A Selective History of Computing

version 0.1

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September 26, 2001

Overview

The development of computers and their application in numerical problem solving is the result of several lines of human activity.

- Invention: the development of machines to perform arithmetic and logic.
- Mathematics: the development of theory and procedures for efficient and accurate computation with machines.
- Academic: the organization and development of knowledge about computer languages, computer hardware, semiconductor process development.
- Military: the use of computers as an instrument of war, conquest, and control.
- Economic and Industrial: the opportunity to profit from the manufacture, sale, and use of automatic computing equipment
- Social: the attraction of cool — owning new technologies, and participating in the creation of those technologies.

This document is a highly selective chronology of events that influenced the current state of numerical computing and computer technology. I have organized the events into the categories listed above. The organization is somewhat arbitrary, and should in no way suggest that events listed in any one category are not related to events in other categories. Clearly the forces that shaped the current state of computing have interacted.

The historical citations were drawn from traditional text references [9] and the web sites:

The history of computers: `www.elanguest.com/reporter/computer.html`

Notes for the history of Paul Dunne's *History of Computing* course at the University of Liverpool: `www.csc.liv.ac.uk/~ped/teachadmin/histsci/notes.html`

The MacTutor History of Mathematics Archive: `turnbull.mcs.st-and.ac.uk/~history/`

The unofficial history of Apple Computer: `www.apple-history.com`

Archives of the International Business Machine Corporation: `http://www-1.ibm.com/ibm/history/`

The PC History site: `www.pc-history.org`

Bell Labs history web site : `www.bell-labs.com/history`

Transcripts from the PBS Television show *Triumph of the Nerds: The Rise of Accidental Empires*: `www.pbs.org/nerds/`

The history of Cray, Inc. `www.cray.com/company/history.html`

Intel Museum site: `www.intel.com/intel/intelis/museum/index.htm`

History of NCSA Mosaic at
`archive.ncsa.uiuc.edu/General/CommGroup/MosaicHistory/timeline.html`

A brief history of the Internet: `www.isoc.org/internet/history/brief.html`

The World Wide Web Consortium: `www.w3.org`

Windows™ History at ComputerHope.com: `www.computerhope.com/history/windows.htm`

I have made no effort to be complete, especially in the early record. Rather, I have chosen some interesting developments that can help to put our current state of computation into perspective.

This document is just an early draft created in preparation for the beginning of Fall Quarter 2001. Some important developments are surely omitted, and some citations may be in error.

Early Calculating Machines and Enabling Technologies

??	sticks, stones, beads.
??	Chinese develope the abacus.
1623	Willhelm Schichard builds two wooden calculators: one for Kepler, and another for himself.
1642	Blaise Pascal builds a calculator to do addition and subtraction on six digit numbers.
1671	Gottfried Liebnitz constructs a calculating machine that can do multiplication and division, as well as addition and subtraction.
1820	Tomas of Comlar constructs the first mechanical calculator that is a commercial success.
1822	Charles Babbage and Countess Lovelace begin construction of Babbage's *Difference Engine* for the automatic computation of tables of values of mathematical formulas
1842	Babbage abandons the *Difference Engine*, in part due to the difficulty of manufacturing gears with sufficient precision to enable accurate calculation.
1843	Goerg Scheutz, a Swedish printer, and his son complete a working *Difference Engine* after 16 years of effort.

Continued ...

1906	Lee de Forest invents the electron tube.
1948	Schockley, Bardeen and Brattain invent the transistor.
1961–1967	Researchers at the RAND Corporation, MIT, and the British NPL, independently develop the concept of a packet-switched network. This allows computer networks to transport information without needing the source and destination computers to be physically connected in an electrical circuit [10].
1969	The first two nodes of ARPANET are connected [10].
1971	Intel Corp releases its first microprocessor, the 4004. The 4004 ran at 108 kHz, and could address 640 Bytes of memory [4].
1972	The first version of the TCP/IP protocols for computer network communications are developed.
1974	Plans for the Mark 8 computer are published in the July issue of Radio Electronics Magazine.
1975	The kit for the MITS Altaire 8800 is announced in the January issue of Popular Electronics. The kit sold for $397, which included $300 for the Intel 8008 chip for the CPU [1].

Mathematics of Computation

This section needs a lot of work. See also the section on Academic contributions.

1580	Francois Vieta introduces the use of letters to represent the unknowns or general parameters in mathematical expressions
1687	Isaac Newton publishes *Principia Mathematica*, which contains the first published version of Newton's method, among many other achievements in Newton's understanding of mathematics and science [8].
1801	Gauss develops *elimination* to solve the least squares problem for determining the orbit of the comet Ceres [11].
1854	George Boole publishes *An Investigation of the Laws of Thought, on which are founded the Mathematical Theories of Logic and Probabilities*, thereby laying the foundation of mathematical logic.
1947-48	von Neumann and Goldstine publish a series of papers on the logical design of computers. These papers established the organization of the functional units of modern computers, as well as how to program computers constructed from those units.
1947-48	In a series of papers, von Neumann, Goldstine, Turing, and Wilkinson show the limits on the stability of Gaussian elimination.
1948	Claude Shannon publishes papers in the July and October issues of the Bell System Technical Journal, that lay the foundation of information theory: the mathematical basis for encoding information in bit patterns.
1963	J.H. Wilkinson publishes *Rounding Errors in Algebraic Processes*, which codifies modern error analysis of numerical algorithms.
1965	James W. Cooley and John W. Tukey publish their algorithm for FFT [3]

Academic

1927 V. Bush, F.D. Gage, and H.R. Stewart of the MIT Electrical Engineering Department, announce the invention of a machine that can evaluate integrals of the form $\int_a^b f_1(x) f_2(x)\, dx$ and solve certain problems related to models of electrical circuits and continuous beams [9, p.88–89].

1942 V. Bush and S.H. Caldwell complete the last in a series of differential analyzers to solve integral equations. This last machine used punched paper tapes that allowed problems to be set up in less time (3 to 5 minutes) than the machine needed to compute the solution [9, p.98]

1944 Howard Aiken at Harvard and engineers at IBM develop the IBM Automatic Sequence Controlled Calculator. This machine used electromechanical relays and was controlled by paper tape. It could multiply two 23 digit numbers in about six seconds. [9, p.112].

1943–45 The ENIAC is developed at the University of Pennsylvania. The ENIAC contained 18000 vacuum tubes. It was 100 feet long, 10 feet high, 3 feet deep, and consumed 140 kW of power [9, p.153].

1945 Researchers at the University of Pennsylvania complete the EDVAC, the successor to ENIAC. The EDVAC was the first computer to use a program stored in a media (magnetic tape) that could be read back for later computation.

1955 At 11:45 on 2 October, the ENIAC is turned off and ceases computation at the Aberdeen Proving Grounds in Maryland.

1965 George Forsythe creates the first Department of Computer Science at Stanford University.

1976 Ken Thompson of Bell Labs takes a leave of absence to teach as a visiting professor in the Computer Science Department at the University of California at Berkeley. He shared his knowledge of the UNIX system with students and professors. They, in turn, enhanced the operating system and released Berkeley Software Division (BSD) UNIX, which was licensed to other universities for a modest fee. BSD Unix was the platform on which much of the Internet was developed. Many of the key software components that make the Internet possible (`sendmail`, DNS servers, sockets) are from BSD Unix.

1982 Four students at Stanford develop the Stanford University Network (SUN) computer that runs a form of Unix.

1993 Marc Andreeson and fellow students at UIUC release Mosaic, a graphical browser for documents delivered by HTTP, and the NCSA HTTPd web server. This software was given away for free.

199x The University of Illinois signs a license with Spyglass, Inc., allowing Spyglass to license the source code for NCSA Mosaic for commercial purposes. The source code for NCSA Mosaic is still free of charge for academic institutions.

Military

Needs lots more work.

193x	Germany develops the ENIGMA machine for encoding messages using a hash. The machine is used to send coded messages to U-boat captains during World War II.
1943–45	ENIAC and EDVAC are developed at the University of Pennsylvania to automate computation of ballistic trajectories.
1967–69	ARPA funds development of distributed network capable of surviving a nuclear attack
1971	ARPANET, the computer network funded by ARPA, consists of 23 host computers at US Universities and government laboratory. The primary activity of ARPANET is the transport of email.
1990	ARPANET is decommissioned. The network of networks communicating via TCP/IP is called the *Internet*. The number of host computers on the network is over 300,000. Traffic over the Internet depends on the National Science Foundations NSFNET, a network of primary computing sites (a *backbone*) that relays traffic from smaller networks.
199x	Supercomputers are used for virtual testing of nuclear weapons, which allows the United States military to agree to a complete ban on physical testing of nuclear weapons.
199x	FBI develops *Carnivore*, a system for tapping email.
1998?	Civil liberties groups around the world uncover the existence of Echelon, a global electronic surveillance system maintained by the United States, Britain, France, Germany, and other countries in the Western Alliance.

Economic and Industrial

1889 Herman Hollerith receives patents on his invention of machines for tabulating population statistics

1890 Hollerith's machines are used in the US Census of 1890

1911 The Computer-Tabulating-Recording Company is formed from Hollerith's earlier company, the Tabulating Machine Company

1914 Thomas J. Watson, Sr. joins the Computer-Tabulating-Recording Company

1924 The International Business Machines Corporation is founded under the direction of Thomas J. Watson, Sr.

1937 G. Stibitz at Bell Labs develops the first binary relay calculator

195x Post WW2 companies UNIVAC, Sperry,

1951 Grace Murray Hopper invents the idea of a compiler for translating computer instructions in human readable form to the machine language used by the computer.

1957 A team at IBM lead by John Backus completes development of Fortran.

1970 Bell labs finishes development of the first version of UNIX

1974 Paul Allen and Bill Gates are students at Harvard University. In December, Allen sees a copy of the January 1975 issue of *Popular Electronics Magazine*, which announces the availability of the kit for the MITS Altair computer. Allen shows the magazine to Gates, who calls MITS and tells him that he has developed a version of BASIC that will run on the Altair. The software did not exist. Gates developed a version of BASIC in eight weeks. Allen took a copy of the interpreter (via paper tape) to the Albuquerque office of MITS, loaded into an Altair, and without ever being tested on a computer, the interpreter worked. Gates and Allen moved to Albuquerque to complete the development of the interpreter, and they founded Microsoft Corporation [7, Part I].

1976 Apple computer is founded on April 1. [5].

1976 The first Cray-I supercomputer is installed at Los Alamos National Laboratory. The machine cost $8.8 million. It had 8 megabytes of main RAM, and could perform 160 million floating point operations per second.

1977 Apple computer releases the Apple II [5].

1980 IBM issues a contract with Microsoft to develop an operating system for the "personal computer" they are developing. Paul Allen and Bill Gates buy the rights to the QDOS operating system from Seattle Computer Products for $50,000. QDOS becomes MS-DOS [7, Part II].

1981 IBM launches the IBM 5150, widely known as the IBM *Personal Computer* or *PC*. The first PC used a 4.77 MHz Intel 8088 processor, had 16 K of RAM, and one or two 160 K floppy disks. It cost $1565. [6]

1983 Microsoft announces its *Windows* graphical user interface for DOS [2].

1984 Apple computer introduces the Macintosh, the first commercially available computer with a graphical user interface. The Macintosh 128 had a 8 MHz processor, 128 K of RAM, and a single 400 K disk and sold for $2495.

1985 Microsoft releases version 1.0 of it *Windows* graphical user interface for DOS [2].

1988 Cray Research introduces the Cray Y-MP. It contained multiple 333 MFLOP processors, and had a sustained computing rate of 2.3 GFLOPS

Continued ...

1990 Microsoft releases version 3.0 of it *Windows* graphical user interface for DOS [2].
1991 NSF lifts the ban on commercial use of NSFNET, the backbone of the Internet.
1992 Microsoft releases version 3.1 of it *Windows* graphical user interface for DOS [2].
1993 Intel releases its Pentium^{TM} processor running at 60 MHz, and capable of addressing 4 GBytes of RAM.
1994 Marc Andreesen and co-workers leave the University of Illinois to found Mosaic Communications Corporations, which is later renamed to Netscape, Corporation.
1995 Bill Gates "gets" the internet, and realigns Microsoft to take advantage of and control it
1995 Microsoft buys a license of NCSA Mosaic and releases Internet Explorer 1.0
1998 The remains of Netscape are acquired by AOL and SUN Microsystems
1999 Microsoft is found in violation of Sherman Antitrust act – in part for it concerted efforts to destroy Netscape

Social

Needs more work

1972 On the newly established ARPANET, email is invented by Ram Tomlinson. Email soon becomes a primary source of traffic on ARPANET as it allows researchers working on the network to communicate about how to build the network.
1990 Tim Berners Lee demonstrates a system for distributing hypertext documentation to distributed computers via HyperText Transport Protocol or HTTP. He gives away the source code. HTTP is able to combine words, pictures, and sounds on "pages". Berners Lee calls the interconnection of servers the "world wide web".
1991 Linus Torvalds announces that he has developed a version of Unix for his 386 (486) IBM AT personal computer. He dubs the operating system *Linux* and freely shares the source code with anyone who wishes to use it.
1994 Tim Berners Lee founds the World Wide Web Consortium (W3C) at the Massachusetts Institute of Technology,Laboratory for Computer
1995 Though it has been in use for at least a decade, the term *Internet* is defined by the Federal Networking Council

References

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[5] Intel Corporation. The Unofficial History of Apple Computer. `www.apple-history.com`.

[6] International Business Machines Corporation. IBM Archives: A History of Innovation. `www-1.ibm.com/ibm/history/`.

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[10] Barry M. Leiner, Vinton G. Cerf, David D. Clark, Robert E. Kahn, Leonard Kleinrock, Daniel C. Lynch, Jon Postel, Larry G. Roberts, and Stephen Wolff. A Brief History of the Internet. `www.isoc.org/internet/history/brief.html`.

[11] Gilbert W. Stewart. Gauss, statistics, and gaussian elimination. Technical Report TR-3307, University of Maryland, Department of Computer Science, College Park, Maryland, 1994.