

## I. IDENTIFICATION DATA

Thesis title:	Visual Landmark Recognition with Deep Learning
Author's name:	Ondřej Bouček
Type of thesis :	bachelor
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Department of Cybernetics
Thesis reviewer:	Dmytro Mishkin
Reviewer's department:	Department of Cybernetics

## II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment	challenging
<i>How demanding was the assigned project?</i>	
I evaluate the assigned project as challenging. It consists of relatively simple components, but there are quite a lot of them - four (from 2 to 5) plus a literature review (1).	

Fulfilment of assignment	fulfilled with major objectic
<i>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>	
Point by point:	
<b>1. Study the literature on deep metric learning and landmark recognition with k-nearest neighbor classifiers.</b>	
Fulfilled very poorly.	
First, the review is very shallow, mostly rephrasing textbook material and often irrelevant.	
For example, a lot of space is spent on: local feature-based image retrieval, SIFT feature description (incorrectly called SWIFT on p.10, although it is probably a typo), neural networks, "popular" CNN architectures, how many parameters does AlexNet have, activation functions (together with plots of tanh, sigmoid and ReLU functions) and so on. None of this is relevant to the topic or used later in the paper.	
The indeed relevant part (3.1.5) about deep metric learning discusses mostly types of (hard) example mining for tuplet-based (pairs and triplets) losses. Classification-based approaches for metric learning (ring-loss, arcface, cosface, and so on) are not discussed.	
Specific landmark-recognition papers are not discussed at all.	
<b>2. Train a CNN to extract image descriptors in a metric learning fashion, using existing implementation.</b>	
As far, as I can tell, this task is not fulfilled and a pretrained model is used instead. Specifically, page 25: "We use their model gl18-tl-resnet101-gem-w for extracting global descriptors from an image."	
Moreover, the description of the used model, p.25 "They trained model with metric learning approach on Paris6k [62] and Oxford5k [41] datasets." is incorrect. The model was <b>trained</b> on Google Landmarks Dataset and <b>tested</b> on Paris6k and Oxford5k.	
Using such a model questions the validity of the results overall, because for the evaluation the subset of the same dataset (GLD) - was created by the author with a name "Tiny GLD". See more about this issue in the "Methodology" section.	
<b>3. Implement a knn classifier based on visual search that uses the learned descriptors.</b>	
Fulfilled.	
<b>4. Investigate ways to improve the performance of the search, therefore of the classifier, by employing multiple descriptors per image.</b>	
Fulfilled.	
<b>5. Design and implement deep pairwise verification model, i.e. to perform binary classification and predict whether two images show the same landmark or not. This will be used to improve the knn classifier.</b>	
Not fulfilled or mentioned.	

Methodology	incorrect
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*Comment on the correctness of the approach and/or the solution methods.*

It is hard to evaluate methodology, because it is not described enough. First, there is no information about possible overlap of created dataset, Tiny GLD, and the training set of the original GLD. Therefore there is a chance that the model is evaluated on a training data.

Second, one of the thesis focuses is the influence of the number  $k$  in the  $k$ -NN classifier. Yet (p.26), the most of classes in the TinyGLD contain only one example per class. I doubt that such a dataset is suitable for the task.

## Technical level

E - sufficient.

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

The technical level of the performed experiments is borderline, if use the the benefit of doubts. Overall, thesis looks written in the very last moment, without proof reading and containing grammar and factual errors (about the used model). There is reference to Fig ?? on page 11, wrong (copy-pasted) caption in Figure 3.6, etc.

Figure 5.5 and Table 5.4 are clashed when viewed in Ubuntu Document Viewer, although rendered correctly on mobile somehow.

The language is rather poor and, as I said above, the significant part of the thesis is spent on the irrelevant things. That is why I cannot really evaluate technical level from the description I got.

From the positive side, the language is simple and not over-complicated.

## Formal and language level, scope of thesis

E - sufficient.

*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?*

See above.

## Selection of sources, citation correctness

D - satisfactory

*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 literature review is discussed in assignment fulfilment section. Students work is clearly distinguished from the earlier work in the field.

The bibliographic citations are mostly ok, although do not meet standards fully, e.g. sometimes conference names or years are missing.

## 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.*

n/a

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



## THESIS REVIEWER'S REPORT

*Summarize your opinion on the thesis and explain your final grading. Pose questions that should be answered during the presentation and defense of the student's work.*

Overall, the thesis does not leave the best impression. It is clear, that it was written in the very last moment and the task is not fulfilled in full. The assignment itself is quite ambitious, probably the overly ambitious for the bachelor project. The grade that I award for the thesis is .

### Questions:

1. Could you please specify, which part of GLD you have created Tiny GLD from? Train, index or test?
2. Are there any mistakes in my judgement about the fulfilment of assignment? I would be really happy if that is the case.
3. Why did you choose the dataset with number of examples per class equal to 1 for the experiment with k in kNN classifier?
4. Why did you create Tiny GLD? The computation issues are understandable, when the models are trained. However, for k-NN classifier, one needs to extract features ones and then perform a k-NN search, which could be done efficiently via libraries like faiss.
5. Thesis has 62 references. Did you read them all?

Date:

Signature: