



Univerza v Mariboru

Fakulteta za naravoslovje
in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Napredni algoritmi
Course title:	Advanced algorithms

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Matematika, 2. stopnja		1. ali 2.	1. ali 3.
Mathematics, 2 nd degree		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		135	7

Nosilec predmeta / Lecturer:

Jeziki / Languages:	Predavanja / Lectures:	<input type="text" value="SLOVENSKO/SLOVENE"/>
	Vaje / Tutorial:	<input type="text" value="SLOVENSKO/SLOVENE"/>

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

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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: Ukkonenov algoritem in Weinerjev algoritem. Neeksaktno iskanje niza.
Aproksimacijski algoritmi. Lokalno iskanje. Osnove hevrističnih in metahevrističnih

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: Ukkonen's algorithm, Weiner's algorithm. Inexact matching.
Approximation algorithms. Local search. Fundamentals of heuristics and metaheuristics methods.
Advanced algorithm analysis. Amortized

algoritmov.
Zahtevnejša analiza algoritmov. Metoda amortiziranih stroškov.

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.

Prenesljive/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:

- Predavanja
- Računalniške vaje

Learning and teaching methods:

- 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%</p> <p>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>
<p>Reference nosilca / Lecturer's references:</p>		

1. VESEL, Aleksander. Binary coding of resonance graphs of catacondensed polyhexes. *Match : communications in mathematical and in computer chemistry*. 2023, vol. 90, no. 2, str. 429-452. ISSN 0340-6253. DOI: [10.46793/match.90-2.429V](https://doi.org/10.46793/match.90-2.429V). [COBISS.SI-ID [148521219](https://www.cobiss.si/urn:nbn:si:coibis-148521219)]
2. KORŽE, Danilo, VESEL, Aleksander. General Position Sets in Two Families of Cartesian Product Graphs. *Mediterranean journal of mathematics*. Published 06 May 2023, 12 str. ISSN 1660-5446. DOI: [10.1007/s00009-023-02416-z](https://doi.org/10.1007/s00009-023-02416-z). [COBISS.SI-ID [151233539](https://www.cobiss.si/urn:nbn:si:coibis-151233539)]
3. KORŽE, Danilo, SHAO, Zehui, VESEL, Aleksander. New results on radio k-labelings of distance graphs. *Discrete applied mathematics*. [Print ed.]. 15 Oct. 2022, vol. 319, str. 472-479. ISSN 0166-218X. DOI: [10.1016/j.dam.2021.09.007](https://doi.org/10.1016/j.dam.2021.09.007). [COBISS.SI-ID [78298371](https://www.cobiss.si/urn:nbn:si:coibis-78298371)]
4. DENG, Fei, SHAO, Zehui, VESEL, Aleksander. On the packing coloring of base-3 Sierpiński graphs and H-graphs. *Aequationes mathematicae*. 2021, vol. 95, iss. 2, str. 329-341. ISSN 0001-9054. DOI: [10.1007/s00010-020-00747-w](https://doi.org/10.1007/s00010-020-00747-w). [COBISS.SI-ID [27121667](https://www.cobiss.si/urn:nbn:si:coibis-27121667)]
5. VESEL, Aleksander. Efficient proper embedding of a daisy cube. *Ars mathematica contemporanea*. [Tiskana izd.]. 2021, vol. 21, no. 2, str. 271-282. ISSN 1855-3966. <https://amc-journal.eu/index.php/amc/article/download/2454/1711>, <http://www.dlib.si/details/URN:NBN:SI:doc-LNSLRXNG>, DOI: [10.26493/1855-3974.2454.892](https://doi.org/10.26493/1855-3974.2454.892). [COBISS.SI-ID [72352259](https://www.cobiss.si/urn:nbn:si:coibis-72352259)]