GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Artificial Intelligence Methods, PG_00057476					
Field of study	Automation, Robotics and Control Systems					
Date of commencement of studies	February 2023		Academic year of realisation of subject		2022/2023	
Education level	second-cycle studies		Subject group			
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		5.0	
Learning profile	general academic profile		Assessment form		assessment	
Conducting unit	Department of Control Engineering -> Faculty of Electrical and Control Engineering					
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Roman Śmierzchalski				
	Teachers	dr hab. inż. Michał Grochowski dr inż. Agnieszka Mikołajczyk-Bareła Zuzanna Klawikowska prof. dr hab. inż. Roman Śmierzchalski				

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	15.0	15.0	0.0	60
	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	60	10.0	55.0	125

Subject objectives	The aim of the course is to introduce students to basic notions and concepts from the field of artificial intelligence.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	K7_W05	The student learns basic computational techniques of artificial intelligence (methods of inference, learning and solution-finding) in an algorithmic approach, selects an AI algorithm to solve a specific practical technical task, implements an AI algorithm in a selected programming language (Matlab or C++) to solve problems of decision-making processes, such as e.g. forecasting, planning, diagnostics, control, optimization.	[SW1] Assessment of factual knowledge
	K7_U08	The student learns the basic principles of conducting work and research in an industrial environment, application of occupational safety and health.	[SU1] Assessment of task fulfilment

Subject contents	LECTURE Basic definitions of intelligence, artificial intelligences, scope of research on artificial intelligence. Tasks of artificial intelligence formal and approximate inference, information-based learning, solution space search, - overview of intelligent computing techniques. Examples of tasks solved by artificial intelligence methods. Formal inference, task formulation, syntax and semantics of the language of logic, construction of an automatic inference system. Approximate inference, fuzzy logic - representation and processing of qualitative knowledge, fuzzy sets, operations on sets, fuzzy inference, fuzzy regulator, fuzzy rule bases on numerical data. Design of fuzzy autopilot for ship heading control. Neural networks, multilayer perceptron learning, reinforcement learning - task formulation, value function, reinforcement learning as a value function approximation method 4. Solution space search methods, evaluation function, heuristic evaluation methods. Random methods - climbing and random straying algorithm, simulated annealing algorithm. 5. solution space search with genetic algorithm (AG). Scheme and operation of AG, population representation, initial population, adaptation function, genetic operators, algorithm parameters. Theoretical basis of AG. Computer implementation of classical AG. Genetic techniques. Representation and structure of populations. AG solving optimization problems. Multicriteria optimization problem in AG. Example evolutionary route planning of an autonomous robot in an environment, trajectory determination of a ship in a collision situation at sea. Hybrid methods - techniques of combining fuzzy-neural systems (fuzzy neural networks), use of genetic algorithms for parameter tuning of fuzzy and neural models. LABORATORY EXERCISES Fuzzy controller - evaluation of control system properties, resistance to disturbances. Synthesis of fuzzy controller - techniques of creating P, PI, PID fuzzy controller. Neural network learning test with teacher. Modeling of continuous industrial process using SN. Study of properties of genetic algorithm depending on selection method, coding method and operators used. Solving an optimization task with constraints using evolutionary method. Optimization of a robot's path in an environment using evolutionary method. PROJECT Design of a selected control system using artificial intelligence.
Prerequisites and co-requisites	Knowledge from the course Fundamentals of Automatics

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Colloquium	50.0%	50.0%
Project documentation	100.0%	20.0%
Report on the exercises	100.0%	30.0%

Recommended reading

Basic literature	1. G. Luger, Artificial intelligence, Prentice Hall, 2008. 2. A. Zilouchian, M. Jamshidi, Intelligent Control Systems Using Soft Computing Methodologies, CRC Press, 2001 3. P. Cichosz, Systemy uczące się, Wydawnictwa Naukowo-Techniczne, Warszawa 2000. 4. S. Osowski, Sieci neuronowe w ujęciu algorytmicznym, Wydawnictwa Naukowo-Techniczne, Warszawa 1999. 5. J. Arabas, Wykłady z algorytmów ewolucyjnych, Wydawnictwa Naukowo-Techniczne, Warszawa 2001. 6. Andrzej Piegat, Modelowanie i sterowanie rozmyte. Exit, 1999 7. L. Rutkowski , Metody i techniki sztucznej inteligencji. Wydawnictwo Naukowe PWN, Warszawa, 2005
Supplementary literature	1. David E. Goldberg, Algorytmy genetyczne i ich zastosowania. WNT, 1995 2. D. Rutkowska, M. Piliński, L. Rutkowski, Sieci neuronowe, algorytmy genetyczne i systemy rozmyte. PWN, 1997 3. Zbigniew Michalewicz, Algorytmy genetyczne + struktury danych = programy ewolucyjne. WNT, 1999
eResources addresses	Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed	Artificial intelligence tasks - formal and approximate inference, information-based learning, solution space search. Fuzzy sets, operations on sets, fuzzy inference, fuzzy controller. Neural networks, multilayer perceptron learning, reinforcement learning. AG scheme and operation, population representation, initial population, adaptation function, genetic operators, algorithm parameters.
Work placement	Not applicable