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“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



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**B. M. S. College of Engineering,
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of Computer Science and Engineering**



CERTIFICATE

This is to certify that the Lab work entitled “**Compiler Design**” carried out by **Anitha K J (1BM22CS401)** , 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, Anitha K J (1BM22CS401), 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. M Lakshmi Neelima, 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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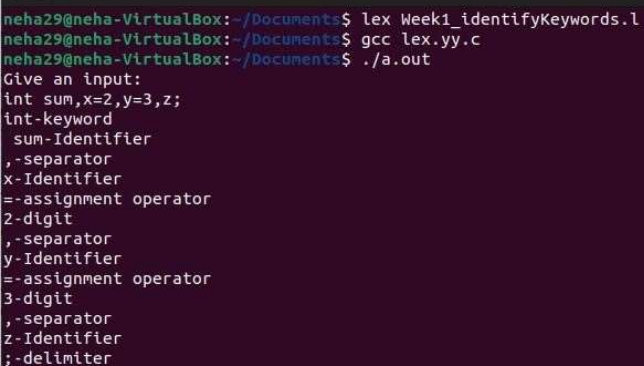
Lab 1

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



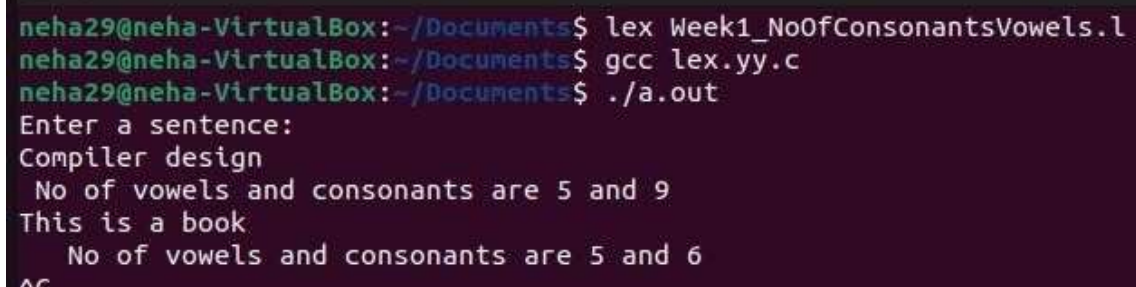
```
neha29@neha-VirtualBox:~/Documents$ lex Week1_NoOfDigChar.l
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a sentence:
I was born in 2003.
No of characters and digits are 10 and 4
Hello123
No of characters and digits are 5 and 3
```

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
```

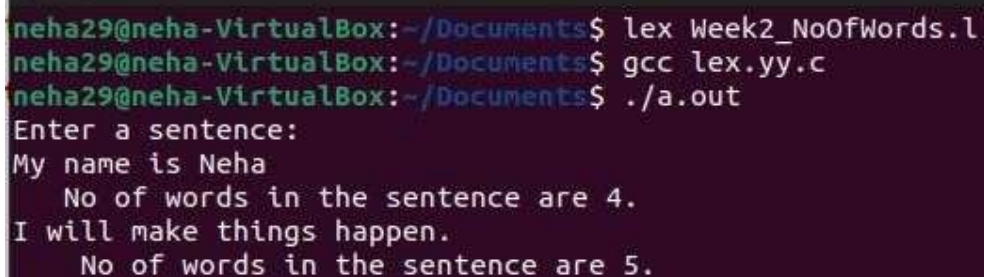

Lab 2

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



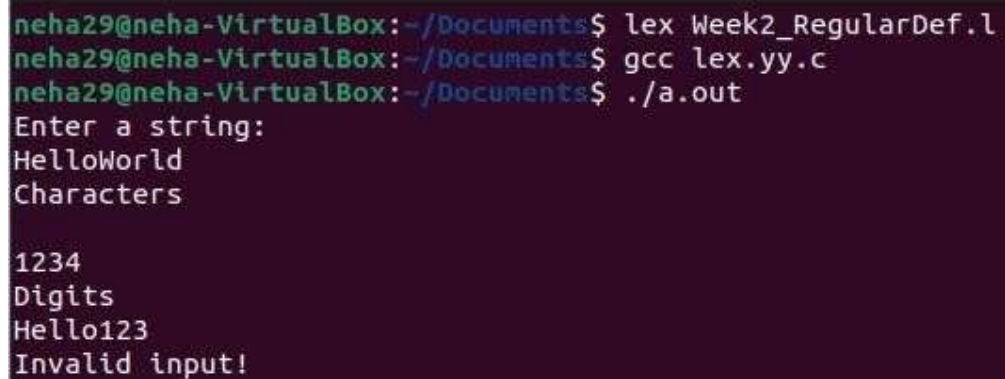
```
neha29@neha-VirtualBox:~/Documents$ lex Week2_NoOfWords.l  
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c  
neha29@neha-VirtualBox:~/Documents$ ./a.out  
Enter a sentence:  
My name is Neha  
    No of words in the sentence are 4.  
I will make things happen.  
    No of words in the sentence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



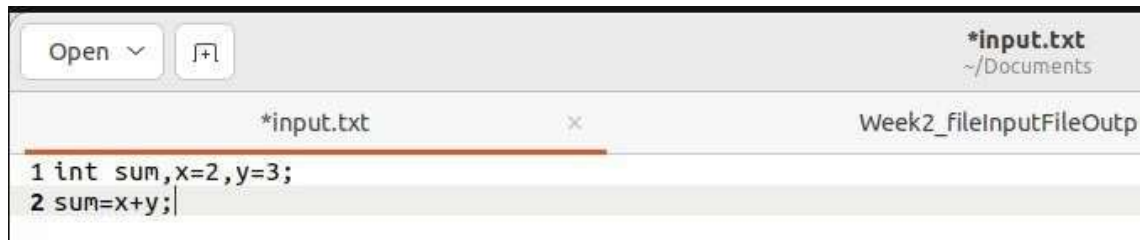
```
neha29@neha-VirtualBox:~/Documents$ lex Week2_RegularDef.l  
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c  
neha29@neha-VirtualBox:~/Documents$ ./a.out  
Enter a string:  
HelloWorld  
Characters  
  
1234  
Digits  
Hello123  
Invalid input!
```

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 ;

%%

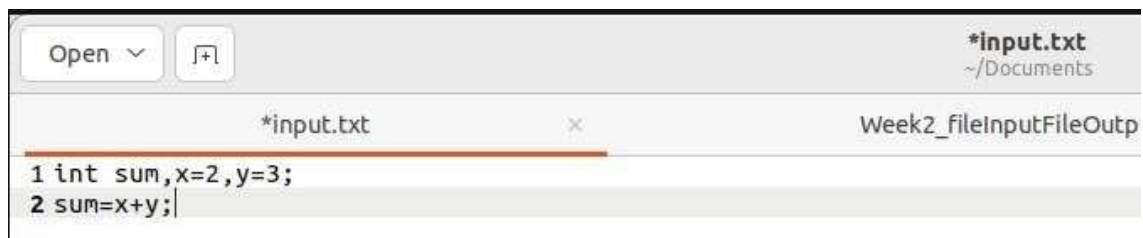
void main()

{
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



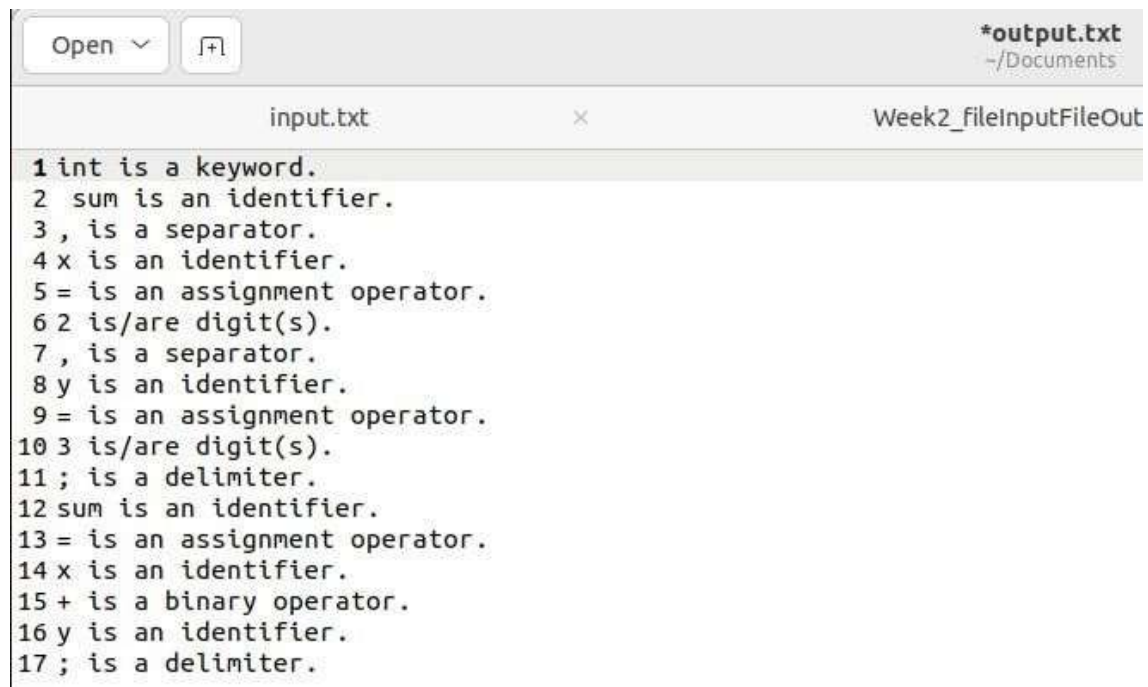
```
Open  [+]
```

*input.txt x Week2_fileInputFileOutp

```
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$
```



```
Open  [+]
```

input.txt x Week2_fileInputFileOut

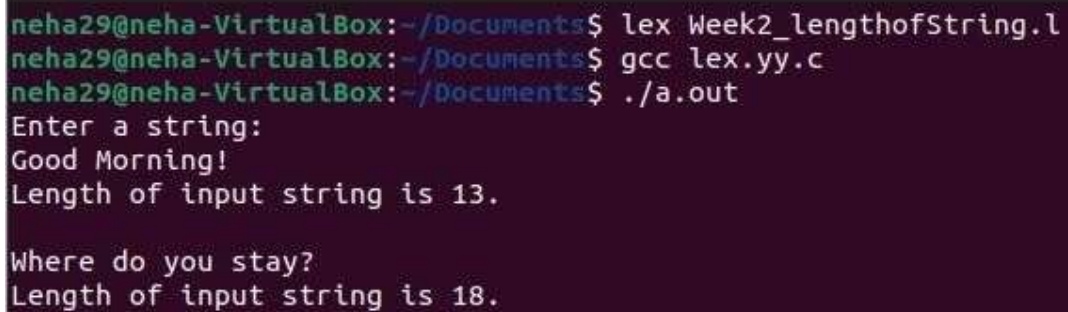
```
1 int is a keyword.
2 sum is an identifier.
3 , is a separator.
4 x is an identifier.
5 = is an assignment operator.
6 2 is/are digit(s).
7 , is a separator.
8 y is an identifier.
9 = is an assignment operator.
10 3 is/are digit(s).
11 ; is a delimiter.
12 sum is an identifier.
13 = is an assignment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

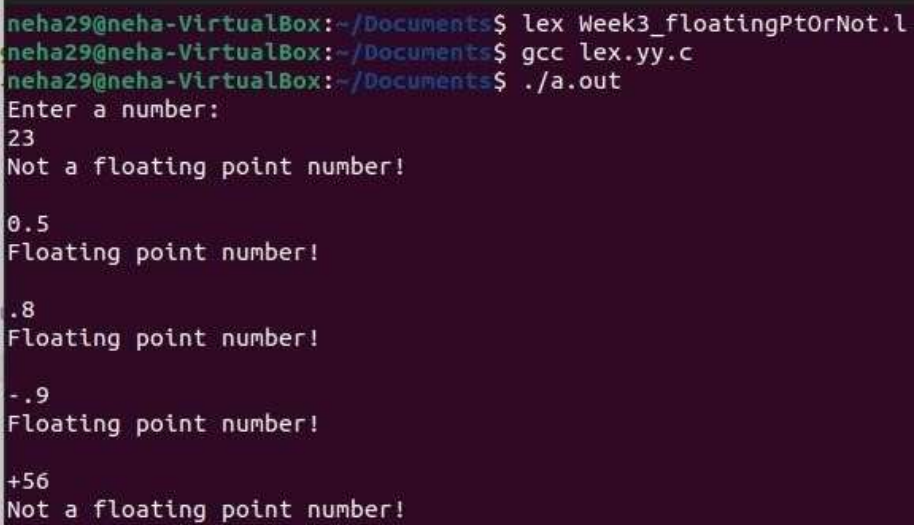
Lab 3

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.

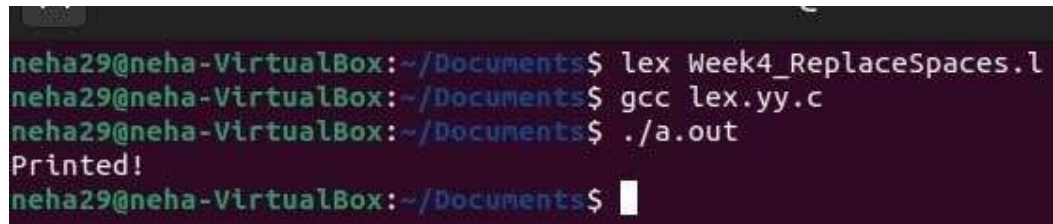
Code

```
%{  
#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 [v] [icon] print.txt
~/Documents
1 Hello World
2 Welcome to programming
```

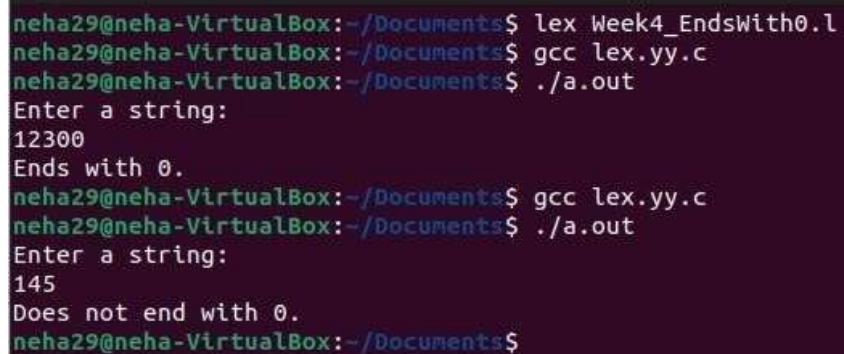
4.2 Write a LEX program to recognize the following tokens over the alphabets {0,1,...,9}

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



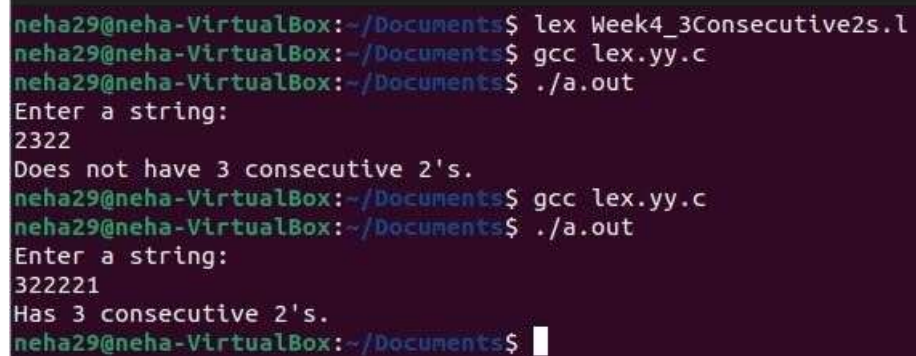
```
neha29@neha-VirtualBox:~/Documents$ lex Week4_EndsWith0.l  
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c  
neha29@neha-VirtualBox:~/Documents$ ./a.out  
Enter a string:  
12300  
Ends with 0.  
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c  
neha29@neha-VirtualBox:~/Documents$ ./a.out  
Enter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

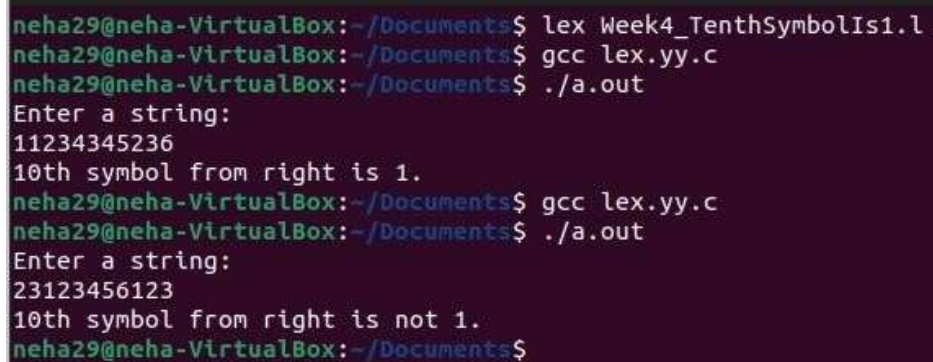
```
neha29@neha-VirtualBox:~/Documents$ lex Week4_BinRepCongruentTo5.l  
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c  
neha29@neha-VirtualBox:~/Documents$ ./a.out  
Enter a string:  
1010  
Decimal representation:10  
Congruent to modulo 5.  
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c  
neha29@neha-VirtualBox:~/Documents$ ./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<yyteng;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  $(a^n)b, n \geq 5$ . \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
```