GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Media Processing in Decision-Making Systems, PG_00063919		
Field of study	Informatics		
Date of commencement of studies	February 2025	Academic year of realisation of subject	2025/2026
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	3.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Multimedia Systems -> Faculty of Electronics, Telecommunications and Informatics		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Andrzej Czyżewski	
	Teachers	dr hab. inż. Piotr Szczuko dr inż. Arkadiusz Harasimiuk mgr inż. Szymon Zaporowski dr inż. Sebastian Cygert	

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	30.0	0.0	0.0	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 lecture is to illustrate the potential applications of machine learning, in particular the ability to adaptively learn, interpret possible variants of objects or patterns, e.g. scale, orientation and perspective in the field of multimedia technologies with particular emphasis on processing sounds, images and noisy data. Among the applications, object detection, autonomous vehicles, biometrics and medicine in particular will be discussed and illustrated by laboratory exercises.

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	He is able to refer to scientific sources in the field of modern methods and technologies, as well as to propose trends in the development of methods and principles of multimedia data acquisition and their use in machine learning, if necessary modifying them accordingly in the the course of the implementation of engineering projects, and apply the relevant principles of security of access to the data used.	[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools
[K7_W101] is able to make an in-depth identification of key objects and phenomena related to the field of study, as well as theories that describe them and applicable analytical and design methods	He is familiar with the cloud approach, how to create and organize services from the field of machine learning and artificial intelligence. He can model objects in an image. Is familiar with the concepts of segmentation, determination of regions of interest. Knows basic techniques for analyzing multimodal medical, biometric data and understands information analysis methods used for vehicle autonomization.	[SW1] Assessment of factual knowledge
[K7_U03] can design, according to required specifications, and make a complex device, facility, system or carry out a process, specific to the field of study, using suitable methods, techniques, tools and materials, following engineering standards and norms, applying technologies specific to the field of study and experience gained in the professional engineering environment	Can apply boosted decision trees, and train neural networks using multimedia data. Knows the design principles of systems that collect, analyze, process and recognize multimedia data. Distinguishes between machine learning methods and in particular neural networks used for multimedia data processing.	[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 [SU1] Assessment of task fulfilment
[K7_W02] knows and understands, to an increased extent, selected laws of physics and physical phenomena, as well as methods and theories explaining the complex relationships between them, constituting advanced general knowledge in the field of technical sciences related to the field of study	Posesses extended knowledge of algorithms for learning distance metrics, learning in computer vision, knows the specific phenomena occurring in the recognition of sounds and images, understands the impact of noise on the effectiveness of their analysis and processing .	[SW1] Assessment of factual knowledge

Subject contents

Lectures: 1 Reinforcement decision trees in applications 2 Overview of algorithms that learn distance metrics 3 Multitasking learning in computer vision 4 Object detection (object detection, keypoints detection, 3D detection). Applications in autonomous vehicles and/or medicine. 5 Semantic segmentation (semantic segmentation, instance segmentation). Applications in autonomous vehicles and / or in medicine. 6 IoT as a data source for ML/AI 7 ML/AI in cloud approach, ML/AI services offered by vendors 8 Practical aspects of using machine learning algorithms (criticism of modern machine learning algorithms, examples of wrong predictions, safety in AI) 9 ML/AI in the automotive area, use of multimedia information sources for autonomization of vehicles - cars and agro equipment. 10 Applications of machine learning in biometrics

Labs 1 Discussion of lab principles, practices used, data sources, tools 2 Reinforcement decision trees in applications 3 Algorithms learning distance metrics 4 Multitasking learning in computer vision 5 Object detection (object detection, keypoints detection, 3D detection). Applications in autonomous vehicles. 6 Semantic segmentation (semantic segmentation, instance segmentation). Applications in medicine. 7 Intepretability of artificial intelligence methods. Decision visualization methods for neural networks. 9 ML/AI in cloud approach, ML/AI services offered by vendors 10 Applications of machine learning in biometrics.

Prerequisites and co-requisites

The student should have knowledge of data preparation in machine learning, ought to know and distinguish artificial intelligence methods, have practical experience in using tools that enable training neural networks.

<table>
<tr><td>Assessment methods and criteria</td><td colspan="2"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>laboratory units</td><td>90.0%</td><td>50.0%</td></tr>
<tr><td>lecture</td><td>60.0%</td><td>50.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>Goodfellow Ian, Bengio Yoshua, Courville Aaron. Deep learning, Systemy uczące się. PWN 2018 (in Polish)

M. Cord, P. Cunningham, Machine Learning Techniques for Multimedia. Case Studies on Organization and Retrieval. . Springer (Part of the Cognitive Technologies book series (COGTECH))

Kumar, Pardeep, Singh, Amit Kumar (Eds.)

Wahiba Ben Abdessalem Karaa, Nilanjan Dey, CRC Press/Taylor & Francis Group, 2017, ISBN 1138031720

Dey, Nilanjan & Ashour, Amira S. & Nhu, Nguyen. (2016). Deep Learning for Multimedia Content Analysis. 10.1201/9781315399744-15.

Le, L., Zheng, Y., Carneiro, G., Yang, L. (Eds.)Deep Learning and Convolutional Neural Networks for Medical Image Computing Precision Medicine, High Performance and Large-Scale Datasets. Springer

MatConvNet: Convolutional Neural Networks for MATLAB, MM '15: Proceedings of the 23rd ACM international conference on Multimedia October 2015 Pages 689692 https://doi.org/10.1145/2733373.2807412</td></tr>
<tr><td>Supplementary literature</td><td>Wahiba Ben Abdessalem Karaa, Nilanjan Dey, Mining Multimedia Documents. CRC Press/Taylor & Francis Group, 2017, ISBN 11380317

Z. Maimon Odet, Data Mining with Decision Trees. World Scientific Publishing.</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:</td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">Describe the principle of reinforcement decision trees. List and briefly characterize the distance learning metrics algorithms you know. Describe the steps of object detection in an image. List the steps required to develop an automatic segmentation algorithm for applications in autonomous vehicles. Describe a multimodal biometric system based on intelligent analysis of biometric data. Draw and describe a diagram of a cloud-based medical data acquisition and intelligent processing system.</td></tr>
<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
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