MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

NATIONAL TECHNICAL UNIVERSITY
"KHARKIV POLYTECHNIC INSTITUTE"

APPROVED

NTU "KhPI" Rector

_____ E.I. Sokol

"____" _____ 2018

EDUCATIONAL-PROFESSIONAL PROGRAM

"COMPUTER SCIENCES"

The first level of higher education

in specialty 122 Computer Science

the field of knowledge 12 Information Technology

Qualifications: Bachelor of Computer Science

APPROVED
ACADEMIC COUNCIL OF NTU "KhPI"

The head of the academic council

_____ L. L. Tovazhnyansky

Protocol №___ ___ from

«__ __ » _____ _____ 2018

Kharkiv 2018

APPROVAL PAGE
Educational-professional program

Higher education level	First (bachelor)
Branch of knowledge	12 Information Technology
Specialty	122 «Computer Science»
Specialization	Computer Science
Qualification	Bachelor of Computer Science

APPROVED
Scientific-methodical commission on the specialty "Computer Science "
Head of Commission

_____ I.P. Gamayun

"____" _____ 2018

AGREED
Head of the Department of System Analysis and Information and Analytical Technologies

_____ O.S. Kutsenko

«____» _____2018

AGREED
Head of the Department of Strategic Management

_____ I.V. Kononenko

"____" _____ 2018

RECOMMENDED
Methodical Council of NTU "KhPI"
Deputy Head methodical council

_____ R.P. Miguschenko

"____" _____ 2018

AGREED
Head of the Department of Computer Mathematics and Data Analysis

_____ L.M. Lyubchik

«____» _____2018

AGREED
Head of the Department of Informatics and Intellectual Property

_____ M.M. Soloshchuk

«____» _____2018

AGREED
Dean of the Faculty of Computer Science and Software Engineering

_____ M.M. Malko

«____» _____ 2018

APPROVED AND ENFORCED

Order of the rector of the National Technical University “Kharkiv Polytechnic Institute" from «___» _____ 2018. № _____.

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PREFACE

Designed by the project team of the Faculty of Computer Science and Software Engineering of the National Technical University "Kharkiv Polytechnic Institute", consisting of:

1. Dr., Professor I.P Gamayun - Professor of the Department of Software Engineering and Information Technologies of Management, Head of the project group (guarantor of the educational program).
2. Dr., Professor O.S. Kutsenko - Head of the Department of System Analysis and Information and Analytical Technologies
3. Dr., Professor LM Lyubchik - Head of the Department of Computer Mathematics and Data Analysis.
4. Dr., Professor I.V. Kononeko - - Head of the Department Strategic Management.
5. Professor MM Soloshchuk - Head of the Department of Informatics and Intellectual Property.

Reviewers:

Reviews External Stakeholders:

1. PROFILE OT THE SPECIALIZED EDUCATIONAL-PROFESIYNOYI PROGRAM ON SPECIALITY 122 «COMPUTER SCIENCE» WITH SPECIALIZATION "COMPUTER SCIENCE"

1 - General information	
Full name of institution of higher education and the structural unit	National Technical University "Kharkiv Polytechnic Institute" Faculty of Computer Science and Software Engineering
Higher education and the name of the qualification in the original language	Bachelor of Computer Science
The official name of the educational program	Specialized Educational-Professional Program "Computer Science"
Type of diploma and volume of educational program	Bachelor's degree, full-time, 240 ECTS credits 3 years 10 months
Availability of accreditation	Certificate RD-IV №2158945 dated August 12, 2013 Valid until July 1, 2023
Cycle / level programs	FQ-EHEA - first cycle, QF LLL - 6 level, NRC - 1 level
Prerequisites	Full secondary education
Language (s) of teaching	Ukrainian / English
The duration of the educational program	According to the validity period of the certificate of accreditation
Internet address of permanent placement description of the educational program	http://blogs.kpi.kharkov.ua/v2/nv/
2 - The purpose of the educational program	
Provide training in the field of computer sciences, is able to formulate, summarize and solve practical problems in their professional activities using fundamental and special methods of mathematical and computer sciences, develop mathematical models, algorithms, create and provide lifecycle support for appropriate software. The specialization is aimed at training specialists who possess modern methods, means and technologies for creation of algorithmic and software, decision support systems for creation of information control systems, artificial intelligence systems, data and knowledge consolidation, IT project management, system design, and can manage their development and implementation/	
3 - Characteristics of the educational program	
Subject area (branch of knowledge , specialty, specialization)	Branch of knowledge: 12 Information technologies Specialty: 122 Computer Science Specialization: Computer Science
Orientation of the educational program	Educational-professional a program focused on the development and application of mathematical methods, algorithms and software products in the field of engineering and research in the field of computer science and information technologies.
The main focus of the educational program and specialization	Special Education in branch of Information Technology for specialty "Computer Science". The emphasis is on the formation and development of professional competencies in the field of computer science and information technologies; studying theoretical positions and obtaining practical skills in the conceptual design and

	implementation of computations in computers; mastering organizational and practical tools for modeling, designing, developing and maintaining data processing systems, information systems and technologies, implementing, developing and maintaining a computing component of cloud information consolidation services, intelligent data analysis and processing systems. Key words: mathematical models and methods, algorithm, programming languages, software product, software, data processing systems and decision support system, web application, IT project management, engineering and data analysis, signal and image processing, image recognition, large data, consolidated information, engineering and knowledge extraction, machine learning, artificial and computing intelligence, engineering of digital intellectual property.
Features of the program	Training lines (sample blocks): "Project management in the field of information technologies"; "Information and analytical systems and technologies"; "Data and knowledge engineering"; "Intellectual property in computer and software engineering"; "Information technology of large data"; "Artificial intelligence and machine learning" Dual training at basic enterprises - leading IT companies. Personalization training with a focus on student. Teaching a number of academic disciplines in English.
4 - Eligibility of graduates to employment and further training	
Suitability for employment	Employment at the enterprises and companies of the IT industry, in the information and analytical departments of the enterprises of production and banking and financial sectors, scientific institutions, in the field of services and consulting, in state and scientific institutions, consulting at enterprises and institutions of intellectual property, etc. Professional opportunities of graduates (according to the Classifier of professions DK 003: 2010). 2131.2 Database Administrator 2131.2 Data Administrator 2131.2 Computer software engineer 2132.2 Programmer engineer 2132.2 Programmer (database) 2131.2 Analyst for software and multimedia 2132.2 Programmer is applied 2139.2 Computer Engineer 2149.2 Researcher 3121.2 IT specialist 3121.2 Specialist in software development and testing 3121.2 Specialist in computer software development 3121.2 Specialist in computer graphics (design) 2447.2 Specialist in project and program management in the field of material (non-material) production

	Primary posts: programmer; developer of software products and cloud services; specialist in data analysis; system analyst; architect, developer and administrator of databases and knowledge; project manager; applied programmer (with advanced competences in the field of digital intellectual property).
Further training	Ability to continue education at the next (master's) level of higher education at the relevant level educational-professional or educational- scientific programs. Possibility of postgraduate education to obtain professional qualifications in accordance with the relevant professional standards.
5 - Teaching and evaluation	
Teaching and learning	Lectures, laboratory and practical classes, scientific and practical workshops, implementation of training and real projects (project training), problem-oriented training and training on request, velocity student-centered learning, dual learning, advanced practical training in the information technology incubator, distance and mixed learning, self-study and self-study, practice, qualifying work.
Evaluation	Current and final control of knowledge (surveys, control and individual tasks, testing, etc.), credits and exams (oral and written), defense of educational and real projects with a presentation, public defense of qualifying work.
6 - Program competencies	
Integral competence	Ability to solve complex specialized problems and practical problems in the field of computer sciences or in the process of learning that involves the application of theories and methods of information technology and is characterized by complexity and uncertainty of the conditions.
General competencies	Ability to think, analyze and synthesize. (GC-1) Ability to apply knowledge in practical situations. (GC-2) Knowledge and understanding of the subject area and understanding of professional activity. (GC-3) Ability to communicate in the state language both verbally and in writing. (GC-4) Ability to communicate in a foreign language. (GC-5) Ability to learn and master modern knowledge. (GC-6) Ability to search, process and analyze information from various sources. (GC-7) Ability to generate new ideas (creativity). (GC-8) Ability to work in a team. (GC-9) Ability to be critical and self-critical. (ЗК-10) Ability to design and manage projects. (GC-11) Ability to make informed decisions. (GC-12) Ability to assess and ensure the quality of work performed. (GC-13) Determination and persistence on the tasks and duties taken. (GC-14) Ability to act on ethical grounds. (GC-15) The ability to exercise their rights and responsibilities as a member of society, to realize the values of a civil (free democratic) society and

	the need for its sustainable development, the rule of law, human and civil rights and freedoms in Ukraine. (GC-16) Ability to preserve and increase the moral, cultural, scientific values and achievements of society on the basis of understanding of the history and patterns of development of the subject area, its place in the general system of knowledge about nature and society and in the development of society, technology and technology, use different types and forms of motor activity for active rest and healthy lifestyle. (GC-17)
Professional competencies of the specialty (defined by the standard of higher education specialty)	Ability to construct and study continuous and discrete mathematical models, substantiation of the choice of methods for solving theoretical and applied problems in the field of computer sciences. (PC-1) Ability to construct models and identify patterns and intelligent data analysis under uncertainty through the application of computational intelligence methods, in particular statistical, neural network and fuzzy data processing, machine learning methods, etc. (PC-2) Ability to logical thinking, constructing logical conclusions, using formal languages, designing, developing and analyzing data structures and algorithms, evaluating their effectiveness and complexity. (PC-3) Ability to use methods for describing discrete objects and structures, numerical methods for solving applied problems of analysis, design and management of complex objects and systems. (PC-4) Ability to carry out a formal description of the tasks of research operations in organizational, technical and socioeconomic systems, to determine their optimal solutions, optimize management processes. (PC-5) Ability to systematic thinking, application of the methodology of system analysis for the study of complex problems of different nature, methods of formalization and solving systemic problems with conflicting goals, uncertainties and risks. (PC-6) Ability to apply theoretical and practical bases of methodology and modeling technology to study the characteristics and behavior of complex objects and systems, to carry out computational experiments with the processing and analysis of the results. (PC-7) Ability to design and develop software with application of various programming paradigms: generalized, object-oriented, functional, logical, component and cross-platform programming. (PC-8) Ability to implement a multi-level computing model based on client-server architecture, design and use databases, knowledge and data warehouses. (PC-9) Ability to apply methodologies, technologies and tools for managing information and software projects, processes of the life cycle of information and software systems, products and services. (PC-10) Ability to develop system software, provide configuration of operating systems, organization, maintenance and administration of computer systems. (PC-11)

	Ability to use network technologies, design, configure and administer network systems, use computer networks for data transmission and exchange. (PC-12) Ability to apply methods and means of information security, develop and operate special software to protect the information resources of objects of critical information infrastructure. (PC-13) Ability to analyze and functional modeling of business processes, project management processes, construction and practical application of functional models of organizational-economic and industrial-technical systems. (PC-14) Ability to implement high-performance parallel and distributed computing based on cloud services and technologies, perform distributed processing of large data on clusters. (PC-15)
Professional competence of specialization (determined by the institution of higher education)	For the training line "Project Management in Information Technology" Ability to design and program information technologies. (PCS-1) Ability to develop and economically justify projects in the field of information technology. (PCS-2) Ability to manage projects in the field of information technology. (PCS-3) For the training line "Information and analytical systems and technologies" Owning the principles of organization of data storage, their operational analytical processing and the ability to identify in the data previously unknown information necessary for decision-making in various areas of professional activities. (PCS-1) Ability to design, develop and use information and analytical systems in the various fields needed by society. (PCS-2) Ability to use applied mathematical methods and computer simulation for the analysis and synthesis of information and analytical systems. (PCS-3) For the training line" Data and knowledge engineering" Ability to implement methods for solving mathematical problems in numerical form means of high-level programming languages in integrated open source development environments using specialized libraries of mathematical programs (FKS-3.1). Ability to master and implement methods, models and algorithms of intellectual analysis of data by means of interactive software platforms, software development for statistical calculations, processing of natural language and graphics (FKS-3.2). Ability to implement the architecture of distributed software systems for sharing using front-end and back-end engineering, web technologies and designing business logic of server components (FCS-3.3). Ability to conceptual design and implementation of relational and non-relational databases, data management processes, development and application of technologies and tools of knowledge engineering, in-depth training, mass-parallel processing of uncertainly structured data of large volumes and significant diversity to obtain perceived and

	effective results of their processing under conditions real time, continuous growth and distribution of data across multiple nodes of the computer network (FCS-3.4). Ability to design and implement methods and algorithms for identifying previously unknown, non-trivial, practically useful and accessible interpretations of knowledge for ensuring soft integration and consolidation of information, knowledge representation and decision-making in various spheres of human activity at all stages of the data lifecycle (FCS -3.5). For the training line "Intellectual property in computer and software engineering" Ability to identify intellectual property objects, understanding their place in the system of human life in a digital society, analyzing, interpreting and applying the provisions of current national and international normative and legal acts to ensure the balance of socio-economic interests of subjects of digital intellectual property rights (FCS-4.1). Ability to search and consolidate patent and patent-related information, patent and informational analytical research of software products and information technologies to predict trends in the development of digital technology markets in the context of globalization of the economy (FKS-4.2). Ability to use the results of patent and informational analytical research to ensure the protection of the rights of digital intellectual property in the early stages of the conceptual design of architecture and the development of software and hardware for computer systems (FCS-4.3). Ability to use means of individualization of digital objects of intellectual property as goods, digital services and subjects of information and technological entrepreneurship in modern digital marketing communication channels (FCS-4.3). For the training line "Information technology analysis of large data" Ability to design and develop algorithms and information technologies for the processing and analysis of large data (PCS-1) Ability to develop and operate software for collecting, storing, processing and analyzing large data (PCS-2). Ability to design and design the architecture and infrastructure of large data of enterprises and institutions (PCS-3). For the training line "Artificial intelligence and machine learning" Ability to use the methods of describing discrete objects and their applications for the implementation of algorithms for digital image synthesis and computer animation, processing, transformation and output of visual data by means of computing equipment, including hardware and software (FCS-6.1). Ability to perceive a variety of problems and approaches to the solution of problems of artificial intelligence, formal description of systems, construction and research of mathematical models, justification of the choice of methods for solving theoretical problems

	and means of realization of applied artificial intelligence systems (FCS-6.2). Ability to choose models, apply mathematical methods and algorithms for constructing and evaluating hypotheses and decision making, implement conceptual design of cognitive computing components of processing platforms for unstructured data and sensory perception of the environment (FCS-6.3). Ability to use, design and implement methods, technologies, and image recognition techniques and machine learning for artificial neural networks to identify previously unknown, non-trivial, practically useful and accessible interpretations of knowledge to ensure soft integration and consolidation of information, knowledge representation and decision-making in various spheres of human activity at all stages of the life cycle of data (FCS-6.4).
7 - Program learning outcomes	
Program learning outcomes in a specialty (defined by the standard of higher education specialty)	Demonstrate knowledge of the basic forms and laws of abstract-logical thinking, the foundations of the methodology of scientific cognition in the domain of computer science. (LO-1) To be able to use the mathematical apparatus of continuous and discrete analysis, linear algebra, analytic geometry, in professional activity for solving problems of theoretical and applied nature. (LO-2) To be able to use the knowledge of the laws of random phenomena, their properties and operations on them, models of random processes for solving tasks of statistical processing of data and the construction of predictive models. (LO-3) To possess methods of computing intelligence, machine learning, genetic and evolutionary programming, neural network and fuzzy data processing technologies for solving problems of recognition, forecasting, classification, object identification, etc. (LO-4) To be able to design, develop and analyze algorithms for solving computational and logical problems, to evaluate the efficiency and complexity of algorithms on the basis of application of formal models. (LO-5) To possess methods of description and modeling of discrete objects and structures, numerical methods for solving applied problems of analysis, optimization, forecasting and management of complex objects and systems (LO-6). Be able to develop and use in practice the methods of research of operations, solving single- and multi-criteria optimization problems of linear, integer, nonlinear, stochastic programming. (LO-7) Own methodology of system analysis of objects, processes and systems, research, decision-making under uncertainty, research of dynamics of processes of functioning and development of systems, project management. (LO-8) Be able to apply the methodology of simulation of objects, processes and systems, to plan and conduct experiments with models. (LO-9)

	Be able to choose and apply the paradigm, technologies and programming languages for implementation of methods and algorithms for solving applied problems, possessing the skills of component and cross-platform programming. (LO-10) Be able to use the tools of client-server application development, to develop conceptual, logical and physical databases, to develop and optimize their requests, to create distributed databases, repositories and showcases of data, knowledge bases, including cloud services, with the use of languages. web programming (LO-11) To be able to use intelligent analysis technologies of large data sets, integration of heterogeneous data from a variety of sources, methods and technology of information consolidation, development and support of infrastructure and large data architectures, data and information management. (LO-12) Have skills in life cycle management software, products and services, project management, ability to prepare project documentation. (PH-13) To speak the languages of system programming and methods of developing programs interacting with components of computer systems, to know network technologies, computer network architecture, have practical skills in computer network administration and their software (LO-14) Own methodology and CASE-tools for modeling and designing complex systems, methods of structural analysis of systems, object-oriented design methodology. (LO-15) Understand the concept of information security, the principles of secure software design, and be able to provide security for computer systems and networks. (LO-16) Ability to perform parallel and distributed computing, apply numerical methods and algorithms for parallel structures, parallel programming language in the development and operation of distributed software (LO-17)
Program learning outcomes of specialization (defined by the institution of higher education)	For the training line “IT project management” Know the basics of financial planning, project management, project management information systems. (LOS-1) Be able to manage projects in the field of information technology. (LOS-2) Have modern programming languages, methods and tools for evaluating the quality and testing of software. (LOS-3) For line Information and analytical systems and technologies Know and be able to implement highly loaded computing and data processing systems in data analysis and decision support systems. (LOS-1) To carry out system analysis of designing objects of information and analytical systems, to justify the architecture and algorithms of their functioning. (LOS-2) Apply knowledge of mathematical methods, simulation technologies, discrete analysis when solving data analysis problems. (LOS-3)

	For the training line “Data Engineering and Knowledge” To know numerical methods of description and modeling of discrete objects and structures, to be able to design, develop and analyze algorithms for solving computational problems, to use high-level programming languages for implementing numerical methods in integrated open source development environments, to have skills in the use of specialized libraries of mathematical programs for numerical solution of theoretical and applied problems (LOS-3.1) To know the methods of computational intelligence, machine learning, genetic and evolutionary programming, to be able to solve problems of recognition, forecasting, classification and identification of objects by means of interactive software platforms, to have skills in software development for statistical calculations, processing of natural language and graphics (LOS- 3.2) Be able to choose and apply a paradigm, technology and programming languages to implement the architecture of distributed distributed software systems, to have skills in using front-end and back-end engineering to design and develop server logic business logic, including cloud-based web-technologies (LOS-3.3) Own the methodology of conceptual designing and implementation of the relational and non-relational model of databases, be able to develop and optimize database queries and data management processes, create distributed databases, have skills to develop and apply technologies and tools of knowledge engineering, deep learning, mass-parallel processing indeterminate structured data of large volumes and large varieties (LOS-3.4). To possess methods, technologies and means of consolidating information and presentation of knowledge, to be able to design, develop and analyze algorithms for the identification of previously unknown, non-trivial, practically useful and accessible interpretations of knowledge for decision-making in various spheres of human activity at all stages of the life cycle of data (LOS- 3.5). For the training line “Intellectual Property in Computer and Software Engineering” Demonstrate knowledge, ability to analyze, interpret and apply the basic provisions of the current national and international normative and legal acts on intellectual property, understand its place in the digital society, be able to identify the objects and subjects of intellectual property rights in software and computer engineering (RNS-4.1). To have the methodology and modern means of access to the main sources of patent, patent and marketing information, to be able to formulate inquiries, to search, consolidate and analyze relevant information, to possess the methodology of patent and information research in the field of information technologies, software and computer engineering, Be able to make forecasts regarding the development of the markets for digital intellectual property in the conditions of globalization of the economy and to develop the patent

	and technological portfolio of subjects Intellectual Property Equity (LOS-4.2). To be able to use the results of patent information and research to ensure the legal protection of digital intellectual property, to be able to make orders for Burglary documents have methodology digital rights protection of intellectual property in the early stages of conceptual design of architecture and design of hardware and software computer systems (LOS-4.3) To be able to use digital means of individualization of intellectual property as goods, services and digital business information technology business in today's digital channels of marketing communication (RNS -4.4). For the training line "Information technology analysis of large data" Know the methods and algorithms of processing and analysis of large data (LOS-1) Be able to design, develop and operate software for the collection and analysis of large data (LOS-2) Own the methods and bursts of architectural design and large data infrastructure (LOS-3) For the training line "Artificial Intelligence and Machine Learning" Own the methods of describing discrete objects and their applications for the implementation of algorithms of synthesis of images and computer animation, able to process, transform and display visual data by means of computer technology and information technologies (LOS-6.1) Demonstrate an understanding of the diversity of problems and approaches to the solution of problems of artificial intelligence, possess the methodology of the formal description of systems, construct and study mathematical models, be able to develop and analyze algorithms for solving computer and logic problems of neural network and fuzzy data processing technologies (LOS-6.2). To be able to choose models, to develop and apply mathematical methods and algorithms for constructing and evaluating hypotheses and decision making, to carry out the conceptual design of cognitive computing components of processing platforms for unstructured data and sensory perception of the environment (LOS-6.3). To be able to design to develop and use in practice methods, technologies and means of image recognition and machine learning of artificial neural networks, possess skills of application of tools for detecting previously unknown, non-trivial, practically useful and accessible interpretations of knowledge in a large amount of data, be able to develop and apply models , methods and algorithms of soft integration and consolidation of information, representation of knowledge and decision making in various spheres of human activity. all stages of the life cycle of the data (LOS-6.4).
8 - Resource support for the implementation of the program	
Staffing	Corresponds to the personnel requirements for ensuring the implementation of educational activities in the field of higher

	education in accordance with the current legislation of Ukraine (Resolution of the Cabinet of Ministers of Ukraine "On approval of licensing conditions for the educational activities of educational institutions" of December 30, 2015, No. 1187, Appendix 12)/
Material and technical support	Complies with the requirements for material and technical support for conducting educational activities in the field of higher education in accordance with the current legislation of Ukraine (Resolution of the Cabinet of Ministers of Ukraine "On Approval of Licensing Conditions for the Educational Activities of Educational Institutions" of December 30, 2015, No. 1187, Appendix 12).
Information and educational and methodological support	It meets the requirements for information and educational and methodological support for the implementation of educational activities in the field of higher education in accordance with the current legislation of Ukraine (Resolution of the Cabinet of Ministers of Ukraine "On Approval of Licensing Conditions for the Educational Activities of Educational Institutions" dated December 30, 2015, No. 1187, Appendix 12).
9 - Academic mobility	
National Credit Mobility	On the basis of bilateral agreements between the National Technical University ohm "Kharkiv Polytechnic Institute" and the leading technical universities in Ukraine.
International Credit Mobility	On the basis of bilateral agreements between the National Technical University ohm "Kharkiv Polytechnic Institute" t and schools of higher education abroad partners.
Teaching foreign applicants for higher education	Probably after studying the Ukrainian language course.

2. LIST OF COMPONENTS OF THE EDUCATIONAL PROGRAM

Code	Components of the educational program (discipline, projects / work, practice, qualification work)	Number of ECTS credit	Form of final control
1	**2**	**3**	**4**
MANDATORY COMPONENTS OF THE EDUCATIONAL PROGRAM			
1. General training cycle			
CL 1	History and culture of Ukraine	4	Exam
CL 2	Foreign Language	12	Passed (1- 7), exam (8)
CL 3	Ukrainian language	3	Exam
CL 4	Philosophy	3	Exam
CL 5	Science of law	3	Credit
CL 6	Economic analysis	3	Credit
CL 7	Economics and organization of production of software products	3	Credit
CL 8	Physics	4	Exam
CL 9	Algebra and geometry. Part 1	4	Exam
CL 10	Algebra and geometry. Part 2	4	Exam
CL 11	Mathematical analysis. Part 1	5	Exam
CL 12	Mathematical analysis. Part 2	5	Credit
CL 13	Ecology	3	Credit
CL 16	Physical Education	12	Passed (1- 6)
2. A cycle of professional and practical training			
2.1. Professional training in specialty			
PP 1	Introduction to computer science and information technology	3	Credit
PP 2	Fundamentals of programming. Part 1	6	Exam
PP 3	Fundamentals of programming. Part 2	6	Exam
PP 4	Architecture of computer systems	4	Exam
PP 5	Discrete Math. Part 1	4	Exam
PP 6	Discrete Math. Part 2	4	Exam
PP 7	Object-Oriented Programming	6	Exam
PP 8	Probability theory	4	Exam
PP 9	Mathematical statistics	4	Exam
PP 10	Cross platform programming	6	Exam
PP 11	Algorithms and data structures	4	Exam
PP 12	Computer networks	4	Exam
PP 13	Fundamentals of web technologies	5	Exam
PP 14	History of science and technology	3	Credit
PP 15	Fundamentals of occupational safety and health	3	Exam
PP 16	Computer simulation of processes and systems	4	Exam
PP 17	Operating systems and system programming	4	Exam
2.2. Practical training			

Code	Components of the educational program (discipline, projects / work, practice, qualification work)	Number of ECTS credit	Form of final control
1	**2**	**3**	**4**
PO 2.3.1	Practice	6	Credit
PO 2.3.2	Preparation of qualifying work (QW)	6	Protection of the QW
Total volume of mandatory components		**154**	
ELECTIVE COMPONENTS OF THE EDUCATIONAL PROGRAM (BY BLOCKS)			
3. Blocks for choosing vocational training			
Block 3.1. "Project Management in Information Technology"			
CB1.1	Fundamentals of project management	4	Credit
CB1.2	Organization of databases	5	Exam
CB1.3	Design databases and information systems	4	Exam
CB1.4	Operations Research. Part 1	5	Exam
CB1.5	Operations Research. Part 2	5	Exam
CB1.6	Python Fundamentals for Data Science	4	Exam
CB1.7	Programming Java Script Web Applications	5	Exam
CB1.8	Fundamentals of Financial Planning	5	Exam
CB1.9	Artificial Intelligence	5	Credit
CB1.10	The theory of decision making	4	Exam
CB1.11	Quality and software testing	4	Exam
CB1.12	Fundamentals of project management information systems	4	Credit
CB1.13	Stack of.NET Technologies	4	Exam
CB1.14	Methods of simulation of complex systems	4	Exam
CB1.15	Cloud computing	3	Exam
CB1.16	Great data	3	Exam
CB1.17	Managing the competitiveness of enterprises	3	Exam
CB1.18	System engineering	3	Credit
Block 3.2. "Information and analytical systems and technologies"			
CB2.1	Differential and difference equations	4	Credit
CB2.2	Organization of databases	5	Exam
CB2.3	Design databases and knowledge	4	Exam
CB2.4	Computational methods	5	Exam
CB2.5	Distributed and cloud information and analytical systems	5	Exam
CB2.6	Data analysis	4	Exam
CB2.7	Computer Graphics	5	Exam
CB2.8	Programming and support of web applications	5	Exam
CB2.9	Methods of optimization and operations research	4	Exam
CB2.10	Platforms of corporate information systems	5	Exam
CB2.11	Image and multimedia processing	4	Exam

Code	Components of the educational program (discipline, projects / work, practice, qualification work)	Number of ECTS credit	Form of final control
1	**2**	**3**	**4**
CB2.12	Parallel and distributed computing	4	Exam
CB2.13	Testing software systems	4	Credit
CB2.14	Intelligent systems	4	Credit
CB2.15	Compression of information	4	Exam
CB2.16	Theory of pattern recognition	4	Exam
CB2.17	Technologies of mobile systems development	4	Exam
Block 3.3. "Data and Knowledge Engineering"			
CB3.1	Computer graphics and 3D simulation	4	Credit
CB3.2	Organization of databases	5	Exam
CB3.3	Methods and tools of computational mathematics	4	Exam
CB3.4	Technologies of the structure of structures. and unstructured information	5	Exam
CB3.5	Methods and tools for data analysis	5	Exam
CB3.6	Digital circuitry and computer architecture	4	Exam
CB3.7	Analysis and design of algorithms	6	Exam
CB3.8	Technologies for the processing of structured and unstructured information	4	Exam
CB3.9	Artificial Intelligence	4	Exam
CB3.10	Game theory and decision making	4	Exam
CB3.11	Basics of data visualization	4	Exam
CB3.12	Technologies and tools for processing large data	4	Credit
CB3.13	Designing consolidated information systems	5	Exam
CB3.14	Basics of computer vision	4	Credit
CB3.15	Information security and cyber security	4	Exam
CB3.16	Fundamentals of Distributed and Parallel Programming	4	Exam
CB3.17	Software Engineering	4	Exam
Block 3, 4. "Intellectual Property in Computer and Software Engineering"			
CB4.1	Computer graphics and 3D simulation	4	Credit
CB4.2	Organization of databases	5	Exam
CB4.3	Methods and tools of computational mathematics	4	Exam
CB4.4	Technologies for the processing of structured and unstructured information	5	Exam
CB4.5	Methods and tools for data analysis	5	Exam
CB4.6	Introduction to Intellectual Property	4	Exam
CB4.7	Analysis and design of algorithms	6	Exam
CB4.8	Intellectual property rights	4	Exam
CB4.9	Patent information and documentation	4	Exam
CB4.10	Patent Analysis and Forecasting	4	Exam
CB4.11	Theory and means of solving inventive tasks	4	Exam
CB4.12	Legal protection of digital intellectual property	4	Credit

Code	Components of the educational program (discipline, projects / work, practice, qualification work)	Number of ECTS credit	Form of final control
1	**2**	**3**	**4**
CB4.13	Designing consolidated information systems	5	Exam
CB4.14	Basics of computer vision	4	Credit
CB4.15	Information security and cyber security	4	Exam
CB4.16	Globalization of Intellectual Property in the Digital Economy	4	Exam
CB4.17	Means of individualization in IT enterprises	4	Exam
Block 3.5. "Information Technology of Large Data"			
CB5.1	Data structures	4	Credit
CB5.2	Numerical Methods	5	Exam
CB5.3	Theory and design of algorithms	4	Exam
CB5.4	Computational methods	5	Exam
CB5.5	Databases and Information Systems	5	Exam
CB5.6	Modern programming techniques	4	Exam
CB5.7	Data analysis	5	Exam
CB5.8	Design and development of software	5	Exam
CB5.9	Design databases and databases	4	Exam
CB5.10	Fundamentals of machine learning	5	Exam
CB5.11	Computer graphics and image processing	4	Exam
CB5.12	Parallel and distributed computing	4	Credit
CB5.13	The theory of decision making	4	Credit
CB5.14	Intelligent data analysis	4	Exam
CB5.15	Software tools for machine learning	4	Exam
CB5.16	Technologies and tools for analyzing large data	4	Exam
CB5.17	Infrastructure and data management	4	Exam
Block 3.6. "Artificial intelligence and machine learning"			
CB6.1	Computer graphics and 3D simulation	4	Credit
CB6.2	Organization of databases	5	Exam
CB6.3	Methods and tools of computational mathematics	4	Exam
CB6.4	Technologies for the processing of structured and unstructured information	5	Exam
CB6.5	Introduction to artificial intelligence	4	Exam
CB6.6	Mathematical foundations of artificial intelligence	5	Exam
CB6.7	Analysis and design of algorithms	6	Exam
CB6.8	Fundamentals of the theory of formal systems	4	Exam
CB6.9	Methods and means of machine learning	4	Exam
CB6.10	The theory of decision making and cognitive calculus	4	Exam
CB6.11	Technologies and means of artificial intelligence	4	Exam
CB6.12	Technologies and tools for processing large data	4	Credit
CB6.13	Designing consolidated information systems	5	Exam
CB6.14	Information security and cyber security	4	Credit
CB6.15	Artificial Neural Networks	4	Exam

Code	Components of the educational program (discipline, projects / work, practice, qualification work)	Number of ECTS credit	Form of final control
1	**2**	**3**	**4**
CB6.16	Pattern recognition	4	Exam
CB6.17	Software Engineering	4	Exam
4. Blocks for choosing vocational training			
DCB1	Discipline 1	4	Credit
DCB2	Discipline 2	4	Credit
DCB3	Discipline 3	4	Credit
Total amount of sample components		**86**	
GENERAL SUMMARY OF THE EDUCATIONAL PROGRAM		**240**	

1. DISTRIBUTION OF CONTENT OF EDUCATIONAL PROGRAM BY GROUPS OF COMPONENTS AND TRAINING CYCLES

No. n / p	Training cycle	Educational load of the applicant of higher education (credits /%)		
		Compulsory components of an educational and professional program	Elective components of the educational-professional program	Total for the whole period of study
1	2	3	4	5
1	General training cycle	**68/28.3**	**12/5**	**80/33.3**
2	A cycle of professional and practical training	**86/35.8**	**74/30.8**	**160/66.7**
Total for the whole period of study		**154/64.2**	**86/35.8**	**240/100**

2. FORM OF CERTIFICATION OF APPLICANTS FOR HIGHER EDUCATION

Certification of graduates of the educational program of specialty 122 "Computer Science" is carried out in the form of protection of qualification bachelor's work and ends with the issuing document of the established sample on awarding the bachelor's degree with the qualification: **" Bachelor of computer sciences "** in the specialty **"Computer Science".** The certification is carried out openly and publicly.