COMPILER CONSTRUCTION (CS-310)

SUBMITTED BY

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ROLL NO #

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SUBMITTED TO

SIR MUHAMMAD RAHIL USMAN

DEPARTMENT OF: Computer Science

SIR SYED UNIVERSITY OF

ENGINEERING &TECHNOLOGY

LAB # 01

Task 01:

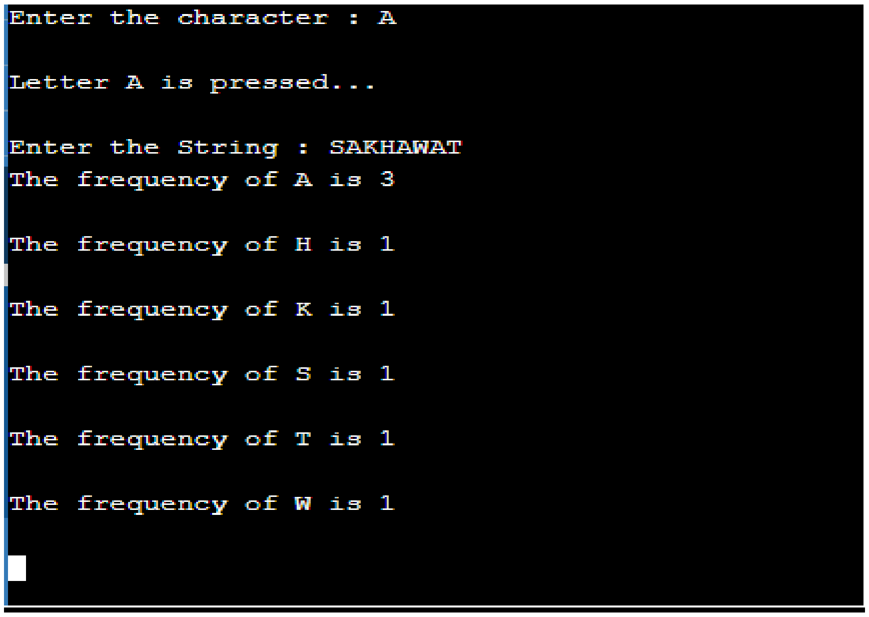
Make a program which recognizes the key strokes as you press different letters. Example: if you press letter A then it displays the output as "Letter A is pressed "After pressing the 10 letters, it counts the # number of occurrences of the letters.

CODING:

```
using System;

using System.Collections.Generic;

using System.Linq;
using System.Text;
using System.Threading.Tasks;
namespace std
{
    public class C_freq
    {
        public int i;
        public int[] freq = new int[256];
        public void cal_freq(char[] str1, int n)
        {
            for (i = 0; i<n ; i++)
            {
                freq[str1[i]]++;
            }
        }
        public void display(char[] str1, int n)
        {
            for (int i = 0; i < 256; i++)
            {
                if (freq[i] != 0)
                {
                    Console.WriteLine("The frequency of " + (char)i + " is " + freq[i] + "\n");
                }
            }
        }
    }
    class Program
    {
```

```
static void Main(string[] args)
{
    char[] str1 = new char[10];
    char ch;
    string str2;
    int n;
    Console.Write("Enter the character : ");
    ch = Console.ReadLine()[0];
    Console.WriteLine("\nLetter " + ch + " is pressed...\n");
    Console.Write("Enter the String : ");
    str2 = Console.ReadLine();
    str1 = str2.ToCharArray();
    n = str1.Length;
    C_freq f = new C_freq();
    f.cal_freq(str1,n);
    f.display(str1,n);
    Console.ReadLine();}}}
```

OUTPUT:



```
Enter the character : A

Letter A is pressed...

Enter the String : SAKHAWAT
The frequency of A is 3

The frequency of H is 1

The frequency of K is 1

The frequency of S is 1

The frequency of T is 1

The frequency of W is 1

```

LAB # 02

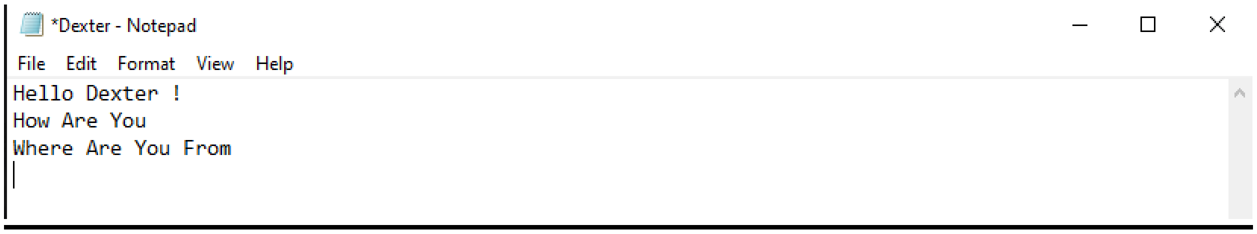
Task 01:

- Saving & opening a given text in a file.
- Searching for a given string in a file
- Replace the searched string with the given string

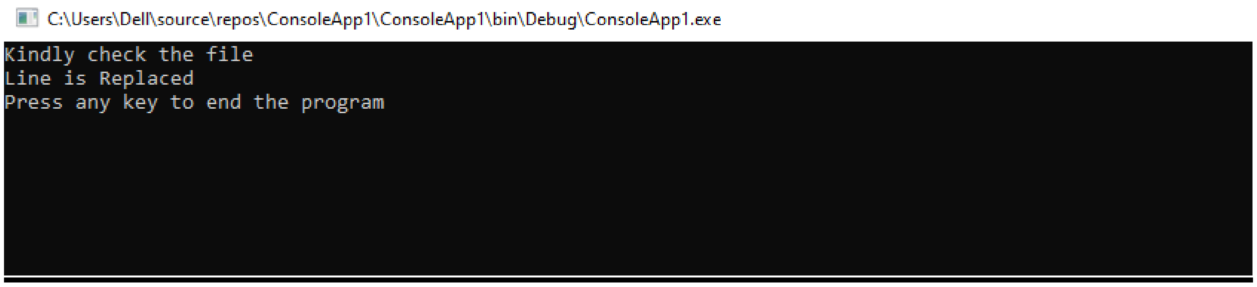
CODING:

```
using System;

using System.IO;

namespace CompilerLab2

{ class Program

  {

      static void Main(string[] args)

      {

         string path = @"D:\LAB\Dexter.txt";

         using (StreamWriter sw = File.CreateText(path))

         { sw.WriteLine("Hello Dexter !");

            sw.WriteLine("How Are You");

            sw.WriteLine("Where Are You From");

            sw.Close();

         }

         Console.WriteLine("Kindly check the file");

         Console.ReadKey();

         string[] lines = File.ReadAllLines(path);

         for (int i = 0; i < lines.Length; i++)

         {

            if (lines[i] == "Hello Dexter !")

            {

               lines[i] = "Hello David !"; }
}
using (StreamWriter sw = File.CreateText(path))
{
    for (int i = 0; i < lines.Length; i++)
    {
        sw.WriteLine(lines[i]);
    }
    sw.Close();
}
Console.WriteLine("Line is Replaced");
Console.WriteLine("Press any key to end the program");
Console.ReadKey(); } }}
```

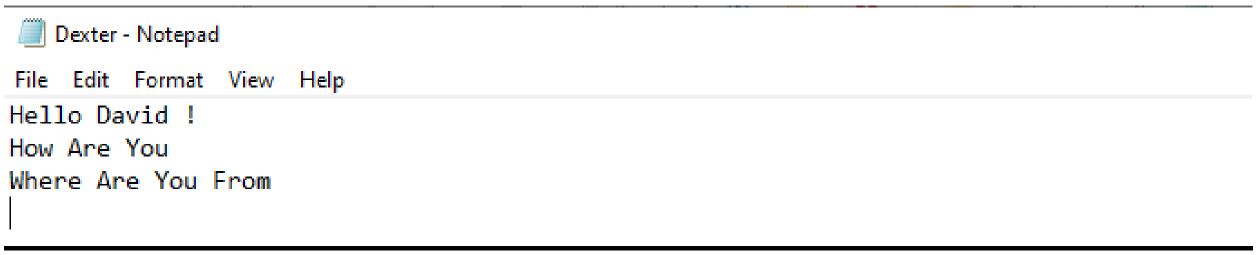
OUTPUT:



```
Hello Dexter !
How Are You
Where Are You From
```


C:\Users\Dell\source\repos\ConsoleApp1\ConsoleApp1\bin\Debug\ConsoleApp1.exe

```
Kindly check the file
Line is Replaced
Press any key to end the program
```



```
Hello David !
How Are You
Where Are You From
```

LAB # 03

Task 01:

Write a lexical analyzer in any language for the given tokens.

CODING:

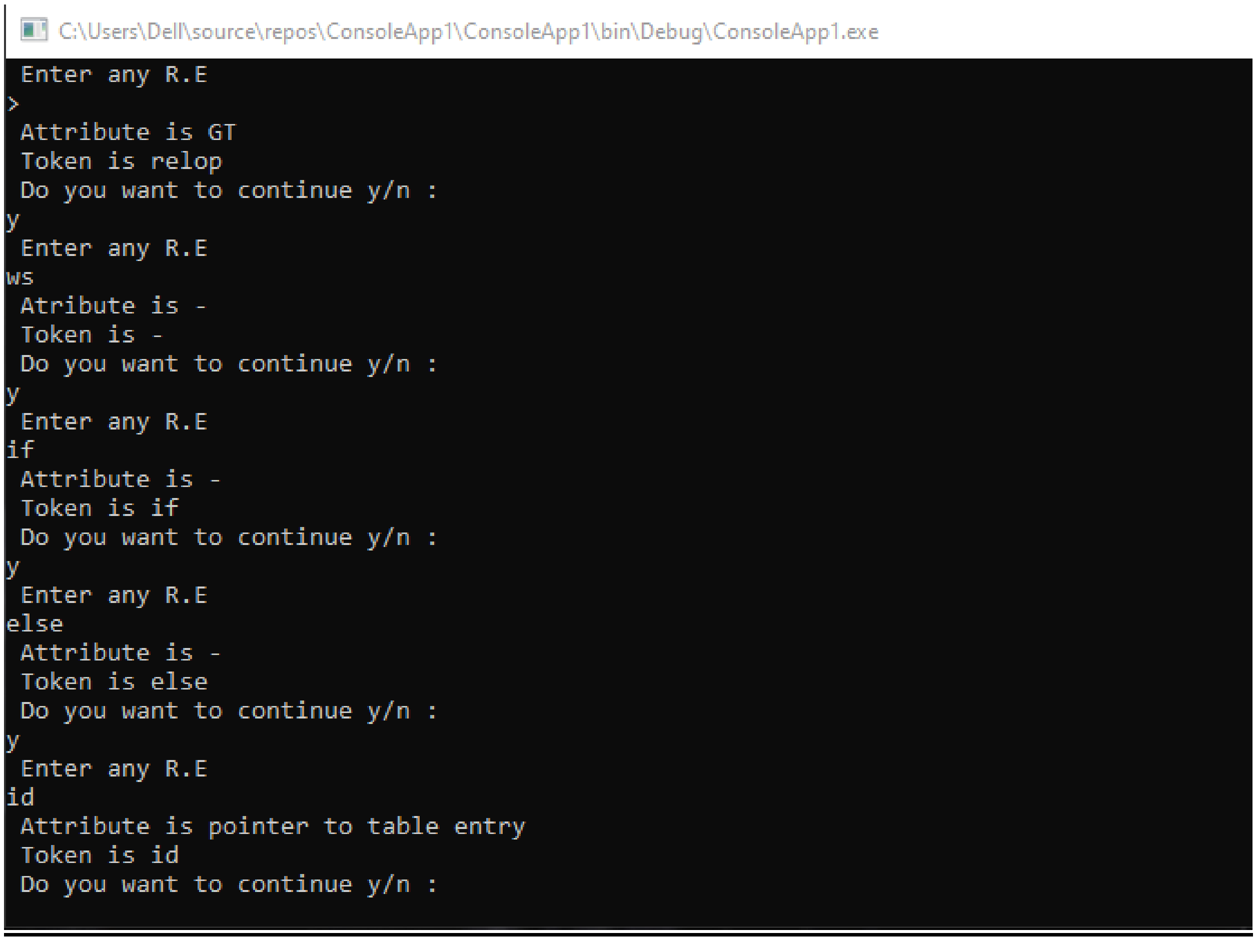
```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
namespace ConsoleApplication4
{
    class Program
    {
        static void Main(string[] args)
        {
            string input, c;
            do
            {
                Console.WriteLine(" Enter any R.E");
                input = Console.ReadLine();
                if (input == "ws")
                {
                    Console.WriteLine(" Atribute is -");
                    Console.WriteLine(" Token is -");
                }
                else if (input == "if")
                {
```

```
    Console.WriteLine(" Attribute is -");
    Console.WriteLine(" Token is if");
}
else if (input == "then")
{
    Console.WriteLine(" Attribute is -");
    Console.WriteLine(" Token is then");
}
else if (input == "else")
{
    Console.WriteLine(" Attribute is -");
    Console.WriteLine(" Token is else");
}
else if (input == "num")
{
    Console.WriteLine(" Attribute is pointer to table entry");
    Console.WriteLine(" Token is num");
}
else if (input == "id")
{
    Console.WriteLine(" Attribute is pointer to table entry");
    Console.WriteLine(" Token is id");
}
else if (input == "<")
{
    Console.WriteLine(" Attribute is LT");
    Console.WriteLine(" Token is relop");
}
```

```
else if (input == "<=")
{
   Console.WriteLine(" Attribute is LE");
   Console.WriteLine(" Token is relop");
}
else if (input == "=")
{
   Console.WriteLine(" Attribute is EQ");
   Console.WriteLine(" Token is relop");
}
else if (input == "<>")
{
   Console.WriteLine(" Attribute is NE");
   Console.WriteLine(" Token is relop");
}
else if (input == ">")
{
   Console.WriteLine(" Attribute is GT");
   Console.WriteLine(" Token is relop");
}
else if (input == ">=")
{
   Console.WriteLine(" Attribute is GE");
   Console.WriteLine(" Token is relop");
}
else
{
   Console.WriteLine(" Expression is invalid  \n");
```

```
                }

                Console.WriteLine(" Do you want to continue y/n : ");
                c = Console.ReadLine();
            }
            while (c != "no");
            Console.ReadLine();
        }
    }
}
```

OUTPUT:



```
C:\Users\Dell\source\repos\ConsoleApp1\ConsoleApp1\bin\Debug\ConsoleApp1.exe
 Enter any R.E
>
 Attribute is GT
 Token is relop
 Do you want to continue y/n :
y
 Enter any R.E
ws
 Atribute is -
 Token is -
 Do you want to continue y/n :
y
 Enter any R.E
if
 Attribute is -
 Token is if
 Do you want to continue y/n :
y
 Enter any R.E
else
 Attribute is -
 Token is else
 Do you want to continue y/n :
y
 Enter any R.E
id
 Attribute is pointer to table entry
 Token is id
 Do you want to continue y/n :
```

LAB # 04

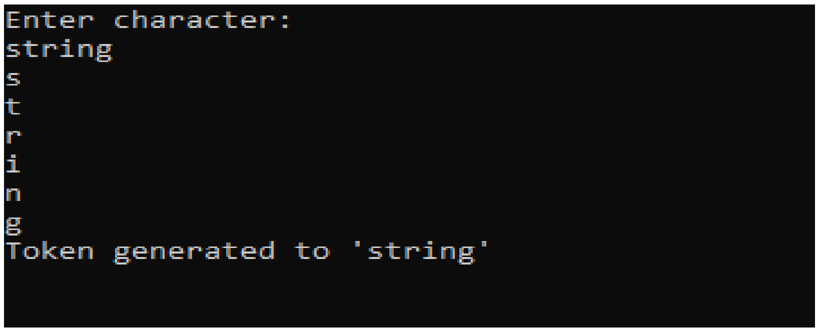
Task 01:

Input Buffering Technique- I

CODING:

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;

namespace ConsoleApplication4
{
    class Program
    {
        static void Main(string[] args)
        {
            string[] token = { "do", "int", "float", "double","string", "char"};
            string input;

    Console.WriteLine("Enter character: ");
            input = Console.ReadLine();

            for (int i = 0; i <= input.Length - 1; i++)
            {
                Char[] buffer;
                if (input == token[i])
                {
             for (int j = 0; j <= input.Length - 1; j++)
                    {
                        Console.WriteLine(buffer[j]);
                    }
                Console.WriteLine("Token generated to '" + token[i] + "'");
                }
            }
            Console.ReadLine();
        }

    }
```

OUTPUT:



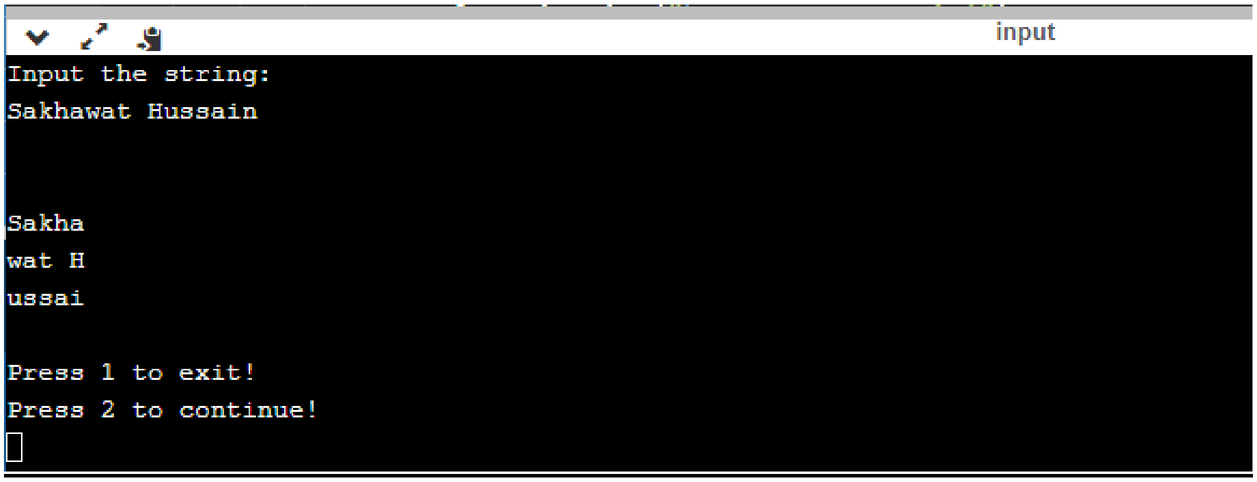
```
Enter character:
string
s
t
r
i
n
g
Token generated to 'string'
```

LAB # 05 (INPUT BUFFERING)

CODING:

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;

namespace buffertechniquetwo
{
   class Program
   {
      static void Main(string[] args)
      {
         string a;
         int len, div, x = 0, y = 5, z = 0, i = 5;
         int choice = 0;

         while (true)
         {
            Console.WriteLine("Input the string:");
            a = Console.ReadLine();
            len = a.Length;
            div = len / 5;

            Console.WriteLine("\n");
            string[] sub = new string[15];
            while (div > z)
            {
               sub[z] = a.Substring(x, y);
               Console.WriteLine(sub[z]);
               x = x + i;
               z++;
            }

            Console.WriteLine("\nPress 1 to exit!");
            Console.WriteLine("Press 2 to continue!");
            choice = int.Parse(Console.ReadLine());
            if (choice == 1)
            {
               Environment.Exit(2);
            }}}}}
```

OUTPUT:



```
Input the string:
Sakhawat Hussain


Sakha
wat H
ussai

Press 1 to exit!
Press 2 to continue!
```

LAB # 06

Task 01:

(a | b) (ba | ab) *

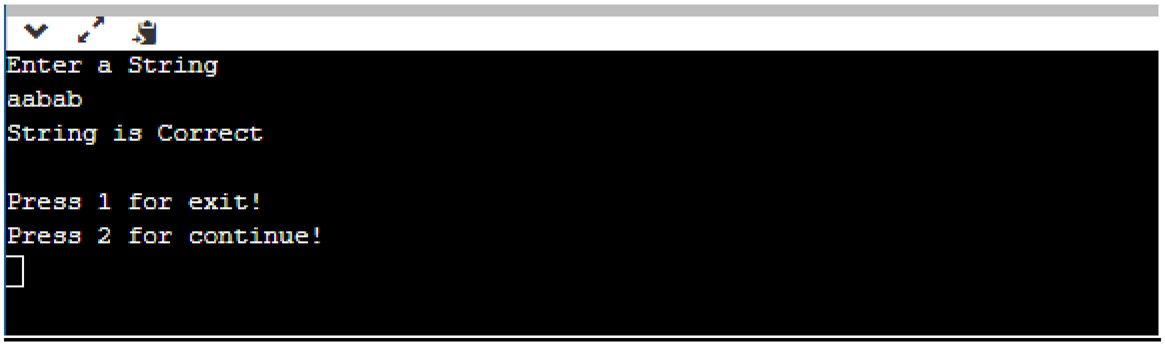
Construct the transition diagram for the above regular expression and implement it in any conventional programming language.

CODING:

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Threading.Tasks;

namespace lab_Ccstr
{
   class Program
   {
      static void Main(string[] args)
      {
         string a, ch;
         int i = 1, len;
         bool flag = false;
```

```
            do
            {
                Console.Write("\nEnter a String : ");
                a = Console.ReadLine();
                char[] x = a.ToCharArray();
                len = x.Length;
                if (x[0] == 'a' || x[0] == 'b')
                {
                    if (len == 1 && len % 2 != 0)
                    {
                        Console.WriteLine("String is Correct");
                        flag = true;
                    }
                    while (i < len && len % 2 != 0)
                    {
                        if (x[i] == 'a' && x[i + 1] == 'b' || x[i] == 'b' && x[i + 1] == 'a')
                        {
                            i += 2;
                            if (i >= len)
                            {
                                Console.WriteLine("String is Correct");
                                flag = true;
                            }
                        }
                    }
                }

                if (flag == false)
                {
                    Console.WriteLine("String is not Correct!");
                }
                flag = false;

                Console.WriteLine("\nEnter Yes IF You Want Try Again Or No To Quit : ");
                ch = Console.ReadLine().ToUpper();
            }
            while (ch == "YES");
            Console.ReadLine();
        }
    }
}
```

OUTPUT:



```
Enter a String
aabab
String is Correct

Press 1 for exit!
Press 2 for continue!
```

LAB # 07

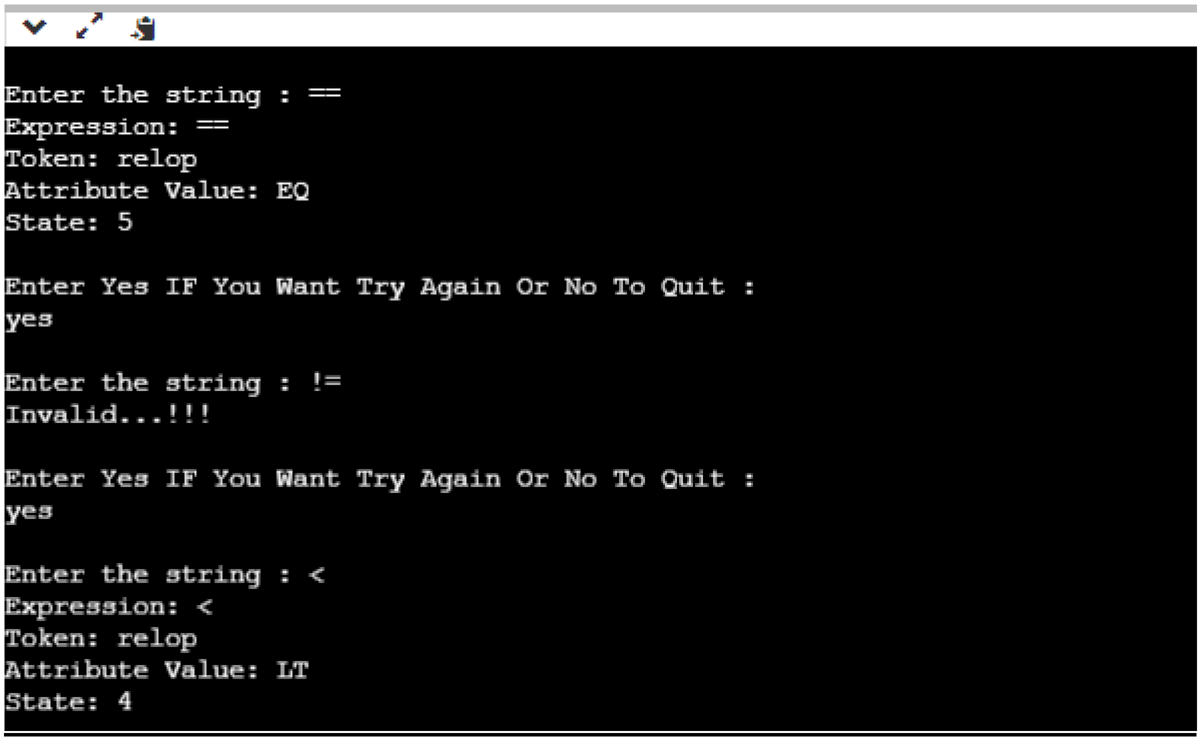
Task 01:

RECOGNITION OF TOKENS :

CODING:

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Threading.Tasks;

namespace lab_Ccstr
{
    class Program
    {
        static void Main(string[] args)
        {
            string a, ch;
            do
            {
                Console.Write("\nEnter the string : ");
                a = Console.ReadLine();
                char[] exp = a.ToCharArray();
                int len = a.Length;

                if (exp[0] == '<')
                {
                    if (len == 2)
                    {
                        if (exp[1] == '=')
                        {
                            Console.WriteLine("Expression: {0} \nToken: relop \nAttribute Value:
LE\nState: 2", a);
                        }
                        else if (exp[1] == '>')
                        {
                            Console.WriteLine("Expression: {0} \nToken: relop \nAttribute Value:
NE\nState: 3", a);
                        }
                    }
                    if (len == 1)
                        Console.WriteLine("Expression: {0} \nToken: relop \nAttribute Value:
LT\nState: 4", a);
                }

                else if (exp[0] == '=')
                {
                    Console.WriteLine("Expression: {0}  \nToken: relop \nAttribute Value: EQ\nState:
5", a);
                }
                else if (exp[0] == '>')
                {
                    if (len == 2)
                    {
                        if (exp[1] == '=')
                        {
                            Console.WriteLine("Expression: {0}  \nToken: relop \nAttribute Value:
GE\nState: 7", a);
                        }
                    }
                    if (len == 1)
                        Console.WriteLine("Expression: {0} \nToken: relop \nAttribute Value:
GT\nState: 8", a);
                }
                else
                {
                    Console.WriteLine("Invalid...!!!");
                }
                Console.WriteLine("\nEnter Yes IF You Want Try Again Or No To Quit : ");
                ch = Console.ReadLine().ToUpper();
            }
            while (ch == "YES");
            Console.ReadLine();
        }
    }
}
```

OUTPUT:



```
Enter the string : ==
Expression: ==
Token: relop
Attribute Value: EQ
State: 5

Enter Yes IF You Want Try Again Or No To Quit :
yes

Enter the string : !=
Invalid...!!!

Enter Yes IF You Want Try Again Or No To Quit :
yes

Enter the string : <
Expression: <
Token: relop
Attribute Value: LT
State: 4
```

LAB # 08

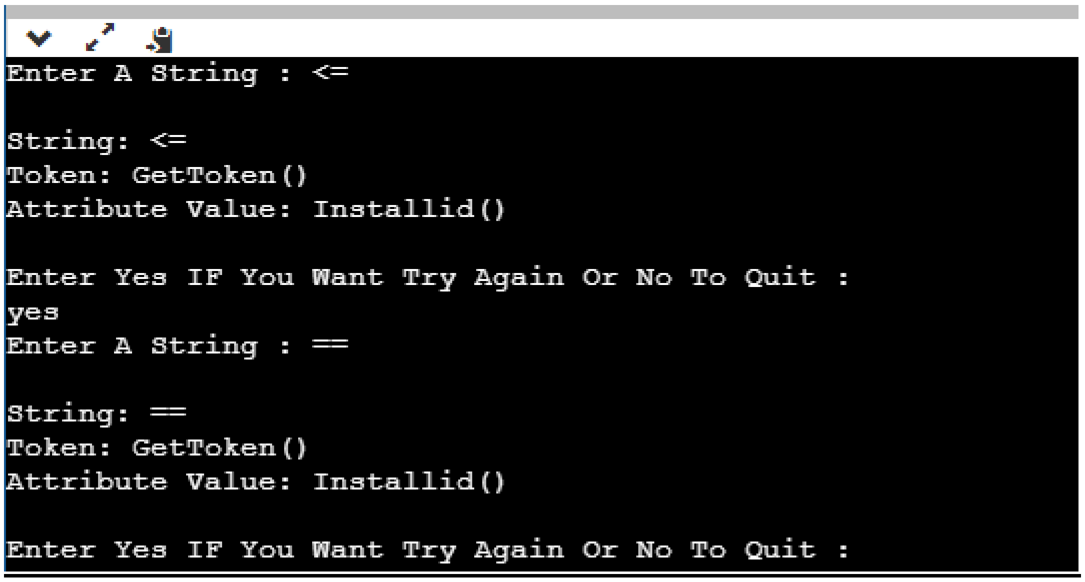
Task 01:

RECOGNITION OF IDENTIFIERS :

CODING:

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Threading.Tasks;

namespace lab_Ccstr
{
    class Program
    {
        static void Main(string[] args)
        {
            int len;
            string exp, ch;
            char[] digit = { '0', '1', '2', '3', '4', '5', '6', '7', '8', '9' };
            do
            {
                Console.Write("Enter A String : ");
                exp = Console.ReadLine();
                char[] exp1 = exp.ToCharArray();
                len = exp1.Length;

                    if (exp1[0] >= digit[0] && exp1[0] <= digit[9])
                    {
                        Console.WriteLine("Invalid Identifier...!!!");
                    }
                    else
                    {
                            Console.WriteLine("\nString: {0} \nToken: GetToken() \nAttribute Value:
Installid()", exp);
                    }

                Console.WriteLine("\nEnter Yes IF You Want Try Again Or No To Quit : ");
                ch = Console.ReadLine().ToUpper();
            }
            while (ch == "YES");
            Console.ReadLine();
        }
    }
}
```

OUTPUT:

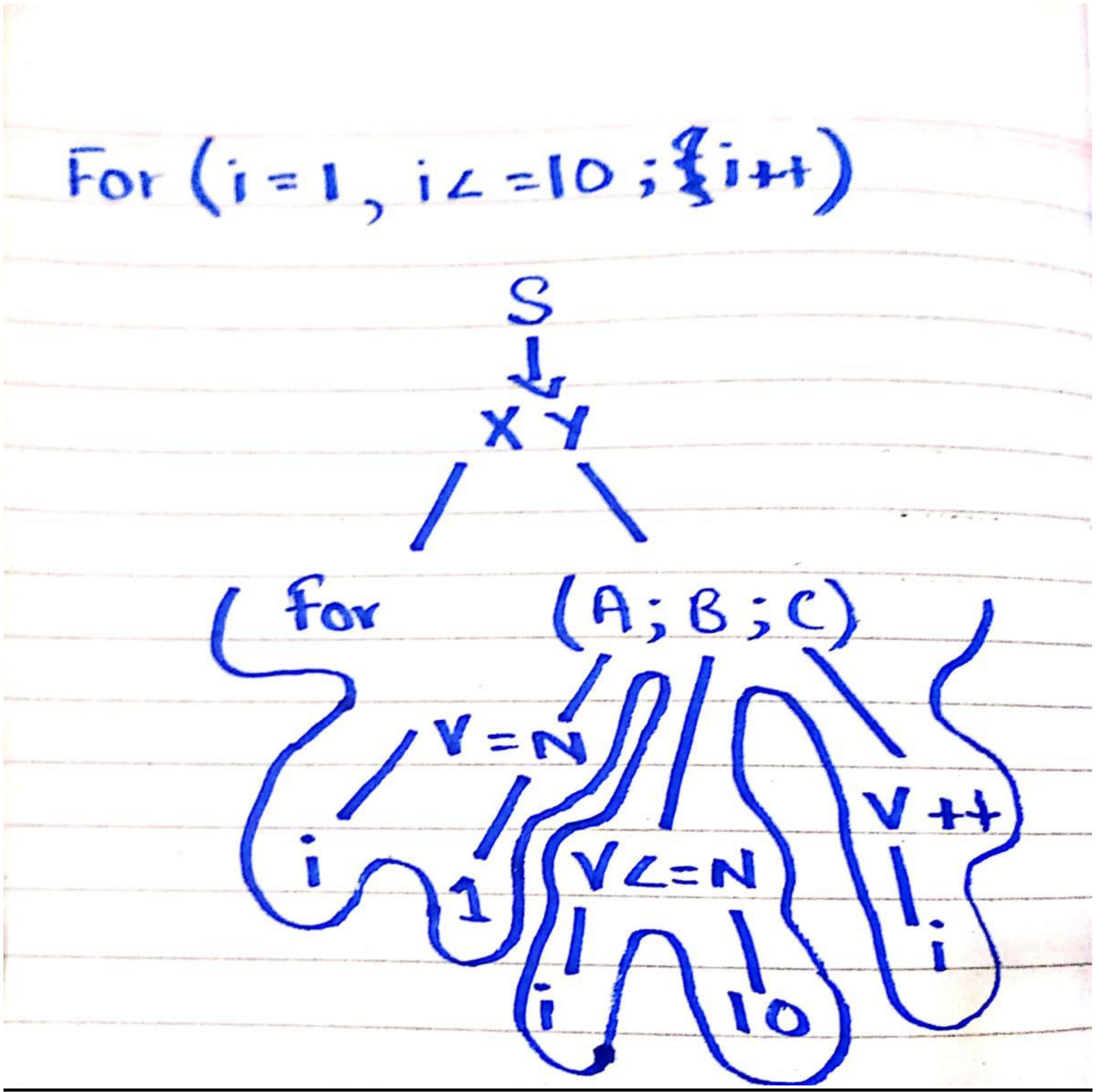


```
Enter A String : <=

String: <=
Token: GetToken()
Attribute Value: Installid()

Enter Yes IF You Want Try Again Or No To Quit :
yes
Enter A String : ==

String: ==
Token: GetToken()
Attribute Value: Installid()

Enter Yes IF You Want Try Again Or No To Quit :
```

LAB # 09

Task 01:

OUTPUT:



LAB # 10

Task 01:

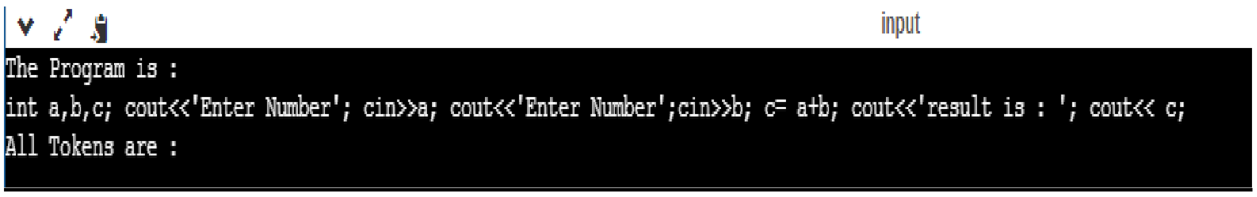
LEXICAL ANALYZER:

CODING:

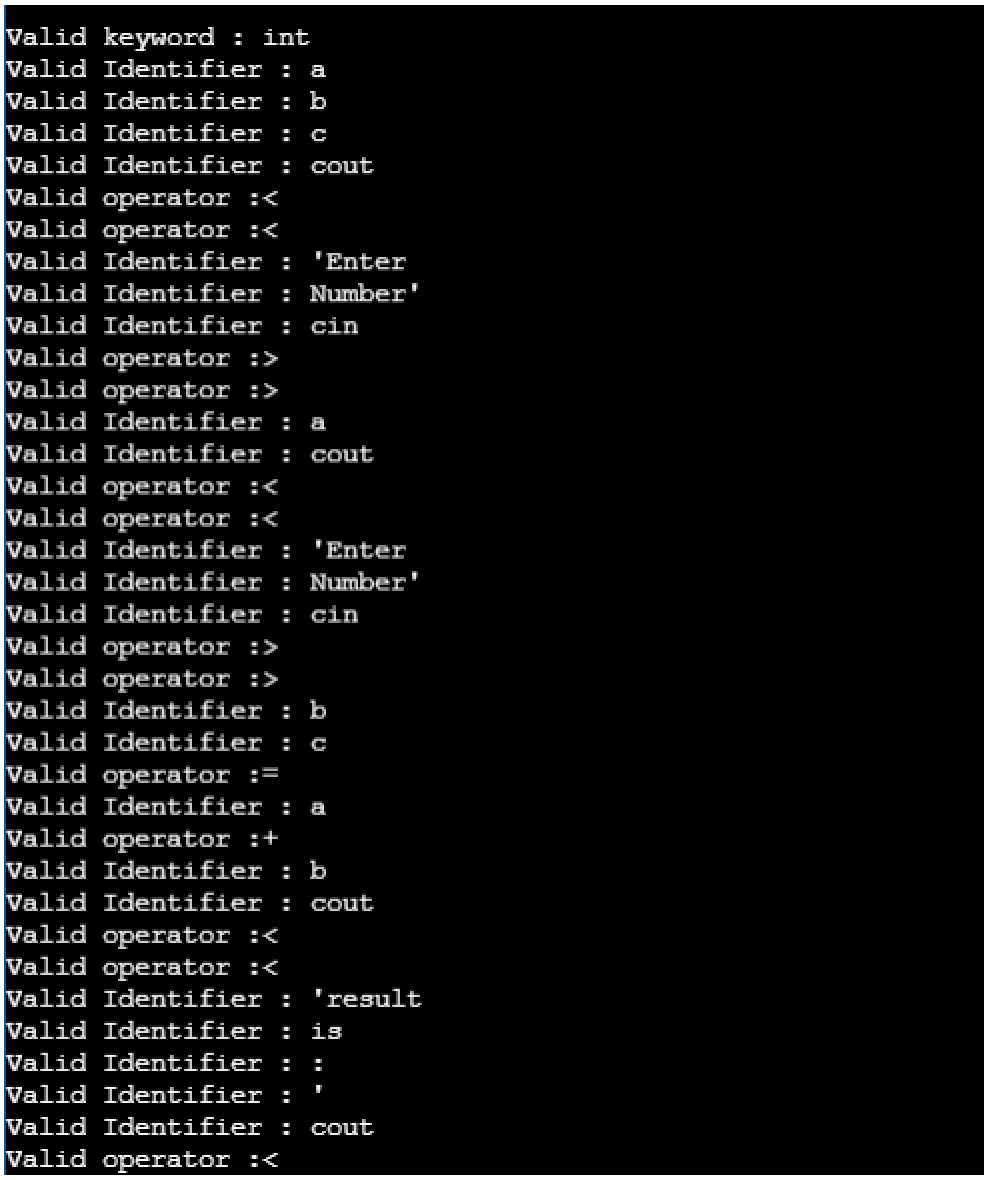
```
#include<iostream>
#include<fstream>
#include<stdlib.h>
#include<string.h>
#include<ctype.h>

using namespace std;

int isKeyword(char buffer[]){
char keywords[32][10] = {"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"};
int i, flag = 0;
for(i = 0; i < 32; ++i){
if(strcmp(keywords[i], buffer) == 0){
flag = 1;
break;
}
}
return flag;
}

int main(){
char ch, buffer[15], operators[] = "+-*/%=";
ifstream fin("program.txt");
int i,j=0;
if(!fin.is_open()){
cout<<"error while opening the file\n";
exit(0);
}
while(!fin.eof()){
   ch = fin.get();

for(i = 0; i < 6; ++i){
   if(ch == operators[i])
   cout<<ch<<" is operator\n";
   }
```

```
  if(isalnum(ch)){
  buffer[j++] = ch;
  }
  else if((ch == ' ' || ch == '\n') && (j != 0)){
  buffer[j] = '\0';
  j = 0;

  if(isKeyword(buffer) == 1)
  cout<<buffer<<" is keyword\n";
  else
  cout<<buffer<<" is indentifier\n";
  }

}
fin.close();
return 0;
}
```

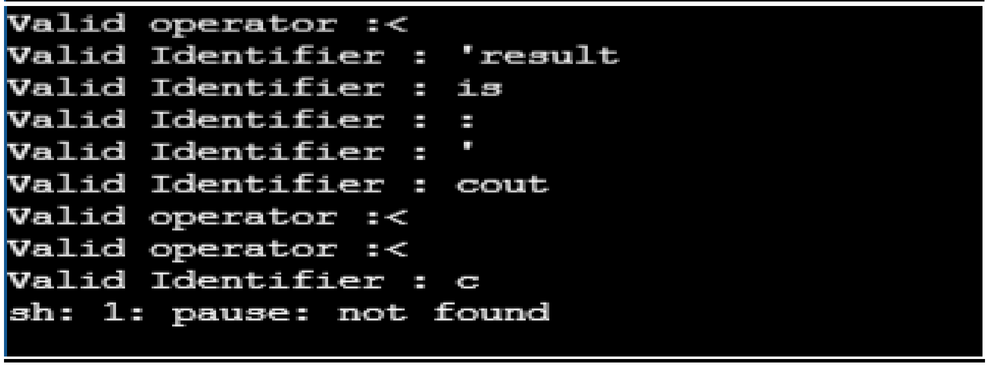
OUTPUT:



```
The Program is :
int a,b,c; cout<<'Enter Number'; cin>>a; cout<<'Enter Number';cin>>b; c= a+b; cout<<'result is : '; cout<< c;
All Tokens are :
```



```
Valid keyword : int
Valid Identifier : a
Valid Identifier : b
Valid Identifier : c
Valid Identifier : cout
Valid operator :<
Valid operator :<
Valid Identifier : 'Enter
Valid Identifier : Number'
Valid Identifier : cin
Valid operator :>
Valid operator :>
Valid Identifier : a
Valid Identifier : cout
Valid operator :<
Valid operator :<
Valid Identifier : 'Enter
Valid Identifier : Number'
Valid Identifier : cin
Valid operator :>
Valid operator :>
Valid Identifier : b
Valid Identifier : c
Valid operator :=
Valid Identifier : a
Valid operator :+
Valid Identifier : b
Valid Identifier : cout
Valid operator :<
Valid operator :<
Valid Identifier : 'result
Valid Identifier : is
Valid Identifier : :
Valid Identifier : '
Valid Identifier : cout
Valid operator :<
```



```
Valid operator :<
Valid Identifier : 'result
Valid Identifier : is
Valid Identifier : :
Valid Identifier : '
Valid Identifier : cout
Valid operator :<
Valid operator :<
Valid Identifier : c
sh: 1: pause: not found
```

LAB # 11

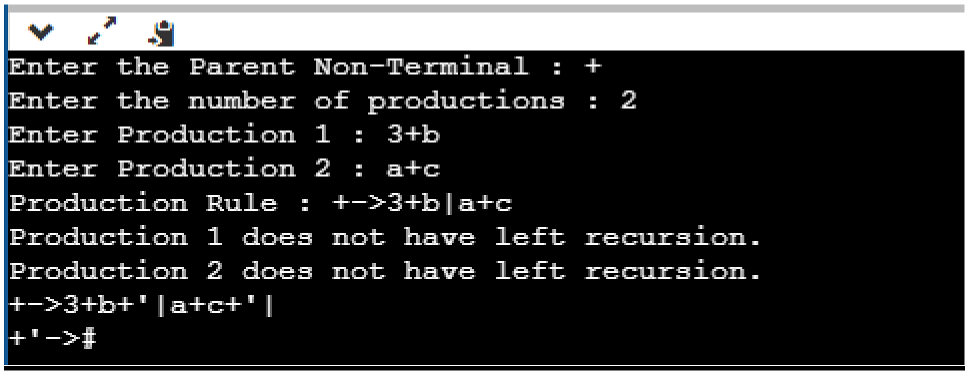
Task 01:

LEFT RECURSION AND LEFT FACTORING:

CODING:

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

using namespace std;
int main()
{  string ip,op1,op2,temp;
   int sizes[10] = {};
   char c;
   int n,j,l;
   cout<<"Enter the Parent Non-Terminal : ";
   cin>>c;
   ip.push_back(c);
   op1 += ip + "\'->";
   ip += "->";
   op2+=ip;
   cout<<"Enter the number of productions : ";
   cin>>n;
   for(int i=0;i<n;i++)
   {   cout<<"Enter Production "<<i+1<<" : ";
      cin>>temp;
      sizes[i] = temp.size();
      ip+=temp;
      if(i!=n-1)
         ip += "|";
   }
   cout<<"Production Rule : "<<ip<<endl;
   for(int i=0,k=3;i<n;i++)
   {
      if(ip[0] == ip[k])
      {
         cout<<"Production "<<i+1<<" has left recursion."<<endl;
         if(ip[k] != '#')
         {
            for(l=k+1;l<k+sizes[i];l++)
               op1.push_back(ip[l]);
            k=l+1;
            op1.push_back(ip[0]);
            op1 += "\'|";
          }
        }
        else
        {
          cout<<"Production "<<i+1<<" does not have left recursion."<<endl;
          if(ip[k] != '#')
          {
            for(j=k;j<k+sizes[i];j++)
              op2.push_back(ip[j]);
            k=j+1;
            op2.push_back(ip[0]);
            op2 += "\'|";
          }
          else
          {
            op2.push_back(ip[0]);
            op2 += "\'";
          }}}
    op1 += "#";
    cout<<op2<<endl;
    cout<<op1<<endl;
          getch();
    return 0;
}
```

OUTPUT:



```
Enter the Parent Non-Terminal : +
Enter the number of productions : 2
Enter Production 1 : 3+b
Enter Production 2 : a+c
Production Rule : +->3+b|a+c
Production 1 does not have left recursion.
Production 2 does not have left recursion.
+->3+b+'|a+c+'|
+'->#
```

LAB # 12

Task 01:

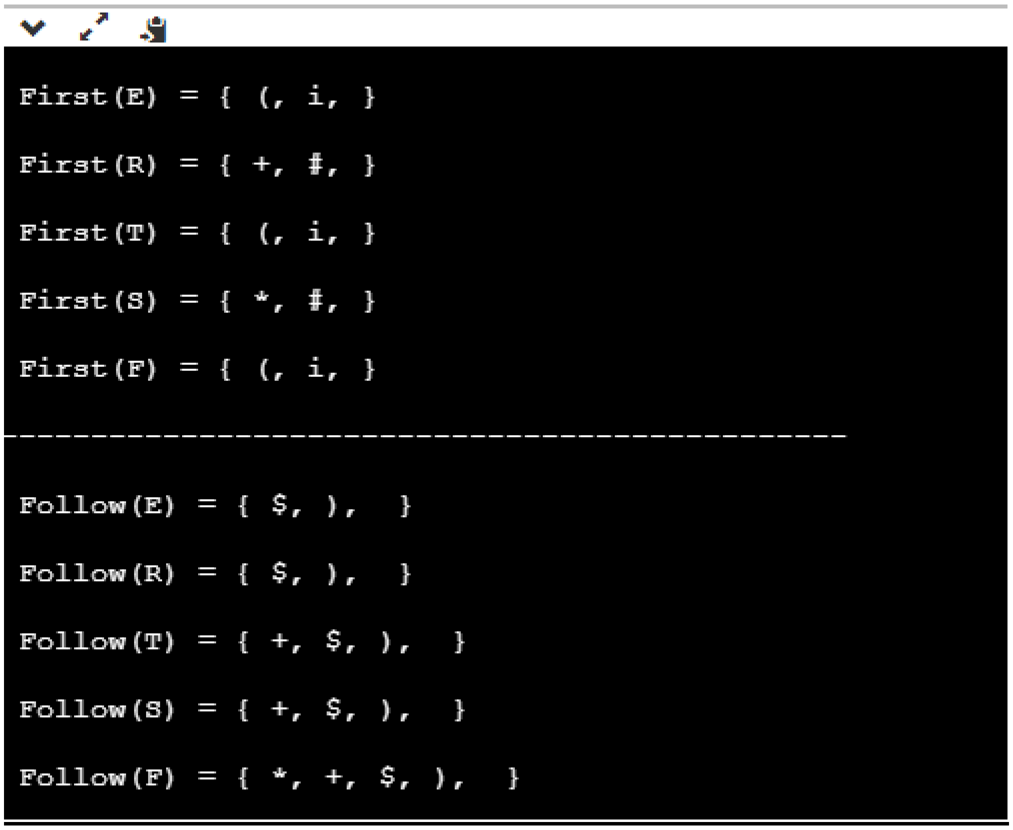
LEFT RECURSION AND LEFT FACTORING:

CODING:

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

void followfirst(char, int, int);
void follow(char c);

void findfirst(char, int, int);

int count, n = 0;
char calc_first[10][100];

char calc_follow[10][100];
int m = 0;

char production[10][10], f[10], first[10];
int k, e;
char ck;

int main(int argc, char **argv)
{
    int jm = 0 , km = 0, i, choice, kay , ptr = -1;
    char c, ch;
    count = 8;

    strcpy(production[0], "E=TR");
    strcpy(production[1], "R=+TR");
    strcpy(production[2], "R=#");
    strcpy(production[3], "T=FS");
    strcpy(production[4], "S=*FS");
    strcpy(production[5], "S=#");
    strcpy(production[6], "F=(E)");
    strcpy(production[7], "F=i");

    char done[count];

    for(k = 0; k < count; k++) {
        for(kay = 0; kay < 100; kay++) {
            calc_first[k][kay] = '!';
    }
}
int point1 = 0, point2, xxx;

for(k = 0; k < count; k++)
{
    c = production[k][0];
    point2 = 0;
    xxx = 0;

    for(kay = 0; kay <= ptr; kay++)
        if(c == done[kay])
            xxx = 1;

    if (xxx == 1)
        continue;

    findfirst(c, 0, 0);
    ptr += 1;

    done[ptr] = c;
    printf("\n First(%c) = { ", c);
    calc_first[point1][point2++] = c;

    for(i = 0 + jm; i < n; i++) {
        int lark = 0, chk = 0;

        for(lark = 0; lark < point2; lark++) {

            if (first[i] == calc_first[point1][lark])
            {
                chk = 1;
                break;
            }
        }
        if(chk == 0)
        {
            printf("%c, ", first[i]);
            calc_first[point1][point2++] = first[i];
        }
    }
    printf("}\n");
    jm = n;
    point1++;
}
printf("\n");
printf("-----------------------------------------------\n\n");
char donee[count];
ptr = -1;

for(k = 0; k < count; k++) {
    for(kay = 0; kay < 100; kay++) {
        calc_follow[k][kay] = '!';
    }
}
point1 = 0;
int land = 0;
for(e = 0; e < count; e++)
{
    ck = production[e][0];
    point2 = 0;
    xxx = 0;

    for(kay = 0; kay <= ptr; kay++)
        if(ck == donee[kay])
            xxx = 1;

    if (xxx == 1)
        continue;
    land += 1;

    follow(ck);
    ptr += 1;

    donee[ptr] = ck;
    printf(" Follow(%c) = { ", ck);
    calc_follow[point1][point2++] = ck;

    for(i = 0 + km; i < m; i++) {
        int lark = 0, chk = 0;
        for(lark = 0; lark < point2; lark++)
        {
            if (f[i] == calc_follow[point1][lark])
            {
                chk = 1;
                break;
            }
        }
        if(chk == 0)
        {
            printf("%c, ", f[i]);
            calc_follow[point1][point2++] = f[i];
            }
        }
        printf(" }\n\n");
        km = m;
        point1++;
    }
}
void follow(char c)
{
    int i, j;

    if(production[0][0] == c) {
        f[m++] = '$';
    }
    for(i = 0; i < 10; i++)
    {
        for(j = 2;j < 10; j++)
        {
            if(production[i][j] == c)
            {
                if(production[i][j+1] != '\0')
                {
                    followfirst(production[i][j+1], i, (j+2));
                }

                if(production[i][j+1]=='\0' && c!=production[i][0])
                {
                    follow(production[i][0]);
                }} } }}
void findfirst(char c, int q1, int q2)
{
    int j;
    if(!(isupper(c))) {
        first[n++] = c;
    }
    for(j = 0; j < count; j++)
    {
        if(production[j][0] == c)
        {
            if(production[j][2] == '#')
            {
                if(production[q1][q2] == '\0')
                    first[n++] = '#';
                else if(production[q1][q2] != '\0'
                          && (q1 != 0 || q2 != 0))
                {
```

```
                findfirst(production[q1][q2], q1, (q2+1));
            }
            else
                first[n++] = '#';
        }
        else if(!isupper(production[j][2]))
        {
            first[n++] = production[j][2];
        }
        else
        {
            findfirst(production[j][2], j, 3);
        }}}}

void followfirst(char c, int c1, int c2)
{
    int k;

    if(!(isupper(c)))
        f[m++] = c;
    else
    {
        int i = 0, j = 1;
        for(i = 0; i < count; i++)
        {
            if(calc_first[i][0] == c)
                break;
        }
        while(calc_first[i][j] != '!')
        {
            if(calc_first[i][j] != '#')
            {
                f[m++] = calc_first[i][j];
            }
            else
            {
                if(production[c1][c2] == '\0')
                {
                    follow(production[c1][0]);
                }
                else
                {
                    followfirst(production[c1][c2], c1, c2+1);
                }
            }
            j++;
        }
    }
}
}
```

OUTPUT:



```
First(E) = {  (, i, }

First(R) = { +, #, }

First(T) = {  (, i, }

First(S) = { *, #, }

First(F) = {  (, i, }

-----------------------------------------------

Follow(E) = { $, ),  }

Follow(R) = { $, ),  }

Follow(T) = { +, $, ),  }

Follow(S) = { +, $, ),  }

Follow(F) = { *, +, $, ),  }
```