CS534 - HW 1

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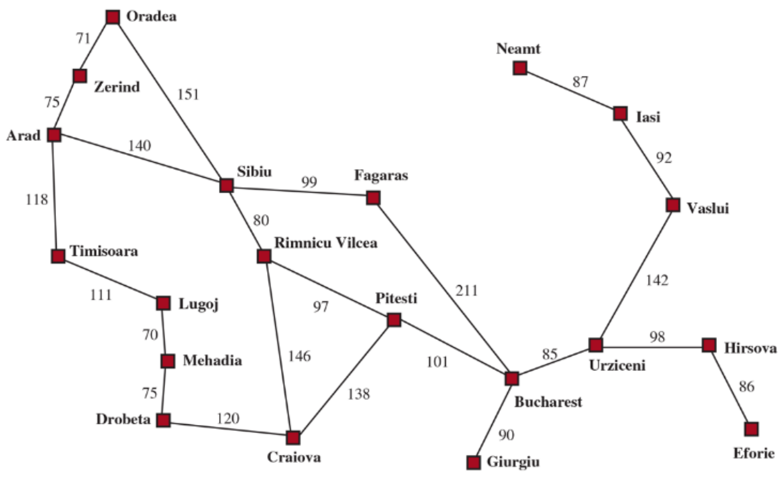
Problem 2

Suppose that two friends live in different cities within the map provided from our textbook Figure 3.1, presented below.



A simplified road map of part of Romania, with road distances in miles.

The amount of time needed to move from city i to neighbor j is equal to the road distance $D(i,j)$ between the cities. On each turn the friend that arrives first must wait until the other arrives before the next turn of travel can begin. Thus we are limited to the travel time of the slowest agent. We aim to get these friends to meet as quickly as possible.

1. Detailed Problem Formulation

For our problem, we have two friends - f_1 and f_2. We wish to find a path such that both end up in the same city c_{goal}, at the same time, in the lowest possible time t. We have a cost between cities, a distance defined by $D(i,j)$ where i and j are adjacent cities. A given state is defined as c_{f_1} and c_{f_2}, which is the city for each given friend. A given action on each discrete step is each friend moving to a new $c_{f_{1/2}}$ until they equal eachother.

2.Which heuristic functions are admissible?

Suppose that $D(i,j)$ is the straight line distance between cities i and j. Which of the following heuristic functions are admissibile?

- $D(i,j)$
- $2D(i,j)$
- $\frac{D(i,j)}{2}$

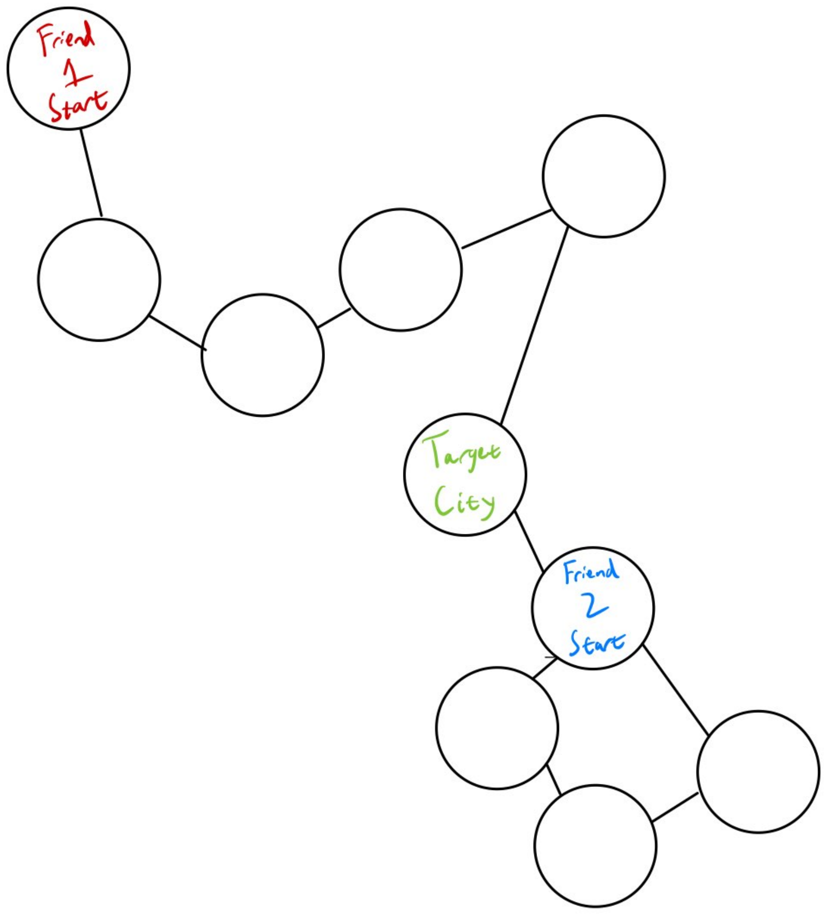
To be admissible, the heuristic must not overestimate the actual cost of a given transition. Thus the second option, $2D(i,j)$, would not be admissible. The first and third options, $D(i,j)$ and $\frac{D(i,j)}{2}$, respectively, would be admissible.

3. Can a completely connected map have no solutions?

Yes - since both travelers must travel at the same time, it's possible that a fully connected graph, such as a simple two node map. As both leave for the other's city, they find themselves in opposite cities again. This repeats forever.

4. Are there maps which every solution would require revisiting a city?

Yes. Consider a map with a singular path, with a cycle on the far end, to the side of the second friend's starting position. For example:



Problem 3

In this problem we explore a simple hill climbing agent and a genetic algorithm client.

Part C

Here we compare the performance and utilization of the hill climbing agent and the genetic algorithm agent we built.

Agent	Generations	Time to solution	Fitness of solution
Hill Climbing	—	6.19 seconds	4669.4 meters
Genetic Algorithm	1000	36.58 seconds	4074.4 meters
Genetic Algoirthm	100	6.06 seconds	4335.3 meters

Here we see that while the hill climbing algorithm is significanlty quicker, just approximately 6 seconds to the genetic algorithm's 30+ - but the hill climbing algorithm gets stuck on a local minimum whereas the genetic algorithm continues to improve. If we drastically lower the number of generations we intend to utilize for the genetic algorithm, we get faster - faster even than hill climbing - and can occasionally score a better result still! Since the genetic algorithm has mutation and crossover causing high exploration, it does not get stuck as easily at suboptimal local minimums.

Problem 4