

**MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN FEDERATION
FEDERAL STATE AUTONOMOUS EDUCATIONAL INSTITUTION OF HIGHER EDUCATION
NORTH CAUCASIAN FEDERAL UNIVERSITY**

Guidelines for completing practical work on the subject
Artificial intelligence technology / Технология искусственного интеллекта
Direction of training
02.04.01 - Mathematics and Computer Science

Stavropol, 2026

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Preface

The course " Artificial intelligence technology / Технология искусственного интеллекта " in the Master's program 02.04.01 "Mathematics and Computer Science" is designed to help each student acquire a set of general professional digital competencies in the field of studying the capabilities of modern artificial intelligence systems.

Reporting forms: credit in the 2nd semester

Implemented competencies:

OPK-1. Capable of identifying, formulating, and solving current and significant problems in applied and computer mathematics.

PC-7. Able to create and explore new mathematical models in the natural sciences, industry, and business, taking into account the capabilities of modern information technology, programming, and computer equipment.

Course completion results.

The student will study the concept of an intelligent system, the history of the development of artificial intelligence, knowledge representation in artificial intelligence systems, production models of knowledge representation, semantic networks, frames, logical systems, levels of knowledge representation about a subject area, the role of concepts and relationships in the description of a subject area, logical formulas of concepts, the concept of a concept, the extension and intension of a concept.

Students will be able to solve practical problems in fundamental and applied mathematics, conduct critical analysis of problematic situations based on a systems approach, develop action strategies, and manage information using digital tools and data processing algorithms to solve professional problems.

Recommended software:

1. Operating system (Windows 7.0 or later or Linux Mint 19.3 or later)
2. Python programming language version not lower than 3.6
3. PyCharm Community Edition (development and debugging environment, version 2020 or later)
4. Word processor for report design (Open / LibreOffice .org)
5. Python programming language (version 3.8 or higher) with the Jupiter shell and NumPy and TensorFlow libraries

Recommended logistics:

A lecture hall with a white screen projection system connected to a computer and configured to play PDF presentation files . For practical work, a computer lab (laboratory, classroom) with a number of functioning computers with sufficient performance for the course, corresponding to the number of students in the group, plus a teacher workstation, is required. All computers in the classroom (laboratory, classroom) must have the software recommended by the course program installed and configured, and internet access (with a speed sufficient for comfortable work) is required to access online resources for the course.

Practical work No. 1

Topic: " The concept of an intelligent system "

Objective: "To study the history of the emergence of artificial intelligence systems and to determine a project option for further development ."

Knowledge, skills and competencies acquired by the student as a result of mastering the topic, within the framework of the developed competencies (OPK-1, PC-7)

Know:

1. Creation of the first computers and neurocomputers
2. Perceptrons
3. Heuristic programming
4. Logical systems of artificial intelligence
5. Semantic networks
6. Frame model of knowledge representation
7. Multilayer artificial neural networks
8. Neocognitron
9. The Turing Test
10. Deep learning of artificial neural networks
11. Big data technology
12. Computer vision
13. Natural Language Processing
14. Speech recognition and synthesis
15. Intelligent decision support
16. Promising methods of artificial intelligence

Be able to: find information on the global Internet or other information sources regarding promising projects of systems based on artificial intelligence technologies.

Possess: the ability to search, analyze and systematize material regarding promising projects of systems based on artificial intelligence technologies.

Theoretical part:

see the list of recommended literature

Equipment and materials: see Appendix 1 of the guidelines for performing the LR .

Safety precautions: see Appendix 2 of the guidelines for performing LR.

Tasks

1. Analyze the list and select an option for an artificial intelligence system model .
2. Using the global information network "Internet" find similar projects.
3. List the technologies used by the authors of similar projects (not necessarily related to artificial intelligence).
4. Write in the report your vision for the development of the project using artificial intelligence technologies (computer vision, natural language processing, speech recognition and synthesis, intelligent decision support).

Options:

1. Project based on artificial intelligence technology "Electronic calculator".
2. Project based on artificial intelligence technology "Electronic notebook".
3. Project based on artificial intelligence technology "Clock".
4. Project based on artificial intelligence technology "Car".
5. Project based on artificial intelligence technology "Airplane".
6. Project based on artificial intelligence technology "Helicopter".
7. Project based on artificial intelligence technology "Ship".

8. Project based on artificial intelligence technology "Smart Home".
9. Project based on artificial intelligence technology "Elevator".
10. Project based on artificial intelligence technology "TV".
11. Project based on artificial intelligence technology "Cell phone".
12. Project based on artificial intelligence technology "Music center (technical device)".
13. Project based on artificial intelligence technology "Washing machine".
14. Project based on artificial intelligence technology "Microwave oven".
15. Project based on artificial intelligence technology "Food processor".
16. Project based on artificial intelligence technology "Dishwasher".
17. Project based on artificial intelligence technology "Kitchen electric stove".
18. Project based on artificial intelligence technology "Lathe".
19. Project based on artificial intelligence technology "Drilling machine".
20. Project based on artificial intelligence technology "Milling machine".
21. Project based on artificial intelligence technology "Management of a simple terrestrial ecosystem".
22. Project based on artificial intelligence technology "Management of a simple aquatic ecosystem".
23. Project based on artificial intelligence technology "Cat (animal)".
24. Project based on artificial intelligence technology "Dog (animal)".
25. Project based on artificial intelligence technology "Hamster (animal)".
26. Project based on artificial intelligence technology "Shark (animal)".
27. Project based on artificial intelligence technology "Crow (animal)".
28. Project based on artificial intelligence technology "Neurocomputer".
29. Project based on artificial intelligence technology "Navigation satellite".
30. Project based on artificial intelligence technology "Nuclear Reactor".

Contents of the report

Practical work is considered completed by the student and is credited by the teacher (with points awarded proportionally to the completed report points, i.e., the report does not necessarily have to contain all the points) upon submission of a neatly formatted report file in . pdf (presentation), . odt (OpenOffice , LibreOffice) or . doc (MicrosoftOffice) format, named according to the template, in electronic form for defense (a paper printout is not required!!!), named according to the template (if the work does not comply, it will not be allowed to be defended):

AI_ LR 1_ V(variant number)_(last name).pdf

The report file must contain the following presentation slides or text report document items in the specified order (with their numbers retained if some items are omitted):

1. Title page containing the name of the discipline, topic and number of the laboratory work, full name of the student, year, group.

The student determines the form and design of the title page independently, focusing on the ease of perception of the information on the title page.

2. A mark on familiarization with safety precautions (rules of conduct in the computer lab (auditorium, laboratory)).

This section must include the entry "I have read and agree to comply with the safety regulations for performing laboratory work and behavior in the computer lab (classroom, laboratory) _____ (full name), _____ date."

3. Statement of the problem (full conditions in accordance with the selected option).

4. Abstract review of information (Internet) sources according to the assignment.

4.1. Creation of the first computers and neurocomputers

4.2 Perceptrons

4.3 Heuristic programming

4.4. Logical systems of artificial intelligence

- 4.5. Semantic networks
- 4.6. Frame model of knowledge representation
- 4.7. Multilayer artificial neural networks
- 4.8. Neocognitron
- 4.9. The Turing Test
- 4.10. Deep learning of artificial neural networks
- 4.11. Big Data Technology
- 4.12. Computer vision
- 4.13. Natural Language Processing
- 4.14. Speech recognition and synthesis
- 4.15. Intelligent decision support
- 4.16. Promising methods of artificial intelligence

It is necessary to list the information sources and their contents in order according to the assignment. Text, hyperlinks, tables, figures, and any other information that facilitates viewing and protection of the presentation report are permitted. Only open public sources of information that do not require copyright transfer or any other royalties are permitted. If information for any section is not publicly available or is classified, then print "information classified" and indicate the agency or organization that classified it. The recommended length of the abstract is 3-10 pages (5-10 slides).

5. A list of similar projects found online or in other information sources, indicating the authors, source, and main features of the projects (briefly). The recommended length is three similar projects, totaling 1-3 report pages (or 1-3 presentation slides).

6. Technologies used by authors of similar projects (briefly) (not necessarily related to artificial intelligence). Recommended length : 1-3 report pages (or 1-3 presentation slides).

7. Write a vision for the project's development using artificial intelligence technologies (computer vision, natural language processing, speech recognition and synthesis, intelligent decision support). The recommended length is 1-3 pages of the report (or 1-3 presentation slides).

8. An optional report item for receiving higher grades. Public defense of the lab report.

In this section, please provide a link to a YouTube video or other public video resource where the student personally defends their report or presents their lab work. The recommended video length is 5-10 minutes.

Security questions

1. Creation of the first computers and neurocomputers
2. Perceptrons
3. Heuristic programming
4. Logical systems of artificial intelligence
5. Semantic networks
6. Frame model of knowledge representation
7. Multilayer artificial neural networks
8. Neocognitron
9. The Turing Test
10. Deep learning of artificial neural networks
11. Big data technology
12. Computer vision
13. Natural Language Processing
14. Speech recognition and synthesis
15. Intelligent decision support
16. Promising methods of artificial intelligence

A list of recommended literature on this topic

Main literature:

1. Sergeev, N. E. Artificial Intelligence Systems: a tutorial / N. E. Sergeev; Ministry of Education and Science of the Russian Federation; Southern Federal University; Engineering and Technological Academy, 1. - Taganrog: Publishing House of Southern Federal University, 2016. - 123 p.: diagrams, ill., tables. - <http://biblioclub.ru/>. - Bibliography in the book. - ISBN 978-5-9275-2113-5, unlimited copies

2. Tolmachev, S. G. Fundamentals of Artificial Intelligence. Electronic resource / Tolmachev S. G.: study guide. - St. Petersburg: BSTU "Voenmekh" named after D. F. Ustinov, 2017. - 132 p. - ISBN 978-5-906920-53-9, unlimited copies

Further reading:

1. Artificial Intelligence. - In 3 books. Book 1. Communication Systems and Expert Systems: Handbook / edited by D.A. Pospelov - Moscow: Radio and Communications, 1990.

2. Artificial Intelligence. - In 3 books. Book 2. Models and Methods: Handbook / edited by D.A. Pospelov - Moscow: Radio and Communications, 1990.

3. Artificial intelligence. - In 3 books. Book 3 Software and hardware: Handbook / edited by D.A. Pospelov - M.: Radio and communication, 1990.

4. Ostroukh, A. V.; Artificial Intelligence Systems Electronic resource / Ostroukh A. V., Surkova N. E.: monograph. - St. Petersburg: Lan, 2019. - 228 p. - ISBN 978-5-8114-3427-5, unlimited copies .

Resources of the information and telecommunications network "Internet" necessary for mastering the discipline

1. Design of artificial intelligence systems [electronic resource] // <https://intuit.ru/studies/courses/1122/167/info>

Practical work #2

Topic: " Knowledge Representation Models "

Objective: "To study the main models of knowledge representation in a subject area and determine the possibility of using these technologies in the project of our own artificial intelligence system "

Knowledge, skills and competencies acquired by the student as a result of mastering the topic, within the framework of the developed competencies (OPK-1, PC-7)

Know:

1. Detection and identification of objects in a complex environment
2. Pattern recognition taking into account context and signals from multiple sources
3. Combination of different types of algorithms within computer vision systems
4. Pattern recognition with "first-time" learning
5. High-speed identification of a large number of objects in various parts of the electromagnetic spectrum
6. Autonomous semantic segmentation, classification and identification of objects
7. Psychographic and emotional analysis of human and animal behavior based on video analytics systems
8. Event analysis using video analytics systems
9. Generation of images and videos, including photorealistic ones
10. Analysis of information about remote objects using active optical systems
11. Classification and clustering of individual statements, short and long texts
12. Search and classification of different types of entities in the text
13. Extracting facts from texts and systematizing them
14. Machine translation
15. Tasks of Dialogue Intelligence
16. Tasks of intelligent information retrieval
17. Identifying semantic errors in the text
18. Grouping information and constructing flowcharts based on text data
19. Recognizing various literary devices and styles
20. Dynamic meaning recognition
21. Creating multitasking conversational assistants
22. Verification of speech authenticity
23. Sound and speech recognition in complex environments
24. Recognition of complex semantic constructions and slang in speech
25. Creation of means for controlling emotions and semantic constructions in synthesized speech
26. Speech synthesis in a foreign language
27. Recognition of anthropological features based on speech
28. Classification and identification of the relative positions of sound sources
29. Recognition of emotional nuances and sub-emotions of speech
30. Predictive and prescriptive analysis
31. Assessing the quality of machine learning models without testing in a real environment
32. Preparing decisions based on open data sources and unstructured information
33. Intelligent simulation modeling of the behavior of participants in the market of goods, works and services
34. Management and/or training of personnel and development of personalized career or educational trajectories
35. Providing decision support based on long-term data
36. Control of equipment and production systems based on data from measuring systems and historical data
37. Predictive equipment maintenance based on mathematical modeling methods
38. Forecast of the quality of manufactured products
39. Visualization of production processes

40. Control and reduction of harmful emissions and environmental pollution
41. Personnel management, monitoring of productivity, psychophysical condition and searching for opportunities to optimize personnel workload.

Be able to: find information on the Internet or other information sources regarding technologies used in modern artificial intelligence systems for implementation in your own artificial intelligence system project.

Possess: the ability to search, analyze and systematize material regarding promising projects of systems based on artificial intelligence technologies.

Theoretical part:

see the list of recommended literature

Equipment and materials: see Appendix 1 of the guidelines for performing the LR .

Safety precautions: see Appendix 2 of the guidelines for performing LR.

Tasks

Continue working on the artificial intelligence system option selected in Lab 1 .

1. Determine the possibility of using computer vision systems in an individual project.
2. Determine the feasibility of using natural language processing systems, in an individual project.
3. Determine the possibility of using speech recognition and synthesis systems in an individual project.
4. Determine the possibility of using intelligent decision support systems in an individual project.
6. Determine the technical limitations of the artificial intelligence system being developed.
7. Determine the social limitations of the developed artificial intelligence system.
8. Determine the moral and ethical limitations of the artificial intelligence system being developed.
9. Determine the legal limitations of the artificial intelligence system being developed.

Contents of the report

Practical work is considered completed by the student and is credited by the teacher (with points awarded proportionally to the completed report points , i.e., the report does not necessarily have to contain all the points) upon submission of a neatly formatted report file in . pdf (presentation), . odt (OpenOffice , LibreOffice) or . doc (MicrosoftOffice) format, named according to the template, in electronic form for defense (a paper printout is not required!!!), named according to the template (if the work does not comply, it will not be allowed to be defended):

AI_ LR 2_ V(variant number)_(last name).pdf

The report file must contain the following presentation slides or text report document items in the specified order (with their numbers retained if some items are omitted):

1. Title page containing the name of the discipline, topic and number of the laboratory work, full name of the student, year, group.

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2. A mark on familiarization with safety precautions (rules of conduct in the computer lab (auditorium, laboratory)).

This section must include the entry “I have read and agree to comply with the safety regulations for performing laboratory work and behavior in the computer lab (classroom, laboratory) _____ (full name), _____ date.”

3. Statement of the problem (full conditions in accordance with the selected option).
4. Abstract review of information (Internet) sources according to the assignment.
 - 4.1. Detection and identification of objects in a complex environment
 - 4.2. Context-aware pattern recognition with signals from multiple sources
 - 4.3. Combination of different types of algorithms within computer vision systems
 - 4.4. Pattern recognition with first-time learning
 - 4.5. High-speed identification of a large number of objects in various parts of the electromagnetic spectrum
 - 4.6. Autonomous semantic segmentation, classification and identification of objects
 - 4.7. Psychographic and emotional analysis of human and animal behavior based on video analytics systems
 - 4.8. Event analysis using video analytics systems
 - 4.9. Generation of images and videos, including photorealistic ones
 - 4.10. Analysis of information about remote objects using active optical systems
 - 4.11. Classification and clustering of individual statements, short and long texts
 - 4.12. Search and classification of different types of entities in the text
 - 4.13. Extracting facts from texts and systematizing them
 - 4.14. Machine translation
 - 4.15. Tasks of Dialogue Intelligence
 - 4.16. Tasks of intelligent information retrieval
 - 4.17. Identifying semantic errors in the text
 - 4.18. Grouping information and constructing flowcharts based on text data
 - 4.19. Recognizing various literary devices and styles
 - 4.20. Dynamic meaning recognition
 - 4.21. Creating multitasking conversational assistants
 - 4.22. Speech Authentication
 - 4.23. Sound and speech recognition in complex conditions
 - 4.24. Recognition of complex semantic constructions and slang in speech
 - 4.25. Creation of means for controlling emotions and semantic constructions in synthesized speech
 - 4.26. Speech synthesis in a foreign language
 - 4.27. Recognition of anthropological features based on speech
 - 4.28. Classification and identification of the relative positions of sound sources
 - 4.29. Recognition of emotional nuances and sub-emotions of speech
 - 4.30. Predictive and prescriptive analysis
 - 4.31. Assessing the quality of machine learning models without testing in a real environment
 - 4.32. Preparing decisions based on open data sources and unstructured information
 - 4.33. Intelligent simulation modeling of the behavior of participants in the market of goods, works and services
 - 4.34. Management and/or training of personnel and development of personalized career or educational trajectories
 - 4.35. Providing decision support based on long-term data
 - 4.36. Control of equipment and production systems based on data from measuring systems and historical data
 - 4.37. Predictive equipment maintenance based on mathematical modeling methods
 - 4.38. Forecast of the quality of manufactured products
 - 4.39. Visualization of production processes
 - 4.40. Control and reduction of harmful emissions and environmental pollution
 - 4.41. Personnel management, monitoring of productivity, psychophysical condition and searching for opportunities to optimize personnel workload.

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5. Describe the feasibility of using computer vision systems in an individual project. Recommended length: 1-3 report pages (or 1-3 presentation slides).

6. Describe the possibility of using natural language processing systems, in an individual project. The recommended length is 1-3 report pages in total (or 1-3 presentation slides).

7. Describe the possibility of using speech recognition and synthesis systems in an individual project. The recommended volume is 1-3 report pages (or 1-3 presentation slides).

intelligent decision support systems . Recommended length : 1-3 report pages (or 1-3 presentation slides).

9. An optional report item for receiving higher scores. Public defense of the laboratory report.

In this section, please provide a link to a YouTube video or other public video resource where the student personally defends their report or presents their lab work. The recommended video length is 5-10 minutes.

Security questions

1. Detection and identification of objects in a complex environment
2. Pattern recognition taking into account context and signals from multiple sources
3. Combination of different types of algorithms within computer vision systems
4. Pattern recognition with first-time learning
5. High-speed identification of a large number of objects in various parts of the electromagnetic spectrum
6. Autonomous semantic segmentation, classification and identification of objects
7. Psychographic and emotional analysis of human and animal behavior based on video analytics systems
8. Event analysis using video analytics systems
9. Generation of images and videos, including photorealistic ones
10. Analysis of information about remote objects using active optical systems
11. Classification and clustering of individual statements, short and long texts
12. Search and classification of different types of entities in the text
13. Extracting facts from texts and systematizing them
14. Machine translation
15. Tasks of Dialogue Intelligence
16. Tasks of intelligent information retrieval
17. Identifying semantic errors in the text
18. Grouping information and constructing flowcharts based on text data
19. Recognizing various literary devices and styles
20. Dynamic meaning recognition
21. Creating multitasking conversational assistants
22. Verification of speech authenticity
23. Sound and speech recognition in complex environments
24. Recognition of complex semantic constructions and slang in speech
25. Creation of means for controlling emotions and semantic constructions in synthesized speech
26. Speech synthesis in a foreign language
27. Recognition of anthropological features based on speech
28. Classification and identification of the relative positions of sound sources
29. Recognition of emotional nuances and sub-emotions of speech
30. Predictive and prescriptive analysis

31. Assessing the quality of machine learning models without testing in a real environment
32. Preparing decisions based on open data sources and unstructured information
33. Intelligent simulation modeling of the behavior of participants in the market of goods, works and services
34. Management and/or training of personnel and development of personalized career or educational trajectories
35. Providing decision support based on long-term data
36. Control of equipment and production systems based on data from measuring systems and historical data
37. Predictive equipment maintenance based on mathematical modeling methods
38. Forecast of the quality of manufactured products
39. Visualization of production processes
40. Control and reduction of harmful emissions and environmental pollution
41. Personnel management, monitoring of productivity, psychophysical condition and searching for opportunities to optimize personnel workload.

A list of recommended literature on this topic

Main literature:

1. Sergeev, N. E. Artificial Intelligence Systems: a tutorial / N. E. Sergeev; Ministry of Education and Science of the Russian Federation; Southern Federal University; Engineering and Technological Academy, 1. - Taganrog: Publishing House of Southern Federal University, 2016. - 123 p.: diagrams, ill., tables. - <http://biblioclub.ru/>. - Bibliography in the book. - ISBN 978-5-9275-2113-5, unlimited copies
2. Tolmachev, S. G. Fundamentals of Artificial Intelligence. Electronic resource / Tolmachev S. G.: study guide. - St. Petersburg: BSTU "Voenmekh" named after D. F. Ustinov, 2017. - 132 p. - ISBN 978-5-906920-53-9, unlimited copies

Further reading:

1. Artificial Intelligence. - In 3 books. Book 1. Communication Systems and Expert Systems: Handbook / edited by D.A. Pospelov - Moscow: Radio and Communications, 1990.
2. Artificial Intelligence. - In 3 books. Book 2. Models and Methods: Handbook / edited by D.A. Pospelov - Moscow: Radio and Communications, 1990.
3. Artificial intelligence. - In 3 books. Book 3 Software and hardware: Handbook / edited by D.A. Pospelov - M.: Radio and communication, 1990.
4. Ostroukh, A. V.; Artificial Intelligence Systems Electronic resource / Ostroukh A. V., Surkova N. E.: monograph. - St. Petersburg: Lan, 2019. - 228 p. - ISBN 978-5-8114-3427-5, unlimited copies.

Resources of the information and telecommunications network "Internet" necessary for mastering the discipline

1. Design of artificial intelligence systems [electronic resource] // <https://intuit.ru/studies/courses/1122/167/info>

Practical work #3

Topic: " Artificial neural networks "

Objective: "To study the main types of artificial neural networks "

Knowledge, skills and competencies acquired by the student as a result of mastering the topic, within the framework of the developed competencies (OPK-1, PC-7)

Know:

1. Main types of artificial neural networks
2. The structure of a biological neuron
3. Models of artificial neurons
4. Rosenblatt's perceptron
5. General principles of training artificial neural networks
6. Multilayer neural networks
7. Training multilayer networks.
8. Counter-propagation neural networks
9. RBF networks
10. Associative memory systems
- Hopfield neural network
12. Hamming neural network
13. Bidirectional associative memory
14. Convolutional neural networks
15. Deep Machine Learning

Be able to: find information on the Internet or other information sources regarding the capabilities of artificial neural networks, their architecture and training methods for implementation in your own artificial intelligence system project.

Possess: the ability to search, analyze and systematize material regarding promising projects of systems based on artificial intelligence technologies.

Theoretical part:

see the list of recommended literature

Equipment and materials: see Appendix 1 of the guidelines for performing the LR .

Safety precautions: see Appendix 2 of the guidelines for performing LR.

Tasks

Continue working on the artificial intelligence system option selected in Lab 1 .

1. Determine the possibility and indicate the place of the Rosenblatt perceptron in the developed artificial intelligence system .
2. Determine the possibility of using and indicate the place of a multilayer neural network in the developed artificial intelligence system.
3. Determine the possibility of using and indicate the place in the developed artificial intelligence system of the RBF network.
4. Determine the possibility of using and indicate the place in the developed system of artificial associative memory subsystem.
5. Determine the possibility of using and indicate the place in the developed artificial neural network subsystem .

Contents of the report

Practical work is considered completed by the student and is credited by the teacher (with points awarded proportionally to the completed report points, i.e., the report does not necessarily have to contain all the points) upon submission of a neatly formatted report file in . pdf (presentation), . odt (OpenOffice , LibreOffice) or . doc (MicrosoftOffice) format, named according to the template, in electronic form for defense (a paper printout is not required!!!), named according to the template (if the work does not comply, it will not be allowed to be defended):

AI_ LR 3_ V(variant number)_(last name).pdf

The report file must contain the following presentation slides or text report document items in the specified order (with their numbers retained if some items are omitted):

1. Title page containing the name of the discipline, topic and number of the laboratory work, full name of the student, year, group.

The student determines the form and design of the title page independently, focusing on the ease of perception of the information on the title page.

2. A mark on familiarization with safety precautions (rules of conduct in the computer lab (auditorium, laboratory)).

This section must include the entry “I have read and agree to comply with the safety regulations for performing laboratory work and behavior in the computer lab (classroom, laboratory) _____ (full name), _____ date.”

3. Statement of the problem (full conditions in accordance with the selected option).

4. Abstract review of information (Internet) sources according to the assignment.

4.1. Main types of artificial neural networks

4.2. Structure of a biological neuron

4.3. Artificial Neuron Models

4.4 Rosenblatt's Perceptron

4. 5. General principles of training artificial neural networks

4. 6. Multilayer neural networks

4. 7. Training multilayer networks.

4. 8. Counter-propagation neural networks

4.9RBF networks

4.10. Associative memory systems

Hopfield neural network

4.12. Hamming neural network

4.13. Bidirectional associative memory

4.14. Convolutional neural networks

4.15. Deep Machine Learning

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5. Determine and write out a location for the Rosenblatt perceptron in the AI system being developed . The recommended length is 1-3 pages of the report (or 1-3 presentation slides).

6. Identify and outline the location for a multilayer neural network in the AI system being developed. The recommended length is 1-3 report pages (or 1-3 presentation slides).

7. Identify and outline the role of the counter-propagation neural network in the AI system being developed. The recommended length is 1-3 report pages (or 1-3 presentation slides).

8. Identify and write out a place for the RBF network in the developed artificial intelligence system . The recommended volume is 1-3 report pages (or 1-3 presentation slides).

9. Determine and specify the location for the associative memory subsystem in the AI system being developed. Recommended length : 1-3 report pages (or 1-3 presentation slides).

10. Determine and outline the location for the convolutional neural network in the AI system being developed . The recommended length is 1-3 report pages (or 1-3 presentation slides).

11. An optional report item for receiving higher grades. Public defense of the lab report.

In this section, please provide a link to a YouTube video or other public video resource where the student personally defends their report or presents their lab work. The recommended video length is 5-10 minutes.

Security questions

1. Main types of artificial neural networks
2. The structure of a biological neuron
3. Models of artificial neurons
4. Rosenblatt's perceptron
5. General principles of training artificial neural networks
6. Multilayer neural networks
7. Training multilayer networks.
8. Counter-propagation neural networks
9. RBF networks
10. Associative memory systems
- Hopfield neural network
12. Hamming neural network
13. Bidirectional associative memory
14. Convolutional neural networks
15. Deep Machine Learning

A list of recommended literature on this topic

Main literature:

1. Sergeev, N. E. Artificial Intelligence Systems: a tutorial / N. E. Sergeev; Ministry of Education and Science of the Russian Federation; Southern Federal University; Engineering and Technological Academy, 1. - Taganrog: Publishing House of Southern Federal University, 2016. - 123 p.: diagrams, ill., tables. - <http://biblioclub.ru/>. - Bibliography in the book. - ISBN 978-5-9275-2113-5, unlimited copies

2. Tolmachev , S. G. Fundamentals of Artificial Intelligence. Electronic resource / Tolmachev S. G.: study guide. - St. Petersburg: BSTU " Voenmekh " named after D. F. Ustinov, 2017. - 132 p. - ISBN 978-5-906920-53-9, unlimited copies

Further reading:

1. Artificial Intelligence. - In 3 books. Book 1. Communication Systems and Expert Systems: Handbook / edited by D.A. Pospelov - Moscow: Radio and Communications, 1990.

2. Artificial Intelligence. - In 3 books. Book 2. Models and Methods: Handbook / edited by D.A. Pospelov - Moscow: Radio and Communications, 1990.

3. Artificial intelligence. - In 3 books. Book 3 Software and hardware: Handbook / edited by D.A. Pospelov - M.: Radio and communication, 1990.

4. Ostroukh, A. V.; Artificial Intelligence Systems Electronic resource / Ostroukh A. V., Surkova N. E.: monograph. - St. Petersburg: Lan, 2019. - 228 p. - ISBN 978-5-8114-3427-5, unlimited copies .

Resources of the information and telecommunications network "Internet" necessary for mastering the discipline

1. Design of artificial intelligence systems [electronic resource] // [https :// intuit . ru /](https://intuit.ru/)

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Practical work #4

Topic: "Creation and training of artificial neural networks "

Objective: "To create and train artificial neural networks as part of the project "

Knowledge, skills and competencies acquired by the student as a result of mastering the topic, within the framework of the developed competencies (OPK-1, PC-7)

Know:

1. Main types of artificial neural networks
2. Training multilayer neural networks
3. Hebb's rule
4. Delta rule
5. Backpropagation algorithm
6. Training the counter-propagation network
7. Training RBF network
8. Training associative memory systems
9. Training a Hopfield neural network
10. Training the Hamming Neural Network
11. Training bidirectional associative memory
12. Training a convolutional neural network
13. Deep Machine Learning

To be able to: find information on the global Internet or other information sources regarding the capabilities of artificial neural networks, their architecture and training methods for implementation in one's own artificial intelligence system project, and create computer programs for the implementation of neural networks within the framework of the project being developed.

Possess: the ability to search, analyze and systematize material regarding promising projects of systems based on artificial intelligence technologies.

Theoretical part:

see the list of recommended literature

Equipment and materials: see Appendix 1 of the guidelines for performing the LR .

Safety precautions: see Appendix 2 of the guidelines for performing LR.

Tasks

Continue working on the artificial intelligence system option selected in Lab 1 .

1. Determine the possibility and indicate the place of the Rosenblatt perceptron in the developed artificial intelligence system .
2. Determine the possibility of using and indicate the place of a multilayer neural network in the developed artificial intelligence system.
3. Determine the possibility of using and indicate the place in the developed artificial intelligence system of the RBF network.
4. Determine the possibility of using and indicate the place in the developed system of artificial associative memory subsystem.
5. Determine the possibility of using and indicate the place in the developed artificial neural network subsystem .

Contents of the report

Practical work is considered completed by the student and is credited by the teacher (with points awarded proportionally to the completed report points , i.e., the report does not necessarily

have to contain all the points) upon submission of a neatly formatted report file in . pdf (presentation), . odt (OpenOffice , LibreOffice) or . doc (MicrosoftOffice) format, named according to the template, in electronic form for defense (a paper printout is not required!!!), named according to the template (if the work does not comply, it will not be allowed to be defended):

AI_ LR 4_ V(variant number)_(last name).pdf

The report file must contain the following presentation slides or text report document items in the specified order (with their numbers retained if some items are omitted):

1. Title page containing the name of the discipline, topic and number of the laboratory work, full name of the student, year, group.

The student determines the form and design of the title page independently, focusing on the ease of perception of the information on the title page.

2. A mark on familiarization with safety precautions (rules of conduct in the computer lab (auditorium, laboratory)).

This section must include the entry “I have read and agree to comply with the safety regulations for performing laboratory work and behavior in the computer lab (classroom, laboratory) _____ (full name), _____ date.”

3. Statement of the problem (full conditions in accordance with the selected option).

4. Abstract review of information (Internet) sources according to the assignment.

4.1. Main types of artificial neural networks

4.2. Training multilayer neural networks

4.3. Hebb's Rule

4.4. Delta rule

4.5. Backpropagation Algorithm

4.6. Training the Counter-Propagation Network

4.7. Training RBF network

4.8. Training associative memory systems

4.9. Training a Hopfield neural network

4.10. Training a Hamming Neural Network

4.11. Training bidirectional associative memory

4.12. Training a convolutional neural network

4.13. Deep Machine Learning

It is necessary to list the information sources and their contents in order according to the assignment. Text, hyperlinks, tables, figures, and any other information that facilitates viewing and protection of the presentation report are permitted. Only open public sources of information that do not require copyright transfer or any other royalties are permitted. If information for any section is not publicly available or is classified, then print "information classified" and indicate the agency or organization that classified it. The recommended length of the abstract review is 5-10 pages (10-20 slides).

5. Create a computer program implementing the Rosenblatt perceptron . The recommended length is 1-3 pages of report (or 1-3 presentation slides).

6. Create a computer program for implementing a multilayer neural network. The recommended length is 1-3 report pages (or 1-3 presentation slides).

7. Create a computer program for implementing a counter-propagation neural network. The recommended length is 1-3 report pages (or 1-3 presentation slides).

8. Create a computer program for implementing an RBF network . The recommended size is 1-3 report pages (or 1-3 presentation slides).

9. Create a computer program to implement associative memory. Recommended length : 1-3 report pages (or 1-3 presentation slides).

10. Create a computer program for implementing a convolutional neural network. Recommended length : 1-3 report pages (or 1-3 presentation slides).

11. Create a shell program to manage information flows between the programs created in steps 5-10 of the lab. Recommended length : 1-3 report pages (or 1-3 presentation slides).

12. An optional report item for receiving higher grades. Public defense of the lab report.

In this section, please provide a link to a YouTube video or other public video resource where the student personally defends their report or presents their lab work. The recommended video length is 5-10 minutes.

Security questions

1. Main types of artificial neural networks
2. Training multilayer neural networks
3. Hebb's rule
4. Delta rule
5. Backpropagation algorithm
6. Training the counter-propagation network
7. Training RBF network
8. Training associative memory systems
9. Training a Hopfield neural network
10. Training the Hamming Neural Network
11. Training bidirectional associative memory
12. Training a convolutional neural network
13. Deep Machine Learning

A list of recommended literature on this topic

Main literature:

1. Sergeev, N. E. Artificial Intelligence Systems: a tutorial / N. E. Sergeev; Ministry of Education and Science of the Russian Federation; Southern Federal University; Engineering and Technological Academy, 1. - Taganrog: Publishing House of Southern Federal University, 2016. - 123 p.: diagrams, ill., tables. - <http://biblioclub.ru/>. - Bibliography in the book. - ISBN 978-5-9275-2113-5, unlimited copies

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4. Ostroukh, A. V.; Artificial Intelligence Systems Electronic resource / Ostroukh A. V., Surkova N. E.: monograph. - St. Petersburg: Lan, 2019. - 228 p. - ISBN 978-5-8114-3427-5, unlimited copies.

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1. Design of artificial intelligence systems [electronic resource] // <https://intuit.ru/studies/courses/1122/167/info>

Practical work #5

Topic: " Creating an artificial intelligence expert system "

Objective: "To study the main capabilities and technical, social and moral-ethical limitations of artificial intelligence systems, to determine the capabilities and limitations in the design of our own artificial intelligence system "

Knowledge, skills and competencies acquired by the student as a result of mastering the topic, within the framework of the developed competencies (OPK-1, PC-7)

Know:

1. Limitations of computer vision systems
2. Limitations of natural language processing systems
3. Limitations of speech recognition and synthesis systems
4. Limitations of intelligent decision support systems
5. Social limitations of artificial intelligence systems
6. Moral and ethical limitations of artificial intelligence systems
7. Legal aspects of the use of artificial intelligence systems.
8. "Three Laws of Robotics"
9. Development of methods towards the creation of universal (strong) artificial intelligence
10. Using quantum computers to speed up the solution of artificial intelligence problems
11. Development of quantum machine learning algorithms, libraries and tools for implementing practical tasks
12. Synthesis (generation) of three-dimensional, two-dimensional images and video objects
13. Using artificial intelligence to design complex objects (systems, robots, algorithms)
14. Automation of neural network training
15. Learning by doing or by analogy
16. Interpretable models of artificial intelligence and methods for generating rationales for automatically made decisions
17. Processing highly noisy signals
18. Restoring lost information on machine-readable storage media

Be able to: find information on the global Internet or other information sources regarding the capabilities of artificial intelligence systems and their natural limitations for implementing an artificial intelligence system in your own project.

Possess: the ability to search, analyze and systematize material regarding promising projects of systems based on artificial intelligence technologies.

Theoretical part:

see the list of recommended literature

Equipment and materials: see Appendix 1 of the guidelines for performing the LR .

Safety precautions: see Appendix 2 of the guidelines for performing LR.

Tasks

Continue working on the artificial intelligence system option selected in Lab 1 .

1. Determine the feasibility of using the developed artificial intelligence system in machine vision systems. Provide an example.
2. Determine the feasibility of using the developed artificial intelligence system in logical inference systems. Provide an example.

3. Determine the feasibility of using the developed artificial intelligence system in forecasting systems. Provide an example.
4. Determine the feasibility of using the developed artificial intelligence system in control systems. Provide an example.

Contents of the report

Practical work is considered completed by the student and is credited by the teacher (with points awarded proportionally to the completed report points, i.e., the report does not necessarily have to contain all the points) upon submission of a neatly formatted report file in . pdf (presentation), . odt (OpenOffice , LibreOffice) or . doc (MicrosoftOffice) format, named according to the template, in electronic form for defense (a paper printout is not required!!!), named according to the template (if the work does not comply, it will not be allowed to be defended):

AI_ LR 5_ V(variant number)_(last name).pdf

The report file must contain the following presentation slides or text report document items in the specified order (with their numbers retained if some items are omitted):

1. Title page containing the name of the discipline, topic and number of the laboratory work, full name of the student, year, group.

The student determines the form and design of the title page independently, focusing on the ease of perception of the information on the title page.

2. A mark on familiarization with safety precautions (rules of conduct in the computer lab (auditorium, laboratory)).

This section must include the entry “I have read and agree to comply with the safety regulations for performing laboratory work and behavior in the computer lab (classroom, laboratory) _____ (full name), _____ date.”

3. Statement of the problem (full conditions in accordance with the selected option).
4. Abstract review of information (Internet) sources according to the assignment.
 - 4.1 Limitations of computer vision systems
 - 4.2 Limitations of Natural Language Processing Systems
 - 4.3. Limitations of speech recognition and synthesis systems
 - 4.4. Limitations of intelligent decision support systems
 - 4.5. Social limitations of artificial intelligence systems
 - 4.6. Moral and ethical limitations of artificial intelligence systems
 - 4.7. Legal aspects of the use of artificial intelligence systems.
 - 4.8. "Three Laws of Robotics"
 - 4.9. Development of methods towards the creation of universal (strong) artificial intelligence
 - 4.10. Using quantum computers to accelerate the solution of artificial intelligence problems
 - 4.11. Development of quantum machine learning algorithms, libraries and tools for implementing practical tasks
 - 4.12. Synthesis (generation) of three-dimensional, two-dimensional images and video objects
 - 4.13. Using artificial intelligence to design complex objects (systems, robots, algorithms)
 - 4.14. Automation of neural network training
 - 4.15. Learning by doing or by analogy
 - 4.16. Interpretable models of artificial intelligence and methods for generating rationales for automatically made decisions
 - 4.17. Processing highly noisy signals
 - 4.18. Restoring lost information on machine-readable storage media

It is necessary to list the information sources and their contents in order according to the assignment. Text, hyperlinks, tables, figures, and any other information that facilitates viewing and protection of the presentation report are permitted. Only open public sources of information that do not require copyright transfer or any other royalties are permitted. If information for any section is not publicly available or is classified, then print "information classified" and indicate the agency or organization that classified it. The recommended length of the abstract review is 5-10 pages (10-20 slides).

5. Identify and outline the technical limitations of the artificial intelligence system being developed. The recommended length is 1-3 report pages (or 1-3 presentation slides).

6. Identify and outline the social constraints of the artificial intelligence system being developed. The recommended length is 1-3 report pages (or 1-3 presentation slides).

7. Identify and write down the moral and ethical limitations of the artificial intelligence system being developed. The recommended volume is 1-3 pages of the report (or 1-3 presentation slides).

8. Identify and write out the legal limitations of the artificial intelligence system being developed. The recommended volume is 1-3 pages of the report (or 1-3 presentation slides).

9. An optional report item for receiving higher grades. Public defense of the laboratory report.

In this section, please provide a link to a YouTube video or other public video resource where the student personally defends their report or presents their lab work. The recommended video length is 5-10 minutes.

Security questions

1. Limitations of computer vision systems
2. Limitations of natural language processing systems
3. Limitations of speech recognition and synthesis systems
4. Limitations of intelligent decision support systems
5. Social limitations of artificial intelligence systems
6. Moral and ethical limitations of artificial intelligence systems
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A list of recommended literature on this topic

Main literature:

1. Sergeev, N. E. Artificial Intelligence Systems: a tutorial / N. E. Sergeev; Ministry of Education and Science of the Russian Federation; Southern Federal University; Engineering and Technological Academy, 1. - Taganrog: Publishing House of Southern Federal University, 2016.

- 123 p.: diagrams, ill., tables. - <http://biblioclub.ru/>. - Bibliography in the book. - ISBN 978-5-9275-2113-5, unlimited copies

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1. Design of artificial intelligence systems [electronic resource] // <https://intuit.ru/studies/courses/1122/167/info>

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Equipment, materials and software used to organize and conduct practical work

Equipment:

A computer class (laboratory, auditorium) with a number of working computers equal to the number of students in the group plus a teacher's workstation and with a performance level sufficient for mastering the subject.

Software:

1. Operating system (Windows XP or later or Linux Mint 19.3 or later)
2. Python programming language version not lower than 3.6
3. PyCharm Community Edition (development and debugging environment, version 2020 or later)
4. Word processor for report design (Open / LibreOffice .org)
5. Python programming language (version 3.8 or higher) with the Jupiter shell and NumPy and TensorFlow libraries

Rules of conduct in the computer lab (classroom, laboratory)

1. Only persons familiar with the safety and health instructions, the rules of conduct, and the placement of information resources are allowed to work in the computer lab.
2. Students are permitted to work in the computer lab only in the presence of a teacher (engineer, laboratory assistant).
3. During group classes, outsiders may be present in the classroom only with the teacher's permission.

4. Before starting work, you must:

- ensure that there is no visible damage at the workplace;
- Place notebooks and textbooks on the table so that they do not interfere with your work on the computer;
- adopt the correct working posture;
- If the previous user's session has not been terminated, terminate it;
- Enter registration information (if necessary).

5. When working in a computer lab, it is strictly prohibited to:

- be in class in outerwear;
- place clothes and bags at work places;
- be in the classroom with food and drinks;
- put books, notebooks, etc. on the keyboard;
- be located to the side or behind the switched-on monitor;
- connect or disconnect cables, touch connectors, wires and sockets;
- move computers;
- open the system unit;
- try to fix equipment malfunctions on your own;
- block the ventilation openings on the system unit and monitor;
- banging on the keyboard, pressing keys aimlessly;
- delete or move other people's files;
- install and run computer games;
- use Internet resources for non-educational purposes.

6. While in the computer lab, you must:

- maintain silence and order, turn off mobile phones from speakerphone mode;
- comply with all requirements of the teacher, engineer and laboratory assistant;
- work only under your name and password;
- adhere to the work regime (the duration of continuous work at the computer should not exceed two hours with a mandatory 10-minute break and eye exercises; the duration of intensive work with the keyboard should not exceed 30 minutes with subsequent hand exercises; the total duration of work should not exceed 4 hours per day);
- If you experience eye pain, a sharp deterioration in visibility, an inability to focus or focus your gaze, pain in your fingers and hands, or increased heart rate, immediately leave your workplace, report the incident to your teacher, and consult a doctor;
- After finishing work, close all active programs and correctly end the session;
- leave the workplace clean.

7. When working at a computer, it is necessary to maintain correct posture:

- the distance from the screen to the eyes is 70-80 cm (arm's length);
- vertically straight back;
- shoulders are down and relaxed;
- feet on the floor and not crossed;
- elbows, wrists and hands at the same level;

- elbow, hip, knee, ankle joints at right angles.
- 8. If software errors or equipment failures occur, the student is obliged to immediately contact the teacher (engineer, laboratory assistant).
- 9. In the event of damage or failure of computer class equipment due to the user's fault, repair or replacement of the equipment is carried out at the user's expense.

MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN FEDERATION
FEDERAL STATE
AUTONOMOUS EDUCATIONAL
INSTITUTION OF HIGHER EDUCATION
NORTH CAUCASIAN FEDERAL UNIVERSITY

Methodological guidelines

for students on organizing and conducting independent work
in the discipline "Artificial intelligence technology / Технология искусственного
интеллекта"

**Stavropol
2026**

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1. General Provisions

Independent work is the planned educational, educational and research, or scientific research work of students, carried out outside of class (in class) time, as assigned and under the methodological guidance of the teacher, but without his or her direct participation (with partial direct participation of the teacher, leaving the leading role to the students' work). To Vladislav Vyacheslavovich

Student independent work (SIW) at a university is an important form of student learning and research activity. Student independent work plays a significant role in the rating system of learning.

The main types of independent work for students include:

- formation and assimilation of the content of lecture notes based on the educational literature recommended by the lecturer, including information educational resources (electronic textbooks, electronic libraries, etc.);
- writing reports;
- preparation for seminars, practical and laboratory work, their design;
- compilation of an annotated list of articles from relevant journals in the fields of knowledge (pedagogical, psychological, methodological, etc.);
- implementation of educational and research work, project activities;
- preparation of practical developments and recommendations for solving problematic situations;
- completing homework assignments in the form of solving individual problems, performing typical calculations, computer calculations and individual work on individual sections of the content of disciplines, etc.;
- computer-based current self-monitoring and progress monitoring based on electronic training and assessment tests;
- completion of coursework (projects) within the framework of disciplines;
- completion of final qualifying work, etc.

The methodology for organizing students' independent work depends on the structure, nature, and characteristics of the discipline being studied, the number of hours for its study, the type of assignments for students' independent work, the individual qualities of students, and the conditions of educational activities.

The process of organizing students' independent work includes the following stages:

- preparatory (defining goals, drawing up a program, preparing methodological support, preparing equipment);
- basic (implementation of the program, use of techniques for searching for information, assimilation, processing, application, transfer of knowledge, recording of results, self-organization of the work process);
- final (assessment of significance and analysis of results, their systematization, assessment of the effectiveness of the program and work methods, conclusions on areas of labor optimization).

Independent work on the course "Information technologies for teamwork and project activities" is aimed at developing the following **competencies** :

Code	Formulation
OPK-1	Able to find, formulate and solve current and significant problems in applied and computer mathematics
PC-7	Able to create and explore new mathematical models in the natural sciences, industry and business, taking into account the capabilities of modern information technology, programming and computer equipment

2. The purpose and objectives of independent work

The main goal of organizing and implementing independent work coincides with the goal of student education – the formation of a set of general scientific, professional and universal competencies of the future bachelor.

When organizing independent work, developing the ability to work independently to acquire knowledge, skills, and the ability to organize educational and research activities is an important and essential condition. The goal of students' independent work is to master fundamental knowledge, professional skills, and relevant professional activities, as well as experience in creative and research activities. Students' independent work promotes the development of independence, responsibility, self-discipline, and a creative approach to solving academic and professional problems.

The objectives of the SRS are:

- systematization and consolidation of the acquired theoretical knowledge and practical skills of students;
- deepening and expanding theoretical knowledge;
- development of skills in using regulatory, legal, reference documentation and specialized literature;
- development of students' cognitive abilities and activity: creative initiative, independence, responsibility and organization;
- development of independent thinking, abilities for self-development, self-improvement and self-realization;
- development of research skills;
- use of material collected and obtained during independent work and laboratory classes.

3. Technological map of independent student work

Codes of implemented competencies	Type of student activity	The final product of independent work	Assessment tools and technologies	Volume of hours, including (astr.)		
				SRS	Contact work with the teacher	Total
2nd semester						
OPK-1 PC-7	Preparation for practical classes	Electronic report	Interview	18.0	18.0	36.0
OPK-1 PC-7	Independent study of literature	Abstract	Interview	18.0	18.0	36.0
OPK-1 PC-7	Self-testing, preparation for testing	Testing	Test tasks	18.0	18.0	36.0
Total for 2nd semester				72.0	72.0	144.0
Total				72.0	72.0	144.0

4. Control points and types of reporting on them

Quality control and deadlines for independent work are assessed in accordance with the academic schedule and are formatted according to the assignment. The following knowledge rating is provided:

Description of the rating scale

Within the framework of the rating system, students' academic performance in each discipline is assessed during ongoing monitoring and midterm assessment.

Current control

5. Procedure for completing independent work by a student

5.1 . Methodological recommendations for working with educational literature

When working with books, you need to select literature, learn to read it correctly, and keep records. To select literature, the library uses alphabetical and systematic catalogs.

It is important to remember that rational skills in working with a book always mean great savings of time and effort.

The instructor teaching the course recommends the appropriate selection of textbooks. Required literature may also be listed in the course's teaching materials.

When studying the material in a textbook, you should move on to the next question only after correctly understanding the previous one, describing on paper all the calculations and computations (including those that are omitted from the textbook or given in the lecture for independent derivation).

When studying any discipline, independent individual work plays a large and important role.

Particular attention should be paid to defining the course's key concepts. Students should thoroughly analyze examples that illustrate these definitions and be able to construct similar examples independently. It's important to develop a clear understanding of what you're learning. Taking supporting notes is helpful. When studying the material from the textbook, it's helpful to supplement your lecture notes in the designated margins in your notebook. You should also note any questions you've identified for consultation with the instructor.

It is recommended to highlight the conclusions obtained as a result of the study in the notes so that they are better remembered when rereading the notes.

Experience shows that many students find it helpful to create a reference sheet containing the most important and frequently used formulas and concepts. Such a sheet helps students remember formulas and key points of the lecture, and can also serve as a constant reference for them.

Reading scientific text is part of cognitive activity. Its goal is to extract the necessary information from the text. The effectiveness of the action largely depends on how consciously the reader approaches the printed word (finding the necessary information, assimilating it in whole or in part, critically analyzing the material, etc.).

There are **four main attitudes towards reading scientific text** :

information retrieval (the task is to find and highlight the desired information)

assimilative (the reader's efforts are aimed at fully comprehending and remembering both the information presented by the author and the entire logic of his reasoning)

analytical-critical (the reader strives to critically comprehend the material, having analyzed it, and determined his attitude toward it)

creative (creates in the reader a readiness in one form or another - as a starting point for his own reasoning, as an image for action by analogy, etc. - to use the author's judgments, his train of thought, the result of observation, the developed methodology, to supplement them, to subject them to new testing).

The main types of systematic recording of what has been read:

Annotation is an extremely brief, coherent description of a book (article) viewed or read, its content, sources, nature and purpose;

Planning is a brief logical organization of the text, revealing the content and structure of the material being studied;

Thesis is a concise reproduction of the author's main assertions without using factual material;

Quoting is the verbatim copying of excerpts and extracts from the text that most significantly reflect a particular idea of the author;

Note-taking is a brief and sequential presentation of the content of what has been read.

A summary is a complex way of presenting the contents of a book or article in a logical sequence. A summary integrates previous notes and allows for a comprehensive understanding of the book or article's content. Therefore, the ability to create an outline, make notes, take excerpts, and other notes determines the technique of summary writing.

5.2. Methodological recommendations for compiling lecture notes:

1. Read the text carefully. Look up any unfamiliar words in reference books. When taking notes, be sure to include reference information in the margins.

2. Highlight the main points and make a plan.

3. Briefly formulate the main points of the text, note the author's argumentation.

4. Take notes on the material, strictly following the outline. When taking notes, try to express your thoughts in your own words. Keep your notes clear and concise.

5. Write quotes correctly. When quoting, keep in mind the brevity and significance of the idea.

In the summary, it is advisable to present not only thesis statements but also their evidence. When formatting the summary, strive for the conciseness of each sentence. The author's thoughts should be presented concisely, with care taken to maintain style and expressiveness. The number of additional elements in the summary should be logically justified, and entries should be arranged in a specific sequence consistent with the logical structure of the work. Leave margins for clarification and addition.

Mastering note-taking skills requires a student to be determined and to work independently on a daily basis.

5.3. Methodological recommendations for preparation for practical classes

To maximize the benefit of practical classes, it's important to remember that exercises and problem solving are based on lecture material and typically involve a detailed analysis of specific topics covered in the lecture course. It's important to emphasize that only after the lecture material has been mastered from a specific perspective (namely, the perspective from which it is presented in lectures) will it be reinforced in laboratory classes, both through discussion and analysis of the lecture material and through solving problem situations and tasks. Under these conditions, students will not only master the material well but also learn to apply it in practice, and will also receive additional incentive (and this is very important) to actively engage with the lecture.

When independently solving problems, it's important to justify each step of the solution based on the theoretical principles of the course. If a student sees several possible solutions to a problem (problem), they should be compared and the most efficient one selected. It's helpful to create a brief plan for solving the problem (problem) before beginning calculations. Solutions to problematic problems or examples should be presented in detail, with calculations arranged in strict order, separating auxiliary calculations from the main ones. Solutions should be accompanied by comments, diagrams, drawings, and illustrations, if necessary.

It's important to remember that the solution to each learning problem should be followed through to the final logical answer required by the conditions, and, if possible, with a conclusion. The resulting answer should be verified using methods specific to the nature of the problem. It's also helpful (if possible) to solve the problem in several ways and compare the results. Problem solving of this type should be continued until solid solving skills are acquired.

Practical work No. 1-5,8 are completed by students of correspondence and part-time education independently.

5.4. Guidelines for self-assessment of knowledge

After studying a specific topic using notes in the notes and textbook, as well as solving a sufficient number of relevant problems in practical classes and independently, the student is advised to conduct a self-assessment of the acquired knowledge by answering test questions on the topic studied.

If necessary, you need to carefully review the material again.

Sometimes, a lack of understanding of a particular question only becomes apparent upon further study. In this case, it's necessary to go back and review the poorly understood material. An important criterion for mastering theoretical material is the ability to answer interview questions.

5.5. Guidelines for creating a project (reports, papers, essays, scientific articles, etc.)

The project is completed by students during their educational programs and must be presented at the end of the academic year as a completed academic research project or a developed academic project, whether informational, creative, social, applied, innovative, design, or engineering. The project must be completed by the student on any topic of their choice. A project is an opportunity for each student to fully develop their creative and intellectual potential. Project-based and academic research activities allow students to fully express themselves, test their abilities, apply their knowledge, and publicly present their achievements. The result of this activity is a solution found by the team.

Project objectives: understanding the basic methods, tools and technologies for effective interaction and implementation of successful teamwork.

- Objectives of the project: study of the theoretical foundations of the formation and development of teamwork skills;
- development of skills in managing group projects;
- mastering the skills of effective social interaction, creating a favorable and constructive atmosphere in a team using available information technologies.

The project is a team effort. Failure to complete the project will result in a failing grade in the course within which the project is being completed.

Evaluation criteria:

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

A "good" grade is given to a student if he/she demonstrates knowledge of the basic methods of programming and information technology and information technologies used in scientific research; the student demonstrates the ability to present and adapt mathematical knowledge, programming methods and information technologies in various ways, taking into account the level of the audience; the student demonstrates skills in scientific research and abstracting scientific results; the student demonstrates knowledge of the basic methods of practical verification of research results and information technologies used in scientific research; the student demonstrates confident skills in constructing mathematical models of information security systems, conducting an analysis of the scientific and practical significance of the research; the student demonstrates good skills in abstracting scientific results.

The grade "satisfactory" is given to a student if he/she demonstrates knowledge of only some of the basic methods of programming and information technology and information

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

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

Description of the rating scale

The maximum possible score for the entire ongoing assessment is set at 55. A current assessment is considered passed if the student receives at least 60% of the maximum score established for that assessment. The rating score assigned to a student for a current assessment completed within the deadlines set in the assessment schedule is determined as follows:

Level of completion of the control task	Rating score (as a percentage of the maximum score for the test task)
Great	100
Good	80
Satisfactory	60
Unsatisfactory	0

5.6. Methodological recommendations for preparation for tests

Monitoring students' independent work

Independent work is monitored by the teacher in the classroom.

The following types of control are provided: interview, assessment of the report and its presentation.

Detailed criteria for assessing competencies are provided in the Fund of Assessment Tools for Conducting Current and Interim Assessments.

6. List of literature for completing independent work

List of key literature:

1. Sergeev, N. E. Artificial Intelligence Systems: a tutorial / N. E. Sergeev; Ministry of Education and Science of the Russian Federation; Southern Federal University; Engineering and Technological Academy, 1. - Taganrog: Publishing House of Southern Federal University, 2016. - 123 p.: diagrams, ill., tables. - <http://biblioclub.ru/>. - Bibliography in the book. - ISBN 978-5-9275-2113-5, unlimited copies

2. Tolmachev , S. G. Artificial Intelligence Technology. Electronic resource / Tolmachev S. G.: study guide. - St. Petersburg: BSTU " Voenmekh " named after D. F. Ustinov, 2017. - 132 p. - ISBN 978-5-906920-53-9, unlimited copies
3. Chervyakov, N. I. Application of artificial neural networks and residual class systems in cryptography / - Moscow: Fizmatlit Publishing House , 2012. - 279 p.

List of additional literature:

1. Galushkin A.I., Tsypkin Ya.Z. Neural networks: history of theory development: a textbook for universities. – M.: IPZhR, 2001. – 840 p.
2. Galushkin A.I. Neurocomputers: A Textbook. – Moscow: Radio Engineering, 2000. – 528 p.
3. Artificial Intelligence. - In 3 books. Book 1. Communication Systems and Expert Systems: Handbook / edited by D.A. Pospelov - Moscow: Radio and Communications, 1990.
4. Artificial Intelligence. - In 3 books. Book 2. Models and Methods: Handbook / edited by D.A. Pospelov - Moscow: Radio and Communications, 1990.
5. Artificial Intelligence. - In 3 books. Book 3 Software and Hardware: Handbook / edited by D.A. Pospelov - Moscow: Radio and Communications, 1990.
6. Neural network technologies for information processing: textbook : Field of study 010200.62 - Mathematics and computer science. Profile of study - Computational mathematics, informatics and computer technology. Bachelor's degree / Aved'yan E. D., Galushkin A. I., Chervyakov N. I., Sakhnyuk P. A.; North- Caucasian Federal University . - Stavropol: SKFU, 2014. - 283 p.: ill. - Stamp: Rec. UMO. - Bibliography : pp. 277-281, unlimited copies
7. Ostroukh, A. V.; Artificial Intelligence Systems Electronic resource / Ostroukh A. V., Surkova N. E.: monograph. - St. Petersburg: Lan, 2019. - 228 p. - ISBN 978-5-8114-3427-5, unlimited copies.

List of educational and methodological support for independent work of students discipline (module)

1. Sergeev, N. E. Artificial Intelligence Systems: a tutorial / N. E. Sergeev; Ministry of Education and Science of the Russian Federation; Southern Federal University; Engineering and Technological Academy, 1. - Taganrog: Publishing House of Southern Federal University, 2016. - 123 p.: diagrams, ill., tables. - <http://biblioclub.ru/>. - Bibliography in the book. - ISBN 978-5-9275-2113-5, unlimited copies

List of resources of the information and telecommunications network "Internet" required for mastering the discipline (module)

1. Machine learning [electronic resource] // <https://intuit.ru/studies/courses/13844/1241/info>