CS & IT ENGINEERING

Operating System

File System

Lecture -3

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Recap of Previous Lecture

Topic File Allocation Method

Topic Unix i-node

Topic Disk Cylinder, Seek Time

Topics to be Covered

Topic — Disk Cylinder, Seek Time

Topic — Disk Scheduling Algorithm

Topic — SSTF, Scan, C-Scan, Look, C-Look

Topic : Question

[GATE-2005]

#Q. In a computer system, four files of size 1 1050 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

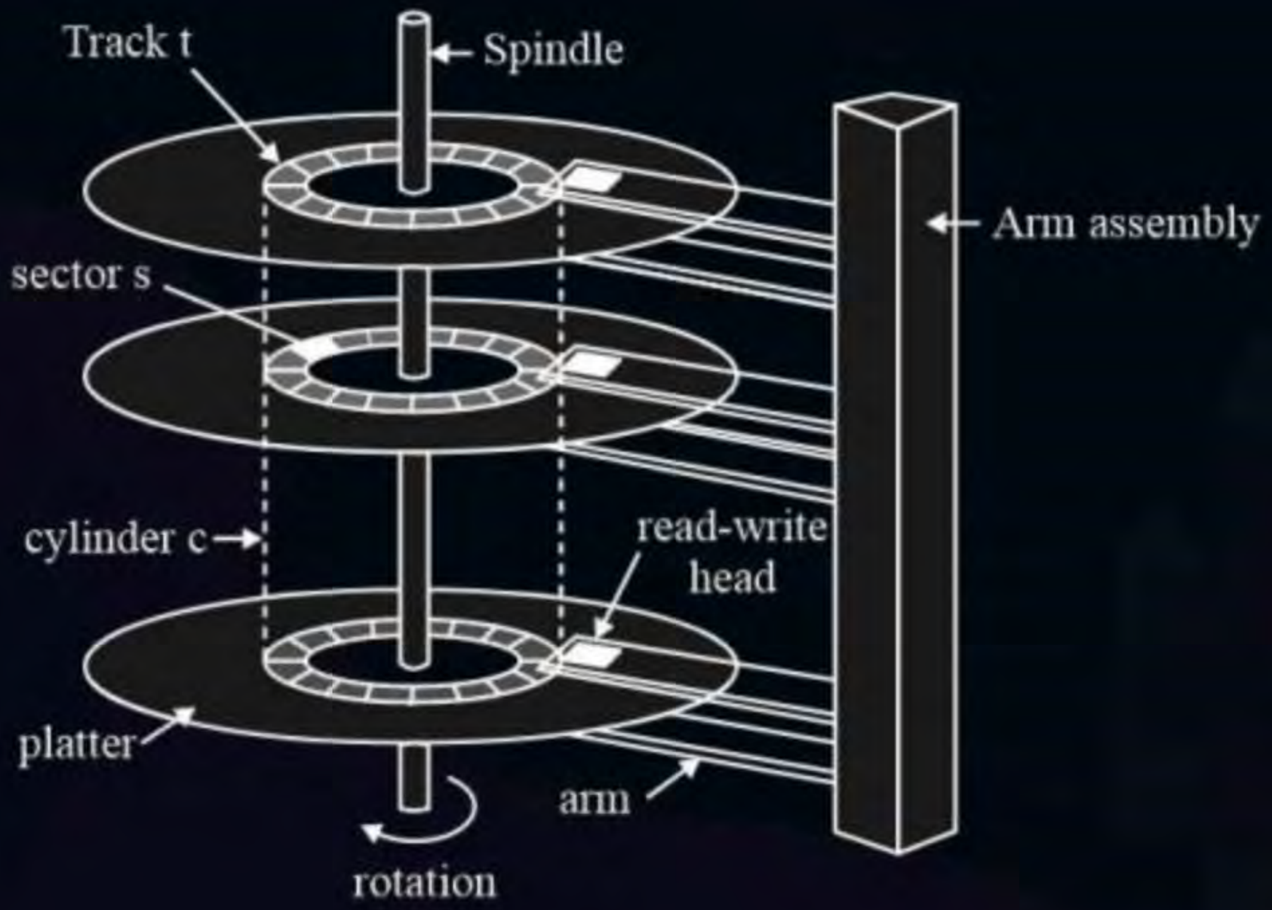
for 100 bytes

File Size	No. of blocks to store file	No. of blocks to store bookkeeping	Total blocks	Total Size
11050 Bytes	$\lceil \frac{11050\,B}{100\,B} \rceil = 111$	$\lceil \frac{111 * 4B}{100B} \rceil = 5$	116	$116 * 100B = 11600\,B$
4990 Bytes	$\lceil \frac{4990\,B}{100\,B} \rceil = 50$	$\lceil \frac{50 * 4B}{100B} \rceil = 2$	52	$= 5200\,B$
5170 Bytes	$\lceil \frac{5170\,B}{100\,B} \rceil = 52$	$\lceil \frac{52 * 4B}{100B} \rceil = 3$	55	$= 5500\,B$
12640 Bytes	$\lceil \frac{12640\,B}{100B} \rceil = 127$	$\lceil \frac{127 * 4B}{100B} \rceil = 6$	133	$= 13300\,B$
				$35600\,B$

Topic : Solution

File Size	No. of blocks to store file	No. of blocks to store bookkeeping	Total blocks	Total Size
11050 Bytes				
4990 Bytes				
5170 Bytes				
12640 Bytes				

Topic : Disk


Track t
Spindle
Arm assembly
sector s
cylinder c
read-write
head
platter
arm
rotation

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

multiple disk requests are pending for various cylinder nos.

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)

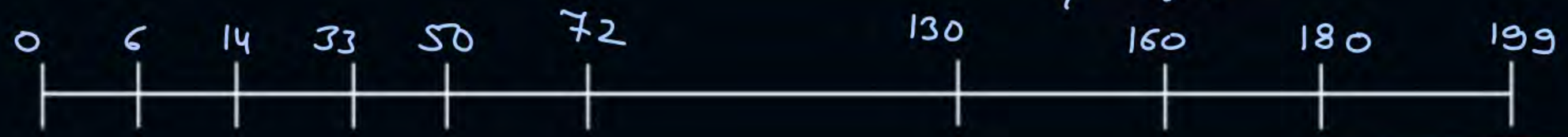
ex:- no. of cylinders = 200 (0–199)

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~~



Total no. of head (cylinder) movements

$= (72-50) + (160-72) + (160-33) + (130-33) + (130-14) + (14-6) + (180-6)$

$= \underline{632}$

assuming:-

for 1 head movement, disk takes time = 0.05 ms

for all requests seek time = 31.6 ms

Ans = 632 * 0.05 ms

= 31.6 ms

Topic : FCFS (First Come First Serve)

Advantages:

- Every request gets a fair chance
- No indefinite postponement (no starvation for disk requests)

Disadvantages:

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

Topic : SSTF (Shortest Seek Time First)

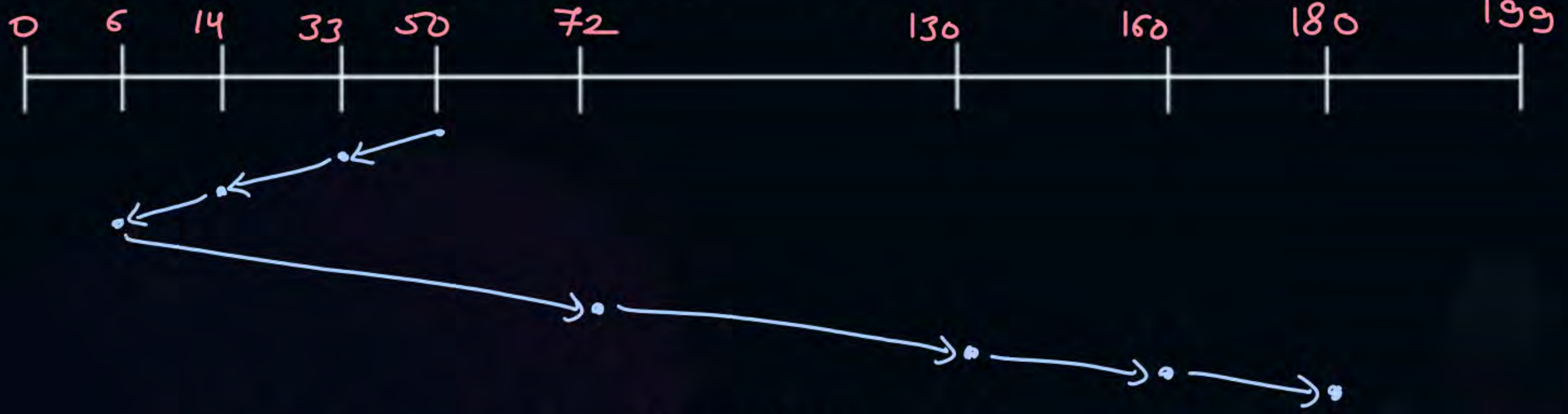
fulfill request of nearest cylinder first.

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 = (50 − 6) + (180 − 6)

= 44 + 174

= 218

Topic : SSTF (Shortest Seek Time First)

Advantages:

- min. no. of head movements
- 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)

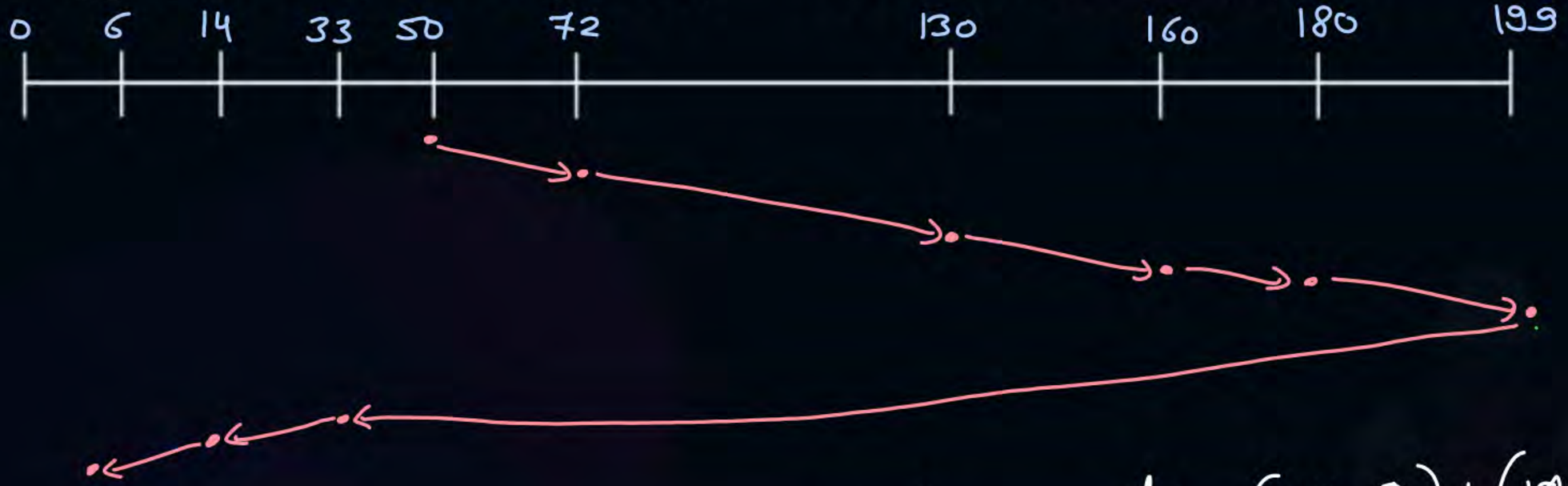
Suppose the order of request is: 72, 160, 33, 130, 14, 6, 180

The Read/Write arm is at 50,

The arm should move “towards the larger value”

Topic : Scan (Elevator)

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



no. of head movements = (199 − 50) + (199 − 6)

= 149 + 193

= 342

Topic : Scan

Advantages:

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

Disadvantages:

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

Topic : C-Scan

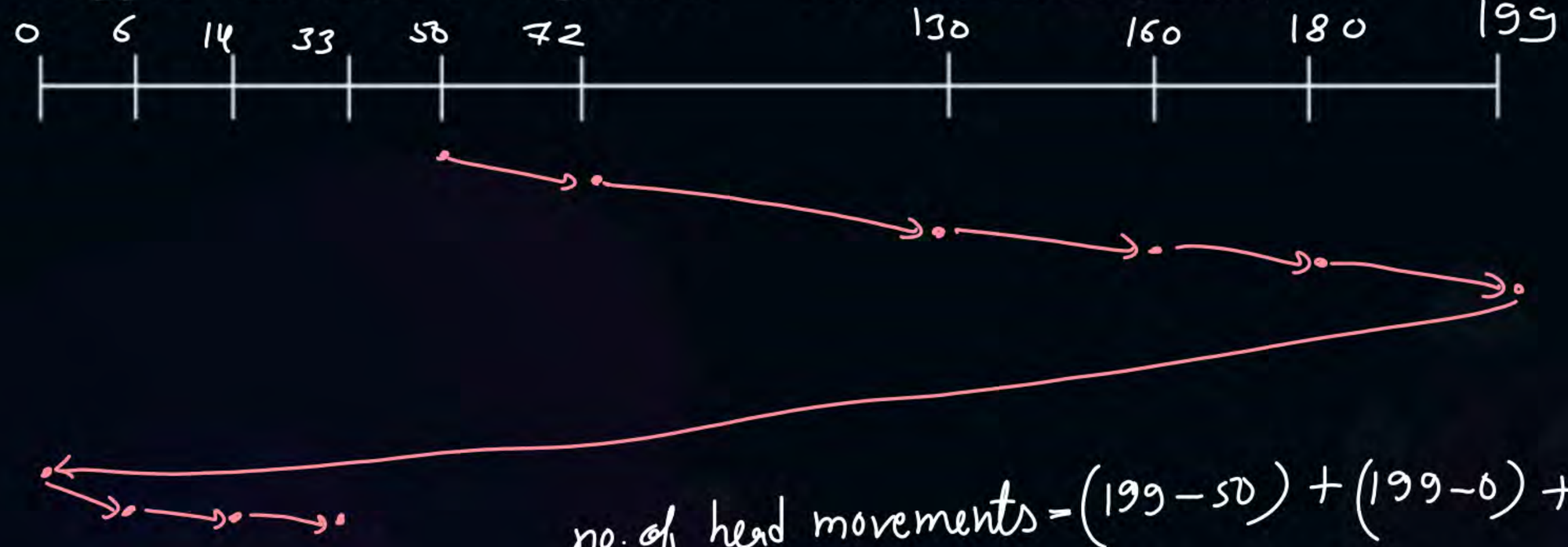
Suppose the order of request is: 72, 160, 33, 130, 14, 6, 180

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 head movements = (199 − 50) + (199 − 0) + (33 − 0)

= 149 + 199 + 33

= 381

Topic : C-Scan

Advantages:

- Provides more uniform wait time compared to SCAN

Topic : Look

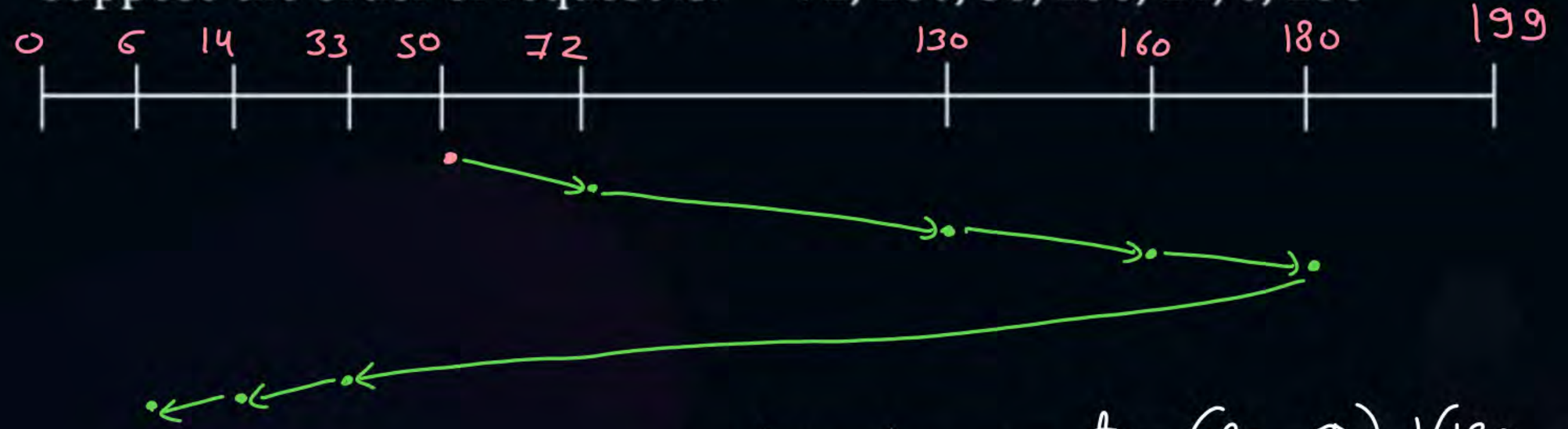
Suppose the order of request is: 72, 160, 33, 130, 14, 6, 180

The Read/Write arm is at 50,

The arm should move “towards the larger value”

Topic : Look

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



no. of head movements = (180 − 50) + (180 − 6)

= 130 + 174

= 304

Topic : C-Look

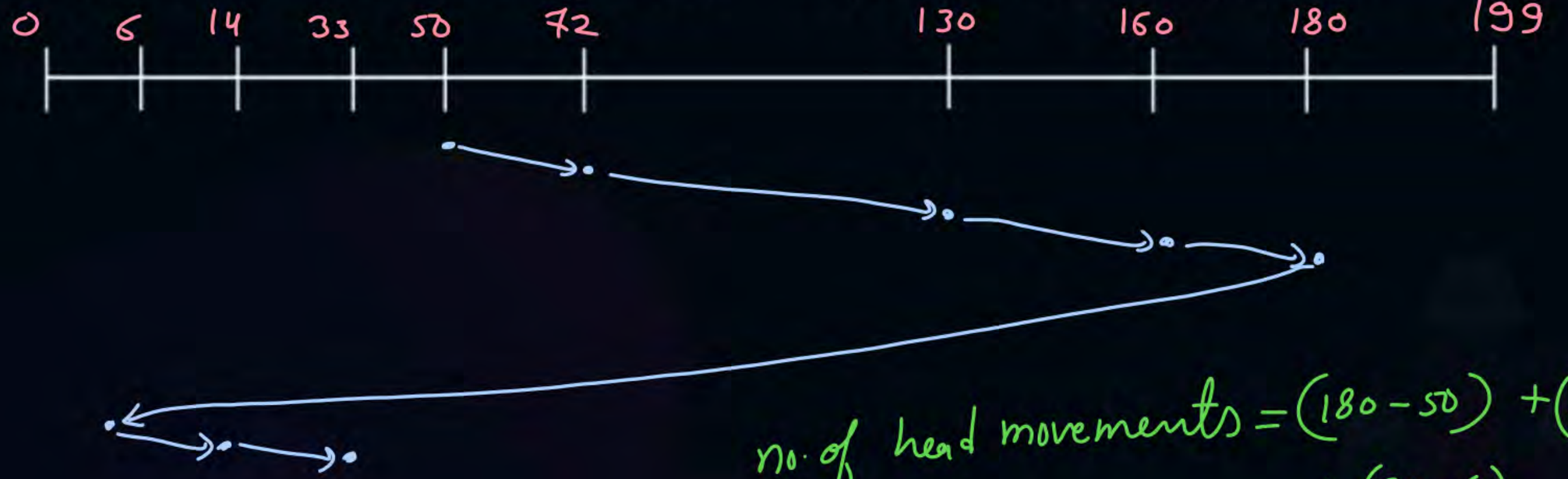
Suppose the order of request is: 72, 160, 33, 130, 14, 6, 180

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 = (180 − 50) + (180 − 6)
+ (33 − 6)
= 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%

[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]

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

What is the maximum cardinality of the request set, so that the head changes its direction after servicing every request if the total number of tracks are 2048 and the head can start from any track? [2007]

A 9

B 10

C 11

D 12

[NAT]

#Q. Suppose a disk has 201 cylinders, numbered from 0 to 200. At some time the disk arm is at cylinder 100, and there is a queue of disk access requests for cylinders 30, 85, 90, 100, 105, 110, 135 and 145. If Shortest-Seek Time First (SSTF) is being used for scheduling the disk access, the request for cylinder 90 is serviced after servicing _____ number of requests. **[2014]**

[NAT]

#Q. Cylinder a disk queue with requests for I/O to blocks on cylinders 47, 38, 121, 191, 87, 11, 92, 10. The C-LOOK scheduling algorithm is used. The head is initially at cylinder number 63, moving towards large cylinder numbers on its servicing pass. The cylinders are numbered from 0 to 199. The total head movement (in number of cylinders) incurred while servicing these requests is _____. **[2016]**

2 mins Summary

Topic Disk Cylinder, Seek Time

Topic Disk Scheduling Algorithm

Topic SSTF, Scan, C-Scan, Look, C-Look

Happy Learning

THANK - YOU