CS & IT ENGINEERING

Operating System

File System & Device Management

Lecture No. 1

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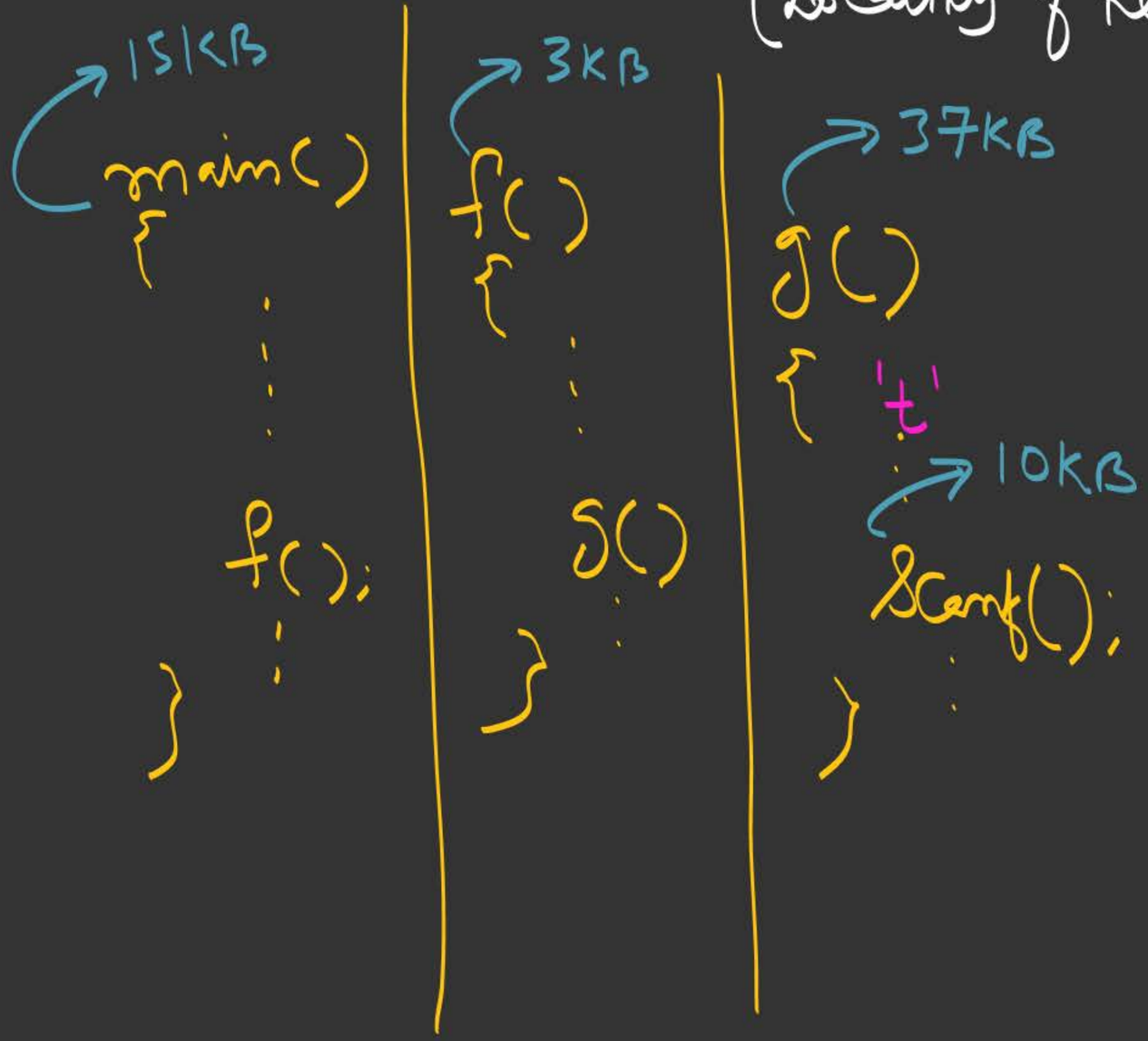
- Introduction to File System
- Physical Structure of Disk
- Problem Solving

Working Set Strategy [Control Page fault rate & utilize Memory efficiently]

[Locality of Reference]

Dynamic frame Alloc



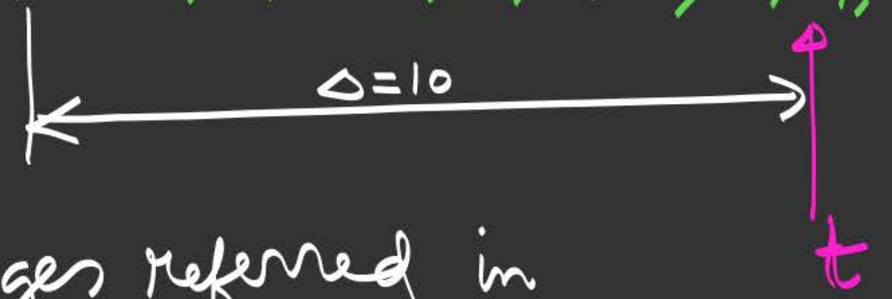
Prog-Size = 65KB

P.S = 1KB

N = 65

Estimate the size of Locality in which the Program is executing & demand those many frames

P_{Vi} : < 4, 5, 8, 2, 4, 5, 8, 20, 22, 21, 19, 20, 18, 19, 54, 58, 56, 54, 53, 51, 52, 58, 56, 57, 54, ..



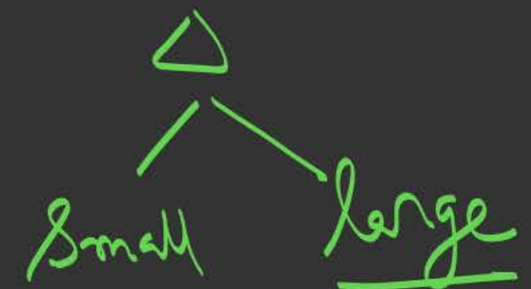
Sliding window

Working-Set-window (wsw) $_t$ = { Set of unique Pages referred in the Ref. String during the past 'Δ' references }

$WSW_{i\ \Delta=10}^{\ t}$ = { 51; 52; 53; 54; 56, 57, 58 }

$WSWS_{i\ \Delta=10}^{\ t} = 7$ Demand

Δ = integer (Given)



Δ = 2 (Lead to more Page faults)

Δ = 25 (Ineffective utilization of memory)

→ No. of Processes = 'n' $\langle P_1 \cdots P_n \rangle$

→ Total Avail Frames = M

→ Demand of each Process for frames $= \delta_i = WSS_i^t$ $\Delta = 10$

→ Total demand @ 't' $= \sum_{i=1}^{n} \delta_i = D$

I. $D \simeq M$ [No-Thrashing]

II. $D < M$ [No-Thrashing ↓ Inc. degree of M.P.]

III. $D > M$ [Sys. is Thrashing]

Q.

Let the Page Reference and the Delta (▲) be "c c d b c e c e a d" and 4, respectively. The initial Working Set a time t = 0 contains the pages {a, d, e}, where 'a' was referenced at time t = 0, 'd' was referenced at time t = -1, and 'e' was referend at time t = -2. Determine the total number of page faults and the average number of page frames used by computing the working set at each reference.

$\Delta = 4$

t	-2	-1	0	1	2	3	4	5	6	7	8	9	10
	e	d	a	c	c	d	b	c	e	c	e	a	d

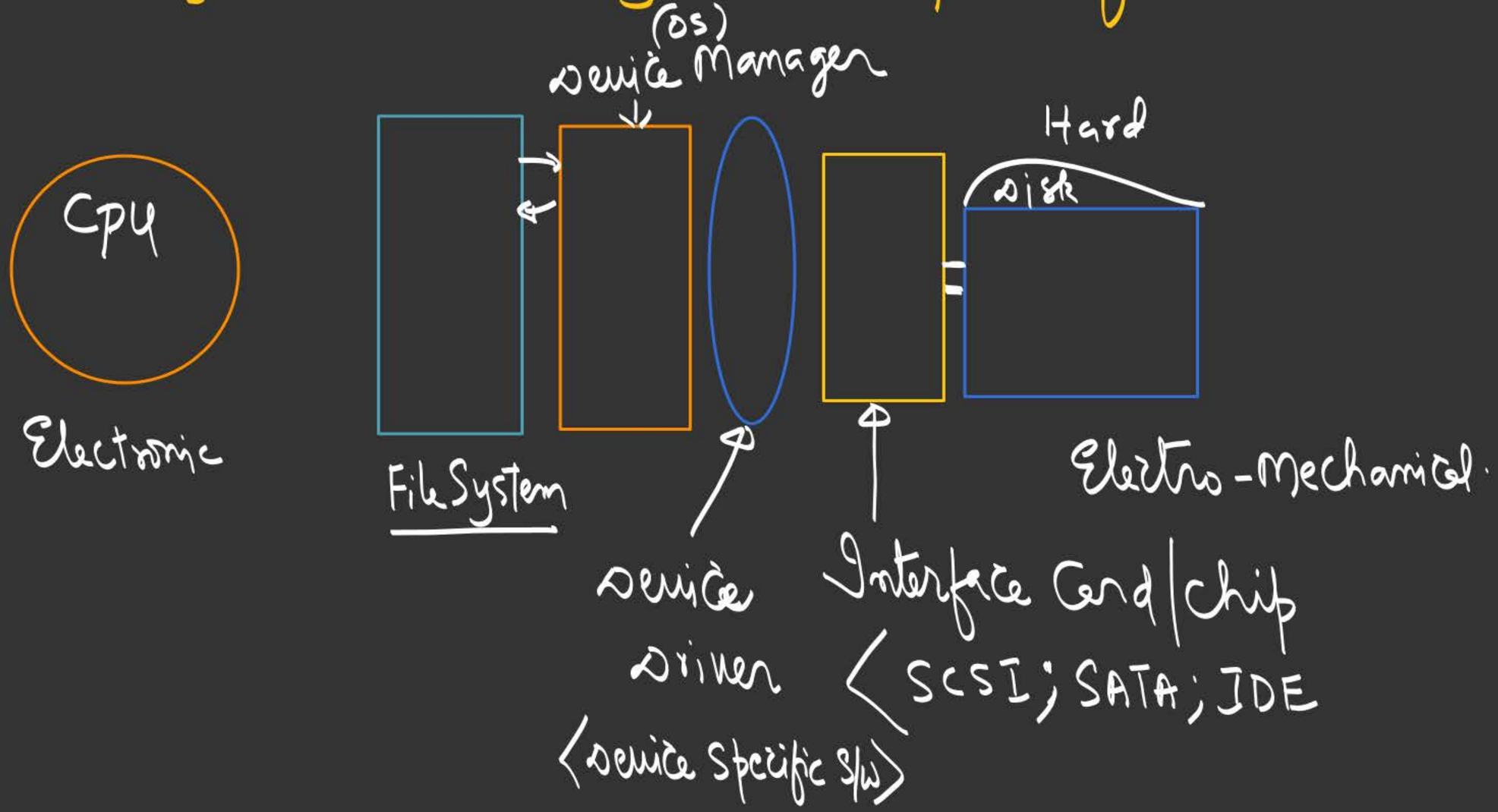
No. of Page faults = 5

Avg. W.S.W.S = $\frac{21}{10}$

t_0: ⟨e d a⟩	WSWS
t_1: ⟨e d a c⟩	4
t_2: ⟨d a c⟩	3
t_3: ⟨a c d⟩	3
t_4: ⟨c d b⟩	3
t_5: ⟨d b c⟩	3
t_6: ⟨d b c e⟩	4
t_7: ⟨b e c⟩	3
t_8: ⟨c e⟩	2
t_9: ⟨c e a⟩	3
t_{10}: ⟨c e a d⟩	4

FILE SYSTEM & DEVICE MANAGEMENT

→ File System is the only visible part of O.S



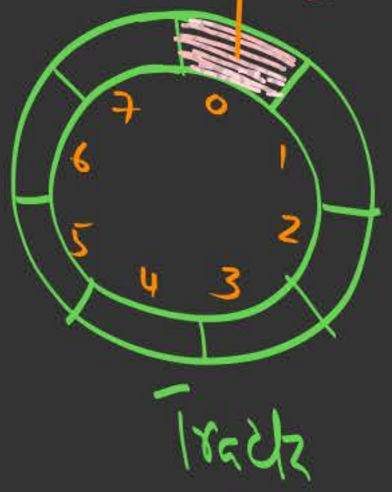
Disk Physical Geometry (Structure)

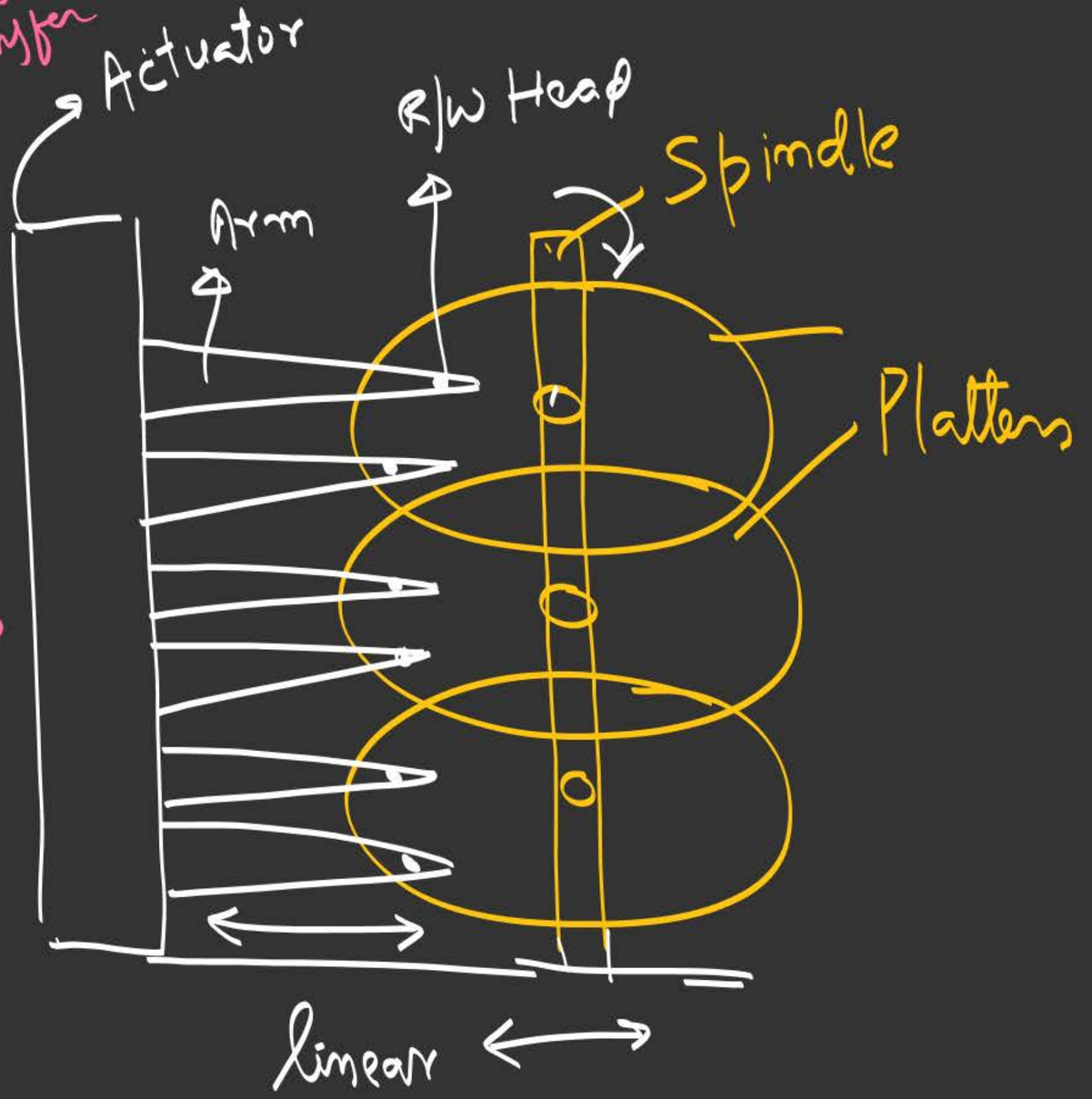
→ Disk is a Collection of circular/Eliptical Platters → 2 Surfaces

Unit of Data Transfer

Block / Sector

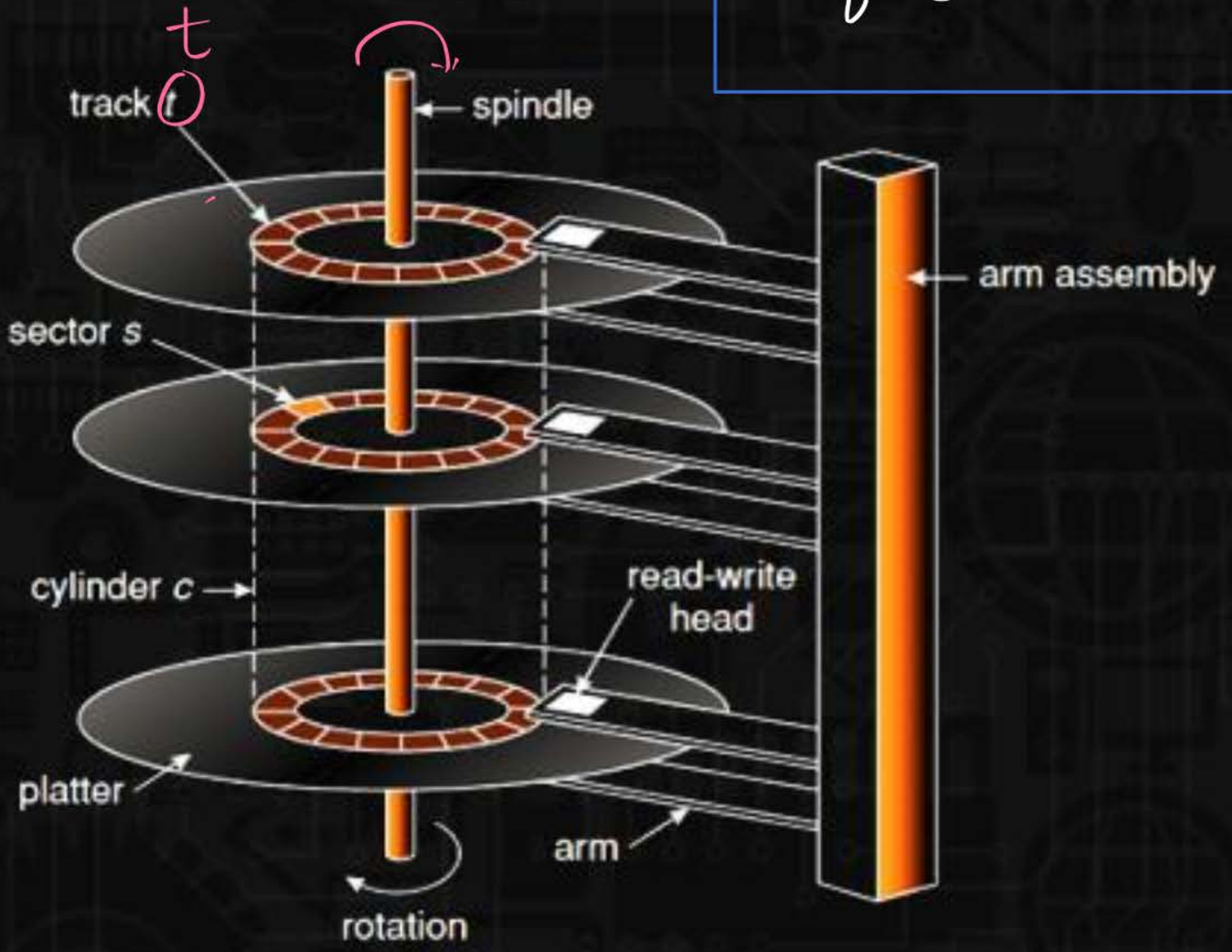
Bytes

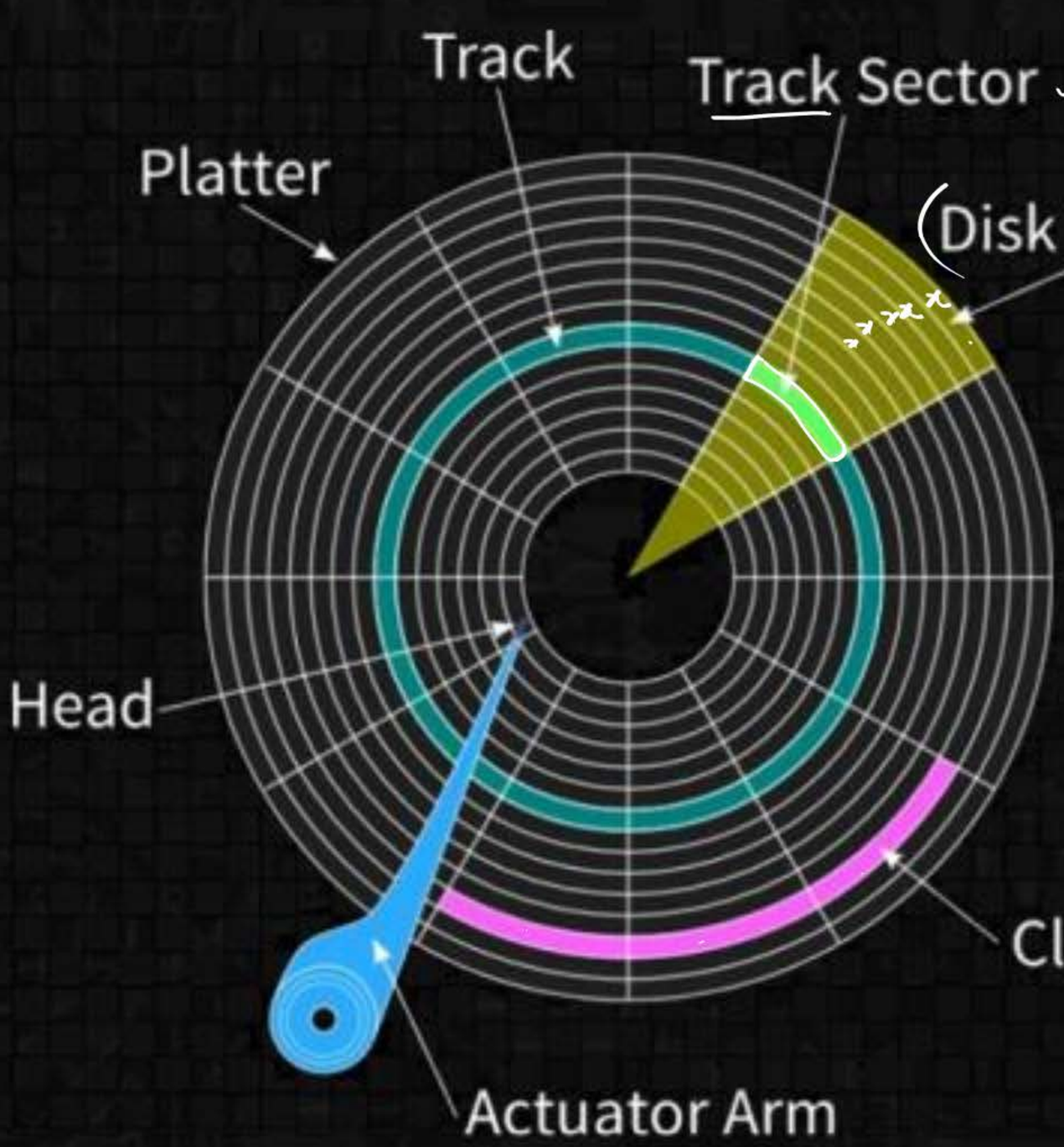





Computer hard drive
read/write head
spindle
Platter
disk
saved file
actuator
arm
power port
data cable port
drive configuration port
circuit board

No. of Cylinders = No. of Tracks




Track
Track Sector
Platter
Disk Sector
Head
Cluster = A group of 1/more Adjacent Sectors
Actuator Arm

TTT (Track-Track Time) = 1 ms

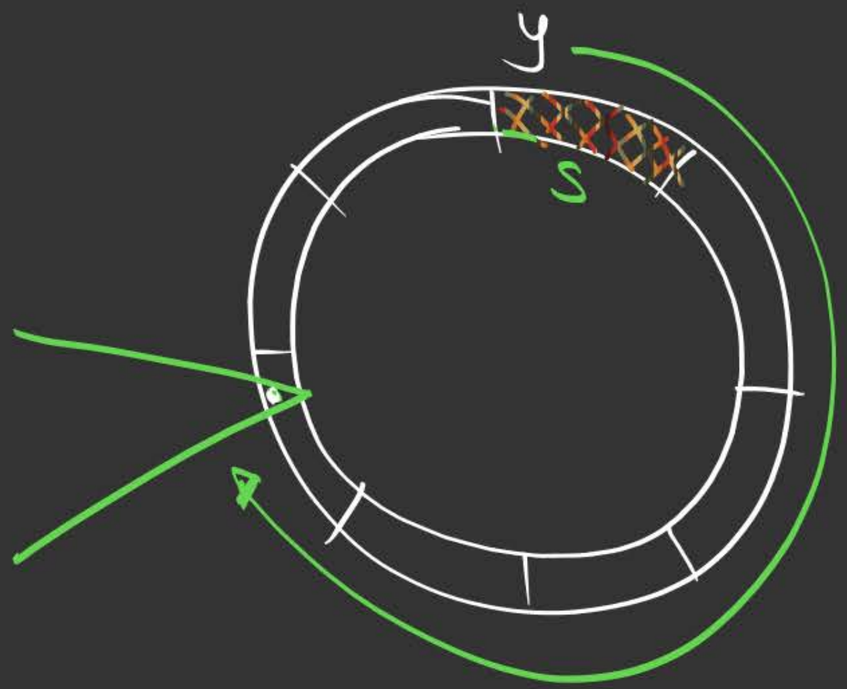
Disk — Platters → 2 Surfaces → Tracks → Sectors :

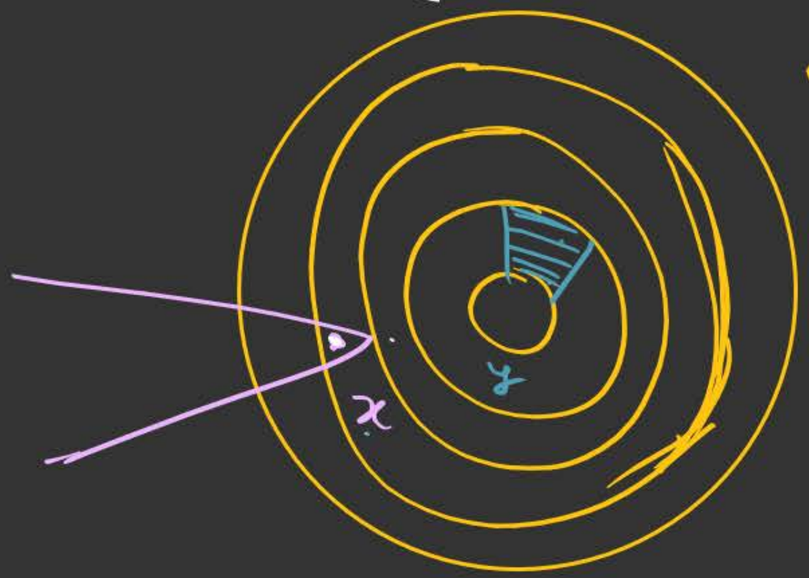
Sec-No | Size (Bytes)

Bits

→ Disk IO Time / one Sector : Seek Time (ST) / (|x − y| * TTT) + Rotational Latency Time (RT) = (R/2)

[80 Seeks)





Surface

R = Time for one Rotation (rpm)

3600 rpm

3600 rots — 60 s

1 rot — ?

$$R = \frac{60}{3600}\,s = 16.67\ ms$$

→ Track Size = 'Z' Bytes

→ Secto Size = 'S' Bytes

→ Rotat. Time = 'R'

→ In one Rot, we can read one complete Track

Disk IO_time = Seek_time + Latency time + Transfer time (TT)

S·T (R·L·T) (TT)

$|x-y| * TT$

$\frac{R}{2}$

Data Transfer Rate

DTR (By/s)

Z Bytes — R x 10^{-3} s

? — 1 s

$\frac{Z}{R} \times 10^{3}$ By/s

('Z' Bytes) — R ms

(S Bytes) — ?

$$\text{Transfer Time} = \left(\frac{S \cdot R}{Z}\right) ms$$

File System Workflow

Hard Drive

Partition

File System

Directory

Files

Q. 1

Consider the following Disk Specifications:

Number of Platters = 16 ⇒ No. of Surfaces = 32

Number of Tracks/Surface = 512

Number of Sectors/Track = 2048 (2K)

Sector offset = 12 bits, Sec-Size = 2^{12} = 4KB

Average Seek Time = 30 ms

Disk RPM = 3600 R = 16.6 ms

Calculate the Following:

Track Size = 2K * 4KB = (8 MB)

Track Size — Rot-time

8MB — 16.6 ms

4KB — ?

$\left(\frac{4KB}{8MB} * 16.6\right)$ ms = x

(512 * 2K * 4KB)

A. Unformatted Capacity of Disk. : 128GB

B. IO-Time/Sector : ST + LT + TT

(R/2) = [30 ms + 8.3 ms + x]

C. Data Transfer Rate

D. (Sector Address) bits

Disk Cap = 32 * 512 * 2K * 4KB

$= 2^5 \times 2^9 \times 2^{11} \times 2^{12} = 2^{37}$ = (128GB) ✓

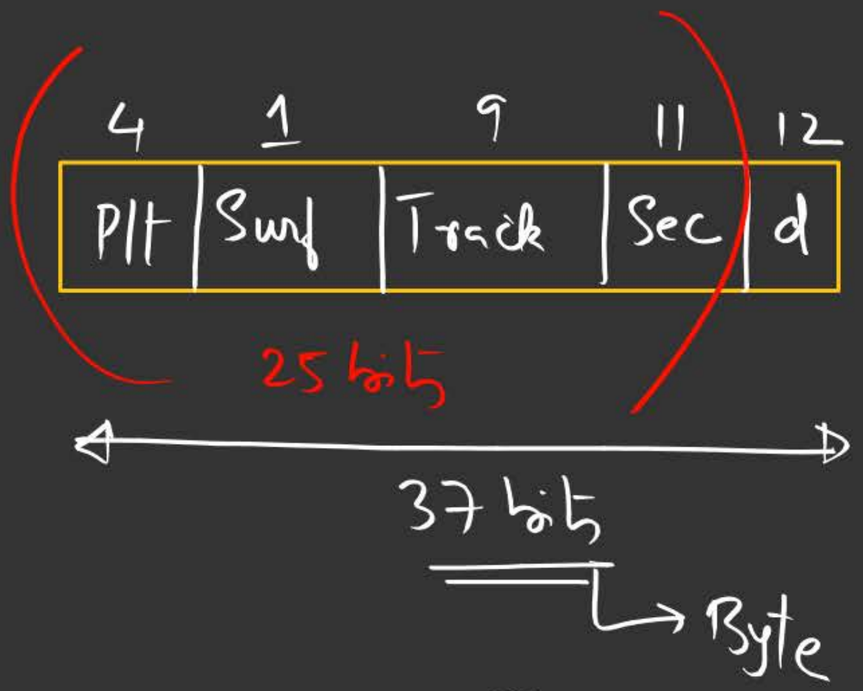
Data Transfer rate (By/s)

T-S	R
8MB	16.6×10^{-3} s
?	1 s

$$\frac{8MB}{16.6 \times 10^{-3}/s}$$

$$\frac{16.6}{2}$$

$$\frac{1}{2} GB/s$$



Disk Capacity $= 2^{37} = 128 GB$

Q. 2

H/W 1

Consider a Disk with the following Specifications:
Number of surfaces = 64
Outer diameter = 16 cm
Inner diameter = 4 cm
Inter Track space = 0.1 mm
Max Density = 8000 bits/cm
Calculate the Unformatted Capacity of Disk.

Q. 3

How long does it take to load a 64 Kbytes Program from a disk whose Average Seek time is 30 ms Rotation time is 20 ms, Track Size is 32 Kbytes, Page Size is 4 Kbytes. Assume that Pages of the Program are distributed randomly around the disk. What will be the % saving in time if 50% of the Pages of program are Contiguous?

HW 2


THANK YOU GW
SOLDIERS !