Syllabus

Course Description

Course Title	Time Series Analysis
Course Code	73074
Course Title Additional	
Scientific-Disciplinary Sector	IINF-05/A
Language	English
Degree Course	Master in Computing for Data Science
Other Degree Courses (Loaned)	
Lecturers	Prof. Johann Gamper, Johann.Gamper@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/748
Teaching Assistant	
Semester	Second semester
Course Year/s	1
CP	6
Teaching Hours	40
Lab Hours	20
Individual Study Hours	90
Planned Office Hours	
Contents Summary	• Basics in time series: motivation, seasonality, univariate vs. multivariate • Similarity measures, search, indexing, correlation • Pre-processing: segmentation, representation, compression, normalization • Advanced analysis: classification, clustering, anomaly detection, motif discovery • Forecasting and missing value imputation • Time series database systems
Course Topics	This course will introduce one one hand basic principles and

	foundations of time series data as well as some advanced methods for the management and analysis of time series. In particular, students will learn various types and properties of time series, similarity measures, pre-processing operations, basic and advanced analysis operations, indexing mechanisms, and the management of time series in databases. This course, by combining theory and project-based learning, aims at providing on one hand a deep understanding of time series data and on the other hand practical skills to use, design and implement advanced time series analysis algorithms.
Keywords	Time series data, representation of time series, similarity metrics for time series, time series analysis, time series database systems
Recommended Prerequisites	Students should be familiar with basic concepts in probability theory and statistics, databases, and algorithms, as well as having good programming skills. These skills are taught in the following courses: Probability Theory and Statistics, Introduction to Databases, Computer Programming, and Data Structures and Algorithms.
Propaedeutic Courses	
Teaching Format	The course alternates frontal lectures and project-based learning, where students implement a project based on a research paper describing a state of the art analysis algorithm of time series data.
Mandatory Attendance	Attendance of classes and labs is not compulsory but highly recommended. In the classes new concepts are introduced, whereas in the labs we discuss problems that occur during the the implementation of the project and define (bi-)weekly milestones and deliverables. Non-attending students have to contact the lecturer at the start of the course to agree on the modalities of the independent study.
Specific Educational Objectives and Learning Outcomes	The course belongs to the type "attività formative caratterizzante-ambito Informatica" in the curriculum “Machine Learning”. This course, by combining theory and project-based learning, aims at providing on one hand a deep understanding of time series data and on the other hand practical skills to use, design and implement advanced time series analysis algorithms. 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 • D1.4 Sound basic knowledge of storing, querying and managing large amounts of data and the associated languages, tools and systems • D1.5 Knowledge of principles and models for the representation, management and processing of complex and heterogeneous data Applying knowledge and understanding: • D2.1 - Practical application and evaluation of tools and techniques in the field of data science • D2.2 - Ability to address and solve a problem using scientific methods 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 Learning skills • D5.3 - Ability to deal with problems in a systematic and creative way and to appropriate problem solving techniques.
Specific Educational Objectives and Learning Outcomes (additional info.)	
Assessment	The exam consists of two parts: • evaluation of the project implementation, the project report, and a final project presentation (60% weight); • theory questions about the course material (40% weight). Both parts must be positive. The final grade is calculated as the weighted average of the two grades.
Evaluation Criteria	The project, project report, and final presentation are evaluated along the following criteria:

	• correct implementation of the project, • completeness with respect to the indicated objectives and tasks, • clarity and quality of the project report and presentation. The oral exam applies the following criteria: • clarity, completeness and correctness of the answers.
Required Readings	There is no specific textbook that covers the entire course material, which is collected mainly from research papers and some text books. Lecture notes will be distributed, which cover all topics and provide sufficient details. They also provide links to research papers and/or text books, which allow students to deepen their understanding and extend their knowledge.
Supplementary Readings	Additional material and readings provided in class by the lecturer.
Further Information	Software used: For the implementation of the project, students can use tools and programming languages of their choice (e.g., Java, C, Python, etc.). For the management of time series data we will use the PostgreSQL database management system.
Sustainable Development Goals (SDGs)	Quality education