

CS 343 - Operating Systems

Module-5B

Disk Scheduling



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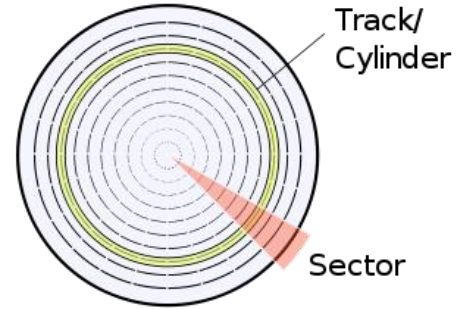
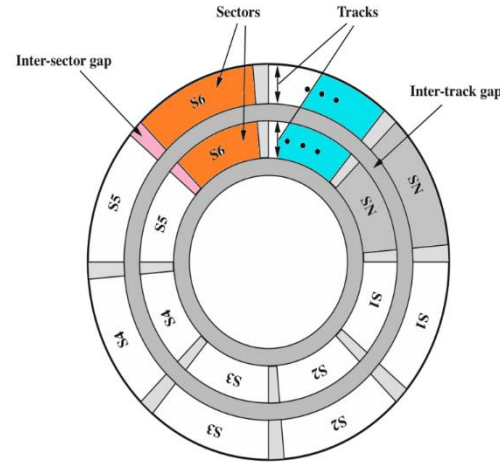
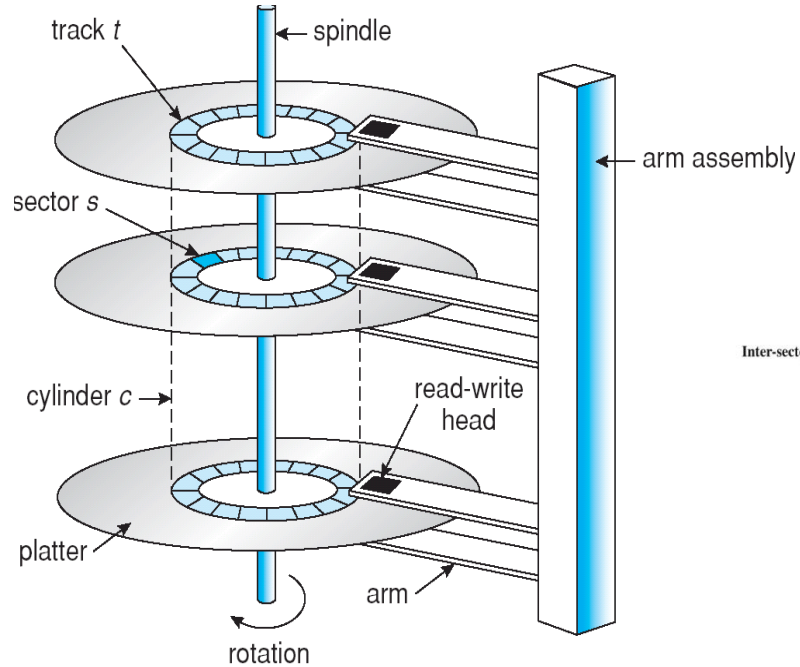
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Disk Storage Systems Management

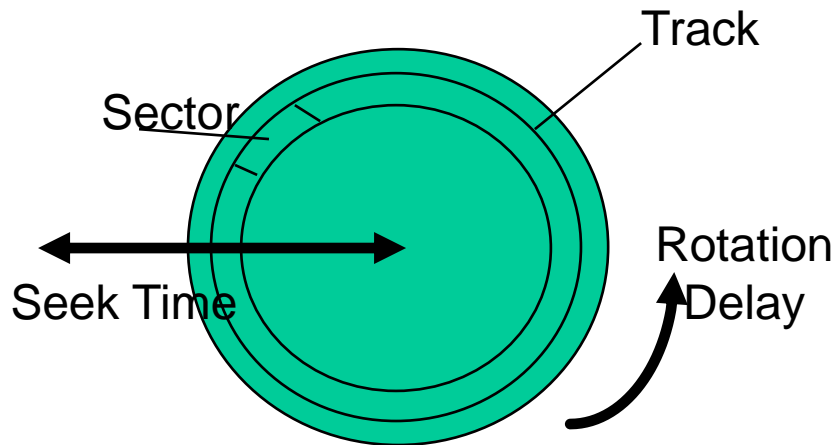
- ❖ Disk Organization & Structure
- ❖ Disk Scheduling
- ❖ Disk Management
- ❖ Swap-Space Management
- ❖ RAID Structure
- ❖ Stable-Storage Implementation

Hard Disk Drive Organization



Disk Access Time

- ❖ To read from disk, we must specify:
 - ❖ cylinder #, surface #, sector #, size, memory address
- ❖ Transfer time includes:
 - ❖ Seek time: to get to the track
 - ❖ Rotational Latency: to get to the sector and
 - ❖ Transfer time: get bits off the disk



Disk Scheduling

- ❖ Access time has two major components
 - ❖ **Seek time** is time to move the heads to the cylinder containing the desired sector
 - ❖ **Rotational latency** is additional time waiting to rotate the desired sector to the disk head.
- ❖ Minimize seek time
- ❖ Disk bandwidth is 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

- ❖ There are many sources of disk I/O request
 - ❖ System processes
 - ❖ Users processes
- ❖ I/O request includes input or output mode, disk address, memory address, number of sectors to transfer
- ❖ OS maintains queue of requests, per disk or device
- ❖ Idle disk can immediately work on I/O request, busy disk means work must queue
 - ❖ Optimization algorithms only make sense when a queue exists

Disk Scheduling

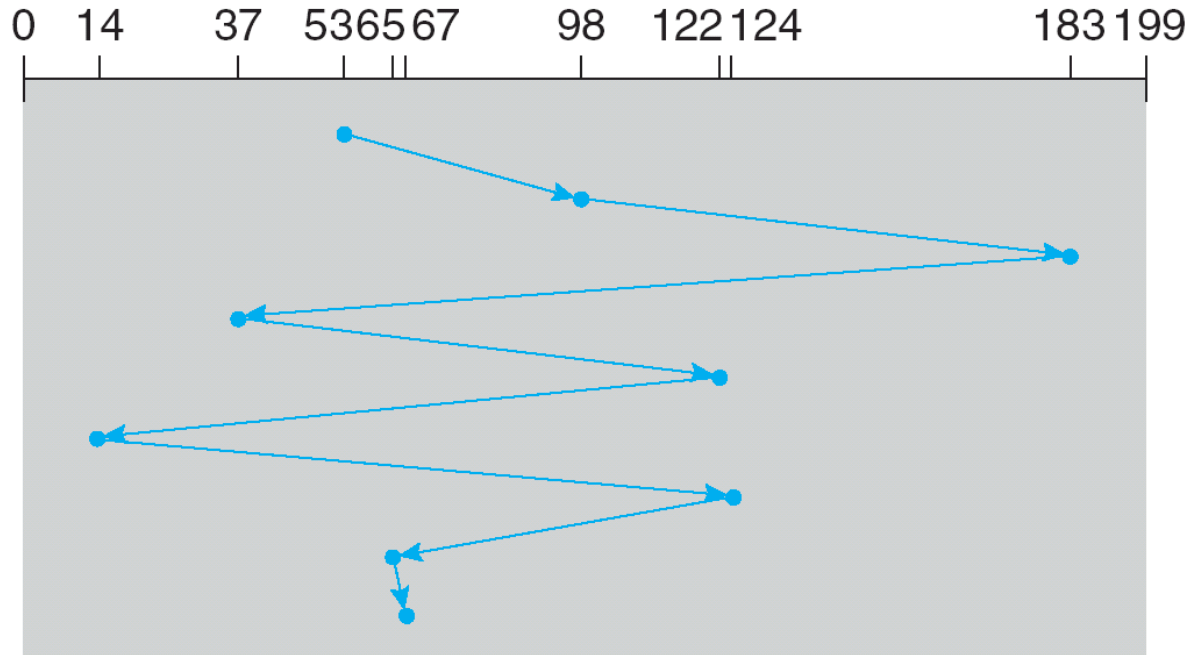
- ❖ Drive controllers have small buffers to manage a queue of I/O requests.
- ❖ Several algorithms exist to schedule the servicing of disk I/O requests
- ❖ Disk Scheduling - The order in which disk cylinder request are serviced so as to optimize average seek time.
 - ❖ **FCFS**
 - ❖ **SSTF**
 - ❖ **SCAN**
 - ❖ **C-SCAN**
 - ❖ **C-LOOK**
- ❖ **Example:** 98, 183, 37, 122, 14, 124, 65, 67 (0-199 cylinders, Head pointer @ 53)

Disk Scheduling Algorithm: FCFS

Total head movements = 640

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

head starts at 53

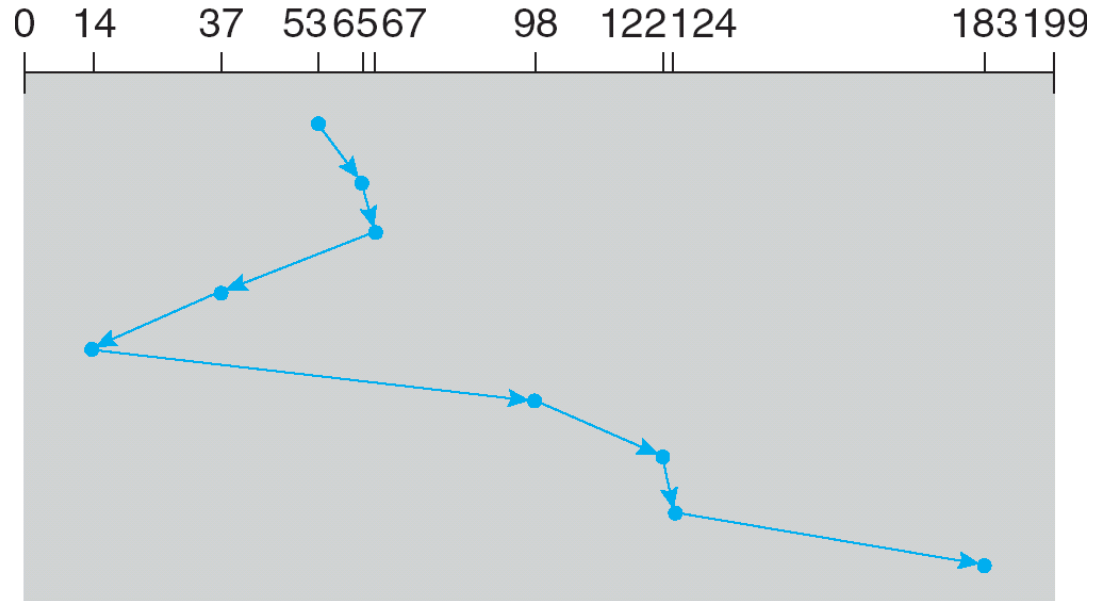


Disk Scheduling Algorithm: SSTF

- ❖ Selects request with minimum seek time from current head position,
- ❖ SSTF scheduling is a form of SJF scheduling; may cause starvation of some requests

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

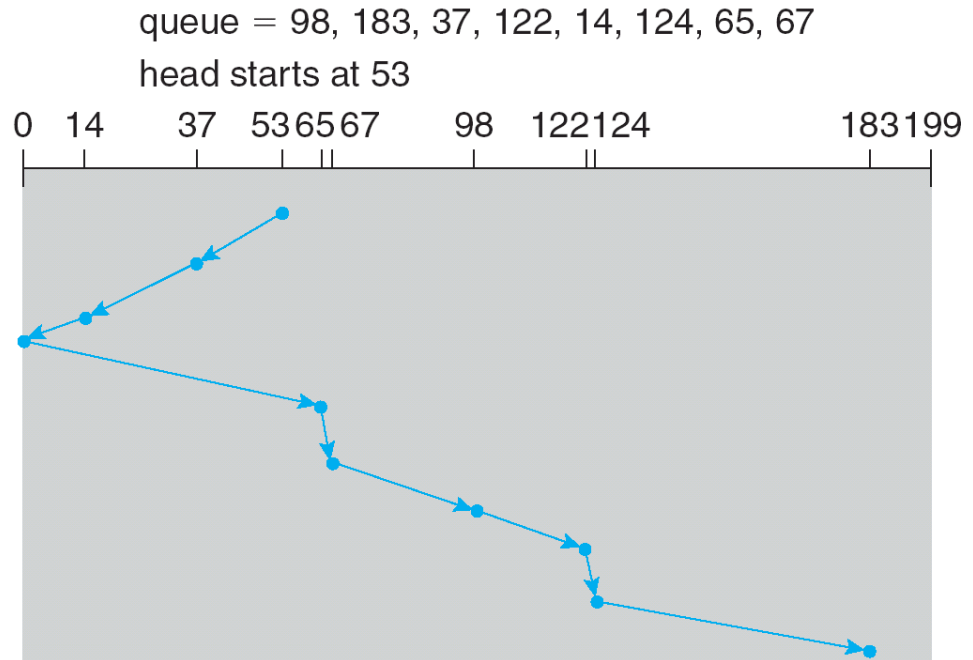
Total head movement
of 236 cylinders



Disk Scheduling Algorithm: SCAN

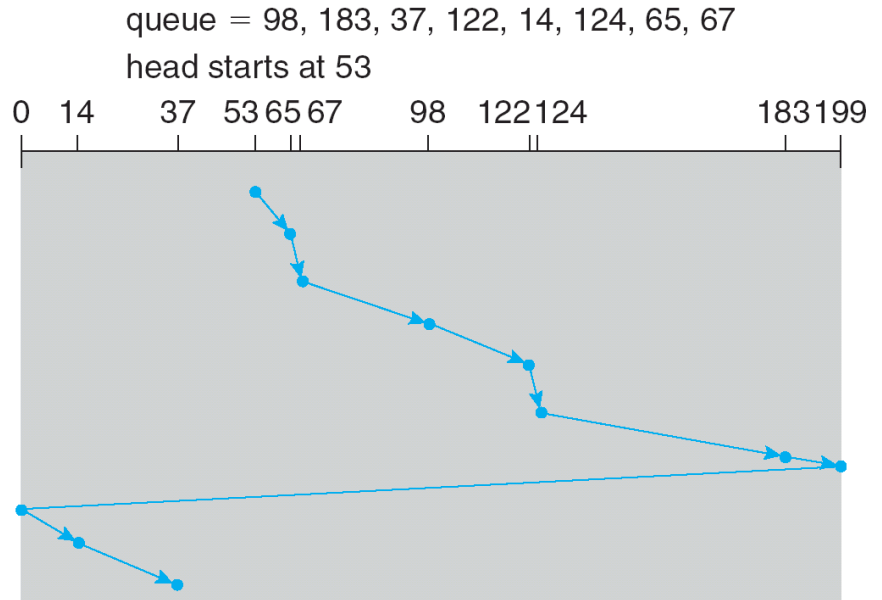
- ❖ The disk arm moves toward one end servicing requests
- ❖ Head movement is reversed when it reach the end and servicing continues. [Also known as elevator algorithm]

Total head movement
of 208 cylinders



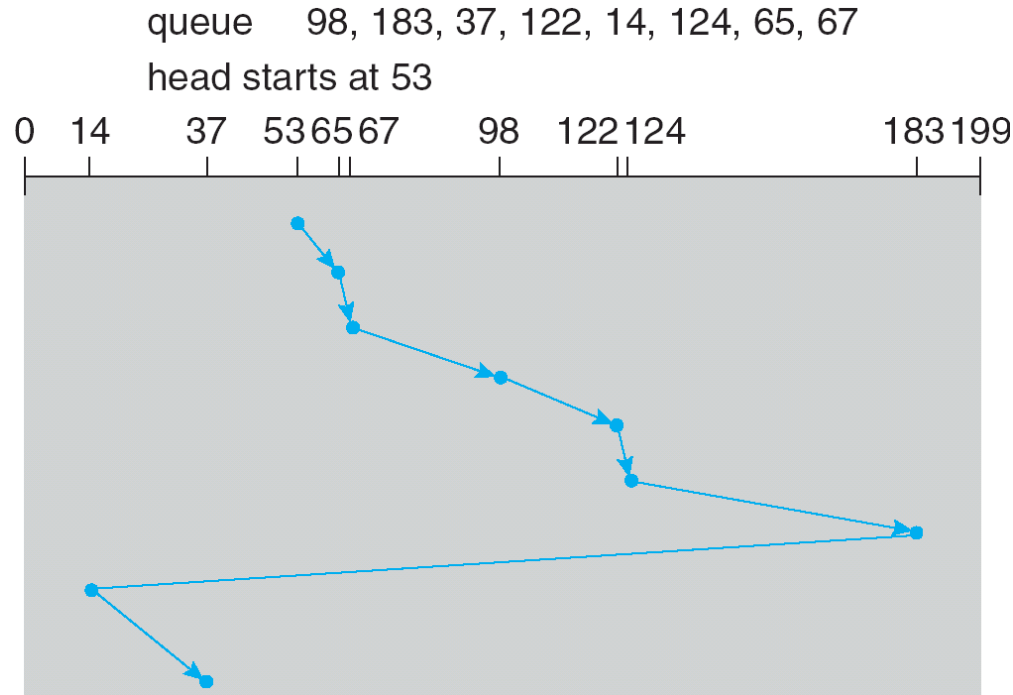
Disk Scheduling Algorithm : C-SCAN

- ❖ The head moves from one end of the disk to the other and service the requests as it goes.
- ❖ When it reaches the other end it immediately returns to beginning of the disk, No servicing on the return trip.



Disk Scheduling Algorithm : C-LOOK

- ❖ Version of C-SCAN
- ❖ Arm only goes as far as last request in each direction, then reverses direction immediately,

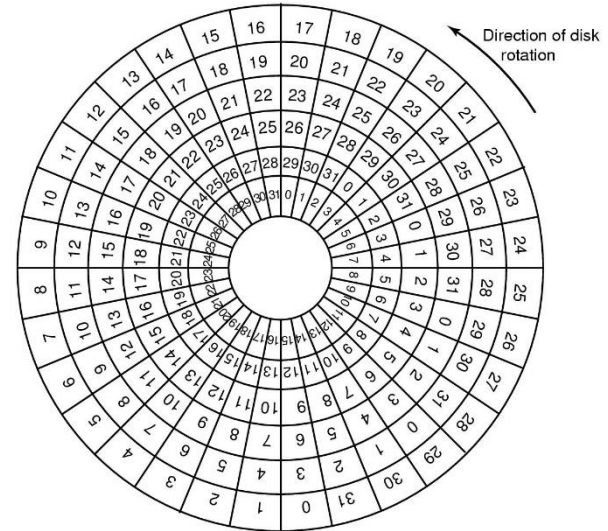


Selecting a Disk-Scheduling Algorithm

- ❖ SSTF is common and has a natural appeal
- ❖ SCAN and C-SCAN perform better for systems that place a heavy load on the disk : Less starvation
- ❖ Performance depends on the number and types of requests
- ❖ 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 LOOK is a reasonable choice for the default algorithm

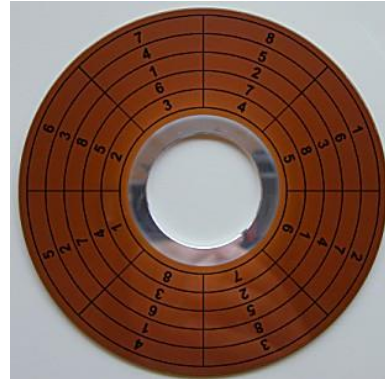
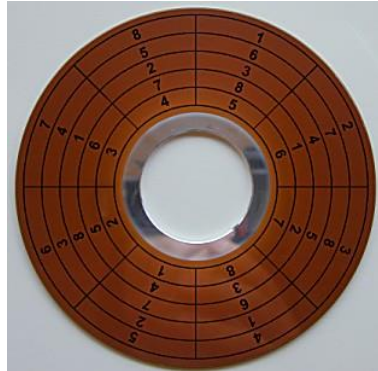
Cylinder Skew

- ❖ Why cylinder skew?
- ❖ Offsetting the start sector of adjacent tracks to minimize the likely wait time (rotational latency) when switching tracks
- ❖ How much skew?
- ❖ Example, if 10000 rpm disk drive rotates in 6 ms.
 - ❖ Track has 300 sectors
 - ❖ New sector every $20\ \mu\text{s}$
 - ❖ If track seek time $800\ \mu\text{s}$
 - ❖ 40 sectors pass on seek
- ❖ Cylinder skew: 40 sectors



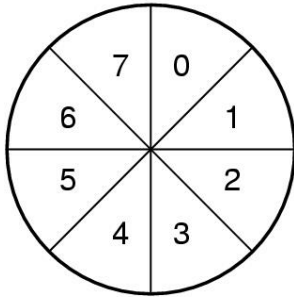
Head Skew

- ❖ Occurs when we change heads within a cylinder, but different platter surfaces.
- ❖ Here there is no physical movement of arm assembly.
- ❖ But it still takes time for the switch from reading one head to reading another.
- ❖ Head skew is the offsetting done on the start sector of tracks of adjacent platters (heads) of same cylinder.



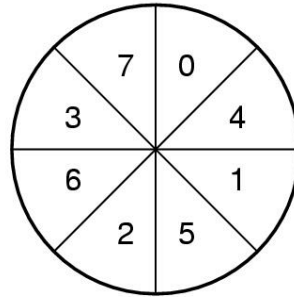
Sector Interleaving

- ❖ To ensure that sector # $n+1$ didn't rotate past the head while sector # n was being processed.



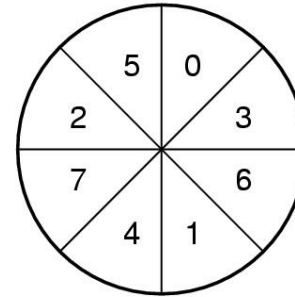
(a)

No interleaving



(b)

Single interleaving



(c)

Double interleaving

Swap-Space Management

- ❖ Swap-space — Virtual memory uses disk space as an extension of main memory
- ❖ Swap-space can be carved out of the normal file system, or, more commonly, it can be in a separate disk partition (raw)
- ❖ Swap-space management in various OS.
 - ❖ Allocates swap space when process starts; holds text segment (the program) and data segment
 - ❖ Uses **swap maps** to track swap-space use
 - ❖ Some allocate swap space only when a dirty page is forced out of physical memory, not when the virtual memory page is first created.



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