GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00066699		
Field of study	Technical Physics		
Date of commencement of studies	February 2026	Academic year of realisation of subject	2025/2026
Education level	second-cycle studies	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	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Division of Theoretical Physics and Quantum Informaton -> Institute of Physics and Applied Computer Science -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Patryk Jasik	
	Teachers	dr inż. Patryk Jasik	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	0.0	0.0	30.0	0.0	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	2.0	18.0	50

Subject objectives

The aim of the course is to teach students the practical use of Python in the field of machine learning.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_K01] knows limitations of own knowledge, understands the need to learn and improve professional and personal competencies	The student understands that programming technologies develop quickly, so there is a need to continuously monitor the functionalities of new versions of Python and its packages.	[SK2] Assessment of progress of work
[K7_U02] has enhanced knowledge of programming languages and can use software packages	The student has advanced programming skills in Python and its libraries for solving tasks using machine learning methods.	[SU1] Assessment of task fulfilment

Subject contents	Course content – laboratory Python language 1. Basic types of data and operations on them. Conditions. Different types of loops. Exceptions. Lists, tuples, dictionaries. 2. Functions. Function with an optional argument. Modules. Creating own module and using it. Writing/ reading data to/from files. YAML files. Classes and objects. Introduction to multithreading. 3. Analysis of the selected dataset. Reading observations for selected variables. Checking basic statistics for individual variables. Creating histograms. Identification of variables with potentially incorrect data (observations) or missing data. Data repair. Calculation of normalized correlations between individual variables. Conducting linear regression for selected variables, including graphs. 5. The scikit-learn package and the linear regression model. The coefficient of determination R^2, MSE, MAE. Division of the data set into a training and test part. Prediction using the created model. 6. The scikit-learn and preprocessing package. Polynomial model. Feature engineering. Reduction of variables in the model - the Schwarz criterion (Bayesian Information Criterion - BIC). Operation of the polynomial model in practice. 7. The scikit-learn package, the k-nearest neighbors method, decision trees and random forests. Classification problem. The choice of features - predictors and the target variable. Parameters of the model. Model quality assessment - confusion matrix, sensitivity, specificity, precision, accuracy, ROC curve, LIFT curve. Cross-validation: k-fold, n-fold and Monte-Carlo (bootstrap). 8. The scikit-learn package and the k-means algorithm as a case of unsupervised learning. Cluster analysis - clustering. Parameters of the model. The Fowlkes-Mallows index, i.e. the consistency between the two divisions of the dataset into clusters. Analysis of the principal components - PCA. 9. XGBoost, LightGBM packages as examples of reinforcement learning. 10. Introduction to neural networks using TensorFlow and PyTorch.
Prerequisites and co-requisites	Basic programming skills in the selected language. Basic knowledge of probability calculus and statistics.
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
The report of the analysis and modeling of the selected data set	60.0%	100.0%

Recommended reading	Basic literature	1. Andreas C. Maźller, Sarah Guido, "Introduction to Machine Learning with Python. A Guide for Data Scientists", O'Reilly Media 2. Alberto Boschetti, Luca Massaron, "Python Data Science Essentials - Second Edition", Packt Publishing 3. Sebastian Raschka, "Python Machine Learning", Packt Publishing

	Supplementary literature	1. James R. Parker, "Python. An Introduction to Python Programming", Mercury Learning and Information 2. Krishna Kumar Mohbey, Brijesh Bakariya, "An Introduction to Python Programming: A Practical Approach", BPB Publications 3. Wes McKinney, "Python for Data Analysis. 3rd Edition", O'Reilly Media
	eResources addresses	
Example issues/ example questions/ tasks being completed	Guidelines for creating the report:1. Report Title2. Introduction motivation, objectives3. Data Description dataset structure, variables, origin4. Description of the Data Preparation Process step-by-step approach5. Data Analysis assumptions, brief overview of methods and chosen analysis methodology6. Data Modeling assumptions, brief overview of methods and chosen modeling methodology7. Results, Conclusions, and DiscussionThe report, along with all code, should be placed in a chosen repository (e.g., GitLab, GitHub).	
Practical activites within the subject	Not applicable	

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