



National Research University Higher School of Economics (HSE)

Basic Curriculum

Field of study 01.03.02 Applied Mathematics and Information Science
Educational Programme "Applied Data Analysis and Artificial Intelligence"

Specializations: "Applied Data Analysis", "Data Analysis in Finance", "Machine Learning Architecture"

Implementing unit: St. Petersburg School of Mathematics, Physics and Computer Science, HSE, HSE - Saint Petersburg

Years of Study: 2024/2025 - 2027/2028

Length of Programme: 4 years

Mode of Study: Full Time

Degree: Bachelor's degree

APPROVED
27.05.2024
Vice Rector
ROSHCHIN S.Y.
Signed with EDS

Block Code	Course	Subject type	Credits	Credits by Years				Planned Educational Programme Development Results
				1	2	3	4	
	Degree Programme		240,00	60,00	60,00	60,00	60,00	
	Major		163,00	45,00	41,00	37,00	40,00	
	Core Professional Block (Major)		83,00	38,00	34,00	8,00	3,00	
1	Linear Algebra and Geometry	C	4,00	4,00				GPC-1, GPC-3, UC-1
2	Calculus 1	C	10,00	10,00				GPC-1, GPC-3, UC-1
3	Introduction to Programming	C	4,00	4,00				GPC-2, GPC-3, GPC-4, UC-1, UC-2
4	Algorithms and Data Structures	C	8,00	8,00				GPC-2, GPC-3, UC-1, UC-2
5	Algebra	C	4,00	4,00				GPC-1, GPC-3, UC-1
6	Differential Equations	C	3,00		3,00			GPC-1, GPC-2, GPC-3, PC-11, UC-1
7	Calculus 2	C	5,00		5,00			GPC-1, GPC-2, GPC-3
8	Probability Theory and Mathematical Statistics	C	13,00		8,00	5,00		GPC-1, GPC-2, GPC-3
9	Numerical and Optimization Methods	C	6,00		3,00	3,00		GPC-1, GPC-3, PC-2, PC-6, UC-1, UC-2
10	Computer Architecture	C	5,00		5,00			GPC-4, UC-1
11	Operating Systems	C	6,00		6,00			GPC-4, UC-1
12	Transformers and LLMs (offered in a foreign language)	C	3,00				3,00	GPC-4, UC-1
13	Discrete Mathematics	C	12,00	8,00	4,00			GPC-1, GPC-3, UC-1, UC-2
	Elective Professional Block (Major)		80,00	7,00	7,00	29,00	37,00	
	Compulsory Courses		40,00	7,00	7,00	17,00	9,00	
1	C++ Programming Language	C	4,00	4,00				GPC-1, GPC-4, PC-1, PC-3, UC-1, UC-2
2	Databases	C	3,00		3,00			PC-10, PC-12
3	Foundations of Machine Learning	C	4,00		4,00			GPC-5, PC-10, PC-11
4	Deep Learning Basics	C	5,00			5,00		PC-10, PC-3, PC-9
5	Research Seminar	C	9,00			3,00	6,00	PC-1, PC-2, UC-1, UC-2, UC-4
6	Parallel programming on GPU (CUDA, OpenMP, numba)	C	4,00			4,00		PC-10, PC-3, PC-9

7	Network Data Analysis	C	5,00			5,00		PC-10, PC-3, PC-9
8	Project Seminar	C	6,00	3,00			3,00	UC-1, UC-2
	-		40,00			12,00	28,00	
	Applied Data Analysis		40,00			12,00	28,00	
	Compulsory Courses		24,00			12,00	12,00	
1	Applied statistics methods in python	C	4,00			4,00		PC-10, PC-3, PC-9
2	Introduction to Hadoop and MapReduce	C	4,00			4,00		PC-10, PC-3, PC-9
3	Monte Carlo Methods	C	4,00			4,00		PC-10, PC-3, PC-9
4	Speech Technologies	C	4,00				4,00	PC-10, PC-3, PC-9
5	Deep Reinforcement Learning	C	4,00				4,00	PC-10, PC-3, PC-9
6	Time series analysis using machine learning models	C	4,00				4,00	PC-10, PC-3, PC-9
	Elective Courses		16,00				16,00	
1	Generative Methods in Machine Learning	E	4,00				4,00	PC-10, PC-3, PC-9
2	Recommender Systems	E	4,00				4,00	PC-10, PC-3, PC-9
3	Image Processing with Deep Learning	E	4,00				4,00	PC-10, PC-3, PC-9
4	ML for eye tracking and neural interfaces	E	4,00				4,00	PC-10, PC-3, PC-9
5	ML for data from unmanned devices	E	4,00				4,00	PC-10, PC-3, PC-9
6	Application of neural networks to solve differential equations	E	4,00				4,00	PC-10, PC-3, PC-9
7	Time series analysis using machine learning models	E	4,00				4,00	PC-10, PC-3, PC-9
	Data Analysis in Finance		40,00			12,00	28,00	
	Compulsory Courses		24,00			12,00	12,00	
1	Theory of random processes in continuous time and fundamentals of stochastic analysis	C	4,00			4,00		PC-11, PC-12, PC-13
2	Stochastic differential equations and statistics of random processes	C	4,00			4,00		PC-11, PC-12, PC-13
3	Stochastic theory of finance	C	4,00			4,00		PC-11, PC-12, PC-13
4	Derivatives	C	4,00				4,00	PC-11, PC-12, PC-13
5	Financial Risk Management	C	4,00				4,00	PC-11, PC-12, PC-13
6	Numerical methods of financial analysis	C	4,00				4,00	PC-11, PC-12, PC-13
	Elective Courses		16,00				16,00	
1	Game Theory	E	4,00				4,00	PC-11, PC-12, PC-13
2	Mathematical Economics and Econometrics	E	4,00				4,00	PC-11, PC-12, PC-13
3	Interest Rate Instruments	E	4,00				4,00	PC-11, PC-12, PC-13
4	Microstructure of financial markets and algorithmic trading strategies	E	4,00				4,00	PC-11, PC-12, PC-13
5	Corporate finance, asset valuations, mergers and acquisitions	E	4,00				4,00	PC-11, PC-12, PC-13
6	Machine learning methods in quantitative finance and algorithmic trading	E	4,00				4,00	PC-11, PC-12, PC-13
7	Alpha-Research	E	4,00				4,00	PC-11, PC-12, PC-13
	Machine Learning Architecture		40,00			12,00	28,00	

	Compulsory Courses		24,00			12,00	12,00	
1	Introduction to Hadoop and MapReduce	C	4,00			4,00		PC-10, PC-11, PC-12, PC-14, PC-3, PC-9
2	Engineering Practices	C	4,00			4,00		PC-10, PC-3, PC-9
3	Programming languages (Kotlin and Scala, functional programming, Haskell)	C	4,00			4,00		PC-10, PC-3, PC-9
4	Deep Reinforcement Learning	C	4,00				4,00	PC-10, PC-3, PC-9
5	Information Retrieval	C	4,00				4,00	PC-10, PC-3, PC-9
6	Time series analysis using machine learning models	C	4,00				4,00	PC-10, PC-3, PC-9
	Elective Courses		16,00				16,00	
1	Generative Methods in Machine Learning	E	4,00				4,00	PC-10, PC-3, PC-9
2	Speech Technologies	E	4,00				4,00	PC-10, PC-3, PC-9
3	Recommender Systems	E	4,00				4,00	PC-10, PC-3, PC-9
4	Image Processing with Deep Learning	E	4,00				4,00	PC-10, PC-3, PC-9
5	ML for eye tracking and neural interfaces	E	4,00				4,00	PC-10, PC-3, PC-9
6	Application of neural networks to solve differential equations	E	4,00				4,00	PC-10, PC-3, PC-9
7	Time series analysis using machine learning models	E	4,00				4,00	PC-10, PC-3, PC-9
	Internship		36,00	8,00	5,00	8,00	15,00	
	Professional Internship		7,00		3,00	4,00		
1	Educational Internship	C	3,00		3,00			PC-1, PC-2, UC-1, UC-2, UC-4
2	Work Experience Internship	C	4,00			4,00		PC-1, PC-2, UC-1, UC-2, UC-4
	Project Internship		14,00	8,00	2,00	4,00		
1	Project	C	14,00	8,00	2,00	4,00		GPC-2, GPC-3, PC-2, PC-3, PC-4, UC-1, UC-3, UC-6
	Research Internship		15,00				15,00	
1	Preparation of Graduation Thesis	C	10,00				10,00	PC-1, PC-4, PC-5, UC-1, UC-2, UC-4, UC-6
2	Graduation Internship	C	5,00				5,00	GPC-2, GPC-3, GPC-4, PC-1, PC-3, PC-6, UC-1, UC-2, UC-3, UC-4, UC-6
	General Courses		14,00	7,00	4,00		3,00	
	Core General Courses		2,00	1,00	1,00			
1	Safe Living Basics	C	1,00	1,00				UC-11, UC-8
2	Physical Training	C	1,00		1,00			UC-7
	Optional General Courses		12,00	6,00	3,00		3,00	
1	Legal Literacy	C	3,00		3,00			UC-10
2	Russian History	C	4,00	4,00				UC-5
3	Foundations of Russian Statehood	C	2,00	2,00				UC-5
4	Economics	C	3,00				3,00	UC-1, UC-9
	Minor		20,00		10,00	10,00		
1	Minor	E	20,00		10,00	10,00		UC-5
	English		1,00				1,00	

	Examinations		1,00			1,00	
1	Independent English Exam (offered in a foreign language)	C					UC-4
2	Project Proposal (offered in a foreign language)	C	1,00			1,00	UC-1, UC-2, UC-4
3	English Language Integrative Exam (offered in a foreign language)	C					UC-4
	Optional Courses						
1	English (offered in a foreign language)	O	14,00	8,00	6,00		UC-4
2	Academic English Writing (offered in a foreign language)	O	2,00			2,00	PC-4
	Data Culture		5,00			5,00	
1	External Examinations on Digital Skills. Entry-level	C					UC-1
2	External Examinations on Digital Skills. Intermediate Level	C					UC-1
3	External Examinations on Digital Skills. Final Level	C					UC-1
4	Independent Programming Test. Advanced Level	C					PC-10
5	Data Science, AI and Generative Models Independent Test. Advanced Level	C	1,00			1,00	GPC-3, PC-10
6	Independent Digital Literacy Test	C					GPC-4, PC-5
7	Machine Learning (offered in a foreign language)	C	4,00			4,00	PC-9
	Final State Certification (FSC)		1,00			1,00	
	Thesis Work		1,00			1,00	
1	Presenting of Graduation Thesis	C	1,00			1,00	GPC-1, GPC-2, GPC-3, GPC-4, PC-1, PC-2, PC-3, PC-4, PC-5, PC-6, PC-7, PC-8, UC-1, UC-2, UC-4

Curriculum agreed:

Academic Supervisor	MUKHIN M.S.	14.05.2024
Dean		14.05.2024
Deputy Director	KUZMIN P.V.	14.05.2024
Head of Centre for Educational Model Design	LEPESHKIN I.A.	23.05.2024

* Subject type:

Compulsory course	C
Elective course	E
Optional course	O