

# **VISVESVARAYA TECHNOLOGICAL UNIVERSITY**

**“JnanaSangama”, Belgaum -590014, Karnataka.**



**LAB REPORT**

**On**

**COMPILER DESIGN**

**Submitted by**

**HARINI N (1BM21CS256)**

**in partial fulfillment for the award of the degree of**

**BACHELOR OF ENGINEERING**

**in**

**COMPUTER SCIENCE AND ENGINEERING**



**B.M.S. COLLEGE OF ENGINEERING**

**(Autonomous Institution under VTU)**

**BENGALURU-560019**

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Department of Computer Science and Engineering**

**CERTIFICATE**



This is to certify that the Lab work entitled “**COMPILER DESIGN**” carried out by **HARINI N(1BM21CS256)**, who is bonafide student of **B. M. S. College of Engineering**. It is in partial fulfillment for the award of **Bachelor of Engineering in Computer Science and Engineering** of the Visvesvaraya Technological University, Belgaum during the year 2023-24. The Lab report has been approved as it satisfies the academic requirements in respect of **Compiler Design Lab - (22CS5PCCPD )**work prescribed for the said degree.

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**DECLARATION**

I, Harini N (1BM21CS256), student of 5th Semester, B.E, Department of Computer Science and Engineering, B. M. S. College of Engineering, Bangalore, here by declare that, this lab report entitled " **Compiler Design**" has been carried out by me under the guidance of Prof. Prameetha Pai, Assistant Professor, Department of CSE, B. M. S. College of Engineering, Bangalore during the academic semester November-2023-February-2024.

I also declare that to the best of my knowledge and belief, the development reported here is not from part of any other report by any other students.

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**Course outcomes:**

CO1	Apply the fundamental concepts for the various phases of compiler design.
CO2	Analyse the syntax and semantic concepts of a compiler.
CO3	Design various types of parsers and Address code generation.
CO4	Implement compiler principles, methodologies using lex, yacc tools.

**1. Write a Lex program to find whether the given input character is valid or invalid.**

```
%option noyywrap

%{

#include<stdio.h>

%}

%%

[0-9]+ {printf("number:%s\n",yytext);}

[+-] {printf("operator:%s\n",yytext);}

[ \t\n] { /*ignore whitespaces and newline*/ }

[a-zA-Z]* {printf("invalid character:%s\n",yytext);}

%%

int main()

{

printf("Enter the input: ");

yylex();

return 0;

}
```

OUTPUT

```
Enter the input: xyz
invalid character:xyz
█
```

**2. Write a lex program to count number of characters in given input string.**

```
%{  
#include<stdio.h>  
  
int c=0;  
  
%}  
  
%%  
  
[a-zA-Z0-9]+ {c++;}  
  
\n {printf("The count is %d",c);}  
  
%%  
  
int yywrap()  
{  
}  
  
int main()  
{  
printf("Enter the sentence : ");  
yylex();  
return 0;  
}
```

OUTPUT

```
Enter the sentence : Have a good day  
The count is 4
```

**3. Write a Lex program to count number of vowels and consonants in a sentence.**

```
%{  
  
#include  
  
<stdio.h>  
  
int  
  
vow_cou  
  
nt = 0;  
  
int  
  
const_co  
  
unt = 0;  
  
%}  
  
  
%%  
  
[aeiouAE  
IOU] {  
    vow_cou  
    nt++; }  
  
[a-zA-Z]  
  
{  
    const_co  
    unt++; }  
  
\n  
{  
    printf("Vo  
wels  
count
```



```
is=%d,
```

```
Consona
```

```
nts count
```

```
is=%d\n",
```

```
vow_cou
```

```
nt,
```

```
const_co
```

```
unt); }
```

```
.
```

```
/* Ignore
```

```
any other
```

```
character
```

```
s */
```

```
%%
```

```
int main()
```

```
{
```

```
printf("En
```

```
ter the
```

```
string of
```

```
vowels
```

```
and
```

```
consona
```

```
nts: ");
```

```
yylex();
```

```
    return
```

```
0;
```

```
}
```

```
int
```

```
yywrap()
```

```
{
```

```
    return
```

```
1; /*
```

```
Indicate
```

```
that
```

```
we've
```

```
reached
```

```
the end
```

```
of input */
```

```
}OUTPUT
```


```
T
```

```
Enter the string of vowels and consonants: Good Morning  
Vowels count is=4, Consonants count is=7
```

**4. Write a lex program to check whether input is digit or not.**

```
%{  
#include<stdio.h>  
#include<stdlib.h>  
%}  
%%  
^[0-9]* printf("digit");  
^[^0-9][0-9]*[a-zA-Z] printf("not a digit");  
.;  
%%  
int yywrap()  
{  
}  
int main()  
{  
yylex();  
return 0;  
}
```

OUTPUT




```
7a  
not a digit  
7  
digit  
█
```

**5. Write a lex program to check whether the given number is even or odd.**

```
%{  
#include<stdio.h>  
  
int i;  
  
%}  
  
%%  
  
[0-9]+ {i=atoi(yytext);  
        if(i%2==0)  
            printf("Even");  
        else  
            printf("Odd");}  
  
%%  
  
int yywrap(){ }  
  
int main()  
{  
    yylex();  
    return 0;  
}
```

OUTPUT:



```
8  
Even  
31  
Odd  
|
```

**6. Write a lex program to check whether a number is Prime or not.**

```
%{  
  
    #include<stdio.h>  
  
    #include<stdlib.h>  
  
    int flag,c,j;  
%}  
  
%%  
  
[0-9]+ { c=atoi(yytext);  
        if(c==2)  
        {  
            printf("\n Prime number");  
        }  
        else if(c==0 || c==1)  
        {  
            printf("\n Not a Prime number");  
        }  
        else  
        {  
            for(j=2;j<c;j++)
```

```
        {
        if(c%j==0)

            flag=1;

        }

        if(flag==1)

            printf("\n Not a prime number");

        else if(flag==0)

            printf("\n Prime number");

        }

    }

%%
```

```
int yywrap()
```

```
{
}
```

```
int main()
```

```
{
    yylex();

    return 0;

}
```

OUTPUT

```
13
    Prime number
6
    Not a prime number

```

**7.i) Write a lex program to recognize a) identifier**

**b) keyword-int and float**

**c) anything else as invalid tokens**

% {

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

```
% }
```

```
alpha[a-zA-Z]
```

```
digit[0-9]
```

```
% %
```

```
(float|int) {printf("\nkeyword");}
```

```
{ alpha } ( { digit } | { alpha } ) * {printf("\nidentifier");}
```

```
{ digit } ( { digit } | { alpha } ) * {printf("\ninvalid token");}
```

```
% %
```

```
int yywrap()
```

```
{
```

```
}
```

```
int main()
```


```
{
```

```
yylex();
```

```
return 0;
```

```
}
```

**OUTPUT:**



```
int
keyword
var
identifier
8b
invalid token
```

7. ii) Write a lex program to identify a) identifiers

b) keyword-int and float

c) anything else as invalid tokens


**Read these from a text file.**

```
% {  
  
    #include <stdio.h>  
  
    char fname[25];  
  
% }  
  
alpha[a-zA-Z]  
digit[0-9]  
  
%%  
  
(float|int) { printf("\nkeyword");}  
  
{ alpha } ( { digit } | { alpha } ) * { printf("\nidentifier");}  
  
{ digit } ( { digit } | { alpha } ) * { printf("\ninvalid token");}  
  
%%  
  
int yywrap()  
  
}  
  
int main()  
  
{
```



```
printf("enter filename");  
scanf("%s",fname);  
yyin=fopen(fname,"r");  
yylex();  
return 0;  
fclose(yyin);  
}
```

#### OUTPUT



```
enter filenameinput.txt  
keyword  
identifier;
```

**8. Lex program to count the number of comment lines (multi line comments or single line) in a program. Read the input from a file called input.txt and print the count in a file called output.txt**

```
%{  
#include <stdio.h>  
  
int cc=0;  
  
%}  
  
%x CMNT  
  
%%  
  
"/" {BEGIN CMNT;}  
  
<CMNT>. ;
```

```

<CMNT>"/" {BEGIN 0; cc++;}

%%

int yywrap() { }

int main(int argc, char *argv[])

{

if(argc!=3)

{

printf("Usage : %s <scr_file> <dest_file>\n",argv[0]);

return 0;

}

yyin=fopen(argv[1],"r");

yyout=fopen(argv[2],"w");

yylex();


printf("\nNumber of multiline comments = %d\n",cc);

return 0;

}

```

## OUTPUT



```

Number of multiline comments = 2

```

**9. Write a program in LEX to recognize Floating Point Numbers. Check for all the following input cases**

```
%{  
  
#include<stdio.h>  
  
int cnt=0;  
  
%}  
  
sign [+|-]  
  
num [0-9]  
  
dot [.]  
  
%%  
  
{sign}?{num}*{dot}{num}* {printf("Floating point no.");cnt=1;}  
  
{sign}?{num}* {printf("Not Floating point no.");cnt=1;}  
  
%%  
  
int yywrap()  
  
{  
  
int main()  
{  
    yylex();  
  
    if(cnt==0){  
  
        printf("Not floating pnt no.");  
    }  
    return 0;  
  
}
```

**OUTPUT**

```
-67.5  
Floating point no.  
-93  
Not Floating point no.  
█
```

**10. Write a program to read and check if the user entered number is signed or unsigned using appropriate meta character**

```
%{  
  
#include<stdio.h>  
  
int cnt=0;  
  
%}  
  
sign [+|-]  
  
num [0-9]  
  
dot [.]  
  
%%  
  
{sign}{num}*{dot}*{num}* {printf("Signed no.");cnt=1;}  
  
{num}*{dot}*{num}* {printf("Unsigned no.");cnt=1;}  
  
%%  
  
int yywrap()  
  
{  
  
}  
  
int main()  
  
{  
  
yylex();  
  
if(cnt==0){  
  
printf("Not floating pnt no.");  
  
}  
  
return 0;  
  
}
```

## OUTPUT

```
+67
Signed no.
89
Unsigned no.

```

**11. Write a program to check if the input sentence ends with any of the following punctuation marks ( ? , fullstop , ! )**

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

int cnt=0;

%}

punc [?|,|.|!]

chars [a-z|A-Z|0-9|" "\t]

%%

{chars}*{punc} {printf("Sentence ends with punc");}

{chars}* {printf("Sentence does not end with punc");}

%%

int yywrap()

{

}

int main()

{
```

```
yylex();  
  
return 0;  
  
}
```

## OUTPUT

```
Hello  
Sentence does not end with punc  
Hello hi.  
Sentence ends with punc  
□
```

**12. a) Write a Lex program to find an article(a,an,the).**

```
%{  
  
#include<stdio.h>  
  
int cnt=0;  
  
%}  
  
chars [a-z|A-Z|0-9]  
  
check [A|a|AN|An|THE|The]  
  
%%  
  
{check}+{chars}* {printf("Begins with %s",yytext);} {chars}* {printf("Invalid");}  
  
%%  
  
int yywrap()  
  
{  
  
}  
  
int main()  
  
{  
  
yylex();  
  
return 0;
```

}

**12. b). Write a program in LEX to recognize different tokens: Keywords, Identifiers, Constants, Operators and Punctuations?**

```
%{  
  
#include<stdio.h>  
  
int cnt=0;  
  
%}  
  
letter [a-zA-Z]  
  
digit [0-9]  
  
punc [!|.|,]  
  
oper [ + | * | - | / | % ]  
  
boole [true|false]  
  
%%  
  
{digit}+|{digit}*.{digit}+ {printf("Constants");}  
  
int|float {printf("Keyword");}  
  
{letter}({digit}|{letter})* {printf("Identifiers");}  
  
{oper} {printf("Operator");}  
  
{punc} {printf("Punctuator");}
```

```
%%
```

```
int yywrap()
```

```
{
```

```
}
```

```
int main()
```

```
{
```

```
yylex();
```

```
return 0;
```

```
}
```

OUTPUT

```
a
Identifiers
25
Constants
int
Keyword
!
Punctuator
+
Operator
hello!
IdentifiersPunctuator
□
```



**12 c).Write a LEX program to recognize the following tokens over the alphabets{0,1,...,9}**

**a) The set of all string ending in 00.**

**b) The set of all strings with three consecutive 222's.**

**c) The set of all string such that every block of five consecutive symbols  
contains at least two 5's.**

```
% {  
  
#include<stdio.h>  
  
int flag=0,i;  
  
% }  
  
  
letter [a-zA-Z]  
  
digit [0-9]  
  
A [0-9]  
  
punc [!,|,|.]  
  
oper [+*|-|/|%]  
  
boole [true|false]  
  
%%  
  
{ digit }*00 {printf("Ending with 00");}  
  
{ digit }*222{ digit }* {printf("Consecutive 222");}  
  
{ A }{ A }{ A }{ A }{ A } {  
  
flag=0;  
  
for(i=0;i<yy leng;i++){  
  
if(yytext[i]=='5'){  
  
flag=flag+1;
```

```

    }

}

if(flag>=2){

printf("Success");

}

else{

printf("Failure");

}

}

%%

int yywrap()

{

}

int main()

{

yylex();

return 0;

}

```

OUTPUT

```

1200
Ending with 00
122233
Consecutive 222
12535
Success

```

**d) The set of all strings such that the 10th symbol from the right end is 1.**

```
d[0-9]

%{

/* d is for recognising digits */

int c1=0,c2=0,c3=0,c4=0,c5=0,c6=0,c7=0;

/* c1 to c7 are counters for rules a1 to a7 */

%}

%%

({d})*00 { c1++; printf("%s rule A\n",yytext);}

({d})222({d}) { c2++; printf("%s rule B\n",yytext);}

(1(0)(11|01)(01*01|00*10(0)(11|1))0)(1|10(0)(11|01)(01*01|00*10(0)(11|1))*10) {

c4++;

printf("%s rule D \n",yytext);

}

({d})*1{d}{9} {

c5++; printf("%s rule E \n",yytext);

}

({d})* {

int i,c=0;

if(yytext[5])

{

printf("%s doesn't match any rule\n",yytext);
```

```
}  
  
else  
  
{  
  
for(i=0;i<5;i++) { if(yytext[i]=='5') {  
  
c++; } }  
  
if(c>=2)  
  
{  
  
for(;i<yyleng;i++)  
  
{  
  
if(yytext[i-5]=='5') {  
  
c--; }  
  
if(yytext[i]=='5') { c++;  
  
}  
  
if(c<2) { printf("%s doesn't match any rule\n",yytext);  
  
break; }  
  
}  
  
if(yyleng==i)  
  
{  
  
printf("%s ruleC\n",yytext); c3++; }  
  
}  
  
else  
  
{  
  
printf("%s doesn't match any rule\n",yytext);
```

```

}

}

}

%%

int yywrap()

{

}

int main()

{

printf("Enter text\n");

yylex();

printf("Total number of tokens matching rules are : \n");

printf("Rule A : %d \n",c1);

printf("Rule B : %d \n",c2);

printf("Rule C : %d \n",c3);

printf("Rule D : %d \n",c4);

printf("Rule E : %d \n",c5);

return 0;

}

```

OUTPUT:

```

Enter text
1000
1000 rule A

122200
122200 rule A

12223
12223 rule B

1253533535
1253533535 rule E

12535
12535 ruleC

```

**13. Write a Program to design Lexical Analyzer in C/C++/Java/python language(to recognize any five keywords,identifiers,numbers,operators and punctuation)**

```
kwd=['int','float','char','if','else']

oper=['+','-','*','/','%']

punct=['.','(',')','!']

def func():

    txt=input("Enter text")

    txt=txt.split()

    for token in txt:

        if token in kwd:

            print(token + "is keyword")

        elif (token in oper):

            print(token + "is operator")

        elif(token in punct): print(token + "is punctuator")
        elif(token.isnumeric()): print(token + "is number")
        elif(not token[0].isnumeric()): print(token + "is identifier")
        else:
            print(token + "is not valid identifier") func()
```

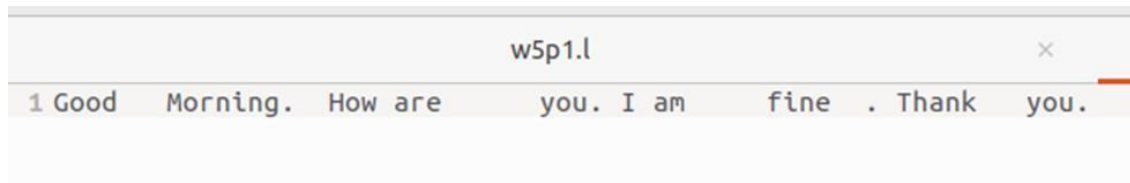
**OUTPUT**

```
Enter textHello int 123 . +
Hellois identifier
intis keyword
123is number
.is punctuator
+is operator
```

**14. Write a Lex Program that copies a file, replacing each nonempty sequence of whitespaces by a single blank.**

```
% {  
  
#include<stdio.h>  
  
% }  
  
%%  
[\\t" "]+ fprintf(yyout," ");  
.\\n fprintf(yyout,"%s",yytext);  
  
%%  
  
int yywrap()  
{  
return 1;  
}  
  
int main(void)  
{  
yyin=fopen("input1.txt","r");  
yyout=fopen("output.txt","w");  
yylex();  
return 0;  
}
```

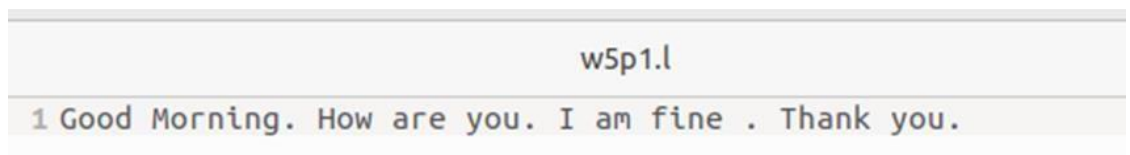
Input.txt



w5p1.l

1 Good Morning. How are you. I am fine . Thank you.

Output.txt



w5p1.l

1 GoodMorning. How areyou. I amfine . Thankyou.



**15 a) Design a suitable grammar for evaluation of arithmetic expression having + and – operators.**

**+ has least priority and it is left associative**

**- has higher priority and is right associative**

**lex**

```
%{  
  
#include "y.tab.h"  
  
%}  
  
%%  
  
[0-9]+ {yylval=atoi(yytext); return NUM;}  
  
[t]    ;  
  
\n     return 0;  
  
.      return yytext[0];  
  
%%  
  
int yywrap()  
  
{  
  
}
```

**yacc**

```
%{  
  
#include<stdio.h>  
  
%}  
  
%token NUM  
  
%left '+'  
  
%right '-'
```

```

%%

expr:e {printf("Valid Expression\n"); printf("Result: %d\n",$$); return 0;}

e:e'+e {$$=$1+$3;}

|e'-e {$$=$1-$3;}

| NUM      {$$=$1;}

;

%%

int main()

{

printf("\n Enter an arithmetic expression\n");

yyparse();

return 0;

}

int yyerror()

{

printf("\nInvalid expression\n");

return 0;

}

```

## OUTPUT

```

Enter an arithmetic expression
5-2+3-6
Valid Expression
Result: 0

```

**15 b) Design a suitable grammar for evaluation of arithmetic expression having + , - , \* , / , % , ^ operators.**

**^ having highest priority and right associative**

**% having second highest priority and left associative**

**\* , / have third highest priority and left associative**

**+ , - having least priority and left associative**

```
%{  
  
#include "y.tab.h"  
  
%}  
  
%%  
  
[0-9]+ {yylval=atoi(yytext); return NUM;}  
  
[t]    ;  
  
\n    return 0;  
  
.      return yytext[0];  
  
%%  
  
int yywrap()  
  
{  
  
}  
  
%{  
  
#include<stdio.h>  
  
%}  
  
%token NUM  
  
%left '+' '-'  
  
%left '*' '/' '%'
```

%right '^'

%%

expr: e { printf("Valid expression\n"); printf("Result: %d\n", \$\$); return 0; }

e: e '+' e { \$\$ = \$1 + \$3; }

| e '-' e { \$\$ = \$1 - \$3; }

| e '\*' e { \$\$ = \$1 \* \$3; }

| e '/' e { \$\$ = \$1 / \$3; }

| e '%' e { \$\$ = \$1 % \$3; }

| e '^' e {

int result = 1;

for (int i = 0; i < \$3; i++) {

result \*= \$1;

}

\$\$ = result;

}

| NUM { \$\$ = \$1; }

;

%%

int main()

{

printf("\nEnter an arithmetic expression:\n");

yyvsparse();

return 0;

```
}
```

```
int yyerror()
```

```
{
```

```
    printf("\nInvalid expression\n");
```

```
    return 0;
```

```
}
```

OUTPUT

```
Enter an arithmetic expression:
1+2*3%1^2
Valid expression
Result: 1
```

**16.a )Program to recognize the grammar (anb,  $n \geq 5$ ).**

Hint : $S \rightarrow aaaaaEb$

$E \rightarrow aE \mid \epsilon$

p2.l

```
%{ #include "y.tab.h" %}
```

```
%%
```

```
[aA] {return A;}
```

```
[bB] {return B;}
```

```
\n {return NL;}
```

```
. {return yytext[0];}
```

```
%%
```

```
int yywrap()
```

```
{
```

```
    return 1;
```

```
}
```

```
p2.y
```

```
%{
```

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

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

```
% }
```

```
%token A B NL
```

```
%%
```

```
stmt: A A A A A S B NL {printf("valid string\n"); exit(0);}
```

```
;
```

```
S: S A
```

```
| ;
```

```
%%
```

```
int yyerror(char *msg)
```

```
{
```

```
    printf("invalid string\n");
```

```
    exit(0);
```

```

}

main()

{

printf("enter the string\n");

yyparse();

}

```

OUTPUT:

```

enter the string
aaaaaab
valid string

```

**16 .b)Program to recognize strings ‘aaab’, ‘abbb’, ‘ab’ and ‘a’ using the grammar (anbn, n>= 0).**

**Hint :  $S \rightarrow aSb \mid \epsilon$**

P3.1

```
%{ #include "y.tab.h" %}
```

```
%%
```

```
[aA] {return A;}
```

```
[bB] {return B;}
```

```
\n {return NL;}
```

```
. {return yytext[0];}
```

```
%%
```

```
int yywrap() {
```

```
    return 1; }
```

P3.y

```
%{
```

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

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

```
% }
```

```
%token A B NL
```

```
%%
```

```
stmt: S NL {printf("valid string\n"); exit(0);}
```

```
;
```

```
S: A S B
```

```
| ;
```

```
%%
```

```
int yyerror(char *msg)
```

```
{
```

```
    printf("invalid string\n");
```

```
    exit(0);
```

```
}
```

```
main()
```

```
{
```

```
    printf("enter the string\n");
```

```
    yyparse();
```

```
}
```



OUTPUT

```
enter the string
abb
invalid string
```

**16 c) Write a YACC program to accept strings with exactly one a where  $\Sigma=\{a,b\}$**

P4.l

```
%{ #include "y.tab.h" %}
%%
[aA] {return A;}
[bB] {return B;}
\n {return NL;}
. {return yytext[0];}
%%
int yywrap() {
    return 1; }
```

P4.y

```
%{
#include<stdio.h>
#include<stdlib.h>
%}
%token A B NL
%%
stmt: S NL {printf("valid string\n"); exit(0);}
;
S: B S
| A X ;

X : B X |
;
%%
int yyerror(char *msg)
{
    printf("invalid string\n");
    exit(0);
}
main()
{
    printf("enter the string\n");
    yyparse();
}
```

OUTPUT

```
enter the string
aabb
invalid string
```

### 17. Recursive Descent Parsing with back tracking (Brute Force Method).

**S->cAd,A>ab/a**

```
#include <stdio.h>

int index = 0;

int parse_A(char input_str[]) {
    int current_index = index;
    if (input_str[index] == 'a') {
        index++;
        if (input_str[index] == 'b') {
            index++;
            return 1;
        } else {
            // Backtrack
            index = current_index;
            return 0;
        }
    } else if (input_str[index] == 'a') {
        index++;
        return 1;
    }
    return 0;
}
```

```
}
```

```
int parse_S(char input_str[]) {
```

```
    if (input_str[index] == 'c') {
```

```
        index++;
```

```
        if (parse_A(input_str)) {
```

```
            if (input_str[index] == 'd') {
```

```
                index++;
```

```
                return 1;
```

```
            }
```

```
        }
```

```
    }
```

```
    return 0;
```

```
}
```

```
void recursive_descent_parser(char input_str[]) {
```

```
    index = 0;
```

```
    if (parse_S(input_str) && input_str[index] == '\0') {
```

```
        printf("Parsing successful.\n");
```

```
    } else {
```

```
        printf("Parsing failed.\n");
```

```
    }
```

```
}
```

```

int main() {

    char input_string[] = "cabdc";

    recursive_descent_parser(input_string);


    return 0;

}

```

## OUTPUT

```

main.c:12:5: warning: built-in function 'index' declared as non-function [-Wbuiltin-declaration-mismatch]
   12 | int index = 0;
      |     ^~~~~
Parsing failed.

```

```

main.c:12:5: warning: built-in function 'index' declared as non-function [-Wbuiltin-declaration-mismatch]
   12 | int index = 0;
      |     ^~~~~
Parsing successful.

```

## 18. Write a Yacc program to generate syntax tree for a given arithmetic expression

### **p1.l**

```

%{
#include "y.tab.h"
extern int yylval;
%}
%%
[0-9]+ { yylval=atoi(yytext); return digit; }
[\t] ;
[\n] return 0;
. return yytext[0];
%%
int yywrap()

```

```
{  
}
```

### **p1.y**

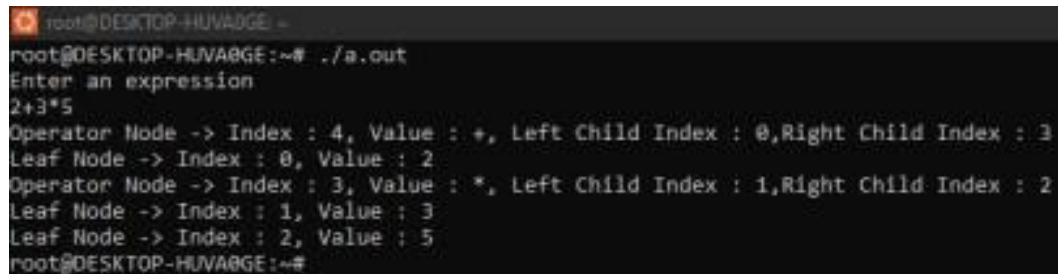
```
%{  
#include <math.h>  
#include <ctype.h>  
#include <stdio.h>  
#include <stdlib.h>  
#include <string.h>  
struct tree_node  
{  
char val[10];  
int lc;  
int rc;  
};  
int ind;  
struct tree_node syn_tree[100];  
void my_print_tree(int cur_ind);  
int mknode(int lc,int rc,char val[10]);  
%}  
%token digit  
%%  
S:E { my_print_tree($1); }  
;  
E:E'+'T { $$= mknode($1,$3,"+"); ; }  
|T { $$=$1; }  
;  
T:T'*'F { $$= mknode($1,$3,"*"); ; }  
|F { $$=$1 ; }  
;  
F:('E') { $$=$2; }  
|digit { char buf[10]; sprintf(buf,"%d", yylval); $$ = mknode(-1,-1,buf);}  
%%  
int main()  
{  
ind=0;  
printf("Enter an expression\n");  
yyparse();  
return 0;  
}  
int yyerror()  
{  
printf("NITW Error\n");  
}
```

```

int mknode(int lc,int rc,char val[10])
{
    strcpy(syn_tree[ind].val,val);
    syn_tree[ind].lc = lc;
    syn_tree[ind].rc = rc;
    ind++;
    return ind-1;
}
/*my_print_tree function to print the syntax tree in DLR fashion*/
void my_print_tree(int cur_ind)
{
    if(cur_ind==-1) return;
    if(syn_tree[cur_ind].lc==-1&&syn_tree[cur_ind].rc==-1)
        printf("Digit Node -> Index : %d, Value : %s\n",cur_ind,syn_tree[cur_ind].val); else
        printf("Operator Node -> Index : %d, Value : %s, Left Child Index : %d,Right Child Index : %d \n",cur_ind,syn_tree[cur_ind].val, syn_tree[cur_ind].lc,syn_tree[cur_ind].rc); my_print_tree(syn_tree[cur_ind].lc); my_print_tree(syn_tree[cur_ind].rc);
}

```

## OUTPUT



```

root@DESKTOP-HUVA0GE: ~
root@DESKTOP-HUVA0GE:~# ./a.out
Enter an expression
2+3*5
Operator Node -> Index : 4, Value : +, Left Child Index : 0,Right Child Index : 3
Leaf Node -> Index : 0, Value : 2
Operator Node -> Index : 3, Value : *, Left Child Index : 1,Right Child Index : 2
Leaf Node -> Index : 1, Value : 3
Leaf Node -> Index : 2, Value : 5
root@DESKTOP-HUVA0GE:~#

```

**19. Use YACC to convert: Infix expression to Postfix expression.**

p4.l

%{

#include "y.tab.h"

extern int yyval;

% }

%%

[0-9]+ { yyval=atoi(yytext); return digit; }

[\t] ;

[\n] return 0;

. return yytext[0];

%%

int yywrap()

{

}

p4.y

%{

#include <ctype.h>

#include<stdio.h>

#include<stdlib.h>

% }

%token digit

%%

S: E { printf("\n\n"); }

;

E: E '+' T { printf ("+" ); }

| T

;

T: T '\*' F { printf ("\*" ); }

| F

```

;
F: '(' E ')'
| digit {printf("%d", $1);}
;
%%

int main()
{
printf("Enter infix expression: ");
yyparse();
}

yyerror()
{
printf("Error");
}

```

## OUTPUT

```

root@DESKTOP-HUNWAGE:~# lex p4.l
root@DESKTOP-HUNWAGE:~# yacc p4.y
root@DESKTOP-HUNWAGE:~# gcc lex.yy.c y.tab.c
y.tab.c: In function 'yyparse':
y.tab.c:1019:16: warning: implicit declaration of function 'yylex' [-Wimplicit-function-declaration]
 1019 |     yychar = yylex ();
      |
y.tab.c:1178:7: warning: implicit declaration of function 'yyerror'; did you mean 'yyerrok'? [-Wimplicit-function-declaration]
 1178 |     yyerror (YY_("syntax error"));
      |     ^~~~~~
      | yyerrok
p4.y: At top level:
p4.y:28:1: warning: return type defaults to 'int' [-Wimplicit-int]
   28 | yyerror()
      | ^~~~~~
root@DESKTOP-HUNWAGE:~# ./a.out
Enter infix expression: 2+8*3+4
263*+4+

```



**20. Modify the program so as to include operators such as / , - , ^ as per their arithmetic associativity and precedence**

```
% {
#include <ctype.h>
#include <stdio.h>
#include <stdlib.h>
% }
%token digit
%left '+' '-'
%left '*' '/'
%right '^'
%%
S: E {printf("\n\n");}
;
E: E '+' T { printf ("+" );}
| E '-' T { printf ("-");}
| T
;
T: T '*' G { printf ("*");}
| T '/' G { printf ("/");}
| G
;
G: G '^' F { printf ("^");}
| F
;
F: '(' E ')'
| digit {printf("%d", $1);}
;
%%
int main()
{
printf("Enter infix expression: ");
yyparse();
}
yyerror()
{
printf("Error");
}
}
```

## OUTPUT

```
y.tab.c: In function 'yparse':
y.tab.c:1223:16: warning: implicit declaration of function 'yylex' [-Wimplicit-f
unction-declaration]
 1223 |         yychar = yylex ();
      |                   ^~~~~~
y.tab.c:1392:7: warning: implicit declaration of function 'yyerror'; did you mea
n 'yyerrok'? [-Wimplicit-function-declaration]
 1392 |         yyerror (YY_("syntax error"));
      |         ^~~~~~
      |         yyerrok
p4.y: At top level:
p4.y:30:1: warning: return type defaults to 'int' [-Wimplicit-int]
   30 |     yyerror()
      |     ^~~~~~
bmsce@bmsce-OptiPlex-3060:~/Desktop/1BM21CS205$ ./a.out
Enter infix expression: 2^3+4^5
23^45^+
```

21 .Use YACC to implement,evaluator for arithmetic expressions(Desktop calculator).

```
%{

/* Definition section */

#include<stdio.h>

#include "y.tab.h"

extern int yylval;

}%

/* Rule Section */

%%

[0-9]+ {

    yylval=atoi(yytext);

    return NUMBER
```

```

    }

    [t] ;

    [n] return 0;

    return yytext[0];

%%

int yywrap()

{

    return 1;

}


token NUMBER

%left '+' '-'

%left '*' '/' '%'

%left '(' ')'

/* Rule Section */

%%

ArithmeticExpression: E{

    printf("\nResult=%d\n", $$);

    return 0;

};

E: E '+' E {$$=$1+$3;}

| E '-' E {$$=$1-$3;}

| E '*' E {$$=$1*$3;}

```

```

|E/'E' {$$=$1/$3;}
|E'%E' {$$=$1%$3;}
|('E') {$$=$2;}
| NUMBER {$$=$1;}

;

%%

//driver code

void main()

{

    printf("\nEnter Any Arithmetic Expression which can have operations Addition, Subtraction,
    Multiplication, Division, Modulus and Round brackets:\n");

    yyparse();

    if(flag==0)

        printf("\nEnter arithmetic expression is Valid\n\n");

}

void yyerror()

{

    printf("\nEnter arithmetic expression is Invalid\n\n");

    flag=1;

}

```

## OUTPUT

```

Enter Any Arithmetic Expression which can have operations Addition, Subtraction, Multiplication, Division, Modulus and Round brackets:
1+2*3
Result=7
Entered arithmetic expression is Valid

```

**22.YACC to generate 3-Adress code for given expression.**

```
p.l
%{
#include<stdio.h>
#include<stdlib.h>
#include"y.tab.h"
extern int yylval;
extern char iden[20];
}%
d [0-9]+
a [a-zA-Z]+
%%
{d} { yylval=atoi(yytext); return digit; }
{a} { strcpy(iden,yytext); yylval=1; return id;}
[ \t] {;}
\n return 0;
. return yytext[0];
%%
int yywrap()
{
}
```

P.y

%{

#include <math.h>

#include<ctype.h>

#include<stdio.h>

int var\_cnt=0;

char iden[20];

%}

%token id

%token digit

%%

S:id '=' E { printf("%s=t%d\n",iden,var\_cnt-1); }

E:E '+' T { \$\$=var\_cnt; var\_cnt++; printf("t%d = t%d + t%d;\n", \$\$, \$1, \$3 );

}

|E '-' T { \$\$=var\_cnt; var\_cnt++; printf("t%d = t%d - t%d;\n", \$\$, \$1, \$3 );

}

|T { \$\$=\$1; }

;

T:T '\*' F { \$\$=var\_cnt; var\_cnt++; printf("t%d = t%d \* t%d;\n", \$\$, \$1, \$3 ); }

|T '/' F { \$\$=var\_cnt; var\_cnt++; printf("t%d = t%d / t%d;\n", \$\$, \$1, \$3 ); }

|F { \$\$=\$1 ; }

F:P '^' F { \$\$=var\_cnt; var\_cnt++; printf("t%d = t%d ^ t%d;\n", \$\$, \$1, \$3 );}

```

| P { $$ = $1;}

;

P: '(' E ')' { $$=$2; }

|digit { $$=var_cnt; var_cnt++; printf("t%d = %d;\n",$$,$1); }

;

%%

int main()

{

var_cnt=0;

printf("Enter an expression : \n");

yyparse();

return 0;

}

yyerror()


{

printf("error");

}

```

## OUTPUT



```

bmscecse@bmscecse-OptiPlex-3060:~/Documents/18M21CS253$ ./a.out
Enter an expression :
a=3*5+4
t0 = 3;
t1 = 5;
t2 = t0 * t1;
t3 = 4;
t4 = t2 + t3;
a=t4

```