Practical no: 3

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Subject: Compiler Design Lab
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Aim:

(A) Write a program to find FIRST for any grammar. All the following rules of FIRST must be implemented.

(B) Further, write a program to find follow() for the given grammar.

(C) Construct the LL(1) parsing table using the FIRST and FOLLOW values computed above.

Program for calculating the first() and follow() for the given production:
A-> SB | B
S-> a | BC | e
B-> b | d

```
#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 = 7;

    // Taking production rules as input from the user
    printf("Enter the number of production rules: ");
    scanf("%d", &count);

    printf("Enter the production rules (e.g., A=SB): \n");
    for (i = 0; i < count; i++) {
        scanf("%s", production[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, x;

    for (k = 0; k < count; k++) {
```

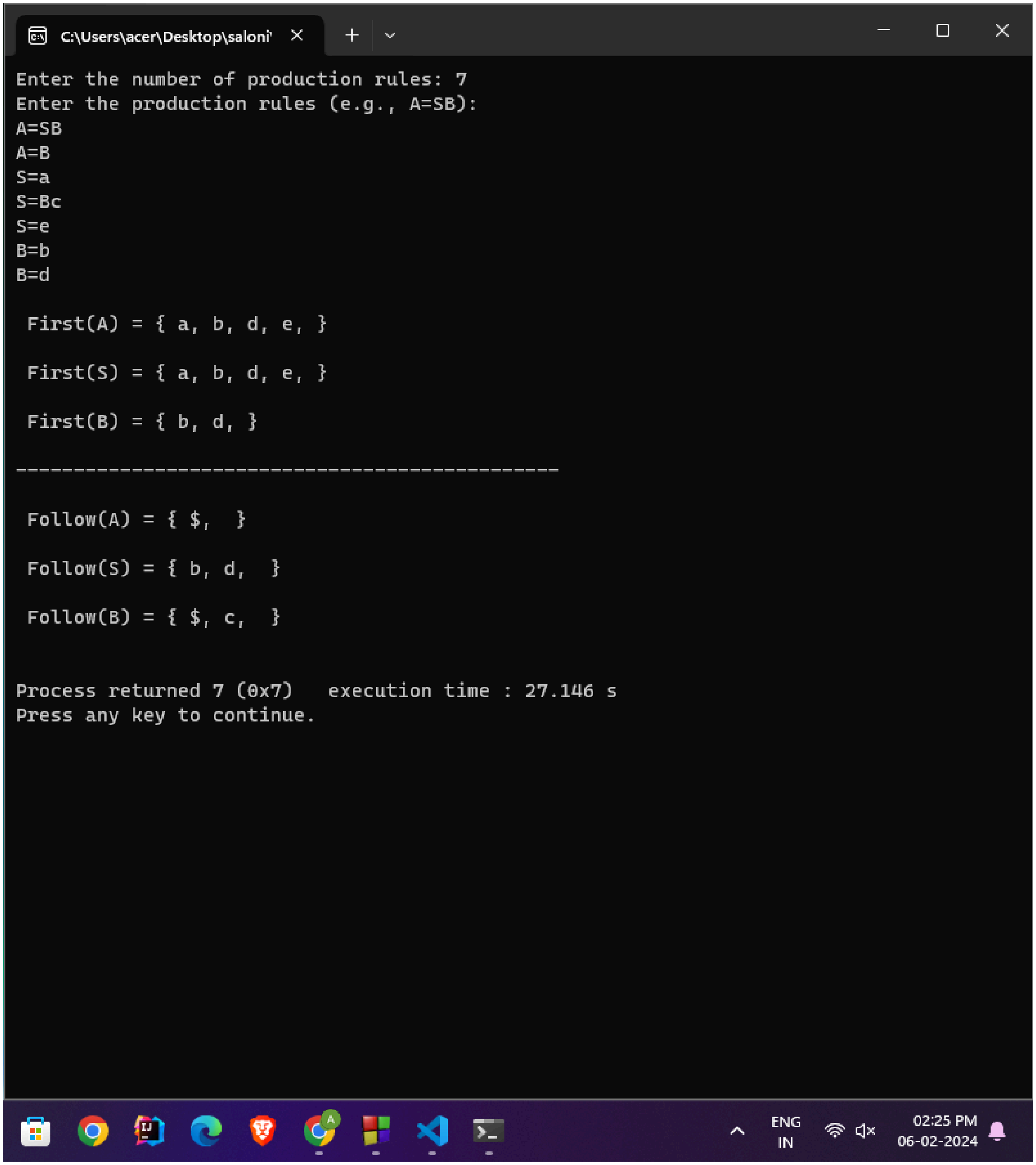
```
c = production[k][0];
point2 = 0;
x = 0;

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

if (x == 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;
    x = 0;

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

    if (x == 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++;
        }
    }
}
```

Output:



```
Enter the number of production rules: 7
Enter the production rules (e.g., A=SB):
A=SB
A=B
S=a
S=Bc
S=e
B=b
B=d

 First(A) = { a, b, d, e, }

 First(S) = { a, b, d, e, }

 First(B) = { b, d, }

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

 Follow(A) = { $,  }

 Follow(S) = { b, d,  }

 Follow(B) = { $, c,  }


Process returned 7 (0x7)   execution time : 27.146 s
Press any key to continue.
```

Saloni Vishwakarma Practical no: 3.
C1-13 Compiler Design Lab(CCP308)

Q. ① $A \to SB \mid B$. Calulate First ().
$S \to a \mid Bc \mid \epsilon$
$B \to b \mid d$.

→ First (B) = {b, d}

First (A) = First (SB) ∪ First (B)

= First (S) − ∈ ∪ First (B) ∪ First (B)

= {a, b, d} ∪ {b, d} ∪ {b, d}

= {b, d, a}.

First (S) = First (a) ∪ First (Bc) ∪ First (∈)

= {a} ∪ {b, d} ∪ {∈}

= {b, d, a, ∈}

Q② Find Follow().

→ Follow (A) = $

	first()	follow()
A	{ a b d }	$
~~B~~S	{a, b, d, ∈}	{b, d}
B	{b, d}	{$, c}

⑧ parse Table

	a	b	c	d	$
A	A→SB	A→B		A→B	
S	S→a	S→Bc S→ϵ	[illegible]	S→Bc S→ϵ	S→ϵ
B		B→b		B→d	

Above grammar is not LL(1) grammar