Nizhny Novgorod State University
Institute of Information Technologies, Mathematics and Mechanics
Department of Computer Software and Supercomputer Technologies

Educational course «Introduction to deep learning using the Intel® neon™ Framework»

Lecture №2
Multilayered fully-connected neural networks

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Kustikova Valentina

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Content

1 Abstract

The goal of this lecture is to discuss the model of multilayered fully-connected networks and the backpropagation method for training the parameters. Firstly, the deterministic model of the neuron is considered [1]. The general structure of the multilayer fully-connected neural network is introduced. The multilayered neural network contains neurons that are distributed across layers. In the simplest case, the network has ***an input and output layers***, and the network is called ***a single layer network***. In general, a network may contain a set of intermediate layers, called ***hidden layers***, and it is ***a multi-layered network***. If all the layer neurons are connected to the next layer neurons, then the layer is called ***fully-connected***. If this condition holds for all layers of the network, then the network is called ***fully-connected neural network*** (FCNN). An optimization statement of the training problem for a multilayered fully-connected network is considered. The problem of training a single layer neural network consists in minimizing ***the cost function*** that show how the neural network output (the expected signal) differ from the actual signal corresponding to the current input throughout the training sample. This function is a measure of the training effectiveness. A backpropagation algorithm for training neural networks is introduced based on the example of a two-layer fully-connected network. The backpropagation algorithm determines the strategy for updating network parameters using gradient optimization methods [2] under the assumption that the cost function is continuous. Gradient methods at each step refine the values of the parameters by which optimization is carried out. The lecture provides a detailed derivation of mathematical formulas for implementing the backpropagation algorithm for a two-layer network corresponding to logistic regression.

2 Literature

2.1 Books

1. Haykin S. Neural Networks: A Comprehensive Foundation. – Prentice Hall PTR Upper Saddle River, NJ, USA. – 1998.
2. Osovsky S. Neural networks for information processing. – 2002.
3. Goodfellow I., Bengio Y., Courville A. Deep Learning. – MIT Press. – 2016. – [http://www.deeplearningbook.org].