GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Deep Learning Architecture, PG_00054418		
Field of study	Informatics		
Date of commencement of studies	February 2025	Academic year of realisation of subject	2024/2025
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	1	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Algorithms and Systems Modelling -> Faculty of Electronics, Telecommunications and Informatics		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Paweł Kowalski	
	Teachers	Paweł Kowalski	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	0.0	15.0	0.0	30

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	30	8.0	62.0	100

Subject objectives

In recent years, a breakthrough in the practical use of deep learning has been made. These methods have become irreplaceable due to the volume of data that requires analysis and processing. Tasks such as image recognition or natural language processing are implemented extremely effectively. In addition, the purpose of scientific research are as abstract tasks as creating art or music.

The aim of the course is to present theories, architectures, practical applications of deep neural networks, the results of current scientific research and potential development directions.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[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	Identifies key architectures of deep neural networks. Also understands their practical applications in tasks such as image processing, audio processing, and natural language processing.	[SW2] Assessment of knowledge contained in presentation [SW3] Assessment of knowledge contained in written work and projects
[K7_W04] knows and understands, to an increased extent, the principles, methods and techniques of programming and the principles of computer software development or programming devices or controllers using microprocessors or other elements or programmable devices specific to the field of study, and organization of work of systems using computers or such devices	He knows the basics of neural network construction, operations performed in neural network layers, the importance of activation functions, functions used in classification and regression tasks, and is able to select the appropriate loss function. Is able to design selected elements of the neural network in selected programming packages	[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge
[K7_K02] is ready to provide critical evaluation of received content and to acknowledge the importance of knowledge in solving cognitive and practical problems	Know how to translate known neural network methods on other practical problems.	[SK5] Assessment of ability to solve problems that arise in practice
[K7_U07] can apply advanced methods of process and function support, specific to the field of study	He can analyze the class of problem solved by machine learning algorithms, analyze and select data, and properly divide the training set. Is able to solve problems using various architectures of deep neural networks	[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject

Subject contents

1. Basics of neural networks on the example of logistic regression

2. Gradient algorithm and methods for optimizing the learning process

3. Neural networks, training of neural networks

4. Convergent neural networks, the most popular architectures including the VGG network, Resnet, Inception, SENet

5. Application of convolutional networks in computer vision (classification, detection, segmentation)

6. Introduction to NLP (natural language processing), language models

7. Recurrent neural networks including models LSTM, GRU

8. Visualization and an attempt to understand the learning process in neural networks

9. Analysis of selected problems using classical, convolutional and recurrent neural networks

Prerequisites and co-requisites

Basics of linear algebra

Basics of mathematical analysis

Basics of probability theory

Subject artificial intelligence

Knowledge of scripting languages

<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>Lecture tasks</td><td>50.0%</td><td>40.0%</td></tr>
<tr><td>Project</td><td>50.0%</td><td>60.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>Deep learning: Ian Goodfellow and Yoshua Bengio and Aaron Courville: http://www.deeplearningbook.org/

Neural Networks and Deep Learning: Michael Nielsen http://neuralnetworksanddeeplearning.com/index.htm</td></tr>
<tr><td>Supplementary literature</td><td>no recommendations</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">Design and conduct the training of a deep neural network for an image classification task.

Implement the selected neural network learning algorithm.

Reproduce the experiments presented in a selected scientific article.</td></tr>
<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
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