V202200664 - Luu Nguyen Chi Duc

Operating System HW2

Part A - Theory Questions

A disk drive has **5,000** cylinders, with the current request at cylinder **2,150** and previous requests at cylinder 1,805. The pending request queue is 2069, 1212, 2296, 2800, 544, 1618, 356, 1523, 4965, 3681.

a. FCFS

```
NMax range of disk: 5000
Size of queue request: 10
Queue of disk positions to be read: 2069 1212 2296 2800 544 1618 356 1523 4965
3681
Init head position: 2150
-------------------------------------------------------------------------------
--
Disk head moves from 2150 to 2069 with seek 81
Disk head moves from 2069 to 1212 with seek 857
Disk head moves from 1212 to 2296 with seek 1084
Disk head moves from 2296 to 2800 with seek 504
Disk head moves from 2800 to 544 with seek 2256
Disk head moves from 544 to 1618 with seek 1074
Disk head moves from 1618 to 356 with seek 1262
Disk head moves from 356 to 1523 with seek 1167
Disk head moves from 1523 to 4965 with seek 3442
Disk head moves from 4965 to 3681 with seek 1284

Total seek time is 13011
Average seek time is 1301.100000
```

b. SCAN

```
Disk head moves from 2069 to 2069 with seek 81
Disk head moves from 1618 to 1618 with seek 451
Disk head moves from 1523 to 1523 with seek 95
Disk head moves from 1212 to 1212 with seek 311
Disk head moves from 544 to 544 with seek 668
Disk head moves from 356 to 356 with seek 188
Disk head moves from 356 to 0 with seek 356
Disk head moves from 2296 to 2296 with seek 2296
Disk head moves from 2800 to 2800 with seek 504
Disk head moves from 3681 to 3681 with seek 881
Disk head moves from 4965 to 4965 with seek 1284
```

```
SCAN Total Head Movement: 7115 cylinders
```

c. C-SCAN

```
Disk head moves from 2296 to 2296 with seek 146
Disk head moves from 2800 to 2800 with seek 504
Disk head moves from 3681 to 3681 with seek 881
Disk head moves from 4965 to 4965 with seek 1284
Disk head moves from 4965 to 4999 then to 0 with seek 5033
Disk head moves from 356 to 356 with seek 356
Disk head moves from 544 to 544 with seek 188
Disk head moves from 1212 to 1212 with seek 668
Disk head moves from 1523 to 1523 with seek 311
Disk head moves from 1618 to 1618 with seek 95
Disk head moves from 2069 to 2069 with seek 451

C-SCAN Total Head Movement: 9917 cylinders
```

Part B - Programing

Implementing Disk-Scheduling Algorithms

Code `disk_sche_algo.c`**:**

```c
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <time.h>

#define MAX_CYLINDER 4999
#define NUM_REQUESTS 1000

int compare(const void *a, const void *b)
{
    return (*(int *)a - *(int *)b);
}

int find_start_index(int *arr, int len, int head)
{
    int left = 0, right = len - 1, mid;
    while (left <= right)
    {
        mid = left + (right - left) / 2;
        if (arr[mid] == head)
            return mid;
        else if (arr[mid] < head)
            left = mid + 1;
```

```
            else
                right = mid - 1;
        }
        return left;
    }

    void generate_random_requests(int *requests, int num_requests)
    {
        srand(time(NULL));
        for (int i = 0; i < num_requests; i++)
            requests[i] = rand() % (MAX_CYLINDER + 1);
    }

    void read_requests_from_file(char *filename, int *requests, int *num_requests)
    {
        FILE *file = fopen(filename, "r");
        if (!file)
        {
            fprintf(stderr, "Error opening file: %s\n", filename);
            exit(1);
        }

        int i = 0;
        while (fscanf(file, "%d,", &requests[i]) != EOF && i < NUM_REQUESTS)
            i++;

        *num_requests = i;
        fclose(file);
    }

    void scan(int *requests, int num_requests, int head)
    {
        qsort(requests, num_requests, sizeof(int), compare);
        int total_movement = 0;
        int start_index = find_start_index(requests, num_requests, head);
        int curr_position = head;
        int seek;

        // Move left
        for (int i = start_index - 1; i >= 0; i--)
        {
            seek = abs(curr_position - requests[i]);
            total_movement += seek;
            curr_position = requests[i];
            printf("Disk head moves from %d to %d with seek %d\n", curr_position,
    requests[i], seek);
        }

        // Move to the beginning
        seek = abs(curr_position);
        total_movement += seek;
        printf("Disk head moves from %d to %d with seek %d\n", curr_position, 0,
    seek);
        curr_position = 0;
```

```
    // Move right
    for (int i = start_index; i < num_requests; i++)
    {
        seek = abs(curr_position - requests[i]);
        total_movement += seek;
        curr_position = requests[i];
        printf("Disk head moves from %d to %d with seek %d\n", curr_position,
requests[i], seek);
    }

    printf("SCAN Total Head Movement: %d cylinders\n", total_movement);
}

void c_scan(int *requests, int num_requests, int head)
{
    qsort(requests, num_requests, sizeof(int), compare);
    int total_movement = 0;
    int start_index = find_start_index(requests, num_requests, head);
    int curr_position = head;
    int seek;

    // Move right
    for (int i = start_index; i < num_requests; i++)
    {
        seek = abs(curr_position - requests[i]);
        total_movement += seek;
        curr_position = requests[i];
        printf("Disk head moves from %d to %d with seek %d\n", curr_position,
requests[i], seek);
    }

    // Jump to the beginning
    seek = (MAX_CYLINDER - curr_position) + MAX_CYLINDER;
    total_movement += seek;
    printf("Disk head moves from %d to %d then to %d with seek %d\n",
curr_position, MAX_CYLINDER, 0, seek);
    curr_position = 0;

    // Continue
    for (int i = 0; i < start_index; i++)
    {
        seek = abs(curr_position - requests[i]);
        total_movement += seek;
        curr_position = requests[i];
        printf("Disk head moves from %d to %d with seek %d\n", curr_position,
requests[i], seek);
    }

    printf("C-SCAN Total Head Movement: %d cylinders\n", total_movement);
}

void c_look(int *requests, int num_requests, int head)
{
```

```
    qsort(requests, num_requests, sizeof(int), compare);
    int total_movement = 0;
    int start_index = find_start_index(requests, num_requests, head);
    int curr_position = head;
    int seek;

    // Move right
    for (int i = start_index; i < num_requests; i++)
    {
        seek = abs(curr_position - requests[i]);
        total_movement += seek;
        curr_position = requests[i];
        printf("Disk head moves from %d to %d with seek %d\n", curr_position,
requests[i], seek);
    }

    // Jump to the furthest request at the left side
    seek = abs(curr_position - requests[0]);
    total_movement += seek;
    printf("Disk head moves from %d to %d with seek %d\n", curr_position,
requests[0], seek);
    curr_position = requests[0];

    // Continue
    for (int i = 0; i < start_index; i++)
    {
        seek = abs(curr_position - requests[i]);
        total_movement += seek;
        curr_position = requests[i];
        printf("Disk head moves from %d to %d with seek %d\n", curr_position,
requests[i], seek);
    }

    printf("C-LOOK Total Head Movement: %d cylinders\n", total_movement);
}

int main(int argc, char *argv[])
{
    int head_position;
    int requests[NUM_REQUESTS];
    int num_requests = NUM_REQUESTS;

    if (argc < 2)
    {
        fprintf(stderr, "Usage: %s <head_position> [series.txt]\n", argv[0]);
        return 1;
    }

    head_position = atoi(argv[1]);

    if (argc == 3)
        read_requests_from_file(argv[2], requests, &num_requests);
    else
        generate_random_requests(requests, num_requests);
```

```
    scan(requests, num_requests, head_position);
    c_scan(requests, num_requests, head_position);
    c_look(requests, num_requests, head_position);

    return 0;
}
```

Output:

```
PS D:\Code\HWTasks\Operating System\HW2> gcc disk_sche_algo.c -o disk_sche_algo
PS D:\Code\HWTasks\Operating System\HW2> ./disk_sche_algo 2150 series.txt
Disk head moves from 2069 to 2069 with seek 81
Disk head moves from 1618 to 1618 with seek 451
Disk head moves from 1523 to 1523 with seek 95
Disk head moves from 1212 to 1212 with seek 311
Disk head moves from 544 to 544 with seek 668
Disk head moves from 356 to 356 with seek 188
Disk head moves from 356 to 0 with seek 356
Disk head moves from 2296 to 2296 with seek 2296
Disk head moves from 2800 to 2800 with seek 504
Disk head moves from 3681 to 3681 with seek 881
Disk head moves from 4965 to 4965 with seek 1284
SCAN Total Head Movement: 7115 cylinders
Disk head moves from 2296 to 2296 with seek 146
Disk head moves from 2800 to 2800 with seek 504
Disk head moves from 3681 to 3681 with seek 881
Disk head moves from 4965 to 4965 with seek 1284
Disk head moves from 4965 to 4999 then to 0 with seek 5033
Disk head moves from 356 to 356 with seek 356
Disk head moves from 544 to 544 with seek 188
Disk head moves from 1212 to 1212 with seek 668
Disk head moves from 1523 to 1523 with seek 311
Disk head moves from 1618 to 1618 with seek 95
Disk head moves from 2069 to 2069 with seek 451
C-SCAN Total Head Movement: 9917 cylinders
Disk head moves from 2296 to 2296 with seek 146
Disk head moves from 2800 to 2800 with seek 504
Disk head moves from 3681 to 3681 with seek 881
Disk head moves from 4965 to 4965 with seek 1284
Disk head moves from 4965 to 356 with seek 4609
Disk head moves from 356 to 356 with seek 0
Disk head moves from 544 to 544 with seek 188
Disk head moves from 1212 to 1212 with seek 668
Disk head moves from 1523 to 1523 with seek 311
Disk head moves from 1618 to 1618 with seek 95
Disk head moves from 2069 to 2069 with seek 451
C-LOOK Total Head Movement: 9137 cylinders
```

FCFS algorithm

Code `fcfs.c`:

```c
#include <stdio.h>
#include <stdlib.h>

int main()
{
    int n, init_head, total_seek = 0;
    printf("NMax range of disk: ");
    scanf("%d", &n);

    printf("Size of queue request: ");
    scanf("%d", &n);

    int *requests = malloc(n * sizeof(int));

    printf("Queue of disk positions to be read: ");
    for (int i = 0; i < n; i++)
        scanf("%d", &requests[i]);

    printf("Init head position: ");
    scanf("%d", &init_head);

    printf("\n");
    int curr_position = init_head;

    for (int i = 0; i < n; i++)
    {
        int seek = abs(curr_position - requests[i]);
        total_seek += seek;
        printf("Disk head moves from %d to %d with seek %d\n", curr_position,
requests[i], seek);
        curr_position = requests[i];
    }

    printf("Total seek time is %d\n", total_seek);
    printf("Average seek time is %.6f\n", (double)total_seek / n);

    free(requests);
    return 0;
}
```

Output:

```
PS D:\Code\HWTasks\Operating System> cd "d:\Code\HWTasks\Operating System\HW2\" ;
if ($?) { gcc fcfs.c -o fcfs } ; if ($?) { .\fcfs }
NMax range of disk: 200
```

```
Size of queue request: 10
Queue of disk positions to be read: 12 34 65 78 22 55 87 97 98 75
Init head position: 50

Disk head moves from 50 to 12 with seek 38
Disk head moves from 12 to 34 with seek 22
Disk head moves from 34 to 65 with seek 31
Disk head moves from 65 to 78 with seek 13
Disk head moves from 78 to 22 with seek 56
Disk head moves from 22 to 55 with seek 33
Disk head moves from 55 to 87 with seek 32
Disk head moves from 87 to 97 with seek 10
Disk head moves from 97 to 98 with seek 1
Disk head moves from 98 to 75 with seek 23
Total seek time is 259
Average seek time is 25.900000
```