THESIS SUPERVISOR'S REPORT

I. IDENTIFICATION DATA

Thesis title:	**Single-Vehicle DARP Optimization for Ridesharing Using Operational Research Methods**
Author's name:	**Pavel Martinec**
Type of thesis :	bachelor
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Department of Cybernetics
Thesis reviewer:	Ing. David Fiedler
Reviewer's department:	Department of Computer Science

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment	**challenging**

How demanding was the assigned project?

The goal of this thesis was to implement an efficient method for the Single-vehicle dial-a-ride problem (SVDARP), which is a subproblem of some useful algorithms, including the Vehicle-group assignment algorithm for solving DARP with multiple vehicles. The methodology was restricted to operational research techniques to disqualify solutions that rely solely on general software engineering optimizations. Because the SVDARP needs to be solved to optimality in order to be used in the VGA method, the research area for this thesis is limited to the exact operational research methods. These exact methods are usually hard to comprehend, and that's why I consider the assignment as challenging.

Fulfilment of assignment	**fulfilled with minor objections**

How well does the thesis fulfil the assigned task? Have the primary goals been achieved? Which assigned tasks have been incompletely covered, and which parts of the thesis are overextended? Justify your answer.

I consider all goals of this thesis to be fulfilled. However, I have some minor reservations about two aspects. First, not all performance optimization techniques from the literature (about exact VRP optimizations) were implemented, probably due to time restrictions. Therefore, the full potential of the SVDARP performance optimization remains uncovered. Second, for the same reasons, the evaluation of the implemented SVDARP solver was performed only on a personal computer instead of the computational cluster, resulting in a less reliable comparison of the evaluated methods.

Activity and independence when creating final thesis	**B - very good.**

Assess whether the student had a positive approach, whether the time limits were met, whether the conception was regularly consulted and whether the student was well prepared for the consultations. Assess the student's ability to work independently.

The student presented his progress on a weekly basis. He was always prepared for the consultation, and he always had a sound plan of the following progress. The plan was not always fulfilled, but from my impression, it was caused by the challenges and difficulties related to the complexity of the problem, rather then by the lost of focus. The student is able to work independently.

Technical level	**B - very good.**

Is the thesis technically sound? How well did the student employ expertise in his/her field of study? Does the student explain clearly what he/she has done?

The technical level of the work is good. The student was able to translate mathematical formulations and text into C++ (a low-level programming language) with only sporadic help. The only real challenge for him was the C++ language itself, where he lacked the knowledge about C++ memory management, constructors and destructors, or Cmake. This was probably because proficiency in this language is not sufficiently stressed in FEE. However, the student improved his C++ skills significantly during the work on the thesis. The description of the implementation is very brief, but that is mainly due to the nature of the thesis topic, which requires a lot of theoretical work rather than a large amount of source code.

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Formal level and language level, scope of thesis	C - good.
Are formalisms and notations used properly? Is the thesis organized in a logical way? Is the thesis sufficiently extensive? Is the thesis well-presented? Is the language clear and understandable? Is the English satisfactory?	
The organization of the thesis is good. The mathematical notation and formalizations are correct. The individual sections of the thesis are sufficiently extensive. Unfortunately, it is not always easy to understand the merit of the problem described in individual sections due to grammatical, but most importantly, stylistic errors (but it should be noted that the final version of the thesis improved significantly over the previous versions).	

Selection of sources, citation correctness	A - excellent.
Does the thesis make adequate reference to earlier work on the topic? Was the selection of sources adequate? Is the student's original work clearly distinguished from earlier work in the field? Do the bibliographic citations meet the standards?	
The bibliography of the thesis is adequate for a Bachelor's thesis, and the resources are relevant, mostly scientific articles.	

Additional commentary and evaluation (optional)
Comment on the overall quality of the thesis, its novelty and its impact on the field, its strengths and weaknesses, the utility of the solution that is presented, the theoretical/formal level, the student's skillfulness, etc.
The presented method proved to outperform the baseline solution both when tested SVDARP separately and when testing its influence on the efficiency of the VGA method. The results show that the baseline method is better for smaller instances. However, these are not so interesting as most of the computational time is spend by computing large instances. One reservation I have to the result section is that the number of test instances for the VGA method is very small.

III. OVERALL EVALUATION, QUESTIONS FOR THE PRESENTATION AND DEFENSE OF THE THESIS, SUGGESTED GRADE

All goals of the thesis were fulfilled. The chosen method was successfully implemented, and it outperformed the currently used backtracking SVDARP component on large instances, which is most important, as these instances consume the vast majority of the computational resources.

While I have some objections about the methodology (not all optimizations from the literature were used) and evaluation (evaluation on a personal computer), I have to acknowledge some positive things. First, the topic itself is very challenging. The exact methods for VRP/DARP are very complicated and hard to grasp, so much that they are not always used even in scientific works (so far, we used a much simpler backtracking solution). Second, the baseline backtracking algorithm is highly optimized. Therefore, it is hard to beat it with some other solution, proving that the methodology from this thesis has some algorithmic qualities.

Therefore, the grade I award for the thesis is **B - very good.**

Date: **27.5.2021**   Signature: