Solving the Vehicle Routing Problem for Multiple Multi-Capacity Vehicles

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Abstract

The Vehicle Routing Problem (VRP) has existed as long as a distributor has needed to deliver items. As such, the VRP has been solved with many different methods, including agent architecture and ant colony modeling. However, these methods have generally been set up for an established organization that has a specific number of vehicles with only a few unique capacities. This project aims to create a program that will solve the VRP, but in a case where all the vehicles could have different capacities. This is the situation faced by some volunteer groups that do not have established vehicle fleets and rely on people volunteering vehicles when something needs to be distributed.

Background

A great deal of research has been done into the VRP and its variants, such as the VRP with Time Windows (VRPTW) and Multi-Depot VRP (MDVRP). Projects have looked into using agent architecture and ant colony optimization to solve the problems. These projects have yielded such ideas as Clarke-Wright Algorithm to place delivery points into routes. Mennell, Shmygelska, and Thangiah did a project to evaluate using agents to solve the VRP. The program used agents to represent the vehicles and “auctioneers” that informed the vehicles of the current situation with regards to customers and deliveries. While the resulting program did not find the optimal solutions for any the sample problems, it was extremely adaptable for the MDVRP and VRP with multi-capacity vehicles.

Image

The image at right is a visualization of how intersections are stored as nodes. The nodes are cross-referenced by which nodes connect to each other and what road connects the two nodes.

Procedures

The first step in this project is to create a program that, given a list of roads, finds the quickest route between two points. This involves an A* search and a geographical heuristic. The next step is to create program that, given a list of delivery points and vehicles and their capacities, creates routes and assigns customers to them based on the most efficient routing possible.

Expected Results

At the end of the project, the program should be given a list of delivery points, amounts of product delivered to where, a list of vehicles and their capacities, and a list of roads for the locality where the deliveries take place. It should return a list of routes that results in the most efficient delivery of the product. Currently, “efficiency” is not defined, but will probably be similar to product delivered over distance traveled. The goal, in this case, would be to maximize the number.