NCR CAMPUS, MODINAGAR

(A Constituent of SRM University, Chennai T.N.)
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Compiler Design Lab
(18CSC304J)

Lab Record

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Course Title : Compiler Design
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SRM IST, DELHI-NCR CAMPUS, MODINAGAR
Department of Computer Science and Engineering

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R	**A**	**1**	**9**	**1**	**1**	**0**	**0**	**3**	**0**	**3**	**0**	**1**	**4**	**7**

BONAFIDE CERTIFICATE

It is to be certified that the bonafide practical record submitted by Abhinav **Tripathi of 6** semester for Bachelor of Technology degree in the Department of Computer Science and Engineering, Delhi-NCR Campus, SRM IST has been done for the course **Compiler Design** Lab (18CSC304J) during the academic semester session Jan 2022 – May2022.

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Examiner 1

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EXPERIMENT 1

Implementation of Lexical Analyzer

Aim: Write a program in C/C++ to implement a lexical analyzer.

Algorithm:

1. Start
2. Get the input expression from the user.
3. Store the keywords and operators.
4. Perform analysis of the tokens based on the ASCII values.
5.

ASCII Range	TOKEN TYPE
97-122	Keyword else identifier
48-57	Constant else operator
Greater than 12	Symbol

6. Print the token types.
7. Stop

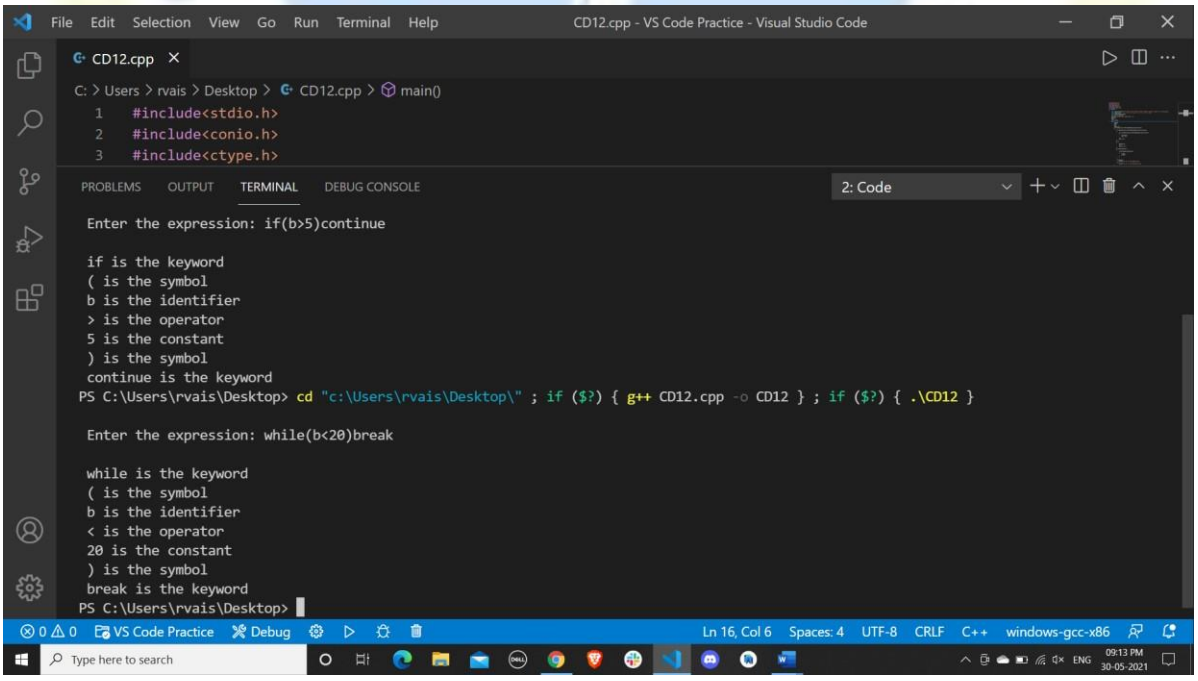
Program (lexi.c):

```
/* Lexical Analyzer */
#include<stdio.h>
#include<conio.h>
#include<ctype.h>
#include<string.h>
using namespace std;
int main()
{
	char
key[11][10]={"for","while","do","then","else","break","switch","case","if","co
ntinue"};
	char oper[13]={'+','-','*','/','%','&','<','>','=',';',':','!'};
	char a[20],b[20],c[20];
	int i,j,l,m,k,flag;
	printf("\n Enter the expression: ");
	gets(a);
	i=0;
	while(a[i])
	{
		flag=0;
		j=0;
```

```
l=0;
b[0]='\0';
if((toascii(a[i]>=97))&&(toascii(a[i]<=122)))
{
        if((toascii(a[i+1]>=97))&&(toascii(a[i+1]<=122)))
        {
                while((toascii(a[i]>=97))&&(toascii(a[i]<=122)))
                {
                        b[j]=a[i];
                        j++; i++;
                }
                b[j]='\0';
        }
        else
        {
                b[j]=a[i];
                i++;
                b[j+1]='\0';
        }

        for(k=0;k<=9;k++)
        {
                if(strcmp(b,key[k])==0)
                {
                        flag=1;
                         break;
                }
        }
        if(flag==1)
                printf("\n %s is the keyword",b);
        else
                printf("\n %s is the identifier",b);
}

else if((toascii(a[i]>=48))&&(toascii(a[i]<=57)))
{
        if((toascii(a[i+1]>=48))&&(toascii(a[i+1]<=57)))
        {
                while((toascii(a[i]>=48))&&(toascii(a[i]<=57)))
                {
                        c[l]=a[i];
                        l++;  i++;
                }
        }else
```

```
                {
                        c[l]=a[i];
                        i++;l++;
                }
                c[l]='\0';
                printf("\n %s is the constant",c);
        }//second ifelse
        else
        {
                for(m=0;m<13;m++)
                {
                        if(a[i]==oper[m])
                        {
                                printf("\n %c is the operator",a[i]);
                                break;
                        }
                }
                if(m>=13)
                        printf("\n %c is the symbol",a[i]);
                i++;
        }//last else
    } //while
    return 0;
}
```

OUTPUT:



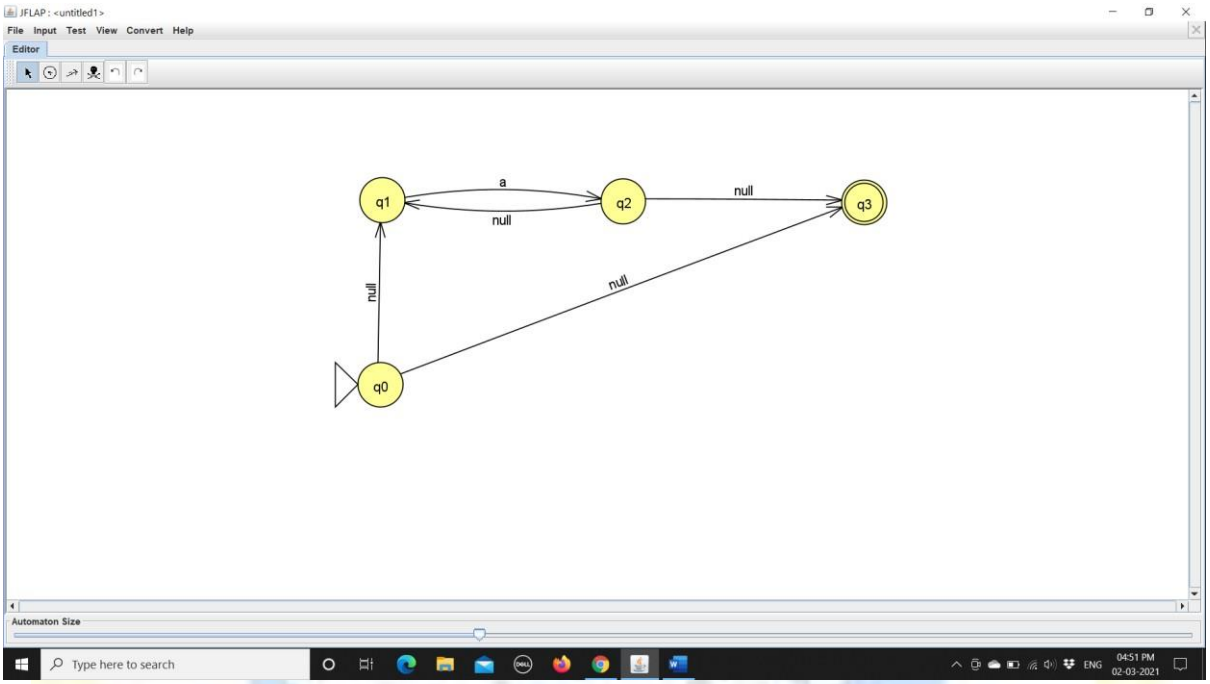
Result: The Program Executed successfully.

EXPERIMENT 2

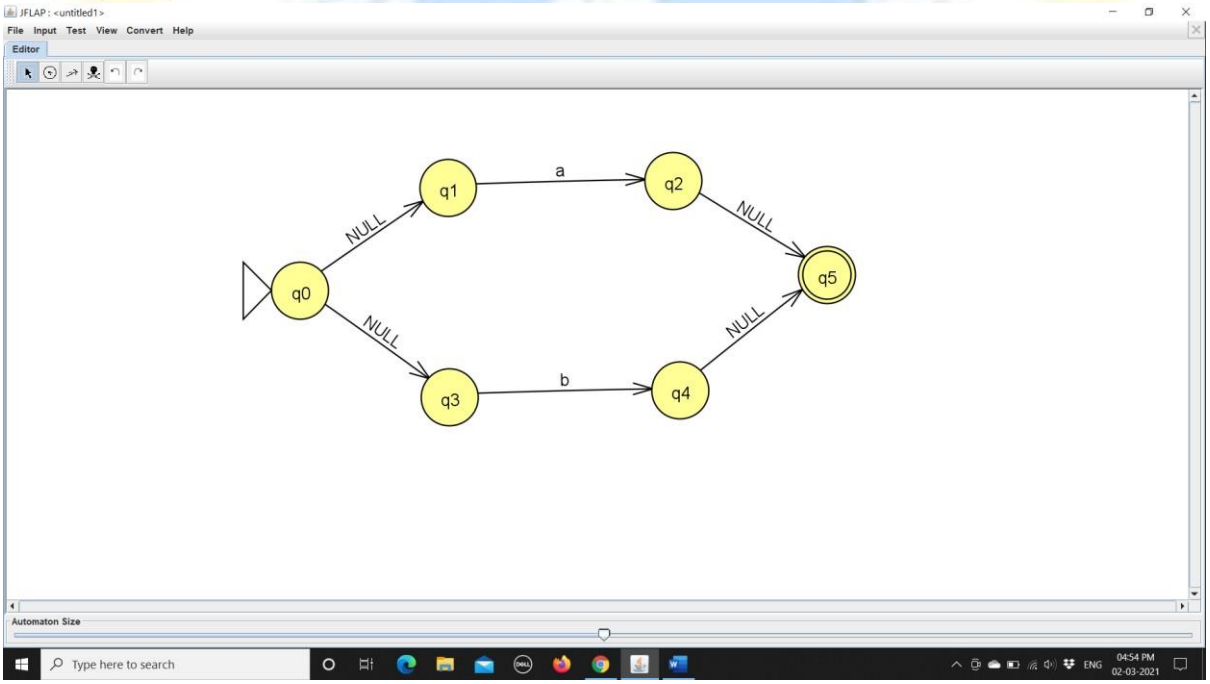
Regular Expression to NFA

Aim: To convert the given Regular expression to NFA by using JFLAP.

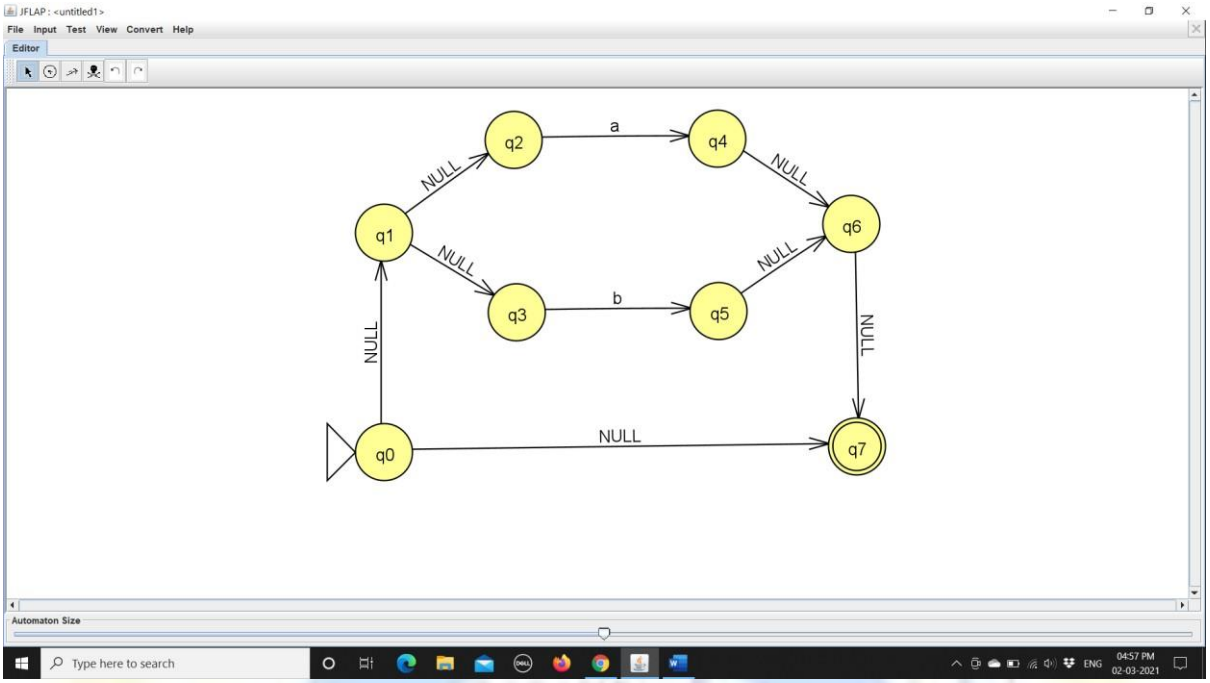
1. a*



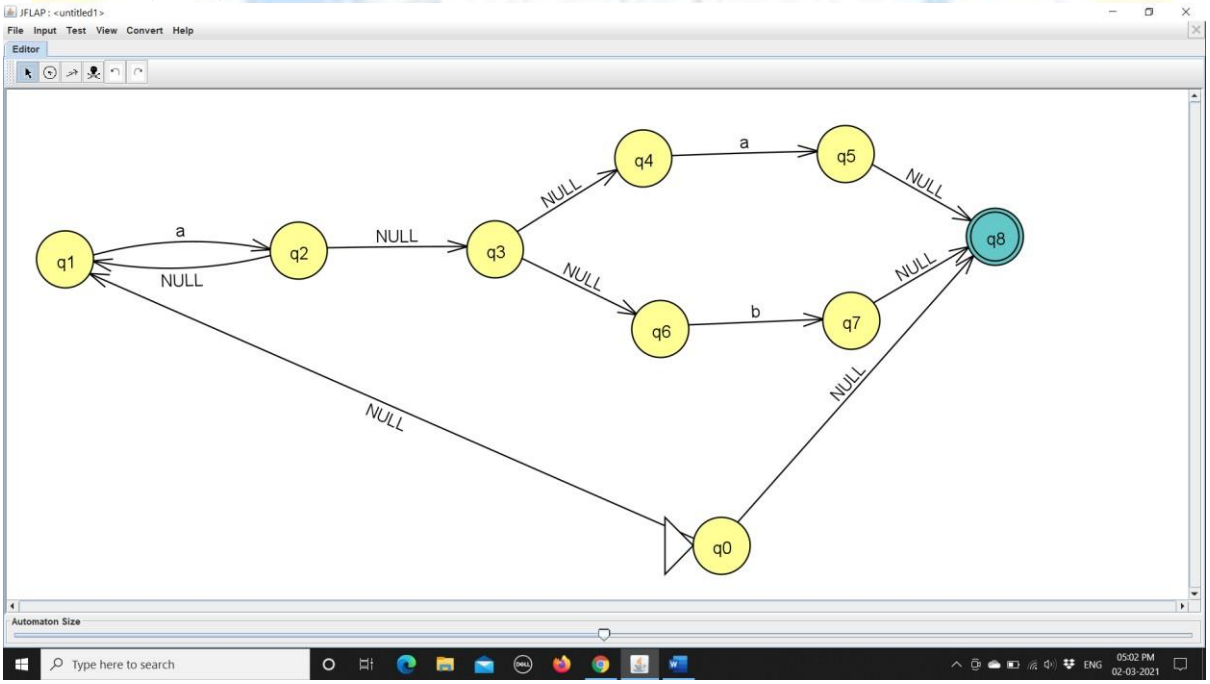
2. (a+b)



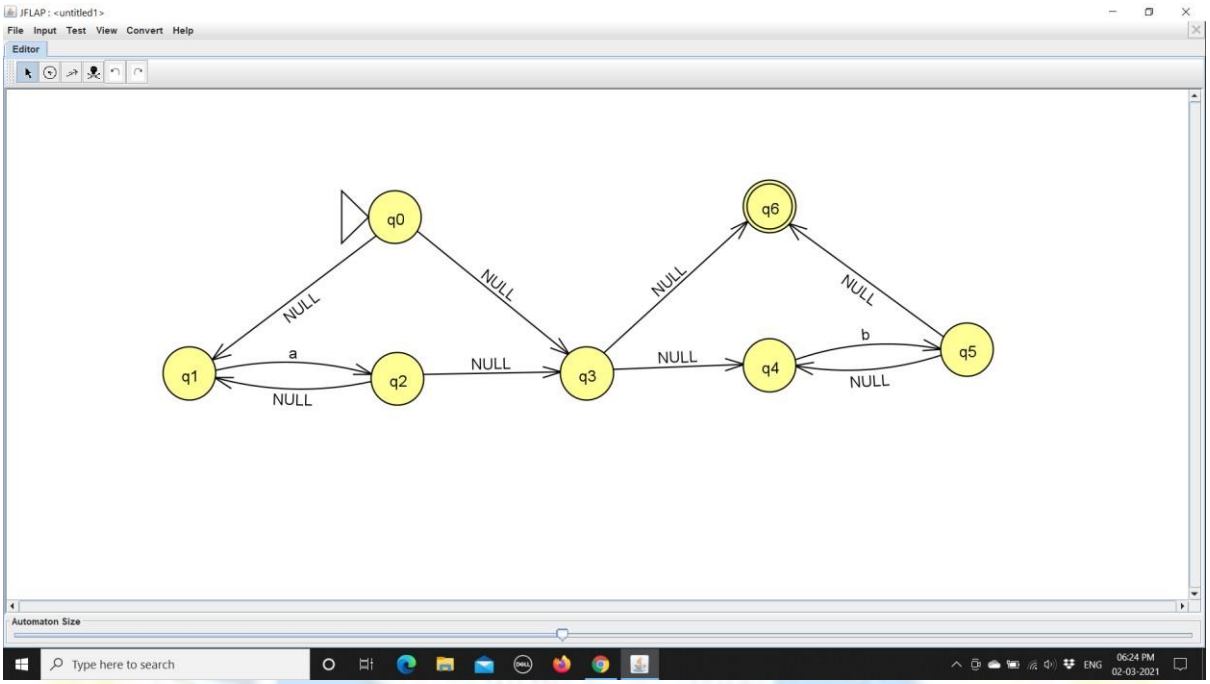
3. (a+b)*


JFLAP : <untitled1>
File Input Test View Convert Help
Editor
q0
q1
q2
q3
q4
q5
q6
q7
a
b
NULL
Automaton Size
Type here to search
04:57 PM
02-03-2021

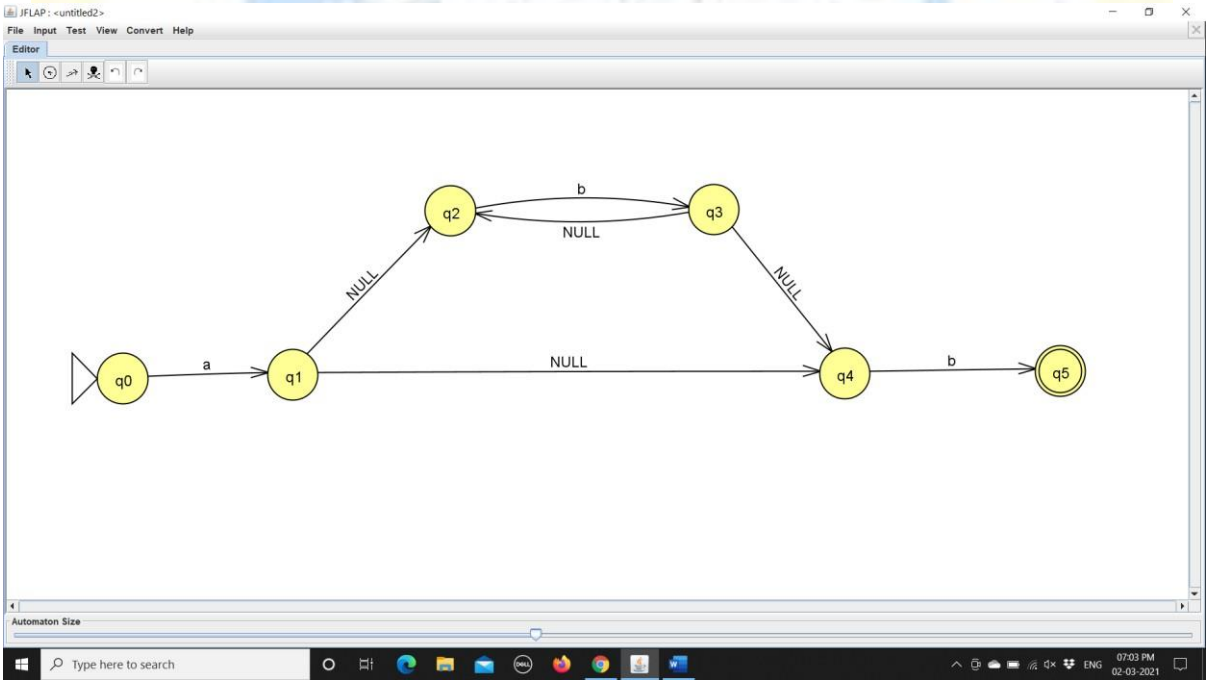
4. a*(a+b)


JFLAP : <untitled1>
File Input Test View Convert Help
Editor
q0
q1
q2
q3
q4
q5
q6
q7
q8
a
b
NULL
Automaton Size
Type here to search
05:02 PM
02-03-2021

5. a*b*



6. ab*b



Result: We converted the given Regular expression to NFA.

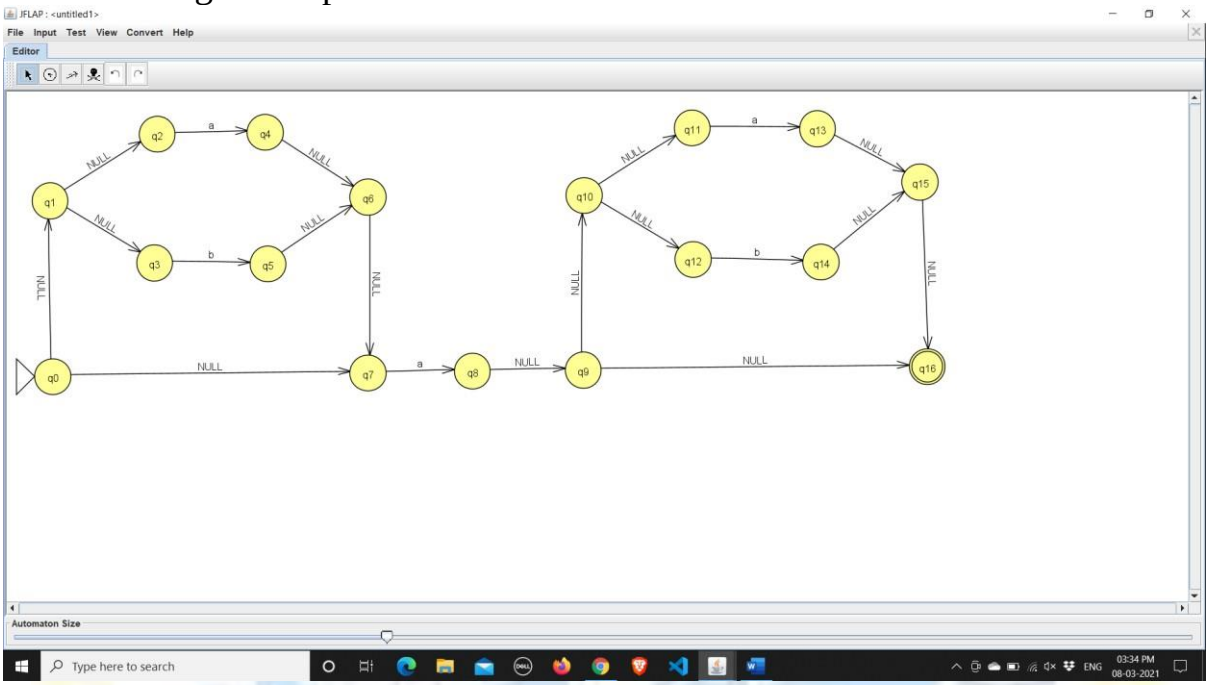
EXPERIMENT 3

Regular Expression to NFA to DFA

Aim: To convert the given Regular expression to DFA by using JFLAP.

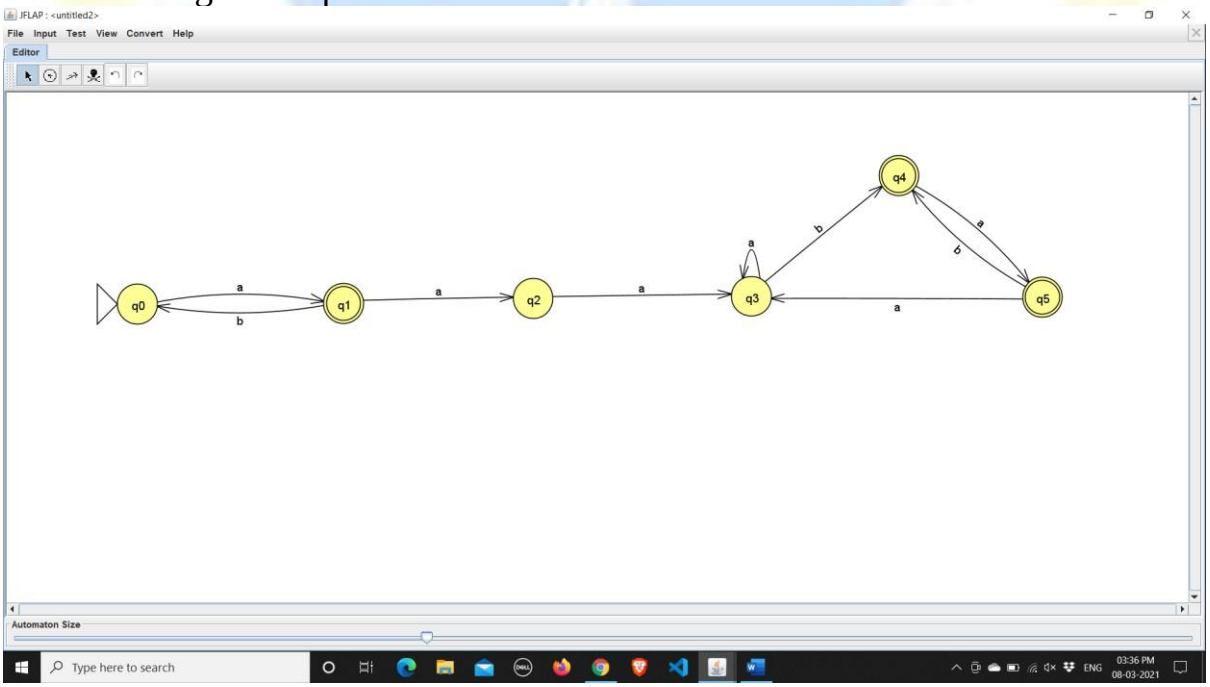
Ques: (a+b) *a(a+b) *

NFA for the given expression is:



OUTPUT: -

DFA for the given expression is:



Result: We converted the given Regular expression to DFA.

EXPERIMENT 4

Computation of FIRST in a grammar

Aim: Write a program in C/C++ to find the FIRST set for a given set of production rule of a grammar.

Algorithm:

Procedure First

1. Input the number of production N.
2. Input all the production rule *PArray*
3. Repeat steps a, b, c until process all input production rule i.e. *PArray*[N]
    a. If $X_i \neq X_{i+1}$ then
        i. Print Result array of X_i which contain FIRST(X_i)
    b. If first element of X_i of *PArray* is Terminal or ε Then
        i. Add Result = Result U first element
    c. If first element of X_i of *PArray* is Non-Terminal Then
        i. searchFirst(i, *PArray*, N)
4. End Loop
5. If N (last production) then
    a. Print Result array of X_i which contain FIRST(X_i)
6. End

Procedure searchFirst(i, *PArray*, N)

1. Repeat steps Loop j=i+1 to N
    a. If first element of X_j of *PArray* is Non-Terminal Then
        i. searchFirst(j, of *PArray*, N)
    b. If first element of X_j of *PArray* is Terminal or ε Then
        i. Add Result = Result U first element
        ii. Flag=0
2. End Loop
3. If Flag = 0 Then
    a. Print Result array of X_j which contain FIRST(X_j)
4. End

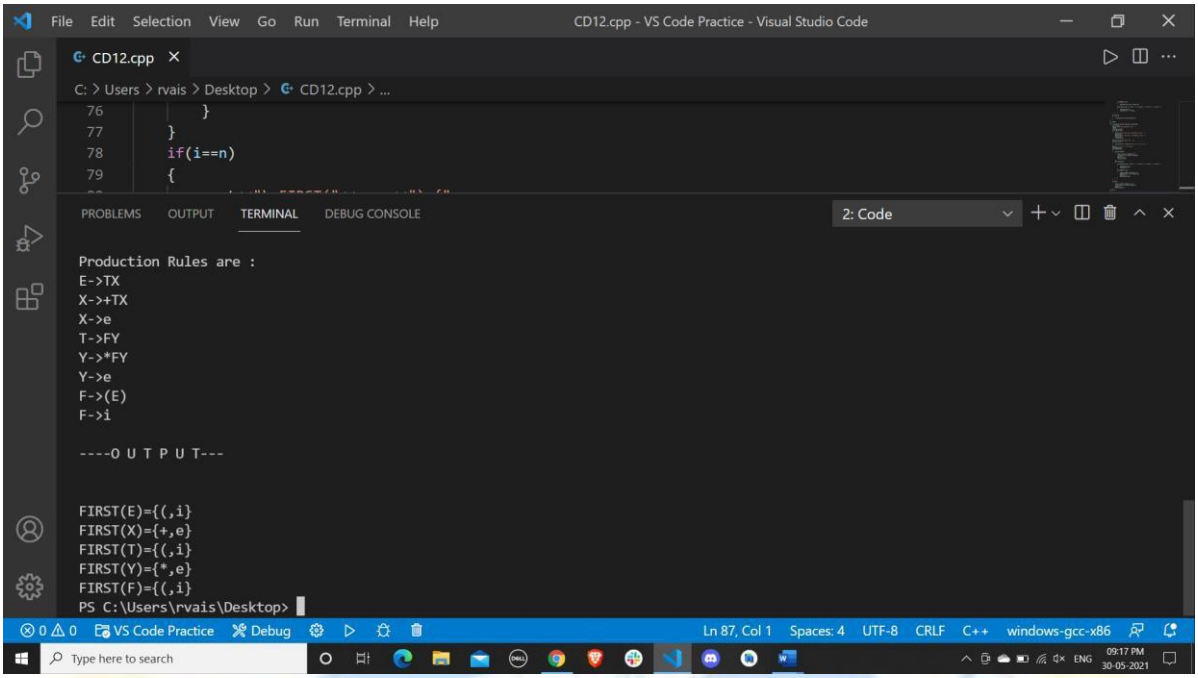
Program:

```
#include<iostream>
#include<conio.h>
#include<stdio.h>
#include<stdlib.h>
#include<ctype.h>
using namespace std;
```

```
void searchFirst(int n, int i, char pl[], char r[], char result[], int k)
{
	int j,flag;
	for(j=i+1;j<n;j++)
	{
		if(r[i]==pl[j])
		{
			if(isupper(r[j]))
			{
				searchFirst(n,j,pl,r,result,k);
			}
			if(islower(r[j]) || r[j]== '+' || r[j]=='*' || r[j]==')' || r[j]=='(')
			{
				result[k++]=r[j];
				result[k++]=','; flag=0;
			}
		}
	}
	if(flag==0)
	{
		for(j=0;j<k-1;j++)cout<<result[j];
	}
}
int main()
{
char pr[10][10],pl[10],r[10],prev,result[10];
	int i,n,k,j;
	cout<<"\nHow many production rule : ";
	cin>>n;
	if(n==0) exit(0);
	for(i=0;i<n;i++)
	{
		cout<<"\nInput left part of production rules : ";
		cin>>pl[i];
		cout<<"\nInput right part of production rules : ";
		cin>>pr[i];
		r[i]=pr[i][0];
	}
	cout<<"\nProduction Rules are : \n";
	for(i=0;i<n;i++)
	{
		cout<<pl[i]<<"->"<<pr[i]<<"\n";//<<";"<<r[i]<<"\n";
	}
```

```
	cout<<"\n----O U T P U T---\n\n";
	prev=pl[0];k=0;
	for(i=0;i<n;i++)
	{
		if(prev!=pl[i])
		{
			cout<<"\nFIRST("<<prev<<")={";
			for(j=0;j<k-1;j++)cout<<result[j];
			cout<<"}";
			k=0;prev=pl[i];
			//cout<<"\n3";
		}
		if(prev==pl[i])
		{
			if(islower(r[i]) || r[i]== '+' || r[i]=='*' || r[i]==')' || r[i]=='('
			{
				result[k++]=r[i];
				result[k++]=',';
			}
			if(isupper(r[i]))
			{
				cout<<"\nFIRST("<<prev<<")={";
				searchFirst(n,i,pl,r,result,k);
				cout<<"}";
				k=0;prev=pl[i+1];
			}
		}
	}
	if(i==n)
	{
		cout<<"\nFIRST("<<prev<<")={";
		for(j=0;j<k-1;j++)cout<<result[j];
		cout<<"}";
		k=0;prev=pl[i];
	}
return 0;
}
```

OUTPUT: -



Result: The Program Executed successfully.

EXPERIMENT 5

Computation of FOLLOW in a grammar

Aim: Write a program in C/C++ to find a FOLLOW set from a given set of production rule.

Algorithm:

1. Declare the variables.
2. Enter the production rules for the grammar.
3. Calculate the FOLLOW set for each element call the user defined function follow().
4. If x->aBb
    a. If x is start symbol then FOLLOW(x)={$}.
    b. If b is NULL then FOLLOW(B)=FOLLOW(x).
    c. If b is not NULL then FOLLOW(B)=FIRST(b).

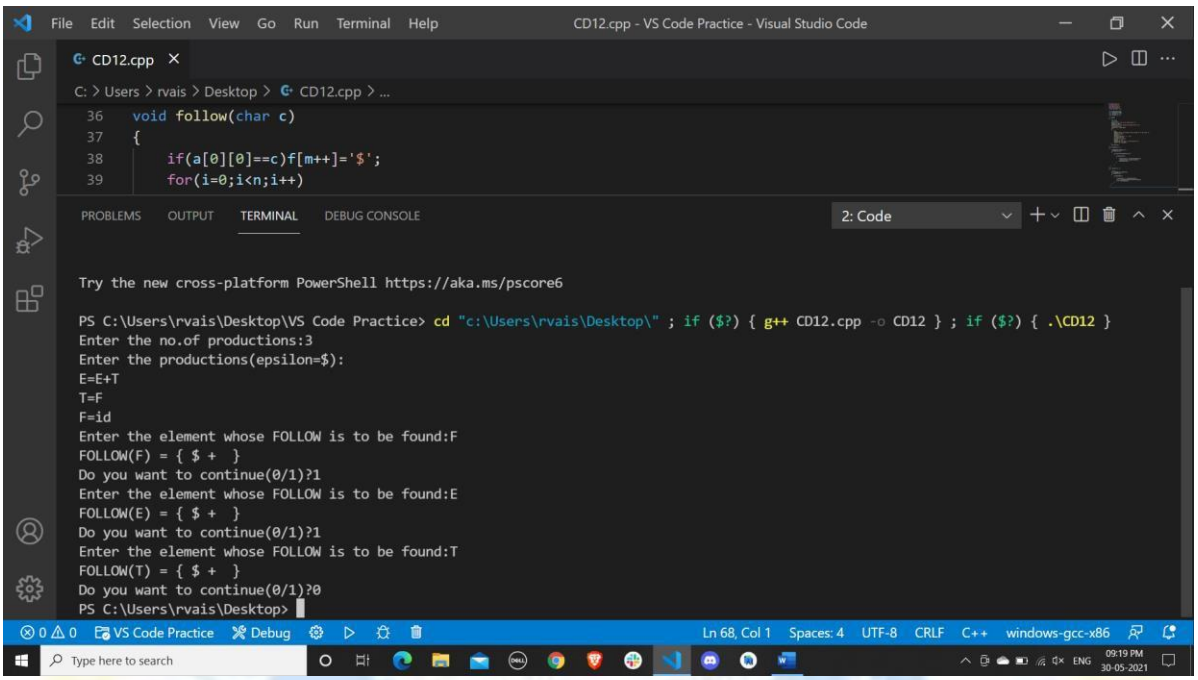
   END.

Program:

```
#include<stdio.h>
#include<conio.h>
#include<string.h>
#include<ctype.h>
using namespace std;

int  n,m=0,p,i=0,j=0;
char a[10][10],f[10];
void  follow(char  c);
void first(char c);

int main()
{
   int i,z;
   char c,ch;
   printf("Enter the no.of productions:");
   scanf("%d",&n);
   printf("Enter the productions(epsilon=$):\n");
   for(i=0;i<n;i++)
   scanf("%s%c",a[i],&ch);
   do
   {
      m=0;
      printf("Enter the element whose FOLLOW is to be found:");
```

```
        scanf("%c",&c);
        follow(c);
        printf("FOLLOW(%c) = { ",c);
        for(i=0;i<m;i++)
        printf("%c ",f[i]);
        printf(" }\n");
        printf("Do you want to continue(0/1)?");
        scanf("%d%c",&z,&ch);
    }
    while(z==1);
}
void follow(char c)
{
    if(a[0][0]==c)f[m++]='$';
    for(i=0;i<n;i++)
    {
        for(j=2;j<strlen(a[i]);j++)
        {
            if(a[i][j]==c)
            {
                if(a[i][j+1]!='\0')first(a[i][j+1]);
                if(a[i][j+1]=='\0'&&c!=a[i][0])
                follow(a[i][0]);
            }

        }
    }
}
void first(char c)
{
    int k;
    if(!(isupper(c)))f[m++]=c;
    for(k=0;k<n;k++)
    {
        if(a[k][0]==c)
        {
            if(a[k][2]=='$') follow(a[i][0]);
            else if(islower(a[k][2]))f[m++]=a[k][2];
            else first(a[k][2]);
        }
     }
  }
```

OUTPUT: -



Result: The Program Executed successfully.

EXPERIMENT 6

Computation of Predictive Parsing

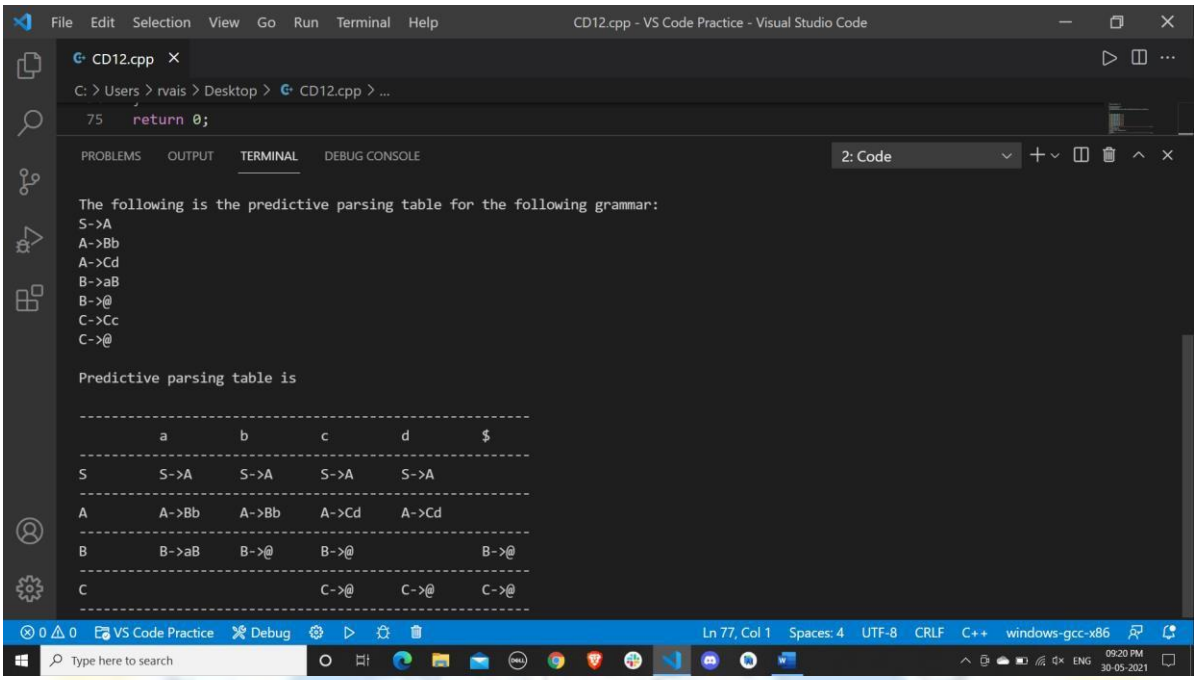
Aim: Write a program in c for construction of predictive parser table.

Program:

```
#include<stdio.h>
#include<conio.h>
#include<string.h>
using namespace std;
char prol[7][10] ={"S","A","A","B","B","C","C"};
char pror [7][10] ={"A","Bb","Cd","aB","@","Cc","@"};
char prod [7][10] ={"S->A","A->Bb","A->Cd","B->aB","B->@","C->Cc","C-
>@"}; char
first [7][10] ={"abcd","ab","cd","a@","@","c@","@"}; char
follow [7][10] ={"$","$","$","a$","b$","c$","d$"};
char table [5][6][10];
int numr (char c)
{
switch(c)
{
case 'S': return 0;
case 'A': return 1;
case 'B': return 2;
case 'C': return 3;
case 'a': return 0;
case 'b': return 1;
case 'c': return 2;
case 'd': return 3;
case '$': return 4;
}
return (2);
}
int main ()
{
int i,j,k;
for (i=0; i<5; i++)
for (j=0; j<6; j++)
strcpy(table[i][j]," ");
printf ("\nThe following is the predictive parsing table for the following
grammar:\n");
for (i=0; i<7; i++)
```

```
printf ("%s\n",prod[i]);
printf ("\nPredictive parsing table is\n");
fflush (stdin);
for (i=0; i<7; i++)
{
k=strlen(first[i]);
for (j=0; j<10; j++)
if(first[i][j] !='@')
strcpy(table[numr(prol[i][0])+1][numr(first[i][j])+1],prod[i]);
}

for(i=0;i<7;i++)
{
        if(strlen(pror[i])==1)
        {
                if(pror[i][0]=='@')
                {
                        k=strlen(follow[i]);
                        for(j=0;j<k;j++)
                strcpy(table[numr(prol[i][0])+1][numr(follow[i][j])+1],prod[i]);
                }
        }
}
strcpy(table[0][0]," ");
strcpy(table[0][1],"a");
strcpy(table[0][2],"b");
strcpy(table[0][3],"c");
strcpy(table[0][4],"d");
strcpy(table[0][5],"$");
strcpy(table[1][0],"S");
strcpy(table[2][0],"A");
strcpy(table[3][0],"B");
strcpy(table[4][0],"C");
printf("\n----------\n");
for(i=0;i<5;i++)
for(j=0;j<6;j++){
printf("%-10s",table[i][j]);
if(j==5)
printf("\n----------\n");
}
return 0;
}
```

OUTPUT:



Result: The Program Executed successfully.

EXPERIMENT 7

Computation of Shift Reduce Parsing

Aim: Write a program in C/C++ to implement the shift reduce parsing.

Algorithm:

1. Start the Process.
2. Symbols from the input are shifted onto stack until a handle appears on top of the stack.
3. The Symbols that are the handle on top of the stack are then replaces by the left-hand side of the production (reduced).
4. If this result in another handle on top of the stack, then another reduction is done, otherwise we go back to shifting.
5. This combination of shifting input symbols onto the stack and reducing productions when handles appear on the top of the stack continues until all of the input is consumed and the goal symbol is the only thing on the stack - the input is then accepted.
6. If we reach the end of the input and cannot reduce the stack to the goal symbol, the input is rejected.
7. Stop the process.

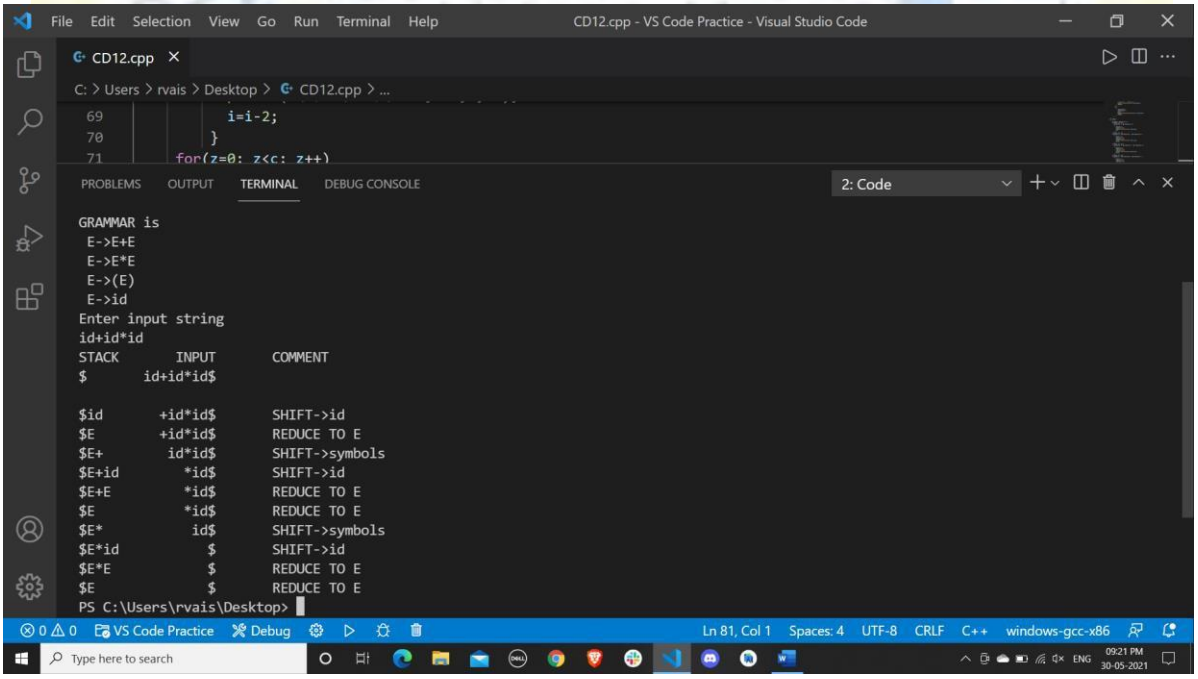
Program (srp.cpp):

```
#include<stdio.h>
#include<string.h>
int k=0,z=0,i=0,j=0,c=0;
char a[16],ac[20],stk[15],act[10];
void check();

int main()
  {

    puts("GRAMMAR is \n E->E+E \n E->E*E \n E->(E) \n E->id");
    puts("Enter input string ");
    gets(a);
    c=strlen(a);
    strcpy(act,"SHIFT->");
    puts("STACK \t    INPUT \tCOMMENT");
    //puts("$    \t");
    //puts(a);
    printf("$    \t%s$\n",a);
```

```
for(k=0,i=0; j<c; k++,i++,j++)
      {
       if(a[j]=='i' && a[j+1]=='d')
         {
           stk[i]=a[j];
           stk[i+1]=a[j+1];
           stk[i+2]='\0';
           a[j]=' ';
           a[j+1]=' ';
           //printf("$    \t%s$\n",a);
           printf("\n$%s\t%s$\t%sid",stk,a,act);
           check();
         }
       else
         {
           stk[i]=a[j];
           stk[i+1]='\0';
           a[j]=' ';
           printf("\n$%s\t%s$\t%ssymbols",stk,a,act);
           check();
         }
      }
  }
void check()
  {
    strcpy(ac,"REDUCE TO E");
    for(z=0; z<c; z++)
     if(stk[z]=='i' && stk[z+1]=='d')
       {
         stk[z]='E';
         stk[z+1]='\0';
         printf("\n$%s\t%s$\t%s",stk,a,ac);
         j++;
       }
    for(z=0; z<c; z++)
    if(stk[z]=='E' && stk[z+1]=='+' && stk[z+2]=='E')
       {
         stk[z]='E';
         stk[z+1]='\0';
         stk[z+2]='\0';
         printf("\n$%s\t%s$\t%s",stk,a,ac);
         i=i-2;
       }
```

```
    for(z=0; z<c; z++)
      if(stk[z]=='E' && stk[z+1]=='*' && stk[z+2]=='E')
        {
          stk[z]='E';
          stk[z+1]='\0';
          stk[z+1]='\0';
          printf("\n$%s\t%s$\t%s",stk,a,ac);
          i=i-2;
        }
    for(z=0; z<c; z++)
    if(stk[z]=='(' && stk[z+1]=='E' && stk[z+2]==')')
        {
          stk[z]='E';
          stk[z+1]='\0';
          stk[z+1]='\0';
          printf("\n$%s\t%s$\t%s",stk,a,ac);
          i=i-2;
        }
  }
```

OUTPUT:



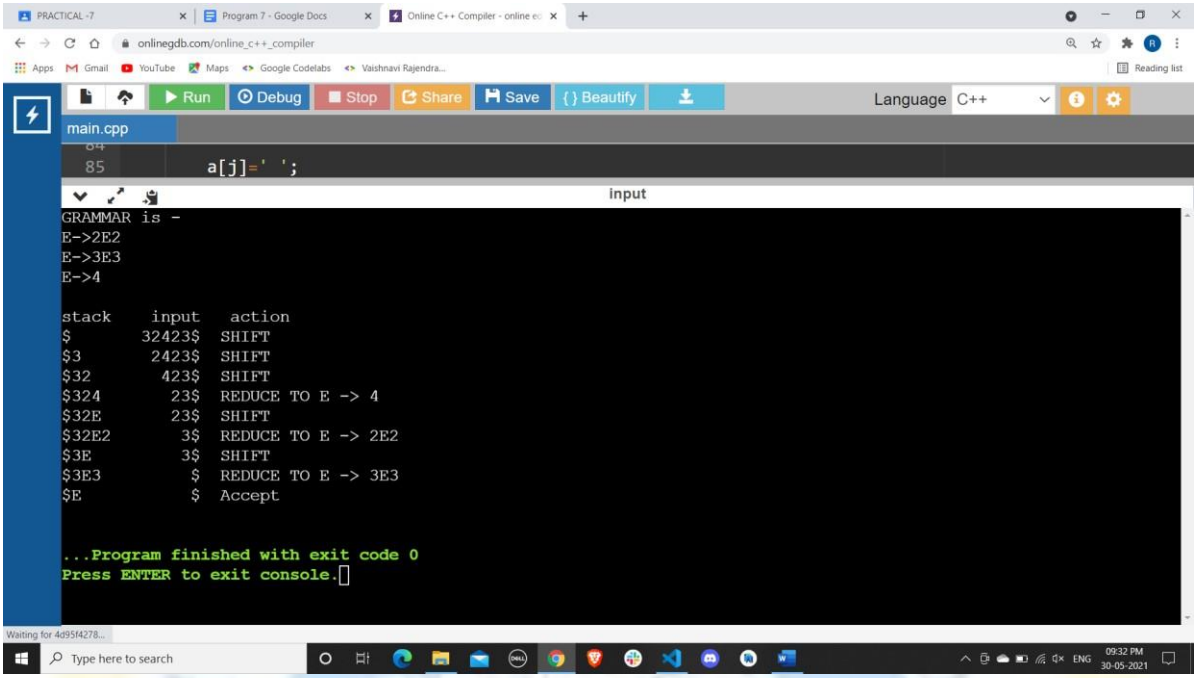
Code for another Grammar: -

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

```
int z = 0, i = 0, j = 0, c = 0;
char a[16], ac[20], stk[15], act[10];

void check()
{
      strcpy(ac,"REDUCE TO E -> ");


   for(z = 0; z < c; z++)
   {
         if(stk[z] == '4')
      {
         printf("%s4", ac);
         stk[z] = 'E';
         stk[z + 1] = '\0';

         printf("\n$%s\t%s$\t", stk, a);
      }
   }

   for(z = 0; z < c - 2; z++)
   {
      if(stk[z] == '2' && stk[z + 1] == 'E' &&
                        stk[z + 2] == '2')
      {
         printf("%s2E2", ac);
         stk[z] = 'E';
         stk[z + 1] = '\0';
         stk[z + 2] = '\0';
         printf("\n$%s\t%s$\t", stk, a);
         i = i - 2;
      }

   }

   for(z=0; z<c-2; z++)
   {

      if(stk[z] == '3' && stk[z + 1] == 'E' &&
                        stk[z + 2] == '3')
      {
         printf("%s3E3", ac);
         stk[z]='E';
```

```
            stk[z + 1]='\0';
            stk[z + 1]='\0';
            printf("\n$%s\t%s$\t", stk, a);
            i = i - 2;
        }
    }
    return; //return to main
}

int main()
{
    printf("GRAMMAR is -\nE->2E2 \nE->3E3 \nE->4\n");

    strcpy(a,"32423");

    c=strlen(a);

    strcpy(act,"SHIFT");

    printf("\nstack \t input \t action");

    printf("\n$\t%s$\t", a);

    for(i = 0; j < c; i++, j++)
    {
        printf("%s", act);

        stk[i] = a[j];
        stk[i + 1] = '\0';

        a[j]=' ';

         printf("\n$%s\t%s$\t", stk, a);

        check();
    }
    check();
         if(stk[0] == 'E' && stk[1] == '\0')
        printf("Accept\n");
    else //else reject
        printf("Reject\n");
}
```

OUTPUT:



Result: The Program Executed successfully.

EXPERIMENT 8

Computation of leading and trailing.

Aim: Write a program for finding the leading and trailing.

Program:

```
#include<iostream>
#include<string.h>
using namespace std;
int nt,t,top=0;
char s[50],NT[10],T[10],st[50],l[10][10],tr[50][50];
int searchnt(char a)
{
        int count=-1,i;
        for(i=0;i<nt;i++)
        {
                if(NT[i]==a)
                return i;
        }
return count;
}

int searchter(char a)
{
        int count=-1,i;
        for(i=0;i<t;i++)
        {
                if(T[i]==a)
                return i;
        }
return count;
}

void push(char a)
{
        s[top]=a;
        top++;
}
char pop()
{
        top--;
        return s[top];
```

```
}
```

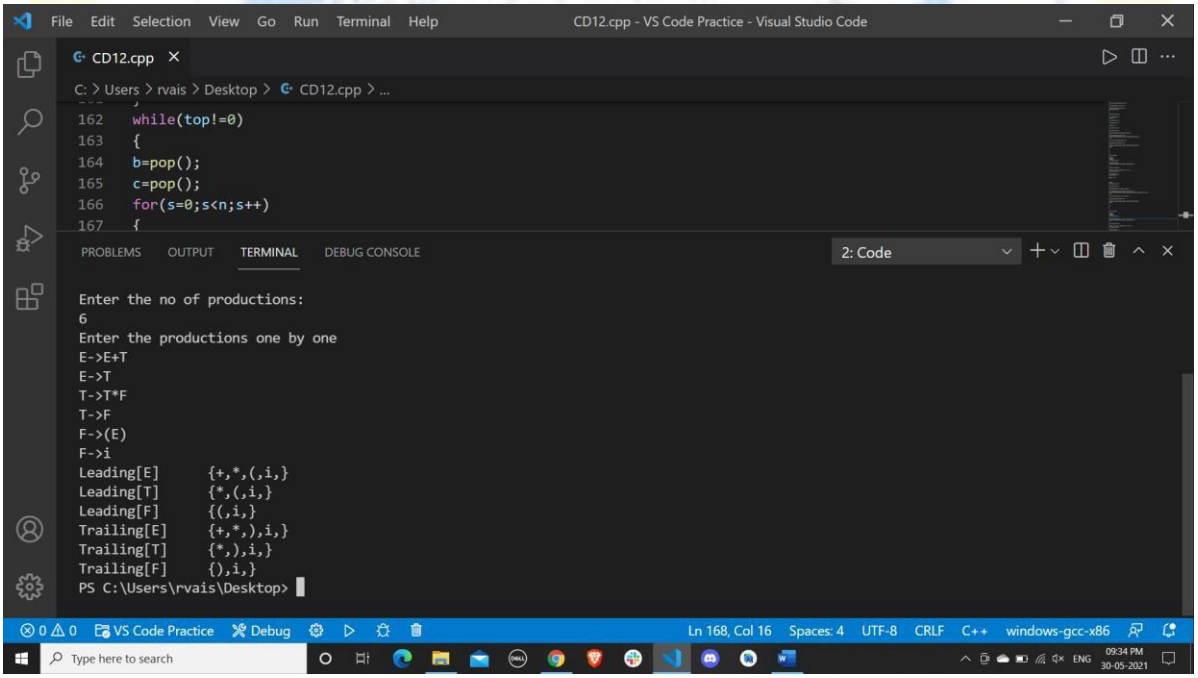
```
void installl(int a,int b)
{
	if(l[a][b]=='f')
	{
		l[a][b]='t';
		push(T[b]);
		push(NT[a]);
	}
}
void installt(int a,int b)
{
	if(tr[a][b]=='f')
	{
		tr[a][b]='t';
		push(T[b]);
		push(NT[a]);
	}
}

int main()
{
	int i,s,k,j,n;
	char pr[30][30],b,c;

	cout<<"Enter the no of productions:\n";
	cin>>n;
	cout<<"Enter the productions one by one\n";
	for(i=0;i<n;i++)
	cin>>pr[i];
	nt=0;
	t=0;
	for(i=0;i<n;i++)
	{
		if((searchnt(pr[i][0]))==-1)
		NT[nt++]=pr[i][0];
	}
	for(i=0;i<n;i++)
	{
		for(j=3;j<strlen(pr[i]);j++)
		{
			if(searchnt(pr[i][j])==-1)
			{
				if(searchter(pr[i][j])==-1)
```

```
                        T[t++]=pr[i][j];
                }
        }
}
for(i=0;i<nt;i++)
{
        for(j=0;j<t;j++)
                l[i][j]='f';
}
for(i=0;i<nt;i++)
{
        for(j=0;j<t;j++)

        tr[i][j]='f';
}
for(i=0;i<nt;i++)
{
        for(j=0;j<n;j++)
        {
                if(NT[(searchnt(pr[j][0]))]==NT[i])
                {
                        if(searchter(pr[j][3])!=-1)
                        installl(searchnt(pr[j][0]),searchter(pr[j][3]));
                        else
                        {
                                for(k=3;k<strlen(pr[j]);k++)
                                {
                                        if(searchnt(pr[j][k])==-1)
                                        {
                                installl(searchnt(pr[j][0]),searchter(pr[j][k]));
                                break;
                                        }
                                }
                        }
                }
        }
}
while(top!=0)
{
        b=pop();
        c=pop();
        for(s=0;s<n;s++)
        {
```

```
        if(pr[s][3]==b)
        installl(searchnt(pr[s][0]),searchter(c));
        }
}
for(i=0;i<nt;i++)
{
        cout<<"Leading["<<NT[i]<<"]"<<"\t{";
        for(j=0;j<t;j++)
        {
                if(l[i][j]=='t')
                cout<<T[j]<<",";
        }
        cout<<"}\n";
}


top=0;
for(i=0;i<nt;i++)
{
        for(j=0;j<n;j++)
        {
                if(NT[searchnt(pr[j][0])]==NT[i])
                {
                        if(searchter(pr[j][strlen(pr[j])-1])!=-1)
                        installt(searchnt(pr[j][0]),searchter(pr[j][strlen(pr[j])-1]));
                        else
                        {
                                for(k=(strlen(pr[j])-1);k>=3;k--)
                                {
                                        if(searchnt(pr[j][k])==-1)
                                        {
                                        installt(searchnt(pr[j][0]),searchter(pr[j][k]));
                                        break;
                                        }
                                }
                        }
                }
        }
}
while(top!=0)
{
        b=pop();
        c=pop();
```

```
        for(s=0;s<n;s++)
        {
                if(pr[s][3]==b)
                installt(searchnt(pr[s][0]),searchter(c));
        }
}
for(i=0;i<nt;i++)
{
        cout<<"Trailing["<<NT[i]<<"]"<<"\t{";
        for(j=0;j<t;j++)
        {
                if(tr[i][j]=='t')
                cout<<T[j]<<",";
        }
        cout<<"}\n";
}

}
```

OUTPUT:



Result: The Program Executed successfully.

EXPERIMENT 9

Implementation of 3-Address Code using Quadruple

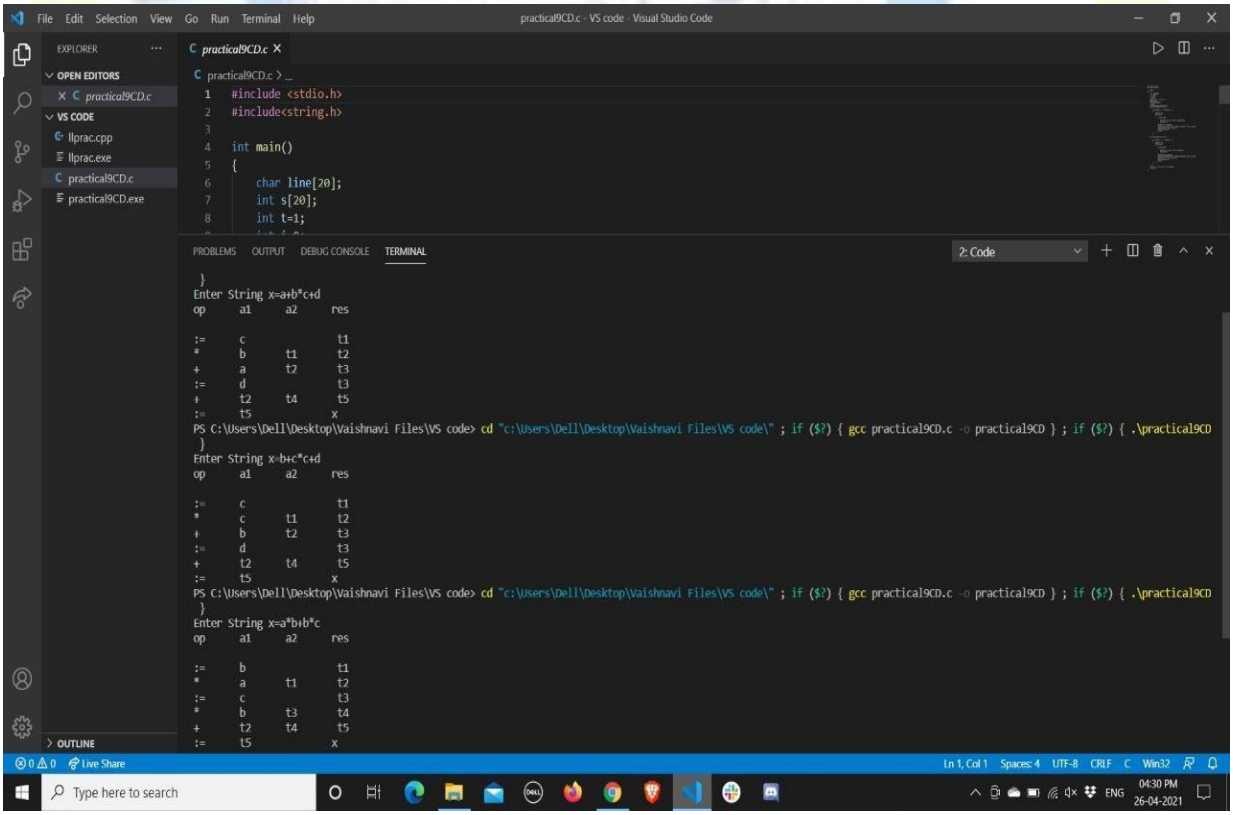
Aim: Write a program to implement 3-Address Code using Quadruple.

Program:

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

int main()
{
   char line[20];
   int s[20];
   int t=1;
   int i=0;
   printf("Enter String ");
   gets(line);
   for(i=0;i<20;i++)
   s[i]=0;
   printf("op\ta1\ta2\tres\n");
   for(i=2;line[i]!='\0';i++)
   {
      if(line[i]=='/' || line[i]=='*')
      {
         printf("\n");
         if(s[i]==0)
         {
            if(s[i+1]==0)
            {
               printf(":=\t%c\t\t t%d\n",line[i+1],t);
               s[i+1]=t++;
            }
            printf("%c\t",line[i]);
            (s[i-1]==0)?printf("%c\t",line[i-1]):printf("t%d\t",s[i-1]);
            printf("t%d \t t%d",s[i+1],t);
            s[i-1]=s[i+1]=t++;
            s[i]=1;
         }
      }
   }
   for(i=2;line[i]!='\0';i++)
   {
```

```
        if(line[i]=='+' || line[i]=='-')
        {
           printf("\n");
           if(s[i]==0)
           {
              if(s[i+1]==0)
              {
                 printf(":=\t%c\t\t t%d\n",line[i+1]);
                 s[i+1]=t++;
              }
              printf("%c\t",line[i]);
              (s[i-1]==0)?printf("%c\t",line[i-1]):printf("t%d\t",s[i-1]);
              printf("t%d \t t%d",s[i+1],t);
              s[i-1]=s[i+1]=t++;
              s[i]=1;
           }
        }
     }
     printf("\n:=\tt%d\t\t%c",t-1,line[0]);
     return 0;
}
```

OUTPUT:



Result: The Program Executed successfully.

EXPERIMENT 10

Intermediate Code Generation

Aim: Write a program in C/C++ to generate intermediate code from a given syntax tree statement.

Algorithm:

1. Start the process.
2. Input an expression EXP from user.
3. Process the expression from right hand side to left hand side.
4. FLAG:=0; TOP = -1;
5. IF EXP = '=' then
    i. IF EXP(index – 1) = 0 then
        1. PRINT EXP element from index to (index – 1) and POP STACK[TOP]. Terminate

   Else
    i. PRINT Wrong Expression

   [EndIF]

   IF an operator is found and FLAG = 0 then
    i. TOP:= TOP + 1
    ii. add to STACK[TOP].
    iii. FLAG:=1

   Else
    i. pop twice the STACK and result add to the newID(identifier) and PRINT.
    ii. TOP:=TOP-2. Save newID to STACK[TOP]
    iii. FLAG:=0

   [EndIF]

6. IF an operand is found then
    i. TOP:=TOP+1
    ii. move to STACK [TOP]
    iii. IF TOP > 1 then
        1. pop twice the STACK and result add to the newID(identifier) and PRINT.
        2. TOP:=TOP-2. Save newID to STACK[TOP]
        3. FLAG:=0

   [End]
7. End the process

Program (icgen.cpp):

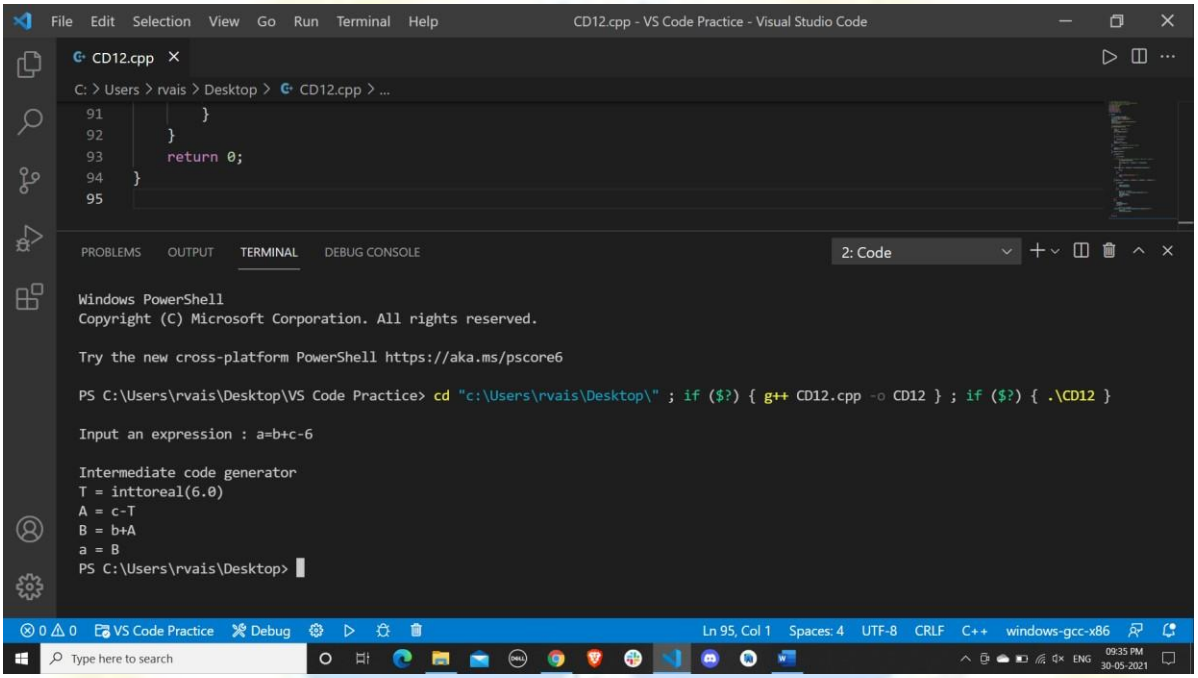
```
/* Intermediate Code Generator */
// Here consideration is any input expression
// only contain digits at the end
#include<iostream>
#include<stdio.h>
#include<conio.h>
#include<string.h>
#include<ctype.h>
using namespace std;

int main()
{
	char g,exp[20],stack[20];
	int m=0,i,top=-1,flag=0,len,j;
	cout<<"\nInput an expression : ";
	gets(exp);
	cout<<"\nIntermediate code generator\n";
	len=strlen(exp);

	//If expression contain digits
	if(isdigit(exp[len-1]))
	{
		cout<<"T = inttoreal(";
		i=len-1;
		while(isdigit(exp[i]))
		{
			i--;
		}
		for(j=i+1;j<len;j++)
		{
			cout<<exp[j];
		}
		cout<<".0)\n";
		exp[i+1]='T';len=i+2;
	}
	else	//If expression having no digit
	{
		cout<<"T = "<<exp[len-1]<<"\n";
		exp[len-1]='T';
	}
	for(i=len-1;i>=0;i--)
	{
```

```
if(exp[i]=='=')
{
        if((i-1)==0)
        {
// If expression contains unary operator in RHS near = operator
                if(isalpha(stack[top]))
                {
                cout<<exp[i-1]<<" "<<exp[i]<<" "<<stack[top];
                }
                else
                {
cout<<exp[i-1]<<" "<<exp[i]<<""<<stack[top]<<stack[top-1];
                }
                break;
        }
        else
        {
                cout<<"\nWrong Expression !!!";
                break;
        }
}

if(exp[i]=='+'||exp[i]=='/'||exp[i]=='*'||exp[i]=='-'||exp[i]=='%')
{
        if(flag==0)
        {
                flag=1;top=top+1;
                stack[top]=exp[i];
        }
        else
        {
                g=char('A' + m);m++;
                cout<<g<<" = "<<stack[top]<<stack[top-1]<<"\n";
                stack[top-1]=g;
                stack[top]=exp[i];
                flag=0;
        }
}
else
{

        top=top+1;
        stack[top]=exp[i];
        if(top>1)
```

{

```
                    g=char('A' + m);m++;
            cout<<g<<" = "<<stack[top]<<stack[top-1]<<stack[top-2]<<"\n";
                    top=top-2;
                    stack[top]=g;flag=0;
                }
            }
        }
        return 0;
}
```

OUTPUT:



Result: The Program Executed successfully

EXPERIMENT 11

Intermediate code generation - Postfix expression

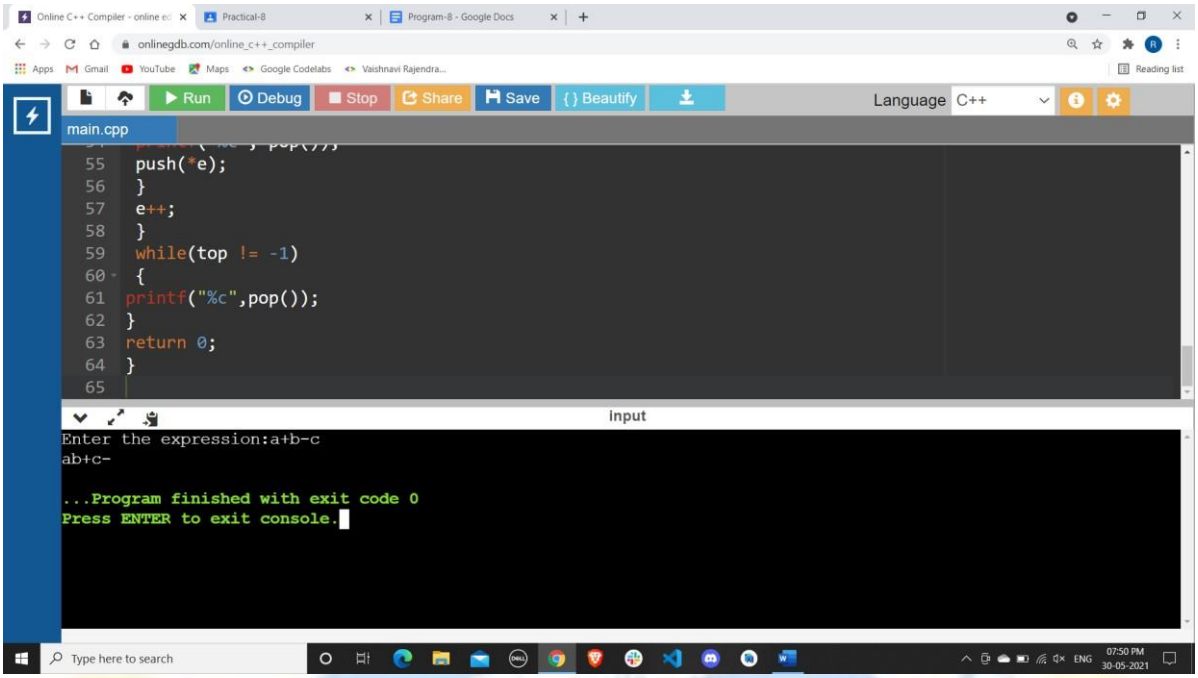
Aim: Write a program in C/C++ or Java to generate Intermediate Code (Postfix Expression) from given syntax tree.

Program:

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

using namespace std;

 char stack[20];
 int top=-1;
void push(char x)
   {
      stack[++top]=x;
   }
char pop()
{
   if(top==-1)
   {
   return -1;
   }
   else
   {
      return stack[top--];
   }
}

//Check the priority of the operator.

int priority(char x)
{
   if(x == '(')
   return 0;
   if(x == '+' || x == '-')
   return 1;
   if(x == '*' || x == '/')
   return 2;
```

```
 }

int main()
{
   char exp[20];
   char *e , x;
   printf("Enter the expression:");
   scanf("%s",exp);
    e = exp ;
 while(*e != '\0')
 {
   if(isalnum(*e))
   printf("%c",*e);
   else if(*e == '(')
   push(*e);
   else if(*e == ')' )
 {
   while(( x =pop() ) != '(' )
   printf("%c:",x);
 }
 else
 {

 //check greater priority operator.

 while(priority(stack[top]) >= priority(*e) )
 printf("%c", pop());
 push(*e);
 }
 e++;
 }
 while(top != -1)
{
        printf("%c",pop());
}

return 0;

}
```

OUTPUT:



Result: The Program Executed successfully

EXPERIMENT 12

Intermediate code generation - Prefix Expression

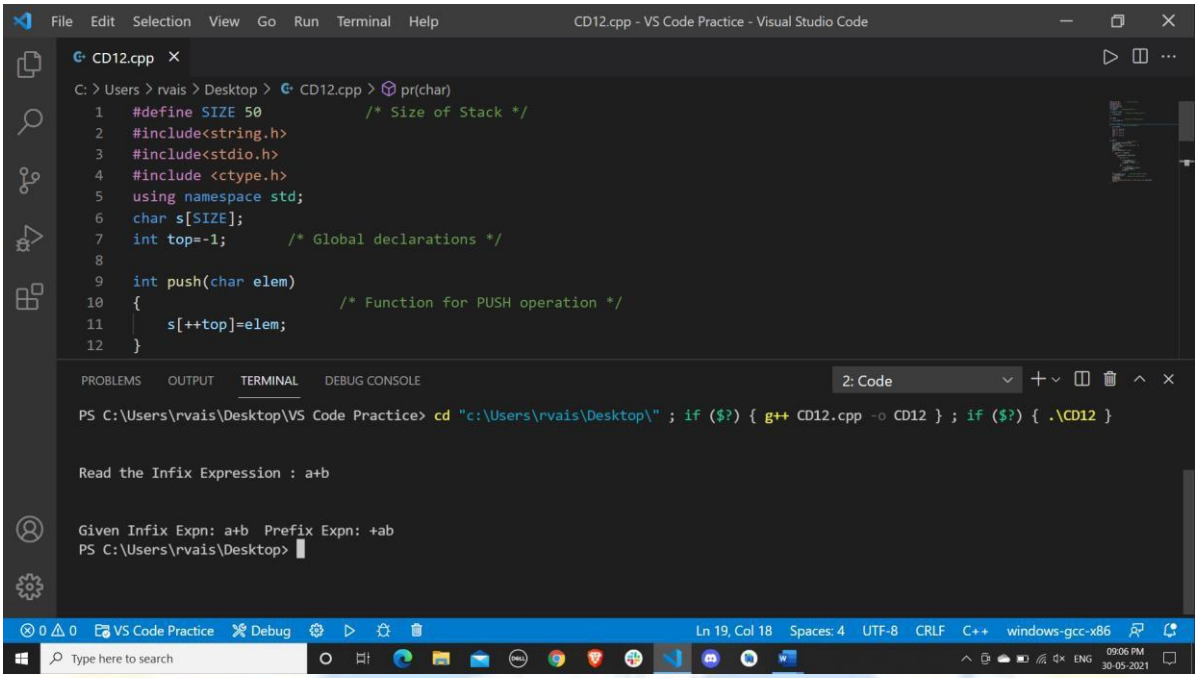
Aim: Write a program in C/C++ or Java to generate Intermediate Code (Prefix Expression) from given syntax tree.

Program:

```
#define SIZE 50            /* Size of Stack */
#include<string.h>
#include<stdio.h>
#include <ctype.h>

using namespace std;
char s[SIZE];
int top=-1;       /* Global declarations */

push(char elem)
{                    /* Function for PUSH operation */
   s[++top]=elem;
}

char pop()
{                    /* Function for POP operation */
   return(s[top--]);
}

int pr(char elem)
{                /* Function for precedence */
   switch(elem)
   {
   case '#': return 0;
   case ')': return 1;
   case '+':
   case '-': return 2;
   case '*':
   case '/': return 3;
   }
}
```

```
int main()
{                       /* Main Program */
   char infx[50],prfx[50],ch,elem;
   int i=0,k=0;
   printf("\n\nRead the Infix Expression : ");
   scanf("%s",infx);
   push('#');
   strrev(infx);

   while( (ch=infx[i++]) != '\0')
   {
      if( ch == ')') push(ch);
      else
         if(isalnum(ch)) prfx[k++]=ch;
         else
            if( ch == '(')
            {
               while( s[top] != ')')
                  prfx[k++]=pop();
               elem=pop(); /* Remove ) */
            }
            else
            {       /* Operator */
               while( pr(s[top]) >= pr(ch) )
                  prfx[k++]=pop();
               push(ch);
            }
   }

   while( s[top] != '#')     /* Pop from stack till empty */
      prfx[k++]=pop();
   prfx[k]='\0';          /* Make prfx as valid string */

   strrev(prfx);
   strrev(infx);
   printf("\n\nGiven Infix Expn: %s  Prefix Expn: %s\n",infx,prfx);

   return 0;
}
```

OUTPUT:



Result: The Program Executed successfully.

EXPERIMENT 13

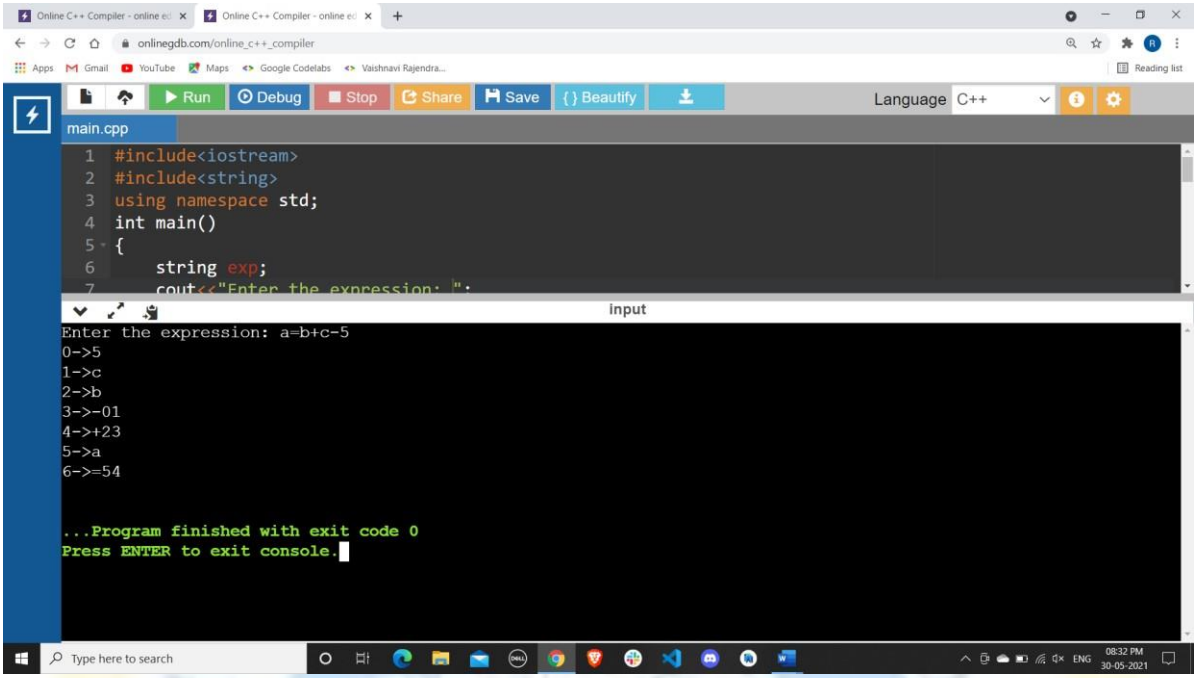
Construction of DAG

Aim: Write a c or c++ or java to Construct DAG for input expression.

Program:

```
#include<iostream>
#include<string>
using namespace std;
int main()
{
	string exp;
	cout<<"Enter the expression:-";
	cin>>exp;
	int j=0,k=0;
	char q;
	for(int i=exp.length()-1;i>1;i--)
	{
		if(islower(exp[i]) || (exp[i]>=48 && exp[i]<=57))
		{
			cout<<j<<"->"<<exp[i]<<endl;
			j++;
		}
	}
	for(int i=exp.length()-1;i>1;i--)
	{
		if(!(islower(exp[i])|| (exp[i]>=48 && exp[i]<=57)))
		{
			cout<<j<<"->"<<exp[i]<<k<<k+1<<endl;
			j++;
			k+=2;
		}
	}
	cout<<j<<"->"<<exp[0]<<endl;
	j++;
	cout<<j<<"->"<<exp[1]<<j-1<<j-2<<endl;
	return 0;
}
```

OUTPUT:



Result: The Program Executed successfully.

EXPERIMENT 14

Recursive Descent Parsing

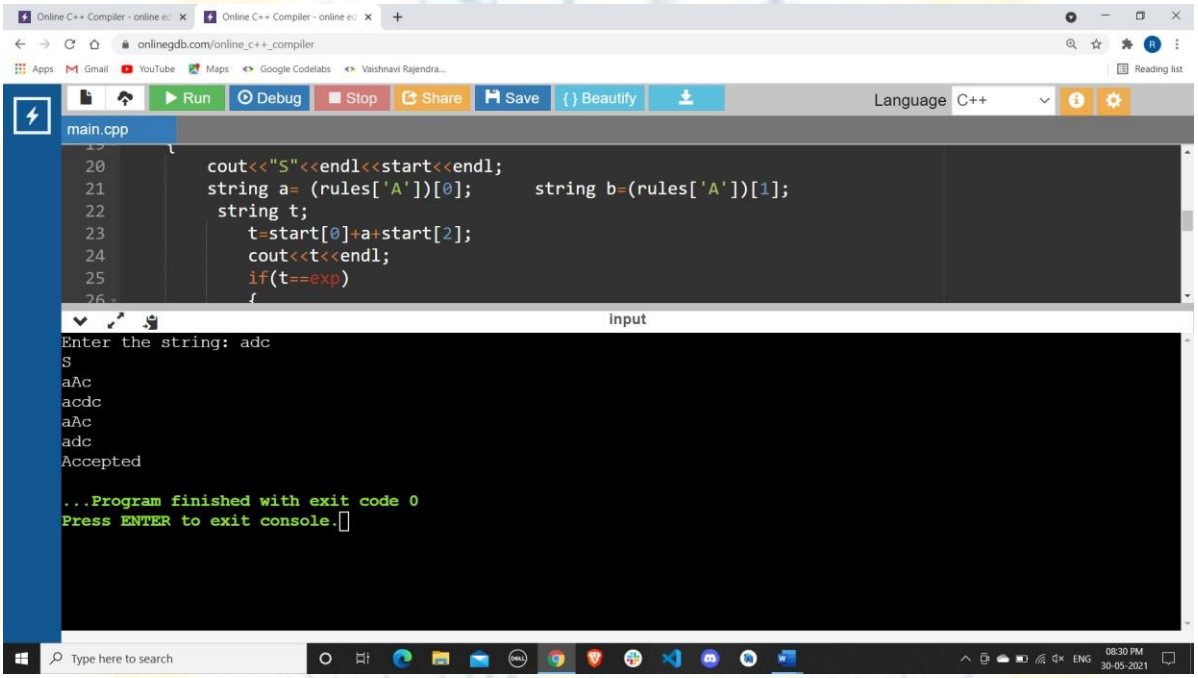
Aim: Write a program in C/ C++ or Java to implement Recursive Descent Parsing.

Program:

```
#include<iostream>
#include<map>
#include<vector>
using namespace std;
int main()
{
	int flag = 0;
	map<char,vector<string> >rules;
	string exp,test;
	rules['S'].push_back("aAc");
	rules['A'].push_back("cd");
	rules['A'].push_back("d");
	cout<<"Enter the string: ";
	cin>>exp;
	string  start="aAc";
	if(start[0]!=exp[0])
		cout<<"Not Accepted";
	else
	{
		cout<<"S"<<endl<<start<<endl;
		string a= (rules['A'])[0];		string b=(rules['A'])[1];
		 string t;
			t=start[0]+a+start[2];
			cout<<t<<endl;
			if(t==exp)
			{
				flag = 1;
				cout<<"Accepted";
			}
			else
			{
				cout<<start<<endl;
			 t=start[0]+b+start[2];
			cout<<t<<endl;
```

```
                    if(t==exp)
                    {
                        flag = 1;
                        cout<<"Accepted";
                    }
                    }
        }
        if(flag == 0) cout<<"Not accepted";
        return 0;
}
```

OUTPUT:



Result: The Program Executed successfully