Secondary Memory

- RAM is expensive and has a limited storage capacity. Since it is a volatile memory, it cannot retain information after the computer is powered off. Thus, in addition to primary memory, an auxiliary or secondary memory is required by a computer. The secondary memory is also called the storage device of computer.

- In comparison to the primary memory, the secondary memory stores much larger amounts of data and information (for example, an entire software program) for extended periods of time. The data and instructions stored in secondary memory must be fetched into RAM before processing is done by CPU.

- Magnetic tape drives, magnetic disk drives, optical disk drives and magneto-optical disk drives are the different types of storage devices.

ACCESS TYPES OF STORAGE DEVICES

- The information stored in storage devices can be accessed in two ways—
    - 1. **Sequential access**
    - 2. **Direct access**
- Sequential Access Devices:
    - Sequential access means that computer must run through the data in sequence, starting from the beginning, in order to locate a particular piece of data.
    - Magnetic tape is an example of sequential access device. Let us suppose that magnetic tape consists of 80 records. To access the 25threcord, the computer starts from first record, then reaches second, third etc. until it reaches the 25th record.
    - Sequential access devices are generally slow devices.

Abhinav Sharma, Assistant Professor
(Computer Applications)
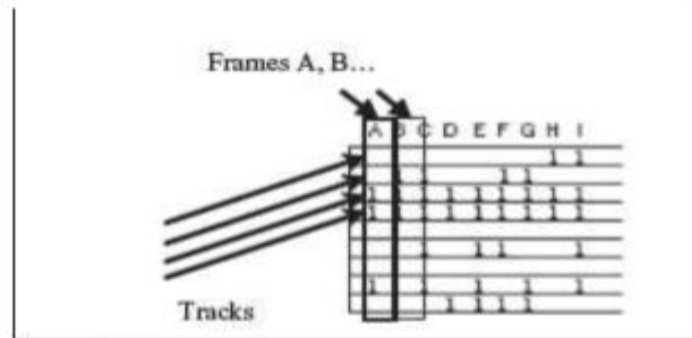
ACCESS TYPES OF STORAGE DEVICES

- Direct Access Devices:
  - Direct access devices are the ones in which any piece of data can be retrieved in a non-sequential manner by locating it using the data's address. It accesses the data directly, from a desired location.
  - **Magnetic disks and optical disks are examples of direct access devices.** There is no predefined order in which one can read and write data from a direct access device.
  - In a magnetic disk consisting of 80 records, to access the 25th record, the computer can directly access the 25th record, without going past the first 24 records.
  - Based on access, magnetic tapes are sequential access devices, and, magnetic disks, optical disk and magneto-optical disks are direct access devices.

Abhinav Sharma, Assistant Professor
(Computer Applications)

Magnetic Tape

- Magnetic tape is a plastic tape with magnetic coating.
- It is a storage medium on a large open reel or in a smaller cartridge or cassette (like a music cassette). Magnetic tapes are cheaper storage media.
- They are durable, can be written, erased, and re-written.
- Magnetic tapes are sequential access devices, which mean that the tape needs to rewind or move forward to the location where the requested data is positioned in the magnetic tape. Due to their sequential nature, magnetic tapes are not suitable for data files that need to be revised or updated often.
- They are generally used to store back-up data that is not frequently used or to transfer data from one system to other.

Abhinav Sharma, Assistant Professor
(Computer Applications)

Working of Magnetic Tape

- Magnetic tape is divided **horizontally into tracks (7 or 9) and vertically into frames**. A frame stores one byte of data, and a track in a frame stores one bit. Data is stored in successive frames as a string with one data (byte) per frame.

Frames A, B…

A B C D E F G H I

Tracks

Abhinav Sharma, Assistant Professor
(Computer Applications)

Working of Magnetic Tape

- Data is recorded on tape in the form of blocks, where a block consists of a group of data also called as records. Each block is read continually. There is an Inter-Record Gap (IRG) between two blocks that provides time for the tape to be stopped and started between records.

Abhinav Sharma, Assistant Professor
(Computer Applications)

Working of Magnetic Tape

- Magnetic tape is mounted on a magnetic tape drive for access. The magnetic tape moves on tape drive from the supply reel to take-up reel, with its magnetic coated side passing over the read/write head.

- Tapes are categorized based on their width - ¼ inch, ½ inch, etc.

- The storage capacity of the tape varies greatly. A 10–inch diameter reel of tape which is 2400 feet long can store up to 180 million characters.

Abhinav Sharma, Assistant Professor (Computer Applications)

Magnetic Disks

- Magnetic disk is a **direct access secondary storage device**. It is a thin plastic or metallic circular plate coated with magnetic oxide and encased in a protective cover. Data is stored on magnetic disks as magnetized spots.

Abhinav Sharma, Assistant Professor
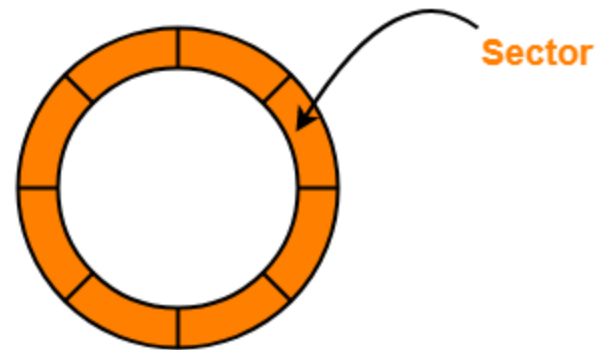(Computer Applications)

Magnetic Disk Architecture

- The entire disk is divided into **platters**.

- Each platter consists of concentric circles called as **tracks**.

- These tracks are further divided into **sectors** which are the smallest divisions in the disk.
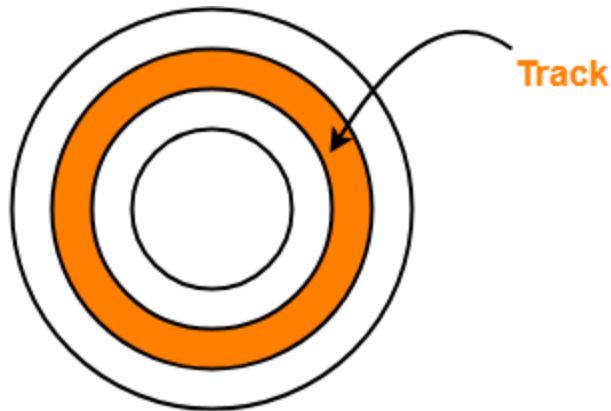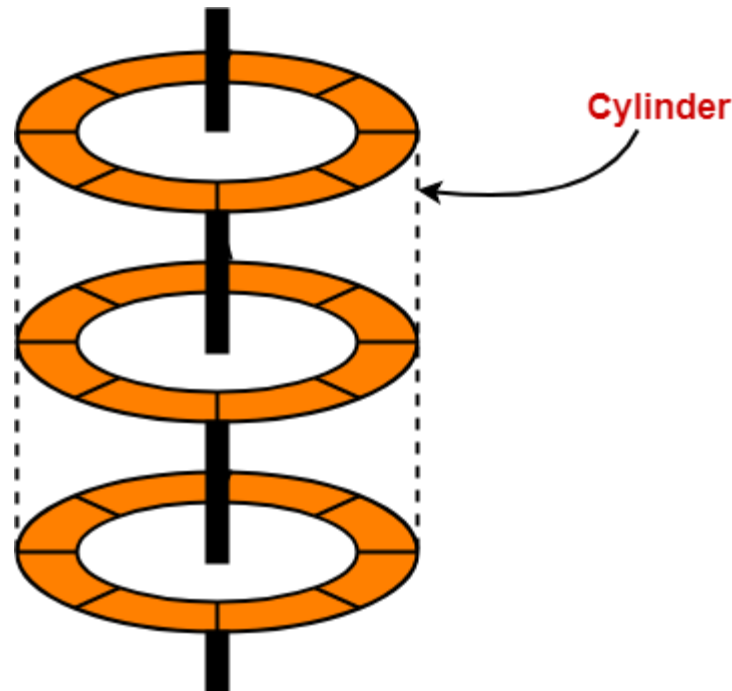
Track

Sector

Disk divided into tracks

Track divided into sectors

Abhinav Sharma, Assistant Professor
(Computer Applications)

Magnetic Disk Architecture

- A **cylinder** is formed by combining the tracks at a given radius of a disk pack.

Abhinav Sharma, Assistant Professor
(Computer Applications)

Magnetic Disk Architecture

- There exists a mechanical arm called as **Read / Write head**.

- It is used to read from and write to the disk.

- Head has to reach at a particular track and then wait for the rotation of the platter.

- The rotation causes the required sector of the track to come under the head.

- Each platter has 2 surfaces- top and bottom and both the surfaces are used to store the data.

- Each surface has its own read / write head.

Abhinav Sharma, Assistant Professor (Computer Applications)

Magnetic Disk Architecture

Abhinav Sharma, Assistant Professor
(Computer Applications)

Disk Performance Parameters

Factors Affecting Disk Performance

- Seek time
- Rotational Latency
- Data Transfer Rate
- Controller Overhead
- Queuing Delay

Abhinav Sharma, Assistant Professor
(Computer Applications)
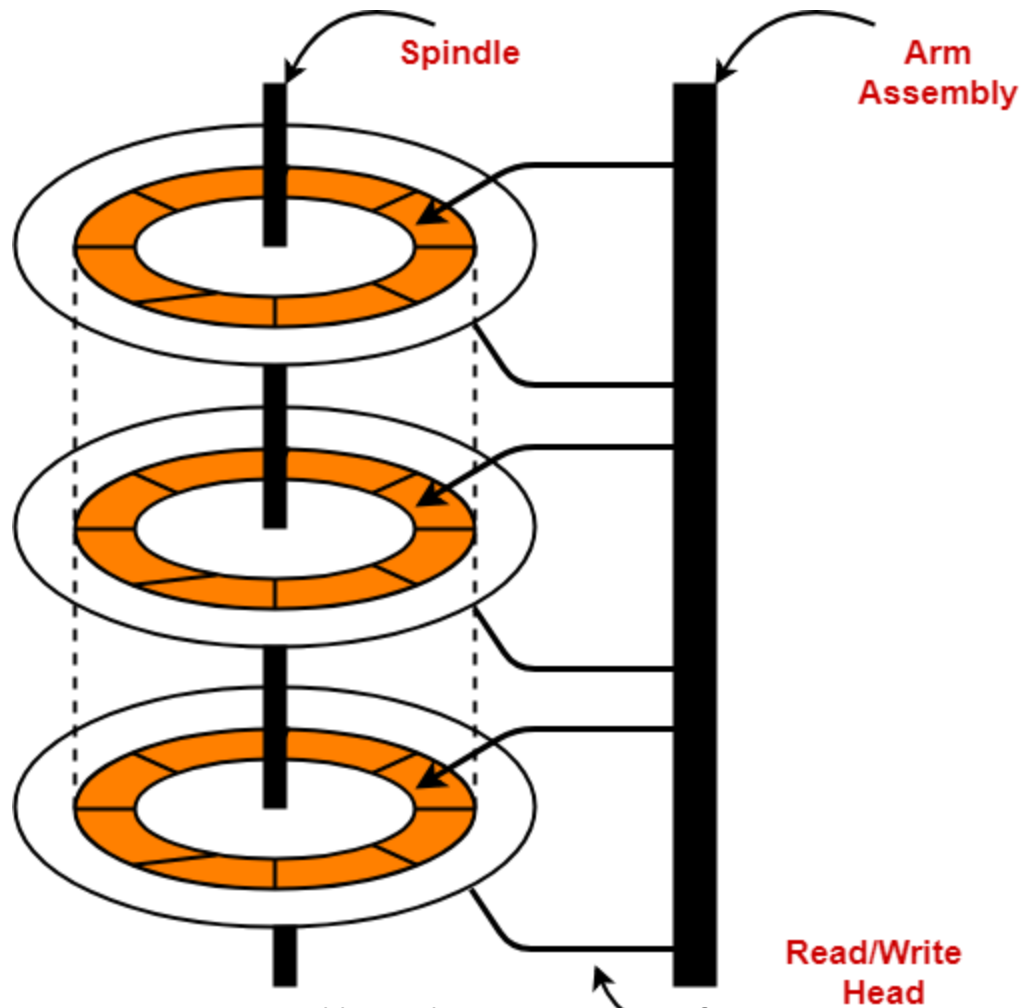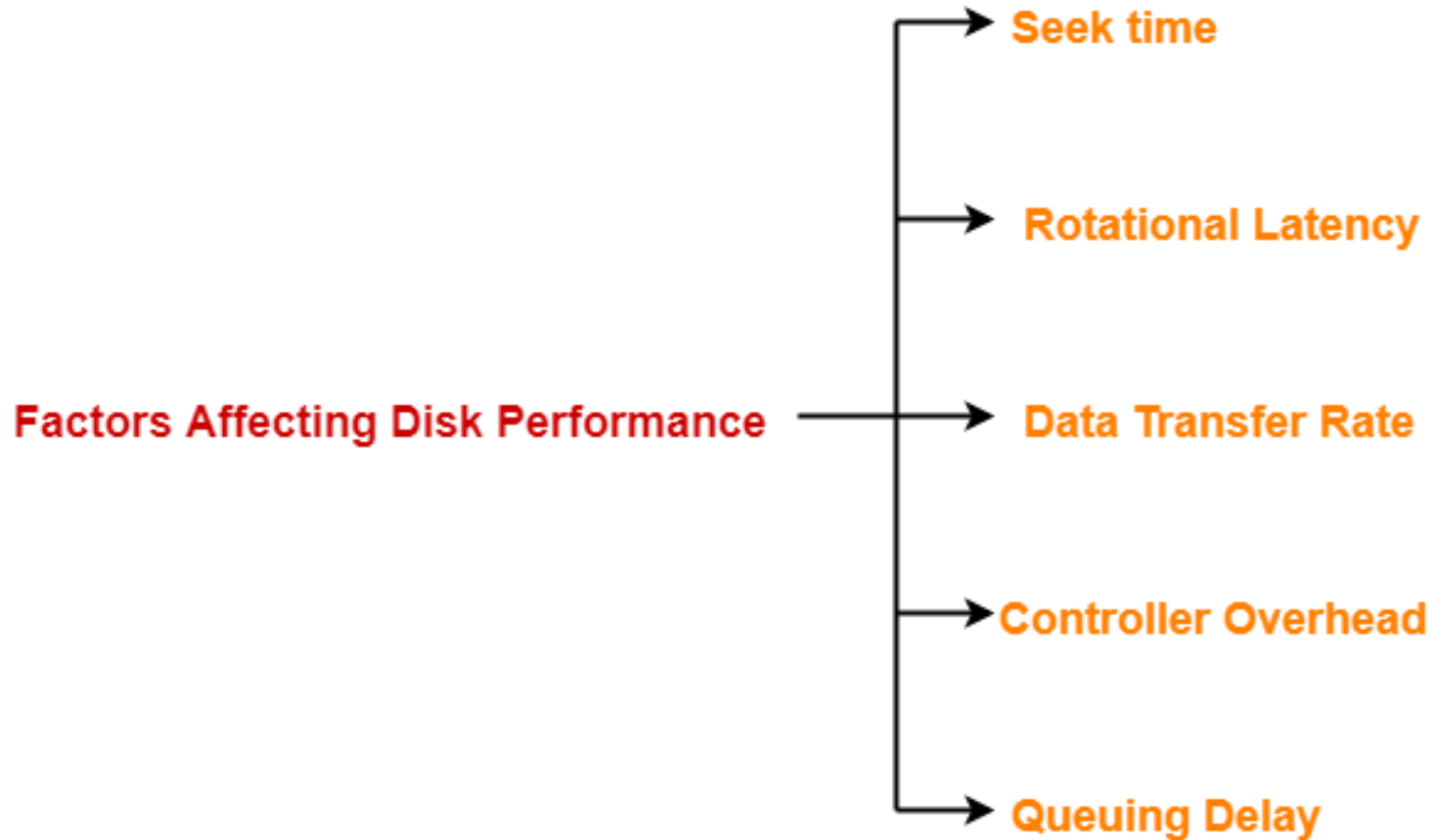
Disk Performance Parameters

- **<u>Seek Time-</u>**
  - The time taken by the read / write head to reach the desired track is called as **seek time**.
  - It is the component which contributes the largest percentage of the disk service time.
  - The lower the seek time, the faster the I/O operation.

Abhinav Sharma, Assistant Professor
(Computer Applications)

Disk Performance Parameters

- **Rotational Latency/ Latency Time-**
  - The time taken by the desired sector to come under the read / write head is called as **rotational latency**.
  - It depends on the rotation speed of the spindle.

- **Data Transfer Rate-**
  - The amount of data that passes under the read / write head in a given amount of time is called as **data transfer rate**.
  - The time taken to transfer the data is called as **transfer time**.

Abhinav Sharma, Assistant Professor (Computer Applications)

Disk Performance Parameters

- **<u>Controller Overhead-</u>**
  - The overhead imposed by the disk controller is called as **controller overhead**.
  - Disk controller is a device that manages the disk.

- **<u>Queuing Delay-</u>**
  - The time spent waiting for the disk to become free is called as **queuing delay**.

Abhinav Sharma, Assistant Professor
(Computer Applications)

- Consider a hard disk with:
  4 surfaces
  64 tracks/surface
  128 sectors/track
  256 bytes/sector

Q:1 What is the capacity of the hard disk?

Abhinav Sharma, Assistant Professor
(Computer Applications)

- Disk capacity = surfaces * tracks/surface * sectors/track * bytes/sector
  Disk capacity = 4 * 64 * 128 * 256
  Disk capacity = 8 MB

Abhinav Sharma, Assistant Professor
(Computer Applications)

- Consider a disk pack with the following specifications- 16 surfaces, 128 tracks per surface, 256 sectors per track and 512 bytes per sector.

Q: What is the capacity of disk pack?

Abhinav Sharma, Assistant Professor (Computer Applications)

- Capacity of disk pack

- = Total number of surfaces x Number of tracks per surface x Number of sectors per track x Number of bytes per sector

- 16 x 128 x 256 x 512 bytes
- $= 2^{28}$ bytes
- = 256 MB

Abhinav Sharma, Assistant Professor
(Computer Applications)