

VISVESVARAYA TECHNOLOGICAL UNIVERSITY

“JnanaSangama”, Belgaum -590014, Karnataka.



LAB REPORT on

COURSE TITLE

Submitted by

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in partial fulfillment for the award of the degree of
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COMPUTER SCIENCE AND ENGINEERING



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Department of Computer Science and Engineering



CERTIFICATE

This is to certify that the Lab work entitled “Compiler Design” carried out by **PRAVIJ GUPTA (1BM21CS141)**, who is bonafide student of **B. M. S. College of Engineering**. It is in partial fulfillment for the award of **Bachelor of Engineering in Computer Science and Engineering** of the Visvesvaraya Technological University, Belgaum during the year 2023. The Lab report has been approved as it satisfies the academic requirements in respect of a **Compiler Design course (21CS5PCCPD)**work prescribed for the said degree.

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Experiment No :01

Aim of the program

Write a program to design Lexical Analyzer in C/C++/Java/Python Language (to recognize any five

keywords, identifiers, numbers, operators and punctuations)

Program

```
def analyze_input(input_text):    keywords = ["char", "float", "bool",
"int", "for", "break", "continue"]    punctuation = [".", "!", ";", "?"]
operators = ["+", "-", "*", "/", "%", "="]
```

```
    keys, ids, nums, ops, punct = 0, 0, 0, 0, 0
```

```
    for i in input_text.split():
```

```
        if i in keywords:            if keys <
5:
```

```
            print(f'{i} is a keyword!\n')
```

```
keys += 1        elif i in punctuation:
```

```
if punct < 5:            print(f'{i} is a
```

```
punctuation!\n')            punct += 1
```

```
elif i in operators:            if ops < 5:
```

```
                print(f'{i} is an operator!\n')
```

```
ops += 1        elif i.isnumeric():
```

```
if nums < 5:            print(f'{i} is a
```

```
number!\n')            nums += 1
```

```
else:            if ids < 5:
```

```
                flag = False            if
```

```
i[0].isalpha() or i[0] == '_':
```

```
                flag = True            for j in i[1:]:
```

```
if j in operators or j in punctuation:
```

```
print(f'{i} is an invalid token!\n')
```

```
flag = False            break            if
```

```
flag:
```

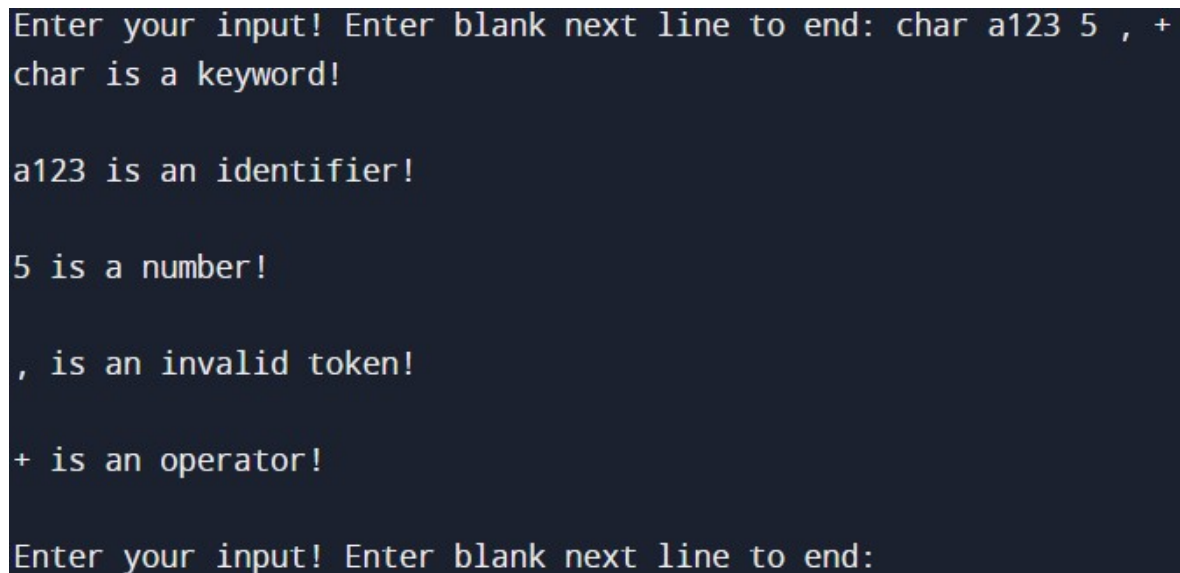
```

        print(f'{i} is an identifier!\n')
ids += 1          else:
        print(f'{i} is an invalid token!\n')

while True:
    user_input = input("Enter your input! Enter blank next line to end: ")
    if not user_input.strip():
        break
    analyze_input(user_input)

```

Output – Screen shot



```

Enter your input! Enter blank next line to end: char a123 5 , +
char is a keyword!

a123 is an identifier!

5 is a number!

, is an invalid token!

+ is an operator!

Enter your input! Enter blank next line to end:

```

Experiment No :02

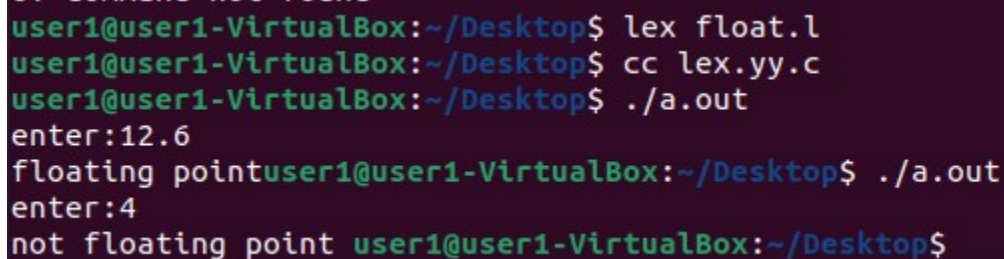
Aim of the program

Write a program in LEX to recognize Floating Point Numbers.

Program

```
%{
#include<stdio.h> int
flag=0;
%} alpha[a-zA-Z]
digit[0-9]
decimal[.]
%%
[+|-]?({digit})*{decimal}({digit})* { flag=1;}
{alpha}({alpha}){digit}* {printf("invalid number ");}
\n return 0;
%%
int yywrap(){ int main(){ printf("enter :");
yylex(); if(flag==1){ printf("floating point
number");} else{printf(" not a floating point
number");}
}
}
```

Output – Screen shot



```
user1@user1-VirtualBox:~/Desktop$ lex float.l
user1@user1-VirtualBox:~/Desktop$ cc lex.yy.c
user1@user1-VirtualBox:~/Desktop$ ./a.out
enter:12.6
floating pointuser1@user1-VirtualBox:~/Desktop$ ./a.out
enter:4
not floating point user1@user1-VirtualBox:~/Desktop$
```

Experiment No :03

Write a program in LEX to recognize different tokens: Keywords, Identifiers, Constants, Operators and Punctuation symbols.

Program

```
%{  
#include<stdio.h> int  
x1=0,x2=0,x3=0,x4=0;  
%}  
alpha[a-zA-Z]  
digit[0-9] d[.]  
%%  
int|float|char { x1++;} {digit}+  
{x2++;}  
[<|>|=|<=|>|=|=] {x3++;}  
{alpha}({digit}|{alpha})* {x4++;}  
\n { printf("\nkey:%d",x1);  
printf("\nconst:%d",x2);  
printf("\noperator:%d",x3);  
printf("\nidentifier:%d",x4);  
}  
%%  
int yywrap(){} int  
main(){
```

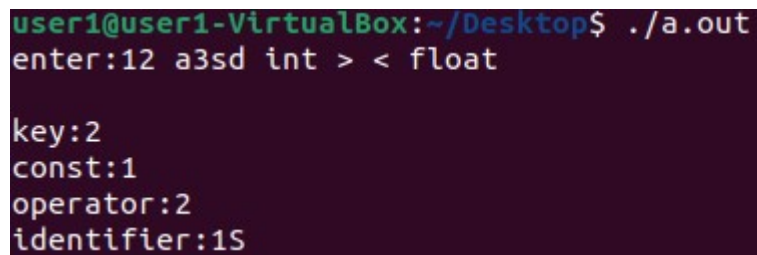

Aim of the program

```
printf("enter:");
```

```
yylex();
```

```
}
```

Output – Screen shot



```
user1@user1-VirtualBox:~/Desktop$ ./a.out
enter:12 a3sd int > < float

key:2
const:1
operator:2
identifier:15
```

Experiment No :04

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

Program

```
%{
```

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

```
%}
```

```
%%
```

```
[ ]([ ])* {fprintf(yyout," ");}
```

```
([ ]*(\n)([ ])* {fprintf(yyout," ");}
```

```
%%
```

```
int yywrap(){} int  
main(){  
printf("running");  
yyin=fopen("txt","r");  
yyout=fopen("txto","w");  
yylex();  
}
```

Output – Screen shot



1 hi friend happy new year welcome to 2024 .

Aim of the program

Experiment No :05

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

- a) The set of all string ending in 00.
- b) The set of all strings with three consecutive 222's.
- c) The set of all string such that every block of five consecutive symbols contains at least two 5's.
- d) The set of all strings beginning with a 1 which, interpreted as the binary representation of an integer, is congruent to zero modulo 5.
- e) The set of all strings such that the 10th symbol from the right end is 1.
- f) The set of all four digits numbers whose sum is 9
- g) The set of all four digital numbers, whose individual digits are in ascending order from left to right.

Program

```
%{  
#include<stdio.h> int  
x1=0,x2=0,x3=0,x4=0;  
%}  
alpha[a-zA-Z]  
digit[0-9] d[.]  
%%  
( {digit})*00 {printf("\n%s rule A",yytext);}   
( {digit})*222( {digit})* {printf("\n%s rule B",yytext);}   
(1(0)*(11|01)(01*01|00*10(0)*(11|1))*0)(1|10(0)*(11|01)(01*01|00*10(0)*(1  
1|1))*10)* {printf("\n%s rule D",yytext);}
```

```

({digit})*1{digit}{9} {printf("\n%s rule E",yytext);}
{digit}{4} { int sum=0;
for(int i=0;i<4;i++){
sum=sum+yytext[i]-48;
} if(sum==9) {printf("\n%s rule
F",yytext);} sum=1; for(int j=0;j<3;j++){
if(yytext[j]>yytext[j+1]) sum=0;
} if(sum==1) {printf("\n%s rule
G",yytext);}

}

```

```

{d}* {int i=0; int c=0;
if(yyvaleng<5) {break;}
for(i=0;i<5;i++) { if(yytext[i]=='5')
c++;

} if(c<2)
{break;}

```

```

else{

for(;i<yyleng;i++){
if(yytext[i-5]=='5') c--;
if(yytext[i]=='5') c++; if(c<2)
break;

} if(i==yyleng) {printf("\n %s rule
C",yytext);}
}

}

%%

```

```

int yywrap(){} int
main(){
printf("enter:");
yylex();
}

```

Output – Screen shot

```
enter: ^C
user1@user1-VirtualBox:~/Desktop$ lex p05.l
user1@user1-VirtualBox:~/Desktop$ cc lex.yy.c
user1@user1-VirtualBox:~/Desktop$ ./a.out
enter:100 122233 10000000001 1010 1234 2205

100 rule A
122233 rule B
10000000001 rule E
1010 rule D
1234 rule G
2205 rule F
```

Part-B:

Experiment No :01

Aim of the program

1. Write a program to implement

(a) Recursive Descent Parsing with back tracking (Brute Force Method). $S \rightarrow cAd$, $A \rightarrow ab/a$

(b) Recursive Descent Parsing with back tracking (Brute Force Method). $S \rightarrow cAd$, $A \rightarrow a/ab$

Program

```
#include<stdio.h>
#include<conio.h>
#include<string.h>
int A(); char str[15];
int isave,curr_ptr=0;
int main(void)
{
    clrscr();
    printf("1.S->cAd\n2.A->ab/a\n");
    printf("this is parser for the above grammar:\n");
    printf("Enter any string:"); scanf("%s",str);
    while(curr_ptr<strlen(str))
    {
        //S has only one immediate derivation which is cAd
        //match with c
        if (str[curr_ptr]=='c')
        {
            curr_ptr++;
            //call function to match A
            if (A()) //checking the productions of A->ab/a
            {
                curr_ptr++; //match
                d
                if (str[curr_ptr]=='d' && str[curr_ptr+1]=='\0')
                {
```

```

//success
printf("string is accepted by the grammar");
getch(); return 1;
}
else break;
}
else break;
}
else break;
}
//incase any of them fail to match return negatively. printf("string
is not accepted by the grammar");
//getch(); return
0;
}
int A() //sub function A()
{
isave=curr_ptr;

if (str[curr_ptr]=='a')
{
curr_ptr++; if(str[curr_ptr]=='b')
return 1;
}
curr_ptr=isave; //return to start //check if a is
matched and return accordingly.
if(str[curr_ptr]=='a')
return 1; else
return 0;
}

```

Output – Screen shot


```
1.S->cAd
2.A->ab/a
this is parser for the above grammar:
Enter any string:cdd
string is not accepted by the grammar
```

```
1.S->cAd
2.A->ab/a
this is parser for the above grammar:
Enter any string:cabd
string is accepted by the grammar
```

Part-C:

Experiment No :01

Aim of the program

Write a program to design LALR parsing using YACC.

Program

Output – Screen shot

Experiment No :02

Aim of the program

Use YACC to Convert Binary to Decimal (including fractional numbers)

Program p.y

```
%{  
#include<stdio.h>  
#include<stdlib.h>  
#include<math.h> void  
yyerror(char *s); float  
x = 0;  
%}  
  
%token ZERO ONE POINT  
%%  
L: X POINT Y {printf("%f", $1+x);}   
| X {printf("%d", $$);}   
X: X B {$$=$1*2+$2;}   
| B {$$=$1;}   
Y: B Y {x=$1*0.5+x*0.5;}   
| {}   
B:ZERO {$$=$1;}   
|ONE {$$=$1;};  
%%
```

```
int main() { printf("Enter the binary  
number : ");
```

```
while(yyparse()); printf("\n");  
}
```

```
void yyerror(char *s)  
{ fprintf(stdout,"\\n%s",s);  
}
```

p.l

```
%{
```

```
#include<stdio.h> #include<stdlib.h>  
#include"y.tab.h"
```

```
extern int yylval;  
%}
```

```
%%
```

```
0 {yylval=0;return ZERO;}
```

```
1 {yylval=1;return ONE;}
```

```
". " {return POINT;}
```

```
[ \\t] {;}
```

```
\\n return 0;
```

```
%%
```

Output – Screen shot

```
user1@user1-VirtualBox:~/Desktop$ lex decimal.l
user1@user1-VirtualBox:~/Desktop$ yacc -d decimal.y
user1@user1-VirtualBox:~/Desktop$ gcc lex.yy.c y.tab.c
user1@user1-VirtualBox:~/Desktop$ ./a.out
Enter the binary number : 111.011
7.375000
```

Experiment No :03

Aim of the program

Use YACC to implement, evaluator for arithmetic expressions (Desktop calculator)

Program

p.y

%{

#include<stdio.h>

int flag=0;

int yylex();

int yyerror();

%}

%token NUMBER

%left '+' '-'

%left '*' '/'

```
%left '%'
%right '^'
%left '(' ' ')
```

```
%%
```

```
ArithmeticExpression: E{
```

```
    printf("\nResult=%d\n", $$);
```

```
    return 0;
```

```
}
```

```
E:E+'E' {$$=$1+$3;}
```

```
|E '-'E {$$=$1-$3;}
```

```
|E '*'E {$$=$1*$3;}
```

```
|E '/'E {$$=$1/$3;}
```

```
|E '%'E {$$=$1%$3;}
```

```
|E '^'E {$$=$1^$3;}
```

```
| '('E') {$$=$2;}
```

```
| NUMBER {$$=$1;}
```

```
;
```

```
%%
```

```
void main()
```

```
{
```

```
    printf("\nEnter Any Arithmetic Expression which can have operations Addition,
    Subtraction, Multiplication, Division, Modulus and Round brackets:\n");
```

```

    yyparse();

    if(flag==0)

        printf("\nEntered arithmetic expression is Valid\n\n");

    }

int yyerror()

{

    printf("\nEntered arithmetic expression is Invalid\n\n");

    flag=1;
    return 0;
}

```

P.I

```

%{

#include<stdio.h>

#include "y.tab.h"

extern int yylval;

}%

%%

[0-9]+ {

```

```

        yyval=atoi(yytext);

        return NUMBER;

    }

```

```

[t] ;

```

```

[n] return 0;

```

```

. return yytext[0];

```

```

%%

```

```

int yywrap()

```

```

{

```

```

return 1;

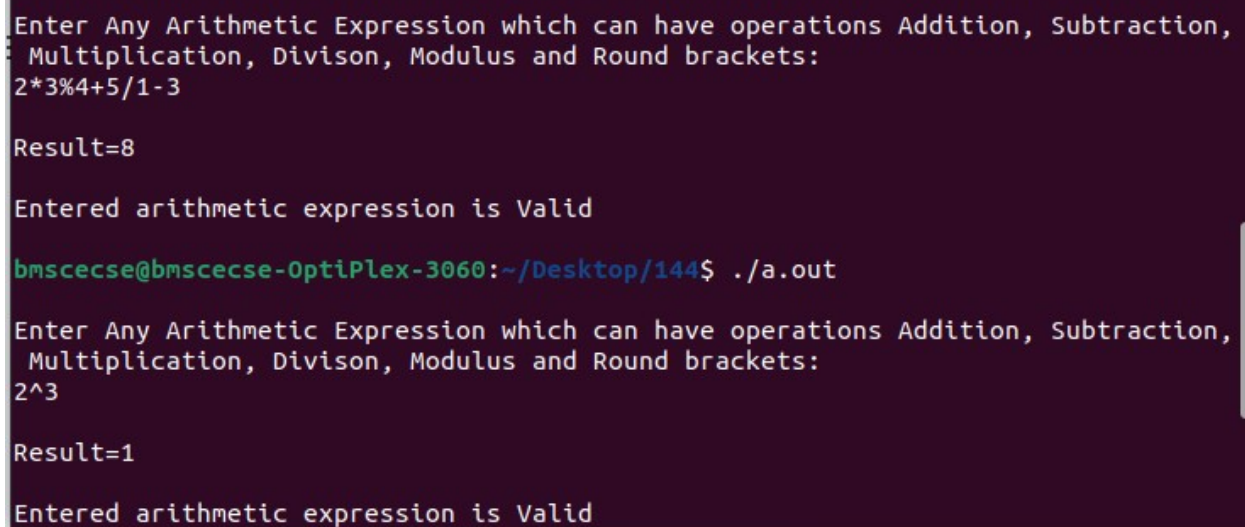
```

```

}

```

Output – Screen shot



```

Enter Any Arithmetic Expression which can have operations Addition, Subtraction,
Multiplication, Divison, Modulus and Round brackets:
2*3%4+5/1-3

Result=8

Entered arithmetic expression is Valid

bmscecse@bmscecse-OptiPlex-3060:~/Desktop/144$ ./a.out

Enter Any Arithmetic Expression which can have operations Addition, Subtraction,
Multiplication, Divison, Modulus and Round brackets:
2^3

Result=1

Entered arithmetic expression is Valid

```

Experiment No :04

Aim of the program

Use YACC to convert: Infix expression to Postfix expression.

Program p.y %{

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

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

```
#include<stdlib.h> int
```

```
yylex();
```

```
%}
```

```
%token digit
```

```
%%
```

```
S: E {printf("\n\n");}
```

```
;
```

```
E: E '+' T { printf ("+" );}
```

```
| E '-' T { printf ("-");}
```

```
| T
```

```
;
```

```
T: T '*' P { printf ("*");}
```

```
| T '/' P { printf ("/");}
```

```
| P
```

```
;
```

```
P: F '^' P { printf ("^");}
```

```
| F
```

```
;
```

```

F: '(' E ')'
| digit {printf("%d", $1);}
;
%%

```

```

int main() { printf("Enter infix
expression: "); yyparse(); }
yyerror() { printf("NITW
Error");
}

```

p.l

```

%{
#include "y.tab.h"
extern int yylval;
}%
%%

```

```

[0-9]+ {yylval=atoi(yytext); return digit;}

```

```

[\t] ;

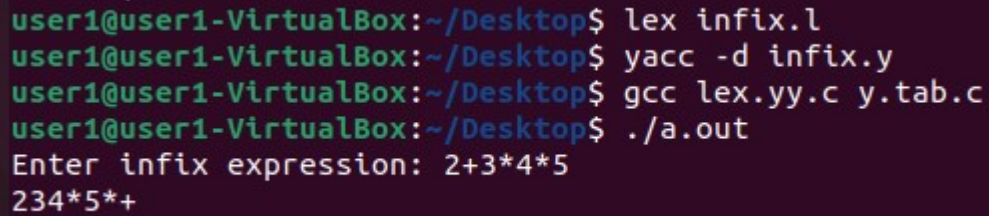
```

```

[\n] return 0;
. return yytext[0];
%%

```

Output – Screen shot



```
user1@user1-VirtualBox:~/Desktop$ lex infix.l
user1@user1-VirtualBox:~/Desktop$ yacc -d infix.y
user1@user1-VirtualBox:~/Desktop$ gcc lex.yy.c y.tab.c
user1@user1-VirtualBox:~/Desktop$ ./a.out
Enter infix expression: 2+3*4*5
234*5*+
```

Experiment No :05

Aim of the program

Use YACC to generate Syntax tree for a given expression

Program p.y

```
%{
#include<math.h>
#include<ctype.h>
#include<stdio.h>
#include<stdlib.h>
#include<string.h>
#include "y.tab.h"

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, const char *val);
```

```
int yylex(void); void
yyerror(const char *s);
%%}
```

```
%token digit
%%
/* print the tree after evaluating E */
S: E { my_print_tree($1); }
;
```

```
E: E '+' T { $$= mknode($1, $3, "+"); }
  | E '-' T { $$= mknode($1, $3, "-"); }
  | T { $$= $1; }
;
```

```
T: T '*' F { $$= mknode($1, $3, "*"); }
  | T '/' F { $$= mknode($1, $3, "/"); }
  | F { $$= $1; }
;
```

```
F: P '^' F { $$= mknode($1, $3, "^"); }
  | P { $$= $1; }
;
```

```
P: '(' 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;
}
```

```
void yyerror(const char *s) {
```

```

        printf("NITW Error: %s\n", s);
    }

int mknnode(int lc, int rc, const char *val) {
    strcpy(syn_tree[ind].val, val);    syn_tree[ind].lc =
    lc;
        syn_tree[ind].rc = rc;
        ind++;
        return ind-1;
    }

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);
}

```

p.l

```

%{
#include "y.tab.h"
%}
%%
[0-9]+ { yylval=atoi(yytext); return digit; }
[\t] ;
[\n] return 0;
. return yytext[0];
%%

```

Output – Screen shot

```

user1@user1-VirtualBox:~/Desktop$ lex syntax.l
user1@user1-VirtualBox:~/Desktop$ yacc -d syntax.y
user1@user1-VirtualBox:~/Desktop$ gcc lex.yy.c y.tab.c
user1@user1-VirtualBox:~/Desktop$ ./a.out
Enter an expression
8*9/3
Operator Node -> Index: 4, Value: /, Left Child Index: 2, Right Child Index: 3
Operator Node -> Index: 2, Value: *, Left Child Index: 0, Right Child Index: 1
Digit Node -> Index: 0, Value: 8
Digit Node -> Index: 1, Value: 9
Digit Node -> Index: 3, Value: 3
user1@user1-VirtualBox:~/Desktop$

```

Experiment No :06

Aim of the program

Use YACC to generate 3-Address code for a given expression **Program**

p.y

```

%{
#include <math.h>
#include<ctype.h>
#include<stdio.h>
int var_cnt=0; char
iden[20];
}%
%token digit
%token id
%%

```

```

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; } yyerror() {
printf("NITW Error\n");
}

```

p.l

%{

#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];

%%

Output – Screen shot


```
user1@user1-VirtualBox:~/Desktop$ lex code3.l
user1@user1-VirtualBox:~/Desktop$ yacc -d code3.y
user1@user1-VirtualBox:~/Desktop$ gcc lex.yy.c y.tab.c
user1@user1-VirtualBox:~/Desktop$ ./a.out
Enter an expression :
result=2+3*4
t0 = 2;
t1 = 3;
t2 = 4;
t3 = t1 * t2;
t4 = t0 + t3;
result = t4
```