AA222 - Project Status Update

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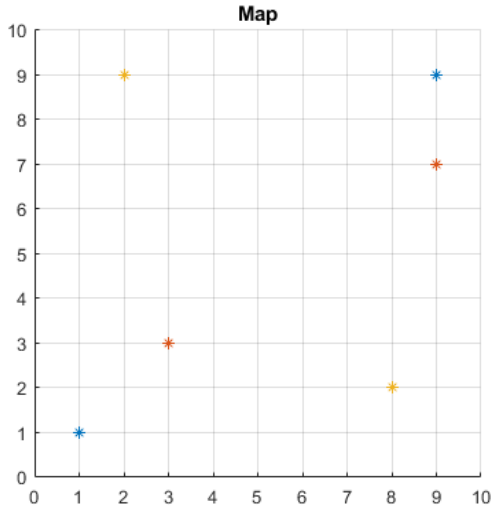
1 Progress to Date

As a reminder, my final project is optimizing the location of new hydrogen refueling stations. Given an existing distribution network for delivering packages, the goal of the project is finding the optimal location for new routes that minimize the distance trucks have to travel when refueling.

Since the proposal, I have divided my project up into three major milestone:

1. Represent the distribution network within the code as a graph
2. Implement a path finding optimization
3. Implement a discrete optimizer to find ideal refueling stations

In milestone 1, I need to represent a physical map of a distribution network as code. To simplify the scope of the problem, the distribution network I have created is a simple n×n grid. An image of an example grid is provided below. The colored dots represent the start and end to routes, while the lines represent roads trucks are allowed to travel on.



To represent the network as a code, we use an *adjacency matrix*. The adjacency matrix is a 2D matrix with dimensions n×n. In an example slot, [i][j] = 1 indicates nodes i and j are connected. Milestone 1 has been completed as of date. Given a value of n, the code creates

an adjacency matrix, and also keep tracks of the route destinations.

For milestone 2, I need to implement a path search algorithm, which I expect to be the bulk of the work for this project. Note that there are numerous path search algorithms I could use to find the optimal route [1]. Given that our network is a simple grid, a Greedy Best-First search would always find the optimal path at a low cost, but this would not translate well to real life road networks that are constrained by geography. As a result, I am implementing an A* search algorithm [2]. This is the current step I am making progress on as of today. The goal is to have this search algorithm fully implemented by the end of the week. Note that a promising algorithm worth looking into is *Ant Colony Optimization*. Although I believe that A* is better suited for this specific case, *Ant Colony Optimization* is probably better for more complex shipping networks where a single truck will have to stop at multiple locations.

I have not started work on Milestone 3, which requires implementing an approach for a discrete optimizer. As a general overview, I am planning to implement the code as follows. Given an existing distribution network, locations will be provided for new refueling stations, and optimal routes will be created by the code written in milestone 2. The refueling locations that generate the shortest routes will be deemed better, so a strategy must be chosen for the selection of new locations. Currently, I believe a population method will be most appropriate for finding refueling locations, but am open to feedback and will seeking advice at office hours.

2 Timeline

With final project due on the May 28 (latest date May 31), my proposed timeline for the next two weeks is provided below.

- Fully Implement A* Algorithm (Milestone 2): May 17 - 21
- Choose and Implement Discrete Optimizer (Milestone 3): May 17 - 23
- Planned Buffer + Debugging time: May 24 - 26
- Write up final report: May 26 - 31

3 Sources

1. https://www.redblobgames.com/pathfinding/a-star/introduction.html
2. https://www.geeksforgeeks.org/a-search-algorithm/