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15-121 Fall 2021 Quiz 2

No calculators, no notes, no books, no computers, no other people. Take this quiz in 20 minutes (time yourself) and upload your work when done. All students who make a real attempt will receive full marks. (So there is no benefit to cheating.)

1. (2 points) **Short Answer**

Write a few lines of code (3-7) that input, from the user, their current age and the prints out how old they will be 10 years from now. (You are not writing a full function, just some lines of code.)

2. (4 points) **Code Tracing:** Indicate what the following program prints. Place your answer (and nothing else) in the box under the code.

```
public class IncrementorExercise {
    public static void main(String[] args) {
        int b = 7;
        int a = 4;

        System.out.println(--b - a++ + ++b - --a + a++ - b++);
        System.out.println(a);
        System.out.println(b);
    }
}
```

3. **Free Response:** Consider the following description (from Wikipedia) of the Collatz conjecture:

The Collatz conjecture is a conjecture in mathematics that concerns sequences defined as follows: start with any positive integer n . Then each term is obtained from the previous term as follows: if the previous term is even, the next term is one half of the previous term. If the previous term is odd, the next term is 3 times the previous term plus 1. The conjecture is that no matter what value of n , the sequence will always reach 1.

Consider the sequence starting from the number 3:

- 3 is odd, so the next term is $3 * 3 + 1 = 10$.
- 10 is even, so the next term is $\frac{10}{2} = 5$.
- 5 is odd, so the next term is $3 * 5 + 1 = 16$.
- 16 is even, so the next term is $\frac{16}{2} = 8$.
- 8 is even, so the next term is $\frac{8}{2} = 4$.
- 4 is even, so the next term is $\frac{4}{2} = 2$.
- 2 is even, so the next term is $\frac{2}{2} = 1$.

So, the sequence was: 3, 10, 5, 16, 8, 4, 2, 1. There are 8 numbers in the sequence.

- (a) (8 points) Write the function `calcCollatz(int n)` which, given an integer n , prints out all of the numbers in the sequence and then returns the how many numbers were in the sequence.

For example, calling `calcCollatz(3)` will *return* 8, and *print*:

```
3
10
5
16
8
4
2
1
```

```
public int calcCollatz(int n) {
```

- (b) (6 points) Write the function `collatzSeqLength(int len, int a, int b)` which returns the smallest number `n`, with $a \leq n \leq b$, which starts a Collatz sequence of length `len`. So, for example, calling `collatzSeqLength(8,1,100)` will return 3, because 3 is the smallest number ≥ 1 and ≤ 100 that begins a Collatz sequence of length 8.

If there is no correct answer in the given range, then return -1.

You may assume that your solution to `calcCollatz()` works, even if yours does not.

```
public int collatzSeqLength(int len, int a, int b) {
```