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STUDY OF DIFFERENT ALGORITHMS USE FOR DISK SCHEDULING PROCESS

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ABSTRACT

This paper aims to discuss the functioning of a disk and the comparative procedure involved in the retrieval of data on a direct access storage device by different algorithms. Efficiency of the different Disk Scheduling algorithms such as First Come First Serve (FCFS), Shortest Seek Time First (SSTF), Scan, Circular Scan (C-Scan) Scheduling algorithm. Disk requests execution and their pros and cons are also provided in this paper in order to make contrasts and comparisons of performance of the said algorithms. This paper also shows the differentiating abilities of the different scheduling algorithms and its effect to storage management, a better analysis of what disk scheduling algorithms do and how these amend the performance of servicing disk requests.

KEYWORDS: Disk Scheduling, SCAN, FCFS, SSTF, C-SCAN.

INTRODUCTION

A hard disk drive is a collection of plates called platters. The surface of each platter is divided into circular tracks. Furthermore, each track is divided into smaller pieces called sectors. Disk I/O is done sector by sector. A group of tracks that are positioned on top of each other form a cylinder. There is a head connected to an arm for each surface, which handles all I/O operations.

For each I/O request, first head is selected. It is then moved over the destination track. The disk is then rotated to position the desired sector under the head and finally, the read/write operation is performed.

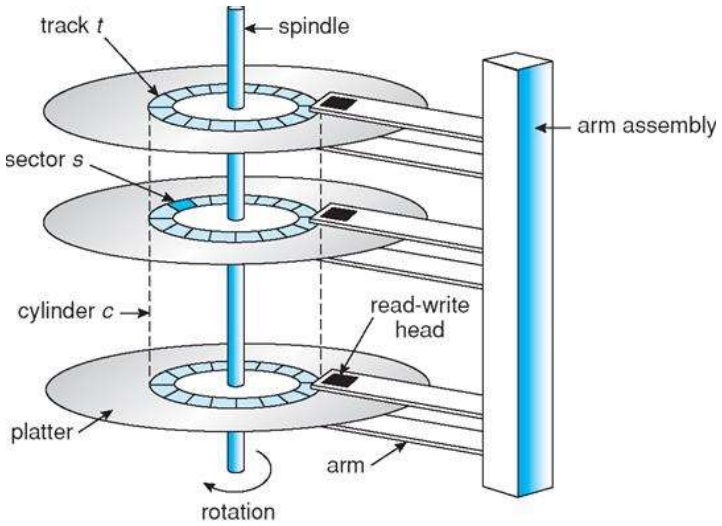

Figure 1: Disk Structure

I/O request issues a system call to the OS. If desired disk drive or controller is available, request is served immediately. ‰ If busy, new request for service will be placed in the queue of pending requests. When one request

is completed, the OS has to choose which pending request to service next and this is done by different disk scheduling algorithms.

There are two objectives for any disk scheduling algorithm:
1. Maximize the throughput - the average number of requests satisfied per time unit.
2. Minimize the response time - the average time that a request must wait before it is satisfied.
Some of the disk scheduling algorithms are:
1.FCFS ‰
2. SSTF ‰
3.SCAN Scheduling ‰
4.C-SCAN Scheduling ‰

DISK SCHEDULING ALGORITHMS

Some of the disks scheduling algorithms are explained below.

1. **FCFS** (First Come, First Served)
   - perform operations in order requested
   - no reordering of work queue
   - no **starvation**: every request is serviced
   - poor performance
2. **SSTF** (Shortest Seek Time First)
   - after a request, go to the closest request in the work queue, regardless of direction
   - reduces total seek time compared to FCFS
   - Disadvantages
   - **starvation** is possible; stay in one area of the disk if very busy
   - switching directions slows things down
3. **SCAN**
   - go from the outside to the inside servicing requests and then back from the outside to the inside servicing requests.
   - repeats this over and over.
   - reduces variance compared to SSTF.
4. **C-SCAN** (circular scan)
   - moves inwards servicing requests until it reaches the innermost cylinder; then jumps to the outside cylinder of the disk without servicing any requests.
   - repeats this over and over.
   - variant: service requests from inside to outside, and then skip back to the innermost cylinder.

REAL-WORLD EXAMPLES

Barbershop Analogy:
Doug, the evil barber, has hired a worker to sweep up the hair that falls as he cuts it. Each day the poor worker tries a different method to satisfy his malevolent boss.

DAY 1 (FCFS: first-come-first-served (first-cut-first-swept))
As Doug cuts hair, worker picks up each clump in the order that it falls.

Results:
Sweeper spends a lot of time running back and forth. Notice that he passes over a lot of hair in order to get to the clump that fell in the next order.

Conclusion:
Good fairness, all hair gets picked up in order that it arrived. Bad throughput, sweeper ignores hair as he waks across room to get the next-fallen clump of hair.

DAY 2 (SJTF: shortest-job-to-finish)
As Doug cuts hair, sweeper always picks up the clumps that are closest to his current position.

Results:
Sweeper is being greedy and lazy. The area that the sweeper starts in tends to get the most attention e.g. if he starts in the middle, say, enough hair may be falling so that he will never make it to the edges.

Conclusion:
Poor fairness, hair on edges may never get picked up (infinite wait) middling throughput, tends to focus on localized area during heavy loads.

DAY 3 (SCAN)
Sweeper starts at one end of the room, walks to the other end sweeping up any hair he comes across. When he reaches the end he turns around and resumes sweeping in the opposite direction.

Results:
Because Sweeper effectively crosses the center twice as often as the edges, hair tends to pile up at the edges of the room i.e. it will take the sweeper twice as long to get to the end of the room than to the center.

Conclusion:
middling fairness, center gets more attention. middling throughput, if hair is falling more heavily on edges then it will not be picked up as fast as if in the center region.

DAY 4 (CSCAN)
Sweeper starts at one end of the room, walks to the other end sweeping up any hair he comes across. When he reaches the end he runs back to the other end of the room and starts over.

Results:
All hair is picked up regardless of where it falls or in what order. Some hair may remain longer than expected because it fell behind the sweeper as he walked past.

Conclusion:
Good fairness, everyone gets equal time good throughput, jobs done as fast as head can move across cylinders. (Note that the difficulty of moving head is in the acceleration/ deceleration of armature. Moving from one end of the disk to the other is not as difficult as moving back and forth in a small area)

Table 1: Comparison between different Disk Scheduling Algorithm

SNo	Non-Functional Parameters	FCFS	SSTF	SCAN	C-SCAN
1	Speed	Fast	Fast	Average	Fast
2	Efficiency				
3	Response Time	Average response time	SSF has significantly worse maximum response time than FCFS	Average response time	CSCAN is able to have lower response time than FCFS because its average response time is lower.
4	Throughput	poor throughput	good throughput	middling throughput	good throughput
5	Performance	Poor Performance	Reduces total seek time compared to FCFS	Reduces variance compared to SSTF.	Offers fairer service with more uniform waiting times. The performance of C-SCAN is somewhat less than SCAN
6	Fairness	good	Poor fairness	middling fairness	good fairness

		fairness			
7	Waiting time	good fairness	Poor fairness	Long waiting time	Provide more uniform wait time compared to scan

Throughput = jobs done / unit time
Fairness = each job waits equally and eventually is serviced

CONCLUSION

Each algorithm is unique in its own way. Overall performance depends on the number and type of requests.

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