



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 |
|---|-------------------------------|-------------------------|----------------------|
| Enovit magistrski študijski program druge stopnje Predmetni učitelj | / | 5. | 9. |
| Five-year master's degree program Subject Teacher | / | | |

Vrsta predmeta / Course type: Izbirni / Elective

Univerzitetna koda predmeta / University course code:

| Predavanja Lectures | Seminar Seminar | Vaje Tutorial | Lab. vaje Laboratory work | Terenske vaje Field work | Samost. delo Individ. work | ECTS |
|------------------------|--------------------|------------------|------------------------------|-----------------------------|-------------------------------|------|
| 30 | | | 30 | | 150 | 7 |

Nosilec predmeta / Lecturer: Aleksander Vesel

Jeziki / Predavanja / Lectures: slovenski / slovene
Languages: Vaje / Tutorial: slovenski / slovene

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

Prerequisites: There are none.

Vsebina:
Razreda NP in P. Primeri NP-polni polnih problemov.
Problemi kombinatorične optimizacije.
Algoritmi urejanja in njihova zahtevnost.
Iskanje niza v besedilu. Klasični algoritmi: BoyerMooreov algoritem, Knuth-Morris-Prattov algoritem.

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. Inexact matching.

Priponska drevesa: Ukkonenov algoritem.
Neeksaktno iskanje niza.
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.

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.

Prenesljive/ključne spretnosti in drugi atributi:

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

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 in teoretične vaje

Learning and teaching methods:

- Lectures
- Computer and theoretical exercises

Delež (v %) /

Načini ocenjevanja:

Weight (in %)

Assessment:

| | | |
|---|-----|--|
| Pisni izpit – teoretični del | 60% | Written exam – theoretical part |
| Projekt – praktični del | 40% | 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. | | Passing grade of the project is required for taking the exam. |

Reference nosilca / Lecturer's references:

A. Vesel, Linear recognition and embedding of Fibonacci cubes. *Algorithmica*, 2013, str. 1-14.

A. Vesel, Fibonacci dimension of the resonance graphs of catacondensed benzenoid graphs. *Discrete appl. math.*, 2013, vol. 161, issue 13-14, str. 2158-2168.

Z. Shao, A. Vesel, Integer linear programming model and satisfiability test reduction for distance constrained labellings of graphs: the case of L(3,2,1) labelling for products of paths and cycles. *IET communications*, 2013, vol. 7, iss. 8, str. 715-720.

D. Korže, A. Vesel, A note on the independence number of strong products of odd cycles. *Ars comb.*, 2012, vol. 106, str. 473-481.

A. Vesel, 4-tilings of benzenoid graphs. *MATCH Commun. Math. Comput. Chem. (Krag.)*, 2009, vol. 62, str. 221-234.