SM450
Take home Exam 1
Prof Joyner

You may use class notes, class text, Python books or the internet, but please reference your use with appropriate detail. Work on your own and no serious discussion (questions like “Did you finish Problem 2 yet?” are okay) of the exam with others until they are all handed in.
Due Friday, 2010-02-19.

1. Write a Python program to convert fahrenheit to celcius. Document your code with examples and references as in §9.2 and §9.4 of the notes (using Wikipedia is okay).

2. To start, in Python, define $A = [2, 3, [4, 5], 6]$, then define $B = A$ and $C = copy(A)$ (You may need to import the copy command using from copy import * or import copy.)
   • Set $C[2] = 1$. What is A, B, C?
   • Start over. Set $C[2][1] = 1$. What are A, B, C?

3. Using the ideas in §8.3.2, write a program to compute the 12-th Lucas number, as defined in P.59, §8.3.3.

4. Write a program `collatz` which has
   INPUT: $n$ - integer $\geq 1$
   OUTPUT: An integer given by
   
   \[
   1, \quad \text{if } n = 1,
   
   \frac{n}{2}, \quad \text{if } n \text{ is even},
   
   3n + 1, \quad \text{if } n \text{ is odd},
   \]
   (See the Wikipedia entry on the Collatz conjecture if you are interested in the underlying question.) How many times you have to iterate your program starting at $n = 100$ ($n_1 = 100$, $n_2 = \text{collatz}(n_1)$, $n_3 = \text{collatz}(n_2)$, ...) before you get to 1? In your program, be careful of what type you are returning.

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5. Explain and properly comment the following program.

```python
def silly(y, x=3):
    z=x
    while(z>0):
        y = y+x
        z = z-1
    return y
```

In other words, add docstrings, formatted as in §§9.2 and 9.4. In particular, explain x=3.

6. Consider the extended Euclidean algorithm as implemented in the second program listed in §6.2, Example 4, of the notes. Modify that program to create a table of values of all the key variables for for each step of the while loop for the case $a = 24$, $b = 15$. (Include the program and the table in your solution.)

7. A bowl of marbles in your math classroom contains 2009 green marbles and 2010 red ones. Every time you go to class, you must pick 2 marbles. If you pick 2 marbles of the same color, your math professor generously adds a red marble to the bowl. If you pick 2 marbles of different colors, your math professor generously adds a green marble to the bowl. What is the color of the last marble and how many times (in a worst case scenario) do you have to go to class before one of the bowls is empty? (Okay, this can be solved with no programming, but if you can program this, you will get extra credit.)