

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: Izbrana poglavja iz algoritmov
Course title: Selected Topics in Algorithms

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Podatkovne znanosti, magistrski študijski program druge stopnje	-	Prvi	Drugi
The second cycle masters study programme Data Sciences	-	First	Second

Vrsta predmeta / Course type

Izbirni / Elective

Univerzitetna koda predmeta / University course code:

2-PZ-MAG-IP-IPA-2020-06-30

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
30	-	30	-	-	90	5

Nosilec predmeta / Lecturer:

izr. prof. dr. Biljana Mileva Boshkoska, izr. prof. dr. Borut Lužar

Jeziki / Languages:**Predavanja / Lectures:** Slovenski / Slovenian, Angleški / English**Vaje / Tutorial:** Slovenski / Slovenian, Angleški / English**Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:**

Specifičnih pogojev za vključitev v delo ni.

Priporočeno je poznavanje temeljnih podatkovnih struktur ter poznavanje osnovnih konceptov algoritmov (npr. opravljen predmet Uvod v algoritme na prvi stopnji študija).

Pogoj za pristop k izpitu so opravljene in pozitivno ocenjene vse obveznosti na vajah.

Prerequisites:

There are no specific requirements for this subject.

Knowledge of fundamental data structures and understanding of basic algorithmic concepts is recommended (e.g., the knowledge obtained at Introduction to Algorithms at the first study cycle).

To attend the exam, a student has to submit all assignments given, and have them positively evaluated.

Vsebina:**Content (Syllabus outline):**

- Požrešna metoda (razvrščanje intervalov, najkrajše poti v grafih, grupiranje, Huffmanovi kodi).
- Deli in vladaj (Urejanje z zlivanjem).
- Dinamično programiranje (memoizacija, vsote podmnožic in problem nahrbtnika, najkrajše poti v grafih, poravnava zaporedij).
- Pretoki v omrežjih (Problema maksimalnega pretoka in minimalnega prereza, Problem prirejanja v dvodelnih grafih, Izdelava anket, razporejanje letov).
- Aproksimacijski algoritmi (požrešni algoritmi in meje optimalnosti, pokritja množic, pokritja vozlišč, Problem disjunktnih poti, Problem nahrbtnika).

- Greedy method (Interval scheduling, Shortest paths in graphs, Clustering, Huffman codes).
- Divide and Conquer (Mergesort).
- Dynamic programming (Memoization, Subset sums and knapsack, Shortest paths in graphs, Sequence alignment).
- Network flows (Maximum flow and Minimum cut problems, Bipartite matching problem, Survey design, Airline scheduling).
- Approximation algorithms (Greedy algorithms and bounds on the optimum, Set cover, Vertex cover, Disjoint paths problem, The knapsack problem).

Temeljni literatura in viri / Readings:

- CORMEN, Thomas, LEISERSON, Charles, RIVEST, Ronald in STEIN, Clifford (2001): Introduction to Algorithms, 2. izdaja, MIT Press, Cambridge.
- KLEINBERG, Jon, TARDOS, Eva (2006): Algorithm Design, Addison Wesley, USA.
- KONONENKO, Igor (1996): Načrtovanje podatkovnih struktur in algoritmov. Ljubljana, Založba FE in FRI.
- KORTE, Bernhard, VYGEN, Jens (2008): Combinatorial Optimization. Springer Verlag, Berlin Heidenberg.
- MOTWANI, R., RAGHAVAN, P. (1995) Randomized Algorithms, Cambridge University Press, Cambridge.
- MILEVA BOSHKOSKA, Biljana in LUŽAR, Borut: Prosojnice iz predavanj in vaj pri predmetu Izbrana poglavja iz algoritmov, Moodle, FIS.

Cilji in kompetence:

Splošne kompetence:

- Sposobnost skrbeti za kakovost strokovnega dela skozi avtonomnost, samoiniciativnost, (samo)kritičnost, (samo)refleksivnost in (samo)evalviranje.
- Sposobnost fleksibilne uporabe znanja v praksi.
- Sposobnost analitičnega in algoritmičnega razmišljanja.

Predmetno-specifične kompetence:

- Sposobnost oblikovanja in razvoja naprednih algoritmov za specifična opravila, določena s problemom.

Objectives and competences:

General competences:

- The ability to manage quality of professional work through autonomy, initiative, as well as (self-)criticism, (self-)reflection and (self-)evaluation.
- The ability of flexible usage of knowledge in practice.
- The ability of analytical and algorithmic thinking.

Subject-specific competences:

- Ability to design and develop advanced algorithms for problem specific tasks.

- Sposobnost primerjave in izbire primernih algoritmov ter orodij za implementacijo le-teh.
- Poznavanje in sposobnost za uporabo širokega spektra komponent potrebnih za celovit razvoj algoritmov.
- Sposobnost interpretacije in modeliranja danega problema v obliki algoritma.

- The ability of comparison and selection of appropriate algorithms and tools for implementation of algorithms.
- Knowledge of and ability to use a wide range of components necessary for full development of algorithms.
- The ability to interpret and model the given problem in a form of an algorithm.

Predvideni študijski rezultati:

Znanje in razumevanje:

- Študentje se bodo spoznali s teoretičnimi osnovami in praktičnimi vidiki razvoja algoritmov.
- Študentje bodo sposobni v izbranem programskem jeziku napisati program ter uporabiti najnovejša programska orodja za implementacijo izbranega algoritma.
- Bistveno bodo izboljšali znanje programiranja algoritmov.

Prenosljive spretnosti:

- Študentje bodo sposobni prenosa znanja na druga področja, vključujoč splošno algoritmično znanje, razvoj novih algoritmov in programov za reševanje problemov iz prakse v obliki aplikacij.

Intended learning outcomes:

Knowledge and understanding:

- Students will get acquainted with theoretical basics and practical aspects of the development of algorithms.
- Students will have the ability to code and use some of the latest software tools that implement state-of-the-art algorithms.
- Significantly will upgrade programming knowledge of algorithms.

Transferable skills:

- Students will be able to transfer their obtained knowledge to other areas, involving the use of general algorithmic knowledge, develop new algorithms and programs to solve a given problem in the form of applications.

Metode poučevanja in učenja:

- predavanja z aktivno udeležbo študentov (razlaga, diskusija, vprašanja, primeri);
- vaje (reševanje različnih problemov, implementacija algoritmov).

Learning and teaching methods:

- lectures with active students' participation (explanations, discussion, questions, examples);
- exercises (solving various problems, implementation of algorithms).

Načini ocenjevanja:

Delež (v %) /

Weight (in %) **Assessment:**

<ul style="list-style-type: none"> • pisni izpit • projektna naloga 	<p>50 %</p> <p>50 %</p>	<ul style="list-style-type: none"> • written exam • project assignment
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Reference nosilca / Lecturer's references:

- F. DROSS, B. LUŽAR, M. MACEKOVÁ, R. SOTÁK, Note on 3-choosability of planar graphs with maximum degree 4, *Discrete Math.* 342 (2019), 3123-3129.
- M. JANICOVÁ, B. LUŽAR, T. MADARAS, R. SOTÁK, From NMNR-coloring of hypergraphs to homogenous coloring of graphs, *Ars Math. Contemp.* 12 (2017), 351-360.
- M. BONAMY, M. KNOR, B. LUŽAR, A. PINLOU, R. ŠKREKOVSKI, On the difference between the Szeged and the Wiener index, *Appl. Math. Comput.* 312 (2017), 202-213.
- P. GREGOR, B. LUŽAR, R. SOTÁK, On incidence coloring conjecture in Cartesian products of graphs, *Discrete Appl. Math.* 213 (2016), 93-100.
- ZHAO, Guoqing, LIU, Shaofeng, LOPEZ, Carmen, LU, Haiyan, ELGUETA, Sebastian, CHEN, Huilan, MILEVA BOSHKOSKA, Biljana. Blockchain technology in agri-food value chain management : a synthesis of applications, challenges and future research directions. *Computers in industry*, ISSN 0166-3615. [Print ed.], 2019, vol. 109, str. 83-99.
- BOŠKOSKI, Pavle, DEBENJAK, Andrej, MILEVA BOSHKOSKA, Biljana. Rayleigh copula for describing impedance data - with application to condition monitoring of proton exchange membrane fuel cells. *European journal of operational research*, ISSN 0377-2217. [Print ed.], 2018, vol. 266, no. 1, str. 269-277.
- GRAŠIČ, Valerij, KOS, Andrej, MILEVA BOSHKOSKA, Biljana. Classification of incoming calls for the capital city of Slovenia smart city 112 public safety system using open Internet of Things data. *International journal of distributed sensor networks*, ISSN 1550-1477. [Online ed.], 2018, vol. 14, no. 9, str. 1-12, ilustr.