1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Administration of network services

Module code: W4-IN-S2-20-F-AUS

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Student has skills for installation and configuration of network services.	K_U01 K_W06	1 1
M_002	Student has knowledge of network services and servers.	K_W03 K_W06	1 1
M_003	Student has ability to implement the concepts in administration of network services.	K_K01 K_U01 K_U02 K_U03 K_U04 K_W03	1 1 1 1 1 1

3. Module description

Description	The module objective is to give students a knowledge, which covers practical and theoretical aspects of network services management. The presented topics are related to servers software, methods of configuration, sharing and monitoring network services as well as principles of ensuring their security and performance.
Prerequisites	

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
W_001	Final test	Two-hour test with closed and open questions.	M_001, M_002
W_002	Reports	Presentation of the reports and discussion of the developed projects.	M_001, M_003

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
Z_001	lecture	Lectures supported by multimedia presentations and e-learning	15	Self-study of literature and materials presented during lectures	25	W_001
Z_002	laboratory classes	Assignments in the form of design projects with use of server software	30	Solving project assignments and preparing presentations	50	W_002

1.	**Field of study**	**Computer Science**
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Advanced methods of data analysis

Module code: W4-IN-S2-20-F-ZMAD

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	The aim of the module is to present the possibilities of data analysis using various methods based on signal theory using spectral methods of analysis. Data analysis aims to extract useful information from data and make decisions based on data distribution. The acquired skills will help students in cleaning, transforming and modeling data in finding useful information for business, as well as in making scientific decisions.	K_K04 K_K05 K_U01 K_U02 K_U03 K_U05 K_U09 K_W01 K_W09	1 1 1 1 1 1 1 1 1

3. Module description

Description	The lectures will discuss the recognition of phenomena occurring in data sets. These phenomena, such as Boolean function properties, data compression or steganography, will be detected using selected discrete transforms like Fourier, Cosine, Sine as well as Walsh or Haar.
Prerequisites	

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
W_001	test	The purpose of the test is to verify learning progress and suggestions for necessary repetitions of the material along with participation in consultations	M_001
W_002	Preparation of a computer program	The student presents and discusses the implementation details of the program which solves the problem of analyzing data given in the form of a set of numbers.	M_001

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
Z_001	lecture	Lectures will be supported by audiovisual methods. The theoretical foundations of selected data analysis methods will be discussed along with examples of practical applications. Some lectures also include discussion with students about possible solution options.	15	The student should read the relevant literature materials for each lecture. To better understand the problem, the student should also solve the examples given in the lectures and consult them with the lecturer.	45	W_001
Z_002	laboratory classes	Matlab will be introduced as a programming method in the laboratory. The student develops computer programs that can be used to solve tasks discussed in lectures or tasks indicated by the laboratory teacher. Program issues will be discussed during laboratory meetings.	30	During individual work the student should check different versions of the program code, paying attention to program optimization. Different discrete transformations can be programmed in different ways, generating different approximations of results, these nuances should be checked during their own work.	30	W_001, W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Algorithmically generated graphics

Module code: W4-IN-S2-20-F-GGA

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Student can design algorithms that generate graphics.	K_K03 K_U01 K_U04 K_W01 K_W02	1 2 1 2 3
M_002	Student is able to implement graphics generating algorithms.	K_K01 K_U02 K_W02 K_W04	1 1 3 2
M_003	Student has the knowledge of the field of application of graphics generating algorithms.	K_K01 K_U01 K_W02	1 2 3

3. Module description

Description	The following topis will be presented: calculation elements, vectors, points, objects, coordinate systems; controls, algorithms, transformations, randomness, artificial intelligence, fractals; designing two and three-dimensional objects.
Prerequisites	

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
W_001	Pass a subject	Submission of projects (applications) within a specified period as a verification of skills acquired during problem solving.	M_001, M_002, M_003

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
Z_001	lecture	Lectures are carried out by using audiovisual means.	15	Studying lecture topics basing on books and materials from the Internet.	30	W_001
Z_002	laboratory classes	Compulsory classes in the computer lab conducted according to the schedule.	30	Solving practical tasks. Development and practical implementation of the project.	45	W_001

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Algorithmics and Advanced Data Structures

Module code: W4-IN-S2-20-1-AiZSD

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Has knowledge in the field of advanced methods of determining the computational complexity of algorithms. Knows and understands classes of algorithms complexity.	K_W01 K_W04	2 2
M_002	Has knowledge in the field of advanced paradigms of algorithms constructing, among others: exhaustive search, greedy strategies. Knows and understands basics of operation and advantages and disadvantages of these algorithms.	K_W04	4
M_003	Has knowledge in the field of graph algorithms.	K_W01 K_W04	1 3
M_004	Knows the concept of approximation algorithm and examples of such algorithms using different approaches, e.g. combinatorial or based on the theory of linear programming.	K_W01 K_W04	1 3
M_005	Knows examples of Monte-Carlo and Las-Vegas randomized algorithms.	K_W01 K_W04	1 3
M_006	Can designate computational complexity of recurrent algorithms and record their complexity, e.g. in the form of recurrent equation and solve such an equation.	K_W01 K_W04	2 2
M_007	Can choose and implement an appropriate, basic or advanced paradigm of algorithm construction for solution of a given problem. Can justify his choice.	K_U08 K_U09	1 3
M_008	Is able to implement an appropriate algorithm to solve a given problem, as well as select the appropriate data structure.	K_U09	3
M_009	Is aware of substantial importance of algorithm features (complexity, correctness) on the basis of which the components (modules, functions, procedures) of bigger software systems are built on final efficiency, correctness of operation and security of these systems.	K_K01 K_U09	1 2

3. Module description

Description	Algorithmics is the science of algorithms. It includes algorithm design, i.e. the art of building a schema that effectively solves a specific problem or class of problems as well as algorithm analysis. The purpose of this module is to introduce the listener to advanced methods of algorithm design and issues of analysis of algorithms as well as data structures
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Written exam	Verification of knowledge basing on content presented during lectures.	M_001, M_002, M_003, M_004, M_005, M_006, M_009
W_002	Reports	Solving assigned tasks and elaborating them in the form of reports.	M_006, M_007, M_008, M_009

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Presenting educational content with use of audio-visual aids and other written education aids. Focusing on issues difficult to understand and these with deeper theoretical bases. Elicitation of students by asking questions concerning presented content.	30	Exam preparation.	30	W_001
Z_002	laboratory classes	Detailed preparation of the students for solving tasks indicating proceeding methodology and proceedings sequence.	30	Individual solution of tasks given during the laboratory class, elaboration of reports.	30	W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Artificial intelligence in computer graphics

Module code: W4-IN-S2-20-F-SIwGK

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Knows evolutionary algorithms, neural networks and machine learning methods, understands optimization and control issues. He can determine the problem, find a solution, develop a mathematical model, apply selected algorithms artificial intelligence.	K_K01 K_K03 K_U01 K_U06 K_U08 K_W01 K_W02 K_W05	1 1 1 1 1 1 1 1
M_002	Knows the rules of modeling 3D scenes, among others problems of physical environment simulation, motion planning, object detection, collision avoidance.	K_K01 K_U02 K_U04 K_W04 K_W05	1 1 1 1 1
M_003	Is able to work individually or in a team, understands the importance of intellectual honesty in their own activities and other people act ethically. He understands the need to constantly improve his competences. Is able to think in a creative way, form opinions on basic issues, current state and development trends in IT and understands non-technical issues of professional activity.	K_K01 K_K02 K_K03 K_U01 K_U02	1 1 1 1 1

		K_U03 K_U04 K_W03 K_W04 K_W05	1 1 1 1 1

3. Module description	
Description	The aim of the course is to acquaint the student with issues related to the use of artificial intelligence methods in computer graphics.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Project	Implementation of a semester project in the field of learning outcomes adopted in the module.	M_001, M_003
W_002	Project presentation	Audiovisual presentation on the forum of a group of students, discussion of assumptions and adopted method of solving a specific problem, analysis and assessment of the implementation of the project goal.	M_003
W_003	Test	Test with open and closed questions	M_001, M_002

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Contents of module training with the use of audiovisual methods.	15	Independent study of lecture topics and recommended literature.	30	W_003
Z_002	laboratory classes	Practical implementation of the training program in the form of tasks to be implemented. Classes are held using computer stations and appropriate software.	30	1. Individual preparation for laboratory classes 2. Individual or multi-person group project execution and its documentation 3. Preparation of the presentation in audiovisual form about the completed project and its presentation on the forum of a group of students	45	W_001, W_002

1.	**Field of study**	**Computer Science**
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Biometric recognition and access control systems

Module code: W4-IN-S2-20-F-BSRUKD

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	The student should have the ability to solve problems individually or in a team, using the acquired knowledge and practical skills.	K_K01 K_K03 K_K04 K_U01 K_U02	1 1 1 1 1
M_002	The student has knowledge regarding the biometric data acquisition and processing process.	K_W01 K_W02 K_W03 K_W05 K_W09	1 1 1 1 1
M_003	The student knows and understands the operation of selected methods and algorithms for biometric verification or identification.	K_W01 K_W02 K_W04 K_W05 K_W09	1 1 1 1 1
M_004	The student is able to design hybrid biometric security systems.	K_U01 K_U03 K_U05	1 1 1

		K_U09 K_U10 K_W01 K_W02 K_W09	1 1 1 1 1
M_005	The student has knowledge of the construction and operation of access control systems.	K_U01 K_U10 K_W01 K_W02 K_W03 K_W06 K_W09	1 1 1 1 1 1 1
M_006	The student is able to evaluate and refer to the degree of advancement of his work or teamwork.	K_K01 K_U03 K_U04 K_U05	1 1 1 1

3. Module description	
Description	The aim of this course is to introduce the issues of broadly understood biometrics and access control systems based on it.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Test	Solving a theoretical test related to the topics discussed in the lecture.	M_002, M_003, M_005
W_002	Project documentation	Presentation of full documentation of the project, including all stages of its implementation.	M_001, M_002, M_003, M_004, M_005, M_006

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Presentation of educational content in verbal form with the use of content visualization. Focusing on material that is difficult to understand. Activating students by asking questions about the content. Classes in a	15	Preparing for the colloquium.	10	W_001

		traditional form, and e-learning.				
Z_002	laboratory classes	Working in the laboratory with the use of a computer and biometric measuring devices. Classes in a traditional form, and e-learning.	30	Preparing for the lab. Solution of tasks assigned to the laboratory and their presentation in the form of reports . Development of biometric identification or verification systems.	65	W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Cloud computing technologies

Module code: W4-IN-S2-20-F-TCO

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Student has basic skills for implementation of cloud services.	K_U09 K_W02	1 1
M_002	Student has knowledge of cloud computing service models.	K_W03	1
M_003	Student has ability to implement the concepts in real world applications of cloud computing.	K_U09	1

3. Module description

Description	The module objective is to give students a knowledge, which is necessary to create scalable and reliable applications in cloud environments. The presented topics are related to architecture of cloud computing platforms, models of cloud services, virtualization, data security in the cloud, dedicated programming methods, hardware solutions, and migration of existing applications to cloud computing. Students will gain the abilities to manage the cloud services.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Final test	Two-hour test with closed and open questions.	M_001, M_002
W_002	Reports	Presentation of the reports and discussion of the developed projects.	M_001, M_003

5. Forms of teaching						
code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Lectures supported by multimedia presentations and e-learning	15	Self-study of literature and materials presented during lectures	25	W_001
Z_002	laboratory classes	Assignments in the form of design projects with use of computational cloud services	30	Solving project assignments and preparing presentations	50	W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: cluster analysis algorithms in applications

Module code: W4-IN-S2-20-F-AASwP

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Is aware of the advantages of grouping algorithms and their impact on learning the analyzed data and their fields.	K_K02	1
M_002	Has knowledge of the basics of data mining, including data types, measures of similarity, methods for determining cluster representatives	K_W01 K_W02 K_W04 K_W09	2 2 2 3
M_003	Has knowledge of partitioning grouping algorithms, including k-means and k-medoids	K_W04 K_W09	2 3
M_004	Has knowledge of hierarchical grouping algorithms including AHC	K_W04 K_W09	2 3
M_005	Has knowledge of the density grouping algorithms including DBSCAN	K_W02 K_W04 K_W09	2 2 3
M_006	Can determine the similarity / distance of objects relative to each other in multidimensional space	K_U01 K_U03 K_U08 K_U09	2 2 2 3
M_007	Is able to implement or use ready-made libraries / packages that allow the use of a split algorithm for any real data set	K_U01	1

		K_U03 K_U08 K_U09	2 2 3
M_008	Is able to implement or use ready-made libraries / packages that allow the use of a hierarchical algorithm for any real data set	K_U01 K_U03 K_U08 K_U09	1 2 2 3
M_009	Is able to implement or use ready-made libraries / packages that allow the use of a density algorithm for any real data set	K_U01 K_U03 K_U08 K_U09	1 2 2 3
M_010	Is able to appoint a representative of a group of objects in multidimensional space	K_U01 K_U03 K_U08 K_U09	2 3 2 4
M_011	Can visualize the received structure of groups and interpret it correctly	K_U01 K_U03 K_U09	1 2 3

3. Module description	
Description	The goal is to introduce the listener to cluster analysis algorithms, both division, hierarchical, density and new cluster analysis algorithms. Their practical use in medicine will be considered.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	exam (test)	Knowledge verification based on the content presented in the lecture. The exam consists of both open and closed theory questions.	M_001, M_002, M_003, M_004, M_005, M_006, M_007, M_008, M_009, M_010, M_011
W_002	Projects and reports	Developing projects with reports for them within a specified period as a verification of the skills acquired in solving problems.	M_001, M_006, M_007, M_008, M_009, M_010, M_011

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Transferring the content of education in verbal form using audiovisual means and other written teaching aids.	15	Preparation for the exam.	15	W_001
Z_002	laboratory classes	Detailed preparation of students to solve tasks with an indication of the methodology of the procedure, an indication of the order of performed activities.	30	Preparation for the laboratory. Student's independent solution of tasks assigned to the laboratory, preparation of reports	60	W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Computational Geometry

Module code: W4-IN-S2-20-F-GO

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Knows and understands mathematical notions used in computational geomery, in particular: cross product, dot product, convex hull, Voronoi diagram	K_W01	1
M_002	Knows and understands the basic algorithms use in computational geometry.	K_W04	1
M_003	Knows and understands the basic principles of geometric algorithms creation.	K_W01 K_W04	1 1
M_004	Can obtain information about computational geometry from literature, databases and other sources.	K_U01 K_U07	1 1
M_005	Can prepare and present a presentation on execution of project's task.	K_U03 K_U04	1 1
M_006	Can work individually and in a team.	K_U02	1
M_007	Can think and act creatively.	K_K01 K_K03	1 1

3. Module description

Description	Aim of the classes is to introduce to the students the basics of computational geometry. Some of geometric problems that arise in practice, e.g., in robotics, GIS systems, computer games and methods of solving them in an efficient way (algorithms and dedicated data structures) will be presented. During the course, the students will prepare projects in teams of maximum two and present results of their work in the form of presentation in front of the group.

Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Project	Preparing the project and presentation of the chosen topic connected with computational geometry.	M_001, M_002, M_003, M_004, M_005, M_006, M_007
W_002	Reports	Solving sets of tasks.	M_001, M_002, M_003, M_006, M_007

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Presenting educational content using audiovisual methods.	15	Independent study of lecture topics and given literature.	15	W_001
Z_002	laboratory classes	Detailed preparation of the students to use of geometry algorithms in practice. Solving programming tasks.	30	Familiarizing with subject of the laboratory. Familiarizing with subject of the project and preparing it in a team. Preparing a presentation of the project.	60	W_001, W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Computational intelligence techniques

Module code: W4-IN-S2-20-F-TIO

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Knows advanced metaheuristics and their applications in selected optimization problems.	K_W01 K_W02	1 1
M_002	Is able to select a method to solve a presented optimization problem	K_U01 K_U05	1 1
M_003	Can write a program that implements a selected metaheuristics for the purpose of optimization calculations	K_U02 K_U03 K_U04	1 1 1
M_004	Understands the need to develop decision-making methods for optimisation problems	K_K01	1

3. Module description

Description	The metaheuristic algorithm can be used to solve any problem that can be described with some terms defined by the algorithm. However, it is most often used to solve optimization problems. A disadvantage of metaheuristic algorithms is the fact that they do not guarantee finding a solution and, moreover, usually it is not possible to give the time of their operation. The effectiveness of metaheuristics also depends largely on the parameters that appear in such algorithms. Unfortunately, there are no universal values of these parameters that behave best for all possible input data.
Prerequisites	

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
W_001	Colloquium	Written work on the description of existing techniques and their adaptation to selected optimization problems.	M_001
W_002	Presentation of the programme related to the implemented project.	Presentation of the program and verification of its effectiveness for the selected optimization problem.	M_001, M_002, M_003
W_003	Preparation of the multimedia presentation	Presentation of advantages and disadvantages of the selected computational intelligence technique and its verification on a specific optimization problem	M_001, M_002, M_004

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
Z_001	lecture	Giving the educational content in verbal form with the use of content visualization. Focusing on conceptually difficult material and indicating addresses of websites and e-learning package	15	Getting to know the topic of the lecture using the existing packages of methods: script, websites and e-learning package	30	W_001
Z_002	laboratory classes	Detailed preparation of students for the implementation of algorithms with indication of the methodology of conduct, indication of the sequence of activities to be performed	30	Self-development and preparation of students for the colloquiums of the laboratory. Project execution - implementation of a given system in a multi-person group	45	W_001, W_002, W_003

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Computer network technologies

Module code: W4-IN-S2-20-2-TSK

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Characterizes network devices, such as: network interface card, switch, router, host. Can describe issues connected with switching frames and routing packets.	K_W02 K_W03 K_W06	1 3 1
M_002	Understands the need to use layered network model OSI-7 for description of phenomena occurring in Computer networks. Understands divisions within TCP/IP stock of phenomena occurring in the Internet.	K_W03 K_W05 K_W06	2 2 2
M_003	Can join hosts in a local network using various transmission media using point-point topologies and joining into infrastructure. Tests advanced media and links.	K_U01 K_U03 K_U05 K_U10	1 1 1 1
M_004	Can configure router as a core layer device. Constructs a network comprising sub-nets of L3 layer. Designs vertical and horizontal cablings.	K_U01 K_U02 K_U03 K_U08	1 1 1 2

3. Module description

Description	Aim of the module is familiarizing with issues connected with designing, implementation and diagnostics of a local computer network. The module deals with issues connected with process of information transfer in three lowest layers of reference model OSI-7.

Prerequisites	

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
W_001	Module credit	Questions from lecture subject matter.	M_001, M_002
W_002	Short tests.	Checking the level of understanding of issues concerning computer network development and routing.	M_001, M_004
W_003	Conversation during tasks crediting.	Checks the skill of generalizing knowledge acquired during tasks solving.	M_003, M_004

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
Z_001	lecture	Content available in the form of multimedia transfer.	15	Preparing for credit.	15	W_001
Z_002	laboratory classes	Exercises referring to networks joining and LAN networks configuring.	30	Designing own networks with use of CISCO Packet Tracer.	30	W_002, W_003

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Computer simulations

Module code: W4-IN-S2-20-1-SK

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Student has skills for creating simulation models.	K_U01 K_U06 K_U08	1 1 1
M_002	Student has knowledge of various computer simulation techniques.	K_U08 K_W02	1 1
M_003	Student has ability to implement the concepts in designing simulation experiments.	K_K04 K_U02 K_U03 K_U04 K_U08 K_U09	1 1 1 1 1 1

3. Module description

Description	The module objective is to give students a knowledge, which is necessary for creating simulation models and conducting simulation experiments . The presented topics are related to various computer simulation techniques, simulation software and applications of simulators in the design and optimization of technical systems. Students will gain the abilities to build models with use of simulation environments.
Prerequisites	

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
W_001	Exam	Two-hour test with closed and open questions.	M_001, M_002, M_003
W_002	Reports	Presentation of the reports and discussion of the developed projects.	M_001, M_002, M_003

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
Z_001	lecture	Lectures supported by multimedia presentations and e-learning	30	Self-study of literature and materials presented during lectures	20	W_001
Z_002	laboratory classes	Assignments in the form of design projects with use of simulation environments	30	Solving project assignments and preparing presentations	40	W_001, W_002

1.	**Field of study**	**Computer Science**
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Concurrent programming

Module code: W4-IN-S2-20-2-PW

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Has extended knowledge of the ways in which parallel and concurrent computing are performed on modern computers.	K_U09 K_W02	1 1
M_002	Has knowledge about the safety properties of concurrent programs and is able to verify that the given concurrent algorithm is correct.	K_U05 K_U09 K_W02 K_W04 K_W05	1 1 1 1 1
M_003	Is able to identify and solve typical problems of concurrent computations.	K_K04 K_U05 K_U09 K_W02 K_W04 K_W05	1 1 1 1 1 1
M_004	Is able to assess the effectiveness of a parallel algorithm.	K_U05 K_W02 K_W04	1 1 1

3. Module description	
Description	The aim of the course is to introduce students to the subject of design and implementation of correct and efficient concurrent algorithms. The practical aspects of the presented issues are emphasized, and examples made using modern programming languages and tools are presented.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Final test.	Students are tested on the knowledge gained during lectures and laboratory classes. The test consists of a number of closed and (optionally) open questions.	M_001, M_002, M_003, M_004
W_002	Test.	At least one test assessing the knowledge gained by students during laboratory classes.	M_001, M_002, M_003
W_003	Programming assignment.	An optional programming assignment (project) that checks the programming skills acquired during the course.	M_001, M_002, M_003, M_004

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Presentation of the course material in spoken and written forms, supplemented with multimedia content. Emphasizing issues that are more difficult to understand and have deeper theoretical foundations. Engaging listeners by asking questions about the content presented.	15	Reading recommended books and articles. Analysis and repetition of lecture content. Preparation for the final test.	15	W_001
Z_002	laboratory classes	Preparation of students to apply the knowledge in programming practice through the presentation of sample programs and programming tools. Discussion of the methodology by pointing out the key steps required to obtain correct and efficient solutions to typical concurrent programming problems.	15	Working on assignments. Studying the recommended literature.	15	W_002, W_003

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Data analysis in business

Module code: W4-IN-S2-20-F-ADwB

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	The student has knowledge about the average measures, the volatility measures and the asymmetry measures and uses them in order to perform a descriptive analysis of business data. The student has knowledge about the issues of interdependence analysis, correlation and regression analysis to discover relationships occurring in business data.	K_W01 K_W09	1 1
M_002	The student has knowledge about classification and regression trees, neural networks, fundamental and technical analysis used to analyse business and financial data.	K_W09	1
M_003	She/He can make an initial assessment of business data, present it in an appropriate form, select the model or models suitable for analysis. She/He can compare the obtained results and draw conclusions based on them.	K_K04 K_U01 K_U08	1 1 1
M_004	She/He can use the selected program for business data analysis.	K_U09	1

3. Module description

Description	Data analysis in business aims at developing skills of using statistical population characteristics and using data mining models for business data analysis. The goal of the course is also to improve knowledge of classic and modern data analysis techniques on the example of financial data. Topics: 1. Gathering, development and graphic presentation of data. 2. Elements of business data descriptive analysis. 3. Analysis of correlation, dependence and regression. 4. Application of classification and regression trees for business data analysis. 5. Application of technical and fundamental analysis to financial data. 6. Application of neural networks for business data analysis.
Prerequisites	

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
W_001	Examination reports	Preparation of written reports and their oral presentation at a specified time as a verification of acquired skills during problems' solving.	M_001, M_002, M_003, M_004
W_002	Test	Verification of knowledge and skills based on the analysis of tasks solutions during written test.	M_001, M_002, M_003

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
Z_001	lecture	Lecture presenting concepts and facts from the scope of program contents which are listed in the module and illustrating them with numerous examples	15	Self-study of lectures and literature	15	W_002
Z_002	laboratory classes	Laboratory, during which students perform exercises with the help of the teacher, which develop the skills listed in the set of learning outcomes of the module	30	Self-improvement of skills listed in the set of learning outcomes of the module	60	W_001, W_002

1.	**Field of study**	**Computer Science**
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Data mining

Module code: W4-IN-S2-20-2-ED

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Is aware of the impact of data mining methods and data types on the quality of knowledge explored.	K_K02	1
M_002	Has knowledge of data types, similarity measures, classification quality measures	K_W09	2
M_003	Has knowledge of data preprocessing (discretization, normalization, empty data)	K_W09	2
M_004	Has knowledge of choosing the right method of exploration depending on the type of input data and expected results	K_W09	3
M_005	Is able to prepare a set for analysis (discretize data, normalize data, fill in empty data)	K_U03 K_U08 K_U09	2 2 4
M_006	Is able to implement selected cluster analysis algorithms	K_U08 K_U09	2 4
M_007	Can determine the quality of classification	K_U08 K_U09	2 3
M_008	Has basic knowledge of association and decision-making rules and approaches to constructing them	K_U09	2
M_009	Is able to present selected algorithms for constructing decision and association rules as well as their application	K_W02 K_W09	2 2
M_010	Has basic knowledge of feature selection	K_W09	1
M_011	He can classify data and properly interpret the result	K_W09	3

M_012	Has basic knowledge of decision trees and teams of classifiers.	K_W05 K_W09	1 1
M_013	Is able to present selected approaches to the construction of decision trees and teams of classifiers.	K_U08	1
M_014	Has basic knowledge of the subject and is able to determine the function of linear regression.	K_U08 K_W01 K_W09	1 1 1
M_015	Has basic knowledge of neural networks	K_W09	1

3. Module description	
Description	The goal is to introduce the listener to data mining methods, classification issues, grouping and induction of rules from data. content: 1. Preliminary concepts 2. data preprocessing 3. Clustering 4. Basics of classification 5. Feature selection 6. Decision rules 7. Testing statistical hypotheses 8. Association rules 9. Decision trees 10. Classifiers 11. Linear regression 12. Neural networks
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	exam (test)	Knowledge verification based on the content presented in the lecture. The exam consists of both open and closed theory questions.	M_001, M_002, M_003, M_004, M_005, M_006, M_007, M_008, M_009, M_010, M_011, M_012, M_013, M_014, M_015
W_002	Projects and reports	Developing projects with reports for them within a specified period as a verification of the skills acquired in solving problems.	M_001, M_002, M_005, M_006, M_007, M_008, M_009, M_010, M_011, M_012, M_013, M_014, M_015

5. Forms of teaching						
code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Transferring the content of education in verbal form using audiovisual means and other written teaching aids.	30	Preparation for the exam.	15	W_001
Z_002	laboratory classes	Detailed preparation of students to solve tasks with an indication of the methodology of the procedure, an indication of the order of performed activities.	30	Preparation for the laboratory. Student's independent solution of tasks assigned to the laboratory, preparation of reports	45	W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Data visualization

Module code: W4-IN-S2-20-F-WD

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Has knowledge about the use and implementation of data visualization methods.	K_W02 K_W04 K_W09	1 1 3
M_002	Has knowledge of how to process and visualize data, about the methods used and how to interpret the results.	K_W04 K_W09	1 2
M_003	Is able to select and implement the appropriate method of data visualization	K_U01 K_U03	1 1
M_004	Is able to interpret the result of data visualization and justify the techniques used	K_U08 K_U09 K_U10	1 1 1
M_005	Can implement an automated data visualization system, working individually or in a team.	K_U02 K_U03 K_U09	1 1 1
M_006	Is aware of the process of improvement and tracking the latest solutions in the field of data visualization	K_K01 K_K03	1 1

3. Module description	
Description	The aim of the module is to introduce students with the possibilities of advanced data visualization with elements of automation using scripting languages such as Python or R.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Reports	Preparation of written reports, their completion within a specified period as a verification of skills acquired during problem solving.	M_001, M_002, M_003, M_004, M_006
W_002	Project	Develop individual or group project and documentation system data visualization.	M_001, M_002, M_003, M_004, M_005, M_006

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Lectures conducted using multimedia tools, discussing issues related to the visualization and automation of data visualization in scripting languages.	15	Preparation for laboratories and passing the lecture.	20	W_002
Z_002	laboratory classes	Preparing students to perform lab exercises. Practical presentation of issues discussed during lectures.	30	Preparation for laboratory exercises. Self-solving laboratory exercises. Preparation of the final project.	55	W_001, W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Data warehouses

Module code: W4-IN-S2-20-F-HDiAMP

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Has knowledge of analytical data processing.	K_W09	4
M_002	Has knowledge about architecture of data warehouses.	K_W02	3
M_003	Is able to use appropriate tools to prepare data that will be used to feed the warehouse, knows the ETL process..	K_U01 K_W09	4 3
M_004	Using appropriate tools is able to perform advanced data analysis, including OLAP.	K_U09 K_W09	4 3
M_005	Using specialized tools is able to create advanced data reports and visualizations.	K_U09	3

3. Module description

Description	The aim of the module is to familiarize students with issues related to architecture of data warehouses, data processing using OLAP technology and advanced reporting tools.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Test	Knowledge verification is based on the content presented during lectures. It consists of questions regarding considered issues.	M_001, M_002, M_004

W_002	Raport presentation for laboratory works	Raport preparation and presentation in specified deadline, as a verification of skills acquired during implementation of laboratory works.	M_001, M_003, M_004, M_005

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Forwarding knowledge in verbal form using audio-visual media and other written didactic aids. Activation of students by asking questions and simple tasks regarding the considered topics.	15	Familiarize students with subject of lectures, investigation considered topics.	5	W_001
Z_002	laboratory classes	Preparation of students for solving laboratory tasks with an indication of the methodology and the order of performed activities.	30	Preparation for the laboratory taks, independent solution of laboratory tasks by students, preparation of reports.	70	W_002

1.	**Field of study**	**Computer Science**
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Decision and association rules in knowledge data discovery

Module code: W4-IN-S2-20-F-RDAOW

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Has knowledge regarding quality measures for knowledge representation in the form of decision and association rules.	K_W09	3
M_002	Knows approaches and algorithms for construction decision and association rules	K_W02 K_W04	3 2
M_003	Is able to apply decision and association rules in knowledge discovery.	K_U01 K_U03 K_U08 K_W09	4 4 3 3
M_004	Is able to choose and present the appropriate algorithm for creating a classification model for the considered problem.	K_U08 K_U09	3 3

3. Module description

Description	The aim is to familiarize students with decision and association rules as a models of knowledge representation and classification models. Measures of rules quality, approaches and algorithms for their construction and applications in knowledge discovery will be studied.
Prerequisites	

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
W_001	Test	Knowledge verification is based on the content presented during lectures. It consists of questions regarding considered issues.	M_001, M_002, M_003
W_002	Raport presentation for laboratory works	Raport preparation and presentation in specified deadline, as a verification of skills acquired during implementation of laboratory assignments.	M_001, M_002, M_003, M_004

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
Z_001	lecture	Forwarding knowledge in verbal form using audio-visual media and other written didactic aids. Activation of students by asking questions and simple tasks regarding the considered topics.	15	Familiarize with subject of lectures, investigation considered topics.	15	W_001
Z_002	laboratory classes	Preparation of students for solving problems and assignments with an indication of the methodology and the order of performed activities.	30	Preparation for the laboratory taks, independent solution of laboratory tasks by students, preparation of reports.	60	W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Deep learning with neuralk networks

Module code: W4-IN-S2-20-F-UGzSN

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Has knowledge of artificial neural networks.	K_W09	1
M_002	Knows methods and algorithms for learning deep neural networks	K_W02	1
M_003	Is able to design and implement a deep neural network	K_U01	1
M_004	Can train a neural network to solve a specific machine learning problem.	K_U02	1
M_005	Can assess the effectiveness of a trained neural network.	K_U05	1
M_006	He knows the possibilities of modern neural networks. He is aware of the importance of machine learning methods in developing modern IT solutions.	K_K01	1

3. Module description

Description	At present, deep learning algorithms are increasingly used in modern information technologies. In 2012, a deep neural network dominated the prestigious competition dedicated to the automatic recognition of image content. Since then, neural networks have revolutionized methods of machine image analysis. Currently, neural networks are also the main engine of speech recognition algorithms and automatic text translation.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Colloquium	Solving tasks and answering open questions.	M_001, M_002

W_002	Implementation project	Project evaluation after the multimedia presentation of the whole group.	M_003, M_004, M_005
W_003	Multimedia presentation	Assessment of the validity of the self-assessment of collective work and verification of the hypotheses.	M_006

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Giving the educational content in verbal form with the use of content visualization. Focusing on conceptually difficult material and indicating addresses of websites and e-learning package	15	Getting to know the topic of the lecture using the existing packages of methods: script, websites and e-learning package	30	W_001
Z_002	laboratory classes	Detailed preparation of students for the implementation of algorithms with indication of the methodology of conduct, indication of the sequence of activities to be performed	30	Self-development and preparation of students for the colloquiums of the laboratory. Project execution - implementation of a given system in a group of many people	45	W_001, W_002, W_003

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Fractal Methods in Computer Graphics

Module code: W4-IN-S2-20-F-MFwGK

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Knows and understands various types of fractals used in computer graphics, in particular: complex fractals, inversion fractals, iterated function system fractals, L-systems, strange attractors.	K_W01 K_W02	1 1
M_002	Knows and understands the basic algorithms used in fractal theory, in particular: chaos game, complex fractals rendering algorithms, fractal dimension computation.	K_W04	1
M_003	Knows and understands mathematical notions used fractal theory, in particular: contractive mapping, metric, mappings composition, iterative process, dynamical system.	K_W01	1
M_004	Can obtain information about fractals and computer graphics from literature, databases and other sources.	K_U01 K_U07	1 1
M_005	Can work individually and in a team.	K_U02	1
M_006	Can prepare and present a presentation on execution of project's task.	K_U03 K_U04	1 1
M_007	Can think and act creatively.	K_K01 K_K03	1 1

3. Module description

Description	Aim of the classes is to introduce to the students the basics of fractal theory and its applications in computer graphics. Various types of fractals and effective methods of their rendering will be presented. Moreover, the applications of fractal theory in image processing and compression, and in the aesthetics evaluation will be presented. During the course, the students will prepare projects in teams of maximum two and present results of their work

	in the form of presentation in front of the group.
Prerequisites	

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
W_001	Project	Preparing the project and presentation of the chosen topic connected with fractals.	M_001, M_002, M_003, M_004, M_005, M_006, M_007
W_002	Reports	Solving sets of tasks.	M_001, M_002, M_003, M_005

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
Z_001	lecture	Presenting educational content using audiovisual methods.	15	Independent study of lecture topics and given literature.	15	W_001
Z_002	laboratory classes	Detailed preparation of the students to: (1) the use of various fractal method in computer graphics, (2) the development of new methods. Solving programming tasks.	30	Familiarizing with subject of the laboratory. Familiarizing with subject of the project and preparing it in a team. Preparing a presentation of the project.	60	W_001, W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Fuzzy Sets nad Systems

Module code: W4-IN-S2-20-F-ZiSR

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Defines the concept of fuzzy set and describes its use in defining imprecise concepts	K_W01 K_W09	1 1
M_002	Knows the basic principles of the mechanism of inference in classical logic and their generalization in fuzzy logic - i.e. fuzzy inference	K_W01	1
M_003	Defined the structure and knows the pronciples of rule-based fuzzy system	K_W01	1
M_004	Knows the tools to implement fuzzy systems	K_W04	1
M_005	Designs information systems using the ideas of fuzzy sets to address the uncertainty of input data	K_U08 K_U09 K_U10	1 1 1
M_006	Implements fuzzy systems using available programming tools	K_U08 K_U09 K_U10	1 1 1
M_007	Is able to assess the importance of using various methods of artificial intelligence in solving a specific problem	K_K01 K_K04	1 1

3. Module description

Description	

	Classes familiarize students with the theory of fuzzy sets in terms of flexible representation of uncertain, inaccurate data or preferences. On the basis of this theory, the basics of fuzzy inference, resulting from classical logic, are introduced. Ultimately, classes lead to the theory of building and applying fuzzy rule-based systems.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Test	Answers to several open questions as part of a written essay. The questions relate to the theoretical aspects presented in the lecture.	M_001, M_002, M_003
W_002	Project assignments	Assessment of the implementation of several project tasks assigned by the teacher and their documentation in the form of a report.	M_004, M_005, M_006, M_007

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Verbal presentation of theoretical content, supported by tools such as classic blackboard or multimedia presentations	15	Studying the content presented during the lecture	25	W_001
Z_002	laboratory classes	Discussing and support of the teacher during the implementation of tasks by students in the computer laboratory	30	Implementation of tasks presented by the teacher in the computer laboratory	50	W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: General academic module (Humanities)

Module code: W4-IN-S2-20-3-MOH

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	The student knows selected issues related to the subject-related specificity of the humanities, understands their nature, place and importance in the system of sciences, as well as their connections with fields of science and scientific disciplines specific to the studied programme, allowing for the integration of perspectives appropriate for different scientific disciplines.	U_OOD W_OOD	4 4
M_002	The student is able to select, interpret and evaluate knowledge from selected disciplines in the field of humanities and integrate and apply it in scientific activity and professional practice in a manner that allows for original and creative solutions to problems that they experience as participants in cultural life.	U_OOD W_OOD	4 4
M_003	The student is able to creatively undertake, analyse and become involved in current sociocultural discourses, using knowledge of the studied problems of contemporary humanities and acquired communication skills as well as subject- related argumentation that considers various scientific approaches and types of scientific reflection.	U_OOD W_OOD	4 4
M_004	The student, who is a participant in cultural life in its various manifestations, shows the need for continuous learning and improvement of those dispositions that allow to appreciate humanistic reflection and integrate it with issues and experiences resulting from choosing one's own path of scientific and professional activities and related to individual cultural activity.	K_OOD U_OOD W_OOD	3 3 3

3. Module description

Description	The humanistic general academic module allows the student to get acquainted with selected areas of the subject-related specificity of humanities. The student has a chance to compare different methodological and interpretative approaches, and gains knowledge about the benefits of adopting a humanistic perspective of the view of reality. The student learns to implement recognized paradigms of humanistic thinking into their scientific activity, creatively solving the problems posed during the classes. Based on specific cases, the student trains the ability to integrate views appropriate for humanities with the points of view that belong to the fields of science and scientific disciplines appropriate for the studied programme. During the meetings, the student identifies manners of participation in present and future cultural formations, recognizing the paths of individual participation in the life of adequate human communities in the presented and experienced activities.

Prerequisites	

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
W_001	Test	A written or oral test in accordance with the description of the verification method included in the syllabus.	M_001, M_002, M_003, M_004
W_002	Continuous assessment	Current assessment of the individual work of the student, which is the mean of the grades from the activities conducted during the classes, is consistent with the description of the verification method included in the syllabus.	M_001, M_002, M_003, M_004

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
Z_001	depending on the choice	Depending on the type of classes, the following methods may be used: expository, problem, task, project methods, the analysis of the source material, etc.	45	Independent and thorough reading of the materials indicated in the syllabus, revision and consolidation of knowledge or skills acquired during classes.	45	W_001, W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: General academic module (Social Sciences)

Module code: W4-IN-S2-20-3-MOS

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	The student knows selected issues related to the subject-related specificity of social sciences, understands their nature, place and importance in the system of sciences, as well as their connections with fields of science and scientific disciplines specific to the studied programme, allowing for the integration of perspectives appropriate for different scientific disciplines.	U_OOD W_OOD	3 3
M_002	The student is able to select, interpret and evaluate knowledge from selected disciplines in the field of social sciences and integrate and apply it in scientific activity and professional practice in a manner that allows for original and creative solutions to problems that they experience as participants in social life.	U_OOD W_OOD	3 3
M_003	The student is able to creatively undertake, analyse and become involved in current sociocultural discourses, using knowledge of the studied content, acquired communication skills and subject-related argumentation taking into account various scientific approaches and types of scientific reflection.	U_OOD W_OOD	3 3
M_004	The student, who is a participant in social life in its various manifestations, shows the need for continuous learning and improvement of those dispositions that result from choosing their own path of scientific and professional activities and related to individual social activity.	K_OOD U_OOD W_OOD	2 2 2

3. Module description

Description	The social general academic module allows the student to get acquainted with selected areas of the subject-related specificity of social sciences. The student has a chance to compare different methodological and interpretative approaches, gains knowledge about the benefits of adopting a perspective of reality appropriate for social sciences. Based on specific cases, the student trains the ability to integrate views appropriate for social sciences with points of view that belong to fields of science and scientific disciplines appropriate for the studied programme.
Prerequisites	

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
W_001	Test	A written or oral test in accordance with the description of the verification method included in the syllabus.	M_001, M_002, M_003, M_004
W_002	Continuous assessment	Current assessment of the individual work of the student, which is the mean of the grades from the activities conducted during the classes, is consistent with the description of the verification method included in the syllabus.	M_001, M_002, M_003, M_004

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
Z_001	depending on the choice	Depending on the type of classes, the following methods may be used: expository, problem, task, project methods, the analysis of the source material, etc.	30	Independent and thorough reading of the materials indicated in the syllabus, revision and consolidation of knowledge or skills acquired during classes.	30	W_001, W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: GPGPU computing

Module code: W4-IN-S2-20-F-ONKG

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	He knows the hardware architecture of GPUs and graphics cards, knows the mechanisms and structures of CPU-GPU communication. Knows the properties of parallel algorithms, understands parallelization techniques at the level of instructions, data and tasks.	K_K01 K_U01 K_W03	1 1 1
M_002	Knows the rules of programming GPUs using CUDA C, knows and understands the functionality of the DirectCompute library and OpenCL language in parallel processing.	K_K01 K_U01 K_U05 K_U06 K_W02 K_W04 K_W05	1 1 1 1 1 1 1
M_003	Is able to work individually or in a team, understands the importance of intellectual honesty in their own activities and other people act ethically. He understands the need to constantly improve his competences. Is able to think in a creative way, form opinions on basic issues, current state and development trends in IT and understands non-technical issues of professional activity.	K_K01 K_K02 K_K03 K_U01 K_U02 K_U03 K_U04 K_W02	1 1 1 1 1 1 1 1

		K_W04	1

3. Module description	
Description	The aim of the course is to acquaint the student with the technique of parallel computing on GPUs. The subject course covers the basics of CUDA C, DirectCompute and OpenCL as well as hardware aspects of calculations on graphics cards.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Project	Implementation of a semester project in the field of learning outcomes adopted in the module	M_001, M_002, M_003
W_002	Project presentation	Audiovisual presentation on the forum of a group of students, discussion of assumptions and adopted method of solving a specific problem, analysis and assessment of the implementation of the project goal.	M_003
W_003	Test	Test with open and closed questions	M_001, M_002

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Content of module training with the use of audiovisual means.	15	Independent study of lecture topics and recommended literature	30	W_003
Z_002	laboratory classes	Practical implementation of the learning content of the module, including on the acquisition of skills and experience of efficient use of CUDA C, DirectCompute or OpenCL libraries. Classes are held using computer stations and appropriate software	30	1. Individual preparation for laboratory classes 2. Individual or multi-person group project execution and its documentation 3. Preparation of the presentation in audiovisual form about the completed project and its presentation on the forum of a group of students	45	W_001, W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Image and video processing techniques

Module code: W4-IN-S2-20-F-TPOiV

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Has knowledge of image and video processing.	K_W01 K_W02	1 1
M_002	Is able to implement selected algorithms in the field of image and video processing.	K_U01 K_U02 K_U03 K_U04 K_U06 K_U09	1 1 1 1 1 1
M_003	Is able to assess and compare the effectiveness of various algorithms for a given problem.	K_K01 K_U01 K_U06	1 2 2

3. Module description

Description	The purpose of the module is to introduce the listener with modern image and video processing techniques and compression standards.
Prerequisites	

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
W_001	Written exam	Knowledge verification based on the content presented in the lecture. The exam consists of open questions from theory.	M_001, M_003
W_002	Examination	Presentation of the implementation of the algorithms from the classes and one independently implemented.	M_002, M_003

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
Z_001	lecture	Transferring the content of education in verbal (or e-learning) form using audiovisual and other teaching aids.	15	Preparation for the exam.	15	W_001
Z_002	laboratory classes	Preparing students for independent implementation of selected algorithms.	30	Implementing selected algorithms in the programming language of your choice.	60	W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Image processing algorithms in biometrics and bioinformatics

Module code: W4-IN-S2-20-F-APOBB

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	The student knows and is able to explain the operation of methods of image processing in biometrics and bioinformatics.	K_W02	5
M_002	The student is able to prepare a presentation devoted to thematic issues.	K_U04	5
M_003	The student is able to analyze and solve the problems of image processing in biometrics and bioinformatics.	K_U09	5

3. Module description

Description	The aim of the course is to introduce students to image processing algorithms used in biometrics and bioinformatics.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Written test.	Theoretical questions concerning the issues discussed in the lecture.	M_001
W_002	Presentation of the set topic.	Preparation of a presentation related to the topic of the lectures.	M_002
W_003	The test in oral form.	Discussion on a given topic related to image processing in biometrics and bioinformatics.	M_003

5. Forms of teaching						
code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	The content of the lecture will be available in the multimedia form. Issues related to the topic will be presented.	15	Getting to know the topics presented in the lecture. Preparing for the exam on your own.	30	W_001, W_002, W_003
Z_002	laboratory classes	Preparation of appropriate tools for implementation of design applications. Solving tasks specified by the teacher.	30	Implementation of a given project at home or on computers at the Institute.	45	W_001, W_002, W_003

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Intellectual property protection

Module code: W4-IN-S2-20-3-OWI

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	explains the basic concepts and principles of intellectual property protection	K_W08	4
M_002	interprets the provisions related to the procedure for obtaining and enforcing protection rights on intellectual property subjects	K_W08	4
M_003	recognizes the processes of implementing procedures related to the protection of intellectual property	K_U01	1
M_004	creates documentation of intellectual property subjects	K_U01	1
M_005	is aware of the importance of intellectual property protection in professional work and in the economy	K_K03	2

3. Module description

Description	During the lecture, the student becomes familiar with the aspects of legal protection of intellectual property objects. Theoretical knowledge transferred concerns concepts in the field of intellectual property, sources of law, and legal protection issues, among others works (including computer programs and databases), inventions, utility models, industrial designs, trademarks. It aims to familiarize with the principles of copyright protection, avoiding infringements of intellectual property and to acquire practical skills regarding applications for the protection of intellectual property.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	written test	a written colloquium (test) will be conducted on the basic issues of intellectual property protection	M_001, M_002, M_003

W_002	problem task	student individually develops a solution to a problem task on a given topic in the field of intellectual property protection	M_002, M_003, M_004, M_005

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Transfer of the content of the lecture using didactic methods - informative lecture, problem lecture and the use of multimedia means and tools and platforms for creating multimedia educational tools. Paying attention to issues that are the subject of the student's own work.	15	Work with selected subject literature and law regulations, including independent assimilation of knowledge on the indicated issues. Preparation to pass - written test and problem task.	45	W_001, W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: intelligent data processing

Module code: W4-IN-S2-20-F-IPD

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Is aware of the possibilities offered by intelligent data processing, especially in the context of large data sets.	K_K02	1
M_002	Has knowledge of the basics of artificial intelligence, including fuzzy logic and fuzzy inference	K_W02 K_W04 K_W09	2 3 2
M_003	Has knowledge of data mining in the context of detecting dependencies and patterns (e.g. rules) in data as well as atypical data.	K_W02 K_W04 K_W08 K_W09	1 2 2 4
M_004	Has knowledge of the basics of artificial neural networks and so-called Deep learning.	K_W02 K_W04 K_W08 K_W09	2 2 2 3
M_005	Is able to implement or manually perform calculations and operations of fuzzyfication, fuzzy inference and defuzzyfication	K_U03 K_U07 K_U08 K_U09	3 2 2 3
M_006	Is able to apply the selected algorithm of rule induction (e.g. decision trees, association rules) for any data set or detection of unusual cases.	K_U01	1

		K_U03 K_U08 K_U09	3 2 3
M_007	Can use a dedicated tool to create a neural network model and interpret learning results of the created model for any data set.	K_U03 K_U07 K_U08 K_U09	3 2 2 3

3. Module description	
Description	The goal is to introduce the student to methods of data mining, classification tasks, clustering and rule induction process. It also includes the basics of fuzzy inference or deep learning with elements of neural networks.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	exam (test)	Knowledge verification based on the content presented in the lecture. The exam consists of both open and closed theory questions.	M_001, M_002, M_003, M_004, M_005, M_006, M_007
W_002	Project reports	Developing projects with reports for them within a specified period as a verification of the skills acquired in solving problems.	M_001, M_005, M_006, M_007

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Transferring the content of education in verbal form using audiovisual means and other written teaching aids	15	Preparation for the exam	15	W_001
Z_002	laboratory classes	Preparing students to solve tasks with an indication of the methodology of the procedure, an indication of the order of performed activities.	30	Students independently solve tasks assigned to the laboratory, prepare reports for their projects.	60	W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Internet of Things technologies

Module code: W4-IN-S2-20-F-TIR

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Student has basic skills for building teleinformatics systems in Internet of Things.	K_U05 K_W06	1 1
M_002	Student has knowledge of standards and protocols used in the Internet of Things.	K_W02 K_W06	1 1
M_003	Student has ability to implement the concepts in real world applications of the Internet of Things technology.	K_U03 K_U08	1 1

3. Module description

Description	The module objective is to give students a knowledge, which covers construction, communication methods, and operation of IoT devices. The presented topics are related to technologies of wireless and wired data exchange that enable the creation of IoT solutions as well as practical aspects of using smart sensors and actuators in such networks.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Final test	Two-hour test with closed and open questions.	M_001, M_002
W_002	Reports	Presentation of the reports and discussion of the developed projects.	M_001, M_003

5. Forms of teaching						
code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Lectures supported by multimedia presentations and e-learning	15	Self-study of literature and materials presented during lectures	25	W_001
Z_002	laboratory classes	Assignments in the form of design projects with use of IoT devices and simulators	30	Solving project assignments and preparing presentations	50	W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Internet protocols

Module code: W4-IN-S2-20-F-PI

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Understands the need for implementing the internet protocols.	K_W03 K_W05 K_W06	3 1 3
M_002	Characterizes TCP/IP protocol stock and understands the need of standardization of Internet layers and application operation.	K_K04 K_W05 K_W06 K_W07	3 1 3 1
M_003	Characterizes the need to use physical and logical addressing* in LAN and WAN networks. Understands the need of migration from IPv4 to IPv6 protocols. Understands threats resulting from this migration. Explains necessity of tunneling IPv6 to IPv4 in the transition period.	K_W03 K_W06	4 3
M_004	Divides big LAN networks into subnet of L3 layer, eliminating excessive number of layer L2 divulgations, selects and configures appropriate hardware devices.	K_W03 K_W06	3 2
M_005	Configures dynamic routing protocols.	K_U08 K_U10	2 1
M_006	Presents the group with his own configuration solutions.	K_K04	1

3. Module description

Description	Aim of the module is familiarizing with issues of need to use network protocols of L3 and L4 layers and OSI-7 model.

Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Lecture.credit.	Questions from the lectures subject matter.	M_001, M_002, M_003
W_002	Module tests CISCO CCNA.	Checking level of understanding of issues concerning designing the computer network and routing protocols.	M_002, M_003, M_004
W_003	Conversation during tasks crediting.	Checks the skill o generalizing knowledge acquired during tasks solution.	M_004, M_005, M_006

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Content available in the form of multimedia transfer.	15	Preparation for the exam.	30	W_001, W_002
Z_002	laboratory classes	Blackboard exercises referring to network addressing and practical exercises referring to routers configuring, reports, CSCO module tests.	30	Designing student’s own network, using CISCO Packet Tracer.	45	W_002, W_003

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Introduction to data classificatin and clusterization in biometry

Module code: W4-IN-S2-20-F-WDZKKD

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Student can choose adequate classification or clustering algorithm to solve a given biometric problem.	K_U03 K_U08 K_U09 K_W01 K_W02 K_W04 K_W05 K_W09	1 1 1 1 1 1 1 1
M_002	Student can design tests for biometric based identification/verification system.	K_K02 K_K04 K_U01 K_U05 K_U09 K_W04 K_W09	1 1 1 1 1 1 1
M_003	Student can implement basic classification and clustering algorithms, used in biometry.	K_U01 K_U02 K_U05	1 1 1

		K_U08 K_U09 K_U10 K_W01 K_W04 K_W05	1 1 1 1 1 1

3. Module description	
Description	The module is dedicated to familiarizing the student with the basic algorithms for classification and clustering of data used in biometric systems.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Small exam	Short exam (or on-line test), verifying knowledge derived from the lecture and laboratories.	M_001, M_002
W_002	Passing project	Project of the biometric system or test environment for the biometric system, with a technical documentation.	M_001, M_002, M_003
W_003	Passing test	Passing test covering the whole topic.	M_001, M_002, M_003

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Classes are run as a lecture (15 hours) with use of a multimedia presentations. Classes in a traditional form, and e-learning.	15	Student should study auxiliary materials, and the literature.	15	W_003
Z_002	laboratory classes	Project/lab classes in computer laboratory, and e-learning.	30	Literature and on-line study, and preparing a passing project.	60	W_001, W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Introduction to reverse engineering

Module code: W4-IN-S2-20-F-WDIW

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	The student knows and is able to explain the operation of advanced mechanisms used in high and low level languages.	K_W02 K_W04	5 5
M_002	The student is able to prepare a presentation devoted to advanced programming issues.	K_U04	5
M_003	The student is able to deassemble a selected computer program and to do the preliminary analysis of an achieved code.	K_U09	5

3. Module description

Description	The goal of the course is to introduce the students to the issues of reverse engineering from the computer science point of view.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Written test.	Theoretical questions concerning the issues discussed in the lecture.	M_001
W_002	Presentation of the set topic	Preparation of a presentation related to the subject of reverse engineering.	M_002
W_003	The test in oral form.	Discussion of how a given computer program works.	M_003

5. Forms of teaching						
code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	The content of the lecture will be available in the multimedia form. Sample project tasks will be presented.	15	Getting to know the topics presented in the lecture. Preparing for the exam on your own.	30	W_001, W_002, W_003
Z_002	laboratory classes	Preparation of appropriate design tools. Solving tasks specified by the teacher.	30	Implementation of a given project at home or on computers at the Institute.	45	W_001, W_002, W_003

1.	**Field of study**	**Computer Science**
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Introduction to scientific research.

Module code: W4-IN-S2-20-1-WDBN

1. Number of the ECTS credits: 1

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Initiating scientific research.	K_K01	1
		K_K02	1
		K_K03	1
		K_K04	1
		K_K05	1
		K_U01	1
		K_U02	1
		K_U06	1
		K_W07	1
		K_W08	1

3. Module description

Description	The aim of the course is to acquaint students with the offer of scientific research carried out in the Institute of Computer Science.
Prerequisites	

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
W_001	Report	Prepare a short report on the selected topic of the research work.	M_001

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
Z_001	seminar	Presentation of educational content in verbal form with the use of content visualization.	2	Participation in meetings carried out by research groups.	28	W_001

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: IT for the Blind and Visually Impaired

Module code: W4-IN-S2-20-3-T

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Is aware of the problems and existing solutions for the availability of IT applications	K_W07	1
M_002	Is able to assess the problems of IT solutions in the context of users with visual impairments and proposes solutions	K_U05	1
M_003	Applies the principles of available (universal) IT system design and makes others aware of it	K_K02 K_K05	1 1

3. Module description

Description	Classes introduce IT problems in the context of blind and visually impaired users. Students learn the WCAG requirements necessary to create and implement IT solutions. Additionally, students learn about tools (hardware and software) that are available for blind and visually impaired people.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Test	Test in the form of several questions regarding the scope of the presented issues	M_001, M_002, M_003

5. Forms of teaching						
code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Verbal presentation of the subject content supported by multimedia materials and the presentation of software and hardware.	15	Studying the content provided during the lecture and in the form of shared materials.	45	W_001

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Machine learning in biometrics and bioinformatics

Module code: W4-IN-S2-20-F-UMwBiB

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	The student should have the ability to solve problems individually or in a team, using the acquired knowledge and practical skills.	K_K01 K_K03 K_K04 K_U01 K_U02	1 1 1 1 1
M_002	The student is able to analyze any biometric system in terms of using the machine learning algorithm.	K_U01 K_U08 K_U09 K_W01 K_W02 K_W04 K_W05 K_W09	1 1 1 1 1 1 1 1
M_003	He has an in-depth knowledge of contemporary methods of artificial intelligence.	K_U01 K_W01 K_W02 K_W05 K_W09	1 1 1 1 1

M_004	He knows selected neural network architectures.	K_W01 K_W04 K_W09	1 1 1
M_005	The student is able to implement, using the necessary software libraries, machine learning models for problems of data classification and regression in biometrics and bioinformatics.	K_W01 K_W02 K_W04 K_W05 K_W09	1 1 1 1 1
M_006	The student is able to evaluate and refer to the degree of advancement of his work or teamwork.	K_U03 K_U04 K_U05	1 1 1
M_007	The student is familiar with the current state and latest developments and trends in computer science, including artificial intelligence, machine learning methods, including their applications in biometrics and bioinformatics.	K_W01 K_W02 K_W09	1 1 1

3. Module description	
Description	The aim of this course is to familiarize students with machine learning algorithms, with particular emphasis on their applications in biometrics and bioinformatics. Different learning methods with and without supervision will be discussed. The main element of the course are methods based on neural networks.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Test	Solving a theoretical test related to the topics discussed in the lecture.	M_003, M_004, M_007
W_002	Project documentation	Presentation of full documentation of the project, including all stages of its implementation.	M_001, M_002, M_003, M_004, M_005, M_006, M_007

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Presentation of educational content in verbal form with the use of content visualization. Focusing on material that is difficult to understand. Activating students by asking	15	Preparing for the colloquium.	10	W_001

		questions about the content. Classes in a traditional form, and e-learning.				
Z_002	laboratory classes	During laboratory classes, students learn about mathematical models of machine learning and solve tasks in this field. Classes in a traditional form, and e-learning.	30	Solving tasks from individual topics with analysis of already existing solutions	65	W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Managing IT projects and teams

Module code: W4-IN-S2-20-2-ZZiP

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Student knows the various methodologies of managing IT projects, primarily project team management, resources, risks, efficiency and quality. Student uses specialist literature (in English).	K_U07 K_W05	2 5
M_002	Student works in a team, uses available IT tools to assist in managing project, understands the need of PM certification.	K_K01 K_U02 K_U03	1 5 3
M_003	Student cans present the effects of team work.	K_U04	1

3. Module description

Description	The module includes issues related to project management methodologies and projects. Topics of the subject are: project teams, issues of their creation, functioning, development, evaluation and management of their work. In particular, the content concerns IT project management methodologies - starting with the components of the project, its resources. Particular attention is paid to planning, scheduling, risk management, efficiency, quality. Available IT solutions - in particular project management packages (depending on availability of licenses - eg MS Project) will be used during laboratory exercises - as a tool to help manage a complex project.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Lecture credit	Exam in written or oral form (open or closed questions).	M_001

W_002	Practical tasks	An exercise card - exercise's documentation of each of the instruction points; The tasks will be described on the card, which will be the basis for passing the exercise. A practical task implemented in the project team, with an indication of roles, schedule, preparation of the report.	M_002
W_003	Team project presentation	Projekt team presents its organization (methodology, roles), IT project, timetable, resources etc.	M_003

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Presenting the chosen issues with use of audio-visual aids. Examples of methodologies' using, reports, certification plans	10	Studying an additional literature	5	W_001
Z_002	laboratory classes	Classes taught in the form of workshops with specifying subsequent tasks to be performed. The project task executed by project teams, discussion, results presentation.	20	Preparation of practical information necessary to implement the project in a working team. Acquiring proficiency in using IT tools.	25	W_002, W_003

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Master's seminar I

Module code: W4-IN-S2-20-1-SMI

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Student can use literature, including in foreign languages to prepare elaboration referring to Master thesis.	K_U01 K_U07	2 2
M_002	Student can prepare a plan of work defining timeliness and activities connected with subsequent stages of the thesis writing process.	K_U01 K_U02	1 1
M_003	Student can edit and formulate direct and indirect aims of Master thesis.	K_U01	1
M_004	Student can summarize basic information connected with the thesis range and describe problem discussed in Master thesis.	K_U04	1
M_005	Student can present his work and provide its thematic range, emphasizing the most important issues.	K_U04	1
M_006	Student can answer questions referring to thesis and defend, in confrontation with other students his opinions on subjects discussed in the thesis and the solutions of the problems presented in it.	K_U01 K_U04	1 1
M_007	Student has ability to negotiate and organize work – ability of self-evaluation and self-organization.	K_U05 K_U06	1 1

3. Module description

Description	Aim of classes is preparing the students to correct planning and executing all the tasks necessary to write Master thesis. As a result, the student should be able to present clearly and justify suggested approach to the described in the thesis problems, including in confrontation with other people.
Prerequisites	

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
W_001	Presentations	Presentations of subsequent stages of Master thesis realization. Periodical reports in the form of presentation will allow systematic verification of the student's work progress.	M_001, M_002, M_003, M_004, M_005, M_006, M_007
W_002	Articles analyses	Presenting opinions about the chosen scientific articles connected with the thesis topic. It will allow the student to familiarize with different approaches connected with thesis subject and to develop critical insight into the solutions used.	M_004, M_005, M_006, M_007

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
Z_001	seminar	Detailed specification of the scientific papers writing principles. Discussing and preparing work plan and the way of thesis writing.	15	Insightful work connected with bibliography analysis thematically close to the student's Master thesis. Detailed preparation of the thesis plan and its content and preparing the final version of the thesis. Earnest analysis of the chosen scientific texts. Preparing summary and own conclusions.	45	W_001, W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Master's seminar II

Module code: W4-IN-S2-20-2-SMII

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Student can use literature, including in foreign languages to prepare elaboration referring to Master thesis.	K_U01 K_U07	2 2
M_002	Student can prepare a plan of work defining timeliness and activities connected with subsequent stages of the thesis writing process.	K_U01 K_U02	1 1
M_003	Student can edit and formulate direct and indirect aims of Master thesis.	K_U01	1
M_004	Student can summarize basic information connected with the thesis range and describe problem discussed in Master thesis.	K_U04	1
M_005	Student can present his work and provide its thematic range, emphasizing the most important issues.	K_U04	1
M_006	Student can answer questions referring to thesis and defend, in confrontation with other students his opinions on subjects discussed in the thesis and the solutions of the problems presented in it.	K_U01 K_U04	1 1
M_007	Student has ability to negotiate and organize work – ability of self-evaluation and self-organization.	K_U05 K_U06	1 1
M_008	Student has ability to critically assess his activities to evaluate and improve work effects.	K_K02 K_K03 K_U05	1 1 1

3. Module description

Description	

	Aim of classes is preparing the students to correct planning and executing all the tasks necessary to write Master thesis. As a result, the student should be able to present clearly and justify suggested approach to the described in the thesis problems, including in confrontation with other people.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Presentations	Presentations of subsequent stages of Master thesis realization. Periodical reports in the form of presentation will allow systematic verification of the student's work progress.	M_001, M_002, M_003, M_004, M_005, M_006, M_007, M_008
W_002	Articles analyses	Presenting opinions about the chosen scientific articles connected with the thesis topic. It will allow the student to familiarize with different approaches connected with thesis subject and to develop critical insight into the solutions used.	M_004, M_005, M_006, M_007, M_008

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	seminar	Detailed specification of the scientific papers writing principles. Discussing and preparing work plan and the way of thesis writing.	30	Insightful work connected with bibliography analysis thematically close to the student's Master thesis. Detailed preparation of the thesis plan and its content and preparing the final version of the thesis. Earnest analysis of the chosen scientific texts. Preparing summary and own conclusions.	30	W_001, W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Master's seminar III

Module code: W4-IN-S2-20-3-SMIIIP

1. Number of the ECTS credits: 9

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Student can present a full written elaboration concerning Master thesis.	K_K04 K_K05 K_U01	1 1 1
M_002	Student can summarize basic information connected with the thesis range and describe problem discussed in Master thesis.	K_K04 K_U01 K_U04	1 1 1
M_003	Student can present his work and provide its thematic range, emphasizing the most important issues.	K_U01 K_U04	1 1
M_004	Student can answer questions referring to thesis and defend, in confrontation with other students his opinions on subjects discussed in the thesis and the solutions of the problems presented in it.	K_K05 K_U04	1 1
M_005	Student understands importance of intellectual honesty in his own activities and in activities of others, acts ethically.	K_K03	2
M_006	Student understands the need of presenting achievements in the field of IT by editing and publishing his Master thesis.	K_K05	2
M_007	Student has ability to critically assess his activities to evaluate and improve work effects.	K_U05	2

3. Module description

Description	Aim of classes is preparing the students to correct planning and executing all the tasks necessary to write Master thesis. As a result, the student should be able to present clearly and justify suggested approach to the described in the thesis problems, including in confrontation with other people.

Prerequisites	

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
W_001	Presentations	Presentations of subsequent stages of Master thesis realization. Periodical reports in the form of presentation will allow systematic verification of the student’s work progress.	M_002, M_003, M_004, M_005, M_007
W_002	Master thesis	Skills verification by writing elaboration of Master thesis.	M_001, M_005, M_006

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
Z_001	seminar	During the classes there are discussions held, presentations given and the knowledge of preparing Master theses is grounded.	30	Studying materials connected with Master thesis thematic, presentation elaboration and preparing the final version of Master thesis. Preparing for the discussion.	240	W_001, W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Master's workshop

Module code: W4-IN-S2-20-2-PMI

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Student can define requirements referring to Master thesis in the range of its form and technical editing.	K_U01	1
M_002	Student can prepare documentation connected with Master thesis.	K_U03	1
M_003	Student can use IT tools for correct edition of Master thesis, understands he need of making thematic and graphic juxtapositions.	K_U09	1
M_004	Student can use statistical methods for verification of hypotheses presented in Master thesis.	K_U08 K_W01	1 1
M_005	Student can use IT techniques in the specified area of use in Master thesis or in the realized project.	K_U09	1
M_006	Student can present results connected with work to a group of people. Exhibits abilities of creative thinking while solving encountered problems.	K_U04	1

3. Module description

Description	Aim of the class is preparing the students for correct edition of Master thesis and preparing its technical part. The student should be able to appropriately present his thesis documentation and used the techniques learnt to compare to other, known solutions similar to questions analyzed in the thesis. Moreover, he should know the principles of correct Master thesis edition and IT tools supporting this process.
Prerequisites	

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
W_001	Presentations	Presentations of subsequent stages of Master thesis realization. Periodical reports in the form of presentation will allow systematic verification of the student’s work progress.	M_001, M_003, M_004, M_005, M_006
W_002	Additional project	Additional project with related topic to Master thesis subject. During its realization, the student will be able to exhibit the skill of self?organizing and timeliness and will acquire knowledge necessary to write Master thesis.	M_002, M_003, M_004, M_005, M_006

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
Z_001	laboratory classes	Detailed specification of technical aspects connected with Master thesis writing. Review of the most popular tools helpful while Master thesis editing and preparing thesis and project documentation.	45	Familiarizing with the learned tools and their use in the process of Master thesis writing, projects creating and preparing presentations.	45	W_001, W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Master's workshop

Module code: W4-IN-S2-20-3-PMII

1. Number of the ECTS credits: 5

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Student can define requirements referring to Master thesis in the range of its form and technical editing.	K_U01	1
M_002	Student can prepare documentation connected with Master thesis.	K_U03	1
M_003	Student can use IT tools for correct edition of Master thesis, understands he need of making thematic and graphic juxtapositions.	K_U09	1
M_004	Student can use statistical methods for verification of hypotheses presented in Master thesis.	K_U08 K_W01	1 1
M_005	Student can use IT techniques in the specified area of use in Master thesis or in the realized project.	K_U09	1
M_006	Student can present results connected with work to a group of people. Exhibits abilities of creative thinking while solving encountered problems.	K_U04	1

3. Module description

Description	Aim of the class is preparing the students for correct edition of Master thesis and preparing its technical part. The student should be able to appropriately present his thesis documentation and used the techniques learnt to compare to other, known solutions similar to questions analyzed in the thesis. Moreover, he should know the principles of correct Master thesis edition and IT tools supporting this process.
Prerequisites	

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
W_001	Presentations	Presentations of subsequent stages of Master thesis realization. Periodical reports in the form of presentation will allow systematic verification of the student's work progress.	M_001, M_003, M_004, M_005, M_006
W_002	Documentation	Presentation of full documentation of the application if there is such in the thesis, documentation of experiments carried out or other examinations carried out tithing the frames of Master thesis.	M_002, M_004, M_006

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
Z_001	laboratory classes	Detailed specification of technical aspects connected with Master thesis writing. Review of the most popular tools helpful while Master thesis editing and preparing thesis and project documentation.	45	Familiarizing with the learned tools and their use in the process of Master thesis writing.	105	W_001, W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Mathematical modeling of optimization problems

Module code: W4-IN-S2-20-3-MMPO

1. Number of the ECTS credits: 3

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Is able to use selected programming libraries in order to formulate combinatorial optimization problems as a linear program (also integer program).	K_U01 K_U05 K_U08 K_U09	1 1 3 3
M_002	Is able to solve an combinatorial optimization task using modern search nethods, such as Answer Set Programming and Satisfiability Modulo Theories, in a selected programming language.	K_U01 K_U05 K_U08 K_U09	1 3 3 3
M_003	Has knowledge about formulating combinatorial optimization tasks by means of the classical and modern methods of mathematical modeling.	K_W01 K_W02 K_W04 K_W09	4 3 1 1

3. Module description

Description	This subject aims at the exact and effective solving of intractable optimization problems. The students are familiarizing with the following three approaches: (i) lineasr and integer programming (for example MathProg language), (ii) satisfiability modulo theories (for example based on Z3 library), and (iii) answer set programming (for example AnsProlog). Thanks to that every student should know all aspects of using classical and modern exact optimization methods.

Prerequisites	

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
W_001	Midterm for lecture	Executing assignments that involve all approaches descibed in the lecture.	M_003
W_002	Midterm for lab	Programming assignments that involve classical and modern combinatorial optimization problems, with the help of glpk and Z3 libraries as well as AnsProlog language.	M_001, M_002

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
Z_001	lecture	Oral presentation with the help of prepared slides. Focusing on the hard part of the topics, giving basic examples and suggesting web pages for more advanced ones.	15	Familiarizing with the topics, appropriate software, selected web pages, and recommended literature.	30	W_001
Z_002	laboratory classes	Preparing students for executing assignments by showing the methodology and handling steps.	15	Writting computer programs and the analysis of existing solutions on the Internet.	30	W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Methods of group decision making

Module code: W4-IN-S2-20-F-MPDG

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	The student has knowledge about the topology and architecture of multiple classifier system, methods of building combined classifiers and techniques for fusion of based models' predictions.	K_W02 K_W05 K_W09	1 2 1
M_002	The student has knowledge of the basic issues related to two-player and n-player games i.e. the payoff matrix, the Nash equilibrium and the Shapley value.	K_W01	1
M_003	She/He can choice appropriate architecture and topology of multiple classifier system to the considerad problem. She/He can carry out the process of building a combined classifiers and apply the appropriate fusion method.	K_U03 K_U08 K_U09	1 1 1
M_004	She/He can use the selected program to perform the analysis using multiple classifier system.	K_U09	1

3. Module description

Description	The course aims to present issues related to multiple classifier system and fusion methods used when making group decisions. The subject will also cover selected issues from game theory. Content: 1. Topology and architecture of multiple classifier system 2. Methods of constructing combined classifiers: Bagging, Boosting, methods of selecting variables 3. Methods for combining prediction results of base classifiers: fusion methods from the abstract, rank and measurement levels 4. The problem of diversity of base models 5. Introduction to the two-player games, payoff matrix and the Nash equilibrium 6. Introduction to the n-player games and the Shapley value

Prerequisites	

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
W_001	Examination reports	Preparation of written reports and their oral presentation at a specified time as a verification of acquired skills during problems' solving.	M_001, M_002, M_003, M_004
W_002	Test	Verification of knowledge and skills based on the analysis of tasks solutions during written test.	M_001, M_002, M_003

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
Z_001	lecture	Lecture presenting concepts and facts from the scope of program contents which are listed in the module and illustrating them with numerous examples	15	Self-study of lectures and literature	15	W_002
Z_002	laboratory classes	Laboratory, during which students perform exercises with the help of the teacher, which develop the skills listed in the set of learning outcomes of the module	30	Self-improvement of skills listed in the set of learning outcomes of the module	60	W_001, W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Microcomputers and network couplers

Module code: W4-IN-S2-20-F-MiSS

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Describes advantages of MCU microcomputer Harvard architecture and reduced instruction set (RISC).	K_W03 K_W06 K_W09	1 1 1
M_002	Presents various concepts of microcontrollers networks.	K_W03 K_W06	3 2
M_003	Understands threats connected with maintenance-free control of manufacturing processes.	K_W03 K_W05 K_W09	2 1 1
M_004	Uses runtime systems for microcomputers.	K_U01 K_U08 K_U09	1 1 1

3. Module description

Description	Aim of the module is to present the concept of communicating networks and cooperating microcontrollers. The student familiarizes with two microcontrollers families and justifies choice of optimum solutions analyzing widely perceived cost of the solution (equipment cost, energy consumption, simplicity of implementation, etc.).
Prerequisites	

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
W_001	Lecture credit	Questions from lecture subject matter.	M_001, M_002, M_003
W_002	Conversation during crediting tasks.	Checks the skill of generalizing skills acquired while tasks execution in the groups of two.	M_004

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
Z_001	lecture	Content available in the form of multimedia transfer.	15	Preparing to laboratory classes and to lecture credit.	15	W_001
Z_002	laboratory classes	Writing simple programs for microcomputer using the chosen programming language and runtime environment. Designing and activating microcomputer-controlled devices.	30	Activating programs dedicated to the designed microcomputer-based device. Preparing specification for the designed device.	60	W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Mobile systems and applications

Module code: W4-IN-S2-20-F-SiAM

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Has knowledge in the field of mobile systems programming and using standard modules of mobile devices.	K_W02	1
M_002	Has knowledge in the field of designing graphical user interfaces for mobile applications	K_U10 K_W05	1 1
M_003	Can select an appropriate programming language and environment for programming a device, can operate emulators of mobile devices	K_W04	1
M_004	Designs and implements applications for mobile devices according to the given specification (having particular functionality)	K_U10 K_W03	1 1
M_005	Independently gets acquainted with issues, also beyond the field of study, which enable to create interdisciplinary projects	K_K01 K_U01 K_U05 K_U06	1 1 1 1
M_006	Is able to prepare a documentation for a project task	K_U03	1
M_007	Presents the results of own work, software functionality, can justify selected solutions and draw the appropriate conclusions	K_U04	1

3. Module description

Description	The aim of classes consisting this module is to prepare students to create applications for mobile devices. As a result, the student should exhibit knowledge in the field of construction and hardware capabilities as well as programming capabilities of mobile devices. Moreover, students should be

	familiar with issues of wireless data transfer and the principles of operating the GPS system and other modules typical for mobile systems and devices. In consequence, this should lead to an acquisition of a complex knowledge enabling to create applications for mobile devices of various types.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Project Task - Mobile App	The task is to design, implement, launch and test a mobile application with a functionality accepted by the teacher	M_001, M_002, M_003, M_004, M_005, M_006
W_002	Presentation and discussion on the implementation of the project task	Questions evaluating the level of understanding of issues related to the construction and operating of mobile device allowing its programming. Verification of the ability to generalize the skills acquired during the implementation of the task.	M_001, M_002, M_003, M_005, M_007

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Description of principles and content, discussion during classes. Material available in the form of a multimedia content. Online courses and training available on e-learning platforms.	15	Familiarization with the materials shared online. Completion of the selected - accepted by the teacher - online course. Preparing to pass the course.	15	W_002
Z_002	laboratory classes	Design, implementation, running and testing of sample mobile applications. Presentation of work effects, discussion of applied solutions.	30	Design, implementation, running and testing of a project task. Familiarization with the specification of the project task. Preparation for laboratory classes. Preparation of documentation and presentation of the project task.	60	W_001, W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Modern programming languages

Module code: W4-IN-S2-20-1-NJP

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Student can choose and implement the appropriate structure in the programming language.	K_K01 K_U01 K_U04 K_W04	1 2 1 2
M_002	Student can describe algorithms using selected programming language structures.	K_K01 K_U04 K_W01 K_W02	1 1 3 3
M_003	Student has the knowledge of the programming language.	K_U04 K_U06 K_W02 K_W04	1 1 2 2

3. Module description

Description	The following topics will be presented. Kotlin for Server Side, Android, JavaScript, Native, Data Science programming. Basic syntax, idioms and coding conventions. Basic types, packages and imports. Classes and objects. Functions, lambdas and inline functions. Collections. Coroutines. Multiplatform programming. Core libraries. Kotlin for Java and JavaScript. Native programming.
Prerequisites	

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
W_001	Written exam	Knowledge verification based on the content presented in the lecture. The exam is carried out in the form of a test.	M_001, M_002, M_003
W_002	Passing exercises	Submission of projects (applications) within a specified period as a verification of skills acquired during problem solving.	M_001, M_002, M_003

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
Z_001	lecture	Lectures are carried out by using audiovisual means.	30	Studying lecture topics basing on books and materials from the Internet.	15	W_001
Z_002	laboratory classes	Compulsory classes in the computer lab conducted according to the schedule.	30	Solving practical tasks. Development and practical implementation of the project.	45	W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Monographic lecture

Module code: W4-IN-S2-20-1-WM

1. Number of the ECTS credits: 1

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Has knowledge about the main research trends in such fields of computer science as: machine learning, biometrics, computer networks and graphics, data analysis, and decision support systems.	K_W02	1

3. Module description

Description	The purpose of this monographic lecture is to familiarize students with scientific research that is conducted in our faculty on computer science and telecommunication. Every research group (within 4 ours) has the opportunity to present basic methods and ideas using in its research and then to list topics of the potential master theses.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Midterm for lecture	Student is suppose to select a supervisor, to determine the theme of his/her thesis, and to demonstrate the basic knowledge about the topic by writting an introduction of the thesis.	M_001

5. Forms of teaching						
code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Oral presentation with the help of prepared slides. Focusing on the hard part of the topics, giving basic examples and suggesting web pages for more advanced ones.	20	Familiarizing with the topics, selected web pages, and recommended literature.	10	W_001

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Monographic lecture - Combinatorial machine learning

Module code: W4-IN-S2-20-2-WMwJA

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Can recognize analogies in the knowledge presented in the lecture, as well as the concepts employed out in other courses.	K_U01 K_W02	4 2
M_002	Knows what are the decision rules, decision trees and reducts, and can provide examples of their application to solve real problems.	K_U07 K_W09	4 3
M_003	Is able to present an algorithm for construction decision rules, decision trees and tests.	K_W02 K_W04	3 1
M_004	Is able to present the problem of construction rules, trees and tests as an optimization problem.	K_U08 K_W02	2 2

3. Module description

Description	The aim is to acquaint students with decision trees, decision rules and tests as tools for discovering knowledge from data, their analysis, study relationships between these objects, and show examples of applications.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Test	Knowledge verification is based on the content presented during lectures.	

			M_001, M_002, M_003, M_004
W_002	Solving assignments	Presentation, in specified term, results of solved assignments as a verification of skills acquired during problem solving.	M_003, M_004

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Forwarding knowledge in verbal form using audio-visual media and other written didactic aids. Paying attention to issues more difficult to understand. Activation of students by asking questions and simple tasks regarding the considered topic.	30	Familiarize the subject of the lecture, investigation discussed issues in the framework of connections between the examined objects, solving tasks in the area of knowledge presented during lecture.	30	W_001, W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Network Systems Security

Module code: W4-IN-S2-20-F-BSS

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Understands the need to protect network devices.	K_W03	3
M_002	Understands the need to encrypt and tunneling transmission on the Internet - IPSec, SSL, VPN.	K_W03 K_W06	2 2
M_003	Understands the need to limit user access to network resources - AAA (Authentication, authorisation and accounting).	K_W03 K_W06 K_W08	1 1 1
M_004	Can implement a firewall.	K_K02 K_U08 K_U10	1 2 1
M_005	Can analyze network traffic.	K_U01 K_U08 K_U09	1 2 1

3. Module description

Description	Aim of the module is familiarizing with issues connected with designing, and operation of secure computer networks and behavior-based security.
Prerequisites	

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
W_001	Module credit.	Questions from lecture subject matter.	M_001, M_002, M_003
W_002	Conversation during tasks crediting.	Checks the skill of generalizing knowledge acquired during tasks solving.	M_004, M_005

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
Z_001	lecture	Content available in the form of multimedia transfer.	15	Preparing for credit.	30	W_001
Z_002	laboratory classes	Exercises referring to network security and LAN networks configuring.	30	Design and implementation of FireWall.	45	W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Object-relational database systems in biometry

Module code: W4-IN-S2-20-F-RSBwB

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Has essential knowledge on designing an object-relational database systems for biometry.	K_U03 K_U10 K_W02 K_W03 K_W05	1 1 1 1 1
M_002	Is able to choose suitable technical tools for solving a given problem.	K_K02 K_U01 K_U02 K_U05 K_U06 K_U08 K_U10 K_W03 K_W04 K_W06	1 1 1 1 1 1 1 1 1 1
M_003	Can prepare a technical documentation for a system.	K_U03 K_U04	1 1

3. Module description	
Description	This module prepares student for development of database systems dedicated for use in biometric systems.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Small exam	Short exam (or on-line test), verifying knowledge derived from the lecture and laboratories.	M_001, M_002
W_002	Passing project	Biometric database system project, and a system documentation.	M_001, M_002, M_003
W_003	Passing test	Passing test covering the whole topic.	M_001, M_002, M_003

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Classes are run as a lecture (15 hours) with use of a multimedia presentations. Classes in a traditional form, and e-learning.	15	Student should study auxiliary materials and the literature.	15	W_003
Z_002	laboratory classes	Project/lab classes in computer laboratory, and e-learning.	30	Literature and on-line study, and preparing a passing project.	60	W_001, W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Outlier detection algorithms

Module code: W4-IN-S2-20-F-AWOwD

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Is aware of the essence of deviations in the data, which are not errors in the data but real different objects.	K_K02	1
M_002	Has knowledge of the basics of descriptive statistics, including issues to identify deviations in data.	K_W04 K_W09	3 2
M_003	Has knowledge of methods of graphical data representation and detection of deviations in such representations.	K_W09	3
M_004	Has knowledge of selected deviation detection algorithms, including algorithms based on distance and data distribution, as well as algorithms based on data density or local deviations.	K_W02 K_W04 K_W09	2 2 3
M_005	He can choose the right algorithm to detect deviations depending on the type of data being analyzed.	K_U01 K_U03 K_U08 K_U09	2 2 2 2
M_006	Can implement or use ready-made libraries / packages that allow the use of a deviation detection algorithm for a selected data set.	K_U01 K_U03 K_U08 K_U09	2 2 2 4
M_007	Can determine the similarity / distance between two objects in multidimensional space.	K_U01 K_U03	2 2

		K_U08 K_U09	2 3

3. Module description	
Description	The goal is to introduce the listener to deviation detection algorithms so important in practical applications, e.g. for detecting embezzlement or unusual disease symptoms. Among the issues raised will be both algorithms based on the distance between objects in the analyzed space as well as algorithms derived from cluster analysis that allow identifying objects unlike others and not groupable.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	exam (test)	Knowledge verification based on the content presented in the lecture. The exam consists of both open and closed theory questions.	M_001, M_002, M_003, M_004, M_005, M_006, M_007
W_002	Projects and reports	Developing projects with reports for them within a specified period as a verification of the skills acquired in solving problems.	M_001, M_005, M_006, M_007

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Transferring the content of education in verbal form using audiovisual means and other written teaching aids.	15	Preparation for the exam.	15	W_001
Z_002	laboratory classes	Detailed preparation of students to solve tasks with an indication of the methodology of the procedure, an indication of the order of performed activities.	30	Preparation for the laboratory. Student's independent solution of tasks assigned to the laboratory, preparation of reports	60	W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Procedural Content Generation

Module code: W4-IN-S2-20-F-PGT

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Knows and understands the basic classes of procedural content generation methods, in particular: pseudorandom numbers generators, generative grammars, spatial algorithms, images filtering.	K_W02 K_W04	1 1
M_002	Knows and understands the basic algorithms and data structures used in the procedural content generation, in particular: quadtree, BSP tree, graph search algorithms, Voronoi diagrams.	K_W04	1
M_003	Knows and understands mathematical notions used in the procedural content generation, in particular: partial derivative, graph, linear and non-linear functions of one and multiple variable, fractal.	K_W01	1
M_004	Can obtain information about procedural content generation methods from literature, databases and other sources.	K_U01 K_U07	1 1
M_005	Can work individually and in a team.	K_U02	1
M_006	Can prepare and present a presentation on execution of project's task.	K_U03 K_U04	1 1
M_007	Can think and act creatively.	K_K01 K_K03	1 1

3. Module description

Description	Aim of classes is to introduce to the students the basics methods that are used in procedural content generation, e.g. levels, music, models etc. Besides the methods, the students will familiarize with the ways of procedural generators evaluation. During the course, the students will prepare projects in teams of maximum two and present results of their work in the form of presentation in front of the group.

Prerequisites	

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
W_001	Project	Preparing the project and presentation of the chosen topic connected with procedural content generation.	M_001, M_002, M_003, M_004, M_005, M_006, M_007
W_002	Reports	Solving sets of tasks.	M_001, M_002, M_003, M_005

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
Z_001	lecture	Presenting educational content using audiovisual methods.	15	Independent study of lecture topics and given literature.	15	W_001
Z_002	laboratory classes	Detailed preparation of the students to: (1) the use of various content generation methods for instance in computer games, (2) the development of new methods. Solving programming tasks.	30	Familiarizing with subject of the laboratory. Familiarizing with subject of the project and preparing it in a team. Preparing a presentation of the project.	60	W_001, W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Real-time Graphics

Module code: W4-IN-S2-20-F-GCR

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Knows and understands the principles of real-time graphics, in particular: programmable graphics pipeline, transform feedback transformation, computational shaders.	K_W02 K_W04	1 1
M_002	Knows and understands mathematical notions used in real-time graphics, in particular: cross product, dot product, normal vector, partial derivative, linear interpolation, matrix computations.	K_W01	1
M_003	Knows and understands physical notions used in real-time graphics, in particular: Snell's law, the law of reflection, the basic equations of kinematics.	K_W01	1
M_004	Can use tools that support shaders' writing process and tools for profiling graphical applications.	K_U09	1
M_005	Can obtain information about real-time graphics from literature, databases and other sources.	K_U01 K_U07	1 1
M_006	Can work individually and in a team.	K_U02	1
M_007	Can prepare and present a presentation on execution of project's task.	K_U03 K_U04	1 1
M_008	Can think and act creatively.	K_K01 K_K03	1 1

3. Module description

Description	Aim of the classes is to introduce to the students the graphics generated in real-time with the use of GPU (Graphics Processing Unit). For this aim the libraries such as OpenGL and Vulkan, and the GLSL programming language will be used. The students will become acquainted with the basic

	mathematical and physical notions, and algorithms, which will allow to generate various effects, e.g., realistic lighting, environment mapping, bump mapping. During the course, the students will prepare projects in teams of maximum two and present results of their work in the form of presentation in front of the group.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Project	Preparing the project and presentation of the chosen topic connected with real-time graphics.	M_001, M_002, M_003, M_004, M_005, M_006, M_007, M_008
W_002	Reports	Solving sets of tasks.	M_001, M_002, M_003, M_004, M_006

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Presenting educational content using audiovisual methods.	15	Independent study of lecture topics and given literature.	15	W_001
Z_002	laboratory classes	Detailed preparation of the students to: (1) the creation of applications displaying a complex computer graphics in real-time, (2) the development of suitable algorithms. Solving programming tasks.	30	Familiarizing with subject of the laboratory. Familiarizing with subject of the project and preparing it in a team. Preparing a presentation of the project.	60	W_001, W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Recommendation systems and social networks

Module code: W4-IN-S2-20-F-SRiSS

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Has knowledge about the use and implementation of algorithms used in recommendation systems	K_W01 K_W02 K_W04	1 1 1
M_002	Has knowledge of the operation of recommendation systems and social networks.	K_W02 K_W05 K_W07	1 1 1
M_003	Can choose and implement the appropriate algorithm used in recommendation systems	K_U01 K_U08 K_U09	1 1 1
M_004	Is able to develop a scheme of dealing with data in recommendation systems, aimed at the proper operation of such a system.	K_U03 K_U04 K_U06 K_U09	1 1 1 1
M_005	Is aware of raising their competences through continuous self-improvement	K_K01 K_K02	1 1

3. Module description	
Description	The aim of the module is to familiarize students with recommendation systems, their operating principles and algorithms associated with them. And with social networks and methods of their analysis.
Prerequisites	

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
W_001	Reports	Preparation of written reports, their completion within a specified period as a verification of skills acquired during problem solving.	M_001, M_002, M_003, M_004, M_005
W_002	Final test	Test checking knowledge of the topics covered in lectures.	M_001, M_002, M_005

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
Z_001	lecture	Lectures conducted using multimedia tools, discussing issues related to recommendation systems and social networks.	15	Preparation for laboratories and passing the lecture.	20	W_002
Z_002	laboratory classes	Preparing students to perform lab exercises. Practical presentation of issues discussed during lectures.	30	Preparation for laboratory exercises. Self-solving laboratory exercises.	55	W_001

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Script languages in data analysis

Module code: W4-IN-S2-20-F-JSwAD

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Has knowledge about the use and implementation of algorithms.	K_W02 K_W09	1 1
M_002	Has knowledge of how to analyse data, about the algorithms used in data analysis and how to interpret the results.	K_W04 K_W09	1 1
M_003	Is able to select and implement the appropriate algorithm for data analysis.	K_U08 K_U09 K_U10	1 1 1
M_004	Is able to interpret the result of data analysis and present the results of data analysis motivate the techniques used	K_U03 K_U04 K_U10	2 2 1
M_005	Is able to develop a scheme of data handling, aimed at their correct analysis.	K_U01 K_U02 K_U03	1 1 1
M_006	Is able to implement an automated data analysis system, working individually or in a team.	K_U02 K_U09 K_U10	1 2 3
M_007	Is aware of the impact of algorithms on the results of data analysis	K_K01	1

3. Module description

Description	The aim of the module is to introduce students with the possibilities of advanced data analysis with elements of automation using scripting languages such as Python or R.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Reports	Preparation of written reports, their completion within a specified period as a verification of skills acquired during problem solving.	M_001, M_002, M_003, M_004, M_007
W_002	Project	Development of an individual or group project with documentation of the data analysis system.	M_001, M_002, M_003, M_005, M_006, M_007

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Lectures conducted using multimedia tools, discussing issues related to the analysis and automation of data analysis in scripting languages.	15	Preparation for laboratories and passing the lecture.	20	W_002
Z_002	laboratory classes	Preparing students to perform lab exercises. Practical presentation of issues discussed during lectures.	30	Preparation for laboratory exercises. Self-solving laboratory exercises. Preparation of the final project.	55	W_001, W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Selected graph algorithms

Module code: W4-IN-S2-20-F-WAG

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	He is familiar with the concept, features and types of graphs, including trees.	K_W01 K_W04 K_W09	1 1 1
M_002	Understands the functioning of graph algorithms and trees used to solve selected practical problems.	K_W02 K_W04 K_W09	1 1 1
M_003	Can apply an appropriate algorithm to solve a given problem.	K_U01 K_U08	1 1
M_004	The student is able to construct a solution to a given problem according to a specific algorithm and program it in the chosen programming language.	K_U01 K_U02 K_U03	1 1 1
M_005	The student can work in a project-programming team.	K_K01 K_K03 K_K05	1 1 1
M_006	He knows how to implement graphs, including trees, using tables and pointers.	K_W01 K_W09	1 1
M_007	The student is able to implement graphs and trees using data structures available in particular programming languages.	K_U01	1

		K_U03 K_U04 K_U09	1 1 1

3. Module description	
Description	The aim of the course is to familiarize students with the basic knowledge of graph theory and selected graph algorithms. Practical problems are discussed for which graph representation can be applied and one can solve them by means of appropriate graph algorithms.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Evaluation of presentation and computer implementation	Students develop their own software, the specification of which is given by the teacher, and make presentations on a chosen topic from the given list.	M_001, M_002, M_003, M_004, M_005, M_006, M_007
W_002	Evaluation work	Written mid-term test (including a test performed on a computer during classes)	M_001, M_002, M_003, M_006, M_007
W_003	End-term test	Students answer test questions and describe problems in answering open questions	M_001, M_002, M_003, M_004, M_006, M_007

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Giving the educational content in verbal form with the use of content visualization. Focusing on conceptually difficult material and indicating sources. Illustrating the content using examples.	15	Getting to know the topic of the lecture using the existing packages of methods: manuals, scripts, websites, etc.	30	W_003
Z_002	laboratory classes	Detailed training of students to solve tasks with reference to the methodology of proceeding, showing the sequence of activities performed. Designing solutions and their computer implementation. The students' presentation of their solutions.	30	Solving tasks from particular topics together with analysis of already existing solutions - in materials and on websites. Preparing issues to be discussed or preparing for catching up.	45	W_001, W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Statistical analysis in research

Module code: W4-IN-S2-20-1-ASwPB

1. Number of the ECTS credits: 2

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	The student has knowledge about the average measures, the measures of variability, dispersion, asymmetry, correlation analysis and is able to use them.	K_U03 K_U08 K_W01 K_W09	1 1 1 1
M_002	The student has knowledge about various methods of graphic presentation of qualitative and quantitative data. She\He can choose the appropriate graph for the data and create it.	K_U01 K_W09	1 1
M_003	The student has knowledge about statistical inference. She/He is able to use selected statistical tests to confirm the significance of the hypotheses. She/He can choose the right test depending on the hypothesis and data.	K_U01 K_U03 K_U09 K_W01 K_W09	1 1 1 1 1
M_004	She/He can use the selected program to perform statistical analysis and to confirm the hypotheses. Based on the obtained experimental results, she/he can draw conclusions and confirm their statistical significance.	K_K04 K_U01 K_U03 K_U07	1 1 1 1

3. Module description

Description	

	The purpose of the module is to present the basics of data analysis including: descriptive statistics, graphic methods for the presentation of qualitative and quantitative data, elements of statistical inference. Content: 1. Descriptive statistics: average measures, measures of variability, dispersion, asymmetry, correlation analysis. 2. Graphic methods for the presentation of qualitative and quantitative data: histogram, frequency diagram, scatter plot, box plot. 3. Elements of statistical inference: concepts of the null and alternative hypothesis, significance level and p-value. Selection of test depending on the hypothesis and the data: Student's t test, Wilcoxon test, Friedman test, Kruskal-Wallis test, Fisher test, chi-square test.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Test	Verification of knowledge and skills based on the analysis of tasks solutions during written test.	M_001, M_002, M_003
W_002	Examination reports	Preparation of written reports and their oral presentation at a specified time as a verification of acquired skills during problems' solving.	M_001, M_002, M_003, M_004

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Lecture presenting concepts and facts from the scope of program contents which are listed in the module and illustrating them with numerous examples	15	Self-study of lectures and literature	15	W_001
Z_002	laboratory classes	Laboratory, during which students perform exercises with the help of the teacher, which develop the skills listed in the set of learning outcomes of the module	15	Self-improvement of skills listed in the set of learning outcomes of the module	15	W_001, W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Systemy wspomagania decyzji

Module code: W4-IN-S2-20-F-SWD

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	The student has basic knowledge of decision support systems.	K_K04 K_U01 K_U05 K_U09 K_U10 K_W02 K_W09	1 1 1 1 1 1 1
M_002	The student has basic knowledge in the field of utility theory, the application of deterministic (Hurwicz, Laplace) and non-deterministic criteria (e.g. max. Expected utility) in decision support systems.	K_U01 K_U05 K_U09 K_W02 K_W05	1 1 1 1 1
M_003	The student has basic knowledge of Bayesian networks and their applications in supported decisions	K_U05 K_W01	1 1
M_004	The student has basic knowledge of time series prediction as part of the decision support system.	K_U01 K_W02	1 1
M_005	The student is able to construct decision support systems on the Genie platform based on ordinary and dynamic Bayesian networks, can implement the Java decision support system using the SMILE library.	K_U01 K_U05	1 1

		K_U08 K_U09 K_U10	1 1 1
M_006	The student is able to construct complex decision support systems implemented using the KNIME package, including time series prediction.	K_U01 K_U05 K_U08 K_U09 K_U10	1 1 1 1 1

3. Module description	
Description	The aim of the course is to prepare students for the design and implementation of decision support systems. In addition to the theoretical foundations, the student gains the ability to implement practical systems supporting decisions in the fields of banking, commerce and other.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Solving decision problems.	Solution of three theoretical tasks, also of a computational nature.	M_001, M_002, M_003
W_002	Design and implementation of a decision support system.	Implementation of the decision support system using the selected platform: 1) Genie / SMILE 2) KNIME	M_004, M_005, M_006

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Lecture in form of the slides presentation.	15	Study of lecture notes, compulsory and supplementary literature.	15	W_001
Z_002	laboratory classes	During classes, the lecturer presents and discusses examples of decision support systems implemented in Genie, QGenie and KNIME. Students independently develop the systems indicated by the teacher. students implement two decision support systems on the Genie/SMILE and KNIME toolkits.	30	Students implement two decision support systems based on the GENIE / SMILE and KNIME toolkits.	60	W_001, W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Techniques for optimizing computer programs

Module code: W4-IN-S2-20-F-TOPK

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Has knowledge of the ways in which computations are made in modern computers and how they impact the overall computation time.	K_K01 K_U05 K_U09 K_W02	1 1 1 1
M_002	Has knowledge of programming techniques and tools that allow better use of the computing power offered by modern computers.	K_U01 K_U09 K_W02 K_W03 K_W04	1 1 1 1 1
M_003	Is able to use tools that facilitate diagnostics of performance-related problems in computer programs.	K_U01 K_U05 K_W02 K_W03	1 1 1 1
M_004	He can choose algorithms and data structures to improve the efficiency of computations.	K_U05 K_U09 K_W02 K_W04	1 1 1 1

3. Module description	
Description	The module aims to familiarize students with methods of optimizing the performance of computer programs. Both programming tools and algorithmic solutions will be discussed, taking into account the architecture of modern computers.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Final test.	Students are tested on the knowledge gained during lectures and laboratory classes. The test consists of a number of closed and (optionally) open questions.	M_001, M_002, M_004
W_002	Midterm test.	At least one test assessing the knowledge gained by students during laboratory classes.	M_001, M_002, M_003, M_004
W_003	Programming assignment.	Optional programming assignments verifying the skills acquired during the course.	M_001, M_002, M_003, M_004

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Presentation of the course material in spoken and written forms, supplemented with multimedia content. Emphasizing issues that are more difficult to understand and have deeper theoretical foundations. Engaging listeners by asking questions about the content presented.	15	Reading recommended books and articles. Analysis and repetition of lecture content. Preparation for the final test.	30	W_001, W_002, W_003
Z_002	laboratory classes	Preparation of students to apply the knowledge in programming practice through the presentation of sample programs and programming tools. Discussion of methodology with indication of key steps for the detection, analysis and resolution of performance problems in computer programs.	30	Working on assignments. Studying the recommended literature.	45	W_002, W_003

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: The concept of programming languages

Module code: W4-IN-S2-20-F-KJP

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	The student is familiar with the programming paradigms: procedural programming, object-oriented programming, structured programming, concurrent programming, imperative, functional and declarative programming and their relation to the computer architecture (including parallel and multiprocessor programming).	K_W02 K_W04	1 1
M_002	The student understands basic programming constructions and knows the data types of imperative languages and programming constructions characteristic for declarative and functional approaches.	K_W04 K_W05	1 1
M_003	The student has knowledge concerning the implementation of mechanisms characteristic for a particular programming paradigm in particular programming languages.	K_W02 K_W04 K_W08 K_W09	1 1 1 1
M_004	The student is able to construct a solution to a given problem according to a specific programming paradigm and program it in the chosen programming language.	K_U01 K_U02 K_U03	1 1 1
M_005	The student is able to apply object-oriented, structured, functional and declarative approaches in particular programming languages.	K_U01 K_U02 K_U03	1 1 1
M_006	The student is able to verify the reliability of a computer program by means of testing in the given programming environment and document the program.	K_U01 K_U02 K_U04	1 1 1

		K_U09	1
M_007	The student can work in a project-programming team	K_K01 K_K03 K_K05	1 1 1

3. Module description	
Description	The aim of the course is to supplement students' knowledge of the principles of designing and implementing computer programs in selected languages representing an imperative, functional and declarative approach.Students develop their knowledge and skills in applying various programming paradigms, learning the concepts of programming languages characteristic for these paradigms.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Evaluation of presentation and computer implementation	Students develop their own software, the specification of which is given by the teacher, and make presentations on a chosen topic from the given list.	M_001, M_002, M_003, M_004, M_006, M_007
W_002	Evaluation work	Written mid-term test (including a test performed on a computer during classes)	M_001, M_002, M_003, M_005
W_003	End-term test	Students answer test questions and describe problems in answering open questions	M_001, M_002, M_003, M_004, M_005, M_006

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Giving the educational content in verbal form with the use of content visualization. Focusing on conceptually difficult material and indicating sources. Illustrating the content using examples.	15	Getting to know the topic of the lecture using the existing packages of methods: manuals, scripts, websites, etc.	30	W_003
Z_002	laboratory classes	Detailed training of students to solve tasks with reference to the methodology of proceeding, showing the sequence of activities performed. Designing solutions and their computer implementation. The students' presentation of their solutions.	30	Solving tasks from particular topics together with analysis of already existing solutions - in materials and on websites. Preparing issues to be discussed or preparing for catching up.	45	W_001, W_002

1.	Field of study	Computer Science
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Web applications

Module code: W4-IN-S2-20-F-AI

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Characterizes applications in the client-server architecture - in particular Internet ones, lists the most important elements of the multi-layer structure of this type of application	K_W03 K_W05	1 1
M_002	Defines the concept of network application and application server, characterizes the application requirements for implementation on servers based on various technologies	K_W03 K_W06	1 1
M_003	Distinguishes and describes elements of internet technologies on the selected platform	K_W05 K_W06	1 1
M_004	Characterizes the rules of connecting and using relational database servers in Internet technologies	K_W06 K_W09	1 1
M_005	Describes the structure of the MVC (Model-Viewer-Controller) application - especially in the context of creating database web applications	K_W05	1
M_006	Uses programming environments to create internet projects, creates applications divided into packages / modules, applies appropriate comments	K_U01 K_U03 K_U09	1 1 1
M_007	Creates controllers (request handling objects), handles requests based on the Get and Post methods, installs a network application on the application server and configures the server in the basic scope	K_U01 K_U02 K_U08 K_U09 K_U10	1 1 1 1 1

M_008	Creates web applications based on the selected technology, uses component libraries, uses cookie and session mechanisms	K_K01 K_K02 K_U01 K_U02 K_U09 K_U10	1 1 1 1 1 1
M_009	Uses libraries / modules for communication with the database to implement the data layer, designs and manages the connection to the database from the level of the application itself and the application server	K_U01 K_U09 K_U10	1 1 1
M_010	Uses the MVC (Model-View-Controller) model in database projects created in the selected technology	K_U09 K_U10	1 1
M_011	Is able to work independently, planning the implementation of assigned tasks	K_K01	1

3. Module description	
Description	Aim of the class is gaining a practical basics in development of web applications in the chosen technology (PHP, Java, ASP .NET, Ruby, Python or other). Through practical laboratory class and project development, the students acquire knowledge, skills and competences related to the subject. When the classes are completed, the students should be able to design a web application using database, implement it and deploy on a web server.
Prerequisites	

4. Assessment of the learning outcomes of the module

code	type	description	learning outcomes of the module
W_001	Test	Answers to several questions selected from the thematic groups covering all the sections discussed in class.	M_001, M_002, M_003, M_004, M_005
W_002	Thematic tasks	Implementation of thematic tasks during the labs.	M_006, M_007, M_008, M_009, M_010, M_011
W_003	Project	Project assessment	M_006, M_007, M_008, M_009, M_010, M_011

5. Forms of teaching

code	form of teaching			required hours of student's own work		assessment of the learning outcomes of the module
	type	description (including teaching methods)	number of hours	description	number of hours	
Z_001	lecture	Verbal transmission of theoretical content of the module with support of multimedia and other materials available on the Internet.	15	Studying lecture topics based on available materials.	25	W_001
Z_002	laboratory classes	Introduction to practical aspects of the	30	Solving practical tasks given by the teacher.	50	W_002, W_003

		module domain. Explanation of problems. Supporting students in the implementation of tasks. Discussion of project topics and support during their implementation.		Implementation of the assigned project using the provided documentation sources and laboratory examples.		

1.	**Field of study**	**Computer Science**
2.	Faculty	Faculty of Science and Technology
3.	Academic year of entry	2021/2022 (summer term)
4.	Level of qualifications/degree	second-cycle studies
5.	Degree profile	general academic
6.	Mode of study	full-time

Module: Wireless and sensor networks

Module code: W4-IN-S2-20-F-SBiS

1. Number of the ECTS credits: 4

2. Learning outcomes of the module

code	description	learning outcomes of the programme	level of competence (scale 1-5)
M_001	Student has skills for wireless network design.	K_U03 K_U04 K_W03	1 1 1
M_002	Student has knowledge of ad-hoc and sensor network architecture and communication protocols.	K_W03 K_W05	1 1
M_003	Student has ability to implement the concepts in real world wireless network applications.	K_K01 K_U08 K_W02	1 1 1

3. Module description

Description	The module objective is to give students a knowledge of the ad-hoc and sensor networks that are based on wireless technology, with special attention on their construction and applications. The presented topics are related to components of the wireless networks, energy-efficient standards of data transmission, routing protocols, dedicated operating systems, programming languages, and principles of adopting the network node architecture to specific requirements. Students will gain the abilities to design and configure the wireless networks.
Prerequisites	

4. Assessment of the learning outcomes of the module			
code	**type**	**description**	**learning outcomes of the module**
W_001	Final test	Two-hour test with closed and open questions.	M_001, M_002
W_002	Reports	Presentation of the reports and discussion of the developed projects.	M_001, M_003

5. Forms of teaching						
code	**form of teaching**			**required hours of student's own work**		**assessment of the learning outcomes of the module**
	type	**description (including teaching methods)**	**number of hours**	**description**	**number of hours**	
Z_001	lecture	Lectures supported by multimedia presentations and e-learning	15	Self-study of literature and materials presented during lectures	25	W_001
Z_002	laboratory classes	Assignments in the form of design projects with use of network devices and simulators	30	Solving project assignments and preparing presentations	50	W_002