Review statement on doctoral thesis

Ph.D. student: **Ing. Martin Krčma**
Proposed thesis title: Fault Tolerant Field Programmable Neural Networks
Supervisor: doc. Ing. Vladimír Drábek, CSc.

The dissertation thesis and attached papers present a comprehensive and in-depth examination of the field of neural networks with a focus on their fault tolerance and acceleration. The author has produced a significant number of publications in the area, demonstrating a deep understanding of the subject matter.

The thesis focused on developing Field Programmable Neural Networks (FPNNs) with a goal to minimize resource consumption while balancing the trade-off between approximation accuracy and resource consumption. Three types of grid FPNNs with varying numbers of affine operators were developed. Reducing the number of affine operators saves resources, but also reduces the approximation accuracy of the FPNN. The experiments showed that the decrease in approximation accuracy depends on the original neural network, task, and the number of affine operators. The thesis also explored the fault-tolerant properties of FPNNs and proposed methods for hardening FPNNs without relying on replicating components, such as using identity operators and modifying activators parameters. A method for detecting permanent faults in neural networks was also proposed.

One of the strengths of the thesis is the thorough analysis of the existing literature and techniques in the field of fault tolerant neural networks.

However, the introduction of the thesis could have been more useful if it provided a clearer motivation for the research. While the author provides a brief history of neural networks, it would have been beneficial to see a clearer explanation of why he decided to work in this particular domain, what was the motivation for experiments, and so on.

The proposed algorithms in the thesis are benchmarked on very basic classification tasks and synthetic data from UCI machine learning repository. It is not clear from the thesis if the algorithms can have any serious real-world applications or if there are any plans for future industrial collaborations. This makes it difficult to assess the practical significance of the research.

Methods for recovery from errors are mentioned just in the conclusion of the thesis, which is pretty good. Perhaps it would be sufficient, if the thesis is just a collection of research papers with the conclusion attached.

In conclusion, the author has produced a significant number of publications and demonstrated a deep understanding of the subject matter. He proved that he is able to

introduce new algorithms and contribute to the work done by other researchers. I recommend the thesis to be accepted by the evaluation committee.

doc. Ing. Pavel Kordík, Ph.D.   Prague, February 4th. 2023,