Computers, Evolution of Electronic

Electronic computers represent and process data through electronic signals and currents. These computers have evolved significantly over the past half century. Today's computers are faster, smaller, more efficient, and more powerful than their room-sized predecessors.

Early Years

There are several opinions about the origin of the first electronic computer. Some believe the credit should go to the individual who provided the first written schematic for the electronic computer. Others credit the scientists who developed the first working model of a system. Many, however, credit the individuals who first patented the electronic computer.

The two earliest electronic computers were the ABC and the ENIAC. The Atanasoff-Berry Computer (ABC) was built at Iowa State University between 1937 and 1942 by John Vincent Atanasoff and Clifford Berry. The ABC—designed to produce solution sets for linear physics equations—performed parallel processing, separated memory and computing functions for calculations, refreshed memory, converted numbers from base-10 to base-2, and carried out binary arithmetic. Atanasoff and Berry did not get a patent for their machine, and Atanasoff shared knowledge of ABC's construction and functions with John W. Mauchly, who visited with Atanasoff and viewed the ABC in 1941.

The ENIAC (Electronic Numerical Integrator and Computer) was created in 1946 by John W. Mauchly and J. Presper Eckert. ENIAC was the first large-scale electronic computer.* The 30-ton machine was built at the Moore School of Electrical Engineering on the University of Pennsylvania Campus with funding from the U.S. Army. The high-speed calculations it performed were used to accurately produce firing tables for artillery gunners.
*Although ENIAC was billed as the first electronic computer, U.S. Federal Judge Earl Richard Lawson settled the dispute in 1973 and named the Atanasoff-Berry Computer the first electronic computer.*

But soon after ENIAC made its debut, its creators discovered some problems. ENIAC did not have enough internal storage to house numbers that it used in calculations. Another problem was ENIAC's difficulty changing programs or instructions. It took several hours to rewire ENIAC to perform different types of computational tasks.

ENIAC's successors were EDVAC (Electronic Discrete Variable Computer), EDSAC (Electronic Delay Storage Automatic Computer), and the IAS Computer. EDVAC, developed in 1949 by Maurice Wilkes and completed 3 years later, used binary numbers for arithmetic operations and digitally stored internal instructions. EDSAC, completed before EDVAC, had the ability to store programs internally. The IAS computer introduced the concept of parallel operations. It captured and moved digits in a number simultaneously.

**Other Early Computers.** Early electronic computing devices developed in the same era as the Atanasoff-Berry Computer and ENIAC also produced significant contributions to the evolution of the electronic computer. Such early devices included George Stibitz's Binary Calculator (1937), Konrad Zuse's Z1 (1941), and Howard Aiken's Mark-1 (1944). These computing devices used electromechanical relays to conduct electricity. Relays either allowed a current to exist in an opened or closed state. When the circuit was closed, the current flowed, but when it was opened, no current traveled through a circuit.

Another electromechanical computer named Colossus (1943) was used to crack secret German military codes during World War II. Alan Turing and other scientists developed Colossus at Bletchley Park, located northwest of London. Colossus functioned on the premise that it could solve every solvable mathematical or logical problem. Composed of vacuum tubes like ENIAC, Colossus read, scanned, and compared ciphered enemy messages with known Enigma codes until a match was found.

**Decreasing Size and Increasing Speed**

The shortcomings of vacuum tubes prompted scientists to look for alternative materials to conduct electricity. Scientists also searched for ways to decrease the size of the computer while increasing its speed. The advent of the transistor and the integrated circuit chip produced the next major development in the evolution of the electronic computer.

**The Transistor.** The transistor, invented in 1947 by John Bardeen, W. H. Brattain, and W. B. Shockley at Bell Laboratories, made it possible to develop an electronic computer that was smaller and more efficient than its predecessors.

Yet two major drawbacks kept the transistor from being mass-produced: high cost and a lack of knowledge of its peculiarities. The transistor was further refined by Gordon Teal, who used silicon instead of
germanium to make the transistor. Silicon was cheaper and its use improved the speed of production and reduced manufacturing costs. New methods were devised to produce large silicon crystals and add the impurities that were necessary to make it usable.

These advances, along with decreasing manufacturing costs and encouragement by the U.S. military to build smaller electronic parts, helped reduce the size of electronic computers. The first computer that used transistors was TRADIC (Transistor Digital Computer). By the 1960s hundreds of computers used transistors to speed processing and reduce production costs.

**The Integrated Circuit.** The integrated circuit, developed by Jack St. Clair Kilby, provided a new means for incorporating transistors and other needed components on the same surface. The integrated circuit board allowed more information to be stored in a smaller area. Transistors also proved to be more reliable, less expensive, and faster than other technology of the time. The first working electronic computer that used semiconductor technology was built by Texas Instruments for the U.S. Air Force.

The early integrated circuit (IC) was soon replaced by an IC created by Robert Noyce. Noyce's version, completed in 1959, was adopted by Texas Instruments and mass-produced in 1962 under the nickname "chips." Chips saved space, miniaturized connections, and provided the speed necessary for sophisticated scientific and commercial applications.

Chips also changed the manufacturing process. Before the integrated circuit was invented, all components of an electronic circuit were produced as separate entities and then combined through wiring. Because chips are made of silicon, they have circuits that contain resistors, capacitors, and transistors that can turn voltage on or off to represent the binary digits used by computers.

see also Bases; Boole, George; Computers and the Binary System; Computers, Personal; Cryptology; Turing, Alan.

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**Internet Resources**


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