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UNIVERSITY INSTITUTEOF ENGINEERING

Bachelor of Engineering (Computer Science & Engineering)

Operating System (CST-328)

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Chapter 5

(Device Management)

Device Management: Disk Structure, Disk formatting, Disk Scheduling Algorithms, RAID structure-RAID levels, problems with RAID.

Lecture 18

Disk Structure
&
Disk Scheduling Algorithms

Why have disks?

- Memory is small. Disks are large. TM
  - Short term storage for memory contents (e.g., swap space). TM
  - Reduce what must be kept in memory (e.g., code pages).
- Memory is volatile. Disks are forever (?!) TM
  - File storage.

Capacity : 2GB vs. 1TB
2GB vs. 400GB
1GB vs 320GB

Different types of disks

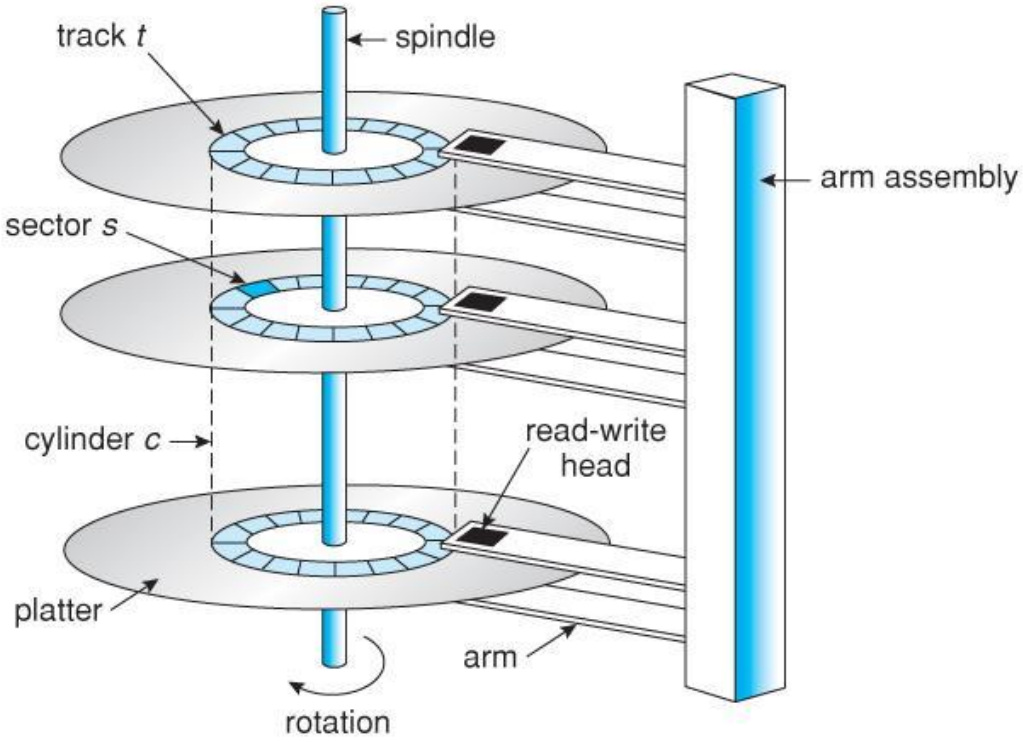
- Advanced Technology Attachment (ATA)
  - Standard interface for connecting storage devices (e.g., hard drives and CD-ROM drives)
  - Referred to as IDE (Integrated Drive Electronics), ATAPI, and UDMA.
  - ATA standards only allow cable lengths in the range of 18 to 36 inches. CHEAP.
- Small Computer System Interface (SCSI)
  - Requires controller on computer and on disk.
  - Controller commands are sophisticated, allow reordering.
- USB connections to ATA disc
  - These are new bus technologies, not new control. Microdrive – impressively small motors

Different types of disks

- Bandwidth ratings
  - These are unachievable.
  - 50 MB/s is max off platters.
  - Peak rate refers to transfer from disc device's memory cache.
- SATA II (serial ATA)
  - 3 Gb/s (still only 50 MB/s off platter, so why do we care?)
  - Cables are smaller and can be longer than pATA
- SCSI
  - 320 MB/s ¾ Enables multiple drives on same bus

Physical Disk Structure

- Disk drives are addressed as large 1-dimensional arrays of logical blocks, where the logical block 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 (top platter) on the outermost cylinder z
  - 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



Disk Management

Here are some common things that you can do in Disk Management:

- Partition a Drive
- Format a Drive
- Change a Drive's Letter
- Shrink a Partition
- Delete a Partition
- Change a Drive's File System

Disk Access Time

- **Two major components**
  - ***Seek time*** is the time for the disk to move the heads to the cylinder containing the desired sector

    Typically 5-10 milliseconds
  - *Rotational latency* is the additional time waiting for the disk to rotate the desired sector to the disk head Typically, 2-4 milliseconds
- **One minor component**
  - ***Read/write time or transfer time*** – actual time to transfer a block, less than a millisecond

Disk Scheduling

- Should ensure a fast access time and disk bandwidth
- Fast access
  - Minimize total seek time of a group of requests
  - If requests are for different cylinders, average rotation latency has to be incurred for each anyway, so minimizing it is not the primary goal (though some scheduling possible if multiple requests for same cylinder is there)
- Seek time ≈ seek distance
- Main goal : reduce total seek distance for a group of requests
- Auxiliary goal: fairness in waiting times for the requests
- 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

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

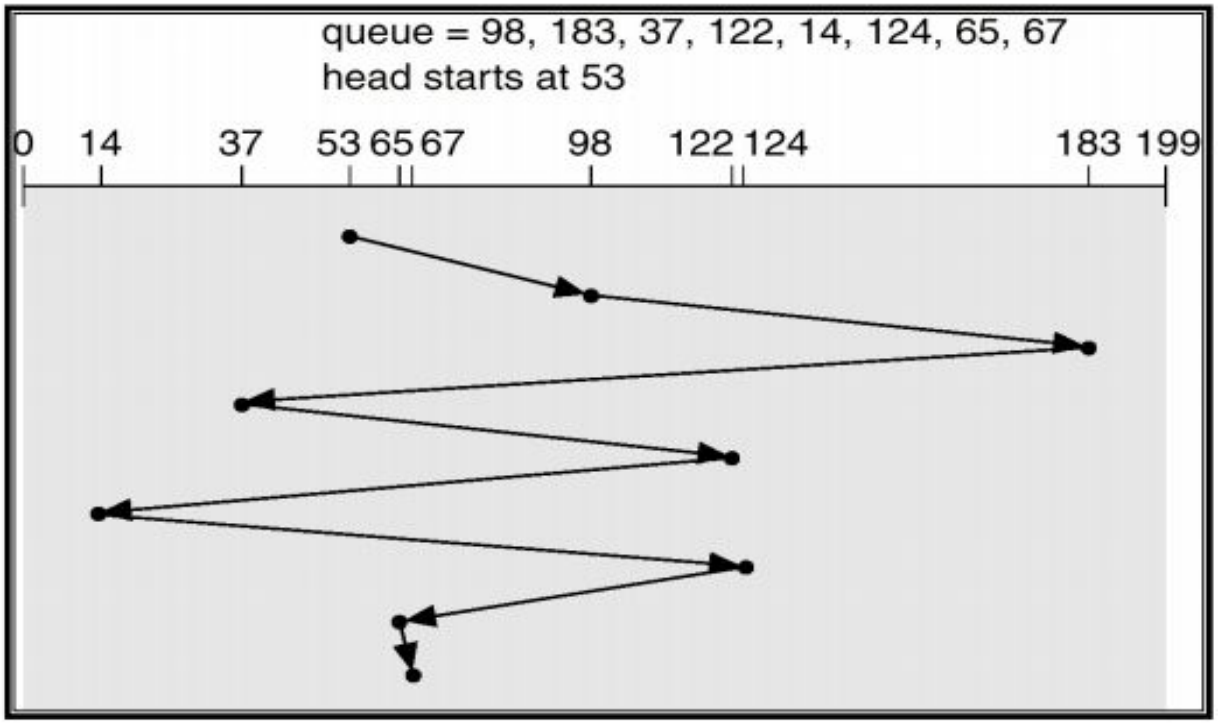
98, 183, 37, 122, 14, 124, 65, 67

Head pointer 53

FCFS

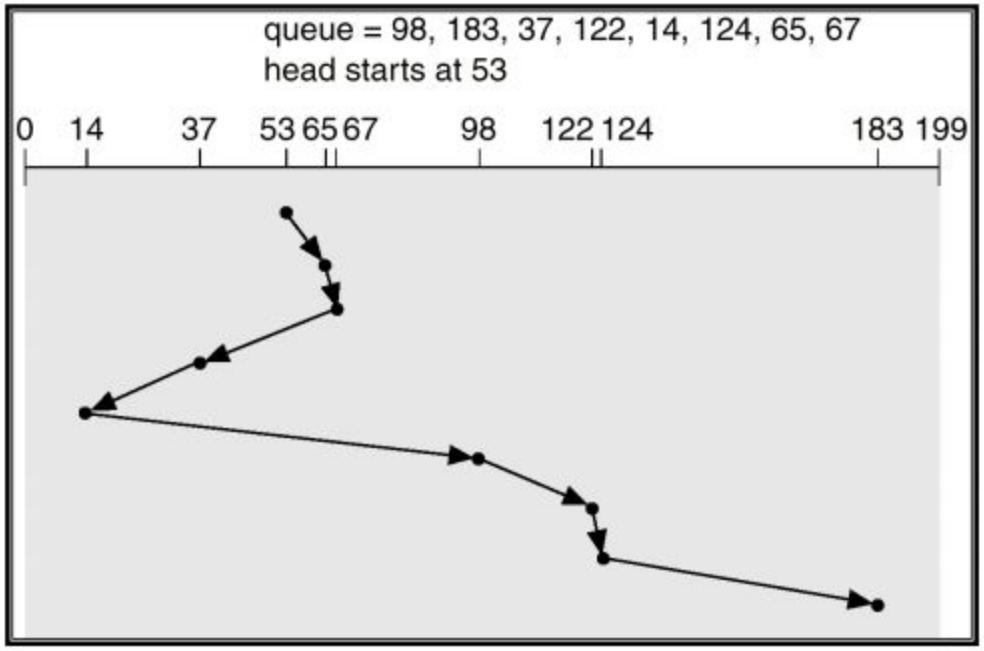
- Service requests in the order they come
- Fair to all requests
- Can cause very large total seek time over all requests if the load is moderate to high

Illustration shows total head movement of 640 cylinders.



SSTF

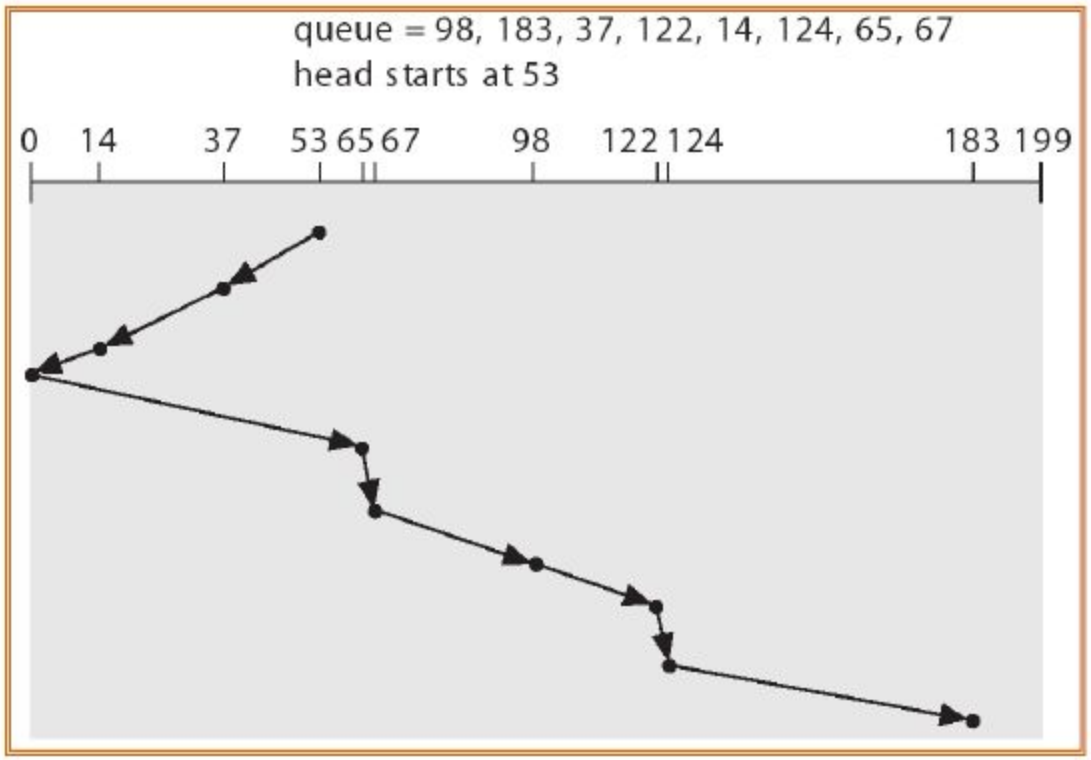
- Selects the request with the minimum seek time from the current head position
- SSTF scheduling is a form of SJF scheduling
  - May cause starvation of some requests like SJF
  - But not optimal, unlike SJF
- Minimizes seek time, but not fair
- May work well if the load is not high



Total head movement = 236 cylinders

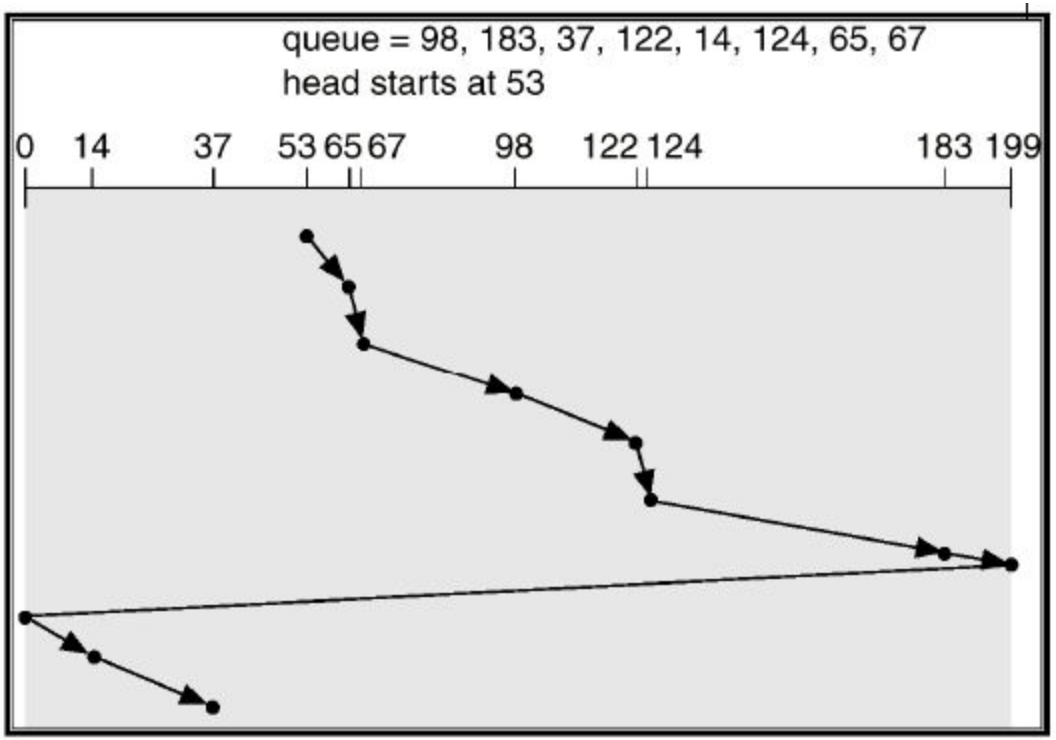
SCAN

- 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
- Sometimes called the *elevator algorithm*



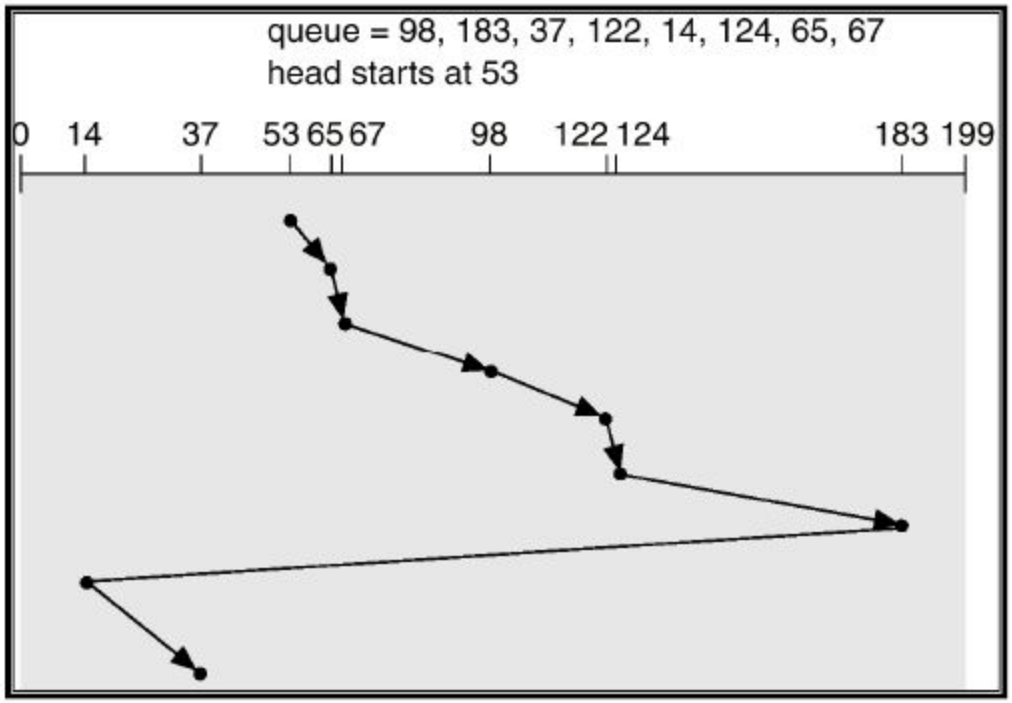
C-SCAN

- 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



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.



Selecting a Disk-Scheduling Algorithm

- SSTF is common and has a natural appeal
- SCAN and C-SCAN perform better for systems that place a heavy load on the disk
- Performance depends on the number and types of requests
- Requests for disk service can be influenced by the file allocation method
- The disk-scheduling algorithm should be written as a separate module of the operating system, allowing it to be replaced with a different algorithm if necessary
- Either SSTF or C-LOOK is a reasonable choice for the default algorithm (depending on load)

Conclusion

This lecture makes students familiar with the Disk management and various disk scheduling algorithms

Video Link

https://www.youtube.com/watch?v=ZjMwUhapSEM

https://www.youtube.com/watch?v=6RyXRde6K00

References

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