CECS 451
Assignment 1
Total: 40 Points

General Instruction

- Submit uncompressed file(s) in the Dropbox 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*). 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.

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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: 442.50 mi
```

vii. Submit `a-star.py` file.

Figure 1: A map of cities in California