NEHRU COLLEGE OF ENGINEERING AND RESEARCH CENTRE

(NAAC Accredited)

(Approved by AICTE, Affiliated to APJ Abdul Kalam Technological University, Kerala)

Pampady, Thiruvilwamala (PO), Thrissur (DT), Kerala 680 588

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

LAB MANUAL

CSL331 SYSTEM SOFTWARE AND MICROPROCESSOR LAB

VISION OF THE INSTITUTION

To mould true citizens who are millennium leaders and catalysts of change through excellence in education.

MISSION OF THE INSTITUTION

NCERC is committed to transform itself into a center of excellence in Learning and Research in Engineering and Frontier Technology and to impart quality education to mould technically competent citizens with moral integrity, social commitment and ethical values.

We intend to facilitate our students to assimilate the latest technological know-how and to imbibe discipline, culture and spiritually, and to mould them in to technological giants, dedicated research scientists and intellectual leaders of the country who can spread the beams of light and happiness among the poor and the underprivileged.

ABOUT THE DEPARTMENT

- ♦ Established in: 2002
- ♦ Course offered: B.Tech. in Computer Science and Engineering

  M. Tech. in Computer Science and Engineering

  M. Tech. in Cyber Security
- ♦ Approved by AICTE New Delhi and Accredited by NAAC
- ♦ Certified by ISO 9001-2015
- ♦ Affiliated to A P J Abdul Kalam Technological University, Kerala.

DEPARTMENT VISSION

Producing Highly Competent, Innovative and Ethical Computer Science and Engineering Professionals to facilitate continuous technological advancement.

DEPARTMENT MISSION

1. To Impart Quality Education by creative Teaching Learning Process
2. To Promote cutting-edge Research and Development Process to solve real world problems with emerging technologies.
3. To Inculcate Entrepreneurship Skills among Students.
4. To cultivate Moral and Ethical Values in their Profession.

PROGRAMME EDUCATIONAL OBJECTIVES

PEO1: Graduates will be able to Work and Contribute in the domains of Computer Science and Engineering through lifelong learning.
PEO2: Graduates will be able to Analyse, design and development of novel Software Packages, Web Services, System Tools and Components as per needs and specifications.
PEO3: Graduates will be able to demonstrate their ability to adapt to a rapidly changing environment by learning and applying new technologies.
PEO4: Graduates will be able to adopt ethical attitudes, exhibit effective communication skills, Team work and leadership qualities.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSO)

PSO1: Ability to Formulate and Simulate Innovative Ideas to provide software solutions for Real-time Problems and to investigate for its future scope.

PSO2: Ability to learn and apply various methodologies for facilitating development of high quality System Software Tools and Efficient Web Design Models with a focus on performance optimization.

PSO3: Ability to inculcate the Knowledge for developing Codes and integrating hardware/software products in the domains of Big Data Analytics, Web Applications and Mobile Apps to create innovative career path and for the socially relevant issues.

COURSE OUTCOME

CO 1	Design and implement programs on 8086 microprocessor
CO 2	To provide solid foundation on interfacing the external devices to the processor according to the user requirements
CO 3	Design and implement 8051 microcontroller based systems
CO 4	To Understand the concepts related to I/O and memory interfacing
CO 5	To learn about interfacing stepper motor working and its interfacing
CO 6	To learn about generation of waveforms using microcontroller
CO 7	To learn about different types of flag registers and their changes while performing arithmetic operations

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓				✓		✓		✓
CO2	✓	✓	✓	✓				✓		✓		✓
CO3	✓	✓	✓	✓				✓		✓		✓
CO4	✓	✓	✓	✓				✓		✓		✓
CO5	✓	✓	✓	✓				✓		✓		✓

MAKE-UPS AND LATE WORK

Students must participate in all laboratory exercises as scheduled. They must obtain permission from the faculty member for absence, which would be granted only under justifiable circumstances. In such an event, a student must make arrangements for a make-up laboratory, which will be scheduled when the time is available after completing one cycle. Late submission will be awarded less mark for record and internals and zero in worst cases.

LABORATORY POLICIES

1. Food, beverages & mobile phones are not allowed in the laboratory at any time.
2. Do not sit or place anything on instrument benches.
3. Organizing laboratory experiments requires the help of laboratory technicians and staff. Be punctual.

MICROPROCESSOR LAB

I. Assembly Language Programming Exercises/Experiments using 8086 Trainer kit
II. Exercises/Experiments using MASM (PC required)
III. Interfacing Exercises/Experiments with 8086 trainer kit through Assembly Language programming
IV. Exercises/Experiments using 8051 trainer kit

SYSTEM SOFTWARE LAB:

I. Experiments related to the operating system.
II. Exercises/Experiments related to the assemblers, loaders and macroprocessors

Practice Questions

MICROPROCESSORS

Minimum 10 Exercises (at least 2 questions from each part I, II, III & IV)) : 2 Hrs/week

I. Assembly Language Programming Exercises/Experiments using 8086 Trainer kit

1. Implementation of simple decimal arithmetic and bit manipulation operations.
2. Implementation of code conversion between BCD, Binary, Hexadecimal and ASCII.
3. Implementation of searching and sorting of 16-bit numbers.

II. Exercises/Experiments using MASM (PC Required)

1. Study of Assembler and Debugging commands.
2. Implementation of decimal arithmetic (16 and 32 bit) operations.
3. Implementation of String manipulations.
4. Implementation of searching and sorting of 16-bit numbers.

III. Interfacing Exercises/Experiments with 8086 trainer kit through Assembly Language Programming

5. Interfacing with stepper motor - Rotate through any given sequence.
6. Interfacing with 8255 (mode0 and mode1 only).
7. Interfacing with 8279 (Rolling message, 2 key lockout and N-key rollover implementation).

IV. Interfacing Exercises/Experiments with 8086 trainer kit through Assembly Language Programming

8. Interfacing with stepper motor - Rotate through any given sequence.
9. Interfacing with 8255 (mode0 and mode1 only).
10. Interfacing with 8279 (Rolling message, 2 key lockout and N-key rollover implementation).

V. Exercises/Experiments using 8051 trainer kit

11. Familiarization of 8051 trainer kit by executing simple Assembly Language programs such as decimal arithmetic and bit manipulation.
12. Implementation of Timer programming (in mode1).

SYSTEM SOFTWARE LAB: List of Exercises/ Experiments

(Minimum 8 Exercises (at least 3 and 5 questions from each part V and VI)): 2 Hrs/week

VI. Exercises/Experiments from operating system

1. Simulate the following non-preemptive CPU scheduling algorithms to find turnaround time and waiting time.
   a) FCFS b) SJF c) Round Robin (pre-emptive) d) Priority
2. Simulate the following file allocation strategies.
   a) Sequential b) Indexed c) Linked
3. Implement the different paging techniques of memory management.
4. Simulate the following file organization techniques
   a) Single level directory b) Two level directory c) Hierarchical
5. Implement the banker's algorithm for deadlock avoidance.
6. Simulate the following disk scheduling algorithms.
   a) FCFS b) SCAN c) C-SCAN
7. Simulate the following page replacement algorithms: a)FIFO b)LRUc) LFU

VII. Exercises/Experiments from assemblers, loaders and microprocessor

1. Implement pass one of a two pass assembler.
2. Implement pass two of a two pass assembler.
3. Implement a single pass assembler.
4. Implement a two pass macro processor
5. Implement a single pass macro processor

PREPARATION FOR THE LABORATORY SESSION GENERAL INSTRUCTIONS TO STUDENTS

1. Read carefully and understand the description of the experiment in the lab manual. You may go to the lab at an earlier date to look at the experimental facility and understand it better. Consult the appropriate references to be completely familiar with the concepts and hardware.

2. Make sure that your observation for previous week experiment is evaluated by the faculty member and you have transferred all the contents to your record before entering to the lab/workshop.

3. At the beginning of the class, if the faculty or the instructor finds that a student is not adequately prepared, they will be marked as absent and not be allowed to perform the experiment.

4. Bring necessary material needed (writing materials, graphs, calculators, etc.) to perform the required preliminary analysis. It is a good idea to do sample calculations and as much of the analysis as possible during the session. Faculty help will be available. Errors in the procedure may thus be easily detected and rectified.

5. Please actively participate in class and don't hesitate to ask questions. Please utilize the teaching assistants fully. To encourage you to be prepared and to read the lab manual before coming to the laboratory, unannounced questions may be asked at any time during the lab.

6. Carelessness in personal conduct or in handling equipment may result in serious injury to the individual or the equipment. Do not run near moving machinery/equipment. Always be on the alert for strange sounds. Guard against entangling clothes in moving parts of machinery.

7. Students must follow the proper dress code inside the laboratory. To protect clothing from dirt, wear a lab coat. Long hair should be tied back. Shoes covering the whole foot will have to be worn.

8. In performing the experiments, please proceed carefully to minimize any water spills, especially on the electric circuits and wire.

9. Maintain silence, order and discipline inside the lab. Don't use cell phones inside the laboratory.

10. Any injury no matter how small must be reported to the instructor immediately.

11. Check with faculty members one week before the experiment to make sure that you have the handout for that experiment and all the apparatus.

AFTER THE LABORATORY SESSION

1. Clean up your work area.

2. Check with the technician before you leave.

3. Make sure you understand what kind of report is to be prepared and due submission of record is next lab class.

4. Do sample calculations and some preliminary work to verify that the experiment was successful

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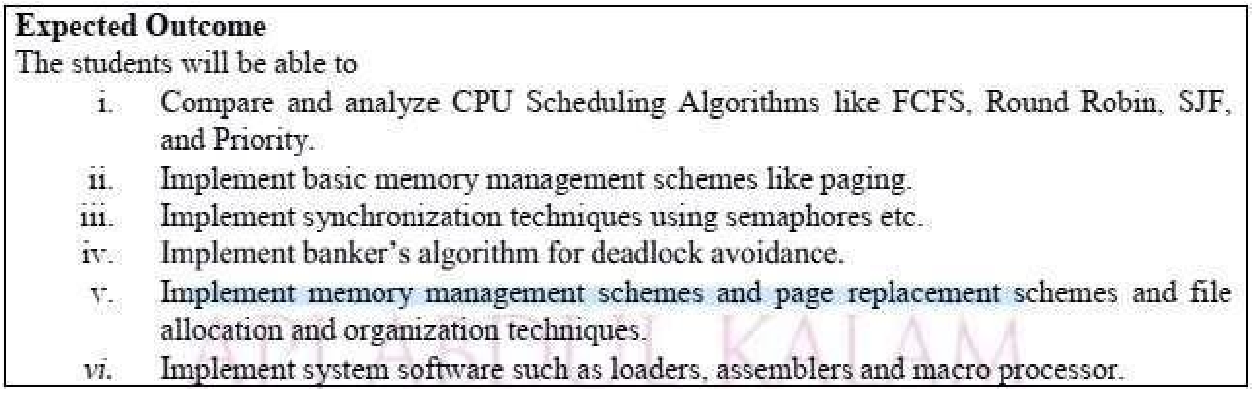


Expected Outcome
The students will be able to

i. Compare and analyze CPU Scheduling Algorithms like FCFS, Round Robin, SJF, and Priority.
ii. Implement basic memory management schemes like paging.
iii. Implement synchronization techniques using semaphores etc.
iv. Implement banker's algorithm for deadlock avoidance.
v. Implement memory management schemes and page replacement schemes and file allocation and organization techniques.
vi. Implement system software such as loaders, assemblers and macro processor.

INDEX

EXPERIMENT – 1

CPU SCHEDULING ALGORITHMS

AIM: Simulate the following non-pre-emptive CPU scheduling algorithms to find turnaround time and waiting time.

a) FCFS
b) SJF
c) Round Robin (pre-emptive)
d) Priority

ALGORITHM

a) First Come First Serve (FCFS):

1. Jobs are executed on first come, first serve basis.
2. It is a non-pre-emptive, pre-emptive scheduling algorithm.
3. Easy to understand and implement.
4. Its implementation is based on FIFO queue.
5. Poor in performance as average wait time is high. Wait time of each process is as follows −

Process Wait Time : Service Time - Arrival Time
P0 0 - 0 = 0
P1 5 - 1 = 4
P2 8 - 2 = 6
P3 16 - 3 = 13
Average Wait Time: (0+4+6+13) / 4 = 5.75

b) Shortest Job First (SJF)

1. This is also known as shortest job next, or SJN
2. This is a non-pre-emptive, pre-emptive scheduling algorithm.
3. Best approach to minimize waiting time.
4. Easy to implement in Batch systems where required CPU time is known in advance.
5. Impossible to implement in interactive systems where the required CPU time is not known.
6. The processer should know in advance how much time process will take.

Wait time of each process is as follows −
Process Wait Time : Service Time - Arrival Time
P0 3 - 0 = 3
P1 0 - 0 = 0
P2 16 - 2 = 14
P3 8 - 3 = 5
Average Wait Time: (3+0+14+5) / 4 = 5.50

c) Priority Based Scheduling

1. Priority scheduling is a non-pre-emptive algorithm and one of the most common scheduling algorithms in batch systems.
2. Each process is assigned a priority. Process with highest priority is to be executed first and so on.
3. Processes with same priority are executed on first come first served basis.
4. Priority can be decided based on memory requirements, time requirements or any other resource requirement.

Wait time of each process is as follows −
Process Wait Time : Service Time - Arrival Time
P0 9 - 0 = 9
P1 6 - 1 = 5
P2 14 - 2 = 12
P3 0 - 0 = 0
Average Wait Time: (9+5+12+0) / 4 = 6.5

d)Round Robin Scheduling

1. Round Robin is the pre-emptive process scheduling algorithm.
2. Each process is provided a fix time to execute, it is called a quantum.
3. Once a process is executed for a given time period, it is pre-empted and other process executes for a given time period.
4. Context switching is used to save states of pre-empted processes. Wait time of each process is as follows −

Process Wait Time : Service Time - Arrival Time
P0 (0 - 0) + (12 - 3) = 9
P1 (3 - 1) = 2
P2 (6 - 2) + (14 - 9) + (20 - 17) = 12
P3 (9 - 3) + (17 - 12) = 11
Average Wait Time: (9+2+12+11) / 4 = 8.5

Important Equations:

Turn Around Time = Completion Time – Arrival Time
Waiting Time = Turn Around Time – Burst Time

PROGRAM:

```
// C program for implementation of FCFS scheduling
#include<stdio.h>
// Function to find the waiting time for all processes
void findWaitingTime(int processes[], int n, int bt[], int wt[])
{
   // waiting time for first process is
   0 wt[0] = 0;
```

```
    // calculating waiting time
    for (int i = 1; i < n ; i++ )
        wt[i] = bt[i-1] + wt[i-1] ;
}

// Function to calculate turn around time
void findTurnAroundTime( int processes[], int n, int bt[], int wt[], int tat[])
{
    // calculating turnaround time by adding
    // bt[i] + wt[i]
    for (int i = 0; i < n ; i++)
        tat[i] = bt[i] + wt[i];
}

//Function to calculate average time
void findavgTime( int processes[], int n, int bt[])
{
    int wt[n], tat[n], total_wt = 0, total_tat = 0;

    //Function to find waiting time of all processes
    findWaitingTime(processes, n, bt, wt);

    //Function to find turn around time for all processes
    findTurnAroundTime(processes, n, bt, wt, tat);

    //Display processes along with all details
    printf("Processes Burst time Waiting time Turn around time\n");

    // Calculate total waiting time and total turn around time
    for (int  i=0; i<n; i++)
    {
        total_wt = total_wt + wt[i];
        total_tat = total_tat + tat[i];
        printf(" %d ",(i+1));
        printf("     %d ", bt[i] );
        printf("     %d",wt[i] );
        printf("     %d\n",tat[i] );
    }
    int s=(float)total_wt / (float)n;
    int t=(float)total_tat / (float)n;
    printf("Average waiting time = %d",s);
    printf("\n");
    printf("Average turn around time = %d ",t);
}
```

```
// Driver code
int main()
{
   //process id's
   int processes[] = { 1, 2, 3};
   int n = sizeof processes / sizeof processes[0];

   //Burst time of all processes
   int burst_time[] = {10, 5, 8};

   findavgTime(processes, n, burst_time);
   return 0;
}
```

Output:

```
Processes  Burst time Waiting time Turn around time
 1        10     0         10
 2        5     10         15
 3        8     15         23
Average waiting time = 8.33333
Average turn around time = 16
```

Result: Program has been executed successfully and   required output obtained

CPU scheduling Program executed successfully and output analyzed.

Viva questions:

1. Which module gives control of the CPU to the process selected by the short-term scheduler?
2. Mention the processes that are residing in main memory and are ready and waiting to execute are kept on a list.
3. What is the interval from the time of submission of a process to the time of completion is termed?
4. which algorithm is defined in Time quantum?

EXPERIMENT – 2
FILE ORGANIZATION TECHNIQUES

AIM: Simulate the following file organization techniques.
a. Single level directory.
b. Two level directory.
c. Hierarchical.

Single level directory:
In a single-level directory system, all the files are placed in one directory. There is a root directory which has all files. It has a simple architecture and there are no sub directories. Advantage of single level directory system is that it is easy to find a file in the directory.
Two level directory:
In the two-level directory system, each user has own user file directory (UFD). The system maintains a master block that has one entry for each user. This master block contains the addresses of the directory of the users. When a user job starts or a user logs in, the system's master file directory (MFD) is searched. When a user refers to a particular file, only his own UFD is searched. This effectively solves the name collision problem and isolates users from one another.
Hierarchical:
Hierarchical directory structure allows users to create their own subdirectories and to organize their files accordingly. A tree is the most common directory structure. The tree has a root directory, and every file in the system has a unique path name. A directory (or subdirectory) contains a set of files or subdirectories.

Algorithm for Single Level Directory Structure:

```
Step 1: Start
Step 2: Initialize values gd=DETECT,gm,count,i,j,mid,cir_x;
Initialize character array fname[10][20];
Step 3: Initialize graph function as Initgraph(& gd, &gm," c:/tc/bgi");
Clear device();
Step 4:set back ground color with setbkcolor();
Step 5:read number of files in variable count.
Step 6:if check i<count
Step 7: for i=0 & i<count i increment; Cleardevice(); setbkcolor(GREEN); read file name; setfillstyle(1,MAGENTA);
Step 8: mid=640/count; cir_x=mid/3; bar3d(270,100,370,150,0,0); settextstyle(2,0,4); settextstyle(1,1); outtextxy(320,125,"rootdirectory"); setcolor(BLUE); i++;
Step 9:for j=0&&j<=i&&cir_x+=mid j increment; line(320,150,cir_x,250); fillellipse(cir_x,250,30,30); outtextxy(cir_x,250,fname[i]);
Step 10: End
```

Program Code:

/* Program to simulate single level directory */

```
#include<stdio.h>
#include<conio.h>
#include<string.h>
void main()
{
int nf=0,i=0,j=0,ch;
char mdname[10],fname[10][10],name[10];
clrscr();
printf("Enter the directory name:");
scanf("%s",mdname);
printf("Enter the number of files:");
scanf("%d",&nf);
do
{
printf("Enter file name to be
created:"); scanf("%s",name);
for(i=0;i<nf;i++)
{
if(!strcmp(name,fname[i]))
break;
}
if(i==nf)
{
strcpy(fname[j++],name);
nf++;
}
else
printf("There is already %s\n",name);
printf("Do you want to enter another file(yes - 1 or no - 0):");
scanf("%d",&ch);
}
while(ch==1);
printf("Directory name is:%s\n",mdname);
printf("Files names are:");
for(i=0;i<j;i++)
printf("\n%s",fname[i]);
getch();
}
```

Output:

```
Enter the directory name:sss
 Enter the number of files:3
 Enter file name to be created:aaa
Do you want to enter another file(yes - 1 or no - 0):1
 Enter file name to be created:bbb
Do you want to enter another file(yes - 1 or no - 0):1
 Enter file name to be created:ccc
Do you want to enter another file(yes - 1 or no - 0):0
 Directory name is:sss
Files names are:
 aaa
bbb
 ccc
```

Result: Program has been executed successfully and required output obtained

EXPERIMENT – 3 BANKERS ALGORITHM

AIM: Implement the banker's algorithm for deadlock avoidance
The Banker algorithm, sometimes referred to as the detection algorithm, is a resource allocation and deadlock avoidance algorithm developed by Edsger Dijkstra that tests for safety by simulating the allocation of predetermined maximum possible amounts of all resources, and then makes an "s-state" check to test for possible deadlock conditions for all other pending activities, before deciding whether allocation should be allowed to continue.

For the Banker's algorithm to work, it needs to know three things:
1. How much of each resource each process could possibly request[MAX]
2. How much of each resource each process is currently holding[ALLOCATED]
3. How much of each resource the system currently has available[AVAILABLE]

Resources may be allocated to a process only if the amount of resources requested is less than or equal to the amount available; otherwise, the process waits until resources are available.The Banker's Algorithm derives its name from the fact that this algorithm could be used in a banking system to ensure that the bank does not run out of resources, because the bank would never allocate its money in such a way that it can no longer satisfy the needs of all its customers. By using the Banker's algorithm, the bank ensures that when customers request money the bank never leaves a safe state. If the customer's request does not cause the bank to leave a safe state, the cash will be allocated; otherwise the customer must wait until some other customer deposits enough.Basic data structures to be maintained to implement the

Banker's Algorithm:

Let n be the number of processes in the system and m be the number of resource types. Then we need the following data structures:
1. Available: A vector of length m indicates the number of available resources of each type. If Available[j] = k, there are k instances of resource type Rj available.

2. Max: An n×m matrix defines the maximum demand of each process. If Max[i,j] = k, then Pi may request at most k instances of resource type Rj.
3. Allocation: An n×m matrix defines the number of resources of each type currently allocated to each process. If Allocation[i,j] = k, then process Pi is currently allocated k instances of resource type Rj.
4. Need: An n×m matrix indicates the remaining resource need of each process. If Need[i,j] = k, then Pi may need k more instances of resource type Rj to complete the task.

PROGRAM:

```
// Banker's Algorithm
#include <stdio.h>
int main()
{
   // P0, P1, P2, P3, P4 are the Process names here

   int n, m, i, j, k;
   n = 5; // Number of processes
   m = 3; // Number of resources
   int alloc[5][3] = { { 0, 1, 0 }, // P0    // Allocation Matrix
                       { 2, 0, 0 }, // P1
                       { 3, 0, 2 }, // P2
                       { 2, 1, 1 }, // P3
                       { 0, 0, 2 } }; // P4

   int max[5][3] = { { 7, 5, 3 }, // P0    // MAX Matrix
                     { 3, 2, 2 }, // P1
                     { 9, 0, 2 }, // P2
                     { 2, 2, 2 }, // P3
                     { 4, 3, 3 } }; // P4
   int avail[3] = { 3, 3, 2 }; // Available Resources
   int f[n], ans[n], ind = 0;
   for (k = 0; k < n; k++) {
      f[k] = 0;
   }
   int need[n][m];
   for (i = 0; i < n; i++) {
      for (j = 0; j < m; j++)
         need[i][j] = max[i][j] - alloc[i][j];
   }
   int y = 0;
   for (k = 0; k < 5; k++) {
      for (i = 0; i < n; i++) {
         if (f[i] == 0) {

            int flag = 0;
            for (j = 0; j < m; j++) {
               if (need[i][j] > avail[j]){
                  flag = 1;
                   break;
```

```
                    }
                }

                if (flag == 0) {
                    ans[ind++] = i;
                    for (y = 0; y < m; y++)
                        avail[y] += alloc[i][y];
                    f[i] = 1;
                }
            }
        }
    }

    printf("Following is the SAFE Sequence\n");
    for (i = 0; i < n - 1; i++)
        printf(" P%d ->", ans[i]);
    printf(" P%d", ans[n - 1]);

    return (0);
}
```

Output:

```
Following is the SAFE Sequence
 P1 -> P3 -> P4 -> P0 -> P2
```

Result: Program has been executed successfully and   required output obtained

VIVA QUESTIONS:

1). What is an operating system? ...
2) What is the main purpose of an operating system? ...
3) What are the different operating systems? ...
4) What is a socket? ...
5) What is a real-time system

EXPERIMENT – 4
DISK SCHEDULING ALGORITHM

AIM: Simulate the following disk scheduling algorithms.
a) FCFS b) SCAN c) C-SCAN

ALGORITHM:

First Come -First Serve (FCFS)

It is the simplest form of disk scheduling algorithms. The I/O requests are served or processes according to their arrival. The request arrives first will be accessed and served first. Since it follows the order of arrival, it causes the wild swings from the innermost to the outermost tracks of the disk and vice versa. The farther the location of the request being serviced by the read/write head from its current location, the higher the seek time will be.

Example:

Given the following track requests in the disk queue, compute for the Total Head Movement2 (THM) of the read/write head: 95, 180, 34, 119, 11, 123, 62, and 64. Consider that the read/write head is positioned at location 50. Prior to this track location 199 was serviced. Show the total head movement for a 200 track disk (0-199).

Solution:

Total Head Movement Computation:
(THM) = (180-50) + (180-34) + (119-34) + (119-11) + (123-11) + (123-62) + (64-62)
= 130 + 146 + 85 + 108 + 112 + 61 + 2 (THM) = 644 tracks
Assuming a seek rate of 5 milliseconds is given, we compute for the seek time using the formula: Seek Time = THM * Seek rate = 644 * 5 ms
Seek Time = 3,220ms
There are some requests that are far from the current location of the R/W head which causes theaccess arm to travel from innermost to the outermost tracks of the disk or vice versa.In this example, it had a total of 644 tracks and a seek time of 3,220 milliseconds. Based on the result, this algorithm produced higher seek rate since it follows the arrival of the track requests.

SCAN Scheduling Algorithm

This algorithm is performed by moving the R/W head back-and-forth to the innermost and outermost track. As it scans the tracks from end to end, it process all the requests found in the direction it is headed. This will ensure that all track requests, whether in the outermost, middle or innermost location, will be traversed by the access arm thereby finding all the requests. This is also known as the Elevator algorithm. Using the same sets of example in FCFS the solution are as follows:
(THM) = (50-0) + (180-0) = 50 + 180
(THM) = 230
Seek Time = THM * Seek rate = 230* 5ms

Seek Time = 1,150ms

This algorithm works like an elevator does. In the algorithm example, it scans down towards the nearest end and when it reached the bottom it scans up servicing the requests that it did not getgoing down. If a request comes in after it has been scanned, it will not be serviced until the process comes back down 8 or moves back up. This process moved a total of 230 tracks and a seek time of 1,150.

Circular SCAN (C-SCAN) Algorithm

This algorithm is a modified version of the SCAN algorithm. C-SCAN sweeps the disk from end-to-end, but as soon it reaches one of the end tracks it then moves to the other end track without servicing any requesting location. As soon as it reaches the other end track it then starts servicing and grants requests headed to its direction. This algorithm improves the unfair situation of the end tracks against the middle tracks. Using the same sets of example in FCFS the solution are as follows: alpha3 symbol (α) was used to represent the dash line. This return sweeps is sometimes given a numerical value which is included in the computation of the THM. As analogy, this can be compared with the carriage return lever of a typewriter. Once it is pulled to the right most direction, it resets the typing point to the leftmost margin of the report. A typist is not supposed to type during the movement of the carriage return lever because the line spacing is being adjusted. The frequent use of this lever consumes time, same with the time consumed when the R/W head is reset to its starting position.

Assume that in this example, α has a value of 20ms, the computation would be as follows:
(THM) = (50-0) + (199-62) + α = 50 + 137 + 20
(THM) = 207 tracks
Seek Time = THM * Seek rate = 187 * 5ms
Seek Time = 935ms
The computation of the seek time excluded the alpha value because it is not an actual seek or search of a disk request but a reset of the access arm to the starting position.

PROGRAM:

```
// C++ program to demonstrate
// C-SCAN Disk Scheduling algorithm
#include <bits/stdc++.h>
using namespace std;

int size = 8;
int disk_size = 200;

void CSCAN(int arr[], int head)
{
```

```
int seek_count = 0;
int distance, cur_track;
```

```
vector<int> left, right;
vector<int>
seek_sequence;

// appending end values
// which has to be visited
// before reversing the direction
left.push_back(0);
right.push_back(disk_size - 1);

// tracks on the left of the
// head will be serviced when
// once the head comes back
// to the beggining (left end).
for (int i = 0; i < size; i++) {
    if (arr[i] < head)
        left.push_back(arr[i]);
    if (arr[i] > head)
        right.push_back(arr[i]);
}

// sorting left and right vectors
std::sort(left.begin(), left.end());
std::sort(right.begin(), right.end());

// first service the requests
// on the right side of the
// head.
for (int i = 0; i < right.size(); i++) {
    cur_track = right[i];
    // appending current track to seek sequence
    seek_sequence.push_back(cur_track);

    // calculate absolute distance
    distance = abs(cur_track - head);

    // increase the total count
    seek_count += distance;

    // accessed track is now new head
    head = cur_track;
}
```

```
    // once reached the right end
    // jump to the beggining.

    head = 0;

    // adding seek count for head returning from 199 to 0
    seek_count += (disk_size - 1);

    // Now service the requests again
    // which are left.
    for (int i = 0; i < left.size(); i++) {
        cur_track = left[i];

        // appending current track to seek sequence
        seek_sequence.push_back(cur_track);

        // calculate absolute distance
        distance = abs(cur_track - head);

        // increase the total count
        seek_count += distance;

        // accessed track is now the new head
        head = cur_track;
    }

    cout << "Total number of seek operations = "
         << seek_count << endl;

    cout << "Seek Sequence is" << endl;

    for (int i = 0; i < seek_sequence.size(); i++) {
        cout << seek_sequence[i] << endl;
    }
}

// Driver code
int main()
{

    // request array
    int arr[size] = { 176, 79, 34, 60, 92, 11, 41, 114 };
    int head = 50;
```

```
cout << "Initial position of head: " << head << endl;
CSCAN(arr, head);
```

```
    return 0;
}
```

Output

```
Initial position of head: 50

Total number of seek operations = 389

 Seek Sequence is

60

79

92

114

176

199

0

11

34

41
```

Result: Program has been executed successfully and required output obtained

Viva Questions:

1.What is RAID structure in OS
2.What is GUI?
3.What is a Pipe and when it is used
4.What are the different kinds of operations that are possible on semaphore?

EXPERIMENT – 5 PRODUCER CONSUMER PROBLEM

AIM: Implement the producer-consumer problem using semaphores.

ALGORITHM

In computing, the producer–consumer problem (also known as the bounded-buffer problem) is a classic example of a multi-process synchronization problem. The problem describes two processes, the producer and the consumer, which share a common, fixed-size buffer used as a queue.

1. The producer's job is to generate data, put it into the buffer, and start again.
2. At the same time, the consumer is consuming the data (i.e. removing it from the buffer), one piece at a time.

Problem: To make sure that the producer won't try to add data into the buffer if it's full and that the consumer won't try to remove data from an empty buffer.

Solution: One solution of this problem is to use semaphores. The semaphores which will be used here are:

1.m, a binary semaphore which is used to acquire and release the lock.
2. empty, a counting semaphore whose initial value is the number of slots in the buffer, since, initially all slots are empty.
3.full, a counting semaphore whose initial value is 0.

At any instant, the current value of empty represents the number of empty slots in the buffer and

The Producer Operation

```
do
{
// wait until empty > 0 and then decrement 'empty'
wait(empty);
// acquire lock
wait(mutex);
/* perform the insert operation in a slot */
// release lock
signal(mutex);
// increment 'full'
signal(full);
}
while(TRUE)
```

1. A producer first waits until there is at least one empty slot.
2. Then it decrements the empty semaphore because, there will now be one less empty slot, since the producer is going to insert data in one of those slots.
3. Then, it acquires lock on the buffer, so that the consumer cannot access the buffer until producer completes its operation.
4. After performing the insert operation, the lock is released and the value of full is incremented because the producer has just filled a slot in the buffer.

The Consumer Operation

```
do
{
// wait until full > 0 and then decrement 'full'
wait(full);
// acquire the lock
wait(mutex);
/* perform the remove operation in a slot */
// release the
lock
signal(mutex);
// increment 'empty'
signal(empty);
}
while(TRUE);
```

1. The consumer waits until there is at least one full slot in the buffer.
2. Then it decrements the full semaphore because the number of occupied slots will be decreased by one, after the consumer completes its operation.
3. After that, the consumer acquires lock on the buffer.
4. Following that, the consumer completes the removal operation so that the data from one of the full slots is removed.
5. Then, the consumer releases the lock.
6. Finally, the empty semaphore is incremented by 1, because the consumer has just removed data from an occupied slot, thus making it empty.

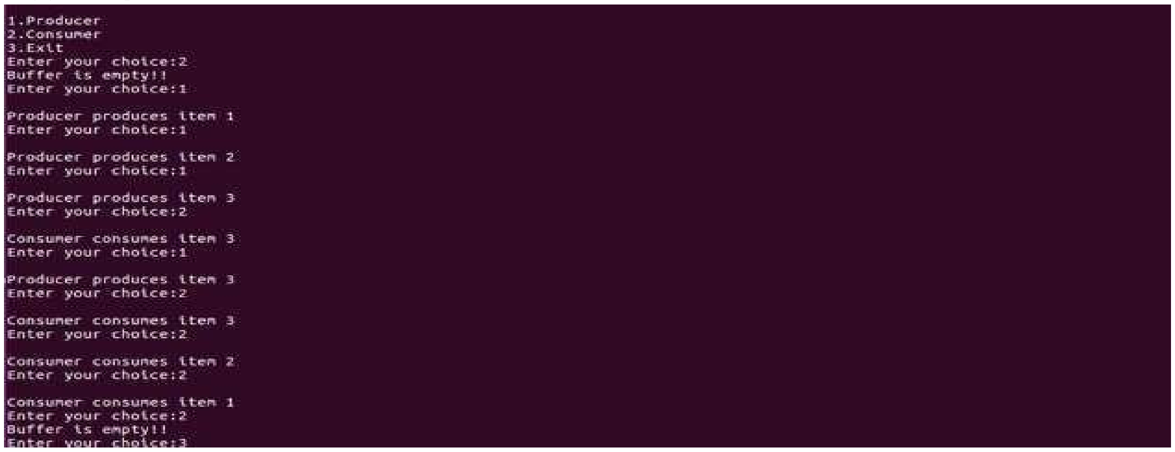
PROGRAM

```
// C program for the above approach

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

// Initialize a mutex to 1
int mutex = 1;

// Number of full slots as 0
int full = 0;
```

```
// Number of empty slots as size
// of buffer
int empty = 10, x = 0;

// Function to produce an item and
// add it to the buffer
void producer()
{
   // Decrease mutex value by 1
   --mutex;

   // Increase the number of full
   // slots by 1
   ++full;

   // Decrease the number of empty
   // slots by 1
   --empty;

   // Item produced
   x++;
   printf("\nProducer produces"
         "item %d",
         x);

   // Increase mutex value by 1
   ++mutex;
}

// Function to consume an item and
// remove it from buffer
void consumer()
{
   // Decrease mutex value by 1
   --mutex;

   // Decrease the number of full
   // slots by 1
   --full;

   // Increase the number of empty
   // slots by 1
   ++empty;
   printf("\nConsumer consumes "
```

```
            "item %d",
            x);
    x--;

    // Increase mutex value by 1
    ++mutex;
}

// Driver Code
int main()
{
    int n, i;
    printf("\n1. Press 1 for Producer"
           "\n2. Press 2 for Consumer"
           "\n3. Press 3 for Exit");

// Using '#pragma omp parallel for'
// can  give wrong value due to
// synchronisation issues.

// 'critical' specifies that code is
// executed by only one thread at a
// time i.e., only one thread enters
// the critical section at a given time
#pragma omp critical

    for (i = 1; i > 0; i++) {

        printf("\nEnter your choice:");
        scanf("%d", &n);

        // Switch Cases
        switch (n) {
        case 1:

            // If mutex is 1 and empty
            // is non-zero, then it is
            // possible to produce
            if ((mutex == 1)
                && (empty != 0)) {
                producer();
            }

            // Otherwise, print buffer
            // is full
            else {
                printf("Buffer is full!");
            }
            break;

        case 2:

            // If mutex is 1 and full
            // is non-zero, then it is
            // possible to consume
            if ((mutex == 1)
                && (full != 0)) {
                consumer();
            }

            // Otherwise, print Buffer
            // is empty
            else {
                printf("Buffer is empty!");
            }
            break;

        // Exit Condition
        case 3:
            exit(0);
            break;
        }
    }}
```

Output:



```
1.Producer
2.Consumer
3.Exit
Enter your choice:2
Buffer is empty!!
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:2

Consumer consumes item 3
Enter your choice:1

Producer produces item 3
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!!
Enter your choice:3
```

Result: Program has been executed successfully and   required output obtained

Viva questions
1.What is a bootstrap program in OS?
2.Explain demand paging
3.What do you mean by RTOS?
4.What do you mean by overlays in OS
5.What is thread in OS

EXPERIMENT – 6
DINING PHILOSOPHER'S PROBLEM

AIM: Write a program to simulate the working of the dining philosopher’s problem.

In computer science, the dining philosopher’s problem is an example problem often used in concurrent algorithm design to illustrate synchronization issues and techniques for resolving them Five silent philosophers sit at a round table with bowls of spaghetti. Forks are placed between each pair of adjacent philosophers.Each philosopher must alternately think and eat. However, a philosopher can only eat spaghetti when they have both left and right forks. Each fork can be held by only one philosopher and so a philosopher can use the fork only if it is not being used by another philosopher. After an individual philosopher finishes eating, they need to put down both forks so that the forks become available to others. A philosopher can take the fork on their right or the one on their left as they become available, but cannot start eating before getting both forks.

Eating is not limited by the remaining amounts of spaghetti or stomach space; an infinite supply and an infinite demand are assumed.The problem is how to design a discipline of behaviour such that no philosopher will starve; i.e.,each can forever continue to alternate between eating and thinking, assuming that no philosopher can know when others may want to eat or think.The main problem in this case is to illustrate the challenges of avoiding deadlock, a system state in which no progress is possible. Resource starvation might also occur independently of deadlock if a particular philosopher is unable to acquire both forks because of a timing problem.

ALGORITHM

```
1.Define the number of philosophers
2Declare one thread per philosopher
3.Declare one semaphore (represent chopsticks) per philosopher
4.When a philosopher is hungry
5.See if chopsticks on both sides are free
6.Acquire both chopsticks or  eat 7.restore
the chopsticks
8.If chopsticks aren’t free
9.Wait till they are available
```

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

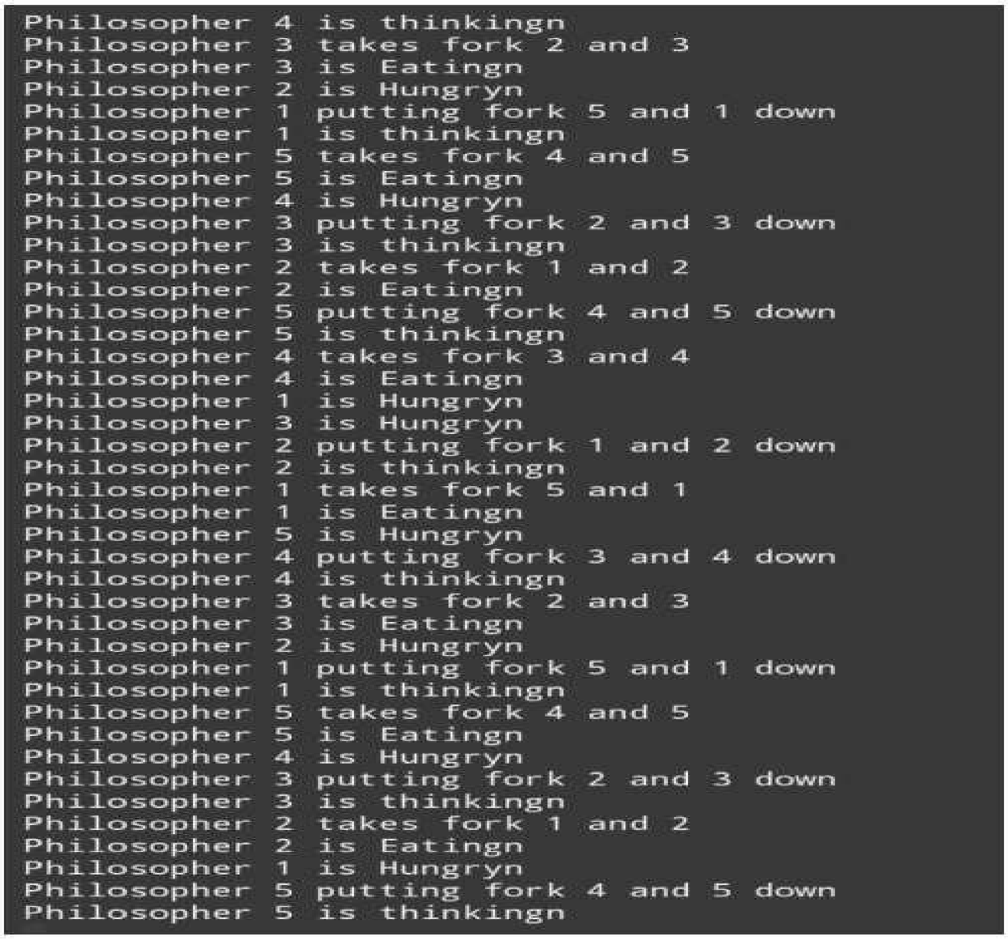
```
#include<pthread.h>
#define N 5
#define THINKING 0
#define HUNGRY 1
#define EATING 2
#define LEFT (ph_num+4)%N
#define RIGHT (ph_num+1)%N
sem_t mutex;
sem_t S[N];
```

```
void * philospher(void *num);
void take_fork(int);
void put_fork(int);
void test(int);
int state[N];
int phil_num[N]={0,1,2,3,4};
int main()
{
int i;
pthread_t thread_id[N];
sem_init(&mutex,0,1);
for(i=0;i<N;i++)
sem_init(&S[i],0,0);
for(i=0;i<N;i++)
{
pthread_create(&thread_id[i],NULL,philospher,&phil_num[i]);
printf("Philosopher %d is thinkingn \n",i+1);
}
for(i=0;i<N;i++)
pthread_join(thread_id[i],NULL);
}
void *philospher(void *num)
{
while(1)
{
int *i = num;
sleep(1);
take_fork(*i);
sleep(0);
put_fork(*i);
}}
void take_fork(int ph_num)
{
sem_wait(&mutex);
state[ph_num] = HUNGRY;
printf("Philosopher %d is Hungryn \n",ph_num+1);
test(ph_num);
```

```
sem_post(&mutex);
sem_wait(&S[ph_num]);
sleep(1);}
void test(int ph_num)
{
if (state[ph_num] == HUNGRY && state[LEFT] != EATING && state[RIGHT] != EATING)
{
state[ph_num] = EATING;
sleep(2);
```

```
printf("Philosopher %d takes fork %d and %d \n",ph_num+1,LEFT+1,ph_num+1);
printf("Philosopher %d is Eatingn \n",ph_num+1);
sem_post(&S[ph_num]);
}}
void put_fork(int ph_num)
{
sem_wait(&mutex);
state[ph_num] = THINKING;
printf("Philosopher %d putting fork %d and %d down \n",ph_num+1,LEFT+1,ph_num+1);
printf("Philosopher %d is thinkingn \n",ph_num+1);
test(LEFT);
test(RIGHT);
sem_post(&mutex);
}
```

OUTPUT



```
Philosopher 4 is thinkingn
Philosopher 3 takes fork 2 and 3
Philosopher 3 is Eatingn
Philosopher 2 is Hungryn
Philosopher 1 putting fork 5 and 1 down
Philosopher 1 is thinkingn
Philosopher 5 takes fork 4 and 5
Philosopher 5 is Eatingn
Philosopher 4 is Hungryn
Philosopher 3 putting fork 2 and 3 down
Philosopher 3 is thinkingn
Philosopher 2 takes fork 1 and 2
Philosopher 2 is Eatingn
Philosopher 5 putting fork 4 and 5 down
Philosopher 5 is thinkingn
Philosopher 4 takes fork 3 and 4
Philosopher 4 is Eatingn
Philosopher 1 is Hungryn
Philosopher 3 is Hungryn
Philosopher 2 putting fork 1 and 2 down
Philosopher 2 is thinkingn
Philosopher 1 takes fork 5 and 1
Philosopher 1 is Eatingn
Philosopher 5 is Hungryn
Philosopher 4 putting fork 3 and 4 down
Philosopher 4 is thinkingn
Philosopher 3 takes fork 2 and 3
Philosopher 3 is Eatingn
Philosopher 2 is Hungryn
Philosopher 1 putting fork 5 and 1 down
Philosopher 1 is thinkingn
Philosopher 5 takes fork 4 and 5
Philosopher 5 is Eatingn
Philosopher 4 is Hungryn
Philosopher 3 putting fork 2 and 3 down
Philosopher 3 is thinkingn
Philosopher 2 takes fork 1 and 2
Philosopher 2 is Eatingn
Philosopher 1 is Hungryn
Philosopher 5 putting fork 4 and 5 down
Philosopher 5 is thinkingn
```

Result: Program has been executed successfully and required output obtained

Viva questions

1.What do you mean by FCFS?

2.What is Reentrancy?

3What is a Scheduling Algorithm?

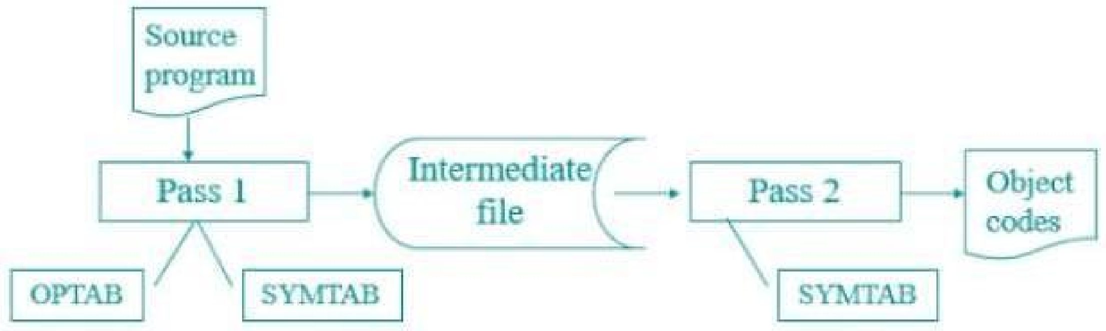
4. What is a Scheduling Algorithm?
5. What do you mean by asymmetric clustering?

EXPERIMENT – 7

PASS ONE OF A TWO PASS ASSEMBLER

AIM: Implement pass one of a two pass assembler.

Two-pass assembler: Assemblers typically make two or more passes through a source program in order to resolve forward references in a program. A forward reference is defined as a type of instruction in the code segment that is referencing the label of an instruction, but the assembler has not yet encountered the definition of that instruction.



Pass 1: Assembler reads the entire source program and constructs a symbol table of names and labels used in the program, that is, name of data fields and programs labels and their relative location (offset) within the segment. . To assign address to labels, the assembler maintains aLocation Counter (LC).
Pass 1 determines the amount of code to be generated for each instruction.

PROGRAM

```
#include<stdio.h>
#include<conio.h>
#include<string.h>
void main()
{
 char opcode[10],operand[10],label[10],code[10][10],ch; char
mnemonic[10][10]={"START","LDA","STA","LDCH","STCH","END"};
 int locctr,start,len,i=0,j=0;
 FILE *fp1,*fp2,*fp3;
 clrscr();
 fp1=fopen("INPUT.DAT","r");
 fp2=fopen("SYMTAB.DAT","w");
 fp3=fopen("OUT.DAT","w");
 fscanf(fp1,"%s%s%s",label,opcode,operand);
 if(strcmp(opcode,"START")==0)
  {
  start=atoi(operand);
  locctr=start;
  fprintf(fp3,"%s\t%s\t%s\n",label,opcode,operand);
  fscanf(fp1,"%s%s%s",label,opcode,operand);
 }
else
 locctr=0;
while(strcmp(opcode,"END")!=0)
 {
  fprintf(fp3,"%d",locctr);
  if(strcmp(label,"**")!=0)
  fprintf(fp2,"%s\t%d\n",label,locctr);
  strcpy(code[i],mnemonic[j]);
  while(strcmp(mnemonic[j],"END")!=0)
   {
    if(strcmp(opcode,mnemonic[j])==0)
    {
     locctr+=3;
     break;
    }
    strcpy(code[i],mnemonic[j]);
    j++;
   }
  if(strcmp(opcode,"WORD")==0)
   locctr+=3;
  else if(strcmp(opcode,"RESW")==0)
   locctr+=(3*(atoi(operand)));
  else if(strcmp(opcode,"RESB")==0)
   locctr+=(atoi(operand));
  else if(strcmp(opcode,"BYTE")==0)
   ++locctr;
  fprintf(fp3,"\t%s\t%s\t%s\n",label,opcode,operand);
  fscanf(fp1,"%s%s%s",label,opcode,operand);
 }
 fprintf(fp3,"%d\t%s\t%s\t%s\n",locctr,label,opcode,operand);
 fcloseall();
 printf("\n\nThe contents of Input Table :\n\n");
 fp1=fopen("INPUT.DAT","r");
 ch=fgetc(fp1);
 while(ch!=EOF)
  {
   printf("%c",ch);
   ch=fgetc(fp1);
  }
 printf("\n\nThe contents of Output Table :\n\n\t");
 fp3=fopen("OUT.DAT","r");
```

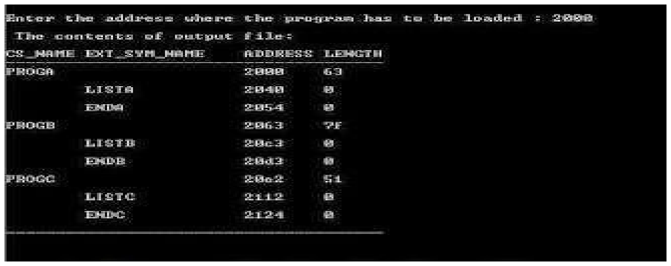
```
  ch=fgetc(fp3);
  while(ch!=EOF)
   {printf("%c",ch); ch=fgetc(fp3);
   }
  len=locctr-start;
  printf("\nThe length of the program is %d.\n\n",len);
  printf("\n\nThe contents of Symbol Table :\n\n");
  fp2=fopen("SYMTAB.DAT","r");
  ch=fgetc(fp2);
  while(ch!=EOF)
   {
    printf("%c",ch);
    ch=fgetc(fp2);
   }
  fcloseall();
  getch();
}
```

<u>INPUT FILE:</u>

INPUT.DAT

```
** START 2000
** LDA FIVE
** STA ALPHA
** LDCH CHARZ
** STCH C1
ALPHA RESW 1
FIVE WORD 5
CHARZ BYTE C'Z'
C1 RESB 1
** END **
```

<u>OUTPUT:</u>



```
Enter the address where the program has to be loaded : 2000
 The contents of output file:
CS_NAME EXT_SYM_NAME    ADDRESS LENGTH
PROGA                   2000    63
        LISTA           2040    0
        ENDA            2054    0
PROGB                   2063    7F
        LISTB           20c3    0
        ENDB            20d3    0
PROGC                   20e2    51
        LISTC           2112    0
        ENDC            2124    0
```

Result: Program has been executed successfully and   required output obtained

Viva questions:

1. What do you mean by Sockets in OS?
2. What is starvation and aging in OS?
3. What do you mean by Semaphore in OS?
4. What is Kernel?
5. What are different types of Kernels?

EXPERIMENT – 8
PASS TWO OF TWO PASS ASSEMBLER

AIM: Implement pass two of a two pass assembler.

Two-pass assembler: Assemblers typically make two or more passes through a source program inorder to resolve forward references in a program. A forward reference is defined as a type of instruction in the code segment that is referencing the label of an instruction, but the assembler has not yet encountered the definition of that instruction. Pass 2: In the second pass the instructions are again read and are assembled using the symbol table.Basically, the assembler goes through the program one line at a time, and generates machine code for that instruction. Then the assembler proceeds to the next instruction. In this way, the entire machine code program is created. For most instructions this process works fine, for example for instructions that only reference registers, the assembler can compute the machine code easily, since the assembler knows where the registers are. It produces .OBJ (Object file), .LST (list file) and cross reference (.CRF) files.

PROGRAM

```
#include<stdio.h>
#include<conio.h>
#include<string.h>
void main()
{
  char a[10],ad[10],label[10],opcode[10],operand[10],symbol[10],ch; int
st,diff,i,address,add,len,actual_len,finaddr,prevaddr,j=0;
  char mnemonic[15][15]={"LDA","STA","LDCH","STCH"};
  char code[15][15]={"33","44","53","57"};
  FILE *fp1,*fp2,*fp3,*fp4;
  clrscr();
  fp1=fopen("ASSMLIST.DAT","w");
  fp2=fopen("SYMTAB.DAT","r");
  fp3=fopen("INTERMED.DAT","r");
  fp4=fopen("OBJCODE.DAT","w");
  fscanf(fp3,"%s%s%s",label,opcode,operand);

  while(strcmp(opcode,"END")!=0)
  {
   prevaddr=address;
   fscanf(fp3,"%d%s%s%s",&address,label,opcode,operand);
```

```
}
finaddr=address;
fclose(fp3);
fp3=fopen("INTERMED.DAT","r");

fscanf(fp3,"%s%s%s",label,opcode,operand);
if(strcmp(opcode,"START")==0)
{
 fprintf(fp1,"\t%s\t%s\t%s\n",label,opcode,operand);
 fprintf(fp4,"H^%s^00%s^00%d\n",label,operand,finaddr);
 fscanf(fp3,"%d%s%s%s",&address,label,opcode,operand);
 st=address;
 diff=prevaddr-st;
 fprintf(fp4,"T^00%d^%d",address,diff);
}
while(strcmp(opcode,"END")!=0)
{
 if(strcmp(opcode,"BYTE")==0)
 {
  fprintf(fp1,"%d\t%s\t%s\t%s\t",address,label,opcode,operand);
  len=strlen(operand);
  actual_len=len-3;
  fprintf(fp4,"^");
  for(i=2;i<(actual_len+2);i++)
  {
   itoa(operand[i],ad,16);
   fprintf(fp1,"%s",ad);
   fprintf(fp4,"%s",ad);
  }
  fprintf(fp1,"\n");
 }
 else if(strcmp(opcode,"WORD")==0)
 {
  len=strlen(operand);
  itoa(atoi(operand),a,10);
  fprintf(fp1,"%d\t%s\t%s\t%s\t00000%s\n",address,label,opcode,operand,a);
  fprintf(fp4,"^00000%s",a);
 }
 else if((strcmp(opcode,"RESB")==0)||(strcmp(opcode,"RESW")==0))
```

```
  fprintf(fp1,"%d\t%s\t%s\t%s\n",address,label,opcode,operand);
 else
 {
  while(strcmp(opcode,mnemonic[j])!=0)
   j++;
  if(strcmp(operand,"COPY")==0)
  fprintf(fp1,"%d\t%s\t%s\t%s\t%s0000\n",address,label,opcode,operand,code[j]);
  else
  {
   rewind(fp2);
   fscanf(fp2,"%s%d",symbol,&add);
   while(strcmp(operand,symbol)!=0)
   fscanf(fp2,"%s%d",symbol,&add);
   fprintf(fp1,"%d\t%s\t%s\t%s\t%s%d\n",address,label,opcode,operand,code[j],add);
   fprintf(fp4,"^%s%d",code[j],add);
  }
 }
 fscanf(fp3,"%d%s%s%s",&address,label,opcode,operand);
}
fprintf(fp1,"%d\t%s\t%s\t%s\n",address,label,opcode,operand);
fprintf(fp4,"\nE^00%d",st);
printf("\n Intermediate file is converted into object code");
fcloseall();

printf("\n\nThe contents of Intermediate file:\n\n\t");
fp3=fopen("INTERMED.DAT","r");
ch=fgetc(fp3);
while(ch!=EOF)
{
 printf("%c",ch);
 ch=fgetc(fp3);
}
printf("\n\nThe contents of Symbol Table :\n\n");
fp2=fopen("SYMTAB.DAT","r");
ch=fgetc(fp2);
while(ch!=EOF)
{
 printf("%c",ch);
 ch=fgetc(fp2);
 }
 printf("\n\nThe contents of Output file :\n\n");
 fp1=fopen("ASSMLIST.DAT","r");
 ch=fgetc(fp1);
 while(ch!=EOF)
 {
  printf("%c",ch);
  ch=fgetc(fp1);
 }
 printf("\n\nThe contents of Object code file :\n\n");
 fp4=fopen("OBJCODE.DAT","r");
 ch=fgetc(fp4);
 while(ch!=EOF)
 {
  printf("%c",ch);
  ch=fgetc(fp4);
 }
 fcloseall();
 getch();
}
```

INPUT FILES:

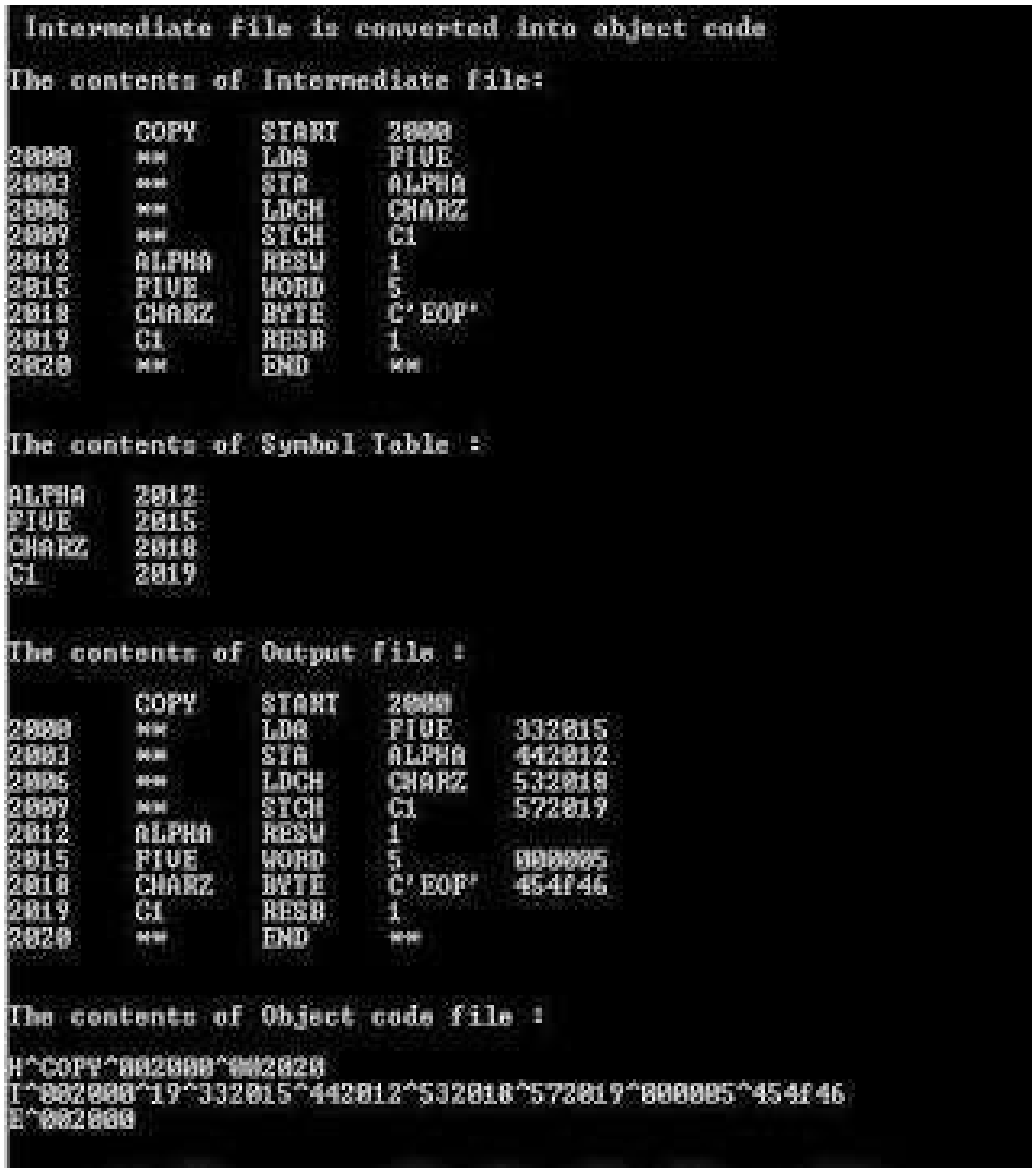
INTERMED.DAT

```
COPY    START    2000
2000    **    LDA    FIVE
2003    **    STA    ALPHA
2006    **    LDCH    CHARZ
2009    **    STCH    C1
2012    ALPHA    RESW    1
2015    FIVE    WORD    5
2018    CHARZ    BYTE    C'EOF'
2019    C1    RESB    1
2020    **    END    **
```

SYMTAB.DAT

```
ALPHA    2012
FIVE    2015
CHARZ    2018
C1    2019
```

OUTPUT:



```
 Intermediate file is converted into object code

The contents of Intermediate file:

        COPY    START   2000
2000    **      LDA     FIVE
2003    **      STA     ALPHA
2006    **      LDCH    CHARZ
2009    **      STCH    C1
2012    ALPHA   RESW    1
2015    FIVE    WORD    5
2018    CHARZ   BYTE    C'EOF'
2019    C1      RESB    1
2020    **      END     **


The contents of Symbol Table :

ALPHA   2012
FIVE    2015
CHARZ   2018
C1      2019


The contents of Output file :

        COPY    START   2000
2000    **      LDA     FIVE    332015
2003    **      STA     ALPHA   442012
2006    **      LDCH    CHARZ   532018
2009    **      STCH    C1      572019
2012    ALPHA   RESW    1
2015    FIVE    WORD    5       000005
2018    CHARZ   BYTE    C'EOF'  454f46
2019    C1      RESB    1
2020    **      END     **


The contents of Object code file :

H^COPY^002000^002020
T^002000^19^332015^442012^532018^572019^000005^454f46
E^002000
```

Result: Program has been executed successfully and required output obtained

Viva questions:

1. What is SMP
2. What is a time-sharing system
3. What is Context Switching?
4. What is difference between Kernel and OS

EXPERIMENT – 9
SINGLE PASS ASSEMBLER

AIM: Implement a single pass assembler.

Single Pass Assembler: A single pass assembler scans the program only once and creates the equivalent binary program. The assembler substitute all of the symbolic instruction with machine code in one pass.The difference between one pass and two pass assemblers is basically in the name. A one pass assembler passes over the source file exactly once, in the same pass collecting the labels, resolving future references and doing the actual assembly. The difficult part is to resolve future label references and assemble code in one pass. . A two pass assembler does two passes over the source file (the second pass can be over a file generated in the first pass). In the first pass all it does is looks for label definitions and introduces them in the symbol table. In the second pass, after the symbol table is complete, it does the actual assembly by translating the operations and so on.

PROGRAM

```
#include<stdio.h>
#include<conio.h>
#include<string.h>
void main()
{
 char opcode[10],operand[10],label[10],a[10],ad[10],symbol[10],ch;
char code[10][10],code1[10][10]={"33","44","53","57"};
 char mnemonic[10][10]={"START","LDA","STA","LDCH","STCH","END"};
 char mnemonic1[10][10]={"LDA","STA","LDCH","STCH"};
 int locctr,start,length,i=0,j=0,k,l=0;
 int st,diff,address,add,len,actual_len,finaddr,prevaddr;
 FILE *fp1,*fp2,*fp3,*fp4,*fp5,*fp6,*fp7;
 clrscr();
 fp1=fopen("INPUT.DAT","r");
 fp2=fopen("SYMTAB.DAT","w");
 fp3=fopen("INETERMED.DAT","w");
 fscanf(fp1,"%s%s%s",label,opcode,operand);
 if(strcmp(opcode,"START")==0)
  {
   start=atoi(operand);
   locctr=start;
   fprintf(fp3,"%s\t%s\t%s\n",label,opcode,operand);
   fscanf(fp1,"%s%s%s",label,opcode,operand);
 }
else
 locctr=0;
while(strcmp(opcode,"END")!=0)
 {
  fprintf(fp3,"%d",locctr);
  if(strcmp(label,"**")!=0)
  fprintf(fp2,"%s\t%d\n",label,locctr);
  strcpy(code[i],mnemonic[j]);
  while(strcmp(mnemonic[j],"END")!=0)
   {
    if(strcmp(opcode,mnemonic[j])==0)
    {
     locctr+=3;
     break;
    }
    strcpy(code[i],mnemonic[j]);
    j++;
   }
  if(strcmp(opcode,"WORD")==0)
   locctr+=3;
  else if(strcmp(opcode,"RESW")==0)
   locctr+=(3*(atoi(operand)));
  else if(strcmp(opcode,"RESB")==0)
   locctr+=(atoi(operand));
  else if(strcmp(opcode,"BYTE")==0)
   ++locctr;
  fprintf(fp3,"\t%s\t%s\t%s\n",label,opcode,operand);
  fscanf(fp1,"%s%s%s",label,opcode,operand);
 }
 fprintf(fp3,"%d\t%s\t%s\t%s\n",locctr,label,opcode,operand);
 length=locctr-start;
 fcloseall();
 printf("\n\nThe contents of Input file:\n\n");
 fp1=fopen("INPUT.DAT","r");
 ch=fgetc(fp1);
 while(ch!=EOF)
  {
   printf("%c",ch);
  ch=fgetc(fp1);
 }
printf("\n\nLength of the input program is %d.",length);
printf("\n\nThe contents of Symbol Table:\n\n");
fp2=fopen("SYMTAB.DAT","r");
ch=fgetc(fp2);
while(ch!=EOF)
 {
  printf("%c",ch);
  ch=fgetc(fp2);
 }
fcloseall();
fp4=fopen("ASSMLIST.DAT","w");
fp5=fopen("SYMTAB.DAT","r");
fp6=fopen("INTERMED.DAT","r");
fp7=fopen("OBJCODE.DAT","w");
fscanf(fp6,"%s%s%s",label,opcode,operand);
while(strcmp(opcode,"END")!=0)
{
 prevaddr=address;
 fscanf(fp6,"%d%s%s%s",&address,label,opcode,operand);
}
finaddr=address;
fclose(fp6);
fp6=fopen("INTERMED.DAT","r");
fscanf(fp6,"%s%s%s",label,opcode,operand);
if(strcmp(opcode,"START")==0)
{
 fprintf(fp4,"\t%s\t%s\t%s\n",label,opcode,operand);
 fprintf(fp7,"H^%s^00%s^00%d\n",label,operand,finaddr);
 fscanf(fp6,"%d%s%s%s",&address,label,opcode,operand);
 st=address;
 diff=prevaddr-st;
 fprintf(fp7,"T^00%d^%d",address,diff);
}
while(strcmp(opcode,"END")!=0)
{
 if(strcmp(opcode,"BYTE")==0)
  {
```

```
 fprintf(fp4,"%d\t%s\t%s\t%s\t",address,label,opcode,operand);
 len=strlen(operand);
 actual_len=len-3;
 fprintf(fp7,"^");
 for(k=2;k<(actual_len+2);k++)
 {
  itoa(operand[k],ad,16);
  fprintf(fp4,"%s",ad);
  fprintf(fp7,"%s",ad);
 }
 fprintf(fp4,"\n");
}
else if(strcmp(opcode,"WORD")==0)
{
 len=strlen(operand);
 itoa(atoi(operand),a,10);
 fprintf(fp4,"%d\t%s\t%s\t%s\t00000%s\n",address,label,opcode,operand,a);
 fprintf(fp7,"^00000%s",a);
}
else if((strcmp(opcode,"RESB")==0)||(strcmp(opcode,"RESW")==0))
 fprintf(fp4,"%d\t%s\t%s\t%s\n",address,label,opcode,operand);
else
{
 while(strcmp(opcode,mnemonic1[l])!=0)
  l++;
 if(strcmp(operand,"COPY")==0)
 fprintf(fp4,"%d\t%s\t%s\t%s\t%s0000\n",address,label,opcode,operand,code1[l]);
 else
 {
  rewind(fp5);
  fscanf(fp5,"%s%d",symbol,&add);
  while(strcmp(operand,symbol)!=0)
  fscanf(fp5,"%s%d",symbol,&add);
  fprintf(fp4,"%d\t%s\t%s\t%s\t%s%d\n",address,label,opcode,operand,code1[l],add);
  fprintf(fp7,"^%s%d",code1[l],add);
 }
}
fscanf(fp6,"%d%s%s%s",&address,label,opcode,operand);
}
```

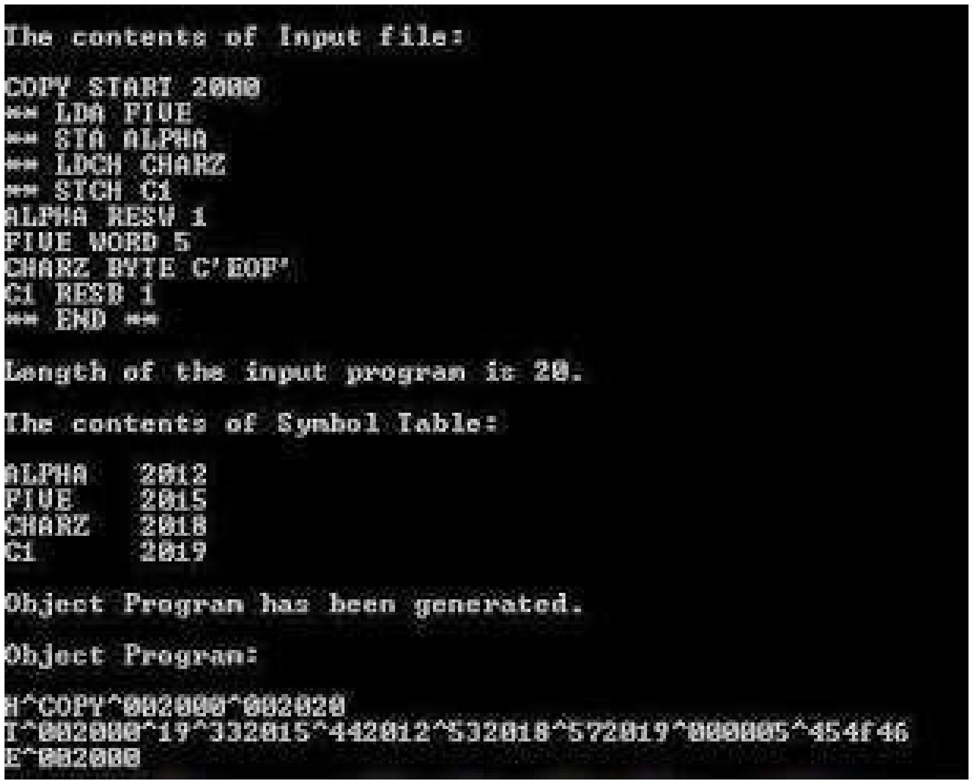
```
  fprintf(fp4,"%d\t%s\t%s\t%s\n",address,label,opcode,operand);
  fprintf(fp7,"\nE^00%d",st);
  printf("\nObject Program has been generated.");
  fcloseall();
  printf("\n\nObject Program:\n\n");
  fp7=fopen("OBJCODE.DAT","r");
  ch=fgetc(fp7);
  while(ch!=EOF)
  {
   printf("%c",ch);
   ch=fgetc(fp7);
  }
  fcloseall();
  getch();
}
```

INPUT FILE:

INPUT.DAT

```
COPY START 2000
** LDA FIVE
** STA ALPHA
** LDCH CHARZ
** STCH C1
ALPHA RESW 1
FIVE WORD 5
CHARZ BYTE C'EOF'
C1 RESB 1
** END **
```

OUTPUT:



```
The contents of Input file:

COPY START 2000
** LDA FIVE
** STA ALPHA
** LDCH CHARZ
** STCH C1
ALPHA RESW 1
FIVE WORD 5
CHARZ BYTE C'EOF'
C1 RESB 1
** END **

Length of the input program is 20.

The contents of Symbol Table:

ALPHA   2012
FIVE    2015
CHARZ   2018
C1      2019

Object Program has been generated.

Object Program:

H^COPY^002000^002020
T^002000^19^332015^442012^532018^572019^000005^454f46
E^002000
```

Result: Program has been executed successfully and   required output obtained.

Viva questions:

1.What is difference between process and thread?

2. What are various sections of the process?

3. What is a deadlock in OS?

4. Which of the following is the main function of the Command Interpreter?

5.Explain loader?

EXPERIMENT – 10
TWO PASS MACRO PROCESSOR

AIM: Implement a two pass macro processor
Macro Processor is a program that lets you define the code that is reused many times giving it a specific Macro name and reuse the code by just writing the Macro name only. Generally it doesn't come as a separate program but as a bundle to either assembler or compiler There are three main steps of using a macro
1.Define the macro name
2.Give it's definition
3.Use the macro name from within the program anywhere to use its definition (this step is called macro call)
Features of macro processor:
1. Recognize the macro definition.
2. Save macro definition.
3. Recognize the macro call.
4. Perform macro expansion. Forward reference Problem
The assembler specifies that the macro definition should occur anywhere in the program. So there can be chances of macro call before its definition witch gives rise to the forwards reference problem of macro.Due to which macro is divided into two passes:
1. PASS 1-
Recognize macro definition save macro definition
1. PASS 2-
Recognize macro call perform macro expansion
Two-pass macro processor
Pass1: process all macro definitions
Pass2: expand all macro invocation statements
Problem
1. Does not allow nested macro definitions
2. Nested macro definitions
The body of a macro contains definitions of other macros Databases required for pass 2
In pass2 we perform recognize macro call and perform macro expansion
1. COPY FILE
It is a file it contains the output given from PASS1
2. MNT
It is used for recognizing macro name
3. MDT
It is used to perform macro EXPANSION
4. MDTP
It is used to point to the index of MDT .

The starting index is given by MNT
5. ALA
It is used to replace the index notation by it actual value

6. ESC

PROGRAM

```
#include<studio.h>
#include<stdlib.h>
#include<conio.h>
#include<string.h>
FILE *f1,*f2,*f3,*f4,*f5;
void main()
{
char lbl[20],opc[20],opr[20],mname[20],arg[20],check[20];char
ch,dlbl[20],dopc[20],dopr[20];
int c;
clrscr();
f1=fopen("MACIN.DAT","r");
rewind(f1);
f2=fopen("NAMETAB.DAT","r");
rewind(f2);
f3=fopen("DEFTAB.DAT","r");
f4=fopen("EXPAND.DAT","w");
f5=fopen("ARGTAB.DAT","w");
while(!feof(f1))
{
l1:
fscanf(f1,"%s %s %s",lbl,opc,opr);
if(strcmp(opc,mname)==0)
c=1;
if(strcmp(opc,"MACRO")==0)
{
while(strcmp(opc,"MEND")!=0)
{
fscanf(f1,"%s%s%s",lbl,opc,opr);
continue;
}
goto l1;
}
rewind(f2);
rewind(f3);

fscanf(f2,"%s",mname);
if(strcmp(opc,mname)==0)
{
fprintf(f5," %s",opr);
rewind(f5);
while(!feof(f3))
{
fscanf(f3,"%s%s%s",dlbl,dopc,dopr);
if(strcmp(dopc,"MEND")!=0)
{
if(strcmp(dopc,"MACRO")==0)
{
continue;
}
if(strcmp(dopr,"=X'?1'")==0)
strcpy(dopr,"=X'F1'");
if(strcmp(dopr,"?2,X")==0)
strcpy(dopr,"BUFFER,X");
if(strcmp(dopr,"?3")==0)
strcpy(dopr,"LENGTH");
if(c==1)
{
fprintf(f4," %s\t%s\t%s\n",lbl,opc,opr);
c=0;
}
fprintf(f4," %s\t%s\t%s\n",dlbl,dopc,dopr);
}
}
goto l1;
}
fprintf(f4," %s\t%s\t%s\n",lbl,opc,opr);
}
fcloseall();
printf("\n INPUT\n\n Macro Program before expanded
\n"); printf("____________________\n");
f1=fopen("MACIN.DAT","r");
ch=fgetc(f1);
while(ch!=EOF)
{

printf("%c",ch);
ch=fgetc(f1);
}
printf("\n Definition Table \n");
printf("________________________
\n"); f2=fopen("DEFTAB.DAT","r");
ch=fgetc(f2);
while(ch!=EOF)
{
printf("%c",ch);
ch=fgetc(f2);
}
printf("\n Name Table \n");
printf("________________________
\n"); f3=fopen("NAMETAB.DAT","r");
ch=fgetc(f3);
while(ch!=EOF)
{
printf("%c",ch);
ch=fgetc(f3);
}
getch();
clrscr();
printf("\n\n OUTPUT\n\n Macro Program after expanded \n");
printf("________________________\n\n");
f4=fopen("EXPAND.DAT","r");
ch=fgetc(f4);
while(ch!=EOF)
{
printf("%c",ch);
ch=fgetc(f4);
}
printf("\n Argument Table \n");
printf("_______________________
\n\n"); f5=fopen("ARGTAB.DAT","r");
ch=fgetc(f5);
while(ch!=EOF)
{
printf("%c",ch);


ch=fgetc(f5);
}
fcloseall();
getch();
}
```

INPUT FILE:

MACIN.DAT

```
COPY    START    NULL
RDBUFF    MACRO INDEV,BUFADR,RECLTH
NULL    CLEAR    X
NULL    CLEAR    A
NULL    CLEAR    S
NULL    +LDT    #4096
NULL    TD    =X'&INDEV'
NULL    JEQ    *-3
NULL    RD
=X'&INDEV' NULL
COMPR A,S NULLJEQ
            *+11
NULL    STCH    BUFADR,X
NULL    TIXR    T
NULL    JLT    *-19
NULL    STX    RECLTH
NULL    MEND    NULL
FIRST    STL    RETADR
CLOOP    RDBUFF
F1,BUFFER,LENGTH NULL    LDA
LENGTH
NULL    COMP    #0
NULL    JEQ    ENDFIL
EOF    BYTE    C'EOF'
THREE    WORD    3
RETADR    RESW    1
LENGTH    RESW    1
```

```
BUFFER    RESB    4096
NULL    END    FIRST
```

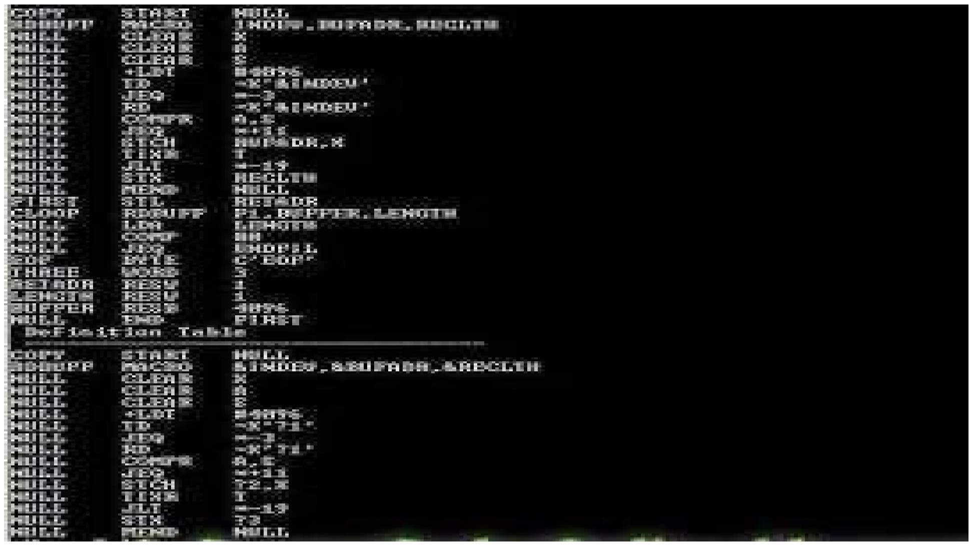
DEFTAB.DAT

```
COPY    START    NULL
RDBUFF    MACRO &INDEV,&BUFADR,&RECLTH
NULL    CLEAR    X
NULL    CLEAR    A
NULL    CLEAR    S
NULL    +LDT    #4096
NULL    TD    =X'?1'
NULL    JEQ    *-3
NULL    RD    =X'?1'
NULL    COMPR    A,S
NULL    JEQ    *+11
NULL    STCH    ?2,X
NULL    TIXR    T
NULL    JLT    *-19
NULL    STX    ?3
NULL    MEND    NULL
```

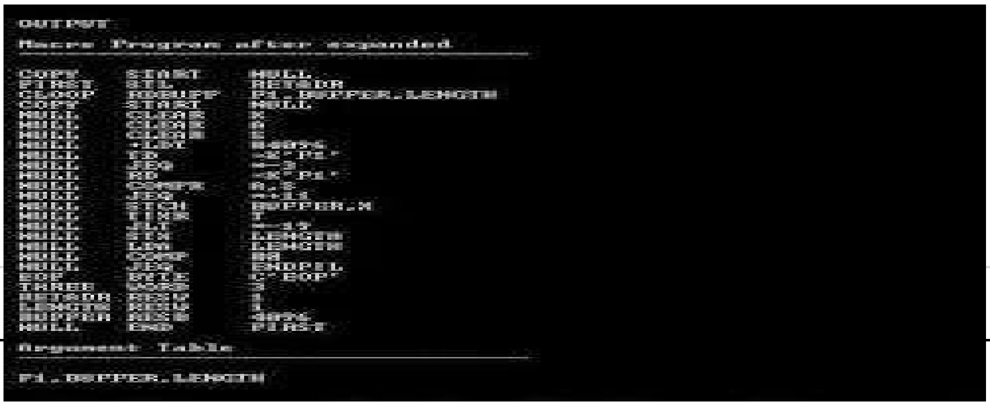
NAMETAB.DAT

```
RDBUFF
```

OUTPUT:



```
COPY     START    NULL
RDBUFF   MACRO    INDEV,BUFADR,RECLTH
NULL     CLEAR    X
NULL     CLEAR    A
NULL     CLEAR    S
NULL     +LDT     #4096
NULL     TD       =X'&INDEV'
NULL     JEQ      *-3
NULL     RD       =X'&INDEV'
NULL     COMPR    A,S
NULL     JEQ      *+11
NULL     STCH     BUFADR,X
NULL     TIXR     T
NULL     JLT      *-19
NULL     STX      RECLTH
NULL     MEND     NULL
FIRST    STL      RETADR
CLOOP    RDBUFF   F1,BUFFER,LENGTH
NULL     LDA      LENGTH
NULL     COMP     #0
NULL     JEQ      ENDFIL
EOF      BYTE     C'EOF'
THREE    WORD     3
RETADR   RESW     1
LENGTH   RESW     1
BUFFER   RESB     4096
NULL     END      FIRST
 Definition Table
 ------------------------------------------
COPY     START    NULL
RDBUFF   MACRO    &INDEV,&BUFADR,&RECLTH
NULL     CLEAR    X
NULL     CLEAR    A
NULL     CLEAR    S
NULL     +LDT     #4096
NULL     TD       =X'?1'
NULL     JEQ      *-3
NULL     RD       =X'?1'
NULL     COMPR    A,S
NULL     JEQ      *+11
NULL     STCH     ?2,X
NULL     TIXR     T
NULL     JLT      *-19
NULL     STX      ?3
NULL     MEND     NULL
```



```
OUTPUT
Macro Program after expanded
------------------------------------------
COPY     START    NULL
FIRST    STL      RETADR
CLOOP    RDBUFF   F1,BUFFER,LENGTH
COPY     START    NULL
NULL     CLEAR    X
NULL     CLEAR    A
NULL     CLEAR    S
NULL     +LDT     #4096
NULL     TD       =X'F1'
NULL     JEQ      *-3
NULL     RD       =X'F1'
NULL     COMPR    A,S
NULL     JEQ      *+11
NULL     STCH     BUFFER,X
NULL     TIXR     T
NULL     JLT      *-19
NULL     STX      LENGTH
NULL     LDA      LENGTH
NULL     COMP     #0
NULL     JEQ      ENDFIL
EOF      BYTE     C'EOF'
THREE    WORD     3
RETADR   RESW     1
LENGTH   RESW     1
BUFFER   RESB     4096
NULL     END      FIRST
Argument Table
------------------------------------------
F1,BUFFER,LENGTH
```

Result: Program has been executed successfully and required output obtained .

Viva Questions:

1.What is assembler?
2.Why relocation loader required?
3.What is bootstrap loader?
4.What is virtual memory?
5.What is pagging?

EXPERIMENT – 11
SINGLE PASS MACRO PROCESSOR

AIM: Implement a single pass macro processor.

A macro instruction is a notational convenience for the programmer. It allows the programmer to write shorthand version of a program (module programming). The macro processor replaces each macro invocation with the corresponding sequence of statements (expanding) One-pass macro processor
1. Every macro must be defined before it is called
2. One-pass processor can alternate between macro definition and macro expansion
3. Nested macro definitions are allowed
The important data structures required in a one-pass macro processor are:

1. DEFTAB (Definition Table): It is a definition table that used to store the macro definition including macro prototype and macro body. Comment lines are not included here, and references to the parameters use a positional notation for efficiency in substituting arguments.
2. NAMTAB (Name Table): This table used for storing macros names. It serves as an index to DEFTAB and maintains pointers that point to the beginning and end of the macro definition in DEFTAB.
3. ARGTAB (Argument Table): It maintains arguments according to their positions in the argument list. During expansion, the arguments from this table substituted for the corresponding parameters in the macro body.

PROGRAM

```
#include<studio.h>
#include<stdlib.h>
#include<conio.h>
#include<string.h>
FILE *f1,*f2,*f3,*f4,*f5;
void main()
{
char lbl[20],opc[20],opr[20],mname[20],arg[20],check[20];char
ch,dlbl[20],dopc[20],dopr[20];
int c;
clrscr();
f1=fopen("MACIN.DAT","r");
rewind(f1);
```

```
f2=fopen("NAMETAB.DAT","r");
rewind(f2);
f3=fopen("DEFTAB.DAT","r");
f4=fopen("EXPAND.DAT","w");
f5=fopen("ARGTAB.DAT","w");
while(!feof(f1))
{
l1:
fscanf(f1,"%s %s %s",lbl,opc,opr);
if(strcmp(opc,mname)==0)
c=1;
if(strcmp(opc,"MACRO")==0)
{
while(strcmp(opc,"MEND")!=0)
{
fscanf(f1,"%s%s%s",lbl,opc,opr);
continue;
}
goto l1;
}
rewind(f2);
rewind(f3);
fscanf(f2,"%s",mname);
if(strcmp(opc,mname)==0)
{
fprintf(f5," %s",opr);
rewind(f5);
while(!feof(f3))
{
fscanf(f3,"%s%s%s",dlbl,dopc,dopr);
if(strcmp(dopc,"MEND")!=0)
{
if(strcmp(dopc,"MACRO")==0)
{
continue;
}
if(strcmp(dopr,"=X'?1'")==0)
strcpy(dopr,"=X'F1'");
if(strcmp(dopr,"?2,X")==0)
strcpy(dopr,"BUFFER,X");
if(strcmp(dopr,"?3")==0)
strcpy(dopr,"LENGTH");
if(c==1)
{
fprintf(f4," %s\t%s\t%s\n",lbl,opc,opr);
c=0;
}
fprintf(f4," %s\t%s\t%s\n",dlbl,dopc,dopr);
}
}
goto l1;
}
fprintf(f4," %s\t%s\t%s\n",lbl,opc,opr);
}
fcloseall();
printf("\n INPUT\n\n Macro Program before expanded
\n"); printf("___________________\n");
f1=fopen("MACIN.DAT","r");
ch=fgetc(f1);
while(ch!=EOF)
{
printf("%c",ch);
ch=fgetc(f1);
}
printf("\n Definition Table \n");
printf("_______________________
\n"); f2=fopen("DEFTAB.DAT","r");
ch=fgetc(f2);
while(ch!=EOF)
{
printf("%c",ch);
ch=fgetc(f2);
}
printf("\n Name Table \n");
printf("_______________________
\n"); f3=fopen("NAMETAB.DAT","r");
ch=fgetc(f3);
while(ch!=EOF)
```

```
{
printf("%c",ch);
ch=fgetc(f3);
}
getch();
clrscr();
printf("\n\n OUTPUT\n\n Macro Program after expanded \n");
printf("________________________\n\n");
f4=fopen("EXPAND.DAT","r");
ch=fgetc(f4);
while(ch!=EOF)
{
printf("%c",ch);
ch=fgetc(f4);
}
printf("\n Argument Table \n");
printf("________________________
\n\n"); f5=fopen("ARGTAB.DAT","r");
ch=fgetc(f5);
while(ch!=EOF)
{
printf("%c",ch);
ch=fgetc(f5);
}
fcloseall();
getch();
}
```

INPUT FILE:

MACIN.DAT

```
COPY    START    NULL
RDBUFF    MACRO INDEV,BUFADR,RECLTH
NULL    CLEAR    X
NULL    CLEAR    A
NULL    CLEAR    S
NULL    +LDT    #4096
NULL    TD    =X'&INDEV'
NULL    JEQ    *-3
NULL    RD
=X'&INDEV' NULL
```

```
NULL    JEQ    *+11
NULL    STCH    BUFADR,X
NULL    TIXR    T
NULL    JLT    *-19
NULL    STX    RECLTH
NULL    MEND    NULL
FIRST    STL    RETADR
CLOOP    RDBUFF
F1,BUFFER,LENGTH NULL    LDA
LENGTH
NULL    COMP    #0
NULL    JEQ    ENDFIL
EOF    BYTE    C'EOF'
THREE    WORD    3
RETADR    RESW    1
LENGTH    RESW    1
BUFFER    RESB    4096
NULL    END    FIRST
```

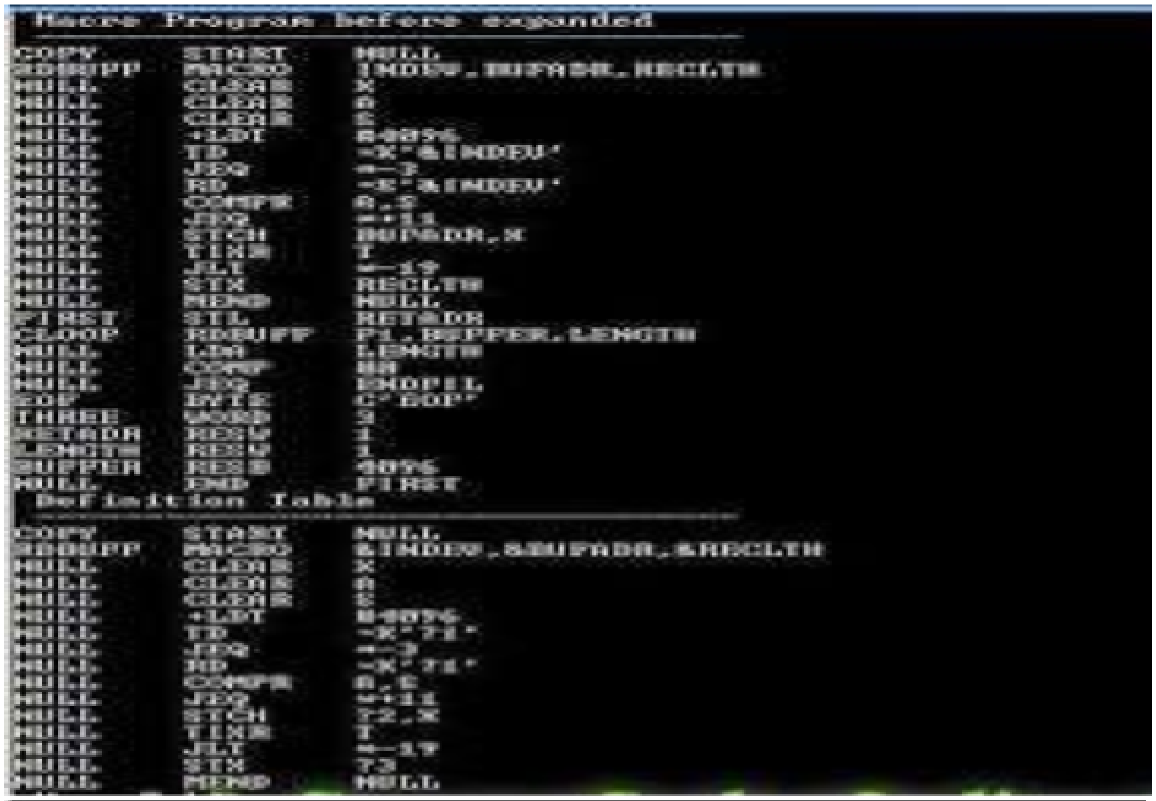
DEFTAB.DAT

```
COPY    START    NULL
RDBUFF    MACRO &INDEV,&BUFADR,&RECLTH
NULL    CLEAR    X
NULL    CLEAR    A
NULL    CLEAR    S
NULL    +LDT    #4096
NULL    TD    =X'?1'
NULL    JEQ    *-3
NULL    RD    =X'?1'
NULL    COMPR    A,S
NULL    JEQ    *+11
NULL    STCH    ?2,X
NULL    TIXR    T
NULL    JLT    *-19
NULL    STX    ?3
NULL    MEND    NULL
```

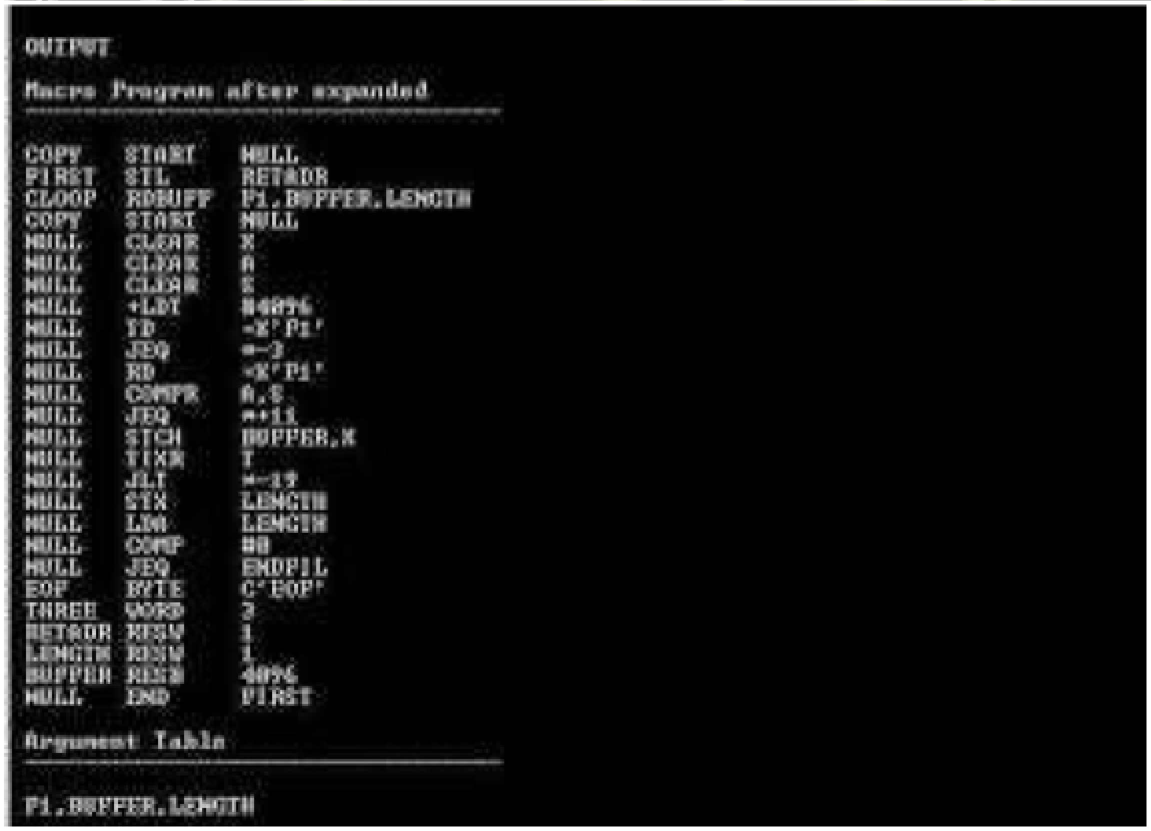
NAMETAB.DAT

```
RDBUFF
```

OUTPUT:



```
 Macro Program before expanded
 ------------------------------------------------
COPY      START    NULL
RDBUFF    MACRO    INDEV,BUFADR,RECLTH
NULL      CLEAR    X
NULL      CLEAR    A
NULL      CLEAR    S
NULL      +LDT     #4096
NULL      TD       =X'&INDEV'
NULL      JEQ      *-3
NULL      RD       =X'&INDEV'
NULL      COMPR    A,S
NULL      JEQ      *+11
NULL      STCH     BUFADR,X
NULL      TIXR     T
NULL      JLT      *-19
NULL      STX      RECLTH
NULL      MEND     NULL
FIRST     STL      RETADR
CLOOP     RDBUFF   F1,BUFFER,LENGTH
NULL      LDA      LENGTH
NULL      COMP     #0
NULL      JEQ      ENDFIL
EOF       BYTE     C'EOF'
THREE     WORD     3
RETADR    RESW     1
LENGTH    RESW     1
BUFFER    RESB     4096
NULL      END      FIRST
 Definition Table
 ------------------------------------------------
COPY      START    NULL
RDBUFF    MACRO    &INDEV,&BUFADR,&RECLTH
NULL      CLEAR    X
NULL      CLEAR    A
NULL      CLEAR    S
NULL      +LDT     #4096
NULL      TD       =X'?1'
NULL      JEQ      *-3
NULL      RD       =X'?1'
NULL      COMPR    A,S
NULL      JEQ      *+11
NULL      STCH     ?2,X
NULL      TIXR     T
NULL      JLT      *-19
NULL      STX      ?3
NULL      MEND     NULL
```



```
OUTPUT

Macro Program after expanded
--------------------------------

COPY   START   NULL
FIRST  STL     RETADR
CLOOP  RDBUFF  F1,BUFFER,LENGTH
COPY   START   NULL
NULL   CLEAR   X
NULL   CLEAR   A
NULL   CLEAR   S
NULL   +LDT    #4096
NULL   TD      =X'F1'
NULL   JEQ     *-3
NULL   RD      =X'F1'
NULL   COMPR   A,S
NULL   JEQ     *+11
NULL   STCH    BUFFER,X
NULL   TIXR    T
NULL   JLT     *-19
NULL   STX     LENGTH
NULL   LDA     LENGTH
NULL   COMP    #0
NULL   JEQ     ENDFIL
EOF    BYTE    C'EOF'
THREE  WORD    3
RETADR RESW    1
LENGTH RESW    1
BUFFER RESB    4096
NULL   END     FIRST

Argument Table
--------------------------------

F1,BUFFER,LENGTH
```

Result: Program has been executed successfully and   required output obtained.

Viva Questions:

1.Why two pass assembler required?
2.What is application software?
3.Why memory need to be managed?
4.what is the function of bootstrap loader?
5. define micro?

EXPERIMENT – 12
ABSOLUTE LOADER

AIM: Implement an absolute loader

ALGORITHM:

An absolute loader loads a binary program in memory for execution. The binary program is stored in a file contains the following:

1. A Header record showing the load origin, length and load time execution start address of the program.
2. A sequence of binary image records containing the program’s code.Each binary image record contains a part of the program’s code in the form of a sequence of bytes, the load address of the first byte of this code and a count of the number of bytes of code.
3. The absolute loader notes the load origin and the length of the program mentioned in the header record.
4. It then enters a loop that reads a binary image record and moves the code contained in it to the memory area starting at the address mentioned in the binary image record.
5. At the end, it transfers control to the execution start address of the program. Advantages of the absolute loading scheme: Absolute Loaders

Simple to implement and efficient in execution. Moreover, saves the memory (core) because the size of the loader is smaller than that of the assembler.

Allows use of multi-source programs written in different languages. In such cases, the given language assembler converts the source program into the language. And a common object file is then prepared by address resolution.

Disadvantages of the absolute loading scheme: Absolute Loaders

1. The programmer must know and clearly specify to the translator (the assembler) the address in the memory for inner-linking and loading of the programs. Care should take so that the addresses do not overlap.
2. For programs with multiple subroutines, the programmer must remember the absolute address of each subroutine and use it explicitly in other subroutines to perform linking.
3. If the subroutine is modified, the program has to assemble again from first to last.

PROGRAM

```
#include<stdio.h>
#include<conio.h>
#include<string.h>
char input[10],label[10],ch1,ch2;
int addr, w=0, start, ptaddr, l, length=0, end, count=0, k, taddr, address, i=0;
FILE *fp1,*fp2;
```

```
void check();
void main()
```

```
{ clrscr();
 fp1=fopen("INPUT.dat","r");
 fp2=fopen("OUTPUT.dat","w");
 fscanf(fp1,"%s",input);
 printf("\n\n\t\t\t\tABSOLUTE LOADER\n");
 fprintf(fp2,"\n________________________________________
 \n"); fprintf(fp2,"MEMORY ADDRESS\t\t\tCONTENTS");
 fprintf(fp2,"\n________________________________________
 \n"); while(strcmp(input,"E")!=0)
 {
  if(strcmp(input,"H")==0)
  {
   fscanf(fp1,"%s %x %x %s",label,&start,&end,input);
   address=start;
  }
  else if(strcmp(input,"T")==0)
  {
   l=length;
   ptaddr=addr;
   fscanf(fp1,"%x %x %s",&taddr,&length,input);
   addr=taddr;
   if(w==0)
   {
    ptaddr=address;
    w=1;
   }
   for(k=0;k<(taddr-(ptaddr+l));k++)
   {
    address=address+1
    ; fprintf(fp2,"xx");
    count++;
    if(count==4)
    {
     fprintf(fp2," ");
     i++;
     if(i==4)
     {
      fprintf(fp2,"\n\n%x\t\t",address);
      i=0;
```

```
      }
      count=0;
     }
    }
    if(taddr==start)
    fprintf(fp2,"\n\n%x\t\t",taddr);
    fprintf(fp2,"%c%c",input[0],input[1]);
    check();
    fprintf(fp2,"%c%c",input[2],input[3]);
    check();
    fprintf(fp2,"%c%c",input[4],input[5]);
    check();
    fscanf(fp1,"%s",input);
   }
   else
   {
    fprintf(fp2,"%c%c",input[0],input[1]);
    check();
    fprintf(fp2,"%c%c",input[2],input[3]);
    check();
    fprintf(fp2,"%c%c",input[4],input[5]);
    check();
    fscanf(fp1,"%s",input);
   }
  }
  fprintf(fp2,"\n________________________________________
  \n"); fcloseall();
  printf("\n\n The contents of output file:\n\n");
  fp2=fopen("OUTPUT.DAT","r");
  ch2=fgetc(fp2);
  while(ch2!=EOF)
  {
   printf("%c",ch2);
   ch2=fgetc(fp2);
  }
  fcloseall();
  getch();
}
void check()
```

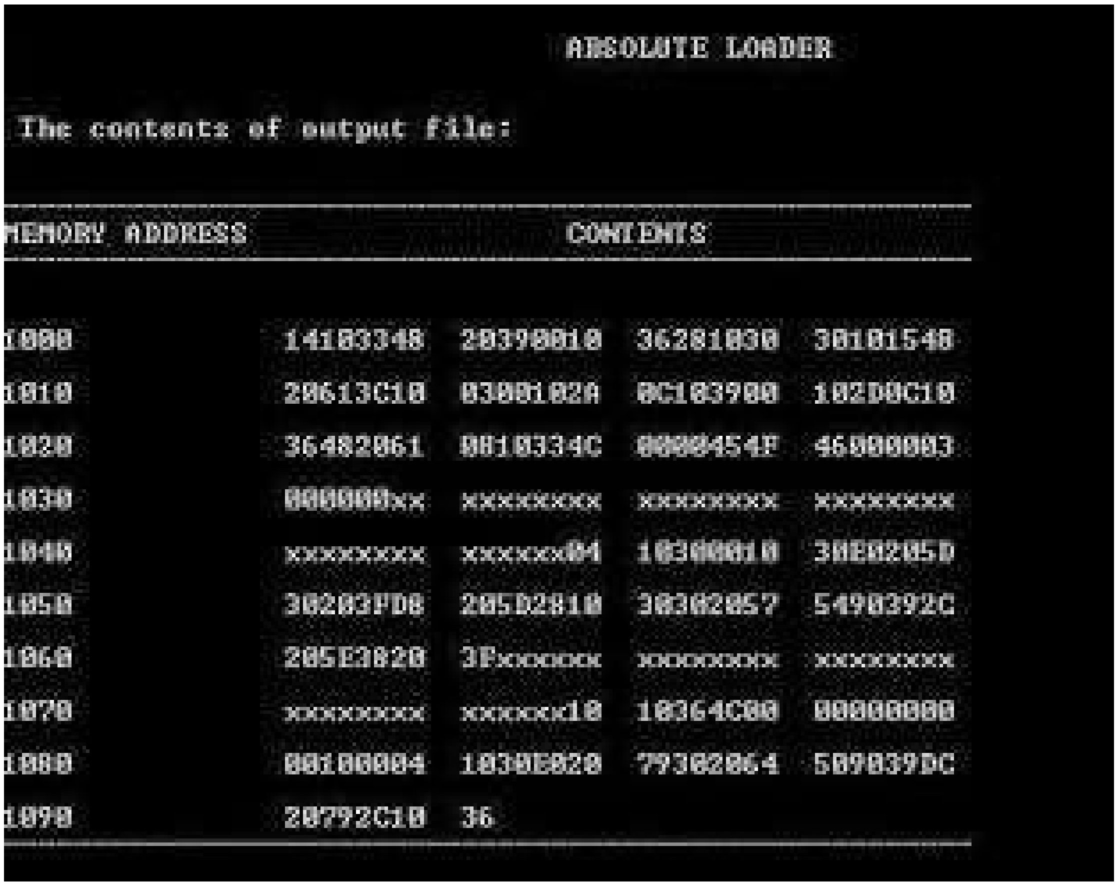
```
{
  count++;
  address++;
  taddr=taddr+1;
  if(count==4)
  {
   fprintf(fp2," ");
   i++;
   if(i==4)
   {
    fprintf(fp2,"\n\n%x\t\t",taddr);
    i=0;
   }
   count=0;
  }
}
```

INPUT FILE:

INPUT.DAT

```
H COPY 001000 00107A
T 001000 1E 141033 482039 001036 281030 301015 482061 3C1003 00102A 0C1039
00102D
T 00101E 15 0C1036 482061 081033 4C0000 454F46 000003 000000
T 001047 1E 041030 001030 E0205D 30203F D8205D 281030 302057 549039 2C205E
38203F
T 001077 1C 101036 4C0000 000000 001000 041030 E02079 302064 509039 DC2079
2C1036
E 001000
```

OUTPUT:



```
                              ABSOLUTE LOADER

 The contents of output file:

----------------------------------------------------------------------
MEMORY ADDRESS                         CONTENTS
----------------------------------------------------------------------

1000               14103348  20390010  36281030  30101548
1010               20613C10  0300102A  0C103900  102D0C10
1020               36482061  0810334C  0000454F  46000003
1030               000000xx  xxxxxxxx  xxxxxxxx  xxxxxxxx
1040               xxxxxxxx  xxxxxx04  10300010  30E0205D
1050               30203FD8  205D2810  30302057  5490392C
1060               205E3820  3Fxxxxxx  xxxxxxxx  xxxxxxxx
1070               xxxxxxxx  xxxxxx10  10364C00  00000000
1080               00100004  1030E020  79302064  509039DC
1090               20792C10  36
----------------------------------------------------------------------
```

Result: Program has been executed successfully and   required output obtained

Viva questions:

1.What is absolute loader?
2. what   is   relative addressing?

3.What is absolute addressing?

4.When macro define in program?

5.What   is utility software?

EXPERIMENT – 13
RELOCATING LOADER

AIM: Implement a relocating loader

A relocating loader load a program in a designated area of memory, relocates it so that it can execute correctly in that area of memory and passes control to it for execution.

1. The binary program is stored in a file contains the following:
A Header record showing the load origin, length and load time execution start address of the program.
2. Similarly, a sequence of binary image records containing the program's code. Each binary image record contains a part of the program's code in the form of a sequence of bytes, the load address of the first byte of this code and a count of the number of bytes of code.
3. Moreover, a table analogous to RELOCTAB table giving linked addresses of address sensitive instructions in the program.

PROGRAM

```
#include<stdio.h>
#include<conio.h>
#include<string.h>
#include<stdlib.h>
void convert(char h[12]);
char bitmask[12];
char bit[12]={0};
void main()
{char add[6],length[10],input[10],binary[12],relocbit,ch,pn[5];
int start,inp,len,i,address,opcode,addr,actualadd,tlen;
FILE *fp1,*fp2;
clrscr();
printf("\n\n Enter the actual starting address : ");
scanf("%x",&start);
fp1=fopen("RLIN.DAT","r");
fp2=fopen("RLOUT.DAT","w");
fscanf(fp1,"%s",input);
fprintf(fp2,"                              \n");
fprintf(fp2," ADDRESS\tCONTENT\n");
fprintf(fp2,"____________________\n");

while(strcmp(input,"E")!=0)
{
if(strcmp(input,"H")==0)
{
fscanf(fp1,"%s",pn);
fscanf(fp1,"%x",add);
fscanf(fp1,"%x",length);
fscanf(fp1,"%s",input);
}
if(strcmp(input,"T")==0)
{
fscanf(fp1,"%x",&address);
fscanf(fp1,"%x",&tlen);
fscanf(fp1,"%s",bitmask);
address+=start;
convert(bitmask);
len=strlen(bit);
if(len>=11)
len=10;
for(i=0;i<len;i++)
{
fscanf(fp1,"%x",&opcode);
fscanf(fp1,"%x",&addr);
relocbit=bit[i];
if(relocbit=='0')
actualadd=addr;
else
actualadd=addr+start;
fprintf(fp2,"\n %x\t\t%x%x\n",address,opcode,actualadd);
address+=3;
}
fscanf(fp1,"%s",input);
}
}
fprintf(fp2,"____________________\n");
fcloseall();
printf("\n\n The contents of output file (RLOUT.DAT):\n\n");
```

```
fp2=fopen("RLOUT.DAT","r");
ch=fgetc(fp2);


while(ch!=EOF)
{
printf("%c",ch);
ch=fgetc(fp2);
}
fclose(fp2);
getch();
}
void convert(char h[12])
{
int i,l;
strcpy(bit,"");
l=strlen(h);
for(i=0;i<l;i++)
{
switch(h[i])
{
case '0':
   strcat(bit,"0");
   break;
case '1':
   strcat(bit,"1");
   break;
case '2':
   strcat(bit,"10");
   break;
case '3':
   strcat(bit,"11");
   break;
case '4':
   strcat(bit,"100");
   break;
case '5':
   strcat(bit,"101");
   break;
case '6':
    strcat(bit,"110");
    break;
case '7':
    strcat(bit,"111");
    break;
case '8':
    strcat(bit,"1000");
    break;
case '9':
    strcat(bit,"1001");
    break;
case 'A':
    strcat(bit,"1010");
    break;
case 'B':
    strcat(bit,"1011");
    break;
case 'C':
    strcat(bit,"1100");
    break;
case 'D':
    strcat(bit,"1101");
    break;
case 'E':
    strcat(bit,"1110");
    break;
case 'F':
    strcat(bit,"1111");
    break;
}
}
}
```

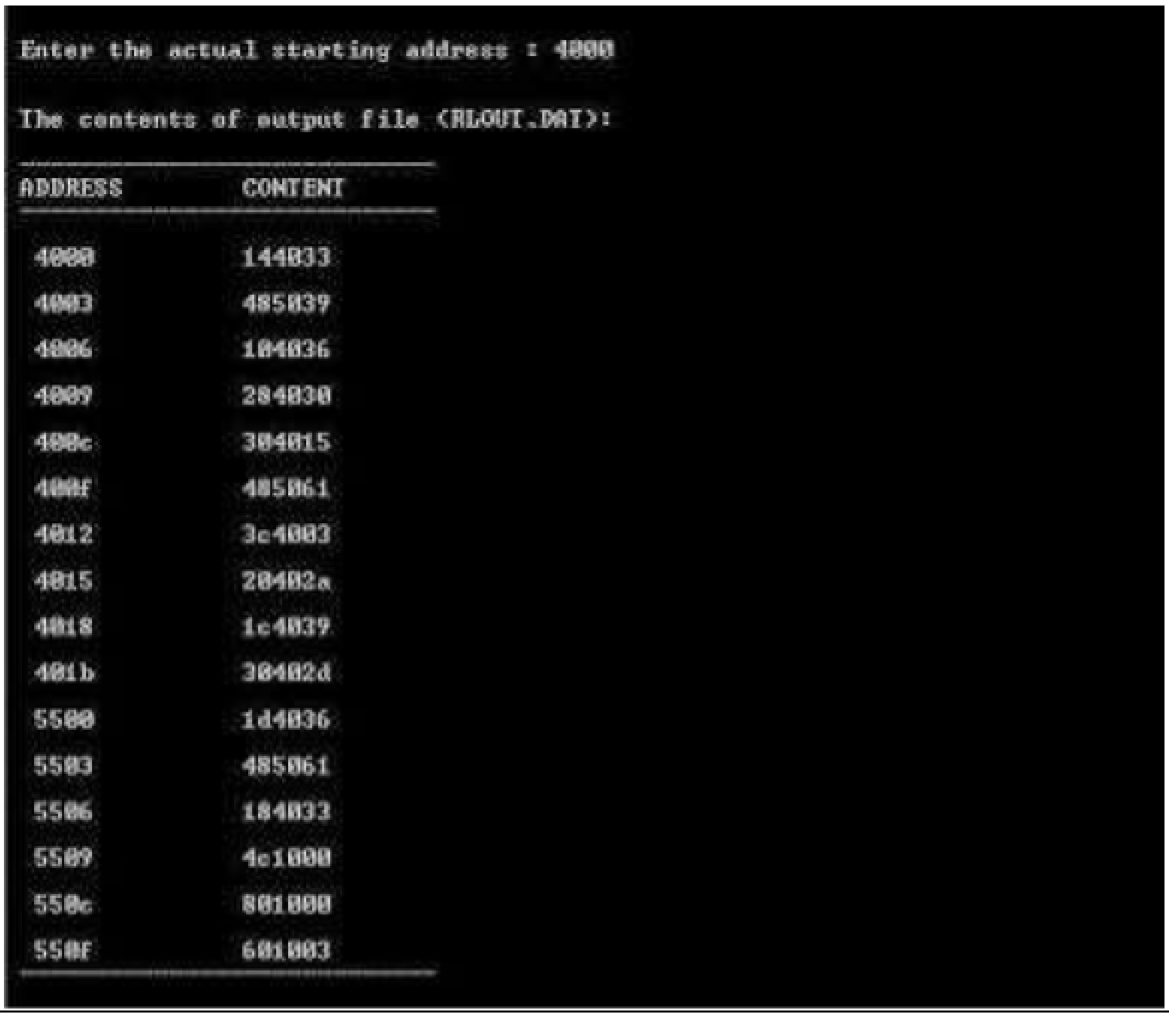
INPUT FILE:

RLIN.DAT

```
H COPY 001000 00107A
```

```
T 001000 1E FFC 14 0033 48 1039 10 0036 28 0030 30 0015 48 1061 3C 0003 20 002A
1C 0039 30 002D
T 002500 15 E00 1D 0036 48 1061 18 0033 4C 1000 80 1000 60 1003
E 000000
```

OUTPUT:



```
Enter the actual starting address : 4000

The contents of output file (RLOUT.DAT):
--------------------------------------------
ADDRESS          CONTENT
--------------------------------------------
 4000            144033
 4003            485039
 4006            104036
 4009            284030
 400c            304015
 400f            485061
 4012            3c4003
 4015            20402a
 4018            1c4039
 401b            30402d
 5500            1d4036
 5503            485061
 5506            184033
 5509            4c1000
 550c            801000
 550f            601003
--------------------------------------------
```

Result: Program has been executed successfully and required output obtained.

Viva questions:

1. What is a Microprocessor?
2. What are the different functional units in 8086?

3. Define bit, byte and word. ...
4. What is the function of BIU?
5. What is the function of EU?

EXPERIMENT – 14
SYMBOL TABLE USING HASHING

AIM: Implement a symbol table with suitable hashing

Symbol table is an important data structure created and maintained by compilers in order to store information about the occurrence of various entities such as variable names, function names,objects, classes, interfaces, etc. Symbol table is used by both the analysis and the synthesis parts of a compiler.

A symbol table may serve the following purposes depending upon the language in hand:

1. To store the names of all entities in a structured form at one place.
2. To verify if a variable has been declared.
3. To implement type checking, by verifying assignments and expressions in the source code are semantically correct.
4. To determine the scope of a name (scope resolution).

A symbol table is simply a table which can be either linear or a hash table.

Symbol table using hashing

1. In hashing scheme two tables are maintained – a hash table and symbol table and is the most commonly used method to implement symbol tables.
2. A hash table is an array with index range: 0 to table size – 1.These entries are pointer pointing to names of symbol table.
3. To search for a name we use hash function that will result in any integer between 0 to table size – 1.
4. Insertion and lookup can be made very fast – O(1).
5. Advantage is quick search is possible and disadvantage is that hashing is complicated to implement.

ALGORITHM

```
1.Start processing.
2.    Declare structure for input and output
files 3.Declare File pointers for input and output
files
4.Open Input File(s) in Read mode and Open Output File(s) in write Mode.
5.Read the Intermediate File until EOF occurs.
        5.1 If Symbol is not equal to - then
        5.2 Generate the hash index for the symbol using the hash function.
        5.3    Write the Symbol Name and its address into Symbol
table. 6.Close all the Files.
```

7.Print Symbol Table is created.
8.Stop processing.

PROGRAM

```
#include<stdio.h>
#include<string.h>
#include<stdlib.h
>
#include<conio.h>
#define size 50
struct intermediate
{
int addr;
char label[10];
char mnem[10];
char op[10];
}res;
struct symbol
{
char symbol[10];
int addr;
}sy,syy[size];
int hs=size;
unsigned hash(char *);
void search();
void main()
{
FILE
*s1,*p1;
char *lb;
int as=0,i=0;
clrscr();
s1=fopen("source.txt","r");
p1=fopen("symbol.txt","w");
while(!feof(s1))
{
fscanf(s1,"%d %s %s
%s",&res.addr,res.label,res.mnem,res.op);
strcpy(lb,res.label);
if(strcmp(res.label,"
-
")!=0)
{
as=ha
sh(lb);
strcpy(syy[as].symbol,res.label);
syy[as].addr=res.addr;
strcpy(sy.symbol,res.label);

sy.addr=res.addr;
fprintf(p1,"%s
\
t%d
\
n",sy.symbol,sy.addr);
}
}
fcloseall();
printf("Symbol Table
\
n");
printf("Index
\
tLabel
\
tAddr
\
n");
for(i=0;i<size;i++)
{
if(syy[i].addr!=0)
printf("%d
\
t%s
\
t%d
\
n",i,syy[i].symbol,syy[i].addr);
}
search();
}
unsigned hash(char *s)
{
unsigned hashval;
for (hashval = 0; *s != '
\
0'; s++)
```

```
hashval = *s + hashval;
return hashval % hs;
}
void sea
rch()
{

char *name;
char ch;
int val=0;
do
{
printf("Do u want to search label using hashing:(y/n)");
ch=getche();
if(ch=='y')
{
printf("
\
nEnter the label to be
searched:"); scanf("%s",name);
val=hash(name);
if(strcmp(syy[val].symbol,name)!=0)
val=0;
if(val!=0)
printf("Label %s found in hash table at index %d
with value
%d
\
n",syy[val].symbol,val,syy[val].addr);
else
printf("Label not found
\
n");
}
}while(ch!='n');
getch();
}
```

```
1009
first
 stl
 endfil
 1012
-
end
 start
Output File:
SYMBOL.TXT
start
 1000
endfil
 1003
copy
 1006
first
 1009
Symbol Table
 Index
Label
 Addr
 17
copy
 1006
24
start
 1000
36
first
 1009
48
endfil
 1003
Do u want to search label using hashing:(y/n)y
 Enter the label to be searched:start
Label start found in hash table at index 24 with value 1000
 Do u want to search label using hashing:(y/n)y
Enter the label to be searched:cloop
 Label not found
Do u want to search label using hashing:(y/n)n
```

Result: Program has been executed successfully and   required output obtained.

Viva questions:

1. What is general purpose registers in 8086?
2. What is special purpose register?
3. What are the functions of base register?
4. What is the segmentation address in 8086?
5. What are the different flags in 8086?