

# VISVESVARAYA TECHNOLOGICAL UNIVERSITY

“JnanaSangama”, Belgaum -590014, Karnataka.



## LAB REPORT on COMPILER DESIGN

*Submitted by*

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*Under the Guidance of*

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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**

**November 2023-February 2024**

**B. M. S. College of Engineering,**

**Bull Temple Road, Bangalore 560019**

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**CERTIFICATE**

This is to certify that the Lab work entitled “**Compiler Design**” carried out by **PRANNAV D(1BM21CS046)**, who is bonafide student of **B. M. S. College of Engineering**. It is in partial fulfilment 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- (22CS5PCCPD)** work prescribed for the said degree.

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### ***DECLARATION***

I, Neha Bhaskar Kamath (1BM21CS113), 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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## Lab 1

### 1.1 Write a program in LEX to recognize different tokens: Keywords, Identifiers, Constants, Operators and Punctuation symbols.

**Code:**

```
%{
```

```

#include<stdio.h>

%} %%

printf|for|void|main|while|do|switch|case|int|char|float|double|if|else {printf("%s-keyword\n",yytext);
, {printf("%s-separator\n",yytext);} ;
{printf("%s-delimiter\n",yytext);}

[a-zA-Z_][a-zA-Z0-9_]* {printf("%s-Identifier\n",yytext);}

">"|"<"|">="|"<="|"==" {printf("%s- Relational operator\n",yytext);}

"=" {printf("%s-assignment operator\n",yytext);}

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

%%

void main()
{
printf("Give an input:\n");
yylex(); } int yywrap()
{ return
1; }

```

## Output

```

neha29@neha-VirtualBox:~/Documents$ lex Week1_identifyKeywords.l
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Give an input:
int sum,x=2,y=3,z;
int-keyword
sum-Identifier
,-separator
x-Identifier
=-assignment operator
2-digit
,-separator
y-Identifier
=-assignment operator
3-digit
,-separator
z-Identifier
;-delimiter

```

## 1.2 Write a program in LEX to count the number of characters and digits in a string.

### Code

```

%{
#include<stdio.h> int
d=0,c=0;
%}
%%

[a-zA-Z] {c++;}
[0-9] {d++;}

.;

```

```

\n {printf("No of characters and digits are %d and %d\n",c,d),c=0,d=0;}

%%

void main()
{
printf("Enter a sentence:\n");
yylex(); } int yywrap()
{ return
1;
}

```

## Output

```

neha29@neha-VirtualBox:~/Documents$ lex Week1_NoOfDigChar.l
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a sentence:
I was born in 2003.
No of characters and digits are 10 and 4
Hello123
No of characters and digits are 5 and 3

```

## 1.3 Write a program in LEX to count the number of vowels and consonants in a string.

### Code

```

%{
#include<stdio.h> int
v=0,c=0;
%}

%%

[AEIOUaeiou] {v++;}
[A-Za-z] {c++;}

\n {printf("No of vowels and consonants are %d and %d\n",v,c),v=0,c=0;}

%%

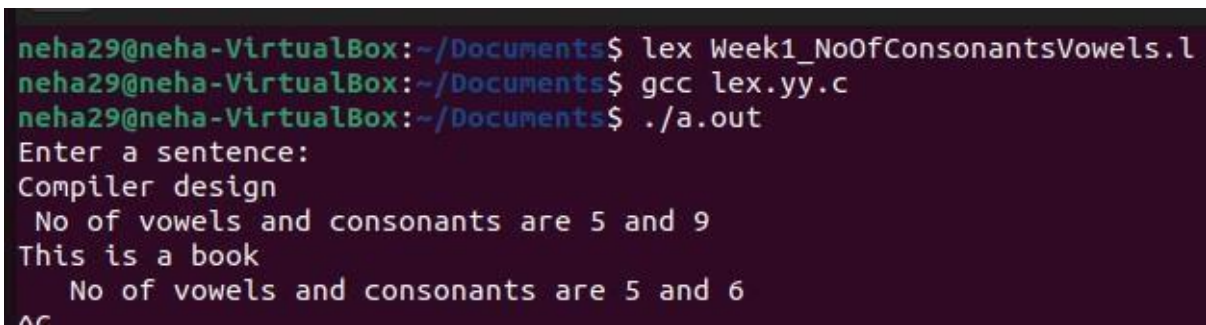
```

```

void main()
{
printf("Enter a sentence:\n");
yylex(); } int yywrap()
{ return
1;
}

```

## Output



```

neha29@neha-VirtualBox:~/Documents$ lex Week1_NoOfConsonantsVowels.l
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a sentence:
Compiler design
  No of vowels and consonants are 5 and 9
This is a book
  No of vowels and consonants are 5 and 6

```

## Lab 2

### 2.1 Write a program in lex to count the number of words in a sentence.

#### Code

```

%{
#include<stdio.h> int
words;
%}
%%
[^\t\n ]+ {words++;}
\n {printf("No of words in the sentence are %d.\n",words),words=0;}
%%
void main() {
printf("Enter a sentence:\n");
yylex(); } int yywrap() {
return 1;
}

```



## Output

```
neha29@neha-VirtualBox:~/Documents$ lex Week2_NoOfWords.l
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a sentence:
My name is Neha
    No of words in the sentence are 4.
I will make things happen.
    No of words in the sentence are 5.
```

## 2.2 Write a program in lex to demonstrate regular definition.

### Code

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

alpha [a-zA-Z0-9]

%%

[a-zA-Z]+ {printf("Characters\n");}
[0-9]+ {printf("Digits");}
{alpha}+ {printf("Invalid input!\n");}

%%

void main() {
printf("Enter a string:\n");
yylex(); } int yywrap() {
return 1;
}
```

## Output

```

neha29@neha-VirtualBox:~/Documents$ lex Week2_RegularDef.l
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a string:
HelloWorld
Characters

1234
Digits
Hello123
Invalid input!

```

## 2.3 Write a program in lex to identify tokens in a program by taking input from a file and printing the output on the terminal.

### Code

```

%{
#include<stdio.h>

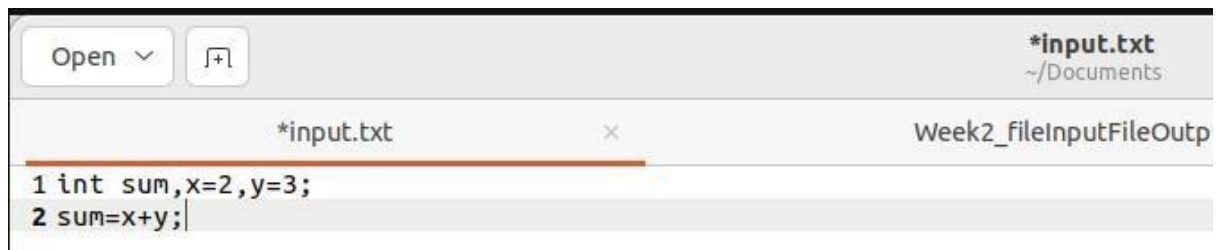
%} %%

char|int|float {printf("%s is a keyword.\n",yytext);}
[a-zA-Z][a-zA-Z0-9]* {printf("%s is an identifier.\n",yytext);}
, {printf("%s is a separator.\n",yytext);}
; {printf("%s is a delimiter.\n",yytext);}
"=" {printf("%s is an assignment operator.\n",yytext);}
"+"|"-"|"*"|"/" {printf("%s is a binary operator.\n",yytext);}
[0-9]+ {printf("%s is/are digit(s).\n",yytext);}
\n ;
%%

void main()
{
yyin=fopen("input.txt","r");
yylex(); fclose(yyin);
} int
yywrap()
{ return
1;
}

```

## Output



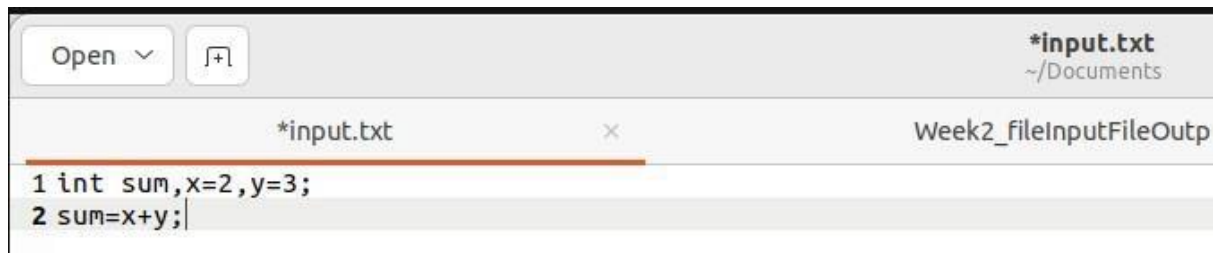
```
neha29@neha-VirtualBox:~/Documents$ lex Week2_FileInput.l
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
int is a keyword.
sum is an identifier.
, is a separator.
x is an identifier.
= is an assignment operator.
2 is/are digit(s).
, is a separator.
y is an identifier.
= is an assignment operator.
3 is/are digit(s).
; is a delimiter.
sum is an identifier.
= is an assignment operator.
x is an identifier.
+ is a binary operator.
y is an identifier.
; is a delimiter.
neha29@neha-VirtualBox:~/Documents$
```

## 2.4 Write a program in lex to identify tokens in a program by taking input from a file and printing the output in another file.

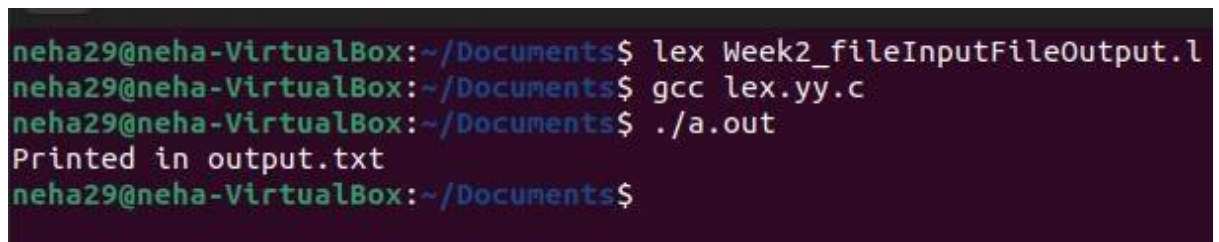
### Code

```
%{  
#include<stdio.h>  
%}  
%%  
char|int|float {fprintf(yyout,"%s is a keyword.\n",yytext);}   
[a-zA-Z][a-zA-Z0-9]* {fprintf(yyout,"%s is an identifier.\n",yytext);}   
, {fprintf(yyout,"%s is a separator.\n",yytext);} ;   
{fprintf(yyout,"%s is a delimiter.\n",yytext);}   
"=" {fprintf(yyout,"%s is an assignment operator.\n",yytext);}   
"+"|"-"|"*"|"/" {fprintf(yyout,"%s is a binary operator.\n",yytext);}   
[0-9]+ {fprintf(yyout,"%s is/are digit(s).\n",yytext);}   
  
\n ;  
%%  
  
void main()  
{  
yyin=fopen("input.txt","r");  
yyout=fopen("output.txt","w"); yylex();  
printf("Printed in output.txt\n");  
fclose(yyin); fclose(yyout);  
}  
int  
yywrap()  
{ return  
1;  
}
```

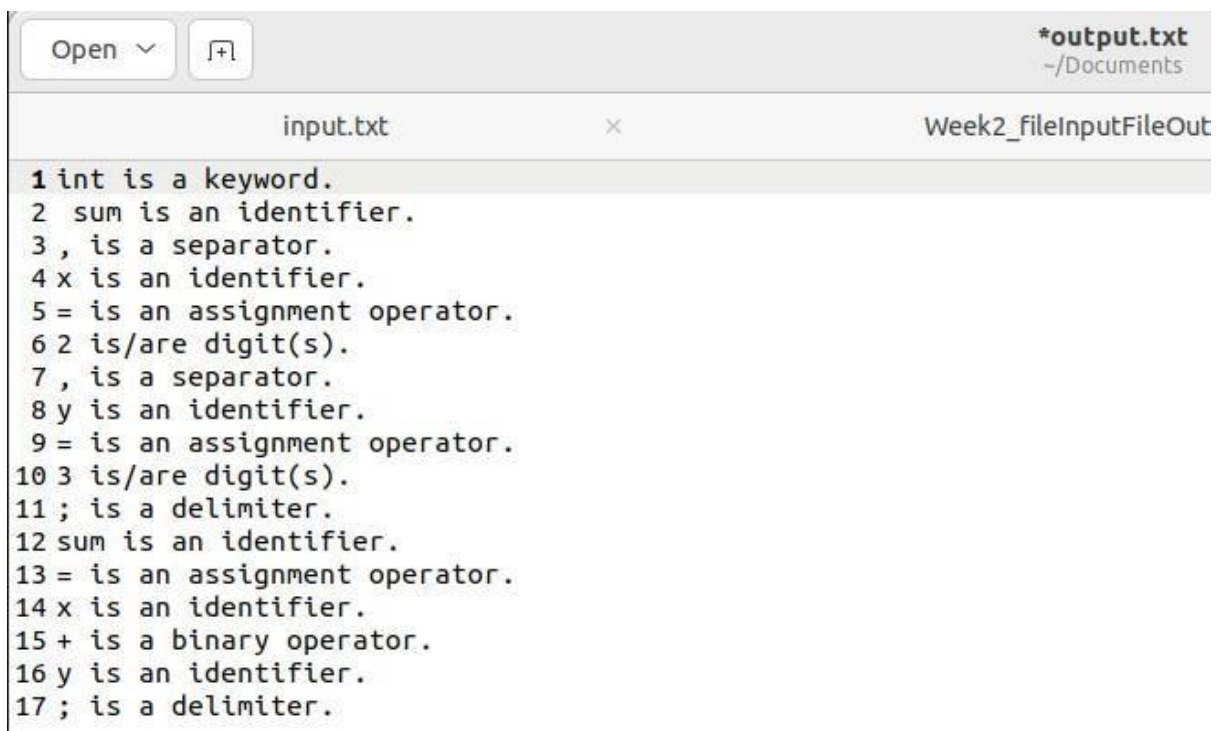
## Output



```
*input.txt
1 int sum,x=2,y=3;
2 sum=x+y;
```



```
neha29@neha-VirtualBox:~/Documents$ lex Week2_fileInputFileOutput.l
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Printed in output.txt
neha29@neha-VirtualBox:~/Documents$
```



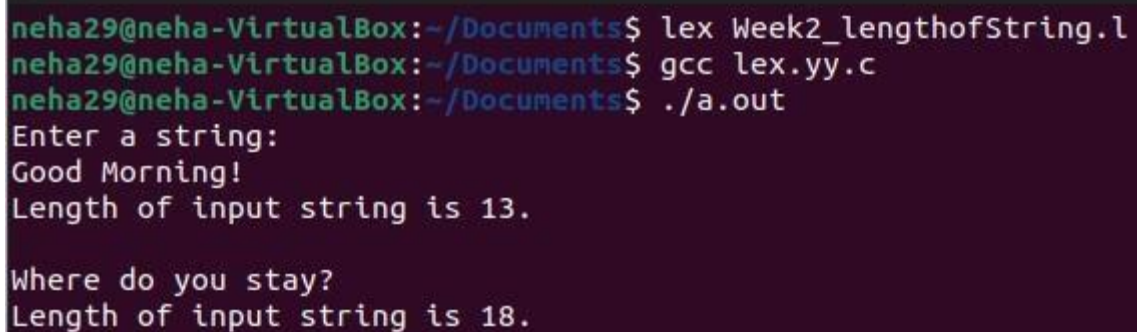
```
*output.txt
input.txt
1 int is a keyword.
2 sum is an identifier.
3 , is a separator.
4 x is an identifier.
5 = is an assignment operator.
6 2 is/are digit(s).
7 , is a separator.
8 y is an identifier.
9 = is an assignment operator.
10 3 is/are digit(s).
11 ; is a delimiter.
12 sum is an identifier.
13 = is an assignment operator.
14 x is an identifier.
15 + is a binary operator.
16 y is an identifier.
17 ; is a delimiter.
```

## 2.5 Write a program in lex to find the length of the input string.

## Code

```
%{  
#include<stdio.h>  
%}  
%%  
[a-zA-Z0-9.,!? \t]+ {printf("Length of input string is %d.\n",yylen);}  
%%  
void main() {  
printf("Enter a string:\n");  
yylex(); } int yywrap() {  
return 1;  
}
```

## Output



```
neha29@neha-VirtualBox:~/Documents$ lex Week2_lengthofString.l  
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c  
neha29@neha-VirtualBox:~/Documents$ ./a.out  
Enter a string:  
Good Morning!  
Length of input string is 13.  
  
Where do you stay?  
Length of input string is 18.
```

## Lab 3

### 3.1 Write a program in LEX to recognize Floating Point Numbers.

#### Code

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

```

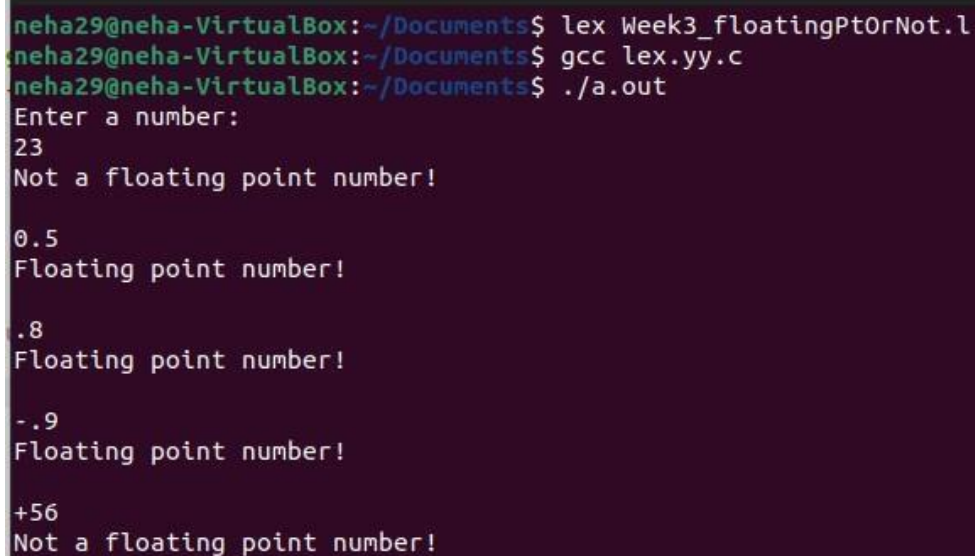
%%
[+-]?[0-9]*[.][0-9]* {printf("Floating point number!\n");};
[+-]?[0-9][0-9]* {printf("Not a floating point number!\n");};
%%

int yywrap()
{ return 1; }

void main()
{
printf("Enter a number:\n");
yylex(); }

```

## Output



```

neha29@neha-VirtualBox:~/Documents$ lex Week3_floatingPtOrNot.l
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a number:
23
Not a floating point number!

0.5
Floating point number!

.8
Floating point number!

-.9
Floating point number!

+56
Not a floating point number!

```

**3.2 Read and input sentence, and check if it is compound or simple. If a sentence has the word- and , or ,but ,because ,if ,then ,nevertheless then it is compound else it is simple.**

## Code

```

%{
#include<stdio.h> int
flag=0;
%} %%

if|then|but|because|nevertheless|and|or {flag=1;}

. ;

\n {return 0;}

%%

```

```

int yywrap()
{ return 1;
} void
main()
{
printf("Enter a sentence:\n");
yylex(); if(flag==1)
printf("Compound sentence!\n"); else
printf("Simple sentence!\n");
}

```

### Output

```

neha29@neha-VirtualBox:~/Documents$ lex Week3_compoundOrSimple.l
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a sentence:
This is a car.
Simple sentence!
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a sentence:
She is good at singing and dancing.
Compound sentence!
neha29@neha-VirtualBox:~/Documents$

```

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

#### Code

```

%{
#include<stdio.h> int
flag=0;
%}
%%

.*[?|!|.]$ {flag=1;}
.* {flag=0;}
\n {return 0;}
%%

int yywrap()
{ return 1;
} void
main()

```



```
{  
printf("Enter a sentence:\n");  
yylex(); if(flag==1)  
printf("Ends with a punctuation!\n"); else  
printf("Does not end with punctuation!\n");  
}
```

## Output

```
neha29@neha-VirtualBox:~/Documents$ lex Week3_endsWithPunc.l  
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c  
neha29@neha-VirtualBox:~/Documents$ ./a.out  
Enter a sentence:  
Is this yours?  
Ends with a punctuation!  
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c  
neha29@neha-VirtualBox:~/Documents$ ./a.out  
Enter a sentence:  
Amazing!  
Ends with a punctuation!  
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c  
neha29@neha-VirtualBox:~/Documents$ ./a.out  
Enter a sentence:  
You are good  
Does not end with punctuation!  
neha29@neha-VirtualBox:~/Documents$
```

### **3.4 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).**

#### **Code**

```
%{
#include<stdio.h> int
flag=0;
%}
%%
^(an|An|The|the|A|a)[ " ].* {flag=1;}
.* {flag=0;}
\n {return 0;}
%%
int yywrap()
{ return 1;
} void
main()
{
printf("Enter a sentence:\n");
yylex(); if(flag==1)
printf("Starts with an article!\n"); else
printf("Does not start with an article!\n");
}
```

## Output

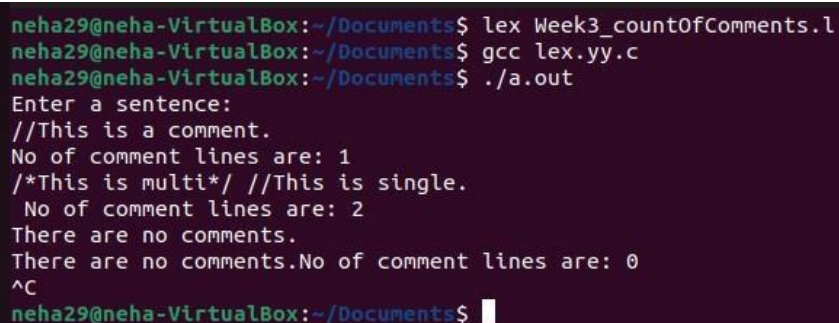
```
neha29@neha-VirtualBox:~/Documents$ lex Week3_startsWithArticle.l
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a sentence:
This is a good idea.
Does not start with an article!
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a sentence:
Amazing experience!
Does not start with an article!
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a sentence:
The sun rises in the east.
Starts with an article!
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a sentence:
An apple a day keeps the doctor away.
Starts with an article!
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a sentence:
A book is lying on the table.
Starts with an article!
neha29@neha-VirtualBox:~/Documents$
```

**3.5 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.**

#### Code

```
%{  
#include<stdio.h> int  
  
c=0;  
%}  
%%  
"\\\\"[^*]*\\*+([\\/]*[\\^*]*\\*+)*\\ {c++;}  
"//".* {c++;}  
  
. ECHO;  
%%  
  
int yywrap()  
{ return 1;  
}  
void  
main()  
{  
yyin=fopen("input.txt","r");  
yyout=fopen("output.txt","w"); yylex();  
printf("The number of comments are:%d\\n",c);  
fclose(yyin); fclose(yyout); }
```

#### Output



```
neha29@neha-VirtualBox:~/Documents$ lex Week3_countOfComments.l  
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c  
neha29@neha-VirtualBox:~/Documents$ ./a.out  
Enter a sentence:  
//This is a comment.  
No of comment lines are: 1  
/*This is multi*/ //This is single.  
No of comment lines are: 2  
There are no comments.  
There are no comments.No of comment lines are: 0  
^C  
neha29@neha-VirtualBox:~/Documents$
```

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

#### Code

```
%{
```

```

#include<stdio.h>

%}

%%

[+|-][0-9]+ {printf("Signed number!\n");}

[0-9]+ {printf("Unsigned number!\n");}

%%

int yywrap()
{ return 1;
} void
main()
{
printf("Enter a number:\n");
yylex(); }

```

## Output

```

neha29@neha-VirtualBox:~/Documents$ lex Week3_signedorNot.l
lex: can't open Week3_signedorNot.l
neha29@neha-VirtualBox:~/Documents$ lex Week3_signedOrNot.l
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a number:
123
Unsigned number!

-123
Signed number!

+123
Signed number!

^C
neha29@neha-VirtualBox:~/Documents$

```

## Lab 4

**4.1 Write a LEX program that copies a file, replacing each nonempty sequence of white spaces by a single blank.**

### Code

```

%{
#include<stdio.h>

%}

```

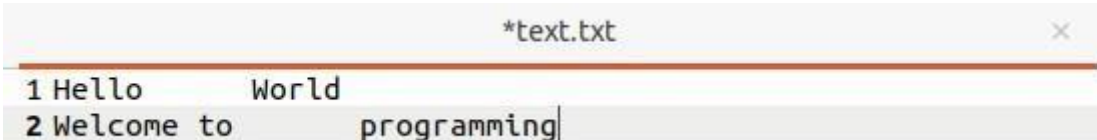
```

%%
[ \t]+ {fprintf(yyout," ");}
.\n {fprintf(yyout,"%s",yytext);}
%%

void main()
{
yyin=fopen("text.txt","r");
yyout=fopen("print.txt","w");
yylex(); fclose(yyin);
fclose(yyout);
printf("Printed!\n");
} int
yywrap()
{ return
1;
}


```

## Output



A screenshot of a text editor window titled "\*text.txt". The window contains two lines of text. The first line is "1 Hello World" and the second line is "2 Welcome to programming|". The cursor is at the end of the second line.

```
neha29@neha-VirtualBox:~/Documents$ lex Week4_ReplaceSpaces.l
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Printed!
neha29@neha-VirtualBox:~/Documents$
```

Open ▾  print.txt  
~/Documents

```
1 Hello World
2 Welcome to programming
```

## 4.2 Write a LEX program to recognize the following tokens over the alphabets {0,1,...,9}

### 4.2.1 The set of all string ending in 00.

#### Code

```
%{
#include<stdio.h> int
flag=0;
%}
%%
[0-9]+[00] {flag=1;}
. ;
```

```

\n {return 0;}

%%

void main()
{
printf("Enter a string:\n");
yylex(); if(flag==1)
printf("Ends with 0.\n");
else
printf("Does not end with 0.\n");
} int
yywrap()
{ return
1; }

```

### Output

```

neha29@neha-VirtualBox:~/Documents$ lex Week4_EndsWith0.l
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a string:
12300
Ends with 0.
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a string:
145
Does not end with 0.
neha29@neha-VirtualBox:~/Documents$

```

### 4.2.2 The set of all strings with three consecutive 222's.

#### Code

```

%{
#include<stdio.h> int
flag=0;
%}
%%
[0-9]*[2][2][2][0-9]* {flag=1;}
. ;
\n {return 0;}
%%

void main() {

```

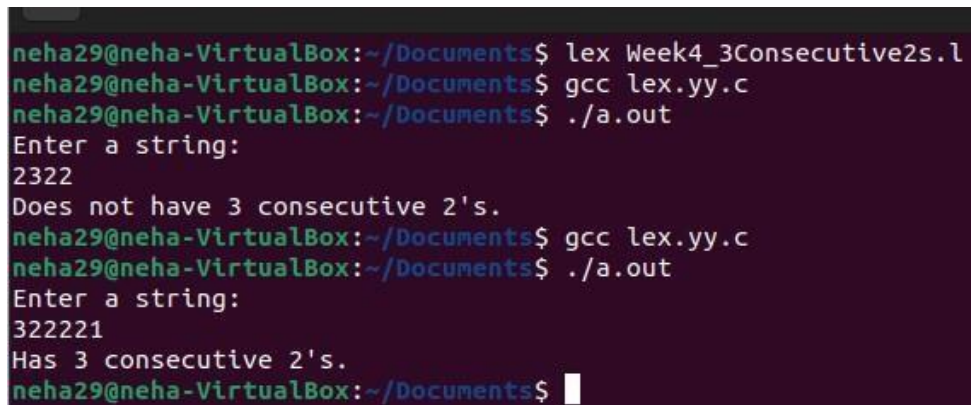


```

printf("Enter a string:\n");
yylex(); if(flag==1)
printf("Has 3 consecutive 2's.\n"); else
printf("Does not have 3 consecutive 2's.\n");
} int
yywrap() {
return 1; }

```

## Output



```

neha29@neha-VirtualBox:~/Documents$ lex Week4_3Consecutive2s.l
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a string:
2322
Does not have 3 consecutive 2's.
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a string:
322221
Has 3 consecutive 2's.
neha29@neha-VirtualBox:~/Documents$

```

### 4.2.3 The set of all string such that every block of five consecutive symbols contains at least two 5's. Code

```

%{
#include<stdio.h> int
i,count=0,flag;
%}
%%
.{1,5} {flag=0; for(i=0;i<5;i++)
{
int c=yytext[i]-'0';
if(c==5)
{
count++;
if(count==2)
{
flag=1;
break;
}
}
}
}

```

```

    }
count=0;

printf("yytext:%s,flag(1 if no of 5 is atleast 2):%d\n",yytext,flag);
if(flag!=1)
{
    printf("Not a valid string!\n");
return 0;
}
}

```

```

\n {return 0;}

%%

void main()
{ printf("Enter a
string:\n"); yylex();
if(flag==1) printf("Valid
string.\n"); } int yywrap()
{ return 1; }

```

## Output

```

neha29@neha-VirtualBox:~/Documents$ lex Week4_BlocksOf5.1
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a string:
1525558566
yytext:15255,flag(1 if no of 5 is atleast 2):1
yytext:58566,flag(1 if no of 5 is atleast 2):1
Valid string.
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a string:
12345455
yytext:12345,flag(1 if no of 5 is atleast 2):0
Not a valid string!
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a string:
5432512345
yytext:54325,flag(1 if no of 5 is atleast 2):1
yytext:12345,flag(1 if no of 5 is atleast 2):0
Not a valid string!
neha29@neha-VirtualBox:~/Documents$ █

```

#### 4.2.4 The set of all strings beginning with a 1 which, interpreted as the binary representation of an integer, is congruent to zero modulo 5.

##### Code

```
%{
#include<stdio.h> int
c,i,flag=1,sum=0,power=1;
%}
%%
^1[01]* {for(i=yytext[0];i<yytext[0]+1;i++)
    {
        c=yytext[i]-'0';
        sum+=c*power;        power*=2;
    }
    printf("Decimal representation:%d\n",sum);
if(sum%5!=0)
    {
        printf("Not congruent to modulo 5.\n");
        sum=0;        power=1;
    }
else
    {
        printf("Congruent to modulo 5.\n");
        sum=0;        power=1;
    }
}
.* {printf("Not a binary number.\n");}
\n {return 0;}
%%
void main()
```

```
{  
printf("Enter a string:\n");  
yylex(); }  
int yywrap()  
{ return 1; }
```

## Output

```
neha29@neha-VirtualBox:~/Documents$ lex Week4_BinRepCongruentTo5.l  
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c  
neha29@neha-VirtualBox:~/Documents$ ./a.out  
Enter a string:  
1010  
Decimal representation:10  
Congruent to modulo 5.  
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c  
neha29@neha-VirtualBox:~/Documents$ ./a.out  
Enter a string:  
101  
Decimal representation:5  
Congruent to modulo 5.  
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c  
neha29@neha-VirtualBox:~/Documents$ ./a.out  
Enter a string:  
111  
Decimal representation:7  
Not congruent to modulo 5.  
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c  
neha29@neha-VirtualBox:~/Documents$ ./a.out  
Enter a string:  
123  
Not a binary number.  
neha29@neha-VirtualBox:~/Documents$
```

#### 4.2.5 The set of all strings such that the 10th symbol from the right end is 1.

##### Code

```
%{
#include<stdio.h> int
flag=0;
%}
%%
[0-9]*1[0-9][0-9][0-9][0-9][0-9][0-9][0-9][0-9] {flag=1;}
. ;
\n {return 0;}
%%
void main() {
printf("Enter a string:\n");
yylex(); if(flag==1)
printf("10th symbol from right is 1.\n"); else
printf("10th symbol from right is not 1.\n");
} int
yywrap()
{ return
1; }
```

##### Output

```

neha29@neha-VirtualBox:~/Documents$ lex Week4_TenthSymbolIs1.l
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a string:
11234345236
10th symbol from right is 1.
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a string:
23123456123
10th symbol from right is not 1.
neha29@neha-VirtualBox:~/Documents$

```

#### 4.2.6 The set of all four digits numbers whose sum is 9.

##### Code

```

%{
#include<stdio.h> int
sum=0,i,flag=0;
%}
%%
[0-9][0-9][0-9][0-9] {for(i=0;i<yyleng;i++)
    {
        sum+=yytext[i]-'0';
    }
if(sum==9)
    {
flag=1;
sum=0;
    }
    else
    {
flag=0;
sum=0;
    }
}

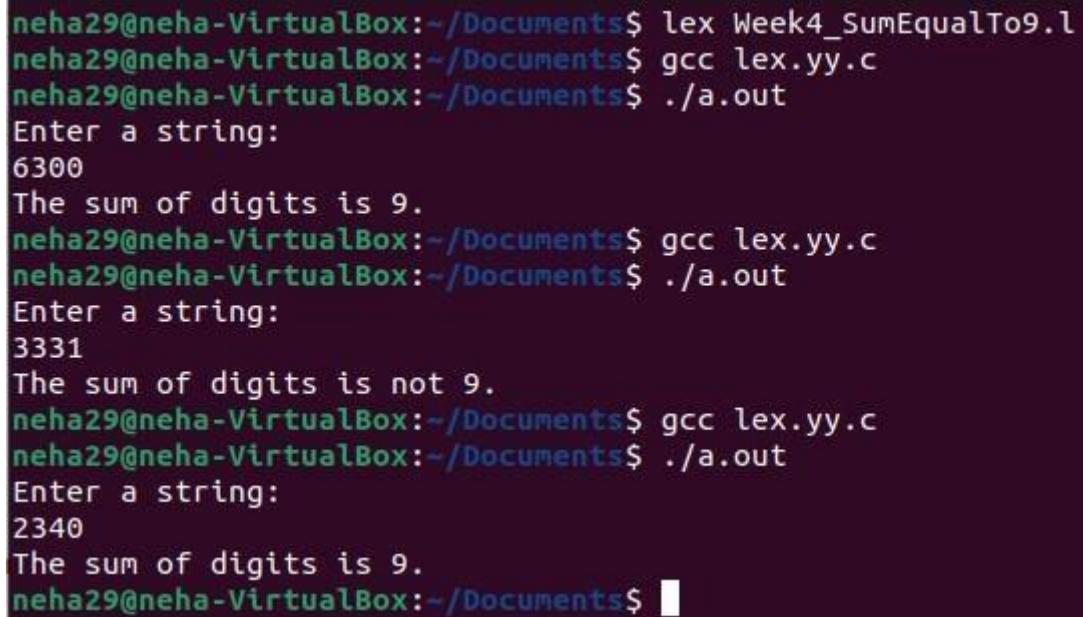
\n {return 0;}
%%

void main() {
printf("Enter a string:\n");
yylex(); if(flag==1)

```

```
printf("The sum of digits is 9.\n"); else
printf("The sum of digits is not 9.\n");
} int
yywrap() {
return 1; }
```

## Output



```
neha29@neha-VirtualBox:~/Documents$ lex Week4_SumEqualTo9.l
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a string:
6300
The sum of digits is 9.
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a string:
3331
The sum of digits is not 9.
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a string:
2340
The sum of digits is 9.
neha29@neha-VirtualBox:~/Documents$
```

#### 4.2.7 The set of all four digital numbers, whose individual digits are in ascending order from left to right.

##### Code

```
%{
#include<stdio.h> int
c,i,flag=1;
%}
%%
[0-9][0-9][0-9][0-9] {for(i=0;i<yyleng-1;i++)
    {
        if(yytext[i]>=yytext[i+1])
        {
flag=0;
break;
        }
    }
}
\n {return 0;}
%%
void main()
{
printf("Enter a string:\n");
yylex(); if(flag==1)
printf("The digits are in ascending order.\n"); else
printf("The digits are not in ascending order.\n");
} int
yywrap()
{ return
1;
}
```

##### Output



```
neha29@neha-VirtualBox:~/Documents$ lex Week4_DigAscOrder.l
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a string:
1235
The digits are in ascending order.
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a string:
1243
The digits are not in ascending order.
neha29@neha-VirtualBox:~/Documents$
```

## Lab 5

Write a C program to design lexical analysis to recognize any five keywords, identifiers, numbers, operators and punctuations.

### Code

```
#include <stdio.h>

#include <string.h>

#include <ctype.h>
```

```

void lexicalAnalyzer(char input_code[]) {

    char *keywords[] = {"if", "else", "while", "for", "return"};   char
*operators[] = {"+", "-", "*", "/", "=", "==", "<", ">", "<=", ">="};   char
*punctuations[] = {"", ";", "(", ")", "{", "}" };

    char *token = strtok(input_code, " \t\n");

    while (token != NULL) {      if
(isdigit(token[0])) {
printf("Number: %s\n", token);

        } else if (isalpha(token[0]) || token[0] == '_' ) {
int isKeyword = 0;

            for (int i = 0; i < sizeof(keywords) / sizeof(keywords[0]); i++) {
if (strcmp(token, keywords[i]) == 0) {                printf("Keyword:
%s\n", token);                isKeyword = 1;                break;

                }

            }

            if (!isKeyword) {

                printf("Identifier: %s\n", token);

            }

            } else if (strchr("+-*/= <>(){}[]", token[0]) != NULL) {
printf("Operator: %s\n", token);

            }

            else if(strchr(";", token[0]) != NULL)

            {

                printf("Punctuation:%s\n", token);

            }

            token = strtok(NULL, " \t\n");

        }

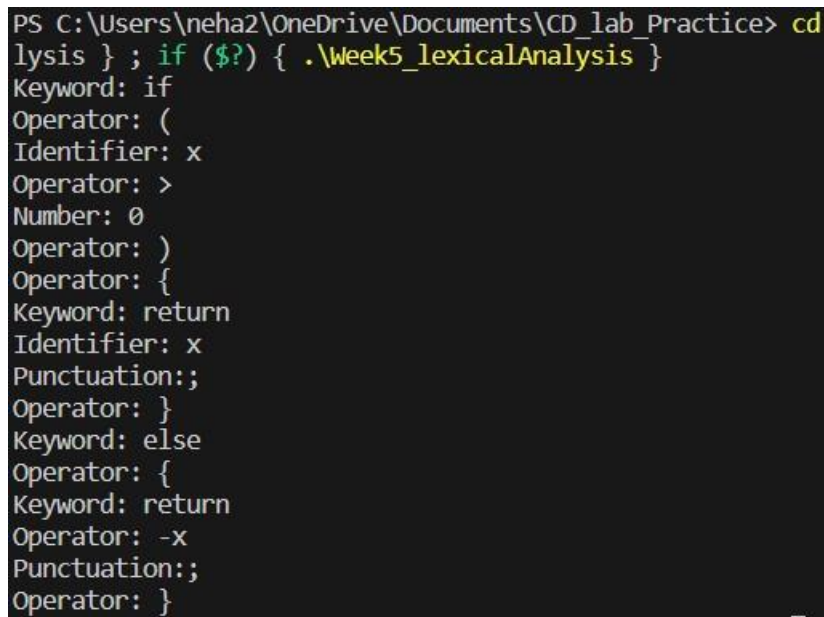
    }

int main() {

```

```
char input_code[] = "if ( x > 0 ) { return x ; } else { return -x ; }";  
lexicalAnalyzer(input_code); return 0; }
```

## Output



```
PS C:\Users\neha2\OneDrive\Documents\CD_lab_Practice> cd lysis } ; if ($?) { .\Week5_lexicalAnalysis }  
Keyword: if  
Operator: (  
Identifier: x  
Operator: >  
Number: 0  
Operator: )  
Operator: {  
Keyword: return  
Identifier: x  
Punctuation:;  
Operator: }  
Keyword: else  
Operator: {  
Keyword: return  
Operator: -x  
Punctuation:;  
Operator: }
```

## Lab 6

Write a program to perform recursive descent parsing on the following grammar:

**S->cAd**

**A->ab | a**

### Code

```
#include <stdio.h>  
#include <stdlib.h>  
char input[100]; int  
ind = 0;  
void match(char expected)  
{  
    if (input[ind] == expected)
```

```

    {
ind++;
    }
} void A();
void S() {
match('c');
A();
match('d');
} void
A() {
    if (input[ind] == 'a')
    {
        printf("Hello\n");
match('a');
match('b');
    } /*else if (input[ind] == 'a')
    {
        printf("Hi!\n");
        match('a');
    }*/ else
    {
        printf("Parsing failed.\n", ind);
exit(1);
    }
} int main() {    printf("Enter the
input string:\n");    scanf("%s",
input);

    S();

    if (input[ind] == '$') {
printf("Parsing successful.\n");
    } else {
        printf("Parsing failed. Extra characters found.\n");

```

```
}
```

```
return 0; }
```

## Output

```
PS C:\Users\neha2\OneDrive\Documents\CD_lab_Practice> cd
Descent } ; if ($?) { .\Week6_RecursiveDescent }
Enter a string:
cad$
Valid string!
PS C:\Users\neha2\OneDrive\Documents\CD_lab_Practice> cd
Descent } ; if ($?) { .\Week6_RecursiveDescent }
Enter a string:
caad$
Invalid String!
PS C:\Users\neha2\OneDrive\Documents\CD_lab_Practice> cd
Descent } ; if ($?) { .\Week6_RecursiveDescent }
Enter a string:
cabd$
Valid string!
```

## Lab 7

**7.1 Write a program in YACC to design a suitable grammar for evaluation of arithmetic expression having +, -, \* and /.**

### Code LEX

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

## YACC

```
%{  
  
#include<stdio.h>  
  
#include<stdlib.h> int  
  
yyerror(const char *s); int  
  
yylex(void);  
  
%}  
  
%token num;  
  
%left '+' '-'  
  
%left '*' '/'  
  
%left ')'   
  
%left '('  
  
%%  
  
s:e {printf("Valid expression!\n");  
printf("Result:%d\n",$$);  exit(0);  
  }  
;  
  
e:e+'e' {$$=$1+$3;} |e-'e'  
  {$$=$1-$3;}  
  
|e'*e' {$$=$1*$3;}  
  
|e'/e' {$$=$1/$3;}  
  
|('e') {$$=$2;}  
  
|num {$$=$1;}  
  
;  
  
%%  
  
void main() {  
  
printf("Enter an arithmetic expression:\n");  
  
yyparse(); } int yyerror(const char *s)  
  
{ printf("Invalid  
expression!\n"); return 0; }
```

## **Output**

```

neha29@neha-VirtualBox:~/Documents/Lex_Programs$ lex week7_yacc_calci.l
neha29@neha-VirtualBox:~/Documents/Lex_Programs$ yacc Week7_yacc_calci.y
neha29@neha-VirtualBox:~/Documents/Lex_Programs$ yacc -d Week7_yacc_calci.y
neha29@neha-VirtualBox:~/Documents/Lex_Programs$ gcc lex.yy.c y.tab.c
neha29@neha-VirtualBox:~/Documents/Lex_Programs$ ./a.out
Enter an arithmetic expression:
2+3*4
Valid expression!
Result:14
neha29@neha-VirtualBox:~/Documents/Lex_Programs$ gcc lex.yy.c y.tab.c
neha29@neha-VirtualBox:~/Documents/Lex_Programs$ ./a.out
Enter an arithmetic expression:
2++3-
Invalid expression!
neha29@neha-VirtualBox:~/Documents/Lex_Programs$

```

**7.2 Write a program in YACC to recognize strings of the form  $\{(a^n)b, n \geq 5\}$ .**

### Code

#### LEX

```

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

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

int yywrap()
{ return
1; }

```

#### YACC

```

%{
#include<stdio.h>
#include<stdlib.h> int
yyerror(char *s); int
yylex(void);
}%
%token A

```

```

%token B
%token NL
%%
smtr:A A A A S B NL {printf("Parsed using the rule (a^n)b, n>=5.\nValid String!\n");}
;
S:S A
|
;
%%
void main() {
printf("Enter a string!\n");
yyparse(); } int
yyerror(char *s) {
printf("Invalid String!\n");
return 0; }

```

## Output

```

neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ lex Week7_yacc_StringMatch.l
neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ yacc Week7_yacc_StringMatch.y
neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ yacc -d Week7_yacc_StringMatch.y
neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ gcc lex.yy.c y.tab.c
neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ ./a.out
Enter a string!
aaaaaaab
Parsed using the rule (a^n)b, n>=5.
Valid String!
ab
Invalid String!
neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ gcc lex.yy.c y.tab.c
neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ ./a.out
Enter a string!
abc
Invalid String!

```



### 7.3 Write a program in YACC to generate syntax tree for a given arithmetic expression.

#### Code

##### LEX

```
%{  
#include<stdio.h>  
#include<stdlib.h>  
#include "y.tab.h" extern  
int yylval;  
%}  
%%  
[0-9]+ {yylval=atoi(yytext);return digit;}  
[t] ;  
[n] return 0;  
. return yytext[0];  
%%  
int yywrap()  
{ return  
1; }
```

##### YACC

```
%{  
#include <math.h>  
#include<ctype.h>  
#include<stdio.h>  
#include<stdlib.h>  
#include<string.h>  
int yyerror(char *s);  
int yylex(void); 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);
%}

%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(char *s)
{
printf("NITW Error\n");
return 0; }

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

```

neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ lex Week7_yacc_SyntaxTree.l
neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ yacc Week7_yacc_SyntaxTree.y
neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ yacc -d Week7_yacc_SyntaxTree.y
neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ gcc lex.yy.c y.tab.c
neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ ./a.out
Enter an expression:
2*3+5*4
Operator Node -> Index : 6, Value : +, Left Child Index : 2,Right Child Index : 5
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
Operator Node -> Index : 5, Value : *, Left Child Index : 3,Right Child Index : 4
Digit Node -> Index : 3, Value : 5
Digit Node -> Index : 4, Value : 4
neha29@neha-VirtualBox:~/Documents/LexLabPrograms$

```

## Lab 8

### 8.1 Write a program in YACC to convert infix to postfix expression.

#### Code

#### LEX

```

%{
#include<stdio.h>

```

```

#include<stdlib.h>

#include "y.tab.h" extern

int yylval;

%}

%%

[0-9]+ {yylval=atoi(yytext);return num;}

[\t] ;

\n {return 0;}

. {return yytext[0];}

%%

int yywrap()

{

}

```

## YACC

```

%{

#include<stdio.h>

#include<stdlib.h> int

yyerror(const char *s); int

yylex(void);

%}

%token num

%left '+' '-'

%left '*' '/'

%left ')'

%left '('

%right '^'

%%

s:e {printf("\n");}

;

e:e+'t' {printf("+");}

|e-'t' {printf("-");}

|t

;

t:t*'h' {printf("*");}

```

```

|t/'h {printf("/");}

|h

;

h:f^'h {printf("^");}

|f;

f:('e')

|num {printf("%d", $1);}

;

%%

void main() { printf("Enter an infix
expression:\n"); yyparse(); } int
yyerror(const char *s) {
printf("Invalid infix expression!\n");
return 0; }

```

## Output

```

neha29@neha-VirtualBox:~/Documents/Lex_Programs$ lex Week8_yacc_InfixToPostfix.l
neha29@neha-VirtualBox:~/Documents/Lex_Programs$ yacc Week8_yacc_InfixToPostfix.y
neha29@neha-VirtualBox:~/Documents/Lex_Programs$ gcc lex.yy.c y.tab.c
neha29@neha-VirtualBox:~/Documents/Lex_Programs$ ./a.out
Enter an infix expression:
2+3*8/4^3-3
238*43^/+3-
neha29@neha-VirtualBox:~/Documents/Lex_Programs$ █

```

## Lab 9

### 9.1 Write a program in YACC to generate three address code for a given expression.

#### Code

#### LEX

```

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

```

```

int yywrap()

```

```

{ return
1; }

```

## YACC

```

%{
#include <math.h>
#include<ctype.h>
#include<stdio.h>
int yyerror(char *s);
int yylex(void); 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; } int

yyerror(char *s)
{
printf("Invalid expression!"); return
0;
}

```

## Output

```

neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ lex Week9_AddressCode.l
neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ yacc Week9_AddressCode.y
neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ yacc -d Week9_AddressCode.y
neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ gcc lex.yy.c y.tab.c
neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ ./a.out
Enter an expression:
a=2*3/6-4
t0 = 2;
t1 = 3;
t2 = t0 * t1;
t3 = 6;
t4 = t2 / t3;
t5 = 4;
t6 = t4 - t5;
a=t6

```

