History Report 1

Team 1

Before 1950

In modern society, most people don’t think computers were relevant, or even existed since they were not even relatively as accessible as they are now. Little do people realize that computers originally were started by mathematicians and various engineers, seen for more of their theoretical use in the simplest machines. Over the years, computers have evolved from being a purely mechanical tool to a tool powered by electricity being able to calculate things quickly at near absolute-zero temperatures. In this paper, we discuss the history of computing regarding its development by pioneers in the field, their relevant technologies and how they have impacted society.

Between the years of 1933 and 1949, large strides have been made in the history of computing. However, we can trace the origins of computing to the 1830s with the Babbage Engines. Charles Babbage, “Father of the Computer”, both studied and taught mathematics at Cambridge in the early 1800s. He is what you can call a ‘gentleman scientist’, someone who is an independently wealthy ametur who can support his own projects. Babbage wrote many mathematical novels and made many great contributions to inventions like pioneering lighthouse signalling, inventing the ophthalmoscope, and proposing black box recorders for monitoring trains. Charles Babbage is largely attributed today toward his development of the babbage engine, composed of a difference engine and a series of analytical engines, which resemble the different parts of a mechanical calculator, which was improved on in later years. The difference engine came first, and was designed “to calculate a series of values and print results automatically in a table”. This led up to the analytical engines, containing essential features that we see in most modern computers today. This started the use of a punch card system and began including decimal use.

After about a century we started to see more mathematicians making great strides in advancing computing. Claude Shannon, the “Founder of Information Theory”, received his masters in Electrical Engineering and PhD in Mathematics from Massachusetts Institute of Technology (MIT) in 1940. In 1941 he started worked for the mathematics department of Bell Labs, contributing in a variety of war related projects and even some cryptography. His master's thesis *“A Symbolic Analysis of Relay and Switching Circuits”* published in 1940 brought forth theoretical concepts of digital circuits using the help of boolean algebra. This led up to a paper he published in 1948 called *“A Mathematical Theory of Communication”*. This further laid down his framework for information theory and contained common terminology that we use today including the ‘bit’ to represent a single binary digit in a base-two counting system.

Alan Turing, the “Founder of Computer Science”, first attended King’s college in Cambridge in 1934 and later received his PhD in Mathematics from Princeton in 1938. Prior to graduating he worked for a British cryptanalytic department known as the Government Code and Cipher School (GC&CS). Once Britain got involved in World War II, their main task was to decrypt the enigma code. This code was the first version of cryptography, used by the Germans to communicate with one another without any outsiders understanding them. Turing helped with the creation of the ‘Bombe’, which took a huge role decrypting the Enigma. They studied how the Germans frequented their messages and was able to build a keys based off of their pattern. The Bombe’s various versions sorted this all out for them as we would have a computer do it for us today, becoming faster with each new model created. Most Computer Scientists and Mathematicians today know Alan Turing for the “Turing Machine”, which “has become the foundation of the modern theory of computation and computability”. His machine wrote a message on a tape using 0’s and 1’s, storing data and dealing with input and output.

The third conceptual inventor of the stored-program digital computer was John Von Neumann. He got a degree in chemical engineering from the Swiss Federal Institute in Zurich (1925) and a PhD in Mathematics from the University of Budapest (1926). Von Neumann was a mathematical genius who developed theories such as game theory, quantum theory, and number theory -- many of which, we still use and reference today. In addition to his theories, he invented the merge sort algorithm, which divides and conquers a set of data in order to sort it. This is still widely used in today and even taught in most algorithms classes. In 1930 he became a visiting professor lecturing quantum theory at Princeton. With WWII happening he got asked in 1943 to work on the ‘Manhattan Project’. This US government research project produced the first atomic bomb, later ending the war by dropping them in Nagasaki and Hiroshima.Von Neumann’s specific work for the project involved figuring out how to properly implode the bomb using a specific degree of symmetry. This didn’t involve too much regarding computers, however, it did spark the value of planning via simulations, which are convenient and mainly used in high risk, expensive experiments today. After his success he got asked to work for many other government projects like the Electronic Numerical Integrator and Computer, or ENIAC for short. This machine was released to the public in 1946 as the “mathematical robot working at phenomenal speed that frees scientific thought from the drudgery of lengthy calculating work”. Of course, Von Neumann wasn’t the inventor, but he did modify it to run as a stored-program machine. After the machine was published, many other versions were being created, pioneering us to the type of memory-based computer systems we have today.

In the era before the 1950s, computers were starting to take a more primal form with technological and network advances really taking place in the 30s and 40s. In 1933, a German development and research program fostered the creation of Telex. Telex was originally intended to be used as a new way to quickly distribute military messages for the Third Reich. Telex was originally intended to be used as a new way to quickly distribute military messages for the Third Reich. The original Telex used the original analog telephone circuit-switched network modified to carry modulated DC telegraph signals, providing a circuit-switched network service for teletypewriters. The use of Telex in other applications quickly became apparent, primarily with intercommunication among businesses. After World War II ended, Telex spread all across Europe as the analog precursor for the invention of the fax machine.

In 1937, Bell laboratories scientist, George Stibitz, developed a relay-based calculator. The calculator used relay circuits which provided a proof-of-concept for applying Boolean logic to the design of computers. He called this the “Model-K”, in honor of the kitchen table where he put it together. A few years later in 1939, the construction of the relay-based Model-I Complex Calculator was completed successfully based on Stibitz’s Model-K.

Also in Germany, Konrad Zuse was also ready to add his name to the history books in 1937. Zuse was an engineer building his Z2 computer through the resources he received from military service. The Z2 was a floating point mechanical binary calculator using telephone relays. This was an improvement upon the inefficient Z1, which contained about thirty-thousand mechanical parts. Zuse presented the Z2 to the DVL, the German Research Institute for Aviation, known today as the DVR, the German Aerospace Center. The Z2 was subsidized enough to start a company, and Zuse continued to improve his design in the Z3 and Z4 models. The Z3 was the first fully working, electromechanical computer used for aerodynamic calculations but was destroyed in a bombing raid on Berlin in late 1943.

In 1939, David Packard and Bill Hewlett created their first product, the HP 200A Audio Oscillator, which became a popular piece of test equipment for engineers. Walt Disney Pictures ordered eight of the 200B model (also developed in 1939) to test recording equipment and speaker systems for the twelve specially equipped theatres that showed the movie “Fantasia” in 1940. In 1940, Stibitz demonstrated the Complex Number Calculator (CNC) at an American Mathematical Society Conference. Stibitz performed calculations remotely on the CNC (located in New York City) using a Teletype terminal connected via to New York over special telephone lines, pioneering the development of remote access computing.

Also in 1939 was the development of the Atanasoff-Berry Computer (ABC) which was built by John Vincent Atanasoff and Clifford E. Berry. The development of parts for the ABC was discontinued in 1942 as a result of WWII. Atanasoff was a physics teacher at the time while Berry was a graduate student studying electrical engineering. The ABC was at the center of a patent dispute related to the invention of the computer. The legal result was a landmark: Atanasoff was declared the originator of several basic computer ideas, but the computer as a concept was declared un-patentable and thus freely open to all. The relevance of the ABC during this time was that it featured the use of binary logic rather than counting which was used in its mechanical counterparts. The ABC also used punch card input/outputs and memory capacitors, making the ABC a true advancement towards the modern computer.

In 1945, Konrad Zuse began working on Plankalkül, Plan Calculus, which was the first algorithmic programming language. This allowed for the creation of procedures (routines or subroutines) and structured data (recorded in a database). This also brought along the use of conditional statements where you begin to seeing loops and repeated, iterative instructions. One of the most important computer projects in the history of computing, named the Whirlwind, began at the same year. The main function of the Whirlwind was for real-time aircraft tracking. This computer used about five-thousand vacuum tubes and was driven by a master clock, a device that synchronizes secondary clocks, similar to the function of the preamble bytes in an Ethernet protocol header today. Foremost among the developments around the Whirlwind was the development of memory. Early memory was proposed to use cathode ray tubes, but was rejected in favor of Jay Forrester’s magnetic core memory, referred to at the time as core memory. Core memory became the dominant form of high-speed, early random access memory for computers between the years of 1955 to 1975. Core memory was patented in 1947. The patent was later purchased by IBM in 1956. Core memory is the precursor for modern Dynamic and Static Random Access Memory (RAM).

The first program in history ran on a digital, electronic, stored-program computer on June 21st 1948. Williams and Kilburn built a new memory technology which was the first high-speed electronic random access memory for computers and developed the Small-Scale Experimental Machine (SSEC) to test it. The room that held the SSEC had a raised roof so that people could look in and see it’s beauty, making it very popular with the press. This also prevented people from tripping over the many wires and cables. The SSEC was one of the last of the generation of 'super calculators' to be built using electromechanical technology. Another one of their inventions was the Williams-Kilburn Tube which was a cathode ray tube that stored bits as dots on a screen’s surface. This was entirely based of of electronic memory.

In 1949, an important change was made by International Business Machines (IBM). IBM was the world leader in electromechanical punched card systems. IBM made the new equipment, call, which was called as “Solid state by ’58”. The birth of this meant that they could use the new technology of transistors in all new IBM computer products. In the same year, Jay Forrester wrote a notebook to explain his idea about “coincident current” technique for a magnetic core memory system. This system as the main memory technology for computers was the first reliable high-speed RAM for computers. The modem was developed in 1949, it modulates digital data into sounds, and demodulates received sounds into digital data. Modem is how computers talk to each other using voice phone lines. It was originally built by Jack Harrington’s group at the Air Force Cambridge Research Center (AFCRC) in order to transmit radar signals. There was also the Electronic Delay Storage Automatic Calculator (EDSAC) that was built at Cambridge University. The EDSAC uses vacuum tubes and mercury delay lines for memory. One major advance in this programming was a library of short programs, called “subroutines”. These were then stored on punched paper tapes and used for performing common repetitive calculations within a larger program.

Prior to 1950, computers were no less relevant than they are today. From mechanical to electrical systems, computers have taken great strides of growth in both a theoretical and practical sense. There were many great inventions and programs created before 1950, giving us over a century of technological advancements to look at. Although machines started off as mechanical, huge, and bulky, they quickly advanced to become the simpler, more efficient, electrical design closer to today. Today's computing capabilities and theories began in the era before the 1950s as society developed us calculators, binary, digital circuitry, cryptanalysis, sorting algorithms, simulators, reliable data storage, and so much more. Many of the machines at the time were attributed to WWII, but started becoming increasingly relevant in the years after the war. Computers were becoming less of an Enigma, and more as a tool that “kickstarted” many of the software and hardware technologies and theories we have seen throughout modern computing.

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