

Operating Systems (Lab Manual)

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Develop new strategies to solve engineering problems related to Information Technology.
Research.

PEO2: Pursue career in the IT industry, academia, engineering management and

PEO3: Provide graduates a platform for life-long learning in innovative technologies.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Design and develop computing systems inculcating the best practices for hardware implementation and software programming.

PSO2: Ability to provide discerning solutions based on the expertise in networking, database administration, distributed applications development and entrepreneur practices to the various societal needs.

COURSE LEARNING OBJECTIVES

- To Demonstrate the need for OS and different types of OS
- To discuss suitable techniques for management of different resources
- To demonstrate different APIs/Commands related to processor, memory, storage and file system management.

COURSE OUTCOMES

CO1: Explain the structure and functionality of operating system

CO2: Apply appropriate CPU scheduling algorithms for the given problem.

CO3: Analyze the various techniques for process synchronization and deadlock handling.

CO4: Apply the various techniques for memory management

CO5: Explain file and secondary storage management strategies.

CO6: Describe the need for information protection mechanisms

Sl.N O	Experiments
1	Develop a c program to implement the Process system calls (fork (), exec(), wait(), create process, terminate process)
2	Simulate the following CPU scheduling algorithms to find turnaround time and waiting time a) FCFS b) SJF c) Round Robin d) Priority.
3	Develop a C program to simulate producer-consumer problem using semaphores.
4	Develop a C program which demonstrates interprocess communication between a reader process and a writer process. Use mkfifo, open, read, write and close APIs in your program.
5	Develop a C program to simulate Bankers Algorithm for DeadLock Avoidance.
6	Develop a C program to simulate the following contiguous memory allocation Techniques: a) Worst fit b) Best fit c) First fit.
7	Develop a C program to simulate page replacement algorithms: a) FIFO b) LRU
8	Simulate following File Organization Techniques a) Single level directory b) Two level directory
9	Develop a C program to simulate the Linked file allocation strategies.
10	Develop a C program to simulate SCAN disk scheduling algorithm.

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

- CO 1. Explain the structure and functionality of operating system
- CO 2. Apply appropriate CPU scheduling algorithms for the given problem.
- CO 3. Analyse the various techniques for process synchronization and deadlock handling.
- CO 4. Apply the various techniques for memory management
- CO 5. Explain file and secondary storage management strategies.
- CO 6. Describe the need for information protection mechanisms

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods

mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.

- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks**).
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test (**duration 02/03 hours**) after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks**.
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Suggested Learning Resources:

Textbooks

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 8th edition, Wiley-India, 2015

Reference Books

1. Ann McHoes Ida M Fylnn, Understanding Operating System, Cengage Learning, 6th Edition
2. D.M Dhamdhere, Operating Systems: A Concept Based Approach 3rd Ed, McGraw- Hill, 2013.
3. P.C.P. Bhatt, An Introduction to Operating Systems: Concepts and Practice 4th Edition, PHI(EEE), 2014.
4. William Stallings Operating Systems: Internals and Design Principles, 6th Edition, Pearson.

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Program-1

Develop a c program to implement the Process system calls (fork (), exec (), wait (), create process,terminate process)

```
#include<stdio.h> // printf()
#include<stdlib.h> // exit()
#include<sys/types.h> // pid_t
#include<sys/wait.h> // wait()
#include<unistd.h> // fork

int main(int argc, char **argv)
{
    pid_t pid;
    pid = fork();
    if(pid==0)
    {
        printf("It is the child process and pid is %d\n",getpid());
        int i=0;
        for(i=0;i<8;i++)
        {
            printf("%d\n",i);
        }
        exit(0);
    }
    else if(pid > 0)
    {
        printf("It is the parent process and pid is %d\n",getpid());
        int status;
        wait(&status);
        printf("Child is repeated\n");
    }
    else
    {
        printf("Error in forking..\n");
        exit(EXIT_FAILURE);
    }
    return 0;
}
```

Output:

```
It is the parent process and pid is 4498
It is the child process and pid is 4499
0
1
2
3
4
5
6
7
Child is reaped
```

Program-2

Simulate the following CPU scheduling algorithms to find turnaround time and waiting time

a) **FCFS**

```
#include<stdio.h>
int main()
{
    int n,bt[20],wt[20],tat[20],avwt=0,avtat=0,i,j;
    printf("Enter total number of processes(maximum 20): ");
    scanf("%d",&n);
    printf("\nEnter Process Burst Time:\n");
    for(i=0;i<n;i++)
    {
        printf("P[%d]: ",i+1);
        scanf("%d",&bt[i]);
    }
    wt[0]=0;
    for(i=1;i<n;i++)
    {
        wt[i]=0;
        for(j=0;j<i;j++)
            wt[i]+=bt[j];
    }

    printf("\nProcess\tBurst Time\tWaiting Time\tTurnaround Time");
    //calculating turnaround time
    for(i=0;i<n;i++)
    {
        tat[i]=bt[i]+wt[i];
        avwt+=wt[i];
        avtat+=tat[i];
        printf("\nP[%d]\t%d\t%d\t%d",i+1,wt[i],tat[i]);
    }
    avwt/=i;
    avtat/=i;
    printf("\n\nAverage Waiting Time:%d",avwt);
    printf("\nAverage Turnaround Time:%d",avtat);
    return 0;
}
```

Output:

```
Enter total number of processes(maximum 20): 4
Enter Process Burst Time:
P[1]: 5
P[2]: 8
P[3]: 2
P[4]: 7
Process      Burst Time   Waiting Time   Turnaround Time
P[1]          5            0              5
P[2]          8            5              13
P[3]          2            13             15
P[4]          7            15             22

Average Waiting Time:8
Average Turnaround Time:13
```

b) SJF

```
#include<stdio.h>
int main()
{
    int bt[20],p[20],wt[20],tat[20],i,j,n,total=0,pos,temp;
    float avg_wt,avg_tat;
    printf("Enter number of process: ");
    scanf("%d",&n);
    printf("\nEnter Burst Time:\n");
    for(i=0;i<n;i++)
    {
        printf("p%d: ",i+1);
        scanf("%d",&bt[i]);
        p[i]=i+1;
    }
    for(i=0;i<n;i++)
    {
        pos=i;
        for(j=i+1;j<n;j++)
        {
            if(bt[j]<bt[pos])
                pos=j;
        }
        temp=bt[i];
        bt[i]=bt[pos];
        bt[pos]=temp;
        temp=p[i];
        p[i]=p[pos];
        p[pos]=temp;
    }
    wt[0]=0;
    for(i=1;i<n;i++)
    {
        wt[i]=0;
        for(j=0;j<i;j++)
            wt[i]+=bt[j];
        total+=wt[i];
    }
    avg_wt=(float)total/n;
    total=0;
    printf("\nProcess\t Burst Time\t Waiting Time\t Turnaround Time");
    for(i=0;i<n;i++)
    {
        tat[i]=bt[i]+wt[i];
        total+=tat[i];
```

```

        printf("\nProcess %d\t %d\t %d",p[i],bt[i],tat[i]);
    }
avg_tat=(float)total/n;
printf("\n\nAverage Waiting Time=%f",avg_wt);
printf("\nAverage Turnaround Time=%f\n",avg_tat);
return 0;
}

```

Output:

```

Enter number of process: 4
Enter Burst Time:
p1: 5
p2: 4
p3: 8
p4: 2
Process      Burst Time      Waiting Time      Turnaround Time
p4          2              0              2
p2          4              2              6
p1          5              6             11
p3          8             11             19

Average Waiting Time=4.750000
Average Turnaround Time=9.500000
|

```

c) Round Robin

```

#include<stdio.h>
int main()
{
    int count,j,n,time,remain,flag=0,time_quantum;
    int wait_time=0,turnaround_time=0,at[10],bt[10],rt[10];
    printf("Enter Total Process:\t ");
    scanf("%d",&n);
    remain=n;
    for(count=0;count<n;count++)
    {
        printf("Enter Arrival Time and Burst Time for Process Process Number %d :",count+1);
        scanf("%d",&at[count]);
        scanf("%d",&bt[count]);
        rt[count]=bt[count];
    }
    printf("Enter Time Quantum:\t");
    scanf("%d",&time_quantum);
    printf("\n\nProcess\t|Turnaround Time|Waiting Time\n\n");
    for(time=0,count=0;remain!=0;)
    {
        if(rt[count]<=time_quantum && rt[count]>0)
        {
            time+=rt[count];
            rt[count]=0;
        }
    }
}

```

```

    flag=1;
}
else if(rt[count]>0)

{
    rt[count]-=time_quantum;
    time+=time_quantum;
}
if(rt[count]==0 && flag==1)
{
    remain--;
    printf("P[%d]\t%d\t%d\n",count+1,time-at[count],time-at[count]-bt[count]);
    wait_time+=time-at[count]-bt[count];
    turnaround_time+=time-at[count];
    flag=0;
}
if(count==n-1)
    count=0;
else if(at[count+1]<=time)
    count++;
else
    count=0;
}
printf("\nAverage Waiting Time= %f\n",wait_time*1.0/n);
printf("Avg Turnaround Time = %f",turnaround_time*1.0/n);

return 0;
}

```

Output:

```

Enter Total Process:      5
Enter Arrival Time and Burst Time for Process Process Number 1 :4
5
Enter Arrival Time and Burst Time for Process Process Number 2 :2
8
Enter Arrival Time and Burst Time for Process Process Number 3 :6
4
Enter Arrival Time and Burst Time for Process Process Number 4 :1
2
Enter Arrival Time and Burst Time for Process Process Number 5 :0
7
Enter Time Quantum: 2
Process |Turnaround Time|Waiting Time

P[4]    |    11    |    9
P[1]    |    11    |    6
P[3]    |    13    |    9
P[2]    |    21    |   13
P[5]    |    26    |   19

Average Waiting Time= 11.200000
Avg Turnaround Time = 16.400000

```

d) Priority

```
#include<stdio.h>

int main()
{
    int bt[20],p[20],wt[20],tat[20],pr[20],i,j,n,total=0,pos,temp,avg_wt,avg_tat;
    printf("Enter Total Number of Process:");
    scanf("%d",&n);

    printf("\nEnter Burst Time and Priority\n");
    for(i=0;i<n;i++)
    {
        printf("\nP[%d]\n",i+1);
        printf("Burst Time:");
        scanf("%d",&bt[i]);
        printf("Priority:");
        scanf("%d",&pr[i]);
        p[i]=i+1;
    }

    for(i=0;i<n;i++)
    {
        pos=i;
        for(j=i+1;j<n;j++)
        {
            if(pr[j]<pr[pos])
                pos=j;
        }

        temp=pr[i];
        pr[i]=pr[pos];
        pr[pos]=temp;

        temp=bt[i];
        bt[i]=bt[pos];
        bt[pos]=temp;

        temp=p[i];
        p[i]=p[pos];
        p[pos]=temp;
    }

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

        for(j=0;j<i;j++)
            wt[i]+=bt[j];

        total+=wt[i];
    }
}
```

```

avg_wt=total/n;
total=0;

printf("\nProcess\t Burst Time \tWaiting Time\tTurnaround Time");
for(i=0;i<n;i++)
{
    tat[i]=bt[i]+wt[i];
    total+=tat[i];
    printf("\nP[%d]\t %d\t %d\t%d",p[i],bt[i],wt[i],tat[i]);
}

avg_tat=total/n;
printf("\n\nAverage Waiting Time=%d",avg_wt);
printf("\nAverage Turnaround Time=%d\n",avg_tat);

return 0;
}

```

Output:

```

Enter Total Number of Process:5
Enter Burst Time and Priority

P[1]
Burst Time:4
Priority:2
P[2]
Burst Time:8
Priority:1
P[3]
Burst Time:9
Priority:4
P[4]
Burst Time:7
Priority:3
P[5]
Burst Time:7
Priority:5
Process      Burst Time      Waiting Time      Turnaround Time
P[2]          8              0                8
P[1]          4              8                12
P[4]          7              12               19
P[3]          9              19               28
P[5]          7              28               35

Average Waiting Time=13
Average Turnaround Time=20
|
```

Program-3

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

```
#include<stdio.h>
void main()
{
int buffer[10], bufsize, in, out, produce, consume, choice=0;
in = 0;
out = 0;
bufsize = 10;
while(choice !=3)
{
printf("\n 1. Produce \t 2. Consume \t3. Exit");
printf("\n Enter your choice: ");
scanf("%d", &choice);
switch(choice) {
case 1: if((in+1)%bufsize==out)
printf("\n Buffer is Full");
else
{
printf("\nEnter the value: ");
scanf("%d", &produce);
buffer[in] = produce;
in = (in+1)%bufsize;
}
break;
case 2: if(in == out)
printf("\nBuffer is Empty");
else
{
consume = buffer[out];
printf("\nThe consumed value is %d", consume);
out = (out+1)%bufsize;
}
break;
} } }
```

Output:

```
1. Produce    2. Consume    3. Exit
Enter your choice: 2
Buffer is Empty
1. Produce    2. Consume    3. Exit
Enter your choice: 1
Enter the value: 56
1. Produce    2. Consume    3. Exit
Enter your choice: 2
The consumed value is 56
1. Produce    2. Consume    3. Exit
Enter your choice:
```

Program-4

Develop a C program which demonstrates inter-process communication between a reader process and a writer process. Use mkfifo, open, read, write and close APIs in your program.

/*Writer Process*/

```
#include <stdio.h>
#include <fcntl.h>
#include <sys/stat.h>
#include <sys/types.h>
#include <unistd.h>
int main()
{
    int fd;
    char buf[1024];
    /* create the FIFO (named pipe) */
    char * myfifo = "/tmp/myfifo";
    mkfifo(myfifo, 0666);
    printf("Run Reader process to read the FIFO File\n");
    fd = open(myfifo, O_WRONLY);
    write(fd,"Hi", sizeof("Hi"));
    /* write "Hi" to the FIFO */
    close(fd);
    unlink(myfifo); /* remove the FIFO */
    return 0;
}
```

/* Reader Process*/

```
#include <fcntl.h>
#include <sys/stat.h>
#include <sys/types.h>
#include <unistd.h>
#include <stdio.h>
#define MAX_BUF 1024
int main()
{
    int fd;
    /* A temp FIFO file is not created in reader */
    char *myfifo = "/tmp/myfifo";
    char buf[MAX_BUF];
    /* open, read, and display the message from the FIFO */
    fd = open(myfifo, O_RDONLY);
    read(fd, buf, MAX_BUF);
    printf("Writer: %s\n", buf);
    close(fd);
    return 0;
}
```

Instructions for Execution:

1. Run Reader Process
2. Then Run Writer Process

Writer: Hi

Program-5

Develop a C program to simulate Bankers Algorithm for DeadLock Avoidance.

```
#include <stdio.h>
#include <stdlib.h>
int main()
{
    int Max[10][10], need[10][10], alloc[10][10], avail[10], completed[10], safeSequence[10];
    int p, r, i, j, process, count;
    count = 0;

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

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

    printf("\n\nEnter the no of resources : ");
    scanf("%d", &r);

    printf("\n\nEnter the Max Matrix for each process : ");
    for(i = 0; i < p; i++)
    {
        printf("\nFor process %d : ", i + 1);
        for(j = 0; j < r; j++)
            scanf("%d", &Max[i][j]);
    }

    printf("\n\nEnter the allocation for each process : ");
    for(i = 0; i < p; i++)
    {
        printf("\nFor process %d : ", i + 1);
        for(j = 0; j < r; j++)
            scanf("%d", &alloc[i][j]);
    }

    printf("\n\nEnter the Available Resources : ");
    for(i = 0; i < r; i++)
        scanf("%d", &avail[i]);

    for(i = 0; i < p; i++)
        for(j = 0; j < r; j++)
            need[i][j] = Max[i][j] - alloc[i][j];

    do
    {
        printf("\n Max matrix:\tAllocation matrix:\n");
        for(i = 0; i < p; i++)
        {
            for(j = 0; j < r; j++)
                printf("%d ", Max[i][j]);
            printf("\t");
        }
    }
```

```

        for( j = 0; j < r; j++)
        {
            printf("%d ", alloc[i][j]);
            printf("\n");
        }
    process = -1;

    for(i = 0; i < p; i++)
    {
        if(completed[i] == 0)//if not completed
        {
            process = i ;
            for(j = 0; j < r; j++)
            {
                if(avail[j] < need[i][j])
                {
                    process = -1;
                    break;
                }
            }
        }
        if(process != -1)
            break;
    }

    if(process != -1)
    {
        printf("\nProcess %d runs to completion!", process + 1);
        safeSequence[count] = process + 1;
        count++;
        for(j = 0; j < r; j++)
        {
            avail[j] += alloc[process][j];
            alloc[process][j] = 0;
            Max[process][j] = 0;
            completed[process] = 1;
        }
    }
}
while(count != p && process != -1);

if(count == p)
{
    printf("\nThe system is in a safe state!!\n");
    printf("Safe Sequence : < ");
    for( i = 0; i < p; i++)
        printf("%d ", safeSequence[i]);
    printf(">\n");
}
else
    printf("\nThe system is in an unsafe state!!");

}

```

Output:

```
Enter the no of processes : 4
Enter the no of resources : 3
Enter the Max Matrix for each process :
For process 1 : 4
4
4
For process 2 : 2
3
4
For process 3 : 5
4
2
For process 4 : 7
4
1
Enter the allocation for each process :
For process 1 : 1
0
2
For process 2 : 2
0
0
For process 3 : 1
3
5
For process 4 : 4
5
2
Enter the Available Resources : 1
2
4
Max matrix: Allocation matrix:
4 4 4      1 0 2
2 3 4      2 0 0
5 4 2      1 3 5
7 4 1      4 5 2

The system is in an unsafe state!!
```

Program-6

Develop a C program to simulate the following contiguous memory allocation Techniques

a) Worst fit

```
#include<stdio.h>
int main()
{
    int fragments[10], blocks[10], files[10];
    int m, n, number_of_blocks, number_of_files, temp, top = 0;
    static int block_arr[10], file_arr[10];
    printf("\nEnter the Total Number of Blocks:\t");
    scanf("%d",&number_of_blocks);
    printf("Enter the Total Number of Files:\t");
    scanf("%d",&number_of_files);
    printf("\nEnter the Size of the Blocks:\n");
    for(m = 0; m < number_of_blocks; m++)
    {
        printf("Block No.[%d]:\t", m + 1);
        scanf("%d", &blocks[m]);
    }
    printf("Enter the Size of the Files:\n");
    for(m = 0; m < number_of_files; m++)
    {
        printf("File No.[%d]:\t", m + 1);
        scanf("%d", &files[m]);
    }
    for(m = 0; m < number_of_files; m++)
    {
        for(n = 0; n < number_of_blocks; n++)
        {
            if(block_arr[n] != 1)
            {
                temp = blocks[n] - files[m];
                if(temp >= 0)
                {
                    if(top < temp)
                    {
                        file_arr[m] = n;
                        top = temp;
                    }
                }
            }
            fragments[m] = top;
            block_arr[file_arr[m]] = 1;
            top = 0;
        }
    }
    printf("\nFile Number\tFile Size\tBlock Number\tBlock Size\tFragment");
    for(m = 0; m < number_of_files; m++)
    {
        printf("\n%d\t%d\t%d\t%d\t%d", m, files[m], file_arr[m], blocks[file_arr[m]], fragments[m]);
    }
    printf("\n");
```

```
return 0;
```

```
}
```

Output:

```
Enter the Total Number of Blocks: 5
Enter the Total Number of Files: 4
Enter the Size of the Blocks:
Block No.[1]: 5
Block No.[2]: 4
Block No.[3]: 3
Block No.[4]: 6
Block No.[5]: 7
Enter the Size of the Files:
File No.[1]: 1
File No.[2]: 3
File No.[3]: 5
File No.[4]: 3
File Number File Size  Block Number  Block Size Fragment
0          1        4          7        6
1          3        0          5        0
2          5        0          5        0
3          3        0          5        0
```

b) Best Fit

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

```
void main()
{
    int fragment[20],b[20],p[20],i,j,nb,np,temp,lowest=9999;
    static int barray[20],parray[20];

    printf("\n\t\tMemory Management Scheme - Best Fit");
    printf("\nEnter the number of blocks:");
    scanf("%d",&nb);
    printf("Enter the number of processes:");
    scanf("%d",&np);

    printf("\nEnter the size of the blocks:-\n");
    for(i=1;i<=nb;i++)
    {
        printf("Block no.%d:",i);
        scanf("%d",&b[i]);
    }

    printf("\nEnter the size of the processes :-\n");
    for(i=1;i<=np;i++)
    {
        printf("Process no.%d:",i);
        scanf("%d",&p[i]);
    }

    for(i=1;i<=np;i++)
    {
```

```

for(j=1;j<=nb;j++)
{
    if(barray[j]!=1)
    {
        temp=b[j]-p[i];
        if(temp>=0)
            if(lowest>temp)
            {
                parray[i]=j;
                lowest=temp;
            }
    }
}

fragment[i]=lowest;
barray[parray[i]]=1;
lowest=10000;
}

printf("\nProcess_no\tProcess_size\tBlock_no\tBlock_size\tFragment");
for(i=1;i<=np && parray[i]!=0;i++)
    printf("\n%d\t%d\t%d\t%d\t%d",i,p[i],parray[i],b[parray[i]],fragment[i]);
}

```

```

Memory Management Scheme - Best Fit
Enter the number of blocks:5
Enter the number of processes:4
Enter the size of the blocks:-
Block no.1:10
Block no.2:15
Block no.3:5
Block no.4:9
Block no.5:3
Enter the size of the processes :-
Process no.1:1
Process no.2:4
Process no.3:7
Process no.4:12
Process_no  Process_size   Block_no   Block_size Fragment
1          1             5           3           2
2          4             3           5           1
3          7             4           9           2
4          12            2          15           3

```

c) First Fit

```
#include<stdio.h>
#define max 25
void main()
{
int frag[max],b[max],f[max],i,j,nb,nf,temp,highest=0;
static 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++)
{
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;
highest=0;
}
printf("\nFile_no:\tFile_size :\tBlock_no:\tBlock_size:\tFragement");
for(i=1;i<=nf;i++)
printf("\n%d\t%d\t%d\t%d\t%d\t%d",
i,f[i],ff[i],b[ff[i]],frag[i]);
}
```

Output:

```
Memory Management Scheme - First Fit
Enter the number of blocks:3
Enter the number of files:2
Enter the size of the blocks:-
Block 1:5
Block 2:2
Block 3:7
Enter the size of the files :-
File 1:2
File 2:5
File_no:    File_size : Block_no:  Block_size: Fragement
1          2          3          7          5
2          5          0          0          0
```

Program-7

Develop a C program to simulate page replacement algorithms

a) FIFO

```
#include<stdio.h>
int main()
{
    int i,j,n,a[50],frame[10],no,k,avail,count=0;
    printf("\n ENTER THE NUMBER OF PAGES:\n");
    scanf("%d",&n);
    printf("\n ENTER THE PAGE NUMBER :\n");
    for(i=1;i<=n;i++)
        scanf("%d",&a[i]);
    printf("\n ENTER THE NUMBER OF FRAMES :");
    scanf("%d",&no);
    for(i=0;i<no;i++)
        frame[i]=-1;
        j=0;
        printf("\tref string\t page frames\n");
    for(i=1;i<=n;i++)
    {
        printf("%d\t",a[i]);
        avail=0;
        for(k=0;k<no;k++)
            if(frame[k]==a[i])
                avail=1;
            if(avail==0)
            {
                frame[j]=a[i];
                j=(j+1)%no;
                count++;
                for(k=0;k<no;k++)
                    printf("%d\t",frame[k]);
            }
            printf("\n");
    }
    printf("Page Fault Is %d",count);
    return 0;
}
```

Output:

```
ENTER THE NUMBER OF PAGES:

8
ENTER THE PAGE NUMBER :
2
4
5
4
6
7
1
5
9
ENTER THE NUMBER OF FRAMES :3
ref string    page frames
2      2    -1    -1
4      2    4    -1
5      2    4    5
4
6      6    4    5
7      6    7    5
5
9      6    7    9
Page Fault Is 6
```

b) LRU

```
#include<stdio.h>
int i,j,nof,nor,flag=0,ref[50],frm[50],pf=0,victim=-1;
int recent[10],lrucal[50],count=0;
int lruvictim();
void main()
{
printf("\n\t\t\t LRU PAGE REPLACEMENT ALGORITHM");
printf("\n Enter no.of Frames....");
scanf("%d",&nof);
printf(" Enter no.of reference string..");
scanf("%d",&nor);
printf("\n Enter reference string..");
for(i=0;i<nor;i++)
scanf("%d",&ref[i]);
printf("\n\n\t\t LRU PAGE REPLACEMENT ALGORITHM ");
printf("\n\t The given reference string:");
printf("\n.....");
for(i=0;i<nor;i++)
printf("%4d",ref[i]);
for(i=1;i<=nof;i++)
{
frm[i]=-1;
lrucal[i]=0;
} for(i=0;i<10;i++)
recent[i]=0;
printf("\n");
for(i=0;i<nor;i++)
{
flag=0;
```

```
printf("\n\t Reference NO %d->\t",ref[i]);  
  
for(j=0;j<nof;j++)  
{  
if(frm[j]==ref[i])  
{  
flag=1;  
break;  
}  
}  
if(flag==0)  
{  
count++;  
if(count<=nof)  
victim++;  
else  
victim=lruvictim();  
pf++;  
frm[victim]=ref[i];  
for(j=0;j<nof;j++)  
printf("%4d",frm[j]);  
}  
recent[ref[i]]=i;  
}  
printf("\n\n\t No.of page faults...%d",pf);  
}  
int lruvictim()  
{  
int i,j,temp1,temp2;  
for(i=0;i<nof;i++)  
{  
temp1=frm[i];  
lrucal[i]=recent[temp1];  
}  
temp2=lrucal[0];  
for(j=1;j<nof;j++)  
{  
if(temp2>lrucal[j])  
temp2=lrucal[j];  
}  
for(i=0;i<nof;i++)  
if(ref[temp2]==frm[i])  
return i;  
return 0;  
}
```

Output:

```
LRU PAGE REPLACEMENT ALGORITHM
Enter no.of Frames....3
Enter no.of reference string..8
Enter reference string..
5
6
4
8
2
5
7
6
3
LRU PAGE REPLACEMENT ALGORITHM
The given reference string:
..... 5 6 4 8 2 7 6 3

Reference NO 5->      5 -1 -1
Reference NO 6->      5 6 -1
Reference NO 4->      5 6 4
Reference NO 8->      8 6 4
Reference NO 2->      8 2 4
Reference NO 7->      8 2 7
Reference NO 6->      6 2 7
Reference NO 3->      6 3 7

No.of page faults...8
```

Program-8 **Simulate following File Organization Techniques**

a) Single level directory

```
#include<stdlib.h>
#include<string.h>
#include<stdio.h>
struct
{
char dname[10],fname[10][10];
int fcnt;
}dir;
void main()
{
int i,ch;
char f[30];
dir.fcnt = 0;
printf("\nEnter name of directory -- ");
scanf("%s", dir.dname);
while(1)
{
printf("\n\n1. Create File\t2. Delete File\t3. Search File \n 4. Display Files\t5. Exit\nEnter your choice
-- ");
scanf("%d",&ch);
switch(ch)
{
case 1: printf("\nEnter the name of the file -- ");
scanf("%s",dir.fname[dir.fcnt]);
dir.fcnt++;
break;
case 2: printf("\nEnter the name of the file -- ");
scanf("%s",f);
for(i=0;i<dir.fcnt;i++)
{
if(strcmp(f, dir.fname[i])==0)
{
printf("File %s is deleted ",f);
strcpy(dir.fname[i],dir.fname[dir.fcnt-1]); break; } }
if(i==dir.fcnt) printf("File %s not found",f);
else
dir.fcnt--;
break;
case 3: printf("\nEnter the name of the file -- ");
scanf("%s",f);
for(i=0;i<dir.fcnt;i++)
{
if(strcmp(f, dir.fname[i])==0)
{
printf("File %s is found ", f);
break;
}
}
if(i==dir.fcnt)
```

```
printf("File %s not found",f);
break;
case 4: if(dir.fcnt==0)
printf("\nDirectory Empty");
else
{
printf("\nThe Files are -- ");
for(i=0;i<dir.fcnt;i++)
printf("\t%s",dir.fname[i]);
}
break;
default: exit(0);
}
}
```

Output:

```
Enter name of directory -- AI
1. Create File 2. Delete File 3. Search File
4. Display Files 5. Exit
Enter your choice -- 1
Enter the name of the file -- ab
1. Create File 2. Delete File 3. Search File
4. Display Files 5. Exit
Enter your choice -- 1
Enter the name of the file -- ac
1. Create File 2. Delete File 3. Search File
4. Display Files 5. Exit
Enter your choice -- 4
The Files are -- ab ac

1. Create File 2. Delete File 3. Search File
4. Display Files 5. Exit
Enter your choice -- 2
Enter the name of the file -- ab
File ab is deleted

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

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

b) Two-Level Directory

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

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

void main()
{
    int i, ch, dcnt, k;
    char f[30], d[30];
    dcnt = 0;
    while(1)
    {
        printf("\n\n1. Create Directory\t2. Create File\t3. Delete File");
        printf("\n4. Search File\t5. Display\t6. Exit\tEnter your choice -- ");
        scanf("%d", &ch);
        switch(ch)
        {
            case 1: printf("\nEnter name of directory -- ");
                scanf("%s", dir[dcnt].dname);
                dir[dcnt].fcnt = 0;
                dcnt++;
                printf("Directory created");
                break;
            case 2: printf("\nEnter name of the directory -- ");
                scanf("%s", d);
                for(i=0; i<dcnt; i++)
                    if(strcmp(d, dir[i].dname) == 0)
                {
                    printf("Enter name of the file -- ");
                    scanf("%s", dir[i].fname[dcnt]);
                    printf("File created");
                    break;
                }
                if(i == dcnt)
                    printf("Directory %s not found", d);
                break;
            case 3: printf("\nEnter name of the directory -- ");
                scanf("%s", d);
                for(i=0; i<dcnt; i++)
                {
                    if(strcmp(d, dir[i].dname) == 0)
                {
                    printf("Enter name of the file -- ");
                    scanf("%s", f);
                    for(k=0; k<dir[i].fcnt; k++)
                    {
                        if(strcmp(f, dir[i].fname[k]) == 0)
                    {
                        printf("File %s is deleted ", f);
                        dir[i].fcnt--;
                    }
                }
            }
        }
    }
}
```

```

strcpy(dir[i].fname[k],dir[i].fname[dir[i].fcnt]);
goto jmp;
}
}
printf("File %s not found",f);
goto jmp;
}
}
printf("Directory %s not found",d);
jmp : break;
case 4: printf("\nEnter name of the directory -- ");
scanf("%os",d);
for(i=0;i<dcnt;i++)
{
if(strcmp(d,dir[i].dname)==0)
{
printf("Enter the name of the file -- ");
scanf("%os",f);
for(k=0;k<dir[i].fcnt;k++)
{
if(strcmp(f, dir[i].fname[k])==0)
{
printf("File %s is found ",f);
goto jmp1;
}
}
printf("File %s not found",f);
goto jmp1;
}
}
printf("Directory %s not found",d);
jmp1: break;
case 5: if(dcmt==0)
printf("\nNo Directory's ");
else
{
printf("\nDirectory\tFiles");
for(i=0;i<dcnt;i++)
{
printf("\n%os\t",dir[i].dname);
for(k=0;k<dir[i].fcnt;k++)
printf("\t%os",dir[i].fname[k]);
}
}
break;
default:exit(0);
}
}
}
}

```

Output:

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

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

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

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

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

Program-9

Develop a C program to simulate the Linked file allocation strategies.

```
#include<stdio.h>
#include<conio.h>
#include<stdlib.h>
void main()
{
int f[50], p,i, st, len, j, c, k, a;
clrscr();
for(i=0;i<50;i++)
f[i]=0;
printf("Enter how many blocks already allocated: ");
scanf("%d",&p);
printf("Enter blocks already allocated: ");
for(i=0;i<p;i++)
{
scanf("%d",&a);
f[a]=1;
}
x: printf("Enter index starting block and length: ");
scanf("%d%d", &st,&len);
k=len;
if(f[st]==0)
{
for(j=st;j<(st+k);j++)
{
if(f[j]==0)
{
f[j]=1;
printf("%d----->%d\n",j,f[j]);
}
else
{
printf("%d Block is already allocated \n",j);
k++;
}
}
}
else
{
printf("%d starting block is already allocated \n",st);
printf("Do you want to enter more file(Yes - 1/No - 0)");
scanf("%d", &c);
if(c==1)
goto x;
else
exit(0);
getch();
}
```

Output:

```
Enter how many blocks already allocated: 3
Enter blocks already allocated: 1 3 5
Enter index starting block and length: 2 2
2----->1
3 Block is already allocated
4----->1
Do you want to enter more file(Yes - 1/No - 0)
```

Program-10

Develop a C program to simulate SCAN disk scheduling algorithm.

```
#include <stdio.h>
int request[50];
int SIZE;
int pre;
int head;
int uptrack;
int downtrack;
struct max{
    int up;
    int down;
} kate[50];
int dist(int a, int b){
    if (a > b)
        return a - b;
    return b - a;
}
void sort(int n){
    int i, j;
    for (i = 0; i < n - 1; i++){
        for (j = 0; j < n - i - 1; j++){
            if (request[j] > request[j + 1]){
                int temp = request[j];
                request[j] = request[j + 1];
                request[j + 1] = temp;
            }
        }
    }
    j = 0;
    i = 0;
    while (request[i] != head){
        kate[j].down = request[i];
        j++;
        i++;
    }
    downtrack = j;
    i++;
    j = 0;
    while (i < n){
        kate[j].up = request[i];
        j++;
        i++;
    }
    uptrack = j;
}
void scan(int n){
    int i;
    int seekcount = 0;
    printf("SEEK SEQUENCE = ");
    sort(n);
    if (pre < head){
        for (i = 0; i < uptrack; i++){
            seekcount += abs(head - request[i]);
            head = request[i];
        }
    }
    else {
        for (i = n - 1; i >= downtrack; i--){
            seekcount += abs(head - request[i]);
            head = request[i];
        }
    }
    printf("\nTotal Seek Count = %d", seekcount);
}
```

```

        printf("%d ", head);
        seekcount = seekcount + dist(head, kate[i].up);
        head = kate[i].up;
    }
    for (i = downtrack - 1; i > 0; i--){
        printf("%d ", head);
        seekcount = seekcount + dist(head, kate[i].down);
        head = kate[i].down;
    }
}
else{
    for (i = downtrack - 1; i >= 0; i--){
        printf("%d ", head);
        seekcount = seekcount + dist(head, kate[i].down);
        head = kate[i].down;
    }
    for (i = 0; i < uptrack - 1; i++){
        printf("%d ", head);
        seekcount = seekcount + dist(head, kate[i].up);
        head = kate[i].up;
    }
}
printf(" %d\nTOTAL DISTANCE :%d", head, seekcount);
}

int main(){
    int n, i;
    printf("ENTER THE DISK SIZE :\n");
    scanf("%d", &SIZE);
    printf("ENTER THE NO OF REQUEST SEQUENCE :\n");
    scanf("%d", &n);
    printf("ENTER THE REQUEST SEQUENCE :\n");
    for (i = 0; i < n; i++)
        scanf("%d", &request[i]);
    printf("ENTER THE CURRENT HEAD :\n");
    scanf("%d", &head);
    request[n] = head;
    request[n + 1] = SIZE - 1;
    request[n + 2] = 0;
    printf("ENTER THE PRE REQUEST :\n");
    scanf("%d", &pre);
    scan(n + 3);
}

```

Output:

```
ENTER THE DISK SIZE :  
4  
ENTER THE NO OF REQUEST SEQUENCE :  
2  
ENTER THE REQUEST SEQUENCE :  
1  
2  
ENTER THE CURRENT HEAD :  
1  
ENTER THE PRE REQUEST :  
2  
SEEK SEQUENCE = 1 0 1 2  
TOTAL DISTANCE :3
```