COSC 311 - Lab 3

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Due: March 4

1 Objectives

1. Gain familiarity with the Python programming language
2. Gain familiarity with Jupyter notebooks
3. Practice efficiently manipulating data with Python

2 Tasks

1. Write a Python function which accepts a single integer parameter, n, and uses ranges and list comprehension to return a list with the sequence of squares $1, 2^2, 3^2, \ldots, n^2$.
2. Write a Python class called `PayRoll` that has the following functionality:
   - Maintains a *list* of employees along with their name, hourly wage, and number of hours in a single pay period.
   - Has a method to add and remove employees from the PayRoll database.
   - Has a function to set the number of hours for a specific employee.
   - Has a function to print a report of each employee and their total pay for the current pay period.
3. You are consulting for a Department of Commerce and you are given access to a Python program/notebook with a pre-defined list of dictionaries, `cities` with the following structure:

```
cities = [
  {
    "id": 1,
    "imports": ["coal", "peaches", "textiles"],
    "exports": ["paper", "lumber"]
  },
  {"id": 2, "imports": ["paper", "steel"], "exports": ["textiles", "cars"]},
  # ... more dictionaries having 'id', 'imports', and 'exports' keys
]
```

   - Write a Python function to return a list of tuples, each of which represents a pair of city ids (a, b) if city a exports a good that is imported by city b. For example, in the above list, the tuple $(1, 2)$ represents that city 1 exports paper, which is imported by city 2.
   - Write a Python function to caclulate how many cities import each type of good. The function should return a structure with the counts, e.g. `{"paper": 2, ...}`.
   - Write a Python function to caclulate how many cities import each type of good.

- What are some ways you would visualize the overall productivity of this set of cities? What sort of plotting could you do, and what quantitative questions could it answer? Implement your choice of visualization and answer your questions.
- What additional information about this data set might you want to request, and what new questions could you answer or explore with it?

4. Compare and contrast the *median*, *mode*, and *mean* of a dataset along each of the following dimensions:
   - What are the different "meanings" of each one, in relation to the underlying data?
   - Computationally, how difficult is each one to compute (using basic approaches from the definitions)?
   - For each quantity, write a Python function to compute it, when given a list of numbers as an argument.
5. Write your testing codes for all the problems above and make sure they are correctly implemented.

3 Submission

Zip your source files and upload them to the assignment page on MyClasses. Be sure to include all source files, properly documented, a `README` file to describe the program and how it works, along with answers to any above discussion questions.