

MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN FEDERATION
Federal State Autonomous Educational Institution
higher education
NORTH CAUCASIAN FEDERAL UNIVERSITY

I APPROVE

Dean of the Faculty of Mathematics
and computer science named after
Professor N.I. Chervyakov,
Candidate of Physical and
Mathematical Sciences, Associate
Professor
Grobova T.A.

ASSESSMENT TOOLS FUND FOR DISCIPLINE
Artificial Intelligence Models and Theories / Модели и теории
искусственного интеллекта

Direction of training	02.04.01 Mathematics and Computer Science
Profile	Training Program for Electronic Information
Year of commencement of studies	<u>2026</u>
Form of study	full-time
Implemented in 1 semester	

Introduction

1. Purpose: The assessment tools fund is intended to provide a methodological basis for organizing and conducting ongoing assessments in the course "Artificial Intelligence Models and Theories / Модели и теории искусственного интеллекта." Ongoing assessments in this course are a systematic method for assessing students' knowledge, skills, and abilities. The objectives of ongoing assessments are to obtain initial information on the progress and quality of competencies acquired, as well as to stimulate regular, targeted student work. This work is intended to develop a certain level of competencies.

2. FOS is an appendix to the program of the discipline "Artificial Intelligence Models and Theories / Модели и теории искусственного интеллекта"

3. Developer: Department of Computational Mathematics and Cybernetics .

4. An examination of the organophosphorus compounds was carried out.

Members of the expert group:

Chairman

Babenko M. G., Head of the Department of Computational Mathematics and Cybernetics

Members of the commission:

Peleshenko V.S., Associate Professor of the Department of Computational Mathematics and Cybernetics

Peleshenko T. A., Associate Professor of the Department of Computational Mathematics and Cybernetics

Representative of the employer organization Kornienko S. A., head of the branch department FSUE "Main Radio Frequency Center" in the Southern and North Caucasian Federal Districts districts

Expert opinion: the fund of assessment tools corresponds to the educational program in the field of training 02.04.01 Mathematics and computer science profile " Training Program for Electronic Information » and is recommended for conducting ongoing monitoring of students' academic performance and midterm assessment.

5. The validity period of the FOS is determined by the period of implementation of the educational program.

1. Description of the criteria for assessing competence at various stages of its development, description of assessment scales

Competence (ii), indicator (s)	Levels of development competence (s),			
	The minimum level has not been reached (Unsatisfactory) 2 points	Minimum level (satisfactorily) 3 points	Intermediate level (Fine) 4 points	High level (excellent) 5 points
<i>Competence: About PC- 2 Able to create and explore new mathematical models in the natural sciences, improve and develop concepts, theories and methods</i>				
Learning outcomes for the course (module): <i>Indicator:</i> ID-1 OPK-2 Conducts research into new mathematical models in the natural sciences ID-1 OPK-2 Develops new and improves existing concepts, theories and methods	The student demonstrates a very low level of knowledge of basic programming methods and information technology and information technology used in scientific research the student demonstrates only rudimentary skills in various ways of presenting and adapting mathematical knowledge, programming methods and information technology, taking into account the level of the audience; the student demonstrates rudimentary skills in scientific research and reviewing scientific results;	The student demonstrates knowledge of only some of the basic programming techniques and information technology and information technology applied in scientific research The student demonstrates some basic skills in various ways of presenting and adapting mathematical knowledge, programming methods, and information technology, taking into account the level of the audience. The student demonstrates basic skills in scientific research and reviewing scientific results.	The student demonstrates knowledge of basic programming methods and information technology and information technology applied in scientific research The student demonstrates the ability to present and adapt mathematical knowledge, programming methods, and information technology in various ways, taking into account the level of the audience. The student demonstrates skills in scientific research and reviewing scientific results.	The student demonstrates comprehensive knowledge of programming methods and information technology and information technology applied in scientific research the student can easily present and adapt mathematical knowledge, programming methods and information technologies in various ways, taking into account the level of the audience; the student has a variety of skills in scientific research and reviewing scientific results;
<i>Competence: PC- 2 Able to conduct scientific research based on existing methods in a specific area of professional activity</i>				

Learning outcomes for the course (module): <i>Indicator:</i> ID-1 PC-2 Conducts scientific research in the field of parallel computer technologies. ID-2 PC-2 Conducts reviews of scientific articles, abstracts and dissertations in the fields of mathematics and information technology	the student demonstrates very weak knowledge of the basic methods of practical verification of research results and information technologies used in scientific research The student demonstrates very weak skills in constructing mathematical models of information security systems and conducting an analysis of the scientific and practical significance of the research conducted. the student shows only rudimentary skills in reviewing scientific results	the student demonstrates knowledge of some of the basic methods of practical verification of research results and information technologies used in scientific research The student demonstrates skills in constructing some of the basic mathematical models of information security systems, conducting an analysis of the scientific and practical significance of the research conducted The student demonstrates basic skills in reviewing scientific results	the student demonstrates knowledge of the basic methods of practical verification of research results and information technologies used in scientific research The student demonstrates confident skills in constructing mathematical models of information security systems and conducting an analysis of the scientific and practical significance of the research conducted. the student demonstrates good skills in reviewing scientific results	The student demonstrates comprehensive knowledge of the main methods of practical verification of research results and information technologies used in scientific research. The student is easily able to construct mathematical models of information security systems and conduct an analysis of the scientific and practical significance of the research conducted. the student is easily able to review scientific results
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The assessment of the level of development of competence in the discipline is carried out on the basis of the "Regulations on the current monitoring of academic performance and midterm assessment of students in higher education programs - bachelor's programs, specialist programs, master's programs - at the federal state autonomous educational institution of higher education "North Caucasus Federal University" in the current version.

ASSESSMENT TOOLS FOR CHECKING THE LEVEL OF DEVELOPMENT OF COMPETENCIES

Task number	Correct answer	Contents of the question	Competence
		Form of study: full-time/part-time/full-time and part-time	
1.	The main types of neural networks include fully connected , convolutional (CNN), and recurrent (RNN) networks. Each type has its own characteristics and applications. For example, CNNs are used for image processing.	What are the main types of neural networks?	About PC- 2 PC- 2
2.	A simple neural network consists of an input layer, one or more hidden layers, and an output layer. Signals are passed through the layers, where activation functions are applied to process the information. This allows the network to learn from the data.	How does a simple neural network work?	About PC- 2 PC- 2
3.	Forward propagation involves passing input data through the network to produce output. Backward propagation is used to adjust the network weights based	What is the difference between forward and backward propagation?	About PC- 2 PC- 2

	on the error between the predicted and actual output.		
4.	Neural networks use activation functions such as ReLU , Sigmoid , and Tanh . These functions allow them to model nonlinear relationships between input and output data.	What activation functions are used in neural networks?	About PC- 2 PC- 2
5.	Convolutional networks are effective in image processing due to their ability to detect local patterns. However, they require large amounts of data and computational resources.	What are the advantages and disadvantages of convolutional neural networks?	About PC- 2 PC- 2
6.	Recurrent networks are implemented using cyclic connections, allowing them to process sequential data. This makes them suitable for text or time series processing tasks.	How to implement a recurrent neural network?	About PC- 2 PC- 2
7.	Autoencoders are used for data compression and decompression, as well as for generating new samples. They are useful in dimensionality	What are the applications of autoencoders ?	About PC- 2 PC- 2

	reduction and anomaly detection.		
8.	Dropout is a regularization method that randomly switches off neurons during training. This helps prevent overfitting and improves the generalization of the model.	How does the dropout mechanism work in neural networks?	About PC- 2 PC- 2
9.	Neural networks use regularization methods such as L1 and L2 regularization to prevent overfitting. L1 regularization results in weight sparsification, while L2 regularization results in weight reduction.	What regularization methods are used in neural networks?	About PC- 2 PC- 2
10.	L1 regularization leads to weight sparsification, which is useful for feature selection. L2 regularization reduces all weights, which helps prevent overfitting without sparsification.	How to compare L1 and L2 regularization?	About PC- 2 PC- 2
11.	Deductive reasoning involves deriving general rules from specific cases. Inductive reasoning	What is the difference between deductive and inductive reasoning?	About PC- 2 PC- 2

	involves deriving specific rules from general observations.		
12.	Abductive reasoning involves searching for the most probable explanation for observed facts. It is often used in expert systems.	How does abductive reasoning work?	About PC- 2 PC- 2
13.	Reasoning systems use logical operations such as conjunction, disjunction, and negation to process and infer knowledge.	What logical operations are used in reasoning systems?	About PC- 2 PC- 2
14.	Prolog is a logic programming language that allows you to implement reasoning systems using rules and facts.	How to implement a logical reasoning system in Prolog?	About PC- 2 PC- 2
15.	Fuzzy reasoning is used in control systems where uncertainty and imprecision in input data must be handled.	What are the applications of fuzzy reasoning?	About PC- 2 PC- 2
16.	Knowledge engineering is the process of collecting, structuring, and using knowledge to solve problems.	What is knowledge engineering?	About PC- 2 PC- 2
17.	The process includes collecting knowledge, structuring it and	What stages does the knowledge engineering process include?	About PC- 2 PC- 2

	integrating it into the system.		
18.	Interviews, surveys and document analysis methods are used to collect knowledge.	What methods are used to collect knowledge?	About PC- 2 PC- 2
19.	Ontologies are formalized representations of knowledge that can be used to create knowledge bases.	How to implement a knowledge base using ontologies?	About PC- 2 PC- 2
20.	Database management systems and specialized tools such as Protege are used for knowledge management .	What tools are used for knowledge management?	About PC- 2 PC- 2
21.	Evolutionary algorithms are optimization methods inspired by evolutionary processes in nature.	What are evolutionary algorithms?	About PC- 2 PC- 2
22.	The genetic algorithm involves generating a population of solutions, evaluating them, and evolving them through selection, crossover, and mutation operations.	How does a genetic algorithm work?	About PC- 2 PC- 2
23.	Evolutionary strategies are used to optimize complex functions and solve problems with multiple local maxima.	What are the applications of evolutionary strategies?	About PC- 2 PC- 2

24.	Implementation involves defining a fitness function, creating an initial population, and applying evolution operations.	How to implement an evolutionary algorithm for function optimization?	About PC- 2 PC- 2
25.	Genetic algorithms and evolutionary strategies are different approaches to evolutionary optimization. Genetic algorithms use binary representation, while evolutionary strategies use real-valued representation.	How do genetic algorithms and evolutionary strategies compare?	About PC- 2 PC- 2
26.	Fuzzy sets are mathematical objects that allow us to describe the uncertainty and imprecision of data.	What are fuzzy sets?	About PC- 2 PC- 2
27.	Membership functions such as trapezoidal, triangular and Gaussian are used.	What types of membership functions are used?	About PC- 2 PC- 2
28.	Fuzzy logic is implemented using rules that link input data to output actions based on membership functions.	How to implement fuzzy logic in control systems?	About PC- 2 PC- 2
29.	Fuzzy sets are used in control systems, image	What are the applications of fuzzy sets in artificial intelligence?	About PC- 2 PC- 2

	processing and decision making.		
30.	Fuzzy approaches describe uncertainty in terms of membership degrees, while probabilistic approaches describe uncertainty in terms of probability.	How to compare fuzzy and probabilistic approaches?	About PC- 2 PC- 2
31.	Ensemble methods are approaches that combine multiple models to improve forecast quality.	What are ensemble methods?	About PC- 2 PC- 2
32.	Bagging involves training multiple models on different subsamples of data and averaging their predictions.	How does bagging work ?	About PC- 2 PC- 2
33.	Boosting is implemented by sequentially training models, where each model corrects the errors of the previous one.	How to implement boosting in machine learning?	About PC- 2 PC- 2
34.	Advantages include increased accuracy and resistance to overfitting. Disadvantages include increased computational complexity.	What are the advantages and disadvantages of ensemble methods?	About PC- 2 PC- 2
35.	Bagging is parallel, while boosting is sequential. Boosting is more sensitive to the choice of	How do bagging and boosting compare ?	About PC- 2 PC- 2

	hyperparameters .		
36.	Pattern recognition is the process of identifying and classifying data based on its characteristics.	What is pattern recognition?	About PC- 2 PC- 2
37.	Methods such as convolutional neural networks and traditional feature-based methods are used.	What methods are used for image recognition?	About PC- 2 PC- 2
38.	The implementation involves the use of convolutional neural networks and training on the MNIST dataset.	How to implement a handwritten digit recognition system?	About PC- 2 PC- 2
39.	Applications include image processing, biometrics and data analysis.	What are the applications of pattern recognition systems?	About PC- 2 PC- 2
40.	Traditional methods use hand-crafted features, while deep methods automatically extract features using neural networks.	How do traditional and deep learning methods compare in pattern recognition?	About PC- 2 PC- 2
41.	Machine learning is a field of AI that allows systems to learn from data without being explicitly programmed.	What is machine learning?	About PC- 2 PC- 2
42.	Tasks include classification, regression	What types of problems are solved in machine learning?	About PC- 2 PC- 2

	and clustering.		
43.	Logistic regression is implemented using the sigmoid function to predict the class probability.	How to implement logistic regression?	About PC- 2 PC- 2
44.	Decision trees are used for classification and regression, as well as for feature selection.	What are the applications of decision trees?	About PC- 2 PC- 2
45.	Linear models describe direct relationships, while nonlinear models describe more complex relationships between variables.	How to compare linear and nonlinear machine learning models?	About PC- 2 PC- 2
46.	Artificial intelligence is a field of science and technology that focuses on creating systems that can perform tasks that typically require human intelligence.	What is artificial intelligence?	About PC- 2 PC- 2
47.	Areas of expertise include machine learning, computer vision, and natural language processing.	What are the main areas of research in AI?	About PC- 2 PC- 2
48.	Applications include virtual assistants, speech recognition systems and self-driving cars.	What applications do AI systems have in real life?	About PC- 2 PC- 2
49.	The expert system is	How to implement a simple expert system?	About PC- 2

	implemented through a set of rules and a knowledge base.		PC- 2
50.	Weak AI solves specific problems, while strong AI is a hypothetical system that possesses human-like intelligence in all areas.	How to compare weak and strong AI?	About PC- 2 PC- 2
51.	Linear algebra, calculus and probability theory are used.	What mathematical tools are used in AI?	About PC- 2 PC- 2
52.	Linear algebra is used to process data, and calculus is used to optimize models.	What are the applications of linear algebra and calculus in AI?	About PC- 2 PC- 2
53.	Implementation involves the selection of mathematical tools and their application to describe the problem.	How to implement a mathematical model for solving AI problems?	About PC- 2 PC- 2
54.	Methods such as gradient descent and its variations are used.	What mathematical methods are used for optimization in AI?	About PC- 2 PC- 2
55.	Discrete mathematics is used to handle integers, while continuous mathematics is used to handle real numbers.	How to compare discrete and continuous mathematics in AI?	About PC- 2 PC- 2
56.	Applications include disease diagnostics and personalized medicine.	What applications do AI systems have in medicine?	About PC- 2 PC- 2
57.	The implementation	How to implement an AI system for financial analysis?	About PC- 2

	involves the use of machine learning to predict market trends.		PC- 2
58.	Applications include autonomous systems and robotic manufacturing.	What applications do AI systems have in robotics?	About PC- 2 PC- 2
59.	The implementation includes the use of NLP methods for text analysis and generation.	How to implement an AI system for natural language processing?	About PC- 2 PC- 2
60.	AI-powered applications vary by industry, but they all aim to automate and improve processes.	How to compare AI applications across industries?	About PC- 2 PC- 2
61.	Issues include model bias, data privacy, and accountability for decisions.	What ethical issues arise when using AI systems?	About PC- 2 PC- 2
62.	The implementation includes the use of encryption and secure data transfer protocols.	How to implement data security in AI systems?	About PC- 2 PC- 2
63.	Risks include unpredictable behavior and potential errors in decision making.	What are the risks associated with the use of autonomous AI systems?	About PC- 2 PC- 2
64.	Transparency means understanding the inner workings of a model, and explainability means being able to interpret its output.	How to compare transparency and explainability of AI models?	About PC- 2 PC- 2
65.	Security includes the use	How to implement protection against attacks on AI systems?	About PC- 2

	of techniques such as reinforcement learning and secure data exchange protocols.		PC- 2
66.	Areas of interest include quantum computing, cognitive architectures, and explainable AI.	Какие будущие направления исследований в ИИ?	About PC- 2 PC- 2
67.	The implementation involves the use of quantum computers to solve optimization and simulation problems.	Как реализовать квантовые вычисления в ИИ?	About PC- 2 PC- 2
68.	Applications include attack detection and data leak prevention.	Какие применения имеют системы ИИ в кибербезопасности?	About PC- 2 PC- 2
69.	Traditional architectures focus on specific tasks, while cognitive architectures focus on general intelligence.	Как сравнить традиционные и когнитивные архитектуры ИИ?	About PC- 2 PC- 2
70.	The implementation includes the use of AI to analyze and optimize social processes.	Как реализовать системы ИИ для решения сложных социальных задач?	About PC- 2 PC- 2
71.	Implementation involves selecting a task, collecting data, and choosing an appropriate AI model.	Как реализовать систему ИИ в реальном проекте?	About PC- 2 PC- 2
72.	Libraries used include TensorFlow , PyTorch and Scikit-Learn .	Какие инструменты и библиотеки используются для разработки систем ИИ?	About PC- 2 PC- 2

73.	The comparison includes an assessment of the accuracy, speed and adaptability of the systems in specific applications.	Как сравнить практические результаты различных систем ИИ в реальных приложениях?	About PC- 2 PC- 2
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2. Description of the rating scale

Under the rating system, student performance in each course is assessed through ongoing assessments and midterm assessments. The student assessment system is based on a set of assessments designed to test the material covered, optimally spaced throughout the course.

3. Competency assessment criteria *

The grade "pass" is given to a student if he/she demonstrates comprehensive knowledge of programming methods and information technology and information technology used in scientific research; the student can easily present and adapt mathematical knowledge, programming methods and information technology in various ways, taking into account the level of the audience; the student has a variety of skills in scientific research and abstracting scientific results; the student demonstrates comprehensive knowledge of the main methods of practical verification of research results and information technology used in scientific research; the student is easily able to build mathematical models of information security systems and conduct an analysis of the scientific and practical significance of the research; the student is easily able to abstract scientific results .

The student demonstrates knowledge of basic programming methods and information technology and information technology used in scientific research, the student demonstrates the ability to present and adapt mathematical knowledge, programming methods and information technology in various ways, taking into account the level of the audience, the student demonstrates skills in scientific research and abstracting scientific results, The student demonstrates knowledge of the basic methods of practical verification of research results and information technologies used in scientific research; the student demonstrates confident skills in constructing mathematical models of information security systems, conducting an analysis of the scientific and practical significance of the research; the student demonstrates good skills in reviewing scientific results.

The student demonstrates knowledge of only some of the basic programming methods and information technology and information technology used in scientific research, the student demonstrates some basic skills in various ways to present and adapt mathematical knowledge, programming methods and information technology taking into account the level of the audience, the student demonstrates basic skills in scientific research and abstracting scientific results, the student demonstrates knowledge of some of the basic methods of practical verification of research results and information technology used in scientific research, the student demonstrates skills in constructing some of the basic mathematical models of information security systems, conducting an analysis of the scientific and practical significance of the research, the student demonstrates basic skills in abstracting scientific results.

A grade of "fail" is given to a student if he/she The student demonstrates a very low level of knowledge of the basic methods of programming and information technology and information technologies used in scientific research. The student demonstrates only rudimentary skills in various ways to present and adapt mathematical knowledge, programming methods and information technologies taking into account the level of the audience. The student demonstrates rudimentary skills in scientific research and abstracting scientific results. The student demonstrates very weak knowledge of the basic methods of practical verification of research results and information technologies used in scientific research. The student demonstrates very weak skills in constructing mathematical models of information security systems, analyzing the scientific and practical significance of the research. The student demonstrates only rudimentary skills in abstracting scientific results.