Epoch Problem Statements

1) **Efficient And Fair Line Construction**

Consider a set of n houses with coordinates given by latitude (x) and longitude (y), defined as a set P = {p_1, p_2, . . . , p_n}. The task is to construct a gas pipeline in a straight line that serves all of them, where a straight line ℓ = {a, b} is defined by a direction vector a of unit norm and a point b on the line.

Distance Definition

The distance from a point p to a line ℓ ={a,b} is given by:

$$\text{dist}(p, \ell) := \left\| (I - aa^T) \cdot (p - b) \right\|^2$$

Objective 1: Efficient Line (Do not use any library function to find the line)

A line is efficient if it minimizes the following cost:

$$\sum_{i \in [n]} \|\text{dist}(p_i, \ell)\|$$

Design an algorithm that computes an efficient line or a line which is almost efficient, meaning the cost is a local minimum.

Objective 2: Fair Line (Do not use any library function to find the line)

A line is fair if it minimizes the maximum distance to any house:

$$\min_{\ell} \max_{i \in [n]} \|\text{dist}(p_i, \ell)\|$$

Design an algorithm that computes a fair line or a line which is almost fair, meaning the above cost is a local minimum.

Objective 3: Multiple Efficient Lines (Do not use any library function to find the lines)

For a set of k lines L = {ℓ_1, . . . , ℓ_k}, the set is efficient if it minimizes:

$$\sum_{i \in [n]} \min_{\ell \in \mathbf{L}} \|\text{dist}(p_i, \ell)\|$$

Design an algorithm that computes k efficient lines or a set of lines which is almost efficient, meaning the above cost is a local minimum.

Dataset

Use the latitude and longitude from the California dataset provided by ‘sklearn‘ to solve these problems.

Calfornia Housing Dataset