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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Razpoznavanje vzorcev | | | | | | | | | | | | | | |
| **Course title:** | | | Pattern Recognition | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| doktorski študijski program tretje stopnje Elektrotehnika | | | | | Ni smeri | | | | | | | | 1 | |  | | |
| 3rd cycle: doctoral study programme Electrical Engineering | | | | |  | | | | | | | | **1** | |  | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | izbirni / elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64839 | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | **Klinične vaje**  **Work** | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **45** | | |  | | |  | | | |  | | | **50** | |  | **5** |
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| **Nosilec predmeta / Lecturer:** | | | | | izr. prof. dr. Simon Dobrišek | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | slovenščina in po potrebi angleščina / Slovene and English, if necessary | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | / | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | |  | **Prerequisites:** | | | | | | | |
| Vpis v ustrezni letnik študijskega programa. | | | | | | | | |  | Enrolment in the corresponding year of the study programme. | | | | | | | |
| **Vsebina:** | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | |
| * Uvod: definicije, oblike vzorcev, razpoznavanje vzorcev z razvrščanjem in analizo, uporaba metod razpoznavanja vzorcev v gospodarstvu, prometu, medicini, robotiki, bančništvu, kriminalistiki, pri komunikaciji človek-stroj ipd. * Predobdelava vzorcev: obnavljanje, izboljšanje kakovosti, normalizacija. * Razčlenjevanje vzorcev: zasnova, razčlenjevanje vidnih vzorcev, razčlenjevanje slušnih vzorcev. * Značilke vzorcev: hevristični in matematični postopki določanja značilk. * Analiza primernosti opisa področja uporabe z učno množico vzorcev: mere razdalje med vzorci, preizkus rojenja vzorcev, »izrazita« in »neizrazita« definicija rojenja, postopki iskanja rojev, »globoko« učenje generativnih modelov. * Razvrščanje vzorcev: razvrščanje vektorjev vrednosti značilk s prileganjem, odločanjem, sklepanjem in umetnimi nevronskimi omrežji; razvrščanje nizov vrednosti značilk z dinamičnim programiranjem in prikritimi Markovovimi modeli; razvrščanje grafnih struktur s prileganjem; razvrščanje ob upoštevanju soodvisnosti vzorcev. * Kombiniranje in zlivanje razvrščevalnikov. | | | | | | | |  | | * Introduction: definitions, pattern representations, pattern recognition by classification and analysis, applications of pattern recognition in economy, traffics, medicine, robotics, banking, forensics, man-machine communication, etc. * Pattern pre-processing: restoration, enhancement, normalization. * Pattern segmentation: basic idea,  image segmentation, and  auditory signals segmentation. * Features: generation of features by heuristic and mathematical methods. * Analysis of learning sets: pattern similarity measures, pattern clustering test, crisp and fuzzy clustering, clustering techniques, deep learning of generative models. * Pattern classification: classification of feature vectors by matching, decision, inference, and artificial neural networks; classification of sequences by dynamic programming and Hidden Markov Models; classification by graph matching; classification of statistically dependent samples. * Combining and fusing classifiers. | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| * Pavešić , N (2012) Razpoznavanje vzorcev : uvod v analizo in razumevanje vidnih in slušnih signalov - 3., popravljena in dopolnjena izdaja, Založba FE in FRI, Slovenija * Murphy , KP (2012) Machine learning: a probabilistic perspective, MIT Press, Cambridge, MA * Theodoridis S, Koutroumbas K (2009) *Pattern Recognition*, Fourth Edition, Academic Press * Bishop, CM (2009) Pattern recognition and machine learnin*g,* Springer, New York | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Seznaniti študenta z naprednimi matematičnimi in računalniškimi metodami razpoznavanja vzorcev z razvrščanjem in analizo. | |  | | To acquaint students with the advanced mathematical and computational approaches to pattern recognition by classification and analysis. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Po zaključku predmeta bo študent zmožen izkazati znanje in razumevanje iz:   * gradnje sistemov, ki temelje na razpoznavanju signalov iz okolja, * modeliranja določenih razumskih zmožnosti človeka (zaznavanje in spoznavanje okolja, učenje), * sodobnih metod razčlenjevanja, luščenja značilk, rojenja in razvrščanja vzorcev.   Med študijem pri tem predmetu bo pridobil ali nadgradil prenosljive spretnosti, kot so:   * uporaba informacijske tehnologije: uporaba razvojnih orodij (OpenCV, Weka Data Mining Toolkit), okolij za programiranje (Matlab, GNU Compiler Collection, Netbeans), programskih jezikov (Matlab, C++, Java), * reševanja problemov: analiza problema, načrtovanje algoritma, implementacija programa in testiranje programa. | | |  | After completion of the course the student will be able to demonstrate knowledge and understanding of:   * developing systems based on recognition of external signals, * modelling rational capabilities of human beings (e.g. perception and cognition of the environment, learning), * state-of-the-art methods for pattern segmentation, feature extraction, clustering and classification.   During the course the student will gain and improve transferable skills such as:   * use of information technology: the use of development tools (OpenCV, Weka Data Mining Toolkit), programming environments (Matlab, GNU Compiler Collection, Netbeans), programming languages (Matlab, C++, Java); and * problem solving: problem analysis, algorithm design, implementation and testing of a program. | |
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| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| * predavanja, * individualne konzultacije, * seminarski projekti. | | |  | * lectures, * individual consultations, * seminar projects. | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| * seminarski projekt, * ustni izpit. | 50%  50% | | | | * seminar project, * oral exam. |
| **Reference nosilca / Lecturer's references:** | | | | | |
| * Dobrišek S, Žibert J, Pavešić N, Mihelič F (2009) An edit-distance model for the approximate matching of timed strings. IEEE transactions on pattern analysis and machine intelligence, 31:736-741 * Gajšek R, Mihelič F, Dobrišek S (2013) Speaker state recognition using an HMM-based feature extraction method. Computer speech & language, 27:135-150 * Križaj J, Štruc V, Dobrišek S (2013) Towards robust 3D face verification using Gaussian mixture models. International journal of advanced robotic systems, 9:1-11 * Dobrišek S, Gajšek R, Mihelič F, Pavešić N, Štruc V (2013) Towards efficient multi-modal emotion recognition. International journal of advanced robotic systems, 10:1-10 * Justin T, Mihelič F, Dobrišek S (2014) Intelligibility assessment of the de-identified speech obtained using phoneme recognition and speech synthesis systems, Lecture Notes in Computer Science - Springer Verlag, 8655:529-536. | | | | | |