Background Part 2 (Computer Organization & Operating System)

Computer Memory Organization

Understanding how different devices are organized within a computer is key to knowing how data is managed and accessed. This includes the Central Processing Unit (CPU), various types of memory, and their interactions.

DESIRABLE FEATURE OF MEMORIES

- **Low Access Time** - Fast retrieval of data.
- **Low Cost -** Affordable for large-scale use.
- **High Capacity -** Ability to store large amounts of data.

Since no single memory type can perfectly balance all of these factors, multiple types are used in a computer system.
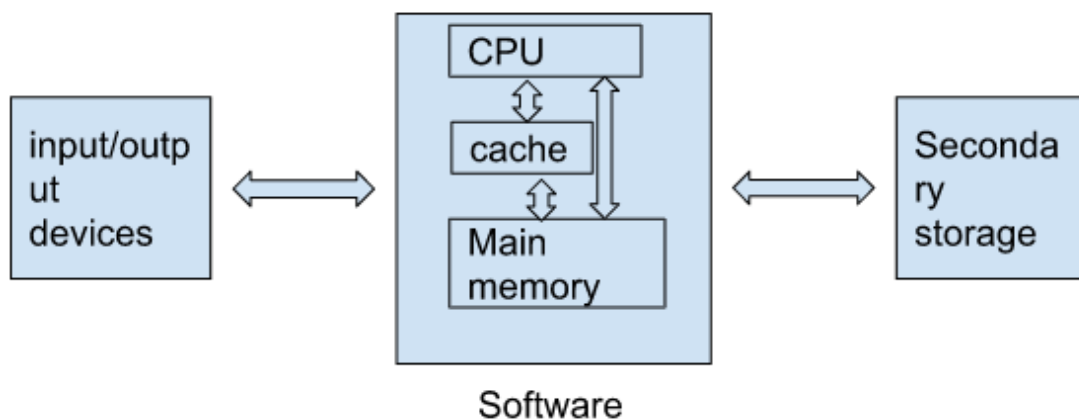
Types of Memory:

1. **Cache Memory**
   - Very fast access time.
   - High cost.
   - Small storage capacity.
   - Volatile (data is lost when the power is off).
2. **Main Memory (RAM)**
   - Moderate speed and cost.
   - Average storage capacity.
   - Volatile (data is lost when power is off).
3. **Hard Disk**

- Large storage capacity.
- Low cost.
- Slower access time.
- Permanent storage (data is retained even when the power is off).

Volatile vs. Non-Volatile Memory

- **Volatile Memory**: Includes cache memory and RAM. Data is lost when the computer is turned off.
- **Non-Volatile Memory**: Includes secondary storage like hard disks. Data remains even when the computer is powered off.

Shopkeeper's Store Analogy

Imagine a shopkeeper organizing their store:

- **Front Counter (Cache Memory)**: The most frequently sold items are placed at the front counter for quick access, much like how cache memory holds data the CPU accesses frequently.
- **Shop Area (Main Memory)**: Items used often, but not as frequently as those at the front counter, are stored here, just like how RAM stores data in use by the computer.
- **Storage Room (Secondary Storage)**: Rarely needed items are kept here. If a customer requests an item not found at the front counter or in the shop area, the shopkeeper retrieves it from the storage room. Similarly, the operating system fetches data from secondary storage when it's not in cache or RAM.

Operating System's Role

The Operating System (OS) manages data movement between the CPU, cache, main memory, and secondary storage. The OS ensures the CPU gets the data it needs as quickly as possible. If the data isn't in the cache or RAM, the OS retrieves it from secondary storage and loads it into main memory for faster access the next time.