UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Modeliranje in predstavljanje znanja
Course title:	Knowledge modelling and representation

Študijski program in stopnja **Study programme and level**	**Študijska smer** **Study field**	**Letnik** **Academic year**	**Semester** **Semester**
Poslovna informatika, magistrski študijski program druge stopnje	-	Prvi ali drugi	Drugi ali tretji
The second cycle masters study programme Business informatics	-	First or second	Second or third

Vrsta predmeta / Course type	Izbirni / Elective
Univerzitetna koda predmeta / University course code:	4-PI-MAG-IP-MPZ-2022-05-27

Predavanja **Lectures**	**Seminar** **Seminar**	**Vaje** **Tutorial**	**Klinične vaje** **work**	**Druge oblike študija**	**Samost. delo** **Individ. work**	**ECTS**
30	/	30	/	/	90	5

Nosilec predmeta / Lecturer:	Doc. dr. Panče Panov / Asst. Prof. Panče Panov, PhD

Jeziki / **Languages:**	**Predavanja / Lectures:**	Slovenski / Angleški
	Vaje / Tutorial:	Slovenski / Angleški

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**

Za vključitev v delo ni posebnih pogojev. Pogoj za pristop k izpitu je priprava in zagovor projektne naloge.	There are no specific requirements for this course. To attend the exam, a student has to prepare and present a project assigment.

Vsebina:	**Content (Syllabus outline):**
1. Uvod v modeliranje in predstavljanje znanja: – izražanje znanja – sistemi, ki temeljijo na znanju – zgodovina prestavljanja znanja 2. Strukture za organizacijo znanja: – terminski seznami (avtoritetne datoteke, glosarji, slovarji, glasila) – klasifikacije in kategorije (predmetni naslovi, klasifikacijske sheme, kategorizacijske sheme, taksonomije) – seznami odnosov (tezavri, semantična omrežja, ontologije) 3. Predstavljanje znanja z opisno logiko: – osnovni koncepti opisne logike in jeziki – osnovni problem sklepanja – kompleksnost jezikov v opisni logiki 4. Modeliranje znanja z ontologijami: – ontologije kot orodje za modeliranje domenskega znanja – glavne komponente ontologij – relacije v ontologijah – referenčne in aplikacijske ontologije – visokonivojske in domenske ontologije – osnovna formalna ontologija (BFO) – primeri ontologij z različnih področij 5. Načrtovanje domenskih ontologij in pregled praks v razvoju ontologij: – splošni principi načrtovanja ontologij – proces razvoja domenskih ontologij – pregled dobrih praks v razvoju ontologij – vrednotenje zgrajenih ontologij 6. Pregled jezika OWL: – osnovni OWL konstrukti – napredni OWL konstrukti – gradnja OWL ontologije – uporaba sklepanja 7. Razvoj domenskih ontologij z odprtokodnimi programskimi orodji	1. Introduction to knowledge modelling and representation: – Expressing knowledge – Knowledge-based systems – History of knowledge representation 2. Knowledge organization structures: – Term lists – authority files, glossaries, dictionaries, gazzeters – Classifications and categories – subject headings, classification schemes, categorization schemes, taxonomies – Relationship lists – thesauri, semantic networks, ontologies 3. Knowledge representation with description logic: – Basic description logic concepts and languages – Basic reasoning problems – Complexity of description logic languages 4. Modelling domain knowledge with ontologies: – Ontology as a representational artefact – Basic components of an ontology – Relations in ontology – Reference and application ontologies – Top-level and domain ontologies – Basic Formal Ontology (BFO) – Examples of ontologies from various domains 5. Domain ontology design and best practices in ontology development: – General principles of ontology design – The process of domain ontology design – Overview of best practices for ontology development – Ontology evaluation methods

8. Grafi znanja: – Kaj je graf znanja? – gradnja grafa znanja – uporaba grafov znanja – primeri aplikacij	6. Overview of the Ontology Web Language (OWL) – Basic OWL constructs – Advanced OWL constructs – Building an OWL ontology – Use of reasoners 7. Developing domain ontologies with open-source ontology development tools 8. Knowledge graphs: – What is a knowledge graph? – Building knowledge graphs – Using knowledge graphs – Examples of applications

Temeljni literatura in viri / Readings:

- Alexopoulos, P. (2020). Semantic Modeling for Data – Avoiding Pitfalls and Breaking Dilemmas. O'Reilly Media.
- Arp, R., Smith, B., & Spear, A. D. (2015). Building ontologies with basic formal ontology. MIT Press.
- Fensel, D., Şimşek, U., Angele, K., Huaman, E., Kärle, E., Panasiuk, O., ... & Wahler, A. (2020). Knowledge Graphs. Springer International Publishing.
- Baader, F., Horrocks, I., Lutz, C., & Sattler, U. (2017). An Introduction to Description Logic. Cambridge: Cambridge University Press.
- Hedden, H. (2016). The Accidental Taxonomist, Second Edition. Information Today, Inc., USA.
- Sowa, J. F. (1999). Knowledge representation: logical, philosophical and computational foundations. Brooks/Cole Publishing Co.
- Panov, P. Prosojnice iz predavanj in vaj pri predmetu Modeliranje in predstavljanje znanja, Moodle, FIŠ.

Cilji in kompetence:	**Objectives and competences:**
Splošne kompetence: • sposobnost pridobivanja, selekcije, ocenjevanja in umeščanja novih informacij in zmožnost njihove interpretacije za reševanje poslovnih problemov. • sposobnost uporabe programskih rešitev za razvoj digitalnih poslovnih modelov. • sposobnost analize in pretvorbe realnega poslovnega problema v obliki lažje predstavljivega poslovnega modela.	***General competences:*** • The ability to obtain, select, evaluate and embed the new information, as well as to interpret them to solve business problems. • The ability to use software solutions for the development of digital business models. • The ability to analyze and transform a real business problem into a simplified business model. • The ability of flexible usage of knowledge in practice

- sposobnost fleksibilne uporabe znanja v praksi

Predmetno-specifične kompetence:

- sposobnost organizacije domenskega znanja v različnih strukturah,
- sposobnost izražanja domenskega znanja v opisni logiki,
- sposobnost načrtovanja domenskih ontologij,
- sposobnost implementacije domenske ontologije z uporabo jezika OWL,
- sposobnost načrtovanja grafa znanja.

Subject-specific competences:

- Ability to organize domain knowledge in different knowledge organization structures,
- Ability to express domain knowledge in description logic,
- Ability to design a domain ontology,
- Ability to implement a domain ontology using the OWL language,
- Ability to design a knowledge graph.

Predvideni študijski rezultati:

Študenti bodo zmožni:

- argumentirati koncept predstavljanja znanja;
- determinirati množico različnih struktur za organizacijo znanja in bodo sposobni izbrati tisto, ki ustreza njihovemu problemu;
- raziskati izražanje domenskega znanja v opisni logiki;
- vrednotiti različne tipe ontologij;
- uporabiti principe načrtovanja domenskih ontologij in bodo sposobni uporabiti to znanje v konkretnih primerih;
- zgraditi domensko ontologijo z uporabo jezika OWL;
- načrtovati, zgraditi in uporabiti grafe znanja za reševanje problemov v praksi.

Intended learning outcomes:

Students will be able to:

- argument the concept of knowledge representation
- determine the different knowledge organization; structures and will be able to choose an adequate one for their use case;
- research the expressing domain knowledge in description logic;
- evaluate the concept of ontology and the different types of ontologies;
- use the basic principles for designing domain ontologies and will be able to apply that knowledge for their use case;
- build domain ontologies using the OWL language; and
- design, implement and apply knowledge graphs in use cases.

Metode poučevanja in učenja:

- *Predavanja z aktivno udeležbo študentov* (razlaga, diskusija, vprašanja, primeri, reševanje problemov);
- *Vaje*, kjer študentje na primerih ponovijo temeljne koncepte, predstavljene na predavanjih;
- *Laboratorijske vaje*, kjer se študenti naučijo načrtovati in implementirati

Learning and teaching methods:

- *Lectures with active participations by the students* (explanation, discussion, questions, cases, problems solving);
- *Tutorials*, where students will recall, reinforce, and shed light on the concepts and methods introduced at lectures;

domenske ontologije z uporabo odprtokodnih orodij.	• *Lab work*, where students will learn to design and implement domain ontologies using open source tools.

Delež (v %) /

Načini ocenjevanja: Weight (in %) **Assessment:**

Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Pisni izpit	60 %	Written Exam
Projektna naloga	40 %	Project assignment

Reference nosilca / Lecturer's references:

- *Tolovski, I., Džeroski, S., Panov, P. (2020). Semantic annotation of predictive modelling experiments. In: Proceedings of 23rd International Conference on Discovery Science, DS 2020, Thessaloniki, Greece, October 19-21, 2020, Lecture notes in computer science Vol. 12323, 124-139 [COBISS.SI-ID 37131267]*
- *Kostovska, A., Džeroski, S., Panov, P. (2020). Semantic description of data mining datasets: an ontology-based annotation schema. In: Proceedings of 23rd International Conference on Discovery Science, DS 2020, Thessaloniki, Greece, October 19-21, 2020, Lecture notes in computer science Vol. 12323, 140-155. [COBISS.SI-ID 37133315]*
- *Kostovska, A., Tolovski, I., Maikore, F., Soldatova, L., Panov, P. (2019). Neurodegenerative disease data ontology, In: Proceedings of 22nd International Conference on Discovery Science DS 2019, Split, Croatia, October 28-30, 2019, Lecture notes in computer science Vol. 11828, 235-245. [COBISS.SI-ID 32864807]*
- *Tolovski, I., Kostovska, A., Simidjievski, N., Todorovski, L., Džeroski, S., Panov, P. (2019) Towards reusable process-based models of dynamical systems : a case study in the domain of aquatic ecosystems, In: Proceedings of 42nd International Convention MIPRO 2019, May 20 -24, 2019, Opatija, Croatia, pp. 1110-1115. [COBISS.SI-ID 32541991]*
- *Lawrynowicz, A., Esteves, D., Panov, P., Soru, T., Džeroski, S., Vanschoren, J. (2017) An algorithm, implementation and execution ontology design pattern. Studies on the semantic web, vol. 32, 55-68, IOS Press. [COBISS.SI-ID 31363623]*
- *Panov, P., Soldatova, L., Džeroski, S.(2016) Generic ontology of datatypes, Information sciences, vol. 329, 900-920. [COBISS.SI-ID 28796199]*
- *Soldatova, L., Panov, P., Džeroski, S. (2015) Ontology engineering : from an art to a craft, In: 12th International Experiences and Directions Workshop on OW, OWLED, 2015 revised and selected papers, Lecture notes in computer science, vol. 9557, 174-181. [COBISS.SI-ID 29448231]*
- *Panov, P., Soldatova, L., Džeroski, S. (2014) Ontology of core data mining entities, Data mining and knowledge discovery, Vol. 28, no. 5/6, 1222-1265. [COBISS.SI-ID 27814439]*
- *Panov, P., Soldatova, L., Džeroski, S. (2013) OntoDM-KDD: ontology for representing the knowledge discovery process", In: Proceedings of 16th International Conference on Discovery Science, DS 2013, Singapore, October 6-9, 2013. Lecture notes in computer science vol. 8140, 126-140. [COBISS.SI-ID 27143207]*