

UČNI NAČRT PREDMETA / COURSE SYLLABUS						
Predmet:		Računska zahtevnost				
Course title:		Computational complexity				
Študijski program in stopnja Study programme and level		Študijska smer Study field		Letnik Academic year	Semester Semester	
Magistrski študijski program Matematika		ni smeri		1 ali 2	prvi ali drugi	
Master's study programme Mathematics		none		1 or 2	first or second	
Vrsta predmeta / Course type				izbirni		
Univerzitetna koda predmeta / University course code:				M2610		
Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
30	15	30			105	6
Nosilec predmeta / Lecturer:		prof. Marko Petkovšek, prof. Sergio Cabello Justo				
Jeziki / Languages:	Predavanja / Lectures:	slovenski/Slovene, angleški/English				
	Vaje / Tutorial:	slovenski/Slovene, angleški/English				
Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:				Prerequisites:		
Vsebina:				Content (Syllabus outline):		

<p>Modeli računanja. Časovna in prostorska zahtevnost. Determinizem in nedeterminizem. Redukcije in polnost.</p> <p>Fenomen NP-polnosti. Nekaj izbranih NP-polnih problemov. Tehnike dokazovanja NP-polnosti. Struktura razreda NP.</p> <p>Verjetnostni algoritmi. Vrste verjetnostnih algoritmov. Verjetnostni razredi zahtevnosti. Generatorji psevdonaključnosti.</p> <p>Aproksimativni algoritmi. Kakovost aproksimacije. Težavnost aproksimacije. Aproksimacijske sheme. Nekaj izbranih aproksimacijskih algoritmov.</p> <p>Dodatno vsebino lahko predavatelj izbere med naslednjimi temami: Booleova vezja, interaktivni dokazi, kvantno računalništvo, izreki PCP, komunikacijska zahtevnost, parametrična zahtevnost.</p>	<p>Models of computation. Time and space complexity. Determinism and nondeterminism. Reductions and completeness.</p> <p>NP-completeness. Some selected NP-complete problems. Techniques to prove NP-completeness. Structure of the class NP.</p> <p>Probabilistic algorithms. Types of probabilistic algorithms. Related computational classes. Pseudorandom generators.</p> <p>Approximation algorithms. Quality of approximation. Hardness of approximation. Approximation schemes. Selected approximation algorithms.</p> <p>Additional content may be selected among the following topics: Boolean circuits, interactive proofs, quantum computing, PCP theorems, communication complexity, parameterized complexity.</p>
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Temeljni literatura in viri / Readings:

<p>S. Arora, B. Barak: Computational Complexity: A Modern Approach, Cambridge University Press, 2009.</p> <p>M. R. Garey, D. S. Johnson: Computers and intractability. A guide to the theory of NP-completeness, W. H. Freeman and Co., 2003.</p> <p>R. Motwani, P. Raghavan: Randomized Algorithms, Cambridge University Press, Cambridge, 1995.</p> <p>V. V. Vazirani: Approximation algorithms, Springer-Verlag, 2001.</p>

Cilji in kompetence:

<p>Študent se seznani z osnovnimi modeli računanja, teorijo NP-polnosti, verjetnostnimi algoritmi in z reševanjem težkih problemov z aproksimativnimi algoritmi.</p>
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Objectives and competences:

<p>Students become acquainted with the basic models of computation, the theory of NP-completeness, probabilistic algorithms, and with solving hard problems approximately.</p>
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Predvideni študijski rezultati:

Intended learning outcomes:

Znanje in razumevanje: Študentje poznajo: povezave med modeli računanja

teorijo NP-polnosti

pojmem verjetnostnega algoritma

pojmem aproksimativnega algoritma

Uporaba: Študentje znajo:

analizirati časovno zahtevnost algoritmov

dokazovati NP-polnost

načrtovati verjetnostne algoritme

načrtovati aproksimativne algoritme

Refleksija: Študentje spoznajo:

hierarhijo problemov glede na njihovo časovno zahtevnost

inherentno težke probleme

relaksacijske pristope k reševanju težkih problemov

Prenosljive spretnosti – niso vezane le na en predmet: Analiza težavnosti problemov s pomočjo redukcij med njimi.

Knowledge and understanding: The students understand: connections between models of computation, theory of NP-completeness, the concept of probabilistic algorithm, the concept of approximation algorithm.

Application: The students are able to: analyze time complexity of algorithms, prove NP-completeness, design probabilistic algorithms, design approximation algorithms.

Reflection: The students meet: problem hierarchies by time complexity, inherently hard problems, relaxations to solve hard problems.

Transferable skills: Analysis of the hardness of problems using reductions between them.

Metode poučevanja in učenja:

Learning and teaching methods:

predavanja, seminar, vaje, domače naloge, konzultacije in samostojno delo študentov

Lectures, seminar, exercises, homework, consultations and independent work by the students

Delež (v %) /

Načini ocenjevanja:

Weight (in %)

Assessment:

Način: izpit iz vaj (2 kolokvija ali pisni izpit) or homework
Ocene: 1-5 (negativno), 6-10 (pozitivno) (po Statutu UL)

50%
50%

Type:
exam of exercises (2 midterm exams or written exam) or homework

oral exam.

Grading: 1-5 (fail), 6-10 (pass) (according to the Statute of UL)

Reference nosilca / Lecturer's references:

Sergio Cabello Justo:

– CABELLO, Sergio, LUKŠIČ, Primož. The complexity of obtaining a distance-balanced graph. The Electronic journal of combinatorics, ISSN 1077-8926. [Online ed.], 2011, vol. 18, no. 1, p49 (10 str.) [COBISS.SI-ID 15832153]

– CABELLO, Sergio. Hardness of approximation for crossing number. Discrete & computational geometry, ISSN 0179-5376, 2013, vol. 49, iss. 2, str. 348-358 [COBISS.SI-ID 16340313]

– CABELLO, Sergio, CARDINAL, Jean, LANGERMAN, Stefan. The clique problem in ray intersection graphs. Discrete & computational geometry, ISSN 0179-5376, 2013, vol. 50, iss. 3, str. 771-783 [COBISS.SI-ID 16728921]

Marko Petkovšek:

– PETKOVŠEK, Marko, PISANSKI, Tomaž. Izbrana poglavja iz računalništva. Del 1, Izračunljivost in rešljivost, jeziki, NP-polnost, naloge, (Matematični rokopisi, 1.a.). 1986: Društvo matematikov, fizikov in astronomov SRS, Ljubljana. 120 str [COBISS.SI-ID 519702]

– PETKOVŠEK, Marko, WILF, Herbert S., ZEILBERGER, Doron. A=B. Wellesley (Massachusetts): A. K. Peters, cop. 1996. VII, 212 str. ISBN 1-56881-063-6 [COBISS.SI-ID 4085337]

– PETKOVŠEK, Marko. Letter graphs and well-quasi-order by induced subgraphs. Discrete Mathematics, ISSN 0012-365X. [Print ed.], 2002, vol. 244, no. 1-3, str. 375-388 [COBISS.SI-ID 11414873]

