VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

LAB REPORT
on

Compiler Design

Submitted by

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in partial fulfillment 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 **Deepini S (1BM21CS050),** who is a 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 academic semester June-2023 to Sep-2023. The Lab report has been approved as it satisfies the academic requirements in respect of a **Compiler Design(22CS5PCCPD)** work prescribed for the said degree.

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Course Outcome

CO1	Apply the fundamental concepts for the various phases of compiler design.
CO2	Analyse the syntax and semantic concepts of a compiler.
CO3	Design various types of parsers and Address code generation
CO4	Implement compiler principles, methodologies using lex, yacc tools

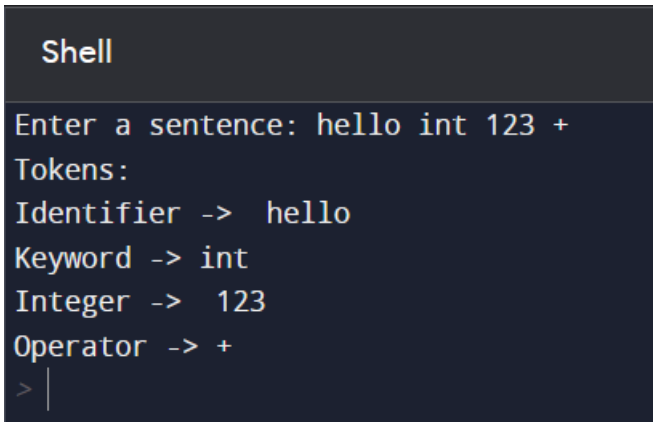
Part-A: Implementation of Lexical Analyzer, By using C/C++/Java/Python language and using LEX tool.

1. **Write a program to design Lexical Analyzer in C/C++/Java/Python Language (to recognize any five keywords, identifiers, numbers, operators and punctuations)**

```
import re


def is_operator(char):
    return char in ['+', '-', '*', '/', '>', '<', '=']


def is_valid_identifier(token):
    return token[0].isalpha() and not token.isdigit()


def get_keywords():
    return ["auto", "break", "case", "char", "const", "continue", "default", "do",
            "double", "else", "enum", "extern", "float", "for", "goto", "if",
            "int", "long", "register", "return", "short", "signed", "sizeof", "static",
            "struct", "switch", "typedef", "union", "unsigned", "void", "volatile", "while"]


def is_integer(token):
    try:
        int(token)
        return True
    except ValueError:
        return False


def lexical_analyzer(input_str):
    tokens = re.findall(r'[a-zA-Z_]\w*|[-+*/<>=]|[(),;]|[0-9]+', input_str)
    print('Tokens: ')
    for token in tokens:
        if token in ['+', '-', '*', '/', '>', '<', '=']:
```

```
            print(f"Operator -> {token}")
        elif token in [',', ';', '(', ')']:
            print(f"Delimiter -> {token}")
        elif token in get_keywords():
            print(f"Keyword -> {token}")
        elif is_integer(token):
            print(f"Integer ->  {token}")
        elif is_valid_identifier(token):
            print(f"Identifier ->  {token}")
        else:
            print(f"Unidentified -> {token}")

if __name__ == "__main__":
    input_string = input("Enter a C program code: ")
    lexical_analyzer(input_string)
```

OUTPUT:



2. Write a program in LEX to recognize Floating Point Numbers.

```
%{
#include<stdio.h>
int cnt=0;
%}
sign [+|-]
num [0-9]
dot [.]
%%
{sign}?{num}*{dot}{num}* {printf("Floating point no.");cnt=1;}
{sign}?{num}* {printf("Not Floating point no.");cnt=1;}
%%
int yywrap()
{
}
int main()
{
yylex();
if(cnt==0){
printf("Not floating pnt no.");
}
return 0;
}
```

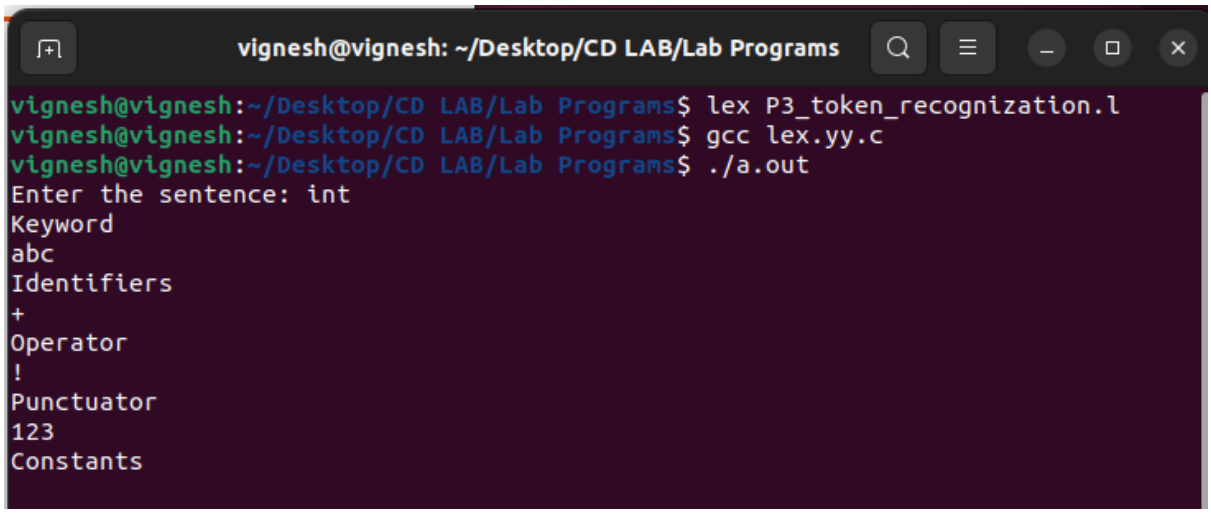
OUTPUT:


vignesh@vignesh: ~/Desktop/CD LAB/Week3
vignesh@vignesh:~/Desktop/CD LAB/Week3$ lex P2.l
vignesh@vignesh:~/Desktop/CD LAB/Week3$ gcc lex.yy.c
vignesh@vignesh:~/Desktop/CD LAB/Week3$ ./a.out
Enter the number: 5
Not Floating point no.
.6
Floating point no.
7.8
Floating point no.

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

```
%{
#include<stdio.h>
int cnt=0;
%}
letter [a-zA-Z]
digit [0-9]
punc [!|,|.]
oper [+|*|-|/|%]
boole [true|false]
%%
{digit}+|{digit}*.{digit}+ {printf("Constants");}
int|float {printf("Keyword");}
{letter}({digit}|{letter})* {printf("Identifiers");}
{oper} {printf("Operator");}
{punc} {printf("Punctuator");}
%%
int yywrap()
{
}
int main()
{
yylex();
return 0;
}
```

OUTPUT:

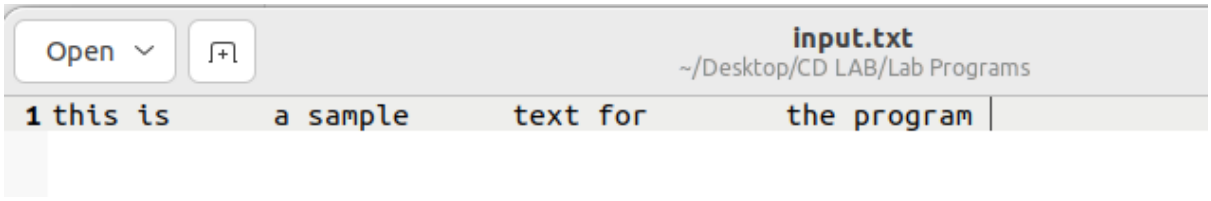

vignesh@vignesh: ~/Desktop/CD LAB/Lab Programs
vignesh@vignesh:~/Desktop/CD LAB/Lab Programs$ lex P3_token_recognization.l
vignesh@vignesh:~/Desktop/CD LAB/Lab Programs$ gcc lex.yy.c
vignesh@vignesh:~/Desktop/CD LAB/Lab Programs$ ./a.out
Enter the sentence: int
Keyword
abc
Identifiers
+
Operator
!
Punctuator
123
Constants

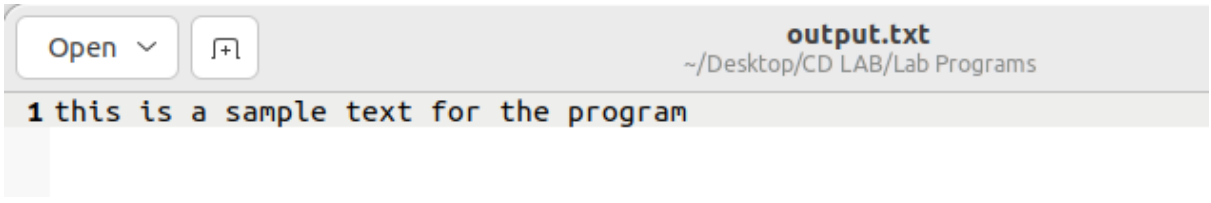
4. Write a LEX program that copies a file, replacing each nonempty sequence of white spaces by a

single blank.

```
%{
#include<stdio.h>
%}
%%
[\t" "]+ fprintf(yyout," ");
.|\n fprintf(yyout,"%s",yytext);
%%
int yywrap()
{
return 1;
}
int main(void)
{
yyin=fopen("input1.txt","r");
yyout=fopen("output.txt","w");
yylex();
return 0;
}
```

OUTPUT:





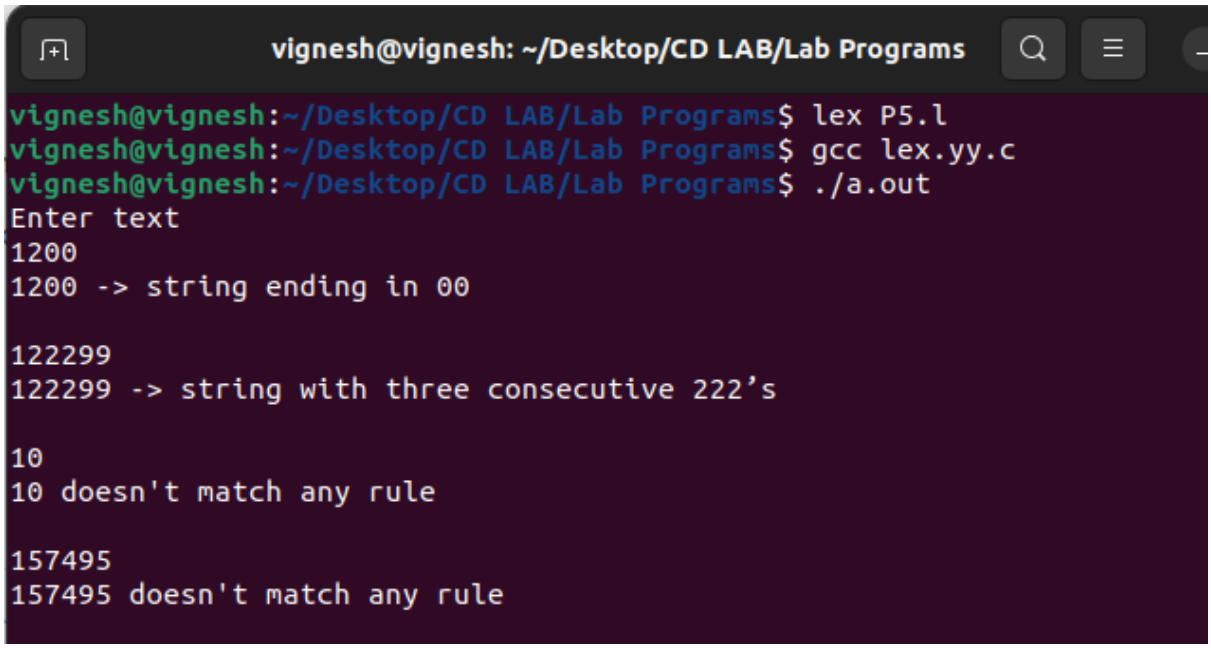
5. **Write a LEX program to recognize the following tokens over the alphabets {0,1,..,9}**
   a) **The set of all string ending in 00.**
   b) **The set of all strings with three consecutive 222's.**
   c) **The set of all string such that every block of five consecutive symbols contains at least two 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.**

```
d[0-9]

%{

/* d is for recognising digits */

int c1=0,c2=0,c3=0,c4=0,c5=0,c6=0,c7=0;

/* c1 to c7 are counters for rules a1 to a7 */

%}

%%

({d})*00 { c1++; printf("%s -> string ending in 00\n",yytext);}

({d})*222({d})* { c2++; printf("%s -> string with three consecutive 222's \n",yytext);}

(1(0)*(11|01)(01*01|00*10(0)*(11|1))*0)(1|10(0)*(11|01)(01*01|00*10(0)*(11|1))*10)* {

c4++;

printf("%s -> string beginning with a 1 which, interpreted as the binary representation of an integer, is congruent to zero modulo 5 \n",yytext);

}

({d})*1{d}{9} {

c5++; printf("%s -> string such that the 10th symbol from the right end is 1 \n",yytext);

}

({d})* {

int i,c=0;

if(yyleng<5)

{

printf("%s doesn't match any rule\n",yytext);

}
```

```
else
{
for(i=0;i<5;i++) { if(yytext[i]=='5') {
c++; } }
if(c>=2)
{
for(;i<yyleng;i++)
{
if(yytext[i-5]=='5') {
c--; }
if(yytext[i]=='5') { c++;
}
if(c<2) { printf("%s doesn't match any rule\n",yytext);
break; }
}
if(yyleng==i)
{
printf("%s -> string such that every block of five consecutive symbols contains at least two 5’s\n",yytext); c3++; }
}
else
{
printf("%s doesn't match any rule\n",yytext);
}
}
}
%%
int yywrap()
{
}
int main()
```

```
{
printf("Enter text\n");
yylex();
printf("Total number of tokens matching rules are : \n");
printf("Rule A : %d \n",c1);
printf("Rule B : %d \n",c2);
printf("Rule C : %d \n",c3);
printf("Rule D : %d \n",c4);
printf("Rule E : %d \n",c5);
return 0;
}
```

OUTPUT:



Part-B: Part-B: Implementation of Parsers (Syntax Analyzers) Using C/C++/Java/Python language)

1. Write a program to implement

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

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

int S();
int A();

char input[100];
int currentIndex = 0;

int match(char symbol) {
   if (input[currentIndex] == symbol) {
      currentIndex++;
      return 1;
   } else {
      return 0;
   }
}

int S() {
   if (match('c')) {
      if (A()) {
         if (match('d')) {
            return 1;
         }
      }
```

```
    }
    return 0;
}

int A() {
    int tempIndex = currentIndex;

    if (match('a')) {
        if (match('b')) {
            return 1;
        }
    }

    currentIndex = tempIndex;

    if (match('a')) {
        return 1;
    }

    return 0;
}

int main() {
    printf("Enter the input string: ");
    scanf("%s", input);

    currentIndex = 0;

    if (S() && currentIndex == strlen(input)) {
        printf("Parsing successful! Input belongs to the given grammar.\n");
    } else {
```

```
        printf("Parsing failed! Input does not belong to the given grammar.\n");
    }

    return 0;
}
```

OUTPUT:

```
Output

/tmp/R63NgA7pEx.o
Enter the input string: cad
Parsing successful! Input belongs to the given grammar.
```

```
Output

/tmp/R63NgA7pEx.o
Enter the input string: cabd
Parsing successful! Input belongs to the given grammar.
```

```
Output

/tmp/R63NgA7pEx.o
Enter the input string: caab
Parsing failed! Input does not belong to the given grammar.
```

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

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

int S();
int A();

char input[100];
int currentIndex = 0;

int match(char symbol) {
    if (input[currentIndex] == symbol) {
        currentIndex++;
        return 1;
    } else {
        return 0;
    }
}

int S() {
    if (match('c')) {
        if (A()) {
            if (match('d')) {
                return 1;
            }
        }
    }
    return 0;
}
```

```
int A() {
    int tempIndex = currentIndex;

    if (match('a')) {
        return 1;
    }

    currentIndex = tempIndex;

    if (match('a')) {
        if (match('b')) {
            return 1;
        }
    }

    currentIndex = tempIndex;

    return 0;
}

int main() {
    printf("Enter the input string: ");
    scanf("%s", input);

    currentIndex = 0;

    if (S() && currentIndex == strlen(input)) {
        printf("Parsing successful! Input belongs to the given grammar.\n");
    } else {
        printf("Parsing failed! Input does not belong to the given grammar.\n");
    }
```

```
    return 0;
}
```

OUTPUT:

```
Output

/tmp/R63NgA7pEx.o
Enter the input string: cad
Parsing successful! Input belongs to the given grammar.
```

```
Output

/tmp/R63NgA7pEx.o
Enter the input string: cabd
Parsing failed! Input does not belong to the given grammar.
```

2. Write a program to implement: Recursive Descent Parsing with back tracking (Brute Force Method).

(a) S→ aaSaa | aa

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

int S();
char input[100];
int currentIndex = 0;

int match(char symbol) {
    if (input[currentIndex] == symbol) {
        currentIndex++;
        return 1;
    } else {
        return 0;
    }
}

int S() {
    int tempIndex = currentIndex;

    if (match('a') && match('a')) {
        if (S() && match('a') && match('a')) {
            return 1;
        }
    }

    currentIndex = tempIndex;
```

```
    if (match('a') && match('a')) {
        return 1;
    }
    return 0;
}

int main() {
    printf("Enter the input string: ");
    scanf("%s", input);

    currentIndex = 0;

    if (S() && currentIndex == strlen(input)) {
        printf("Parsing successful! Input belongs to the given grammar.\n");
    } else {
        printf("Parsing failed! Input does not belong to the given grammar.\n");
    }

    return 0;
}
```

OUTPUT:

```
Output
/tmp/R63NgA7pEx.o
Enter the input string: aaaaaa
Parsing successful! Input belongs to the given grammar.
```

```
/tmp/R63NgA7pEx.o
Enter the input string: aaaa
Parsing failed! Input does not belong to the given grammar.
```

(b) S → aaaSaaa | aa

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

int S();
char input[100];
int currentIndex = 0;

int match(char symbol) {
    if (input[currentIndex] == symbol) {
        currentIndex++;
        return 1;
    } else {
        return 0;
    }
}

int S() {
    int tempIndex = currentIndex;

    if (match('a') && match('a') && match('a')) {
        if (S() && match('a') && match('a') && match('a')) {
            return 1;
        }
    }

    currentIndex = tempIndex;

    if (match('a') && match('a')) {
        return 1;
    }
```

```
    return 0;
}

int main() {
    printf("Enter the input string: ");
    scanf("%s", input);

    currentIndex = 0;

    if (S() && currentIndex == strlen(input)) {
        printf("Parsing successful! Input belongs to the given grammar.\n");
    } else {
        printf("Parsing failed! Input does not belong to the given grammar.\n");
    }

    return 0;
}
```

OUTPUT:

```
Output
/tmp/eBrNhwCQKh.o
Enter the input string: aaaaaaaa
Parsing successful! Input belongs to the given grammar.
```

```
/tmp/eBrNhwCQKh.o
Enter the input string: aaaaa
Parsing failed! Input does not belong to the given grammar.
```

(c) S → aaaaSaaaa | aa

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

int S();
char input[100];
int currentIndex = 0;

int match(char symbol) {
    if (input[currentIndex] == symbol) {
        currentIndex++;
        return 1;
    } else {
        return 0;
    }
}

int S() {
    int tempIndex = currentIndex;

    if (match('a') && match('a') && match('a') && match('a')) {
        if (S() && match('a') && match('a') && match('a') && match('a')) {
            return 1;
        }
    }

    currentIndex = tempIndex;

    if (match('a') && match('a')) {
        return 1;
```

```
    }

    return 0;
}

int main() {
    printf("Enter the input string: ");
    scanf("%s", input);

    currentIndex = 0;

    if (S() && currentIndex == strlen(input)) {
        printf("Parsing successful! Input belongs to the given grammar.\n");
    } else {
        printf("Parsing failed! Input does not belong to the given grammar.\n");
    }

    return 0;
}
```

OUTPUT:

```
Output
/tmp/eBrNhwCQKh.o
Enter the input string: aaaaaaaaaa
Parsing successful! Input belongs to the given grammar.
```

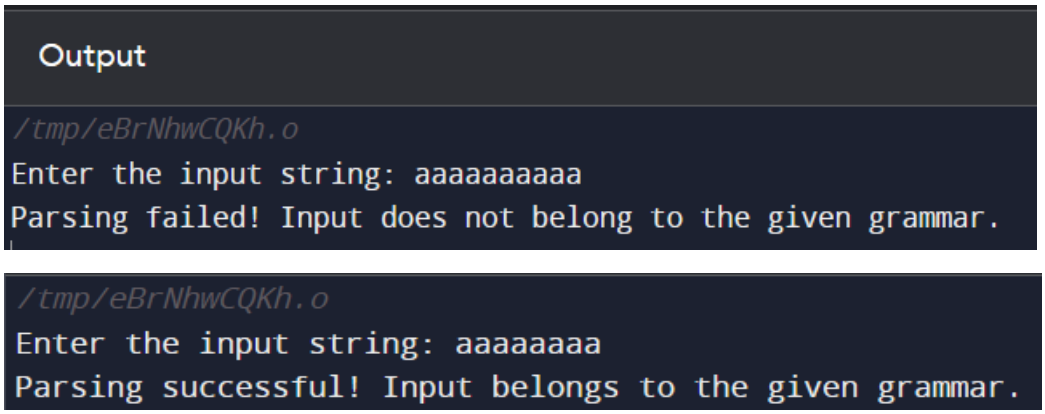
```
/tmp/eBrNhwCQKh.o
Enter the input string: aaaaaaa
Parsing failed! Input does not belong to the given grammar.
```

(d) S → aaaSaaa |aSa | aa

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

int S();
char input[100];
int currentIndex = 0;

int match(char symbol) {
    if (input[currentIndex] == symbol) {
        currentIndex++;
        return 1;
    } else {
        return 0;
    }
}

int S() {
    int tempIndex = currentIndex;

    if (match('a') && match('a') && match('a')) {
        if (S() && match('a') && match('a') && match('a')) {
            return 1;
        }
    }
    currentIndex = tempIndex;

    if (match('a') && S() && match('a')) {
        return 1;
    }
```

```
    currentIndex = tempIndex;

    if (match('a') && match('a')) {
        return 1;
    }

    return 0;
}
int main() {
    printf("Enter the input string: ");
    scanf("%s", input);
    currentIndex = 0;
    if (S() && currentIndex == strlen(input)) {
        printf("Parsing successful! Input belongs to the given grammar.\n");
    } else {
        printf("Parsing failed! Input does not belong to the given grammar.\n");
    }

    return 0;
}
```

OUTPUT:



Part-C: Syntax Directed Translation using YACC tool

1. Write a program to design LALR parsing using YACC.

Lex:

```
%{
 #include "y.tab.h"
 extern int yylval;
%}
%%
//If the token is an Integer number,then return it's value.
[0-9]+ {yylval=atoi(yytext); return digit;}
//If the token is space or tab,then just ignore it.
[\t] ;
//If the token is new line,return 0.
[\n] return 0;
//For any other token, return the first character read since the last
match.
. return yytext[0];
%%
```

Yacc:

```
%{
#include <math.h>
#include<ctype.h>
#include<stdio.h>
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;

}

yyerror()

{

printf("error");

}
```

OUTPUT:

```
usnraju@usnraju-PC: ~/CompilerDesignPrograms/Set_C/C1
(base) usnraju@usnraju-PC:~$ cd CompilerDesignPrograms/Set_C/C1
(base) usnraju@usnraju-PC:~/CompilerDesignPrograms/Set_C/C1$ yacc -d C1.y
(base) usnraju@usnraju-PC:~/CompilerDesignPrograms/Set_C/C1$ lex C1.l
(base) usnraju@usnraju-PC:~/CompilerDesignPrograms/Set_C/C1$ gcc y.tab.c lex.yy.c -o C1 -ll
(base) usnraju@usnraju-PC:~/CompilerDesignPrograms/Set_C/C1$ ./C1
Enter infix expression:  2+3*4
Reached

(base) usnraju@usnraju-PC:~/CompilerDesignPrograms/Set_C/C1$ ./C1
Enter infix expression:  2++
NITW Error(base) usnraju@usnraju-PC:~/CompilerDesignPrograms/Set_C/C1$
```

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

Lex:

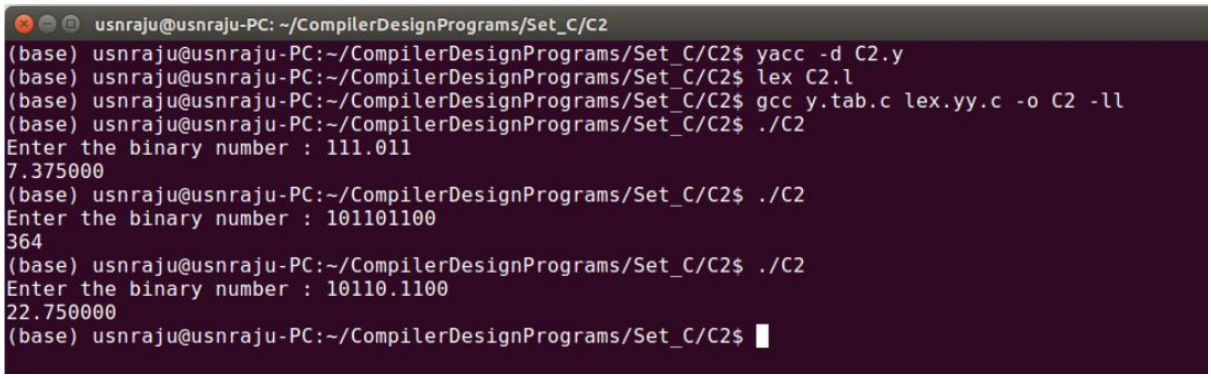
```
/* definitions */
%{
// including required header files
#include<stdio.h>
#include<stdlib.h>
#include"y.tab.h"
// declaring a external variable yylval
extern int yylval;
%}
/* rules
if 0 is matched ,make yylval to 0 and return ZERO which is
variable in Yacc program
if 1 is matched ,make yylval to 1 and return ONE which is
variable in Yacc program
if . is matched ,return POINT which is variable in Yacc program
if line change , return 0
otherwise ,ignore*/
%%
0 {yylval=0;return ZERO;}
1 {yylval=1;return ONE;}
"." {return POINT;}
[ \t] {;}
\n return 0;
%%
```

Yacc:

```
/* definition section*/
%{
#include<stdio.h>
#include<stdlib.h>
#include<math.h>
//#define YYSTYPE double
void yyerror(char *s);
float x = 0;
%}
// creating tokens whose values are given by lex
%token ZERO ONE POINT
// following a grammer rule which is converting binary number to
decimal number (float value)
%%
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;};
%%
// main function
int main()
{
printf("Enter the binary number : ");
// calling yyparse function which execute grammer rules and
lex
while(yyparse());
```

```
printf("\n");
}
// if any error
void yyerror(char *s)
{
fprintf(stdout,"\n%s",s);
}
```

OUTPUT:



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

Lex:

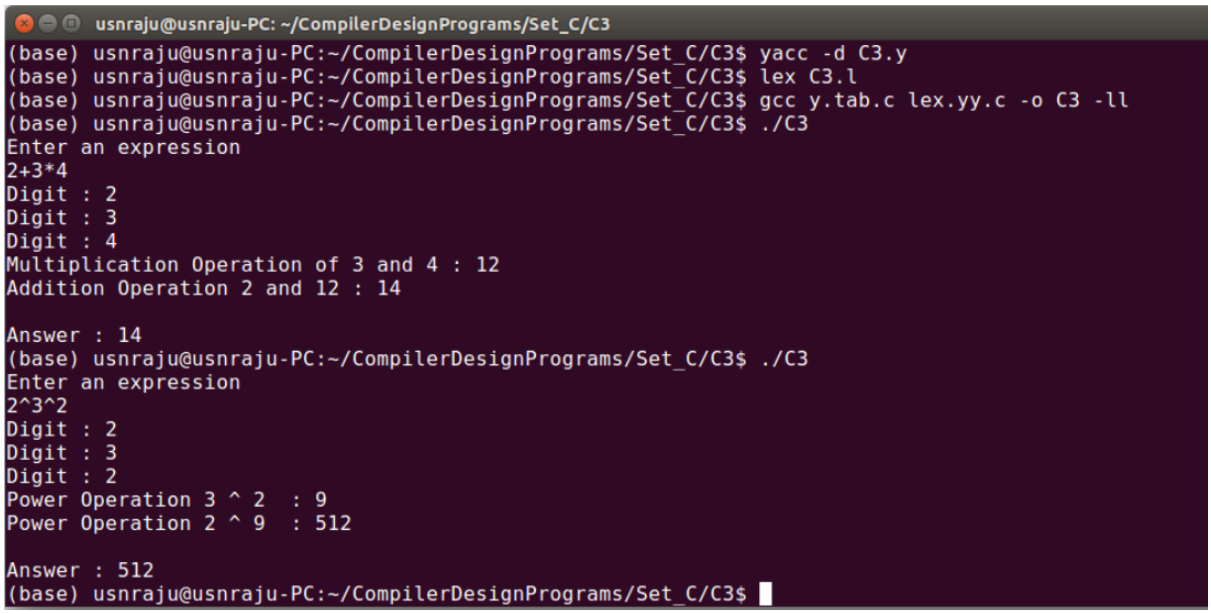
```
%{
#include<stdio.h>
#include "y.tab.h"
extern int yylval;
%}

%%
[0-9]+ {
                yylval=atoi(yytext);
                return NUMBER;
        }
[\t] ;
[\n] return 0;
. return yytext[0];
%%
int yywrap()
{
return 1;
}
```

Yacc:

```
%{
#include<stdio.h>
int flag=0;
%}
%token NUMBER
%left '+' '-'
%left '*' '/' '%'
%left '(' ')'
```

```
/* Rule Section */
%%
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')' {$$=$2;}
| NUMBER {$$=$1;}
;
%%
//driver code
void main()
{
printf("\nEnter Any Arithmetic Expression: \n");
yyparse();
if(flag==0)
printf("\nEntered arithmetic expression is Valid\n\n");
}
void yyerror()
{
printf("\nEntered arithmetic expression is Invalid\n\n");
flag=1;
}
```

OUTPUT:


usnraju@usnraju-PC: ~/CompilerDesignPrograms/Set_C/C3
(base) usnraju@usnraju-PC:~/CompilerDesignPrograms/Set_C/C3$ yacc -d C3.y
(base) usnraju@usnraju-PC:~/CompilerDesignPrograms/Set_C/C3$ lex C3.l
(base) usnraju@usnraju-PC:~/CompilerDesignPrograms/Set_C/C3$ gcc y.tab.c lex.yy.c -o C3 -ll
(base) usnraju@usnraju-PC:~/CompilerDesignPrograms/Set_C/C3$ ./C3
Enter an expression
2+3*4
Digit : 2
Digit : 3
Digit : 4
Multiplication Operation of 3 and 4 : 12
Addition Operation 2 and 12 : 14
Answer : 14
(base) usnraju@usnraju-PC:~/CompilerDesignPrograms/Set_C/C3$ ./C3
Enter an expression
2^3^2
Digit : 2
Digit : 3
Digit : 2
Power Operation 3 ^ 2 : 9
Power Operation 2 ^ 9 : 512
Answer : 512
(base) usnraju@usnraju-PC:~/CompilerDesignPrograms/Set_C/C3$

4. Use YACC to convert: Infix expression to Postfix expression.

Lex:

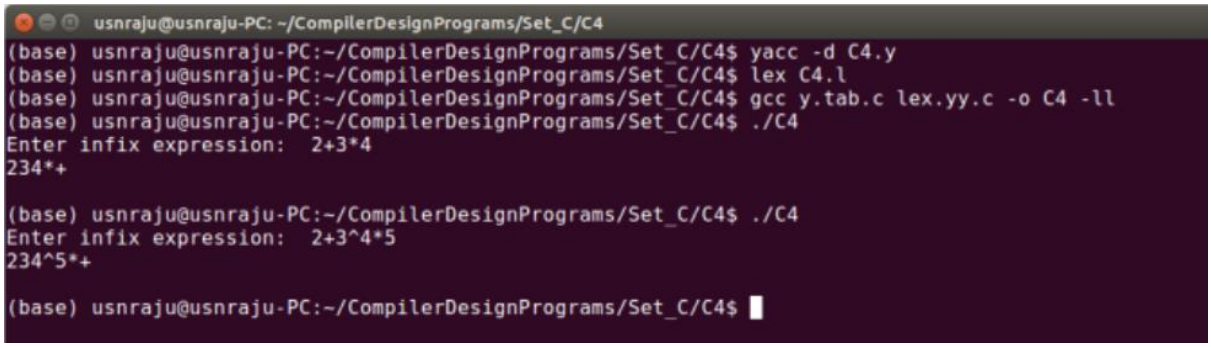
```
%{
#include "y.tab.h"
extern int yylval;
%}
%%
[0-9]+ { yylval=atoi(yytext); return digit;}
[\t] ;
[\n] return 0;
. return yytext[0];
%%
int yywrap()
{
}
```

Yacc:

```
%{
#include <ctype.h>
#include <stdio.h>
#include <stdlib.h>
#include <math.h>
%}

%token digit

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

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

```
  | T
  ;

T: T '*' F { printf("*"); }
  | T '/' F { printf("/"); }
  | F
  ;

F: F '^' G { printf("^"); }
  | G
  ;

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

%%

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

yyerror()
{
  printf("Error");
}
```

OUTPUT:


usnraju@usnraju-PC: ~/CompilerDesignPrograms/Set_C/C4
(base) usnraju@usnraju-PC:~/CompilerDesignPrograms/Set_C/C4$ yacc -d C4.y
(base) usnraju@usnraju-PC:~/CompilerDesignPrograms/Set_C/C4$ lex C4.l
(base) usnraju@usnraju-PC:~/CompilerDesignPrograms/Set_C/C4$ gcc y.tab.c lex.yy.c -o C4 -ll
(base) usnraju@usnraju-PC:~/CompilerDesignPrograms/Set_C/C4$ ./C4
Enter infix expression: 2+3*4
234*+
(base) usnraju@usnraju-PC:~/CompilerDesignPrograms/Set_C/C4$ ./C4
Enter infix expression: 2+3^4*5
234^5*+
(base) usnraju@usnraju-PC:~/CompilerDesignPrograms/Set_C/C4$

5. Use YACC to generate Syntax tree for a given expression

Lex:

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

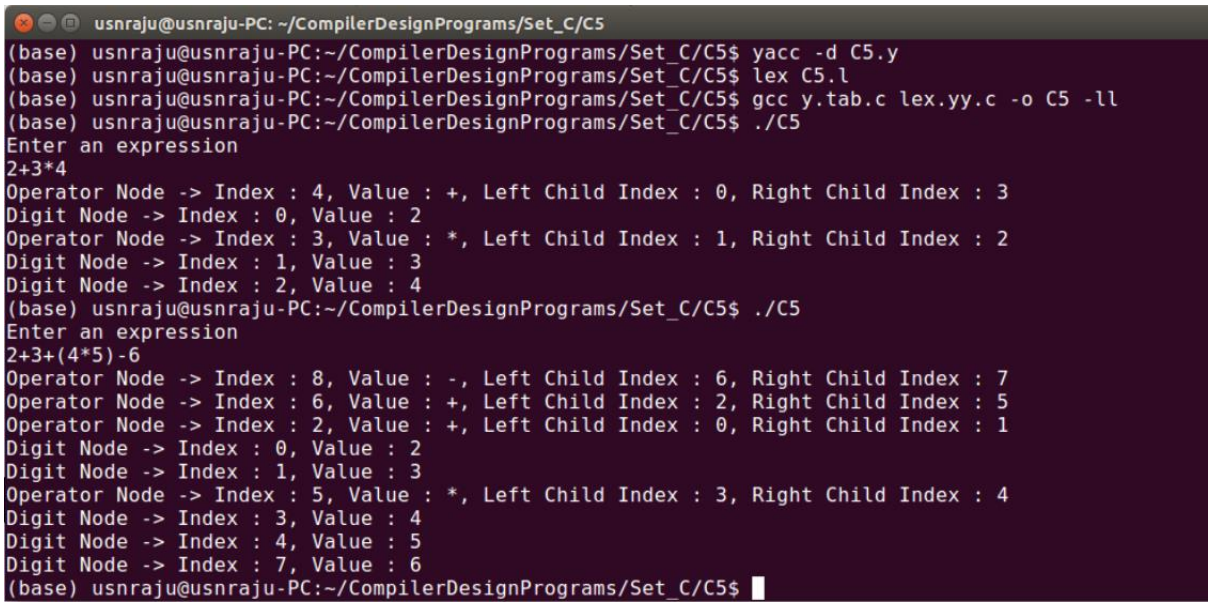
Yacc:

```
%{
#include <math.h>
#include<ctype.h>
#include<stdio.h>
#include<stdlib.h>
#include<string.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,char val[10]);
%}
%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()
{
printf("NITW Error\n");
}
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:



6. Use YACC to generate 3-Address code for a given expression

Lex:

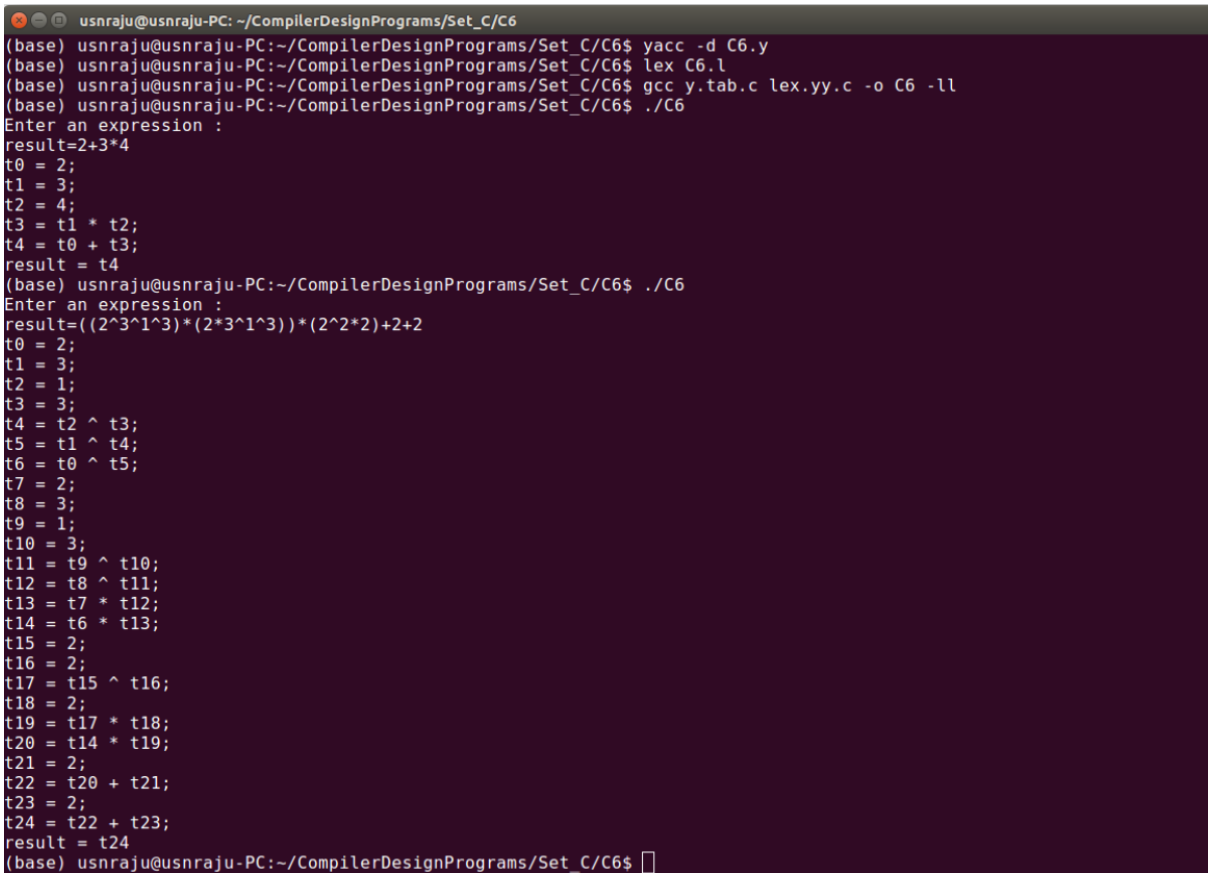
```
d [0-9]+
a [a-zA-Z]+
%{
#include<stdio.h>
#include<stdlib.h>
#include"y.tab.h"
extern int yylval;
extern char iden[20];
%}
%%
{d} { yylval=atoi(yytext); return digit; }
{a} { strcpy(iden,yytext); yylval=1; return id;}
[ \t] {;}
\n return 0;
. return yytext[0];
%%
int yywrap()
{
}
```

Yacc:

```
%{
#include <math.h>
#include<ctype.h>
#include<stdio.h>
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;
}
yyerror()
{
printf("error");
}
```

OUTPUT:


usnraju@usnraju-PC: ~/CompilerDesignPrograms/Set_C/C6
(base) usnraju@usnraju-PC:~/CompilerDesignPrograms/Set_C/C6$ yacc -d C6.y
(base) usnraju@usnraju-PC:~/CompilerDesignPrograms/Set_C/C6$ lex C6.l
(base) usnraju@usnraju-PC:~/CompilerDesignPrograms/Set_C/C6$ gcc y.tab.c lex.yy.c -o C6 -ll
(base) usnraju@usnraju-PC:~/CompilerDesignPrograms/Set_C/C6$ ./C6
Enter an expression :
result=2+3*4
t0 = 2;
t1 = 3;
t2 = 4;
t3 = t1 * t2;
t4 = t0 + t3;
result = t4
(base) usnraju@usnraju-PC:~/CompilerDesignPrograms/Set_C/C6$ ./C6
Enter an expression :
result=((2^3^1^3)*(2*3^1^3))*(2^2*2)+2+2
t0 = 2;
t1 = 3;
t2 = 1;
t3 = 3;
t4 = t2 ^ t3;
t5 = t1 ^ t4;
t6 = t0 ^ t5;
t7 = 2;
t8 = 3;
t9 = 1;
t10 = 3;
t11 = t9 ^ t10;
t12 = t8 ^ t11;
t13 = t7 * t12;
t14 = t6 * t13;
t15 = 2;
t16 = 2;
t17 = t15 ^ t16;
t18 = 2;
t19 = t17 * t18;
t20 = t14 * t19;
t21 = 2;
t22 = t20 + t21;
t23 = 2;
t24 = t22 + t23;
result = t24
(base) usnraju@usnraju-PC:~/CompilerDesignPrograms/Set_C/C6$