COMP 3411

Assignment 7

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Question 1

Queue: **45, 110, 12, 15, 20, 70, 145, 90, 80**
Cylinder Range: **0 - 199**

What is the order that the requests are serviced for the algorithms listed below

A. FCFS Scheduling

Order	**45**		**110**		**12**		**15**		**20**		**70**		**145**		**90**		**80**
Diff.		65		98		3		5		50		75		55		10	

(Seek Time) Total Head Movement = 65 + 98 + 3 + 5 + 50 + 75 + 55 + 10 = 361

B. SCAN Scheduling (arm moving from cylinder 45 towards cylinder 0)

Order	**45**		**20**		**15**		**12**		**70**		**80**		**90**		**110**		**145**
Diff.		25		5		3		82		10		10		20		35	

**82 because 12 needs to go to 0, then all the way back to 70*

(Seek Time) Total Head Movement = 25 + 5 + 3 + 82 + 10 + 10 + 20 + 35 = 190

C. C-SCAN Scheduling

Order	**45**		**70**		**80**		**90**		**110**		**145**		**12**		**15**		**20**
Diff.		25		10		10		20		35		265		3		5	

**265 because 145 needs to go to 199, then all the way back to 0, then to 12*

(Seek Time) Total Head Movement = 25 + 10 + 10 + 20 + 35 + 265 + 3 + 5 = 373

D. Which algorithm gives the best result (i.e., services all the requests with the minimum amount of head movement).

SCAN algorithm with a head movement of 190, compared to 361 from FCFS and 373 from C-SCAN

Question 2

Queue: **85, 115, 13, 25, 35, 75, 155, 100, 90**
Cylinder Range: **0 - 199**

E. FCFS Scheduling

Order	**85**		**115**		**13**		**25**		**35**		**75**		**155**		**100**		**90**
Diff.		30		102		12		10		40		80		55		10	

(Seek Time) Total Head Movement = 30 + 102 + 12 + 10 + 40 + 80 + 55 + 10 = 339

F. SCAN Scheduling (arm moving right from cylinder 85 towards cylinder 0)

Order	**85**		**75**		**35**		**25**		**13**		**90**		**100**		**115**		**155**
Diff.		10		40		10		12		103		10		15		40	

**103 because 13 needs to go to 0, then all the way back to 90*

(Seek Time) Total Head Movement = 10 + 40 + 10 + 12 + 103 + 10 + 15 + 40 = 240

G. C-SCAN Scheduling

Order	**85**		**90**		**100**		**115**		**155**		**13**		**25**		**35**		**75**
Diff.		5		10		15		40		256		12		10		40	

**256 because 155 needs to go to 199, then all the way back to 0, then to 13*

(Seek Time) Total Head Movement = 5 + 10 + 15 + 40 + 256 + 12 + 10 + 40 = 388

H. Which algorithm gives the worst result (i.e., services all the requests but requires the maximum amount of head movement).

C-SCAN algorithm with a head movement of 388, compared to 339 from FCFS and 240 from SCAN.

Question 3

Consider a legacy disk drive with a sector size of 512 bytes, 128 tracks per surface and 500 sectors per track. The disk has 5 double-sided platters.

A. **Calculate capacity of a track in bytes? What is the capacity of each surface? What is the capacity of the disk?**

Bytes per Track **= Bytes per sector * Sectors per Track**
= 512 bytes * 500
= 256,000 bytes per track

Bytes per Surface **= Bytes per Track * Tracks per Surface**
= 256,000 * 128
= 32,768,000 bytes per surface

Bytes per Disk **= Bytes per surface * surfaces per disk**
= 32,768,000 * 5 * 2 (5 double-sided platters)
= 327,680,000 bytes per disk

B. **How many cylinders does the disk have?**

Number of cylinders == Number of tracks on each platter

Therefore, Number of cylinders = 128

C. **Give 3 examples of valid block sizes.**

Block size should be a multiple of the sector size (512 bytes). Cannot exceed track size (256,000):

1. 1,024
2. 2,048
3. 4,096

Question 4

Assume that a hard disk rotates at 15,000 revolutions per minute (rpm). Each track of the disk has 500 sectors. The average seek time of the disk is 8 milliseconds. Calculate the average access time for this disk. *Hint: the average rotation time is ½ of the maximum rotation time.*

- **Disk Rotation Speed =** 15,000 rpm
- **Sectors per Track =** 500 sectors
- **Avg. Seek Time =** 8 ms

Avg. Access Time = Avg. Seek Time + Rotational Latency + Transfer Time

1. ***Seek Time:*** *This is the time taken by the read/write head to move to the desired track.*
2. ***Rotation Latency:*** *This is the time it takes for the desired sector to rotate under the read/write head. As per the hint, the average rotation time is half of the maximum rotation time.*
3. ***Transfer Time:*** *This is the time taken to read the actual data from the sector.*

Seek time (given) = 8ms

The disk rotates at 15,000 revolutions per minute (rpm). To find the time for one complete revolution:

Time for 1 revolution **=** 60,000ms (1min) / RPM
= 60,000 / 15,000
= 4ms

The average rotation time is half of the maximum rotation time, so average rotation time

Avg. rotation time **=** Half of the maximum rotation time
= 4ms / 2
= 2ms

Since each track has 500 sectors, the time taken to read one sector:

Transfer Time= Time for one revolution / Sectors per track
= 4ms / 500 sectors
= 0.008ms

Avg. Access Time **= Avg. Seek Time + Rotational Latency + Transfer Time**
= 8ms + 2ms + 0.008ms
= 10.008ms