VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

LAB REPORT
on

OPERATING SYSTEMS

Submitted by

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

B.M.S. COLLEGE OF ENGINEERING
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Department of Computer Science and Engineering

CERTIFICATE

This is to certify that the Lab work entitled "OPERATING SYSTEMS" carried out by **DHRAVYA M (1BM21CS056),** 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.

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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.

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Question:

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

(a) FCFS

(b) SJF

Code:

```
#include<stdio.h>
   int n, i, j, pos, temp, choice, Burst_time[20], Waiting_time[20],
   Turn_around_time[20], process[20], total=0;
   float avg_Turn_around_time=0, avg_Waiting_time=0;

int FCFS()
{
   Waiting_time[0]=0;

   for(i=1;i<n;i++)
   {
      Waiting_time[i]=0;
      for(j=0;j<i;j++)
         Waiting_time[i]+=Burst_time[j];
   }

   printf("\nProcess\t\tBurst Time\t\tWaiting Time\t\tTurnaround Time");

   for(i=0;i<n;i++)
   {
      Turn_around_time[i]=Burst_time[i]+Waiting_time[i];
      avg_Waiting_time+=Waiting_time[i];
      avg_Turn_around_time+=Turn_around_time[i];

printf("\nP[%d]\t\t%d\t\t\t%d\t\t\t\t%d",i+1,Burst_time[i],Waiting_time[i],Turn_ar
ound_time[i]);
   }

   avg_Waiting_time =(float)(avg_Waiting_time)/(float)i;
   avg_Turn_around_time=(float)(avg_Turn_around_time)/(float)i;
```

```
    printf("\nAverage Waiting Time:%.2f",avg_Waiting_time);
    printf("\nAverage Turnaround Time:%.2f\n",avg_Turn_around_time);

    return 0;
}

int SJF()
{
    //sorting
    for(i=0;i<n;i++)
    {
        pos=i;
        for(j=i+1;j<n;j++)
        {
            if(Burst_time[j]<Burst_time[pos])
                pos=j;
        }

        temp=Burst_time[i];
        Burst_time[i]=Burst_time[pos];
        Burst_time[pos]=temp;

        temp=process[i];
        process[i]=process[pos];
        process[pos]=temp;
    }
        Waiting_time[0]=0;


    for(i=1;i<n;i++)
    {
        Waiting_time[i]=0;

        for(j=0;j<i;j++)
            Waiting_time[i]+=Burst_time[j];

        total+=Waiting_time[i];
    }

    avg_Waiting_time=(float)total/n;
```

```
    total=0;

    printf("\nProcess\t\tBurst Time\t\tWaiting Time\t\tTurnaround Time");

    for(i=0;i<n;i++)
    {
        Turn_around_time[i]=Burst_time[i]+Waiting_time[i];
        total+=Turn_around_time[i];

printf("\nP[%d]\t\t%d\t\t\t%d\t\t\t\t%d",process[i],Burst_time[i],Waiting_time[i],T
urn_around_time[i]);
    }

    avg_Turn_around_time=(float)total/n;
    printf("\n\nAverage Waiting Time=%f",avg_Waiting_time);
    printf("\nAverage Turnaround Time=%f\n",avg_Turn_around_time);
}

int main()
{
    printf("Enter the total number of processes:");
    scanf("%d",&n);

    printf("\nEnter Burst Time:\n");
    for(i=0;i<n;i++)
    {
        printf("P[%d]:",i+1);
        scanf("%d",&Burst_time[i]);
        process[i]=i+1;
    }

    while(1)
    {   printf("\n-----MAIN MENU-----\n");
        printf("1. FCFS Scheduling\n2. SJF Scheduling\n");
        printf("\nEnter your choice:");
        scanf("%d", &choice);
        switch(choice)
        {
            case 1: FCFS();
            break;
```

```
            case 2: SJF();
            break;

            default: printf("Invalid Input!!!");
        }
    }
    return 0;
}
```

output

```
D:\Codes\c\OS_Lab>gcc "SJF(Non-Premptive).c"

D:\Codes\c\OS_Lab>.\a.exe
Enter the number of processes: 4
Enter the burst times of 4 processes:
------------------------
Enter the burst times Process1:4
Enter the burst times Process2:5
Enter the burst times Process3:2
Enter the burst times Process4:7

The details of the processes are as below:
Process Burst Time      Turn Around Time        Waiting Time
   1    2.000000                2.000000           0.000000
   2    4.000000                6.000000           2.000000
   3    5.000000                11.000000          6.000000
   4    7.000000                18.000000          11.000000
The average waiting time is: 4.750000
The average turn around time is: 9.250000
```

```
D:\Codes\c\OS_Lab>gcc "SJF(Non-Premptive).c"

D:\Codes\c\OS_Lab>.\a.exe
Enter the number of processes: 4
Enter the burst times of 4 processes:
------------------------
Enter the burst times Process1:4
Enter the burst times Process2:5
Enter the burst times Process3:2
Enter the burst times Process4:7

The details of the processes are as below:
Process Burst Time      Turn Around Time        Waiting Time
   1    2.000000                2.000000           0.000000
   2    4.000000                6.000000           2.000000
   3    5.000000                11.000000          6.000000
   4    7.000000                18.000000          11.000000
The average waiting time is: 4.750000
The average turn around time is: 9.250000
```

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Question:

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

(a) Priority (pre-emptive & Non-pre-emptive)

(b) Round Robin (Experiment with different quantum sizes for RR algorithm)

Code:

(a) <u>Priority (Non-pre-emptive)</u>

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

struct process {
   int process_id;
   int burst_time;
   int priority;
   int waiting_time;
   int turnaround_time;
};

void find_average_time(struct process[], int);

void priority_scheduling(struct process[], int);

int main()
{
   int n, i;
   struct process proc[10];

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

for(i = 0; i< n; i++)
   {
      printf("\nEnter the process ID: ");
      scanf("%d", &proc[i].process_id);
```

```
        printf("Enter the burst time: ");
        scanf("%d", &proc[i].burst_time);

        printf("Enter the priority: ");
        scanf("%d", &proc[i].priority);
    }

    priority_scheduling(proc, n);
    return 0;
}

void find_waiting_time(struct process proc[], int n, int wt[])
{
    int i;
    wt[0] = 0;

    for(i = 1; i< n; i++)
    {
        wt[i] = proc[i - 1].burst_time + wt[i - 1];
    }
}

void find_turnaround_time(struct process proc[], int n, int wt[], int tat[])
{
    int i;
    for(i = 0; i< n; i++)
    {
        tat[i] = proc[i].burst_time + wt[i];
    }
}

void find_average_time(struct process proc[], int n)
{
    int wt[10], tat[10], total_wt = 0, total_tat = 0, i;

    find_waiting_time(proc, n, wt);
    find_turnaround_time(proc, n, wt, tat);

    printf("\nProcess ID\tBurst Time\tPriority\tWaiting Time\tTurnaround Time");
```

```
    for(i = 0; i< n; i++)
    {
        total_wt = total_wt + wt[i];
        total_tat = total_tat + tat[i];
        printf("\n%d\t\t%d\t\t%d\t\t%d\t\t%d", proc[i].process_id, proc[i].burst_time,
proc[i].priority, wt[i],              tat[i]);
    }
    printf("\n\nAverage Waiting Time = %f", (float)total_wt/n);
    printf("\nAverage Turnaround Time = %f\n", (float)total_tat/n);
}
void priority_scheduling(struct process proc[], int n)
{
    int i, j, pos;
    struct process temp;
    for(i = 0; i< n; i++)
    {
        pos = i;
        for(j = i + 1; j < n; j++)
        {
            if(proc[j].priority< proc[pos].priority)
            pos = j;
        }
        temp = proc[i];
        proc[i] = proc[pos];
        proc[pos] = temp;
    }
    find_average_time(proc, n);
}
```

(b) <u>Round Robin (Non-pre-emptive)</u>

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

int turnarroundtime(int processes[], int n, int bt[], int wt[], int tat[]) {
   for (int i = 0; i < n ; i++)
   tat[i] = bt[i] + wt[i];
   return 1;
}
```

```
int waitingtime(int processes[], int n, int bt[], int wt[], int quantum)
{
  int rem_bt[n];
  for (int i = 0 ; i < n ; i++)
  rem_bt[i] = bt[i];
  int t = 0;

   while (1)
   {
      bool done = true;

      for (int i = 0 ; i < n; i++)
      {
         if (rem_bt[i] > 0)
         {
            done = false;
            if (rem_bt[i] > quantum)
            {
               t += quantum;
               rem_bt[i] -= quantum;
            }

            else
            {
               t = t + rem_bt[i];
               wt[i] = t - bt[i];
               rem_bt[i] = 0;
            }
         }
     }
     if (done == true)
       break;
  }
  return 1;
}

int findavgTime(int processes[], int n, int bt[], int quantum) {
   int wt[n], tat[n], total_wt = 0, total_tat = 0;

   waitingtime(processes, n, bt, wt, quantum);
```

```
    turnarroundtime(processes, n, bt, wt, tat);

    printf("\n\nProcesses\t\t Burst Time\t\t Waiting Time\t\t turnaround time\n");
    for (int i=0; i<n; i++)
    {
        total_wt = total_wt + wt[i];
        total_tat = total_tat + tat[i];
        printf("\n\t%d\t\t\t%d\t\t\t%d\t\t\t%d\n",i+1, bt[i], wt[i], tat[i]);
    }

    printf("\nAverage waiting time = %f", (float)total_wt / (float)n);
    printf("\nAverage turnaround time = %f", (float)total_tat / (float)n);
    return 1;
}

int main()
{
   int n, processes[n], burst_time[n], quantum;
   printf("Enter the Number of Processes: ");
   scanf("%d",&n);

   printf("\nEnter the quantum time: ");
   scanf("%d",&quantum);

    int i=0;
    for(i=0;i<n;i++)
    {
        printf("\nEnter the process: ");
        scanf("%d",&processes[i]);
        printf("Enter the Burst Time:");
        scanf("%d",&burst_time[i]);
   }

   findavgTime(processes, n, burst_time, quantum);
   return 0;
}
```

OUTPUT

```
Enter the number of processes: 3

Enter the process ID: 1
Enter the burst time: 10
Enter the priority: 3

Enter the process ID: 2
Enter the burst time: 8
Enter the priority: 2

Enter the process ID: 3
Enter the burst time: 5
Enter the priority: 1

Process ID      Burst Time      Priority        Waiting Time    Turnaround Time
3               5               1               0               5
2               8               2               5               13
1               10              3               13              23

Average Waiting Time = 6.000000
Average Turnaround Time = 13.666667
```

```
Enter the Number of Processes: 3

Enter the quantum time: 2

Enter the process: 1
Enter the Burst Time:4

Enter the process: 2
Enter the Burst Time:3

Enter the process: 3
Enter the Burst Time:5


Processes               Burst Time              Waiting Time            turnaround time

       1                       4                       4                       8

       2                       3                       6                       9

       3                       5                       7                       12

Average waiting time = 5.666667
Average turnaround time = 9.666667
```

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Question:

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.

Code:

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

struct process {
    int pid;
    int arrival_time;
    int burst_time;
    int priority;
    int waiting_time;
    int turnaround_time;
};

void FCFS(struct process *queue, int n) {
    int i, j;
    struct process temp;
    for (i = 0; i < n; i++) {
        for (j = i + 1; j < n; j++) {
            if (queue[i].arrival_time > queue[j].arrival_time) {
                temp = queue[i];
                queue[i] = queue[j];
                queue[j] = temp;
            }
        }
    }
}

int main() {
    int n, i;
    struct process *system_queue, *user_queue;
```

```
    int system_n = 0, user_n = 0;
    float avg_waiting_time = 0, avg_turnaround_time = 0;

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

    system_queue = (struct process *) malloc(n * sizeof(struct process));
    user_queue = (struct process *) malloc(n * sizeof(struct process));

    for (i = 0; i < n; i++) {
        struct process p;
        printf("Enter arrival time, burst time, and priority (0-System/1-User) for
process %d: ", i + 1);
        scanf("%d %d %d", &p.arrival_time, &p.burst_time, &p.priority);
        p.pid = i + 1;
        p.waiting_time = 0;
        p.turnaround_time = 0;
        if (p.priority == 0) {
            system_queue[system_n++] = p;
        } else {
            user_queue[user_n++] = p;
        }
    }

    FCFS(system_queue, system_n);
    FCFS(user_queue, user_n);

    int time = 0;
    int s=0,u=0;
    while(s<system_n || u<user_n){
        if(system_queue[s].arrival_time <= time){
            if(user_queue[u].arrival_time <= time &&  user_queue[u].arrival_time <
system_queue[s].arrival_time){
                user_queue[u].waiting_time = time - user_queue[u].arrival_time;
                time += user_queue[u].burst_time;
                user_queue[u].turnaround_time = user_queue[u].waiting_time +
user_queue[u].burst_time;
                avg_waiting_time += user_queue[u].waiting_time;
                avg_turnaround_time += user_queue[u].turnaround_time;
                u++;
```

```
            }
            else{
                system_queue[s].waiting_time = time - system_queue[s].arrival_time;
                time += system_queue[s].burst_time;
                system_queue[s].turnaround_time = system_queue[s].waiting_time +
system_queue[s].burst_time;
                avg_waiting_time += system_queue[s].waiting_time;
                avg_turnaround_time += system_queue[s].turnaround_time;
                s++;
            }
        }
        else if(user_queue[u].arrival_time <= time){
            user_queue[u].waiting_time = time - user_queue[u].arrival_time;
                time += user_queue[u].burst_time;
                user_queue[u].turnaround_time = user_queue[u].waiting_time +
user_queue[u].burst_time;
                avg_waiting_time += user_queue[u].waiting_time;
                avg_turnaround_time += user_queue[u].turnaround_time;
                u++;
        }
        else{
            if(system_queue[s].arrival_time <= user_queue[u].arrival_time){
                time = system_queue[s].arrival_time;
            }
            else{
                time = user_queue[u].arrival_time;
            }
        }
    }

    avg_waiting_time /= n;
    avg_turnaround_time /= n;

    printf("PID\tBurst Time\tPriority\tQueue Type\tWaiting Time\tTurnaround
Time\n");
    for (i = 0; i < system_n; i++) {
        printf("%d\t%d\t\t%d\t\tSystem\t\t%d\t\t%d\n", system_queue[i].pid,
system_queue[i].burst_time, system_queue[i].priority,
system_queue[i].waiting_time, system_queue[i].turnaround_time);
    }
```

```
    for (i = 0; i < user_n; i++) {
        printf("%d\t%d\t\t%d\t\tUser\t\t%d\t\t%d\n", user_queue[i].pid,
user_queue[i].burst_time, user_queue[i].priority, user_queue[i].waiting_time,
user_queue[i].turnaround_time);
    }

    printf("Average Waiting Time: %.2f\n", avg_waiting_time);
    printf("Average Turnaround Time: %.2f\n", avg_turnaround_time);

    free(system_queue);
    free(user_queue);

    return 0;
}
```

OUTPUT

```
Enter the number of processes: 4
Enter arrival time, burst time, and priority (0-System/1-User) for process 1: 0 3 0
Enter arrival time, burst time, and priority (0-System/1-User) for process 2: 1 3 1
Enter arrival time, burst time, and priority (0-System/1-User) for process 3: 8 3 0
Enter arrival time, burst time, and priority (0-System/1-User) for process 4: 8 3 1
PID     Burst Time      Priority        Queue Type      Waiting Time    Turnaround Time
1       3               0               System          0               3
3       3               0               System          0               3
2       3               1               User            2               5
4       3               1               User            3               6
Average Waiting Time: 1.25
Average Turnaround Time: 4.25
```

4

Question:

Write a C program to simulate Real-Time CPU Scheduling algorithms:
(a) Rate- Monotonic
(b) Earliest-deadline First
(c) Proportional scheduling

Code:

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

#define MAX_PROCESS 10

typedef struct {
    int id;
    int burst_time;
    float priority;
} Task;

int num_of_process;
int execution_time[MAX_PROCESS], period[MAX_PROCESS],
remain_time[MAX_PROCESS], deadline[MAX_PROCESS],
remain_deadline[MAX_PROCESS];

void get_process_info(int selected_algo)
{
    printf("Enter total number of processes (maximum %d): ", MAX_PROCESS);
    scanf("%d", &num_of_process);
    if (num_of_process < 1)
    {
        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];
        if (selected_algo == 2)
        {
            printf("==> Deadline: ");
            scanf("%d", &deadline[i]);
        }
        else
        {
            printf("==> Period: ");
            scanf("%d", &period[i]);
        }
    }
}

int max(int a, int b, int c)
{
    int max;
    if (a >= b && a >= c)
        max = a;
    else if (b >= a && b >= c)
        max = b;
    else if (c >= a && c >= b)
        max = c;
    return max;
}

int get_observation_time(int selected_algo)
{
    if (selected_algo == 1)
    {
        return max(period[0], period[1], period[2]);
    }
    else if (selected_algo == 2)
    {
        return max(deadline[0], deadline[1], deadline[2]);
    }
}

void print_schedule(int process_list[], int cycles)
```

```
{
    printf("\nScheduling:\n\n");
    printf("Time: ");
    for (int i = 0; i < cycles; i++)
    {
        if (i < 10)
            printf("| 0%d ", i);
        else
            printf("| %d ", i);
    }
    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)
{
    int process_list[100] = {0}, min = 999, next_process = 0;
    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;
    int m = (float) (n * (pow(2, 1.0 / n) - 1));
    if (utilization > m)
    {
        printf("\nGiven problem is not schedulable under the said scheduling
algorithm.\n");
    }
```

```
    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;
            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);
}

void earliest_deadline_first(int time){
    float utilization = 0;
    for (int i = 0; i < num_of_process; i++){
        utilization += (1.0*execution_time[i])/deadline[i];
    }
    int n = num_of_process;

    int process[num_of_process];
    int max_deadline, current_process=0, min_deadline,process_list[time];
```

```
bool is_ready[num_of_process];

for(int i=0; i<num_of_process; i++){
   is_ready[i] = true;
   process[i] = i+1;
}

max_deadline=deadline[0];
for(int i=1; i<num_of_process; i++){
   if(deadline[i] > max_deadline)
      max_deadline = deadline[i];
}

for(int i=0; i<num_of_process; i++){
   for(int j=i+1; j<num_of_process; j++){
      if(deadline[j] < deadline[i]){
         int temp = execution_time[j];
         execution_time[j] = execution_time[i];
         execution_time[i] = temp;
         temp = deadline[j];
         deadline[j] = deadline[i];
         deadline[i] = temp;
         temp = process[j];
         process[j] = process[i];
         process[i] = temp;
      }
   }
}

for(int i=0; i<num_of_process; i++){
   remain_time[i] = execution_time[i];
   remain_deadline[i] = deadline[i];
}

for (int t = 0; t < time; t++){
   if(current_process != -1){
      --execution_time[current_process];
      process_list[t] = process[current_process];
   }
   else
```

```
            process_list[t] = 0;

        for(int i=0;i<num_of_process;i++){
            --deadline[i];
            if((execution_time[i] == 0) && is_ready[i]){
                deadline[i] += remain_deadline[i];
                is_ready[i] = false;
            }
            if((deadline[i] <= remain_deadline[i]) && (is_ready[i] == false)){
                execution_time[i] = remain_time[i];
                is_ready[i] = true;
            }
        }

        min_deadline = max_deadline;
        current_process = -1;
        for(int i=0;i<num_of_process;i++){
            if((deadline[i] <= min_deadline) && (execution_time[i] > 0)){
                current_process = i;
                min_deadline = deadline[i];
            }
        }
    }
    print_schedule(process_list, time);
}

void proportionalScheduling() {
    int n;
    printf("Enter the number of tasks: ");
    scanf("%d", &n);

    Task tasks[n];
    printf("Enter burst time and priority for each task:\n");
    for (int i = 0; i < n; i++) {
        tasks[i].id = i + 1;
        printf("Task %d - Burst Time: ", tasks[i].id);
        scanf("%d", &tasks[i].burst_time);
        printf("Task %d - Priority: ", tasks[i].id);
        scanf("%f", &tasks[i].priority);
    }
```

```
    // Sort tasks based on priority (ascending order)
    for (int i = 0; i < n - 1; i++) {
        for (int j = 0; j < n - i - 1; j++) {
            if (tasks[j].priority > tasks[j + 1].priority) {
                // Swap tasks
                Task temp = tasks[j];
                tasks[j] = tasks[j + 1];
                tasks[j + 1] = temp;
            }
        }
    }

    printf("\nProportional Scheduling:\n");

    int total_burst_time = 0;
    float total_priority = 0.0;

    for (int i = 0; i < n; i++) {
        total_burst_time += tasks[i].burst_time;
        total_priority += tasks[i].priority;
    }

    for (int i = 0; i < n; i++) {
        float time_slice = (tasks[i].priority / total_priority) * total_burst_time;
        printf("Task %d executes for %.2f units of time\n", tasks[i].id, time_slice);
    }
}


int main()
{
    int option;
    int observation_time;

    while (1)
    {
    printf("\n1. Rate Monotonic\n2. Earliest Deadline first\n3. Proportional
Scheduling\n\nEnter your choice: ");
    scanf("%d", &option);
```

```
    switch(option)
    {
       case 1: get_process_info(option);
               observation_time = get_observation_time(option);
               rate_monotonic(observation_time);
               break;
       case 2: get_process_info(option);
               observation_time = get_observation_time(option);
               earliest_deadline_first(observation_time);
               break;
       case 3: proportionalScheduling();
               break;
       case 4: exit (0);
       default: printf("\nInvalid Statement");
    }
    }
    return 0;
}
```

OUTPUT

Output:

(a) Rate Monotonic:

```
1. Rate Monotonic
2. Earliest Deadline first
3. Proportional Scheduling

Enter your choice: 1
Enter total number of processes (maximum 10): 3

Process 1:
==> Execution time: 3
==> Period: 20

Process 2:
==> Execution time: 2
==> Period: 5

Process 3:
==> Execution time: 2
==> Period: 10

Scheduling:

Time: | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
P[1]: |    |    |    |    |####|    |    |####|####|    |    |    |    |    |    |    |    |    |    |    |
P[2]: |####|####|    |    |    |####|####|    |    |    |####|####|    |    |    |####|####|    |    |    |
P[3]: |    |    |####|####|    |    |    |    |    |    |    |    |####|####|    |    |    |    |    |    |
```

(b) Earliest Deadline First:

```
1. Rate Monotonic
2. Earliest Deadline first
3. Proportional Scheduling

Enter your choice: 2
Enter total number of processes (maximum 10): 3

Process 1:
==> Execution time: 3
==> Deadline: 7

Process 2:
==> Execution time: 2
==> Deadline: 4

Process 3:
==> Execution time: 2
==> Deadline: 8

Scheduling:

Time: | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 |
P[1]: |    |    |####|####|####|    |    |    |
P[2]: |####|####|    |    |    |    |    |####|
P[3]: |    |    |    |    |    |####|####|    |
```

(c) Proportional Scheduling:

```
1. Rate Monotonic
2. Earliest Deadline first
3. Proportional Scheduling

Enter your choice: 3
Enter the number of tasks: 3
Enter burst time and priority for each task:
Task 1 - Burst Time: 4
Task 1 - Priority: 2
Task 2 - Burst Time: 6
Task 2 - Priority: 3
Task 3 - Burst Time: 5
Task 3 - Priority: 1

Proportional Scheduling:
Task 3 executes for 2.50 units of time
Task 1 executes for 5.00 units of time
Task 2 executes for 7.50 units of time
```

5

Question:

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

Code:

```
#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("\nEnter 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("\nProducer produces the item %d",x);
   mutex=signal(mutex);
}

void consumer()
{
   mutex=wait(mutex);
   full=wait(full);
   empty=signal(empty);

   printf("\nConsumer consumes item %d",x);
   x--;
   mutex=signal(mutex);
}
```

OUTPUT

```
1.Producer
2.Consumer
3.Exit
Enter your choice: 1

Producer produces the item 1
Enter your choice: 2

Consumer consumes item 1
Enter your choice: 2
Buffer is empty!!
Enter your choice: 1

Producer produces the item 1
Enter your choice: 1

Producer produces the item 2
Enter your choice: 1

Producer produces the item 3
Enter your choice: 1
Buffer is full!!
Enter your choice: 3
```

6

Question:

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

Code:

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

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

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

sem_t mutex;
sem_t S[N];

void test(int num_of_philosopher)
{
        if (state[num_of_philosopher] == HUNGRY && state[LEFT] !=
EATING && state[RIGHT] != EATING)
        {
                state[num_of_philosopher] = EATING;

                sleep(2);

                printf("Philosopher %d takes fork %d and %d\n",
num_of_philosopher +1, LEFT +1, num_of_philosopher +1);

                printf("Philosopher %d is Eating\n", num_of_philosopher +1);

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

```
void take_fork(int num_of_philosopher)
{
        sem_wait(&mutex);
        state[num_of_philosopher] = HUNGRY;
        printf("Philosopher %d is Hungry\n", num_of_philosopher +1);
        test(num_of_philosopher);

        sem_post(&mutex);
        sem_wait(&S[num_of_philosopher]);
        sleep(1);
}

void put_fork(int num_of_philosopher)
{
        sem_wait(&mutex);
        state[num_of_philosopher] = THINKING;

        printf("Philosopher %d putting fork %d and %d
down\n",num_of_philosopher +1, LEFT +1, num_of_philosopher +1);

        printf("Philosopher %d is thinking\n", num_of_philosopher +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:

```
Philosopher 1 is thinking
Philosopher 2 is thinking
Philosopher 3 is thinking
Philosopher 4 is thinking
Philosopher 5 is thinking
Philosopher 1 is Hungry
Philosopher 5 is Hungry
Philosopher 4 is Hungry
Philosopher 3 is Hungry
Philosopher 2 is Hungry
Philosopher 2 takes fork 1 and 2
Philosopher 2 is Eating
Philosopher 2 putting fork 1 and 2 down
Philosopher 2 is thinking
Philosopher 1 takes fork 5 and 1
Philosopher 1 is Eating
Philosopher 3 takes fork 2 and 3
Philosopher 3 is Eating
Philosopher 1 putting fork 5 and 1 down
Philosopher 1 is thinking
Philosopher 5 takes fork 4 and 5
Philosopher 5 is Eating
Philosopher 2 is Hungry
Philosopher 3 putting fork 2 and 3 down
Philosopher 3 is thinking
Philosopher 2 takes fork 1 and 2
Philosopher 2 is Eating
Philosopher 1 is Hungry
Philosopher 5 putting fork 4 and 5 down
Philosopher 5 is thinking
Philosopher 4 takes fork 3 and 4
Philosopher 4 is Eating
Philosopher 3 is Hungry
Philosopher 2 putting fork 1 and 2 down
Philosopher 2 is thinking
Philosopher 1 takes fork 5 and 1
Philosopher 1 is Eating
```

7

Question:

Write a C program to simulate Bankers algorithm for the purpose of deadlock avoidance.

Code:

```
#include <stdio.h>

int main()
{
   int n, m, i, j, k;
   printf("Enter the number of processes: ");
   scanf("%d", &n);
   printf("Enter the number of resources: ");
   scanf("%d", &m);

   int allocation[n][m];
   printf("Enter the Allocation Matrix:\n");
   for (i = 0; i < n; i++)
   {
      for (j = 0; j < m; j++)
      {
         scanf("%d", &allocation[i][j]);
      }
   }

   int max[n][m];
   printf("Enter the MAX Matrix:\n");
   for (i = 0; i < n; i++)
   {
      for (j = 0; j < m; j++)
      {
         scanf("%d", &max[i][j]);
      }
   }

   int available[m];
   printf("Enter the Available Resources:\n");
   for (i = 0; i < m; i++)
```

```
{
   scanf("%d", &available[i]);
}

int f[n], ans[n], ind = 0;
for (k = 0; k < n; k++)
{
   f[k] = 0;
}

int need[n][m];
for (i = 0; i < n; i++)
{
   for (j = 0; j < m; j++)
   {
      need[i][j] = max[i][j] - allocation[i][j];
   }
}

int y = 0;
for (k = 0; k < n; k++)
{
   for (i = 0; i < n; i++)
   {
      if (f[i] == 0)
      {
         int flag = 0;
         for (j = 0; j < m; j++)
         {
            if (need[i][j] > available[j])
            {
               flag = 1;
               break;
            }
         }

         if (flag == 0)
         {
            ans[ind++] = i;
            for (y = 0; y < m; y++)
```

```
                {
                    available[y] += allocation[i][y];
                }
                f[i] = 1;
            }
        }
    }

    int flag = 1;
    for (i = 0; i < n; i++)
    {
        if (f[i] == 0)
        {
            flag = 0;
            printf("The following system is not safe\n");
            break;
        }
    }

    if (flag == 1)
    {
        printf("Following is the SAFE Sequence\n");
        for (i = 0; i < n - 1; i++)
        {
            printf(" P%d ->", ans[i]);
        }
        printf(" P%d\n", ans[n - 1]);
    }
    return 0;
}
```

Output:

```
Enter the number of processes: 5
Enter the number of resources: 3
Enter the Allocation Matrix:
0 1 0
2 0 0
3 0 2
2 1 1
0 0 2
Enter the MAX Matrix:
7 5 3
3 2 2
9 0 2
2 2 2
4 3 3
Enter the Available Resources:
3 3 2
Following is the SAFE Sequence
 P1 -> P3 -> P4 -> P0 -> P2
```

```
Enter the number of processes: 5
Enter the number of resources: 3
Enter the Allocation Matrix:
0 2 0
2 0 0
3 0 2
2 1 1
0 0 2
Enter the MAX Matrix:
8 4 6
3 5 7
3 6 7
9 5 3
2 5 7
Enter the Available Resources:
3 2 2
The following system is not safe
```

8

Question:

Write a C program to simulate deadlock detection.

Code:

```
#include<stdio.h>

int max[100][100];
int allocation[100][100];
int need[100][100];
int available[100];
int n,r;

int main()
{
   int i,j;
   printf("Deadlock Detection\n");
   input();
   show();
   cal();
   return 0;
}

void input()
{
   int i,j;
   printf("Enter the no of Processes: ");
   scanf("%d",&n);
   printf("Enter the no of resource instances: ");
   scanf("%d",&r);
   printf("Enter the Max Matrix:\n");
   for(i=0;i<n;i++)
   {
      for(j=0;j<r;j++)
      {
         scanf("%d",&max[i][j]);
      }
   }
   printf("Enter the Allocation Matrix:\n");
```

```
    for(i=0;i<n;i++)
    {
        for(j=0;j<r;j++)
        {
            scanf("%d",&allocation[i][j]);
        }
    }
    printf("Enter the available Resources:\n");
    for(j=0;j<r;j++)
    {
        scanf("%d",&available[j]);
    }
}

void show()
{
    int i,j;
    printf("Process\t Allocation\t Max\t Available\t");
    for(i=0;i<n;i++)
    {
        printf("\nP%d\t   ",i+1);
        for(j=0;j<r;j++)
        {
            printf("%d ",allocation[i][j]);
        }
        printf("\t");
        for(j=0;j<r;j++)
        {
            printf("%d ",max[i][j]);
        }
        printf("\t");
        if(i==0)
        {
            for(j=0;j<r;j++)
            printf("%d ",available[j]);
        }
    }
}

void cal()
```

```
{
   int finish[100],temp,need[100][100],flag=1,k,c1=0;
   int dead[100];
   int safe[100];
   int i,j;
   for(i=0;i<n;i++)
   {
      finish[i]=0;
   }

   for(i=0;i<n;i++)
   {
      for(j=0;j<r;j++)
      {
         need[i][j]=max[i][j]-allocation[i][j];
      }
   }
   while(flag)
   {
      flag=0;
      for(i=0;i<n;i++)
      {
         int c=0;
         for(j=0;j<r;j++)
         {
            if((finish[i]==0)&&(need[i][j]<=available[j]))
            {
               c++;
               if(c==r)
               {
                  for(k=0;k<r;k++)
                  {
                     available[k]+=allocation[i][j];
                     finish[i]=1;
                     flag=1;
                  }
                  if(finish[i]==1)
                  {
                     i=n;
                  }
```

```
                }
            }
        }
    }
}

j=0;
flag=0;
for(i=0;i<n;i++)
{
    if(finish[i]==0)
    {
        dead[j]=i;
        j++;
        flag=1;
    }
}
if(flag==1)
{
    printf("\n\nSystem is in Deadlock and the Deadlock process are\n");
    for(i=0;i<n;i++)
    {
        printf("P%d\t",dead[i]);
    }
}
else
{
    printf("\nNo Deadlock Occur");
}
}
```

Output:

```
Deadlock Detection
Enter the no of Processes: 3
Enter the no of resource instances: 3
Enter the Max Matrix:
3 6 8
4 3 3
3 4 4
Enter the Allocation Matrix:
3 3 3
2 0 4
1 2 4
Enter the available Resources:
1 2 0
Process  Allocation      Max     Available
P0         3 3 3        3 6 8   1 2 0
P1         2 0 4        4 3 3
P2         1 2 4        3 4 4

System is in Deadlock and the Deadlock process are
P0      P1      P2
```

```
Deadlock Detection
Enter the no of Processes: 5
Enter the no of resource instances: 3
Enter the Max Matrix:
0 0 0
2 0 2
0 0 0
1 0 0
0 0 2
Enter the Allocation Matrix:
0 1 0
2 0 0
3 0 3
3 1 1
0 0 2
Enter the available Resources:
0 0 0
Process  Allocation      Max     Available
P0         0 1 0        0 0 0   0 0 0
P1         2 0 0        2 0 2
P2         3 0 3        0 0 0
P3         3 1 1        1 0 0
P4         0 0 2        0 0 2
No Deadlock Occur
```

9

Question:

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

(a) Worst-fit

(b) Best-fit

(c) First-fit

Code:

```
#include <stdio.h>

#define max 25

void firstFit(int b[], int nb, int f[], int nf);
void worstFit(int b[], int nb, int f[], int nf);
void bestFit(int b[], int nb, int f[], int nf);

int main()
{
   int b[max], f[max], nb, nf;

   printf("Memory Management Schemes\n");

   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 (int i = 1; i <= nb; i++)
   {
      printf("Block %d:", i);
      scanf("%d", &b[i]);
   }

   printf("\nEnter the size of the files:\n");
   for (int i = 1; i <= nf; i++)
```

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

    printf("\nMemory Management Scheme - First Fit");
    firstFit(b, nb, f, nf);

    printf("\n\nMemory Management Scheme - Worst Fit");
    worstFit(b, nb, f, nf);

    printf("\n\nMemory Management Scheme - Best Fit");
    bestFit(b, nb, f, nf);

    return 0;
}

void firstFit(int b[], int nb, int f[], int nf)
{
    int bf[max] = {0};
    int ff[max] = {0};
    int frag[max], i, j;

    for (i = 1; i <= nf; i++)
    {
        for (j = 1; j <= nb; j++)
        {
            if (bf[j] != 1 && b[j] >= f[i])
            {
                ff[i] = j;
                bf[j] = 1;
                frag[i] = b[j] - f[i];
                break;
            }
        }
    }

    printf("\nFile_no:\tFile_size:\tBlock_no:\tBlock_size:\tFragment");
    for (i = 1; i <= nf; i++)
    {
```

```
        printf("\n%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(int b[], int nb, int f[], int nf)
{
    int bf[max] = {0};
    int ff[max] = {0};
    int frag[max], i, j, temp, highest = 0;

    for (i = 1; i <= nf; i++)
    {
        for (j = 1; j <= nb; j++)
        {
            if (bf[j] != 1)
            {
                temp = b[j] - f[i];
                if (temp >= 0 && 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:\tFragment");
    for (i = 1; i <= nf; i++)
    {
        printf("\n%d\t\t%d\t\t%d\t\t%d\t\t%d", i, f[i], ff[i], b[ff[i]], frag[i]);
    }
}

void bestFit(int b[], int nb, int f[], int nf)
{
    int bf[max] = {0};
    int ff[max] = {0};
```

```
    int frag[max], i, j, temp, lowest = 10000;

    for (i = 1; i <= nf; i++)
    {
        for (j = 1; j <= nb; j++)
        {
            if (bf[j] != 1)
            {
                temp = b[j] - f[i];
                if (temp >= 0 && 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("\n%d\t\t%d\t\t%d\t\t%d\t\t%d", i, f[i], ff[i], b[ff[i]], frag[i]);
    }
}
```

Output:

```
Memory Management Schemes

Enter the number of blocks:3
Enter the number of files:2

Enter the size of the blocks:
Block 1:5
Block 2:2
Block 3:7

Enter the size of the files:
File 1:1
File 2:4

Memory Management Scheme - First Fit
File_no:        File_size:      Block_no:       Block_size:     Fragment
1               1               1               5               4
2               4               3               7               3

Memory Management Scheme - Worst Fit
File_no:        File_size:      Block_no:       Block_size:     Fragment
1               1               3               7               6
2               4               1               5               1

Memory Management Scheme - Best Fit
File_no:        File_size:      Block_no:       Block_size:     Fragment
1               1               2               2               1
2               4               1               5               1
```

10

Question:

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

Code:

```
#include<stdio.h>
#define MAX 50
int main()
{
   int page[MAX],i,n,f,ps,off,pno;
   int choice=0;
   printf("Enter the number of pages in memory: ");
   scanf("%d",&n);
   printf("\nEnter Page size: ");
   scanf("%d",&ps);

   printf("\nEnter number of frames: ");
   scanf("%d",&f);
   for(i=0;i<n;i++)
      page[i]=-1;

   printf("\nEnter the Page Table\n");
   printf("(Enter frame no as -1 if that page is not present in any frame)\n\n");

   printf("\nPage No\t\tFrame No\n-------\t\t-------");
   for(i=0;i<n;i++)
   {
      printf("\n\n%d\t\t",i);
      scanf("%d",&page[i]);
   }

   do
   {
      printf("\n\nEnter the logical address(i.e,page no & offset):");
      scanf("%d%d",&pno,&off);

      if(page[pno]==-1)
         printf("\n\nThe required page is not available in any of frames");
      else
```

```
        printf("\nPhysical address(i.e,frame no & offset):%d,%d",page[pno],off);

      printf("\n\nDo you want to continue(1/0)?:");
      scanf("%d",&choice);
   }while(choice==1);

   return 1;
}
```

Output:

```
Enter the number of pages in memory: 4

Enter Page size: 10

Enter number of frames: 4

Enter the Page Table
(Enter frame no as -1 if that page is not present in any frame)


Page No         Frame No
-------         -------

0               -1


1               8


2               5


3               2
```

```
Enter the logical address(i.e,page no & offset):0 100

The required page is not available in any of frames

Do you want to continue(1/0)?:1

Enter the logical address(i.e,page no & offset):1 25

Physical address(i.e,frame no & offset):8,25

Do you want to continue(1/0)?:1

Enter the logical address(i.e,page no & offset):2 352

Physical address(i.e,frame no & offset):5,352

Do you want to continue(1/0)?:1

Enter the logical address(i.e,page no & offset):3 20

Physical address(i.e,frame no & offset):2,20

Do you want to continue(1/0)?:0
```

11

Question:

Write a C program to simulate page replacement algorithms:

(a) FIFO

(b) LRU

(c) Optimal

Code:

```
#include<stdio.h>
int n, nf, i, j, k;
int in[100];
int p[50];
int hit=0;
int pgfaultcnt=0;

void getData()
{
   printf("\nEnter length of page reference sequence:");
   scanf("%d",&n);
   printf("\nEnter the page reference sequence:");
   for(i=0; i<n; i++)
      scanf("%d",&in[i]);
   printf("\nEnter no of frames:");
   scanf("%d",&nf);
}

void initialize()
{
   pgfaultcnt=0;
   for(i=0; i<nf; i++)
      p[i]=9999;
}

int isHit(int data)
{
   hit=0;
   for(j=0; j<nf; j++)
   {
```

```
        if(p[j]==data)
        {
            hit=1;
            break;
        }
    }
    return hit;
}

int getHitIndex(int data)
{
    int hitind;
    for(k=0; k<nf; k++)
    {
        if(p[k]==data)
        {
            hitind=k;
            break;
        }
    }
    return hitind;
}

void dispPages()
{
    for (k=0; k<nf; k++)
    {
        if(p[k]!=9999)
            printf(" %d",p[k]);
    }
}

void dispPgFaultCnt()
{
    printf("\nTotal no of page faults:%d",pgfaultcnt);
}

void fifo()
{
    initialize();
```

```
    for(i=0; i<n; i++)
    {
        printf("\nFor %d :",in[i]);

        if(isHit(in[i])==0)
        {

            for(k=0; k<nf-1; k++)
                p[k]=p[k+1];

            p[k]=in[i];
            pgfaultcnt++;
            dispPages();
        }
        else
            printf("No page fault");
    }
    dispPgFaultCnt();
}


void optimal()
{
    initialize();
    int near[50];
    for(i=0; i<n; i++)
    {

        printf("\nFor %d :",in[i]);

        if(isHit(in[i])==0)
        {

            for(j=0; j<nf; j++)
            {
                int pg=p[j];
                int found=0;
                for(k=i; k<n; k++)
                {
                    if(pg==in[k])
```

```
                {
                    near[j]=k;
                    found=1;
                    break;
                }
                else
                    found=0;
            }
            if(!found)
                near[j]=9999;
        }
        int max=-9999;
        int repindex;
        for(j=0; j<nf; j++)
        {
            if(near[j]>max)
            {
                max=near[j];
                repindex=j;
            }
        }
        p[repindex]=in[i];
        pgfaultcnt++;

        dispPages();
      }
      else
        printf("No page fault");
   }
   dispPgFaultCnt();
}

void lru()
{
   initialize();

   int least[50];
   for(i=0; i<n; i++)
   {
```

```
printf("\nFor %d :",in[i]);

if(isHit(in[i])==0)
{

   for(j=0; j<nf; j++)
   {
      int pg=p[j];
      int found=0;
      for(k=i-1; k>=0; k--)
      {
         if(pg==in[k])
         {
            least[j]=k;
            found=1;
            break;
         }
         else
            found=0;
      }
      if(!found)
         least[j]=-9999;
   }
   int min=9999;
   int repindex;
   for(j=0; j<nf; j++)
   {
      if(least[j]<min)
      {
         min=least[j];
         repindex=j;
      }
   }
   p[repindex]=in[i];
   pgfaultcnt++;

   dispPages();
}
else
   printf("No page fault!");
```

```
    }
    dispPgFaultCnt();
}

int main()
{
    int choice;
    while(1)
    {
        printf("\nPage Replacement Algorithms\n1.Enter data\n2.FIFO\n3.Optimal\n4.LRU\n5.Exit\nEnter your choice:");
        scanf("%d",&choice);
        switch(choice)
        {
        case 1: getData();
                break;
        case 2: fifo();
                break;
        case 3: optimal();
                break;
        case 4: lru();
                break;
        default: return 0;
                 break;
        }
    }
}
```

Output:

(a) Enter Data:

```
Page Replacement Algorithms
1.Enter data
2.FIFO
3.Optimal
4.LRU
5.Exit
Enter your choice:1

Enter length of page reference sequence:8

Enter the page reference sequence:2 3 4 2 3 5 6 2

Enter no of frames:3
```

(b) FIFO:

```
Page Replacement Algorithms
1.Enter data
2.FIFO
3.Optimal
4.LRU
5.Exit
Enter your choice:2

For 2 : 2
For 3 : 2 3
For 4 : 2 3 4
For 2 :No page fault
For 3 :No page fault
For 5 : 3 4 5
For 6 : 4 5 6
For 2 : 5 6 2
Total no of page faults:6
```

(c) OPTIMAL:

```
Page Replacement Algorithms
1.Enter data
2.FIFO
3.Optimal
4.LRU
5.Exit
Enter your choice:3

For 2 : 2
For 3 : 2 3
For 4 : 2 3 4
For 2 :No page fault
For 3 :No page fault
For 5 : 2 5 4
For 6 : 2 6 4
For 2 :No page fault
Total no of page faults:5
```

(d) LRU:

```
Page Replacement Algorithms
1.Enter data
2.FIFO
3.Optimal
4.LRU
5.Exit
Enter your choice:4

For 2 : 2
For 3 : 2 3
For 4 : 2 3 4
For 2 :No page fault!
For 3 :No page fault!
For 5 : 2 3 5
For 6 : 6 3 5
For 2 : 6 2 5
Total no of page faults:6
```

12

Question:

Write a C program to simulate disk scheduling algorithms:

(a) FCFS

(b) SCAN

(c) c-SCAN

Code:

(a) FCFS:

```
#include<stdio.h>
#include<stdlib.h>
int main()
{
   int RQ[100],i,n,TotalHeadMoment=0,initial;
   printf("Enter the number of Requests\n");
   scanf("%d",&n);
   printf("Enter the Requests sequence\n");
   for(i=0;i<n;i++)
    scanf("%d",&RQ[i]);
   printf("Enter initial head position\n");
   scanf("%d",&initial);

   // logic for FCFS disk scheduling

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

   printf("Total head moment is %d",TotalHeadMoment);
   return 0;

}
```

(b) SCAN:

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

```
int main()
{
   int RQ[100],i,j,n,TotalHeadMoment=0,initial,size,move;
   printf("Enter the number of Requests\n");
   scanf("%d",&n);
   printf("Enter the Requests sequence\n");
   for(i=0;i<n;i++)
    scanf("%d",&RQ[i]);
   printf("Enter initial head position\n");
   scanf("%d",&initial);
   printf("Enter total disk size\n");
   scanf("%d",&size);
   printf("Enter the head movement direction for high 1 and for low 0\n");
   scanf("%d",&move);

   // logic for Scan disk scheduling

      /*logic for sort the request array */
   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 movement is towards high value
if(move==1)
{
    for(i=index;i<n;i++)
    {
        TotalHeadMoment=TotalHeadMoment+abs(RQ[i]-initial);
        initial=RQ[i];
    }
    //  last movement for max size
    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];

    }
}
// if movement is towards low value
else
{
    for(i=index-1;i>=0;i--)
    {
        TotalHeadMoment=TotalHeadMoment+abs(RQ[i]-initial);
        initial=RQ[i];
    }
    //  last movement for min size
    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);
```

```
    return 0;
}
```

(c) c-SCAN:

```
#include<stdio.h>
#include<stdlib.h>
int main()
{
    int RQ[100],i,j,n,TotalHeadMoment=0,initial,size,move;
    printf("Enter the number of Requests\n");
    scanf("%d",&n);
    printf("Enter the Requests sequence\n");
    for(i=0;i<n;i++)
     scanf("%d",&RQ[i]);
    printf("Enter initial head position\n");
    scanf("%d",&initial);
    printf("Enter total disk size\n");
    scanf("%d",&size);
    printf("Enter the head movement direction for high 1 and for low 0\n");
    scanf("%d",&move);

    // logic for C-Scan disk scheduling

        /*logic for sort the request array */
    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 movement is towards high value
if(move==1)
{
   for(i=index;i<n;i++)
   {
      TotalHeadMoment=TotalHeadMoment+abs(RQ[i]-initial);
      initial=RQ[i];
   }
   //  last movement for max size
   TotalHeadMoment=TotalHeadMoment+abs(size-RQ[i-1]-1);
   /*movement max to min disk */
   TotalHeadMoment=TotalHeadMoment+abs(size-1-0);
   initial=0;
   for( i=0;i<index;i++)
   {
       TotalHeadMoment=TotalHeadMoment+abs(RQ[i]-initial);
       initial=RQ[i];

   }
}
// if movement is towards low value
else
{
   for(i=index-1;i>=0;i--)
   {
      TotalHeadMoment=TotalHeadMoment+abs(RQ[i]-initial);
      initial=RQ[i];
   }
   //  last movement for min size
```

```
        TotalHeadMoment=TotalHeadMoment+abs(RQ[i+1]-0);
        /*movement min to max disk */
        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);
    return 0;
}
```

Output:

(a) FCFS:

```
Enter the number of Requests
8
Enter the Requests sequence
95 180 34 119 11 123 62 64
Enter initial head position
50
Total head moment is 644
```

(b) SCAN:

```
Enter the number of Requests
6
Enter the Requests sequence
90 120 30 60 50 80
Enter initial head position
70
Enter total disk size
200
Enter the head movement direction for high 1 and for low 0
0
Total head movement is 190
```

(c) C-SCAN:

```
Enter the number of Requests
3
Enter the Requests sequence
2 1 0
Enter initial head position
1
Enter total disk size
3
Enter the head movement direction for high 1 and for low 0
1
Total head movement is 4
```

13

Question:

Write a C program to simulate disk scheduling algorithms:

(a) SSTF

(b) LOOK

(c) C-LOOK

Code:

(a) SSTF:

```
#include<stdio.h>
#include<stdlib.h>
int main()
{
   int RQ[100],i,n,TotalHeadMoment=0,initial,count=0;
   printf("Enter the number of Requests\n");
   scanf("%d",&n);
   printf("Enter the Requests sequence\n");
   for(i=0;i<n;i++)
    scanf("%d",&RQ[i]);
   printf("Enter initial head position\n");
   scanf("%d",&initial);

   // logic for sstf disk scheduling

      /* loop will execute until all process is completed*/
   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];
        // 1000 is for max
        // you can use any number
        RQ[index]=1000;
        count++;
    }

    printf("Total head movement is %d",TotalHeadMoment);
    return 0;
}
```

(b) <u>LOOK</u>:

```
#include<stdio.h>
#include<stdlib.h>
int main()
{
    int RQ[100],i,j,n,TotalHeadMoment=0,initial,size,move;
    printf("Enter the number of Requests\n");
    scanf("%d",&n);
    printf("Enter the Requests sequence\n");
    for(i=0;i<n;i++)
     scanf("%d",&RQ[i]);
    printf("Enter initial head position\n");
    scanf("%d",&initial);
    printf("Enter total disk size\n");
    scanf("%d",&size);
    printf("Enter the head movement direction for high 1 and for low 0\n");
    scanf("%d",&move);

    // logic for look disk scheduling

        /*logic for sort the request array */
    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 movement is towards high value
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];

    }
}
// if movement is towards low value
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);
    return 0;
}
```

(c) c-LOOK:

```
#include<stdio.h>
#include<stdlib.h>
int main()
{
   int RQ[100],i,j,n,TotalHeadMoment=0,initial,size,move;
   printf("Enter the number of Requests\n");
   scanf("%d",&n);
   printf("Enter the Requests sequence\n");
   for(i=0;i<n;i++)
    scanf("%d",&RQ[i]);
   printf("Enter initial head position\n");
   scanf("%d",&initial);
   printf("Enter total disk size\n");
   scanf("%d",&size);
   printf("Enter the head movement direction for high 1 and for low 0\n");
   scanf("%d",&move);

   // logic for C-look disk scheduling

      /*logic for sort the request array */
   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 movement is towards high value
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];

    }
}
// if movement is towards low value
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);
```

```
    return 0;
}
```

Output:

(a) SSTF:

```
Enter the number of Requests
8
Enter the Requests sequence
95 180 34 119 11 123 62 64
Enter initial head position
50
Total head movement is 236
```

(b) LOOK:

```
Enter the number of Requests
3
Enter the Requests sequence
2 1 0
Enter initial head position
1
Enter total disk size
3
Enter the head movement direction for high 1 and for low 0
1
Total head movement is 3
```

(c) c-LOOK:

```
Enter the number of Requests
3
Enter the Requests sequence
2 1 0
Enter initial head position
1
Enter total disk size
3
Enter the head movement direction for high 1 and for low 0
1
Total head movement is 4
```