VISVESVARAYA TECHNOLOGICAL UNIVERSITY

“JnanaSangama”, Belgaum -590014, Karnataka.

LAB REPORT

on

Compiler Design

Submitted by

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in partial fulfilment 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

Nov -2023 to Feb-2024

B. M. S. College of Engineering,

Bull Temple Road, Bangalore 560019

(Affiliated To Visvesvaraya Technological University, Belgaum)

Department of Computer Science and Engineering

CERTIFICATE

This is to certify that the Lab work entitled "**Compiler Design**" carried out by **VIBHA HUGAR (1BM21CS255),** 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 academic semester Nov -2023 to Feb-2024. The Lab report has been approved as it satisfies the academic requirements in respect of a **Compiler Design (22CS5PCCPD)** work prescribed for the said degree.

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Index Sheet

Course Outcome

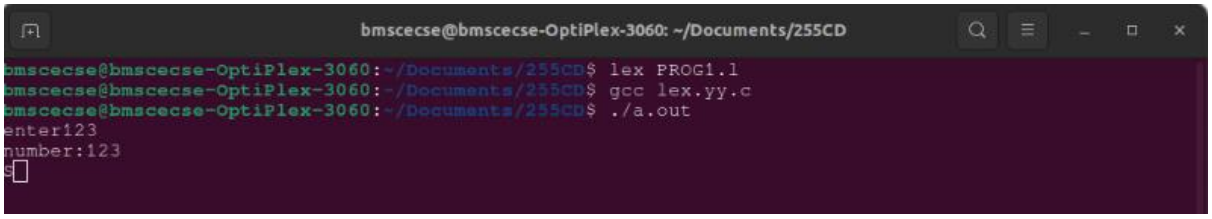
CO1	Apply the fundamental concepts for the various phases of compiler design.
CO2	CO2 Analyse the syntax and semantic concepts of a compiler.
CO3	Design various types of parsers and Address code generation
CO4	Implement compiler principles, methodologies using lex, yacc tools

WEEK-1

1.Write a LEX program to identify numbers and operators from input.

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

OUTPUT



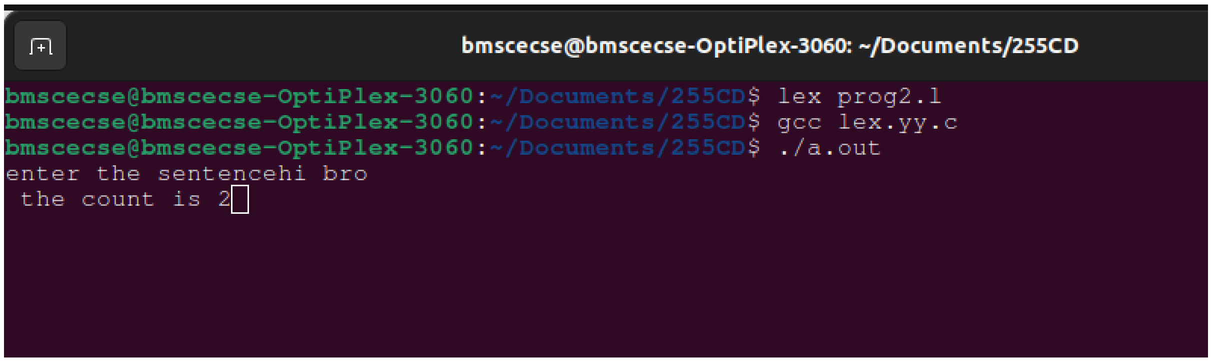
```
bmscecse@bmscecse-OptiPlex-3060:~/Documents/255CD$ lex PROG1.l
bmscecse@bmscecse-OptiPlex-3060:~/Documents/255CD$ gcc lex.yy.c
bmscecse@bmscecse-OptiPlex-3060:~/Documents/255CD$ ./a.out
enter123
number:123
$
```

2. Write LEX a program to identify the number of words in the sentence.

```
%{
#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

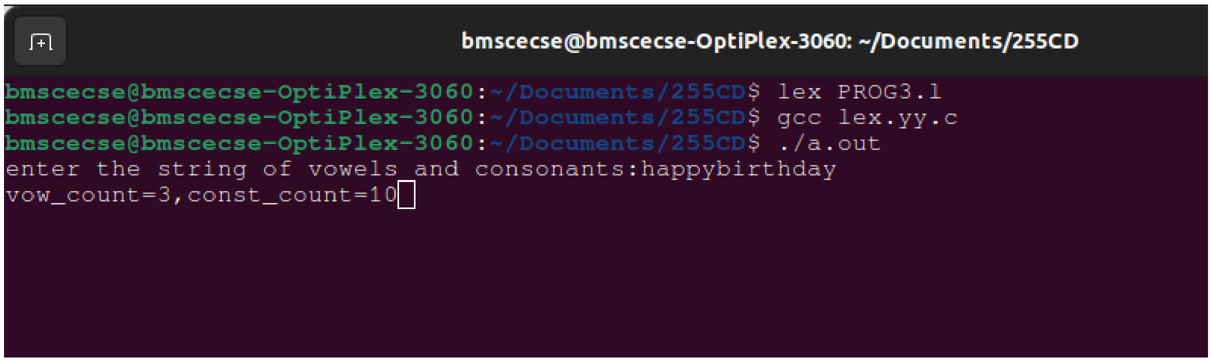


```
bmscecse@bmscecse-OptiPlex-3060:~/Documents/255CD$ lex prog2.l
bmscecse@bmscecse-OptiPlex-3060:~/Documents/255CD$ gcc lex.yy.c
bmscecse@bmscecse-OptiPlex-3060:~/Documents/255CD$ ./a.out
enter the sentencehi bro
 the count is 2
```

3. Write a LEX program to give the number of vowels and consonants in a sentence.

```
%{
#include<stdio.h>
int vow_count=0;
int const_count=0;
%}
%%
[aeiouAEIOU] {vow_count++;}
[a-zA-Z] {const_count++;}
\n {printf("vow_count=%d,const_count=%d",vow_count,const_count);}
%%
int yywrap()
{
}
int main()
{
printf("enter the string of vowels and consonants:");
yylex();
return 0;
}
```

OUTPUT

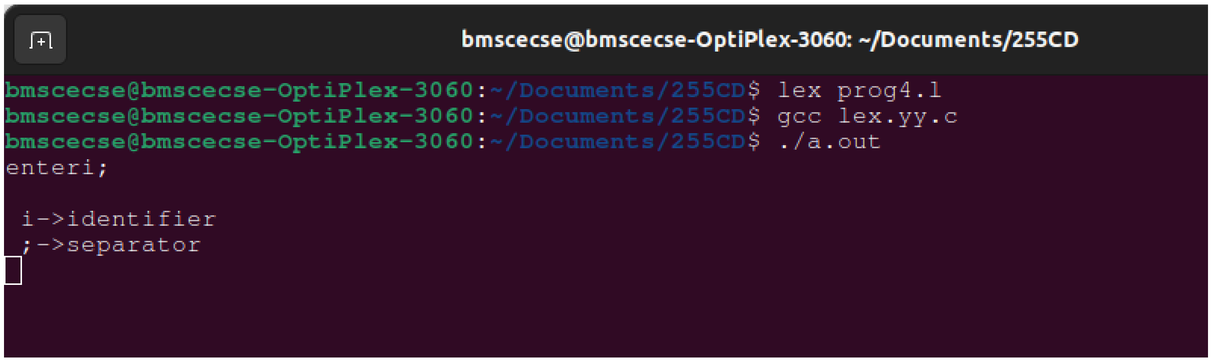


```
bmscecse@bmscecse-OptiPlex-3060:~/Documents/255CD$ lex PROG3.l
bmscecse@bmscecse-OptiPlex-3060:~/Documents/255CD$ gcc lex.yy.c
bmscecse@bmscecse-OptiPlex-3060:~/Documents/255CD$ ./a.out
enter the string of vowels and consonants:happybirthday
vow_count=3,const_count=10
```

4. Write a LEX program to identify keywords, separator and identifiers.

```
%option noyywrap
%{
#include<stdio.h>
%}
%%
int|char|float {printf("\n%s->keyword",yytext);}
,|; {printf("\n %s->separator",yytext);}
[a-zA-Z0-9]* {printf("\n %s->identifier",yytext);}
%%
int wrap()
{
}
int main()
{
printf("enter");
yylex();
return 0;
}
```

OUTPUT

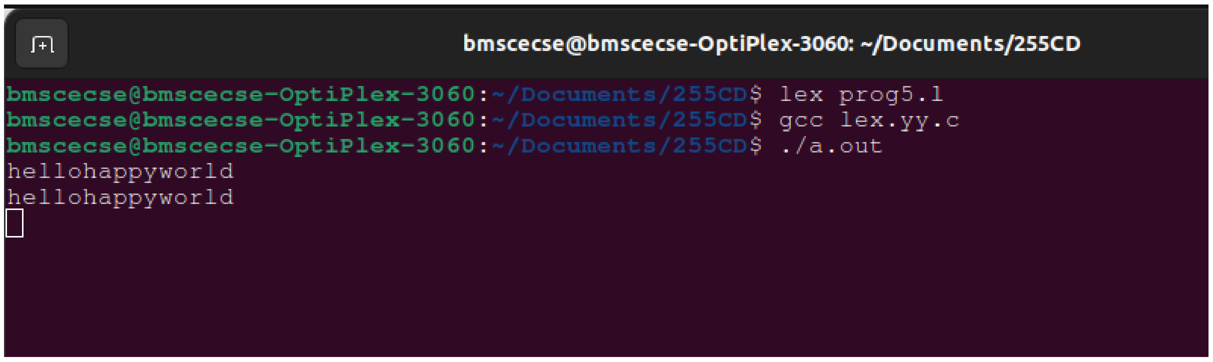


```
bmscecse@bmscecse-OptiPlex-3060:~/Documents/255CD$ lex prog4.l
bmscecse@bmscecse-OptiPlex-3060:~/Documents/255CD$ gcc lex.yy.c
bmscecse@bmscecse-OptiPlex-3060:~/Documents/255CD$ ./a.out
enteri;

 i->identifier
 ;->separator
```

5. Write a LEX program to print the input given.

```
%%
. ECHO;
%%
int yywrap(void)
{
}
int main(void)
{
yylex();
return 0;
}
```

OUTPUT



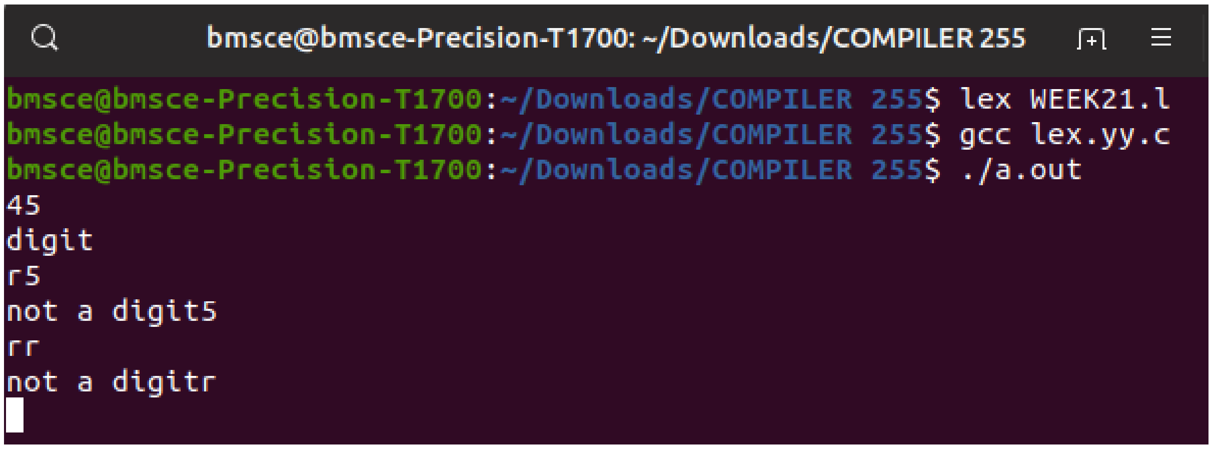
```
bmscecse@bmscecse-OptiPlex-3060:~/Documents/255CD$ lex prog5.l
bmscecse@bmscecse-OptiPlex-3060:~/Documents/255CD$ gcc lex.yy.c
bmscecse@bmscecse-OptiPlex-3060:~/Documents/255CD$ ./a.out
hellohappyworld
hellohappyworld
```

WEEK-2

1. 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



bmsce@bmsce-Precision-T1700: ~/Downloads/COMPILER 255

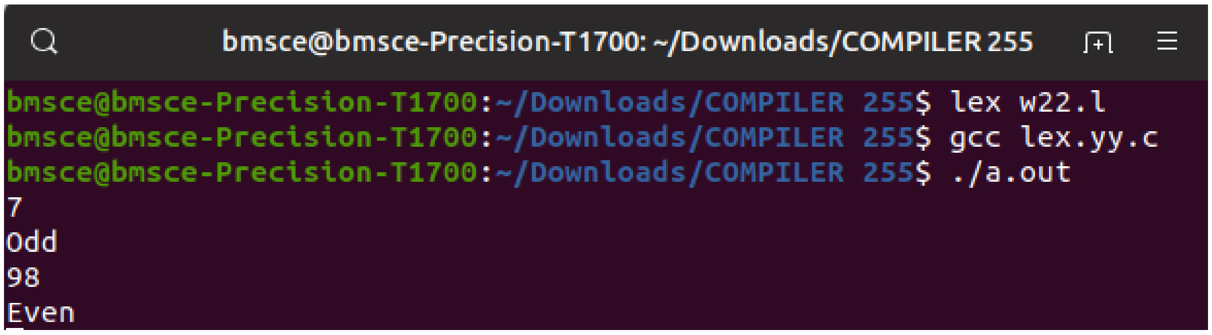
```
bmsce@bmsce-Precision-T1700:~/Downloads/COMPILER 255$ lex WEEK21.l
bmsce@bmsce-Precision-T1700:~/Downloads/COMPILER 255$ gcc lex.yy.c
bmsce@bmsce-Precision-T1700:~/Downloads/COMPILER 255$ ./a.out
45
digit
r5
not a digit5
rr
not a digitr
```

2. 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



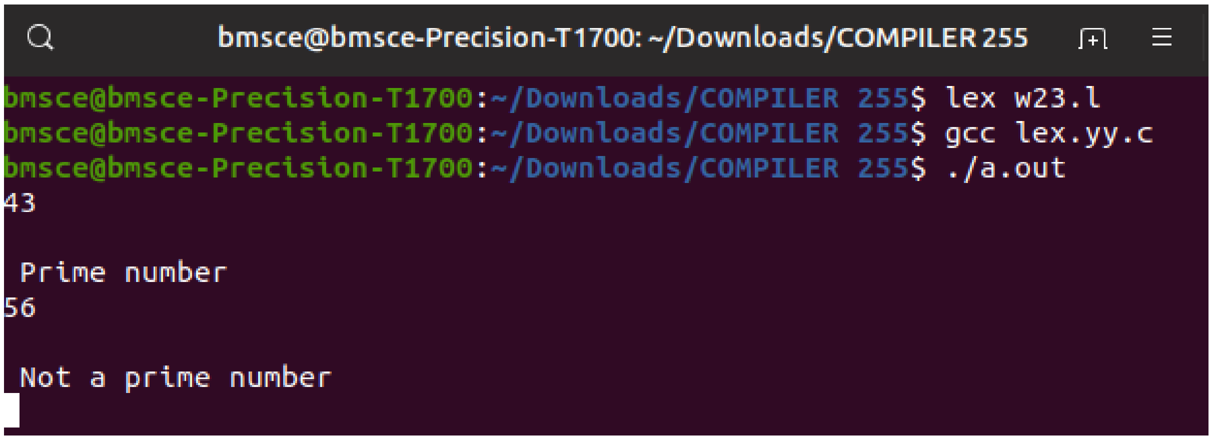
bmsce@bmsce-Precision-T1700: ~/Downloads/COMPILER 255

```
bmsce@bmsce-Precision-T1700:~/Downloads/COMPILER 255$ lex w22.l
bmsce@bmsce-Precision-T1700:~/Downloads/COMPILER 255$ gcc lex.yy.c
bmsce@bmsce-Precision-T1700:~/Downloads/COMPILER 255$ ./a.out
7
Odd
98
Even
```

3. 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

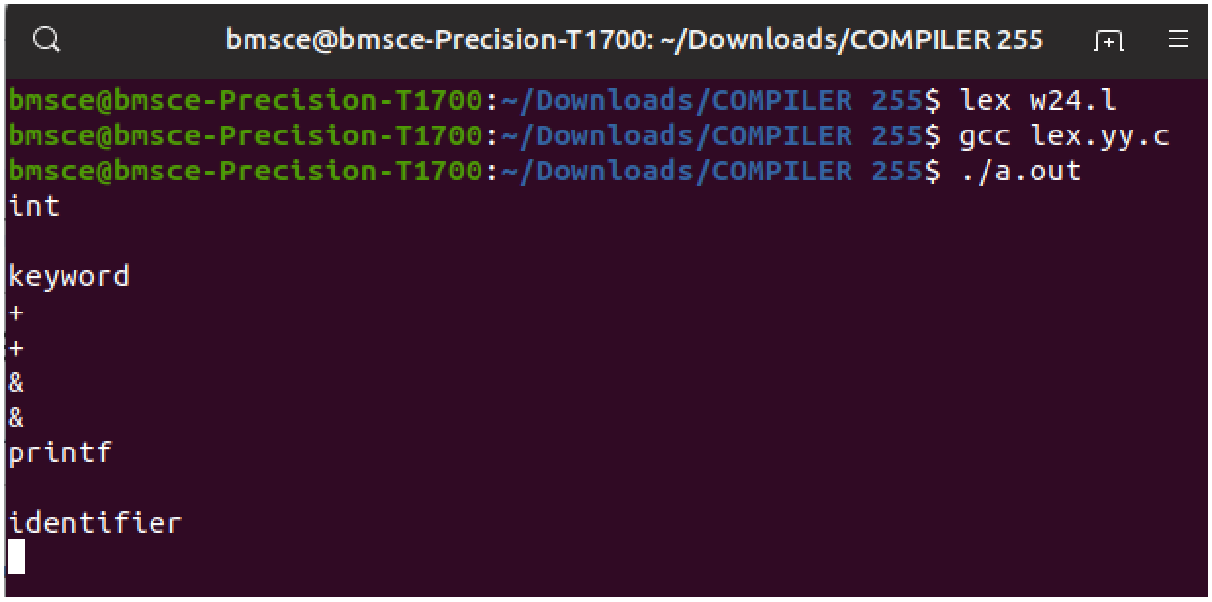


```
bmsce@bmsce-Precision-T1700:~/Downloads/COMPILER 255$ lex w23.l
bmsce@bmsce-Precision-T1700:~/Downloads/COMPILER 255$ gcc lex.yy.c
bmsce@bmsce-Precision-T1700:~/Downloads/COMPILER 255$ ./a.out
43

 Prime number
56

 Not a prime number
```

4. Write a lex program to recognize a) identifiers
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

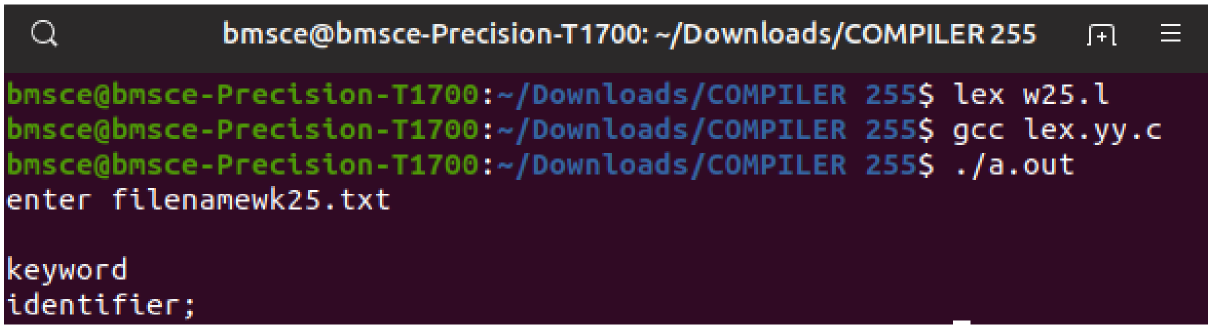


```
bmsce@bmsce-Precision-T1700:~/Downloads/COMPILER 255$ lex w24.l
bmsce@bmsce-Precision-T1700:~/Downloads/COMPILER 255$ gcc lex.yy.c
bmsce@bmsce-Precision-T1700:~/Downloads/COMPILER 255$ ./a.out
int

keyword
+
+
&
&
printf

identifier
```

5. 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



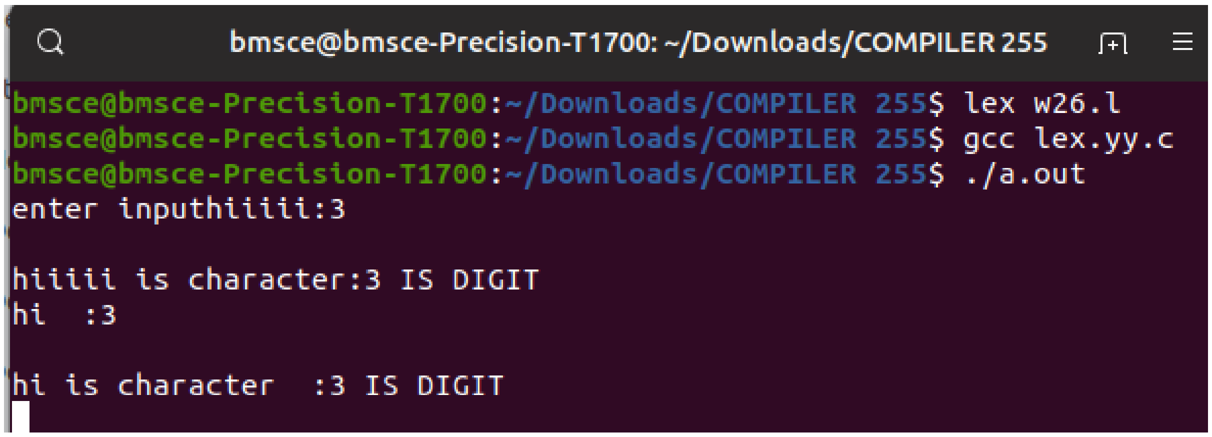
```
bmsce@bmsce-Precision-T1700: ~/Downloads/COMPILER 255
bmsce@bmsce-Precision-T1700:~/Downloads/COMPILER 255$ lex w25.l
bmsce@bmsce-Precision-T1700:~/Downloads/COMPILER 255$ gcc lex.yy.c
bmsce@bmsce-Precision-T1700:~/Downloads/COMPILER 255$ ./a.out
enter filenamewk25.txt

keyword
identifier;
```

6)Write a Program to print invalid string if a Alpha-Numeric string is entered as input.

```
%{
#include<stdio.h>
%}
alpha [a-zA-Z0-9]*
%%
```

```
[0-9]* {printf("%s IS DIGIT",yytext);}
[a-zA-Z]* {printf("\n%s is character",yytext);}
{alpha} {printf("invalid string");}
%%
int yywrap()
{
}
int main()
{
printf("enter input");
yylex();
return 0;
}
```

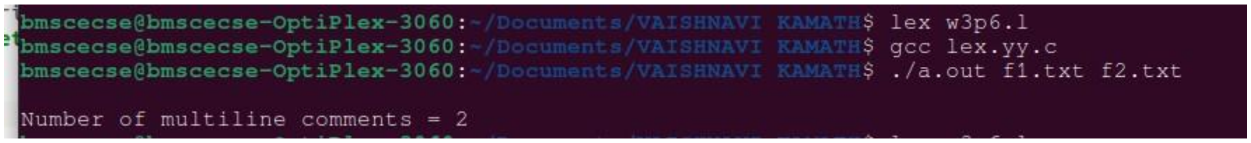
OUTPUT


```
bmsce@bmsce-Precision-T1700:~/Downloads/COMPILER 255$ lex w26.l
bmsce@bmsce-Precision-T1700:~/Downloads/COMPILER 255$ gcc lex.yy.c
bmsce@bmsce-Precision-T1700:~/Downloads/COMPILER 255$ ./a.out
enter inputhiiiii:3

hiiiii is character:3 IS DIGIT
hi  :3

hi is character  :3 IS DIGIT
```

WEEK-3

1.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
```

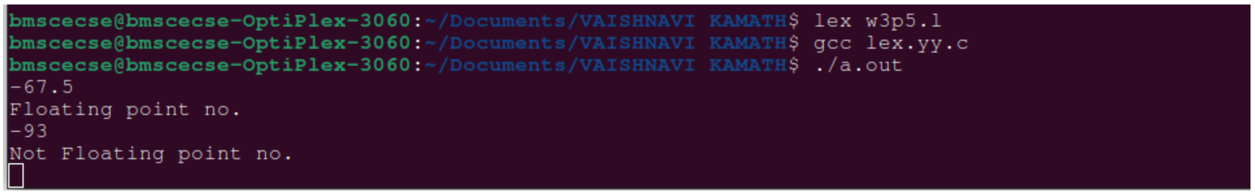


```
bmscecse@bmscecse-OptiPlex-3060:~/Documents/VAISHNAVI KAMATH$ lex w3p6.l
bmscecse@bmscecse-OptiPlex-3060:~/Documents/VAISHNAVI KAMATH$ gcc lex.yy.c
bmscecse@bmscecse-OptiPlex-3060:~/Documents/VAISHNAVI KAMATH$ ./a.out f1.txt f2.txt

Number of multiline comments = 2
```

2.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

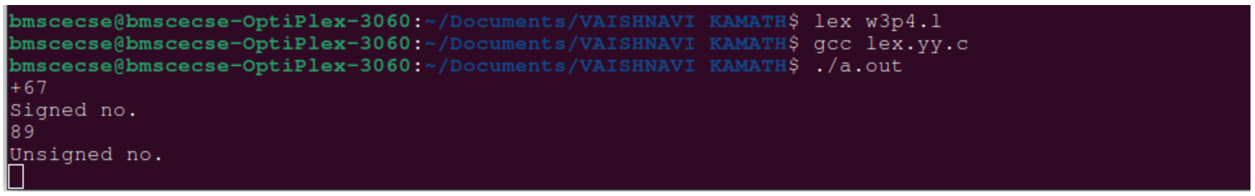


```
bmscecse@bmscecse-OptiPlex-3060:~/Documents/VAISHNAVI KAMATH$ lex w3p5.l
bmscecse@bmscecse-OptiPlex-3060:~/Documents/VAISHNAVI KAMATH$ gcc lex.yy.c
bmscecse@bmscecse-OptiPlex-3060:~/Documents/VAISHNAVI KAMATH$ ./a.out
-67.5
Floating point no.
-93
Not Floating point no.
```

3.Write a program to read and check if the user entered number is signed or unsigned usingappropriate 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

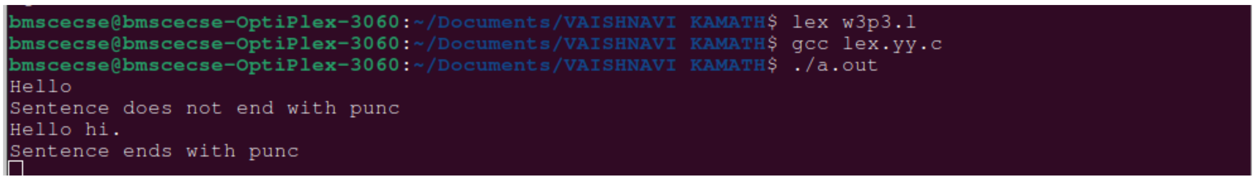


```
bmscecse@bmscecse-OptiPlex-3060:~/Documents/VAISHNAVI KAMATH$ lex w3p4.l
bmscecse@bmscecse-OptiPlex-3060:~/Documents/VAISHNAVI KAMATH$ gcc lex.yy.c
bmscecse@bmscecse-OptiPlex-3060:~/Documents/VAISHNAVI KAMATH$ ./a.out
+67
Signed no.
89
Unsigned no.
```

4.Write a program to check if the input sentence ends with any of the following punctuationmarks (? , 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



```
bmscecse@bmscecse-OptiPlex-3060:~/Documents/VAISHNAVI KAMATH$ lex w3p3.l
bmscecse@bmscecse-OptiPlex-3060:~/Documents/VAISHNAVI KAMATH$ gcc lex.yy.c
bmscecse@bmscecse-OptiPlex-3060:~/Documents/VAISHNAVI KAMATH$ ./a.out
Hello
Sentence does not end with punc
Hello hi.
Sentence ends with punc
```

5. Write a program to read an input sentence and to check if the sentence begins with English articles (A, a,AN,An,THE and The). If the sentence starts with the article appropriate message should be printed. If the sentence does not start with the article appropriate message should be printed.

```
%{
#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;}
```

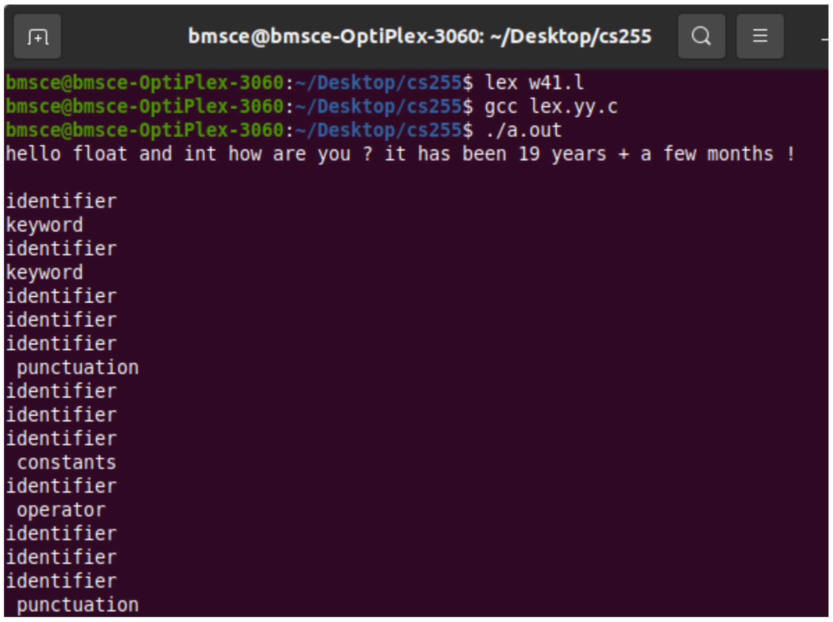
WEEK-4

1.Write a program in LEX to recognize different tokes:Keywords, Identifiers, Constants, Operators and Punctuations.

CODE

```
%{
  #include<stdio.h>
%}
alpha[a-zA-Z]
digit[0-9]
%%
(float|int) {printf("\nkeyword");}
{alpha}({digit}|{alpha})* {printf("\nidentifier");}
[+|-|*|/] {printf("\n operator");}
[0-9]+ {printf("\n constants");}
[?|.|!] {printf("\n punctuation");}
%%
int yywrap()
{
}
int main()
{
yylex();
return 0;
}
```

OUTPUT



```
bmsce@bmsce-OptiPlex-3060:~/Desktop/cs255$ lex w41.l
bmsce@bmsce-OptiPlex-3060:~/Desktop/cs255$ gcc lex.yy.c
bmsce@bmsce-OptiPlex-3060:~/Desktop/cs255$ ./a.out
hello float and int how are you ? it has been 19 years + a few months !

identifier
keyword
identifier
keyword
identifier
identifier
identifier
 punctuation
identifier
identifier
identifier
 constants
identifier
 operator
identifier
identifier
identifier
 punctuation
```

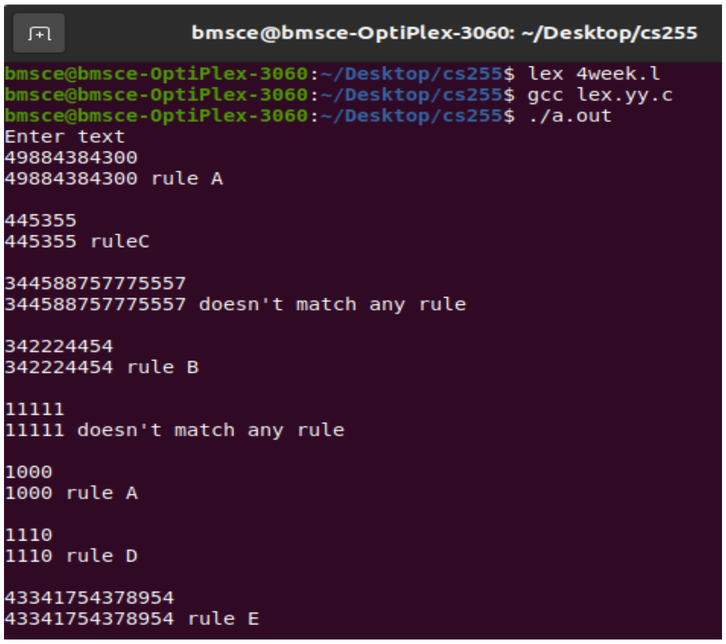
2. Write a LEX program to recognize the following tokens over the alphabets{0,1,..,9}
a) The set of all string ending in 00.
b) The set of all strings with three consecutive 222's.
c) The set of all string such that every block of five consecutive symbols contains at least two 5's.
d) The set of all strings beginning with a 1 which, interpreted as the binary representation of an integer, is congruent to zero modulo 5.
e) The set of all strings such that the 10th symbol from the right end is 1.

CODE

```
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(yyleng<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

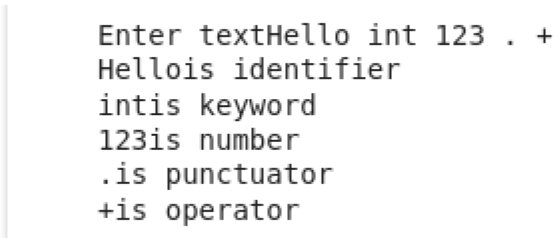

bmsce@bmsce-OptiPlex-3060: ~/Desktop/cs255

```
bmsce@bmsce-OptiPlex-3060:~/Desktop/cs255$ lex 4week.l
bmsce@bmsce-OptiPlex-3060:~/Desktop/cs255$ gcc lex.yy.c
bmsce@bmsce-OptiPlex-3060:~/Desktop/cs255$ ./a.out
Enter text
49884384300
49884384300 rule A

445355
445355 ruleC

344588757775557
344588757775557 doesn't match any rule

342224454
342224454 rule B

11111
11111 doesn't match any rule

1000
1000 rule A

1110
1110 rule D

43341754378954
43341754378954 rule E
```

WEEK-5

1.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()):
```

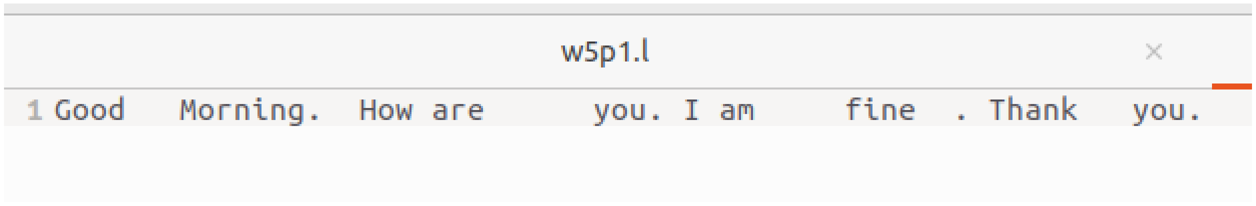


```
Enter textHello int 123 . +
Hellois identifier
intis keyword
123is number
.is punctuator
+is operator
```

2.Write a Lex Program that copies a file,replacing each nonempty sequence of white spaces by a single blank.

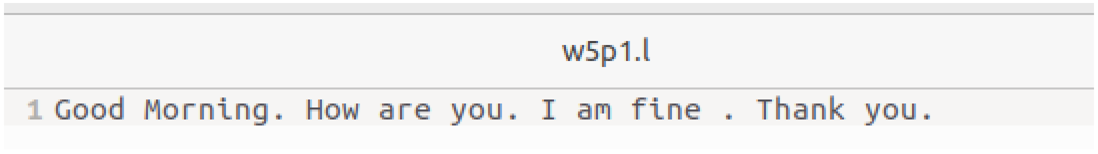
```
%{
    #include<stdio.h>
    %}

    %%

    [\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



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

Output.txt



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

WEEK-6

1.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

CODE

LEX

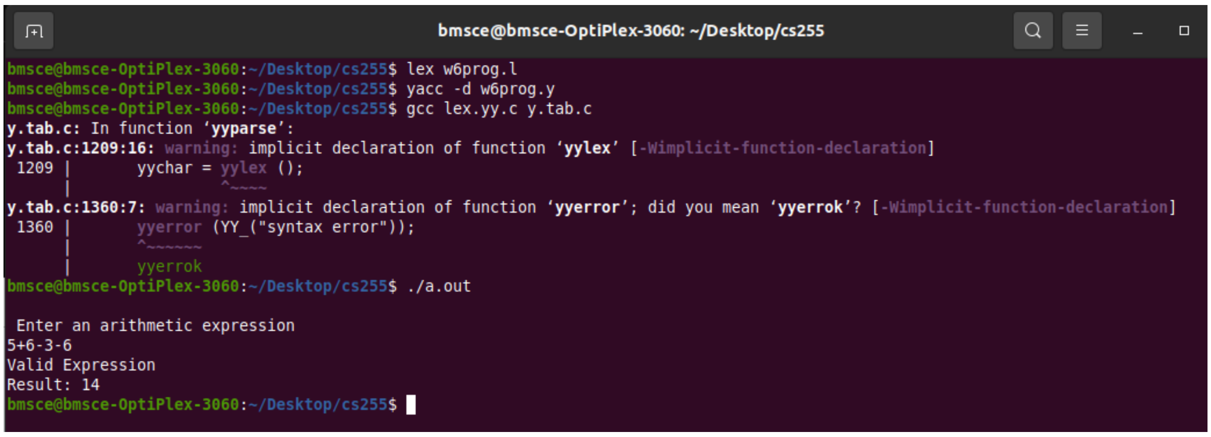
```
%{
#include "y.tab.h"
%}

%%
[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("\Enter an arithmetic expression\n");
        yyparse();
        return 0;
}


int yyerror()
{
        printf("\nInvalid expression\n");
        return 0;
}
```

OUTPUT



```
bmsce@bmsce-OptiPlex-3060: ~/Desktop/cs255
bmsce@bmsce-OptiPlex-3060:~/Desktop/cs255$ lex w6prog.l
bmsce@bmsce-OptiPlex-3060:~/Desktop/cs255$ yacc -d w6prog.y
bmsce@bmsce-OptiPlex-3060:~/Desktop/cs255$ gcc lex.yy.c y.tab.c
y.tab.c: In function ‘yyparse’:
y.tab.c:1209:16: warning: implicit declaration of function ‘yylex’ [-Wimplicit-function-declaration]
 1209 |       yychar = yylex ();
      |                ^~~~~
y.tab.c:1360:7: warning: implicit declaration of function ‘yyerror’; did you mean ‘yyerrok’? [-Wimplicit-function-declaration]
 1360 |       yyerror (YY_("syntax error"));
      |       ^~~~~~~
      |       yyerrok
bmsce@bmsce-OptiPlex-3060:~/Desktop/cs255$ ./a.out

 Enter an arithmetic expression
5+6-3-6
Valid Expression
Result: 14
bmsce@bmsce-OptiPlex-3060:~/Desktop/cs255$ 
```

2.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

CODE

LEX

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

%%
[0-9]+ {yylval=atoi(yytext); return NUM;}
[\t]    ;
\n      return 0;
.       return yytext[0];
```

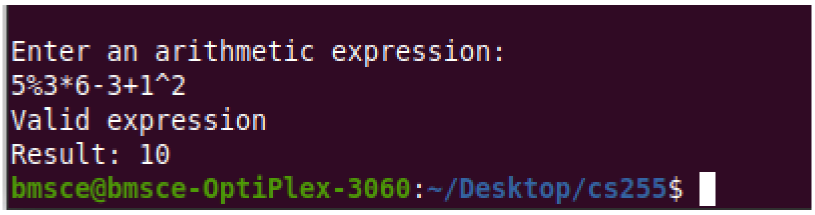
```
%%

int yywrap()
{
}
```

YACC

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


%token NUM
%left '+' '-'
%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");
    yyparse();
    return 0;
}

int yyerror()
```

```
{
    printf("\nInvalid expression\n");
    return 0;
}
```

OUTPUT



```
Enter an arithmetic expression:
5%3*6-3+1^2
Valid expression
Result: 10
bmsce@bmsce-OptiPlex-3060:~/Desktop/cs255$
```

WEEK-7

1 a)Program to recognize the grammar (anb, n>= 5).
Hint :S → aaaaaEb
E →a E| €

CODE:

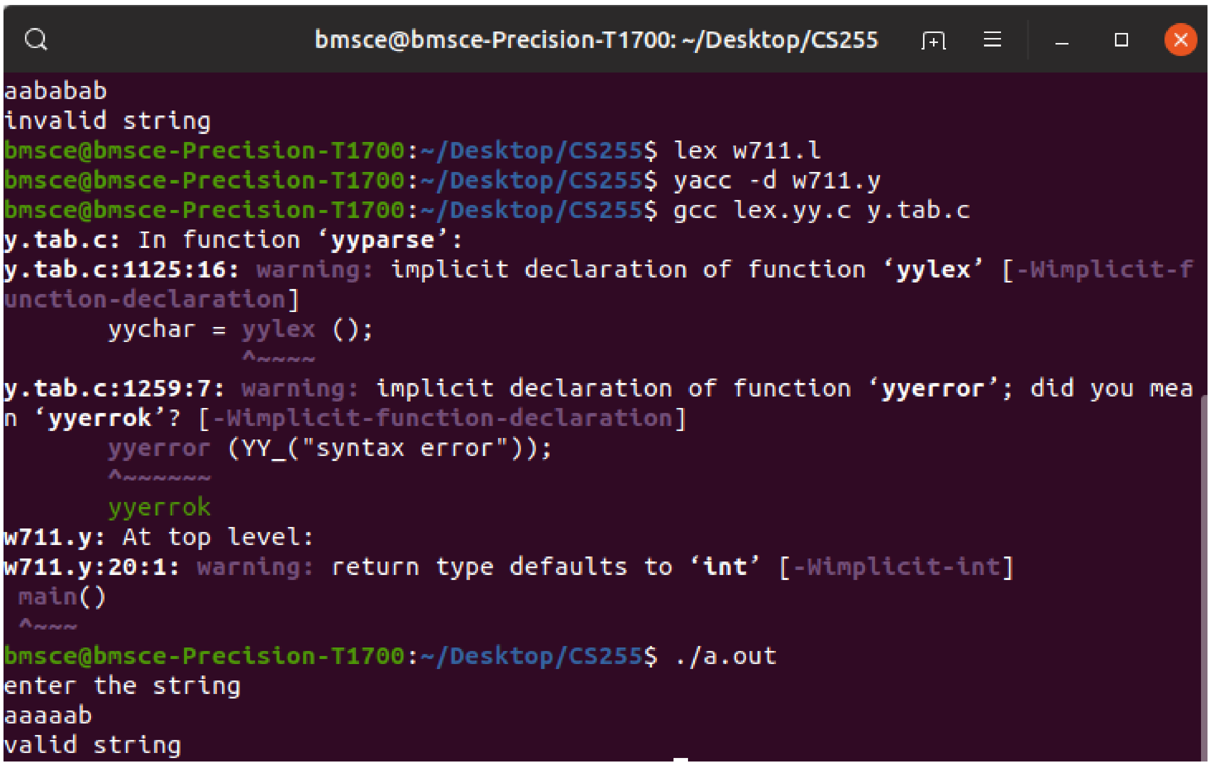
LEX

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

%%
[aA] {return A;}
[bB] {return B;}
\n {return NL;}
.   {return yytext[0];}
%%

  int yywrap()
{
   return 1;
}
```

YACC

```
%{
#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



```
aababab
invalid string
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ lex w711.l
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ yacc -d w711.y
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ gcc lex.yy.c y.tab.c
y.tab.c: In function ‘yyparse’:
y.tab.c:1125:16: warning: implicit declaration of function ‘yylex’ [-Wimplicit-f
unction-declaration]
       yychar = yylex ();
                ^~~~~
y.tab.c:1259:7: warning: implicit declaration of function ‘yyerror’; did you mea
n ‘yyerrok’? [-Wimplicit-function-declaration]
       yyerror (YY_("syntax error"));
       ^~~~~~~
       yyerrok
w711.y: At top level:
w711.y:20:1: warning: return type defaults to ‘int’ [-Wimplicit-int]
 main()
 ^~~~
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ ./a.out
enter the string
aaaaab
valid string
```

1b)Program to recognize strings ‘aaab’, ‘abbb’, ‘ab’ and ‘a’ using the grammar (anbn, n>= 0).
Hint : S → aSb | €

CODE:

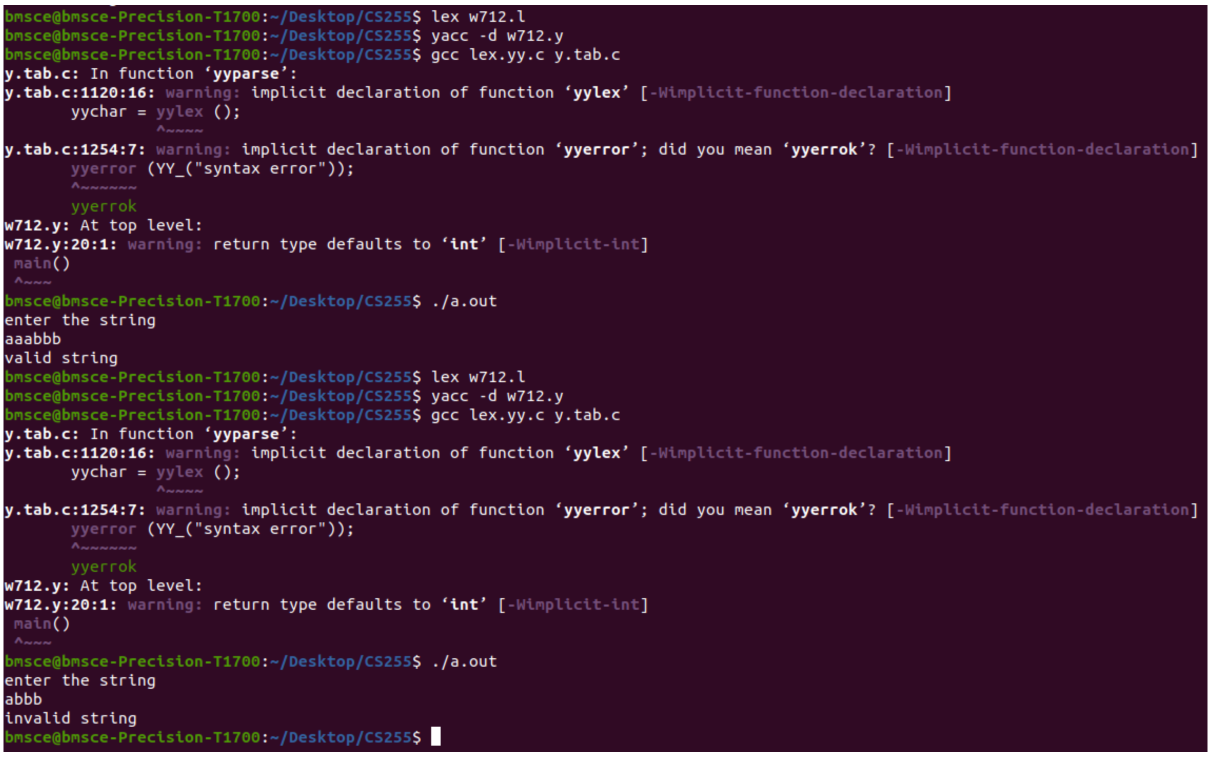
LEX

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


%%
[aA] {return A;}
[bB] {return B;}
\n {return NL;}
.  {return yytext[0];}
%%


 int yywrap()
{
 return 1;
}
```

YACC

```
%{
#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

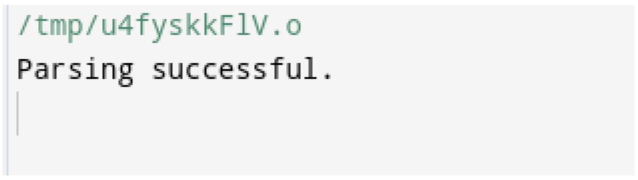


```
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ lex w712.l
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ yacc -d w712.y
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ gcc lex.yy.c y.tab.c
y.tab.c: In function ‘yyparse’:
y.tab.c:1120:16: warning: implicit declaration of function ‘yylex’ [-Wimplicit-function-declaration]
       yychar = yylex ();
                ^~~~~
y.tab.c:1254:7: warning: implicit declaration of function ‘yyerror’; did you mean ‘yyerrok’? [-Wimplicit-function-declaration]
       yyerror (YY_("syntax error"));
       ^~~~~~~
       yyerrok
w712.y: At top level:
w712.y:20:1: warning: return type defaults to ‘int’ [-Wimplicit-int]
 main()
 ^~~~
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ ./a.out
enter the string
aaabbb
valid string
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ lex w712.l
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ yacc -d w712.y
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ gcc lex.yy.c y.tab.c
y.tab.c: In function ‘yyparse’:
y.tab.c:1120:16: warning: implicit declaration of function ‘yylex’ [-Wimplicit-function-declaration]
       yychar = yylex ();
                ^~~~~
y.tab.c:1254:7: warning: implicit declaration of function ‘yyerror’; did you mean ‘yyerrok’? [-Wimplicit-function-declaration]
       yyerror (YY_("syntax error"));
       ^~~~~~~
       yyerrok
w712.y: At top level:
w712.y:20:1: warning: return type defaults to ‘int’ [-Wimplicit-int]
 main()
 ^~~~
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ ./a.out
enter the string
abbb
invalid string
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$
```

2) Recursive Descent Parsing with back tracking(Brute Force Method).S->cAd,A->ab/a

CODE:
```
#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[] = "cabd";
    recursive_descent_parser(input_string);

    return 0;
}
```

OUTPUT



```
/tmp/u4fyskkFlV.o
Parsing successful.
```

3) Use YACC to generate Syntax tree for a given expression.

CODE:

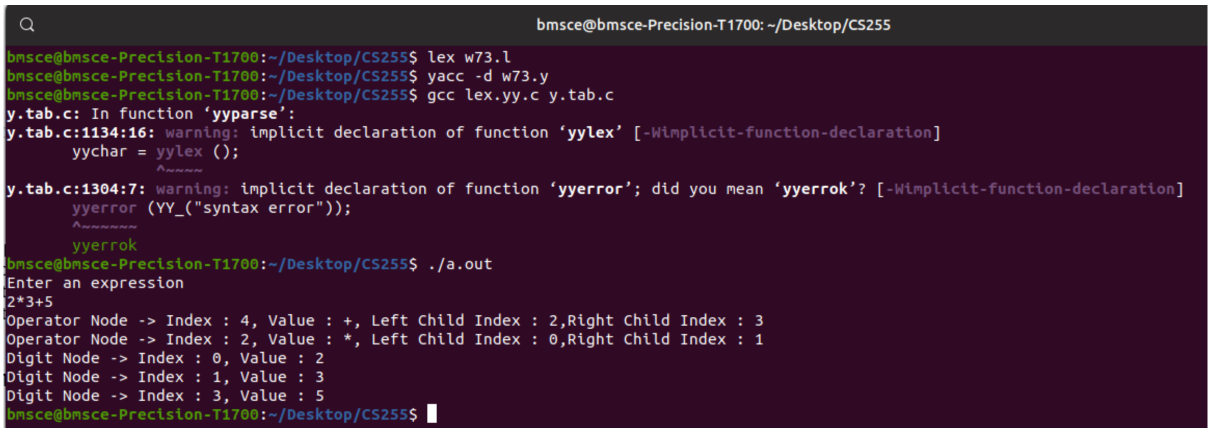
LEX

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

YACC

```
%{
#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;
}

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



```
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ lex w73.l
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ yacc -d w73.y
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ gcc lex.yy.c y.tab.c
y.tab.c: In function ‘yyparse’:
y.tab.c:1134:16: warning: implicit declaration of function ‘yylex’ [-Wimplicit-function-declaration]
       yychar = yylex ();
                ^~~~~
y.tab.c:1304:7: warning: implicit declaration of function ‘yyerror’; did you mean ‘yyerrok’? [-Wimplicit-function-declaration]
       yyerror (YY_("syntax error"));
       ^~~~~~~
       yyerrok
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ ./a.out
Enter an expression
2*3+5
Operator Node -> Index : 4, Value : +, Left Child Index : 2,Right Child Index : 3
Operator Node -> Index : 2, Value : *, Left Child Index : 0,Right Child Index : 1
Digit Node -> Index : 0, Value : 2
Digit Node -> Index : 1, Value : 3
Digit Node -> Index : 3, Value : 5
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ 
```

WEEK-8

1. Use YACC to convert: Infix expression to Postfix expression.

CODE

LEX

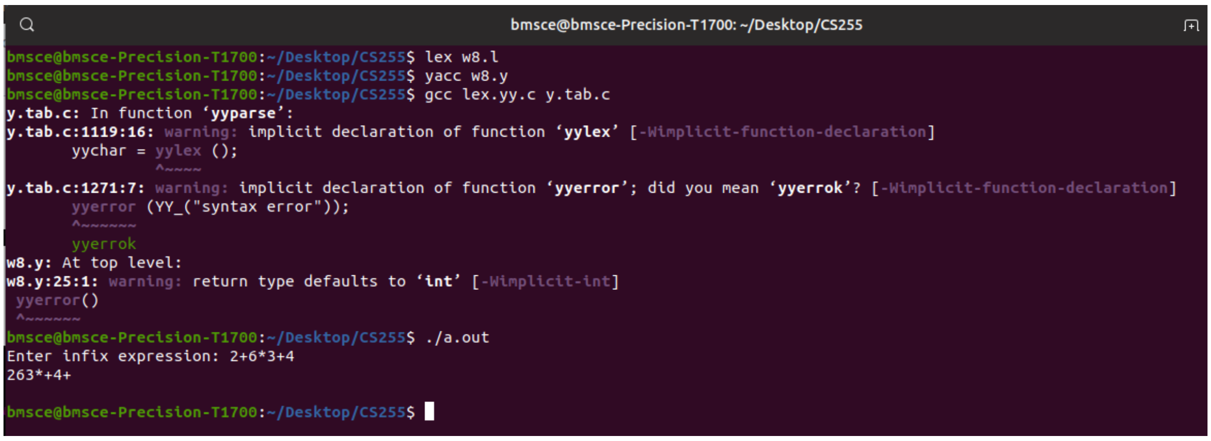
```
%{
#include "y.tab.h"
extern int yylval;
%}
%%
[0-9]+ { yylval=atoi(yytext); return digit;}
[\t] ;
[\n] return 0;
. return yytext[0];
%%
int yywrap()
{
}
```

YACC

```
%{
#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



```
bmsce@bmsce-Precision-T1700: ~/Desktop/CS255
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ lex w8.l
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ yacc w8.y
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ gcc lex.yy.c y.tab.c
y.tab.c: In function ‘yyparse’:
y.tab.c:1119:16: warning: implicit declaration of function ‘yylex’ [-Wimplicit-function-declaration]
       yychar = yylex ();
                ^~~~~
y.tab.c:1271:7: warning: implicit declaration of function ‘yyerror’; did you mean ‘yyerrok’? [-Wimplicit-function-declaration]
       yyerror (YY_("syntax error"));
       ^~~~~~~
       yyerrok
w8.y: At top level:
w8.y:25:1: warning: return type defaults to ‘int’ [-Wimplicit-int]
 yyerror()
 ^~~~~~~
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ ./a.out
Enter infix expression: 2+6*3+4
263*+4+

bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ █
```

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

CODE

LEX

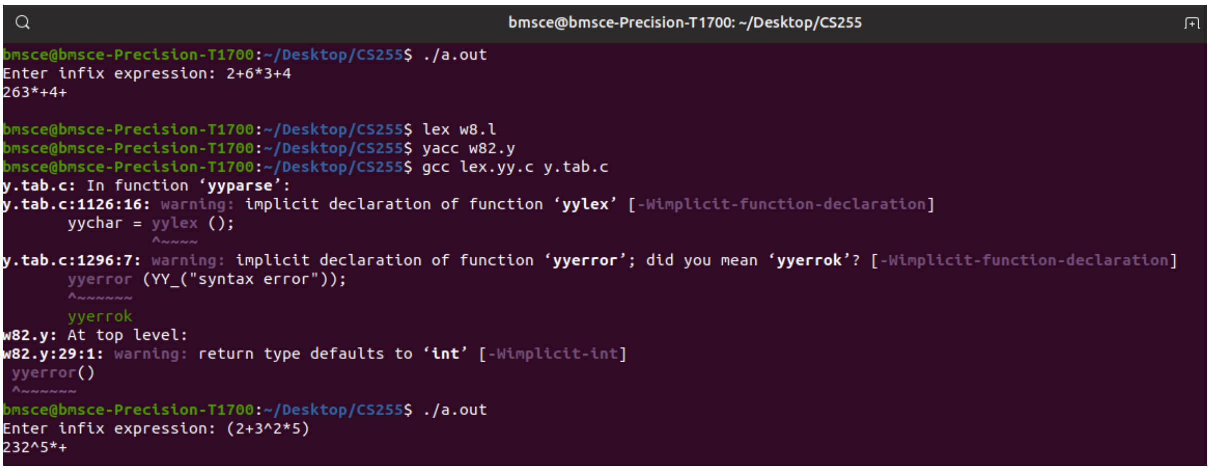
```
%{
#include "y.tab.h"
extern int yylval;
%}
%%
[0-9]+ { yylval=atoi(yytext); return digit;}
[\t] ;
[\n] return 0;
. return yytext[0];
%%
int yywrap()
{
}
```

YACC

```
%{
#include <ctype.h>
#include<stdio.h>
#include<stdlib.h>
%}
%token digit
%%
```

```
S: E {printf("\n\n");}
;
E:  E '+'  T { printf ("+");}
|  E '-'  T { printf ("-");}
|  T
;
T:  T '*'  P { printf("*");}
|  T '/'  P { printf("/");}
|  P
;
P:  F '^'  P { printf ("^");}
|  F
;
F: '(' E ')'| digit {printf("%d", $1);}
;
%%
int main()
{
printf("Enter infix expression: ");
yyparse();
}
yyerror()
{
printf("Error");
}
```

OUTPUT



```
bmsce@bmsce-Precision-T1700: ~/Desktop/CS255
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ ./a.out
Enter infix expression: 2+6*3+4
263*+4+

bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ lex w8.l
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ yacc w82.y
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ gcc lex.yy.c y.tab.c
y.tab.c: In function ‘yyparse’:
y.tab.c:1126:16: warning: implicit declaration of function ‘yylex’ [-Wimplicit-function-declaration]
       yychar = yylex ();
                ^~~~~
y.tab.c:1296:7: warning: implicit declaration of function ‘yyerror’; did you mean ‘yyerrok’? [-Wimplicit-function-declaration]
       yyerror (YY_("syntax error"));
       ^~~~~~~
       yyerrok
w82.y: At top level:
w82.y:29:1: warning: return type defaults to ‘int’ [-Wimplicit-int]
 yyerror()
 ^~~~~~~
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ ./a.out
Enter infix expression: (2+3^2*5)
232^5*+
```

WEEK-9

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

LEX

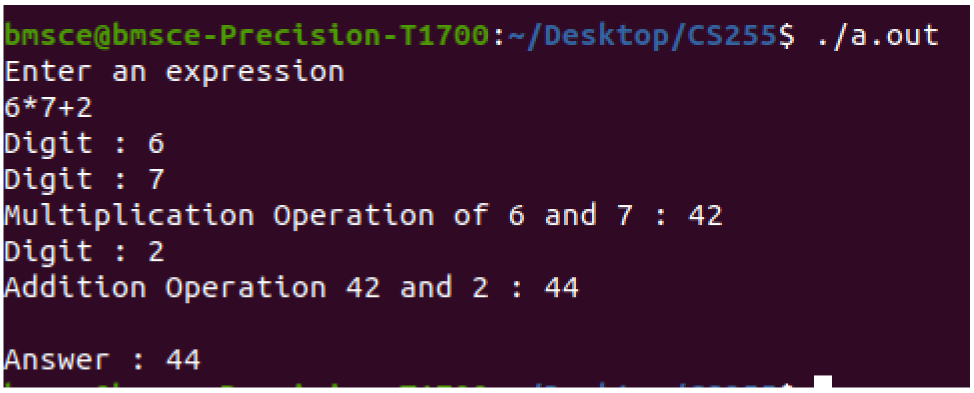
```
%{
#include "y.tab.h"
#include <stdlib.h>
extern int yylval;
%}

%%
[0-9]+ {yylval=atoi(yytext);return digit;}
[\t] ;
[\n] return 0;
. return yytext[0];
%%
```

YACC

```
%{
 #include <stdio.h>
 #include <ctype.h>
 int x[5],y[5],k,j[5],a[5][10],e,w;
%}

%token digit

%%
S : E { printf("\nAnswer : %d\n",$1); }
 ;
E : T { x[e]=$1; } E1 { $$=x[e]; }
 ;
E1 : '+' T { w=x[e]; x[e]=x[e]+$2; printf("Addition Operation %d and %d : %d\n",w,$2,x[e]);
} E1 { $$=x[e]; }
 | '-' T { w=x[e]; x[e]=x[e]-$2; printf("Subtraction Operation %d and %d : %d\n",w,$2,x[e]);
} E1 { $$=x[e]; }
 | { $$=x[e]; }
 ;
T : Z { y[e]=$1; } T1 { $$=y[e]; }
 ;
T1 : '*' Z { w=y[e]; y[e]=y[e]*$2; printf("Multiplication Operation of %d and %d :
%d\n",w,$2,y[e]); } T1 { $$=y[e]; }
 | { $$=y[e]; }
 ;
Z : F { a[e][j[e]++]=$1; } Z1 { $$=$3; }
 ;
Z1 : '^' Z { $$=$2; }
```

```
 | { for(k=j[e]-1;k>0;k--) { w=a[e][k-1]; a[e][k]=powr(a[e][k-1],a[e][k]); printf("Power
Operation %d ^ %d :
%d\n",w,a[e][k],a[e][k-1]); } $$=a[e][0]; j[e]=0; }
 ;
F : digit { $$=$1; printf("Digit : %d\n",$1); }
 | '(' { e++; } E { e--; } ')' { $$=$3; }
2
 ;
%%
int main()
{
//initializing all the variables to zero
 for(e=0;e<5;e++) { x[e]=y[e]=0; j[e]=0; }
 e=0;
// takes input as a expression
 printf("Enter an expression\n");
 yyparse();
 return 0;
}
// if any error yyerror will be called
yyerror()
{
 printf("NITW Error");
}
// when the input is finished yywrap is called to exit the code
int yywrap()
{
 return 1;
}
// power function to calculate m ^ n
int powr(int m,int n)
{
 int ans=1;
 while(n) { ans=ans*m; n--; }
 return ans;
}
```

OUTPUT



```
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ ./a.out
Enter an expression
6*7+2
Digit : 6
Digit : 7
Multiplication Operation of 6 and 7 : 42
Digit : 2
Addition Operation 42 and 2 : 44

Answer : 44
```

2.YACC to generate 3-Address code for given expression.
CODE

LEX

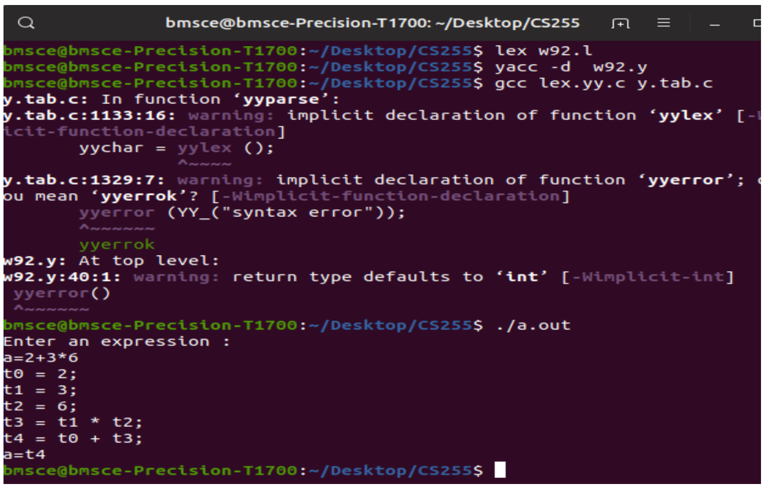
```
d [0-9]+
a [a-zA-Z]+

%{
#include<stdio.h>
#include<stdlib.h>
#include"y.tab.h"
extern int yylval;
extern char iden[20];
%}

%%
{d} { yylval=atoi(yytext); return digit; }
{a} { strcpy(iden,yytext); yylval=1; return id;}
[ \t] {;}
\n return 0;
. return yytext[0];
%%

int yywrap()
{
}
```

YACC

```
%{
#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



```
bmsce@bmsce-Precision-T1700: ~/Desktop/CS255
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ lex w92.l
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ yacc -d  w92.y
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ gcc lex.yy.c y.tab.c
y.tab.c: In function ‘yyparse’:
y.tab.c:1133:16: warning: implicit declaration of function ‘yylex’ [-W
icit-function-declaration]
       yychar = yylex ();
                ^~~~~
y.tab.c:1329:7: warning: implicit declaration of function ‘yyerror’; d
ou mean ‘yyerrok’? [-Wimplicit-function-declaration]
       yyerror (YY_("syntax error"));
       ^~~~~~~
       yyerrok
w92.y: At top level:
w92.y:40:1: warning: return type defaults to ‘int’ [-Wimplicit-int]
 yyerror()
 ^~~~~~~
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$ ./a.out
Enter an expression :
a=2+3*6
t0 = 2;
t1 = 3;
t2 = 6;
t3 = t1 * t2;
t4 = t0 + t3;
a=t4
bmsce@bmsce-Precision-T1700:~/Desktop/CS255$
```