COMPILER DESIGN LAB

EXP 5 – First and Follow

Name- *HUSNA QASIM*

Reg. no. *- RA1911031010138*

Date- *24th February 2022*

AIM:

To write a program to perform first and follow using any language.

ALGORITHM:

For computing the first:

1. If X is a terminal then FIRST(X) = {X}
Example: F -> (E) | id
We can write it as FIRST(F) -> { (, id }
2. If X is a non terminal like E -> T then to get
FIRST(E) substitute T with other productions until you get a terminal as the first symbol
3. If X -> ε then add ε to FIRST(X).

For computing the follow:

1. Always check the right side of the productions for a non-terminal, whose FOLLOW set is
being found. (never see the left side).
2. (a) If that non-terminal (S,A,B…) is followed by any terminal (a,b…,*,+,(,)…) , then add
that "terminal" into FOLLOW set.
(b) If that non-terminal is followed by any other non-terminal then add "FIRST of other nonterminal"
into FOLLOW set.

CODE:

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

// Functions to calculate Follow
void followfirst(char, int, int);
void follow(char c);

// Function to calculate First
void findfirst(char, int, int);

int count, n = 0;

// Stores the final result
// of the First Sets
char calc_first[10][100];

// Stores the final result
// of the Follow Sets
char calc_follow[10][100];
int m = 0;

// Stores the production rules
char production[10][10];
char f[10], first[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;
        count = 8;

        // The Input grammar
        strcpy(production[0], "E=TR");
        strcpy(production[1], "R=+TR");
        strcpy(production[2], "R=#");
        strcpy(production[3], "T=FY");
        strcpy(production[4], "Y=*FY");
        strcpy(production[5], "Y=#");
        strcpy(production[6], "F=(E)");
        strcpy(production[7], "F=i");

        int kay;
        char done[count];
```

```
int ptr = -1;

// Initializing the calc_first array
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;

        // Checking if First of c has
        // already been calculated
        for(kay = 0; kay <= ptr; kay++)
                if(c == done[kay])
                        xxx = 1;

        if (xxx == 1)
                continue;
```

```
// Function call
findfirst(c, 0, 0);
ptr += 1;

// Adding c to the calculated list
done[ptr] = c;
printf("\n First(%c) = { ", c);
calc_first[point1][point2++] = c;

// Printing the First Sets of the grammar
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;

// Initializing the calc_follow array
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;
```

```
// Checking if Follow of ck
// has alredy been calculated
for(kay = 0; kay <= ptr; kay++)
    if(ck == donee[kay])
        xxx = 1;

if (xxx == 1)
    continue;
land += 1;

// Function call
follow(ck);
ptr += 1;

// Adding ck to the calculated list
donee[ptr] = ck;
printf(" Follow(%c) = { ", ck);
calc_follow[point1][point2++] = ck;

// Printing the Follow Sets of the grammar
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])
```

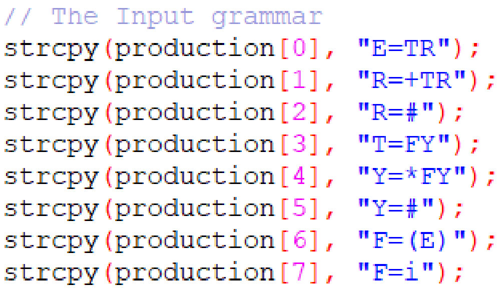
```
                {
                    chk = 1;
                    break;
                }
            }
            if(chk == 0)
            {
                printf("%c, ", f[i]);
                calc_follow[point1][point2++] = f[i];
            }
        }
        printf(" }\n\n");
        km = m;
        point1++;
    }
}

void follow(char c)
{
    int i, j;

    // Adding "$" to the follow
    // set of the start symbol
    if(production[0][0] == c) {
        f[m++] = '$';
        }
        for(i = 0; i < 10; i++)
        {
                for(j = 2;j < 10; j++)
                {
                        if(production[i][j] == c)
                        {
                                if(production[i][j+1] != '\0')
                                {
                                        // Calculate the first of the next
                                        // Non-Terminal in the production
                                        followfirst(production[i][j+1], i, (j+2));
                                }

                                if(production[i][j+1]=='\0' && c!=production[i][0])
                                {
                                        // Calculate the follow of the Non-Terminal
                                        // in the L.H.S. of the production
                                        follow(production[i][0]);
                                }
                        }
                }
        }
}
```

```
void findfirst(char c, int q1, int q2)
{
        int j;

        // The case where we
        // encounter a Terminal
        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))
                                {
                                        // Recursion to calculate First of New
                                        // Non-Terminal we encounter after epsilon
                                        findfirst(production[q1][q2], q1, (q2+1));
                                }
                                else
```

```
                    first[n++] = '#';
                }
                else if(!isupper(production[j][2]))
                {
                    first[n++] = production[j][2];
                }
                else
                {
                    // Recursion to calculate First of
                    // New Non-Terminal we encounter
                    // at the beginning
                    findfirst(production[j][2], j, 3);
                }
            }
        }
}

void followfirst(char c, int c1, int c2)
{
    int k;

    // The case where we encounter
    // a Terminal
    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;
        }

        //Including the First set of the
        // Non-Terminal in the Follow of
        // the original query
        while(calc_first[i][j] != '!')
        {
                if(calc_first[i][j] != '#')
                {
                        f[m++] = calc_first[i][j];
                }
                else
                {
                        if(production[c1][c2] == '\0')
                        {
                                // Case where we reach the
                                // end of a production
                                follow(production[c1][0]);
                }
                else
                {
                    // Recursion to the next symbol
                    // in case we encounter a "#"
                    followfirst(production[c1][c2], c1, c2+1);
                }
            }
            j++;
        }
    }
}
```

INPUT:



```
// The Input grammar
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strcpy(production[2], "R=#");
strcpy(production[3], "T=FY");
strcpy(production[4], "Y=*FY");
strcpy(production[5], "Y=#");
strcpy(production[6], "F=(E)");
strcpy(production[7], "F=i");
```
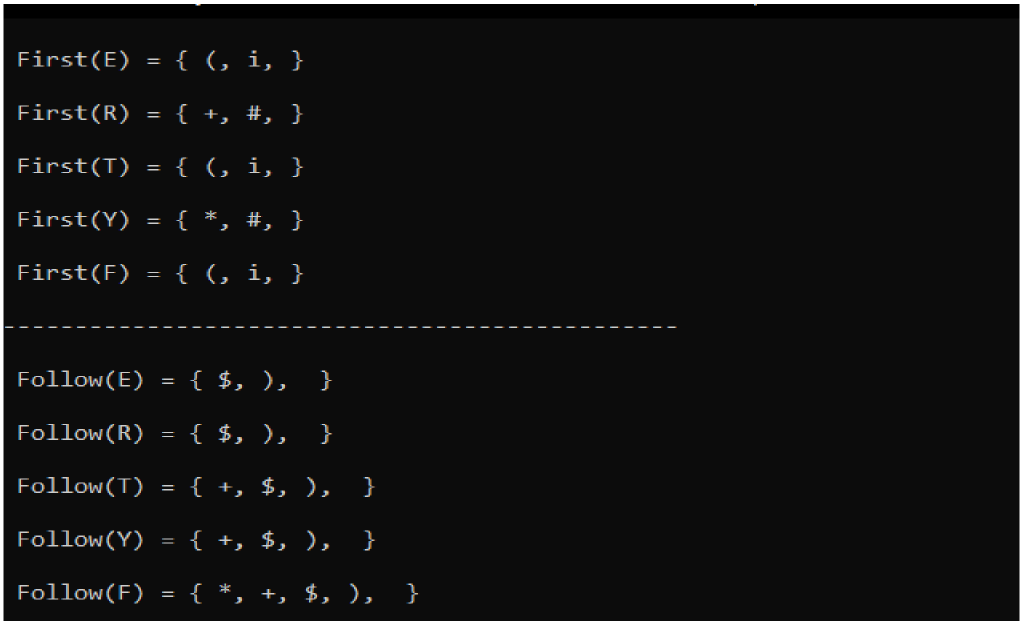

OUTPUT:



```
First(E) = { (, i, }

First(R) = { +, #, }

First(T) = { (, i, }

First(Y) = { *, #, }

First(F) = { (, i, }

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

Follow(E) = { $, ),  }

Follow(R) = { $, ),  }

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

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

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

RESULT: The FIRST and FOLLOW sets of the non-terminals of a grammar were found successfully using C language.