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Schlichtkrull, Anders; Christensen, J. B. S. ; Feld, T.; Hansen, T. B.

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Nature-Inspired and Energy Efficient Route Planning

A. Schlichtkrull, J.B.S. Christensen, T. Feld, and T.B. Hansen

DTU Compute, Technical University of Denmark

INTRODUCTION

Cars are responsible for substantial CO_2 emission worldwide. Computers can help solve this problem by computing shortest routes on maps. A good example of this is the popular Google Maps service. However, such services often require the order of the stops on the route to be fixed. By not enforcing an order on the stops, the route can be made shorter. When, for instance, a furniture dealer has to deliver goods, the order of visiting the customers will often be unimportant. We present a prototype app that can make shorter and more energy efficient routes by allowing it to change the order of the stops. The app is aimed at private persons and small businesses. The app works by using a nature-inspired algorithm called Ant Colony Optimization.

THEORY

The problem of finding the shortest path to visit a set of locations is known in the literature as the Traveling Salesperson Problem. It has been shown to be part of the class of NP-complete problems for which no efficient and optimal algorithm has been found. This challenge can be overcome by allowing near optimal solutions. We use the nature-inspired algorithm called ant colony optimization. It works by simulating ants finding the shortest path from an ant colony to the food in their environment. When an ant walks from the colony to the food, it lays a trail of pheromones that attracts other ants. The idea is that when there are several alternative paths, the shorter ones will have their pheromones reinforced more often, as they take less time to traverse. Ants walk with a certain amount of randomness, which is modelled by a random number generator.

METHODS

We have implemented a prototype of the app in the Java programming language. For the prototype, we made the simplification that the distance between locations can be calculated as the crow flies. We have tested the prototype on a publicly available problem instance consisting of 52 locations in Berlin. Finally, we compare the results produced by the prototype with the theoretical optimum.

RESULTS

For the test on the 52 locations in Berlin, our prototype was able to produce results very close to the theoretical optimum. In some cases, the simulated ants were even able to find the optimum route.

CONCLUSION

We have developed a prototype of a nature inspired route planner app. Our prototype gives near optimal results and we therefore think that it has great potential for further development. With a good interface for computers, tablets and smart-phones, we think the app could be a viable solution for private persons and small businesses.