Review of Bachelor's Thesis

Student: Tlustoš Vít
Title: Automatic Detection of Eye Retinal Pathologies (id 25232)
Reviewer: Beran Vítězslav, Ing., Ph.D., DCGM FIT BUT

1. Assignment complexity — **more demanding assignment**

The difficulty of the assignment lies in the familiarity with advanced machine learning methods, especially convolutional networks, and the need for creativity in solving the problem.

2. Completeness of assignment requirements — **assignment fulfilled**

3. Length of technical report — **in usual extent**

Although the report is slightly unbalanced - a significant part is devoted to the theoretical background, it contains all relevant and key information without unnecessary passages.

4. Presentation level of technical report — **80 p. (B)**

The report is logically structured and carefully crafted, containing information-rich content. The text is clear, concise and easy to understand.

However, the author devotes much of the report to an overview of selected areas of machine learning, particularly neural and convolutional networks. The summary of important architectures, features, and techniques is quite relevant, and very well and expertly described. However, it is questionable whether such an extensive theoretical introduction is relevant to the actual solution, however good it may be.

In the theoretical section, some equations lack an explanation of the meaning of the variables (e.g., Equation 2.10 and some others).

Chapter 3.3, which is actually a tutorial on how to use the scripts and tools developed, should be included in an appendix rather than in a technical text.

The author sometimes provides essential information in the figure captions (e.g. Figure 4.2), although this would be more appropriate to present it in the text.

5. Formal aspects of technical report — **90 p. (A)**

The work is of excellent typographical and linguistic quality. For some figures it would be advisable to adjust the size of the captions (e.g. Fig. 2.10, 2.11, etc.) or, better still, to put them in vector format.

6. Literature usage — **90 p. (A)**

The author makes good use of the extensive list of references studied, which are carefully referenced in the text. The quality of the text and the information presented shows a good understanding of a non-trivial subject.

Not exceptionally, the author inappropriately refers to literature outside of sentences (after a paragraph).

7. Implementation results — **95 p. (A)**

The author has designed and implemented his own U-Net architecture, supplemented by other well-chosen techniques. He has made good use of the existing IDRiD dataset for which he has prepared the necessary functions for slice creation, data augmentation, etc.

In the experiments, the author mentions that more than 100 models were trained, which differed in the chosen parameters, learning procedure or loss function. However, nowhere is it mentioned with which settings these experiments were performed, only the resulting configuration is given.

The author does a good job of analyzing the imbalance of the dataset, and appropriately substitutes the ROC evaluation of AUC-PR based on the imbalance to better account for this. The values in the confusion matrix could be normalized.

It uses modern and relevant tools and technologies for implementation, development and experimental user interface.

The source codes are carefully annotated and although they do not contain a declaration of authorship, given their careful explanation and correspondence with the contents of the technical report, Mr. Tlustos' authorship is obvious.

8. Utilizability of results

The results of the work are not only usable in practice, but also suitable for further research in this area.

9. Questions for defence

- What parameters, learning procedures and loss functions did you experiment with before you selected the final configuration?
- What are the specifics of the task or data that led you to choose the U-Net architecture and the additional procedures you selected?
- What do you see as the benefit of training multiple models with different resolutions?

10. Total assessment **100 p. excellent (A)**

Mr. Tlustos solved the non-trivial problem of segmenting retinal images into selected pathological classes. He very carefully studied and developed the necessary methods in the field of convolutional networks. He designed and implemented the U-Net architecture with other appropriate modifications, with which he performed a number of relevant experiments. He has carefully evaluated and interpreted the results. The result is thus a functional and usable model. It is a very successful and high quality work.

In Brno 3 June 2022

Beran Vítězslav, Ing., Ph.D.
reviewer