Introduction to Computers

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What is a computer?

What is a computer?

- Retrieve and store

- Process

- Input and output

Types of computers

- Microcomputer (personal)
- Minicomputer (server)
- Mainframe computer (server rack)
- Supercomputer (multiple racks)

https://en.wikipedia.org/wiki/Classes_of_computers

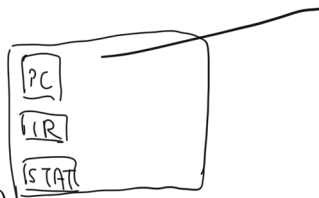# Hardware vs Software

Software Hierarchy

- User Applications (high-level)

- Operating System

- Device Drivers

- Hardware (lowest level)

Computer Hardware

Central Processing Unit (CPU)

Memory
- Read Only Memory (ROM)
- Random Access Memory (RAM)

Storage (e.g. Hard Disk, DVD)

Input (e.g. mouse, keyboard)

Output (e.g. display, printer)

Communication (e.g Wi-Fi devices)

Bus

Computer Hardware

(Can be in/outside CPU)

Clock
- synchronization (cycles)
- determines speed (frequency)

CPU
- Control Unit
- Registers

    Program Counter (PC)
    Instruction Register (IR)
    Condition Code Register (status)
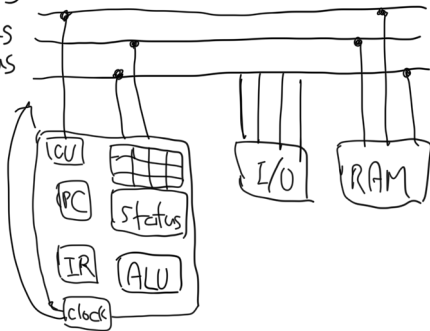
- Arithmetic + Logic (ALU)

Bus
- Control
- Address
- Data
- Serial vs Parallel

CU

PC   Status

IR   ALU

clock

I/O   RAM

PC. 0

16 MHz

Execution Cycle

Fetch

Decode

Execute

Store/retrieve

Classification: RISC vs CISC

Complex Instruction Set Computer (CISC)

- instructions range in complexity
- instructions can take several clock cycles

Reduced Instruction Set Computer (RISC)

- very simple instructions
- minimizes number of cycles per instruction

Classification: Princeton vs Harvard

Princeton Architecture (a.k.a. von Neumann)

- Developed by John von Neumann

- Program is stored in data memory

- Slower but cheaper

Harvard Architecture

- Memory for programs is separate from data

- Two separate buses (simultaneous instruction fetch and data access)

- Faster but at costs

Main Bus Types

Memory mapped I/O

- Single bus between CPU and others
- Address on the address bus eventually translates to either memory location or I/O device
- e.g. room 623 vs room 249

    6th floor, door 23
    2nd floor, door 49
    first digit distinguishes between types of location (floor)

Port I/O

- CPU to memory bus is separate from CPU to peripherals
- separate sets of instructions
- possibly different size of buses
- each bus is still composed of control, address, and data

Memory Hierarchy

Highest level (farthest from the CPU, slowest access)

- Tape
- Disk
- Memory
- Cache
- Registers

Lowest level (closest to the CPU, fastest access)

Computer Organization and Architecture

Computer architecture refers to those attributes of a system visible to a programmer or, put another way, those attributes that have a direct impact on the logical execution of a program.
(Also known as ISA)

Computer organization refers to operational units and their interconnections that realize the architectural specifications.

From page 2 of Computer Organization and Architecture by W. Stallings

Moore's Law

Relation to other courses

CSC 110 - basic programming skills

CSC230 - computer architecture at functionality level

CSC350 - how to design processors

CSC355 - how to design digital logic elements

CSC360 - how operating systems manage software execution