Master Thesis Assignment: Multi-objective Dynamic Vehicle Routing Problem

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1 Problem and goal of the thesis

The vehicle routing problem (VRP) is concerned with scheduling a fleet of vehicles (for instance trucks) to deliver goods from a depot to customers due to time constraints (typically time windows). Formally a solution to the VRP can be modeled as a set of routes $R = \{R_1, \ldots, R_n\}$ and each route represents a single tour starting from the depot and ending in the depot. A single tour $R_i = (s_{i_1}, \ldots, s_{i_j}, \ldots)$ represents the sequence in which the customers are served according to the schedule. The cost of a schedule can be computed in linear time using a cost matrix m_{qk} that contains the cost for traveling from some customer q to another customer k. In the dynamic vehicle routing problem (DVRP) orders might be placed while the schedule is already in process. This requires online adaptations of the schedules for integrating new requests.
In its general form VRP problems belong to the class of NP hard problems and heuristic methods are often used to solve these. While many combinatorial algorithms for the vehicle routing and vehicle routing problem are known, there is much less work on the *dynamic vehicle routing problem*. Larsen [1] treats the DVRP as a single objective optimization problem, but due to several conflicting objectives (e.g. cost, tardiness) it is interesting to follow an multi-objective optimization approach to its solution. The goal of this project is to design, implement and test multi-objective search heuristics for the DVRP.

2 Cooperation with Almende (Rotterdam) and LIACS (Leiden University)

This work will be embedded in a Dutch-German bilateral collaboration project (DELIVER), between LS11, TU Dortmund, Leiden Institute for Advanced Computer Science (Leiden) and Almende e.V. (Rotterdam), who is a developer for logistics software. Besides developing algorithms for a challenging combinatorial search problem, there will be an option to visit the researchers in the Netherlands and test the algorithm on real world logistics problems.

3 Qualification profile

Required is an interest in multiobjective combinatorial optimization, basic understanding of algorithms on networks, and the ability to develop algorithm prototypes in Java or C++. As the project includes meetings with the research partners in the Netherlands, good English writing and speaking skills are desirable.

References

[1] Allen Larsen: The Dynamic Vehicle Routing Problem, PhD Thesis, June 2000, Department of Mathematical Modeling (IMM) at the Technical University of Denmark (DTU).

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