



Subject card

Subject name and code	Deep Learning with Reinforcement, PG_00048248						
Field of study	Informatics						
Date of commencement of studies	February 2027	Academic year of realisation of subject			2027/2028		
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	2	ECTS credits			2.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Department of Algorithms and Systems Modelling -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Paweł Kowalski					
	Teachers	dr inż. Paweł Kowalski					
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	0.0	15.0	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	Introduction to reinforcement learning, with a particular focus on scaling these methods in complex environments using deep neural networks. The course provides an overview of the most promising approaches, including methods based on Value Function approximation and Policy Gradient. It also develops skills in designing, implementing, and analyzing agents learning in complex decision-making environments through the completion of an experimental project.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K7_U12] is able, to an increased extent, to analyze the operation of components and systems related to the field of study, as well as to measure their parameters and study their technical characteristics, and to plan and carry out experiments related to the field of study, including computer simulations, interpret the obtained results and draw conclusions	Is able to plan and conduct neural network training using a selected reinforcement learning algorithm.	[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject [SU5] Assessment of ability to present the results of task
	[K7_W10] knows and understands, to an increased extent, the basic processes occurring in the life cycle of equipment, objects and technical systems, as well as methods of supporting processes and functions, specific to the field of study	Understands the impact of reinforcement learning methods and parameters on the behavior of simulated systems, particularly in video games, and is familiar with the principles governing agent behavior in these environments.	[SW3] Assessment of knowledge contained in written work and projects [SW2] Assessment of knowledge contained in presentation
	[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	Knows theoretical model for reinforcement learning: Markov's process. Knows algorithms used for reinforced learning	[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge
[K7_U04] can apply knowledge of programming methods and techniques as well as select and apply appropriate programming methods and tools in computer software development or programming devices or controllers using microprocessors or programmable elements or systems specific to the field of study, making assessment and critical analysis of the prepared software as well as a synthesis and creative interpretation of information presented with it	Can reproduce an experiment from a selected scientific publication and assess the correctness of the results.	[SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information	
Subject contents	Course content – lecture		
	<ul style="list-style-type: none"> • Imitation learning. • Reinforcement Learning Introduction. • Markov Decision Process. • Dynamic Programming Methods. • Model Free Learning. • Deep Learning using value function approximation. • Deep Learning using policy gradient methods. • Practical aspects of Deep Reinforcement Learning. 		
Prerequisites and co-requisites	Course content – project		
	<ul style="list-style-type: none"> • Project topic selection: computer and board games, autonomous vehicle control, or investment strategies. • Use of modern programming tools and AI models to support literature analysis, code implementation, and results interpretation. • Reproduction of an experiment from a publication and verification of the correctness of obtained results. • Teamwork and presentation of results with a critical evaluation of the experiment. 		
Assessment methods and criteria	Knowledge of Python programming language		
	Basic calculus, linear algebra and probabilistic theory		
	Machine Learning and Deep Learning fundamentals		
	Subject passing criteria	Passing threshold	Percentage of the final grade
	Project	50.0%	60.0%
	Lecture tasks	50.0%	40.0%

Recommended reading	Basic literature	Reinforcement Learning, Richard S. Sutton and Andrew G. Barto Neural Networks and Deep Learning, Michael A. Nielsen
	Supplementary literature	Deep Reinforcement Learning Hands-On, Maxim Lapan
	eResources addresses	
Example issues/ example questions/ tasks being completed	<ul style="list-style-type: none"> • Design and train an agent playing a selected video game. • Design and train a network controlling an autonomous vehicle. • Define a system of rewards and penalties in a selected computer game (e.g., maze, Mario Bros, Pac-Man, Snake) and observe how it affects the agents behavior. • Compare the performance of a selected RL algorithm in two different games or environments and present conclusions based on differences in the agents behavior. • Conduct an experiment with two or more agents in a game (e.g., racing, strategy game) and evaluate how cooperation or competition affects learning. 	
Practical activities within the subject	Not applicable	

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