Date:

Experiment – 5

Aim:

Implement a C program to calculate FIRST and FOLLOW sets of given Grammar

Description:

In **compiler design**, **FIRST** and **FOLLOW** sets are essential for **parsing** and **syntax analysis** in **context-free grammars (CFGs)**.

- **FIRST Set**: The set of terminals that appear at the **beginning** of any string derived from a non-terminal.
- **FOLLOW Set**: The set of terminals that can appear **immediately after** a non-terminal in some derivation.

This program takes a **user-defined grammar**, computes the **FIRST** and **FOLLOW** sets, and displays them. It helps in **LL(1) parsing table construction**, making it crucial for **syntax analysis** in **compilers**.

Program:

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

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

int count = 8, n = 0, m = 0;
char calc_first[10][100];
char calc_follow[10][100];
char production[10][10];
```

```
char f[10], first[10];
int k;
char ck;
int e;

int main(int argc, char **argv) {
    int jm = 0, km = 0;
    int i, choice;
    char c, ch;
    int kay;
    int ptr = -1;
    char done[count];

    // Initialize productions
    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");

    // Initialize calc_first and calc_follow
    for(k = 0; k < count; k++) {
        for(kay = 0; kay < 100; kay++) {
            calc_first[k][kay] = '!';
            calc_follow[k][kay] = '!';
        }
```

```
}

// Calculate FIRST sets
int point1 = 0, point2, xxx;
for(k = 0; k < count; k++) {
    c = production[k][0];
    point2 = 0;
    xxx = 0;

    // Skip if already calculated FIRST set
    for(kay = 0; kay <= ptr; kay++) {
        if(c == done[kay]) {
            xxx = 1;
            break;
        }
    }

    if (xxx == 1)
        continue;

    findfirst(c, 0, 0);
    ptr += 1;
    done[ptr] = c;

    // Print FIRST set
    printf("\nFirst(%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----------------------------------------------
\n\n");

    // Calculate FOLLOW sets
    char donee[count];
    ptr = -1;
    point1 = 0;
    int land = 0;
    for(e = 0; e < count; e++) {
        ck = production[e][0];
        point2 = 0;
        xxx = 0;

        // Skip if already calculated FOLLOW set
```

```
for(kay = 0; kay <= ptr; kay++) {
    if(ck == donee[kay]) {
        xxx = 1;
        break;
    }
}

if (xxx == 1)
    continue;

land += 1;
follow(ck);
ptr += 1;
donee[ptr] = ck;

// Print FOLLOW set
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++;
    }

    return 0;
}

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]);
                }
            }
        }
    }
}
```

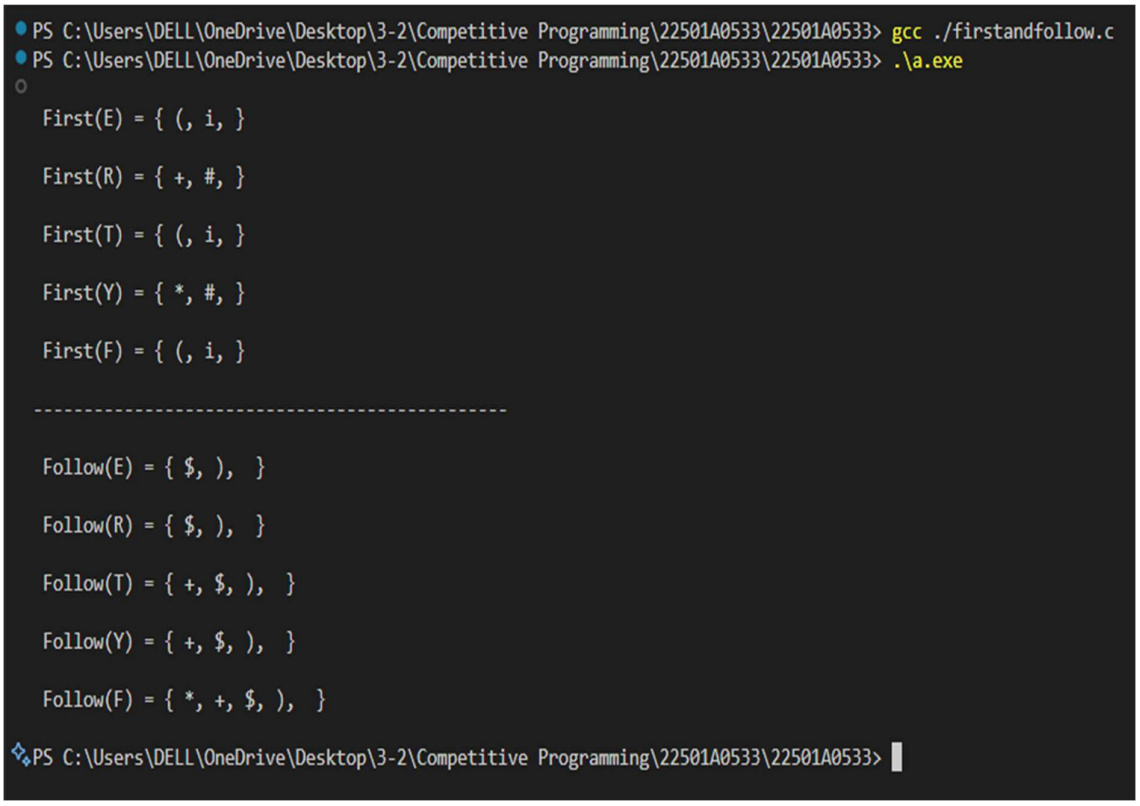
```
void findfirst(char c, int q1, int q2) {
    int j;
    if (!(isupper(c))) {
        first[n++] = c;
    }

    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:


PS C:\Users\DELL\OneDrive\Desktop\3-2\Competitive Programming\22501A0533\22501A0533> gcc ./firstandfollow.c
PS C:\Users\DELL\OneDrive\Desktop\3-2\Competitive Programming\22501A0533\22501A0533> .\a.exe
First(E) = { (, i, }
First(R) = { +, #, }
First(T) = { (, i, }
First(Y) = { *, #, }
First(F) = { (, i, }
Follow(E) = { $,), }
Follow(R) = { $,), }
Follow(T) = { +, $,), }
Follow(Y) = { +, $,), }
Follow(F) = { *, +, $,), }
PS C:\Users\DELL\OneDrive\Desktop\3-2\Competitive Programming\22501A0533\22501A0533>