CSci 1113: Introduction to C/C++
Programming for Scientists and Engineers
Homework 6
Spring 2020

Due Date: Friday, April 3, 2020 before 11:55pm.

Instructions: This is an individual homework assignment. There are two problem worth 20 points each. Solve the problem below by yourself (unlike the labs, where you work collaboratively), and submit the solution as a C++ source code file. Here are a few more important details:

1. Unlike the computer lab exercises, this **is not** a collaborative assignment. You must design, implement, and test the solution to each problem on your own without the assistance of anyone other than the course instructor or TAs. In addition, you may not include solutions or portions of solutions obtained from any source other than those provided in class: examples from the textbook, lectures, or code you and your partner write to solve lab problems. Otherwise obtaining or providing solutions to any homework problems for this class is considered academic misconduct. See the "collaboration rules" file on the class website page for more details, and ask the instructor if you have questions.

2. Because all homework assignments are submitted and tested electronically, the following are important:
   - You follow the naming conventions mentioned at the end of the problems.
   - You submit the correct file(s) on gradescope (https://www.gradescope.com/) by the due deadline.
   - You follow the example input and output formats exactly given in each problem description.
   - **Regardless of how or where you develop your solutions, your programs compile and execute on gradescope computers (which run Linux/Ubuntu operating system like the cselabs machines).**

3. The problem descriptions will usually show at least one test case and the resulting correct output. However, you should test your program on other test cases (that you make up) as well. Making up good test cases is a valuable programming skill, and is part of ensuring your code solution is correct.

Problem A: Golden ratio (20 points)
The golden ratio is defined as:

$$\frac{1+\sqrt{5}}{2}$$

You can approximate this using a **recursive** function:
gold(n) = 1 + 1/gold(n-1)
... where gold(0) = 1

Have the user enter a number, then use this approximation to display the estimated ratio using the formula above.

Example 1 (user input is underlined):

```
Enter number for approximation:
9
1.61818
```

Example 2 (user input is underlined):

```
Enter number for approximation:
1
2
```

When you are done, name the source code file hw6A.cpp. Then log into gradescope and upload your file for the "Homework 6A" submission. **If you name your file incorrectly it will be unable to compile and run your code, so you will fail all test cases**. You may submit cpp files as many times as you want until the deadline to try and fix the code if you fail a test case. Following rigorous naming conventions and using test cases are something computer programmers often must do in "real life" programming , and so submitting your program with the correct name and functionality is part of doing this assignment correctly.

Problem B: Collatz Problem (20 points)
The "Collatz Problem" is an unsolved mathematics problem you can read about here if you want some background:
https://mathworld.wolfram.com/CollatzProblem.html

Much like the Fibonacci numbers, this creates a sequence of numbers and is defined as:
c(n) = c(n-1)/2 ... if c(n-1) is even
c(n) = 3*c(n-1) + 1 ... if c(n-1) is odd

So... if you started with the number 7 as c(0)... then the next number, c(1), would be 3*7+1 = 22 (as the previous number was odd). Then c(2) would be 22/2 = 11 (as the previous number was even). And so on. This continues until you reach the number 1, at which point the sequence stops.

Ask the user to enter a starting number from the keyboard, then display the number sequence. **Please ensure you use recursion to solve this problem and the words "for", "while" or "goto" do not appear in your program (even in a comment).**

Example 1 (user input is underlined):

```
Enter first/initial number:
2
2 1
```

Example 2 (user input is underlined):

```
Enter first/initial number:
3
3 10 5 16 8 4 2 1
```

Example 3 (user input is underlined):

```
Enter first/initial number:
7
7 22 11 34 17 52 26 13 40 20 10 5 16 8 4 2 1
```

When you are done, name the source code file hw6B.cpp. Then log into gradescope and upload your file for the “Homework 6B” submission. **If you name your file incorrectly it will be unable to compile and run your code, so you will fail all test cases**. You may submit cpp files as many times as you want until the deadline to try and fix the code if you fail a test case. Following rigorous naming conventions and using test cases are something computer programmers often must do in “real life” programming, and so submitting your program with the correct name and functionality is part of doing this assignment correctly.