Analysis of Algorithms

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 study : full-time studies

Study profile : general academic

Mandatory status : compulsory

Education cycle : 2022/23

Course code : UJ.WMIIANS.1100.03358.22

Language of instruction : Polish

Course related to scientific research : Yes

Disciplines : Computer Science

ISCED classification : 0613 Software and applications development and analysis

USOS code : WMI.TCS.AA1.OL

Course coordinator

Maciej Ślusarek

Course instructor

Maciej Ślusarek

Period Semester 5	Form of verification of learning outcomes exam Teaching format and hours lecture: 30 tutorials: 30	Number of ECTS credits 6.0

Learning outcomes for the course

Code	Outcomes in terms of	Directional learning outcomes	Verification methods

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Knowledge – The student knows and understands:			
W1	knows basic methods of probabilistic algorithm analysis and can apply them in selected areas of algorithmics	IAN_K1_W06, IAN_K1_W11	oral exam, credit
W2	knows the amortized analysis method and can use it to analyze a sequence of operations on a data structure	IAN_K1_W06, IAN_K1_W11	oral exam, credit
W3	knows selected advanced algorithms and data structures for problems related to sorting and searching and can analyze their complexity	IAN_K1_W06, IAN_K1_W11	oral exam, credit
Skills – The student can:			
U1	uses algorithm analysis to assess the possibility of effectively solving a given problem and to estimate the effectiveness of a given solution	IAN_K1_U01, IAN_K1_U02, IAN_K1_U06, IAN_K1_U10, IAN_K1_U11, IAN_K1_U17, IAN_K1_U21	oral exam, credit
Social competences – The student is ready to:			
K1	precisely formulate questions for the analysis of a given algorithmic problem	IAN_K1_K01	oral exam, credit

ECTS credits balance

Student activity form	Average number of hours* dedicated to completed activity types	
lecture	30	
tutorials	30	
preparation for tutorials	60	
exam preparation	40	
Total student workload	Number of hours 160	ECTS 6.0

* hour (lesson) means 45 minutes

Course content

No.	Program content	Learning outcomes for the course
1.	1. Recurrence equations in algorithm analysis. Master theorem, variants. 2. Elements of probability calculus: indicator random variables, secretary problem, generating random permutations. 3. Generating functions technique in average case analysis, example: analysis of the secretary problem. 4. Analysis of the Quicksort algorithm: expected value and variance of the number of comparisons. 5. Lower bounds on sorting complexity, Ford-Johnson algorithm and the problem of minimum number of comparisons. 6. Probabilistic analysis of tree-based dictionary implementations - binary search trees and treaps. 7. Amortized analysis using the example of splay trees and the static dictionary problem. 8. Find-Union problem, analysis using iterated logarithm. 9. Interpolation search, quadratic method and its complexity. 10. Hashing: open hashing analysis, universal families of hash functions, perfect hashing. 11. Selected online algorithms: graph coloring, maximum matching in bipartite graphs. 12. Priority queues and mergeable heaps: Fibonacci heaps, van Emde Boas queues, applications in graph algorithms.	W1, W2, W3, U1, K1

Extended information

Teaching methods:

conventional lecture, subject tutorials

Class type	Credit forms	Course credit conditions
lecture	oral exam	Positive exam grade. Admission to the exam provided positive grade from tutorials. The final grade is the average of the tutorial grade and the exam.
tutorials	credit	Credit based on homework assignments and tests.

Prerequisites and additional requirements

Algorithms and Data Structures 2, Discrete Mathematics, Probabilistic Methods in Computer Science

Literature

Required

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

Additional

1. L.Banachowski, K.Diks, W.Rytter, Algorytmy i struktury danych, WNT, 2001
2. L.Banachowski, A.Kreczmar, W.Rytter, Analiza algorytmów i struktur danych, WNT, 1987

3. A.V.Aho, J.E.Hopcroft, J.D.Ullman, Projektowanie i analiza algorytmów, PWN 1985, Helion 2003