# CS:1210 Homework 2

## Due via ICON on Friday, Feb 13th, 4:59 pm

**What to submit:** Your submission for this homework will consist of three text files, named `hw2a.py`, `hw2b.py`, and `hw2c.py`. The `.py` files should contain Python programs that solve Problems (a), (b), and (c) respectively. These files should each start with with a comment block containing your name, section number, and student ID. You will get no credit for this homework if your files are named differently, have a different format, and if your files are missing your information. Your program should all be well documented, i.e., have useful comments. We will discuss what constitutes good documentation and coding style in class. Part of good documentation is choosing meaningful names for your variables.

(a) Write a program that reads some number of nonnegative integers, between 0 and 100. These integers will be provided one per line and the user will type "Done" in the line after the input to indicate the end of input. An example of the input might be:

```
22
67
50
98
30
56
89
65
12
0
55
100
Done
```

Now imagine that the nonnegative integers provided as input were exam scores in a class. As output, your program is required to produce a histogram that shows the number of scores in each of the following four ranges: [0, 25], (25, 50], (50, 75], (75, 100]. For the above input, the output should be the following histogram:

```
[0, 25]    ***
(25, 50]   **
(50, 75]   ****
(75, 100]  ***
```

showing that there are three scores in the range [0, 25], two scores in the range (25, 50], four scores in the range (50, 75], and three scores in the range (75, 100]. Note that the score 50 is included in the second range and not in the third range. Your output should have exactly the form shown above. For example, you are required to use "*" symbols to indicate the scores. Also, the beginning of each line of "*" symbols should nicely line up.

(b) A *Pythagorean triple* is a sequence of three positive integers $(x, y, z)$, $x < y < z$, such that $x^2 + y^2 = z^2$. Examples of Pythagorean triples are: (3, 4, 5), (5, 12, 13), (6, 8, 10), etc. Write a Python program that reads a positive integer, say $M$, and generates all Pythagorean triples $(x, y, z)$ such that $x \leq M$ and $y \leq M$. Here is an example of the desired interaction between the user and the program:

```
Enter a positive integer for M: 30
3 4 5
5 12 13
6 8 10
7 24 25
8 15 17
9 12 15
10 24 26
12 16 20
15 20 25
16 30 34
18 24 30
20 21 29
21 28 35
```

The order in which the triples are listed does not matter, as long as all triples are listed and no triple appears more than once. Also note that $x$ and $y$ cannot exceed $M$, but $z$ can.

(c) A *twin prime pair* is a pair of prime numbers that differ exactly by 2. Some examples of twim prime pairs are $(3, 5)$, $(5, 7)$, $(11, 13)$, $(41, 43)$, $(269, 271)$, etc. Write a program that reads a positive integer, say $M$, and generates all twin prime pairs $(x, x+2)$ such that $x+2 \leq M$. It makes a lot of sense to start with the program `listPrimes.py` (discussed in class) and modify it to solve this problem. The modifications I made to obtain my solution were minor. Here is an example of the interaction between the user and the program.

```
Please type a positive integer: 200
3 5
5 7
11 13
17 19
29 31
41 43
59 61
71 73
101 103
107 109
137 139
149 151
179 181
191 193
197 199
```

**Note:** There is a famous, old conjecture in mathematics that says that there are infinitely many twin prime pairs. In the last couple of years some exciting progress has been made towards proving this conjecture. You can google "twin primes conjecture" to learn more.