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TRANSLATION

INFORMATION MACHINE

By

L. I. Gutenmakher

FOREIGN TECHNOLOGY DIVISION

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BY: L. I. Gutenmakher

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TRANSLATION SERVICES BRANCH
FOREIGN TECHNOLOGY DIVISION
WP-AFB, OHIO.

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Information Machine

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L. I. Gutenmakher,

The information machine. An electronic digital machine designated for automating the processes of storage, search and logical processing of large volumes of information. Such a machine has extremely capacious intristic and extristic memory devices. Information machine installations basically perform logic operations (approximately 90%) and a small number of arithmetical ones (about 10%). It is used for processing statistical information concerning the national economy, search and logical processing of scientific and technical information, treatment of medical observations for refining and generalizing symptoms of an illness and methods for curing, for processing observations of natural phenomena (meteorological, seismic, cosmic, etc.).

The information inside the information machine is expressed in binary form. A literal-digital group of symbols having a certain meaning is taken as a word and a series of words connected in a sense to the communication. Digits are usually expressed in a binary-decimal system of numeration with a fixed point. The words are conditionally divided into signs and digits. The signs are designations and characteristics of objects, discretors, semantic factors, units of measurement, etc. The communications frequently have an alternate length (from 200 to 2,000 binary signs). Separating signs are placed between words. For immediate numeration of printed information from documents and translation into binary form automatic readers are used which permit the recording to be read on magnetic ink of up to 500 documents per minute with 30 signs in each, and with the aid of automatic photoelectronic optical devices, 120 signs per second. For the input of data into the information machine photoelectric numeration is also used from punch cards and punch tapes (up to 1,000 signs per second) and numeration from magnetic tapes and disks.

The derivation of results from the information machine can be done by means of "symbolic" electron-beam tubes (charactrons), combined with a xerographic printer, which permits the obtainment of a speed of up to 10 thousand signs per second (approximately 5,000 lines per minute with 120 signs per line).

In many information machines the derivation of data is made on punch cards, punch tapes, magnetic tapes and on electromechanical high-speed "teletype" installations. In every information machine there are usually independently operating sets of input-output devices (up to 16 are known) and communication channels for them. Magnetic tapes basically are utilized as external devices for the storage of large volumes of information (external memory). The density of the recording is up to 20 signs per millimeter, and the number of tracks on the tape is up to 36. The capacity of the magnetic tapes in some information machines is brought to a billion words (in the "Datamatic", USA). The speed of numeration on the average is approximately 10 thousand pulses per second. Groups of blocks of magnetic tapes in 4 or 5 pieces are often united with one control and amplifier system. The time of conversion to a given zone of magnetic tape consists of usually about 20 seconds.

Long-range memory devices with one-way selection (only for numeration) of information and operational memory devices allowing rapid recording and reading of information serve as the internal memory of the information machine. The first are designated only for the reproduction of constant stored information, stored in an invariable form for many years. Now in practical operation there are experimental samples of such a memory with a capacity in the block of up to 30 million signs.

The operational memory devices are magnetic (ferrite) blocks with a capacity of up to 32,768 words with 38 to 42 signs in a conversion time of about 10 microseconds. In certain machines the capacity of parallel-operating blocks is brought up to 100 thousand words. As we see, the ratio between the speed of selection of information in the operational memory and in magnetic tapes is more than one million. This circumstance requires the construction of a complicated system of solving devices, part of which are used for work with relatively slow external storage devices, and another, with high-speed memory. Electron logic devices are constructed specifically for sorting and selecting according to an assigned symbol admitted from the external storage units. One of them (interrogation unit) collects materials for dispatching them to the operational memory, and the others (sorting units) preliminarily sort the external information or words according to the program.

The address systems of the memory units are divided into literal, numerical and associative. The numerical system permits in one cycle to select and reproduce information from one cell of the memory unit during feed of the adress code representing its number of the cell of the memory unit in binary form. The address code, consequently, cannot exceed the number of cells of the memory unit.

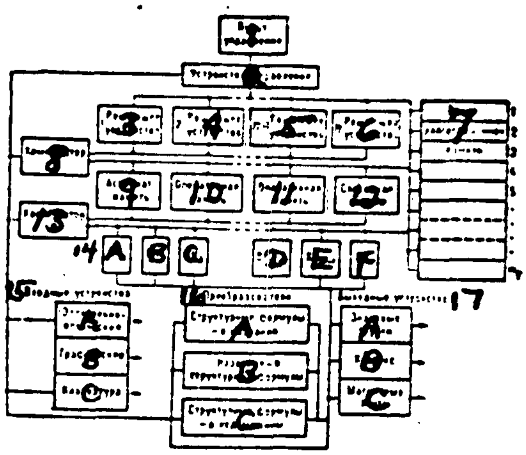
The literal address system offers the possibility in n cycles to select information on a word, assigned with a certain definite succession ($n \neq 1$) of letters (symbols). The codes ($n \neq 1$) of the letters given successively one after another in this literal address system which only upon termination of code feed of the entire word yields information, serve as the address in this case. The address code of a word can many times exceed the total number of cells of the memory unit. The associative address system in two or three cycles reproduces from the memory unit information characterized by a given combination (association) of symbols (without partition and pre-sorting of information according to symbols). The associative address system permits the solution of a reciprocal memory problem: according to the content of the memory cell to determine its address, i.e. the cell number.

In one and only one case of coincidence of the interrogation code and the code recorded in one cell of the memory, this address system will reproduce the cell number. If in all cells of the memory exists a code given in the form of a question, then the answer is obtained in the form of a negation. In that case, when the assigned code is contained in several cells, then according to an additional program the number of all of these cells is automatically reinforced with a general code.

Reading of the numerical, literal and associative address systems of memory permits the construction of extremely perfected and effective information machines, modeling many processes of mental work.

The volumes of separate types of memory and their relationship depends on the nature of the problems to be solved. The information machine is characterized by the application of a certain number of simultaneously operating solving units, controlled by one general commutation (coordinating) unit. Some of them ("sorting") accomplish pre-sorting of information on a given combination of symbols, using for this a small number (approximately ten) of commands of the control program, others (interrogation units) immediately select information according to interrogation symbols. High-speed logic and arithmetical units together with the operational and long-range high-speed memory perform according to the assigned program, information processing, partially admitted and from the external storage devices through sorting. Usually a single-address system of commands is applied here. Each command consists of a code of operation and one address, the storage place of the needed information. Characteristically, the application of group operations, when one task of the operation is successively and multiply performed with a large group of communications. Often, group transfers of information are used from one memory cell to another. The operations of conditional and unconditional transitions are utilized.

In the information machine there are libraries of progams of automatic solution of typical problems. Some programs are stored and can be quickly reproduced from the long-range memory.



Block-diagram of Information Machine Applicable to Processing and Search of Chemical Information.

KEY

1. Control Desk.
2. Control Unit.
3. Solving Unit 1.
4. Solving Unit 2.
5. Solving Unit n-1.
6. Solving Unit n.
7. Long-Range Memory Blocks.
8. Commutator 1.
9. Associative Memory.
10. Operational Memory.
11. Operational Memory.
12. Literal Memory.
13. Commutator 2.
14. A. BH1   E. BH_{m-1}
    B. BH2   F. BH_m
    C. BH3
    D. BH_{m-2}
15. Input Units
    - A. Electron-Optical.
    - B. Graphic.
    - C. Key Board.
16. Converters
    - A. Structural Formulas into Designations.
    - B. Designations into Structural Formulas.
    - C. Structural Formulas into Machine Code.
17. Output Units
    - A. Symbol Tubes.
    - B. Xerox.
    - C. Magnetic Tapes.

Let us look at the diagram for processing and search of chemical information. In the long-range memory with a volume of a billion binary symbols information must be stored on several hundred thousand chemical compounds and millions of chemical reactions. Recording of one chemical formula represents a unit of information, a word. The words consist of letters, i.e. symbols of specific atoms, the bonds between them and other symbols. The information in this recording are equations of chemical reactions, consisting of words, i.e. structural formulas of compounds perticipating in the reactions, and information on the technical means of their accomplishment, etc. Lead-in units turn on the automatic devices for conversion of the chemical information fed into the information machine into machine language. At the output of the machine reverse translation must be performed into the language of structural formulas and special terms that chemists are used to.

The computer must solve the following problems:

1. Search of chemical structural formulas, in which there are or are not any given structure fragments. As we know, there are fragments consisting of 15 to 20 atoms, appearing as carriers of various properties, and fragments of about 3 to 4 atoms designated by chemical functions. 2. Search of possible synthetic chains of a chemical reaction. This problem leads to a search of ways of synthetizing a definite given compound, originating from a certain permissible setup of the initial products with the use of the processes of chemical conversions stored in the machine memory. The information search is accomplished by means of a series of logic operations of comparison and identification of classification and analogies.

In certain cases the information machine is constructed as a system of collectively operating electronic machines with a narrow specialization of each one, by which the automatic exchange of results of group operations and exchange of programs is provided for.This sense represents the beginning stage of the creation of information systems. We know, for example, a system of three machines, out of which one is extremely high-speed, another serves as a program preparation, and the third, for selection from the external storage units, sorting and other preliminary information searches. General control is used for coordination and transmission of the information for the purpose of ensuring the most productive system.

The development of information machines goes along the lines of creating an even more capacious and high-speed internal machine memory and the perfection of logic computers for the purpose of radical conversion of all forms of mental labor, that leads to a sharp increase in its productivity in the utilization in the memory of information machines of all stored reserves of knowledge in a given field. The potential possibilities of information machines permit us to consider that the practice of publication of scientific works and other types of information in the future will be converted to the radical manner. Machine processing of flows of literal-digital information and their filtration according to significance, storage of the most valuable information and the possibility of its rapid reproduction and transmission through any communications channel to remote distances will lead to a revolutionary change in mental labor.

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