CS & IT ENGINEERING

COMPUTER ORGANIZATION AND ARCHITECTURE

Magnetic Disk

Lecture No.- 02

By- Vishvadeep Gothi sir

Recap of Previous Lecture

Topic Magnetic Disk

Topic Disk Capacity

Topic Disk Access Time

Topics to be Covered

Topic Disk Addressing

Topic Pipeline Processing

Topic Speed Up

Ques) A file is stored on 5 consecutive tracks on all their sectors

$\rightarrow$ no. of sectors = 5 * 200 = 1000

No. of sectors/track = 200

Disk rotatn ⇒ 6000 rpm $\rightarrow$ 1 rotatn time = 10 ms

seek time = 10 msec

file access time = ________ msec ?

$$= (5 * 10) + 5 * \frac{10}{2} + 1000 * \frac{10}{200}$$

$$= 50 + 25 + 50$$

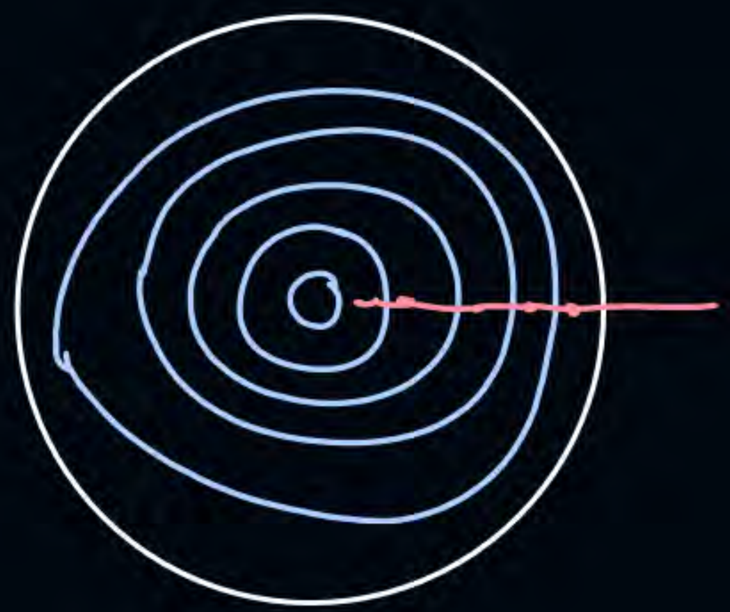
$$= 125 \text{ msec}$$

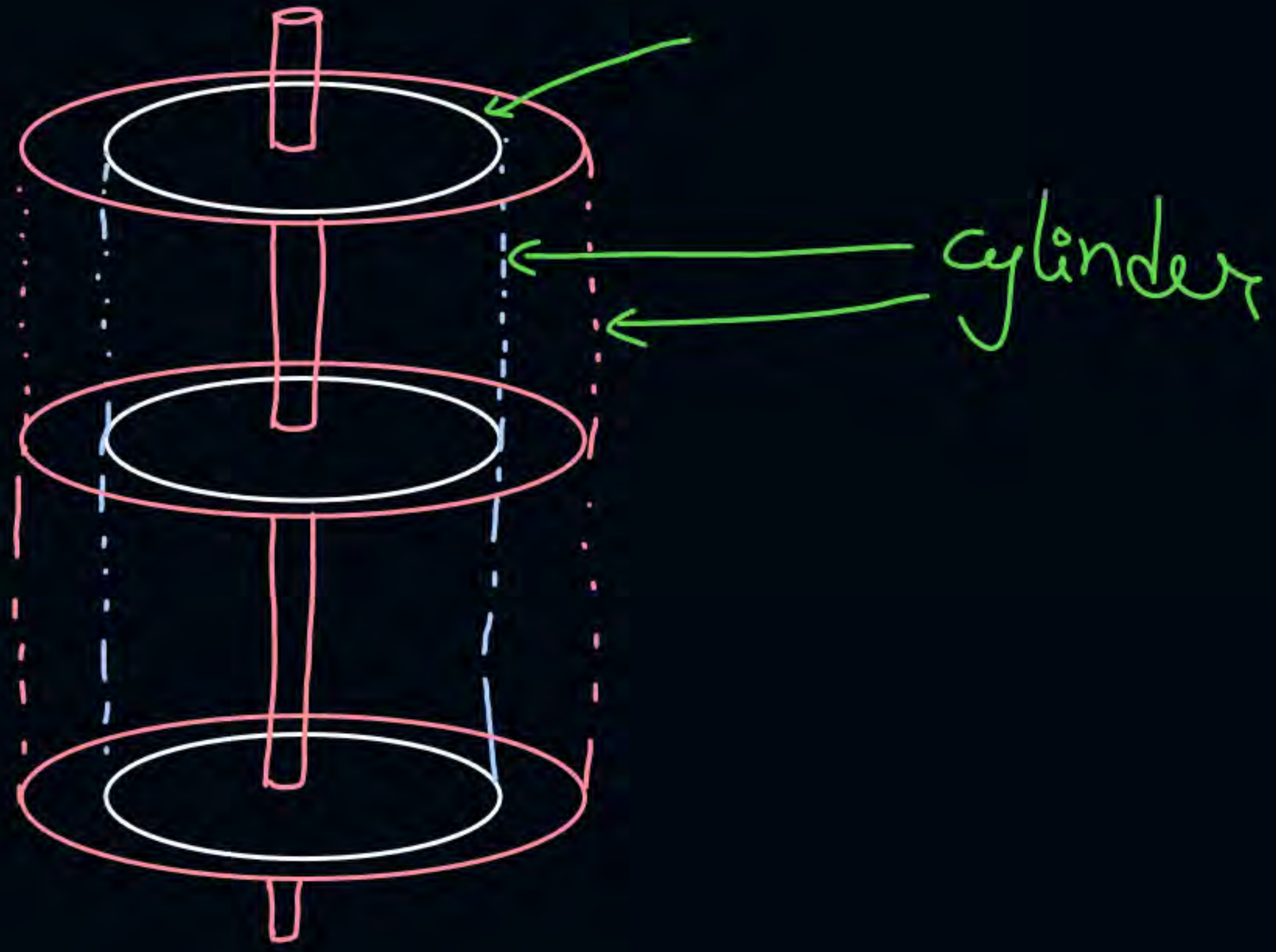
Assume all 5 tracks are under a cylinder in last Questⁿ, then

$$\text{file access time} = 10 + 5 * \frac{10}{2} + 1000 * \frac{10}{200}$$

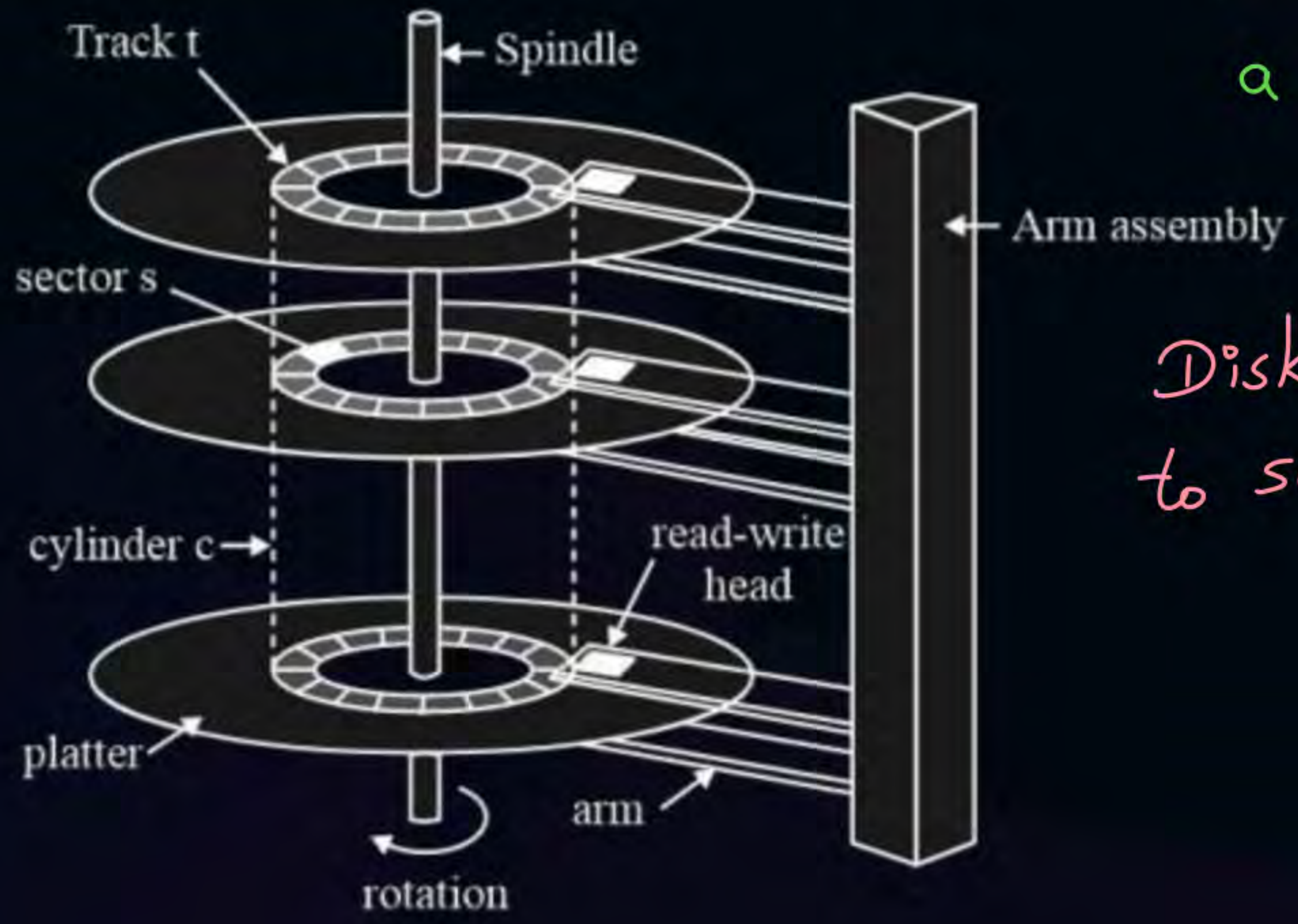
$$= 85 \text{ ms}$$

cylinder :-





Topic : Cylinder



Collect^n of same radius tracks from all surfaces, form a cylinder.

Disk is accessed cylinder wise to save seek time.

Topic : Disk Addressing

<cylinder no, surface no, sector no>

Assume

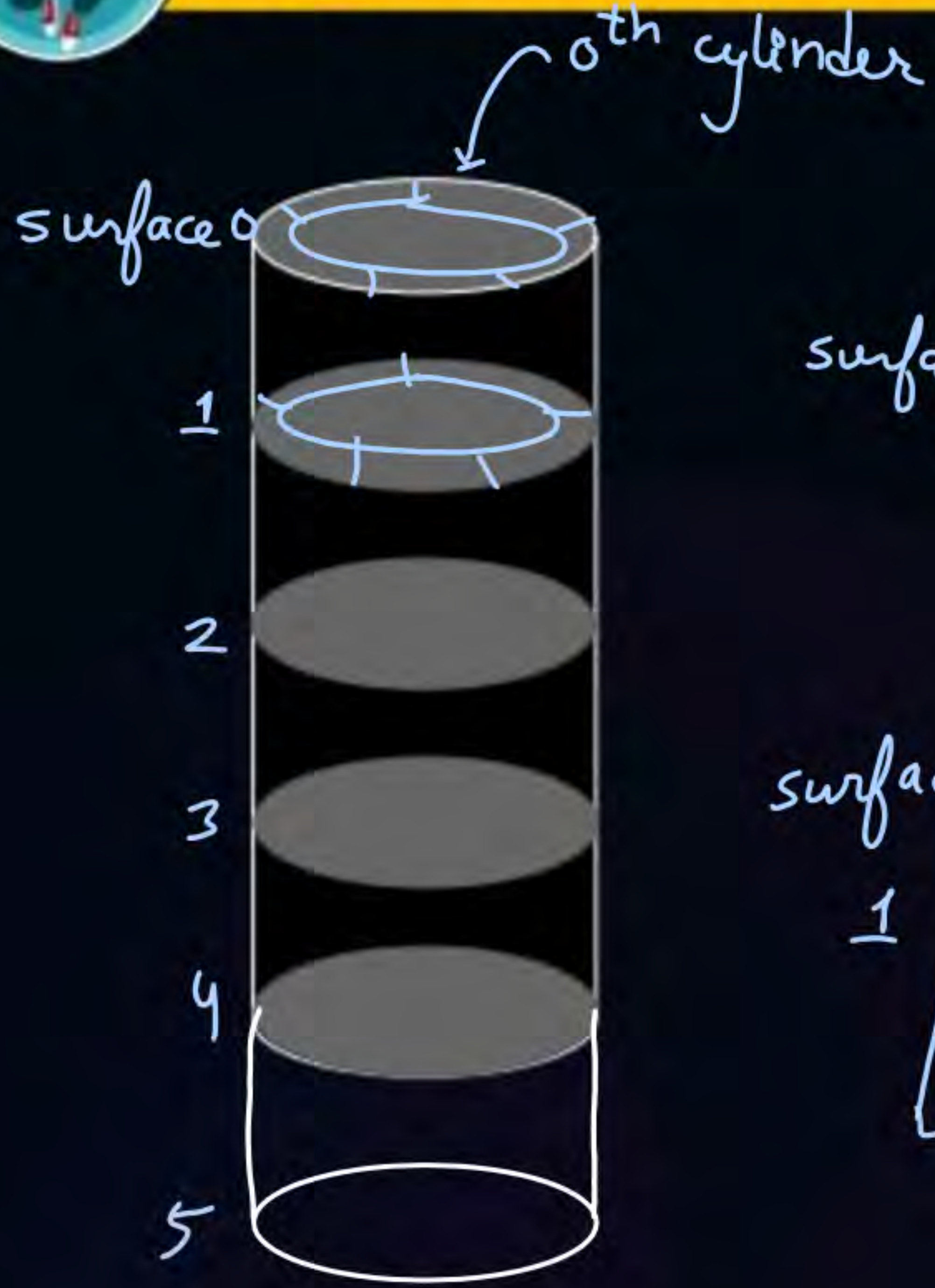
- Disk has 3 platters with 2 recording surfaces on each ⇒ no. of surfaces in disk = 6
- Number of tracks per surface = 4
- Number of sectors per track = 5

no. of sectors per cylinder = no. of surfaces * no. of sectors per track

= 6 * 5

= 30

Topic : Disk Addressing



0th cylinder

surface 0
- <0, 0, 0> 0th sector
- <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> 7th
- <0, 1, 3> 8th
- <0, 1, 4> 9th

⋮

surface 5
- <0, 5, 0> 25th
- <0, 5, 1> 26th
- <0, 5, 2> 27th
- <0, 5, 3> 28th
- <0, 5, 4> 29th sector

cylinder 1

surface 0

$\langle 1, 0, 0 \rangle$ 30^{th} sector

$\langle 1, 0, 1 \rangle$ 31^{st}

$\langle 1, 0, 2 \rangle$ 32^{nd}

$\langle 1, 0, 3 \rangle$ 33^{rd}

$\langle 1, 0, 4 \rangle$ 34^{th}

⋮

53^{rd} 1,

surface 5

$\langle 1, 5, 0 \rangle$ 55^{th} sector

⋮

$\langle 1, 5, 4 \rangle$ 59^{th} sector

Address :- $\langle 1, 5, 2 \rangle$

belongs to which sector no ?

no. of sectors before cylinder 1 = 30
(1 complete cylinder)

no. of sectors covered before surface 5 in cylinder 1 $= 5 * 5$
$= 25$
(5 complete surfaces 0 to 4)

sector of surface $= 2$

57

Address $\Rightarrow \langle c, h, s \rangle$

cylinder no

surface no.

sector no.

Add. belongs to sector $= (c * n_c) + (h * n_t) + s$

n_c = no. of sectors per cylinder = no. of surfaces in disk $* \, n_t$

n_t = —''— per track

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

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

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

53^{rd} sector

$$c = \lfloor 53 / 30 \rfloor = 1$$

$$h = \lfloor (53 \,\%\, 30) / 5 \rfloor = 4$$

$$s = (53 \,\%\, 30) \,\%\, 5 = 3$$

add. $= \langle 1, 4, 3 \rangle$

[NAT]

Ans = 1644

#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?

$n_t = 16$

$n_c = 8 * 16 = 128$

sector no. $= (12 * 128) + (6 * 16) + 12$

$= \underline{\underline{1644}}$

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

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

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

$$\text{add.} = \langle 12, 6, 12 \rangle$$

[NAT]

#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 0th sector is addressed as ⟨0,0,0⟩, the 1st sector as ⟨0,0,1⟩, and so on.

Ans $\langle 6, 6, 3 \rangle$

The address of 867th sector?

$n_t = 16$

$n_c = 8 * 16 = 128$

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

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

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

[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?

$n_t = 64$

$n_c = 36 * 64 = 2304$

sector no. of first sector the file $= (1660 * 2304)$
$+ 28 * 64$
$+ 38$

$38,26,470$

[NAT]

#Q. In above questions if a file is stored on 55788 sectors in contiguous manner then what is the sector number of the last sector of the file?

$$
\begin{array}{r}
= 3826470 \\
+ \quad 55788 \\
-1 \\
\hline
3882257
\end{array}
$$

[NAT]

from last Questⁿ

#Q. Calculate the address in format <c, h, s> for the last sector of the file?

$c \quad \lfloor 3882257/2304 \rfloor = 1685$

$\langle 1685, 0, 17 \rangle$

$h = \lfloor (3882257 \% 2304)/64 \rfloor = 0$

$s = (3882257 \% 2304) \% 64 = 17$

[NAT] GATE PYQ

Ans = $\underline{\underline{1284}}$

#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. of first sector of file $= (1200 * 1024) + (9 * 64) + 40$

$= 1229416$

no. of sectors needed to store file $= \dfrac{42797 \cancel{K}\cancel{B}^{2}}{\cancel{512}\ \cancel{B}} = 85594$

sector no. of last sector of file $=$

$$\begin{array}{r} 1229416 \\ +85594 \\ -\underline{1} \\ \hline 1315009 \end{array}$$

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

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

$$s = (1315009 \% 1024) \% 64 = \underline{1}$$

$\langle 1284, 3, \underline{1} \rangle$

Topic : Parallel Processing

Parallel Processing: Simultaneous data processing

Types:

- Vector Processing
- Array Processing
- Pipeline Processing (Pipelining)

Topic : Flynn's Classification of Computers

1. SISD (single Inst^n stream single Data stream)
2. SIMD —— 11 —— multiple —11— ⇒ Pipeline processor
3. MISD multiple —11—— single ——11—— ⇒ not practical
4. MIMD multiple ——11—— multiple —11—— ⇒ superscalar computers (multiple pipelines)

Topic : Pipeline Processing

- Pipelining is useful, When same processing is applied over multiple inputs

Topic : Pipeline Processing

- Technique to decompose a sequential process into sub-operations
- Sub-operations are performed in segments or stages.
- **Task:** One operation performed in all segments

  → no. of inputs to be processed.

Topic : Pipelining Example

$(4+5-1) = 8$ cycles

cycles		Person 1 (cut)	Person 2 (stitch)	Person 3 (finish)	Person 4 (Pack)
1	10 min	Cut_1			
2	20 min	Cut_2	$stitch_1$		
3	30 min	Cut_3	$stitch_2$	$finish_1$	
4	40 min	Cut_4	$stitch_3$	$finish_2$	$Pack_1$
5	50 min	Cut_5	$stitch_4$	$finish_3$	$Pack_2$
6	60 min	–	$stitch_5$	$finish_4$	$Pack_3$
7	70 min	–	–	$finish_5$	$Pack_4$
8	80 min	–	–	–	$Pack_5$

Topic : Pipeline Cycle Time (t_p)

Min. time in which all segments can finish their respective sub-operations.

Topic : General Consideration About Pipeline

- Consider a k segment pipeline with clock cycle time = t_p to perform n tasks

	no. of cycles	time
time needed to perform 1^{st} task =	k	$k * t_p$
time needed to perform remaining $(n-1)$ tasks =	$(n-1)$	$(n-1) * t_p$
Total time needed to perform all n tasks =	$(k+n-1)$	$(k+n-1)\,t_p$

Topic : General Consideration About Pipeline

- Consider a non-pipeline system that takes t_n time to perform a task

time needed to perform n tasks in non-pipeline system $= n * t_n$

Topic : General Consideration About Pipeline

- Performance of a pipeline is given by Speed up ratio.

$$\text{Speed up } (S) = \frac{\text{non-pipeline time}}{\text{pipeline time}}$$

$$\boxed{S = \frac{n * t_n}{(k+n-1)\, t_p}}$$

when no. of tasks increases

$n >> k$

$$\boxed{S_{ideal} = \frac{t_n}{t_p}}$$

max speed up possible

☆ Special case :-

if one operation takes same time in pipeline & non-pipeline both. then

$$t_n = k * t_p$$

$$\boxed{S_{ideal} = k}$$

2 mins Summary

Topic Disk Addressing

Topic Pipeline Processing

Topic Speed Up

Happy Learning

THANK - YOU