Syllabus
«Neural Network Methods of Computational Intelligence»

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Expected learning outcomes
As a result of studying the discipline, the student
must know:

- classification of neural networks, successful applications and implementations, typical architectures of neural networks, concepts and definitions of computational intelligence;
- types and methods of neural networks training, criteria for evaluating the accuracy of models, parameters of neural networks affecting accuracy;
- modern software and tools for developing systems based on neural networks, forward and back error propagation algorithms;
- possibilities and features of neural networks of direct signal propagation, with reverse and lateral connections, deep neural networks and adaptive neuro-fuzzy systems;

must be able to:

- develop models of neural networks to solve the tasks, independently determine their architecture and learning methods;
- investigate the influence of neural network parameters on model accuracy, compare neural network methods and models;
- independently choose software means and tools for developing systems based on neural networks, solve problems of recognition, classification, clustering, forecasting, etc.;
- implement and apply neural networks of direct signal propagation, with reverse and lateral connections, deep neural networks and adaptive neuro-fuzzy systems for various applied problems.

The scope of the discipline: 3,5 ECTS credits (16 hours of lectures, 32 hours of practice).

Purpose: teaching students the use of methods and approaches based on neural networks, as well as the development of appropriate architectures and models for solving problems of recognition, classification, clustering, forecasting, etc. Mastering the course material should provide students with a theoretical and practical basis in the field of neural networks and artificial intelligence and form the basic skills of users and developers of modern intelligent systems.

The content of the discipline

Topic 1. General characteristics and properties of neural networks. Biological neuron. Models of artificial neuroelements. Classification and types of neural network models. A general idea of the synthesis of neural networks.
Topic 2. Direct signal propagation neural networks. Single layer perceptron. Multilayer neural network. The method of backpropagation of the error. Radial-basis neural networks.
Topic 3. Neural networks with feedback. Hopfield's neural network. Elman's neural network.
Topic 4. Neural networks with lateral connections. Kohonen's SOM neural network. Kohonen's LVQ neural network.
Topic 5. Neural networks in control systems. Principles of Neural network control. Predictive neural network controller.
Topic 6. Deep neural networks. Convolutional neural networks. Networks of long short-term memory. Hybrid deep networks.

Prerequisites
"Higher mathematics", "Fundamentals of programming", "Object-oriented programming", "Methods and systems of machine learning", "Theory of decision-making", "Fuzzy logic basics".

Consequences
The knowledge gained during the discipline can be used in the disciplines or areas of "Intelligent decision support systems", "Software of intelligent systems", "Fuzzy models and methods of computational intelligence", as well as during pre-diploma practice and preparation of qualification work.

Technical support
Practices on the discipline are carried out in computer classes using Microsoft Visual Studio, Java SE, Python, C#.

Deadline policy
Works that are submitted in violation of deadlines without good reason are evaluated at a lower grade.

Academic Integrity Policy
Provides independent performance of practices. Write-off (including using mobile devices) is prohibited. The work is not credited in case of detection of plagiarism or write-off.

Evaluation criteria of laboratory works / practices / individual works / reports / projects

Maximum number of points – a student with high quality independently performed the entire scope of work, answers all questions related to the work performed, and makes additional calculations, for example, using the neural network methods offered to him by the teacher. The teacher has no complaints about the software implementation and performance requirements.
Approximately 70%-99% of the maximum number of points – a student with sufficient quality independently completed all tasks, but in the process he made some mistakes, which, after pointing to them by the teacher, corrected themselves. He answers some questions with a slight error. The additional calculations offered by the teacher make with some complexity. Not all work requirements are met.
Approximately 40%-69% of the maximum number of points – a student of average quality independently completed all tasks, but did not meet all the requirements for implementation. He answers the question with a slight error. The additional calculations offered by the teacher, for example, using neural network methods makes with insignificant errors. Not all requirements for the design of the work are met.
Approximately 1%-39% of the maximum number of points – a student performed all the work independently, but the quality of implementation is insufficient (errors in calculations, not all work requirements are met). The answers to the questions about the work are not entirely clear. There are errors in the answers.
0 points – a student did not perform the entire amount of work, or performed with gross errors. He has problems with calculations by certain methods, does not know the theoretical material, the software implementation does not meet the requirements.