CECS 451
Assignment 3
Total: 50 Points

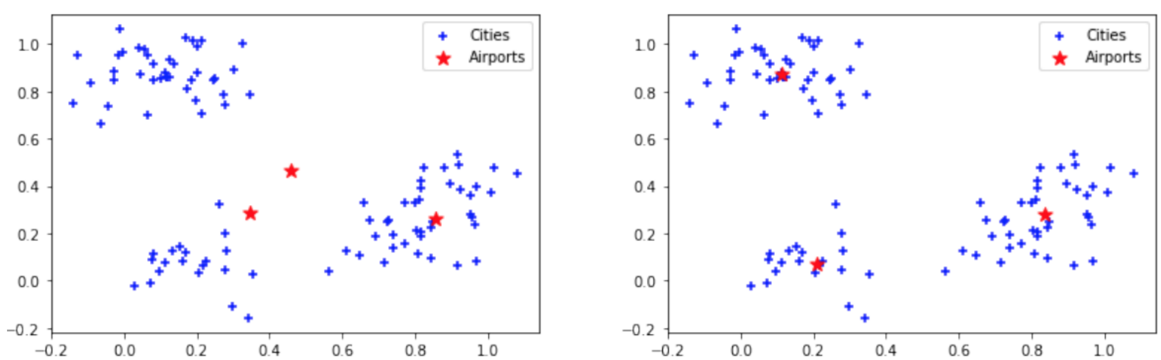
General Instruction

- Submit **uncompressed** file(s) in the Assignment folder via Canvas (Not email)
- Use **Python 3**, any other programming language is not acceptable
- You can import modules in the **Python Standard Library** (please check the full list [here](#))
- Follow the **required format**. Your submission may be evaluated automatically using a script file, so if you would not follow the output format, you may receive zero point even though your program outputs correct answers

---

Solve the n-airports problem using **gradient based optimization algorithm**.

1. Find n-airports.ipynb
2. A random initial state is given as Figure 1a



(a) An initial state (b) An optimal state

Figure 1: n-airports problem state

3. The objective function is given by

$$f(x_1, y_1, x_2, y_2, x_3, y_3) = \sum_{i=1}^{n} \sum_{c \in C_i} (x_i - x_c)^2 + (y_i - y_c)^2$$

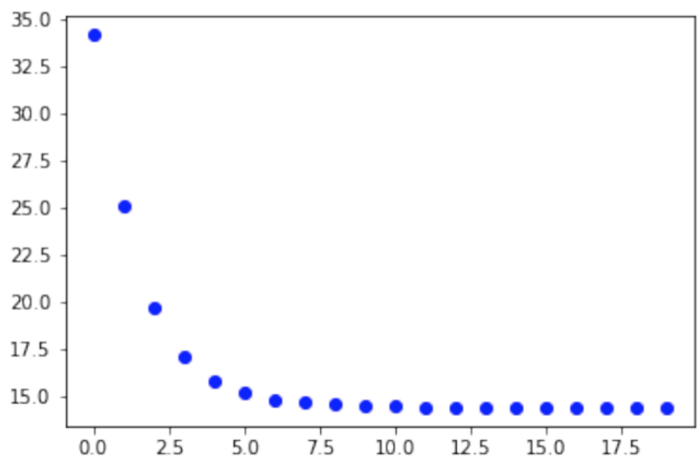
where n is the number of the airports and Ci is the set of cities whose closest airport is airport i

4. The goal of the program is determining the locations of airports that minimize the objective function using gradient based optimization. By updating

$$(x_1, y_1, x_2, y_2, x_3, y_3) \leftarrow (x_1, y_1, x_2, y_2, x_3, y_3) - \alpha \nabla f(x_1, y_1, x_2, y_2, x_3, y_3)$$

where $0 < \alpha \ll 1$ is a constant, find an optimal location of the airports as Figure 1b

5. As shown in Figure 2, plot the objective function at every time of updating the locations to terminate the algorithm. (The objective values may be different from the example)



6. Plot the final optimal state. (i.e. Figure 1b)

7. Submit your n-airports.ipynb