CECS 551
Assignment 1
Total: 40 Points

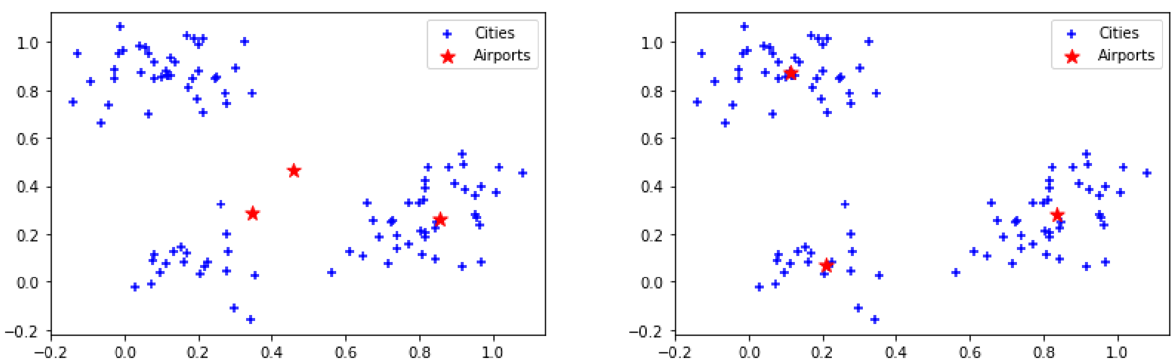
General Instruction

- Submit uncompressed file(s) 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*). If you want to use any other library, please consult with the instructor or TA.

1. (40 points) Solve the n-airports problem using gradient based optimization algorithm.

   i. Find `n-airports.ipynb`.

   ii. A random initial state is given as Figure 1a.



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

Figure 1: n-airports problem state

   iii. 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 C_i is the set of cities whose closest airport is airport i.

   iv. 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.

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

vi. Submit your `n-airports.ipynb`.

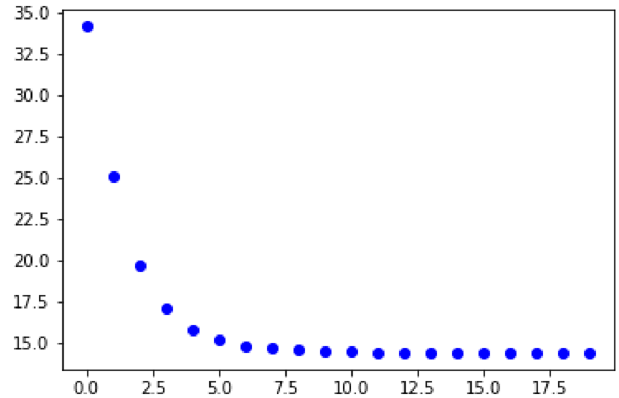


Figure 2: Objective values as a function of epoch