

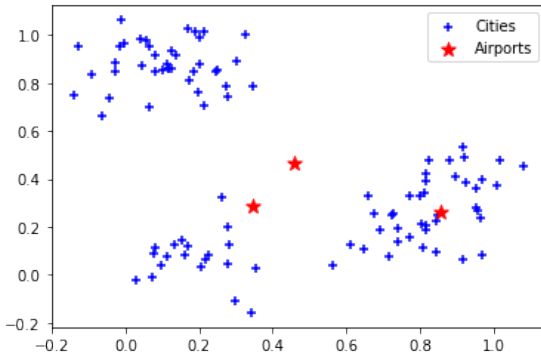
CECS 451
Assignment 5
Total: 40 Points

General Instruction

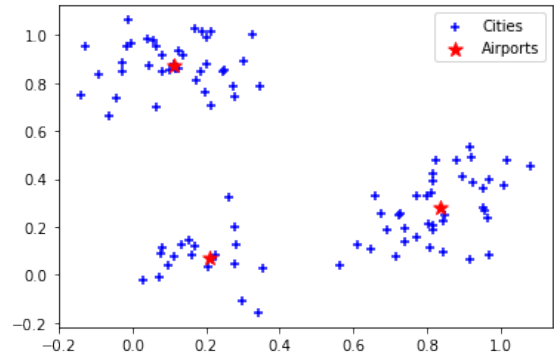
- Submit uncompressed file(s) in the Dropbox folder via BeachBoard (Not email).
 - Use Python 3, any other programming language is not acceptable.
 - You can import modules in the Python Standard Library (please check the full list [here](#)). If you want to use any other library, please consult with the instructor or TA.
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1. (40 points) Solve the n -airports problem using gradient based optimization algorithm.

- Find `n-airports.ipynb`.
- 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`.

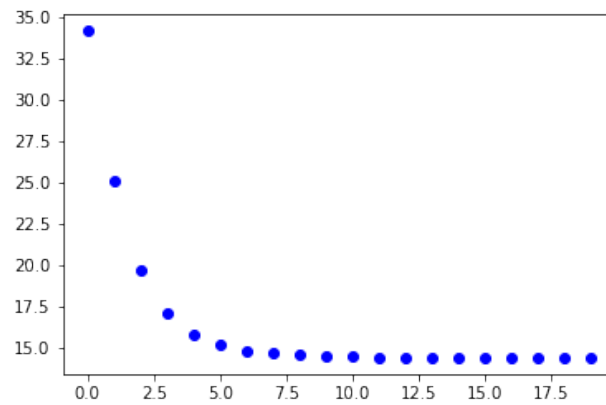


Figure 2: Objective values as a function of epoch