

Документ подписан простой электронной подписью

Информация о владельце:

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MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN FEDERATION
Federal State Autonomous Educational Institution
Higher Education
"NORTH CAUCASUS FEDERAL UNIVERSITY"

APPROVED BY

Acting Director of the Institute

Advanced Engineering

A.A. Porokhnya

DISCIPLINE ASSESSMENT TOOLS FUND

"Introduction to Pattern Recognition and Machine Learning"

Field of study	11.03.02 Infocommunication Technologies and Communication Systems
Profile	Intelligent Data Processing in Infocommunication Systems and Networks
Year of start of training	<u>2026</u>
Form of study	<u>Full-time</u>
Implemented in a semester	<u>5</u>

Introduction

1. Purpose

The fund of assessment tools for the discipline "Introduction to Pattern Recognition and Machine Learning" is designed to objectively assess the level of competence formation.

2. FOS is an appendix to the program of the discipline "Introduction to Pattern Recognition and Machine Learning".

3. Developer N.Y. Bratchenko, Associate Professor of the Department of Digital, Robotic Systems and Electronics of the Institute of Advanced Engineering.

4. An examination of the FOC was carried out.

Members of the expert group:

Chairman: N.Y. Bratchenko, Chairman of the CMT of the Institute of Advanced Engineering, Associate Professor of the Department of Digital, Robotic Systems and Electronics of the Institute of Advanced Engineering.

Members of the Commission:

V.P. Mochalov, Professor of the Department of Digital, Robotic Systems and Electronics of the Institute of Advanced Engineering.

S.V. Melnikov, Senior Researcher of the Interdisciplinary Training and Research Center for Agricultural Technologies, Associate Professor of the Department of Digital, Robotic Systems and Electronics of the Institute of Advanced Engineering.

Representative of the employer's organization:

Mironov V.A., General Director of Orintex LLC.

Expert opinion: The FAT for the discipline allows you to assess the level of competence formation. Start approbation.

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

1. Description of indicators and assessment criteria at various stages of their formation, description of assessment scales

Competency(s), indicator(s)	Levels of competence formation(s),			
	The minimum level has not been reached (Unsatisfactory) 2 points	Minimum level (satisfactory) 3 points	Intermediate level (good) 4 points	High level (excellent) 5 points
Competence: OPK-4				
Learning outcomes in the discipline (module): <i>Indicator:</i> ID-3OPK-4	Does not know and does not understand modern interactive software systems and basic methods of processing experimental data, including the use of standard software, general-purpose and special-purpose software packages; understands methods and tools for designing pattern recognition systems; does not understand methods and techniques for formalizing digital image processing tasks; does not understand the capabilities of modern and promising means of developing software	Insufficiently knows and understands modern interactive software complexes and basic techniques for processing experimental data, including the use of standard software, general- purpose and special-purpose software packages; understands methods and tools for designing pattern recognition systems; understands methods and techniques for formalizing digital image processing tasks; understands the capabilities of modern and promising means for the development of software products and hardware	Knows and understands modern interactive software systems and basic techniques for processing experimental data, including the use of standard software, general and special purpose software packages; understands the methods and tools for designing pattern recognition systems; understands the methods and techniques for formalizing digital image processing tasks; understands the capabilities of modern and future tools for the development of software products and hardware	Fully Knows and understands modern interactive software systems and basic techniques for processing experimental data, including the use of standard software, general-purpose and special- purpose software packages; understands the methods and tools for designing pattern recognition systems; understands the methods and techniques for formalizing digital image processing tasks; understands the capabilities of modern and promising tools for the development of software products and hardware

Learning outcomes in the discipline (module): <i>Indicator:</i> ID-4OPK-4	Insufficiently uses the capabilities of computer technology and software to solve practical problems, develops options for the development of a computer vision system, pattern recognition and evaluates and substantiates the developed solutions. Insufficiently selects hardware and software, uses existing standard solutions and design templates in the process of developing computer vision systems.	Partially uses the capabilities of computer technology and software to solve practical problems, develops options for the development of a computer vision system, pattern recognition and evaluates and substantiates the developed solutions. Partially selects hardware and software, uses existing standard solutions and design templates in the process of developing computer vision systems.	Uses the capabilities of computer technology and software to solve practical problems, develops options for the development of a computer vision system, pattern recognition and evaluates and substantiates the developed solutions. Selects hardware and software, uses existing standard solutions and design templates in the process of developing computer vision systems.	Fully uses the capabilities of computer technology and software to solve practical problems, develops options for the development of a computer vision system, pattern recognition and evaluates and substantiates the developed solutions. Independently selects hardware and software, uses existing standard solutions and design templates in the process of developing computer vision systems.
Learning outcomes in the discipline (module): <i>Indicator:</i> ID-5OPK-4	Does not have the skills to apply methods of computer modeling of physical processes in the transmission of information, skills in the use of engineering and computer graphics techniques. Evaluates the time and labor intensity of the implementation of requirements for the developed software. Applies methods and tools for	Partially has the skills of applying methods of computer modeling of physical processes in the transfer of information, the skills of using engineering and computer graphics techniques. Evaluates the time and labor intensity of the implementation of requirements for the developed	He has the skills of applying methods of computer modeling of physical processes in the transfer of information, the skills of using engineering and computer graphics techniques. He estimates the time and labor intensity of the implementation of requirements for the	He has full skills in applying methods of computer modeling of physical processes in the transfer of information, skills in the use of engineering and computer graphics techniques. Estimates the time and labor intensity of the implementation of requirements for the

	designing a pattern recognition system	software. Applies methods and tools for designing an image recognition system	developed software. He applies methods and tools for designing a pattern recognition system	developed software. Applies methods and tools for designing a pattern recognition system
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ASSESSMENT TOOLS TO CHECK THE LEVEL OF FORMATION OF COMPETENCIES

Full-time, Semester 5			
Job Number	Correct answer	Content of the question	Competence
1.	b	What does a computer simulation system include? a) Software only b) Hardware, software, mathematical models, users c) Only mathematical models d) Users and software only	OPK-4
2.	b	Which of the following is a key component of computer modeling? a) Graphical interface (b) Mathematical model c) Computer monitor (d) Keyboard	OPK-4
3.	c	What level of modeling is responsible for detailing physical processes? (a) System level (b) Functional level (c) Detailed (physical) layer (d) Logical level	OPK-4
4.	b	What level of modeling is used to analyze the interaction of subsystems? a) Algorithmic layer (b) System level (c) Component level (d) Physical layer	OPK-4
5.	b	What is the main task of computer vision systems? a) Random image generation b) Processing and analysis of visual information (c) Mechanical drive control (d) Storage of large amounts of data	OPK-4
6.	b	What is the most common method used to recognize objects in vision systems? (a) Monte Carlo method b) Neural networks	OPK-4

		(c) Linear programming (d) Queue theory	
7.	b	What criterion evaluates the compliance of the product with the terms of reference? a) Ergonomics (b) Functionality c) Aesthetics (d) Cost	OPK-4
8.	c	Which of the quality criteria is NOT technical? (a) Reliability (b) Maintainability c) Exterior design (d) Accuracy	OPK-4
9.	a	What stage of modeling follows after building a mathematical model? a) Verification of the model (b) Interface design (c) Conducting experiments (d) Documentation	OPK-4
10.	b	What is the final step in the computer simulation process? a) Build a 3D model (b) Analysis of results and decision-making c) Launch of production (d) Publication of the report	OPK-4
11.	b	What is the main purpose of modeling technical devices? (a) Reduction of development costs b) Predicting the behavior of a system without creating a physical prototype (c) Speeding up proceedings (d) Simplification of documentation	OPK-4
12.	b	Which stage is NOT included in the process of modeling technical systems? a) Construction of a mathematical model (b) Full-scale testing without simulation c) Verification and validation of the model (d) Analysis of modelling results	OPK-4

13.	b	Which model describes the system using equations and algorithms? (a) Physical model (b) Mathematical model (c) Graphical model (d) Analogue model	OPK-4
14.	b	What type of model is used to visualize the device design? (a) Simulation model (b) 3D geometric model (c) Analytical model (d) Statistical model	OPK-4
15.	b	Which model describes the system with differential equations? (a) Statistical model (b) Deterministic model (c) Simulation model (d) Stochastic model	OPK-4
16.	b	What kind of model takes into account random factors and probabilities? (a) Analytical model (b) Stochastic model (c) Graphical model (d) Physical model	OPK-4
17.	c	What modeling method is often used for optical systems? (a) Finite element method (FEM) (b) Monte Carlo method (c) Ray Tracing Method (d) Statistical modelling method	OPK-4
18.	c	Which stage of the design of optoelectronic devices requires accurate modeling of light fluxes? (a) Conceptual design (b) Conceptual design (c) Detailed optical simulation (d) Feasibility study	OPK-4

19.	c	Which technology has had the most significant impact on the development of vision systems in recent years? (a) Relational databases (b) Network protocols c) Deep learning and neural networks (d) Analogue computing systems	OPK-4
20.	b	Which of the following factors is NOT the current trend in the development of computer vision systems? a) Improved image processing performance (b) Transition to analogue processing methods c) Development of 3D vision (d) Sensor miniaturization	OPK-4
21.	b	What is the direction of development of computer vision systems related to real-time image processing? (a) Batch data processing b) Video Streaming c) Offline analysis (d) Static frame processing	OPK-4
22.	c	Which aspect becomes key when integrating vision systems with robotics? (a) Increasing sensor sizes b) Reduced computing power requirements c) Low processing latency (d) Use of black and white images only	OPK-4
23.	a	What technology allows vision systems to operate in low-light conditions? (a) Infrared sensors (b) Ultrasonic sensors (c) Radar systems (d) Analogue television cameras	OPK-4
24.	c	What approach is used to improve the accuracy of object recognition in difficult environments? a) Simplification of algorithms b) Use of a single processing algorithm	OPK-4

		(c) Algorithmic ensembles and multimodal systems d) Reducing the resolution of images	
25.	c	What is the advantage of cloud technology for vision systems? a) Complete Autonomy from the Internet (b) Limited computing resources c) Scalability and distributed processing (d) Reduced recognition accuracy	OPK-4
26.	c	What is the trend associated with the introduction of computer vision systems in consumer devices? a) Increase in the cost of devices b) Reduced recognition accuracy c) Ubiquity (smartphones, household appliances) d) Refusal of color vision	OPK-4
27.	c	What area of research in computer vision systems is related to medical diagnostics? (a) Traffic sign recognition (b) Analysis of industrial defects (c) Computed tomography and X-ray analysis (d) Vehicle speed control	OPK-4
28.	c	What factor is accelerating the development of vision systems in industry? a) Reduced safety requirements (b) Increased demand for manual labour c) Implementation of Industry 4.0 and automation (d) Reduction in the number of surveillance cameras	OPK-4
29.	a	What object detection method does the sliding window use to analyze an image? (a) Viola-Jones method b) k-nearest neighbors method (c) Principal Component Method (PCA) (d) Support Vector Method (SVM)	OPK-4
30.	b	What is the most common deep learning algorithm used to detect objects? a) Random Forest b) YOLO (You Only Look Once) c) K-means (d) DBSCAN	OPK-4

31.	b	Which method is NOT traditional object detection methods? a) Boundary Detector Kanni b) Convolutional neural networks (CNNs) (c) Harris Angle Detector (d) Algorithm for contour selection	OPK-4
32.	b	What statistical method does the Bayesian approach use to classify objects? (a) Linear regression (b) Naïve Bayesian classifier (c) K-means method (d) Principal component method	OPK-4
33.	b	Which method allows you to reduce the dimensionality of the feature space? a) Support Vector Method (SVM) (b) Principal Component Method (PCA) (c) Viola-Jones method (d) Algorithm Khafa	OPK-4
34.	b	What criterion is used to assess the quality of classification in statistical methods? a) RMS error (b) Error matrix (Confusion Matrix) (c) Correlation coefficient (d) Euclidean distance	OPK-4
35.	b	What indicator estimates the share of correctly detected objects among all real objects? a) Precision b) Recall (c) F1 measure d) Accuracy	OPK-4
36.	b	What metric measures the overall quality of the model, which takes into account both accuracy and completeness? a) ROC curve (b) F1 measure (c) Standard deviation (d) Coefficient of determination	OPK-4
37.	b	What criterion is used to evaluate false positives of the detector? a) True Positive Rate	OPK-4

		b) False Positive Rate c) Intersection over Union (IoU) d) Mean Average Precision (mAP)	
38.	c	Which metric estimates the area of intersection of the predicted and true bounding box? a) Precision b) Recall c) Intersection over Union (IoU) (d) F1 measure	OPK-4
39.		What are the current trends in the development of information models for image processing?	OPK-4
40.		How do machine learning methods change approaches to the information description of image processing processes?	OPK-4
41.		What standards and protocols are used to ensure the interoperability of information models in vision systems?	OPK-4
42.		How is the effectiveness of the informational description of image processing processes evaluated?	OPK-4
43.		What promising areas for the development of information support for computer vision systems can you highlight?	OPK-4
44.		What are the main conditions that determine the operability of computer vision systems?	OPK-4
45.		How do the characteristics of the input image (resolution, illumination, contrast) affect the performance of the system?	OPK-4
46.		Describe the compute requirements for keeping your vision systems running.	OPK-4
47.		What environmental factors can disrupt the performance of computer vision systems?	OPK-4
48.		How is the system monitored and maintained during operation?	OPK-4
49.		Describe the main stages of the information process of searching for objects in the image.	OPK-4
50.		What information flows exist in the object recognition system? How do they interact?	OPK-4
51.		How is the problem of object recognition formalized from the point of view of information description?	OPK-4
52.		What methods of information description are used to characterize the objects of recognition?	OPK-4

53.		What is the role of the feature space in the information description of the recognition process?	OPK-4
54.		Define an information model in the context of image processing. What components does it include?	OPK-4
55.		What types of information models are used to represent images? Describe their features.	OPK-4
56.		How do image storage formats (raster, vector) affect information processing models?	OPK-4
57.		What is the difference between structural and statistical image information models?	OPK-4
58.		How can image metadata be used in processing information models?	OPK-4
59.		How does the method of selecting related areas depend on the type of problem to be solved? Give examples for different areas of application.	OPK-4
60.		What criteria are used to assess the quality of image segmentation? How is the measurement carried out?	OPK-4
61.		Describe current trends in the development of algorithms for identifying and analyzing related areas.	OPK-4
62.		How do hardware accelerators (GPUs, TPUs) affect the performance of related area processing algorithms?	OPK-4
63.		What libraries and software tools exist to implement the methods considered? Compare their capabilities.	OPK-4
64.		Define correlation analysis in image processing. What tasks does it solve?	OPK-4
65.		Describe how the normalized cross-correlation (NCC) algorithm works. When is it used?	OPK-4
66.		What is the difference between autocorrelation and image cross-correlation? Give examples of how they can be used.	OPK-4
67.		How are images matched using correlation methods? What metrics are used?	OPK-4
68.		Describe the problem of computational complexity of correlation algorithms. What are the methods for speeding up calculations?	OPK-4
69.		How are correlation methods used for tracking objects in video sequences?	OPK-4
70.		What are the alternative methods of image matching to correlations? Compare their effectiveness.	OPK-4
71.		Define image segmentation. What are the main tasks solved with its help?	OPK-4

72.		Describe how threshold segmentation works. What threshold selection methods are available?	OPK-4
73.		What is the area segmentation method (region-oriented segmentation)? What algorithms are used for this?	OPK-4
74.		Describe how the watershed method works for image segmentation. What advantages and disadvantages does it have?	OPK-4
75.		How are cluster methods (e.g., k-means) used to segment grayscale images?	OPK-4
76.		What are the features of segmentation based on texture characteristics? How do textures stand out in an image?	OPK-4
77.		How are machine learning methods used for image segmentation tasks? Give examples of modern approaches.	OPK-4
78.		Define the concept of "connected area" in a binary image. What types of connectivity are there?	OPK-4
79.		Describe the algorithm for selecting related areas in binary images. What are the main steps it includes?	OPK-4
80.		What is the difference between 4-connectivity and 8-connectivity in binary image analysis? What are some examples of how each type can be used?	OPK-4
81.		What labels are used to mark related areas? Describe the process of labeling connectivity components.	OPK-4
82.		How are the characteristics of the selected areas (area, perimeter, center of mass) calculated? What mathematical methods are used?	OPK-4
83.		What problems can arise when highlighting related areas in noisy binary images? How can they be solved?	OPK-4
84.		Describe the methods for selecting boundaries of related areas in binary images. What algorithms are used for this?	OPK-4

2. Description of the rating scale

Rating assessment of knowledge is not provided.

3. Criteria for assessing competencies

The grade "excellent" is given to the student if the theoretical content of the topic is mastered completely, without gaps; exhaustively, consistently, clearly and logically harmoniously presents the material; freely copes with tasks, questions and other types of application of knowledge; uses additional material in the answer all the tasks provided for by the program are completed, the quality of their performance is evaluated by the number of points close to the maximum; analyzes the results obtained; shows independence in the performance of tasks.

A grade of "good" is given to a student if the theoretical content of the topic is fully mastered, the necessary practical competencies are basically formed, all the educational tasks provided for by the training program are completed, the quality of their performance is quite high. The student knows the material firmly, presents it competently and to the point, without making significant inaccuracies in answering the question.

The grade "satisfactory" is given to a student if the theoretical content of the topic is partially mastered, but the gaps are not significant, most of the tasks provided for by the program are completed, but there are errors in them, when answering the question, the student makes inaccuracies, insufficiently correct wording, there are violations of the logical sequence in the presentation of the program material.

An "unsatisfactory" grade is given to a student if he does not know a significant part of the program material, makes significant mistakes, performs practical work unconfidently, with great difficulty, the necessary practical competencies are not formed, most of the educational tasks are not completed, the quality of their performance is evaluated by the number of points close to the minimum.