# VISVESVARAYA TECHNOLOGICAL UNIVERSITY

**"JnanaSangama", Belgaum -590014, Karnataka.**

**LAB REPORT**
**on**

# OPERATING SYSTEMS

***Submitted by***

**Shashank H S (1BM21CS198)**

***in partial fulfillment for the award of the degree of***
**BACHELOR OF ENGINEERING**
***in***
**COMPUTER SCIENCE AND ENGINEERING**

**B.M.S. COLLEGE OF ENGINEERING**
**(Autonomous Institution under VTU)**
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# B. M. S. College of Engineering,

**Bull Temple Road, Bangalore 560019**

(Affiliated To Visvesvaraya Technological University, Belgaum)

## Department of Computer Science and Engineering

## CERTIFICATE

This is to certify that the Lab work entitled "OPERATING SYSTEMS" carried out by **Shashank H S (1BM21CS198),** who is bonafide student of **B.M.S. College of Engineering.** It is in partial fulfillment for the award of **Bachelor of Engineering in Computer Science and Engineering** of the Visvesvaraya Technological University, Belgaum during the academic semester June-2023 to September-2023. The Lab report has been approved as it satisfies the academic requirements in respect of a **OPERATING SYSTEMS (22CS4PCOPS)** work prescribed for the said degree.

**Mrs. Sneha S Bagalkot**

Assistant Professor
Department of CSE
BMSCE, Bengaluru

**Dr. Jyothi S Nayak**

Professor and Head
Department of CSE
BMSCE, Bengaluru

# Index Sheet

## Course Outcome

| | |
|---|---|
| CO1 | Apply the different concepts and functionalities of Operating System. |
| CO2 | Analyse various Operating system strategies and techniques. |
| CO3 | Demonstrate the different functionalities of Operating System. |
| CO4 | Conduct practical experiments to implement the functionalities of Operating system. |

# PROGRAM -1

**Write a C program to simulate the following non-pre-emptive CPU scheduling algorithm to find turnaround time and waiting time.**

- **FCFS**
- **SJF (pre-emptive & non-pre-emptive)**

## *FCFS*

```
#include <stdio.h>
typedef struct
{
   int pID, aT, bT, sT, cT, taT, wT;
} Process;

double avgTAT;
double avgWT;

void calculateTimes(Process p[], int n)
{

   int currT = 0;
   for (int i = 0; i < n; i++)
   {
      p[i].sT = currT;
      p[i].cT = currT + p[i].bT;
      p[i].taT = p[i].cT - p[i].aT;
      p[i].wT = p[i].taT - p[i].bT;
      currT = p[i].cT;
```

```
    }

    // To calculate Avg Turn Around Time and Avg Wating Time
    int sumTAT = 0;
    int sumWT = 0;

    for (int i = 0; i < n; i++)
    {
        sumTAT += p[i].taT;
        sumWT += p[i].wT;
    }
    avgTAT = (double)sumTAT / n;
    avgWT = (double)sumWT / n;
}

void displayp(Process p[], int n)
{
    printf("Process\tArrival Time\tBurst Time\tStart Time\tCompletion Time\tTurnaround
Time\tWaiting Time\n");
    for (int i = 0; i < n; i++)
    {
        printf("%d\t%d\t\t%d\t\t%d\t\t%d\t\t%d\t\t%d\n", p[i].pID, p[i].aT,
            p[i].bT, p[i].sT, p[i].cT,
            p[i].taT, p[i].wT);
    }
    printf("Average Turnaround time = %.2f\n", avgTAT);
    printf("Average Waiting time = %.2f\n", avgWT);
}
int main()
```

```
{
    int n;
    printf("Enter the number of processes: ");
    scanf("%d", &n);
    Process p[n];
    for (int i = 0; i < n; i++)
    {
        printf("Enter the arrival time and burst time for process %d: ", i + 1);
        scanf("%d %d", &p[i].aT, &p[i].bT);
        p[i].pID = i + 1;
    }
    for (int i = 0; i < n - 1; i++)
    {
        for (int j = 0; j < n - i - 1; j++)
        {
            if (p[j].aT > p[j + 1].aT)
            {
                Process temp = p[j];
                p[j] = p[j + 1];
                p[j + 1] = temp;
            }
        }
    }
    calculateTimes(p, n);
    displayp(p, n);
    return 0;
}
```

## OUTPUT:

```
PROBLEMS    OUTPUT    TERMINAL

PS C:\Users\VIGNESH\Desktop\4th Sem Lab\OS Lab> gcc FCFS.c
PS C:\Users\VIGNESH\Desktop\4th Sem Lab\OS Lab> .\a.exe
Enter the number of processes: 4
Enter the arrival time and burst time for process 1: 0 8
Enter the arrival time and burst time for process 2: 1 4
Enter the arrival time and burst time for process 3: 2 9
Enter the arrival time and burst time for process 4: 3 5
Process Arrival Time    Burst Time      Start Time      Completion Time Turnaround Time Waiting Time
1               0               8               0               8               8               0
2               1               4               8               12              11              7
3               2               9               12              21              19              10
4               3               5               21              26              23              18
Average Turnaround time = 15.25
Average Waiting time = 8.75
PS C:\Users\VIGNESH\Desktop\4th Sem Lab\OS Lab>
```

***SJF (pre-emptive & non-pre-emptive)***

```
#include <stdio.h>
#include <stdbool.h>

#define MAX_PROCESSES 10

struct Process
{
    int pid;
    int arr_time;
    int burst_time;
    int rem_time;
    int tat;
    int wt;
};

void sjf_nonpreemptive(struct Process p[], int n)
{
    int i, j, count = 0, m;
    for (i = 0; i < n; i++)
    {
        if (p[i].arr_time == 0)
            count++;
    }
    if (count == n || count == 1)
    {
        if (count == n)
```

```
{
   for (i = 0; i < n - 1; i++)
   {
      for (j = 0; j < n - i - 1; j++)
      {
         if (p[j].burst_time > p[j + 1].burst_time)
         {
            struct Process temp = p[j];
            p[j] = p[j + 1];
            p[j + 1] = temp;
         }
      }
   }
}
else
{
   for (i = 1; i < n - 1; i++)
   {
      for (j = 1; j <= n - i - 1; j++)
      {
         if (p[j].burst_time > p[j + 1].burst_time)
         {
            struct Process temp = p[j];
            p[j] = p[j + 1];
            p[j + 1] = temp;
         }
      }
   }
```

```
        }
    }

    int total_time = 0;
    double total_tat = 0;
    double total_wt = 0;

    for (i = 0; i < n; i++)
    {
        total_time += p[i].burst_time;
        p[i].tat = total_time - p[i].arr_time;
        p[i].wt = p[i].tat - p[i].burst_time;

        total_tat += p[i].tat;
        total_wt += p[i].wt;
    }

    printf("Process\tTurnaround Time\tWaiting Time\n");
    for (i = 0; i < n; i++)
    {
        printf("%d\t%d\t\t%d\n", p[i].pid, p[i].tat, p[i].wt);
    }

    printf("Average Turnaround Time: %.2f\n", total_tat / n);
    printf("Average Waiting Time: %.2f\n", total_wt / n);
}

void sjf_preemptive(struct Process p[], int n)
```

```
{
    int total_time = 0, i;
    int completed = 0;

    while (completed < n)
    {
        int shortest_burst = -1;
        int next_process = -1;

        for (i = 0; i < n; i++)
        {
            if (p[i].arr_time <= total_time && p[i].rem_time > 0)
            {
                if (shortest_burst == -1 || p[i].rem_time < shortest_burst)
                {
                    shortest_burst = p[i].rem_time;
                    next_process = i;
                }
            }
        }

        if (next_process == -1)
        {
            total_time++;
            continue;
        }

        p[next_process].rem_time--;
```

```
        total_time++;

        if (p[next_process].rem_time == 0)
        {
            completed++;
            p[next_process].tat = total_time - p[next_process].arr_time;
            p[next_process].wt = p[next_process].tat - p[next_process].burst_time;
        }
    }

    double total_tat = 0;
    double total_wt = 0;

    printf("Process\tTurnaround Time\tWaiting Time\n");
    for (i = 0; i < n; i++)
    {
        printf("%d\t%d\t\t%d\n", p[i].pid, p[i].tat, p[i].wt);
        total_tat += p[i].tat;
        total_wt += p[i].wt;
    }
    printf("Average Turnaround Time: %.2f\n", total_tat / n);
    printf("Average Waiting Time: %.2f\n", total_wt / n);
}

int main()
{
    int n, quantum, i, choice;
    struct Process p[MAX_PROCESSES];
```

```
    printf("Enter the number of Processes: ");
    scanf("%d", &n);
    for (i = 0; i < n; i++)
    {
        printf("\nFor Process %d\n", i + 1);
        printf("Enter Arrival time, Burst Time: ");
        scanf("%d%d", &p[i].arr_time, &p[i].burst_time);
        p[i].pid = i + 1;
        p[i].rem_time = p[i].burst_time;
        p[i].tat = 0;
        p[i].wt = 0;
    }
    printf("\n>> SJF Non-preemptive Scheduling:\n");
    sjf_nonpreemptive(p, n);
    printf("\n>> SJF Preemptive Scheduling:\n");
    sjf_preemptive(p, n);

    return 0;
}
```

**OUTPUT:**

```
PROBLEMS    OUTPUT    TERMINAL

PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> gcc SJF.c
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> .\a.exe
Enter the number of Processes: 4

For Process 1
Enter Arrival time, Burst Time: 0 5

For Process 2
Enter Arrival time, Burst Time: 1 3

For Process 3
Enter Arrival time, Burst Time: 2 3

For Process 4
Enter Arrival time, Burst Time: 4 1

>> SJF Non-preemptive Scheduling:
Process Turnaround Time Waiting Time
1       5               0
4       2               1
2       8               5
3       10              7
Average Turnaround Time: 6.25
Average Waiting Time: 3.25

>> SJF Preemptive Scheduling:
Process Turnaround Time Waiting Time
1       12              7
4       1               0
2       3               0
3       6               3
Average Turnaround Time: 5.50
Average Waiting Time: 2.50
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab>
```

# PROGRAM-2

**Write a C program to simulate the following CPU scheduling algorithm to find turnaround time and waiting time.**

- **Priority (pre-emptive & non-pre-emptive)**
- **Round Robin (Experiment with different quantum sizes for RR algorithm)**

```
#include <stdio.h>
#include <stdbool.h>

#define MAX_PROCESSES 10

struct Process
{
    int pid;
    int arr_time;
    int burst_time;
    int priority;
    int rem_time;
    int tat;
    int wt;
};


void priority_nonpreemptive(struct Process p[], int n)
{
    int i, j, count = 0, m;
    for (i = 0; i < n; i++)
    {
        if (p[i].arr_time == 0)
```

```
        count++;
    }
    if (count == n || count == 1)
    {
        if (count == n)
        {
            for (i = 0; i < n - 1; i++)
            {
                for (j = 0; j < n - i - 1; j++)
                {
                    if (p[j].priority > p[j + 1].priority)
                    {
                        struct Process temp = p[j];
                        p[j] = p[j + 1];
                        p[j + 1] = temp;
                    }
                }
            }
        }

        else
        {
            for (i = 1; i < n - 1; i++)
            {
                for (j = 1; j <= n - i - 1; j++)
                {
                    if (p[j].priority > p[j + 1].priority)
                    {
```

```
                struct Process temp = p[j];
                p[j] = p[j + 1];
                p[j + 1] = temp;
            }
        }
    }
}

int total_time = 0;
double total_tat = 0;
double total_wt = 0;

for (i = 0; i < n; i++)
{
    total_time += p[i].burst_time;
    p[i].tat = total_time - p[i].arr_time;
    p[i].wt = p[i].tat - p[i].burst_time;

    total_tat += p[i].tat;
    total_wt += p[i].wt;
}

printf("Process\tTurnaround Time\tWaiting Time\n");
for (i = 0; i < n; i++)
{
    printf("%d\t%d\t\t%d\n", p[i].pid, p[i].tat, p[i].wt);
}
```

```
    printf("Average Turnaround Time: %.2f\n", total_tat / n);
    printf("Average Waiting Time: %.2f\n", total_wt / n);
}

void priority_preemptive(struct Process p[], int n)
{
    int total_time = 0, i;
    int completed = 0;

    while (completed < n)
    {
        int highest_priority = -1;
        int next_process = -1;

        for (i = 0; i < n; i++)
        {
            if (p[i].arr_time <= total_time && p[i].rem_time > 0)
            {
                if (highest_priority == -1 || p[i].priority < highest_priority)
                {
                    highest_priority = p[i].priority;
                    next_process = i;
                }
            }
        }

        if (next_process == -1)
```

```
    {
        total_time++;
        continue;
    }

    p[next_process].rem_time--;
    total_time++;

    if (p[next_process].rem_time == 0)
    {
        completed++;
        p[next_process].tat = total_time - p[next_process].arr_time;
        p[next_process].wt = p[next_process].tat - p[next_process].burst_time;
    }
}

double total_tat = 0;
double total_wt = 0;

printf("Process\tTurnaround Time\tWaiting Time\n");
for (i = 0; i < n; i++)
{
    printf("%d\t%d\t\t%d\n", p[i].pid, p[i].tat, p[i].wt);

    total_tat += p[i].tat;
    total_wt += p[i].wt;
}
```

```
    printf("Average Turnaround Time: %.2f\n", total_tat / n);
    printf("Average Waiting Time: %.2f\n", total_wt / n);
}

void round_robin(struct Process p[], int n, int quantum)
{
    int total_time = 0, i;
    int completed = 0;

    printf("\nGantt Chart: \n");
    while (completed < n)
    {

        for (i = 0; i < n; i++)
        {
            if (p[i].arr_time <= total_time && p[i].rem_time > 0)
            {
                if (p[i].rem_time <= quantum)
                {
                    printf("P%d ", p[i].pid);
                    total_time += p[i].rem_time;
                    p[i].rem_time = 0;
                    p[i].tat = total_time - p[i].arr_time;
                    p[i].wt = p[i].tat - p[i].burst_time;
                    completed++;
                }
                else
                {
```

```
                printf("P%d ", p[i].pid);
                total_time += quantum;
                p[i].rem_time -= quantum;
            }
        }
    }
}

double total_tat = 0;
double total_wt = 0;

printf("\n");
printf("\nProcess\tTurnaround Time\tWaiting Time\n");
for (i = 0; i < n; i++)
{
    printf("%d\t%d\t\t%d\n", p[i].pid, p[i].tat, p[i].wt);

    total_tat += p[i].tat;
    total_wt += p[i].wt;
}

printf("Average Turnaround Time: %.2f\n", total_tat / n);
printf("Average Waiting Time: %.2f\n", total_wt / n);
}

int main()
{
int n, quantum, i, choice;
```

```
struct Process p[MAX_PROCESSES];

printf("Enter the number of Processes: ");
scanf("%d", &n);
for (i = 0; i < n; i++)
{
   printf("\nFor Process %d\n", i + 1);
   printf("Enter Arrival time, Burst Time, Priority:\n");
   scanf("%d%d%d",&p[i].arr_time,&p[i].burst_time,&p[i].priority);
   p[i].pid = i + 1;
   p[i].rem_time = p[i].burst_time;
   p[i].tat = 0;
   p[i].wt = 0;
}

printf("\nSelect a scheduling algorithm:\n");

printf("1. Priority (Preemtive & Non-preemptive)\n");
printf("2. Round Robin\n");
printf("Enter your choice: ");
scanf("%d", &choice);
switch (choice)
{
case 1:
   printf("\n>> Priority Non-preemptive Scheduling:\n");
   priority_nonpreemptive(p, n);
   printf("\n>> Priority Preemptive Scheduling:\n");
   priority_preemptive(p, n);
```

```
            break;
        case 2:
            printf("\nEnter the quantum size for Round Robin: ");
            scanf("%d", &quantum);
            printf("\n>> Round Robin Scheduling (Quantum: %d):\n", quantum);
            round_robin(p, n, quantum);
            break;
        default:
            printf("Invalid choice!\n");
            return 1;
        }

        return 0;
}
```

## OUTPUT:

### Priority (pre-emptive & non-pre-emptive):

```
PROBLEMS    OUTPUT    TERMINAL

PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> gcc Program2_Priority_and_RR.c
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> .\a.exe
Enter the number of Processes: 5

For Process 1
Enter Arrival time, Burst Time, Priority:
0 10 4

For Process 2
Enter Arrival time, Burst Time, Priority:
0 3 1

For Process 3
Enter Arrival time, Burst Time, Priority:
3 8 2

For Process 4
Enter Arrival time, Burst Time, Priority:
4 16 3

For Process 5
Enter Arrival time, Burst Time, Priority:
7 2 5
Select a scheduling algorithm:
1. Priority (Preemtive & Non-preemptive)
2. Round Robin
Enter your choice: 1

>> Priority Non-preemptive Scheduling:
Process Turnaround Time Waiting Time
1       10              0
2       13              10
3       18              10
4       33              17
5       32              30
Average Turnaround Time: 21.20
Average Waiting Time: 13.40

>> Priority Preemptive Scheduling:
Process Turnaround Time Waiting Time
1       37              27
2       3               0
3       8               0
4       23              7
5       32              30
Average Turnaround Time: 20.60
Average Waiting Time: 12.80
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab>
```

**Round Robin:**

```
PROBLEMS    OUTPUT    TERMINAL

PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> gcc Program2_Priority_and_RR.c
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> .\a.exe
Enter the number of Processes: 5

For Process 1
Enter Arrival time, Burst Time, Priority:
0 8 0

For Process 2
Enter Arrival time, Burst Time, Priority:
1 1 0

For Process 3
Enter Arrival time, Burst Time, Priority:
3 2 0

For Process 4
Enter Arrival time, Burst Time, Priority:
4 1 0

For Process 5
Enter Arrival time, Burst Time, Priority:
2 5 0

Select a scheduling algorithm:
1. Priority (Preemtive & Non-preemptive)
2. Round Robin
Enter your choice: 2

Enter the quantum size for Round Robin: 2

>> Round Robin Scheduling (Quantum: 2):

Gantt Chart:
P1 P2 P3 P4 P5 P1 P5 P1 P5 P1

Process Turnaround Time Waiting Time
1       17              9
2       2               1
3       2               0
4       2               1
5       13              8
Average Turnaround Time: 7.20
Average Waiting Time: 3.80
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab>
```

# PROGRAM-3

**Write a C program to simulate multi-level queue scheduling algorithm considering the following scenario. All the processes in the system are divided into two categories – system processes and user processes. System processes are to be given higher priority than user processes. Use FCFS scheduling for the processes in each queue.**

```
#include <stdio.h>
#include <stdlib.h>
#define MAX_QUEUE_SIZE 100

int totalTime = 0;
int userProcess = 0, systemProcess = 0;

typedef struct {
    int processID;
    int arrivalTime;
    int burstTime;
    int remainingTime;
    int priority; // 0 for system process, 1 for user process
} Process;

void executeProcess(Process process) {
    printf("Executing Process %d\n", process.processID);
    for (int i = 1; i <= process.burstTime; i++) {
        printf("Process %d: %d/%d\n", process.processID, i, process.burstTime);
    }
    printf("Process %d executed\n", process.processID);
}
```

```
void scheduleFCFS(Process system[], Process user[]) {
    for (int i = 0; i < systemProcess; i++) {
        for (int j = i + 1; j < systemProcess; j++) {
            if (system[i].arrivalTime > system[j].arrivalTime) {
                Process temp = system[i];
                system[i] = system[j];
                system[j] = temp;
            }
        }
    }
    for (int i = 0; i < userProcess; i++) {
        for (int j = i + 1; j < userProcess; j++) {
            if (user[i].arrivalTime > user[j].arrivalTime) {
                Process temp = user[i];
                user[i] = user[j];
                user[j] = temp;
            }
        }
    }
    int completed = 0;
    int currentProcess = -1;
    int isUserProcess = 0; // Changed bool to int
    int size = userProcess + systemProcess;
    while (1) {
        int count = 0;
        for (int i = 0; i < systemProcess; i++) {
            if (system[i].remainingTime <= 0) {
                count++;
```

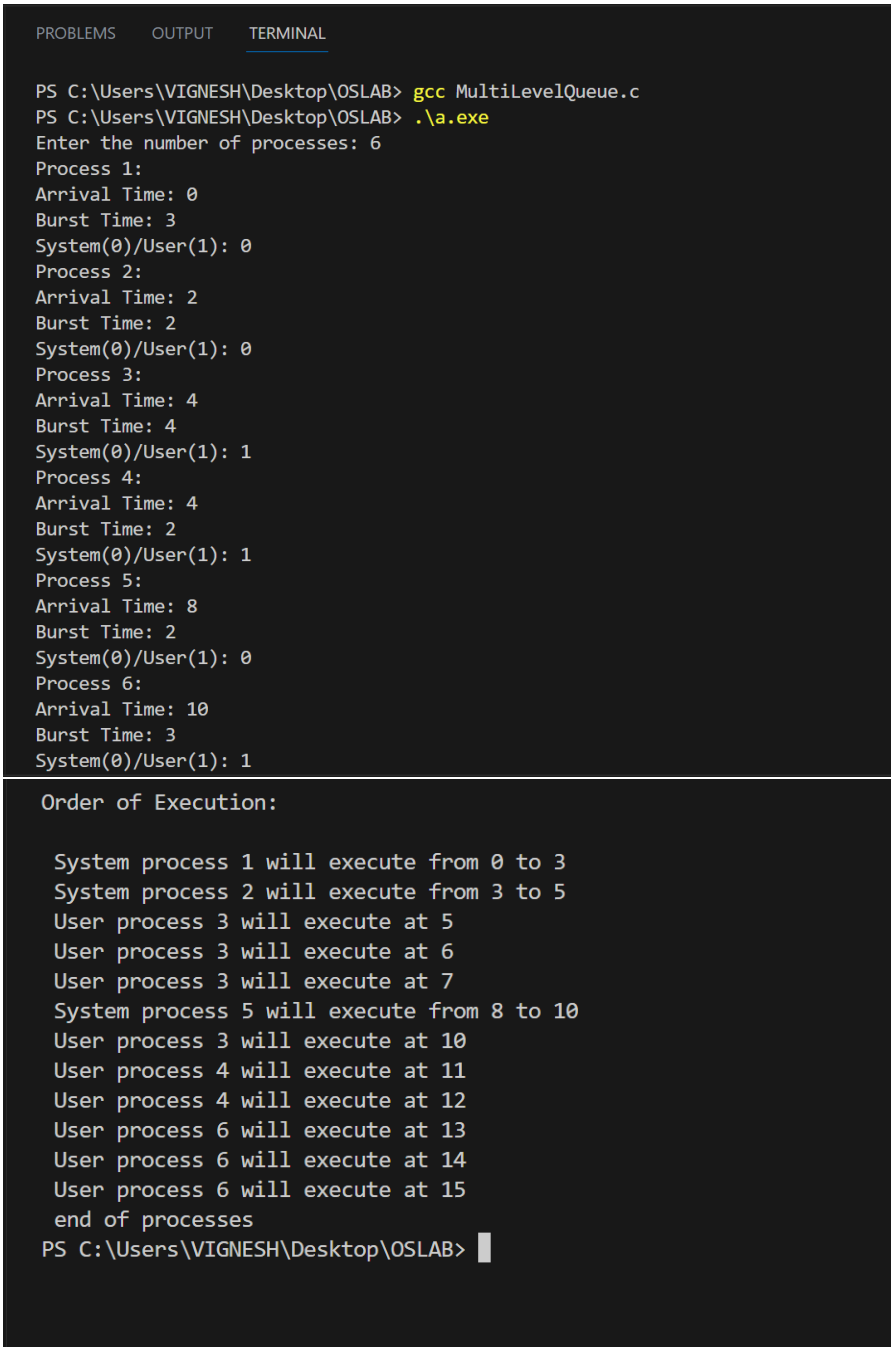
```
    }
}
for (int j = 0; j < userProcess; j++) {
    if (user[j].remainingTime <= 0) {
        count++;
    }
}
if (count == size) {
    printf("\n end of processes");
    exit(0);
}
for (int i = 0; i < systemProcess; i++) {
    if (totalTime >= system[i].arrivalTime && system[i].remainingTime > 0) {
        currentProcess = i;
        isUserProcess = 0; // Changed true to 0
        break;
    }
}
if (currentProcess == -1) {
    for (int j = 0; j < userProcess; j++) {
        if (totalTime >= user[j].arrivalTime && user[j].remainingTime > 0) {
            currentProcess = j;
            isUserProcess = 1; // Changed true to 1
            break;
        }
    }
}
if (currentProcess == -1) {
```

```
            totalTime++;
            printf("\n %d   idle time...", totalTime);
            if (totalTime == 1000) {
                exit(0);
            }
            continue;
        }
        if (isUserProcess == 1) { // Changed true to 1
            user[currentProcess].remainingTime--;
            printf("\n User process %d will execute at %d ", user[currentProcess].processID,
(totalTime));
            totalTime++;
            isUserProcess = 0; // Changed true to 0
            currentProcess = -1;
            if (user[currentProcess].remainingTime == 0) {
                completed++;
            }
        } else {
            int temp = totalTime;
            while (system[currentProcess].remainingTime--) {
                totalTime++;
            }
            if (system[currentProcess].remainingTime == 0) {
                completed++;
            }
            printf("\n System process %d will execute from %d to %d ",
system[currentProcess].processID, temp, (totalTime));
            isUserProcess = 0; // Changed true to 0
            currentProcess = -1;
```

```
        }
    }
}

int main() {
    int numProcesses;
    Process processes[MAX_QUEUE_SIZE];

    // Reading the number of processes
    printf("Enter the number of processes: ");
    scanf("%d", &numProcesses);
    // Reading process details
    for (int i = 0; i < numProcesses; i++) {
        printf("Process %d:\n", i + 1);
        printf("Arrival Time: ");
        scanf("%d", &processes[i].arrivalTime);
        printf("Burst Time: ");
        scanf("%d", &processes[i].burstTime);
        printf("System(0)/User(1): ");
        scanf("%d", &processes[i].priority);
        processes[i].processID = i + 1;
        processes[i].remainingTime = processes[i].burstTime;
        if (processes[i].priority == 1) {
            userProcess++;
        } else {
            systemProcess++;
        }
    }
```

```
    Process systemQueue[MAX_QUEUE_SIZE];
    int systemQueueSize = 0;
    Process userQueue[MAX_QUEUE_SIZE];
    int userQueueSize = 0;
    for (int i = 0; i < numProcesses; i++) {
        if (processes[i].priority == 0) {
            systemQueue[systemQueueSize++] = processes[i];
        } else {
            userQueue[userQueueSize++] = processes[i];
        }
    }
    printf("Order of Execution:\n");
    scheduleFCFS(systemQueue, userQueue);
    return 0;
}
```

## OUTPUT:



```
PROBLEMS    OUTPUT    TERMINAL

PS C:\Users\VIGNESH\Desktop\OSLAB> gcc MultiLevelQueue.c
PS C:\Users\VIGNESH\Desktop\OSLAB> .\a.exe
Enter the number of processes: 6
Process 1:
Arrival Time: 0
Burst Time: 3
System(0)/User(1): 0
Process 2:
Arrival Time: 2
Burst Time: 2
System(0)/User(1): 0
Process 3:
Arrival Time: 4
Burst Time: 4
System(0)/User(1): 1
Process 4:
Arrival Time: 4
Burst Time: 2
System(0)/User(1): 1
Process 5:
Arrival Time: 8
Burst Time: 2
System(0)/User(1): 0
Process 6:
Arrival Time: 10
Burst Time: 3
System(0)/User(1): 1
Order of Execution:

 System process 1 will execute from 0 to 3
 System process 2 will execute from 3 to 5
 User process 3 will execute at 5
 User process 3 will execute at 6
 User process 3 will execute at 7
 System process 5 will execute from 8 to 10
 User process 3 will execute at 10
 User process 4 will execute at 11
 User process 4 will execute at 12
 User process 6 will execute at 13
 User process 6 will execute at 14
 User process 6 will execute at 15
 end of processes
PS C:\Users\VIGNESH\Desktop\OSLAB>
```

# PROGRAM-4

**Write a C program to simulate Real-Time CPU Scheduling algorithms:**

**a) Rate- Monotonic**

**b) Earliest-deadline First**

***a) Rate- Monotonic***

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

#define MAX_PROCESS 10

int num_of_process = 3;
int execution_time[MAX_PROCESS], period[MAX_PROCESS],
remain_time[MAX_PROCESS];

// collecting details of processes
void get_process_info()
{
   printf("Enter total number of processes (maximum %d): ", MAX_PROCESS);
   scanf("%d", &num_of_process);
   if (num_of_process < 1)
   {
      printf("Do you really want to schedule %d processes? -_-\n", num_of_process);
      exit(0);
   }
   for (int i = 0; i < num_of_process; i++)
   {
      printf("\nProcess %d:-\n", i + 1);
```

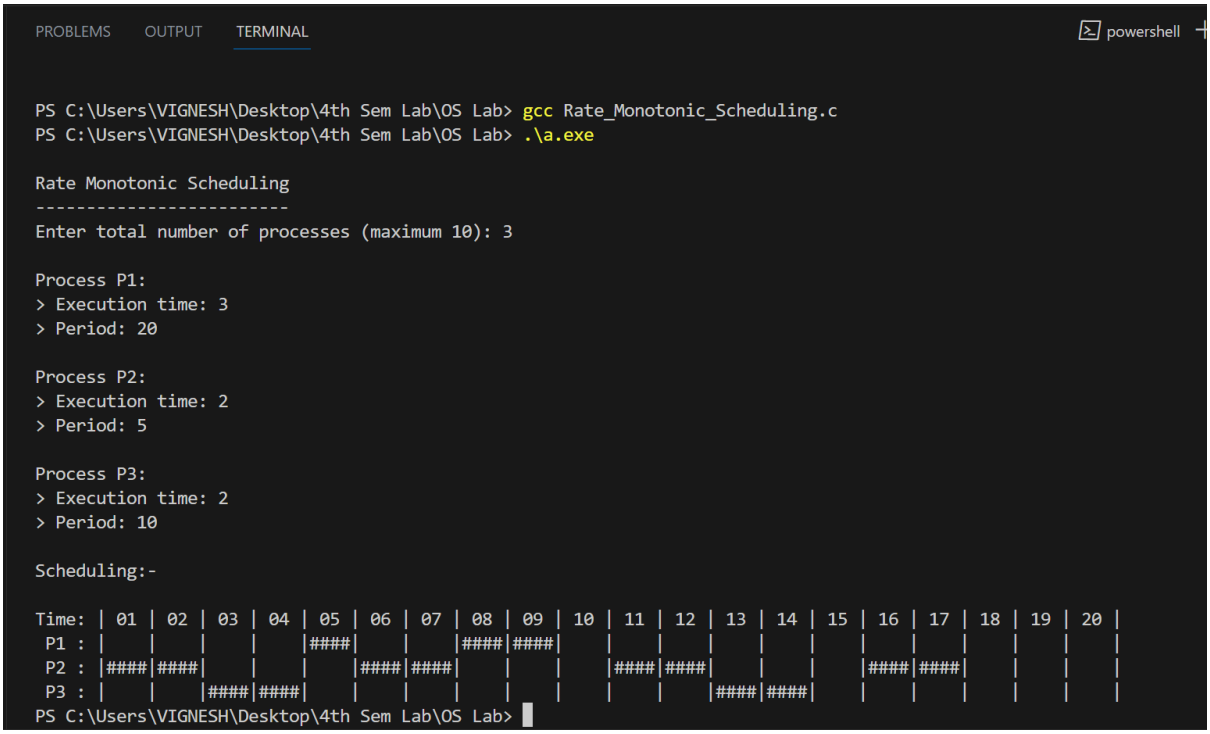
```
        printf("==> Execution time: ");
        scanf("%d", &execution_time[i]);
        remain_time[i] = execution_time[i];

        printf("==> Period: ");
        scanf("%d", &period[i]);
    }
}

// get maximum of three numbers
int max(int a, int b, int c)
{
    if (a >= b && a >= c)
        return a;
    else if (b >= a && b >= c)
        return b;
    else
        return c;
}

// calculating the observation time for scheduling timeline
int get_observation_time()
{
    return max(period[0], period[1], period[2]);
}
// print scheduling sequence
void print_schedule(int process_list[], int cycles)
```

```
{
    printf("\nScheduling:-\n\n");
    printf("Time: ");
    for (int i = 0; i < cycles; i++)
    {
        if (i < 9)
            printf("| 0%d ", i + 1);
        else
            printf("| %d ", i + 1);
    }
    printf("|\n");

    for (int i = 0; i < num_of_process; i++)
    {
        printf("P[%d]: ", i + 1);
        for (int j = 0; j < cycles; j++)
        {
            if (process_list[j] == i + 1)
                printf("|####");
            else
                printf("|    ");
        }
        printf("|\n");
    }
}

void rate_monotonic(int time)
{
```

```
float utilization = 0;
for (int i = 0; i < num_of_process; i++)
{
   utilization += (1.0 * execution_time[i]) / period[i];
}
int n = num_of_process;
if (utilization > n * (pow(2, 1.0 / n) - 1))
{
   printf("\nGiven problem is not schedulable under said scheduling algorithm.\n");
   exit(0);
}

int process_list[time];
int min = 999, next_process = 0;
for (int i = 0; i < time; i++)
{
   min = 1000;
   for (int j = 0; j < num_of_process; j++)
   {
      if (remain_time[j] > 0)
      {
         if (min > period[j])
         {
            min = period[j];
            next_process = j;
         }
      }
   }
```

```
        if (remain_time[next_process] > 0)
        {
            process_list[i] = next_process + 1; // +1 for catering 0 array index.
            remain_time[next_process] -= 1;
        }

        for (int k = 0; k < num_of_process; k++)
        {
            if ((i + 1) % period[k] == 0)
            {
                remain_time[k] = execution_time[k];
                next_process = k;
            }
        }
    }
    print_schedule(process_list, time);
}

int main(int argc, char *argv[])
{
    printf("Rate Monotonic Scheduling\n");
    printf("------------------------\n");

    get_process_info(); // collecting processes detail
    int observation_time = get_observation_time();
    rate_monotonic(observation_time);
    return 0;
}
```

## OUTPUT:


PROBLEMS
OUTPUT
TERMINAL
powershell
PS C:\Users\VIGNESH\Desktop\4th Sem Lab\OS Lab> gcc Rate_Monotonic_Scheduling.c
PS C:\Users\VIGNESH\Desktop\4th Sem Lab\OS Lab> .\a.exe
Rate Monotonic Scheduling
Enter total number of processes (maximum 10): 3
Process P1:
> Execution time: 3
> Period: 20
Process P2:
> Execution time: 2
> Period: 5
Process P3:
> Execution time: 2
> Period: 10
Scheduling:-
Time: | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
P1 : | | | | | |####| | | |####|####| | | | | | | | | | | |
P2 : |####|####| | | | |####|####| | | | |####|####| | | | |####|####| | | | |
P3 : | | | |####|####| | | | | | | | | |####|####| | | | | | | |
PS C:\Users\VIGNESH\Desktop\4th Sem Lab\OS Lab>

***b) Earliest-Deadline First***

```
#include <stdio.h>
#include <malloc.h>

#define arrival 0
#define execution 1
#define deadline 2
#define period 3
#define abs_arrival 4
#define execution_copy 5
#define abs_deadline 6

typedef struct
{
   int T[7], instance, alive;

} task;

#define IDLE_TASK_ID 1023
#define ALL 1
#define CURRENT 0

void get_tasks(task *t1, int n);
int hyperperiod_calc(task *t1, int n);
float cpu_util(task *t1, int n);
int gcd(int a, int b);
int lcm(int *a, int n);
int sp_interrupt(task *t1, int tmr, int n);
```

```
int min(task *t1, int n, int p);
void update_abs_arrival(task *t1, int n, int k, int all);
void update_abs_deadline(task *t1, int n, int all);
void copy_execution_time(task *t1, int n, int all);

int timer = 0;

int main()
{
    task *t;
    int n, hyper_period, active_task_id;
    float cpu_utilization;
    printf("Enter number of tasks\n");
    scanf("%d", &n);
    t = (task *)malloc(n * sizeof(task));
    get_tasks(t, n);
    cpu_utilization = cpu_util(t, n);
    printf("CPU Utilization %f\n", cpu_utilization);

    if (cpu_utilization < 1)
        printf("Tasks can be scheduled\n");
    else
        printf("Schedule is not feasible\n");

    hyper_period = hyperperiod_calc(t, n);
    copy_execution_time(t, n, ALL);
    update_abs_arrival(t, n, 0, ALL);
    update_abs_deadline(t, n, ALL);
```

```
while (timer < hyper_period)
{
   ++timer;
   if (timer < 10)
      printf("|  %d", timer);
   else
      printf("| %d", timer);
}
printf("|\n");

timer = 0;
while (timer < hyper_period)
{

   if (sp_interrupt(t, timer, n))
   {
      active_task_id = min(t, n, abs_deadline);
   }

   if (active_task_id == IDLE_TASK_ID)
   {
      printf("|Idl");
   }

   if (active_task_id != IDLE_TASK_ID)
   {
```

```
            if (t[active_task_id].T[execution_copy] != 0)
            {
                t[active_task_id].T[execution_copy]--;
                printf("|T-%d", active_task_id + 1);
            }

            if (t[active_task_id].T[execution_copy] == 0)
            {
                t[active_task_id].instance++;
                t[active_task_id].alive = 0;
                copy_execution_time(t, active_task_id, CURRENT);
                update_abs_arrival(t, active_task_id, t[active_task_id].instance, CURRENT);
                update_abs_deadline(t, active_task_id, CURRENT);
                active_task_id = min(t, n, abs_deadline);
            }
        }
        ++timer;
    }
    printf("|\n");
    free(t);
    return 0;
}

void get_tasks(task *t1, int n)
{
    int i = 0;
    while (i < n)
    {
```

```
        printf("Enter Task %d parameters\n", i + 1);
        t1->T[arrival] = 0;
        printf("Execution time: ");
        scanf("%d", &t1->T[execution]);
        printf("Deadline time: ");
        scanf("%d", &t1->T[deadline]);
        printf("Period: ");
        scanf("%d", &t1->T[period]);
        t1->T[abs_arrival] = 0;
        t1->T[execution_copy] = 0;
        t1->T[abs_deadline] = 0;
        t1->instance = 0;
        t1->alive = 0;
        t1++;
        i++;
    }
}

int hyperperiod_calc(task *t1, int n)
{
    int i = 0, ht, a[10];
    while (i < n)

    {
        a[i] = t1->T[period];
        t1++;
        i++;
    }
```

```
    ht = lcm(a, n);

    return ht;
}

int gcd(int a, int b)
{
    if (b == 0)
        return a;
    else
        return gcd(b, a % b);
}

int lcm(int *a, int n)
{
    int res = 1, i;
    for (i = 0; i < n; i++)
    {
        res = res * a[i] / gcd(res, a[i]);
    }
    return res;
}

int sp_interrupt(task *t1, int tmr, int n)
{
    int i = 0, n1 = 0, a = 0;
    task *t1_copy;
    t1_copy = t1;
```

```
while (i < n)
{
   if (tmr == t1->T[abs_arrival])
   {
      t1->alive = 1;
      a++;
   }
   t1++;
   i++;
}

t1 = t1_copy;
i = 0;

while (i < n)
{
   if (t1->alive == 0)
      n1++;
   t1++;
   i++;
}

if (n1 == n || a != 0)
{
   return 1;
}

return 0;
```

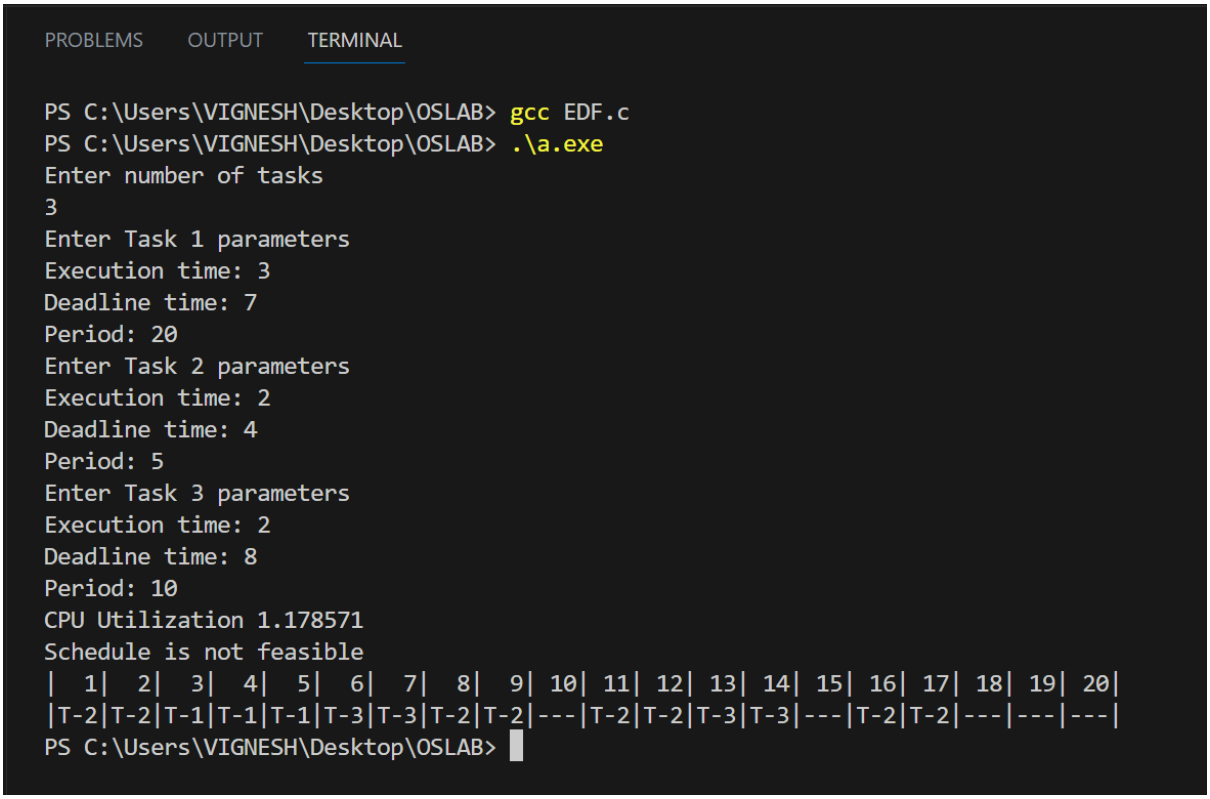
```
}

void update_abs_deadline(task *t1, int n, int all)
{
   int i = 0;
   if (all)
   {
      while (i < n)
      {
         t1->T[abs_deadline] = t1->T[deadline] + t1->T[abs_arrival];
         t1++;
         i++;
      }
   }
   else
   {
      t1 += n;
      t1->T[abs_deadline] = t1->T[deadline] + t1->T[abs_arrival];
   }
}

void update_abs_arrival(task *t1, int n, int k, int all)
{
   int i = 0;
   if (all)
   {
      while (i < n)
      {
```

```
            t1->T[abs_arrival] = t1->T[arrival] + k * (t1->T[period]);
            t1++;
            i++;
        }
    }
    else
    {
        t1 += n;
        t1->T[abs_arrival] = t1->T[arrival] + k * (t1->T[period]);
    }
}

void copy_execution_time(task *t1, int n, int all)
{
    int i = 0;
    if (all)
    {
        while (i < n)
        {
            t1->T[execution_copy] = t1->T[execution];
            t1++;
            i++;
        }
    }
    else
    {
        t1 += n;
        t1->T[execution_copy] = t1->T[execution];
```

```
    }
}

int min(task *t1, int n, int p)
{
    int i = 0, min = 0x7FFF, task_id = IDLE_TASK_ID;
    while (i < n)
    {
        if (min > t1->T[p] && t1->alive == 1)
        {
            min = t1->T[p];
            task_id = i;
        }
        t1++;
        i++;
    }
    return task_id;
}

float cpu_util(task *t1, int n)
{
    int i = 0;
    float cu = 0;
    while (i < n)
    {
        cu = cu + (float)t1->T[execution] / (float)t1->T[deadline];
        t1++;
        i++;
```

```
    }
    return cu;
}
```

## OUTPUT:



# PROGRAM-5

**Write a C program to simulate producer-consumer problem using semaphores.**

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

int mutex = 1;
int full = 0;
int empty = 10;
int count = 0;

int wait(int s)
{
   while (s <= 0)
      ;
   s--;
   return s;
}

int signal(int s)
{
   s++;
   return s;
}

void producer()
{
```

```
    empty = wait(empty);
    mutex = wait(mutex);
    count++;
    printf("Producer produces an item %d\n", count);
    mutex = signal(mutex);
    full = signal(full);
}

void consumer()
{
    full = wait(full);
    mutex = wait(mutex);
    printf("Consumer consumes an item %d\n", count);
    count--;
    mutex = signal(mutex);
    empty = signal(empty);
}
void main()
{
    int choice;
    printf("\n>Enter 1 for Producer\n>Enter 2 for Consumer\n>Enter 3 for Exit\n");
    while (1)
    {
        printf("\nEnter your choice: ");
        scanf("%d", &choice);
        switch (choice)
        {
        case 1:
```

```
            if (empty == 0)
            {
                printf("\nBuffer is full!!\n");
            }
            else
            {
                producer();
            }
            break;
        case 2:
            if (full == 0)
            {
                printf("\nBuffer is empty!!\n");
            }
            else
            {
                consumer();
            }
            break;
        case 3:
            exit(0);
            break;
        default:
            printf("Invalid choice\n");
        }
    }
}
```

**OUTPUT:**

```
PROBLEMS    OUTPUT    TERMINAL

PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> gcc Producer_Consumer.c
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> .\a.exe

>Enter 1 for Producer
>Enter 2 for Consumer
>Enter 3 for Exit

Enter your choice: 2

Buffer is empty!!

Enter your choice: 1
Producer produces an item 1

Enter your choice: 1
Producer produces an item 2

Enter your choice: 1
Producer produces an item 3

Enter your choice: 1
Producer produces an item 4

Enter your choice: 2
Consumer consumes an item 4

Enter your choice: 2
Consumer consumes an item 2

Enter your choice: 1
Producer produces an item 2

Enter your choice: 2
Consumer consumes an item 2

Enter your choice: 2
Consumer consumes an item 1

Enter your choice: 2

Buffer is empty!!

Enter your choice: 3
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab>
```

# PROGRAM-6

**Write a C program to simulate the concept of Dining-Philosophers problem.**

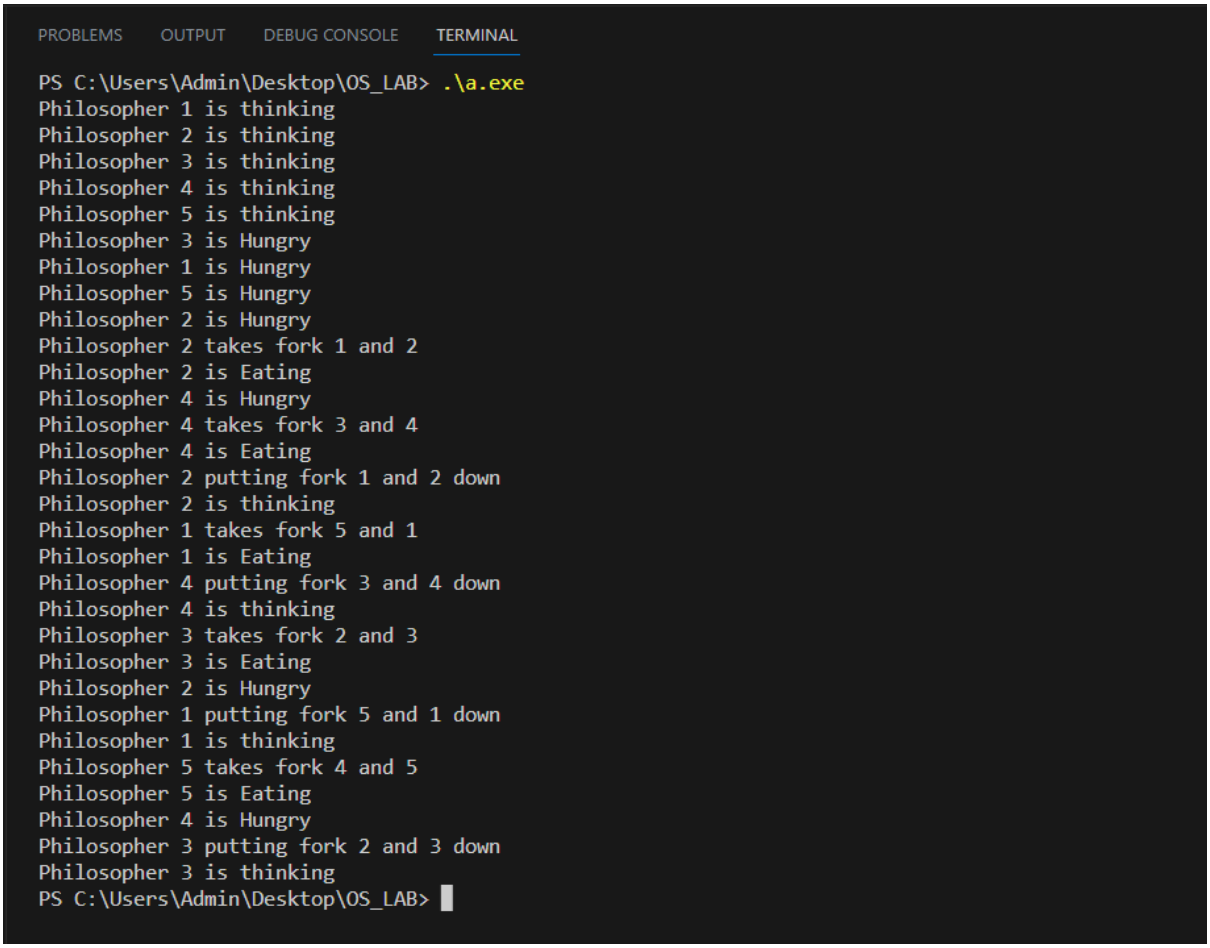
```
#include <pthread.h>
#include <semaphore.h>
#include <stdio.h>

#define N 5
#define THINKING 2
#define HUNGRY 1
#define EATING 0
#define LEFT (phnum + 4) % N
#define RIGHT (phnum + 1) % N

int state[N];
int phil[N] = {0, 1, 2, 3, 4};

sem_t mutex;
sem_t S[N];

void test(int phnum)
{
   if (state[phnum] == HUNGRY && state[LEFT] != EATING && state[RIGHT] != EATING)
   {
      state[phnum] = EATING;
      sleep(2);
      printf("Philosopher %d takes fork %d and %d\n", phnum + 1, LEFT + 1, phnum + 1);
      printf("Philosopher %d is Eating\n", phnum + 1);
```

```
        sem_post(&S[phnum]);
    }
}

void take_fork(int phnum)
{

    sem_wait(&mutex);
    state[phnum] = HUNGRY;
    printf("Philosopher %d is Hungry\n", phnum + 1);
    test(phnum);
    sem_post(&mutex);
    sem_wait(&S[phnum]);
    sleep(1);
}

void put_fork(int phnum)
{

    sem_wait(&mutex);
    state[phnum] = THINKING;
    printf("Philosopher %d putting fork %d and %d down\n", phnum + 1, LEFT + 1, phnum + 1);
    printf("Philosopher %d is thinking\n", phnum + 1);
    test(LEFT);
    test(RIGHT);
    sem_post(&mutex);
}
```

```
void *philosopher(void *num)
{

    while (1)
    {

        int *i = num;
        sleep(1);
        take_fork(*i);
        sleep(0);
        put_fork(*i);
    }
}

int main()
{

    int i;
    pthread_t thread_id[N];
    sem_init(&mutex, 0, 1);

    for (i = 0; i < N; i++)
        sem_init(&S[i], 0, 0);

    for (i = 0; i < N; i++)
    {
        pthread_create(&thread_id[i], NULL, philosopher, &phil[i]);
        printf("Philosopher %d is thinking\n", i + 1);
```

```
    }

    for (i = 0; i < N; i++)
        pthread_join(thread_id[i], NULL);
}
```

## OUTPUT:



# PROGRAM-7

**Write a C program to simulate Banker's algorithm for the purpose of deadlock avoidance.**

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

int main()
{
   int N, M = 3, ind = 0;
   printf("\nEnter the number of processess: ");
   scanf("%d", &N);
   printf("Enter the number of resources: ");
   scanf("%d", &M);

   int alloc[N][M], max[N][M], need[N][M], finished[N], ans[N], avail[M];

   printf("\nEnter allocated resources\n");
   for (int i = 0; i < N; i++)
   {
      printf("For Process %d: ", i);
      for (int j = 0; j < M; j++)
      {
         scanf("%d", &alloc[i][j]);
      }
   }

   printf("\nEnter Maximum resources\n");
   for (int i = 0; i < N; i++)
```

```
{
   printf("For Process %d: ", i);
   for (int j = 0; j < M; j++)
   {
      scanf("%d", &max[i][j]);
   }
}

printf("\nEnter available resources\n");
for (int i = 0; i < M; i++)
{
   scanf("%d", &avail[i]);
}

for (int i = 0; i < N; i++)
{
   finished[i] = 0;
}

for (int i = 0; i < N; i++)
{
   for (int j = 0; j < M; j++)
   {
      need[i][j] = max[i][j] - alloc[i][j];
   }
}

for (int k = 0; k < N; k++)
```

```
{
   for (int i = 0; i < N; i++)
   {
      if (finished[i] == 0)
      {
         int flag = 0;
         for (int j = 0; j < M; j++)
         {
            if (need[i][j] > avail[j])
            {
               flag = 1;
               break;
            }
         }

         if (flag == 0)
         {
            ans[ind++] = i;
            for (int p = 0; p < M; p++)
            {
               avail[p] += alloc[i][p];
            }
            finished[i] = 1;
         }
      }
   }
}
```

```
printf("\nProcess\tAllocation\tMax\tNeed\tAvailable");
for (int i = 0; i < N; i++)
{
   printf("\n P%d: \t", i);

   for (int j = 0; j < M; j++)
      printf("%d ", alloc[i][j]);
   printf("\t\t");

   for (int j = 0; j < M; j++)
      printf("%d ", max[i][j]);

   printf("\t");

   for (int j = 0; j < M; j++)
      printf("%d ", need[i][j]);

   printf("\t");

   if (i == 0)
   {
      for (int j = 0; j < M; j++)
         printf("%d ", avail[j]);
   }
}

int flag = 1;
for (int i = 0; i < N; i++)
```

```
    {
        if (finished[i] == 0)
        {
            flag = 0;
            printf("\n\nThe System is NOT in safe state(DeadLock Detected)\n");
            break;
        }
    }

    if (flag == 1)
    {
        printf("\n\n--No DeadLock--\nSafe Sequence:\n");
        for (int i = 0; i < N - 1; i++)
        {
            printf("P%d --> ", ans[i]);
        }
        printf("P%d\n", ans[N - 1]);
    }
}
```

## OUTPUT:

```
PROBLEMS    OUTPUT    TERMINAL

PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> gcc Bankers_Algorithm.c
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> .\a.exe

Enter the number of processess: 5
Enter the number of resources: 3

Enter allocated resources
For Process 0: 0 1 0
For Process 1: 2 0 0
For Process 2: 3 0 2
For Process 3: 2 1 1
For Process 4: 0 0 2

Enter Maximum resources
For Process 0: 7 5 3
For Process 1: 3 2 2
For Process 2: 9 0 2
For Process 3: 2 2 2
For Process 4: 4 3 3

Enter available resources
3 3 2

Process Allocation      Max     Need    Available
 P0:    0 1 0           7 5 3   7 4 3   10 5 7
 P1:    2 0 0           3 2 2   1 2 2
 P2:    3 0 2           9 0 2   6 0 0
 P3:    2 1 1           2 2 2   0 1 1
 P4:    0 0 2           4 3 3   4 3 1

--No DeadLock--
Safe Sequence:
P1 --> P3 --> P4 --> P0 --> P2
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab>
```

# PROGRAM-8

**Write a C program to simulate deadlock detection.**

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

int main()
{
    int N, M, ind = 0;
    printf("\nEnter the number of processess: ");
    scanf("%d", &N);
    printf("Enter the number of resources: ");
    scanf("%d", &M);

    int alloc[N][M], max[N][M], need[N][M], finished[N], ans[N], avail[M];

    printf("\nEnter allocated resources\n");
    for (int i = 0; i < N; i++)
    {
        printf("For Process %d: ", i);
        for (int j = 0; j < M; j++)
        {
            scanf("%d", &alloc[i][j]);
        }
    }

    printf("\nEnter Maximum resources\n");
    for (int i = 0; i < N; i++)
    {
```

```
    printf("For Process %d: ", i);
    for (int j = 0; j < M; j++)
    {
        scanf("%d", &max[i][j]);
    }
}

printf("\nEnter available resources\n");
for (int i = 0; i < M; i++)
{
    scanf("%d", &avail[i]);
}

for (int i = 0; i < N; i++)
{
    finished[i] = 0;
}

for (int i = 0; i < N; i++)
{
    for (int j = 0; j < M; j++)
    {
        need[i][j] = max[i][j] - alloc[i][j];
    }
}

for (int k = 0; k < N; k++)
{
```

```
    for (int i = 0; i < N; i++)
    {
        if (finished[i] == 0)
        {
            int flag = 0;
            for (int j = 0; j < M; j++)
            {
                if (need[i][j] > avail[j])
                {
                    flag = 1;
                    break;
                }
            }

            if (flag == 0)
            {
                ans[ind++] = i;
                for (int p = 0; p < M; p++)
                {
                    avail[p] += alloc[i][p];
                }
                finished[i] = 1;
            }
        }
    }
}

int flag = 1;
```

```
    for (int i = 0; i < N; i++)
    {
        if (finished[i] == 0)
        {
            flag = 0;
            printf("\nSystem is in a DeadLock state.\n");
            break;
        }
    }

    if (flag == 1)
    {
        printf("\nSystem is in a safe state(No DeadLock).\n");
    }
}
```

**OUTPUT:**

```
PROBLEMS    OUTPUT    TERMINAL

PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> gcc DeadLock_Detection.c
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> .\a.exe

Enter the number of processess: 3
Enter the number of resources: 3

Enter allocated resources
For Process 0: 3 3 3
For Process 1: 2 0 3
For Process 2: 1 2 4

Enter Maximum resources
For Process 0: 3 6 8
For Process 1: 4 3 3
For Process 2: 3 4 4

Enter available resources
1 2 0

System is in a DeadLock state.
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab>
```

```
PROBLEMS    OUTPUT    TERMINAL

PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> gcc DeadLock_Detection.c
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> .\a.exe

Enter the number of processess: 3
Enter the number of resources: 3

Enter allocated resources
For Process 0: 0 0 1
For Process 1: 1 3 6
For Process 2: 9 5 1

Enter Maximum resources
For Process 0: 1 0 2
For Process 1: 2 0 9
For Process 2: 1 1 0

Enter available resources
1 2 4

System is in a safe state(No DeadLock).
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab>
```

# PROGRAM-9

**Write a C program to simulate the following contiguous memory allocation techniques**

**a) Worst-fit**

**b) Best-fit**

**c) First-fit**

```
#include <stdio.h>
#define max 25

int frag[max], b[max], f[max], i, j, nb, nf, temp, highest = 0, lowest = 10000, ch;
static int bf[max], ff[max];

void firstfit();
void bestfit();
void worstfit();

void main()
{
   printf("\n\t   Memory Management Scheme\n");
   printf("\t------------------------------");

   printf("\nEnter the number of blocks: ");
   scanf("%d", &nb);
   printf("Enter the number of files: ");
   scanf("%d", &nf);

   printf("\nEnter the size of the blocks\n");
   for (i = 1; i <= nb; i++)
```

```
{
   printf("Block %d: ", i);
   scanf("%d", &b[i]);
}

printf("\nEnter the size of the files\n");
for (i = 1; i <= nf; i++)
{
   printf("File %d: ", i);
   scanf("%d", &f[i]);
}

printf("\n1.First Fit || 2.Best Fit || 3.Worst Fit ||\nEnter the Allocation Technique: ");
scanf("%d", &ch);
switch (ch)
{
case 1:
   firstfit();
   break;
case 2:
   bestfit();
   break;
case 3:
   worstfit();
   break;
default:
   printf("Invalid choice");
}
```

```
}

void firstfit()
{
   for (i = 1; i <= nf; i++)
   {
      for (j = 1; j <= nb; j++)
      {
         if (bf[j] != 1)
         {
            temp = b[j] - f[i];
            if (temp >= 0)
            {
               ff[i] = j;
               break;
            }
         }
      }
      frag[i] = temp;
      bf[ff[i]] = 1;
   }
   printf("\nFile No\tFile Size\tBlock No\tBlock Size\tFragement");
   for (i = 1; i <= nf; i++)
      printf("\nF%d\t%d\t\t%d\t\t%d\t\t%d", i, f[i], ff[i], b[ff[i]], frag[i]);
}

void bestfit()
{
```

```
    for (i = 1; i <= nf; i++)
    {
        for (j = 1; j <= nb; j++)
        {
            if (bf[j] != 1)
            {
                temp = b[j] - f[i];
                if (temp >= 0)
                    if (lowest > temp)
                    {
                        ff[i] = j;
                        lowest = temp;
                    }
            }
        }
        frag[i] = lowest;
        bf[ff[i]] = 1;
        lowest = 10000;
    }
    printf("\nFile No\tFile Size \tBlock No\tBlock Size\tFragment");
    for (i = 1; i <= nf && ff[i] != 0; i++)
        printf("\nF%d\t\t%d\t\t%d\t\t%d\t\t%d", i, f[i], ff[i], b[ff[i]], frag[i]);
}

void worstfit()
{
    for (i = 1; i <= nf; i++)
    {
```

```
        for (j = 1; j <= nb; j++)
        {
            if (bf[j] != 1)
            {
                temp = b[j] - f[i];
                if (temp >= 0)
                    if (highest < temp)
                    {
                        ff[i] = j;
                        highest = temp;
                    }
            }
        }
        frag[i] = highest;
        bf[ff[i]] = 1;
        highest = 0;
    }
    printf("\nFile No\tFile Size\tBlock No\tBlock Size\tFragement");
    for (i = 1; i <= nf; i++)
        printf("\nF%d\t\t%d\t\t%d\t\t%d\t\t%d", i, f[i], ff[i], b[ff[i]], frag[i]);
}
```

## OUTPUT:

### 1) Worst-fit

```
PROBLEMS    OUTPUT    TERMINAL

PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> gcc Program9.c
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> .\a.exe

          Memory Management Scheme
        ------------------------------
Enter the number of blocks: 8
Enter the number of files: 3

Enter the size of the blocks
Block 1: 10
Block 2: 4
Block 3: 20
Block 4: 18
Block 5: 7
Block 6: 9
Block 7: 12
Block 8: 15

Enter the size of the files
File 1: 12
File 2: 10
File 3: 9

|| 1.First Fit || 2.Best Fit || 3.Worst Fit ||
Enter the Allocation Technique: 3

File No File Size       Block No        Block Size      Fragement
F1              12              3               20              8
F2              10              4               18              8
F3              9               8               15              6
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab>
```

## 2) Best-Fit

```
PROBLEMS    OUTPUT    TERMINAL

PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> gcc Program9.c
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> .\a.exe

          Memory Management Scheme
        ------------------------------
Enter the number of blocks: 8
Enter the number of files: 3

Enter the size of the blocks
Block 1: 10
Block 2: 4
Block 3: 20
Block 4: 18
Block 5: 7
Block 6: 9
Block 7: 12
Block 8: 15

Enter the size of the files
File 1: 12
File 2: 10
File 3: 9

|| 1.First Fit || 2.Best Fit || 3.Worst Fit ||
Enter the Allocation Technique: 2

File No File Size       Block No        Block Size      Fragment
F1              12              7               12              0
F2              10              1               10              0
F3              9               6               9               0
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab>
```

### 3) First-Fit

```
PROBLEMS    OUTPUT    TERMINAL

PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> gcc Program9.c
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> .\a.exe

          Memory Management Scheme
        ----------------------------
Enter the number of blocks: 8
Enter the number of files: 3

Enter the size of the blocks
Block 1: 10
Block 2: 4
Block 3: 20
Block 4: 18
Block 5: 7
Block 6: 9
Block 7: 12
Block 8: 15

Enter the size of the files
File 1: 12
File 2: 10
File 3: 9

|| 1.First Fit || 2.Best Fit || 3.Worst Fit ||
Enter the Allocation Technique: 1
File No File Size       Block No        Block Size      Fragement
F1      12              3               20              8
F2      10              1               10              0
F3      9               4               18              9
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab>
```

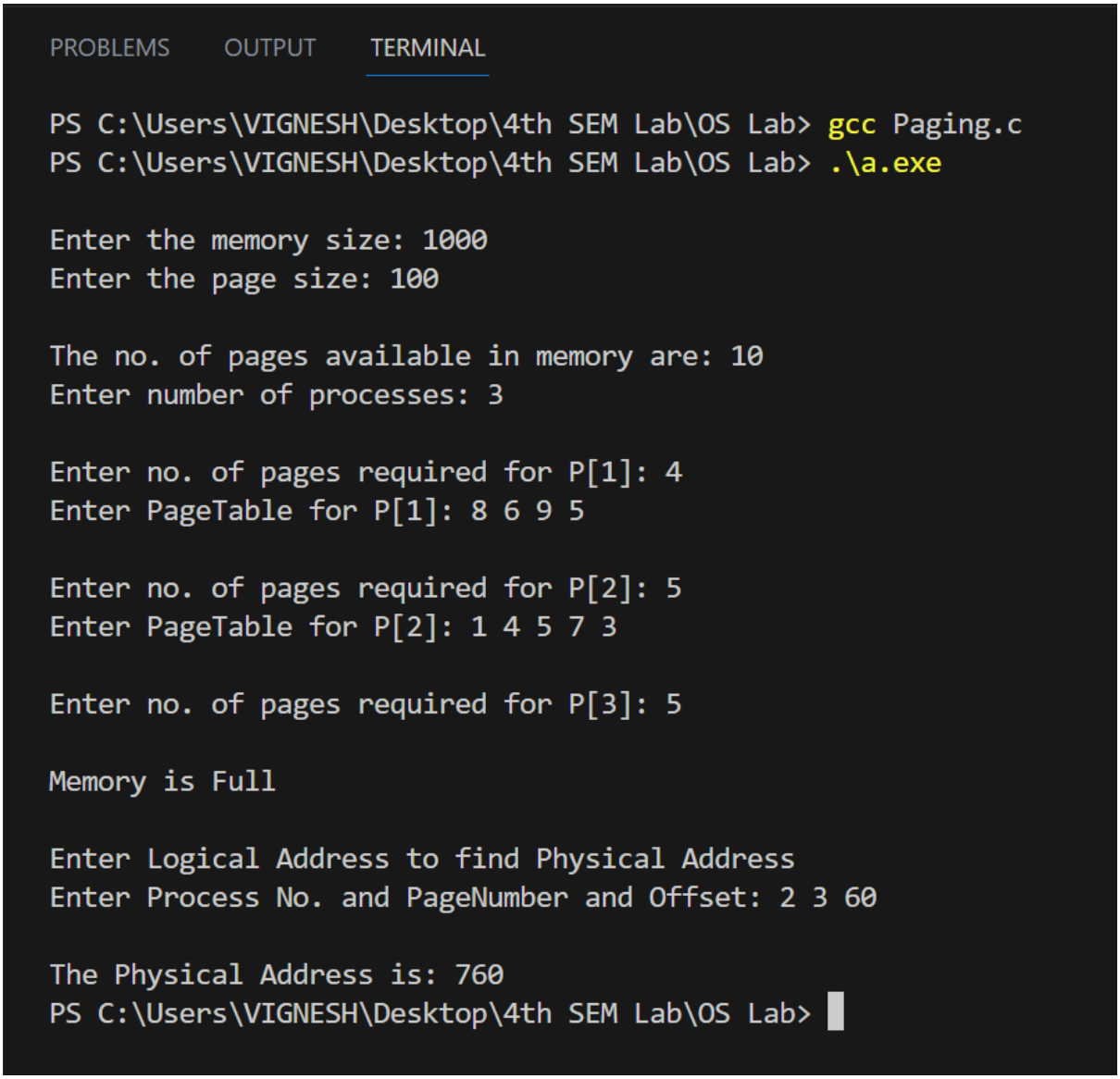
# PROGRAM-10

**Write a C program to simulate paging technique of memory management.**

```
#include <stdio.h>
void main()
{
   int ms, ps, nop, np, rempages, i, j, x, y, pa, offset;
   int s[10], fno[10][20];

   printf("\nEnter the memory size: ");
   scanf("%d", &ms);

   printf("Enter the page size: ");
   scanf("%d", &ps);

   nop = ms / ps;
   printf("\nThe no. of pages available in memory are: %d ", nop);

   printf("\nEnter number of processes: ");
   scanf("%d", &np);
   rempages = nop;
   for (i = 1; i <= np; i++)

   {
      printf("\nEnter no. of pages required for P[%d]: ", i);
      scanf("%d", &s[i]);

      if (s[i] > rempages)
```

```
        {
            printf("\nMemory is Full\n");
            break;
        }
        rempages = rempages - s[i];

        printf("Enter PageTable for P[%d]: ", i);
        for (j = 0; j < s[i]; j++)
            scanf("%d", &fno[i][j]);
    }

    printf("\nEnter Logical Address to find Physical Address ");
    printf("\nEnter Process No. and PageNumber and Offset: ");

    scanf("%d %d %d", &x, &y, &offset);

    if (x > np || y >= s[i] || offset >= ps)
        printf("\nInvalid Process or Page Number or offset\n");
    else
    {
        pa = fno[x][y] * ps + offset;
        printf("\nThe Physical Address is: %d", pa);
    }
}
```

**OUTPUT:**


PROBLEMS
OUTPUT
TERMINAL
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> gcc Paging.c
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> .\a.exe
Enter the memory size: 1000
Enter the page size: 100
The no. of pages available in memory are: 10
Enter number of processes: 3
Enter no. of pages required for P[1]: 4
Enter PageTable for P[1]: 8 6 9 5
Enter no. of pages required for P[2]: 5
Enter PageTable for P[2]: 1 4 5 7 3
Enter no. of pages required for P[3]: 5
Memory is Full
Enter Logical Address to find Physical Address
Enter Process No. and PageNumber and Offset: 2 3 60
The Physical Address is: 760
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab>

# PROGRAM-11

**Write a C program to simulate page replacement algorithms**

**a) FIFO**

**b) LRU**

**c) Optimal**

```
#include <stdio.h>

#define MAX_FRAMES 3
#define MAX_PAGES 20

void fifo(int pages[], int n, int frames)
{
    int frame[frames];
    int front = 0, rear = 0;
    int page_faults = 0;

    for (int i = 0; i < frames; i++)
    {
        frame[i] = -1;
    }

    for (int i = 0; i < n; i++)
    {
        int found = 0;
        for (int j = 0; j < frames; j++)
        {
            if (frame[j] == pages[i])
```

```
            {
                found = 1;
                break;
            }
        }

        if (!found)
        {
            frame[rear] = pages[i];
            rear = (rear + 1) % frames;
            page_faults++;
        }

        printf("Page %d: ", pages[i]);
        for (int j = 0; j < frames; j++)
        {
            if (frame[j] == -1)
                printf("- ");
            else
                printf("%d ", frame[j]);
        }
        printf("\n");
    }

    printf("Total Page Faults (FIFO): %d\n", page_faults);
}

void lru(int pages[], int n, int frames)
```

```
{
    int frame[frames];
    int page_faults = 0;
    int used[MAX_PAGES] = {0};

    for (int i = 0; i < frames; i++)
    {
        frame[i] = -1;
    }

    for (int i = 0; i < n; i++)
    {
        int found = 0;
        for (int j = 0; j < frames; j++)
        {
            if (frame[j] == pages[i])
            {
                found = 1;
                used[j] = i;
                break;
            }
        }

        if (!found)
        {
            int min = 0;
            for (int j = 1; j < frames; j++)
            {
```

```
            if (used[j] < used[min])
            {
                min = j;
            }
        }
        frame[min] = pages[i];
        used[min] = i;
        page_faults++;
    }

    printf("Page %d: ", pages[i]);
    for (int j = 0; j < frames; j++)
    {
        if (frame[j] == -1)
            printf("- ");
        else
            printf("%d ", frame[j]);
    }
    printf("\n");
  }

  printf("Total Page Faults (LRU): %d\n", page_faults);
}

void optimal (int pages[], int n, int frames)
{
  int frame[frames];
  int page_faults = 0;
```

```
for (int i = 0; i < frames; i++)
{
   frame[i] = -1;
}

for (int i = 0; i < n; i++)
{
   int found = 0;
   for (int j = 0; j < frames; j++)
   {
      if (frame[j] == pages[i])
      {
         found = 1;
         break;
      }
   }

   if (!found)
   {
      if (i < frames)
      {
         frame[i] = pages[i];
      }
      else
      {
         int max_dist = -1;
         int replace_page = -1;
```

```
        for (int j = 0; j < frames; j++)
        {
            int dist = MAX_PAGES;
            for (int k = i + 1; k < n; k++)
            {
                if (pages[k] == frame[j])
                {
                    dist = k - i;
                    break;
                }
            }
            if (dist > max_dist)
            {
                max_dist = dist;
                replace_page = j;
            }
        }
        frame[replace_page] = pages[i];
    }
    page_faults++;
}

printf("Page %d: ", pages[i]);
for (int j = 0; j < frames; j++)
{
    if (frame[j] == -1)
        printf("- ");
    else
```

```
            printf("%d ", frame[j]);
        }
        printf("\n");
    }

    printf("Total Page Faults (Optimal): %d\n", page_faults);
}

int main()
{
    int pages[MAX_PAGES];
    int n, frames;

    printf("Enter the number of pages: ");
    scanf("%d", &n);

    printf("Enter the reference string: ");
    for (int i = 0; i < n; i++)
    {
        scanf("%d", &pages[i]);
    }

    printf("Enter the number of frames: ");
    scanf("%d", &frames);

    printf("\nFIFO Page Replacement:\n");
    fifo(pages, n, frames);
```

```
    printf("\nLRU Page Replacement:\n");
    lru(pages, n, frames);

    printf("\nOptimal Page Replacement:\n");
    optimal(pages, n, frames);

    return 0;
}
```

## OUTPUT:

**a) FIFO**

```
PROBLEMS    OUTPUT    TERMINAL

PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> gcc Page_Replacement.c
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> .\a.exe
Enter the number of pages: 14
Enter the reference string: 7 0 1 2 0 3 0 4 2 3 0 3 2 3
Enter the number of frames: 4

FIFO Page Replacement:
Page 7: 7 - - -
Page 0: 7 0 - -
Page 1: 7 0 1 -
Page 2: 7 0 1 2
Page 0: 7 0 1 2
Page 3: 3 0 1 2
Page 0: 3 0 1 2
Page 4: 3 4 1 2
Page 2: 3 4 1 2
Page 3: 3 4 1 2
Page 0: 3 4 0 2
Page 3: 3 4 0 2
Page 2: 3 4 0 2
Page 3: 3 4 0 2
Total Page Faults (FIFO): 7
```

**b) LRU**

```
PROBLEMS    OUTPUT    TERMINAL

LRU Page Replacement:
Page 7: 7 - - -
Page 0: 0 - - -
Page 1: 0 1 - -
Page 2: 0 1 2 -
Page 0: 0 1 2 -
Page 3: 0 1 2 3
Page 0: 0 1 2 3
Page 4: 0 4 2 3
Page 2: 0 4 2 3
Page 3: 0 4 2 3
Page 0: 0 4 2 3
Page 3: 0 4 2 3
Page 2: 0 4 2 3
Page 3: 0 4 2 3
Total Page Faults (LRU): 6
```

**c) Optimal**

```
Optimal Page Replacement:
Page 7: 7 - - -
Page 0: 7 0 - -
Page 1: 7 0 1 -
Page 2: 7 0 1 2
Page 0: 7 0 1 2
Page 3: 3 0 1 2
Page 0: 3 0 1 2
Page 4: 3 0 4 2
Page 2: 3 0 4 2
Page 3: 3 0 4 2
Page 0: 3 0 4 2
Page 3: 3 0 4 2
Page 2: 3 0 4 2
Page 3: 3 0 4 2
Total Page Faults (Optimal): 6
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab>
```

# PROGRAM-12

**Write a C program to simulate the following file allocation strategies.**

**a) Sequential**

**b) Indexed**

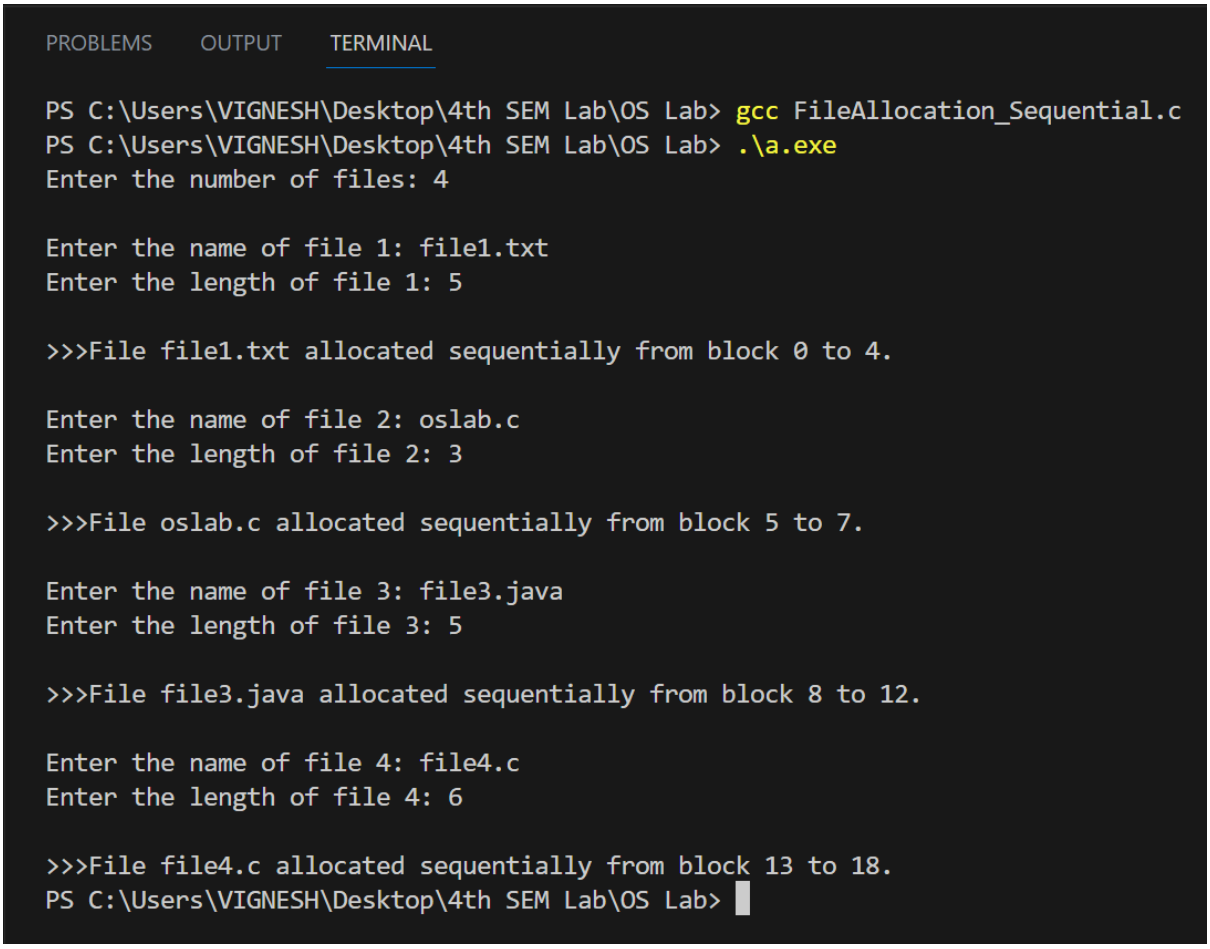
**c) Linked**

***a) Sequential***

```
#include <stdio.h>
#include <string.h>
#define MAX_FILES 100
#define MAX_FILE_NAME 20
struct File
{
   char name[MAX_FILE_NAME];
   int startBlock;
   int length;
};
struct File fileTable[MAX_FILES];
int totalFiles = 0;
int currentBlock = 0;

void allocateSequential(char *fileName, int length)
{
   if (currentBlock + length <= MAX_FILES)
   {
      strcpy(fileTable[totalFiles].name, fileName);
      fileTable[totalFiles].startBlock = currentBlock;
```

```
        fileTable[totalFiles].length = length;
        currentBlock += length;
        totalFiles++;
        printf("\n>>>File %s allocated sequentially from block %d to %d.\n", fileName,
fileTable[totalFiles - 1].startBlock, currentBlock - 1);
    }
    else
    {
        printf("\nNot enough space for file allocation.\n");
    }
}

int main()
{
    int numFiles;
    printf("Enter the number of files: ");
    scanf("%d", &numFiles);
    for (int i = 0; i < numFiles; i++)
    {
        char fileName[MAX_FILE_NAME];
        int fileLength;
        printf("\nEnter the name of file %d: ", i + 1);
        scanf("%s", fileName);
        printf("Enter the length of file %d: ", i + 1);
        scanf("%d", &fileLength);
        allocateSequential(fileName, fileLength);
    }
    return 0;
}
```

**OUTPUT:**


PROBLEMS
OUTPUT
TERMINAL
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> gcc FileAllocation_Sequential.c
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> .\a.exe
Enter the number of files: 4
Enter the name of file 1: file1.txt
Enter the length of file 1: 5
>>>File file1.txt allocated sequentially from block 0 to 4.
Enter the name of file 2: oslab.c
Enter the length of file 2: 3
>>>File oslab.c allocated sequentially from block 5 to 7.
Enter the name of file 3: file3.java
Enter the length of file 3: 5
>>>File file3.java allocated sequentially from block 8 to 12.
Enter the name of file 4: file4.c
Enter the length of file 4: 6
>>>File file4.c allocated sequentially from block 13 to 18.
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab>

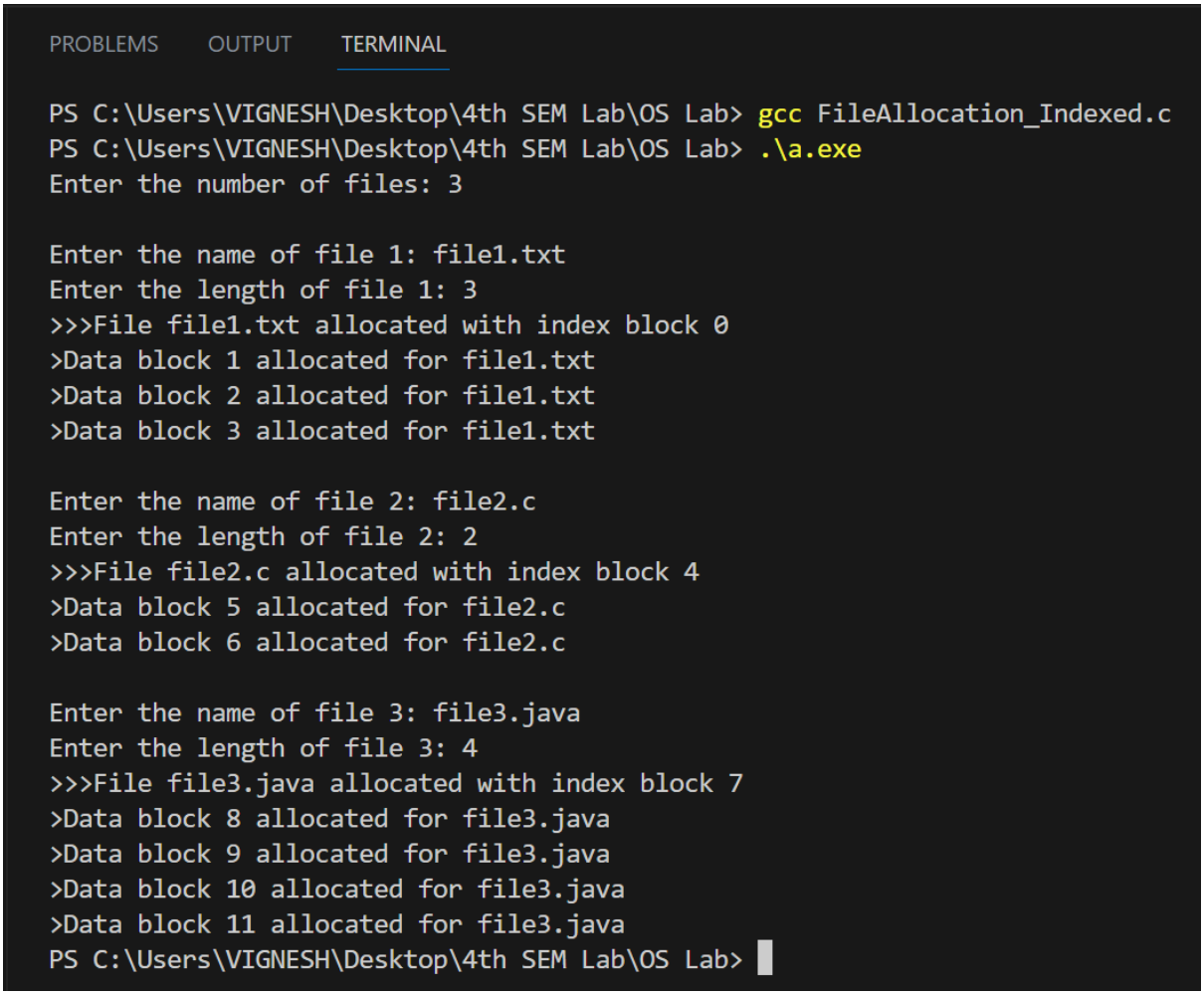
***b) Indexed***

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

#define MAX_FILES 100
#define MAX_FILE_NAME 20
#define MAX_BLOCKS 100

struct File {
    char name[MAX_FILE_NAME];
    int indexBlock;
    int length;
};

struct File fileTable[MAX_FILES];
int totalFiles = 0;
int currentBlock = 0;
int freeBlocks[MAX_BLOCKS]; // List of free blocks

void initializeFreeBlocks() {
    for (int i = 0; i < MAX_BLOCKS; i++) {
        freeBlocks[i] = 1;
    }
}

int allocateBlock() {
    for (int i = 0; i < MAX_BLOCKS; i++) {
```

```
        if (freeBlocks[i]) {
            freeBlocks[i] = 0;
            return i;
        }
    }
    return -1; // No free block available
}

void allocateIndexed(char *fileName, int length) {
    if (totalFiles < MAX_FILES) {
        strcpy(fileTable[totalFiles].name, fileName);
        fileTable[totalFiles].indexBlock = allocateBlock();
        fileTable[totalFiles].length = length;

        if (fileTable[totalFiles].indexBlock != -1) {
            printf(">>>File %s allocated with index block %d\n", fileName,
fileTable[totalFiles].indexBlock);

            for (int i = 0; i < length; i++) {
                int dataBlock = allocateBlock();
                if (dataBlock != -1) {
                    printf(">Data block %d allocated for %s\n", dataBlock, fileName);
                } else {
                    printf("Not enough space for data block allocation.\n");
                    break;
                }
            }
            totalFiles++;
        } else {
```

```
            printf("\nNot enough space for index block allocation.\n");
        }
    } else {
        printf("\nFile table is full.\n");
    }
}

int main() {
    initializeFreeBlocks();
    int numFiles;
    printf("Enter the number of files: ");
    scanf("%d", &numFiles);

    for (int i = 0; i < numFiles; i++) {
        char fileName[MAX_FILE_NAME];
        int fileLength;

        printf("\nEnter the name of file %d: ", i + 1);
        scanf("%s", fileName);
        printf("Enter the length of file %d: ", i + 1);
        scanf("%d", &fileLength);

        allocateIndexed(fileName, fileLength);
    }

    return 0;
}
```

**OUTPUT:**

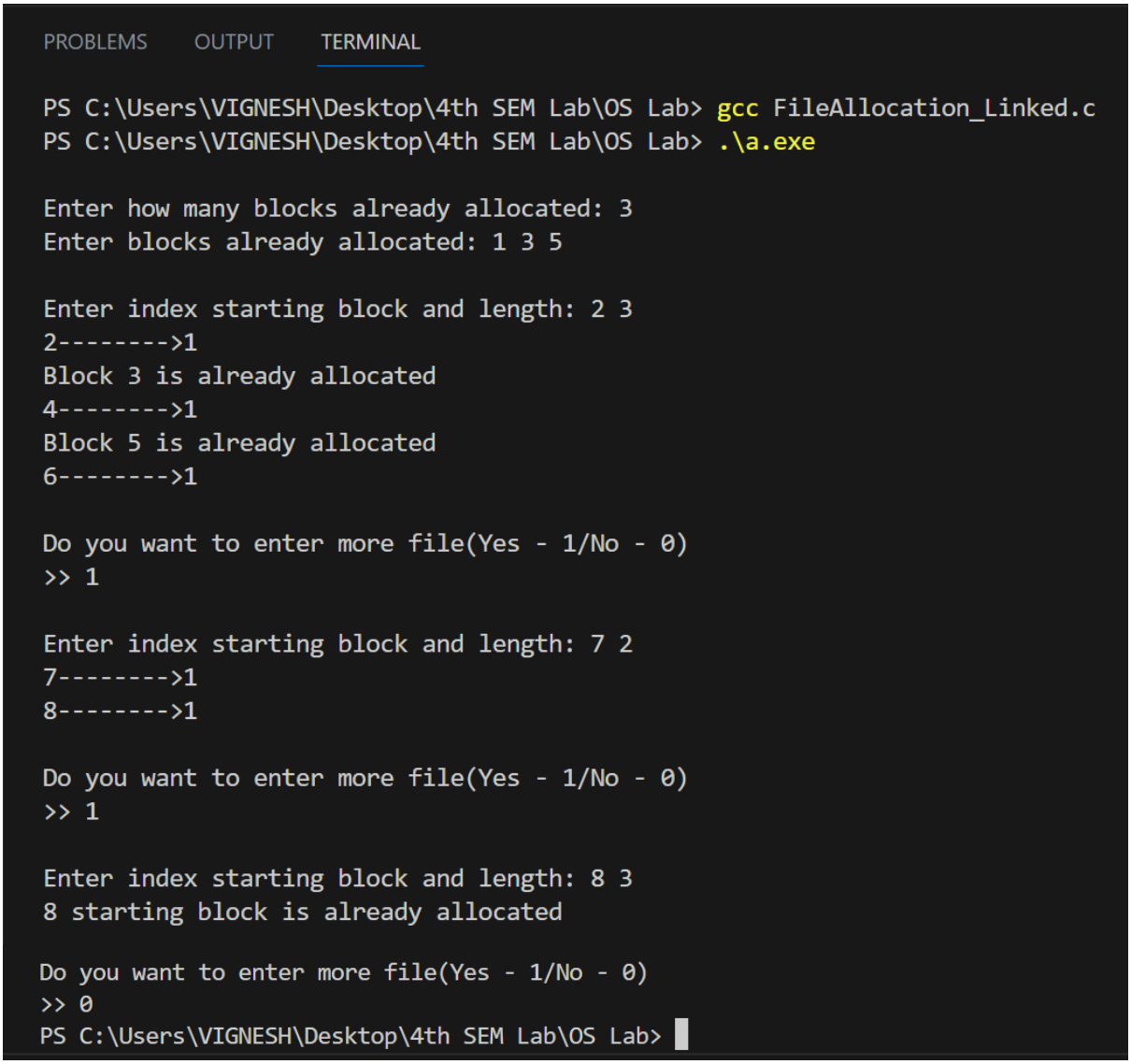

PROBLEMS
OUTPUT
TERMINAL
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> gcc FileAllocation_Indexed.c
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> .\a.exe
Enter the number of files: 3
Enter the name of file 1: file1.txt
Enter the length of file 1: 3
>>>File file1.txt allocated with index block 0
>Data block 1 allocated for file1.txt
>Data block 2 allocated for file1.txt
>Data block 3 allocated for file1.txt
Enter the name of file 2: file2.c
Enter the length of file 2: 2
>>>File file2.c allocated with index block 4
>Data block 5 allocated for file2.c
>Data block 6 allocated for file2.c
Enter the name of file 3: file3.java
Enter the length of file 3: 4
>>>File file3.java allocated with index block 7
>Data block 8 allocated for file3.java
>Data block 9 allocated for file3.java
>Data block 10 allocated for file3.java
>Data block 11 allocated for file3.java
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab>

***c) Linked***

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

void main()
{
   int f[50], p, i, st, len, j, c, k, a;
   for (i = 0; i < 50; i++)
      f[i] = 0;
   printf("\nEnter how many blocks already allocated: ");
   scanf("%d", &p);
   printf("Enter blocks already allocated: ");
   for (i = 0; i < p; i++)
   {
      scanf("%d", &a);
      f[a] = 1;
   }
x:
   printf("\nEnter index starting block and length: ");
   scanf("%d%d", &st, &len);
   k = len;
   if (f[st] == 0)
   {
      for (j = st; j < (st + k); j++)
      {
         if (f[j] == 0)
         {
```

```
            f[j] = 1;
            printf("%d-------->%d\n", j, f[j]);
        }
        else
        {
            printf("Block %d is already allocated \n", j);
            k++;
        }
    }
  }
  else
    printf("%d starting block is already allocated \n", st);

  printf("\nDo you want to enter more file(Yes - 1/No - 0)\n>> ");
  scanf("%d", &c);
  if (c == 1)
    goto x;
  else
    exit(0);
}
```

**OUTPUT:**


PROBLEMS
OUTPUT
TERMINAL
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> gcc FileAllocation_Linked.c
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> .\a.exe
Enter how many blocks already allocated: 3
Enter blocks already allocated: 1 3 5
Enter index starting block and length: 2 3
2-------->1
Block 3 is already allocated
4-------->1
Block 5 is already allocated
6-------->1
Do you want to enter more file(Yes - 1/No - 0)
>> 1
Enter index starting block and length: 7 2
7-------->1
8-------->1
Do you want to enter more file(Yes - 1/No - 0)
>> 1
Enter index starting block and length: 8 3
8 starting block is already allocated
Do you want to enter more file(Yes - 1/No - 0)
>> 0
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab>

# PROGRAM-13

**Write a C program to simulate the following file organization techniques**

**a) Single level directory**

**b) Two level directories**

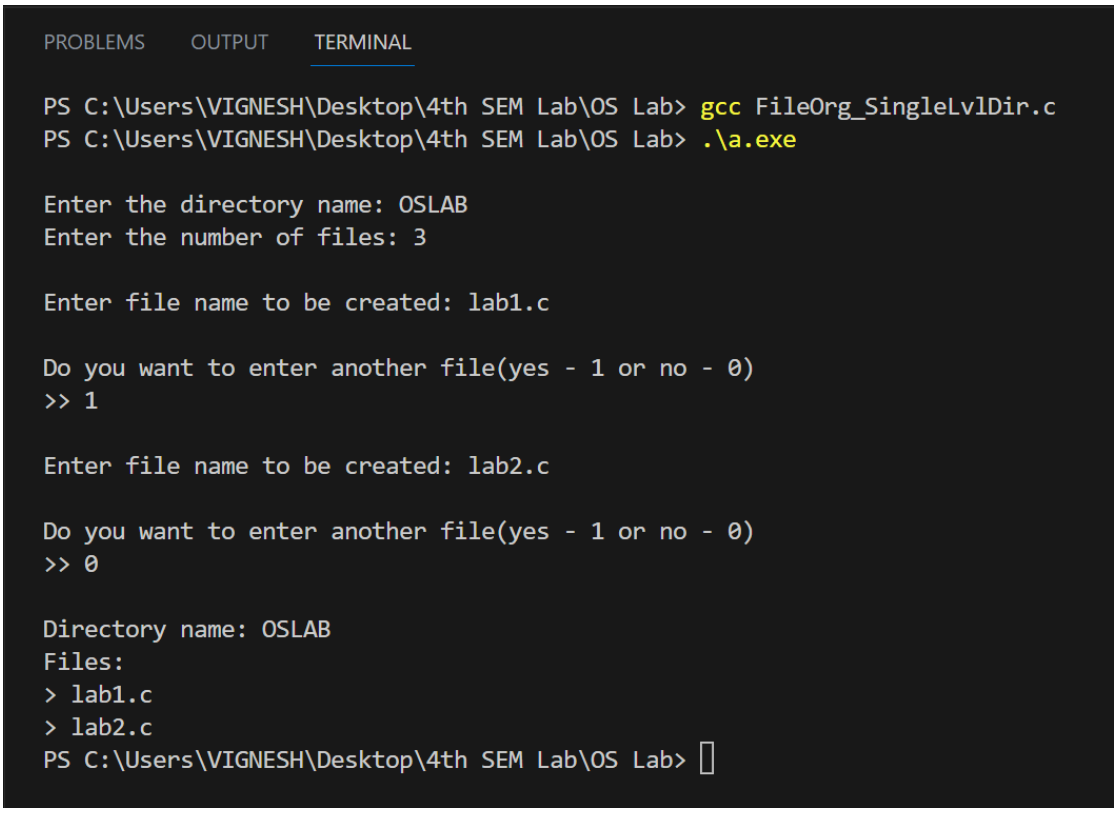
**c) Hierarchical**

***a) Single level directory***

```
#include <stdio.h>
#include <string.h>

void main()
{
   int nf = 0, i = 0, j = 0, ch;
   char mdname[10], fname[10][10], name[10];
   printf("\nEnter the directory name: ");
   scanf("%s", mdname);
   printf("Enter the number of files: ");
   scanf("%d", &nf);
   do
   {
      printf("\nEnter file name to be created: ");
      scanf("%s", name);
      for (i = 0; i < nf; i++)
      {
         if (!strcmp(name, fname[i]))
            break;
      }
      if (i == nf)
```

```
    {
        strcpy(fname[j++], name);
        nf++;
    }
    else
        printf("\nFile nam already exits!\n", name);
    printf("\nDo you want to enter another file(yes - 1 or no - 0)\n>> ");
    scanf("%d", &ch);
  } while (ch == 1)
  printf("\nDirectory name: %s\n", mdname);
  printf("Files:");
  for (i = 0; i < j; i++)
    printf("\n> %s", fname[i]);
}
```

**OUTPUT:**



***b) Two level directories***

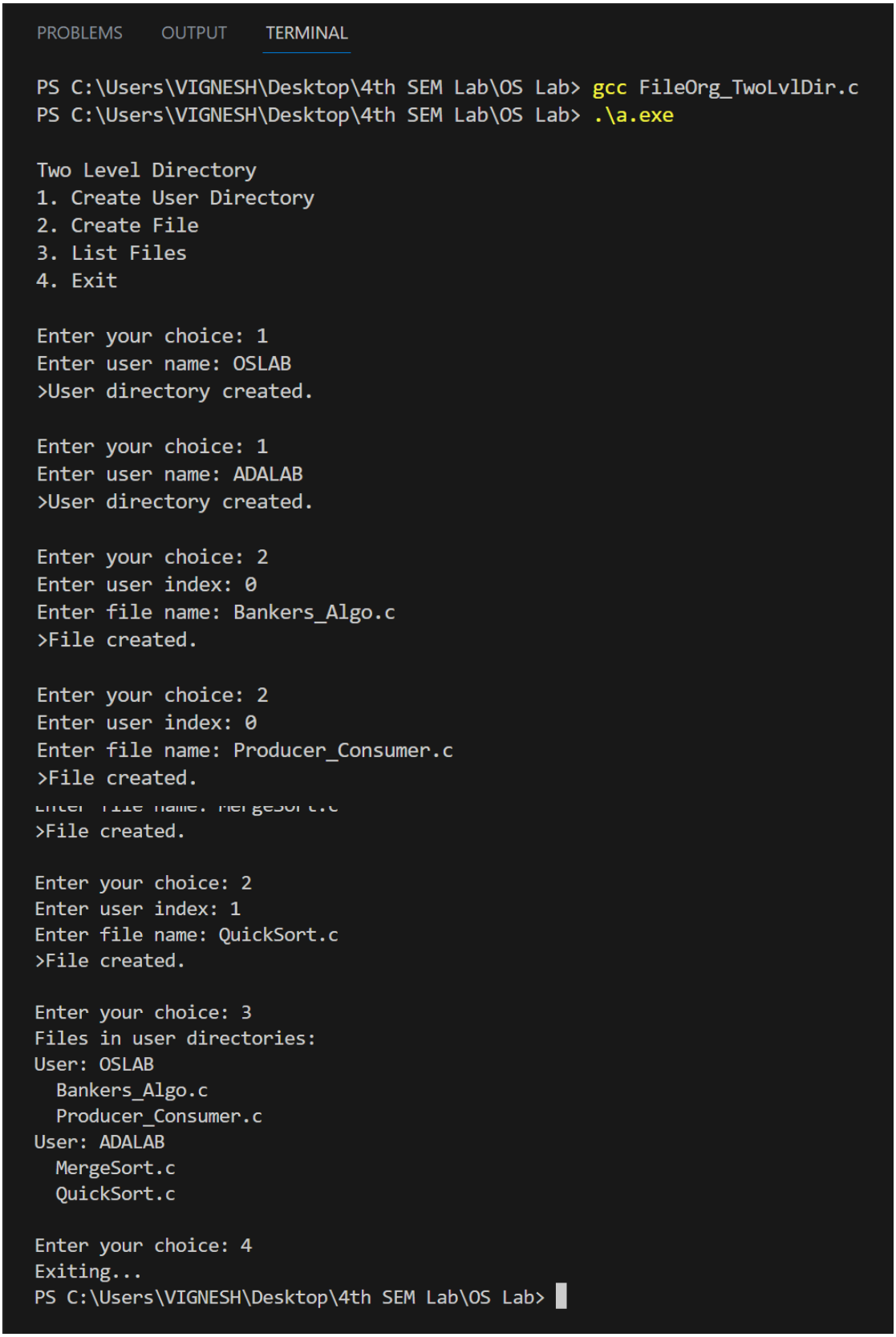
```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

struct File
{
   char name[50];
};

struct UserDirectory
{
   char name[50];
   struct File files[100];
   int fileCount;
};

struct RootDirectory
{
   struct UserDirectory users[10];
   int userCount;
};

int main()
{
   struct RootDirectory rootDir;
   rootDir.userCount = 0;
```

```
int choice;
printf("\nTwo Level Directory\n");
printf("1. Create User Directory\n");
printf("2. Create File\n");
printf("3. List Files\n");
printf("4. Exit\n");
do
{
   printf("\nEnter your choice: ");
   scanf("%d", &choice);

   switch (choice)
   {
   case 1:
      if (rootDir.userCount < 10)
      {
         printf("Enter user name: ");
         scanf("%s", rootDir.users[rootDir.userCount].name);
         rootDir.users[rootDir.userCount].fileCount = 0;
         rootDir.userCount++;
         printf(">User directory created.\n");
      }
      else
      {
         printf(">User directory limit reached.\n");
      }
      break;
```

```
case 2:
    if (rootDir.userCount > 0)
    {
        printf("Enter user index: ");
        int userIndex;
        scanf("%d", &userIndex);
        if (userIndex >= 0 && userIndex < rootDir.userCount)
        {
            struct UserDirectory *userDir = &rootDir.users[userIndex];
            if (userDir->fileCount < 100)
            {
                printf("Enter file name: ");
                scanf("%s", userDir->files[userDir->fileCount].name);
                userDir->fileCount++;
                printf(">File created.\n");
            }
            else
            {
                printf(">User directory is full.\n");
            }
        }
        else
        {
            printf(">Invalid user index.\n");
        }
    }
    else
    {
```

```
            printf(">No user directories available.\n");
        }
        break;
    case 3:
        printf("Files in user directories:\n");
        for (int i = 0; i < rootDir.userCount; i++)
        {
            struct UserDirectory *userDir = &rootDir.users[i];
            printf("User: %s\n", userDir->name);
            for (int j = 0; j < userDir->fileCount; j++)
            {
                printf("  %s\n", userDir->files[j].name);
            }
        }
        break;
    case 4:
        printf("Exiting...\n");
        break;
    default:
        printf("Invalid choice.\n");
    }
  } while (choice != 4);

  return 0;
}
```

**OUTPUT:**



```
PROBLEMS    OUTPUT    TERMINAL

PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> gcc FileOrg_TwoLvlDir.c
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> .\a.exe

Two Level Directory
1. Create User Directory
2. Create File
3. List Files
4. Exit

Enter your choice: 1
Enter user name: OSLAB
>User directory created.

Enter your choice: 1
Enter user name: ADALAB
>User directory created.

Enter your choice: 2
Enter user index: 0
Enter file name: Bankers_Algo.c
>File created.

Enter your choice: 2
Enter user index: 0
Enter file name: Producer_Consumer.c
>File created.
Enter file name: MergeSort.c
>File created.

Enter your choice: 2
Enter user index: 1
Enter file name: QuickSort.c
>File created.

Enter your choice: 3
Files in user directories:
User: OSLAB
  Bankers_Algo.c
  Producer_Consumer.c
User: ADALAB
  MergeSort.c
  QuickSort.c

Enter your choice: 4
Exiting...
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab>
```

***c) Hierarchical***

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

struct File
{
    char name[50];
};

struct Directory
{
    char name[50];
    struct File files[100];
    int fileCount;
    struct Directory *subdirectories[10];
    int subdirCount;
};

void createSubdirectory(struct Directory *parentDir)
{
    if (parentDir->subdirCount < 10)
    {
        struct Directory *subDir = (struct Directory *)malloc(sizeof(struct Directory));
        printf("Enter subdirectory name: ");
        scanf("%s", subDir->name);
        subDir->fileCount = 0;
```

```
        subDir->subdirCount = 0;
        parentDir->subdirectories[parentDir->subdirCount] = subDir;
        parentDir->subdirCount++;
        printf("Subdirectory created.\n");
    }
    else
    {
        printf("Subdirectory limit reached.\n");
    }
}

int main()
{
    struct Directory rootDir;
    strcpy(rootDir.name, "Root");
    rootDir.fileCount = 0;
    rootDir.subdirCount = 0;

    int choice;
    printf("\nHierarchical Directory\n");
    printf("1. Create Subdirectory\n");
    printf("2. Create File\n");
    printf("3. List Files and Directories\n");
    printf("4. Exit\n");
    do
    {
        printf("\nEnter your choice: ");
        scanf("%d", &choice);
```

```
switch (choice)
{
case 1:
    createSubdirectory(&rootDir);
    break;
case 2:
    printf("Enter directory name: ");
    char dirName[50];
    scanf("%s", dirName);

    struct Directory *targetDir = NULL;
    for (int i = 0; i < rootDir.subdirCount; i++)
    {
        if (strcmp(rootDir.subdirectories[i]->name, dirName) == 0)
        {
            targetDir = rootDir.subdirectories[i];
            break;
        }
    }

    if (targetDir != NULL)
    {
        if (targetDir->fileCount < 100)
        {
            printf("Enter file name: ");
            scanf("%s", targetDir->files[targetDir->fileCount].name);
            targetDir->fileCount++;
```

```
            printf("File created.\n");
        }
        else
        {
            printf("Directory is full.\n");
        }
    }
    else
    {
        printf("Directory not found.\n");
    }
    break;
case 3:
    printf("Files and subdirectories:\n");
    printf("Root:\n");
    for (int i = 0; i < rootDir.subdirCount; i++)
    {
        printf("  %s (directory)\n", rootDir.subdirectories[i]->name);

        for (int j = 0; j < rootDir.subdirectories[i]->fileCount; j++)
        {
            printf("    %s (file)\n", rootDir.subdirectories[i]->files[j].name);
        }
    }
    for (int i = 0; i < rootDir.fileCount; i++)
    {
        printf("  %s (file)\n", rootDir.files[i].name);
    }
```

```
            break;
        case 4:
            printf("Exiting...\n");
            break;
        default:
            printf("Invalid choice.\n");
        }
    } while (choice != 4);

    return 0;
}
```

**OUTPUT:**

```
PROBLEMS    OUTPUT    TERMINAL

PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> gcc FileOrg_Hierarchial.c
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> .\a.exe

Hierarchical Directory
1. Create Subdirectory
2. Create File
3. List Files and Directories
4. Exit

Enter your choice: 1
Enter subdirectory name: Docs
Subdirectory created.

Enter your choice: 1
Enter subdirectory name: Labs
Subdirectory created.

Enter your choice: 2
Enter directory name: Docs
Enter file name: notes.pdf
File created.

Enter your choice: 2
Enter directory name: Docs
Enter file name: test.pdf
File created.

Enter your choice: 2
Enter directory name: Labs
Enter file name: Program1.c
File created.

Enter your choice: 3
Files and subdirectories:
Root:
  Docs (directory)
    notes.pdf (file)
    test.pdf (file)
  Labs (directory)
    Program1.c (file)

Enter your choice: 4
Exiting...
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab>
```

# PROGRAM-14

**Write a C program to simulate disk scheduling algorithms**

**a) FCFS**

**b) SCAN**

**c) C-SCAN**

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

void FCFS()
{
    int RQ[100], i, n, TotalHeadMoment = 0, initial;
    printf("\n>>> FCFS Algorithm <<<");
    printf("\nEnter the number of Requests: ");
    scanf("%d", &n);
    printf("Enter the Requests sequence: ");
    for (i = 0; i < n; i++)
        scanf("%d", &RQ[i]);

    printf("Enter initial head position: ");
    scanf("%d", &initial);

    for (i = 0; i < n; i++)
    {
        TotalHeadMoment = TotalHeadMoment + abs(RQ[i] - initial);
        initial = RQ[i];
    }
```

```
    printf("Total head moment is: %d", TotalHeadMoment);
}

void SCAN()
{
    int RQ[100], i, j, n, TotalHeadMoment = 0, initial, size, move;
    printf("\n>>> SCAN Algorithm <<<");
    printf("\nEnter the number of Requests: ");
    scanf("%d", &n);
    printf("Enter the Requests sequence: ");
    for (i = 0; i < n; i++)
        scanf("%d", &RQ[i]);

    printf("Enter initial head position: ");
    scanf("%d", &initial);
    printf("Enter total disk size: ");
    scanf("%d", &size);
    printf(">>Choose the head movement direction\n>0.Towards the smaller value\n>1.Towards
the larger value\n>>: ");
    scanf("%d", &move);

    for (i = 0; i < n; i++)
    {
        for (j = 0; j < n - i - 1; j++)
        {
            if (RQ[j] > RQ[j + 1])
            {
                int temp;
                temp = RQ[j];
```

```
            RQ[j] = RQ[j + 1];
            RQ[j + 1] = temp;
        }
    }
}

int index;
for (i = 0; i < n; i++)
{
    if (initial < RQ[i])
    {
        index = i;
        break;
    }
}
if (move == 1)
{
    for (i = index; i < n; i++)
    {
        TotalHeadMoment = TotalHeadMoment + abs(RQ[i] - initial);
        initial = RQ[i];
    }
    TotalHeadMoment = TotalHeadMoment + abs(size - RQ[i - 1] - 1);
    initial = size - 1;
    for (i = index - 1; i >= 0; i--)
    {
        TotalHeadMoment = TotalHeadMoment + abs(RQ[i] - initial);
        initial = RQ[i];
```

```
        }
    }
    else
    {
        for (i = index - 1; i >= 0; i--)
        {
            TotalHeadMoment = TotalHeadMoment + abs(RQ[i] - initial);
            initial = RQ[i];
        }
        TotalHeadMoment = TotalHeadMoment + abs(RQ[i + 1] - 0);
        initial = 0;
        for (i = index; i < n; i++)
        {
            TotalHeadMoment = TotalHeadMoment + abs(RQ[i] - initial);
            initial = RQ[i];
        }
    }

    printf("Total head movement is: %d", TotalHeadMoment);
}
void C_SCAN()
{
    int RQ[100], i, j, n, TotalHeadMoment = 0, initial, size, move;

    printf("\n>>> C-SCAN Algorithm <<<");
    printf("\nEnter the number of Requests: ");
    scanf("%d", &n);
    printf("Enter the Requests sequence: ");
```

```
    for (i = 0; i < n; i++)
        scanf("%d", &RQ[i]);

    printf("Enter initial head position: ");
    scanf("%d", &initial);
    printf("Enter total disk size: ");
    scanf("%d", &size);
    printf(">>Choose the head movement direction\n>0.Towards the smaller value\n>1.Towards
the larger value\n>>: ");
    scanf("%d", &move);

    for (i = 0; i < n; i++)
    {
        for (j = 0; j < n - i - 1; j++)
        {
            if (RQ[j] > RQ[j + 1])
            {
                int temp;
                temp = RQ[j];
                RQ[j] = RQ[j + 1];
                RQ[j + 1] = temp;
            }
        }
    }

    int index;
    for (i = 0; i < n; i++)
    {
        if (initial < RQ[i])
```

```
    {
        index = i;
        break;
    }
}

if (move == 1)
{
    for (i = index; i < n; i++)
    {
        TotalHeadMoment = TotalHeadMoment + abs(RQ[i] - initial);
        initial = RQ[i];
    }
    TotalHeadMoment = TotalHeadMoment + abs(size - RQ[i - 1] - 1);
    TotalHeadMoment = TotalHeadMoment + abs(size - 1 - 0);
    initial = 0;
    for (i = 0; i < index; i++)
    {
        TotalHeadMoment = TotalHeadMoment + abs(RQ[i] - initial);
        initial = RQ[i];
    }
}
else
{
    for (i = index - 1; i >= 0; i--)
    {
        TotalHeadMoment = TotalHeadMoment + abs(RQ[i] - initial);
        initial = RQ[i];
```

```
        }
        TotalHeadMoment = TotalHeadMoment + abs(RQ[i + 1] - 0);
        TotalHeadMoment = TotalHeadMoment + abs(size - 1 - 0);
        initial = size - 1;
        for (i = n - 1; i >= index; i--)
        {
            TotalHeadMoment = TotalHeadMoment + abs(RQ[i] - initial);
            initial = RQ[i];
        }
    }
    printf("Total head movement is: %d", TotalHeadMoment);
}

void main()
{
    int ch;
    printf("\nDisk Scheduling Algorithms");
    while (1)
    {
        printf("\n\nChoose an Algorithm\n");
        printf("1.FCFS\n2.SCAN\n3.C-SCAN\n4.EXIT");
        printf("\n>>Enter your choice: ");
        scanf("%d", &ch);
        switch (ch)
        {
        case 1:
            FCFS();
            break;
```

```
        case 2:
            SCAN();
            break;
        case 3:
            C_SCAN();
            break;
        case 4:
            exit(0);
        default:
            printf("Invalid choice\n");
        }
    }
}
```

## OUTPUT:

### a) FCFS

```
PROBLEMS    OUTPUT    TERMINAL

PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> gcc Disk_Scheduling1.c
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> .\a.exe

Disk Scheduling Algorithms

Choose an Algorithm
1.FCFS
2.SCAN
3.C-SCAN
4.EXIT
>>Enter your choice: 1

>>> FCFS Algorithm <<<
Enter the number of Requests: 7
Enter the Requests sequence: 82 170 43 140 24 16 190
Enter initial head position: 50
Total head moment is: 642
```

**b) SCAN**

```
PROBLEMS    OUTPUT    TERMINAL

Choose an Algorithm
1.FCFS
2.SCAN
3.C-SCAN
4.EXIT
>>Enter your choice: 2

>>> SCAN Algorithm <<<
Enter the number of Requests: 7
Enter the Requests sequence: 82 170 43 140 24 16 190
Enter initial head position: 50
Enter total disk size: 200
>>Choose the head movement direction
>0.Towards the smaller value
>1.Towards the larger value
>>: 1
Total head movement is: 332
```

**c) C-SCAN**

```
Choose an Algorithm
1.FCFS
2.SCAN
3.C-SCAN
4.EXIT
>>Enter your choice: 3

>>> C-SCAN Algorithm <<<
Enter the number of Requests: 7
Enter the Requests sequence: 82 170 43 140 24 16 190
Enter initial head position: 50
Enter total disk size: 200
>>Choose the head movement direction
>0.Towards the smaller value
>1.Towards the larger value
>>: 1
Total head movement is: 391

Choose an Algorithm
1.FCFS
2.SCAN
3.C-SCAN
4.EXIT
>>Enter your choice: 4
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab>
```

# PROGRAM-15

**Write a C program to simulate disk scheduling algorithms**

**a) SSTF**

**b) LOOK**

**c) c-LOOK**

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

void SSTF()
{
    int RQ[100], i, n, TotalHeadMoment = 0, initial, count = 0;
    printf("\n>>> SSTF Algorithm <<<");
    printf("\nEnter the number of Requests: ");
    scanf("%d", &n);
    printf("Enter the Requests sequence: ");
    for (i = 0; i < n; i++)
        scanf("%d", &RQ[i]);
    printf("Enter initial head position: ");
    scanf("%d", &initial);
    while (count != n)
    {
        int min = 1000, d, index;
        for (i = 0; i < n; i++)
        {
            d = abs(RQ[i] - initial);
            if (min > d)
            {
```

```
            min = d;
            index = i;
          }
        }
        TotalHeadMoment = TotalHeadMoment + min;
        initial = RQ[index];
        RQ[index] = 1000;
        count++;
    }

    printf("Total head movement is: %d", TotalHeadMoment);
}

void LOOK()
{
    int RQ[100], i, j, n, TotalHeadMoment = 0, initial, size, move;
    printf("\n>>> LOOK Algorithm <<<");
    printf("\nEnter the number of Requests: ");
    scanf("%d", &n);
    printf("Enter the Requests sequence: ");
    for (i = 0; i < n; i++)
        scanf("%d", &RQ[i]);
    printf("Enter initial head position: ");
    scanf("%d", &initial);
    printf(">>Choose the head movement direction\n>0.Towards the smaller value\n>1.Towards
the larger value\n>>: ");
    scanf("%d", &move);

    for (i = 0; i < n; i++)
```

```
{
   for (j = 0; j < n - i - 1; j++)
   {
      if (RQ[j] > RQ[j + 1])
      {
         int temp;
         temp = RQ[j];
         RQ[j] = RQ[j + 1];
         RQ[j + 1] = temp;
      }
   }
}

int index;
for (i = 0; i < n; i++)
{
   if (initial < RQ[i])
   {
      index = i;
      break;
   }
}

if (move == 1)
{
   for (i = index; i < n; i++)
   {
      TotalHeadMoment = TotalHeadMoment + abs(RQ[i] - initial);
```

```
            initial = RQ[i];
        }

        for (i = index - 1; i >= 0; i--)
        {
            TotalHeadMoment = TotalHeadMoment + abs(RQ[i] - initial);
            initial = RQ[i];
        }
    }
    else
    {
        for (i = index - 1; i >= 0; i--)
        {
            TotalHeadMoment = TotalHeadMoment + abs(RQ[i] - initial);
            initial = RQ[i];
        }

        for (i = index; i < n; i++)
        {
            TotalHeadMoment = TotalHeadMoment + abs(RQ[i] - initial);
            initial = RQ[i];
        }
    }

    printf("Total head movement is: %d", TotalHeadMoment);
}

void C_LOOK()
```

```
{
    int RQ[100], i, j, n, TotalHeadMoment = 0, initial, size, move;

    printf("\n>>> C-LOOK Algorithm <<<");
    printf("\nEnter the number of Requests: ");
    scanf("%d", &n);
    printf("Enter the Requests sequence: ");
    for (i = 0; i < n; i++)
        scanf("%d", &RQ[i]);
    printf("Enter initial head position: ");
    scanf("%d", &initial);

    printf(">>Choose the head movement direction\n>0.Towards the smaller value\n>1.Towards
the larger value\n>>: ");
    scanf("%d", &move);

    for (i = 0; i < n; i++)
    {
        for (j = 0; j < n - i - 1; j++)
        {
            if (RQ[j] > RQ[j + 1])
            {
                int temp;
                temp = RQ[j];
                RQ[j] = RQ[j + 1];
                RQ[j + 1] = temp;
            }
        }
    }
```

```
int index;
for (i = 0; i < n; i++)
{
   if (initial < RQ[i])
   {
      index = i;
      break;
   }
}

if (move == 1)
{
   for (i = index; i < n; i++)
   {
      TotalHeadMoment = TotalHeadMoment + abs(RQ[i] - initial);
      initial = RQ[i];
   }

   for (i = 0; i < index; i++)
   {
      TotalHeadMoment = TotalHeadMoment + abs(RQ[i] - initial);
      initial = RQ[i];
   }
}
else
{
   for (i = index - 1; i >= 0; i--)
   {
```

```
        TotalHeadMoment = TotalHeadMoment + abs(RQ[i] - initial);
        initial = RQ[i];
      }

      for (i = n - 1; i >= index; i--)
      {
        TotalHeadMoment = TotalHeadMoment + abs(RQ[i] - initial);
        initial = RQ[i];
      }
   }

   printf("Total head movement is: %d", TotalHeadMoment);
}

void main()
{
   int ch;
   printf("\nDisk Scheduling Algorithms");
   while (1)
   {
      printf("\n\nChoose an Algorithm\n");
      printf("1.SSTF\n2.LOOK\n3.C-LOOK\n4.EXIT");
      printf("\n>>Enter your choice: ");
      scanf("%d", &ch);
      switch (ch)
      {
      case 1:
        SSTF();
```

```
            break;
        case 2:
            LOOK();
            break;
        case 3:
            C_LOOK();
            break;
        case 4:
            exit(0);
        default:
            printf("Invalid choice\n");
        }
    }
}
```

## OUTPUT:

**a) SSTF**

```
PROBLEMS    OUTPUT    TERMINAL

PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> gcc Disk_Scheduling2.c
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab> .\a.exe

Disk Scheduling Algorithms

Choose an Algorithm
1.SSTF
2.LOOK
3.C-LOOK
4.EXIT
>>Enter your choice: 1

>>> SSTF Algorithm <<<
Enter the number of Requests: 7
Enter the Requests sequence: 82 170 43 140 24 16 190
Enter initial head position: 50
Total head movement is: 208
```

**b) LOOK**

```
PROBLEMS    OUTPUT    TERMINAL

Choose an Algorithm
1.SSTF
2.LOOK
3.C-LOOK
4.EXIT
>>Enter your choice: 2

>>> LOOK Algorithm <<<
Enter the number of Requests: 7
Enter the Requests sequence: 82 170 43 140 24 16 190
Enter initial head position: 50
>>Choose the head movement direction
>0.Towards the smaller value
>1.Towards the larger value
>>: 1
Total head movement is: 314
```

**c) c-LOOK**

```
Choose an Algorithm
1.SSTF
2.LOOK
3.C-LOOK
4.EXIT
>>Enter your choice: 3

>>> C-LOOK Algorithm <<<
Enter the number of Requests: 7
Enter the Requests sequence: 82 170 43 140 24 16 190
Enter initial head position: 50
>>Choose the head movement direction
>0.Towards the smaller value
>1.Towards the larger value
>>: 1
Total head movement is: 341

Choose an Algorithm
1.SSTF
2.LOOK
3.C-LOOK
4.EXIT
>>Enter your choice: 4
PS C:\Users\VIGNESH\Desktop\4th SEM Lab\OS Lab>
```