FUNDAMENTALS OF KNOWLEDGE BASES

СИЛАБУС

Code and name of specialty	122 Computer Science	**Institute / faculty**	Faculty of Computer Science and Software Engineering
Program name	"Computer Science and Intelligent Systems"	**Department**	Software Engineering and Management Information Technologies
Type of program	Educational and Professional	**Language of instruction**	Ukrainian, English

Lecturer

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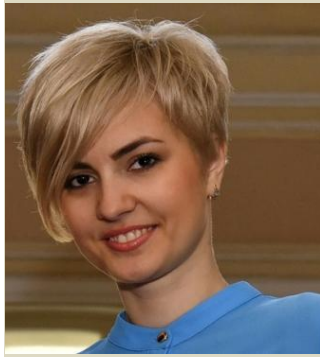

PhD, Candidate of Engineering Sciences (05.13.06 – information technologies), Associate Professor of Department of Software Engineering and Management Information Technologies. Work experience – since 2011. Prepared and published more than 20 publications, 1 collective monographs, 2 articles in publications indexed in Scopus and Web of Science.

https://scholar.google.com.ua/citations?hl=uk&user=jnDzQRAAAAAJ

https://orcid.org/0000-0001-9012-7889

https://www.scopus.com/authid/detail.uri?origin=resultslist&authorId=57190428440&zone=57190428440

Extensive teaching at the university level: Bachelor:

- Artificial intelligence systems (in English),
- Introduction into neural networks (in English and Ukrainian),
- Basics of soft computing theory (in English and in Ukrainian)

GENERAL DESCRIPTION OF THE COURSE

Summary	The course "Fundamentals of the knowledge bases" is a discipline in the cycle of professional training in the specialty 122 "Computer Science". It is taught in the 8 semester in the amount of 90 hours (3 ECTS credits), in particular: lectures - 20 hours, laboratory classes - 10 hours, independent work - 60 hours. There is an individual task (project course). The study of the discipline ends with a test. The course aims to form students' general understanding of the principles of expert systems development, models of knowledge representation and modern expert systems.
Course objectives	To represent the systematic review of modern knowledge representation models,to study and master the principles of the expert systems construction, to consider the perspective directions of artificial intelligence and decision making systems development.
Types of classes and control	Lectures, laboratory classes. Current control - laboratory work, intermediate modular control. Final control – credit.
Term	8

Student workload (credits) / Type of course (mandatory / elective)	3/ mandatory	Lectures (hours)	20	Workshops (hours)	10	Self-study (hours)	60

Program competences	GC1. Ability to abstract thinking, analysis and synthesis. GC2. Ability to apply knowledge in practical situations. GC3. Knowledge and understanding of the subject area and understanding of professional activity. GC6. Ability to learn and master modern knowledge. GC7. Ability to search, process and analyze information from various sources. PC9. Ability to implement a multi-tier computing model based on the client-server architecture, including databases, knowledge bases, and data warehouses, perform distributed processing of large data sets on clusters of standard servers to meet the computing needs of users, including cloud services. PC11. Ability to conduct intelligent data analysis based on methods of computational intelligence, including large and poorly structured data, their operational processing and visualization of analysis results in the process of solving applied problems.

Learning outcomes	Teaching and learning methods	Forms of assessment (continuous assessment CAS, final assessment FAS)
PLO10. Use tools for developing client-server applications, design conceptual, logical, and physical models of databases, develop and optimize database queries, create distributed databases, repositories and showcases of databases, and knowledge bases, including those based on cloud services, using web programming languages. PLO12. Apply methods and algorithms of computational intelligence and intelligent data analysis in the tasks of classification, prediction, cluster analysis, search for associative rules using software tools to support multidimensional data analysis based on technologies DataMining, TextMining, WebMining.	In the process of teaching is used such initial technologies as: lectures, laboratory work, presentations that develop communication and leadership skills, independent work with literary sources, mixed forms of learning using distance platforms	**Current CAS assessment:** Assessment of students' work in the laboratory Intermediate modular control **Final FAS assessment:** Credit

ASSESSMENT AND GRADING

Ranges of points corresponding to grades	Total score (points) for all types of learning activities	ECTS grading scale	The national grading scale	Allocation of grade points	
	90-100	A	Excellent		**100% final assessment** in the form of credit **(30%)** and current assessment **(70%).** **30%** credit **70%** current rating: Module №1 (10%) Module №2 (20%) Laboratory work (40%)
	82-89	B	Good		
	74-81	C			
	64-73	D	Satisfactory		
	60-63	E			
	35-59	FX	Unsatisfactory (with the exam retake option)		
	0-34	F	Unsatisfactory (with mandatory repetition of the course)		

Course policy	The student is required to attend all classes according to the curriculum and adhere to the norms of academic ethics. To study the discipline you need to have your own personal computer and / or use the computers of the computer center of the department. The student must work with required and additional literature, including information resources on the Internet. All laboratory work must be completed and submitted by the student during the semester in which the discipline is taught, before the start of the test week. Without the personal presence of the student the final control is not carried out.

COURSE STRUCTURE AND CONTENT

Lecture 1	Introduction The purpose and objectives of the discipline, its role and place in the general system of specialist training. Representation of knowledge in information systems as an element of artificial intelligence and new information technologies. The stages of creating artificial intelligence. Thinking process. Basic concepts and classification of knowledge-based systems. Knowledge acquisition principles.	**Laboratory work 1-2**	Development of an expert system based on fuzzy logic	**Individual work**	Elaboration of lectures, review of recommended literature, preparation for laboratory classes, preparation of reports on laboratory work
Lecture 2-3	Models of knowledge representation Logical model of knowledge representation and inference rules. Production model of knowledge representation and rules for their processing. Conclusions based on production rules. The theory of frames and frame systems. Objects with frames. The main attributes (slots) of the object. Procedural frames and slots. Representation of knowledge in the form of a semantic network. Bulletin board model. Model of knowledge representation in the form of a script.				Elaboration of lectures, review of recommended literature, preparation for laboratory classes, preparation of reports on laboratory work
Lecture 4	Architecture and technology for the development of expert systems. Introduction to expert systems. Roles of an expert, knowledge engineer and user. General description of expert systems architecture. Knowledge base, rules, inference engine, user interface, tools for working with files. Expert systems development technology. Logic programming and expert systems. Artificial Intelligence	**Laboratory work 3-4**	Testing the operation of the genetic algorithm		

	Languages. Subsystem for analysis and synthesis of input and output messages. Dialogue subsystem. Explanatory abilities of expert systems.				
Lecture 5-6	Application of fuzzy logic in expert systems. The concept of fuzzy sets and their relationship with the theory of constructing expert systems. Confidence Coefficients. Weighing the evidence. Likelihood ratio of hypotheses. Membership function of an element to a subset. Operations on fuzzy sets. Defazification of a fuzzy set. Fuzzy inference rules in expert systems.				
Lecture 7-8	Genetic algorithm in optimization problems The concept of a genetic algorithm. Stages of the genetic algorithm. Information coding and population formation. Population estimation. Selection. Crossbreeding and the formation of a new generation. Mutation. Setting the parameters of the genetic algorithm. Canonical genetic algorithm. An example of how a genetic algorithm works. Recommendations for the software implementation of the genetic algorithm. Application of a genetic algorithm for solving optimization and approximation problems.				Elaboration of lectures, review of recommended literature, preparation for laboratory classes, preparation of reports on laboratory work
Lecture 9-10	Artificial neural networks in information processing The concept of neural network systems. Biological neural networks. Formal neuron. Artificial neural networks. Neural network training. Backpropagation algorithm. An example of working and training a neural network. Software implementation. Application of neural networks for solving problems of approximation, classification, automatic control, recognition and prediction. Multi-agent systems	**Laboratory work 5**	Construction and analysis of the neural network		
RECOMMENDED READING					

Compulsory	1. Harmelen F., Frank van Harmelen, Vladimir Lifschitz, Bruce Porter (2008) Handbook of Knowledge Representation. 2. Stefan Kojouharov (2019) Downloadable: Cheat Sheets for AI, Neural Networks, Machine Learning, Deep Learning & Data Science, PDF March Retrieyeved from: URL: https://becominghuman.ai/cheat-sheets-for-ai-neural-networks-machine-learning-deep-learning-big-data-science-pdf-f22dc900d2d7 3. Mohan Chandler (2019) AN INTRODUCTION TO FUZZY SET THEORY AND FUZZY LOGIC (Second Edition). 4. Eiben A.E., Smith, J.E. (2015) Introduction to Evolutionary Computing (Second Edition) New York. 5. Haykin S. (2009) Neural Networks and Learning Machines (Third Edition) 6. Samui P., Sanjiban Sekhar Roy, Valentina Balas (2017) Handbook of Neural Computation (1st Edition) Academic Press.	**Recommended**	1. Coley D.A. (1999) An Introduction to Genetic Algorithms for Scientists and Engineers, World Scientific Publishing, Singapore. 2. Voskoglou, M. (2020) Fuzzy Sets, Fuzzy Logic and Their Applications, Mathematics, Switzerland. 3. Timothy J. Ross, Graupe D. (2010) FUZZY LOGIC WITH ENGINEERING APPLICATIONS UK., Advanced Series in Circuits and Systems: Volume 8, Principles of Artificial Neural Daniel Graupe (2019) Networks, Basic Designs to Deep Learning (4th Edition) /, University of Illinois, Chicago. Retriyeved from: https://doi.org/10.1142/11306
Academic integrity			
The student must adhere to the Code of Ethics of Academic Relations and Integrity of NTU "KhPI": to show discipline, politeness, friendliness, honesty, responsibility			
The content of this syllabus is consistent with the course program.			