GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2024-2025

Knowledge Graphs (E018160)

Course size *(nominal values; actual values may depend on programme)*

Credits 3.0 **Study time 90 h**

Course offerings and teaching methods in academic year 2024-2025

A (semester 2)	English	Gent	practical	15.0h
			lecture	30.0h

Lecturers in academic year 2024-2025

Colpaert, Pieter	TWO6	lecturer-in-charge
Verborgh, Ruben	TWO6	co-lecturer

Offered in the following programmes in 2024-2025	**crdts**	**offering**
Bridging Programme Master of Science in Bioinformatics(main subject Engineering)	3	A
Master of Science in Bioinformatics(main subject Engineering)	3	A
Master of Science in Computer Science Engineering	3	A
Micro-credential Knowledge Graphs	3	A

Teaching languages

English

Keywords

Semantic Web technologies, Web Querying, Linked Data, Knowledge Graphs, Open Data, Big Data, Data Spaces, FAIR, information technology, data architecture, HTTP, Solid, RDF, interoperability

Position of the course

Managing data on one machine for one specific kind of use is fairly straightforward. It is from the moment that that initial dataset needs to be shared with more than one application and needs to be combined with other datasets managed by other organizations on different machines, that more complex computer science and information technology problems arise. In this course we will deep-dive in the current state of the art in creating Knowledge on Web-Scale. Your personal data, data published publicly on the Web and data explicitly shared with you, becomes your Knowledge Graph that applications and services can use to assist you in your day to day activities.
Data scientists and engineers today claim 80% of their time goes to preparing and integrating the data: let us take you on a quest to fully automate data integration.

Contents

- Open Data
  - Web Scraping
  - Legal aspects of data reuse
  - Findable, Accessible, Interoperable and Reusable data
  - Open Data portals
- The quest for the universal data model
  - Knowledge Representations: key–val, resource-based, triple-based
  - Linked Data and the RDF data model
  - Linked Data and its serializations
  - Property graphs and RDF*
  - Logic with N3
- Data Architectures
  - Linked Data Fragments
  - Event sourcing and Linked Data Event Streams
  - RDF Stream Processing

    - The Open World Assumption
    - Conway's law
  - Web Querying
    - An introduction to SPARQL
    - Querying endpoints
    - Link Traversal
    - Hypermedia-based querying
    - Data summaries
  - Building Linked Data spaces
    - Data Spaces with IDSA
    - Metadata management with DCAT
    - Identity management with Solid-OIDC
    - Authorization and policies with WAC, ACP, ODRL and N3 rules
    - Personal data management with Solid
    - Cross-app interoperability with Solid
    - Data provenance with PROV-O, P-Plan, SDS
    - Ontology engineering with SKOS, RDFS and OWL
    - Validating RDF and building application profiles with SHACL and ShEx

Guest Lectures from European data tech companies and data publishers

Initial competences

- Being able to read HTTP messages (URL, method, body, response codes, headers…)
- Executing HTTP requests via the browser and the command-line
- Reading and writing data from/in a CSV-file, a JSON-file and relational databases
- Making small JavaScript programs in the browser and Node.js (reading files, performing HTTP interactions)

Final competences

1 Arguing the positioning, importance, and limitations of open data
2 Choosing the appropriate Web API to publish knowledge graphs
3 Modeling data as RDF graphs
4 Publishing knowledge graph on the Web from raw data
5 Designing a data architecture with fully automated data adoption and assessing trade-offs
6 Building a Linked Data vocabulary and application profile in RDF
7 Interpreting and creating SKOS, RDFS, and OWL constraints
8 Interpreting provenance of RDF data
9 Performing validation on RDF data
10 Querying the Web of Linked Data using Comunica
11 Positioning the industry opportunities and challenges on graph data

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Lecture, Practical

Study material

None

References

- Aidan Hogan, Eva Blomqvist, Michael Cochez, Claudia d'Amato, Gerard de Melo, Claudio Gutierrez, Sabrina Kirrane, José Emilio Labra Gayo, Roberto Navigli, Sebastian Neumaier, Axel-Cyrille Ngonga Ngomo, Axel Polleres, Sabbir M. Rashid, Anisa Rula, Lukas Schmelzeisen, Juan Sequeda, Steffen Staab, Antoine Zimmermann (2021) Knowledge Graphs, Synthesis Lectures on Data, Semantics, and Knowledge, No. 22, 1–237, DOI: 10.2200/S01125ED1V01Y202109DSK022, Morgan & Claypool
- Jose E. Labra Gayo, Eric Prud'hommeaux, Iovka Boneva, Dimitris Kontokostas (2018) Validating RDF Data, Synthesis Lectures on the Semantic Web: Theory and Technology, Vol. 7, No. 1, 1-328, DOI: 10.2200/S00786ED1V01Y201707WBE016, Morgan & Claypool

Course content-related study coaching

- contact with the lecturers (through email and in person after appointment)
- supervised labs

Assessment moments

end-of-term and continuous assessment

Examination methods in case of periodic assessment during the first examination period

Oral assessment

Examination methods in case of periodic assessment during the second examination period

Oral assessment

Examination methods in case of permanent assessment

Peer and/or self assessment, Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is possible in modified form

Extra information on the examination methods

- Non-periodical evaluation
  - labs in groups
- Periodical evaluation
  - oral examination
  - written preparation
  - open book and open Web

Calculation of the examination mark

The final grade is the average grade of the two parts (exam and labs).
In case the grade for any part is less than 10/20, the final grade is capped at 9/20.
In case the grade for any part is 7/20 or less, the final grade is capped at 7/20.
For students who have not passed the permanent evaluation, an alternative assignment is provided in the second examination period. Depending on the situation, it may be in a group and/or may be an extension of the original assignment.

Facilities for Working Students

Possibility to perform an individualized version of the practical sessions, given a timely notification at the start of the semester.