

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

SUGGESTIONS FOR TEACHING

on the organization and conduct of independent work
in the discipline "**Statistical Methods in Machine Learning**"
for students of the field of study

11.03.02 Infocommunication Technologies and Communication Systems
Profile

"Intelligent Data Processing in Infocommunication Systems and Networks"

Table of Contents

Introduction

Independent work as the most important form of the educational process

Goals and main objectives of the ACS

Types of independent work

Organisation of SSDs

General recommendations for the organization of independent work

Educational, methodological and information support of the discipline

INTRODUCTION

1. Purpose and objectives of mastering the discipline (module)

The purpose of the discipline is to form, according to the educational program, the competencies of the OPK-1 student.

To achieve this goal, the following tasks are solved in the course of studying the discipline: familiarization with the basic concepts and types of machine learning problems; study of data preparation methods, including cleansing, normalization and engineering transformation of features; mastery of basic supervised learning models, such as linear and logistic regression; mastering stochastic gradient descent as a method of model optimization; forming ideas about metrics for assessing the quality of classification and interpretation of model results; studying methods for combating overfitting, including regularization and cross-validation; mastering classification algorithms based on the nearest neighbor method and the support vector method; studying algorithms for building decision trees and ensemble models, such as random forest and gradient boosting; familiarity with unsupervised learning methods, including clustering algorithms; mastering methods for reducing dimensionality and data visualization, such as PCA and t-SNE; developing practical skills in tuning models using hyperparameter selection; formation of skills to compare and interpret the results of various models based on objective metrics.

2. Place of the discipline (module) in the structure of the educational program

Discipline refers to the part formed by the participants of educational relations.

3. List of planned learning outcomes in the discipline (module) correlated with the planned results of the development of the educational program

Code, formulation of competence	Indicator code, wording	Planned learning outcomes in the discipline (module), characterizing the stages of the formation of competencies, indicators
OPK-1. Able to use the provisions, laws and methods of natural sciences and mathematics to solve problems of engineering activities	ID-1 OPK-1 understands the fundamental laws of nature and the basic physical mathematical laws and methods of accumulating, transmitting and processing information.	Knows and understands optimization methods in the design of AI and ML systems, is able to justify the choice.
	ID-2 OPK-1 applies physical laws and mathematical methods to solve problems of a theoretical and applied nature.	Ability to solve optimization problems in the design of machine learning systems.
	ID-3 OPK-1 uses the knowledge of physics and mathematics to solve practical problems.	Collecting, processing, and analyzing the results of ready-made machine learning systems for compliance.

4. Scope of the academic discipline (module) and forms of control *

Scope of classes: total: 3 EC 108 academic hours.	OFO, In acad. hours
Contact work:	
Lectures/from them practical training	32.00

Laboratory work/from them practical training	-
Practical training/of which practical training	
Independent work	76.00
Forms of control	
Exam	-
Credit	Yes
Credit with a grade	-
Course work	no

INDEPENDENT WORK AS THE MOST IMPORTANT FORM OF THE EDUCATIONAL PROCESS

Independent work of students is an integral part of mastering the discipline *"Statistical Methods in Machine Learning"* and plays a key role in the formation of sustainable and deep knowledge. Modern methods of machine learning require not only a theoretical understanding of algorithms, but also confident use of tools, skills in data analysis, interpretation of results, and critical thinking.

In the process of independent work, the student gets the opportunity to:

- to consolidate and deepen the material studied in lectures and practical classes;
- learn to independently find and study professional sources of information;
- apply the learned algorithms to real or near-reality tasks;
- develop practical skills in programming, working with Python libraries and data visualization;
- master different approaches to solving the same problem, choose optimal methods, justify the choice made;
- prepare for the final control, demonstrating confidence in the basic concepts and algorithms.

In addition, independent work develops discipline, initiative, the ability to plan one's own learning and adapt to an ever-evolving subject area. These skills are especially important in the field of artificial intelligence, where the pace of technological change requires constant self-updating of knowledge.

Independent work is the planned educational, research, research work of students, performed in extracurricular (classroom) time on the assignment and under the methodological guidance of the teacher, but without his direct participation (with the partial direct participation of the teacher, leaving the leading role behind the work of students).

Independent work of students at the university is an important type of educational and scientific activity of the student. Independent work of students plays a significant role in the rating technology of education. Education at the university includes two parts that are almost the same in volume and mutual influence - the process of learning and the process of self-study. Therefore, the SRS should become an effective and purposeful work of the student.

The concept of modernization of Russian education defines the main tasks of vocational education - "training a qualified worker of the appropriate level and profile, competitive in the labor market, competent, responsible, fluent in his profession and oriented in related fields of activity, capable of effective work in the specialty at the level of world standards, ready for constant professional growth, social and professional mobility."

The solution of these problems is impossible without increasing the role of students' independent work on educational material, increasing the responsibility of teachers for the development of independent work skills, for stimulating the professional growth of students, fostering creative activity and initiative.

Society imposes a fairly wide list of requirements on a modern specialist, among which it is important that graduates have certain abilities and ability to independently obtain knowledge from various sources, systematize the information received, and assess a specific financial

situation. The formation of such a skill occurs during the entire period of study through the participation of students in laboratory classes, the performance of control tasks and tests, the writing of term papers and graduation qualification papers. At the same time, the independent work of students plays a decisive role in the entire educational process.

The forms of independent work of students are diverse. In this discipline "**Statistical Methods in Machine Learning**" the following are provided:

Use of the material of the educational and methodological complex of the discipline

At the first stage, it is necessary to familiarize yourself with the mandatory minimum content of the main educational program for the discipline studied. Next, it is necessary to study the work program of the discipline, which considers the content of the topics of the lecture course, the relationship between the topics of lectures and laboratory classes, topics and types of independent work.

Work with literature

For the successful development of the discipline, it is necessary to independently study the presented topics in detail according to the recommended sources of information that are presented in the curriculum.

Independent work introduces students to scientific creativity, the search for and solution of urgent modern problems.

GOALS AND MAIN TASKS OF THE SS

Goals of independent work:

- Deepening of theoretical knowledge gained at lectures;
- Consolidation of practical skills acquired at seminars;
- Development of skills to solve applied problems of machine learning in practice;
- Formation of a critical approach to the selection of models, parameters and metrics.

Forms of independent work:

- Study of recommended sources and lecture materials;
- Analysis and solution of the proposed tasks;
- Performing individual practical tasks in Jupyter Notebook;
- Preparation of mini-reports and interpretation of the results obtained;
- Independent revision of the material and preparation for testing.

The leading goal of the organization and implementation of SRS should coincide with the goal of teaching a student - the preparation of a bachelor with higher education. In the organization of SRS, an important and necessary condition is the formation of the ability to work independently to acquire knowledge, skills and the ability to organize educational and scientific activities.

The purpose of students' independent work is to master fundamental knowledge, professional skills and abilities in the profile, experience in creative and research activities. Independent work of students contributes to the development of independence, responsibility and organization, a creative approach to solving problems of the educational and professional level.

The objectives of the SRS are:

- systematization and consolidation of the theoretical knowledge and practical skills of students;
- deepening and expanding theoretical knowledge;

- formation of skills to use regulatory, legal, reference documentation and special literature;
- development of cognitive abilities and activity of students: creative initiative, independence, responsibility and organization;
- formation of independent thinking, abilities for self-development, self-improvement and self-realization;
- development of research skills;
- the use of material collected and obtained in the course of independent studies at seminars, laboratory classes, when writing term papers and final qualification papers, for effective preparation for final tests and exams.

TYPES OF INDEPENDENT WORK

In the educational process of a higher professional educational institution, two types of independent work are distinguished: classroom, under the guidance of a teacher, and extracurricular. The close relationship between these types of work provides for differentiation and effectiveness of the results of its implementation and depends on the organization, content, logic of the educational process (interdisciplinary connections, promising knowledge, etc.). :

Classroom independent work on the discipline is carried out in classes under the direct guidance of the teacher and on his assignment.

Extracurricular independent work is performed by the student on the instructions of the teacher, but without his direct participation.

The main types of independent work of students without the participation of a teacher in this discipline are:

- formation and assimilation of the content of lecture notes on the basis of educational literature recommended by the lecturer, including information educational resources (electronic textbooks, electronic libraries, etc.);

- preparation for laboratory work, their design.

The main types of independent work of students with the participation of teachers are:

- ongoing consultations;
- acceptance and defense of laboratory work (during the L/R).

ORGANIZATION OF THE SPC

The methodology for organizing students' independent work depends on the structure, nature and features of the discipline "**Statistical Methods in Machine Learning**", the number of hours for its study, the type of tasks for students' independent work, the individual qualities of students and the conditions of educational activity.

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

- preparatory (definition of goals, drawing up a program, preparation of methodological support, preparation of equipment);
- the main one (implementation of the program, the use of methods of information search, assimilation, processing, application, transfer of knowledge, recording of results, self-organization of the work process);
- final (assessment of the significance and analysis of the results, their systematization, assessment of the effectiveness of the program and methods of work, conclusions about the directions of labor optimization).

Recommended topics and tasks for self-study:

1. Data preparation and visualization

- Learn feature types, scaling and coding techniques.
- **Task:** select a dataset from 'sklearn.datasets' (e.g. 'wine' or 'breast_cancer'), visualize the distribution of features (histograms, paired graphs), apply 'StandardScaler' and 'OneHotEncoder'.

2. Linear and logistic regression analysis

- To study the mathematical foundations and methods of quality assessment.
- **Task:** train a linear regression model on Boston housing data, calculate MAE and R^2 ; build a logistic regression on 'breast_cancer' and build a ROC curve.

3. Retraining and regularization

- Learn the concepts of L1 and L2 regularization, the meaning of the 'C' parameter.
- **Task:** train a logistic regression with different regularization values on the 'digits' dataset and compare the results on the training and test samples.

4. Classification methods: KNN and SVM

- Compare the performance of models with different parameters.
- **Task:** implement KNN and SVM on the same set of data ('iris'), build precision graphs depending on the parameters ('k', 'C', 'kernel').

5. Model Ensembles

- Learn the basics of random forest and gradient boosting.
- **Task:** train the 'RandomForestClassifier' and 'GradientBoostingClassifier' models, compare their accuracy and feature importance ('feature_importances_').

6. Clustering methods

- To study the difference between K-means and hierarchical clustering.
- **Task:** Apply KMeans and Agglomerative Clustering to 'iris', compare the results with the true labels. Build a dendrogram.

7. Dimensionality reduction and visualization

- Study the PCA and t-SNE algorithms.
- **Task:** reduce the dimension of 'digits' with PCA to 2 components and visualize the result. Repeat with t-SNE.

8. Hyperparameter Selection

- Learn how to work with 'GridSearchCV'.
- **Task:** select the optimal parameters for SVMs using 'GridSearchCV' on the 'wine' dataset. Fix the evaluation metric.

Typical tasks for SRS:

General approach to assessment:

- Each task is evaluated on a **10-point scale**;
- The total grade for the independent work block can be calculated as an average or a sum (at the discretion of the teacher);
- It is possible to use **partial points (0.5, 1, etc.)** with partially completed points of the task;
- No points are awarded **for copying without comprehension, broken code, or missing interpretation.**

№	Task	Evaluation criteria (max. 10 points)
---	------	--------------------------------------

1	Explore the differences between supervised and unsupervised learning. Give 2 examples of each type of problem from a professional area.	2 points — correct theoretical definition; 4 points — relevant examples; 4 points — explanation and analysis of differences.
2	Load the <code>iris</code> or <code>wine</code> dataset. Perform a preliminary analysis: dimensionality, feature types, distributions.	3 points — data loading and description; 3 points — visualization of distributions; 4 points — interpretation of results.
3	Scale features using <code>StandardScaler</code> and <code>MinMaxScaler</code> . Compare the impact of scaling.	3 points — correct implementation; 3 points — visualization of changes; 4 points — analytical comparison.
4	Encode categorical features using <code>OneHotEncoder</code> and <code>OrdinalEncoder</code> , explain the difference.	3 points — correct implementation; 3 points — examples; 4 points — explanation of differences and when to apply what.
5	Build a linear regression model on Boston housing. Calculate MAE, MSE, R^2 .	2 points — data preparation; 4 points — implementation of the model and metrics; 4 points — interpretation of the results.
6	Build a logistic regression on <code>breast_cancer</code> , calculate metrics, build a ROC curve.	3 points — model training; 4 points — correct metric calculations; 3 points — ROC curve and conclusions.
7	Implement gradient descent manually for linear regression, plot the error function.	4 points — implementation without SKLEARN; 3 points — visualization; 3 points — interpretation of the graph.
8	Compare the work of KNN and SVM on the same dataset, visualize and compare metrics.	3 points — correct implementation; 3 points — visualization; 4 points — analytical comparison.
9	Build a decision tree on <code>iris</code> , visualize, analyze the signs of overtraining.	3 points — construction and visualization; 3 points — analysis of the structure of the tree; 4 points — signs of overtraining.
10	Train the <code>RandomForestClassifier</code> , compare it to the standard tree.	3 points — correct implementation of both models; 3 points — comparison of accuracy; 4 points — analysis of the importance of features.
11	Train the <code>GradientBoostingClassifier</code> on <code>wine</code> , select the parameters.	3 points — model training; 3 points — enumeration of parameters; 4 points — justification of the choice and comparison.
12	Cross-validate for logistic regression, compare with train/test.	3 points — CV implementation; 3 points — comparison of results; 4 points — conclusions about the stability of the model.
13	Find SVM hyperparameters using <code>GridSearchCV</code> , present a table.	3 points — implementation of the search; 3 points — table design; 4 points — justification of the choice.
14	K-means clustering on <code>iris</code> , comparison with real labels, silhouette score.	3 points — implementation; 3 points — comparison of clusters and labels; 4

		points — quality assessment.
15	Hierarchical clustering, dendrogram, determination of the number of clusters.	3 points — model construction; 3 points — visualization of the dendrogram; 4 points — correct interpretation.
16	Apply PCA to <code>digits</code> , render in 2D.	3 points — PCA implementation; 3 points — visualization; 4 points — interpretation of dimensional changes.
17	Compare PCA and t-SNE visualizations. Explain the identified structures.	3 points — implementation and graphs; 3 points — comparison of results; 4 points — explanation of differences.
18	To study the effect of regularization on logistic regression, to plot the dependence of accuracy on <code>C</code> .	3 points — experiment with <code>C</code> ; 3 points — graph; 4 points — interpretation and conclusions.
19	Make a table according to classification algorithms: pros, cons, application.	3 points — completeness of the table; 3 points — correctness of information; 4 points — clarity of wording and practicality.
20	Prepare a Jupyter Notebook with a full ML cycle on an arbitrary dataset.	2 points — data selection and loading; 4 points — completion of all stages (preprocessing, model, metrics); 4 points — logical structure and design.
21	Select any dataset from <code>sklearn.datasets</code> and perform exploratory data analysis (EDA).	4 — correct and diverse EDA; 3 — conclusions; 3 — neat design and visualization.
22	Implement code that checks for missing values and outliers.	3 — check code; 3 — visualization of emissions; 4 — interpretation.
23	Visualize feature correlations using a heatmap (<code>seaborn.heatmap</code>).	3 — correct code; 3 — visual visualization; 4 — conclusions about multicollinearity.
24	Compare scaling methods: <code>StandardScaler</code> , <code>MinMaxScaler</code> , <code>RobustScaler</code> .	4 — application of all methods; 3 — visualization; 3 — conclusions on differences.
25	Apply <code>PolynomialFeatures</code> and train polynomial regression.	3 — generation of new features; 4 — training and visualization; 3 — conclusions.
26	Implement the function of your own cross-validation splitting (without <code>sklearn</code>).	5 — implementation; 2 — correctness; 3 — explanation of logic.
27	To investigate the effect of unbalanced classes on the accuracy of logistic regression.	4 — creating/loading an unbalanced set; 3 — comparison; 3 — conclusions.
28	Use SMOTE to balance classes.	3 — correct application; 4 — comparison of the results before and after; 3 — conclusions.
29	Apply the classifier to randomly generated data (<code>make_classification</code>).	3 — Generation of the set; 4 — Training and metrics; 3 — Interpretation of the complexity of the task.

30	Investigate the impact of feature count on model performance.	3 — creation of dataset versions; 4 — training; 3 — graph/dependency analysis.
31	Implement greedy feature selection (<code>SelectKBest</code>) and compare with a model without selection.	3 — implementation; 4 — comparison of accuracy; 3 — conclusions.
32	Apply the Pipeline from <code>sklearn</code> for the full cycle: scaling + model.	4 — correct pipeline structure; 3 — conclusions; 3 — code refactoring.
33	Investigate the effect of outliers on KNN accuracy.	3 — creation of a set with outliers; 4 — metrics; 3 — analysis of model behavior.
34	Classify using <code>NaiveBayes</code> , compare with logistic regression.	3 — model training; 4 — metrics and table; 3 — conclusions.
35	Implement a voting method (<code>VotingClassifier</code>) based on 3 models.	3 — assembling the ensemble; 4 — comparison of accuracy; 3 — explanation of the effect.
36	Implement a random forest model using only the most important features.	3 — determination of importance; 4 — selection of features; 3 — comparison of quality.
37	Perform a regression using <code>Ridge</code> and <code>Lasso</code> .	3 — implementation; 4 — scales charts; 3 — comparison and interpretation.
38	Plot the dependence of classification accuracy on the proportion of the training sample.	4 — creation of splits; 3 — plotting; 3 — conclusions.
39	Compare the accuracy of models with normalized and non-normalized features.	3 — comparison; 4 — table of results; 3 — explanation of differences.
40	Write your own implementation of logistic regression (without <code>sklearn</code>).	4 — implementation; 3 — testing; 3 — comparison with <code>SKLEARN</code> .
41	Visualize the decisive boundaries for SVMs and KNNs on two-dimensional data.	4 — chart; 3 — annotation; 3 — explanation of features.
42	Compare models by training time and prediction time.	3 — correct measurements; 4 — graph or table; 3 — interpretation.
43	To study the impact of noise in data on classification.	3 — adding noise; 4 — comparison of models; 3 — conclusions.
44	Compare models for resilience to overfitting on small and large amounts of data.	4 — implementation; 3 — visualization of results; 3 — analysis.
45	Implement training and validation curves (<code>learning_curve</code>) for SVMs.	3 — code; 4 — graphs; 3 — interpretation.
46	Build a confusion matrix and analyze model errors.	3 — implementation; 4 — visualization; 3 — interpretation.
47	Implement an analysis of the impact of categorical features on the quality of the model before and after coding.	3 — examples; 4 — model results; 3 — explanation of differences.
48	Investigate the impact of unbalanced classes on decision trees and random forest.	3 — realization; 4 — comparison; 3 — interpretation.
49	Train a classification model on arbitrary text data (<code>TF-IDF</code> + logistic regression).	3 — preprocessing; 4 — training and metrics; 3 — conclusions.
50	To analyze the relationship between the number of features and model retraining.	3 — dimensionality change; 4 — training and graph; 3 — interpretation of results.

Students' Activities for the Formation and Development of Skills of Educational Independent Work

In the process of independent work, the student acquires the skills of self-organization, self-control, self-management, self-reflection and becomes an active independent subject of educational activity.

Performing independent work under the supervision of a teacher

The student must:

- master the minimum content submitted for independent work of students and proposed by the teacher in accordance with the educational standards of higher education;
- plan independent work in accordance with the schedule of independent work proposed by the teacher;
- the student must carry out independent work in the organizational forms provided for by the curriculum and the teacher's work program;
- perform independent work and report on its results in accordance with the schedule for submitting results, types and terms of reporting on students' independent work.

A student can:

in addition to the one proposed by the teacher (with justification and agreement with him) and the minimum mandatory content determined by the program for this discipline:

- independently determine the level (depth) of the study of the content of the material;
- to suggest topics and questions for independent study;
- within the framework of the general schedule for the performance of independent work, offer a reasonable individual schedule for the implementation and reporting on the results of independent work;
- offer their own options for organizational forms of independent work;
- to use for independent work methodological manuals, manuals, developments in addition to the list proposed by the teacher;
- to use not only control, but also self-control of the results of independent work in accordance with the methods of self-control proposed by the teacher or chosen independently.

Independent work of students should have an important impact on the formation of the personality of the future bachelor, it is planned by the student independently. Each student independently determines the mode of his work and the degree of work spent on mastering the educational content in each discipline. He performs extracurricular work according to a personal individual plan, depending on his preparation, time and other conditions.

Questions to check the CPS

1. What is machine learning? How is it different from rule-based programming?
2. What types of tasks are solved with supervised learning?
3. What is the difference between teaching with a teacher and teaching without a teacher?
4. Give examples of classification and regression problems.
5. What is training and test sampling? Why is it important to separate them?
6. What is overfitting and how can it be detected?
7. What methods can be used to combat overtraining?
8. What is the difference between L1 and L2 regularization?
9. What are features and target?
10. Why do we need methods for normalizing and standardizing features?
11. What is one-hot encoding and when is it used?
12. What is linear regression and what problems does it solve?
13. How are coefficients interpreted in a linear regression model?
14. What is logistic regression and how does it differ from linear regression?

15. What tasks is logistic regression suitable for?
16. How does the sigmoid function work and how is it used in logistic regression?
17. What is classification accuracy?
18. What's the difference between precision and recall?
19. When is it important to use an F1 measure?
20. What does the ROC curve and AUC show?
21. How does the nearest neighbor (KNN) method work?
22. How to choose the optimal number of neighbors in KNN?
23. What is Support Vector Method (SVM)?
24. What is the difference between a linear and a nonlinear kernel in SVM?
25. How Does Stochastic Gradient Descent Work?
26. Why use mini-batches when training a model?
27. What is a decision tree and how is it built?
28. How does the decision tree make a decision on new data?
29. Why do trees tend to overlearn and how to prevent it?
30. What are the advantages of ensemble models compared to single models?
31. What is a random forest and how does it work?
32. What is Gradient Boosting?
33. What is the difference between K-means and hierarchical clustering?
34. What is PCA and why is it used?
35. What is the difference between PCA and t-SNE?
36. What methods do you know for assessing the quality of clustering?
37. What are model hyperparameters?
38. How does GridSearchCV work and what is it for?
39. What Python libraries are used for machine learning?
40. How to interpret the results of the model and decide on their applicability?

GENERAL RECOMMENDATIONS FOR THE ORGANIZATION OF INDEPENDENT WORK

The main form of independent work of the student is the study of lecture notes, their supplementation, recommended literature, active participation in laboratory classes. But for successful educational activity, its intensification, it is necessary to take into account the following subjective factors:

1. Knowledge of school program material, the presence of a solid system of gaps necessary for mastering the main university courses. This is especially important for mathematical disciplines. It is necessary to distinguish gaps in knowledge that make it difficult to assimilate new material from small abilities. By spending effort to overcome these gaps, the student will ensure normal academic performance and believe in his abilities.
2. Availability of skills, skills of mental work:
 - a) the ability to take notes at lectures and when working with a book;
 - b) mastery of logical operations: comparison, analysis, synthesis, generalization, definition of concepts, rules of systematization and classification.
3. The specifics of cognitive mental processes: attention, memory, speech, observation, intelligence and thinking. Poor development of each of them becomes a serious obstacle in learning.
4. Good working capacity, which is ensured by normal physical condition. After all, serious learning is a large, versatile and diverse work. The result of learning is evaluated not by the amount of information communicated, but by the quality of its assimilation, the ability to use it and the development of one's ability for further independent education.
5. Correspondence of the chosen activity, profession to individual abilities. It is necessary to develop the ability to self-regulate one's emotional state and eliminate circumstances that disturb the business mood, interfere with the planned work.

6. Mastering the optimal style of work that ensures success in activities. Alternating work and pauses in work, rest periods, individually justified sleep duration, preference for evening or morning classes, stress resistance at exams and features of preparation for them,

7. The level of demands on oneself, determined by the established self-esteem.

An adequate assessment of knowledge, advantages, disadvantages is an important component of a person's self-organization, without it it is impossible to successfully manage one's behavior and activity.

One of the main features of education in higher school is that constant external control is replaced by self-control, the active role in learning belongs not so much to the teacher as to the student.

Knowing the basic methods of scientific organization of mental work, it is possible to achieve the best results with the least expenditure of time, money and labor efforts.

The effectiveness of assimilation of incoming information depends on the working capacity of a person at a particular moment of his activity.

Working capacity is the ability of a person to work with a high degree of intensity for a certain time. There are internal and external factors of working capacity.

Internal factors of working capacity include intellectual characteristics, will, and state of health.

External:

- organization of the workplace, work and rest schedule;
- the level of labor organization - the ability to obtain information and use information;
- the amount of mental load.

The outstanding Russian physiologist N. E. Vvedensky identified the following conditions for the productivity of mental activity:

- Any work should be entered gradually;
- dimensionality and rhythm of work. Different people have a more or less different pace of work;
- the usual sequence and systematicity of activity;
- correct alternation of work and rest.

Rest does not imply obligatory complete inaction on the part of a person, it can be achieved by a simple change of business. During the day, the working capacity changes. The most fruitful is the *morning time* (from 8 to 14 hours), and the maximum working capacity falls on the period from 10 to 13 hours, then the *afternoon* (from 16 to 19 hours) and the *evening* (from 20 to 24 hours). It is better to study the material that is very difficult to understand at the beginning of each period of time (preferably in the morning) after a good rest. After 1-1.5 hours, breaks of 10 - 15 minutes are needed, after 3 - 4 hours of work, the rest should be long - about an hour.

An integral part of the scientific organization of mental labor is the mastery of the technique of mental labor.

The time that the student has to complete the curriculum consists of two components: one of them is classroom work at the university according to the schedule of classes, the other is extracurricular independent work. Tasks and materials for independent work are given during classes according to the schedule, in the same classes the teacher controls independent work, and also assists students in the correct organization of work.

Self-study will require intensive mental work, which must not only be properly organized, but also stimulated. At the same time, it is very important to be able to maintain steady attention to the material being studied. The development of attention requires significant volitional efforts. That is why, if a student notices that he is often distracted during independent studies, he needs to force himself to concentrate. Such a procedure must be done constantly, as this is attention training. Sustained attention appears when a person treats the matter with interest.

It is necessary to properly organize your classes in time: 50 minutes - work, 5-10 minutes - break; after 3 hours of work, a break - 20-25 minutes. Otherwise, increasing fatigue will lead to

instability of attention. A very significant factor affecting the increase in mental performance is systematic physical education. The organization of active recreation provides for the alternation of mental and physical activity, which completely restores a person's working capacity.

EDUCATIONAL, METHODOLOGICAL AND INFORMATION SUPPORT OF THE DISCIPLINE

Reference citations:

Bolotsky, A. V.; Investigation of operations and optimization methods Electronic resource / Bolotsky A. V., Kochetkova O. A. - St. Petersburg : Lan, 2020. - 116 p. - ISBN 978-5-8114-4568-4

Saraev, P. V.; Methods of Machine Learning Electronic resource: Guidelines and tasks for laboratory work on the course / P. V. Saraev. - Lipetsk : Lipetsk State Technical University, EBS ASV, 2017. - 48 p. - The book is in the premium version of EBS IPR BOOKS. - ISBN 2227-8397

Sopov, E. A.; Multi-Criteria Neuroevolutionary Systems in Machine Learning and Human-Machine Interaction Electronic resource / Sopov E. A., Ivanov I. A. : monograph. - Krasnoyarsk : SibFU, 2019. - 160 p. - ISBN 978-5-7638-3969-2

Further reading:

Methodical recommendations for practical classes in the discipline "Theory and Practice of Machine Translation": Direction of training 45.04.02 Linguistics. Master's program "Translation and Translation Studies". Qualification of the graduate - master. Form of study - full-time. Curriculum of 2015. Studied in the 3rd semester. - Stavropol : NCFU, 2015. - 9 p.

Nedelko, V. M.; Fundamentals of Statistical Methods of Machine Learning Electronic resource: Textbook / V. M. Nedelko. - Novosibirsk: Novosibirsk State Technical University, 2010. - 72 p. - The book is in the premium version of EBS IPR BOOKS. - ISBN 978-5-7782-1385-2

Rapakov, G. G.; Methods and algorithms of machine learning in making management decisions in the regional system of medical prevention (experience of the Vologda region) Elektronnyi resurs / Rapakov G. G., Kasimov R. A. : monograph. - Vologda : VoSU, 2014. - 143 p. - ISBN 978-5-87851-548-1

Educational and methodical literature:

Saraev, P. V.; Methods of Machine Learning Electronic resource: Guidelines and tasks for laboratory work on the course / P. V. Saraev. - Lipetsk : Lipetsk State Technical University, EBS ASV, 2017. - 48 p. - The book is in the premium version of EBS IPR BOOKS. - ISBN 2227-8397