digital computer

Encyclopædia Britannica Article

any of a class of devices capable of solving problems by processing information in discrete form. It operates on data, including magnitudes, letters, and symbols, that are expressed in binary form—i.e., using only the two digits 0 and 1. By counting, comparing, and manipulating these digits or their combinations according to a set of instructions held in its memory, a digital computer can perform such tasks as to control industrial processes and regulate the operations of machines; analyze and organize vast amounts of business data; and simulate the behaviour of dynamic systems (e.g., global weather patterns and chemical reactions) in scientific research.

A brief treatment of digital computers follows. For full treatment, *see* computer science: Basic computer components.

Functional elements

A typical digital computer system has four basic functional elements: (1) input-output equipment, (2) main memory, (3) control unit, and (4) arithmetic-logic unit. Any of a number of devices is used to enter data and program instructions into a computer and to gain access to the results of the processing operation. Common input devices include keyboards and optical scanners; output devices include printers and cathode-ray tube and liquid-crystal display monitors. The information received by a computer from its input unit is stored in the main memory or, if not for immediate use, in an auxiliary storage device. The control unit selects and calls up instructions from the memory in appropriate sequence and relays the proper commands to the appropriate unit. It also synchronizes the varied operating speeds of the input and output devices to that of the arithmetic-logic unit (ALU) so as to ensure the proper movement of data through the entire computer system. The ALU performs the arithmetic and logic algorithms selected to process the incoming data at extremely high speeds—in many cases in nanoseconds (billionths of a second). The main memory, control unit, and ALU together make up the central processing unit (CPU) of most digital computer systems, while the input-output devices and auxiliary storage units constitute peripheral equipment.

Development of the digital computer

Blaise Pascal of France and Gottfried Wilhelm Leibniz of Germany invented mechanical digital calculating machines during the 17th century. The English inventor Charles Babbage, however, is generally credited with having conceived the first automatic digital computer. During the 1830s Babbage devised his so-called Analytical Engine, a mechanical device designed to combine basic arithmetic operations with decisions based on its own computations. Babbage's plans embodied most of the fundamental elements of the modern digital computer. For example, they called for sequential control—i.e., program control that included branching, looping, and both arithmetic and storage units with automatic printout. Babbage's device, however, was never completed and was forgotten until his writings were rediscovered over a century later.

Of great importance in the evolution of the digital computer was the work of the