CS & IT ENGINEERING

COMPUTER ORGANIZATION AND ARCHITECTURE

Magnetic Disk

Lecture No.- 01

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Recap of Previous Lecture

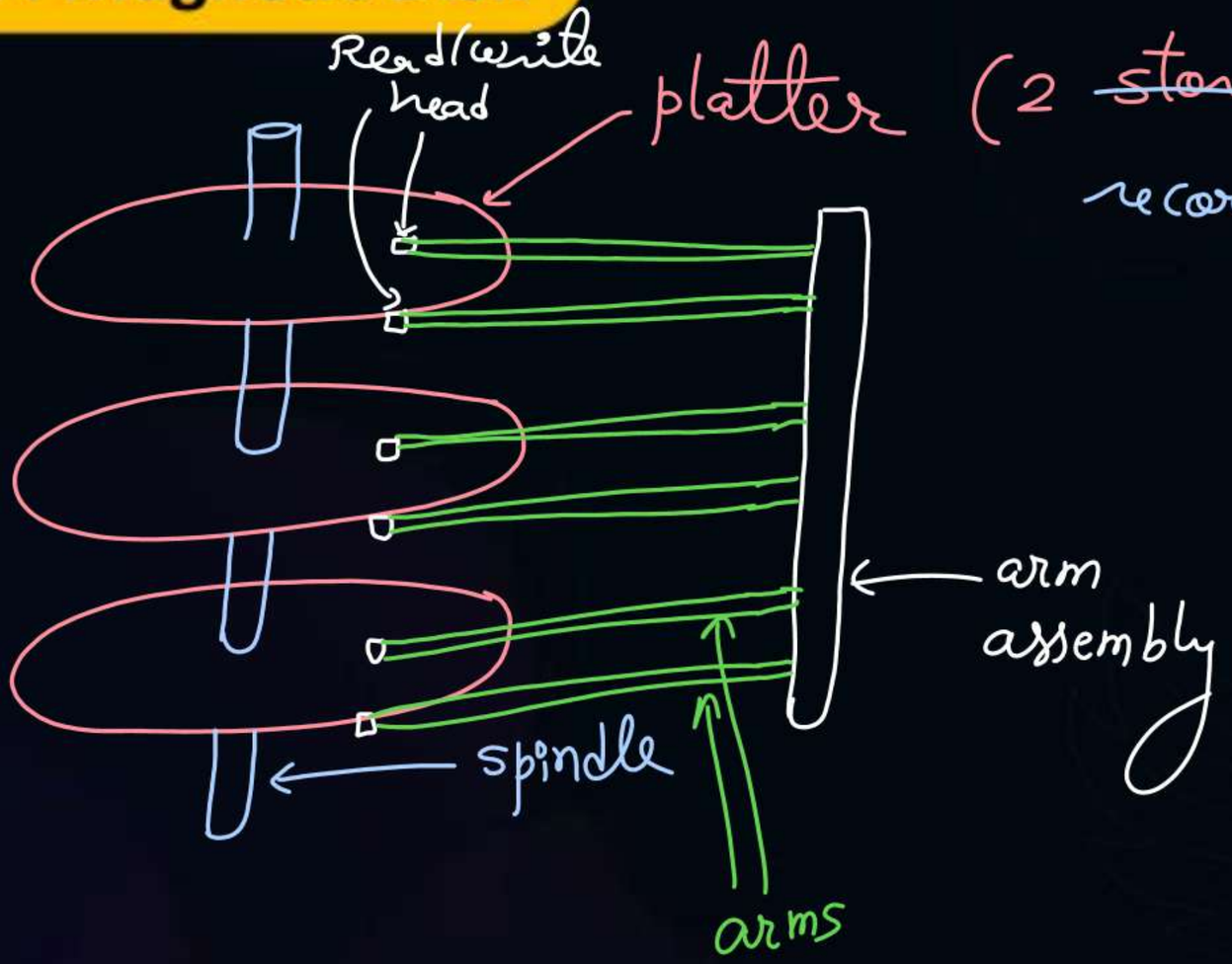
Topic Multilevel Cache

Topic Cache Inclusion Policy

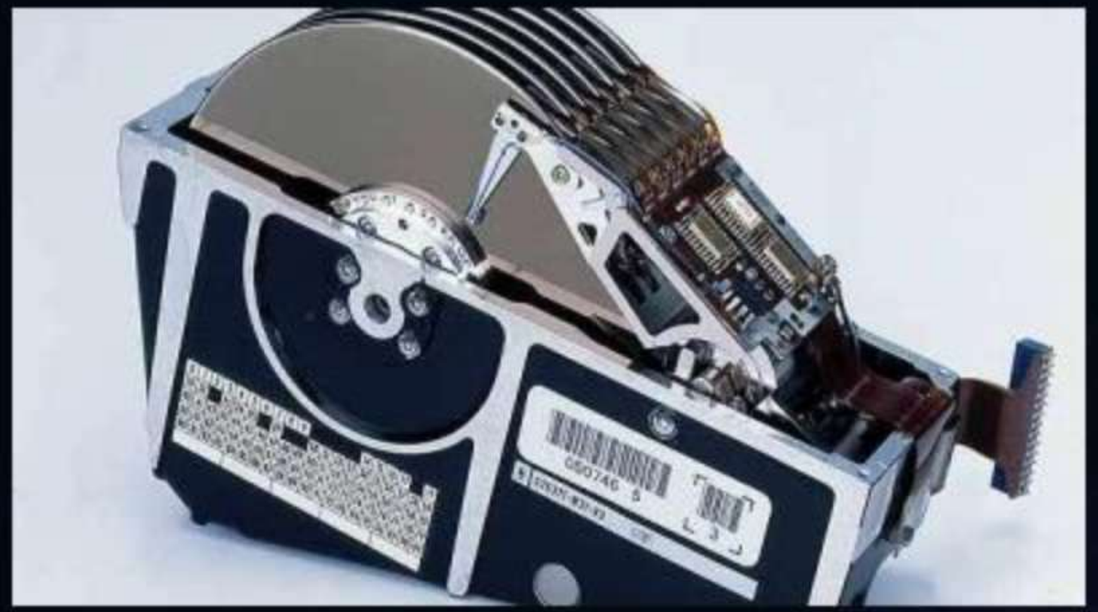
Topics to be Covered

- Topic: Magnetic Disk
- Topic: Disk Capacity
- Topic: Disk Access Time

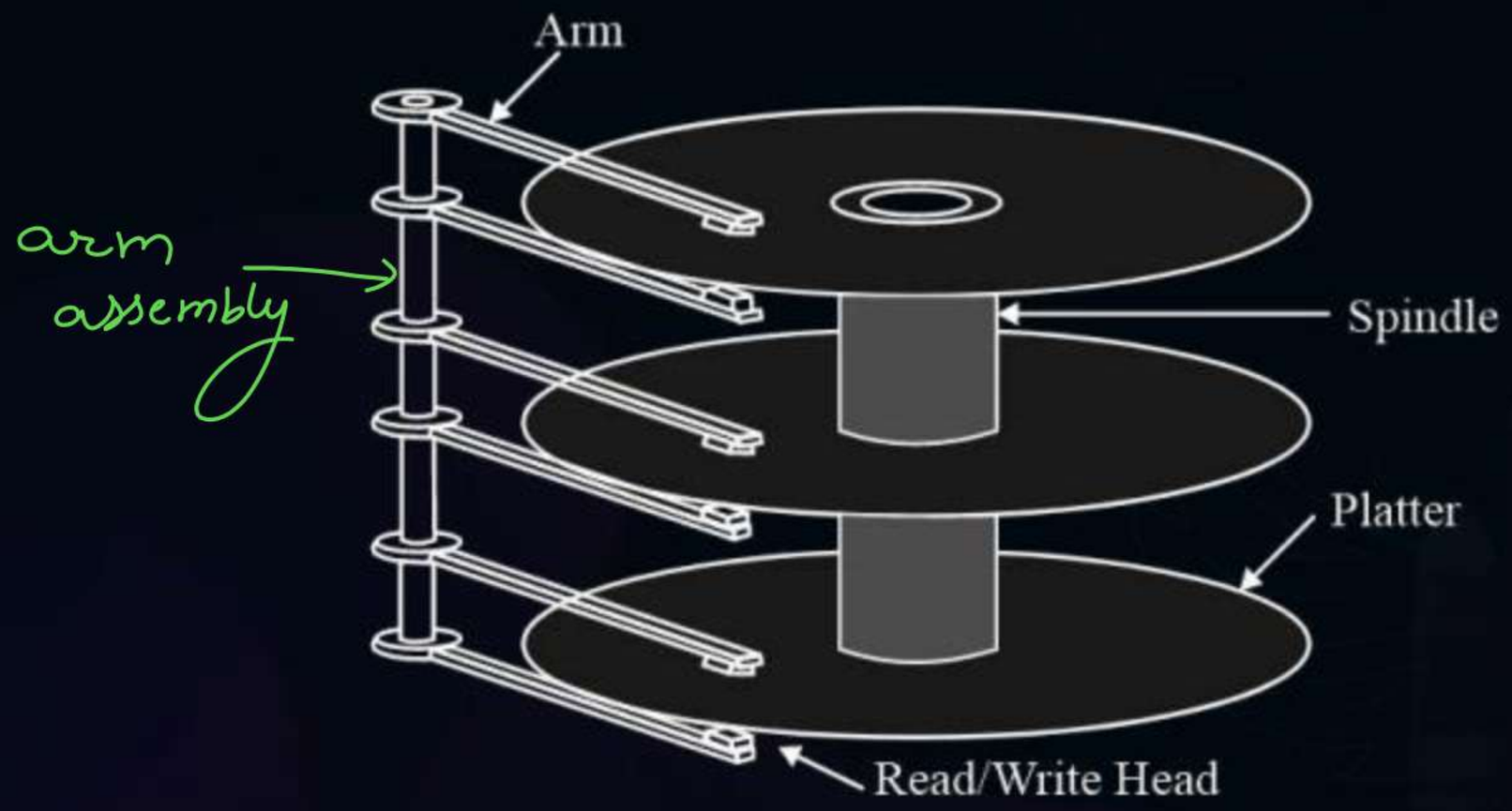
Topic : Magnetic Disk



Topic : Magnetic Disk



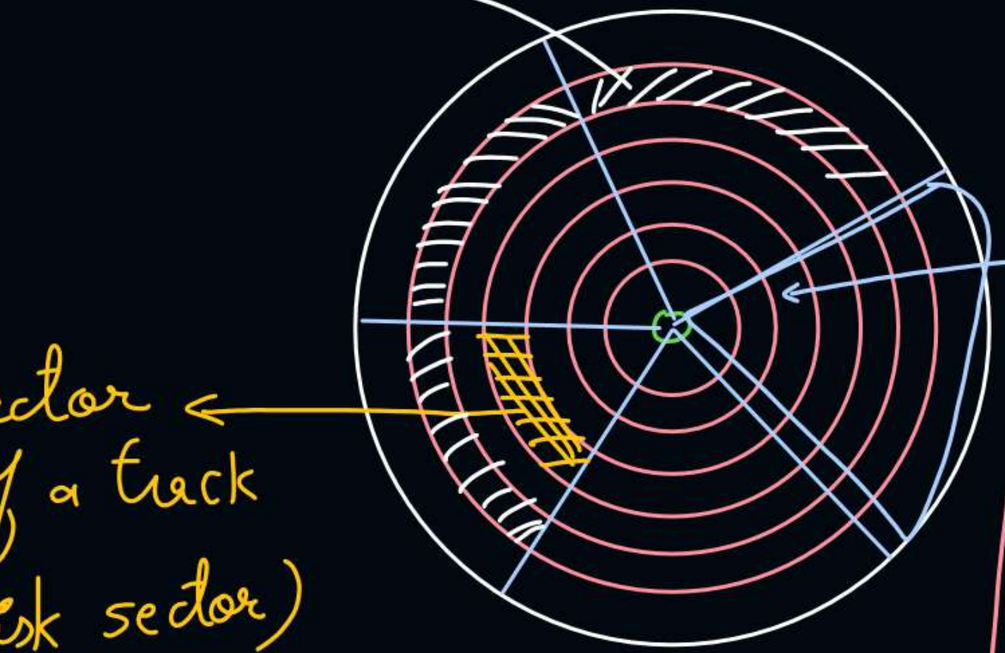
Topic : Magnetic Disk



Topic : Magnetic Disk

Number of surfaces in disk: 2 * no. of platters on disk

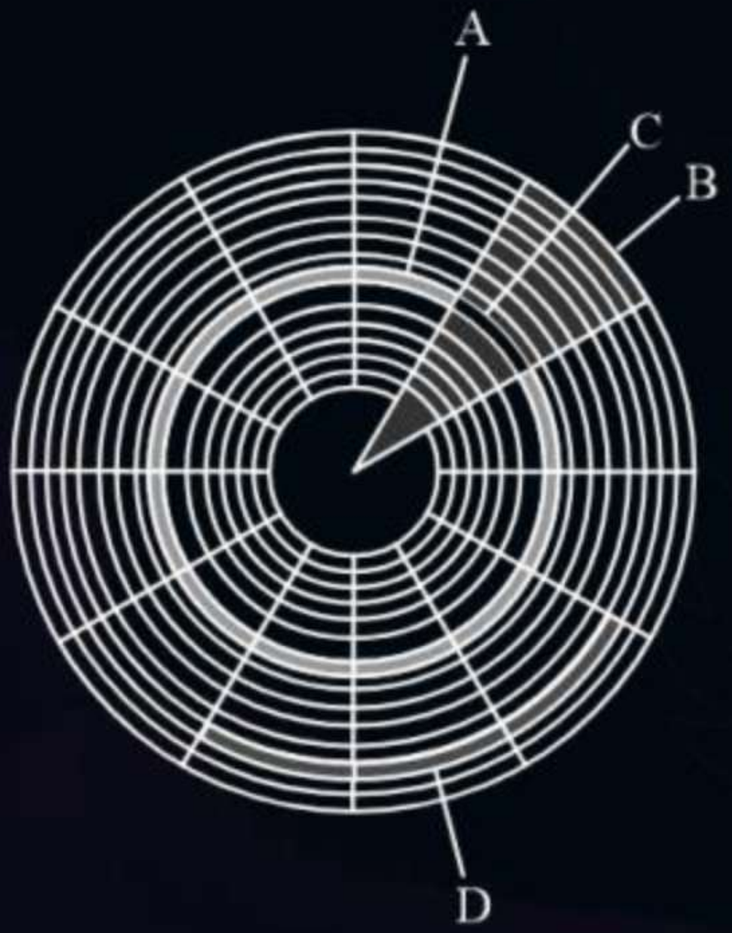
Top view of disk



sector is the smallest unit in the disk which can be read or written at once.

Each sector gets an address in disk.

Topic : Magnetic Disk



Topic : Magnetic Disk

Number of surfaces in disk: 2 * no. of platters

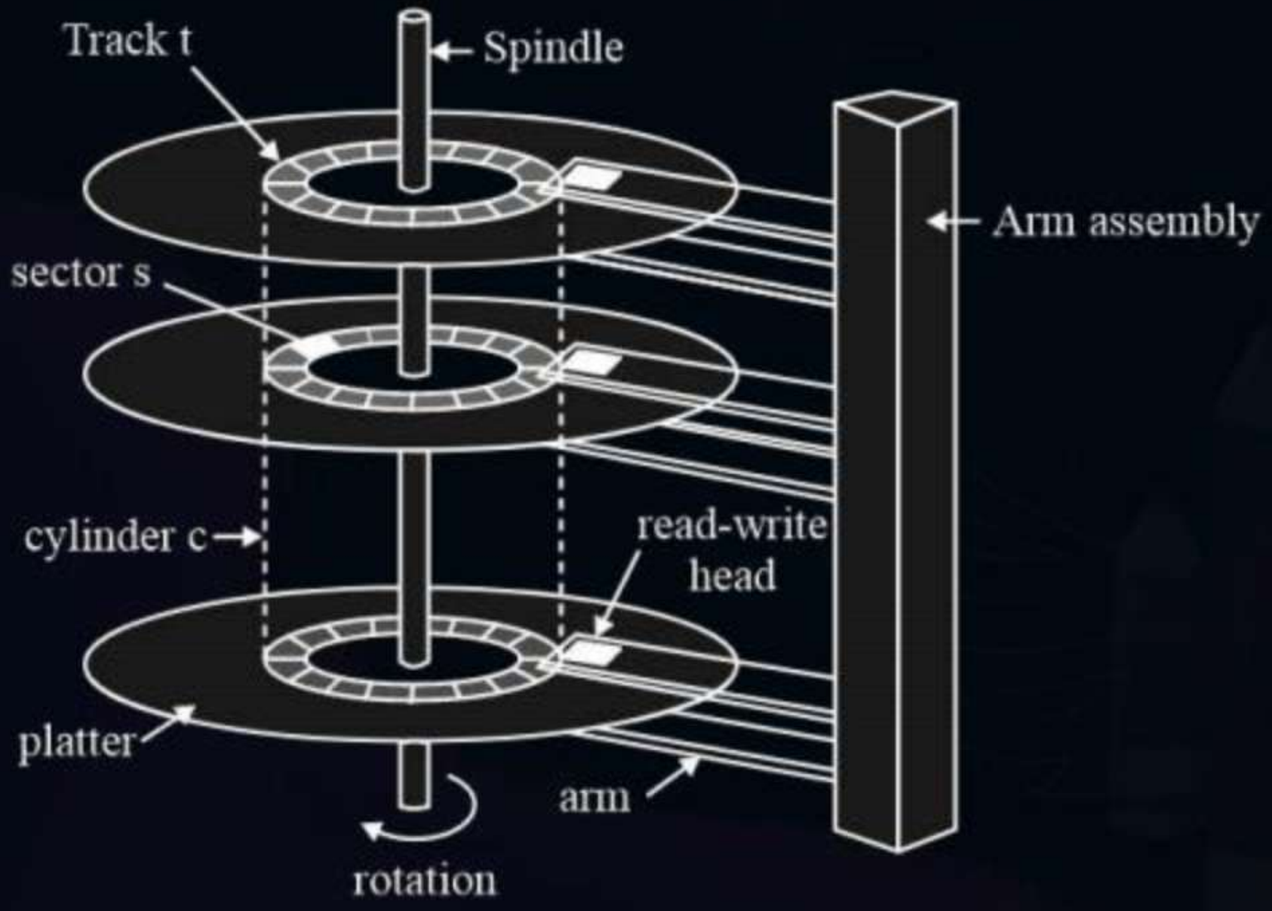
Number of tracks on disk: no. of surfaces on disk * no. of tracks per surfaces

Number of sectors in disk: no. of tracks on disk * no. of sectors per track

= 2 * no. of platters on disk * no. of tracks per surface * no. of sectors per track

Number of bytes on disk: no. of sectors on disk * 1 sector capacity

Topic : Magnetic Disk



Topic : Sector Capacity

(default)

Constant sector capacity
or
Variable storage density
or
Constant angular velocity

Variable sector capacity
or
Constant storage density
or
Constant linear velocity

[NAT]

#Q. Consider a disk with 32 platters each with 2 recording surfaces. There are 128 tracks per surface and 32 sectors per track. Each sector has equal capacity of 1KBytes.

Calculate:

1. Number of surfaces in disk: $32 * 2 = 64$
2. Number of tracks on disk: $64 * 128 = 2^{13}$
3. Number of sectors in disk: $2^{13} * 32 = 2^{18}$
4. Number of bytes on disk: $2^{18} * 2^{10} B = 2^{28} B = 256\ MB$
5. Number of bits for disk addressing: 18-bits

Disk Access time

1 disk access time

= seek time + rotational latency (delay) + 1 sector transfer time + additional time

Topic : Disk Access Time

Seek Time: Time required to position the arm over the desired track

Rotational Latency: time required to rotate desired sector under R/W head

Transfer Time: Time required to read or write 1 sector

$$\text{Avg. rotational latency} = \frac{1 \text{ rotation time}}{2}$$

Note:- In one rotation time, 1 track can be transferred.

$$1 \text{ sector transfer time} = \frac{1 \text{ rotation time}}{\text{no. of sectors per track}}$$

[NAT]

#Q. Consider a disk with 16 platters, 2 surfaces per platter, 2K tracks per surface, 4K sectors per track and 4096 Bytes per sector. Disk rotates with 6000 rpm. Seek time is 5ms. Find disk access time?

rpm → rotations per minute

$$\text{Disk access time} = 5 + \frac{10}{2} + \frac{10}{4k} = 10.0025 \text{ ms}$$

for 6000 rotations, disk takes time = 1 min = 60 sec = 60 * 1000 ms

for 1 —— || —— = $\frac{60\,000 \text{ ms}}{6000}$

= 10 msec

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1 track capacity = 4k * 4KB = 16 MB

In 10 msec time, data transferred = 16 MB

In 1 sec time, —— 11 —— = $\frac{16\ MB}{10 * 10^{-3}\ sec}$

$= \frac{16\ GB}{10}$ /sec

$= 1.6\ GB$ /sec

$= 1600\ MB$/sec

#Q.) 3000 rpm
no. of sectors per track = 1k
seek time = 10 ms

Disk access time = ____ ms

Soln 1 rotation time = $\frac{60000}{3000} = 20$ ms

1 Disk access time = $10 + \frac{20}{2} + \frac{20}{1k} = 20.02$ ms

[NAT]

#Q. A disk has each track with 1k sectors each with 4KB capacity and it takes 10msec for 1 rotation. The transfer rate of the disk is?

Track capacity = $1k * 4kB = 4MB$

1 rotation time = 10msec

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in 10 msec, data = 4MB

1 sec, —11— = $\frac{4MB}{10 * 10^{-3} sec}$

= 400 MB/sec or 0.4 GB/sec

#Q) seek time = 5 ms

6000 rpm

transfer rate = 200MB/sec

1 sector capacity = 2kB

Disk access time = ——

for 200MB, time = 1sec

for 2kB, time = $\frac{1\,sec}{200MB} * 2kB$

$= \frac{1}{100}$ msec

$= 0.01$ ms

$= 5 + \frac{10}{2} + 0.01 = 10.01$ ms

1 rotation time = $\frac{60000\,ms}{6000} = 10$ ms

Topic : Where Disk Transfer Rate can be use?

in DMA cycle stealing to calculate % of time CPU is blocked.

[NAT]

Ans ⇒ 40 %

#Q. Consider a disk with 16 platters, 2 surfaces per platter, 1K tracks per surface, 2K sectors per track and 2048 Bytes per sector. Disk rotates with 3000 rpm. Seek time is 10ms.

If the disk is used in cycle stealing mode of DMA, such that whenever 64-bits word is available, it will be transferred in 16ns. What is the % of time CPU is blocked?

8 bytes

Track capacity = 2k * 2kB = 4MB

1 rotation time = $\frac{60000}{3000}$ = 20 ms

4MB, data = 20msec

8 bytes, —11— = $\frac{20\,ms}{4MB} * 8B$

= 40 ns

Data preparat^n = 40 ns

% of time CPU blocked due to DMA

$= \frac{16}{40} * 100\%$

$= 40\%$

2 mins Summary

Topic Magnetic Disk

Topic Disk Capacity

Topic Disk Access Time

Happy Learning

THANK - YOU