VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

LAB REPORT on

Operating Systems

(22CS4PCOPS)

Submitted by:

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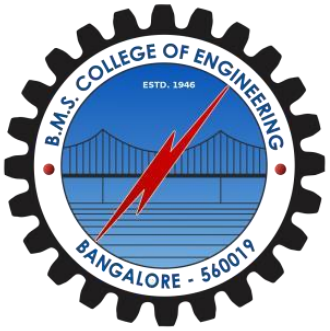
in partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

in

COMPUTER SCIENCE AND ENGINEERING



B.M.S. COLLEGE OF ENGINEERING

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CERTIFICATE

This is to certify that the Lab work entitled "**Operating Systems**" carried out by **Chandrasekhar Patil(1BM21CS043),** 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 year 2022-23. The Lab report has been approved as it satisfies the academic requirements in respect of **Operating Systems - (22CS4PCOPS)** work prescribed for the said degree.

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1. Course Outcomes

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.

2. Experiments 2.1

Experiment - 1

2.1.1 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

2.1.2 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_around_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],Turn_aroun
d_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;
}
```

2.1.3 Output:

```
Enter the total number of processes:3

Enter Burst Time:
P[1]:5
P[2]:12
P[3]:19

-----MAIN MENU-----
1. FCFS Scheduling
2. SJF Scheduling

Enter your choice:1

Process         Burst Time              Waiting Time            Turnaround Time
P[1]            5                       0                               5
P[2]            12                      5                               17
P[3]            19                      17                              36
Average Waiting Time:7.33
Average Turnaround Time:19.33

-----MAIN MENU-----
1. FCFS Scheduling
2. SJF Scheduling

Enter your choice:2

Process         Burst Time              Waiting Time            Turnaround Time
P[1]            5                       0                               5
P[2]            12                      5                               17
P[3]            19                      17                              36

Average Waiting Time=7.333333
Average Turnaround Time=19.333334
```

```
Enter the total number of processes:3

Enter Burst Time:
P[1]:19
P[2]:5
P[3]:12

-----MAIN MENU-----
1. FCFS Scheduling
2. SJF Scheduling

Enter your choice:1

Process         Burst Time              Waiting Time            Turnaround Time
P[1]            19                      0                               19
P[2]            5                       19                              24
P[3]            12                      24                              36
Average Waiting Time:14.33
Average Turnaround Time:26.33

-----MAIN MENU-----
1. FCFS Scheduling
2. SJF Scheduling

Enter your choice:2

Process         Burst Time              Waiting Time            Turnaround Time
P[2]            5                       0                               5
P[3]            12                      5                               17
P[1]            19                      17                              36

Average Waiting Time=7.333333
Average Turnaround Time=19.333334
```

2.2 Experiment - 2

2.2.1 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)

2.2.2 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;
}
```

2.2.3 Output:

(a) Priority (Non-pre-emptive)

```
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
```

(b) Round Robin (Non-pre-emptive)

```
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
```

2.3 Experiment - 3

2.3.1 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.

2.3.2 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;
}
```

2.3.3 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
```

2.4 Experiment - 4

2.4.1 Question:

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

2.4.2 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;
}
```

2.4.3 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
```

2.5 Experiment - 5

2.5.1 Question:

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

2.5.2 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);
}
```

2.5.3 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
```

2.6 Experiment - 6

2.6.1 Question:

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

2.6.2 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);
        }
}
```

2.6.3 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
```

2.7 Experiment - 7

2.7.1 Question:

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

2.7.2 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;
}
```

2.7.3 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
```

2.8 \Experiment - 8

2.8.1 Question:

Write a C program to simulate deadlock detection.

2.8.2 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");
   }
}
```

2.8.3 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
```

2.9 Experiment - 9

2.9.1 Question:

Write a C program to simulate the following contiguous memory allocation techniques: **(a)** Worst-fit

(b) Best-fit

(c) First-fit

2.9.2 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]);
}
}
```

2.9.3 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
```

2.10 Experiment - 10

2.10.1 Question:

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

2.10.2 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;
}
```

2.10.3 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
```

2.11 Experiment - 11

2.11.1 Question:

Write a C program to simulate page replacement algorithms:

(a) FIFO

(b) LRU

(c) Optimal

2.11.2 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;
        }
    }
}
```

2.11.3 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
```

2.12 Experiment - 12

2.12.1 Question:

Write a C program to simulate the following file allocation strategies: **(a)** Sequential

(b) Indexed

(c) Linked

2.12.2 Code:

(a) <u>Sequential</u>:

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

struct fileTable {
char name[20];
int sb, nob; }
ft[30];

void main() {
   int i, j, n; char s[20];
printf("Enter no of files  :");
   scanf("%d",&n);
   for(i=0;i<n;i++)
   {
      printf("\nEnter file name %d  :",i+1);
scanf("%s",ft[i].name);
      printf("Enter starting block of file %d  :",i+1);
scanf("%d",&ft[i].sb);              printf("Enter no of
blocks in file %d :",i+1);
scanf("%d",&ft[i].nob);
   }
   printf("\nEnter the file name to be searched -- ");
scanf("%s",s);        for(i=0;i<n;i++)
if(strcmp(s, ft[i].name)==0)
   break;
   if(i==n)
   printf("\nFile Not Found");
else
   {
      printf("\nFILE NAME   START BLOCK   NO OF BLOCKS   BLOCKS OCCUPIED\n");
printf("\n%s\t\t%d\t\t%d\t",ft[i].name,ft[i].sb,ft[i].nob);                  for(j=0;j<ft[i].nob;j++)
printf("%d, ",ft[i].sb+j);
   }
}
```

(b) Indexed:

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

struct fileTable
{     char name[20];
int nob, blocks[30];
}ft[30];

void main()
{
   int i, j, n; char s[20];
printf("Enter no of files  :");
   scanf("%d",&n);
   for(i=0;i<n;i++)
   {
      printf("\nEnter file name %d  :",i+1);
scanf("%s",ft[i].name);
      printf("Enter no of blocks in file %d :",i+1);
scanf("%d",&ft[i].nob);
      printf("Enter the blocks of the file    :");
for(j=0;j<ft[i].nob;j++)
scanf("%d",&ft[i].blocks[j]);
   }

   printf("\nEnter the file name to be searched -- ");
scanf("%s",s);  for(i=0;i<n;i++)

   if(strcmp(s, ft[i].name)==0)
   break;

   if(i==n)
      printf("\nFile Not Found");

else
   {
      printf("\nFILE NAME  NO OF BLOCKS   BLOCKS OCCUPIED");
      printf("\n    %s\t\t%d\t",ft[i].name,ft[i].nob);
for(j=0;j<ft[i].nob;j++)                printf("%d,
",ft[i].blocks[j]);       }
}
```

(c) Linked:

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

struct fileTable
{     char
name[20];     int
nob;     struct
block *sb;
}ft[30];

struct block
{            int
bno;
   struct block *next;
};

void main()
{       int i, j, n;       char s[20];
struct block *temp;
printf("Enter no of files  :");
scanf("%d",&n);
   for(i=0;i<n;i++)
   {
      printf("\nEnter file name %d  :",i+1);
scanf("%s",ft[i].name);
      printf("Enter no of blocks in file %d :",i+1);
scanf("%d",&ft[i].nob);

      ft[i].sb=(struct block*)malloc(sizeof(struct block));
temp = ft[i].sb;

      printf("Enter the blocks of the file    :");
      scanf("%d",&temp->bno);

      temp->next=NULL;

      for(j=1;j<ft[i].nob;j++)
      {
         temp->next = (struct block*)malloc(sizeof(struct block));
temp = temp->next;
```

```
            scanf("%d",&temp->bno);
        }

        temp->next = NULL;
    }
        printf("\nEnter the file name to be searched   --   ");
scanf("%s",s);          for(i=0;i<n;i++)
            if(strcmp(s, ft[i].name)==0)
break;

        if(i==n)
        printf("\nFile Not Found");

else
        {
            printf("\nFILE NAME  NO OF BLOCKS   BLOCKS OCCUPIED");
            printf("\n    %s\t\t%d\t",ft[i].name,ft[i].nob);
temp=ft[i].sb;
            for(j=0;j<ft[i].nob;j++)
            {
                printf("%d->",temp->bno);
temp = temp->next;
            }
        }
}
```

2.12.3 Output:

(a) Sequential:

```
Enter no of files  :3

Enter file name 1  :A
Enter starting block of file 1  :85
Enter no of blocks in file 1 :6

Enter file name 2  :B
Enter starting block of file 2  :102
Enter no of blocks in file 2 :4

Enter file name 3  :C
Enter starting block of file 3  :60
Enter no of blocks in file 3 :4

Enter the file name to be searched -- B

FILE NAME   START BLOCK   NO OF BLOCKS   BLOCKS OCCUPIED

B              102             4       102, 103, 104, 105,
```

(b) Indexed:

```
Enter no of files  :2

Enter file name 1  :A
Enter no of blocks in file 1 :4
Enter the blocks of the file    :12 23 9 4

Enter file name 2  :G
Enter no of blocks in file 2 :5
Enter the blocks of the file    :88 77 66 55 44

Enter the file name to be searched -- G

FILE NAME  NO OF BLOCKS   BLOCKS OCCUPIED
    G           5       88, 77, 66, 55, 44,
```

(c) Linked:

```
Enter no of files  :2

Enter file name 1  :A
Enter no of blocks in file 1 :4
Enter the blocks of the file    :12 23 9 4

Enter file name 2  :G
Enter no of blocks in file 2 :5
Enter the blocks of the file    :88 77 66 55 44

Enter the file name to be searched   --   G

FILE NAME  NO OF BLOCKS   BLOCKS OCCUPIED
    G           5       88->77->66->55->44->
```

2.13 Experiment - 13

2.13.1 Question:

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

(a) Single level directory

(b) Two level directory

(c) Hierarchical

2.13.2 Code:

(a) Single Level Directory:

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

struct {
   char dname[10],fname[10][10];
   int fcnt;
} dir;

void main()
{     int i,ch;
char f[30];
dir.fcnt = 0;
   printf("\nEnter name of directory -- ");
scanf("%s", dir.dname);

   while(1)
   {
      printf("\n\n1. Create File\t2. Delete File\t3. Search File \n4. Display Files\t5. Exit\nEnter
your choice -- ");
      scanf("%d",&ch);

      switch(ch)
      {
         case 1: printf("\nEnter the name of the file -- ");
scanf("%s",dir.fname[dir.fcnt]);
                 dir.fcnt++;
break;

         case 2: printf("\nEnter the name of the file -- ");
scanf("%s",f);                  for(i=0;i<dir.fcnt;i++)
                 {
```

```
                if(strcmp(f, dir.fname[i])==0)
                {
                   printf("File %s is deleted ",f);
strcpy(dir.fname[i],dir.fname[dir.fcnt-1]);                    break;
                }
             }

             if(i==dir.fcnt)
                printf("File %s not found",f);
             else
dir.fcnt--;
break;

        case 3: printf("\nEnter the name of the file -- ");
             scanf("%s",f);
             for(i=0;i<dir.fcnt;i++)
             {
                if(strcmp(f, dir.fname[i])==0)
                {
                   printf("File %s is found ", f);
                   break;
                }
}
if(i==dir.fcnt)
                printf("File %s not found",f);
             break;

        case 4: if(dir.fcnt==0)
printf("\nDirectory Empty");
else                 {
                printf("\nThe Files are -- ");
for(i=0;i<dir.fcnt;i++)
                   printf("\t%s",dir.fname[i]);
             }
break;

        default: exit(0);
      }
   }
}
```

(b) <u>Two Level Directory:</u>

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

struct {
   char dname[10],fname[10][10];
   int fcnt;
}dir[10];

void main()
{     int i,ch,dcnt,k;
char f[30], d[30];
dcnt=0;

   while(1)
   {
      printf("\n1. Create Directory\t2. Create File\t3. Delete File");
printf("\n4. Search File\t\t5. Display\t6. Exit\nEnter your choice --");
scanf("%d",&ch);

   switch(ch)
   {
      case 1: printf("\nEnter name of directory -- ");
scanf("%s", dir[dcnt].dname);
            dir[dcnt].fcnt=0;
dcnt++;               printf("Directory
created");
            break;

      case 2: printf("\nEnter name of the directory -- ");
scanf("%s",d);               for(i=0;i<dcnt;i++)
               if(strcmp(d,dir[i].dname)==0)
               {
                  printf("Enter name of the file -- ");
scanf("%s",dir[i].fname[dir[i].fcnt]);
                  dir[i].fcnt++;
printf("File created");
                  break;
               }
if(i==dcnt)
               printf("Directory %s not found",d);
            break;
```

```
      case 3: printf("\nEnter name of the directory -- ");
scanf("%s",d);
            for(i=0;i<dcnt;i++)
            {
               if(strcmp(d,dir[i].dname)==0)
               {
                  printf("Enter name of the file -- ");
scanf("%s",f);
                  for(k=0;k<dir[i].fcnt;k++)
                  {
                     if(strcmp(f, dir[i].fname[k])==0)
                     {
                        printf("File %s is deleted ",f);
                        dir[i].fcnt--;
                        strcpy(dir[i].fname[k],dir[i].fname[dir[i].fcnt]);
goto jmp;
                     }
                  }

               printf("File %s not found",f);
               goto jmp;
            }
            }

            printf("Directory %s not found",d);
            jmp : break;

      case 4: printf("\nEnter name of the directory -- ");
scanf("%s",d);
            for(i=0;i<dcnt;i++)
            {
               if(strcmp(d,dir[i].dname)==0)
               {
                  printf("Enter the name of the file -- ");
                  scanf("%s",f);
                  for(k=0;k<dir[i].fcnt;k++)
                  {
                     if(strcmp(f, dir[i].fname[k])==0)
                     {
                        printf("File %s is found ",f);
goto jmp1;
```

```
                    }
                }
                printf("File %s not found",f);
                goto jmp1;
            }
        }
        printf("Directory %s not found",d);
        jmp1: break;

    case 5: if(dcnt==0)
printf("\nNo Directory's ");
        else
        {
            printf("\nDirectory\tFiles");
            for(i=0;i<dcnt;i++)
            {
                printf("\n%s\t\t",dir[i].dname);
for(k=0;k<dir[i].fcnt;k++)
                printf("\t%s",dir[i].fname[k]);
            }
}           break;
default:exit(0);
  }
}
}
```

(c) <u>Hierarchical</u>:

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

struct tree_element
{   char name[20];   int
x,y,ftype,lx,rx,nc,level;
struct tree_element *link[5];
};

typedef struct tree_element node;

void main() {
int gm;   node
```

```
*root;
root=NULL;
create(&root,0,
"root",0,639,3
20);

   //initgraph(&gd,&gm,"c:\\tc\\BGI");
   display(root);

   //closegraph();
}

create(node **root,int lev,char *dname,int lx,int rx,int x)
{
   int i,gap;
   if(*root==NULL)
   {
      (*root)=(node *)malloc(sizeof(node));

      printf("Enter name of dir/file(under %s) :",dname);
fflush(stdin);        gets((*root)->name);

      printf("enter 1 for Dir/2 forfile :");
      scanf("%d",&(*root)->ftype);

      (*root)->level=lev;
      (*root)->y=50+lev*50;
      (*root)->x=x;
      (*root)->lx=lx;
      (*root)->rx=rx;

      for(i=0;i<5;i++)
         (*root)->link[i]=NULL;

      if((*root)->ftype==1)
      {
         printf("No of sub directories/files(for %s):",(*root)->name);
scanf("%d",&(*root)->nc);            if((*root)->nc==0)
gap=rx-lx;
         else
            gap=(rx-lx)/(*root)->nc;
```

```
        for(i=0;i<(*root)->nc;i++)

create(&((*root)->link[i]),lev+1,(*root)->name,lx+gap*i,lx+gap*i+gap,lx+gap*i+gap/2);
      }

      else (*root)->nc=0;
   }
}

/*display(node *root)
{
   int i;
settextstyle(2,0,4);
settextjustify(1,1);
setfillstyle(1,BLUE);
   setcolor(14);

   if(root!=NULL)
   {
      for(i=0;i<root->nc;i++)
      {
         line(root->x,root->y,root->link[i]->x,root->link[i]->y);
      }

      if(root->ftype==1)
         bar3d(root->x-20,root->y-10,root->x+20,root->y+10,0,0);

      else
         fillellipse(root->x,root->y,20,20);

      outtextxy(root->x,root->y,root->name);

      for(i=0;i<root->nc;i++)
      {          display(root-
>link[i]);
      }
   }
}*/
```

2.13.3 Output:

(a) Single Level Directory:

```
Enter name of directory -- BMSCE


1. Create File  2. Delete File  3. Search File
4. Display Files        5. Exit
Enter your choice -- 1

Enter the name of the file -- CSE


1. Create File  2. Delete File  3. Search File
4. Display Files        5. Exit
Enter your choice -- 1

Enter the name of the file -- ISE


1. Create File  2. Delete File  3. Search File
4. Display Files        5. Exit
Enter your choice -- 4

The Files are --        CSE     ISE

1. Create File  2. Delete File  3. Search File
4. Display Files        5. Exit
Enter your choice -- 2

Enter the name of the file -- CSE
File CSE is deleted
```

```
1. Create File  2. Delete File  3. Search File
4. Display Files        5. Exit
Enter your choice -- 3

Enter the name of the file -- CSE
File CSE not found

1. Create File  2. Delete File  3. Search File
4. Display Files        5. Exit
Enter your choice -- 4

The Files are --        ISE

1. Create File  2. Delete File  3. Search File
4. Display Files        5. Exit
Enter your choice -- 5
```

(b) Two Level Directory:

```
1. Create Directory     2. Create File  3. Delete File
4. Search File          5. Display      6. Exit
Enter your choice --1

Enter name of directory -- BMSCE
Directory created
1. Create Directory     2. Create File  3. Delete File
4. Search File          5. Display      6. Exit
Enter your choice --2

Enter name of the directory -- BMSCE
Enter name of the file -- CSE
File created
1. Create Directory     2. Create File  3. Delete File
4. Search File          5. Display      6. Exit
Enter your choice --2

Enter name of the directory -- BMSCE
Enter name of the file -- ISE
File created
1. Create Directory     2. Create File  3. Delete File
4. Search File          5. Display      6. Exit
Enter your choice --5

Directory       Files
BMSCE                   CSE     ISE
```

```
1. Create Directory     2. Create File  3. Delete File
4. Search File          5. Display      6. Exit
Enter your choice --3

Enter name of the directory -- BMSCE
Enter name of the file -- CSE
File CSE is deleted
1. Create Directory     2. Create File  3. Delete File
4. Search File          5. Display      6. Exit
Enter your choice --4

Enter name of the directory -- BMSCE
Enter the name of the file -- CSE
File CSE not found
1. Create Directory     2. Create File  3. Delete File
4. Search File          5. Display      6. Exit
Enter your choice --6
```

2.14 Experiment - 14

2.14.1 Question:

Write a C program to simulate disk scheduling algorithms:

(a) FCFS

(b) SCAN

(c) c-SCAN

2.14.2 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) <u>c-SCAN:</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 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;
}
```

2.14.3 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
```

2.15 Experiment - 15

2.15.1 Question:

Write a C program to simulate disk scheduling algorithms:

(a) SSTF

(b) LOOK

(c) C-LOOK

2.15.2 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) 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 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) <u>c-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 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;
}
```

2.15.3 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
```