#include<stdio.h>

#include<ctype.h>

#include<conio.h>

#include<stdlib.h>

#include<string.h>

#include<iostream.h>

#define epsilon '^'

// since I didn't know how to type epsilon symbol temporily I am using ^

char prod[20][20],T[20],NT[20],c[10][10],foll[10][10],fir[10][10];

int tt,tnt,tp,a;

int follow[20][20],first[20][20];

void first\_of(char);

int count(int j);

void rhs(int j);

void read\_tnt();

int rhs(int j);

void read\_tnt()

{

cout<<"For SLR parser: ";

cout<<"\nEnter number of terminals: ";

cin>>tt;

cout<<"\nEnter terminals: ";

for(int i=0;i<tt;i++)

T[i]=getche();

getch();

cout<<"\nEnter number of Non-terminals: ";

cin>>tnt;

cout<<"\nEnter Non-terminals: ";

for(i=0;i<tnt;i++)

NT[i]=getche();

getch();

}

void read\_prod()

{

int j;

char x=0;

cout<<"\n\nEnter number of productions: ";

cin>>tp;

cout<<"\n Enter productions: ";

for(int i=0;i<tp;i++)

{

j=x=0;

while(x!='\r')

{

prod[i][j]=x=getche();

j++;

}

cout<<"\n";

}

getch();

}

int nt\_no(char n)

{

for(int i=0;i<tnt;i++)

if(NT[i]==n)

return(i);

return(-1);

}

int t\_no(char t)

{

for(int i=0;i<tt;i++)

if(T[i]==t)

return(i);

if(t=='$')

return(tt);

return(-1);

}

int terminal(char x)

{

for(int i=0;i<tt;i++)

if(T[i]==x)

return(1);

return(0);

}

int nonterminal(char x)

{

for(int i=0;i<tnt;i++)

if(NT[i]==x)

return(1);

return(0);

}

int in\_rhs(char \*s,char x)

{

for(int i=0;i<=strlen(s);i++)

if(\*(s+i)==x)

return(i);

return(-1);

}

void find\_first()

{

for(int i=0;i<tnt;i++)

first\_of(NT[i]);

}

void first\_of(char n)

{

int t1,t2,p1,cnt=0,i,j;

char x;

static int over[20];

p1=t\_no(epsilon);

if(terminal(n))

return;

t1=nt\_no(n);

if(over[t1])

return;

over[t1]=1;

for(i=0;i<tp;i++)

{

t1=nt\_no(prod[i][0]);

if(prod[i][0]==n)

{

int k=0;

cnt=count(1);

rhs(i);

while(k<cnt)

{

x=c[i][k];

if(terminal(x))

{

t2=t\_no(x);

first[t1][t2]=1;

break;

}

else

{

t2=nt\_no(x);

first\_of(x);

for(int j=0;j<tt;j++)

if(p1!=j && first[t2][j])

first[t1][j]=1;

if(p1!=-1 && first[t2][p1])

k++;

else

break;

}

}

if(p1!=-1 && k>=cnt)

first[t1][p1]=1;

}

}

}

void follow\_of(char n)

{

int f,t1,t2,p1,t,cnt=0;

char x,beta;

static int over[20];

p1=t\_no(epsilon);

t1=nt\_no(n);

if(over[t1])

return;

over[t1]=1;

if(NT[0]==n)

follow[nt\_no(NT[0])][tt]=1;

for(int i=0;i<tp;i++)

{

rhs(i);

cnt=count(i);

t=in\_rhs(c[i],n);

if(t==-1)

continue;

for(int k=t+1;k<=cnt;k++)

{

rhs(i);

beta=c[i][k];

if(terminal(beta))

{

t2=t\_no(beta);

follow[t1][t2]=1;

break;

}

int bno;

for(int j=0;j<tt;j++)

{

bno=nt\_no(beta);

if((first[bno][j]) && (j!=p1))

follow[t1][j]=1;

}

if((p1!=-1) && (first[bno][p1]==1))

continue;

else if((t==(cnt-1)||(k>=cnt)))

{

follow\_of(prod[i][0]);

t1=nt\_no(prod[i][0]);

for(int l=0;l<=tt+1;l++)

if(follow[t][l])

follow[t1][l]=1;

}

}

}

}

int count(int j)

{

int c1=0;

for(int q=3;prod[j][q]!='\r';q++)

c1++;

return(c1);

}

void rhs(int j)

{

int a,h=0;

a=j;

for(int q=3;prod[j][q]!='\r';q++)

{

c[a][h]=prod[j][q];

h++;

}

}

void find\_follow()

{

for(int i=0;i<tnt;i++)

follow\_of(NT[i]);

}

void show\_follow()

{

int b=0;

a=0;

cout<<"\n\n Follow Table For Grammar: \n";

for(int i=0;i<tnt;i++)

{

b=0;

cout<<"\n FOLLOW ("<<NT[i]<<" )= { ";

for(int j=0;j<tt+1;j++)

if(follow[i][j] && j!=tt)

{

foll[a][b]=T[j];

b++;

cout<<T[j]<<" ";

}

else

if(j==tt)

{

foll[a][b]='$';

b++;

cout<<'$';

}

a++;

cout<<" } ";

}

getch();

}

void show\_first()

{

int b=0;

a=0;

cout<<"\n\n First Table For Grammar: \n";

for(int i=0;i<tnt;i++)

{

b=0;

cout<<"\n FIRST ("<<NT[i]<<" )= { ";

for(int j=0;j<tt+1;j++)

if(first[i][j] && j!=tt)

{

fir[a][b]=T[j];

b++;

cout<<T[j]<<" ";

}

a++;

cout<<" } ";

}

getch();

}

void mainf(void)

{

clrscr();

read\_tnt();

read\_prod();

find\_first();

find\_follow();

show\_follow();

show\_first();

}

To construct parse table:

#include<stdio.h>

#include<conio.h>

#include<string.h>

#include<ctype.h>

#include<stdlib.h>

#include<iostream.h>

#include"c:\tc\bin\SLR.h"

int S=0,i=0,j=0,state[20];

char TNT[15];

struct node

{

int pno,dpos;

};

struct t

{

char s;

int n;

};

struct t1

{

struct t lr[10];

int gr[5];

};

struct t1 action[15];

struct node closure[10][10];

int g[15][10];

int l;

void sclosure(int,int);

int added(int);

int t\_into(char);

void print\_table(int);

void parser(void);

int find\_index(char);

int t\_ino(char);

void pop(void);

void push(char,int);

void find\_closure(int,int);

void SLR(void);

void main()

{

clrscr();

mainf();

getch();

for(int i=0;i<tnt;i++)

TNT[i]=NT[i];

for(int j=0;j<tt;j++)

{

TNT[i]=T[j];

i++;

}

strcat(T,"$");

i=j=0;

SLR();

print\_table(S);

getch();

// clrscr();

// parser();

// getch();

}

void SLR()

{

int clno,no=0,x,y,z,len,cnt=-1,d=0;

closure[i][j].pno=0;

closure[i][j++].dpos=3;

find\_closure(no,3);

sclosure(i,j);

state[i]=j;

S=0;

do

{

cnt++;

z=state[cnt];

for(int k=0;k<tnt+tt;k++)

{

i++;

j=0;d=0;

for(int l=0;l<z;l++)

{

x=closure[cnt][1].pno;

y=closure[cnt][1].dpos;

if(prod[x][y]==TNT[k])

{

d=1;

closure[i][j].pno=x;

closure[i][j++].dpos=++y;

if((y<strlen(prod[x])) && (isupper(prod[x][y])))

find\_closure(x,y);

}

}

if(d==0)

{

i--;

continue;

}

sclosure(i,j);

state[i]=j;

clno=added(i-1);

if(clno==-1)

clno=i;

if(isupper(TNT[k]))

action[cnt].gr[k]=clno;

else

{

action[cnt].lr[k-tnt].s='S';

action[cnt].lr[k-tnt].n=clno;

}

if(added(i-1)!=-1)

i--;

else

{

S++;

for(l=0;l<state[i];l++)

{

if(closure[i][1].pno==0)

{

action[i].lr[tt].s='A';

continue;

}

len=(strlen(prod[closure[i][l].pno])-1);

if(len==closure[i][l].dpos)

{

char v=prod[closure[i][l].pno][0];

int u=nt\_no(v);

for(x=0;x<strlen(foll[u]);x++)

{

int w=t\_ino(foll[u][x]);

action[i].lr[w].s='R';

action[i].lr[w].n=closure[i][l].pno;

}

}

}

}

}

}

while(cnt!=S);

}

void print\_table(int states)

{

int lin=5;

cout<<"\n\n Parser Table: \n";

for(int i=0;i<tt;i++)

cout<<"\t"<<T[i];

cout<<"\t$";

for(i=0;i<tnt;i++)

cout<<"\t"<<NT[i];

cout<<"\n\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\n";

for(i=0;i<=states;i++)

{

gotoxy(l,lin);

cout<<"I"<<i<<"\t";

for(int j=0;j<=tt;j++)

{

if(action[i].lr[j].s!='\x0')

{

if(action[i].lr[j].s=='A')

{

cout<<"Acc";

continue;

}

cout<<action[i].lr[j].s;

cout<<action[i].lr[j].n;

cout<<"\t";

}

else

cout<<"\t";

}

for(j=0;j<tnt;j++)

if(action[i].gr[j])

{

cout<<action[i].gr[j];

cout<<"\t";

}

else

cout<<"\t";

lin++;

cout<<"\n";

}

cout<<"\n\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_";

}

void sclosure(int clno,int prodno)

{

struct node temp;

for(int i=0;i<prodno-1;i++)

{

for(int j=i+1;j<prodno;j++)

{

if(closure[clno][i].pno>closure[clno][j].pno)

{

temp=closure[clno][i];

closure[clno][i]=closure[clno][j];

closure[clno][j]=temp;

}

}

}

for(i=0;i<prodno-1;i++)

{

for(j=i+1;j<prodno;j++)

{

if((closure[clno][i].dpos>closure[clno][j].dpos) &&

(closure[clno][i].pno==closure[clno][j].pno))

{

temp=closure[clno][i];

closure[clno][i]=closure[clno][j];

closure[clno][j]=temp;

}

}

}

}

int added(int n)

{

int d=1;

for(int k=0;k<=n;k++)

{

if(state[k]==state[n+1])

{

d=0;

for(int j=0;j<state[k];j++)

{

if((closure[k][j].pno!=closure[n+1][j].pno) ||

(closure[k][j].dpos!=closure[n+1][j].dpos))

break;

else

d++;

}

if(d==state[k])

return(k);

}

}

return(-1);

}

void find\_closure(int no,int dp)

{

int k;

char temp[5];

if(isupper(prod[no][dp]))

{

for(k=0;k<tp;k++)

{

if(prod[k][0]==prod[no][dp])

{

closure[i][j].pno=k;

closure[i][j++].dpos=3;

if(isupper(prod[k][3])&&

(prod[k][3]!=prod[k][0]))

find\_closure(k,3);

}

}

}

return;

}

int t\_ino(char t)

{

for(int i=0;i<=tt;i++)

if(T[i]==t)

return(i);

return(-1);

}

char pops2;

struct node1

{

char s2;int s1;

};

struct node1 stack[10];

int pops1,top=0;

void parser(void)

{

int r,c;

struct t lr[10];

char t,acc='f',str[10];

cout<<"Enter I/p String To Parse: ";

cin>>str;

strcat(str,"$");

stack[0].s1=0;

stack[0].s2='\n';

cout<<"\n\n STACK";

cout<<"\t\t INPUT";

cout<<"\t\t ACTION";

cout<<"\n =====";

cout<<"\t\t =======";

cout<<"\t\t =======";

i=0;

cout<<"\n";

cout<<stack[top].s1;

cout<<" \t\t\t ";

for(int j=0;j<strlen(str);j++)

cout<<str[j];

do

{

r=stack[top].s1;

c=find\_index(str[i]);

if(c==-1)

cout<<"\n Error! Invalid String!";

return;

}

while(top!=0);

switch(action[r],lr[c].s)

{

case 'S':

{

push(str[i],action[r].lr[c].n);

i++;

cout<<"\t\t\t Shift";

break;

}

case 'R':

{

t=prod[action[r].lr[c].n][3];

do

{

pop();

}

while(pops2!=t);

t=prod[action[r].lr[c].n][0];

r=stack[top].s1;

c=find\_index(t);

push(t,action[r].gr[c-tt-1]);

cout<<"\t\t\t Reduce";

break;

}

case 'A':

{

cout<<"\t\t\t Accept";

cout<<"\n\n\n String accepted";

acc='t';

getch();

return;

}

default:

{

cout<<"\n\n\n Error! String not accepted!";

getch();

exit(0);

}

}

for(j=0;j<=top;j++)

cout<<stack[j].s2<<stack[j].s1;

if(top<4)

cout<<"\t\t\t";

else

cout<<"\t\t";

for(j=i;j<strlen(str);j++)

cout<<str[j];

if(acc=='t')

return;

}

int find\_index(char temp)

{

for(int i=0;i<=tt+tnt;i++)

{

if(i<=tt)

{

if(T[i]==temp)

return(i);

}

else

if(NT[i-tt-1]==temp)

return(i);

}

return(-1);

}

void push(char t2,int t1)

{

++top;

stack[top].s1=t1;

stack[top].s2=t2;

return;

}

void pop(void)

{

pops1=stack[top].s1;

pops2=stack[top].s2;

--top;

return; }