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

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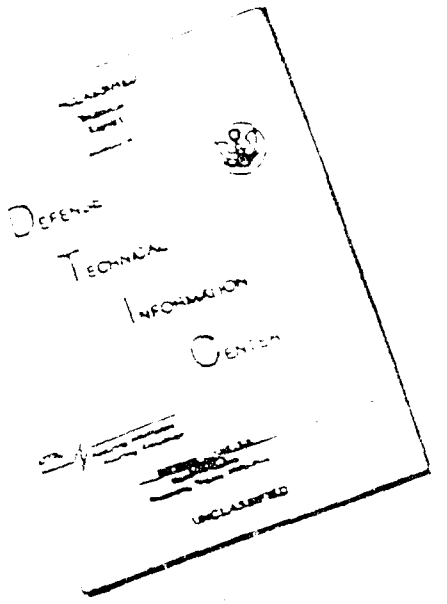

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COMPUTERS

ABERDEEN PROVING GROUND COMPUTERS

A CRC 105 Digital Differential Analyzer was delivered to the BRL Computing Laboratory on 25 November. Installation and testing are being performed by Computer Research Corporation personnel.

No significant improvements in the Aberdeen Proving Ground computers were completed during the period of this report.

Operational experience of the BRL computers for the eleven months ending 27 November (47 weeks) is compared with the previously published records for 1952 (DCN Vol V, No. 2, p. 8) in the following table:

	Average Machine Week in Hours					
	ORDVAC		EDVAC		ENIAC	
	1952	1953	1952	1953	1952	1953
Scheduled Engineering*	23.8	26.4	34.4	29.8	12.5	24.1
Unscheduled Engineering	27.2	27.6	70.4	55.0	35.6	32.7
Problem Set-Up and Code Checking	39.1	34.8	23.3	19.4	20.4	18.3
Production	29.4	53.7	21.7	30.4	67.1	79.4
Idle	26.3	23.8	2.4	26.1	3.7	5.4
Total Machine Time	145.8	165.3	152.2	160.7	139.3	159.9

*These terms were defined in DCN Vol V, No. 2, p. 8.

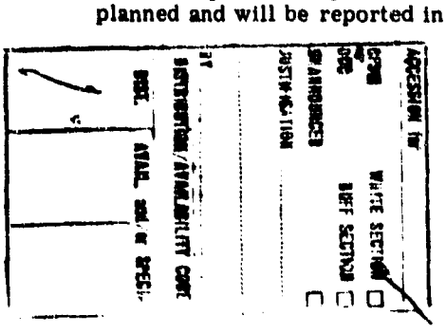
THE UNIVAC

The first industrial application of Univac is announced for March 1954, when the Remington Rand System goes into operation at Appliance Park, newly-constructed home of General Electric's Major Appliance Division in Louisville, Kentucky. Heading the list of functions to be electronically processed are payroll and labor distribution, material scheduling, and inventory control. Later in 1954, some commercial service and billing will be added. By the end of the year, the program is to include general and cost accounting as well.

Compared with conventional methods in the same administrative areas, annual savings of $500,000 are estimated in performing these initial functions alone. Univac's potential, however, permits planning to enlarge its scope considerably. One of the computer's most important eventual uses at Appliance Park is expected to be in the compilation of sales statistics and the preparation of market forecasts for division and product department management.

THE INSTITUTE FOR ADVANCED STUDY COMPUTER (IAS)

The relocation of the Institute for Advanced Study machine within the Computer Laboratory is completed and it is being placed in use again. Various changes were made in the circuitry for the magnetic drum during the move. The revised drum unit is now being tested and should be placed in operation soon. Various further engineering improvements are now being planned and will be reported in succeeding issues.



THE ILLIAC

Many different departments of the University of Illinois continued to use the ILLIAC on a 16-hour-per-day basis. During November the machine was "running" about 93 percent of each 12 hour period designated for use, and during this period an interruption in computation due to an error or other causes occurred on the average each 11 hours.

New developmental cathode ray tubes, specifically manufactured for storage and developed by RCA for the Bureau of Ships, have been installed in the Illiac memory. This change has increased the minimum "read-around-ratio" from the former value of 60 to the present value of 250. These results are based upon only four days of use. The tubes are 3-inch type C73621.

A change in the control and the use of an extra set of gates has made a left shift in addition unnecessary and hence increased the machine speed on addition. A summary of machine speeds is:

Memory cycle	18.8 microseconds
Addition	75 microseconds
Multiplication by Zeros	640 microseconds
Multiplication by Ones	860 microseconds
Division	940 microseconds
Input One Character from Tape	4 milliseconds
Punch One Character on Tape	40 milliseconds
Display One Spot on Oscilloscope	1 millisecond

The times listed include the times for bringing out the order and the operand. The multiplication and division orders can vary by ±50 microseconds from the figures given because of the dependence of shift time on the relative numbers of 1's and 0's in the registers.

CONSOLIDATED MODEL 30-201 COMPUTER

The Consolidated Engineering Corporation announces that the prototype computer, Model 30-201, is in operation and has solved a number of problems. Among these was the inversion of a 26th-order matrix.

Before it was shut down to be packaged in the prototype cabinet, the engineering breadboard computer had solved a number of problems. Among them were computation of 2184 values for a complex probability-integral, completed in 8 hours, and the computation of mole percent, weight percent, and liquid volume percent for a 21-component mass-spectrometer analysis of a natural gas. Running time of the latter problem was 14 seconds and print-out took 1-1/2 minutes.

Two scheduled training courses in coding have been held for customer personnel and others are planned.

Construction has begun on three production-model computers, the first of which will be delivered 1 April 1954.

WHIRLWIND I

Applications

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

Problem No.	Title
144	Self-Consistent Molecular Orbitals
145	Evaluation of Second-Order Temperature Diffuse Scattering from Zinc
146	Largest Eigenvalue of Real, Symmetric Matrix
147	Energy Bands in Crystals
148	Elliptic Boundary-Value Problems
149	Digital Methods of Detecting Signals in Noise
151	Machine Programming and Mathematical Analysis of the General Game of NIM
152	Diffusion in an Oxide-Coated Cathode
153	Gust Response; Simultaneous Linear Integro-Differential Equations
155	Synoptic Climatology
156	Evaluation of the Reflection Coefficient in a Semi-Infinite Rectangular Wave Guide
157	Rectangular Matrix Multiplication

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

Magnetic-Core Memory

The excellent performance record which the new magnetic-core memory has established during the five weeks Nov. 2 to Dec. 6 is encouraging. Only one parity alarm (indicating a failure to get correct information from memory) was made during approximately 700 hours of computer operation. This figure is in contrast to the average of 2 alarms per day encountered when electrostatic storage was part of the Whirlwind I system. The comparison is more impressive when one considers that the access time of magnetic-core memory is 8 microsec, whereas electrostatic storage required an average of 30 microsec for the equivalent operations.

THE SWAC

The SWAC has been scheduled for 80-hour-per-week operation. Of this time 60 hours represent useful computing. Routine and preventative maintenance account for about 15 hours.

NAVAL PROVING GROUND CALCULATORS

During the last quarter the Aiken Relay Calculator (Mark II) and the Mark III Calculator have operated on a 24-hour-per-day schedule five days a week.

The operating efficiency of the Mark II has averaged 89 per cent, and that of the Mark III has averaged 75 per cent during the same period. The Mark III has shown substantial improvement in recent months, and the average efficiency for the period indicated is its best record for any similar period of time.

The addition of the new checked sequencing system to the Mark III Calculator, described in a previous issue, has provided more flexibility for solving problems on the Calculator. It has also improved the techniques for the immediate detection of operating errors, and this has been reflected in more accurate and more reliable computation.

Recent additions to the computing facilities at Dahlgren are the IBM type 063 card-to-tape converter and the IBM type 043 tape-to-card converter. These two machines will provide communication between the Mark II Calculator and the IBM facility. A conversion system to provide communication between the Mark III Calculator and the IBM Calculators is planned.

The Calculators continue to be occupied in urgent ballistic computations; however, the recent improvement in the Mark III operating efficiency has reduced the backlog of problems considerably. Problems originating in Defense Department activities (including contractors) can usually be scheduled to meet the requested deadlines.

THE CIRCLE COMPUTER

The first production model of the Circle Computer has been completed at Hogan Laboratories, 155 Perry Street, New York, N. Y. The first test routine was successfully run on the machine on November 30, 1953. The first computer is scheduled for delivery during the first week of January 1954.

The Computer proper, shown in Figure 1, is 3 x 4 x 6 feet and consumes 3.5 Kw. of power from a single-phase, 60-cycle, 110-volt line. The electronic components are divided

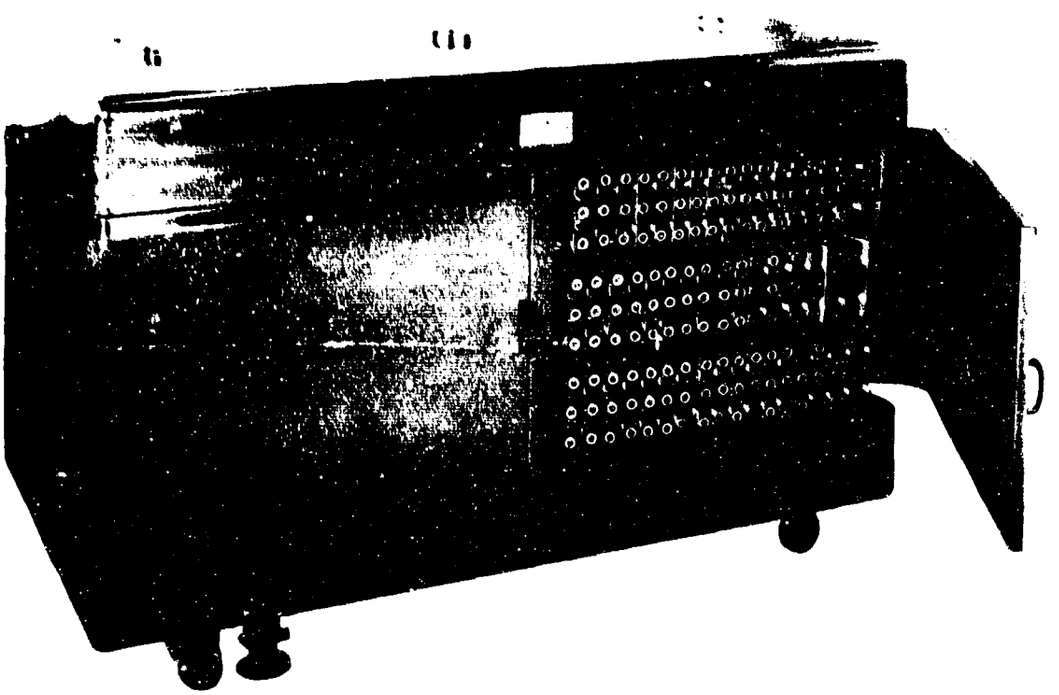


Figure 1. The Circle Computer.

into small logical units which are built on three-tube subchassis. These are mounted in such a way that they are easily removable for checking and service.

The logical design is patterned after the Princeton-type machines. Serial operation and single-address coding are used. The logical characteristics of the Circle Computer are:

Word Structure:	Words are 40 binary digits plus two sign digits. Two orders may be stored in one word space.	
Memory:	Magnetic drum rotating at 3540 rpm. Capacity is 1024 words.	
Arithmetic:	Binary with fixed binary point.	
Operating Speed:	Additions and subtractions	25 milliseconds
	Multiplication and division	45 milliseconds
	Transfers	17 milliseconds
	Reading and writing	100 milliseconds / digit
Input:	Flexowriter	
Output:	Flexowriter	

Three circle Computers are in the process of manufacture.

THE MINIAC

The first MINIAC was delivered by Marchant Research, Inc. several months ago to the Atlantic Refining Co., Philadelphia, Pennsylvania, where it was placed in service and is, at last report, doing a very fine job. A second machine purchased by Atlantic for their Dallas, Texas, research installation is under construction and is expected to be delivered early 1954.

Considerable design revision was made upon the MINIAC effective on the second Atlantic machine in that it is a decimal computer of 10-digit word length but retaining the 4096-word magnetic-drum memory turning at 6000 rpm. One of the features of this revised MINIAC is that it may be operated hexa-decimally, yielding better than two additional decimal places. Running time required for the same problem in hexadecimal notation is identical with that required by the decimal notation; however, sub-routine translation between these two notations requires a moderate amount of time. This machine is also capable of storing alphabetical data.

An accessory feature providing 256 words of the 4096 words storage at 1.25 milliseconds average access time has been developed. An accessory flip-flop register whose primary use is in command revision is also offered as an accessory. Either or both of these units may be added to a standard machine in the field.

ELECOM COMPUTERS

Elecom 100

Elecom model 100 electronic computer number three is in the final stages of engineering test, and will be ready for delivery in December, 1953. A binary, three-address computer with a 512 word memory drum, Elecom 100 number three handles alphabetic as well as numeric data. It also has built-in auto-monitoring.

Previous Elecom 100s are operating at the Aberdeen Proving Grounds (delivered November, 1952), and Project Cyclone (delivered April, 1953).

Elecom 120

Courses in programming, logic, circuitry, maintenance, etc. for purchasers of the Elecom 120 electronic computer were held at Elecom's facilities in Long Island City, New York, in November. The first three Elecom 120 computers are scheduled for delivery early in 1954. The computer is an alpha-numeric, decimal, two-address machine with a 1,000 word memory drum, and a ten word rapid-access recirculating channel. Built-in floating decimal, and an additional 1,000 words of memory, are available as extra features on the Elecom 120.

THE MANIAC

The computer was first operated in early March, 1952, with its 1024 40-binary-digit words of electrostatic storage on 2" cathode ray tubes, and a complete arithmetic unit, but with relatively slow input-output devices (teletype). The schedule has been on the basis of a 16-hr. day, 7 days per week. During the period several modifications have been made and additional equipment added. The computer now has a Ferranti photo-electric paper tape reader, an Analex high speed printer, a 10,000 word ERA magnetic drum, and a slow, single channel magnetic tape to record complete electrostatic memory contents.

The operating experience in the three six-month periods follows:

	Effective Computation	Computation time nullified by computer error	Testing and Maintenance
Second half 1952	70.0	9.5	20.5
First half 1953	75.5	8.5	16.0
Second half 1953	73.5	5.3	21.2

The time spent to incorporate additional equipment is not included in the above table. Those figures are 11.6 percent, 8.0 percent, and 7.0 percent of the total time, respectively. However, warm-up time of nearly one hour each morning is included under "Testing and Maintenance" and "Scheduled Maintenance" does not exist.

CRC DIGITAL DIFFERENTIAL ANALYZER

A CRC 105 Decimal Digital Differential Analyzer is currently undergoing final acceptance tests at the Ballistic Research Laboratories, Aberdeen Proving Ground. Three other CRC 105 Differential Analyzers have been giving reliable service for varying periods. These machines are located in the Navy Bureau of Ordnance in Washington, D. C., Naval Ordnance Test Station, Pasadena, California, and Lockheed Aircraft Corporation, Burbank, California. Machine Number 5 was to be delivered in December to the Air Force, and Machine Number 6 is to be delivered this month to Army Ordnance.

COMPUTER COMPONENTS

RAYTHEON MAGNETIC SHIFT REGISTERS

SR-20

The Raytheon Four-Stage 20KC Magnetic Shift Register, known as the SR-20, is a compact, ruggedly built unit incorporating 4-"bit" storage capacity in one small package. Its unique features include: A single magnetic core and single diode for each binary digit of information; a 12-volt output with "one-zero" ratio of more than 10:1; highly stable operation. The low output impedance of this element permits its use with loads as low as 1000 ohms and

up to 0.02 microfarad of capacitance. The input and output may be parallel or serial; furthermore, as many of those elements as desired may be used to build up a register. One successful commercial application already in operation utilizes forty-one SR-20 packages connected in series to form a register 164 binary digits in length.

SR-100

The Raytheon Single-Stage 100KC Magnetic Shift Register known as the SR-100, several views of which are shown in Figure 2, has many of the same circuit characteristics as the SR-20. All components are sealed in a plastic case, except the diode, which is readily removable. The wide margins of the operating parameters give this component exceptional circuit stability. The rated maximum frequency of operation is 100KC. The tolerance of shift-pulse width is greater than plus or minus 30%. The minimum load impedance that can be tolerated without appreciable attenuation at the output is 7500 ohms. The output is 16 volts in amplitude with a 5:1 "one-zero" ratio and the "line" runs at a power level of less than 1/4 watt per stage with a full load at maximum rated frequency.

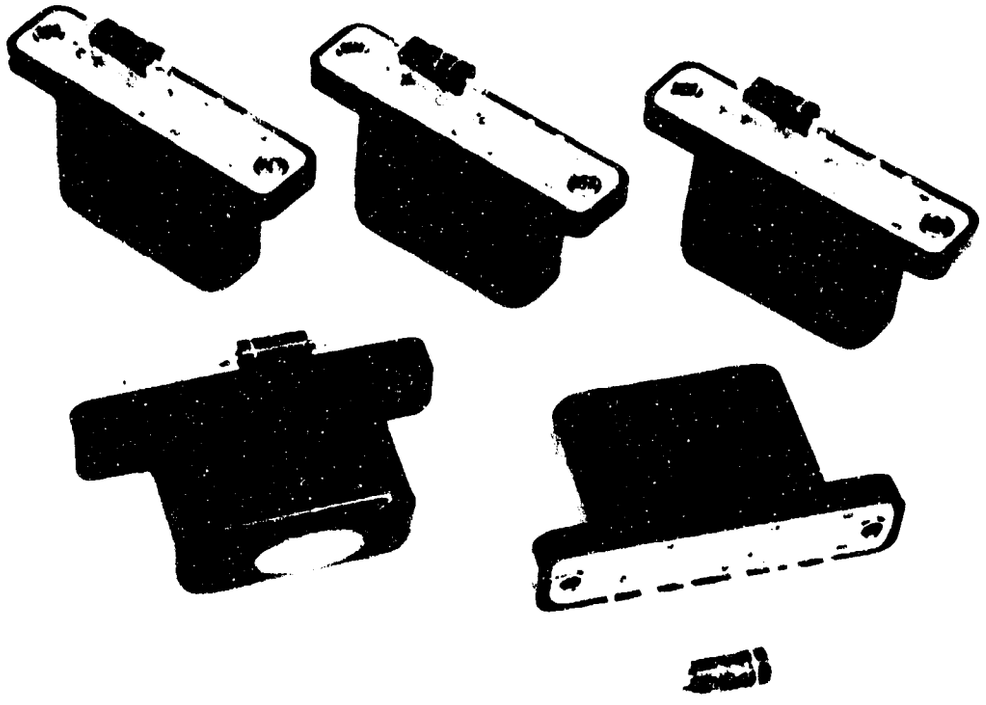


Figure 2. Raytheon magnetic shift register SR-100.

Raytheon has also developed compatible electronic driver packages for both the SR-20 and SR-100 Shift Register components. Work is proceeding towards the utilization of magnetic cores in logical and arithmetic circuitry. These developments give promise of a substantial reduction of tube count in future computer systems.

BURROUGHS BEAM-SWITCHING TUBES

The new Burroughs Beam Switching Tubes permit the forming, switching and modulating of an electron beam in ten discrete positions—either consecutively or at random. Fractional microsecond switching from output to output is obtained from a single impulse or from

high-speed pulses up into the 5-megacycle range. These low-power, high-vacuum tubes are available with single output or with 10 outputs and with selective reset or zero reset.

LOGISTICS RESEARCH SHEET-METAL MAGNETIC DRUM

A new "memory wheel" has been developed by Logistics Research, Inc., Redondo Beach, Calif. The device consists of a four-foot welded sheet-metal magnetic drum with magnetized surface, rotating at high speed. Magnetic readers are said to float above the surface of the drum on cushions of air 0.0004 in. thick. The memory capacity of the new wheel is claimed at approximately 1 million "words."

The system utilizes an application of the Bernoulli principle, which may be demonstrated by blowing through a spool of thread with a piece of paper (pierced by a common pin to keep it centered) against the other end. The air exiting from the front end of the spool flows outward in a thin layer under the paper, creating a partial vacuum strong enough to hold the paper in place rather than blowing it off. Similarly, in the Memory Wheel the air between the head and drum positions the head at a constant distance from the drum's surface.

In experiments with a model, a three-foot sheet-metal drum known to be several thousandths of an inch out of a true circle, the heads were found to maintain a gap of 0.0001 in. between head and drum with less than 5 percent variation in the signals produced.

NOTICE

DCN NEWS ITEMS

The Electronics Branch of the Office of Naval Research, Washington 25, D. C., solicits news items for inclusion in the Digital Computer Newsletter. Material should be received by 10 March, 10 June, 10 September, or 10 December for publication in the Newsletter of the following month.

SURVEY OF AUTOMATIC DIGITAL COMPUTERS

The Office of Naval Research has recently completed a tabulation of data on Automatic Digital Computers throughout the world, comprising 98 pages on as many models. Three indexes are included. This "Survey of Automatic Digital Computers" is being published by the Office of Technical Services, Commerce Department, Washington 25, D. C., at a price of $2.00, payable to the Treasurer of the United States. It is identified by P B No. 111-293.