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Experiment 4 - Left Recursion and Left Factoring

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CSE A2

Experiment 4a

Aim:
A program for Elimination of Left Recursion

Algorithm:
1. Start the program.
2. Initialize the arrays for taking input from the user.
3. Prompt the user to input the no. of non-terminals having left recursion and no. of productions for these non-terminals.
4. Prompt the user to input the production for non-terminals.
5. Eliminate left recursion using the following rules:-
   A->Aα1| Aα2 | . . . . . |Aαm
   A->β1| β2| . . . . .| βn
   Then replace it by
   A-> βi A' i=1,2,3,…..m
   A'-> αj A' j=1,2,3,…..n
   A'-> Ɛ
6. After eliminating the left recursion by applying these rules, display the productions without left recursion.
7. Stop.

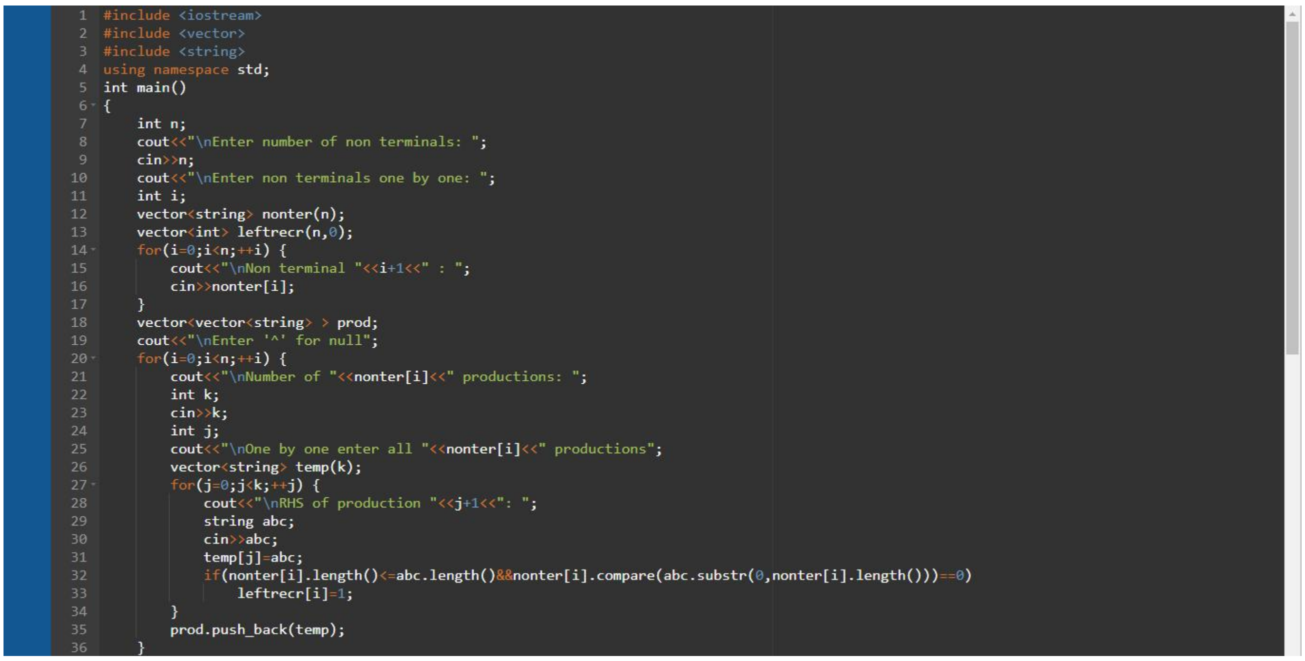
Code:

```
#include <iostream>
#include <vector>
#include <string>
using namespace std;
int main()
{
   int n;
   cout<<"\nEnter number of non terminals: ";
   cin>>n;
   cout<<"\nEnter non terminals one by one: ";
   int i;
   vector<string> nonter(n);
   vector<int> leftrecr(n,0);
```

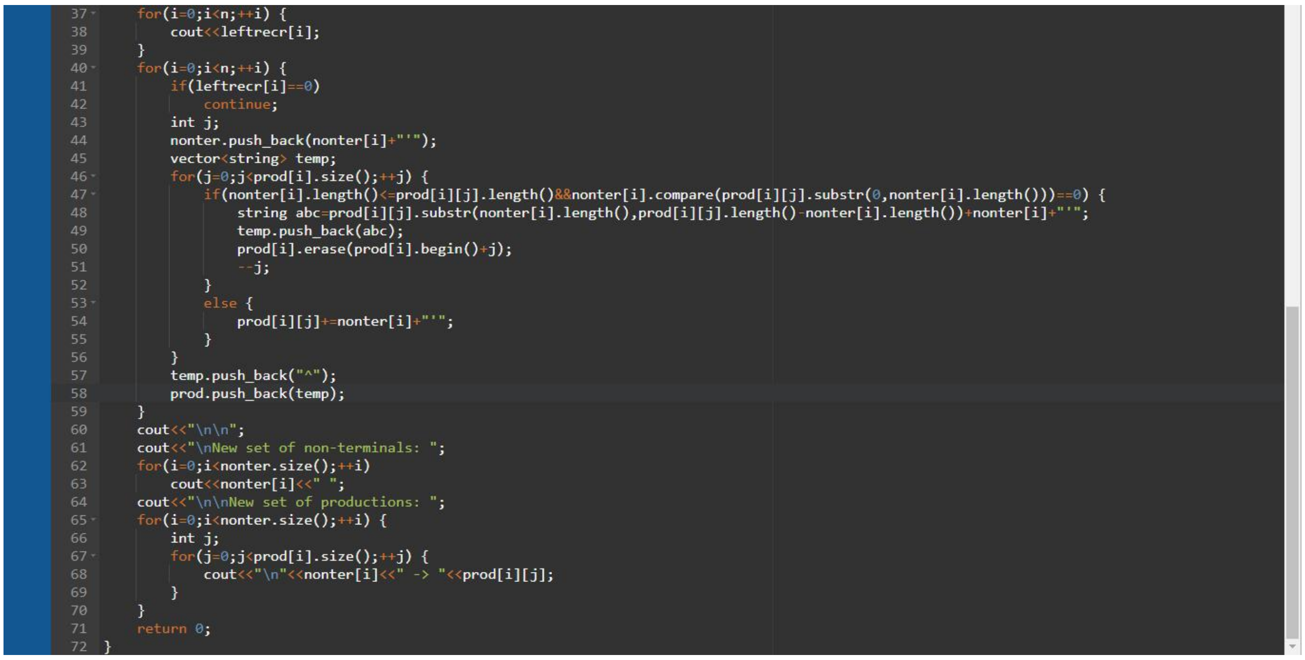
```
    for(i=0;i<n;++i) {
        cout<<"\nNon terminal "<<i+1<<" : ";
        cin>>nonter[i];
    }
    vector<vector<string> > prod;
    cout<<"\nEnter '^' for null";
    for(i=0;i<n;++i) {
        cout<<"\nNumber of "<<nonter[i]<<" productions: ";
        int k;
        cin>>k;
        int j;
        cout<<"\nOne by one enter all "<<nonter[i]<<" productions";
        vector<string> temp(k);
        for(j=0;j<k;++j) {
            cout<<"\nRHS of production "<<j+1<<": ";
            string abc;
            cin>>abc;
            temp[j]=abc;

if(nonter[i].length()<=abc.length()&&nonter[i].compare(abc.substr(0,nonter[i].length()))==0)
                leftrecr[i]=1;
        }
        prod.push_back(temp);
    }
    for(i=0;i<n;++i) {
        cout<<leftrecr[i];
    }
    for(i=0;i<n;++i) {
        if(leftrecr[i]==0)
            continue;
        int j;
        nonter.push_back(nonter[i]+"'");
        vector<string> temp;
        for(j=0;j<prod[i].size();++j) {

if(nonter[i].length()<=prod[i][j].length()&&nonter[i].compare(prod[i][j].substr(0,nonter[i].le
ngth()))==0) {
                string abc=prod[i][j].substr(nonter[i].length(),prod[i][j].length()-
nonter[i].length())+nonter[i]+"'";
                temp.push_back(abc);
                prod[i].erase(prod[i].begin()+j);
                --j;
            }
            else {
                prod[i][j]+=nonter[i]+"'";
            }
        }
        temp.push_back("^");
        prod.push_back(temp);
    }
    cout<<"\n\n";
    cout<<"\nNew set of non-terminals: ";
    for(i=0;i<nonter.size();++i)
        cout<<nonter[i]<<" ";
    cout<<"\n\nNew set of productions: ";
    for(i=0;i<nonter.size();++i) {
        int j;
        for(j=0;j<prod[i].size();++j) {
            cout<<"\n"<<nonter[i]<<" -> "<<prod[i][j];
        }
    }
    return 0;
}
```

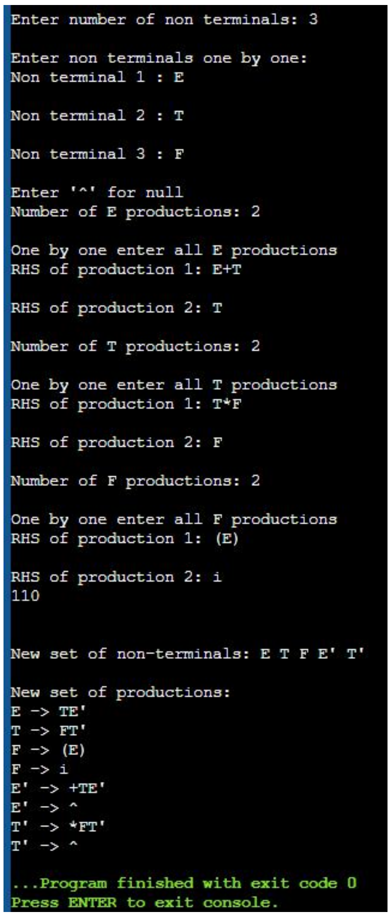


```
#include <iostream>
#include <vector>
#include <string>
using namespace std;
int main()
{
    int n;
    cout<<"\nEnter number of non terminals: ";
    cin>>n;
    cout<<"\nEnter non terminals one by one: ";
    int i;
    vector<string> nonter(n);
    vector<int> leftrecr(n,0);
    for(i=0;i<n;++i) {
        cout<<"\nNon terminal "<<i+1<<" : ";
        cin>>nonter[i];
    }
    vector<vector<string> > prod;
    cout<<"\nEnter '^' for null";
    for(i=0;i<n;++i) {
        cout<<"\nNumber of "<<nonter[i]<<" productions: ";
        int k;
        cin>>k;
        int j;
        cout<<"\nOne by one enter all "<<nonter[i]<<" productions";
        vector<string> temp(k);
        for(j=0;j<k;++j) {
            cout<<"\nRHS of production "<<j+1<<": ";
            string abc;
            cin>>abc;
            temp[j]=abc;
            if(nonter[i].length()<=abc.length()&&nonter[i].compare(abc.substr(0,nonter[i].length()))==0)
                leftrecr[i]=1;
        }
        prod.push_back(temp);
    }
```



```cpp
    for(i=0;i<n;++i) {
        cout<<leftrecr[i];
    }
    for(i=0;i<n;++i) {
        if(leftrecr[i]==0)
            continue;
        int j;
        nonter.push_back(nonter[i]+"'");
        vector<string> temp;
        for(j=0;j<prod[i].size();++j) {
            if(nonter[i].length()<=prod[i][j].length()&&nonter[i].compare(prod[i][j].substr(0,nonter[i].length()))==0) {
                string abc=prod[i][j].substr(nonter[i].length(),prod[i][j].length()-nonter[i].length())+nonter[i]+"'";
                temp.push_back(abc);
                prod[i].erase(prod[i].begin()+j);
                --j;
            }
            else {
                prod[i][j]+=nonter[i]+"'";
            }
        }
        temp.push_back("^");
        prod.push_back(temp);
    }
    cout<<"\n\n";
    cout<<"\nNew set of non-terminals: ";
    for(i=0;i<nonter.size();++i)
        cout<<nonter[i]<<" ";
    cout<<"\n\nNew set of productions: ";
    for(i=0;i<nonter.size();++i) {
        int j;
        for(j=0;j<prod[i].size();++j) {
            cout<<"\n"<<nonter[i]<<" -> "<<prod[i][j];
        }
    }
    return 0;
}
```

Output:



```
Enter number of non terminals: 3

Enter non terminals one by one:
Non terminal 1 : E

Non terminal 2 : T

Non terminal 3 : F

Enter '^' for null
Number of E productions: 2

One by one enter all E productions
RHS of production 1: E+T

RHS of production 2: T

Number of T productions: 2

One by one enter all T productions
RHS of production 1: T*F

RHS of production 2: F

Number of F productions: 2

One by one enter all F productions
RHS of production 1: (E)

RHS of production 2: i
110


New set of non-terminals: E T F E' T'

New set of productions:
E -> TE'
T -> FT'
F -> (E)
F -> i
E' -> +TE'
E' -> ^
T' -> *FT'
T' -> ^

...Program finished with exit code 0
Press ENTER to exit console.
```

Result:

A program for Elimination of Left Recursion was run successfully.

Experiment 4b

Aim:
A program for implementation Of Left Factoring

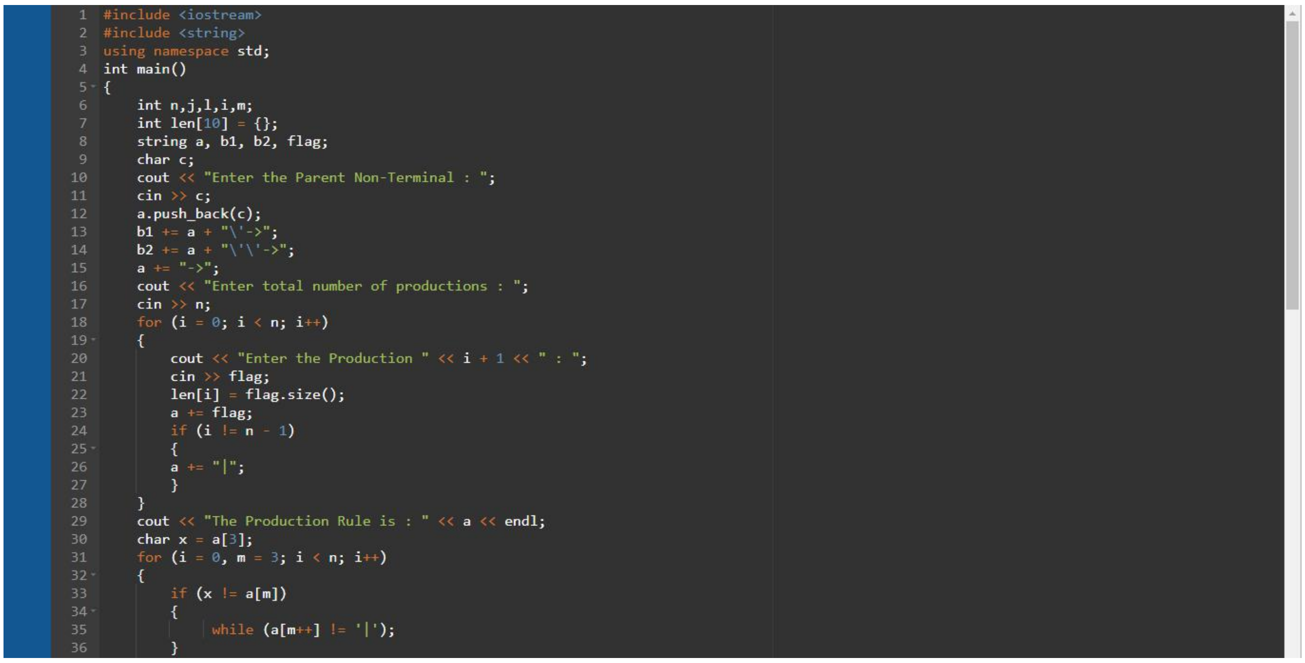
Algorithm:
1. Start
2. Ask the user to enter the set of productions
3. Check for common symbols in the given set of productions by comparing with:
   A->aB1|aB2
4. If found, replace the particular productions with:
   A->aA’
   A’->B1 | B2|ε
5. Display the output
6. Exit

Code:

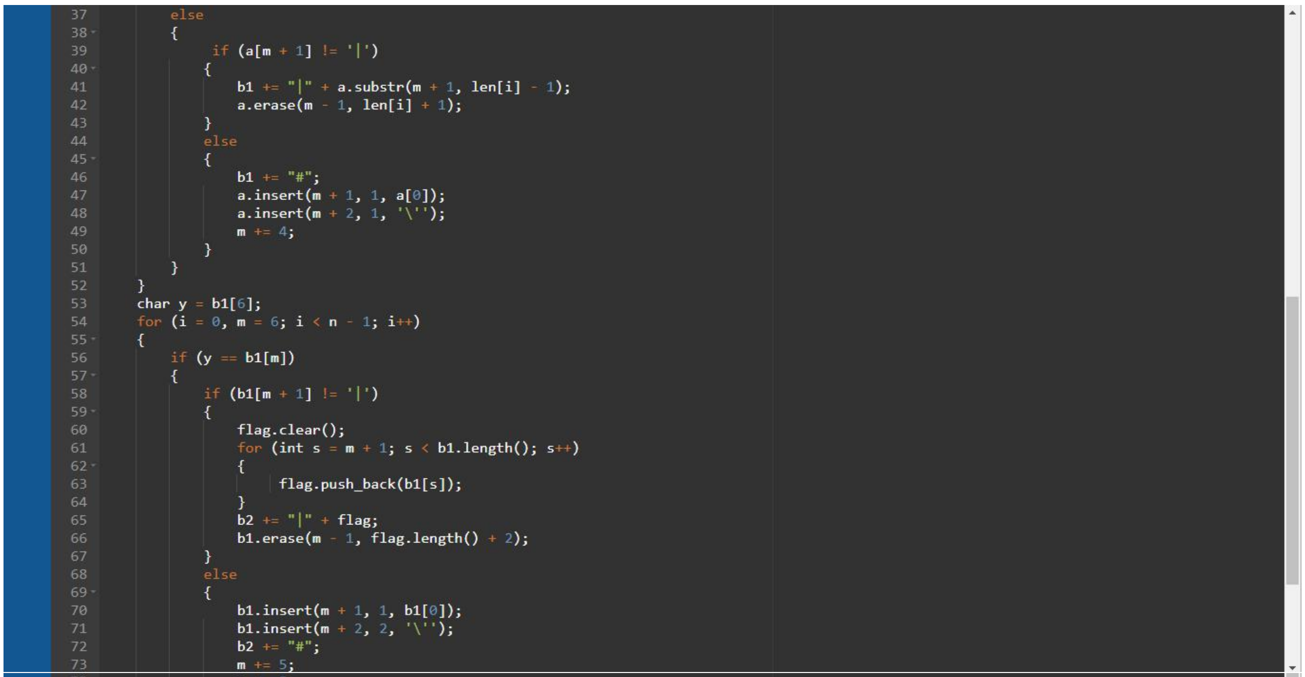
```
#include <iostream>
#include <string>
using namespace std;
int main()
{
        int n,j,l,i,m;
        int len[10] = {};
  string a, b1, b2, flag;
  char c;
  cout << "Enter the Parent Non-Terminal : ";
  cin >> c;
  a.push_back(c);
  b1 += a + "\'->";
  b2 += a + "\'\'->";
  a += "->";
  cout << "Enter total number of productions : ";
  cin >> n;
  for (i = 0; i < n; i++)
  {
    cout << "Enter the Production " << i + 1 << " : ";
    cin >> flag;
    len[i] = flag.size();
    a += flag;
    if (i != n - 1)
    {
```

```
    a += "|";
                }
}
cout << "The Production Rule is : " << a << endl;
char x = a[3];
for (i = 0, m = 3; i < n; i++)
{
    if (x != a[m])
    {
         while (a[m++] != '|');
    }
    else
    {
         if (a[m + 1] != '|')
        {
            b1 += "|" + a.substr(m + 1, len[i] - 1);
            a.erase(m - 1, len[i] + 1);
        }
        else
        {
        b1 += "#";
            a.insert(m + 1, 1, a[0]);
            a.insert(m + 2, 1, '\'');
            m += 4;
        }
    }
}
char y = b1[6];
for (i = 0, m = 6; i < n - 1; i++)
{
    if (y == b1[m])
    {
        if (b1[m + 1] != '|')
        {
            flag.clear();
            for (int s = m + 1; s < b1.length(); s++)
            {
                 flag.push_back(b1[s]);
                                    }
            b2 += "|" + flag;
            b1.erase(m - 1, flag.length() + 2);
        }
        else
```

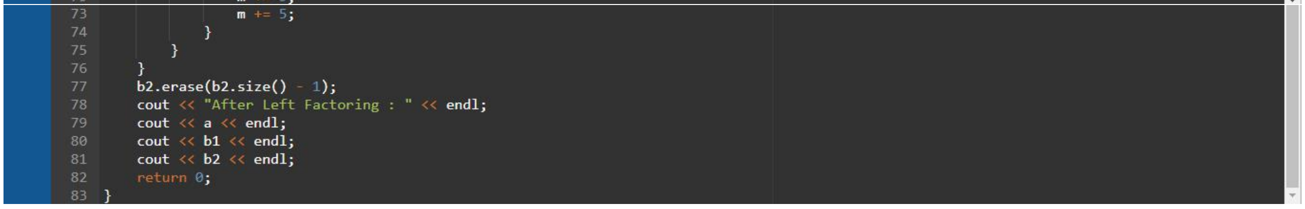
```
            {
            b1.insert(m + 1, 1, b1[0]);
                b1.insert(m + 2, 2, '\'');
                b2 += "#";
                m += 5;
            }
        }
    }
    b2.erase(b2.size() - 1);
    cout << "After Left Factoring : " << endl;
    cout << a << endl;
    cout << b1 << endl;
    cout << b2 << endl;
    return 0;
}
```



```
#include <iostream>
#include <string>
using namespace std;
int main()
{
    int n,j,l,i,m;
    int len[10] = {};
    string a, b1, b2, flag;
    char c;
    cout << "Enter the Parent Non-Terminal : ";
    cin >> c;
    a.push_back(c);
    b1 += a + "\'->";
    b2 += a + "\'\'->";
    a += "->";
    cout << "Enter total number of productions : ";
    cin >> n;
    for (i = 0; i < n; i++)
    {
        cout << "Enter the Production " << i + 1 << " : ";
        cin >> flag;
        len[i] = flag.size();
        a += flag;
        if (i != n - 1)
        {
        a += "|";
        }
    }
    cout << "The Production Rule is : " << a << endl;
    char x = a[3];
    for (i = 0, m = 3; i < n; i++)
    {
        if (x != a[m])
        {
            while (a[m++] != '|');
        }
```

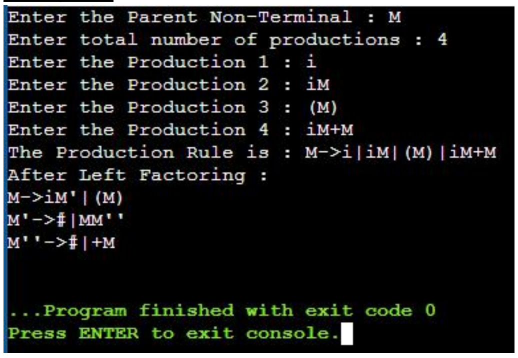


```
        else
        {
            if (a[m + 1] != '|')
            {
                b1 += "|" + a.substr(m + 1, len[i] - 1);
                a.erase(m - 1, len[i] + 1);
            }
            else
            {
                b1 += "#";
                a.insert(m + 1, 1, a[0]);
                a.insert(m + 2, 1, '\'');
                m += 4;
            }
        }
    }
    char y = b1[6];
    for (i = 0, m = 6; i < n - 1; i++)
    {
        if (y == b1[m])
        {
            if (b1[m + 1] != '|')
            {
                flag.clear();
                for (int s = m + 1; s < b1.length(); s++)
                {
                    flag.push_back(b1[s]);
                }
                b2 += "|" + flag;
                b1.erase(m - 1, flag.length() + 2);
            }
            else
            {
                b1.insert(m + 1, 1, b1[0]);
                b1.insert(m + 2, 2, '\'');
                b2 += "#";
                m += 5;
```



```
                m += 5;
            }
        }
    }
    b2.erase(b2.size() - 1);
    cout << "After Left Factoring : " << endl;
    cout << a << endl;
    cout << b1 << endl;
    cout << b2 << endl;
    return 0;
}
```

Output:



```
Enter the Parent Non-Terminal : M
Enter total number of productions : 4
Enter the Production 1 : i
Enter the Production 2 : iM
Enter the Production 3 : (M)
Enter the Production 4 : iM+M
The Production Rule is : M->i|iM|(M)|iM+M
After Left Factoring :
M->iM'|(M)
M'->#|MM''
M''->#|+M


...Program finished with exit code 0
Press ENTER to exit console.
```

Result:

A program for implementation Of Left Factoring was compiled and run successfully