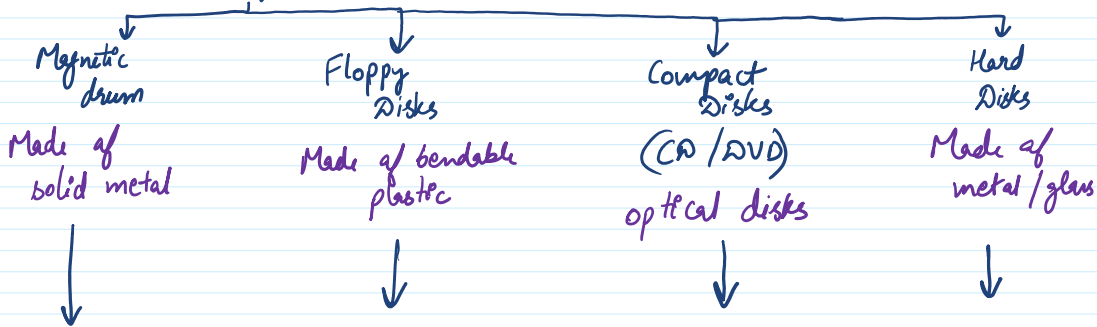Magnetic Disks
          (Hard Disks)

How a Hard Disk Drive (HDD) Works | Magnetic Memory Explain
Majd Goraya

→ In the Magnetic disks the data (bits) are stored
   in the form of a ————

→ Non-volatile storage of information.

→ Rotating platter coated with a thin
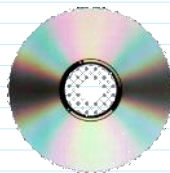   magnetic material.

→ Data is stored as tiny magnets.

→   Types of magnetic devices

Magnetic drum	Floppy Disks	Compact Disks (CD/DVD) optical disks	Hard Disks
Made of solid metal	Made of bendable plastic		Made of metal/glass

62.5 Kbytes

8" floppy disk   5.25"   3.5"
(360kbytes) (800kbytes) (1.2 Mbytes)

4.7"

3.5"

Flash Drives :— (small circuit boards)

Pen-drives   1.8" solid-state disk (SSD)
                              (512 GB)

Organization of data on a Hard Disk :—

Format ←   Sectors

→ Tracks

Cylinder
(Set of tracks/
platters)
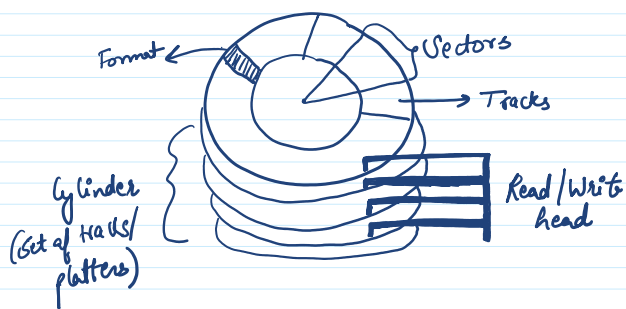
Read/Write
head

HARD DISK

⇒ Hard disk is made up of platters (flat plates
                                     that stores the data)

(typically 1 to 5)

⇒ Each plate has its own read/write head.
          and has two recording surfaces in
                  various sizes.
          (1-8 inches)

⇒ Stack of platter typically rotates at
    a speed of 5400 to 7200 rpm

⇒ Each disk surface is divided into

concentric circles called tracks.
No. of tracks per surface → (1000 – 5000)

⇒ Within each platter data is organized into

    Tracks
    (concentric rings)
           ↓
       Sectors
    (fractions of a ring) $\left(\dfrac{64-200\ sectors}{track}\right)$

    Each sector standard size is
            512 – 2048 bytes
⇒ Sector is the smallest unit that
            can be read or written

    ⇒ Constant no. of sectors per track.
    ⇒ Capacity of all sectors is same.

Three components of the access time in
                    hard disk :

ⓐ Seek Time :—
    → The time required to move the head to
                    the desired track.
    → Average seek time are in the range (8-20 msec)

② Rotational Delay :—
    → Once the head is on the correct track,
      we must wait for the desired sector to rotate under the head.
    → The average delay or latency is the time for half the rotation.
    Example :— 3600 rpm,

            average rotational delay = 0.5 rotation/3600 rpm

                            = 8.3 msec

③ Transfer time :—
    → Total time to transfer a block of data (typically, a sector)
    → Transfer rates are typically 15 MB/sec or more.

Average Access Time =

Seek time + rotational latency +
(T_seek)   (T_Rot.)

data transfer time
(T_trans)

T_{seek} → Time taken by read/write head of
disk to move from one part of
disk to another.

T_{rot} → Time taken by a sector of a disk to
rotate under the read-write heads
of disk drive.

Example:—

⇒ Consider a disk with 32 surfaces, 64 tracks, 512 sectors/pack.
256 bytes of data are stored in a bit serial number in a sector.
The number of bits required to specify a particular sector in a
disk is:

No. of surfaces = 32 = 2^5

Tracks per surface = 64 = 2^6

Sectors per surface = 512 = 2^9

No. of sectors = no. of surfaces × tracks per surface
× sectors per track.

= $2^5 \times 2^6 \times 2^9 = 2^{20}$

⇒ bits required to specify a particular sector

= $\lceil \log_2 2^{20} \rceil = 20$

⇒ Consider a disk with sector size 512 bytes, 2000 tracks per
surface, 64 sectors per track, three double-sided platters,
and average seek time of 10 msec.

① Capacity of the disk?

bytes/track = 512 × 64 = 32K

bytes/surface = 32K × 2000 = 64000K

Bytes/disk = 64000K × 3 × 2
= 384000K

② If the disk platter rotates at 7200 rpm, and one track of data can be transferred per revolution, What is transfer rate?

Transfer rate = Capacity of a track / average rotational delay

$$= 32K /4.5 \text{ msec} = 7711 \text{ k bytes/sec}$$

Interfacing I/O devices is more complex as compared to interfacing memory systems.

① Interfacing Memory Systems } Cache → Static RAM
Main Memory → Dynamic RAM
only these types

② Interfacing I/O devices }
→ Wide variety of peripherals
→ Widely varying speeds
→ Data Transfer rate can be irregular
→ Slower than processor and memory