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Chairman of the
Educational and Methodological
Council of JSC «International Information
Technology University»

_____ **Mustafina A.K.**

«12» December 2024 Protocol of the EMC № 3

APPROVED
By the Chairman of the Board - Rector
of the JSC «International Information
Technology University»

_____ **Issakhov A.A.**

«28» February 2025 Protocol of the AC № 10

EDUCATIONAL PROGRAM

7M06106 Data Science

Code and classification of the field of education: 7M06 Information and Communication technologies

Code and classification of study area: 7M061 Information and Communication technologies

Group of educational programs: M094 Information technologies

ISCED level: 7

NQR level: 7

ORC level: 7

Academic Degree Awarded: Master of Technical Sciences in the educational program «7M06106 - Data Science»

Duration of study: 2 years

Number of credits: 120

AGREED
by Director REDPRINT LLP
(Digital Agency NHDGI)

_____ M.M. Ryskeldi

«__» _____ 2025.

AGREED
Deputy Director for Research of the Institute of Ionosphere

_____ B.A. Iskakov

«__» _____ 2025.

Almaty, 2025

The code and name of the educational program: **7M06106 «Data Science»**

№	**Developers of the Educational Program (Position, Academic Degree, Scientific Degree, Full Name)**	**Date**	**Signature**	**Note**
1	Associate Professor of the Department of Mathematical and Computer Modeling, PhD Nurtas M.			
2	Associate Professor of the Department of Mathematical and Computer Modeling, PhD Ydyrys A.Zh.			
3	Associate Professor of the Department of Mathematical and Computer Modeling, PhD Abdikalikova Z.T.			

Contents

List of designations and abbreviations

CD	Cycle of core disciplines
BC	Basic competency
BM	Basic module
UC	University component
HE	Higher education
NMS	National Mandatory Standards of Higher and Post-Graduate Education
ATT	Additional types of training
EQF	European qualifications framework
EFE	European foundation for education
KSA	Knowledge, Skills and Abilities
FA	Final attestation
OC	Optional component
ISCED	International Standard Classification of Education
NQF	National qualifications framework
NQS	National qualifications system
GHM	General humanitarian module
RC	Required component
GEM	General education module
GED	Cycle of general education disciplines
AP	Academic program
GPM	General professional module
SQF	Sectoral qualifications framework
GEC	General education competence
PD	Cycle of profiling disciplines
PI	Professional internship
PS	Professional standard
PE	Postgraduate education
PC	Professional competence
PM	Professional module
LO	Learning outcome
QMS	Quality Management System
RW	Research work

1. Description of the educational program

Data Science is the science of methods for data analysis and extraction of valuable information and knowledge from them. It closely intersects with such areas as Machine Learning, Cognitive Science and, of course, Big Data. During the mass spread of technology, people have generated a huge amount of data. It is Big Data. And they can be of great use if properly processed. At all times before, computers received new opportunities through programming – a person created understandable algorithms for the machine, which led to the expected result. This approach is outdated.

For effective work with the big data another approach is needed, it was machine learning. In this case, a person only gives the computer some input, but the results of this algorithm are not determined by the person. Man determines how the machine learns, but the machine learns by itself; it comes to certain answers and analyzes them. Neural networks are self-learning networks (i.e. Machine Learning technology), arranged in the image and likeness of the human brain, which use Big Data as the material on which they learn. In other words, it is Data Science product.

All listed Science sections are studied in the EP "Data Science".

2. Goals and objectives of the educational program

The goal of the "Data Science" educational program is to study undergraduates of machine learning, deep learning and neural networks.

The objectives of the "Data Science" educational program are:

1. Receiving a good training in databases by master students.
2. Learning the machine learning methods by master students.
3. Study of the main methods of deep learning
4. Getting skills to work with neural networks.

3. Passport of the educational program

№	Field name	Note
1.	Code and classification of the field of education	7M06 Information and communication technologies
2.	Code and classification of study areas	7M061 Information and communication technologies
3.	Educational programs group	M094 Information technologies
4.	Name of the educational program	7M06106 Data Science
5.	Purpose of the EP	The purpose of the educational program "Data Science" is to study undergraduates of machine learning, deep learning and neural networks.
6.	Type of Educational Program	New EP
7.	Level according to NQF	7
8.	Level according to SQF	7
9.	EP distinctive features	No
10.	University - partner	No
11.	Degree to be conferred	Master
12.	Period of study	2 years
13.	Volume of the credits	120
14.	Language of education	English
15.	Atlas of new professions	Engineer-Developer of Artificial Neural Networks General Artificial Intelligence Developer Designer of Artificial Neural Networks
16.	Regional standard	No
17.	Existence of the annex to the license for	Yes

	the direction of personnel training	
18.	The license number on the direction of training	KZ81LAM00001263
19.	EP accreditation existence	Yes
20.	The formed educational outcomes	LO1: Demonstrate communication skills, initiative and psychological preparedness for work, including when working in a team and to make managerial and technical decisions LO2: Extract the desired information from various sources, including information flows in real time LO3: Argue the choice of basic standards, principles and design patterns, methods, tools and programming languages, including the choice of methods and means of building information security systems of modern ICT LO4: Apply research methodology in the field of data science LO5: Develop and/or use software, hardware, information, mathematical, functional support of information systems, including algorithms and methods of information security LO6: Build a mathematical model of energy problems LO7: Build 3D visualization LO8: Apply mathematical models and methods of various processes LO9: Create mathematical models using the methods of modern information technology LO10: Solve applied problems of data processing and analysis in order to identify hidden dependencies in them LO11: Carry out a comprehensive analysis and analytically summarize the results of scientific research using modern achievements of science and technology, skills of independent data collection, study, analysis and generalization.

4. Professional Standards (PS), Job Cards, Job Functions

№	Name of PS	Job card	Job functions
1	Professional Standard: for educators (faculty members) of higher and/or postgraduate education institutions	Lecturer, Assistant in the field of education, HE and/or postgraduate education (HEPGE)	Teaching Conducting scientific research
2		Lecturer, Senior Lecturer in the field of education, HE and/or postgraduate education (HEPGE)	Carrying out scientific and methodological work Teaching
3	Development of big data	Neural Network Specialist	Data preparation for use in neural systems Application of neural networks to solve complex

	processing and storage systems		problems in data processing
4		Machine Learning Specialist	Design and implementation of systems using machine learning
5		Computer Vision Programmer	Management of applications and equipment for computer vision

5. List of competences of the educational program:

GEC1: To know: social and ethical values based on public opinion, traditions, customs, social norms and be guided by them in their professional activities; traditions and culture of the people of Kazakhstan; human and civil rights and freedoms; the foundations of the legal system and legislation of Kazakhstan; trends in social development of society; the basics of physical culture and the principles of a healthy lifestyle.
GEC2: Have an idea about: the ethical and spiritual values; the sociological approach to personality, the basic laws and forms of regulation of social behavior; the nature of power and political life, political relationship and processes, the role of political systems in society and different social groups; the role of consciousness and self-awareness in behavior, communication and activities of people, the formation and development of personality.
GEC3: Possess: ethical and legal norms of behavior; a system of practical knowledge and skills ensuring the acquisition, development, improvement and activation of psychophysical abilities and qualities, the acquisition, preservation and strengthening of health, the ability to work in a team, correctly defend their point of view, propose new solutions.
GEC4: Ability to write and oral communication in the state language and the language of international communication; ability to logically correct, reasoned and clearly build oral and written speech; readiness to use one of the foreign languages
GEC5: Ability to use modern information technologies, manage information using business application programs; use network computer technologies, databases and application packages in their subject area
GEC6: To be competent to model financial and economic processes to solve specific problems
GEC7: The ability to predict financial and economic data using modern information technologies, computer technologies, databases and application packages programs in their subject area
BC1: The ability to actually use the state language, the language of international communication and foreign language in professional activities.
BC2: Ability to understand the basics of economic knowledge, scientific ideas about finance, economics.
BC3: Ability to professional use of modern equipment, devices, network components, computer systems (in accordance with the objectives of the program), as well as use the rules of safety, industrial hygiene, fire safety and labour protection standards.
BC4: Ability to possess skills of using algorithms and programs for calculating parameters of business processes.
BC5: The ability to use the basic provisions and methods for solving problems, the ability to carry out project documentation in the software environment of computer graphics for various types of projects.
BC6: The ability to be competent in the choice of mathematical modeling methods for solving specific problems, including the willingness to identify the natural scientific essence of the problems arising in the course of professional activity, and the ability to involve the appropriate physical and mathematical apparatus to solve it.
BC7: The ability to develop information and software information systems based on modern methods and development tools.
BC8: Ability to find limits, uncover uncertainties; differentiate and integrate basic elementary functions; investigate functions using differential calculus; apply the methods of differential and integral calculus in solving applied problems. be able to classify differential equations and apply the necessary methods to solve these equations; solve linear differential equations of order n and

systems of linear equations with constant coefficients; find the quiescent points of the autonomous system.
PC1: The ability to create mathematical models using the methods of modern information technologies
PC2: The ability to model problems of pollution of ecological systems and forecast cause-and-effect relationships in the ecological system
PC3: The ability to model energetical problems
PC4: The ability to build the problem solution algorithm
PC5: The ability to apply the software programs to solve the problem
PC6: The ability to build 3D visualizations

6. Educational program learning outcomes

LO1: Demonstrate communication skills, initiative and psychological preparedness for work, including when working in a team and making managerial and technical decisions
LO2: Extract the desired information from various sources, including information flows in real time
LO3: Argue the choice of basic standards, principles and design patterns, methods, tools and programming languages, including the choice of methods and means of building information security systems of modern ICT
LO4: Apply research methodology in the field of data science
LO5: Develop and/or use software, hardware, information, mathematical, functional support of information systems, including algorithms and methods of information security
LO6: Build a mathematical model of energy problems
LO7: Build 3D visualization
LO8: Apply mathematical models and methods of various processes
LO9: Create mathematical models using the methods of modern information technology
LO10: Solve applied problems of data processing and analysis in order to identify hidden dependencies in them
LO11: Carry out a comprehensive analysis and analytically summarize the results of scientific research using modern achievements of science and technology, skills of independent data collection, study, analysis and generalization.

7. Correlation matrix of learning outcomes of the educational program with the formed competencies

	LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	LO9	LO10	LO11
BC1	V					V					
BC2		V			V	V				V	
BC3	V		V				V				
BC4						V		V	V	V	
BC5	V	V	V	V							V
BC6		V	V					V			V
BC7			V				V				
BC8						V				V	V
PC1	V		V						V		
PC2						V			V	V	V
PC3								V			V
PC4				V	V	V					V
PC5			V				V		V	V	
PC6					V					V	

8. Correlation of Learning Outcomes (LO) with Job Functions

№	LO	Job functions
1.	LO1	Teaching Carrying out scientific and methodological work
2.	LO2	Conducting scientific research Data preparation for use in neural systems
3.	LO3	Teaching Data preparation for use in neural systems Design and implementation of systems using machine learning
4.	LO4	Conducting scientific research Carrying out scientific and methodological work
5.	LO5	Data preparation for use in neural systems Application of neural networks to solve complex problems in data processing
6.	LO6	Conducting scientific research Data preparation for use in neural systems
7.	LO7	Conducting scientific research Teaching Data preparation for use in neural systems
8.	LO8	Conducting scientific research Teaching Carrying out scientific and methodological work
9.	LO9	Conducting scientific research Data preparation for use in neural systems Design and implementation of systems using machine learning
10.	LO10	Management of applications and equipment for computer vision Design and implementation of systems using machine learning Application of neural networks to solve complex problems in data processing
11.	LO11	Conducting scientific research Carrying out scientific and methodological work

9. Table of relationships between competencies, learning outcomes, assessment methods and criteria

Competencies of an EP graduate	Competencies expressed in expected learning outcomes	Evaluation criteria	Name of assessment method
Basic competencies			
BC2 BC6 BC8	LO2	Knows the basic concepts of the area under study	Test
	LO3	Knows the basic concepts of the area under study	Case study
	LO8	Knows the basic concepts of the area under study	Test
	LO4	Knows how to apply mathematical methods to solve various problems	Workbook
	LO5	Knows the basic concepts of the area under study	Case study
	LO11	Knows the basic concepts of the area under study	Control work
	LO9	Knows the basic concepts of the area under study	Case study
BC3 BC4 BC5 BC7	LO1	Applies acquired knowledge to solve practical problems	Project
	LO2	Solve complex problems based on acquired knowledge	Multi-level tasks and assignments
	LO3	Applies acquired knowledge to solve practical	Project

		problems	
	LO5	Applies acquired knowledge	Laboratory work
	LO6	Applies acquired knowledge to solve practical problems	Project
	LO9	Applies acquired knowledge to solve practical problems	Project
	LO10	Applies acquired knowledge to solve practical problems	Project
	LO11	Solving complex problems based on acquired knowledge	Multi-level tasks and assignments
BC1	LO1	Able to present his ideas in a compelling manner	Colloquium
	LO6	Able to communicate clearly in writing	Summary
Basic competencies			
PC1 PC3 PC4 PC5	LO1	Applies acquired knowledge to solve practical problems	Project
	LO3	Applies acquired knowledge to solve practical problems	Project
	LO8	Applies acquired knowledge to solve practical problems	Project
	LO9	Applies acquired knowledge to solve practical problems	Calculation and graphic work
	LO5	Applies acquired knowledge	Laboratory work
	LO10	Applies acquired knowledge to solve practical problems	Project
	LO11	Applies acquired knowledge to solve practical problems	Project
PC2 PC6 PC7	LO2	Able to present his ideas in a compelling manner	Laboratory work
	LO8	Able to retrieve necessary information	Colloquium
	LO9	Able to present his ideas in a compelling manner	Laboratory work
	LO10	Able to present his ideas in a compelling manner	Laboratory work
	LO11	Able to retrieve necessary information	Colloquium
PC8	LO11	Able to apply acquired knowledge in the chosen additional educational program	Project

10. Information about the modules of the educational program

Module code / Module name	Module volume (work intensity)	Learning outcomes	Criteria for assessing learning outcomes	Disciplines forming the module Code and Name
BASIC MODULES				
BM7502 Humanitarian and pedagogical module	20	Understands the meaning of world knowledge, analysis evaluation and comparison of various theoretical concepts in the field of scientific research. Knows critical analysis of current events. Works with scientific apparatus and sources.	Oral interview, testing, report, midterm control, semester work	History and philosophy of science
		Knows English as the language of communication in the scientific environment, sources of information and knowledge bases.		Foreign Language (professional)
		They are competent in the field of scientific and scientific-pedagogical activity in the conditions of rapid updating and growth of information flows.		Higher education: psychological and pedagogical development strategies
		Master's methods of planning and conducting classes, acquires skills of pedagogical communication and assessment of students' academic achievements. Develops the ability to apply modern educational technologies and analyze their own teaching activities.	Report	Pedagogical practice
BM7504 Module of computing technologies and scientific activity	15	Masters numerical modeling methods and their implementation in Python for data analysis and model building. Acquires skills in developing and verifying numerical algorithms, visualizing results, and solving applied problems in the field of Data Science.	Oral interview, testing, report, midterm control, semester work	Numerical simulations using Python for DS
		Studies the architectures of deep neural networks used in computer vision tasks, such as classification, segmentation, and object detection. Masters practical skills in developing and training models using frameworks (e.g., TensorFlow, PyTorch) and analyzing the results.		Deep Learning in computer vision
		Gets acquainted with the basics of high-performance computing (HPC) and the principles of parallel programming using MPI. Acquires skills in developing and running parallel applications for processing big data and modeling in DS tasks.		Introduction to HPC with Mpi for DS
		In-depth studies of the principles of designing, optimizing and scaling relational and non-relational databases. Masters working with advanced SQL capabilities, indexing, transactions, as well as modern DBMS, including distributed data storage systems.		Databases: Advanced
		Masters the basics of the PL/SQL programming language in the Oracle 11g environment, including creating procedures, functions, packages, and triggers. Acquires skills in data processing and transaction management to automate		Oracle database 11g: PLSQL Fundamentals (Oracle)

		database operations.		
		Study of types of scientific research, methodology of scientific knowledge, research, drawing conclusions and findings, writing scientific articles and conference reports, summarizing the results of research work in a dissertation, its structure and content.	Oral interview, testing, report, midterm control, semester work	Fundamentals of research work
		Learns the principles of the Bayesian approach to statistical analysis, including prior and posterior distributions. Masters methods for constructing and interpreting probabilistic models to analyze uncertainty in data.	Oral interview, testing, report, midterm control, semester work	Bayesian statistics and analysis
		Masters methods for analyzing multivariate data, including clustering, discriminant analysis, component and factor analysis. Apply acquired knowledge to identify hidden structures and dependencies in complex data sets.		Applied multivariate statistical analysis
PROFILING MODULES				
PM7501 Neural network module	28	Knows mathematical models of liquid and gas dynamics, physics, chemistry, biology, mechanics, Economics, Finance, which consist mainly of a system of differential equations, partial differential equations, stochastic equations, random processes.	Oral interview, testing, report, midterm calculation and graphic works	Methods of mathematical modeling
		Know the theory of machine learning, including discriminant cluster and regression analysis, and master the skills of practical solutions to data mining problems.		Machine learning 1, 2
		Develops software in the field of machine learning, a mathematical model of a neuron.		Problem of neural network retraining and data augmentation
		Gains experience in independently conducting scientific research, including formulating goals, choosing methods, collecting and analyzing data. Develops skills in critical thinking, presenting scientific results, and preparing publications.	Report	Research practice
PM7503 Mathematical modeling and data mining module	10	Can use programming skills to build predictive models, visualize data, and work with neural networks.	Oral interview, testing, report, midterm calculation and graphic works	Python/R for data analysis
		Studies methods of mathematical modeling of enumerative combinatorics problems, including recurrence relations, generating functions and inclusion-exclusion principles. Masters the application of these methods for analyzing and solving combinatorial problems in various applied areas.		Mathematical modeling of enumerative combinatorics
		Studies the principles of developing and applying artificial intelligence systems to solve social and humanitarian problems. Masters approaches to creating ethical, fair and sustainable AI solutions in the fields of healthcare, education, ecology and social support.		Artificial Intelligence for Social Good
PM7502 Applied Artificial Intelligence and Scientific Computing module	15	Masters modern methods of advanced data analysis, including regression models, dimensionality reduction methods, clustering and classification. Acquires skills in processing, interpreting and visualizing complex data sets to	Oral interview, testing, report, midterm	Advanced Data Analysis

		extract meaningful insights.	calculation and graphic works	
		Studies fundamental and applied optimization methods, including gradient, stochastic and numerical approaches applicable to Data Science problems. Masters the formulation and solution of optimization problems in the context of model training, parameter tuning and improving computational efficiency. Acquires skills in applying optimization algorithms in real data analysis projects.		Optimization methods for DS applications
		Studies methods of mathematical modeling of threats and vulnerabilities in cybersecurity, including graph theory, probabilistic models and dynamic systems. Masters approaches to risk analysis, attack modeling and development of information system protection strategies.		Mathematical modeling of cybersecurity
		Studies finite difference methods for numerical solution of partial differential equations, including explicit and implicit schemes. Masters construction, stability analysis and convergence of difference schemes, as well as their application in applied problems of mathematical modeling.		Finite-difference methods for partial differential equations
		Explores deep learning architectures and algorithms, including convolutional, recurrent, and transformer neural networks. Learns how to apply these models to real-world problems, such as image, text, and time series processing, using modern frameworks.	Oral interview, testing, report, midterm calculation and graphic works	Applied Deep Learning
		Learns exploratory data analysis (EDA) techniques, including identifying patterns, outliers, and hidden structures. Acquires data visualization skills using modern tools to effectively interpret and present analysis results.		Exploratory data analysis and visualization
		Studies the application of machine learning methods to solving inverse problems arising in physics, engineering, and applied mathematics. Masters approaches to approximating hidden dependencies, reconstructing parameters, and increasing the stability of solutions using neural networks and regression models.	Oral interview, testing, report, midterm calculation and graphic works	Machine learning methods for solving inverse problems
		Studies the principles of parallel computing, including parallelism models, synchronization, and task distribution. Masters tools and technologies for developing parallel programs to speed up computations in data processing and scientific modeling tasks.		Parallel computation
Scientific research work	24	Knows the organizational structure and complex of technical means of the information and analytical center (IAC) of organization. Can identify the main tasks solved by the IAC. Knows the mathematical support for the selected task (set of tasks or subsystem) and software for the selected task (set of tasks or subsystem), organizational and legal support for the selected task (set of tasks or subsystem). systematization and analysis of actual materials required for writing a course paper, scientific report, and internship report.	Report	The research work of a student, including an internship and implementation of master's thesis

11. Information about the disciplines of the educational program

№	Name of module / discipline	Brief description of discipline (30-50 words)	Number of credits	Formed competences (codes)	Prerequisites	Post-requisites
Basic disciplines University component						
1.	Higher education: psychological and pedagogical development strategies	The discipline focuses on studying psychological and pedagogical strategies for the development of higher education, as well as forming competencies in designing and organizing the educational process. Master's students will master modern psychological and pedagogical approaches to teaching, methods for diagnosing and assessing students, as well as digital and inclusive education technologies. Special attention is given to the development of pedagogical, research, and communication skills, as well as the prevention of professional burnout among educators. Upon completion of the course, students will be able to develop and implement effective educational strategies in universities.	6	LO1	-	Teaching Practice
2.	Foreign language (professional)	It is a one-semester practical course that tailors the English language program to the Master's students' professional/research needs. During the course the Master's students will work on an individual project and a research portfolio. By the end of the course, students will organize and present research portfolio.	5	LO1 LO3	-	-
3.	History and philosophy of science	The purpose of the discipline is to form the skills of working with scientific literature; logical, systemic, and critical thinking skills. The discipline will study: the main stages of the development of science; history and philosophy of science to form a conscious attitude to the environment and history, the basic principles of research activities.	5	LO1	-	-
4.	Teaching Practice	The course is aimed at developing master's students' professional competencies in the field of teaching. As part of the practice, students master methods of organizing the educational process, conduct classes, develop methodological materials and analyze their own teaching activities.	4	LO1 LO3		
The cycle of basic disciplines Elective components						
5.	Elective courses 1		5			
	Numerical simulations using Python for DS	The purpose of the course is to study and apply methods such as the finite difference method, the pseudospectral method, the method of linear and spectral elements to the 1D (or 2D) scalar wave equation, the algorithm of which is written in Python. The main focus is on illustrating the fundamental mathematical components of various numerical methods (e.g. Taylor series, Fourier series, differentiation, function interpolation, numerical integration) and how they are compared.		LO3 LO6 LO8 LO9	Python/R for Data Analysis	-
	Deep Learning in computer vision	The purpose of this course is to introduce undergraduates to computer vision, starting with		LO2 LO4	Machine	-

		the basics and then moving on to more modern models of deep learning. We consider the recognition of images and videos, including classification and annotation of images, object recognition and image retrieval, various methods of object detection, motion estimation, object tracking in video, recognition of human actions and, finally, styling the images, editing and generation of a new image. As part of the course project, undergraduates will learn how to build a system of facial recognition and manipulation to understand the internal mechanics of this technology, probably the most famous and often demonstrated in films and TV shows on the example of computer vision and artificial intelligence.		LO10	Learning	
	Introduction to HPC with Mpi for DS	The aim of the course is to acquire skills in parallel programming for high-performance computing using Message Transfer Interface (MPI) standards and in high-performance data analytics on computer clusters.		LO3 LO6 LO8 LO9	Machine Learning	-
	Databases: Advanced	The purpose of the discipline "Database advanced course" is the development of students ' professional skills in the design of relational database models, the General principles of construction and functional features of the main database management systems (DBMS), presented on the software market, the construction of information systems based on the architecture of "client-server" using database management systems, features of the language SQL.		LO4 LO7 LO9 LO10	Database Theory	
	Oracle database 11g: PLSQL Fundamentals (Oracle)	This course introduces study about data base management systems, actually working with PL SQL. Course demonstrates some of the power of PL SQL Programming. Students will have some common tasks that come up when dealing with structured data. During this course students learn how to create subprograms as procedures and functions, working with simple and complex data types, working with cursors, using triggers in their code.		LO4 LO7 LO9 LO10	Algorithms and data structures	
6.	Fundamentals of research work	The study of types of scientific research, the methodology of scientific knowledge, research, the formation of conclusions and conclusions, writing scientific articles and reports at the conference, summarizing the results of research work in a dissertation, its structure and content.	5	LO4 LO11	Research methodology	-
7.	Elective courses 2		5			
	Bayesian statistics and analysis	This course will allow undergraduates to develop skills in statistics, Bayesian statistics, Bayesian inference, programming in R. The course covers topics such as Bayesian methods, mixed models and dynamic linear modeling, which will give undergraduates the skills necessary to perform analysis, engage in forecasting and create statistical models using real data.		LO2 LO8 LO9 LO11	Statistics for data analysis	
	Applied multivariate statistical analysis	The course describes the basic questions of the statistical analysis: confidence intervals, hypothesis testing, regression and analysis of variance. The course also touches on some modern methods of regression analysis: regression based on Gaussian processes and generalized linear models.		LO4 LO8 LO10 LO11	Statistics for data analysis	-

Cycle of profiling disciplines University components						
8.	Machine Learning 1	This course focuses on the main types of machine learning tasks — mainly classification, regression and clustering. It provides knowledge about the basic methods of machine learning and their features, teach to assess the quality of models — and decide whether the model is suitable for a specific task. Introduces modern libraries that implement the discussed models and methods for assessing their quality.	5	LO2 LO4 LO10	Linear Algebra	Machine Learning 2
9.	Machine Learning 2	The purpose of the course is an in-depth study of the methods of applying machine learning to solve practical problems.	5	LO7 LO9	Machine Learning 1	Applied Deep Learning
10.	Methods of mathematical modelling	The purpose of this course is to study approximate methods for solving various applied problems. Each method is accompanied by the compilation of an algorithm and the development of a software product. Investigation of various properties of methods based on computational experiments.	5	LO7 LO9	Numerical Methods	
11.	The problem of retraining neural networks, data argumentation	The first lesson on neural networks - an introduction to the niche, the path of the developer in the field of machine learning, a mathematical model of the neuron, the principles of neural network training and training of the first neural network on the example of digit recognition.	5	LO2 LO4 LO10	Applied Deep Learning	
12.	Research Internship	The course is aimed at developing the research skills of master's students. During the internship, students formulate scientific goals, collect and analyze data, apply methods of scientific justification, and prepare materials for publications and scientific presentations.	8	LO2 LO11		
Cycle of profiling disciplines Elective components						
13.	Python/R for analysing data	The aim of the course is to acquire programming skills for building predictive models, data visualization and working with neural networks in Python/R when solving practical problems.	5	LO4 LO7 LO9 LO10	Python programming	Numerical Simulation Using Python
14.	Elective courses 3		5			
	Mathematical modeling of enumerative combinatorics	The aim of the course is to acquire skills in applying the methods of enumerative combinatorics to scientific research in various fields. The course covers topics such as binomial coefficients, the inclusion and exclusion formula, nonlinear repetition: the versatility of Catalan numbers, generating functions, generating functions, the Euler generating function for partitions and the pentagonal formula.		LO1 LO5 LO6 LO11	Mathematical Analysis	-
	Artificial Intelligence for Social Good	Students will learn and apply advanced artificial intelligence techniques for real social benefits such as healthcare, education and the environment. The goal of this lesson is to give students the opportunity to apply these methods outside the classroom. The class will focus on		LO1 LO4 LO5 LO7	Machine Learning	-

		machine learning and deep learning methods, including regression, reference vector machines (SVMs), neural networks, convolutional neural networks (CNNs), and recurrent neural networks (RNNs). The course alternates with lectures on the theory of machine learning and discussions that will offer students to apply methods in their areas of social welfare.				
15.	Elective courses 4		5			
	Advanced Data Analysis	Undergraduate students will gain a deep understanding of parallel processing of massive data, their research and visualization, as well as advanced machine learning and deep learning. Understanding the mathematical foundations of all machine learning algorithms and deep learning. A master's degree student can apply knowledge in practical use cases, justify architectural solutions, understand the characteristics of various algorithms, structures and technologies and how they affect the performance and scalability of the model.		LO2 LO4 LO10	Database Theory	-
	Optimization methods for DS applications	This course offers an introduction to nonlinear mathematical optimization with applications in data science. The theoretical foundation and the fundamental algorithms for nonlinear optimization are studied and applied to supervised learning models, including nonlinear regression, logistic regression, support vector machines, and deep neural networks. Students write their own implementation of the algorithms in the Python programming language and explore their performance on realistic data sets.		LO3 LO6 LO8 LO9	Neural Networks	-
	Mathematical modeling of cybersecurity	The aim of the course is to apply mathematical modeling methods to solve cybersecurity problems.		LO1 LO5 LO6 LO11	Methods of mathematical modeling	-
	Finite-difference methods for partial differential equations	The goal of the course is to give students knowledge about finite-difference methods for solving the initial-boundary-value problem posed for equations of parabolic, hyperbolic and elliptic types.		LO2 LO8 LO9 LO11	Differential equation	-
16.	Elective courses 5		5			
	Applied Deep Learning	The purpose of this course is to introduce undergraduates to computer vision, starting with the basics and then moving on to more modern models of deep learning. We consider the recognition of images and videos, including classification and annotation of images, object recognition and image retrieval, various methods of object detection, motion estimation, object tracking in video, recognition of human actions and, finally, styling the images, editing and generation of a new image. As part of the course project, undergraduates will learn how to build a system of facial recognition and manipulation to understand the internal mechanics of this technology, probably the most famous and often demonstrated in films and TV shows on the		LO2 LO4 LO8 LO9 LO10 LO11	Machine Learning	-

		example of computer vision and artificial intelligence.				
	Exploratory data analysis and visualization	The goal for the course is to emphasise on the tools and techniques of visual business intelligence to help you make better use of your valuable information assets. Visualization is a tool to explore trends, relationships, confirm hypothesis, communicate findings and gain insight about data. This course will focus on teaching participants the principles and techniques for creating interactive visual representations from raw data in particular for quantitative analysis		LO2 LO5 LO7 LO9 LO11	-	-
17.	Elective courses 6		5			
	Machine learning methods for solving inverse problems	The purpose of the course is to provide students with knowledge of methods for solving inverse and ill-posed problems widely used in practice and production using machine learning based on mathematical modeling of processes occurring in the selected area of the object under study.		LO4 LO6 LO7 LO8 LO11	Machine Learning	-
	Parallel computation	The purpose of the course is to study the basic architecture of the MVS, with two standards (OpenMP and MPI), the development of parallel programs for systems with shared and distributed memory. Using practical examples, the main structures and ways of distributing work will be analyzed.		LO1 LO2 LO4 LO10	Database Theory	-

12. Educational program curriculum (Платонус)

№	Module Code	Module Name in Three Languages (Kazakh / Russian / English)	Discipline code	Course Name in Three Languages (Kazakh / Russian / English)	Cycle (GED, BD, MD)	Component (RC, EC, UC)	Total Credits (ECTS)	Total Academic Hours	Number of contact hours				Number of hours		Assessment Method (Att. 1, Att. 2, Exam, Coursework/Project, Differentiated Pass/Fail, Thesis/Dissertation Defense)	Prerequisites (Course Code)
									Total contact hours	including:			Total SIS hours	including TSIS		
										Lectures	Practical sessions (seminars)	Laboratory sessions				
1	2	3	4	5	6	7	8	9	10	11	12	13	1	2	3	4
1 course																
1 semester																
1		Ғылыми зерттеу жұмысы/ Научно-исследовательская работа/ Scientific research work	RW7001	Магистранттың ғылыми-зерттеу жұмысы, оның ішінде тағылымдама және магистрлік диссертациясының орындалуы / Научно-исследовательская работа магистранта, включая прохождение стажировки и выполнение магистерской диссертации (НИРМ) / The research work of a student, including an internship and implementation of master's thesis	GED	RC	2	60	0	0	0	0	60	15	report, diff.offset	-
2	BM7502	Гуманитарлық және педагогикалық модуль / Гуманитарно-педагогический модуль/ Humanitarian and pedagogical module	SPS7001	Тарих және ғылым философиясы / История и философия науки / History and philosophy of science	BD	UC	5	150	45	30	15	0	105	15	MT,ET, exam	-
3	BM7502	Гуманитарлық және педагогикалық модуль / Гуманитарно-педагогический модуль/ Humanitarian and pedagogical module	SPS7002	Жоғары мектеп: психологиялық-педагогикалық даму стратегиялары / Higher education: psychological and pedagogical development strategies	BD	UC	6	180	60	30	30	0	120	15	MT,ET, exam	-
4	PM7501	Нейрондық желілер модулі/ Модуль нейронных сетей/ Neural network module	MAT7508	Машиналық оқыту 1 / Машинное обучение 1 / Machine Learning 1	MD	UC	5	150	45	15	30	0	105	15	MT,ET, exam	-

5	PM7501	Нейрондық желілер модулі/ Модуль нейронных сетей/ Neural network module	MAT7531	Математикалық модельдеудің әдістері / Методы математического моделирования / Methods of mathematical modelling	MD	UC	5	150	45	15	30	0	105	15	MT,ET, exam	
6	PM7503	Математикалық модельдеу және деректерді талдау модулі/ Модуль математического моделирования и интеллектуального анализа данных/ Mathematical modeling and data mining module	MAT7506	Деректерді талдау үшін Python/R / Python/R для анализа данных / Python/R for analysing data	MD	EC	5	150	45	15	30	0	105	15	MT,ET, exam	
7	BM7504	Есептеу технологиясы және ғылыми қызмет модулі/ Модуль вычислительных технологий и научной деятельности / Module of computing technologies and scientific activity	MAT7552	DS үшін Python көмегімен сандық модельдеу / Численное моделирование с использованием Python для DS / Numerical simulations using Python for DS	BD	EC	5	150	45	15	30	0	105	15	MT,ET, exam	
			MAT7522	Компьютер көзқарасында терең оқыту / Глубокое обучение в компьютерном зрении / Deep Learning in computer vision												
			MAT7542	DS үшін Mpi бар HPC-ге кіріспе / Введение в HPC с Mpi для DS / Introduction to HPC with Mpi for DS												
			MAT7502	Деректер қоры: Жоғары деңгейлі / Базы данных: Продвинутый / Databases: Advanced												
			MAT7532	Oracle database 11g: PLSQL негіздері (Oracle) / База данных Oracle 11g: Основы PLSQL (Oracle) / Oracle database 11g: PLSQL Fundamentals (Oracle)												
				In total for 1st semester:			**33**	**990**	**285**	**120**	**165**	**0**	**705**	**105**		
2 semester																
8		Ғылыми зерттеу жұмысы/ Научно-исследовательская работа/ Scientific research work	RW7002	Магистранттың ғылыми-зерттеу жұмысы, оның ішінде тағылымдама және магистрлік диссертациясының орындалуы / Научно-исследовательская работа магистранта, включая прохождение стажировки и выполнение магистерской диссертации (НИРМ) / The research work of a student, including an internship and implementation of master's thesis	GED	RC	3	90	0	0	0	0	90	15	report, diff.offset	
9	BM7502	Гуманитарлық және педагогикалық модуль / Гуманитарно-педагогический модуль/ Humanitarian and pedagogical module	LAN 7001A	Шет тілі (кәсіби) / Иностранный язык (профессиональный) / Foreign language (professional)	BD	UC	5	150	45		45	0	105	15	MT,ET, exam	-
10	BM7502	Гуманитарлық және педагогикалық модуль /	PP7501	Педагогикалық тәжірибе / Педагогическая практика / Teaching practice	BD	UC	4	120	0	0	0	0	120	15	report	

		Гуманитарно-педагогический модуль/ Humanitarian and pedagogical module														
11	PM7501	Нейрондық желілер модулі/ Модуль нейронных сетей/ Neural network module	MAT7510	Машиналық оқыту 2 / Машинное обучение 2 / Machine Learning 2	MD	UC	5	150	45	15	30	0	105	15	MT,ET, exam	MAT7508
12	BM7504	Есептеу технологиясы және ғылыми қызмет модулі/ Модуль вычислительных технологий и научной деятельности / Module of computing technologies and scientific activity	RM7502	Ғылыми-зерттеу жұмысының негіздері / Основы научно-исследовательской работы / Fundamentals of research work	BD	EC	5	150	45	15	30	0	105	15	MT,ET, exam	
13	PM7502	Қолданбалы жасанды интеллект және ғылыми есептеулер модулі / Модуль Прикладной искусственный интеллект и научные вычисления / PM7502 Applied Artificial Intelligence and Scientific Computing module	MAT7536	Дербес туындылы теңдеулер үшін ақырлы айырымдар әдісі / Конечно-разностные методы для уравнений в частных производных / Finite-difference methods for partial differential equations	MD	EC	5	150	45	15	30	0	105	15	MT,ET, exam	
			MAT7556	Киберқауіпсіздікті математикалық модельдеу / Математическое моделирование кибербезопасности / Mathematical modeling of cybersecurity												
			MAT7576	DS қосымшаларын оңтайландыру әдістері / Методы оптимизации для приложений DS / Optimization methods for DS applications												
			MAT7566	Жоғары деңгейде деректерді зерттеу / Продвинутый анализ данных / Advanced Data Analysis												
				In total for 2nd semester:			**27**	**810**	**180**	**45**	**135**	**0**	**630**	**90**		
				TOTALLY FOR 1st COURSE:			**60**	**1800**	**465**	**165**	**300**	**0**	**1335**	**195**		
2 course																
3 semester																
14		Ғылыми зерттеу жұмысы/ Научно-исследовательская работа/ Scientific research work	RW7003	Магистранттың ғылыми-зерттеу жұмысы, оның ішінде тағылымдама және магистрлік диссертациясының орындалуы / Научно-исследовательская работа магистранта, включая прохождение стажировки и выполнение магистерской диссертации (НИРМ) / The research work of a student, including an internship and implementation of master's thesis	GED	RC	5	150	0	0	0	0	150	15	report, diff.offset	
15	PM7501	Нейрондық желілер модулі/ Модуль нейронных сетей/ Neural network module	MAT7509	Нейрондық желілерді қайта дайындау, деректерді көбейту проблемасы / Проблема переобучения нейронных сетей,	MD	UC	5	150	45	15	30	0	105	15	MT,ET, exam	MAT7510

				аугментация данных / The problem of retraining neural networks, data argumentation												
16	BM7504	Есептеу технологиясы және ғылыми қызмет модулі/ Модуль вычислительных технологий и научной деятельности / Module of computing technologies and scientific activity	MAT7511	Байестік статистика және талдау / Байесовская статистика и анализ / Bayesian statistics and analysis	BD	EC	5	150	45	15	30	0	105	15	MT,ET, exam	
			MAT7501	Қолданбалы көп өлшемді статистикалық талдау / Прикладной многомерный статистический анализ / Applied multivariate statistical analysis												
17	PM7503	Математикалық модельдеу және деректерді талдау модулі/ Модуль математического моделирования и интеллектуального анализа данных/ Mathematical modeling and data mining module	MAT7540	Есептеу комбинаторикасын математикалық модельдеу / Математическое моделирование перечислительной комбинаторики / Mathematical modeling of enumerative combinatorics	MD	EC	5	150	45	15	30	0	105	15	MT,ET, exam	
			MAT7543	Әлеуметтік игілікке арналған жасанды интеллект / Искусственный интеллект для социального блага / Artificial Intelligence for Social Good												
18	PM7502	Қолданбалы жасанды интеллект және ғылыми есептеулер модулі / Модуль Прикладной искусственный интеллект и научные вычисления / PM7502 Applied Artificial Intelligence and Scientific Computing module	MAT7555	Кері есептерді шешудегі машиналық оқыту әдістері / Методы машинного обучения в решениях обратных задач / Machine learning methods for solving inverse problems	MD	EC	5	150	45	15	30	0	105	15	MT,ET, exam	
			MAT7545	Параллельді есептеу / Параллельные вычисления / Parallel computation												
19	PM7502	Қолданбалы жасанды интеллект және ғылыми есептеулер модулі / Модуль Прикладной искусственный интеллект и научные вычисления / PM7502 Applied Artificial Intelligence and Scientific Computing module	MAT7505	Қолданбалы терең оқыту / Прикладное глубокое обучение / Applied Deep Learning	MD	EC	5	150	45	15	30	0	105	15	MT,ET, exam	
			MAT7534	Деректерді зерттеу және визуализация / Исследовательский анализ и визуализация данных / Exploratory data analysis and visualization												
				In total for 3rd semester:			**30**	**900**	**225**	**75**	**150**	**0**	**675**	**90**		
4 semester																
20		Ғылыми зерттеу жұмысы/ Научно-исследовательская работа/ Scientific research work	RW7008	Магистранттың ғылыми-зерттеу жұмысы, оның ішінде тағылымдама және магистрлік диссертациясының орындалуы / Научно-исследовательская работа магистранта, включая прохождение стажировки и выполнение магистерской диссертации (НИРМ) / The research work of a student, including an internship and implementation of master's thesis	GED	RC	14	420	0	0	0	0	420	15	report, diff.offset	

21	PM7501	Нейрондық желілер модулі/ Модуль нейронных сетей/ Neural network module	PP7504	Зерттеу тәжірибесі / Исследовательская практика / Research practice	MD	UC	8	240	0	0	0	0	240	15	report	
22				Магистрлік диссертацияны тіркеу және қорғау / Оформление и защита магистерской диссертации / Registration and defense of a master's thesis			8	240	0	0	0	0	240	15	Defense of Master's Thesis	
				In total for 4th semester:			**30**	**900**	**0**	**0**	**0**	**0**	**900**	**45**		
				TOTALLY FOR 2ND COURSE:			**60**	**1800**	**225**	**75**	**150**	**0**	**1575**	**135**		
				TOTALLY:			**120**	**3600**	**690**	**240**	**450**	**0**	**2910**	**330**		