



## Subject card

Subject name and code	Deep neural networks for data analysis, PG_00053025						
Field of study	Data Engineering						
Date of commencement of studies	October 2022	Academic year of realisation of subject			2025/2026		
Education level	first-cycle studies	Subject group			Optional 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	4	Language of instruction			English		
Semester of study	7	ECTS credits			4.0		
Learning profile	general academic profile	Assessment form			exam		
Conducting unit	Department of Computer Architecture -> Faculty of Electronics, Telecommunications and Informatics						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Julian Szymański				
	Teachers		dr hab. inż. Julian Szymański				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	0.0	30.0	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		51.0	100
Subject objectives	The aim of the course is to familiarize students with the methods of deep learning for advanced data analysis. Typical areas of application of these types of methods include: image classification, speech recognition and natural language understanding.						
Learning outcomes	Course outcome		Subject outcome			Method of verification	
	[K6_U03] analyses problems and creates appropriate models, data structures and algorithms (including heuristic and numerical ones), assesses their computational complexity, estimates errors of the received solutions		Student uses the available deep learning tools to build / select, train and evaluate performance of the designed model to solve a chosen problem.			[SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information	
	[K6_W08] Knows the models and structure of the data mining process and their multidimensional analysis and can assess the results of such analyses		Based on analysis of available data, student is able to assess the usefulness of deep learning methods in a given problem.			[SW1] Assessment of factual knowledge	
	[K6_W01] has basic knowledge in the field of mathematics, including mathematical analysis, algebra, geometry, probability calculus, statistics and numerical methods, necessary to formulate and solve simple tasks in the field of IT		Student knows how artificial neural network is constructed, how is trained and how it works.			[SW1] Assessment of factual knowledge	

Subject contents	<ol style="list-style-type: none"> <li>1. Machine learning and artificial neural networks basics</li> <li>2. Image data analysis with convolutional neural networks</li> <li>3. Sequence analysis with recurrent neural networks</li> <li>4. Natural language neural models</li> <li>5. Generalization improvement techniques</li> <li>6. Deep learning optimization techniques</li> <li>7. Practical methodology and tips for deep learning</li> </ol>											
Prerequisites and co-requisites	<p>Basic knowledge of linear algebra and statistics.</p> <p>Intermediate programming skills in Python.</p>											
Assessment methods and criteria	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 33%;">Subject passing criteria</th> <th style="width: 33%;">Passing threshold</th> <th style="width: 33%;">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td>Multiple choice written test</td> <td>50.0%</td> <td>50.0%</td> </tr> <tr> <td>Project</td> <td>50.0%</td> <td>50.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Multiple choice written test	50.0%	50.0%	Project	50.0%	50.0%
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Multiple choice written test	50.0%	50.0%										
Project	50.0%	50.0%										
Recommended reading	Basic literature	<p>Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016, url: <a href="http://www.deeplearningbook.org/">http://www.deeplearningbook.org/</a></p> <p>Michael Nielsen, "Neural Networks and Deep Learning", <a href="http://neuralnetworksanddeeplearning.com/">http://neuralnetworksanddeeplearning.com/</a></p>										
	Supplementary literature	<p>Andrew Ng, "Machine Learning Yearning", <a href="http://www.mlyearning.org/">http://www.mlyearning.org/</a></p> <p>Tutorials on deep learning frameworks pages, such as: <a href="https://www.tensorflow.org/tutorials">https://www.tensorflow.org/tutorials</a>, <a href="http://torch.ch/docs/tutorials.html">http://torch.ch/docs/tutorials.html</a></p>										
	eResources addresses											
Example issues/ example questions/ tasks being completed	<p>Present the architecture of a convolutional neural network, show its advantages over traditional networks and describe typical applications.</p> <p>During the development of a deep learning project, a satisfactory level of training error was observed, but at the same time the testing error was unacceptable. What could be the reason for this? Consider several scenarios. Suggest ways to improve.</p>											
Work placement	Not applicable											