

Syllabus

Descrizione corso

Titolo insegnamento	Programming and Visualisation for Data Science
Codice insegnamento	73081
Titolo aggiuntivo	
Settore Scientifico- Disciplinare	
Lingua	Inglese
Corso di Studio	Corso di laurea magistrale in Informatica per la Data Science
Altri Corsi di Studio (mutuati)	
Docenti	prof. Antonio Liotta, Antonio.Liotta@unibz.it https://www.unibz.it/en/faculties/engineering/academic- staff/person/41903 dr. Ozan Kahramanogullari, Ozan.Kahramanogullari@unibz.it https://www.unibz.it/en/faculties/engineering/academic- staff/person/47253
Assistente	
Semestre	Primo semestre
Anno/i di corso	1
CFU	12
Ore didattica frontale	80
Ore di laboratorio	40
Ore di studio individuale	180
Ore di ricevimento previste	
Sintesi contenuti	 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 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
Argomenti	Module 1: Programming in Python
dell'insegnamento	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.
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	The course belongs to the type "caratterizzanti – discipline informatiche".
	The course is designed to provide specific professional skills for advanced programming in Python and professional skills and knowledge useful when dealing with large-scale datasets.
	 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 manmachine interface and of the methods and techniques for overcoming these challenges D1.12 - Basic knowledge of the main ethical and social implications of data science
	 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



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	analysis and management of data and related infrastructures
	D2.8 - Practical application and evaluation of tools and Lasterians for data and less
	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.
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, <u>David.Gebhardi@unibz.it</u>
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	Software used: Jupyter Notebook (for Python programming)
Obiettivi di Sviluppo Sostenibile (SDGs)	Innovazione e infrastrutture, Istruzione di qualità

Modulo del corso

Titolo della parte costituente del corso	Programming in Python
Codice insegnamento	73081A



Settore Scientifico- Disciplinare	INFO-01/A
Lingua	Inglese
Docenti	
Assistente	
Semestre	Primo semestre
CFU	6
Docente responsabile	
Ore didattica frontale	40
Ore di laboratorio	20
Ore di studio individuale	90
Ore di ricevimento previste	
Sintesi contenuti	 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
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	Data Analysis and Visualization
Codice insegnamento	73081B
Settore Scientifico- Disciplinare	IINF-05/A
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	40
Ore di laboratorio	20
Ore di studio individuale	90
Ore di ricevimento previste	



Sintesi contenuti

- 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

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	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/