Master Thesis Proposal

Machine Learning Approaches for Transportation Crew Scheduling

The Transportation Crew Scheduling problem is one of the most complex Integer Problems (IP) in transportation, therefore, a sequential solution approach is state of the art: The Crew Pairing Problem creates pairings by deciding which flights or jobs are combined to become a work schedule of several days for a crew. In the Crew Assignment Problem, these pairings are assigned to particular crew members for a planning period such as a month. This approach is used in the airline as well as the railway industry. Column generation is the most common solution technique and so far, and few (other) heuristics have been applied. Recently, machine learning has been used to generate new candidate pairings and bidlines as stand-alone approach or as part of the column generation process. In addition to the minimization of cost, these algorithms also have to consider multiple flight or working time limitations. They represent rules from regulators, working contracts or the operator itself and have to be considered when creating duties, pairings and bidlines.

The objectives of this thesis are to…
- introduce crew scheduling and provide an overview about machine learning and the intersection of both topics,
- introduce and compare the different machine learning algorithms as well as other heuristics for the application in crew scheduling (including their advantages and disadvantages and capabilities to cover scheduling rules),
- discuss one model in detail,
- apply the model to the dataset provided by Kasirzadeh et al. (2017),
- provide open research gaps and future trends.

Basic Literature:

Gattermann-Itschert, T., Poreschack, L. M., & Thonemann, U. W. (2023): Using Machine Learning to Include Planners' Preferences in Railway Crew Scheduling Optimization. *Transportation Science*, *57*(3), 796-812.

Heil, J., Hoffmann, K., & Buscher, U. (2020): Railway crew scheduling: Models, methods and applications. *European Journal of Operational Research*, *283*(2), 405-425.

Kasirzadeh, A., Saddoune, M., & Soumis, F. (2017): Airline crew scheduling: models, algorithms, and data sets. *EURO Journal on Transportation and Logistics*, *6*(2), 111-137.

Tahir, A., Quesnel, F., Desaulniers, G., El Hallaoui, I., & Yaakoubi, Y. (2021): An improved integral column generation algorithm using machine learning for aircrew pairing. *Transportation Science*, *55*(6), 1411-1429