

REVIEW OF BACHELOR THESIS

Name of the student: Vojtěch Poříz

Thesis title: Diabetic Retinopathy Detection Using Neural Networks

Name of the reviewer: Boris Flach

Institution: Czech Technical University in Prague, Faculty of Electrical Engineering

1. RESULTS OF THE WORK AND THESIS STRUCTURE

The bachelor thesis presented by Vojtěch Poříz aims at automated diabetic retinopathy detection in ophthalmoscopic eye fundus images. In particular it focuses on deep learning methods and convolutional networks as well as on methods that allow to improve their performance.

The thesis starts with an thorough description of the diabetic retinopathy disease, explains the relevant symptoms and the underlying anatomical and physiological changes in the retina and the blood vessel system. The next two chapters describe the current state of art of deep learning based approaches for the detection of the disease and its stages. The authors considers in particular the Diabetic Retinopathy Challenge 2015 (Kaggle), describes available datasets and gives an overview on related work. The next chapters describe relevant concepts needed for successfully training deep networks (loss functions, learning schedules, etc.) as well as methods needed for ensembling results from different networks. In his work, the author considers standard networks for classification and for regression as a baseline and develops several methods for improving them. This includes vessel segmentation as an additional input channel and ensembling of networks learned on the same data with different loss functions. These approaches and methods and the results achieved by them are described in the remaining part of the thesis.

2. COMMENTS

The thesis is written in a linguistically competent way and is very well structured. Its main strengths and contributions are in my opinion the following.

- (1) It presents a pragmatically successful combined detection approach for diabetic retinopathy that is very competitive.
- (2) It reflects a very large amount of experimental research done by the author.
- (3) Last but not least, I find it worth mentioning that the author started from an thorough explanation of the disease, its related symptoms and physiological changes, which is indispensable for a successful design of medical diagnostic tools.

The main weakness of the thesis is in my opinion its unusual length in combination with the attempt to give an overview over all conceptual and practical details. As a result, quite a few of them are explained on an “encyclopedic” level only. A reader familiar with them will skip these parts and a reader without this background will not learn much. From the graduation point of view, it remains unclear which of them are considered by the author as most important for the considered task, thereby being worth of deeper understanding and possibly adaptation.

The list of references is very comprehensive. Personally, I would prefer to concentrate on most relevant work only.

3. DEFENSE QUESTIONS

- Q1: The used pseudo-labelling approach (Sec. 5.8) seems to be not very well grounded. Discuss possible well grounded approaches for semi-supervised learning that can be used in deep learning.
- Q2: Explain what is meant by “normalisation to the range $[0, 1]$ ” (Sec. 6.2.2). Why do you think that channel-wise independent normalisation is appropriate/sufficient?

4. CONCLUSIONS

The thesis reflects an impressive amount of work performed by the author. It fulfills the criteria of a graduation thesis. I recommend to accept the thesis for the defense. In view of slight weaknesses mentioned above, I recommend to grade it with 'B' (very good).

Dresden, 21.08.2020

Dr.rer.nat.habil. Boris Flach