

Scientific Programming and Visualization with Python

Alessio Botta, Stefania Zinno, Giovanni Stanco

University of Napoli Federico II

Department of Electrical Engineering and Information Technologies

a.botta@unina.it stefania.zinno@unina.it, giovanni.stanco@unina.it

Introduction to Programming, Data Analysis, and Machine Learning with Python

This course provides a comprehensive and progressive overview of using Python for programming, data analysis, and an introduction to machine learning. The course guides students from the fundamentals of the Python language to advanced applications in data analysis and modelling. Students will acquire practical skills through hands-on exercises with real datasets, using visualization tools and Machine Learning frameworks commonly applied in the field.

Syllabus

1. Python Syntax Basics, Loops, and Data Structures

Date: 03/02/2026, 14.30 – 17.30, 3h

Content: Introduction to Python syntax, understanding basic concepts, and writing foundational code. Using for and while loops to automate repetitive tasks and efficiently manage iterations. Working with lists, tuples, dictionaries, and sets to structure and manage data effectively.

2. Numpy Arrays and Mathematical Operators, Basic Statistical Functions, Classes and Objects

Date: 04/02/2026, 14.30 – 17.30, 3h

Content: Utilizing Numpy arrays for numerical data operations and applying mathematical operators and basic functions for numerical computation. Applying statistical functions for descriptive data analysis, covering foundational methods for summarizing data. Introduction to object-oriented programming, focusing on using classes and objects to handle complex data and behaviors.

3. Plotting with Matplotlib

Date: 06/02/2026, 14.30 – 17.30, 3h

Content: Creating visualizations with Matplotlib, including one-dimensional, two-dimensional, and three-dimensional plots.

4. Dataset Elaboration with Matplotlib

Date: 09/02/2026, 14.30 – 17.30, 3h

Content: Practical exercise focused on using Matplotlib to create and interpret visualizations based on real-world datasets.

5. Pandas: Dataset Elaboration

Date: 11/02/2026, 14.30 – 17.30, 3h

Content: Managing, cleaning, and transforming structured data using Pandas, including practical dataset exercises.

6. Seaborn: Dataset Elaboration

Date: 13/02/2026, 14.30 – 17.30, 3h

Content: Advanced data visualization techniques using Seaborn, with a focus on creating detailed and visually appealing plots.

7. Scikit-learn: Clustering and Binary Classification

Date: 23/02/2026, 14.30 – 17.30, 3h

Content: Introduction to machine learning with Scikit-learn, covering clustering techniques to identify patterns in data and binary classification models for predictive tasks.

8. Test

Date: 26/02/2026, 14.30 – 17.30, 3h

Content: A review of all covered material, followed by a test to assess understanding and practical application skills.

Course Objectives

By the end of the course, students will have acquired the following skills:

- Programming in Python and using its main data structures.
- Using Numpy, Matplotlib, Pandas, and Seaborn for data analysis and visualization.
- Fundamentals of Machine Learning with scikit-learn, focusing on clustering and binary classification techniques.
- Practical application of data science tools and methodologies on real datasets.

This course is ideal for anyone looking to get started in Data Science and Machine Learning, providing a solid theoretical and practical foundation.

The course lasts **24 hours**, with **3- hour lessons**.

The course will involve practical assignments and a final test on the last day of the course. Students are required to bring their own laptops.