Fakulteta za industrijski inženiring
Faculty of Industrial Engineering

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	**Metode in orodja umetne inteligence**
Course title:	**Artificial intelligence methods and tools**

Študijski program Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Inženiring in avtomobilska industrija	**/**	**prvi**	**prvi**
Engineeing in automobile industry	**/**	**First**	**First**

Vrsta predmeta / Course type	**Modul II – Obvezni / Mandatory**
Univerzitetna koda predmeta / University course code:	**DR_31007**

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
60	**/**	**30**	**/**	**/**	**180**	**10**

Nosilec predmeta / Lecturer:	**Doc. dr. Bernard Ženko** **Doc. dr. Martin Žnidaršič**

Jeziki / Languages:	**Predavanja / Lectures:**	**slovenski / Slovenian**
	Vaje / Tutorial:	**slovenski / Slovenian**

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
– Druga stopnja naravoslovno-tehnične smeri. – Osnovna znanja iz računalništva.	– Second level degree from a natural sciences or ingeneering programme. – Basic knowledge of computer science.

Vsebina:	Content (Syllabus outline):
Uvod v umetno inteligenco – Kaj je inteligenca? – Pregled raziskav UI – Reševanje problemov s preiskovanjem – Preiskovanje globino – Preiskovanje v širino – Hevristično preiskovanje – Predstavitev znanja in sklepanje Strojno učenje – Strojno učenje, rudarjenje podatkov in statistika – Postopek analize podatkov – Predobdelava podatkov – Nadzorovano in nenadzorovano učenje – Učenje konceptov – Klasifikacija in regresija – Metode najbližjih sosedov – Bayesovske metode – Metoda podpornih vektorjev – Umetne nevronske mreže – Regresijske metode – Ansambelske metode – Vrednotenje modelov in mere uspešnosti Ekspertni sistemi, odločanje in podpora pri odločanju – Kvantitativne metode – Kvalitativne metode – Funkcije koristnosti – Odločanje ob negotovosti	Introduction to artificial intelligence – What is intelligence? – AI research overview – Solving problems by searching – Depth-first search – Breadth-first search – Heuristic search – Knowledge representation and reasoning Machine learning – Machine learning, data mining and statistics – Data analysis process – Data preprocessing – Supervised and unsupervised learning – Concept learning – Classification and regression – Instance-based methods – Bayesian methods – Support vector machines – Artificial neural networks – Regression methods – Ensemble methods – Model evaluation and performance measures Expert systems, decision making and decision support – Quantitative methods – Qualitative methods – Utility functions – Decision making under uncertainty

Temeljni literatura in viri / Readings:

- S. Russell, P. Norvig. Artificial Intelligence: A Modern Approach, Third edition, Prentice Hall, 2010.
- H. Witten, F. Eibe, M. A. Hall. Data mining: Practical machine learning tools and techniques, Morgan Kaufman, 2011
- I. Kononenko in M. Kukar: Machine Learning and Data Mining: Introduction to Principles and Algorithms. Horwood, 2007.
- Hastie T., Tibshirani R., Friedman J.: The elements of statistical learning: Data Mining, Inference, and Prediction, Springer.
- M. Bohanec: Odločanje in modeli. DMFA - založništvo, 1. ponatis, 2012.

Priporočljiva literatura / Recomended Textbooks

- Bratko. Prolog, Programming for Artificial Intelligence, Pearson, Addison-Wesley, 2001.
- T. Mitchell. Machine Learning. McGraw-Hill, 1997.
- K. A. De Jong. Evolutionary Computation, MIT Press, 2006.
- T. L. Brink, R.L. Keeney, H. Raiffa: Decisions with multiple objectives–preferences and value

tradeoffs, Cambridge University Press, Cambridge & New York, 1993.

Cilji in kompetence:	**Objectives and competences:**
Seznaniti študente z različnimi metodami umetne inteligence ter jih naučiti samostojne uporabe metod umetne inteligence za samostojno reševanje praktičnih problemov s poudarkom na izbranih tematikah. Kompetence: – poznavanje osnov različnih metod umetne inteligence ter podrobnejše poznavanje izbranih metod; – sposobnost samostojnega reševanja praktičnih problemov z metodami umetne inteligence; – sposobnost samostojne uporabe metod umetne inteligence za praktično in raziskovalno delo.	To introduce students to different methods of artificial intelligence and teach them to autonomously use artificial intelligence methods for solving practical problems, with a focus on selected topics. Competencies: – basic knowledge of different artificial intelligence methods and detailed knowledge of the selected methods; – ability to autonomously solve practical problems using the methods of artificial intelligence; – ability to autonomously use the artificial intelligence methods for practical and research work.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Študenti bodo – obvladovali znanja o različnih metodah umetne inteligence ter poglobljeno poznavanje izbranih metod; – sposobni razpoznavanja katere metode umetne inteligence so primerne za reševanje katerih praktičnih problemov; – obvladovali samostojno načrtovanje in realizacijo konkretnih rešitev z metodami umetne inteligence	Students will – demonstrate knowledge of the various methods of artificial intelligence and in-depth knowledge of selected methods; – demonstrate the ability of identifying which methods of artificial intelligence are appropriate for solving which practical problems; – demonstrate the ability of designing and implementing concrete solutions with methods of artificial intelligence.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Poučevanje bo sestavljeno iz dveh sklopov. Prvi sklop bodo predavanja, kjer bodo predstavljene in razložene vsebine iz učnega programa. Drugi sklop bo obsegal samostojno delo študentov, v okviru katerega bodo morali na koncu izdelati tudi seminarsko nalogo. V primeru majhnega števila vpisanih študentov je možno selektivno poglobiti obravnavo posameznih tem glede na individualne potrebe študentov.	Teaching will consist of two parts. The first part will be lectures, which will present and explain the content of the curriculum. The second part will consist of independent work of students, during which they will also have to produce the seminar paper. In case of a small number of enrolled students it is possible to treat selected curriculum topics in more depth, in line with individual needs of the enrolled students.

Načini ocenjevanja:	Delež (%) / Weight (%)	Assessment:
Seminarska naloga z ustnim zagovorom, kjer se preveri zmožnost samostojnega reševanja izbranega praktičnega problema.	100 %	Seminar paper with oral presentation with the aim of evaluating student's ability of independent solving of practical problems.

Reference nosilca / Lecturer's references:

Doc. dr. Bernard Ženko je raziskovalec na Odseku za tehnologije znanja, Institut Jožef Stefan, Ljubljana. Njegove raziskave so povezane s strojnim učenjem in njegovo uporabo pri reševanju praktičnih problemov na področju znanosti o okolju in življenju. Njegovi prispevki vključujejo metode za kombiniranje več klasifikatorjev in učenje modelov v obliki pravil za napovedovanje več ciljnih spremenljivk, kot tudi aplikacije metod strojnega učenja. **Doc. dr. Martin Žnidaršič** je raziskovalec na Odseku za tehnologije znanja, Institut Jožef Stefan, Ljubljana. Njegove raziskave so povezane s podatkovnim rudarjenjem s poudarkom na verjetnostnem modeliranju, modeliranju ocenjevanja in analizi sentimenta ter uporabo teh metod na področjih ekologije in financ.	**Asst. Prof. Bernard Ženko** is a researcher at the Department of Knowledge Technologies, Jožef Stefan Institute, Ljubljana. His research interests are related to machine learning and its application to practical problems from environmental and life sciences. His contributions include methods for combining multiple classifiers and learning rule-based models for predicting multi-target variables, as well as applications of machine learning methods. **Asst. Prof. Martin Žnidaršič** is a researcher at the Department of Knowledge Technologies, Jožef Stefan Institute, Ljubljana. His main research interests are in data mining with a focus on probabilistic modelling, evaluation modelling and sentiment analysis. Applications of his work are conducted mostly in domains of ecology and finance.

Izbrane objave

- S. Džeroski in B. Ženko. Is combining classifiers with stacking better than selecting the best one? Machine learning, 2004, vol. 54, str. 255-273.
- T. Aho, B. Ženko, S. Džeroski, T. Elomaa. Multi-target regression with rule ensembles. Journal of machine learning research, 2012, vol. 13, str. 2367-2407.
- M. Debeljak, A. Poljanec, B. Ženko. Modelling forest growing stock from inventory data: a data mining approach. Ecological indicators, 2014, vol. 41, pp. 30-39.
- S. Džeroski, P. Panov, B. Ženko. Machine learning ensemble methods. In: R. A. Meyers (ed.). Encyclopedia of complexity and systems science. New York: Springer, 2009, vol. 6, pp. 5317-5325.
- J. Škraban, S. Džeroski, B. Ženko, D. Mongus, S. Gangl, M. Rupnik. Gut microbiota patterns associated with colonization of different clostridium difficile ribotypes. PloS one, 2013, vol. 8, iss. 2, pp. e58005-1-e58005-13.
- M. Carotenuto, S. Džeroski, B. Ženko, I. Slavkov, et al. Neuroblastoma tumorigenesis is regulated through the Nm23-H1/h-Prune C-terminal interaction. Scientific reports, 2013, vol. 3, pp. 1351-1-1351-11.
- D. Stojanova, A. Kobler, P. Ogrinc, B. Ženko, S. Džeroski. Estimating the risk of fire outbreaks in the natural environment. Data mining and knowledge discovery, 2012, vol. 24, no. 2, pp. 411-442.
- J. Škraban, S. Džeroski, B. Ženko, L. Tušar, M. Rupnik. Changes of poultry faecal microbiota associated with Clostridium difficile colonisation. Veterinary Microbiology, 2013, vol. 165, iss. 3/4, pp. 416-424.
- D. Kobal Grum, A. B. Kobal, N. Arnerić, M. Horvat, B. Ženko, S. Džeroski, J. Osredkar. Personality Traits in Miners with Past Occupational Elemental Mercury Exposure. Environmental health perspectives, 2006, vol. 114, no. 1.

- M. Novak, P. Zalar, B. Ženko, SCHROERS, Hans-Josef, S. Džeroski, N. Gunde-Cimerman. Candida and Fusarium species known as opportunistic human pathogens from customer-accessible parts of residential washing machines. Fungal biology, 2015, vol. 119, iss. 2/3, pp. 95-113.
- B. Ženko, S. Džeroski. Learning classification rules for multiple target attributes. Lecture notes in computer science, 2008, vol. 5012, pp. 454-465.
- D. Gamberger, B. Ženko, A. Mitelpunkt, N. Lavrač. Homogeneous clusters of Alzheimer's disease patient population. BioMedical engineering online, 2016, vol. 15, suppl. 1, pp. 578-1-578-34.
- P. Tomašič, G. Papa, M. Žnidaršič, Using a genetic algorithm to produce slogans, Informatica (Ljublj.), vol. 39, no. 2, str.125-133, Jun. 2015.
- J. Kranjc, J. Smailović, V. Podpečan, M. Grčar, M. Žnidaršič, N. Lavrač, Active learning for sentiment analysis on data streams : methodology and workflow implementation in the ClowdFlows platform, Inf. process. manage., vol. 51, no. 2, str. 187-203, 2015.
- J. Smailović, M. Grčar, N. Lavrač, M. Žnidaršič, Stream-based active learning for sentiment analysis in the financial domain, Inf. sci., vol. 285, str. 181-203, nov. 2014.
- J. Smailović, M. Grčar, N. Lavrač, M. Žnidaršič, Predictive sentiment analysis of tweets : a stock market application, V: Human-computer interaction and knowledge discovery in complex, unstructured, big data : proceedings, Third International Workshop, HCI-KDD 2013, Held at SouthCHI 2013, Maribor, Slovenia, July 1-3, 2013, (Lecture notes in computer science, Lecture notes in artificial intelligence, vol. 7947), Andreas Holzinger, ur., Gabriella Pasi, ur., Berlin, Heidelberg, Springer, 2013, vol. 7947, str. 77-88, 2013.
- M. Bohanec, M. Žnidaršič, V. Rajkovič, I. Bratko, B. Zupan, DEX methodology : three decades of qualitative multi-attribute modeling, Informatica (Ljublj.), vol. 37, no. 1, str. 49-54, mar. 2013.
- M. Žnidaršič, M. Bohanec, B. Zupan, Modelling impacts of cropping systems: demands and solutions for DEX methodology, Eur. J. oper. res., vol. 189, no. 3, str. 594-608, 2008.
- M. Žnidaršič, M. Bohanec, Automatic revision of qualitative multi-attribute decision models, Fund. Computing Decis. Sci., vol. 32, no. 4, str. 315-326, 2007.
- M. Žnidaršič, M. Bohanec, B. Zupan, proDEX - a DSS tool for environmental decision-making, Environ. model. softw., vol. 21, no. 10, str. 1514-1516, 2006.
- M. Žnidaršič, A. Jakulin, S. Džeroski, C. Campichler, Automatic construction of concept hierarchies : the case of foliage-dwelliung spiders, V: Selected papers from the Fourth International Workshop on Environmental Applications of Machine Learning, September 27 - October 1,2004, Bled, Slovenia : special issue, (Ecological modelling, vol. 191, issue 1, 2006), Sašo Džeroski, ur., Bernard Ženko, ur., Marko Debeljak, ur., Amsterdam, Elsevier, 2006, vol. 191, str. 144-158, 2006.
- M. Žnidaršič, M. Bohanec, Data-based revision of probability distributions in qualitative multi-attribute decision models, Intelligent data analysis, vol. 9, str. 159-174, 2005.
- M. Žnidaršič, M. Bohanec, I. Bratko, Categorization of numerical values for DEX hierarchical models, Informatica (Ljublj.), vol. 27, no. 4, str. 405-409, 2003.
- N. Lavrač, M. Žnidaršič, Inteligenca, človek in stroj, Emzin (Ljubl.), letn. 17, št. 3/4, str. 64-67, 2007.