Opponent Evaluation of the Bachelor Thesis

Author of the thesis and title:

Otakar Jašek: Detecting Objects for Autonomous System Verification

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Summary of the thesis:

The goal of this thesis was to develop a software package that supported automated annotation of verification data. The system should be able to use pre-trained algorithms and also it should allow the user to re-train the algorithms on specific data. The first algorithms which should be tested in this software package were some of the latest state of the art convolutional neural networks (CNN). The implementation should be modular and allow the integration into various frameworks. The author planned to evaluate the SW on standard datasets as well as specific data.

There are 4 main parts of the thesis. Theory and state of the art in CNN is discussed in the first part. The theory briefly describes the learning and detection process of CNN as well as detailed description of the two tested CNNs structure. This part is brief and clear which is suitable for bachelor thesis. I have a few comments for this part. The author uses many sentences which are not backed up by relevant citations in the literature. E.g.:

Ch. 1.2.1 „The object detection problem is inherently much more difficult than object recognition ...“

„... however it was shown that ReLU unit is important in increasing capability of network to express non-linearity which is desired“

and many more not referenced claims. Not all the equations were thoroughly checked but seem to be correct.

Second part of the work is a detailed description of functions written in Python - the created framework wrappes around the Caffe framework and provides functionality more suitable for needs of the CNN re-training and comparison for experimental purposes. This part is well structured and serves as a documentation for the user of the framework.

The third part provides an experimental evaluation of 2 tested CNN. The experiments provide a comparison of performance on two datasets (victims dataset and standard KITTI dataset). Both pre-

trained and re-trained networks are evaluated. I find the results of the re-trained CNN not reliable because of the extremely low number of training samples (a few thousands) used from both datasets. Such a low number of training data clearly indicate overfitting which we can read (besides other ROC) from ROC Fig.3.15, 3.17. Also I am missing the training ROC which (compared to testing ROC) could show if the classifier was overfitted or not. The second tested CNN called ZFNet was obviously trained incorrectly – but that was probably not a mistake in the framework of the author but again probably due to a very low number of training samples. Also giving a different number of samples for each class must damage the detection rates on classes with smaller number of training samples. The author should be carefull when trying to make some conclusions about the CNNs from these experimental results. But a proper training of various CNN was not the goal of this thesis – this is a task for the user of this framework. The goal was to test if the framework works correctly and is able to re-train networks and evaluate the performance which was successful and I find the goal met.

Final Evaluation:

The thesis is well written. The framework in python is well described and its functionality was tested. The author met the main goals of the thesis. There are a few drawbacks – namely not enough references to the scientific literature for supporting the claims and some of the conclusions made on not properly trained CNN, but as I said this is not a big mistake in a bachelor thesis. I consider this work as a good bachelor thesis (grade C).

Questions for the candidate defense:

1. Automated annotation of the verification data – one of the goals which was not evaluated in the conclusion nor in experiments. Why is it missing, how was it be done from the results of CNN detections?
2. The modularity of the SW integration to various frameworks – one of the goals which was not discussed in the thesis. Why? What other frameworks did you integrate your SW to?
3. There is no chapter in the thesis which would provide any desing pattern suitable for this kind of modular framework – which was also one of the requirements. Please explain why it is missing, what kind of design pattern did you use and why was it suitable.

In Prague, June 2016

David Hurych