OPERATING SYSTEMS

Disk Scheduling

Class Presentations on Operating System

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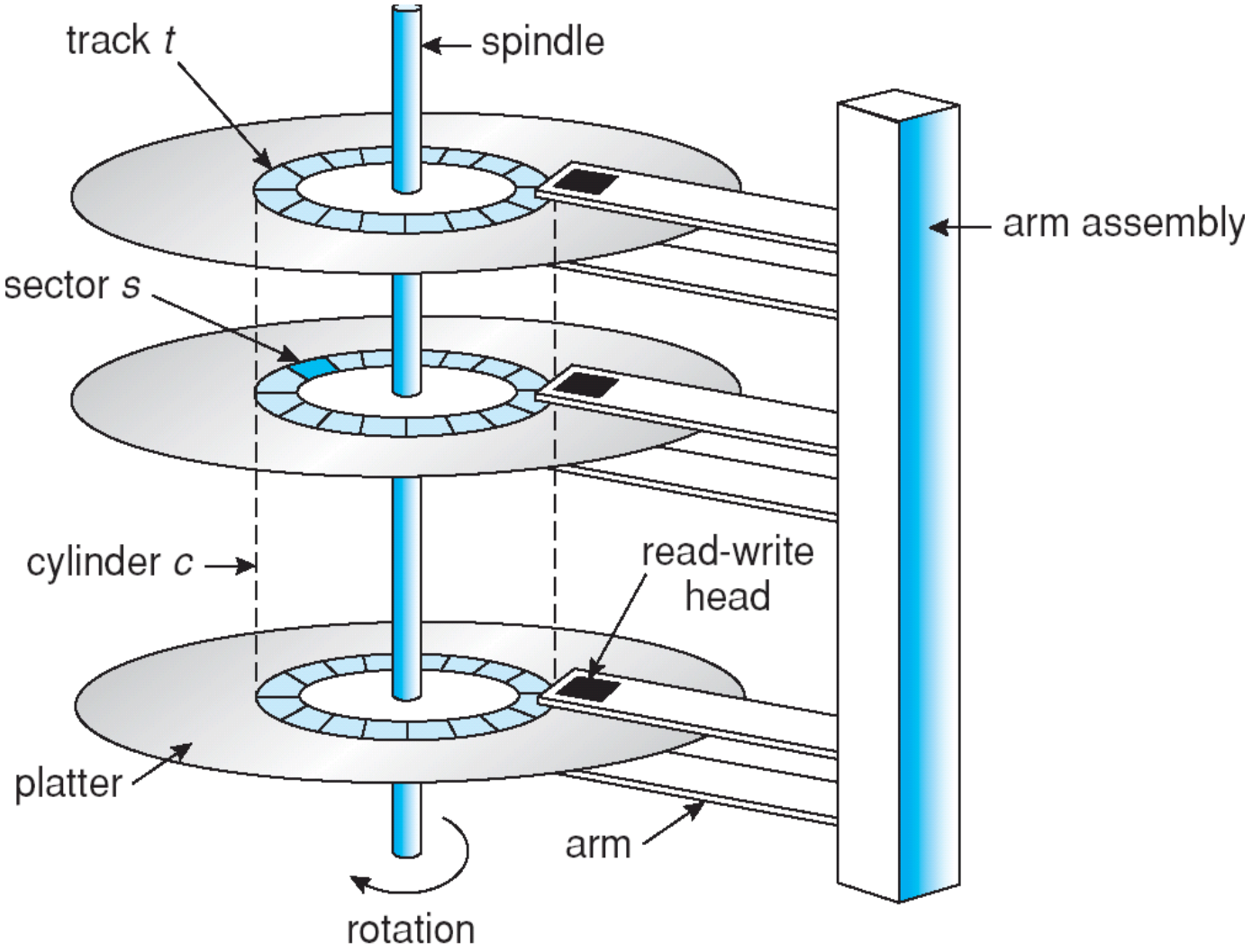
Disk Scheduling

- As we know, a process needs two type of time, CPU time and IO time. For I/O, it requests the Operating system to access the disk.
- However, the operating system must be fare enough to satisfy each request and at the same time, operating system must maintain the efficiency and speed of process execution.
- The technique that operating system uses to determine the request which is to be satisfied next is called disk scheduling.

Moving-head Disk Mechanism



- **Seek Time**
- Seek time is the time taken in locating the disk arm to a specified track where the read/write request will be satisfied.
- **Rotational Latency**
- It is the time taken by the desired sector to rotate itself to the position from where it can access the R/W heads.
- **Transfer Time**
- It is the time taken to transfer the data.

- **Disk Access Time**
- Disk access time is given as,
- Disk Access Time = Rotational Latency + Seek Time + Transfer Time
- **Disk Response Time**
- It is the average of time spent by each request waiting for the IO operation.

Purpose of Disk Scheduling

- The main purpose of disk scheduling algorithm is to select a disk request from the queue of IO requests and decide the schedule when this request will be processed.

Goal of Disk Scheduling Algorithm

- Fairness
- High throughout
- Minimal traveling head time

Disk Scheduling Algorithms

- FCFS scheduling algorithm
- SSTF (shortest seek time first) algorithm
- SCAN scheduling
- C-SCAN scheduling
- LOOK Scheduling
- C-LOOK scheduling

Disk Scheduling Algorithms

- We illustrate them with a I/O request queue (cylinders are between 0-199):

  queue = 98, 183, 37, 122, 14, 124, 65, 67

  head starts at 53

First Come First Serve (FCFS) Example

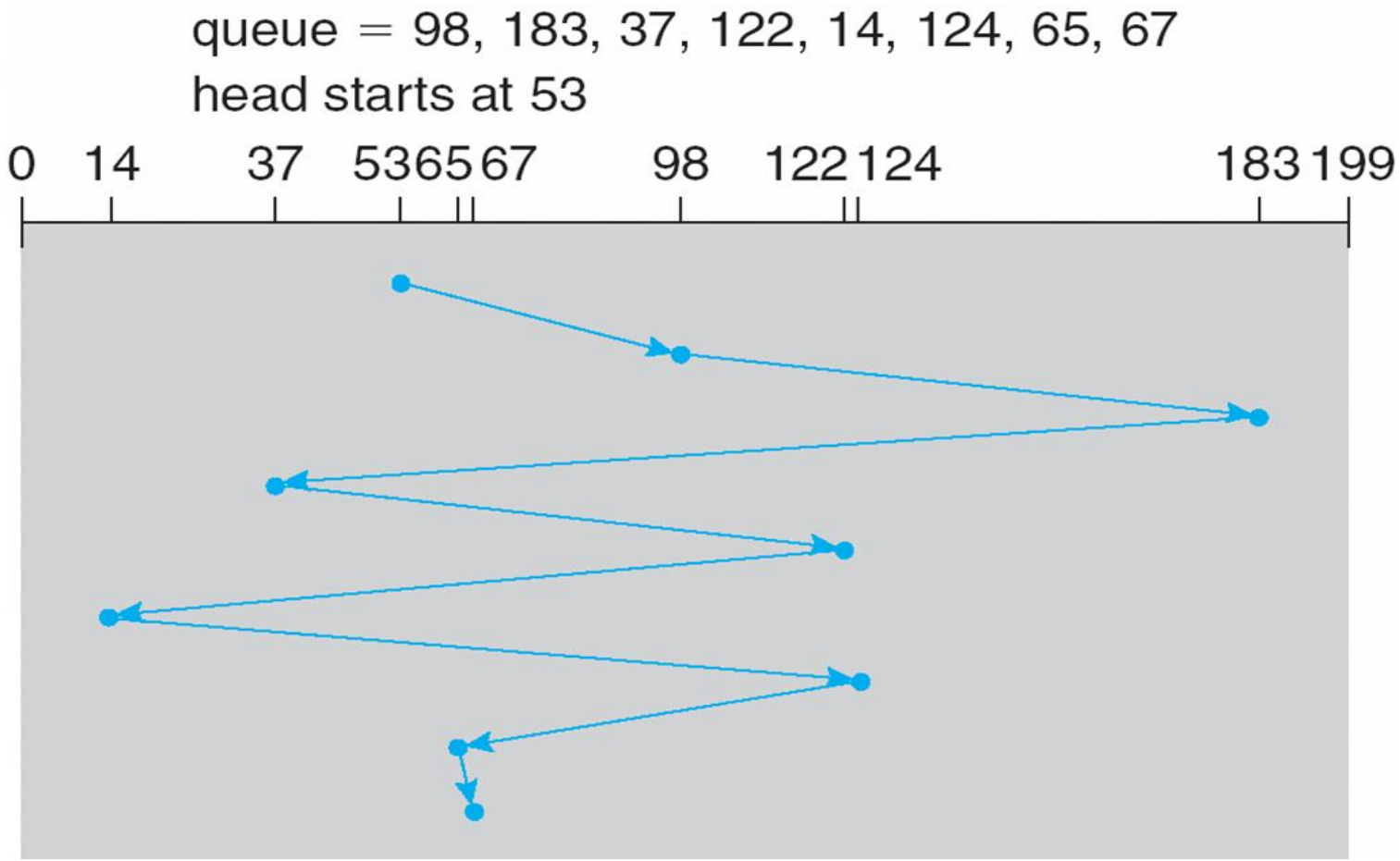


Illustration shows total head movement of 640 cylinders.

First Come First Serve (FCFS)

- Handle I/O requests sequentially.
- Fair to all processes.
- Suffers from global zigzag effect.

Shortest Seek Time First (SSTF) Example

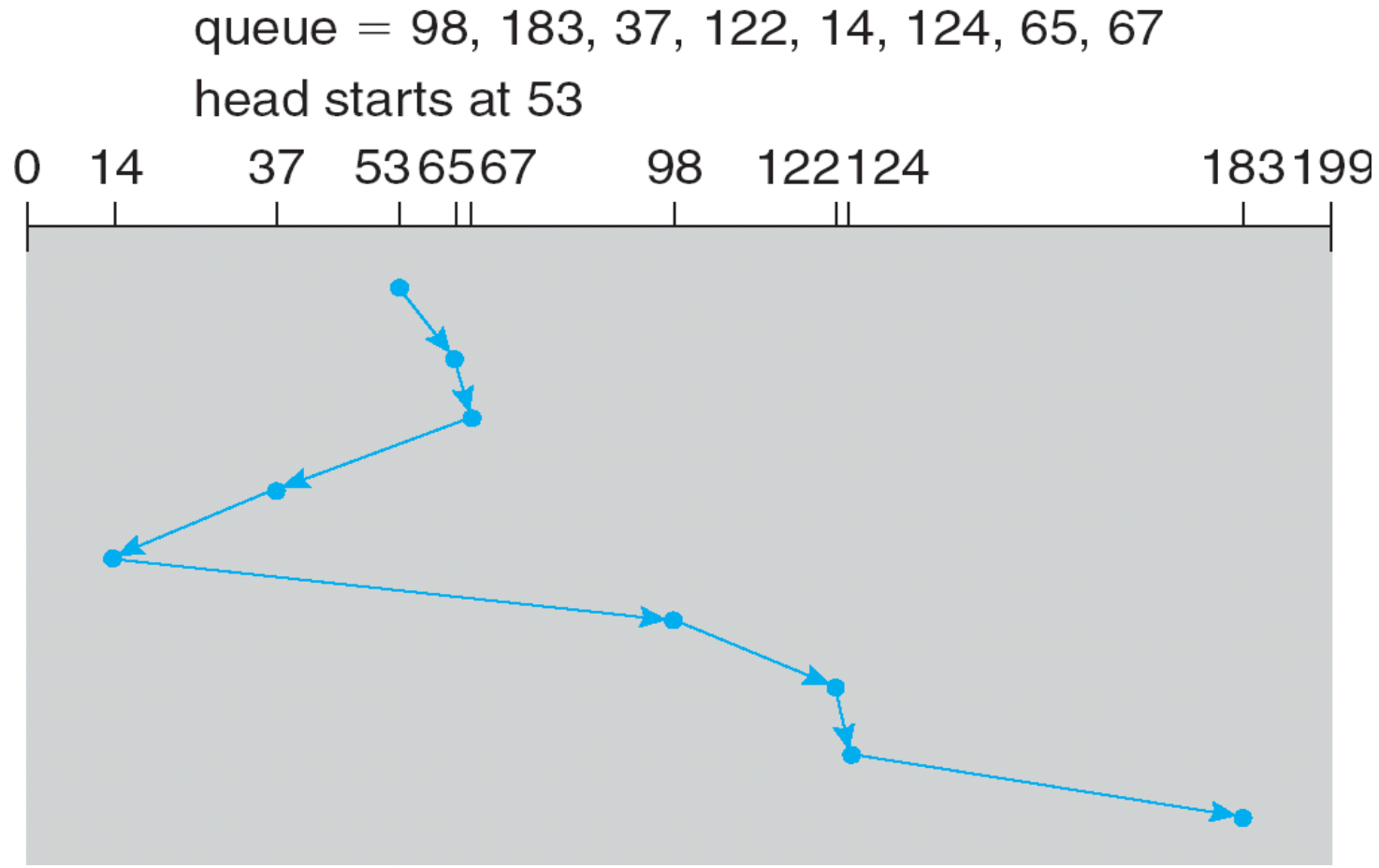


Illustration shows total head movement of 236 cylinders.

Shortest Seek Time First (SSTF)

- Selects the request with the minimum seek time from the current head position.
- Also called Shortest Seek Distance First (SSDF) – It's easier to compute distances.
- It's biased in favor of the middle cylinders requests.
- SSTF scheduling is a form of SJF scheduling; may cause starvation of some requests.

FCFS

- Request sequence = {176, 79, 34, 60, 92, 11, 41, 114}
- Initial head position = 50
- Total number of seek operations or head movement?

Therefore, the total seek count is calculated as:
=(176-50)+(176-79)+(79-34)+(60-34)+(92-60)+(92-11)+(41-11)+(114-41) = 510

SSTF

- Consider the following disk request sequence for a disk with 100 tracks
- 45, 21, 67, 90, 4, 89, 52, 61, 87, 25
- Head pointer starting at 50. Find the number of head movements in cylinders using SSTF scheduling.

4 21 25 45 50 52 61 67 87 89 90

Number of cylinders = 5 + 7 + 9 + 6 + 20 + 2 + 1 + 65 + 4 + 17 = 136

Elevator Algorithms

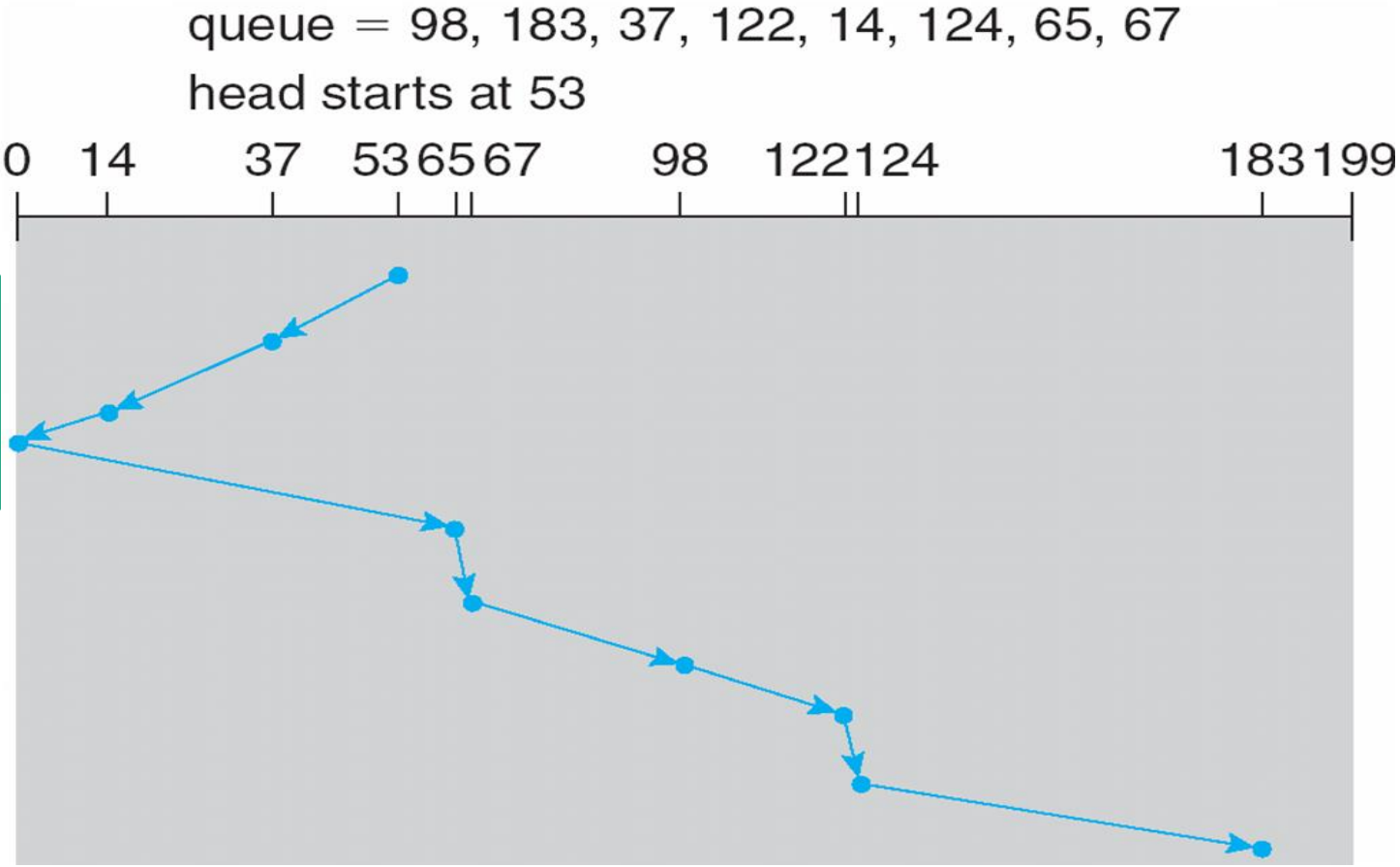
- Algorithms based on the common elevator principle.
- Four combinations of Elevator algorithms:
  - Service in both directions or in only one direction.
  - Go until last cylinder or until last I/O request.

Direction \ Go until	Go until the last cylinder	Go until the last request
Service both directions	**Scan**	**Look**
Service in only one direction	**C-Scan**	**C-Look**

Scan

- The disk arm starts at one end of the disk, and moves toward the other end, servicing requests until it gets to the other end of the disk, where the head movement is reversed and servicing continues.
- It moves in both directions until both ends.
- Tends to stay more at the ends so more fair to the extreme cylinder requests.

Scan Example



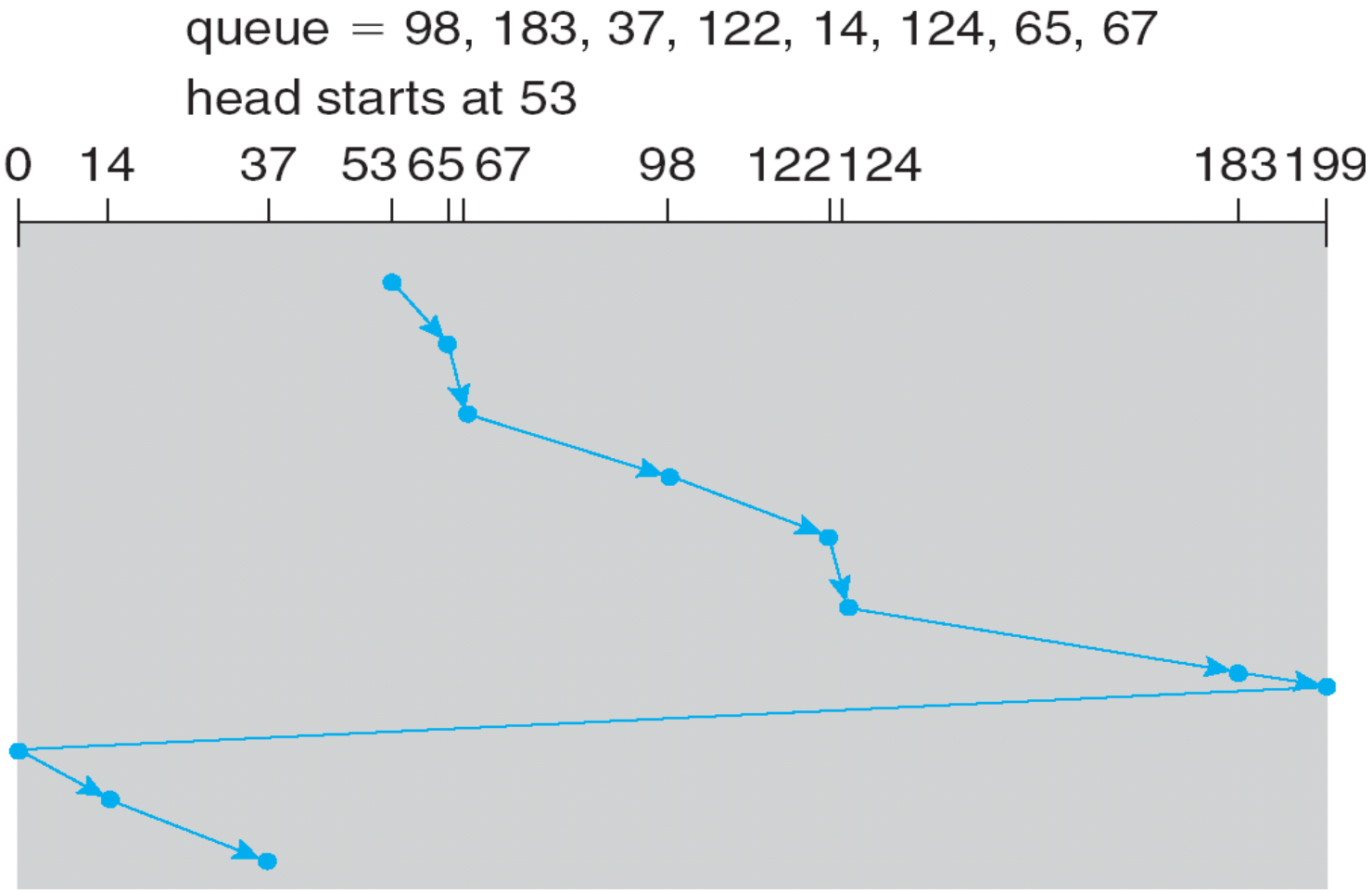
Assuming disk arm is moving toward 0

Illustration shows total head movement of 236 cylinders.

C-Scan

- The head moves from one end of the disk to the other, servicing requests as it goes. When it reaches the other end, however, it immediately returns to the beginning of the disk, without servicing any requests on the return trip.
- Treats the cylinders as a circular list that wraps around from the last cylinder to the first one.
- Provides a more uniform wait time than SCAN; it treats all cylinders in the same manner.

C-Scan Example



Look

- The disk arm starts at the first I/O request on the disk, and moves toward the last I/O request on the other end, servicing requests until it gets to the other extreme I/O request on the disk, where the head movement is reversed and servicing continues.
- It moves in both directions until both last I/O requests;

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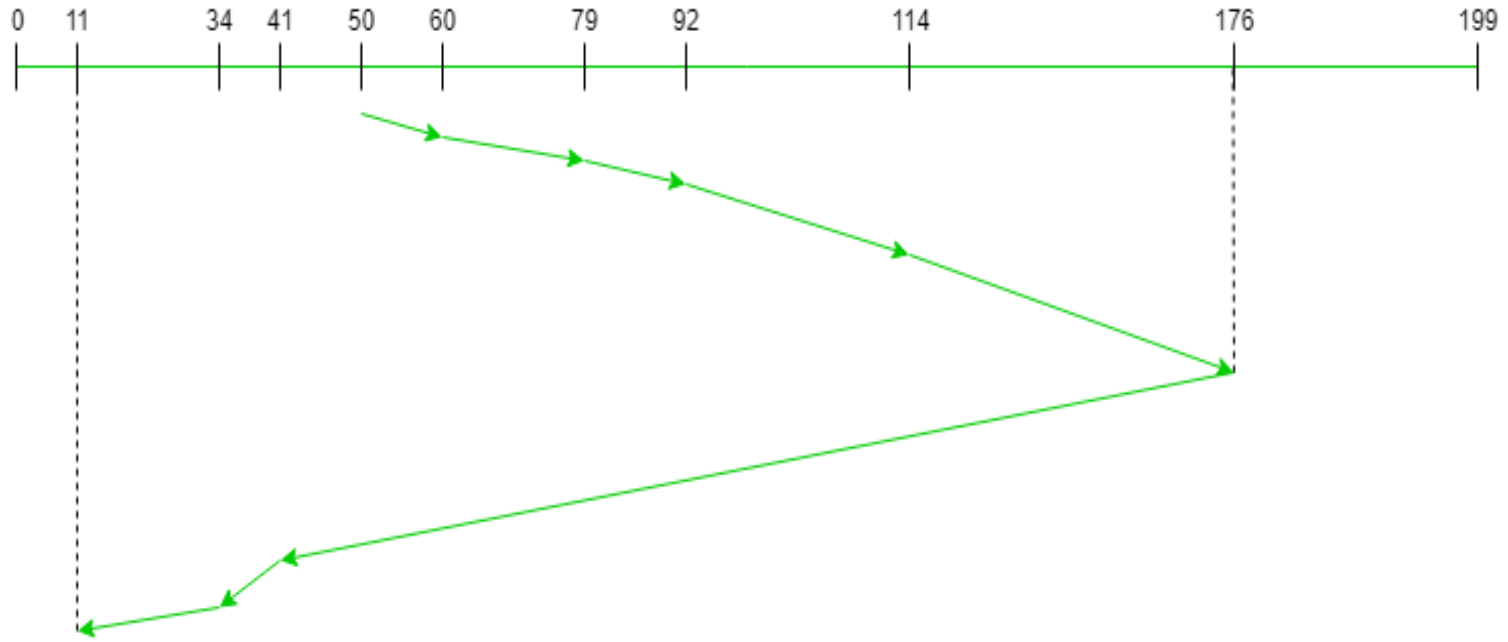
Example

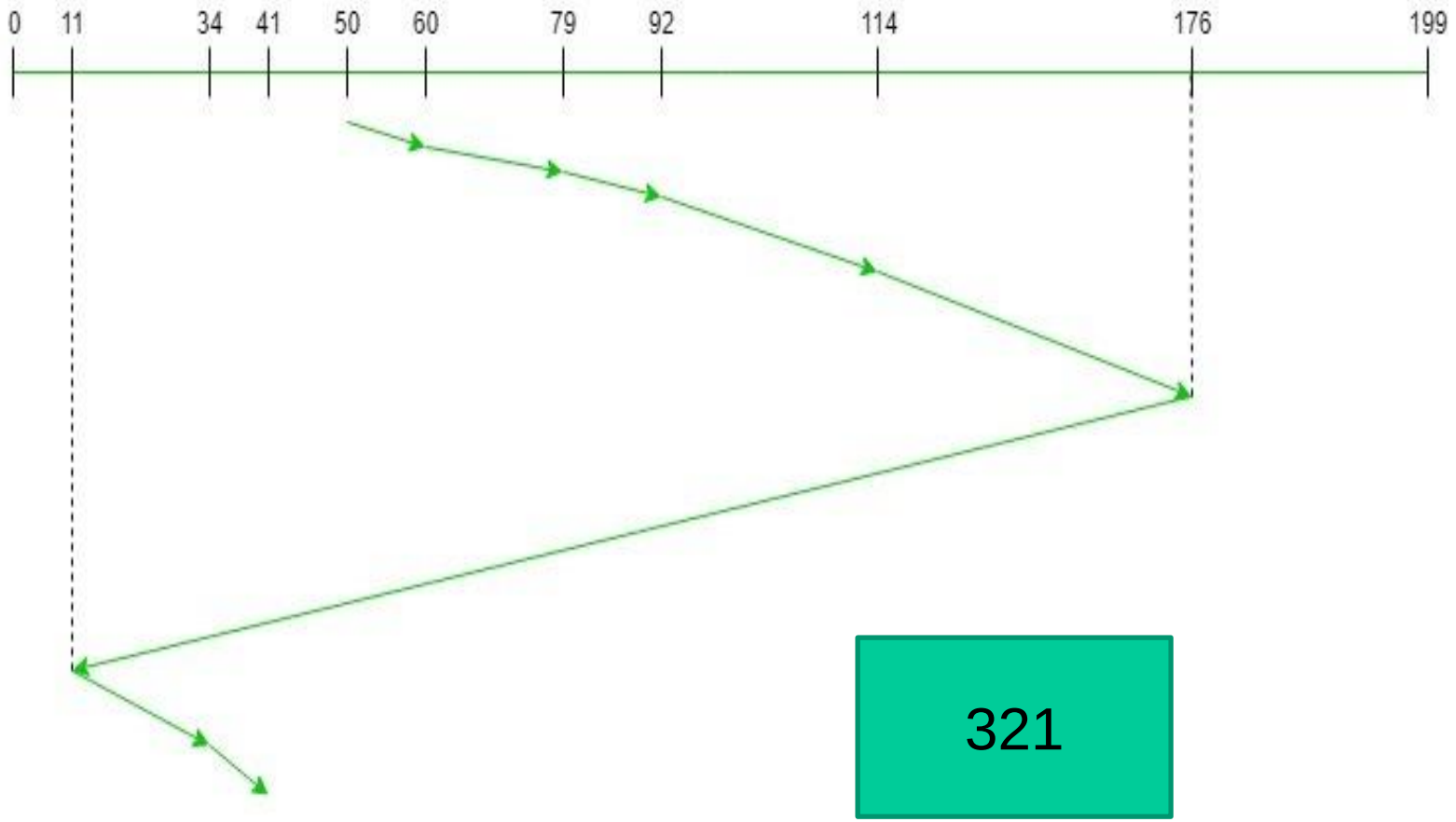
- Request sequence = {176, 79, 34, 60, 92, 11, 41, 114} Initial head position = 50 Direction = right (We are moving from left to right)



C-Look

- Look version of C-Scan.
- Arm only goes as far as the last request in each direction, then reverses direction immediately, without first going all the way to the end of the disk.
- In general, Circular versions are more fair but pay with a larger total seek time.
- Scan versions have a larger total seek time than the corresponding Look versions.

Request sequence = {176, 79, 34, 60, 92, 11, 41, 114}
Initial head position = 50
Direction = right (Moving from left to right)



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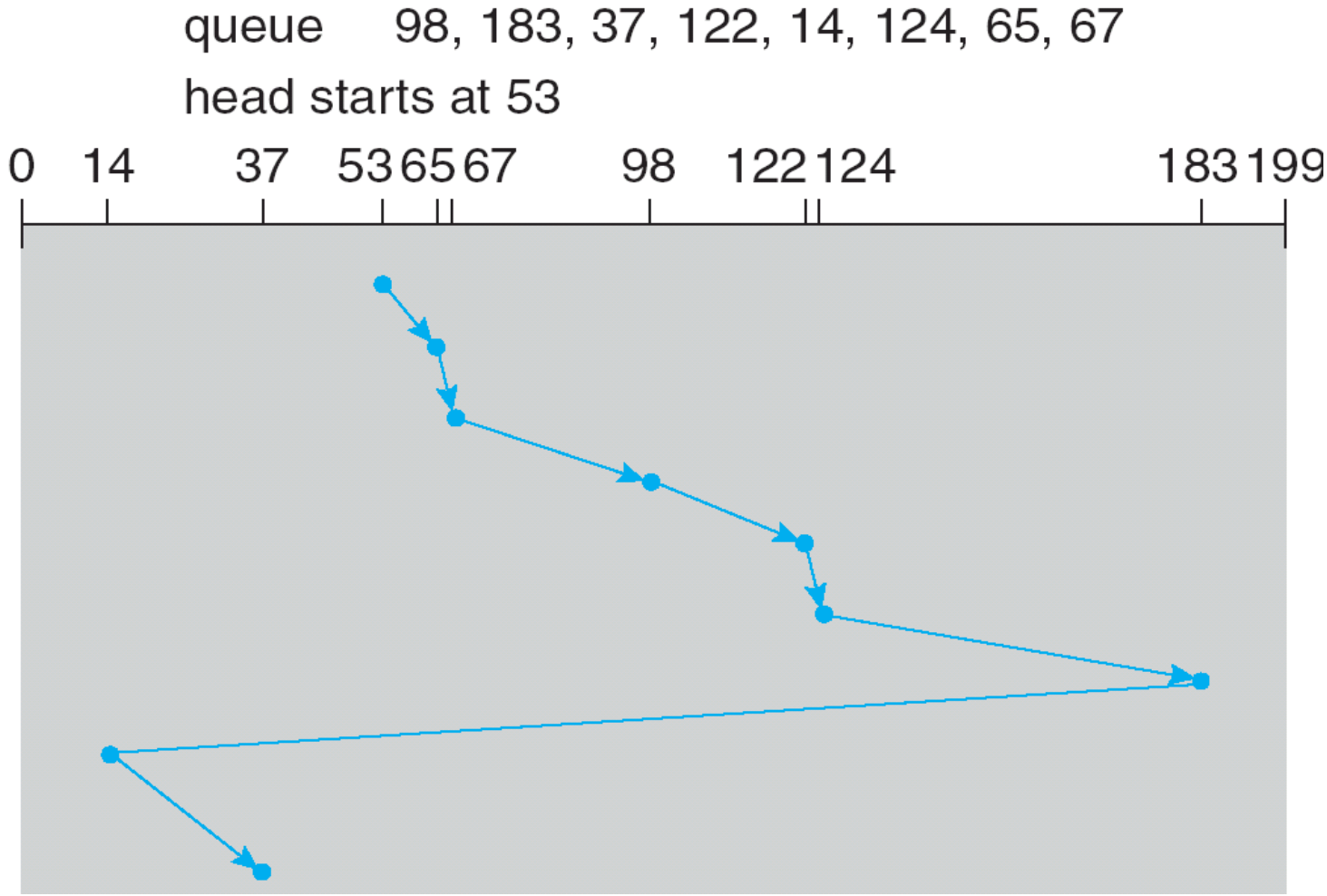
C-Look Example

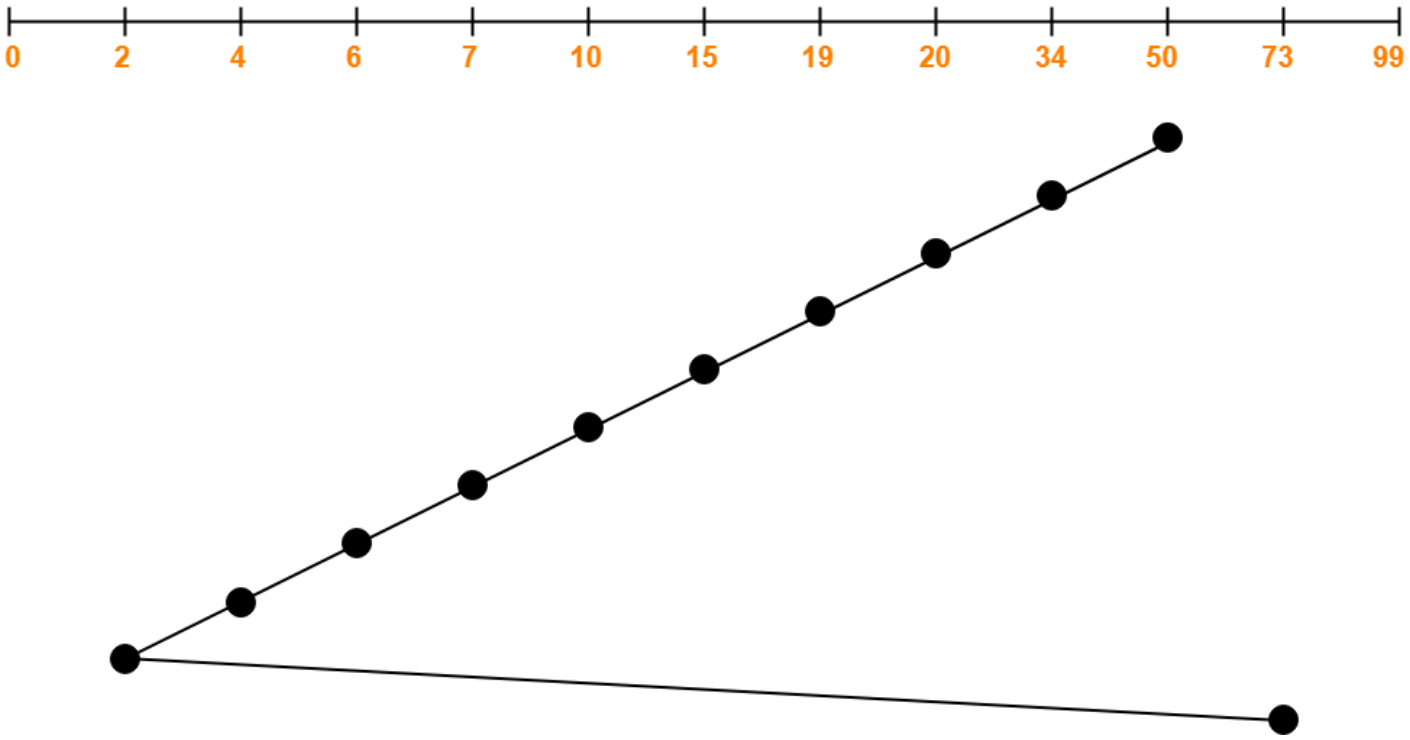


Q1

- Consider a disk system with 100 cylinders. The requests to access the cylinders occur in following sequence-
- 4, 34, 10, 7, 19, 73, 2, 15, 6, 20
- Assuming that the head is currently at cylinder 50, what is the time taken to satisfy all requests if it takes 1 ms to move from one cylinder to adjacent one and shortest seek time first policy is used?
- 95 ms
- 119 ms
- 233 ms
- 276 ms

Solution

- 119

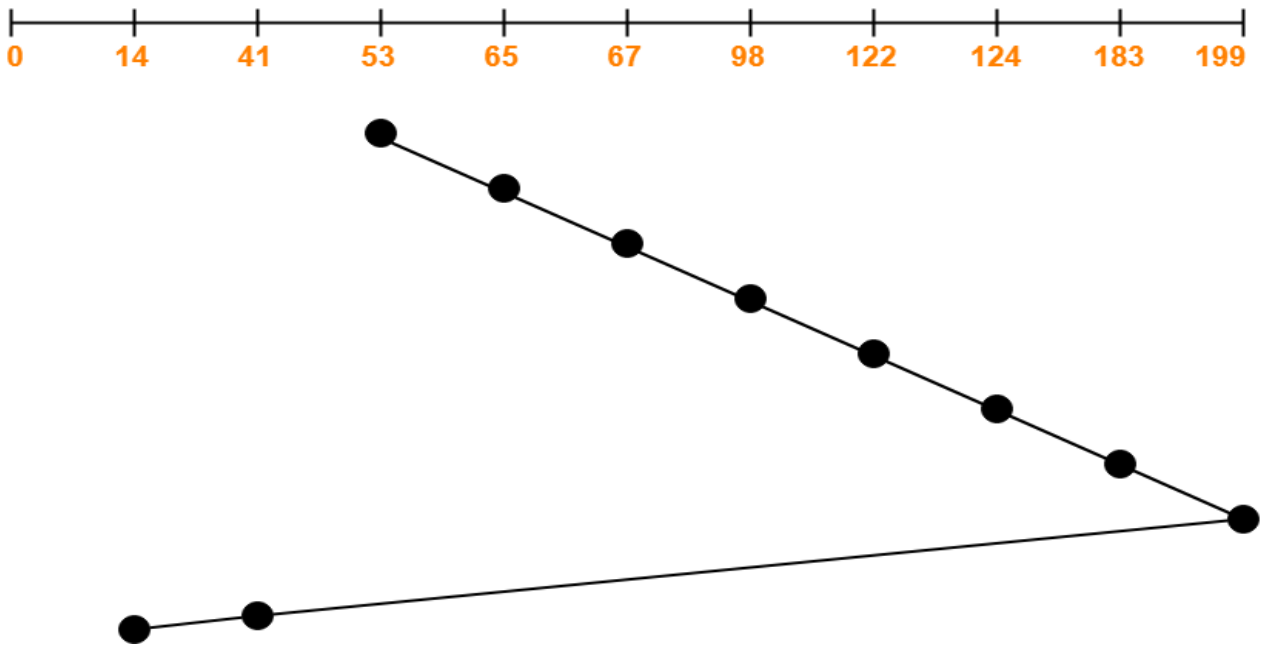


Q2

- Consider a disk queue with requests for I/O to blocks on cylinders 98, 183, 41, 122, 14, 124, 65, 67. The SCAN scheduling algorithm is used. The head is initially at cylinder number 53 moving towards larger 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 _____.

Solution

- 331

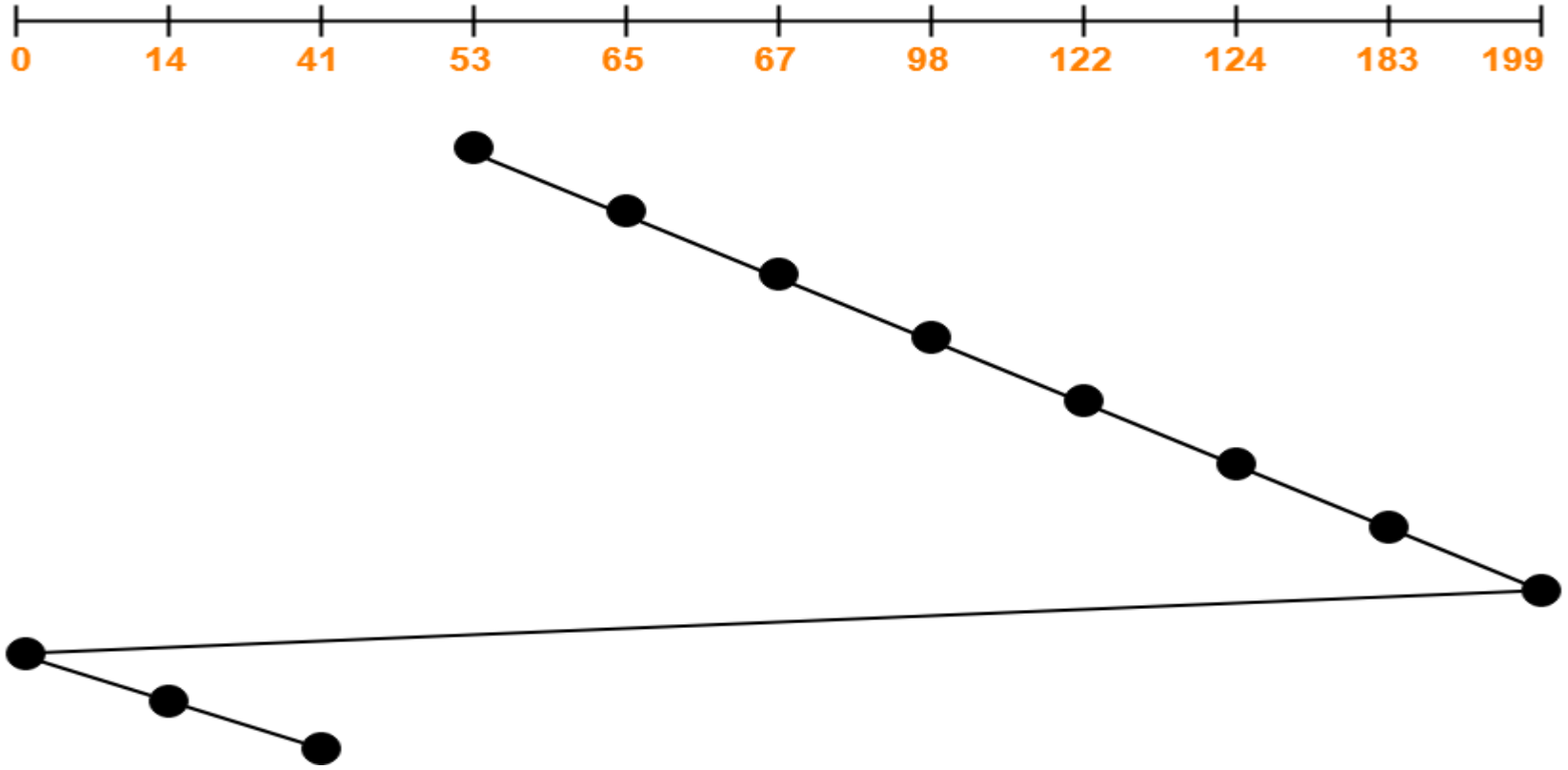


Q3

- Consider a disk queue with requests for I/O to blocks on cylinders 98, 183, 41, 122, 14, 124, 65, 67. The C-SCAN scheduling algorithm is used. The head is initially at cylinder number 53 moving towards larger 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 _____.

Solution

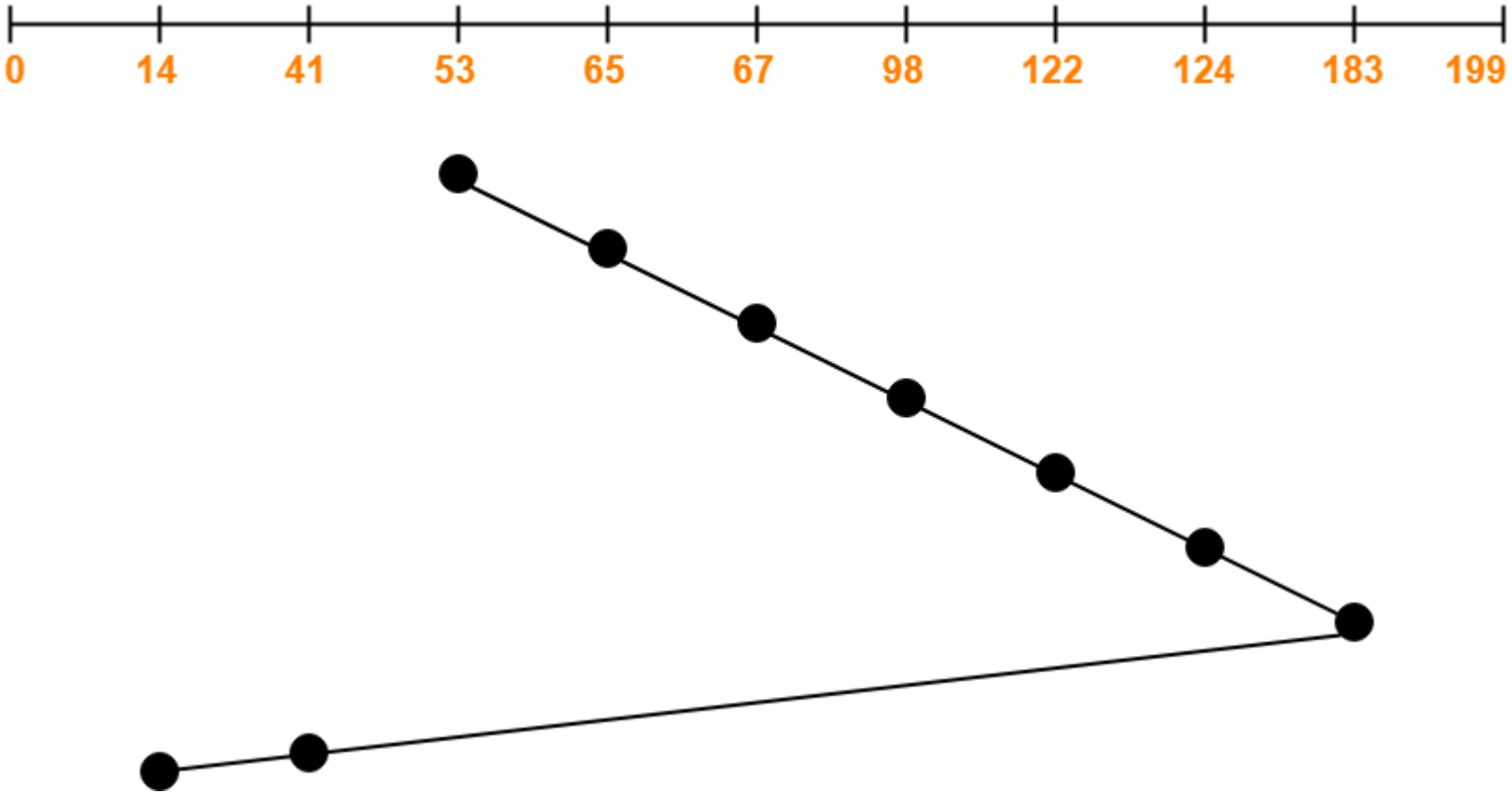
- 386



Q4

- Consider a disk queue with requests for I/O to blocks on cylinders 98, 183, 41, 122, 14, 124, 65, 67. The LOOK scheduling algorithm is used. The head is initially at cylinder number 53 moving towards larger 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 _____.

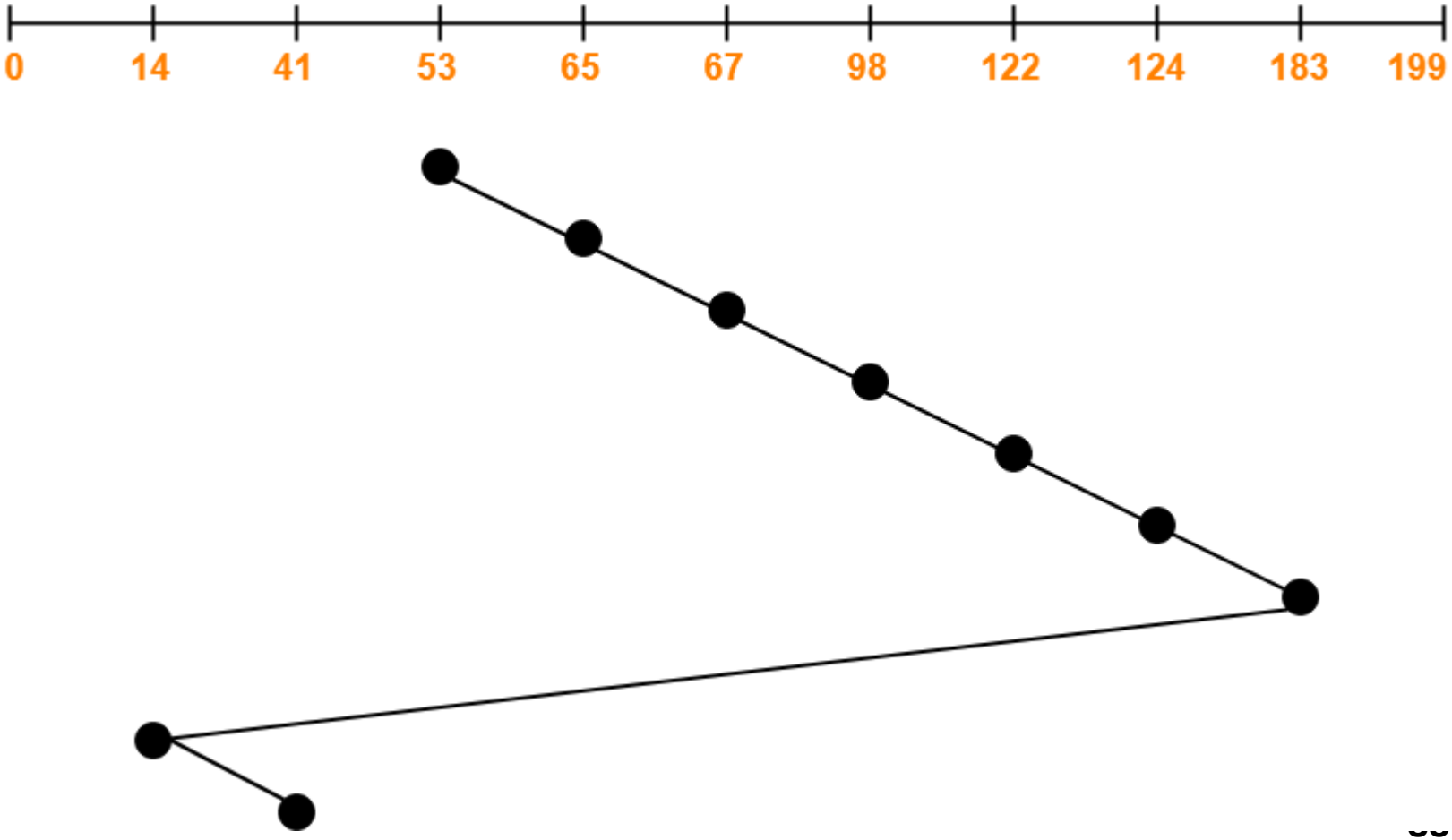
Solution: 299



Q5

- Consider a disk queue with requests for I/O to blocks on cylinders 98, 183, 41, 122, 14, 124, 65, 67. The C-LOOK scheduling algorithm is used. The head is initially at cylinder number 53 moving towards larger 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 _____.

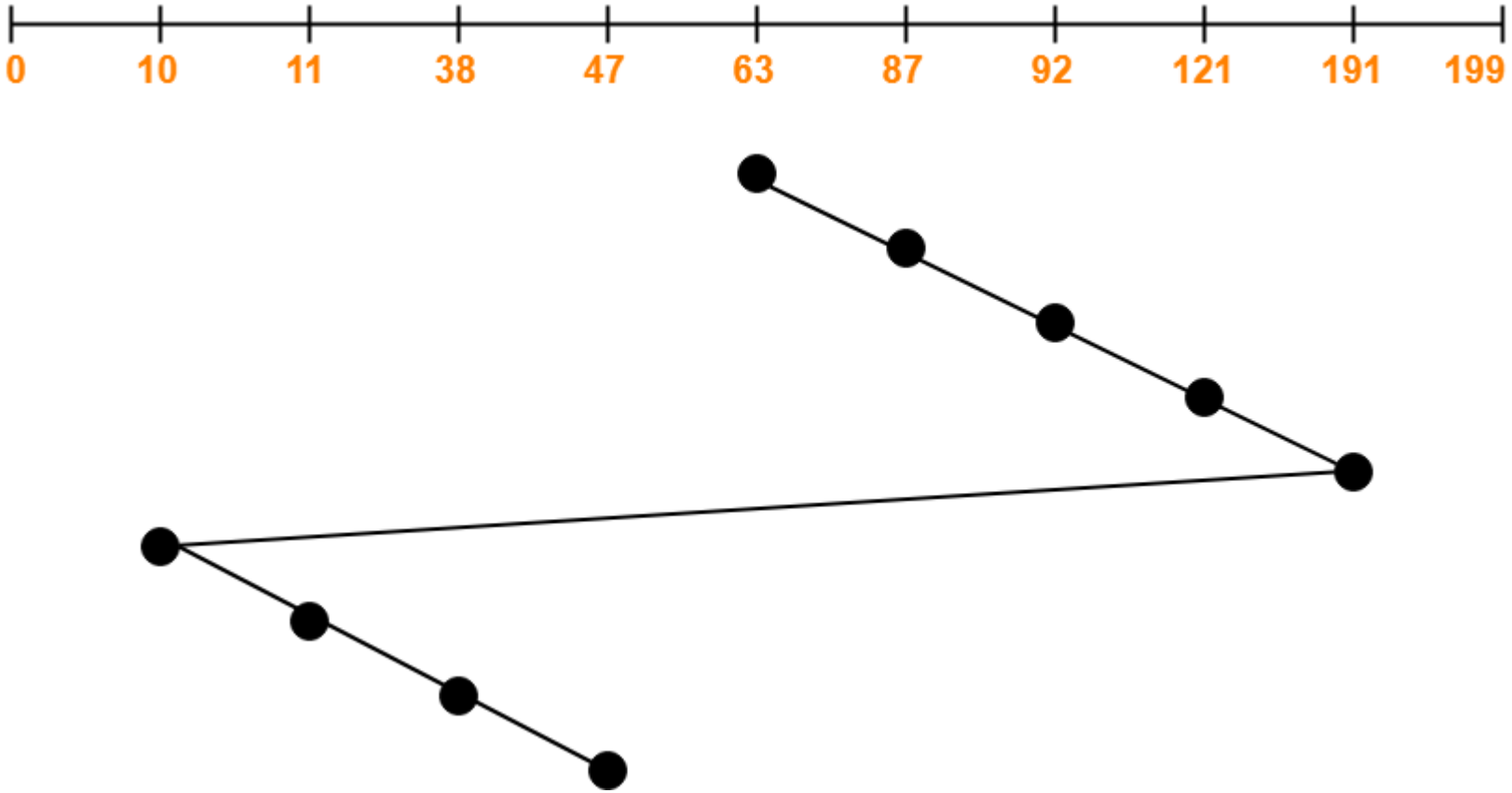
Solution:326



Q6:

- Consider 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 larger 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 _____.

Solution:346



- https://www.geeksforgeeks.org/disk-scheduling-algorithms/