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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COMPUTERS

THE RAND JUNIOR JOHNNIAC

A 10-digit Junior Johnniac machine has been completed and is in operation at the RAND Corporation. This machine is built mechanically and electrically like the larger machine and uses components which are interchangeable with it. It contains a complete arithmetic unit, a 5-selectron 128-word electrostatic memory, but only sufficient control to do fixed program memory evaluation tests of the leapfrog variety. To date it has been used to dynamically test selectron tubes, and to accumulate life data on these tubes. The system has performed exceedingly well, and usually runs test routines unattended and over night. Two endurance runs have been attempted. The first was terminated at 80 hours by a systematic memory error; the second was deliberately terminated at 90 hours with no errors. The first run was interrupted twice by tube failures in a power supply and in a register; the second was deliberately interrupted a few times to accomodate engineering measurements. No adjustments were ever made, however, and after every interruption the system resumed operation promptly and without difficulty. In each case the system was executing a self-checking error-detecting memory test routine which continually altered the information stored at each address, however verifying the correctness of the information at each address before alteration. The nature of the test routine and of the checking feature is such that any random or systematic error will be detected and stop the test. During selectron tube checking, there also has been accumulated a large number of error-free runs of 8-20 hours extent.

One particular selectron has been in the memory through all testing and endurance runs. Its life now exceeds 600 hours and there is no sign of deterioration or change. Sufficient good tubes are on hand to fully equip the full size memory. It is expected that the arithmetic unit and parts of the control of the large machine will be operative in the middle of October, and that the complete machine will be operative by 1954.

THE ILLIAC

The Illiac has been in general use by the University of Illinois since September 1, 1952. It was shut down on August 10, 1953, to allow the installation of a new set of covers and some control changes which will increase the addition speed of the machine. The machine has been used by fifteen different departments within the University for many different types of research work. A library of about one hundred routines has greatly extended the usefulness of the machine to all of these groups.

PROJECT HURRICANE COMPUTER (RAYDAC)

The RAYDAC Computer is now installed and in operation at the Naval Air Missile Test Center, Point Mugu, California. The machine completed its engineering acceptance tests early in July and has been operated by the NAMISTESTCEN staff since that time. It is expected that a contractor will take over the computer in early autumn under an operation and evaluation program.

WHIRLWIND I

Applications

Since June 1 the following problems have been initiated by the Scientific and Engineering Computation (S&EC) Group for solution on the Whirlwind I Computer:

No. 137. Investigation of Atmospheric Turbulence

No. 138. Spheroidal Wave Functions

No. 139. Calculations of the Shape of Nuclear-Magnetic-Resonance Absorption Lines

No. 142. Study of Shock Waves (a two-dimensional grid of concentrated masses subjected to impulsive loads)

No. 143. Vibrational Frequency Spectrum of a Copper Crystal

These problems were in addition to the long-range problems reported in the previous Digital Computer Newsletter.

Summer Session

During July the S&EC Group developed an experimental computer logic which was used in a two-week Summer Session course at MIT (August 24 - September 4) entitled "Digital Computers and their Applications." This logic involved the physical equipment of Whirlwind I and made use of interpretive routines for programmed extra precision and floating-point arithmetic, cycle counting, input and output, together with facilities for program conversion, mistake recognition, and post-mortem diagnosis. The course was attended by 106 persons representing 67 organizations.

ACM Meeting

The summer conference of the Association for Computing Machinery was held at MIT on September 9, 10, and 11. During the meeting, the Digital Computer Laboratory was open for inspection and 239 visitors were recorded.

Magnetic-Core Memory

A new internal high-speed memory utilizing magnetic cores has replaced electrostatic storage in Whirlwind I. The storage capacity of the new memory is the same as the old (2048 registers), but performance tests have indicated that magnetic cores will greatly reduce maintenance time as well as increase the computer's operating speed. The next issue of the Newsletter will contain detailed information on the operation of this system.

ABERDEEN PROVING GROUND COMPUTERS

The ORDVAC

The Ordvac underwent a thorough overhaul in July. Available machine time for the past five weeks following the overhaul has averaged 126 hours per week. The last week in August, 40 RCA Type C73376B developmental-type cathode-ray tubes were installed in the memory. On the basis of early experience with this installation, it appears that minimum read around ratios of 100 can be maintained. This is about twice the read around ratio obtained previously.

The EDVAC

During the week ending 26 June 1953, the Edvac broke all previous records of available weekly machine time for BRL machines, with an available time of 159.9 hours. For the past three months the Edvac has averaged 92 hours per week of available machine time, reflecting the effect of improvements which have been incorporated into the basic machine during the past year.

The ENIAC

Installation of the new 100-word static magnetic memory was satisfactorily completed. The unit, designed and constructed by the Burroughs Corporation, increases the internal high-speed memory to 120 words and is one of the most significant improvements to the ENIAC since its completion in February 1946. It is interesting to note that the memory was delivered, installed, successfully tested with the ENIAC, and placed in routine operation in a four-day period. Operating experience with the memory to date has been highly satisfactory.

THE MIDAC (University of Michigan Digital Automatic Computer)

Regular operation of the MIDAC, begun June 1, 1953, has increased over the summer period to approximately 40 hours of scheduled operational time per week. The MIDAC, a general purpose digital computer patterned after the SEAC, was constructed by the Willow Run Research Center of the University of Michigan under the auspices of the Air Forces. A majority of the internal operations, about equivalent to those on the SEAC, are now available. Additional "relative addressing" operations, designed specifically for use with subroutines stored on a magnetic drum, are now being checked out.

Construction has been under the supervision of John DeTurk and, later, Roy Hock. The machine, which was begun in 1951, is a serial machine using a basic "clock" frequency of one megacycle. The principal engineering characteristics of the machine are:

Word length	44 bits plus sign bit (45 total)
Arithmetic Unit Type	Serial
Type of Code	Three-address
Average number of additions, subtractions, etc./sec.	1,000 (including four accesses to memory)
Average number of multiplications or divisions/sec.	300 (including four accesses to memory)
Memory Type	Acoustic delay line; Drum
Memory Capacity	512 words (Acoustic) 6,144 words (Drum)
Number of vacuum tubes	1500
Number of germanium diodes	20,000
Physical Layout	Packaged units
Input	Photo-electric reader
Output	Flexowriter (at present)

During the three months of operation an interim "Input Translation Program" has been checked out to provide complete translation of instructions and numbers from an external decimal-algebraic language into the internal machine binary language. Upon completion of the drum and "relative-addressing" features, this program will be extended to call in subroutines automatically and to provide automatic code-checking and utility program features.

Among the problems coded, checked out, or solved on the MIDAC are: solution of simultaneous equations for general order $n \leq 17$, solution of a parabolic differential equation, solution of a problem in the dynamics of a large-scale economic system, several data-reduction problems, and simulation of a number of large-scale dynamic systems. In addition, a floating point program is available for short problems where elimination of scaling procedure can save programming time.

The machine has been so constructed that it can be expanded, without changes in the logical structure, to twice the acoustic memory storage capacity and four times the drum storage capacity.

A special two-week Summer Program on "Digital Computers - Their Application and Evaluation" was held at the University of Michigan, August 10 through August 21. The MIDAC was used as the laboratory machine for course members. The course itself stressed programming and formulation, numerical analysis, applications, and evaluation of existing commercial computers.

A graduate course in "Methods in High-Speed Computation" (M174) was given at the University for the first time last spring. This course will be repeated in 1953-1954 as a two-semester course aimed at training for use of the MIDAC. In addition, a two-semester course in "Digital Technology" (EE258) will be concerned with the design, construction, and simulation uses of digital computers.

THE FLAC

During the past two months a limited computational work load has been assumed by FLAC. Lack of both coding personnel and multiple input units has delayed transfer of all Air Force Missile Test Center computations from SEAC to FLAC. Several problems have been solved, however, including one for F. J. Murray of Columbia pertaining to crystal growths.

The final control console has been attached to the computer, and the addition of four Raytheon multichannel magnetic tape handling units is in progress. With all auxiliaries operating, the total power furnished by the computer's power supplies is less than six kilowatts.

Since little information has been made available on the coding for FLAC, the operation codes and operating times are given in Figure 1. It should be noted that the addresses specified in FLAC instruction words may be either absolute or relative, hence the machine is called a floating three-address machine. Further, when relative addresses are employed, they may be relative to either the control counter (Cc) which sequences the machine through its instructions, or relative to a number stored in the base counter (Cb). The contents of Cb can be modified only by a tally instruction.

The terminology used in Figure 1 is explained as follows: α and β designate the locations of the two operands, γ the result. (α), (β), and (γ) designate the quantities stored in α, β, and γ. The binary control digits a,b,c, and d are used to indicate whether α, β, γ are relative (i.e. presence of an a, b, or c digit indicates a relative address) and the presence of a d digit indicates that the relative addresses are with respect to the base counter (Cb). These relative-address features greatly simplify and accelerate handling of iterative processes.

THE SWAC

During the last quarter the SWAC worked on 29 different problems for a computing time of 623 hours out of a scheduled time of 845 hours. A full set of eigenvalues and eigenvectors for a 32nd order matrix was computed, to 10 significant decimal digits. With the aid of the magnetic drum memory, the complete solution was obtained in 18 hours of computing time.

Methods were developed for the solution of assignment problems, by permutation of matrix elements. In particular, solutions for 8 x 8, 10 x 10, and 12 x 12 matrices were obtained. The solution of the 12 x 12 was obtained in 3 hours running time.

THE ORACLE (Oak Ridge Automatic Computer)

The Oak Ridge National Laboratory's high-speed, electronic, digital computer (ORACLE) has passed the final acceptance tests at the Argonne National Laboratory and is at present being installed in its permanent location (ORNL) at Oak Ridge, Tennessee.

The ORACLE ran successfully at ANL for approximately 250 hours, solving problems with an efficiency of 92%; i.e., 23 hours of the total available problem time were used for trouble-shooting machine failures. During this time, the 2048-word electrostatic memory feature of the ORACLE was utilized in solving a Monte Carlo type problem.

The installation at ORNL will incorporate a Ferranti photoelectric reader and a teletype fast punch in the input-output system.

FLAC OPERATING CHARACTERISTICS

CODE	OPERATION	DESCRIPTION	STORED IN FFF[1]	OPERATIONS PER/SEC
0	INPUT	INSERT α NUMBER OF WORDS FROM β INPUT - UNIT INTO MEMORY COMMENCING WITH γ MEMORY CELL.	RESULTS OF PRECEDING OPERATION	*
1	LOGICAL TRANSFER	a.) TRANSFER DIGITS IN (α) CORRESPONDING TO ONES IN (β) TO (γ) b.) LOGICAL PRODUCT (i.e. PRODUCT $(\alpha) \times (\beta)$ DIGIT BY DIGIT) IS AVAILABLE FROM (FFF)[1]	LOGICAL PRODUCT[2] $(\alpha) \times (\beta)$	1100
2	SHIFT	$(\gamma) = (\alpha)$ SHIFTED BY "η" IN $\vert(\beta)\vert$, WHERE $(\beta) = \eta \times 2^{-44}$ AND $+\eta$ IS SHIFT LEFT ($-\eta$, RIGHT)	SHIFTED NUMBER	330-1100
3	I. DECIMAL - BINARY CONVERSION II. BINARY - DECIMAL CONVERSION	β EVEN, (α) = DECIMAL NUMBER, (γ) = CONVERTED NUMBER (BINARY) β ODD, (α) = BINARY NUMBER, (γ) = CONVERTED NUMBER (DECIMAL)	CONVERTED NUMBER	285 800
4	SUBTRACTION	$(\gamma) = (\alpha) - (\beta)$	$(\alpha) - (\beta)$	1100
5	ADDITION	$(\gamma) = (\alpha) + (\beta)$	$(\alpha) + (\beta)$	1100
6	I. POWER EXTRACT	a.) β EVEN, THE NUMBER "η" IN (γ) = NUMBER OF PLACES (α) MUST BE SHIFTED TO BRING MOST SIGNIFICANT DIGIT TO THE BINARY POINT. $(\gamma) = -\eta \times 2^{-44}$ b.) THE SHIFTED NUMBER IS AVAILABLE FROM (FFF)[1]	SHIFTED NUMBER[2]	330-1100
	II. FILE	a.) β ODD, d = o, FILE CONTROL COUNTER PLUS ONE IN γ POSITION OF (α), RESET CONTROL COUNTER TO $C_c + \gamma$ OR γ b.) β ODD, d = 1, FILE BASE COUNTER PLUS ONE IN α POSITION OF (α), RESET CONTROL COUNTER TO $C_c + \gamma$ OR γ	FILED COUNTER PLUS ONE	2000
7	I. TAPE ADVANCE II. TAPE REVERSE III. TAPE HUNT	β EVEN, ADVANCE γ UNIT, α NUMBER OF WORDS β ODD, REVERSE γ UNIT, α NUMBER OF WORDS ON HIGH SPEED TAPE UNITS, HUNT FOR BLOCK α ON TAPE UNIT γ	RESULTS OF PRECEDING OPERATION	*
8	MULTIPLICATION (Complete Product)	a.) $(\gamma) = (\alpha) \times (\beta)$, HIGH ORDER PRODUCT b.) (FFF)[1] $= (\alpha) \times (\beta)$, LOW ORDER PRODUCT	$(\alpha) \times (\beta)$ LOW ORDER[2]	330
9	MULTIPLICATION (Rounded)	$(\gamma) = (\alpha) \times (\beta)$ ROUNDED TO 44 BINARY DIGITS	$(\alpha) \times (\beta)$ ROUNDED	330
A	TALLY	a.) a = o, RESETS BASE COUNTER (C_B) TO α AND COMPARES α AND β. IF $\alpha < \beta$ NEXT INSTRUCTION TAKEN FROM γ OR $C_c + \gamma$. IF $\alpha \geq \beta$ NEXT INSTRUCTION TAKEN FROM $C_c + 1$ b.) a = 1 ADDS α TO BASE COUNTER AND COMPARES SUM WITH β AS INDICATED ABOVE	RESULTS OF PRECEDING OPERATION	2850
B	DIVISION (Unrounded)	a.) $(\gamma) = (\beta) / (\alpha)$ b.) (FFF)[1] = TRUE REMAINDER FOLLOWING DIVISION $(\beta) / (\alpha)$	REMAINDER $\frac{(\beta)}{(\alpha)}$ **[2]	330
C	ALGEBRAIC COMPARISON	IF $(\alpha) < (\beta)$ NEXT INSTRUCTION TAKEN FROM γ OR $C_c + \gamma$ IF $(\alpha) \geq (\beta)$ NEXT INSTRUCTION TAKEN FROM $C_c + 1$.	$(\alpha) - (\beta)$	1100
D	ABSOLUTE COMPARISON	IF $\vert(\alpha)\vert < \vert(\beta)\vert$ NEXT INSTRUCTION TAKEN FROM γ OR $C_c + \gamma$ IF $\vert(\alpha)\vert \geq \vert(\beta)\vert$ NEXT INSTRUCTION TAKEN FROM $C_c + 1$	$\vert(\alpha)\vert - \vert(\beta)\vert$[2]	1100
E	EQUALITY COMPARISON	IF $(\alpha) \neq (\beta)$ NEXT INSTRUCTION TAKEN FROM γ OR $C_c + \gamma$ IF $(\alpha) = (\beta)$ NEXT INSTRUCTION TAKEN FROM $C_c + 1$	$(\alpha) - (\beta)$	1100
F	READ OUT	READ α NUMBER OF WORDS COMMENCING WITH (β) INTO OUTPUT UNIT γ	RESULTS OF PRECEDING OPERATION	*

C_c IS THE CONTROL COUNTER USED FOR SEQUENCING INSTRUCTIONS.
C_B IS THE BASE COUNTER USED AS AN ADJUSTABLE REFERENCE POINT FOR RELATIVE ADDRESSES, AS WELL AS FOR A TALLY REGISTER
a, b, c, d, ARE CONTROL DIGITS TO INDICATE ABSOLUTE OR RELATIVE ADDRESSES FOR α, β, γ, ETC.
1 FFF IS A SPECIAL MINIMUM ACCESS STORAGE REGISTER, THE CONTENTS OF WHICH ARE CHANGED BY ALL OPERATIONS EXCEPT THE TALLY (A), INPUT (O), OUTPUT (F), OR TAPE (7) INSTRUCTIONS. OPERATION TIMES ARE BASED ON RANDOM ACCESS TO MERCURY ACCOUSTIC MEMORY.
2 QUANTITIES AVAILABLE ONLY AS SECONDARY RESULTS OF NORMAL OPERATIONS.
* INPUT - OUTPUT OPERATING SPEEDS (a) PUNCHED TAPE ≈10 DEC DIGITS / SEC, (b) MAGNETIC WIRE = 50 WORDS / SEC, (c) MAGNETIC TAPE = 250 WORDS / SEC
** THE SIGN OF THE REMAINDER IS ALWAYS THE SAME AS THE SIGN OF (β)

Figure 1

THE IAS COMPUTER (Institute for Advanced Study Computer)

For the period 1 June through 29 July 1953 the Institute for Advanced Study machine was in operation for 1176 of the 1416 hours in that period. Of this total number of hours the machine was available for computation 1017 hours and was used for computing 920 hours, i.e. about 90.5% of the available time.

Since that date the machine has been in the process of being moved from its temporary to its permanent location in the computer building at the Institute. At the time of this move minor wiring changes and rearrangements have been made. The new location has been planned and arranged so that it should be considerably more advantageous from the point of view of convenience of operation. The machine proper is to be housed in a room by itself with the machine operators in a separate and adjoining room. The manual control of the machine is to be in the latter room and has been simplified.

COMPUTER RESEARCH CORPORATION COMPUTERS

CRC 102-A

The twenty-ninth 102-A is now in production, and the first training class for maintenance and programming personnel has been held for customers. These classes will be held bimonthly, and are four weeks in length. The next class will begin October 12.

A special address, 2100, has been made available in the 102-A, providing a zero as an operand with no access time. This programming feature makes possible unconditional transfer, easy transfer of information from one cell to another, and a new mode of extracting; provides zero test; and facilitates certain logical products.

The Magnetic Tape-Handling Unit, an auxiliary piece of equipment for use with the 102-A, is now in production, and it is expected that it will be purchased by the majority of 102-A customers. The Tape Editing and Printing Unit is in final test and will be available as auxiliary equipment shortly.

CRC 105

Three 105 Decimal Digital Differential Analyzers are now in use. Acceptance was made of a 105 on September 10 at the U. S. Naval Ordnance Test Station at Pasadena. The 105 which has been operating at Lockheed Aircraft has, according to the Mathematical Analysis Department there, "... been in fault-free operation for 21 days (9-hour shift), with an over-all availability time since the date of installation of 91%." One more 105 is in the test stage for another government installation and four more are under construction.

CRC 107

The first 107, along with the High Speed Printer, was delivered in August to the Bureau of Aeronautics, Washington. Final tests are being made on a similar installation to be delivered in November to the White Sands Proving Grounds.

The High Speed Printer, part of the BuAer installation, consists of a mechanical printer and paper feed, and a separate cabinet containing the logical circuitry. It is designed to print 120 characters per line at the rate of ten lines per second. It can prepare forms, paper copies and carbons, or duplicating masters. The printer can print 55 characters, which include all the characters on a Flexowriter, excepting the lower case alphabet but including "1", "=", and "+". The printer is capable of handling information at an average rate of 1300 decimal digits per second, with a peak of 2000 decimal digits per second.

IBM TYPE 701 ELECTRONIC DATA PROCESSING MACHINE

The 701 is a large-scale electronic digital computer controlled by a stored program of the one-address type, and utilizing cathode ray and magnetic drum types of internal storage.

The machine operates in the parallel mode, working internally in the binary system. The input and output, however, may be accomplished on standard IBM cards in the decimal system. Conversion between the decimal and binary systems is accomplished by a subroutine, which does not decrease reading, punching, and printing speeds. The 701 has a maximum multiplication time of 456 microseconds and will execute instructions at a rate of about 14,000 per second on typical problems. Results of a computation are printed on a modified IBM Type 407 accounting machine operating at a speed of over 10,000 characters per minute. Output can also be taken in the form of cards punched in either the binary or the decimal system.

One electrostatic storage unit in the 701 can accommodate 2048 full words or 4096 half words. Each full word consists of 35 bits (binary digits) and a sign or 36 bits in all. This is equivalent to about ten decimal digits and a sign. Any of the full words can be split into two "half words", each having 17 bits and a sign, or 18 bits in all. Two electrostatic storage systems may be used to provide a maximum storage of 4096 full words.

Additional storage capacity is provided by two magnetic drums, each having a storage capacity of 4096 full words. Average access time to the drum is 40 milliseconds. It is contemplated that the drums will be used for storing large blocks of information. After the first word of such a block has been located, the remaining words are read at a rate of 800 per second. The magnetic drums will retain stored information after the power is off. The 701 also has a tape-storage section which includes four magnetic tape units. Each tape, which may be up to 1200 feet long, is wound on a reel. The tape itself is a nonmetallic, oxide-coated band one-half inch wide. It is possible to store upwards of 200,000 words on each tape. It takes, on the average, about 10 milliseconds for the tape to accelerate to its reading or writing speed, after which the reading or writing takes place at a rate of 1250 words per second. Since the tapes are removable, a library of standard programming and mathematical tables may be kept on tapes.

As of September 1, 1953, installations of the IBM 701 which have been in operation include the following:

Consolidated Vultee Aircraft, Fort Worth, Texas
Douglas Aircraft, Santa Monica, California
General Electric, Cincinnati, Ohio
IBM, New York City, N.Y.
Lockheed Aircraft, Glendale, California
Los Alamos Scientific Laboratory, Albuquerque, New Mexico

IBM TYPE 650 MAGNETIC DRUM CALCULATOR

The Magnetic Drum Computer was designed to meet the accounting and computing requirements in areas between those now served by the IBM 701 and the 604 Electronic Calculating Punch. A numeric decimal machine using a self checking bi-quinary code, it has a punched-card input-output unit and a magnetic drum memory with a capacity of either 1000 or 2000 words, as specified by the user. A word is 10 decimal digits plus algebraic sign.

All of the calculator's arithmetic operations are controlled through a stored program which may be entered either automatically from punched cards or manually from the operator's console and stored in the form of magnetized spots on the surface of a drum 4 inches in diameter and 12 inches long, spinning at 12,500 revolutions a minute. The calculator's arithmetic unit operates at electronic speeds. It can: accumulate 10-digit numbers to form a 20-digit total at the rate of 200 a second; multiply a 10-digit number by a 10-digit number to develop a 20-digit product at the rate of 100 a second; and divide a 19-digit number by a 10-digit divisor to develop a 10-digit quotient and a 10-digit remainder at the rate of 80 per second. It has an input rate of 200 punched cards a minute and a separate output of 100 cards a minute.

In addition to its large numerical capacity, the calculator also features a "Table Look-Up" operation which facilitates the automatic searching of rate tables such as occur in the utilities, life and casualty insurance, transportation, and other commercial fields.

By means of the console, the operator has control over all stages of the calculations and may manually insert instructions or data into any desired storage location, examine the contents of these locations, stop the calculation at any required point, and begin calculation with any desired instruction located in the memory unit.

THE SEAC

The electrostatic (Williams) memory is now available for problems which require 512 words in addition to the 512 words of acoustic memory capacity. Since the beginning of June, it has been used on 45 different occasions with productive results. These error-free runs ranged from about 10 minutes to 9 hours in duration. Its use is now limited mainly by the fact that most problems are coded for only 512 words of memory. The acoustic memory has been provided with an odd-even (parity) check for all words read from memory. This equipment has added to the efficiency of machine operation.

The computer is now powered by a set of regulated dc power supplies, the output voltages of which are variable from the computer power panel for purposes of marginal checking. In addition, controllable ac stabilizers are now being used. A closed-cycle air-conditioning system, which is independent of the building air conditioning, is provided for the computer.

An additional magnetic wire input-output dumper has been added to the installation. Using this dumper, a code has been devised which will check-sum all but eight words of the 1024-word memory, transfer the entire contents of the memory to a removable wire cartridge, check the complete recording for accuracy, and enable the machine automatically to resume computation, all within 90 seconds.

During July and August 1953, average "good" operating time was 83 percent of total assigned time, good time being defined as time during which the computer was used without error for problem solution or code checking, or in which it was idle but in order. The average computational time per week during the June-September quarter has been 74 hours.

CONSOLIDATED MODEL 30-201 COMPUTER

The breadboard of the Consolidated Model 30-201 Computer has been in continuous operation for three months, as of September 8, 1953, except for scheduled tests and preparation for transferring the breadboard assemblies to the prototype packaging. This prototype, which is near completion, will remain at the Consolidated plant for engineering and application studies. The first two production models of the computer will be delivered to customers early in 1954, and computing systems incorporating the 30-201 as a central unit will be available for delivery in the latter half of 1954.

Print-out and control commands have been expanded by the addition of several variants for further flexibility in programming, and the use of interpretive subroutines has been facilitated by making the contents of the order counter available in the R register as an automatic exit point and entrance point.

Diagnostic routines and operational test programs have been edited and thoroughly checked. The library of subroutines has been expanded, and in addition to the problems mentioned in the July 1953 Newsletter, matrix inversion is being programmed and floating-point arithmetic is available in two forms, one economical of time and the other of space.

Development of IBM card input-output is continuing.

BURROUGHS LABORATORY AND WAYNE UNIVERSITY COMPUTERS

The installation of a new Burroughs Unitized Computer was scheduled for completion in late September at Wayne University, Detroit.

The Wayne Computer, designed and engineered by Burroughs Corporation's engineers in the Philadelphia Research Center, has been named "UDEC"—Unitized Digital Electronic Computer. This digital computer will have been installed and in operation at Wayne University in only four months after the job was begun.

The primary differences between UDEC and the original Burroughs Laboratory Computer are: (a) use of new model magnetic shift registers, and (b) incorporation of a magnetic drum memory of 5,300-word capacity, using low-level head switching techniques. The new model magnetic shift register has also been installed in the Laboratory Computer in Philadelphia and has given excellent performance. The magnetic drum in UDEC was tried out over a two-week period in the Philadelphia Computer. Taking advantage of the flexibility of the Pulse Control Units in the Philadelphia computer, it was possible to install the new magnetic drum in only a few hours and later remove it in an equally short time without serious interruption to Computation Services.

The Philadelphia Laboratory Computer is now largely engaged in Computation Services to industry on engineering problems. Among the recent computations and programming developments are included: pipe stress analysis; rotating disk stress analysis; servo-mechanical calculations; and, turbojet performance.

During a two-week special session on digital computers at Wayne University in August, problems were transmitted from Detroit by teletype for solving on the Computer in the Philadelphia Research Center, and solutions were sent back to Wayne University by teletype.

THE JAINCOMP-D

Preliminary design work has been completed on JAINCOMP-D, an unusually small, extremely flexible, high-speed general purpose digital computer. This machine will occupy three cabinets, each 24-1/4 x 21-7/8 x 27-5/8 inches in size, exclusive of power supply. The machine will contain a 36,864-digit (1,024 36-bit numbers) rapid access (3 μsec/36-bit word) magnetic storage of the JAINCOMP type, plus a 4,608-digit (128 36-bit numbers) static punched card random access (1 μsec/36-bit word) storage for constants, plus a high capacity magnetic tape storage of long access time. This very small computer can be programmed externally from magnetic tape or a static punched card, or can be programmed from storage. Orders can be manipulated in the arithmetic unit. Special operations such as extraction are possible. The machine is basically of the three-address type, although it can be programmed to be used as a four-address computer.

THE OARAC (Aeronautical Research Laboratory Computer)

The Aeronautical Research Laboratory (formerly Office of Air Research) Automatic Computer was delivered to Wright-Patterson Air Force Base in February 1953. Six weeks were required for the physical installation, including air conditioning. Two more weeks were required for electrical installation and checking. The addition of a motor-generator set was found necessary to eliminate line transients. Full-scale computing was under way the latter part of April.

The OARAC is a coded decimal, single-address, serial machine with magnetic drum storage of 10,000 eleven-digit words. The input-output medium is magnetic tape with Flexowriter tape preparation and reading units. The operating speed is about 100 operations per second at present. The design has been completed for conversion to a two-address system and the addition of a high-speed printer.

The machine is presently operating five days a week, twenty-four hours a day, with one shift of engineering service. Since operations began, the machine has been available for use 1157 hours out of 1672 hours of "on" time. During the month of August the machine was operated two shifts a day. In that period the available time was 270 hours out of 327 hours of "on" time.

THE ALWAC

The ALWAC is a general purpose digital computer of the internally programmed magnetic drum type. It is a serial, binary computer with automatic conversion from decimal-to-binary and binary-to-decimal during input and output, accomplished by an internally programmed routine. Recirculating working channels and arithmetic registers permit high computational rates as a result of the low access times in these stores.

Electric typewriters with associated paper tape perforating and tape reading equipment are used as the basic input-output devices. Master programs containing numerical data to be operated on by these standard routines can be entered into the computer from the punched tape or manually via the keyboard. The final results can be printed out with form control, signs, decimal points, and alphabetical headings completely under the control of a permanently stored sequence of instructions. As many as ten electric typewriters can be attached to this machine at various remote locations.

The magnetic drum memory consists of a 2048-word main storage, a 64-word working storage, 4 arithmetical registers, and the clock and timing channels. The words in the main storage are arranged into 64 channels containing 32 words each. Each word consists of a 32-binary bit number (equivalent to about 9.5 decimal digits) with a sign digit and two check digits. Additional 2048-word drums can be attached when greater storage capacity is required.

Each word space in the memory is divided into four order spaces, called syllables, and each syllable is capable of storing a command or order, which the computer will carry out. This compact method of storage for instructions is made possible by the system for specifying addresses for the computer. Most of the commands that the machine will carry out do not require addresses; therefore, a great deal of storage space is saved by having addresses only when they are needed. The machine proceeds from one syllable to the next in a standard sequence in looking for its orders. When it finds an order which requires an address, it looks at the next syllable in the normal sequence and interprets the number located there as the address. Then it will look in the next space after that for its next order.

The first ALWAC has been in successful operation for six months at Redondo, California. The second ALWAC installation will be at the Navy's David Taylor Model Basin in December 1953. The development of the computer was sponsored by Dr. Axel L. Wenner-gren, the well-known Swedish industrialist, and the work is being done by Logistics Research, Inc. in Redondo, California.

THE MONROBOT MU

A new series of Electronic Calculators currently under construction, to be called MONROBOT MU, will soon be available. In a variety of combinations, these units possess the ability to meet a wide assortment of requirements in storage capacity, operating speed, facilities for input-output, etc. The present MONROBOT V may also be obtained with multiple input-output units, including Flexowriter, keyboard, and perforated paper tape, each individually under programmed computer control. The computers are made by MONROBOT Corporation, Morris Plains, N.J. (Subsidiary of Monroe Calculating Machine Co.)

DATA PROCESSING AND CONVERSION EQUIPMENT

KEARFOTT SADAC

SADAC (Servo-Analog-Digital-Analog-Converter) was designed and built by Kearfott Company, Inc., Engineering Division, Clifton, New Jersey, during the second quarter of 1953. SADAC, a compact converter measuring only 2-1/4 inches in diameter by 3-3/4 inches in height, accepts analog information in voltage form from a remote transmitter and converts it to digital readout in unambiguous cyclic-binary form.

Conversion of the analog information is made in a servo loop which, except for the amplifier, is enclosed in the SADAC converter. A remote synchro transmitter, mounted on the shaft to be measured, furnishes an electrical indication of shaft movement to a control transformer in SADAC, and any change in shaft position causes a departure from null in the control transformer. A servo motor responding to the amplified control transformer signal neutralizes this error signal by turning the control transformer back to the null position. Simultaneously, the servo drives a series of segmented drums whose electrical output when the control transformer returns to the null position is the cyclic binary representation of the position of the shaft being measured.

SADAC has a digitalized capacity of 2^{12} or 4096 bits. Accuracy is .02% (one bit). Follow up speed of SADAC Model 1 is 330 bits per second and readout can be either "on the run" or on demand.

SADAC Model 2, which operates on the same basic principle, is a smaller unit designed for mounting directly on the shaft to be measured so that one servo loop can be eliminated.

Design work has already begun at the Kearfott Company to modify SADAC for use as an inverse converter (digital-to-analog) as well as on a miniaturized high-speed true binary converter.

CCP 701 DIGITAL POINT PLOTTER

The new CCP 701 Digital Point Plotter, recently announced by California Computer Products, 3927 West Jefferson Boulevard, Los Angeles 16, California, is a high-speed, low-cost digital point-by-point plotter developed primarily for preparing curves and graphs of data received from general-purpose digital computers.

It has an aluminum plotting drun 12 inches long and 6 inches in diameter capable of producing 11- x 17-inch plots. Plotting resolution is 40 points per inch, with accuracy held to $\pm$0.025". Plotting speed is 2 seconds per point. A variety of stylus-symbols may be selected by the user.

An optional decimal keyboard is available for manual plotting, and provision can be made to plot data from magnetic and paper tape or IBM card readers. Other features include automatic multiple curve plotting, arbitrary origin location, scale factor trim adjustment, a swing-out chassis rack for easy accessibility to component parts, plug-in components, and a choice of type of digital input system.

SOLID ACOUSTIC DELAY LINE MEMORY UNIT

Additional information has been received concerning the memory unit, Model 3C1-384, mentioned in the July 1953 Newsletter, which was developed by the Computer Control Company. The design includes the entire memory circuit in one plug-in type chassis (Figure 2) ready for installation in a computer. Groups of these units are used in a computer to provide sufficient memory. A complete memory circuit can easily be removed for servicing, and a spare unit plugged in to keep the computer operating. The unit stores 384 bits at a pulse repetition rate of 1 Mc. A self-contained heating element and thermal control gives temperature stability to the quartz line. Inherent accuracy of delay control greatly exceeds design requirements. All germanium diodes are grouped in a single plug-in type subunit. All five tubes are 6AN5's operated 80% below manufacturer's design center. The over-all dimensions of the plug-in chassis are 4-1/2 x 5-1/2 x 10 inches. A self-contained filament transformer is optional. The input voltage requirement into write-erase gate is 10 volts. The reshaped output signal level is 15 volts into a 100-ohm impedance load. Carrier frequency is 20 Mc. All circuits are degenerated, with reserve gain in the wide band i.f. amplifier. There is a gain control for initial adjustment of the i.f. stage. No tuning is necessary. The temperature coefficient of the quartz delay line is -123 parts per million per degree centigrade. The unit is especially fitted for airborne use and is insensitive to shock.

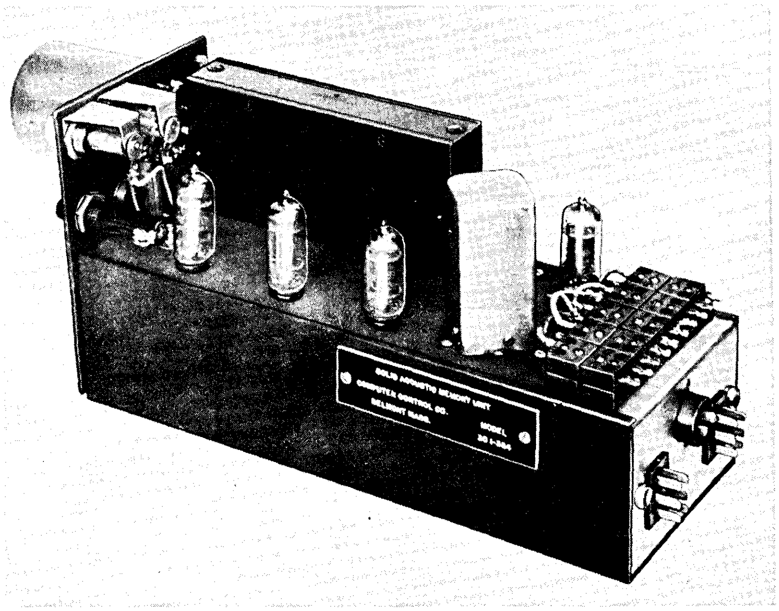

Figure 2 - Solid acoustic memory unit

MACDONALD MAGNETIC STORAGE DRUMS

The W. S. Macdonald Co., Inc., 33 University Road, Cambridge 38, Mass., originally designed a magnetic drum for the "Magnefile" electronic office equipment of the Company's manufacture. It is now offered as a separate unit for those requiring data storage of the drum type. This design and modifications thereof are available in several standard sizes; where a standard size or capacity of memory will not meet the user's requirements, other sizes can be furnished within rather broad limits.

The magnetic storage drum consists of an aluminum or magnesium ingot which is mounted on ball bearings and driven by a belt or direct-coupled electric motor. One drum type features a moving head which travels on machined ways parallel to the axis of the drum and at constant spacing from the drum surface. Heads which are adjustable in respect to drum clearance but fixed in their lateral position may be supplied in addition to the moving head or in place of this head. All heads are normally operated out of contact with the drum surface.

The magnetic storage medium of the drums consists of the red oxide of iron applied to the drum surface as a coating of high uniformity.

POTTER MAGNETIC TAPE HANDLER

The Potter Magnetic Tape Handler, Models 901A and 901B, is an instrument for intermittent or continuous recording and playback of digital information (Figure 3).

High-speed starts and stops in either direction (within 5 milliseconds) controlled by external signals and dual-speed tape drive provide the facilities for all types of high-speed recording, sorting, collating, comparing, and processing of any data which can be expressed in digital form.

Tape drive is independent of the reel drives and symmetrical with respect to the recording head to provide uniform tape speed in the forward and reverse directions and to assure optimum compliance on all recording tracks. Independent proportional photoelectric servos for each reel maintain proper tension and completely eliminate breaking or spilling. Standard NAB 10-1/2-inch reels provide a tape capacity of 2400 feet.

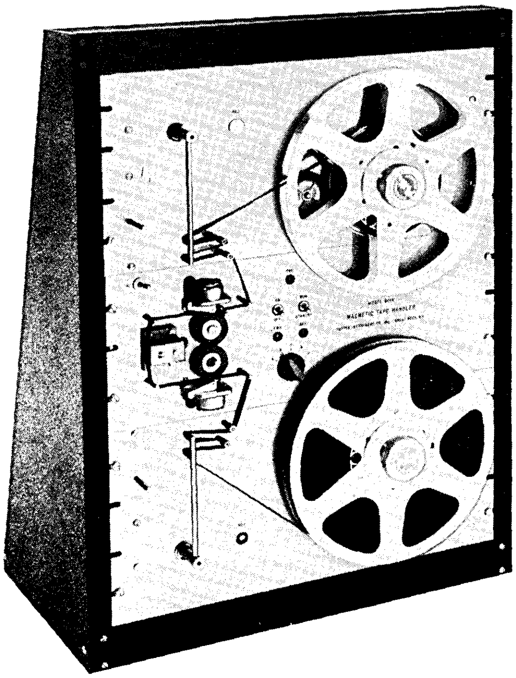

Figure 3 - Potter Magnetic Tape Handler

LIST OF COMPUTING SERVICES

Key: (a) Name and Address of Contact
(b) Facilities and their Location
(c) Coding and Mathematical Services
(d) To Whom Available

(1) Wayne University, Computation Laboratory

(a) A. W. Jacobson or E. P. Little, Wayne University, Computation Laboratory, Detroit 1, Michigan

(b) Burroughs Unitized Digital Electronic Computer and a Differential Analyzer

(c) Available

(d) No restrictions

(2) Remington Rand, Inc.

(a) Remington Rand Inc., 1615 L Street, N. W., Washington, D. C.

(b) UNIVAC with auxiliary equipment located at: Remington Rand Inc., 315 Fourth Avenue, New York 10, N. Y.

(c) Complete coding and mathematical service available

(d) No restrictions on utilization

COMPUTER COURSES

WAYNE UNIVERSITY COMPUTATION LABORATORY

Six academic courses in machine computation are being offered during the fall semester. These include numerical analysis, design and application of analogue and digital computers, pulse circuitry, and physics of solids as applied to computers. A program of study and research leading to advanced degrees in computational analysis is available. Several fellowships in machine computation are being sponsored by industry.

COMPUTER RESEARCH CORPORATION

Computer Research Corporation will conduct its Operation and Maintenance of the 102-A Courses on the following dates: October 12 to November 4, 1953, and November 23 to December 18, 1953. Courses for the year of 1954 will be announced later, both for the CRC 102-A and CRC 105.

NOTICES

NEWSLETTER TO BE REPRINTED IN JOURNAL OF ACM

Beginning with the January 1954 issue, the Digital Computer Newsletter will be reprinted in the newly established Journal of the Association for Computing Machinery, which will be distributed to all members of the ACM. Prospective members of ACM or nonmembers desiring to subscribe to the Journal should write to the Association for Computing Machinery, 2 East 63rd Street, New York 21, N. Y.

Distribution of the Newsletter to agencies of the Federal Government and Federal Government contractors will continue as before. Non-government addressees who have remained on the distribution list through this issue will no longer receive the Newsletter from government distribution.

JOINT COMPUTER CONFERENCE

Statler Hotel
Washington, D. C.
December 8-10, 1953

"Information Processing Systems - Reliability and Requirements", is the general theme of the Joint Computer Conference sponsored by the Institute of Radio Engineers, the Association for Computing Machinery, and the American Institute of Electrical Engineers, to be held December 8-10, 1953, at the Statler Hotel, Washington, D. C.

Mr. Mark Swanson, Chairman of the local committee on arrangements, has announced the completion of plans for all important aspects of this Conference. Mr. L. R. Johnson, vice-chairman in charge of registration, stated that present interest in the Conference indicates an attendance of at least 1600 persons.

Dr. Howard T. Engstrom, chairman of the technical program committee, reports that arrangements have been finalized for the following presentations:

Tuesday, December 8th

Morning

"Address of Welcome"
John H. Howard, Burroughs Corporation

"Keynote Address"
Howard T. Engstrom, Remington Rand, Inc.

"The RTMA Support of the 1950 Computer Conference - A Progress Report"
Thomas H. Briggs, Burroughs Corporation

"The Use of Electronic Data Processing Systems in the Life Insurance Business"
M. E. Davis, Metropolitan Life Insurance Company

"Computer Applications in Air Traffic Control"
Vernon I. Weihe, Air Transport Association of America

Afternoon

"Data Processing Requirements for the Purposes of Numerical Weather Prediction"
Joseph Smagorinsky, U. S. Weather Bureau

"Methods Used to Improve Reliability in Military Electronics Equipment"
L. D. Whitelock, Bureau of Ships

"Digital Computers for Linear, Real-Time Control Systems"
Ralph B. Conn, Jet Prop. Lab., Calif. Institute of Technology

Wednesday, December 9th

Morning

"Reliability Experience on the OARAC"
Robert W. House, Wright-Patterson Air Force Base

"Operating Experience with the Los Alamos 701"
Willard G. Bouricius, Los Alamos Scientific Laboratory

"Acceptance Tests for the Raytheon Hurricane Computer"
Professor Francis J. Murray, Columbia University

"Reliability of a Large REAC Installation"
Bernard D. Loveman, Reeves Instrument Corporation

"National Bureau of Standards Performance Tests"
S. N. Alexander and R. D. Elbourn, NBS

"Experience on the Air Force UNIVAC"
Robert Kopp, Headquarters, U. S. Air Force

Afternoon

"Electron Tube and Crystal Diode Experience in Computing Equipment"
J. A. Goetz and H. J. Geisler, IBM Corporation

"Reliability and Performance of the ILLIAC Electrostatic Memory"
Joseph M. Wier, University of Illinois

"Electron Tube Performance in Some Typical Military Environments"
D. W. Sharp, Aeronautical Radio Incorporated

Thursday, December 10th

Morning

"SEAC - Review of Three Years of Operation"
R. A. Kirsch and P. D. Shupe, Jr., NBS

"A Review of ORDVAC Operating Experience"
Charles R. Williams, Ballistic Research Laboratory

"Some Remarks on Logical Design and Programming Checks"
Herman H. Goldstine, The Institute for Advanced Study

"The Advantages of Built-in Checking"
John W. Mauchly, Remington Rand, Inc.

"Recent Progress in the Production of Error Free Magnetic Computer Tape"
W. W. Wetzel, Minnesota Mining and Manufacturing Company

Afternoon

"Reliability of Electrolytic Capacitors in Computers"
Mark VanBuskirk, P. R. Mallory and Company, Inc.

"A Method of Reliability Specification and its Application to Transistors"
W. J. Pietenpol, Bell Telephone Laboratories

"Case Histories in Resistor Reliability"
Jesse Marsten, International Resistance Company

"The MIT Magnetic-Core Memory"
William N. Papian, Massachusetts Institute of Technology

Discussion of these papers will occur both in the sessions themselves and in additional sessions to be held solely for the purpose of discussing topics of unusual interest. Miss Margaret Fox, vice-chairman for inspection trips, has completed arrangements for visits to various computer installations in the Washington area. All registrants will have the opportunity to indicate which inspection trips they prefer to make.

Mr. L. D. Whitelock, vice-chairman for exhibits, has prepared an unusual arrangement for demonstrators at the Statler Hotel. A unique feature of this arrangement provides a large uncongested area, so that all parties will be able to view exhibits specially arranged by outstanding manufacturers.

Preliminary announcements have been mailed to all members of the sponsoring organizations. The final program and applications for reservations are now being processed for the same mailing list. Interested parties who are not members of any one of the three sponsoring organizations may request the final program and reservation application from Mr. L. R. Johnson, 2018 Sycamore Drive, Falls Church, Virginia.

JOINT COMPUTER CONFERENCE PUBLICATIONS AVAILABLE

A limited number of Joint Computer Conference Proceedings are available from AIEE, IRE, and ACM at the prices listed below. These Proceedings provide a comprehensive source of information in the field of electronic computers. Many organizations are using them as textbooks for courses on computer design and application and for the instruction of new employees.

Orders should be sent to R. S. Gardner, American Institute of Electrical Engineers, 33 W. 39 Street, New York 18, N. Y.; L. G. Cumming, Technical Secretary, The Institute of

Radio Engineers, 1 East 79th Street, New York 21, N. Y.; or R. V. D. Campbell, Treasurer, Association for Computing Machinery, c/o Burroughs Corporation, 511 N. Broad Street, Philadelphia 23, Pa.

Publication	Content	Price
Joint AIEE-IRE-Computer Conference Proceedings (Published Feb. 1952)	REVIEW OF ELECTRONIC DIGITAL COMPUTERS. Papers and Discussions presented at the Joint AIEE-IRE Computer Conference, Philadelphia, Pa., Dec. 10-12, 1951 (114 Pages)	$ 3.50
Joint AIEE-IRE-ACM Computer Conference Proceedings (Published March, 1953)	REVIEW OF INPUT AND OUTPUT EQUIPMENT USED IN COMPUTING SYSTEMS. Papers and Discussions presented at the Joint AIEE-IRE-ACM Computer Conference, New York, N. Y., Dec. 10-12, 1952 (142 pages)	$ 4.00
Joint AIEE-IRE-ACM Computer Conference Proceedings (Published June, 1953)	PROCEEDINGS OF WESTERN COMPUTER CONFERENCE, Los Angeles, Calif., Feb. 4-8, 1953. Twenty-two papers and discussions on computers and their application (231 pages)	$ 3.50

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 for the following months.