THESIS SUPERVISOR'S REPORT

I. IDENTIFICATION DATA

Thesis title:	**Representation learning for trademark search with limited supervision**
Author's name:	**Pavel Suma**
Type of thesis :	master
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Cybernetics
Thesis reviewer:	Alexander Shekhovtsov
Reviewer's department:	Cybernetics

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment	**challenging**

How demanding was the assigned project?

The assignment focuses on a particular learning setup, which, even though well reflects aspects of real world applications, has not been studied in the literature. Despite the many examples of semi-supervised learning with deep models for classification tasks, there are no examples for deep metric learning in a semi-supervised setup. This is well suited to the considered task of landmark identification, but also in the more general case of representation learning. Existing datasets do not well reflect the needs of the training part. Therefore, the work of the thesis included the collection of a new dataset, and the design of a new benchmark. At the same time, good baselines needed to be developed and evaluated to form the grounds for direct and fair comparisons. Proposing new methods to solve the task at hand was challenging as there are no prior examples to show the promising directions.

The assignment requires to develop knowledge on a number of different topics (deep convolutional networks, transfer learning, metric learning, semi-supervised learning) and tasks (image retrieval, trademark identification). Other than the required theoretical and technical background, the work was demanding implementation-wise.

Fulfilment of assignment	**fulfilled**

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 the thesis to very well fulfil the assigned task, achieve the originally assigned goals and even exceed the expectations. The existing datasets were well explored to discover that they are not well suited to reflect aspects of the real world applications; a new dataset was collected. As there is no prior work on this particular flavor of a learning task, baseline approaches were properly considered and evaluated in a way that allows for direct comparisons and fair conclusions. Some of the introduced approaches are generic and applicable beyond the considered task of trademark identification. This thesis opens up future directions of exploring such approaches in more domains and other similar tasks.

Activity and independence when creating final thesis	**A - excellent.**

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.

Regular consultations were planned, and the student was well prepared to present the current progress. Pavel paid good amount of importance on collecting results and presenting them in a way that allows to get some insight and was quite helpful in providing feedback. The consultations included discussions about possible solutions and future steps, usually in a generic and high-level way. The student was able to proceed independently, following the consultations, but expanding the ideas with creativity and figuring out the details by himself.

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 thesis is technically sound with minor exceptions (eg. vectors should be centered in (2.16) which is presumably just an omission in the text, a probably undesired discontinuity at (5.7), etc...). The student appropriately used background from

deep learning, and creatively used background from other fields, such as graph theory. The technical clarity of the manuscript is at good level, but could be improved at cases. For instance, different ways to extract the visual representation are discussed, and it might not be very clear to the reader (due to the consultations it is clear to me, but the general reader might have harder time) at which parts each way is used.

Formal level and language level, scope of thesis	B - very 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?

Despite the difficulties about dealing with a number of different background approaches, learning setups and tasks, the manuscript does good work putting these in order and clarifying the relevance to the work of the thesis. The level and usage of the English language is very satisfactory, clear and always understandable. An aspect to be improved is a missing overview. For example, this would be a high-level description about how the manuscript is organized and how are the different parts of the work forming the overall story. Some parts of the semi-supervised learning benchmark (eg. when existing labels are just discarded, or when they do not exist at all) could have been presented in a slightly clearer way.

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 thesis successfully discusses the relevant prior methods and the connection to this particular flavor of learning task that is considered in the thesis. The bibliographic citations contain recent work published at major conferences; this is work that constitutes that state-of-the-art in the relevant tasks.

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 thesis focuses on a very specific domain, i.e. trademarks, because of the connection to real world applications and the interest of both the student and the supervisor about it. Nevertheless, the work is done in a way that, and the nature of the contributions are so that, the findings are possibly applicable beyond this domain and beyond the task of image retrieval (eg. suits for fine-grained recognition with knn classifiers which is a common example in the deep metric learning literature).

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

My interaction with the student during the whole duration of the work was very constructive and very satisfactory overall characterized with good and smooth communication. Pavel was committed to and focused very well on the work. Pavel managed, in relatively short amount of time, to familiarize himself with the required background and managed to deal effectively and efficiently with a big load of implementations and experimentations. Findings in the thesis reveal promising direction for future research. *The challenging aspects of the assignment, the independent progress by the student, the good quality of the manuscript, and the usefulness of the findings in the thesis justify my rating.*

The grade that I award for the thesis is **A - excellent.**

Date: **18.1.2021**   Signature: