

Документ подписан простой электронной подписью
Информация о владельце:
ФИО: Порохня Андрей Алексеевич
Должность: И.о. директора института перспективной инженерии
Дата подписания: 22.10.2026 13:25:38
Уникальный программный ключ:
990bea3aeec48c23bd8699e48288f8d1960c600

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
Data Structure and Algorithm

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	2026
Form of study	Full-time
Implemented in a semester	5

Introduction

1. Purpose: conducting current monitoring of progress and intermediate certification in the discipline "Data Structure and Algorithm".
2. FOS is an appendix to the program of the discipline "Data Structure and Algorithm"
3. Developer: Melnikov S.V., Associate Professor, School of Digital, Robotic Systems and Electronics
4. An examination of the FAT 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 the criteria for assessing competence at various stages of their formation, description of assessment scales

Competence(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
PC-1				
Learning outcomes in the discipline (module): <i>Indicator:</i> ID-1PC-1 understands the principles of building software architecture and types of software architecture; understands methods and tools for software design, methods and tools for designing databases; understands methods and tools for designing program interfaces; understands methods and techniques for formalizing tasks; understands the capabilities of modern and promising tools for the development of software products and hardware.	Does not understand and does not know the methods and means of designing program interfaces Cannot name methods for designing databases or interfaces. Does not understand the connection between the formalization of the task and the choice of tools.	Understands and knows several methods and tools for designing program interfaces. Can name the main methods of designing databases or interfaces. Understands the basics of task formalization, but does not apply them systematically.	Understands and knows methods and tools for designing program interfaces. Can name methods for designing databases or interfaces. Formalizes tasks in the form of technical specifications.	Deeply understands and knows the methods and means of designing program interfaces. Can name the methods of designing databases or interfaces as part of a complex solution. Formalizes tasks in the form of an interrelated and structured technical specification.
Learning outcomes in the discipline (module): <i>Indicator:</i> ID-2PC-1 analyzes the fulfillment of requirements; develops options for implementing requirements; evaluates and substantiates recommended solutions; selects means for implementing software requirements; uses existing standard solutions and software	Cannot single out the key requirements from the ToR. Does not distinguish between typical design patterns. Does not understand the criteria for choosing means of implementation.	Highlights basic requirements, but misses nuances (for example, non-functional requirements). Names 1-2 design patterns, but applies them in a stereotyped way. Understands the differences between languages, but does not justify the choice.	Analyzes requirements, including performance and security. Applies design patterns. Compares tools and justifies the choice.	Conducts an in-depth analysis of requirements, taking into account edge cases (for example, loss of communication with sensors). Critically evaluates patterns. Selects instruments based on metrics.

design templates; develops technical specifications for software components and their interaction.				
PC-2				
Learning outcomes in the discipline (module): <i>Indicator:</i> ID-6PC-2 Applies methods and algorithms for optimizing executable code	has difficulty choosing ways constructive interactions with people with taking into account their socio-cultural Features	is not fully able to choose ways constructive interactions with people with taking into account their socio-cultural Features	takes into account socio-cultural Characteristics of people when choosing methods constructive interaction with them	chooses methods constructive interactions with people with taking into account their socio-cultural features in the goals of successful completion professional tasks and Strengthening the social integration.
Learning outcomes in the discipline (module): <i>Indicator:</i> ID-7PC-2 Uses modern software development methodologies and programming technologies	Doesn't understand the basic principles of code optimization. Cannot explain the difference between temporal and spatial complexity. Not familiar with profiling tools Makes changes that degrade performance. It does not even use the simplest optimizations.	Understands the basic principles of optimization (data locality, avoidance of branches). Knows basic optimization techniques. Knows how to use simple profilers. Applies simple optimizations with predictable effect.	Understands modern optimization methods. Knows the specifics of optimization for different architectures. Knows how to work with advanced profilers. Conducts a comprehensive performance analysis. Applies specialized optimizations for a specific task.	Deeply understands the relationship between algorithms and hardware implementation. Knows optimization methods for real-time systems. Develops highly optimized solutions. Understands how adaptive systems work.
Learning outcomes in the discipline (module): <i>Indicator:</i> ID-14PK-2 Defines and applies the necessary algorithms and data structures to solve the problems of	He cannot name the basic algorithms and data structures for robotics. Doesn't understand the relationship between a task (e.g.,	Knows the basic algorithms and their application. Understands the differences between data structures.	Understands modern algorithms. Knows how to adapt algorithms to specific conditions. Can compare algorithms according to several criteria	He has a deep understanding of modern algorithms. Knows how to combine algorithms for better results. Develops hybrid

navigation, planning, sensor data processing, control and decision-making in robotic systems	navigation) and algorithm selection. Is not familiar with typical approaches to sensory data processing. Unable to choose the right algorithm even for simple tasks. Does not know how to evaluate the performance of algorithms.	Can explain the pros/cons of algorithms. Selects standard algorithms for typical tasks. Implements simple solutions. Conducts basic performance analysis (runtime, memory usage).	(accuracy, speed, reliability). Selects and adjusts algorithms for complex tasks. Optimizes algorithms. Analyzes performance (robot in Gazebo).	solutions. Creates adaptive systems that automatically select algorithms based on optimization parameters.
Learning outcomes in the discipline (module): <i>Indicator:</i> ID-9PC-2 Designs Data Structures	Does not distinguish between basic data structures (arrays, lists, trees) Does not understand the principles of choosing structures for the task Does not take into account memory and performance requirements. Uses suboptimal structures (linear search in an unsorted array). Cannot justify the choice of structure. The created structures do not meet the requirements of the task.	Knows the basic data structures and their complexity. Understands the basic principles of design (encapsulation, abstraction). Takes into account data access and modification requirements. Selects standard structures for typical tasks (hash table for quick search). It implements simple composite structures.	Understands advanced structures. Knows the principles of optimization for specific processors. Takes into account real-time requirements. Designs specialized structures. Optimizes structures for specific algorithms.	Deeply understands the relationship between data structures and hardware implementation. Knows the principles of optimization for specific processors. Creates structures for requirements. Optimizes structures according to several criteria (memory, speed, power consumption). Develops structures with predictable execution times.

Assessment of the level of competence in the discipline is carried out on the basis of the "Regulation on the current monitoring of progress and intermediate certification of students in educational programs of higher education - bachelor's programs, specialist programs, master's programs - in the Federal State Autonomous Educational Institution of Higher Education "North Caucasus Federal University" in the current edition.

ASSESSMENT TOOLS FOR CHECKING THE LEVEL OF COMPETENCE FORMATION

Job Number	Correct answer	Content of the question	Competence
		Full-time, Semester 1 (3)	
1.	c)	What is the optimal data structure for storing and quickly accessing data by key? (a) Array (b) Linked list (c) Hash table (d) Stack	PC-2
2.	b)	What is the time difficulty of inserting in red and ebony? a) $O(1)$ b) $O(\log n)$ c) $O(n)$ d) $O(n \log n)$	PC-2
3.	b)	What data structure is used to implement a queue in ROS? (a) Array (b) Ring buffer (c) Binary heap (d) Graph	PC-2
4.	b)	What algorithm is used to find the shortest path in a graph without negative weights? a) A* b) Dijkstra's algorithm (c) Bellman-Ford algorithm d) Floyd-Warshell algorithm	PC-2
5.	a)	Which algorithm is best for a dynamic environment? a) RRT (b) Dijkstra c) A* d) Greedy algorithm	PC-2

6.	b)	What is the main idea behind the D* Lite algorithm? a) Depth search b) Incremental renewal of the path (c) Random search (d) Greedy strategy	PC-2
7.	a)	What filter is used to evaluate the state of a dynamic system with noise? (a) Kalmann filter (b) Median filter c) FIR filter (d) Bloom filter	PC-2
8.	a)	What data structure is used to store 3D maps in SLAM? a) Octotree (b) Linked list c) Hash table d) Binary Tree	PC-2
9.	b)	What method is used to eliminate noise in lidar data? (a) Savitsky-Golay filter (b) Median filter c) Fast Fourier transform (d) Quantization	PC-2
10.	a)	What code optimization method does SIMD instruction use? a) Vectorization b) Inlining c) Caching (d) Memoization	PC-2
11.	b)	What is the purpose of using a ring buffer in robotics? a) Reducing memory fragmentation b) Guaranteed access time c) Automatic scaling (d) Parallel processing	PC-2
12.	c)	What design pattern is used to manage the robot's state?	PC-2

		a) Singleton b) Observer c) State Machine d) Factory	
13.	b)	Which data structure provides quick access to an item by index? (a) Linked list (b) Array (c) Queue (d) Stack	PC-2
14.	a)	What is the time difficulty of finding an item in a hash table in the average case? a) The(1) b) $O(n)$ c) $O(\log n)$ d) $O(n^2)$	PC-2
15.	c)	What data structure is used to implement LIFO (Last In, First Out)? (a) Queue (b) Dec (c) Stack (d) Heap	PC-2
16.	c)	What is the spatial complexity of a connected list of n elements? a) $O(1)$ b) $O(\log n)$ c) $O(n)$ d) $O(n^2)$	PC-2
17.	c)	What is the best data structure for implementing a priority queue? (a) Array b) Hash table	PC-2

		c) Binary heap (d) Graph	
18.	b)	What algorithm does the heuristic function use to find a path? (a) Dijkstra b) A* c) BFS (d) DFS	PC-2
19.	b)	What is the time complexity of Dijkstra's algorithm when using heap? a) $O(n)$ b) $O(n \log n)$ c) $O(n^2)$ d) $O(\log n)$	PC-2
20.	a)	Which algorithm is suitable for path planning in an unknown environment? a) RRT b) A* (c) Dijkstra d) Greedy algorithm	PC-2
21.	a)	What algorithm is used to reschedule the path in a dynamic environment? a) D* Lite b) BFS c) DFS d) Floyd's algorithm	PC-2
22.	b)	What is the main idea behind the Jump Point Search algorithm? a) Random search (b) Omission of symmetrical paths (c) Greedy strategy (d) Recursive traversal	PC-2

23.	b)	What filter is used to assess the state of a Gaussian noise system? (a) Median filter (b) Kalmann filter (c) FIR filter (d) Bloom filter	PC-2
24.	d)	What tool is used for performance profiling in ROS? a) gprof b) Valgrind c) rqt_graph d) ros2 profiler	PC-2
25.	a)	What synchronization method is used for thread-safe access to data in ROS? (a) Mutex (b) Semaphore (c) Spinlock (d) Barrier	PC-2
26.	a)	What algorithm is used to route messages in ROS? a) TCP/IP b) UDP c) HTTP (d) MQTT	PC-2
27.	b)	What is the purpose of using QoS (Quality of Service) in ROS 2? (a) Capacity management (b) Guarantee of message delivery (c) Data encryption (d) Data compression	PC-2
28.	a)	What tool is used to visualize data in ROS? a) RViz b) Gazebo c) rqt_plot (d) TF	PC-2

29.	a)	What algorithm is used to classify features in lidar data? a) k-NN b) SVM c) Random Forest d) Neural Network	PC-2
30.	a)	What algorithm is used for reinforcement learning in robotics? a) Q-Learning b) K-means c) DBSCAN (d) SVM	PC-2
31.	a)	What framework is used for deep learning in ROS? a) TensorFlow b) OpenCV c) PCL (d) Own	PC-2
32.	a)	What method is used for semantic image segmentation? a) U-Net b) YOLO c) SSD d) Faster R-CNN	PC-2
33.	a)	What algorithm is used for consensus in distributed systems? a) Paxos b) Raft c) MapReduce d) Gossip	PC-2
34.	a)	What method is used to parallelize data processing? a) OpenMP b) MPI c) MIRACLES (d) SIMD	PC-2

35.	a)	What algorithm is used for load balancing in distributed systems? a) Round Robin b) Least Connections c) Random d) Weighted	PC-2
36.	a)	What protocol is used for messaging in distributed systems? a) gRPC b) HTTP c) MQTT d) WebSocket	PC-2
37.	a)	What method is used to synchronize time in distributed systems? a) NTP b) PTP c) SNTP (d) GPS	PC-2
38.	a)	What algorithm is used to detect anomalies in the data? a) Isolation Forest b) K-means c) DBSCAN (d) SVM	PC-2
39.	a)	What method is used to ensure fault tolerance? (a) Replication b) Sharding c) Caching (d) Balancing	PC-2
40.	a)	What algorithm is used to verify data integrity? a) CRC b) MD5 c) SHA (d) ESA	PC-2

41.	a)	What method is used for authentication in ROS? a) SSL/TLS b) OAuth c) JWT d) API Key	PC-2
42.	a)	What method is used to optimize energy consumption? a) DVFS b) SIMD c) OpenMP (d) CUDA	PC-2
43.	a)	What method is used to reduce real-time latency? a) Interruptions (b) Survey c) DMA (d) Caching	PC-2
44.	a)	What algorithm is used for real-time task scheduling? a) EDF b) Round Robin c) FIFO d) Priority	PC-2
45.	<u>a)</u>	What method is used to optimize memory access? a) Cache-aware algorithms b) SIMD c) OpenMP (d) CUDA	PC-2
46.		How would you implement a ring buffer to handle sensor streaming data?	PC-2
47.		Explain how to choose between an array and a linked list for a specific task in robotics.	PC-2
48.		In what cases will a hash table be worse than a tree for storing robot data?	PC-2
49.		How would you design a storage system and quick access to a 3D map of the room?	PC-2

50.		Why is the octree often used in SLAM instead of simple meshes?	PC-2
51.		How would you implement a thread-safe queue for communication between ROS modules?	PC-2
52.		Explain how the Kalman filter works in mobile robot navigation.	PC-2
53.		What data structures would you use to store a navigation map graph?	PC-2
54.		How would you optimize the data structure to run on a low-power robot processor?	PC-2
55.		What are the advantages and disadvantages of RRT* over regular RRT?	PC-2
56.		How would you implement a path rescheduling system in a dynamic environment?	PC-2
57.		Why is A* not always suitable for path planning in real robotic systems?	PC-2
58.		How would you process lidar data to build a real-time map?	PC-2
59.		What methods would you use to cluster point cloud points from lidar?	PC-2
60.		How would you implement a noise filtering system in the IMU data?	PC-2
61.		Explain how the scan matching algorithm works in SLAM.	PC-2
62.		What are the most efficient data structures for storing voxel maps?	PC-2
63.		How would you design a memory management system for the SLAM algorithm?	PC-2
64.		What are the advantages and disadvantages of using k-d trees in robotics?	PC-2
65.		How would you implement a task prioritization system for the robot processor?	PC-2
66.		What optimization techniques would you apply to the camera image processing algorithm?	PC-2

67.		How would you use SIMD instructions to speed up sensor processing algorithms?	PC-2
68.		How would you implement a system for caching compute results to speed things up?	PC-2
69.		Which design patterns are most useful in robotic systems?	PC-2
70.		How would you design a system for handling interrupts from sensors?	PC-2
71.		How would you implement a system for synchronizing data between multiple robot processors?	PC-2
72.		What methods would you use to debug algorithms in real time?	PC-2
73.		How would you rate the performance of your path planning algorithm?	PC-2
74.		What metrics would you use to compare different SLAM algorithms?	PC-2
75.		What are the features of designing data structures for real-time systems?	PC-2
76.		How would you adapt the data processing algorithm to work with different types of sensors?	PC-2
77.		What methods would you use to reduce the power consumption of algorithms?	PC-2
78.		How would you implement a system of dynamic switching between algorithms?	PC-2
79.		What are the features of working with memory in embedded robot systems?	PC-2
80.		How would you design a system for testing your algorithms?	PC-2
81.		What methods would you use to visualize how algorithms work?	PC-2
82.		How would you implement a data logging system for subsequent analysis?	PC-2
83.		What are the features of designing algorithms for autonomous robots?	PC-2

84.		What machine learning methods are the most promising for use in robotics?	PC-2
85.		How would you design a system for classical algorithms and neural networks to work together?	PC-2
86.		How would you implement a ring buffer to handle sensor streaming data?	PC-2

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.