Foundations of Semantic Knowledge Graphs

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Organisational Matters (Kick-Off)

Objectives ◎

After completing the course, students are able to...

- understand **concepts**, **technologies** and **languages** used the create semantic knowledge graphs
- differentiate semantic knowledge graphs from other **graph-based data structures** (so-called data graphs)
- build ontologies and define the **formal**, **model-theoretic semantics** to be used in a knowledge graph
- **query** knowledge graphs using standard semantic query languages (e.g. SPARQL)
- make judgements about the **meaningfulness** (ie. expressivity) of knowledge representation frameworks and domain modelling languages
- understand what **semantics** mean in a machine-processable context
- understand the knowledge representation frameworks used in popular KG applications

We will talk about... 👉

- the **mathematical foundations** of modern knowledge graphs
- the **domains** in which KGs can be applied and are used
- the different **types** of KGs and the elements that separates them
- how KGs can be represented electronically, i.e., in a **machine-processable** way
- the role **semantics** play in processing KG elements
- what **RDF/S** is and how RDF can be used to represent KGs
- how **domain knowledge** can be encoded in RDFS and what limitations exist in terms of expressivity
- the role of **ontologies** in KGs and how to define them using SOTA ontology languages
- how to **query** KGs
- different associated, peripherial **topics** related to KGs and their application (see topics list)

How this Module is structured

The module consists of **7 main parts**:

1. Introduction to knowledge graph concepts and terminology
2. Knowledge representation frameworks
3. Methods for ontology and knowledge graph construction
4. Query languages for semantic knowledge graphs (SPARQL)
5. Application and use cases of semantic knowledge graphs (information integration, query answering, navigation support etc.)
6. Individual project work and supervision
7. Student lectures (ie. semester projects) and final assessment

Preliminary Schedule

- Week 1: Kick-off and organisational matters
- Week 2: Knowledge, Graphs, and Semantics
- Week 3: Introduction to RDF
- Week 4: RDF Serialization + Introduction to RDF Schema (RDFS)
- Week 5: Reasoning in RDFS
- Week 6: Ontologies and Expressive KG Languages
- Week 7: Querying RDF Graphs
- Week 8 - 9: Preparation of student tutorials
- Week 10 - 13: student tutorials
- Week 14: short written or oral examination (30min) during the learning week

Lecture and Practical Sessions

- **Lecture**: 📅 WED, 1st Block (8:30 - 10:00)
  - conducted in a seminal style
  - with many examples – but also theoretical background information
  - discussion of homework
- **Practical Sessions** (⇝ ✎ independent work)
  - weekly tasks in moodle (see slots)
  - no in-class lecture
  - discussions in plenum in the next lecture
  - I will not check the homework – I trust that you are interested in the topics and work through them on your own
  - I am available online/offline for discussion / feedback / support / etc.

Lecture Material 🕮

The **Moodle course** (https://lernen.h-da.de/course/view.php?id=20070) hosts all relevant lecture material

- The course and all material are freely available
- no key needed
- please enter your names for the semester projects (tutorials) (--> see corresponding activity)
- use the **discussion forum** for questions
- Announcements will be communicated via the Moodle course
- Semester projects uploaded by the students (the resp. slots will be created during the semester)

Semester Project (general)

- Practical application of KG technology
  - in a software project adressing a defined and agreed goal
- Conducted in teams of 2-3 members
- Topic will be defined in coordination with the lecturer
- Final results will be presented during the last course weeks

Semester Project (Summer Term 2023)

Objective: The semester project gives you the chance to individually work trough a topic of interest and teach others about it in form of a self-designed lecture in tutorial style.

- Teamwork with up to 3-4 students
- Choosing a topic from the **topics list** (see Moodle) and presenting it in form of a **tutorial**
  - provide the necessary theoretical background information
  - create and conduct practical exercises to help the audience in becoming more familiar with SOTA concepts and technologoies of your topic
  - use any didactic tools you like (quizzes, interactive tools, gamification, group work, etc)
- Upload slides and lecture material to Moodle beforehand so that other can access it
- The lecture should be **approx. 60 minutes**
- Afterwards, there is a feedback session and an assessment session
- The grading will be caluculated from the scores of the lecturer (50%) and the audience (50%)

There will be separate slots for each topic.
Each group receives a score from the lecturer and all other attendees. The score sheets will be made available online (the necessary information will be communicated during the semester).

Grading

Your **final mark** will be composed of two single scores

- 70% score of the **semester project**
- 30% mark of the **written** or **oral examination** at the semester's end

Questions ?