EX NO 2

Conversion from Regular Expression to NFA

AIM: To write a program for converting Regular Expression to ε-NFA

CODE:

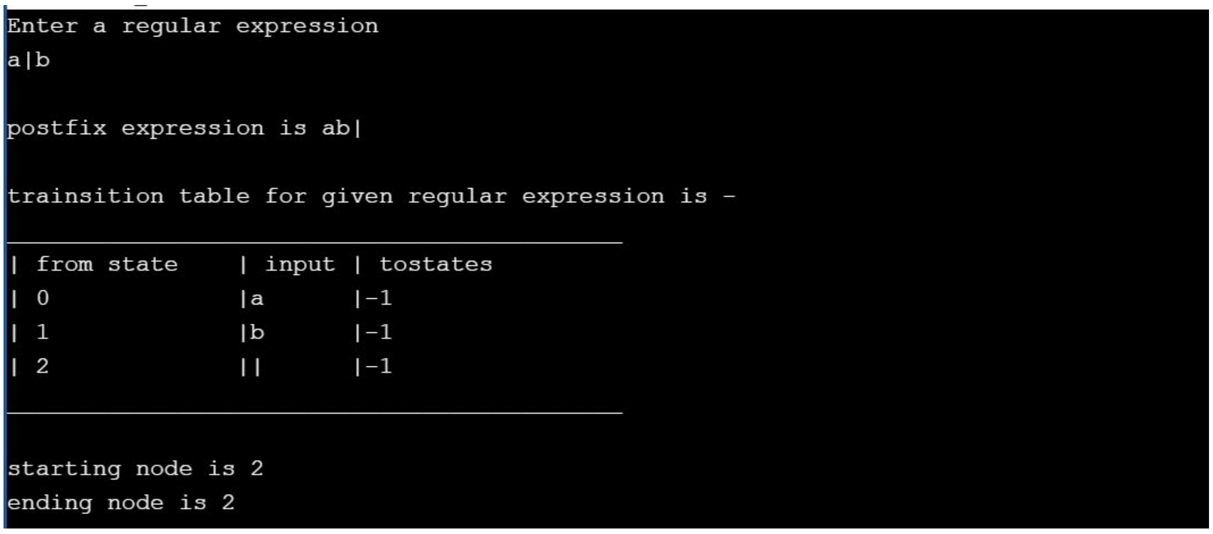
```
#include<iostream>
#include<stack>
#include<string>
#include <algorithm>
#include<vector>

using namespace std;

class node{
public:
        char input;
        int to;
        node *next;
};



int prec(char c){
        if(c=='*'){
                return 3;
        }else if(c=='.'){
                return 2;
        }else if(c=='+'){
                return 1;
        }else{
                return -1;
        }
}



string post(string s)
{
   stack<char> st;
   st.push('N');
   int l = s.length();
   string ns;
```

```
    for(int i = 0; i < l; i++)
    {
        if((s[i] >= 'a' && s[i] <= 'z')||(s[i] >= 'A' && s[i] <= 'Z')){
                ns+=s[i];
        }

        else if(s[i] == '('){
                st.push('(');
        }
        else if(s[i] == ')')
        {
            while(st.top() != 'N' && st.top() != '(')
            {
                char c = st.top();
                st.pop();
               ns += c;
            }
            if(st.top() == '(')
            {
                char c = st.top();
                st.pop();
            }
        }
        else{
            while(st.top() != 'N' && prec(s[i]) <= prec(st.top()))
            {
                char c = st.top();
                st.pop();
                ns += c;
            }
            st.push(s[i]);
        }

    }
    while(st.top() != 'N')
    {
        char c = st.top();
        st.pop();
        ns += c;
    }
return ns;
}

void printnode(vector<node*> v){
	cout<<"____________________________________________"<<endl;
	cout<<"| from state\t| input\t| tostates"<<endl;
	for(int i=0;i<v.size();i++){
		cout<<"| "<<i<<"         \t|";
		node* head = v[i];
		cout<<head->input;
		bool first = true;
		while(head!=NULL){
			if (first)
			{
				cout<<"     \t|";
				first = false;
			}else{
				cout<<"     \t";
			}
			cout<<head->to;
			head = head->next;
		}
		cout<<endl;
		// cout<<"\t\t\t\t\t\t|"<<endl;
	}
	cout<<"____________________________________________"<<endl;
}



node* makenode(char in){
	node* a = new node;
	a->input = in;
	a->to = -1;
	a->next = NULL;
	return a;
}

node* copynode(node* a){
	node* b = new node;
	b->input = -1;
	b->to = -1;
	b->next =NULL;
	return b;
}
```

```
void andd(vector<node*> &v,vector<vector<int> > &st){
        int x,y;
        int first,last1;
        y = st[st.size()-1][0];
        x = st[st.size()-2][1];
        first = st[st.size()-2][0];
        last1 = st[st.size()-1][1];

        st.pop_back();
        st.pop_back();

        vector<int> ptemp;
        ptemp.push_back(first);
        ptemp.push_back(last1);
        st.push_back(ptemp);

        node* last = v[y];
        node * lnode= v[x];
        node* temp = copynode(last);
        // temp->to = -1;
        while(lnode->next!=NULL){
                lnode = lnode->next;
        }
        lnode->next = temp;
        lnode->to = y;

}

void orr(vector<node*> &v,vector<vector<int> > &st){
        int x,y,x1,y1;
        x = st[st.size()-2][0];
        y = st[st.size()-1][0];
        x1 = st[st.size()-2][1];
        y1 = st[st.size()-1][1];
        node* start = makenode('e');
        node* end = makenode('e');
        v.push_back(start);
        int firstnode = v.size() -1;
        v.push_back(end);
        int endnode = v.size() -1;

        st.pop_back();
        st.pop_back();
        vector<int> ptemp;
        ptemp.push_back(firstnode);
        ptemp.push_back(endnode);
        st.push_back(ptemp);

        for(int i=0;i<v.size()-2;i++){
                node* h=v[i];
                while(h->next!=NULL){
                        if(h->to==x || h->to == y){
                                h->to = firstnode;
                        }
                        h = h->next;
                }
        }


        node* temp = copynode(v[x]);
        node* temp1 = copynode(v[y]);
        node* t = v[firstnode];
        while(t->next!=NULL){
                t = t->next;
        }
        t->to = x;
        t->next  = temp;
        t->next->to = y;
        t->next->next = temp1;

        node* adlink = v[x1];
        while(adlink->next!=NULL){
                adlink = adlink->next;
        }

        adlink->to= endnode;
        adlink->next = copynode(end);

        node* adlink1 = v[y1];
        while(adlink1->next!=NULL){
                adlink1 = adlink1->next;
        }
        adlink1->to = endnode;
        adlink1->next = copynode(end);

}
```

```
void closure(vector<node*> &v, vector<vector<int> > &st){
	int x,x1;
	x = st[st.size()-1][0];
	x1 = st[st.size()-1][1];
	node* s = makenode('e');
	// node* e = makenode('e');
	v.push_back(s);
	int firstnode = v.size() -1;
	// v.push_back(e);
	// int endnode = v.size() -1;
	st.pop_back();
	vector<int> ptemp;
	ptemp.push_back(x);
	ptemp.push_back(firstnode);
	st.push_back(ptemp);

	for(int i=0;i<v.size()-2;i++){
		node* h=v[i];
		while(h->next!=NULL){
			if(h->to==x){
				h->to = firstnode;
			}
			h = h->next;
		}
	}

	// node* strt = v[firstnode];
	// while(strt->next!=NULL){
	//	strt = strt->next;
	// }
	// strt->to = x;
	// strt->next = copynode(v[x]);
	// strt->next->to = endnode;
	// strt->next->next = copynode(v[endnode]);


	node* t = v[x1];
	while(t->next!=NULL){
		t = t->next;
	}
	t->to = x;
	t->next = copynode(t);
	t->next->to = firstnode;
	t->next->next = copynode(s);
}


int main(){
	string in;
	cout<<"Enter a regular expression\n";
	cin>>in;
	string o;
	vector<node*> v;
	o = post(in);
	cout<<"\npostfix expression is "<< o<<endl;
	vector<vector<int>> st;
	int firstnode = 0;
	for(int l =0 ;l<o.length();l++){
		if(o[l] !='+' && o[l]!='*' && o[l]!='.'){
			node* temp = makenode(o[l]);
			v.push_back(temp);
			vector<int> ptemp;
			ptemp.push_back(v.size()-1);
			ptemp.push_back(v.size()-1);
			st.push_back(ptemp);
		}
		else if(o[l]=='.'){
			andd(v,st);
		}
		else if(o[l]=='+'){
			orr(v,st);
		}
		else if(o[l]=='*'){
			closure(v,st);
		}


	}
	cout<<"\ntrainsition table for given regular expression is - \n";
	printnode(v);
	cout<<endl;
	cout<<"starting node is ";
	cout<<st[st.size()-1][0]<<endl;
	cout<<"ending node is ";
	cout<<st[st.size()-1][1]<<endl;
	return 0;
}
```

OUTPUT:



```
Enter a regular expression
a|b

postfix expression is ab|

trainsition table for given regular expression is -
___________________________________________
| from state    | input | tostates
| 0             |a      |-1
| 1             |b      |-1
| 2             ||      |-1
___________________________________________

starting node is 2
ending node is 2
```

RESULT: The program to convert regular expression to ε-NFA was implemented successfully.