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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Inteligentne metode raziskovanja podatkov v biomedicini | | | | | | | | | | | | | | |
| **Course title:** | | | Intelligent methods in biomedicine data-mining | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| Podiplomski magistrski študijski program druge stopnje Elektrotehnika | | | | | Biomedicinska tehnika | | | | | | | | 1 | | 1 | | |
| 2nd cycle masters study programme in ELECTRICAL ENGINEERING | | | | | Biomedicine | | | | | | | | 1 | | 1 | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | Obvezni-strokovni / Mandatory professional | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64280 | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | **Klinične vaje**  **work** | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| 45 | 0 | | | 30 | | |  | | | |  | | | 75 | |  | 6 |
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| **Nosilec predmeta / Lecturer:** | | | | | Igor Škrjanc | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | slovenski in po potrebi angleški / Sloveneian and English, if necessary | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | slovenski in po potrebi angleški / Sloveneian and English, if necessary | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | |  | **Prerequisites:** | | | | | | | |
| Vpis v letnik predmeta | | | | | | | | |  | Enrolment in the year of the course | | | | | | | |
| **Vsebina:** | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | |
| * Uvod v inteligentne sisteme. Prikaz inteligentnih sistemov v raziskovanju podatkov, modeliranju, razvrščanju v biomedicini, razpoznavanju, vodenju in detekciji napak. * Osnovne metode nelinearne lokalne optimizacije, s poudarkom na metodah, ki so uporabne v inteligentnih sistemih in metode nelinearne globalne optimizacije. * Metode nelinearne globalne optimizacije s primeri: metoda ohlajanja, evolucijskih algoritmov, genetskih algoritmov, metoda delcev, metoda drevesnega iskanja. * Nenadzorovane metode učenja. Metoda glavnih komponent. Uporaba metode glavnih komponent pri identifikaciji, filtriranju, stiskanju podatkov in detekciji napak. * Metode rojenja. Metode mehkega rojenja: metoda mehkih c-povprečij, metod Gustafson-Kessel, metoda možnih c-povprečij, metoda regresijskega rojenja. * Optimizacija kompleksnosti modelov. Verifikacija in validacija modelov. Eksplicitna in implicitna optimizacija strukture modela. * Statični modeli. Formulacija na osnovi baznih funkcij. Polinomski modeli. * Nevronske mreže. Večplastni perceptron. Gaussove nevronske mreže in aproksimacija funkcij. Primeri nevronskih mrež v biomedicini. * Mehki in nevro-mehki modeli. Mehka logika. Tipi mehkih sistemov. Učenje nevro-mehkih sistemov. Ocenjevanje izhodnih parametrov mehkih modelov. Globalna in lokalna estimacija. * Ekspertni sistemi na osnovi mehkih modelov. Gradnja ekspertnih sistemov na osnovi podatkov. Primeri ekspertnih sistemov v biomedicini. * Nelinearni dinamični sistemi. Klasični polinomski modeli v nelinearnem modeliranju. Dinamični mehki in nevronski modeli. | | | | | | | |  | | * Introduction to intelligent systems. Intelligent systems in data-mining, classification in biomedicine, control and fault detection. * Basic methods of local nonlinear optimization used in intelligent systems and global nonlinear optimization methods. * Methods of global nonlinear optimization: simulated annealing, evolutionary algorithms, particle swarm optimization, genetic algorithms, branch and bound algorithms. * Unsupervised learning methods. Principle component analysis. PCA in identification, data filtering, data compression and fault detection. * Data clustering. Methods of clustering: fuzzy c-means, Gustafon-Kessel fuzzy c-means, possibilistic c-means clustering, method of regression clustering. * Optimization of complex models. Verification and validation of models. Explicit and implicit optimization of model structure. * Static models. Model based on basis function formulation. Polynomial models. * Neural networks. Multilayer perceptron network. Radial basis function networks in function approximation. Examples from biomedicine. * Fuzzy and neuro-fuzzy models. Fuzzy logic. Types of fuzzy models. Estimation of fuzzy model parameter. Global and local estimation. * Expert systems based on fuzzy models. Development of expert systems. Examples of expert systems in biomedicine. * Nonlinear dynamical systems. Classical polynomial models in nonlinear modelling. Dynamical fuzzy and neuro-fuzzy modelas. | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. I. Škrjanc: Inteligentni sistemi pri raziskovanju podatkov in odločanju, skripta v pripravi | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Seznaniti študenta z osnovnimi matematičnimi in računalniškimi načeli izgradnje inteligentnih sistemov za pomoč pri odločanju v sodobnih sistemih. | |  | | To provide students with an understanding of the basic mathematical and computational principles of constructing artificial perception systems, which are an essential part of intelligent systems in automation and control. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Znanje in razumevanje:  Po zaključku tega predmeta bo študent zmožen izkazati znanje in razumevanje:   * gradnje inteligentnih sistemov, ki so osnova za raziskovanje in razumevanje biomedicinskih sistemov, * raziskovanja biomedicinskih podatkov na osnovi metod umetne inteligence.   Uporaba znanja:  Pridobljeno znanje bo študent lahko uporabil pri gradnji modelov za raziskovanje in nadzor biomedicinskih podatkov. Študent bo zmožen kritično ovrednotiti skladnost med pridobljenim znanjem ter uporabo v praksi.  Prenosljive spretnosti:  Študent si bo pridobil spretnosti:   * uporabe literature ter drugih virov s področja inteligentnih sistemov pri raziskovanju podatkov. * uporaba računalniških razvojnih orodij in okolij za programiranje (pisanje programov programskem okolju Matlab), * reševanja problemov: analiza problema, načrtovanje algoritma, implementacija programa in testiranje programa, | | |  | Knowledge and understanding:  After completing this course the student will be able to demonstrate a knowledge and understanding of the:   * construction of intelligent systems which are basis to understand and analyse biomedicine systems, * data-mining of biomedicine data based on intelligent methods.   The use of knowledge:  The student will be able to use the acquired knowledge to construct different intelligent systems for data-mining and monitoring of biomedicine data. The student will be able to critically evaluate the consistency between the acquired knowledge and the application of the concepts in practice.  Transferable skills:   * the use of literature and other resources in the fields of intelligent systems in data mining and system monitoring; * the use of development tools and environments for computer programming (writing computer programs in different programming languages or using the Matlab development environment); * 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, * laboratorijske vaje in projekti, * reševanje domačih nalog. | | |  | * lectures, * laboratory exercises and projects, * coursework. | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| * domače naloge, * laboratorijske vaje in projekt, * ustni izpit. | 10 %  50 %  40 % | | | | * coursework, * laboratory exercises and project, * oral examination. |
| **Reference nosilca / Lecturer's references:** | | | | | |
| 1. ŠKRJANC, Igor. Evolving fuzzy-model-based design of experiments with supervised hierarchical clustering. IEEE transactions on fuzzy systems, ISSN 1063-6706. [Print ed.], 2014, vol. , no. , str. 1-12. 2. ŠKRJANC, Igor. Fuzzy confidence interval for pH titration curve. Applied mathematical modelling, ISSN 0307-904X. [Print ed.], Aug. 2011, vol. 35, no. 8, str. 4083-4090. 3. HARTMANN, Benjamin, BÄNFER, Oliver, NELLES, Oliver, SODJA, Anton, TESLIĆ, Luka, ŠKRJANC, Igor. Supervised hierarchical clustering in fuzzy model identification. *IEEE transactions on fuzzy systems*, ISSN 1063-6706. [Print ed.], Dec. 2011, vol. 19, no. 6, str. 1163-1176. 4. BELIČ, Aleš, ŠKRJANC, Igor, ZUPANČIČ-BOŽIČ, Damjana, VREČER, Franc. Tableting process optimisation with the application of fuzzy models. *International journal of pharmaceutics*, ISSN 0378-5173. [Print ed.], Apr. 2010, vol. 389, no. 1/2, str. 86-93. 5. ŠKRJANC, Igor. Confidence interval of fuzzy models : an example using a waste-water treatment plant. *Chemometrics and Intelligent Laboratory Systems*, ISSN 0169-7439. [Print ed.], Apr. 2009, vol. 96, no. 2, str. 182-187. | | | | | |