

# VISVESVARAYA TECHNOLOGICAL UNIVERSITY

“JnanaSangama”, Belgaum -590014, Karnataka.



## LAB REPORT on COMPILER DESIGN

*Submitted by*

**HARSHAVARDHAN HC(1BM22CS407)**

*Under the Guidance of*

**DR. LATHA N R**  
**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 HARSHAVARDHAN HC(1BM22CS407), 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.Latha N R  
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, HARSHAVARDHAN HC (1BM22CS407), 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 Dr.Latha N R, 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
<b>1</b>		<b>6-8</b>
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
	Write a program in LEX to count the number of vowels and consonants in a string.	8
<b>2</b>		<b>9-15</b>
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
<b>3</b>		<b>16-23</b>
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
<b>4</b>		<b>24-36</b>
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
<b>5</b>		<b>37-38</b>
5.1	Write a C program to design lexical analysis to recognize any five keywords, identifiers, numbers, operators and punctuations.	37-38
<b>6</b>		<b>39-40</b>
6.1	Write a program to perform recursive descent parsing on the following grammar: S->cAd A->ab   a	39-40
<b>7</b>		<b>41-47</b>
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
<b>8</b>		<b>48-49</b>
8.1	Write a program in YACC to convert infix to postfix expression.	48-49
<b>9</b>		<b>50-52</b>
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);}

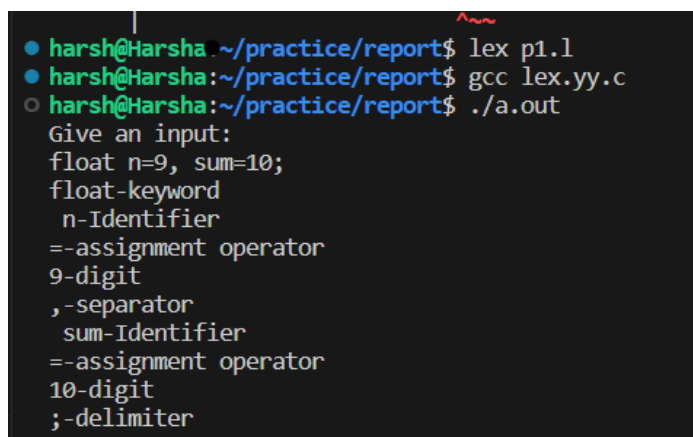
[0-9]+ {printf("%s-digit\n",yytext);}

%%

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

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

### OUTPUT



```
harsh@Harsha:~/practice/report$ lex p1.l
harsh@Harsha:~/practice/report$ gcc lex.yy.c
harsh@Harsha:~/practice/report$ ./a.out
Give an input:
float n=9, sum=10;
float-keyword
n-Identifier
=-assignment operator
9-digit
,-separator
sum-Identifier
=-assignment operator
10-digit
;-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++;}

. ;

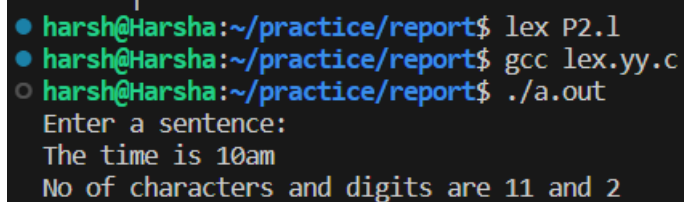
\n {printf("No of characters and digits are %d and %d\n",c,d),c=0,d=0;}

%%

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

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

### Output



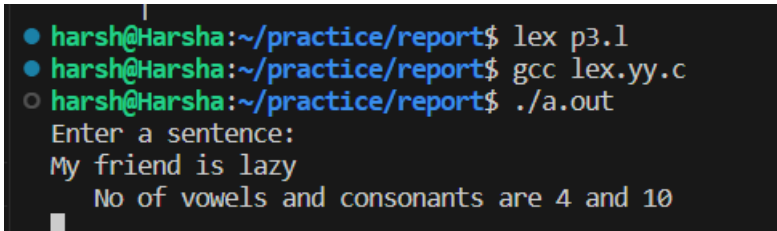
```
● harsh@Harsha:~/practice/report$ lex P2.1
● harsh@Harsha:~/practice/report$ gcc lex.yy.c
○ harsh@Harsha:~/practice/report$ ./a.out
Enter a sentence:
The time is 10am
No of characters and digits are 11 and 2
█
```

### 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



```
● harsh@Harsha:~/practice/report$ lex p3.1  
● harsh@Harsha:~/practice/report$ gcc lex.yy.c  
○ harsh@Harsha:~/practice/report$ ./a.out  
Enter a sentence:  
My friend is lazy  
No of vowels and consonants are 4 and 10
```



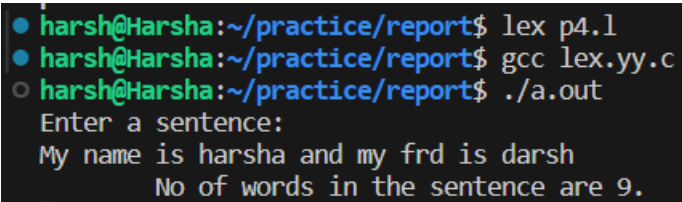
## Lab 2

### 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



```
● harsh@Harsha:~/practice/report$ lex p4.1  
● harsh@Harsha:~/practice/report$ gcc lex.yy.c  
○ harsh@Harsha:~/practice/report$ ./a.out  
Enter a sentence:  
My name is harsha and my frd is darsh  
No of words in the sentence are 9.
```

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

### Code

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

%}

alpha [a-zA-Z0-9]

%%

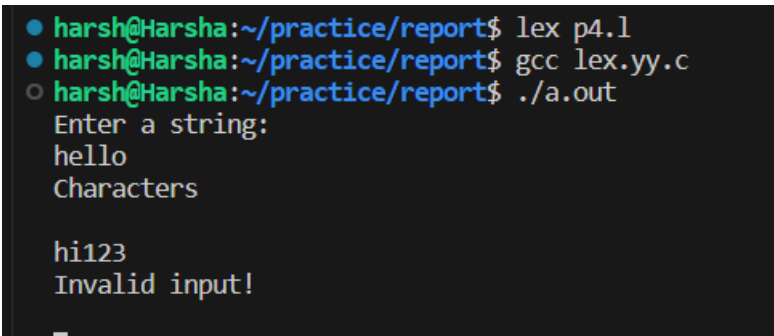
[a-zA-Z]+ {printf("Characters\n");}
[0-9]+ {printf("Digits");}
{alpha}+ {printf("Invalid input!\n");}

%%

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

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

### Output



```
● harsh@Harsha:~/practice/report$ lex p4.l
● harsh@Harsha:~/practice/report$ gcc lex.yy.c
○ harsh@Harsha:~/practice/report$ ./a.out
Enter a string:
hello
Characters

hi123
Digits
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>

%}

%%

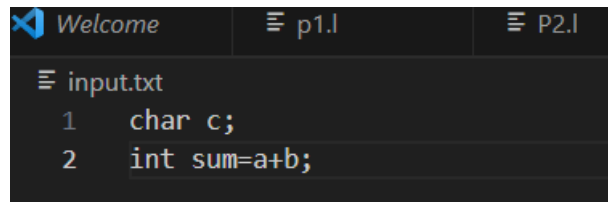
char|int|float {printf("%s is a keyword.\n",yytext);}
[a-zA-Z][a-zA-Z0-9]* {printf("%s is an identifier.\n",yytext);}
, {printf("%s is a separator.\n",yytext);}
; {printf("%s is a delimiter.\n",yytext);}
"=" {printf("%s is an assignment operator.\n",yytext);}
"+"|"-"|"*"|"|" "/" {printf("%s is a binary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



```
Welcome p1.l P2.l
input.txt
1 char c;
2 int sum=a+b;
```

```
● harsh@Harsha:~/practice/report$ lex p5.1
● harsh@Harsha:~/practice/report$ gcc lex.yy.c
● harsh@Harsha:~/practice/report$ ./a.out
char is a keyword.
c is an identifier.
; is a delimiter.
int is a keyword.
sum is an identifier.
= is an assignment operator.
a is an identifier.
+ is a binary operator.
b is an identifier.
; is a delimiter.
○ harsh@Harsha:~/practice/report$
```

## 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

```
Welcome  p1.l  P2.l
input.txt
1 char c;
2 int sum=a+b;
```

```
harsh@Harsha:~/practice/report$ lex p6.l
harsh@Harsha:~/practice/report$ gcc lex.yy.c
harsh@Harsha:~/practice/report$ ./a.out
Printed in output.txt
harsh@Harsha:~/practice/report$
```

```
output.txt
1 char is a keyword.
2 c is an identifier.
3 ; is a delimiter.
4 int is a keyword.
5 sum is an identifier.
6 = is an assignment operator.
7 a is an identifier.
8 + is a binary operator.
9 b is an identifier.
10 ; is a delimiter.
11
```

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

### Code

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

%}

%%

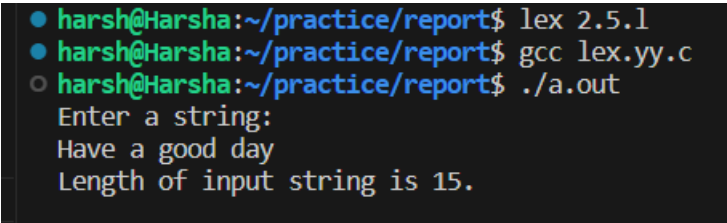
[a-zA-Z0-9.,!? \t]+ {printf("Length of input string is %d.\n",yyleng);}

%%

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

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

### Output



```
● harsh@Harsha:~/practice/report$ lex 2.5.1
● harsh@Harsha:~/practice/report$ gcc lex.yy.c
○ harsh@Harsha:~/practice/report$ ./a.out
Enter a string:
Have a good day
Length of input string is 15.
```

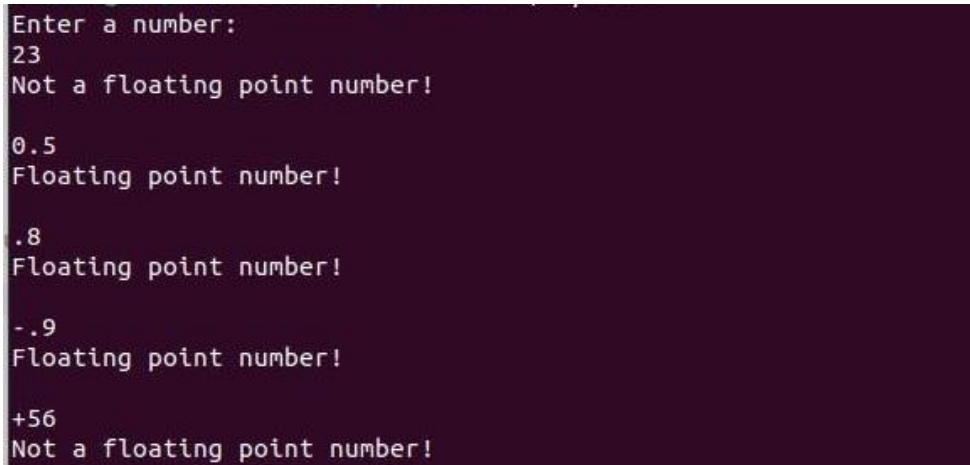
## Lab 3

### 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



```
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;}

.;

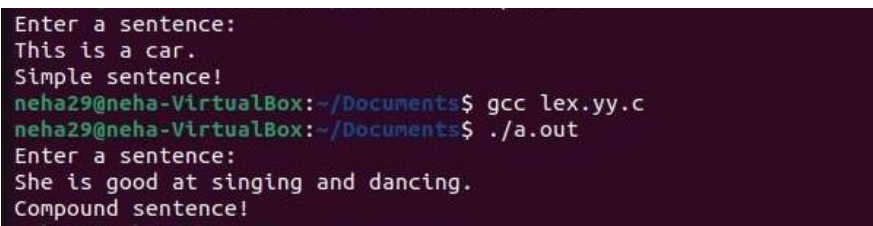
\n {return 0;}

%%

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



```
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!
```

### 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

```
Enter a sentence:  
Amazing!  
Ends with a punctuation!
```

```
Enter a sentence:  
Is this yours?  
Ends with a punctuation!
```

### 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

```
Enter a sentence:  
This is a good idea.  
Does not start with an article!
```

```
Enter a sentence:  
Amazing experience!  
Does not start with an article!
```

**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;

%%

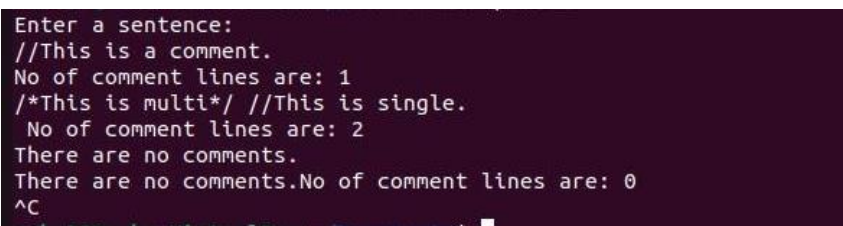
int yywrap()
{
return 1;
}

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



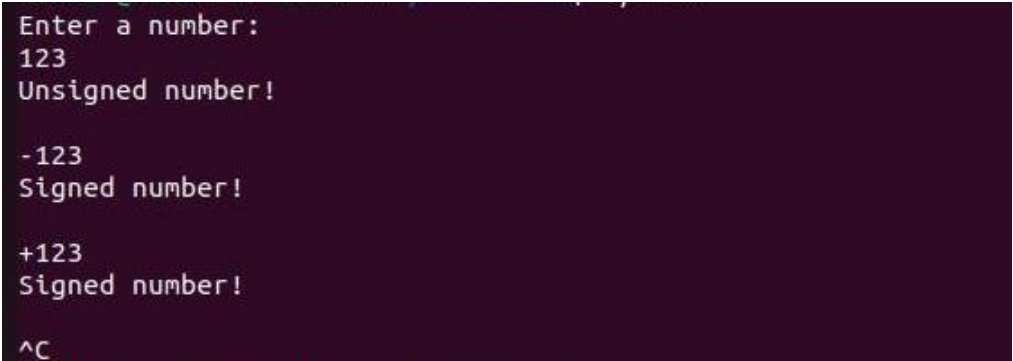
```
Enter a sentence:
//This is a comment.
No of comment lines are: 1
/*This is multi*/ //This is single.
No of comment lines are: 2
There are no comments.
There are no comments.No of comment lines are: 0
^C
```

### 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



```
Enter a number:  
123  
Unsigned number!  
  
-123  
Signed number!  
  
+123  
Signed number!  
  
^C
```

## 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);}

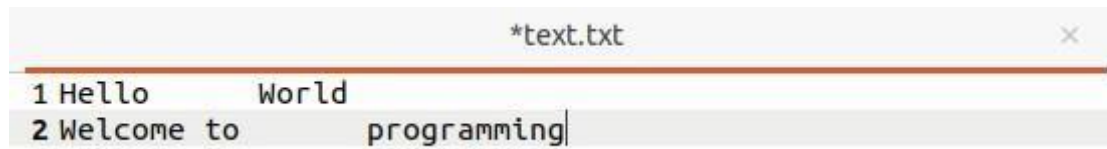
%%

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

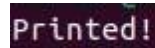
int yywrap()
{
return 1;
}
```



## Output



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



```
Printed!
```



```
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

```
Enter a string:  
12300  
Ends with 0.
```

```
Enter a string:  
145  
Does not end with 0.
```

### 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

```
Enter a string:  
2322  
Does not have 3 consecutive 2's.
```

```
Enter a string:  
322221  
Has 3 consecutive 2's.
```

### 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

```

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.

```

```

Enter a string:
12345455
yytext:12345,flag(1 if no of 5 is atleast 2):0
Not a valid string!

```

#### 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

```
Enter a string:  
1010  
Decimal representation:10  
Congruent to modulo 5.
```

```
Enter a string:  
111  
Decimal representation:7  
Not congruent to modulo 5.
```

#### 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

```
Enter a string:
11234345236
10th symbol from right is 1.
```



#### 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**

```
Enter a string:  
6300  
The sum of digits is 9.
```

#### 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

```
Enter a string:  
1235  
The digits are in ascending order.
```

## 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

```

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

```

Descent } ; if ($?) { .\Week6_RecursiveDescent }
Enter a string:
cad$
Valid string!

```

```

Enter a string:
caad$
Invalid 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

```

Enter an arithmetic expression:
2+3*4
Valid expression!
Result:14

```

## 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

A terminal window with a dark purple background and light green text. It shows the program's output for two test cases: a valid string and an invalid string.

```
Enter a string!
aaaaaaaaab
Parsed using the rule (a^n)b, n>=5.
Valid String!
ab
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

```

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

```

## 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



```

Enter an infix expression:
2+3*8/4^3-3
238*43^/+3-

```

## 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

```
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
```