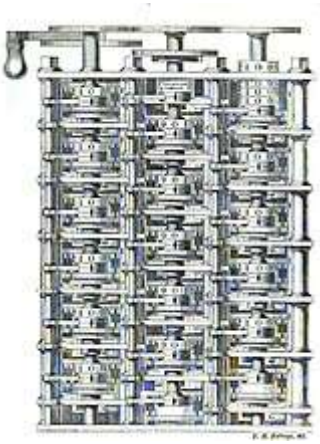
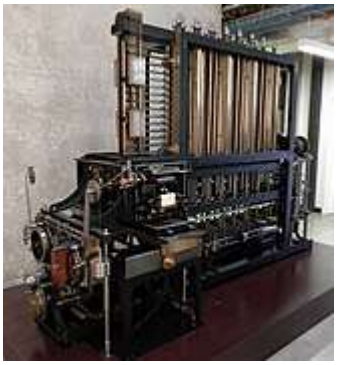
First computer

Charles Babbage c. 1850



A diagram of a portion of Babbage's Difference engine



The Difference Engine Number 2 at the Intellectual Ventures laboratory in Seattle

Charles Babbage, an English mechanical engineer and polymath, originated the concept of a programmable computer. Considered the "father of the computer",[1] he conceptualized and invented the first mechanical computer in the early 19th century.

After working on his difference engine he announced his invention in 1822, in a paper to the Royal Astronomical Society, titled "Note on the application of machinery to the computation of astronomical and mathematical tables",[1] he also designed to aid in navigational calculations, in 1833 he realized that a much more general design, an analytical engine, was possible. The input of programs and data was to be provided to the machine via punched cards, a method being used at the time to direct mechanical looms such as the Jacquard loom. For output, the machine would have a printer, a curve plotter and a bell. The machine would also be able to punch numbers onto cards to be read in later. The Engine incorporated an arithmetic logic unit, control flow in the form of conditional branching and loops, and integrated memory, making it the first design for a general-purpose computer that could be described in modern terms as Turing-complete.

The machine was about a century ahead of its time. All the parts for his machine had to be made by hand – this was a major problem for a device with thousands of parts. Eventually, the project was dissolved with the decision of the British Government to cease funding. Babbage's failure to complete the analytical engine can be chiefly attributed to political and financial difficulties as well as his desire to develop an increasingly sophisticated computer and to move ahead faster than anyone else could follow. Nevertheless, his son, Henry Babbage, completed a simplified version of the analytical engine's computing unit (the *mill*) in 1888. He gave a successful demonstration of its use in computing tables in 1906.

Electromechanical calculating machine

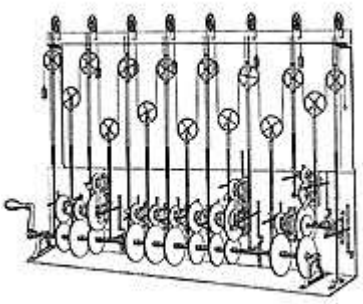
Electro-mechanical calculator (1920) by Leonardo Torres Quevedo.

In his work *Essays on Automatics* published in 1914, Leonardo Torres Quevedo wrote a brief history of Babbage's efforts at constructing a mechanical Difference Engine and Analytical Engine. He described the Analytical Engine as exemplifying his theories about the potential power of machines, and takes the problem of designing such an engine as a challenge to his skills as an inventor of electromechanical devices. The paper contains a design of a machine capable of calculating completely

automatically the value of the formula , for a sequence of sets of values of the variables involved. The whole machine was to be controlled by a read-only program, which was complete with provisions

for conditional branching. He also introduced the idea of floating-point arithmetic. In 1920, to celebrate the 100th anniversary of the invention of the arithmometer, Torres presented in Paris the Electromechanical Arithmometer, which consisted of an arithmetic unit connected to a (possibly remote) typewriter, on which commands could be typed and the results printed automatically demonstrating the feasibility of an electromechanical analytical engine.[

Analog computers



Sir William Thomson's third tide-predicting machine design, 1879–81

During the first half of the 20th century, many scientific computing needs were met by increasingly sophisticated analog computers, which used a direct mechanical or electrical model of the problem as a basis for computation. However, these were not programmable and generally lacked the versatility and accuracy of modern digital computers.[33] The first modern analog computer was a tide-predicting machine, invented by Sir William Thomson (later to become Lord Kelvin) in 1872. The differential analyser, a mechanical analog computer designed to solve differential equations by integration using wheel-and-disc mechanisms, was conceptualized in 1876 by James Thomson, the elder brother of the more famous Sir William Thomson.

The art of mechanical analog computing reached its zenith with the differential analyzer, built by H. L. Hazen and Vannevar Bush at MIT starting in 1927. This built on the mechanical integrators of James Thomson and the torque amplifiers invented by H. W. Nieman. A dozen of these devices were built before their obsolescence became obvious. By the 1950s, the success of digital electronic computers had spelled the end for most analog computing machines, but analog computers remained in use during the 1950s in some specialized applications such as education (slide rule) and aircraft (control systems).