Heuristic approach to testing neural networks that meets software testing concepts

 ¹Yu. L. Karpov <y.l.karpov@yandex.ru>
²L. E. Karpov <mak@ispras.ru>
³Yu. G. Smetanin <ysmetanin@rambler.ru>
¹Luxoft Professional LLC
²V. P. Ivannikov Institute for System Programming of Russian Academy of Sciences, Moscow State University
³Federal Research Center "Informatics and Control" of Russian Academy of Sciences, Moscow Institute of Physics and Technology (Technical University)

In practice, the choice of the neural network architecture for solving a specific problem is based on the experience of developers. When constructing deep neural networks, this can lead to a choice that is far from the best.

The difference between neural networks and software systems that implement algorithmic methods for solving problems is quite significant. In software implementation of algorithms, one can trace the movement of data, testing the software system can detect and localize errors. In contrast, a neural network is often considered as a black box, and the conclusion about correctness of operations is based on its *<input, output>* pairs. However, this is not always the case. The structure of the neural network used to solve a particular problem can be well known a priori. Moreover, although the algorithmic connection among the elements of this structure is not always clear, some parameters of structural elements can be corrected in the same way as in essentially heuristic procedures for testing and debugging software systems.

In applied problems, type of input and output data and its dimension are determined by the specific nature of the problem and by the particular system within which the problem is being solved. Based on these initial data, the designers of neural network systems select the number and types of neurons, their partition into layers, the types of these layers, the methods of interaction between neurons, the weight of the synapses, the activation functions, and some other characteristics.

The most promising seems the approach based on modeling a neural network by a generalized hierarchical nondeterministic automaton with spontaneous changes of its states. This approach complies with the accepted norms and standards for testing software systems. It is now implementing by authors in their research project supported by Russian Foundation for Basic Research (grant No. 18-07-00697).

Full version of the article was published in 'Programming and Computer Software' journal, vol. 44, No 5, 2018, pp. 324-334, doi: 10.1134/S0361768818050031.