Compiler Design Lab - 6

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Question:
Q1. Write a c program to build a predictive parsing table for the following grammar:

```
E  -> T E'
E' -> + T E' | ε
T  -> F T'
T' -> * F T' | ε
F  -> ( E ) | id
```

Q2. Write a C program that uses the table that you built in Q1 to parse an input 'id + id * id' and output the parse tree for the same.

Code:

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

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

int count,n=0;
char calc_first[10][100];
char calc_follow[10][100];
int m=0;
char production[10][10], first[10];
char f[10];
int k;
char ck;
int e;

int main(int argc,char **argv)
{
        int jm=0;
        int km=0;
        int i,choice;
        char c,ch;
        printf("How many productions ? :");
        scanf("%d",&count);
        printf("\nEnter %d productions in form A=B where A and B are grammar symbols
:\n\n",count);
        for(i=0;i<count;i++)
        {
                scanf("%s%c",production[i],&ch);
        }
        int kay;
        char done[count];
        int ptr = -1;
        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++;
	}
	char ter[10];
	for(k=0;k<10;k++){
		ter[k] = '!';
	}
	int ap,vp,sid = 0;
	for(k=0;k<count;k++){
		for(kay=0;kay<count;kay++){
			if(!isupper(production[k][kay]) && production[k][kay]!= '#' &&
production[k][kay] != '=' && production[k][kay] != '\0'){
				vp = 0;
				for(ap = 0;ap < sid; ap++){
					if(production[k][kay] == ter[ap]){
						vp = 1;
```

```
                                        break;
                                    }
                                }
                                if(vp == 0){
                                    ter[sid] = production[k][kay];
                                    sid ++;
                                }
                            }
                        }
                    }
            ter[sid] = '$';
            sid++;
            printf("\n\t\t\t\t\t\t\t The LL(1) Parsing Table for the above grammer :-");
            printf("\n\t\t\t\t\t\t\t^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^\n");

printf("\n\t\t\t====================================================================
==========================================================\n");
            printf("\t\t\t\t|\t");
            for(ap = 0;ap < sid; ap++){
                printf("%c\t\t",ter[ap]);
            }

printf("\n\t\t\t====================================================================
==========================================================\n");
            char first_prod[count][sid];
            for(ap=0;ap<count;ap++){
                int destiny = 0;
                k = 2;
                int ct = 0;
                char tem[100];
                while(production[ap][k] != '\0'){
                    if(!isupper(production[ap][k])){
                        tem[ct++] = production[ap][k];
                        tem[ct++] = '_';
                        tem[ct++] = '\0';
                        k++;
                        break;
                    }
                    else{
                        int zap=0;
                        int tuna = 0;
                        for(zap=0;zap<count;zap++){
                            if(calc_first[zap][0] == production[ap][k]){
                                for(tuna=1;tuna<100;tuna++){
```

```
                        if(calc_first[zap][tuna] != '!'){
                            tem[ct++] = calc_first[zap][tuna];
                        }
                        else
                            break;
                    }
                break;
                }
            }
            tem[ct++] = '_';
        }
        k++;
    }
    int zap = 0,tuna;
    for(tuna = 0;tuna<ct;tuna++){
        if(tem[tuna] == '#'){
            zap = 1;
        }
        else if(tem[tuna] == '_'){
            if(zap == 1){
                zap = 0;
            }
            else
                break;
        }
        else{
            first_prod[ap][destiny++] = tem[tuna];
        }
    }
}
char table[land][sid+1];
ptr = -1;
for(ap = 0; ap < land ; ap++){
    for(kay = 0; kay < (sid + 1) ; kay++){
        table[ap][kay] = '!';
    }
}
for(ap = 0; ap < count ; ap++){
    ck = production[ap][0];
    xxx = 0;
    for(kay = 0; kay <= ptr; kay++)
        if(ck == table[kay][0])
            xxx = 1;
    if (xxx == 1)
```

```
                continue;
            else{
                ptr = ptr + 1;
                table[ptr][0] = ck;
            }
        }
        for(ap = 0; ap < count ; ap++){
            int tuna = 0;
            while(first_prod[ap][tuna] != '\0'){
                int to,ni=0;
                for(to=0;to<sid;to++){
                    if(first_prod[ap][tuna] == ter[to]){
                        ni = 1;
                    }
                }
                if(ni == 1){
                    char xz = production[ap][0];
                    int cz=0;
                    while(table[cz][0] != xz){
                        cz = cz + 1;
                    }
                    int vz=0;
                    while(ter[vz] != first_prod[ap][tuna]){
                        vz = vz + 1;
                    }
                    table[cz][vz+1] = (char)(ap + 65);
                }
                tuna++;
            }
        }
        for(k=0;k<sid;k++){
            for(kay=0;kay<100;kay++){
                if(calc_first[k][kay] == '!'){
                    break;
                }
                else if(calc_first[k][kay] == '#'){
                    int fz = 1;
                    while(calc_follow[k][fz] != '!'){
                        char xz = production[k][0];
                        int cz=0;
                        while(table[cz][0] != xz){
                            cz = cz + 1;
                        }
                        int vz=0;
```

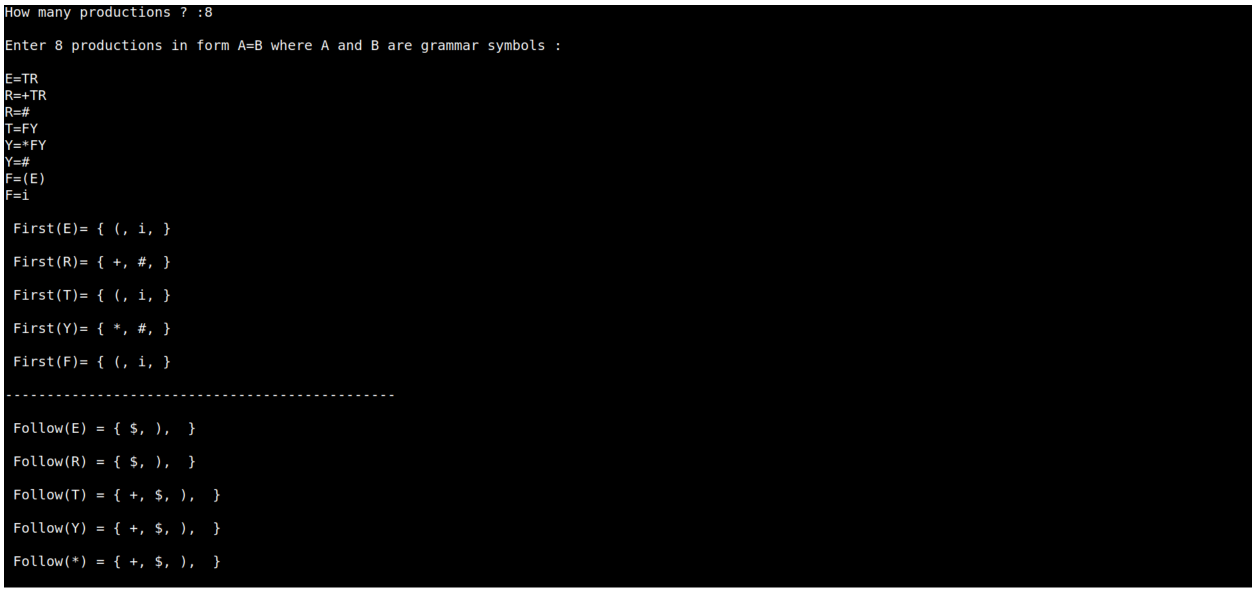
```
                                        while(ter[vz] != calc_follow[k][fz]){
                                                vz = vz + 1;
                                        }
                                        table[k][vz+1] = '#';
                                        fz++;
                                }
                                break;
                        }
                }
        }
        for(ap = 0; ap < land ; ap++){
                printf("\t\t\t   %c\t|\t",table[ap][0]);
                for(kay = 1; kay < (sid + 1) ; kay++){
                        if(table[ap][kay] == '!')
                                printf("\t\t");
                        else if(table[ap][kay] == '#')
                                printf("%c=#\t\t",table[ap][0]);
                        else{
                                int mum = (int)(table[ap][kay]);
                                mum -= 65;
                                printf("%s\t\t",production[mum]);
                        }
                }
                printf("\n");

printf("\t\t\t-----------------------------------------------------------------------------------------------------------------
---");
                printf("\n");
        }
        int j;
        printf("\n\nPlease enter the desired INPUT STRING = ");
        char input[100];
        scanf("%s%c",input,&ch);

printf("\n\t\t\t\t\t===================================================================
=============\n");
        printf("\t\t\t\t\t\tStack\t\t\tInput\t\t\tAction");

printf("\n\t\t\t\t\t===================================================================
=============\n");
        int i_ptr = 0,s_ptr = 1;
        char stack[100];
        stack[0] = '$';
        stack[1] = table[0][0];
```

```
while(s_ptr != -1){
        printf("\t\t\t\t\t\t");
        int vamp = 0;
        for(vamp=0;vamp<=s_ptr;vamp++){
                printf("%c",stack[vamp]);
        }
        printf("\t\t\t");
        vamp = i_ptr;
        while(input[vamp] != '\0'){
                printf("%c",input[vamp]);
                vamp++;
        }
        printf("\t\t\t");
        char her = input[i_ptr];
        char him = stack[s_ptr];
        s_ptr--;
        if(!isupper(him)){
                if(her == him){
                        i_ptr++;
                        printf("POP ACTION\n");
                }
                else{
                        printf("\nString Not Accepted by LL(1) Parser !!\n");
                        exit(0);
                }
        }
        else{
                for(i=0;i<sid;i++){
                        if(ter[i] == her)
                                break;
                }
                char produ[100];
                for(j=0;j<land;j++){
                        if(him == table[j][0]){
                                if (table[j][i+1] == '#'){
                                        printf("%c=#\n",table[j][0]);
                                        produ[0] = '#';
                                        produ[1] = '\0';
                                }
                                else if(table[j][i+1] != '!'){
                                        int mum = (int)(table[j][i+1]);
                                        mum -= 65;
                                        strcpy(produ,production[mum]);
                                        printf("%s\n",produ);
                                        }
                                        else{
                                                printf("\nString Not Accepted by LL(1) Parser !!\n");
                                                exit(0);
                                        }
                                }
                        }
                        int le = strlen(produ);
                        le = le - 1;
                        if(le == 0){
                                continue;
                        }
                        for(j=le;j>=2;j--){
                                s_ptr++;
                                stack[s_ptr] = produ[j];
                        }
                }
        }

printf("\n\t\t\t===================================================================
============================================================\n");
        if (input[i_ptr] == '\0'){
                printf("\t\t\t\t\t\t\t\tYOUR STRING HAS BEEN ACCEPTED !!\n");
        }
        else
                printf("\n\t\t\t\t\t\t\t\tYOUR STRING HAS BEEN REJECTED !!\n");

printf("\t\t\t=====================================================================
==========================================================\n");
}

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'){
```

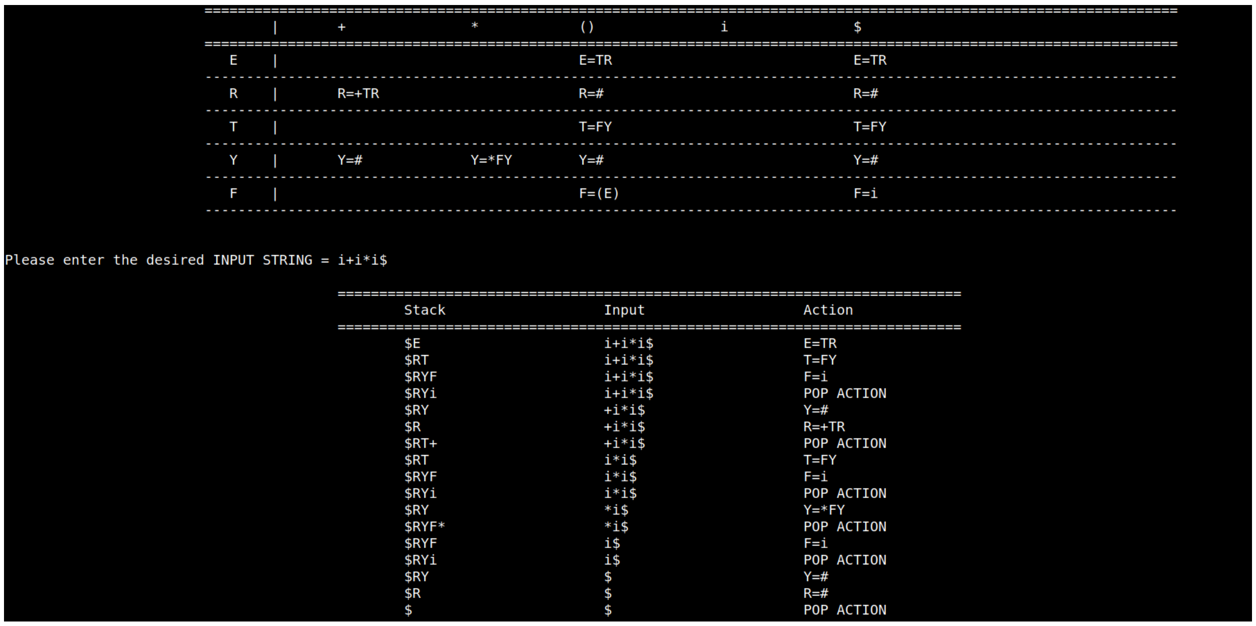
```
                                        followfirst(production[i][j+1],i,(j+2));
                                    }
                            if(production[i][j+1]=='\0'&&c!=production[i][0]){
                                    follow(production[i][0]);
                                    }
                            }
                    }
            }
}

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:



```
How many productions ? :8

Enter 8 productions in form A=B where A and B are grammar symbols :

E=TR
R=+TR
R=#
T=FY
Y=*FY
Y=#
F=(E)
F=i

 First(E)= { (, i, }

 First(R)= { +, #, }

 First(T)= { (, i, }

 First(Y)= { *, #, }

 First(F)= { (, i, }

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

 Follow(E) = { $, ),  }

 Follow(R) = { $, ),  }

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

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

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



```
                        =====================================================================================================================
                                |       +               *            ()                i               $
                        =====================================================================================================================
                           E    |                                    E=TR                              E=TR
                        ---------------------------------------------------------------------------------------------------------------------
                           R    |       R=+TR                        R=#                               R=#
                        ---------------------------------------------------------------------------------------------------------------------
                           T    |                                    T=FY                              T=FY
                        ---------------------------------------------------------------------------------------------------------------------
                           Y    |       Y=#             Y=*FY        Y=#                               Y=#
                        ---------------------------------------------------------------------------------------------------------------------
                           F    |                                    F=(E)                             F=i
                        ---------------------------------------------------------------------------------------------------------------------


Please enter the desired INPUT STRING = i+i*i$

                                        ===========================================================================
                                                Stack                   Input                   Action
                                        ===========================================================================
                                                $E                      i+i*i$                  E=TR
                                                $RT                     i+i*i$                  T=FY
                                                $RYF                    i+i*i$                  F=i
                                                $RYi                    i+i*i$                  POP ACTION
                                                $RY                     +i*i$                   Y=#
                                                $R                      +i*i$                   R=+TR
                                                $RT+                    +i*i$                   POP ACTION
                                                $RT                     i*i$                    T=FY
                                                $RYF                    i*i$                    F=i
                                                $RYi                    i*i$                    POP ACTION
                                                $RY                     *i$                     Y=*FY
                                                $RYF*                   *i$                     POP ACTION
                                                $RYF                    i$                      F=i
                                                $RYi                    i$                      POP ACTION
                                                $RY                     $                       Y=#
                                                $R                      $                       R=#
                                                $                       $                       POP ACTION
```