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Report on the Bachelor Thesis of David Pavlicek entitled “Scalable Representations of Neural Networks”

Supervisor: Zdenek Buk, Department of Cybernetics, FEL, CTU.

Opponent evaluation.

Opponent name: Sebastian Basterrech

Affiliation: Department of Computer Science, FEL, CTU

Global context of the report:

The thesis proposed by David Pavlicek presents experimental results about the scalability of Neural Networks (NNs). The student analyzed the problems of representation of a NN using evolutionary algorithms. Nowadays, the area studied in this thesis is very relevant in the community due to the large size of complex networks. There are two common approaches of representing complex networks using evolutionary algorithms: direct and indirect ones. A direct method encodes the topology of the network in a set of genes using directly the information of the network topology (such as weights, activation function parameters, etc). A main limitation of this approach is that the required size for representing the network grows with the network size. Another approach encodes the network using a representation that is independent of the network itself. Then, the method can require less space, and offer more possibilities concerning to the scalability of the network. The main objectives in the thesis were to compare several techniques to evolution of NNs using a method named HyperGP. The thesis is structured as follows. In the first part of the report the student presented the background of the area (NN, HyperGP, etc.). Section 3 describes the implementation of the developed algorithms. Experimental results are presented in Section 4. In addition, the student added helpful annexes with figures, code, a tutorial for using the software.

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Evaluation and global analysis:

The document presented by David Pavlicek clearly has the level and content according to a Bachelor thesis in computer science. I consider that the author shows a wide domain of NN, encoding techniques, as well as good skills for developing software. Besides, the student proves good capabilities for writing a report following a scientific format. In addition, I would like to say that I enjoyed to read it, the report is self-contained, helpful figures, well-detailed concepts, and good references.

I would like also to add some minor remarks. The experimental part could be more rich, the performance evaluation was made following only one experiment, which was presented in [3]. In addition, even though the thesis focuses in indirect methods of encoding NNs, a better presentation of the direct methods could be included. I also consider that the description of FFNN is too concise, some parameters are not well specified. Some acronyms are not defined neither. I consider that there exists a bit of confusion in the section 3.2.1 between Genetic Algorithm (GA) and Genetic Programing (GP). The conceptual separation between GA and GP isn't clear. An explanation of the selection of the fitness function is missing, as well as more details about the GP.

Recommendation:

To sum up, I truly believe, and strongly supports that M. David Pavlicek deserves to obtain his Bachelor title in computer science. I evaluate his thesis with B (very good, 85%) following the ECTS grading scale.

Your sincerely,

Sebastian Basterrech, PhD.