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LAB REPORT on COMPILER DESIGN

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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

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CERTIFICATE

This is to certify that the Lab work entitled “**Compiler Design**” carried out by **B C Surag(1BM21C037)** , 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, B C Surag(1BM21CS037), 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. Sunayana S, 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

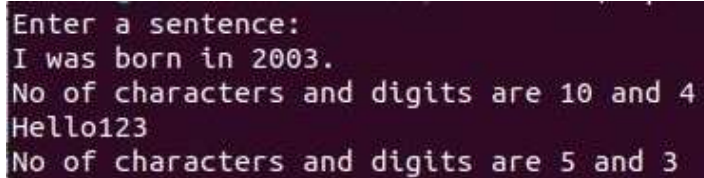
```
Give an input:  
int sum,x=2,y=3,z;  
int-keyword  
sum-Identifier  
, -separator  
x-Identifier  
=-assignment operator  
2-digit  
, -separator  
y-Identifier  
=-assignment operator  
3-digit  
, -separator  
z-Identifier  
;-delimiter
```

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 input sentences. 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.

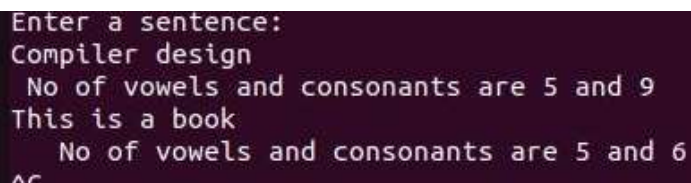
```
Enter a sentence:  
I was born in 2003.  
No of characters and digits are 10 and 4  
Hello123  
No of characters and digits are 5 and 3
```

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



```
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
```

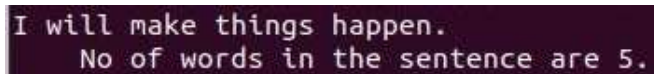

Lab 2

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




```
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>

%}

%%

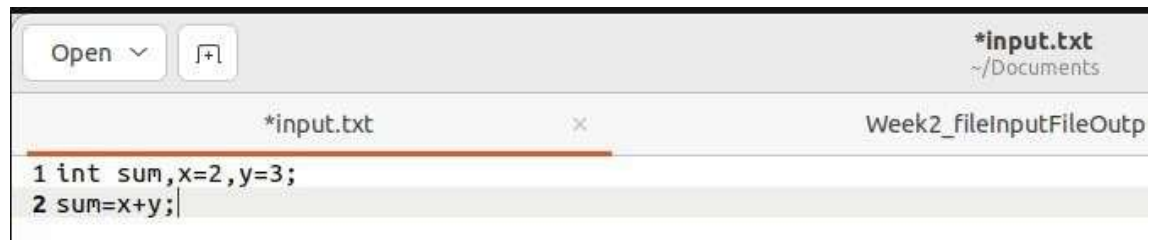
char|int|float {printf("%s is a keyword.\n",yytext);}
[a-zA-Z][a-zA-Z0-9]* {printf("%s is an identifier.\n",yytext);}
, {printf("%s is a separator.\n",yytext);}
; {printf("%s is a delimiter.\n",yytext);}
"=" {printf("%s is an assignment operator.\n",yytext);}
"+"|"-"|"*"|"/" {printf("%s is a binary operator.\n",yytext);}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



A screenshot of a text editor window. The title bar shows "Open" with a dropdown arrow and a "+" icon. The file name is "*input.txt" and the path is "~/Documents". The editor content shows two lines of C code: "1 int sum,x=2,y=3;" and "2 sum=x+y;". The line numbers 1 and 2 are in the left margin. The window title is "Week2_fileInputFileOutp".

```
1 int sum,x=2,y=3;
2 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.
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);}

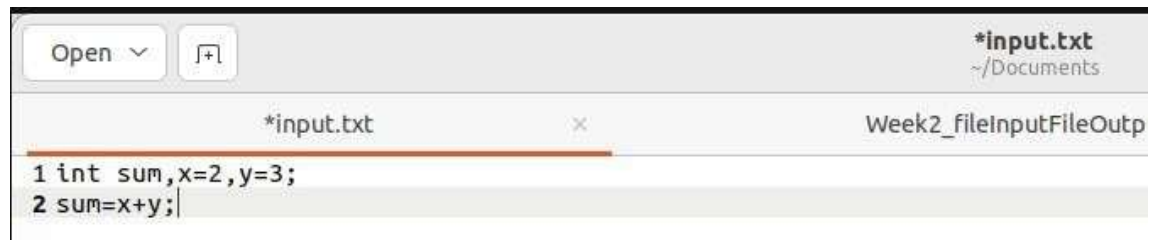
\n ;

%%

void main()
{
yyin=fopen("input.txt","r");
yyout=fopen("output.txt","w");
yylex();
printf("Printed in output.txt\n");
fclose(yyin);
fclose(yyout);
}

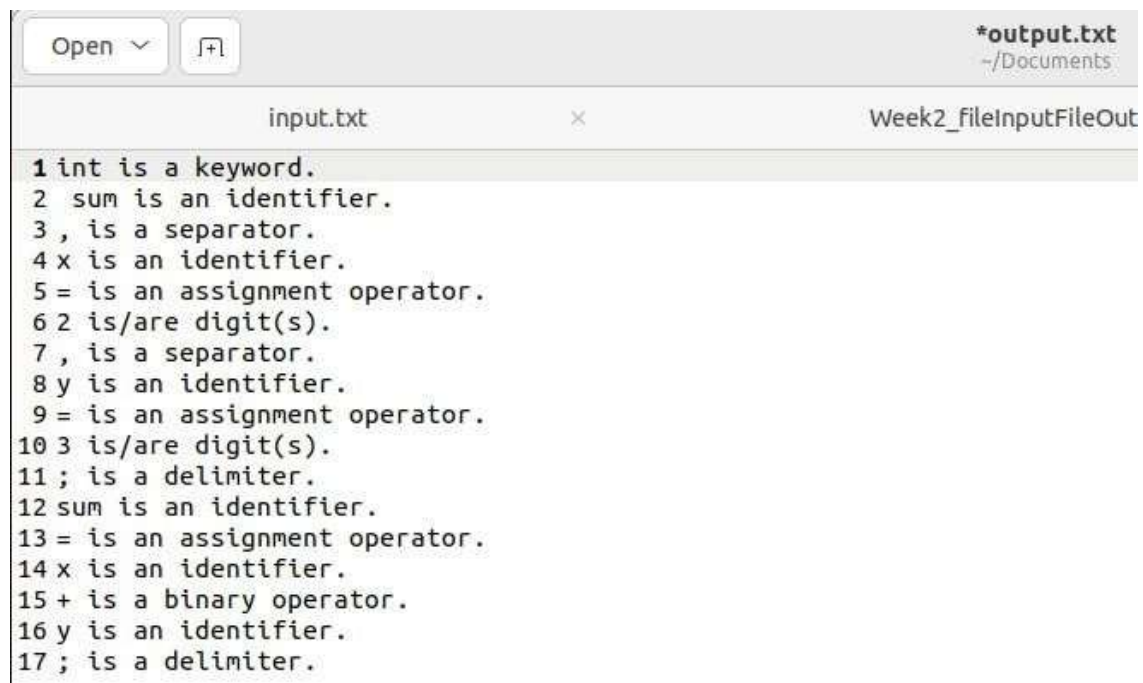
int yywrap()
{
return 1;
}
```

Output



A screenshot of a text editor window. The title bar shows "Open" with a dropdown arrow and a file icon, followed by the filename "*input.txt" and the path "~/Documents". The editor area contains two lines of code: "1 int sum,x=2,y=3;" and "2 sum=x+y;". The second line is currently selected.

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



A screenshot of a text editor window. The title bar shows "Open" with a dropdown arrow and a file icon, followed by the filename "*output.txt" and the path "~/Documents". The editor area contains a list of 17 numbered items, each describing a token from the input code: "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."

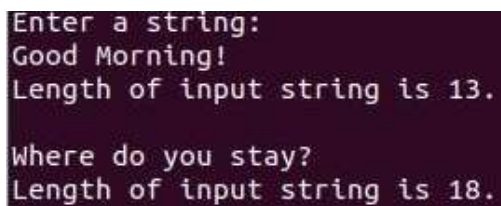
```
1 int is a keyword.
2 sum is an identifier.
3 , is a separator.
4 x is an identifier.
5 = is an assignment operator.
6 2 is/are digit(s).
7 , is a separator.
8 y is an identifier.
9 = is an assignment operator.
10 3 is/are digit(s).
11 ; is a delimiter.
12 sum is an identifier.
13 = is an assignment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

A screenshot of a terminal window with a dark background and light-colored text. It shows the program's execution for two different inputs. The first input is "Good Morning!", which results in a length of 13. The second input is "Where do you stay?", which results in a length of 18.

```
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:
This is a car.
Simple 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!  
Enter a sentence:  
Amazing!  
Ends with a punctuation!
```

3.4 Write a program to read an input sentence and to check if the sentence begins with English articles (A, a,AN,An,THE and The).

Code

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

int flag=0;

%}

%%

^(an|An|The|the|A|a)[ " ].* {flag=1;}

.* {flag=0;}

\n {return 0;}

%%

int yywrap()
{
return 1;
}

void main()
{
printf("Enter a sentence:\n");
yylex();
if(flag==1)
printf("Starts with an article!\n");
else
printf("Does not start with an article!\n");
}
```

Output

```
Enter a sentence:  
This is a good idea.  
Does not start with an article!  
Enter a sentence: The sun rises in the east.  
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++;}

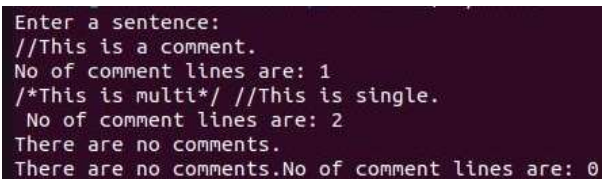
. ECHO;

%%

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



```
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

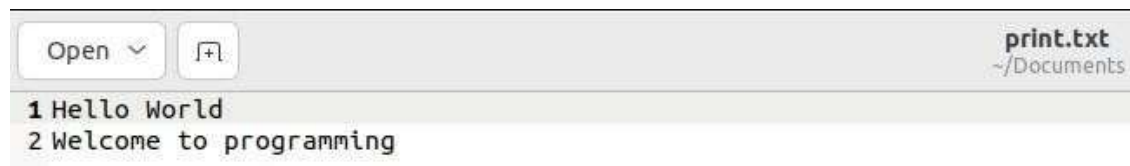
```
%{  
#include<stdio.h>  
%}  
%%  
[ \t]+ {fprintf(yyout," ");}  
.\|n {fprintf(yyout,"%s",yytext);}  
%%  
void main()  
{  
yyin=fopen("text.txt","r");  
yyout=fopen("print.txt","w");  
yylex();  
fclose(yyin);  
fclose(yyout);  
printf("Printed!\n");  
}  
int yywrap()  
{  
return 1;  
}
```


Output



*text.txt

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



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



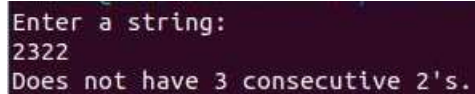
```
Enter a string:  
12300  
Ends with 0.
```

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:  
2322  
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

```
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-1;i>=0;i--)
    {
        c=yytext[i]-'0';
        sum+=c*power;
        power*=2;
    }
    printf("Decimal representation:%d\n",sum);
    if(sum%5!=0)
    {
        printf("Not congruent to modulo 5.\n");
        sum=0;
        power=1;
    }
    else
    {
        printf("Congruent to modulo 5.\n");
        sum=0;
        power=1;
    }
}

.* {printf("Not a binary number.\n");}

\n {return 0;}

%%

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

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

Output

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

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

Code

```
%{  
#include<stdio.h>  
  
int flag=0;  
%}  
%%  
[0-9]*1[0-9][0-9][0-9][0-9][0-9][0-9][0-9][0-9] {flag=1;}  
.  
\n {return 0;}  
%%  
  
void main()  
{  
printf("Enter a string:\n");  
yylex();  
if(flag==1)  
printf("10th symbol from right is 1.\n");  
else  
printf("10th symbol from right is not 1.\n");  
}  
  
int yywrap()  
{  
return 1;  
}
```

Output

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


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

Code

```
%{  
#include<stdio.h>  
int sum=0,i,flag=0;  
%}  
%%  
[0-9][0-9][0-9][0-9] {for(i=0;i<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:  
6300  
The sum of digits is 9.
```

4.2.7 The set of all four digital numbers, whose individual digits are in ascending order from left to right.

Code

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

int c,i,flag=1;

%}

%%

[0-9][0-9][0-9][0-9] {for(i=0;i<yyleng-1;i++)
    {
        if(yytext[i]>=yytext[i+1])
        {
            flag=0;
            break;
        }
    }
}

\n {return 0;}

%%

void main()
{
printf("Enter a string:\n");
yylex();
if(flag==1)
printf("The digits are in ascending order.\n");
else
printf("The digits are not in ascending order.\n");
}

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

Output

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

Lab 5

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

Code

```
#include <stdio.h>
#include <string.h>
#include <ctype.h>

void lexicalAnalyzer(char input_code[]) {
    char *keywords[] = {"if", "else", "while", "for", "return"};
    char *operators[] = {"+", "-", "*", "/", "=", "==", "<", ">", "<=", ">="};
    char *punctuations[] = {",", ";", "(", ")", "{", "}" };

    char *token = strtok(input_code, " \t\n");

    while (token != NULL) {
        if (isdigit(token[0])) {
            printf("Number: %s\n", token);
        } else if (isalpha(token[0]) || token[0] == '_') {
            int isKeyword = 0;
            for (int i = 0; i < sizeof(keywords) / sizeof(keywords[0]); i++) {
                if (strcmp(token, keywords[i]) == 0) {
                    printf("Keyword: %s\n", token);
                    isKeyword = 1;
                    break;
                }
            }
            if (!isKeyword) {
                printf("Identifier: %s\n", token);
            }
        } else if (strchr("+-*/=<>(){}[]", token[0]) != NULL) {
            printf("Operator: %s\n", token);
        }
        else if(strchr(",;", token[0]) != NULL)
```

```

    {
        printf("Punctuation:%s\n",token);
    }

    token = strtok(NULL, " \t\n");
}

}

int main() {
    char input_code[] = "if ( x > 0 ) { return x ; } else { return -x ; }";
    lexicalAnalyzer(input_code);
    return 0;
}

```

Output

```

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