VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

LAB REPORT

on

OPERATING SYSTEMS

Submitted by

YOGARAJ KH (1WA23CS054)

in partial fulfillment for the award of the degree of

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in

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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 – 23CS4PCOPS" carried out by Yogaraj KH(1WA23CS054), who is Bonafide student of B. M. S. College of Engineering. It is in partial fulfilment for the award of Bachelor of Engineering in Computer Science and Engineering of the Visvesvaraya Technological University, Belgaum during the year Feb 2025- June 2025. The Lab report has been approved as it satisfies the academic requirements in respect of a OPERATING SYSTEMS - (23CS4PCOPS) work prescribed for the said degree.

Faculty Incharge Name
Assistant Professor
Department of CSE
BMSCE, Bengaluru

Dr. Kavitha Sooda
Professor and Head
Department of CSE
BMSCE, Bengaluru

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Course Outcomes

C01	Apply the different concepts and functionalities of Operating System
C02	Analyse various Operating system strategies and techniques
C03	Demonstrate the different functionalities of Operating System.
C04	Conduct practical experiments to implement the functionalities of Operating system.

Program -1

Question:

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

→FCFS

→ SJF (pre-emptive & Non-preemptive)

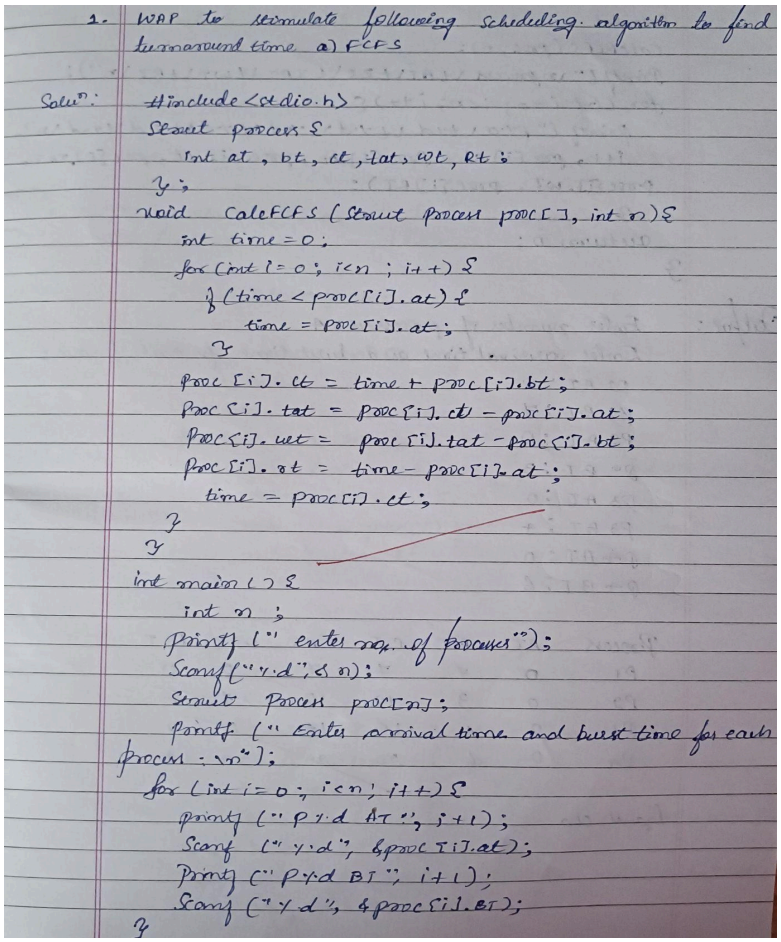
=>FCFS:

```
#include <stdio.h>

typedef struct {
   int id, at, bt, wt, tat, ct,rem,rt, started;
} Process;

void sortByArrival(Process p[], int n) {
   for (int i = 0; i < n - 1; i++) {
      for (int j = 0; j < n - i - 1; j++) {
         if (p[j].at > p[j + 1].at) {
            Process temp = p[j];
            p[j] = p[j + 1];
            p[j + 1] = temp;
         }
      }
   }
}

void fcfs(Process p[], int n) {
   sortByArrival(p, n);
   int time = 0;

   for (int i = 0; i < n; i++) {
      if (time < p[i].at)
         time = p[i].at;

      p[i].ct = time + p[i].bt;
      p[i].tat = p[i].ct - p[i].at;
      p[i].wt = p[i].tat - p[i].bt;
      time = p[i].ct;
   }
}
```

```
void display(Process p[], int n) {
   printf("\nPID\tAT\tBT\tCT\tTAT\tWT\n");

   float totalWT = 0, totalTAT = 0;
   for (int i = 0; i < n; i++) {
      printf("P%d\t%d\t%d\t%d\t%d\t%d\n", p[i].id, p[i].at, p[i].bt, p[i].ct, p[i].tat, p[i].wt);
      totalWT += p[i].wt;
      totalTAT += p[i].tat;
   }

   printf("\nAverage Waiting Time: %.2f\n", totalWT / n);
   printf("Average Turnaround Time: %.2f\n", totalTAT / n);
}

void main() {
   int n;
   printf("Enter number of processes: ");
   scanf("%d", &n);
   Process p[n];
   printf("Enter Arrival Time and Burst Time for each process:\n");
   for (int i = 0; i < n; i++) {
      p[i].id = i + 1;
      printf("P[%d]: ", i + 1);
      scanf("%d %d", &p[i].at, &p[i].bt);
   }
   printf("First Come First Serve (FCFS)\n");
   fcfs(p, n);
   display(p, n);
}
```

Result:

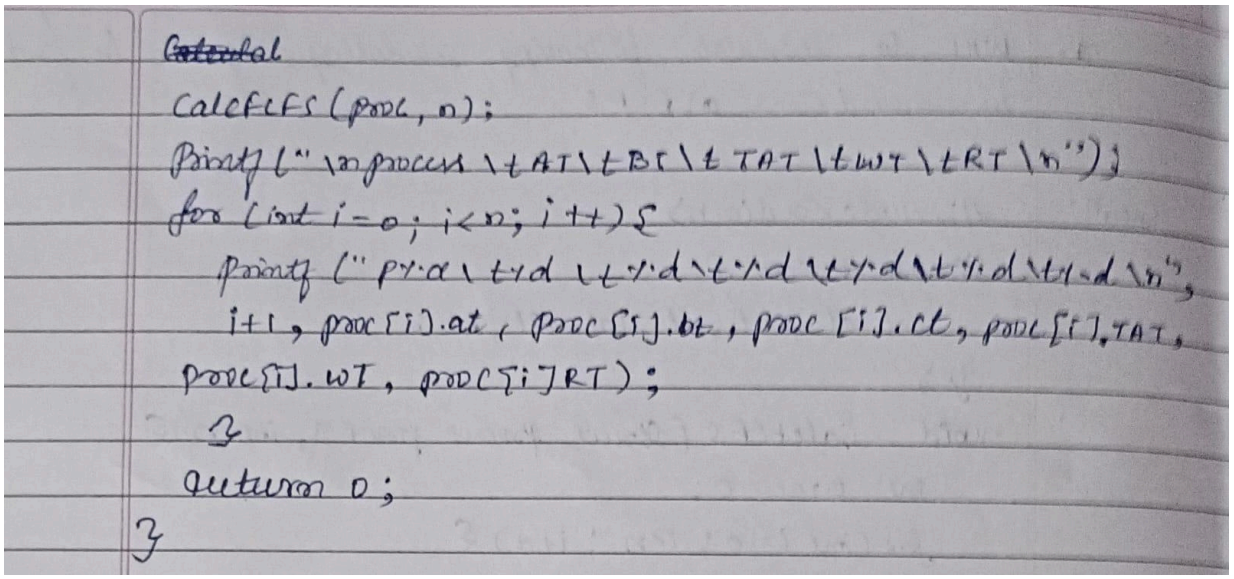
```
P2 Arrival Time: 0
P2 Burst Time: 3
P3 Arrival Time: 0
P3 Burst Time: 4
P4 Arrival Time: 0
P4 Burst Time: 6

Process AT      BT      CT      TAT     WT      RT
P1      0       7       7       7       0       0
P2      0       3       10      10      7       7
P3      0       4       14      14      10      10
P4      0       6       20      20      14      14

Process returned 0 (0x0)   execution time : 16.832 s
Press any key to continue.
```



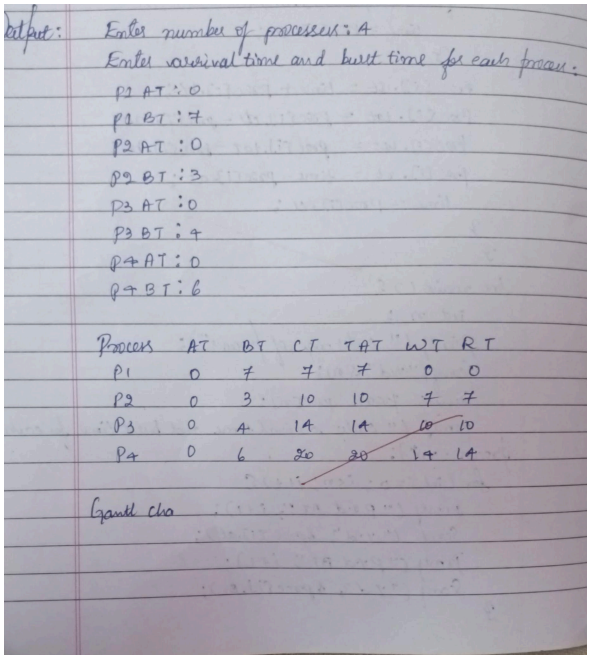
1. WAP to simulate following scheduling algorithm to find turnaround time a) FCFS

Solⁿ:

```
#include<stdio.h>
Struct process{
    int at, bt, ct, tat, wt, rt;
};
void CalcFCFS(Struct Process proc[], int n){
    int time=0;
    for(int i=0; i<n; i++){
        if(time<proc[i].at){
            time = proc[i].at;
        }
        proc[i].ct = time + proc[i].bt;
        proc[i].tat = proc[i].ct - proc[i].at;
        proc[i].wt = proc[i].tat - proc[i].bt;
        proc[i].rt = time - proc[i].at;
        time = proc[i].ct;
    }
}
int main(){
    int n;
    Printf(" enter no. of processes");
    Scanf("%d",&n);
    Struct Process proc[n];
    Printf(" Enter arrival time and burst time for each
process :\n");
    for(int i=0; i<n; i++){
        printf(" P%d AT ", i+1);
        Scanf("%d", &proc[i].at);
        Printf("P%d BT", i+1);
        Scanf("%d", &proc[i].BT);
    }
```



```
Calcfcfs(proc, n);
Printf("\nprocess\tAT\tBT\tTAT\twT\tRT\n");
for(int i=0; i<n; i++){
   Printf("p%d\t%d\t%d\t%d\t%d\t%d\t%d\n",
    i+1, proc[i].at, proc[i].bt, proc[i].ct, proc[i].TAT,
proc[i].WT, proc[i]RT);
  }
return 0;
}
```



Output:

```
Enter number of processes: 4
Enter arrival time and burst time for each proces:
P1 AT : 0
P1 BT : 7
P2 AT : 0
P2 BT : 3
P3 AT : 0
P3 BT : 4
P4 AT : 0
P4 BT : 6
```

Process	AT	BT	CT	TAT	WT	RT
P1	0	7	7	7	0	0
P2	0	3	10	10	7	7
P3	0	4	14	14	10	10
P4	0	6	20	20	14	14

Gantt cha

=>SJF(Non-preemptive):

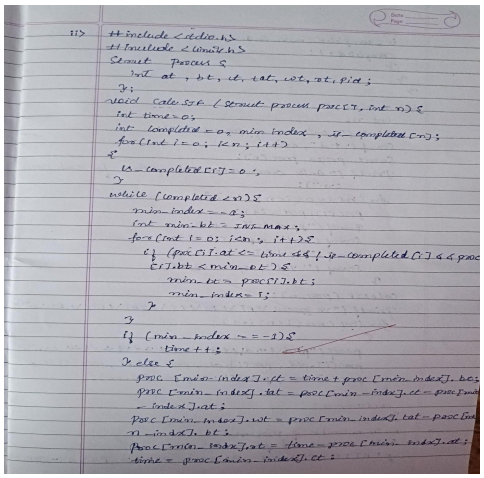
```
#include <stdio.h>
#include <limits.h>
typedef struct {
    int id, arrival, burst, completion, turnaround, waiting;
} Process;
```

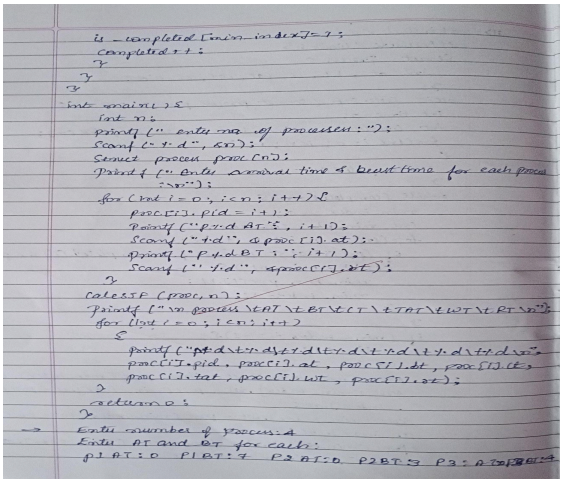
```
void sortByArrival(Process p[], int n) {
    for (int i = 0; i < n - 1; i++) {
        for (int j = 0; j < n - i - 1; j++) {
            if (p[j].arrival > p[j + 1].arrival) {
                Process temp = p[j];
                p[j] = p[j + 1];
                p[j + 1] = temp;
            }
        }
    }
}

void sjf_non_preemptive(Process p[], int n) {
    int completed = 0, time = 0, minIdx;
    int isCompleted[n];
    for (int i = 0; i < n; i++) isCompleted[i] = 0;
    while (completed < n) {
        minIdx = -1;
        int minBurst = INT_MAX;
        for (int i = 0; i < n; i++) {
            if (!isCompleted[i] && p[i].arrival <= time && p[i].burst < minBurst) {
                minBurst = p[i].burst;
                minIdx = i;
            }
        }
        if (minIdx == -1) { time++; continue; }
        p[minIdx].completion = time + p[minIdx].burst;
        p[minIdx].turnaround = p[minIdx].completion - p[minIdx].arrival;
        p[minIdx].waiting = p[minIdx].turnaround - p[minIdx].burst;
        time = p[minIdx].completion;
        isCompleted[minIdx] = 1;
```

```
        completed++;
    }
}

void display(Process p[], int n) {
    printf("\nPID Arrival Burst Completion Turnaround Waiting\n");
    float totalWT = 0, totalTAT = 0;
    for (int i = 0; i < n; i++) {
        printf("%3d %7d %6d %10d %10d %8d\n", p[i].id, p[i].arrival, p[i].burst, p[i].completion,
p[i].turnaround, p[i].waiting);
        totalWT += p[i].waiting;
        totalTAT += p[i].turnaround;
    }
    printf("\nAverage Waiting Time: %.2f\n", totalWT / n);
    printf("Average Turnaround Time: %.2f\n", totalTAT / n);
}

int main() {
    int n;
    printf("Enter number of processes: ");
    scanf("%d", &n);
    Process p[n];
    printf("Enter Arrival Time and Burst Time for each process:\n");
    for (int i = 0; i < n; i++) {
        p[i].id = i + 1;
        printf("P[%d]: ", i + 1);
        scanf("%d %d", &p[i].arrival, &p[i].burst);
    }
    printf("\nShortest Job First (Non-Preemptive) Scheduling\n");
    sjf_non_preemptive(p, n);
    display(p, n);
    return 0;
```

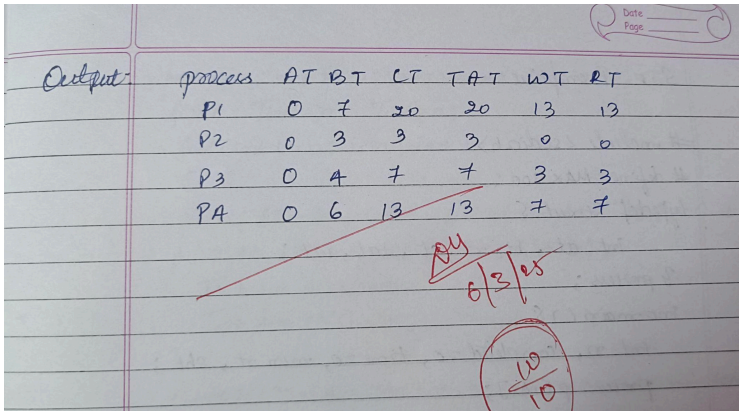
}

Result:





```
P1 Arrival Time: 0
P1 Burst Time: 7
P2 Arrival Time: 0
P2 Burst Time: 3
P3 Arrival Time: 0
P3 Burst Time: 4
P4 Arrival Time: 0
P4 Burst Time: 6

Process AT      BT      CT      TAT     WT      RT
P1      0       7       20      20      13      13
P2      0       3       3       3       0       0
P3      0       4       7       7       3       3
P4      0       6       13      13      7       7

Process returned 0 (0x0)   execution time : 14.656 s
Press any key to continue.
```



Output:

process	AT	BT	CT	TAT	WT	RT
P1	0	7	20	20	13	13
P2	0	3	3	3	0	0
P3	0	4	7	7	3	3
PA	0	6	13	13	7	7

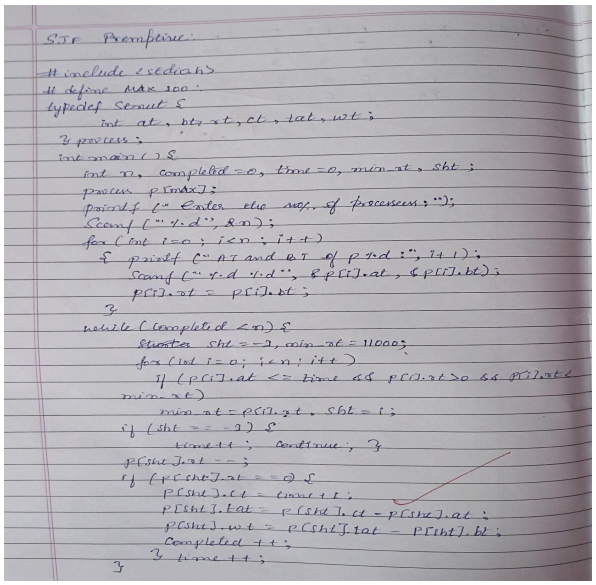
=>SJF(preemptive):

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

typedef struct {
   int id, arrival, burst, remaining, waiting, turnaround, completion,response,started;
} Process;

void sortByArrival(Process p[], int n) {
   for (int i = 0; i < n - 1; i++) {
      for (int j = 0; j < n - i - 1; j++) {
         if (p[j].arrival > p[j + 1].arrival) {
            Process temp = p[j];
            p[j]=p[j+1];
            p[j+1]=temp;
         }
      }
   }
}

void sjfPreemptive(Process p[], int n) {
   int completed = 0, time = 0, minIndex, minBurst;

   while (completed < n) {
      minIndex = -1, minBurst = INT_MAX;
      for (int i = 0; i < n; i++) {
         if (p[i].arrival <= time && p[i].remaining > 0) {
            if (p[i].remaining < minBurst || (p[i].remaining == minBurst && p[i].arrival <
p[minIndex].arrival)) {
               minBurst = p[i].remaining;
               minIndex = i;
            }
         }
```

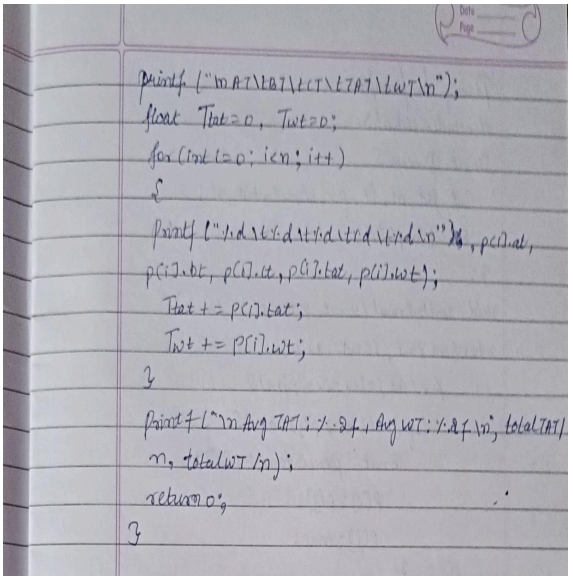
```
        }

        if (minIndex == -1) {
            time++;
            continue;
        }
        if (p[minIndex].started == 0) {
            p[minIndex].response = time - p[minIndex].arrival;
            p[minIndex].started = 1;
        }
        p[minIndex].remaining--;
        time++;
        if (p[minIndex].remaining == 0) {
            p[minIndex].completion = time;
            p[minIndex].turnaround = p[minIndex].completion - p[minIndex].arrival;
            p[minIndex].waiting = p[minIndex].turnaround - p[minIndex].burst;
            completed++;
        }
    }
}

void displayResults(Process p[], int n, const char *title) {
    printf("\n--- %s ---\n", title);
    printf("\nPID\tAT\tBT\tCT\tTAT\tWT\tRT\n");
    float totalWT = 0, totalTAT = 0, totalRT = 0;
    for (int i = 0; i < n; i++) {
        printf("P%d\t%d\t%d\t%d\t%d\t%d\t%d\n", p[i].id, p[i].arrival, p[i].burst, p[i].completion,
p[i].turnaround, p[i].waiting, p[i].response);
        totalWT += p[i].waiting;
        totalTAT += p[i].turnaround;
        totalRT += p[i].response;
    }
```

```
    printf("Average Waiting Time: %.2f\n", totalWT / n);
    printf("Average Turnaround Time: %.2f\n", totalTAT / n);
    printf("Average Response Time: %.2f\n", totalRT / n);
}

int main() {
    int n, choice;
    printf("Enter number of processes: ");
    scanf("%d", &n);
    Process p[n], temp[n];
    printf("Enter Arrival Time and Burst Time:\n");
    for (int i = 0; i < n; i++) {
        p[i].id = i + 1; // Auto-generate PID
        scanf("%d %d", &p[i].arrival, &p[i].burst);
        p[i].remaining = p[i].burst;
        p[i].waiting = p[i].turnaround = p[i].completion = p[i].response = p[i].started = 0;
    }
    sjfPreemptive(p, n);
    displayResults(p, n, "Shortest Job First (Preemptive)");
    return 0;
}
```

Result:

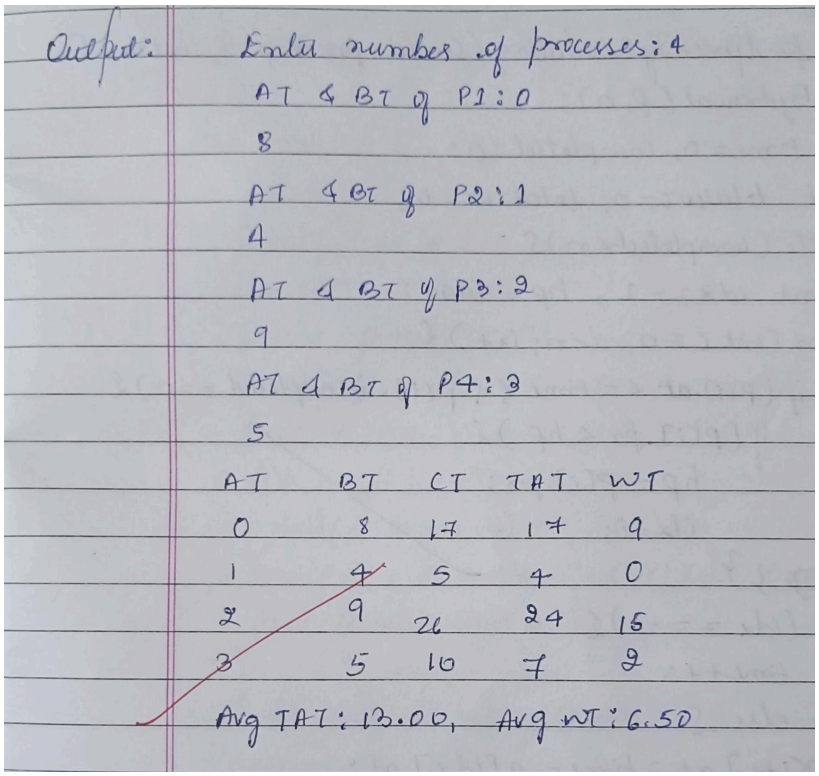


```
SJF Premptive:

#include<stdio.h>
#define MAX 100
typedef struct {
    int at, bt, rt, ct, tat, wt;
} process;
int main() {
    int n, completed=0, time=0, min_at, sht;
    process p[MAX];
    printf("Enter the no. of processes:");
    scanf("%d",&n);
    for(int i=0; i<n; i++)
    {  printf("AT and BT of p%d:", i+1);
       scanf("%d %d", &p[i].at, &p[i].bt);
       p[i].rt = p[i].bt;
    }
    while(completed<n) {
        shorter sht=-1, min_at=11000;
        for(int i=0; i<n; i++)
          if(p[i].at<=time && p[i].rt>0 && p[i].rt<
        min_at)
            min_at=p[i].at, sht=i;
        if(sht==-1) {
            time++; continue; }
        p[sht].rt--;
        if(p[sht].rt==0) {
            p[sht].ct = time+1;
            p[sht].tat = p[sht].ct - p[sht].at;
            p[sht].wt = p[sht].tat - p[sht].bt;
            completed++;
        } time++;
    }
```



```
printf("\nAT\tBT\tCT\tTAT\tWT\n");
float Tat=0, Twt=0;
for(int i=0; i<n; i++)
{
printf("%d\t%d\t%d\t%d\t%d\n", p[i].at,
p[i].bt, p[i].ct, p[i].tat, p[i].wt);
  Tat += p[i].tat;
  Twt += p[i].wt;
}
printf("\nAvg TAT: %.2f, Avg WT: %.2f\n", totalTAT/
n, totalWT/n);
return 0;
}
```

```
uments\vicky042\SJF preemptive.exe"
ocesses: 4
 and burst time for process 1: 0

 and burst time for process 2: 1

 and burst time for process 3: 2

 and burst time for process 4: 3


     WT      TAT
     9       17
     0       4
     15      24
     2       7

 (0x0)   execution time : 37.778 s
ontinue.
```



Program - 2

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

=>CPU SCHEDULING:

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

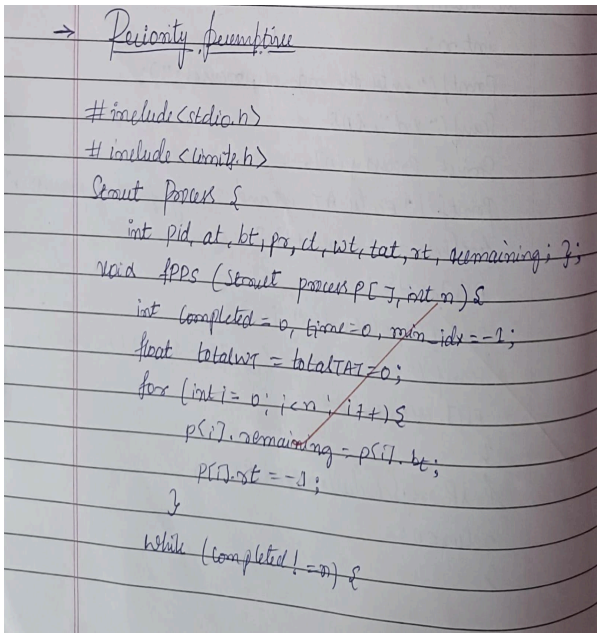
```
#define MAX 10
typedef struct {
    int pid, at, bt, pt, remaining_bt, ct, tat, wt, rt, is_completed, st;
} Process;
void nonPreemptivePriority(Process p[], int n) {
    int time = 0, completed = 0;

    while (completed < n) {
        int lowest_priority = 9999, selected = -1;
        for (int i = 0; i < n; i++) {
            if (p[i].at <= time && !p[i].is_completed && p[i].pt < lowest_priority) {
                lowest_priority = p[i].pt;
                selected = i;
            }
        }
        if (selected == -1) {
            time++;
            continue;
        }
        if (p[selected].rt == -1) {
            p[selected].st = time;
            p[selected].rt = time - p[selected].at;
        }
        time += p[selected].bt;
        p[selected].ct = time;
        p[selected].tat = p[selected].ct - p[selected].at;
        p[selected].wt = p[selected].tat - p[selected].bt;
        p[selected].is_completed = 1;
        completed++;
    }
}
void preemptivePriority(Process p[], int n) {
```

```
    int time = 0, completed = 0;
    while (completed < n) {
        int lowest_priority = 9999, selected = -1;

        for (int i = 0; i < n; i++) {
            if (p[i].at <= time && p[i].remaining_bt > 0 && p[i].pt < lowest_priority) {
                lowest_priority = p[i].pt;
                selected = i;
            }
        }

        if (selected == -1) {
            time++;
            continue;
        }

        if (p[selected].rt == -1) {
            p[selected].st = time;
            p[selected].rt = time - p[selected].at;
        }

        p[selected].remaining_bt--;
        time++;

        if (p[selected].remaining_bt == 0) {
            p[selected].ct = time;
            p[selected].tat = p[selected].ct - p[selected].at;
            p[selected].wt = p[selected].tat - p[selected].bt;
            completed++;
        }
    }
}
```

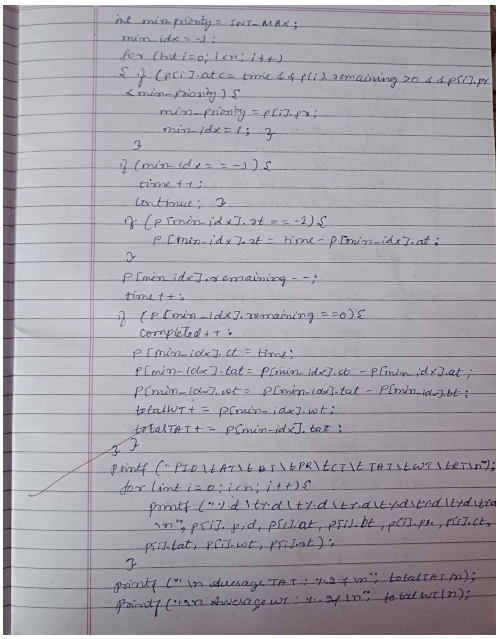
```
void displayProcesses(Process p[], int n) {
    float avg_tat = 0, avg_wt = 0, avg_rt = 0;
    printf("\nPID\tAT\tBT\tPriority\tCT\tTAT\tWT\tRT\n");
    for (int i = 0; i < n; i++) {
        printf("%d\t%d\t%d\t%d\t\t%d\t%d\t%d\t%d\n",
               p[i].pid, p[i].at, p[i].bt, p[i].pt, p[i].ct, p[i].tat, p[i].wt, p[i].rt);
        avg_tat += p[i].tat;
        avg_wt += p[i].wt;
        avg_rt += p[i].rt;
    }
    printf("\nAverage TAT: %.2f", avg_tat / n);
    printf("\nAverage WT: %.2f", avg_wt / n);
    printf("\nAverage RT: %.2f\n", avg_rt / n);
}
int main() {
    Process p[MAX];
    int n, choice;
    printf("Enter the number of processes: ");
    scanf("%d", &n);
    for (int i = 0; i < n; i++) {
        p[i].pid = i + 1;
        printf("\nEnter Arrival Time, Burst Time, and Priority for Process %d:\n", p[i].pid);
        printf("Arrival Time: ");
        scanf("%d", &p[i].at);
        printf("Burst Time: ");
        scanf("%d", &p[i].bt);
        printf("Priority (lower number means higher priority): ");
        scanf("%d", &p[i].pt);
        p[i].remaining_bt = p[i].bt;
        p[i].is_completed = 0;
        p[i].rt = -1;
    }
```

```
    while (1) {
        printf("\nPriority Scheduling Menu:\n");
        printf("1. Non-Preemptive Priority Scheduling\n");
        printf("2. Preemptive Priority Scheduling\n");
        printf("3. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                nonPreemptivePriority(p, n);
                printf("Non-Preemptive Scheduling Completed!\n");
                displayProcesses(p, n);
                break;
            case 2:
                preemptivePriority(p, n);
                printf("Preemptive Scheduling Completed!\n");
                displayProcesses(p, n);
                break;
            case 3:
                printf("Exiting...\n");
                return 0;
            default:
                printf("Invalid choice! Try again.\n");
        }
    }
    return 0;
}
```

Result:

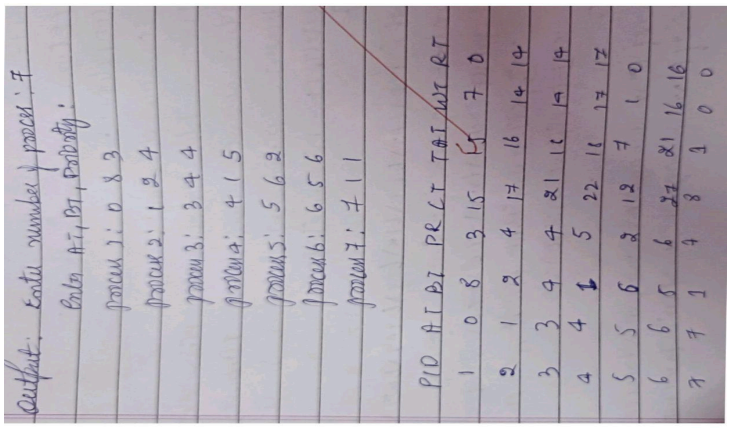


```
→ Priority preemptive

#include<stdio.h>
#include<limits.h>
Struct Process {
    int pid, at, bt, pr, ct, wt, tat, rt, remaining; };
void fpps (struct process p[], int n) {
    int completed = 0, time = 0, min_idx = -1;
    float totalwt = totalTAT = 0;
    for (int i = 0; i<n; i++) {
        p[i].remaining = p[i].bt;
        p[i].rt = -1;
    }
    while (completed != n) {
```



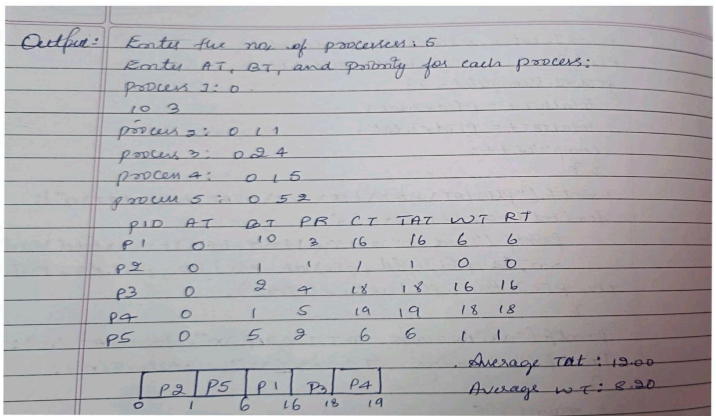
```
int min_priority = INT_MAX;
min_idx = -1;
for (int i=0; i<n; i++)
{ if (p[i].at<= time && p[i].remaining>0 && p[i].pr
<min_priority) {
    min_priority = p[i].pr;
    min_idx = i; }
}
if (min_idx == -1) {
  time++;
  continue; }
if (p[min_idx].rt == -1) {
  p[min_idx].rt = time - p[min_idx].at;
}
p[min_idx].remaining--;
time++;
if (p[min_idx].remaining == 0) {
  completed++;
  p[min_idx].ct = time;
  p[min_idx].tat = p[min_idx].ct - p[min_idx].at;
  p[min_idx].wt = p[min_idx].tat - p[min_idx].bt;
  totalWT += p[min_idx].wt;
  totalTAT += p[min_idx].tat;
}
printf("PID\tAT\tBT\tPR\tCT\tTAT\tWT\tRT\n");
for (int i=0; i<n; i++) {
  printf("%d\t%d\t%d\t%d\t%d\t%d\t%d\t%d
  \n", p[i].pid, p[i].at, p[i].bt, p[i].pr, p[i].ct,
  p[i].tat, p[i].wt, p[i].rt);
}
printf("\n Average TAT : %.2f\n", totalTAT/n);
printf("\n Average WT : %.2f\n", totalWT/n);
```

```
Enter the number of processes: 5
Enter Arrival Time, Burst Time, and Priority for each process:
Process 1: 0
10
3
Process 2: 0
1
1
Process 3: 0
2
4
Process 4: 0
1
5
Process 5: 0
5
2
PID AT  BT  PR  CT  TAT WT  RT
1   0   10  3   16  16  6   6
2   0   1   1   1   1   0   0
3   0   2   4   18  18  16  16
4   0   1   5   19  19  18  18
5   0   5   2   6   6   1   1

Average Turnaround Time: 12.00
Average Waiting Time: 8.20
```



Output: Enter number of process: 7
Enter AT, BT, Priority:
process 1: 0 8 3
process 2: 1 2 4
process 3: 3 4 4
process 4: 4 1 5
process 5: 5 6 2
process 6: 6 5 6
process 7: 7 1 1

PID	AT	BT	PR	CT	TAT	WT	RT
1	0	8	3	15	15	7	0
2	1	2	4	17	16	14	14
3	3	4	4	21	18	14	14
4	4	1	5	22	18	17	17
5	5	6	2	12	7	1	0
6	6	5	6	27	21	16	16
7	7	1	1	8	1	0	0



Output: Enter the no. of processes: 5
Enter AT, BT, and Priority for each process:
Process 1: 0
10 3
process 2: 0 1 1
process 3: 0 2 4
process 4: 0 1 5
process 5: 0 5 2

PID	AT	BT	PR	CT	TAT	WT	RT
P1	0	10	3	16	16	6	6
P2	0	1	1	1	1	0	0
P3	0	2	4	18	18	16	16
P4	0	1	5	19	19	18	18
P5	0	5	2	6	6	1	1

Average TAT: 13.00
Average WT: 8.20

Program - 3

Write a C program to simulate a 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.

=>MULTI LEVEL SCHEDULING:

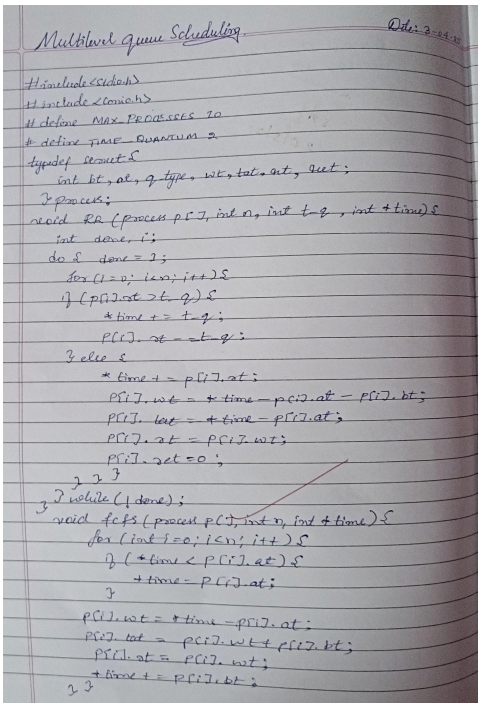
```
#include <stdio.h>
#define MAX_PROCESSES 10
#define TIME_QUANTUM 2
typedef struct {
    int burst_time, arrival_time, queue_type, waiting_time, turnaround_time, response_time, remaining_time;
} Process;
```

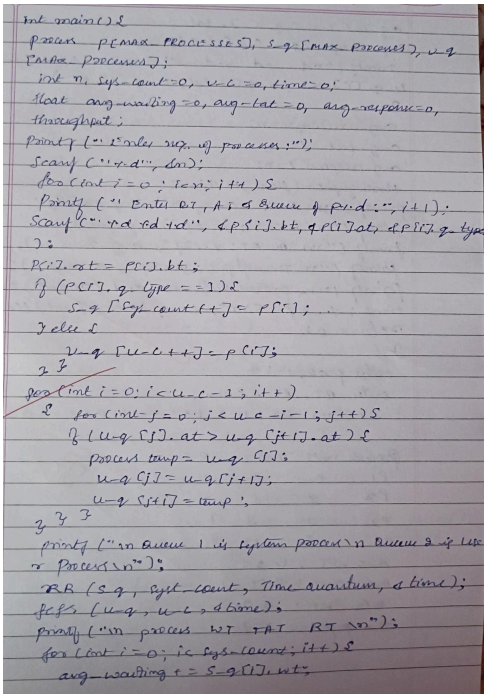
```
void round_robin(Process processes[], int n, int time_quantum, int *time) {
    int done, i;
    do {
        done = 1;
        for (i = 0; i < n; i++) {
            if (processes[i].remaining_time > 0) {
                done = 0;
                if (processes[i].remaining_time > time_quantum) {
                    *time += time_quantum;
                    processes[i].remaining_time -= time_quantum;
                } else {
                    *time += processes[i].remaining_time;
                    processes[i].waiting_time = *time - processes[i].arrival_time - processes[i].burst_time;
                    processes[i].turnaround_time = *time - processes[i].arrival_time;
                    processes[i].response_time = processes[i].waiting_time;
                    processes[i].remaining_time = 0;
                }
            }
        }
    } while (!done);
}

void fcfs(Process processes[], int n, int *time) {
    for (int i = 0; i < n; i++) {
        if (*time < processes[i].arrival_time) {
            *time = processes[i].arrival_time;
        }
        processes[i].waiting_time = *time - processes[i].arrival_time;
        processes[i].turnaround_time = processes[i].waiting_time + processes[i].burst_time;
        processes[i].response_time = processes[i].waiting_time;
        *time += processes[i].burst_time;
    }
```

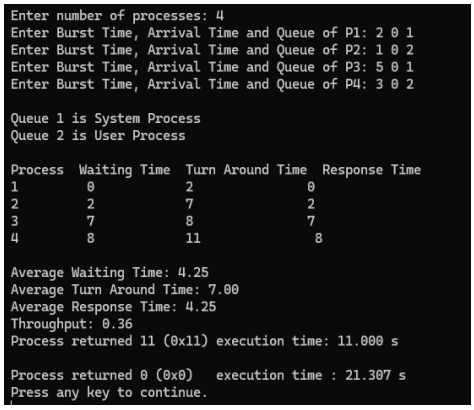
```
}

int main() {
    Process processes[MAX_PROCESSES], system_queue[MAX_PROCESSES],
user_queue[MAX_PROCESSES];
    int n, sys_count = 0, user_count = 0, time = 0;
    float avg_waiting = 0, avg_turnaround = 0, avg_response = 0, throughput;
    printf("Enter number of processes: ");
    scanf("%d", &n);
    for (int i = 0; i < n; i++) {
        printf("Enter Burst Time, Arrival Time and Queue of P%d: ", i + 1);
        scanf("%d %d %d", &processes[i].burst_time, &processes[i].arrival_time,
&processes[i].queue_type);
        processes[i].remaining_time = processes[i].burst_time;
        if (processes[i].queue_type == 1) {
            system_queue[sys_count++] = processes[i];
        } else {
            user_queue[user_count++] = processes[i];
        }
    }
    for (int i = 0; i < user_count - 1; i++) {
        for (int j = 0; j < user_count - i - 1; j++) {
            if (user_queue[j].arrival_time > user_queue[j + 1].arrival_time) {
                Process temp = user_queue[j];
                user_queue[j] = user_queue[j + 1];
                user_queue[j + 1] = temp;
            }
        }
    }
    printf("\nQueue 1 is System Process\nQueue 2 is User Process\n");
    round_robin(system_queue, sys_count, TIME_QUANTUM, &time);
    fcfs(user_queue, user_count, &time);
```

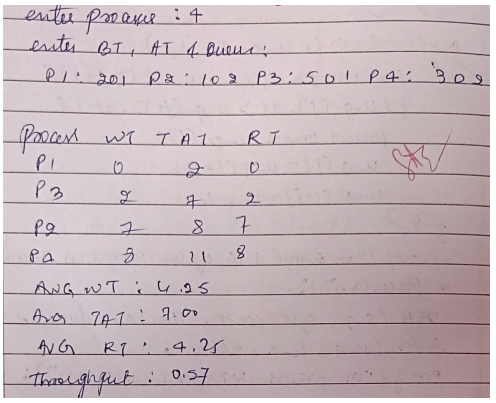
```
    printf("\nProcess  Waiting Time  Turn Around Time  Response Time\n");
    for (int i = 0; i < sys_count; i++) {
        avg_waiting += system_queue[i].waiting_time;
        avg_turnaround += system_queue[i].turnaround_time;
        avg_response += system_queue[i].response_time;
        printf("%d        %d          %d              %d\n", i + 1, system_queue[i].waiting_time,
system_queue[i].turnaround_time, system_queue[i].response_time);
    }
    for (int i = 0; i < user_count; i++) {
        avg_waiting += user_queue[i].waiting_time;
        avg_turnaround += user_queue[i].turnaround_time;
        avg_response += user_queue[i].response_time;
        printf("%d        %d          %d              %d\n", i + 1 + sys_count, user_queue[i].waiting_time,
user_queue[i].turnaround_time, user_queue[i].response_time);
    }
    avg_waiting /= n;
    avg_turnaround /= n;
    avg_response /= n;
    throughput = (float)n / time;
    printf("\nAverage Waiting Time: %.2f", avg_waiting);
    printf("\nAverage Turn Around Time: %.2f", avg_turnaround);
    printf("\nAverage Response Time: %.2f", avg_response);
    printf("\nThroughput: %.2f", throughput);
    printf("\nProcess returned %d (0x%d) execution time: %.3f s\n", time, time, (float)time);
    return 0;
}
```

Result:









Program -4

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

a) Rate- Monotonic
b) Earliest-deadline First

=> Rate Monotonic

```
#include <stdio.h>
#define MAX_PROCESSES 10
```

```
typedef struct {
    int id;
    int burst_time;
    int period;
    int remaining_time;
    int next_deadline;
} Process;

void sort_by_period(Process processes[], int n) {
    for (int i = 0; i < n - 1; i++) {
        for (int j = 0; j < n - i - 1; j++) {
            if (processes[j].period > processes[j + 1].period) {
                Process temp = processes[j];
                processes[j] = processes[j + 1];
                processes[j + 1] = temp;
            }
        }
    }
}

int gcd(int a, int b) {
    return b == 0 ? a : gcd(b, a % b);
}
int lcm(int a, int b) {
    return (a * b) / gcd(a, b);
}

int calculate_lcm(Process processes[], int n) {
    int result = processes[0].period;
    for (int i = 1; i < n; i++) {
        result = lcm(result, processes[i].period);
    }
```

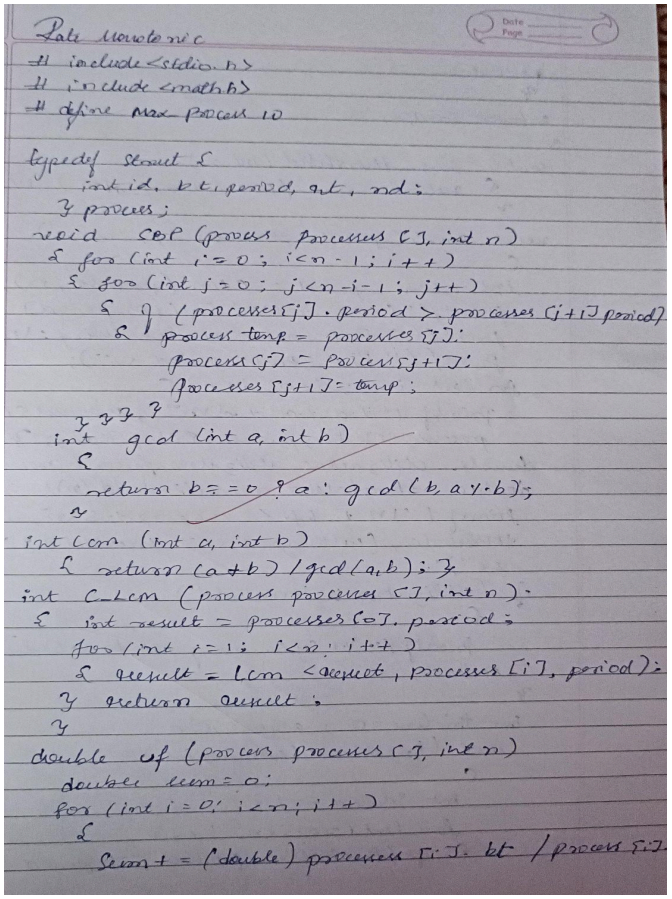
```
    return result;
}

double utilization_factor(Process processes[], int n) {
    double sum = 0;
    for (int i = 0; i < n; i++) {
        sum += (double)processes[i].burst_time / processes[i].period;
    }
    return sum;
}
double rms_threshold(int n) {
    return n * (pow(2.0, 1.0 / n) - 1);
}

void rate_monotonic_scheduling(Process processes[], int n) {
    int lcm_period = calculate_lcm(processes, n);
    printf("LCM=%d\n\n", lcm_period);
    printf("Rate Monotone Scheduling:\n");
    printf("PID  Burst  Period\n");
    for (int i = 0; i < n; i++) {
        printf("%d    %d      %d\n", processes[i].id, processes[i].burst_time, processes[i].period);
    }

    double utilization = utilization_factor(processes, n);
    double threshold = rms_threshold(n);
    printf("\n%.6f <= %.6f => %s\n", utilization, threshold, (utilization <= threshold) ? "true" :
"false");
    if (utilization > threshold) {
        printf("\nSystem may not be schedulable!\n");
        return;
    }
    int timeline = 0, executed = 0;
```

```
    while (timeline < lcm_period) {
        int selected = -1;
        for (int i = 0; i < n; i++) {
            if (timeline % processes[i].period == 0) {
                processes[i].remaining_time = processes[i].burst_time;
            }
            if (processes[i].remaining_time > 0) {
                selected = i;
                break;
            }
        }
        if (selected != -1) {
            printf("Time %d: Process %d is running\n", timeline, processes[selected].id);
            processes[selected].remaining_time--;
            executed++;
        } else {
            printf("Time %d: CPU is idle\n", timeline);
        }
        timeline++;
    }
}


int main() {
    int n;
    Process processes[MAX_PROCESSES];
    printf("Enter the number of processes: ");
    scanf("%d", &n);
    printf("Enter the CPU burst times:\n");
    for (int i = 0; i < n; i++) {
        processes[i].id = i + 1;
        scanf("%d", &processes[i].burst_time);
```

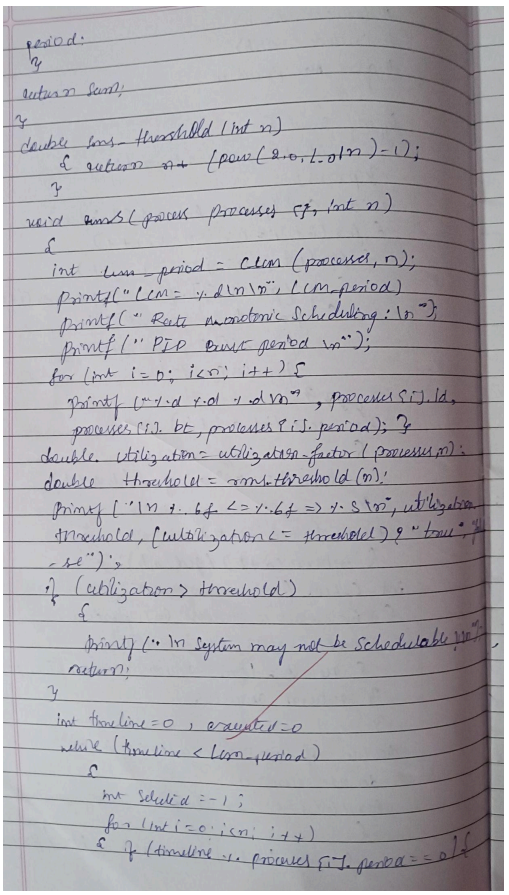
```
        processes[i].remaining_time = processes[i].burst_time;
    }
    printf("Enter the time periods:\n");
    for (int i = 0; i < n; i++) {
        scanf("%d", &processes[i].period);
    }
    sort_by_period(processes, n);
    rate_monotonic_scheduling(processes, n);
    return 0;
}
```

Result :

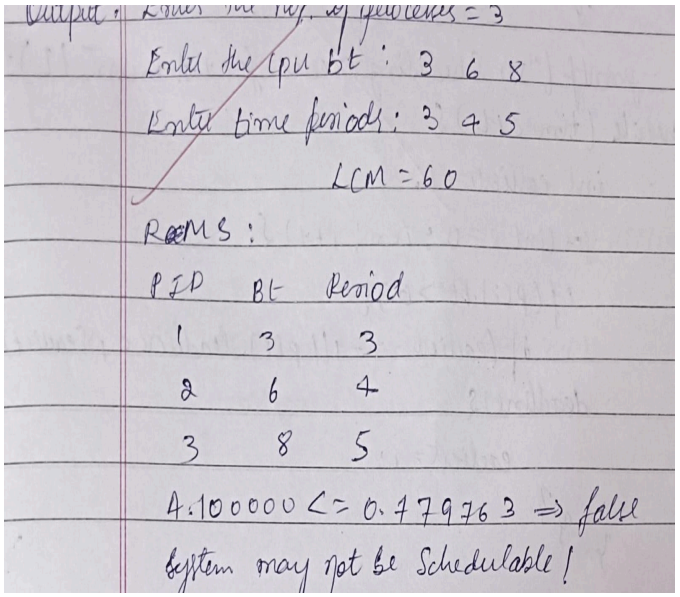
```
Enter the number of processes: 3
Enter the CPU burst times:
3
6 8
Enter the time periods:
3 4 5
LCM=60

Rate Monotone Scheduling:
PID  Burst  Period
1    3      3
2    6      4
3    8      5

4.100000 <= 0.779763 => false

System may not be schedulable!

Process returned 0 (0x0)   execution time : 18.410 s
Press any key to continue.
```



```
Rate Monotonic
#include <stdio.h>
#include <math.h>
#define Max_Process 10

typedef struct {
    int id, bt, period, rt, nd;
} process;
void sort(process processes[], int n)
{ for (int i=0; i<n-1; i++)
  { for (int j=0; j<n-i-1; j++)
    { if (processes[j].period > processes[j+1].period)
      { process temp = processes[j];
        processes[j] = processes[j+1];
        processes[j+1] = temp;
      }}}}
int gcd(int a, int b)
{
    return b==0 ? a : gcd(b, a%b);
}
int lcm(int a, int b)
{ return (a*b)/gcd(a,b); }
int c_lcm(process processes[], int n)
{ int result = processes[0].period;
  for(int i=1; i<n; i++)
  { result = lcm(result, processes[i].period);
  } return result;
}
double cf(process processes[], int n)
{
  double sum=0;
  for (int i=0; i<n; i++)
  {
    sum += (double) processes[i].bt / processes[i].
```



```
period;
}
return sum;
}
double rms_threshold(int n)
{ return n*(pow(2.0,1.0/n)-1); }
void rms(process processes[], int n)
{
  int lcm_period = c_lcm(processes, n);
  printf("LCM = %d\n\n", lcm_period);
  printf("Rate Monotonic Scheduling:\n");
  printf("PID Burst period\n");
  for (int i=0; i<n; i++) {
    printf("%-d %-d %-d\n", processes[i].id,
    processes[i].bt, processes[i].period); }
double utilization = utilization_factor(processes,n);
double threshold = rms_threshold(n);
printf("\n%.6f <= %.6f => %s\n", utilization,
threshold, (utilization <= threshold) ? "true" : "fal
se");
if (utilization > threshold)
{
  printf("\n System may not be Schedulable\n");
  return;
}
int timeline=0, executed=0
while (timeline < lcm_period)
{
  int Selected = -1;
  for (int i=0; i<n; i++)
  { if (timeline % processes[i].period == 0){
```



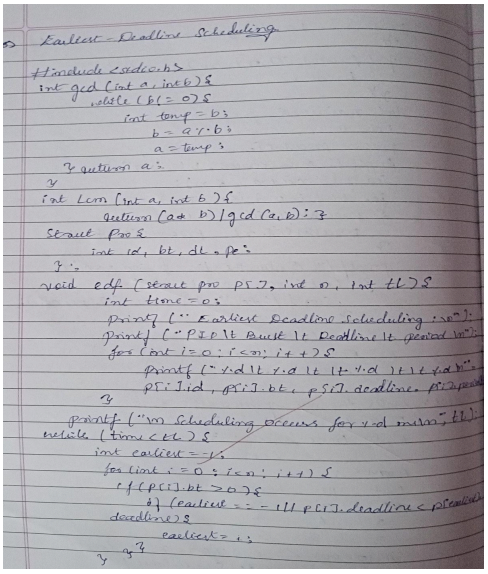
=> Earliest Deadline

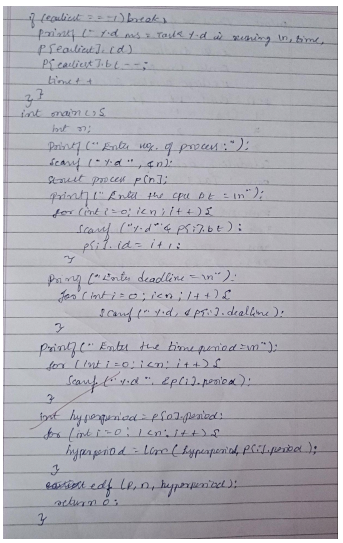
```
#include <stdio.h>
int gcd(int a, int b) {
    while (b != 0) {
        int temp = b;
        b = a % b;
        a = temp;
    }
    return a;
}

int lcm(int a, int b) {
    return (a * b) / gcd(a, b);
}

struct Process {
    int id, burst_time, deadline, period;
};
```

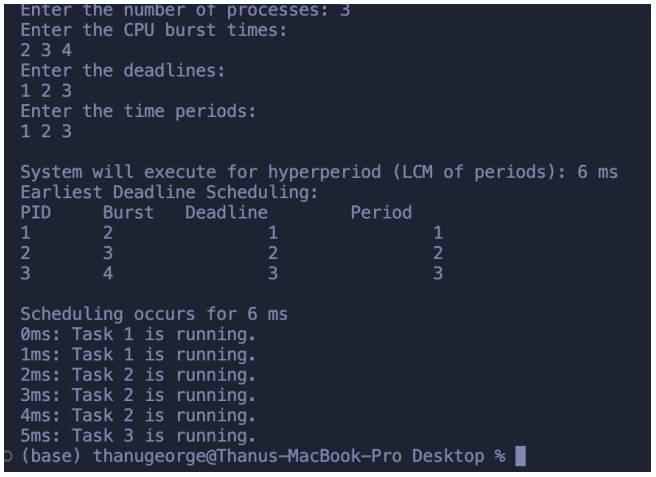
```
void earliest_deadline_first(struct Process p[], int n, int time_limit) {
    int time = 0;
    printf("Earliest Deadline Scheduling:\n");
    printf("PID\tBurst\tDeadline\tPeriod\n");
    for (int i = 0; i < n; i++) {
        printf("%d\t%d\t\t%d\t\t%d\n", p[i].id, p[i].burst_time, p[i].deadline, p[i].period);
    }

    printf("\nScheduling occurs for %d ms\n", time_limit);
    while (time < time_limit) {
        int earliest = -1;
        for (int i = 0; i < n; i++) {
            if (p[i].burst_time > 0) {
                if (earliest == -1 || p[i].deadline < p[earliest].deadline) {
                    earliest = i;
                }
            }
        }
        if (earliest == -1) break;
        printf("%dms: Task %d is running.\n", time, p[earliest].id);
        p[earliest].burst_time--;
        time++;
    }
}

int main() {
    int n;
    printf("Enter the number of processes: ");
    scanf("%d", &n);
    struct Process processes[n];
    printf("Enter the CPU burst times:\n");
    for (int i = 0; i < n; i++) {
```

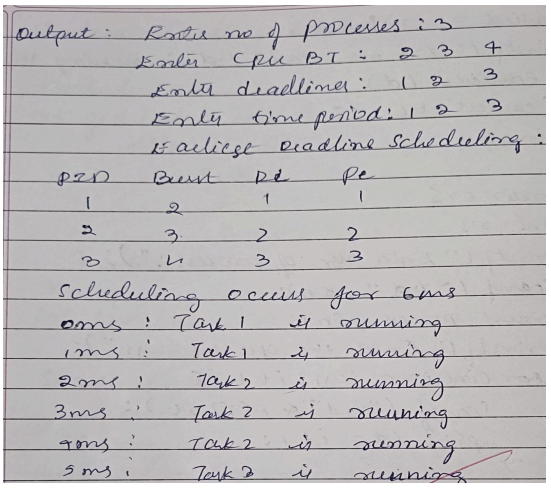
```
        scanf("%d", &processes[i].burst_time);
        processes[i].id = i + 1;
    }
    printf("Enter the deadlines:\n");
    for (int i = 0; i < n; i++) {
        scanf("%d", &processes[i].deadline);
    }
    printf("Enter the time periods:\n");
    for (int i = 0; i < n; i++) {
        scanf("%d", &processes[i].period);
    }
    int hyperperiod = processes[0].period;
    for (int i = 1; i < n; i++) {
        hyperperiod = lcm(hyperperiod, processes[i].period);
    }
    printf("\nSystem will execute for hyperperiod (LCM of periods): %d ms\n", hyperperiod);
    earliest_deadline_first(processes, n, hyperperiod);
    return 0;
}
```

Result:









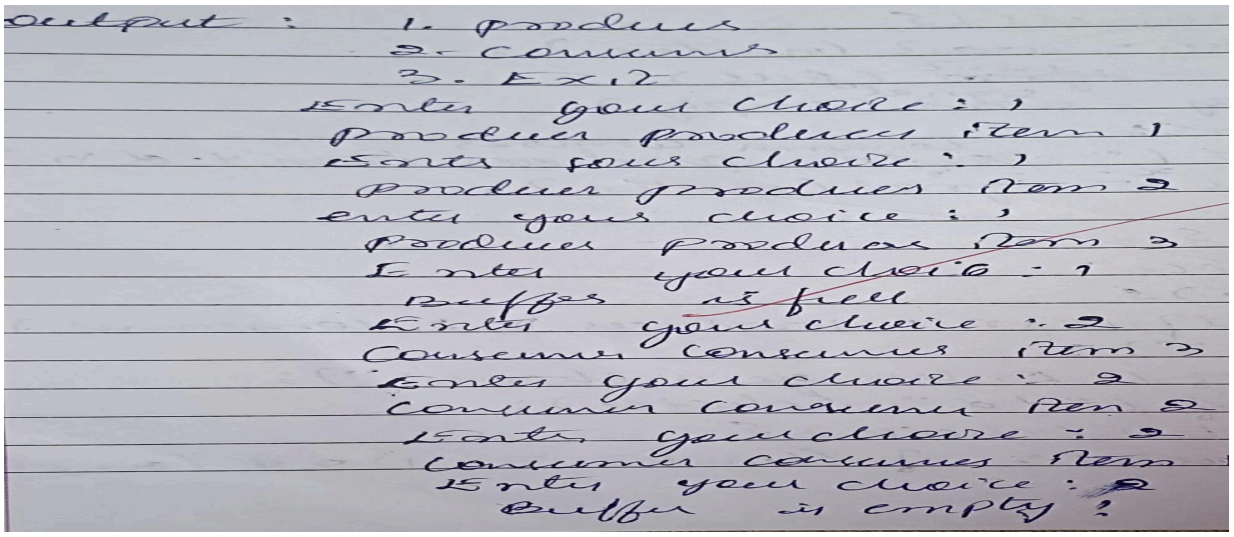
Program 5

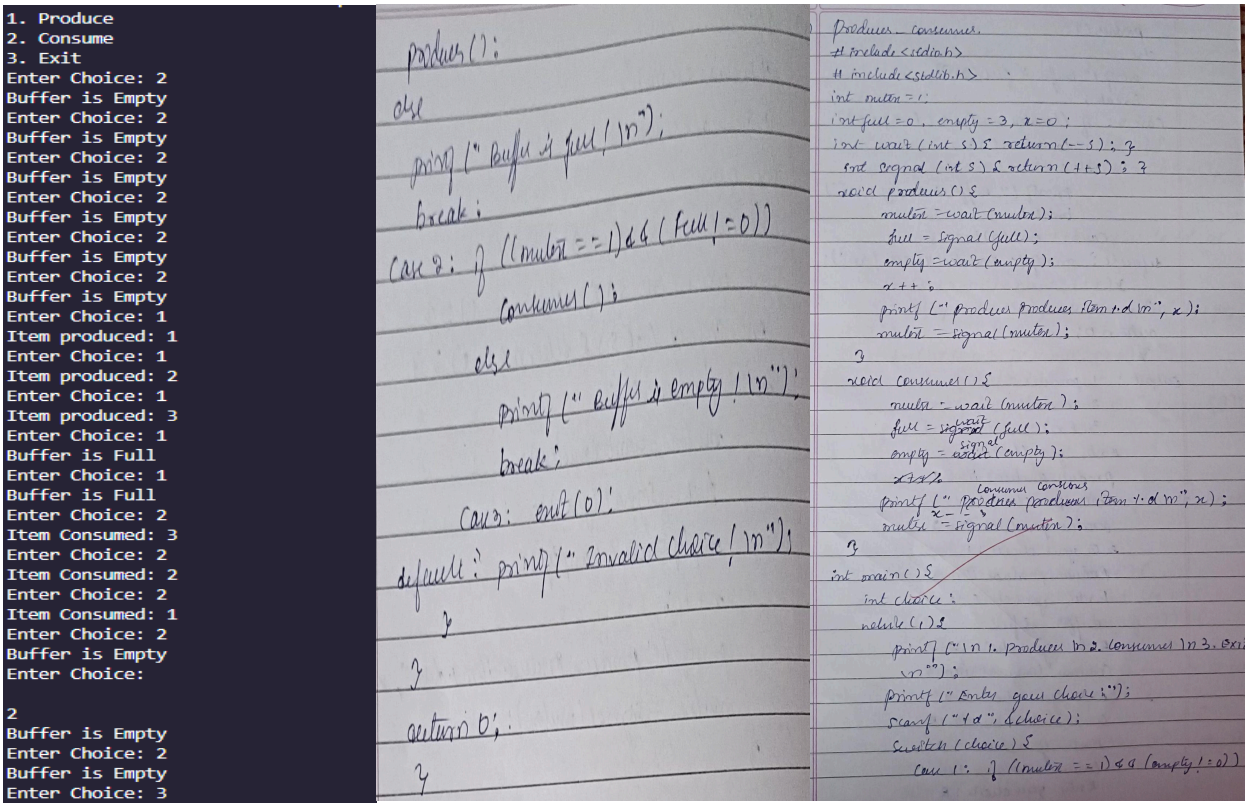
Write a C program to simulate producer-consumer problem using semaphores
=> Producer Consumer

```
#include <stdio.h>

int mutex = 1, full = 0, empty = 3, x = 0;

void wait(int *s) {
   --(*s);
}

void signal(int *s) {
   ++(*s);
}

void producer() {
   wait(&empty);
   wait(&mutex);
   x++;
   printf("The item produced is %d\n", x);
   signal(&mutex);
   signal(&full);
```

```
}

void consumer() {
    wait(&full);
    wait(&mutex);
    printf("Consumed item %d\n", x);
    x--;
    signal(&mutex);
    signal(&empty);
}

int main() {
    int choice;
    do {
        printf("\n1. Produce\n2. Consume\n3. Exit\nEnter choice: ");
        scanf("%d", &choice);
        switch (choice) {
            case 1:
                if ((mutex == 1) && (empty != 0)) {
                    producer();
                } else {
                    printf("The buffer is full\n");
                }
                break;
            case 2:
                if ((mutex == 1) && (full != 0)) {
                    consumer();
                } else {
                    printf("The buffer is empty\n");
                }
                break;
            case 3:
                printf("Exiting.\n");
                break;
            default:
                printf("Invalid choice.\n");
        }
    } while (choice != 3);
    return 0;
}
```

Result:


Output :
1. Produce
2. Consume
3. Exit
Enter your choice : 1
Producer produces item 1
Enter your choice : 1
Producer produces item 2
Enter your choice : 1
Producer produces item 3
Enter your choice : 1
Buffer is full
Enter your choice : 2
Consumer consumes item 3
Enter your choice : 2
Consumer consumes item 2
Enter your choice : 2
Consumer consumes item 1
Enter your choice : 2
Buffer is empty !


1. Produce
2. Consume
3. Exit
Enter Choice: 2
Buffer is Empty
Enter Choice: 2
Buffer is Empty
Enter Choice: 2
Buffer is Empty
Enter Choice: 2
Buffer is Empty
Enter Choice: 2
Buffer is Empty
Enter Choice: 2
Buffer is Empty
Enter Choice: 2
Buffer is Empty
Enter Choice: 1
Item produced: 1
Enter Choice: 1
Item produced: 2
Enter Choice: 1
Item produced: 3
Enter Choice: 1
Buffer is Full
Enter Choice: 1
Buffer is Full
Enter Choice: 2
Item Consumed: 3
Enter Choice: 2
Item Consumed: 2
Enter Choice: 2
Item Consumed: 1
Enter Choice: 2
Buffer is Empty
Enter Choice:
2
Buffer is Empty
Enter Choice: 2
Buffer is Empty
Enter Choice: 3

Program 6
Write a C program to simulate the concept of Dining Philosophers problem

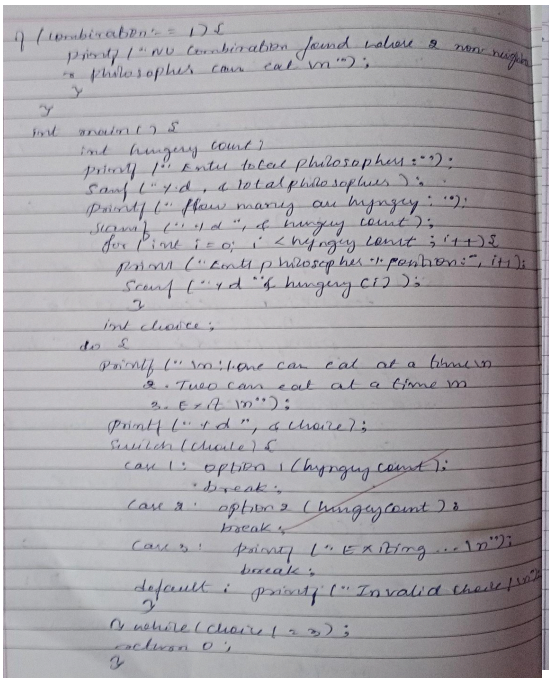
```
#include <pthread.h>
#include <semaphore.h>
#include <stdio.h>
#include <unistd.h>
#define N 5
#define THINKING 2
#define HUNGRY 1
#define EATING 0
#define LEFT (phnum + 4) % N
#define RIGHT (phnum + 1) % N

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

sem_t mutex;
sem_t S[N];

void* philosopher(void* num);
void take_fork(int phnum);
void put_fork(int phnum);
void test(int phnum);

int main() {
   int i;
   pthread_t thread_id[N];

   // initialize the semaphores
   sem_init(&mutex, 0, 1);

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

   for (i = 0; i < N; i++) {
      // create philosopher processes
      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);
```

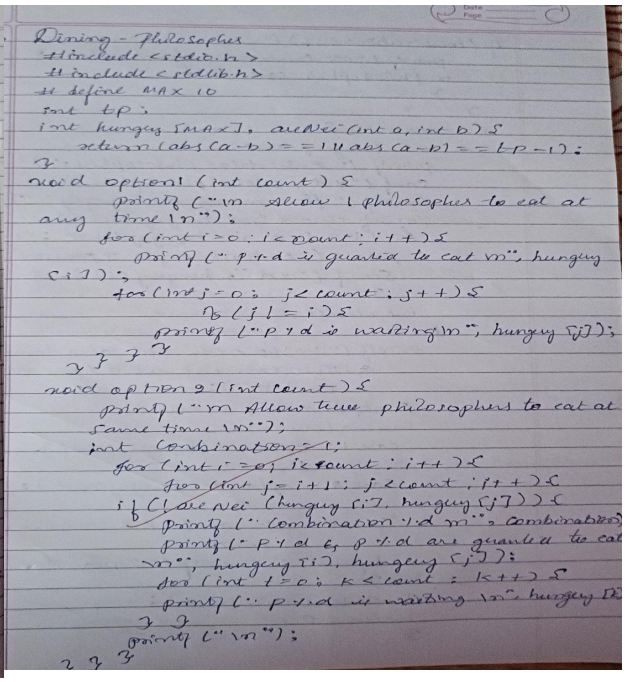
```
    return 0;
}

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

// take up chopsticks
void take_fork(int phnum) {
    sem_wait(&mutex);
    // state that hungry
    state[phnum] = HUNGRY;
    printf("Philosopher %d is Hungry\n", phnum + 1);

    // eat if neighbours are not eating
    test(phnum);
    sem_post(&mutex);
    // if unable to eat wait to be signalled
    sem_wait(&S[phnum]);
    sleep(1);
}

// put down chopsticks
void put_fork(int phnum) {
    sem_wait(&mutex);

    // state that thinking
    state[phnum] = THINKING;

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

    test(LEFT);
    test(RIGHT);
```

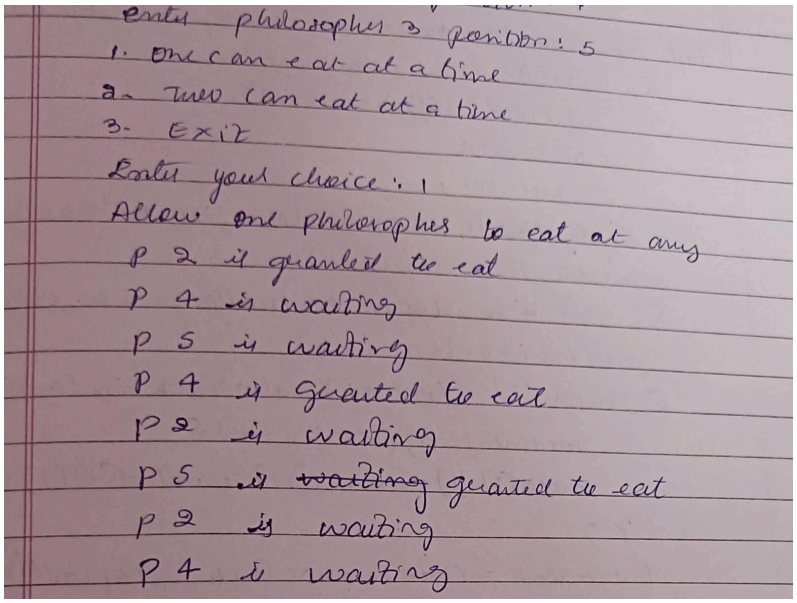
```
    sem_post(&mutex);
}

void* philosopher(void* num) {
    int* i = (int*)num;
    while (1) {
        sleep(1);
        take_fork(*i);
        sleep(0);
        put_fork(*i);
    }
}
```

Result:

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







Program 7

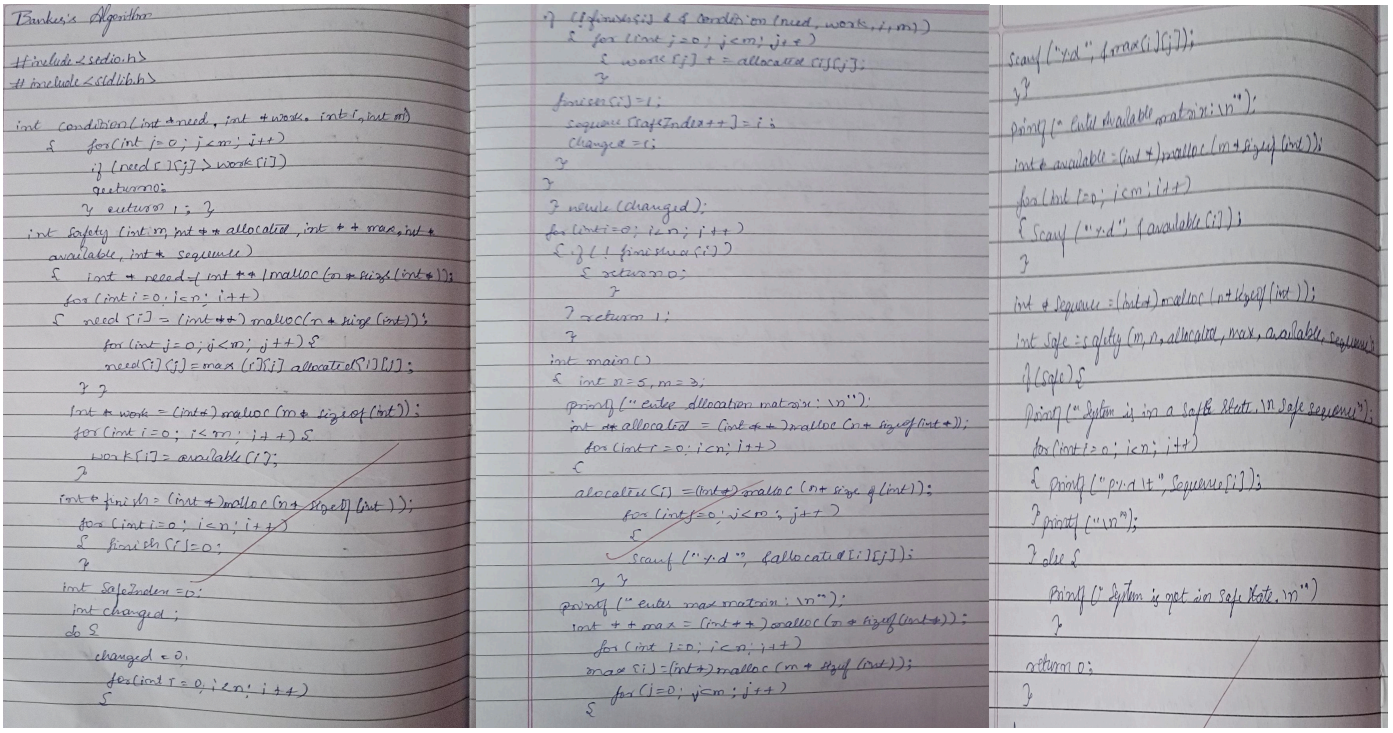
Write a C program to simulate Bankers algorithm for the purpose of deadlock avoidance.

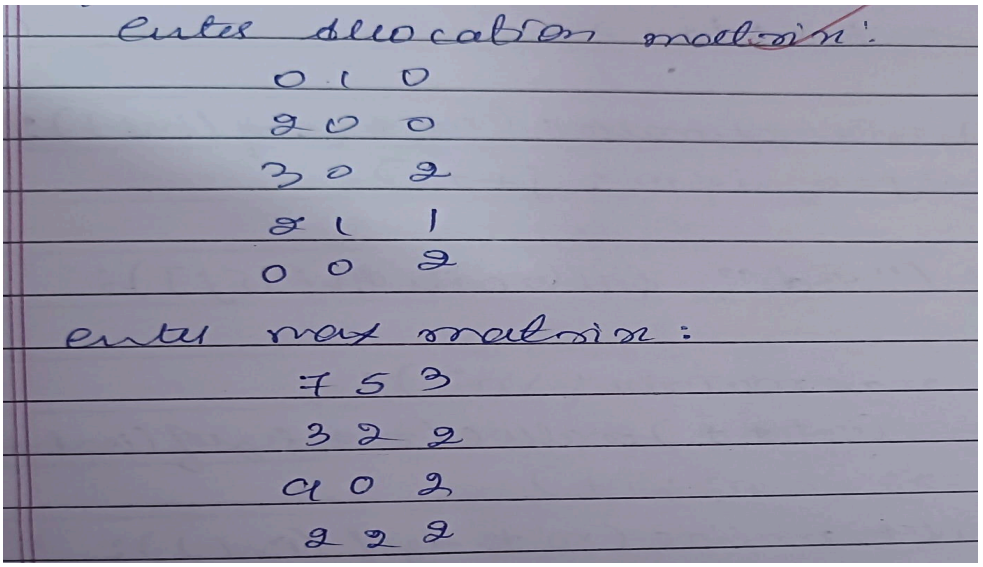
```
#include <stdio.h>
#include <stdbool.h>

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

   int alloc[n][m], max[n][m], avail[m];
   int need[n][m];

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

   printf("Enter max matrix (%d x %d):\n", n, m);
   for (i = 0; i < n; i++) {
      printf("Max for process %d: ", i);
```

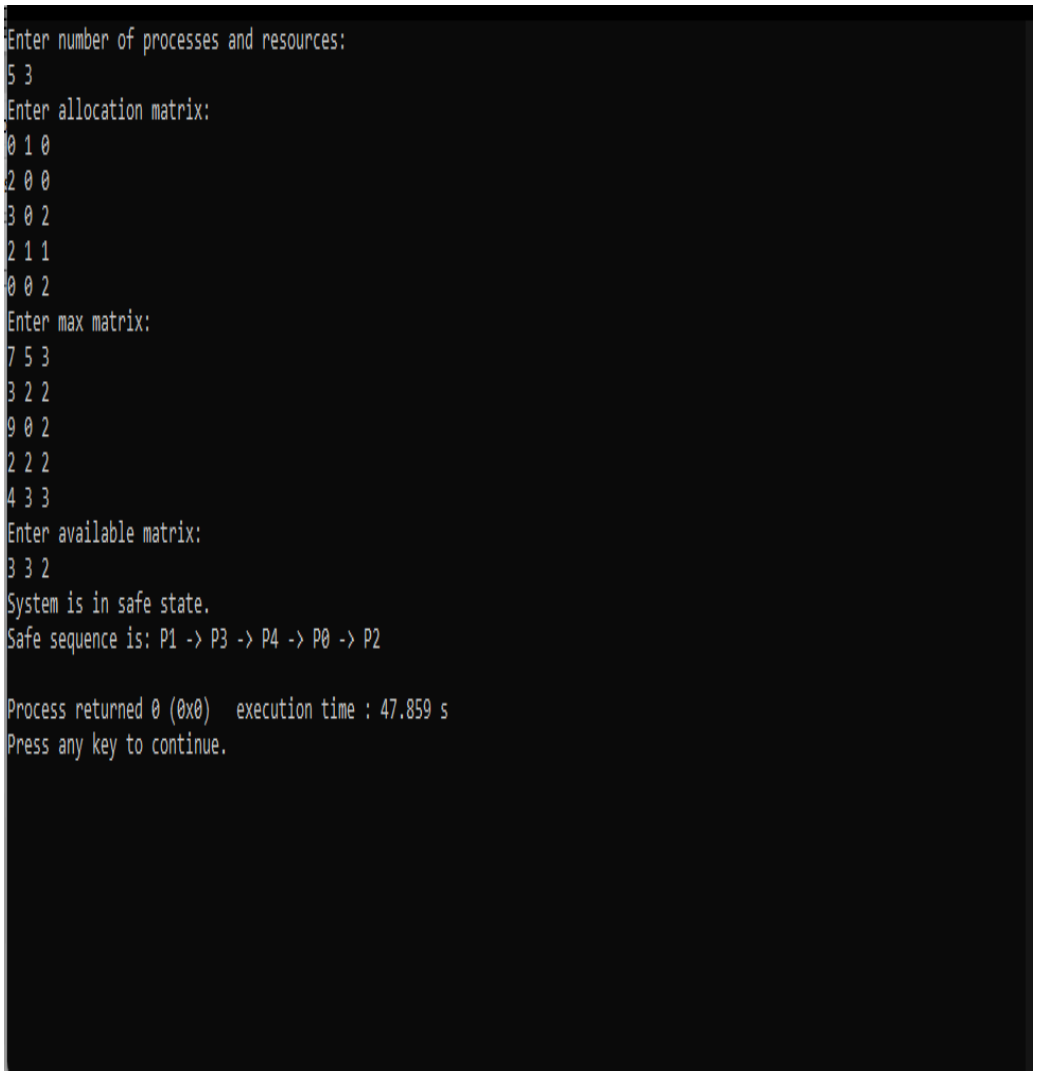
```
    for (j = 0; j < m; j++)
        scanf("%d", &max[i][j]);
}

printf("Enter available resources (%d values): ", m);
for (i = 0; i < m; i++)
    scanf("%d", &avail[i]);

for (i = 0; i < n; i++)
    for (j = 0; j < m; j++)
        need[i][j] = max[i][j] - alloc[i][j];

bool finish[n];
int safeSeq[n];
int count = 0;

for (i = 0; i < n; i++)
    finish[i] = false;

while (count < n) {
    bool found = false;
    for (i = 0; i < n; i++) {
        if (!finish[i]) {
            for (j = 0; j < m; j++)
                if (need[i][j] > avail[j])
                    break;

            if (j == m) {
                for (k = 0; k < m; k++)
                    avail[k] += alloc[i][k];

                safeSeq[count++] = i;
                finish[i] = true;
                found = true;
            }
        }
    }

    if (!found) {
        printf("System is not in safe state.\n");
        return 1;
    }
}
```

```
    printf("System is in safe state.\n");
    printf("Safe sequence is: ");
    for (i = 0; i < n; i++) {
        printf("P%d", safeSeq[i]);
        if (i != n - 1)
            printf(" -> ");
    }
    printf("\n");

    return 0;
}
```

Result:







Program 8
Write a C program to simulate deadlock detection

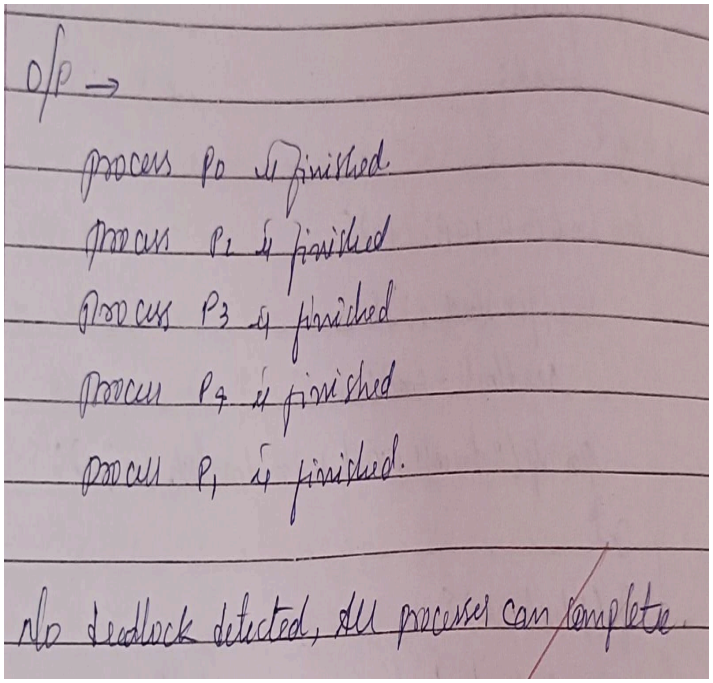
```
#include <stdio.h>
#include <stdbool.h>

int main() {
```

```
int n, m, i, j, k;

printf("Enter number of processes and resources:\n");
scanf("%d %d", &n, &m);

int allocation[n][m], request[n][m], available[m];
int work[m];
bool finish[n];

printf("Enter allocation matrix:\n");
for (i = 0; i < n; i++)
   for (j = 0; j < m; j++)
      scanf("%d", &allocation[i][j]);

printf("Enter request matrix:\n");
for (i = 0; i < n; i++)
   for (j = 0; j < m; j++)
      scanf("%d", &request[i][j]);

printf("Enter available matrix:\n");
for (i = 0; i < m; i++) {
   scanf("%d", &available[i]);
   work[i] = available[i];
}

for (i = 0; i < n; i++) {
   bool zero_allocation = true;
   for (j = 0; j < m; j++) {
      if (allocation[i][j] != 0) {
         zero_allocation = false;
         break;
      }
   }
   finish[i] = zero_allocation;
}

bool found_process;
do {
   found_process = false;
   for (i = 0; i < n; i++) {
      if (!finish[i]) {
         bool can_allocate = true;
         for (j = 0; j < m; j++) {
            if (request[i][j] > work[j]) {
```

```
                can_allocate = false;
                break;
            }
        }
        if (can_allocate) {
            for (k = 0; k < m; k++)
                work[k] += allocation[i][k];
            finish[i] = true;
            printf("Process %d can finish.\n", i);
            found_process = true;
        }
    }
  }
} while (found_process);

bool deadlock = false;
for (i = 0; i < n; i++) {
  if (!finish[i]) {
    deadlock = true;
    break;
  }
}

if (deadlock)
  printf("System is in a deadlock state.\n");
else
  printf("System is not in a deadlock state.\n");

return 0;
}
```

Result:

```
Enter number of processes and resources:
5 3
Enter allocation matrix:
0 1 0
2 0 0
3 0 2
2 1 1
0 0 2
Enter request matrix:
7 5 3
3 2 2
9 0 2
2 2 2
4 3 3
Enter available matrix:
3 3 2
Process 1 can finish.
Process 3 can finish.
Process 4 can finish.
System is in a deadlock state.

Process returned 0 (0x0)   execution time : 47.372 s
Press any key to continue.
```



Program 9:

Write a C program to simulate the following contiguous memory allocation techniques
a) Worst-fit
b)Best-fit
c)First-fit

```
#include <stdio.h>

struct Block {
   int size;
   int allocated;

};

struct File {
   int size;
   int block_no;
};

void resetBlocks(struct Block blocks[], int n) {
   for (int i = 0; i < n; i++) {
      blocks[i].allocated = 0;
   }
}

void firstFit(struct Block blocks[], int n_blocks, struct File files[], int n_files) {
   printf("\n\tMemory Management Scheme – First Fit\n");
   printf("File_no:\tFile_size\tBlock_no:\tBlock_size:\n");
   for (int i = 0; i < n_files; i++) {
      files[i].block_no = -1;
      for (int j = 0; j < n_blocks; j++) {
         if (!blocks[j].allocated && blocks[j].size >= files[i].size) {
            files[i].block_no = j + 1;
            blocks[j].allocated = 1;
            printf("%d\t\t%d\t\t%d\t\t%d\n", i + 1, files[i].size, j + 1, blocks[j].size);
            break;
         }
      }
      if (files[i].block_no == -1) {
         printf("%d\t\t%d\t\t_\t\t_\n", i + 1, files[i].size);
      }
   }
}
```

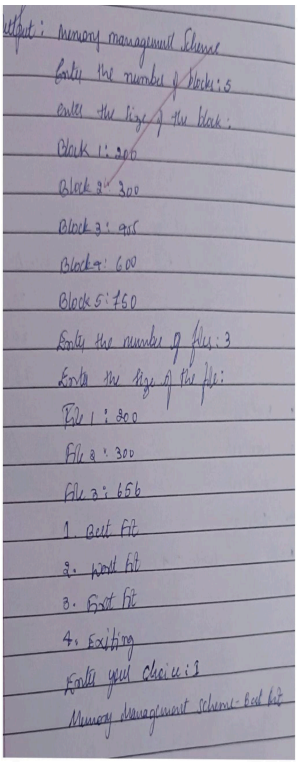
```
void bestFit(struct Block blocks[], int n_blocks, struct File files[], int n_files) {
   printf("\n\tMemory Management Scheme – Best Fit\n");
   printf("File_no:\tFile_size\tBlock_no:\tBlock_size:\n");
   for (int i = 0; i < n_files; i++) {
      int bestIdx = -1;
      for (int j = 0; j < n_blocks; j++) {
         if (!blocks[j].allocated && blocks[j].size >= files[i].size) {
            if (bestIdx == -1 || blocks[j].size < blocks[bestIdx].size) {
               bestIdx = j;
            }
         }
      }
      if (bestIdx != -1) {
         blocks[bestIdx].allocated = 1;
         files[i].block_no = bestIdx + 1;
         printf("%d\t\t%d\t\t%d\t\t%d\n", i + 1, files[i].size, bestIdx + 1, blocks[bestIdx].size);
      } else {
         printf("%d\t\t%d\t\t_\t\t_\n", i + 1, files[i].size);
      }
   }
}

void worstFit(struct Block blocks[], int n_blocks, struct File files[], int n_files) {
   printf("\n\tMemory Management Scheme – Worst Fit\n");
   printf("File_no:\tFile_size\tBlock_no:\tBlock_size:\n");
   for (int i = 0; i < n_files; i++) {
      int worstIdx = -1;
      for (int j = 0; j < n_blocks; j++) {
         if (!blocks[j].allocated && blocks[j].size >= files[i].size) {
            if (worstIdx == -1 || blocks[j].size > blocks[worstIdx].size) {
               worstIdx = j;
            }
         }
      }
      if (worstIdx != -1) {
         blocks[worstIdx].allocated = 1;
         files[i].block_no = worstIdx + 1;
         printf("%d\t\t%d\t\t%d\t\t%d\n", i + 1, files[i].size, worstIdx + 1, blocks[worstIdx].size);
      } else {
         printf("%d\t\t%d\t\t_\t\t_\n", i + 1, files[i].size);
      }
   }
}
```

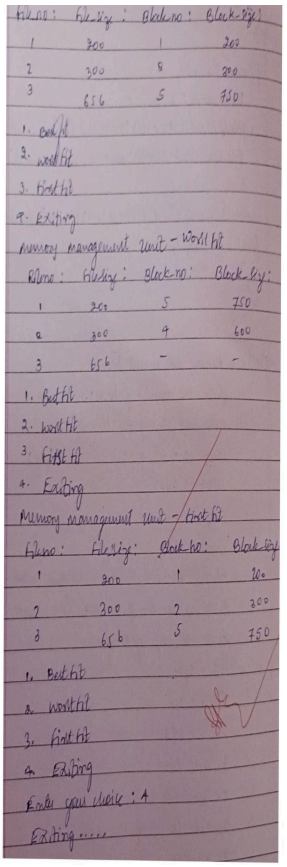
```
int main() {
    int n_blocks, n_files, choice;
    printf("Memory Management Scheme\n");
    printf("Enter the number of blocks: ");
    scanf("%d", &n_blocks);
    printf("Enter the number of files: ");
    scanf("%d", &n_files);
    struct Block blocks[n_blocks];
    struct File files[n_files];
    printf("\nEnter the size of the blocks:\n");
    for (int i = 0; i < n_blocks; i++) {
        printf("Block %d: ", i + 1);
        scanf("%d", &blocks[i].size);
        blocks[i].allocated = 0;
    }
    printf("Enter the size of the files:\n");
    for (int i = 0; i < n_files; i++) {
        printf("File %d: ", i + 1);
        scanf("%d", &files[i].size);
    }
    do {
        printf("\n1. First Fit\n2. Best Fit\n3. Worst Fit\n4. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);
        resetBlocks(blocks, n_blocks); // Reset block allocation before each strategy
        switch (choice) {
            case 1:
                firstFit(blocks, n_blocks, files, n_files);
                break;
            case 2:
                bestFit(blocks, n_blocks, files, n_files);
                break;
            case 3:
                worstFit(blocks, n_blocks, files, n_files);
                break;
            case 4:
                printf("\nExiting...\n");
                break;
            default:
                printf("Invalid choice.\n");
        }
    } while (choice != 4);
    return 0;
```

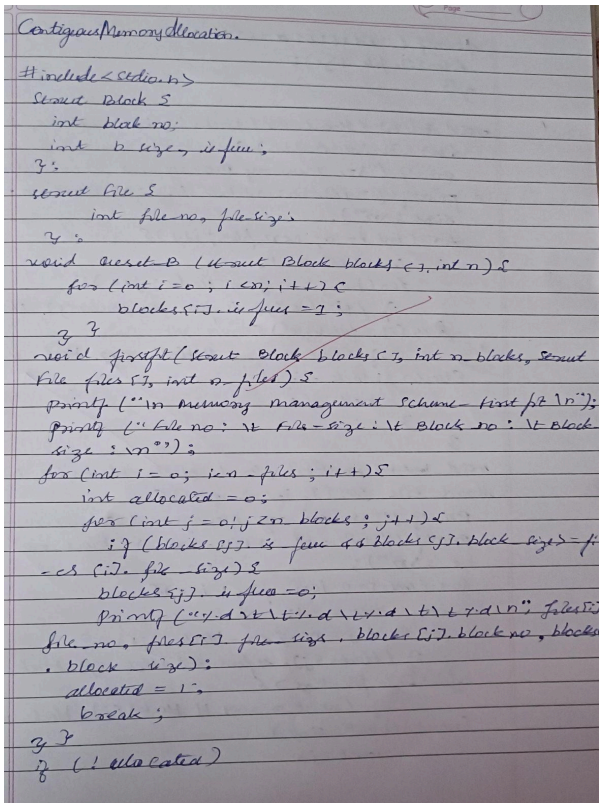
}

Result:

```
Block 2: 300
Block 3: 455
Block 4: 600
Block 5: 750
Enter the number of files: 3
Enter the size of the file:
File 1: 200
File 2: 300
File 3: 656

1. Best Fit
2. Worst Fit
3. First Fit
4. Exiting
Enter your choice: 1

Memory Management Scheme - Best Fit
File_no :       File_size :     Block_no :      Block_size :
1               200             1               200
2               300             2               300
3               656             5               750

1. Best Fit
2. Worst Fit
3. First Fit
4. Exiting
Enter your choice: 2

Memory Management Scheme - Worst Fit
File_no :       File_size :     Block_no :      Block_size :
1               200             5               750
2               300             4               600
3               656             -               -

1. Best Fit
2. Worst Fit
3. First Fit
4. Exiting
Enter your choice: 3

Memory Management Scheme - First Fit
File_no :       File_size :     Block_no :      Block_size :
1               200             1               200
2               300             2               300
3               656             5               750

1. Best Fit
2. Worst Fit
3. First Fit
4. Exiting
Enter your choice: 4
```

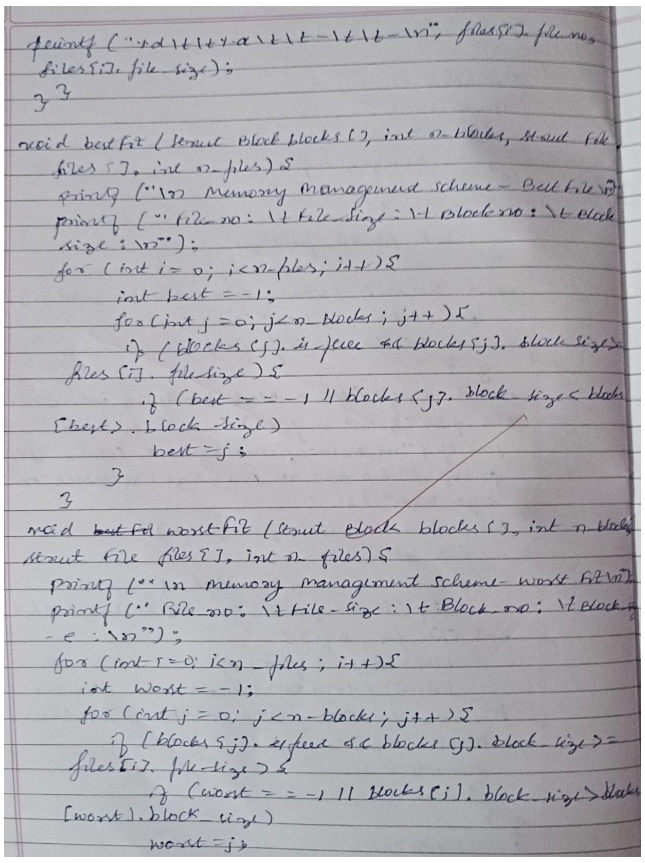






Contiguous Memory Allocation.

```
#include<stdio.h>
struct Block {
  int block_no;
  int b_size, is_free;
};
struct File {
    int file_no, file_size;
};
void reset(struct Block blocks[], int n) {
   for (int i = 0 ; i < n; i++) {
       blocks[i].is_free = 1;
   }
}
void firstfit(struct Block blocks[], int n_blocks, struct
File files[], int n_files) {
  printf("\n\n Memory management scheme - first fit\n");
  printf("File no: \t File size : \t Block no : \t Block
  size : \n\n");
  for (int i = 0; i<n_files ; i++) {
     int allocated = 0;
     for (int j = 0; j<n_blocks ; j++) {
       if (blocks[j].is_free && blocks[j].block_size>=fi
  -es[i].file_size) {
        blocks[j].is_free = 0;
        printf("%d\t\t%d\t\t%d\t\t%d\n", files[i]
  file_no, files[i].file_size, blocks[j].block_no, blocks
  .block_size);
        allocated = 1;
        break;
     }
  }
  if (!allocated)
```



```
printf("%d\t\t%d\t\t-1\t\t-\n", files[i].file_no,
  files[i].file_size);
}}

void bestFit(struct Block blocks[], int n_blocks, struct File
  files[], int n_files) {
  printf("\n\n Memory Management Scheme - Best Fit\n");
  printf("File no: \t File Size : \t Block no : \t Block
  size : \n");
  for (int i = 0; i<n_files; i++) {
       int best = -1;
       for (int j = 0; j<n_blocks; j++) {
         if (blocks[j].is_free && blocks[j].block_size>=
  files[i].file_size) {
           if (best == -1 || blocks[j].block_size < block
  [best].block_size)
             best = j;
         }
  }
void worstFit(struct Block blocks[], int n_blocks,
struct File files[], int n_files) {
  printf("\n\n Memory Management Scheme - Worst Fit\n");
  printf("File no: \t File Size : \t Block no : \t Block
  e : \n");
  for (int i = 0; i<n_files ; i++) {
    int worst = -1;
    for (int j = 0; j<n_blocks; j++) {
      if (blocks[j].is_free && blocks[j].block_size>=
  files[i].file_size) {
        if (worst == -1 || blocks[j].block_size>block
  [worst].block_size)
          worst = j;
```

Program 9
Write a C program to simulate page replacement algorithms
a) FIFO
b) LRU
c) Optimal

```
#include<stdio.h>
int n,m;
int p[10000],f[10000];
void fifo(){
   for(int i=0;i<m;++i) f[i]=-1;
   int h=0;
   int s=0;
   for(int i=0;i<n;++i){
      int k=0;
      for(int r=0;r<m;++r)
      if(p[i]==f[r]){++h;k=1;break;}
      if(k==1)continue;
      for(int r=0;r<m;++r)
      if(f[r]==-1){
         f[r]=p[i];k=2;break;}
      if(k==2) continue;
      f[s]=p[i];
```

```
        s=(s+1)%m;
    }
    printf("FIFO :\t\t\t Page-Hit:%d\t\t\tPage-Fault:%d\n",h,n-h);
}
void lru(){
    for(int i=0;i<m;++i) f[i]=-1;
    int h=0;
    int t[m];
    for(int i=0;i<m;++i) t[i]=0;
    for(int i=0;i<n;++i){
        int k=0;
        for(int r=0;r<m;++r)
        if(f[r]!=-1) ++t[r];
        for(int r=0;r<m;++r)
        if(f[r]==p[i]){t[r]=1;k=1;break;}
        if(k==1){++h;continue;}
        for(int r=0;r<m;++r)
        if(f[r]==-1){f[r]=p[i];t[r]=1;
            k=2;break;}
        if(k==2) continue;
        int x=0;
        for(int r=1;r<m;++r)
        if(t[r]>t[x]) x=r;
        t[x]=1;f[x]=p[i];
    }
    printf("LRU :\t\t\t Page-Hit:%d\t\t\tPage-Fault:%d\n",h,n-h);
}
void optimal(){
    for(int i=0;i<m;++i) f[i]=-1;
    int h=0;
    for(int i=0;i<n;++i){
        int k=0;
        for(int r=0;r<m;++r)
        if(f[r]==p[i]){k=1;
            ++h;break;}
        if(k==1) continue;
        for(int r=0;r<m;++r)
```

```
        if(f[r]==-1){
        k=2;f[r]=p[i];break;}
        if(k==2) continue;
        int l=-1,xx=-1,y=1;
        for(int j=0;j<m;++j){
           y=1;
           for(k=i+1;k<n;++k)
            if(f[j]==p[k]){
               y=0;
               if(k>l){xx=j;l=k;}break;
            }
           if(y){
              f[j]=p[i];break;}
        }
        if(y) continue;
        f[xx]=p[i];
    }
    printf("OPTIMAL :\t\t Page-Hit:%d\t\t\tPage-Fault:%d\n",h,n-h);
}
int main(){
    printf("Enter No. of Page Strign and Page-Frame : ");
    scanf("%d%d",&n,&m);
    printf("Enter the Page-String : ");
    for(int i=0;i<n;++i)
    scanf("%d",&p[i]);
    fifo();lru();optimal();
}
```

RESULT:

```
Enter No. of Page Strign and Page-Frame : 7 3
Enter the Page-String : 1 3 0 3 5 6 3
FIFO :                  Page-Hit:1                  Page-Fault:6
LRU :                   Page-Hit:2                  Page-Fault:5
OPTIMAL :               Page-Hit:2                  Page-Fault:5

Process returned 0 (0x0)   execution time : 15.202 s
Press any key to continue.
```