



Subject card

Subject name and code	Artificial intelligence, PG_00064056						
Field of study	Technical Physics						
Date of commencement of studies	October 2026	Academic year of realisation of subject				2027/2028	
Education level	first-cycle studies	Subject group				Optional 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	2	Language of instruction				Polish	
Semester of study	4	ECTS credits				3.0	
Learning profile	general academic profile	Assessment form				assessment	
Conducting unit	Division of Theoretical Physics and Quantum Informaton -> Institute of Physics and Applied Computer Science -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Paweł Syty					
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	0.0	0.0	15.0	45
	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	45	4.0		26.0	75	
Subject objectives	The aim of the course is to familiarize students with the scope of research and basic methods of artificial intelligence, including automatic reasoning, two-player game strategies, evolutionary algorithms, machine learning, neural networks, and cellular automata, along with their principles of operation and applications.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K6_U08] communicates effectively using specialist terminology in physics and related disciplines, enabling the preparation of reports, publications or presentations, as well as participation in discussion and expression of opinions.	The student is able to prepare and present a presentation on a selected topic related to artificial intelligence issues.			[SU5] Assessment of ability to present the results of task [SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information		
	[K6_W01] demonstrates an understanding of the civilisational significance of physics and its applications.	The student is aware of the significance of artificial intelligence methods in today's world, including both the opportunities and the risks.			[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation		
	[K6_W03] possesses structured knowledge of higher mathematics, including algebra, analysis, probability and numerical methods, sufficient to describe, understand and model complex physical phenomena and selected technical processes.	The student has knowledge of the mathematical foundations of selected artificial intelligence algorithms and methods and is able to apply this knowledge to the modelling of technical processes.			[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation		
	[K6_W07] is familiar with the basic economic, legal and ethical conditions of engineering activity, including principles of intellectual property protection and entrepreneurship.	The student is familiar with the economic, legal and ethical considerations associated with the development of systems based on artificial intelligence methods.			[SW1] Assessment of factual knowledge		

Subject contents	<p>Course content – lecture</p> <ol style="list-style-type: none"> <li>1. The importance of intelligence. Natural and artificial intelligence. The scope of research into artificial intelligence.</li> <li>2. Inference. The syntax and semantics of the language of logic. Construction of automated reasoning.</li> <li>3. Language PROLOG inference system as an example, the realization of the principle of automatic inference, sample predicates. PROLOG as a declarative language.</li> <li>4. Genetic algorithms. Encoding function adaptation, mating, mutation. Applications of genetic algorithms to solve NP problems.</li> <li>5. Fuzzy logic. The role of imperfect knowledge in the inference. Bayesian inference.</li> <li>6. Inference as the task of searching space. A review of selected strategies search space: search in depth and breadth of the growth method, random walk, simulated annealing.</li> <li>7. Doubles game strategies. MINMAX algorithm and alpha-beta pruning.</li> <li>8. Inductive inference. Discussion of conditional attribute properties. The principle of learning from the teacher. Error function. The problem of generalization. Role trenującego and test set.</li> <li>9. Methods for construction of decision trees.</li> <li>10. Machine learning and Neural Networks. The problem of multilayer perceptron learning.</li> <li>11. Recursive neural networks - Hopfield network, Boltzmann machine. Self-organizing maps - Kohonen networks.</li> <li>12. With reinforcement learning as a method of approximation of functions. Discussion of features.</li> <li>13. Selected applications of neural networks.</li> <li>14. Introduction to cellular automata. Gödel's theorem. Turing machine.</li> <li>15. Applications of artificial intelligence in the media. Image recognition, speech and speakers.</li> </ol>
	<p>Course content – seminar</p> <p>As part of the project, students develop topics directly related to the lecture subject matter. Some topics are purely theoretical, while others require programming. Examples of topics to be developed:</p> <ul style="list-style-type: none"> <li>- Expert systems.</li> <li>- Artificial intelligence in the automotive industry.</li> <li>- Artificial intelligence in computer games.</li> <li>- Programming in Prolog. Application of the language to solving logical tasks.</li> <li>- Combating spam using a Bayesian classifier.</li> <li>- Artificial intelligence - opportunities and threats.</li> </ul>

	<ul style="list-style-type: none"> <li>- Neural networks in practice.</li> <li>- Modeling traffic and gas dispersion using cellular automata.</li> <li>- Kalman filtering.</li> <li>- Gödel's theorem.</li> </ul>		
Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Interview	50.0%	60.0%
	Presenting a talk	50.0%	40.0%
Recommended reading	Basic literature	Mordechai Ben-Ari, Mathematical Logic for Computer Science, 3rd ed., Springer, 2012 Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow, 3rd ed., O'Reilly, 2022 Tom M. Mitchell, Machine Learning, McGraw-Hill, 1997 Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow, 3rd ed., O'Reilly, 2022 David E. Goldberg, Genetic Algorithms in Search, Optimization, and Machine Learning, Addison-Wesley, 1989	
	Supplementary literature	U. Nilsson, J. Maluszynski, Logic, Programming and Prolog (2nd ed.), John Wiley & Sons Ltd, NY, 2000  Simon Haykin, Neural Networks and Learning Machines, 3rd ed., Pearson, 2009	
	eResources addresses		
Example issues/ example questions/ tasks being completed	Lecture: Methods of teaching neural networks.  Seminar: Application of the Prolog language to solving logical tasks.		
Practical activities within the subject	Not applicable		

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