

A History of Information Technologies



IST 523

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Information and Communication Technologies

- Information Use
- Computing Devices
- Electronic Computers
- Other Computing Technologies
- Telecommunications Systems
- Programming technologies / languages

Information and Communication

Information

- Knowledge derived from study, experience, or instruction
- A collection of facts or data

Communication

- The act of communicating

Communicate

- The exchange of thoughts, messages, or information, as by speech, signals, writing, or behavior.

Information

Modes of Information Use in Human History

- Oral cultures (> 1,000,000 years ago)
- Painting (> 20,000 B.C.E.)
- Writing (7,000 - 3800 B.C.E.)
- Printing (circa 800 B.C.E. - 1456 C.E.)
- Non-electronic Computation (1623 - 1940s)
- Telegraphy (1844)
- Telephone (1876)
- Radio (1895)
- Television (1929)
- Electronic Computation (circa 1945)
- Computer networking (1969)
- Commercial Internet (1990)
- World Wide Web (1992)

Computation

Computation

The act of computing.

Compute

1. to determine by mathematics, especially by numerical methods
2. to determine by the use of a computer
3. to count

Ancient Computational Devices

Hand Devices

- Counting bones (circa 6,000 B.C.)
 - calendar or enumeration systems
- Khipu (or Quipu) (600 - 1000 B.C.)
 - Andean peoples
 - made from string
 - used to record various kinds of information, including numbers
- Abacus (circa 500 B.C.)
 - counting boards
 - Chinese, Korea, and Japan

Early Computational Devices

Mechanical Calculators

- Wilhelm Schickard (1624)
 - Addition, Subtraction, Multiplication, Division
- Blaise Pascal's *Pascaline* (1645)
 - Addition, Subtraction, Multiplication
- Gottfried Leibniz Calculator (1694)
 - division, square root
- Development influenced by:
 - European Scientific Revolution
 - Growth in Commerce
- Not widely adopted
 - Most people did not yet understand their benefits
 - Expensive and hard to fix

Early Computational Devices

Industrial Revolution

- Joseph Marie Jacquard -- *The Jacquard Loom* (1801)
 - automated weaving
 - cards used to “program” the loom
 - widely adopted
 - 11,000 Jacquard looms in France by 1812.

Sources

Stern and Stern (1983). *Computers in Society*. Prentice-Hall.

Early Computational Devices

Programmable Machines

- Charles Babbage's *Difference Engine* (1822*)
 - * never completed
 - designed to automate the *process* for calculating the roots of polynomials
- Charles Babbage and Ada Byron, Lady Lovelace's *Analytical Engine* (1837*)
 - * never completed
 - introduced concept of stored program
 - borrowed concepts from Jacquard
 - Ada is said to be the world's first programmer.
- Pehr George Scheutz's *Difference Engine* (1854)
 - Based on Babbage's work.

Early Computational Devices

Programmable Machines

- Herman Hollerith's *Tabulating Machine* (1884)
 - used paper cards with holes punched in them
 - holes in the cards permitted an electrical contact to be made, activating a counter
 - developed for the U.S. census of 1890.
 - reduced the census count to 2 years from 6 years for the 1880 census.
 - approx. 60,000,000 cards were processed.

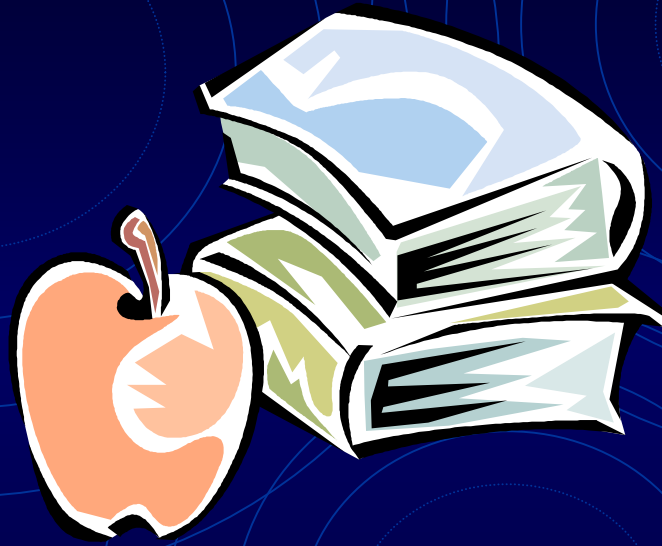
Sources

Stern and Stern (1983). *Computers in Society*. Prentice-Hall.

Questions?



Quick break



Digital Computers

Computer

A set of data structures and algorithms capable of storing and executing programs.

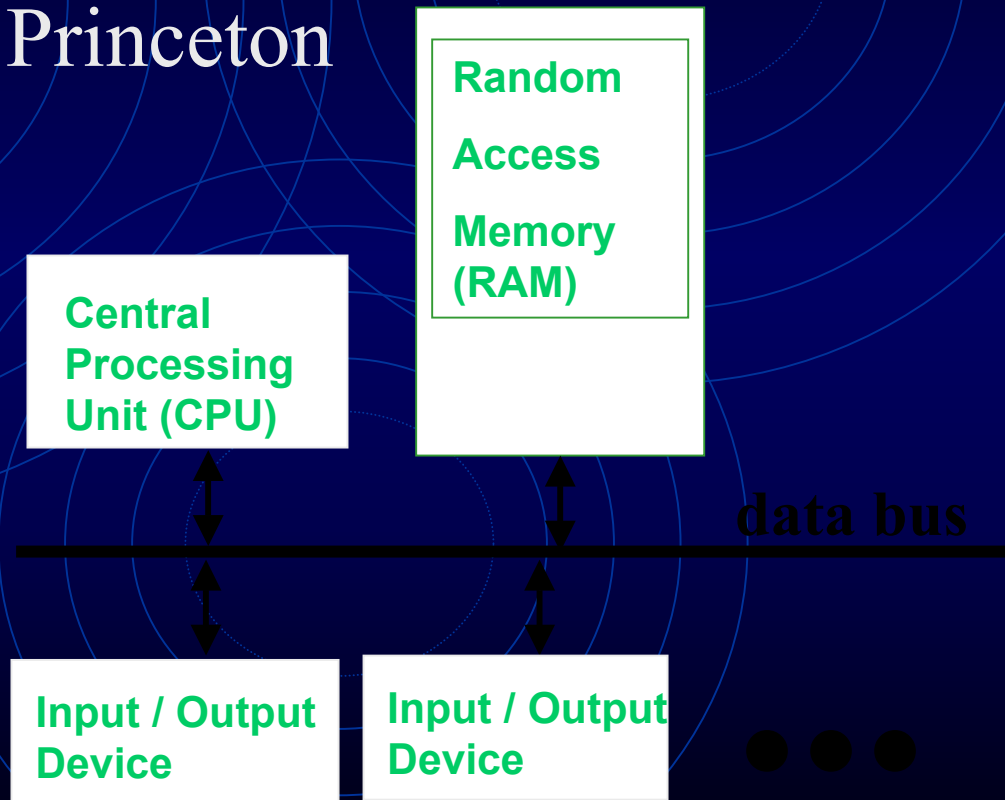
Digital Computers

Unlike mechanical calculators, the internal state of the device dealt with “0” and “1”

Digital Computers

The Basic Architecture

- Due to *John von Neumann*, a mathematician at Princeton University.



Digital Computers

Electromechanical computers

- Used relays (electro-mechanical switches) to complete circuits.
- Influenced by World War II.
- Most developers unaware of Babbage's work.

- *Z3*, Konrad Zuse, Germany (1941)
 - probably the first fully functional digital computer.
- *Mark I*, Howard Aiken, Harvard University (1944)
- *Models I - V*, George R. Stibitz, Bell Labs (1946)

Sources

Stern and Stern (1983). *Computers in Society*. Prentice-Hall.

Digital Computers

Electronic computers

First generation computers (1942 - 1956)

- No moving parts.
- Used vacuum tubes
- *ABC*, Atanasoff and Berry, Iowa State University (1942)
 - never completed
- *ENIAC*, Mauchly and Eckert, University of Pennsylvania (1946)
 - programmed by setting switches
- *EDVAC*, Mauchly and Eckert, University of Pennsylvania (1951)
 - stored programs

Digital Computers

Electronic computers

- UNIVAC, Mauchly and Eckert, Remington Rand (1951)
 - first commercial computer
 - used magnetic for input and output
 - 46 machines were sold.

Sources

Kathleen Guinee. (1995). A Journey through the History of Information Technology. <http://www.cs.princeton.edu/~kguinee/thesis.html>

Stern and Stern (1983). *Computers in Society*. Prentice-Hall.

Digital Computers

Electronic computers

Second Generation Computers (1956 - 1958)

- transistors
 - smaller and more reliable than vacuum tubes
 - faster
- Bell Labs *Leprechaun* (1956)
- Other computers built by IBM, Philco, GE, and RCA

Sources

Kathleen Guinee. (1995). A Journey through the History of Information Technology.
<http://www.cs.princeton.edu/~kguinee/thesis.html>

Digital Computers

Electronic computers

Third Generation Computers (1958 -)

- computers built with integrated circuits (ICs)
 - ICs were invented in 1958 by Fairchild Semiconductor
 - ICs are silicon “chip” containing transistors.
- ICs reduced the size of computers and allowed specific functions to be “packaged” into mass produced units
 - e.g. adders, flip-flops, memory, etc.

Sources

Kathleen Guinee. (1995). A Journey through the History of Information Technology.
<http://www.cs.princeton.edu/~kguinee/thesis.html>

Digital Computers

Electronic computers

- Digital Equipment Corporation (1962 - 1971)
 - produced a minicomputer
 - \$15,000
- IBM 360 Computer (1964)
 - Made using ICs
 - addressed compatibility and scalability issues
 - could be expanded
 - each member of the 360 line was compatible with the other
 - perhaps the most popular mainframe computer for over 2 decade.

Sources

Kathleen Guinee. (1995). A Journey through the History of Information Technology.
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Digital Computers

Electronic computers

Fourth Generation (1971 - present)

- Computers built with microprocessors
- Intel invented the first microprocessor in 1971 -- the 4004.
- Microprocessors are large integrated circuits
 - based on transistors -- like other ICs
 - all of the logic of a CPU contained in one chip

Sources

Kathleen Guinee. (1995). A Journey through the History of Information Technology.
<http://www.cs.princeton.edu/~kguinee/thesis.html>

Digital Computers

Electronic computers

- First personal computers were developed
 - Altair (1974)
 - Bill Gates and Paul Allen license their version of BASIC to Altair
 - Apple I (1976), Apple II (1977)
 - IBM PC (1981)
 - Macintosh (1984)

Sources

Kathleen Guinee. (1995). A Journey through the History of Information Technology.
<http://www.cs.princeton.edu/~kguinee/thesis.html>

Other Computing Technologies

- The first hard drive invented by IBM (1956)
 - the RAMAC 305
 - 5 MB
 - 50 platters, each 2 ft in diameter

Other Computing Technologies

- **Interactive Computing Concepts**
 - Vannevar Bush (1945) essay “As We May Think”
 - The Memex concept
 - J.C.R. Licklider (1960)
 - article “Man Computer Symbiosis”
 - MIT Sketchpad: first interactive graphics system (1963)
 - Douglas Englebart (1963 - present)
 - mouse and windowing concepts invented and developed (1963 - 1968)
 - Xerox PARC (1970s)
 - developed first commercial windows-based computers

Other Computing Technologies

- Computer Plotters (1960s)
- Compact Disc invented at Philips Research (1969)
 - Released in 1982 and 1983.

Telecommunication Technologies

- Telegraph
 - Samuel Morse 1844
 - First telegraph line was between Baltimore and Washington, DC in 1844
 - Trans-Atlantic communication 1866
 - Trans- U.S. communication 1869
- Facsimile (FAX) (1842 - 1865)
- Telephone
 - Invented in 1876
 - 1,000,000 phones by 1900
 - First call from NY to San Francisco in 1915

Telecommunication Technologies

- Radio

- Guglielmo Marconi invented radio (1895)
- First trans-Atlantic signal (1901)

- Television

- Vladimir Kosma Zworykin, Russia, invents the kinescope (television receiver) (1923-1924)
- First demonstration 1929-- Pittsburgh, USA

Telecommunication Technologies

- MODEM (Modulator/Demodulator)
 - AT&T Bell Labs 1960
 - 300 Baud
- Computer Networking (1965 - 1969)
 - MIT, RAND, National Physical Labs in UK develop packet switching
 - ARPANET started in the U.S. (1969)
 - 50 computers by 1975
- Interactive Cable Television (1973-1977)
- Minitel/Teletel, France, 1979 - present

Telecommunication Technologies

- ARPANET --> CSNET, NSFNET, etc.
(1980s -)
- World Wide Web released for public use
1992
- First Web browser released 1993

Digital Computers

Software Technologies

- Machine languages/programming
 - Wires and Plug Boards used to program the earliest computers
 - Cards encoded with “machine language” then used.
 - Short Code -- hand compiled

Sources

BYTE, www.byte.com

Kathleen Guinee. (1995). A Journey through the History of Information Technology.
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Digital Computers

Software Technologies

- First High Level Languages
 - *compilers* -- programs which translated programs from one language to another high level language --> machine instructions.
 - *interpreters* -- programs which interpret programs in a language
- FORTRAN, John Backus (1956)
- COBOL, Grace Hopper (1959)
- LISP (1959)
- BASIC, John Kemeny and Thomas Kurtz, Dartmouth College (1964)

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Kathleen Guinee. (1995). A Journey through the History of Information Technology.
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Digital Computers

Software Technologies

- Structured Programming Languages
 - introduced ideas of variable scope, strong typing, and disciplined program structure
 - ALGOL (1960 and 1968)
 - PASCAL (1970)
 - C (1974)
 - Modula II (1980)
 - Ada (1983)

Sources

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Kathleen Guinee. (1995). A Journey through the History of Information Technology.
<http://www.cs.princeton.edu/~kguinee/thesis.html>

Digital Computers

Software Technologies

- Object-Oriented Programming Languages
 - introduced ideas of information hiding (encapsulation), inheritance, and polymorphism
 - SmallTalk (1980)
 - C++ (1986)
 - Java (1995)

Sources

BYTE, www.byte.com

Kathleen Guinee. (1995). A Journey through the History of Information Technology. <http://www.cs.princeton.edu/~kguinee/thesis.html>

Sun Microsystems, Inc. www.javasoft.com

Questions?

