. Jean had no knowledge of this, nor could your statement be confirmed from the files in her possession. Unfortunately, SICSIC has never seen fit to comply with the provision of ACM Bylaw 7 which requires every SIG and SIC to file a roster of members at Headquarters yearly, and to submit a report to the Council yearly. Thus

there is no official record of any of the activities of SICSIC, and we cannot be expected to ferret out a secretary, mailing list, and round table discussions. Because this Special Interest Committee was dissolved, I must ask you not to issue statements in the name of either ACM, or ACM SICSIC.

I am delighted to find out that there is activity under way in New York, but I wonder whether you are perhaps confusing local chapter activity with a national SIC. We are investigating the status of this.

With regard to your formal request that SIC[2] be reinstated immediately, my answer must unfortunately be negative. Each SIC commits ACM to spending a fair amount of money, and we do not currently have evidence that this is a viable committee, let alone a thriving one. However, Mr. Robert Bigelow is attempting to start from scratch to comply with our requirements for a new Special Interest Committee, and you should certainly contact him at 39 Grove Street, Winchester, Massachusetts 01890. You may also be unaware that there is an AFIPS committee in this area, and we are represented on it by Dr. Anatol Holt.

I have been delighted to see the number of people who are concerned about this subject, because I think there should be a great deal of involvement in this area. What we wish to do now is make sure that if a new Special Interest Committee is formed, it will be strong enough to become a permanent financially self-supporting Special Interest Group within a year, as is our policy.

II. From Jean E. Sammet, Chairman
ACM Committee on Special Interest Committees
  and Groups
IBM Corp.
545 Technology Square
Cambridge, Mass. 02139

In the "Multi-Access Forum" in your April, 1969, issue you published a letter to ACM President B. A. Galler from Mr. Robert Shapiro who stated that he was the Secretary of SICSIC. An answer from Professor Galler was sent to Mr. Shapiro essentially indicating that the claim was a surprise to Professor Galler, the Headquarters staff, and myself, and could not be confirmed by any files in my possession. Further details and comments are included in the letter from Professor Galler [published below].

Your statement that "It seems . . . unlikely that the President of the Association for Computing Machinery by his sole action has the power under the Constitution to dissolve a Special Interest Committee." would be correct if we were dealing with a Special Interest *Group,* but is not correct as applied to a Special Interest *Committee.* The fundamental difference between a SIC and a SIG is that the former is a temporary organization formed to ascertain whether there is enough interest and activity to sustain a permanent organization (namely a SIG). Action was taken because of the provision in ACM Bylaw 7, Section 6, which states that "A special interest committee shall be established for a period of one year. The Council may, at its discretion, continue a committee for an additional period of time if circumstances warrant. A special interest group shall exist until eliminated by Council action." Please note carefully the difference in treatment between Special Interest *Committees* and Special Interest *Groups.* Professor Galler announced at the December 1968 Council meeting that he had taken the action of dissolving SICSIC and nobody protested this or raised any questions about it. According to the Bylaw, it was in some legalistic sense already dead, and the action was not "null and void". However, you and your readers might appreciate a little more background on how this came about.

When I was appointed Chairman of the ACM Committee on Special Interest Committees and Groups, one of the first things I did was to determine which Special Interest Committees had been in existence for more than one year. I then contacted each chairman (including the chairman of SICSIC) requesting that he inform me of any special reasons that his SIC should not comply with the provision that it convert to a SIG or else dissolve. In all cases except SICSIC, there was indication of interest and activity from the chairman and/or the members, and I therefore requested the Council to approve (and they did) their continuance as Special Interest Committees until specified dates. However, no answer was received from the SICSIC chairman, and no mailing list (indicating current members) was available. No ACM members had requested information from, nor expressed complaint about, the inactivity of SICSIC. I felt, under the circumstances, that I had no choice but to recommend dissolution, and this recommendation was supported by several other responsible officials. The recommendation was reluctantly accepted by Professor Galler.

I must regretfully disagree strongly with your statement (on page 14) that "There is no doubt at all that it is a vigorous and functioning Special Interest Committee". If it had been, then it never would have been dissolved. It is essential to understand that Special Interest Committees and Groups are formed by the wish of the members of the society, and not by direct action of the leaders. When the chairman is non-responsive to correspondence, no activities are undertaken, and no members can even be identified, this is not a committee of any kind, let alone a group of people who voluntarily banded together to fulfill some mutual interests and goals. In essence, we removed some words from some pieces of paper.   □

"THE MISDIRECTION OF DEFENSE — AND THE SOCIAL RESPONSIBILITIES OF COMPUTER PEOPLE" — COMMENTS

Mrs. Phyllis Hyde
Box 4068
Santa Barbara, Calif. 93103

I like a number of things about your April, 1969 editorial ("The Misdirection of Defense — and the Social Responsibilities of Computer People") :

(1) The title, which sees social responsibility as belonging to *people* — one at a time; not the "industry" or some other magic personification of an "it" which exists only in the head of *a* (primitive-overlaid-intellectual) *person;*

(2) The clear-sighted diagnosis of technology-gone-wrong as illustrated by the acquisitive determination of ABM policy;

(3) The fact that 80% of computer application is civilian, not military. But does this mean really not military-serving? Or might this look entirely different were military-supportive civilian applications subtracted from that figure?

I read eagerly through your suggestions for how "Computer people . . . should now seek to fulfill their social responsibilities". What you outlined is not to be gainsaid. But the

frankness of your article about the money facts of life for the military-industrial complex in a demilitarized economy seemed noticeably to shy at the logical carry-through of *people* responsibility: some one person has to opt for *his own* larger self-interest vs. *his own* narrower dollar-interest, like refusing to serve the military-industrial complex dollar-

proliferation at the cost of humane value-proliferation. That might mean a hunk of *people* paychecks — not just the computer industry — which is precisely the way the Defense Department is going to get "reoriented". People will do it, one at a time, if it gets done at all; and it will be *people,* one at a time, who "make less money". □

THE GROWING SEMANTICS PROBLEM

Grace J. Kelleher
IDA-SED
400 Army Navy Drive
Arlington, Va. 22202

As a member of the Long Range Planning Committee of the Operations Research Society of America (ORSA), I have undertaken the task of investigating various facets of the increasing interchange between the terms "operations research" and "systems analysis". I am sure you have noted how these terms are more or less used interchangeably by many people today. The semantics become even more complicated when we consider that the terms "cost-effectiveness" and "cost-benefit analysis" also are being used interchangeably with "operations research" (OR). And the problem is further complicated by the fact that many employers and professional recruiters have shortened the term "computer systems analyst" to "systems analyst", thereby precluding the general use of an occupational term which was intended to apply (or could apply) to the analysis of any type of system (space systems, logistic systems, physiological systems, etc.).

This semantics problem is more apparent to some than to others, and also disturbs some more than others. However, the long-term problem, as I see it, is that communication between prospective employer and prospective employee is becoming more and more complicated because of the subjectivity with which each may choose *the* term that best describes his needs on the one hand, or his capabilities on the other.

This topic will be discussed at the Session of our Committee at the ORSA National Meeting June 17-20 in Denver, Colorado. To aid in your consideration of this semantics problem, a list of selected excerpts from current literature is shown below. Viewed collectively, I think they provide a fair reflection of the semantics confusion that exists and tends to be growing.

The Semantic Jungle of Operations Research, Systems Analysis, et al. (as reflected in a series of excerpts drawn from current literature)

Although certain *mathematical* techniques have become associated with and identified with *operations research,* these techniques do not constitute OR. Rather OR is the *application* of scientific methods, techniques and tools to problems involving the operation of *systems* so as to provide those in control with optimum solutions to problems.

OR is problem oriented rather than technique oriented; the scientific methods are a means to an end and not an end in themselves.

Operations research: a scientific methodology for examining, defining, analyzing and solving complex problems.

Systems analysis is a body of techniques and theories for analyzing complex problems.

The comprehensiveness of OR's aim is an example of a *"systems"* approach, since system implies an interconnected complex of functionally related components.

The term *management science* refers to applications of the operations research approach in the general area of management.

The establishment of the position of Assistant Secretary of Defense for Systems Analysis confirmed the role of *systems analysis* in DoD and marked the "coming of age" of military *cost-benefit analysis.*

Essentially, *cost-benefit anlysis* is *operations analysis* at one higher level of optimization, with the various physical inputs to the operation being variables rather than givens.

The methodology of *operations analysis* as developed during World War II concentrated on the best use of currently available equipment without regard to cost or worth. Consequently, operations analysis at its inception stopped just short of *applied economics.* □

WILL THE PLIGHT OF MOE THE ELK BE THE PLIGHT OF THE AMERICAN CITIZEN?

Congressman Cornelius E. Gallagher
Chairman, Special Subcommittee on Invasion of Privacy
U.S. House of Representatives
Washington, D.C.

An elk named Moe, which resides in Yellowstone National Park, was recently electronically connected to a recently launched U.S. Satellite, Nimbus 3. The comings and goings of Moe are carefully and accurately recorded by the spy satellite. The animal's graceful movements are now just a jagged curve on a graph; his investigation of the beautiful plains is but another statistic.

No matter how fleet footed his flight from the night, Moe can never outrun the super sleuth which hovers over head and antlers. In other words, Moe may be nimble, but he cannot beat Nimbus.

Unfortunately, it is not absurd to draw a comparison between the plight of Moe the elk and the growing plight of John Doe, the American citizen. Everywhere our technology is producing new means of invading, indeed destroying, individual privacy in America. The very notion that a satellite flying thousands of miles from the earth can record even

the most insignificant movements of an elk in Yellowstone National Park demonstrates how awesome this technology has become.

Indeed, with snooping devices on the rampage, the Creator may soon not be alone in observing the fall of a sparrow. Unless we Americans fully comprehend that the destruction of privacy means the undoing of all our basic rights, then we may witness a slow and subtle repeal of our National Constitution.

The example of Moe provides an eery lesson for us human beings. Who can say that the bugging of Moe is not a mere prelude to the bugging of men? Who can say that the insatiable thirst for statistics may not someday be quenched by the creation of a total surveillance society in which the movements of man, like the movements of poor Moe the elk, are open to general scrutiny.

Yellowstone National Park has become an open book to the Nimbus satellite that records the every movement of one of its inhabitants. Obviously, it is time to take steps to insure that our homes are not similarly violated by some inquiring snooper who, while perhaps acting with the best of intentions, has lost sight of humanity. □

C·a

NUMBLES

Number Puzzles for Nimble Minds
— and Computers

Neil Macdonald
Assistant Editor

A "numble" is an arithmetical problem in which: digits have been replaced by capital letters; and there are two messages, one which can be read right away and a second one in the digit cipher. The problem is to solve for the digits.

Each capital letter in the arithmetical problem stands for just one digit 0 to 9. A digit may be represented by more than one letter. The second message, which is expressed in numerical digits, is to be translated (using the same key) into letters so that it may be read; but the spelling uses puns or is otherwise irregular, to discourage cryptanalytic methods of deciphering.

We invite our readers to send us solutions, together with human programs or computer programs which will produce the solutions.

We have a computer program for the Digital Equipment Corporation PDP-9 computer which will solve addition Numbles such as Numble 695. The program was created by Stewart B. Nelson, Software Editor of *Computers and Automation*. A copy of the punched paper tapes for the symbolic program and the working binary program, and a copy of the operating instructions will be sent to any reader on request for the nominal price of $8.00. Please enclose this amount with your order, and send it to:

Computers and Automation
Numbles, Att'n Neil Macdonald
815 Washington St.
Newtonville, Mass. 02160

NUMBLE 696

```
        W A L L S

      x   H E A R

      U N T N W H

      R N I E L U

      R N I A H U        H E = L A

      E S A S N N

    = L I H N U R L I H


   90645   16932   8087
```

Solution to Numble 695

In Numble 695 in our May issue, the digits 0 through 9 are represented by letters as follows:

N = 0	H,W = 5
T = 1	I = 6
S = 2	K,L = 7
O = 3	A = 8
P,R = 4	E = 9

The full message is: When sorrow is asleep, awake it not.

Our thanks to the following individuals for submitting their solutions to Numble 694: A. Sanford Brown, Dallas, Tex.; T. P. Finn, Indianapolis, Ind.; Ross F. Garbig, Toronto, Ontario, Canada; Ron Geist, Allentown, Pa.; Joe King, Anchorage, Alaska; George Seminara, New Carrollton, Md.; and Elizabeth C. Wolfe, Baltimore, Md. 21203. ☐

FORMATION OF NEW HEALTH RECORD ASSOCIATION TO BE DISCUSSED AT JUNE MEETING

Fred Moncrieff
Ad Hoc Committee
P.O. Box 432
Ann Arbor, Mich. 48108

Formation of a new health record association will be discussed at a meeting in Ann Arbor, Michigan, June 23-24. Some 100 persons from throughout the United States are expected to attend.

The purpose of the new association would be to fill the needs for a multi-disciplinary forum for all persons concerned with medical data systems and to increase the number of personnel in the medical and health record field.

The spread of computerization, telecommunication, comprehensive planning, integrated health care, regional medical programs, health data banks, and other modern developments demonstrate the need for such a broad-based forum.

In addition to medical record librarians, many other persons today are making major contributions to the field and, through their efforts in research and development, are shaping the future of health record practice. Among these are physicians, biostatisticians, systems analysts, and computer experts concerned with the recording, storage and retrieval of health data.

It is anticipated that the new health record association would supplement rather than duplicate the functions and goals of existing groups.

All persons interested in the meeting and/or the association are invited to write to the address above. ☐

AN AUTOMATED BLOOD BANK SYSTEM FOR THE MILWAUKEE BLOOD CENTER

Robert T. Stelloh, Program Manager
International Computing
3235 Kifer Rd.
Santa Clara, Calif. 95051

Mr. Stelloh received his education at the Univ. of Missouri School of Mines, Rolla, Missouri, graduating with an M.S. in Mining Engineering in 1961. He has worked for Lockheed Missiles and Space Co. as a systems programmer, with particular interests in machine-independent programming and medical data processing; and as a medical systems consultant. He is currently a senior partner of ICC and manager of their office in Santa Clara, California, with specific responsibility for the ABIIS, and for a medical business system under development by ICC.

In his letter submitting this article, Mr. Stelloh said: "Please excuse the very rough draft state of the manuscript. As senior author, I had the responsibility for completion of the article, including preparation of the final manuscript. Unfortunately (from many aspects), I became aware that I had tuberculosis ten days ago, and was immediately and unexpectedly incarcerated in an isolation ward of the county hospital. This had the initial effect of distracting me from the article, and the final effect of forcing an inexpert typist (me) to type it on a very tired typewriter. I beg your understanding. If I may be of further assistance, I can be reached at [name of hospital]."

The editors of C&A would like to publicly express their admiration of Mr. Stelloh for submitting his article under these conditions — and to wish him a full and rapid recovery.

The Automated Blood Inventory Information System (ABIIS) is a general system for data file creation, maintenance, and data retrieval. It was conceived in response to the question "Can automation help in blood resource management?". Feeling that the answer is a strong "Yes", the Milwaukee Blood Center (MBC) and International Computing Company (ICC) are developing the ABIIS as a prototype system to demonstrate the feasibility of inventory control and a management information system for a blood bank, and to serve as a test bed for the design of a production system. This article outlines some problems unique to blood resource management, the design approach used with ABIIS, and some implementation and operational aspects of ABIIS.

Goals of a Blood Bank

Human blood is in many ways as priceless as a human heart or a human kidney — it fills a unique need in the preservation of human life, and it can only be obtained from human beings. Accordingly, the primary goal of a blood bank is to meet all requests made upon it for blood, with the strong secondary goal of minimizing waste.

In view of the 21-day shelf life of blood and the wide fluctuations in demand for blood, these goals are in strong conflict, and make determination of optimum inventory levels a very difficult problem.

Associated problems include control of costs, control of incoming blood from volunteer donors (i.e., trying to match unpredictable input with equally unpredictable output demands), control of average inventory age, control of disease transmission via blood transfusions, and determination of proper inventory distributions, both between bank and hospital, and between whole blood and blood components.

The Milwaukee Blood Center is a regional blood center serving the blood needs of 34 member hospitals in a four-county area of southeastern Wisconsin centered around Milwaukee. Approximately 50,000 units of blood are processed each year, providing for the needs of about one-third of the population of Wisconsin.

Blood is collected at an average rate of 175 units per day from an active donor population numbering over 70,000. A daily inventory of whole blood and blood components is

"Human blood is in many ways as priceless as a human heart or a human kidney — it fills a unique need in the preservation of human life, and it can only be obtained from human beings. The automation of the Milwaukee Blood Center was conceived as a positive response to the question: 'Can automation help in blood resource management?'"

maintained at an average level of 1500 units, with about 40% of the inventory at the blood center. Approximately 1000 transactions are performed against this inventory each day, to record the following operations:

- Draw, process, and add a unit of blood to the inventory
- Convert whole blood units into blood components
- Ship blood units to and from member hospitals
- "Cross-match" blood units to ensure donor-recipient compatibility
- Transfuse blood into a recipient, or otherwise dispose of it
- Maintain a file of blood donors
- Maintain a file of blood recipients

Functional Requirements

Review of the overall blood center operations and needs led to the development of the following key functional requirements for a blood center information system:

- **Operation by personnel unskilled in data processing.**
  Blood center personnel must be able to use the system with a minimum of special training, which dictates very simple and even helpful interface procedures and the use of familiar interface equipment such as typewriters.
- **Production capability.**
  The system will be used to process large numbers of transactions on a day-to-day basis, which implies user-level efficiency or economy, reliability both in terms of the machine and the user, and the need for fixed interface procedures in spite of future system additions and modifications.
- **Experimental capability.**
  The system will be used to support yet-undefined experiments in blood resource management, and thus must be very flexible and versatile, in contrast to the production requirements. In addition, these experiments must be supported without disturbance to the production system.
- **Provide data for research.**
  The system should provide a long term historical record of the blood center operation, to facilitate any future studies of the blood center. Data conversion to machine readable form can be a very costly item. Since this system must capture the data for its ongoing operation, it can readily save the data for later use at very little additional cost.
- **Prototype design.**
  The major thrust of the contract is a feasibility study and design of a production system. Thus, the proto-

type ABIIS must have the flexibility to allow testing of concepts and development of management policies, and must contain program "instrumentation" to aid in the design process.

Hardware

At this point, it was decided the Milwaukee Blood Center and National Heart Institute needs would not be met by the normal approach of careful development of specifications with a "cast-in-concrete" program written to those specifications, but that they would only be met by a very general and flexible software system. Additionally, it was decided to acquire a dedicated hardware system to allow maximum freedom in development of the overall system, provide unlimited online operation, and to allow the project to be under the complete control of the Milwaukee Blood Center. The Scientific Data Systems Sigma 2 computer system was selected, with the following hardware configuration:

- Sigma 2 CPU — 16K 16 bit words, 1.1 microsec. cycle time
- RAD disc storage unit — 3 megabytes, 17 millisec. access time, 188 KC transfer rate
- Magnetic tape units (2) — 20KC transfer rate
- Communications controller
- KSR 33/35 teletype terminals (5)

Program Design Goals

With the functional requirements in mind, a number of program design goals were established to serve as guides for the detailed program design. These goals are:

- **Machine transferability.**
  To be of maximum benefit to the NHI, programs developed for the Milwaukee Blood Center computer should be easily transferred to other computers. This is accomplished primarily through the use of a "machine-independent" language such as FORTRAN or COBOL, since compilers are provided by most computer manufacturers for their specific computers. A high degree of transferability is also achieved by actively ignoring specific machine characteristics such as word length, number of words, and input/output devices; and by segregating any required machine-dependent instructions into a few, easily identified program segments.
- **Dependability.**
  The day-to-day operational requirements impose the need for back-up and recovery procedures to allow continued operation in the face of equipment

failures, and the need for extensive user error detection and correction procedures to insure the input of reliable data. Dependability also implies the need for careful modification of the system to avoid the introduction of errors and attendant degradation of a once reliable system.

- **Flexibility.**
  A great deal of flexibility is required to allow the system to accommodate blood resource management experiments and to test systems design concepts as they evolve through operational experience. This flexibility begins with the user interface, in terms of what the system accepts from and provides to the user; continues with the data base design, which must be capable of being easily expanded to include additional items of interest, and modified to allow examination of the inter-relationships of these data items; and concludes with the overall program structure, which must allow the inexpensive and reliable introduction of major program changes and additions.

- **Simplicity.**
  The system/user interface must be simple, reasonable, easy to learn, and must provide help when requested. Internally, simplicity implies modular program structure and avoidance of sophisticated programming techniques, to minimize the effort required for program modifications.

Use of FORTRAN

The "machine-independent" language chosen for the ABIIS was FORTRAN, since the ABIIS is apt to be installed on other small computers, and, while FORTRAN is implemented to some degree on most small computers, COBOL is not. To further enhance machine transferability, the FORTRAN used corresponds very closely to the ASA Basic FORTRAN standard[1], further restricted to those language features felt most likely to be implemented by other computer manufacturers. Character and bit manipulation was facilitated by developing machine language functions for AND, OR, LSHIFT (left shift n bits), and RSHIFT (right shift n bits).

To achieve the flexibility required for the ABIIS, a set of general purpose file handling routines were developed in FORTRAN for both random access and sequential files. These routines are called in lieu of the standard FORTRAN input/output statements. Use of calls on these routines (GET, PUT, UPDATE, CHANGE, FIND, CREATE, ERASE, etc.) allowed the ABIIS files to be designed to best meet ABIIS objectives, without regard to the restrictions inherent in standard FORTRAN input/output statements. Additionally, the input/output is uncoupled from the formatting for formatted input/output (teletype, etc.), which provides more flexibility and simplifies overlapping of computation with input/output.

File Maintenance and Retrieval Language

A file maintenance and information retrieval language called QUERY was designed to allow file processing operations in a blood center environment to be expressed simply and succinctly. It was felt that use of this language would allow the majority of the software to be developed in parallel with the definition of specific user requests and report formats, and would allow the rapid implementation of these

specific user requirements, both initially and as they changed. QUERY has now been implemented as an interpretive processor, written in FORTRAN. This proved to be a very successful approach, allowing the programming and specification to be performed in parallel as planned. It has also had the very desirable effect of allowing significant ABIIS modifications to be made by programmers knowledgeable only in the QUERY language.

Language for Terminal User

A simple language was designed for the terminal user, consisting of a number of verbs, such as ADD (add a unit of blood to the inventory), with modifiers for each verb to either request further input, or restrict the output in the case of output-directed verbs. This language is implemented as a number of QUERY language programs, one for each verb. Use of these verbs includes access to an extensive system of cues or prompts, which are text messages designed to elicit the correct response. The terminal user has full control over the amount of information presented for his assistance, to the extent of suppression of all cues when he becomes sufficiently proficient. However, the cues are always available, and are automatically given in the case of an error, or when the user forgets the form or content of a data field.

It can be seen from the preceding that ABIIS consists of a hierarchy of program modules. This complete hierarchy consists of:

- The terminal interface routines, written in FORTRAN, which initiate and maintain a dialogue with the terminal user. These routines provide the user prompts associated with the terminal language verbs, and call up the appropriate QUERY program for each verb. With respect to the overall ABIIS structure, these routines know only the logical structure of data files and user dialogues, and the calls on the file handler.

- QUERY programs, written in QUERY, which provide a means for the terminal user to interrogate or modify the data files. These programs must know the logical structure of data files, and the format of file handler calls and terminal interface routine calls.

- The QUERY processor, written in FORTRAN, which executes QUERY programs. This program knows the structure of QUERY programs, file handler calls, and terminal interface routine calls.

- The file handler, written in FORTRAN, which carries out all data file manipulation in response to requests from higher level routines. The file handler translates the logical structure of ABIIS files into the physical structure understood by the manufacturer-supplied software and hardware. To do this, the file handler knows both the logical and physical structure of the data files, and the format of calls on the input/output support routines.

- The input/output support routines, written partially in FORTRAN and partially in machine language, which interface between ABIIS and the hardware. These routines are machine-dependent, and must know the physical structure and characteristics of the input/output devices (disc, tape, communications equipment) and the format of calls on the manufacturer-supplied input/output handlers.

In addition, some overall ABIIS control routines exist which initiate ABIIS execution and otherwise control execution under the framework provided by the manufacturer-supplied operating system. These routines are by their nature dependent on the operating system. Finally, a number

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[1]"FORTRAN vs. Basic FORTRAN," *Communications of the ACM*, Vol. 7, No. 10, Oct. 1964, pp. 591-625.

of ABIIS maintenance routines are available to modify or become aware of the current state of ABIIS software and files. These routines make use of the file handler and terminal interface routines, and are thus machine independent.

Minimizing Program Development Time

Although a high degree of machine transferability implies little dependence on manufacturer supplied software, it was decided to minimize program development time and cost by making as much use of this software as possible. The dependence is automatically minimized by the program hierarchy, which has the effect of channelling all potential references to manufacturer software through ABIIS routines, primarily the input/output support routines. For example, a user may ask for information regarding a specific blood unit. This request is received by a QUERY program, converted by the QUERY processor into calls on the file handler, which further converts it into calls on the input/output support routines, which finally convert it into a machine-dependent call on the manufacturer-supplied disc read routine to procure the appropriate disc record.

After consideration of factors such as machine availability, time available for program development, and overall development costs, the program development was begun on a commercial IBM 360/50 time-sharing system. This approach also deferred the difficulty of implementing a large software system on a small computer, and enforced adherence to some of the subtler aspects of machine transferability. When the file handler and QUERY interpreter became operational on the IBM 360/50, the system was transferred to the Sigma 2 computer.

The ABIIS is now operational, on a test basis, on the Sigma 2 as a non-resident foreground task under their Real-time Batch Monitor (RBM) operating system. During ABIIS operation, RBM functions primarily as an input/output processor, by initiating all requests to the hardware and processing all hardware interrupts. Since RBM provides approximately 10K words for ABIIS, and ABIIS currently includes over 20K words of program code and constants, the overlay loader capabilities of RBM are used extensively. RBM is also extremely useful during program preparation, serving all the normal functions of a general operating system, and allowing use of the disc file for source and object program storage.

Conclusion

This article presents some of the considerations which led to the development of a very general and highly machine-transferable programming system for the solution of a specific problem on a very specific small computer. The approach taken entails considerably more effort than coding to a set of rigid program specifications. However, since even "production" business systems are changed almost as much as they are executed, it is felt that the increased ease of modification soon outweighs the additional development effort, and this is particularly true for a prototype system.

Finally, with respect to efficiency, the authors are firmly convinced that an excellent design coded in a higher level language (therefore, "inefficient") is superior to an adequate design coded in machine language (therefore "efficient"), and that this is true even for systems programs such as the file handler and QUERY interpreter portions of the ABIIS. Since there is seldom enough time to do everything perfectly, it is better to spend the time on the design. ☐
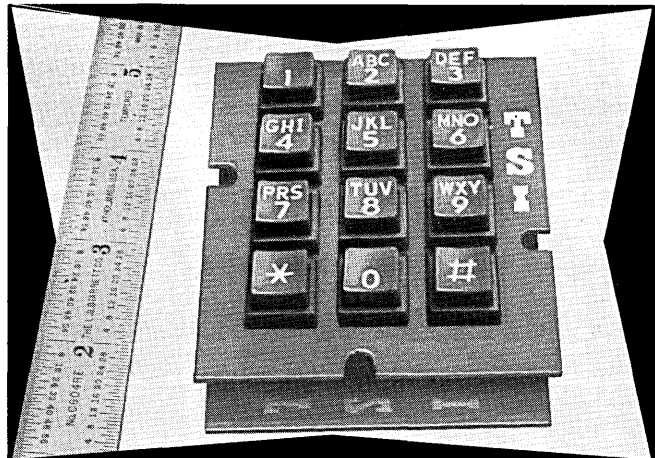
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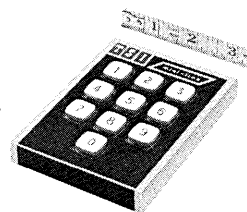
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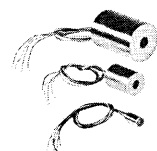
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⊤ S I

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AUTOMATED DIAGNOSIS

James A. Boyle, M.D.
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Basic Sciences Bldg.
Univ. of Calif. at San Diego
La Jolla, Calif. 92037

"At present no one has produced a practical diagnostic system which takes into account the risk of misdiagnosis. However such systems have been developed from a theoretical standpoint — and the way is now open for their incorporation into practical diagnostic computer models."

What have statistical methods of diagnosis by computer to recommend them? The data (patients' complaints, clinical features and laboratory tests) on which doctors make decisions as to what is wrong with a patient are usually highly variable in most diseases and there exist specially designed statistical methods for decision making in such circumstances. Moreover it seems reasonable to suppose that the computer with its huge capacity for information storage and data processing would be of value to the doctor faced with a difficult diagnostic problem. We still have a long way to go before the computer becomes a routine diagnostic aid and there are those who believe, with some justification, that this day will never come.

Diagnostic Situations in Clinical Medicine

Medical diagnosis may be divided into three categories. In one the doctor is faced with the interpretation of clinical diagnostic tests such as the analysis of an electrocardiogram or electroencephalogram. In this area the use of the computer is well established as a diagnostic aid. For example in some hospitals the on-line analysis by machine of electrocardiographic patterns is offered to the clinician as a routine service; many hours of his time are thereby saved.

James A. Boyle graduated in medicine at the University of Glasgow, Scotland in 1960. He first became interested in the possibilities of automated diagnosis in 1964. At present he is working in the Department of Medicine at the University of California at San Diego.

In the second category of diagnosis is the situation where the doctor is starting from scratch with a new patient. Here he has initially at any rate no idea of what the final diagnosis is going to be. It may be that the patient will turn out to have a ruptured appendix or he could be suffering from an overactive thyroid gland. It seems unlikely that computer-assisted diagnosis will ever be feasible in this situation because there are far too many possible diagnoses that a new patient could have and the amount of information required to prime the machine would be astronomically great. Nonetheless in one study where the results of the Cornell Medical Index Questionnaire (CMI) were analysed by machine, promising results were obtained. The CMI takes a fairly comprehensive medical history from a patient. It lists 195 questions of the "Yes" or "No" variety pertaining to alterations of body functions known to be associated with disease states. The patient is also asked about his past medical history and his family and psychiatric history. A correct machine diagnosis was reached on the basis of these data (out of a total of 60 possible diagnoses) in 48 per cent of 350 patients. A clinician, experienced in the use of the CMI was correct in 43 per cent of these cases.

In the third category of diagnosis the doctor makes the correct diagnosis from a relatively small number of alternatives, for he knows roughly the area in which the patient's trouble lies. For example if the patient presents a goiter then the field of diagnostic possibilities is narrowed down to some form of thyroid disease. The number of diagnoses the doctor has to consider falls from almost infinite to perhaps less than ten. In this area of diagnosis the computer may be the greatest value as an aid to the clinician.

Forming the Computer Memory of Disease

Samples of patients with soundly established diagnoses are needed to provide the computer with a memory or "experience" of the diseases in question. Once these have been obtained, the incidence of symptoms and signs which these patients exhibit and the results of special investigative procedures are recorded in the form of a data or probability matrix. Part of such a matrix is shown in Table I where a few of the

Table 1

A DATA OR PROBABILITY MATRIX

Clinical Data	Outcome	Probability of disease: Hashimoto's Disease	Simple Goiter	Thyroid Cancer
Precipitin test:	Pos.	0.7255	0.0010	0.1053
	Neg.	0.2745	0.9990	0.8947
Discomfort:	No	0.9434	0.6666	0.4545
	Yes	0.0566	0.3334	0.5455
Roentgenologic evidence of deviation of trachea:	No	0.7500	0.8889	0.2083
	Yes	0.2500	0.1111	0.7919
Vocal cord paralysis:	No	0.9900	0.9900	0.7647
	Yes	0.0100	0.0100	0.2353
Fixation of goiter to tissues	No	0.9800	0.9029	0.3958
	Yes	0.0200	0.0980	0.6042
Protein bound iodine (µg per cent):	0-3.0	0.6316	0.0270	0.0769
	3.1-5.0	0.3421	0.4595	0.6923
	5.0 up	0.0263	0.5135	0.2308
Duration of disease (years):	0-1.0	0.3478	0.1667	0.4423
	1.1-10.0	0.5870	0.5208	0.4231
	10.0 up	0.0652	0.3125	0.1346

These figures are derived from the percentage frequencies of occurrence of symptoms and signs in the three diseases. For example, two per cent of patients with Hashimoto's disease were found to have a goiter which was fixed to the surrounding tissues.

symptoms (discomfort, duration of disease), signs (vocal cord paralysis, fixation of the enlarged goiter to the surrounding tissues), and results of investigative procedures (precipitin test, roentgenologic evidence of tracheal compression or deviation, plasma protein-bound iodine) are shown for a sample of patients with three different forms of thyroid disease: Hashimoto's disease, simple goiter and thyroid cancer.

The data accruing from examination of a new patient are fed into the machine and compared with the data in the probability matrix. The most probable or likely diagnosis is then computed.

Theoretical Considerations

Computer programs have been used by different workers to calculate the most probable diagnosis. Most of these techniques are based on the general theory of allocation. Suppose that we have a complete set of data on one patient and we wish to allocate him to one of several diagnostic possibilities or diseases. Suppose too, that we know the likelihood of finding each individual piece of diagnostic information that this patient exhibits, given that he has first one of the diseases and then another. Then, provided that the patient has been randomly drawn from a population of patients with these diseases, we can use conditional probability theory to calculate the probability that he has each of the illnesses we are concerned about. We then allocate the patient to the condition

having the largest probability. This procedure, modified slightly to take account of the frequency of occurrence of the diseases themselves in the general population (which obviously has some bearing on the probability that the patient has or does not have a certain condition), is sometimes called the Bayesian approach and it was suggested as being applicable to medical diagnosis as far back as 1959. It assumes that the symptoms and signs which the patient exhibits are conditionally independent, that is to say that the likelihood of finding a certain symptom in a patient is not influenced by the presence or absence of another symptom.

Practical Example of the Theory

An example may serve to illustrate the diagnostic strategy which many programs employ and may explain the foregoing more clearly. Part of a probability matrix is shown in Table II. This Table depicts the likelihood of finding a certain

Table 2

Clinical Data	Outcome	Disease: A	B	C
F	f_1	0.30	0.75	0.10
	f_2	0.65	0.20	0.10
	f_3	0.05	0.05	0.80

Patient has f_3. Likelihood of disease A = 0.05. Likelihood of disease B = 0.05. Likelihood of disease C = 0.80. Thus disease C is 16 times more likely than either disease A or disease C.

clinical feature F in each of three diseases A, B and C. The feature has three outcomes: f_1, f_2, and f_3. As an example of such a situation one might be talking about a feature such as the color of hair and the three outcomes might be red, blond or dark. Suppose that a patient presents with feature outcome f_3. Then the likelihood that this is disease A, is 0.05. Diseases B and C have likelihoods of 0.05 and 0.80 respectively. Thus on the basis of these data we can say that this patient is 16 times more likely to have disease C than either disease A or B.

Table 3

Clinical Data	Outcome	Disease: A	B	C
F	f_1	0.30	0.75	0.10
	f_2	0.65	0.20	0.10
	f_3	0.05	0.05	0.80
S	s_1	0.97	0.80	0.20
	s_2	0.01	0.10	0.20
	s_3	0.02	0.10	0.60

Patient has f_3 and s_3. Likelihood of disease A = 0.05 x 0.02 = 0.001. Likelihood of disease B = 0.05 x 0.10 = 0.005. Likelihood of disease C = 0.80 x 0.60 = 0.48. Thus disease C is now 480 times more likely than disease A and 96 times more likely than disease B.

Now consider Table III. This Table shows the likelihood of a particular symptom S in the three diseases. The possible outcomes that this symptom may have are s_1, s_2, and s_3. Such a symptom might be shortness of breath and the outcomes might be, "Not present," "Present but mild" and "Present and severe." Suppose that our patient not only has feature f_3 but that he also has symptom s_3. Then we multiply the likelihoods for each of these events occurring separately and arrive

at an estimate of the likelihood of their joint occurrence in each of the three diseases. This has been done in Table III where it can be seen that he now has a greater than ever chance of having disease C rather than the other conditions. Further information about his complaints and the features recorded by the doctor during his physical examination will alter the likelihoods of diagnosis in the way which has been described. Finally after allowance has been made for the relative frequency with which the diseases occur the patient is allocated to the disease with the highest likelihood (in this case, on the basis of somewhat limited information), disease C.

Diagnosis of Congenital Heart Disease

The potential value of the computer as a diagnostic aid to the clinician has been studied in a wide variety of situations in medicine. The first practical study to appear was that of Dr. Homer Warner and his colleagues in 1961. They applied a machine to the differential diagnosis of congenital heart disease. This is a field which often poses particularly difficult problems even to the expert and to the average doctor it may well be a closed book. Data on 53 symptoms and signs pertaining to children with 32 different forms of congenital heart disease were fed into the machine. A series of new patients was studied. It was found that the diagnosis calculated by the computer agreed with the actual diagnosis (which was found at operation or by cardiac catheterization studies at least as often as did the diagnosis determined by three *experienced* cardiologists. Presumably therefore the machine performs better than would a doctor inexperienced in the management of children with congenital heart disease, although there is little or no proof of this. By following a simple checklist of questions on a proforma sheet, the doctor is able to generate the data which the machine needs to make the diagnosis. The computer program thus gives all doctors the facility of arriving at correct diagnoses; it allows the accumulated experience of a few experts in the field to be available to all.

Diagnosis of Thyroid Disease

In continuing studies conducted in the Nuclear Medicine Laboratory at the University of Florida College of Medicine, a computer program has been developed which will make a correct assessment of the thyroid function of an individual after his symptoms, signs, and laboratory test results have been supplied to the machine. The original probability matrix for this program was constructed from data from 879 patients. There are many interesting points about this program. First, the probability matrix is an accumulating one in that it allows the patient's symptoms and signs and laboratory tests to be entered into the matrix after the correct diagnosis has been confirmed. Thus the program is to some extent self-learning for it becomes modified by its past experience.

Second, a great deal of knowledge of a practical sort has been gathered over the last few years with use of the program. Although the basic diagnostic decision model is founded on Bayesian conditional probability theory, the program has been modified by subroutines which search routinely for some 10-15 specific combinations of laboratory tests and probability values that are produced by some rare thyroid diseases, that otherwise might be missed by the machine. Over 1300 cases of thyroid diseases or of patients suspected of having thyroid disease have been examined by the program. The most recent published experience of the workers at the University of Florida showed that only 2.8 per cent of the last 500 patients screened had been misdiagnosed by the program. This is an impressively small number and most doctors would probably feel quite happy if they could approach this degree of accuracy in diagnosis.

The third intriguing feature of this computer program for diagnosis is that it has been used in another country (Germany) and has given very good results. Thus it would appear that once a program has been developed by one set of doctors to deal with the differential diagnosis of one set of diseases, it can be used with profit by another set of doctors. This facility is important for it is precisely because we wish to place the accumulated experience of one doctor at the service of another that the idea of computer-assisted diagnosis is so attractive.

Many other studies can be cited to show that at the experimental level, computer-assisted differential diagnosis, where the doctor is concerned to choose between a small number of diagnostic possibilities, is feasible. Thus programs have been written to help in the diagnosis of abdominal pain, benign versus malignant gastric ulcer, bone tumors, adrenal disease and even headache.

Limitations of Computer Diagnosis

There are a number of limitations to the use of computers for diagnostic purposes. It may be said at the outset that none of these are insuperable; but a great deal of work remains to be done if the technic is ever to win wide acceptance in the practice of clinical medicine. The concept of "robot diagnosis" may cause antipathy to many patients, for it appears to strike at the roots of the doctor-patient relationship, a relationship which is still very important in most Western countries. Machines are now programmed in some medical centers to take a history from patients and as man-machine communication becomes faster and therefore easier, increasing exposure to procedures of this kind may bring first familiarity and then confidence. Many patients today rely heavily on machines of one sort or another for their medical well being. The day may not be far off when the diagnostic computer with its wide range of diagnostic programs is merely another familiar machine in the doctor's office or outpatient clinic.

The value of the computer yet remains to be proven however in a real life situation rather than in an artificial experimental setting. We need to know more about the incidence of various diseases in the population and of the frequency of symptoms and signs associated with them. Some work has already been undertaken along these lines but much more needs to be done: collecting data of this sort is laborious and time-consuming. Moreover the data must be accurate; but doctors are not especially noted for the accuracy of the notes which they make about their patients. More too needs to be known about the diagnostic process; in common with the process of creative thinking, the art of diagnosis is poorly understood. Consequently attempts to mimic it on a machine are, from an esthetic point of view, crude.

There is a relative lack of information on the importance of the observer error that exists between doctors when two or more of them attempt to record the same set of clinical features on the same patient. The relevance of this error to the usefulness of the information generated by the doctor during his examination of the patient, and to the validity of machine diagnoses based upon it, is only too obvious.

Finally some thought must be given to the *costs* of misdiagnosis. If the doctor or machine misses a case of the common cold, not too much damage is done. If, however, he misses an early case of potentially remediable carcinoma, the outcome is disastrous. At present no one has produced a practical diagnostic system which takes account of the risk of misdiagnosis of one condition compared with another. Such systems have been developed from a theoretical standpoint however; the way is now open for their incorporation into practical diagnostic computer models. □

c.a

PROBLEM CORNER

Walter Penney, CDP
Problem Editor
Computers and Automation

PROBLEM 696: THE UNBEATABLE MACHINE

"You go without me", Pete said as Joe came by to pick him up for lunch: "I'll get a sandwich at the snack bar."

Joe looked at the scope which showed a circle of dots. "That must be pretty interesting to make you pass up lunch. What is it?"

"This is going to be the big attraction at the Summer Joint Computer Conference. Our booth is going to feature the new Data-Visi-Scope and visitors will be invited to play this game I'm working on. The computer will be the opponent and the progress of the game will be displayed on the DV Scope."

"Game? Not another Nimbonacci, I hope."

"No, this game is foolproof. A win or loss is completely under the control of the machine."

"How are you going to arrange that?" Joe was beginning to forget about lunch too.

"Well, the game consists of 21 points equally spaced as though outlining a circle — the vertices of a regular icosaen-gon, you might say." Pete couldn't resist parading the new-found knowledge he had just acquired from Lambros, the classical scholar.

"Icosa-shmicosa, how does it work?"

"The player and the machine play alternately, connecting any two points with a straight line. No lines may cross and each point may be used only once. Whoever can't make a move loses."

"And you're saying that no matter what the player does the machine can always win?"

"Yes, or lose if the program calls for it as it will every so often in order to keep up the interest. We were thinking of allowing about one win per hour with some small prize for the player who won."

"I don't think it will work."

Will it?

Solution to Problem 695: Search Research

The minimum average number of steps is 5.72, but a 50-50 split (or as near this as possible) is not the only way this could be obtained. For example if the 50 had been divided 21-29 and these divided 9-12 and 13-16 respectively, each of these being split as nearly evenly as possible, this would have yielded the same average number of steps.

Readers are invited to submit problems (and their solutions) for publication in this column to: Problem Editor, Computers and Automation, 815 Washington St., Newtonville, Mass. 02160.

WHO'S WHO IN THE COMPUTER FIELD, 1968-1969 — ENTRIES

WHO'S WHO ENTRY FORM
(may be copied on any piece of paper)

1. Name? (Please print)_____
2. Home Address (with Zip)?_____
3. Organization?_____
4. Its Address (with Zip)?_____
5. Your Title?_____
6. Your Main Interests?

Applications	( )	Mathematics	( )
Business	( )	Programming	( )
Construction	( )	Sales	( )
Design	( )	Systems	( )
Logic	( )	Other	( )
Management	( )	(Please specify)	

_____
_____

7. Year of Birth?_____
8. Education and Degrees?_____
9. Year Entered Computer Field?_____
10. Occupation?_____
11. Publications, Honors, Memberships, and other Distinctions?_____
_____
_____

(attach paper if needed)

12. Do you have access to a computer? ( )Yes ( )No
   a. If yes, what kind of computer?
      Manufacturer?_____
      Model_____
   b. Where is it installed:
      Manufacturer?_____
      Address?_____
   c. Is your access: Batch? ( ) Time-shared? ( )
      Other? ( ) Please explain:_____
   d. Any remarks?_____

13. Associates or friends who should be sent Who's Who entry forms?

Name and Address

_____
_____
_____
_____

(attach paper if needed)

When completed, please send to:

Who's Who Editor, Computers and Automation, 815 Washington St., Newtonville, Mass. 02160

RECENT DEVELOPMENTS IN

AUTOMATING THE MEDICAL HISTORY

Herbert A. Haessler, M.D.
Medidata Sciences Inc.
140 Fourth Ave.
Waltham, Mass. 02154

"Patient response to automated medical history taking has been quite favorable. When patients are asked routinely whether they would prefer to give their history to the machine as they have done; to a physician; to a nurse; or whether they have no preference, over half the patients expressed no preference. And of those who did express a preference, the machine was favored over the physician by a margin of approximately three to one."

Dr. Haessler is the Medical Director of Medidata Sciences. He is a graduate of Marquette University School of Medicine and served as a Resident in Pediatrics and a Post Doctoral Fellow in Internal Medicine at The Massachusetts General Hospital. For the past five years he has been working in the area of computer-based medical data handling. He participated in the design of the Medidata Sciences' Profile 320 Medical History Taking Terminal and wrote the General Medical History discussed in this article.

Until relatively recently, there have been few serious attempts at either investigating the procedure of medical history taking or at automating the process even though it is among the most time-consuming parts of the physician-patient interaction. Not until 1949 did the Cornell Medical Index,[1] the common ancestor of most of today's automated medical history systems appear. In this fixed format paper and pencil questionnaire the patient is asked to answer every one of approximately 150 questions. It covers a conventional medical systemic review with added emphasis on the psychologic state of the patient. The Index has been widely used and has been automated to the extent that scoring can be done by machines using mark sense techniques.

Since publication of the Cornell Medical Index, many other medical questionnaires have been developed for special purposes. For example, industrial organizations have developed history questionnaires for their own use containing material specially suited to aspects of the patient's health which might affect performance of a specific task. Multiphasic health screening centers have also made use of the fixed format history. The Rhode Island Multiphasic Health Screening Center has developed an interval history covering the patient's health only in the past year.[2] This check sheet is machine scored after it has been translated into computer readable form by a keypunch operator. The Kaiser-Permanente Multiphasic Health Screening Center uses a somewhat different format.[3] Here patients are given a set of cards with a single question on each. They are asked to sort the cards into piles containing questions to which they have answered "No" and those to which they have answered "Yes." The patient's responses are then entered directly into the computer using a card reader.
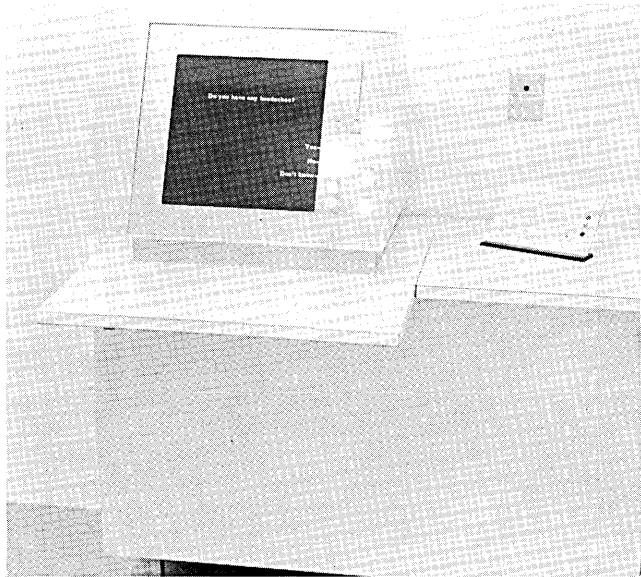
Figure 1

The questionnaire terminal developed at Medidata Sciences. Questions and response choices are projected onto the screen. The main cabinet of the terminal contains the projection optics, display transport mechanism, and associated electronics.
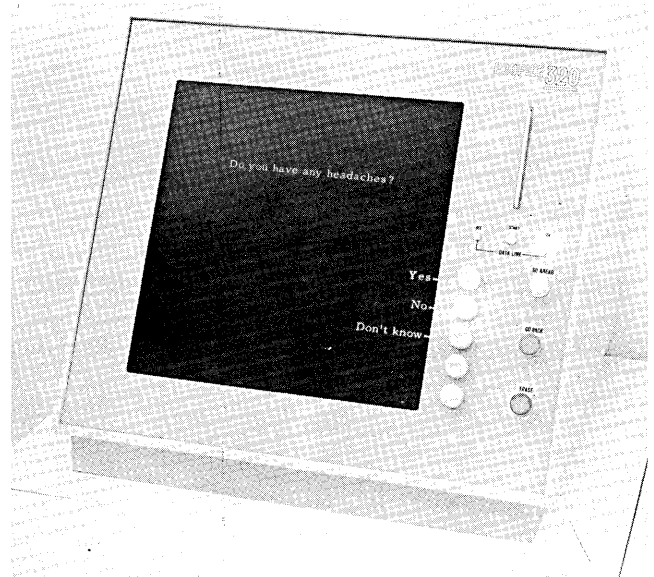

Figure 2

Display screen of terminal and associated response hardware. In addition to the screen this panel contains a card reader, five white response buttons, a green Go Ahead button, a red Go Back button, and blue Erase button.

Basic Concepts

Within the past four years interest has arisen in using the computer in a more active way to obtain medical historic information directly from patients. Work is in progress at four centers on systems which allow the patient to carry on a dialogue with a terminal. In this way a tailored medical history responsive to the patient's problem is obtained. The basic concepts of this method were developed by Dr. Warner Slack at the University of Wisconsin, and he also demonstrated the feasibility of the system in the clinical setting.[4] For all of his initial work Slack used the cathode ray tube of a LINC-8 computer to display his questions and answer choices, and used certain keys on a standard alphanumeric keyboard for responding. Following Slack's pioneering efforts, Dr. John Mayne at the Mayo Clinic, with the cooperation of the IBM Corporation, developed a color film projection display which also has light pen capabilities.[5] Questions and response choices are displayed on the face of the cathode ray tube and the patient points to his answer with the light pen. At the Massachusetts General Hospital, Dr. Octo Barnett has developed a system using a teletypewriter as a terminal.[6] Questions and response choices are presented by the computer operating the teletypewriter and the patient enters his choice using certain keys of the teletypewriter keyboard. The fourth group working in this area has been our own group at Medidata Sciences, Inc.[7] Here a relatively simple optical display has been developed for question presentations. A series of push buttons next to the edge of the display screen which are aligned with the answer choices are used for patient response.
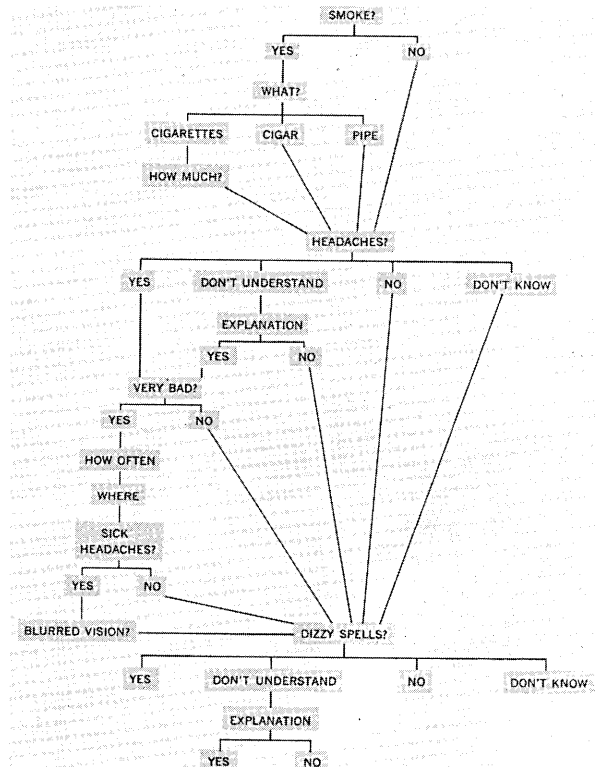
Figure 3

An example of the medical logic used in the General Medical History.

These four systems are conceptually similar although the hardware used for display and response entry is quite different. To demonstrate how the concept works, our system will be described in more detail.

The Questionnaire Terminal

The questionnaire terminal is shown in Figure 1. The patient is identified to the terminal through use of a plastic card inserted into the terminal's card reader. Questions and response choices are projected onto the screen as shown in Figure 2. Each response choice has a corresponding button on the edge of the screen. To enter a response a patient presses a button which then lights. If he is satisfied with the response he may move to the next display by pressing the Go Ahead Button. The lighted response button will be extinguished and the next display will appear on the screen. If, on the other hand, the patient is dissatisfied with his response, he can change his answer by extinguishing the lighted button using the Erase facility and reentering a different response. Should he wish to see an earlier display, he presses the Go Back Button.

The history is arranged in such a way that a patient sees questions appropriate to his condition. An example of the medical logic is shown in Figure 3. Note that if a patient responds "Yes," he has headaches, the computer presents him with a series of questions designed to characterize them. If, on the other hand, he responds "No," he does not have headaches, the computer skips over that block of questions and goes on to another set of symptoms. To provide some variety to the user, three general types of question format are used. The first offers a simple yes-no response. For this type of question a "don't know" response is often added and sometimes also a "don't understand" option. A don't understand response is always followed by an explanation of the question. The second general type of question is multiple choice. Here the patient is offered a choice of responses and limited to a single entry. The third general type is also a multiple choice, but the patient is not limited and may enter several responses. For this third type of question the instruction "You may press more than one white button" always appears on the screen. The system also contains a number of error displays. If the patient enters more than one response to a single response question, an error display appears, and if the patient fails to enter a response, but presses the Go Ahead Button, a different error display appears.

How Many Questions?

The terminal has the capability of projecting in random sequence 320 individual displays. In addition, any display can be used more than once. In this way the programmer may use generalized questions about frequency of occurrence or duration of a problem in many different contexts. In practice this allows construction of histories containing over 400 questions. Our General Medical History contains about 350 questions. A man will never see fewer than about 95, a woman never fewer than about 105. In comparison, Slack's General Medical History contains somewhat over 400, Mayne's something over 300, and Barnett's just over 200 questions. Both ours and Slack's General Medical History contain a substantial number of questions about the patient's social and family history, whereas Barnett's is more strictly a systemic review. All groups are apparently developing a variety of histories for their systems.

Printout

After the patient has completed the interview with the machine, the medical history can be printed out. Figure 4

MEDICAL HISTORY NO. 0215-0215

```
    THE PATIENT IS MARRIED AND LIVES IN A SINGLE FAMILY HOUSE
IN A SMALL CITY.  HE WAS BORN IN NORTH AMERICA.  PATIENT COMPLETED
4 YEARS OF EDUCATION PAST HIGH SCHOOL, AND DOES PROFESSIONAL
OR OFFICE WORK.  FATHER DIED OF HEART DISEASE.  MOTHER IS LIVING.
THERE IS A FAMILY HISTORY OF HIGH BLOOD PRESSURE.

    THE PATIENT CLAIMS TO BE IN GENERALLY FAIR HEALTH. DOES
NOT HAVE DIABETES.  HAS NOT UNDERGONE MAJOR SURGERY.  PATIENT
DOES NOT SMOKE.  HE DRINKS SOCIALLY.

    HAS MILD HEADACHES.  PATIENT JUDGES HIS MEMORY TO BE PERFECTLY
SOUND.

    PATIENT WEARS GLASSES FOR READING.

    COMPLAINS OF MODERATE, DULL, DEEP, LEFT-SIDED CHEST PAIN
OCCURRING SPONTANEOUSLY WHICH DOES NOT RADIATE DOWN THE LEFT
ARM AND OCCURS ABOUT ONCE A WEEK OR MORE.  THE PAIN OCCURS WHILE
EXERCISING.  IT IS RELIEVED BY REST.  HE HAS NOT TAKEN MEDICINE.

    PATIENT'S APPETITE IS GOOD.  DIGESTION IS GOOD.

    ONCE HAD HEMORRHOIDS.

    THERE IS NO FAMILY HISTORY OF DIABETES, NERVOUS OR MENTAL
DISORDERS, ASTHMA OR ALLERGIES.

    PATIENT DENIES SYMPTOMS REFERABLE TO THE FOLLOWING: THE
CENTRAL NERVOUS SYSTEM, SKIN PROBLEMS, VISUAL DIFFICULTIES,
EAR, NOSE AND THROAT DIFFICULTIES, THE PULMONARY SYSTEM, THE
CARDIOVASCULAR SYSTEM, THE UPPER GI TRACT, THE LOWER GI TRACT,
THE URINARY TRACT, THE GENITALIA, HEMATOLOGICAL DISORDERS, ENDOCRINE
DISORDERS, THE MUSCULO-SKELETAL SYSTEM AND EMOTIONAL PROBLEMS.

    THE PATIENT DENIES THE FOLLOWING: BEING EASILY FATIGUED,
WEIGHT LOSS IN THE PAST YEAR, CHANGE IN BOWEL HABITS IN THE
PAST YEAR.
```

Figure 4

A typical printout.

This history was given by a man whose major medical difficulty was chest pain.

shows a sample printout. This printout is designed to simulate the type of note that an intern might write in a hospital chart. The statements are constructed out of sentence fragments associated with each response. These fragments are systematically built up into full sentences. For example, a positive response to the question about headaches will initiate the sentence, "The patient complains of ....(1).... headaches ....(2)....." If the patient then indicates that the headaches are moderately severe, the space marked (1) will be filled in with "Moderately severe," and similarly when the patient indicates that they occur twice each week, the space marked (2) will be filled in so the sentence reads, "The patient complains of moderately severe headaches occurring twice weekly." All positive responses are handled in a similar manner. Negative responses are collected and printed out at the end of the history. If the patient gives negative responses to all questions relating to a single physiologic system, a statement to that effect will be generated. An example of this would be, "The patient denies symptoms referable to the cardiovascular, upper and lower gastrointestinal systems." However, if the patient indicates some negative and some positive responses in a given system, all negatives will be collected and listed.

It is, of course, possible to produce more compact printouts. Negative responses can be completely ignored and positives merely tabulated. Slack has chosen to do this and his program constructs a numbered list of short positive statements under paragraph headings for each body system.

Computer Requirements and Terminal Configurations

The Medidata terminal is under the control of a PDP-8I computer. One computer can service about 20 terminals. Since it is an on-line interactive system, it of course, requires dedication of the computer to that use. The system requires that the PDP-8I have at least 8000 words of core storage and about 20,000 words of disc storage for each type of history to be used. The questionnaire terminal can be used in any of three configurations. The first is as a history-taking station in a multiphasic health screening center. In this configuration, patient identity is entered into the system at an

Table I

Reactions of 200 Patients to the Medidata Sciences General Medical History.

Question A (Single Response Required)

Patient Preference	Males	Females	Total Group
		(in percentage)	
Prefer Machine	30.9	28.0	29.0
Prefer Physician	10.3	9.9	10.0
Prefer Nurse	10.3	2.3	5.0
No Preference	48.5	59.9	56.0

Question B (Multiple Response Required)

Patient Evaluation	Males	Females	Total Group
		(in percentage)	
Interesting	75.0	81.8	79.5
Dull	2.9	1.5	2.0
Complete	36.8	30.3	32.5
Incomplete	13.2	5.3	8.0
Difficult	0.0	5.3	3.5

admissions station and the patient name and historic material are re-associated from the number on the plastic identification card at the time of printout. The second configuration is as a group of freestanding terminals hard-wired to their own computer. A third remote configuration has been built in which a single terminal can be installed in a medical facility and linked to a central computer through the telephone network. This requires an acoustic coupler at the terminal and a Dataphone at the computer. In both the latter configurations the patient is only identified by number. Output is accomplished on a teletypewriter. In the remote configuration one is associated with each input terminal.

Program Structure

Control over terminals and printer is maintained by a dual program structure — a "supervisory" program for administrative tasks and "worker" programs to do the productive computing. The supervisory program sequences the operation of all the questionnaire terminals, schedules operation of the worker programs, and performs input and output on the disc, paper tape, punch, and console typewriter.

There are also two worker programs: one for recording the patient's answers and computing the next frame to be displayed, and the other for preparing the printed report. They operate under the direction of the supervisor and are called whenever the patients' actions at the terminals require them. The worker programs in turn, call on the supervisor for input and output services, whether to the printer or disc or to the terminals.

The display and report programs are both table-driven processors, using tables stored on the disc. The table-driven structure consumes less core memory space and the tables are more easily changed than program instructions. The display program uses a branching array which contains the next frame to be shown for each possible answer to the current frame. Auxiliary tables deal with special problems posed by questions which permit multiple answers. The report program operates with several tables of logical conditions and text fragments in order to assemble the coherent text which makes up the patient's history report.

Patient Response

The time spent by patients at the terminal has varied from 12 to over 60 minutes. One group of 200 patients averaged 25 minutes and two smaller groups came within 2 minutes of this figure. Barnett has reported that his patients took an average of 45 minutes,[6] Slack's patients average 30 minutes,[8] and Mayne's 66 minutes.[5]

Patient response to automated medical history taking has been quite favorable. At the end of our history patients are routinely asked whether they would prefer to give the history to the machine as they have done; to a physician; to a nurse; or whether they have no preference. They are also asked to indicate whether they think the history was complete, incomplete, interesting, dull, or difficult to understand. The results of 200 patient reactions are shown in Table I. Question A was set up in a manner which required the patients to give a single response. Although over half the patients expressed no preference, it is of interest to note that of those who did express a preference, the machine was favored over the physician by a margin of approximately three to one. Question B allowed the patient to respond to as many of the five choices as he felt were appropriate. Approximately 80% of the patients tested expressed an opinion about interest. Virtually all of these gave a positive response. Only 40% of the patients expressed an opinion about completeness and four-fifths of these also gave a positive response. All of the seven patients who found the history difficult to understand were females, but none made over five errors operating the machine and none used the Go Back facility over five times. Of the seven, three indicated they preferred the machine, and four indicated no preference. Both Slack's[8] and Mayne's[5] patients have expressed similarly favorable responses.

At present interactive medical history systems are operating in only a few parts of the country. Both Barnett's and our system are in routine daily use in Massachusetts. Slack's system is operating at the University of Wisconsin as well as in a private Wisconsin medical clinic. Mayne's system is operating in Rochester, Minnesota. Medidata systems are also in routine daily operation in both Utah and California. Within the next eight months, additional installations will be made in both California and Washington, D.C. Because of the favorable patient response to this type of questionnaire it is expected that computer-based medical history systems will soon be built in many medical centers.

Acknowledgment

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REPORT FROM GREAT BRITAIN

Before long Britain's single major domestic computer company, International Computers Limited, will have been brought round through the force of sheer hard economics to a used equipment policy that, to be quite blunt, is less than equitable for second-generation computer users.

Maintenance Problems for ICL

Under constant pressure from the one company which makes a living from handling second-hand equipment, ICL has come out with a number of pronouncements on what it was going to do and what it was not going to do about systems manufactured by the various companies which in the past six years or so have been put together to form the one $250m group.

These boil down to a refusal to maintain most of the earlier equipment once it has changed hands, and if ICL itself does not do the refurbishing. All well and good, the average American user would say. However, it must be remembered that some of this equipment belongs to the earlier stages of a range which is still being built and delivered to at least one UK user. I have in mind the Post Office, sold on the LEO equipment originated by and long since abandoned by English Electric, now defunct.

The net result is that there are little or no pickings for the company — Computer Resale Brokers — which wants to make a living by handling castoff systems. There are likely to be even fewer pickings, because by the time these lines are printed, I expect that ICL will have introduced a policy of going to users of the more obstreperous machines among the vast range of different units the UK company has to maintain (about eighteen different makes from six or more companies) and saying: "Enough is enough; this equipment is costing us fabulous sums in maintenance and the provision of extra program support. It is now five . . . six . . . seven . . . years old. We are prepared to pay you a trade-in price of X sterling if you will take an up-to-date machine from our range".

Once again, the average American user will say: "So what is new in all that?" It is very new in Britain where some users certainly have not gotten the usage they should have had out of the machines they bought in good faith. But then, the Government forced the merger through without considering the problems which would face the group thus created. ICL, which is facing the extremely hard task of producing in the near future a range of machines which will unify the almost incompatible characteristics of the 1900 series with System-4 (that is, a byte oriented machine with a 24-bit word machine), has enough on its hands without worrying about a hundred or so systems, most of which have passed into a stage of obsolescence.

Univac Bursts Upon the Ministry of Technology

I am glad to report that action by one important American group, the Univac Division of Remington Rand, has burst upon the Ministry of Technology like a small and rather unwelcome bombshell. The Ministry had just gotten used to the idea that Honeywell was a good enough "British" company to get itself a Queen's Award for export performance. Now, Univac is spending anything up to $12m to set up in the heart of London a vast computer workshop with twin 494 machines and a wealth of memory on which it will sharpen the teeth of the best real-time men it can recruit from Univac outside and inside the UK (or so the announcement said, though I wager some good real-time men will be attracted by the open-ended system idea to leave virtually anything they are working on at the moment).

In fact, Univac rather gave the game away by saying that Britain had been chosen because of the "high level of technical capability and natural inventiveness available here". How about that now? It is all of a piece with the IBM decision to establish one of the main PL/1 development centres, if not the major one, at Hursley in Britain.

The task to be imposed on Univac's Paddington centre will be to devise a system or systems which will be able to take on extra processors virtually in a daisy-chain fashion, in addition to the first two machines. The latter will be delivered in September and share a segment of core. They will be able to handle several thousand terminals, the company says, though whether this is the intention — that is, whether the company is now proposing to establish its first large service bureau in the UK — is not indicated. It does not seem to be in the cards, at least for the moment. The aim is to improve the design of multi-processor systems, both from the operating system and the hardware viewpoints, and the feed-back from London could well be incorporated into extensions to the 400 and other Univac series.

Whatever the outcome, it can only strengthen the hand of Univac in Britain. So far it has enjoyed an excellent reputation by the performance of its big systems, second to none.

University Computing Expands Services

A major user of Univac computers in the UK, University Computing Company International Inc., is spreading its already broad wings still further over Europe. The group operates an 1108 and an 1107 in Britain, the former being linked by rented line to a number of users in Europe from a centre in London. It had six centres in European countries to handle contract computing business and before the end of the current year it will have added another ten.

At present, the share of spending on hardware between the U.S. and outside the U.S. is in a ratio of $280m to $20m. But the European growth is over 20% and UCC will be setting up a European plant to assemble the Cope 51 terminals

COMPUTER PLANNING FOR HOSPITALS:
The Large-Scale Education and Involvement of Employees

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"One of the first problems in setting up a large scale education program for employees is stimulation of interest. This problem has apparently been solved at the Los Angeles County Department of Hospitals' Computer Center. Requests from nursing personnel for classes and committee involvement in the County Hospital's computer project are coming in so fast that it is not possible to satisfy all of them."
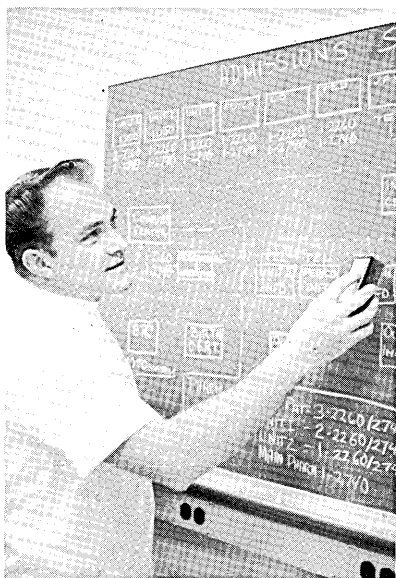
For two years, Mr. Runck was the Nursing Systems Coordinator for the Los Angeles County Hospitals' Computer Center in the development of automated hospital information systems. At present, he is Special Systems Consultant and Director of Nursing at John Wesley County Hospital, which is one of the Los Angeles County hospitals. He holds a B.S. in nursing from Union College, Lincoln, Neb., an M.A. in health education from Cal. State at Los Angeles and several certificates on programming and systems analyst courses from the IBM Educational Center at Los Angeles. He is also a member of the "Systems and Computers Committee" for Area V — Regional Medical Programs.

In recent years, the information requirements and communication systems within most larger hospitals have reached stifling proportions and awesome complexity. This has proceeded to such a degree that a breakdown of accurate patient record-keeping seems inevitable. The situation becomes even more critical because of the problems of obsolete equipment and buildings, the shortage of doctors, nurses, and technologists, and expanded government health programs. Fortunately, digital and analog computers have presented a means to break this "logjam" before the health of the population is disastrously affected.

Medical scientists and hospital experts recognized the potential of computers in hospitals almost a decade ago. It has been said:

> Within the lifetime of most of us, every major hospital will be using computers and allied automated equipment as basic tools in diagnosis, as monitors of patients' conditions in the crucial hours after surgery, and as compilers and analyzers of patient-history information.[1]

Some large projects in hospital computer systems have been in developmental stages for several years; but progress has been disappointingly slow. The hardware and technical know-how is a reality. But the software for implementing an efficient, real-time system at the level of the hospital ward is still a few years away. However, recent recognition of "within hospital" resources justifies an optimistic outlook.

Sources of Information

In other computer words, systems designers and analysts have begun turning to those most involved in current manual systems, in order to define and recommend the present subsystems that would be feasible now to convert to electronic

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1. F. E. Wertz quoted in "Data Processing — Present and Potential" by Elmina Price, *American Journal of Nursing*, December, 1967, p. 2558.

data processing (EDP). It is a recognized fact that registered nurses and other nursing personnel probably handle patient records more than any other category or group of people in a hospital. Their written observations and their recordings of treatments, medications, and results are vital to the physician who is managing the care of a patient. Thus they are the logical people to define their needs.

A System for Eight Hospitals

A case in point of utilizing hospital personnel in developing a total system is the Los Angeles County Department of Hospitals' Computer Center. This system is probably one of the most ambitious undertakings of its kind in the world. Here are eight hospitals widely spread geographically with an average daily census of 5,700 patients, plus 3,000 daily out-patient clinic visits. Over 11,000 patients are admitted per month, and 1,500 births occur monthly throughout the system. A ninth general hospital of an eventual 780 beds, the new Martin Luther King, Jr., County Hospital, will be operational and added to the system by 1971. With more than two and one-half million names in the patient files and 15,000 employees, the information handling requirements are staggering.

To automate a vast portion of the massive record-keeping, a comprehensive, computer-based system is being designed. It will handle the total requirements for health information for the nine Los Angeles County hospitals, the Bureau of Resources and Collections (the County hospitals' billing and accounting system), and other agencies of the Department of Hospitals. This centralized EDP system is being developed in three stages. The first stage is now in progress. An on-line admissions program, with the automation of patient identification files for The Los Angeles County-University of Southern California (LAC-USC) Medical Center, is a large part of this stage. This will be expanded, via telephone cable, to the admitting sections of the other County hospitals. A sequential file retrieval system is now operational at the LAC-USC Medical Center.

Initial Hardware

The initial hardware includes an IBM 360/40, with planned expansion to a 360/50 in June, and a 256K CPU, with a series of 28 remote terminals (IBM 2260 cathode-ray tubes and IBM 2740 printers) in the admitting areas and pharmacy dispensing points. Patient files are being built on the data bank concept. As the system expands into hospital service departments such as the laboratory, x-ray, dietary and patient wards, the individual file will be expanded vertically in separate modules or components. That is, individual records of a patient's file can be retrieved independently without retrieving the entire file.

In the second and third stages of the system, the remote terminals will expand to all service and patient areas of the entire County hospitals' system with an enlarged CPU and more random access storage.

In developing the system, involvement of staff members and department representatives of these hospitals has been emphasized. Of course, a basic knowledge of computer systems is essential in order for these hospital personnel to make accurate and effective contributions. It is my contention that in order to represent the department effectively, those persons doing the manual record-keeping now must be involved widely.

Nursing service in hospitals includes more than half of total employees, so the task of involving nursing personnel in preliminary planning for a large EDP system is formidable.

However, the past two years of experience at the largest County hospital, LAC-USC Medical Center, has proved that a very large group of employees can make useful recommendations and decisions for automating patient record-keeping. There are almost 3,000 persons in nursing service at this hospital, including over 800 Registered Nurses and 120 Ward Clerks. Pilot testing in automating medication records, diet orders, and laboratory requisitioning has shown the successful role that nurses can play in expediting the development of an efficient and workable system.

Feasibility Committee of Registered Nurses

During the past year, a feasibility committee composed entirely of Registered Nurses has been defining sub-systems, work flow, data flow, program requirements, assignments of priorities, and so forth. When completed, this feasibility study will serve as a very important guide to the County Hospitals' Computer Center; the system analysts and programmers will then be working hand in hand with the nursing service in developing and testing a real-time system for ward communications. In order to keep all hospitals and departments coordinated, the nursing service representatives (called coordinators) meet weekly with the analysts as a Documentation Standards Committee and also as a planning committee.

The most frequent question asked by visitors and "outside" systems people is: "How do you educate such a large group of persons in the fundamentals of computers?"

Stimulating Interest in Computers

The most vital area in setting up such large scale education is probably the stimulation of interest. Our first step toward this was questionnaire survey of all categories of nursing personnel. This questionnaire was given to a sample of persons and was in three parts. (1) Ten questions on "What do you think you know about computers and EDP?"; (2) Ten questions measuring attitudes toward manual and automatic record-keeping methods (For example, "Do you think computerized methods of record-keeping would save time?" ☐ definitely, ☐ some, ☐ doubtful, ☐ very little, ☐ none.); and (3) an open-ended question, "Would you like to learn more about computers and their use in the hospital? If so, how do you think would be the best way to learn more about computers?"

Non-Technical Education

Responses were most favorable in expressing the desire to learn more about computers. This desire was met through simplified printed material, a series of lectures, classroom instruction, tape-slides on "Hospital Information Systems," a short talk on how a computer handles data, and question-and-answer periods. All presentations were kept at as non-technical level as possible. The Registered Nurses' series of lectures emphasized the role of the nurse in patient record-keeping and how the computer could allow him or her to spend more time with patients. The series of lectures for ancillary nursing personnel was directed more toward how the computer could help them in the tedious tasks of charting, ordering supplies, and so forth. Attendance was strictly voluntary, yet almost one-half of the total nursing staff attended.

A second step was the writing and printing of an illustrated manual called "An Introduction To Computer Systems For Nursing Personnel". This manual was placed on all wards; the Head Nurse encouraged each employee to read through it. Again, in non-technical terms, it explained the nature of a computer and defined Input, Control, Storage, Processing

and Output. Also, the role of nursing personnel in hospital record-keeping was expanded upon. A glossary of terms and a reference list of articles oriented to EDP in hospitals was included. This manual is the first volume of what will eventually be a procedure guide for future EDP operations on the patient wards.

Lecture Series

The third and most comprehensive step was the establishment of a continuing classroom lecture series on hospital computer systems. These classroom sessions are limited to a maximum of fifteen people and run one hour per week for eight weeks each. One series is for Registered Nurses and one series for Ward Clerks; there are plans to include Licensed Vocational Nurses and Nursing Attendants (Aides) in the future. Sign-up for the classes is voluntary and on hospital time; but once employees have started, they are expected to continue through the eight weeks.

An outline of the course is as follows:

Lecture 1:
— What is a computer? (Definitions of components)
— What is hardware and software?
— Analog and digital computers.

Lecture 2:
— The use of the computer in problem-solving.
— Computer "logic" vs. human "thinking".

Lecture 3:
— What is a program?
— Samples of various program coding.

Lecture 4:
— Outlining data for the Programmer. Problem statements, decision tables, flowcharting, fields, records, and files.

Lecture 5:
— How does the computer manipulate data?
  Common inputs, binary arithmetic, bytes, bits, computer addresses, transactions, updating, sorting and merging files.

Lecture 6:
— Tour of the L.A. County Hospitals' Computer Center.

Lecture 7:
— Hospital Applications.
— Nursing Systems —
  Determining feasibility, pilot-testing new forms, writing Input and Output procedures.

Lecture 8:
— Open question and answer period.

Independent Study Encouraged

Although this appears to be a great deal of ground to cover in eight hours, yet one must keep in mind that only basic fundamentals are covered. A large amount of illustrated notes and more detailed "handouts" are distributed with each class. After completion of the eight weeks, those who desire may take a self-study programmed instruction course called "Computing Systems Fundamentals".

In this way, interest in the County Hospitals' computer project by nursing personnel is rapidly gaining momentum. Requests for classes and committee involvement are occurring at a faster rate than it is possible to satisfy. But probably the most beneficial result will be the willingness, with some workable EDP knowledge, of nursing personnel at the ward level

to contribute and cooperate in testing at the ward level. In fact, several computer industry representatives have asked for our suggestions and ideas in developing more efficient on-line terminals. A Systems Development Engineer from a major computer company remarked: "Never have I seen such a vast resource of knowledgeable people to provide ideas, who would actually be handling the input and output of terminal data".

Applications

In addition to these educational programs with nursing staff, a unit of study on computer applications in hospitals is being prepared for inclusion in the senior year nursing school curriculum at the LAC/USC Medical Center School of Nursing. This diploma school of nursing is the largest of its kind west of the Mississippi River; its graduate nurses are employed in hospitals across the nation. We hope that the future impact of these EDP-trained nurses will result in practical computer applications at the hospital ward level much sooner than otherwise would have happened.

Hospitals are still several years away from having effective, total, real-time systems integrated into all levels of patient record-keeping. However, the orientation and involvement of hospital nursing personnel in computer systems planning and testing has already proved its worth in the Los Angeles County Hospitals' Computer project. We, as nurses, need to make every effort to accept and learn more about the automation of patient record-keeping and patient monitoring. In this way we will be relieved of a great many clerical tasks, and will be able to devote more time to the actual nursing care of patients. □

DESCRIBING WORKLOAD

FOR ACQUIRING ADP

EQUIPMENT AND SOFTWARE

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"When workload is described in terms of a mix of representative benchmark programs and expected workload levels, vendors are really able to determine the configuration that must be proposed, and users are able to verify the adequacy of the proposed configurations and the expected costs of these configurations."

We have all often heard the old sage's saying of "Many is the slip between the cup and the lip." The computer field has a subcategory of that statement which says that "Many a mistake is made between a good system study and the computer installation." This article deals with a mistake very frequently made: a poor description of workload.

Definition

A good workload description should serve three important functions. First, it should permit the vendors to determine what they need to propose for automatic data processing equipment and software (ADPE/S) to satisfy your workload requirements. Second, it should facilitate your verification of the proposed systems, both as to their capabilities to handle your workload, and as to the time required to complete your workload. Third, it should permit realistic costing of the bid systems.

The first two points, permitting determination of the proper system by the vendor and verification of that system's capabilities, can really be combined — for if a good technique is achieved for the second purpose, that same method of workload description will also serve the first purpose. This need of verification by both the vendor and the user is very important since the only real way of determining the influences of some of the third generation features, both hardware and software, upon the thruput of your workload is to put your workload through the bid system. However, to put your whole workload through would normally be impractical; therefore what is needed is a sample of your workload that acts like the whole.

In order for the sample to act like the whole, it must be representative of the full workload. The need for the sample to be representative is necessary to insure that the demonstration is indicative of the way the system will behave for you when installed in your shop doing your workload. In order for the sample to be representative of your workload, it should be composed of a mix of representative benchmark programs. Obtaining this mix of representative benchmark programs is the first necessary requirement for describing workload. The second requirement is to describe the system growth in terms of a series of expected workload levels.

Representative Benchmark Program Mix

There are several steps to obtaining the mix of representative programs to be used for benchmarking purposes. However, before discussing the detailed steps, the following general thoughts should be kept in mind while searching out representative benchmark programs. (1) Where possible, benchmark programs should be written in a standard higher-level programming language, e.g., USASI FORTRAN or USASI COBOL. (2) The mix of benchmark problems should be small enough that it is capable of being processed during a single half-day benchmark demonstration. (3) The selected mix of benchmarks will demonstrate that the supplier's proposed system contains adequate memory and input/output devices, that the software proposed is operative and adequate, and that it has sufficient throughput speeds to do the normal workload. The benchmark programs are not to be selected to prove the worst case situation, but rather to demonstrate timing and capability for the normal situation. If it is necessary to assure capability to handle worst case situations, benchmark programs selected for that purpose will be obtained; but they are not to be included in the mix; rather they will be treated separately as capability benchmarks.

Derivation of Representative Programs

The following paragraphs describe a method for obtaining the representative programs.

A. **Application** — List each of the applications making up the total workload. See Illustration 1.

B. **Programs and Tasks** — For each computer program pertaining to the above applications, list the program and provide the information required in Illustration 1. For new programs or for acquisition of equipment that is for a new installation, it will be necessary to go through the normal design process with program flowcharts which lead to estimates of program run times, or to simulate the programs to obtain this information. Once the necessary estimates are obtained for Illustration 1, these new programs can be treated in the same way as any existing programs. Each program shall be broken down into its major functions or

Illustration 1

APPLICATION, PROGRAM, AND TASK INFORMATION

APPLICATION & PROGRAM TASKS	Individual Run Time *1 (hours) (1)	Frequency Per Month (2)	Estim. Monthly Time *1 (hours) (3) = (1) x (2)	Sub-total (4)
Application A – ADMINISTRATION				
A1: Time/Cost Studies	.52	22		11.44
a. Sort			10.00	
b. Edit			1.44	
A2: Payroll Processing	.25	4.3		1.08
a. Sort			1.00	
b. Validate			.08	
A3: Transportation Usage				9.30
a. Compile – COBOL	.50	1	.50	
b. Extract	.40	22	8.80	
......				......
A27: Miscellaneous				20.00
a. Sort			10.00	
b. Update			10.00	
Application B – DISTRIBUTION CONTROL				
B1: Inventory Control	.45	22		10.00
a. Sort			10.00	
B2: Allowance Generation *2				2.50
a. Compile – COBOL	3.00	1/6	0.50	
b. Extract	12.00	1/6	1.00	
c. Compute			1.00	
......				......
Application K – MATRIX INVERSION				
......				......
Time Required on System *1			Total, 880.00	

*1 All Timing Information for processing common tasks must be based on a common computer system (for multiple computer configurations per installation, this would normally be the fastest system of those to be replaced). For multi-computer configurations, describe time and applications on individual sheets for each system, and then combine onto a summary sheet in this style.

*2 Program to be added in the second year of planned system life.

Illustration 2

TASK SUMMARY SHEET — DESIGN

The column headings are successively:

```
Identification
I/O or File Description
  Media Code
  No. of Devices
  Category
  Block Size
Monthly Averages
  Frequency
  Volume
  Total Time (hours)
  Peripheral Equipment Time
    Mag. Tape
    Card
    Printer
    Other
Internal Storage Requirements (in K's of registers)
Language
  Present
  Planned
```

tasks, such as: sort, validate, update, extract, compute, card-to-tape conversion, tape-to-printer conversion, trajectory calculation, matrix manipulation, simulation, etc.

C. **Task Summary** — From each of the programs listed in Illustration 1 extract the like tasks from the various programs and prepare a separate Task Summary Sheet, Illustration 2, for each task. Provide the information required, in accordance with table headings which are explained below. A completed sample is given in Illustration 3. A description of the columns in the Task Summary Sheet, Illustration 2, follows:

Illustration 3

TASK SUMMARY SHEET (CONDENSED) FOR SORT EXAMPLE

I/O or File Description			Monthly Averages			Peripheral Equipment Time		
Media Code	No. of Devices	Category	Frequency	Volume (*2)	Total Time (Hours)	Mag. Tape	Card	Other
Task A1a:								
PC	1	0	22	200	10.00	5.67	8.20	-
MT	5	2		15				
Task A2a:								
PC	1	0	4.3	3	1.00	.60	.10	-
MT	2	1		1				
MT	4	2		2				
....					....			
Task B1a (*1)								
PC	1	0	22	14	10.00	5.50	.66	-
MT	1	1		15				
MT	3	2		5				
Total Task Time,					145.00	125.00	115.00	-
Typical Sort Task:								
PC	1	0		150				
MT	1	1	18	6	12.00	8.00	5.00	-
MT	3	2		2				

(*1) B1a is an actual task most nearly like the typical sort.

(*2) in thousands

Note: Because of column width and legibility requirements, the table here is condensed and shows only the essentially varying information, not the constant information such as block size, programming language, etc.

(1) *Identification* — This column contains the code for each program in which the task is found. In the example shown in Illustration 1 the identification codes which would be given on a Sort Task Summary Sheet would be A1a, A2a, ... A27a and B1a, etc.

(2) *I/0 or File Description* — This section is divided into four parts:

(a) *Media Code* — Enter a mnemonic for the media that contains the I/0 or file. Examples are:
MT Magnetic Tape
PT Paper Tape
PC Punched Cards
PR Printer

(b) *Number of Devices* — Number of devices that will be required for the use of this media which will have the same capability and category of use.

(c) *Category* — Code designating the type or use of the I/0 or file. The following codes shall be used:
0 Source or original input
1 Master File
2 Intermediate, working or scratch
3 Final Output

(d) *Block Size* — Product of the number of characters per record and records per block.

(3) *Monthly* — This column is divided into four parts:

(a) *Frequency* — Give the monthly run frequency of this program.

(b) *Volume* — The number of blocks contained in the I/0 or file(s). If this is a multi-tape file, follow the number of blocks by a slash and give the number of tapes. The volume to be recorded will be the average per unit, per month, for this task.

(c) *Total Time (Thruput)* — Average total time to perform this task in the identified program. All times shall be given in hours and hundredths of hours.

(d) *Peripheral Equipment Time* — Estimated average time required per task by each type of peripheral equipment. If similar units of differing capability are used, this timing information should be based on the highest capability available. Due to simultaneity and overlap, it is not expected that the total of the individual units will agree with the total time.

(4) *Internal Storage* — Estimated amount of internal storage required to process the task (not the full program, if the program is a multi-task program). If two or more processors are used for the task enter the information accordingly.

(5) *Language* — List the language in which the task is programmed (first column) or is to be programmed (second column). If task is a self-contained library routine, the initials "L.R." should be entered.

(6) *Total Task Time* — At the end of the last Task Summary Sheet used for each type task, there should be a line for total task time. The sum of these totals from all the Task Summary Sheets should equal total system time.

(7) *Typical Task* — On the last entry of the last Task Summary Sheet used on each type of task, there should be an entry for a nonexistent program. This entry should be weighted average (weighted by used time per month) for all previous entries for this type of task, and it should depict what a typical task of this type would look like. This is shown on Illustration 3.

D. Selection of Representative Tasks — From each of the sets of tasks, select tasks (preferably a single task program) which are representative of the set, or a substantial portion thereof, and identify these tasks with asterisks. The types and time of processing, amount of internal storage used,

language used, and equipment configuration should all be taken into account when selecting the representative task; that is, it should be as nearly similar to the typical task as possible.

Extension Factors

A chart should now be prepared showing each of the representative tasks and the functions it represents. The monthly times required for each of these functions within a task should be listed alongside of the individual times of the benchmarks chosen to represent these task functions. The individual benchmark times for the functions should be divided into monthly times for these functions to obtain individual extension factors, which show how many times a month the representative benchmark would have to be run

Illustration 4

REPRESENTATIVE PROGRAMS

Task Set	Workload Functions	Time (hours): Monthly Task	Represen-tative Task (single run)	Exten-sion Factor
Sort	Total thruput	145.00	0.45	322
B-1a	Mag. tape	125.00	0.25	500
	Card reader	115.00	0.03	3833
Edit	Total thruput	120.00	0.75	160
E-4a	Mag. tape	80.00	0.60	133
	Card reader	20.00	0.50	40
	Printer	100.00	0.25	400
Update	Total thruput	100.00	0.16	625
D-5a	Mag. tape	70.00	0.10	700
	Card reader	25.00	0.05	500
	Printer	50.00	0.10	500
Matrix	Total thruput	90.00	0.45	200
Inversion	Card reader	3.50	0.02	175
K-6a	Mag. drum	24.00	0.15	160
	Printer	1.50	0.01	150
FORTRAN	Total thruput	85.00	0.17	500
Compile	Mag. tape	78.00	0.15	520
H-3a	Card reader	6.00	0.02	300
	Printer	4.00	0.01	400
COBOL	Total thruput	40.00	0.12	333
Compile	Mag. tape	38.00	0.11	345
G-2	Card reader	4.00	0.04	100
	Printer	3.00	0.04	75
Tape to	Total thruput	300.00	1.00	300
Print	Mag. tape	300.00	1.00	300
F-4	Printer	300.00	1.00	300

Total Monthly Time 880.00

to make up the full monthly workload for that task. An example is shown in Illustration 4. If only sequential systems were to be considered, the individual functional extension factors would be sufficient, and each vendor could run the benchmark program, extend his system running time for each benchmark by the functional extension factors just derived, and thus be able to tell how long his system would take to complete the total workload.

However, in third-generation systems where many degrees of simultaneity must be considered, it is possible that while the system is handling one function, it could simultaneously be handling another, or even be multiply handling various tasks on programs. Thus, all the representative programs must be considered together to form the representative sample of the total workload. If the normal workload could be processed in variable ways, then a vendor should be permitted to handle the grouping or mix of representative

benchmark programs in whichever way his system can best handle them. If normally, one type of workload would be handled before the other, then the mix should be structured in that way. However, just taking one each of the representative benchmark programs does not make a representative mix, because the related extension factors also have to

Illustration 5

Program	Quantity	Provisions
B-1a	2	Normal
E-4a	1	Input from tape
D-5a	4	Twice normal
		Twice no output
K-6a	1	Normal
H-3a	3	Normal
G-2	2	Normal
F-4	2	Normal

Extension Factor for Mix: 160

be considered. Illustration 5 shows a mix of representative benchmark programs and the mix extension factor.

Mix of Tasks

This extension factor for the mix is derived by examining the information contained in Illustration 4 and obtaining the lowest practical extension factor to reduce the number of problems to be run in the mix while retaining the required representative nature of the mix of problems, which in this case is 160. This extension factor is then divided into each of the sequential extension factors to obtain the quantity column. The provisions column is then used to make the input/output total time when extended by the mix extension factor equal to the total projected input/output time. This mix of tasks (15) can then be used as a proper demonstration of a supplier's multiprogramming or multiprocessing. This mix of representative benchmark programs and its related extension factor completes the first requirement for describing workload.

Expected Workload Levels

Another requirement for defining workload is to describe the system growth in terms of a series of expected workload levels. Two aspects about expected workload levels need to be considered: their derivation and their use.

Derivation

The workload to be processed by an acquired system can be expected to increase overtime. Therefore, the workload for a system can be envisioned as consisting of a series of various levels. These workload levels can be roughly approximated by the average monthly workload levels for each year of system life. As the system ages, the workload increases from one level to another. However, because of the uncertainties that are associated with projecting workload growth overtime, it is impossible to predict with complete accuracy just when the workload will reach a given level. Therefore, probabilities are used for this purpose as described below:

a. **System Life.** First, a chart showing system life should be prepared showing the number of years that the system is expected to be in existence. See Illustration 6a.

b. **Projected Growth.** A best-guess approximation of projected growth of the system should then be superimposed on the foregoing chart, the vertical axis depicting the workload in hours-per-month. See Illustration 6b.

c. **Workload Levels.** At the midpoint of the projected growth line for each year, construct a workload level line parallel to the horizontal axis. See Illustration 6c.
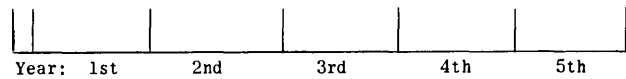
SYSTEM LIFE

Illustration 6a

Year: 1st   2nd   3rd   4th   5th

Illustration 6b

Year: 1st   2nd   3rd   4th   5th

Illustration 6c
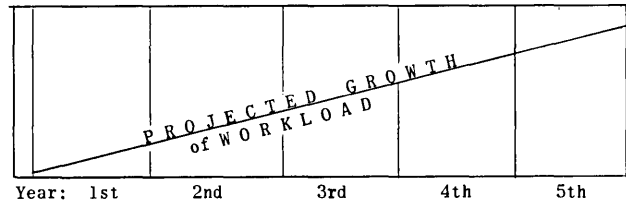
Year: 1st   2nd   3rd   4th   5th
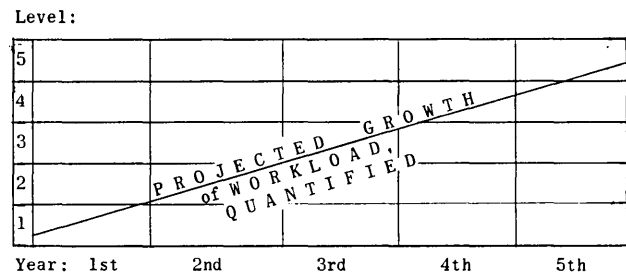
Illustration 6d

Projected Growth of Workload, Quantified, and Assigned Probabilities

Level:

7	0	0	0	0	5%
6	0	0	0	5%	20%
5	0	0	5%	15%	70%
4	0	0	10%	75%	5%
3	0	10%	80%	5%	0
2	10%	85%	5%	0	0
1	90%	5%	0	0	0
Year:	1st	2nd	3rd	4th	5th

d. **Level Probability.** Then, for each year of system life enter the probability of the average workload for that year being at or near each of these levels. Since there are only a finite number of levels used, the probabilities must be thought of as lumped at these levels in such a way that the total probability for a year adds up to 100%.

For example, referring to Illustration 6d, it can be seen that the workload there illustrated has a probability of 90% of being at level 1 for the first twelve months and a 5% chance of still being there for the second twelve months. Therefore, each vendor would be asked to determine the configuration necessary to process workload level 1 in the allotted time period, and to determine the monthly cost of that configuration. Suppose that monthly cost is designated MC_{w11}. In a similar manner, we determine the monthly cost of the configurations to handle each of the other workload levels, MC_{w12}, MC_{w13}, MC_{w14}, MC_{w15}, etc. Now MC_{w11} has a 90% chance of being incurred for 12 months, when a discount factor of 0.91 would be applied, and a 5% chance of being incurred

for 12 more months, when a discount factor of 0.83 would be applied. This can mathematically be written as:

$$12MC_{w11} \times 0.90 \times 0.91 + 12MC_{w11} \times 0.05$$
$$\times 0.83 \qquad = 10.33MC_{w11}$$

Similarly:

$$12MC_{w12} \times 0.10 \times 0.91 + 12MC_{w12} \times 0.85$$
$$\times 0.83 + 12MC_{w12} \times 0.05 \times 0.75 \quad = 10.00MC_{w12}$$

$$12MC_{w13} \times 0.10 \times 0.83 + 12MC_{w13} \times 0.80$$
$$\times 0.75 + 12MC_{w13} \times 0.05 \times 0.68 \quad = 8.56MC_{w13}$$

$$12MC_{w14} \times 0.10 \times 0.75 + 12MC_{w14} \times 0.75$$
$$\times 0.68 + 12MC_{w13} \times 0.10 \times 0.62 \quad = 7.75MC_{w14}$$

$$12MC_{w15} \times 0.05 \times 0.75 + 12MC_{w13} \times 0.15$$
$$\times 0.68 + 12MC_{w15} \times 0.70 \times 0.62 \quad = 6.89MC_{w15}$$

$$12MC_{w16} \times 0.05 \times 0.68 + 12MC_{w16} \times 0.20$$
$$\times 0.62 \qquad = 1.89MC_{w16}$$

$$12MC_{w17} \times 0.05 \times 0.62 \qquad = 0.37MC_{w17}$$

Therefore, the present worth of the total expected payments for each configuration is:

$$10.33MC_{w11} + 10.00MC_{w12} + 8.56MC_{w13}$$
$$+ 7.78MC_{w14} + 6.89MC_{w15} + 1.89MC_{w17}$$

However, two additional points should be made. First, since the probability of ever incurring WL_7 is slight, that workload level should probably not be made mandatory, and if a vendor could not handle Workload Level 7, the cost of doing that work at a service bureau instead might be considered. The same argument might also be applied to Workload Level 6.

Second, it is not likely that the vendors will bid seven different configurations. For instance, a vendor who does not charge for extra shift usage, might bid three configurations. The smallest leases for $15,000 per month and or completes the mix of representative benchmark programs in 2,630 hours; the second configuration (with higher density tape drives) leases for $18,000 per month and completes the mix in 1.562 hours and the third configuration (with a faster processor) leases for $23,000 per month and completes the mix in less than one hour. When these configurations are matched against the given workload levels, it is seen that the smallest configuration can satisfy the first two workload levels (2.630 x 160 $\leq$ 500 and 2.630 x 190 $\leq$ 500); the second configuration could satisfy the next three levels (1.562 x 250 $\leq$ 500, and 1.562 x 280 $\leq$ 500 and 1.562 x 320 $\leq$ 500) and the largest configuration could handle the last two levels. The present value of the expected lease cost for that vendor's configuration would therefore be: (10.33 + 10.00) $15,000 + (8.56 + 7.75 + 6.89) $18,000 + (1.89 + 0.37) $23,000 or $775,070 over the five-year system life.

Summary of Workload Description

Describing workload for ADPE/S Acquisition purposes requires; first, a good knowledge of the future workload requirements of the organization; second, the construction of a mix of representative benchmark programs which represents the make-up of the workload; and third, a statement of expected workload levels over the life of the system.

The use of a mix of representative benchmark programs not only provides a tool by which the make-up of the workload can be described to the vendors, but also provides a very good means of validation. The determination of the workload levels indicates the extension factors that need to

C·a

PROOF GOOFS

**Neil Macdonald
Assistant Editor**

We print here actual proofreading errors in context as found in actual books; we print them concealed, as puzzles or problems. The correction that we think should have been made will be published in our next issue.

If you wish, send us a postcard stating what you think the correction should be.

We invite our readers to send in actual proofreading errors they find in books, *not* newspapers or magazines (for example, *Computers and Automation*), where the pressure of near-at-hand deadlines interferes with due care. Please send us: (1) the context for at least twenty lines before the error, then the error itself, then the context for at least twenty lines after the error; (2) the full citation of the book including edition and page of the error (for verification); and (3) on a separate sheet the correction that you propose.

We also invite discussion from our readers of how catching of proofreading errors could be practically programmed on a computer.

For more comment on this subject, see the editorial in the September 1968 issue of *Computers and Automation*.

Proof Goof 696

(Find one or more proofreading errors.)

. . . If, therefore, one were talking to anyone on the Moon there would be this slight but annoying time-lag before there was any reply. (This point was brought out well in the film *Destination Moon.*) Over interplanetary distances this time-lag is so great that conversation would be quite impossible. It would take five and nine minutes respectively to get replies from Venus and Mars, even at their closest to the Earth!

This difficulty is a fundamental one, and is nothing to do with the inadequacies of our present-day equipment. Unless we discover something that can carry signals at a speed greater than light (which according to the Theory of Relativity is impossible) nobody on one planet will ever be able to converse, in the usual sense of the word, with anybody on another. One could listen to the voice of a friend on Mars, but the words that reached Earth would always have been spoken at least four minutes before.

> — pages 87 and 88, *The Exploration of Space*, by Arthur C. Clarke, Harper & Brothers, New York, 1951.

Solution to Proof Goof 695:

Paragraph 1, line 15: Replace "irreducable" with "irreducible". □

be related to the mix of representative benchmark programs; and further, these levels can be used for costing purposes.

When workload is described in terms of a mix of representative benchmark programs and expected workload levels, the vendors are really able to determine the configuration that must be proposed and users are able to verify the adequacy of the proposed configurations and the expected costs of these configurations. Therefore, this method of describing workload makes it ideal for acquisition purposes. □

Leadership in a Changing Society

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630 5th Ave.
New York, N.Y. 10020

We are surrounded by evidence that technological growth and change will exert profound and complex pressures on society throughout the world. The influence which these pressures are bringing to bear is, and will be, increasingly relentless. It is inescapable; it must be shaped. The critical question now is: Are we prepared for accelerating change?

Some of those who dream of the future raise the frightening possibility that man will be the victim of his own knowledge; that technology will override him; that his freedom will be imperiled and his values lost. Others, like Sir Julian Huxley, foresee the fruition of a "fulfillment society" . . . or, as Robert Hutchins said in his book *The Learning Society*: "A world community learning to be civilized, learning to be human, is at last a possibility".

Throughout history, leadership and organization have strongly influenced the development of man. Leaders create the ideas or chart the courses of action for organizational implementation, and thus society moves. However, as society grows increasingly complicated, so will the demands on leaders in every segment of it. Thus we are facing a desperate need for innovators and creators, for large numbers of people who truly understand the nature of their technological environment and have the courage to act on the new ideas that will benefit it.

To understand some of the demands facing tomorrow's leaders, consider our immediate future, as described by Jean-Jacques Servan-Schreiber in *The American Challenge*:

> There is a new society on the horizon, one which will come into being before today's thirty-year-olds go into retirement. The "post-industrial society" will be distinguished by man's unprecedented freedom from physical, economic, and biological constraints. Not only will it be a richer society, but a different kind of society, since beyond a certain level wealth is measured not so much by a higher standard of living as by a completely different way of life.

Are we ready for this kind of society? Are we developing the leadership to assure a higher quality of life in this new society, or to cope with the social problems which stem from onrushing technology?

Mastery of Our Social Environment

Mastery of our social environment most likely will continue to be a crucial challenge, primarily because of the extremely powerful acceleration of technical change. Lord Ritchie-Calder traces the acceleration of scientific progress to the feedback from interrelationships between what he calls a hierarchy of science — pure science which seeks knowledge for its own sake; oriented fundamental science, or research with a practical purpose; and technology, which is the transfer of scientific knowledge into practice.

The result has been, according to Ritchie-Calder, that:

> . . . the volume of knowledge — six million published scientific communications, increasing at the rate of half-a-million a year — has become a Niagara of information; that the number of scientists is doubling every ten years; and that science is becoming more and more fragmented into specializations, barely able to communicate with each other because of the unique language each has invented for its convenience. And "natural philosophy" has been swamped by experimental results. No wonder, then, that the ordinary intelligent layman finds himself overawed and feels that scientists have become a priesthood, creating and conserving their own mysteries.

We need not join this scientific priesthood to fulfill a function in our changing society, but it will become increasingly imperative to have some insight into the focus and directions of science and technology if we are to understand their impact. And we can only achieve this awareness if improvements in the technology of communication keep pace with the general technological revolution.

Communication

Communication is undergoing a revolution today as great as that occurring in energy. The manipulating and storing of data through the use of computers is rapidly being supplemented by an ability to serve information to man at speeds and quantities undreamed of two or three decades ago. All of the data describing the citizens of a nation may soon be collected and monitored by a single machine. The information generated and needed by the increasing variety of the activities of humans will require a store of facts of almost unimaginable complexity. It must be made usable if the data is not to overwhelm us. Intellectual attainment of the highest order will be required for leadership in such a situation.

If our ability to draw upon the information created by those who went before us is a uniquely human characteristic, then communication, which includes important elements of education, is close to being the essence of humanism. The massive increase in available energy and the equally striking improvement in communication have produced something that we call "automation." It is fashionable to blame automation for current upheavals in society: the frustrations of workers with more leisure time through shortened work

schedules or extended vacations; the worldwide anomy and alienation of young people reflected in demonstrations and rebellions, misuse of drugs, and "hippie" movements; increasing crime rates and domestic discord; and even inequalities in the development of nations and the progress of ethnic groups within nations.

But few now claim that more automation must inevitably increase the level of involuntary unemployment in society. If this does occur, it will be because of poor management or inadequate education and training of people, not because of automation. Most people would more readily agree with Professor Emmanuel Mesthene of Harvard that "technological development has provided substitutes for human muscle power and mechanical skills for most of history." But Professor Mesthene also warns that disruptions from advancing technology will devolve on society "a major responsibility for inventing and adopting mechanisms and procedures of occupational innovation."

Placing the Hard-Core Unemployed

Industry in the United States is facing this problem right now. Our economy produces a million-and-a-half new jobs a year, and the current need to place a half-million urban dwellers would not seem difficult to fulfill. But in America's technologically-oriented economy, placing the hard-core unemployed, usually black men, has shown businessmen, in a very real way, not only the need for their greater involvement in society but, perhaps more significantly, the difficulty of the social challenges which stem from technological progress. To turn unschooled, unskilled and unmotivated people into productive workers, we have to help them overcome a heritage of handicaps that bar them from meaningful jobs: grossly deficient education, fear of failure, culturally impoverished lives and, ultimately, society's discrimination against them.

We are only beginning to come to grips with this fundamental social problem. Most business leaders in America now recognize that it must be solved, and that business must explore other ways of contributing to greater social progress.

Demands on Tomorrow's Leaders

Yet those who aspire to be tomorrow's business leaders face chilling demands. Because they will direct the new technologies, they will be held accountable in larger part for the total quality of society, for the kind of life people live in their own country, and throughout much of the world. In the past, business leaders have placed as much stress on the value of individual incentives as on the need for total profits. I suggest, however, that this emphasis is changing, and that in the future socially useful profit and involvement will be as important to an organization as it is becoming to the individual people in the organization. We therefore cannot give lip service to social progress. We must be committed to it, work for it and achieve it . . . or else we shall lose our power to be free.

Many of us in U.S. business believe that education is the greatest and most promising single endeavor, and the best hope for solutions to our terribly complex problems. The university today shapes more and more people for productive roles in society, and it increasingly is responsible for leadership in all segments of society. The essential role of a leader is to clarify choices and place priorities. The chief asset of any business leader historically has been instinctive good judgment, but this is no longer enough with the emergence of complex economic, social and technical problems that can affect priorities and choices.

Thus leadership in the years ahead, at all levels of society, will require intellectual capacity beyond mere technical, managerial or professional skills. Tomorrow's leaders will face increasing pressures to expand their knowledge and abilities — or forfeit their rights to leadership.

We can foresee some of the qualities that will be required of tomorrow's leaders by studying our present problems. They must be able to motivate people towards social participation rather than isolation, towards rebuilding society rather than exploiting it. They must have sufficient intellectual insight and sensitivity to stimulate people to strive for excellence, to adapt to new environments, or to use increased leisure time effectively to raise their own intellectual capacities and accept broader social responsibilities.

The Quality of Life

These leaders will be concerned with the quality of life, from individual fulfillment to the beauty of the countryside; with technologies and organizations that serve, and do not menace, the individual; with making change work for society and assuring that change in a framework of order.

In business, unbalanced emphasis on specialization and dedication to single prime functions is ending. Perhaps this is a harbinger for other disciplines and professions. The prime movers in tomorrow's society may well be those leaders who are truly generalists — who understand and can direct the utilization of the new tools . . . but who also can foresee the full effects of new technologies and will demonstrate the ethical and moral strengths to insist upon applications which place society's best interest before individual or special interest.

For the new leader, more appropriate tomorrow than ever may be H. G. Wells' prediction that "the future is a race between education and catastrophe." We are reaching a point in time when a leader must feel comfortable in the world of ideas. The only limitations on the province of this leader will be his capacity for thought and his ability and willingness to act on it and to articulate it. The new leader's aspirations will be higher and his goals will more deeply challenge. But he will, I believe, be less a Captain of Fate and more a Captain of Mankind.   ☐

REPORT FROM GREAT BRITAIN

it assembles around the PDP-8 computer it gets from Reading in the UK and from Maynard, Mass.

The president of UCCII, Mr. Richard Fagin, has more than hinted at an extension of this manufacturing activity to not only such devices as a magnetic tape terminal for off-line transmissions, but also storage and central processing units — the last two by about 1973. This must make unwelcome reading for Univac; but much can happen in the next four years, and it would not be the first time that newcomers to a highly specialized area of computing have bitten off more than they could chew.

Ted Schoeters
Stanmore, Middlesex
England

CALENDAR OF COMING EVENTS

June 8-12, 1969: Sixth Annual Design Automation Workshop, Hotel Carillon, Miami Beach, Fla.; contact N. Garaffa, Jr., RCA ISD, Bldg. 13-2-8, Camden, N.J. 08101

June 9-11, 1969: IEEE International Communications Conference, University of Colorado, Boulder, Colo.; Dr. Martin Nesenbergs, Environmental Science Services Administration, Institute for Telecommunication Sciences, R614, Boulder, Colo. 80302

June 12-14, 1969: Assoc. for Computing Machinery, Eighth Annual Southeastern Regional Meeting, Carriage Inn, Huntsville, Ala.; contact Dr. Leland H. Williams, Computer Center, Auburn Univ., Auburn, Ala. 36830

June 16-19, 1969: Data Processing Management Association (DPMA) 1969 Internat'l Data Processing Conference and Business Exposition, Montreal, Quebec, Canada; contact Mrs. Margaret Rafferty, DPMA, 505 Busse Hwy., Park Ridge, Ill. 60068

June 16-21, 1969: Fourth Congress of the International Federation of Automatic Control (IFAC), Warsaw, Poland; contact Organizing Comm. of the 4th IFAC Congress, P.O. Box 903, Czackiego 3/5, Warsaw 1, Poland.

June 17-19, 1969: IEEE Computer Group Conference, Leamington Hotel, Minneapolis, Minn.; contact Scott Foster, The Sheffield Group, Inc., 1104 Currie Ave., Minneapolis, Minn. 55403

June 17-20, 1969: American Astronautic Society and the Operations Research Society of America, Brown Palace Hotel, Denver, Colo.; contact Dr. George W. Morgenthaler, General Program Chairman, Martin Marietta Corp., P.O. Box 179, Denver, Colo. 80201

June 19-20, 1969: American Society of Mechanical Engineers and Association for Computing Machinery Joint Computer Conference on "Computational Approaches in Applied Mechanics", Illinois Institute of Technology, Chicago, Ill.; contact E. Sevin, IIT Research Institute, 10 West 35 St., Chicago, Ill. 60616

June 19-20, 1969: Assoc. of Data Processing Service Organizations Management Conference, Sheraton Ritz Hotel, Minneapolis, Minn.; contact Jerome L. Dreyer, Assoc. of Data Processing Service Organizations, Inc., 420 Lexington Ave., New York, N.Y. 10017.

June 19-20, 1969: Seventh Annual Conference of the Special Interest Group, Computer Personnel Research of the Association of Computing Machinery, Univ. of Chicago, Chicago, Ill.; contact A. W. Stalmaker, School of Industrial Management, Georgia Tech., Atlanta, Ga. 30332

June 21-28, 1969: Second Conference on Management Science for Transportation, Transportation Center at Northwestern University, 1818 Hinman Ave., Evanston, Ill. 60204; contact Page Townsley, Asst. Dir., Management Programs, 1818 Hinman Ave., Evanston, Ill.

June 23-24, 1969: National Gaming Council Eighth Symposium, Sheraton-Elms Hotel, Excelsior Springs, Mo.; contact Dr. Richard L. Crawford, Booz, Allen Applied Research Inc., 911 Walnut St., Kansas City, Mo. 64114

June 30-July 1, 1969: ACM/IEEE/SHARE/SCi Conference on Applications of Continuous System Simulation Languages, Sheraton-Palace Hotel, San Francisco, Calif.; contact Robert Brennan, IBM Scientific Center, 2670 Hanover St., Palo Alto, Calif.

June 30-July 3, 1969: Institution of Electrical Engineers Conference on Computer Science and Technology, Univ. of Manchester Institute of Science and Technology, Manchester, England; contact Conference Secretariat, Institution of Electrical Engineers, Savoy Place, London, W.C.2, England.

July 8-10, 1969: IEEE Conference on Measurement Education, Univ. of Warwick, Warwickshire, England; contact The Conference Dept., The Institution of Electrical Engineers, Savoy Place, London W.C.2, England.

July 8-11, 1969: IEEE Annual Conference on Nuclear and Space Radiation Effects, Penn State University, University Park, Pa.; contact D. K. Wilson, Bell Telephone Laboratories, Whippany, N.J. 07981.

July 19-22, 1969: 30th Annual Convention of the National Audio-Visual Association, Conrad Hilton Hotel, Chicago, Ill.; contact Harry R. McGee, National Audio-Visual Association, Inc., 3150 Spring St., Fairfax, Va. 22030

Aug. 6-8, 1969: Joint Automatic Control Conference, Univ. of Colorado, Boulder, Colorado; contact W. E. Schiesser, Dept. of Chem. Engrg., Lehigh Univ., Bethlehem, Pa. 18015

Aug. 11-15, 1969: Australian Computer Society, Fourth Australian Computer Conference, Adelaide Univ., Adelaide, South Australia; contact Dr. G. W. Hill, Prog. Comm. Chrmn., A.C.C.69, C/-C.S.I.R.O., Computing Science Bldg., Univ. of Adelaide, Adelaide, S. Australia 5000.

Aug. 25-29, 1969: Datafair 69 Symposium, Manchester, England; contact the British Computer Society, 23 Dorset Sq., London, N.W. 1, England

Aug. 26-28, 1969: Association for Computing Machinery (ACM) National Conference and Exposition, San Francisco, Calif.; contact Pasteur S. T. Yuen, P.O. Box 2867, San Francisco, Calif. 94126

Sept. 8-12, 1969: International Symposium on Man-Machine Systems, St. John's College, Cambridge, England; contact Robert C. McLane, G-MMS Meetings Chairman, Honeywell Inc., 2345 Walnut St., St. Paul, Minn. 55113

Sept. 15-17, 1969: First International Conference on Programming Languages for Numerically Controlled Machine Tools, IFIP-IFAC, Rome, Italy; contact Dr. E. L. Harder, R & D Center, Westinghouse Electric Corp., Beulah Rd., Pittsburgh, Pa. 15235

Sept. 28-Oct. 1, 1969: Association for Systems Management International (formerly Systems and Procedures Association) International Systems Meeting, New York Hilton Hotel, New York City, N.Y.; contact Richard L. Irwin, Association for Systems Management, 24587 Bagley Rd., Cleveland, Ohio 44138.

Oct. 1-5, 1969: American Society for Information Science, 32nd Annual Meeting, San Francisco Hilton Hotel, San Francisco, Calif.; contact Charles P. Bourne, Programming Services, Inc., 999 Commercial St., Palo Alto, Calif. 94303.

Oct. 6-10, 1969: Second International Congress on Project Planning by Network Analysis, INTERNET 1969, International Congress Centre RAI, Amsterdam, the Netherlands; contact Local Secretariat, c/o Holland Organizing Centre, 16 Lange Voorhout, The Hague, the Netherlands

Oct. 9-11, 1969: DPMA Div. 3 Conference, Lafayette Hotel, Little Rock, Ark.; contact Robert Redus, 6901 Murray St., Little Rock, Ark.

Oct. 13-16, 1969: Association for Computing Machinery (ACM) Symposium on Data Communications, Calloway Gardens, Pine Mountain, Ga.; contact Edward Fuchs, Room 2C-518, Bell Telephone Laboratories, Inc., Holmdel, N. J. 07735; Walter J. Kosinski, Interactive Computing Corp., P.O. Box 447, Santa Ana, Calif. 92702

Oct. 13-16, 1969: 1969 International Visual Communications Congress, International Amphitheatre, Chicago, Ill.; contact Internat'l Assoc. of Visual Communications Management, Suite 610, 305 S. Andrews Ave., Fort Lauderdale, Fla. 33301

Oct. 14-16, 1969: American Society for Cybernetics, Third Annual Symposium, National Bureau of Standards, Gaithersburg, Md.; contact Dr. Edmond M. Dewan, Data Sciences Lab., Air Force Cambridge Research Laboratories, Hanscom Field, Bedford, Mass. 01731

Oct. 15-17, 1969: IEEE Tenth Annual Symposium on Switching and Automata Theory, University of Waterloo, Waterloo, Ontario, Canada; contact Prof. J. A. Brzozowski, Dept. of Applied Analysis and Computer Science, University of Waterloo, Waterloo, Ontario, Canada

Computing Must Acquire an Excellence of Professionalism and Responsibility

Few of us would doubt that computing is having an increasing impact on the professions. Many of the influences are peculiar to one profession or another, but the most pervasive influence — one that cuts across most if not all — is simply that computing is forcing a more rational approach on the professional.

For example, in assessing the elasticity of a market today, the marketing professional is less likely to depend upon a seat-of-the-pants opinion and more likely to consult a computer model of the market supplemented with information from a market survey. The military planner, in determining appropriate levels for his various forces, relies less upon the convictions of his generals and admirals, and more upon computer studies of conflict situations and estimates of the performance of opposing forces.

Needless to say, this transition is not without its frictions and disputes between "old pros" and "young Turks". The "pros" fear that computed results are often accepted as authoritative just because they come from the "Great Brain", and this fear leads them to denunciations of the "garbage-in-garbage-out" variety. The "young Turks" must admit that there are real dangers here — of uncritical acceptance and uncritical rejection.

In fact, all recognize that salvation here lies in a balanced approach, a middle view which James Schesinger of Rand Corporation calls "2½ cheers for computer analysis". In outline, it goes as follows:

- Computer models and data do not lead to a scientific procedure for making decisions without using intuitive elements.

- Rather, they provide a mechanism for sharpening the intuitions of the decision maker.

- The objective of computer analysis of situations, then, is to qualify common sense and make it explicit.

However, as some wag has said, "intuition and common sense are fine as long as they're right." The models and data represented in the computer must be congruent with the mechanics of the real world. For many problems in many professions our knowledge is insufficient for good modeling, and our measurement techniques are inadequate. This situation limits the power of computer analysis and puts an increasing burden on informed judgement. The wise balance depends upon the state of knowledge in the particular professional field.

All this moderation is easy to accept in the abstract. Putting it into practice is another matter. To strike the proper balance, perspective and excellence are vital, not only within the target professional field but also from the computing community itself. Thus, the influence of computing on the professions can be only as great as the professions' influence on computing. In short, as computing invades the professions, computing itself must acquire a professionalism of excellence and responsibility which goes well beyond what we see in the industry at the present time. A failure to develop this excellence and responsibility could be disastrous, not only to computing but to the professions that it touches.

— from "Computing and the Professions" by Edward E. David, Jr., Executive Director, Research Communications Systems Division, Bell Telephone Laboratories, Inc., in *Technology Review* for April 1969, published by the Alumni Association of M.I.T., Massachusetts Institute of Technology, E19-430, Cambridge, Mass. 02139. □

Oct. 22-24, 1969: IEEE 1969 Systems Science and Cybernetics Conference, Philadelphia, Pa.; contact C. Nelson Dorny, Moore School of Electrical Engineering, Univ. of Pa., Philadelphia, Pa. 19104.

Oct. 26-30, 1969: ACM/SIAM/IEEE Joint Conference on Mathematics and Computer Aided Design, Disneyland Hotel, Anaheim, Calif.; contact J. F. Traub, Program Chairman, Computing Science Research Center, Bell Telephone Laboratories, Inc., Murray Hill, N.J. 07974.

Oct. 27-31, 1969: Business Equipment Manufacturers Assoc. (BEMA) Annual Business Equipment Exposition and Management Conference, New York Coliseum, Columbus Circle, New York, N.Y. 10023; contact Laurance C. Messick, Business Equipment Manufacturers Assoc., 235 East 42nd St., New York, N.Y. 10017

Oct. 30-31, 1969: Assoc. of Data Processing Service Organizations Management Conference, Regency Hyatt Hotel, Atlanta, Ga.; contact Jerome L. Dreyer, Assoc. of Data Processing Service Organizations, Inc., 420 Lexington Ave., New York, N.Y. 10017.

Nov. 3-5, 1969: 5th Annual IEEE Symposium on Automatic Support Systems for Advanced Maintainability, Chase-Park Plaza Hotel, St. Louis, Mo.; contact Matthew F. Mayer, Program Chairman, P.O. Box 4124 Jennings Station, St. Louis, Mo. 63136

November 15-16, 1969: ACUTE (Accountants Computer Users Technical Exchange), Jack Tar, San Francisco, Calif.;

contact ACUTE, 947 Old York Rd., Abington, Pa. 19001

Nov. 17-19, 1969: IEEE Eighth Symposium on Adaptive Processes, The Pennsylvania State Univ., State College, Pa.; contact Dr. George J. McMurtry, Program Chairman IEEE 1969 (8th) Symposium on Adaptive Processes, Dept. of Electrical Engineering, The Pennsylvania State Univ., University Park, Pa. 16802

Nov. 18-20, 1969: Fall Joint Computer Conference, Convention Hall, Las Vegas, Nev.; contact American Federation for Information Processing (AFIPS), 345 E. 47th St., New York, N.Y. 10017

Nov. 25-27, 1969: Digital Satellite Communication Conference, Savoy Place, London, England; contact IEE Joint Conference Secretariat, Savoy Place, London WC2, England.

March 17-20, 1970: IEEE Management and Economics in the Electronics Industry Symposium, Appleton Tower, University of Edinburgh, Edinburgh, Scotland; contact Conference Secretariat, Institution of Electrical Engineers, Savoy Place, London, W.C.2, England.

Apr. 14-16, 1970: Computer Graphics 70, Second Interna'l Symposium, Brunel Univ., Uxbridge, Middlesex, England; contact Prof. M. L. V. Pitteway, Computer Science Dept., Brunel Univ., Uxbridge, Middlesex, England.

Sept. 1-4, 1970: Association for Computing Machinery (ACM) National Conference and Exposition, New York, N.Y.; contact Sam Matsa, IBM Corp., 410 E. 62 St., New York, N.Y. 10021; or Bob Bemer, General Electric Co., 13430 N. Black Canyon Hwy., Phoenix, Ariz. 85029 □

ACROSS THE EDITOR'S DESK

Computing and Data Processing Newsletter

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APPLICATIONS

CANADIAN FIRM WILL USE COMPUTERS FOR AERIAL SURVEY WORK

Geo-X Surveys Ltd. of Vancouver, Canada, has acquired the first four-channel differential gamma ray spectrometer manufactured by Exploranium Corp. of Canada Ltd., of Toronto. The sensitive equipment will be used in airborne survey work for more than a dozen companies seeking uranium in northern Saskatchewan. (Northern Saskatchewan has been an area of intensive uranium exploration in recent months.)

The spectrometer will be integrated with a system of recording data on magnetic tape. The equipment, installed in a high-performance, specially fitted aircraft, detects radiation emitted by uranium deposits on the ground, differentiating between uranium rays and rays emitted by other types of minerals. A radio location system in northern Saskatchewan (also operated by the company) will pinpoint locations of radioactivity readings. The locations will be recorded directly on the spectrometer's magnetic data tape which will be fed into computers.

Under the old system, surveys were often flown in the summer, results analyzed later, and maps produced in the off-season or winter months. The new spectrometer, tied in with the digital recorder, enables the firm to fly surveys...feed the recorded data by communication lines into computers and plotters in Edmonton, Calgary or Vancouver and have the maps produced within a day or two.

HOSPITAL INFORMATION SYSTEM INTEGRATES ALL FUNCTIONS IN 400-BED PSYCHIATRIC HOSPITAL

The Institute of Living, a 400-bed non-profit psychiatric hospital in Hartford, Conn., has integrated its computer system into every area from administration to clinical decision-making. The high-speed computer keeps track of patient behavior, drugs administered and a long list of hospital medical and business information. The computer also aids hospital training programs by allowing personnel to give themselves tests placed in the system by training directors.

The major difference in the approach to developing the operational system at the Institute from that of other hospital systems is that it began on the clinical side rather than on the business side of the

hospital. The system is centered on the patient's needs and does not split financial data from patient data in the belief that patient care and total operations of the hospital are inseparable. "The system has been operated from its inception by doctors, not computer people", explained Dr. John Donnelly, psychiatrist and chief of The Institute of Living.

On request, the system can describe in detail the patient's state on admission, last week, yesterday; his medication at every point; compare him with other patients and with normal persons — thereby aiding diagnostic accuracy — and turn all of this into graphs and charts that make this data dramatically visual. Moreover, the
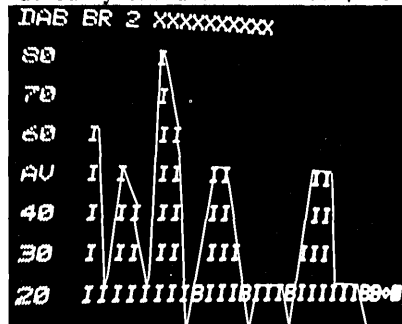
— Computer-produced profile of emotionally disturbed patient

computer's ability to accumulate and process data on a growing number of patients, with various psychiatric disorders, makes it possible to predict with increasing success everything from the course of the disease to what drugs will probably be most successful in treating a particular patient.

Administrative information, from patient billing to assignment of doctors, can be displayed — including percentage and actual bed occupation, average number of days patients of any named age are in the hospital, the costs to the hospital of any increases in services or wages, and the basic patient information obtained by the admissions staff.

Clinical observations and other appropriate information on patient care are entered in the system by the nurses, in language common to both doctors and nurses. They use a standard form called "Automated Nursing Notes" with 215 questions about the patient, plus space for narrative comments if needed.

All information about each patient entered by a member of the staff is instantly recallable on a screen in order that it may be checked for accuracy. It can be displayed in both narrative and graphic format and can be printed out for permanent records or detailed study.

A confidential coding system locks the information in until proper codes and identification numbers are signaled at terminals such as the one pictured. Only the authorized

— Nurse Laverne Beatty at the Institute of Living using terminal and display

persons have access to certain portions of a patient's record — a nurse, for instance, cannot have access to the patient's financial record, and only doctors have access to physician information.

The totality of the system is shown by describing what happens when a doctor orders a medication for a patient. When the pharmacist receives the doctor's prescription, he enters the information in the computer system. The computer prints out the label, the patient's clinical record is immediately up-dated to indicate the order, and the patient's total billing order is altered to indicate the charge.

The computerized system has been under development by the Institute over a five year period, supported in part through a grant from the National Institute of Mental Health. During the past two years further development and elaboration of the system was made possible through a joint effort with TravCom, Inc., a subsidiary of The Travelers Corp.

GOURMET SERVICE AIDED BY A COMPUTER IN THE WINE CELLAR

At au Pere Jacques, an internationally known restaurant located in Moreland Hills, Ohio, the wine cellar houses 20,000 bottles of vintage wines — and an IBM 1130 computer. This small gourmet restaurant, with a seating capacity of only 120, uses the computer to control an inventory of 2,000 different foodstuffs, to provide a running audit of sales and receipts — and to automatically prepare guest checks.

Each meal at au Pere Jacques is prepared individually which allows guests time to enjoy fine wines or other beverages, and relax before

dinner is served. The computer handles those impersonal chores which do not add to guest care or satisfaction. When a waiter takes an order, the emphasis is on recording instructions for the chef, rather than detailing a guest check for later billing.

As items on the menu are ordered, a simple identifying notation is made by the waiter (each food item is represented by a three-digit number). At the conclusion of the meal, these numerical codes are keyed into the computer through its typewriter keyboard. The numbers are converted by the computer into a printed, itemized, guest check. Item quantities and prices are listed, totaled and the correct tax is added — all automatically.
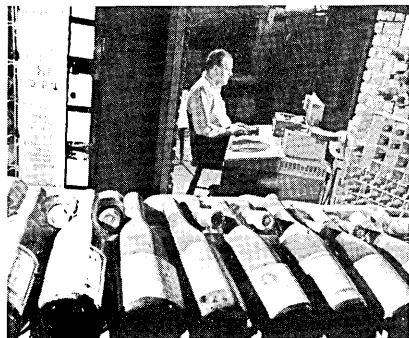
— Owner Jack Schindler is shown keying information into IBM 1130 computer and receiving printout of the number and kinds of wines available in stock

In addition, the 1130 performs a nightly revenue (total and audit), and on the close of business the last day of each month, all critical records of the restaurant are updated, ready for analysis, said owner Jack Schindler.

Au Pere Jacques, cited by Holiday Magazine as one of the country's outstanding restaurants, specializes in French cuisine and has an international clientele from as far away as Paris and the Philippine Islands. Specialty of the house is Dover Sole prepared 16 different ways.

TECHNIQUE FOR FORECASTING SEVERITY OF EARTHQUAKES BEING DEVELOPED WITH IBM COMPUTER

The sudden movement of blocks of rock to relieve themselves of accumulated strain results in an earthquake. A computer, charting the strain patterns along earthquake faults, is enabling scientists to develop a technique for forecasting the severity of possible earthquakes. Dr. Stewart W. Smith, associate professor of geophysics at

the California Institute of Technology, and Dr. William J. van de Lindt, staff member of IMB's Los Angeles Scientific Center, have applied the technique to a large portion of the San Andreas Fault in Southern California and northern Mexico.

The computer calculated that the magnitude 6.3 earthquake at Santa Barbara in 1925 and the magnitude 7.7 earthquake in Kern County in 1952 have significantly reduced the strain stored in the rock along the San Andreas Fault in the vicinity of Fort Tejon in the Tehachapi Mountains. If the calculations are correct, there is less likelihood than anticipated of Southern California being hit by a great earthquake during the next few years.

The research has included 31 earthquakes ranging from 6.1 to 7.8 magnitude and dating back to 1812. Detailed information about each was fed into an IBM System/360 Model 65 along with a mathematical model representing the geologic structure and elastic characteristics of the earth along the fault. The computer simulated each earthquake and calculated the amount of strain that was either built up or relieved in various locations. The strain patterns then were translated by the computer into letters that formed outlines and shaded areas representing the patterns, with different letters representing variations of strain.

The strain maps now cover the San Andreas country from the San Joaquin Valley to the Gulf of California — a distance of 450 miles. A similar study is contemplated of the fault northward to the Mendocino County coast, where the fault disappears into the ocean. The studies are being supported by the National Science Foundation and the Air Force Office of Scientific Research.

NEW SYSTEM FOR LOS ANGELES COUNTY SHERIFF'S DEPARTMENT WILL RETRIEVE AND COMPARE FINGERPRINTS AND PHOTOGRAPHS

ORACLE (Optimum Record Automation for Court and Law Enforcement) is a new program for the Los Angeles County Sheriff's Department which will speed and automate the handling of more than 18,000,000 law enforcement documents. Key element in ORACLE will be an Ampex Videofile information system — a system which combines videotape recording and computer technologies to store visual records. The system will include a central system located in the Hall of Justice, and document filing and retrieval equipment at the 15 outlying Sheriff's facilities.

Law enforcement records, stored as television recordings on video tape, are immediately available for viewing as television pictures in the Sheriff's facilities throughout the county and at the Hall of Justice. A Sheriff's facility will be able to enter case reports, finger-

— Video fingerprints being viewed by fingerprint analyst

prints, photographs and other documents into the master file remotely, or retrieve documents from the master file as television images in minutes. Average time required to locate and retrieve documents will be shortened from hours to minutes. Positive identification of arrested persons at outlying Sheriff's facilities will be dramatically speeded — often a prime factor in crime prevention.

The Los Angeles County system, scheduled for installation in 1970, will be the first application of the Videofile system in law enforcement.

EDUCATION NEWS

STUDENTS AT NOVA UNIV. SEEK DOCTORATES THROUGH RESEARCH WITH COMPUTER

At Nova University, Fort Lauderdale, Fla., a computer is helping PhD candidates and faculty members perform original research for theses. The university stresses complete academic freedom for its scholars. It provides informal class sessions, offers no courses for credit and ignores grading in the traditional manner.

Many of Nova's 18 doctoral students and 15 faculty members use an IBM 1130 computing system as an integral part of their learning process. Each student works independently at his own project in one

of four broad fields of research: physical sciences, education research, science education, or oceanography. Initial research direction is provided by the university, but each individual sets his own pace and objectives on projects requiring three to four years of intensive study. Nova's 1130, centrally located at the Student Center on campus, is available at all times to help researchers collect, store and analyze data pertinent to individual projects.

Dr. Abraham S. Fischler, dean of Graduate Studies, said, "Computer science makes practical Nova's aim of developing question-askers and problem-solvers rather than creating an institution of departmentalized structures."

INTERACTIVE PROGRAM HELPS STUDENTS EXPLORE VARIOUS OCCUPATIONS

The Interactive Occupational Exploration System, announced by Interactive Learning Systems, Inc. (Boston, Mass.), is the newest of the company's existing Guidance Assistance Programs. Utilizing an on-line computer to retrieve data, the new system is intended to aid students in exploring various occupational possibilities. The student interacts with the data file by typing simple alpha-numeric commands on a teletypewriter located in the school guidance office. The teletype is connected to a Burroughs B3500 computer by regular telephone lines. Designed for use by the student in high school, application also may be made on the junior high school and junior college levels.

The data file contains information about thousands of occupations coded from the U.S. Department of Labor's _Dictionary of Occupational Titles_. The student inputs characteristics which are important to him in choosing a job. The computer responds with a list of occupations having these particular characteristics. Each job is described by 15 categories such as work activities, physical demands, working conditions, earnings, education required, and others.

The company's previously announced computer systems for education are: the Interactive College Suggesting System, and the Career Training Information System. A Scholarship Search System is under development now and is expected to be ready within the year.
(For more information, circle #41 on the Reader Service Card.)

COMDYNA, INC. OFFERS ON-SITE ANALOG SIMULATION COURSE

The Comdyna GP-6 Analog Simulation and Computation Course was developed primarily for the digital computer programmer who desires to learn more of analog techniques. It is a 16 lesson program and includes on-site operation of the GP-6 computer and associated CRT readout display. The course includes: analog simulation; operational element model building; transfer function analysis; systems with variable and nonlinear co-efficients; analog techniques for instrumentation and online data analysis; and the fundamentals of hybrid computation.
(For more information, circle #42 on the Reader Service Card.)

FREE AUTOMATION FILM OFFERED BY HONEYWELL

Honeywell's Commercial Division has announced the availability of a new film on automation for local ASHRAE, CEC, AIA, NSPE meetings, and other engineering and industry sessions. The full-color, 16-millimeter sound film, entitled "The Pulse," runs about 20 minutes. The film, which is based on actual case histories, shows automation systems at work in hospitals, factories, colleges, schools and office buildings. The film is available on a loan-out basis.
(For more information, circle #43 on the Reader Service Card.)

COBOL HOME STUDY COURSE ADDED TO ATI'S CURRICULUM

COBOL (COmmon Business Oriented Language), the universal language of computers, has been established as a home study course at Automation Training, Inc., St. Louis, Mo. ATI is accredited by the National Home Study Council.

The COBOL course is taught on a short concentrated home study basis. It is offered to experienced data processing personnel and recent data processing graduates. ATI also teaches data processing and computer programming courses in residence as well as through correspondence.
(For more information, circle #44 on the Reader Service Card.)

AUDIO-PROGRAMMED COURSE ON EDP TERMINOLOGY IS AVAILABLE FROM DATA DISCIPLINE WORKSHOPS

An audio-programmed course, "EDP Terminology — The Language of the Computer Age", is being offered by Data Discipline Workshops (Ketter-

ing, Ohio). The course is contained in a set of tape cassettes assembled in a portfolio. Any type of conventional cassette recorder may be used. The learner progresses at his own pace and may undertake the instruction even in time not usually considered productive, such as while driving to or from work. Approximately eight weeks — on the basis of one hour a day instruction — is required to complete the course.
(For more information, circle #45 on the Reader Service Card.)

NEW PRODUCTS

Digital

PDP-15 COMPUTER / Digital Equipment Corp.

The new PDP-15 (PDP for Programmed Data Processor) computer, shown by Digital Equipment Corp. at the recent Spring Joint Computer Conference, is designed to fill the gap between 8-, 12- and 16-bit minicomputers and the large, high-performance, 32- and 36-bit machines. The high-speed, medium-scale PDP-15 has an 18-bit word length. It is being offered in four basic configurations, each upward expandable and each accompanied by the software and peripherals necessary to accomplish the tasks for which it was designed.
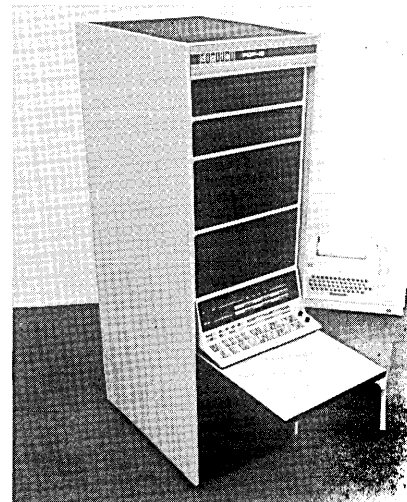
— PDP-15/10, the most basic of the four configurations, is pre-wired for expansion

Core memory begins at 4,096 words, expandable in 4,096-word modules to 32,768 words and to 131,072 words by means of the three additional bits built into the addressing register of the central

processor. Memory cycle time is 800 nanoseconds; add time is 1.6 microseconds.

The PDP-15 is expected to have a wide range of applications in such areas as physics, chemistry, communications, biomedicine, industry, education, oceanography and hybrid computation. First deliveries of the new computer are scheduled for early fall.
(For more information, circle #46 on the Reader Service Card.)

VARIAN DATA R-620/i /
Varian Data Machines

The Varian Data R-620/i, a ruggedized version of the Varian Data 620/i, is designed for mobile applications where vibration, shock, humidity, and other environmental extremes might be encountered. The ruggedized computer, now being produced by Varian Data Machines, subsidiary of Varian Associates, is functionally identical to the standard computer.

Circuit cards are identical except that components have been substituted in some cases to obtain the required space, corrosion-resistant, or fungus-proof characteristics. The packaging of the cards and the exterior chassis design are, however, completely different. The chassis itself is constructed of heavy aluminum members, assembled into a container 19 inches wide, 15-3/4 inches high, and 24 inches deep. The container is designed to slide in and out of a standard RETMA enclosure on ball-bearing slides.

The front panel of the computer carries all the controls found on the standard unit. The control elements and displays are rearranged to fit the new configuration; control components have been selected to provide the necessary humidity and temperature characteristics.
(For more information, circle #47 on the Reader Service Card.)

HP 2005A REAL-TIME EXECUTIVE SYSTEM /
Hewlett Packard Co.

The HP 2005A Real-Time Executive, introduced at the Spring Joint Computer Conference (held in Boston, Mass. last month), is a real-time computer system that can function in a multi-programming environment allowing higher priority programs to interrupt and take control from lower priority programs. Up to 99 levels of program priority are possible with more than one program grouped into the same priority.

In a multi-programming environment, the computer can operate many concurrent programs in foreground mode, simultaneously with a program in the background mode and with input/output operations. The Real-Time Executive supervises all interrupts, all I/O operations — including memory transfer to and from the disc — and all "housekeeping" chores necessary to a multi-programming system.

The basic Executive system combines an HP 2116B computer (with a 16K memory), a head-per-track storage disc (with a 174K memory), a teleprinter and a punched-tape reader. Test instruments and peripherals may be added to the system by inserting circuit interface cards into slots in the computer main frame. Cards and modular software are available for many peripherals and HP instrumentation.
(For more information, circle #48 on the Reader Service Card.)

MC232 TIME-SHARING COMPUTER SYSTEM / Mini-Comp, Inc.

A new Integrated Time-Sharing Computer System (MC232), has been announced by Mini-Comp, Inc. The basic system includes up to 32 local or remote terminals. All the terminals can operate simultaneously. It has a 16K-word memory and operates in fixed and/or floating decimal modes with 12-place accuracy; larger core and mass memories can be provided. The MC232 is of modular construction, allowing the purchase of minimum memory and terminal hardware with further expansion as required to meet the user's changing needs.

A library of software packages, designed to meet the specific requirements of various kinds of users in engineering and manufacturing activities is being developed. A simple terse language — MINI-TOK — communicates substantial instruction with a minimum of effort. The range of Mini-Comp products is expected to extend from single specialty terminals to the combination of multiple small computer systems into a large network.
(For more information, circle #49 on the Reader Service Card.)

ADVANCE 6135 / EMR-Computer

The 500-nanosecond ADVANCE 6135 computer, announced last month by EMR-Computer, has a 16-bit word central processor. The EMR 6135 is capable of an input/output burst rate in excess of six million words per second in a 32,768-word configuration. Designed for real-time data acquisition and data reduction

applications, the new computer is well-suited for seismic, bio-medical, process control, telemetry, automatic test and other applications requiring high throughput.

The low-cost, medium-scale EMR 6135 system incorporates most of the features of the larger, costlier machines including total monolithic integrated circuitry, asynchronous bus system of logic organization, three hardware index registers, hardware multiply and divide, and double-precision integer arithmetic. The new ADVANCE 6135 offers a versatile software system of programming packages and a wide variety of peripheral equipments and options for standard and special applications.
(For more information, circle #50 on the Reader Service Card.)

Special Purpose Systems

ILLUSTROMAT "1200" DRAWING SYSTEM / Perspective Systems, Inc.

The Illustromat 1200, a second generation model of Perspective Systems' Illustromat 1100, is a modular graphics system for creating three-dimensional drawings. The Illustromat, directed by an analog computer, enables any draftsman to convert orthographic (blueprint) plans into visually accurate 3-D illustrations, in a fraction of the time required by hand.
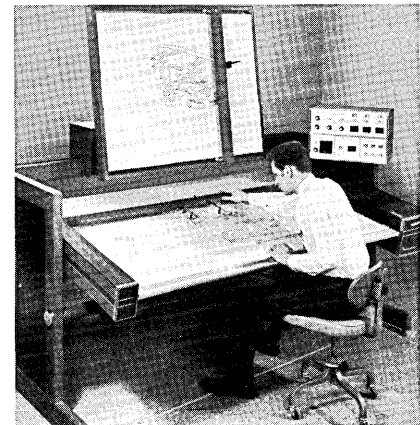
The new modular 1200 system consists of three major components: the tracing table, the computer, and the x-y plotter. Controls are consolidated in a console adjustable for reach. The table is easily raised, lowered, or tilted and locked in the most comfortable position for the operator.

As blueprint views are traced with two styluses mounted on a moveable gantry, the analog computer guides the pen on the vertical

x-y plotter. The console contains controls for the basic axonometric model. Additional plug-in modules can provide the 1200 with graphics capabilities such as perspective or stereo view, secondary axis, and view rotation.
(For more information, circle #51 on the Reader Service Card.)

COMPUTER-CONTROLLED CLOTH CUTTING SYSTEM / Gerber Garment Technology, Inc.

The development of a computer-controlled cloth cutting system for garment industry applications has been announced by Gerber Garment Technology, Inc., a subsidiary of The Gerber Scientific Instrument Company. The system, called the GERBERcutter, employs a digital control for high-speed, precise cutting of limp materials.

Major equipment consists of the computer control and a cutter drive system, modular spreading and cutting tables (sized to the user's cutting room requirements and which can use both automatic and manual cloth spreaders), and a transporter table for moving the cutting head and carriage to adjacent tables for continuous use. The system is designed so present cutting room personnel can easily use it without restructuring cutting room operations.

In addition to following pattern curves and straight lines within tolerances of $\pm 1/64$th of an inch, the versatile GERBERcutter drills holes, notches cloth, and annotates bundles for identification purposes. It also can make internal cuts, such as pockets, and outside cuts, such as contours. It can cut all typically used fabrics and is sufficiently versatile to handle supported vinyl automotive fabrics, paddings, and a wide variety of industrial textiles.
(For more information, circle #52 on the Reader Service Card.)

"1260" ECG RECORDER SYSTEM / 3M Company

A new system, known as The 3M "1260" ECG Recorder, transmits electrocardiographic signals by telephone for prompt and accurate diagnosis by a cardiologist. The system, developed by 3M Company, recently was demonstrated at the Oakland Naval Hospital (Calif.). It is the first one in use in a military hospital and the third such system in use in the United States.

A conventional electrocardiograph records the electrical energy generated by the heart as a line traced on a strip of paper by a heated stylus. Normally only one electrical signal, known as an ECG "lead", can be recorded at one time. The "1260" handles three or six "leads" simultaneously. The signals are transformed into tones that can be transmitted by special Dataphones to the central console where they are displayed on a cathode ray tube. A microfilm processor-camera in the console automatically prints a picture of the electrocardiographic signals on a microfilm mounted in an aperture data card. The entire process requires only 45 seconds.

A separate component, a reader-printer device, produces an 8 x 11" copy for filing in the patient's chart. If there is no urgency, the signals may be routed to a multi-channel magnetic tape recorder and the tape later played through the central console to produce the permanent microfilm record.
(For more information, circle #53 on the Reader Service Card.)

INDAC-8, MULTI-USE INDUSTRIAL CONTROL SYSTEM / Digital Equipment Corp.

INDAC-8, the latest in a line of small computer-based systems from Digital Equipment Corp., is designed for real-time use in a variety of industries. The system uses the company's PDP-8 family of small computers and includes a compiler level, real-time software and a real-time monitor software. INDAC-8 is designed for the engineer with FORTRAN level programming experience.

The typical INDAC-8 configuration is built around a PDP-8/1 computer with 4,096 words of core memory. The system includes a 32,768-word disk storage unit, a paper tape reader and punch, a real-time clock, two Teletypes and a 100-channel integrating digital volt meter.

Markets for INDAC-8 include the chemical, petrochemical, manufacturing, metals, utility, aerospace and research industries. Tasks to which it might be assigned include logging, alarming, basic set-point control, quality testing and a variety of jobs on the research level.
(For more information, circle #55 on the Reader Service Card.)

IDENTIMAT® 2000, PERSONAL IDENTIFICATION SYSTEM / Identimation Corp.

The Identimat® 2000, a completely automatic positive Personal Identification System, is designed to be used as a free-standing unmanned machine or in conjunction with computer equipment. (Identimat® is the tradename of Identimation Corporation, a subsidiary of Sibany Manufacturing Corp.) The Identimat® was developed in the Sibany Laboratory to fill the growing need for a quick and economic means of positive personal identification.

Here is how Identimat works: The geometry of the hand is measured and reduced to a series of codes which can be stored in various ways and then utilized in conjunction with the individual and the Identimat 2000. For "on-line" applications the coded information may be stored in computer memory
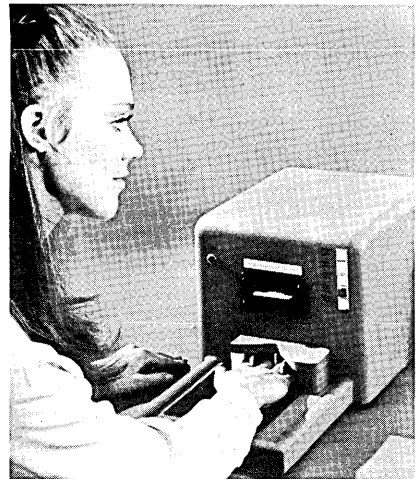
for call out to arm the Identimat 2000. Principle means of input for the Identimat 2000 are laminated plastic security passes or credit cards which can contain various types of coding (holes, magnetic, optics, etc.).

The new system instantly compares the user characteristically to information on his ID card or to information stored in a computer at an estimated cost of a fraction of a cent per verification. Identimat gives a Go/No-Go signal in a fraction of a second — and when installed with computer equipment, the accept-reject cycle is accomplished in milliseconds.
(For more information, circle #54 on the Reader Service Card.)

Memories

THE 380 CORE MEMORY SYSTEM / Fabri-Tek, Inc.

The versatile core memory system announced by Fabri-Tek, Inc., is designed to meet a variety of requirements in the data processing and data handling field. The 380 System operates on full cycle at 950 nanoseconds and split cycle at 1.0 usec. It stores up to 655,360

bits (8K x 40 to 64K x 10) in its compact, 10½" high by 20" deep chassis complete with power supply. The 80 pound unit makes maximum use of integrated circuits, including sense amplifiers, decoding and all internal digital logic.
(For more information, circle #85 on the Reader Service Card.)

1024-BIT MOS READ ONLY MEMORY / National Semiconductor Corp.

The MM522, introduced by National Semiconductor, is a 1024-bit MOS Read only Memory arranged as 256 x 4 or 128 x 8 bit words. The device has DC coupled logic on chip with no clocks required; high speed operation of less than 1 usec, and complete compatibility with DTL or TTL logic. Wire "AND" capability at the outputs is provided for building memories larger than 1024 bits. The MM522 is suited for code conversion, random logic synthesis, table look up functions, and character generators.
(For more information, circle #56 on the Reader Service Card.)

DELAY LINE MEMORY SYSTEM / Digital Devices Division of Tyco Laboratories, Inc.

A new low cost memory system, the FIFO Memory System, which uses a magnetostrictive delay line, was among the systems on display at the Spring Joint Computer Conference by the Digital Devices Division of Tyco Laboratories, Inc.
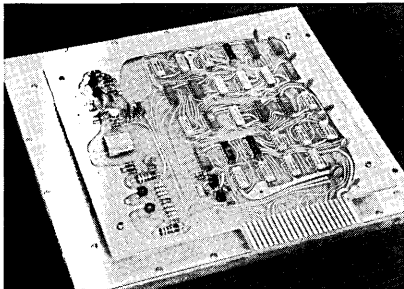
The FIFO Memory System will store up to 512 words of 8 bits each, or 341 words of 12 bits, or 256 words of 16 bits. The system, designed to operate from common DC voltages, is best suited for buffering limited message keyboard or communications systems.
(For more information, circle #57 on the Reader Service Card.)

Software

ADPAC / Adpac Computing Languages Corp., San Francisco, Calif. /

A complete programming language like COBOL or FORTRAN; it is a single language able to handle the total programming load. One of the five languages currently used for business programming, Adpac may be used as a high-level assembler, as a complete program generator or simply to generate subroutines. Adpac programs take 50% to 75% less machine time to compile and debug; beginners learn Adpac twice as fast as other languages. Now available for all IBM System/360 computers under TOS, DOS, and OS, Adpac will be available for other manufacturers' computers later this year.
(For more information, circle #58 on the Reader Service Card.)

A/R-70 / National Software Exchange, Inc., Great Neck, N.Y. / Developed by the Computer Processing Corp. of Hartford, Conn. this accounts receivable system provides the flexibility of specifying either Open Item or Balance Forward method of accounting by individual account. A/R-70 can be operated on any IBM System/360 with a minimum of 32K core, under either DOS or OS operating system. The system generates five comprehensive reports including an Edit Report, Accounts Receivable Posting, Aged Trial Balance Report, Past Due Listing and a Customer Status Report. It is priced at $16,000 which includes documentation, installation and four days of on-site support.
(For more information, circle #59 on the Reader Service Card.)

BEEF2/360 / Computation Planning, Inc. (COMPLAN), Bethesda, Md. / A software package which permits 360 FORTRAN and COBOL programmers to manipulate and test bit and byte strings easily and efficiently; consists of 52 CALLable operations of 9 basic types, such as string manipulation, decision making, searching, conversion, and character code transformation. BEEF2/360 sells complete with documentation and installation support, and three-year maintenance, for $4,750 for unlimited use in one installation; also available on a lease basis.
(For more information, circle #60 on the Reader Service Card.)

COMPUMETER / Computyne, Inc., Deer Park, N.Y. / A software system compatible with the entire IBM System/360 series, both DOS and OS; generates computer program identification and "on" time summaries for management to analyze and evaluate computer utilization and productivity without manual intervention. It does not drain line power. Price progresses proportionately to computer size;

i.e., for the IBM/360-25, $2500; -30, $3000; etc.
(For more information, circle #61 on the Reader Service Card.)

DEPRECIABLE PROPERTY SYSTEM / Process Consulting and Computing, Inc., San Diego, Calif. / A proprietary software package written in FORTRAN, the programs output schedule of depreciation (C-2), location (subsidiary) by property class, location (subsidiary) historical report, legal corporation by property class, transaction report and account ledger cards (reserve and expense). The programs are compatible with any computer using FORTRAN compilers. User manual, flowcharts, installation, training and maintenance sell for $2,000 plus expenses.
(For more information, circle #62 on the Reader Service Card.)

RAPS (Retrieval Analysis and Presentation System) / Leasco Systems & Research Corp., Bethesda, Md. / An information retrieval software package which can be applied with equal versatility to normal business reporting as well as analyzing and presenting data for statistical, scientific and engineering uses. Basic system contains two special-purpose compilers which transform RAPS language statements into retrieval programs, sort parameters, and output programs. The output program is compiled from RAPS language into FORTRAN source code, thus allowing any special logic that is not standard in the basic system to be included in the output program being compiled. Minimum configuration required is IBM System/360-30 with 32K core.
(For more information, circle #63 on the Reader Service Card.)

SUBSCRIPTION FULFILLMENT SYSTEMS BPA or ABC / Computerology, Inc., New York, N.Y. / Several comprehensive subscription fulfillment systems are available for immediate installation; systems will operate on IBM 1401, 1460, 1410 or 360/25-30 tape configurations. These include ABC (Audit Bureau of Circulations Inc.) and BPA (Business Publications Audit of Circulations Inc.) systems which provide for a full range of audit requirements as a minimum.
(For more information, circle #64 on the Reader Service Card.)

ULTRA-X (Universal Language for Typographic Reproduction Applications) / Printing Industry Computer Associates (PICA), Princeton, N.J. / A standard language which permits users in the printing and publishing industry to communicate easily and effectively with an IBM 360 computer. Simple

typographic statements are used to define the formats and ULTRA-X translates these statements into computer logic to achieve full-page composition. ULTRA-X is immediately available to IBM users on a sale or lease basis.
(For more information, circle #65 on the Reader Service Card.)

Peripheral Equipment

VIATRON COLOR DISPLAY UNIT / Viatron Computer Systems Corp.

Viatron officials at the Spring Joint Computer Conference announced that a VIATRON color display unit will be available for a rental charge of $35 a month. When tied to a VIATRON System 21 data entry systems, the color display will give operators a choice of eight vivid colors for processed data and eight background colors on a 12-inch television screen. The color capability is accomplished by decoding color characters and generating color signals which are then fed into a slightly modified standard color receiver — a technique developed by Michael J. Flanagan, Manager of Viatron's Display Development Department.

There are two color modes, Color A Mode and Color B Mode. Using Color A Mode, the operator enters the color coding right into the data stream via a keyboard. If the operator does not desire to use any of the eight colors and selects none, the display automatically shows white data on a black background. In Color B Mode, the colors are preset and the operator has no choice of colors.

Color television in EDP makes possible another level of coding of data, providing different colors for conveying different meanings (e.g., deficits in red, assets in black, etc.); it is an attention device, calling certain data to the viewer's attention by proper use of contrasting colors, such as urgent data in red, routine data in green, etc.
(For more information, circle #66 on the Reader Service Card.)

VIDEOMASTER 7000 DISPLAY SYSTEM / Ultronic Systems Corp.

Videomaster 7000, a general-purpose alphanumeric display system announced by Ultronic Systems Corp., a subsidiary of Sylvania Electric Products Inc., offers IBM System/ 360 users displays that are both hardware and software compatible at lower cost than systems currently available.

Videomaster 7000 includes a display monitor and a standard alphanumeric keyboard. In both the stand-alone and cluster environment, 960 displayable characters may be presented on the 74-sq. in. screen. The display logic, memory, character generator and power supply unit may be separately located to conserve desk space. No special power or air conditioning is required.

The system, specifically designed to operate with existing software in a remote mode, interfaces to either a 1200 or 2400 baud communications circuit terminating into an IBM 2701 Type III Communications Adapter.

In addition to standard editing features, Videomaster 7000 offers both formatting and hard-copy options. The system will operate with other computers besides the IBM System/360.
(For more information, circle #67 on the Reader Service Card.)

LOW COST TERMINAL WITH HARD COPY READOUT / TransCom, Inc.

A low cost remote computer terminal with hard copy readout has been developed by TransCom, Inc., subsidiary of Hi-G Incorporated. The patented device, designated the RCT-203, converts any standard telephone into a data transmission computer terminal. Input and output of information are accomplished by a simplified push button phone keyboard that requires little or no operator training.

Hard copy readout is on easy-to-read 3/4-in. tape providing instant verification of messages sent or received, and a permanent printed record of every transmission in or out of the unit. Information is printed out at a speed of 10 characters a second.

The RCT-203 is compatible with any information system. The only installation requirements are a telephone and a standard 110 volt electrical outlet. The RCT-203, weighing less than 15 lbs., is fully portable and can be easily moved making it possible to use a single unit in several locations.

In addition to its use as a computer terminal, the RCT-203 can be used to replace more expensive Teletype equipment in any business communication system. The device can be bought outright for less than $1000, or rented for less than $25 a month.
(For more information, circle #68 on the Reader Service Card.)

IBM COMPATIBLE DISK DRIVE / Greyhound Computer Corp.

The GCC 3311, a new data storage device for System/360 users has been announced by Greyhound Computer Corp. The disk storage device is fully compatible with the IBM 2311. Several new features, including advanced circuitry, will provide for maximum reliability, ease of problem isolation and a minimum number of parts.

The GCC 3311 was designed and is manufactured by General Electric to Greyhound Computer's specifications. Maintenance will be provided by the 180 nationwide service organizations of General Electric.
(For more information, circle #70 on the Reader Service Card.)

GRAPHICAL COMPUTER INPUT SYSTEM / Bolt Beranek and Newman Inc.

The GRAFACON Model 2020, a new graphical computer input system, available from Bolt Beranek and Newman Inc., has a tilt-top table for operator convenience. The versatile system interfaces directly on/line with 20 bits of X-Y data or digitizes off/line at sketching rates of 4,500 X-Y points/second.

Sitting at the console, the operator uses a pen-like stylus to input sketches, compose or edit text, digitize curves and points, and control data entry and processing.

The Model 2020 GRAFACON can be interfaced to the input channels of most small and large computers, either directly or via Bell System or Western Union dial-up line facilities. In the off/line operation, X-Y positions may be digitized in a variety of formats for interfacing to punched tape, punched cards and magnetic tape.
(For more information, circle #69 on the Reader Service Card.)

TC700 ELECTRONIC TELLER TERMINAL / Burroughs Corp.

The TC700 electronic teller terminal is designed for the preparation and communication of information between remote locations and a central computer system. The new teller console will operate with all Burroughs computers and other manufacturers' computers that meet USASI and ISO standards. In addition, the TC700 can be mixed in an on-line network with existing Burroughs teller consoles to provide additional capability.

The TC700 was designed to provide the capabilities required to implement the new total management information systems concept. In addition to performing on-line transactions with a central computer, the TC700 can function off-line as a completely self-sufficient unit with its own memory and programming system. First deliveries are expected in January of 1970.
(For more information, circle #71 on the Reader Service Card.)

COMPUTER ORIENTED DATA ENTRY SCANNER / Addressograph Multigraph Corp.

Designed to save time and extra steps in capturing source data for computer input, the Addressograph 9650 C.O.D.E. (Computer Oriented Data Entry) Scanner is an optical code reader and data converter interfaced to a buffered magnetic tape unit. Both imprinted A-M bar code language and Hollerith punched data (or combinations of both on the same source documents) are scanned and converted by the 9650 to magnetic tape ready for computer entry. Its high speed card reader scans up to 300 original source documents every minute. A separate out-file hopper diverts scanning exceptions, enabling the machine to operate without interruption.
(For more information, circle #72 on the Reader Service Card.)

DELTA 1 VIDEO DISPLAY TERMINAL / Delta Data Systems Corp.

The new low cost CRT display terminal, called the Delta 1 Video Display Terminal, has full computer systems input/output and video compatibility. The Delta 1 may be used with the IBM 360 Operating Systems without any software or hardware modifications; and it uses the same interface communications dialogue and command structure as IBM CRT terminals.

Delta 1's Format Mode simplifies computer operator interaction by protecting the format data that is displayed and enabling the variable data to be entered via the keyboard. Complete Edit and Erase capabilities permit quick, easy data manipulation. The screen may be erased, either by line or message, and characters or lines may be deleted or inserted without jumbling the text.

Maximum data display on a 12" diagonal CRT screen provides 960 characters (24 lines, 40 characters each). A 128 by 64 matrix provides full graphic display capability. The Delta 1's flexible data communication permits the transmission of a line, a message or the entire screen. The terminal operates at line speeds up to 2400 baud (asynchronous). The parallel high speed data transfer rate is up to 800,000 characters per second.
(For more information, circle #75 on the Reader Service Card.)

IKOR KEYBOARD / Ikor, Inc.

Electro-mechanical switching with its inherent limitations is eliminated in the new solid state electronic keyboard developed by Ikor, Inc. Ikor developed capacitance coupling as the motive force and introduced the advanced design in which each key code is built into the key structure itself. The unit is true solid state and rated for 30,000 hours MTBF. Output is TTL compatible.

One-key memory holds the key code in an output buffer until cleared by the operation of the next key. When two keys are struck simultaneously, a two-key roll-over feature prevents garbled encoding by stopping data output from both keys. Conventional boards transmit one key or the other.

Because each key carries its own built-in code, re-arrangement of keys may be done without wiring or circuitry changes. Any number of function keys may be used and arranged in any convenient configuration.
(For more information, circle #74 on the Reader Service Card.)

MODEL 801 CARD RECORDER / Electronic Laboratories, Inc.

The Model 801 Card Reader includes a magnetic tape recorder and a card reader that records fixed and variable data. Available from Electronic Laboratories, Inc., the Model 801 may be connected with a cash register or other business machine at the point of sale, in warehouses, shops, fleet garages, etc.

Up to 14 lines of fixed data is scanned from a paper or plastic card. Variable data is entered manually with a 3-digit thumbwheel switch and/or keyboard input located on the front of the machine.

Data in BCD format is recorded on magnetic tape through a multi-track tape head. Tape is stored in a standard 1/8" tape cartridge, with over 100,000 character capacity. Parity check assures validity of data recorded. Record, stop, rewind, card release and other controls are located on the front of the recorder.
(For more information, circle #73 on the Reader Service Card.)

FORDATA 1200 DATA COUPLER / Ford Industries

A new entrant in the data coupler market, Ford is a major manufacturer of telephone-associated communications equipment. The Fordata 1200 acoustic/inductive coupler is designed to connect a remote terminal to the telephone line and a central processor.

The Fordata 1200 coupler mounts directly on a standard model 500 telephone. The telephone handset rests in the coupler, which is cable-connected to a compact electronic control package (left in picture).
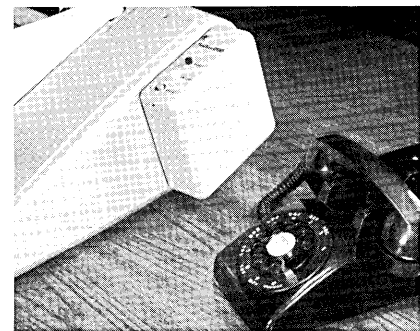
This package may be mounted on the outside (as on a teletypewriter), or inside, of the terminal equipment used. Normal use of the telephone is not disturbed by the installation.
(For more information, circle #76 on the Reader Service Card.)

ASTROSET 200 SERIES, DATA COMMUNICATIONS SYSTEMS / Astrocom Corp.

The first product group for sale from the recently formed Astrocom Corporation, a group of data communications specialists, is a family of data communications systems. The Astroset 200 Series offers six models having high speed data rates from 2000 to 9600 bits per second.

Astrosets can be installed using either private or dedicated leased lines. Several operating configurations are available including, simplex, half or full duplex, and party line situations. Ring indicators, remote control, and other options are available. Astrocom provides complete system installation service plus one-day unit interchange maintenance.
(For more information, circle #77 on the Reader Service Card.)

Data Processing Accessories

"OCTOBLIQUES", INTERCHANGEABLE TYPING SPHERES / Camwil, Inc.

Eight lines, described as "octobliques," now make possible the printing of complex molecular structures, especially stereochemical (three-dimensional) forms, without enlargement, reorientation, or distortion. They may vary from simple bridged rings to the complex carborane icosahedron. The "octobliques" were developed by Ronald Gottardi, Systems Analyst of Smith Kline & French Laboratories (Philadelphia, Pa.) for use in a Chemical Information Retrieval System at SK&F. The "octobliques" are adaptable to virtually any printing device from typewriters through high-speed computer printers for chemical documentation or chemical information storage and retrieval systems.
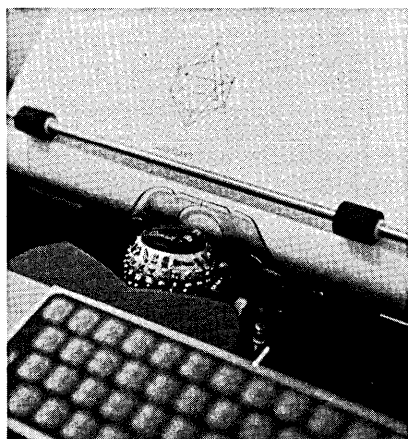
— Interchangeable typing sphere prints complex stereochemical structure

The "octobliques", with other symbols useful in chemical nomenclature and laboratory report preparation, have been placed on an interchangeable typing element. This interchangeable typing sphere, suitable for any Selectric® device from typewriters to computer terminals, will be marketed by Camwil Inc. The typing sphere may be

used to provide original documentation or produce suitable computer input along with a typed copy of the structure.

The same characters also have been engineered for use on a high-speed computer printer. The structures typed on input may be reproduced in approximately the same size and quality on the high-speed printer.
(For more information, circle #78 on the Reader Service Card.)

"SCOTCH" BRAND 911 DISK PACK / 3M Company

A new conductive coating, unique to the "Scotch" Brand 911 Disk Pack, minimizes the development of static charges which cause "phantom" errors and collection of dust and contamination. Build-up of these charges is particularly critical in the IBM 2314 compatible drive systems, for which the 911 has been introduced. A 3M spokesman said this is due to the reduced thickness of the air-bearing film between the flying head and disk surface. Available for lease or purchase, the 911 pack is pre-initialized and has high signal uniformity and coating durability.
(For more information, circle #79 on the Reader Service Card.)

MODEL 401 FORMSTACKER / Advanced Terminals Inc.

The Model 401 FORMSTACKER is a free-standing machine compatible with all line printers currently in use. Printed output is accepted at rates up to 2,000 lines per minute and high speed skipping rates up to 80 inches per second.

All standard continuous fan fold forms, including 11 pound single part paper, are stacked automatically. Paper widths of 4 to 18 inches can be accommodated. Model 401 stacks forms onto a tray which lowers automatically as the height of the forms increases. A maximum depth of 15 inches can be stacked; an automatic alarm notifies the operator of a stacker-full condition.
(For more information, circle #80 on the Reader Service Card.)

COMPUTER-RELATED SERVICES

"HEART HOT-LINE" WILL HELP DOCTORS PRESCRIBE FOR CARDIAC CASES

The world's available knowledge about heart disease treatment soon will be accessible to physicians in

abstract form through the Indiana University Medical Center's "heart Hot-Line". Emergency answers by telephone will be possible three minutes or less after they are requested. Initial use of the system will be restricted to Indiana region physicians. The service will be extended to other state medical schools as rapidly as possible. Ultimately it could service physicians through the world.

The memory bank retrieval system, as installed by Data Corporation, a subsidiary of The Mead Corporation, contains almost all of the available current information on heart disease treatment. As other abstracts are published, they will be added to the system.

The memory bank is available to inquirers by means of an input typewriter, a television screen and a readout machine which is, in effect, a teletype machine. The trained physician in charge answers the inquiring physician's query by phone. He feeds key words into the computer. Immediately the computer lists the titles of pertinent publications. In under three minutes the inquiring physician has his answer read out in abstract form. Later a substantiating readout is sent to the physician.

Aware that abstracts possess inherent limitations, one of which is subjective interpretation, the effort is now being made to supplement abstracts by immediate access to original documents through the computer. As soon as the Indiana University system is in full operation, the Indiana Regional Medical Program, operators of the system, will begin compiling treatment data on cancer and cerebral hemorrhage in similar manner.

FLEXIBLE SERVICE MATCHES SOFTWARE USERS WITH CONTRACTORS

The initial testing of a flexible service for locating and preselecting software contractors to meet specific, but variable, user needs, has been concluded by System Interaction Corporation. The service, known as M.A.V.I.N. (Machine Assisted Vendor Information Network), allows a user to select qualifications for contractors and to rank them in his own order of importance. The network accepts prioritized user parameters and then seeks contractors who most closely match them. Major selection parameters include: geographic coverage, development and language strength, mainframe and peripheral experience and commercial and scientific areas of specialization.

From its continually updated data base, M.A.V.I.N. (to be operational in the third quarter of 1969) will process user-defined demands and generate contract lists. The user will receive profile sheets covering all contractors matching his specific pre-selection requirements. (For more information, circle #81 on the Reader Service Card.)

GE EXPANDING MEDINET COVERAGE INTO CHICAGO AREA

General Electric Company has expanded coverage of MEDINET (their group providing computer services to hospitals) into the Chicago area. The first two offices of MEDINET, located in New York City and Watertown, Mass. (outside of Boston), have been serving hospitals in the Northeast with both administrative and patient care applications for the past year. MEDINET presently offers eight different applications designed to automate various hospital functions, and is continuing to design others in its development of a comprehensive hospital information management system. A hospital may use as few of the applications as it desires, adding others as need arises.

NEW LITERATURE

MINNESOTA PUBLISHES DIRECTORY OF STATE'S ENGINEERING AND SCIENTIFIC CONSULTANTS

Minnesota's Department of Economic Development has published a 47-page directory of engineering and scientific consultants in the state, available free to interested companies. The directory lists more than 200 consultants and includes the specialty fields of each firm. Copies may be obtained by writing to: Research Division, Department of Economic Development, 57 W. Seventh St., St. Paul, Minn. 55102.

FREE "SPEC BOOK" TO HELP VISUAL AID USERS

Admaster is now offering a free booklet titled "Practical Specifications for Visual Aids". While the publication is in one sense a catalog and price list, it has been designed to serve as a quick easy to use handbook. The booklet includes a dozen charts and tables which have proved their usefulness. These range from one that shows audience capacity in terms of size of screen, seating area, and number of persons, to one that tells at a glance the playing time of tape,

and speed. Single copies of "Practical Specifications for Visual Aids" may be obtained on request. (For more information, circle #82 on the Reader Service Card.)

TRAINING MANUAL FOR BASIC PROGRAMMING LANGUAGE

Dr. Robert E. Smith, author of several computer programming training manuals, has written a new manual for the conversational BASIC language. The book has been designed to allow the student to "interact" both with the computer as well as the manual, using it as a self-teaching guide or a classroom text.

Each page is a lesson printed on heavy stock paper held in a looseleaf binder and can be easily removed from the book to be used at a time-sharing terminal. Individual lessons consist of a problem, a flow chart of the problem, and the correct answer. The student is expected to write the program in the BASIC language to arrive at the solution.

Basic Ideas, published by International Timesharing Corp., is priced at $5.95 per copy with quantity discount prices available on request. (For more information, circle #83 on the Reader Service Card.)

USA STANDARD COBOL, X3.23 — 1968, AVAILABLE FROM USA STANDARDS INSTITUTE
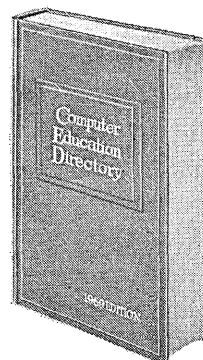
USA Standard COBOL, X3.23 - 1968, the result of a ten year COBOL development and standardization effort, is now available. The Common Business Oriented Language was designed to permit the specification of solutions to an extremely wide-range of commercial data processing problems. COBOL has been kept reasonably machine-independent in order to permit a high degree of program exchange across machine lines. The document may be purchased from the USA Standards Institute, 10 East 40th St., New York, N.Y. 10016. Single copy price is $6.50.

TAKING THE MYSTERY OUT OF THE MEMORY

Ferroxcube Corp. is offering, free of charge, a technical note providing basic electronic memory system interface information, definition of terms, common memory and digital binary math. This six page sheet will be a help to persons looking into memory for the first time. (For more information, circle #84 on the Reader Service Card.)

NEW CONTRACTS

TO	FROM	FOR	AMOUNT
Information Storage Systems, Inc., Cupertino, Calif.	Telex Corp., Tulsa, Okla.	Marketing rights to end-user customers in the U.S.A., Canada and Mexico for disk pack drives manufactured by ISS	$30 million
Business and Computer Devices, Inc., Plainview, N.Y.	Data Processing Financial & General Corp.	Manufacture of their new Models 2425 and 2427 Series magnetic tape systems exclusively for Data Processing Financial & General Corp.'s distribution to the end-user market	$10+ million
General Electric Co.	J. C. Penney Co., Inc.	Purchase of a new computerized information system designed to speed customer service, eliminate clerical errors and increase completeness of sales and merchandising information for store management	$10 million
Bryant Computer Products, Walled Lake, Mich.	Collins Radio Co.	Purchase of 40 Bryant Series 4000 Disc Files for use in Collins' C-8500 Computer System	$3.8 million
Scientific Data Systems, Computer Systems Division, Los Angeles, Calif.	Douglas Aircraft Co., Div. of McDonnell Douglas Corp., Long Beach, Calif.	A Sigma 7 computer and three Sigma 2 computers to update the flight test data processing facility; SDS has total systems responsibility, including development of special applications software and hardware	$3.3 million
Hazeltine Corp., Little Neck, N.Y.	Department of Defense	Production of electronic warfare equipment under a definitized contract	$2,323,000
EMR-Aerospace Sciences	National Aeronautics and Space Administration	Integration, test and launch of IMP-I, H and J spacecraft (IMP series of spacecraft are Interplanetary Monitoring Platforms designed to obtain solar, astronomical and environmental data outside the earth's atmosphere	$1.37 million
Planning Research Corp., Los Angeles, Calif.	U.S. Army, Defense Supply Services	Design and development of a Management Information System for U.S. Army real property resources	$1,257,000
Fischer & Porter Co., Warminster, Pa.	Seaford Associates, N.Y.	Instrumentation and chemical feed equipment to be used in a large water pollution control plant under construction for the County of Nassau, N.Y.	$1.2 million
Recognition Equipment Inc., Dallas, Texas	Pharmacists of Hessia, Rheinland-Pfalz, and Saarland	An optical reading and high-speed sorting equipment to automate drug claim processing	$1.1 million
Systems Engineering Laboratories, Inc., Fort Lauderdale, Fla.	McDonnell Douglas Corp.	Multi-computer system that will give complete preflight profile of the DC-10 jetliner	$1 million
EPSCO, Inc., Westwood, Mass.	U.S. Army Missile Command	Additional Mobile Target Tracking Systems (MITS)	$847,000
Data Products Corp., Woodland Hills, Calif.	Recognition Equipment Inc., Dallas, Texas	Model 4300 LINE/PRINTERS for use in conjunction with optical character reading equipment designed by Recognition Equipment	$846,000
Ampex Corp., Redwood City, Calif.	Oak Park and River Forest High School, Oak Park, Ill.	Design and installation of random access video system, the third part of a scheduled three-phase computer-controlled instructional resource center	$400,000
	Sycor Corp., Ann Arbor, Mich.	Model TMZ digital tape memories (100) for use in Sycor's off-line data translation system	$350,000
Memorex Corp., Santa Clara, Calif.	Intranet Industries, Inc., Los Angeles, Calif.	Ten disk drives for use in Intranet's computer time-sharing system	$250,000 (approximate)
System Development Corp., Santa Monica, Calif.	U.S. Office of Education	A study to determine if a computer, connected to a classroom of electronic pianos, can be used to teach music to third graders	$180,000
Datametrics Corp., Van Nuys, Calif.	Intranet Industries, Inc., Los Angeles, Calif.	Five disk controllers for use in Intranet's computer time-sharing system	$175,000 (approximate)
Electronic Associates, Inc., West Long Branch, N.J.	U.S. Naval Weapons Laboratory, Dahlgren, Va.	Two EAI 680 Analog/Hybrid computers for weapons system simulation and hybrid evaluation of fire control computers and programs	$160,000+
General Electric Co., Instrument Department, West Lynn, Mass.	City of Los Angeles, Dept. of Water and Power (Calif.)	A GE-TAC 7020 supervisory control system for control of a high-voltage, direct current transmission system's alternating current switchyard	$104,000
Dataram Corp., Princeton, N.J.	Navcor, Inc., division of KDI Corp.	300 PDM-10 Memory Systems; PDM-10's are used as low-cost buffer memories in keypunch-to-tape and high-speed printer applications	$100,000 (approximate)
Ampex Corp., Redwood City, Calif.	IRA Systems Inc., Waltham, Mass.	Model TMZ digital tape memories which will be standard equipment in IRA's new SPIRAS-65 Stored Program Controller	$100,000
Digital Products Corp., Fort Lauderdale, Fla.	Broward Junior College	Design and construction of five digital trainers for use in student instruction in computer technology	—
Strategic Systems Inc., New York, N.Y.	National Association of Securities Dealers, Washington, D.C.	Fully computerizing NASD's mailing, information and record-keeping facilities	—
Conrac Corp., New York, N.Y.	Air Force Systems Command, Aeronautical Systems Div., Wright-Patterson AFB, Dayton, Ohio	Three solid state digital altitude encoding computers to be evaluated by the military as part of its air traffic control radar beacon and identification system (AIMS)	—

NEW INSTALLATIONS

OF	AT	FOR
Burroughs B340 system	Highland Park State Bank, Des Moines, Iowa	Proof and transmit, demand deposit accounting, savings and installment loans; also will offer service bureau facilities to customers and other banks
Burroughs B500 system	Las Vegas International Hotel, Las Vegas, Nev.	Basic administrative functions, payroll, and will process all room reservations
	Somerset Trust Company, Somerville, N.J.	Demand deposit accounting, proof and transit, installment loans and general service functions
Control Data 3150 system	Electric Machinery Mfg. Co.	A variety of business applications and for solving engineering problems
Digital Equipment PDP-10	Badger Meter Mfg. Co., Milwaukee, Wis.	Quality testing and in-house time-sharing services
	Chase Brass & Copper Co., Montpelier, Ohio	Expansion of computer-based logistics management system; replaces older DEC system
GE-405 system	Fisher-Price Toys, Inc., East Aurora, N.Y.	Processing inventory, parts explosion, order entry and financial applications
GE-425 system	City of Tulsa, Tulsa, Okla.	Customer utility accounting system, immediate customer inquiry response; personnel/payroll system for City's 3,000 employees will be added later
Honeywell Model 120 system	Grimes Mfg. Co., Urbana, Ohio	Engineering work, bill of materials, order entry, net requirements for 40,000 items and inventory
	Laurens Glass Co., a div. of Indian Head Inc., Laurens, S.C.	Order entry, sales analysis, payroll for three plants, and accounts receivable applications
	Jim Robbins Seat Belt Co., Mount Clemens, Mich.	Production reporting, scheduling, routing, general accounting and payroll
Honeywell Model 125 system	General Dynamics Electronics Corp., San Diego, Calif.	General ledger, accounts payable, financial reporting, material control requisition purchase and status, parts application, pricing and estimating and budget control
Honeywell Model 2200 system	Varo Inc., Garland, Texas	Corporate-wide accounting and payroll; plan to establish a central data base later, using computer for material control, production control and personnel work for all company divisions
IBM System/360 Model 25	Chamberlayne Junior College, Boston, Mass.	"Hands-on" experience for their computer programming students; administrative services; and automating the college's library catalog
IBM System/360 Model 30	Association of Ancilla Domini Hospitals, Chicago, Ill.	Hub of a computer network serving nine hospitals in four midwestern states; applications now on the system include patient billing, accounts receivable, payroll, fixed asset accounting, and maintenance; direct patient care applications are being phased into the system
IBM System/360 Model 40	Farmers & Mechanics Savings Bank, Minneapolis, Minn.	An on-line data information system providing one-stop customer service for over 260,000 accounts
	Orlando Utilities Commission, Orlando, Fla.	Customer service; accepting, processing and dispatching service orders; calculating engineering project schedules; management summaries and analyses
IBM System/360 Model 44	Information Network Corp., Phoenix, Ariz.	Replacement of a Model 30 increasing time-sharing speed and capacity tenfold
NCR Century 100 system	AMETEK/Straza, California-based subsidiary of AMETEK, Inc.	Processing payroll, personnel statistics, and accounts payable; will add purchasing records and accounts receivable; also will be available for engineering applications
NCR Century 200 system	Banco de Cedulas Hipotecarias, Mexico City, Mexico	Processing about 50,000 savings accounts on-line; also some 25,000 mortgage accounts, general accounting and payroll, off-line
	Bankers Computer Services, Longview, Texas	Data center services on a cooperative basis for the Longview National Bank and the First National Bank of Longview; will extend services later to other institutions in the area
	Belgian Treasury Department (2 systems)	Handling complexities of Belgium's new "added value" tax which becomes effective next January
	Thomas Nationwide Transport, Australia (2 systems)	Preparation of invoices and statements, branch analysis of revenue, manifest analysis, printing of consignment summaries, and depot tonnage analysis
UNIVAC 9200 system	Electronic Computer Programming Institute, Fresno, Calif.	Facilitating the teaching of computer languages
	Sunroc Corp., Glen Riddle, Pa.	Payroll processing, orders and invoices, calculation of commissions, production scheduling and preparation of various management reports
	Tiny Tot Diaper Service, Indianapolis, Inc.	Billing, diaper check-in, accounts receivable and payable, sales promotion, direct mail, routing, pre-natal analysis and inventory control
UNIVAC 9300 system	Clark County, Vancouver, Wash.	Processing work originating in the County auditor's, treasurer's and assessor's offices; applications include preparation of county payroll, assessment of valuation of land and buildings
	Kentron Hawaii Ltd., Honolulu, Hawaii	Scientific analysis of data received from missile and satellite tracking stations; general accounting, materials management and logistic applications

NEW PATENTS

3,430,225 / Michel Louis Avignon, Neuilly-sur-Seine, France / International Standard Electric Corporation, New York, N. Y., a corporation of Delaware / Analog information storing device.

March 4, 1969

3,431,491 / Lanny L. Harklau, Minneapolis, Minn. / Sperry Rand Corporation, New York, N. Y., a corporation of Delaware / Memory apparatus and method.

3,431,558 / Anthony J. Capozzi, Binghamton, N. Y. / International Business Machines Corporation, Armonk, N. Y., a corporation of New York / Data storage system employing an improved indexing technique therefor.

March 11, 1969

3,432,686 / Louzelle Albert Luke, Coon Rapids, Minn. / Sperry Rand Corporation, New York, N. Y., a corporation of Delaware / Search memory match logic detector.

3,432,815 / Donald J. Lem, Peekskill, N. Y., and Wilhelm G. Spruth, Boeblingen, Germany / International Business Machines Corporation, Armonk, N. Y., a corporation of New York / Switching logic for a two-dimensional memory.

3,432,825 / Hisao Maeda, 211 Minamisenzoku-machi, Ota-ku, Tokyo-to, Japan; Hisaaki Maeda, heir of said Hisao Maeda, deceased / Matrix memory device with conductors of which some have magnetic thin film coating.

3,432,834 / Harry Putterman, Elizabeth, N. J. / General Precision Systems Inc., Little Falls, N. J., a corporation of Delaware / Non-destructive read-out memory.

March 18, 1969

3,433,938 / Arnold R. Johnson, Omaha, Nebr. / Western Electric Company, Inc., New York, N. Y., a corporation of New York / Data processing apparatus.

3,433,973 / David Joseph Morris, Stoke-on-Trent, England / The English Electric Company Limited, London, England, a British company / Magnetic logical device.

3,434,118 / Antonin Svoboda, Jan Oblonsky and Zdenek Korvas, Prague, Czechoslovakia / Vyzkumny ustav matematickych stroju, Prague, Czechoslovakia / Modular data processing system.

3,434,119 / Lubomyr S. Onyshkevych, Trenton, N. J. / Radio Corporation of America, a corporation of Delaware / Magnetic memory employing stress wave.

3,434,120 / Everett O. Olsen, Wrentham, Mass. / The Foxboro Company, Foxboro, Mass., a corporation of Massachusetts / Capacitive memory storage device employing magnetizable material as a dielectric.

3,434,121 / Robert A. Gange, Belle Mead, N. J. / Radio Corporation of America, a corporation of Delaware / Cryoelectric memory system.

3,434,122 / Cecil E. Land and Gene H. Haertling, Albuquerque, N. Mex. / United States of America as represented by the United States Atomic Energy Commission / Multiremanence Ferroelectric ceramic memory element.

3,434,125 / John A. Baldwin, Jr., Fullerton, Calif., and Andrew H. Bobeck, Chatham, N. J. / Bell Telephone Laboratories, Inc., New York, N. Y., a corporation of New York / Magnetic information storage circuits.

3,434,127 / Gerald Patrick Rodgers, Southampton, England / The General Electric Company Limited, London England, a British company / Magnetic storage apparatus employing high permeability auxiliary core.

3,434,128 / Richard P. Shively and David V. Dickey, Los Angeles, Calif. / Litton Systems, Inc., Beverly Hills, Calif., a corporation of Maryland / Coincident current memory.

March 25, 1969

3,435,423 / Richard H. Fuller, Sherman Oaks, Ju C. Tu, Sylmar, and Robert M. Worthy, Hollywood, Calif. / General Precision Systems Inc., a corporation of Delaware / Data processing system.

3,435,426 / George H. Barnes, West Chester, Pa. / Burroughs Corporation, Detroit, Mich., a corporation of Michigan / Method and apparatus for non-destructive memory devices.

3,435,427 / Orville L. Schaefer, Phoenix, Ariz. / General Electric Company, a corporation of New York / Magnetic memory system for the storage of digital information.

3,435,428 / Bruce I. Bertelsen, Hans G. Hottenrott, and Herbert J. Kump, Poughkeepsie, N. Y. / International Business Machines Corporation, New York, N. Y., a corporation of New York / Dispersion locked memory.

3,435,430 / Hans Georg Bengtsson, Hagersten, Sweden / Telefonaktiebolaget L M Ericsson, Stockholm, Sweden, a corporation of Sweden / Multistage magnetic shift register with each stage having four cores.

3,435,433 / David Ralph Bennion and William Kirk English, Menlo Park, Calif. / AMP Incorporated, Harrisburg, Pa., a corporation of New Jersey / Magnetic core shift register.

3,435,434 / Donal A. Meier, Inglewood, Calif. / The National Cash Register Company, Dayton, Ohio, a corporation of Maryland / Two-magnetic element memory per bit.

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.

15th ANNUAL EDITION OF THE

COMPUTER DIRECTORY AND
BUYERS' GUIDE, 1969

June 30, 1969 Midyear Issue of **computers** Vol. 18, No. 6
and automation

The COMPUTER DIRECTORY is:

- an annual comprehensive directory of the firms which offer products and services to the electronic computing and data processing industry

- the basic buyers' guide to the products and services available for designing, building, and using electronic computing and data processing systems

- published in June as the midyear issue of Computers and Automation magazine, and is included in the full annual subscription (12 monthly issues plus Directory)

The CONTENTS of the 1969 Directory will include:

- A Roster of Organizations in the Electronic Computing and Data Processing Industry
- A Buyers' Guide to Products and Services in the Electronic Computing and Data Processing Field
- Special Geographic Rosters of:
  1. Organizations selling computing and data processing services;
  2. Organizations selling commercial time-shared computing services;
  3. Commercial organizations offering courses, training, or instruction in computing, programming, or systems;
  4. Organizations selling consulting services to the computer field;
  5. Organizations offering computing and data processing equipment on a lease basis;
  6. Organizations selling software or computer programs.
- Characteristics of General Purpose Digital and Analog Computers
- A Roster of College and University Computer Centers
- A List of Over 1500 Applications of Electronic Computing and Data Processing Equipment
- A World Computer Census
  ... and much more

PRICES for the 1969 Computer Directory are:

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  present subscription does not include the Directory (magazine address label is
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  is $10.00, and thereafter $12.00.)

- Special prepublication price for non-subscribers $12.00
  (After publication, price to non-subscribers is $14.50)

- The Directory is included in the $18.50 full annual subscription (13 issues) to
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If not satisfactory, the DIRECTORY is returnable in seven days for full refund.

YOU ARE INVITED TO ENTER OUR

7th annual
COMPUTER ART CONTEST

the special feature of the
August, 1969 issue of

computers
and automation

The winning entry will appear on the cover
of our August issue — more than 25 entries
will be published inside.   The 1968 first
prize winner, "Hummingbird", is shown
here at the left.

GUIDELINES FOR ENTRY

1. Any interesting and artistic drawing, design or sketch
   made by a computer (analog or digital) may be entered.
2. Entries should be submitted on white paper in black ink
   for best reproduction.   Color entries are acceptable,
   but they may be published in black and white.
3. Each entry should be accompanied by an explanation in
   three or four sentences of how the drawing was pro-
   grammed for a computer, the type of computer used,
   and how the art was produced by the computer.

There are no formal entry blanks; any letter submitting
and describing the entry is acceptable.   We cannot under-
take to return artwork, and we ask that you not send orig-
nals if good copies are available.

Deadline for receipt of entries in our office is July 3, 1969.