Digital computers

Electromechanical

By 1938, the United States Navy had developed an electromechanical analog computer small enough to use aboard a submarine. This was the Torpedo Data Computer, which used trigonometry to solve the problem of firing a torpedo at a moving target. During World War II similar devices were developed in other countries as well.


Replica of Konrad Zuse's Z3, the first fully automatic, digital (electromechanical) computer

Early digital computers were electromechanical; electric switches drove mechanical relays to perform the calculation. These devices had a low operating speed and were eventually superseded by much faster all-electric computers, originally using vacuum tubes. The Z2, created by German engineer Konrad Zuse in 1939 in Berlin, was one of the earliest examples of an electromechanical relay computer.[]


Konrad Zuse, inventor of the modern computer

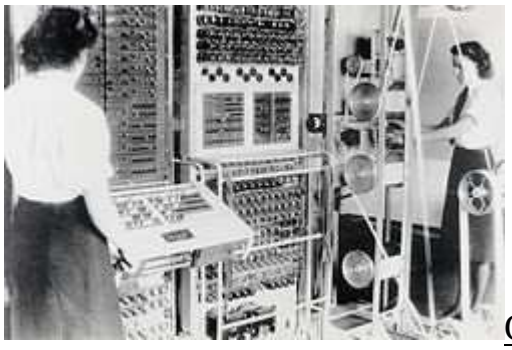
In 1941, Zuse followed his earlier machine up with the Z3, the world's first working electromechanical programmable, fully automatic digital computer. The Z3 was built with 2000 relays, implementing a 22 bit word length that operated at a clock frequency of about 5–10 Hz.[1] Program code was supplied on punched film while data could be stored in 64 words of memory or supplied from the keyboard. It was quite similar to modern machines in some respects, pioneering numerous advances such as floating-point numbers. Rather than the harder-to-implement decimal system (used in Charles Babbage's earlier design), using a binary system meant that Zuse's machines were easier to build

and potentially more reliable, given the technologies available at that time.[] The Z3 was not itself a universal computer but could be extended to be Turing complete.

Zuse's next computer, the Z4, became the world's first commercial computer; after initial delay due to the Second World War, it was completed in 1950 and delivered to the ETH Zurich.[] The computer was manufactured by Zuse's own company, Zuse KG [de], which was founded in 1941 as the first company with the sole purpose of developing computers in Berlin.[]

Vacuum tubes and digital electronic circuits

Purely electronic circuit elements soon replaced their mechanical and electromechanical equivalents, at the same time that digital calculation replaced analog. The engineer Tommy Flowers, working at the Post Office Research Station in London in the 1930s, began to explore the possible use of electronics for the telephone exchange. Experimental equipment that he built in 1934 went into operation five years later, converting a portion of the telephone exchange network into an electronic data processing system, using thousands of vacuum tubes.[] In the US, John Vincent Atanasoff and Clifford E. Berry of Iowa State University developed and tested the Atanasoff–Berry Computer (ABC) in 1942,[] the first "automatic electronic digital computer".[] This design was also all-electronic and used about 300 vacuum tubes, with capacitors fixed in a mechanically rotating drum for memory.[]



Colossus, the first electronic digital programmable computing device, was used to break German ciphers during World War II. It is seen here in use at Bletchley Park in 1943.

During World War II, the British code-breakers at Bletchley Park achieved a number of successes at breaking encrypted German military communications. The German encryption machine, Enigma, was first attacked with the help of the electro-mechanical bombes which were often run by women. To crack the more sophisticated German Lorenz SZ 40/42 machine, used for high-level Army communications, Max

Newman and his colleagues commissioned Flowers to build the Colossus.[1] He spent eleven months from early February 1943 designing and building the first Colossus.[1] After a functional test in December 1943, Colossus was shipped to Bletchley Park, where it was delivered on 18 January 1944[1] and attacked its first message on 5 February.

Colossus was the world's first electronic digital programmable computer.[1] It used a large number of valves (vacuum tubes). It had paper-tape input and was capable of being configured to perform a variety of boolean logical operations on its data, but it was not Turing-complete. Nine Mk II Colossi were built (The Mk I was converted to a Mk II making ten machines in total). Colossus Mark I contained 1,500 thermionic valves (tubes), but Mark II with 2,400 valves, was both five times faster and simpler to operate than Mark I, greatly speeding the decoding process.