

VISVESVARAYA TECHNOLOGICAL UNIVERSITY

“JnanaSangama”, Belgaum -590014, Karnataka.



LAB REPORT

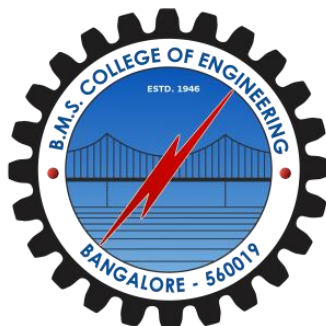
on

Operating Systems (22CS4PCOPS)

Submitted by:

Anoshor B. Paul (1BM21CS024)

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



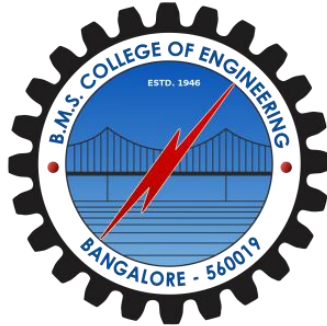
B.M.S. COLLEGE OF ENGINEERING

(Autonomous Institution under VTU)

BENGALURU-560019

June 2023 - August 2023

B. M. S. College of Engineering,
Bull Temple Road, Bangalore 560019
(Affiliated To Visvesvaraya Technological University, Belgaum)
Department of Computer Science and Engineering



CERTIFICATE

This is to certify that the Lab work entitled “**Operating Systems**” carried out by **Anoshor B. Paul (1BM21CS024)**, 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.

Prof. Basavaraj Jakkali
Associate Professor
Department of CSE
BMSCE, Bengaluru

Dr. Jyothi S Nayak
Professor and Head
Department of CSE
BMSCE, Bengaluru

Table Of Contents

S.No.	Experiment Title		Page No.
1	Course Outcomes		4
2	Experiments		
	2.1	Experiment - 1	4-8
	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 (pre-emptive & Non-pre-emptive)	
	2.1.2	Code	
	2.1.3	Output	
	2.2	Experiment - 2	9-14
	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	
	2.2.3	Output	
	2.3	Experiment – 3	15-18
	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	
	2.3.3	Output	

	2.4	Experiment - 4		19-27
		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	
		2.4.4	Output	
	2.5	Experiment - 5		28-30
		2.5.1	Question: Write a C program to simulate producer-consumer problem using semaphores.	
		2.5.2	Code	
		2.5.3	Output	
	2.6	Experiment - 6		31-33
		2.6.1	Question: Write a C program to simulate the concept of Dining-Philosophers problem.	
		2.6.2	Code	
		2.6.3	Output	
	2.7	Experiment - 7		34-37
		2.7.1	Question: Write a C program to simulate Bankers algorithm for the purpose of deadlock avoidance.	
		2.7.2	Code	
		2.7.3	Output	
	2.8	Experiment - 8		38-42
		2.8.1	Question: Write a C program to simulate deadlock detection.	
		2.8.2	Code	
		2.8.3	Output	
	2.9	Experiment - 9		39-42

	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	
	2.9.3	Output	
2.10	Experiment - 10		43-47
	2.10.1	Question: Write a C program to simulate page replacement algorithms: (a) FIFO (b) LRU (c) Optimal	
	2.10.2	Code	
	2.10.3	Output	
2.11	Experiment - 11		54-59
	2.11.1	Question: Write a C program to simulate disk scheduling algorithms: (a) FCFS (b) SCAN (c) C-SCAN	
	2.11.2	Code	
	2.11.3	Output	

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%d\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%d\t\t%d",process[i],Burst_time[i],Waiting_time[i],Turn_around_time[i]);
}

avg_Turn_around_time=(float)total/n;
printf("\n\nAverage Waiting Time=%f",avg_Waiting_time);
printf("\n\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) Priority (Non-pre-emptive)

```
#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%d\t%d\t%d\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("\n\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) Round Robin (Non-pre-emptive)

```

#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%d\t%d\tSystem\t%d\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%d\t%d\tUser\t%d\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 = 101010, 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%d\t%d\t%d\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%d\t%d\t%d\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%d\t%d\t%d\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 page replacement algorithms:

(a) FIFO

(b) LRU

(c) Optimal

2.10.2 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]=10101010;
}

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]!=10101010)
            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]=10101010;
            }
            int max=-10101010;
            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]=-10101010;
    }
    int min=10101010;
    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;
        }
    }
}

```

Algorithms\n1.Enter

```
}  
}
```

2.10.3 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

2.11 Experiment - 11

2.11.1 Question:

Write a C program to simulate disk scheduling algorithms:

- (a) FCFS
- (b) SCAN
- (c) c-SCAN

2.11.2 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) 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;
}

```

2.11.3 Output:

2.11.4

(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
```