University of Gdańsk

Subject card

Subject name and code	AI and Machine Learning, PG_00178723						
Field of study	Informatics and Econometrics						
Date of commencement of studies	October 2026		Academic year of realisation of subject		2027/2028		
Education level	Master'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	2		Language of instruction		Polish		
Semester of study	3		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	8.0	16.0	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 provide basic knowledge about selected Machine Learning methods and selected models of artificial neural networks, as well as the skills to use them in solving selected socio-economic problems.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[IiEMU2_W06] Possesses a structured understanding of the processes, methods, and tools necessary for the design, creation, development, and provision of suitable conditions for informatics, econometrics or statistics tools	The student knows the process of building, optimizing, verifying and implementing selected ML and ANN models for selected socio-economic applications.	[SW4] test/exam - oral or written [SW2] presentation/project/paper/ report
[IiEMU2_W07] Possesses a comprehensive understanding of regulations and legal, organizational, and ethical norms, particularly those related to the protection of intellectual property and relevant informatics tools	The student knows and understands legal, organizational, and ethical standards related to the use of information technology tools in socio-economic research.	[SW2] presentation/project/paper/ report
[IiEMU2_U05] Can recognize and effectively apply legal, professional, and ethical standards within management, quality sciences, economics, and finance	The student is able to identify and apply legal, professional, and ethical standards related to the use of Machine Learning (ML) methods and Artificial Neural Networks (ANNs) in socio-economic research.	[SU2] presentation/project/paper/ report
[IiEMU2_W08] Possesses a comprehensive understanding of the methods, conditions, directions, and dilemmas involved in applying advanced econometrics, informatics or statistics tools in response to dynamic environmental changes	The student knows the theoretical foundations of Machine Learning and ANNs and the basic tools for their construction, learning, optimization and verification.	[SW4] test/exam - oral or written [SW2] presentation/project/paper/ report
[IiEMU2_U06] Can utilize structured and detailed knowledge of management, quality sciences, economics, and finance to address dilemmas and develop innovative solutions for complex or unusual problems that arise in professional settings	The student is able to build, optimize and evaluate selected ML and ANN models for selected socio-economic applications.	[SU2] presentation/project/paper/ report
[IiEMU2_W10] Possesses a deeper understanding of the essential dilemmas of modern civilization, particularly concerning the IT development	The student understands the dilemmas related to the use of ML and ANN methods in socio-economic research.	[SW4] test/exam - oral or written [SW2] presentation/project/paper/ report
[IiEMU2_U03] Is able to obtain and verify data from properly selected sources and to collect, process, and visualize it using modern econometrics, informatics or statistics tools	The student is able to collect, verify and prepare data for the application of selected ML and ANN methods.	[SU2] presentation/project/paper/ report

Subject contents

ML introductory topics: ML definition, Concept of algorithmic learning, learning models: logical, geometric and probabilistic. ML methods: supervised, unsupervised, reinforcement learning. Life cycle of ML models. Application areas. Advantages and disadvantages of ML methods. Ethical and legal issues of using ML and AI models.

Selected models of supervised and unsupervised learning:

- Classification and regression trees (partitioning algorithms, stopping criteria, model evaluation, edge pruning)
- Multi-model approach to classification and regression trees (bagging, boosting, random forest, gradient boosting)
- Multivariate Adaptive Regression Splines (MARS)
- k-nearest neighbors algorithm
- Selected regression models.

Artificial Neural Networks - introductory topics: introduction to neural computing, perceptron, layered unidirectional networks, recurrent and self-learning networks, error backpropagation algorithms: gradient, conjugate gradients, BroydenFletcherGoldfarbShanno (BFGS), LavenbergMarquardt, Autoencoders, selected reinforcement learning models, selected ANN models used in image processing and text document analysis.

SVM support vector machines: linear and nonlinear,
ML model evaluation: ML model testing, model variance and bias, overfitting and regularization methods, ML model evaluation metrics (technical and business).

Prerequisites and co-requisites

Basics of linear algebra, mathematical analysis, descriptive statistics, preliminary preparation of data for statistical analysis. Basics of programming in Python.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
semester project	51.0%	50.0%
written exam	51.0%	50.0%

Recommended reading	Basic literature	1. K. Migdał-Najman, K. Najman, Samouczące się sztuczne sieci neuronowe w grupowaniu i klasyfikacji danych. Teoria i zastosowania w ekonomii, Wydawnictwo Uniwersytetu Gdańskiego, 2013. 2. G. Aurelien - Uczenie maszynowe z użyciem Scikit-Learn, Keras i TensorFlow, Helion, 2023 3. 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. 4. G. James i inni, An Introduction to Statistical Learning with Applications in Python, 2024
	Supplementary literature	T. Rashid, Make your own neural network, CreateSpace Independent Publishing Platform, 2016 Charu C. Aggarwal, Neural Networks and Deep Learning, Springer, 2023
	eResources addresses	
Example issues/ example questions/ tasks being completed		
Work placement	Not applicable	

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