VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

LAB REPORT

on

Operating Systems

(22CS4PCOPS)

Submitted by:

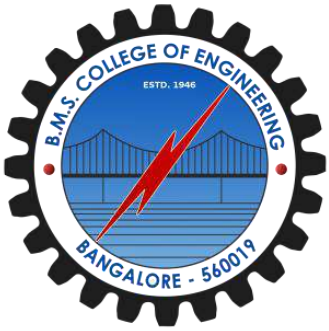
Sanchay Agrawal (1BM21CS186)

in partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

in

COMPUTER SCIENCE AND ENGINEERING



B.M.S. COLLEGE OF ENGINEERING

(Autonomous Institution under VTU)

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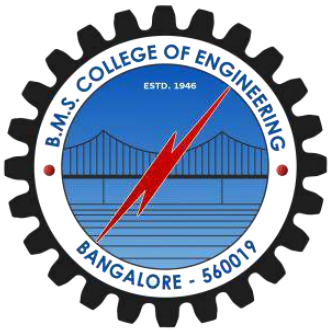
B. M. S. College of Engineering,
Bull Temple Road, Bangalore 560019
(Affiliated To Visvesvaraya Technological University, Belgaum)
Department of Computer Science and Engineering



CERTIFICATE

This is to certify that the Lab work entitled "**Operating Systems**" carried out by **Sanchay Agrawal (1BM21CS186),** 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.

Dr. Nandini Vineeth
Assistant Professor
Department of CSE
BMSCE, Bengaluru

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

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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();
```

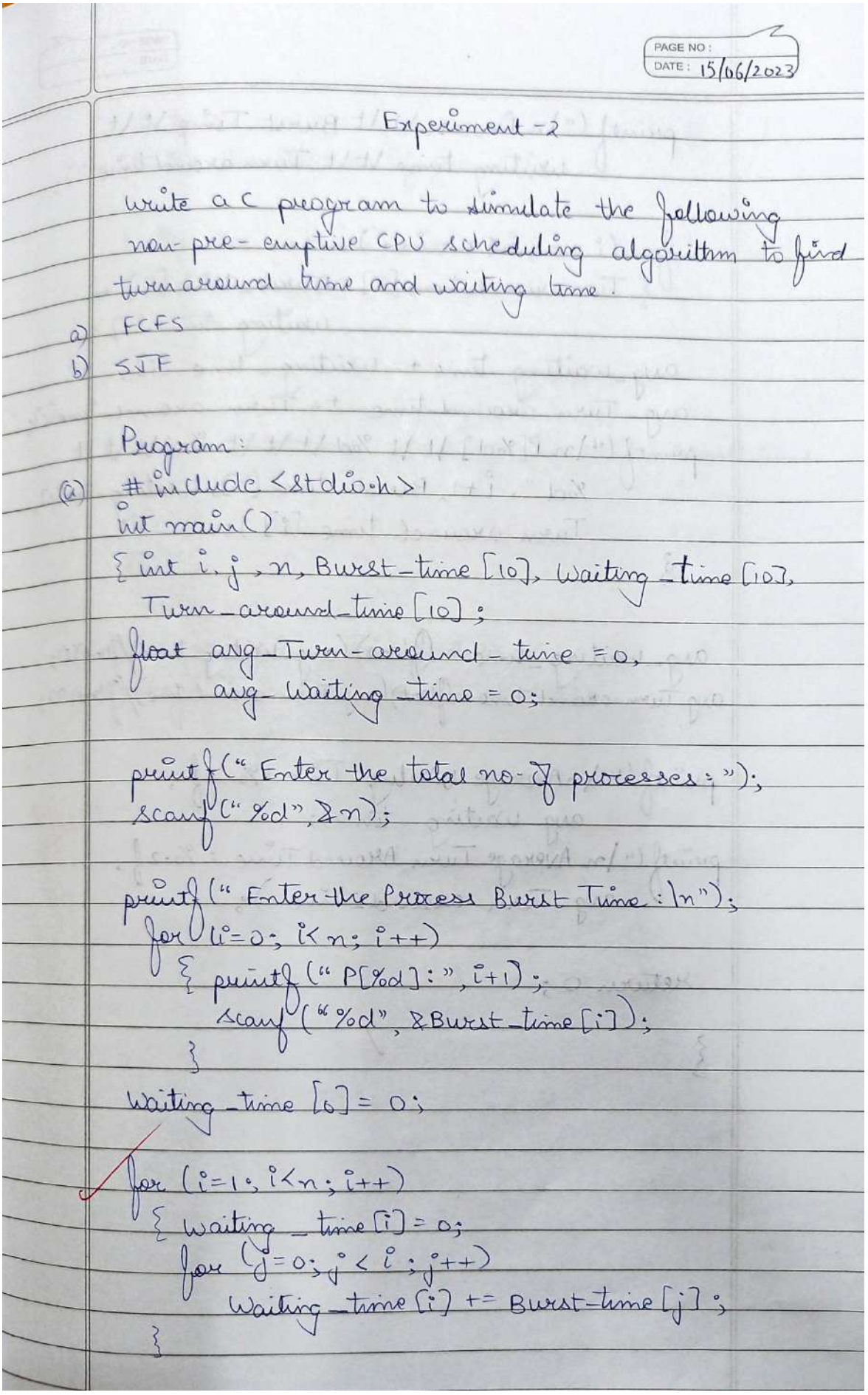
```
            break;

            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
```

2.1.4 Observation Book Pictures:



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Experiment -2

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

Program:

(a)
```
#include <stdio.h>
int main()
{ int i, j, n, Burst_time[10], waiting_time[10],
  Turn_around_time[10];
float avg_Turn-around_time = 0,
      avg_waiting_time = 0;

printf(" Enter the total no. of processes : ");
scanf(" %d", &n);

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

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("\n Process \t\t Burst Time \t\t
        waiting time \t\t Turn around time");

for (i=0; i<n; i++)
{ Turnaround_time[i] = Burst_time[i] +
                       waiting_time[i];
avg_waiting_time += waiting_time[i];
avg_Turn_around_time += Turn_around_time[i];
printf("\n P[%d] \t\t %d \t\t \t %d \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("\n Average Turn Around Time : %.2f",
        avg_Turn_around_time);

return 0;

}
```

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DATE :

Output:

Enter the total no. of processes : 3

Enter the process Burst time:

P[1] : 5

P[2] : 12

P[3] : 19

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

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(b)
```
#include<stdio.h>
{ int Burst_time[20], process[20],
    Waiting_time[20], Turn_around_time[20],
    i,j,n, total=0, pos, temp;

  float avg_Waiting_time, avg_Turn_around_time;

printf("Enter no. of processes:");
scanf("%d", &n);

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

//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("\n Process \t Burst Time \t waiting time
    \t Turn around time");
for (i=0; i<n; i++)
{ Turnaround_time[i] = Burst_time[i] +
                       waiting_time[i];

  total += Turn_around_time[i];
  printf("\n P[%d] \t \t %d \t \t %d \t \t \t %d",
      process[i], Burst_time[i], waiting_time[i],
      Turn_around_time[i]);
}

avg_Turn_around_time = (float) total/n;
printf("\n\n Average waiting Time = %f",
      avg_waiting_time);
printf("\n Average Turnaround Time = %f\n",
      avg_Turn_around_time);

}
```

Output:

Enter the no of processes : 3

Enter Burst Time:

P[1] : 19

P[2] : 5

P[3] : 12

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 : 7.333

Average Turnaround Time : 19.333

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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:

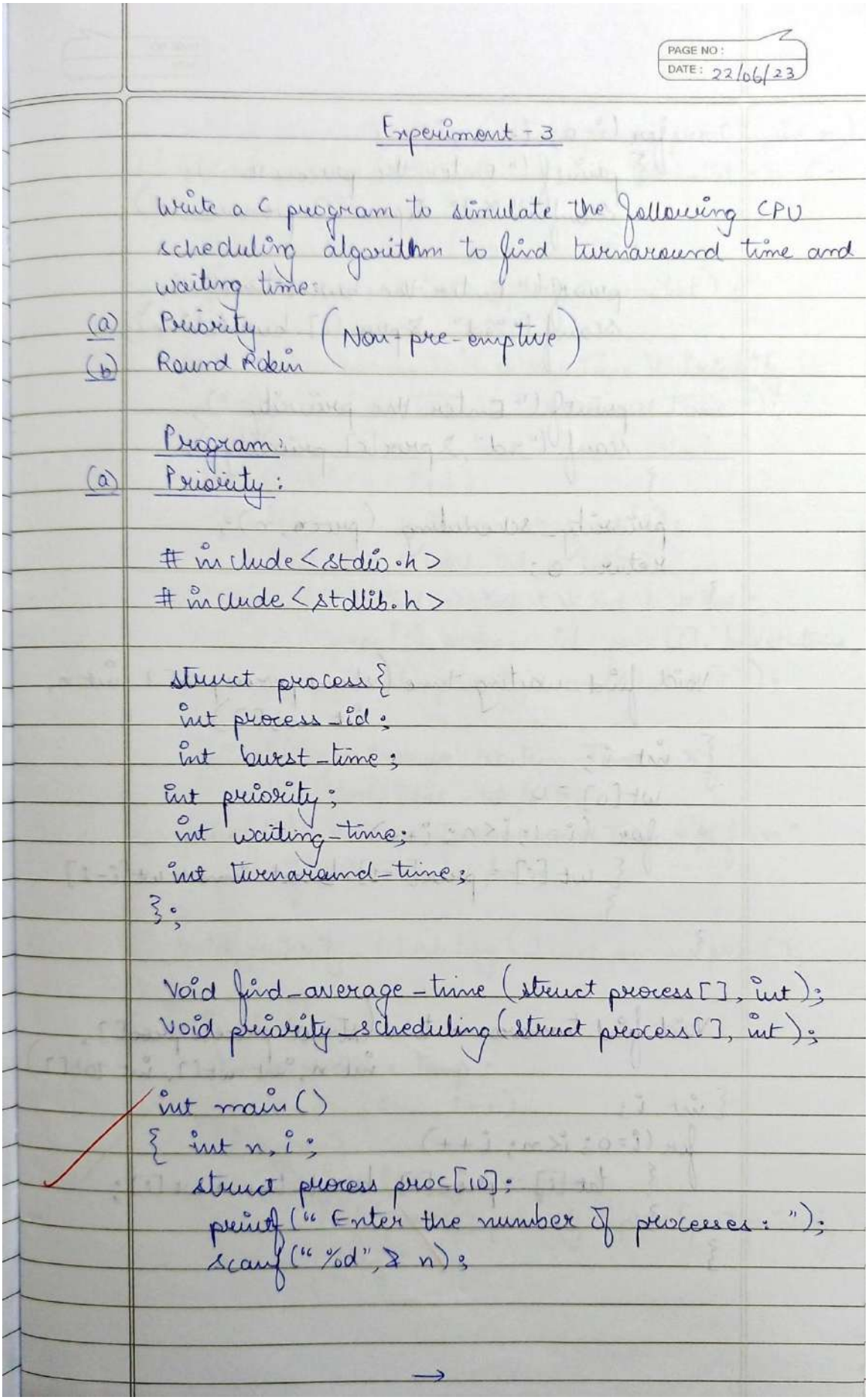
(a) Priority (Non-pre-emptive)

```
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
```

2.2.3 Observation Book Pictures:



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Experiment - 3

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

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

Program:

(a) Priority:

```
#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("Enter 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("\n Process ID\t Burst Time \t Priority \t
        Waiting Time \t Turnaround 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 ",
      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 Average 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);
}
```

Output:

Enter the number of processes: 3

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

Enter the process ID = 2
Enter the ~~process~~ 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 = 6.000
Average Turnaround Time = 13.666

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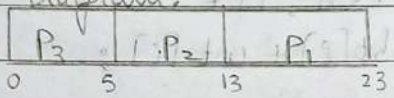
Traversal:

Processes	Burst time	Priority
P_1	10	3
P_2	8	2
P_3	5	1

Grant Diagram:



Waiting Time	Turnaround Time	Process ID
0	5	P3
5	13	P2
13	23	P1

Avg waiting Time = $\frac{0+5+13}{3}$ = 6.0000

Avg Turnaround Time = $\frac{5+13+23}{3}$ = 13.6666

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(b) Round Robin

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

int turnaroundtime (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 waiting time (int processes[], int n, int bt[],
                  int wt[], int tat[])
{ 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_bit[i] -= quantum;
        }
      else
      {t = t + rem_bt[i];
       wt[i] = t - bt[i];
       rem_bit[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);
  Turnaroundtime (processes, n, bt, wt, tat);

  printf ("\n\n Processes \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\t %d \t\t\t\t %d \t\t\t %d\n",
              i+1, bt[i], wt[i], tat[i]);
    }
  printf ("\n Average waiting Time = %f ",
          (float) total_wt / (float) n);
  printf ("\n Average 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("Enter the quantum time: ");
  scanf("%d", &quantum);

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

Output:

```
Enter the Number of Processes: 3

Enter the 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
```

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Processes	Burst Time	waiting Time	Turnaround Time
1	4	4	8
2	3	6	9
3	5	7	12

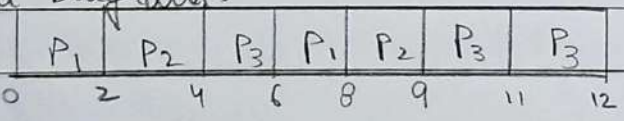
Average Waiting time : 5.6666
Average Turnaround time : 9.6666

Traversal:

Process	Burst time	waiting Time	Turnaround Time
P1	4	4	8
P2	3	6	9
P3	5	7	12

Quantum Time : 2

Grant Diagram :



Avg waiting Time : $\frac{4+6+7}{3} = 5.6666$

Avg Turnaround Time : $\frac{8+9+12}{3} = 9.6666$

N
23/6/23

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));
```

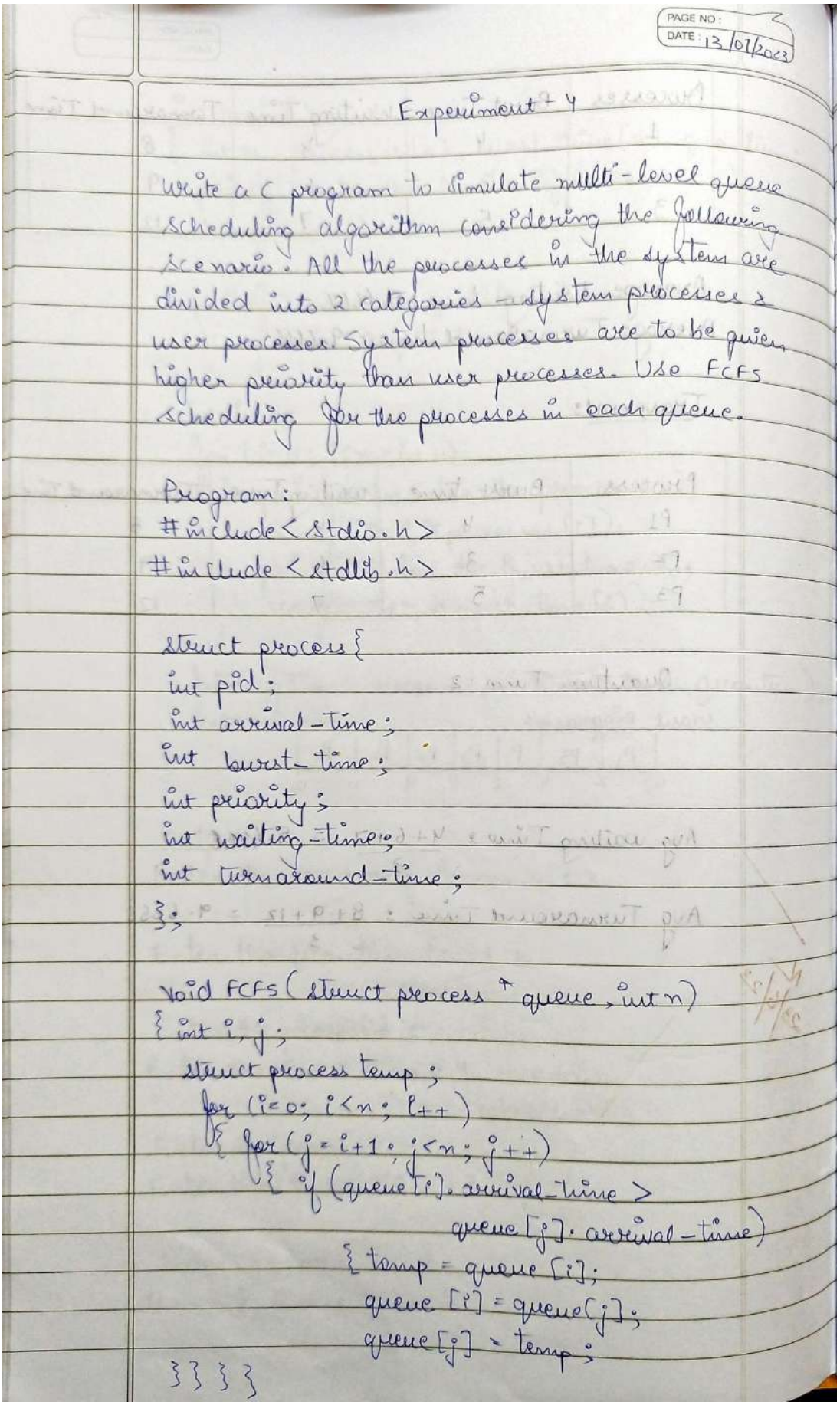
```
    user_queue = (struct process *) malloc(n * sizeof(struct process));

    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
```

2.3.4 Observation Book Pictures:



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Experiment - 4

Write a C program to simulate multi-level queue scheduling algorithm considering the following scenario. All the processes in the system are divided into 2 categories - system processes & user processes. System processes are to be given higher priority than user processes. Use FCFS scheduling for the processes in each queue.

Program:

```
#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].waiting_time;
    system_queue[s].turnaround_time = system_queue[s].
    avg_waiting_time   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\t Burst Time\t Priority\t Queue Type\t
      Waiting Time\t Turnaround Time\n");
for(i=0; i< system_n; i++)
   { printf("%d\t %d\t\t%d\t\t System\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\t User \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: %f\n",
            avg_waiting_time);          avg_turnaround_time
    printf("Average Turnaround Time: %f\n");

    return 0;

}
```

Output:

Enter the number of processes: 4

Enter arrival time, burst time, and priority (0-system/ 1-user) for process 1: 0 3 0

Enter arrival time, burst time, and priority (0-system/ 1-user) for process 2: 1 3 1

Enter arrival time, burst time and priority (0-system/ 1-user) for process 3: 8 3 0

Enter arrival time, burst time and priority (0-System/1-user) for process 4: 8 3 1

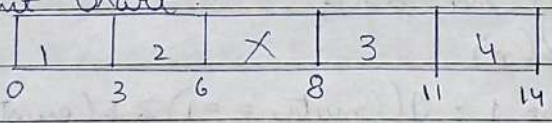
PID	Burst time	Priority	Queue Type	Waiting Time	Turnaround Time
1	3	0	System	0	3
3	3	0	System	0	3
2	3	1	User	2	5
4	3	1	User	3	6

Average waiting time = 1.25
Average Turnaround time = 4.25.

Traversal:

Process	System-0/user-1	arrival time	B.T	W.T	TAT
1	0	0	3	0	3
2	1	1	3	2	5
3	0	8	3	0	3
4	1	8	3	3	6

Gant Chart



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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]: |    |    |    |    |    |####|####|    |
```

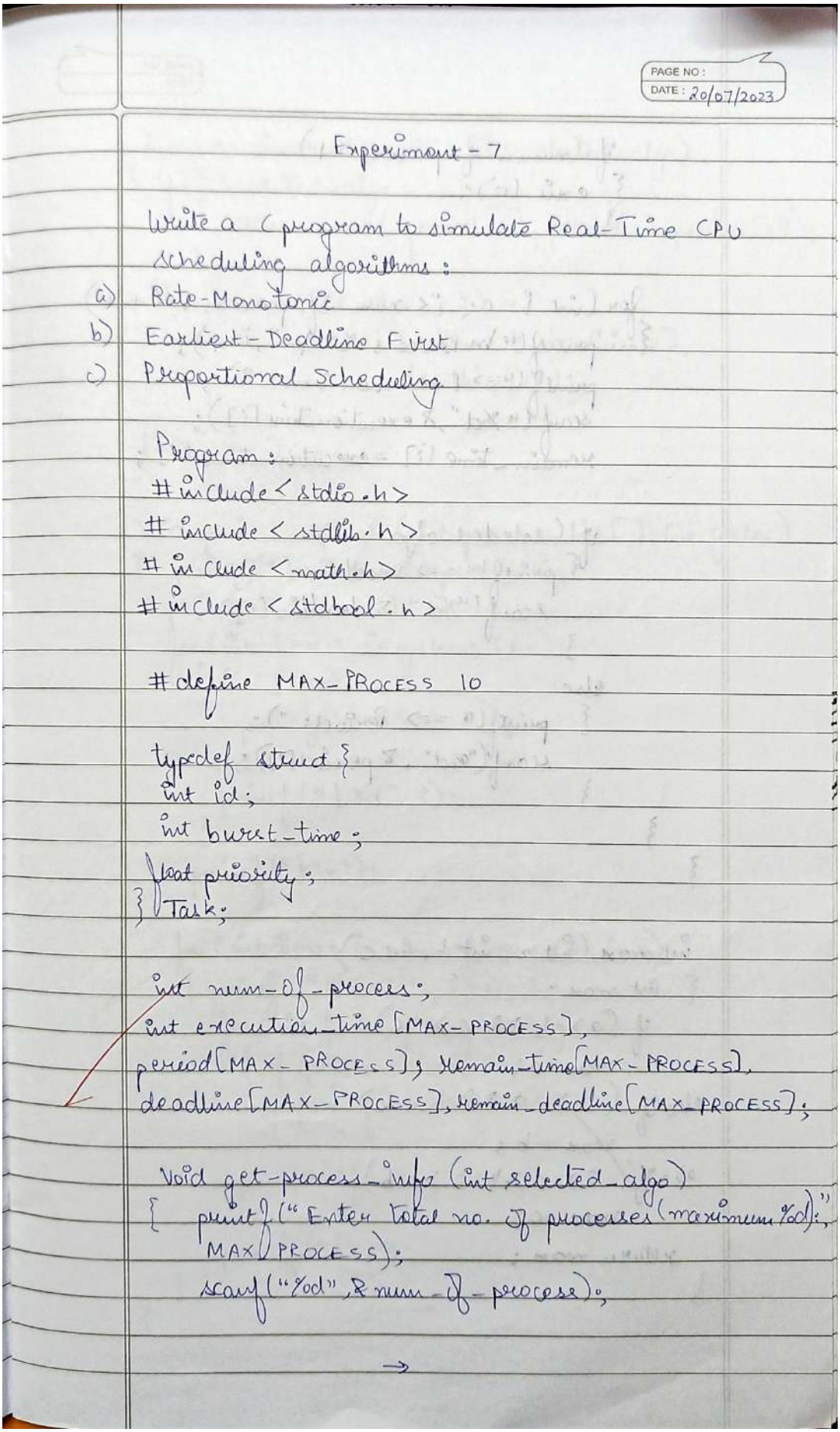
(c) Proportional Scheduling:

```
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
```

2.4.4 Observation Book Pictures:



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Experiment - 7

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

a) Rate-Monotonic
b) Earliest-Deadline First
c) Proportional Scheduling

Program :

```
#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 no. 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("\n Process %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("\n Scheduling : \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("\n Given 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;
  if (utilization > 1)
  { printf("Given problem is not schedulable
            under the said algorithm\n");
  }

  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(j=j+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 no. of tasks : ");
  scanf("%d", &n);

  Task tasks[n];
  printf("Enter the 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);
    scanf("%f", &tasks[i].priority);
  }

  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)
      { Task temp = tasks[j];
        tasks[j] = tasks[j+1];
        tasks[j+1] = temp;
      }
    }
  }

  printf("\nProportional Scheduling :\n");
  int burst_time = 0;
  int 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 choice;
  int observation_time;
  printf("\n1. Rate Monotonic\n2. Earliest
          Deadline First\n3. Proportional
          Scheduling\n Enter your choice: ");
  scanf("%d", &choice);

  switch(choice)
  { case 1 : get_process_info(choice);
             observation_time = get_observation_time
                                (choice);
             rate_monotonic(observation_time);
             break;

    case 2 : get process_info(choice);
             observation_time = get_observation_time
                                (choice);
             earliest_deadline_first(observation_
                                     time);
             break;

    case 3 : proportionalScheduling();
             break;
```

```
    default: printf("\n Invalid Statement");
    }
    return 0;
}
```

Output

1. Rate Monotonic
2. Earliest Deadline First
3. Proportional Scheduling.

Enter your choice : 1

Enter total no. of processes (max 10) : 3

Process 1 :

=> Execution time : 3

=> Period : 20

Process 2 :

=> Execution time : 2

=> Period : 5

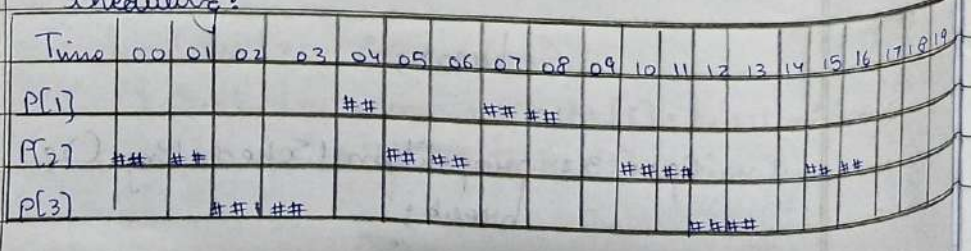
Process 3 :

=> Execution time : 2

=> Period : 10

Given problem is schedulable under the said algorithm.

Scheduling :



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

Enter your choice : 2

Enter total no. of processes (max 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]						##	##	

→

1. Rate Monotonic
2. Earliest Deadline First
3. Proportional Scheduling.

Enter your choice: 3

Enter no. of tasks: 3

Enter burst time & priority for each task:
Task-1 - Burst Time: 4
Task-1 - Priority: 2

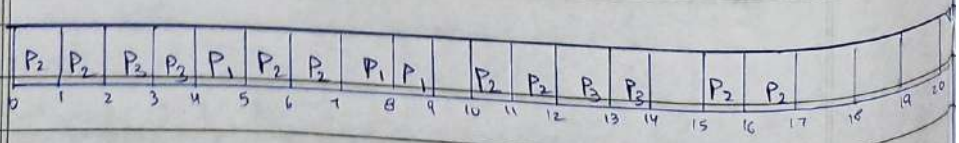
Task-2 - Burst Time: 6
Task-2 - Priority: 3

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.

Traversal:

1. Rate Monotonic:



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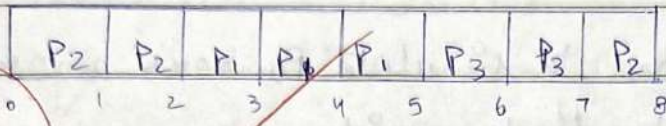
2. Earliest Deadline First.



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2.5 Experiment - 5

2.5.1 Question:

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

2.5.2 Code:

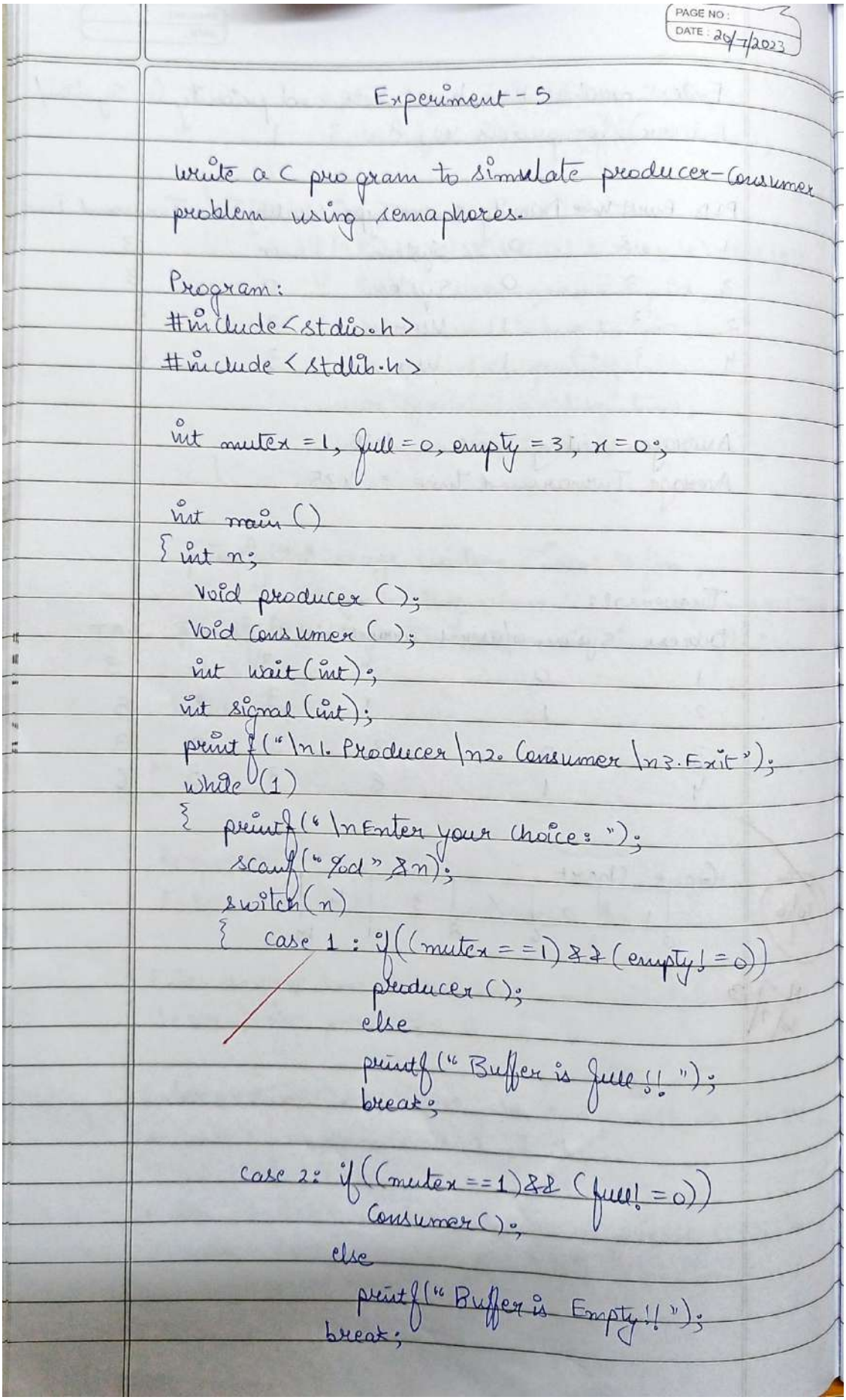
```
#include<stdio.h>
#include<stdlib.h>

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
```

2.5.4 Observation Book Pictures:



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Experiment - 5

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

Program:

```
#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("Consumer consumes item %d", x);
  x--;
  mutex = signal(mutex);
}
```

Output:

1. Producer
2. Consumer
3. Exit

Enter your choice : 1

Producer produces item 1

Enter your choice : 2

Consumer consumes item 1

Enter your choice : 2

Buffer is Empty !!

Enter your choice : 1

Producer produces item 1

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Enter your choice : 1

producer produces item 2

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Enter your choice : 1

Producer produces 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);
```

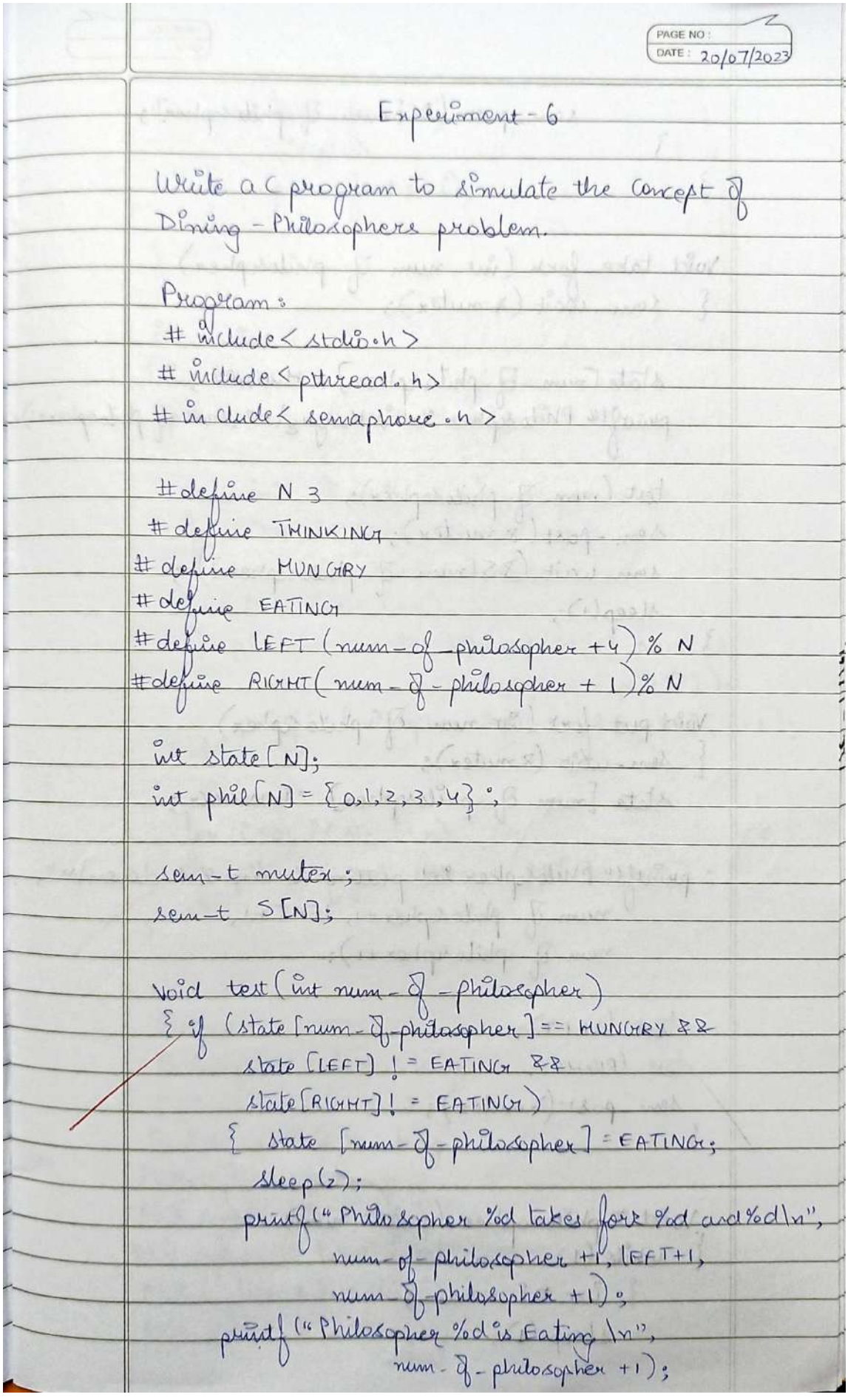
```
        for (i =0; i < N; i++)
        {
                pthread_create(&thread_id[i],NULL,philosopher, &phil[i]);
                printf("Philosopher %d is thinking\n", i +1);
        }

        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
```

2.6.4 Observation Book Pictures:



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Experiment - 6

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

Program :

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

#define N 3
#define THINKING
#define HUNGRY
#define EATING
#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);
```

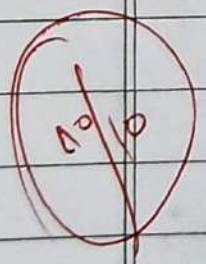
```
        sem_post (&S[num_of_philosopher]);
    }
}

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 %d and %d down\n",
            num_of_philosopher+1, LEFT+1,
            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, &phid[i]);
     printf(" Philosopher %d is thinking \n", i+1);
  }

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

Output:

Philosopher 1 is thinking
Philosopher 2 is thinking
Philosopher 3 is thinking
Philosopher 1 is Hungry
Philosopher 3 is Hungry
Philosopher 3 takes fork 1 and 3
Philosopher 3 is eating
Philosopher 2 is Hungry

Philosopher 3 putting fork 1 and 3 down
Philosopher 3 is thinking
Philosopher 1 takes fork 2 and 1
Philosopher 1 is eating
Philosopher 3 is Hungry
Philosopher 1 putting fork 2 and 1 down
Philosopher 1 is thinking
Philosopher 2 takes fork 3 and 2
Philosopher 2 is eating
Philosopher 1 is Hungry
Philosopher 2 putting ~~down~~ fork 3 and 2 down
Philosopher 2 is thinking
Philosopher 3 takes fork 1 and 3
Philosopher 3 is eating
Philosopher 2 is Hungry
Philosopher 3 putting fork 1 and 3 down



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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++)
```

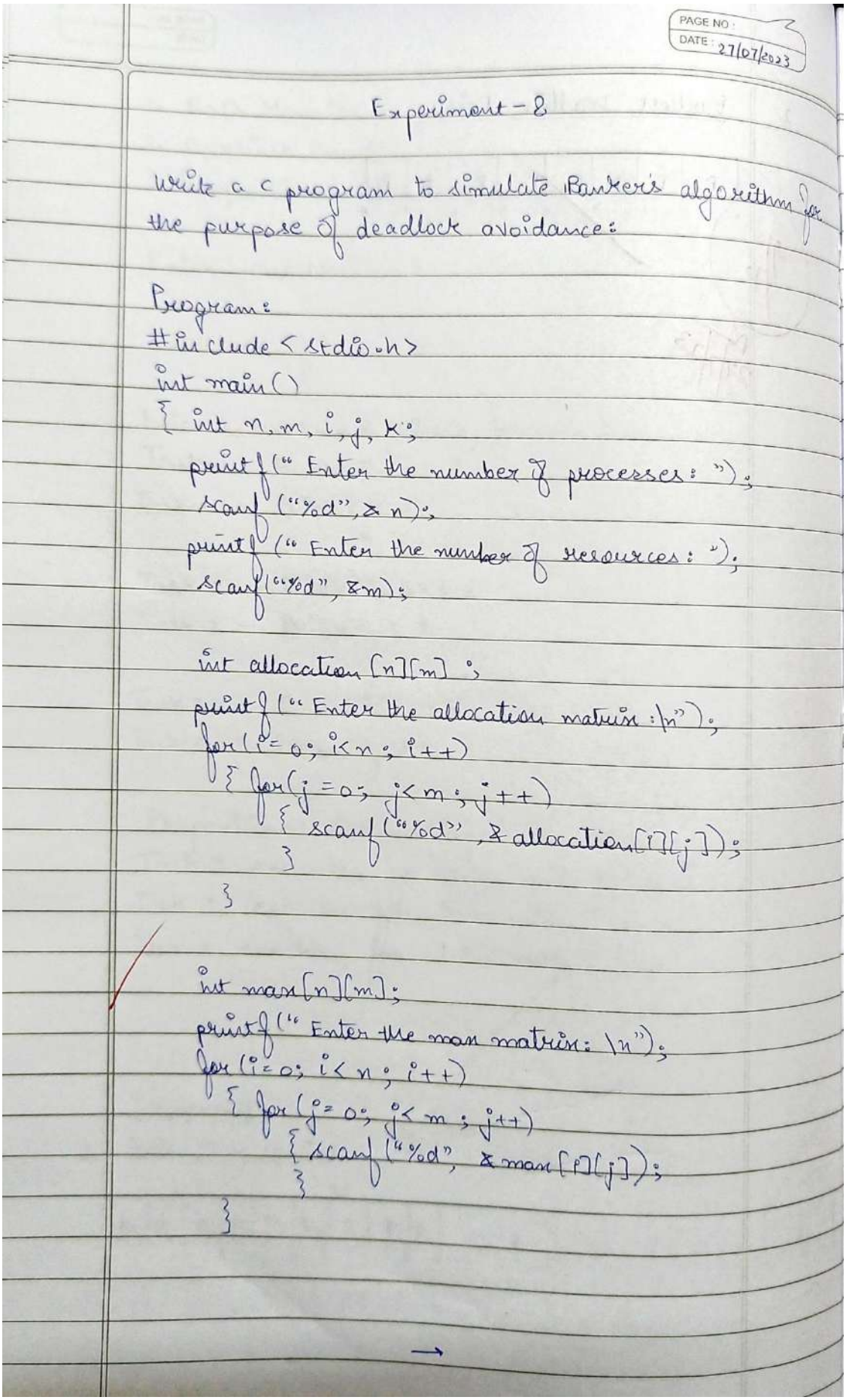
```
    {
        if (f[i] == 0)
        {
            flag = 0;
            printf("The following system is not safe\n");
            break;
        }
    }

    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
```

2.7.4 Observation Book Pictures:



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Experiment - 8

Write a c program to simulate Banker's algorithm for the purpose of deadlock avoidance:

Program:

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

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

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

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

return 0;
}
```

Output:

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

Enter Allocation Matrix :

0 1 0
2 0 0
3 0 2
2 1 1
0 0 2

→

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Enter the max matrix:
7 5 3
3 2 2
9 0 2
2 2 2
4 3 3

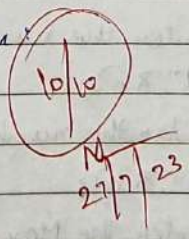
Enter the available Resources:
3 3 2

Following is the Safe sequence:
P_1, P_3, P_4, P_0, P_2

Enter the no. of processes: 5
Enter the no. of resources: 3

Enter 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 resource: 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");
  }
}
```

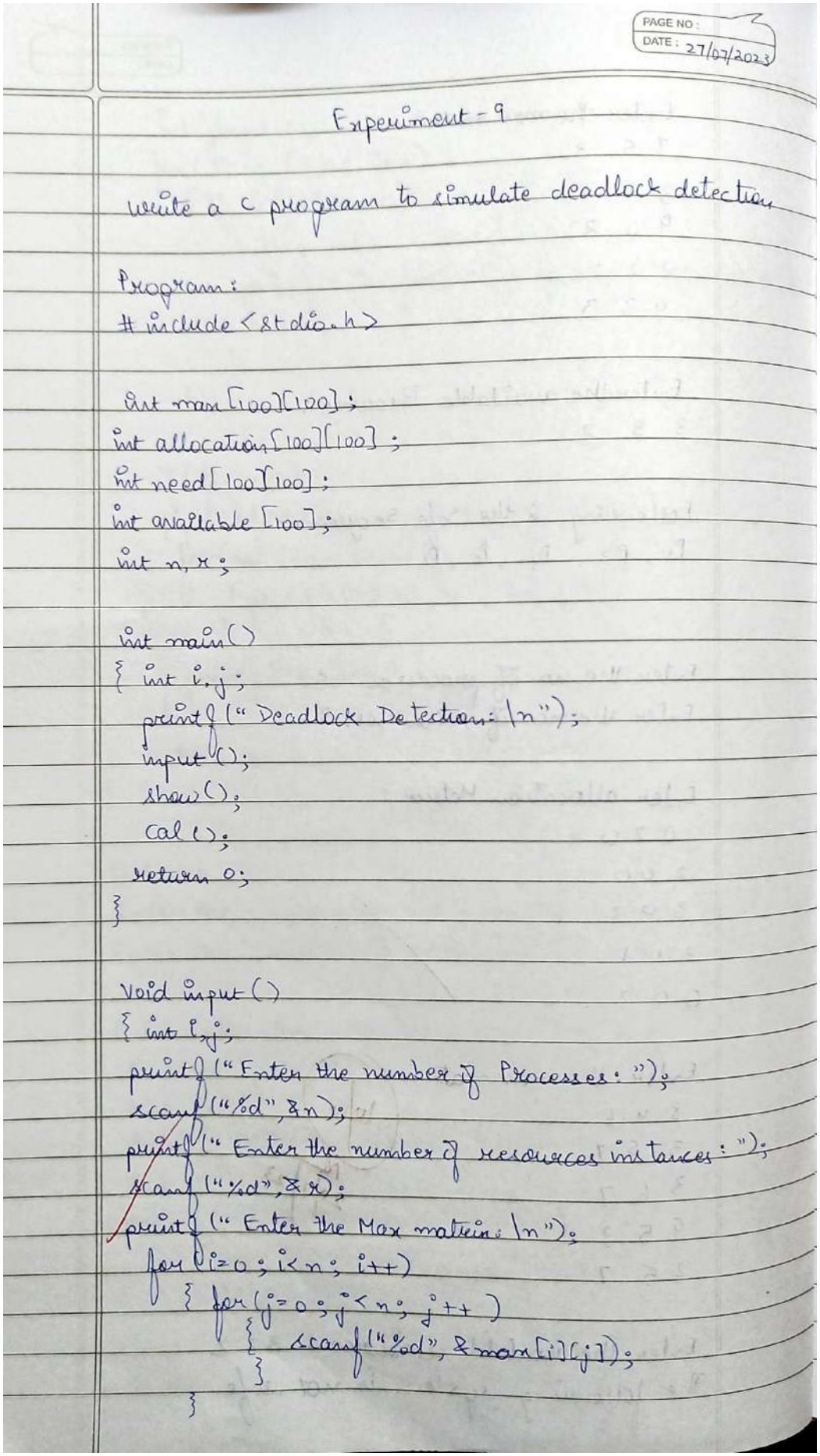
2.8.3 Output:

```
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
```

2.8.4 Observation Book Pictures:



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Experiment - 9

write a c program to simulate deadlock detection

Program:

```
#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 number of Processes: ");
  scanf("%d", &n);
  printf("Enter the number of resources instances: ");
  scanf("%d", &r);
  printf("Enter the Max matrix: \n");
    for(i=0; i<n; i++)
      { for(j=0; j<n; j++)
          { scanf("%d", &max[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("\n P%d \t ", i);
      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], need[100][100], temp, k, flag=1, c1=0;
  int dead[100];
  int safe[100];
  int i, j;
```

```
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\n System is in Deadlock and the
          Deadlock process are:\n");
  for(i=0; i<n; i++)
  { printf("%d\t", dead[i]);
  }
}
else
{ printf("\n No Deadlock Occur");
}
}
```

Output:

a) Deadlock Detection:

Enter the number of processes: 3

Enter the number 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

→

DATE :

Enter the available resources :
1 2 0

Process	Allocation	Max	Available
P_0	3 3 3	3 6 8	1 2 0
P_1	2 0 4	4 3 3	
P_2	1 2 4	3 4 4	

System is in Deadlock and the Deadlock process are :
P_0 P_1 P_2

b) Deadlock Detection :
Enter the number of Processes : 5
Enter the number 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

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Process	Allocation	Max	Available
P_0	0 1 0	0 0 0	0 0 0
P_1	2 0 0	2 0 2	
P_2	3 0 3	0 0 0	
P_3	3 1 1	1 0 0	
P_4	0 0 2	0 0 2	

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No Deadlock.

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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++)
    {
```

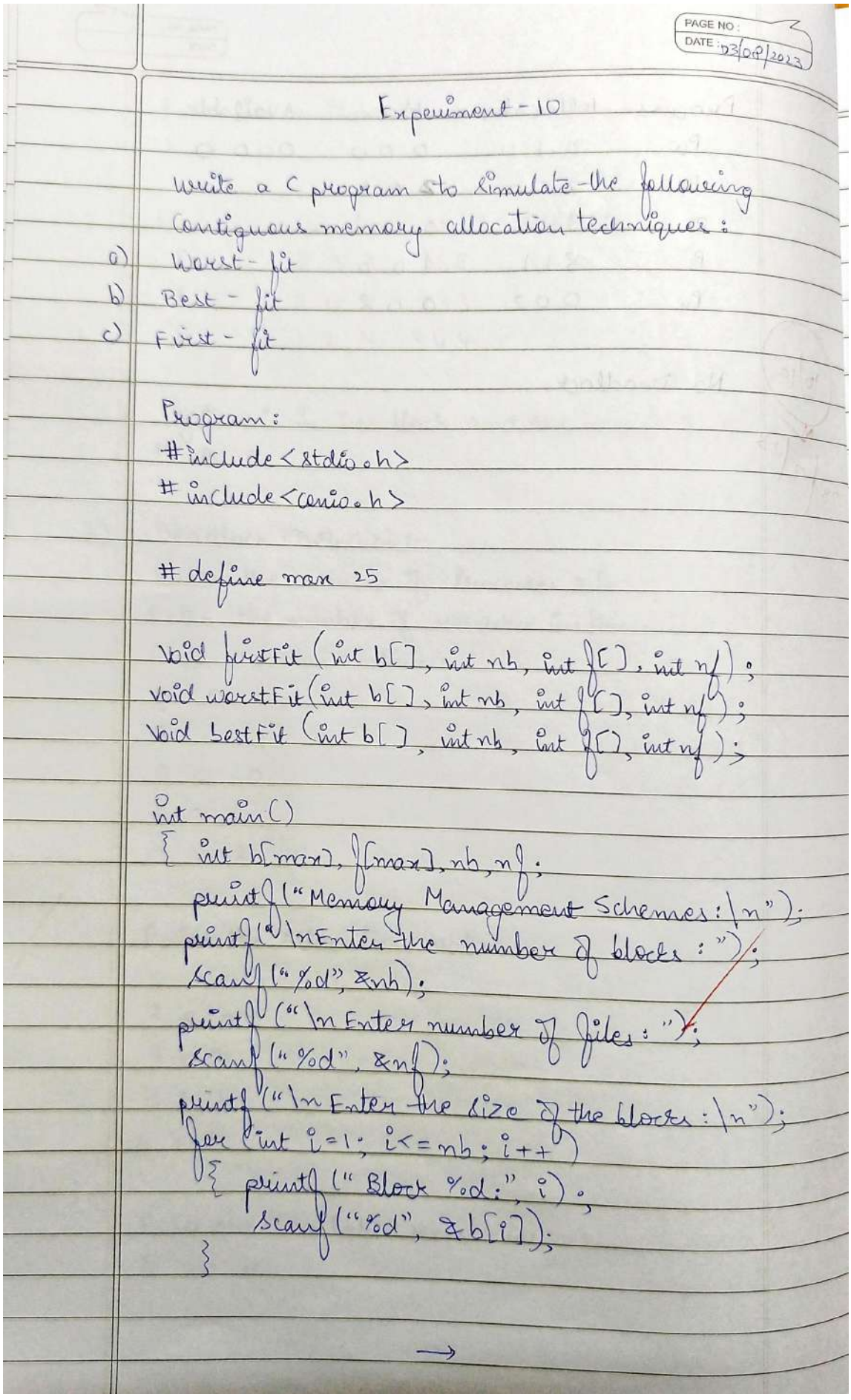
```
        for (j = 1; j <= nb; j++)
        {
            if (bf[j] != 1)
            {
                temp = b[j] - f[i];
                if (temp >= 0 && highest < temp)
                {
                    ff[i] = j;
                    highest = temp;
                }
            }
        }
        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
```

2.9.4 Observation Book Pictures:



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Experiment - 10

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

a) Worst - fit
b) Best - fit
c) First - fit

Program :

```
#include <stdio.h>
#include <conio.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("\n Enter number of files :");
  scanf("%d", &nf);
  printf("\n Enter the size of the blocks :\n");
  for (int i=1; i<=nb; i++)
  { printf("Block %d:", i);
    scanf("%d", &b[i]);
  }
```

→

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

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

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

printf("\n\n Memory Management Scheme -
        Best Fit \n");
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("\n File no:\t File size:\t Block no:\t
        Block size:\t Fragment");
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("\n File no. \t File size: \t Block no: \t
        Block size: \t Fragment ");
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("\n File no: \t File size: \t Block no: \t
        Block size: \t Fragment ");
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]);
}
}
```

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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);
```

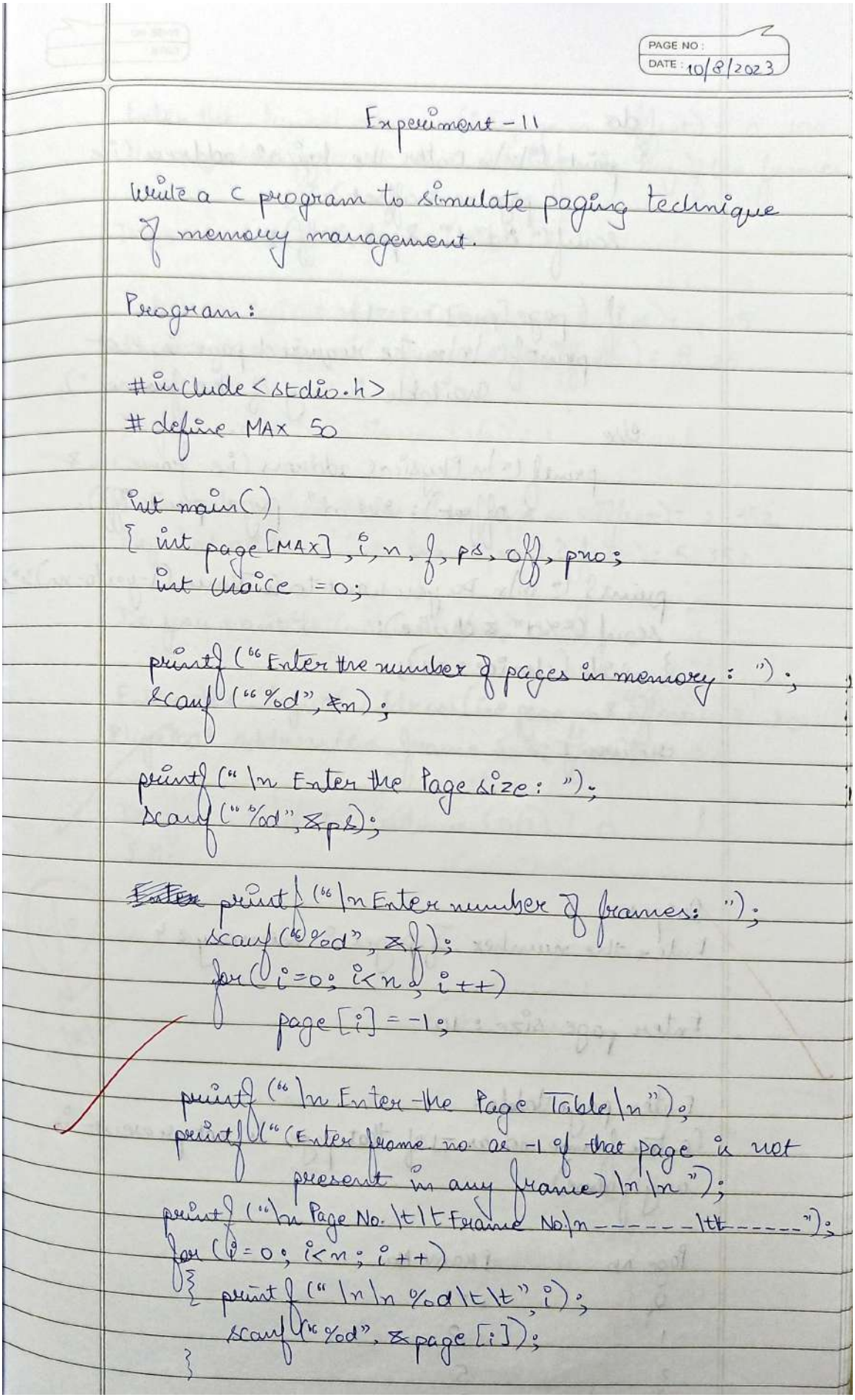
```
    return 1;
}
```

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
```

2.10.4 Observation Book Pictures:



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Experiment - 11

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

Program:

```
#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("\n Enter the Page size : ");
scanf("%d", &ps);

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

printf("\n Enter the Page Table\n");
printf("(Enter frame no. as -1 if that page is not
        present in any frame)\n\n");
printf("\n Page No.\t\t Frame No\n ------\t\t------");
for(i=0; i<n; i++)
{ printf("\n\n %d\t\t", i);
  scanf("%d", &page[i]);
}
```

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

  if (page[pno] == -1)
    printf("\n\n The required page is not
          available in any of the frames");
  else
    printf("\n Physical address (i.e frame no. &
          offset): %d%d", page[pno], off);

  printf("\n\n Do you want to continue (1-yes/0-no)?:");
  scanf("%d", &choice);
} while (choice == 1);

return 1;

}
```

Output:

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

Enter page size : 10

Enter 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 the 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 (0/1)? 0
Exit.

10/10

10/8/23

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
```

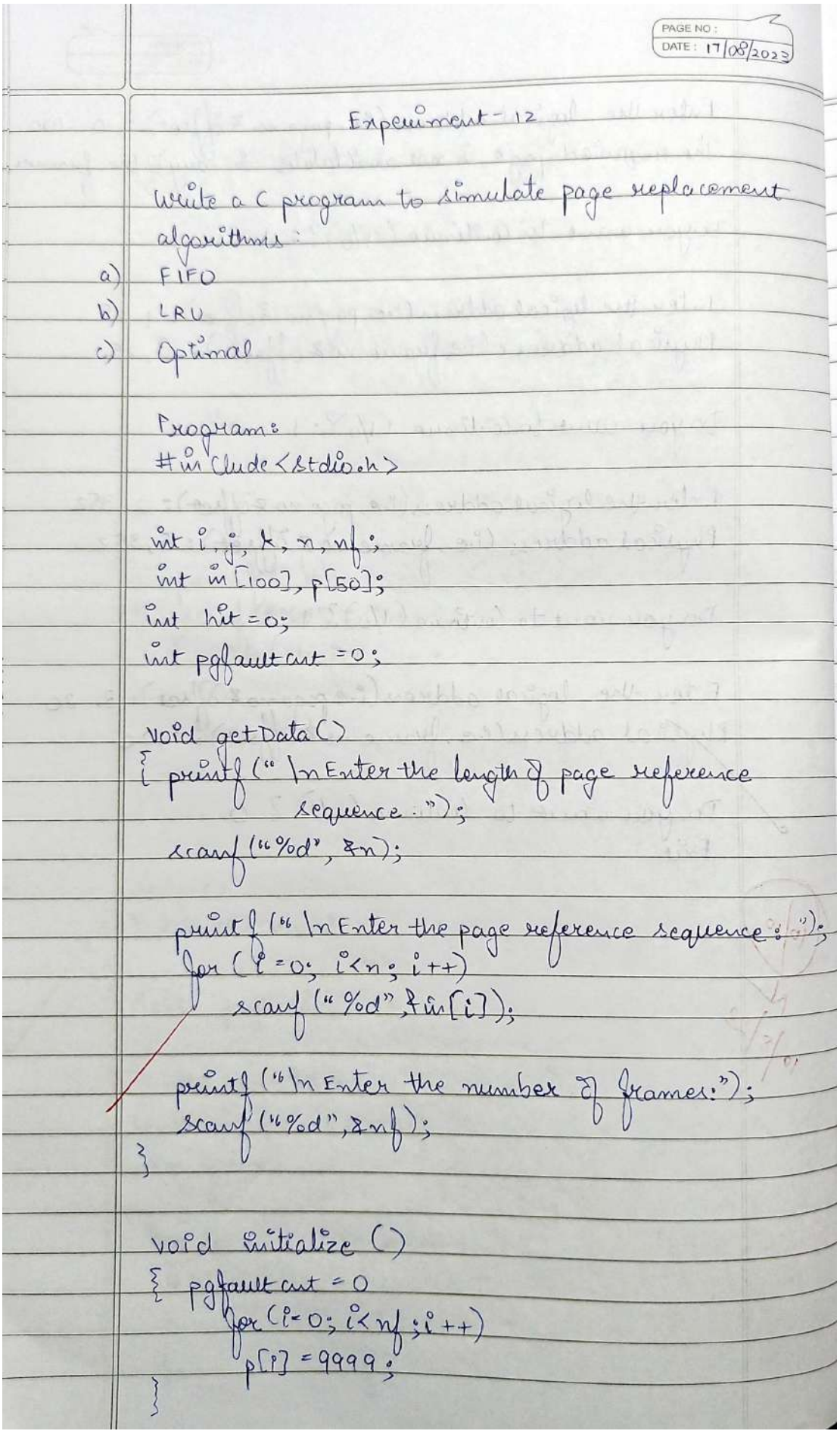
(c) OPTIMAL:

```
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
```

2.11.4 Observation Book Pictures:



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Experiment - 12

Write a C program to simulate page replacement algorithms:

a) FIFO
b) LRU
c) Optimal

Program:

```
#include<stdio.h>

int i, j, k, n, nf;
int in[100], p[50];
int hit=0;
int pgfaultcnt=0;

void getData()
{ printf("\nEnter the 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 the number 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("\n Total no. of page faults : %d", pgfaultcnt);
}
```

→

```
void fifo()
{ initialize();
  for(i=0; i<n; i++)
  { printf("\n For %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("\n For %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("Page Replacement Algorithms:\n
        1. Enter data\n2. FIFO\n3. Optimal\n
        4. LRU\n5. Exit\n\nEnter your choice:");
    scanf("%d", &choice);

    switch(choice)
    { case 1: getData()
              break;

      case 2: fifo()
              break;

      case 3: Optimal()
              break;

      case 4: lru()
              break;

      default: return 0;
               break;
    }
  }
}
```

Output:

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 the number of frames : 3

Enter your choice : 2

FIFO :

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

Enter your choice : 3

Optimal :

For 2 : 2

For 3 : 2 3

PAGE NO :
DATE :

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

Enter your choice : 4
LRU :
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

10/10
19/8/23

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) Sequential:

```
#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) <u>Indexed</u>:

```
#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,
```

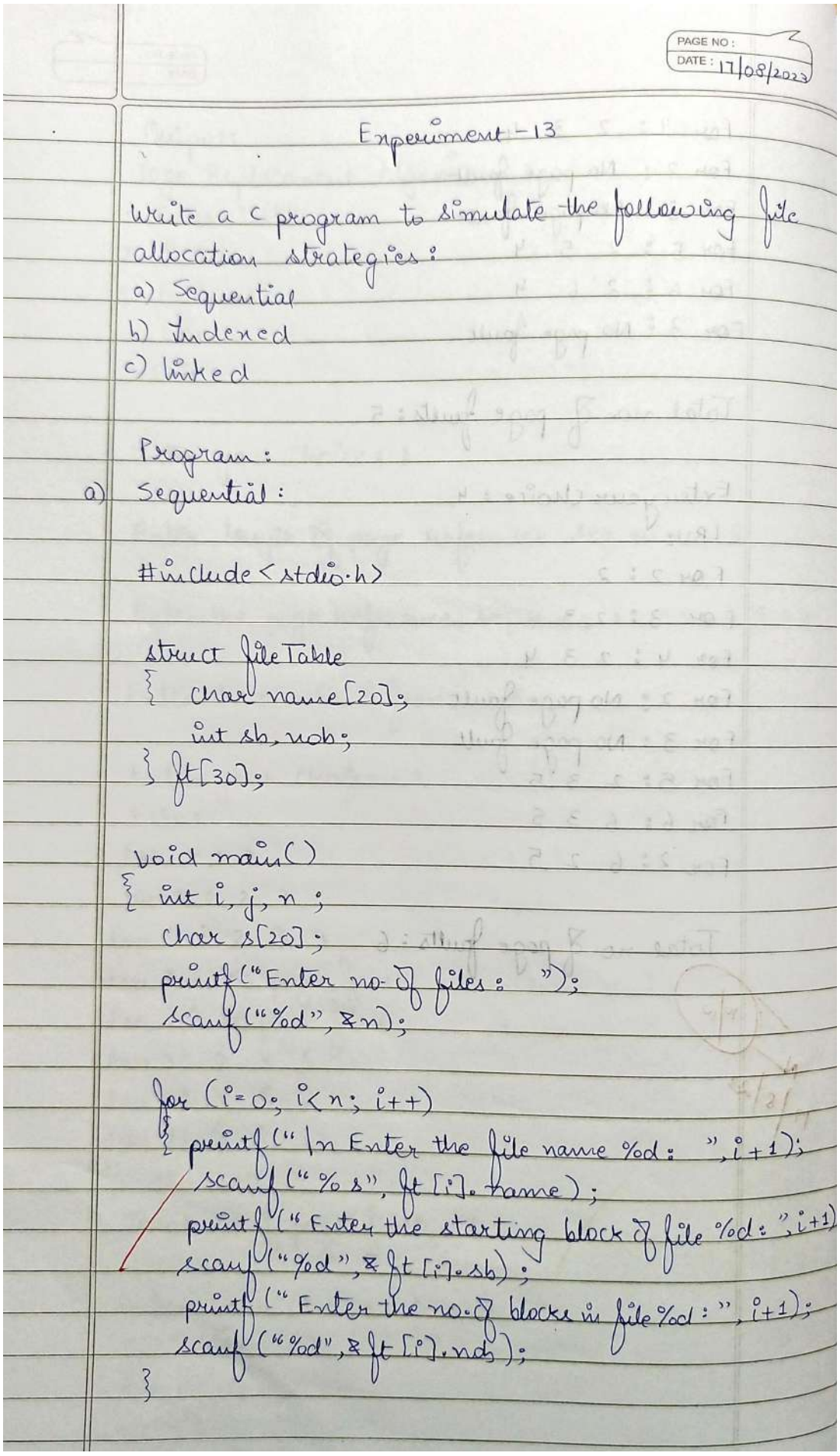
(b) Indexed:

```
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->
```

2.12.4 Observation Book Pictures:



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Experiment - 13

Write a c program to simulate the following file allocation strategies:
a) Sequential
b) Indexed
c) linked

Program:
a) Sequential:

```
#include<stdio.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("\n Enter the file name %d: ", i+1);
    scanf("%s", ft[i].name);
    printf("Enter the starting block of file %d: ", i+1);
    scanf("%d", &ft[i].sb);
    printf("Enter the no. of blocks in file %d: ", i+1);
    scanf("%d", &ft[i].nob);
  }
```

```
printf("\n Enter 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("\n File Not Found");

    else
    { printf("\n FILE 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);
    }
}
```

Output:

Enter no. of files : 3
Enter file name 1 : A
Enter starting block of file 1 : 85
Enter the no. of blocks in file 1 : 6

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

Enter file name 3 : C
Enter starting block of file 3 : 60
Enter the 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:

```
#include <stdio.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("Enter the 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("\n Enter 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("\n File not found");
```

→

```
else
{ printf("\n FILE 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]);
}
}
```

Output:

Enter no. of files : 2

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

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

Enter File to be searched : G

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

→

c) Linked:

```
#include<stdio.h>

struct FileTable
{ char name[20];
  int nob;
  struct blocks *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 the filename %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("\n Enter the filename to be searched: ");
scanf("%s", s);
for(i=0; i<n; i++)
  if(strcmp(s, ft[i].name) == 0)
    break;
if(i==n)
  printf("\n File not found");

else
{ printf("\n FILE 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;
  }
}
```

Output:

Enter the no. of files: 2

Enter file name 1: A

Enter no. of blocks in file 1: 4

Enter the blocks of the file 1: 12 23 9 4

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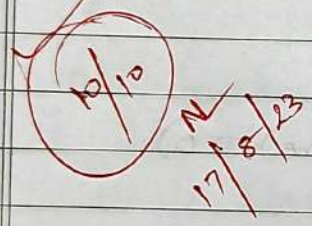
Enter file name 2 : G
Enter no. of blocks in file 2 : 5
Enter the blocks of file 2 : 88 77 66 55 44

Enter the file to be searched : G

FILENAME	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",0,639,320);

   //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
```

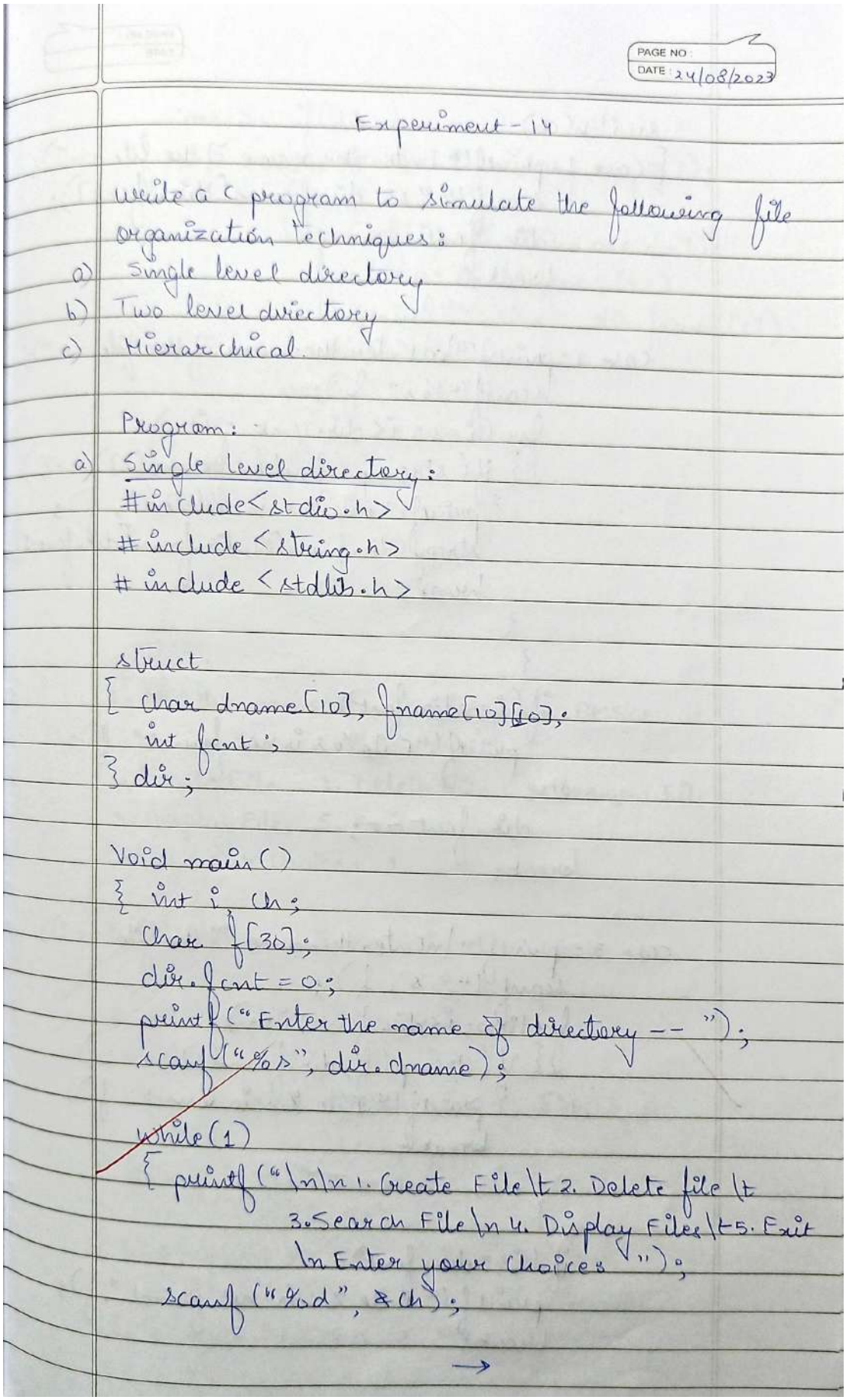
```
1. Create File  2. Delete File  3. Search File
4. Display Files        5. Exit
Enter your choice -- 3

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
```

2.13.4 Observation Book Pictures:



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Experiment - 14

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

a) Single level directory
b) Two level directory
c) Hierarchical

Program:

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("Enter the name of directory -- ");
  scanf("%s", dir.dname);

  while(1)
  { printf("\n\n 1. Create File\t 2. Delete file\t
           3. Search File\n 4. Display Files\t 5. Exit
           \n Enter your choice: ");
    scanf("%d", &ch);
```

→

```
switch(ch)
{ case 1: printf("Enter 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 is 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 is not found", f);
          break;
```

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

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

Output:

Enter the 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

Enter your choice: 1

Enter the name of the file -- ISE

Enter your choice: 4

The Files are -- CSE ISE

Enter your choice: 2

Enter the name of the File -- CSE
File CSE is deleted.

Enter your choice -- 3

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

Enter your Choice -- 5
Exit.

b) Two 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("\n Enter the name of the directory: ");
  scanf("%s", dir.dname);

  while(1)
  { printf("\n\n 1. Create File \t 2. Delete File\t
           3. Search File\t 4. Display Files \t 5. Exit\n
           Enter your choice: ");
```

```
scanf("%d", &ch);

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

case 2: printf("\n Enter the name of 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("Enter the name of 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("\n Directory Empty");
        else
        { printf("\n The Files are : ");
          for (i=0; i<dir.fcnt; i++)
          { printf("\t %s", dir.fname[i
        }
    }
    break;

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

Output 1:

Enter the name of directory : BMSCE

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

Enter the name of File -- ISE

Enter your choice : 1

Enter the name of File -- CSE

Enter your choice : 4

The Files are -- ISE CSE

Enter your choice : 2.

Enter the name of the file -- CSE
File CSE has been deleted.

Enter your choice :- 3

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

Enter your choice : 5
Exit.

c) Hierarchical :

```
#include <stdio.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 gd = DETECT, gm;
  node *root;
  root = NULL;
  create(&root, 0, "root", 0, 639, 320);
  initgraph(&gd, &gm, "C:\\tc\\BGI");
  display(root);
  getch();
  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 the name of dir/file(under %s)",
           dname);
    fflush(stdin);
    gets((*root) -> name);
    printf(" enter 1 for Dir/2 for file : ");
    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);
    }
```

```
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 the name of dir/file(under %s)
            dname);
    fflush(stdin);
    gets((*root) -> name);
    printf(" enter 1 for Dir/2 for file : ");
    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]);
    }
  }
}
*/
```

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Output:

Enter the Name of dir/file(under root) : ROOT
Enter 1 for Dir/ 2 for file : 1
No. of subdirectories/files (for ROOT) : 2
Enter the Name of dir/file(under ROOT) : USER 1
Enter 1 for Dir/2 for file : 1
No. of subdirectories/files(for User 1) : 1
Enter the name of dir/file(under USER 1) : SUBDIR
Enter 1 for Dir/ 2 for file : 1
No. of subdirectories/files(for SUBDIR) : 2
Enter the name of dir/file(under SUBDIR) : JAVA
Enter 1 for Dir/2 for file : 1
NO. of subdirectories/files for JAVA : 0
Enter the Name of dir/file (under SUBDIR) : VB
Enter 1 for Dir/2 for file : 1
No. of subdirectories/files (for VB) = 0

Enter the Name of dir/file(under ROOT) : USER2
Enter 1 for Dir/2 for file : 1
No. of subdirectories/files (for USER2) : 2
Enter the Name of dir/file(under ROOT) : A
Enter 1 for Dir/2 for file : 2
Enter Name of dir/file (under USER2) : SUBDIR2
Enter 1 for Dir/2 for file : 1
No. of subdirectories/files(for SUBDIR2) : 2
Enter the Name of dir/file (under SUBDIR2) : PPL
Enter 1 for Dir/2 for file : 1
No. of subdirectories/files (for PPL) : 2
Enter Name of dir/file under PPL) : B
Enter 1 for Dir/2 for file : 2
Enter Name of Dir/file (under PPL) : C
Enter 1 for Dir/2 for file : 2
Enter the Name of dir/file(under SUBDIR) : AI

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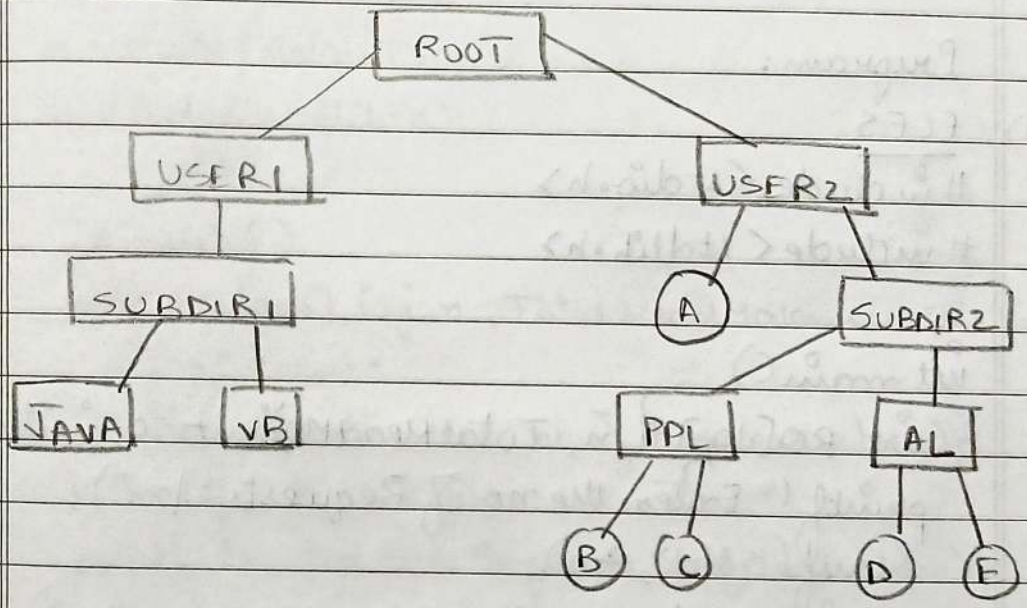
Enter 1 for Dir/2 for file : 1
No. of Subdirectories / files (for AI) : 2
Enter name of dir/file (under AI) : D
Enter 1 for Dir/2 for file : 2
Enter Name of dir/file (under AI) : F
Enter 1 for Dir/2 for File : 2

10/10

24/8/23



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
```

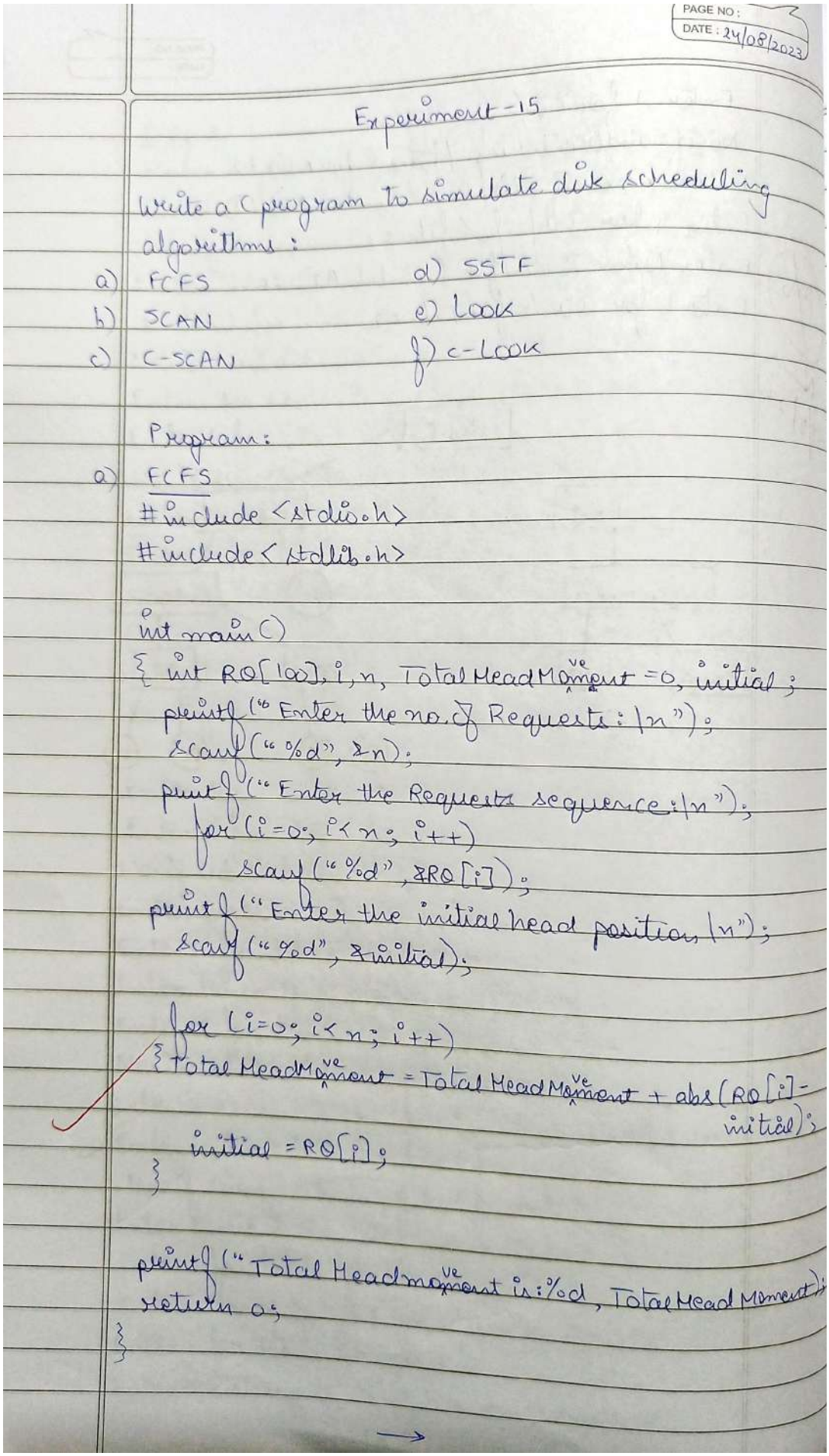
(b) SCAN:

```
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
```

2.14.4 Observation Book Pictures:



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Experiment - 15

Write a C program to simulate disk scheduling algorithms :

a) FCFS
b) SCAN
c) C-SCAN
d) SSTF
e) Look
f) c-Look

Program:

a) FCFS

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

int main()
{ int RQ[100], i, n, TotalHeadMoment = 0, initial;
  printf("Enter the no. of Requests : \n");
  scanf("%d", &n);
  printf("Enter the Requests sequence : \n");
    for (i=0; i<n; i++)
      scanf("%d", &RQ[i]);
  printf("Enter the initial head position, \n");
    scanf("%d", &initial);

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

  printf("Total Headmoment is : %d, TotalHeadMoment);
  return 0;
}
```

Output:

```
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: 644
```

b) SCAN:

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

int main()
{ int RQ[100], i, j, n, TotalHeadMovement=0, initial,
  size, move;
  printf("Enter the no. of Requests:\n");
   scanf("%d", &n);
printf("Enter the Requests sequence:\n");
  for(i=0; i<n; i++)
   scanf("%d", &RQ[i]);
printf("Enter the 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);
  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++)
      { TotalHeadMovement = TotalHeadMovement +
                            abs(RQ[i]-initial);
        initial = RQ[i];
      }
      // last movement for max size
      TotalHeadMovement = TotalHeadMovement +
                          abs(size-RQ[i-1]-1);
      initial = size-1;
      for(i=index-1; i>=0; i--)
      { TotalHeadMovement = TotalHeadMovement +
                            abs(RQ[i]-initial);
        initial = RQ[i];
      }
}
```

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

// last movement for min size.
TotalHeadMovement = TotalHeadMovement +
                    abs(RQ[i+1] - 0);
initial = 0;
for (index; i < n; i++)
{ TotalHeadMovement = TotalHeadMoment +
                      abs(RQ[i] - initial);
  initial = RQ[i];
}
}

printf("Total Head Movement is : %d",
       TotalHeadMovement);
return 0;
}
```

Output :

```
Enter the no. 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 / for low-0 :
0
Total head movement is 190.
```

c) C-SCAN

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

int main()
{ int RQ[100], i, j, n, initial, size, move;
  int TotalHeadMovement = 0;
  printf("Enter the no. of Requests: ");
  scanf("%d", &n);
  printf("Enter the Request sequence:\n");
  for (i=0; i<n; i++)
    scanf("%d", &RQ[i]);
  printf("Enter the initial head position:\n");
  scanf("%d", &initial);
  printf("Enter total disk size:\n");
  scanf("%d", &size);
  printf("Enter the head movement direction for hig
        for low-0:\n");
  scanf("%d", &move);

  // 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++)
  { TotalHeadMovement = TotalHeadMovement +
                        abs(RQ[i] - initial);
    initial = RQ[i];
  }
  // last movement for max size
  TotalHeadMovement = TotalHeadMovement +
                      abs(size - RQ[i-1] - 1);
  // movement max to min disk.
  TotalHeadMovement = TotalHeadMovement +
                      abs(size - 1 - 0);
  initial = 0;
  for(i=0; i<index; i++)
  { TotalHeadMovement = TotalHeadMovement +
                        abs(RQ[i] - initial);
    initial = RQ[i];
  }
}

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

→

```
//movement min to max disk
TotalHeadMovement = TotalHeadMovement +
                    abs(size-1-0);
initial = size-1;
for(i=n-1; i>=index; i--)
{ TotalHeadMovement = TotalHeadMovement +
                      abs(RQ[i]-initial);
  initial = RQ[i]
}

// last movement for min size
TotalHeadMovement = TotalHeadMovement +
                    abs(RQ[i+1]-0);
}
printf("Total Head Movement is: %d",
       TotalHeadMovement);
return 0;
}
```

Output:

```
Enter the no. 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 for low-0
1
Total Head Movement: 4
```

10/10

24/8/23

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) <u>LOOK</u>:

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

    // logic for look disk scheduling

       /*logic for sort the request array */
    for(i=0;i<n;i++)
    {
       for(j=0;j<n-i-1;j++)
       {
          if(RQ[j]>RQ[j+1])
          {
             int temp;
             temp=RQ[j];
             RQ[j]=RQ[j+1];
             RQ[j+1]=temp;
          }

       }
    }

    int index;
    for(i=0;i<n;i++)
    {
```

```
        if(initial<RQ[i])
        {
            index=i;
            break;
        }
    }

    // if movement is towards high value
    if(move==1)
    {
        for(i=index;i<n;i++)
        {
            TotalHeadMoment=TotalHeadMoment+abs(RQ[i]-initial);
            initial=RQ[i];
        }

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

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

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

        }
    }

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

(c) c-LOOK:

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

   // logic for C-look disk scheduling

      /*logic for sort the request array */
   for(i=0;i<n;i++)
   {
      for( j=0;j<n-i-1;j++)
      {
         if(RQ[j]>RQ[j+1])
         {
            int temp;
            temp=RQ[j];
            RQ[j]=RQ[j+1];
            RQ[j+1]=temp;
         }

      }
   }

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

```
    // if movement is towards high value
    if(move==1)
    {
       for(i=index;i<n;i++)
       {
          TotalHeadMoment=TotalHeadMoment+abs(RQ[i]-initial);
          initial=RQ[i];
       }

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

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

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

       }
    }

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

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
```

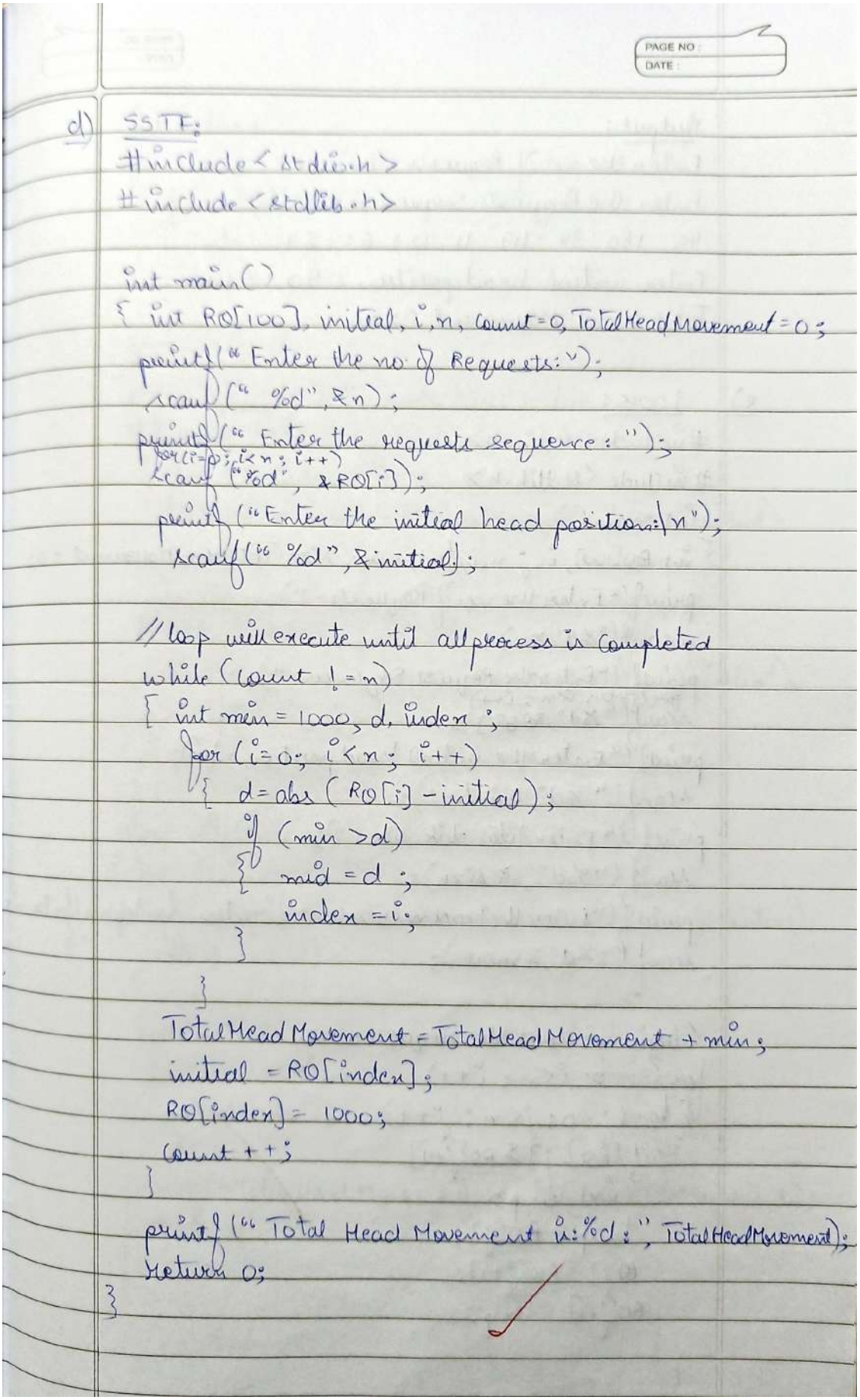
(b) LOOK:

```
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
```

2.15.4 Observation Book Pictures:



d) SSTF:

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

int main()
{ int RQ[100], initial, i, n, count = 0, TotalHeadMovement = 0;
  printf("Enter the no of Requests:");
  scanf("%d", &n);
  printf("Enter the requests sequence:");
  for(i=0; i<n; i++)
  scanf("%d", &RQ[i]);
  printf("Enter the initial head position:\n");
  scanf("%d", &initial);

// 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;
    }
  }
  TotalHeadMovement = TotalHeadMovement + min;
  initial = RQ[index];
  RQ[index] = 1000;
  count++;
}
printf("Total Head Movement is: %d:", TotalHeadMovement);
return 0;
}
```

Output:

Enter the no of Requests : 8
Enter the Requests Sequence :
95 180 34 119 11 123 62 64
Enter initial head position : 50
Total Head Movement : 236

e) Look:

```
#include<stdio.h>
#include<stdlib.h>
int main()
{ int RQ[100], i, j, n, initial, move, size, TotalHeadMovement = 0;
 printf("Enter the no. of Requests : ");
 scanf("%d", &n);
 printf("Enter the Request Sequence : ");
 for(i=0; i<n; i++)
 scanf("%d", &RQ[i]);
printf("Enter the initial head position : \n");
 scanf("%d", &initial);
printf("Enter total disk size : ");
 scanf("%d", &size);
 printf("Enter the head movement direction for high-1 for low-
 scanf("%d", &move);

// logic for sort the request array
for(i=0; i<n; i++)
{ for(j=0; j<n; 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++)
  { TotalHeadMovement = TotalHeadMovement + abs(RQ[i] - initial);
    initial = RQ[i];
  }
 for (i= index-1; i>=0; i--)
 { TotalHeadMovement = TotalHeadMovement + abs(RQ[i] - initial);
   initial = RQ[i];
 }

else // if movement is towards low value
{ for (i= index-1; i>=0; i--)
{ TotalHeadMovement = TotalHeadMovement + abs(RQ[i] - initial);
  initial = RQ[i];
}
 for (i= index; i<n; i++)
 { TotalHeadMovement += abs(RQ[i] - initial);
   initial = RQ[i];
 } }
printf("Total Head Movement is: %d", TotalHeadMovement);
return 0;
}
```

PAGE NO :
DATE :

Output:

```
Enter the no. of Requests : 3
Enter Request Sequence : 2 1 0
Enter initial head position : 1
Enter total disk size : 3
Enter head movement direction for high-1 for low-0 : 1
Total Head Movement : 3.
```

g) c-Look:

```
#include<stdio.h>
#include<stdlib.h>
int main()
{ int RQ[100], i, j, n, initial, size, move, TotalHeadMovement=0;
  printf("Enter the no. of requests: ");
   scanf("%d", &n);
printf("Enter the Request sequance: ");
  for(i=0; i<n; i++)
    scanf("%d", &RQ[i]);
printf("Enter initial head position: ");
  scanf("%d", &initial);
printf("Enter total disk size: ");
  scanf("%d", &size);
printf("Enter head movement direction for high-1 for low-0: ");
  scanf("%d", &move);

for(i=0; i<n; i++) // logic for sort the request array
{ for(j=0; j<n; j++)
   { if(RQ[j] > RQ[j+1])
      { int temp;
        temp = RQ[j];
        RQ[j] = RQ[j+1];
        RQ[j+1] = temp;
      }
   }
}
```

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

if(move==1) // if movement is towards high value
{ for(i=index; i<n; i++)
  { TotalHeadMovement += abs(RQ[i]-initial);
    initial = RQ[i];
  }
  for(i=0; i<index; i++)
  { TotalHeadMovement += abs(RQ[i]-initial);
    initial = RQ[i];
  }
}
else // if movement is towards low value
{ for(i=index-1; i>=0; i--)
{ TotalHeadMovement += abs(RQ[i] - initial);
  initial = RQ[i];
}
for(i=n-1; i>=index; i--)
{ TotalHeadMovement += abs(RQ[i]-initial);
  initial = RQ[i];
  }
}
printf("Total Head Movement: %d", TotalHeadMovement);
return 0;
}
```

→

PAGE NO :
DATE :

Output :

Enter the no. of Requests : 3

Enter the Requests Sequence : 2 1 0

Enter initial head position : 1

Enter total disk size : 3

Enter head movement direction for high-1 / for low-0 : 1

Total Head Movement : 4