02-201 Homework 0 Fall 2015 DUE: Friday, January 22 at the beginning of class.

Reading: Read chapters 1 and 2 of the "Introduction to Go Programming" textbook, which is available online here.

Then read "Memorable dates that always land on Doomsday" at the Wikipedia article on the Doomsday algorithm:

0. Piazza. Make sure that you are able to sign into the course's Piazza page at: https://piazza. com/cmu/spring2016/02201.

1. Getting the hang of the command line. We will run programs in this class by navigating the command line (which you can reach by visiting "Command Prompt" in Windows and "Terminal" in Mac). To learn the basics, complete Units 1 and 2 of "Learning the Command Line" at Codecademy: https://www.codecademy.com/learn/learn-the-command-line. (Note: you do not need to complete the quizzes, so don't sign up for Codecademy Pro.)

2. Going Go. Install or find a way to run "Go" and to create a text file. See the "Resources" page on Piazza for instructions on how to do this for various types of computers.

Then visit Autolab (http://autolab.andrew.cmu.edu) and submit a program called name.go that prints your name. (You don't necessarily need to understand all the aspects of how this program works yet, but you should be able to experiment to get your program working.)

The following problems should be turned at the beginning of class on Friday, January 22.

2. Doomsday. Write pseudocode for a function based on the Doomsday Algorithm that takes a date in 2016 as input and generates the day of the week that day falls on as output. (Hint: 2016 is a leap year, and the "Doomsday" in 2016 is Monday.)

3. Practicing pseudocode. Write pseudocode for each of the following programs. You might like to define subroutines to help you along the way:

• Generalized Fibonacci sequences: A generalized Fibonacci sequence is defined by two starting integers a_0 and a_1 using the rule:

$$a_i = a_{i-1} + a_{i-2}$$

for $i \ge 2$. Write a function GenFib(a0, a1, n) that takes 3 integers and returns the *n*th number in the generalized Fibonacci sequence defined by a_0 and a_1 .

• Hailstone function: The Hailstone function h(n) is defined by:

$$h(n) = \begin{cases} n/2 & \text{if } n \text{ is even} \\ 3n+1 & \text{if } n \text{ is odd} \end{cases}$$

The Hailstone sequence for n is defined by repeatedly applying this function:

 $h(n), h(h(n)), h(h(h(n))), \ldots$

For example, the Hailstone sequence for n = 19 is

19, 58, 29, 88, 44, 22, 11, 34, 17, 52, 26, 13, 40, 20, 10, 5, 16, 8, 4, 2, 1.

It has been conjectured (but never proven!) that for all n, this sequence eventually returns to 1.

Write a function HailstoneReturnsTo1(n) to compute the smallest number of times h must be applied to n before the sequence returns to 1. For example, for n = 2 your function should return 1, and for n = 19 your function should return 20.

• Finding Minimum Skew (from class). Write a function that takes a DNA string (representing a bacterial genome) as input and returns the positions in this string having minimum skew. (Hint: first construct an array containing the skew value at each position.)

4. The moving microscope. You have a microscope arm positioned someplace over a field — you don't know exactly where. In the field is a cell where the cell wall has been stained so it shows up very dark. We assume the field is divided into discrete units (analogous to pixels). The situation looks something like this:



where the microscope arm is positioned at the shaded circle in this example, and this particular stained cell wall is shown as black squares.

The microscope can be given the following commands:

- LEFT, RIGHT, UP, DOWN: move one unit in the given direction
- CHECK_IF_WALL: reports whether the microscope is currently positioned over the cell wall.
- GET_COORDINATES: reports the (x, y) coordinates of where the microscope is currently.

You don't know what shape the cell wall will take and you don't know where the microscope will start. However, you can assume that:

a. the microscope starts on the outside of the cell.

b. for any cell-wall (filled) unit, exactly two of its adjacent units to the N, S, E, W are also filled (such as below or rotations of below):



Describe a procedure (in English) that will move the microscope from wherever it is to someplace *into the interior* of the cell. Your procedure should work no matter where the microscope starts outside the cell and for any cell shape that obeys restriction (b) above.