

Selected landmarks in

The History of Computing

A contribution to the Institution's 150th anniversary celebrations in 2021
from the IET History of Technology Network

This is one of a series of timelines which focus on a selection of engineering and technology landmarks which have occurred during the lifetime of the Institution since its foundation in 1871.

Comments regarding any errors in, or significant additions to, this timeline should be sent to the History of Technology Network Manager Anne Locker by Email to alocker@theiet.org

Etymology

The term 'computer' was originally used to define somebody who carried out calculations.

For example, in 1660 Samuel Pepys, the British navy administrator and famous diarist, wrote of ...'spending a morning computing the 30 ships' pay'. In 1731 the Edinburgh Weekly Journal advised young married women to know their husbands' income and be so good a Computer as to keep within it."

It was common for companies and government departments to advertise jobs for people to work as "computers" - right up to the time when the word was also used for early electronic devices, and in some cases until the 1970s.

Source: BBC News Blogs

<https://www.bbc.co.uk/news/blogs-magazine-monitor-35428300#:~:text=%22Computer%22%20comes%20from%20the%20Latin,to%20think%20and%20to%20prune.&text=In%2016>

Date	Event
	For a selection of computing events prior to 1871 see footnote
1871	IET FOUNDED AS SOCIETY OF TELEGRAPH ENGINEERS
1873	<p>William Thomson (Lord Kelvin) develops Tide Predictor, a mechanical analogue device and harmonic analyser, based on the work of his brother, James Thomson, on differential analysers.</p> <p>The Tide Predictor was designed to analyse graphical records of daily changes in atmospheric temperature and pressure. It was brought into use by the Meteorological Office in 1878 and is part of the collections of the Science Museum, London.</p> <p>The Tide Predictor is considered one of the earliest differential analysers, an analogue computer designed to solve a class of mathematical functions called differential equations, although the term "differential analyser" was not used until the early 1930s.</p>

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Date	Event
1873	QWERTY keyboard layout <i>devised by Christopher Latham Sholes and sold to Remington for their early typewriters.</i>
1875	<p>Anna Winlock became a "computer" for the Harvard Observatory in 1875. Women were hired as "computers", especially for astronomy calculations and classification, from the mid-1800s and many went on to make contributions to astronomy in their own right.</p> <p>Prominent examples of female "computers" who made contributions to astronomy include Maria Mitchell, discoverer of comet 1847 VI later known as "Miss Mitchell's Comet" and professor of astronomy at Vassar College from 1865 onwards and Annie Jump Cannon, creator of the Harvard Classification Scheme, the first serious attempt to organise and classify stars based on their temperatures and spectral types, and a suffragist.</p>
1880 to 1889	
1887	Comptometer – the first successful <i>key driven</i> calculating machine introduced by Dorr E Felt in the USA. The Comptometer was made from 1887 until the 1970s, when it was largely replaced by electronic calculators.
1889	Punched card technology adopted by <i>Herman</i> Hollerith <i>see footnote</i>
1890	Hollerith design a tabulating machine for the 1890 U.S census
1896	Herman Hollerith establishes the Tabulating Machine Company, renamed the International Business Machines Corporation (IBM) in 1924, one of the leading data processing companies from the late nineteenth century onwards.
1898	A.A. Michelson and S.W. Stroud developed a "new" harmonic analyser, usually referred to as Michelson's Harmonic Analyzer. This analogue computing device was capable of analysing harmonic series.
1930 to 1939	
1930	<p>Harold Locke Hazen and Vannevar Bush developed the first widely used practical general-purpose differential analyser at MIT, possibly building on the work of Lord Kelvin's Tide Predictor.</p> <p>In 1931, Bush introduced the term "differential analyzer" [US spelling] to describe this type of analogue computing device which was used to solve differential equations.</p> <p>Their differential analyser is considered the precursor to the digital computer and could solve a number of mathematical problems.</p>

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Date	Event
1935	<p>The Manchester Differential Analyser was an analogue computer designed and used by Douglas Hartree at the University of Manchester to solve a class of mathematical functions called differential equations.</p> <p>The machine was built by the Metropolitan-Vickers Electrical Company and completed in 1935 for the Physics Department at Manchester University.</p> <p>The machine was based on an American design by Hazen and Bush, powered by electric motors, and uses mechanical components to model mathematical relationships. The central device is a disc-and-wheel device integrator which performs mathematical integration.</p>
1936	<p>Alan Turing published his seminal paper "On Computable Numbers, with an Application to the Entscheidungsproblem" and outlined the 'Universal Computing Machine' (now a 'Universal Turing machine'), a simple abstract computational machine intended to help investigate the extent and limitations of what can be computed.</p> <p>These abstract machines are considered to be one of the foundational models of computability and theoretical computer science.</p>
1939	Hewlett Packard (HP) company formed
	1940 to 1949
1941	<p>German civil engineer Konrad Zuse introduced the Z3, the first programmable fully automatic digital computer and a design Zuse had been working on since 1935. In the midst of the Second World War, the machine was not considered essential to the German war effort and so was never brought into use. It was destroyed by the Allied bombardment of Berlin in December 1943 but a fully functioning replica built in 1961 is on display in the Deutsches Museum, Munich.</p>
1942	Atanasoff-Berry (ABC) digital non programmable computing machine devised
1943	<p>The first Colossus computer was delivered to Bletchley Park by Tommy Flowers of Post Office Research. Colossus, equipped with thermionic valves, was used to find the wheel settings of the enemy Lorenz teleprinters thereby assisting in breaking high-grade German military communications, revealing longer-term military strategy and planning. Colossus is considered the first operational semi-programmable, electronic, digital computer and was a single-purpose rather than general-purpose computer. However, Colossus computers were kept secret and later almost entirely destroyed due to their key role in British codebreaking by GCHQ during and after the Second World War.</p> <p>Many Colossus computers at Bletchley Park were operated by women from the Women's Royal Naval Service.</p>

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Date	Event
1944	In the UK the Telecoms Research Establishment proposed that a cathode Ray Tube (CRT) could be used a computer memory device
	ASCC (Automatic Sequence Controlled Calculator), later referred to as the Harvard Mark I, was unveiled by IBM. It was based on an original concept for automated calculations proposed by Howard Aitken, a physicist at Harvard University. One of the early programmers of the Harvard Mark I in 1944 and 1945 was Grace Hopper, a pioneer in computer programming.
1945	ENIAC (Electronic Numerical Integrator And Computer) : a device for calculating ballistic trajectory used by USA military
1946	ACE (Automatic Computing Engine) proposed by Turing
	Fredrick C. Williams demonstrated the storage of a single binary digit (bit) on a Cathode Ray Tube (CRT) screen at the Telecommunications Research Establishment in October 1946.
1948	Manchester University's 'Baby' the SSEM (Small Scale Experimental Machine) using a CRT to provide storage as a Random Access Memory (RAM). The designers were Professor Freddie Williams, Tom Kilburn, and Geoff Tootill at the University of Manchester. 'Baby' was the first experimental stored-program computer and ran its first program on 21 June 1948.
1949	EDSAC (Electronic Delay Storage Automatic Calculator) at Cambridge University. world's first stored program computer with fully integrated Input/Output. Also had sub-routine libraries - forerunners of 'Operating Systems'
	Manchester University build Mark 1 based on the SSEM 'Baby'.
	In USA EDVAC (Electronic Discrete Variable Automatic Computer) created as ENIAC successor with digital operation and stored programmes
	1950 to 1959
1950	In USA ERA (Engineering Research Associates) make first use of a Magnetic Drum for data storage
1951	Lyons & Co developed the Lyons Electronic Office, to be used for stock control and ordering, statistics and payroll. Better known as LEO I and based on the Cambridge EDSAC design, this was the world's first automated office computer system, transforming office work and kick-starting the British computer industry.

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Date	Event
1951	The Eckert-Mauchly Computer Corporation (EMCC) introduced a tape unit recorder developed for data storage and first used with the UNIVAC 1. This was the first practical time magnetic recording tape was used for computing memory.
	Ferranti Mark 1 becomes the first commercially available computer
1952	To avoid the entering data in binary machine code, US Navy officer Grace Hopper develops a technique for entering data in words into the UNIVAC 1. Titled a 'compiler' it represents the first concept of a high level language.
	Mary Coombs became the first female commercial computer programmer in Britain, working on the Lyons Electronic Office (LEO) computer, developed by Lyons & Co., best known for its high street teashops.
	Magnetic recording tape available for memory See 1951 above
1953	Manchester University demonstrates prototype transistorised computer
	Magnetic Core memory matrix developed first used as part of Whirlwind computer project at Massachusetts Institute of Technology (MIT) for a US Navy real-time flight simulator.
1956	IBM introduced the first commercial magnetic disc memory, based on the work of Reynold Johnson and the Research & Development (R&D) team at IBM in the mid-1950s. The five-foot tall Model 350 disk storage unit weighed one ton and was part of the IBM 305 RAMAC (Random Access Method of Accounting and Control) system. It was leased out by IBM for about \$750 a month.
	MIT researchers led by Doug Ross begin experimenting with direct keyboard input to computers and later that year attached an electric typewriter to the MIT Whirlwind computer for direct keyboard input. This replaced the then standard modes of inputting programmes such as punched cards or paper tape.
1957	Robert Noyce and Gordon Moore, former members of <i>William Shockley's team at Bell Lab</i> , leave to establish Fairchild Semiconductors in Silicon Valley, California, as a subsidiary of Fairchild cameras.
	FORTRAN (Formula Translation) compiled programme published
	US President Eisenhower establishes ARPA (Advanced Research Projects Agency). A network of US research establishments whose objective was to accelerate the US technology development programme.
1958	Ferranti Pegasus 2 computer produced

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Date	Event
1958	Dina St Johnston (née Vaughan) founded Vaughan Programming Services (VPS), the first independent software production company in the UK.
1959	COBOL (common business orientated language) compiled programme published
	1960 to 1969
1960	Algol 60 (algorithmic language 1960) developed and becomes the basis of many programming trees
	DEC (Digital equipment Corporation) releases their first mini- computer: PDP-1
1962	In the USA Licklider outlines a vision for a global network of computers which would allow data and programmes to be accessible from any site. Many of the concepts he envisaged appear in the modern Internet.
1963	ASCII (American Standard Code for Information Interchange) published
1964	Metal Oxide Silicon (MOS) Random Access Memory launched;
	BASIC (Beginners All-purpose Symbolic Instruction Code) programming language launched
	In UK the Data Modem 1A becomes available operating at 200Bit/sec
1965	Robert Noyce and Gordon Moore establish INTEL (Integrated Electronics) in Silicon Valley, California USA
	Gordon Moore predicts a doubling of components per chip every 2 years (later the prediction was adjusted to a doubling transistors per chip every 2years) : it became known worldwide as Moore's Law
1966	Dynamic RAM (DRAM) launched;
	A team of three engineers at Texas Instruments - Jack Kilby, Jerry Merryman, and James Van Tassel - began developing a prototype hand-held pocket calculator using integrated circuits (IC) and powered by a battery that would be capable of addition, subtraction, multiplication, and division but could still fit in the palm of a hand. In 1967, they introduced the Cal-Tech prototype calculator but commercial hand-held calculators would not be available until the early 1970s.
1967	Plans for a network interconnecting ARPA sites (the ARPANET) are published. A wide area packet switched network using mini-computers equipped with IMPs (Interface Message Processors) to interface with the physical transmission network. IMPs are forerunners of routers

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Date	Event
1968	Richard Morley at Bedford Associates designs the first Programmable Logic Controller (PLC) the MODICON 084 for industrial production control. For more information on the evolution of the PLC see the Control and Automation timeline.
1969	ARPANET (Advanced Research Projects Agency Network) a packet switched network is established (see 1967) It uses a Network Control Program (NCP) which is replaced by TCP in 1983
	AMD (Advance Micro Devices) formed by ex-Fairchild employees
	The RS 232 C standard is defined for the interface between computers and modems or other serial devices
	1970 to 1979
1970	UNIX operating system originally conceived in the mid-1960s is published – originally spelling used by its developers was UNICS (Uniplexed Information and Computing Services)
	The PROM (Programmable Read Only Memory) chip created
1971	The INTEL company produce the first MICROPROCESSOR – the 4004 .It is a 4 bit device having an arithmetic and logic unit (ALU), a control unit, registers, a bus system and a clock effectively being a computer on a single chip
	LASER (Light Amplification by Stimulated Emission of Radiation) printers are launched
1972	C programming language finalised by Dennis Ritchie and Ken Thompson: derived from assembly language and closely associated with the UNIX development
	Texas Instruments introduced the first commercially available handheld pocket calculator, the TI 2500 "Datamath", based on the earlier work and Cal-Tech prototype of Jack Kilby, Jerry Merryman, and James Van Tassel.
1973	Robert Metcalfe at Xerox PARC defines a packet switched network for Local Area Networks (LAN) later name changed to ETHERNET
	Graphical User Interface (GUI) developed by Xerox Palo Alto
	Hard Drives and floppy discs introduced by IBM
1974	The architecture of Transmission Control Protocol (TCP) which will allow different computer networks to interoperate is published in the USA by Vint Cerf and Robert Kahn. TCP will be split into two parts in 1988 –a slimmed down TCP part and a routing part IP (Internet Protocol) see 1978 TCP/IP will become a vital enabler for the public Internet

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Date	Event
1974	INTEL 8080 2MHz 8 bit microprocessor introduced
1975	Microsoft founded
1976	The International Telecommunications Union (ITU) publishes a recommended standard for Packet Switched Networks termed X25 aimed primarily at wide area networks. Alongside this a recommendation for interconnecting links – X75 – is published.
	Apple Computers Inc founded.
	CP/M op systems launched
	A 3.125MHz version of the 8080, the B version launched by Intel
1977	First exhibited at the Consumer Electronics Show in the United States in January 1977, the Commodore PET (Personal Electronic Transactor) was one of the first consumer-level microcomputers to be launched and revolutionised home and personal computing. The PET was popular in schools throughout UK, US, and Canada due to its simple keyboard and all-in-one design.
	In the UK Post Office Telecommunications establishes a national Packet Switched Network
1978	Acorn Computers Ltd formed in Cambridge UK
	TCP is split into two protocols. A slimmed down TCP would manage data flow control and error correction while a separate Internet Protocol (IP) would deal with the routing of packets across the networks
	1980 to 1989
1980	Microsoft wins a contract with IBM to create Operating Systems
	Tim Berners- Lee working at CERN develops an application namd 'Enquire' : forerunner of the World Wide Web
	The IBM 801 a Reduced Instruction Set Computer (RISC) started in 1975 is completed. Although not widely adopted for some years the RISC approach, broadly conforming to Alan Turing's 1946 ACE concepts, optimises the instruction sets for processors thereby reducing the number of commands and operations per clock cycle.
1981	Microsoft develops MS-DOS (Microsoft Disc Operating System) a command line programme but with no graphical interface
	Acorn BBC micro, Sinclair ZX 81 & IBM personal computers launched
	3.5 inch floppy discs become generally available

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Date	Event
1982	Sinclair Spectrum and Commodore 64 personal computers launched
	CRAY X-MP computer launched
1983	Apple launches the LISA (Local Integrated Software Architecture) personal computer using a Graphical User Interface (GUI). and a mouse . It used the Motorola 68000 microprocessor, had a clock speed of 5MHz and 1MHz of RAM
	Microsoft introduces WINDOWS a graphical interface version of MS-DOS
	ARPANET changes from its original Network Control Program (see 1969) to TCP working. It also splits into 2 parts one for military and one for civilian use. The civilian part will go on to form the public Internet.
	2 button Mouse. becomes generally available
	Lotus 1-2-3 spreadsheet programme becomes available
1984	Apple launches the Apple Mackintosh 128K
	HP 110 Laptop launched
	Toshiba Flash memory launched
	Philips launch CD-ROM
1985	Universal Quantum Computing concept is proposed by David Deutsch, a physicist at the Clarendon Laboratory, Oxford University UK
	C++ object orientated programme launched
1986	Apple Mackintosh Plus, Acorn BBC Master and Ninetendo NES launched
1987	A RISC microprocessor is developed by ARM
	Commodore Amiga 500 and 2000
	Mackintosh II released
	Windows 2.0 released
1988	A specification for ADSL (Asymmetric Digital Subscriber Line) is published in the USA. ADSL adds a wideband channel above the voice band for data download and a narrower bandwidth channel for data upload. It becomes a means of enabling operators to provide broadband computing capacity to customers over existing copper telephone lines

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Date	Event
1989	Tim Berners-Lee at CERN (in French – Conseil European pour la Recherche Nuclear) writes a paper titled 'Information Management: a proposal' for information exchanges between CERN sites. It will eventually form the basis of the public World Wide Web. (WWW) Apple Macintosh SE/30 and Macintosh portable launched
	1990 to 1999
1990	Tim Berners-Lee defines how HTML, URL and HTTP should be used on the World Wide Web
	Commodore Amiga 3000 released
	IBM RS/6000 launched
	Military section of ARPANET is decommissioned.
1991	Linux – a free operating system, developed by Finnish student Linus Torvalds, is released .
	CERN releases the World Wide Web for public use over the internet
1992	Internet freed of US Government control
	Windows 3.1 released
	JPEG (Joint Picture Expert Group) standard finalised
	Sun Disc, a solid state disc (SSD) is developed
1993	Intel Pentium microprocessor available
	MOSAIC web browser developed
1994	World Wide Web Consortium (W3C) founded by Tim Berners-Lee
	Shore proposes an algorithm to enable Quantum Computer operation
1995	Windows 95 released
	Sun Microsystems launches JAVA 1.0 a programme which alters the way applications, and information can be retrieved, displayed and used over the internet.
	Microsoft obtains licence for use of MOSAIC web browser and re-brands it as Internet Explorer
	Sony PlayStation available in Europe

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Date	Event
1996	Term 'CLOUD COMPUTING coined for a technique using a network of remote servers on the internet to process, manage and store data instead of doing so on a personal computer or local server
	eBay created
1997	INTEL Pentium MMX processor launched:
	CD-RW discs introduced
	IBM Deep Blue computer beats World Chess champion
1998	Google founded;
	Apple i Mac launched;
	Windows 98 released
1999	SanDisc, Panasonic and Toshiba develop the secure digital (SD) memory card,
	NAPSTER a file sharing programme released
	Wi Fi (IEEE802) short range radio local networks specification issued
	2000 to 2009
2000	USB v2.0 released
	Windows 2000 released;
2001	Apple launches iPad Tablet computer in USA
	Windows XP released
2002	Amazon Web Services (AWS) launched – first available public CLOUD
	Microsoft launch a Tablet computer
2003	ANDROID Inc a company in the USA commence development of operating system based on Linux
	Athlon launch a 64 bit processor
	BLU-RAY discs introduced
2004	FACEBOOK launched;
	Google launches Gmail
	Firefox 1.0 introduced

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Date	Event
2005	Open Nebula public CLOUD computing platform launched:
	ANDROID Inc is bought by Google
	You Tube launched
2006	Twitter social media launched
2007	Windows Vista and Office 2007 released
	Google forms the Open Handset Alliance: a consortium including Samsung, Motorola, Intel, Sprint, T-Mobile, Texas Instruments, LG Electronics to promote ANDROID as an open source operating system
2008	ANDROID operating system released for first use on cellular phones
	USB v 3.0 released
2009	Cisco propose EDGE computing to reduce network usage demand
	Apple iPad launched in UK
	WHATSAPP a messaging and voice calling application is launched
	INSTAGRAM, a video and photo sharing platform is launched
	2010 to 2019
2010	Microsoft launch AZURE public cloud service:
	Windows 2010 released
2011	Apple launches SIRI smart speaker- a voice activated personal assistant
2012	Raspberry Pi released
	Quantum Supremacy defined by John Preskill of Caltech
	ANDROID becomes the most popular operating system surpassing Apples iOS
2013	Xbox one and PlayStation 4 released
	Microsoft Office 365 announced
2014	Amazon launch Echo smart speaker for Prime customers
2015	NASA demonstrates their D-Wave Quantum Computer
	Apple watch launched

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Date	Event
2016	IBM announce Quantum Cloud computing available on their small 5 Qubit machine
	Google launch Google Home smart speaker personal assistant
2018	INTEL at early stage research of silicon-based spin-qubit processors
2019	Google claim 'Quantum Supremacy' had been achieved with their quantum computer 'Sycamore' solving a problem in 200 seconds which would take 10,000 years on the fastest alternative traditional computer
2020	ANDROID claimed to be used by 75% of world's mobile devices

Footnote.

Prior to the formation of the Society of Telegraph Engineers in 1871, French mathematician Pascal devised in 1642 a mechanical calculating machine. In 1804 French Weaver Joseph Marie Jacquard patented a technique for automating complex cloth weaving patterns using pre-programmed punched cards to control his weaving machines. . This technique was later used for data entry in early computers. In 1821 Charles Babbage designed a Difference Engine, an ingenious mechanical device to automate essential calculations for navigation and astronomical tables. A replica Difference Engine is on display at the London Science Museum. Babbage also designed in 1843 an Analytical Engine, a massive mechanical device whose architecture closely aligned with a modern electronic computer. Mathematician Ada, Lady Lovelace, identified the need for programmes for this machine to operate, essentially establishing the concept of 'software. Babbage never completed building the Analytical Engine.

Ada Lovelace's work on Charles Babbage's Analytical Engine has led her to be considered the person who first saw the potential of computing for general programming beyond simple calculations.

For further information see: -

- Science Museum London computer history website <https://www.sciencemuseum.org.uk/objects-and-stories/thinking-machines-stories-history-computing>
- Computer History Museum timeline <https://www.computerhistory.org/timeline/computers/>
- Centre for Computing History <http://www.computinghistory.org.uk/cgi/computing-timeline.pl>
- Lecture 'A Brief History of Computing 1948-2015' by Martyn Thomas Professor of Information Technology and Computing, Gresham College.

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<https://www.gresham.ac.uk/lectures-and-events/a-very-brief-history-of-computing-1948-2015>

- Lecture : Computers :a history, Prof Richard Harvey Gresham College
<https://www.gresham.ac.uk/lectures-and-events/computer-history>
- British Computer Society <https://www.bcs.org/content-hub/a-brief-history-of-british-computers-the-first-25-years-1948-1973/>
- Timeline of Computer History <https://www.computerhistory.org/timeline/>