Syllabus
«Mathematical Methods of Intelligent Computing»

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

- the main forms and laws of abstract and logical thinking, the basics of logic, the norms of a critical approach, the basics of the methodology of scientific knowledge, the forms and methods of analysis and synthesis;
- basic concepts of the theory of intelligent systems, fuzzy logic, artificial neural networks, hybrid neuro-fuzzy networks, bio-inspired evolutionary and multi-agent computing methods of collective intelligence;
- modern software and tools for developing systems based on fuzzy logic, artificial neural networks, hybrid neuro-fuzzy networks, bio-inspired evolutionary and multi-agent computing methods;
- basic software and algorithmic tools used at all stages of the life cycle (design, modeling, programming, operation) of intelligent information systems and control systems;

must be able to:

- implement the learned concepts, concepts, theories and methods in intellectual and practical activities in the field of computer science, understand the content and sequence of application of methods of performing actions, generalize and systematize the results of works;
- use formal models of intelligent systems based on the theory of fuzzy logic, artificial neural networks, hybrid neuro-fuzzy networks, evolutionary and multi-agent computing methods, design, develop and analyze algorithms for evaluating their effectiveness and complexity;

The scope of the discipline: 4,5 ECTS credits (30 hours of lectures, 30 hours of practice).

Purpose: teaching students the use of modern computing methods based on the principles of the theory of artificial intelligence and used in information systems to solve various classes of problems. Mastering the course material should provide students with a theoretical base in the field of modern intelligent information systems and control systems, as well as form in them the basic skills of using computational methods of these intelligent systems. Also, this course provides students with the skills to implement methods of intelligent computing on a computer.

The content of the discipline

Topic 1. Mathematical methods of modern intelligent systems. General provisions.
Topic 2. Bio-inspired evolutionary and multi-agent methods of intelligent computing. Classification of bio-inspired methods of intelligent computing.
Topic 3. Genetic methods of intellectual computing. Peculiarities of the application of genetic methods in solving different classes of problems.
Topic 4. Methods of intelligent computing based on artificial immune systems. Peculiarities of using methods of artificial immune systems in solving different classes of problems.
Topic 5. Biogeographical methods of intellectual computing. Types of biogeographical methods. Peculiarities of the application of biogeographical methods in solving different classes of problems.
Topic 6. Intelligent methods of ant colonies. Types of ant colony methods. Peculiarities of using methods of ant colonies in solving different classes of problems.
Topic 7. Intelligent particle swarm methods. Types of particle swarm methods. Peculiarities of using particle swarm methods in solving different classes of problems.
Topic 8. Intelligent computing methods based on the simulation of bacteria movement. Types of methods simulating the movement of bacteria. Peculiarities of the application of

- use mathematical packages and develop programs for the implementation of mathematical computing methods of artificial intelligence, reasonably choose these methods when solving engineering problems in the process of designing and modeling information and software systems and technologies, evaluate the effectiveness of the applied methods, in particular, convergence, stability and complexity of implementation;
- use algorithmic software at the stages of design, modeling, programming and operation of intelligent information systems and control systems.

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", "Neural network methods of computational intelligence, " "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.

methods simulating the movement of bacteria when solving different classes of problems.

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 mathematical 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 mathematical 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.