Computer Systems Overview

Computer systems:
  Hardware -
  Software -

Hardware Components:
  CPU -
    Main Memory - (or Random Access Memory, RAM).

Secondary Memory -

Input and Output Devices (I/O) -

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Main memory:
  - Data are encoded as binary numbers. Binary digit (0 or 1) is called a bit. 8 bits forms one byte. A word is typically 4 bytes, or 32 bits.
  - Main memory is subdivided into units, called cells.
  - The location of a memory cell is called its address.
  - The smallest addressable unit is typically one byte, but consecutive bytes can be used to store longer data items.
  - With k bits you can store up to $2^k$ different values.

  (byte) $2^8 = 256$
  (word) $2^{32} \approx 4$ billion

  Kilobyte $2^{10} = 1024$
  Megabyte $2^{20} \approx 1$ million
  Gigabyte $2^{30} \approx 1$ billion
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Program Execution:
- Programs are stored permanently in secondary memory (e.g. on hard disk). Instructions are encoded as binary numbers (machine code).
- When a program is to be run, it is copied (loaded) into main memory, and the CPU executes the instructions of the program.
- Program may read data from secondary memory and input devices.
- Through flow-control (if-then-else, loops) the program can control the order in which program instructions are executed.
- Program data (variables) are stored in main memory.
- Results are written to output devices or to secondary memory.

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Major Software Categories

Operating System (OS): Manages the computer’s resources.
- Process management:
- Memory management:
- I/O, Window System, and Network Control:
- Enforces Security:

Applications Software:
- Any software other than the operating system.

Programming Languages

Types of programming languages
- Machine code -
- Assembly language -
- High-level languages -
  - 1950’s-early 60’s: Fortran (scientific), Cobol (business)
  - late 60’s: Algol
  - 70’s: Pascal
  - 80’s: C
Modern Program Development

Old way:
Text editor (vi, emacs):

Compiler:

Debugger:

Modern way: Integrated Development Environment (IDE).

Programming Errors

Syntax:

Semantics: The program fails to satisfy its operational specifications.
Run-time errors:

Logic errors:

Debugging: