



Algorithms and Data Structures 1

Course description

Basic Information

Field of study : Analytical Computer Science

Path : -

Organizational unit : Faculty of Mathematics and Computer Science

Education level : first-cycle

Form of studies : full-time studies

Study profile : general academic

Required : mandatory

Education cycle : 2022/23

Course code : UJ.WMIIANS.140.03340.22

Languages : Polish

Disciplines : Computer Science

ISCED Classification : 0613 Software and applications development and analysis

USOS Code : WMI.TCS.ASD1.OL

Course coordinator

Maciej Ślusarek

Course instructors

Maciej Ślusarek, Piotr Micek, Krzysztof Potępa

Period Semester 3	Form of verification of learning outcomes	
	graded credit	ECTS credits 5.0
	Course format and hours	
	lecture: 30 laboratory classes: 30	

Learning outcomes for the course

Code	Outcomes in the area of:	Directional learning outcomes	Verification methods
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Code	Outcomes in the area of:	Directional learning outcomes	Verification methods
Knowledge – Student knows and understands:			
W1	knows advanced data structures based on binary search trees: AVL trees, red-black trees, B-trees, heaps, splay trees and methods of their programming implementation	IAN_K1_W04, IAN_K1_W06, IAN_K1_W07, IAN_K1_W08, IAN_K1_W11	graded credit, credit
W2	has in-depth knowledge of algorithm construction techniques, in particular dynamic programming and the greedy method	IAN_K1_W06, IAN_K1_W07, IAN_K1_W08, IAN_K1_W09, IAN_K1_W10, IAN_K1_W11, IAN_K1_W12	graded credit, credit
W3	knows basic as well as selected advanced algorithms for many graph problems	IAN_K1_W06, IAN_K1_W07, IAN_K1_W09, IAN_K1_W10, IAN_K1_W11	graded credit, credit
Skills – Student can:			
U1	model problems presented in natural language using mathematical language and algorithmic concepts	IAN_K1_U01, IAN_K1_U03, IAN_K1_U05, IAN_K1_U06, IAN_K1_U07, IAN_K1_U08, IAN_K1_U10, IAN_K1_U11, IAN_K1_U17, IAN_K1_U21, IAN_K1_U22	graded credit
U2	design and implement algorithms using basic and selected advanced algorithmic techniques	IAN_K1_U06, IAN_K1_U07, IAN_K1_U08, IAN_K1_U10, IAN_K1_U11, IAN_K1_U17, IAN_K1_U21, IAN_K1_U22	graded credit
U3	test their program, look for errors and optimize it	IAN_K1_U05, IAN_K1_U11, IAN_K1_U18	graded credit
Social competences – Student is ready to:			
K1	formulate precise questions that serve to deepen or supplement their understanding of a given topic	IAN_K1_K01	graded credit

ECTS credit balance

Student's activity form	Average number of hours* allocated to completed activity types	
lecture	30	
laboratory classes	30	
independently solving computer problems	60	
preparation for classes	30	
Total student workload	Hours 150	ECTS 5.0

* hour (lesson) means 45 minutes

Course content

No.	Course content	Learning outcomes for the course
1.	1. Dynamic programming: DAG of subtasks, solution reconstruction, memory size problem. Examples: traveling salesman problem, knapsack problem, longest common subsequence and Hirschberg's algorithm, optimal BST trees. 2. Greedy algorithms - selected examples: Huffman codes, scheduling with delay minimization, optimal buffering in cache memory. 3. Balanced trees: AVL trees, red-black trees, B-trees. 4. Other tree balancing mechanisms: probabilistic (heaps), amortized (splay trees). 5. Connectivity problems in graphs, strongly connected components, biconnected components. 6. Shortest paths in graphs, algorithms: Bellman/Ford, Dijkstra, Warshall/Floyd, Johnson. 7. Minimum spanning trees, algorithms: Jarnik/Prim, Boruvka/Sollin, Kruskal; disjoint-set data structure. 8. Network flows, algorithms: Ford/Fulkerson, Edmonds/Karp, push-relabel. 9. Bipartite graph matching, "turbo matching" algorithm, Hopcroft/Karp algorithm.	W1, W2, W3, U1, U2, U3, K1

Extended information

Teaching methods:

conventional lecture, laboratory classes

Class type	Assessment forms	Course completion conditions
lecture	credit	Participation in lectures.
laboratory classes	graded credit	Laboratory completion based on assessment programs, homework assignments and tests.

Prerequisites and additional requirements

Programming Methods

Literature

Required

1. T.H. Cormen, Ch.E. Leiserson, R.L. Rivest, C. Stein, Wprowadzenie do algorytmów, wydanie III, PWN, 2012

Additional

1. L.Banachowski, K.Diks, W.Rytter, Algorytmy i struktury danych, PWN, 2018