

Syllabus

Kursbeschreibung

Titel der Lehrveranstaltung	Advanced Data Management for Artificial Intelligence: Knowledge Graphs and Vector Databases
Code der Lehrveranstaltung	71084
Zusätzlicher Titel der Lehrveranstaltung	
Wissenschaftlich-disziplinärer Bereich	IINF-05/A
Sprache	Englisch
Studiengang	Doktoratsstudium in Informatik
Andere Studiengänge (gem. Lehrveranstaltung)	
Dozenten/Dozentinnen	Prof. Davide Lanti, Davide.Lanti@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/34107
Wissensch. Mitarbeiter/Mitarbeiterin	
Semester	Zweites Semester
Studienjahr/e	1
KP	2
Vorlesungsstunden	20
Laboratoriumsstunden	0
Stunden für individuelles Studium	50
Vorgesehene Sprechzeiten	
Inhaltsangabe	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.
Themen der Lehrveranstaltung	- Knowledge Graphs - RDF and OWL - Query Answering over KGs - Virtual Knowledge Graphs - Vector Databases - KNN - Approximated KNN - RAG
Stichwörter	Knowledge Graphs; Vector Databases
Empfohlene Voraussetzungen	
Propädeutische Lehrveranstaltungen	
Unterrichtsform	Lectures. In person.
Anwesenheitspflicht	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.
Spezifische Bildungsziele und erwartete Lernergebnisse	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.
Spezifisches Bildungsziel und erwartete Lernergebnisse (zusätzliche Informationen)	
Art der Prüfung	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).

Bewertungskriterien	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.
Pfichtliteratur	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 <i>An Introduction to Description Logic</i> by Franz Baader, Ian Horrocks, Carsten Lutz, and Uli Sattler (Cambridge University Press). Subject Librarian: David Gebhardi, David.Gebhardi@unibz.it and Ilaria Miceli, Ilaria.Miceli@unibz.it
Weiterführende Literatur	Scientific papers and additional books will be specified on each course topic during lectures.
Weitere Informationen	Protege, Ontop, Milvus
Ziele für nachhaltige Entwicklung (SDGs)	Hochwertige Bildung