

## 。 GDAŃSK UNIVERSITY OF TECHNOLOGY

## Subject card

| Subject name and code                          | Advanced Programming, PG_00044139   |  |   |                |                |   |         |     |  |
|--|---|--|---|----------------|----------------|---|---------|-----|--|
| Field of study                                 | Mathematics   |  |   |                |                |   |         |     |  |
| Date of commencement of studies                | October 2024  |  | Academic year of<br>realisation of subject  |                |                | 2024/2025   |         |     |  |
| Education level                                | second-cycle studies  |  | Subject group   |                |                | Specialty subject group<br>Subject group related to scientific<br>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  |                |                | 4.0   |         |     |  |
| Learning profile                               | general academic profile  |  | Assessment form   |                |                | assessment  |         |     |  |
| Conducting unit                                | Institute of Applied M  | athematics -> F                            | aculty of Appli   | ed Physics and | d Mathe        | matics  |         |     |  |
| Name and surname                               | Subject supervisor dr hab. Paweł Pilarczyk  |  |   |                |                |   |         |     |  |
| of lecturer (lecturers)                        | Teachers  |  | dr hab. Paweł Pilarczyk   |                |                |   |         |     |  |
|  |   | dr inž. Paweł Wojda                        |   |                |                |   |         |     |  |
| Lesson types and methods                       | Lesson type   | Lecture                                    | Tutorial  | Laboratory     | Project        |   | Seminar | SUM |  |
| of instruction                                 | Number of study hours   | 15.0                                       | 0.0   | 45.0           | 0.0            |   | 0.0     | 60  |  |
|  | E-learning hours included: 0.0  |  |   |                |                |   |         |     |  |
| Learning activity<br>and number of study hours | Learning activity   | Participation in<br>classes includ<br>plan | I didactic 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_W06] analyzes the<br>mathematical foundations of<br>information theory, the theory of<br>algorithms and cryptography and<br>their practical applications, i.a. in<br>programming and computer<br>science.                                   |  | Can choose appropriate<br>algorithms, methods and software<br>libraries for solving specific<br>problems.                                     |                |                | [SW1] Assessment of factual knowledge   |         |     |  |
|  | [K7_U10] understands the<br>mathematical foundations of the<br>analysis of algorithms and<br>computational processes,<br>constructs algorithms with good<br>numerical properties, used to<br>solve typical and unusual<br>mathematical problems |  | Can write software in Python.<br>Can create software for solving<br>selected mathematical problems.   |                |                | [SU1] Assessment of task<br>fulfilment<br>[SU4] Assessment of ability to<br>use methods and tools |         |     |  |
|  | [K7_W07] describes well symbolic<br>computation software package<br>and statistical data processing<br>package.   |  | Knows the principles of<br>programming in Python and is<br>familiar with software libraries<br>related to data analysis and<br>visualization. |                |                | [SW1] Assessment of factual<br>knowledge  |         |     |  |
|  | [K7_W03] demonstrates<br>knowledge advanced computation<br>techniques, supporting the work of<br>a<br>mathematician and understand<br>their limitations.  |  | Can use Python libraries for<br>processing and visualization of<br>data.  |                |                | [SW2] Assessment of knowledge contained in presentation   |         |     |  |

| 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-<br>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<br>and co-requisites | Basic programming skills. Familiarity with mathematical analysis, linear algebra and statistics at elementary level.  |   |                               |  |  |  |  |  |
| Assessment methods                 | Subject passing criteria  | Passing threshold   | Percentage of the final grade |  |  |  |  |  |
| and criteria                       | Programming projects – laboratory   | 60.0%   | 50.0%                         |  |  |  |  |  |
|                                    | Tests and guizzes at the lectures   | 60.0%   | 50.0%                         |  |  |  |  |  |
| Recommended reading                | Basic literature  | [1] Marek Gągolewski, Maciej Bartoszuk, Anna Cena. Przetwarzanie i<br>analiza danych w języku Python. Wydawnictwo Naukowe PWN, 2016.<br>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  | Adresy na platformie eNauczanie:<br>Zaawansowane programowanie 2024 - Moodle ID: 37140<br>https://enauczanie.pg.edu.pl/moodle/course/view.php?id=37140                  |                               |  |  |  |  |  |

| Example issues/<br>example questions/<br>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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