University of Gdańsk

Subject card

Subject name and code	Introduction to Neural Network, PG_00155289		
Field of study	Mathematical Modeling and Data Analysis		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2027/2028
Education level	Bachelor's studies	Subject group	Obligatory subject group 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	6	ECTS credits	6.0
Learning profile	academic	Assessment form	exam
Conducting unit			
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Marek Krośnicki	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	30.0	0.0	0.0	60

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	60	10.0	80.0	150

Subject objectives

The aim of the course is to familiarize students with the basics of artificial neural networks and their application in machine learning, present the most important network architectures currently used, and make them aware of the limitations of models based on neural networks.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[MMiADL3_U10] is able to recognise problems, including practical issues, that can be solved algorithmically; can make a specification of such a problem	can recognize problems that can be solved using neural networks	[SU2] presentation/project/paper/ report [SU4] test/exam - oral or written
[MMiADL3_U12] can compile, run and test a self-written computer programme	can compile and run a self-written program while working on a project implementing a selected neural network	[SU2] presentation/project/paper/ report
[MMiADL3_U11] knows how to arrange and analyse an algorithm in accordance with the specification and save it in the selected programming language	is able to create and analyze an algorithm while working on a project implementing a selected neural network	[SU2] presentation/project/paper/ report
[MMiADL3_K03] is ready to work in a team; understands the need for systematic work on all projects that have a long-term character	is ready for teamwork; understands the need for systematic work	[SK8] observation of student's independent or team work
[MMiADL3_W09] knows and understands the basics of computational and programming techniques supporting mathematician's work and understands their limitations	knows and understands the basics of computational techniques necessary to implement selected neural networks	[SW4] test/exam - oral or written [SW2] presentation/project/paper/ report

<table>
<tr><td>Subject contents</td><td colspan="3">1. Introductory concepts to supervised learning and optimization - linear regression, logistic regression, gradient descent, softmax regression, cost functions, network overfitting and other method limitations.
2. Regularization and data preparation for processing.
3. Supervised neural networks: single neuron, multi-layer perceptron.
4. PINN networks (Physics informed neural networks).
5. Supervised convolutional neural networks.
6. Recurrent neural networks.
7. Elements of unsupervised learning: autodecoder networks.
8. GANN networks (Generative Adversarial Network).</td></tr>
<tr><td>Prerequisites and co-requisites</td><td colspan="3">Knowledge of probability calculus, elementary knowledge of stochastic processes.</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>exam</td><td>51.0%</td><td>25.0%</td></tr><tr><td>observation of the student's attitude</td><td>100.0%</td><td>0.0%</td></tr><tr><td>partial projects</td><td>51.0%</td><td>75.0%</td></tr></table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td colspan="2">Uczenie maszynowe z użyciem Scikit-Learn i TensorFlow. Aurelian Geron, Helion SA, 2020

Deep Learning. Ian Goodfellow and Yoshua Bengio and Aaron Courville. MIT Press 2016.

http://www.deeplearningbook.org

Online Course: Machine Learning for Physicists by Florian Marquardt https://pad.gwdg.de/s/Machine_Learning_For_Physicists_2021

Studies found independently by students in scientific publications and on technical blogs regarding solving specific problems using neural networks (work on a final project)</td></tr>
<tr><td>Supplementary literature</td><td colspan="2">N/A</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"></td></tr>
<tr><td>Work placement</td><td colspan="3">Not applicable</td></tr>
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