Institute Automation and information technology
Department Software Engineering

EDUCATIONAL PROGRAM
8D06102 «Machine Learning & Data Science»

Code and classification of the field of education: **8D06 «Information and communication technologies»**
Code and classification of training directions: **8D061 «Information and communication technologies»**
Group of educational programs: **D094 «Information technology»**
Level based on NQF: **8**
Level based on IQF: **8**
Study period: **3 years**
Amount of credits: **180**

Almaty 2025

NCJS «KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY
named after K.I.SATBAYEV»

Educational program 8D06102 «Machine Learning & Data Science» was approved at the meeting of K.I.Satbayev KazNRTU Academic Council.
Minutes No. 10 dated March 6, 2025.

Was reviewed and recommended for approval at the meeting of K.I.Satbayev KazNRTU Educational and Methodological Council.
Minutes No. 3 dated December 20, 2024.

Educational program 8D06102 «Machine Learning & Data Science» was developed by Academic committee based on direction 8D061 «Information and communication technologies».

№	Full name	Academic degree/ academic title	Position	Workplace	Signature
Field of Study: **6B061, 7M061, 8D061 – Information and Communication Technologies**					
Chairperson of Academic Committee:					
1	Abdoldina Farida Nauruzbaevna	Candidate of Technical Sciences	Head of Department, Associate Professor	NJSC "Kazakh National Research Technical University named after K.I. Satpayev", mob. phone: **+7 707 820 6525**	
Members of the Academic Committee:					
Academic Staff:					
2	Mukhamediev Ravil Ilgizovich	Candidate of Technical Sciences	Professor	NJSC "Kazakh National Research Technical University named after K.I. Satpayev", mob. phone: **+7 777 241 8672**	
3	Moldagulova Ayman Nikolaevna	Candidate of Physical and Mathematical Sciences	Professor	NJSC "Kazakh National Research Technical University named after K.I. Satpayev", mob. phone: **+7 701 727 9025**	
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5	Kasenkhan Aray Meyrabaykyzy	PhD	Associate professor	NJSC "Kazakh National Research Technical University named after K.I. Satpayev", mob. phone: **+7 777 288 0626**	
6	Gertsen Yevgeniy Alexandrovich	Master of Science	Senior teacher	NJSC "Kazakh National Research Technical University named after K.I. Satpayev", mob. phone: +7 777 209 4343	
7	Baimbetov Daulet Abibullaevich	Master of Science	Senior teacher	NJSC "Kazakh National Research Technical University named after K.I. Satpayev", mob. phone: +7 707 891 4322	
Employers:					
8	Konysbaev Amiret Tuyakuly	Candidate of Philosophical Sciences	President of the Association	Association of Innovative Companies FEZ "PIT", mob. phone: **+7 708 106 5028**	
9	Nurseitov Daniyar	Candidate of Physical and	Expert (disciplinary)	BigDATA sector, KMG engineering LLP, mob. phone:	

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F KazNRTU 703-05 Educational program

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9	Nurseitov Daniyar Borisovich	Candidate of Physical and Mathematical Sciences	Expert (disciplinary)	BigDATA sector, KMG engineering LLP, mob. phone: +7 777 127 7711	
10	Akylaev Zhasulan Akzholovich	Master of Science	Chief IT Officer for Information Systems Development	JSC "Tenge Bank", a subsidiary bank of JSC Halyk Bank of Kazakhstan, representative office in the CIS, mobile. phone: +7 771 701 2811	
11	Ramazan Aitkaliyev	Master of Science	Senior data scientist	JSC Halyk Bank of Kazakhstan, mobile. phone: +7 771 701 2811	
Representatives of graduates:					
12	Rustam Rafikovich Musabayev	PhD in Computer Science, Associate Professor	Head of Scientific Laboratory	RSE on REM "Institute of Information and Computational Technologies", Laboratory of Information Processes Analysis and Modeling, mobile. phone: +7 777 283 1533	
13	Zhanibek Amirkhanovich Sydykov	Specialist	Teaching Methodologist	1C Kazakhstan. Certified 1C: Specialist and 1C: Expert, mobile. phone: +7 777 130 2323	
14	Jalal Kudratovich Jamalov	PhD	Team Lead	Kaspi Bank JSC, Kaspi Pay Transfers Development Team, mobile. phone: +7 701 949 7935	
Receiving education:					
15	Rystygulov Panabek Abashovich	Master of Science	Doctoral student, 2nd year	mobile. phone: +7 775 202 4224	
16	Mukin Dmitry Mikhailovich	Bachelor	Master's student, 2nd year	mobile. phone: +7 707 157 5233	
17	Halmatai Nurbek Kasymuly	-	Student, 4th year	mobile. phone: +7 700 484 4808	

* The composition of the Academic Committees for the 2025–2026 academic year was approved by Order No. 228-П/Ө dated April 28, 2025.

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F KazNRTU 703-05 Educational program

Table of contents

List of abbreviations and designations

EP – educational program
BC – basic competencies
PC – professional competencies
LO – learning outcomes
MOOC – Massive Open Online Courses
NQF – National Qualifications Framework
IQF – Industry Qualifications Framework

1. Description of educational program

The educational program 8D06102 «Machine Learning & Data Science» aims to train scholars capable of independently conducting scientific research, developing comprehensive software solutions, working in a team, and being well-versed in modern aspects of data science while achieving the following competencies:

- Provide practice-oriented training for specialists in scientific activities and production in the fields of data analysis, machine learning, and artificial intelligence.
- Prepare for career prospects in academic and research activities, as well as in the industry, as data analysts, software developers, machine learning engineers, and artificial intelligence researchers.
- Create conditions for conducting original scientific research in machine learning and data science, publishing research results in international and domestic peer-reviewed journals, creating and implementing machine learning algorithms to solve practical problems, and developing comprehensive software systems for big data analysis.

The educational program 8D06102 «Machine Learning & Data Science» is based on the state educational standard for higher professional education, professional standards, and the Atlas of New Professions.

The content of the program's courses has been developed with consideration of corresponding educational programs from leading universities worldwide and the international classifier of professional activities in the field of information and communication technologies.

Graduates of the educational program 8D06102 «Machine Learning & Data Science» are oriented towards organizing, designing, and developing machine learning algorithms and comprehensive software systems for big data analysis and process automation for all sectors of the economy, government organizations, and other areas of activity.

The educational program ensures the application of an individualized approach to students, transforming professional competencies from professional standards and qualification standards into learning outcomes. Student-centered learning is provided – a principle of education that shifts the focus in the educational process from teaching (as the primary role of the teaching staff in «transmitting» knowledge) to learning (as the active educational activity of the student).

The educational program was developed based on an analysis of the labor functions of AI system development engineers and data science specialists, and professional standards, including professions such as ICT researcher and IT project manager.

Representatives of Kazakhstan companies and associations, specialists from departmental structures in the field of AI system development and data science participated in the development of the educational program.

2. Purpose and objectives of educational program

Purpose of EP: The educational program is aimed at training a scientist who is able to independently conduct scientific research, develop comprehensive software solutions, work effectively in a team and innovate in the field of artificial intelligence and data science, considering the principles of sustainable development, digital inclusivity and ethics.

The program prepares highly qualified specialists capable of conducting independent research, developing comprehensive software solutions, working effectively in a team, and confidently navigating the modern aspects of data science. It focuses on equipping graduates with the competencies necessary for practice-oriented work in data analysis, machine learning, and artificial intelligence, as well as for conducting original research and implementing innovative solutions in various industries.

Tasks of EP:

- Providing doctoral students with practical skills and knowledge necessary for work in the fields of data analysis, machine learning, and artificial intelligence.
- Developing the ability to apply theoretical knowledge to solve real-world problems.
- Creating conditions for conducting original research in machine learning and data science.
- Promoting the publication of research results in international and national peer-reviewed journals.
- Teaching doctoral students research methods and scientific analysis.
- Developing skills in designing and implementing effective machine learning algorithms to solve practical problems.
- Training doctoral students in creating and optimizing algorithms for various applications and industries.
- Preparing doctoral students to develop and implement complex software systems for big data analysis.
- Teaching the use of modern tools and technologies in software development.
- Developing skills for working in interdisciplinary teams and effectively interacting with other professionals.
- Teaching communication and presentation skills for presenting research results.
- Promoting continuous self-education and professional development of doctoral students.
- Developing critical thinking and the ability for self-directed learning.
- Instilling a sense of responsibility and ethics in the use of data and algorithm development in doctoral students.
- Ensuring understanding of the social, economic, and environmental aspects of working with data.

The content of the educational program 8D06102 «Machine Learning & Data Science» is implemented in accordance with the credit system of education and is

conducted in both state and Russian languages. The educational program will facilitate the implementation of the principles of the Bologna Process. Based on their choice and independent planning of the sequence of studying subjects, students independently form an individual study plan (ISP) for each semester according to the Working Curriculum and the Catalog of Elective Disciplines. The educational program increases the volume of mathematical, natural science, basic, and language disciplines.

The curriculum includes subjects such as: Machine Learning, Big Data Storage Systems And Computations, Sustainability Science, Predictive Analytics and Data Mining, Applied Machine Learning Research Projects, Natural Language Processing, Research methodology, Academic Writing and others.

Doctoral students undergo scientific research internships in banking institutions, government agencies, and corporate structures such as JSC «Institute of Digital Equipment and Technologies», Republican State Enterprise on the right of economic management «Institute of Information and Computing Technologies» of the Committee of Science of the Ministry of Science and Higher Education of the Republic of Kazakhstan, JSC «Kaspi Bank», JSC «Halyk Bank», JSC «Centrkredit Bank», among others. They also participate in international internships at leading foreign universities focused on scientific research. Additionally, doctoral students undergo pedagogical practice at domestic universities.

3. Requirements for the evaluation of educational program learning outcomes

The educational program is developed in accordance with the State Mandatory Standards of Higher and Postgraduate Education, approved by the order of the Minister of Science and Higher Education of the Republic of Kazakhstan dated July 20, 2022, №2 (registered in the Register of Regulatory Legal Acts under №28916). It reflects the learning outcomes based on which study plans (work study plans, individual study plans of students) and syllabi are developed for disciplines. At least 10% of the total credit volume of the educational program is covered through MOOCs on the official platform https://polytechonline.kz/cabinet/login/index.php/ and also by studying disciplines via the international educational platform Coursera https://www.coursera.org/.

Assessment of learning outcomes is conducted through developed assignments within the educational program in accordance with the requirements of the State Mandatory Standards of Higher and Postgraduate Education.

During the assessment of learning outcomes, equal conditions and opportunities are provided for students to demonstrate their levels of knowledge, skills and abilities.

Online proctoring is utilized for intermediate assessment conducted in an online format.

4. Passport of educational program

4.1. General information

№	Field name	Comments
1	Code and classification of the field of education	8D06 «Information and communication technologies»
2	Code and classification of training directions	8D061 «Information and communication technologies»
3	Educational program group	D094 «Information technologies»
4	Educational program name	program 8D06102 «Machine Learning & Data Science»
5	Short description of educational program	To provide practice-oriented training for specialists in scientific activities and production in the fields of data analysis, machine learning, and artificial intelligence. To prepare students for career prospects in academic and research activities, as well as in the industry as data analysts, software developers, machine learning engineers, and artificial intelligence researchers. To create conditions for conducting original scientific research in machine learning and data science, publishing research results in international and national peer-reviewed journals, developing and implementing machine learning algorithms to solve practical problems, and designing complex software systems for big data analysis.
6	Purpose of EP	The aim of the educational program is to train scientists capable of conducting independent research, developing comprehensive software solutions, working in a team, and being well-versed in modern aspects of artificial intelligence and data science.
7	Type of EP	New
8	The level based on NQF	8
9	The level based on IQF	8
10	Distinctive features of EP	No
11	List of competencies of educational program	BC: - Develop practical skills and knowledge necessary for work in the fields of data analysis, machine learning, and artificial intelligence. - Study research methods and scientific analysis. - Develop skills in designing and implementing effective machine learning algorithms to solve practical problems. - Develop algorithms for various applications and industries. PC: - Conduct original scientific research in the field of machine learning and data science. - Publish research results in international and national peer-reviewed journals. - Plan and execute work on developing and implementing effective machine learning algorithms to solve practical

		problems.
12	Learning outcomes of educational program	**LO1:** Extract the necessary information from various sources, including real-time information flows, develop scientific, technical and innovative solutions for the enterprise information infrastructure, taking into account the possibilities of big data technologies. **LO2:** Apply text processing methods, use the principles of constructing vector representations of words and texts, design the architecture of dialogue systems, develop text classifiers and algorithms for identifying topics. **LO3:** Apply machine learning methods in relation to big data processing tasks, conduct scientific research, organize work on collecting, storing and processing information. **LO4:** Conduct a stylistic analysis of scientific, scientific, technical and popular science texts, apply the methodology of working with text, including searching for information in reference, specialized literature and computer networks, use the skills of oratory, the correct and logical formulation of one's thoughts in oral and written form. **LO5:** Create analytical systems and recommender services based on machine learning and deep learning algorithms. **LO6:** Apply the methodology of scientific knowledge, principles and structure of scientific research, use experimental and theoretical research methods in the field of artificial intelligence and data science, considering the impact of technology on society and the environment, observing the principles of an open, inclusive and ethically responsible scientific approach. **LO7:** Integrate knowledge gained from different disciplines to solve research problems in new unfamiliar environments and generate new ideas in the context of scientific research in the field of artificial intelligence and data science. **LO8:** Apply various types of models used in the development of artificial intelligence systems, describe the relationship between models and the development of artificial intelligence systems.
13	Education form	Daytime, online
14	Period of training	3 years
15	Amount of credits	180
16	Languages of instruction	Kazakh, Russian
17	Academic degree awarded	Doctor of Philosophy (PhD) upon successful defense of the doctoral dissertation
18	Developer(s) and authors	Abdoldina F.N., Moldagulova A.N., Mukhamediev R.I., Mukazhanov N.K.

Professional Standard for the EP

№	Name of professional standard	Date of approval of the PS
1	Teacher (faculty) of higher and (or) postgraduate education organizations	20.11.2023
2	Software testing	05.12.2022
3	Creation and management of information technologies	24.12.2019

4.2 Relationship between the achievability of the formed learning outcomes according to educational program and academic disciplines

№	Discipline name	Short description of discipline	Amount of credits	The formed educational outcomes (code)							
				LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8
Cycle of basic disciplines University component											
1	Academic writing	Objective: to develop academic writing skills and writing strategies for doctoral students in engineering and natural sciences. Content: fundamentals and general principles of academic writing, including: writing effective sentences and paragraphs, writing an abstract, introduction, conclusion, discussion, and references; in-text citation; preventing plagiarism; and preparing a conference presentation.	5	v							
2	Research methodology	Objective: to acquire knowledge about the laws, principles, concepts, terminology, content, and specific features of organizing and managing scientific research using modern scientometric methods. Content: the structure of technical sciences, the application of general scientific, philosophical, and specialized methods of scientific research, principles of organizing scientific research, methodological features of modern science, ways of developing science and scientific research, the role of	5	v			v		v	v	v

		technical sciences, informatics, and engineering research in theory and practice.									
Cycle of basic disciplines Component of choice											
3	Machine Learning I	Objective: To introduce fundamental concepts and methods of machine learning, as well as to study the key aspects of artificial intelligence. Content: Learners will delve into the basic principles of machine learning algorithms, including regression analysis methods, gradient descent algorithms, and backpropagation. They will also study classic machine learning methods such as k-nearest neighbors, decision trees, naive Bayes classifier, and support vector machines.	5	v		v		v		v	v
4	Sustainability Science	Objective: to develop a deep understanding among doctoral students of the interactions between natural and social systems, as well as to develop skills for identifying and developing strategies for sustainable development that promote long-term human well-being and environmental preservation. Content: complex interconnections between ecosystems and societies, as well as an in-depth analysis of sustainability issues at local, national, and international levels.	5	v					v		
5	Big Data Storage Systems And	The course explores the theoretical foundations of big data and distributed	5	v		v	v				

	Computations	computing, as well as technologies for building storage and processing systems for big data. It includes topics such as the study of network interaction protocols, defining asynchronous and synchronous operations, issues of memory fragmentation and virtual machine instruction execution, multithreaded programming, multiprocessor programming, problems of coherence and fault tolerance and their solutions, and network interaction issues.									
Cycle of profile disciplines Component of choice											
6	Machine Learning II	Objective: To immerse in advanced methods and concepts of machine learning, including ensemble methods, clustering, and neural networks, with a focus on deep learning and its applications in various fields. Content: The course covers the study of ensemble methods such as random forests, gradient boosting, and model ensembling, which enhance prediction quality by combining multiple base models	5	v	v	v					v
7	Predictive Analytics and Data Mining	The course studies technologies that rely on large datasets to develop scenarios for future human behavior and make optimal decisions. It covers predictive analytics, which includes a variety of methods from statistics and data mining. To forecast future events,	5	v	v		v				v

		the course analyzes both current and historical data. It also examines models for predicting potential customer behavior and identifying the most popular products and services.									
8	Applied Machine Learning Research Projects	Objective: To apply machine learning practically and conduct research in this field through participation in real research projects. Content: In this course, students participate in real research projects aimed at developing and implementing machine learning algorithms and models to solve specific tasks. Projects cover various areas of machine learning application, such as computer vision, natural language processing, medical diagnostics, financial analysis, and others.	5		v	v					v
9	Natural Language Processing	The course covers theoretical aspects of NLP, including basic information from linguistics, and practical methods of text processing. It discusses classical algorithms for processing textual information, such as regular expressions, distance measurement, substitutions, string and substring search. Linguistic trees. Text corpus. Taxonomy. The course also covers Word2Vec models, Text Embedding, LSTM models of neural networks. Existing libraries for text information analysis are studied as well.	5	v		v					

5. Curriculum of educational program

NON-PROFIT JOINT STOCK COMPANY
"KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY NAMED AFTER K.I. SATBAYEV"

SATBAYEV UNIVERSITY

«APPROVED»
Decision of the Academic Council
NPJSC«KazNRTU
named after K.Satbayev»
dated 06.03.2025 Minutes № 10

WORKING CURRICULUM

Academic year	**2025-2026 (Spring, Autumn)**
Group of educational programs	**D094 - "Information technologies"**
Educational program	**8D06102 - "Machine Learning & Data Science"**
The awarded academic degree	**Doctor of Philosophy PhD**
Form and duration of study	**full time (scientific and pedagogical track) - 3 years**

Discipline code	Name of disciplines	Block	Cycle	Total ECTS credits	Total hours	lek/lab/pr Contact hours	in hours SIS (including TSIS)	Form of control	Allocation of face-to-face training based on courses and semesters						Prerequisites
									1 course		2 course		3 course		
									1 sem	2 sem	3 sem	4 sem	5 sem	6 sem	
CYCLE OF GENERAL EDUCATION DISCIPLINES (GED)															
CYCLE OF BASIC DISCIPLINES (BD)															
M-1. Module of basic training (university component)															
LNG305	Academic writing		BD, UC	5	150	0/0/45	105	E		5					
CSE339	Research methodology		BD, UC	5	150	30/0/15	105	E		5					
Component of choice															
CSE306	Big Data Storage Systems And Computations	1	BD, CCH	5	150	30/0/15	105	E		5					
MNG350	Sustainability Science	1	BD, CCH	5	150	30/0/15	105	E		5					
CSE340	Machine Learning I	1	BD, CCH	5	150	30/0/15	105	E		5					
M-3. Practice-oriented module															
AAP350	Pedagogical practice		BD, UC	10				R	10						
CYCLE OF PROFILE DISCIPLINES (PD)															
M-2. Module of professional activity (component of choice)															
CSE327	Predictive Analytics and Data Mining	1	PD, CCH	5	150	15/15/15	105	E		5					
CSE341	Machine Learning II	1	PD, CCH	5	150	30/15/0	105	E		5					
CSE304	Natural Language Processing	2	PD, CCH	5	150	30/15/0	105	E		5					
CSE342	Applied Machine Learning Research Projects	2	PD, CCH	5	150	15/15/15	105	E		5					
M-3. Practice-oriented module															
AAP355	Research practice		PD, UC	10				R			10				
M-4. Experimental research module															
AAP347	Research work of the doctoral student, including internships and doctoral dissertation		RWDS	20				R	20						
AAP336	Research work of the doctoral student, including internships and doctoral dissertation		RWDS	5				R		5					
AAP347	Research work of the doctoral student, including internships and doctoral dissertation		RWDS	20				R			20				
AAP356	Research work of the doctoral student, including internships and doctoral dissertation		RWDS	30				R				30			
AAP356	Research work of the doctoral student, including internships and doctoral dissertation		RWDS	30				R					30		
AAP348	Research work of the doctoral student, including internships and doctoral dissertation		RWDS	18				R						18	
M-5. Module of final attestation															
ECA325	Final examination (writing and defending a doctoral dissertation)		FA	12										12	

Total based on UNIVERSITY:	30	30	30	30	30	30	
	60		**60**		**60**		

Number of credits for the entire period of study

Cycle code	Cycles of disciplines	Credits			
		Required component (RC)	University component (UC)	Component of choice (CCH)	Total
GED	Cycle of general education disciplines	0	0	0	0
BD	Cycle of basic disciplines	0	20	5	25
PD	Cycle of profile disciplines	0	10	10	20
Total for theoretical training:		**0**	**30**	**15**	**45**
RWDS	Research Work of Doctoral Student				123
ERWDS	Experimental Research Work of Doctoral Student				0
FA	Final attestation				12
TOTAL:					**180**

Decision of the Educational and Methodological Council of KazNRTU named after K.Satpayev. Minutes № 3 dated 20.12.2024

Decision of the Academic Council of the Institute. Minutes № 4 dated 22.11.2024

Signed:

Governing Board member - Vice-Rector for Academic Affairs	Uskenbayeva R. K.
Approved:	
Vice Provost on academic development	Kalpeyeva Z. B.
Head of Department - Department of Educational Program Management and Academic-Methodological Work	Zhumagaliyeva A. S.
acting Director of Institute - Institute of Automation and Information Technologies	Chinibayev Y. Г.
Department Chair - Software Engineering	Abdoldina F. .
Representative of the Academic Committee from Employers ____Acknowledged____	Konysbayev A. T.