DATA STORAGE TECHNOLOGIES & NETWORKS

(CS C446, CS F446 & IS C446)

LECTURE 14– STORAGE

Disk Scheduling (Cont.)

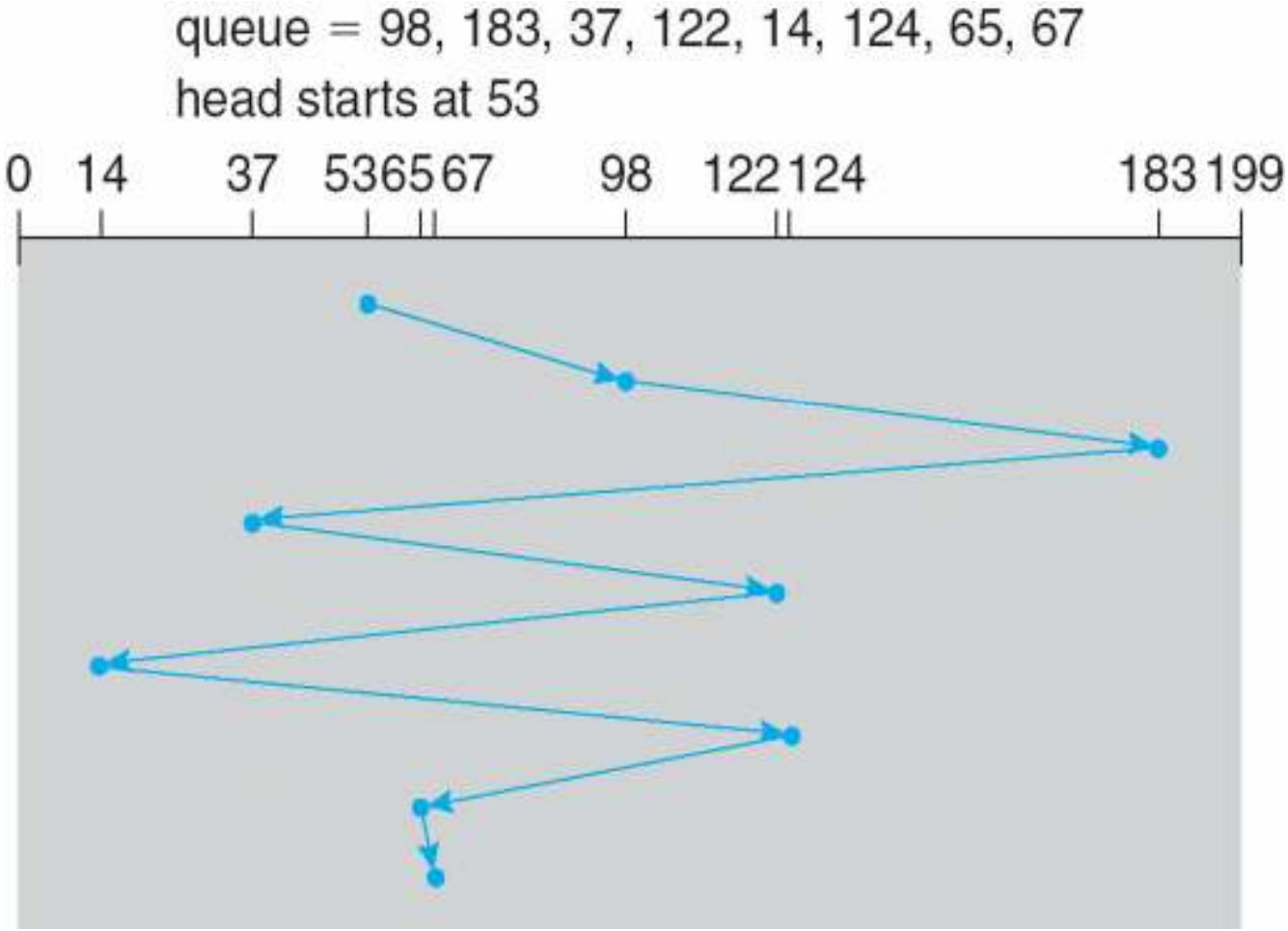
- Several algorithms exist to schedule the servicing of disk I/O requests.
- We illustrate them with a request queue (0-199).

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

Head pointer 53

FCFS

Illustration shows total head movement of 640 cylinders.



Disk Scheduling Policies

- Priority
  - Goal is not to optimize disk use but to meet other objectives
  - Short batch jobs may have higher priority
  - Provide good interactive response time

Disk Scheduling Policies

- Last-in, first-out
  - Good for transaction processing systems
    - The device is given to the most recent user so there should be little arm movement
  - Possibility of starvation since a job may never regain the head of the line

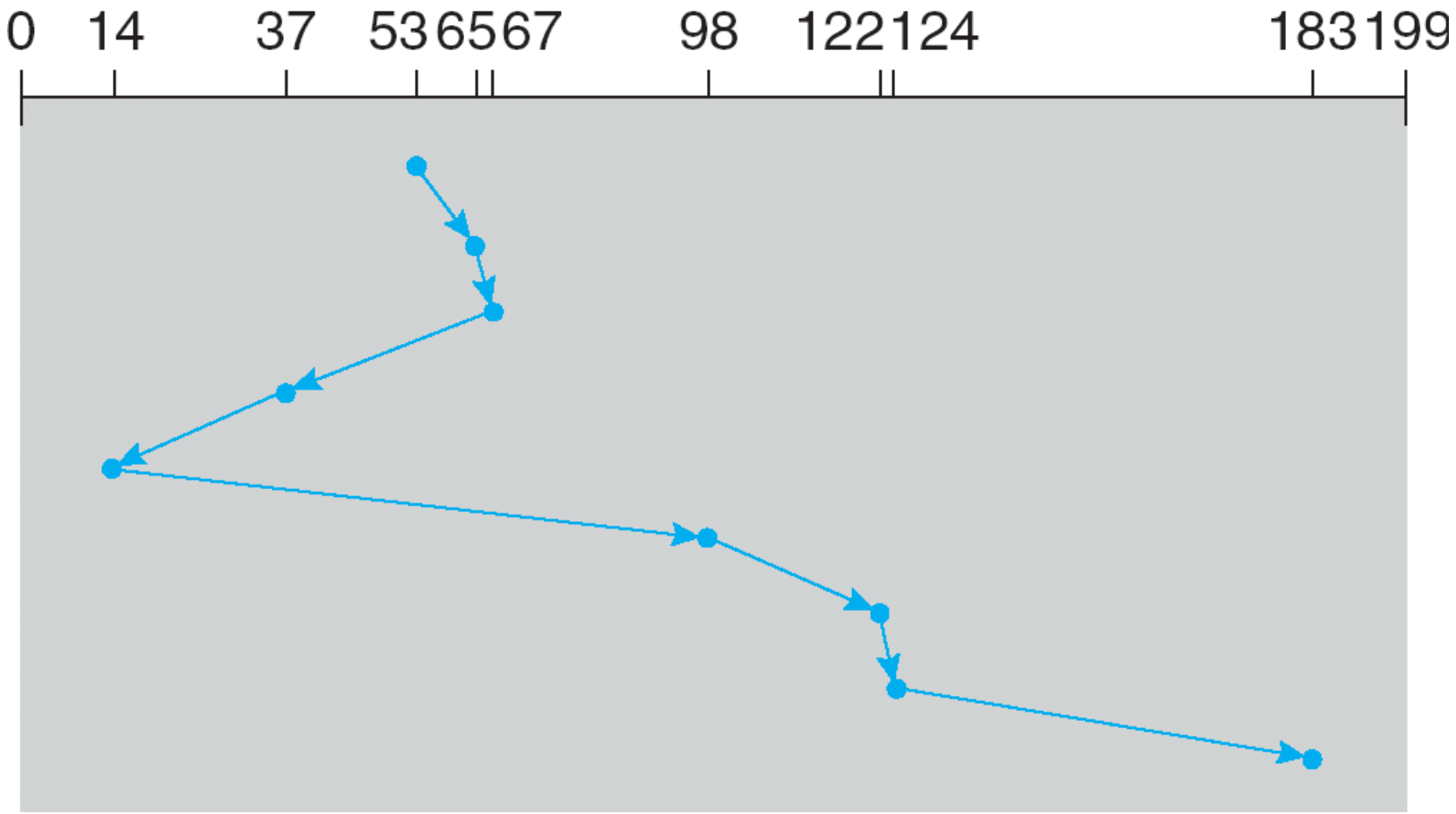
SSTF

- Select the disk I/O request that requires the least movement of the disk arm from its current position
- Selects the request with the minimum seek time from the current head position.
- SSTF scheduling is a form of SJF scheduling; may cause starvation of some requests.

SSTF (Cont.)

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

head starts at 53

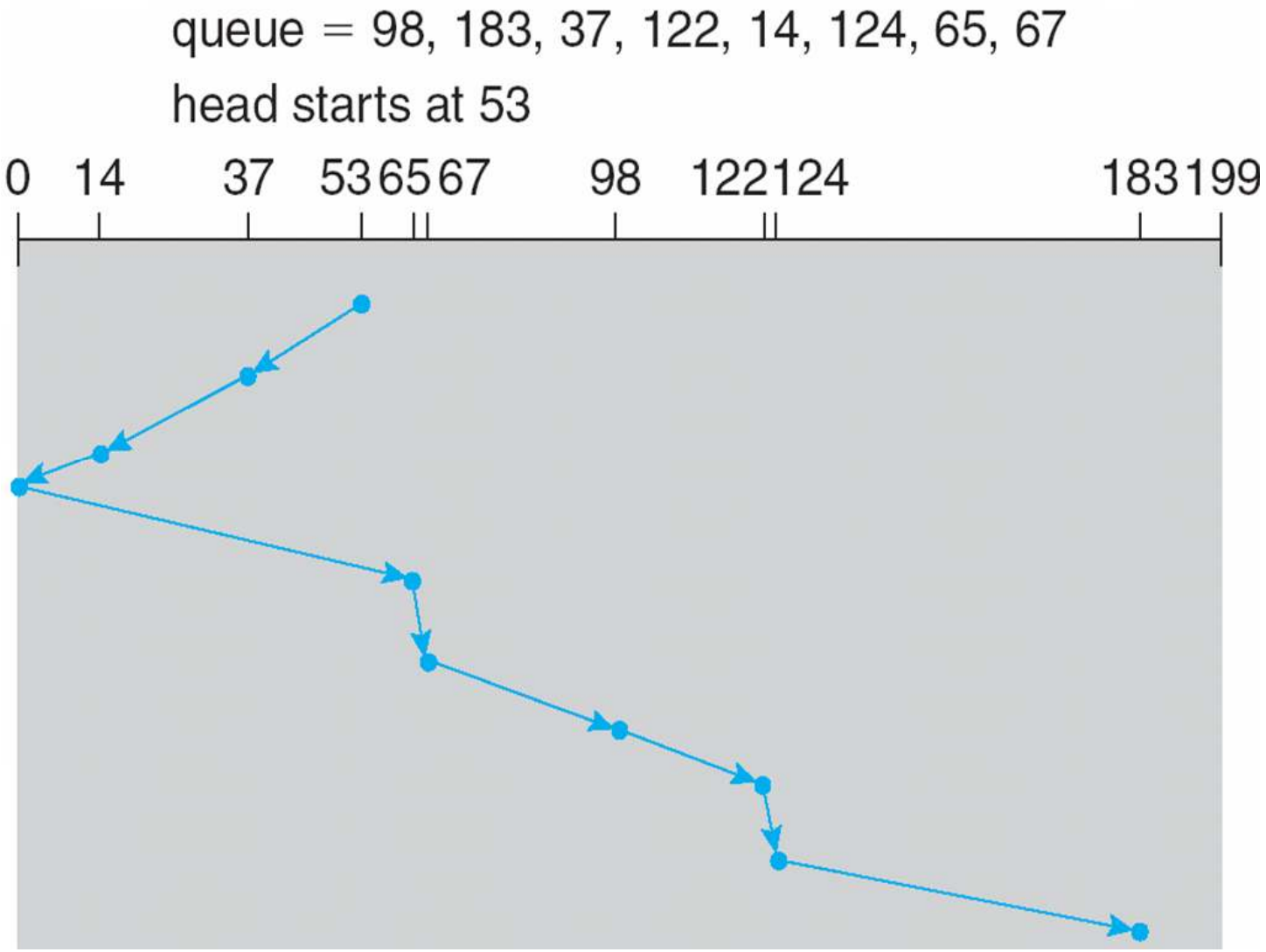


SSTF With Aging

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.
- Arm moves in one direction only, satisfying all outstanding requests until it reaches the last track in that direction
- Direction is reversed
- Sometimes called the *elevator algorithm*.
- Illustration shows total head movement of 208 cylinders.

SCAN (Cont.)


queue = 98, 183, 37, 122, 14, 124, 65, 67
head starts at 53
0
14
37
53
65
67
98
122
124
183
199

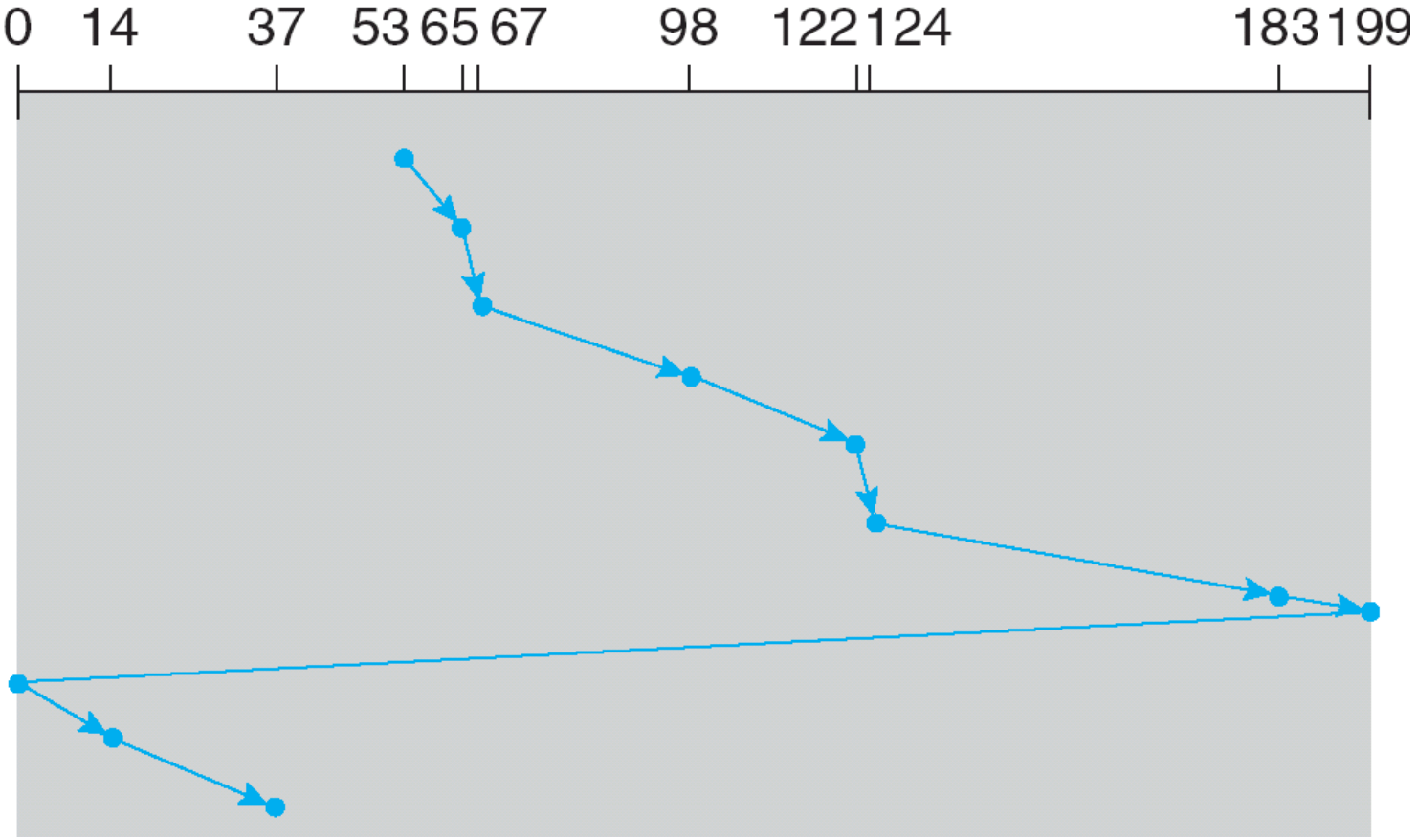
C-SCAN

- Provides a more uniform wait time than 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.
- Restricts scanning to one direction only
- When the last track has been visited in one direction, the arm is returned to the opposite end of the disk and the scan begins again

C-SCAN (Cont.)

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

head starts at 53



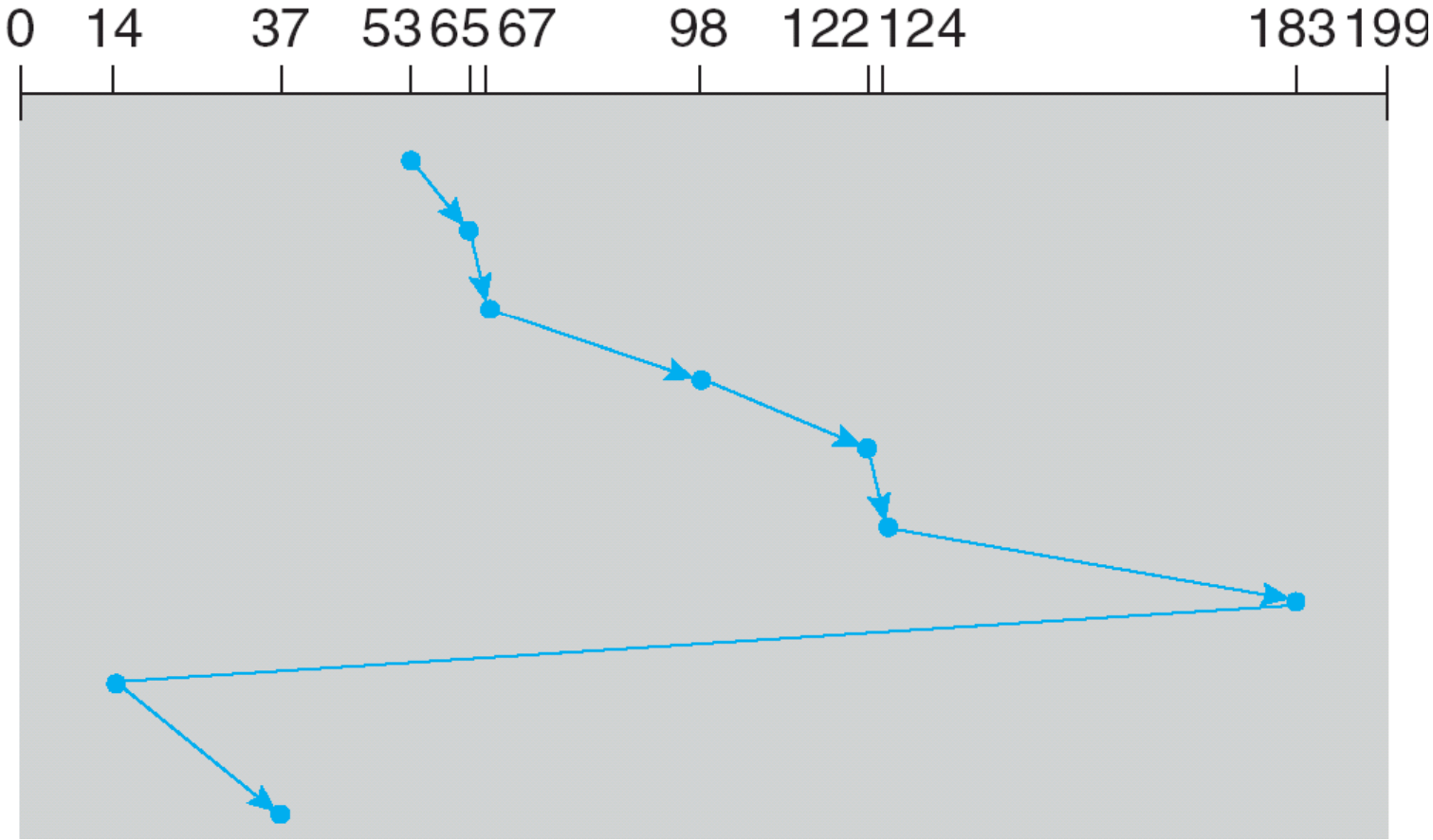
C-LOOK

- 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.

C-LOOK (Cont.)

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

head starts at 53



Deadline Scheduler

- Attempts to guarantee a start service time for a request
- Imposes a deadline on all I/O operations to prevent starvation of requests.
- Maintains two deadline queues in addition to the sorted queues [both read and write]
  - Deadline queues are sorted by their deadline (the expiration time)
  - Sorted queues are sorted by the sector number
- Scheduler decides which queue to use before serving the next request
  - Read queues are given a higher priority [processes usually block on read operations]

Deadline Scheduler

- Scheduler checks if the first request in the deadline queue has expired
  - Otherwise the scheduler serves a batch of requests from the sorted queue.
- Scheduler [In both cases] also serves a batch of requests following the chosen request in the sorted queue.
- Implements request merging and one way elevator
- By default, read requests have an expiration time of 500 ms, write requests expire in 5 seconds.
- This is the preferred scheduler for database systems, especially if you have system with high disk performance

NOOP scheduler [simplest I/O scheduler for the Linux kernel]

- Scheduler inserts all incoming I/O requests into a simple, unordered FIFO queue and implements request merging.
- The scheduler assumes I/O performance optimization will be handled at some other layer of the I/O hierarchy
  - e.g., at the block device; by an intelligent HBA such as a Serial Attached SCSI (SAS) RAID controller or by an externally attached controller
- Scheduler is best used with solid state devices such as flash memory or in general with devices that do not depend on mechanical movement to access data
- A technique that groups together I/O requests that are physically close together on the disk reduces average seek time and the variability of I/O service time