Operating Systems - Mass Storage Structure

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Overview

- Magnetic disks provide bulk of secondary storage of modern computers
- Disk drives are addressed as large 1-dimensional arrays of logical blocks, where the logical block (size=512 bytes) is the smallest unit of transfer
- The 1-dimensional array of logical blocks is mapped into the sectors of the disk sequentially
  - Sector 0 is the first sector of the first track on the outermost cylinder
  - Mapping proceeds in order through that track, then the rest of the tracks in that cylinder, and then through the rest of the cylinders from outermost to innermost

The First Commercial Disk Drive

- 1956 IBM RAMDAC computer included the IBM Model 350 disk storage system
  - 5M (7 bit) characters
  - 50" × 24" platters
  - Access time ≈ 1 second

Moving Head Disk Mechanism
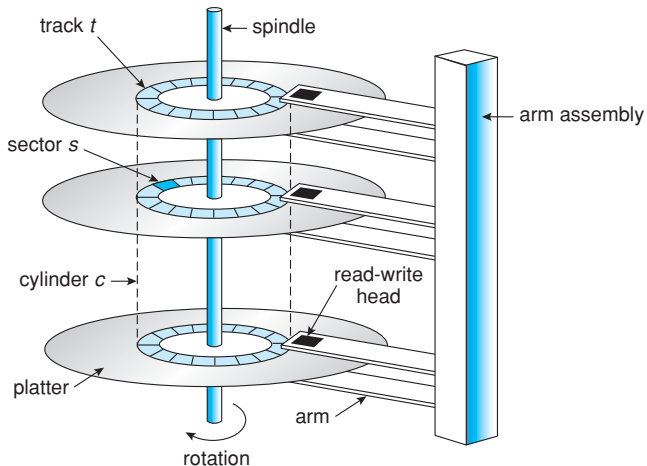
Disk Scheduling I

- The operating system is responsible for using hardware efficiently — for the disk drives, this means having a fast access time and disk bandwidth

- Access time has two major components
  - **Seek time** is the time for the disk are to move the heads to the cylinder containing the desired sector
  - **Rotational latency** is the additional time waiting for the disk to rotate the desired sector to the disk head

- Minimize seek time

- Seek time $\approx$ seek distance

- Disk bandwidth is the total number of bytes transferred, divided by the total time between the first request for service and the completion of the last transfer

Disk Scheduling II

- Whenever a process needs I/O to or from the disk, it issues a system call to the OS
- The request specifies
  - Type of operation (Input/Output)
  - Disk address for the transfer
  - Memory address for the transfer
  - Number of bytes to be transferred
- If the desired disk drive and controller are available, the request can be serviced immediately
- Otherwise, new requests are placed in the queue of pending requests for that drive
- When one request is completed, the OS chooses which pending request to service next

FCFS

- Intrinsically fair, but generally does not provide the fastest service
- Example: Total head movement required is 640 cylinders

queue = 98, 183, 37, 122, 14, 124, 65, 67
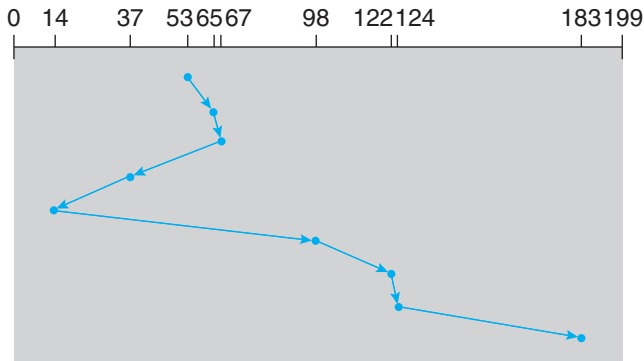head starts at 53
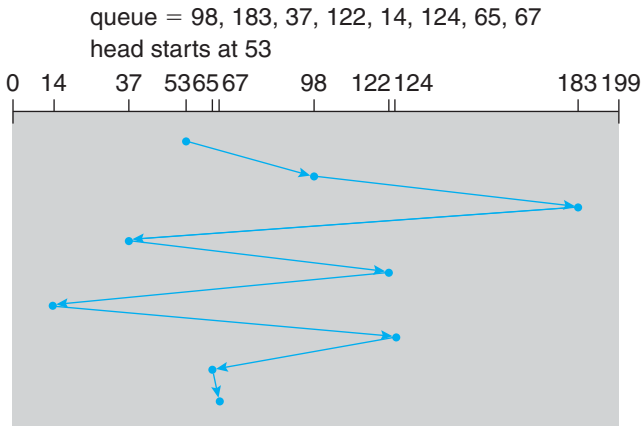
Shortest Seek Time First (SSTF)

- Selects the request with the minimum seek time from the current head position
- A form of SJF scheduling; may cause starvation of some requests
- Example: Total head movement required is 236 cylinders

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

head starts at 53

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.
- SCAN algorithm sometimes called the elevator algorithm
- Example: Total head movement required is 208 cylinders

queue = 98, 183, 37, 122, 14, 124, 65, 67
head starts at 53
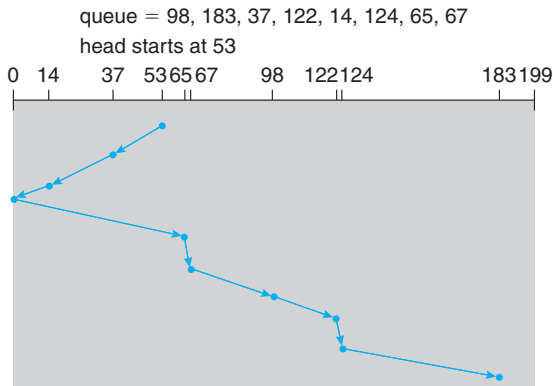
C-SCAN

- 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
- Example: Total head movement required is 183 cylinders

queue = 98, 183, 37, 122, 14, 124, 65, 67
head starts at 53
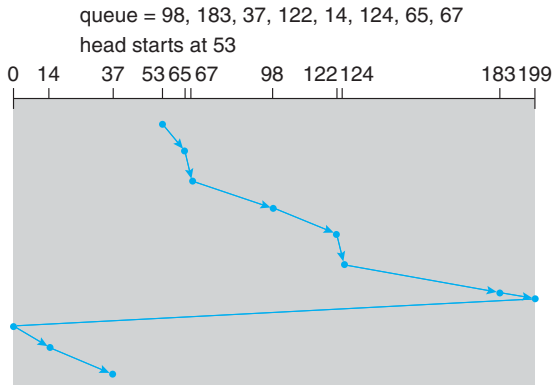
C-LOOK

- C-LOOK a 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
- Example: Total head movement required is 153 cylinders

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