

# 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)**

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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 **Dhavan SK(1BM21CS054)** , 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, Dhavan SK (1BM21CS054), 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. Sonika D Sharma, 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);}

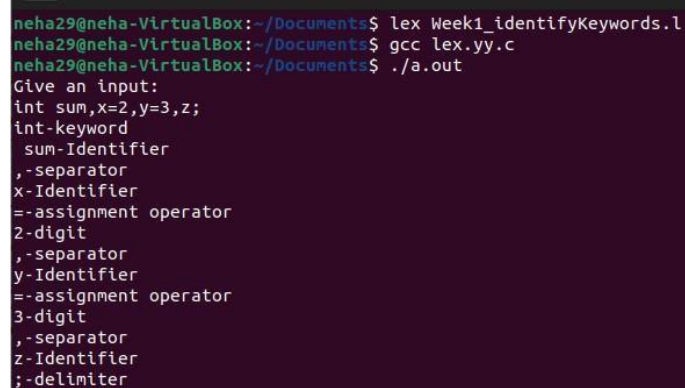
[0-9]+ {printf("%s-digit\n",yytext);}

%%

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++;}

.;

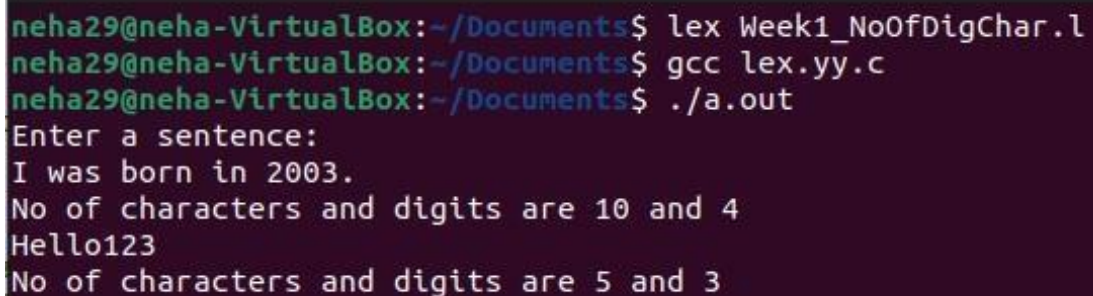
\n {printf("No of characters and digits are %d and %d\n",c,d),c=0,d=0;}

%%

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++;}

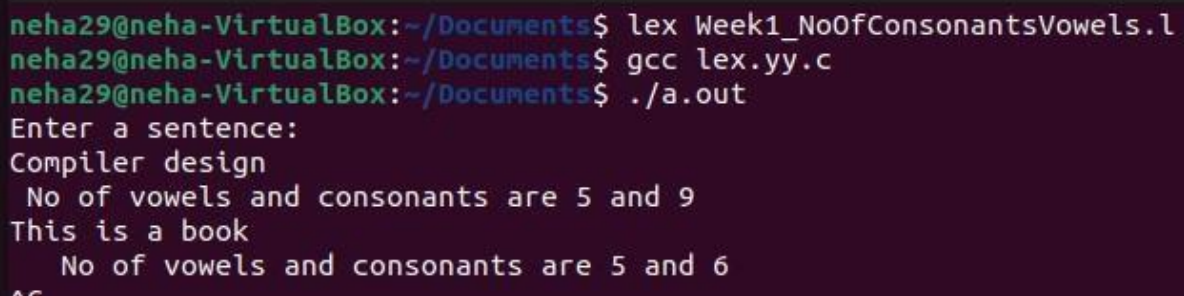
\n {printf("No of vowels and consonants are %d and %d\n",v,c),v=0,c=0;}

%%

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
AC
```



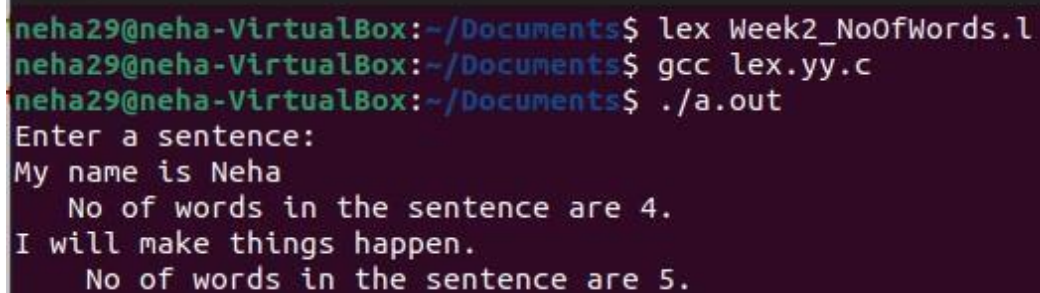
## Lab 2

### 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]

%%

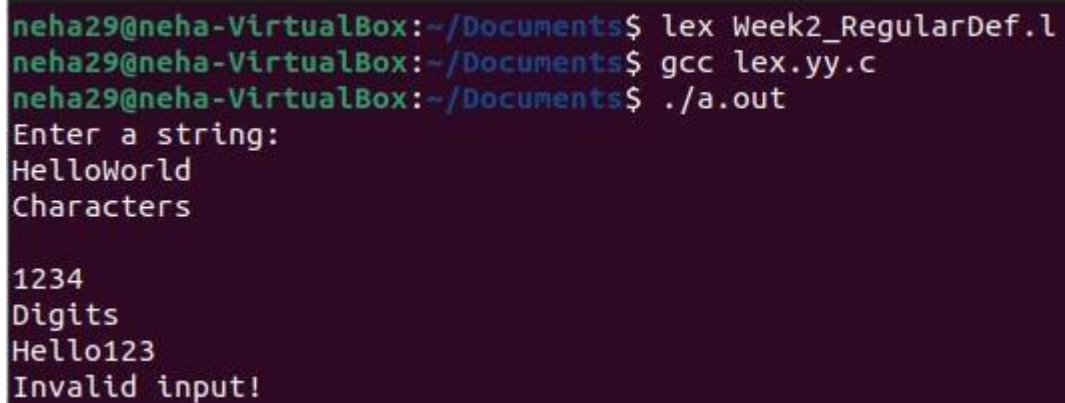
[a-zA-Z]+ {printf("Characters\n");}
[0-9]+ {printf("Digits");}
{alpha}+ {printf("Invalid input!\n");}

%%

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

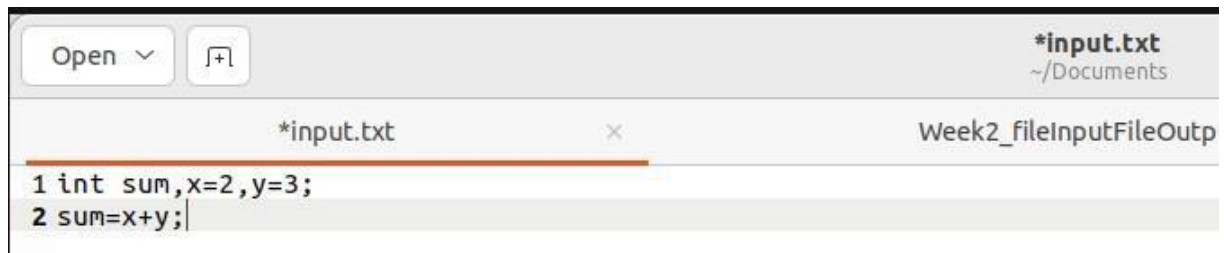
1234
Digits
Hello123
Invalid input!
```

## 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



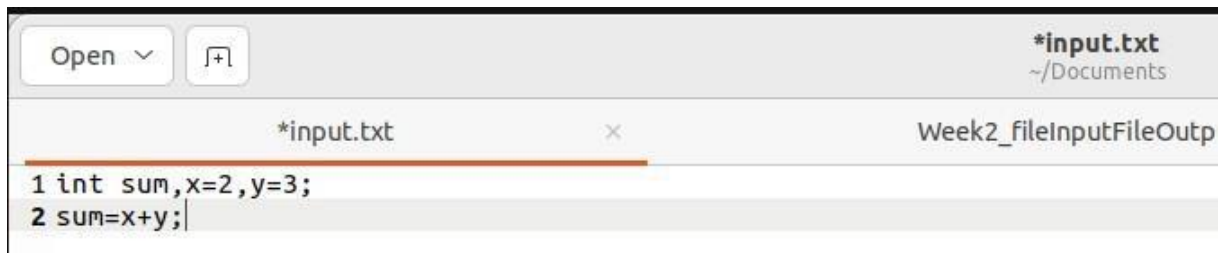
```
neha29@neha-VirtualBox:~/Documents$ lex Week2_FileInput.l
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
int is a keyword.
sum is an identifier.
, is a separator.
x is an identifier.
= is an assignment operator.
2 is/are digit(s).
, is a separator.
y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

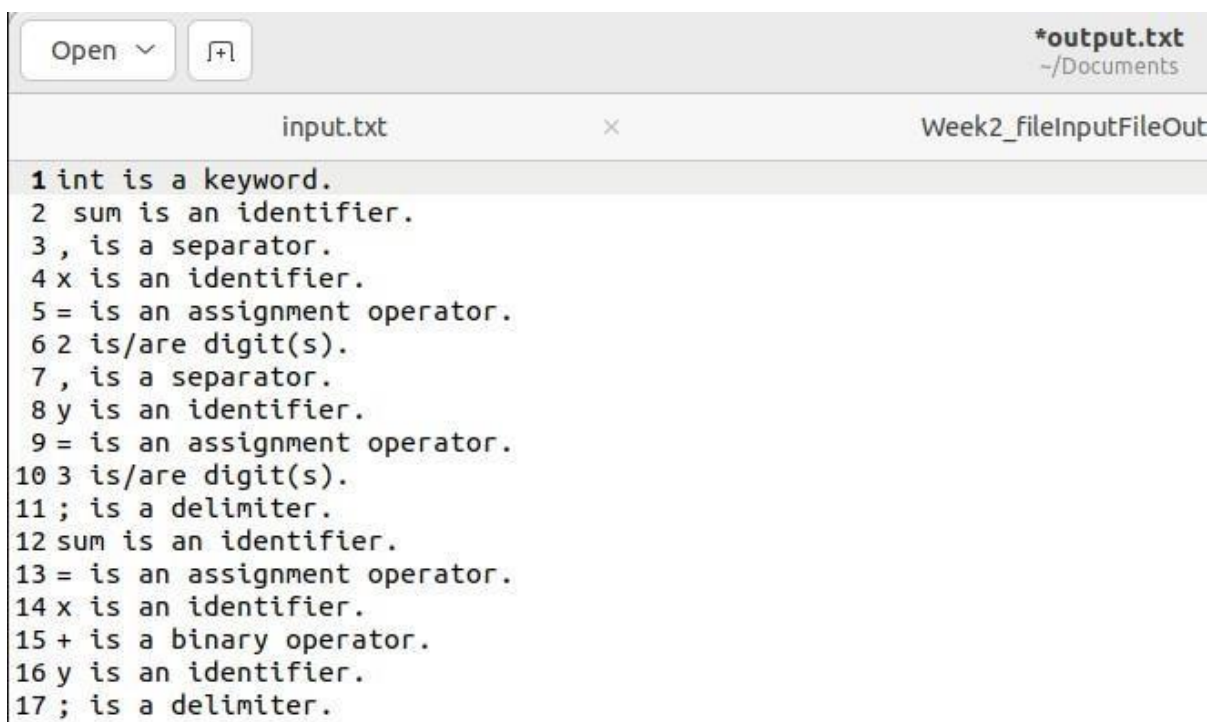
## Output



The screenshot shows a text editor window with a title bar containing "Open", a file icon, and the filename "\*input.txt" with the path "~/Documents". The editor has a tab labeled "\*input.txt" and a window title "Week2\_fileInputFileOutp". The content of the file is:

```
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$
```



The screenshot shows a text editor window with a title bar containing "Open", a file icon, and the filename "\*output.txt" with the path "~/Documents". The editor has a tab labeled "input.txt" and a window title "Week2\_fileInputFileOut". The content of the file is:

```
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>

%}

%%

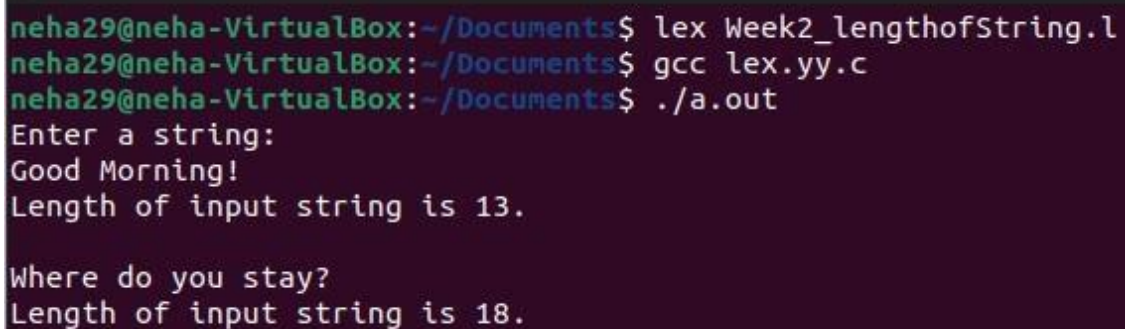
[a-zA-Z0-9.,!? \t]+ {printf("Length of input string is %d.\n",yyleng);}

%%

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.
```

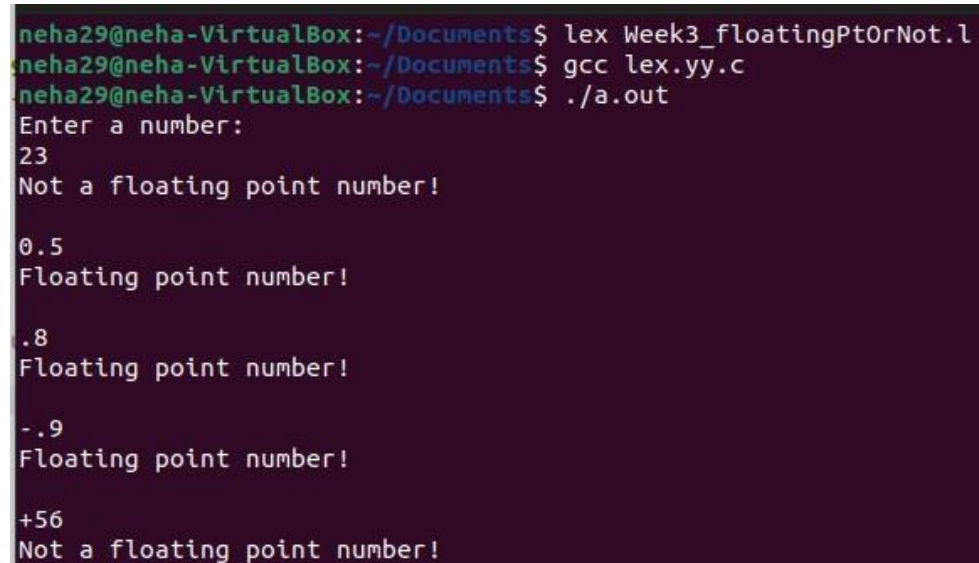
## Lab 3

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

#### Code

```
%{  
#include<stdio.h>  
%}  
%%  
[+]?[0-9]*[.][0-9][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;}

.;

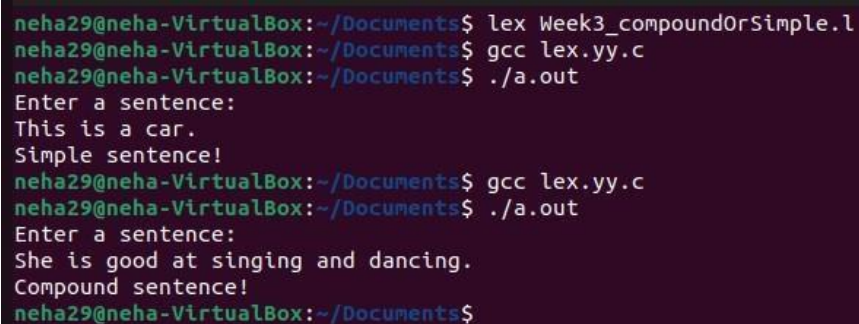
\n {return 0;}

%%

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;

%%

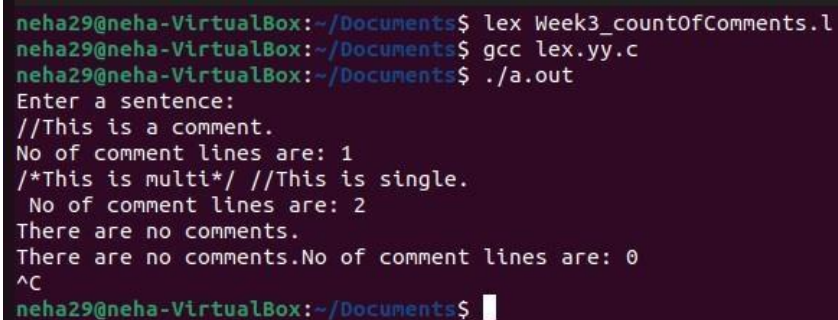
int yywrap()
{
return 1;
}

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>

%}

%%

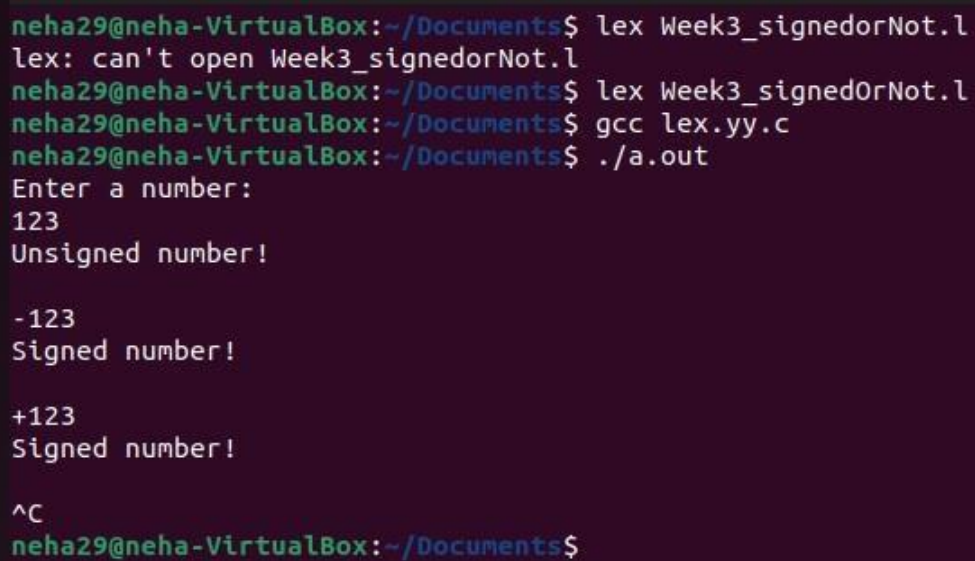
[+|-][0-9]+ {printf("Signed number!\n");}
[0-9]+ {printf("Unsigned number!\n");}

%%

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);}

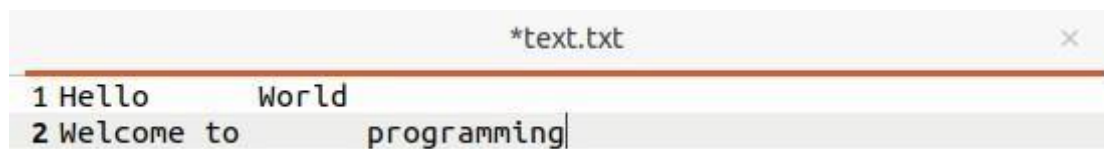
%%

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

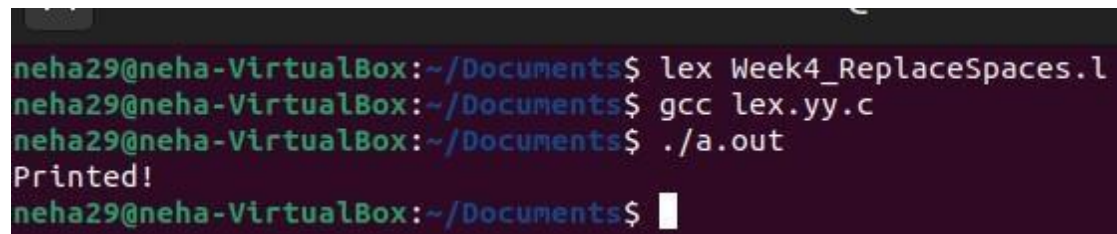
int yywrap()
{
return 1;
}
```



## Output



```
*text.txt
1 Hello World
2 Welcome to programming
```



```
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$
```



```
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;}

. ;

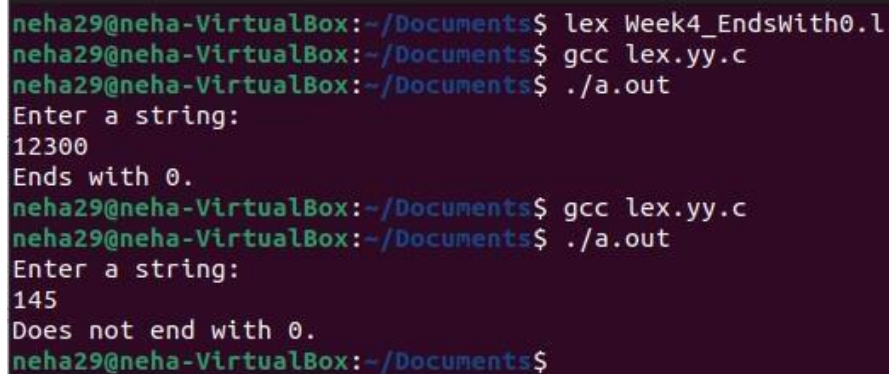
\n {return 0;}

%%

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;}

.;

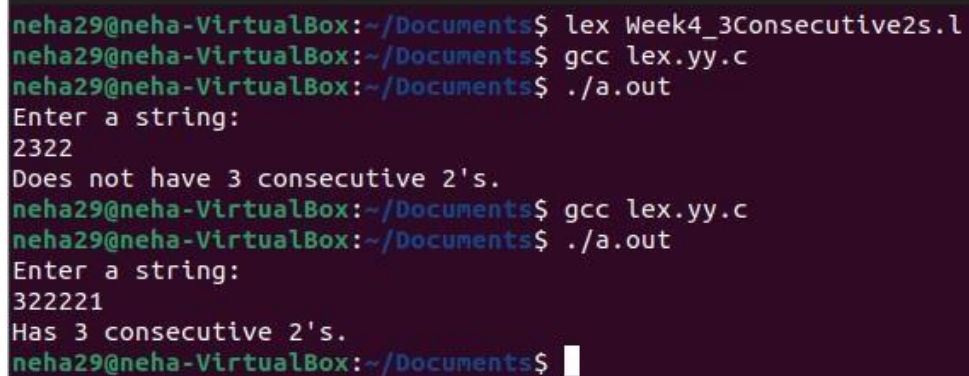
\n {return 0;}

%%

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.l
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=yy leng-1;i>=0;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");}

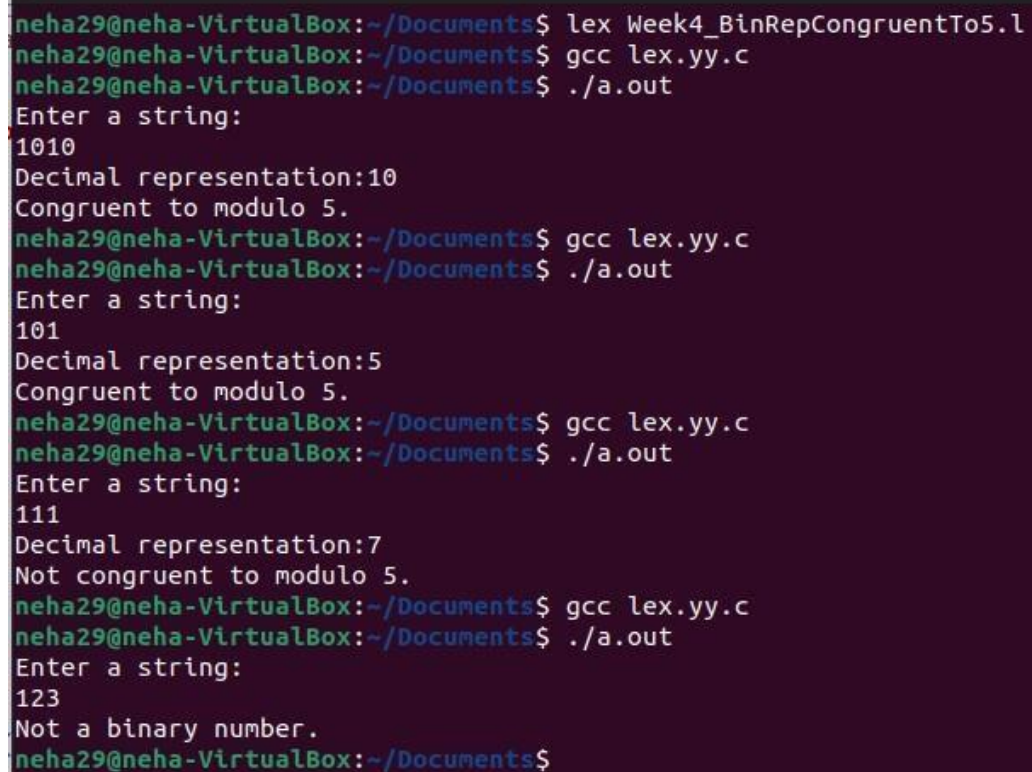
\n {return 0;}

%%

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;}

. ;

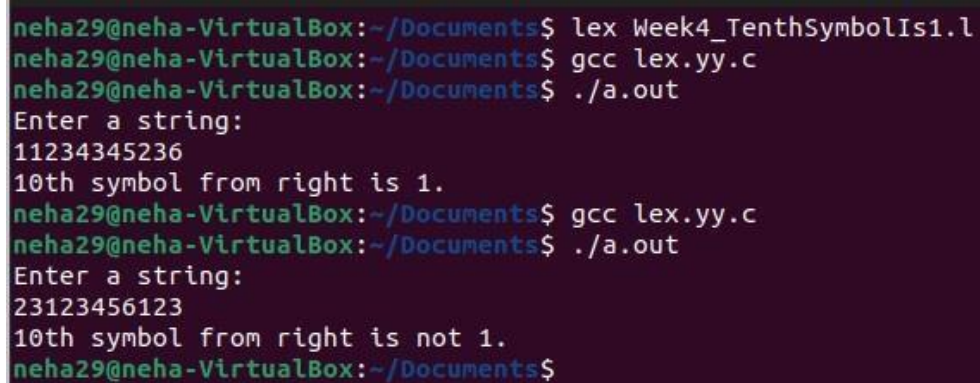
\n {return 0;}

%%

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<yytext[i];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 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 '^'  
%%
```



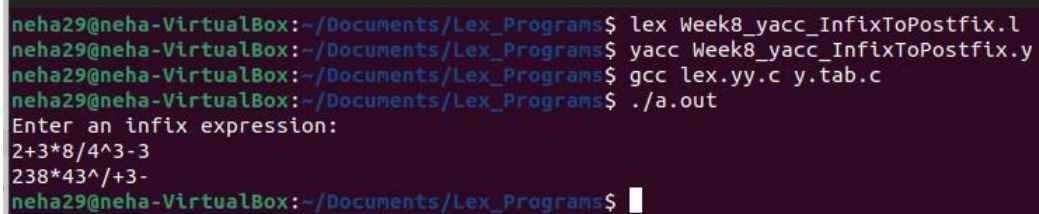
```

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} { yylval=atoi(yytext); return digit; }  
{a} { strcpy(iden,yytext); yylval=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
```