CS 1110, LAB 11: LOOPS AND INVARIANTS

http://www.cs.cornell.edu/courses/cs1110/2013fa/labs/lab11.pdf

First Name: _____ **Last Name**: _____ **NetID**: _____

Once again, this lab focuses on while loops. However, this time you need to use invariants to design your loops and verify that they are correct. We have tried to keep thus lab short again, but that affects when this lab is due. **Pay close attention to how to get credit for the lab**.

Lab Materials. We have created a single file for this lab: `lab11.py`. You can download it from the Labs section of the course web page. You will modify this file, as well as answer some questions on this worksheet. You need to show both to your instructor to get credit for the lab.

Getting Credit for the Lab. When you are done, show both this handout and `lab11.py` to your instructor. You instructor will then swipe your ID card to record your success. You do not need to submit the paper with your answers, and you do not need to submit the computer file.

While it is okay if you do not finish the lab during class time, remember that there is *no official lab next week* because of Thanksgiving. We will hold lab on Tuesday for students who want the help, but there is no lab on Wednesday. However, this is an important enough lab that we do not want it to wait until after Thanksgiving. Therefore, **you must turn in this lab by Tuesday of next week**. You can turn it in at any lab section on Tuesday, or during consultant hours.

WRITTEN EXERCISES

Completing Assertions. Each line below contains an assertion P guaranteed to be true. It also contains an assertion R, which we would like to be true. In the righthand column, put a boolean expression that, when true, allows us to conclude R is true. We have filled in the first one for you.

Know P	Want R	Additional Info Needed
x is the sum of 1..n	x is the sum of 1..100	`n == 100`
x is the sum of 1..(n−1)	x is the sum of 1..100	
x is smallest element of the segment s[0..k−1]	x is smallest element of the segment s[0..len(s)−1]	
x is no. of blanks in s[0..k-1]	x is no. of blanks in s[0..]	
x is the smallest element of the segment s[h..]	x is the smallest element of the segment s[0..]	
x is the product of k..n	x is the product of 1..n	
b is True if nothing in h..k divides x; False otherwise	b is True if nothing in m..k divides x; False otherwise	

Course authors: D. Gries, L. Lee, S. Marschner, W. White

Preserving Invariants. Below is a precondition P, an assignment to a variable, and P rewritten as a postcondition. At the place indicated, write a statement so that if P is true initially, it will be true afterward (as indicated). The statement can be in English, if you are not sure how to write it in Python, but make it a command to do something. In the exercises below, `v` is a list of `ints`.

```
(a) # P: x is the sum of 1..n          (b) # P: x is the sum of h..100
    # Put a statement here:                # Put a statement here:

    n = n + 1                              h = h - 1
    # P: x is the sum of 1..n              # P: x is the sum of h..100




(c) # P: x is the minimum of v[0..k-1]  (d) # P: x is the minimum of v[h..100]
    # Put a statement here:                # Put a statement here:

    k = k + 1                              h = h - 1
    # P: x is the minimum of v[0..k-1]     # P: x is the minimum of v[h..100]
```

Designing Loops With Invariants

Inside of `lab11.py` you will see the specifications of four functions. You are to implement **the first three of the functions in this module**. The last function is optional.

Each implementation must contain a while-loop. Write one at a time, implementing the specification that we give you. When a loop invariant has not been given (such as with the last function), write your own.

Make sure each function is correct before proceeding to the next one. Do this by writing suitable calls in the interactive prompt or making a unit test (though we do not ask that you turn in these tests). Use enough different test cases so that you really are sure that the function is correct. If the function uses a string value, make sure that it works on an empty string (one whose length is 0). File `lab11.py` contains additional comments.

You may not finish these functions during the lab. Near the end of the lab, show an instructor or consultant what you have done so far. If necessary, complete the lab **before leaving for Thanksgiving** and show what you have done to an instructor or consultant then.