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

EXPERIMENT NO: 05,06 & 07
NAME OF EXPERIMENT: Two Way Linked Lists,Stack,Recursion & Queue

SUBMITTED TO:

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DATE OF EXP.: 02-10-2019
DATE OF SUB. : 09-11-2019
SERIES: 18 SERIES

MACHINE CONFIGURATION:

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

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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.

The process in which **a function calls itself** directly or indirectly is called **recursion** and the corresponding function is called as **recursive function**.

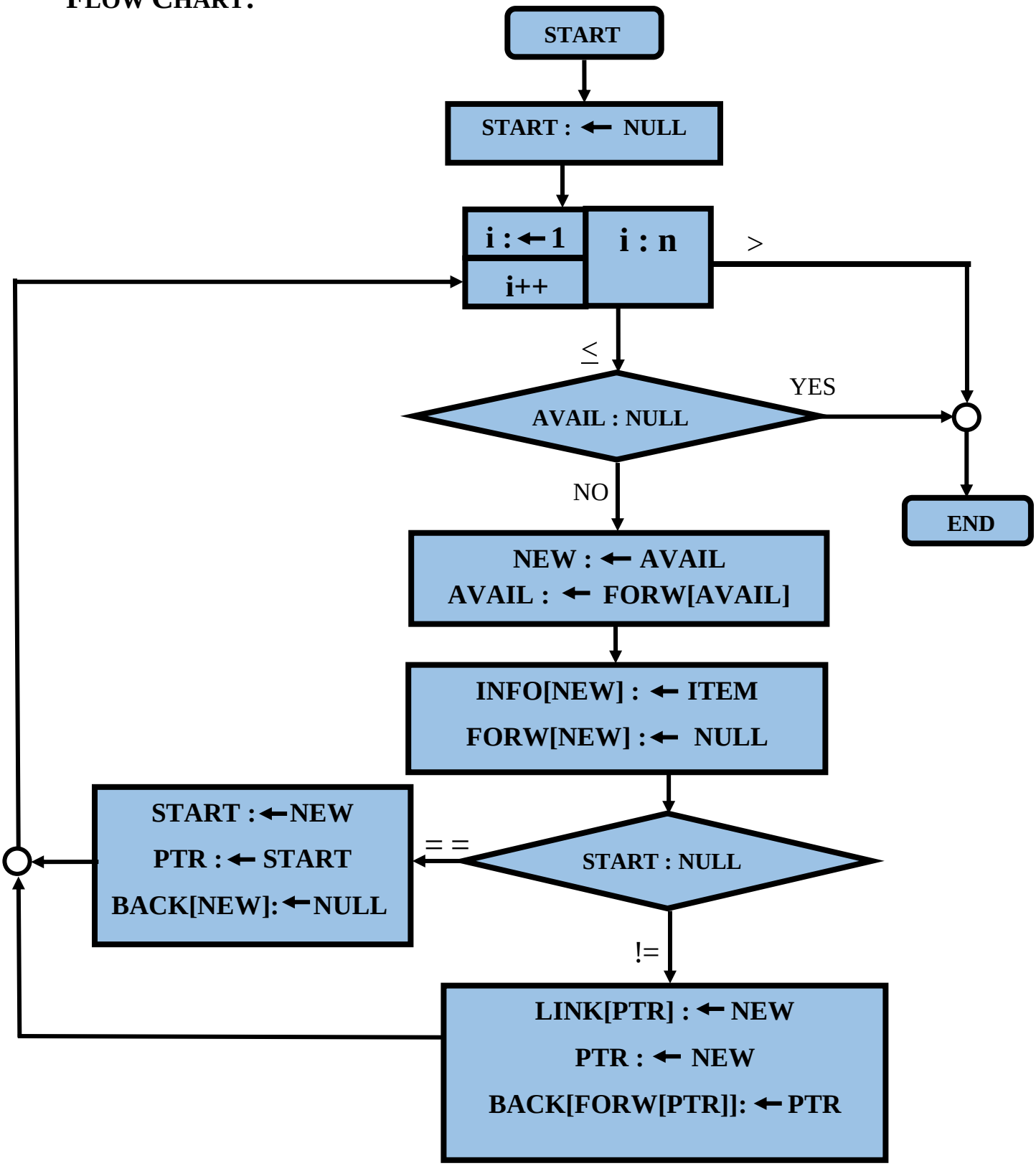
A **Queue** is a linear structure in which items may be **added** one by one only at the end or **removed** one by one only at the beginning.It means that the last item to be added to a queue is the last item to be removed.
The main concept of queue is **First In - First Out.**

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

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

PROBLEM 1: Creating a two way linked list.

FLOW CHART:



ALGORITHM:

1. (Creating a Two Way Linked List) This algorithm create a linked list with n nodes.
   a. START := NULL
   b. Repeat Steps 3 to 5 for I = 1 to N
      [OVERFLOW] If AVAIL = NULL, then:
      Write: OVERFLOW, and Exit.
2. [Remove first node from AVAIL.]
   Set NEW:=AVAIL and AVAIL := FORW[AVAIL]
3. Set INFO[NEW] := ITEM and FORW[NEW] := NULL
4. If START = NULL, then:
   Set START := NEW and PTR : = START and
   BACK[NEW]:=NULL
5. Else:
   Set FORW[PTR] := NEW and PTR = NEW and
   BACK[FORW[PTR]]:=PTR
   [End of If structure]
6. Exit.

Code:

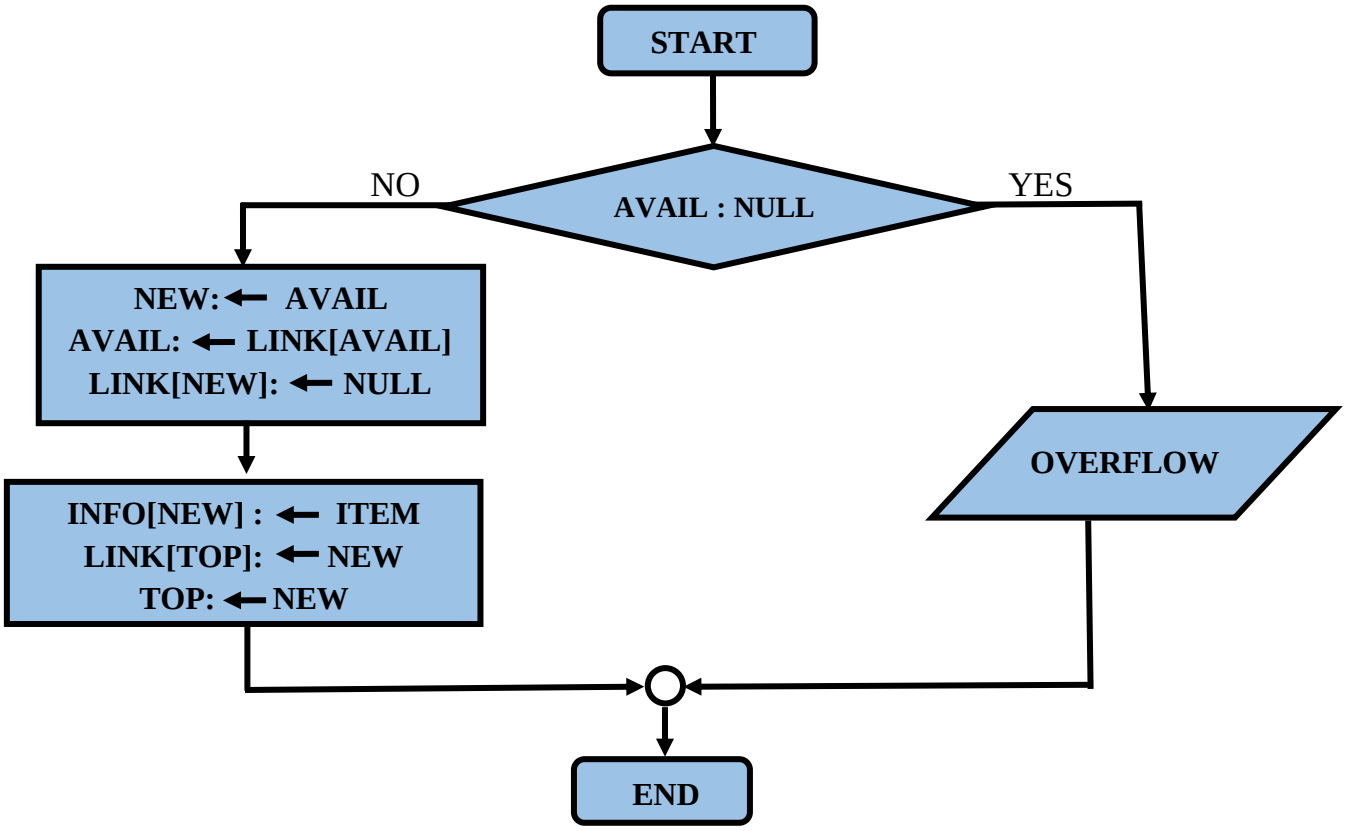
```
#include<stdio.h>

char info[15];
int forw[10]={2,3,4,5,6,7,8,9,1,-1};
int back[10];
int start=-1;
int avail=0;
static int end=-1;
int newnode(){
      int newindex;
      if(avail==-1){
         printf("\nOverflow\n");    return -1;
      }
      else{
```

```
        newindex=avail;
        avail=forw[avail];
        return newindex;
    }
}
void creat_list(){
   int ptr=-1,i,newindex;
   char ch='H';
   for(i=0;i<10;i++){
      newindex=newnode();
      if(newindex==-1)
         break;
      info[newindex]=ch;
      forw[newindex]=-1;
      if(start==-1){
         start=newindex;
         back[newindex]=-1;
         ptr=newindex;
         end=newindex;
      }
      else{
         forw[ptr]=newindex;
         back[forw[ptr]]=ptr;
         ptr=newindex;
         end=newindex;
      }
      ch++;
   }
   ptr=-1;  }

int main(){
   creat_list();
   traverse_list();

   return 0;
}
```

Problem No: 02

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

Flow Chart :



Algorithm: PUSH(INFO,LINK, TOP, AVAIL,NEW, ITEM)

This procedure pushes an ITEM into a stack.

1. [Stack already filled]
   IF AVAIL = NULL, then Write: OVERFLOW, and Return
2. Set NEW:= AVAIL and AVAIL:= LINK[AVAIL]
   LINK[NEW]:= NULL
3. Set INFO[NEW]:= ITEM and LINK[TOP]:= NEW and TOP:= NEW.
4. Return.

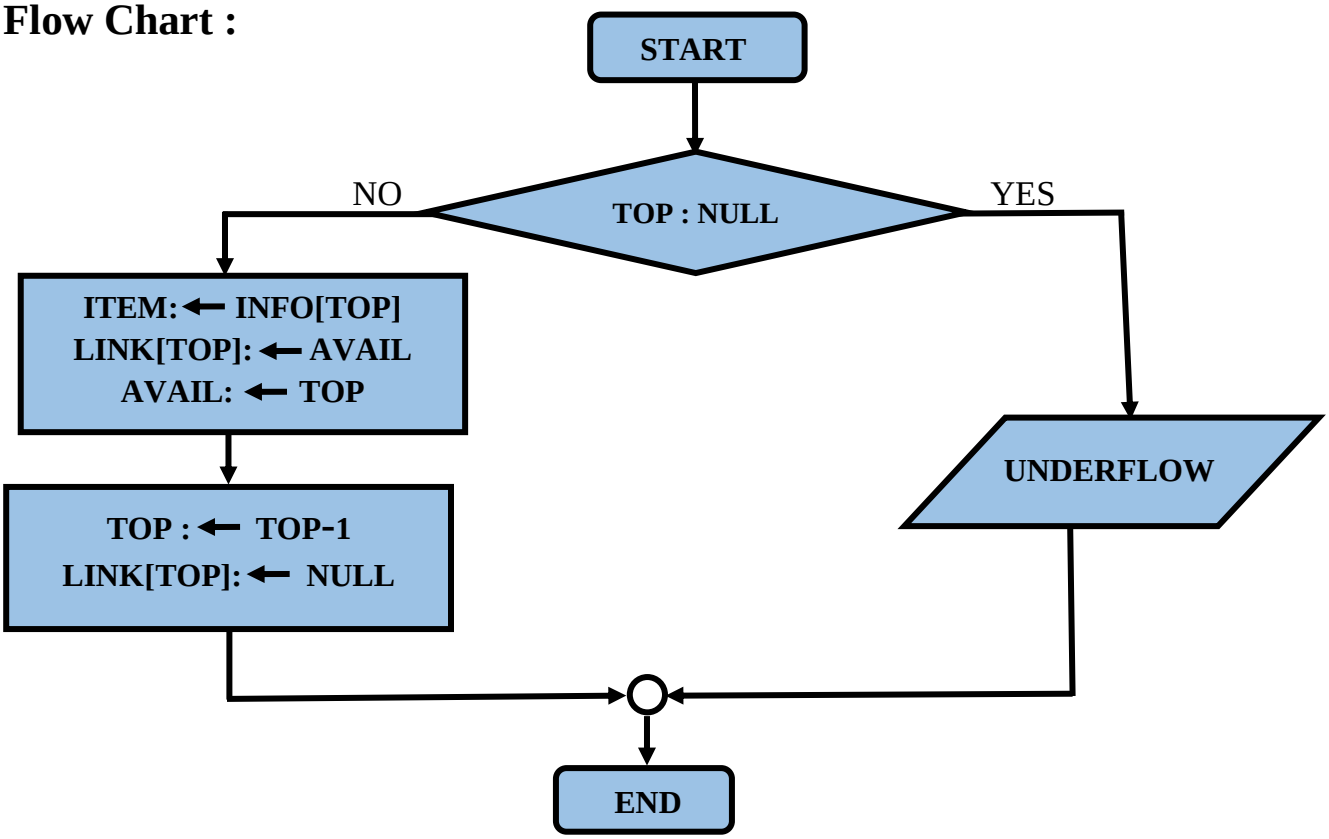
Code:

```
#include<stdio.h>

int main(){
   int info[10]={10,20,30,40,50,0,0,0,0,0};
   int link[10]={2,3,4,5,0,7,8,9,10,0};
   int start=1,top=5,avail=6,ptr,New,item;

   if(avail==0)
      printf("Overflow\n");
   else{
      New=avail;
      avail=link[avail-1];
      link[New-1]=0;
      scanf("%d",&item);
      info[New-1]=item;
      link[top-1]=New;
   }

   return 0;
}
```

Problem No: 03

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

Flow Chart :



Algorithm: **POP(INFO,LINK, TOP, AVAIL,NEW, ITEM)**

This procedure pushes an ITEM into a stack.

1. [Stack already filled]
   IF AVAIL = NULL, then Write: UNDERFLOW, and Return
2. Set ITEM:= INFO[TOP] and LINK[TOP] and AVAIL:= TOP.
3. Set TOP:= TOP-1 and LINK[TOP]:= NULL.
4. Return.

Code:

```
#include<stdio.h>

int main(){
   int info[10]={10,20,30,40,50,0,0,0,0,0};
   int link[10]={2,3,4,5,0,7,8,9,10,0};
   int start=1,top=5,avail=6,ptr,New,item;

   if(top==0)
```

```
        printf("Underflow\n");
    else{
        item=info[top-1];
        link[top-1]=avail;
        avail=top;
        top=top-1;
        link[top-1]=0;
    }

    return 0;
}
```

Problem No: 04

Problem Statement: Calculating factorial of n with recursion.

Algorithm: **FACTORIAL(FACT, N)**

This process calculates N! And returns the value in the variable FACT.

1. If N:=0, then : Set FACT:= 1 and Return.
2. Call FACTORIAL(FACT,N-1).
3. Set FACT:= FACT*N.
4. Return.
5.

Code:

```
#include<stdio.h>

int factorial(int fact,int n){
    if(n==0)
        fact=1;
    else
        fact=n*factorial(fact,n-1);
    return fact;
}
int main(){
    int n,fact;
    scanf("%d",&n);
    fact=factorial(fact,n);
    printf("\nFactorial %d =  %d\n",n,fact);

    return 0;
}
```

Problem No: 05

Problem Statement: Calculating n^{th} term of fibonacci sequence with recursion.

Algorithm: **FIBONACCI(FIB, N)**

This process calculates F_N and returns the value in the first parameter FIB.

1. If N:=0 or N:= 1, then : Set FIB:= N and Return.
2. Call FIBONACCI(FIBA, N-2).
3. Call FIBONACCI(FIBB, N-1).
4. Set FIB:= FIBA+FIBB.
5. Return.

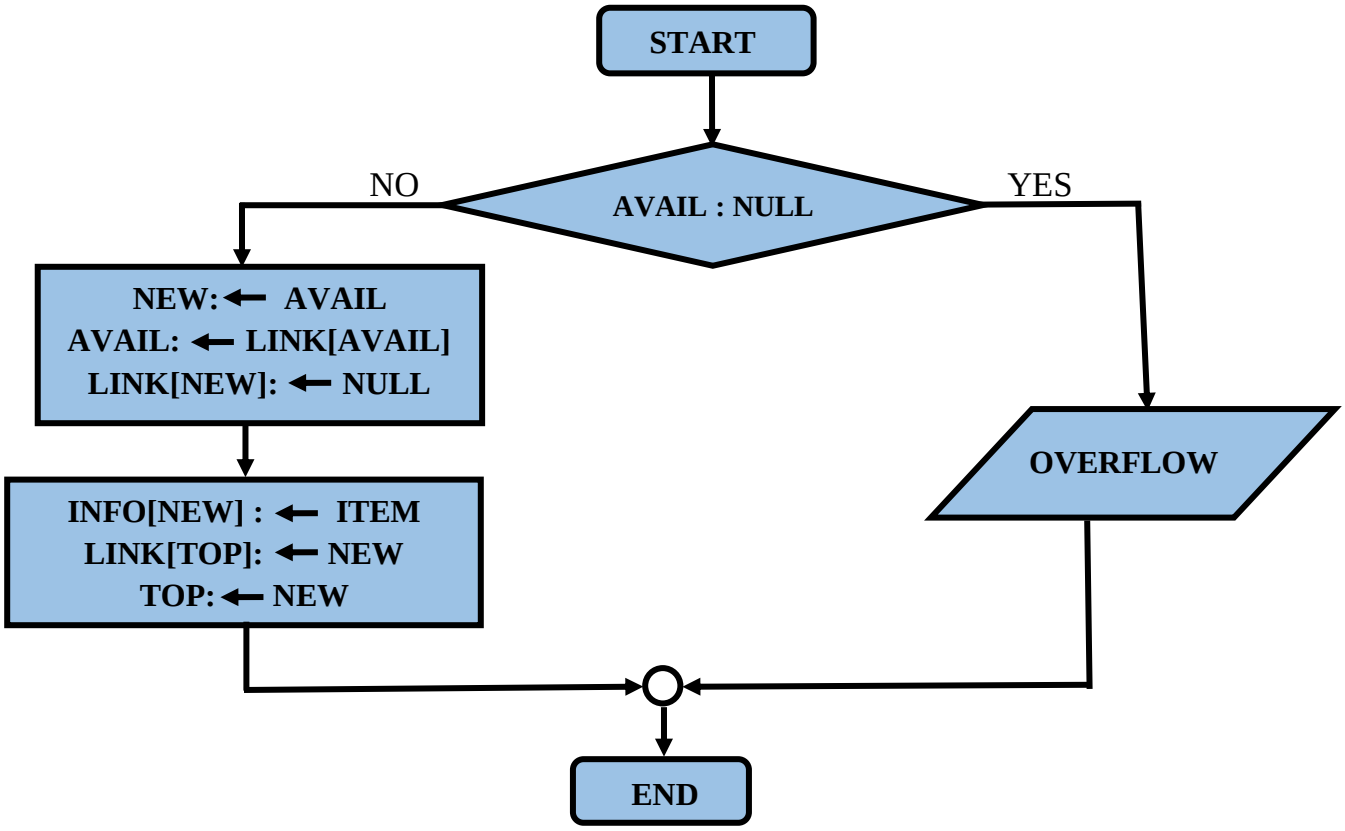
Code:

```
#include<stdio.h>

int fibonacci(fib,n){
   int fiba,fibb;
   if(n==0||n==1)
      fib=n;
   else
      fib=fibonacci(fib,n-2)+fibonacci(fib,n-1);

   return fib;
}

int main(){
   int n,fib;

   scanf("%d",&n);
   fib=fibonacci(fib,n);
   printf("\n\n%dth of Fibonacci Sequence =  %d\n",n,fib);

}
```

Problem No: 06

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

Flow Chart :



Algorithm: PUSH(INFO,LINK,TOP,AVAIL, ITEM)

This procedure pushes an ITEM into a stack.

1. IF AVAIL:= NULL, then Write: OVERFLOW, and Return.
   [Stack already filled]
2. Else Set NEW:= AVAIL and AVAIL:= LINK[AVAIL]
   and LINK[NEW]:= NULL.
3. Set INFO[NEW]:= ITEM and LINK[TOP]:=NEW
   and TOP:= NEW.
4. Return.

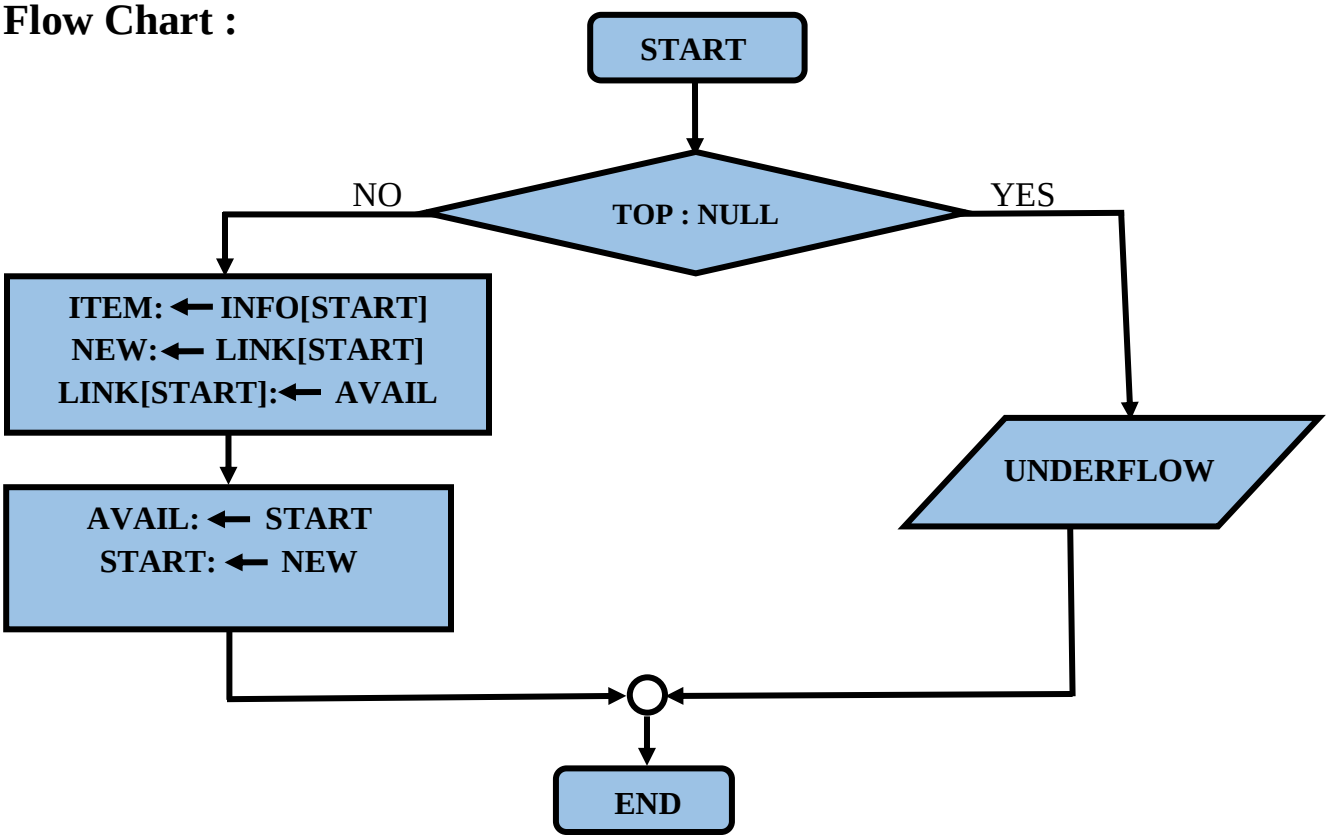
Code:

```
#include<stdio.h>

int main(){
   int info[10]={10,20,30,40,50,0,0,0,0,0};
   int link[10]={2,3,4,5,0,7,8,9,10,0};
   int start=1,top=5,avail=6,ptr,New,item;

   if(avail==0)
      printf("Overflow\n");
   else{
      New=avail;
      avail=link[avail-1];
      link[New-1]=0;
      scanf("%d",&item);
      info[New-1]=item;
      link[top-1]=New;
      top=New;
   }

   return 0;
}
```

Problem No: 07

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

Flow Chart :



Algorithm: POP(INFO,LINK,TOP,AVAIL, ITEM)

This procedure pushes an ITEM into a stack.

1. IF TOP:= NULL, then Write: UNDERFLOW, and Return.
   [Stack already empty]
2. Else Set ITEM:= INFO[START] and NEW:= LINK[START]
   and LINKSTART]:= AVAIL.
3. Set AVAIL:= START and START:=NEW.
4. Return.

Code:

```
#include<stdio.h>

int main(){
   int info[10]={10,20,30,40,50,0,0,0,0,0};
   int link[10]={2,3,4,5,0,7,8,9,10,0};
   int start=1,top=5,avail=6,ptr,New,item;

   if(top==0)
      printf("Underflow\n");
   else{
      item=info[start-1];
      New=link[start-1];
      link[start-1]=avail;
      avail=start;
      start=New;
   }

   return 0;
}
```

 # THE END #