

## The Evolution of Computer Science

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### ABSTRACT

This article studies the evolution of computer science. In the past sixty years or so, computers have migrated from room-size megaboxes to desktops to laptops to our pockets. But the real history of machine-assisted human computation (“computer” originally referred to the person, not the machine) goes back even further. The computer was born not for entertainment or email but out of a need to solve a serious number-crunching crisis. By 1880, the U.S. population had grown so large that it took more than seven years to tabulate the U.S. Census results. The government sought a faster way to get the job done, giving rise to punch-card based computers that took up entire rooms. Today, we carry more computing power on our smartphones than was available in these early models. The following brief history of computing is a timeline of how computers evolved from their humble beginnings to the machines of today that surf the Internet, play games and stream multimedia in addition to crunching numbers. Before the 1920s, computers (sometimes computers) were human clerks that performed computations. They were usually under the lead of a physicist. Many thousands of computers were employed in commerce, government, and research establishments. Most of these computers were women. Some performed astronomical calculations for calendars, others ballistic tables for the military. Computers no longer take up rooms even very powerful ones now fit in the palm of your hand. They are cheap enough to put in refrigerators, irrigation systems, thermostats, smoke detectors, cars, streetlights, and clothing.

Keywords: Evolution, Computer, science.

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### INTRODUCTION

In the past sixty years or so, computers have migrated from room-size megaboxes to desktops to laptops to our pockets. But the real history of machine-assisted human computation (“computer” originally referred to the person, not the machine) goes back even further. First in the historical record was the abacus, helping the ancient technorati gain an edge over trading partners still counting cows and amphorae by hand. The oldest known complex computing device, called the Antikythera mechanism, dates back to 87 B.C; it’s surmised the Greeks used this gear-operated contraption (found in a shipwreck in the Aegean Sea early in the 20th century, though its significance wasn’t realized until 2006) to calculate astronomical positions and help them navigate through the seas [1] [2] [3] [4].

Computing took another leap in 1843, when English mathematician Ada Lovelace wrote the first computer algorithm, in collaboration with Charles Babbage, who devised a theory of the first programmable computer. But the modern computing-machine era began with Alan Turing’s conception of the Turing Machine, and three Bell Labs scientists invention of the transistor, which made modern-style computing possible, and landed them the 1956 Nobel Prize in Physics. For decades, computing technology was exclusive to the government and the military; later, academic institutions came online, and Steve Wozniak built the circuit board for Apple-1, making home computing practicable [5] [6]. On the connectivity side, Tim Berners-Lee created the World

Wide Web, and Marc Andreessen built a browser, and that's how we came to live in a world where our glasses can tell us what we're looking at. With wearable computers, embeddable chips, smart appliances, and other advances in progress and on the horizon, the journey towards building smarter, faster and more capable computers is clearly just beginning [7].

### **History of Computers: A Brief Timeline**

The computer was born not for entertainment or email but out of a need to solve a serious number-crunching crisis. By 1880, the U.S. population had grown so large that it took more than seven years to tabulate the U.S. Census results [8] [9] [10]. The government sought a faster way to get the job done, giving rise to punch-card based computers that took up entire rooms. Today, we carry more computing power on our smartphones than was available in these early models. The following brief history of computing is a timeline of how computers evolved from their humble beginnings to the machines of today that surf the Internet, play games and stream multimedia in addition to crunching numbers [11].

1801: In France, Joseph Marie Jacquard invents a loom that uses punched wooden cards to automatically weave fabric designs. Early computers would use similar punch cards [12].

1822: English mathematician Charles Babbage conceives of a steam-driven calculating machine that would be able to compute tables of numbers. The project, funded by the English government, is a failure. More than a century later, however, the world's first computer was actually built [13].

1890: Herman Hollerith designs a punch card system to calculate the 1880 census, accomplishing the task in just three years and saving the government \$5 million. He establishes a company that would ultimately become IBM.

1936: Alan Turing presents the notion of a universal machine, later called the Turing machine, capable of computing anything that is computable. The central

concept of the modern computer was based on his ideas [14].

1937: J.V. Atanasoff, a professor of physics and mathematics at Iowa State University, attempts to build the first computer without gears, cams, belts or shafts.

1939: Hewlett-Packard is founded by David Packard and Bill Hewlett in a Palo Alto, California, garage, according to the Computer History Museum.

1941: Atanasoff and his graduate student, Clifford Berry, design a computer that can solve 29 equations simultaneously. This marks the first time a computer is able to store information on its main memory [15].

1943-1944: Two University of Pennsylvania professors, John Mauchly and J. Presper Eckert, build the Electronic Numerical Integrator and Calculator (ENIAC). Considered the grandfather of digital computers, it fills a 20-foot by 40-foot room and has 18,000 vacuum tubes.

1946: Mauchly and Presper leave the University of Pennsylvania and receive funding from the Census Bureau to build the UNIVAC, the first commercial computer for business and government applications [16].

1947: William Shockley, John Bardeen and Walter Brattain of Bell Laboratories invent the transistor. They discovered how to make an electric switch with solid materials and no need for a vacuum.

1953: Grace Hopper develops the first computer language, which eventually becomes known as COBOL. Thomas Johnson Watson Jr., son of IBM CEO Thomas Johnson Watson Sr., conceives the IBM 701 EDPM to help the United Nations keep tabs on Korea during the war.

1954: The FORTRAN programming language, an acronym for FORMula TRANslation, is developed by a team of programmers at IBM led by John Backus, according to the University of Michigan [17] [18].

1958: Jack Kilby and Robert Noyce unveil the integrated circuit, known as the computer chip. Kilby was awarded the Nobel Prize in Physics in 2000 for his work.

1964: Douglas Engelbart shows a prototype of the modern computer, with a mouse and a graphical user interface (GUI). This marks the evolution of the computer from a specialized machine for scientists and mathematicians to technology that is more accessible to the general public [19].

1969: A group of developers at Bell Labs produce UNIX, an operating system that addressed compatibility issues. Written in the C programming language, UNIX was portable across multiple platforms and became the operating system of choice among mainframes at large companies and government entities. Due to the slow nature of the system, it never quite gained traction among home PC users.

1970: The newly formed Intel unveils the Intel 1103, the first Dynamic Access Memory (DRAM) chip.

1971: Alan Shugart leads a team of IBM engineers who invent the "floppy disk," allowing data to be shared among computers.

1973: Robert Metcalfe, a member of the research staff for Xerox, develops Ethernet for connecting multiple computers and other hardware.

1974-1977: A number of personal computers hit the market, including Scelbi & Mark-8 Altair, IBM 5100, Radio Shack's TRS-80 — affectionately known as the "Trash 80" — and the Commodore PET.

1975: The January issue of Popular Electronics magazine features the Altair 8080, described as the "world's first minicomputer kit to rival commercial models." Two "computer geeks," Paul Allen and Bill Gates, offer to write software for the Altair, using the new BASIC language. On April 4, after the success of this first endeavor, the two childhood friends form their own software company, Microsoft.

1976: Steve Jobs and Steve Wozniak start Apple Computers on April Fool's Day and roll out the Apple I, the first computer with a single-circuit board, according to Stanford University.

1977: Radio Shack's initial production run of the TRS-80 was just 3,000. It sold like crazy. For the first time, non-geeks could

write programs and make a computer do what they wished.

1977: Jobs and Wozniak incorporate Apple and show the Apple II at the first West Coast Computer Faire. It offers color graphics and incorporates an audio cassette drive for storage.

1978: Accountants rejoice at the introduction of VisiCalc, the first computerized spreadsheet program.

1979: Word processing becomes a reality as MicroPro International releases WordStar. "The defining change was to add margins and word wrap," said creator Rob Barnaby in email to Mike Petrie in 2000. "Additional changes included getting rid of command mode and adding a print function. I was the technical brains. I figured out how to do it, and did it, and documented it." 1981: The first IBM personal computer, code-named "Acorn," is introduced. It uses Microsoft's MS-DOS operating system. It has an Intel chip, two floppy disks and an optional color monitor. Sears & Roebuck and Computer land sell the machines, marking the first time a computer is available through outside distributors. It also popularizes the term PC.

1983: Apple's Lisa is the first personal computer with a GUI. It also features a drop-down menu and icons. It flops but eventually evolves into the Macintosh. The Gavilan SC is the first portable computer with the familiar flip form factor and the first to be marketed as a "laptop."

1985: Microsoft announces Windows, according to Encyclopedia Britannica. This was the company's response to Apple's GUI. Commodore unveils the Amiga 1000, which features advanced audio and video capabilities.

1985: The first dot-com domain name is registered on March 15, years before the World Wide Web would mark the formal beginning of Internet history. The Symbolics Computer Company, a small Massachusetts computer manufacturer, registers Symbolics.com. More than two years later, only 100 dot-coms had been registered [20].

1986: Compaq brings the Deskpro 386 to market. Its 32-bit architecture provides as speed comparable to mainframes.

1990: Tim Berners-Lee, a researcher at CERN, the high-energy physics laboratory in Geneva, develops HyperText Markup Language (HTML), giving rise to the World Wide Web.

1993: The Pentium microprocessor advances the use of graphics and music on PCs.

1994: PCs become gaming machines as "Command & Conquer," "Alone in the Dark 2," "Theme Park," "Magic Carpet," "Descent" and "Little Big Adventure" are among the games to hit the market.

1996: Sergey Brin and Larry Page develop the Google search engine at Stanford University.

1997: Microsoft invests \$150 million in Apple, which was struggling at the time, ending Apple's court case against Microsoft in which it alleged that Microsoft copied the "look and feel" of its operating system.

1999: The term Wi-Fi becomes part of the computing language and users begin connecting to the Internet without wires.

2001: Apple unveils the Mac OS X operating system, which provides protected memory architecture and preemptive multi-tasking, among other benefits. Not to be outdone, Microsoft rolls out Windows XP, which has a significantly redesigned GUI.

2003: The first 64-bit processor, AMD's Athlon 64, becomes available to the consumer market.

2004: Mozilla's Firefox 1.0 challenges Microsoft's Internet Explorer, the dominant Web browser. Facebook, a social networking site, launches.

2005: YouTube, a video sharing service, is founded. Google acquires Android, a Linux-based mobile phone operating system.

2006: Apple introduces the MacBook Pro, its first Intel-based, dual-core mobile computer, as well as an Intel-based iMac. Nintendo's Wii game console hits the market.

2007: The iPhone brings many computer functions to the smartphone.

2009: Microsoft launches Windows 7, which offers the ability to pin applications to the taskbar and advances in touch and handwriting recognition, among other features.

2010: Apple unveils the iPad, changing the way consumers view media and jumpstarting the dormant tablet computer segment.

2011: Google releases the Chromebook, a laptop that runs the Google Chrome OS.

2012: Facebook gains 1 billion users on October 4.

2015: Apple releases the Apple Watch. Microsoft releases Windows 10.

2016: The first reprogrammable quantum computer was created. "Until now, there hasn't been any quantum-computing platform that had the capability to program new algorithms into their system. They're usually each tailored to attack a particular algorithm," said study lead author Shantanu Debnath, a quantum physicist and optical engineer at the University of Maryland, College Park.

2017: The Defense Advanced Research Projects Agency (DARPA) is developing a new "Molecular Informatics" program that uses molecules as computers. "Chemistry offers a rich set of properties that we may be able to harness for rapid, scalable information storage and processing," Anne Fischer, program manager in DARPA's Defense Sciences Office, said in a statement [21]. "Millions of molecules exist, and each molecule has a unique three-dimensional atomic structure as well as variables such as shape, size, or even color. This richness provides a vast design space for exploring novel and multi-value ways to encode and process data beyond the 0s and 1s of current logic-based, digital architectures."

#### **Creation of the computer**

Before the 1920s, computers (sometimes computers) were human clerks that performed computations. They were usually under the lead of a physicist. Many thousands of computers were employed in commerce, government, and research establishments. Most of these computers were women. Some performed astronomical calculations for calendars, others ballistic tables for the military [22].

After the 1920s, the expression computing machine referred to any machine that performed the work of a human computer, especially those in accordance with effective methods of the Church-Turing thesis. The thesis states that a mathematical method is effective if it could be set out as a list of instructions able to be followed by a human clerk with paper and pencil, for as long as necessary, and without ingenuity or insight. Machines that computed with continuous values became known as the analog kind. They used machinery that represented continuous numeric quantities, like the angle of a shaft rotation or difference in electrical potential [23] [24].

Digital machinery, in contrast to analog, were able to render a state of a numeric

value and store each individual digit. Digital machinery used difference engines or relays before the invention of faster memory devices [25]. The phrase computing machine gradually gave way, after the late 1940s, to just computer as the onset of electronic digital machinery became common. These computers were able to perform the calculations that were performed by the previous human clerks. Since the values stored by digital machines were not bound to physical properties like analog devices, a logical computer, based on digital equipment, was able to do anything that could be described "purely mechanical." The theoretical Turing Machine, created by Alan Turing, is a hypothetical device theorized in order to study the properties of such hardware [26].

#### CONCLUSION

There have been many different computers that were made before now. People say the ENIAC was the first computer ever made, and people say the Difference Engine was the first computer ever made, but no one actually knows who made the first computer. Technology in the world today is getting more and more difficult. Computers like the ENIAC and the Z3 are not going to be made anymore because people want something new. Even though computers are being changed every second without the people who invented them a long time ago, we would not have computers. Computers no

longer take up rooms even very powerful ones now fit in the palm of your hand [27] [28]. They are cheap enough to put in refrigerators, irrigation systems, thermostats, smoke detectors, cars, streetlights, and clothing. They can even be embedded in your skin. The coming computing era will be dominated by artificial intelligence, the IoT, robotics, and unprecedented connectivity. And even if things are advancing at a sub-exponential rate, it will still be an incredible next step in the evolution of computer science.

#### REFERENCES

1. "Al-Kindi, Cryptography, Codebreaking and Ciphers". Retrieved 2007-01-12.
2. "Charles Babbage". Encyclopædia Britannica Online Academic Edition. Encyclopædia Britannica In. Retrieved 2013-02-20.
3. "History of Computing Science: The First Mechanical Calculator". [eingang.org](http://eingang.org).
4. "The First "Computer Bug"" (PDF). CHIPS. United States Navy. 30 (1): 18. January–March 2012.
5. Ancient Discoveries, Episode 11: Ancient Robots, History Channel, archived from the original on March 1, 2014, retrieved 2008-09-06
6. Barker-Plummer, David (1995). "Turing Machines". The Stanford Encyclopedia of Philosophy. Retrieved 2013-02-20.
7. Bellos, Alex (2012). "Abacus adds up to number joy in Japan". The Guardian. London. Retrieved 2013-06-25.
8. Boyer, Carl B.; Merzbach, Uta C. (1991). A History of Mathematics (2nd ed.). John Wiley & Sons, Inc. pp. 252-253. ISBN 978-0-471-54397-8.
9. Cragon, Harvey G. (2000). Computer Architecture and

- Implementation. Cambridge: Cambridge University Press. pp. 1-13. ISBN 978-0-521-65168-4.
10. Fritz, W. B. (1996). "The women of ENIAC". *IEEE Annals of the History of Computing*. 18 (3): 13-28.
  11. Gürer, Denise (2002-06-01). "Pioneering Women in Computer Science". *SIGCSE Bull.* 34 (2): 175-180.
  12. History of Research on Switching Theory in Japan, *IEEJ Transactions on Fundamentals and Materials*, Vol. 124 (2004) No. 8, pp. 720-726, Institute of Electrical Engineers of Japan
  13. Hittinger, William C. (1973). "Metal-Oxide-Semiconductor Technology". *Scientific American*. 229 (2): 48-59.
  14. Ifrah, Georges (2001). *The Universal History of Computing: From the Abacus to the Quantum Computer*. John Wiley & Sons. ISBN 978-0-471-39671-0.
  15. In search of lost time, Jo Marchant, *Nature* 444, #7119 (November 30, 2006), pp. 534-538,
  16. Isaacson, Betsy (2012). "Ada Lovelace, World's First Computer Programmer, Celebrated With Google Doodle". *The Huffington Post*. Retrieved 2013-02-20.
  17. Kidwell, Peggy Aldritch; Williams, Michael R. (1992). *The Calculating Machines: Their history and development*. MIT Press., p.38-42, translated and edited from Martin, Ernst (1925). *Die Rechenmaschinen und ihre Entwicklungsgeschichte*. Germany: Pappenheim.
  18. Kiesler, Sara; Sproull, Lee; Eccles, Jacqueline S. (1985). "Pool Halls, Chips, and War Games: Women in the Culture of Computing". *Psychology of Women Quarterly*. 9 (4): 451-462.
  19. Koetsier, Teun (2001), "On the prehistory of programmable machines: musical automata, looms, calculators", *Mechanism and Machine Theory*, 36 (5): 589-603, Lavington, Simon (1998), *A History of Manchester Computers* (2 ed.), Swindon: The British Computer Society, pp. 34-35
  20. Lee, Thomas H. (2003). *The Design of CMOS Radio-Frequency Integrated Circuits* (PDF). Cambridge University Press. ISBN 9781139643771.
  21. Light, Jennifer S. (1999). "When Computers Were Women". *Technology and Culture*. 40 (3): 455-483. ISSN 1097-3729.
  22. Lorch, R. P. (1976), "The Astronomical Instruments of Jabir ibn Aflah and the Torquetum", *Centaurus*, 20 (1): 11-34,
  23. Moskowitz, Sanford L. (2016). *Advanced Materials Innovation: Managing Global Technology in the 21st century*. John Wiley & Sons. pp. 165-167.
  24. Motoyoshi, M. (2009). "Through-Silicon Via (TSV)" (PDF). *Proceedings of the IEEE*. 97 (1): 43-48.
  25. Puers, Robert; Baldi, Livio; Voorde, Marcel Van de; Nooten, Sebastiaan E. van (2017). *Nanoelectronics: Materials, Devices, Applications*, 2 Volumes. John Wiley & Sons. p. 14.
  26. Radomir S. Stanković (University of Niš), Jaakko T. Astola (Tampere University of Technology), Mark G. Karpovsky (Boston University), *Some Historical Remarks on Switching Theory*, 2007,
  27. Radomir S. Stanković, Jaakko Astola (2008), *Reprints from the Early Days of Information Sciences: TICSP Series on the Contributions of Akira Nakashima to Switching Theory*, TICSP Series #40, Tampere International Center for Signal Processing, Tampere University of Technology
  28. Rojas, R. (1998). "How to make Zuse's Z3 a universal computer". *IEEE Annals of the History of Computing*. 20 (3): 51-54.