Rajshahi University of Engineering & Technology
Department of Computer Science of Engineering

EXPERIMENT NO: 05 & 06
NAME OF EXPERIMENT: Two Way Linked Lists & Stack

SUBMITTED TO:

RIZOAN TOUFIQ
ASSISTANT PROFESSOR
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
RAJSHAHI UNIVERSITY OF ENGINEERING & TECHNOLOGY

SUBMITTED BY:

NAME: MD. ARIFUL ISLAM
ROLL NO.: 1803046
GROUP: 2ND THIRTY
DATE OF EXP.: 14-10-2019
DATE OF SUB. : 02-11-2019
SERIES: 18 SERIES

MACHINE CONFIGURATION:

ASUS X510UF
CORE I5 8TH GEN PROCESSOR
UP TO 3.4 GHZ
8 GB RAM
OS WIN 10

INDEX

THEORY: A two way linked list is a linear collection of data elements,called **nodes**,where the linear order is given by means of pointers. Each node is divided into three parts :

1. The first part contains the **information** of the elements.
2. The second part called the **Forward field** or **next pointer field** that contains the address of the next node in the list.
3. The third part called the **Backward field** or **previous pointer field** that contains the address of the previous node in the list.

The operations normally performed on any linear structures are :

1. **Traversal :** Processing each elements in the list.
2. **Search :** Finding the location of an element.
3. **Insertion :** Adding a new element to the list.
4. **Deletion :** Removing an element from the list.

   Etc.

A **Stack** is a linear structure in which items may be **added** or **removed** one by one only at the end. It means that the last item to be added to a stack is the first item to be removed. The main concept of stack is **Last In - First Out.**

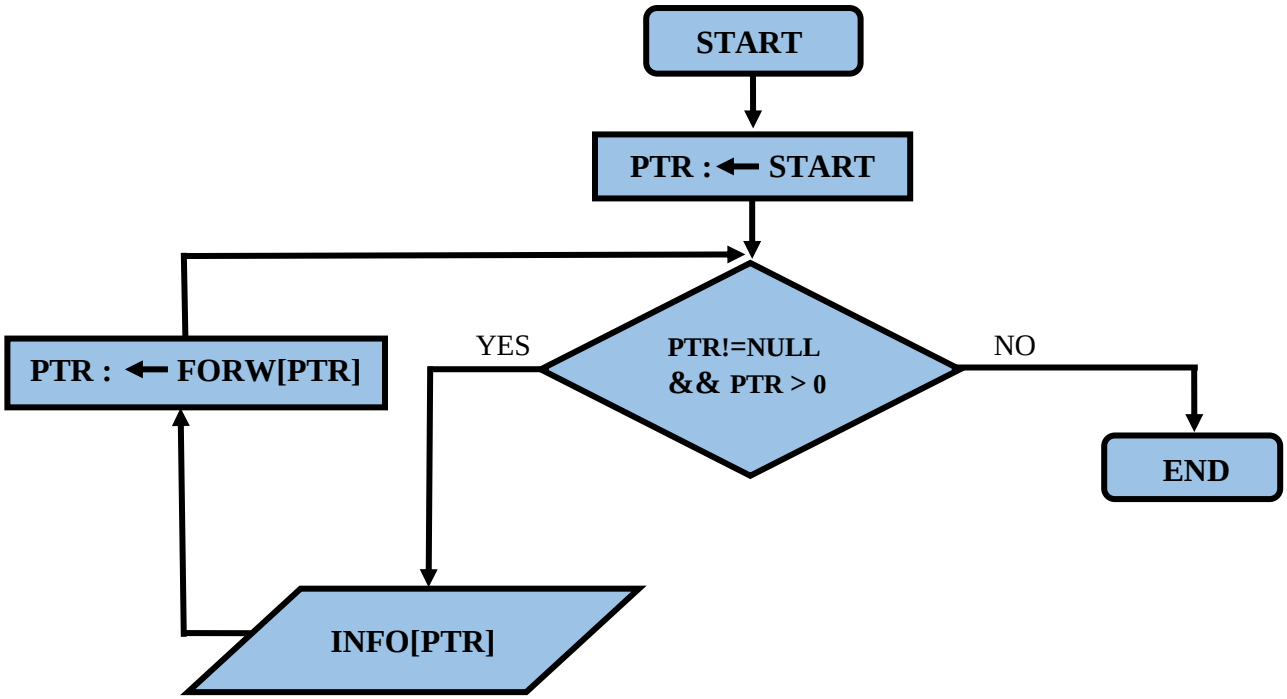
In a stack there is a pointer **TOP** that shows the **location** of **last data item.** There are two operations that are normally performed on any stack :

1. **PUSH :** Inserting an element into a stack.
2. **POP :** Deleting an element from a stack.

Problem No: 01

Problem Statement: Traversing a two way linked list.

Flow Chart :



Algorithm:

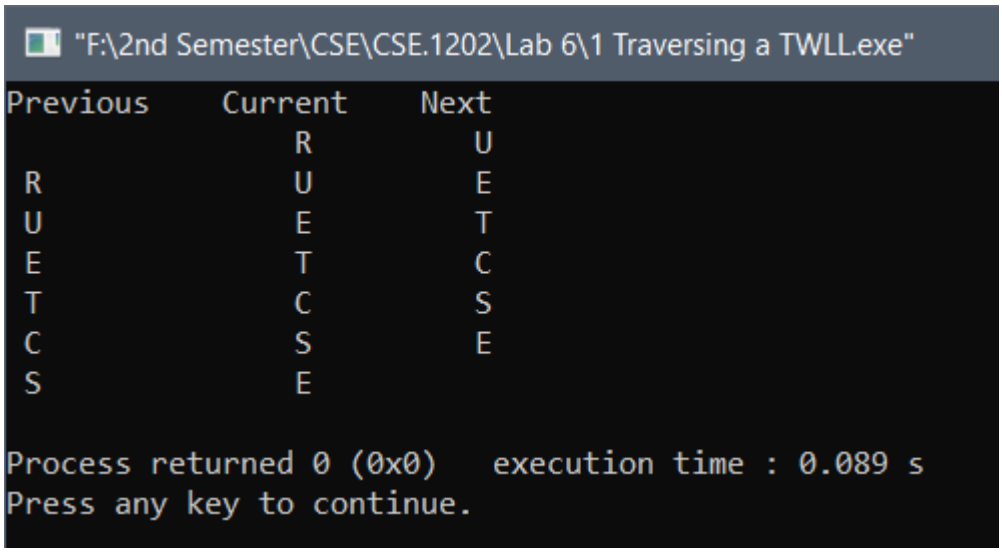
LIST is a two way linked list in memory. This algorithm traverses LIST, applying an operation PROCESS to each element of LIST. The variable PTR points to a node currently being processed.

1. Set PTR:= START
2. Repeat steps 3 and 4 while PTR≠NULL
3. Apply PROCESS to INFO[PTR]
4. SET PTR := FORW[PTR]
   [End of Repeat 2 loop]
5. Exit.

Code:

```
#include<stdio.h>

int main(){
   char INFO[12]={'\0','\0','U','E','C','R','T','E','\0','\0','S','\0'};
   int FORW[12]={12,9,8,'\0',11,3,5,7,'\0',2,4,10};
   int BACK[12]={0,0,6,11,7,0,8,3,0,0,5,0};
   int ptr,start=6,Back_start=4,avail=1;

   printf("Previous    Current    Next\n");
   ptr=start;
   while(ptr!='\0'){
      printf(" %c\t\t%c\t  %c\n",INFO[BACK[ptr-1]-1],INFO[ptr-1],INFO[FORW[ptr-1]-1]);
      ptr=FORW[ptr-1];
   }

   return 0;
}
```

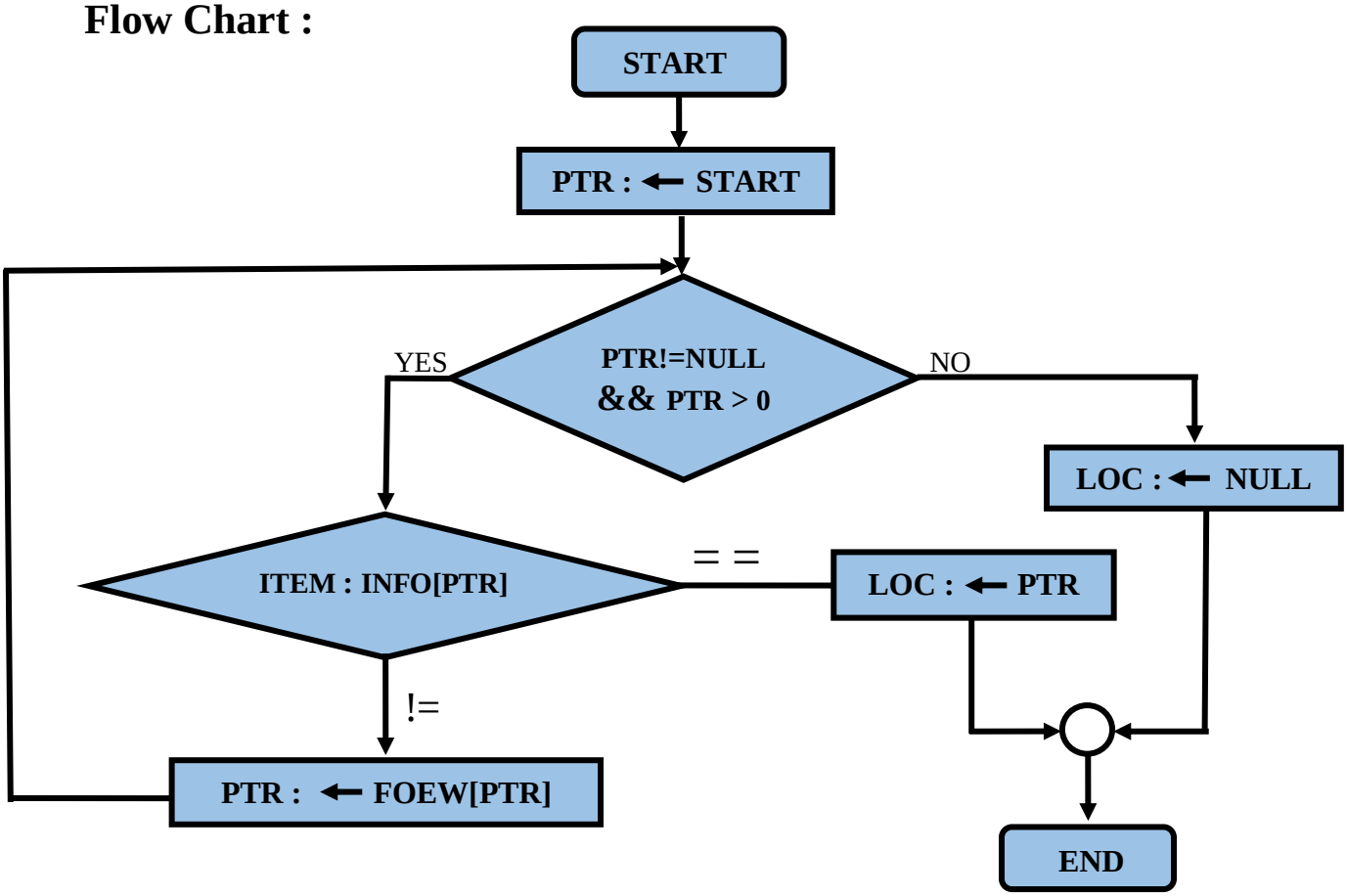
Output:



Problem No: 02

Problem Statement: Searching ITEM in a two way linked list.

Flow Chart :



Algorithm: **SEARCH (INFO, LINK, START, ITEM, LOC)**

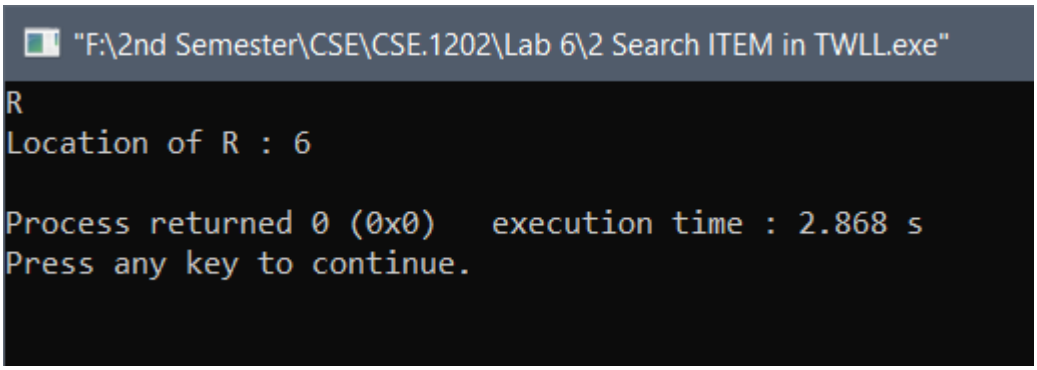
LIST is a two way linked list in memory. This algorithm finds the location LOC of the node where ITEM first appears in LIST, or sets LOC=NULL.

1. Set PTR:= START
2. Repeat steps 3 and 4 while PTR≠NULL
3. If ITEM = INFO[PTR] then:
   Set LOC:=PTR and Exit.
   Else:
   SET PTR := FORW[PTR]
   [End of If statement]
   [End of Repeat 2 loop]
4. [Search is unsuccessful] Set LOC:=NULL
5. Exit.

Code:

```
#include<stdio.h>

int main(){
   char INFO[12]={'\0','\0','U','E','C','R','T','E','\0','\0','S','\0'},ITEM;
   int FORW[12]={12,9,8,'\0',11,3,5,7,'\0',2,4,10};
   int BACK[12]={0,0,6,11,7,0,8,3,0,0,5,0};
   int ptr,start=6,Back_start=4,avail=1,LOC;

   scanf("%c",&ITEM);
   ptr=start;
   while(INFO[ptr-1]!=ITEM&&ptr!='\0'){
      ptr=FORW[ptr-1];
   }
   if(ptr=='\0')
      printf("%c not found in INFO\n",ITEM);
   else{
      LOC=ptr;
      printf("Location of %c : %d\n",ITEM,LOC);
   }

   return 0;
}
```

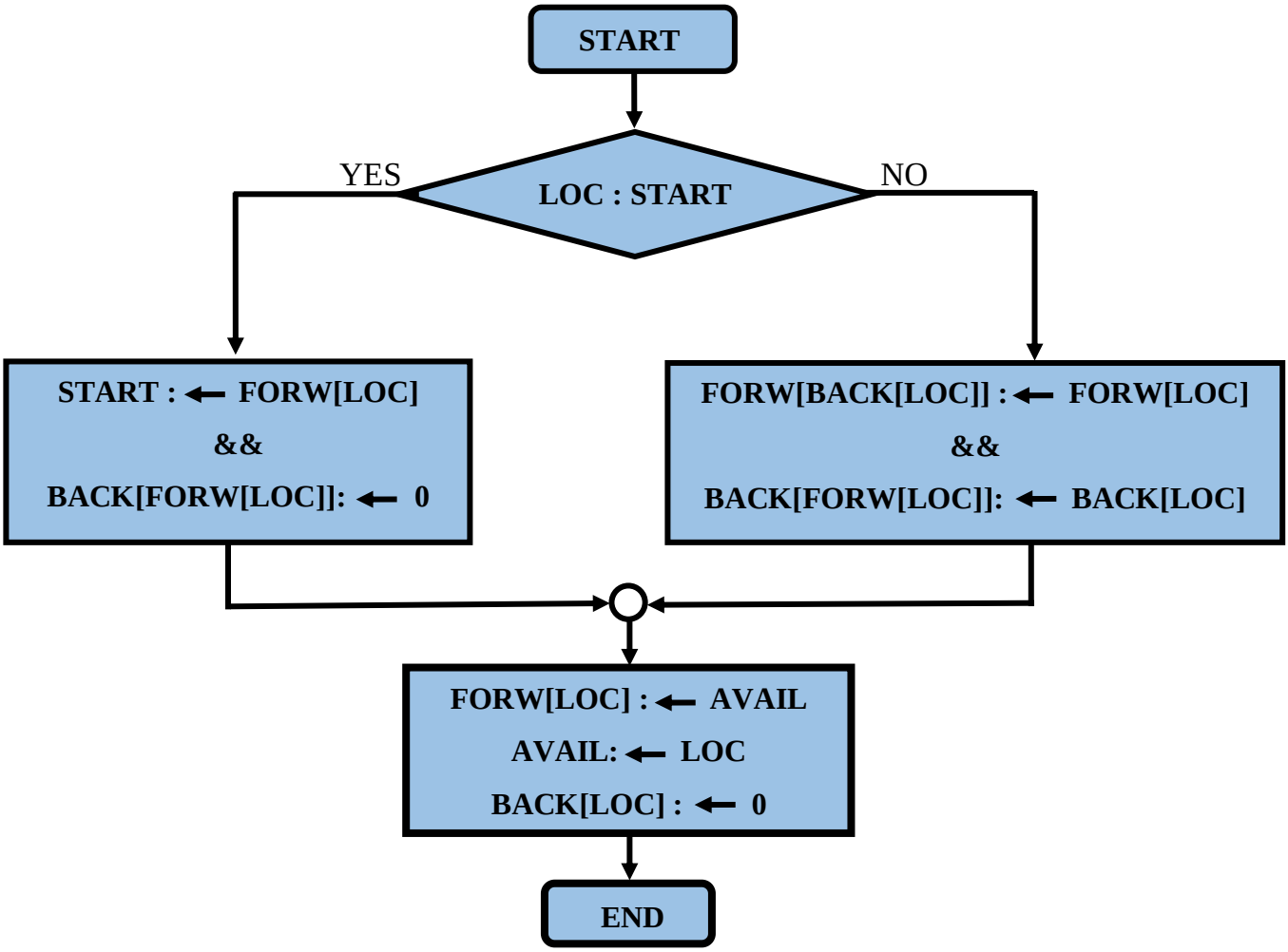
Output:



Problem No: 03

Problem Statement: Deleting a node from a two way linked list.

Flow Chart :



Algorithm: DEL (INFO, LINK, START, AVAIL, LOC, LOCP)

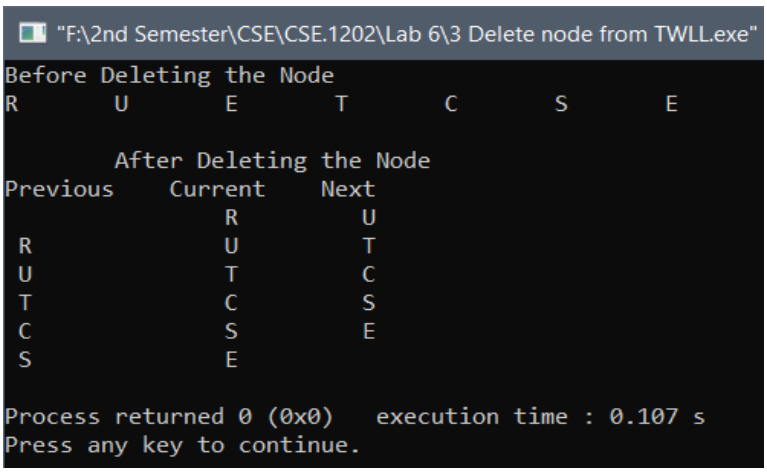
This algorithm delete the node N with location LOC. When LOC is the first node, LOC = START.

1. IF LOC=START then:
   Set START:= FORW[LOC] and
   Set BACK[FORW[LOC]]=0 . [Delete First Node]
   Else:
   Set FORW[BACK[LOC]]=FORW[LOC] and
   Set BACK[FORW[LOC]]=BACK[LOC] . [Delete N node]
   [End of IF structure]
2. FORW[LOC]=AVAIL and AVAIL=LOC and BACK[LOC-1]=0 .
3. Exit.

Code:

```
#include<stdio.h>

 int main(){
   char INFO[12]={'\0','\0','U','E','C','R','T','E','\0','\0','S','\0'},ITEM;
   int FORW[12]={12,9,8,'\0',11,3,5,7,'\0',2,4,10};
   int BACK[12]={0,0,6,11,7,0,8,3,0,0,5,0};
   int ptr,start=6,Back_start=4,avail=1,LOC=8;
   printf("Before Deleting the Node\n");
   ptr=start;
   while(ptr!='\0'){
      printf("%c\t",INFO[ptr-1]);
      ptr=FORW[ptr-1];   }
   if(LOC==start){
         start=FORW[LOC-1];
         BACK[FORW[LOC-1]-1]=0;   }
   else{
      FORW[BACK[LOC-1]-1]=FORW[LOC-1];
      BACK[FORW[LOC-1]-1]=BACK[LOC-1];
      FORW[LOC-1]=avail;
      avail=LOC;
      BACK[LOC-1]=0;  }
   printf("\n\n\tAfter Deleting the Node\n");
   printf("Previous    Current    Next\n");
   ptr=start;
   while(ptr!='\0'){
      printf(" %c\t\t%c\t  %c\n",INFO[BACK[ptr-1]-1],INFO[ptr-1],INFO[FORW[ptr-1]-1]);
      ptr=FORW[ptr-1];    }
   return 0;
 }
```

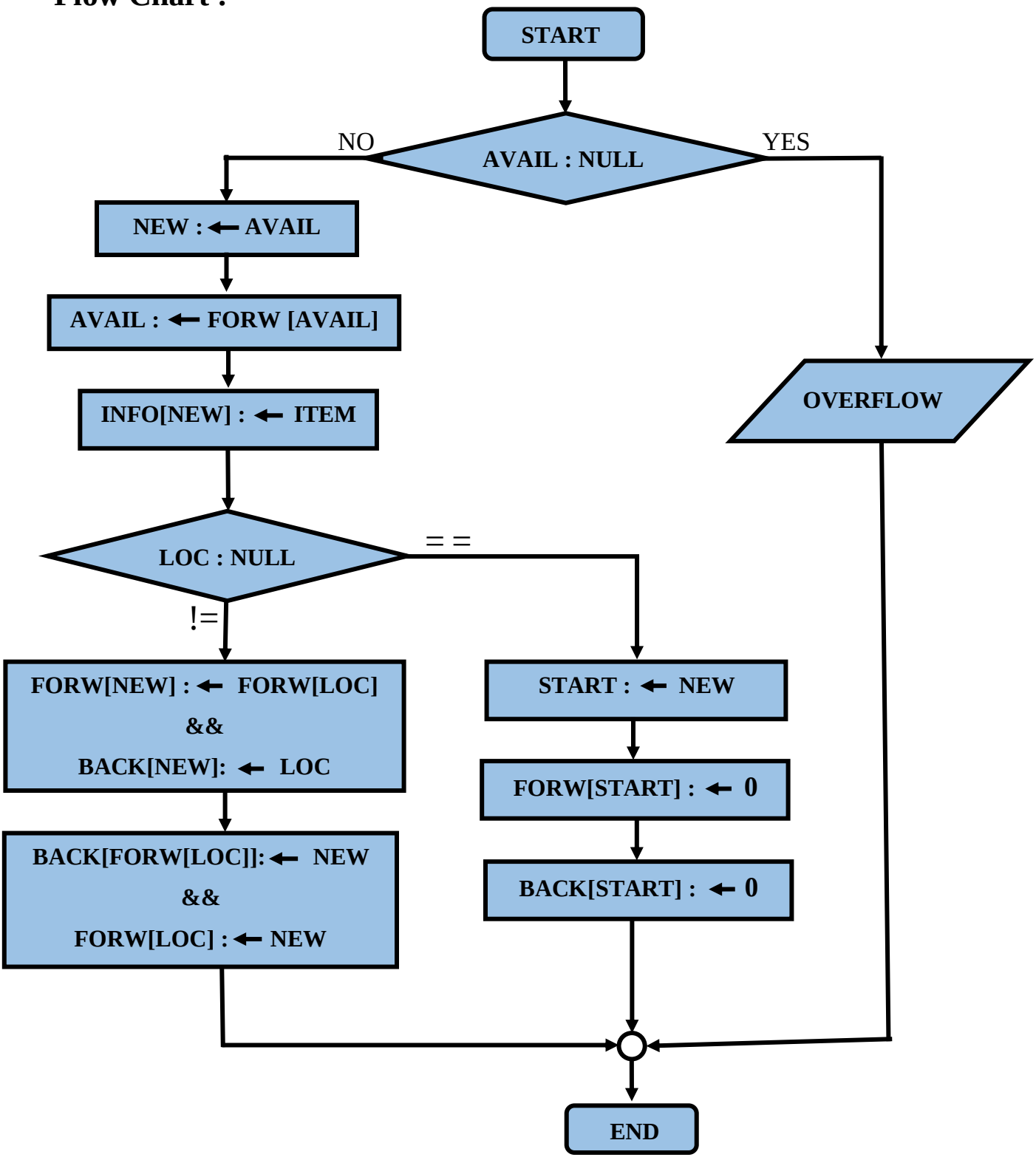
Output:



Problem No: 04

Problem Statement: Inserting a node into a two way linked list.

Flow Chart :



Algorithm: INSTWL(INFO,FORW,BACK,START,AVAIL,LOC, ITEM)

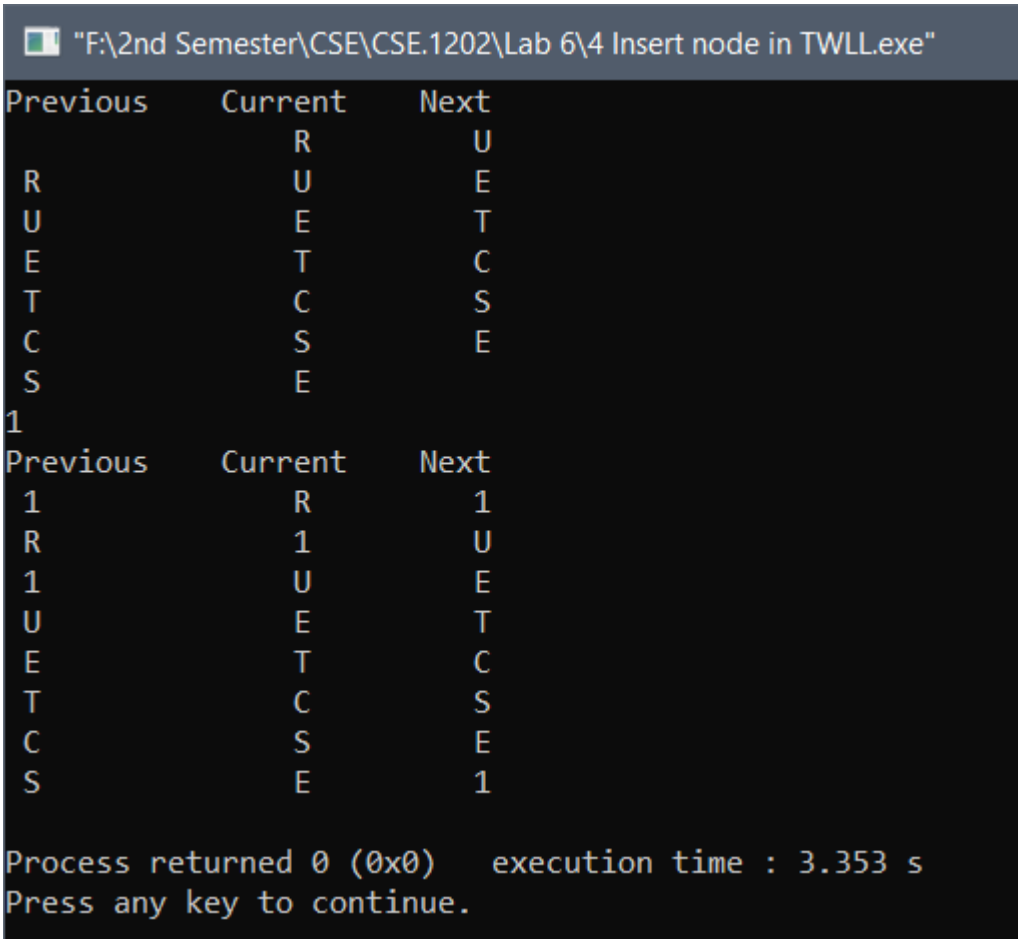
1. [OVERFLOW?] If AVAIL = NULL, then Write: OVERFLOW, and Exit
2. [Remove first node from AVAIL list]
   Set NEW := AVAIL, AVAIL:= FORW [AVAIL]
   Set INFO[NEW]:=ITEM.
2. [Insert node into list]
   If LOC=0 then
      Set START=NEW, FORW[START]=0, BACK[START]=0.
   Else
      Set FORW[NEW] := FORW[LOC], BACK[NEW]:= LOC.
      Set BACK[FORW[LOC]]:=NEW, FORW[LOC]:= NEW.
4. Exit.

Code:

```
#include<stdio.h>
 int main(){
   char INFO[12]={'\0','\0','U','E','C','R','T','E','\0','\0','S','\0'},ITEM;
   int FORW[12]={12,9,8,'\0',11,3,5,7,'\0',2,4,10};
   int BACK[12]={0,0,6,11,7,0,8,3,0,0,5,0};
   int ptr,start=6,Back_start=4,avail=1,LOC=8,New;
   printf("Previous    Current    Next\n");
   ptr=start;
   while(ptr!='\0'){
      printf(" %c\t\t%c\t  %c\n",INFO[BACK[ptr-1]-1],INFO[ptr-1],INFO[FORW[ptr-1]-1]);
      ptr=FORW[ptr-1];    }
   if(avail=='\0')
      printf("Overflow");
   else{
      New=avail;
      avail=FORW[avail-1];
      scanf("%c",&ITEM);
      INFO[New-1]=ITEM;
      if(LOC==0){  start=NEW;   FORW[NEW]=0;  BACK[NEW]=0;  }
      else{
         FORW[New-1]=FORW[LOC-1];
         BACK[New-1]=LOC;
         BACK[FORW[LOC-1]-1]=New;
```

```
        FORW[LOC-1]=New;    }
   printf("Previous    Current    Next\n");
   ptr=start;
   while(ptr!='\0'){
      printf(" %c\t\t%c\t  %c\n",INFO[BACK[ptr-1]-1],INFO[ptr-1],INFO[FORW[ptr-1]-1]);
      ptr=FORW[ptr-1];    }
   return 0;
}
```

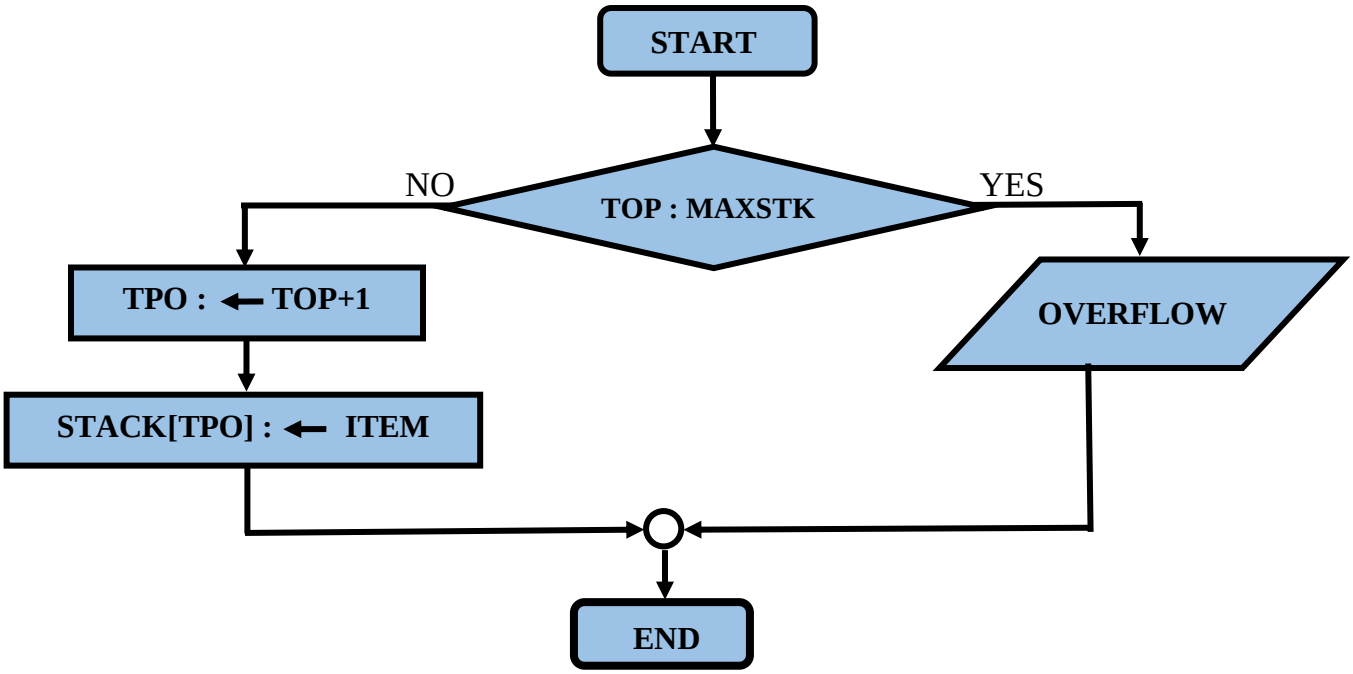
Output:



Problem No: 05

Problem Statement: Adding an item into a stack (PUSH).

Flow Chart :



Algorithm: **PUSH(STACK, TOP, MAXSTK, ITEM)**

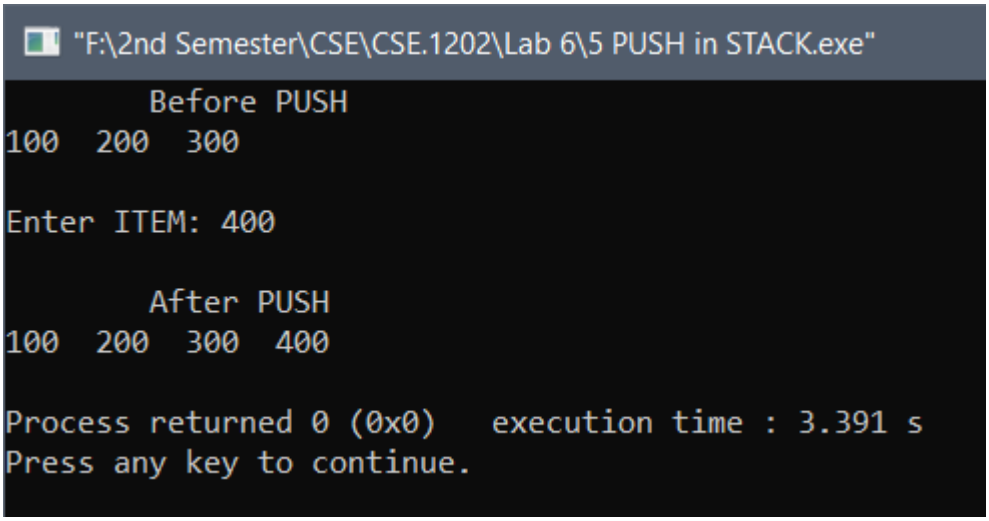
This procedure pushes an ITEM into a stack.

1. [Stack already filled]
   IF TOP = MAXSTK, then Write: OVERFLOW, and Return
2. Set TOP:= TOP+1.
3. Set STACK[TOP]:= ITEM.
4. Return.

Code:

```
#include<stdio.h>

int main(){
   int STACK[10]={100,200,300};
   int top=3,max=10,ITEM,i;

   printf("\tBefore PUSH\n");
   for(i=0;i<top;i++)
   printf("%d  ",STACK[i]);

   if(top==max)
      printf("Overflow\n");
   else{
         printf("\n\nEnter ITEM: ");
         scanf("%d",&ITEM);
      top=top+1;
      STACK[top-1]=ITEM;
   }

   printf("\n\tAfter PUSH\n");
   for(i=0;i<top;i++)
      printf("%d  ",STACK[i]);
   printf("\n");

   return 0;
}
```

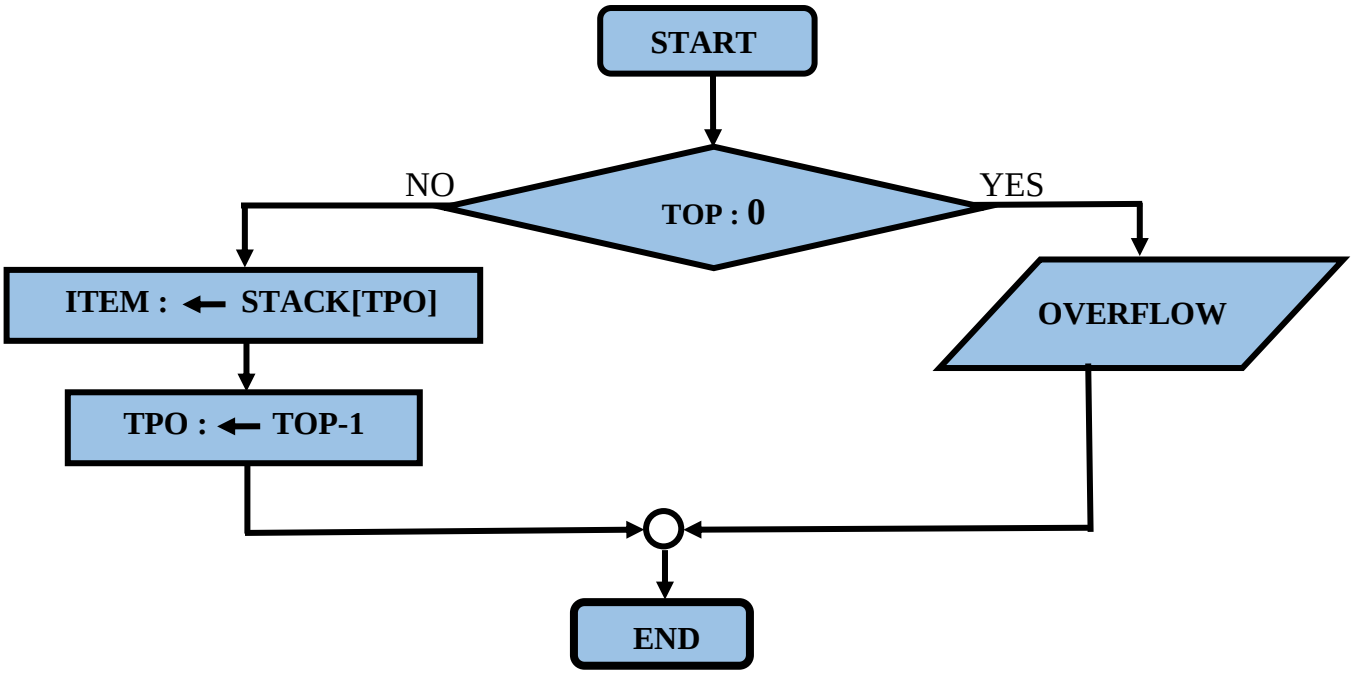
Output:



Problem No: 06

Problem Statement: Deleting an item from a stack (POP).

Flow Chart :



Algorithm: POP(STACK, TOP, ITEM)

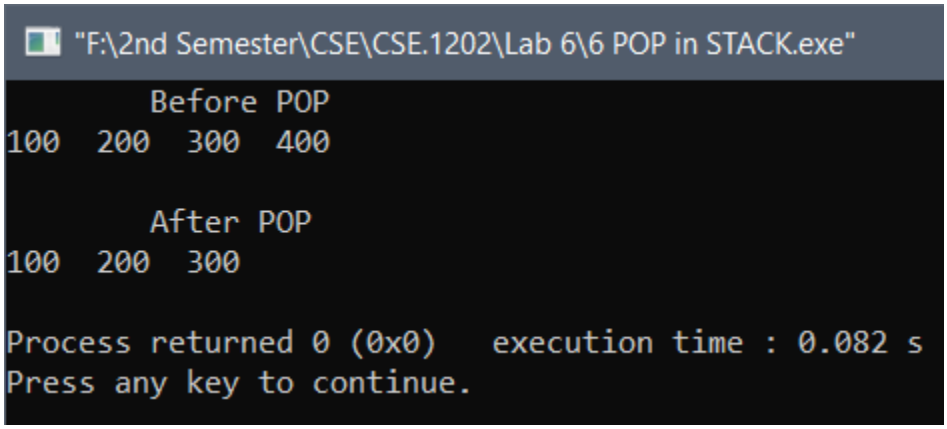
This procedure deletes the top elements of STACK and assigns it to the variable ITEM.

1. [Stack already Empty]
   IF TOP = 0 then: Write: UNDERFLOW, and Return.
2. Set ITEM:= STACK[TOP]
3. Set TOP:= TOP-1
4. Return.

Code:

```
#include<stdio.h>

int main(){
    int STACK[10]={100,200,300};
    int top=3,max=10,ITEM,i;

    printf("\tBefore POP\n");
    for(i=0;i<top;i++)
    printf("%d  ",STACK[i]);

    if(top==max)
        printf("Overflow\n");
    else{
        top=top+1;
        STACK[top-1]=ITEM;
    }

    printf("\n\tAfter POP\n");
    for(i=0;i<top;i++)
        printf("%d  ",STACK[i]);
    printf("\n");

    return 0;
}
```

Output:



 # THE END #