Practical-10

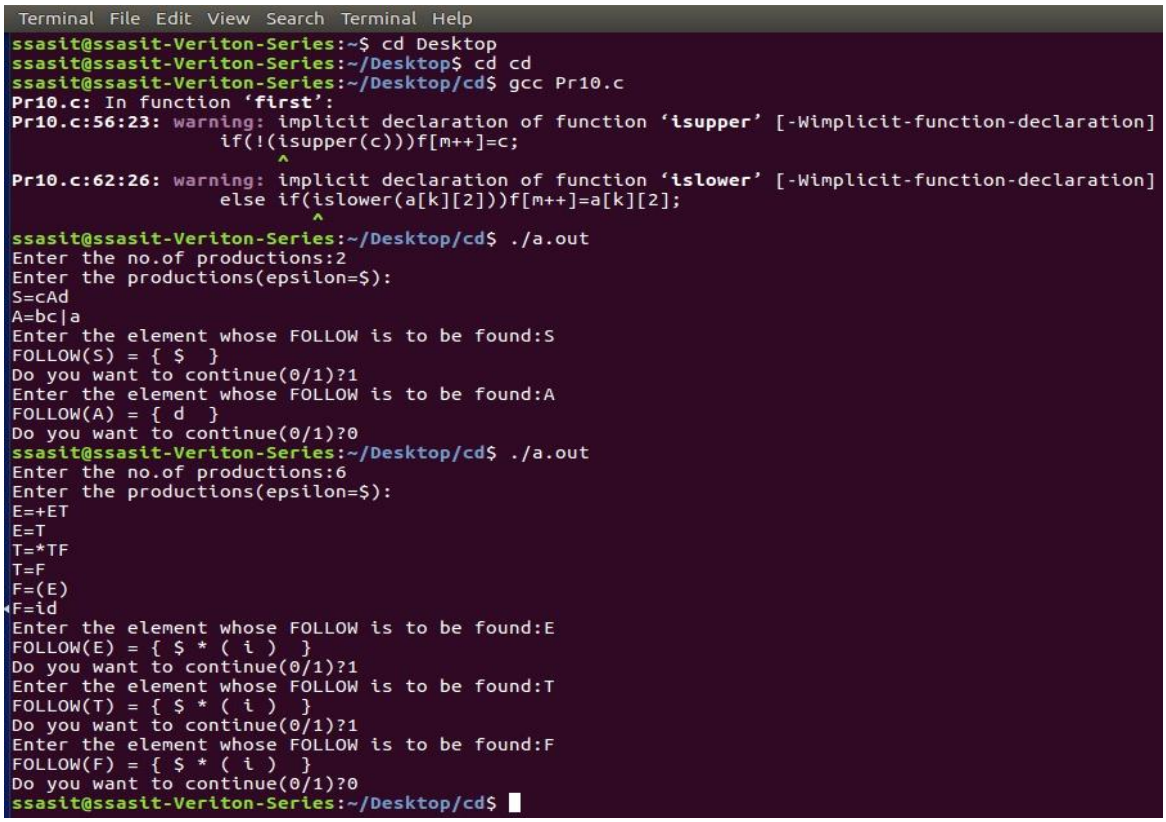
Aim: Finding “Follow” set Input: The string consists of grammar symbols. Output: The Follow set for a given string. Explanation: The student has to assume a typical grammar. The program when run will ask for the string to be entered. The program will find the Follow set of the given string.

Code:

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

#define MAX_PRODUCTIONS 10
#define MAX_LENGTH 10

int n, m = 0;
char productions[MAX_PRODUCTIONS][MAX_LENGTH];
char followSet[MAX_LENGTH];

void follow(char c);
void first(char c);

int main() {
   int z;
   char c, ch;

   printf("Enter the no. of productions: ");
   scanf("%d", &n);
   printf("Enter the productions (epsilon=$):\n");

   for (int i = 0; i < n; i++) {
      scanf("%s%c", productions[i], &ch);
   }

   do {
      m = 0; // Reset follow set size
      printf("Enter the element whose FOLLOW is to be found: ");
      scanf(" %c", &c); // Notice the space before %c to consume any newline

      follow(c);

      printf("FOLLOW(%c) = { ", c);
      for (int i = 0; i < m; i++) {
         printf("%c ", followSet[i]);
      }
      printf("}\n");

      printf("Do you want to continue (0/1)? ");
```

```
        scanf("%d%c", &z, &ch);

    } while (z == 1);

    return 0;
}

void follow(char c) {
    if (productions[0][0] == c) {
        followSet[m++] = '$';
    }

    for (int i = 0; i < n; i++) {
        for (int j = 2; j < strlen(productions[i]); j++) {
            if (productions[i][j] == c) {
                // Check the next character
                if (productions[i][j + 1] != '\0') {
                    first(productions[i][j + 1]);
                }
                // If there's no next character, find the follow of the left-hand side
                if (productions[i][j + 1] == '\0' && c != productions[i][0]) {
                    follow(productions[i][0]);
                }
            }
        }
    }
}

void first(char c) {
    if (!isupper(c)) {
        followSet[m++] = c; // Add terminal to follow set
    }

    for (int k = 0; k < n; k++) {
        if (productions[k][0] == c) {
            if (productions[k][2] == '$') {
                follow(productions[k][0]); // Follow the left-hand side
            } else if (islower(productions[k][2])) {
                followSet[m++] = productions[k][2]; // Add terminal to follow set
            } else {
                first(productions[k][2]); // Recursive call for non-terminal
            }
        }
    }
}
```

Output:


Terminal File Edit View Search Terminal Help
ssasit@ssasit-Veriton-Series:~$ cd Desktop
ssasit@ssasit-Veriton-Series:~/Desktop$ cd cd
ssasit@ssasit-Veriton-Series:~/Desktop/cd$ gcc Pr10.c
Pr10.c: In function 'first':
Pr10.c:56:23: warning: implicit declaration of function 'isupper' [-Wimplicit-function-declaration]
if(!(isupper(c)))f[m++]=c;
^
Pr10.c:62:26: warning: implicit declaration of function 'islower' [-Wimplicit-function-declaration]
else if(islower(a[k][2]))f[m++]=a[k][2];
^
ssasit@ssasit-Veriton-Series:~/Desktop/cd$ ./a.out
Enter the no.of productions:2
Enter the productions(epsilon=$):
S=cAd
A=bc|a
Enter the element whose FOLLOW is to be found:S
FOLLOW(S) = { $ }
Do you want to continue(0/1)?1
Enter the element whose FOLLOW is to be found:A
FOLLOW(A) = { d }
Do you want to continue(0/1)?0
ssasit@ssasit-Veriton-Series:~/Desktop/cd$ ./a.out
Enter the no.of productions:6
Enter the productions(epsilon=$):
E=+ET
E=T
T=*TF
T=F
F=(E)
F=id
Enter the element whose FOLLOW is to be found:E
FOLLOW(E) = { $ * (i) }
Do you want to continue(0/1)?1
Enter the element whose FOLLOW is to be found:T
FOLLOW(T) = { $ * (i) }
Do you want to continue(0/1)?1
Enter the element whose FOLLOW is to be found:F
FOLLOW(F) = { $ * (i) }
Do you want to continue(0/1)?0
ssasit@ssasit-Veriton-Series:~/Desktop/cd$

Practical-11

Aim: Implement a C program for constructing LL (1) parsing.

Code:

```
#include<stdio.h>
#include<ctype.h>
#include<string.h>
#include<stdlib.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------------------------------------------------------------------------------
-----------------------------------");
```

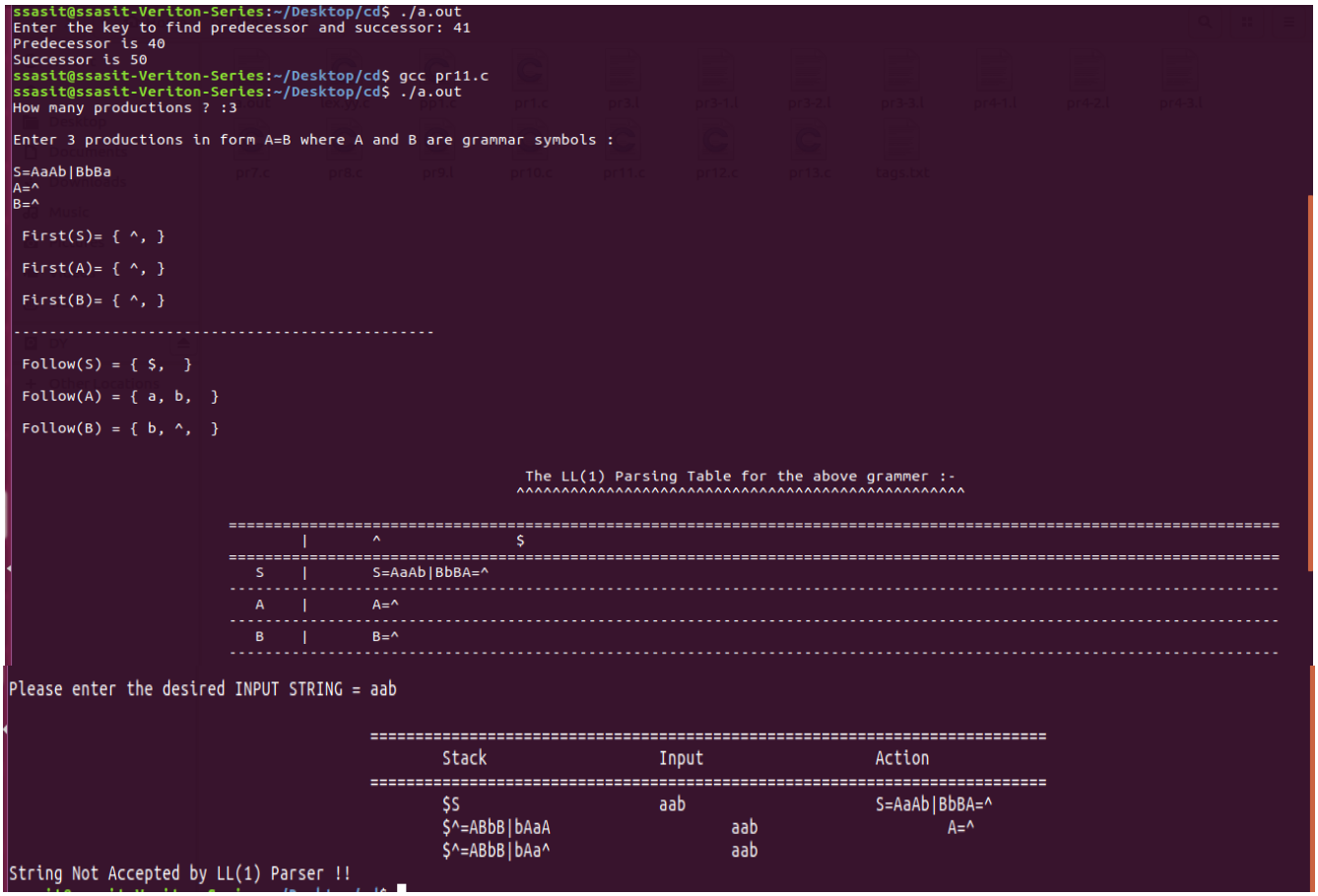
```
                printf("\n");
        }
        int j;
        printf("\n\nPlease enter the desired INPUT STRING = ");
        char input[100];
        scanf("%s%c",input,&ch);
        printf("\n\t\t\t\t\t==========================================================
==========================\n");
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


ssasit@ssasit-Veriton-Series:~/Desktop/cd$ ./a.out
Enter the key to find predecessor and successor: 41
Predecessor is 40
Successor is 50
ssasit@ssasit-Veriton-Series:~/Desktop/cd$ gcc pr11.c
ssasit@ssasit-Veriton-Series:~/Desktop/cd$ ./a.out
How many productions ? :3
Enter 3 productions in form A=B where A and B are grammar symbols :
S=AaAb|BbBa
A=^
B=^
First(S)= { ^, }
First(A)= { ^, }
First(B)= { ^, }
Follow(S) = { $, }
Follow(A) = { a, b, }
Follow(B) = { b, ^, }
The LL(1) Parsing Table for the above grammer :-
| ^ $
S | S=AaAb|BbBA=^
A | A=^
B | B=^
Please enter the desired INPUT STRING = aab
Stack Input Action
$S aab S=AaAb|BbBA=^
$^=ABbB|bAaA aab A=^
$^=ABbB|bAa^ aab
String Not Accepted by LL(1) Parser !!

Practical-7

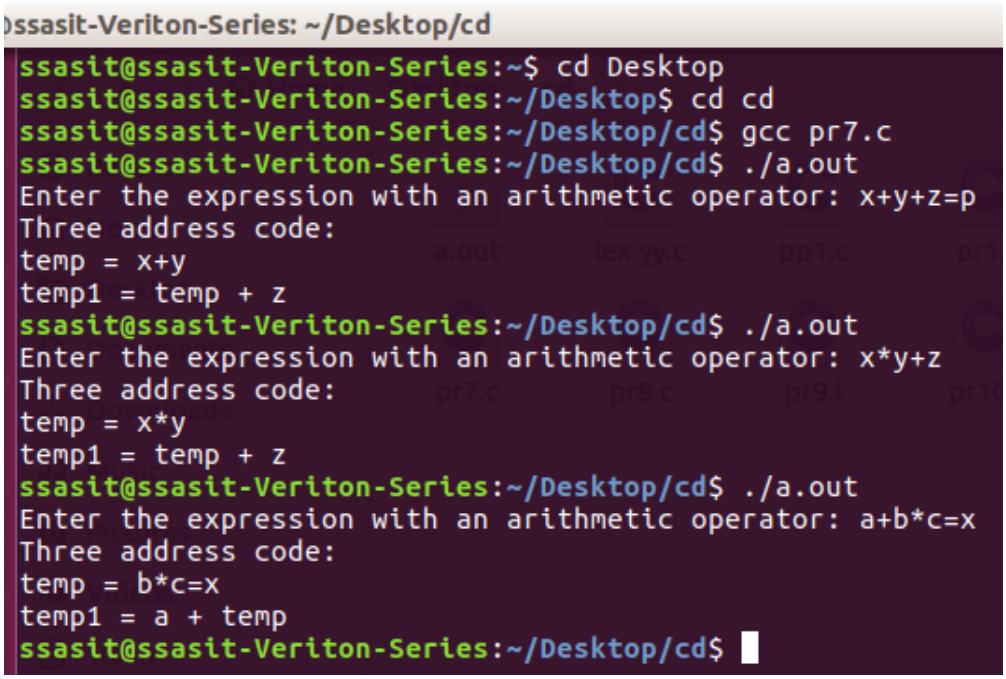
Aim: Generate 3-tuple intermediate code for given infix expression.

Code:

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

void pm();
void plus();
void div();

int i, j, l;
char ex[20], expr[20], expr1[20], id1[5], op[5], id2[5];

void reverse_string(char *str);

int main() {
   printf("Enter the expression with an arithmetic operator: ");
   scanf("%19s", ex); // Limit input size to avoid buffer overflow
   strcpy(expr, ex); // Copy the expression into expr
   l = strlen(expr); // Get the length of the expression
   expr1[0] = '\0'; // Initialize expr1 as an empty string

   // Parse the input expression
   for (i = 0; i < l; i++) {
      if (expr[i] == '+' || expr[i] == '-') {
         // Check if the next operator has higher precedence
         if (expr[i + 2] == '/' || expr[i + 2] == '*') {
            pm(); // Handle precedence case
            break;
         } else {
            plus(); // Handle + or - operation
            break;
         }
      } else if (expr[i] == '/' || expr[i] == '*') {
         div(); // Handle division or multiplication
         break;
      }
   }

   return 0;
}

// Function to handle precedence (pm)
void pm() {
   reverse_string(expr); // Reverse the expression
   j = l - i - 1; // Calculate the position from where to cut the expression
   strncpy(expr1, expr, j); // Copy the relevant part
```

```
    expr1[j] = '\0'; // Null-terminate the string
    reverse_string(expr1); // Reverse back the expression

    printf("Three address code:\n");
    printf("temp = %s\n", expr1);
    printf("temp1 = %c %c temp\n", expr[j + 1], expr[j]);
}

// Function to handle division or multiplication (div)
void div() {
    strncpy(expr1, expr, i + 2); // Copy the part of the expression up to the operator
    expr1[i + 2] = '\0'; // Null-terminate the string

    printf("Three address code:\n");
    printf("temp = %s\n", expr1);
    printf("temp1 = temp %c %c\n", expr[i + 2], expr[i + 3]);
}

// Function to handle addition or subtraction (plus)
void plus() {
    strncpy(expr1, expr, i + 2); // Copy the part of the expression up to the operator
    expr1[i + 2] = '\0'; // Null-terminate the string

    printf("Three address code:\n");
    printf("temp = %s\n", expr1);
    printf("temp1 = temp %c %c\n", expr[i + 2], expr[i + 3]);
}

// Helper function to reverse a string
void reverse_string(char *str) {
    int len = strlen(str);
    for (int i = 0; i < len / 2; i++) {
        char temp = str[i];
        str[i] = str[len - i - 1];
        str[len - i - 1] = temp;
    }
}
```

Output:


ssasit-Veriton-Series: ~/Desktop/cd
ssasit@ssasit-Veriton-Series:~$ cd Desktop
ssasit@ssasit-Veriton-Series:~/Desktop$ cd cd
ssasit@ssasit-Veriton-Series:~/Desktop/cd$ gcc pr7.c
ssasit@ssasit-Veriton-Series:~/Desktop/cd$ ./a.out
Enter the expression with an arithmetic operator: x+y+z=p
Three address code:
temp = x+y
temp1 = temp + z
ssasit@ssasit-Veriton-Series:~/Desktop/cd$ ./a.out
Enter the expression with an arithmetic operator: x*y+z
Three address code:
temp = x*y
temp1 = temp + z
ssasit@ssasit-Veriton-Series:~/Desktop/cd$ ./a.out
Enter the expression with an arithmetic operator: a+b*c=x
Three address code:
temp = b*c=x
temp1 = a + temp
ssasit@ssasit-Veriton-Series:~/Desktop/cd$

Practical-8

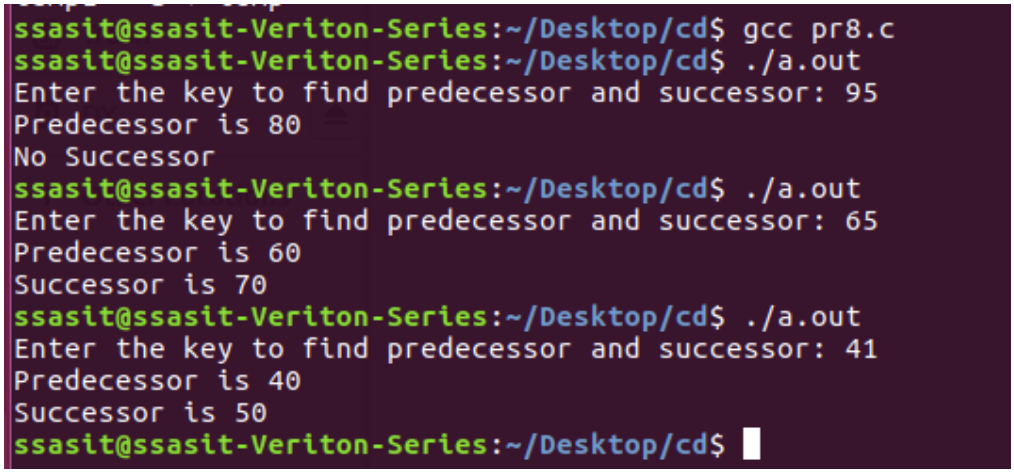
Aim: Extract Predecessor and Successor from given Control Flow Graph

Code:

```
#include <stdio.h>
#include <stdlib.h>
struct Node {
int key;
struct Node* left;
struct Node* right;
};
struct Node* pre = NULL;
struct Node* suc = NULL;
void findPreSuc(struct Node* root, int key) {
if (root == NULL)
return;
if (root->key == key) {
if (root->left != NULL) {
struct Node* tmp = root->left;
while (tmp->right != NULL)
tmp = tmp->right;
pre = tmp;
}
if (root->right != NULL) {
struct Node* tmp = root->right;
while (tmp->left != NULL)
tmp = tmp->left;
suc = tmp;
}
return;
}
if (root->key > key) {
suc = root;
findPreSuc(root->left, key);
} else {
pre = root;
findPreSuc(root->right, key);
}
}
struct Node* insert(struct Node* node, int key) {
if (node == NULL) {
struct Node* newNode = (struct Node*)malloc(sizeof(struct Node));
newNode->key = key;
newNode->left = newNode->right = NULL;
return newNode;
}
if (key < node->key)
node->left = insert(node->left, key);
```

```
else if (key > node->key)
node->right = insert(node->right, key);
return node;
}
int main() {
int key;
printf("Enter the key to find predecessor and successor: ");
scanf("%d", &key);
struct Node* root = NULL;
root = insert(root, 50);
insert(root, 30);
insert(root, 20);
insert(root, 40);
insert(root, 70);
insert(root, 60);
insert(root, 80);
findPreSuc(root, key);
if (pre != NULL)
printf("Predecessor is %d\n", pre->key);
else
printf("No Predecessor\n");
if (suc != NULL)
printf("Successor is %d\n", suc->key);
else
printf("No Successor\n");
return 0;
}
```

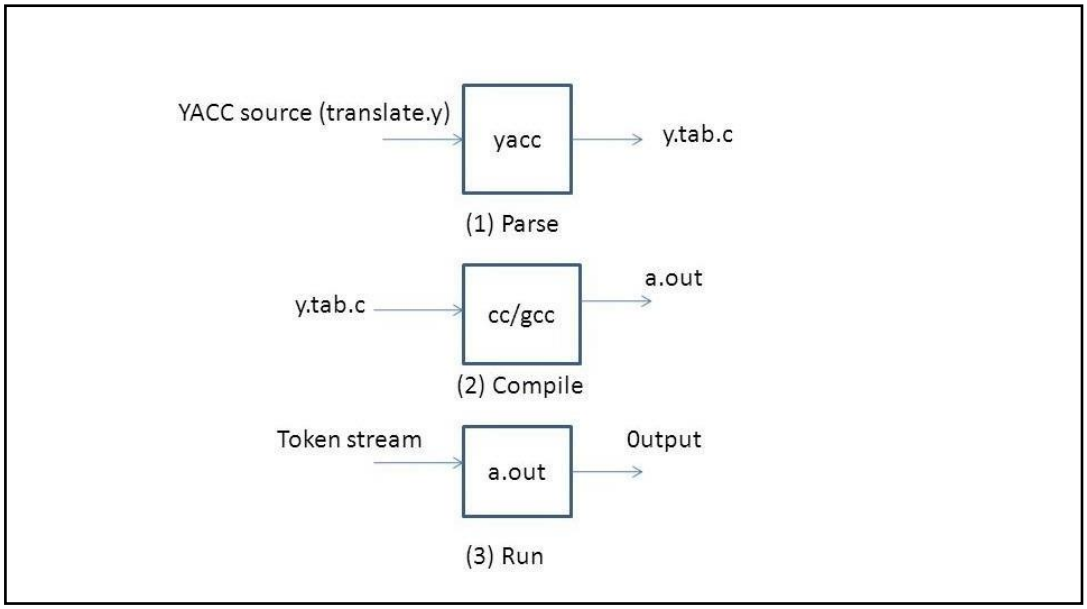
Output:



Practical-9

Aim: Introduction to YACC and generate Calculator Program.

- YACC (Yet Another Compiler Compiler) is a tool used to generate a parser. This document is a tutorial for the use of YACC to generate a parser for ExpL. YACC translates a given Context Free Grammar (CFG) specifications (input in input_file.y) intoa C implementation (y.tab.c) of a corresponding push down automaton (i.e., a finite state machine with a stack). This C program when compiled, yields an executable parser.



How yacc works?

- The input to **yacc** describes the rules of a grammar. **yacc** uses these rules to produce the source code for a program that parses the grammar. You can then compile this source code to obtain a program that reads input, parses it according to the grammar, and takes action based on the result.
- The source code produced by **yacc** is written in the C programming language. It consistsof a number of data tables that represent the grammar, plus a C function named **yyparse()**.By default, **yacc** symbol names used begin with **yy**. This is an historical convention, dating back to **yacc**'s predecessor, UNIX **yacc**. You can avoid conflicts with **yacc** namesby avoiding symbols that start with **yy**.

The structure of YACC programs:

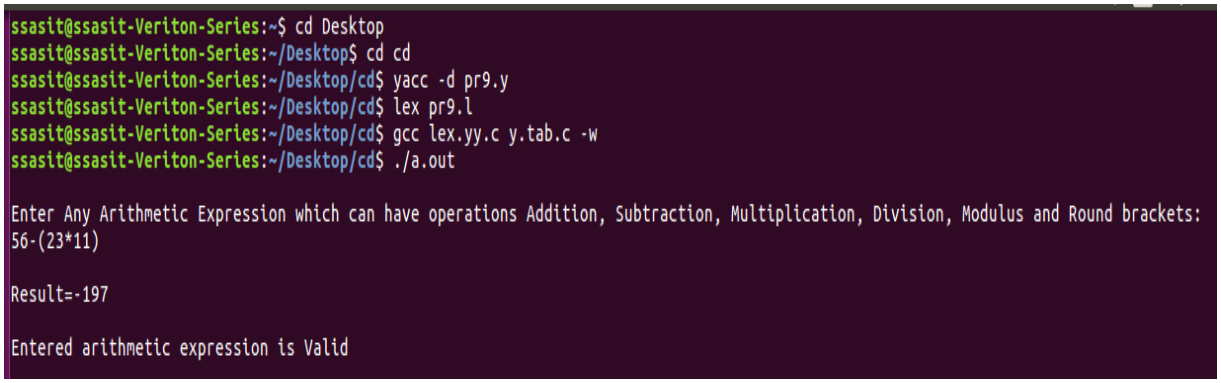
- A YACC program consists of three sections: Declarations, Rules and Auxiliary functions.(Note the similarity with the structure of LEX programs).

DECLARATIONS %% RULES %% AUXILIARY FUNCTIONS

Code:

```
#include<stdio.h>
#include "y.tab.h"
#include<ctype.h>
extern int yylval;
%%
[0-9]+ {
yylval=atoi(yytext);
return NUMBER;
}
[\t] ;
[\n] return 0;
. return yytext[0];
%%
int yywrap()
{
return 1;
}
```

Output:



Practical-12

Aim: Implement a C program to implement LALR parsing.

Code:

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

// Function prototypes
void push(char *, int *, char);
char stacktop(char *);
void isproduct(char, char);
int ister(char);
int isnter(char);
int isstate(char);
void error();
void isreduce(char, char);
char pop(char *, int *);
void printt(char *, int *, char[], int);
void rep(char[], int);

// Structures for action and goto tables
struct action {
   char row[6][5];
};

struct gotol {
   char r[3][4];
};

// Action and Goto tables
const struct action A[12] = {
   {"sf", "emp", "emp", "se", "emp", "emp"},
   {"emp", "sg", "emp", "emp", "emp", "acc"},
   {"emp", "rc", "sh", "emp", "rc", "rc"},
   {"emp", "re", "re", "emp", "re", "re"},
   {"sf", "emp", "emp", "se", "emp", "emp"},
   {"emp", "rg", "rg", "emp", "rg", "rg"},
   {"sf", "emp", "emp", "se", "emp", "emp"},
   {"sf", "emp", "emp", "se", "emp", "emp"},
   {"emp", "sg", "emp", "emp", "sl", "emp"},
   {"emp", "rb", "sh", "emp", "rb", "rb"},
   {"emp", "rb", "rd", "emp", "rd", "rd"},
   {"emp", "rf", "rf", "emp", "rf", "rf"}
};

const struct gotol G[12] = {
```

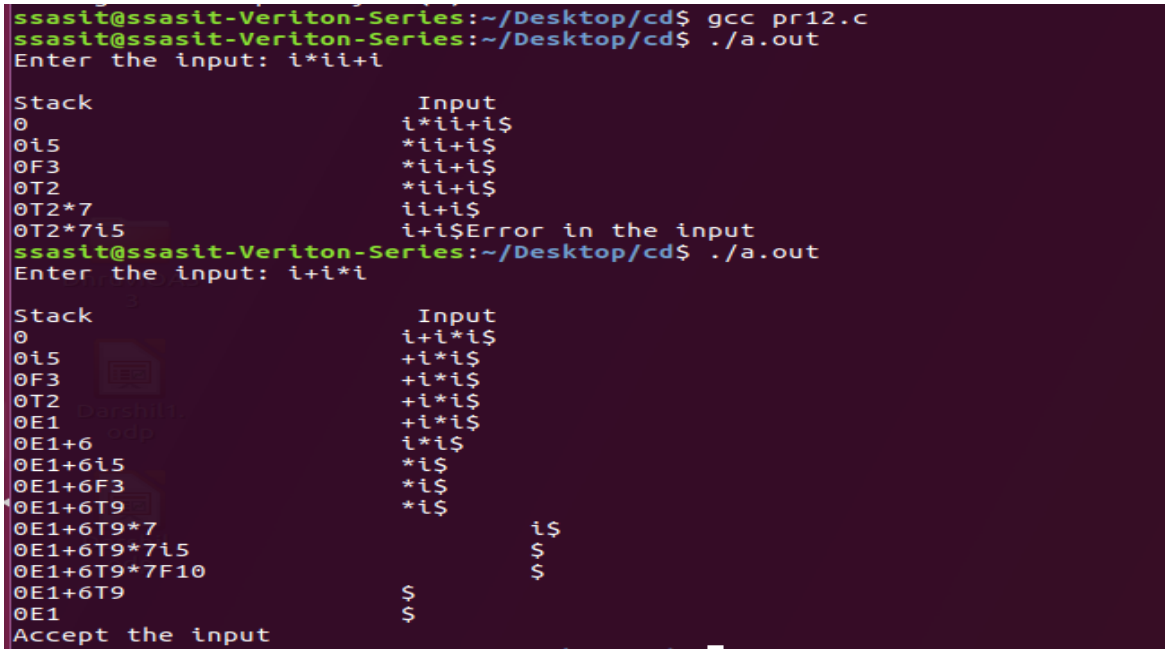
```
    {"b", "c", "d"},
    {"emp", "emp", "emp"},
    {"emp", "emp", "emp"},
    {"emp", "emp", "emp"},
    {"i", "c", "d"},
    {"emp", "emp", "emp"},
    {"emp", "j", "d"},
    {"emp", "emp", "k"},
    {"emp", "emp", "emp"},
    {"emp", "emp", "emp"}
};

// Terminal and non-terminal symbols
char ter[6] = {'i', '+', '*', ')', '(', '$'};
char nter[3] = {'E', 'T', 'F'};
char states[12] = {'a', 'b', 'c', 'd', 'e', 'f', 'g', 'h', 'm', 'j', 'k', 'l'};
char stack[100];
int top = -1;
char temp[10];

// Grammar rules
struct grammar {
    char left;
    char right[5];
};

const struct grammar rl[6] = {
    {'E', "e+T"},
    {'E', "T"},
    {'T', "T*F"},
    {'T', "F"},
    {'F', "(E)"},
    {'F', "i"}
};

// Push function to add an item to the stack
void push(char *s, int *sp, char item) {
    if (*sp == 100) {
        printf("Stack is full\n");
    } else {
        *sp = *sp + 1;
        s[*sp] = item;
    }
}

// Get the top item of the stack
char stacktop(char *s) {
    return s[top];
}
```

```
// Determine the product action based on input and stack top
void isproduct(char x, char p) {
    int k = ister(x);
    int l = isstate(p);
    strcpy(temp, A[l - 1].row[k - 1]);
}

// Check if the character is a terminal
int ister(char x) {
    for (int i = 0; i < 6; i++) {
        if (x == ter[i]) return i + 1;
    }
    return 0;
}

// Check if the character is a non-terminal
int isnter(char x) {
    for (int i = 0; i < 3; i++) {
        if (x == nter[i]) return i + 1;
    }
    return 0;
}

// Check if the character is a state
int isstate(char p) {
    for (int i = 0; i < 12; i++) {
        if (p == states[i]) return i + 1;
    }
    return 0;
}

// Error handling function
void error() {
    printf("Error in the input\n");
    exit(0);
}

// Perform reduction based on the state and non-terminal
void isreduce(char x, char p) {
    int k = isstate(x);
    int l = isnter(p);
    strcpy(temp, G[k - 1].r[l - 1]);
}

// Pop function to remove and return the top item from the stack
char pop(char *s, int *sp) {
    if (*sp == -1) {
        printf("Stack is empty\n");
```

```
        return '\0';
    }
    return s[(*sp)--];
}

// Print the current state of the stack and input
void printt(char *t, int *p, char inp[], int i) {
    printf("\n");
    for (int r = 0; r <= *p; r++) rep(t, r);
    printf("\t\t\t");
    for (int r = i; inp[r] != '\0'; r++) printf("%c", inp[r]);
}

// Helper function to represent states
void rep(char t[], int r) {
    char c = t[r];
    switch (c) {
        case 'a': printf("0"); break;
        case 'b': printf("1"); break;
        case 'c': printf("2"); break;
        case 'd': printf("3"); break;
        case 'e': printf("4"); break;
        case 'f': printf("5"); break;
        case 'g': printf("6"); break;
        case 'h': printf("7"); break;
        case 'm': printf("8"); break;
        case 'j': printf("9"); break;
        case 'k': printf("10"); break;
        case 'l': printf("11"); break;
        default: printf("%c", t[r]); break;
    }
}

// Main function
int main() {
    char inp[80], x, p, dl[80], y, bl = 'a';
    int i = 0, j, k, l, n, m;

    printf("Enter the input: ");
    if (scanf("%79s", inp) != 1) {
        printf("Error reading input\n");
        return 1;
    }

    // Append termination symbol
    int len = strlen(inp);
    inp[len] = '$';
    inp[len + 1] = '\0';
```

```
    // Initialize the stack
    push(stack, &top, bl);
    printf("\nStack \t\t\t Input");
    printt(stack, &top, inp, i);

    do {
        x = inp[i];
        p = stacktop(stack);
        isproduct(x, p);

        if (strcmp(temp, "emp") == 0) {
            error();
        }
        if (strcmp(temp, "acc") == 0) {
            break;
        }

        // Shift action
        if (temp[0] == 's') {
            push(stack, &top, inp[i]);
            push(stack, &top, temp[1]);
            i++;
        }
        // Reduce action
        else if (temp[0] == 'r') {
            j = isstate(temp[1]);
            strcpy(temp, rl[j - 2].right);
            dl[0] = rl[j - 2].left;
            dl[1] = '\0';
            n = strlen(temp);
            for (k = 0; k < 2 * n; k++) pop(stack, &top);
            for (m = 0; dl[m] != '\0'; m++) push(stack, &top, dl[m]);
            l = top;
            y = stack[l - 1];
            isreduce(y, dl[0]);
            for (m = 0; temp[m] != '\0'; m++) push(stack, &top, temp[m]);
        }
        printt(stack, &top, inp, i);
    } while (inp[i] != '\0');

    // Final acceptance check
    if (strcmp(temp, "acc") == 0) {
        printf("\nAccept the input\n");
    } else {
        printf("\nDo not accept the input\n");
    }
    return 0;
}
```

Output:


ssasit@ssasit-Veriton-Series:~/Desktop/cd$ gcc pr12.c
ssasit@ssasit-Veriton-Series:~/Desktop/cd$ ./a.out
Enter the input: i*ii+i
Stack Input
0 i*ii+i$
0i5 *ii+i$
0F3 *ii+i$
0T2 *ii+i$
0T2*7 ii+i$
0T2*7i5 i+i$Error in the input
ssasit@ssasit-Veriton-Series:~/Desktop/cd$ ./a.out
Enter the input: i+i*i
Stack Input
0 i+i*i$
0i5 +i*i$
0F3 +i*i$
0T2 +i*i$
0E1 +i*i$
0E1+6 i*i$
0E1+6i5 *i$
0E1+6F3 *i$
0E1+6T9 *i$
0E1+6T9*7 i$
0E1+6T9*7i5 $
0E1+6T9*7F10 $
0E1+6T9 $
0E1 $
Accept the input

Practical-13

Aim: Implement a C program to implement operator precedence parsing.

Code:

```
#include<stdio.h>
#include<string.h>
#include<stdlib.h>
char *input; int
i=0;
char lasthandle[6],stack[50],handles[][5]={")E(","E*E","E+E","i","E^E"}; //(E)
becomes )E( when pushed to stack
int top=0,l;
char prec[9][9]={
/*stack + - * / ^ i ( ) $ */
/* + */ '>', '>','<','<','<','<','<','>','>',
/* - */ '>', '>','<','<','<','<','<','>','>',
/* * */ '>', '>','>','>','<','<','<','>','>',
/* / */ '>', '>','>','>','<','<','<','>','>',
/* ^ */ '>', '>','>','>','<','<','<','>','>',
/* i */ '>', '>','>','>','>','e','e','>','>',
/* ( */ '<', '<','<','<','<','<','<','>','e',
/* ) */ '>', '>','>','>','>','>','e','e','>','>',
/* $ */ '<', '<','<','<','<','<','<','<','>',
};
int getindex(char c)
{ switch(c)
{
case '+':return 0;
case '-':return 1;
case '*':return 2;
case '/':return 3; case
'^':return 4; case
'i':return 5; case
'(':return 6; case
')':return 7; case
'$':return 8;
}
}
int shift()
{
stack[++top]=*(input+i++);
stack[top+1]='\0';
}
int reduce()
{
int i,len,found,t;
for(i=0;i<5;i++)//selecting handles
```

```
{
len=strlen(handles[i]);
if(stack[top]==handles[i][0]&&top+1>=len)
{
found=1;
for(t=0;t<len;t++){
if(stack[top-t]!=handles[i][t]) {
found=0;
break;
}
}
if(found==1){
stack[top-t+1]='E';
top=top-t+1;
strcpy(lasthandle,handles[i]);
stack[top+1]='\0';
return 1;//successful reduction
}
}
}
return 0;
}
void dispstack(){
int j;
for(j=0;j<=top;j++)
printf("%c",stack[j]);
}
void dispinput(){
int j;
for(j=i;j<l;j++)
printf("%c",*(input+j)); }
void main(){
int j;
input=(char*)malloc(50*sizeof(char));
printf("\nEnter the string\n");
scanf("%s",input);
input=strcat(input,"$");
l=strlen(input);
strcpy(stack,"$");
printf("\nSTACK\tINPUT\tACTION");
while(i<=l){
shift();
printf("\n");
dispstack();
printf("\t");
dispinput();
printf("\tShift");
if(prec[getindex(stack[top])][getindex(input[i])]=='>'){
while(reduce()){
```

```
printf("\n");
dispstack();
printf("\t");
dispinput();
printf("\tReduced: E->%s",lasthandle);
}
}
}
if(strcmp(stack,"$E$")==0)
printf("\nAccepted;"); else
printf("\nNot Accepted;");
}
```

Output: