```c
// C program to calculate the First and
// Follow sets of a given grammar
#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 already 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]);
                                }
                        }
                }
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        }
}

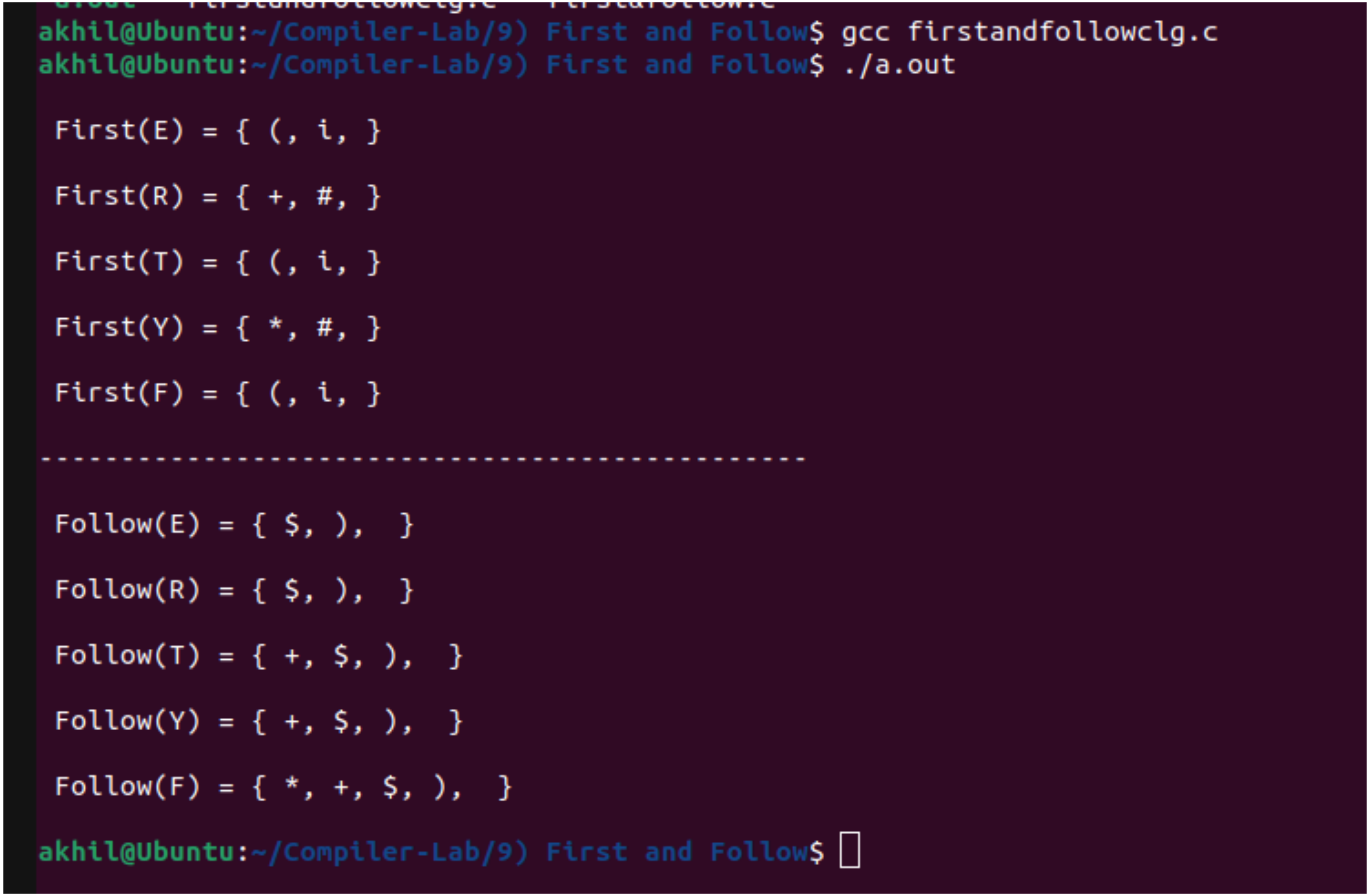
void findfirst(char c, int q1, int q2)
{
        int j;

        // 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++;
                }
        }
}
```



```
akhil@Ubuntu:~/Compiler-Lab/9) First and Follow$ gcc firstandfollowclg.c
akhil@Ubuntu:~/Compiler-Lab/9) First and Follow$ ./a.out

 First(E) = { (, i, }

 First(R) = { +, #, }

 First(T) = { (, i, }

 First(Y) = { *, #, }

 First(F) = { (, i, }

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 Follow(E) = { $, ),  }

 Follow(R) = { $, ),  }

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

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

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

akhil@Ubuntu:~/Compiler-Lab/9) First and Follow$ 
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