DIGITAL COMPUTER NEWSLETTER

The purpose of this newsletter is to provide a medium for the interchange, among interested persons, of information concerning recent developments in various digital computer projects

OFFICE OF NAVAL RESEARCH • MATHEMATICAL SCIENCES DIVISION

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Approved by
The Under Secretary of The Navy
27 August 1951

COMPUTERS

HUGHES DIGITAL COMPUTERS FOR AIRBORNE CONTROL SYSTEMS

Computer Characteristics

The latest model Hughes airborne digital computer is a serial, general purpose machine with a word length of 16 binary digits, plus one sign digit and a digit repetition rate of 160 kc. The computer code has 46 orders. The orders include addition, subtraction, multiplication, division, and square rooting, as well as various transfers, sign checks, etc. The memory of the computer is a magnetic drum with a storage capacity of 2500 words. The drum rotates at 8000 rpm and the density of magnetic recording is 100 binary digits per inch. Input-output equipment for use with the airborne computer can handle up to 50 voltage inputs or outputs. Shaft to digital conversion units are also used depending on the system requirements.

Operational Performance

Models of an airborne digital computer have been flight-tested in a C-47 aircraft. The computer has been used to automatically control the aircraft through an autopilot. Automatic control of the C-47 aircraft by the digital computer was smooth and accurate. A successful autopilot coupler has been built which takes digital outputs from the computer and supplies heading-angle corrections to the autopilot. Flight tests have included automatic dead reckoning during flight and programmed flight through a series of preselected points.

THE UNIVAC

Franklin Life Insurance Company of Springfield, Illinois, will install a Remington Rand UNIVAC in the late Spring of 1954. Charles E. Becker, Franklin Life's president, says:

"We are convinced that the insurance field in general will not be able to keep up with the continued demand for its services without introducing electronic data-processing equipment to handle the heavy volume of paperwork which future expansion will bring. The physical problem of finding enough room for the employees and office equipment needed would be staggering in itself, without giving thought to anything else.

"We have been in process of converting our procedures to electronic requirements for some time now. Four primary functions will go on the UNIVAC first: premium billing and accounting, valuation, agents' commission calculating and accounting, and dividend accounting. Others will be added as we go along.

"In premium billing and accounting the UNIVAC will maintain the master file, select notices due and prepare them so that they will only have to be placed in a window envelope for mailing, and handle the payments as they come in. In valuation the system will take care of the computation of reserve liability. All the computations and accounting volume in the other functions will also be handled automatically.

"Current plans for all four of these functions, based on present volume, will be accomplished in daily operations totaling 10 to 12 hours, five days a week—one-and-a-half shifts. The UNIVAC staff will total 20 people for both shifts. At present, this work requires 1200 clerical hours of work every day."

THE ORACLE

The ORACLE is now installed in its permanent location and has been on an operating basis since February 15, 1954. Input information is inserted by means of a Ferranti photo-electric reader utilizing five-hold paper tape. The magnetic tape auxiliary memory will not be installed until summer.

A photographic curve plotter is under development which will afford fast output information of either graphical or digital nature. Other high-speed output equipment is under consideration.

Another project in progress is the design of an automatic checking facility of the odd-even type. This feature will check reading from both the electrostatic and auxiliary memories.

THE FLAC

By the end of January 1954, three magnetic wire units had been attached to the Florida Automatic Computer, FLAC and placed in reliable operation. Final debugging of the interconnections between the Computer proper and the rack containing four Raytheon high speed tape units was in progress. FLAC's performance since placed in scheduled operation, 1 September 1953, may be summarized as follows:

FLAC OPERATION LOG SUMMARY

	Oct.	Nov.	Dec.	Jan.
Useful Time (Prob. Running & Eng.)	93.0%	77.0%	92.4%	87.2%
Down Time	7.0%	23.0%	7.6%	12.8%
Break Down of Useful Time				
Problem Running & Code Check	21.0%	22.5%	49.0%	46.0%
Good Eng. Time & Idle Time	49.5%	45.7%	36.4%	38.8%
For Computer Check	2.0%	4.3%	5.0%	1.3%
Scheduled Maintenance	20.5%	4.5%	2.0%	1.1%
	93.0%	77.0%	92.4%	87.2%
Elapsed Time for Month	142.1 hrs.	156.0 hrs.	153.5 hrs.	231.2 hrs.

COMPUTER RESEARCH CORPORATION, of CALIFORNIA

The Applications Department of Computer Research Corporation has recently been expanded and is now in the process of making a number of diversified applications studies for the CRC 102-A General Purpose Computer.

The second CRC 102-A General Purpose Computer was shipped to Holloman Air Force Base on February 19. The number one machine is being kept in the Computing Center at Computer Research Corporation for use in the Applications Department. The machine will be used to make case studies of the use of the CRC 102-A. It will also be available for problem solution on a contract basis.

Six CRC 105 Decimal Digital Differential Analyzers are now in use by various government agencies and private companies. Their average performance to date has exceeded 90% up time.

A CRC 127 Magnetic Tape Editing and Printing Unit and a CRC 126 Magnetic Tape Unit have been delivered to the Navy Bureau of Aeronautics in Washington for use with the CRC 107 GPC and the High Speed Printer delivered last August.

THE RAND

The RAND computer (JOHNNIAC) started operating February 16 with a 256 word selectron memory (40 tubes) and IBM card input and output. A magnetic drum of about 12,000 word capacity is to be delivered in March from the W. S. Macdonald Company. A 4096 word ferrite

magnetic core memory is under construction at International Telemeter Corporation. It is scheduled to be installed in place of the selectrons in November of this year.

WHIRLWIND I

Applications

During the past three months, the following problems were initiated by the Scientific and Engineering Computation (S&EC) Group, in conjunction with various departments at MIT, for solution on Whirlwind I:

Problem No.	Title
154	Magnetic Susceptibility Evaluation
158	Relay Servo Response
159	Water Use in a Hydroelectric System
160	Similarity Transformation of a Matrix
161	Response of Mass-Plastic Spring System to Transient Loading
162	Determination of Phase Shifts from Experimental Cross-Sections
163	Ferrite Phase Shifters in Rectangular Wave Guide
166	Construction and Testing of a Delta-Wing Flutter Model
167	Products of Batch Distillations with Holdup
168	Indicial Downwash Behind a Two-Dimensional Wing
169	Utilizing a General-Purpose Digital Computer in Switching Circuit Designing

Work was also done on other problems described in previous issues.

The development of the comprehensive system of routines for the input conversion of suitably prepared punched paper tapes has continued. These routines automatically provide a program with suitable programmed-arithmetic, cycle-counting, and output facilities. The original system, which has been used successfully for more than a year, is now being revised to expand the facilities available.

Academic Program

The following seminars on computing machine methods were held:

Dec. 1, 1953 "An Interpretive Program for Mathematical Equations"
Dr. J. H. Laning, Jr., Instrumentation Lab., MIT

Dec. 15, 1953 "A Mistake Diagnosis Routine for WWI"
D. T. Ross, Servomechanisms Lab., MIT

Jan. 12, 1954 "Some Aspects of the Numerical Integration of Ordinary Differential Equations"
Dr. Per-Olav Löwdin, University of Uppsala, Sweden

Feb. 23, 1954 "Survey of Commercially-Available Digital Computers"
Dr. F. M. Verzuh, Director Statistical Services, MIT

A series of seminars on advanced programming techniques has been organized and presented by members of the Digital Computer Laboratory staff. These seminars provide an extension of the basic ideas that are presented in the special two-week introductory programming course offered to persons who have been unable to take the more formal MIT courses but who desire to carry out the solution of approved problems.

Plans are being made for two Special Summer Programs on digital computers to be presented during the 1954 Summer Session. One two-week program (MIT subject 6.531) will describe the planning and coding needed in using stored-program general-purpose digital computers, with special reference to business applications. The other program (6.532) will provide a one-week series of lectures and discussions on automatic coding techniques for a group of experienced computer programmers.

ABERDEEN PROVING GROUND COMPUTERS

The ENIAC completed its eighth year as an operating machine in February 1954. A number of basic improvements during this period have enabled the ENIAC to remain efficient to operate. Maintenance and administrative expenses cost $32 per available hour of machine time, based on 1953 figures.

The EDVAC high speed tape reader has been installed. The EDVAC IBM has been installed. The EDVAC IBM input-output has been satisfactorily used, but is not yet available for 24 hour operation.

The IBM-CPC has been retired. The high speed machines now all have IBM input-output and can satisfactorily handle the former CPC programs.

An Ordnance Computer Newsletter, to be published by the Ballistic Research Laboratories, will appear quarterly beginning 15 April 1954 for the purpose of providing an interchange of computer information among the various Army Ordnance installations and their contractors. To date about 50 Ordnance installations have requested to be put on the distribution list.

ELECTRODATA CORPORATION (formerly Consolidated)

The Computer Division of Consolidated Engineering Corporation has become a wholly-owned subsidiary of Consolidated with offices at 717 North Lake Avenue, Pasadena, and a production plant nearby. The name of the new firm is ElectroData Corporation.

The prototype model of the Consolidated 30-201 Computer, which continues in operation at the ElectroData plant, will be brought up to date with new developments.

Data-processing systems delivered in late 1954, ElectroData 203, will have punched-card input-output and line-at-a-time printer output in addition to paper tape, Flexowriter, and photoelectric paper tape reader. Systems delivered earlier are engineered so that they can be modified for punched cards.

The ElectroData 204, at the beginning of 1955, will be delivered with, in addition to the equipment mentioned above, one master magnetic-tape unit containing equipment relating the tape medium to the computer, and up to nine other tape units controlled by the computer. Each magnetic-tape unit will have more than forty times the capacity of the magnetic drum in the computer.

The prototype model has solved differential equations, inverted matrices, and performed a variety of data-reduction and statistical computation.

NAVAL PROVING GROUND CALCULATORS

The Aiken Relay Calculator (Mark II) and the Mark III Electronic Calculator have been operated on a 24-hour per day schedule six days a week. The operating efficiency of the Mark II has averaged 91 percent and that of the Mark III has averaged 70 percent.

The Computer Research and Development Group has been engaged in projects designed to improve the reliability of the various components in the Calculators. Considerable attention has been given to the magnetic tape input-output system and the output printing system for the Mark III Calculator. Various tests have also been conducted on the magnetic drum recording system in order to determine optimum recording current.

Urgent ballistic computations of the Bureau of Ordnance still occupy a major portion of the available time of the Calculators. In addition to this some other types of computation have been performed for contractors of the Bureau of Ordnance.

THE INSTITUTE FOR ADVANCED STUDY ELECTRONIC COMPUTER PROJECT

The Institute for Advanced Study machine was in full use during the period from December 1953 to date. Operating experience with the Williams memory has been extremely good; changes made during the relocation of the machine appear to have virtually eliminated slow parameter drifts.

The 2048 word magnetic drum auxiliary memory is now in full scale operation. In addition, a division spill indicator was added to the machine to help control mathematical scaling errors.

The mathematical group has among other things made a quite extensive investigation of the decay of a spherical blast wave moving into air. The motion was investigated with a starting over-pressure of 99 atmospheres and continued to an over-pressure of about .02 atmospheres. The calculations were checked by re-running the problem with a different spatial mesh. The results of the calculations are now being analyzed and will be prepared for publication in the very near future.

The meteorology group continued investigations into mathematical models suitable for numerical prediction and preliminary tests were made with two multi-level non-linear models with encouraging results. Forecasts were made with several existing models for the severe East Coast storm of November 5, 1953 with very satisfactory predictions of the onset and motion of the storm center.

COMPUTER COMPONENTS

NON-MAGNETIC RELAY

Development of an electronic relay that promises to be as revolutionary to relay design as the transistor was to vacuum tubes has been announced by Mullenbach Electrical Manufacturing Co., Los Angeles.

The new device, called the "Capaswitch", is basically an ultra-sensitive, non-magnetic D.C. relay with unusual current carrying capacity. An entirely new operating principle is used to provide the mechanical energy to open and close the contacts. Instead of the conventional electromagnetic armature, the Capaswitch uses a unique electrostrictive capacitive element (.05 microfarad), requiring only .5 milliwatt-seconds of operating power (150 DC volts) to close the contacts, and less than .1 milliwatt to hold them closed; or in many cases, only one-hundredth of the power required to keep a conventional magnetic-coil relay closed! The electrostatic element may also be used to store minute amounts of energy from a low-energy source until enough has been accumulated to operate the relay.

To open the contacts, the voltage is removed and the electrostatic element is discharged through other circuit elements or a resistor.

This low operating power requirement permits even the small current from a photo tube to operate the relay directly, without the use of an intermediate amplifier tube. It also permits an extremely sensitive photo-multiplier-type radioactive radiation detector to be built, whereby almost zero standby current would be consumed.

The input resistance of the electrostatic element is approximately 100 megohms, increasing the value of the Capaswitch in other electronic applications. Current capacity of the contacts is sufficient to carry many direct loads without recourse to additional relay systems.

TELEDUCER

Telecomputing Corporation's TELEDUCER converts analog positive or negative DC voltages into digital form with 0.1% accuracy throughout a continuously variable range from 0.010 to 1.00 volt (± 999 counts full scale). Three combinations of zero offset voltage are available for each sensitivity range: 0 to ±0.1 volt, and +0.05 to -0.05 volt. The three-digit reading may be simultaneously transferred to a Telecomputing Program Unit for subsequent automatic recording in tape by a Tape Perforator, typed lists and/or punched cards.

Telecomputing Corporation's LINEAR CALIBRATOR is an analog multiplier which performs the linear operation $ax \pm b$ upon deflections (x) measured with a Telecomputing record reader and presents the result on calibrated dials for transcription or automatic recording. The controls enable a separate zero reference point, scale multiplication factor, and sign to be applied to the tracings.

Telecomputing Corporation's CONTACT TELEREADER is a direct record reading device designed to facilitate measurements from oscillographic tracings. The large illuminated viewing area will accommodate transparent or translucent records up to 18 inches in width. Smooth synchronization of crosswires and calibrated dials for both axes give accurate readings that can be easily transcribed or speedily and automatically recorded.

The Digitester, Type 48A, has also been developed by this Corporation. This device measures resistance, voltage and current with laboratory standard accuracy and supplies a direct-reading digital output. Voltage Range is .01 to 1000 volts, in six steps. Current range from .01 milliamperes (full scale) to 1000 milliamperes in six steps. Resistance range, 10 ohms to 10 megohms in seven steps. Digital Capacity is 999. Maximum Readout time is one second, including reset cycle.

THE ENIAC

A static magnetic memory has been designed by the Burroughs Corporation for use as high-speed internal memory for the ENIAC, at the Ballistic Research Laboratories, Aberdeen, Maryland. This memory has operated for 3900 hours in the six months since its installation in ENIAC, and has stepped up the speed of this computer significantly.

Burroughs has also developed a new beam switching tube—essentially 10 pentode-like tubes in one envelope—permitting the forming, switching or modulating of an electron beam in ten discrete positions. Switching times are of the order of a fraction of a microsecond; and may be accomplished either consecutively or in random manner. These tubes are of long life, low-wattage characteristic, and of simple mechanical structure.

THE REACON

The REACON high-speed analog-to-digital converter processes analog signals into acceptable binary-digitized form. This is recorded on a magnetic tape recorder which provides a permanent, accurate record. Information can be recorded at high speeds and reproduced at lower speeds for later computation or printing out. Upon reproduction of the magnetic tape signals, the readout circuitry converts it to a form acceptable to a computer, IBM card punch, or other device.

The REACON high-speed analog-to-digital converter operates with inputs from strain-gages, thermocouples, resistance thermometers, or any device producing a low level DC voltage. A digital output count is produced which is proportional to the input voltage. The minimum input voltage change to change the output count by one unit is 30 microvolts. A typical full scale input voltage is ±3 millivolts for an output count of ±99 thus having a resolution of 30 microvolts. Larger input voltages can be used, i.e.: ±2 volts for an output count of ±999 with a resolution of 2 millivolts.

If the input is a single channel of information, the sampling rate can be varied up to 8000 pieces of information per second. If the input is commutated so that a number of different voltages are sampled in sequence, the basic sampling rate is 640 samples per second. This commutation rate is limited by the speed at which the mercury relays used in the commutator will operate. Thus the total period required to sample all inputs is the number of input channels times the reciprocal of the sampling rate; for example, a 64 channel REACON has a sampling period of one tenth of a second. The converter can be operated continuously, at pre-selected intervals from an intervalometer, or at intervals selected manually. When operated continuously, records will be taken as long as a pushbutton switch is operated; when operated "manually," one set of channels will be recorded each time the pushbutton is operated.

NOTICE

DCN NEWS ITEM

Commencing with the January 1954 issue, this Newsletter is being republished in the Proceedings of the Association of Computing Machinery. These Proceedings may be obtained from the Association of Computing Machinery, 2 East 63rd Street, New York, New York.