Version: 2/2/2013 (3:30 PM)

HW4: CS 110X C 2013

Note: This homework (and all remaining homework assignments) is a **partner homework** and must be completed by each partner pair. When you complete this assignment, you must not share your answers with any other student. Only one person from a partner pair needs to submit the assignment.

Q1	Working with Functions and While Loop

Skills

Lecture Dependency

Feb-1

In a past homework assignment, you wrote code to compute newton's method 10 times for a given `f(x)` and its `derivative(x)`.

Now, write two helper functions `f(x)` and `derivative(x)` using the structure as you saw in lab3 (and in class on February 1st). Write a `newtonMethod()` function that uses a `while` loop to compute a root given an initial guess. This `while` loop will terminate only when no more accuracy can be gained from the iteration. Review the provided code example to see how this would work.

Sample Output

```
>>> newtonMethod()
Enter initial guess for root 2
4.11795316565
3.37028590044
3.20769863535
3.20001689463
3.20000000008
3.2
The root 3.2 was found in 6 iterations
```

Define "no more accuracy" as follows. Stop the `while` loop when two successive computations are within 1e-9 of each other (i.e., .000000001).

Use `f(x)` = $x^3 + 7.5x^2 - 18.94x - 48.96$ and `derivative(x)` = $3x^2 + 15x - 18.94$

Hint: Look at my solution working with sums of negative powers, provided with the template as a basis for this assignment.

Also: Experiment with a variety of sample inputs to find the three roots of `f(x)` and report them in your solution.

Important: Report your roots by adding a variable like this:

```
Q1_roots = [0.0, 0.0, 0.0]
```

Where you replace the 0.0 above with the values you determine.

Q2	Demonstrate knowledge of functions that have parameters

Skills

Lecture Dependency
Feb-1

The Collatz conjecture in mathematics is based on the following function `collatz(n)`. If n is an even number, then `collatz(n)` = n/2; if n is an odd number, then `collatz(n)` = 3*n + 1

One of the interesting observations about this function is that for any integer n > 1, you can generate a series n0, n1, n2, n3, … as follows:

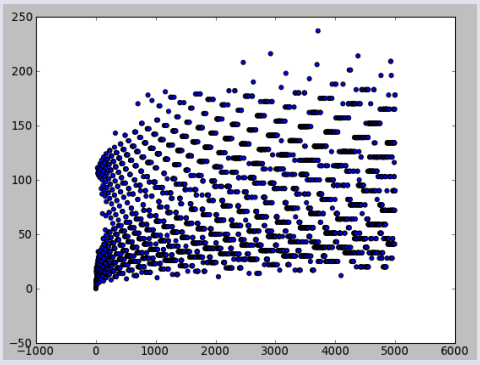
n0 = initial number
n1 = collatz(n0)
n2 = collatz(n1)
n3 = collatz(n2)
…

Sample Output

```
>>> collatz(6)
3
>>> collatz(5)
16
```

No one has been able to prove (or disprove) the simple claim that eventually you will reach 1 after a finite number of iterations. For example, if you start with 6, then after 8 iterations you will reach 1. Define a function `collatzIterations(n)` that uses a `while` loop to compute the number of iterations it takes to get from `n` to 1.

n0 = 6
n1 = 3
n2 = 10
n3 = 5
n4 = 16
n5 = 8
n6 = 4
n7 = 2
n8 = 1



Sample Output

```
>>> collatzIterations(6)
8
>>> collatzIterations(1287687156763264782)
443
>>> collatzIterations(1)
0
```

Then write a function `plotCollatz()` that generates a scatter plot of `(n, collatzIterationss(n))` for integers in the range 1 through and including 5000. You should be able to produce a scatter plot graph like you see above.

Q3	Demonstrate ability to read and write values to and from a file

Skills

Lecture Dependency

Feb-1

You are to write a Python function `sortit(input, output)` that reads in a number of words (one per line) stored in the file identified by `input`, and then writes to `output` these words, one per line, in sorted order.

InputFile.txt	OutputFile.txt
This Is A Test	A Is Test This

You can be assured that the designated input file will always exist. Look at the template for the structure of this function.

To validate that your function works, you should write a `testSortIt()` method that calls `sortit()` with file names of your choosing. Note that the TA will evaluate using their own files.

Q4	Test Interactive Functions

Skills

Lecture Dependency

Feb-1

The Body Mass Index (BMI) is calculated as a person's weight (in pounds) times 720, divided by the square of the person's height (in inches). A BMI in the range 19-25, inclusive, is considered healthy. Write a function `BMIcheck(weight, height)` that calculates a person's BMI and prints a message telling whether they are above, within, or below the healthy range.

Q5	Test Interactive Functions

Skills

Lecture Dependency

Feb-1

A speeding ticket fine policy is defined as following. The base ticket is $50 plus $5 for each mile per hour over the limit plus a penalty of $200 for any speed over 90 miles per hour. Write a python function `speedCheck(speedLimit, actualSpeed)` that accepts a speed limit and a clocked speed and either prints a message indicating the speed was legal or prints the amount of the fine, if the speed was illegal.

Version: 2/2/2013 (3:30 PM)

How To Get Started On This Assignment

A template HW4.py file is provided to you with sample enrollment data.

To solve question you need to know how to determine if a number is odd. This is mentioned in the book (page 59) but you might not have noticed it because I have not yet demonstrated this in class. There is a Python operator, % (percent sign), that can be used to determine the remainder during integer division.

Here is a snippet to get you started:

```
print ("remainder when dividing 10 by 3:")
print (10 % 3)

print ("remainder when dividing 6 by 2:")
print (6 % 2)

if 5 % 2 == 1:
    print ("5 is an odd number.")
```

To see if a number is odd, check (using ==) whether the remainder of dividing that number by 2 is 1.

Submit your HW4.py file using the web-based turnin system. As we have mentioned in class, only one of the team members needs to submit the assignment. But just make sure that something gets submitted!