

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Programiranje, podatkovne strukture in algoritmi
Course title:	Programming, Data Structures, and Algorithms

Študijski program in stopnja Study programme and level	Modul Module	Letnik Academic year	Semester Semester
Informacijske in komunikacijske tehnologije, 2. stopnja	vsi	1	1
Information and Communication Technologies, 2 nd cycle	all	1	1

Vrsta predmeta / Course type Obvezni / Mandatory

Univerzitetna koda predmeta / University course code: IKT2-693

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Druge oblike	Samost. delo Individ. work	ECTS
30	30			30	210	10

**Navedena porazdelitev ur velja, če je vpisanih vsaj 15 študentov. Drugače se obseg izvedbe kontaktnih ur sorazmerno zmanjša in prenese v samostojno delo. / This distribution of hours is valid if at least 15 students are enrolled. Otherwise the contact hours are linearly reduced and transferred to individual work.*

Nosilec predmeta / Lecturer: Doc. dr. Anton Biasizzo
Prof. dr. Janez Demšar

Jeziki / Predavanja / Lectures: slovenščina, angleščina / Slovenian, English
Languages: Vaje / Tutorial:

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

Zaključen študijski program prve stopnje s področja naravoslovja, tehnike ali računalništva.

Prerequisites:

Student must complete first-cycle study programmes in natural sciences, technical disciplines or computer science.

Vsebina:

Uvod: matematične osnove, modeli računanja in tehnike programiranja, pregled programskih jezikov in izbranega programskega jezika.
Analiza algoritmov: računska zahtevnost algoritmov deli in vladaj, amortizirana analiza algoritmov.
Seznami in skladi: sezname, dvosmerno povezani sezname, krožni sezname, osnovne operacije nad sezname, model sklada, izvedbe sklada, uporaba sklada, obrnjeni poljski zapis.
Drevesa: definicija drevesa, dvojiška drevesa, operacije v drevesih, iskalna drevesa,

Content (Syllabus outline):

Introduction: mathematical fundamentals, models of computation, and programming techniques, overview of the programming languages and selected programming language.
Algorithm analysis: computational complexity of divide and conquer algorithms, amortized analysis of algorithms
Lists and stacks: linked list, double linked list, circular list, basic operations on lists, stack model, stack implementation, applications, reverse polish notation.
Trees: definition of tree, binary trees, operations on

uravnotežena drevesa, samonastavljiva drevesa, B-drevesa, uporaba dreves.

Razpršene tabele: funkcija razprševanja, trčenja, popolno razprševanje, univerzalno razprševanje.

Vrste in prednostne vrste: model vrste, uporaba vrst, prednostne vrste, dvojiška kopica, leve kopice, izmaknjene kopice, binomske prioritete vrste, uporaba prednostnih vrst.

Grafi: definicija grafov, usmerjeni in neusmerjeni grafi, predstavitev grafov, problem najkrajše poti, določanje najmanjšega vpetega drevesa, določanje pretoka v omrežju, iskanje v globino, NP-polni problemi.

Tehnike načrtovanja algoritmov: požrešna metoda, deli in vladaj, dinamično programiranje, sestopanje.

Praktični primeri: računalniške komunikacije, vgradne aplikacije, velika podatkovja.

trees, search tree, balanced trees, self-adjusting trees, B-trees, applications of trees.

Hash tables: hash functions, collisions, perfect hashing, universal hashing

Queues and priority queues: queue model, queue applications, priority queues, binary heaps, leftist heaps, skew heaps, binomial queues, applications of priority queues.

Graphs: graph definition, directed and undirected graph, graph representation of graphs, shortest-path problem, minimum spanning tree, network flow problem, depth-first search, NP-completeness.

Algorithm design techniques: greedy algorithms, divide and conquer, dynamic programming, backtracking algorithms.

Practical examples: computer communications, embedded applications, massive data storages.

Temeljna literatura in viri / Readings:

Izbrana poglavja iz naslednjih knjig: / Selected chapters from the following books:

- M. A. Weiss, *Data Structures and Algorithm Analysis in C++*. Addison-Wesley, 2013. ISBN 978-0-132-84737-7
- R. Sedgwick, and K. Wayne, *Algorithms*. Addison-Wesley, 2011. ISBN 978-0-321-57351-3
- D. Knuth, *The Art of Computer Programming, Vol. 1: Fundamental Algorithms*. Addison-Wesley, 1997. ISBN 0-201-89683-4
- T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, *Introduction to Algorithms*. MIT Press and McGraw-Hill, 2009. ISBN 0-262-03384-4

Cilji in kompetence:

Cilj predmeta je nadgraditi znanje programiranja ter pridobiti poglobljeno znanje s področja načrtovanja algoritmov, analize algoritmov in uporabe zahtevnejših podatkovnih struktur.

Kompetence študenta z uspešno zaključenim predmetom bodo vključevale poglobljeno znanje programiranja v izbranem programskem jeziku, poznavanje zahtevnejših podatkovnih struktur in algoritmov, zmožnost uporabe obstoječih algoritmov pri reševanju problemov.

Objectives and competences:

The goal of the course is to upgrade the knowledge of the programming and to gain deeper knowledge of algorithm design techniques, algorithm analysis, and use of advanced data structures.

The competences of the students completing this course successfully would include the in-depth programming knowledge in selected programming language, the knowledge of advanced data structures and algorithms, the ability to reuse the existing algorithms in problem solving.

Predvideni študijski rezultati:

Študenti bodo z uspešno opravljenimi obveznostmi tega predmeta pridobili:

- poglobljeno znanje izbranega programskega jezika
- poznavanje zahtevnejših podatkovnih struktur

Intended learning outcomes:

Students successfully completing this course will acquire:

- In-depth knowledge of the selected programming language,
- Knowledge of the advanced data structures and

<p>in algoritmov ter njihovih značilnosti</p> <ul style="list-style-type: none"> • sposobnost snovanja novih podatkovnih struktur in algoritmov za specifične probleme • sposobnost analize in vrednotenja razvitih podatkovnih struktur in algoritmov
--

<p>algorithms and their characteristics,</p> <ul style="list-style-type: none"> • Ability to develop new data structures and algorithms for specific problem, • Ability to perform the analysis and validation of the developed algorithms and data structures.

Metode poučevanja in učenja:

Predavanja, seminar, konzultacije, individualno delo
--

Learning and teaching methods:

Lectures, seminar, consultancy, individual work

Načini ocenjevanja:

Seminarska naloga
Ustni zagovor seminarske naloge

Delež (v %) /
Weight (in %)

Assessment:

Seminar work
Oral defense of seminar work

Reference nosilca / Lecturer's references:

<ul style="list-style-type: none"> • U. Legat, A. Biasizzo, and F. Novak, "SEU recovery mechanism for SRAM-based FPGAs", IEEE trans. on nuclear science, vol. 59, no 5, pp. 2562-2571, 2012. • A. Biasizzo and F. Novak, "Hardware accelerated compression of LIDAR data using FPGA devices", Sensors, vol. 13, no. 5, pp. 6405-6422, 2013. • A. Biasizzo, " On-line testing and recovery of systems with dynamic partial reconfiguration = Sprotno preiskušanje in popraviljanje sistemov z dinamično delno rekonfiguracijo", Informacije MIDEM, vol. 43, no. 4, pp. 259-266, 2013 • A. Biasizzo, F. Novak, and P. Korošec, "A multi-alphabet arithmetic coding hardware implementation for small FPGA devices", Journal of electrical engineering, vol. 64, no. 1, pp 44-49, 2013 • A. Biasizzo and F. Novak, "Security problems of scan design and accompanying measures", <i>Journal of electrical engineering</i>, vol. 67, no. 3, pp 192-198, 2016
--