Computer History Worldwide and Dr. Chase's Computer History

Prehistory of Digital Computers

3000BC Abacus invented in ancient near East and used in Western world, since arithmetic is difficult with Roman numerals.

400BC **Aristotle** (Greece) developed logic.

1614 **John Napier** (Scotland) invented logarithms and "bones" (or rods)—a precursor to the slide rule.

1623 **Schickard** (Germany) invented a mechanical calculator based on Napier's bones, that could add and subtract.

1642 **Blaise Pascal** (France) mechanical calculator that could add and subtract. Long thought to be the first invented, because Schickard's work was unknown until the 20th century.

1672 **G. W. Leibniz** (Germany) invented a calculator that could also multiply and divide.

1801 **Jacquard** (France) perfected the punch-card programmable loom, invented in 1750.

1823 **Charles Babbage** (England) invented the Difference Engine. Computed formulae up to 3rd degree polynomials and 15 digit numbers using an idea of Isaac Newton's to use only addition and subtraction. Based on mechanical registers. Answer "cranked out" by a motor. Problem: larger calculations were never in operation, since it was too hard to build precision pieces.

Fig. 1 Charles Babbage's Difference Engine

1836 Babbage Analytical Engine: General purpose design with cpu, memory, card input, and printer output. Memory of 1000 50-digit numbers, but not funded, so not built. The genius ideas were long forgotten.

Augusta Ada Byron, countess of Lovelace, was somewhat of an amateur programmer for the analytic engine. She did an incredible job of accuracy, given that the machine wasn't built to debug the code.

1854 **George Boole** (English) developed boolean logic: a mathematical language for logic. Logic had previously used English, and was applicable to philosophy, but not math or computers.

1884 **Hermann Hollerith** (USA) patented an electromechanical system for counting and sorting punched cards. Used for 1890 US census, adopted worldwide. His firm after mergers became IBM in 1911.

1890's Many analog calculators were developed: Burroughs, Lord Kelvin, and others.

1927 **Vannevar Bush** (MIT) designed the differential analyzer, an analog computer.

Fig. 2 Vannevar Bush, Differential Analyzer

History of Digital Computers

There were many independent attempts: in Germany (Zuse), England (Turing), and the USA (Aiken at Harvard, Atanasoff at Iowa State, and Eckert & Mauchly at University of Pennsylvania). The Atanasoff version called ABC and Eckert & Mauchly's ENIAC most directly led to modern computers, whereas the other projects died out.

The history is divided roughly into **5 past, and 3 future generations of hardware:**

0	1940s mechanical relays
1	1950s vacuum tubes replace mechanical relays
2	1960s transistors
3	1970s integrated circuits (many transistors on one circuit board)
4	1980s LSI and VLSI and ELSI (extremely-large scale integration)
5	??? optical-based computers. Prototypes of optical transistors have been built.
6	??? DNA-based. Chemical processes based on DNA strands have been used in prototype for calculation, notably by mathematician Leonard Addleman, who is the "A" in "RSA encryption" as well.
7	??? Quantum-based. Speculation is underway on how to use low-level physics to compute rapidly. A seven-bit quantum-based computer has been built.

1936 **Konrad Zuse** (Germany) used the binary system and relays in his special purpose computer, Z1. The general purpose one he designed was not funded since Hitler thought they'd win the war before better computers could be built.

1937 **Howard Aiken** (IBM) developed relay-based (electromechanical) MARK computers, but this line died in 1946, (with a few vacuum-tube models), since it couldn't compete with the ENIAC (below). It had no central CPU.

1938 **Claude Shannon's** ground-breaking Master's thesis applied Boole's logic to mechanical relays. He later developed a mathematics of information theory based on probability.

1939 **John Atanasoff** and his grad student **Berry** (Iowa State) used vacuum tubes, but their ABC was never fully operational.

1943 **Alan Turing** studied a stolen German ENIGMA encryption machine, and developed the COLOSSUS decryption machine using 2000 tubes. Turing's general-purpose design developed slowly due to British bureaucracy. Turing was also a genius computer theoretician, mathematically analyzing the limits of computability (The Turing Machine).

1946 First electronic computer: **J. Presper Eckert & John Mauchly** (U of Penna, Philadelphia) designed ENIAC for military purposes. It had vacuum tubes and was like a calculator that is programmed with plugs and switches.

John von Neumann (USA) proposed the EDVAC that used the stored-program concept: Serial execution, a single memory, and the ability to construct instructions in the memory. It was built in 1952.

1949 First stored-program: **Maurice Wilkes** (Cambridge, England), a student of von Neumann, built EDSAC for research.

1951 First successful commercial computer (48 systems built): Eckert & Mauchly (Remington-Rand) built UNIVAC I.

1952 First modern computer (used

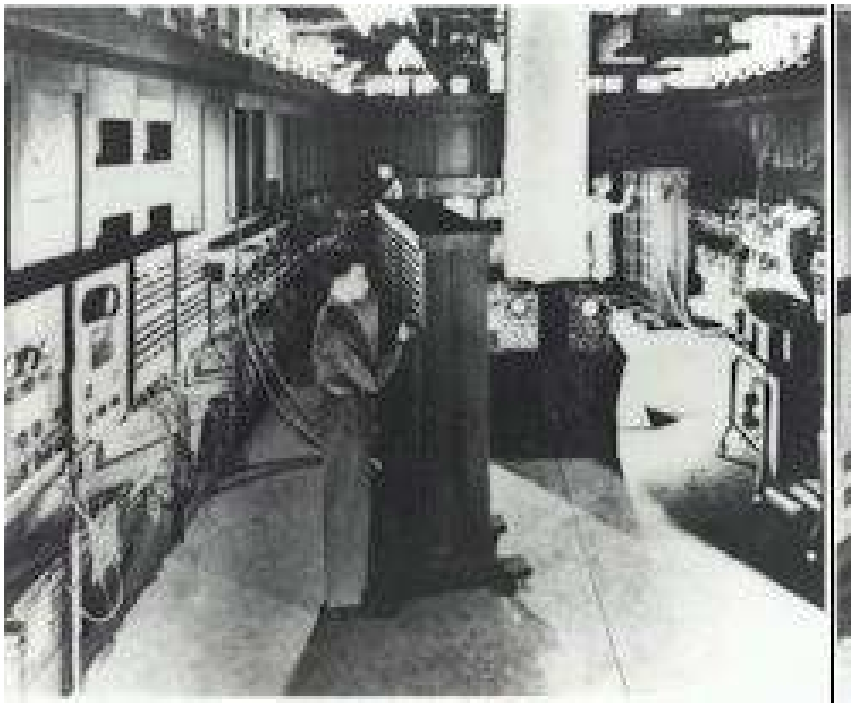

Fig. 3 Electrical Numerical Integrator & Calculator (ENIAC)

most architectural concepts of today): Bigelow (Princeton) built the IAS.

1952 First IBM digital computer: Model 701 (19 sold, mostly to the government and to airplane designers.)

1954 Fortran was designed by **John Backus,** and developed by a group that he lead over 3.5 years (12 person-years). Much system software was developed thereafter.

1963 First "supercomputer," the Control Data Corporation's CDC 6600 (Minnesota) by **Seymour Cray.** He later founded his own company to make Cray supercomputers (1976).

1964 First family of computers integrating hardware and software: IBM System/360. IBM always cared for backward compatibility, which was great for marketing, since companies could upgrade, staying with IBM. IBM now calls the current generation of that series the zSeries.

1965 First commercial **minicomputer** as opposed to **mainframe**: DEC PDP-8 (under $20,000). Messiah College bought one about 10 years later when the price came down.

1968 First 1k RAM memory chip: Intel.

1969 UNIX designed at Bell Laboratories by **Dennis Ritchie** and **Brian Kernighan** for the Digital Equipment Corporation PDP-7. First in assembly language, then in the new language C that they invented, for portability to other computers.

1971 First microprocessor: Intel 4004, 4 bits, no multiplication, used in calculators.

1972 Intel 8008 (8 bit), 1974: 8080, 1979: 8086 (16 bit), 1985: 80386 (32 bit). The PowerPC (Motorola) has 64 bit instructions by comparison.

1970's First **personal computer:** Apple, early 70's. 1977, Apple II. **Steve Jobs** and **Steve Wozniak.** (Early Apples were in wooden cases.)

1970's RISC: John Cocke, IBM research; **David Patterson** (Berkeley) and **John Hennessy** (Stanford), your textbook authors. RISC was popular by late 1980's, was added to Intel's Pentium chip in extra logic called MMX (an acronym for nothing in particular, although "MultiMedia eXtensions" may be its major application).

1976 Cray-1 fastest, most expensive, best cost/performance ever.

1981 IBM PC best selling computer ever.

Dr. Chase's Personal Computer History

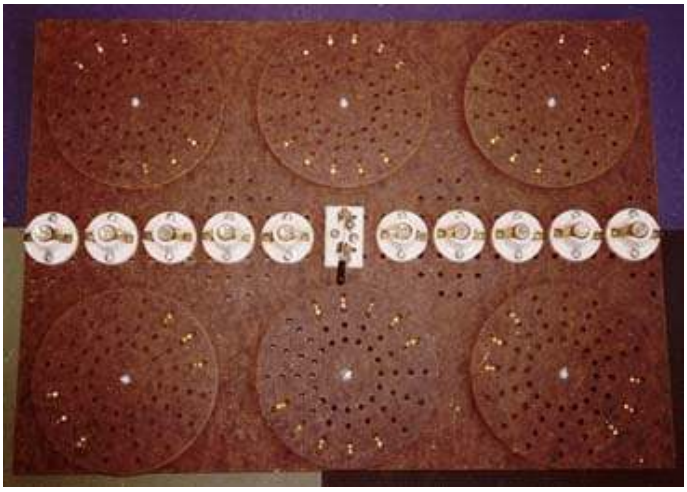

Fig. 4 Geniac

1957 Received from my dad as a Christmas present a "Geniac" computer made out of Masonite pressboard, bell wire, and metal switches. Followed instructions to build a tic-tac-toe playing computer and other computers. Read Shannon's 1938 master's thesis on doing logic with switching circuits, which was enclosed with the Geniac for the curious. Cost: $19.95 (one-fifth of my father's weekly salary). I was an eighth grader.

1961 Took the only course I ever took for credit in computers: a college freshman survey of a high level scientific language (Fortran), an assembly language (FAP), and a then-new research language (Lisp), at MIT.

1963 Worked with an analog computer that digested flight telemetry data for Grumman Aircraft Engineering Corporation as a summer intern "apprentice engineer."

1964 Grumman invited me and two other college students to spend a summer learning Snobol. Our assignment was, "At the end of the summer, give us a report about whether Snobol can be a useful computer language for the aircraft industry." Alan Gottlieb (now a professor of computer science researching parallel processing at New York University), James Vaupel (now a professor of public policy researching aging at Duke University) and I each had a different project. One of theirs was symbolic algebra of polynomial arithmetic and the other was symbolic integration and differentiation (like Derive®). Mine was to write an Alladin-to-APT translator. Alladin was a drafting language (like AutoCAD), and APT was metal milling machine software for an "Automatic Programmed Tool."

Fig. 5 PDP-1, Digital Equipment Corporation

1964 At MIT, I was a hacker on the PDP-1 computer and the TX-0. The PDP-1 used punched paper tape for input, long term storage, and output, and a typewriter for input. On the TX-0 I played Space War, since there was an oscilloscope as output device as well. A graduate student, Ivan Sutherland, was working on that computer for graphical input during those same days, but I didn't know him. Sutherland is now called the "father of computer graphics."

1965 Continued work at Grumman for one final summer. A new IBM 7094 II was replacing the old IBM 7090. My job was to convert as many production programs as possible from Fortran II on the old machine to Fortran IV on the new machine. I converted one that did polynomial curve fitting, another that did printer-plotter graphing, and others.

1967 Audited a computer course by Juris Hartmanis at Cornell University on computability to complement my mathematical studies in recursive functions.

1969 Taught a small course at Wells College in computers for the humanities, using the Snobol4 language.

1970 Was hired for the summer by a regional consortium, Finger Lakes Area Regional Computer Organization (FLARCO), to research and catalogue all available software for the humanities, to be housed at Cornell University. Audited a course in the APL language, invented by Ken Iverson.

1971 Taught precalculus mathematics using PL/C, Cornell's student-oriented dialect of PL/1.

1972 Discovered that I had to learn some statistics for my doctoral research. Used a variety of statistical packages on an IBM mainframe computer: SPSS, Carolina, and a few others.

1973 Came to Messiah College. We rented time on a Sperry-Rand Univac computer housed at Franklin and Marshall College for the benefit of a regional consortium (like FLARCO). I took chapel attendance by processing punched cards with a Fortran program. We taught many students Basic, and a few Fortran, using only two teletypewriter terminals.

1979? The PDP-8 was Messiah College's first computer of our own for academic computing. We were still renting time on another computer for administrative processing. I taught Fortran, and Basic, and PDP-8 assembly language courses on it.

1980 I wrote a proposal for a Computer Science major at Messiah, which began the next year. The Computer Science at Messiah College is 22 years old this year!

1981 Messiah purchased a couple Apple II computers to replace the PDP-8. I bought one for my home for $2,000 and an extra $200 for a second disk drive.

1982 My year-long sabbatical to Wycliffe Bible Translators in Dallas, Texas, gave me a chance to do some computational linguistics. I had trained in linguistics during the summers of 1974 and 1975.

1983 We added many more Apple II computers, some of them with a Z-80 coprocessor so that we could teach COBOL on it. Mr. Bill Strausbaugh (Messiah College's Dean of Enrollment Management now) was my first colleague in Computer Science, and the first to teach COBOL here. As part of Dr. Strausbaugh's graduate studies, we consulted with each other on automatic program translation from Fortran to PL/1, using the Model language.

Fig. 6 Apple][Computer

Fig. 7 VAX 11/750 Digital Equipment Corporation

1987 Messiah bought a DEC VAX 11/750, the big brother of the PDP series, and a room full of "dumb terminals" (DEC VT52). A year-long leave of absence to work with Wycliffe Bible Translators in Peru gave me a chance to do more computational linguistics.

1993 Dr. Paul van Arragon replaced Bill Strausbaugh after Messiah College survived a year without a replacement. Van Arragon and I consulted with each other on artificial intelligence topics.

1995 I discovered the Internet, and became Messiah College's first webmaster.

1997 Another year-long sabbatical to Cornell University allowed me to catch up with the field of Computer Science by taking two seminars.

1998 Dr. van Arragon returned suddenly to Canada, and so Messiah College began a search to replace him that lasted four years. We are thankful for both Scott Weaver and Brian Nejmeh for joining us, and for colleagues in other departments who teach Computer Science courses from time to time—Dr. Robert Kilmer in BIS, and Dr. Eugene Rohrbaugh in Linguistics.

Fig. 1 http://www.arachnoid.com/cpptutor/
Fig. 2 http://www.science.uva.nl/faculteit/museum/vbush_tbl.html
Fig. 3 http://www.eniac.utwente.nl/about.htm
Fig. 4 http://online.sfsu.edu/~hl/c.Geniac.html
Fig. 5 http://java.sun.com/products/jfc/tsc/sightings/S04/spacewar/new/pdp1.2.jpg
Fig. 6 http://apple2history.org/history/ah03.html
Fig. 7 http://telnet.hu/hamster/vax/kepek/vax750.jpg