DESCRIPTION/Syllabi of Curricula/Module

Short Name of the University/Country code Date (Month / Year)	DSEA/P11 Sept 2020
TITLE OF THE MODULE	Code
Computing Intelligence Technologies	

Teacher(s)	Department
Coordinating: Pavlo Sahaida, Dr. Sci. (Engineering), Assoc. Prof. **Others:**	Department of Computer and Information Technology (CIT)

Study cycle (BA/MA)	Level of the module (Semester number)	Type of the module (compulsory/elective)
Masters	2nd semester (1st year) for Masters	Compulsory

Form of delivery (theory/lab/exercises)	Duration (weeks/months)	Language(s)
Lectures, Labs	18 weeks	English/Ukranian

Prerequisites	
Prerequisites:	**Co-requisites (if necessary):**
Knowledge: basic knowledge of Programme, Discrete math, Database design, Intellectual data processing.	none
Skills: C# programming, sending SQL records and procedure storing for MS SQL Server	
Competences: free mailing, data and database management	

ECTS (Credits of the module)	Total student workload hours	Contact hours	Individual work hours
4,5	135	54	81

Aim of the module (course unit): competences foreseen by the study programme

Students should be able:

- to know and use the basic principles of intellectual data processing and hybrid methods of artificial intelligence methods for domain modeling and data processing, including the field of biomedicine;

- to know and use the appropriate mathematical, algorithmic and software support to analyze data and find hidden dependencies and models of behavior of the subject areas, including the field of biomedicine;

- to build models and find dependencies in the behavior of the subject areas with the help of computational intelligence methods, namely, by means of neural networks, systems based on fuzzy inference, neural-fuzzy networks, specialized software;

- to implement intelligent data processing algorithms and user interfaces of integrated computer systems and software systems for using computational intelligence methods in database content processing, including biomedical content.

Learning outcomes of module (course unit)	Teaching/learning methods (theory, lab, exercises)	Assessment methods (written exam, oral exam, reports)
Knowledge: familiarization with the basic principles of intelligent data processing; using hybrid artificial intelligence methods for domain modeling and data processing, including the field of biomedicine.	Working with lecture notes and basic literature on relevant topics	Written exam
Skills: ability to use development tools to create integrated computer systems and software for analytical processing through multidimensional representation of aggregate data, including the field of biomedicine.	Lectures, practical training, consultations	Active attendance of lectures, performing of individual assignments and their presentation
Competences: ability to intelligent multidimensional data analysis and on-line analytical processing (OLAP) to visualize the results of the analysis in the process of solving computer science problems.	Lectures, practical training, consultations	Performing of individual assignments and their presentation

Themes	Contact work hours							Time and tasks for individual work	
	Lectures	Consultations	Seminars	Practiacl work	Laboratory work	Placements	Total contact work	Individual work	Tasks
1. Basic methods and technologies of computational intelligence.	2				2		4	6	General characteristics and directions of the use of computational intelligence methods and technologies. Fuzzy set theory as a mathematical apparatus for processing the results of data collection and measurement in the conditions of uncertainty. Individual student work (*ISW*): Substantiate the feasibility of using fuzzy sets for supporting decision making in the subject area of biomedicine according to an individual task.
2. Basic characteristics of fuzzy sets and operations on them	1				2		3	6	The concept of fuzzy sets. Affiliation functions and methods of their construction. Logical operations on fuzzy sets. Triangular norms and co-norms. Arithmetic operations on fuzzy sets. Fuzzy and linguistic variables. Fuzzy numbers and operations on them. *ISW*: Formulate fuzzy and linguistic variables to support subject-specific decision making in the field of biomedicine.
3. Fuzzy relations and fuzzy rules in knowledge bases	1				2		3	6	Fuzzi relations, methods of their task. Fuzzy relation operations. Fuzzy rules and fuzzy output over fuzzy rule bases. Fuzzy output algorithms for Mamdani, Tsukamoto, Sugeno and Larsen. *ISW*: Build a fuzzy rule base to support subject-specific decision making.

Topic									Content
4. Implementation and use of fuzzy output over rule bases	1				4		5	6	Simplified fuzzy output algorithm and clarity (dephasing) methods. Fuzzy controller. Effectiveness of the decision-making support systems using fuzzy logic. *ISW* tasks: Apply a simplified fuzzy output algorithm to support subject-specific decision making.
5. The basics of organization and conducting Machine learning with the use of artificial neural network (ANN)s	2			2		4		6	General definition of the artificial neural network (ANN). Intelligent data processing tasks solved by ANN. The concept of the biological neuron. Structure and properties of the artificial neuron. Classification of ANNs and their properties. *ISW* task: Justify the choice of ANN to solve the problem of intelligent data processing according to an individual task.
6. ANN training in supervising and non-supervising modes	1				4		5	6	General characteristics of the process of ANN learning. Algorithm for back propagation of an error in the process of ANN training. The process of teaching ANN "without a teacher". Principles of the Kohonen Network working. Principles for the organization and functioning of probabilistic ANN (PNN) and generalized regression ANN (GRNN). *ISW* tasks: Build a generalized regression ANN in accordance with an individual task
7. Peculiarities of using ANN when performing tasks of intelligent data processing	1			2		3		6	Principles of organization and functioning of perceptrons. Using perceptrons to solve classification problems. Principles of organization and functioning of the Hopfield and Heming ANN. Principles of organization

								and functioning of ANNs with radial basis elements (RBE). ANN effectiveness. Advantages and disadvantages of using ANN when performing tasks of intellectual data processing. *ISW* task: Determine the effectiveness of the ANN, which was built in accordance with an individual task.
8. Data processing with the use of hybrid neural-fuzzy networks	1				2		3	6	Basic concepts and definitions of hybrid neural-fuzzy networks (NFN). NFN learning algorithms. NFN using algorithm. A fuzzy conclusion to a base of fuzzy NFN-based rules in the form of an Adaptive Neuro-Fuzzy Inference System (ANFIS). *ISW* task: Build a hybrid neuro-fuzzy network according to an individual task.
9. Development of integrated subsystems of intelligent data processing in biomedicine	2				2		4	6	Organization of data warehouses for multidimensional presentation of data by means of modern client-server DBMS. *ISW* tasks: Organize a data warehouse for multidimensional presentation according to an individual task.
10. Data mining services of modern client-server database management systems (DBMS)	1				2		3	6	Data mining services of modern client-server databases, their architecture and functionality. *ISW* task: Describe the architecture and functionality of the analytical analysis service Analysis Services MS SQL Server.
11. Typical tasks of data analysis based on their multidimensional representation	1				2		3	6	Solving of typical data processing tasks based on their multidimensional presentation (On-line Analytical Processing (OLAP)) by means of data mining tools. *ISW* task:

								Solve the problem of data analysis on the basis of their multidimensional presentation according to an individual task.
12. Integration of data analysis services of modern client-server DBMS with external applications	1				2		3	5	Integration of service data of modern client-server DBMS with the latest applications (for example, MS SQL Server and analysis services). *ISW* task: Provide an integrated data service for the СУБД MS SQL Server DBMS to send mail from my MDX and DMX records in an individual message.
13. Development of data analysis applications with access to the Analysis Services (in MS SQL Server) functionality using Visual Studio	2				4		6	5	Principles of developing data analysis applications with access to Analysis Services functionality and using modern development tools (such as Visual Studio). *ISW* task: Develop an application for data analysis with access to Analysis Services functionality and using Visual Studio.
14. Analysis of the adequacy of models and experience of project implementation for solving Data Mining tasks	1				4		5	5	Architecture and functionality of modern software products for solving Data Mining problems. Interpretation and analysis of the adequacy of the models obtained in the process of solving machine learning tasks. Experience in implementing data analysis projects. *ISW* tasks: Conduct an analysis of implementing an individual project.
Total	18				36		54	81	

Assessment strategy	Weight in %	Deadlines	Assessment criteria
Individual testing during seminars	20	9th and 18th week	Tests
Final exam	80		Knowledge assessment by means of answering theoretical questions and solving practical tasks

Author	Year of issue	Title	No of periodical or volume	Place of printing. Printing house or internet link
Compulsory literature				
Rutkowski L.	2008	Computational Intelligence: Methods and Techniques.		https://www.amazon.com/gp/product/B007GIHE0I/
Witten Ian H., Frank Eibe, Hall Mark A., Pal Christopher J.	2016	Data mining: practical machine learning tools and techniques. – 4rd ed.		https://www.amazon.com/Data-Mining-Practical-Techniques-Management/dp/0128042915/
Harinath S., Quinn S.R.	2006	Professional SQL Server Analysis Services 2005 with MDX		https://www.amazon.com/Principles-Neural-Science-Fifth-Kandel/dp/0071390111
Additional literature				
Барсегян А.А., Куприянов М.С., Степаненко В.В., Холод И.И.	2004	Методы и модели анализа данных: OLAP и Data Mining		СПб.: БХВ
Субботін С.О.	2008	Подання й обробка знань у системах штучного інтелекту та підтримки прийняття рішень : навчальний посібник.		Запоріжжя: ЗНТУ