CS & IT ENGINEERING

COMPUTER ORGANIZATION AND ARCHITECTURE

Magnetic Disk

Lecture No.- 02

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Recap of Previous Lecture

Topic Magnetic Disk

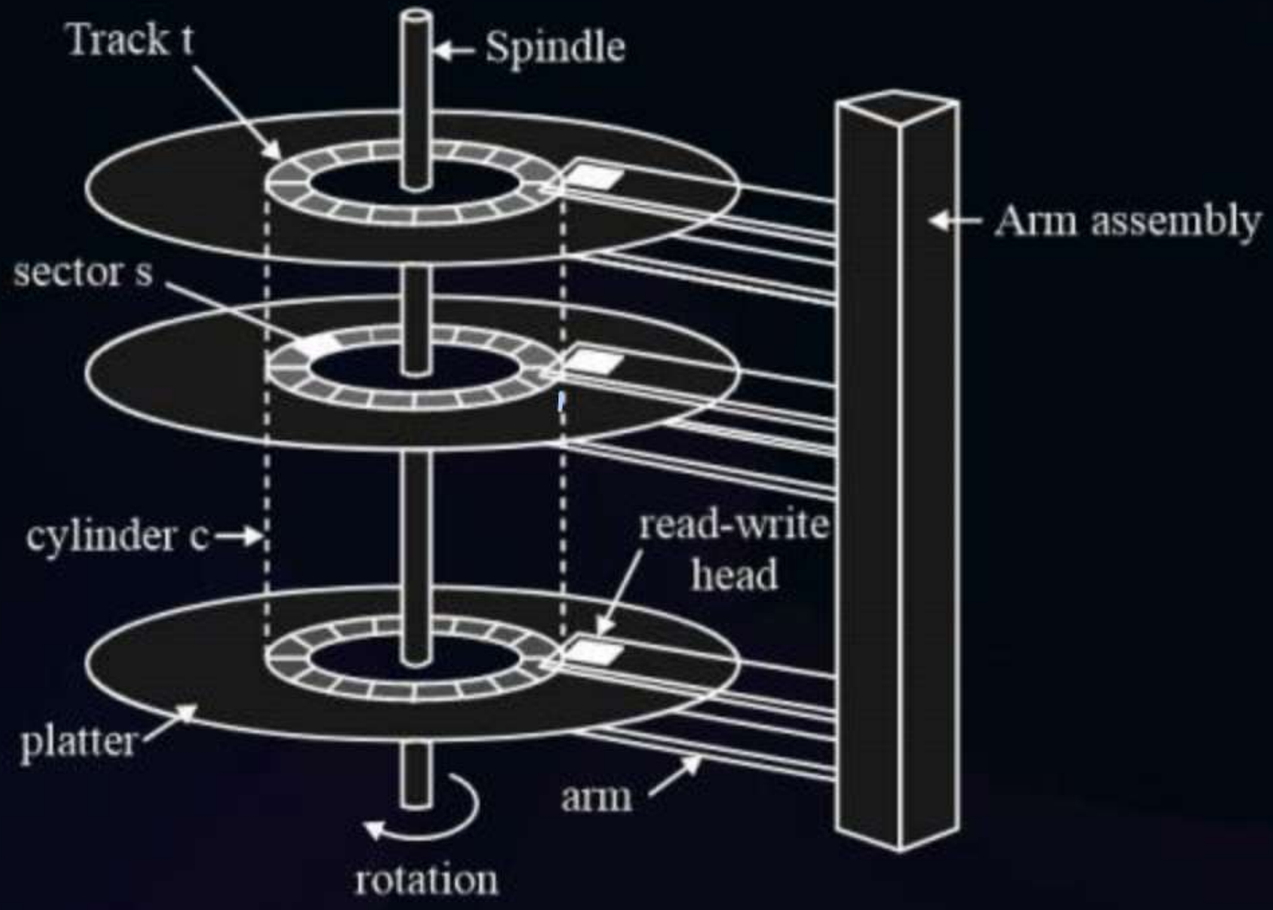
Topic Disk Capacity

Topic Disk Access Time

Topics to be Covered

- Topic: Multiple Sector Access
- Topic: Disk Cylinder
- Topic: Disk Addressing

Topic : Multiple Sectors Access Time: Sequential



Topic : Multiple Sectors Access Time: Sequential

on single track

Consider n sectors to be transferred:

Time needed to access all sectors

= 1 seek time + 1 rotational latency + $n * \frac{1}{\text{sector transfer time}}$

Assume, a file is stored on 4 tracks (consecutive) and each track contains 2000 sectors.

$$\text{file access time} = (4 * \text{seek time}) + (4 * \text{rotational latency}) + (8000 * \text{1 sector transfer time})$$

Topic : Multiple Sectors Access Time: Random

Consider n sectors to be transferred:

$$\text{total time} = n * \left[\text{seek time} + \text{rotational latency} + \text{1 sector transfer} \right]$$

[MCQ]

1 rotat^{n} time $= \frac{60000}{10000} = 6$ ms

#Q. Consider a disk pack with a seek time of 4 milliseconds and rotational speed of 10000 rotations per minute (RPM). It has 600 sectors per track and each sector can store 512 bytes of data. Consider a file stored in the disk. The file contains 2000 sectors. Assume that every sector access necessitates a seek, and the average rotational latency for accessing each sector is half of the time for one complete rotation. The total time (in milliseconds) needed to read the entire file is

A ✓ 14020

B 14000

C 25030

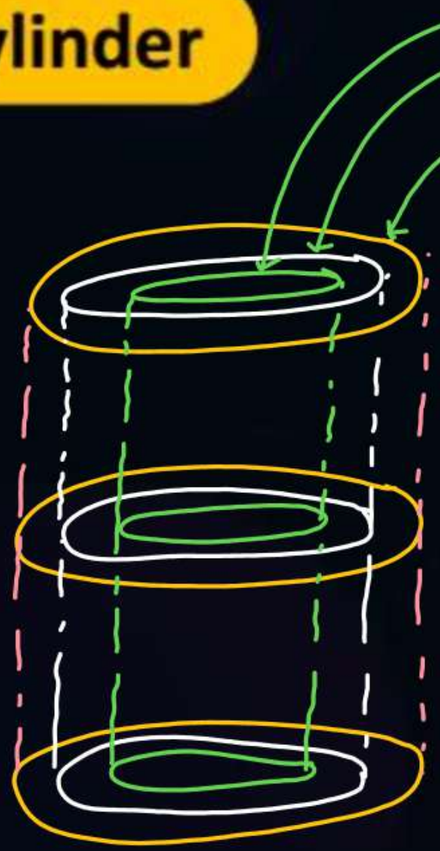
D 15000

$$\text{Total time} = 2000 * \left[4 + \frac{6}{2} + \frac{6}{600}\right]$$

$$= 2000 * 7.01$$

$$= 14020 \text{ ms}$$

Topic : Cylinder



cylinders

collection of same radius tracks from all surfaces.

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no. of cylinders in disk = no. of tracks per surface

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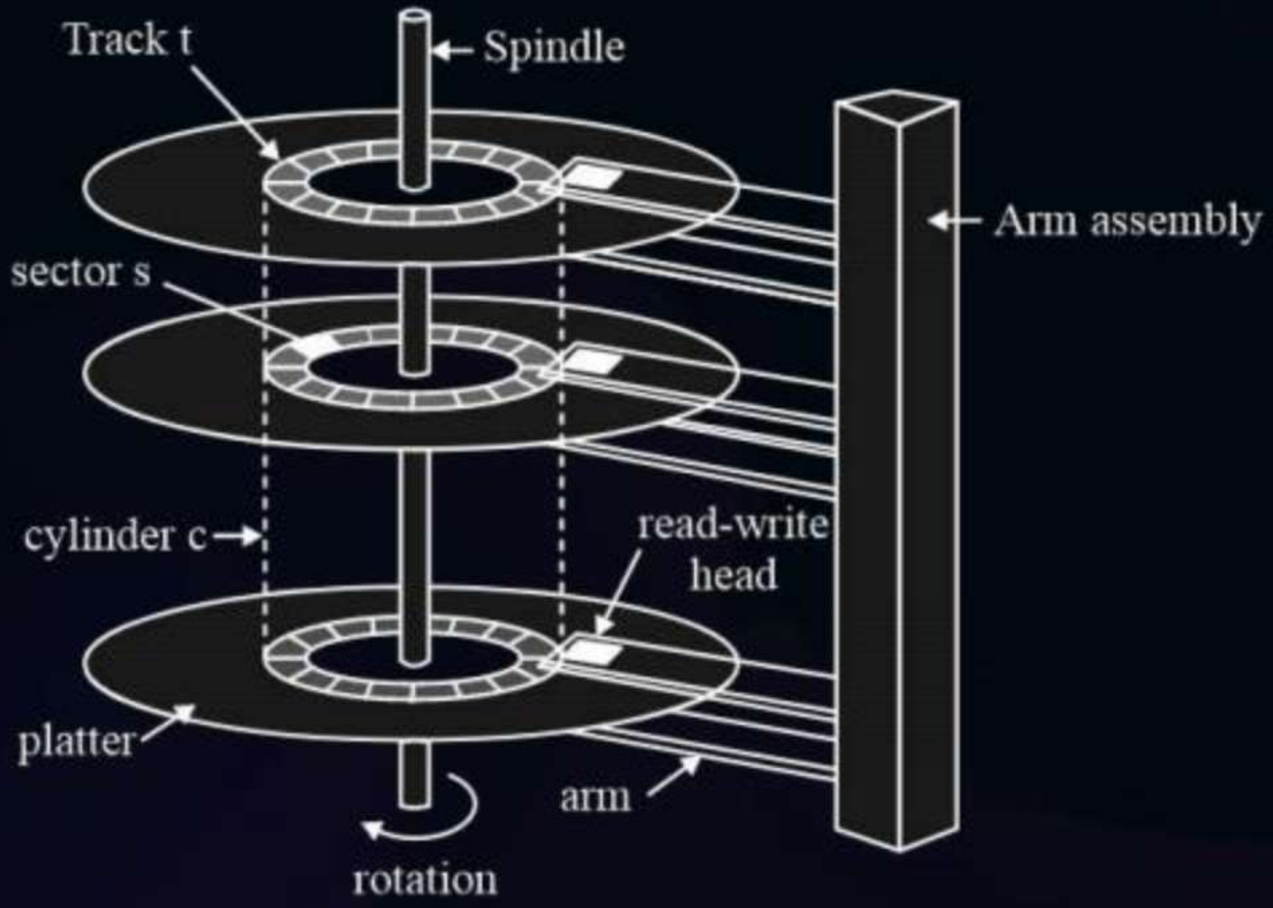
files are stored cylinder wise to save seek time

Topic : Cylinder



Topic : Disk Addressing

⇒ <Cylinder no surface no., Sector no.>

ex:- Disk ⇒ 3 platters ⇒ 2 surface each

no. of tracks per surface = 4 ⇒ no. of cylinder = 4 (0-3)

no. of sectors per track = 5

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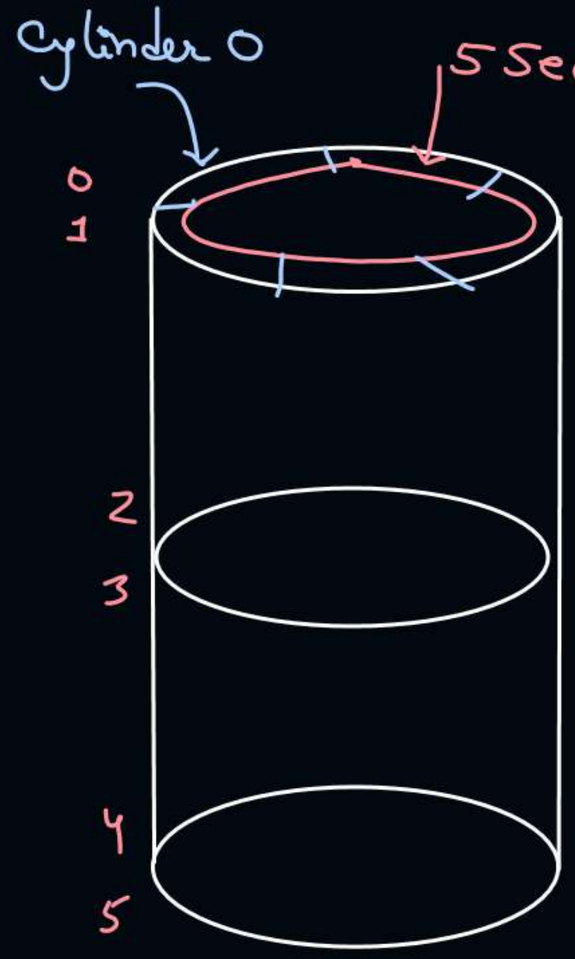
no. of sector per cylinder = no. of surfaces in disk * no. of sectors per track

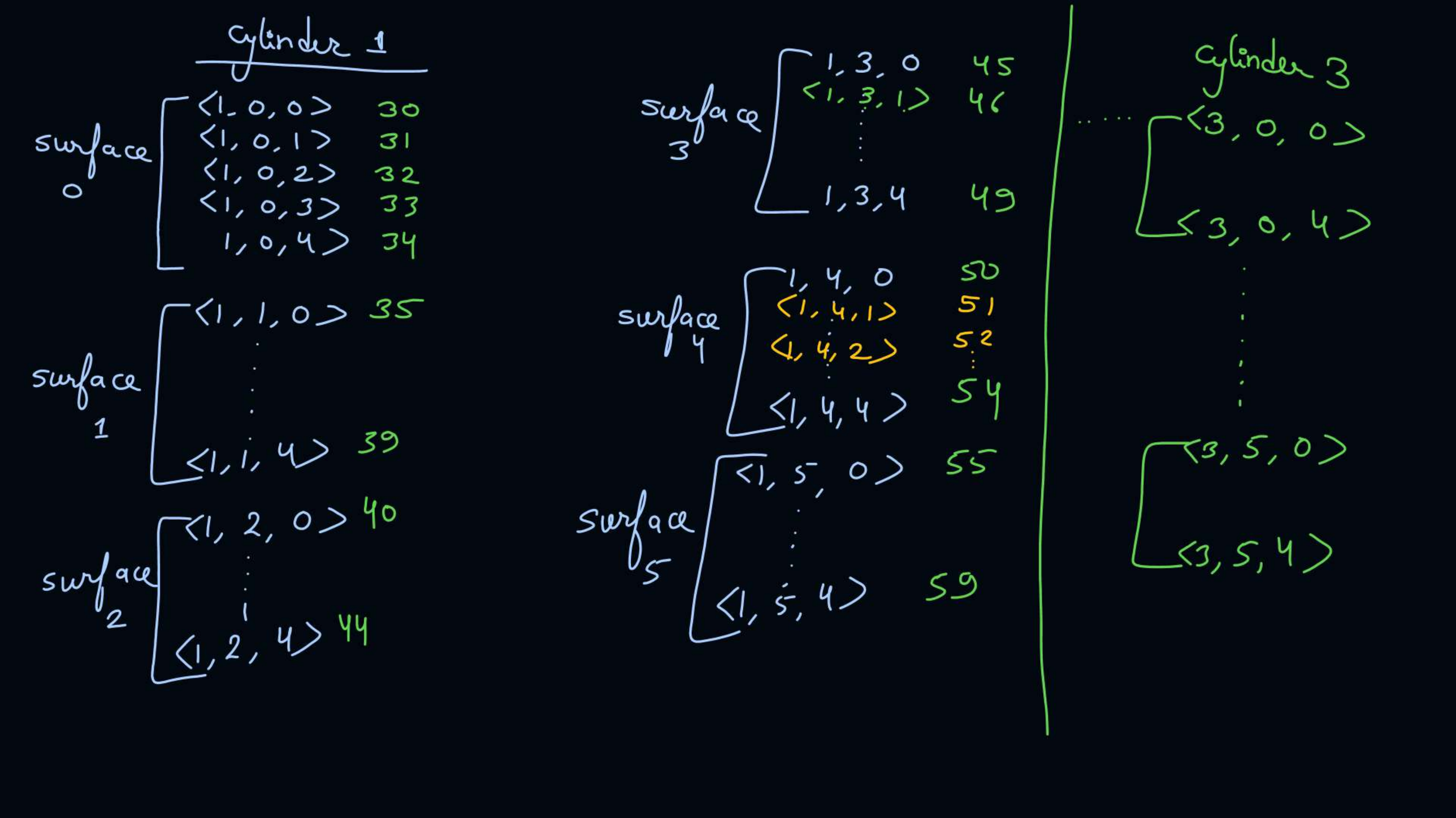
= 6 * 5

= 30

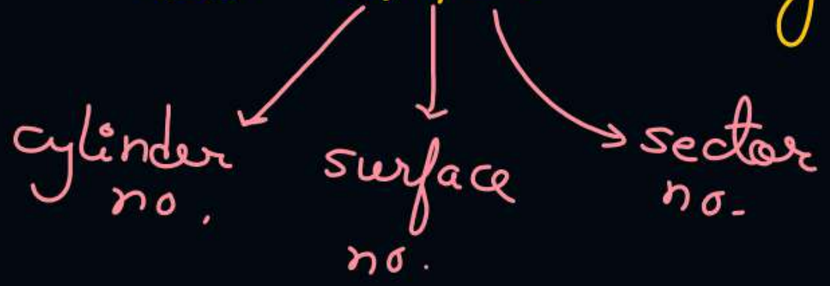


Cylinder 0

		sector
surface 0	<0, 0, 0>	0th
	<0, 0, 1>	1st
	<0, 0, 2>	2nd
	<0, 0, 3>	3rd
	<0, 0, 4>	4th
surface 1	<0, 1, 0>	5th
	<0, 1, 1>	6th
	<0, 1, 2>	7
	<0, 1, 3>	8
	<0, 1, 4>	9
surface 2	<0, 2, 0>	10
	⋮	
	<0, 2, 4>	14
surface 3	<0, 3, 0>	15
	⋮	⋮
	<0, 3, 4>	19
surface 4	<0, 4, 0>	20
	⋮	⋮
	<0, 4, 4>	24
surface 5	<0, 5, 0>	25
	⋮	⋮
	<0, 5, 4>	29


Cylinder 1
surface 0
<1, 0, 0> 30
<1, 0, 1> 31
<1, 0, 2> 32
<1, 0, 3> 33
1, 0, 4> 34
surface 1
<1, 1, 0> 35
<1, 1, 4> 39
surface 2
<1, 2, 0> 40
<1, 2, 4> 44
surface 3
1, 3, 0 45
<1, 3, 1> 46
1, 3, 4 49
surface 4
1, 4, 0 50
<1, 4, 1> 51
<1, 4, 2> 52
<1, 4, 4> 54
surface 5
<1, 5, 0> 55
<1, 5, 4> 59
Cylinder 3
<3, 0, 0>
<3, 0, 4>
<3, 5, 0>
<3, 5, 4>

add. <1, 4, 2> belongs to sector ____ ?



before reaching to cylinder 1, in cylinder no. 0 no. of sectors covered = 30

before reaching to surface 4 of cylinder 1, no. of sectors covered in 4 surfaces (0 to 3) = 4 * 5 = 20 +

sector of surface 4 = 2

52

for add. <c, h, s>, belongs to ——— sector #.

$$sector = (c * n_c) + (h * n_t) + s$$

n_c = no. of sectors per cylinder

n_t = —"— ——— per track

add. => <3, 3, 4> belongs to ____ sector ?

$$= (3 * 30) + (3 * 5) + 4$$

$$= 90 + 15 + 4$$

$$= \underline{\underline{109}} \quad \text{Ans.}$$

$$c = \left\lfloor \text{sector no.} \,/\, n_c \right\rfloor$$

$$h = \left(\text{sector no.} \,\%\, n_c\right) / n_t$$

$$s = \left(\text{sector no.} \,\%\, n_c\right) \,\%\, n_t$$

[NAT]

no. of surfaces = 8

#Q. A hard disk has 16 sectors per track, 4 platters each with 2 recording surfaces and 32 cylinders. The address of a sector is given as a triple ⟨c,h,s⟩, where c is the cylinder number, h is the surface number and s is the sector number. Thus, the 0^{th} sector is addressed as ⟨0,0,0⟩, the 1st sector as ⟨0,0,1⟩, and so on.

The address ⟨12, 6 ,12⟩ corresponds to sector number?

c h s

$n_t = 16$

$n_c = 16 * 8 = 128$

$sector = (12 * 128) + (6 * 16) + 12$

$= \underline{1644}$ Ans.

$$c = \lfloor 1644 / 128 \rfloor = 12$$

$$h = \lfloor (1644 \,\%\, 128) / 16 \rfloor = 6$$

$$s = (1644 \,\%\, 128) \,\%\, 16 = 12$$

[NAT]

Ans = ⟨6, 6, 3⟩

#Q. A hard disk has 16 sectors per track, 4 platters each with 2 recording surfaces and 32 cylinders. The address of a sector is given as a triple ⟨c,h,s⟩, where c is the cylinder number, h is the surface number and s is the sector number. Thus, the 0^{th} sector is addressed as ⟨0,0,0⟩, the 1st sector as ⟨0,0,1⟩, and so on.

The address of 867th sector?

$n_t = 16$

$n_c = 16 * 8 = 128$

$c = \lfloor 867 / 128 \rfloor = 6$

$h = \lfloor (867 \% 128) / 16 \rfloor = 6$

$s = (867 \% 128) \% 16 = 3$

[NAT]

#Q. Consider a hard disk with 36 recording surfaces (0-35) having 10000 cylinders (0-9999) and each track contains 64 sectors (0-63). Data in disk are organized cylinder-wise and the addressing format is <cylinder no., surface no., sector no.>. A file in the disk is stored starting from address <1660, 28, 38>. What is the sector number of the first sector of the file in the disk?

$n_c = 36 * 64 = 2304$

$n_t = 64$

Sector no. $= (1660 * 2304) + (28 * 64) + 38$

$= 3826470$

The file is stored on 5000 consecutive sectors, then sector no. of last sector of file ?

Ans: Last sector no. of file = 3826470 + 5000 − 1

= 3831469

Add. of last sector of file => ?

Soln

$C = \lfloor 3831469 / 2304 \rfloor = 1662$

$h = \lfloor (3831469 \% 2304) / 64 \rfloor = 34$

$S = (3831469 \% 2304) \% 64 = 45$

<1662, 34, 45>

Ans.

[NAT] GATE - PYQ

Ans = 1284

#Q. Consider a hard disk with 16 recording surfaces (0-15) having 16384 cylinders (0-16383) and each track contains 64 sectors (0-63). Data storage capacity of in each sector is 512 Bytes. Data are organized cylinder-wise and addressing format is <cylinder no., surface no., sector no.>. A file of size 42797 KB is stored in the disk and the starting disk location of the file is <1200, 9, 40>. What is the cylinder number of the last sector of the file, if it is stored in a contiguous manner?

$n_t = 64$

$n_c = 16 * 64 = 1024$

Sector no. $= (1200 * 1024) + (9 * 64) + 40$

$= 1229416$

no. of sectors needed to store file $= \frac{42797\ kB}{512\ B}$

$= \frac{42797 * 2^{10}\ B}{2^9\ B}$

$= 85594$

Last sector no. of file $= 1229416 + 85594 - 1$

$= 1315009$

$C = \lfloor 1315009 / 1024 \rfloor = 1284$

$h = \lfloor (1315009 \% 1024) / 64 \rfloor = 3$

$s = (1315009 \% 1024) \% 64 = 1$

2 mins Summary

Topic Multiple Sector Access

Topic Disk Cylinder

Topic Disk Addressing

Happy Learning

THANK - YOU