

# 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  
(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 **Varun Raj S(1BM21CS264)** , 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, Varun Raj S (1BM21CS264), 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. Sandhya A Kulkarni, 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



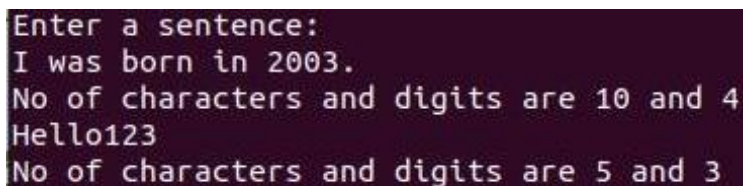
```
Give an input:
int sum,x=2,y=3,z;
int-keyword
sum-Identifier
,-separator
x-Identifier
=-assignment operator
2-digit
,-separator
y-Identifier
=-assignment operator
3-digit
,-separator
z-Identifier
;-delimiter
```

## 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

A screenshot of a terminal window with a dark background and light-colored text. It shows the output of the LEX program for two inputs. The first input is "I was born in 2003.", which results in 10 characters and 4 digits. The second input is "Hello123", which results in 5 characters and 3 digits.

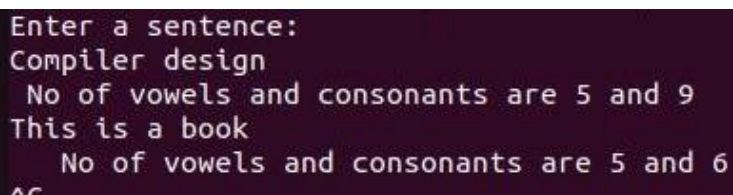
```
Enter a sentence:  
I was born in 2003.  
No of characters and digits are 10 and 4  
Hello123  
No of characters and digits are 5 and 3
```

### 1.3 Write a program in LEX to count the number of vowels and consonants in a string.

#### Code

```
%{  
#include<stdio.h>  
int v=0,c=0;  
%}  
%%  
  
[AEIOUaeiou] {v++;}  
[A-Za-z] {c++;}  
  
\n {printf("No of vowels and consonants are %d and %d\n",v,c),v=0,c=0;}  
%%  
  
void main()  
{  
printf("Enter a sentence:\n");  
yylex();  
}  
int yywrap()  
{  
return 1;  
}
```

#### Output

A screenshot of a terminal window with a dark purple background and light green text. It shows the output of the LEX program. The first prompt is "Enter a sentence:", followed by the input "Compiler design". The output is "No of vowels and consonants are 5 and 9". The second prompt is "This is a book", followed by the input "This is a book". The output is "No of vowels and consonants are 5 and 6". The prompt "AC" is partially visible at the bottom.

```
Enter a sentence:  
Compiler design  
No of vowels and consonants are 5 and 9  
This is a book  
No of vowels and consonants are 5 and 6  
AC
```



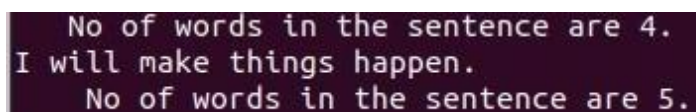
## Lab 2

### 2.1 Write a program in lex to count the number of words in a sentence.

#### Code

```
%{  
#include<stdio.h>  
int words;  
%}  
%%  
[^\t\n ]+ {words++;}  
\n {printf("No of words in the sentence are %d.\n",words),words=0;}  
%%  
void main()  
{  
printf("Enter a sentence:\n");  
yylex();  
}  
int yywrap()  
{  
return 1;  
}
```

#### Output

A screenshot of a terminal window with a dark purple background and light green text. It shows the output of the program for two different inputs. The first input is "No of words in the sentence are 4." and the second is "I will make things happen." Both lines are followed by the output "No of words in the sentence are 5.".

```
No of words in the sentence are 4.  
I will make things happen.  
No of words in the sentence are 5.
```

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

### Code

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

alpha [a-zA-Z0-9]

%%

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

%%

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

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

### Output

```
Enter a string:
HelloWorld
Characters

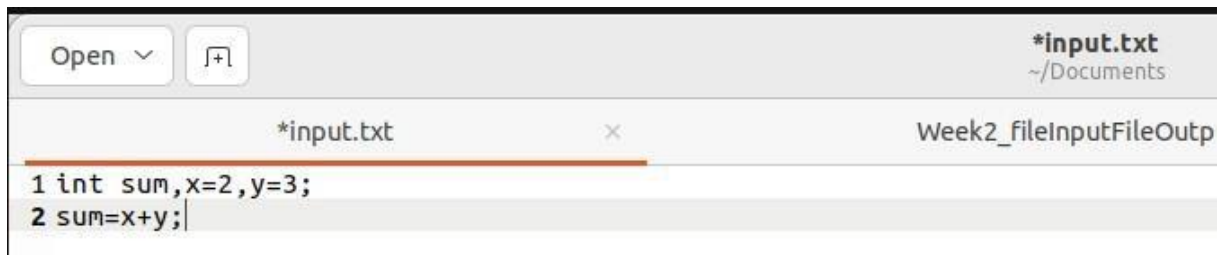
1234
Digits
Hello123
Invalid input!
```

## 2.3 Write a program in lex to identify tokens in a program by taking input from a file and printing the output on the terminal.

### Code

```
%{  
#include<stdio.h>  
%}  
%%  
  
char|int|float {printf("%s is a keyword.\n",yytext);}   
[a-zA-Z][a-zA-Z0-9]* {printf("%s is an identifier.\n",yytext);}   
, {printf("%s is a separator.\n",yytext);}   
; {printf("%s is a delimiter.\n",yytext);}   
"=" {printf("%s is an assignment operator.\n",yytext);}   
"+"|"-"|"*"|"/" {printf("%s is a binary operator.\n",yytext);}   
[0-9]+ {printf("%s is/are digit(s).\n",yytext);}   
  
\n ;  
%%  
  
void main()  
{  
yyin=fopen("input.txt","r");  
yylex();  
fclose(yyin);  
}  
int yywrap()  
{  
return 1;  
}
```

## Output



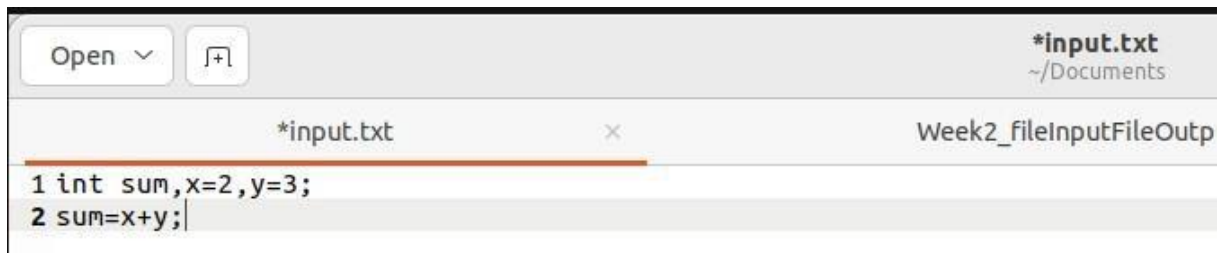
```
int is a keyword.  
sum is an identifier.  
, is a separator.  
x is an identifier.  
= is an assignment operator.  
2 is/are digit(s).  
, is a separator.  
y is an identifier.  
= is an assignment operator.  
3 is/are digit(s).  
; is a delimiter.  
sum is an identifier.  
= is an assignment operator.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

## 2.4 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

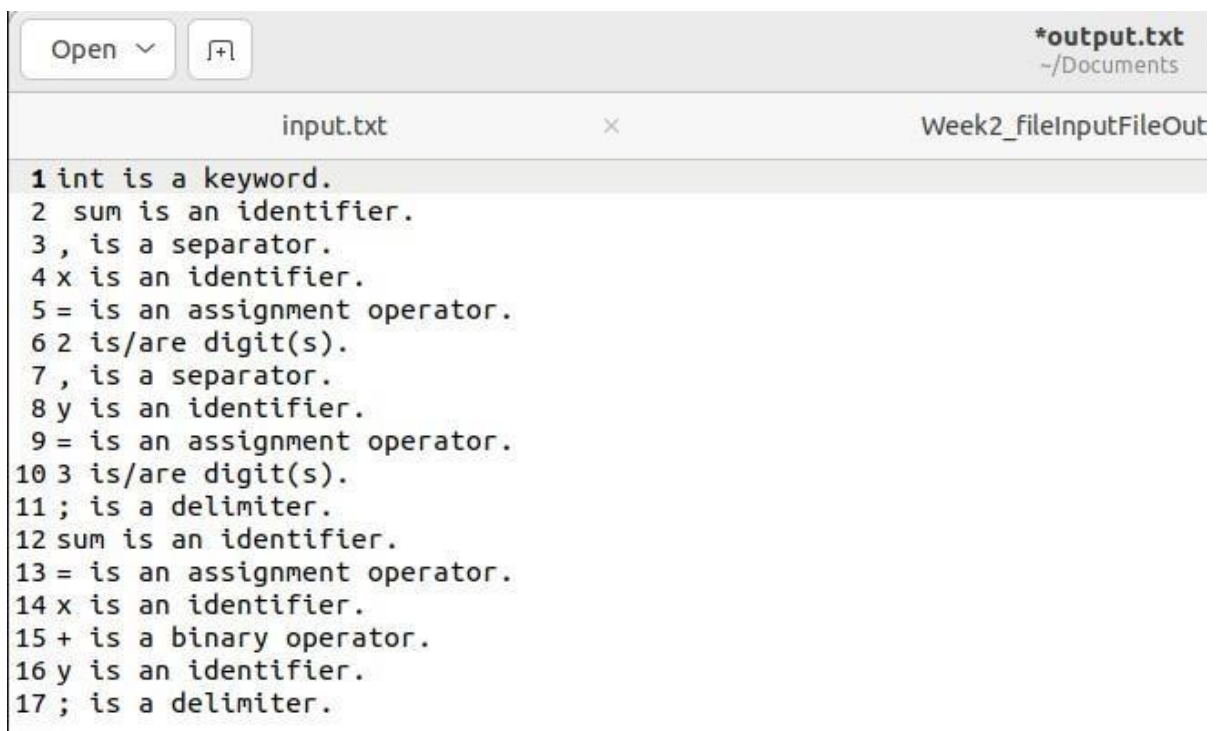
```
%{  
#include<stdio.h>  
%}  
%%  
  
char|int|float {fprintf(yyout,"%s is a keyword.\n",yytext);}   
[a-zA-Z][a-zA-Z0-9]* {fprintf(yyout,"%s is an identifier.\n",yytext);}   
, {fprintf(yyout,"%s is a separator.\n",yytext);}   
; {fprintf(yyout,"%s is a delimiter.\n",yytext);}   
"=" {fprintf(yyout,"%s 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



The screenshot shows a text editor window with a title bar containing a file icon, an 'Open' button, and a '+' icon. The title bar text is '\*input.txt' and '~ / Documents'. The editor has a tab labeled '\*input.txt' with a close button 'x' and a window title 'Week2\_fileInputFileOutp'. The content of the file is as follows:

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



The screenshot shows a text editor window with a title bar containing a file icon, an 'Open' button, and a '+' icon. The title bar text is '\*output.txt' and '~ / Documents'. The editor has a tab labeled 'input.txt' with a close button 'x' and a window title 'Week2\_fileInputFileOut'. The content of the file is as follows:

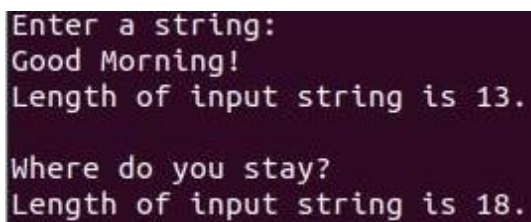
```
1 int is a keyword.
2 sum is an identifier.
3 , is a separator.
4 x is an identifier.
5 = is an assignment operator.
6 2 is/are digit(s).
7 , is a separator.
8 y is an identifier.
9 = is an assignment operator.
10 3 is/are digit(s).
11 ; is a delimiter.
12 sum is an identifier.
13 = is an assignment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

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

### Code

```
%{  
#include<stdio.h>  
%}  
%%  
[a-zA-Z0-9.,!? \t]+ {printf("Length of input string is %d.\n",yyleng);}   
%%  
void main()  
{  
printf("Enter a string:\n");  
yylex();  
}  
int yywrap()  
{  
return 1;  
}
```

### Output



```
Enter a string:  
Good Morning!  
Length of input string is 13.  
  
Where do you stay?  
Length of input string is 18.
```

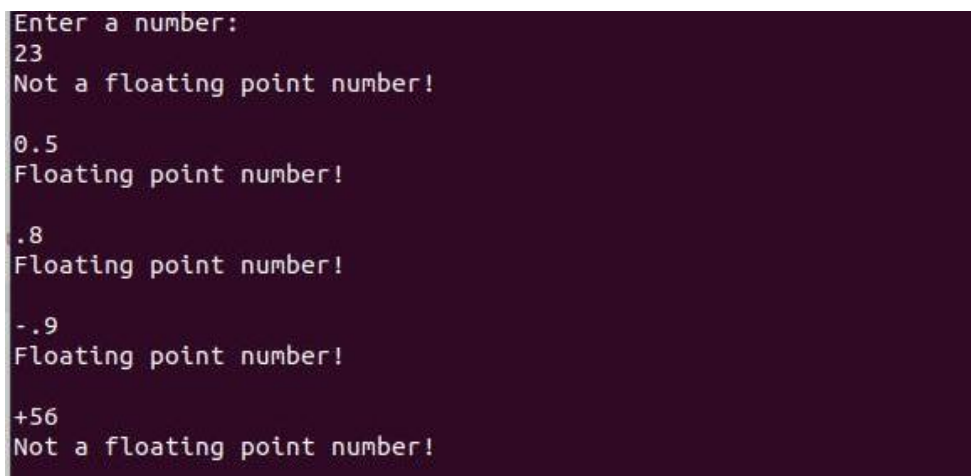
## Lab 3

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

#### Code

```
%{  
#include<stdio.h>  
%}  
%%  
[+]?[0-9]*[.][0-9]* {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:
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:  
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:  
A book is lying on the table.  
Starts 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;

%%

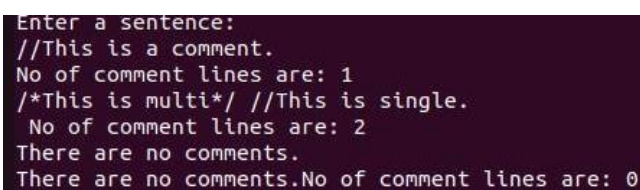
int yywrap()
{
return 1;
}

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

A screenshot of a terminal window showing the output of the Lex program. The output consists of four lines of text: 'Enter a sentence:', '//This is a comment.', 'No of comment lines are: 1', and '/\*This is multi\*/ //This is single.'. The second line is indented. The third line is followed by 'No of comment lines are: 2'. The fourth line is followed by 'There are no comments.'. The fifth line is 'There are no comments.No of comment lines are: 0'.

```
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
```

### 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!
```

## 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);}

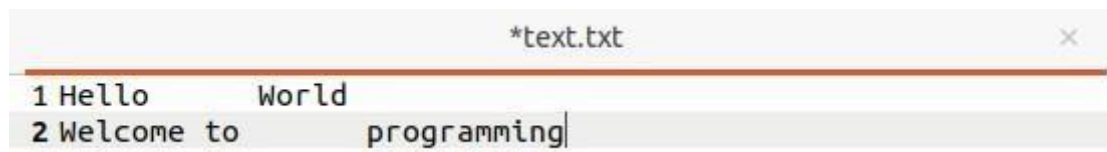
%%

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|
```



Open ▾  print.txt  
~/Documents

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


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

### 4.2.1 The set of all string ending in 00.

#### Code

```
%{  
#include<stdio.h>  
int flag=0;  
%}  
%%  
[0-9]+[00] {flag=1;}  
.  
\n {return 0;}  
%%  
void main()  
{  
printf("Enter a string:\n");  
yylex();  
if(flag==1)  
printf("Ends with 0.\n");  
else  
printf("Does not end with 0.\n");  
}  
int yywrap()  
{  
return 1;  
}
```

#### Output




```
Enter a string:  
12300  
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



```
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.
```

#### 4.2.4 The set of all strings beginning with a 1 which, interpreted as the binary representation of an integer, is congruent to zero modulo 5.

##### Code

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

int c,i,flag=1,sum=0,power=1;
%}

%%

^1[01]* {for(i=yytext[0];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

A terminal window with a dark purple background and light green text. It shows the program's output for the input '101'.

```
Enter a string:  
101  
Decimal representation:5  
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

A screenshot of a terminal window with a dark background. It shows the program's output for the input string "11234345236". The first line is the prompt "Enter a string:", followed by the input string on the next line. The final line of output is "10th symbol from right is 1.", indicating that the 10th character from the right end of the string is indeed '1'.

```
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<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**

```
Enter a string:  
2340  
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

```

Enter a string:
cad$
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

```

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 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

```
Enter a string!
aaaaaaaab
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
```