GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Advanced Programming, PG_00044139
Field of study	Mathematics

Date of commencement of studies	October 2025	Academic year of realisation of subject	2025/2026
Education level	second-cycle studies	Subject group	
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	Institute of Applied Mathematics -> Faculty of Applied Physics and Mathematics -> Wydziały Politechniki Gdańskiej

Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. Paweł Pilarczyk
	Teachers	dr inż. Paweł Wojda
		dr hab. Paweł Pilarczyk

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	45.0	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	5.0	35.0	100

Subject objectives	Acquiring the ability to create software in Python at advanced level, including the usage of various software libraries, and applying this ability to solve specific mathematical problems, especially concerned with data analysis.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K7_W03] demonstrates knowledge advanced computation techniques, supporting the work of a mathematician and understand their limitations.	Can use Python libraries for processing and visualization of data.	[SW2] Assessment of knowledge contained in presentation
	[K7_W07] describes well symbolic computation software package and statistical data processing package.	Knows the principles of programming in Python and is familiar with software libraries related to data analysis and visualization.	[SW1] Assessment of factual knowledge
	[K7_U10] understands the mathematical foundations of the analysis of algorithms and computational processes, constructs algorithms with good numerical properties, used to solve typical and unusual mathematical problems	Can write software in Python. Can create software for solving selected mathematical problems.	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
	[K7_W06] analyzes the mathematical foundations of information theory, the theory of algorithms and cryptography and their practical applications, i.a. in programming and computer science.	Can choose appropriate algorithms, methods and software libraries for solving specific problems.	[SW1] Assessment of factual knowledge

Subject contents	Lecture:
	1. Introduction to programming in Python and to working with Jupyter notebooks.
	2. Built-in data types and syntax of Python.
	3. Data processing: vectors, matrices, data frames, strings. Access to files and Internet resources.
	4. Analysis and visualization of data.
	5. Software libraries related to data analysis, for example: NumPy - a library with numerical methods for Python that provides, among others, data structures and methods for working with large and high-dimensional vectors and matrices; SciPy - a library for scientific and technical computations; Pandas - a library for data analysis and manipulation.
	6. Object-oriented programming.
	7. Graphical user interface: Tkinter and PyQt.
	Laboratory: Hands-on experience in creating programs in Python for solving specific problems in the analysis and visualization of data, following the topics dealt with at the lecture.

Prerequisites and co-requisites	Basic programming skills. Familiarity with mathematical analysis, linear algebra and statistics at elementary level.

Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Tests and quizzes at the lectures	60.0%	50.0%
	Programming projects – laboratory	60.0%	50.0%

Recommended reading	Basic literature	[1] Marek Gągolewski, Maciej Bartoszuk, Anna Cena. Przetwarzanie i analiza danych w języku Python. Wydawnictwo Naukowe PWN, 2016. 400 ss. ISBN: 978-83-01-18940-2
		The textbook is available at the university library, also remotely through IBUK. The course is in Polish, and so is the textbook.
	Supplementary literature	[2] Mark Lutz. Learning Python, 5th Edition.
		[3] Data Science from Scratch: First Principles with Python, 2nd Edition.
	eResources addresses	

Example issues/ example questions/ tasks being completed	Text formatting in the Markdown language in a Jupyter notebook.
	Unchangeable data structures in Python.
	Copying objects in Python by value or by reference. Deep copy of a list.
	Crating a DataFrame object and using it.
	Creating various graphs using matplotlib.pyplot.
	Opening a file in different modes, reading and writing, closing the file.
	Generating pseudo-random samples following some distribution using the scipy.stats module.
	Linear regression in Python using the sklearn.linear_model module.
Work placement	Not applicable

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