UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Izbrana poglavja umetne inteligence
Course title:	Selected Topics in Artificial Intelligence

Študijski program in stopnja **Study programme and level**	**Študijska smer** **Study field**	**Letnik** **Academic year**	**Semester** **Semester**
Informacijske znanosti, doktorski študijski program tretje stopnje	Računalniške znanosti	Drugi	Tretji ali četrti
Information Sciences, third cycle Doctoral Study Programme	Computer sciences	Second	Third or fourth

Vrsta predmeta / Course type	Izbirni / Elective
Univerzitetna koda predmeta / University course code:	1-IZ-DR-RZ-IP-IPUI-2024-04-24

Predavanja **Lectures**	**Seminar** **Seminar**	**Vaje** **Tutorial**	**Klinične vaje** **work**	**Druge oblike študija**	**Samost. delo** **Individ. work**	**ECTS**
30	-	-	-	-	270	10

Nosilec predmeta / Lecturer:	doc. dr. Panče Panov
Jeziki / Languages: **Predavanja / Lectures:**	Slovenski, angleški / Slovene, English
Vaje / Tutorial:	

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Pogoj za vključitev v delo je vpis v 1. ali 2. letnik študija.	To join the course the student must have enrolled in the first or second year of the study programme.

Vsebina:	**Content (Syllabus outline):**
• Uvod in pregled področja: zgodovina umetne inteligence in strojnega učenja, pregled metod in aplikacij. Inteligentni agenti. • Reševanje problemov v umetni inteligenci. Reševanje problemov z iskanjem. Iskanje v kompleksnih okoljih. Problemi z zadovoljevanjem omejitev. • Znanje, sklepanje in načrtovanje. Logični agenti. Logika prvega reda. Sklepanje v logičnem znanju prvega	• Introduction and overview of the field: history of artificial intelligence (AI) and machine learning, an overview of methods and applications. Intelligent Agents. • Problem-solving in AI. Solving Problems by Searching. Search in Complex Environments. Constraint Satisfaction Problems. • Knowledge, reasoning, and planning. Logical Agents. First-Order Logic. Inference in First-Order Logic

reda. Avtomatizirano načrtovanje reprezentacije. • Negotovo znanje in sklepanje. Količinska negotovost. Verjetnostno sklepanje. Verjetnostno sklepanje skozi čas. Verjetnostno programiranje za sprejemanje preprostih odločitev. Sprejemanje zapletenih odločitev. Večagentno odločanje. • Strojno učenje. Učenje verjetnostnih modelov. Globoko učenje. Vzpodbujevalno učenje. Učenje iz podatkovnih tokov. • Globoko učenje za obdelavo naravnega jezika. Računalniški vid. • Etika in varnost umetne inteligence.	Knowledge. Representation Automated Planning. • Uncertain knowledge and reasoning. Quantifying Uncertainty. Probabilistic Reasoning. Probabilistic Reasoning over Time. Probabilistic Programming. Making Simple Decisions. Making Complex Decisions. Multiagent Decision Making. • Machine Learning. Learning Probabilistic Models. Deep Learning. Reinforcement Learning. Learning from data streams. • Deep Learning for Natural Language Processing. Computer Vision. • Ethics, and Safety of AI.

Temeljni literatura in viri / Readings:

- Russell, S., & Norvig, P. (2022). *Artificial Intelligence: A Modern Approach (4th edition)*. Prentice Hall.
- Géron, A. (2023). *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems (3rd Edition)*. O'Reilly.
- Bifet, A., Gavaldà, R., Holmes, G., & Pfahringer, B. (2023). *Machine learning for data streams with practical examples in MOA*. The MIT Press.
- Aggarwal, C. C. (2021). *Artificial Intelligence: A Textbook*. Springer Cham.
- Hastie, T., Tibshirani, R., & Friedman, J. (2016). *The Elements of Statistical Learning*. *(2th edition)*. New York, Wiley.

Cilji in kompetence:	**Objectives and competences:**
Učna enota prispeva k razvoju naslednjih splošnih in predmetno-specifičnih kompetenc: Splošne kompetence: • Sposobnost identificiranja danega raziskovalnega problema, njegove analize, ovrednotenja ter oblikovanja možnih rešitev. • Ustvarjanje novega znanja, ki pomeni relevanten prispevek k razvoju znanosti. • Sposobnost obvladanja standardnih metod, postopkov in procesov raziskovalnega dela na znanstvenem področju študija. • Prizadevanje za kakovost znanstveno-raziskovalnega dela skozi avtonomnost, (samo)kritičnost, (samo)refleksivnost in (samo)evalviranje.	*The module contributes to the following general and subject-specific competences:* *General competences:* • Ability to identify a given research problem, analyse it, evaluate it and formulate possible solutions. • Ability to create new knowledge, which represents a contribution to science. • Ability to master standard methods, procedures and processes of research work in the scientific field of study. • Striving for quality in scientific research through autonomy, (self-)criticism, (self)reflexivity and (self-)evaluation.Development of skills and abilities in usage of knowledge in the scientific field of doctoral dissertation. • Ability to innovatively use and combine diverse research methods.

• Razvoj veščin in spretnosti v uporabi znanja na raziskovalnem področju doktorske disertacije. • sposobnost inovativne uporabe in kombiniranja raznih raziskovalnih metod. *Predmetno-specifične kompetence:* • Sposobnost za reševanje konkretnih raziskovalnih problemov z uporabo metod umetne inteligence. • Sposobnost pridobivanja, selekcije, ocenjevanja in umeščanja novih znanj s področja umetne inteligence in zmožnost njihove interpretacije. • Sposobnost oblikovanja in implementacije izvirnih rešitev danih znanstvenih problemov na področju umetne inteligence.	*Subject-specific competences:* • Ability to solve specific research problems questions related to artificial intelligence. • Ability to acquire, interpret, select, evaluate and insert new knowledge in the field of artificial intelligence and ability for its interpretation. • Ability to design and implement original solutions of given scientific problems in the field of artificial intelligence.
Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Študent • zna analizirati svoj raziskovalni problem z vidika umetne inteligence in transformirati domenski problem v nalogo umetne inteligence; • zna argumentirati izbor ustreznih metod umetne inteligence pri svojem raziskovalnem delu; • zna ovrednotiti in primerjati različne metode in orodja umetne inteligence na študiju primera iz svoje raziskovalne domene; • zna oblikovati in implementirati različne raziskovalne scenarije z uporabo metod umetne inteligence. • je sposoben prenosa znanja na različna profesionalna in znanstvena področja, kjer se uporabljajo metode umetne inteligence.	Knowledge and Understanding: The student • knows how to analyse the research problem at hand from an artificial inteliigence viewpoint and transform the problem into a artificial intelligence task; • know how to discuss the choice of adequate AI methods in the research work; • knows how to evaluate and compare different AI methods and tools on a case study from the research domain; • knows how to design and implement different research scenarios with the use of al methods work; • can transfer knowledge to various professional and scientific fields, where artificial intelligence methods are used.
Metode poučevanja in učenja:	**Learning and teaching methods:**
• Predavanja z aktivno udeležbo študentov (razlaga, diskusija, vprašanja, primeri, reševanje problemov); • Individualno seminarsko delo v obliki priprave raziskovalne seminarske naloge: predlog raziskovalnega projekta, utemeljitev raziskave,	• Lectures with active students' participation (explanation with discussions, questions, case studies, presentations); • Individual seminar work: preparation of research seminar paper: a proposal for a research project, justification of

poročanje o rezultatih in podajanje predloga rešitev; • Individualne in skupinske konzultacije (diskusija, dodatna razlaga, obrazložitev konkretnih vprašanj); • Individualno delo študentov; samostojni študij znanstvene in strokovne literature ter rezultatov raziskav.	research, reporting results and proposing solutions; • Individual and group consultations (discussions, supplementary explanations, treatment of specific questions); • Student individual work (literature overview, state-of-the art research in the field)

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt): • Seminarska raziskovalna naloga in predstavitev naloge. V raziskovalni seminarski nalogi študent izvede analizo svojega raziskovalnega problema iz vidika umetne inteligence, transformira problem ter ustrezno izbere primerne metode in jih med seboj primerja. Na študiji primera pokaže različne scenarije uporabe metod umetne inteligence na svojem raziskovalnem problemu.	100 %	**Type (examination, oral, coursework, project)** • Research seminar paper and its presentation. In the research seminar paper, the student conducts an analysis of their research problem from the perspective of artificial intelligence, transforms the problem, and appropriately selects suitable methods and compares them. Through a case study, they demonstrate different scenarios of applying artificial intelligence methods to their research problem.

Reference nosilca / Lecturer's references:

- Dimitrovski, I., Kitanovski, I., Panov, P., Kostovska, A., Simidjievski, N., & Kocev, D. (2023) AiTLAS : artificial intelligence toolbox for Earth observation. Remote Sensing 15(9):2343. https://dx.doi.org/10.3390/rs15092343
- Kostovska, A., Vermetten, D., Doerr, C., Džeroski, S., Panov, P., & Eftimov, T. (2023) OPTION: OPTImization algorithm benchmarking ONtology, IEEE transactions on evolutionary computation 27(6):1618-1632. https://dx.doi.org/10.17605/OSF.IO/TD25YKostovska
- Petković, M., Lucas, L., Levatić, J., Breskvar, M., Stepišnik, T., Kostovska, A., Panov, P., Osojnik, A., Boumghar, R., Martínez-Heras, J.A., Godfrey, J., Donati, A., Džeroski, S., Simidjievski, N., Ženko, B., & Kocev, D. (2022) Machine-learning ready data on the thermal power consumption of the Mars Express Spacecraft. Scientific Data 9:229. https://doi.org/10.1038/s41597-022-01336-z
- Osojnik, A., Panov, P., & Džeroski, S. (2020). Incremental predictive clustering trees for online semi-supervised multi-target regression. *Machine Learning, 109*(11), 2121–2139. https://doi.org/10.1007/s10994-020-05918-z
- Osojnik, A., Panov, P., & Džeroski, S. (2018). Tree-based methods for online multi-target regression. *Journal of Intelligent Information Systems, 50*(2), 315–339. https://doi.org/10.1007/s10844-017-0462-7