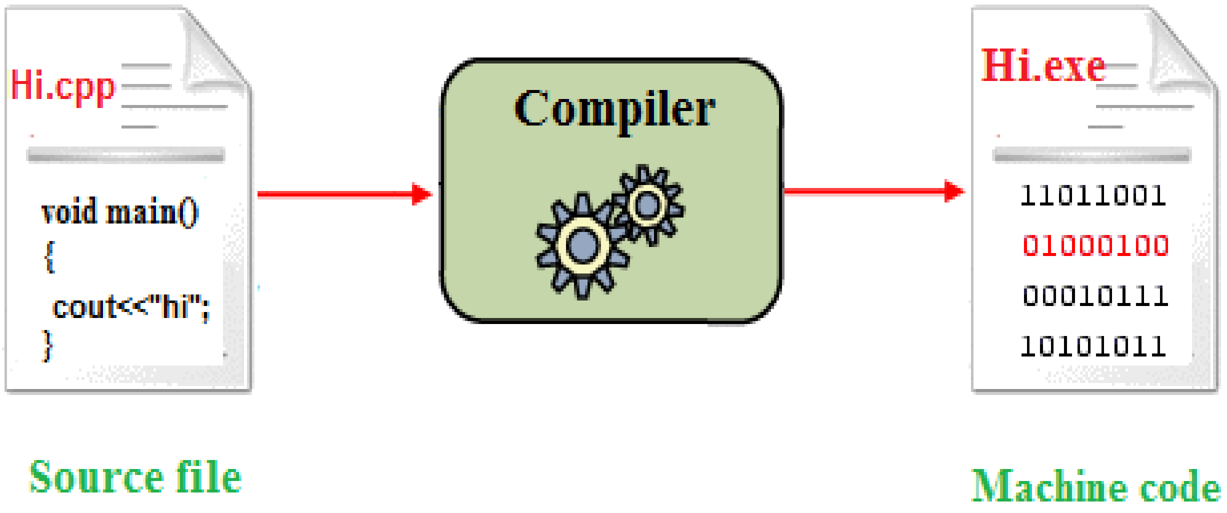
MADANAPALLE INSTITUTE OF TECHNOLOGY & SCIENCE
Post Box No: 14, Madanapalle-517325, Chittoor, Andhra Pradesh, India
(Affiliated to Jawaharlal Nehru Technological University, Anantapur)

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Regulation R18

18CSE211 - COMPILER DESIGN LABORATORY

LAB MANUAL



ACADEMIC YEAR 2020 - 2021

III B.Tech. CSE – II Semester

1. VISION AND MISSION OF THE INSTITUTION

Vision

To become a globally recognized research and academic institution and there by contribute to technological and socio-economic development of the nation.

Mission

To foster a culture of excellence in research, innovation, entrepreneurship, rational thinking and civility by providing necessary resources for generation, dissemination and Utilization of knowledge and in the process creates an ambience for practice-based learning to the youth for success in their careers.

2. VISION AND MISSION OF THE DEPARTMENT

Vision

To excel in technical education and research in area of Computer Science & Engineering and to provide expert, proficient and knowledgeable individuals with high enthusiasm to meet the societal challenges.

Mission

M1: To provide an open environment to the students and faculty that promotes professional and personal growth.

M2: To impart strong theoretical and practical background across the computer science discipline with an emphasis on software development and research.

M3: To inculcate the skills necessary to continue their education after graduation, as well as for the societal needs.

3. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The B. Tech. CSE graduates will be able to:

PEO1: Gain successful professional career in IT industry as an efficient software engineer.

PEO2: Succeed in Masters/Research programmes to gain knowledge on emerging technologies in Computer Science & Engineering.

PEO3: Grow as a responsible computing professional in their own area of interest with intellectual skills and ethics through lifelong learning approach to meet societal needs.

4. PROGRAMMEOUTCOMES (POs)

Engineering Graduates will be able to:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. 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.

PO3. 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.

PO4. 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.

PO5. 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.

PO6. 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.

PO7. 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.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multi disciplinary settings.

PO10. 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.

PO11.**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.

PO12. 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.

5. PROGRAMME SPECIFIC OUTCOMES (PSO)

The Computer Science and Engineering Graduates will be able to:

PSO1: Apply mathematical foundations, algorithmic principles and computing techniques in the modeling and design of computer-based systems

PSO 2: Design and develop software in the areas of relevance under realistic constraints.

PSO3: Analyze real world problems and develop computing solutions by applying concepts of Computer Science.

Syllabus

Course Prerequisites: 18CSE201, 18CSE203

Course Description:
This course helps the students to implement the principles and phases of compiler design in the programming languages in which they are familiar. This practical comprises the simulation of Finite Automata, implementation of the data structure used by the compiler and implementation of different phases of compiler.

Course Objectives:
1. To simulate finite automata, regular expression
2. To implement lexical analyzer, top down and bottom up parsing techniques.
3. To implement intermediate code generator to produce form of three address code.
4. To perform operations on symbol table.
5. To work with Lex & Yacc (Bison) for implementing scanner and parser.

LIST OF EXPERIMENTS

1. Design a lexical analyzer for given language and the lexical analyzer should ignore redundant spaces, tabs and new lines. It should also ignore comments. Although the syntax specification states that identifiers can be arbitrarily long, you may restrict the length to some reasonable value. Simulate the same in C/C++ language.

2. (a) Write a C program to identify whether a given line is a comment or not
   (b) Write a C program to test whether a given identifier is valid or not.

3. Write a C program to validate operators.

4. (a) Write a program to convert Regular Expression to Non-Deterministic Finite Automata.
   (b) Write program to simulate DFA, NFA for accept any input belongs to a particular language.

5. To implement Lexical Analyzer using LEX or FLEX (Fast Lexical Analyzer). The program should separate the tokens in the given C program and display with appropriate caption.

6. Implement following programs using LEX.
   a. Write a LEX specification file to take input C program from a .c file and count the number of characters, number of lines & number of words.
   b. Write a LEX program to count the number of Macros defined and header files included in the C program.
7. Implement following programs using LEX.
   a. Write a LEX program to print all the constants in the given C source program file.
   b. Write a LEX program to print all HTML tags in the input file.
   c. Write a LEX program which adds line numbers to the given C program file and display the same in the standard output.

8. Write a LEX program to count the number of comment lines in a given C program and eliminate them and write into another file.

9. Implement a C program to perform symbol table operations.
10. Implement a C program to eliminate left recursion and left factoring from a given CFG.
11. Write a C program to find FIRST and FOLLOW for predictive parser.
12. Write a C program for constructing of LL (1) parsing.
13. Write a C program to construct recursive descent parsing.
14. Write a C program for stack implementation of Shift Reduce parser.
15. Write a C program to implement operator precedence parsing.
16. Create YACC (or BISON) and LEX specification files to implement a basic calculator which accepts variables and constants of integer and float type.
17. Implement a simple intermediate code generator in C program, which produces three address code statements for a given input expression.

Course Outcomes:
Upon successful completion of the course, students will be able to

1. Understand the principles of compiler design
2. Gain knowledge on implementation of the phases of compiler including lexical analyzer, syntax analyzer.
3. Implement intermediate code generator
4. Work with scanner generator and parser generator tools such as Lex & Yacc to design compiler.

Major Equipment: PC, UNIX Server/Client or Windows, LEX & YACC for Linux, FLEX for Windows.

Mode of Evaluation: Practical.

Experiment 1: Design a lexical analyzer for given language and the lexical analyzer should ignore redundant spaces, tabs and new lines. It should also ignore comments. Although the syntax specification states that identifiers can be arbitrarily long, you may restrict the length to some reasonable value. Simulate the same in C/C++ language.

Aim: Design a lexical analyzer for given language.

Algorithm:

1. Start
2. Declare an array of characters, an input file to store the input;
3. Read the character from the input file and put it into character type of variable, say ‘c’.
4. If ‘c’ is blank then do nothing.
5. If ‘c’ is new line character line=line+1.
6. If ‘c’ is digit, set token Val, the value assigned for a digit and return the ‘NUMBER’.
7. If ‘c’ is proper token then assign the token value.
8. Print the complete table with token entered by the user and associated token value.
9. Stop

Program:

```
#include<string.h>
#include<ctype.h>
#include<stdio.h>
void keyword(char str[10])
{
if(strcmp("for",str)==0||strcmp("while",str)==0||strcmp("do",str)==0||strcmp("int",str
)==0||strcmp("float",str)==0||strcmp("char",str)==0||strcmp("double",str)==0||strcmp("st
atic",str)==0||strcmp("switch",str)==0||strcmp("case",str)==0)
printf("\n%s is a keyword",str);
else
printf("\n%s is an identifier",str);
}

main()
{
  FILE *f1,*f2,*f3;
char c, str[10], st1[10];
int num[100], lineno=0, tokenvalue=0,i=0,j=0,k=0;
printf("\n Enter the c program : ");/*gets(st1);*/
f1=fopen("input","w");
while((c=getchar())!=EOF)
putc(c,f1);
fclose(f1);
f1=fopen("input","r");
f2=fopen("identifier","w");

f3=fopen("specialchar","w");
```

```
while((c=getc(f1))!=EOF)
{
if(isdigit(c))
{
tokenvalue=c-'0';
c=getc(f1);
while(isdigit(c))
{
tokenvalue*=10+c-'0';
c=getc(f1);
}
num[i++]=tokenvalue;
ungetc(c,f1);
}
else
if(isalpha(c))
{
putc(c,f2);
c=getc(f1);
while(isdigit(c)||isalpha(c)||c=='_'||c=='$')
{
putc(c,f2);
c=getc(f1);
}
putc(' ',f2);
ungetc(c,f1);
}
else
if(c==' '||c=='\t')
printf(" ");
else
if(c=='\n')
lineno++;
else
putc(c,f3);
}
fclose(f2);
fclose(f3);
fclose(f1);
printf("\n The no's in the program are :");
for(j=0; j<i; j++)
printf("%d", num[j]);
printf("\n");
f2=fopen("identifier", "r");
k=0;
printf("The keywords and identifiers are:");
while((c=getc(f2))!=EOF)
{
```

```
if(c!=' ')
str[k++]=c;
else
{
str[k]='\0';
keyword(str);
k=0;
}
}
fclose(f2);
f3=fopen("specialchar","r");
printf("\n Special characters are : ");
while((c=getc(f3))!=EOF)
printf("%c",c);
printf("\n");
fclose(f3);
printf("Total no. of lines are:%d", lineno);
 }
```

Sample Input & Output:

Input:

```
Enter Program  Ctrl+D for termination:
{
int a[3],t1,t2;
t1=2;  a[0]=1; a[1]=2; a[t1]=3;
t2=-(a[2]+t1*6)/(a[2]-t1);
if t2>5 then print(t2); else {
int t3; t3=99; t2=-25;
print(-t1+t2*t3);   /* this is a comment   on 2 lines */
}  endif
}
```

Output:

```
 Variables : a[3] t1 t2 t3  Operator : - + * / >
Constants :  2 1 3 6 5 99 -25
Keywords : int if then else endif  Special Symbols : , ;
( ) { }
Comments :  this is a comment on 2 lines
```

Experiment 2(a): Write a C program to identify whether a given line is a comment or not

Aim: C program to identify whether a given line is a comment or not

Program:

```
#include<stdio.h>
#include<conio.h>
void main()
{
char com[30];
int i=2,a=0;
clrscr();
printf("\n Enter comment:");
gets(com);
if(com[0]=='/') {
        if(com[1]=='/')
        printf("\n It is a comment");
        else if(com[1]=='*')  {
                         for(i=2;i<=30;i++)
                              {
        if(com[i]=='*'&&com[i+1]=='/')
                               {
        printf("\n It is a comment");  a=1;
        break;       }
        else continue;  }
        if(a==0)
        printf("\n It is not a comment");
        }
        else
                           printf("\n It is not a comment");
                         }
        else
        printf("\n It is not a comment");
        getch();
            }
```

Sample Input & Output:

Input: Enter comment: //hello
Output: It is a comment
Input: Enter comment: hello
Output: It is not a comment

Experiment 2(b): Write a C program to test whether a given identifier is valid or not.

Aim: Write a C program to test whether a given identifier is valid or not.

Algorithm:

1. Start
2. Read the given input string.
3. Check the initial character of the string is numerical or any special character except '_' then print it is not a valid identifier.
4. Otherwise print it as valid identifier if remaining characters of string doesn't contains any special characters except '_'.
5. Stop.

Program:

```
#include<stdio.h>
#include<conio.h>
#include<ctype.h>
void main()
{
char a[10];
int flag, i=1;
clrscr();
printf("\n Enter an identifier:");
gets(a);
if(isalpha(a[0]))
flag=1;
else
printf("\n Not a valid identifier");
while(a[i]!='\0')
{
if(!isdigit(a[i])&&!isalpha(a[i]))
{
flag=0;
break;
} i++;
  }
if(flag==1)
printf("\n Valid identifier");
getch();
}
```

<u>Sample Input & Output:</u>

Input: Enter an identifier: first

Output:

```
Valid identifier
Enter an identifier:1aqw
Not a valid identifier
```

Experiment 3: Write a C program to validate operators.

Aim: Write a C program to validate operators.

Algorithm:

1. Start
2. Read the given input.
3. If the given input matches with any operator symbol.
4. Then display in terms of words of the particular symbol. Else print not an operator.
5. Stop

Program:

```
#include<stdio.h>
#include<conio.h>
void main()
{
char s[5];
clrscr();
printf("\n Enter any operator:");
gets(s);
switch(s[0])
{
case'>': if(s[1]=='=')
printf("\n Greater than or equal");
else
printf("\n Greater than");
break;
case'<':  if(s[1]=='=')
printf("\n Less than or equal");
else
printf("\nLess than");
break;
case'=':   if(s[1]=='=')
 printf("\nEqual to");
 else printf("\nAssignment");  break;
case'!':    if(s[1]=='=')
printf("\nNot Equal");
else
 printf("\n Bit Not");
 break;
case'&':  if(s[1]=='&')
```

```
     printf("\nLogical AND");
     else
    printf("\n Bitwise AND");
    break;
    case'|':   if(s[1]=='|')
    printf("\nLogical OR");
    else
   printf("\nBitwise OR");
   break;
   case'+':   printf("\n Addition");
     break;
   case'-':  printf("\nSubstraction");
   break;
   case'*':   printf("\nMultiplication");
   break;
    case'/':    printf("\nDivision");
    break;
    case'%': printf("Modulus");
    break;
    default:  printf("\n Not a operator");
    }
    getch();
    }
```

Sample Input & Output:

Input

Enter any operator: *

Output

Multiplication

Experiment 4(a): Write a program to convert Regular Expression to Non-Deterministic Finite Automata.

Aim: C Program to convert Regular Expression to Non-Deterministic Finite Automata.

Algorithm:
1. Start
2. Create a menu for getting four regular expressions input as choice.
3. To draw NFA for a, a/b ,ab ,a* create a routine for each regular expression.
4. For converting from regular expression to NFA, certain transition had been made based on choice of input at the runtime.
5. Each of the NFA will be displayed is sequential order.
6. Stop

Program:
```
#include<iostream>
#include<conio.h>
#include<process.h>
using namespace std;
struct node
{
char start;
char alp;
node *nstate;
}*p,*p1,*p2,*p3,*p4,*p5,*p6,*p7,*p8;
char e='e';
void disp();
        void re1()
{
p1=new(node);
p2=new(node);
p1->start='0';
p1->alp='e';
p1->nstate=p2;
p2->start='1';
p2->alp='a';
p2->nstate=NULL;
disp();
getch();
}
void re2()
{
p1=new(node);
p2=new(node);
p3=new(node);
p4=new(node);
p5=new(node);
p6=new(node);
```

```
p7=new(node);
p8=new(node);
p1->start='0';
p1->alp='e';
p1->nstate=p2;
p2->start='1';
p2->alp='a';
p2->nstate=p3;
p3->start='2';
p3->alp='e';
p3->nstate=p4;
p4->start='5';
p4->alp=' ';
p4->nstate=p5;
p5->start='0';
p5->alp='e';
p5->nstate=p6;
p6->start='3';
p6->alp='b';
p6->nstate=p7;
p7->start='4';
p7->alp='e';
p7->nstate=p8;
p8->start='5';
p8->alp=' ';
p8->nstate=NULL;
disp();
getch();
}
void re3()
{
p1=new(node);
p2=new(node);
p3=new(node);
p1->start='0';
p1->alp='a';
p1->nstate=p2;
p2->start='1';
p2->alp='b';
p2->nstate=p3;
p3->start='2';
p3->alp=' ';
p3->nstate=NULL;
disp();
getch();
}
void re4()
{
```

```
p1=new(node);
p2=new(node);
p3=new(node);
p4=new(node);
p5=new(node);
p6=new(node);
p7=new(node);
p8=new(node);
p1->start='0';
p1->alp='e';
p1->nstate=p2;
p2->start='1';
p2->alp='a';
p2->nstate=p3;
p3->start='2';
p3->alp='e';
p3->nstate=p4;
p4->start='3';
p4->alp=' ';
p4->nstate=p5;
p5->start='0';
p5->alp='e';
p5->nstate=p6;
p6->start='3';
p6->alp=' ';
p6->nstate=p7;
p7->start='2';
p7->alp='e';
p7->nstate=p8;
p8->start='1';
p8->alp=' ';
p8->nstate=NULL;
disp();
getch();
}
void disp()
{
p=p1;
while(p!=NULL)
{
cout<<"\t"<<p->start<<"\t"<<p->alp;
p=p->nstate;
}
}
int main()
{
p=new(node);
int ch=1;
```

```
while(ch!=0)
{
cout<<"\nMenu"<<"\n1.a"<<"\n2.a/b"<<"\n3.ab"<<"\n4.a*";
cout<<"\n Enter the choice:";
cin>>ch;
switch(ch)
{
case 1:
{
re1();
break;
}
case 2:
{
re2();
break;
}
case 3:
{
re3();
break;
}
case 4:
{
re4();
break;
}
default:
{
exit(0);
}
}
//clrscr();
}
}
```

Sample Output:

```
Menu
1. a
2. a/b
3. ab
4. a*
Enter the choice: 1
0        a     1

Menu
```

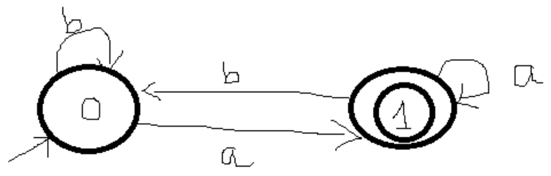
```
  1. a
  2. a/b
  3. ab
  4. a*
  Enter the choice: 2
  0     e     1   a   2    e    5    0    e     3     b    4    e    5

  Menu
  1. a
  2. a/b
  3. ab
  4. a*
  Enter the choice: 3
  0    a      1    b   2

  Menu
  1. a
  2. a/b
  3. ab
  4. a*
  Enter the choice: 4
  0 e 1 a 2 e 3 0 e 3 2 e 1


Menu
  1. a
  2. a/b
  3. ab
  4. a*
  Enter the choice: 5
```

Experiment 4(b): Write program to simulate DFA for accept any input belongs to a particular language.

Aim: C program for simulating Deterministic Finite Automata.

Algorithm:

1. Start
2. Consider the DFA represented in this transition diagram.



3. The sample DFA with starting state " 0 ", and accepting state " 1" . "a" and "b" are the input symbols.
4. The final DFA will accept any string containing 'a's and 'b' and last symbol should be 'a'.
5. Stop

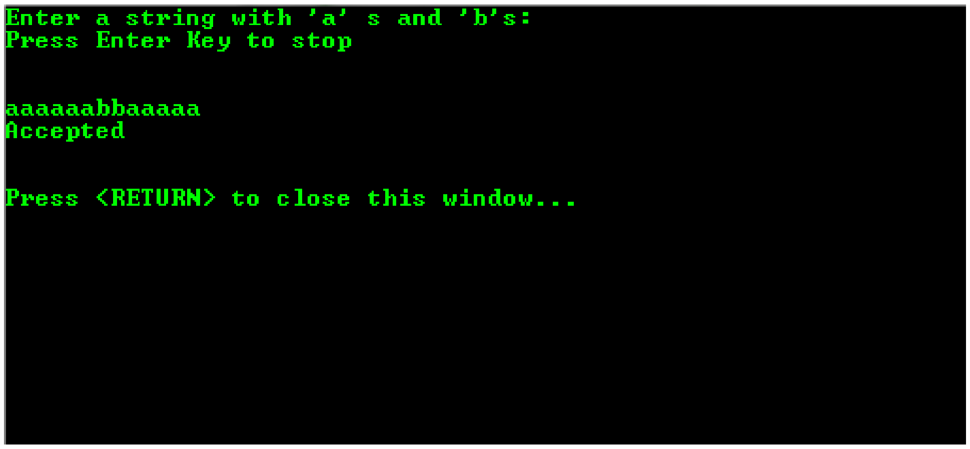
Program:

```
#include <stdio.h>
#define TOTAL_STATES 2
#define FINAL_STATES 1
#define ALPHABET_CHARCTERS 2
#define UNKNOWN_SYMBOL_ERR 0
#define NOT_REACHED_FINAL_STATE 1
#define REACHED_FINAL_STATE 2
enum DFA_STATES{q0,q1};
enum input{a,b};
int Accepted_states[FINAL_STATES]={q1};
char alphabet[ALPHABET_CHARCTERS]={'a','b'};
int Transition_Table[TOTAL_STATES][ALPHABET_CHARCTERS];
int Current_state=q0;
void DefineDFA()
{
   Transition_Table[q0][a] = q1;
   Transition_Table[q0][b] = q0;
   Transition_Table[q1][a] = q1;
   Transition_Table[q1][b] = q0;
}
int DFA(char current_symbol)
{
int i,pos;
   for(pos=0;pos<ALPHABET_CHARCTERS; pos++)
```

```
        if(current_symbol==alphabet[pos])
            break;//stops if any character other than a or b
    if(pos==ALPHABET_CHARCTERS)
         return UNKNOWN_SYMBOL_ERR;
    for(i=0;i<FINAL_STATES;i++)
 if((Current_state=Transition_Table[Current_state][pos])
==Accepted_states[i])
            return REACHED_FINAL_STATE;
    return NOT_REACHED_FINAL_STATE;
}
int main(void)
{
    char current_symbol;
    int result;

    DefineDFA();    //Fill transition table

    printf("Enter a string with 'a' s and 'b's:\nPress Enter Key to stop\n");


    while((current_symbol=getchar())!= '\n')
        if((result= DFA(current_symbol))==UNKNOWN_SYMBOL_ERR)
            break;
    switch (result) {
    case UNKNOWN_SYMBOL_ERR:printf("Unknown Symbol %c",
  current_symbol);
 break;
    case NOT_REACHED_FINAL_STATE:printf("Not accepted"); break;
    case REACHED_FINAL_STATE:printf("Accepted");break;
    default: printf("Unknown Error");
    }
    printf("\n\n\n");
    return 0;
}
```

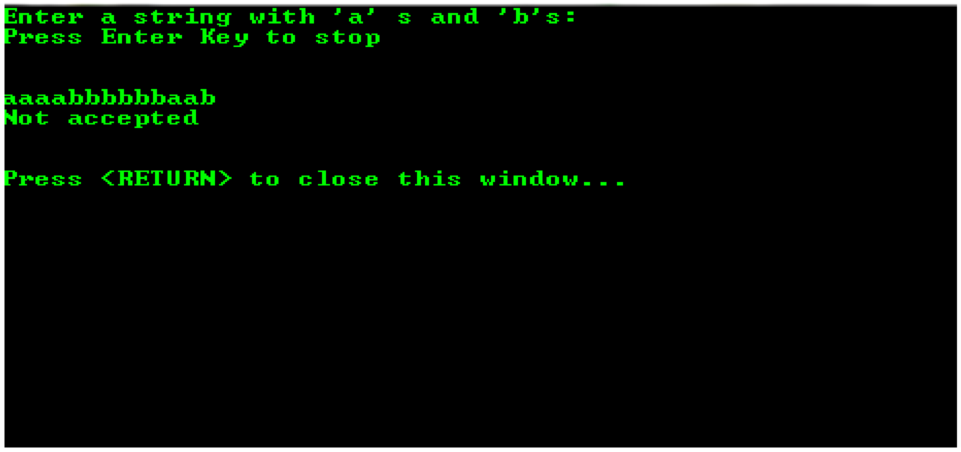
Sample Output:

String with only "a"s and "b"s and last symbol is "a".   ACCEPTED..!!



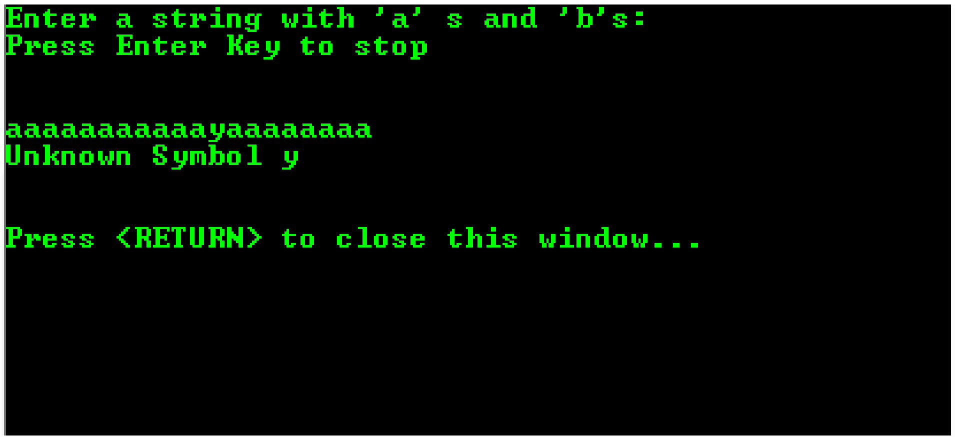
```
Enter a string with 'a' s and 'b's:
Press Enter Key to stop


aaaaaabbaaaaa
Accepted


Press <RETURN> to close this window...
```

String with only "a"s and "b"s but last symbol is not "a".   REJECTED..!!



```
Enter a string with 'a' s and 'b's:
Press Enter Key to stop


aaaabbbbbbaab
Not accepted


Press <RETURN> to close this window...
```

Unknown symbol "y" in input. REJECTED.!!!!



```
Enter a string with 'a' s and 'b's:
Press Enter Key to stop


aaaaaaaaaaayaaaaaaaa
Unknown Symbol y


Press <RETURN> to close this window...
```

<u>Experiment 5:</u> To implement Lexical Analyzer using LEX or FLEX (Fast Lexical Analyzer). The program should separate the tokens in the given C program and display with appropriate caption.

<u>Aim:</u> Design a Lexical Analyzer using LEX or FLEX to separate the tokens in the given C program.

<u>Algorithm:</u>

1. Start
2. Open a file in text editor
3. Create a Lex specifications file to declare the variables, constants and inclusion of header files in the following format.
    a) %{
       Definition of constant /header files
       %}
    b) Regular Expressions
       %%
       Transition rules
       %%
    c) Auxiliary Procedure (main( ) function)
4. Save file with .l extension e.g. token.l
5. Open Command prompt and switch to your working directory where you have stored your lex file (".l").
6. Compile the lex file named "token.l" using the command "flex token.l". It will produce a 'C' version of lexical analyzer which is stored in "lex.yy.c".
7. Compile the file lex.yy.c using C / C++ compiler. e.g. gcc lex.yy.c. After compilation the file lex.yy.c, the output file is in a.exe.
8. Run the file a.exe giving an input (text/file) e.g. a.exe sample.c
9. Upon processing, the sequence of tokens will be displayed as output.
10. Stop

<u>Lex Program:</u> (token.l)

```
digit [0-9]
letter [A-Za-z]
%{
int count_id,count_key;
%}
%%
(stdio.h|conio.h) { printf("%s is a standard library\n",yytext); }
(include|void|main|printf|int) { printf("%s is a keyword\n",yytext); count_key++; }
{letter}({letter}|{digit})*  { printf("%s is a identifier\n", yytext); count_id++; }
{digit}+  { printf("%s is a number\n", yytext); }
\"(\\.|[^"\\])*\"  { printf("%s is a string literal\n", yytext); }
.|\n {  }
%%
int yywrap(void) {
return 1;
}
int main(int argc, char *argv[]) {
```

```
yyin = fopen(argv[1], "r");
yylex();
printf("number of identifiers = %d\n", count_id);
printf("number of keywords = %d\n", count_key);
fclose(yyin);
}
```

<u>**Input Source Program:**</u> **(sample.c)**

```
#include<stdio.h>
void main()
{
 int a,b,c = 30;
 printf("hello");
 }
```

<u>**Compilation & Execution of Lex Program:**</u>

1. Open Command prompt and switch to your working directory where you have stored your lex file (".l").
2. Let lex file be "token.l". Now, follow the preceding steps to compile and run lex program.
   A. <u>For Compiling **Lex** file:</u>
      i. flex token.l
      ii. gcc lex.yy.c
   B. <u>For **Executing** the Program</u>
      a.exe sample.c

<u>**Sample Output:**</u>

```
G:\lex>flex token.l

G:\lex>gcc lex.yy.c

G:\lex>a.exe sample.c
include is a keyword
stdio.h is a standard library
void is a keyword
main is a keyword
int is a keyword
a is a identifier
b is a identifier
c is a identifier
30 is a number
printf is a keyword
"hello" is a string literal
number of identifiers = 3
number of keywords = 5

G:\lex>
```

Experiment 6(a): Write a LEX specification file to take input C program from a .c file and count the number of characters, number of lines & number of words.

Aim: Design a Lexical Analyzer using LEX or FLEX to count the number of characters, number of lines & number of words.

Algorithm:

1. Start
2. Open a file in text editor
3. Create a Lex specifications file and save file with .l extension.
4. Open Command prompt and switch to your working directory where you have stored your lex file.
5. Compile the lex file named “xxxxx.l” using the command “flex xxxxx.l”. It will produce a ‘C’ version of lexical analyzer which is stored in “lex.yy.c”.
6. Compile the file lex.yy.c using C / C++ compiler. e.g. gcc lex.yy.c. After compilation the file lex.yy.c, the output file is in a.exe.
7. Run the file a.exe giving an input (text/file) e.g. a.exe sample.c
8. Upon processing, the sequence of tokens will be displayed as output.
9. Stop

Lex Program: (count_lines.l)

```
%{
int nchar, nword, nline;
%}
%%
\n { nline++; nchar++; }
[^ \t\n]+ { nword++, nchar += yyleng; }
. { nchar++; }
%%
int yywrap(void) {
return 1;
}
int main(int argc, char *argv[]) {
yyin = fopen(argv[1], "r");
yylex();
printf("Number of characters = %d\n", nchar);
printf("Number of words = %d\n", nword);
printf("Number of lines = %d\n", nline);
fclose(yyin);
}
```

Input Source Program: (sample.c)

```
#include<stdio.h>
void main()
{
 int a,b,c = 30;
 printf("hello");
}
```

<u>Compilation & Execution of Lex Program:</u>

1. Open Command prompt and switch to your working directory where you have stored your lex file (".l").
2. Let lex file be "count_lines.l". Now, follow the preceding steps to compile and run lex program.

A. <u>For Compiling **Lex** file:</u>

   i. flex count_lines.l
   ii. gcc lex.yy.c

B. <u>For **Executing** the Program</u>

   a.exe sample.c

<u>Sample Output:</u>

```
G:\lex>flex count_line.l

G:\lex>gcc lex.yy.c

G:\lex>a.exe sample.c
Number of characters = 71
Number of words = 10
Number of lines = 6

G:\lex>
```

Experiment 6(b): Write a LEX program to count the number of Macros defined and header files included in the C program.

Aim: Design a Lexical Analyzer using LEX or FLEX to count the number of Macros defined and header files.

Algorithm:

1. Start
2. Open a file in text editor
3. Create a Lex specifications file and save file with .l extension.
4. Open Command prompt and switch to your working directory where you have stored your lex file.
5. Compile the lex file named "xxxxx.l" using the command "flex xxxxx.l". It will produce a 'C' version of lexical analyzer which is stored in "lex.yy.c".
6. Compile the file lex.yy.c using C / C++ compiler. e.g. gcc lex.yy.c. After compilation the file lex.yy.c, the output file is in a.exe.
7. Run the file a.exe giving an input (text/file) e.g. a.exe sample.c
8. Upon processing, the sequence of tokens will be displayed as output.
9. Stop

Lex Program: (count_macro.l)

```
%{
int nmacro, nheader;
%}
%%
^#define { nmacro++; }
^#include { nheader++; }
.|\n {  }
%%
int yywrap(void) {
return 1;
}
int main(int argc, char *argv[]) {
yyin = fopen(argv[1], "r");
yylex();
printf("Number of macros defined = %d\n", nmacro);
printf("Number of header files included = %d\n", nheader);
fclose(yyin);
}
```

Input Source Program: (sample.c)

```
#define PI 3.14
#include<stdio.h>
#include<conio.h>
void main()
{
 int a,b,c = 30;
```

```
    printf("hello");
    }
```

<u>Sample Output:</u>

```
G:\lex>flex count_macro.l

G:\lex>gcc lex.yy.c

G:\lex>a.exe sample.c
Number of macros defined = 1
Number of header files included = 2

G:\lex>
```

Experiment 7(a): Write a LEX program to print all the constants in the given C source program file.

Aim: Design a Lexical Analyzer using LEX or FLEX to print all the constants.

Algorithm:

1. Start
2. Open a file in text editor
3. Create a Lex specifications file and save file with .l extension.
4. Open Command prompt and switch to your working directory where you have stored your lex file.
5. Compile the lex file named “xxxxx.l” using the command “flex xxxxx.l”. It will produce a ‘C’ version of lexical analyzer which is stored in “lex.yy.c”.
6. Compile the file lex.yy.c using C / C++ compiler. e.g. gcc lex.yy.c. After compilation the file lex.yy.c, the output file is in a.exe.
7. Run the file a.exe giving an input (text/file) e.g. a.exe sample.c
8. Upon processing, the sequence of tokens will be displayed as output.
9. Stop

Lex Program: (7a_countconstants.l)

```
digit [0-9]
%{
int cons=0;
%}
%%
{digit}+ { cons++; printf("%s is a constant\n", yytext);  }
.|\n { }
%%
int yywrap(void) {
return 1; }
int main(void)
{
FILE *f;
char file[10];
printf("Enter File Name : ");
scanf("%s",file);
f = fopen(file,"r");
yyin = f;
yylex();
printf("Number of Constants : %d\n", cons);
fclose(yyin);
}
```

Input Source Program: (sample.c)

```
#include<stdio.h>
void main()
{
 int a,b = 20, c = 30;
printf("hello");
}
```

Sample Output:

```
G:\lex>flex 7a_countconstants.l

G:\lex>gcc lex.yy.c

G:\lex>a.exe
Enter File Name : sample.c
20 is a constant
30 is a constant
Number of Constants : 2

G:\lex>
```

Experiment 7(b): Write a LEX program to print all HTML tags in the input file.

Aim: Design a Lexical Analyzer using LEX or FLEX to print all HTML tags in the input file.

Algorithm:

1. Start
2. Open a file in text editor
3. Create a Lex specifications file and save file with .l extension.
4. Open Command prompt and switch to your working directory where you have stored your lex file.
5. Compile the lex file named "xxxxx.l" using the command "flex xxxxx.l". It will produce a 'C' version of lexical analyzer which is stored in "lex.yy.c".
6. Compile the file lex.yy.c using C / C++ compiler. e.g. gcc lex.yy.c. After compilation the file lex.yy.c, the output file is in a.exe.
7. Run the file a.exe giving an input (text/file) e.g. a.exe sample.c
8. Upon processing, the sequence of tokens will be displayed as output.
9. Stop

Lex Program: (7b_html.l)

```
%{
int tags;
%}
%%
"<"[^>]*>  { tags++; printf("%s \n", yytext); }
.|\n { }
%%
int yywrap(void) {
return 1; }
int main(void)
{
FILE *f;
char file[10];
printf("Enter File Name : ");
scanf("%s",file);
f = fopen(file,"r");
yyin = f;
yylex();
printf("\n Number of html tags: %d",tags);
fclose(yyin);
}
```

Input Source Program: (sample.html)

```
<html>
<body>
```

```
<h1>My First Heading</h1>
<p>My first paragraph.</p>
</body>
</html>
```

Sample Output:

```
G:\lex>flex 7b_html.l

G:\lex>gcc lex.yy.c

G:\lex>a.exe
Enter File Name : sample.html
<html>
<body>
<h1>
</h1>
<p>
</p>
</body>
</html>

 Number of html tags: 8
G:\lex>
```

Experiment 7(c): Write a LEX program which adds line numbers to the given C program file and display the same in the standard output.

Aim: Design a Lexical Analyzer using LEX or FLEX to add line numbers to the given C program file.

Algorithm:

1. Start
2. Open a file in text editor
3. Create a Lex specifications file and save file with .l extension.
4. Open Command prompt and switch to your working directory where you have stored your lex file.
5. Compile the lex file named “xxxxx.l” using the command “flex xxxxx.l”. It will produce a ‘C’ version of lexical analyzer which is stored in “lex.yy.c”.
6. Compile the file lex.yy.c using C / C++ compiler. e.g. gcc lex.yy.c. After compilation the file lex.yy.c, the output file is in a.exe.
7. Run the file a.exe giving an input (text/file) e.g. a.exe sample.c
8. Upon processing, the sequence of tokens will be displayed as output.
9. Stop

Lex Program: (7c_addlinenos.l)

```
%{
int yylineno;
%}
%%
^(.*)\n printf("%4d\t%s", ++yylineno, yytext);
%%
int yywrap(void) {
return 1;
}
int main(int argc, char *argv[]) {
yyin = fopen(argv[1], "r");
yylex();
fclose(yyin);
}
```

Input Source Program: (sample.c)

```
#define PI 3.14
#include<stdio.h>
#include<conio.h>
void main()
{
 int a,b,c = 30;
 printf("hello");
 }
```

Sample Output:

```
G:\lex>flex 7c_addlinenos.l

G:\lex>gcc lex.yy.c

G:\lex>a.exe sample.c
   1    #define PI 3.14
   2    #include<stdio.h>
   3    #include<conio.h>
   4    void main()
   5    {
   6     int a,b,c = 30;
   7     printf("hello");
   8     }

G:\lex>
```

Experiment 8: Write a LEX program to count the number of comment lines in a given C program and eliminate them and write into another file.

Aim: Design a Lexical Analyzer using LEX or FLEX to count the number of comment lines in a given C program and eliminate them and write into another file.

Algorithm:

1. Start
2. Open a file in text editor
3. Create a Lex specifications file and save file with .l extension.
4. Open Command prompt and switch to your working directory where you have stored your lex file.
5. Compile the lex file named "xxxxx.l" using the command "flex xxxxx.l". It will produce a 'C' version of lexical analyzer which is stored in "lex.yy.c".
6. Compile the file lex.yy.c using C / C++ compiler. e.g. gcc lex.yy.c. After compilation the file lex.yy.c, the output file is in a.exe.
7. Run the file a.exe giving an input (text/file) e.g. a.exe sample.c
8. Upon processing, the sequence of tokens will be displayed as output.
9. Stop

Lex Program: (comment.l)

```
%{
int com=0;
%}
%s COMMENT
%%
"/*" {BEGIN COMMENT;}
<COMMENT>"*/" {BEGIN 0; com++;}
<COMMENT>\n {com++;}
<COMMENT>. {;}
\/\/.* {; com++;}
.|\n {fprintf(yyout,"%s",yytext);}
%%
void main(int argc, char *argv[])
{
if(argc!=3)
{
printf("usage : ./a.exe input.c output.c\n");
exit(0);
}
yyin=fopen(argv[1],"r");
yyout=fopen(argv[2],"w");
yylex();
printf("\n number of comments are = %d\n",com);
}
int yywrap()
{
```

```
return 1;
}
```

<u>Input Source File:</u> (input.c)

```
#include<stdio.h>
int main()
{
int a,b,c; /*varible declaration*/
printf("enter two numbers");
scanf("%d %d",&a,&b);
c=a+b;//adding two numbers
printf("sum is %d",c);
return 0;
}
```

<u>Output Destination File:</u> (output.c)

```
include<stdio.h>
int main()
{
int a,b,c;
printf("enter two numbers");
scanf("%d %d",&a,&b);
c=a+b;
printf("sum is %d",c);
return 0;
}
```

<u>Sample Output:</u>

```
G:\lex>flex comment.l

G:\lex>gcc lex.yy.c

G:\lex>a.exe input.c output.c

 number of comments are = 2

G:\lex>
```

Experiment 9: Implement a C program to perform symbol table operations.

Aim: Implement a C program to perform symbol table operations.

Algorithm:

1. Start the program for performing insert, display, delete, search and modify option in symbol table
2. Define the structure of the Symbol Table
3. Enter the choice for performing the operations in the symbol Table
4. If the entered choice is 1, search the symbol table for the symbol to be inserted. If the symbol is already present, it displays "Duplicate Symbol". Else, insert the symbol and the corresponding address in the symbol table.
5. If the entered choice is 2, the symbols present in the symbol table are displayed.
6. If the entered choice is 3, the symbol to be deleted is searched in the symbol table.
7. If it is not found in the symbol table it displays "Label Not found". Else, the symbol is deleted.
8. Stop

Program:

```
#include<stdio.h>
#include<conio.h>
#include<malloc.h>
#include<string.h>
#include<stdlib.h>
#define NULL 0
int size=0;
void Insert();
void Display();
void Delete();
int Search(char lab[]);
void Modify();
struct SymbTab
{
 char label[10],symbol[10];
 int addr;
struct SymbTab *next;};
struct SymbTab *first,*last;
int main()
{
 int op,y;
 char la[10];
 //clrscr();
 do
 {
  printf("\n\tSYMBOL TABLE IMPLEMENTATION\n");
  printf("\n\t1.INSERT\n\t2.DISPLAY\n\t3.DELETE\n\t4.SEARCH\n\t5.MODIFY\n\t6.END\n");
  printf("\n\tEnter your option : ");
 scanf("%d",&op);
 switch(op)
 {
  case 1:
     Insert();
     break;
  case 2:
     Display();
     break;
  case 3:
     Delete();
     break;
  case 4:
     printf("\n\tEnter the label to be searched : ");
     scanf("%s",la);
     y=Search(la);
     printf("\n\tSearch Result:");
     if(y==1)
   printf("\n\tThe label is present in the symbol table\n");
     else
   printf("\n\tThe label is not present in the symbol table\n");
     break;
  case 5:
     Modify();
     break;
  case 6:
     exit(0);
  }
 }while(op<6);
 getch();
}
void Insert()
{
 int n;
 char l[10];
 printf("\n\tEnter the label : ");
 scanf("%s",l);
 n=Search(l);
 if(n==1)
  printf("\n\tThe label exists already in the symbol table\n\tDuplicate can't be inserted");
 else
  {
   struct SymbTab *p;
   p=malloc(sizeof(struct SymbTab));
   strcpy(p->label,l);
   printf("\n\tEnter the symbol : ");
   scanf("%s",p->symbol);
   printf("\n\tEnter the address : ");
```

```
    scanf("%d",&p->addr);
    p->next=NULL;
    if(size==0)
     {
      first=p;
      last=p;
     }
    else
     {
      last->next=p;
      last=p;
     }
    size++;
   }
   printf("\n\tLabel inserted\n");
}
void Display()
{
  int i;
  struct SymbTab *p;
  p=first;
  printf("\n\tLABEL\t\tSYMBOL\t\tADDRESS\n");
  for(i=0;i<size;i++)
   {
    printf("\t%s\t\t%s\t\t%d\n",p->label,p->symbol,p->addr);
    p=p->next;
   }
}
int Search(char lab[])
{
 int i,flag=0;
 struct SymbTab *p;
 p=first;
  for(i=0;i<size;i++)
   {
    if(strcmp(p->label,lab)==0)
     flag=1;
    p=p->next;
   }
 return flag;
}
void Modify()
{
  char l[10],nl[10];
  int add,choice,i,s;
  struct SymbTab *p;
  p=first;
  printf("\n\tWhat do you want to modify?\n");
  printf("\n\t1.Only the label\n\t2.Only the address\n\t3.Both the label and address\n");
  printf("\tEnter your choice : ");
  scanf("%d",&choice);
  switch(choice)
   {
     case 1:
       printf("\n\tEnter the old label : ");
       scanf("%s",l);
       s=Search(l);
       if(s==0)
     printf("\n\tLabel not found\n");
       else
    {
     printf("\n\tEnter the new label : ");
     scanf("%s",nl);
     for(i=0;i<size;i++)
      {
       if(strcmp(p->label,l)==0)
         strcpy(p->label,nl);
       p=p->next;
      }
     printf("\n\tAfter Modification:\n");
     Display();
    }
    break;
    case 2:
       printf("\n\tEnter the label where the address is to be modified : ");
       scanf("%s",l);
       s=Search(l);
       if(s==0)
     printf("\n\tLabel not found\n");
       else
    {
     printf("\n\tEnter the new address : ");
     scanf("%d",&add);
     for(i=0;i<size;i++)
      {
       if(strcmp(p->label,l)==0)
        p->addr=add;
       p=p->next;
      }
     printf("\n\tAfter Modification:\n");
     Display();
    }
    break;
    case 3:
       printf("\n\tEnter the old label : ");
       scanf("%s",l);
```

```
      s=Search(l);
      if(s==0)
    printf("\n\tLabel not found\n");
      else
    {
    printf("\n\tEnter the new label : ");
    scanf("%s",nl);
    printf("\n\tEnter the new address : ");
    scanf("%d",&add);
    for(i=0;i<size;i++)
     {
     if(strcmp(p->label,l)==0)
      {
      strcpy(p->label,nl);
      p->addr=add;
      }
     p=p->next;
     }
    printf("\n\tAfter Modification:\n");
    Display();
    }
   break;
    }
}
void Delete()
{
  int a;
  char l[10];
  struct SymbTab *p,*q;
  p=first;
  printf("\n\tEnter the label to be deleted : ");
  scanf("%s",l);
  a=Search(l);
  if(a==0)
    printf("\n\tLabel not found\n");
  else
   {
    if(strcmp(first->label,l)==0)
    first=first->next;
    else if(strcmp(last->label,l)==0)
     {
      q=p->next;
      while(strcmp(q->label,l)!=0)
      {
       p=p->next;
       q=q->next;
      }
      p->next=NULL;
      last=p;
     }
    else
     {
      q=p->next;
      while(strcmp(q->label,l)!=0)
      {
       p=p->next;
       q=q->next;
      }
      p->next=q->next;
    }
    size--;
    printf("\n\tAfter Deletion:\n");
    Display();
   }
}
```

Sample Output:

```
SYMBOL TABLE IMPLEMENTATION

        1.INSERT
        2.DISPLAY
        3.DELETE
        4.SEARCH
        5.MODIFY
        6.END

        Enter your option : 1

        Enter the label : plus

        Enter the symbol : +

        Enter the address : 100

        Label inserted

        SYMBOL TABLE IMPLEMENTATION

        1.INSERT
        2.DISPLAY
        3.DELETE
        4.SEARCH
        5.MODIFY
        6.END
```

```
Enter your option : 2

LABEL          SYMBOL          ADDRESS
plus           +               100

SYMBOL TABLE IMPLEMENTATION

1.INSERT
2.DISPLAY
3.DELETE
4.SEARCH
5.MODIFY
6.END

Enter your option : 3

Enter the label to be deleted : plus

After Deletion:

LABEL          SYMBOL          ADDRESS

SYMBOL TABLE IMPLEMENTATION

1.INSERT
2.DISPLAY
3.DELETE
4.SEARCH
5.MODIFY
6.END

Enter your option : 2

LABEL          SYMBOL          ADDRESS

SYMBOL TABLE IMPLEMENTATION

1.INSERT
2.DISPLAY
3.DELETE
4.SEARCH
5.MODIFY
6.END

Enter your option : 1

Enter the label : minus
Enter the symbol : -

Enter the address : 200

Label inserted

SYMBOL TABLE IMPLEMENTATION

1.INSERT
2.DISPLAY
3.DELETE
4.SEARCH
5.MODIFY
6.END

Enter your option : 4

Enter the label to be searched : minus

Search Result:
The label is present in the symbol table

SYMBOL TABLE IMPLEMENTATION

1.INSERT
2.DISPLAY
3.DELETE
4.SEARCH
5.MODIFY
6.END

Enter your option : 5

What do you want to modify?

1.Only the label
2.Only the address
3.Both the label and address
Enter your choice : 1

Enter the old label : minus

Enter the new label : minus_new
```

```
After Modification:

LABEL          SYMBOL         ADDRESS
minus_new         -            200

SYMBOL TABLE IMPLEMENTATION

1.INSERT
2.DISPLAY
3.DELETE
4.SEARCH
5.MODIFY
6.END

Enter your option : 6
```

Experiment 10(a): Implement a C program to eliminate left recursion from a given CFG.

Aim: Implement a C program to eliminate left recursion from a given CFG.

Algorithm:

1. Start the program.
2. Define the structure of the CFG.
3. Left recursion is eliminated by converting the grammar into a right recursive grammar.
4. If we have the left-recursive pair of productions-

   A → Aα / β (Left Recursive Grammar)

   where β does not begin with an A.
5. Then, we can eliminate left recursion by replacing the pair of productions with-

   A → βA'

   A' → αA' / ∈ (Right Recursive Grammar)
6. This right recursive grammar functions same as left recursive grammar.
7. Stop

Program:

```
#include<stdio.h>
#include<string.h>
#define SIZE 10
 int main () {
     char non_terminal;
     char beta,alpha;
     int num;
     char production[10][SIZE];
     int index=3; /* starting of the string following "->" */
     printf("Enter Number of Production : ");
     scanf("%d",&num);
     printf("Enter the grammar as E->E-A :\n");
     for(int i=0;i<num;i++){
         scanf("%s",production[i]);
     }
     for(int i=0;i<num;i++){
         printf("\nGRAMMAR : : : %s",production[i]);
         non_terminal=production[i][0];
         if(non_terminal==production[i][index]) {
             alpha=production[i][index+1];
             printf(" is left recursive.\n");
             while(production[i][index]!=0 && production[i][index]!='|')
                 index++;
```

```
            if(production[i][index]!=0) {
                beta=production[i][index+1];
                printf("Grammar without left recursion:\n");
                printf("%c->%c%c\'",non_terminal,beta,non_terminal);
                printf("\n%c\'->%c%c\'|E\n",non_terminal,alpha,non_terminal);
            }
            else
                printf(" can't be reduced\n");
        }
        else
            printf(" is not left recursive.\n");
        index=3;
    }
}
```

Sample Output:

```
Enter Number of Production : 4
Enter the grammar as E->E-A :
E->EA|A
A->AT|a
T->a
E->i

GRAMMAR : : : E->EA|A is left recursive.
Grammar without left recursion:
E->AE'
E'->AE'|E

GRAMMAR : : : A->AT|a is left recursive.
Grammar without left recursion:
A->aA'
A'->TA'|E

GRAMMAR : : : T->a is not left recursive.

GRAMMAR : : : E->i is not left recursive.
```

Experiment 10(b): Implement a C program to eliminate left factoring from a given CFG.

Aim: Implement a C program to eliminate left factoring from a given CFG.

Algorithm:

1. Start the program.
2. Define the structure of the CFG.
3. Make one production for each common prefixes.
4. The common prefix may be a terminal or a non-terminal or a combination of both.
5. Rest of the derivation is added by new productions.
6. Stop

Program:

```
#include<stdio.h>
#include<string.h>
  int main()
  {
     char gram[20],part1[20],part2[20],modifiedGram[20],newGram[20],tempGram[20];
     int i,j=0,k=0,l=0,pos;
     printf("Enter Production : A->");
     gets(gram);
     for(i=0;gram[i]!='|';i++,j++)
         part1[j]=gram[i];
     part1[j]='\0';
     for(j=++i,i=0;gram[j]!='\0';j++,i++)
         part2[i]=gram[j];
     part2[i]='\0';
     for(i=0;i<strlen(part1)||i<strlen(part2);i++)
     {
         if(part1[i]==part2[i])
         {
             modifiedGram[k]=part1[i];
             k++;
             pos=i+1;
         }
     }
     for(i=pos,j=0;part1[i]!='\0';i++,j++){
         newGram[j]=part1[i];
     }
     newGram[j++]='|';
     for(i=pos;part2[i]!='\0';i++,j++){
         newGram[j]=part2[i];
     }
     modifiedGram[k]='X';
     modifiedGram[++k]='\0';
```

```
    newGram[j]='\0';
    printf("\n A->%s",modifiedGram);
    printf("\n X->%s\n",newGram);
}
```

Sample Output:

```
Enter Production : A->abCDE|abCFG

 A->abCX
 X->DE|FG
```

Experiment 11(a): Write a C program to find FIRST set for predictive parser.

Aim: Implement a C program to find FIRST set for predictive parser.

Algorithm:

1. Start
2. First(α) is a set of terminal symbols that begin in strings derived from α
3. Rules for Calculating First Function
   Rule-01: For a production rule X → ∈, First(X) = { ∈ }
   Rule-02: For any terminal symbol 'a', First(a) = { a }
   Rule-03: For a production rule X → Y1Y2Y3.
   (a) For calculating First(X), If ∈ ∉ First(Y1), then First(X) = First(Y1) If ∈ ∈ First(Y1), then First(X) = { First(Y1) − ∈ } ∪ First(Y2Y3).
   (b) Calculating First(Y2Y3) If ∈ ∉ First(Y2), then First(Y2Y3) = First(Y2) If ∈ ∈ First(Y2), then First(Y2Y3) = { First(Y2) − ∈ } ∪ First(Y3) Similarly, we can make expansion for any production rule X → Y1Y2Y3…..Yn.
4. Stop

Program:
```
#include<stdio.h>
#include<ctype.h>
void FIRST(char[],char );
void addToResultSet(char[],char);
int numOfProductions;
char productionSet[10][10];
int main()
{
   int i;
   char choice;
   char c;
   char result[20];
   printf("How many number of productions ? :");
   scanf(" %d",&numOfProductions);
   for(i=0;i<numOfProductions;i++)//read production string eg: E=E+T
   {
      printf("Enter productions Number %d : ",i+1);
      scanf(" %s",productionSet[i]);
   }
   do
   {
      printf("\n Find the FIRST of  :");
      scanf(" %c",&c);
      FIRST(result,c); //Compute FIRST; Get Answer in 'result' array
      printf("\n FIRST(%c)= { ",c);
      for(i=0;result[i]!='\0';i++)
      printf(" %c ",result[i]);       //Display result
      printf("}\n");
```

```
         printf("press 'y' to continue : ");
        scanf(" %c",&choice);
    }
    while(choice=='y'||choice =='Y');
}
/*
 *Function FIRST:
 *Compute the elements in FIRST(c) and write them
 *in Result Array.
 */
void FIRST(char* Result,char c)
{
    int i,j,k;
    char subResult[20];
    int foundEpsilon;
    subResult[0]='\0';
    Result[0]='\0';
    //If X is terminal, FIRST(X) = {X}.
    if(!(isupper(c)))
    {
        addToResultSet(Result,c);
              return ;
    }
    //If X is non terminal
    //Read each production
    for(i=0;i<numOfProductions;i++)
    {
//Find production with X as LHS
        if(productionSet[i][0]==c)
        {
//If X → ε is a production, then add ε to FIRST(X).
 if(productionSet[i][2]=='$') addToResultSet(Result,'$');
            //If X is a non-terminal, and X → Y1 Y2 … Yk
            //is a production, then add a to FIRST(X)
            //if for some i, a is in FIRST(Yi),
            //and ε is in all of FIRST(Y1), …, FIRST(Yi-1).
      else
            {
               j=2;
               while(productionSet[i][j]!='\0')
               {
               foundEpsilon=0;
               FIRST(subResult,productionSet[i][j]);
               for(k=0;subResult[k]!='\0';k++)
                   addToResultSet(Result,subResult[k]);
                for(k=0;subResult[k]!='\0';k++)
                    if(subResult[k]=='$')
                    {
                        foundEpsilon=1;
                        break;
                     }
                //No ε found, no need to check next element
                if(!foundEpsilon)
                   break;
                j++;
                }
            }
    }
}
    return ;
}
/* addToResultSet adds the computed
 *element to result set.
 *This code avoids multiple inclusion of elements
  */
void addToResultSet(char Result[],char val)
{
    int k;
    for(k=0 ;Result[k]!='\0';k++)
        if(Result[k]==val)
            return;
    Result[k]=val;
    Result[k+1]='\0';
}
```

<u>Sample Output:</u>

```
How many number of productions ? :8
Enter productions Number 1 : E=TD
Enter productions Number 2 : D=+TD
Enter productions Number 3 : D=$
Enter productions Number 4 : T=FS
Enter productions Number 5 : S=*FS
Enter productions Number 6 : S=$
Enter productions Number 7 : F=(E)
Enter productions Number 8 : F=a

 Find the FIRST of  :E
 FIRST(E)= {  (  a }
press 'y' to continue : y

 Find the FIRST of  :D
 FIRST(D)= {  +  $ }
press 'y' to continue : y

 Find the FIRST of  :T
 FIRST(T)= {  (  a }
press 'y' to continue : n
```

Experiment 11(b): Write a C program to find FOLLOW set for predictive parser.

Aim: Implement a C program to find FOLLOW set for predictive parser.

Algorithm:

1. Start the program
2. Follow(α) is a set of terminal symbols that appear immediately to the right of α. Rules. For Calculating Follow Function
3. Rule-01: For the start symbol S, place $ in Follow(S).
4. Rule-02: For any production rule A → αB, Follow(B) = Follow(A)
5. Rule-03: For any production rule A → αBβ, If ∈ ∉ First(β), then Follow(B) = First(β). If ∈ ∈ First(β), then Follow(B) = { First(β) – ∈ } ∪ Follow(A).
6. Stop the program

Program:

```
#include<stdio.h>
#include<ctype.h>
#include<string.h>
int limit, x = 0;
char production[10][10], array[10];

void find_first(char ch);
void find_follow(char ch);
void Array_Manipulation(char ch);

int main()
{
    int count;
    char option, ch;
    printf("\nEnter Total Number of Productions:\t");
    scanf("%d", &limit);
    for(count = 0; count < limit; count++)
    {
        printf("\nValue of Production Number [%d]:\t", count + 1);
        scanf("%s", production[count]);
    }
    do
    {
        x = 0;
        printf("\nEnter production Value to Find Follow:\t");
        scanf(" %c", &ch);
        find_follow(ch);
        printf("\nFollow Value of %c:\t{ ", ch);
        for(count = 0; count < x; count++)
        {
            printf("%c ", array[count]);
        }
        printf("}\n");
        printf("To Continue, Press Y:\t");
        scanf(" %c", &option);
    }while(option == 'y' || option == 'Y');
    return 0;
}

void find_follow(char ch)
{
    int i, j;
    int length = strlen(production[i]);
    if(production[0][0] == ch)
    {
        Array_Manipulation('$');
    }
    for(i = 0; i < limit; i++)
    {
        for(j = 2; j < length; j++)
        {
            if(production[i][j] == ch)
            {
                if(production[i][j + 1] != '\0')
                {
                    find_first(production[i][j + 1]);
                }
                if(production[i][j + 1] == '\0' && ch != production[i][0])
                {
                    find_follow(production[i][0]);
                }
            }
        }
    }
}

void find_first(char ch)
{
    int i, k;
    if(!(isupper(ch)))
    {
        Array_Manipulation(ch);
    }
    for(k = 0; k < limit; k++)
    {
        if(production[k][0] == ch)
        {
            if(production[k][2] == '$')
            {
                find_follow(production[i][0]);
            }
            else if(islower(production[k][2]))
            {
                Array_Manipulation(production[k][2]);
            }
            else
            {
                find_first(production[k][2]);
            }
        }
    }
}

void Array_Manipulation(char ch)
{
    int count;
    for(count = 0; count <= x; count++)
    {
        if(array[count] == ch)
        {
            return;
        }
    }
    array[x++] = ch;
}
```

Sample Output:

```
Enter Total Number of Productions:      8

Value of Production Number [1]: E=TD

Value of Production Number [2]: D=+TD

Value of Production Number [3]: D=$

Value of Production Number [4]: T=FS

Value of Production Number [5]: S=*FS

Value of Production Number [6]: S=$

Value of Production Number [7]: F=(E)

Value of Production Number [8]: F=a
```

```
Enter production Value to Find Follow:  E

Follow Value of E:      { $ ) }
To Continue, Press Y:   y

Enter production Value to Find Follow:  D

Follow Value of D:      { ) }
To Continue, Press Y:   n
```

Experiment 12: Write a C program for constructing of LL (1) parsing.

Aim: Implement a C program to construct LL (1) parsing.

Algorithm:

1. Start the program
2. For constructing of LL(1) parsing for the given grammar.
   b->tb
   t->cf
   f->i
   i->@
   c->f|@
   b->+tb
   f->id
   t->*ft
3. First check for left recursion in the grammar, if there is left recursion in the grammar remove that and go to step 4.
4. Calculate First() and Follow() for all non-terminals.
   i. First(): If there is a variable, and from that variable, if we try to drive all the strings then the beginning Terminal Symbol is called the First.
   ii. Follow(): What is the Terminal Symbol which follows a variable in the process of derivation.
5. For each production A –> α. (A tends to alpha)
   i. Find First(α) and for each terminal in First(α), make entry A –> α in the table.
   ii. If First(α) contains ε (epsilon) as terminal than, find the Follow(A) and for each terminal in Follow(A), make entry A –> α in the table.
   iii. If the First(α) contains ε and Follow(A) contains $ as terminal, then make entry A –> α in the table for the $.
6. Stop the program

Program:

```
#include<stdio.h>
#include<conio.h>
#include<string.h>
char s[20],stack[20];
int main()
{
   char m[5][6][3]={"tb"," "," ","tb"," "," "," ","+tb"," "," ","n","n","fc"," "," ","fc"," "," ","
","n","*fc"," a ","n","n","i"," "," ","(e)"," "," "};
   int size[5][6]={2,0,0,2,0,0,0,3,0,0,1,1,2,0,0,2,0,0,0,1,3,0,1,1,1,0,0,3,0,0};
   int i,j,k,n,str1,str2;
  // clrscr();
   printf("\n Enter the input string: ");
   scanf("%s",s);
   strcat(s,"$");
   n=strlen(s);
   stack[0]='$';
   stack[1]='e';
```

```
i=1;
j=0;
printf("\nStack Input\n");
printf("__________________\n");
while((stack[i]!='$')&&(s[j]!='$'))
{
   if(stack[i]==s[j])
   {
      i--;
      j++;
   }
   switch(stack[i])
   {
      case 'e':
      str1=0;
      break;
      case 'b':
      str1=1;
      break;
      case 't':
      str1=2;
      break;
      case 'c':
      str1=3;
      break;
      case 'f':
      str1=4;
      break;

   }
   switch(s[j])
   { case 'i':
   str2=0;
   break;
   case '+':
   str2=1;
   break;
   case '*': str2=2;
   break;
   case '(': str2=3;
   break;
   case ')': str2=4;
   break;
   case '$': str2=5;
   break;

   }
   if(m[str1][str2][0]=='\0')
```

```
        {
           printf("\nERROR");
           exit(0);

        }
        else if(m[str1][str2][0]=='n')
        i--;
        else if(m[str1][str2][0]=='i')
        stack[i]='i';
        else
        {
           for(k=size[str1][str2]-1;k>=0;k--)
           {
              stack[i]=m[str1][str2][k];
              i++;

           }
           i--;

        }
        for(k=0;k<=i;k++)
        printf(" %c",stack[k]);
        printf(" ");
        for(k=j;k<=n;k++)
        printf("%c",s[k]);
        printf(" \n ");

     }
     printf("\n SUCCESS");
     getch();
    }
```

<u>Sample Output:</u>

```
    Enter the input string: i*i+i

    Stack Input
    __________________
     $ b t                  i*i+i$
      $ b c f               i*i+i$
      $ b c i               i*i+i$
      $ b c f *             *i+i$
      $ b c i               i+i$
      $ b                   +i$
      $ b t +               +i$
      $ b c f                i$
      $ b c i               i$
      $ b $
 SUCCESS
```

Experiment 13: Write a C program to construct recursive descent parsing.

Aim: Implement a C program to construct recursive descent parsing.

Algorithm:

1. Write procedures for the non-terminals.
   Consider the grammar for arithmetic expressions
   E → E+T | T T → T*F | F F → (E) | id
   After eliminating the left-recursion the grammar becomes,
   E → TE’
   E’ → +TE’ | ε
   T → FT’
   T’ → *FT’ | ε
   F → (E) | id

Recursive procedure:

```
Procedure E()
begin T( );
EPRIME( );
End

Procedure EPRIME( )
begin
If input_symbol='+' then
ADVANCE( ); T( );
EPRIME( );
end

Procedure T( )
begin F( );
TPRIME( );
End Procedure

TPRIME( )
begin
If input_symbol='*' then
ADVANCE( ); F( );
TPRIME( );
End

Procedure F( )
begin
If input-symbol='id' then
ADVANCE( );
else if input-symbol='(' then
ADVANCE( ); E( );
else if input-symbol=')' then
```

```
    ADVANCE( );
    end
    else ERROR( );
```

2. Read the input string.
3. Verify the next token equals to non-terminals if it satisfies match for the non-terminal.
4. If the input string does not match print error.

Program:

```
#include<stdio.h>
#include<conio.h>
#include<string.h>
char input[100];
int i,l;
void main()
{
//clrscr();
printf("\nRecursive descent parsing for the following grammar\n");
printf("\nE->TE'\nE'->+TE'/@\nT->FT'\nT'->*FT'/@\nF->(E)/ID\n");
printf("\nEnter the string to be checked:");
gets(input);
if(E())
{
if(input[i+1]=='\0')
printf("\nString is accepted");
else
printf("\nString is not accepted");
}
else
printf("\nString not accepted");
getch();
}
E()
{
if(T())
{
if(EP())
return(1);
else
return(0);
}
else
return(0);
}
EP()
{
if(input[i]=='+')
{
```

```
i++;
if(T())
{
if(EP())
return(1);
else
return(0);
}
else
return(0);
}
else
return(1);
}
T()
{
if(F())
{
if(TP())
return(1);
else
return(0);
}
else
return(0);
}
TP()
{
if(input[i]=='*')
{
i++;
if(F())
{
if(TP())
return(1);
else
return(0);
}
else
return(0);
}
else
return(1);
}
F()
{
if(input[i]=='(')
{
```

```
i++;
if(E())
{
if(input[i]==')')
{
i++;
return(1);
}
else
return(0);
}
else
return(0);
}
else if(input[i]>='a'&&input[i]<='z'||input[i]>='A'&&input[i]<='Z')
{
i++;
return(1);
}
else
return(0);
}
```

Sample Output:

```
Recursive descent parsing for the following grammar

E->TE'
E'->+TE'/@
T->FT'
T'->*FT'/@
F->(E)/ID

Enter the string to be checked: (a+b)*c

String is accepted

Enter the string to be checked: a/c+d

String is not accepted
```

Experiment 14: Write a C program for stack implementation of Shift Reduce parser.

Aim: Implement a C program for stack implementation of Shift Reduce parser.

Algorithm:

1. Start the program
2. Get the input expression and store it in the input buffer.
3. Read the data from the input buffer one at the time.
4. Using stack and push & pop operation shift and reduce symbols with respect to production rules available.
5. Continue the process till symbol shift and production rule reduce reaches the start symbol.
6. Display the Stack Implementation table with corresponding Stack actions with input symbols.
7. Stop

Program:

```
#include<stdio.h>
#include<stdlib.h>
#include<conio.h>
#include<string.h>
char ip_sym[15],stack[15];
int ip_ptr=0,st_ptr=0,len,i;
char temp[2],temp2[2];
char act[15];
void check();
int main()
{
//clrscr();
printf("\n\t\t SHIFT REDUCE PARSER\n");
printf("\n GRAMMER\n");
printf("\n E->E+E\n E->E/E");
printf("\n E->E*E\n E->a/b");
printf("\n enter the input symbol:\t");
gets(ip_sym);
printf("\n\t stack implementation table");
printf("\n stack \t\t input symbol\t\t action");
printf("\n________\t\t____________\t\t____________\n");
printf("\n $\t\t%s$\t\t\t--",ip_sym);
strcpy(act,"shift ");
temp[0]=ip_sym[ip_ptr];
temp[1]='\0';
strcat(act,temp);
len=strlen(ip_sym);
for(i=0;i<=len-1;i++)
{
stack[st_ptr]=ip_sym[ip_ptr];
stack[st_ptr+1]='\0';
ip_sym[ip_ptr]=' ';
ip_ptr++;
printf("\n $%s\t\t%s$\t\t\t%s",stack,ip_sym,act);
strcpy(act,"shift");
temp[0]=ip_sym[ip_ptr];
temp[1]='\0';
strcat(act,temp);
check();
st_ptr++;
}
st_ptr++;
check();
}
void check()
{
int flag=0;
temp2[0]=stack[st_ptr];
temp2[1]='\0';
if((!strcmpi(temp2,"a"))||(!strcmpi(temp2,"b")))
{
stack[st_ptr]='E';
if(!strcmpi(temp2,"a"))
printf("\n $%s\t\t%s$\t\t\tE->a",stack,ip_sym);
else
printf("\n $%s\t\t%s$\t\t\tE->b",stack,ip_sym);
flag=1;
}
if((!strcmpi(temp2,"+"))||(strcmpi(temp2,"*"))||(!strcmpi(temp2,"/")))
{
flag=1;
}
if((!strcmpi(stack,"E+E"))||(!strcmpi(stack,"E\E"))||(!strcmpi(stack,"E*E")))
{
strcpy(stack,"E");
st_ptr=0;
if(!strcmpi(stack,"E+E"))
printf("\n $%s\t\t%s$\t\t\tE->E+E",stack,ip_sym);
else
if(!strcmpi(stack,"E\E"))
printf("\n $%s\t\t%s$\t\t\tE->E\E",stack,ip_sym);
else
if(!strcmpi(stack,"E*E"))
printf("\n $%s\t\t%s$\t\t\tE->E*E",stack,ip_sym);
else
printf("\n $%s\t\t%s$\t\t\tE->E+E",stack,ip_sym);
flag=1;
}
```

```
if(!strcmpi(stack,"E")&&ip_ptr==len)
{
printf("\n $%s\t\t%s$\t\t\tACCEPT",stack,ip_sym);
getch();
exit(0);
}
if(flag==0)
{
printf("\n%s\t\t\t%s\t\t reject",stack,ip_sym);
exit(0);
}
return;
}
```

Sample Output:

```
               SHIFT REDUCE PARSER

 GRAMMER
 E->E+E
 E->E/E
 E->E*E
 E->a/b
 enter the input symbol:        a+b

        stack implementation table
 stack          input symbol          action
______        _____________        _____________
 $                 a+b$                --
 $a                +b$               shift a
 $E                +b$               E->a
 $E+                b$              shift +
 $E+b               $               shift b
 $E+E              $                E->b
 $E                $                E->E+E
 $E                $                ACCEPT
```

Experiment 15: Write a C program to implement operator precedence parsing.

Aim: Implement a C program for operator precedence parsing.

Algorithm:

1. Start the program
2. Read the arithmetic input string.
3. Verify the precedence between terminals and symbols
4. Find the handle enclosed in < . > and reduce it to production symbol.
5. Repeat the process till we reach the start node.
6. Stop

Program:

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

char *input;
int i=0;
char lasthandle[6],stack[50],handles[][5]={")E(","E*E","E+E","i","E^E"};
//(E) becomes )E( when pushed to stack

int top=0,l;
char prec[9][9]={

                    /*input*/

        /*stack   +   -   *   /   ^   i   (   )   $  */

        /*  + */  '>', '>','<','<','<','<','<','>','>',

        /*  - */  '>', '>','<','<','<','<','<','>','>',

        /*  * */  '>', '>','>','>','<','<','<','>','>',

        /*  / */  '>', '>','>','>','<','<','<','>','>',

        /*  ^ */  '>', '>','>','>','<','<','<','>','>',

        /*  i */  '>', '>','>','>','>','e','e','>','>',

        /*  ( */  '<', '<','<','<','<','<','<','>','e',

        /*  ) */  '>', '>','>','>','>','e','e','>','>',

        /*  $ */  '<', '<','<','<','<','<','<','<','>',
            };

int getindex(char c)
{
switch(c)
  {
  case '+':return 0;
  case '-':return 1;
  case '*':return 2;
  case '/':return 3;
  case '^':return 4;
  case 'i':return 5;
  case '(':return 6;
  case ')':return 7;
  case '$':return 8;
  }
}


int shift()
{
stack[++top]=*(input+i++);
stack[top+1]='\0';
}


int reduce()
{
int i,len,found,t;
for(i=0;i<5;i++)//selecting handles
  {
  len=strlen(handles[i]);
  if(stack[top]==handles[i][0]&&top+1>=len)
    {
    found=1;
    for(t=0;t<len;t++)
      {
      if(stack[top-t]!=handles[i][t])
        {
        found=0;
        break;
        }
      }
    if(found==1)
      {
      stack[top-t+1]='E';
      top=top-t+1;
      strcpy(lasthandle,handles[i]);
```

```
            stack[top+1]='\0';
            return 1;//successful reduction
            }
        }
    }
return 0;
}


void dispstack()
{
int j;
for(j=0;j<=top;j++)
    printf("%c",stack[j]);
}


void dispinput()
{
int j;
for(j=i;j<l;j++)
    printf("%c",*(input+j));
}

void main()
{
int j;

input=(char*)malloc(50*sizeof(char));
printf("\nEnter the string\n");
scanf("%s",input);
input=strcat(input,"$");
l=strlen(input);
strcpy(stack,"$");
printf("\nSTACK\tINPUT\tACTION");
while(i<=l)
  {
  shift();
  printf("\n");
  dispstack();
  printf("\t");
  dispinput();
  printf("\tShift");
  if(prec[getindex(stack[top])][getindex(input[i])]=='>')
             {
             while(reduce())
                       {
                       printf("\n");
```

```
                        dispstack();
                        printf("\t");
                        dispinput();
                        printf("\tReduced: E->%s",lasthandle);
                        }
                }
        }

        if(strcmp(stack,"$E$")==0)
           printf("\nAccepted;");
        else
           printf("\nNot Accepted;");
        }
```

Sample Output:

```
Enter the string
i*(i+i)*i

STACK           INPUT           ACTION
$i              *(i+i)*i$       Shift
$E              *(i+i)*i$       Reduced: E->i
$E*             (i+i)*i$        Shift
$E*(            i+i)*i$         Shift
$E*(i           +i)*i$          Shift
$E*(E           +i)*i$          Reduced: E->i
$E*(E+          i)*i$           Shift
$E*(E+i         )*i$            Shift
$E*(E+E         )*i$            Reduced: E->i
$E*(E           )*i$            Reduced: E->E+E
$E*(E)          *i$             Shift
$E*E            *i$             Reduced: E->)E(
$E              *i$             Reduced: E->E*E
$E*             i$              Shift
$E*i            $               Shift
$E*E            $               Reduced: E->i
$E              $               Reduced: E->E*E
$E$             Shift
$E$             Shift
Accepted;
```

Experiment 16: Create YACC (or BISON) and LEX specification files to implement a basic calculator which accepts variables and constants of integer and float type.

Aim: Design a lexical analyzer and parser using Lex/Flex and YACC/Bison for a basic calculator.

Algorithm:

1. Get the input from the user and parse it token by token.
2. First identify the valid inputs that can be given for a program.
3. The inputs include numbers, variables and operators.
4. Define the precedence and the associativity of various operators like +,-,/,* etc.
5. Write codes for saving the answer into memory and displaying the result on the screen.
6. Write codes for performing various arithmetic operations.
7. Display the possible Error message that can be associated with this calculation.
8. Display the output on the screen else display the error message on the screen.

Program:

calc.l (flex source program)

```
%{
    #include <stdlib.h>
    void yyerror(char *);
    #include "calc.tab.h"
%}
%%
    /* variables */
[a-z] {
    yylval = *yytext - 'a';
    return VARIABLE;
    }
    /* integers */
[0-9]+ {
    yylval = atoi(yytext);
    return INTEGER;
    }
    /* operators */
```

```
[-+()=/*\n]           { return *yytext; }
    /* skip whitespace */
[ \t]          ;
    /* anything else is an error */
. yyerror("invalid character");
%%
int yywrap(void) {
return 1;
}
```

calc.y (bison source program)

```
%token INTEGER VARIABLE
%left '+' '-'
%left '*' '/'
%{
    #include <stdio.h>
    void yyerror(char *);
    int yylex(void);
    int sym[26];
%}
%%
program:
              program statement '\n'
              |
              ;
statement:
                        expr { printf("%d\n", $1); }
                        | VARIABLE '=' expr { sym[$1] = $3; }
                        ;
expr:
              INTEGER
              | VARIABLE { $$ = sym[$1]; }
              | expr '+' expr { $$ = $1 + $3; }
              | expr '-' expr { $$ = $1 - $3; }
              | expr '*' expr { $$ = $1 * $3; }
              | expr '/' expr { $$ = $1 / $3; }
              | '(' expr ')' { $$ = $2; }
              ;
%%
```

```
void yyerror(char *s) {
fprintf(stderr, "%s\n", s);
}

int main(void) {
yyparse();
return 1;
}
```

Sample Output:

```
G:\lex>flex calc.l

G:\lex>bison calc.y

G:\lex>gcc calc.tab.c lex.yy.c -o calc.exe

G:\lex>calc.exe
3*(5+6)
33
x = 3 * (4 + 5)
y = 5
x
27
y
5
x + 2*y
37

G:\lex>
```

Experiment 17: Implement a simple intermediate code generator in C program, which produces three address code statements for a given input expression.

Aim: Design a simple intermediate code generator in C program, which produces three address code statements.

Algorithm:

1. Begin the program.
2. The expression is read from the file using a file pointer.
3. Each string is read and the total no. of strings in the file is calculated.
4. Each string is compared with an operator, if any operator is seen then the previous string and next string are concatenated and stored in a first temporary value and the three address code expression is printed
5. Suppose if another operand is seen then the first temporary value is concatenated to the next string using the operator and the expression is printed.
6. The final temporary value is replaced to the left operand value.
7. End the program.

Program:

```
#include<stdio.h>
#include<conio.h>
#include<stdlib.h>
#include<string.h>
struct three
{
char data[10],temp[7];
}s[30];
int main()
{
char d1[7],d2[7]="t";
int i=0,j=1,len=0;
FILE *f1,*f2;
//clrscr();
f1=fopen("sum.txt","r");
f2=fopen("out.txt","w");
while(fscanf(f1,"%s",s[len].data)!=EOF)
len++;
itoa(j,d1,7);
strcat(d2,d1);
strcpy(s[j].temp,d2);
strcpy(d1,"");
strcpy(d2,"t");
if(!strcmp(s[3].data,"+"))
{
fprintf(f2,"%s=%s+%s",s[j].temp,s[i+2].data,s[i+4].data);
j++;
}
else if(!strcmp(s[3].data,"-"))
{
fprintf(f2,"%s=%s-%s",s[j].temp,s[i+2].data,s[i+4].data);
j++;
}
for(i=4;i<len-2;i+=2)
{
itoa(j,d1,7);
strcat(d2,d1);
strcpy(s[j].temp,d2);
if(!strcmp(s[i+1].data,"+"))
fprintf(f2,"\n%s=%s+%s",s[j].temp,s[j-1].temp,s[i+2].data);
else if(!strcmp(s[i+1].data,"-"))
fprintf(f2,"\n%s=%s-%s",s[j].temp,s[j-1].temp,s[i+2].data);
strcpy(d1,"");
strcpy(d2,"t");
j++;
}
fprintf(f2,"\n%s=%s",s[0].data,s[j-1].temp);
fclose(f1);
fclose(f2);
getch();
}
```

Sample Output:

Input: sum.txt

```
out = in1 + in2 + in3 - in4
```

Output: out.txt

```
t1=in1+in2
t2=t1+in3
t3=t2-in4
out=t3
```