

**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 laboratory work on the subject
Reinforcement Learning / Обучение с подкреплением
Direction of training
02.04.01 - Mathematics and Computer Science

Stavropol, 2026

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Preface

Discipline " Reinforcement" Learning » for the Master's program 02.04.01 "Mathematics and Computer Science" is designed to help each student master a set of general professional digital competencies in the field of studying the capabilities of modern artificial intelligence systems.

Reporting forms: credit assessment in the 6th semester

Implemented competencies:

PC-3 Capable of conducting methodological and expert work in the field of mathematics and computer science.

PC-9 Able to take into account knowledge of problems and trends in the development of the software market in professional activities.

Results of mastering the discipline.

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 laboratory 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 abilities acquired by the student as a result of mastering the topic, within the framework of the developed competencies (PC-3, PC-9)

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 points of the report, i.e. it is not necessary for the report to contain all the points) upon submission in electronic form for defense (a paper printout is not required!!!) of a neatly formatted report file in the format . pdf (presentation), . odt (OpenOffice , LibreOffice) or . doc (Microsoft) Office), named according to a template (if there is a discrepancy, the work is not allowed to be protected):

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) on ____ (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, and 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. Reinforcement Learning Electronic resource / Tolmachev S. G .: textbook. - St. Petersburg : BSTU " Voenmekh " named after. D.F. Ustinova, 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](https://intuit.ru/studies/courses/1122/167/info)

Practical work #2

Topic: " Models for representing knowledge about a subject area "

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 abilities acquired by the student as a result of mastering the topic, within the framework of the developed competencies (PC-3, PC-9)

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 possibility 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 .

Contents of the report

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

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

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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 . The recommended length is 1-3 report pages (or 1-3 presentation slides).

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

speech recognition and synthesis systems in an individual project . Recommended length: 1-3 report pages (or 1-3 presentation slides).

8. Describe the feasibility of using intelligent decision support systems . Recommended report length: 1-3 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. Reinforcement Learning Electronic resource / Tolmachev S. G .: textbook. - St. Petersburg : BSTU " Voenmekh " named after. D.F. Ustinova, 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](https://intuit.ru/studies/courses/1122/167/info)

Practical work #3

Topic: " Representation of knowledge about a subject area "

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 abilities acquired by the student as a result of mastering the topic, within the framework of the developed competencies (PC-3, PC-9)

Know:

1. Limitations of computer vision systems
2. Limitations of natural language processing systems
3. Limitations of speech recognition and synthesis systems
- 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

artificial intelligence system option selected in Lab 1 .

1. Determine the technical limitations of the artificial intelligence system being developed.
2. Determine the social limitations of the artificial intelligence system being developed.
3. Determine the moral and ethical limitations of the artificial intelligence system being developed.

4. Determine the legal limitations of the artificial intelligence system being developed.

Contents of the report

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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) on ____ (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 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. Limitations of computer vision systems
2. Limitations of natural language processing systems
3. Limitations of speech recognition and synthesis systems
- 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

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. Reinforcement Learning Electronic resource / Tolmachev S. G. : textbook. - St. Petersburg : BSTU "Voenmekh" named after. D.F. Ustinova, 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.
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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 .

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](https://intuit.ru/studies/courses/1122/167/info)

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Equipment, materials and software used to organize and conduct laboratory 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.

GUIDELINES
on organizing and conducting independent work
in the discipline «**Reinforcement Learning / Обучение с подкреплением**»
for students in the field of study
02.04.01 "Mathematics and Computer Science"
direction (profile)
"Training Program for Electronic Information"

INTRODUCTION

Discipline " Reinforcement" Learning » is included in the bachelor's degree program in the field 02.04.01 – “Mathematics and Computer Science” and is a mandatory part of the discipline block.

This course explores the application of mathematical tools to solving applied problems, approximating functions, solving differential equations with boundary conditions, and numerically calculating definite integrals and derivatives. To reinforce the material covered, students will complete practical assignments using modern information technologies.

The purpose of this course is to ensure the fulfillment of the requirements of the State Educational Standard "Mathematics and Computer Science", according to which a bachelor's degree must have the ability to use fundamental knowledge in the field of mathematical analysis, complex and functional analysis, algebra, analytical geometry, differential geometry and topology, differential equations, discrete mathematics and mathematical logic, probability theory, mathematical statistics and random processes, numerical methods, theoretical mechanics in future professional activities.

To consolidate the material studied, it is expected that practical tasks will be completed using modern mathematical packages, MahCad , Maple , MatLab .

This discipline is designed to promote the fundamentalization of education, strengthen mathematical knowledge and develop students' systems thinking, and study theoretical, methodological and practical problems of the formation, functioning and development of information systems.

1 Requirements for the level of mastery of the discipline content

As a result of mastering the discipline, the student should possess the following competencies:

Index	Formulation:
PC-3	Capable of conducting methodological and expert work in the field of mathematics and computer science.
PC-9	Able to take into account knowledge of the problems and development trends of the software market in professional activities.

2 Organizational and methodological recommendations for mastering the discipline

Students' independent work is a crucial prerequisite for developing a scientific approach to learning. It is conducted before each practical and laboratory lesson and involves completing a specific assignment.

The prepared material and practical assignment are presented in notes.

Independent study (IS) is one of the active forms of learning.

Independent study of the discipline " Reinforcement" Learning » aims to:

- to consolidate and deepen the knowledge acquired by students in lectures and laboratory classes;
- to instill practical skills in working with modern information technologies.

Independent studies are conducted in specialized classrooms equipped with computer technology and the ability to use Internet and library resources.

The proposed methodological recommendations contain information for students necessary for the preparation and conduct of laboratory classes in the discipline " Reinforcement" Learning ", and may also be useful for officials whose responsibilities include working with organizational and administrative documents (ORD).

GOST R 51141-08 defines the ORD as a type of written document that records the resolution of administrative and organizational issues, as well as issues of management, interaction, support and regulation of the activities of government bodies, institutions, enterprises, organizations, their divisions and officials.

According to the All-Russian Classifier of Management Documentation (OKUD), ORD are classified into four groups:

- organizational and legal documentation (charters, regulations, rules, staffing schedules, instructions);
- administrative documentation (orders, instructions, decrees, decisions, directions);
- information and reference documentation (letters, telegrams, faxes, acts, protocols, reports and memos, etc.);
- documents on personnel (applications, personal cards, orders on personnel, etc.).

The preparation of the ORD is carried out in accordance with the requirements of GOST R 6.30-2003 "Unified documentation systems. Unified system of organizational and administrative documentation. Requirements for document preparation."

This standard establishes: the composition of document details; requirements for the execution of document details; requirements for document forms.

3 Methodological guidelines for students' independent work

The guidelines include the following sections:

- the purpose of the work;
- a task that must be completed by a student as a result of independent work;
- task options;
- the main theoretical provisions necessary for completing the assignment, they should be brief and contain references to literature in which these provisions are set out in a volume sufficient for completing independent work;
- stages of task completion with indication of specific deadlines for completion of each stage and the entire task as a whole;
- requirements for the design of the graphic and text parts of independent work;
- an example of completing one of the task options and preparing a report;
- bibliographic list of used sources.

To help students and monitor their independent work, teacher consultations are used.

Consultations are one of the forms of work of the department to provide pedagogically appropriate assistance to students in their independent work.

Consultations should be individualized. If clarification of common issues is needed for several students, group consultations are held.

Consultations are conducted with the aim of:

- clarification of questions that arise among students during independent study of educational material and completion of homework;
- deepening and consolidating knowledge on individual issues and topics of the discipline;
- providing methodological assistance in choosing methods of independent work.

Attendance at student consultations is voluntary. However, the instructor may call for interviews those students who do not demonstrate solid knowledge during their studies and who do not voluntarily participate in the consultations.

During the consultation, the teacher explains the most complex issues that are unclear to students and points out literature that covers them.

When consulting students, the teacher is obliged to become familiar with how they study the recommended literature, give instructions and advice on methods of working on the educational material, facilitating a deeper and more lasting assimilation of it

Consultations should not be additional classes or substitutes for them. Doing homework for students or with them is prohibited. Consultations should not become a form of cramming for tests and exams.

If during the consultation it becomes clear that the student's lack of understanding of the question is due to insufficient study of certain sections of the program, then the consultant is obliged to recommend that the student study them and monitor the degree of assimilation of these issues.

Consultations do not constitute a knowledge assessment. The student's knowledge of the subject matter demonstrated during the consultation should not influence their assessment of the course material in exams and tests.

4. Organization of students' knowledge control. Forms of students' knowledge control

Monitoring and assessment of students' knowledge, skills, and abilities is carried out during laboratory classes, consultations, and exams. During knowledge assessment, the instructor evaluates the student's understanding of the course content " Reinforcement. " Learning ", his ability to apply management methods to solve specific problems.

Students' knowledge assessment can be carried out in the following forms:

- current knowledge control;
- intermediate knowledge control.

Current monitoring of students' knowledge aims to:

- to evaluate the work of each student in assimilation of the educational material, to identify shortcomings in his preparation and to provide practical assistance in eliminating them;

The main forms of current monitoring of students' knowledge are:

- oral control survey;
- written control blitz survey;
- protection of laboratory work;
- intermediate testing;
- checking lecture notes.

Oral assessments of students are conducted during lectures (and lab sessions). Based on these assessments, the instructor evaluates the student's preparation for the class.

Students complete a written quiz during lectures and labs scheduled by the instructor. Students provide written responses to questions posed by the instructor. The results are recorded in the student's journal. During labs, students' knowledge and practical skills are assessed on a 4-point scale. The grades received are recorded in the journal.

When reviewing lecture notes, the quality of their writing is analyzed. Errors are noted, the instructor's review evaluates the quality of note-taking, and provides recommendations for improving the quality of lecture note-taking.

Interim assessment in the discipline is carried out in the form of a credit test and a credit test with a grade.

5 Recommendations for working with literature and sources

The study of literature and sources must begin with reading the relevant chapters of textbooks, teaching aids, or literature recommended as primary or secondary for the discipline “Information Systems Tools,” which directly or indirectly relate to the topic being studied.

When studying literature and sources, students are advised to take brief notes. However, they should not rewrite the entire content of the topic being studied; they should only jot down the main ideas and, in their opinion, the most important thoughts. In certain cases, where important definitions, concepts, necessary factual material and examples, or statistical information related to the topic being studied are encountered, students should transcribe them as citations with full bibliographical references.

A summary of recommended literature and sources should be kept, with the collected materials divided into individual chapters and sections according to the curriculum. All references to the literature and sources used should be included.

An important step in working with recommended literature and sources is studying legislative and regulatory acts at the federal, regional, local, and departmental levels. When studying Decrees of the President of the Russian Federation, Laws and Codes of the Russian Federation, resolutions, regulations, recommendations, etc., students should identify any changes and additions that may have been made since their publication.

The basis of the technology for intensifying training on the platform of digital educational technologies are educational and illustrative materials (support notes) on the discipline " Reinforcement" Learning ».

Working with educational and illustrative materials has the following stages.

1. Study of the theoretical foundations of the educational material in the classroom:

presentation of the material being studied by the teacher to students with an explanation based on the supporting notes;

2. Independent work:

Individual work of students on the supporting notes; frontal consolidation of the supporting notes' blocks.

3. First repetition – reproduction of the content of the given topic of the reference summary from memory.

4. Oral recitation of the supporting notes is a necessary stage of external speech activity in the assimilation of educational material.

5. The second repetition is mutual questioning and mutual assistance of students to each other.

The use of educational and illustrative materials allows us to generalize complex material and activate students' thinking.

It is important to remember that the most important thing for a student in independent work with recommended literature and sources is the formation of

their own individual style, which can become the basis for future professional activity.

6 List of recommended literature

Main literature:

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