GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Machine learning in decision-making processes for autonomous electric vehicles, PG_00057622		
Field of study	Electrical Engineering		
Date of commencement of studies	October 2022	Academic year of realisation of subject	2022/2023
Education level	second-cycle studies	Subject group	
Mode of study	Part-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	2	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Controlled Electric Drives -> Faculty of Electrical and Control Engineering		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Marcin Drzewiecki	
	Teachers	dr inż. Marcin Drzewiecki	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	10.0	0.0	10.0	0.0	0.0	20

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	20	10.0	45.0	75

Subject objectives

The aim of the course is to broaden and deepen the skills related to machine learning enabling recognition of images and applicable in the decision-making processes of autonomous electric vehicles.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K7_W02	The student implements artificial neural networks and machine learning algorithms in a programming language. The student implements solutions enabling image recognition, applicable in the decision-making processes of autonomous electric vehicles.	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects
K7_U02	The student discusses selected issues related to machine learning in the decision-making processes of autonomous electric vehicles.	[SU3] Assessment of ability to use knowledge gained from the subject
K7_W01	The student implements artificial neural networks and machine learning algorithms in a programming language. The student implements solutions enabling image recognition, applicable in the decision-making processes of autonomous electric vehicles.	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects
K7_U03	On the basis of literature studies, the student is able to obtain from public databases teaching data sets and programming libraries needed to train multilayer neural networks.	[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information

Subject contents	**Lecture:** Introduction to machine learning, applicable in the decision-making processes of autonomous electric vehicles. Autonomous electric vehicles. Image recognition. ADALINE model. Rosenblatt perceptron model. McCulloch-Pitts neuron model. Multilayer neural networks and their learning algorithms. Deep learning. Back propagation algorithm. Training the artificial neural network. Convolutional neural networks in image recognition. The use of a general-purpose high-level programming language: Python in machine learning. **Laboratory:** Practical exercises in the field of machine learning enabling image recognition, applicable in the decision-making processes of autonomous electric vehicles. Performing practical exercises in Python with the use of programming libraries. Implementation of back propagation algorithm to train multilayer neural network. Teaching multilayer neural network of image recognition. The use of available training sets for machine learning algorithms. Image recognition by convolutional neural network using the TensorFlow library.
Prerequisites and co-requisites	

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Test	60.0%	50.0%
Practical exercises	60.0%	50.0%

Recommended reading

Basic literature	1. S. Raschka, V. Mirjalili: Python. Uczenie maszynowe. Wydanie 2. Wyd. Helion, 2019. 2. P. Wawrzyński. Systemy adaptacyjne i uczące się. Oficyna Wydawnicza Politechniki Warszawskiej, 2009. 3. D. Rutkowska, M. Piliński, L. Rutkowski: Sieci neuronowe, algorytmy genetyczne i systemy rozmyte. Wyd. Naukowe PWN, 1997.
Supplementary literature	1. M. Pilgrim: Dive Into Python 3. Wyd. Springer-Verlag Berlin and Heidelberg GmbH & Co. KG, 2009. 2. J. Korbicz, A. Obuchowicz, D. Uciński: Sztuczne sieci neuronowe. Podstawy i zastosowania, Akademicka Oficyna Wydawnicza, 1994. 3. R. Tadeusiewicz: Sieci neuronowe. Akademicka Oficyna Wydawnicza, 1993.
eResources addresses	Adresy na platformie eNauczanie: UCZENIE MASZYNOWE W PROCESACH DECYZYJNYCH AUTONOMICZNYCH POJAZDÓW ELEKTRYCZNYCH [Niestacjonarne][2022/23] - Moodle ID: 28635 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=28635

Example issues/ example questions/ tasks being completed	Implementation of a multilayer neural network in Python. Training a multilayer neural network with the use of available training sets. Recognition of images or signs by a learned multilayer neural network. Image recognition and classification using a multilayer neural network using the TensorFlow library.
Work placement	Not applicable