Syllabus

Descrizione corso

Titolo insegnamento	Programming and Visualisation for Data Science
Codice insegnamento	27500
Titolo aggiuntivo	
Settore Scientifico-Disciplinare	INF/01
Lingua	Inglese
Corso di Studio	Corso di laurea magistrale in Data Analytics for Economics and Management
Altri Corsi di Studio (mutuati)	Loaned from course 73081 - Master in Computing for Data Science (LM-18)
Docenti	prof. Antonio Liotta, Antonio.Liotta@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/41903
Assistente	
Semestre	Primo semestre
Anno/i di corso	1
CFU	12
Ore didattica frontale	M1: 40 hours M2: - 24 hours of in-person lectures - 12 hours of video lectures (counted as 24 hours to account for re-watching)
Ore di laboratorio	40 (20 + 20)
Ore di studio individuale	-
Ore di ricevimento previste	M1: 18 hours M2: 18 hours
Sintesi contenuti	Module 1 provides a comprehensive introduction to Python programming, starting with the setup of the development environment and core programming constructs. Students will

	explore Python's data structures and programming primitives, progressing to object-oriented programming and the development of structured, reusable code using functions, classes, and libraries. Emphasis is placed on best practices in software development, including code documentation, testing, version control, and distribution. The module concludes with advanced Python programming techniques, preparing students to build robust and maintainable applications. Module 2 guides students through the complete data science pipeline, from raw data acquisition to advanced analytics and visualization. Students will gain hands-on experience in data ingestion, exploration, cleaning, and feature engineering, building a strong foundation for effective data modeling. The course covers key machine learning techniques—including clustering, classification, and regression—alongside model tuning, validation, and testing. Emphasis is placed on producing insightful and reproducible visualizations using specialized Python libraries, enabling students to communicate data-driven findings with clarity and impact.
Argomenti dell'insegnamento	Module 1 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 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.

Parole chiave	Python Programming; data science; data curation; data modeling; machine learning; data visualization.
Prerequisiti	Basic programming concepts. Linear algebra. Basic Statistics.
Insegnamenti propedeutici	
Modalità di insegnamento	The course adopts a blended, student-centered approach that emphasizes problem-based learning and active engagement. Selected lecture content is made available online in advance, enabling students to explore key concepts independently and at their own pace. This preparatory work allows in-person sessions to focus on applying knowledge through problem-solving, collaborative activities, and guided discussions—fostering critical thinking and deeper understanding. The teaching format combines frontal lectures, hands-on lab assignments, and project work, ensuring that students develop both theoretical knowledge and practical skills in python programming, and in data analysis, modelling, and visualization. The course is aligned with the principles of the EDUNEXT initiative (https://edunext.eu), promoted by Italian universities, which supports the integration of digital resources and active learning strategies in higher education.
Obbligo di frequenza	Not compulsory. Non attending students have to agree with the lecturer on the modalities of independent study at the beginning of the course.
Obiettivi formativi specifici e risultati di apprendimento attesi	
Obiettivi formativi specifici e risultati di apprendimento attesi (ulteriori info.)	
Modalità di esame	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.
Criteri di valutazione	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.
Bibliografia obbligatoria	*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
Bibliografia facoltativa	*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/
Altre informazioni	
Obiettivi di Sviluppo	Innovazione e infrastrutture, Istruzione di qualità

Sostenibile (SDGs)	

Modulo del corso

Titolo della parte costituente del corso	M1 - Introduction to programming for data science
Codice insegnamento	27500A
Settore Scientifico-Disciplinare	INF/01
Lingua	Inglese
Docenti	
Assistente	
Semestre	Primo semestre
CFU	6
Docente responsabile	
Ore didattica frontale	40
Ore di laboratorio	20
Ore di studio individuale	-
Ore di ricevimento previste	18
Sintesi contenuti	This module provides a comprehensive introduction to Python programming, starting with the setup of the development environment and core programming constructs. Students will explore Python's data structures and programming primitives, progressing to object-oriented programming and the development of structured, reusable code using functions, classes, and libraries. Emphasis is placed on best practices in software development, including code documentation, testing, version control, and distribution. The module concludes with advanced Python programming techniques, preparing students to build robust and maintainable applications.
Argomenti dell'insegnamento	This course provides students with advanced professional skills for developing robust and maintainable Python applications. It covers the full development lifecycle—from program design to implementation, testing, and validation. Students will master Python's object-oriented programming features and learn how to build well-structured, reusable, and modular code using functions, classes, and libraries. The course

	also introduces essential tools and techniques for code documentation, testing, version control, and distribution, preparing students for collaborative and production-level development environments.
Modalità di insegnamento	The course adopts a blended, student-centered approach that emphasizes problem-based learning and active engagement. Selected lecture content is made available online in advance, enabling students to explore key concepts independently and at their own pace. This preparatory work allows in-person sessions to focus on applying knowledge through problem-solving, collaborative activities, and guided discussions—fostering critical thinking and deeper understanding. The teaching format combines frontal lectures, hands-on lab assignments, and project work, ensuring that students develop both theoretical knowledge and practical programming skills. The course is aligned with the principles of the EDUNEXT initiative (https://edunext.eu), promoted by Italian universities, which supports the integration of digital resources and active learning strategies in higher education.
Bibliografia obbligatoria	*Python for Data Analysis.* By Wes McKinney. O'Reilly, 3nd Edition, 2022, https://www.oreilly.com/library/view/python-for-data/9781098104023/
Bibliografia facoltativa	Jupyter Notebook Documentation. https://jupyter-notebook.readthedocs.io/en/stable/

Modulo del corso

Titolo della parte costituente del corso	M2 - Data visualization and exploration
Codice insegnamento	27500B
Settore Scientifico-Disciplinare	INF/01
Lingua	Inglese
Docenti	prof. Antonio Liotta, Antonio.Liotta@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/41903

Assistente	
Semestre	Primo semestre
CFU	6
Docente responsabile	
Ore didattica frontale	- 24 hours of in-person lectures - 12 hours of video lectures (counted as 24 hours to account for re-watching)
Ore di laboratorio	20
Ore di studio individuale	-
Ore di ricevimento previste	18
Sintesi contenuti	This module guides students through the complete data science pipeline, from raw data acquisition to advanced analytics and visualization. Students will gain hands-on experience in data ingestion, exploration, cleaning, and feature engineering, building a strong foundation for effective data modeling. The course covers key machine learning techniques—including clustering, classification, and regression—alongside model tuning, validation, and testing. Emphasis is placed on producing insightful and reproducible visualizations using specialized Python libraries, enabling students to communicate data-driven findings with clarity and impact.
Argomenti dell'insegnamento	This course equips students with professional skills and knowledge essential for working with large-scale datasets. Through a hands-on and rigorous approach, students will learn to collect, explore, transform, curate, analyze, and visualize data—selecting the most appropriate techniques based on the nature and structure of the data. The course emphasizes the development of insights through a complete data science pipeline: starting from raw data, progressing through data preprocessing and machine learning modeling, and culminating in advanced visualizations. Students will gain practical experience using specialized Python libraries and will learn how to adopt best practices for reproducible, data-driven analysis and research. Common pitfalls in data analysis will be addressed, helping students to critically assess results and avoid misleading interpretations. By the end of the course, students will be able to design and implement robust analytical workflows that support decision-making and scientific inquiry.

Modalità di insegnamento	The course adopts a blended, student-centered approach that emphasizes problem-based learning and active engagement. Selected lecture content is made available online in advance, enabling students to explore key concepts independently and at their own pace. This preparatory work allows in-person sessions to focus on applying knowledge through problem-solving, collaborative activities, and guided discussions—fostering critical thinking and deeper understanding. The teaching format combines frontal lectures, hands-on lab assignments, and project work, ensuring that students develop both theoretical knowledge and practical data analysis, modelling, and visualization skills. The course is aligned with the principles of the EDUNEXT initiative (https://edunext.eu), promoted by Italian universities, which supports the integration of digital resources and active learning strategies in higher education.
Bibliografia obbligatoria	EN - Required readings *Data Visualization. A practical introduction.* Haley. Available online *A layered grammar of graphics*. Wickham. Available online
Bibliografia facoltativa	*Fundamentals of Data Visualization*. Wilke. https://www.oreilly.com/library/view/fundamentals-of-data/9781492031079/ *Visualization Analysis and Design*. Munzer. https://www.oreilly.com/library/view/visualization-analysis-and/9781466508910/ *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/