RTU Course "Fundamentals of Artificial Intelligence"

12309 null

General data

Code	DSP332
Course title	Fundamentals of Artificial Intelligence
Course status in the programme	Compulsory/Courses of Limited Choice; Courses of Free Choice
Course level	Undergraduate Studies
Course type	Academic
Field of study	Computer Science
Responsible instructor	Alla Anohina-Naumeca
Volume of the course: parts and credits points	1 part, 3.0 Credit Points, 4.5 ECTS credits
Language of instruction	LV, EN, RU
Annotation	Artificial intelligence is a sub-field of computer science that deals with the design and development of such computer systems that possess characteristics (ability to understand, solve problems, infer, learn, etc.) related to the intelligence in human behaviour. Last decades influence of artificial intelligence on society is growing extremely quickly: speech recognition and natural language processing technologies, strategic planning and diagnosis, process and systems control and management, computer vision and authentication, information retrieval and data mining are only some directions where progress is impossible without artificial intelligence. Such a quickly growing role of artificial intelligence in the modern and future society determines the necessity for academically educated specialists, which have mastered fundamentals of artificial intelligence, know its perspectives and have experience in solving problems of artificial intelligence. This course focuses on two fundamental research objects of artificial intelligence: solution search and knowledge representation. The main attention is paid to the construction of a state space of a problem and searching a solution using uninformed and heuristically informed search algorithms, as well as representing knowledge about a problem using different knowledge representation schemas. Implementation of two-person games with full information is used as a practical application of all concepts and algorithms taught in the course. During the semester, students working in class in pairs or small groups solve practical tasks with the aim of strengthening mastered knowledge.
Goals and objectives of the course in terms of competences and skills	The goal of the course is to develop students' knowledge system on fundamental objects of artificial intelligence (search and knowledge representation) and to develop skills of solving complex problems using such methods of artificial intelligence as the construction of a state space, uninformed search algorithms, heuristically informed search algorithms, and knowledge representation schemes
Structure and tasks of independent studies	During the semester, students should independently study offered information sources, lecturer's prepared lecture notes, and animated examples of the algorithms taught in the course, as well as to complete self-assessment tests available in the e-course while preparing to practical tasks and assessments
Recommended literature	•Mueller J. P., Massaron L. (2018). Artificial Intelligence For Dummies. For Dummies, 336 p. •Ertel W., Black N.T. (2018). Introduction to Artificial Intelligence, Springer, 356 p. •Kaplan J. (2016). Artificial Intelligence: What Everyone Needs to Know. Oxford University Press, 2016, 192 p. •Lucci S., Kopec D. (2012). Artificial Intelligence in the 21st Century. Mercury Learning & Information, 2012, 590 p. •Negnevitsky M. (2011). Artificial Intelligence: a Guide to Intelligent Systems. Pearson Education Canada, 2011, 504 p. •Hopgood A. A. (2011). Intelligent Systems for Engineers and Scientists, CRC Press, 451 p. •Jones T.M. (2009). Artificial Intelligence: A Systems Approach. Jones & Bartlett Learning, 2009, 498 p. •Luger G.F. (2009). Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Education, 784 p. •Coppin B. Artificial Intelligence Illuminated, Jones and Bartlett Publishers, 2004, 739 p.
Course prerequisites	Students must know characteristics and processing capabilities of different data structures such as lists, stacks and queues, implementation methods of recursive algorithms, sets and set operations, relations, their types and characteristics, basic concepts of graph theory and special graph types - trees and networks

Course outline

Theme	Hours
Definitions, goals, approaches, tasks, methods, and research objects of artificial intelligence	2
Research history of artificial intelligence	2
Achievements of artificial intelligence in specific fields	2
Definition of a state space. Interpretation and examples of state space elements	2
Game tree as an application of state space	4
Search and backtracking algorithm	2
Data- and goal-driven state space search	2

Uninformed search algorithms (Breadth-first search, Depth-first search, Bidirectional search, Depth-limited search)	4
Heuristically informed search and complexity of state space	2
Heuristically informed search algorithms (Hill climbing, Best-first search, Beam search)	4
Algorithms for implementation of two-persons games with perfect information (Minimax algorithm, Alpha-beta pruning, Iterative deepening method, N-ply look ahead)	4
General principles of knowledge representation	2
Semantic networks	2
Conceptual graphs	2
Frames	2
Scripts	2
Production systems	2
Logical knowledge representation schemes (propositional and predicate calculus)	6

Learning outcomes and assessment

Learning outcomes	Assessment methods
Students will know definition categories of artificial intelligence, Turing test, goals, approaches, tasks, methods, and research objects of artificial intelligence	Assessment 1, theoretical questions of the exam
Students will know definitions, elements, and characteristics of state space and game tree, general principles of search, search directions, implementation principles of uninformed search algorithms	Assessment 2, theoretical questions of the exam
Students will be able to create a game tree for two-person game with perfect information	Practical task 1, a practical task of the exam
Students will be able to implement uninformed search algorithms	Practical task 2, a practical task of the exam
Students will know definitions and application of heuristic knowledge, constituent parts of heuristic evaluation function, principles of calculation of state space complexity and methods of reducing it, implementation principles of heuristically uninformed search and game algorithms	Assessment 3, theoretical questions of the exam
Students will be able to define a heuristic evaluation function, as well as to implement heuristically informed search algorithms	Practical task 3, a practical task of the exam
Students will be able to apply the Minimax algorithm and the Alpha-Beta pruning for the implementation of two-person games with perfect information	Practical task 4, a practical task of the exam
Students will know what is a knowledge representation, knowledge base, inference engine, as well as elements, representation rules, advantages, and drawbacks of different knowledge representation schemes	Assessment 4, theoretical questions of the exam
Students will be able to represent domain knowledge using different knowledge representation schemes	Practical task 5, a practical task of the exam

Study subject structure

Part	CP	Hours per Week			Tests			Tests (free choice)		
		Lectures	Practical	Lab.	Test	Exam	Work	Test	Exam	Work
1.	3.0	3.0	0.0	0.0		*		*		