

16th July 2026

BACHELOR'S AND MASTER'S THESIS TOPICS: OPERATIONS RESEARCH

RESEARCH

The core area of *operations research* focuses on classical combinatorial optimisation problems. This topic includes many common problems that arise, e.g., in industrial logistics, such as supply chain management or scheduling. The aim here, roughly spoken, is to find realisable solutions in a reasonable amount of time. At our chair, we investigate, on one side, various meta- and matheuristic algorithms like simulated annealing, tabu search, genetic algorithms or the large neighbourhood search and, on the other side, the exact boundary between $\mathcal{NP}$ -hard problems and polynomial solvable special cases of them.

All these topics are essential parts of the bachelor's and master's programmes *Industrial Logistics* and *Industrial Data Science*.

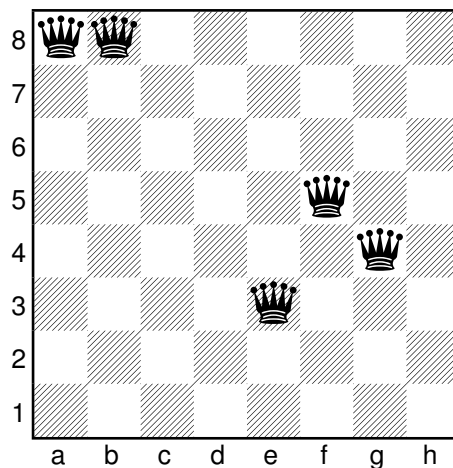
Quadratic assignment problem (QAP)

The quadratic assignment problem (QAP) is one of the fundamental combinatorial optimization problems for which it is very hard to find good solutions even for relatively small instances. Given n departments with pairwise flow volumes and n locations with relative distances for each pair of them, the QAP asks for an assignment of all departments to different locations that minimises the sum of all distances multiplied by the corresponding flow volumes.

We solve this problem by dividing the test instances into many subproblems, which then are solved. Because all flow volumes and all distances always contribute to the objective function value, we cannot make local changes without considering the remainder of the test instance. We address this issue by weighting the particular changes based on an estimate.

Queen/knight/janus domination problem

The *queen (/knight/janus)* domination problem asks for the minimum number of queens (*/knights/jani*) needed to attack or occupy all squares on an $n \times n$ chessboard. In our research, we focus on ILP-based matheuristics producing good upper bounds used within a branch-and-bound framework. In particular, we utilise and envelop the *kernel search* and the *corridor method*. These matheuristics are used, on the one hand, to find a feasible solution for the whole chessboard and, on the other hand, to solve subproblems whose solutions are then combined to obtain a feasible solution to the original problem. For the queen domination problem and $n = 8$, one optimum solution is:



Your contribution

In a bachelor's or master's thesis, you can actively contribute to the research described above as a member of the research team. The main focus will be on utilising and enveloping various ILP-based meta- and matheuristics, either to solve the whole problem or to solve auxiliary problems as part of a larger solution framework. An integral part of such a bachelor's or master's thesis will be not only realising an existing algorithm, but also developing new solution strategies, which must then be critically compared in a statistical evaluation. Excellent programming skills are essential!

For further reading on meta- and matheuristics, see:

- Éric D. Taillard, *Design of Heuristic Algorithms for Hard Optimization*. Springer, 2022
- V. Maniezzo, M. A. Boschetti, and T. Stützle, *Matheuristics: Algorithms and Implementations*. Springer, 2021

TEACHING

If you enjoy programming graphical applications with GUIs, you can also write teaching apps for use in lectures, which illustrate and compare various algorithms relating to the *Fundamentals of Operations Research VU* and *Operations Research*. If you choose such a topic for your bachelor's or master's thesis, you must be an exceptional programmer, because the apps must be designed so that they can be enlarged for other algorithms (or algorithm variants) in the future, be platform-independent, and run without the need to install additional software! The programs should clearly and innovatively illustrate the particular algorithms – so creativity is an important skill!

OTHER TOPICS

If you have another idea for your bachelor's or master's thesis, please feel free to contact me via email: rostislav.stanek@unileoben.ac.at! Collaborations with companies are welcome, too!