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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 №1
Introduction to deep learning

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1 Abstract

This lecture is an introductory one. The goal of this lecture is to get acquainted with the history of deep learning and the practical examples of using the methodology.

Deep learning is a field of machine learning, that examines methods for solving problems of artificial intelligence using deep neural networks.

In different historical periods, there are ups and downs of interest in the field of deep learning. Rosenblatt's perceptron is one of the basic neural network models, which is widely known to the community (1957). Essentially, the perceptron is a computer model of the information perception by the brain and has a biological rationale for functioning. The first works on deep neural networks appear in the 60s of the last century, and they are inextricably linked with the name of Alexei Grigorievich Ivakhnenko (the scheme of mass selection, the method of group accounting of arguments), the Soviet scientist in the field of control systems. The next stage in the history of deep learning is the development by Geoffrey Hinton of the backpropagation method for training neural networks (1986). This method is still used in its original form.

Further, methods based on the construction of deep neural networks fall out of the practical application. This is largely due to the complexity of training deep structures, the lack of necessary computing resources and extremely small amounts of training data. A new surge of interest occurred in 2006, when graphic processors and multi-core systems appeared that made it possible to effectively implement the training of deep neural networks. As a consequence, in 2011, the research division of Microsoft made a breakthrough in solving the problem of speech recognition (services for automatic translation of voice into written text) [5], and in 2012 the team of Geoffrey Hinton achieved outstanding results in the problem of classification of images with a large number of categories [4].

At present, the methods of deep learning are successfully applied in various fields of science and technology. The most impressive example of the effective use of deep neural networks is the creation of a computer algorithm AlphaGo that defeated the best player in Go [6, 7]. It may seem that the victory in the board game is not a very useful achievement, however, it is a significant step towards creating a strong artificial intelligence. Technologies that a few years ago seemed like a pipe dream, are already commercializing. The technology of autonomous cars is certainly one of those. At the moment, the autonomous cars are tested on the streets by well-known companies, such as Google, Tesla and Uber [8]. Along with this, most people daily and unconsciously use the results of the work of deep learning methods, opening an online translator, such as Google Translate or Yandex Interpreter, or performing a voice request to search for any information on the Internet, or simply taking a picture of the liked scene and processing the photo on the phone. In the lecture, we consider the most significant examples of the use of deep learning in computer vision and natural language processing. Also, we introduce a classification of models by the method of training.

2 Literature

2.1 Books

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

2.2 Further reading

4. Krizhevsky, A., Sutskever, I. Hinton, G. E. ImageNet Classification with Deep Convolutional Neural Networks // Advances in Neural Information Processing Systems. – 2012.

2.3 References

5. Dahl G., Yu D., Deng L., Acero A. Context-Dependent Pre-trained Deep Neural Networks for Large Vocabulary Speech Recognition // IEEE Transactions on Audio, Speech, and Language Processing. – [https://www.microsoft.com/en-us/research/publication/context-dependent-pre-trained-deep-neural-networks-for-large-vocabulary-speech-recognition].
6. How the Computer Beat the Go Master [https://www.scientificamerican.com/article/how-the-computer-beat-the-go-master].
7. Google’s AlphaGo Defeats Chinese Go Master in Win for A.I. [https://www.nytimes.com/2017/05/23/business/google-deepmind-alphago-go-champion-defeat.html].
8. An Introduction to Deep Learning [http://blog.algorithmia.com/introduction-to-deep-learning-2016].