CS-303 Assignment 4

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Course: Operating System

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Problem Statement

As part of this assignment, we need to develop a simulation program in C on Linux that implements the simulation of the read, write and seek operations of a disk. These operations can be simulated by functions that just return the time (in ms) required to service each request. The program has to be developed in the C programming language on a Linux OS.

The problem statement had the following main components:

1. **Request Generator**
2. **Dispatcher**

Thus, the problem statement asked us to create a scenario to mimic the disk scheduling which occurs and to compare the various algorithms for the same. For this, we would be asking for certain sectors of disks as requests. This would lead to the formation of a sequence of requests of different tracks and then given the revolution speed, seek time, transfer time we could compute the response time for each request and therefore compare the results from the various algorithms.

Approach to Solution

Overview

First I am taking the arguments from the user and then calculate the rotational latency and transfer delay for the given arguments. Thereafter I am generating random requests with the given parameters <platter,cylinder,sector,number_of_sector>. The dispatcher then takes up this request array and as per the algorithm selected by the user, it assigns it to a particular algorithm function where the total response time is computed using Seek time+Rotational delay+Transfer Time. The results are then computed on this value. I have implemented the algorithms:

1. **Random**
2. **FIFO**
3. **SSTF**
4. **SCAN**
5. **CSCAN**

The results pertaining to the above algorithms can be found at the bottom.

Directory Structure

```
|-- README.md
|-- main.c
|-- test.c
|-- Readme.pdf
|-- images
|-- |-- figure.png..
```

Detailed Explanation of the solution and contents of each file

main.c

This is the main file that starts the program. The file takes the following arguments upon execution and if not provided the server would not start.

1. **Revolution Speed.**
2. **Seek Time**
3. **Sector Size**
4. **Type Of Algorithm**

Seek Time: Seek time is the time taken to locate the disk arm to a specified track where the data is to be read or written. So the disk scheduling algorithm that gives minimum average seeks time is better.

Rotational Latency: Rotational Latency is the time taken by the desired sector of the disk to rotate into a position so that it can access the read/write heads. So the disk scheduling algorithm that gives minimum rotational latency is better.

Transfer Time: Transfer time is the time to transfer the data. It depends on the rotating speed of the disk and the number of bytes to be transferred.

Upon receiving the above-mentioned arguments the programs start by creating the memory blocks and initializing the space for OS and marking the rest of the space as free. For the memory blocks, each partition has been implemented as a linked list with the following structures.

```
struct request {
    int platter_number;
    int track_number;
    int sector_begin;
    int sector_count;
    clock_t start;
};
```

After generating a fixed amount of requests the dispatcher then on the selection of algorithm sends the requests to the respective functions after segregating the requests based on their platter number. After the

computation of the requests, the results are pushed into a queue where results are computed and printed later.

test.c

This is the file contacting the unit tests written by me to test the functions. The tests check the working of the heuristic, multithreading functions. The test cases basically run tests on heuristic operations such as sorting. The random generation of requests for each type of resource. Proper allocation of items to a request if available. The use of thread library to create threads.

Procedure to run the files

To run the solution only one file needs to run. main.c is the file containing the entire codebase.

Commands to compile and run the main.c and a standard argument list that could be changed by the user are provided below.

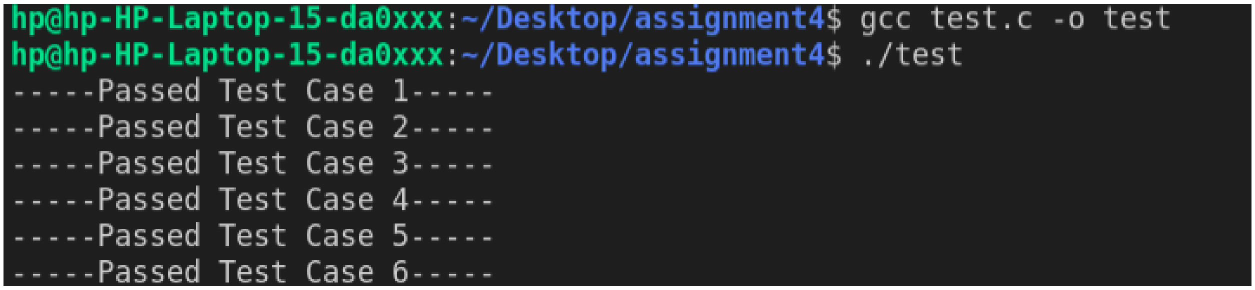
```
gcc main.c -pthread -o main
./main
```

Then provide the arguments as needed by the function.

```
Enter the revolution speed
7500
Enter the seek time
4
Enter the sector size
512
Select the algorithm you want to test
[0]->Random
[1]->FIFO
[2]->SSTF
[3]->SCAN
[4]->CSCAN
1
```

Commands to run the unit test file code

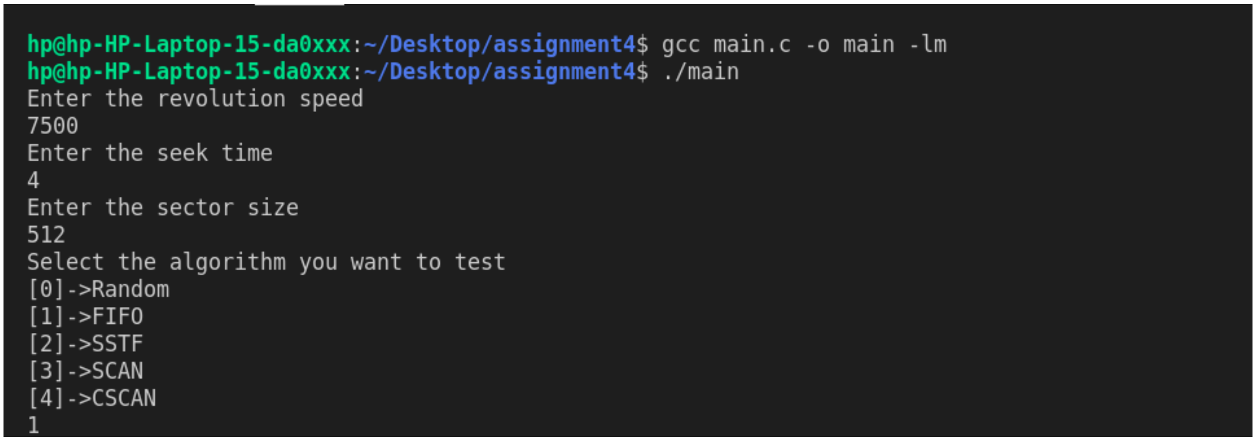
```
gcc test.c -o test
./test
```



```
hp@hp-HP-Laptop-15-da0xxx:~/Desktop/assignment4$ gcc test.c -o test
hp@hp-HP-Laptop-15-da0xxx:~/Desktop/assignment4$ ./test
-----Passed Test Case 1-----
-----Passed Test Case 2-----
-----Passed Test Case 3-----
-----Passed Test Case 4-----
-----Passed Test Case 5-----
-----Passed Test Case 6-----
```

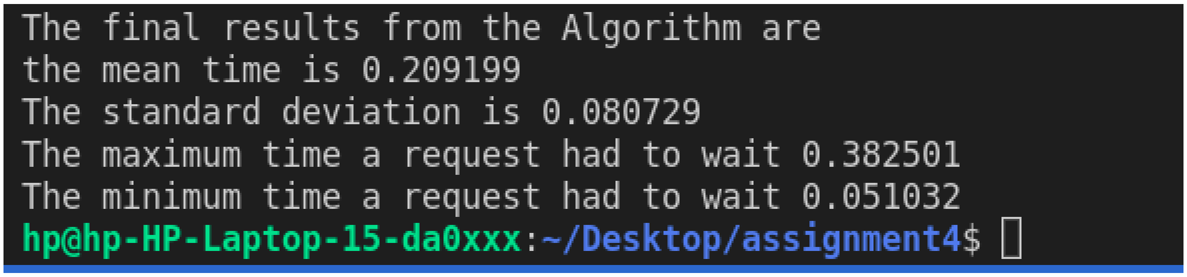
Snapshots of the results

Main program asking for arguments



```
hp@hp-HP-Laptop-15-da0xxx:~/Desktop/assignment4$ gcc main.c -o main -lm
hp@hp-HP-Laptop-15-da0xxx:~/Desktop/assignment4$ ./main
Enter the revolution speed
7500
Enter the seek time
4
Enter the sector size
512
Select the algorithm you want to test
[0]->Random
[1]->FIFO
[2]->SSTF
[3]->SCAN
[4]->CSCAN
1
```

The main program running



```
The final results from the Algorithm are
the mean time is 0.209199
The standard deviation is 0.080729
The maximum time a request had to wait 0.382501
The minimum time a request had to wait 0.051032
hp@hp-HP-Laptop-15-da0xxx:~/Desktop/assignment4$ 
```

A demo video can be found in the images folder

Results

Input	Scheduling Policy	Avg	Min	Max	Std Dev	Throughput
7500,512,4	Random	0.355984	0.013262	0.375196	0.282208	2857

15000,512,4	Random	0.204684	0.008831	0.221618	0.160234	5000
7500,512,4	FIFO	0.209739	0.051215	0.383454	0.080738	4784
15000,512,4	FIFO	0.123878	0.033800	0.223374	0.041991	8333
7500,512,4	SSTF	0.177608	0.026491	0.329314	0.083637	5649
15000,512,4	SSTF	0.091993	0.017854	0.192001	0.042834	10818
7500,512,4	SCAN	0.191820	0.034544	0.335524	0.082973	5235
15000,512,4	SCAN	0.106322	0.026080	0.175209	0.042573	9433
7500,512,4	CSCAN	0.191395	0.034820	0.343871	0.083431	5238
15000,512,4	CSCAN	0.105653	0.026091	0.182876	0.042835	9488

RANDOM Useful benchmark to test other algorithms.Used for simulations

FCFS Advantages: Every request gets a fair chance No indefinite wait Disadvantages: Large seek time

SSTF-- Advantages: Average Response Time decreases Throughput increases Disadvantages: Overhead to calculate seek time in advance Can cause Starvation for a request High standard deviation of response time as SSTF favours only some requests

SCAN Advantages: High throughput Standard deviation in response time is low Average response time is low Disadvantages: Long waiting time for requests for locations just visited by disk arm

CSCAN Advantages: Compared to SCAN provides a more uniform wait time.

Thus in terms of time SSTF provides the best results.

References

https://www.geeksforgeeks.org/disk-scheduling-algorithms/