SYLLABUS
Spring semester 2025 – 2026 academic year
Educational program "6B06301 Information Security Systems"

ID and name of course	Independent work of the student (IWS)	Number of credits			General number of credits	Independent work of the student under the guidance of a teacher (IWST)
		Lectures (L)	Practical classes (PC)	Lab. classes (LC)		
102513 – Machine Learning	2	1,7	-	3,3	5	6

ACADEMIC INFORMATION ABOUT THE COURSE

Learning Format	Cycle, component	Lecture types	Types of practical classes	Form and platform final control
Offline	MD. University component. M-15: Cybersecurity technologies	Lecture	Laboratory work	DES MOODLE, Test
Lecturer - (s)	Ospan Assel			
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ACADEMIC COURSE PRESENTATION

Purpose of the course	Expected Learning Outcomes (LO) *	Indicators of LO achievement (ID)
The purpose of the discipline: to develop skills in using algorithms and machine learning methods, implemented using open source Python libraries to solve applied problems. Will be studied: ML algorithms – Regression (linear, logistic). Classification (Decision Trees, Support Vector Machine, Naive Bayes, Random Forest). Clustering (K- means, mean shift algorithm, hierarchical clustering). Neural networks.	1. Cognitive. Understand the basic concepts of machine learning methods	1.1. Can identify basic machine learning techniques (supervised learning, unsupervised learning, reinforcement learning).
		1.2 Can explain the application scenarios and limitations of each method.
	2. Functional. Solve classification, regression and clustering problems	2.1 Knows how to choose the appropriate machine learning algorithms to solve problems.
		2.2 Can implement algorithms using popular libraries in Python or other languages (sklearn, TensorFlow, PyTorch).
	3. Functional. Use data processing and dimensionality reduction techniques	3.1 Determines whether dimensionality is required to be reduced and selects the method that corresponds to the data.
		3.2 Is able to analyze the results using the dimensionality reduction method and explain its impact on the original model.
	4. Systemic. Evaluate and optimize models	4.1 Can use relevant metrics (accuracy, completeness, F1 measure, etc.) to evaluate models.
		4.2 Can use hyperparameter optimization techniques (e.g., grid search, random search, Bayesian optimization).
	5. Systemic. Apply and automate models in production systems	5.1 Is able to adapt the model to a specific application and create an appropriate data flow.
		5.2 Is able to adapt existing advances in data mining to specific business situations and goals. Knows the trends in the development of data mining methods.
Prerequisites	11767 - Object-oriented programming,	

	1657 - Theory of Probability and Mathematical Statistics
Postrequisites	97646 - Data Mining
Learning Resources	**Literature:** main, additional. 1. Géron, A. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques for Building Intelligent Systems / A. Géron; translated from English. — 3rd ed. — Saint Petersburg: Piter, 2023. — 832 p.: ill. — Parallel title in English. — ISBN 978-5-4461-2155-6. 2. Serrano, L. G. Grokking Machine Learning: A Practical Introduction to Machine Learning / L. G. Serrano. — Shelter Island, NY: Manning Publications Co., 2021. — In English. 3. Chollet, F. Deep Learning with Python / F. Chollet; translated from English. — 2nd ed. — Shelter Island, NY: Manning Publications, 2021. — 544 p.: ill. — In English. 4. Raschka, S.; Mirjalili, V. Machine Learning and Deep Learning with Python, scikit-learn, and PyTorch / S. Raschka, V. Mirjalili. — 2nd ed. — Birmingham: Packt Publishing, 2022. — 770 p. — In English. 5. McKinney, W. Python for Data Analysis / W. McKinney; translated from English. — 3rd ed. — Saint Petersburg: Piter, 2023. — 544 p.: ill. — ISBN 978-5-4461-2154-9. 6. Lee, K.-F.; Chen, C. AI 2041: Ten Visions for Our Future / K.-F. Lee, C. Chen; translated from English. — Moscow: Alpina Non-Fiction, 2022. — 384 p. 7. Müller, A. C.; Guido, S. Introduction to Machine Learning with Python / A. C. Müller, S. Guido; translated from English. — Updated ed. — Saint Petersburg: Piter, 2021. — 496 p.: ill. 8. Brownlee, J. Machine Learning: A Practical Guide for Engineers / J. Brownlee. — Melbourne: Machine Learning Mastery, 2021. — 362 p. — In English. 9. Goodfellow, I.; Bengio, Y.; Courville, A. Deep Learning for Practitioners: Foundations and Modern Applications. — Cambridge, MA: MIT Press, 2023. — 640 p. — In English. **Research infrastructure** 1. Computer classroom 2. Lecture room **Professional scientific databases** 1 sciencedirect.com 2 scopus.com **Internet resources** 1. https://elibrary.kaznu.kz/ru/ 2. Coursera Specialization: Statistics and Machine Learning 3. Coursera: Introduction to TensorFlow 4. https://www.python.org/ 5. Cisco Networking Academy: https://www.netacad.com 6. Python Tutor (RU): https://pythontutor.ru/lessons/inout_and_arithmetic_operations/ **Software** 1. Python (https://www.python.org/) 2. Jupyter Notebook

Academic course policy	The academic policy of the course is determined by the Academic Policy and the Policy of Academic Integrity of Al-Farabi Kazakh National University . Documents are available on the main page of IS Univer . **Integration of science and education.** The research work of students, undergraduates and doctoral students is a deepening of the educational process. It is organized directly at the departments, laboratories, scientific and design departments of the university, in student scientific and technical associations. Independent work of students at all levels of education is aimed at developing research skills and competencies based on obtaining new knowledge using modern research and information technologies. A research university teacher integrates the results of scientific activities into the topics of lectures and seminars (practical) classes, laboratory classes and into the tasks of the IWST, IWS, which are reflected in the syllabus and are responsible for the relevance of the topics of training sessions and assignments. **Attendance.** The deadline for each task is indicated in the calendar (schedule) for the implementation of the content of the course. Failure to meet deadlines results in loss of points. **Academic honesty.** Practical/laboratory classes, IWS develop the student's independence, critical thinking, and creativity. Plagiarism, forgery, the use of cheat sheets, cheating at all stages of completing tasks are unacceptable. Compliance with academic honesty during the period of theoretical training and at exams, in addition to the main policies, is regulated by the "Rules for the final control" , "Instructions for the final control of the autumn / spring semester of the current academic year" , "Regulations on checking students' text documents for borrowings". Documents are available on the main page of IS Univer . **Basic principles of inclusive education.** The educational environment of the university is conceived as a safe place where there is always support and equal attitude from the teacher to all students and students to each other, regardless of gender, race / ethnicity, religious beliefs, socio-economic status, physical health of the student, etc. All people need the support and friendship of peers and fellow students. For all students, progress is more about what they can do than what they can't. Diversity enhances all aspects of life. All students, especially those with disabilities, can receive counseling assistance by phone / e- mail assel.ospan@kaznu.kz or via video link in MS Teams *https://teams.microsoft.com/l/team/19%3Aafdfda9bdb1d4a60b6abe9db96fcaae1%40thread.tacv2/conversations?groupId=efed4caf-9211-410c-ab64-b489c7085133&tenantId=b0ab71a5-75b1-4d65-81f7-f479b4978d7b.*

INFORMATION ABOUT TEACHING, LEARNING AND ASSESSMENT

Score-rating letter system of assessment of accounting for educational achievements

Grade	Digital equivalent points	points, % content	Assessment according to the traditional system
A	4.0 _	/ 95-100	Great
A-	3.67	90-94	
B+	3.33	85-89	Fine
B	3.0	80-84	
B-	2.67	75-79	
C+	2.33	70-74	
C	2.0	65-69	Satisfactorily
C-	1.67	60-64	
D+	1.33	55-59	
FX	0,5	25-49	Unsatisfactory
F	0	0-24	

Assessment Methods

Criteria-based assessment is the process of correlating actual learning outcomes with expected learning outcomes based on clearly defined criteria. Based on formative and summative assessment.

Formative assessment is a type of assessment that is carried out in the course of daily learning activities. It is the current measure of progress. Provides an operational relationship between the student and the teacher. It allows you to determine the capabilities of the student, identify difficulties, help achieve the best results, timely correct the educational process for the teacher. The performance of tasks, the activity of work in the classroom during lectures, seminars, practical exercises (discussions, quizzes, debates, round tables, laboratory work, etc.) are evaluated. Acquired knowledge and competencies are assessed.

Summative assessment - type of assessment, which is carried out upon completion of the study of the section in accordance with the program of the course. Conducted 2 times per semester when performing IWS. This is the assessment of mastering the expected learning outcomes in relation to the descriptors. Allows you to determine and fix the level of mastering the course for a certain period. Learning outcomes are evaluated.

Formative and summative assessment	Points % content
Verification work on lectures	18
Work in laboratory classes	30
Independent work	12
Final control (exam)	40
TOTAL	100

Calendar (schedule) for the implementation of the content of the course. Methods of teaching and learning.

Week	Topic Name	Number of hours	Max. point
	Module 1 Basic Machine Learning Algorithms		
1	L 1. Introduction. Machine Learning Theory.	1	
	LW 1. Forecasting models. Examples.	2	6
2	L 2. Data preprocessing	1	

	LW 2. Solving linear regression problems. Evaluate the data model for a prediction task	2	6
	IWST 1. Consultation on the implementation of IWS 1.	1	
3	L 3. Linear, logistic, and polynomial regression.	1	
	LW 3. Data partitioning and polynomial regression.	2	6
4	L 4. Classes and OOP	1	
	LW 4. Completing the task by classes and OOP.	2	6
5	L 5. Optimized for machine learning. Introduction to the Kaggle platform.	1	
	LW 5. Penguin Classification Using Machine Learning	2	6
	IWST 2. Test work on the basic algorithms of ML.	1	10
6	L 6. Probability Theory	1	
	LW 6. A naïve Bayesian classifier. Examples.	2	6
7	L 7. Regularization Details	1	
	LW 7. Perform tasks on regularization details. Ensemble of models	2	7
	IWS 1. Project delivery using a family of supervised machine learning methods.	2	20
8	L 8. Unsupervised learning. Clustering methods.	1	
	LW 8. Performing tasks using k-means, EM, agglomerative and DBscan methods.	2	7
	IWST 3. Final test on the topics covered.	2	20
Midterm control 1			**100**
Module 2: Machine Learning Best Practices			
9	L 9. Boosting. Stacking	1	
	LW 9. Perform practical tasks using the GradientBoostingClassifier and AdaBoost methods	2	7
10	L 10. Recommendation systems.	1	
	LW 10. Performing tasks on recommendation systems using associative rules.	2	7
	IWST 4. Consultation on the implementation of IWS 2. Implementation of a project task for unsupervised learning.	2	
11	L 11. Time Series in Machine Learning	1	
	LW 11. Performing Time Series Problems and Interpolations.	2	7
12	L 12. Natural Language Processing (NLP)	1	
	LW 12. Text clustering using the Word2Vec method on PyTorch	2	7
13	L 13. Sentimental Analysis Using ML Algorithms	1	
	LW 13. Perform tasks on youtube comment classifications.	2	7
	IWST 5. Consultation on the completion of the final test.	2	
14	L 14. Introduction to deep learning. Deep learning tasks.	1	
	LW 14. Deep Learning Problem Solving	2	7
	IWS 2. Execution of project work on natural language processing.	2	20
15	L 15. Generative Deep Learning Models and Applications.	1	
	LW 15. Performing Transfer Learning Tasks	2	8
	IWST 6. Final testing on the topics covered.	2	30
Midterm control 2			**100**
Final control (exam)			**100**
TOTAL for course			**100**

RUBRICATOR OF THE SUMMATIVE ASSESSMENT

CRITERIA EVALUATION OF LEARNING OUTCOMES

IWS 1. Project delivery using a family of supervised machine learning methods. (20% of 100% MT 1)

Criterion	Score	ДЕСКРИПТОРЫ				
		"Excellent"	"Good"	"Satisfactory"	"Unsatisfactory"	
		10%	9-8%	7-6%	5-3%	2-0 %
Project design	10	The design meets all the requirements: a standard structure (title page, table of contents, main sections, conclusions and sources), correct text formatting (fonts, spacing, margins, indents) are used. Tables, graphs and images are aesthetically designed, have names and numbers.	Most of the design elements are done correctly, but there are minor inconsistencies. For example, insufficiently signed tables or formatting flaws.	The design is done, but with several significant drawbacks, for example, the lack of content or poor quality of graphs.	Design issues affect the perception of the project. There is no clear structure, tables and graphs are not signed, and some of the standard elements are missing.	The design is completely absent or extremely poor-quality.

Criterion	Score	ДЕСКРИПТОРЫ				
		"Excellent"	«Хорошо»	«Удовлетворительно»	"Excellent"	
		10%	9-8%	7-6%	10%	2-0 %
Effectiveness of the method used	10	The method has shown excellent results. An optimal technique is used, fully justified and proven to be effective (e.g., high accuracy of models, accurate conclusions based on data). All stages of the analysis are carried out consistently and logically.	The method is used effectively, but there may be minor omissions, for example, insufficient analysis of alternative solutions. The results are convincing, but the rationale for choosing a method is a bit limited.	The effectiveness of the method is limited: the chosen approach showed average results, more suitable methods for this type of data were not taken into account.	The method chosen is poorly substantiated. The results of the project are mediocre, the effectiveness of the method has not been proven, and errors are observed in the application.	The method used is completely ineffective, there is no logic in choosing an approach. The results do not correspond to the purpose of the study.

IWS 2. Implementation of project work on natural language processing. **(20% of 100% MT1)**

Criterion	Score	ДЕСКРИПТОРЫ				
		"Excellent"	«Хорошо»	«Удовлетворительно»	"Excellent"	
		10%	9-8%	7-6%	10%	2-0 %
Research of supervised learning methods	10	An in-depth study of the selected methods of supervised learning is presented. The differences between classification and regression, including the rationale for the applications, are well demonstrated. The details of the algorithms, limitations, advantages and applicability to various data sets are considered. The examples are clear and detailed.	The methods are presented correctly, the main aspects are disclosed, but there is a lack of depth in the analysis or justification for the choice of method for a particular task.	Understanding of supervised learning methods is partially demonstrated. The choice of approach to the problem is poorly substantiated, there may be gaps in the description or erroneous interpretation.	The study is performed superficially, most aspects of the methods are omitted. Understanding of supervised learning is limited.	The study of methods is absent or performed incorrectly.

Criterion	Score	ДЕСКРИПТОРЫ				
		"Excellent"	«Хорошо»	«Удовлетворительно»	"Excellent"	
		10%	9-8%	7-6%	10%	2-0 %
Conducting experiments according to the chosen method	10	The experiments were carried out qualitatively, various metrics were used to evaluate the results. Regularization, parameter adjustment, and comparison of model results are considered. The conclusions are clearly substantiated, confident mastery of the course material is demonstrated.	The experiments are performed at a high level, but the results are not presented in such detail, or there are small shortcomings in interpretation.	Experiments have been carried out, but the methodology is limited or not fully applied. Some results are left unanalyzed.	The experiments are carried out formally, the analysis of the data is superficial or erroneous. The main method is not fully demonstrated.	Lack of experiments or completely incorrect calculations.

Dean _____ **Imankulov T.**

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Lecturer _____ **Ospan A.**