KNOWLEDGE REPRESENTATION MODELS

COURSE SYLLABUS

Code and name of specialty	121 Software Engineering 122-Computer Science 126-Information Systems and technologies	**Institute / faculty**	**Computer Sciences and Software Engineering**
Program name	Software Engineering Computer Science and Intelligent Systems Information Systems Software	**Department**	Software Engineering and Management Information Technologies
Type of program	**Educational and Professional**	**Language of instruction**	**Ukrainian**

LECTURER

Olga CHEREDNICHENKO ***Olga.Cherednichenko@khpi.edu.ua***

Doctor of Engineering Sciences, Professor of SEMIT Department. Working experience 23 years.
Number of scientific and educational publications is more then 70.
Scientific interests: methodological bases of information technologies of actual information monitoring, artificial intelligence, multiagent systems.
Courses taught: "Software of intelligent systems", "Models of artificial intelligence", "Modern models and methods of artificial intelligence"

GENERAL DESCRIPTION OF THE COURSE

Summary	The discipline is aimed at forming the knowledge, skills and abilities necessary for the use of modern methods and means of presenting knowledge to solve problems in the field of professional activity. Systems and methods of knowledge presentation and tools for their development and use are considered.
Course objectives	The purpose of the discipline is to study modern information technology, methodological and practical foundations of knowledge representation. Formation of theoretical bases for the use of intelligent information technologies to solve problems in the professional sphere.
Types of classes and control	Lectures, laboratory classes, seminars. Final assessment – credit test
Term	4

Student workload (credits) / Type of course	6 / Elective	**Lectures (hours)**	32	**Laboratory classes (hours)**	32	**Self-study (hours)**	116

Program	121-GC 01. Ability to abstract thinking, analysis and synthesis.

competences	121-GC 02. Ability to apply knowledge in practical situations. 121-GC 05. Ability to learn and master modern knowledge. 121-GC 06. Ability to search, process and analyze information from various sources. 121- PC20. Ability to apply fundamental and interdisciplinary knowledge to successfully solve software engineering problems. 122-GC1. Ability to abstract thinking, analysis and synthesis. 122-GC2. Ability to apply knowledge in practical situations. 122-GC3. Knowledge and understanding of the subject area and understanding of professional activity. 122-GC6. Ability to learn and master modern knowledge. 122-GC7. Ability to search, process and analyze information from various sources. 122- PC6. Ability to think systematically, apply the systems analysis methodology to study complex problems of different nature, methods of formalization and solution of system problems with conflicting goals, uncertainties, and risks. 126-GC 1. Ability to abstract thinking, analysis and synthesis. 126-GC 2. Ability to apply knowledge in practical situations. 126-GC 3. Ability to understand the subject area and professional activity. 126-GC 5. Ability to learn and master modern knowledge. 126-GC 6. Ability to search, process and summarize information from various sources. 126-PC 11. Ability to analyze, synthesize and optimize information systems and technologies using mathematical models and methods.

Learning outcomes	Teaching and learning methods	Forms of assessment (continuous assessment CAS, final assessment FAS)
121-PO05. Know and apply relevant mathematical concepts, methods of domain, system and object-oriented analysis and mathematical modelling for software development.	lectures, laboratory work, work in small groups, brainstorming, presentations, independent work with literary sources; methods of project-based learning and challenge-based learning in the training laboratory Innovation Campus of the Department of SEMIT NTU "KhPI"; mixed forms of learning using distance platforms	Oral and written tests, credit test.
121- PLO17. Apply for the construction of intelligent management systems theoretical and practical foundations of modern management theory, design intelligent systems using modern information processing technologies and methods of computational intelligence.	lectures, laboratory work, work in small groups, brainstorming, presentations, independent work with literary sources; methods of project-based learning and challenge-based learning in the training laboratory Innovation Campus of the Department of SEMIT NTU "KhPI"; mixed forms of learning using distance platforms	Oral and written tests, credit test.
126- PLO 4. Conduct a systematic analysis of design objects and justify the choice of structure, algorithms and methods of information transfer in information systems and technologies.	lectures, laboratory work, work in small groups, brainstorming, presentations, independent work with literary sources; methods of project-based learning and challenge-based learning in the training laboratory Innovation Campus of the Department of SEMIT NTU "KhPI"; mixed forms of learning using distance platforms	Oral and written tests, credit test
126- PLO 6. Demonstrate knowledge of the current level of information systems technology, practical skills of programming and use of applied and specialized computer systems and environments for their	lectures, laboratory work, work in small groups, brainstorming, presentations, independent work with literary sources; methods of project-based learning and challenge-based learning in the training laboratory Innovation Campus of the Department of SEMIT NTU	Oral and written tests, credit test

implementation in professional activities.	"KhPI"; mixed forms of learning using distance platforms	

ASSESSMENT AND GRADING

	core (points) for all types of learning activities	ECTS grading scale	The national grading scale		
Ranges of points corresponding to grades	90-100	A	excellent	**Allocation of grade points**	**100% Final assessment** as a result of credit test (40%) and Current assessment (60%). **30% Final exam** **70% Current assessment**
	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

COURSE STRUCTURE AND CONTENT

Lecture 1	Artificial intelligence as a scientific field. The main areas of research. Expert systems and their characteristics.	**Laboratory work 1**	Analysis of parameters by which the level of intelligence of complex systems is estimated.	**Self-study**	Analysis of the reasons for the spread of intelligent control systems. Basic classes of intelligent information systems. Modern software and tools for creating artificial intelligence systems. Fuzzy sets and fuzzy logic. Examples of the use of fuzzy logic. Expert systems: purpose and principles of construction; generalized architecture; classes of problems that are solved with the help of expert systems. History of artificial neural network creation. Principles of building expert systems Random search method. Methods of building multiagent systems. Interaction of agents in multiagent systems. Tools for building multiagent systems. Agent infrastructure: ontologies, communication protocols, interaction protocols. Varieties of software agents in the MAC: facilitators, mediators, brokers, matchmakers, blackboards, local coordinators, etc.
Lecture 2	History of artificial intelligence systems. Differences between intelligent control systems and traditional systems.	**Laboratory work 2-4**	Development of a knowledge representation model. Search in the state space.		
Lecture 3	The concept of intelligent systems, basic properties. Representation of knowledge as a direction of research on artificial intelligence. Modern models of knowledge representation.				
Lecture 4	Data and knowledge. Distinctive features of knowledge.				
Lecture 5	Languages of description and data manipulation. Models of knowledge representation in intelligent systems: a comparative characteristic.	**Laboratory work 5-8**	Development of a database of facts and rules of the intelligent system.		
Lecture 6	Representation of knowledge by means of logic. Production model of knowledge representation Frame model. Model of knowledge representation in the form of a				

	semantic network.				
Lecture 7	Presentation of knowledge by rules. Product structure. Basic requirements for the language of presentation of knowledge of the intelligent system.				
Lecture 8	Direct and inverse conclusion. Conflict resolution. Analysis of the context of application of rules.				
Lecture9	Frame concept. Features of frame representation of knowledge. Basic properties of Frames. Slots. Frame systems.	**Laboratory work 9-12**	Development of an output algorithm. Analysis of the production model of knowledge representation.		
Lecture 10	Features of knowledge representation in the form of a semantic network. Examples of application. Comparative analysis of knowledge representation models.				
Lecture 11	Models of knowledge representation based on fuzzy logic. The concept of fuzzy inference. Examples of typical fuzzy conclusions. Fuzzy expert systems.				
Lecture 12	Neural network model of knowledge representation. The process of learning neural networks. Reference data				
Lecture 13	Agents: concepts, properties and classification.	**Laboratory work 13-16**	Agent architecture and its main components: interface with the outside world; components of behavior; planning components; components responsible for cooperation and knowledge bases		
Lecture 14	Multiagent systems: essence, elements of realization and advantages				
Lecture 15	Use of multiagent systems to solve practical problems				
Lecture 16	Models of knowledge representation and knowledge base. Practical aspects of knowledge base design. Perspective				

	directions of application of knowledge-oriented methods of software systems development.				

RECOMMENDED READING

Compulsory

1. Чередніченко, О. Ю., Орловський, Д. Л., Копп, А. М. (2017). Методичні вказівки для самостійної роботи з курсу «Теорія інтелекту»: для студ. спец. 121 «Інженерія програмного забезпечення» / Харків. політех. ін-т, нац. техн. ун-т. Харків: НТУ «ХПІ», 76 с.
2. Іванченко, Г. Ф. (2014). Прикладні системи штучного інтелекту: навч. посібник. Київ: КНЕУ, 630 с.
3. Субботін, С. О. (2008). Подання й обробка знань у системах штучного інтелекту та підтримки прийняття рішень: навч. посібник. Запоріжжя: ЗНТУ, 341 с.
4. Нікольський, Ю. В., Пасічник, В. В., Щербина, Ю. М. (2010). Системи штучного інтелекту: навч. посібник / за наук. ред. В. В. Пасічника. Львів: Магнолія 2006, 279 с.

Recommended

1. Субботін, С. О., Олійник, А. О., Олійник О. О. (2009). Неітеративні, еволюційні та мультиагентні методи синтезу нечіткологічних і нейромережних моделей: монографія / за заг. ред. С. О. Субботіна. Запоріжжя: ЗНТУ, 375 с.
2. Wooldridge, Michael & Nicholas, R. (1995). Jennings, Agent Theories, Architectures and Languages: a Survey, inWooldridge and Jennings. Eds. Intelligent Agents. Berlin. *Springer*. Verlag.
3. Genesereth Michael, Chaudhri Vinay K. (2020). Introductionto Logic Programming Genesereth Michael, (Synthesis Lectures on Artificial Intelligence and Machine Learning). Morgan & Claypool, 220 p.
4. Гамаюн, І. П., Чередніченко, О. Ю., Єршова С. І. та ін. (2019). Аналіз та моделювання проблемно-орієнтованих програмних систем: навч. посібник для студентів спец. 121 – Інженерія програмного забезпечення, спец. 122 – Комп'ютерні науки. Харків: ФОП Черняк Л. О., 179 с.
5. Yaroslav Hnatchuk, Alina Hnatchuk, Maryan Pityn, Ivan Hlukhov, Olga Cherednichenko. (2021). Intelligent Decision Support Agent Based on Fuzzy Logic in Athletes 'Adaptive E-Learning Systems. *2nd International Workshop on Intelligent Information Technologies and Systems of Information Security* (March 24-26, 2021, Khmelnytskyi, Ukraine). Khmelnytskyi, 8 p.

Academic integrity

Graduate students are expected to adhere to the Code of Ethics of Academic Relations and Integrity" of NTU "KhPI".

The content of this syllabus is consistent with the course program.