22C:16 Homework 3

Due via ICON on Wednesday, Feb 15, 4:59 pm

What to submit: Your submission for this homework will consist of four files. One of these will be a pdf file called `homework3.pdf`. This will contain the answers to Problems 2, 4, 5, and 7. This pdf file should start with your name, section number and student ID. The remaining files should be called `PythagoreanTriple.py` (solution to Problem 1), `countPythagoreanTriples.py` (solution to Problem 3), and `PythagoreanQuadruple.py` (solution to Problem 6). Each of these Python files should start also with your name, section number and student ID appearing at the top of the file as Python comments. You will get no credit for this homework if your files are named differently, have a different format (e.g., docx), or if your files are missing your information.

1. 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 $y \leq M$. Type this program into a Python IDE and save it as a file called `PythagoreanTriple.py`. Your program should include comments as discussed in the class lecture, including a section at the start that includes your full name, section, and student ID. Your program may assume that the user will input only a positive integer for M and does not have to do any error checking.

2. Use your program from Problem 1 to find a Pythagorean triple (x, y, z) such that $1500 \leq x \leq 1700$ and $1500 \leq y \leq 1700$. Write down one such triple as the answer to this problem.

3. Modify your program from Problem 1 to make it count Pythagorean triples. More specifically, write a Python program that reads a positive integer, say M, and counts the number of distinct Pythagorean triples (x, y, z) such that $x \leq M$ and $y \leq M$. Your program should print this count.

   Type this program into a Python IDE and save it as a file called `countPythagoreanTriples.py`. Your program should include comments as discussed in the class lecture, including a section at the start that includes your full name, section, and student ID. Your program may assume that the user will input only a positive integer for M and does not have to do any error checking.

4. Use your program from Problem 3 to find the number of distinct Pythagorean triples (x, y, z) such that $x \leq 10,000$ and $y \leq 10,000$. Write down this count as the answer to this problem.

5. Recall how we timed code fragments using functions from the `time` module. In this problem, we want use to use a similar approach to acquire a sense of how long it takes to generate Pythagorean triples. For each $M = 1000, 2000, \ldots, 10000$ compute the running time of the Python program you wrote for Problem 3. Make a plot of the running times, with the x-axis showing M and the y-axis showing the running time of your program, when executed with input M. Based on the shape of your plot, make a guess about how the running time of your program grows as M increases.

6. A natural generalization of the notion of Pythagorean triples is the following. Let us define a *Pythagorean quadruple* as a sequence (a, b, c, d) of positive integers, $a \leq b \leq c \leq d$ such that $a^2 + b^2 + c^2 = d^2$.

   Write a Python program that reads a positive integer, say M, and generates all Pythagorean quadruples (a, b, c, d) such that $a \leq M$, $b \leq M$, and $c \leq M$. Type this program into a

Python IDE and save it as a file called `PythagoreanQuadruple.py`. Your program should include comments as discussed in the class lecture, including a section at the start that includes your full name, section, and student ID. Your program may assume that the user will input only a positive integer for M and does not have to do any error checking.

7. Use your program from Problem 6 to find all Pythagorean quadruples (a, b, c, d) such that a, b, and c are all between 10 and 20 (inclusive of 10 and 20). Write down all such quadruples as the answer to this problem.
