

Unit 3

Algorithms

History of Computing

Before studying algorithms, it is useful to investigate the history of computers, identify some key contributors, and major milestones. It is hard to say when the first computers were invented because there is not a strict definition of a computer. Nor is there a strict difference between a computer and a calculator. After all, the words, "calculate" and "compute" are close synonyms.

Blaise Pascal and the Pascaline

The earliest computing device surveyed will be the Pascaline, invented by the French mathematician Blaise Pascal in 1642. The Pascaline was a mechanical calculator capable of adding and subtracting two numbers, as well as multiplication and division. For his legacy in the fields of computer science and mathematics, the programming language, Pascal, was named after him.

Charles Babbage and the Analytical Engine

The next prominent figure in computer science is Charles Babbage, an English mathematician who was one of the pioneers of computer science. In 1837, he designed the Analytical Engine—a mechanical computer that was capable of being programmed using punch cards. This device was one of the earliest examples of a programmable, general-purpose computer.

Ada Lovelace and the First Computer Program

The first computer programmer, a woman named Ada Lovelace developed and published the first algorithm to be run to a computing machine. Her algorithm was designed to calculate the series of Bernoulli numbers. She designed the algorithm to be run on Babbage's Analytical Engine. For her legacy in the field of computer science, the programming language, Ada, was named after her.

The ENIAC

The 20th Century saw computers escape the realm of mechanical devices and evolve into the devices we know today. One of the first and most notable electronic general-purpose computers was the ENIAC (Electronic Numerical Integrator and Computer), made known to the public in 1946. Instead of using microchips like the computers of today, the ENIAC operated using vacuum tubes. This machine was the size of several rooms and was used primarily to calculate trajectories for artillery tables. Interestingly, the machine did have some roles in determining the feasibility of thermonuclear weapons.

Grace Hopper and the UNIVAC I

Grace Hopper was an influential American computer scientist and US Navy rear admiral. Hopper had worked as a member of the programming on the IBM Mark I, a computer similar to the ENIAC during the latter parts of WWII. After her work on the Mark I, Hopper became a senior staff member developing the UNIVAC I computer finishing in 1950. This business-oriented computer would go on to be the first commercially successful electronic general-purpose computer.

Along with her work on the UNIVAC I, Hopper was influential in popularizing high-level programming languages. These high-level programming languages looked closer to human language and made programming more accessible to beginners and more efficient for experts. Hopper also invented one of the first compilers, a program that translates high-level, human-understandable code into low-level, computer-understandable code. She was also involved in the development of COBOL, (Common Business-Oriented Language) a high-level programming language still used today.

Alan Turing and the Turing Test

Another influential figure of the mid-20th century was Alan Turing, an English cryptanalyst and computer scientist. During WWII, Turing worked as a cryptanalyst and contributed work to breaking encryption used by the axis powers. Following WWII, he pioneered some of the earliest work in the field of artificial intelligence. One of his most notable legacies is the Turing Test—a theoretical standard used to determine whether a machine can be considered intelligent.

The idea of the Turing Test is to have a tester blindly run the same battery of tests on both a human and a machine. The tester does not know which participant is human and which is machine. If the results of the two tests are indistinguishable from one another, then the machine is said to be intelligent because its behavior is indistinguishable from that of a human.

Transistors, Integrated Circuits, Microchips, and Moore's Law

In the mid 1950's, transistors came on to the commercial computing machine and quickly began replacing vacuum-tube technology. Transistors were faster, more reliable, much smaller, and allowed computers to shrink while increasing in power.

In the early 1960's integrated circuits came onto the scene. These integrate circuits allowed 10's and soon 100's of transistors to be crammed onto a small chip. Again, computers were able to shrink while increasing in power.

In late 1971, the microchip or microprocessor entered the scene with the Intel 4004 CPU. This microchip was able to cram 2300 transistors on a chip the size of a AA battery. The introduction of microchips began the modern era of computing technology that continues to the present day. The number of transistors that could be fit onto a small chip grew rapidly. Intel cofounder Gordon Moore made an observation in 1965 that the number of transistors per square inch on roughly doubles every year. This observation has become known today as Moore's law.

In the present day (2018), transistor counts on processors have reach the billions. Moore's law is starting to break down in the present day, however. Currently, the smallest manufacturing size is 14 nm, meaning that processors can be manufactured with circuits only 14 billionths of a meter wide. For a comparison, the diameter of a silicon atom is 0.2nm, making the circuits only 70 atoms wide! Eventually, processor manufacturers will reach a point where they cannot manufacture any smaller.

The IBM PC and the Era of Personal Computing

In 1981, IBM released the IBM Model 5150 better known as the IBM Personal Computer. This computer cost **\$1,565** on release (Roughly \$4,231 in 2018 dollars) and brought computing within the grasp of regular people. Along with the IBM PC came the era of personal computing—an era in which companies began to make computers that were marketed to average consumers rather than businesses. No longer were computers large enough to fill entire rooms. Instead they sat on desktops, earning them the name "desktops." Software giants like Microsoft and Apple were born in this era. Along with wealthier consumers adopting PCs, computers gained a heavy presence in most businesses.

Proliferation of Computer Networking, the Internet, and The World Wide Web

Until the mid 1980's, most computers were isolated from one another. If users wanted to share programs, printers, files, or other resources, they had to copy it to a floppy disk and physically hand it to their colleague. The idea of computer networks—connecting multiple computers together to facilitate sharing of resources and communication—had been around since the 1960's. However, it was mostly restricted to government and academia.

In the mid-late 1980's, small-scale computer networks called LANs (local-area networks) became a popular solution to share business resources more efficiently and communicate through the newly invented E-mail. Eventually, companies would connect their computer networks to government and academic computer networks. Soon, modem technology arrived and allowed consumers to connect their PCs to these networks. This rapidly burgeoning network of inter-connected networks became known as the internet.

In 1990, amidst the proliferation of the internet, Tim Berners-Lee, an English computer scientist, invented the world-wide-web. He designed the world-wide-web to be an information-exchange system that resided on the internet. Anyone with a special program called a web-browser could connect to the world-wide-web and visit inter-linked documents called webpages.

The Information age, Social Media, and Mobile Computing

With the advent of the world-wide-web in 1990, the so-called information age had arrived. No longer was information confined to encyclopedias in libraries. Rather, it was easily searchable using search engines like Google or Yahoo. The internet and the world-wide-web has greatly influenced modern-day global culture by ushering in an era of near-instant information exchange.

Around 2004, Mark Zuckerberg invented one of the first successful social media platforms—Facebook. Initially confined to college campuses, Facebook was the first of many Social Media platforms that would rapidly expand and change how people socialize in the span of less than a decade.

With computing technology growing smaller and faster by the year, mobile computing technology was on the rise for much of the early 2000's. In 2007, Apple introduced the iPhone—the first massively successful smartphone—and within a decade, smartphones and other mobile computers have become an integral part of western society.