

UČNI NAČRT PREDMETA / COURSE SYLLABUS (leto / year 2017/18)							
Predmet:		Izbrana poglavja iz računalniške matematike					
Course title:		Topics in mathematical foundations of computer science					
Študijski program in stopnja Study programme and level		Študijska smer Study field			Letnik Academic year		Semester Semester
Interdisciplinarni magistrski študijski program Računalništvo in matematika		ni smeri			1 ali 2		prvi ali drugi
Interdisciplinary Master's study programme Computer Science and Mathematics		none			1 or 2		first or second
Vrsta predmeta / Course type					izbirni / elective		
Univerzitetna koda predmeta / University course code:					M2830		
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. dr. Andrej Bauer, prof. dr. Sergio Cabello Justo, prof. dr. Marko Petkovšek					
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:			
Vpis v letnik študija.				Enrolment in the programme.			
Vsebina:				Content (Syllabus outline):			

<p>Predavatelj/ica izbere nekatere pomembne teme iz računalniške matematike, kot so na primer:</p> <p>Vizualizacija grafov in podatkov. Računalniška grafika. Računalniški vid.</p> <p>Matroidi. Dualnost in povezanost. Linearni in binarni matroidi. Grafični matroidi. Minorji v matroidih.</p> <p>Teorija iger. Matrične igre. Rešitve in ravnovesja. Negotovost in tveganje. Evolucijska teorija iger.</p> <p>Bioinformatika. Algoritmi sekvenciranja. Markovski modeli. Filogenija in razvrščanje v skupine. Struktura proteinov.</p> <p>Orodja za težke probleme. FPT, eksponentni algoritmi, aproksimacijski algoritmi.</p> <p>Alternativni modeli računanja. Algoritmi za predpomnilnik. Algoritmi za tokove podatkov. Word RAM. Vzoredni algoritmi. Kvantni algoritmi.</p> <p>Povezave med načrtovanjem gibanja robotov in računsko geometrijo.</p> <p>Algoritmi za grafe. Ravninski grafi. Povezanost. Drevesna širina.</p> <p>Računska finančna matematika.</p>	<p>The lecturer chooses some important topics from computer mathematics, like for example: Visualization of graphs and data. Computer Graphics. Computer vision.</p> <p>Matroids. Duality and connectivity. Linear and binary matroids. Graphic matroids. Minors in matroids.</p> <p>Game theory. Matrix games. Solutions and equilibria. Uncertainty and risks. Evolutional game theory. Combinatorial games.</p> <p>Bioinformatics. Sequencing algorithms. Markov models. Phylogeny and classification of groups. Protein structure.</p> <p>Tools for hard problems. FPT, exponential algorithms, approximation algorithms.</p> <p>Alternative models of computation. Algorithms for cache models. Algorithms for data streams. Word RAM. Parallel algorithms. Quantum algorithms.</p> <p>Connections between motion planning and computational geometry.</p> <p>Algorithms for graphs. Planar graphs. Connectivity. Treewidth.</p> <p>Computational financial mathematics.</p>
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Temeljni literatura in viri / Readings:

<p>A. Jaklič, A. Leonardis, F. Solina: Segmentation and Recovery of Superquadrics, Computational imaging and vision 20, Kluwer, Dordrecht, 2000.</p> <p>B. Mohar: Teorija matroidov, DMFAS, Ljubljana, 1996.</p> <p>S. H. Heap, Y. Varoufakis: Game Theory: A Critical Introduction, Routledge, London, 2004.</p> <p>N. C. Jones, P. A. Pevzner: An Introduction to Bioinformatics Algorithms, MIT Press, Cambridge MA, 2004.</p>

R. Niedermeier: Invitation to Fixed-Parameter Algorithms, Oxford University Press, 2006.

V. V. Vazirani: Approximation algorithms, Springer-Verlag, Berlin, 2001.

S. M. LaValle: Planning Algorithms, Cambridge University Press, 2006.

A. O. Pittenger: An introduction to Quantum Computing Algorithms, Birkhäuser Boston, 1999.

R. Seydel: Tools for Computational Finance, Springer, 2000.

G. Di Battista, P. Eades, R. Tamassia, I.G. Tollis: Graph Drawing: Algorithms for the Visualization of Graphs, Prentice Hall, 1998.

C. H. Lampert: Kernel Methods in Computer Vision, Foundations and Trends in Computer Graphics and Vision 4 (2009) 193-285.

N. Nisan, T. Roughgarden, E. Tardos (ur.): Algorithmic Game Theory, Cambridge University Press, 2007.

D.P. Williamson, D.B. Shmoys: The Design of Approximation Algorithms, Cambridge University Press, 2011.

J. JaJa. Introduction to parallel algorithms. Addison-Wesley, 1992.

S. Muthukrishnan: Data Streams: Algorithms and Applications, Foundations & Trends in Theoretical Computer Science, 2005.

Znanstveni članki.

Cilji in kompetence:

Študent spozna osnove nekaterih pomembnih področij računalniške matematike.

Objectives and competences:

The student gets acquainted of some important subareas of computer mathematics.

Predvideni študijski rezultati:

Študentje poznajo in razumejo osnove koncepte, probleme in orodje na različnih področjih računalniške matematike. Povezanost med teorijo in prakso.

Intended learning outcomes:

The students learn and understand basic concepts, problems, and tools in different areas of computer mathematics.

Metode poučevanja in učenja:

Predavanja, seminar, vaje, domače naloge, konzultacije, in samostojno delo študentov.

Learning and teaching methods:

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

Načini ocenjevanja:

Delež (v %) /

Weight (in %)

Assessment:

Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
izpit iz vaj (2 kolokvija ali pisni izpit) ali		exam of exercises (2 midterm exams or
homework		written exam) or homework
ustni izpit	50%	oral exam.
Ocene: 6-10 pozitivno, 1-5 negativno	50%	Grading: 6-10 pass, 1-5 fail (according to
(v skladu s Statutom UL)		the rules of University of Ljubljana)

Reference nosilca / Lecturer's references:

Andrej Bauer:

BAUER, Andrej, STONE, Christopher A. RZ: a tool for bringing constructive and computable mathematics closer to programming practice. Journal of logic and computation, ISSN 0955-792X, 2009, vol. 19, no. 1, str. 17-43. [COBISS.SI-ID 15325785]

BAUER, Andrej, CLARKE, Edmund, ZHAO, Xudong. Analytica - An experiment in combining theorem proving and symbolic computation. Journal of automated reasoning, ISSN 0168-7433, 1998, vol. 21, no. 3, str. 295-325. [COBISS.SI-ID 10606425]

BAUER, Andrej, PETKOVŠEK, Marko. Multibasic and mixed hypergeometric Gosper-type algorithms. Journal of symbolic computation, ISSN 0747-7171, 1999, let. 28, št. 4-5, str. 711-736. [COBISS.SI-ID 9210969]

Sergio Cabello:

CABELLO, Sergio, KREVELD, Marc van. Approximation algorithms for aligning points. Algorithmica, ISSN 0178-4617, 2003, vol. 37, no. 3, str. 211-232. ,19,105,linkingpublicationresults,1:100117,1. [COBISS.SI-ID 13352793]

CABELLO, Sergio. Approximation algorithms for spreading points. *Journal of algorithms*, ISSN 0196-6774, 2007, vol. 62, no. 2, str. 49-73. [COBISS.SI-ID 14298201]

CABELLO, Sergio, HAVERKORT, Herman Johannes, KREVELD, Marc van, SPECKMANN, Bettina. Algorithmic aspects of proportional symbol maps. *Algorithmica*, ISSN 0178-4617, 2010, vol. 58, no. 3, str. 543-565. [COBISS.SI-ID 15151193]

Marko Petkovšek:

PETKOVŠEK, Marko. Counting Young tableaux when rows are cosets. *Ars combinatoria*, ISSN 0381-7032, 1994, let. 37, str. 87-95. [COBISS.SI-ID 8048473]

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]