

# Essentials of Computer Organization and Architecture IN 2300

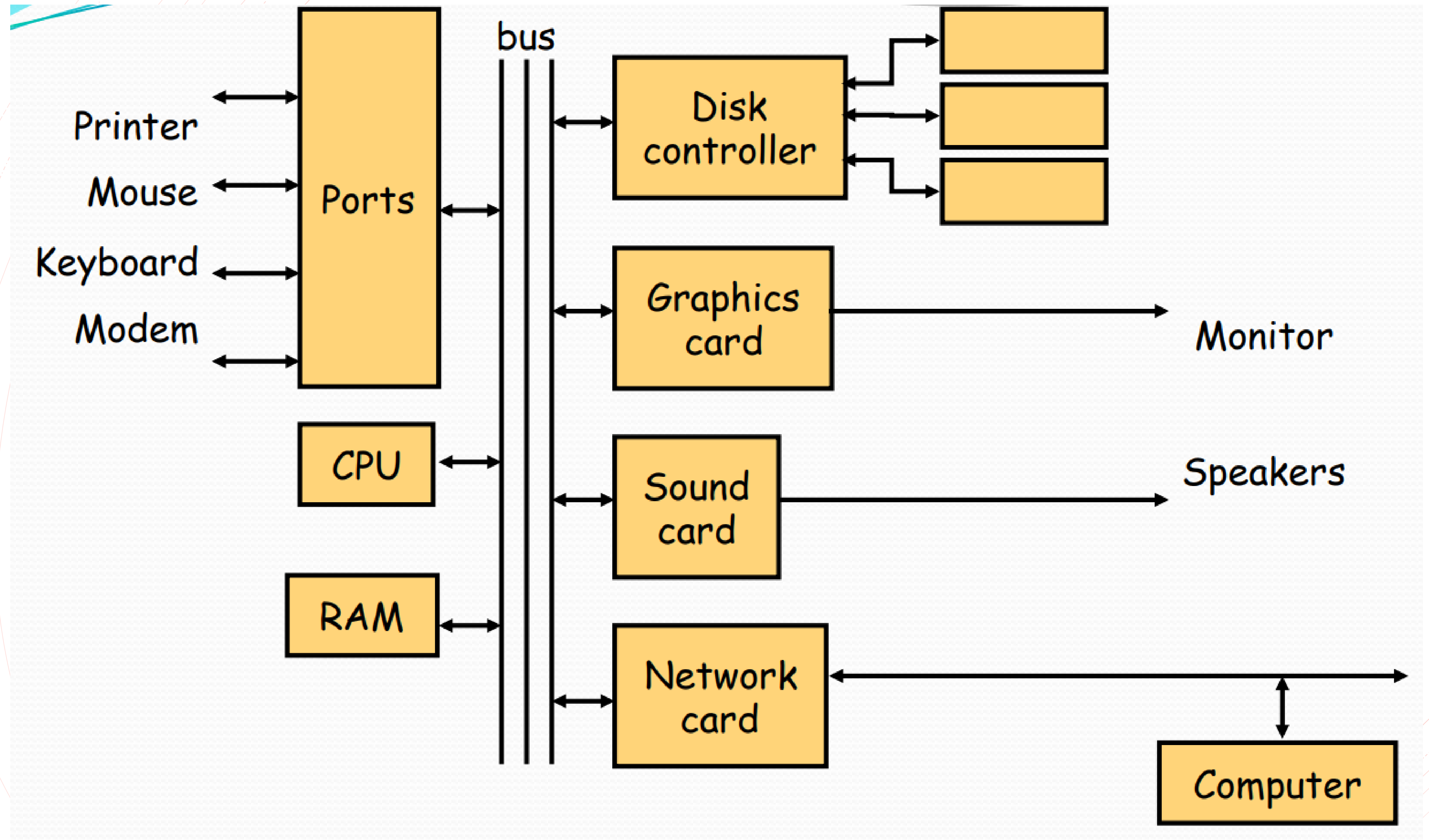
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# Computer Operations

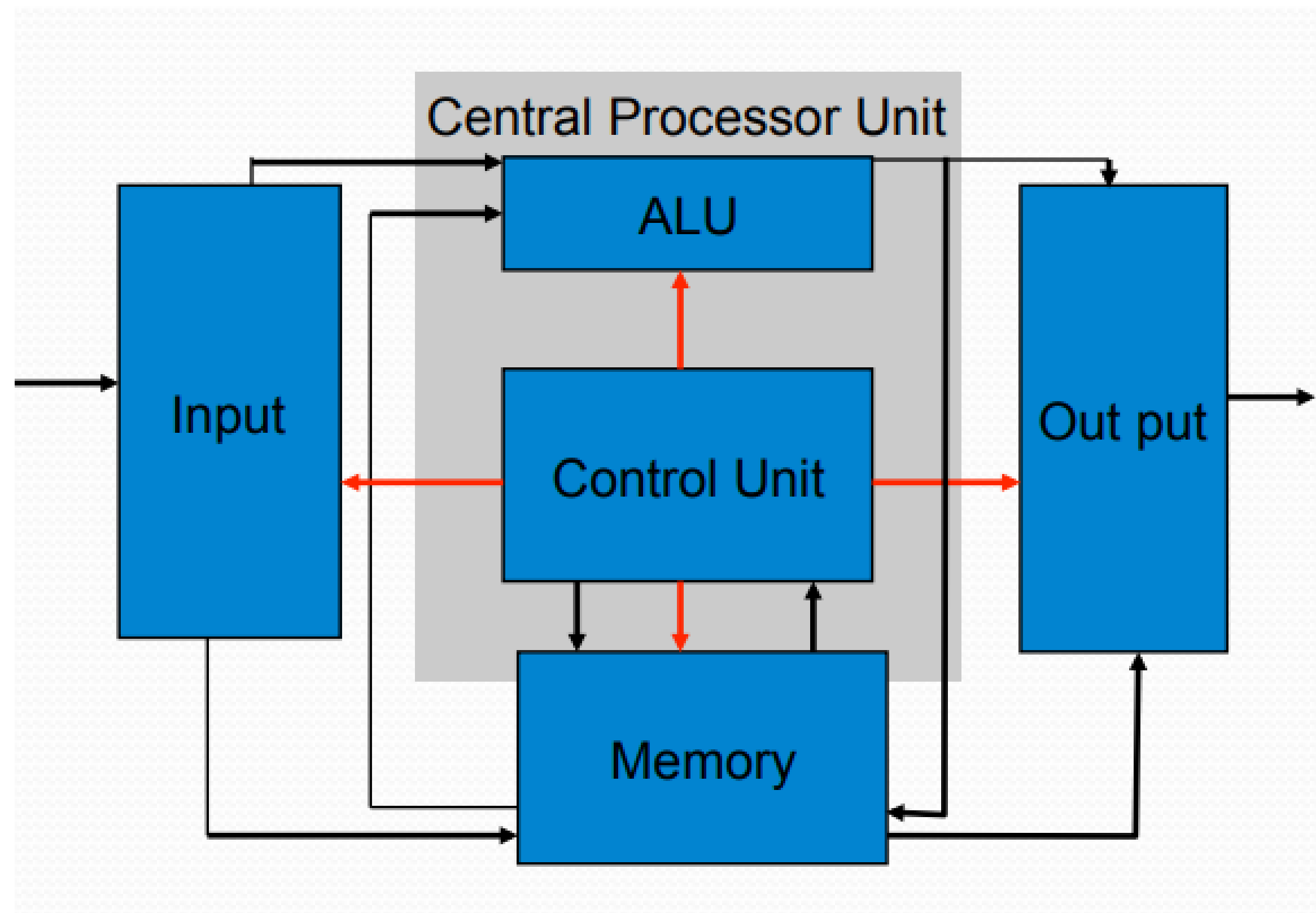
- Computer is an electronic device capable of doing arithmetic calculations faster
- It serves different purposes to different people
- Computer is a machine capable of solving problems and manipulating data
  - Accepts data, processes the data by doing some mathematical and logical operations and gives us the desired output.
- Some time it is a monitoring and controlling device
- Can see a computer as a device that transforms data
  - Accept data
  - Store data
  - Process data as desired
  - Retrieve the stored data
  - Print the result in desired format





# Basic Computer Organization

- Every computer contains five essential elements or units:
  - Arithmetic and Logic Unit (ALU)
  - Memory
  - Control Unit
  - Input Unit
  - Output Unit



- Memory
  - Main memory (Including cache)
  - Auxiliary storage
- Control Unit
  - Directs the operations of all units

# Outline Components

## ■ Input

**This is the process of entering data and programs in to the computer system. Computer takes as inputs raw data and performs some processing giving out processed data.**

**Therefore, the input unit takes data from us to the computer in an organized manner for processing**

## Outline Components (Cont.)

- **Storage (Memory):**

The process of saving data and instructions permanently is known as storage (Memory). Data has to be fed into the system before the actual processing starts. It provides space for storing data and instructions.

- All data and instructions are stored here before and after processing.
- Intermediate results of processing are also stored here.



## Outline Components (Cont.)

- **Processing:**

The task of performing operations like arithmetic and logical operations is called processing. The Central Processing Unit (CPU) takes data and instructions from the storage unit and makes all sorts of calculations based on the instructions given and the type of data provided. It is then sent back to the storage unit.

## Outline Components (Cont.)

- **Output:**

This is the process of producing results from the data for getting useful information. Similarly the output produced by the computer after processing must also be kept somewhere inside the computer before being given to you in human readable form. Again the output is also stored inside the computer for further processing.



## Outline Components (Cont.)

- **Control:**

**The manner how instructions are executed and the above operations are performed. Controlling of all operations like input, processing and output are performed by control unit. It takes care of step by step processing of all operations inside the computer.**

- Computers have two kinds of sub systems:
  1. Hardware, consisting of its physical devices (CPU, memory, bus, storage devices, ...)
  2. Software, consisting of the programs it has (Operating system, applications, utilities, ...)
- Central Processing Unit (CPU):
  - the “brain” of the machine
  - location of circuitry that performs arithmetic and logical ML statements
  - measurement: speed (roughly) in megahertz (millions of clock-ticks per second) or Gigahertz
  - examples: Intel Pentium, AMD K6, Motorola PowerPC, Sun SPARC,



- Memory technology – DRAM
  - Bits stored as charge in capacitors
  - Charges leak
  - Need refreshing even when powered
  - cycle time traditionally longer than the access time
  - Simpler construction
  - Smaller per bit
  - Less expensive
  - Need refresh circuits
  - Slower
- “main” memory, which is fast, but volatile...
- analogous to a person’s short-term memory.

- many tiny “on-off” switches: for convenience
  - “on” is represented by 1, “off” by 0.
- each switch is called a binary digit, or bit.
  - 8 bits is called a byte.
  - $2^{10}$  bytes = 1024 bytes is called a kilobyte (1K)
  - $2^{20}$  bytes is called a megabyte (1M).



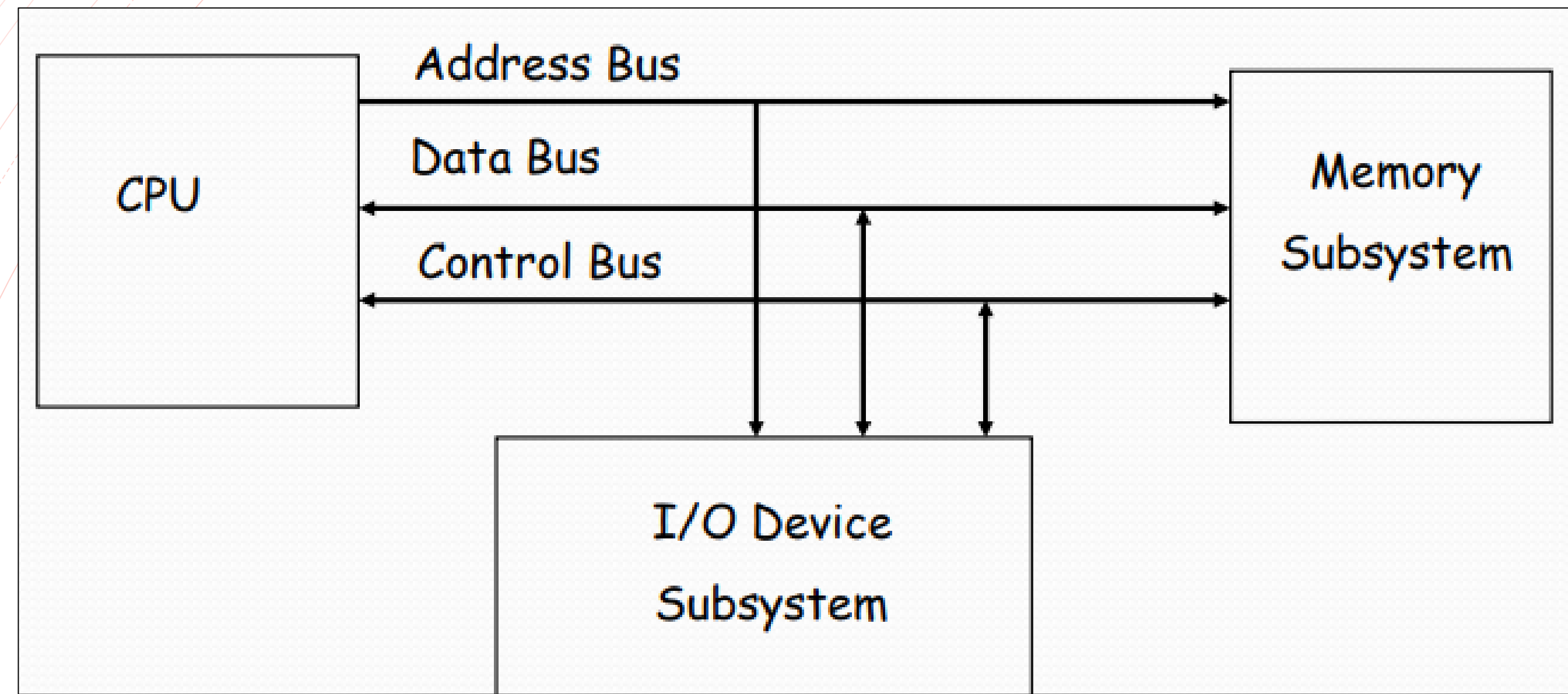
- **Secondary Memory (Disk):**
- **Stable storage using magnetic or optical media.**
- **Analogous to a person's long-term memory.**
- **Larger capacities**
- **Slower to access than RAM.**
- **Examples:**
  - **Floppy disk (measured in kilobytes)**
  - **Hard disk (measured in GB, TB)**
  - **CD-ROM (measured in megabytes)**

- **The Bus:**
  - **Connects CPU to other hardware devices.**
  - **Analogous to a person's spinal cord.**
  - **Speed measured in megahertz (like the CPU), but typically much slower than the CPU...**



# Interconnected Components of Computer

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- The CPU (ALU, Control Unit, Registers)
- The Memory Subsystem (Stored Data)
- The I/O subsystem (I/O devices)

**Questions?**