

VISVESVARAYA TECHNOLOGICAL UNIVERSITY

“JnanaSangama”, Belgaum -590014, Karnataka.



LAB REPORT on COMPILER DESIGN

Submitted by

RAHUL C SHIRUR(1BM21CS157)

Under the Guidance of

Dr. Lohith J J

Assistant Professor, BMSCE

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

**(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 **Rahul C Shirur(1BM21CS157)** , 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.

Dr. Lohith J J
Assistant professor
Department of CSE
BMSCE, Bengaluru

Dr. Jyothi Nayak
Professor and Head
Department of CSE
BMSCE, Bengaluru

B. M. S. COLLEGE OF ENGINEERING
DEPARTMENT OF COMPUTER SCIENCE AND
ENGINEERING



DECLARATION

I, Rahul C Shirur (1BM21CS157), 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.

TABLE OF CONTENTS

Lab No	Title	Page No
1		6-8
1.1	Write a program in LEX to recognize different tokens: Keywords, Identifiers, Constants, Operators and Punctuation symbols.	6
1.2	Write a program in LEX to count the number of characters and digits in a string.	7
1.3	Write a program in LEX to count the number of vowels and consonants in a string.	8
2		9-15
2.1	Write a program in lex to count the number of words in a sentence.	9
2.2	Write a program in lex to demonstrate regular definition.	10
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.	11-12
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.	13-14
2.5	Write a program in lex to find the length of the input string.	15
3		16-23
3.1	Write a program in LEX to recognize Floating Point Numbers.	16
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.	17
3.3	Write a program to check if the input sentence ends with any of the following punctuation marks (? , fullstop , !)	18-19
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).	20-21
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.	22
3.6	Write a program to read and check if the user entered number is signed or unsigned using appropriate meta character.	23
4		24-36
4.1	Write a LEX program that copies a file, replacing each nonempty sequence of white spaces by a single blank.	24-25

4.2	Write a LEX program to recognize the following tokens over the alphabets {0,1,...,9}	26-36
4.2.1	The set of all string ending in 00.	26
4.2.2	The set of all strings with three consecutive 222's.	27
4.2.3	The set of all string such that every block of five consecutive symbols contains at least two 5's.	28-29
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.	30-31
4.2.5	The set of all strings such that the 10th symbol from the right end is 1.	32
4.2.6	The set of all four digits numbers whose sum is 9.	33-34
4.2.7	The set of all four digital numbers, whose individual digits are in ascending order from left to right.	35-36
5		37-38
5.1	Write a C program to design lexical analysis to recognize any five keywords, identifiers, numbers, operators and punctuations.	37-38
6		39-40
6.1	Write a program to perform recursive descent parsing on the following grammar: S->cAd A->ab a	39-40
7		41-47
7.1	Write a program in YACC to design a suitable grammar for evaluation of arithmetic expression having +, -, * and /.	41-42
7.2	Write a program in YACC to recognize strings of the form $\{(a^n)b, n \geq 5\}$.	43-44
7.3	Write a program in YACC to generate a syntax tree for a given arithmetic expression.	45-47
8		48-49
8.1	Write a program in YACC to convert infix to postfix expression.	48-49
9		50-52
9.1	Write a program in YACC to generate three address code for a given expression.	50-52

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);}

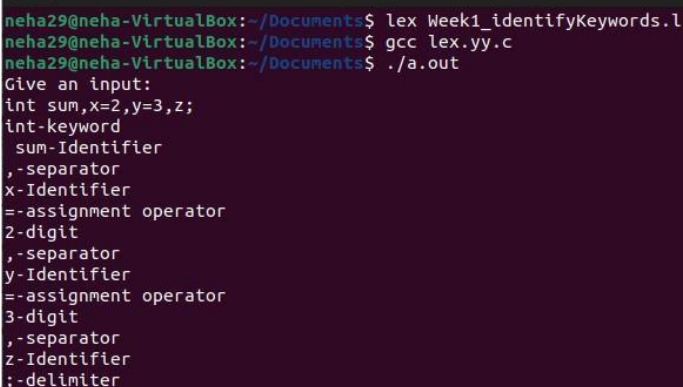
"=" {printf("%s-assignment operator\n",yytext);}

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

%%

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

Output



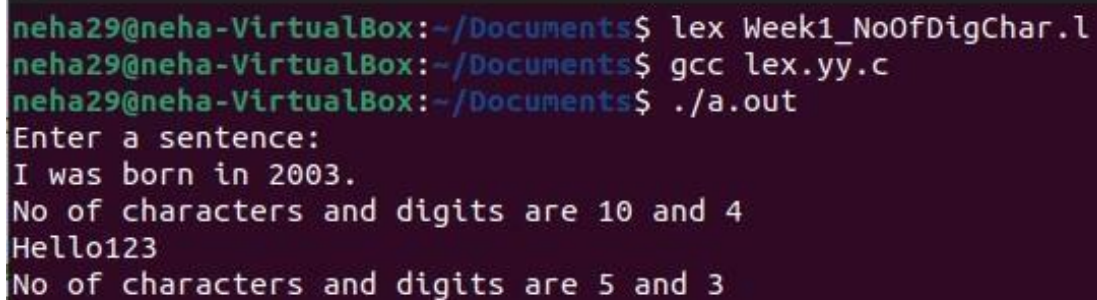
```
neha29@neha-VirtualBox:~/Documents$ lex Week1_identifyKeywords.l
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Give an input:
int sum,x=2,y=3,z;
int-keyword
sum-Identifier
-,separator
x-Identifier
=-assignment operator
2-digit
-,separator
y-Identifier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

```
%{
```

```

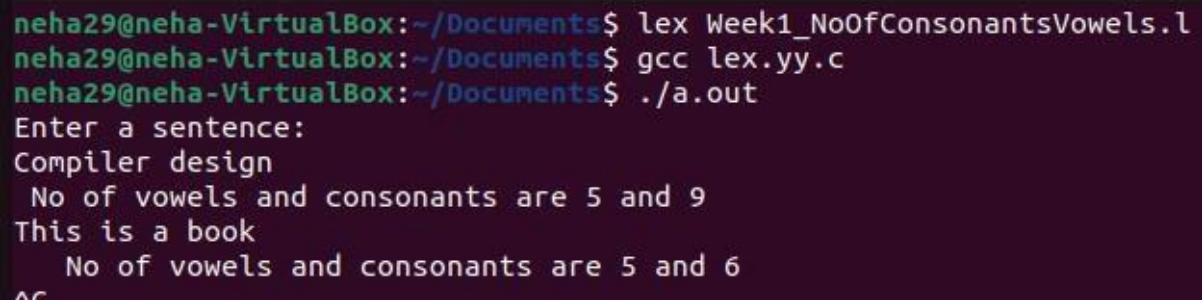
#include<stdio.h> int
v=0,c=0;
%}
%%

[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

```

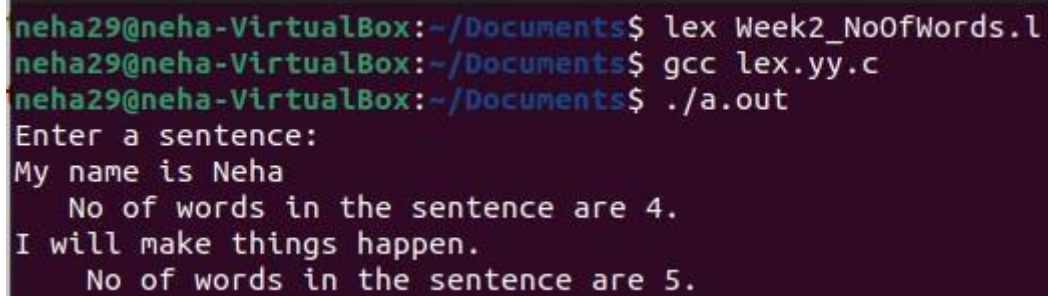

Lab 2

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]

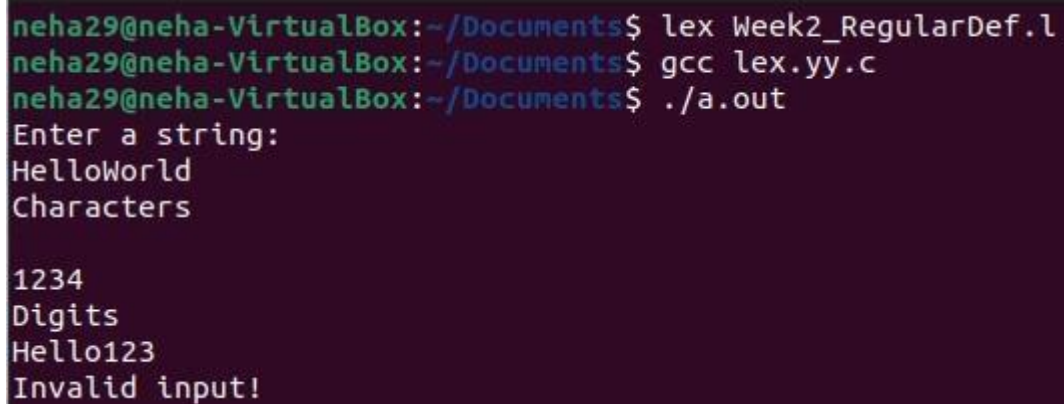
%%

[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

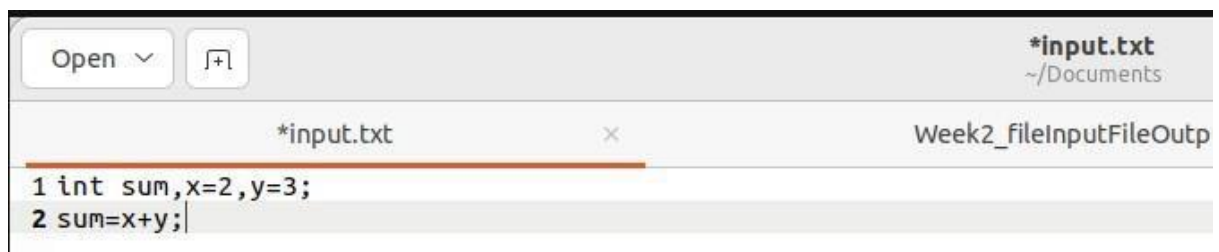
```
%{
#include<stdio.h>

%} %%

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>

%} %%

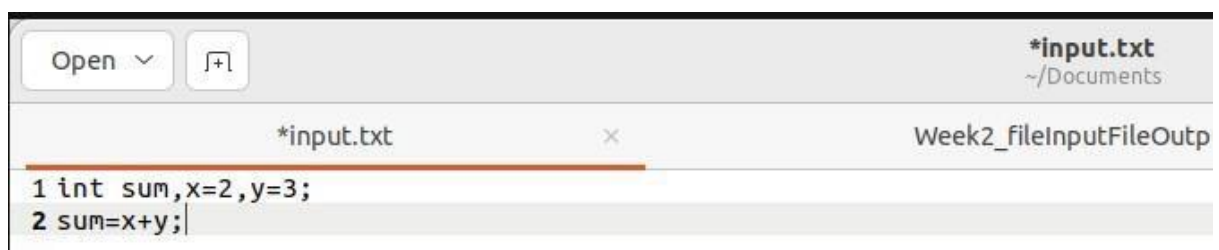
char|int|float {fprintf(yyout,"%s is a keyword.\n",yytext);}
[a-zA-Z][a-zA-Z0-9]* {fprintf(yyout,"%s is an identifier.\n",yytext);}
, {fprintf(yyout,"%s is a separator.\n",yytext);} ;
{fprintf(yyout,"%s is a delimiter.\n",yytext);}
"=" {fprintf(yyout,"%s is an assignment operator.\n",yytext);}
"+"|"-"|"*"|"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



```
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$
```

Open ▾  *output.txt
~/Documents

input.txt × Week2_fileInputFileOut

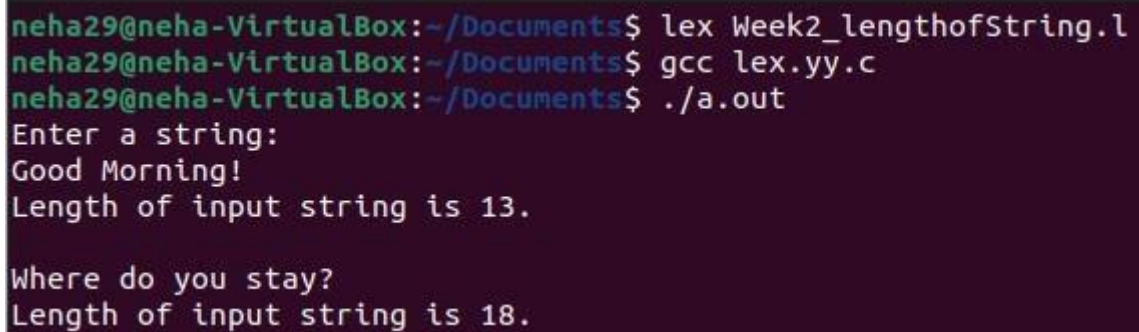
```
1 int is a keyword.
2 sum is an identifier.
3 , is a separator.
4 x is an identifier.
5 = is an assignment operator.
6 2 is/are digit(s).
7 , is a separator.
8 y is an identifier.
9 = is an assignment operator.
10 3 is/are digit(s).
11 ; is a delimiter.
12 sum is an identifier.
13 = is an assignment 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.
```

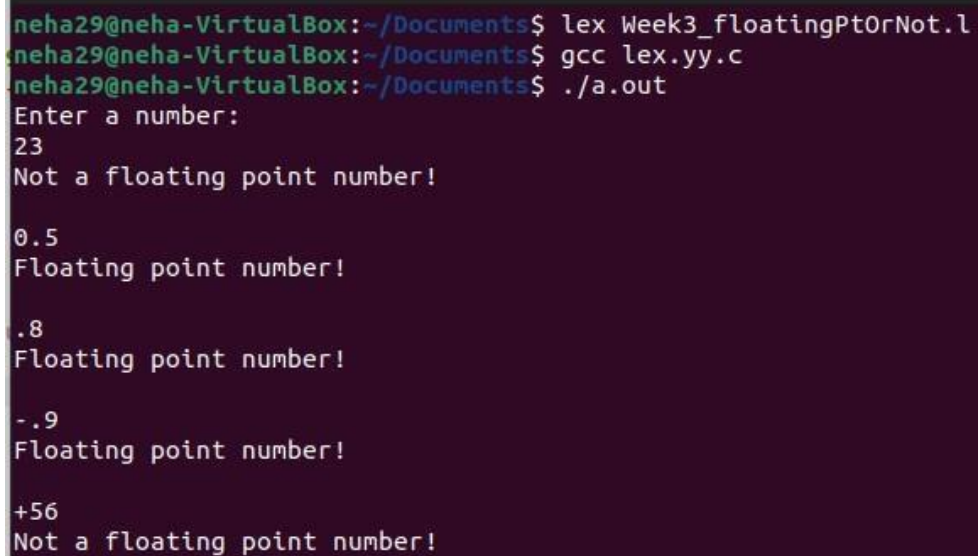
Lab 3

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

Code

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

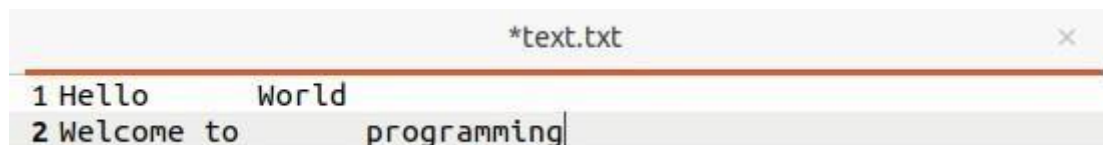
Lab 4

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$
```

Open ▾  print.txt
~/Documents

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

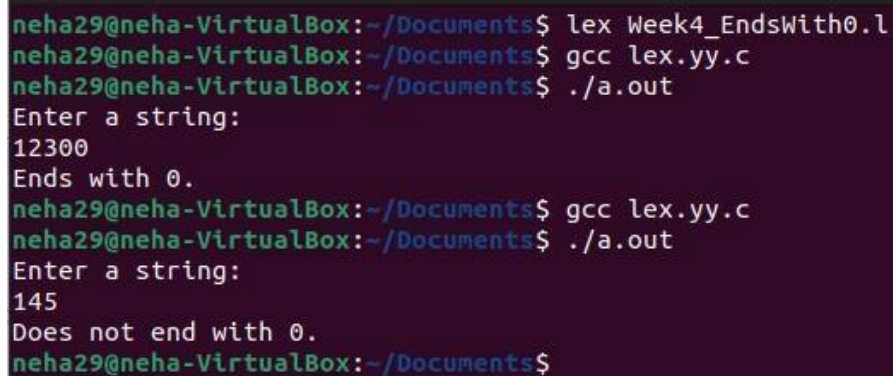
4.2 Write a LEX program to recognize the following tokens over the alphabets {0,1,...,9}

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



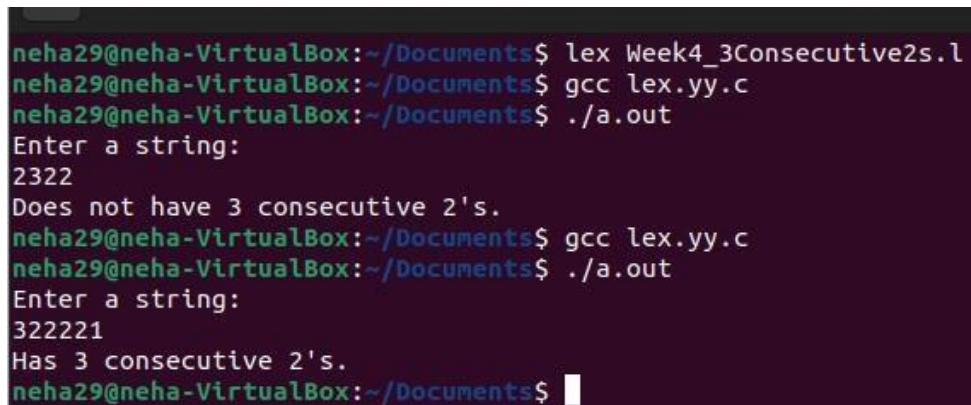
```
neha29@neha-VirtualBox:~/Documents$ lex Week4_EndsWith0.l  
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c  
neha29@neha-VirtualBox:~/Documents$ ./a.out  
Enter a string:  
12300  
Ends with 0.  
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c  
neha29@neha-VirtualBox:~/Documents$ ./a.out  
Enter 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.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=yyldeng-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<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 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!  
aaaaaaaab  
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
```