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Computer

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A device that receives, processes, and presents information. The two basic types of computers are analog and digital. Although generally not regarded as such, the most prevalent computer is the simple mechanical analog computer, in which gears, levers, ratchets, and pawls perform mathematical operations—for example, the speedometer and the watt-hour meter (used to measure accumulated electrical usage). The general public has become much more aware of the digital computer with the rapid proliferation of the hand-held calculator and a large variety of intelligent devices, ranging from typewriters to washing machines, and especially with exposure to the Internet and the World Wide Web. See also: Calculators; Internet; World Wide Web

In the 1950s and 1960s the definition of “computer” included only the provision of input and output, and the ability to process the input to produce the output. Since then, the common understanding of the term (in particular, for digital computers) has come to include storage, and even the ability to store the program of instructions, allowing decision making based on previously computed results. See also: Computer programming; Computer storage technology

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DICTIONARY

- **computer**
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- **active computer**
- **analog computer**
- **analog-digital computer**
- **arbitrary course computer**

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Analog computer

An analog computer uses inputs that are proportional to the instantaneous value of variable quantities, combines these inputs in a predetermined way, and produces outputs that are a continuously varying function of the inputs and the processing. These outputs are then displayed or connected to another device to cause action, as in the case of a speed governor or other control device. See also: Control systems

Small electronic analog computers are frequently used as components in control systems. Inputs come from sensing devices which output an electrical signal (transducers). These electrical signals are presented to the analog computer, which processes them and provides a series of electronic outputs that are then displayed on a meter for observation by a human operator or connected to an electrical action device to ring a bell, flash a light, or adjust a remotely controlled valve to change the flow in a pipeline system. If the analog computer is built solely for one purpose, it is termed a special-purpose electronic analog computer.

In any analog computer the key concepts involve special versus general-purpose computer designs, and the technology utilized to construct the computer itself, mechanical or electronic. An analog computer is often combined with a digital computer to form a hybrid computer. See also: Analog computer

Digital computer

In contrast, a digital computer uses symbolic representations of its variables. The arithmetic unit is constructed to follow the rules of one (or more) number systems. Further, the digital computer uses individual discrete states to represent the digits of the number system chosen.

Electronic versus mechanical computers

The most prevalent special-purpose mechanical digital computers used to be the supermarket cash register, the office adding machine, and the desk calculator. Each of these has been universally replaced by electronic devices allowing much greater logical decision making and greatly increased speed. For example, most products now carry a bar code, the Universal Product Code (UPC). The code is scanned by a light-sensitive device, bringing information about each product into the point-of-sale (POS) terminal that has replaced the mechanical cash register. The POS terminal then computes total charges and provides a receipt for the customer. It may also communicate with a centralized computer system that controls inventory, accounts payable, salaries and commissions, and so on. While a mechanical cash register could carry out only a small number of operations each minute, and some electromechanical devices might handle several hundred operations per second, even a small general-purpose electronic computer can carry out its computations at millions of operations per second.

Stored program operation

A digital computer works with a symbolic representation of variables; consequently, it can easily store and manipulate numbers, letters, images, sounds, or graphical information represented by a symbolic code. Typically, a general-purpose electronic digital computer operates on numbers by using both decimal and binary number systems, and on symbolic data expressed in an alphabet. It contains both an arithmetic unit and a storage unit. As the digital computer processes its input, it proceeds through a series of discrete steps called a program. The storage unit serves to retain both the values of the variables and the program to process those variables. The arithmetic unit may operate on either variables or coded program instructions interchangeably, since both are usually retained in the storage unit in the same form. Thus, the digital computer has the capability to be adaptive, because processing can be determined by the previously prepared program, by the data values supplied as input to the computation, and by the values generated during the course of the computation. Through the use of the stored program, the digital computer achieves a degree of flexibility unequaled by any other computing or data-processing device.

Applications

In the past, most digital computers were confined to standard applications, such as bookkeeping, accounting, engineering design, and test data reduction. However, the advent of the relatively inexpensive and readily available personal computer, and the combination of the computer and communications, such as by the use of networks, have dramatically altered that pattern. The most common application now is probably text and word processing, followed by electronic mail. See also: Electronic mail; Local-area networks; Microcomputer; Word processing

Ready access to national networks has fostered the growth of communities of computer users who communicate easily and effectively on the World Wide Web, including an explosion of commerce via online communications. The convergence of computers and network communications also has encouraged the development of network computers, smaller and simpler computers that depend on the availability of software and data from around the world arriving via networks in order to accomplish their tasks.

The ability of even modest computer systems to store, organize, and retrieve very large amounts of information has brought about radical changes in the very nature of many business offices. Indeed, many industrial, academic, and governmental processes have been irrevocably changed by the computer. It is often said that the Manhattan Project, although managed by paper and pencil in the 1940s, simply could not have been accomplished at all today without using computers. That is, there has been a change in the very thought processes that people use to accomplish tasks, in order to accommodate computer-based solutions for those tasks.

Personal workstations, used in engineering design and other applications requiring intense computation and sophisticated graphics, have become more powerful than earlier, very large computer systems. This has moved computation, and even the storage of many large data files, directly onto each person's desk, and in many cases, into handheld computers. In addition, applications that were once considered esoteric have led to industrial applications, such as the use of robots on manufacturing assembly lines. Many of the heuristic techniques employed by these robots are based on algorithms developed in such artificial-intelligence applications as virtual reality. See also: Artificial intelligence; Computer-aided design and manufacturing; Computer-aided engineering; Computer graphics; Robotics; Virtual reality

Computers have begun to meet the barrier imposed by the speed of light in achieving higher speeds. This has led to research and development in the areas of parallel computers (in order to accomplish more in parallel rather than by serial computation) and distributed computers (taking advantage of network connections to spread the work around, thus achieving more parallelism). Continuing demand for more processing power has led to significant changes in computer hardware and software architectures, both to increase the speed of basic operations and to reduce the overall processing time. See also: Computer architecture; Concurrent processing; Distributed systems (computers); Multiprocessing; Supercomputer

In the hardware domain, clock rates approaching gigahertz speed have led to ever smaller computers, since electronic pulses cannot travel further than 1 ft (0.3 m) per nanosecond; instruction and video caches have been enlarged for faster processing and display; and central processing units are continually being redesigned to enable more parallelism (and to avoid the “von Neumann bottleneck” inherent in a serial architecture). In the software domain, parallelism is being achieved both locally via multithreading and multiprocessor operating systems, and globally via distributed computation. See also: Computer peripheral devices; Database management system; Digital computer; Human-computer interaction

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- Related Web Site: Association for Computing Machinery
- Related Web Site: Institute of Electrical and Electronics Engineers
- Related Web Site: Charles Babbage Institute of Computer History
- Related Web Site: TechEncyclopedia of Computer Technical Terms
- Related Web Site: Webopedia: Online Dictionary for Computer and Internet Terms

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