Improved Methods for the Travelling Salesperson Problem with Hotel Selection

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Abstract

In this talk, a new formulation and a new metaheuristic solution procedure for the travelling salesperson problem with hotel selection (TSPHS) is presented. The metaheuristic is a multi-start procedure that outperforms existing heuristics on all benchmark instances. We also provide a number of new optimal solutions found by a commercial solver extended with a dedicated cutting plane procedure, as well as new best known solutions for most benchmark instances.

Keywords: TSP, Hotel Selection

The *travelling salesperson problem with hotel selection* (TSPHS) [3] was recently introduced. Due to limitations in the number of worked hours per day, a salesperson often cannot visit all customers in one day. This implies that the salesperson needs to select a hotel to stay each night. Every day should start and end in one of the available hotels and, if a given day ends in a certain hotel, the next day should start in the same hotel. The primary goal of this problem is to minimise the required number of days, while the secondary goal is to minimise the total travel time.

The TSPHS is a difficult combinatorial optimisation problem and has been tackled in [3] where a mathematical formulation and a heuristic solution method are introduced. The authors also define four sets of instances based on well-known VRP and TSP benchmark containing between 10 and 1002 customers.

In this talk, we present an alternative integer programming (IP) formulation for the TSPHS. By extending an commercial solver with a dedicated cutting plane procedure, new optimal solutions and lower bounds are found.

The heuristic method for the TSPHS which is presented in this paper, is a two-phase multi-start procedure that iteratively (i) constructs a feasible solution and (ii) improves

that solution. The heuristic tries to minimise the number of trips and the total length of the tour by means of classical techniques to solve the TSP like the Lin-Kernighan heuristic [2] and operators for the VRP like `relocation` and `exchange` [1] as well as operators specifically designed for this problem.

To test the heuristic developed in this paper, the available benchmark instances have been used. From the results, it is possible to see that our heuristic method is able to produce better results for almost all benchmark instances. Due to its multi-start nature, our heuristic method is slightly slower than the only other heuristic approach described in the literature. Nevertheless, the computing time required for our method is still reasonable.

The research on the TSPHS is not yet concluded. In order to make the problem more realistic, some extensions are subject of scientific interest. Such extensions include: vehicle capacity, hotel costs and time windows.

References

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