MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE REPUBLIC OF KAZAKHSTAN

GRADUATE PROFILE (MASTER'S DEGREE)

Of Educational Program
7M06102 – Machine Learning & Data Science
(M094 «Information Technologies»)

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CONTENTS

INTRODUCTION

The educational program 7M06102 «Machine Learning & Data Science» is developed within the framework of the field 7M061 «Information and Communication Technologies» and is aimed at training highly qualified specialists in machine learning and data science. In a context of rapid technological progress and growing data volumes, graduates of this program will have the necessary knowledge and skills to address pressing challenges in areas such as business, healthcare, finance, and beyond.

A key focus of the program is the in-depth study of disciplines such as computational intelligence, sustainable development strategies, and advanced courses in Python and R programming languages. The curriculum also includes research methodology, innovation, AI and machine learning, business data analytics systems, and IT project management, offering a comprehensive and practice-oriented learning experience.

The program develops both technical and analytical competencies, equipping students to work with big data, design intelligent systems, and make data-driven decisions. Special emphasis is placed on critical thinking, creativity, and research skills.

In addition, the program integrates Sustainable Development Goals (SDGs) and ESG (Environmental, Social, and Corporate Governance) principles, promoting environmental and social responsibility, digital ethics, and inclusive innovation in the development of IT solutions.

The educational process follows a credit-based system, allowing for flexible and personalized learning paths. It combines theoretical training, internships, and research work, concluding with a master's thesis defense. Final assessment ensures a holistic evaluation of students’ competencies and professional readiness.

Thus, the program prepares competitive professionals ready to contribute innovative and sustainable solutions in machine learning and data science for the modern IT sector and research.

1 Goals and Objectives of the Educational Program «7M06102 – Machine Learning & Data Science»

Goal: The goal of the educational program is to train Masters of Technical Sciences with specialized competencies in data analysis, machine learning, and artificial intelligence for the development of sustainable, inclusive, and ethically-oriented digital solutions, as well as the ability to conduct scientific research and carry out pedagogical activities in the field of information and communication technologies.

Objectives:

– Acquire theoretical and practical knowledge in system and network administration, including advanced methods for ensuring security and managing cloud technologies.

– Study and apply natural language processing (NLP) methods, including text analysis, language generation, and information extraction, for the development of intelligent applications.

– Master principles and technologies of deep learning to create models capable of adaptation and self-learning in real-time environments.

– Develop and implement sustainable development strategies, utilizing technologies to address environmental and social issues.

– Apply business analysis methods and Business Intelligence tools for data-driven decision-making.

– Research and apply reinforcement learning algorithms to solve problems in robotics, management, and business.

– Develop intelligent applications using machine learning methods, including process automation and decision-making.

– Analyze and develop big data-based solutions with a focus on efficient storage, processing, and data visualization.

– Prepare Masters for conducting research and innovation activities, including intellectual property protection and research results management.

– Explore modern architectures and technologies for developing complex systems, including transformers and neural networks for various applications.

– Investigate ethical and social aspects of artificial intelligence and machine learning, understanding the potential consequences and limitations of these technologies.

– Develop and implement research projects, including creating and publishing scientific papers, as well as managing research projects.

– Apply data visualization methods to present analytical information and support decision-making at all management levels.

– Study and apply methods of generative artificial intelligence, including image, text, and music generation, to create innovative solutions.

– Develop strategies for integrating machine learning and big data into existing business processes to optimize and improve efficiency.

– Create prototypes and minimum viable products (MVPs) using machine learning and data analysis technologies to test ideas and concepts.

– Evaluate and monitor data quality to ensure the accuracy and reliability of analytical insights and predictions.

– Design adaptive systems capable of self-learning and improvement based on data analysis and user feedback.

– Study and apply foundational methods of cloud architecture for the development and deployment of scalable machine learning applications.

– Analyze current trends and the latest research in data science and machine learning to equip graduates with up-to-date knowledge and skills for successful careers.

– Foster sustainable thinking among graduate students by integrating the Sustainable Development Goals (SDGs) and ESG (Environmental, Social, and Corporate Governance) principles into the design and implementation of digital solutions.

– Develop the ability to consider social, environmental, and ethical responsibility when implementing technologies across various sectors of the economy.

These objectives will help shape the profile of graduates ready to meet the challenges and demands of the modern industry in machine learning and data science.

2 List of Qualifications and Positions

A graduate of the 7M06102 – «Machine Learning & Data Science» program is awarded the academic degree of Master of Science in Engineering. The educational program is developed in accordance with the State Compulsory Standards of Higher and Postgraduate Education, approved by Order No. 2 of the Minister of Science and Higher Education of the Republic of Kazakhstan dated July 20, 2022 (registered in the State Registry of Normative Legal Acts under No. 28916). It reflects the learning outcomes that serve as the basis for the development of academic plans (working curricula, individual study plans of students) and course syllabi.

Graduates of the 7M06102 – «Machine Learning & Data Science» program can hold the following positions:

– Machine learning engineer;
– Data analyst;
– Artificial intelligence algorithm and model developer;
– Big data analyst;
– Cloud computing engineer;
– IT project manager;
– Research scientist in IT and data science;
– University lecturer.

The professional field of the graduate encompasses all sectors of the economy where machine learning and data analysis technologies are applied, including healthcare, finance, retail, information technology, and scientific research.

The objects of professional activity for a Master's graduate include:

– Machine learning models and data analysis algorithms developed to address practical challenges;
– Big data processing and storage systems;
– Cloud computing platforms and their integration with machine learning solutions;
– Tools and technologies for data visualization and interpretation across various domains.

3 Descriptors

The requirements for the level of preparation of a master's student in the 7M06102 – «Machine Learning & Data Science» program are determined based on the Dublin Descriptors for the second cycle of higher education (master's level) and reflect the acquired competencies expressed in learning outcomes. Learning outcomes are formulated at both the program level and the level of individual modules or disciplines. These descriptors outline the capabilities of the graduate as follows:

– Demonstrate deep knowledge and understanding of the fundamentals of machine learning and data science, including modern algorithms, methods, and tools. Graduates must be able to apply this knowledge to solve complex problems across various industries, integrating scientific and practical advancements.

– Analyze and process large volumes of data using statistical methods and machine learning techniques. This includes the ability to select and apply appropriate algorithms and approaches, as well as assess their efficiency and reliability in the context of specific tasks.

– Develop and implement machine learning models and algorithms, including testing and optimizing them to enhance performance and accuracy. Graduates should be proficient in using modern tools and platforms to execute data science projects.

– Evaluate and interpret data analysis results, forming well-founded conclusions and recommendations. It is important to consider the social, ethical, and scientific aspects of technology applications, as well as their potential impact on society and the environment.

– Effectively communicate the results of their work, presenting complex ideas and findings both orally and in writing to diverse audiences, including professionals and non-specialists. This also involves teamwork skills and the ability to constructively interact with other project participants.

– Exhibit self-directed learning and research skills essential for ongoing professional development. Graduates must be prepared to update their knowledge and skills in the rapidly evolving field of machine learning and data science, leveraging various resources and learning approaches.

– Integrate sustainable development and ESG principles into professional practice, including the design and implementation of digital solutions with awareness of their social, environmental, and economic impact. Graduates should understand the importance of sustainability and responsibility in technology application.

– Demonstrate understanding of digital ethics, inclusiveness, and social responsibility in data analysis and machine learning model development, particularly in the context of automated decision-making and societal impact.

4 Competencies upon completion of training

4.1 Requirements for Key Competencies of Graduates of Scientific and Pedagogical Master's Programs

Graduates of the scientific and pedagogical master's program are expected to:

1) Have an understanding of:

- the role of science and education in societal life;
- contemporary trends in the development of scientific knowledge;
- current methodological and philosophical issues in natural (social, humanitarian, and economic) sciences;
- the professional competence of higher education instructors;
- the contradictions and socio-economic consequences of globalization processes.

2) Possess knowledge of:

- the methodology of scientific inquiry;
- the principles and structure of organizing scientific activities;
- the psychology of cognitive activity among master's students during the learning process;
- psychological methods and tools for enhancing the efficiency and quality of education.

3) Be able to:

- use acquired knowledge for the original development and application of ideas in the context of scientific research;
- critically analyze existing concepts, theories, and approaches to the study of processes and phenomena;
- integrate knowledge obtained from various disciplines to address research problems in new and unfamiliar conditions;
- make judgments and decisions based on incomplete or limited information through the integration of knowledge;
- apply the principles of pedagogy and psychology of higher education in teaching practices;
- utilize interactive teaching methods;
- perform information-analytical and bibliographic work using modern information technologies;
- think creatively and approach new problems and situations innovatively;
- fluently use a foreign language at a professional level, enabling scientific research and teaching specialized disciplines in higher education institutions;
- summarize the results of scientific and analytical work in the form of a thesis, scientific article, report, analytical note, and other formats.

4) Possess skills in:

- conducting scientific research and solving standard scientific problems;

- carrying out educational and pedagogical activities within the framework of credit-based learning technology;
- teaching professional disciplines;
- using modern information technologies in the educational process;
- professional communication and intercultural interaction;

public speaking, articulating thoughts correctly and logically in both oral and written forms;

- expanding and deepening knowledge required for daily professional activities and for continuing education in doctoral studies.

5) Be competent in:

- the methodology of scientific research;
- scientific and scientific-pedagogical activities in higher education institutions;
- contemporary educational technologies;
- implementing scientific projects and research in their professional field;
- methods for continuously updating knowledge and expanding professional skills and abilities.

Professional Competencies:

- Ability to independently acquire, comprehend, structure, and apply new knowledge and skills in professional activities, develop innovative capabilities, and use them to address current challenges in data science and machine learning.
- Skill in independently formulating research goals, determining the sequence of solving professional tasks, and developing strategies to achieve set objectives.
- Ability to apply knowledge of fundamental and applied sections of disciplines relevant to the master's program profile, including statistical methods, probability theory, and machine learning algorithms, in practice.
- Proficiency in professionally selecting and creatively utilizing modern scientific and technical equipment, software tools, and instruments for solving scientific and practical problems in data analysis.
- Capability to critically analyze, present, defend, discuss, and disseminate results of professional activities, including publishing in scientific journals and participating in conferences.
- Mastery of drafting and formatting scientific and technical documentation, writing reports, reviews, presentations, and articles, as well as preparing presentations to demonstrate work outcomes.
- Readiness to lead a team in the professional sphere, embracing social, ethnic, religious, and cultural differences, and contributing to a productive and inclusive work environment.
- Preparedness for communication in oral and written forms in a foreign language to solve professional tasks, including presenting scientific results and participating in international projects.

Universal and Socio-Ethical Competencies:

- Ability to think abstractly, analyze, and synthesize, enabling effective work with complex concepts and models in data science.
- Using basic philosophical knowledge to shape a worldview, fostering critical thinking and an ethical approach to technology application.
- Analyzing key stages and patterns of societal development to form a civic stance and understand the impact of technologies on social processes.
- Applying basic economic knowledge in various spheres of life, including evaluating the economic efficiency of data science projects.
- Using fundamental legal knowledge to address tasks in various activities, including intellectual property and data protection.
- Ability to act in non-standard situations, bear social and ethical responsibility for decisions made, and consider potential consequences for society and the environment.
- Skills in self-development, self-realization, and unlocking creative potential, contributing to the continuous improvement of professional skills and knowledge.
- Applying physical culture methods to ensure full social and professional activity, including stress management and health maintenance.
- Proficiency in first aid techniques and emergency response methods, which are essential for ensuring workplace safety.

Specialized and Managerial Competencies:

- Ability to analyze and assess the degree of anthropogenic impact on humans and the environment, including ecological risks, forecast negative effects, and evaluate their consequences in the context of software development and data analysis.
- Skill in modeling hazardous processes in the technosphere and ensuring the safety of designed systems using systemic analysis and risk assessment approaches.
- Mastery of modern software products for modeling, forecasting, assessing, and preventing risks, as well as managing them, including platforms for big data processing.
- Ability to design and calculate safety systems and devices, evaluating their effectiveness considering living conditions and regulatory requirements.
- Skill in identifying key hazards to the environment in accordance with legislative and legal acts, as well as terminology in the field of life safety and environmental protection.
- Competence in conducting engineering and economic calculations for ensuring technosphere safety, reading project documentation, and competently preparing project assignments for safety measures.
- Readiness to lead a team in professional activities, embracing social, ethnic, religious, and cultural diversity, and fostering effective communication and collaboration.

4.2 Requirements for the Master's Research Work

- The ability to solve professional tasks by integrating fundamental and technical sciences, which implies the use of theoretical knowledge for practical application in software development and data science.
- The ability to conduct independent scientific research and analyze experimental data, including formulating hypotheses, developing methodologies, and interpreting results in accordance with modern scientific standards.
- The ability to create and study models of the objects under investigation, enabling master's students to conduct in-depth analysis, simulations, and predictions in the context of real-world tasks.
- The ability to analyze and apply modern information technologies to scientific tasks, including the use of specialized software, databases, and tools for processing large volumes of information.

4.3 Requirements for Organizing Internships

The educational program includes pedagogical and research internships:

- Pedagogical Internship: Conducted to master teaching methods, including the involvement of master's students in undergraduate courses. This provides them with the opportunity to gain teaching experience, interact with students, and organize the learning process, while also developing communication and mentoring skills.
- Research Internship: Aimed at familiarizing students with the latest research methods, including data processing and interpretation. It fosters the development of professional research skills, allowing master's students to apply theoretical knowledge in practice and enhance their competencies in scientific inquiry.

5 Requirements for Completion of Studies and Degree Award

To complete the Master's program in Technical Sciences under the direction of 7M06102 – «Machine Learning & Data Science», the student must earn at least 120 credits:

- 88 credits of theoretical learning
- 12 credits for pedagogical and research internships
- 24 credits for the Master's research work

Degree Awarded

Graduates of the program are awarded the academic degree «Master of Technical Sciences» in the field of «Machine Learning & Data Science».

Graduate Competencies

A graduate who has completed the Master's program must possess the following competencies:

General Professional Competencies:

- The ability to independently acquire, understand, and apply new knowledge and skills in professional activities, and to develop an innovative approach.
- Skills in setting research goals and choosing the sequence of actions for solving professional tasks.
- The ability to apply knowledge from fundamental and applied areas of disciplines relevant to the Master's program.
- The ability to critically analyze, present, and defend the results of professional activities.
- Skills in preparing technical documentation, writing reports, reviews, presentations, and scientific articles.
- Readiness to lead a team while considering socio-cultural differences and promoting tolerance.
- Proficiency in communication in a foreign language to solve professional tasks.

Professional Competencies by Activity Type

Engineering, Design, and Research Activity:

- The ability to perform complex technical developments in the field of machine learning.
- Skills in analyzing and developing algorithms and models for various machine learning applications.
- Proficiency in data analysis methods and handling large volumes of information.
- The ability to use modern programming tools and languages for developing and optimizing models.
- The ability to design and develop machine learning systems for solving specific tasks.

Production and Technological Activity:

- Skills in independently performing design and scientific-production work in the field of machine learning.
- Proficiency in using modern equipment and development tools.
- The ability to apply modern methods of data processing and information management for production tasks.
- Skills in testing and validating machine learning models.
- The ability to manage the machine learning lifecycle, including data preparation, model training, and deployment.

Organizational and Managerial Activity:

- Readiness to organize and manage research and production projects in the field of machine learning.
- The ability to apply regulatory and methodological documents for planning the development of models.
- Skills in interacting with clients and partners using project and process documentation standards.
- The ability to evaluate and choose approaches for the development and integration of machine learning models, considering risk management.
- Proficiency in decision-making and data analysis methods for optimizing the model development process.

Scientific and Pedagogical Activity:

- Skills in conducting seminars, lab, and practical sessions on machine learning.
- Participation in the development of educational and methodological documentation and materials.
- The ability to supervise the scientific and educational activities of students in the field of machine learning.

Outcomes of Master's Program Completion

The Master's program includes the necessary cultural and professional competencies, ensuring graduates are ready for successful professional activities and research work in the fields of machine learning and data analysis.

CONCLUSION

The Master's program 7M06102 – "Machine Learning & Data Science" is designed to train highly qualified specialists capable of effectively addressing challenges in the development, implementation, and support of machine learning systems. Graduates will gain essential competencies, including both general professional and specialized skills aligned with current industry demands.

The combination of solid theoretical foundations with practical experience will enable students to adapt successfully to rapidly changing labor market conditions and continue their professional growth. Their ability for critical thinking, innovation, and effective communication will contribute to the creation of competitive professionals capable of making a meaningful impact in the field of information technology.

Special attention is given to the integration of sustainable development and ESG principles, as well as the formation of digital ethics and social responsibility—preparing not just technically proficient, but ethically aware specialists.

The program emphasizes an individualized approach to learning, helping students develop both professional and personal qualities. It also supports opportunities for scientific and research activities, preparing graduates for doctoral studies or other academic endeavors.

Thus, the 7M06102 – "Machine Learning & Data Science" program is focused on developing not only high-level engineers but also forward-thinking leaders capable of sustainable innovation and responsible decision-making in the modern technological world.

Head of the Department of «Software Engineering» _____ **Abdoldina F.N.**