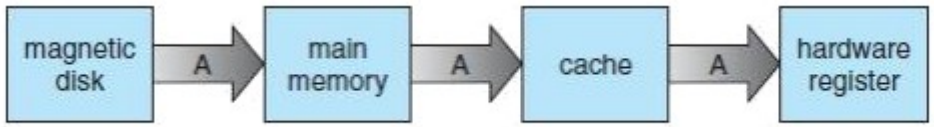
Module 7
Storage Management, Protection and Security

Disk structure and attachment – Disk scheduling algorithms (seek time, rotational latency based)- System threats and security – Policy vs mechanism - Access vs authentication -System protection: Access matrix – Capability based systems - OS: performance, scaling, future directions in mobile OS.

MASS STORAGE STRUCTURE- OVERVIEW

- Main memory is usually too small to store all needed programs and data permanently.
- Main memory is a volatile storage device that loses its contents when power is turned off or otherwise lost.
- Thus, most computer systems provide secondary storage as an extension of main memory.
- The main requirement for secondary storage is that it be able to hold large quantities of data permanently.
- The most common secondary-storage device is a magnetic disk, which provides storage for both programs and data.
- Most of the secondary storage devices are internal to the computer such as the hard disk drive, the tape disk drive and even the compact disk drive and floppy disk drive.



Hard Disk Drives

- Hard Disk Drives are relatively simple.
- Each disk platter has a flat circular shape, like a CD. Common platter diameters range from 1.8 to 3.5 inches. The two surfaces of a platter are covered with a magnetic material.
- The information is stored by recording it magnetically on the platters, and we read information by detecting the magnetic pattern on the

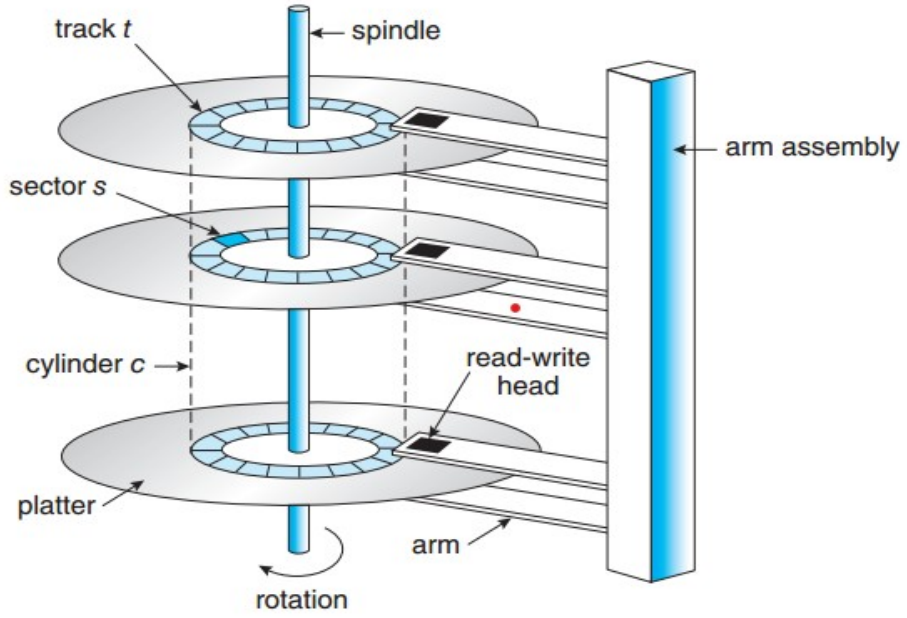


Figure 11.1 HDD moving-head disk mechanism.

Hard Disk Drives

- A read –write head “flies” just above each surface of every platter.
- The heads are attached to a disk arm that moves all the heads as a unit.
- The surface of a platter is logically divided into circular tracks, which are subdivided into sectors.
- The set of tracks at a given arm position make up a cylinder. There may be thousands of concentric cylinders in a disk drive, and each track may contain hundreds of sectors.
- Each sector has a fixed size and is the smallest unit of transfer.
- The sector size was commonly 512 bytes and the storage capacity of common disk drives is measured in gigabytes and terabytes.

Hard Disk Drives

- The transfer rate is the rate at which data flow between the drive and the computer.
- The positioning time, or random-access time, consists of two parts:
- The time necessary to move the disk arm to the desired cylinder, called the seek time.
- The time necessary for the desired sector to rotate to the disk head, called the rotational latency.
- The device 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

- Whenever a process needs I/O to or from the disk, it issues a system call to the operating system. The request specifies several pieces of information:

  Whether this operation is input or output

  What the disk address for the transfer is

  What the memory address for the transfer is

  What the number of sectors to be transferred is

  Disk Scheduling:

  If the desired disk drive and controller are available, the request can be serviced immediately. If the drive or controller is busy, any new requests for service will be placed in the queue of pending requests for that drive. When one request is completed, the operating system chooses which pending request to service next. This is called as Disk Scheduling.

  Disk Components:

  The two major components of the hard disk are Seek time and Rotational Latency.

  Seek time: The seek time is the time for the disk arm to move the heads to the cylinder containing the desired sector.

  Rotational latency: The rotational latency is the additional time for the disk to rotate the desired sector to the disk head.

  Disk bandwidth: The 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 Algorithms

- First Come First Serve (FCFS)
- Shortest Seek Time First (SSTF)
- Scan Algorithm
- Circular Scan Algorithm (C-Scan)
- Look Algorithm
- Circular Look Algorithm (C-Look)

FCFS Scheduling

- The simplest form of disk scheduling, easy to implement and does not provide the fastest service.
- Example: Given a disk with 200 cylinders and a disk queue with requests 98, 183, 37, 122, 14, 124, 65, 67, for I/O to

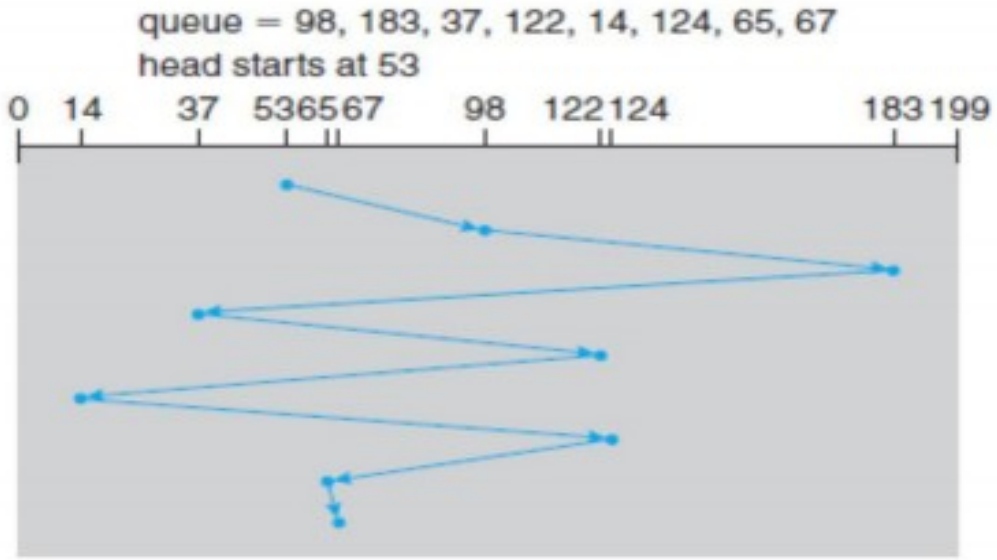
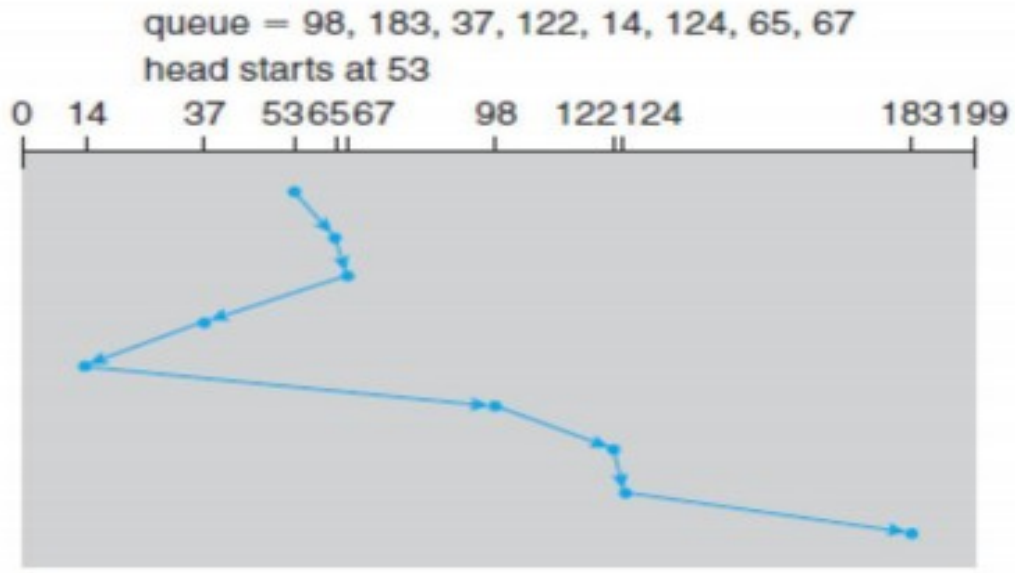


Figure 10.4 FCFS disk scheduling.

- The total head movements = (53-98)+(98-183)+((183-37)+(37-122)+(122-14)+(14-124)+(124-65)+(65-67) = 640 Head Movements.
- 45+85+146+85+108+110+59+2 = 640

SSTF Scheduling

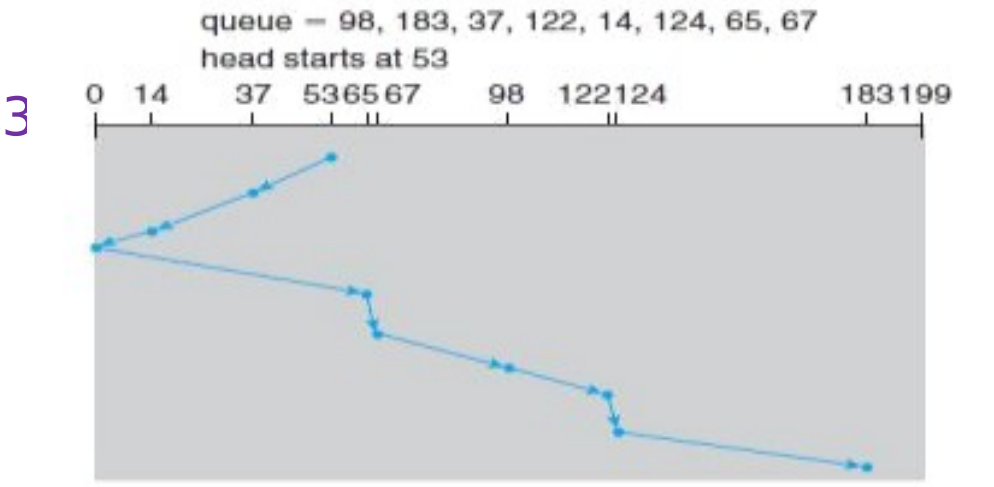
- The shortest-seek-time-first (SSTF) algorithm selects the request with the least seek time from the current head position.
- It chooses the pending request closest to the current head position.
- Example: Consider, for example, Given a disk with 200 cylinders and a disk queue with requests 98. 183. 37. 122. 14. 124. 65. 67. for I/O to blocks on cylinders. Disk head



- =(53-65)+(65-67)+(67-37)+(37-14)+(14-98)+(98-122)+(122-124)+(124-183)
- Total head movement of only 236 cylinders.

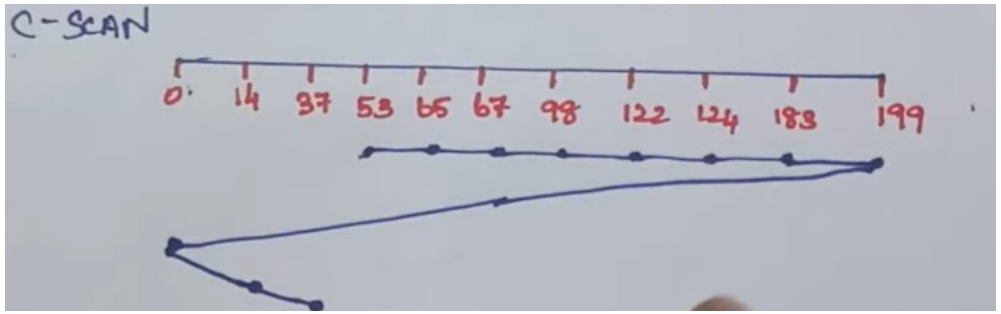
SCAN Scheduling

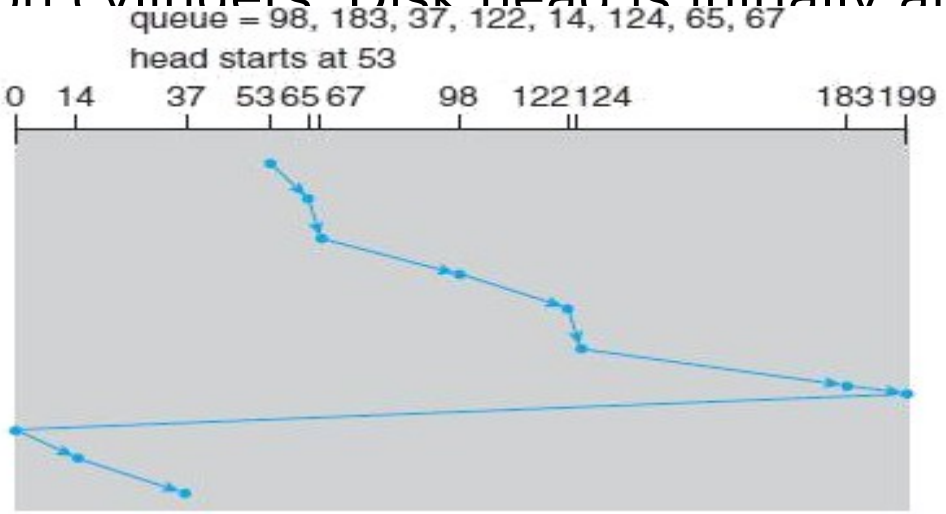
- The disk arm starts at one end of the disk and moves toward the other end, servicing requests as it reaches each cylinder, until it gets to the other end of the disk.
- At the other end, the direction of head movement is reversed, and servicing continues.
- The head continuously scans back and forth across the disk. The SCAN algorithm is sometimes called the elevator algorithm.
- Example: Given a disk with 200 cylinders and a disk queue with requests 98, 183, 37, 122, 14, 124, 65, 67 for I/O to blocks on cylinders. Disk head is initially at 53.
- Forward Direction : 33



Circular SCAN Algorithm

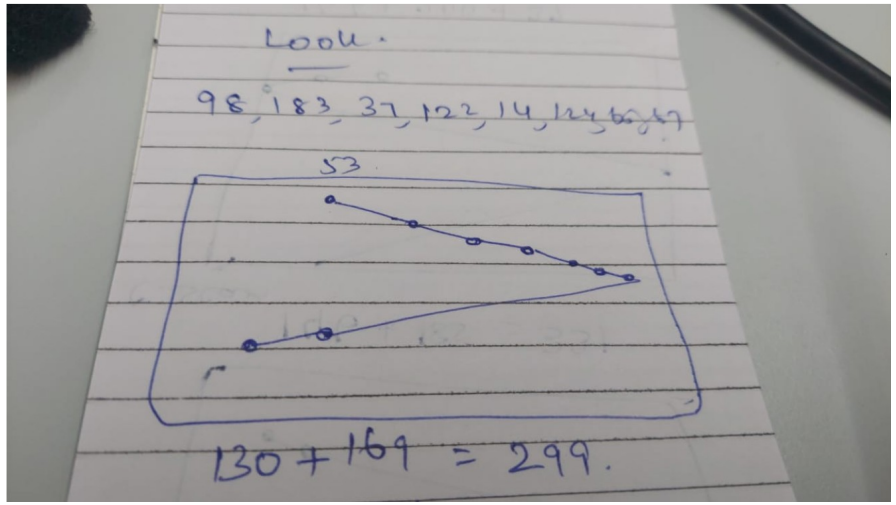
- Circular SCAN (C-SCAN) scheduling is a variant of SCAN designed to provide a more uniform wait time.
- C-SCAN moves the head from one end of the disk to the other, servicing requests along the way.
- When the head reaches the other end, however, it immediately returns to the beginning of the disk without servicing any requests on the return trip.
- The C-SCAN scheduling algorithm essentially treats the cylinders as a circular list that wraps around from the final cylinder to the first one.
- Example: Given a disk with 200 cylinders and a disk queue with requests 98, 183, 37, 122, 14, 124, 65, 67, for I/O to blocks on cylinders. Disk head is initially at 53.
- Forward Direction : 382 Head Movements





LOOK scheduling

- The LOOK algorithm is the same as the SCAN algorithm in that it also services the requests on both directions of the disk head, but it “looks" ahead to see if there are any requests pending in the direction of head movement.
- If no requests are pending in the direction of head movement, then the disk head traversal will be reversed to the opposite direction and requests on the other direction can be served.
- In LOOK scheduling, the arm goes only as far as final requests in each direction and then reverses direction without going all the way to the end.
- Given a disk with 200 cylinders (0-199), suppose we have 8 pending requests: 98, 183, 37, 122, 14, 124, 65, 67 and that the read/write head is currently at cylinder 53.
- In order to complete these requests, the arm will move in the increasing order first and then will move in decreasing order after reaching the end. So, the order in which it will execute is 65, 67, 98, 122, 124, 183, 37, and 14.
- Forward Direction : 299 Head Movements



C-LOOK Scheduling

- This is just an enhanced version of C-SCAN.
- Arm only goes as far as the last request in each direction, then reverses direction immediately, without servicing all the way to the end of the disk and then turns the next direction to provide the service.
- Forward Direction : 322 Head Movements