Package Delivery Model with Weighting

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Project Group 4

Problem Statement

Through this project, we seek to extend the package delivery model. This model consists of trucks that pick up and deliver packages to their required destinations by moving along available edges. The aim is to factor in traffic, fuel, distances and road conditions by specifying an edge cost along with the existing connections. Furthermore, the trucks will be modelled to carry multiple packages based on their capacity. The goal of this model is to determine the most efficient set of actions to deliver all the packages. Figure 1 shows a sample environment representing this scenario. The number and location of warehouses, trucks, packages, and destinations, will be randomly generated.

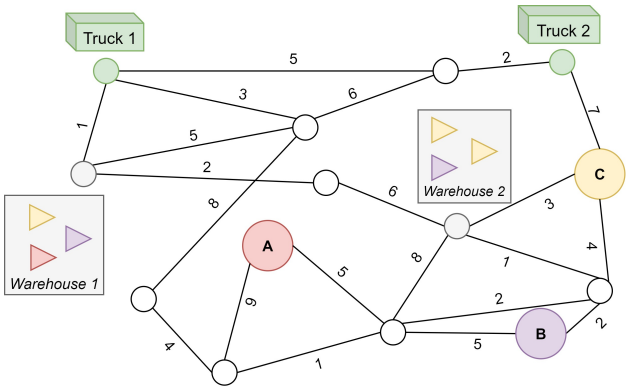

Figure 1: Sample Environment

Motivation

Many companies employ package delivery models to automate their delivery schedules for deliveries such as mail, produce, supplies, and others. Therefore, finding the optimal solution for this type of problem is useful for the companies who want to reduce their operating costs as much as possible. The truck delivery examples shown in class leave out some of the additional factors mentioned before. These complicate the delivery scenarios in the real world. Hence we are introducing these factors to our model to make our solutions more realistic.

Approach

Steps: The proposed delivery model consists of four operations.

1. Moving trucks to package locations by determining closest warehouses.
2. Determining an optimal loading scheme for the available packages and trucks by grouping deliveries based on goal location.
3. Optimizing the delivery route for each truck based on weights through a search algorithm. We can compare the performance of different algorithms/ heuristics here.
4. Repeat the above three steps if there are packages left out in a warehouse.

The current truck delivery model described in class does not take the path or edge costs into consideration. This model incorporates weights to each path and predicts the path that has the highest efficiency.

The evaluation of different schemes would be based on the overall cost of the action scheme generated. At each step, a truck will be able to load or unload a package, or move along any of the edges connected to the node it is present in.

Task Assignment

We have identified the following tasks that must be completed for our project. Based on these tasks, we can split them evenly between the members of our group.

1. Developing an environment.
2. Creating scheme to move trucks to warehouse locations based on the path cost.
3. Creating a scheme for loading packages in trucks based on grouping of deliveries.
4. Generating a delivery route.
5. Validating the optimality of the solution and simulating the outcome.

Changes and Responses

1. We consider a grid-like environment for simulations in gazebo.
2. We use a hierarchical planning approach to the problem, compared to search.
3. We use greedy assignment to assign trucks to warehouses.
4. We group packages using two clustering approaches: capacited k-means and sweep line.
5. We optimize the delivery routes by modelling it as a TSP and solving using two algorithms: greedy and dynamic programming.
6. ~~Qianru Zhao~~.