**MAT 2540: Data Structures and Algorithms II**

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| **PROJECT 4** |

The goal of this project is to make you become familiar with the recursive algorithms, and how they are implemented in a computer programming language, like C++. For this assignment, please first see the link on *Blackboard* for the **Fibonacci Sequence Program**, writtenin C++ (See <http://cpp.sh/3voyr> for the factorial program, and <http://cpp.sh/9ppjj> for the Fibonacci Program.)

**Assignment 1:**

1. The **Stern Sequence** s(n), which is a variation of the Fibonacci Sequence, is defined by **two** recursive relations:
**s(2n)=s(n)** (for even numbers 2n) and
**s(2n+1)=s(n)+s(n+1)** (for odd numbers 2n+1);
together with two initial conditions: **s(0)=0** and **s(1)=1**. Compute s(2), s(3), . . . , s(10) **by hand**, to get a feeling of how the Stern Sequence works.
2. Modify the Fibonacci Sequence program in the link above as follows: it should first asks the user for a positive integer n. Then is should print the list s(0), s(1), . . ., s(n).
3. Save the program on cpp.sh.
4. NOTE: The Stern sequence has very interesting properties. For example, even though there are repetitions in the sequence {s(n)}, the ratios {s(n}/s(n+1)} are all different. Morever, it turns out that for any given rational number a/b (for example 214/73), you can always find a number n, so that s(n)/s(n+1)= a/b. You may want to watch the Numberphile video: <https://www.youtube.com/watch?v=DpwUVExX27E>

**Assignment 2:**

1. First, find a recursive relation that for the number a(n) of ternary bit strings of length n that contain two consecutive 0's. (This was one of the worksheet problems, which was also discussed in class.). Determine the two initial conditions a(0) and a(1).
2. Modify the Fibonacci Sequence program so that it computes a(n) mentioned above. Your code should first ask the user for a positive number n. Then, it should print a(n).
3. Think about other possible uses of the code you've written. Extend your code.
4. **BONUS**: Modify the program even more, so that it not only computes the number, but also lists the ternary strings of any given length that contain two consecutive 0's.

**Submit the following by e-mail by the due date:**

1. Two cpp.sh links (or souce codes) containing the code for Assignment 1 and Assignment 2.
2. A short paragraph that explains how you extended the code in Assignment 2 to accomplish other tasks.

**Grading Scheme:**

**70% for the accuracy**: Your code is expected to do everything what is asked in the assignment. It must be error-free. Especially if you are working on this assignment in pairs...

**20% for the clarity**: You are expected to write comments within your code that explain the role of each of the line you add to the original code. Pay attention to spacing and indentation. Name your variables and functions appropriately.

**10% for additional work**: Think of other possible uses of the code you've written, and extend it to make it more useful.