



Univerza v Mariboru



Univerza v Mariboru

Fakulteta za naravoslovje in  
matematiko

## UČNI NAČRT PREDMETA / COURSE SYLLABUS

|                      |            |
|----------------------|------------|
| <b>Predmet:</b>      | Algoritmi  |
| <b>Course title:</b> | Algorithms |

| Študijski program in stopnja<br>Study programme and level | Študijska smer<br>Study field | Letnik<br>Academic year | Semester<br>Semester |
|-----------------------------------------------------------|-------------------------------|-------------------------|----------------------|
| Matematika                                                | Uporabna matematika           | 2.                      | 4.                   |
| Mathematics                                               | Applied Mathematics           | 2.                      | 4.                   |

Vrsta predmeta / Course type

Univerzitetna koda predmeta / University course code:

| Predavanja<br>Lectures | Seminar<br>Seminar | Sem. vaje<br>Tutorial | Lab. vaje<br>Laboratory work | Teren. vaje<br>Field work | Samost. delo<br>Individ. work | ECTS |
|------------------------|--------------------|-----------------------|------------------------------|---------------------------|-------------------------------|------|
| 45                     |                    |                       | 45                           |                           | 150                           | 8    |

Nosilec predmeta / Lecturer:

Aleksander VESEL

Jeziki /

Languages:

Predavanja /

Lectures:

Vaje / Tutorial:

SLOVENSKO/SLOVENE

SLOVENSKO/SLOVENE

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

Jih ni.

Prerequisites:

There are none.

Vsebina:

Analiza algoritma: časovna in prostorska zahtevnost.

Deli in vladaj: bisekcija, urejanje (hitro urejanje, urejanje z zlivanjem), iskanje  $k$ -tega najmanjšega elementa v zaporedju, množenje velikih števil, množenje matrik.

Požrešna metoda: preprosti problem nahrbtnika, minimalno vpeto drevo, drevo najkrajših poti, Huffmanovo kodiranje.

Content (Syllabus outline):

Algorithm analysis: time and space complexity.

Divide and conquer: bisection, sorting (quick sort, merge sort), selection problem, big numbers multiplication, matrix multiplication.

Greedy algorithms: fractional knapsack problem, minimum spanning tree, single-source shortest path in a graph, Huffman codes.

Dynamic programming: all-pairs shortest paths

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| <p>Dinamično programiranje: dolžine najkrajših poti v grafu, 0/1 nahrbtnik, problem trgovskega potnika.</p> <p>Sestopanje: barvanje grafa, problem <math>n</math> kraljic, igre za dva igralca, <math>\alpha</math>-<math>\beta</math> obrezovanje.</p> <p>Verjetnostni algoritmi: testiranje praštevilstva, verjetnostni heuristični algoritmi.</p> | <p>in a graph, 0/1 knapsack problem, traveling salesman problem.</p> <p>Backtracking: graph coloring, <math>n</math>-queens on a chessboard, strategic games, <math>\alpha</math>-<math>\beta</math> pruning.</p> <p>Randomized algorithms: primality testing, randomized heuristics.</p> |
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### Temeljni literatura in viri / Readings:

T.H. Cormen, C.E. Leiserson, R.L. Rivest, Introduction to algorithms, The MIT Press, 2001.

J. Kozak, Podatkovne strukture in algoritmi, Ljubljana, DMFA, 1997.

S.S. Skiena, The Algorithm Design Manual, Springer, 1998.

### Cilji in kompetence:

Spoznati temeljne koncepte analize algoritmov.  
 Spoznati osnovne strategije snovanja algoritmov: deli in vladaj, požrešne algoritme, dinamično programiranje in sestopanje.  
 Spoznati verjetnostne algoritme in osnove heurističnih algoritmov.

### Objectives and competences:

Know fundamental concepts from algorithm analysis.  
 Know basic algorithm design techniques: divide and conquer, greedy algorithms, dynamic programming, backtracking. Know randomized algorithms and the principles of heuristics.

### Predvideni študijski rezultati:

Znanje in razumevanje:

- Razumevanje principov analize algoritmov.
- Razumeti pomen strategij snovanja algoritmov.
- Spoznati različne strategije oziroma pristope pri snovanju algoritmov.
- Razumeti pomen verjetnostnih algoritmov.

Prenosljive/ključne spretnosti in drugi atributi:

- Prenos znanja metod snovanja in analize algoritmov na sorodna oziroma povezana področja (računalništvo, diskretna matematika, biologija, ekonomija...)

### Intended learning outcomes:

Knowledge and Understanding:

- To understand principals of algorithm analysis.
- To understand the meaning of algorithm design.
- To know a variety of algorithm design techniques.
- To recognize the meaning of randomized algorithms.

Transferable/Key Skills and other attributes:

- Knowledge transfer of methods of algorithm analysis and design into other fields (discrete mathematics, computer science, biology, economics, ...)

### Metode poučevanja in učenja:

- Predavanja

### Learning and teaching methods:

- Lectures

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| • Računalniške vaje                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                     | • Computer exercises                                                                                                                                                                                                                                                                                             |
| <b>Načini ocenjevanja:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                     | <b>Assessment:</b>                                                                                                                                                                                                                                                                                               |
| <p>Način (pisni izpit, ustno izpraševanje, naloge, projekt)</p> <p>Pisni test – problemi</p> <p>Izpit (pisni) - teorija</p> <p>Naloge</p> <p>Vsaka izmed naštetih obveznosti mora biti opravljena s pozitivno oceno.</p> <p>Pozitivni oceni pri pisnem testu in nalogah sta pogoj za pristop k izpitu.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <p>Delež (v %) / Weight (in %)</p> <p>40%</p> <p>40%</p> <p>20%</p> | <p>Type (examination, oral, coursework, project):</p> <p>Written test - problems</p> <p>Exam (written) – theory</p> <p>Coursework</p> <p>Each of the mentioned commitments must be assessed with a passing grade.</p> <p>Passing grades of the written test and coursework are required for taking the exam.</p> |
| <b>Reference nosilca / Lecturer's references:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                     |                                                                                                                                                                                                                                                                                                                  |
| <p>1. KORŽE, Danilo, VESEL, Aleksander. A note on the independence number of strong products of odd cycles. <i>Ars comb.</i>, 2012, vol. 106, str. 473-481. [COBISS.SI-ID <a href="#">16138006</a>]</p> <p>2. TARANENKO, Andrej, VESEL, Aleksander. 1-factors and characterization of reducible faces of plane elementary bipartite graphs. <i>Discuss. Math., Graph Theory</i>, 2012, vol. 32, no. 2, str. 289-297, doi: <a href="#">10.7151/dmgt.1607</a>. [COBISS.SI-ID <a href="#">19104264</a>]</p> <p>3. SALEM, Khaled, KLAVŽAR, Sandi, VESEL, Aleksander, ŽIGERT, Petra. The Clar formulas of a benzenoid system and the resonance graph. <i>Discrete appl. math.</i>. [Print ed.], 2009, vol. 157, iss. 11, str. 2565-2569. <a href="http://dx.doi.org/10.1016/j.dam.2009.02.016">http://dx.doi.org/10.1016/j.dam.2009.02.016</a>. [COBISS.SI-ID <a href="#">15142489</a>]</p> <p>4. VESEL, Aleksander. 4-tilings of benzenoid graphs. <i>MATCH Commun. Math. Comput. Chem. (Krag.)</i>, 2009, vol. 62, no. 1, str. 221-234. [COBISS.SI-ID <a href="#">16886536</a>]</p> <p>5. TARANENKO, Andrej, VESEL, Aleksander. Characterization of reducible hexagons and fast decomposition of elementary benzenoid graphs. <i>Discrete appl. math.</i>. [Print ed.], 2008, vol. 156, iss. 10, str. 1711-1724. <a href="http://dx.doi.org/10.1016/j.dam.2007.08.029">http://dx.doi.org/10.1016/j.dam.2007.08.029</a>, doi: <a href="#">10.1016/j.dam.2007.08.029</a>. [COBISS.SI-ID <a href="#">16140552</a>]</p> |                                                                     |                                                                                                                                                                                                                                                                                                                  |