CECS 451
Assignment 1
Total: 40 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

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Implement an optimal route finder program using **A* algorithm**

1. Find `coordinates.txt` and `map.txt`

2. `coordinates.txt` stores the **latitude** and **longitude** of each city

      `City:(Latitude,Longitude)`

3. `map.txt` stores **actual** distances between connected cities in California as shown in Figure 1. We assume each city is connected with a limited number of nearby cities

      `City-NearbyCity1(Distance),NearbyCity2(Distance),...`

4. You can compute the straight line distance between two cities using the **Haversine formula**

    a. You need to convert latitude and longitude to radian. $(radian = \frac{\pi}{180}degree)$

    b. Let $\varphi1$, $\varphi2$ be the latitude of point 1 and latitude of point 2

       and $\lambda1$, $\lambda2$ be the longitude of point 1 and longitude of point 2

    c. The straight line distance d is defined by

$$d = 2 \cdot r \cdot \arcsin\left(\sqrt{\sin^2\left(\frac{\varphi_2 - \varphi_1}{2}\right) + \cos\varphi_1 \cdot \cos\varphi_2 \cdot \sin^2\left(\frac{\lambda_2 - \lambda_1}{2}\right)}\right)$$

      ,where r is the radius of the earth. Use $r = 3{,}958.8$ mile

5. The program should be able to

   a. parse `coordinates.txt` and `map.txt`

   b. take a departure city and an arrival city as input arguments (Interactive style is not acceptable)

   c. output an optimal route from the departure city to arrival city

6. Please follow the output format below

   ```
   > python a-star.py SanFrancisco LongBeach

   From city: SanFrancisco

   To city: LongBeach

   Best Route: SanFrancisco - SanJose - Fresno - LosAngeles - LongBeach

   Total distance: 442.50 mi
   ```
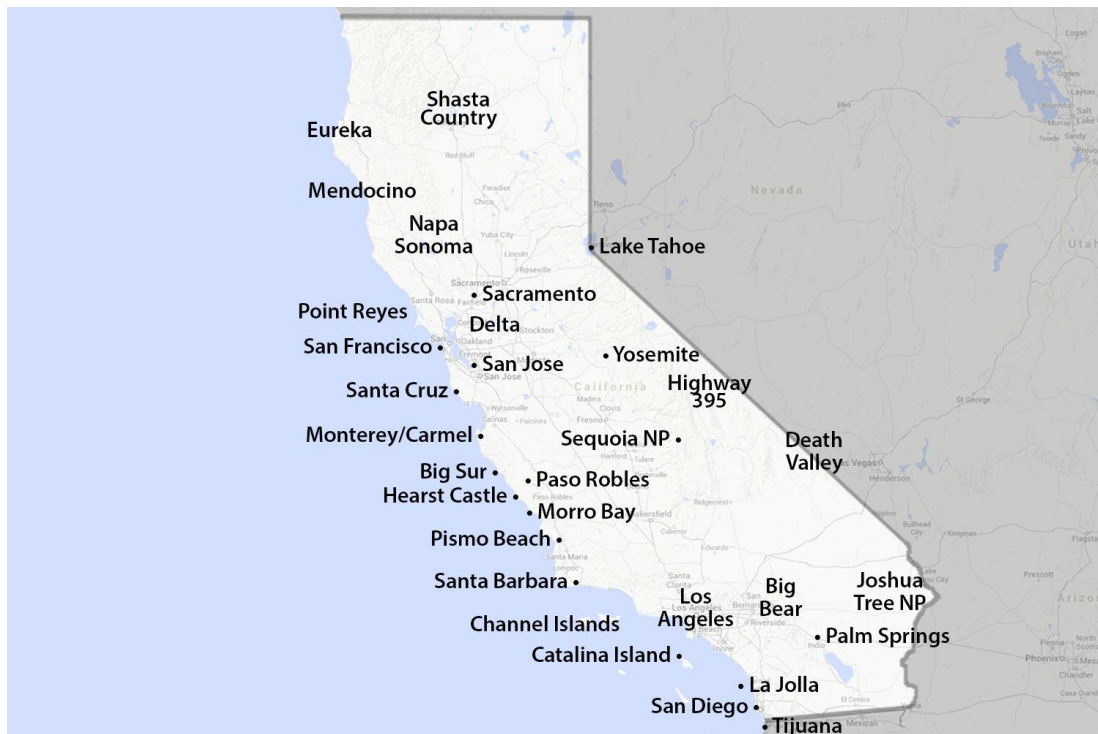
7. Only submit **a-star.py** file

Figure 1: A map of cities in California