

Summary of Degree Programme 'Math of Machine Learning'

Field of Studies

01.04.02 Applied Mathematics and Informatics

Approved by

The academic council meeting protocol № 08 from 30.09.2016

HSE University Educational Standard

[HSE University Educational Standard: Master's Degree \(from 2022\)\(signature\)](#) (PDF, 1.06 Mb)

Last Update

Approved by the academic head of the program, 15.08.2023

Network Programme

Yes

[НИУ ВШЭ и Автономная некоммерческая образовательная организация высшего образования «Сколковский институт науки и технологий» \(М\)](#)

Length of Studies, Mode of Studies, Credit Load

2 years [□]

Full-time, 120 credits

Language of instruction



Instruction in English

Qualification upon graduation

Master

Double-degree Programme

Yes

Use of online learning

Tracks

2024/2025 ACADEMIC YEAR

Math of Machine Learning

Type: General

Track Supervisor: [Naumov, Alexey](#)

Language of instruction: English

Use of online learning: With online tools

Qualification upon graduation: Магистр

2023/2024 ACADEMIC YEAR

Math of Machine Learning

Type: General

Track Supervisor: [Naumov, Alexey](#)

Language of instruction: English

Use of online learning: With online tools

Qualification upon graduation: Магистр

Key learning outcomes:

KLO-1: Knows the basics of mathematical analysis, linear algebra, discrete mathematics, probability theory, mathematical statistics and convex optimization. Proficient in the basic methods of discrete and continuous optimization.

KLO-2: Able to develop mathematical and simulation models for solving Machine Learning problems use standard computer tools to study the effectiveness of their work.

KLO-3: Owns the basic methods of data analysis and machine learning, is able to work with data of various nature.

KLO-4: Knows the basic algorithms and data structures, is able to apply them to solve practical problems and evaluate the effectiveness of solutions.

KLO-5: Has the skills to develop new methods of statistical training.

Description of the professional field:

This programme stands at the crossroads of various disciplines of modern mathematics and computer science, including statistics, optimization, learning theory, information theory, complexity theory, as well as at the intersection of science and innovation in the field of modern information technology. Leading experts at HSE and Skoltech jointly provide instruction in this unique research-driven programme.

Students participate in one or more working groups (research seminars), where they determine focus areas for an initial survey report and then solve challenges at the intersection of cutting-edge research and technology in statistical learning theory. These seminars are built on teamwork, as the tasks undertaken are so complex that they can't be solved by one person alone. Students learn how to effectively collaborate, bringing together their diverse collective skills, competencies, and experiences to determine successful solutions for complicated issues.

Description of educational modules:

The format of the program provides for learning within the master's curriculum a number of mandatory courses, as well as a number of courses of the student's choice.

Courses taught include basic and advanced courses in optimization, stochastics, statistics and machine learning.

The variable part contains a number of special advanced courses on special sections of the statistical theory of training, and also a number of the courses focused on applications of the theory of statistical training to the solution of applied problems.

All courses of the program are taught in the first year and a half of training. The greatest intensity falls on 3-4 modules of the first year of training and 1-2 modules of the second year of training.

Within the framework of the program, students are expected to participate in a research seminar.

Competitive Advantages

Compared to all similar programs, the program "Math of Machine Learning" stands out by the significantly stronger level of training in the following areas: mathematical statistics, convex optimization.

These areas are key in the development of new methods of statistical learning, as well as for the understanding of this area of knowledge. This is also a key difference from the training program in the direction of "Data Analysis" in the Yandex school of data analysis. SHAD provides additional training in discrete optimization, as well as significantly more attention to the development of programming skills.

The program is designed primarily to train researchers in the modern theory of machine learning and the main expected direction of career development of graduates-academic. The level of the proposed program "Math of Machine Learning" largely corresponds to the level of preparation of the first years at a similar Ph.D. programs of foreign Universities. This circumstance gives graduates of the program a competitive advantage when entering the Ph. D. programs of foreign universities. It is also worth considering that the necessary programming skills can be mastered thanks to the large number of available online courses, while the analogues of the most advanced courses of the program in the public domain are virtually absent.

Professional Activities and Competencies of Programme Graduates

The program "Math of Machine Learning" is formed on the basis of the Data Analysis program in Skoltech.

The program is designed to train researchers and developers of new methods at the intersection of several modern mathematical disciplines: statistics, optimization, machine learning.

The program is focused on training specialists in the field of statistical theory of learning. Graduates of the educational program must have the skills of a developer and researcher in this field and meet the highest professional requirements of leading domestic and foreign companies and research and educational centers. Graduates should have a broad professional Outlook and possess methodological approaches in the field, have sufficient knowledge and skills to develop and analyze the effectiveness of new methods and approaches for solving machine learning problems.

Graduates should be able to show leadership qualities and apply the received fundamental and applied knowledge for the choice of an actual problem (which can be solved within the framework of the concept of statistical theory of training), development of algorithms for solving this problem, organization of the development process, including, with the involvement of narrowly focused specialists in different fields.

Graduates will be able to develop mathematical and simulation models for solving machine learning problems, use standard computer tools to study the effectiveness of their work, use professional search engines, present the results in the form of publications and reports, make expert assessments.

Programme Modules

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Options for Students with Disabilities

This degree programme of HSE University is adapted for students with special educational needs (SEN) and disabilities. Special assistive technology and teaching aids are used for collective and individual learning of students with SEN and disabilities. The specific adaptive features of the programme are listed in each subject's full syllabus and are available to students through the online Learning Management System.

Programme Documentation

All documents of the degree programme are stored electronically on this website. Curricula, calendar plans, and syllabi are developed and approved electronically in corporate information systems. Their current versions are automatically published on the website of the degree programme. Up-to-date teaching and learning guides, assessment tools, and other relevant documents are stored on the website of the degree programme in accordance with the local regulatory acts of HSE University.

I hereby confirm that the degree programme documents posted on this website are fully up-to-date.

Vice Rector Sergey Yu. Roshchin

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