VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

LAB REPORT

on

COMPILER DESIGN

Submitted by

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Under the Guidance of
Prof. Sonika Sharma D
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 **G Sanjana Hebbar(1BM21CS062)**, 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.

Prof. Sonika Sharma D	Dr. Jyothi Nayak
Assistant professor	and Head
Department of CSE	Department of CSE
BMSCE, Bengaluru	BMSCE, Bengaluru

B. M. S. COLLEGE OF ENGINEERING

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

DECLARATION

I, G Sanjana Hebbar (1BM21CS062), student of 5th Semester, B.E, Department of Computer Science and Engineering, B. M. S. College of Engineering, Bangalore, here by declare that, this lab report entitled " **Compiler Design**" has been carried out by me under the guidance of Prof. Sonika 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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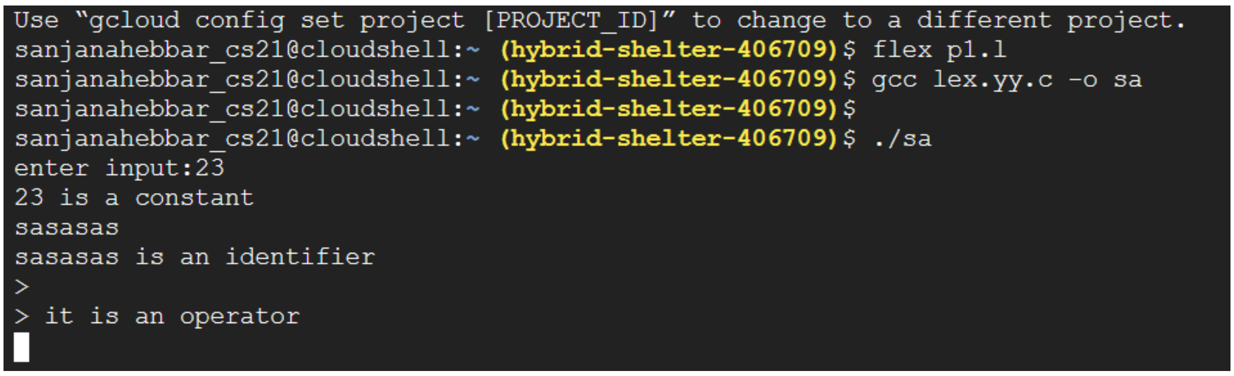
Lab 1

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



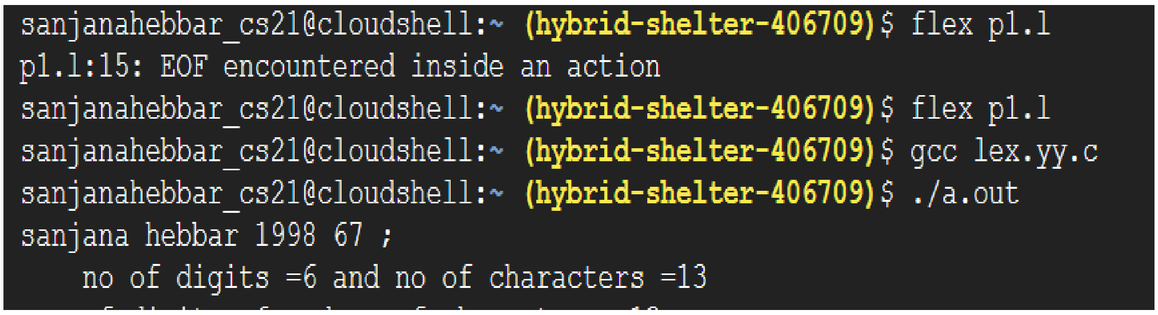
```
Use "gcloud config set project [PROJECT_ID]" to change to a different project.
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ flex p1.l
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ gcc lex.yy.c -o sa
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ ./sa
enter input:23
23 is a constant
sasasas
sasasas is an identifier
>
> it is an operator
```

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



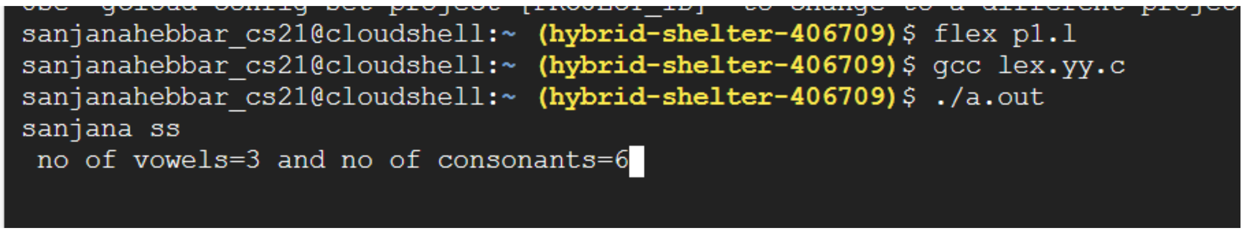
```
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ flex p1.l
p1.l:15: EOF encountered inside an action
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ flex p1.l
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ gcc lex.yy.c
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ ./a.out
sanjana hebbar 1998 67 ;
    no of digits =6 and no of characters =13
```

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



```
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ flex p1.l
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ gcc lex.yy.c
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ ./a.out
sanjana ss
 no of vowels=3 and no of consonants=6
```

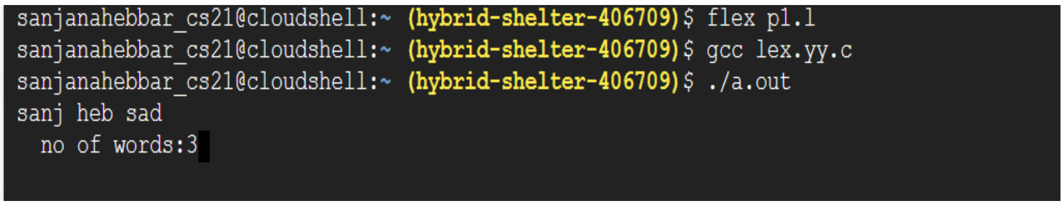
Lab 2

2.1Write 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



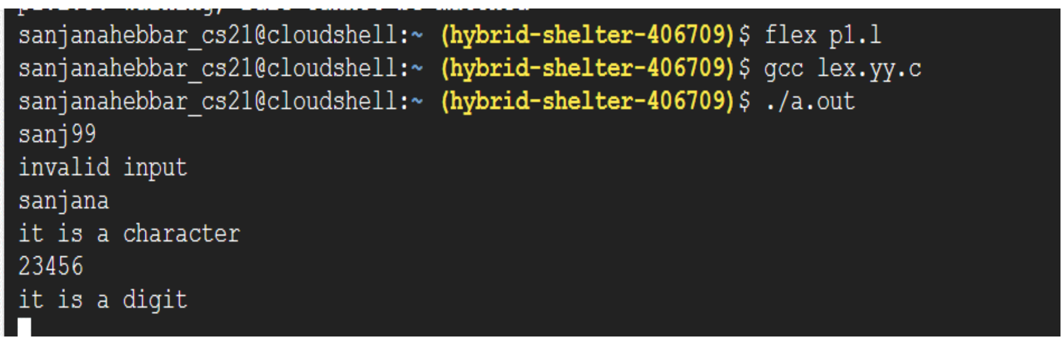
```
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ flex p1.l
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ gcc lex.yy.c
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ ./a.out
sanj heb sad
  no of words:3
```

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



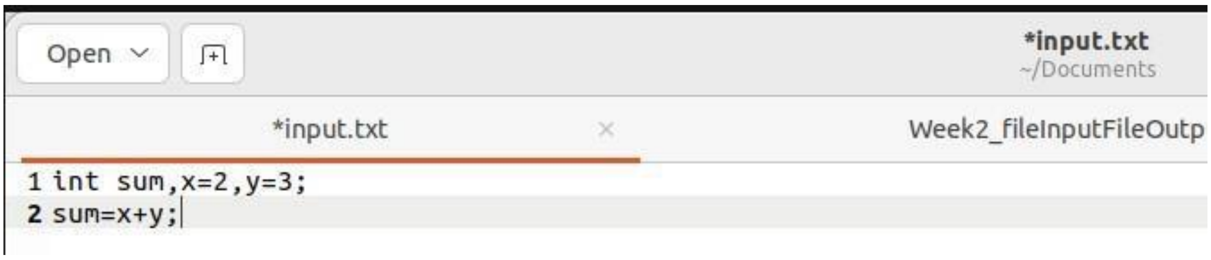
```
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ flex p1.l
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ gcc lex.yy.c
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ ./a.out
sanj99
invalid input
sanjana
it is a character
23456
it is a digit
```

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.

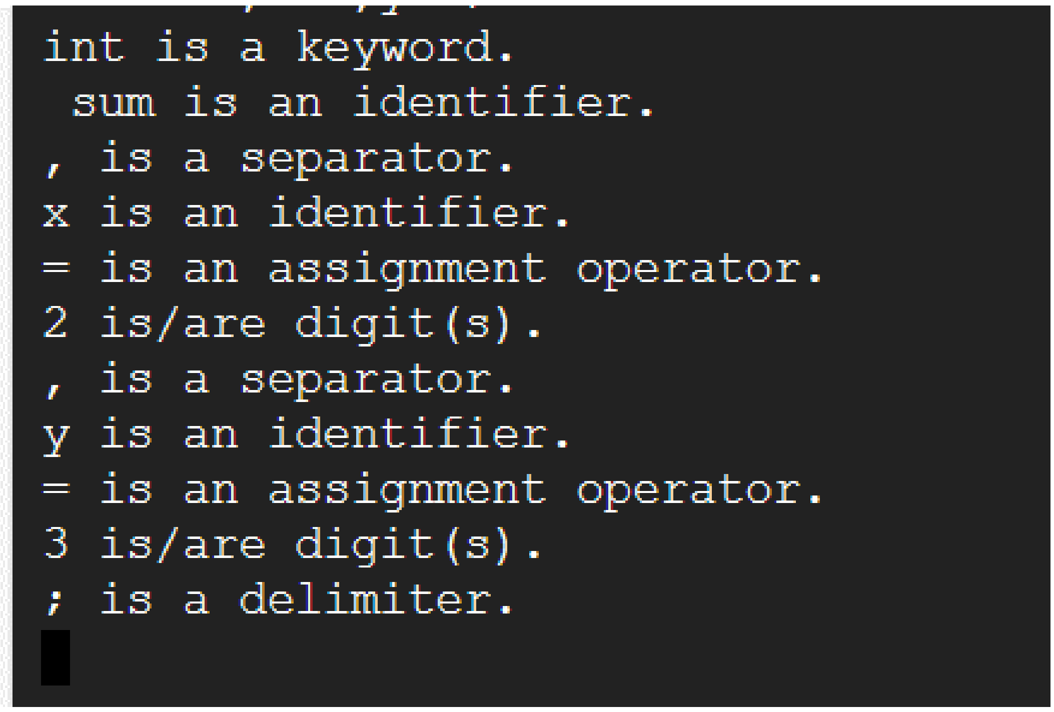
Code

```
%{
#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



```
int sum,x=2,y=3;
sum=x+y;
```



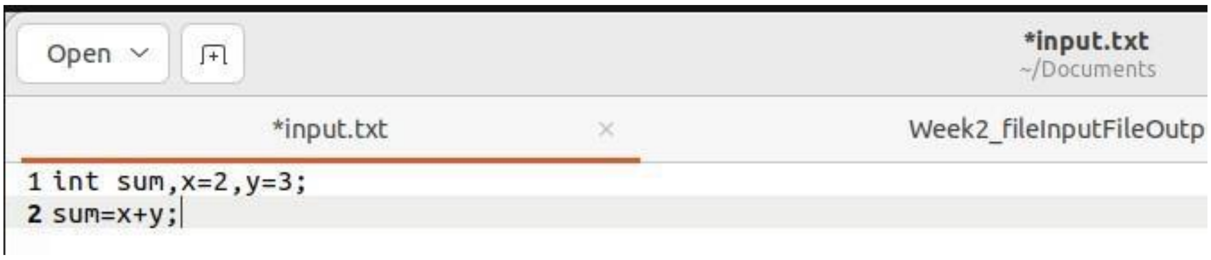
```
int is a keyword.
 sum is an identifier.
, is a separator.
x is an identifier.
= is an assignment operator.
2 is/are digit(s).
, is a separator.
y is an identifier.
= is an assignment operator.
3 is/are digit(s).
; is a delimiter.
```

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.

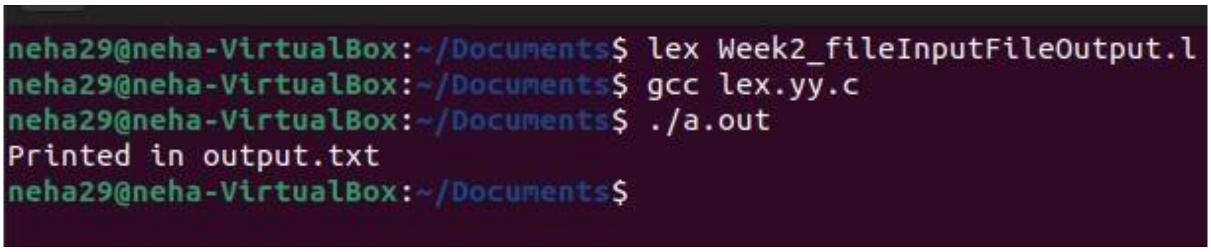
Code

```
%{
#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;
}
```

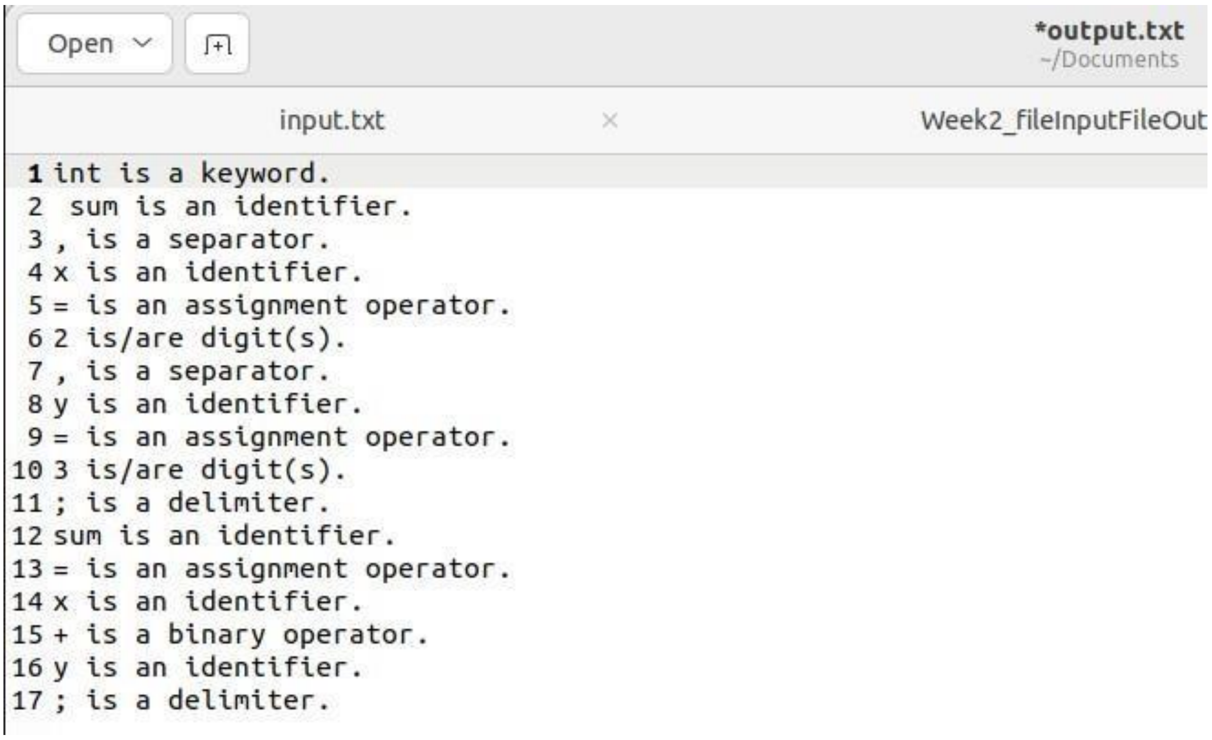
Output



```
int sum,x=2,y=3;
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$
```



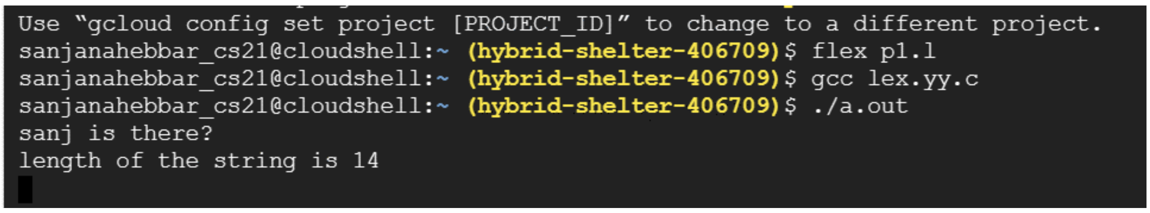
```
int is a keyword.
 sum is an identifier.
, is a separator.
x is an identifier.
= is an assignment operator.
2 is/are digit(s).
, is a separator.
y is an identifier.
= is an assignment operator.
3 is/are digit(s).
; is a delimiter.
sum is an identifier.
= is an assignment operator.
x is an identifier.
+ is a binary operator.
y is an identifier.
; is a delimiter.
```

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



```
Use "gcloud config set project [PROJECT_ID]" to change to a different project.
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ flex p1.l
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ gcc lex.yy.c
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ ./a.out
sanj is there?
length of the string is 14
```

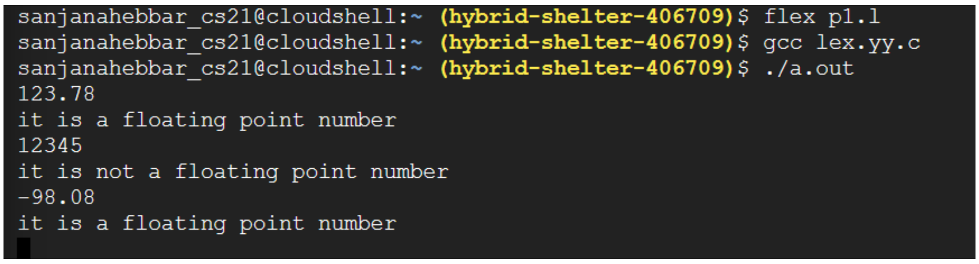
Lab 3

3.1Write 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



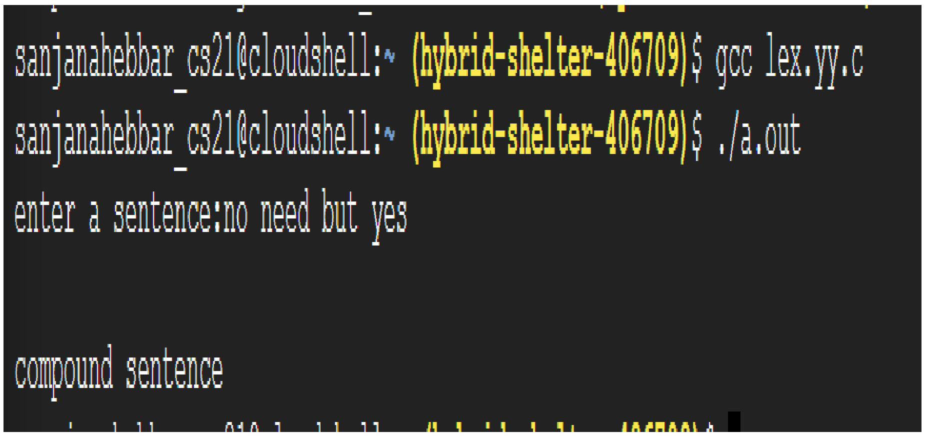
```
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ flex p1.l
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ gcc lex.yy.c
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ ./a.out
123.78
it is a floating point number
12345
it is not a floating point number
-98.08
it is a floating 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



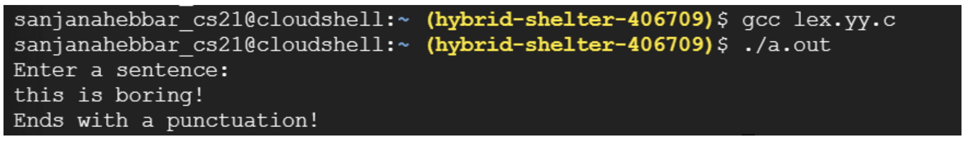
```
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ gcc lex.yy.c
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ ./a.out
enter a sentence:no need but yes


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



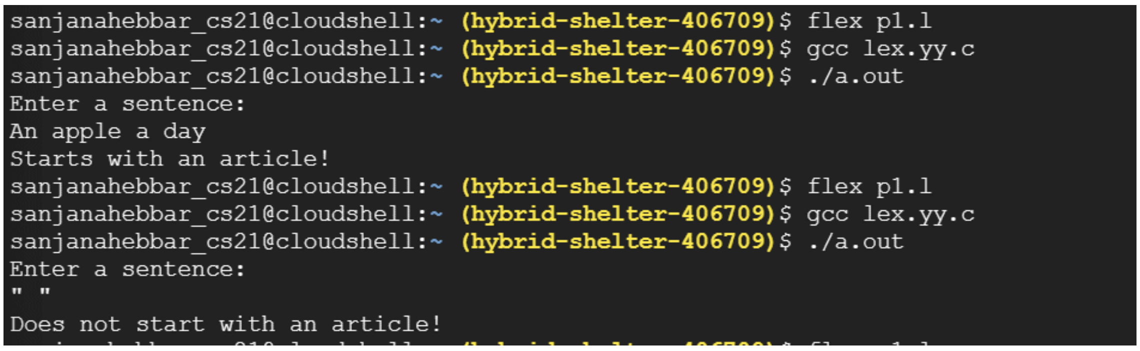
```
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ gcc lex.yy.c
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ ./a.out
Enter a sentence:
this is boring!
Ends with a punctuation!
```

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



```
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ flex p1.l
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ gcc lex.yy.c
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ ./a.out
Enter a sentence:
An apple a day
Starts with an article!
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ flex p1.l
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ gcc lex.yy.c
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ ./a.out
Enter a sentence:
" "
Does not start with an article!
```

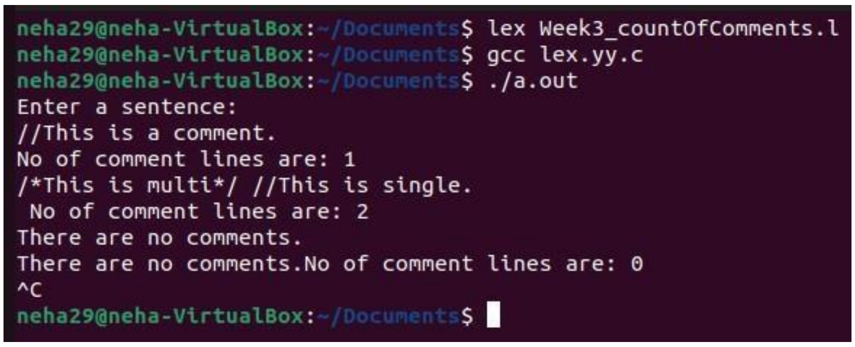
3.5 Lex program to count the number of comment lines (multi line comments or single line) in a program. Read the input from a file called input.txt and print the count in a file called output.txt.

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



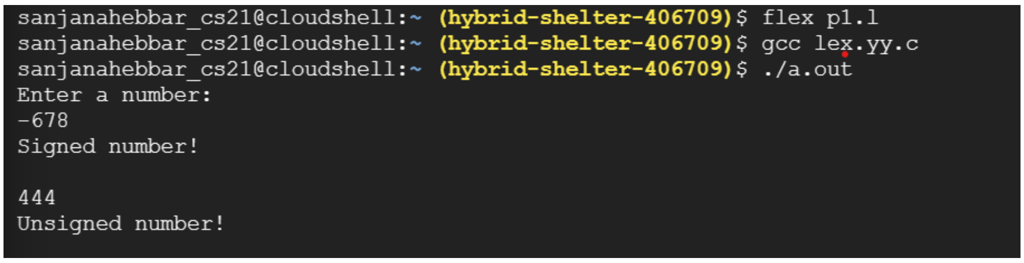
```
neha29@neha-VirtualBox:~/Documents$ lex Week3_countOfComments.l
neha29@neha-VirtualBox:~/Documents$ gcc lex.yy.c
neha29@neha-VirtualBox:~/Documents$ ./a.out
Enter a sentence:
//This is a comment.
No of comment lines are: 1
/*This is multi*/ //This is single.
 No of comment lines are: 2
There are 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



```
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ flex p1.l
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ gcc lex.yy.c
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ ./a.out
Enter a number:
-678
Signed number!

444
Unsigned number!
```

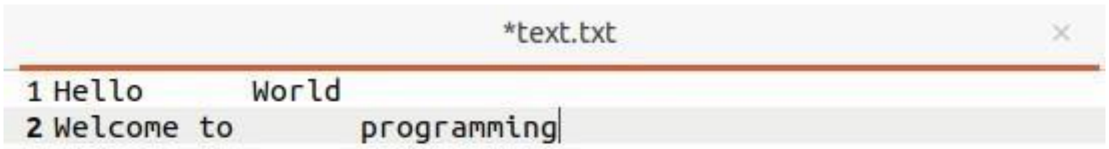
Lab 4

4.1 Write a LEX program that copies a file, replacing each nonempty sequence of white spaces by a single blank.

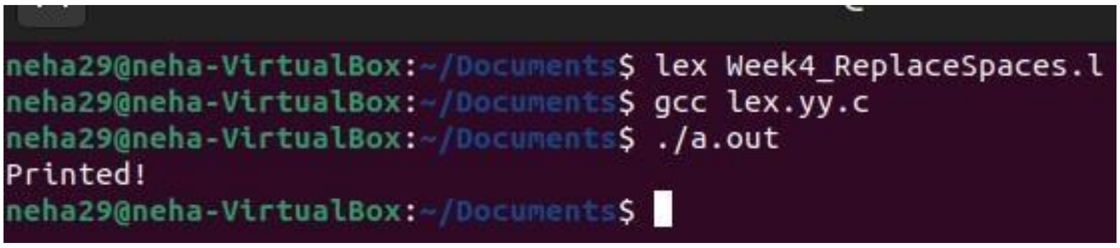
Code

```
%{
#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;
}
```

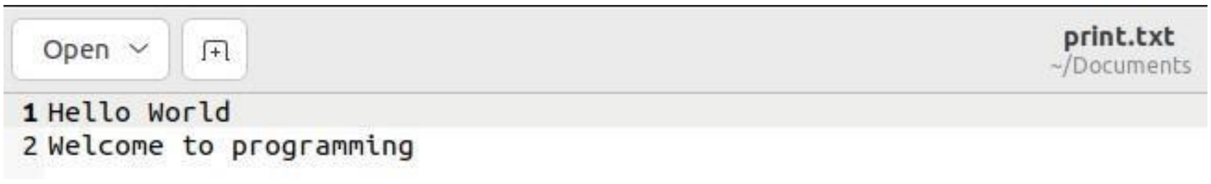
Output



```
Hello       World
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$
```



```
Hello World
Welcome to programming
```

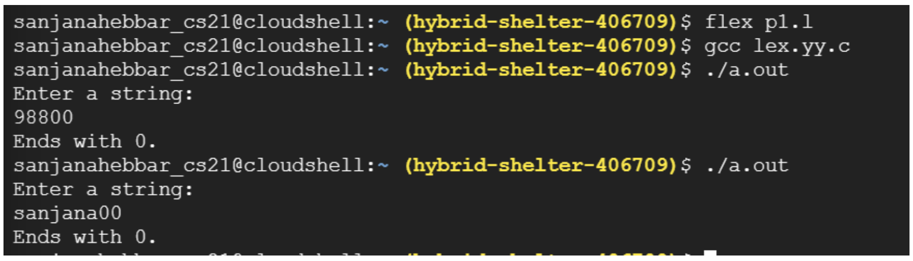
4.2 Write a LEX program to recognize the following tokens over the alphabets {0,1,..,9}

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



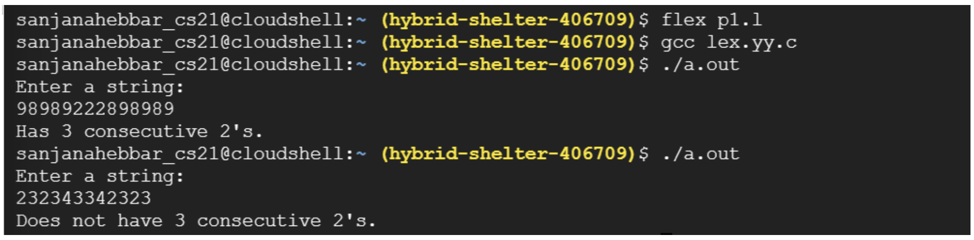
```
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ flex p1.l
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ gcc lex.yy.c
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ ./a.out
Enter a string:
98800
Ends with 0.
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ ./a.out
Enter a string:
sanjana00
Ends 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



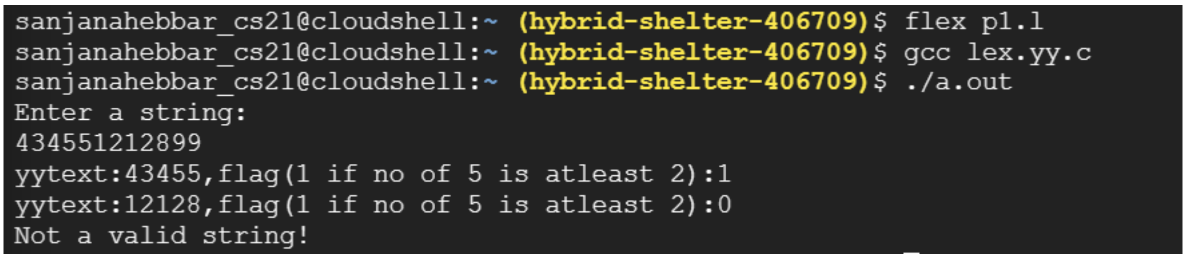
```
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ flex p1.l
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ gcc lex.yy.c
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ ./a.out
Enter a string:
98989222898989
Has 3 consecutive 2's.
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ ./a.out
Enter a string:
232343342323
Does not have 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



```
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ flex p1.l
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ gcc lex.yy.c
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ ./a.out
Enter a string:
434551212899
yytext:43455,flag(1 if no of 5 is atleast 2):1
yytext:12128,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

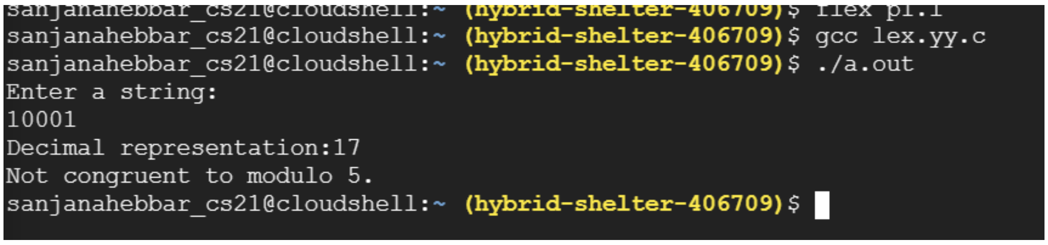
```
%{
#include<stdio.h> int
c,i,flag=1,sum=0,power=1;
%}
%%
^1[01]* {for(i=yyleng-1;i>=0;i--)
        {
         c=yytext[i]-'0';
sum+=c*power;           power*=2;
        }
         printf("Decimal representation:%d\n",sum);
if(sum%5!=0)
         {
         printf("Not congruent to modulo 5.\n");
sum=0;          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



```
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ flex p1.l
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ gcc lex.yy.c
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ ./a.out
Enter a string:
10001
Decimal representation:17
Not congruent to modulo 5.
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$
```

4.2.5 The set of all strings such that the 10th symbol from the right end is 1.

Code

%{

#include<stdio.h> int

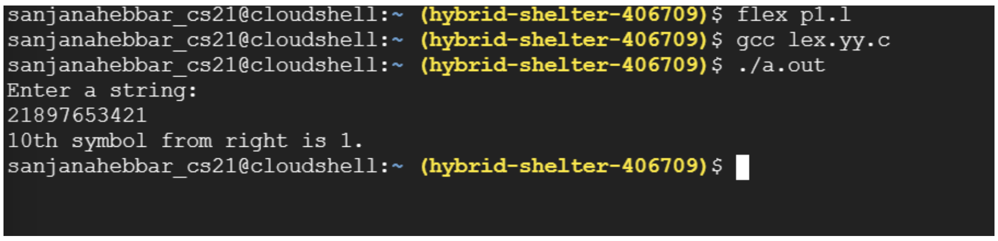
flag=0;

%}

%%

```
[0-9]*1[0-9][0-9][0-9][0-9][0-9][0-9][0-9][0-9][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



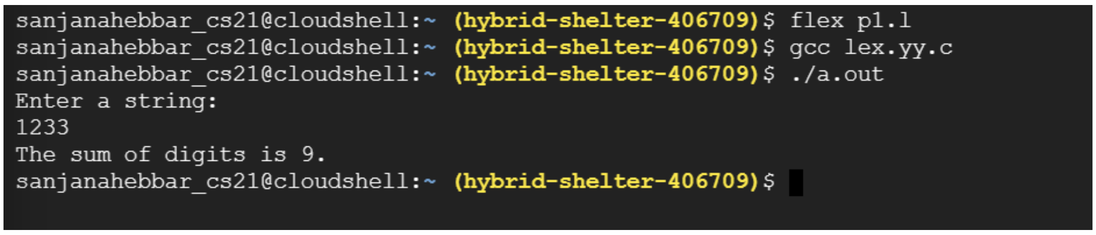
```
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ flex p1.l
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ gcc lex.yy.c
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ ./a.out
Enter a string:
21897653421
10th symbol from right is 1.
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$
```

4.2.6 The set of all four digits numbers whose sum is 9.

Code

```
%{

#include<stdio.h> int

sum=0,i,flag=0;

%}

%%

[0-9][0-9][0-9][0-9] {for(i=0;i<yyleng;i++)

                 {

                  sum+=yytext[i]-'0';

                  }

if(sum==9)

                 {

flag=1;

sum=0;
}                       else
{
flag=0;
sum=0;
                    }
                    }
\n {return 0;}
%%
void main() {
printf("Enter a string:\n");
yylex(); if(flag==1)
printf("The sum of digits is 9.\n"); else
printf("The sum of digits is not 9.\n");
} int
yywrap() {
return 1; }
```

Output



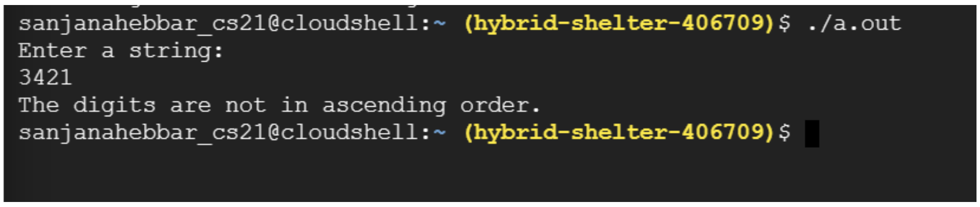
```
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ flex p1.l
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ gcc lex.yy.c
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ ./a.out
Enter a string:
1233
The sum of digits is 9.
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$
```

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



```
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ ./a.out
Enter a string:
3421
The digits are not in ascending order.
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$
```

Lab 5

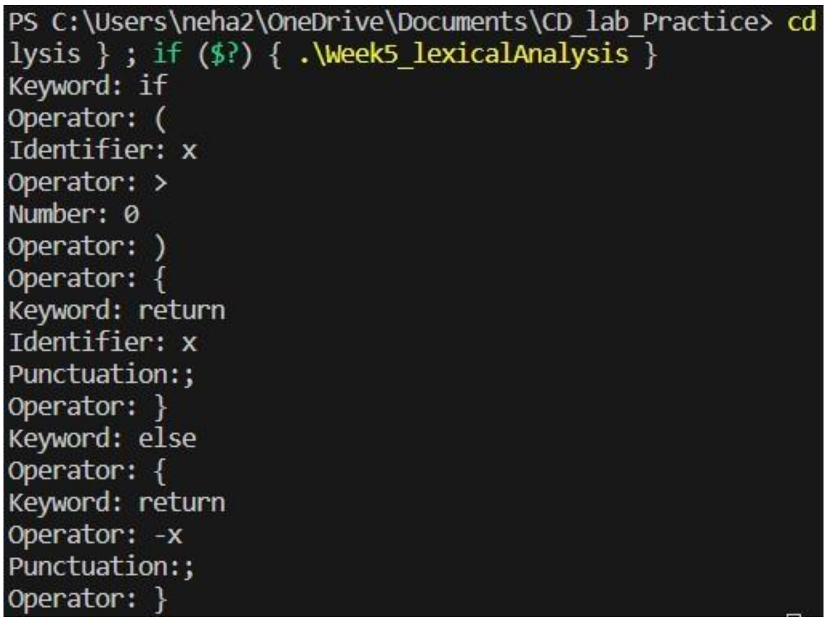
Write a C program to design lexical analysis to recognize any five keywords, identifiers, numbers, operators and punctuations.

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

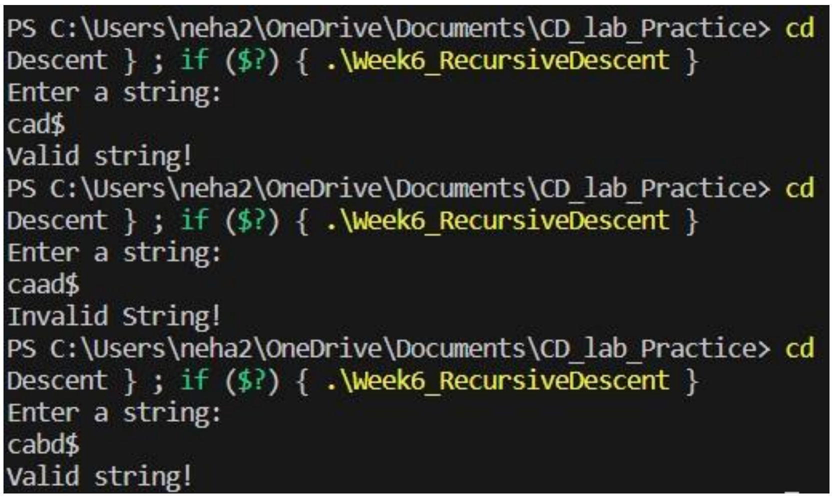
Code

```
#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

7.1Write 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()
{
}
```

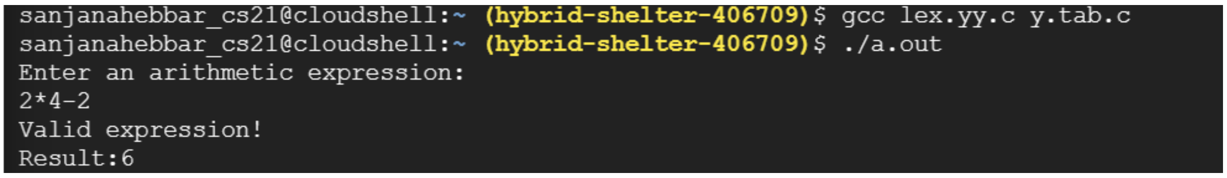
YACC

```
%{
#include<stdio.h>
#include<stdlib.h> int
yyerror(const char *s); int
yylex(void);
%}
%token num;
%left '+' y'-'
%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



```
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ gcc lex.yy.c y.tab.c
sanjanahebbar_cs21@cloudshell:~ (hybrid-shelter-406709)$ ./a.out
Enter an arithmetic expression:
2*4-2
Valid expression!
Result:6
```

7.2 Write a program in YACC to recognize strings of the form {(a^n)b , n>=5}.

Code

LEX

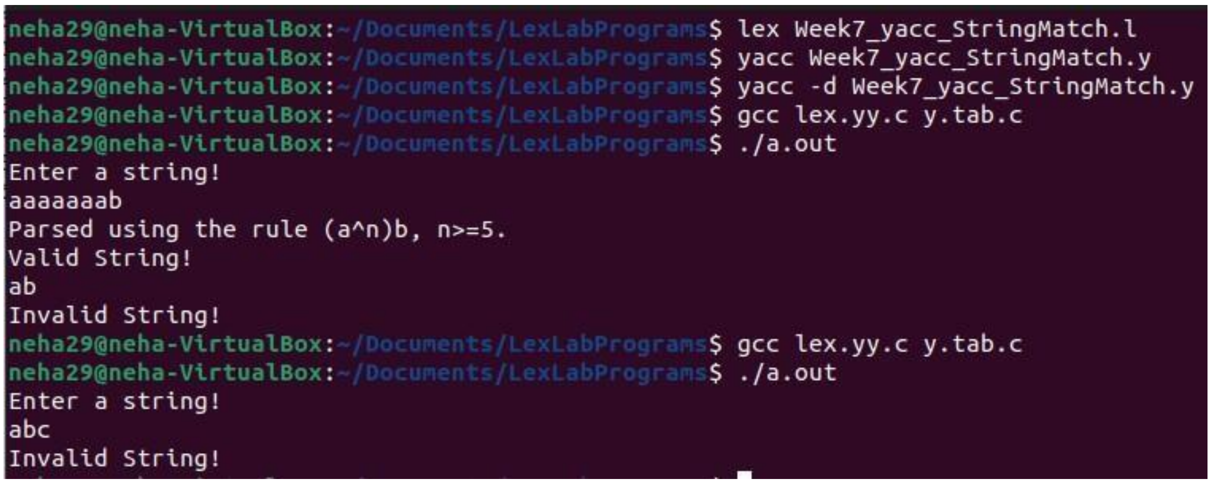
```
%{

#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 S B NL {printf("Parsed using the rule (a^n)b, n>=5.\nValid String!\n");}
;
S:S A
|
;
%%
void main() {
printf("Enter a string!\n");
yyparse(); } int
yyerror(char *s) {
printf("Invalid String!\n");
return 0; }
```

Output



```
neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ lex Week7_yacc_StringMatch.l
neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ yacc Week7_yacc_StringMatch.y
neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ yacc -d Week7_yacc_StringMatch.y
neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ gcc lex.yy.c y.tab.c
neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ ./a.out
Enter a string!
aaaaaaab
Parsed using the rule (a^n)b, n>=5.
Valid String!
ab
Invalid String!
neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ gcc lex.yy.c y.tab.c
neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ ./a.out
Enter a string!
abc
Invalid String!
```

7.3 Write a program in YACC to generate syntax tree for a given arithmetic expression.

Code

LEX

```
%{
#include<stdio.h>
#include<stdlib.h>
#include "y.tab.h" extern
int yylval;
%}
%%
[0-9]+ {yylval=atoi(yytext);return digit;}
[\t] ;
[\n] return 0;
. return yytext[0];
%%
int yywrap()
{ return
1; }
```

YACC

```
%{
#include <math.h>
#include<ctype.h>
#include<stdio.h>
#include<stdlib.h>
#include<string.h>
int yyerror(char *s);
int yylex(void); struct
tree_node
{ char
val[10]; int
lc; int rc; };

int ind;
struct tree_node syn_tree[100];
void my_print_tree(int cur_ind); int
mknode(int lc,int rc,char *val);
%}
%token digit
%%
S:E {my_print_tree($1);}
;
E:E'+'T {$$=mknode($1,$3,"+");}
|T {$$=$1;}
;
T:T'*'F {$$= mknode($1,$3,"*");}
|F {$$=$1;}
;
F:'('E')' {$$=$2;}
|digit {char buf[10];sprintf(buf,"%d", yylval);$$ = mknode(-1,-1,buf);}
;
%%
int main()
{ ind=0;
printf("Enter an expression:\n");
yyparse(); return 0; } int
yyerror(char *s)
{
printf("NITW Error\n");
return 0; }
int mknode(int lc,int rc,char val[10])
{
strcpy(syn_tree[ind].val,val);
syn_tree[ind].lc = lc;
syn_tree[ind].rc = rc;
ind++; return ind-1;
}
```

/*my_print_tree function to print the syntax tree in DLR fashion*/ void

my_print_tree(int cur_ind)

{

if(cur_ind==-1) return;

if(syn_tree[cur_ind].lc==-1&&syn_tree[cur_ind].rc==-1)

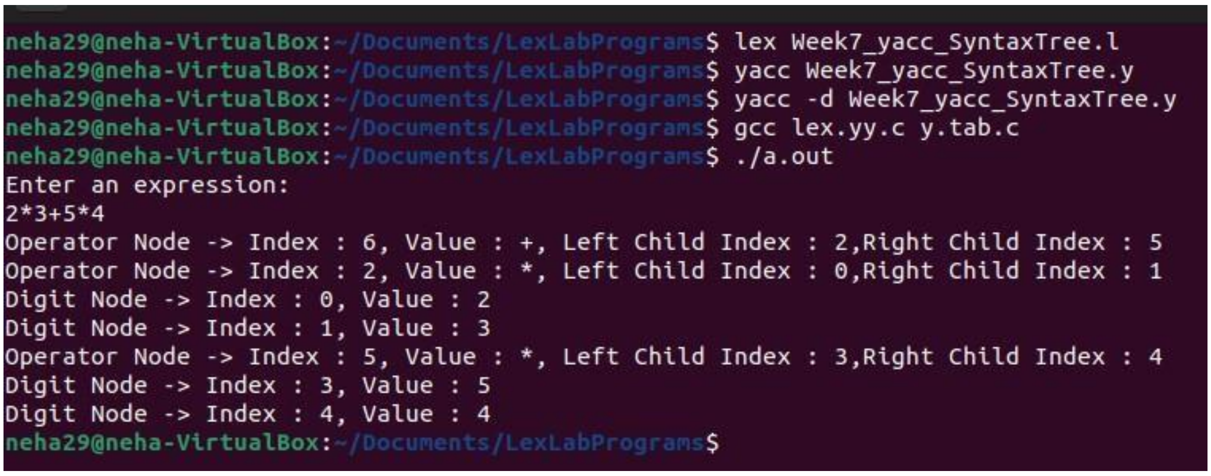
printf("Digit Node -> Index : %d, Value : %s\n",cur_ind,syn_tree[cur_ind].val); else

printf("Operator Node -> Index : %d, Value : %s, Left Child Index : %d,Right Child Index : %d\n",cur_ind,syn_tree[cur_ind].val, syn_tree[cur_ind].lc,syn_tree[cur_ind].rc);

my_print_tree(syn_tree[cur_ind].lc); my_print_tree(syn_tree[cur_ind].rc);

}

Output



```
neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ lex Week7_yacc_SyntaxTree.l
neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ yacc Week7_yacc_SyntaxTree.y
neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ yacc -d Week7_yacc_SyntaxTree.y
neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ gcc lex.yy.c y.tab.c
neha29@neha-VirtualBox:~/Documents/LexLabPrograms$ ./a.out
Enter an expression:
2*3+5*4
Operator Node -> Index : 6, Value : +, Left Child Index : 2,Right Child Index : 5
Operator Node -> Index : 2, Value : *, Left Child Index : 0,Right Child Index : 1
Digit Node -> Index : 0, Value : 2
Digit Node -> Index : 1, Value : 3
Operator Node -> Index : 5, Value : *, Left Child Index : 3,Right Child Index : 4
Digit Node -> Index : 3, Value : 5
Digit Node -> Index : 4, Value : 4
neha29@neha-VirtualBox:~/Documents/LexLabPrograms$
```

Lab 8

8.1Write 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

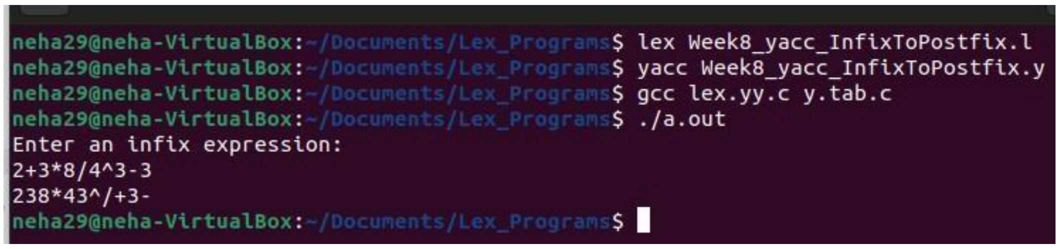
expression:\n"); yyparse(); } int

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

9.1Write 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)

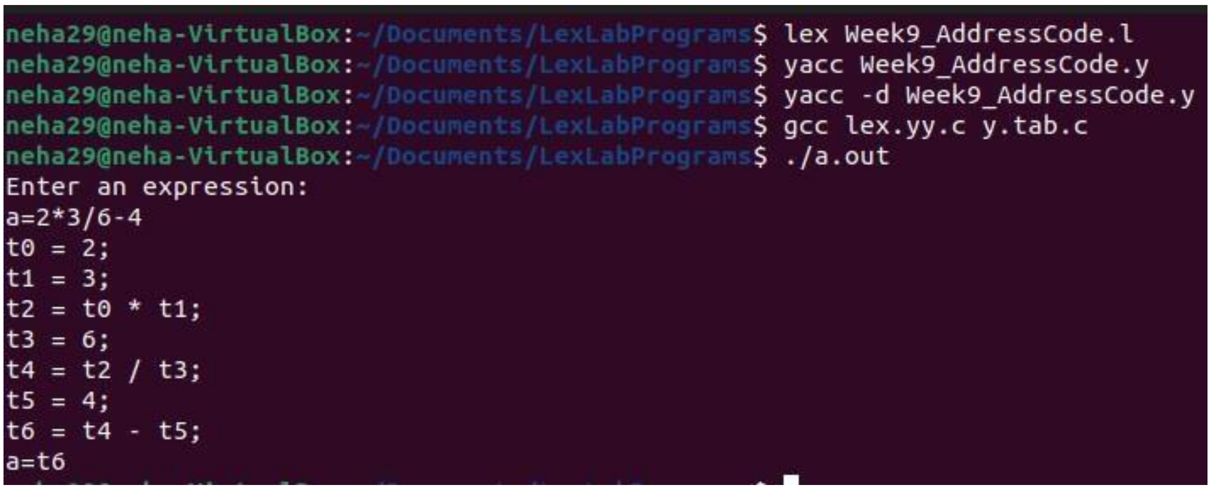
{

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
```