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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Institute for Advanced Study Computer

Since the last Newsletter most of the work at the Institute for Advanced Study has been devoted to bringing the Arithmetic Organ into its final form and to producing the full scale Williams-type memory organ.

At this time quite extensive tests have been made of the multiplier operating at high duty cycle on several periodic tests. These tests have been quite successful; and there have been no difficulties nor malfunctions of the unit.

The full 40-fold Williams-type memory is being fabricated now, and it is hoped that in the near future it will be ready for its initial engineering tests, at which time the results will be reported.

Whirlwind I

The Whirlwind I arithmetic element, central control, and 32-register test storage have been operating together for several months. No extended reliability runs have been made, but a number of different test and display programs have been run without error for hours at a time. The test programs were designed to use as many parts of the computer as possible. The display programs include the solution of a second order differential equation with means for manual adjustment of the constants. The solutions are computed point by point and displayed on an oscilloscope by means of a binary-to analog decoder. Some 200 points are calculated per sweep of the scope, and this is repeated 15 times per second.

The 5-digit multiplier has been in continuous operation multiplying 31 x 31 and checking each answer at a repetition rate of 15,000 per second. From July 15 to December 30 there have been 5 breakdowns due to known causes and a total of 14 single random unexplained errors.

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One Eastman reader-recorder unit has been received and is undergoing tests with the computer input-output registers and control.

Eight electrostatic storage tubes have been accepted as satisfactory for Whirlwind I; an additional 8 are believed to be satisfactory. The initial bank of 16 tubes, storing 256 binary digits each, will be completed and installed during January and February.

Raytheon SDC Computer

The basic designs for almost all components of the Raytheon computer have been completed. The machine's one-thousand word internal memory will occupy a volume equivalent to one standard radio relay rack. Final design of the external memory units is nearing completion. The tape handling mechanism and recording circuits are operating satisfactorily.

During the past few months, techniques for printing permanent marks on the back of magnetic recording tape have been perfected. The marks are used to catalogue each of the three-thousand blocks of data in the external memory units. Photoelectrically operated hunt controls permit rapid access to any of the one-hundred thousand external memory positions.

CALDIC, University of California, Berkeley

At the present time, the logical design has been completed, the techniques to be used in the magnetic-drum memory have been developed, and some circuits have been developed, including the shifting registers. The drawings for the magnetic-drum and heads are being prepared and construction will begin soon. Construction of some electronic components will also begin soon, while investigation of other circuit techniques is being carried on. Input and output are in the design stage. The present estimate of the tube count is 2000, and floor space required is estimated to be 100 square feet.

Institute for Numerical Analysis Computer

There are two types of chassis in the arithmetic unit consisting of 40 chassis each. Construction of one type has been completed and these chassis are now being put through resistance and DC voltage checks. Prototypes of the other type have been approved and a contractor is proceeding with production. The required driver chassis to supply signals to the arithmetic unit have also been constructed. The chassis of the control unit have been completed and checked out, and work is proceeding on the final details of the interconnecting wiring of the chassis.

A production model of the cathode ray tube memory unit has been built, tested, and found to be entirely satisfactory. A contract for the signal amplifier that goes in this unit has been awarded to a local contractor who is proceeding with production. Requests for quotations for fabricating 45 cathode ray tube memory units have been asked from contractors at the present time.

The heater transformers of the power supply are now being constructed by a local transformer company and will be delivered within a week. The DC power supply specifications have been prepared and various bids have been obtained from local contractors for fabricating these units.

NBS Interim Computer

Essentially the complete control system for the computer has been assembled and successfully operated. In addition to verifying the design procedures this assembly provides a series of signals useful in the testing of arithmetic and input-output components as they are completed. The design of the arithmetic unit is complete, and its physical fabrication nearly finished. Also the input-output equipment suitable for the initial use of punched paper tape is nearly as far along.

The machine is now laid out so that in addition to the original 512 words of acoustic memory, to be delivered in February, it is possible to use simultaneously an electrostatic memory of any size

up to a total machine capacity of 4048 words. This electrostatic memory would operate in parallel in spite of the serial nature of the machine's arithmetic unit, and would decrease the machine's average computation time by a factor of the order of 2 or 3. Circuitry for such a memory is now being assembled and if successful it is planned to construct a complete memory of 512 or 1024 words.

Provision has been made in the machine design for the possible future addition of commands for accumulation, high-speed shift, and operation with a so-called base number, which under certain circumstances is automatically added to the addresses of a command, and commands having addresses which refer to relative rather than absolute memory locations—this being convenient in the multiple use of subroutines.

The Bell Computer - Model VI

The Bell Computer - Model VI is a general purpose digital relay computer with an electronically or tape controlled program. The electronic program arrangement has access to combinations of several semi-permanent built-in standard formulae. The solution of any standard problem requires that the problem tape simply furnish the formula number and the input data of the problem. Non-standard problems are programmed by individually coded instructions on the problem tape.

Data Conversion Equipment

The Telecomputing Corporation, Burbank, California, reports the development of a "Telereader" to facilitate the rapid transfer of data from film, oscillograms or graphs to numeric form in punched cards. Another device, the "Telecorder" converts a magnitude as represented by an electrical voltage or current, a mechanical rotation or linear travel, a hydraulic pressure or a displacement on a photographic record, to a discreet number of pulses or counts, which are accumulated by an electronic counter. The numbers standing in the counter can be read-out and punched into IBM cards for reduction or subsequent handling.

In general, auxiliary equipment, designed by the company, is required to couple the physical systems being measured to the recorders. Conversion of the binary numbers punched on the cards to decimal numbers can be accomplished on an IBM calculator associated with the equipment.

Also reported is work on an automatic high-speed plotting machine which will be actuated by IBM punch cards and will record up to 50 points per minute on a Cartesian coordinate system. The location of the desired points will be accomplished by actually counting grid lines on the graph paper.

THE EDSAC, CAMBRIDGE UNIVERSITY, ENGLAND

This computer, containing about 3000 vacuum tubes, was completed by Dr. M. V. Wilkes and his co-workers at the University Mathematical Laboratory in June 1949. The 512 word memory consists of two batteries of 16 mercury acoustic delay lines, each line capable of storing 16 words of 35 binary digits including the algebraic sign. Each 35 binary digit word can be split into two smaller words. Since the pulse repetition rate is 500 k.c.p.s. access to the internal storage varies from about .2 to 1.2 milliseconds. Addition time is 1.5 milliseconds and multiplication 7.0 milliseconds. Since its completion, the EDSAC has been used for a number of simple computational problems, such as the calculation of prime numbers, tabulation of the complex gamma function, computation of the number "e" to 200 decimal places, and calculation of the Airy integrals. These problems have been carried out not so much for their intrinsic interest, but rather in order to gain experience with programming of problems for the EDSAC.

COMPUTER, MANCHESTER UNIVERSITY, ENGLAND

This computer was built by Professor F. C. Williams in the Electrical Engineering Laboratories and has operated successfully on test problems. It has an electrostatic storage of 128 words of 40 binary digits each and a magnetic storage of 1024 words. Each of the two storage tubes in the electronic memory has a capacity of 2,560 binary digits, and words are stored or read by scanning the desired

word in serial fashion. The digits zero and one appear as dots and dashes on the storage surface. The information on the tube is continuously read and regenerated, thus making possible the use of ordinary cathode ray tubes, and fairly simple deflection circuits. Storage tubes are also used as registers associated with the arithmetic element and the control.

DIGITAL COMPUTERS, BIRKBECK COLLEGE, UNIVERSITY OF LONDON

Dr. A. D. Booth is building three computers: the automatic relay computer (ARC), the simple electronic computer (SEC) and the all purpose X-ray computer (APEXC). The ARC, as completed, had a magnetic drum memory of 22 tracks around the drum, on each of which 256 binary digits could be stored The arithmetic and control units are comprised of about 800 Siemens high speed relays. Including access to the memory, addition or subtraction required 20 msec and multiplication or division about 1 second. After having been successfully operated in the solution of several simple problems, it has been temporarily dismantled in order to replace the magnetic memory by several cross bar type memory units, each storing 32 words of 21 binary digits.

The SEC, to be completed this summer, will employ the ARC magnetic drum storage. An all electronic computer, it will contain between 180 and 300 vacuum tubes.

The APEXC will be an evolution of the SEC. It will employ about 800 vacuum tubes and will use a magnetic drum memory store 5" in diameter and 7" long, storing 1,024 numbers of 32 binary digits. Reading out and into the memory will require 1 msec. Not counting access time to the memory, addition and subtraction will take 30 microseconds, multiplication and division will take about 1 msec. Input will be on magnetic tape and output will be on a magnetic tape typewriter. Dr. Booth expects that the APEXC will be completed by the summer of 1951. Although it is a general purpose digital computer, it will probably be used initially for making crystallographic computations.

DIGITAL COMPUTERS IN SWEDEN

Under the direction of the Swedish Board for Computing Machinery the development of a large relay computer is being completed at the Swedish Telephone Company's laboratories and the construction is being undertaken by an industrial contractor. Consisting of about 5,000 relays of a very reliable Swedish type, it will have considerably faster operating speed than American relay computers. It will operate in the binary system with "floating binary point," a standard number being of the form $(2^{\pm a})(\pm n)$ where a is a 6 binary digit integer and n is a 24 binary digit fraction. At first a storage unit of 50 numbers to be later expanded to 100 will be provided.

Programming will be done by plugging with provisions for 840 (later 1200) steps, a step being essentially a "4 address order."

A large scale electronic digital computer is also being planned, which will probably employ an electrostatic storage device.

COMPUTER AT MATHEMATISCH CENTRUM, AMSTERDAM

Dr. A. Wijngaarden of the Mathematisch Centrum, Amsterdam, is building a relay computer very similar to Booth's ARC machine at Birkbeck College. Presumably it will be completed sometime in 1950. The main difference between it and the ARC is that the former will use a magnetic disc rather than a magnetic drum.

Comments, Letters to the editor, and additional contributions for inclusion in the Newsletter should be addressed to: Code 434, Office of Naval Research, Navy Department, Washington D. C.