



Univerza v Mariboru

Fakulteta za naravoslovje
in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS

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|----------------------|----------------------------|
| Predmet: | Napredni algoritmi |
| Course title: | Advanced Algorithms |

| Študijski program in stopnja Study programme and level | Študijska smer Study field | Letnik Academic year | Semester Semester |
|---|-------------------------------|-------------------------|----------------------|
| Izobraževalna matematika - enopredmetna, 2. stopnja | | 1. ali 2. | 1. ali 3. |
| Educational Mathematics – single major, 2 nd cycle | | 1. or 2. | 1. or 3. |

Vrsta predmeta / Course type

Univerzitetna koda predmeta / University course code:

| Predavanja Lectures | Seminar Seminar | Sem. vaje Tutorial | Lab. vaje Laboratory work | Teren. vaje Field work | Samost. delo Individ. work | ECTS |
|------------------------|--------------------|-----------------------|------------------------------|---------------------------|-------------------------------|------|
| 45 | | | 30 | | 105 | 6 |

Nosilec predmeta / Lecturer:

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|----------------------------|-------------------------------|-------------------|
| Jeziki / Languages: | Predavanja / Lectures: | SLOVENSKO/SLOVENE |
| | Vaje / Tutorial: | SLOVENSKO/SLOVENE |

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Prerequisites:

Vsebina:

Razreda NP in P. Primeri NP-polni polnih problemov. Problemi kombinatorične optimizacije.

Algoritmi urejanja in njihova zahtevnost.

Iskanje niza v besedilu. Klasični algoritmi: Boyer-Mooreov algoritem, Knuth-Morris-Prattov algoritem.

Priponska drevesa.

Content (Syllabus outline):

Classes NP and P. NP-complete problems. Combinatorial optimization problems.

Sorting algorithms in their complexity.

String matching. Classical methods: Boyer-Moore algorithm, Knuth-Morris-Pratt algorithm. Suffix trees.

Aproksimacijski algoritmi. Lokalno iskanje. Osnove hevrističnih in metahevrističnih algoritmov.

Zahtevnejša analiza algoritmov. Metoda amortiziranih stroškov.

Approximation algorithms. Local search. Fundamentals of heuristics and metaheuristics methods.

Advanced algorithm analysis. Amortized analysis.

Temeljni literatura in viri / Readings:

M. A. Weiss, Data Structures and Algorithm Analysis in C++, Addison-Wesley, 2007.

C.H. Papadimitriou, K. Steiglitz, Combinatorial Optimization - Algorithms and Complexity, Prentice-Hall, 1998.

M. Dorigo, T. Stutzle, Ant colony optimization, MIT Press, 2004.

D. Gusfield, Algorithms on strings, trees and sequences, Cambridge University Press, 1999.

M. Mitchell, An introduction to genetic algorithms, MIT Press, 2002.

Cilji in kompetence:

Poglobiti znanje iz izbranih algoritmov, tehnik zahtevnejših analiz algoritmov in osnov teorije NP-polnosti. Poglobiti znanje iz načinov reševanja težkih (grafovskih) problemov. Predstaviti algoritme iskanja niza.

Objectives and competences:

To deepen the knowledge of selected algorithms, techniques for advanced algorithm analysis and the principles of NP-completeness theory. To deepen the knowledge of skills for solving hard (graph) problems. To present string matching algorithms.

Predvideni študijski rezultati:

Znanje in razumevanje:

- Poglobiti znanje iz osnovnih in zahtevnejših grafovskih algoritmov.
- Prepoznati težke probleme.
- Razumeti pomen aproksimacijskih algoritmov.
- Poglobiti znanje iz različnih vrst hevrističnih in metahevrističnih tehnik.
- Razumevanje zahtevnejših postopkov analize algoritmov.

Prenosljive/ključne spretnosti in drugi atributi:

- Prenos znanja algoritmičnih tehnik na druga področja (diskretna matematika, biologija, ekonomija, ...).

Intended learning outcomes:

Knowledge and Understanding:

- To deepen the knowledge of elementary and advanced graph algorithms
- To recognize hard problems.
- To understand the importance of approximation algorithms.
- To deepen the knowledge of a variety of heuristics and metaheuristics techniques.
- To understand techniques for advanced algorithm analysis

Transferable/Key Skills and other attributes:

- Knowledge transfer of algorithmic techniques into other fields (discrete mathematics, computer science, biology, economics, ...).

Metode poučevanja in učenja:

Learning and teaching methods:

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|---|---|
| <ul style="list-style-type: none"> • Predavanja • Računalniške vaje | <ul style="list-style-type: none"> • Lectures • Computer exercises |
| Načini ocenjevanja: | Assessment: |
| <p><u>Sprotno preverjanje:</u> Projekt Pisni testi – teorija (3 do 5 pisnih testov na semester)</p> <p><u>Izpit:</u> Pisni izpit – problemi</p> <p>Vsaka izmed naštetih obveznosti mora biti opravljena s pozitivno oceno.</p> <p>Opravljene sprotne obveznosti so pogoj za pristop k izpitu.</p> | <p>Delež (v %) / Weight (in %)</p> <p>40% 40%</p> <p>20%</p> <p><u>Mid-term testing:</u> Project Written tests – theory (from 3 to 5 written tests during the semester)</p> <p><u>Exams:</u> Written exam - problems</p> <p>Each of the mentioned commitments must be assessed with a passing grade.</p> <p>Passing grades of all mid-term testings are required for taking the exam.</p> |

Reference nosilca / Lecturer's references:

1. KORŽE, Danilo, MARKUŠ, Žiga, VESEL, Aleksander. A heuristic approach for searching (d,n)-packing colorings of infinite lattices. *Discrete applied mathematics*, ISSN 0166-218X. [Print ed.], March 2019, vol. 257, str. 353-358. <https://doi.org/10.1016/j.dam.2018.09.018>, [COBISS.SI-ID [21821462](#)].
2. KORŽE, Danilo, VESEL, Aleksander. Packing coloring of generalized Sierpiński graphs. *Discrete mathematics and theoretical computer science*, ISSN 1365-8050, 2019, vol. 21, no. 3, str. 1-18. <https://dmtcs.episciences.org/5178/pdf>. [COBISS.SI-ID [22126870](#)].
3. VESEL, Aleksander. Cube-complements of generalized Fibonacci cubes. *Discrete Mathematics*, ISSN 0012-365X. [Print ed.], April 2019, vol. 342, iss. 4, str. 1139-1146. <https://doi.org/10.1016/j.disc.2019.01.008>, [COBISS.SI-ID [18539097](#)].
4. SHAO, Zehui, VESEL, Aleksander, XU, Jin. The k-distance independence number and 2-distance chromatic number of Cartesian products of cycles. *Bulletin of the Malaysian Mathematical Society*, ISSN 0126-6705, 2018, vol. 41, iss. 3, str. 1377-1391, doi: [10.1007/s40840-016-0397-0](https://doi.org/10.1007/s40840-016-0397-0). [COBISS.SI-ID [22601992](#)].
5. KORŽE, Danilo, VESEL, Aleksander. (d,n)-packing colorings of infinite lattices. *Discrete applied mathematics*, ISSN 0166-218X. [Print ed.], March 2018, vol. 237, str. 97-108, doi: [10.1016/j.dam.2017.11.036](https://doi.org/10.1016/j.dam.2017.11.036). [COBISS.SI-ID [21067542](#)].