MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
NATIONAL TECHNICAL UNIVERSITY
"KHARKIV POLYTECHNIC INSTITUTE"

I APPROVE
Rector of NTU "KhPI"

_____Evgen SOKOL

"09"_____May__2023

EDUCATIONAL AND SCIENTIFIC PROGRAM

"Computer science and intelligent systems"
Second (master's) level of higher education

in the specialty 122 - Computer Science
fields of knowledge 12 - Information technologies
Master's qualification in computer science

APPROVED
BY THE ACADEMIC COUNCIL OF NTU "KhPI"
Chairman of the Academic Council

_____/ Leonid TOVAZHNIANSKYI
Protocol No. 4
from "05"_____May__2023

Kharkiv 2023

LETTER OF AGREEMENT

Educational and scientific program Computer science and intelligent systems

The second level of higher education (master's)

Branch of knowledge 12 – Information technologies

Specialty 122 – Computer Science

Master's degree in computer science

APPROVED

Working group of OP from the specialty "Computer science"

Guarantor of the educational program "Computer science and intelligent systems"

_____Valentyn MOSKALENKO

"___" _____ 2023

RECOMMENDED

Methodical Council of NTU "KhPI"

Deputy Chairman of the Methodical Council

_____Ruslan MYGUSHCHENKO

"___" _____ 2023

AGREED

Head of the Department of Software Engineering and Intelligent Management Technologies

_____Ihor GAMAYUN

"___" _____ 2023

AGREED

Director of the educational and scientific institute of computer sciences and information technologies

_____ Mykhailo GODLEVSKYI

"___" _____ 2023

AGREED

Student (member of EP working group)

group KH-N422

_____Dmytro HOLOVNYA

"___" _____ 2023

REVIEWERS: Productive comments and feedback on the project of the educational and scientific program (ESP) were received from:

1. EPAM SYSTEMS LLC
2. LLC "NIX SOLUTIONS LTD"
3. ACADEMY SMART LLC

PREFACE

Corresponds to the Standard of higher education of the second (master's) level of the field of knowledge 12 - Information technologies, specialty 122 - Computer science, approved and put into effect by the order of the Ministry of Education and Science of Ukraine dated 04/28/2022. No. 393.

Developed by the OST working group "Computer science and intelligent systems"
Educational and Scientific Institute of Computer Sciences and Information Technologies of the National Technical University "Kharkiv Polytechnic Institute"
consisting of:

Guarantor of the educational program
Valentina Volodymyrivna Moskalenko, Doctor of Technical Sciences, Associate Professor, Professor of the Department of Information Systems and Technologies

OP working group members:

1. Cherednichenko Olga Yuriivna, Doctor of Technical Sciences, Associate Professor, Professor of the Department of Software Engineering and Intelligent Management Technologies
   (name, scientific degree, academic title, position)
2. Kovalenko Svitlana Mykolaivna, Candidate of Technical Sciences, Associate Professor, Associate Professor of the Department of Software Engineering and Intelligent Management Technologies
   (name,academic degree, academic title, position)
3. Andrii Mykhailovych Kopp, Doctor of Philosophy, Associate Professor, Associate Professor of the Department of Software Engineering and Intelligent Management Technologies
   (name, scientific degree, academic title, position)
4. Head Dmytro Mykolayovych, student of group KN-N422
   student (name, group)

1. PROFILE OF THE EDUCATIONAL PROGRAM BY SPECIALTY

1 - General information	
Higher educational institution and structural unit	National Technical University "Kharkiv Polytechnic Institute", Educational and Scientific Institute of Computer Sciences and Information Technologies, Department of Software Engineering and Intelligent Management Technologies (SEMIT)
The degree of higher education and the title of the qualification in the original language	Degree of higher education: master's degree Educational qualification: master's degree in computer science Diploma Qualification: Master of Computer Science
The official name of the educational program	Computer science and intelligent systems
Type of diploma and scope of the educational program	Master's degree, single, 120 ECTS credits, study period - 1 year 9 months
Availability of accreditation	Accreditation Commission. Ukraine. Certificate - ND No. 2192120 dated 09/06/2017. Validity period - 07/01/2026.
Cycle/level	Second (master's) level of higher education, NRK – 7th level, QF-LLL – 7th level, FQ-EHEA – second cycle
Prerequisites	Individuals who have obtained a bachelor's degree can apply for a master's degree.
Language of teaching	Ukrainian language. Teaching in English is possible.
The term of validity of the educational program	According to the validity period of the accreditation certificate Updated annually
Link to the permanent posting of the description of the educational program	http://web.kpi.kharkov.ua/asu/122-komp-yuterni-nauki-2/
2 - The purpose of the educational program	
Training of professionals in the field of computer sciences and intellectual systems, capable of independent scientific research, production-technological and organizational-management activities.	
3 – Characteristics of the educational program	
Subject area (field of knowledge, specialty, specialization)	Field of knowledge: 12 - Information technologies Specialty: 122 – Computer science Object of study: processes of collection, presentation, processing, storage, transmission and access to information in computer systems. Learning goals: acquiring the ability to solve problems of a research and/or innovative nature in the field of computer science. Theoretical content of the subject area: modern models, methods, algorithms, technologies, processes and methods of obtaining, presenting, processing, analyzing, transmitting, storing data in information and computer systems. Methods, techniques and technologies: methods and algorithms for solving theoretical and applied problems of computer science; mathematical and computer modeling, modern programming technologies; methods of collection, analysis and consolidation of distributed information; technologies and methods of design, development and quality assurance of information technology components, computer graphics methods and data visualization technologies; knowledge engineering technologies, CASE modeling and IT design technologies. Tools and equipment: distributed computing

	systems; computer networks; mobile and cloud technologies, database management systems, operating systems, means of developing information systems and technologies.
Orientation of the educational program	Educational and scientific program for training specialists in the field of computer science and intelligent systems.
The main focus of the educational program and specialization	Special education in the field of information technologies in the specialty 122 - "Computer Science", which involves in-depth study of methods of artificial intelligence, business analysis, information technologies for the development of intelligent systems, as well as in-depth study of a foreign language in professional and scientific activities. Keywords: computer science, intelligent management system, business analytics, information technologies.
Features programs	Orientation on partnership with domestic and foreign educational and scientific institutions, the private sector, scientists and practitioners, participation in international programs. Dual form of education, which involves practice in IT companies and students' participation in real projects.
4 – Suitability of graduates for employment and further education	
Suitability for employment	Graduates can work in professions according to the National Classifier of Professions DK 003:2010 for the following types of activities: 72 Scientific research and development; 62 Computer programming, consultancy and related activities; 63 Provision of information services; 72 Scientific research and development; 85.4 Higher education; for the following professions: 213 Professionals in the field of computing (computerization); 2131 Professionals in the field of computer systems; 2131.1 Research staff (computer systems); 2131.2 Developers of computing systems; 2132 Professionals in the field of programming; 2132.1 Research staff (programming); 2132.2 Developers of computer programs; 2139 Professionals in other fields of computing (computerization); 2139.1 Research staff (other fields of computing); 2139.2 Professionals in other fields of computing; 2149.1 Scientific employees (other branches of engineering); 2310 Teachers of universities and higher educational institutions; 2433.1 Research staff (information analytics); 2433.2 Information professionals and information analysts; 2447 Professionals in the field of project and program management; 2447.1 Research staff (projects and programs); 2447.2 Project and program management professionals.
Further education	The opportunity to study at a third-level educational and scientific program (Doctor of Philosophy - PhD) in accordance with the National Framework of Qualifications in the field of knowledge "Information Technologies" or related fields of knowledge.
5 – Teaching and assessment	
Teaching and learning	Student-centered learning, problem-oriented learning, distance learning in the Office 365 system, self-learning, learning through project practice, learning based on research. Lectures, laboratory

	classes, work in small groups, seminars-discussions, practical classes, practical scientific research works are used for teaching.
Assessment	Monitoring of students' knowledge and skills is carried out in the form of current and final control. Current control – oral and written survey, assessment of work in small groups, testing, defense of group and individual research tasks and projects. Final control - oral and written exams, assessments taking into account the accumulated points of the current control, defense of practical reports, defense of term papers. State certification – preparation and public defense (presentation) of the final qualification work. Evaluation is carried out according to the national scale ("excellent", "good", "satisfactory", "unsatisfactory"), 100-point scale and ECTS scale (A, B, C, D, E, FX, F). Control of students' knowledge and skills is carried out in the form of current and final control. Evaluation of the student's educational achievements is carried out according to the rating system. Current control includes control of students' knowledge, abilities, and skills in lectures, laboratory and practical classes, and during the performance of individual educational tasks and tests. Assessment of students' knowledge of a certain discipline is carried out within the classroom hours allocated to it. At the end of each semester, in addition to the assessment of students' knowledge by discipline, an assessment of practical skills and research work is conducted. Final control is carried out in the form of exams, assessments and certification of higher education applicants. Attestation is carried out in the form of a public defense (demonstration) of the qualification work (in the form of a diploma project). The qualification work must include elements of scientific research and practical nature. The institution of higher education carries out a mandatory check for plagiarism of all master's qualification works. The uniqueness of the content for the works of the educational and scientific training program should be at least 70%.
6 – Software competencies	
Integral competence	The ability to solve problems of a research and/or innovative nature in the field of computer science.
General competences (defined by the standard of higher education of the specialty)	GC01. Ability to abstract thinking, analysis and synthesis. GC02. Ability to apply knowledge in practical situations. GC03. Ability to communicate in the national language both orally and in writing. GC04. Ability to communicate in a foreign language. GC05. Ability to learn and master modern knowledge. GC06. The ability to be critical and self-critical. GC07. Ability to generate new ideas (creativity).
Special (professional) competences of the specialty (defined by the standard of higher education of the specialty)	PC01. Awareness of the theoretical foundations of computer science. PC02. The ability to formalize the subject area of a certain project in the form of an appropriate information model. PC03. Ability to use mathematical methods to analyze formalized models of the subject area. PC04. The ability to collect and analyze data (including large data) to ensure the quality of project decision-making.

	PC05. Ability to develop, describe, analyze and optimize architectural solutions of information and computer systems for various purposes. PC06. Ability to apply existing and develop new algorithms for solving problems in the field of computer science. PC07. Ability to develop software according to formulated requirements, taking into account available resources and constraints. PC08. The ability to develop and implement software creation projects, including in unpredictable conditions, with unclear requirements and the need to apply new strategic approaches, use software tools to organize teamwork on the project. PC09. Ability to develop and administer databases and knowledge bases. PC10. The ability to evaluate and ensure the quality of IT projects, information and computer systems of various purposes, to apply international standards for assessing the quality of software of information and computer systems, models for assessing the maturity of information and computer systems development processes. PC11. Ability to initiate, plan and implement the development processes of information and computer systems and software, including its development, analysis, testing, system integration, implementation and support. PC12. The ability to use basic methods and models of artificial intelligence for the development of intelligent systems in various fields of professional activity. PC13. The ability to apply business analysis methods to conduct research on the development of intelligent systems in various fields of activity.
Additional special competencies to the educational and scientific program of master's training	APC1. Ability to plan and carry out scientific research in the field of computer science. APC2. The ability to conduct scientific and pedagogical activities in institutions of higher education.
7 - Learning outcomes	
The results of studies in the specialty (defined by the standard of higher education of the specialty)	LO1. Have specialized conceptual knowledge that includes modern scientific achievements in the field of computer science and is the basis for original thinking and conducting research, critical understanding of problems in the field of computer science and at the border of fields of knowledge. LO2. Have specialized computer science problem-solving skills necessary for conducting research and/or carrying out innovative activities in order to develop new knowledge and procedures. LO3. It is clear and unambiguous to convey one's own knowledge, conclusions and arguments in the field of computer science to specialists and non-specialists, in particular to people who are studying. LO4. Manage work processes in the field of information technologies, which are complex, unpredictable and require new strategic approaches. LO5. Evaluate the results of teams and collectives in the field of information technologies, ensure the effectiveness of their activities. LO6. Develop a conceptual model of an information or computer system. LO7. Develop and apply mathematical methods for the analysis of information models.

	LO8. Develop mathematical models and methods of data analysis (including large data). LO9. Develop algorithmic and software for data analysis (including large data). LO10. To design architectural solutions of information and computer systems for various purposes. LO11. Create new algorithms for solving problems in the field of computer science, evaluate their effectiveness and limitations on their application. LO12. Design and maintain databases and knowledge. LO13. Assess and ensure the quality of information and computer systems for various purposes. LO14. Test the software. LO15. Identify the needs of potential customers regarding the automation of information processing. LO16. Conduct research in the field of computer science. LO17. Identify and eliminate problematic situations during software operation, formulate tasks for its modification or reengineering. LO18. Collect, formalize, systematize and analyze the needs and requirements for the information or computer system being developed, operated or supported. LO19. To analyze the current state and global trends in the development of computer sciences and information technologies. LO20. Develop artificial intelligence models and algorithms for creating intelligent systems in various fields of professional activity. LO21. Analyze the needs of companies and organizations in various fields of activity regarding the implementation of intelligent systems, develop, analyze and manage requirements for the development of intelligent systems using business analysis methods.
Additionally for educational and scientific programs (defined by the standard of higher education of the specialty)	LO22. Create and research informational and mathematical models of systems and processes under investigation, including automation objects. LO23. Develop and teach specialized educational disciplines in information technologies in institutions of higher education.
8 – Resource support for program implementation	
Staff support	Personnel provision of the National Academy of Sciences corresponds to the Resolution of the Cabinet of Ministers of Ukraine No. 1187 of 12/30/2015 "On approval of the Licensing conditions for conducting educational activities of educational institutions" (as amended in accordance with the Resolution of the Cabinet of Ministers of Ukraine No. 365 of 24/03/2021. Appendix 15-16). The educational process is provided by scientific and pedagogical workers who work at the main place of work and have appropriate educational and/or professional qualifications. Practical teachers, specialists and employees of IT companies, foreign experts are also involved in teaching.
Material and technical support	The material and technical support of the OST corresponds to the Resolution of the Cabinet of Ministers of Ukraine No. 1187 dated 30.12.2015 "On approval of the Licensing conditions for conducting educational activities of educational institutions" (as amended in accordance with Resolution of the Cabinet of Ministers of Ukraine No. 365 of 24.03.2021 Appendix 17). In the educational process, educational facilities of NTU "KhPI" are used, in particular, computer laboratories and educational laboratory

	"Innovation Campus" of the SEMIT department, premises for scientific and pedagogical workers, other premises.
Informational and educational and methodological support	The informational and educational and methodological support of OST complies with the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 No. 1187 "On Approval of Licensing Conditions for Conducting Educational Activities of Educational Institutions" (as amended in accordance with Resolution of the Cabinet of Ministers of Ukraine No. 365 dated 24.03.2021. Appendix 18) . Application of the Office 365 system, LMS (Learning Management System) in the educational process, in particular, for distance learning. Access to the electronic repository (eNTUKhPIIR) of the scientific and technical library of NTU "KhPI" via the Internet (including the university Wi-Fi network) for access to educational publications and periodical scientific publications on IT, in particular, in English.
9 – Academic mobility	
National credit mobility	Based on bilateral agreements on academic mobility with institutions of higher education within Ukraine.
International credit mobility	Based on an agreement with Université Paris-Nord (University of Paris-North, France), Univerza v Mariboru (University of Maribor, Slovenia). Academic mobility projects ERASMUS+ KA1.
Education of foreign students of education	Training of foreign citizens and stateless persons is carried out in Ukrainian or English in accordance with the requirements of the Law of Ukraine "On Higher Education". At least 25% of scientific-pedagogical staff who ensure the implementation of the educational process in English have a document certifying English language proficiency at a level not lower than B2 in accordance with the Common European Recommendations on Language Education: Study, Teaching, Evaluation (Common European Framework of Reference for Languages, CEFR).

LIST OF EDUCATIONAL COMPONENTS OF THE EDUCATIONAL PROGRAM AND THEIR LOGICAL SEQUENCE

Code n/a	*Components of the educational program*	*Number of credits*	*Final control form*
1	**2**	**3**	**4**
1 Mandatory educational components			
1.1 General preparation			
GT 1	Foreign language by professional direction	4	Test
GT 2	English for scientific purposes	4	Exam
GT 3	Intellectual Property	3	Test
GT 4	Innovative entrepreneurship and startup project management	3	Test
		14	
1.2 Special (professional) training			
PT 1	Business analysis methods for managing requirements for intelligent systems	4	Exam
PT 2	Management of intelligent systems development projects	3	Exam
PT 3	Basics of computational intelligence	3	Exam
PT 4	Methods of intelligent data analysis	4	Exam
PT 5	Workshop "Intelligent Systems"	4	Test
PT 6	Mathematical models of complex systems and decision support	4	Exam
PT 7	Models of artificial intelligence	4	Exam
PT 8	Representation of knowledge in intelligent systems	3	Exam
PT 9	Life cycle management of intelligent systems	3	Test
PT 10	Databases and knowledge	4	Exam
PT 11	Architecture and software design of intelligent systems	3	Exam
PT 12	Big Data	3	Test
		42	
1.3 Scientific training			
ST 1	Basics of the scientific research	3	Test
ST 2	Modern scientific schools of the department	3	Test
ST 3	Philosophical problems of modern scientific knowledge (MSK)	3	Exam
ST 4	R&D	1	Test
ST 5	Scientific research practice	9	Test
	Certification	9	
		28	
The total amount of mandatory components		**84**	
2 Elective educational components			
2.1 Professional training			
Profiled package of disciplines 01"Business Intelligence"			
OP 1.1	BI technologies	5	Test
OP 1.2	Data Mining Tools	5	Test
OP 1.3	Data visualization tools	5	Test

Code n/a	*Components of the educational program*	*Number of credits*	*Final control form*
Profiled package of disciplines 02 "Computational Intelligence"			
OP 2.1	Evolutionary technologies in artificial intelligence systems	5	Test
OP 2.2	Development of neural network models for artificial intelligence tasks	5	Test
OP 2.3	Models and methods of soft computing	5	Test
Profiled package of disciplines 03 "Machine Learning"			
OP 3.1	Machine Learning methods	5	Test
OP 3.2	Reinforcement learning	5	Test
OP 3.3	Machine Learning models and frameworks	5	Test
		15	
2.2 Disciplines of free choice of specialized training according to the list (the list of disciplines is attached to the curriculum)			
OD 1	Cloud Computing: cloud technologies and applications	3	Test
OD 2	Analytical data warehouses	3	Test
OD 3	Group dynamics and communications	3	Test
OD 4	Distributed and parallel computing	3	Test
OD 5	Modern programming technologies	3	Test
OD 6	Introduction to DevOps	3	Test
OD 7	Data Integration and Cleaning (ETL) Tools	3	Test
OD 8	Decentralized applications and blockchain technology	3	Test
		3	
2.3 Legal and psychological disciplines according to the list (the list of disciplines is attached)		**6**	
2.4. Disciplines of free choice of scientific and professional direction (SPD)			
SPD 1	Models and methods of natural language processing	4	Test
SPD 2	Simulation modeling	4	Test
SPD 3	Modeling and analysis of business processes	4	Test
SPD 4	Models and technologies for ensuring the security of intelligent systems	4	Test
SPD 5	Promising technologies and directions of development of intelligent systems	4	Test
SPD 6	Mathematical logic and formal languages	4	Test
SPD 7	Scientific directions of research in computer science and in the development of intelligent systems	4	Test
SPD 8	Game theory	4	Test
SPD 9	Business analytics and software development methodologies	4	Test
		12	
The total amount of sample components:		**36**	
GENERAL SCOPE OF THE EDUCATIONAL PROGRAM:		**120**	

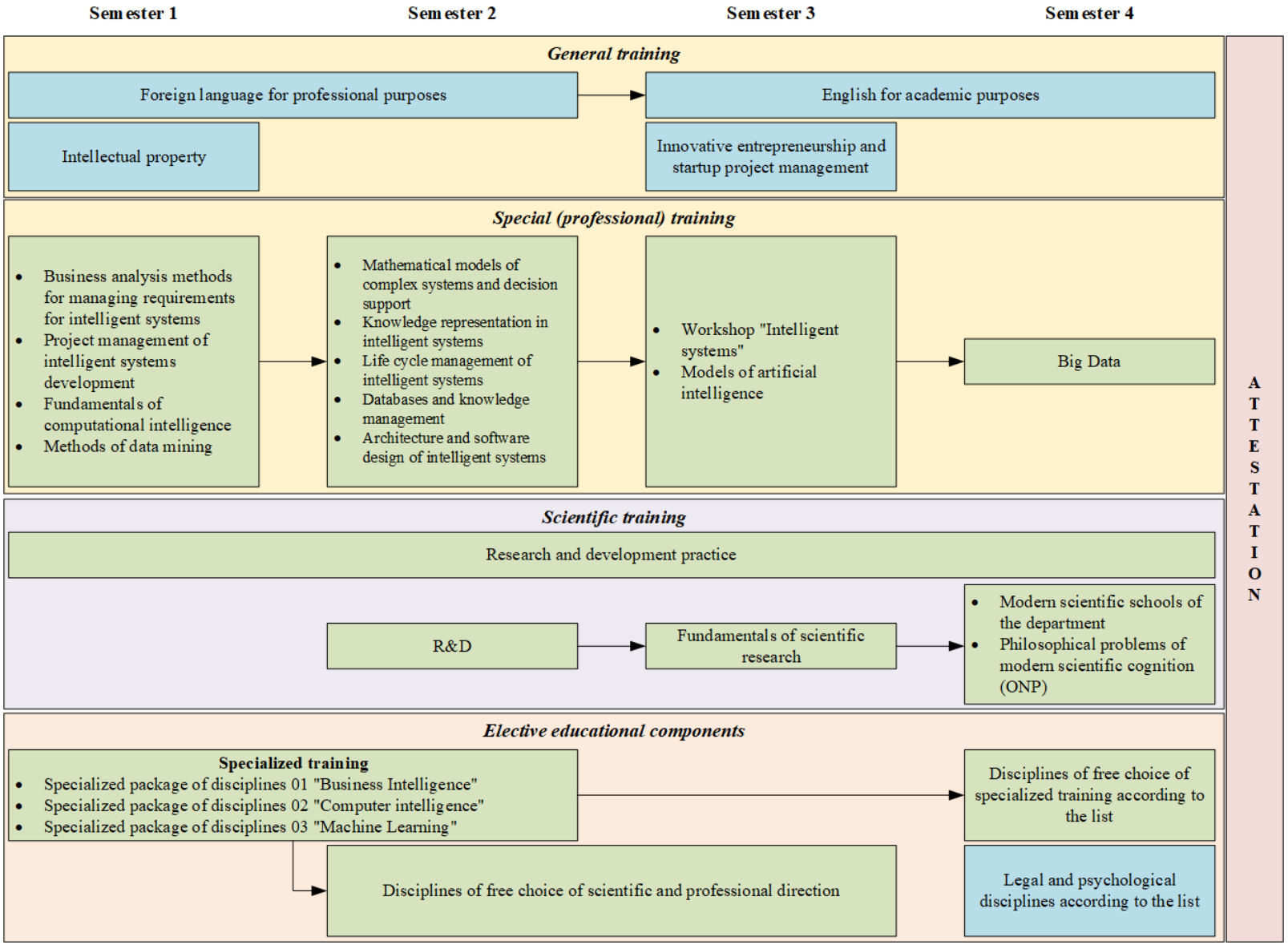
Distribution of the content of the educational program by component groups and training cycles

No	Training cycle	The volume of the educational load of the student of higher education (ECTS credits / %)		
		Mandatory components of the educational and scientific program	Elective components of the educational and scientific program	Total for the entire period of study
1	General training	14 / 12	-	14 / 12
2	Special (professional) training	42 / 35	-	42 / 35
3	Scientific training	28 / 23		28 / 23
4	Disciplines of free choice	-	36 / 30	36 / 30
Total for the entire period of study		**84 / 70**	**36 / 30**	**120 / 100**

FORM OF CERTIFICATION OF HIGHER EDUCATION ACQUIRES

Forms of attestation of applicants of higher education	Attestation of master's degree holders is carried out in the form of a public defense of the qualification work.
Requirements for qualifying work	The qualification work should involve solving a complex task of a research and/or innovative nature in the field of computer science. The qualification work should not contain academic plagiarism, falsification, fabrication. The qualification work must be posted on the website or in the public repository of the higher education institution or its structural division. Publication of qualification works containing information with restricted access should be carried out in accordance with the requirements of the law.

STRUCTURAL AND LOGICAL SCHEME



Correspondence matrix of defined learning outcomes, competencies and educational components

Learning outcomes	General competences						
	GC1	GC2	GC3	GC4	GC5	GC6	GC7
LO1	+	+	+				+
LO2	+	+	+		+		+
LO3		+	+		+	+	
LO4	+	+					+
LO5			+	+	+	+	
LO6	+	+	+				+
LO7	+	+	+		+		+
LO8	+	+	+		+		+
LO9	+	+	+		+		+
LO10	+	+	+		+		+
LO11	+	+	+		+		+
LO12	+	+	+		+		+
LO13	+	+	+		+		+
LO14	+	+	+		+		+
LO15	+	+	+		+		+
LO16	+	+	+		+		+
LO17	+	+	+		+		+
LO18	+	+	+		+		+
LO19	+	+	+		+		+
LO20	+	+	+		+		+
LO21	+	+	+		+		+
LO22	+	+	+		+		+
LO23	+	+	+		+		+

Learning outcomes	Special (professional) competences														
	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9	PC10	PC11	PC12	PC13	APC1	APC2
LO1	+		+								+				
LO2	+	+													
LO3	+														
LO4										+	+				
LO5	+									+					
LO6		+													
LO7			+												
LO8				+											
LO9					+		+								
LO10					+										
LO11						+									
LO12									+						
LO13										+					
LO14							+			+	+				
LO15											+				
LO16														+	
LO17								+		+	+				
LO18		+		+							+				
LO19	+									+	+			+	
LO20												+			
LO21													+		
LO22								+		+	+			+	
LO23															+