REVIEWER'S OPINION OF FINAL THESIS

I. IDENTIFICATION DATA

Thesis name:	**ROADEF Challenge 2022: Optimization of truck fleet loading**
Author's name:	**Tomáš Hromada**
Type of thesis :	master
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Department of Computer Science
Thesis reviewer:	Dr.-Ing. Jan Kristof Behrens
Reviewer's department:	CIIRC CTU

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment	challenging

Evaluation of thesis difficulty of assignment.

The Assignment requires the development of high performance code for very challenging problems from the field of operations research. The formal setting of the ROADEF competition clearly defines inputs, outputs, and quality measures, which certainly allows to concentrate on the algorithmic problem. Being successful in the challenge requires to decode the impact of explicit problem constraints and the implicit nature of the problem instances, and then to address them with specific algorithmic features. Therefore, I rate this assignment as challenging.

Satisfaction of assignment	fulfilled

Assess that handed thesis meets assignment. Present points of assignment that fell short or were extended. Try to assess importance, impact or cause of each shortcoming.

The thesis fulfills the assignment.

Method of conception	correct

Assess that student has chosen correct approach or solution methods.

The presented solution approach is based on a iterated local search, combined with custom search algorithm for truck loading (making it a hybrid metaheuristic). The excellent performance in the competition underlines the approach's validity. The art, when applying local search to a problem, is to define suitable operators, a suitable scheme for applying the operators, and a perturbation function to escape local minima. The student obviously managed to arrive at reasonable designs for these, but I would have liked to see how and why. Also a deeper discussion of the soundness and completeness of the method would be great. The method of running the operators (ordering and disabling) has possibly effects on the completeness. I would suggest to try a random selection of the operators and adapting the probabilities of each operator online. For DFST and the compared ILP model for truck loading, the random search should be combined with the Luby restart strategy to escape the long-tailed searches.

Technical level	A - excellent.

Assess level of thesis specialty, use of knowledge gained by study and by expert literature, use of sources and data gained by experience.

The work for this thesis seems to be executed extremely well. The student's implementation is able to generate high-quality solutions (or even find solutions that are better than all previously known solutions on competition instances). The performance of each operator was analyzed in terms of cost reduction per ms runtime, computational costs, and contribution to cost reduction in total. I expect that these metrics helped with the tuning to arrive at the presented solution. It would be interesting to see some of the experiments that were used to find the parameters. I assume that the data from the interaction with the problem instances could be used to learn better parameters or operators. The topic of learning was not mentioned in the thesis at all.

Formal and language level, scope of thesis	A - excellent.

Assess correctness of usage of formal notation. Assess typographical and language arrangement of thesis.

The thesis is very well written and contains nearly no language mistakes. The mathematical notations in formulas and the pseudocode for the operators are flawless. The thesis is illustrated with nice graphics that help the reader to grasp the effect of the operators easily.

Selection of sources, citation correctness	**A - excellent.**

Present your opinion to student's activity when obtaining and using study materials for thesis creation. Characterize selection of sources. Assess that student used all relevant sources. Verify that all used elements are correctly distinguished from own results and thoughts. Assess that citation ethics has not been breached and that all bibliographic citations are complete and in accordance with citation convention and standards.

The citation style and habit are good. The age of the sources is a bit dated (only two scientific publications from the last ten years). The topic of learning from experience is not covered. The Google OR-Tools solvers provide support for some parts of the problem and could be mentioned in the related work chapter.

Additional commentary and evaluation

Present your opinion to achieved primary goals of thesis, e.g. level of theoretical results, level and functionality of technical or software conception, publication performance, experimental dexterity etc.

This thesis is very good. It would be nice if it could receive some honorable mention or Dean's award.
One comment about the provided software. I was able to compile and run it, but the documentation did not mention how to run it with a time budget. It terminated with a suboptimal initial solution after less than a second for instance AS from the first competition round.

III. OVERALL EVALUATION, QUESTIONS FOR DEFENSE, CLASSIFICATION SUGGESTION

Summarize thesis aspects that swayed your final evaluation. Please present apt questions which student should answer during defense.

The thesis was easy to read and understand. The solved problem was hard, and the student demonstrated his capability to transfer and adapt knowledge to new contexts. He developed software that proved to compare well to 51 other competitors. The reported results from the competition underline the positive impression.

Questions:

1) OpenMP was used to use parallel computing. Please explain which parts of the computations can actually run in parallel!

2) Is the order of operator application anyhow constraint? Please motivate the selected way of operator application. Comment on my suggestion above to make the operator selection probabilistic and tune down the probabilities of non-improving operators (instead of removing them) to maintain better completeness.

3) The thesis mentions that the unloading is not optimized. Please elaborate what does it mean for the stack arrangement in the truck to be optimized or not optimized for unloading. Is it in conflict with the optimization for loading?

I evaluate handed thesis with classification grade **A - excellent.**

Date: **18.6.2023**   Signature: