FEDERAL STATE BUDGETARY
EDUCATIONAL INSTITUTION OF HIGHER EDUCATION
«AMUR STATE MEDICAL ACADEMY»
MINISTRY OF HEALTH OF THE RUSSIAN FEDERATION

AGREED
Vice-Rector for Academic Affairs,

_____N.V. Loskutova

April 17, 2025

Decision of the CCMC
April 17, 2025

Protocol No. 7

APPROVED
by decision of the Academic Council of the FSBEI HE Amur SMA of the Ministry of Health of the Russian Federation
April 22, 2025

Protocol No. 15

Acting Rector of the FSBEI HE Amur SMA of the Ministry of Health of the Russian Federation

_____I.V. Zhukovets

April 22, 2025

ДОКУМЕНТ ПОДПИСАН
ЭЛЕКТРОННОЙ ПОДПИСЬЮ

Сертификат: 50AB2242604E64520B52614FA420034A
Владелец: Жуковец Ирина Валентиновна
Действителен: с 15.04.2025 до 09.07.2026

EDUCATIONAL PROGRAM

discipline «Introduction to Artificial Intelligence»

Specialty: 31.05.01 General Medicine
Course: 4
Semester: 7
Total hours: 72 hrs.
Total credits: 2 credit units
Control form: credit, 7semester

Blagoveshchensk, 2025

The educational program of the discipline is designed in accordance with the requirements of the Federal State Educational Standard of Higher Education - specialist in specialty 31.05.01 General Medicine, approved by the order of the Ministry of Education and Science of Russia dated 08.12.2020 No. 988 (registered with the Ministry of Justice of Russia on 08.26.2020 No. 59493), BPEP HE (2021).

Author:

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Reviewers:

Head of the Department of Physiology and Pathophysiology of the Federal State Budgetary Educational Institution of Higher Education Amur State Medical Academy, Holder of an Advanced Doctorate (Doctor of Science) in Biological Sciences, Ph.D. of Chemical Sciences, Associate Professor, T.A. Batalova

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APPROVED at the meeting of the Department of Medical Physics,
Protocol No. 12 dated April 15, 2025

Head of Department, Ph.D. of Pedagogic Sciences,
Associate Professor _____ **E.V. Plashchevaya**

Conclusion of the Expert Commission on the review of the Educational Programs:
Protocol No. 2 dated April 16, 2025

Expert of the expert commission,
Ph.D. of Engineering Sciences _____ **E.A. Utochkina**

APPROVED at the meeting of the Cycle Methodical Committee No. 1: Protocol No. 7 dated April 16, 2025.

Chairman of the CMC No. 1
Holder of the Advanced Doctorate (Doctor of Sciences)
in Medical Sciences, Professor _____ **E.A. Borodin**

AGREED: Dean of the Faculty of Medicine,
Ph.D. of Medical Sciences _____ **N.G. Brush**

April 17, 2025

CONTENT

1. EXPLANATORY NOTE

1.1. Characteristics of the discipline

Artificial intelligence (AI) is one of the fastest growing segments of the global healthcare market today. On the one hand, AI helps automate the work of doctors and make it more efficient. On the other hand, it is used in the search for solutions to dramatically extend human life. Thanks to extensive medical data, AI can be useful in making a diagnosis and choosing the right treatment by providing the doctor with a «third opinion»; predicting treatment prospects; analyzing the obtained medical data; diagnosing patients' conditions; drawing conclusions, etc. With all the available medical information about a particular disease, AI will be able to analyze it and find out which treatment methods and drugs have been the most effective throughout the history of medical practice, etc.

The use of AI in medicine requires specialists to understand interdisciplinary connections at the intersection of several sciences: computer science, mathematics, biology, psychology, cybernetics, etc.

The features of studying the discipline «Introduction to Artificial Intelligence» are: the interdependence between the goals of information and medical education; the universality and fundamental nature of the course; the peculiarity of constructing their content depending on the nature and general goals of training a doctor and his specialization.

1.2. Goal and objectives of the discipline.

The goal of teaching the discipline:

- formation of a holistic and systemic understanding of the process of scientific research, processing and presentation of the results of scientific research using information technology;
- to develop theoretical knowledge about the mathematical and algorithmic apparatus used in medicine for diagnosing pathological conditions;
- develop skills in the practical application of artificial intelligence methods and technologies in medicine to construct formal mathematical models and interpret modeling results;
- develop the ability to build artificial intelligence systems that solve typical problems of analyzing human diseases using machine learning software;

Educational objectives of the discipline:

- formation of systemic theoretical knowledge about obtaining, structuring and forming medical information;
- development of skills to carry out text and graphic processing of medical data using standard operating system tools and generally accepted office applications, as well as application and special software;
- development of skills in developing a nomenclature of medical concepts, formalizing regulatory documents in the field of healthcare, developing a database and knowledge of systems for supporting medical decisions;

1.3. The place of the discipline in the structure of the main professional educational program of higher education.

In accordance with the Federal State Educational Standard of Higher Education - a specialist in the specialty 31.05.01 General Medicine (2020), the discipline «Introduction to Artificial Intelligence» refers to the disciplines of the elective part, Block 1. The total workload is 2 credits (72 hours), of which 48 classroom hours, 24 hours are allocated for independent work of students. The discipline is taught in the 7th semester in the 4th year. The form of control is a test with a grade in the 7th semester.

Students are trained on the basis of continuity of knowledge and skills obtained from previous disciplines: «Physics, Mathematics» and «Medical Informatics». To master the discipline «Introduction to Artificial Intelligence», theoretical knowledge, skills and abilities are required:

- fundamentals of mathematical statistics, elements of integral and differential calculus (define basic statistical parameters, construct histograms, formulate conclusions based on available data);
- basic principles of storing, collecting and processing information; components of a computer and principles of its operation (use of educational, scientific, popular science literature, the Internet for educational activities; use of basic office software packages).

The course «Introduction to Artificial Intelligence» is a subject necessary for studying the following specialized disciplines: normal physiology, pathophysiology, clinical pathophysiology; biochemistry; histology, embryology, cytology; hygiene; microbiology and virology; public health and healthcare; neurology and neurosurgery; otolaryngology; ophthalmology, radiation diagnostics and radiation therapy; infectious diseases, anesthesiology, resuscitation, intensive care and other clinical disciplines.

1.4 Requirements for students

To study the course «Introduction to Artificial Intelligence», the student must have the necessary knowledge, skills and abilities formed by previous disciplines:

Mathematics
Knowledge: Fundamentals of mathematical statistics, elements of integral and differential calculus.
Abilities:determine the main statistical parameters (means, medians, modes, etc.), construct histograms, formulate conclusions based on available data.
Skills: graphical presentation of statistical data and methods of their description.
Medical informatics
Knowledge: basic principles of storing, collecting and processing information; components of a computer and principles of its operation.
Abilities:use educational, scientific, popular science literature, the Internet for educational activities; use basic office software packages.
Skills:use of basic software packages and the Internet in educational activities.

1. 5 Interdisciplinary links with subsequent disciplines

Knowledge, skills and abilities necessary for studying subsequent disciplines:

No. p/p	Name of subsequent disciplines	Introduction to artificial intelligence
1	Hospital therapy	+
2	Ophthalmology	+
3	Infectious diseases	+
4	Traumatology, orthopedics	+
5	Endocrinology	+
6	Dentistry	+
7	Outpatient therapy	+
8	Hospital surgery, pediatric surgery	+
9	Pediatrics	+
10	Obstetrics and gynecology	+
11	Anesthesiology, resuscitation, intensive care	+
12	Oncology, radiation therapy	+
13	Emergency conditions in the practice of a local therapist	+
14	Differential diagnostics in cardiology	+
15	Clinical pharmacology	+
16	Dermatovenereology	+
17	Organization of medical and preventive care for the adult population in a polyclinic setting	+

1. 6 Requirements for the results of mastering the discipline

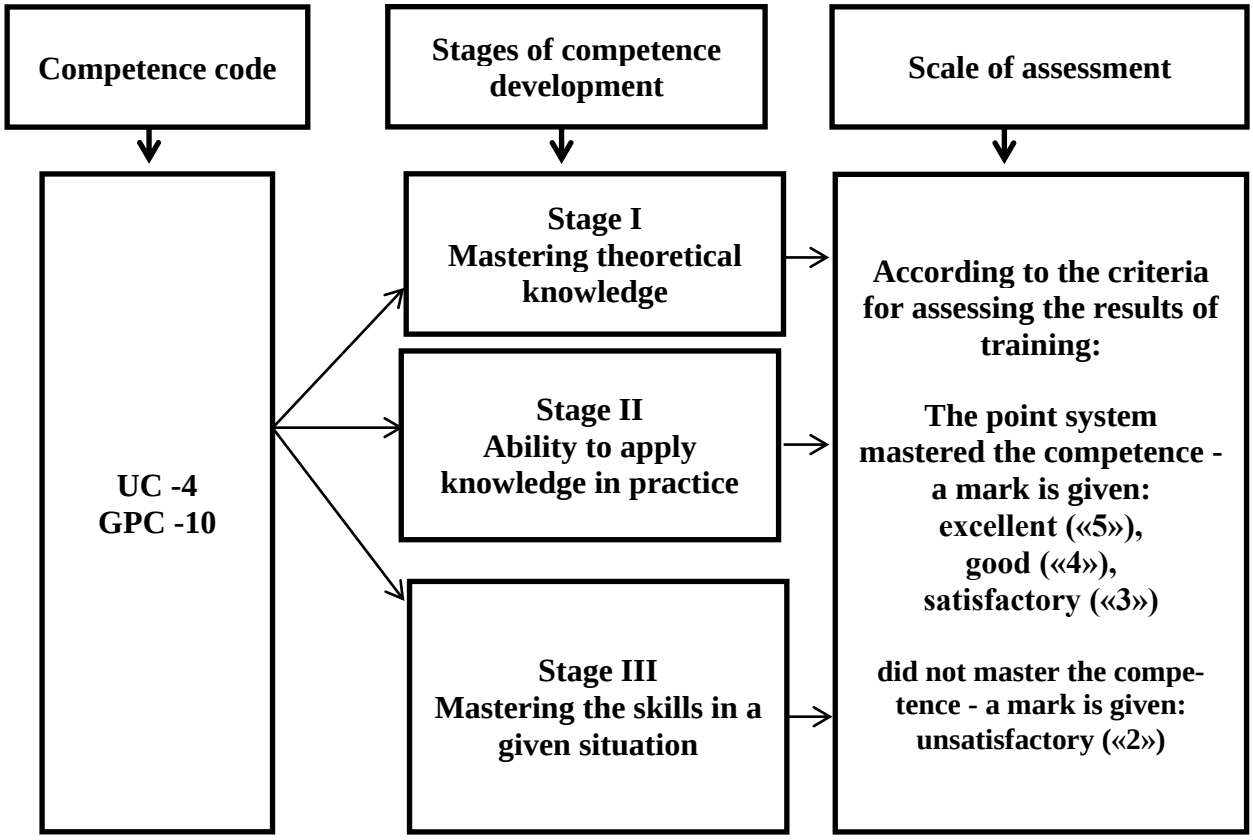
The study of the discipline «Introduction to Artificial Intelligence» is aimed at the formation of the following competencies: universal (UC-4) and general professional (GPC-10).

No. p/p	Code and name of competence	Code and name of the indicator of achievement of competence
Universal Competencies		
1	**UC-4.** Able to apply modern communication technologies, including in foreign language(s), for academic and professional interaction.	**AIUC-4.2.**Uses modern communication resources to search, process and transmit information necessary for the high-quality performance of professional tasks and the achievement of professionally significant goals.
General Professional Competencies		
2	**GPC-10.** Able to understand the principles of operation of modern information technologies and use them to solve professional activities.	**AIGPC-10.1.** Maintains confidentiality when working with information databases and with individual data of citizens. **AIGPC-10.2.** Carries out effective search for information necessary for solving problems of professional activity, using legal reference systems and professional pharmaceutical databases. **AIGPC-10.3.** Uses specialized software for mathematical processing of observational and experimental data when solving problems in professional activities.

Sections of the discipline and the code of the competence being formed

Item No.	Section name	Code of the competence being formed
1	Introduction to Artificial Intelligence.	UC-4 GPC-10

1.7 Stages of competencies development and description of assessment scales



1.8 Forms of training organization and types of control

Form of organization of students' training	Brief characteristic
Lectures	LecturematerialcontainsKeyAndmostproblematicquestionsdisciplines, mostsignificantVpreparationspecialist.
Practical classes	IntendedForanalysis (consolidation) of theoreticalprovisionsandcontrolovertheirassimilationwithsubsequentapplicationreceivedknowledgeVin the coursestudy of the topic.
Interactive forms of education	- solution situationaltasks and exercises followed bydiscussion, - interactive survey; - executioncreativetasks, - small group method, - discussions,

	- online course of the discipline in the Moodle system, - testing in the Moodle system.
Participation in the research work of the department and conferences	- Preparationoralmessages and poster presentations forspeechesat a scientific conference; - writing theses and abstracts on the chosen scientific field; - preparation of a literature review using educational, scientific, reference literature andInternet sources.
Types of control	**Brief description**
Incoming inspection	Testing theoretical knowledge and practical skills formed by the work program and previous disciplines. The entrance knowledge control includes: - testing in the Moodle system (test of incoming knowledge control), - solving situational problems and exercises. The results of the incoming inspection are systematized, analyzed and used by the teaching staff of the department to develop measures to improve and update the teaching methods of the discipline.
Current control	Current knowledge control includes: - checking the solution of situational problems and exercises completed independently (extracurricular independent work); - assessment of the assimilation of theoretical material (oral survey and computer testing); - control over the technique of performing laboratory work during practical classes and drawing up protocols; - testing in the Moodle system on all topics of the discipline (tests include questions of a theoretical and practical nature); - individual assignments (practical and theoretical) for each topic of the discipline being studied.
Interim assessment	The midterm assessment is presented as a test at the end of the 7th semester. The test includes the following stages: - assessment of knowledge of theoretical material (oral survey and interview); - testing in the Moodle system (interim assessment test); - check of assimilationpracticalskillsandskills; - solving situational problems and exercises on each topic of the discipline studied.

2. STRUCTURE AND CONTENT OF THE DISCIPLINE

2.1 Scope of the discipline and types of educational activities

No. p/p	Types of educational work	Total hours	Semester
			7
1	Lectures	14	14
2	Practical classes	34	34
3	Independent work of students	24	24
	Total workload intensity in hours	**72**	72
	Total workload in credit units	**2**	2

2.2 Thematic plan of lectures and their brief content

Item No.	Topics and content of lectures	Codes being formed competencies	Labor intensity (hour.)
1	**Fundamentals of Artificial Intelligence.** Definition, classification. Stages of development of artificial intelligence (AI) systems. Main directions of development of research in the field of AI systems. Architecture of AI. Methodology of building AI. Models. Databases (DB). Stages of development. Requirements. Advantages and disadvantages.	UC-4 GPC-10	2
2	**Introduction to Expert Systems.** Basic concepts. Tasks. Features of expert systems. Operating modes. General structure and functioning scheme. Stages of creating expert systems. Selection of tools for implementing an expert system. Application of expert systems. Advantages and limitations of expert systems. Application of expert systems in medicine.	UC -4 GPC -10	2
3	**Expert systems.Knowledge representation models.** Knowledge representation in expert systems. Semantic networks. Frame model. Production model. Logical model.	UC -4 GPC -10	2
4	**Introduction to Machine Learning.** The concept of machine learning. Types of machine learning. Machine learning models. Application of machine learning in medicine. Advantages and limitations of ML.	UC -4 GPC -10	2
5	**Machine learning.** Stages of developing machine learning models. Model evaluation metrics. Overfitting and underfitting.	UC -4 GPC -10	2
6	**Neural networks.** The concept of a neural network. Tasks of neural networks. The structure of a neural network. Classification of neural networks.Architecture and models of neural networks. Deep learning. Training neural networks. Problems in training. Advantages and limitations of neural networks.	UC -4 GPC -10	2
7	**Basics of the Python programming language.** Features of the Python language. Basic language constructs. Working with data. Libraries for data analysis and machine learning.	UC -4 GPC -10	2
	Total hours:		**14**

2.3 Thematic plan of practical classes and their content.

No. p/p	Name practical topics classes	Contents of practical classes	Codes being formed competencies and indicators their achievements	Types control	Labor intensity (hours)
1	Fundamentals of Artificial Intelligence. Application of Artificial Intelligence Systems in Medicine.	Entrance control (checking theoretical knowledge and practical skills) formed by the work program of previous disciplines. **Theoretical part:** What is artificial intelligence? What goals do AI researchers set? What approaches are distinguished by these goals? What is the Turing test? What does the symbolic physical system hypothesis say? What is the Chinese room paradox? What objections can be made to this paradox? What sections does the field of AI consist of? How can the structure of this field be generally represented? What are the most significant limitations of existing intelligent systems? What further development is possible in this field? Reveal the trends in AI development in technology and market trends. What are neural networks? What are their characteristics and main models. Describe the structural elements of an artificial intelligence system. What is methodology. What is the methodology of science Types of methodologies. Methodological foundations and main paradigms, and directions of development of artificial intelligence. **Practical part:** Prepare a message and presentations for the lesson on the topics: 1. Artificial intelligence: possibilities, development prospects. 2. History of the development of artificial intelligence.	UC- 4: AI 4.1., 4.2., 1.3. GPC-10: AI 10.1., 10.2., 10.3.	Entrance knowledge control (testing) frontal survey, discussion, testing in the Moodle system	3.4

		3. Presentation of artificial intelligence: myths and reality. 4. Intelligent systems and their possible application in medicine. 5. Intelligent systems and their classification. 6. Main directions of research development in the field of AI systems. 7. Areas of application of artificial intelligence in medicine.			
2	Digital technologies in medicine	**1. Big data.** **Theoretical part:** The concept of big data. Global data. BigData – concept, requirements, solutions. Russian experience. Big data and artificial intelligence (AI). Neural networks. Tasks for neural networks. Big data – a source for AI. **Practical part:** – Big data in personalized medicine; – genetic passport; – new diagnostics based on big genetic data; – BigData and analytical models for managing health and other aspects of quality of life; – Why does medicine need machine learning? **2. Artificial intelligence in medicine** **Theoretical part:** AI history of technology: concept, characteristics, tasks, main problems. Basic directions in the field of AI. Current development of AI: challenges. Application of AI in different fields. AI cases in the field of medicine. **Practical part:** – AI technologies in diagnostics: analysis of mammography and fluorography; – modeling of insulin-glucose balance in the blood;	UC - 4: AI 4.1., 4.2., 1.3. GPC -10: AI 10.1., 10.2., 10.3.	Initial knowledge assessment (testing), solving situational problems, working on a practical assignment, testing in the Moodle system.	3.4

		– intelligent assessment of therapy for dialysis patients; – decision making system for the treatment of patients on dialysis; – image analysis in radiology; – patient safety monitoring; – AI in diagnostics of ENT diseases; – Neurorehabilitation of patients; Digital laboratory for diagnostics of oncopathologies. **3. Additive technologies** **Practical part:** – bone tissue reconstruction; – gene-activated materials; – bone implants; – additive manufacturing for biomedical applications; – application of 3D SCANNING AND modeling in medicine; – 3D PRINTING OF medical products: implants and prostheses.			
3	Expert systems. Knowledge representation models	**Theoretical part:** Basic concepts. Tasks. Features of expert systems. Operating modes. General structure and functioning scheme. Stages of creating expert systems. Building a conceptual model. Formalization of the knowledge base. Selection of tools for implementing an expert system. Representation of knowledge in expert systems. Semantic networks. Frame model. Production model. Logical model. Methods for finding solutions. **Practical part:** - create a semantic model of knowledge representation;	UC - 4: AI 4.1., 4.2., 1.3. GPC -10: AI 10.1., 10.2., 10.3.	Initial knowledge assessment (testing), solving situational problems, working on a practical assignment, testing in the Moodle system.	3 ,4

		- create a frame model for knowledge representation; - create a production model for knowledge representation.			
4	Neurosimulator	**Theoretical part:** Biological and mathematical neuron. Perceptron and its training. Limitations of a single-layer perceptron. Generalized delta rule algorithm. Squared error of a perceptron. Gradient descent method. Backpropagation algorithm. Two-layer perceptron. **Practical part:** – mathematical neuron; – classification of numbers; – print letter recognition; – handwritten letter recognition; – two-layer perceptron; – medical diagnostics.	UC - 4: AI 4.1., 4.2., 1.3. GPC -10: AI 10.1., 10.2., 10.3.	Initial knowledge assessment (testing), solving situational problems, working on a practical assignment, testing in the Moodle system.	3.4
5	Neurosimulator	**Theoretical part:** Biological and mathematical neuron. Perceptron and its training. Limitations of a single-layer perceptron. Generalized delta rule algorithm. Squared error of a perceptron. Gradient descent method. Backpropagation algorithm. Two-layer perceptron. **Practical part:** – mathematical neuron; – classification of numbers; – print letter recognition; – handwritten letter recognition; – two-layer perceptron; – medical diagnostics.	UC - 4: AI 4.1., 4.2., 1.3. GPC -10: AI 10.1., 10.2., 10.3.	Initial knowledge control (testing), frontal survey, discussion, testing in the Moodle system	3.4
6.	Neural networks	**Theoretical part:** The concept of a neural network. Types. Neural transmission. Synaptic connections. Artificial neuron. Neuron ac-	UC - 4: AI 4.1., 4.2., 1.3. GPC -10: AI 10.1., 10.2., 10.3.	Initial knowledge assessment (test-	3.4

		tivation functions, types of activation functions . Preparing input data for neural networks . Setting high-quality input data for neural networks . Interpreting the results (output data) of a neural network . Multilayer neural networks . Training a neural network . Pattern recognition using neural networks . Problems that neural networks are used to solve . What is the idea of self-training of a network based on . **Practical part:** Using neural networks to solve problems.		ing), solving situational problems, working on a practical assignment, testing in the Moodle system.	
7	Python Programming Language	**Theoretical part:** Concept. Advantages. Basic properties and capabilities of Python. Syntax of the Python language. Strings, operators, functions of the Python language. Working with the file system. **Practical part:** Solving problems and exercises on the topics: – variables; – data types; numbers; strings; – operators; lists; functions, etc.	UC - 4: AI 4.1., 4.2., 1.3. GPC -10: AI 10.1., 10.2., 10.3.	Initial knowledge assessment (testing), solving situational problems, working on a practical assignment, testing in the Moodle system.	3.4
8	Python programming language	**Theoretical part:** Concept. Advantages. Basic properties and capabilities of Python. Syntax of the Python language. Strings, operators, functions of the Python language. Working with the file system. **Practical part:** Solving problems and exercises on the topics: – variables; – data types; numbers; strings; – operators; lists; functions, etc.	UC - 4: AI 4.1., 4.2., 1.3. GPC -10: AI 10.1., 10.2., 10.3.	Initial knowledge assessment (testing), frontal survey, discussion, testing in the Moodle system.	3.4
9	Python Programming Language	**Theoretical part:** Concept. Advantages.	UC - 4: AI 4.1., 4.2., 1.3. GPC -10: AI 10.1., 10.2.,	Initial knowledge assessment (test-	3.4

		Basic properties and capabilities of Python. Syntax of the Python language. Strings, operators, functions of the Python language. Working with the file system. **Practical part:** Solving problems and exercises on the topics: – variables; – data types; numbers; strings; – operators; lists; functions, etc.	10.3.	ing), solving situational problems, working on a practical assignment, testing in the Moodle system.	
10	Credit lesson	The interim assessment includes: - assessment of knowledge of theoretical material; - testing in the Moodle system; - testing the acquisition of practical skills and abilities; - solving situational problems and exercises.	UC - 4: AI 4.1., 4.2., 1.3. GPC -10: AI 10.1., 10.2., 10.3.	Interview, problem solving, testing in the Moodle system.	3.4
Total hours					**34**

2. 4 Interactive forms of training

interactive methods are widely used in practical classes.training (interactive survey, work in small groups, computer testing, etc.), participation in educational and research and scientific research work.

No. p/p	Topic of the practical class	Workload intensity in hours	Interactive form of education	Workload intensity in hours, in % of the practical class
1	Fundamentals of Artificial Intelligence. Application of Artificial Intelligence Systems in Medicine.	3.4	Interactive survey Testing in Moodle	30 min (0.7 hours) 19.6%
2	Digital technologies in medicine	3.4	Interactive survey Work in groups Testing in Moodle	10 min (0.2 hours) 6%
3	Expert systems. Knowledge representation models	3.4	Interactive survey Work in groups Testing in Moodle	30 min (0.7 hours) 19.6%
4	Neurosimulator	3.4	Interactive survey Work in groups Testing in Moodle	25 min (0.55 hours) 16.1%
5	Neurosimulator	3.4	Interactive survey Work in groups Testing in Moodle	30 min (0.7 hours) 19.6%
6	Neural networks	3.4	Interactive survey Testing in the Moodle system.	25 min (0.55 hours) 16.1%
7	Python programming language	3.4	Interactive survey Work in groups Testing in Moodle	25 min (0.55 hours) 16.1%
8	Python Programming Language	3.4	Interactive survey Work in groups Testing in Moodle	30 min (0.7 hours) 19.6%
9	Python Programming Language	3.4	Interactive survey Work in groups Testing in Moodle	30 min (0.7 hours) 19.6%
10	Credit lesson	3.4	Testing in Moodle system	90 min (2 hours) 100%

2.5 Criteria for assessing students' knowledge

The assessment of learning outcomes is carried out in accordance with the Regulations on the system for assessing the learning outcomes of students of the Federal State Budgetary Educational Institution of Higher Education Amur State Medical Academy of the Ministry of Health of Russia.

The basis for determining the level of knowledge, skills, and abilities are the assessment criteria - completeness and correctness:

- correct, precise answer;
- correct but incomplete or imprecise answer
- incorrect answer; no answer.

When assigning marks, the classification of errors and their quality are taken into account:

- gross errors;
- similar errors;
- minor errors; shortcomings.

Incoming inspection

Conducted during the first lesson, includes: testing in the Moodle system.

Access mode: https://educ-amursma.ru/course/view.php?id=853

The test control includes questions on the course of the previous disciplines «Physics, Mathematics» and «Medical Informatics».

Current control

Current control includes initial and final control of knowledge.

Initial control **is** carried out by the teacher at the beginning of each lesson in the form of a frontal survey and solution of situational problems.

Final control – includes control over the technique of performing practical work, drawing up a protocol , and testing in the Moodle system.

Access mode: https://educ-amursma.ru/course/view.php?id=853

The final grade during the current knowledge assessment is given on the day of the lesson, as the arithmetic mean result for all types of activities provided for in the given lesson of the discipline's work program.

Table of criteria for assessing incoming and current control

Quality of development	Mark on a 5-point scale
90 - 100%	«5»
80 - 89%	«4»
70 - 79%	«3»
less than 70%	«2»

Criteria for assessing the oral response

- **«5» (excellent)** – the student demonstrates deep and complete knowledge of the educational material, does not allow inaccuracies or distortions of facts when presenting, presents the material in a logical sequence, is well oriented in the presented material, and can provide justification for the judgments expressed.
- **«4» (good) -** the student has mastered the educational material in full, is well oriented in the educational material, presents the material in a logical sequence, but makes inaccuracies when answering.
- **«3» (satisfactory)** – the student has mastered the basic principles of the topic of the practical lesson, but when presenting the educational material, he/she makes inaccuracies, presents it incompletely and inconsistently, requires leading questions from the teacher to present it, and has difficulty substantiating the judgments expressed.
- **«2» (unsatisfactory)** – the student has fragmented and unsystematic knowledge of the educational material, is unable to distinguish between the main and the secondary, makes mistakes in defining basic concepts, distorts their meaning, and cannot independently present the material.

Assessment criteria for the practical part

- **«5» (excellent)** – the student has fully mastered the practical skills and abilities provided for by the course work program.
- **«4» (good)** – the student has fully mastered the practical skills and abilities provided for in the course program, but makes some inaccuracies.

- **«3» (satisfactory)** – the student has only some practical skills and abilities.
- **«2» (unsatisfactory)** – the student demonstrates the performance of practical skills and abilities with gross errors.

Criteria for assessing independent extracurricular work:

- the level of student mastery of the educational material;
- the completeness and depth of general educational concepts, knowledge and skills on the topic being studied, to which this independent work relates;
- development of universal and general professional competencies (ability to apply theoretical knowledge in practice).
- clinical problems were solved correctly, accurate answers were given to test tasks – «passed».
- clinical problems were not solved correctly, inaccurate answers were given to test tasks – «failed».

Essay evaluation criteria:

- **«5» (excellent) –** awarded to a student if he has prepared a complete, detailed, and formatted according to requirements, abstract on the chosen topic, presented his work in the form of a report with a computer presentation, and answered questions on the topic of the report;
- **«4» (good) –** awarded to a student for a complete, detailed essay that is formatted according to requirements, but poorly presented;
- **«3» (satisfactory) –** the abstract does not contain information on the issue being studied in full, is formatted with errors, and is poorly presented;
- **«2» (unsatisfactory)** – given to a student if the abstract is not written, or is written with gross errors, the report and computer presentation are not prepared, or their content does not correspond to the topic of the abstract.

Working off disciplinary debts.

1. If a student misses a class for a valid reason, he/she has the right to make it up and receive the maximum grade provided for by the course work program for that class. A valid reason must be documented.
2. If a student misses a class for an unjustified reason or receives a «2» mark for all activities in the class, he/she is required to make it up. In this case, the mark received for all activities is multiplied by 0.8.
3. If a student is excused from a class at the request of the dean's office (participation in sports, cultural and other events), then he is given a grade of «5» for this class, provided that he submits a report on the completion of mandatory extracurricular independent work on the topic of the missed class.

Criteria for assessing midterm assessment.

Midterm assessment (credit with assessment in 7th semester) – is intended to assess the degree of achievement of planned learning outcomes upon completion of the discipline and allows assessing the level and quality of its mastery by students. The subject of assessment of mastery is knowledge, abilities, skills.

The students' success in mastering the discipline is assessed on a 5-point scale: «5» – excellent, «4» – good, «3» – satisfactory, «2» – unsatisfactory.

«Excellent» - for the depth and completeness of mastery of the content of the educational material, in which the student easily navigates, for the ability to connect theoretical questions with practical ones, express and justify their judgments, correctly and logically present the answer; when testing, allows up to 10% of erroneous answers. Practical skills and abilities provided for by the working program of the discipline are fully mastered.

«Good» - the student has fully mastered the educational material, is oriented in it, correctly states the answer, but the content and form have some inaccuracies; during testing allows up to 20% of erroneous answers. Completely practical skills and abilities provided by the working program of the discipline, but allows some inaccuracies

«Satisfactory»- the student has mastered the knowledge and understanding of the main provisions of the educational material, but presents it incompletely, inconsistently, does not know how to express and justify his/her judgments; during testing, allows up to 30% of erroneous answers. Has only some practical skills and abilities.

«Unsatisfactory»- the student has fragmented and unsystematic knowledge of the educational material, is unable to distinguish between the main and secondary, makes mistakes in defining concepts, distorts their meaning, presents the material in a disorderly and uncertain manner, and makes more than 30% of erroneous answers during testing. Performs practical skills and abilities with gross errors.

A student can claim to receive an "excellent" grade automatically if he/she has won a prize in disciplinary or interdisciplinary Olympiads (university, regional) and has an average grade for the current academic performance of at least 4.8 points**.** A student can refuse the "automatic" grade and take the test together with the group on a general basis.

Interim assessment is carried out through a system of passing a test in 3 stages:

1. Testing in the Moodle system:
   Access mode: https://educ-amursma.ru/course/view.php?id=853
2. Completion of the practical part of the discipline in full: involves attending all practical classes, performing practical work with the preparation of a protocol. Based on the assessments of the current control of knowledge, skills, and abilities in practical classes, the average score of current academic performance is calculated, which is recorded in the educational (electronic) journal. The average score of the current knowledge control is taken into account during the midterm assessment.
3. Delivery of practical skills (control of the level of development of competencies). Includes 10 options, containing 10 practical questions each.

Assessment criteria for midterm assessment

Stages	Mark out of 5 point scale	Point system
Test control in the Moodle system	3-5	**5 –«excellent»** **4 –«good»** **3 – «satisfactory»**
Complete completion of the practical part of the course	3-5	
Delivery of practical skills (control of the formation of competencies)	3-5	
Test control in the Moodle system	2	**2 – «unsatisfactory»**
Complete completion of the practical part of the course	2	
Delivery of practical skills (control of the formation of competencies)	2	

2.6 Independent work of students: in-class and out-of-class.

The organization of independent classroom work of students is carried out with the help of methodological instructions for students, which contain educational goals, a list of the main theoretical questions for study, a list of practical work and the methodology for conducting it, instructions for the presentation of the results obtained, their discussion and conclusions, assignments for self-control with standard answers, a list of recommended literature.

From 1/4 to 1/2 of the practical lesson time is allocated for independent work of students: conducting research, recording results, discussing them, formulating conclusions, completing individual assignments. The preparatory stage, or the formation of an approximate basis for actions, begins for students outside of class time when preparing for the practical lesson, and ends in class.

All subsequent stages are carried out in class. The stage of materialized actions (solving problems using an algorithm or without an algorithm, with an unknown answer in advance) is carried out independently. The teacher, if necessary, provides consultation, provides assistance and simultaneously monitors the quality of students' knowledge and their ability to apply existing knowledge to solve assigned problems.

No. p/p	Topic practical lesson	Time for student preparation for the lesson	Forms of extracurricular independent work	
			Mandatory and the same for everyone students	**At the student's choice (abstract on topics)**
1	Fundamentals of Artificial Intelligence. Application of Artificial Intelligence Systems in Medicine.	2.4 hours	– preparation for practical classes (lectures, basic and additional literature); – preparing messages and presentations for the lesson.	**Message topics:** - Artificial intelligence: possibilities, development prospects. - History of the development of artificial intelligence. - Presentation of artificial intelligence: myths and reality. - Neural networks and their capabilities. - Types of neural network. The principle of operation of a neural network. - Expert systems based on artificial intelligence systems. - Intelligent systems and their possible application in medicine. - Intelligent systems and their classification. - Main directions of development of research in the field of AI systems - Areas of application of artificial intelligence in medicine.
2	Digital technologies in medicine	2.4 hours	– preparation for practical classes (lectures, basic and additional literature); – drawing up a plan to answer questions; – completing a practical task (problem) to monitor the assimilation of the topic.	**Message topics:** Big data. – Big data in personalized medicine; – genetic passport; – new diagnostics based on big genetic data; – BigData and analytical models for managing health and other aspects of quality of life;

				- Why does medicine need machine learning? Artificial Intelligence in Medicine - AI technologies in diagnostics: analysis of mammography and fluorography; - modeling of insulin-glucose balance in the blood; - intelligent assessment of therapy for dialysis patients; - decision making system for the treatment of patients on dialysis; - image analysis in radiology; - patient safety monitoring; - AI in diagnostics of ENT diseases; - Neurorehabilitation of patients; - Digital laboratory for diagnostics of oncopathologies. Additive technologies - bone tissue reconstruction; - gene-activated materials; - bone implants; - additive manufacturing for biomedical applications; - application of 3D SCANNING AND modeling in medicine; - 3D PRINTING OF medical products: implants and prostheses.
3	Expert systems. Knowledge representation models	2.4 hours	- preparation for practical classes (lectures, basic and additional literature); - drawing up a plan to answer questions; - completing a practical task (problem) to monitor the assimilation of the topic.	**Message topics:** - The concept of expert systems. - Structure of expert systems. - Classification of expert systems: interpretation, diagnostics, monitoring, design, forecasting, learning, etc. - Stages of development of expert systems. - Semantic technologies in medicine.

				- Frame model. - Production model. - Formal logical model.
4	Neurosimulator	2.4 hours	- preparation for practical classes (lectures, basic and additional literature); - drawing up a plan to answer questions; - completing a practical task (problem) to monitor the assimilation of the topic."	**Message topics:** Basics of Neurosimulation: What are neurosimulators and why are they needed: – An overview of technologies and tools used in neurosimulation. Development of a neural network in a simulator from A to Z: – detailed instructions on how to create your first neural network model in a simulation environment. Creating virtual experiments in neurostimulators: – how to conduct research on the behavior of neurons and networks using digital models of the brain. Brain-Computer Interfaces (BCI): – the possibilities of interaction of human consciousness with digital systems through simulators. Modeling synaptic plasticity in neurostimulators: – algorithms used to reproduce learning and memory processes in artificial networks.
5	Neurosimulator	2.4 hours	- preparation for tests (lectures, basic and additional literature); - repeat examples of solutions to typical problems; - Completion of a sample test.	**Message topics:** Artificial Intelligence and the Study of Brain Functions: – Using neurostimulators to understand the mechanisms of human perception, information processing and decision making. Neuromorphic computing: the possibilities of new generation neurosimulators: – Prospects for the development of specialized processors optimized for working with artificial neurons. Modern approaches to the study

				of diseases of the nervous system: – the use of neurosimulations to study pathologies such as Alzheimer's, Parkinson's and other CNS diseases. Application of simulators in the development of drugs against brain diseases: – the role of modeling in the creation of new methods of treating neurological disorders.
6	Neural networks	2.4 hours	- preparation for practical classes (lectures, basic and additional literature); - drawing up a plan to answer questions; - familiarization with examples of solutions to typical problems - completing a practical task (problem) to monitor the assimilation of the topic.	**Message topics:** - The concept of a neural network. Types. - Neural transmission. - Synaptic connections. - Artificial neuron. - Activation functions of neurons, types of activation functions **.** - Preparing input data for neural networks **.** - Specifying quality input data for neural networks **.** - Interpretation of the results (output data) of a neural network **.** - Multilayer neural networks **.** - Training a neural network **.** - Pattern recognition using neural networks **.** - Problems for which neural networks are used **.** - What is the idea behind self-learning networks?
7	Python Programming Language	2.4 hours	- preparation for practical classes (lectures, basic and additional literature); - drawing up a plan to answer questions; - completing a practical task (problem) to monitor the assimilation of the topic.	**Message topics:** – What is Python and why is it popular among programmers: the history of the language, areas of application, advantages over other languages. – Installing Python development environment on Windows/ Mac /Linux: step-by-step installation of Python

				interpreter and popular IDEs (PyCharm, VS Code). – First Python Program: Hello World: A simple introduction to writing basic scripts. – Variables and data types in Python: working with numbers, strings, lists, tuples, sets, and dictionaries. – Operations and expressions in Python: basic arithmetic operations, comparison operators, boolean expressions. – If-else conditionals and the ternary operator: branching logic and decision making in code. – Working with functions and parameters: creating your own functions, passing arguments, returning values. – Handling errors and try-except-finall exceptions: debugging and handling unexpected situations in a program.
8	Python Programming Language	2.4 hours	- preparation for practical classes (lectures, basic and additional literature); - drawing up a plan to answer questions; - completing a practical task (problem) to monitor the assimilation of the topic.	**Message topics:** – Object-oriented programming (OOP) in Python: classes, objects, inheritance, polymorphism, encapsulation. – Modules and packages in Python: importing standard library modules and third-party libraries, package structure. – Regular Expressions in Python: Find, Replace, and Match Text Patterns. – File I/O in Python: reading and writing files of various formats (txt, csv, json). – Working with SQL databases via Python: connecting to MySQL, SQLite databases, executing SELECT, INSERT, UPDATE queries. – Libraries for data analysis (Pandas, NumPy): master-

				ing basic operations with arrays and data tables. – Web Development with Python (Flask / Django): Getting started with building web applications using the Flask and Django frameworks.
9	Python Programming Language	2.4 hours	- preparation for practical classes (lectures, basic and additional literature); - drawing up a plan to answer questions; - completing a practical task (problem) to monitor the assimilation of the topic.	**Message topics:** – Best practices for writing clean and understandable code: PEP8 design standards, project structure recommendations. – Code testing and debugging tools: writing unit tests, performance profiling, using the pdb debugger. – Practical projects for beginners: and projects to consolidate the material learned (calculator, snake game, news parser).
10	Credit lesson	2.4 hours	- preparation for the test (lectures, basic and additional literature); - drawing up a plan to answer questions; - preparing for testing.	
Labor intensity in hours		**24**	20 hours	4 hours
Total labor intensity in hours			**24 hours**	

2.7 Research (project) work

Research (project) work of studentsisa mandatory section of the discipline and is aimed at the comprehensive development of universal and general professional competencies of students. Research (project) workIt involves studying specialized literature and other scientific and technical information about the achievements of domestic and foreign science and technology in the relevant field of knowledge, participation in scientific research, etc. The topics are determined by students independently or in consultation with the teacher.

List of recommended topics for research (project) work:

1. Application of artificial intelligence in healthcare: laws, standards, ethical issues.
2. Application of artificial intelligence systems in medicine.
3. Expert systems based on artificial intelligence systems.
4. Expert systems and their application for solving problems in medicine.
5. Neural networks.
6. Areas of application of neural networks, classes of problems solved through their use.
7. Formalization and structuring of knowledge in the design of medical databases.

8. Tools and programming languages used to develop artificial intelligence systems.
9. Basic concepts of predicate theory and its use for knowledge representation.
10. Fuzzy sets, operations on them. Using fuzzy inferences in expert systems.
11. Application of artificial intelligence systems for statistical analysis of data and forecasting the behavior of objects and systems.

Criteria for assessing students' research (project) work:

- the material on the results of the research in the report is presented in detail, the specialized literature is well-developed, scientific and technical information on the achievements of domestic and foreign science and technology in the relevant field of knowledge is studied - "passed".
- the material on the results of the research in the report is not presented accurately enough, the special literature is poorly studied, the scientific and technical information on the achievements of domestic and foreign science and technology in the relevant field of knowledge is not studied - "failed".

3. EDUCATIONAL, METHODOLOGICAL, MATERIAL, TECHNICAL AND INFORMATION SUPPORT OF DISCIPLINE

3.1 Main literature:

1. Fundamentals of Artificial Intelligence: Practical Work on Creating and Training Artificial Neural Networks in Python / N. V. Markina, E. I. Belenkova , G. A. Didenko et al. - Chelyabinsk: TETA, 2023. - 72 p. - Text: electronic // Electronic Library System "Bukap". Access mode:https://www.books-up.ru/ru/book/osnovy-iskusstvennogo-intellekta-16176302/
2. Medical informatics: textbook / edited by T. V. Zarubina, B. A. Kobrinsky - Moscow: GEOTAR-Media, 2022. 464 p. - ISBN 978-5-9704-6273-7. Electronic library system "Student consultant"– ISBN 978-5-9704-4573-0. Access mode: https://www.studentlibrary.ru/book/ISBN9785970462737.html

3.2 Further reading:

1. Fundamentals of Artificial Intelligence: Practical Work on Clustering and Classification of Medical Data in the R Language / N. V. Markina, E. I. Belenkova , G. A. Didenko et al. - Chelyabinsk: SUMU, 2023. - 142 p. - Text: electronic // EBS "Bukap". Access mode:https://www.books-up.ru/ru/book/osnovy-iskusstvennogo-intellekta-16547957/
2. Maksimenko, E. V. Hardware and software for processing medical information: a teaching aid / E. V. Maksimenko, A. A. Khripunova. - Stavropol: StGMU, 2020. - 104 p. Lan: electronic library system. Access mode:https://e.lanbook.com/book/259103

3.3 Educational and methodological support for the discipline prepared by the department staff:

Electronic and digital technologies:

1. **Online course on the subject** "Medical Informatics" in the EIS FGBOU VO Amur State Medical Academy
   Access mode: https://educ-amursma.ru/course/view.php?id=853
   Characteristics of modules in electronic information and educationalcourse

Educational	Controlling
Theoretical (lecture) material, video experiments, scientific and educational films	Methodological recommendations for students on independent extracurricular work.
Methodological recommendations for students for practical classes.	List of recommended topics for abstracts and guidelines for abstract design.
Reference material, tables of standard values.	Tests of entrance, current and final knowledge control.

2. **Multimedia presentations** for lecture-type classes, according to the thematic plan of lectures:
   Access mode:https://educ-amursma.ru/course/view.php?id=853
   - Fundamentals of Artificial Intelligence.
   - The structure of artificial intelligence systems.
   - Application of artificial intelligence systems in medicine.
   - Expert systems based on artificial intelligence systems.
   - Neural networks.
   - Principles of constructing neural networks.
   - Application of neural networks in medicine.

3. **Video materials:**
   Interactive video course: «Fundamentals of the Python programming language».

3.4 Equipment used for the educational process

No. p/p	Name	Quantity
1.	**Room for practical classes: DK - 1**	
	Board	1
	Teacher's desk	1
	Study table	4
	Computer desk	13
	Computers	18
	Set of headphones	18
	Chairs	20
	Handout kit	30
2.	**Room for practical classes: DK - 2**	
	Board	1
	Teacher's desk	1
	Study table	4
	Computer desk	13
	Computers	17
	Set of headphones	17
	Chairs	20
	Handout kit	30
3.	**Room for practical classes: DK - 3**	1
	Board	1
	Teacher's desk	1
	Computer desk	13
	Set of headphones	13
	Computers	13

	Chairs	20
	Handout kit	30
4	**Practical training room: Workshop 2**	2
	Board	1
	Teacher's desk	1
	Chairs	20
	Study table	10
	Handout kit	30
5	**Room for independent work of students, workshop 3**	
	Board	1
	Teacher's desk	1
	Chairs	20
	Study table	7
	Handout kit	60

3.5. Professional databases, information and reference systems, electronic educational resources.

Name resource	Resource Description	Access	Resource address
ELECTRONIC LIBRARY SYSTEMS			
«Student consultant. Electronic library of the medical university»	For students and teachers of medical and pharmaceutical universities. Provides access to electronic versions of textbooks, teaching aids and periodicals.	Remote access after registration under the university profile	https://www.studentlibrary.ru/
Reference and information system MedBaseGeotar».	The reference and information system " MedBaseGeotar " is intended for practicing medical specialists, researchers, teachers, postgraduate students, residents, senior students, and managers in the field of healthcare for the rapid search, selection, and reading of medical literature necessary for work in a single data source.	Remote access after registration under the university profile	https://mbasegeotar.ru/pages/index.html
EBS «Bookup»	Large medical library - information and educational platform for the joint use of electronic educational, educational and methodological publications of medical universities of Russia and the CIS countries	Remote access after registration under the university profile	https://www.books-up.ru/
EBS «Lan»	Network electronic library of medical universities - an electronic database of educational and scientific works on medical topics, created for the purpose of implementing network forms of professional educational programs, open access to educational materials for	Remote access after registration under the university profile	https://e.lanbook.com/

	partner universities		
Scientific electronic library «CyberLeninka»	CyberLeninka is a scientific electronic library built on the paradigm of open science (Open Science), the main objectives of which are the popularization of science and scientific activity, public control over the quality of scientific publications, the development of interdisciplinary research, a modern institute of scientific review, increasing the citation of Russian science and building a knowledge infrastructure. Contains more than 2.3 million scientific articles.	free access	https://cyberleninka.ru/
Oxford Medicine Online	A collection of Oxford medical publications, bringing together over 350 titles into a single, cross- searchable resource. Publications include The Oxford Handbook of Clinical Medicine and The Oxford Textbook of Medicine, the electronic versions of which are constantly updated.	free access	http://www.oxfordmedicine.com
Human Biology Knowledge Base	Reference information on physiology , cell biology , genetics , biochemistry , immunology , pathology . (Resource of the Institute of Molecular Genetics of the Russian Academy of Sciences .)	free access	http://humbio.ru/
Medical online library	Free reference books, encyclopedias, books, monographs, abstracts, English-language literature, tests.	free access	https://www.medlib.ru/library/library/books
INFORMATION SYSTEMS			
Clinical Guidelines Rubricator	A resource of the Russian Ministry of Health that contains clinical recommendations developed and approved by medical professional non-profit organizations of the Russian Federation, as well as methodological guidelines, nomenclatures and other reference materials.	Link to download the application	https://cr.minzdrav.gov.ru/#!/
Federal Electronic Medical Library (FEMB)	The Federal Electronic Medical Library is part of the unified state information system in the field of healthcare as a reference system. FEMB was created on the basis of the funds of the Central Scientific Medical Library named after I.M. Sechenov.	free access	https://femb.ru/
Russian Medical Association	Professional Internet resource. Objective: to promote effective professional activity of medical personnel. Contains the charter, personnel, structure, rules of entry, information about the Russian	free access	http://www.rmass.ru/

	Medical Union.		
Web -medicine	The site presents a catalog of professional medical resources, including links to the most authoritative subject sites, journals, societies, as well as useful documents and programs. The site is intended for doctors, students, employees of medical universities and scientific institutions.	free access	http: //webmed.irkutsk.ru/
DATABASES			
World Health Organization	The site contains news, statistics on countries that are members of the World Health Organization, fact sheets, reports, WHO publications and much more.	free access	http://www.who.int/ru/
Ministry of Science and Higher Education of the Russian Federation	The website of the Ministry of Science and Higher Education of the Russian Federation contains news, newsletters, reports, publications and much more.	free access	http://www.minobrnauki.gov.ru
Ministry of Education of the Russian Federation	The website of the Ministry of Education of the Russian Federation contains news, newsletters, reports, publications and much more.	free access	https://edu.gov.ru/
Federal portal "Russian education"	A single window for access to educational resources. This portal provides access to textbooks on all branches of medicine and health care.	free access	http: // www . edu.ru/
Polpred.com	Electronic library system Business media. Media review	free access	https://polpred.com/news
BIBLIOGRAPHICAL DATABASES			
Database "Russian Medicine"	It is created in the Central Scientific and Methodological Library and covers the entire collection, starting from 1988. The database contains bibliographic descriptions of articles from domestic journals and collections, dissertations and their abstracts, as well as domestic and foreign books, collections of institute proceedings, conference materials, etc. Thematically, the database covers all areas of medicine and related areas of biology, biophysics, biochemistry, psychology, etc.	free access	https://rucml.ru/
PubMed	A text database of medical and biological publications in English. The PubMed database is an electronic search engine with free access to 30 million publications from 4,800 indexed jour-	free access	https :// pubmed . ncbi . nlm . nih . gov /

	nals on medical topics. The database contains articles published from 1960 to the present day, including information from MEDLINE, PreMEDLINE, NLM. Each year, the portal is replenished with more than 500 thousand new works.		
eLIBRARY.RU	Russian information portal in the field of science, technology, medicine and education, containing abstracts and full texts of more than 13 million scientific articles and publications. The eLIBRARY.RU platform provides electronic versions of more than 2,000 Russian scientific and technical journals, including more than 1,000 open access journals.	Full functionality of the site is available after registration	http://elibrary.ru/defaultx.asp
Electronic library of dissertations (RSL)	Currently, the Electronic Library of Dissertations of the Russian State Library contains more than 919,000 full texts of dissertations and abstracts.	free access	http://diss.rsl.ru/?menu=disscatalog/
Medline.ru	Medical and biological portal for specialists. Biomedical journal.	free access	https://journal.scbmt.ru/jour/index
Official Internet portal of legal information	The single official state information and legal resource in Russia	free access	http://pravo.gov.ru/

3.6. Licensed and freely distributed software used in the educational process.

List of software (commercial software products).

No. p/p	List of software (commercial software products)	Details of confirming documents documents
1.	MS Operating System Windows 7 Pro	License number 48381779
2.	MS Operating System Windows 10 Pro	CONTRACT No.UT-368 from 09.21.2021
3 .	MS Office	License number: 43234783, 67810502, 67580703, 64399692, 62795141, 61350919
4.	Kaspersky Endpoint Security for Business – Standard Russian Edition. 50-99 Node 1-year Educational Renewal License	Agreement No. 7 AA dated 02/07/2025
5.	1C Accounting and 1C Salary	LICENSE AGREEMENT 612/L dated 02.02.2022 (additional licenses)
6.	1C: PROF University	LICENSE AGREEMENT No. KrTsB-004537 dated 12/19/2023
7.	1C: PROF Library	LICENSE AGREEMENT No. 2281 dated 11.11.2020
8.	Consultant Plus	Contract No. 41AA dated 12/27/2024
9.	Contour.Tolk	Agreement No. K213753/24 dated 13.08.2024

10.	E-learning environment 3KL (Russian Moodle)	Agreement No. 1362.5 dated November 20, 2024
11.	Astra Linux Common Edition	Agreement No. 142 A dated September 21, 2021
12.	Information system "Plans"	Agreement No. 2873-24 dated June 28, 2024
13.	1C: Document Management	Agreement No. 2191 dated 10/15/2020
14.	R7-Office	Agreement No. 2 KS dated 12/18/2020
15.	License "OS ROSA CHROME workstation"	Agreement No. 88A dated 08/22/2024
16.	Alt Virtualization Server 10 (for secondary specialized and higher professional education)	Agreement No. 14AK dated 09/27/2024
17.	Dr.Web Desktop Security Suite Comprehensive protection + Control Center for 12 months.	Agreement No. 8 dated October 21, 2024
18.	Software "Schedule for educational institutions"	Agreement No. 82A dated July 30, 2024

List of freely distributed software

No. p/p	The list is free distributed software	Links to license agreement
1.	Yandex Browser	Freely distributed License Agreement for the Use of Yandex Browser Programs https://yandex.ru/legal/browser_agreement/
2.	Yandex.Telemost	Freely distributed License agreement for the use of programs https://yandex.ru/legal/telemost_mobile_agreement/
3.	Dr.Web CureIt !	Freely distributed License Agreement: https://st.drweb.com/static/new-www/files/license_CureIt_ru.pdf
4.	OpenOffice	Freely distributed License: http://www.gnu.org/copyleft/lesser.html
5.	LibreOffice	Freely distributed License:https://ru.libreoffice.org/about-us/license/
6.	VK Calls	Freely distributed https://vk.com/license
7.	Kaspersky Free Antivirus	Freely distributed https://products.s.kaspersky-labs.com/homeuser/Kaspersky4Win2021/21.16.6.467/english-0.207.0/3830343439337c44454c7c4e554c4c/kis_eula_en-in.txt

3.7. Resources of the information and telecommunications network "Internet"

- Library of Amur State Medical Academy. Access mode: https://amurgma.ru/obuchenie/biblioteki/biblioteka-amurskoy-gma/
- Electronic library system "Student consultant". Access mode: https://www.studentlibrary.ru

4. ASSESSMENT TOOLS FUND

4.1. Current test control (input, initial, output), final.

4.1.1 Examples of entrance control test tasks (with standard answers)

Test assignments are located in the Moodle system.
Access mode :https://educ-amursma.ru/course/view.php?id=853
Total number of tests – 100.

1. ARTIFICIAL INTELLIGENCE IS:
    1) software with a set of algorithms and methods that can solve intellectual problems in the same way as a person would;
    2) an area of human activity associated with the processes of transformation and use of information using computer technologies;
    3) the science of the structure of a computer and the methods of its application in various areas of human activity;
    4) a program that simulates human thinking on a computer;
2. NEURAL NETWORK IS:
    1) a method in artificial intelligence that teaches computers to process data in the same way as the human brain;
    2) a sequence of neurons connected to each other by synapses (connections);
    3) a method of knowledge representation that allows describing objects, phenomena and concepts of a subject area using network structures;
    4) a computer program that operates with the formalized knowledge of medical specialists and imitates the logic of human thinking based on the knowledge and experience of experts in order to develop recommendations and solve problems;
3. EXPERT SYSTEM IS:
    1) a set of programs or software that performs the functions of an expert in solving a problem in the area of his competence;
    2) a software tool with a set of algorithms and methods that can solve intellectual problems in the same way as a human would;
    3) the science of developing algorithms and statistical models that computer systems use to perform tasks without explicit instructions, relying instead on patterns and logical inference;
    4) a system built on the basis of computer technology, designed for storing, searching, processing and transmitting significant volumes of information, having a specific practical scope of application;

Answer standards: 1-1; 2-1; 3-1.

4.1.2 Examples of test tasks for initial control (with standard answers)

Test assignments are located in the Moodle system.
Access mode:https://educ-amursma.ru/course/view.php?id=853

Total number of tests – 200.

1. HOW DOES A NEURAL NETWORK LEARN?
    1) the network is run on the training set and the weight values are adjusted;
    2) experts tune a neural network;
    3) the network is run on the training set, and unused neurons are discarded;
    4) the network is run on the training set, and connections between neurons are added or removed;

2. SOLVER - THIS:
    1) algorithm, program, set of rules by which a problem is solved;
    2) a database necessary for solving problems;
    3) an expert who leads the problem solving process;
    4) a specialist in developing software to solve assigned tasks;

3. WHAT ARE THE TWO APPROACHES TO BUILDING A SUBJECT DOMAIN MODEL:
    1) characteristic and structural;
    2) step-by-step and systematic;
    3) procedural and structural;
    4) systemic and symptomatic;

Answer standards: 1-1; 2-1; 3-1.

4.1.3 Examples of test tasks for final control (with standard answers)

Test assignments are located in the Moodle system.
Access mode: https://educ-amursma.ru/course/view.php?id=853
Total number of tests – 200.

1. EXPERT SYSTEMS ARE USED FOR:
    1) non-formalized tasks;
    2) structural tasks;
    3) logical problems;
    4) formalized tasks;
2. THE TASKS OF DIAGNOSTICS ARE:
    1) identifying the reasons that led to the emergence of the situation;
    2) predicting the consequences of the development of current situations;
    3) influence on an object to achieve the desired result;
    4) observations of the changing state of an object;
3. A PREDICATE IS A SENTENCE THAT TAKES TWO MEANINGS:
    1) truth and falsehood;
    2) yes and no;
    3) one and zero;
    4) there is no correct answer;

Answer standards: 1-1; 2-1; 3-1.

4.1.4 Examples of test tasks for assessing practical skills (with standard answers)
Test assignments are located in the Moodle system.
Access mode:https://educ-amursma.ru/course/view.php?id=853
Total number of tests – 200.

1. EXPRESSION WRITTEN IN SYMBOL FORM $\exists_y$ (БОЛЕЕТ (АНТОН, x) $\supset$ ДИАБЕД (x) $\wedge$ *II*OF TYPE *(x)* :
    1) Anton suffers from type 2 diabetes;
    2) Anton does not have type 2 diabetes;
    3) Anton probably has type 2 diabetes;
    4) there is no correct answer;
2. IF WITH SYMPTOM 1 YOU OBTAINED P(E:H) = 0.8 And P (E: NOT H)= 0.2 . WHAT DOES P(E:H) MEAN?
    1) if the expert is sick with disease 1, then in 8 cases out of 10 he will answer yes;
    2) if the expert is sick with disease 1, then in 2 cases out of 8 he will answer yes;
    3) if the expert is sick with disease 1, then in 8 cases out of 10 he will answer no;
    4) if the expert is sick with disease 1, then in 2 cases out of 8 he will answer no;
3. EXPRESSION WRITTEN IN SYMBOL FORM $\forall_x\exists_y$ (ЧЕЛОВЕК (x) $\supset$ ОТЕЦ (x, y):
    1) every person has a father;
    2) a father is also a person;
    3) anyone can be a father;
    4) there is no correct answer;

Answer standards: 1-1; 2-1; 3-1.

4.1.5 Examples of test tasks for the final assessment (with standard answers)

Test assignments are located in the Moodle system.
Access mode:h https://educ-amursma.ru/course/view.php?id=853
Total number of tests – 200.

1. THE MAIN TYPES OF MEDICAL LOGIC INCLUDE:
    1) deterministic logic, phase interval method, information-probabilistic logic;
    2) logic of emotions, metalogic, modal logic;
    3) formal logic, vital logic;
    4) chaotic, analytical, synthetic, perfect;
2. SOFT KNOWLEDGE REPRESENTATION MODELS INCLUDE:
    1) hybrid systems;
    2) evolutionary systems;
    3) neural networks;
    4) fuzzy systems;
3. SOLVER - THIS:
    1) algorithm, program, set of rules by which a problem is solved;
    2) a database necessary for solving problems;
    3) an expert who leads the problem solving process;
    4) a specialist in developing software to solve assigned tasks;

Answer standards: 1-1; 2-1; 3-1.

4.2 Situational tasks, exercises

Example No. 1.

The source of infection with a dangerous infectious disease was the failure of three patients A, B and C to comply with the isolation regime. The following was established:

1) if A is not guilty of infection or B is guilty, then C is guilty;
2) if A is not guilty, then C is not guilty of infection.

Question: Is it possible to establish guilt for each of the three infected patients A, B and C?

Example No. 2.

As a result of the examination, the patient was found to have the following symptoms:
S_2 - abdominal pain,
S_4 - leukocytosis,
S_9 - ECG change,
S_{10} - pale skin,
S_{11} - increased heart rate,
S_{13} - depression of reflexes,
S_{14} - abdominal wall tension,
S_{15} - bloating
Based on the established symptom complex, calculate the probabilities of four possible diseases:
$P(D_1 / S_{ci})$ - myocardial infarction,
$P(D_2 / S_{ci})$ - peritonitis,
$P(D3 / Sci)$ - lobar pneumonia ,
$P(D_4 / S_{ci})$ - pulmonary embolism.
Draw a conclusion about the most likely pathology.
When solving the given problem, use a ready-made diagnostic table of conditional probabilities.

Example No. 3.

Creation of a prototype of an expert system (ES) based on artificial intelligence technology**.**

The subject area of the ES is «Vehicles», which includes the following objects that form the dictionary of this subject area:

1. Airplane.
2. Helicopter.
3. Boat.
4. Tanker.
5. Truck.
6. Taxi.

The specified objects can have the following properties:

1. Has wheels.
2. Has a screw.
3. Has wings.
4. Carries cargo.

Taking into account the specified information, the composition of the ES knowledge base can be presented as follows (table No. 1) :

Table No. 1.

Composition of the ES knowledge base

Object No.	**Objects**	**Properties of objects**			
		1	2	3	4
		Wheels	Screw	Wings	Carries cargo
1	Airplane	+	+	+	+
2	Helicopter	+	+	-	+
3	Boat	-	+	-	+
4	Tanker	-	+	-	+
5	Truck	+	-	-	+
6	Taxi	+	-	-	-

where: “+” – the object has the specified property;

"-" – the object does not have the specified property.

Task: it is necessary to create a prototype of an ES for solving a recognition problem. When solving such a problem, the user's request may consist of determining the name of an object that is in the

ES knowledge base and has,for example, such properties: has wheels; does not have a propeller; carries loads .

recognition problem is solved in dialog mode:The ES will ask questions that the user must answer. The questions and answers to them in this case will be as follows:

1."Does the object have wheels?" " Yes. "

2."Does the object have a screw?" " No. "

3." Does the object carry cargo?" " Yes. "

Results of solving the recognition problem, the ES selects the required objects according to the user's answers (table No. 2):

Table No. 2.

Solving the recognition problem

Questionnaire		**ES Questions**		
		1)The object has wheels?	2) Does the object have a screw?	3)Object carries cargo?
Item No.	Object	**User's answers**		
		Yes	**No**	**Yes**
1	Airplane	×	-	-
2	Helicopter	×	-	-
3	Cutter	-	-	-
4	Tanker	-	-	-
5	Truck	×	×	×
6	Taxi	×	×	-

It should be noted that objects that do not have the desired property (i.e. that received the "-" sign at some step) are further excluded from consideration, since they are not the desired objects. Taking into account the specified answers from Table No. 2, the solution to the ES problem follows: " The desired object is "Truck".

Task: select a subject area option (SA) from table No. 3 (the student can suggest his own subject area option).

Table No. 3

List of subject areas (task options)

Task number	Subject region	Objects (knowledge base dictionary)	Approximate properties of objects (knowledge of objects)	Approximate user request (ES task)
1	Junior medical staff (nurses)	Surnames employees	Age, abilities, number of absences, etc.	Which employees should be awarded?
2	Departments of the hospital	Names departments	Treatment profile, availability of intensive care units, 24-hour stay or day hospital, etc.	What department is the patient in?
3	Medical staff of surgical departments of the city of Astrakhan	Surnames workers	Age, qualifications, number of absences, number of awards, etc.	Which department should I go to for surgical care?
4	Pharmacy	Painkillers	Cost, contraindications, side effects, etc.	Which drug should I choose?
5	Diagnostics diseases	Scroll diseases	Signs of diseases	Identify the disease

6	Medicines	Scroll drugs	Price, scarcity, quality, company, etc.	Determine the required drug
7	Directory	Universities	Daytime, evening, pay, options, etc.	Where to go to study

1. Make a list of objects (dictionary) of the subject area (10-15 names).
2. Determine the properties (features) of objects(5-7 items).
3. Establish the composition of the knowledge base.
4. Formulate a requestuser (recognition task) with the aim of identifying the desired object by someits specified properties (3-4 names).
5. Develop a questionnaire (relevant questions)to implement a dialogue between the user and the ES.
6. Develop a flow chart (step-by-step description)of the solution algorithmES tasks.

4.3. List of practical skills that a student should have after mastering the discipline.

- search for specialized information using software;
- to master methods for constructing models of knowledge representation in medicine and healthcare;
- to master methods of obtaining medical knowledge, ways of structuring information to build a knowledge base of an intelligent system;
- predict and interpret research results;
- solve typical practical problems;
- solve situational problems based on theoretical knowledge;
- work with databases and spreadsheets to improve medical practice;
- carry out text and graphic processing of documents using standard computer software;
- use a computer to perform statistical processing of available data.

4.4.List of questions for the test

1. Introduction to Artificial Intelligence. Definition, classification.
2. Stages of development of artificial intelligence systems.
3. Main directions of research development in the field of artificial intelligence systems.
4. The structure of artificial intelligence systems.
5. Architecture of artificial intelligence systems.
6. Methodology for constructing artificial intelligence systems.
7. Developing efficient methods for sorting, processing and presenting knowledge in a knowledge base.
8. Knowledge representation models: semantic, frame, production.
9. Neural networks**.** Concept and types.
10. Neural transmission.
11. Synaptic connections.
12. Artificial neuron. Comparative characteristics.
13. Artificial neural network.
14. Pattern recognition and classification. Forecasting.
15. Principles of constructing neural networks.
16. Architecture of neural networks.
17. Types of neural networks.
18. Training a neural network.
19. Rules for training a neural network.
20. Deep learning and its methods.
21. Computer vision.
22. What is a neurosimulator and what is it used for?
23. What problems can artificial neural networks solve?
24. Under what conditions can neural networks be used?
25. What processes occur in a neural network during its training?
26. How are synaptic connection strengths set before the network is trained?
27. What methods of training perceptrons are known?
28. Can we say that the intelligence of the Neurosimulator program is stronger than the intelligence of a child learning the multiplication table?
29. Is it always possible to select and train a perceptron that can solve any problem?
30. What is the best way to specify the number of internal neural layers and the number of neurons in them?
31. What is a function in Python?
32. What are local and global variables in Python?
33. What data types are supported in Python?
34. What are indices?
35. What Python function is used to get the length of a list?
36. Machine learning. Basic concepts.
37. What is the basic idea of machine learning?
38. How many main types of machine learning are there?
39. In what type of machine learning does an algorithm receive unlabeled data?
40. What application of machine learning is not mentioned in the text?
41. Which machine learning library is recommended for use with Python programming language?
42. What problem does the project presented in the presentation solve?
43. What is the name of the method used in the project to train the neural network model?
44. What is the difference between artificial learning and machine learning?
45. What is a classifier in machine learning?
46. How does a regression problem differ from a classification problem?
47. How is supervised learning different from unsupervised learning?

48. What is the difference between model parameters and hyperparameters?
49. What is cross validation used for?
50. What are its advantages and disadvantages compared to using a separate validation set?