



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
15	15		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:**

Vsebina predmeta se prilagaja aktualnim potrebam in razvoju.  
Razreda NP in P. Primeri iz razreda NP-polnih problemov.  
Primeri problemov iz razreda P (iskanje niza v besedilu, problemi na grafih,...).  
Problemi kombinatorične optimizacije.  
Aproksimacijski algoritmi.

**Content (Syllabus outline):**

The contents of this subject is adjusted to the current needs and development.  
Complexity classes NP and P.  
Examples of NP-complete problems.  
Examples of problems in P (string matching, graph theory problems, ...).  
Combinatorial optimization problems.  
Approximation algorithms. Local search.

Lokalno iskanje. Osnove hevrističnih in metahevrističnih algoritmov.  
Zahtevnejša analiza algoritmov. Metoda amortiziranih stroškov.

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.  
D. P. Williamson, D. B. Shmoys, The design of approximation algorithms, Cambridge University Press, 2011.

### 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.
- Zmožnost povezovanja med različnimi pojmi.

### 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:

- Poznavanje zahtevnejših grafovskih algoritmov.
- Zmožnost prepoznati težke probleme.
- Razumeti pomen aproksimacijskih algoritmov.
- Poglobljeno poznavanje različnih vrst hevrističnih in metahevrističnih tehnik.
- Sposobnost uporabe 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:

- The knowledge of advanced graph algorithms
- Ability to recognize hard problems.
- To understand the importance of approximation algorithms.
- To deepen the knowledge of a variety of heuristics and metaheuristics techniques.
- Ability to apply 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:**

<ul style="list-style-type: none"> <li>• Predavanja, seminar</li> <li>• Računalniške in teoretične vaje</li> </ul>	<ul style="list-style-type: none"> <li>• Lectures, seminary</li> <li>• Computer and theoretical exercises</li> </ul>
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**Načini ocenjevanja:**

Delež (v %) /

Weight (in %)

**Assessment:**

<u>Sprotno preverjanje:</u>		<u>Mid-term testing:</u>
Projekt	20%	Project
Seminar	20%	Seminary work
Pisni testi – teorija (2 pisna testa)	40%	Written tests – theory (2 written tests)
<u>Izpit:</u>		<u>Exams:</u>
Pisni izpit – problemi	20%	Written exam - problems
Vsaka izmed naštetih obveznosti mora biti opravljena s pozitivno oceno. Opravljene sprotne obveznosti so pogoj za pristop k izpitu.		Each of the mentioned commitments must be assessed with a passing grade. Passing grades of all mid-term testings are required for taking the exam.

**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].