| UČNI NAČRT PREDMETA / COURSE SYLLABUS | | |
|---|---|---|
| **Predmet:** | Izbrana poglavja iz računalniške matematike | |
| **Course title:** | Topics in mathematical foundations of computer science | |

| **Študijski program in stopnja**<br>**Study programme and level** | **Študijska smer**<br>**Study field** | **Letnik**<br>**Academic year** | **Semester**<br>**Semester** |
|---|---|---|---|
| Magistrski študijski program<br>Finančna matematika | ni smeri | 1 ali 2 | prvi ali drugi |
| Master's study programme<br>Financial Mathematics | none | 1 or 2 | first or second |

| **Vrsta predmeta / Course type** | izbirni |
|---|---|

| **Univerzitetna koda predmeta / University course code:** | M2609 |
|---|---|

| **Predavanja**<br>**Lectures** | **Seminar**<br>**Seminar** | **Vaje**<br>**Tutorial** | **Klinične vaje**<br>**work** | **Druge oblike**<br>**študija** | **Samost. delo**<br>**Individ.**<br>**work** | **ECTS** |
|---|---|---|---|---|---|---|
| 30 | 15 | 30 | | | 105 | 6 |

| **Nosilec predmeta / Lecturer:** | prof. Andrej Bauer, prof. Marko Petkovšek, prof. Sergio Cabello Justo |
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| **Jeziki /**<br>**Languages:** | **Predavanja /**<br>**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):** |
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|---|---|
| Predavatelj izbere nekatere pomembne teme s področja računalniške matematike, kot so na primer:<br><br>Računska geometrija in geometrijska optimizacija.<br><br>Računska topologija.<br><br>Algoritmi na grafih.<br><br>Vizualizacija grafov in podatkov.<br><br>Računalniška grafika.<br><br>Računalniški vid.<br><br>Matroidi.<br><br>Algoritmična teorija iger.<br><br>Aproksimacijski algoritmi.<br><br>Vzporedni algoritmi.<br><br>Algoritmi za tokove podatkov.<br><br>Simbolno računanje.<br><br>Bioinformatika. | The lecturer selects some important topics in computational mathematics, such as:<br>Computational geometry and geometric optimization.<br><br>Computational topology.<br><br>Graph algorithms.<br><br>Graph and data visualization.<br><br>Computer graphics.<br><br>Computer vision.<br><br>Matroids.<br><br>Algorithmic game theory.<br><br>Approximation algorithms.<br><br>Parallel algorithms.<br><br>Algorithms for data streams.<br><br>Symbolic computation.<br><br>Bioinformatics. |

**Temeljni literatura in viri / Readings:**

M. de Berg, O. Cheong, M. van Kreveld, M. Overmars: Computational Geometry: Algorithms and Applications, 3. izdaja, Springer-Verlag, 2008.

S. Har-Peled: Geometric approximation algorithms, AMS, 2011.

H. Edelsbrunner, J.L. Harer: Computational Topology. An Introduction, AMS, 2010.

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.

B. Mohar: Teorija matroidov, DMFAS, Ljubljana, 1996.

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.

J. von zur Gathen, J. Gerhard: Modern Computer Algebra, 3rd ed., Cambridge University Press, 2013.

M. Kauers, P. Paule: The concrete tetrahedron. Symbolic sums, recurrence equations, generating functions, asymptotic estimates, Springer, 2011.

N. C. Jones, P. A. Pevzner: An Introduction to Bioinformatics Algorithms, MIT Press, Cambridge MA, 2004.

Znanstveni članki.

**Cilji in kompetence:**

Študent spozna osnove nekaterih pomembnih področij računalniške matematike.

**Objectives and competences:**

The students get acquainted with some important and actual areas of computational mathematics.

**Predvideni študijski rezultati:**

Znanje in razumevanje: Slušatelj se natančneje seznani z izbranim področjem računalniške matematike. Spozna teoretične osnove ter praktične prijeme z izbranega področja. Uporaba Reševanje računalniških problemov iz različnih prodročij.

Refleksija: Študentje spoznajo računalniške probleme in modeliranje. Povezanost med teorijo in prakso.

**Intended learning outcomes:**

Knowledge and understanding: Students gain deeper knowledge of selected areas in computational mathematics. They become familiar with both the theoretical foundations and the techniques for solving problems in these areas.Application: Solving computational problems from different areas.Reflection: The students see computational problems and modelling. Connection between theory and praxis.Transferable skills: Use of algorithmic thinking for solving imperfectly defined

| Prenosljive spretnosti – niso vezane le na en predmet: Uporaba algoritmičnega mišljenja pri reševanju nepopolno definiranih problemov | problems. |
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**Metode poučevanja in učenja:**

| predavanja, seminar, vaje, domače naloge, konzultacije in samostojno delo študentov |
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**Learning and teaching methods:**

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

| **Načini ocenjevanja:** | Delež (v %) / Weight (in %) | **Assessment:** |
|---|---|---|
| Način:izpit iz vaj (2 kolokvija ali pisni izpit) or homework ustni izpitOcene: 1-5 (negativno), 6-10 (pozitivno) (po Statutu UL) | 50%<br>50% | Type:<br>exam of exercises (2 midterm exams or written exam) or homework<br><br>oral exam.<br><br>Grading: 1-5 (fail), 6-10 (pass) (according to the Statute of UL) |

**Reference nosilca / Lecturer's references:**

Andrej Bauer:

– 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]

– 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, 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]

Sergio Cabello Justo:

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

– 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]