

# **VISVESVARAYA TECHNOLOGICAL UNIVERSITY**

“JnanaSangama”, Belgaum -590014, Karnataka.



## **LAB REPORT** **on** **COMPILER DESIGN**

*Submitted by*  
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*Under the Guidance of*  
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*in partial fulfilment for the award of the degree of*  
**BACHELOR OF ENGINEERING**  
*in*  
**COMPUTER SCIENCE AND ENGINEERING**



**B.M.S. COLLEGE OF ENGINEERING**  
**(Autonomous Institution under VTU)**  
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**B. M. S. College of Engineering,**  
**Bull Temple Road, Bangalore 560019**  
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**Department of Computer Science and Engineering**



**CERTIFICATE**

This is to certify that the Lab work entitled “**Compiler Design**” carried out by **SHASHANK D K(1BM21CS197)** , 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, Shashank D K (1BM21CS197), 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 Sonika Sharma D, 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

henn29@henn29-VirtualBox: ~/Documents\$ ./7.8.001

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

henn29@henn29-VirtualBox: ~/Documents\$ ./7.8.001

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

```
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ lex chardig.l
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ gcc lex.yy.c
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ ./a.out
Enter a sentence:
i have scored 125 out of 150
    No of characters and digits are 16 and 6
```



### 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

```
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ lex vowels.l
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ gcc lex.yy.c
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ ./a.out
Enter a sentence:
comipler design book
No of vowels and consonants are 7 and 11
```

## 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++;}

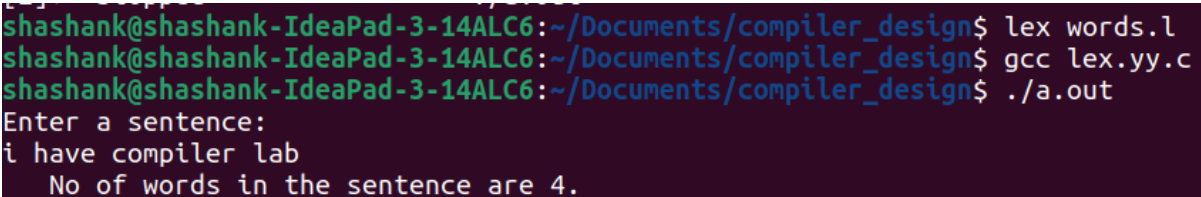
\n {printf("No of words in the sentence are %d.\n",words),words=0;}

%%

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

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

### Output



```
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ lex words.l
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ gcc lex.yy.c
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ ./a.out
Enter a sentence:
i have compiler lab
    No of words in the sentence are 4.
```

## 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

```
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ lex regdef.l
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ gcc lex.yy.c
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ ./a.out
Enter a string:
hello
Characters

234
Digits
hel34gd
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>

%}

%%

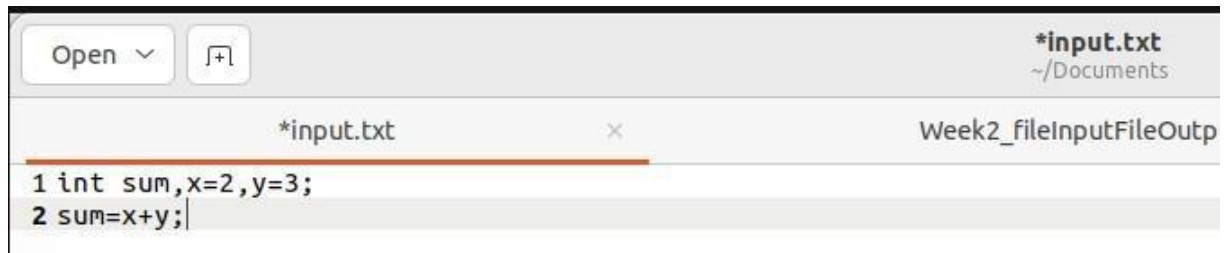
char|int|float {printf("%s is a keyword.\n",yytext);}
[a-zA-Z][a-zA-Z0-9]* {printf("%s is an identifier.\n",yytext);}
, {printf("%s is a separator.\n",yytext);}
; {printf("%s is a delimiter.\n",yytext);}
"=" {printf("%s is an assignment operator.\n",yytext);}
"+"|"-"|"*"|"/" {printf("%s is a binary operator.\n",yytext);}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



```
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ lex exip.l
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ gcc lex.yy.c
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ ./a.out
int is a keyword.
a is an identifier.
, is a separator.
b is an identifier.
= is an assignment operator.
4 is/are digit(s).
, is a separator.
d is an identifier.
= is an assignment operator.
67 is/are digit(s).
; is a delimiter.
```

## 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

```
in.txt x
1 int a,b=4,d=67;
```

```
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ lex exipexop.l
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ gcc lex.yy.c
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ ./a.out
Printed in output.txt
```

```
1 int is a keyword.
2 a is an identifier.
3 , is a separator.
4 b is an identifier.
5 = is an assignment operator.
6 4 is/are digit(s).
7 , is a separator.
8 d is an identifier.
9 = is an assignment operator.
10 67 is/are digit(s).
11 ; is a delimiter.
```

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

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

%}

%%

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

%%

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

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

### Output

```
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ lex len.l
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ gcc lex.yy.c
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ ./a.out
Enter a string:
string
Length of input string is 6.
```



## 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

```
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ lex float.l
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ gcc lex.yy.c
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ ./a.out
Enter a number:
78
Not a floating point number!

.67
Floating point number!

-.009
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;}

.;

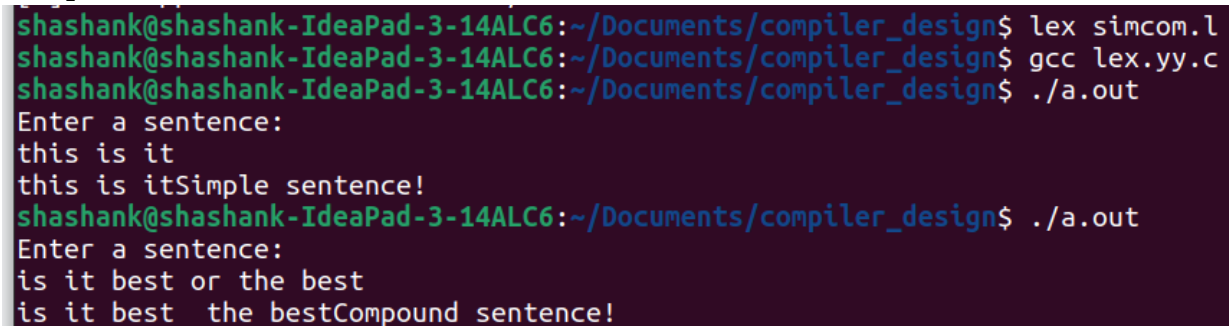
\n {return 0;}

%%

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



```
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ lex simcom.l
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ gcc lex.yy.c
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ ./a.out
Enter a sentence:
this is it
this is itSimple sentence!
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ ./a.out
Enter a sentence:
is it best or the best
is it best the bestCompound 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

```
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ lex punctuation.
l
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ gcc lex.yy.c
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ ./a.out
Enter a sentence:
it is good
Does not end with punctuation!
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ ./a.out
Enter a sentence:
ohhh!
Ends with a punctuation!
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ ./a.out
Enter a sentence:
are you okay?
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

```
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ lex senbeg.l
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ gcc lex.yy.c
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ ./a.out
Enter a sentence:
the sun rises
Starts with an article!
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ ./a.out
Enter a sentence:
wonderful moment
Does not start with an article!
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ ./a.out
Enter a sentence:
A book is on desk
Starts with an article!
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$
```

### 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();

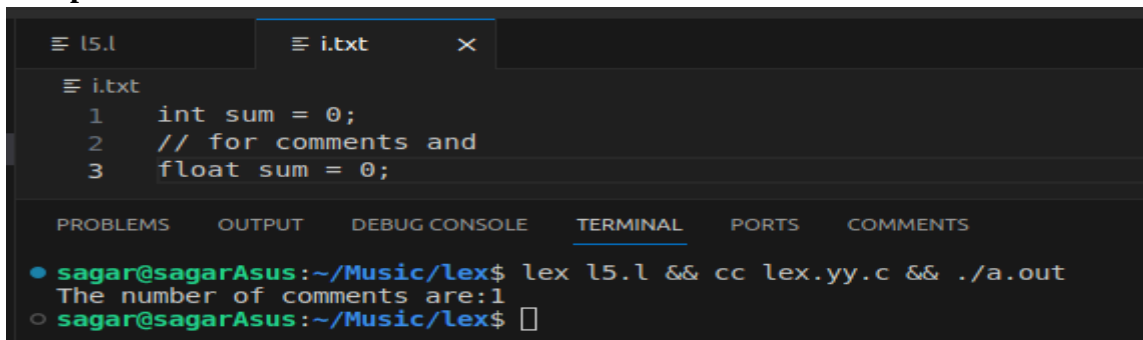
printf("The number of comments are:%d\\n",c);

fclose(yyin);

fclose(yyout);

}
```

#### Output



The screenshot shows a code editor with two tabs: 'l5.1' and 'i.txt'. The 'i.txt' tab is active, displaying the following code:

```
1 int sum = 0;
2 // for comments and
3 float sum = 0;
```

Below the code editor, there is a terminal window with tabs for 'PROBLEMS', 'OUTPUT', 'DEBUG CONSOLE', 'TERMINAL', 'PORTS', and 'COMMENTS'. The 'TERMINAL' tab is active, showing the following command and output:

```
sagar@sagarAsus:~/Music/lex$ lex l5.1 && cc lex.yy.c && ./a.out
The number of comments are:1
sagar@sagarAsus:~/Music/lex$
```

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

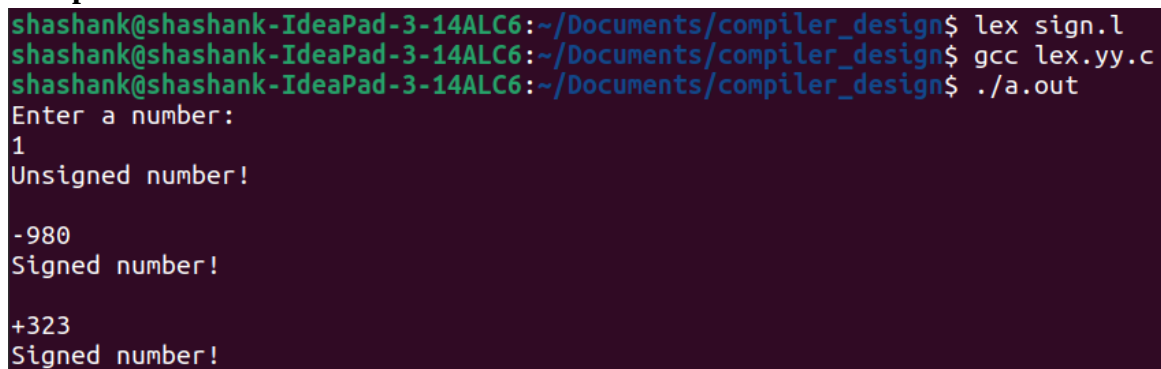
#### Code

```
%{
#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



```
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ lex sign.l
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ gcc lex.yy.c
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ ./a.out
Enter a number:
1
Unsigned number!

-980
Signed number!

+323
Signed number!
```



## 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

```
*in.txt ×
1 hello          programmers  welcome    to      world of      coding
```

```
[9]+  Stopped                  ./a.out
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ lex extraspace.l
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ gcc lex.yy.c
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$ ./a.out
Printed!
shashank@shashank-IdeaPad-3-14ALC6:~/Documents/compiler_design$
```

```
out.txt ×
1 hello programmers welcome to world of coding
```

## 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;}

. ;

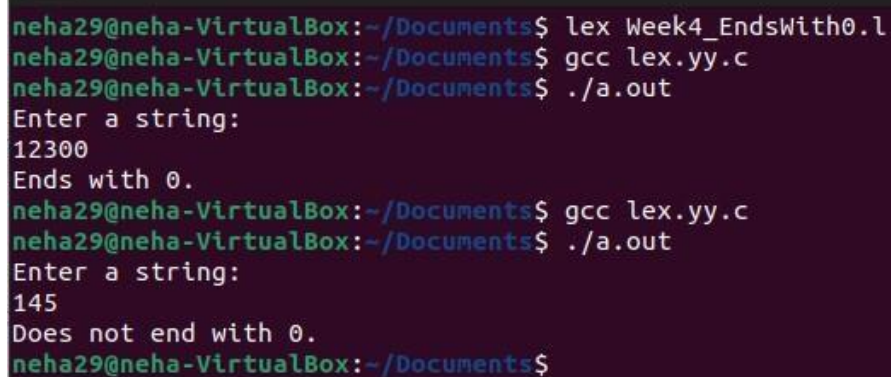
\n {return 0;}

%%

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;}

. ;

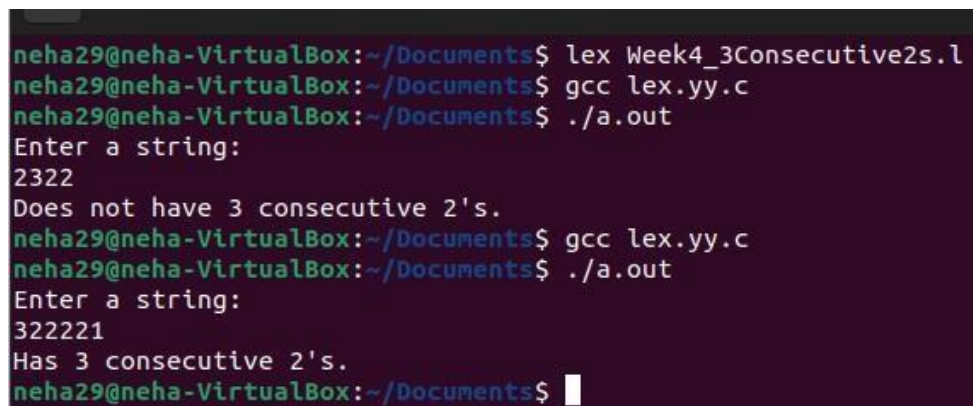
\n {return 0;}

%%

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;
}
}

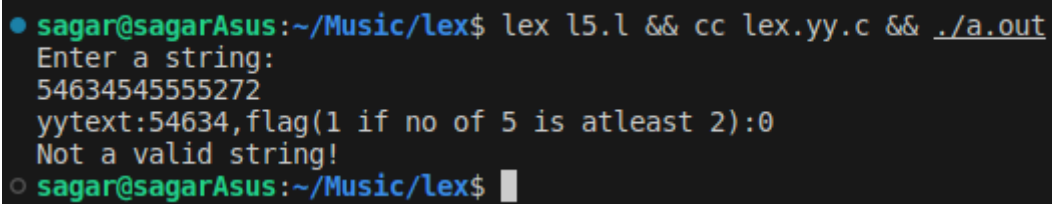
\n {return 0;}

%%

void main()
```

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

## Output



```
● sagar@sagarAsus:~/Music/lex$ lex l5.l && cc lex.yy.c && ./a.out  
Enter a string:  
54634545555272  
yytext:54634,flag(1 if no of 5 is atleast 2):0  
Not a valid string!  
○ sagar@sagarAsus:~/Music/lex$
```

#### 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");}

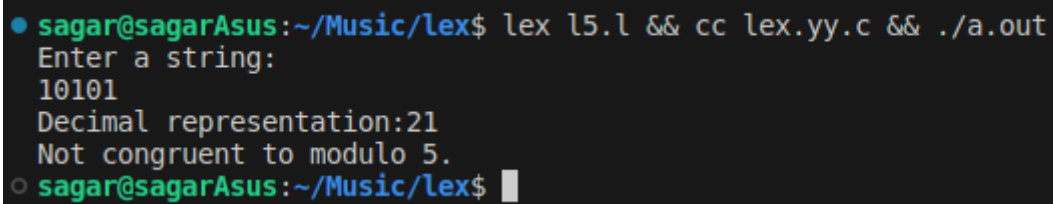
\n {return 0;}

%%

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

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

## Output



```
● sagar@sagarAsus:~/Music/lex$ lex l5.l && cc lex.yy.c && ./a.out  
Enter a string:  
10101  
Decimal representation:21  
Not congruent to modulo 5.  
○ sagar@sagarAsus:~/Music/lex$
```



## 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;}

.;

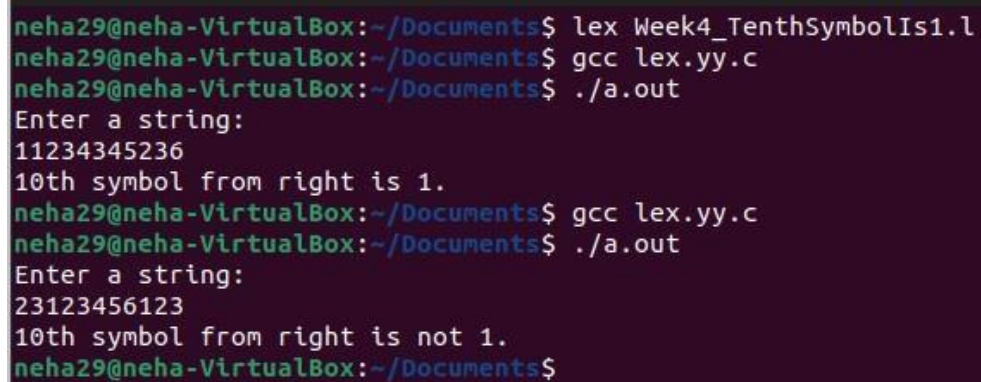
\n {return 0;}

%%

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()
```

## 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])
        {
            f
            l
            a
            g
            =
            0
        }
    }
}

\n {return 0;}

%%

void main()
{
    e
    a
    k
    ;
}

}

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;  
}
```

## 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

```

sagar@sagarAsus:~/Music/lex$ lex l5.l
sagar@sagarAsus:~/Music/lex$ yacc -d l.y
sagar@sagarAsus:~/Music/lex$ gcc lex.yy.c y.tab.c
sagar@sagarAsus:~/Music/lex$ ./a.out
Enter an arithmetic expression:
2-3/5
Valid expression!
Result:2
sagar@sagarAsus:~/Music/lex$

```

## 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  $(a^n)b, n \geq 5$ . Valid 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

```

● sagar@sagarAsus:~/Music/lex$ lex l5.l
● sagar@sagarAsus:~/Music/lex$ yacc -d l.y
● sagar@sagarAsus:~/Music/lex$ gcc lex.yy.c y.tab.c
l.y:2:19: warning: extra tokens at end of #include directive
  2 | #include<stdio.h> #include<stdlib.h>
    |                   ^
● sagar@sagarAsus:~/Music/lex$ ./a.out
Enter an infix expression:
2+3*4
234*+
○ sagar@sagarAsus:~/Music/lex$ █

```

## 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

```
● sagar@sagarAsus:~/Music/lex$ lex l5.l
● sagar@sagarAsus:~/Music/lex$ yacc -d l.y
● sagar@sagarAsus:~/Music/lex$ gcc lex.yy.c y.tab.c
● sagar@sagarAsus:~/Music/lex$ ./a.out
Enter an expression:
a=2
t0 = 2;
a=t0
● sagar@sagarAsus:~/Music/lex$ ./a.out
Enter an expression:
a=3+4
t0 = 3;
t1 = 4;
t2 = t0 + t1;
a=t2
```