Computer Fundamentals

Unit-III

Mrs. Kiran Bala Dubey

Assistant Professor

Department of Computer Science

Govt. N. P. G. College of Science,

Raipur

Contents

- **Central Processing Unit**
  - Microprocessor
  - Control Unit
  - ALU
  - Registers
  - Buses
  - Main Memory RAM
  - ROM
- **Storage device**
  - Primary & Secondary Storage
  - Data Storage & Retrieval Methods- Sequential, Direct & Indexed Sequential
  - Tape storage & retrieval methods
- **Direct access storage & microcomputers**
  - Hard disk
  - Disk cartridges
  - DASD
  - Optical disks
  - CD ROM

The central processing unit (CPU) consists of six main components:
- **control unit (CU)**
- **arithmetic logic unit (ALU)**
- **registers**
- **Buses**
- **Cache**
- **clock**

All the components work together to allow processing and system control.

- **Cache** is a small amount of high-speed random access memory (RAM) built directly within the processor. It is used to temporarily hold data and instructions that the processor is likely to reuse. This allows for faster processing, as the processor does not have to wait for the data and instructions to be fetched from the RAM.

- The CPU contains a **clock** which, along with the CU, is used to coordinate all of the computer's components. The clock sends out a regular electrical pulse which synchronizes (keeps in time) all the components. The frequency of the pulses is known as **clock speed**. Clock speed is measured in **hertz (Hz)**.

Microprocessor

- A microprocessor, also simply called a processor or CPU is a computer processor that is implemented on a single integrated circuit (IC).

- The microprocessor is a multipurpose, clock-driven, register-based, digital integrated circuit that accepts binary data as input, processes it according to instructions stored in its memory, and provides results as output.

- Microprocessors contain both combinational logic and sequential digital logic.

- Microprocessors operate on numbers and symbols represented in the binary number system.

Control Unit

- The control unit (CU) is a component of a computer's central processing unit (CPU) that directs the operation of the processor.

- It tells the computer's memory, arithmetic and logic unit and input and output devices how to respond to the instructions that have been sent to the processor.

- A control unit (CU) is an integrated circuit in a processor that controls the input and output. It receives instructions from a program, then passes them to the arithmetic logic unit (ALU). The ALU performs the appropriate calculations and sends the resulting values back to the control unit. The control unit sends these values to the corresponding program as output.

- A typical control unit is comprised of several logic gates and includes two important components:
  - Program Counter (PC)
  - Instruction Register (IR)

- The program counter loads individual instructions from memory and stores them sequentially. The instruction register decodes these instructions and converts them to commands for the CPU. After each instruction, the CU increments the program counter and fetches the next instruction.

Registers

- A register is the smallest storage units built inside the processor for quick store & transfer of data & instruction necessary for the processor. The CPU can directly access the register for quick actions. They store operands or instruction that is currently being used by the processor.

- Register are used to quickly accept, store, and transfer data and instructions that are being used immediately by the CPU.

There are various types of Registers those are used for various purpose. Some of them are as follows-

- **Data Register Or DR:**

It temporarily stores the data or operand that is currently being processed by the processor.

- **Accumulator Register or AR:**

This register is used to accumulate the operands used by the ALU during processing

- **Program Counter or PC:**

This register stores the address of the next instruction to be fetched for execution.

- **Instruction Register or IR:**

This register stores the instructions ready to be fetched by the control unit for processing.

- **Memory Address Register or MAR**

It stores the address location of the memory where the CPU wants to read or write some data.

- **Memory Buffer Register or MBR:**

This is a buffer register for any data or instruction going from or to any memory. It holds the instruction/data before sending it to IR/ AR respectively.

ALU

- An arithmetic logic unit (ALU) is a digital circuit used to perform arithmetic and logic operations. It represents the fundamental building block of the central processing unit (CPU) of a computer.

- The main functions of the ALU are to do arithmetic and logic operations, including bit shifting operations. These are essential processes that need to be done on almost any data that is being processed by the CPU.

Buses

- A bus is a high-speed internal connection. Buses are used to send control signals and data between the processor and other components.

- Three types of bus are used -

- **Address bus** - carries memory addresses from the processor to other components such as primary storage and input/output devices. The address bus is unidirectional.

- **Data bus -** carries the data between the processor and other components. The data bus is bidirectional.

- **Control bus -** carries control signals from the processor to other components. The control bus also carries the clock's pulses. The control bus is unidirectional.

- Main Memory (RAM)

- ROM

Primary & Secondary Storage

- **Primary / Main memory:**
  Primary memory is the computer memory that is directly accessible by CPU. It holds the data and instructions that the processor is currently working on.

The memory devices used for primary memory are semiconductor memories. Examples: RAM, ROM, Cache memory, Registers, etc.

- **Secondary Memory / Mass Storage:**
  The contents of the secondary memory first get transferred to the primary memory and then are accessed by the processor, this is because the processor does not directly interact with the secondary memory.

The secondary memory devices are magnetic and optical memories. Examples: Hard Disk, Floppy Disk, Magnetic Tapes, etc.

Data Storage & Retrieval Methods- Sequential, Direct & Indexed Sequential

- **Sequential access**
  - Storing and sorting in contiguous block within files on tape or disk is called as **sequential access**.
  - In sequential access, all records are stored in a sequential order. The records are arranged in the ascending or descending order of a key field.
  - Sequential file search starts from the beginning of the file and the records can be added at the end of the file.
  - In sequential file, it is not possible to add a record in the middle of the file without rewriting the file.

- **Advantages of sequential access**

  It is simple to program and easy to design.
  - Sequential file is best use if storage space.

- **Disadvantages of sequential access**
  - It is time consuming process.
  - It has high data redundancy.
  - Random searching is not possible.

Direct access

- Direct access file is also known as random access or relative file organization.
- In direct access file, all records are stored in direct access storage device (DASD), such as hard disk. The records are randomly placed throughout the file.
- The records does not need to be in sequence because they are updated directly and rewritten back in the same location.
- This file organization is useful for immediate access to large amount of information. It is used in accessing large databases.
- It is also called as hashing.

Direct access

- **Advantages of direct access**

  Direct access file helps in online transaction processing system (OLTP) like online railway reservation system.

  - In direct access file, sorting of the records are not required.
  - It accesses the desired records immediately.
  - It has better control over record allocation.

- **Disadvantages of direct access**

  Direct access file does not provide back up facility.

  - It is expensive.
  - It has less storage space as compared to sequential file.

Indexed Sequential

- Indexed sequential access file combines both sequential file and direct access file organization.

- In indexed sequential access file, records are stored randomly on a direct access device such as magnetic disk by a primary key.

- The data can be access either sequentially or randomly using the index. The index is stored in a file and read into memory when the file is opened.

Indexed sequential access

- **Advantages of Indexed sequential access**
  In indexed sequential access file, sequential file and random file access is possible.
    - It accesses the records very fast if the index table is properly organized.
    - The records can be inserted in the middle of the file.
    - It provides quick access for sequential and direct processing.
    - It reduces the degree of the sequential search.

- **Disadvantages of Indexed sequential access**
  Indexed sequential access file requires unique keys and periodic reorganization.
    - Indexed sequential access file takes longer time to search the index for the data access or retrieval.
    - It requires more storage space.
    - It is expensive because it requires special software.
    - It is less efficient in the use of storage space as compared to other file organizations.
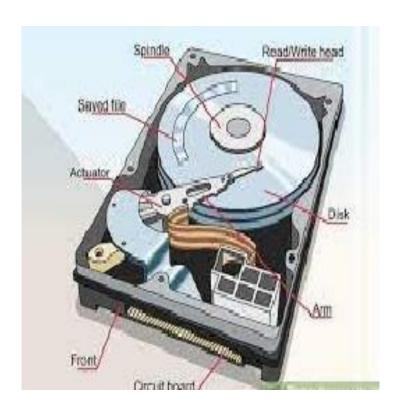
Tape storage & retrieval methods

- A tape drive is a data storage device that reads and writes data on a magnetic tape.

- Magnetic tape data storage is a system for storing digital information on magnetic tape using digital recording.

- Tape was an important medium for primary data storage in early computers. Modern magnetic tape is most commonly packaged in cartridges and cassettes.

- A tape drive provides sequential access storage.

Direct access storage

Hard disk

- A hard disk drive (HDD), hard disk, hard drive, or fixed disk is an electro-mechanical data storage device that stores and retrieves digital data using magnetic storage and one or more rigid rapidly rotating platters coated with magnetic material. The platters are paired with magnetic heads, usually arranged on a moving actuator arm, which read and write data to the platter surfaces.

- Data is accessed in a random-access manner, meaning that individual blocks of data can be stored and retrieved in any order.

- HDDs are a type of non-volatile storage, retaining stored data even when powered off

DASD

- A direct-access storage device (DASD) is a secondary storage device in which each physical record has a discrete location and a unique address such as hard disk drives, optical drives and most magnetic storage devices.

- The "direct access" means that all data can be accessed directly in about the same amount of time rather than having to progress sequentially through the data.

Optical disks

- An optical disk is primarily used as a portable and secondary storage device.

- An optical disc is an electronic data storage medium that uses optical storage techniques and technology to read and write data. It is a computer storage disk that stores data digitally and uses laser beams to read and write data.

- Compact disks (CD), digital versatile/video disks (DVD) and Blu-ray disks are currently the most commonly used forms of optical disks.

CD-ROM

- Stands for "Compact Disc Read-Only Memory." A CD-ROM is a CD that can be read by a computer with an optical drive. The "ROM" part of the term means the data on the disc is "read-only," or cannot be altered or erased.