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UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Napredna obdelava podatkov v geoznanosti
Course title:	Advanced Data Processing Methods in Geosciences

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Okoljske in regionalne študije, doktorski študij 3. stopnje	4D Zemlja	/	/
Environmental and Regional Studies, doctoral study 3rd cycle	4D Earth	/	/

Vrsta predmeta / Course type	izbirni / elective
Univerzitetna koda predmeta / University course code:	DIZ01

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
10	10	10			150	6

Nosilec predmeta / Lecturer:	doc. dr. Gorazd Žibret
Jeziki / Languages: Predavanja / Lectures:	Slovenščina / English
Vaje / Tutorial:	Slovenščina / English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Končana druga bolonjska stopnja ustrezne smeri ali univerzitetni študij VII stopnje.	Second-cycle Bologna degree in the relevant track or a university (level VII) degree

Vsebina:	**Content (Syllabus outline):**
1) Uvod v umetno inteligenco 2) Specifika podatkov v geoznanosti: ▪ kompozitni podatki, ▪ orientacije, ▪ ekstremne vrednosti, ▪ tributivni podatki 3) Nevronske mreže: ▪ lastnosti, ▪ vrste, ▪ topologije, ▪ propagacija naprej in ▪ povratne mreže; 4) Metode strojnega učenja mrež: ▪ nadzorovano	1) Introduction to artificial intelligence 2) Data in geosciences and its specifics: ▪ compositional and ▪ orientational data, ▪ outliers, ▪ attributive data 3) Neural networks: ▪ properties, ▪ types, ▪ topologies, ▪ feed-forward and ▪ recurrent networks 4) Neural network machine learning paradigms: ▪ supervised,

▪ nenadzorovano ▪ okrepljeno ▪ evolucijsko 5) Priprava podatkov, validacija 6) Dobre in slabe lastnosti nevronskih mrež 7) Načini pristopa k problemu 8) Primeri iz prakse 9) Druge metode umetne inteligence: ▪ linearna in multipla regresija, ▪ odločitvena drevesa, ▪ metoda podpornih vektorjev, ▪ "mehka" logika ipd. 10) samostojne vaje	▪ unsupervised, ▪ reinforced, ▪ evolutionary 5) Data preparation and validation methods 6) Positive and negative aspects of neural networks 7) Approach to the problem 8) Examples from practice 9) Other methods of artificial intelligence: ▪ linear and multiple regression, ▪ decision trees, ▪ support vector machines, ▪ fuzzy logic 10) individual work

Temeljni literatura in viri / Readings:

Izbrana poglavja iz knjig ter članki / Selected chapters from books and papers:

- Nielsen A.M. Neural Networks and deep learning. Determination press, 2015, 224 p.
- https://static.latexstudio.net/article/2018/0912/neuralnetworksanddeeplearning.pdf
- http://neuralnetworksanddeeplearning.com/
- Haykin S. Neural Networks and learning machines, 3rd ed. Prentice Hall, 2009. https://dai.fmph.uniba.sk/courses/NN/haykin.neural-networks.3ed.2009.pdf
- ŽIBRET, Gorazd, ŠAJN, Robert. Hunting for geochemical associations of elements: factor analysis and self-organising maps. Mathematical geology. 2010, vol. 42, no. 6, str. 681-703. DOI: 10.1007/s11004-010-9288-3.
- ŽIBRET, Gorazd, ŠAJN, Robert, ALIJAGIĆ, Jasminka, STAFILOV, Trajče. Use of neural networks in the geochemical data interpretation. Zeitschrift für geologische Wissenschaften. 2012, bd. 40, h. 4/5, str. 253-266.
- CERAR, Sonja, MEZGA, Kim, ŽIBRET, Gorazd, URBANC, Janko, KOMAC, Marko. Comparison of prediction methods for oxygen-18 isotope composition in shallow groundwater. Science of the total environment. 2018, vol. 631-632, str. 358-368. DOI: 10.1016/j.scitotenv.2018.03.033.

Cilji in kompetence:	Objectives and competences:
Študent oz. študentka pozna osnove metod umetne inteligence in jih je zmožen uporabiti metode nevronskih mrež pri reševanju problemov	Student knows principles of artificial intelligence, and can use neural networks for solving problems

Predvideni študijski rezultati:	Intended learning outcomes:
Študentka oz. študent je zmožen samostojne uporabe metod nevronskih mrež z uporabo simulatorja MemBrain. Zna analizirati problem, določiti primerne topologije mrež, pripraviti podatke, mrežo naučiti, dobljeni model primerno ovrednotiti in ga tudi uporabiti v praksi.	The student is able to independently apply neural network methods using the MemBrain simulator. He/she knows how to analyse a problem, determine suitable network topologies, prepare data, train the network, properly evaluate the resulting model and use it in practice.

Metode poučevanja in učenja:	Learning and teaching methods:
☒Predavanja	☒Lectures
☐Laboratorijske vaje	☐Lab work/tutorials
☐Terensko delo	☐ Field work
☒Seminar	☒Seminar
☒Individualne naloge	☒Independent work assignments
☒Konzultacije	☒Consultations
☒e-izobraževanje	☒e-Learning

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Seminarska naloga z zagovorom	100%	written paper with presentation

Reference nosilca / Lecturer's references:

- CERAR, Sonja, MEZGA, Kim, **ŽIBRET, Gorazd**, URBANC, Janko, KOMAC, Marko. Comparison of prediction methods for oxygen-18 isotope composition in shallow groundwater. Science of the total environment. 2018, vol. 631-632, str. 358-368. DOI: 10.1016/j.scitotenv.2018.03.033.
- AMEIRÃO PINTO, Márcio, **ŽIBRET, Gorazd**, LOPES, Luís, BODÓ, Balázs, ZAJZON, Norbert. UNEXUP: robot-based exploration technology for underground flooded mines. Advances in geosciences. 2020, vol. 54, str. 109-117. DOI: 10.5194/adgeo-54-109-2020.
- LOPES, Luís, BODÓ, Balázs, ROSSI, Claudio, HENLEY, Stephen, **ŽIBRET, Gorazd**, KOT-NIEWIADOMSKA, Alicja, CORREIA, Vitor. ROBOMINERS - Developing a bio-inspired modular robot-miner for difficult to access mineral deposits. Advances in geosciences. 2020, vol. 54, str. 99-108. DOI: 10.5194/adgeo-54-99-2020.
- ZAJZON, Norbert, TOPA, Boglárka Anna, PAPP, Richárd Zoltán, AALTONEN, Jussi, ALMEIDA, José Miguel, ALMEIDA, Carlos, MARTINS, Alfredo, BODÓ, Balázs, HENLEY, Stephen, TAMEIRÃO PINTO, Márcio, **ŽIBRET, Gorazd**. Underwater measurements with UX robots; a new and available tool developed by UNEXUP. Advances in geosciences. 2023, vol. 62, 10 str. DOI: 10.5194/adgeo-62-1-2023.
- **ŽIBRET, Gorazd**, KOPAČKOVÁ, Veronika. Comparison of two methods for indirect measurement of atmospheric dust deposition: street-dust composition and vegetation-health status derived from hyperspectral image data. Ambio. 2019, vol. 48, no. 4, str. 423-435. DOI: 10.1007/s13280-018-1093-0.