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**
Kibernetska varnost, magistrski študijski program druge stopnje	-	Prvi	Drugi
The second cycle masters study programme Cyber Security	-	First	Second

Vrsta predmeta / Course type	Izbirni / Elective
Univerzitetna koda predmeta / University course code:	5-KV-MAG-IP-IPA-2022-06-10

Predavanja **Lectures**	**Seminar** **Seminar**	**Vaje** **Tutorial**	**Klinične vaje** **work**	**Druge oblike študija**	**Samost. delo** **Individ. work**	**ECTS**
25	-	25	-	-	100	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:	**Prerequisites:**
Pogoj za vključitev v delo je poznavanje temeljnih podatkovnih struktur, zaželeno pa je tudi 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.	A knowledge of fundamental data structures is required for a student to attend the course. Additionally, a knowledge and understanding of basic algorithmic concepts will be helpful (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).	• Greedy method (Interval scheduling, Shortest paths in graphs, Clustering, Huffman codes). • Divide and Conquer (Mergesort).

• 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).	• 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:

- ASPNES, J. (2020). Notes on Computational Complexity Theory, Zapiski predavanj
- CORMEN, Thomas, LEISERSON, Charles, RIVEST, Ronald in STEIN, Clifford (2001) Introduction to Algorithms, 2. izdaja, MIT Press, Cambridge.
- ERICKSON, J. (2019). Algorithms, 1. izdaja, Samozaložba, Illinois, ZDA.
- 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.
- WILLIAMSON, D. P., Shmoys, D. B. (2011). The Design of Approximation Algorithms. Cambridge University Press, Cambridge, Združeno kraljestvo.

Cilji in kompetence:

Splošne kompetence:

- Poznavanje pomena kakovosti in prizadevanje za kakovost strokovnega dela skozi avtonomnost, samoiniciativnost, (samo)kritičnost, (samo)refleksivnost in (samo)evalviranje.
- Sposobnost fleksibilne uporabe pridobljenega znanja o kibernetski varnosti v praksi.
- Sposobnost pridobivanja, selekcije, analize informacij in zmožnost njihove interpretacije za celovito reševanje problemov, izzivov in incidentov s področja kibernetske varnosti.

Objectives and competences:

General competences:

- Knowledge of the importance of quality and striving for the quality of professional work through autonomy, self-initiative, as well as (self-)criticism, (self-)reflection, and (self-)evaluation.
- The ability of flexible usage of the acquired knowledge on cyber security in practice.
- The ability to obtain, select, analyze information, as well as to interpret them to comprehensively solve problems, challenges and incidents in the field of cyber security.

Subject-specific competences:

Predmetno-specifične kompetence: • Sposobnost oblikovanja in razvoja naprednih algoritmov za specifična opravila, določena s problemom. • 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.	• Ability to design and develop advanced algorithms for problem specific tasks. • 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:	**Intended learning outcomes:**
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.	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:	**Learning and teaching methods:**
• predavanja z aktivno udeležbo študentov (razlaga, diskusija, vprašanja, primeri); • vaje (reševanje različnih problemov, implementacija algoritmov).	• lectures with active students' participation (explanations, discussion, questions, examples); • exercises (solving various problems, implementation of algorithms).

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**

• pisni izpit • projektna naloga	50 % 50 %	• written exam • project assignment

Reference nosilca / Lecturer's references:

- H. La, B. Lužar, K. Štorgel: Further extensions of the Grötzsch Theorem, Discrete Math. 345 (2022), 112849.
- K. Rojko, B. Lužar: Scientific performance across research disciplines: Trends and differences in the case of Slovenia, J. Informetrics 16(2) (2022), 101261.
- B. Lužar, E. Máčajová, M. Škoviera, R. Soták: Strong edge colorings of graphs and the covers of Kneser graphs, J. Graph Theory (2022)
- A. Hinz, B. Lužar, C. Petr: The Dudeney-Stockmeyer Conjecture, Discrete Appl. Math. (2021).
- P. Holub, B. Lužar, E. Mihaliková, M. Mockovčiaková, R. Soták: Star edge-coloring of square grids, Appl. Math. Comput. 392 (2021), 125741.
- Andonovikj, Viktor, Boškoski, Pavle, Evkoski, Bojan, Redek, Tjaša, Boshkoska, Biljana Mileva. Community analysis in Slovenian labour network 2010-2020. Journal of decision systems. [in press] 2022. DOI: 10.1080/12460125.2022.2070944.
- Hajnić, Miljenko, Boshkoska, Biljana Mileva. A disruptive decision support platform for reengineering the strategic transfer of employees. IEEE access. 2021, vol. 9, str. 29921-29928. DOI: 10.1109/ACCESS.2021.3059895.
- Boškoski, Pavle, Perne, Matija, Rameša, Martina, Boshkoska, Biljana Mileva. Variational Bayes survival analysis for unemployment modelling. Knowledge-based systems. [Print ed.]. 11 Oct. 2021, vol. 229, [article no.] 107335, str. 1-11, graf. prikazi, tabele. DOI: 10.1016/j.knosys.2021.107335.