University of Huddersfield
School of Computing and Engineering

CFM2103 Mathematical Programming

Practical **Week 5**

Work through the questions included below. If you get stuck, please revisit the information on the slides used today before you ask for help.

1. This question is from the recommended textbook – please follow the instructions. Your program should let the user enter the name of a Galilean moon of Jupiter, then it should display the moon's mean radius, surface gravity and orbital period.

Programming Exercises

1. Galilean Moons of Jupiter

Write a program that creates a dictionary containing the names of the Galilean moons of Jupiter as keys and their mean radiuses (in kilometers) as values. The dictionary should contain the following key-value pairs:

Moon Name (key)	Mean Radius (value)
Io	1821.6
Europa	1560.8
Ganymede	2634.1
Callisto	2410.3

The program should also create a dictionary containing the moon names and their surface gravities (in meters per second squared). The dictionary should contain the following key-value pairs:

Moon Name (key)	Surface Gravity (value)
Io	1.796
Europa	1.314
Ganymede	1.428
Callisto	1.235

The program should also create a dictionary containing the moon names and their orbital periods (in days). The dictionary should contain the following key-value pairs:

Moon Name (key)	Orbital Period (value)
Io	1.769
Europa	3.551
Ganymede	7.154
Callisto	16.689

2. Write a program that generates 100 random integers between 1 and 10. The program should store the frequency of each number generated in a dictionary with the number as the key and

the amount of times it has occurred as the value. For example, if the program generates the number 6 a total of 11 times, the dictionary will contain a key of 6 with an associated value of 11. Once all of the numbers have been generated, display information about the frequency of each number.

3. A *Mersenne prime*, M_i, is a prime number of the form

$$M_i = 2^i - 1\,.$$

The set of Mersenne primes less than $n \in \mathbb{N}$ may be thought of as the intersection of the set of all prime numbers less than n, P_n (say), with the set A_n (say), of all integers satisfying $2^i - 1 < n$.

Write a Python code that returns the list of Mersenne primes less than an arbitrary natural number N provided by the user. For example, if $N = 1 \times 10^6$, the output of such a code should be

$$[3,\ 7,\ 31,\ 127,\ 8191,\ 131071,\ 524287]\,.$$

Optional question:
If you would like to receive additional feedback on your work, you should attempt the questions included below and submit your computer code in a zipped folder on Brightspace by no later than 5:00 PM next Tuesday.

1. Write a computer program that counts how many positive integers $2 \leq z \leq 1000$ can be expressed in the form

$$z^3 = x^2 + y^2\,, \qquad 1 \leq x \leq y < 1000\,, \qquad x, y \in \mathbb{N}\,.$$

[HINT: Think of the *sets* that contain elements of the form corresponding to the expressions on the right- and left-hand sides of this equation, respectively. What can you do with these sets?]