CECS 451
Assignment 1
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.

- 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 contents.

1. (40 points) Implement an optimal route finder program using **A* algorithm**.

   i. Find `coordinates.txt` and `map.txt`. Figure 1 is attached for your information.

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

   `City:(Latitude,Longitude)`

   iii. `map.txt` stores **actual** distances between connected cities in California. We assume each city is connected with limited number of nearby cities.

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

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

   - You need to convert latitude and longitude to radian. ($radian = \frac{\pi}{180}degree$)
   - Let φ_1, φ_2 be the latitude of point 1 and latitude of point 2 and λ_1, λ_2 be the longitude of point 1 and longitude of point 2.
   - 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.

   v. The program should be able to

   - parse `coordinates.txt` and `map.txt`
   - take a departing city and an arriving city as input arguments (an interactive style is not acceptable).
   - output an optimal route from the departing city to the arriving city.

vi. 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 mi
```

vii. Submit a-star.py file.

Figure 1: A map of cities in California