Foundations of Linked Data - Summer 2024
Welcome and Introduction

Prof. Dr. Andreas Harth

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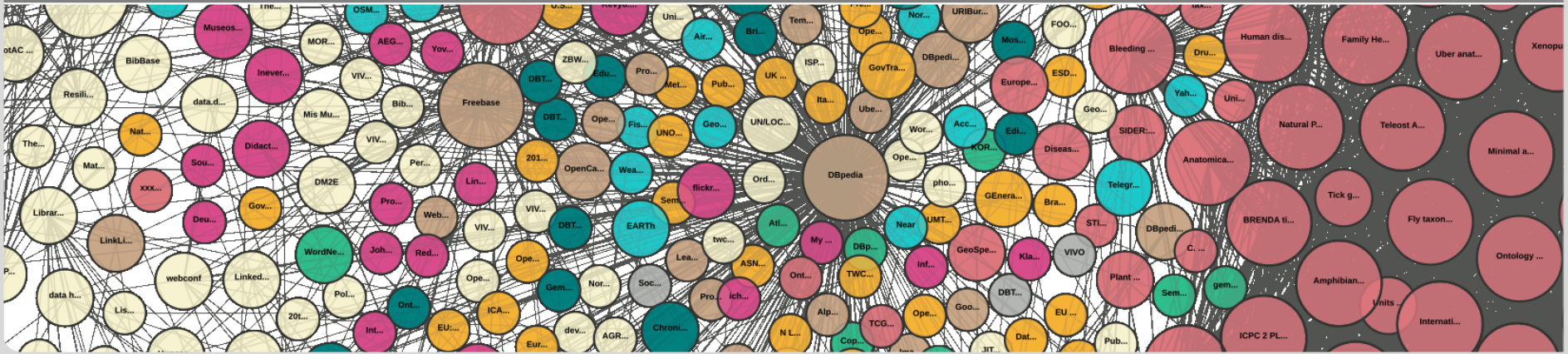
CHAIR OF TECHNICAL INFORMATION SYSTEMS



Agenda

- **Overview**
- Lecturers
- Course Organisation
- Content
- Theses and Jobs

What is Foundations of Linked Data?

- What is Linked Data?

  Linked Data describes the concept in transforming the Web of documents to a Web of data.

- What is meant by Foundations?

  Foundations of Linked Data is an introductory course. The course covers the basic theoretical and practical knowledge to start applying Linked Data.

- How can I learn more?

  We do not offer an advanced Linked Data course. However, we are offering thesis and practical seminar topics in this field.

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- What is Foundations of Linked Data?
- **Who will you learn from?**
- Course Oganisation
- Content
- Theses and Jobs

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Lecture Team: Prof. Dr. Andreas Harth

- Research topics: Semantic Web, Linked Data, Web Architectures, Rule-based Systems, and Knowledge Graphs
- Professor, FAU (since 2018)
- Leader of department “Data Spaces and IoT Solutions” at Fraunhofer SCS (since 2018)
- Project lead, Karlsruhe Institute of Technology (2009 - 2018)
- Ph.D. Digital Enterprise Research Institute (DERI), National University of Ireland, Galway, Topic: Exploring Linked Data at Web Scale

Lecture Team: Jun.-Prof. Dr. Maribel Acosta

- Research topics: Databases, Semantic Web, and Artificial Intelligence
- Junior Professor, Databases and Information Systems, at Ruhr-Universität Bochum (since 2020)
- Deputy Professor, Web Science at Karlsruhe Institute of Technology (2020)
- Dissertation on "Query Processing over Graph-structured Data on the Web"
- Find out more about me

Lecture Team: Dr.-Ing. Tobias Käfer

- Research topics: Semantic Web, Linked Data, Web Architectures, Rule-based Systems, and Knowledge Graphs
- Deputy Professor, Web Science at Karlsruhe Institute of Technology (since 2020)
- Junior Research Group Leader for Knowledge Graph-based AI Systems
- Coordinator of the COST Action 19134, a European network on the topic of Distributed Knowledge Graphs
- PhD thesis “Behaviour on Linked Data”
- Find out more about me

Lecture Team: Thomas Wehr

- Research topics: Semantic Web, Linked Data, and Web of Things
- Research Associate, Chair of Information Systems, especially Technical Information Systems (since 2024)
- M.Sc. in Computer Science, Friedrich-Alexander-University Erlangen-Nürnberg
- Master thesis “Improving Interoperability of Wearables by integrating them into the Web of Things”
- Find out more about me

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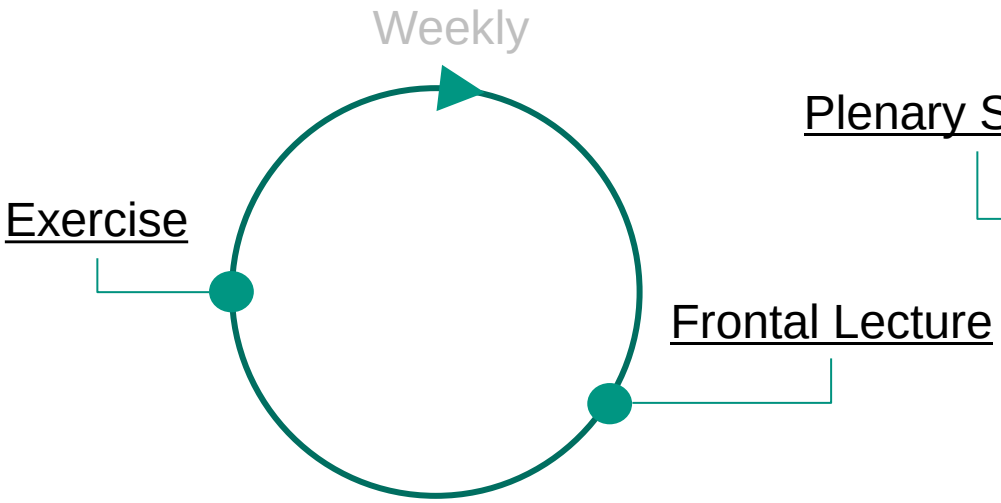
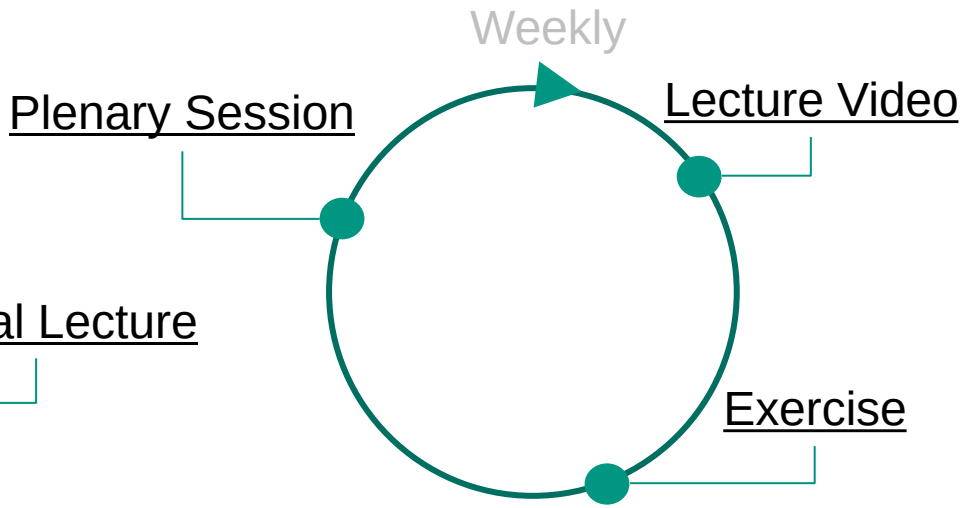
Our Inverted Classroom Concept



Traditional Teaching Concept



Inverted Classroom Concept

Our Inverted Classroom Concept

- The Inverted Classroom (or Flipped Classroom) concept describes a blended learning approach where new learning material is consumed by students on their own before discussing the material in the group together with the lecturer.
- The discussion round is referred to as Plenary Session.
- In the Plenary Session, the lecturer summarizes the learning material, asks about specific elements and initates discussions.
- Learning material is provided in form of videos on FAU.tv one week before the Plenary Session.
- The benefit of having pre-recorded videos of the learning material is that you can expect the videos to have a better audio quality and if you did not understand something, you can rewind.

Lectures and Exercises

- Lecture slides will be provided at least one week before the Plenary Sessions.
- Plenary Sessions take place Wednesdays from 13:15 to 14:45 in LG H6 and in Zoom. The plenary session will NOT be recorded.
- Exercises are also held in Zoom and will NOT be recorded.
- All course related study materials will be uploaded in the course StudOn instance.

See the syllabus for more information.

Exam

- The 60min written exam will be in English but may be answered in German.
- The exam’s content is based on the Learning Goals that can be found at the end of each chapter presentation.
- An 0.3/0.4 grade improvement can be achieved by solving all three bonus tasks before their due dates.
- The written examination takes place during the official exam period.
- You must register for the exam on Campo.

Bonus Tasks

- The bonus tasks are practical exercises to deepen your understanding of publishing and consuming Linked Data.
- The bonus tasks will be sequentially published, because each task depends on its predecessor. The exact schedule when a task is published, and when it must be submitted is marked in the syllabus.
- The structure is as follows:
  - In the first task, you must write and publish an RDF document.
  - In the second task, you must query RDF documents with SPARQL.
  - In the third task, you must map entities with OWL.

StudOn

- It is important to join the StudOn instance of this course, because lecture slides, exercises and additional learning material is published there.
- Sign up at https://www.studon.fau.de/crs5533245_join.html. If you encounter any problems to join, write a mail to the FLD-coordination
- Important announcements are published in StudOn, please check the course instance in StudOn regularly.
- ***[Very important!!!]*** Please post all the course related questions in the StudOn forum. We encourage you to answer questions you know the answer for. Nonetheless, we will answer all questions as soon as we can.

Tip: Study in groups

- Our experience shows, that students benefit greatly from studying in groups
  - Helps with procrastination, understand information more efficiently, minimize test anxiety, different perspectives, …

- To help you find a study group we created a classroom in GatherTown for you to meet virtually

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Overall Goals

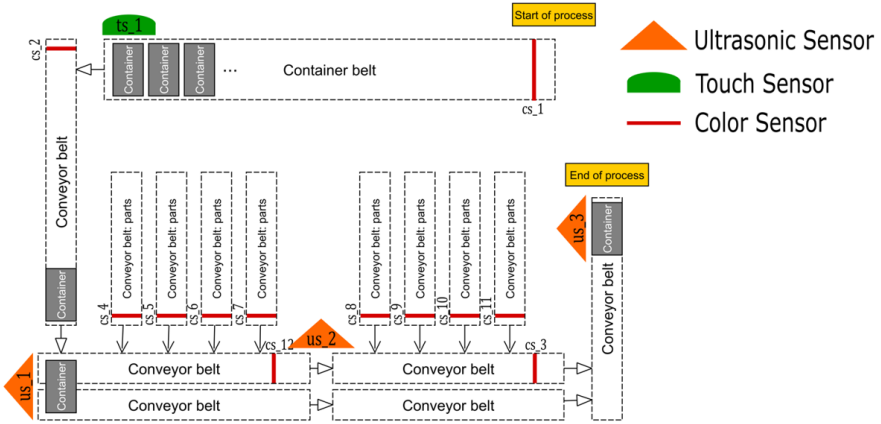
- You can access, model, and publish data on the web.
- You can integrate and query data from multiple Web sources.
- You can manipulate data and can create applications based on components with a Linked Data interface.
- You can perform reasoning on data.
- You can apply all these technologies to build Enterprise Knowledge Graphs.

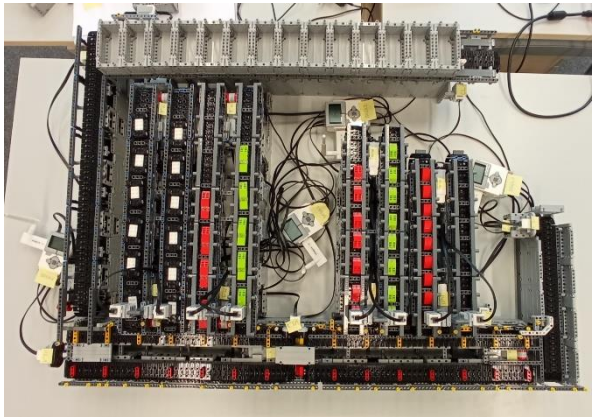
Major Topics

- Lecture 1 – 3, 6 – 7: reading, writing, and publishing RDF (Resource Description Framework) documents in Turtle syntax on the Web.
- Lecture 4 – 5, 11: querying local and remote data with SPARQL (SPARQL Protocol And RDF Query Language) while understanding its algebra.
- Lecture 8 – 10: design vocabularies and ontologies and integrate data while taking into account the semantics of RDFS (Resource Description Framework Schema) and OWL (Web Ontology Language).

Web of Things - LinkedLego

- Interoperability Problem: “all Cyber-Physical Systems within the same production plant or from different production houses, are able to connect, communicate, and exchange information, knowledge, modules, and expertise with each.” [1]
- Proposed Solution: Use the Linked Data Principles to publish data and resources.
- Development of a demonstrator called LinkedLego



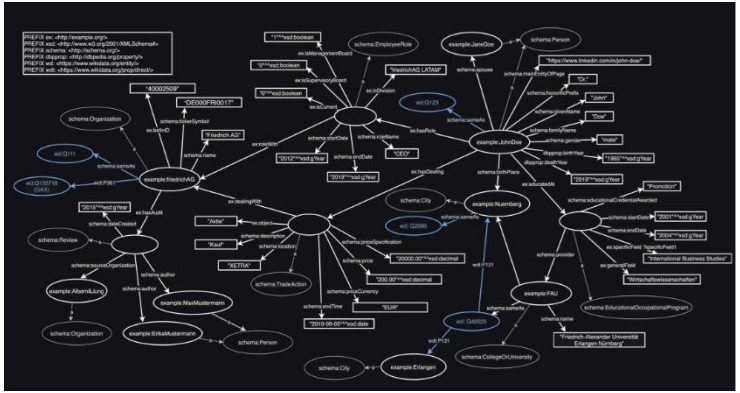


[1] Sinha, Devarpita, and Rajarshi Roy. "Reviewing cyber-physical system as a part of smart factory in industry 4.0." IEEE Engineering Management Review 48.2 (2020): 103-117.

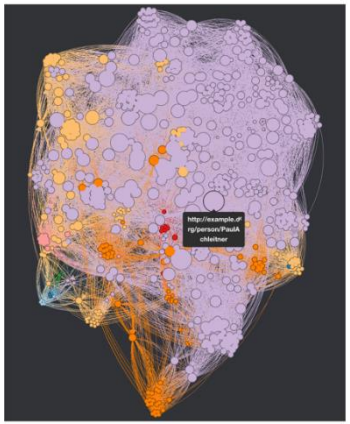
Fraunhofer IIS

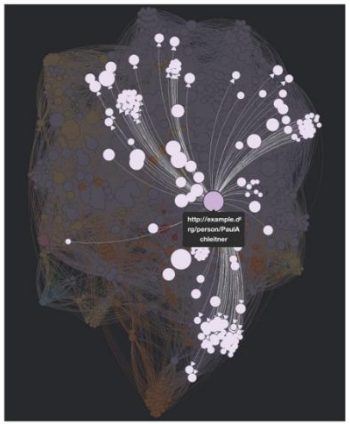
ExecGraph

- Auditing Problem: The aftermath or impact of relationships among CEOs or CEOs in spé are hard to grasp. For instance, is it relevant if they attended the same university?
- Proposed Solution: Use Linked Data to understand the impact of relationships among CEOs.
- Development of a browsable Knowledge Graph



Ontology of execGraph in RDF





Visualization of execGraph

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Theses

- Main thesis topics are focused on Linked Data, Semantic Web, Knowledge Graphs and the Internet of Things/Web of Things.
- Some thesis topics, however, focus on microcontrollers with sensors and actuators, Natural Language Processing, chatbots, Computer Vision, Virtual Reality
- Our theses have in general a programming component. If you are interested to write your thesis at our Chair, we recommend to work at least the prior three month as a working student at the Chair or at Fraunhofer IIS, or to take our practical seminar in preparation of a thesis topic.
- It is possible to write your master thesis in cooperation with DATEV within the software campus framework.

TI-Softwarecampus Program

Requirements:

- Master students in 1. or 2. semester / FLD must be completed before or during program.
- Student works at least 4 months at TI, before software campus application is supported.
- Student must be fluent in German and must have practical programming experience.

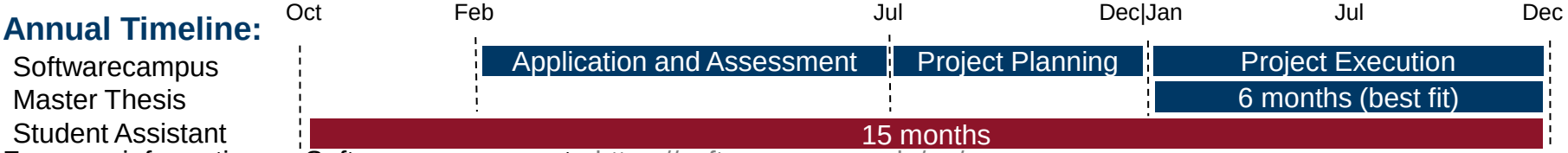
Content:

- Student manages research project with 50.000 € funding in cooperation with industrial partners
- Student coordinates tasks between one research associate and two student assistants
- Student completes the master thesis as part of the program
- Duration: 3 semesters

Benefits:

- More than 1-year experience in research (interesting for future PhD students)
- Contact to renowned industrial partners (it is common to directly receive a job offer from cooperation partner)
- Experience in leadership including 6 leadership workshops

Annual Timeline:



For more information on Softwarecampus, go to https://softwarecampus.de/en/ .

If you are interested in this program, contact Prof. Harth after the lecture or via email.

Job Offerings

- We are always looking for students who are interested in (Semantic) Web technologies at the Chair and at the Fraunhofer Group Data Spaces and IoT-Solutions.
- We recommend unsolicited applications, as we do not regularly publish open positions.
- Most students have a 10h/12h per week contract.
- Applicants should be experienced in one of the following programming languages: Python, JavaScript, TypeScript.

Contact

- How to find us

  The Chair of Information Systems – Technical Information Systems is located at the School of Business and Economics in Lange Gasse 20, 90403 Nürnberg (Germany). Room 4.435– 4.446.

- For more information, see our website

- Use the StudOn forum for any questions related to the course “Foundations of Linked Data” or send a mail to FLD-coordination