

Syllabus

Descrizione corso

Titolo insegnamento	Advanced Data Management for Artificial Intelligence: Knowledge Graphs and Vector Databases
Codice insegnamento	71084
Titolo aggiuntivo	
Settore Scientifico-Disciplinare	IINF-05/A
Lingua	Inglese
Corso di Studio	Corso di Dottorato di ricerca in Scienze e Tecnologie informatiche
Altri Corsi di Studio (mutuati)	
Docenti	prof. Alessandro Artale, Alessandro.Artale@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/3026
Assistente	
Semestre	Secondo semestre
Anno/i di corso	2026/27
CFU	2
Ore didattica frontale	20
Ore di laboratorio	0
Ore di studio individuale	25
Ore di ricevimento previste	
Sintesi contenuti	This course aims to equip Ph.D. students with: A solid understanding of modern data management paradigms, focusing on Knowledge Graphs and Vector Databases. The ability to model, query, and reason over semantic data using RDF, OWL, and SPARQL. Practical skills in designing and querying Virtual Knowledge Graphs with tools like Protégé and Ontop. Knowledge of vector-based similarity search, indexing techniques, and the use of systems like Milvus.

	The competence to critically assess and apply these technologies in AI research and applications.
Argomenti dell'insegnamento	Knowledge Graphs RDF and OWL Query Answering over KGs Virtual Knowledge Graphs Vector Databases KNN Approximated KNN RAG
Parole chiave	Knowledge Graphs RDF and OWL
Prerequisiti	
Insegnamenti propedeutici	
Modalità di insegnamento	Frontal Lectures
Obbligo di frequenza	Attendance is not mandatory but strongly recommended. Non-attending students must contact the lecturer at the start of the course to agree on the modalities of the independent study.
Obiettivi formativi specifici e risultati di apprendimento attesi	D1 - Knowledge and Understanding - Understand the principles of semantic data representation using RDF, OWL, and SPARQL. - Demonstrate deep knowledge of virtual knowledge graphs, description logics, and vector database technologies. - Grasp the integration of symbolic and vector-based approaches in AI systems, including RAG. D2 - Applying Knowledge and Understanding - Design and query ontologies and knowledge graphs using tools such as Protégé and Ontop. - Build and optimize vector search systems, similarity measures, and indexing structures. - Implement retrieval-augmented pipelines combining vector search and large language models. D3 - Making Judgements - Critically assess semantic and vector-based methods for data management and AI integration. - Evaluate modeling and system design choices based on

	scalability, expressiveness, and performance. - Analyze and interpret experimental results to improve system design and methodology. D4 - Communication - Clearly present complex technical content in both academic and interdisciplinary settings. - Produce well-structured documentation, presentations, and research papers in the field. D5 - Learning Skills - Independently explore advanced literature and technologies in semantic and AI-driven data systems. - Design and conduct original research projects, demonstrating scholarly autonomy and innovation.
Obiettivi formativi specifici e risultati di apprendimento attesi (ulteriori info.)	
Modalità di esame	The final exam will consist of either: A critical presentation based on scientific literature, or A small applied project related to the course topics (e.g., knowledge graphs, vector databases, retrieval-augmented generation).
Criteri di valutazione	Evaluation will be on a pass/fail basis, according to the following criteria: 1. Relevance and Understanding - The work demonstrates a solid grasp of the selected topic and its connection to the course content. 2. Analytical and Critical Thinking - The student shows the ability to analyze and explain key concepts, methods, or design choices. 3. Technical or Conceptual Accuracy - Presentations accurately synthesize the literature; projects are functional and coherent. 4. Communication and Clarity - The student clearly presents the material and responds appropriately to questions. To pass, students must meet acceptable standards in all areas. Outstanding work may be acknowledged informally during feedback.
Bibliografia obbligatoria	All the required reading material will be provided during the course

	and will be available in electronic format. Copy of the slides will be available as well. While not strictly required, a useful reference for the first part of the course is An Introduction to Description Logic by Franz Baader, Ian Horrocks, Carsten Lutz, and Uli Sattler (Cambridge University Press).
Bibliografia facoltativa	Scientific papers and additional books will be specified on each course topic during lectures.
Altre informazioni	Protege, Ontop, Milvus
Obiettivi di Sviluppo Sostenibile (SDGs)	Istruzione di qualità