COURSE DESCRIPTION CARD - SYLLABUS

Course name
Knowledge modeling tools

Course

Field of study
Computing

Year/Semester
1/1

Area of study (specialization)
Artificial Intelligence

Profile of study
general academic

Level of study
Second-cycle studies

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
15

Laboratory classes
15

Other (e.g. online)

Tutorials

Projects/seminars

Number of credit points

3

Lecturers

Responsible for the course/lecturer:
Agnieszka Ławrynowicz, Ph.D., D.Sc.
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Faculty of Computing and Telecommunications

Responsible for the course/lecturer:

Prerequisites

A student starting this course should have basic knowledge of Internet technologies (including XML and JSON data representation formats), basics of logic and databases, basics of artificial intelligence and Python programming. The student should also have the ability to obtain information from the indicated sources and be ready to cooperate as part of the team. Moreover, in terms of social competences, the student must present such attitudes as honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, respect for other people.

Course objective

Provide students with basic knowledge of methods, technologies and tools for knowledge modeling. Discussion of good practices of knowledge representation on the Web and knowledge engineering. Presentation of the application of knowledge representation methods and tools (e.g., knowledge extraction from text, integration of information from heterogeneous sources, semantic search or recommendation systems in specific application scenarios). Developing students' problem-solving skills in using and designing systems utilizing knowledge processing technologies.

Course-related learning outcomes

Knowledge

Student:

1. Has advanced and in-depth knowledge of broadly understood knowledge-based information systems, theoretical foundations for their construction, and programming methods, tools and environments used for their implementation [K2st_W1]

2. Has a structured and theoretically founded general knowledge related to key issues in the field of knowledge engineering [K2st_W2]

3. Has advanced and detailed knowledge of selected issues in the field of knowledge engineering [K2st_W3]

4. Has knowledge of development trends and the most important new achievements of computer science and other selected related scientific disciplines within the area of knowledge engineering [K2st_W4]

5. Knows advanced methods, techniques and tools used in solving complex engineering tasks and conducting research in the area of knowledge engineering [K2st_W6]

Skills

Student:

1. Can obtain information from literature, databases and other sources (in Polish and English), integrate them, interpret and critically evaluate them, draw conclusions and formulate and exhaustively justify opinions [K2st_U1]

2. Can plan and carry out experiments, including measurements and computer simulations, interpret the obtained results and draw conclusions as well as formulate and verify hypotheses related to complex engineering problems in the field of knowledge engineering and simple research problems [K2st_U3]

3. Can use analytical, simulation and experimental methods to formulate and solve engineering tasks in the field of knowledge engineering and simple research problems [K2st_U4]

4. Can - when formulating and solving tasks in the field of knowledge engineering - integrate knowledge from various areas of computer science (and, if necessary, also knowledge from other scientific disciplines) and apply a systemic approach, also taking into account non-technical aspects [K2st_U5]

5. Can assess the usefulness and the possibility of using new achievements (methods and tools) in knowledge modeling and knowledge engineering as well as new IT products making use of ontologies and knowledge graphs [K2st_U6]

6. Can make a critical analysis of the existing technical solutions in the field of knowledge representation and propose their improvements [K2st_U8]

7. Can assess the usefulness of methods and tools for solving an engineering task consisting in the construction or evaluation of an information system or its components (in particular ontology, knowledge graphs or other artifacts in the area of knowledge representation), including the limitations of these methods and tools [K2st_U9]

8. Can - using, among others conceptually new methods - solve complex IT tasks, including non-standard tasks and tasks with a research component, in particular in the field of knowledge representation and reasoning [K2st_U10]

Social competences

Student:

1. Understands that in computer science knowledge and skills very quickly become obsolete [K2st_K1]

2. Understands the importance of using the latest knowledge in the field of computer science, in particular in the area of knowledge modeling, in solving research and practical problems [K2st_K2]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Formative assessment:

a) lectures: on the basis of answers to questions about the material discussed in previous lectures (in the form of quizzes).

b) laboratories: based on the evaluation of the current progress in the implementation of sub-tasks.

Total assessment:

a) lectures: verification of the assumed learning outcomes is carried out by assessment of the knowledge and skills demonstrated during the presentation resulting from the analysis of the indicated problem related to knowledge modeling, as well as summing up points and discussing the lecture quizzes. The final grade for the lectures consists of: points from the quizzes available after selected lectures, points from the presentation.

b) laboratories: verification of the assumed learning outcomes is carried out by assessment of skills related to the implementation of laboratory exercises, assessment of the performance of tasks partially carried out during the laboratories and partially after their completion, assessment of the mini-project that students will implement to consolidate the acquired knowledge and skills.

Obtaining additional points for activity during classes, especially for: discussing additional aspects of the issue, demonstrating interesting extracurricular skills, the effectiveness of applying the acquired knowledge while solving a given problem, comments leading to the improvement of didactic materials or the didactic process.

Passing threshold: 50% of points.

Programme content

The lecture covers the following topics: the concept of the Semantic Web, triple data model, RDF resource description language, knowledge representation using ontologies (OWL language), SPARQL query language, ontology-based data access, databases and knowledge graphs on the Web, knowledge representation using vector models (embeddings), good practices of metadata modeling and knowledge engineering, making use of existing resources (Wikidata / DBpedia, Freebase, YAGO, WordNet / Słowosieć, etc.) in own applications, semantic metadata on the Web (http://schema.org).

The laboratory program includes the following content:

Data representation in the RDF model. SPARQL query language. (rdflib library)

Ontology modeling with the use of an ontology editor (Protégé).

Manipulating knowledge modeled in the ontology and inference using an API (owlready2). Illustration of use in semantic search (smart tags).

Using software libraries to generate knowledge graph embeddings (AmpliGraph library). Application illustration for product recommendation based on similarity.

Methods of ontology-based data access and data transformation to the knowledge graph format (R2RML language). Illustration of the application in the integration of various databases into the canonical model.

Enriching websites with metadata (schema.org, microdata, RDFa, JSON-LD). Application illustration for Search Engine Optimization (SEO).

Consolidation of acquired knowledge and skills within a mini-project.

Teaching methods

Lecture: multimedia presentation (theory, examples, quizzes, exercises), examples presented on the blackboard.

Laboratory exercises: multimedia presentations, practical exercises, solving assigned tasks, solving problems in groups, discussion.

Bibliography

Basic

1. Linked Data: Evolving the Web into a Global Data Space (1st edition). Tom Heath and Christian Bizer, Synthesis Lectures on the Semantic Web: Theory and Technology, 1:1, 1-136. Morgan & Claypool, 2011, http://linkeddatabook.com/book

Additional

1. Demystifying OWL for the Enterprise, Michael Uschold, Morgan & Claypool Publishers, 2018

2. Semantic Web for the Working Ontologist, Third Edition, Dean Allemang, Jim Hendler, Fabien Gandon, ACM Books, 2020

3. An Introduction to Ontology Engineering. Keet, C.M. College Publications, volume 20, November 2018

4. Programming the Semantic Web: Build Flexible Applications with Graph Data 1st Edition, Toby Segaran, Colin Evans, Jamie Taylor, O'Reilly Media, 2009

5. Knowledge Engineering. Building Cognitive Assistants for Evidence-based Reasoning, Gheorghe Tecuci, Dorin Marcu, Mihai Boicu, David A. Schum, Cambridge University Press, 2016

6. Ontologie w systemach informatycznych, Krzysztof Goczyła, EXIT 2011

7. Semantic data mining. An ontology-based approach. Agnieszka Ławrynowicz. Studies on the Semantic Web, Vol. 29. IOS Pres/AKA Verlag 2017

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,0
Classes requiring direct contact with the teacher	30	1,5
Student's own work (literature studies, preparation for laboratory classes, preparation for tests, project preparation) [1]	45	1,5

[1] delete or add other activities as appropriate