Solutions of Review 2 Problems

1. How many function calls are performed during computing
   (i) \( F(4) \) by the algorithm
   ```
   int F(int n)
   {
     if(n==0 || n==1 || n==2)
       return 1;
     else
       return F(n-1)+F(n-2)+F(n-3);
   }
   ```
   (ii) \( C(5,3) \) by the algorithm
   ```
   int C(int n,int k)
   {
     if(k==0 || k==n)
       return 1;
     else
       return C(n-1,k-1)+C(n-1,k);
   }
   ```
   **Solution:**
   (i) 7
   (ii) 19

2. Design a function implementing the following recursive procedure.
   
   \[
   F(n) = \begin{cases} 
   1 & \text{for } n = 0 \\
   4 * F(n - 1) + 3 & \text{for } n > 0 
   \end{cases}
   \]
   What is the value of \( F(4) \)?
   **Solution:**
   ```
   int G(int n)
   {
     if(n==0)
       return 1;
     else
       return 4*G(n-1)+3;
   }
   ```
   \( F(4) = 511 \)

3. Draw the decision tree for the binary search algorithm acting on a sorted list consisting of 9 elements (if there is no middle take the “middle left” element).
   Compute the following with the help of the decision tree:
   (i) The number of possible executions
   (ii) The average number of operations
   (iii) The number of operations in the worst case
   **Solution:**
(i) 19 
(ii) \((4 \times 6 + 3 \times 10 + 2 \times 2 + 1) / 19 = 59 / 19\) 
(iii) 4 

4. Construct the Huffman tree for characters a, b, c, d, e, f, g and frequencies 21, 5, 20, 10, 18, 12, 14. What codes correspond to letters a, b, c, d, e, f, g? 

Solution:

- a: 01
- b: 1100
- c: 00
- d: 1101
- e: 111
- f: 100
5. What is the output of the following algorithm? The initial value of the pointer T_ptr is the address of the root of the tree sketched below?

```c
void T_traversal(TNode *T_ptr)
{
    if(T_ptr!=NULL)
    {
        cout << T_ptr->data << endl;
        T_traversal(T_ptr->left_link);
        T_traversal(T_ptr->right_link);
        cout << T_ptr->data << endl;
    }
}
```

Solution:

```
1
2
4
4
5
5
2
3
6
7
7
8
8
8
6
3
1
```
6. Write a function, which computes the number of nodes with one child inside a
given tree.

**Solution:**
void F(TNode *T_ptr,int& num)
{
    if(T_ptr!=NULL)
    {
        if((T_ptr->left_link==NULL && T_ptr->right_link!=NULL)
           ||(T_ptr->left_link!=NULL && T_ptr->right_link==NULL))
            num++;  
        F(T_ptr->left_link,num);
        F(T_ptr->right_link,num);
    }
}

7. Write a function, which computes the sum of data fields of internal nodes in a
given tree.

**Solution:**
void G(TNode *T_ptr,int& sum)
{
    if(T_ptr!=NULL)
    {
        if(T_ptr->left_link!=NULL || T_ptr->right_link!=NULL)
            sum=sum+T_ptr->data;
        G(T_ptr->left_link,sum);
        G(T_ptr->right_link,sum);
    }
}

8. What is the value of F(8)? Can you recognize what F is?

int F(int n)
{
    Stack<int> s;
    int i,x,y,z;

    if(n<=1)
        return 1;
    else
    {
        s.push(1);
        s.push(1);
        for(i=1;i<n;i++)
        {
            x=s.pop();
            y=s.pop();
            z=x+y;
            s.push(y);
            s.push(x);
        }
    }
s.push(z);
}
return s.pop();

Solution:
F(8)=34
This is Fibonacci’s sequence.