

# VISVESVARAYA TECHNOLOGICAL UNIVERSITY

“JnanaSangama”, Belgaum -590014, Karnataka.



## LAB REPORT on

## OPERATING SYSTEMS

*Submitted by*

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



**B.M.S. COLLEGE OF ENGINEERING**  
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**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 **GAMANA YELURI R (1BM21CS065)**, who is a bonafide student of **B.M.S. College of Engineering**. It is in partial fulfillment for the award of **Bachelor of Engineering in Computer Science and Engineering** of the Visvesvaraya Technological University, Belgaum during the academic semester June-2023 to September-2023. The Lab report has been approved as it satisfies the academic requirements in respect of a OPERATING SYSTEMS (**22CS4PCOPS**) work prescribed for the said degree.

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## Course Outcome

CO1	Apply the different concepts and functionalities of Operating Systems.
CO2	Analyze various Operating system strategies and techniques.
CO3	Demonstrate the different functionalities of Operating Systems.
CO4	Conduct practical experiments to implement the functionalities of Operating system.

## WEEK 1

**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 (preemptive & Non-pre-emptive)**

CODE:

```
#include <stdio.h>
int at[10], pt[10], ia, ip, n;
int tat[10], wt[10], it, iw, pos, j, i;
float atat = 0, awt = 0;
void fcfs()
{
    int t;
    printf("Enter number of processes: ");
    scanf("%d", &n);

    printf("Enter arrival times:\n");
    for (ia = 0; ia < n; ia++)
        scanf("%d", &at[ia]);

    printf("Enter process times:\n");
    for (ip = 0; ip < n; ip++)
        scanf("%d", &pt[ip]);

    if (at[0] == at[1])
    {
        t = pt[1];
        pt[1] = pt[0];
        pt[0] = t;
    }

    if (at[0] != 0)
        tat[0] = at[0];

    for (it = 0; it < n; it++)
```

```

    tat[it] = 0;

int i = 0;
for (it = 0; it < n; it++)
{
    while (i <= it)
        tat[it] += pt[i++];
    i = 0;
}

for (it = 0; it < n; it++)
    tat[it] = tat[it] - at[it];

for (ia = 0; ia < n; ia++)
    wt[ia] = tat[ia] - pt[ia];

for (i = 0; i < n; i++)
{
    atat += tat[i];
    awt += wt[i];
}

atat = atat / n;
awt = awt / n;

for (i = 0; i < n; i++)
{
    printf("P%d\t%d\t%d\n", i, tat[i], wt[i]);
}

printf("Average TAT=%.2f\nAverage WT=%.2f\n", atat, awt);
}

void srtf()
{
    int rt[10], endTime, i, smallest;
    int remain = 0, time, sum_wait = 0, sum_turnaround = 0;
    printf("Enter no of Processes : ");
    scanf("%d", &n);
    printf("Enter arrival times\n");

```

```

for (i = 0; i < n; i++)
{
    scanf("%d", &at[i]);
}
printf("Enter Process times \n");
for (i = 0; i < n; i++)
{
    scanf("%d", &pt[i]);
    rt[i] = pt[i];
}
rt[9] = 9999;
for (time = 0; remain != n; time++)
{
    smallest = 9;
    for (i = 0; i < n; i++)
    {
        if (at[i] <= time && rt[i] < rt[smallest] && rt[i] > 0)
        {
            smallest = i;
        }
    }
    rt[smallest]--;
    if (rt[smallest] == 0)
    {
        remain++;
        endTime = time + 1;
        printf("\nP%d %d %d", smallest + 1, endTime - at[smallest], endTime - pt[smallest] -
at[smallest]);
        sum_wait += endTime - pt[smallest] - at[smallest];
        sum_turnaround += endTime - at[smallest];
    }
}
printf("\n\nAverage waiting time = %f\n", sum_wait * 1.0 / n);
printf("Average Turnaround time = %f", sum_turnaround * 1.0 / n);
}

void sjf()
{
    int completed = 0;
    int currentTime = 0;

```



```

int complete[n], ct[n];

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

printf("Enter arrival times:\n");
for (int ia = 0; ia < n; ia++)
    scanf("%d", &at[ia]);

printf("Enter process times:\n");
for (int ip = 0; ip < n; ip++)
    scanf("%d", &pt[ip]);

for (int i = 0; i < n; i++)
{
    complete[i] = 0;
    ct[i] = 0;
}

while (completed != n)
{
    int shortest = -1;
    int min_bt = 9999;

    for (int i = 0; i < n; i++)
    {
        if (at[i] <= currentTime && complete[i] == 0)
        {
            if (pt[i] < min_bt)
            {
                min_bt = pt[i];
                shortest = i;
            }
            if (pt[i] == min_bt)
            {
                if (at[i] < at[shortest])
                {
                    shortest = i;
                }
            }
        }
    }
}

```

```

    }
}

if (shortest == -1)
{
    currentTime++;
}
else
{
    ct[shortest] = currentTime + pt[shortest];
    tat[shortest] = ct[shortest] - at[shortest];
    wt[shortest] = tat[shortest] - pt[shortest];
    complete[shortest] = 1;
    completed++;
    currentTime = ct[shortest];
}
}

for (int i = 0; i < n; i++)
{
    atat += tat[i];
    awt += wt[i];
}

atat = atat / n;
awt = awt / n;

for (int i = 0; i < n; i++)
{
    printf("P%d\t%d\t%d\n", i, tat[i], wt[i]);
}

printf("\nAverage TAT = %f\nAverage WT = %f\n", atat, awt);
}

void main()
{
    int op = 1, x;
    printf("1.FCFS \n2.SJF \n3.SRTF\n");
    scanf("%d", &x);

```

```

switch (x)
{
case 1:
    fcfs();
    break;
case 2:
    sjf();
    break;

case 3:
    srtf();
    break;

default:
    printf("Invalid option \n");
}
}

```

## OUTPUT:

```

PS D:\VS Code\OS> cd "d:\VS Code\OS\" ; if ($?) { gcc os.c -o os } ; if ($?) { .\os }
1.FCFS
2.SJF
3.SRTF
2
Enter number of processes: 3
Enter arrival times:
0 0 1
Enter process times:
8 4 1
P0      13      5
P1       4       0
P2       4       3
Average TAT = 7.000000
Average WT = 2.666667
PS D:\VS Code\OS>

PS D:\VS Code\OS> cd "d:\VS Code\OS\" ; if ($?) { gcc os.c -o os } ; if ($?) { .\os }
1.FCFS
2.SJF
3.SRTF
1
Enter number of processes: 3
Enter arrival times:
0 0 1
Enter process times:
8 4 1
P0       4       0
P1      12       4
P2      12      11
Average TAT=9.33
Average WT=5.00
PS D:\VS Code\OS>

PS D:\VS Code\OS> cd "d:\VS Code\OS\" ; if ($?) { gcc os.c -o os } ; if ($?) { .\os }
1.FCFS
2.SJF
3.SRTF
3
Enter no of Processes : 3
Enter arrival times
0 0 1
Enter Process times
8 4 1
P3  1  0
P2  5  1
P1 13  5
Average waiting time = 2.000000
Average Turnaround time = 6.333333
PS D:\VS Code\OS>

```

## WEEK 2

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

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

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

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

CODE:

```
#include<stdio.h>
int at[10],t,pt[10],tat[10],wt[10],n,time=0,i,ready[10],pry[10],op=0, maxpr,x,p[10];
float atat=0,awt=0;
```

```
void main()
{
    printf("Enter number of processes \n");
    scanf("%d",&n);

    printf("Enter arrival times: \n");
    for(i=0;i<n;i++)
        scanf("%d",&at[i]);

    printf("Enter process times: \n");
    for(i=0;i<n;i++)
        scanf("%d",&pt[i]);

    printf("Enter priority: \n");
    for(i=0;i<n;i++)
        scanf("%d",&pry[i]);

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

    for(i=0;i<n;i++)
        p[i]=pt[i];
```

```

for(i=0;i<n;i++)
time+=pt[i];
t=n;
while(t--)
{
    for(i=0;i<n;i++)
    if(op>=at[i])
    ready[i]=1;

    for(i=0;i<n;i++)
    if(pt[i]==0)
    pry[i]=0;

    maxpr=pry[0];
    for(i=0;i<n;i++)
    if(ready[i]==1)
    if(pry[i]>maxpr)
    maxpr=pry[i];

    for(i=0;i<n;i++)
    if(maxpr==pry[i])
    x=i;

    printf("%d p%d ",op,(x+1));

    op=op+pt[x];
    tat[x]=op;
    ready[x]=0;
    pry[x]=0;
}
printf("%d",op);

//finding avgtat and avg wt
for(i=0;i<n;i++)
{
    tat[i]=tat[i]-at[i];
}

for(i=0;i<n;i++)

```

```

{
    atat+=tat[i];
    wt[i]=tat[i]-pt[i];
}
for(i=0;i<n;i++)
awt+=wt[i];

awt=awt/n;
atat=atat/n;

printf("\n");
for(i=0;i<n;i++)
printf("P%d %d %d \n", (i+1), tat[i], wt[i]);
printf("ATAT=%f \nAWT=%f ", atat, awt);
}

```

## OUTPUT:

```

PS D:\VS Code\OS> cd "d:\VS Code\OS\" ; if ($?) { gcc npp.c -o npp } ; if ($?) { .\npp }
Enter number of processes
4
Enter araival times:
0 1 2 3
Enter process times:
4 3 3 5
Enter priority:
3 4 6 5
0 p1 4 p3 7 p4 12 p2 15
P1 4 0
P2 14 11
P3 5 2
P4 9 4
ATAT=8.000000
AWT=4.250000
PS D:\VS Code\OS> █

```

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

CODE:

```
#include<stdio.h>
int tq, at[10], pt[10], p[10], time=0, op=0, i,j ,n, ready[10],q[100];
int r=-1,f=0,tat[10],wt[10],z,fg,y=9999,ch;
float atat,awt;

int rr(int x)
{
    if(pt[x]>tq)
    {
        pt[x]-=tq;
        op+=tq;
    }
    else
    {
        op+=pt[x];
        pt[x]=0;
        tat[x]=op;
        ready[x]=0;
    }
    return x;
}

void main()
{
    printf("Enter number or processes \n");
    scanf("%d",&n);

    printf("Enter araival times: \n");
    for(i=0;i<n;i++)
        scanf("%d",&at[i]);

    printf("Enter process times: \n");
    for(i=0;i<n;i++)
        scanf("%d",&pt[i]);
```

```

printf("Enter TQ \n");
scanf("%d",&tq);

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

for(i=0;i<n;i++)
q[i]=9999;

for(i=0;i<n;i++)
p[i]=pt[i];

for(i=0;i<n;i++)
time+=pt[i];

for(i=0;i<n;i++)
    if(op>=at[i])
        ready[i]=1;

for(i=0;i<n;i++)
    if(ready[i]==1)
    {
        q[++r]=i;
    }

while(op!=time)
{
    printf("%d ",op);
    if(z==y)
        q[++f];
    y=z;

    ch=q[f];
    if(pt[ch]!=0)
    {
        z=rr(q[f]);

        printf("P%d ",(z+1));
    }
}

```



```

for(i=0;i<n;i++)
{
    if(op>=at[i] && pt[i]!=0)
    {
        fg=0;
        j=f;
        while(j<=r)
        {
            if(i==q[j])
            {
                fg=1;
                j++;
            }
        }
        if(fg==0)
        {
            q[++r]=i;
        }
    }
    if(pt[z]!=0)
    {
        q[++r]=z;
    }
    f++;
}

printf("%d ",op);

for(i=0;i<n;i++)
{
    tat[i]=tat[i]-at[i];
    wt[i]=tat[i]-p[i];
    atat+=tat[i];
    awt+=wt[i];
}
atat=atat/n;
awt=awt/n;

printf("\n");
for(i=0;i<n;i++)
printf("P%d %d %d \n",(i+1),tat[i],wt[i]);
printf("ATAT=%f \nAWT=%f ",atat,awt);

```

}

## OUTPUT:

```
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL

PS D:\VS Code> cd "d:\VS Code\OS\" ; if ($?) { gcc RR1.c -o RR1 } ; if ($?) { .\RR1 }
Enter number or processes
5
Enter araival times:
0 1 2 3 4
Enter process times:
5 3 1 2 3
Enter TQ
2
0 P1 2 P3 3 P1 5 P2 7 P4 9 P5 11 P1 12 P2 13 P5 14
P1 12 7
P2 12 9
P3 1 0
P4 6 4
P5 10 7
ATAT=8.200000
AWT=5.400000
PS D:\VS Code\OS>
```

## WEEK 3

**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  $\pm$  system processes and user processes. System processes are to be given higher priority than user processes. Use FCFS scheduling for the processes in each queue.**

CODE:

```
#include <stdio.h>

int spat[10], upat[10], i, n1, n2, p1[10], p2[10];
int sppt[10], uppt[10], time = 0, op = 0, y, z, pt;
int sptat[10], uptat[10];
int spwt[10], upwt[10];
float spatat = 0, spawt = 0;
float upatat = 0, upawt = 0;

void process(int x, int isSystem) {
    if (isSystem) {
        op += sppt[x];
        sptat[x] = op - spat[x];
        sppt[x] = 0;
        spwt[x] = sptat[x] - p1[x];
        spatat += sptat[x];
        spawt += spwt[x];
    } else {
        op += uppt[x];
        uptat[x] = op - upat[x];
        uppt[x] = 0;
        upwt[x] = uptat[x] - p2[x];
        upatat += uptat[x];
        upawt += upwt[x];
    }
}

int main() {
    printf("Enter the number of System Processes: ");
```

```

scanf("%d", &n1);

printf("Enter the number of User Processes: ");
scanf("%d", &n2);

printf("Enter the arrival times for System Processes:\n");
for (i = 0; i < n1; i++)
    scanf("%d", &spat[i]);

printf("Enter the process times for System Processes:\n");
for (i = 0; i < n1; i++)
    scanf("%d", &sppt[i]);

printf("Enter the arrival times for User Processes:\n");
for (i = 0; i < n2; i++)
    scanf("%d", &upat[i]);

printf("Enter the process times for User Processes:\n");
for (i = 0; i < n2; i++)
    scanf("%d", &uppt[i]);

for (i = 0; i < n1; i++)
    time += sppt[i];

for (i = 0; i < n2; i++)
    time += uppt[i];

for (i = 0; i < n1; i++)
    p1[i] = sppt[i];

for (i = 0; i < n2; i++)
    p2[i] = uppt[i];

printf("\n");

while (op < time) {
    y = -1;
    z = -1;

    for (i = 0; i < n1; i++) {

```

```

        if (op >= spat[i] && sppt[i] != 0) {
            y = i;
            break;
        }
    }

    for (i = 0; i < n2; i++) {
        if (op >= upat[i] && uppt[i] != 0) {
            z = i;
            break;
        }
    }

    if (y != -1) {
        printf("%d SP%d ", op, y + 1);
        process(y, 1);
    } else if (z != -1) {
        printf("%d UP%d ", op, z + 1);
        process(z, 0);
    } else {
        op++;
    }
}

printf("%d ", op);
printf("\n");
printf("System Processes:\n");
for (i = 0; i < n1; i++)
    printf("SP%d %d %d\n", i + 1, sptat[i], spwt[i]);
printf("ATAT(System Processes): %.2f\n", spatat / n1);
printf("AWT(System Processes): %.2f\n", spawt / n1);

printf("User Processes:\n");
for (i = 0; i < n2; i++)
    printf("UP%d %d %d\n", i + 1, uptat[i], upwt[i]);
printf("ATAT(User Processes): %.2f\n", upatat / n2);
printf("AWT(User Processes): %.2f\n", upawt / n2);

return 0;
}

```

## OUTPUT:

```
"C:\Users\ysrmo\OneDrive - Base PU College\Desktop\4thsem\OS\oslab\lab3\bin\Debug\lab3.exe"
Enter the number of System Processes: 3
Enter the number of User Processes: 1
Enter the arrival times for System Processes:
0 0 10
Enter the process times for System Processes:
4 3 5
Enter the arrival times for User Processes:
0
Enter the process times for User Processes:
8

0 SP1 4 SP2 7 UP1 15 SP3 20
System Processes:
SP1 4 0
SP2 7 4
SP3 10 5
ATAT(System Processes): 7.00
AWT(System Processes): 3.00

User Processes:
UP1 15 7
ATAT(User Processes): 15.00
AWT(User Processes): 7.00

Process returned 0 (0x0)   execution time : 51.340 s
Press any key to continue.
```

## WEEK 4

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

**a) Rate- Monotonic**

**b) Earliest-deadline First**

CODE:

```
#include <stdio.h>
#include <stdlib.h>
int et[10], i, n, dl[10], p[10], ready[10], flag = 1;
```

```
int lcm(int a, int b) {
    int max = (a > b) ? a : b;
    while (1) {
        if (max % a == 0 && max % b == 0)
            return max;
        max++;
    }
}
```

```
int lcmArray(int arr[], int n) {
    int result = arr[0];
    for (int i = 1; i < n; i++) {
        result = lcm(result, arr[i]);
    }
    return result;
}
```

```
void mono() {
    int time = lcmArray(dl, n);
    int op = 0, pr = 0, pre = pr;
```

```
    while (op <= time) {
        for (i = 0; i < n; i++) {
            if (op % dl[i] == 0) {
                ready[i] = 1;
            }
        }
    }
}
```

```

flag = 0;
for (i = 0; i < n; i++) {
    if (ready[i] == 1) {
        flag = 1;
        break;
    }
}

if (flag == 0) {
    pr = -1;
} else {
    pr = -1;
    for (i = 0; i < n; i++) {
        if (ready[i] == 1) {
            if (pr == -1 || dl[i] < dl[pr]) {
                pr = i;
            }
        }
    }
}

if (pr != pre) {
    if (pr == -1) {
        printf("%d Idle ",op);
    } else {
        printf("%d P%d ",op, pr + 1);
    }
}

op++;
if (pr != -1) {
    p[pr] = p[pr] - 1;
    if (p[pr] == 0) {
        p[pr] = et[pr];
        ready[pr] = 0;
    }
}

pre = pr;
}

```



```

    printf("\n");
}

void edf() {
    int time = lcmArray(dl, n);
    int op = 0, pr = 0, pre = -1;
    int flag, i;

    while (op <= time) {
        for (i = 0; i < n; i++) {
            if (op % dl[i] == 0) {
                ready[i] = 1;
            }
        }

        flag = 0;
        for (i = 0; i < n; i++) {
            if (ready[i] == 1) {
                flag = 1;
                break;
            }
        }

        if (flag == 0) {
            pr = -1;
        } else {
            pr = -1;
            for (i = 0; i < n; i++) {
                if (ready[i] == 1) {
                    if (pr == -1 || p[i] < p[pr]) {
                        pr = i;
                    }
                }
            }
        }
    }

    if (pr != pre) {
        if (pr == -1) {
            printf("%d Idle ", op);

```

```

        } else {
            printf("%d P%d ", op, pr + 1);
        }
    }

    op++;

    if (pr != -1) {
        p[pr] = p[pr] - 1;
        if (p[pr] == 0) {
            p[pr] = et[pr];
            ready[pr] = 0;
        }
    }

    pre = pr;
}

printf("\n");
}

int main() {
    int ch, k = 1;
    while (k) {
        printf("Enter your choice: \n1. Monotonic \n2. EDF \n3. Proportional \n4. Exit\n");
        scanf("%d", &ch);
        if (ch == 3)
            exit(0);
        printf("Enter the number of processes: ");
        scanf("%d", &n);
        printf("Enter execution times: \n");
        for (i = 0; i < n; i++)
            scanf("%d", &et[i]);

        printf("Enter deadlines: \n");
        for (i = 0; i < n; i++)
            scanf("%d", &dl[i]);

        for (i = 0; i < n; i++)
            p[i] = et[i];
    }
}

```

```

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

    switch (ch) {
        case 1:
            mono();
            break;

        case 2:
            edf();
            break;

        case 3:
            k = 0;
            break;

        default:
            printf("Invalid choice.\n");
    }
}

return 0;
}

```

## OUTPUT:

```

"C:\Users\ysmo\OneDrive - Base PU College\Desktop\4thsem\OS\oslab\edfrm\bin\Debug\edfrm.exe"
Enter your choice:
1. Monotonic
2. EDF
3. Exit
1
Enter the number of processes: 3
Enter execution times:
3 2 2
Enter deadlines:
20 5 10
0 P2 2 P3 4 P1 5 P2 7 P1 9 Idle 10 P2 12 P3 14 Idle 15 P2 17 Idle 20 P2
Enter your choice:
1. Monotonic
2. EDF
3. Exit
2
Enter the number of processes: 2
Enter execution times:
20 35
Enter deadlines:
80 80
0 P1 20 P2 55 P1 75 Idle 80 P2 115 P1 135 Idle 150 P1 170 P2 205 P1 225 Idle 240 P2 250 P1 270 P2 295 Idle 300 P1 320 P2 355 P1 375 Idle 400 P1
Enter your choice:
1. Monotonic
2. EDF
3. Exit

```

## WEEK 5

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

CODE:

```
#include<stdio.h>
#include<stdlib.h>
int mutex=1,full=0,empty=3,x=0;
int main()
{
    int n;
    void producer();
    void consumer();
    int wait(int);
    int signal(int);
    printf("\n1.Producer\n2.Consumer\n3.Exit");
    while(1)
    {
        printf("\nEnter your choice:");
        scanf("%d",&n);
        switch(n)
        {
            case 1:  if((mutex==1)&&(empty!=0))
                      producer();
                    else
                      printf("Buffer is full!!");
                    break;
            case 2:  if((mutex==1)&&(full!=0))
                      consumer();
                    else
                      printf("Buffer is empty!!");
                    break;
            case 3:
                      exit(0);
                      break;
        }
    }
}
```

```

    return 0;
}

int wait(int s)
{
    return (--s);
}

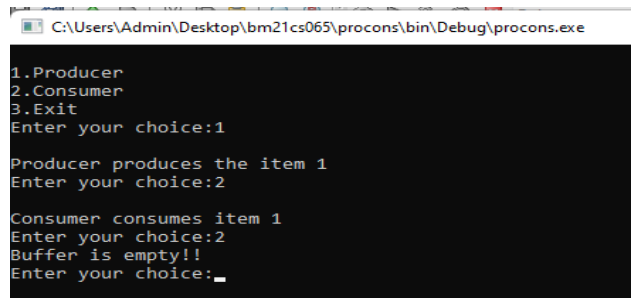
int signal(int s)
{
    return(++s);
}

void producer()
{
    mutex=wait(mutex);
    full=signal(full);
    empty=wait(empty);
    x++;
    printf("\nProducer produces the item %d",x);
    mutex=signal(mutex);
}

void consumer()
{
    mutex=wait(mutex);
    full=wait(full);
    empty=signal(empty);
    printf("\nConsumer consumes item %d",x);
    x--;
    mutex=signal(mutex);
}

```

## OUTPUT:



```

C:\Users\Admin\Desktop\bm21cs065\procons\bin\Debug\procons.exe
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:_

```

## WEEK 6

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

CODE:

```
#include <pthread.h>
#include <semaphore.h>
#include <stdio.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 test(int phnum)
{
    if (state[phnum] == HUNGRY
        && state[LEFT] != EATING
        && state[RIGHT] != 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]);
    }
}
```

```

void take_fork(int phnum)
{
    sem_wait(&mutex);

    state[phnum] = HUNGRY;

    printf("Philosopher %d is Hungry\n", phnum + 1);

    test(phnum);

    sem_post(&mutex);

    sem_wait(&S[phnum]);

    sleep(1);
}

void put_fork(int phnum)
{
    sem_wait(&mutex);

    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)
{
    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++) {

        // 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);
}

```



## OUTPUT:

```
C:\Users\Admin\Desktop\bin2\c000\bin\Debug\un.exe
Philosopher 1 is thinking
Philosopher 2 is thinking
Philosopher 3 is thinking
Philosopher 4 is thinking
Philosopher 5 is thinking
Philosopher 3 is Hungry
Philosopher 1 is Hungry
Philosopher 5 is Hungry
Philosopher 4 is Hungry
Philosopher 4 takes Fork 3 and 4
Philosopher 4 is Eating
Philosopher 2 is Hungry
Philosopher 2 takes Fork 1 and 2
Philosopher 2 is Eating
Philosopher 4 putting Fork 3 and 4 down
Philosopher 4 is thinking
Philosopher 5 takes Fork 4 and 5
Philosopher 5 is Eating
Philosopher 2 putting Fork 1 and 2 down
Philosopher 2 is thinking
Philosopher 3 takes Fork 2 and 3
Philosopher 3 is Eating
Philosopher 5 putting Fork 4 and 5 down
Philosopher 5 is thinking
Philosopher 1 takes Fork 5 and 1
Philosopher 1 is Eating
Philosopher 4 is Hungry
Philosopher 2 is Hungry
Philosopher 3 putting Fork 2 and 3 down
Philosopher 3 is thinking
Philosopher 4 takes Fork 3 and 4
Philosopher 4 is Eating
Philosopher 1 putting Fork 5 and 1 down
Philosopher 1 is thinking
Philosopher 2 takes Fork 1 and 2
Philosopher 2 is Eating
Philosopher 5 is Hungry
Philosopher 3 is Hungry
Philosopher 4 putting Fork 3 and 4 down
Philosopher 4 is thinking
Philosopher 5 takes Fork 4 and 5
Philosopher 5 is Eating
Philosopher 1 is Hungry
Philosopher 2 putting Fork 1 and 2 down
Philosopher 2 is thinking
Philosopher 3 takes Fork 2 and 3
Philosopher 3 is Eating
Philosopher 4 is Hungry
Philosopher 5 putting Fork 4 and 5 down
Philosopher 5 is thinking
Philosopher 1 takes Fork 5 and 1
Philosopher 1 is Eating
Philosopher 2 is Hungry
Philosopher 3 putting Fork 2 and 3 down
Philosopher 3 is thinking
Philosopher 4 takes Fork 3 and 4
Philosopher 4 is Eating
Philosopher 5 is Hungry
Philosopher 1 putting Fork 5 and 1 down
Philosopher 1 is thinking
Philosopher 2 takes Fork 1 and 2
Philosopher 2 is Eating
Philosopher 3 is Hungry
```

## WEEK 7

### To Simulate bankers algorithm for DeadLock Avoidance (Banker's Algorithm)

CODE:

```
#include <stdio.h>

int main() {
    int n, m, all[10][10], req[10][10], ava[10], need[10][10];
    int i, j, k, flag[10], prev[10], c, count = 0;

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

    printf("Enter total number of required resources %d for each process\n", n);
    for (i = 0; i < n; i++)
        for (j = 0; j < m; j++)
            scanf("%d", &req[i][j]);

    printf("Enter number of allocated resources %d for each process\n", n);
    for (i = 0; i < n; i++)
        for (j = 0; j < m; j++)
            scanf("%d", &all[i][j]);

    printf("Enter number of available resources \n");
    for (i = 0; i < m; i++)
        scanf("%d", &ava[i]);

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

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

    k = 1;

    while (k) {
```

```

k = 0;

for (i = 0; i < n; i++) {
    if (flag[i]) {
        c = 0;
        for (j = 0; j < m; j++) {
            if (need[i][j] <= ava[j]) {
                c++;
            }
        }
        if (c == m) {
            printf("Resources can be allocated to Process:%d and available resources are: ", (i +
1));

            for (j = 0; j < m; j++) {
                printf("%d ", ava[j]);
            }
            printf("\n");

            for (j = 0; j < m; j++) {
                ava[j] += all[i][j];
                all[i][j] = 0;
            }

            flag[i] = 0;
            count++;
        }
    }
}

for (i = 0; i < n; i++) {
    if (flag[i] != prev[i]) {
        k = 1;
        break;
    }
}

for (i = 0; i < n; i++) {
    prev[i] = flag[i];
}
}

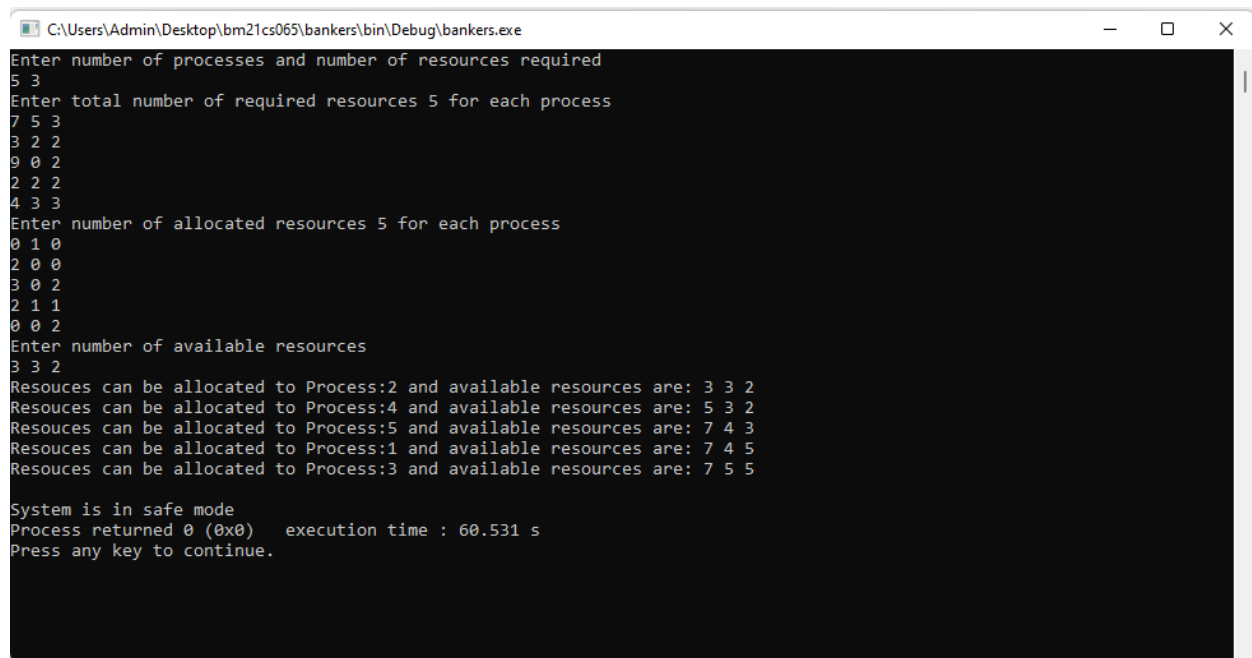
```

```

if (count == n) {
    printf("\nSystem is in safe mode ");
} else {
    printf("\nSystem is not in safe mode deadlock occurred \n");
}
return 0;
}

```

## OUTPUT:



```

C:\Users\Admin\Desktop\bm21cs065\bankers\bin\Debug\bankers.exe
Enter number of processes and number of resources required
5 3
Enter total number of required resources 5 for each process
7 5 3
3 2 2
9 0 2
2 2 2
4 3 3
Enter number of allocated resources 5 for each process
0 1 0
2 0 0
3 0 2
2 1 1
0 0 2
Enter number of available resources
3 3 2
Resouces can be allocated to Process:2 and available resources are: 3 3 2
Resouces can be allocated to Process:4 and available resources are: 5 3 2
Resouces can be allocated to Process:5 and available resources are: 7 4 3
Resouces can be allocated to Process:1 and available resources are: 7 4 5
Resouces can be allocated to Process:3 and available resources are: 7 5 5

System is in safe mode
Process returned 0 (0x0)   execution time : 60.531 s
Press any key to continue.

```

## WEEK 8

**Write a C program to simulate deadlock detection.**

CODE:

```
#include <stdio.h>

int main() {
    int n, m, all[10][10], req[10][10], ava[10], need[10][10];
    int i, j, k, flag[10], prev[10], c, count = 0;

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

    printf("Enter total number of required resources %d for each process\n", n);
    for (i = 0; i < n; i++)
        for (j = 0; j < m; j++)
            scanf("%d", &req[i][j]);

    printf("Enter number of allocated resources %d for each process\n", n);
    for (i = 0; i < n; i++)
        for (j = 0; j < m; j++)
            scanf("%d", &all[i][j]);

    printf("Enter number of available resources \n");
    for (i = 0; i < m; i++)
        scanf("%d", &ava[i]);

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

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

    k = 1;

    while (k) {
        k = 0;
```

```

for (i = 0; i < n; i++) {
    if (flag[i]) {
        c = 0;
        for (j = 0; j < m; j++) {
            if (need[i][j] <= ava[j]) {
                c++;
            }
        }
        if (c == m) {
            for (j = 0; j < m; j++) {
                for (j = 0; j < m; j++) {
                    ava[j] += all[i][j];
                    all[i][j] = 0;
                }

                flag[i] = 0;
                count++;
            }
        }
    }
}

for (i = 0; i < n; i++) {
    if (flag[i] != prev[i]) {
        k = 1;
        break;
    }
}

for (i = 0; i < n; i++) {
    prev[i] = flag[i];
}

if (count == n) {
    printf("\nNo deadlock");
} else {
    printf("\nDeadlock occurred \n");
}

```

```

    }
    return 0;
}

```

## OUTPUT:

```

C:\Users\Admin\Desktop\bm21cs065\deadlock_deec\bin\Debug\deadlock_deec.exe
Enter number of processes and number of resources required
5 3
Enter total number of required resources 5 for each process
7 5 3
3 2 2
9 0 2
2 2 2
4 3 3
Enter number of allocated resources 5 for each process
0 1 0
2 0 0

3 0 2
2 1 1
0 0 2
Enter number of available resources
1 1 1

Deadlock occurred

Process returned 0 (0x0)   execution time : 65.375 s
Press any key to continue.

```

```

C:\Users\Admin\Desktop\bm21cs065\deadlock_deec\bin\Debug\deadlock_deec.exe
Enter number of processes and number of resources required
5 3
Enter total number of required resources 5 for each process
7 5 3
3 2 2
9 0 2
2 2 2
4 3 3
Enter number of allocated resources 5 for each process
0 1 0
2 0 0
3 0 2
2 1 1
0 0 2
Enter number of available resources
3 3 2

No deadlock
Process returned 0 (0x0)   execution time : 86.778 s
Press any key to continue.

```

## WEEK 9

**Write a C program to simulate the first fit contiguous memory allocation technique.**

CODE:

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

#define max 25

void main()
{
    int frag[max], b[max], f[max], i, j, nb, nf, temp;
    int bf[max], ff[max];
    printf("\n\tMemory Management Scheme - First Fit");
    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 (i = 1; i <= nb; i++)
    {
        printf("Block %d:", i);
        scanf("%d", &b[i]);
    }
    printf("Enter the size of the files:\n");
    for (i = 1; i <= nf; i++)
    {
        printf("File %d:", i);
        scanf("%d", &f[i]);
    }
    for (i = 1; i <= nf; i++)
    {
        temp = -1; // Reset temp to -1 for each new file
        for (j = 1; j <= nb; j++)
        {
```

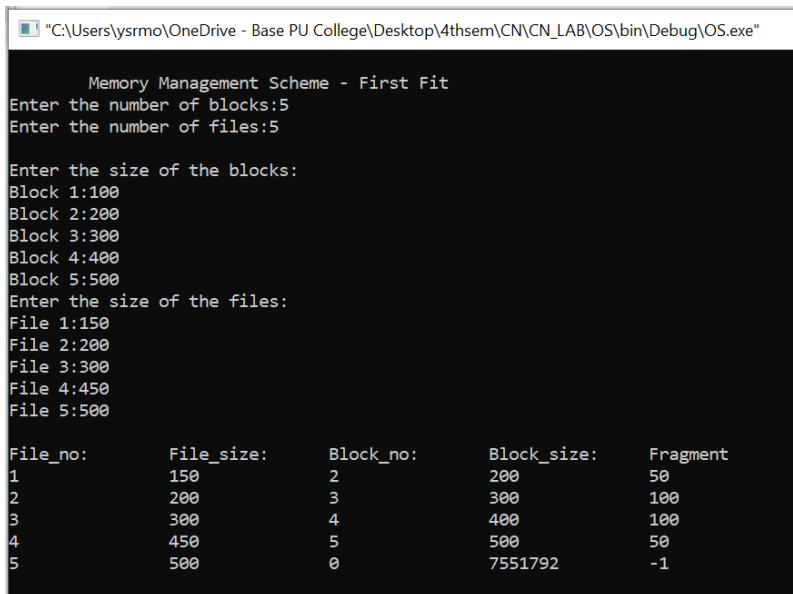


```

        if (bf[j] != 1)
        {
            if (b[j] >= f[i])
            {
                ff[i] = j;
                temp = b[j] - f[i];
                break;
            }
        }
        frag[i] = temp;
        if (temp != -1)
        {
            bf[ff[i]] = 1;
        }
    }
    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]);
    }
    getch();
}

```

## OUTPUT:



```

Memory Management Scheme - First Fit
Enter the number of blocks:5
Enter the number of files:5

Enter the size of the blocks:
Block 1:100
Block 2:200
Block 3:300
Block 4:400
Block 5:500
Enter the size of the files:
File 1:150
File 2:200
File 3:300
File 4:450
File 5:500

File_no:      File_size:      Block_no:      Block_size:      Fragment
1             150             2             200             50
2             200             3             300             100
3             300             4             400             100
4             450             5             500             50
5             500             0             7551792         -1

```

## WEEK 10

**Write a C program to simulate the best fit contiguous memory allocation technique.**

CODE:

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

#define max 25

void main()
{
    int frag[max], b[max], f[max], i, j, nb, nf, temp, lowest = 10000;
    static int bf[max], ff[max];

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

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

    for (i = 1; i <= nf; i++)
    {
        lowest = 10000; // Reset lowest to a high value for each new file
        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;
}

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]);
}

getch();
}

```

## OUTPUT:

```

"C:\Users\ysrmo\OneDrive - Base PU College\Desktop\4thsem\CN\CN_LAB\OS\bin\Debug\OS.exe"

Enter the number of blocks:5
Enter the number of files:5

Enter the size of the blocks:
Block 1:200
Block 2:300
Block 3:400
Block 4:560
Block 5:670
Enter the size of the files:
File 1:256
File 2:345
File 3:200
File 4:400
File 5:500

File No File Size      Block No   Block Size  Fragment
1       256         2         300        44
2       345         3         400        55
3       200         1         200        0
4       400         4         560       160
5       500         5         670       170

```

## WEEK 11

**Write a C program to simulate the worst fit contiguous memory allocation technique.**

CODE:

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

#define max 25

void main()
{
    int frag[max], b[max], f[max], i, j, nb, nf, temp, highest = 0;
    int bf[max], ff[max]; // Initialized these arrays to 0
    printf("\n\tMemory Management Scheme - Worst Fit");
    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 (i = 1; i <= nb; i++)
    {
        printf("Block %d:", i);
        scanf("%d", &b[i]);
    }
    printf("Enter the size of the files:\n");
    for (i = 1; i <= nf; i++)
    {
        printf("File %d:", i);
        scanf("%d", &f[i]);
    }

    for (i = 1; i <= nf; i++)
    {
        highest = 0; // Reset highest to 0 for each new file
        for (j = 1; j <= nb; j++)
        {
            if (bf[j] != 1) // If bf[j] is not allocated
```

```

        {
            temp = b[j] - f[i];
            if (temp >= 0)
            {
                if (highest < temp)
                {
                    ff[i] = j;
                    highest = temp;
                }
            }
        }
    }
    frag[i] = highest;
    bf[ff[i]] = 1;
}

printf("\nFile_no:\tFile_size:\tBlock_no:\tBlock_size:\tFragement");
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]);
}

getch();
}

```

## OUTPUT:

```

Memory Management Scheme - Worst Fit
Enter the number of blocks:5
Enter the number of files:4

Enter the size of the blocks:
Block 1:200
Block 2:300
Block 3:400
Block 4:500
Block 5:600
Enter the size of the files:
File 1:350
File 2:450
File 3:670
File 4:200

File_no:      File_size:      Block_no:      Block_size:      Fragement
1             350             5             600             250
2             450             4             500             50
3             670             0             4223008         0
4             200             3             400             200_

```

## WEEK 12

**Write a C program to simulate page replacement algorithms**

- a) FIFO**
- b) LRU**
- c) Optimal**

**CODE:**

```
#include<stdio.h>
void main()
{
    int mem[20],process[20],n,m,i,j,k,c,z,a,distance=0,b;
    printf("Enter Size of memory:\n");
    scanf("%d",&n);

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

    printf("Enter number of process in queue:\n");
    scanf("%d",&m);

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

    j=0;
    i=0;

    printf("\nFIFO:");
    while(j!=m)
    {
        k=0;
        c=0;
        while(k!=n)
        {
            c++;
            if(mem[k]==process[j])
```

```

        {
            j++;
            break;
        }
        k++;
    }
    if(c==n)
    {
        mem[i]=process[j];
        i=(i+1)%n;
    }
    printf("\nMemory: ");
    for(z=0;z<n;z++)
        printf("%d ",mem[z]);
    j++;
}

printf("\n\nLRU:");
for(i=0;i<n;i++)
    mem[i]=0;

i=0;
j=0;
while(j!=m)
{
    k=0;
    c=0;
    while(k!=n)
    {
        c++;
        if(mem[k]==process[j])
        {
            j++;
            break;
        }
        k++;
    }
    if(c==n)
    {
        distance=0;

```

```

for(a=0;a<n;a++)
{
    b=99;
    z=j;
    while(z>=0)
    {
        if((j-z)>distance)
        if(mem[a]==process[z])
        {
            distance=(z-j);
            b=z;
        }
        z--;
    }
}
if(b==99)
b=i;
mem[b]=process[j];
i=(i+1)%n;
}
printf("\nMemory: ");
for(z=0;z<n;z++)
    printf("%d ",mem[z]);
j++;
}

printf("\n\nOptimal:");
for(i=0;i<n;i++)
    mem[i]=0;

i=0;
j=0;
while(j!=m)
{
    k=0;
    c=0;
    while(k!=n)
    {
        c++;
        if(mem[k]==process[j])

```



```

        {
            j++;
            break;
        }
        k++;
    }
    if(c==n)
    {
        distance=0;
        for(a=0;a<n;a++)
        {
            b=99;
            z=j;
            while(z!=m)
            {
                if((z-j)>distance)
                if(mem[a]==process[z])
                {
                    distance=(z-j);
                    b=z;
                }
                z++;
            }
        }
        if(b==99)
        b=i;
        mem[b]=process[j];
        i=(i+1)%n;
    }
    printf("\nMemory: ");
    for(z=0;z<n;z++)
        printf("%d ",mem[z]);
    j++;
}
}

```

## OUTPUT:

```
"C:\Users\ysrmo\OneDrive - Base PU College\Desktop\4thsem\CN\CN_LAB\OS\bin\Debug\OS.exe"
Enter Size of memory:
3
Enter number of process in queue:
6
Enter 6 process
7 4 10 4 2 1

FIFO:
Memory: 7 0 0
Memory: 7 4 0
Memory: 7 4 10
Memory: 7 4 10
Memory: 1 4 10

LRU:
Memory: 7 0 0
Memory: 7 4 0
Memory: 7 4 10
Memory: 7 4 10
Memory: 7 4 1

Optimal:
Memory: 7 0 0
Memory: 7 4 0
Memory: 7 4 10
Memory: 7 4 10
Memory: 1 4 10
Process returned 6 (0x6)   execution time : 14.298 s
Press any key to continue.
```

## WEEK 13

**Write a C program to simulate disk scheduling algorithms**

**a) FCFS**

**b) SCAN**

**c) C-SCAN**

CODE:

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

int disks;

void quicksort(int number[25], int first, int last)
{
    int i, j, pivot, temp;
    if (first < last)
    {
        pivot = first;

        i = first;
        j = last;
        while (i < j)
        {
            while (number[i] <= number[pivot] && i < last)
                i++;
            while (number[j] > number[pivot])
                j--;
            if (i < j)
            {
                temp = number[i];
                number[i] = number[j];
                number[j] = temp;
            }
        }
        temp = number[pivot];
        number[pivot] = number[j];
        number[j] = temp;
    }
}
```

```

        quicksort(number, first, j - 1);
        quicksort(number, j + 1, last);
    }
}
void fcfs(int arr[],int src, int n)
{
    int sseq[20],i;

    sseq[0]=abs(arr[0]-src);
    for(i=1;i<n;i++)
        sseq[i]=abs(arr[i]-arr[i-1]);

    int sum=0;
    for(i=0;i<n;i++)
        sum+=sseq[i];

    printf("\nFCFS \nTotal seek sequenece: %d \nSeek Sequence: \n",sum);
    for(i=0;i<n;i++)
        printf("%d ",sseq[i]);
    printf("\n");
}

void cscan(int arr[], int src, int n)
{
    int i,sum=0,j,sseq[20];
    quicksort(arr, 0, n-1);
    int index;
    for (index = 0; index < n; index++) {
        if (arr[index] == src) {
            break;
        }
    }
    i=index+1;
    j=0;
    while(i<=n)
    {
        sseq[j]=abs(arr[i]-arr[i-1]);
        i++;
        j++;
    }
}

```

```

    sseq[j++]=abs(disks-arr[i-1]);
    i=0;
    sseq[j++]=abs(disks);
    sseq[j++]=abs(arr[0]);
    while(i<index)
    {
        sseq[j++]=abs(arr[i]-arr[i-1]);
        i++;
    }
    for(i=0;i<(n+2);i++)
    sum+=sseq[i];

    printf("\nC-SCAN \nTotal seek sequenece: %d \nSeek Sequence: \n",sum);
    for(i=0;i<n+2;i++)
    printf("%d ",sseq[i]);
    printf("\n");

}

void scan(int arr[], int src, int n)
{
    int i,sum=0,j,sseq[20];
    quicksort(arr, 0, n-1);
    int index;
    for (index = 0; index < n; index++) {
        if (arr[index] == src) {
            break;
        }
    }
    i=index+1;
    j=0;
    while(i<=n)
    {
        sseq[j]=abs(arr[i]-arr[i-1]);
        i++;
        j++;
    }
    sseq[j++]=abs(disks-arr[i-1]);

    i=index-1;
    sseq[j++]=abs(arr[i]-disks);

```

```

while(i>=0)
{
    sseq[j++]=abs(arr[i]-arr[i-1]);
    i--
}
for(i=0;i<(n+2);i++)
sum+=sseq[i];

printf("\nSCAN \nTotal seek sequenece: %d \nSeek Sequence: \n",sum);
for(i=0;i<n+2;i++)
printf("%d ",sseq[i]);
printf("\n");
}
void main()
{
    int source, arr[20],i,n,copy[20];
    printf("Enter number of disks: ");
    scanf("%d",&n);

    printf("\nEnter %d values: ",n);
    for(i=0;i<n;i++)
    scanf("%d",&arr[i]);

    printf("\nEnter source position: ");
    scanf("%d",&source);

    printf("\nEnter number disks: ");
    scanf("%d",&disks);

    for(i=0;i<n;i++)
    copy[i]=arr[i];

    arr[n]=source;
    copy[n]=arr[n];
    fcfs(copy , source , n);
    scan(copy , source , n);
    cscan(arr , source , n);
}

```

## OUTPUT:

```
"C:\Users\ysrmo\OneDrive - Base PU College\Desktop\4thsem\CN\CN_LAB\OS\bin\Debug\OS.exe"
Enter number of disks: 5
Enter 5 values: 10 25 30 45 12
Enter source position: 19
Enter number disks: 50
FCFS
Total seek sequence: 77
Seek Sequence:
9 15 5 15 33
SCAN
Total seek sequence: 81
Seek Sequence:
31 5 15 5 13 2 10
C-SCAN
Total seek sequence: 116
Seek Sequence:
31 50 10 5 2 13 5
```