GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Computational Intelligence, PG_00064252		
Field of study	Automatic Control, Cybernetics and Robotics		
Date of commencement of studies	February 2026	Academic year of realisation of subject	2025/2026
Education level	second-cycle studies	Subject group	Optional subject group Specialty subject group Subject group related to scientific research in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	1	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Decision Systems and Robotics -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Tomasz Białaszewski	
	Teachers	dr inż. Tomasz Białaszewski	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	15.0	0.0	0.0	0.0	30

E-learning hours included: 0.0

Learning activity and number of study hours

Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
Number of study hours	30	4.0	16.0	50

Subject objectives

Widening the students knowledge about the selected methods of artificial intelligence

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W01] knows and understands, to an increased extent, mathematics to the extent necessary to formulate and solve complex issues related to the field of study	Student explains the genetic programing method	[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge
[K7_W03] knows and understands, to an increased extent, the construction and operating principles of components and systems related to the field of study, including theories, methods and complex relationships between them and selected specific issues - appropriate for the curriculum	Student explains learning methods of parameters of Bayesian networks	[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge
[K7_U03] can design, according to required specifications, and make a complex device, facility, system or carry out a process, specific to the field of study, using suitable methods, techniques, tools and materials, following engineering standards and norms, applying technologies specific to the field of study and experience gained in the professional engineering environment	Student apply radial artificial neural networks in machine learning problems Student prepares programs in the LISP language	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment

Subject contents	Course content – lecture 1. Organization of the course and assessment criteria 2. Modern research trends in computational intelligence symbolic and connectionist paradigms 3. Overview of scope and schedule of lectures, practice and laboratory 4. LISP introduction 5. LISP advanced construction of language 6. LISP application in artificial intelligence 7. Genetic programming basic algorithms 8. Genetic programming representation of programs in LISP language 9. Genetic programming examples and application 10. Bayesian networks inference methods 11. Bayesian networks parameters learning 12. Bayesian networks parameters learning with incomplete data 13. Bayesian networks structure learning 14. Radial artificial neural networks - basic concepts 15. Radial artificial neural networks - applications in machine learning problems.
	Course content – exercises 1. Presentation of the schedule, forms of class activities, assessment criteria, and requirements for course completion. 2. Introduction to the syntax of the LISP programming language, prefix notation, the structure of S-expressions, and list operations. 4. Definition of functions, recursion, macros, and the use of higher-order functions in problem modeling. 5. Examples of LISP applications in knowledge representation, rule-based systems, and symbolic processing. 6. Discussion of the basic operators of genetic programming (selection, crossover, mutation) and the general scheme of an evolutionary algorithm. 7 .Representation of programs as tree structures (S-expressions) and implementation of genetic operators on list-based structures. 8. Applications of genetic programming in symbolic regression, classification, and optimization problems. 9. Introduction to Bayesian networks as graph-based probabilistic models and the principles of probabilistic inference.109. Parameter estimation in Bayesian networks based on complete data using statistical methods.

	10. Application of the ExpectationMaximization (EM) algorithm for parameter estimation in the presence of missing data. 11. Methods for searching and evaluating graph structures in the process of building a Bayesian network model. 12. Methods for learning the structure of Bayesian networks. 13. Architecture of Radial Basis Function (RBF) networks, basis functions, and methods for determining their parameters. 14 Implementation of RBF networks. 15. Application of RBF networks in classification, regression, and function approximation problems in machine learning.
Prerequisites and co-requisites	No requirements
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
Tutorials	50.0%	50.0%
Exam	50.0%	50.0%

Recommended reading	Basic literature	1. Neapolitan R.:Learning Bayesian Networks, Prentice Hall, 2003 2. Koza J., et al: Genetic Programming IV, Spriger, 2005 3. http://www.scheme.com/tspl4/ The Scheme Programming LanguageFourth Edition R. Kent Dybvig 4. https://racket-lang.org/ 5. http://www.genetic-programming.org/ 6. https://www.mathworks.com/help/deeplearning/ug/radial-basisneural-networks.html
	Supplementary literature	https://htdp.org/
	eResources addresses	
Example issues/ example questions/ tasks being completed		1. Explain a mechanism of mutation by changing the intermediate node in genetic programming?. Showan example of the situation. Write a mutant program as a s-expressions of LISP. 2. Define the procedure power-list, which takes a nonnegative integer n and an list of numbers and returns a new list, each element of which is the number of the power n 3. Explain the Bayes network parameter learning algorithm for incomplete data.
Practical activites within the subject	Not applicable	

Document generated electronically. Does not require a seal or signature.