unibz
Fakultät für Ingenieurwesen
Facoltà di Ingegneria
Faculty of Engineering

COURSE DESCRIPTION – ACADEMIC YEAR 2025/2026

Course title	**Programming and Visualization for Data Science**
Course code	73081
Scientific sector	ING-INF/05
Degree	Master in Computing for Data Science (LM-18)
Semester	1
Year	1
Credits	12
Modular	Yes

Total lecturing hours	80
Total lab hours	40
Attendance	Not compulsory. Non attending students have to agree with the lecturer on the modalities of independent study at the beginning of the course.
Prerequisites	Basic programming concepts
Course page	https://ole.unibz.it/ and https://teams.microsoft.com/

Specific educational objectives	The course belongs to the type "caratterizzanti – discipline informatiche". **Module 1: Programmi**ng in Python The course is designed to provide specific professional skills for advanced programming in Python. The students will learn how to develop a Python program, starting from designing it, and going through coding, testing and validation. They will master Python in its full object-oriented features, learning how to develop complex programs that are well structured, and make use of techniques for code re-use, pipelining, maintenance, and deployment. **Module 2: Data Analysis and Visualization** The course is designed to acquire professional skills and knowledge useful when dealing with large-scale datasets. In particular, the students will master data collection, exploration, transformation, curation, analysis, and visualization, choosing the most appropriate technique for the data at hand. They will make insights from the data, supported by a rigorous data science pipeline, which starts with raw data, produces machine learning models, and ends with advanced visualizations. This module, addresses common pitfalls that can mislead the analysis and makes extensive use of specialized Python libraries, acquiring the best practices of reproducible, data-driven analysis and research.

Module 1	**Programming in Python**
Module code	73081A
Module scientific sector	INF/01
Lecturer	TBD

Contact	
Scientific sector of lecturer	INF/01
Teaching language	English
Office hours	Arranged beforehand by email
Lecturing assistant (if any)	--
Contact LA	--
Office hours LA	--
Credits	6
Lecturing hours	40
Lab hours	20
List of topics	• Introduction to Python and programming environment • Python data structures and programming primitives • Object-oriented programming in Python • Writing structured/reusable code in Python: functions, classes, libraries • Code documentation, testing, version-control, and distribution • Advanced Python programming
Teaching format	Frontal lectures, lab assignments, project work.

Module 2	**Data Analysis and Visualization**
Module code	73081B
Module scientific sector	ING-INF/05
Lecturer	Antonio Liotta
Contact	antonio.liotta@unibz.it
Scientific sector of lecturer	ING-INF/05
Teaching language	English
Office hours	Arranged beforehand by email
Lecturing assistant (if any)	--
Contact LA	--
Office hours LA	--
Credits	6
Lecturing hours	40
Lab hours	20
List of topics	• The data science pipeline: from raw data to advanced analytics and visualization • Data ingestion, exploration, cleaning, and pre-processing • Feature analysis and engineering • Machine learning for data modelling: clustering, classification and regression • Model tuning, validation, and testing • Advanced data visualization
Teaching format	Frontal lectures, lab assignments, project work.

Learning outcomes	Knowledge and understanding: • D1.1 - Knowledge of the key concepts and technologies of data science disciplines • D1.2 - Understanding of the skills, tools and techniques required for an effective use of data science

	• D1.3 - Knowledge of principles, methods and techniques for processing data in order to make them usable for practical purposes, and understanding of the challenges in this field • D1.9 - Knowledge of the challenges in the field of man-machine interface and of the methods and techniques for overcoming these challenges Applying knowledge and understanding: • D2.1 - Practical application and evaluation of tools and techniques in the field of data science • D2.4 - Ability to develop programmes and use tools for the analysis and management of data and related infrastructures • D2.8 - Practical application and evaluation of tools and techniques for data analysis • D2.9 - Design, application and evaluation of technologies and tools for human-machine interaction, data exploration and data visualization Making judgments • D3.2 - Ability to autonomously select the documentation (in the form of books, web, magazines, etc.) needed to keep up to date in a given sector. Communication skills • D4.1 - Ability to use English at an advanced level with particular reference to disciplinary terminology • D4.2 - Ability to present one's work in a clear and comprehensible way in front of an audience, including non-specialists • D4.3 - Ability to structure and draft scientific and technical documentation Learning skills • D5.3 – Ability to deal with problems in a systematic and creative way and to appropriate problem solving techniques.

Assessment	The exam modalities are the same for both the attending and the non-attending students. Project work (70% of the final grade) and oral exam (30% of the final grade). All project works must have been submitted, at the very latest, 15 days ahead of the oral exam. In case of a positive mark, the projects will count for all 3 regular exam sessions.
Assessment language	English
Assessment Typology	Collegial
Evaluation criteria and criteria for awarding marks	70% project work, 30% oral exam. • Relevant for project work: clarity of presentation, ability to gain useful and novel insights from data, creativity, critical thinking, ability to adhere to reproducible research best practices • Ability to use Python to write, evaluate and deploy advanced, object-oriented computer programs

	• Ability to use Python to employ (understand, recall and use) data analytics methods in practical settings, from data collection and curation, to data analysis, modelling and visualization.

Required readings	• *Data Visualization. A practical introduction.* Haley. Available online • *A layered grammar of graphics*. Wickham. Available online • *Python Data Science Handbook*, by Jake VanderPlas. O'Reilly Media (1st Edition, 2016). Subject Librarian: David Gebhardi, David.Gebhardi@unibz.it
Supplementary readings	• *Fundamentals of Data Visualization*. Wilke. Available online • *Visualization Analysis and Design*. Munzer. Amazon • *Data Visualization: Charts, Maps, and Interactive Graphics.* Grant. Amazon • *Doing Data Science*. Cathy O'Neil, Rachel Schutt. O'Reilly, 2013, https://www.oreilly.com/library/view/doing-data-science/9781449363871/ • *Python for Data Analysis.* By Wes McKinney. O'Reilly, 2nd Edition, 2017, https://www.oreilly.com/library/view/python-for-data/9781491957653/
Software used	• Jupyter Notebook (for Python programming)