GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Introduction to Artificial Intelligence - Laboratory, PG_00068074						
Field of study	Automatic Control, Cybernetics and Robotics						
Date of commencement of studies	October 2025		Academic year of realisation of subject		2027/2028		
Education level	first-cycle studies		Subject group		Obligatory subject group in the field of study 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	3		Language of instruction		Polish		
Semester of study	5		ECTS credits		1.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Department of Decision Systems and Robotics -> Faculty of Electronics Telecommunications and Informatics -> Wydziały Politechniki Gdańskiej						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Tomasz Białaszewski				
	Teachers						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	0.0	0.0	15.0	0.0	0.0	15
	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	15		1.0		9.0	25
Subject objectives	The aim of the course is the practical solving of programming problems using appropriate languages and tools, combined with the fundamental concepts, techniques, and tools used in modern artificial intelligence (AI). The course integrates elements of the classical symbolic (logical) approach with the statistical and computational methods characteristic of machine learning.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U09] can carry out a critical analysis of the functioning of existing technical solutions and assess these solutions, as well as apply experience related to the maintenance of technical systems, devices and facilities typical for the field of studies, gained in the professional engineering environment	The student understands the basics of fuzzy logic and its use in representing uncertainty and designing fuzzy systems. The student is able to design and implement a simple system based on fuzzy logic. The student understands key concepts and stages of the machine learning process, such as data preparation, model training, and performance evaluation. The student applies the Python programming language and machine learning libraries (e.g., scikit-learn) to solve problems related to classification, regression, and data analysis.	[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools
[K6_U07] can apply methods of process and function support, specific to the field of study	The student is able to implement and compare selected machine learning algorithms, such as: simulated annealing, – decision trees, Bayesian networks, – ensemble learning, support vector machines (SVM), Gaussian mixture models. The student understands the differences between symbolic and statistical approaches to artificial intelligence and knows their areas of application. The student is able to analyze the performance of various AI algorithms and choose appropriate methods for specific types of problems.	[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools
[K6_U01] can apply mathematical knowledge to formulate and solve complex and non-typical problems related to the field of study and perform tasks, in an innovative way, in not entirely predictable conditions, by:n- appropriate selection of sources and information obtained from them, assessment, critical analysis and synthesis of this information,n- selection and application of appropriate methods and toolsn	The student understands the fundamental principles of declarative programming in Prolog, including unification, backtracking, and recursion. The student is able to write and execute Prolog programs that solve logical and symbolic problems typical of artificial intelligence. The student applies techniques for controlling the flow of computation in logic programs and effectively uses backtracking mechanisms.	[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information

Subject contents

1. Programming in Prolog . Unification (pattern matching). Backtracking mechanism. Control of backtracking and program flow. Recursion in defining rules and data structures. Solving complex artificial intelligence problems (e.g., planning, reasoning, predicate logic).

2. Fuzzy Systems. Introduction to fuzzy logic. Modeling imprecise and uncertain information. Designing simple fuzzy systems. Applications of fuzzy logic in intelligent systems

3. Machine Learning in a High-Level Language (Python). Introduction to machine learning libraries (e.g., scikit-learn). Data preparation and preprocessing. Building, training, and testing machine learning models. Model evaluation and hyperparameter tuning

4. Overview and Implementation of Selected Machine Learning Algorithms. Simulated Annealing optimization metaheuristic. Decision Trees and Random Forests. Bayesian Networks modeling probabilistic dependencies. Ensemble learning techniques for combining multiple models (e.g., AdaBoost, Bagging). Support Vector Machines (SVM). Gaussian Mixture Models (GMM)

<table>
<tr><td>Prerequisites and co-requisites</td><td colspan="3">The student should complete the course Introduction to Artificial Intelligence (lecture).</td></tr>
<tr><td>Assessment methods and criteria</td><td colspan="3"><table><tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr><tr><td>5 tests, each lasting 45 minutes</td><td>51.0%</td><td>100.0%</td></tr></table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td colspan="2">1. Bratko I. Prolog Programming for Artificial Intelligence, 4th Edition, Addison-Wesley, 2011.
2. Russell S., Norvig P. Artificial Intelligence: A Modern Approach, 4th Edition, Pearson, 2021.
3. Geron A. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition, OReilly, 2019.
4. Zadeh L.A. Fuzzy Sets, Information and Control, 1965</td></tr>
<tr><td>Supplementary literature</td><td colspan="2">1. Mitchell T. Machine Learning, McGraw-Hill, 1997.
2. Hastie T., Tibshirani R., Friedman J. The Elements of Statistical Learning, Springer, 2009.
3. Molnar C. Interpretable Machine Learning, 2nd Edition, 2022.
4. Negnevitsky M. Artificial Intelligence: A Guide to Intelligent Systems, 3rd Edition, Pearson, 2011.</td></tr>
<tr><td>eResources addresses</td><td colspan="2"></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="3">1.
Implement a Prolog-based system to solve a logic puzzle such as the "Zebra puzzle" or Sudoku.
2.
Build a simple fuzzy system to classify stress levels based on input data (e.g., heart rate, sleep quality, number of working hours).
3.
Using the scikit-learn library, create a decision tree model for the Iris dataset.
4.
Compare the performance of Random Forest, AdaBoost, and SVM algorithms on the same dataset (e.g., wine or digits).
5.
Implement Simulated Annealing to solve the Traveling Salesman Problem (TSP) for several dozen or more cities.</td></tr>
<tr><td>Work placement</td><td colspan="3">Not applicable</td></tr>
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