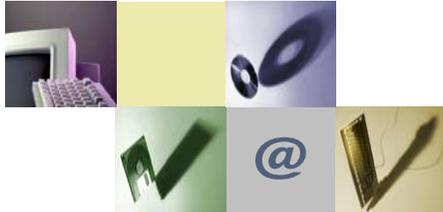


Introduction to Computers



Digital Computer Concept and Practice

What is a Computer?

Accepts data

Raw facts, figures, and symbols

Processes data into information

Data that is organized, meaningful, and useful

Produces and stores results

- Components: Hardware + Software
- Generally, the term is used to describe a collection of devices that function together as a system.



What is a Computer?

- A machine for automatically performing calculations
- A computer is an electronic device, operating under the control of instructions (software) stored in its own memory unit, that can accept data (input), manipulate data (process), and produce information (output) from the processing.



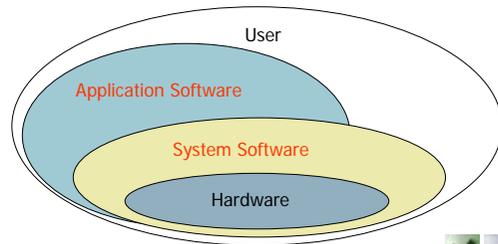
Computer System (Hardware)

Input devices + Processor (CPU) + Output devices



Software

- How does a computer know what to do?
 - It must be given a detailed list of instructions (computer program or software) that tells it exactly what to do.



Categories of Computers



Software

- System software
 - Programs that control or maintain the operations of a computer and its devices
 - Operating systems
 - MS Windows, Mac OS X, Unix
- Application software
 - Program that perform specific tasks for users
 - Word processing software, graphics software, moving picture players



컴퓨터의 종류

- Data type
 - Digital computers (vs. analog computers)
- Purpose
 - General (vs. domain-specific)
- Size (processing capacity)
 - Personal computer (PC)
 - Mainframe
 - Supercomputer



Personal Computer (PC)

- Computer systems developed for individuals
 - Price, size, and capabilities



Mainframe

- Mainly used by large organizations
- Focusing on business problems and reliable operations
- Census, industry or consumer statistics, and financial transaction processing.



Personal Computer (PC)

- Laptop
- PDA (Personal Digital Assistant)



Supercomputer

- Employed for specialized applications that requires massive amounts of mathematical calculations
- Weather forecasting, nuclear energy research, etc.



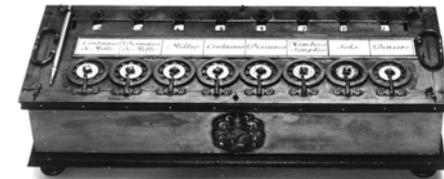
Mainframe vs. Supercomputers

- Mainframe
 - Execute many programs concurrently
 - Business purpose
- Supercomputer
 - Execute a few programs as fast as possible
 - Scientific purpose



The Early Period: Up to 1940

- 1672: The Pascaline
 - Designed and built by Blaise Pascal
 - One of the first mechanical calculators
 - Could do addition and subtraction

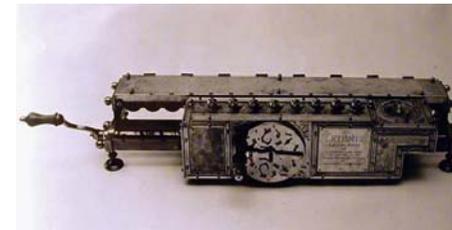


History of Computer Hardware



The Early Period: Up to 1940

- 1674: Leibnitz's Wheel
 - Constructed by Gottfried Leibnitz
 - Mechanical calculator
 - Could do addition, subtraction, multiplication, and division



The Early Period: Up to 1940

- 1801: The Jacquard loom
 - Developed by Joseph Jacquard
 - Automated loom
 - Used punched cards to create desired pattern



The Early Period: Up to 1940

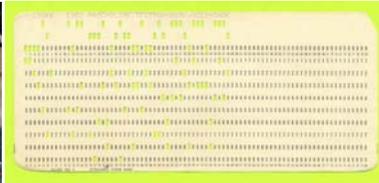
- 1823: The Difference Engine
 - Developed by Charles Babbage
 - Did addition, subtraction, multiplication, and division to 6 significant digits
 - Solved polynomial equations and other complex mathematical problems



Punched Cards



Jacquard Loom

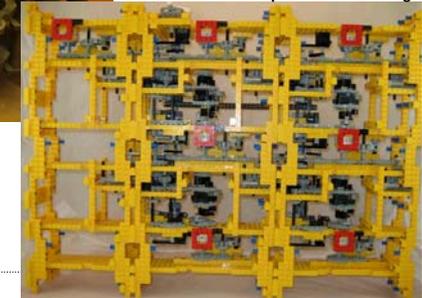


CTR Census Machine

Difference Engine



<http://acarol.woz.org>



The Early Period: Up to 1940

- 1830s: The Analytic Engine
 - Designed by Charles Babbage
 - Mechanical general-purpose computer
 - Components were functionally similar to the four major components of today's computers
 - Mill → arithmetic/logic unit
 - Store → memory
 - Operator → processor
 - Output → input/output



The Early Period: Up to 1940

- 1890: U.S. census carried out with programmable card processing machines
 - Built by Herman Hollerith
 - These machines could automatically read, tally, and sort data entered on punched cards
 - 1880 census: 8 years → 1890 census: 1 year

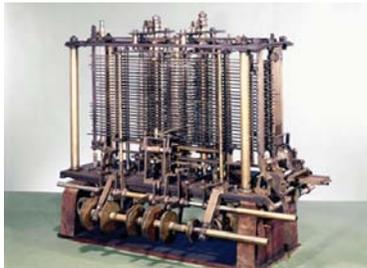


Tabulating Machine Company (1896)
→ Computing Tabulating Recording Corporation (1911)
→ IBM (1924)



Analytic Engine

- First computer programmer: Ada Byron
 - The modern computer programming language, "Ada" is named in her honor.

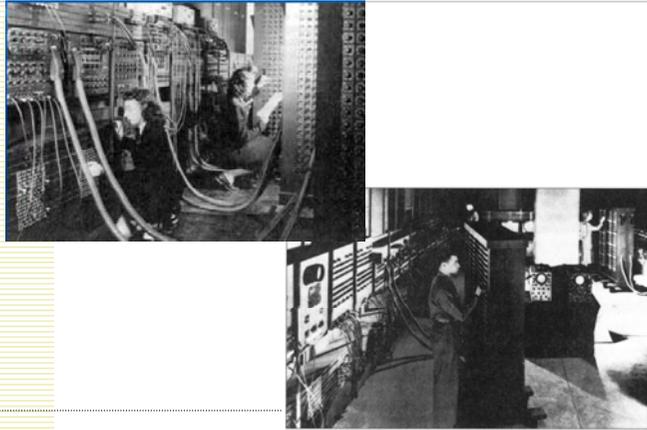


The Birth of Computers: 1940-1950

- Development of electronic, general-purpose computers
 - Did not begin until after 1940
 - Was fueled in large part by needs of World War II
- Early digital computers
 - Mark I
 - ENIAC (Electronic Numerical Integrator and Calculator)
 - ABC (Atanasoff-Berry Computer)
 - Colossus
 - Z1

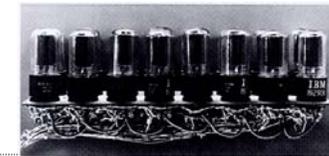


ENIAC



The Modern Era: 1950 to the Present

- 1st generation of computing (1950-1959)
 - Used vacuum tubes to store data and programs
 - Each computer was multiple rooms in size
 - Computers were not very reliable
 - ABC, ENIAC, EDSAC, EDVAC, UNIVAC



The Birth of Computers: 1940-1950

- Stored program computer model
 - Proposed by John Von Neumann in 1946
 - Stored binary algorithm in the computer's memory along with the data
 - Is known as the Von Neumann architecture
 - Modern computers remain, fundamentally, Von Neumann machines
 - First stored program computers
 - EDVAC
 - EDSAC



The Modern Era: 1950 to the Present

- 2nd generation of computing (1959-1965)
 - Vacuum tubes → transistors and magnetic cores
 - Dramatic reduction in size
 - Computer could fit into a single room
 - Increase in reliability of computers
 - Reduced costs of computers
 - High-level programming languages (FORTRAN, COBOL)
 - The programmer occupation was born



The Modern Era: 1950 to the Present

- 3rd generation of computing (1965-1975)
 - Used integrated circuits (ICs) rather than individual electronic components
 - Further reduction in size and cost of computers
 - Computers became desk-sized
 - First minicomputer developed
 - Software industry formed



The Modern Era: 1950 to the Present



The Altair 8800: world's first microcomputer



The Modern Era: 1950 to the Present

- 4th generation of computing (1975-current)
 - Reduced to the size of a typewriter
 - Appearance of
 - Computer networks
 - Electronic mail
 - Graphical user interfaces (GUIs)
 - Apple Computer (Steve Jobs and Steve Wozniak, 1977)
 - IBM PC (1981)
 - Microsoft: MS-DOS



Future?

- Quantum computer
- DNA computing
- Chemical computer
- Optical computer

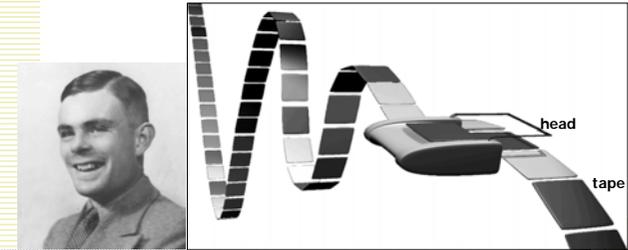


Theoretical Models of Computers



Turing Machine

- Abstract symbol-manipulating device
- A thought experiment about the limits of mechanical computation (Not a practical computing technology)



Church's Thesis

- Every '*function*' which would naturally be regarded as '*computable*' can be computed by a **Turing machine**.
- Any computer with a certain minimum capability is, in principle, capable of performing the same tasks that any other computer can perform.



Turing Machine

- A tape which is divided into cells, one next to the other. Each cell contains a symbol from some finite alphabet.
- A head that can read and write symbols on the tape and move left and right one step at a time.
- A state register that stores the state of the Turing machine.
- An action table (or transition function) that tells the machine what symbol to write, how to move the head and what its new state will be, given the symbol it has just read on the tape and the state it is currently in.

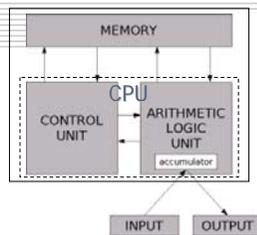


Von Neumann Architecture

- Modern computer → “Programmable”
- Stored program architecture
- Nearly all modern computers implement some form of the stored program architecture
- Computers are controlled by stored programs (algorithms).



- Contributions of John von Neumann (1903-1957)
quantum physics, functional analysis, set theory,
economics and game theory, computer science,
numerical analysis, hydrodynamics (of
explosions), statistics, ...



- (1) Fetch an instruction from memory
- (2) Fetch any data required by the instruction from memory
- (3) Execute the instruction
- (4) Store results in memory
- (5) Go back to Step (1)

