Experiment 1:- Basic UNIX System calls

1.1 Objective:

Write C programs to implement basic UNIX system calls – read(), write(), open(), close(), lseek(), create().

1.2 Software Required:

- Operating System: UBUNTU/Linux
- Software Required: Terminal

1.3 Pre-Requisite:

- Basic C Programming,
- Concept of Unix System call commands
- Understanding of File I/O.

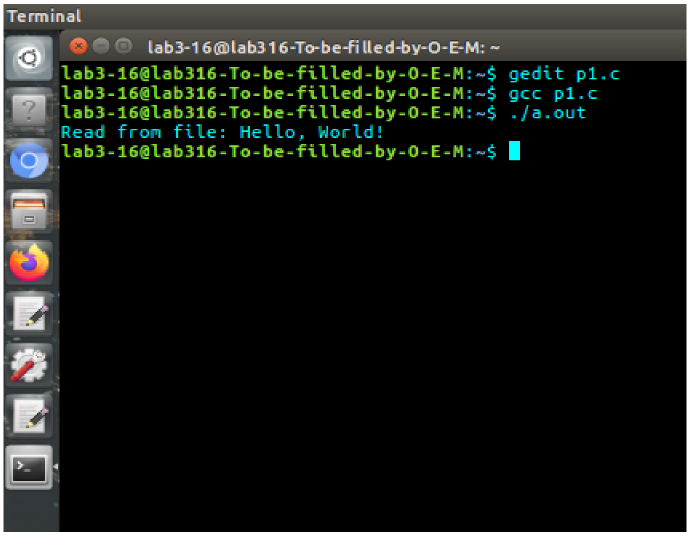
1.4 Program:

```
#include<stdio.h>
#include<stdlib.h>
#include<fcntl.h>
#include<unistd.h>

int main()
{
        int fd, ret;
        char buffer[20];

        // Create a new file
        fd = creat("example.txt", 0644);
        if (fd == -1)
        {
```

```
        perror("creat");
        exit(EXIT_FAILURE);
    }
    // Write to the file
    ret = write(fd, "Hello, World!", 13);
    if (ret == -1)
    {
        perror("write");
        exit(EXIT_FAILURE);
    }

    // Close the file
    ret = close(fd);
    if (ret == -1)
    {
        perror("close");
        exit(EXIT_FAILURE);
    }

    // Open the file again
    fd = open("example.txt", O_RDWR);
    if (fd == -1)
    {
        perror("open");
        exit(EXIT_FAILURE);
    }
```

```
        // Move the file cursor to the beginning of the file
        ret = lseek(fd, 0, SEEK_SET);
        if (ret == -1)
        {
                perror("lseek");
                exit(EXIT_FAILURE);
        }

        // Read from the file
        ret = read(fd, buffer, 13);
        if (ret == -1)
        {
                perror("read");
                exit(EXIT_FAILURE);
        }
        buffer[ret] = '\0'; // Null-terminate the string
        printf("Read from file: %s\n", buffer);
        // Close the file
        ret = close(fd);
        if (ret == -1)
        {
                perror("close");
                exit(EXIT_FAILURE);
        }
        return 0;
}
```

1.5 Results:


Terminal
lab3-16@lab316-To-be-filled-by-O-E-M: ~
lab3-16@lab316-To-be-filled-by-O-E-M:~$ gedit p1.c
lab3-16@lab316-To-be-filled-by-O-E-M:~$ gcc p1.c
lab3-16@lab316-To-be-filled-by-O-E-M:~$ ./a.out
Read from file: Hello, World!
lab3-16@lab316-To-be-filled-by-O-E-M:~$

Experiment 2:- UNIX Directory API's

2.1 Objective:

Write C programs to implement UNIX Directory API's – opendir, closedir, readdir, mkdir.

2.2 Software Required:

- Operating System: UBUNTU/Linux
- Software Required: Terminal

2.3 Pre-Requisite:

- Basic C Programming,
- Concept of Unix System call commands
- Understanding of File I/O.

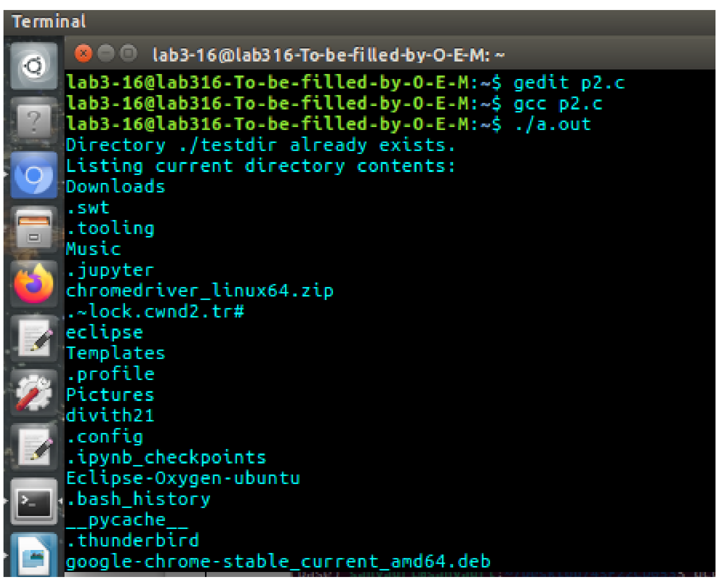
2.4 Program:

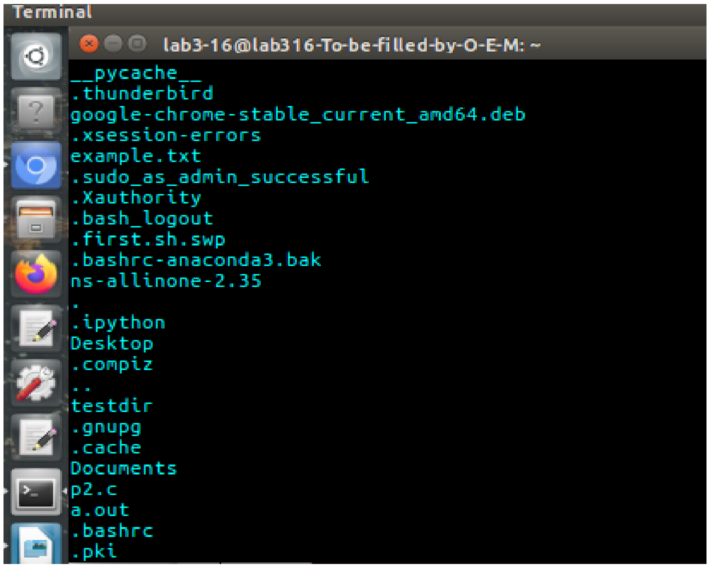
```
#include <stdio.h>
#include <stdlib.h>
#include <dirent.h>
#include <sys/stat.h>
#include <errno.h>

void listDirectory(const char *path)
{
        DIR *dir = opendir(path);
        if (dir == NULL)
        {
                perror("opendir");
                return;
        }
```

```
        struct dirent *entry;
        while ((entry = readdir(dir)) != NULL)
        {
                printf("%s\n", entry->d_name);
        }
        if (closedir(dir) == -1)
        {
                perror("closedir");
        }
}
void createDirectory(const char *path)
{
        if (mkdir(path, 0755) == -1)
        {
                if (errno == EEXIST)
                {
                printf("Directory %s already exists.\n", path);
                } else
                {
                        perror("mkdir");
                }
        } else
        {
            printf("Directory %s created successfully.\n", path);
        }
}

int main()
```

```
{
        const char *dirPath = "./testdir";
         // Create a directory
         createDirectory(dirPath);

        // List the contents of the current directory
        printf("Listing current directory contents:\n");
        listDirectory(".");
         // List the contents of the new directory
        printf("\nListing new directory contents:\n");
        listDirectory(dirPath);
        return 0;
}
```

2.5 Results:




Terminal
lab3-16@lab316-To-be-filled-by-O-E-M: ~
__pycache__
.thunderbird
google-chrome-stable_current_amd64.deb
.xsession-errors
example.txt
.sudo_as_admin_successful
.Xauthority
.bash_logout
.first.sh.swp
.bashrc-anaconda3.bak
ns-allinone-2.35
.
.ipython
Desktop
.compiz
..
testdir
.gnupg
.cache
Documents
p2.c
a.out
.bashrc
.pki

Experiment 3:- Process creation and Termination

3.1 Objective:

Demonstrate the Process creation and Termination using System calls –fork (), vfork (), getpid (), waitpid (), exec, exit (), return 0.

3.2 Software Required:

- Operating System: UBUNTU/Linux
- Software Required: Terminal

3.3 Pre-Requisite:

- Basic C Programming,
- Concept of Unix System call commands
- Understanding of File I/O.

3.4 Program:

a) fork

```
#include <stdio.h>
#include <unistd.h>
#include <sys/wait.h>

int main()
{
        pid_t pid;
        int status;
       // fork() system call
        pid = fork();
        if (pid < 0)
       {
               printf("Error: fork() failed.\n");
```

```
        return 1;
    }
    else if (pid == 0)
    {
        // child process
        printf("This is the child process with PID: %d\n", getpid());
        printf("Parent process PID: %d\n", getppid());
        // exec() system call
        execlp("/bin/ls", "ls", NULL);
        printf("This should not be printed if exec() is successful.\n");
        return 0;
    }
    else
    {
        // parent process
        printf("This is the parent process with PID: %d\n", getpid());
        printf("Child process PID: %d\n", pid);
        // wait() system call
         wait(&status);
         printf("Child process exited with status: %d\n", status);
        return 0;
    }
}
```

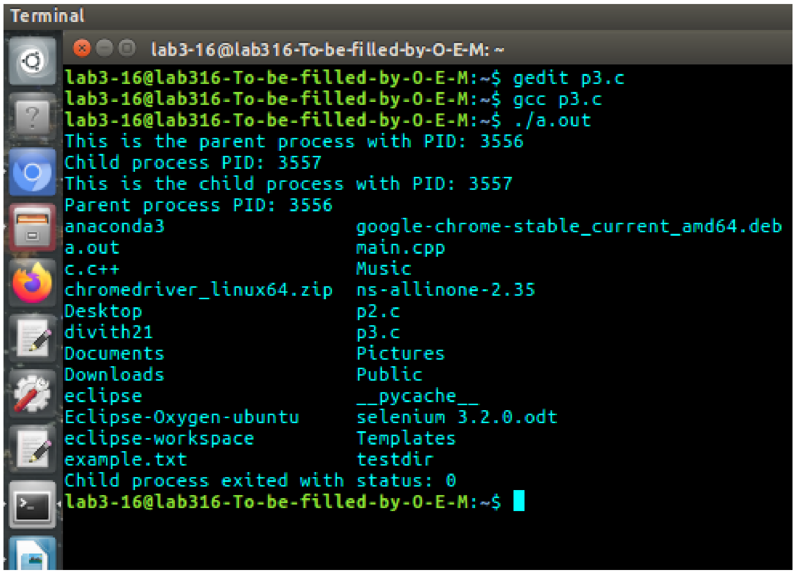
b) vfork

```
#include <stdio.h>
#include <unistd.h>
#include <sys/types.h>
#include <sys/wait.h>

int main()
{
    pid_t pid;
    // Fork a child process using vfork()
    pid = vfork()
    if (pid == -1)
    {
        // Forking failed
        perror("vfork");
        return 1;
    } else if (pid == 0)
    {
      // Child process
      printf("Child process: Hello, I'm the child!\n");
      printf("Child process: My PID is %d\n", getpid());
      printf("Child process: My parent's PID is %d\n", getppid());
      // Terminate the child process
      _exit(0);
    }
    else
```

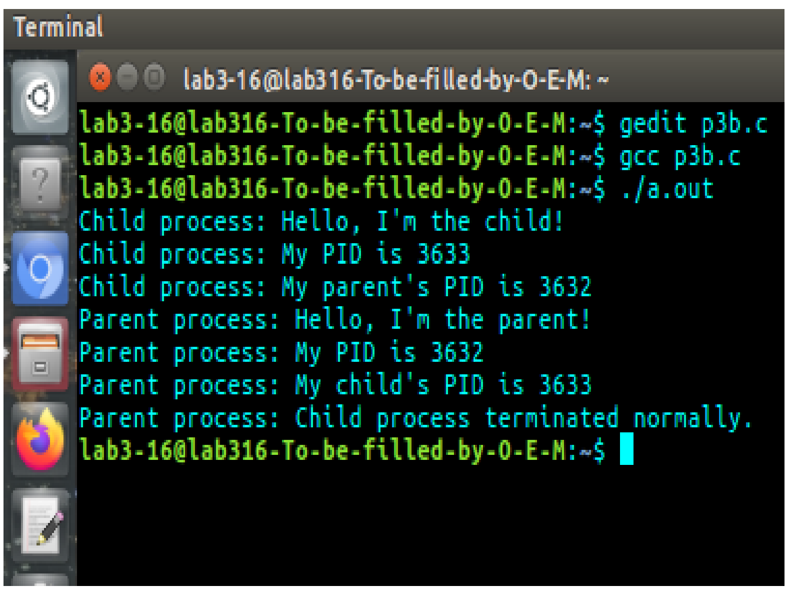
```
        {
            // Parent process
            printf("Parent process: Hello, I'm the parent!\n");
            printf("Parent process: My PID is %d\n", getpid());
            printf("Parent process: My child's PID is %d\n", pid);
            // Wait for the child process to terminate
            int status;
            waitpid(pid, &status, 0);
            if (WIFEXITED(status))
            {
                printf("Parent process: Child process terminated normally.\n");
            }
            else
            {
                printf("Parent process: Child process terminated abnormally.\n");
            }
        }
        return 0;
    }
```

3.5 Results:

a. fork



b. vfork



Experiment 4:- UNIX Directory API's

4.1 Objective:

Write C programs to simulate Inter – Process Communication (IPC) techniques: Pipes, Messages Queues, and Shared Memory.

4.2 Software Required:

- Operating System: UBUNTU/Linux
- Software Required: Terminal

4.3 Pre-Requisite:

- Basic C Programming,
- Concept of Unix System call commands
- Understanding of File I/O.

4.4 Program:

Write.c

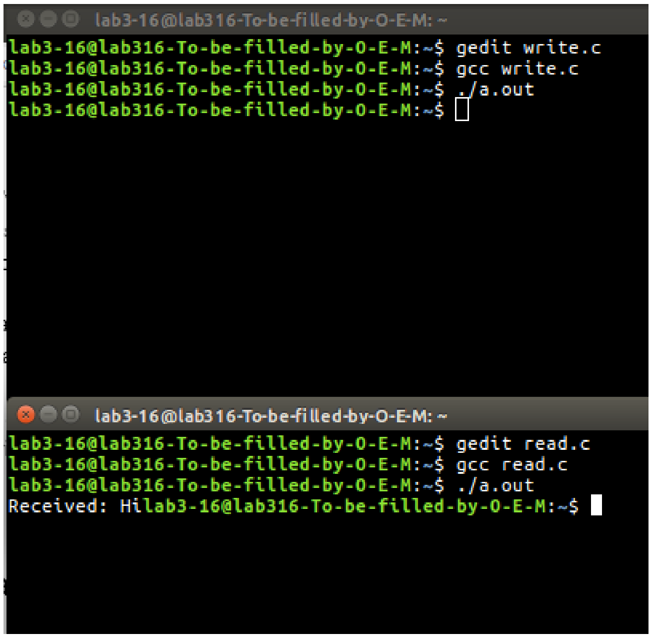
```
#include <fcntl.h>
#include <sys/stat.h>
#include <sys/types.h>
#include <unistd.h>

int main()
{
        int fd;
        char * myfifo = "/tmp/myfifo"; /* create the FIFO (named pipe) */
        mkfifo(myfifo, 0666);
        fd = open(myfifo, O_WRONLY);
        write(fd,"Hi", sizeof("Hi")); /* write "Hi" to the FIFO */
        close(fd);
```

```
    unlink(myfifo); /* remove the FIFO */
    return 0;
}
```

Reader.c

```
#include <fcntl.h>
#include <sys/stat.h>
#include<stdio.h>
#include <unistd.h>
#define MAX_BUF 1024

int main()
{
    int fd;
    char *myfifo = "/tmp/myfifo";
    char buf[MAX_BUF];
/* open, read, and display the message from the FIFO */
    fd = open(myfifo, O_RDONLY);
    read(fd, buf, MAX_BUF);
    printf("Received: %s", buf);
    close(fd);
    return 0;
}
```

4.5 Results:


lab3-16@lab316-To-be-filled-by-O-E-M: ~
lab3-16@lab316-To-be-filled-by-O-E-M:~$ gedit write.c
lab3-16@lab316-To-be-filled-by-O-E-M:~$ gcc write.c
lab3-16@lab316-To-be-filled-by-O-E-M:~$ ./a.out
lab3-16@lab316-To-be-filled-by-O-E-M:~$
lab3-16@lab316-To-be-filled-by-O-E-M: ~
lab3-16@lab316-To-be-filled-by-O-E-M:~$ gedit read.c
lab3-16@lab316-To-be-filled-by-O-E-M:~$ gcc read.c
lab3-16@lab316-To-be-filled-by-O-E-M:~$ ./a.out
Received: Hilab3-16@lab316-To-be-filled-by-O-E-M:~$

Experiment 5:- CPU Scheduling Algorithms

5.1 Objective:

Simulate the following CPU scheduling algorithms 1. FCFS 2. SJF 3. Priority 4. Round Robin. Calculate Average Waiting Time, Average Turn-Around Time, Average Response time for each algorithm.

5.2 Software Required:

- Operating System: UBUNTU/Linux
- Software Required: Terminal

5.3 Pre-Requisite:

- Basic C Programming,
- Concept of Unix System call commands
- Understanding of File I/O.

5.4 Program:

```
#include <stdio.h>
 void FCFS(int processes[], int n, int burst_time[])
 {
        int waiting_time[n], turnaround_time[n], total_waiting_time = 0,total_turnaround_time = 0;
        waiting_time[0] = 0;
        // Waiting time for first process is 0
        // Calculating waiting time for each process
        for (int i = 1; i < n; i++)
        {
                waiting_time[i] = burst_time[i - 1] + waiting_time[i - 1];
                total_waiting_time += waiting_time[i];
        }
```

```
    // Calculating turnaround time for each process
        for (int i = 0; i < n; i++)
        {
                turnaround_time[i] = burst_time[i] + waiting_time[i];
                total_turnaround_time += turnaround_time[i];
        }
        printf("First-Come, First-Served (FCFS) Scheduling Algorithm\n");
        printf("--------------------------------------------------\n");
        printf("Process\tBurst Time\tWaiting Time\tTurnaround Time\n");
    // Printing process details
        for (int i = 0; i < n; i++)
        {
        printf("%d\t%d\t\t%d\t\t%d\n", processes[i], burst_time[i],waiting_time[i], turnaround_time[i]);
        }
        printf("Average Waiting Time: %.2f\n", (float)total_waiting_time / n);
        printf("Average Turnaround Time: %.2f\n",(float)total_turnaround_time / n);
        printf("\n");
}
void SJF(int processes[], int n, int burst_time[])
{
        int waiting_time[n], turnaround_time[n], completion_time[n],total_waiting_time = 0,
        total_turnaround_time = 0;
        for (int i = 0; i < n; i++)
        {
                int shortest_job_index = i;
              // Find the shortest job
                for (int j = i + 1; j < n; j++)
```

```
            {
                    if (burst_time[j] < burst_time[shortest_job_index])shortest_job_index = j;
            }
        // Swap the shortest job with the current process
            int temp = burst_time[i];
            burst_time[i] = burst_time[shortest_job_index];
            burst_time[shortest_job_index] = temp;
            temp = processes[i];
            processes[i] = processes[shortest_job_index];
            processes[shortest_job_index] = temp;

    }

    waiting_time[0] = 0;

    // Waiting time for first process is 0

    // Calculating waiting time for each process

    for (int i = 1; i < n; i++)

    {

            waiting_time[i] = burst_time[i - 1] + waiting_time[i - 1];
            total_waiting_time += waiting_time[i];

    }
     // Calculating turnaround time for each process
    for (int i = 0; i < n; i++)

    {

            turnaround_time[i] = burst_time[i] + waiting_time[i];
            total_turnaround_time += turnaround_time[i];
    }
    printf("Shortest Job First (SJF) Scheduling Algorithm\n");
```

```
        printf("----------------------------------------------\n");
        printf("Process\tBurst Time\tWaiting Time\tTurnaround Time\n");
        // Printing process details
        for (int i = 0; i < n; i++)
        {
        printf("%d\t%d\t\t%d\t\t%d\n", processes[i], burst_time[i],waiting_time[i], turnaround_time[i]);
        }
         printf("Average Waiting Time: %.2f\n", (float)total_waiting_time / n);
         printf("Average Turnaround Time: %.2f\n", (float)total_turnaround_time / n);
         printf("\n");
}
void RoundRobin(int processes[], int n, int burst_time[], int quantum)
{
        int remaining_time[n], waiting_time[n], turnaround_time[n],total_waiting_time = 0,
        total_turnaround_time = 0;
        // Copying burst time into remaining time array
        for (int i = 0; i < n; i++)
        {
                remaining_time[i] = burst_time[i];
        }
        int time = 0; // Current time
        // Run the round robin algorithm
        while (1)
        {
                int all_processes_completed = 1;
                // Traverse all processes
```

```
        for (int i = 0; i < n; i++)
        {
            if (remaining_time[i] > 0)
            {
                all_processes_completed = 0;
                // There is still a pending process
                if (remaining_time[i] > quantum)
                {
                    time += quantum;
                    remaining_time[i] -= quantum;
                }
                else
                {
                    time += remaining_time[i];
                    waiting_time[i] = time - burst_time[i];
                    remaining_time[i] = 0;
                }
            }
        }
        if (all_processes_completed)
        {
            break;
        }
    }
    // Calculating turnaround time for each process
    for (int i = 0; i < n; i++)
```

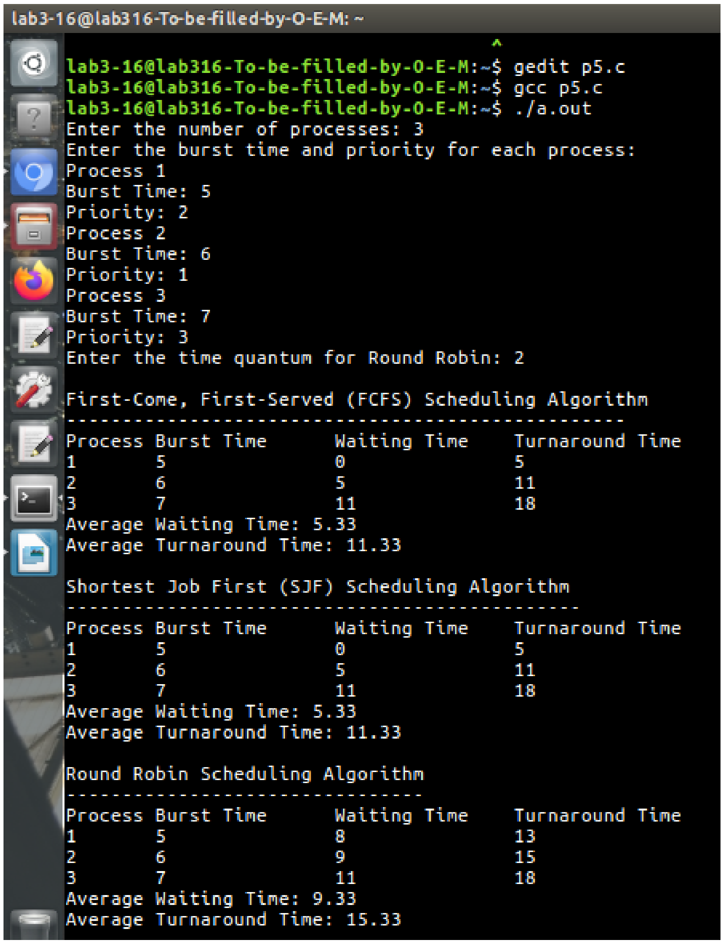
```
        {
                turnaround_time[i] = burst_time[i] + waiting_time[i];
                total_waiting_time += waiting_time[i];
                total_turnaround_time += turnaround_time[i];
        }
        printf("Round Robin Scheduling Algorithm\n");
        printf("--------------------------------\n");
        printf("Process\tBurst Time\tWaiting Time\tTurnaround Time\n");
        // Printing process details
        for (int i = 0; i < n; i++)
        {
        printf("%d\t%d\t\t%d\t\t%d\n", processes[i], burst_time[i],waiting_time[i], turnaround_time[i]);
        }
        printf("Average Waiting Time: %.2f\n", (float)total_waiting_time / n);
        printf("Average Turnaround Time: %.2f\n", (float)total_turnaround_time / n);
        printf("\n");
}
void Priority(int processes[], int n, int burst_time[], int priority[])
{
        int waiting_time[n], turnaround_time[n], total_waiting_time = 0,total_turnaround_time = 0;
        for (int i = 0; i < n; i++)
        {
                int highest_priority_index = i;
                // Find the highest priority job
                 for (int j = i + 1; j < n; j++)
```

```
        {
            if (priority[j] < priority[highest_priority_index])highest_priority_index = j;
        }
        // Swap the highest priority job with the current process
        int temp = burst_time[i];
        burst_time[i] = burst_time[highest_priority_index];
        burst_time[highest_priority_index] = temp;
        temp = processes[i];
        processes[i] = processes[highest_priority_index];
        processes[highest_priority_index] = temp;
        temp = priority[i];
        priority[i] = priority[highest_priority_index];
        priority[highest_priority_index] = temp;
    }
    waiting_time[0] = 0; // Waiting time for first process is 0
    // Calculating waiting time for each process
    for (int i = 1; i < n; i++)
    {
        waiting_time[i] = burst_time[i - 1] + waiting_time[i - 1];
        total_waiting_time += waiting_time[i];
    }
    // Calculating turnaround time for each process
    for (int i = 0; i < n; i++)
    {
        turnaround_time[i] = burst_time[i] + waiting_time[i];
        total_turnaround_time += turnaround_time[i];
```

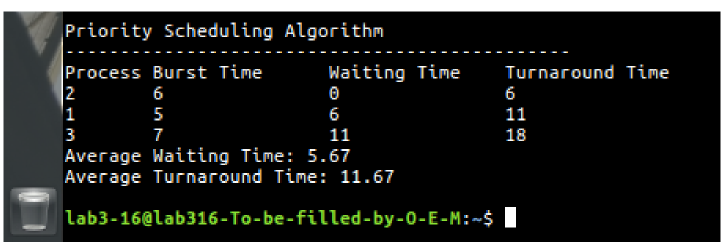
```
        }
        printf("Priority Scheduling Algorithm\n");
        printf("---------------------------------------------\n");
        printf("Process\tBurst Time\tWaiting Time\tTurnaround Time\n");
         // Printing process details
        for (int i = 0; i < n; i++)
        {
        printf("%d\t%d\t\t%d\t\t%d\n", processes[i], burst_time[i],waiting_time[i], turnaround_time[i]);
        }
        printf("Average Waiting Time: %.2f\n", (float)total_waiting_time / n);
        printf("Average Turnaround Time: %.2f\n", (float)total_turnaround_time / n);
        printf("\n");
}
int main()
{
        int n;
        printf("Enter the number of processes: ");
        scanf("%d", &n);
        int processes[n], burst_time[n], priority[n];
        printf("Enter the burst time and priority for each process:\n");
        for (int i = 0; i < n; i++)
        {
                printf("Process %d\n", i + 1);
                printf("Burst Time: ");
```

```
        scanf("%d", &burst_time[i]);
        printf("Priority: ");
        scanf("%d", &priority[i]);
        processes[i] = i + 1;
    }
    int quantum;
    printf("Enter the time quantum for Round Robin: ");
    scanf("%d", &quantum);
    printf("\n");
    FCFS(processes, n, burst_time);
    SJF(processes, n, burst_time);
    RoundRobin(processes, n, burst_time, quantum);
    Priority(processes, n, burst_time, priority);
    return 0;
}
```

5.5 Results:



```
lab3-16@lab316-To-be-filled-by-O-E-M: ~
lab3-16@lab316-To-be-filled-by-O-E-M:~$ gedit p5.c
lab3-16@lab316-To-be-filled-by-O-E-M:~$ gcc p5.c
lab3-16@lab316-To-be-filled-by-O-E-M:~$ ./a.out
Enter the number of processes: 3
Enter the burst time and priority for each process:
Process 1
Burst Time: 5
Priority: 2
Process 2
Burst Time: 6
Priority: 1
Process 3
Burst Time: 7
Priority: 3
Enter the time quantum for Round Robin: 2

First-Come, First-Served (FCFS) Scheduling Algorithm
--------------------------------------------------
Process Burst Time      Waiting Time    Turnaround Time
1       5               0               5
2       6               5               11
3       7               11              18
Average Waiting Time: 5.33
Average Turnaround Time: 11.33

Shortest Job First (SJF) Scheduling Algorithm
----------------------------------------------
Process Burst Time      Waiting Time    Turnaround Time
1       5               0               5
2       6               5               11
3       7               11              18
Average Waiting Time: 5.33
Average Turnaround Time: 11.33

Round Robin Scheduling Algorithm
--------------------------------
Process Burst Time      Waiting Time    Turnaround Time
1       5               8               13
2       6               9               15
3       7               11              18
Average Waiting Time: 9.33
Average Turnaround Time: 15.33
```



```
Priority Scheduling Algorithm
---------------------------------------------
Process Burst Time      Waiting Time    Turnaround Time
2       6               0               6
1       5               6               11
3       7               11              18
Average Waiting Time: 5.67
Average Turnaround Time: 11.67

lab3-16@lab316-To-be-filled-by-O-E-M:~$
```

Experiment 6:- Synchronization using Semaphores

6.1 Objective:

Demonstrate the following Classical problems of synchronization using semaphores- a. Producer-Consumer b. Dining Philosopher

6.2 Software Required:

- Operating System: UBUNTU/Linux
- Software Required: Terminal

6.3 Pre-Requisite:

- Basic C Programming,
- Concept of Unix System call commands
- Understanding of File I/O.

6.4 Program:

a. Producer-Consumer

```
#include<stdio.h>
#include<stdlib.h>
int mutex=1,full=0,empty=3,x=0;
int main()
{
        int n;
        void producer();
        void consumer();
        int wait(int);
        int signal(int);
        printf("\n1.producer\n2.consumer\n3.exit");
        while(1)
```

```
        {
                printf("\n enter your choice");
                scanf("%d",&n);
                switch(n)
                {
                        case 1:if((mutex==1)&&(empty!=0))
                        producer();
                        else
                        printf("buffer is full!!");
                        break;
                        case 2:if((mutex==1)&&(full!=0))
                        consumer();
                        else
                        printf("buffer is empty!!");
                        break;
                        case 3:
                        exit(0);
                        break;
                }
        }
        return 0;
}
int wait(int s)
{
        return(--s);
}
```

```
int signal(int s)
{
        return(++s);
}
void producer()
{
        mutex=wait(mutex);
        full=signal(full);
        empty=wait(empty);
        x++;
        printf("\n producer produces the item %d",x);
        mutex=signal(mutex);
}
void consumer()
{
        mutex=wait(mutex);
        full=wait(full);
        empty=signal(empty);
        printf("\n consumer consumes the item %d",x);
        x--;
        mutex=signal(mutex);
}
```

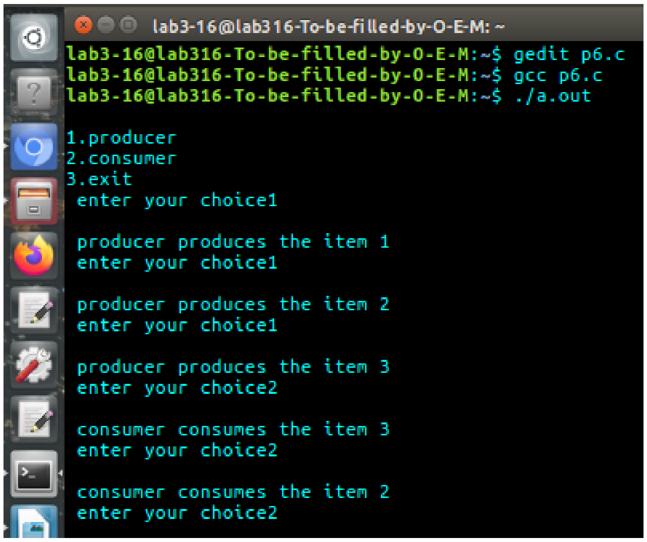
b. Dining Philosopher

```
#include<stdio.h>
#include<stdlib.h>
#include<pthread.h>
#include<semaphore.h>
#include<unistd.h>
sem_t room;
sem_t chopstick[5];
void eat(int);
void *philosopher(void *);
void eat(int phil)
{
	printf("\nPhilosopher %d is eating",phil);
}
 int main()
{
	int i,a[5];
	pthread_t tid[5];
	sem_init(&room,0,4);
	for(i=0;i<5;i++)
	sem_init(&chopstick[i],0,1);
	for(i=0;i<5;i++)
	{
		a[i]=i;
		pthread_create(&tid[i],NULL,philosopher,(void*)&a[i]);
	}
	for(i=0;i<5;i++)
```

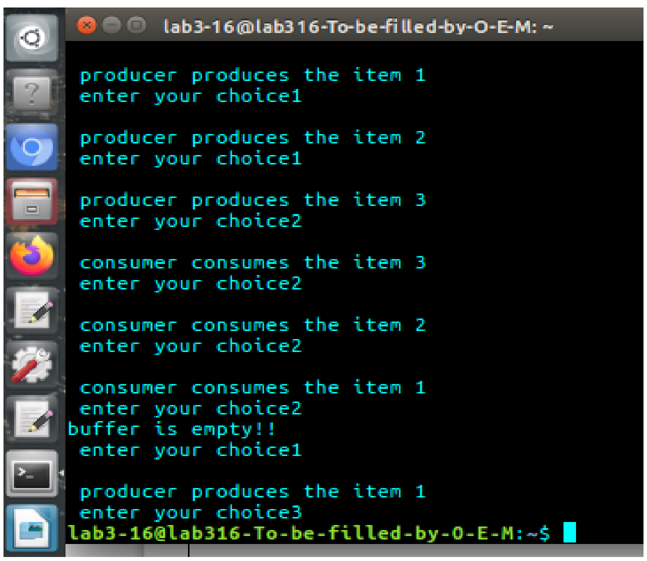
```
        pthread_join(tid[i],NULL);
        //return 0;
}
void *philosopher(void *num)
{
        int phil=*(int*)num;
        sem_wait(&room);
        printf("\n Philosopher %d has entered room",phil);
        sem_wait(&chopstick[phil]);
        sem_wait(&chopstick[(phil+1)%5]);
        eat(phil);
        sleep(2);
        printf("\n Philosopher %d has finished eating",phil);
        sem_post(&chopstick[(phil+1)%5]);
        sem_post(&chopstick[phil]);
        sem_post(&room);
}
```

6.5 Results:

a. Producer-Consumer



```
lab3-16@lab316-To-be-filled-by-O-E-M: ~
lab3-16@lab316-To-be-filled-by-O-E-M:~$ gedit p6.c
lab3-16@lab316-To-be-filled-by-O-E-M:~$ gcc p6.c
lab3-16@lab316-To-be-filled-by-O-E-M:~$ ./a.out

1.producer
2.consumer
3.exit
 enter your choice1

 producer produces the item 1
 enter your choice1

 producer produces the item 2
 enter your choice1

 producer produces the item 3
 enter your choice2

 consumer consumes the item 3
 enter your choice2

 consumer consumes the item 2
 enter your choice2
```



```
lab3-16@lab316-To-be-filled-by-O-E-M: ~

 producer produces the item 1
 enter your choice1

 producer produces the item 2
 enter your choice1

 producer produces the item 3
 enter your choice2

 consumer consumes the item 3
 enter your choice2

 consumer consumes the item 2
 enter your choice2

 consumer consumes the item 1
 enter your choice2
buffer is empty!!
 enter your choice1

 producer produces the item 1
 enter your choice3
lab3-16@lab316-To-be-filled-by-O-E-M:~$
```

b. Dining Philosopher

```
lab3-16@lab316-To-be-filled-by-O-E-M: ~
lab3-16@lab316-To-be-filled-by-O-E-M:~$ gedit din.c
lab3-16@lab316-To-be-filled-by-O-E-M:~$ gcc din.c -pthread
lab3-16@lab316-To-be-filled-by-O-E-M:~$ ./a.out

Philosopher 2 has entered the room
Philosopher 2 is eating
Philosopher 0 has entered the room
Philosopher 0 is eating
Philosopher 3 has entered the room
Philosopher 1 has entered the room
Philosopher 2 has finished eating
Philosopher 0 has finished eating
Philosopher 1 is eating
Philosopher 3 is eating
Philosopher 4 has entered the room
Philosopher 3 has finished eating
Philosopher 1 has finished eating
Philosopher 4 is eating
Philosopher 4 has finished eatinglab3-16@lab316-To-be-filled-by-O-E-M:
```

Experiment 7:- Page Replacement Algorithms

7.1 Objective:

Demonstrate following page replacement algorithms: a. FIFO, b. LRU, c. OPTIMAL.

7.2 Software Required:

- Operating System: UBUNTU/Linux
- Software Required: Terminal

7.3 Pre-Requisite:

- Basic C Programming,
- Concept of Unix System call commands
- Understanding of File I/O.

7.4 Program:

a. FIFO

```
#include<stdio.h>
int main()
{
        int i,j,n,a[50],frame[10],no,k,avail,count=0;
        printf("\n ENTER THE NUMBER OF PAGES:\n");
        scanf("%d",&n);
        printf("\n ENTER THE PAGE NUMBER :\n");
        for(i=1;i<=n;i++)
        scanf("%d",&a[i]);
        printf("\n ENTER THE NUMBER OF FRAMES :");
        scanf("%d",&no);
        for(i=0;i<no;i++)
        frame[i]= -1;
        j=0;
        printf("\tref string\t page frames\n");
```

```
        for(i=1;i<=n;i++)
        {
                printf("%d\t\t",a[i]);
                avail=0;
                for(k=0;k<no;k++)
                if(frame[k]==a[i])
                avail=1;
                if (avail==0)
                {
                        frame[j]=a[i];
                        j=(j+1)%no;
                        count++;
                        for(k=0;k<no;k++)
                        printf("%d\t",frame[k]);
                }
                printf("\n");
        }
        printf("Page Fault Is %d",count);
        return 0;
}
```

b. LRU

```
#include<stdio.h>
#include<limits.h>
int checkHit(int incomingPage, int queue[], int occupied)
{
    for(int i = 0; i < occupied; i++)
    {
            if(incomingPage == queue[i])
            return 1;
    }
    return 0;
}
void printFrame(int queue[], int occupied)
{
    for(int i = 0; i < occupied; i++)
    printf("%d\t",queue[i]);
}

int main()
{

//    int incomingStream[] = {7, 0, 1, 2, 0, 3, 0, 4, 2, 3, 0, 3, 2, 1};
//    int incomingStream[] = {1, 2, 3, 2, 1, 5, 2, 1, 6, 2, 5, 6, 3, 1, 3, 6, 1, 2, 4, 3};
    int incomingStream[] = {1, 2, 3, 2, 1, 5, 2, 1, 6, 2, 5, 6, 3, 1, 3};
    int n = sizeof(incomingStream)/sizeof(incomingStream[0]);
    int frames = 3;
    int queue[n];
    int distance[n];
    int occupied = 0;
    int pagefault = 0;
```

```
printf("\tPage\tFrame1\tFrame2\tFrame3\n");
for(int i = 0;i < n; i++)
{
     printf("%d:\t\t",incomingStream[i]);
    // what if currently in frame 7
    // next item that appears also 7
    // didnt write condition for HIT
    if(checkHit(incomingStream[i], queue, occupied))
    {
        printFrame(queue, occupied);
    }
    // filling when frame(s) is/are empty
    else if(occupied < frames)
    {
        queue[occupied] = incomingStream[i];
        pagefault++;
        occupied++;
        printFrame(queue, occupied);
    }
    else
    {
        int max = INT_MIN;
        int index;
        // get LRU distance for each item in frame
        for (int j = 0; j < frames; j++)
        {
            distance[j] = 0;
             // traverse in reverse direction to find
             // at what distance  frame item occurred last
```

```
                    for(int k = i - 1; k >= 0; k--)
                     {
                          ++distance[j];
                          if(queue[j] == incomingStream[k])
                          break;
                    }
                    // find frame item with max distance for LRU
                    // also notes the index of frame item in queue
                    // which appears furthest(max distance)
                    if(distance[j] > max)
                    {
                           max = distance[j];
                          index = j;
                    }
               }
               queue[index] = incomingStream[i];
               printFrame(queue, occupied);
               pagefault++;
          }
          printf("\n");
     }
     printf("Page Fault: %d\n",pagefault);
     return 0;
}
```

c. OPTIMAL

```
#include <stdio.h>
#include <stdbool.h>
// Function to find the index of the page in the frames
int findIndex(int frames[], int n, int page)
{
    for (int i = 0; i < n; i++)
    {
        if (frames[i] == page)
        return i;
    }
    return -1;
}
// Function to print the contents of the frames
void printFrames(int frames[], int n)
{
    for (int i = 0; i < n; i++)
    {
        if (frames[i] == -1)
        printf("- ");
        else
        printf("%d ", frames[i]);
    }
    printf("\n");
}
// OPTIMAL page replacement algorithm
void optimal(int pages[], int n, int capacity)
{
```

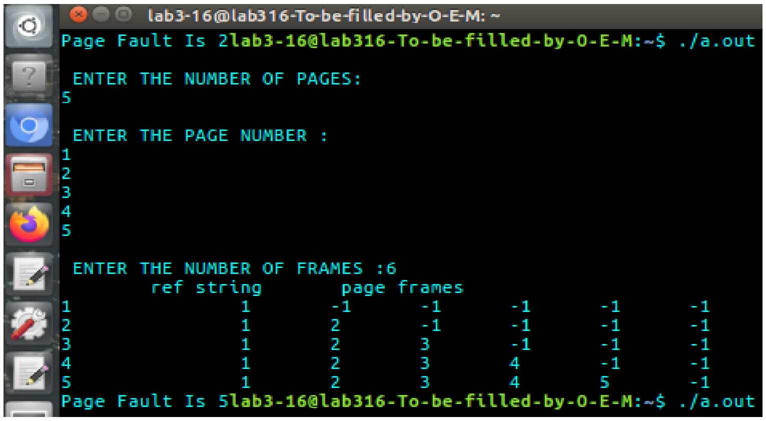
```
int frames[capacity];
int pageFaults = 0;
int index, farthest, futureIndex;
for (int i = 0; i < capacity; i++)
frames[i] = -1;
for (int i = 0; i < n; i++)
{
    int page = pages[i];
    index = findIndex(frames, capacity, page);
    if (index == -1)
    {
        int emptyIndex = findIndex(frames, capacity, -1);
        if (emptyIndex != -1)
        {
            frames[emptyIndex] = page;
        }
        else
        {
            farthest = i + 1;
            futureIndex = -1;
            for (int j = 0; j < capacity; j++)
            {
                int currentPage = frames[j];
                int k;
                for (k = i + 1; k < n; k++)
                {
                    if (currentPage == pages[k])
                    {
```

```
                        if (k > farthest)
                        {
                            farthest = k;
                            futureIndex = j;
                        }
                        break;
                    }
                }
                if (k == n)
                {
                    futureIndex = j;
                    break;
                }
            }
            frames[futureIndex] = page;
        }
        pageFaults++;
    }
    printFrames(frames, capacity);
}
printf("Optimal Page Faults: %d\n", pageFaults);
}
int main()
{
    int pages[] = {1, 2, 3, 4, 1, 5, 6, 7, 8, 7, 8, 9, 7, 8, 9, 5, 4, 5, 4, 2};
    int capacity = 3;
    int n = sizeof(pages) / sizeof(pages[0]);
```

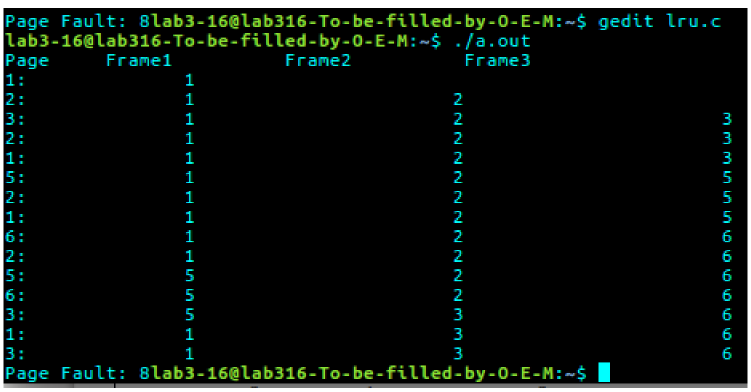
```
        printf("Page reference sequence:\n");
        for (int i = 0; i < n; i++)
        {
                printf("%d ", pages[i]);
        }
        printf("\n\n");
        printf("\n");
        printf("Optimal Algorithm:\n");
        optimal(pages, n, capacity);
        printf("\n");
        return 0;
}
```

7.5 Results:

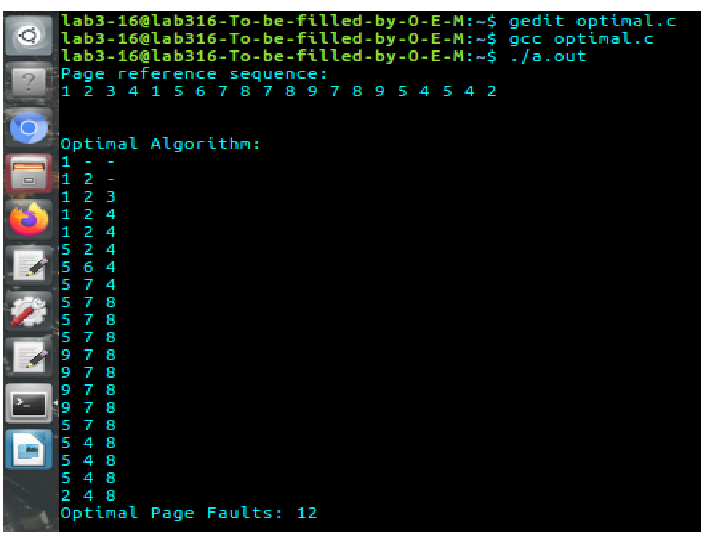
a. FIFO


```
lab3-16@lab316-To-be-filled-by-O-E-M: ~
Page Fault Is 2lab3-16@lab316-To-be-filled-by-O-E-M:~$ ./a.out

 ENTER THE NUMBER OF PAGES:
5

 ENTER THE PAGE NUMBER :
1
2
3
4
5

 ENTER THE NUMBER OF FRAMES :6
       ref string       page frames
1              1       -1      -1      -1      -1      -1
2              1       2       -1      -1      -1      -1
3              1       2       3       -1      -1      -1
4              1       2       3       4       -1      -1
5              1       2       3       4       5       -1
Page Fault Is 5lab3-16@lab316-To-be-filled-by-O-E-M:~$ ./a.out
```

b. LRU


```
Page Fault: 8lab3-16@lab316-To-be-filled-by-O-E-M:~$ gedit lru.c
lab3-16@lab316-To-be-filled-by-O-E-M:~$ ./a.out
Page     Frame1          Frame2          Frame3
1:              1
2:              1               2
3:              1               2               3
2:              1               2               3
1:              1               2               3
5:              1               2               5
2:              1               2               5
1:              1               2               5
6:              1               2               6
2:              1               2               6
5:              5               2               6
6:              5               2               6
3:              5               3               6
1:              1               3               6
3:              1               3               6
Page Fault: 8lab3-16@lab316-To-be-filled-by-O-E-M:~$
```

c. OPTIMAL


```
lab3-16@lab316-To-be-filled-by-O-E-M:~$ gedit optimal.c
lab3-16@lab316-To-be-filled-by-O-E-M:~$ gcc optimal.c
lab3-16@lab316-To-be-filled-by-O-E-M:~$ ./a.out
Page reference sequence:
1 2 3 4 1 5 6 7 8 7 8 9 7 8 9 5 4 5 4 2


Optimal Algorithm:
1 - -
1 2 -
1 2 3
1 2 4
1 2 4
5 2 4
5 6 4
5 7 4
5 7 8
5 7 8
5 7 8
9 7 8
9 7 8
9 7 8
9 7 8
5 7 8
5 4 8
5 4 8
5 4 8
2 4 8
Optimal Page Faults: 12
```

Experiment 8:- Disk Scheduling Algorithms

8.1 Objective:

Analyze the seek time for the following Disk scheduling algorithms –1. FCFS 2. SCAN 3. LOOK

8.2 Software Required:

- Operating System: UBUNTU/Linux
- Software Required: Terminal

8.3 Pre-Requisite:

- Basic C Programming,
- Concept of Unix System call commands
- Understanding of File I/O.

8.4 Program:

```
#include <stdio.h>
#include <stdlib.h>
#include <stdbool.h>
// Function to calculate absolute difference between two numbers
int absDiff(int a, int b)
{
    return abs(a - b);
}
```

// FCFS Disk Scheduling Algorithm

```
int FCFS(int *requests, int numRequests)
{
    int totalSeekTime = 0;
    for (int i = 1; i < numRequests; i++)
    {
        totalSeekTime += absDiff(requests[i], requests[i - 1]);
```

```
        }
        return totalSeekTime;
    }
```

// SCAN Disk Scheduling Algorithm

```
    int SCAN(int *requests, int numRequests, int start, int end)
    {
        int totalSeekTime = 0;
        int currentTrack = start;
        bool movingUp = true;
        // Moving towards the end of the disk

        while (numRequests > 0)
        {
            for (int i = 0; i < numRequests; i++)
            {
                if (requests[i] == currentTrack)
                {
                    totalSeekTime += absDiff(currentTrack, start);
                    start = currentTrack;
                    requests[i] = -1;
                    // Mark this request as processed
                }
            }
            if (movingUp)
            {
                currentTrack++;
```

```
        if (currentTrack > end)
        {
            movingUp = false;
            currentTrack = end;
        }
    }
    else
    {
        currentTrack--;
        if (currentTrack < 0)
        {
            movingUp = true;
            currentTrack = 0;
        }
    }
    // Remove processed requests
    int newNumRequests = 0;
    for (int i = 0; i < numRequests; i++)
    {
        if (requests[i] != -1)
        {
            requests[newNumRequests++] = requests[i];
        }
    }
    numRequests = newNumRequests;
}
```

```
        return totalSeekTime;
    }
```

// **LOOK Disk Scheduling Algorithm**

```
    int LOOK(int *requests, int numRequests, int start, int end)
    {
        int totalSeekTime = 0;
        int currentTrack = start;
        bool movingUp = true;
         // Moving towards the end of the disk

        while (numRequests > 0)
        {
            for (int i = 0; i < numRequests; i++)
            {
                if (requests[i] == currentTrack)
                {
                    totalSeekTime += absDiff(currentTrack, start);
                    start = currentTrack;
                    requests[i] = -1;
                 // Mark this request as processed
                }
            }
            if (movingUp)
            {
                currentTrack++;
                if (currentTrack > end)
```

```
                {
                        movingUp = false;
                        currentTrack = end;
                }
        }
        else
        {
                currentTrack--;
                if (currentTrack < 0)
                {
                        movingUp = true;
                        currentTrack = 0;
                }
        }
        // Remove processed requests
        int newNumRequests = 0;
        for (int i = 0; i < numRequests; i++)
        {
                if (requests[i] != -1)
                {
                        requests[newNumRequests++] = requests[i];
                }
        }
        numRequests = newNumRequests;
}
return totalSeekTime;
```

```
}

int main()
{
    int numRequests, start, end;
    printf("Enter the number of requests: ");
    scanf("%d", &numRequests);
    int *requests = (int *)malloc(numRequests * sizeof(int));
    printf("Enter the requests: ");
    for (int i = 0; i < numRequests; i++)
    {
        scanf("%d", &requests[i]);
    }
    printf("Enter the start and end of the disk: ");
    scanf("%d %d", &start, &end);
    int fcfsSeekTime = FCFS(requests, numRequests);
    int scanSeekTime = SCAN(requests, numRequests, start, end);
    int lookSeekTime = LOOK(requests, numRequests, start, end);
    printf("FCFS Seek Time: %d\n", fcfsSeekTime);
    printf("SCAN Seek Time: %d\n", scanSeekTime);
    printf("LOOK Seek Time: %d\n", lookSeekTime);
    free(requests);
    return 0;
}
```

8.5 Results:

```
lab3-16@lab316-To-be-filled-by-O-E-M: ~
lab3-16@lab316-To-be-filled-by-O-E-M:~$ gedit p8.c
lab3-16@lab316-To-be-filled-by-O-E-M:~$ gcc p8.c
lab3-16@lab316-To-be-filled-by-O-E-M:~$ ./a.out
Enter the number of requests: 5
Enter the requests:
11
22
33
44
55
Enter the start and end of the disk:
10  100
FCFS Seek Time: 44
SCAN Seek Time: 45
LOOK Seek Time: 45
lab3-16@lab316-To-be-filled-by-O-E-M:~$
```