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). Of particular interest to this project are those that deal with solutions making use of genetic algorithms. Several projects have made use of genetic vehicle representation (GVR), where each solution has genetic material that represents the solution's routes.

Genetic Algorithms

The solution finder will implement a genetic algorithm to manipulate Solution objects. Operations will involve removing customers from one route and placing them in another, switching two customers between or inside of a route, and inverting routes, among other operations.

Table

TigerLine ID: 76033712
Name: Braddock Rd
Street Direction: 246.384432363328, Southwest
Length: 0.0843058817053028 miles
City: Fairfax County
Start Address, Left: 6555; End Address, Left: 6567
Start Address, Right: 6560; End Address, Left: 6566
Zip Code, Left: 22312; Zip Code, Right: 22312
Starting Coordinates: +38.817271, -77.166726
Ending Coordinates: +38.816700, -77.168032
Additional Coordinates: [[["+38.817200", "-77.167098"], ["+38.817182", "-77.167268"], ["+38.817171", "-77.167327"], ["+38.817137", "-77.167439"], ["+38.817063", "-77.167616"], ["+38.817007", "-77.167707"], ["+38.816919", "-77.167817"], ["+38.816825", "-77.167921"]]]
Additional Names: [["", "State Route 620", "", ""]]

Procedures

The program first reads in all the customers, road information, and vehicle information. It then begins creating Solution objects that are composed of a set of Route objects. A set of Solution objects is then manipulated to create an acceptable result.

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. Efficiency is defined as maximizing product delivered while minimizing distance traveled. As a single number, solutions can be evaluated by product delivered divided by distance traveled.

Table

The information below is all the data that pertains to one road segment. This is the information for Braddock Road, immediately outside the school. The program currently processes the data and outputs a set of information that can be seen at left. RT# denotes the Census Bureau record type that the data comes from.

RT1:	"11106 76033712 A Braddock Rd A31 6555 6567 6560 656611112231222312 515105905994543945434 57840191245250045210030074003 -77166726+38817271 -77168032+38816700"
RT2:	"21106 76033712 1 -77167098+38817200 -77167268+38817182 -77167327+38817171 -77167439+38817137 -77167616+38817063 -77167707+38817007 -77167817+38816919 -77167921+38816825+000000000+00000000+000000000+00000000"
RT4:	"41106 76033712 1 269 "
RT5:	"5110651059 269 State Route 620 "
RT6:	None