

**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
Deep learning / Глубокое обучение
Direction of training
02.04.01 - Mathematics and Computer Science

Stavropol, 2026

**MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN
FEDERATION**

**Federal State Autonomous Educational Institution
higher professional education
NORTH CAUCASIAN FEDERAL UNIVERSITY**

Guidelines for performing laboratory work
by discipline

Deep learning / Глубокое обучение

for students in the field of study
02.04.01 Mathematics and Computer Science

Content

		P.
1.	Introduction	
2.	Practical Work #1: Introduction to Deep Learning	
3.	Practical Work #2: Artificial Neural Networks	
4.	Practical Work #3 "TensorFlow Library"	
5.	Literature.....	
6.	Appendix 1. Equipment, materials and software used for organizing and conducting practical work	
7.	Appendix 2. Contents of the laboratory work report...	
8.	Appendix 3. Rules of conduct in the computer lab (classroom, laboratory)	

Introduction

The “Deep learning / Глубокое обучение” discipline is part of the elective part of the curriculum of the 2026 master’s program and is studied by students of the specialty 02.04.01 of the “Mathematics and Computer Science” direction in the 3rd semester.

The goal of mastering the discipline is to develop understanding and fundamental knowledge of modern machine learning methods.

The main objective of studying the discipline is to study machine learning methods.

Reporting forms: credit in the 3rd semester.

Course Contents: Introduction to Deep Learning. Artificial Neural Networks. Supervised Learning. Single-Layer Neural Networks. Multilayer Neural Networks. Unsupervised Learning. Self-Organization Maps. Recurrent Neural Networks. Fully Connected Deep Networks. Convolutional Neural Networks. TensorFlow Library.

Implemented competencies:

PC-1. Able to demonstrate fundamental knowledge of mathematical and natural sciences, programming, and information technology.

PC-6. Capable of using modern methods for developing and implementing specific algorithms for mathematical models based on programming languages and application modeling packages .

Results of mastering the discipline.

Know: Artificial neural networks. Supervised learning. Single-layer neural networks. Multilayer neural networks. Unsupervised learning. Self-organization maps. Recurrent neural networks. Fully connected deep networks. Convolutional neural networks. TensorFlow library.

Be able to: apply data processing and machine learning methods in practice

Possess: data processing and machine learning skills

Recommended software:

1. PyCharm integrated development environment
2. Python programming language (version 3.8 or higher) with the Jupiter shell and NumPy and TensorFlow libraries
3. TensorFlow library
4. Operating system: Windows (at least XP), Linux Mint

Recommended equipment: a computer lab (or laboratory, or classroom) with a number of working computers equal to the number of students in the class, plus a teacher workstation, and with sufficient performance to cover the course. All computers in the lab or classroom must be equipped with software and internet access for studying online resources for the course (with access speeds sufficient for comfortable use).

Practical work No. 1

Topic: "Introduction to Deep Learning"

The purpose of the work: “ to consolidate knowledge on the theoretical foundations of machine learning .”

Competencies being developed (part of the competencies is being developed)
:

PC-3. Ability to collect, process and interpret experimental data necessary for project activities in the field of information technology .

PC-5. Capable of developing software and information support for computer systems, services, computing complexes, and databases.

Progress of work

1. Organizational moment.
2. Selecting a task in accordance with the option.
3. Study of the theoretical part (literature) on the topic of the work.
4. Study of safety precautions (rules of conduct in a computer laboratory).
5. Execution of work.
6. Presentation of work results.
7. Conclusions on the work done.
8. Protection of work.

Theoretical part

See the list of recommended reading.

Equipment and materials: see Appendix 1.

Safety precautions: see Appendix 2.

Assignments for laboratory work

Tasks

1. Analyze the list and select an option for an artificial intelligence system model for further machine learning .
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 machine learning and artificial intelligence).
4. Write in the report your vision for the development of the project using machine learning and artificial intelligence technologies.

Options:

1. Create a neuro-project simulating an electronic calculator.
2. Create a neuro-project simulating an electronic notebook.
3. Create a neural network project that simulates a clock.
4. Create a neural network project that simulates a car.
5. Create a neuro-project that simulates an airplane.
6. Create a neuro-project simulating a helicopter.
7. Create a neuro-project that simulates a ship.
8. Create a neuro-project simulating a “Smart Home”.

9. Create a neuro-project simulating an elevator.
10. Create a neuro-project that simulates a television.
11. Create a neuro-project simulating a cell phone.
12. Create a neuro-project simulating a music center (technical device).
13. Create a neuro-project simulating a washing machine with electronic control.
14. Create a neuro-project simulating a microwave oven.
15. Create a neural network project that simulates a food processor.
16. Create a neural network project that simulates a dishwasher.
17. Create a neural network project simulating a kitchen electric stove with electronic controls.
18. Create a neuro-project simulating a lathe with electronic control.
19. Create a neuro-project simulating an electronically controlled drilling machine.
20. Create a neuro-project simulating a milling machine with electronic control.
21. Create a neuro-project simulating a simple terrestrial ecosystem.
22. Create a neuro-project simulating a simple aquatic ecosystem.
23. Create a neuro-project that simulates simplified behavior of a cat (animal).
24. Create a neuro-project that simulates simplified behavior of a dog (animal).
25. Create a neuro-project simulating simplified behavior of a hamster (animal).
26. Create a neuroproject that simulates simplified shark behavior (animal).
27. Create a neuro-project simulating simplified behavior of a crow (animal).
28. Create a neural network project that simulates the development of a lilac bush (plant).
29. Create a neuro-project that simulates the process of burning a fire (a physical process).
30. Create a neuro-project that simulates the processes occurring inside a cloud (a natural phenomenon).
31. Create a neuro-project simulating a thunderstorm (a natural phenomenon).
32. Create a neuro-project simulating a copying machine.
33. Create a neuro-project simulating a von Neumann architecture computer.
34. Create a neuro-project simulating a single-tape Turing machine.
35. Create a neuro-project that simulates a neurocomputer.
36. Create a neural network project that simulates a local area network.
37. Create a neuro-project simulating a navigation satellite.
38. Create a neuro-project simulating a nuclear reactor.
39. Create a neural network project that simulates a grocery store.

40. Create a neuro-project that simulates the school's work process.

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):

ML _ LR 1_ V(variant number)_(surname).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 What is Deep Learning?

4.2 Basic principles of machine learning.

4.3. Artificial neural networks.

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 your vision for the project's development. The recommended length is 1-3 report pages (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. What is Deep Learning?
2. Basic principles of machine learning.
3. Artificial neural networks.

A list of recommended literature on this topic

Main literature:

1. Chervyakov N.I., Lyakhov P.A., Kopytkova L.B., Gladkov A.V. Information processing in the system of residual classes: Tutorial. – Stavropol: SKFU, 2016. – 182 p.
2. Chervyakov N.I. et al. Modular arithmetic and its applications in infocommunication technologies / Ed. N.I. Chervyakov. – Moscow : F izmatlit, 2017. – 400 p.
3. Voronova, L. I. MachineLearning: Regression Methods of Data Mining Electronic resource : Study guide / L. I. Voronova, V. I. Voronov. - MachineLearning: Regression Methods of Data Mining, 2024-02-26. - Moscow : Moscow Technical University of Communications and Informatics, 2018. - 82 p. - The book is in the premium version of the IPR BOOKS electronic library system. - ISBN 2227-8397, unlimited copies

Further reading

1. Brooks F. The Mythical Man-Month or How Software Systems Are Created. St. Petersburg : Symbol-Plus, 1999. - 304 p.
2. Lipaev V.V. Program testing. Moscow: Radio and Communications, 1986. - 296 p.

Methodological literature

1. Myers G. The Art of Program Testing M.: Finance and Statistics, 2014. -176 p.

Internet resources

1. Fundamentals of Software Testing
<http://www.intuit.ru/studies/courses/48/48/info>

Practical work #2

Topic: "Artificial Neural Networks"

The purpose of the work: “ to consolidate knowledge on the theoretical foundations of artificial neural networks .”

Competencies being developed (part of the competencies is being developed)
:

PC-3. Ability to collect, process and interpret experimental data necessary for project activities in the field of information technology .

PC-5. Capable of developing software and information support for computer systems, services, computing complexes, and databases.

Progress of work

1. Organizational moment.
2. Selecting a task in accordance with the option.
3. Study of the theoretical part (literature) on the topic of the work.
4. Study of safety precautions (rules of conduct in a computer laboratory).
5. Execution of work.
6. Presentation of work results.
7. Conclusions on the work done.
8. Protection of work.

Theoretical part

See the list of recommended reading.

Equipment and materials: see Appendix 1.

Safety precautions : see Appendix 2.

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):

ML _ LR 2_ V(variant number)_(surname).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. 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

4.9.Fully connected networks

4.10. Associative memory systems

4.11. Hopfield neural network

4.12. Hamming neural network

4.13. Bidirectional associative memory

4.14. Convolutional neural networks

4.15. Deep 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. Determine 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).

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

7. Determine and write out a place in the developed artificial intelligence system for the associative memory subsystem . The recommended volume is 1-3 report pages (or 1-3 presentation slides).

8. Determine and write out a place in the developed artificial intelligence system for the convolutional neural network . The recommended volume is 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. 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. Fully connected networks
10. Associative memory systems
11. Hopfield neural network
12. Hamming neural network
13. Bidirectional associative memory
14. Convolutional neural networks
15. Deep learning

A list of recommended literature on this topic

Main literature:

1. Chervyakov N.I., Lyakhov P.A., Kopytkova L.B., Gladkov A.V. Information processing in the system of residual classes: Tutorial. – Stavropol: SKFU, 2016. – 182 p.
2. Chervyakov N.I. et al. Modular arithmetic and its applications in infocommunication technologies / Ed. N.I. Chervyakov. – Moscow : F izmatlit, 2017. – 400 p.

3. Voronova, L. I. MachineLearning: Regression Methods of Data Mining Electronic resource : Study guide / L. I. Voronova, V. I. Voronov. - MachineLearning: Regression Methods of Data Mining, 2024-02-26. - Moscow : Moscow Technical University of Communications and Informatics, 2018. - 82 p. - The book is in the premium version of the IPR BOOKS electronic library system. - ISBN 2227-8397, unlimited copies

Further reading

1. 1. Brooks F. The Mythical Man-Month or How Software Systems Are Created. St. Petersburg : Symbol-Plus, 1999. - 304 p.
2. Lipaev V.V. Program testing. Moscow: Radio and Communications, 1986. - 296 p.

Methodological literature

1. Myers G. The Art of Program Testing M.: Finance and Statistics, 2014. -176 p.

Internet resources

1. Fundamentals of Software Testing
<http://www.intuit.ru/studies/courses/48/48/info>

Practical work #3

Topic: "TensorFlow Library".

The purpose of the work: " to consolidate knowledge of working with the TensorFlow library ."

Competencies being developed (part of the competencies is being developed)
:

PC-3. Ability to collect, process and interpret experimental data necessary for project activities in the field of information technology .

PC-5. Capable of developing software and information support for computer systems, services, computing complexes, and databases.

Progress of work

1. Organizational moment.
2. Selecting a task in accordance with the option.
3. Study of the theoretical part (literature) on the topic of the work.
4. Study of safety precautions (rules of conduct in a computer laboratory).
5. Execution of work.
 - download the program template.
 - make the necessary changes to the template.
 - debug the resulting computer program.
6. Presentation of work results.
7. Conclusions on the work done.
8. Protection of work.

Theoretical part

See the list of recommended reading.

Equipment and materials: see Appendix 1.

Safety precautions : see Appendix 2.

Tasks

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

1. Using the TensorFlow library , create and train a multilayer neural network in the artificial intelligence system being developed.

2. Using the TensorFlow library , create and train a fully connected neural network in the artificial intelligence system being developed.

3. Using the TensorFlow library , create and train an associative memory subsystem in the artificial intelligence system being developed.

4. Using the TensorFlow library , create and train a convolutional neural network in 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):

ML_LR3_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. 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 associative memory systems

4.7. Training a Convolutional Neural Network

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

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

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

8. Create a computer program to implement a convolutional neural network. The recommended length is 1-3 report pages (or 1-3 presentation slides).

9. Create a shell program to manage information flows between the programs created in steps 5-8 of the lab. The recommended length is 1-3 report pages (or 1-3 presentation slides).

10. 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 associative memory systems
7. Training a convolutional neural network

A list of recommended literature on this topic

Main literature:

1. Chervyakov N.I., Lyakhov P.A., Kopytkova L.B., Gladkov A.V. Information processing in the system of residual classes: Tutorial. – Stavropol: SKFU, 2016. – 182 p.
2. Chervyakov N.I. et al. Modular arithmetic and its applications in infocommunication technologies / Ed. N.I. Chervyakov. – Moscow : F izmatlit, 2017. – 400 p.
3. Voronova, L. I. MachineLearning: Regression Methods of Data Mining Electronic resource : Study guide / L. I. Voronova, V. I. Voronov. - MachineLearning: Regression Methods of Data Mining, 2024-02-26. - Moscow : Moscow Technical University of Communications and Informatics, 2018. - 82 p. - The book is in the premium version of the IPR BOOKS electronic library system. - ISBN 2227-8397, unlimited copies

Further reading

1. Brooks F. The Mythical Man-Month or How Software Systems Are Created. St. Petersburg : Symbol-Plus, 1999. - 304 p.
2. Lipaev V.V. Program testing. Moscow: Radio and Communications, 1986. - 296 p.

Methodological literature

1. Myers G. The Art of Program Testing M.: Finance and Statistics, 2014. -176 p.

Internet resources

1. Fundamentals of Software Testing
<http://www.intuit.ru/studies/courses/48/48/info>

Literature

Main literature:

1. Chervyakov N.I., Lyakhov P.A., Kopytkova L.B., Gladkov A.V. Information processing in the system of residual classes: Tutorial. – Stavropol: SKFU, 2016. – 182 p.
2. Chervyakov N.I. et al. Modular arithmetic and its applications in infocommunication technologies / Ed. N.I. Chervyakov. – Moscow : F izmatlit, 2017. – 400 p.
3. Voronova, L. I. MachineLearning: Regression Methods of Data Mining Electronic resource : Study guide / L. I. Voronova, V. I. Voronov. - MachineLearning: Regression Methods of Data Mining, 2024-02-26. - Moscow : Moscow Technical University of Communications and Informatics, 2018. - 82 p. - The book is in the premium version of the IPR BOOKS electronic library system. - ISBN 2227-8397, unlimited copies

Further reading

1. Suzi, R.A.; The Python Programming Language. Electronic resource : a tutorial / R.A. Suzi. - The Python Programming Language, 2020-07-28. - Moscow : Internet University of Information Technologies (INTUIT), 2016. - 350 p. - The book is in the basic version of the IPRbooks electronic library system. - ISBN 5-9556-0058-2, unlimited copies

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. PyCharm integrated development environment
2. Python programming language (version 3.8 or higher) with the Jupiter shell and NumPy and TensorFlow libraries
3. TensorFlow library
4. Operating system: Windows (at least XP), Linux Mint

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 Caucasus Federal University"

GUIDELINES

on organizing and conducting independent work
in the discipline "**Deep learning / Глубокое обучение**"
for students in the field of study

02.04.01 "Mathematics and Computer Science"
direction (profile)

"Training Program for Electronic Information"

INTRODUCTION

The discipline "Deep learning / Глубокое обучение" 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 block of disciplines.

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- 1	Able to demonstrate fundamental knowledge of mathematics and natural sciences, programming and information technology
PC-6	Able to use modern methods of development and implementation of specific algorithms of mathematical models based on programming languages and application packages for modeling

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 studies in the discipline "Deep learning / Глубокое обучение" have the following goals:

- 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 access to Internet and library resources.

The proposed methodological recommendations contain information for students necessary for preparing and conducting laboratory classes in the discipline "Deep learning / Глубокое обучение", 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

Students' knowledge, skills, and abilities are monitored and assessed during laboratory classes, consultations, and exams. During assessments, the instructor evaluates the student's understanding of the "Deep learning / Глубокое обучение" course content and their ability to apply management techniques 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) for the discipline "Information Systems Tools".

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

List of key literature:

1. Voronova, L. I.; MachineLearning: Regression Methods of Data Mining Electronic resource : Study guide / L. I. Voronova, V. I. Voronov. - MachineLearning: Regression Methods of Data Mining, 2024-02-26. - Moscow : Moscow Technical University of Communications and Informatics, 2018. - 82 p. - The book is in the premium version of the IPR BOOKS electronic library system. - ISBN 2227-8397
2. Modular arithmetic and its applications in information and communication technologies : monograph / N.I. Chervyakov, A.A. Kolyada, P.A. Lyakhov, M.G. Babenko, I.N. Lavrinenko, A.V. Lavrinenko. - Moscow : F izmatlit, 2017. - 400 p. : tables, graphs, diagrams. - <http://biblioclub.ru/>. - Bibliography in the book - ISBN 978-5-9221-1716-6
3. Information processing in the residual class system (RCS) Electronic resource : textbook / A.V. Gladkov / L.B. Kopytkova / P.A. Lyakhov / N.I. Chervyakov. - Stavropol : North Caucasus Federal University, 2016. - 225 p. - The book is in the basic version of the IPRbooks electronic library system

List of additional literature:

1. Suzi, R.A.; The Python Programming Language. Electronic resource : a tutorial / R.A. Suzi. - The Python Programming Language, 2020-07-28. - Moscow : Internet University of Information Technologies (INTUIT), 2016. - 350 p. - The book is in the basic version of the IPRbooks electronic library system. - ISBN 5-9556-0058-2

1.1. List of educational and methodological support for independent work of students in a discipline (module)

1. Sheludko, V. M. The Python High-Level Programming Language. Functions, Data Structures, and Additional Modules. Electronic resource : Tutorial / V. M. Sheludko. - Rostov-on-Don, Taganrog : Southern Federal University Publishing House, 2017. - 107 p. - The book is in the premium version of the IPR BOOKS electronic library system. - ISBN 978-5-9275-2648-2 .

1.2. 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>

