University of Gdańsk

Subject card

Subject name and code	Foundations of Artificial Intelligence, PG_00178517						
Field of study	Informatics and Econometrics						
Date of commencement of studies	October 2026		Academic year of realisation of subject		2028/2029		
Education level	Bachelor's studies		Subject group		Obligatory subject group in the field of study Optional subject group Subject group related to scientific research in the field of study		
Mode of study	part-time studies		Mode of delivery		at the university		
Year of study	3		Language of instruction		Polish		
Semester of study	6		ECTS credits		7.0		
Learning profile	academic		Assessment form		exam		
Conducting unit	Department of Statistics -> Faculty of Management -> Rector						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. Krzysztof Najman				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	16.0	16.0	8.0	0.0	0.0	40
	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	40		2.0		133.0	175
Subject objectives	The aim of the course is to familiarize students with the essence of artificial intelligence, the history and directions of AI development, basic AI models, methods of data preparation, construction, analysis, verification, visualization and implementation of selected AI models in socio-economic research.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[IiEL3_U12] Can design and implement IT systems to enhance business operations and effectively utilize modern ICT technologies for management and business communication	The student is able to design and implement selected artificial intelligence models.	[SU2] presentation/project/paper/ report
[IiEL3_U03] Can obtain data from appropriately selected sources, use these data to solve economic and social problems, and process and interpret them using econometrics, informatics or statistics tools	The student can collect, verify and prepare data sets for analysis using selected artificial intelligence models.	[SU2] presentation/project/paper/ report
[IiEL3_U02] Can select or construct econometrics, informatics or statistics tools and apply them to describe and solve economic and social problems	The student can build selected artificial intelligence models to solve selected economic and social problems.	[SU2] presentation/project/paper/ report
[IiEL3_W10] Knows and understands to an advanced degree the fundamental dilemmas of modern civilization, especially in the face of IT development	The student knows and understands the dilemmas related to the construction and application of artificial intelligence models.	[SW4] test/exam - oral or written [SW2] presentation/project/paper/ report
[IiEL3_W07] Knows and understands regulations and legal, organizational, and ethical norms, including those related to protecting intellectual property, especially when using informatics tools	The student knows, understands and complies with the legal and ethical principles of building and implementing artificial intelligence models.	[SW4] test/exam - oral or written [SW2] presentation/project/paper/ report

Subject contents

1. History and directions of artificial intelligence research, application areas.

2. Biological prototype of neural computations. Construction of a mathematical neuron. Perceptron. Types and properties of basic transformation functions.

3. Basic methods of learning a mathematical neuron. (Perceptron Learning Rule).

4. Selected architectures of artificial neural networks: layered, unidirectional and recurrent networks, networks with variable structure, self-learning networks.

5. Methods of learning artificial neural networks: learning rules, state and weight space, minimization of the value of the network error function.

6. Methods of preparing data for analyses based on artificial neural networks: learning sets, test sets, control sets, data transformations, preprocessing and postprocessing.

7. Construction and methods of learning layered artificial neural networks. Error backpropagation algorithm and its variants.

8. Construction and methods of learning recurrent artificial neural networks. Elman, Hopfield network, LSTM (Long short-term memory), GRU (Gate Recurrent Unit).
9. Evaluation of the quality of neural models, evaluation of network stability, the problem of loss of generalization ability (underfitting, overfitting), network regularization.
10. Selected applications of artificial neural networks - approximation, regression, clustering and classification, time series forecasting.
11. Construction of selected ANN models in programming languages: Python and R.
12. Introduction to LLM (Large Language Models).
13. Practical notes on the process of building artificial intelligence models.
14. Advantages and disadvantages of using artificial neural networks.
15. Implementation and evaluation of AI model performance, AI model evaluation metrics (technical and business).
16. Legal and ethical aspects of implementing AI models.

Prerequisites and co-requisites

Linear algebra, mathematical analysis, foundations of statistics and operational research.

<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>semester project</td><td>51.0%</td><td>50.0%</td></tr>
<tr><td>theoretical exam</td><td>51.0%</td><td>50.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>K. Migdał-Najman, K. Najman, Samouczące się sztuczne sieci neuronowe w grupowaniu i klasyfikacji danych. Teoria i zastosowania w ekonomii, Wydawnictwo Uniwersytetu Gdańskiego, 2013.

G. Aurelien - Uczenie maszynowe z użyciem Scikit-Learn, Keras i TensorFlow, Helion, 2023

John D. Kelleher, B. Mac Namee, A. D'Arcy, Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies, MIT Press, 2020.

G. James i inni, An Introduction to Statistical Learning with Applications in Python

T. Rashid, Make your own neural network, CreateSpace Independent Publishing Platform, 2016

Charu C. Aggarwal, Neural Networks and Deep Learning, Springer, 2023

Sepp Hochreiter, Jürgen Schmidhuber, Long Short-Term Memory. Neural Comput 1997; 9 (8): 17351780

M.S. Islam, E. Hossain, Foreign exchange currency rate prediction using a GRU-LSTM hybrid network, Soft Computing Letters, Volume 3, 2021</td></tr>
<tr><td>Supplementary literature</td><td>M. Hagan,H. Demuth, M. Beale, O. de Jesus, Neural Network Design (2nd Edition), 2014

R. Tadeusiewicz, Sieci neuronowe, Akademicka Oficyna Wydawnicza, Warszawa 1993

M. Szeliga, Praktyczne uczenie maszynowe. PWN, Warszawa 2019</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2"></td></tr>
<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
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