CS & IT ENGINEERING

Operating System

Disk Scheduling Algorithm

(one shot)

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Recap of Previous Lecture

Topic File System

Topic Blocks and File Allocation Methods

Topics to be Covered

Topic Disk Scheduling

Topic SSTF, Scan, Look

Topic : Question

[GATE-2022]

#Q. Consider two files systems A and B , that use contiguous allocation and linked allocation, respectively. A file of size 100 blocks is already stored in A and also in B. Now, consider inserting a new block in the middle of the file (between 50^{th} and 51^{st} block), whose data is already available in the memory. Assume that there are enough free blocks at the end of the file and that the file control blocks are already in memory. Let the number of disk accesses required to insert a block in the middle of the file in A and B are n_A and n_B respectively, then the value of $n_A + n_B$ is 153 ?

#Q. In a computer system, four files of size 11050 bytes, 4990 bytes, 5170 bytes and 12640 bytes need to be stored. For storing these files on disk, we can use either 100 byte disk blocks or 200 byte disk blocks (but can't mix block sizes). For each block used to store a file, 4 bytes of bookkeeping information also needs to be stored on the disk. Thus, the total space used to store a file is the sum of the space taken to store the file and the space taken to store the book keeping information for the blocks allocated for storing the file. A disk block can store either bookkeeping information for a file or data from a file, but not both.

What is the total space required for storing the files using 100 byte disk blocks and 200 byte disk blocks respectively?

A. 35400 and 35800 bytes

B. 35800 and 35400 bytes

C. 35600 and 35400 bytes

D. 35400 and 35600 bytes

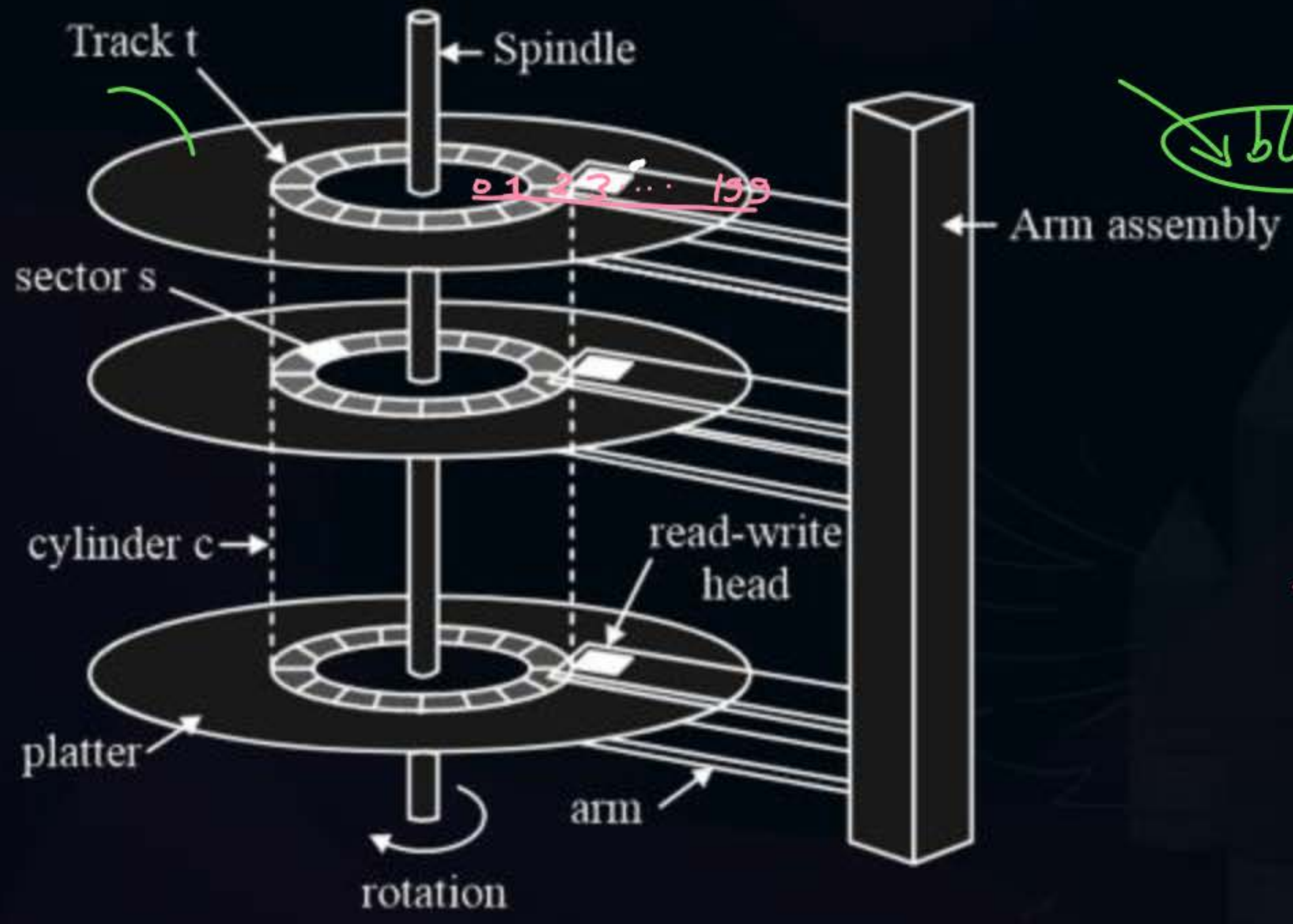
Topic : Solution

File Size	No. of blocks to store file	No. of blocks to store bookkeeping	Total blocks	Total Size
11050 Bytes	$\left\lceil \frac{11050B}{100} \right\rceil = 111$	$\left\lceil \frac{111 * 4B}{100} \right\rceil = 5$	116	
4990 Bytes	50	= 2	52	
5170 Bytes	52	= 3	55	
12640 Bytes	127	= 6	133	

$356 \Rightarrow 356 * 100B$

$35600B$

Topic : Disk



Running

P3

P2

P1

blocked

pending request for disk

Topic : Cylinder

- Collection of tracks of same radius from all surfaces

Topic : Disk Scheduling

- Done by operating systems to schedule I/O requests arriving for the disk

Topic : Disk Scheduling Algorithms

1. FCFS (First Come First Serve)
2. SSTF (Shortest Seek Time First)
3. Scan
4. C-Scan (Circular-Scan)
5. Look
6. C-Look (Circular-Look)

Topic : FCFS (First Come First Serve)

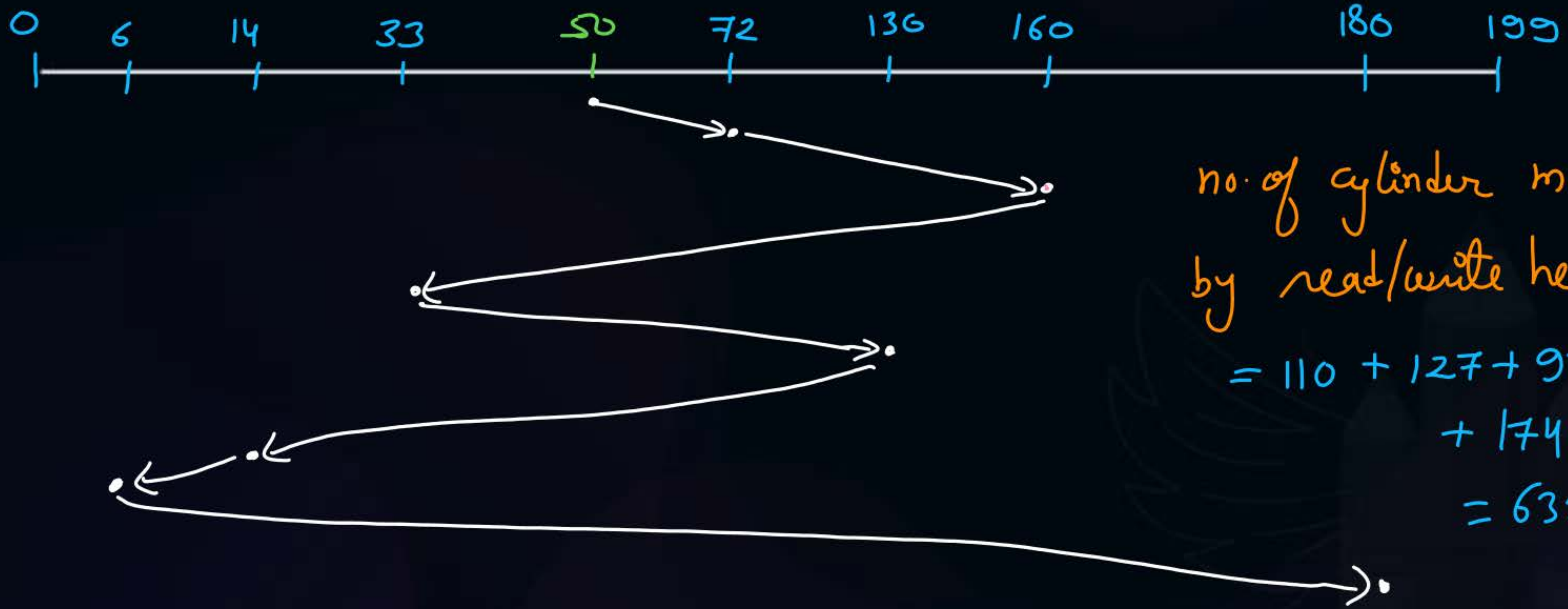
no of cylinders = 200 (0 - 199)

Suppose the order of request is: 72, 160, 33, 130, 14, 6, 180

The Read/Write arm is at 50

Topic : FCFS (First Come First Serve)

Suppose the order of request is: 72, 160, 33, 130, 14, 6, 180



no. of cylinder movements by read/write head =

$= 110 + 127 + 97 + 124 + 174$

$= 632$

no. of times R/W head has changed direction $\Rightarrow$ 4 times

Ques) If each head movement from one cylinder to next takes time = 2 ms and each head direction change takes = 10 ms

total seek time = $632 * 2 = 1264$

$4 * 10 = 40$

$\underline{\underline{1304 \text{ ms}}}$

Ques) last 2 requests fulfilled are at 42 and 50.

no. of direction change = 4

Ques) last 2 requests fulfilled are at 80 and 50.

no. of direction change = 5

Topic : FCFS (First Come First Serve)

Advantages:

- Every request gets a fair chance
- No indefinite postponement ⇒ starvation

Disadvantages:

- Does not try to optimize seek time
- May not provide the best possible service

Topic : SSTF (Shortest Seek Time First)

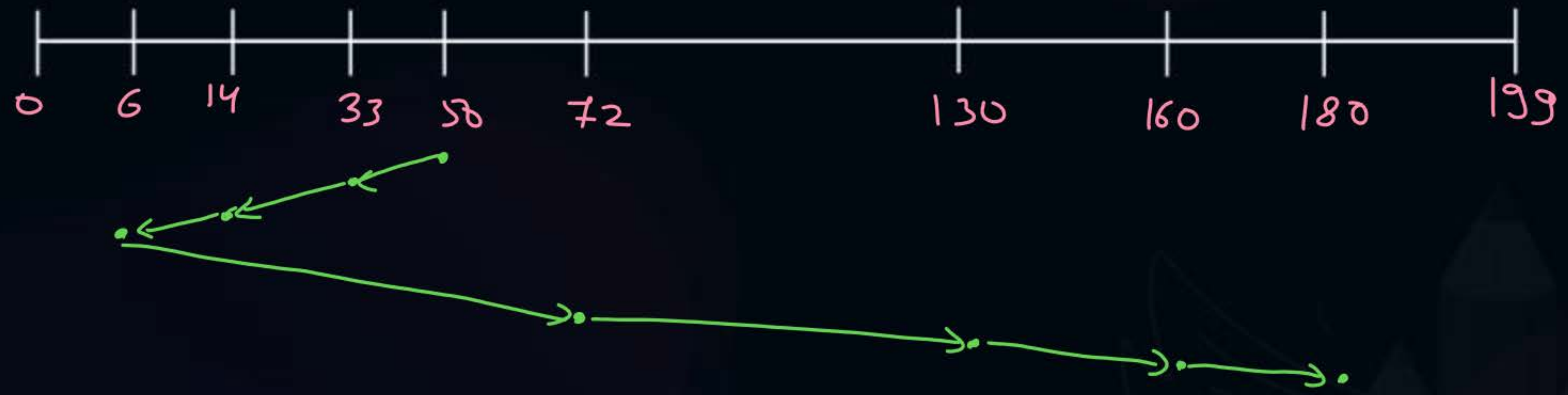
→ serve the nearest request from current position

Suppose the order of request is: 72, 160, 33, 130, 14, 6, 180

The Read/Write arm is at 50

Topic : SSTF (Shortest Seek Time First)

Suppose the order of request is: 72, 160, 33, 130, 14, 6, 180



no. of head movements = 44 + 174
= 218

Topic : SSTF (Shortest Seek Time First)

Advantages:

- Average Response Time decreases
- Throughput increases

Disadvantages:

- Overhead to calculate seek time in advance
- Can cause Starvation for a request if it has higher seek time as compared to incoming requests
- High variance of response time as SSTF favors only some requests

Topic : Scan (Elevator)

Suppose the order of request is: 72, 160, 33, 130, 14, 6, 180

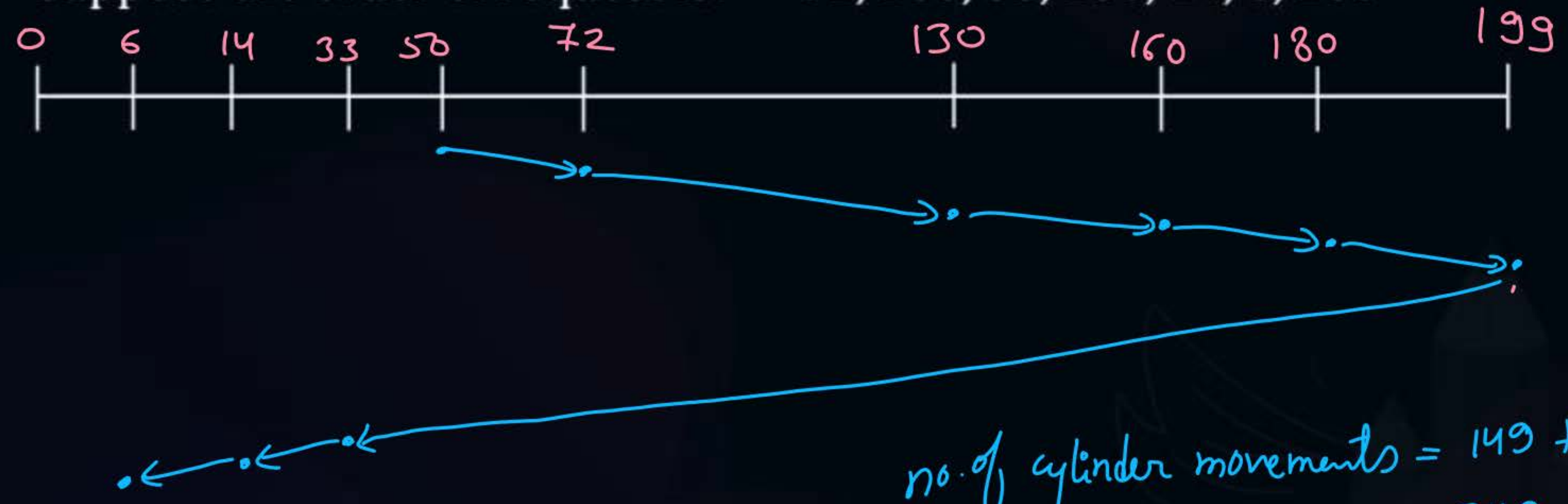
The Read/Write arm is at 50,

The arm should move "towards the larger value"

Direction changes from last cylinder

Topic : Scan (Elevator)

Suppose the order of request is: 72, 160, 33, 130, 14, 6, 180



no. of cylinder movements = 149 + 193

= 342

Topic : Scan

Advantages:

- High throughput
- Low variance of response time
- low Average response time

Disadvantages:

- Long waiting time for requests for locations just visited by disk arm

Topic : C-Scan (circular scan)

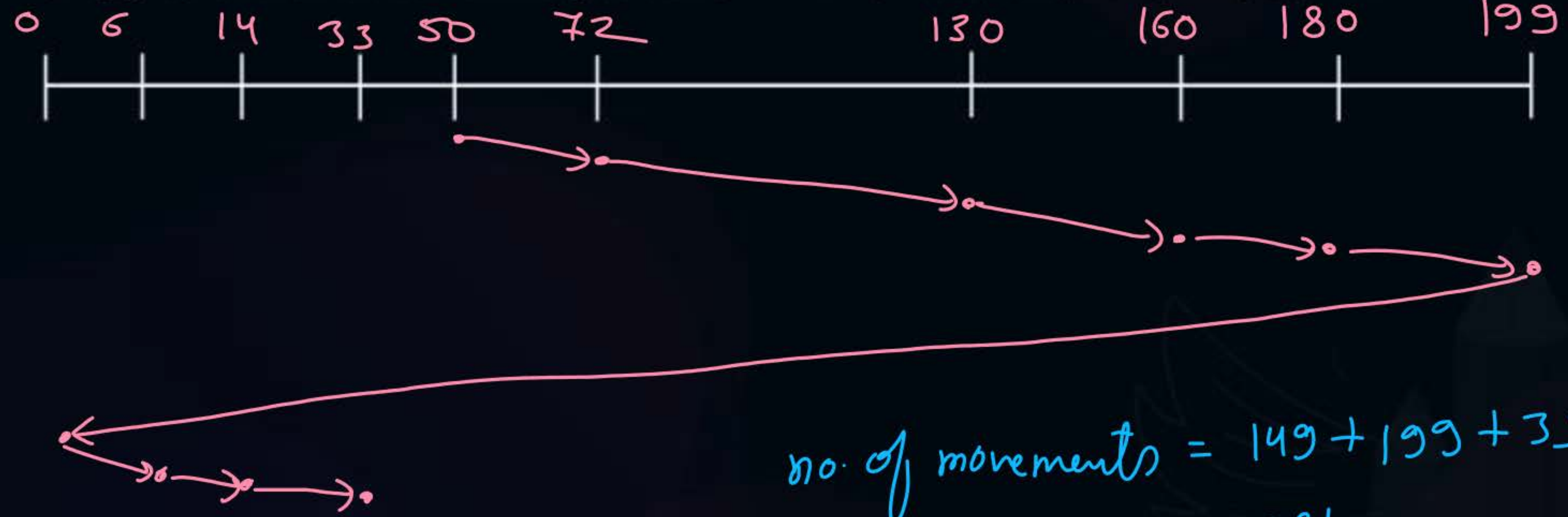
Suppose the order of request is: 72, 160, 33, 130, 14, 6, 180

The Read/Write arm is at 50,

The arm should move "towards the larger value"

Topic : C-Scan

Suppose the order of request is: 72, 160, 33, 130, 14, 6, 180



no. of movements = 149 + 199 + 33

= 381

Topic : C-Scan

Advantages:

- Provides more uniform wait time compared to SCAN

Topic : Look

Suppose the order of request is: 72, 160, 33, 130, 14, 6, 180

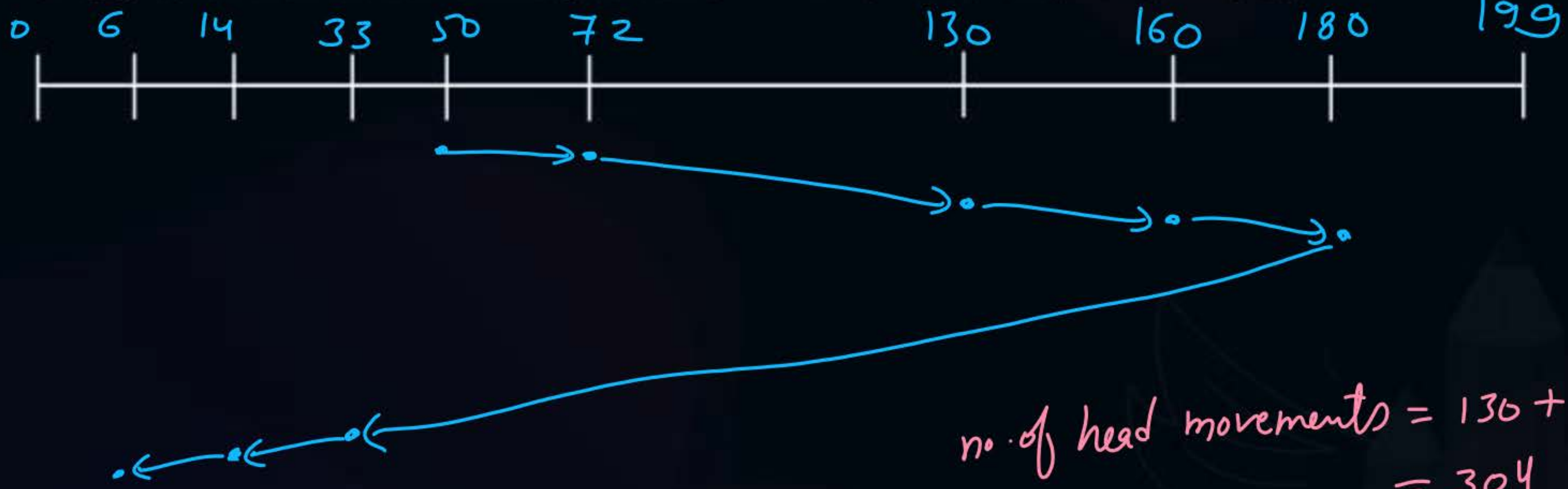
The Read/Write arm is at 50,

The arm should move "towards the larger value"

Direction of head changes from cylinder where last corner pending requests is there

Topic : Look

Suppose the order of request is: 72, 160, 33, 130, 14, 6, 180



no. of head movements = 130 + 174

= 304

Topic : C-Look

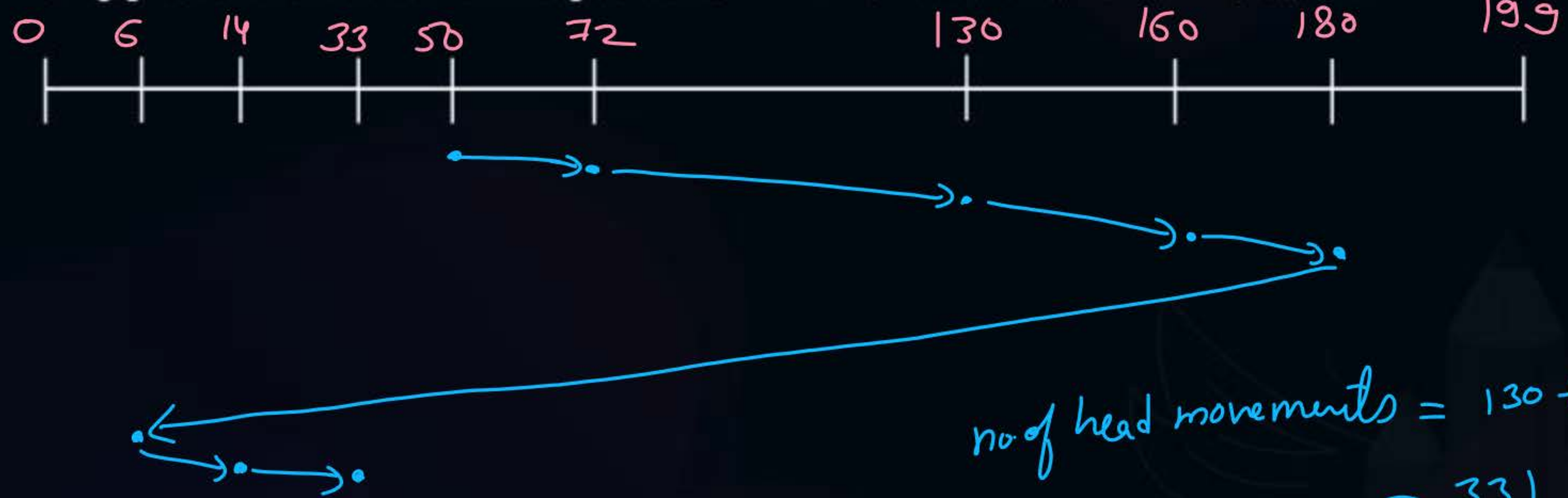
Suppose the order of request is: 72, 160, 33, 130, 14, 6, 180

The Read/Write arm is at 50,

The arm should move “towards the larger value”

Topic : C-Look

Suppose the order of request is: 72, 160, 33, 130, 14, 6, 180



no of head movements $= 130 + 174 + 27$

$= 331$

[MCQ]

#Q. Consider an operating system capable of loading and executing a single sequential user process at a time. The disk head scheduling algorithm used is First Come First Served (FCFS). If FCFS is replaced by Shortest Seek Time First (SSTF), claimed by the vendor to give 50% better benchmark results, what is the expected improvement in the I/O performance of user programs? [2004]

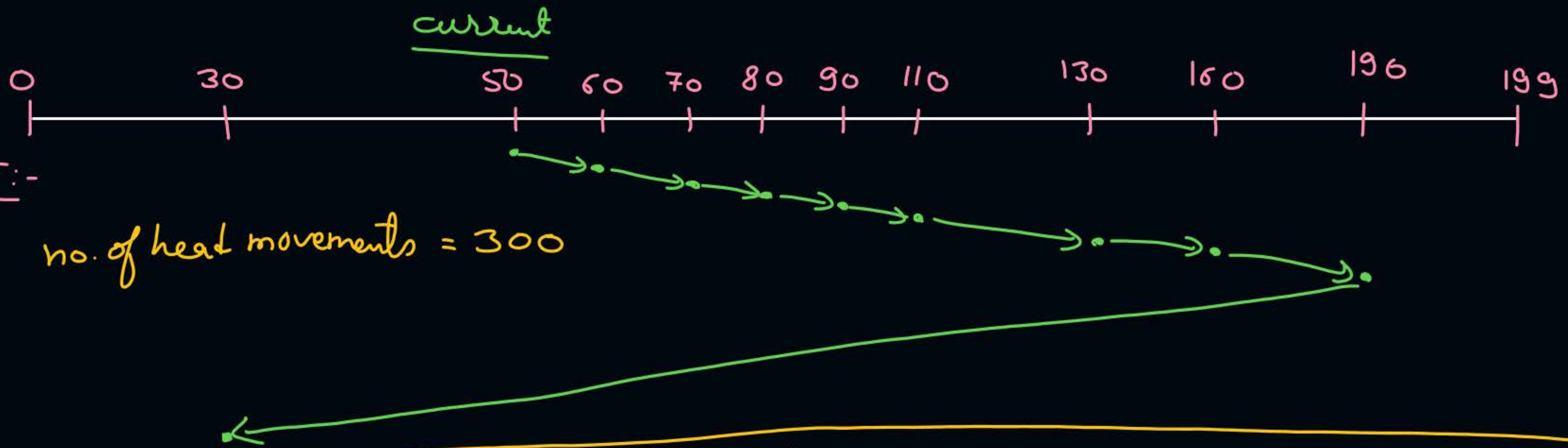
A) 50%

B) 40%

C) 25%

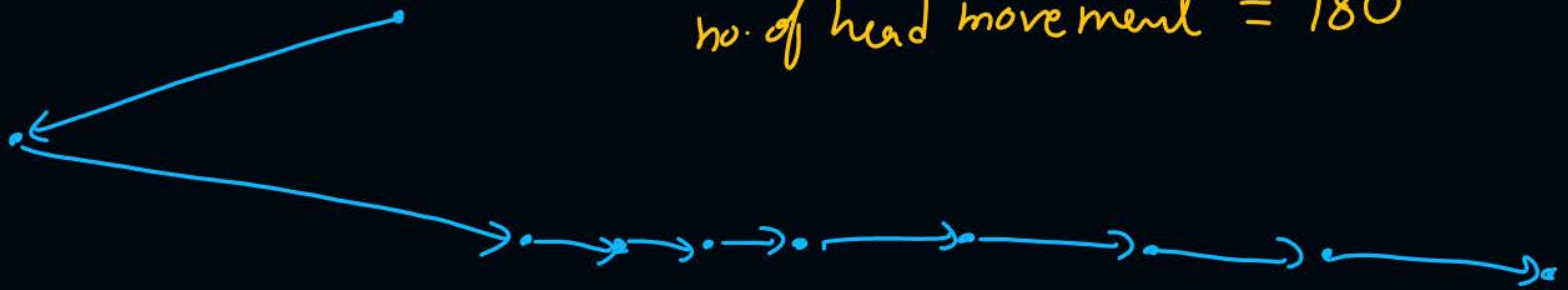
D) 0%

SSTF:-



no. of head movements = 300

Look:- (head moving towards lower cylinder no.)



no. of head movement = 180

⇒ There is no any clear conclusion that which scheduling can provide min. no. of head movements.

[MCQ]

#Q. The head of a hard disk serves request following the shortest seek time first (SSTF) policy. The head is initially positioned at track number 180.

Which of the request sets will cause the head to change its direction after servicing every request assuming that the head does not change direction if there is a tie in SSTF and all the request arrive before the servicing starts?

[2007]

A. 11, 139, 170, 178, 181, 184, 201, 265

B. 10, 138, 170, 178, 181, 185, 201, 265

C. 10, 139, 169, 178, 181, 184, 201, 265

D. 10, 138, 170, 178, 181, 185, 200, 265

[MCQ]

Disk

#Q. Consider a storage disk with 4 platters (numbered as 0, 1, 2 and 3), 200 cylinders (numbered as 0, 1, ... , 199), and 256 sectors per track (numbered as 0, 1, ... 255). The following 6 disk requests of the form [sector number, cylinder number, platter number] are received by the disk controller at the same time:

[120, 72, 2], [180, 134, 1], [60, 20, 0], [212, 86, 3], [56, 116, 2], [118, 16, 1]

sector cyl surf.

Currently head is positioned at sector number 100 of cylinder 80 and is moving towards higher cylinder numbers. The average power dissipation in moving the head over 100 cylinders is 20 milliwatts and for reversing the direction of the head movement once is 15 milliwatts. Power dissipation associated with rotational latency and switching of head between different platters is negligible. The total power consumption in milliwatts to satisfy all of the above disk requests using the Shortest Seek Time First disk scheduling algorithm is _____ . ?

[2018]

Ques) variation from last questⁿ

sector no. will be given ⇒ cylinder

$$C = \left\lfloor \frac{\text{sector no.}}{\text{no. of sectors per cylinder}} \right\rfloor$$

2 mins Summary

Topic Disk Scheduling

Topic SSTF, Scan, Look

Happy Learning

THANK - YOU