CMSC 341 Data Structures
Recursion Review

These quesiotn will help test your understanding of the recursion material presented in class and in the text. These questions are only a study guide. Questions found here may be found on your exam, although perhaps in a different format. Questions NOT found here may also be on your exam.

1. Describe the fundamental structure of any correctly written recursive function.

2. Define ***linear recursion***. Give an example of a common mathematical function which exhibits linear recursion.

3. Define ***tree recursion***. Give an example of a common mathematical function which exhibits tree recursion.

4. Explain what is meant by a "pending operation". How are pending operations related to ***linear*** and ***tree*** recursion?

5. The well-known Fibonacci sequence is 1, 1, 2, 3, 5, 8, 13, 21, ... and is given by the following mathematical definition
   $Fib(n) = \begin{cases} 1, & if\, n = 0\, or\, n = 1 \\ Fib(n-1) + Fib(n-2), & otherwise \end{cases}$
   Write a recursive C++ function that calculated the nth Fibonacci number.

6. Write a recursive function that counts the number of 1s in the binary representation of an integer, N. (Hint: Think about how many 1s there might be in N/2).

7. Write a recursive function named pattern whose prototype is
   VOID PATTERN(INT LITTLE, INT BIG).The funtion outputs a pattern of integers as shown by the examples below.
   pattern(1, 5) produces the output 5, 4, 3, 2, 1, 2, 3, 4, 5
   pattern(17, 20) produces the output 20, 19, 18, 17, 18, 19, 20

8. What's wrong with the following code that attempts to calculate $n!$.

```
int Factorial( int n )
{
  if( n == 0 ) return 1;
  else return n * (n - 1) * Factorial(n - 2);
}
```

9. What output is produced by the following program?

```
int mystery( int n)
{
    if (n == 0) return;
   for (int i = 0; i < n; i++)
   {
      cout << n;
      mystery (n - 1);
    }
    cout << endl;
}
int main( )
{
    mystery(3);
    return 0;
}
```