



Univerza v Mariboru



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:

Aleksander VESEL

Jeziki /

Languages:

Predavanja /

Lectures:

SLOVENSKO/SLOVENE

Vaje / Tutorial:

SLOVENSKO/SLOVENE

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

Jih ni.

Prerequisites:

There are none.

Vsebina:

Content (Syllabus outline):

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 algoritmov.

Zahtevnejša analiza algoritmov. Metoda amortiziranih stroškov.

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 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:

Learning and teaching methods:

- Predavanja
- Računalniške vaje

- Lectures
- Computer exercises

Delež (v %) /

Načini ocenjevanja:

Weight (in %)

Assessment:

Pisni izpit – teoretični del Projekt – praktični del		Written exam – theoretical part Project – practical part
Vsaka izmed naštetih obveznosti mora biti opravljena s pozitivno oceno.		Each of the mentioned commitments must be assessed with a passing grade.
Pozitivna ocena pri projektu je pogoj za pristop k izpitu.	60%, 40%	Passing grade of the project is required for taking the exam.

Reference nosilca / Lecturer's references:

1. TARANENKO, Andrej, VESEL, Aleksander. 1-factors and characterization of reducible faces of plane elementary bipartite graphs. *Discuss. Math., Graph Theory*, 2012, vol. 32, no. 2, str. 289-297, doi: [10.7151/dmgt.1607](https://doi.org/10.7151/dmgt.1607). [COBISS.SI-ID [19104264](https://cobiss.si/19104264)]
2. SALEM, Khaled, KLAVŽAR, Sandi, VESEL, Aleksander, ŽIGERT, Petra. The Clar formulas of a benzenoid system and the resonance graph. *Discrete appl. math.*. [Print ed.], 2009, vol. 157, iss. 11, str. 2565-2569. <http://dx.doi.org/10.1016/j.dam.2009.02.016>. [COBISS.SI-ID [15142489](https://cobiss.si/15142489)]
3. VESEL, Aleksander. 4-tilings of benzenoid graphs. *MATCH Commun. Math. Comput. Chem. (Krag.)*, 2009, vol. 62, no. 1, str. 221-234. [COBISS.SI-ID [16886536](https://cobiss.si/16886536)]
4. TARANENKO, Andrej, VESEL, Aleksander. Characterization of reducible hexagons and fast decomposition of elementary benzenoid graphs. *Discrete appl. math.*. [Print ed.], 2008, vol. 156, iss. 10, str. 1711-1724. <http://dx.doi.org/10.1016/j.dam.2007.08.029>, doi: [10.1016/j.dam.2007.08.029](https://doi.org/10.1016/j.dam.2007.08.029). [COBISS.SI-ID [16140552](https://cobiss.si/16140552)]
5. TARANENKO, Andrej, VESEL, Aleksander. On elementary benzenoid graphs: new characterization and structure of their resonance graphs. *MATCH Commun. Math. Comput. Chem. (Krag.)*, 2008, #Vol. #60, #no. #1, str. 193-216, ilustr. [COBISS.SI-ID [1939989](https://cobiss.si/1939989)]