UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Evolucijski algoritmi
Course title:	Evolutionary Algorithms

Študijski program in stopnja Study programme and level	Modul Module	Letnik Academic year	Semester Semester
Informacijske in komunikacijske tehnologije, 3. stopnja	Inteligentni sistemi in robotika	1	1
Information and Communication Technologies, 3rd cycle	Intelligent Systems and Robotics	1	1

Vrsta predmeta / Course type Izbirni / Elective

Univerzitetna koda predmeta / University course code: IKT3-622

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Druge oblike	Samost. delo Individ. work	ECTS
15	**15**			**15**	**105**	**5**

**Navedena porazdelitev ur velja, če je vpisanih vsaj 15 študentov. Drugače se obseg izvedbe kontaktnih ur sorazmerno zmanjša in prenese v samostojno delo. / This distribution of hours is valid if at least 15 students are enrolled. Otherwise the contact hours are linearly reduced and transfered to individual work.*

Nosilec predmeta / Lecturer: Prof. dr. Bogdan Filipič

Jeziki / Languages:		
	Predavanja / Lectures:	slovenščina, angleščina / Slovenian, English
	Vaje / Tutorial:	

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Zaključen študij druge stopnje s področja informacijskih ali komunikacijskih tehnologij ali zaključen študij druge stopnje na drugih področjih z znanjem osnov s področja predmeta. Potrebna so tudi osnovna znanja matematike, računalništva in informatike.	Completed second cycle studies in information or communication technologies or completed second cycle studies in other fields with knowledge of fundamentals in the field of this course. Basic knowledge of mathematics, computer science and informatics is also requested.

Vsebina:	**Content (Syllabus outline):**
Uvod: preiskovanje in optimizacija, optimizacijski problemi in njihove značilnosti, deterministična in stohastična optimizacija, optimizacijski algoritmi po zgledih iz narave, evolucijsko računanje, računska inteligenca Osnove evolucijskih algoritmov: motivacija, terminologija, zgradba in delovanje, vrste evolucijskih algoritmov, teoretično ozadje, prednosti in slabosti	Introduction: search and optimization, optimization problems and their characteristics, deterministic and stochastic optimization, nature-inspired optimization algorithms, evolutionary computation, computational intelligence Foundations of evolutionary algorithms: motivation, terminology, composition and functioning, types of evolutionary algorithms, theoretical background, advantages and

Mehanizmi in tehnike:
uglaševanje parametrov algoritmov, obravnavanje omejitev, reševanje multimodalnih, dinamičnih in večkriterijskih optimizacijskih problemov, paralelizacija, hibridizacija
Vrednotenje in uporaba:
statistična analiza rezultatov, mere kakovosti rezultatov in računske učinkovitosti, razvoj evolucijskega algoritma za izbrani optimizacijski problem, primeri uporabe v znanosti, inženirstvu in poslovnem svetu
Sorodni algoritmi:
optimizacija z roji delcev, optimizacija s kolonijami mravelj, kulturni algoritmi, memetski algoritmi, umetni imunski sistemi

disadvantages
Mechanisms and techniques:
algorithm parameter tuning, constraint handling, solving multimodal, dynamic and multiobjective optimization problems, parallelization, hybridization
Evaluation and applications:
statistical analysis of results, measures of effectiveness and efficiency, design of an evolutionary algorithm for a selected optimization problem, use cases from science, engineering and business
Related algorithms:
particle swarm optimization, ant colony optimization, cultural algorithms, memetic algorithms, artificial immune systems

Temeljna literatura in viri / Readings:

Izbrana poglavja iz naslednjih knjig: / Selected chapters from the following books:

- Th. Bäck, Ch. Foussette, and P. Krause. *Contemporary Evolution Strategies*. Springer, 2013. ISBN 978-3-642-40136-7
- A. E. Eiben, and J. E. Smith. *Introduction to Evolutionary Computing*, 2nd edition. Springer, 2015. ISBN 978-3-662-44873-1
- Th. Jansen. *Analyzing Evolutionary Algorithms*. Springer, 2013. ISBN 978-3-642-17338-7
- G. Rozenberg, Th. Bäck, and J. N. Kok (Eds.). *Handbook of Natural Computing*. Springer, 2012. ISBN 978-3-540-92909-3
- X. Yu, and M. Gen. *Introduction to Evolutionary Algorithms*. Springer, 2010. ISBN 978-1-84996-128-8

Cilji in kompetence:

Cilji predmeta so (a) predstaviti osnove optimizacije in evolucijskega računanja, (b) predstaviti gradnike in mehanizme evolucijskih algoritmov in njihove značilnosti, (c) predstaviti metodologijo vrednotenja rezultatov in praktično uporabnost algoritmov, (d) podati pregled sorodnih algoritmov.

Študenti, ki bodo uspešno končali ta predmet, bodo obvladali osnove evolucijskega računanja in bodo usposobljeni za uporabo evolucijskih algoritmov v reševanju zahtevnih optimizacijskih problemov in vrednotenje njihovih rezultatov.

Objectives and competences:

The course objectives are to (a) introduce the basics of optimization and evolutionary computation, (b) present the building-blocks and mechanisms of evolutionary algorithms and their characteristics, (c) present the methodology of result evaluation and the algorithm practical potential, (d) give an overview of the related algorithms.

The students who will successfully complete this course will master the basics of evolutionary computation and will be capable of applying evolutionary algorithms in solving demanding optimization problems and evaluating their results.

Predvideni študijski rezultati:

Študenti bodo z uspešno opravljenimi obveznostmi tega predmeta pridobili:
- razumevanje konceptov optimizacije in evolucijskega računanja,
- obvladovanje tehničnih vidikov evolucijskih

Intended learning outcomes:

Students successfully completing this course will acquire:
- understanding the concepts of optimization and evolutionary computation,
- mastering technical aspects of evolutionary

algoritmov, • usposobljenost za njihov razvoj in uporabo v reševanju praktičnih problemov, • usposobljenost za interpretacijo in vrednotenje njihovih rezultatov.	algorithms, • ability to design the algorithms and apply them in practical problem solving, • ability of to interpret and evaluate their results.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminar, konzultacije, samostojno delo	Lectures, seminar, consultancy, individual work

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni ali ustni izpit	100 %	Written or oral exam

Reference nosilca / Lecturer's references:

- T. Tušar, and B. Filipič. “Visualization of Pareto front approximations in evolutionary multiobjective optimization: A critical review and the prosection method.” IEEE Transactions on Evolutionary Computation, vol. 19, no. 2, pp. 225-245, 2015.
- M. Mlakar, D. Petelin, T. Tušar, and B. Filipič. “GP-DEMO: Differential evolution for multiobjective optimization based on Gaussian process models.” European Journal of Operational Research, vol. 243, no. 2, pp. 347-361, 2015.
- E. Dovgan, M. Javorski, T. Tušar, M. Gams, and B. Filipič. “Discovering driving strategies with a multiobjective optimization algorithm.” Applied Soft Computing, vol. 16, no. 1, pp. 50-62, 2014.
- M. Depolli, R. Trobec, and B. Filipič. “Asynchronous master-slave parallelization of differential evolution for multiobjective optimization.” Evolutionary Computation, vol. 21, no. 2, pp. 261-291, 2013.
- P. Korošec, J. Šilc, and **B. Filipič**. “The differential ant-stigmergy algorithm.” *Information Sciences*, vol. 192, no. 1, pp. 82-97, 2012.