Algorithms and Data Structures 2

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.180.03345.22

Languages : Polish

Course related to scientific research : Yes

Disciplines : Computer Science

ISCED Classification : 0613 Software and applications development and analysis

USOS Code : WMI.TCS.ASD2.OL

Course coordinator

Maciej Ślusarek

Course instructors

Maciej Ślusarek, Marcin Briański, Krzysztof Potępa

Period Semester 4	Form of verification of learning outcomes exam Course format and hours lecture: 30 laboratory classes: 30	ECTS credits 6.0

Learning outcomes for the course

Code	Outcomes in the area of:	Directional learning outcomes	Verification methods

Code	Outcomes in the area of:	Directional learning outcomes	Verification methods
Knowledge – Student knows and understands:			
W1	knows standard algorithms and data structures used in solutions to algorithmic problems in computational geometry, text processing, and number theory	IAN_K1_W04, IAN_K1_W06, IAN_K1_W07, IAN_K1_W08, IAN_K1_W09, IAN_K1_W10, IAN_K1_W11, IAN_K1_W12	oral exam, credit
W2	understands the concept of computational complexity, knows the definition of NP class and NP-complete problems, identifies example NP-complete problems, knows selected approximation algorithms	IAN_K1_W11	oral exam, credit
Skills – Student can:			
U1	model problems presented in natural language using mathematical language and advanced algorithmic concepts	IAN_K1_U01, IAN_K1_U06, IAN_K1_U07, IAN_K1_U17, IAN_K1_U21, IAN_K1_U22	oral exam, credit
U2	propose a solution for a typical algorithmic problem in the discussed fields and present its solution orally and in writing	IAN_K1_U03, IAN_K1_U06, IAN_K1_U10, IAN_K1_U11, IAN_K1_U17, IAN_K1_U21, IAN_K1_U22	oral exam, credit
U3	design and implement algorithms using basic and selected advanced algorithmic techniques	IAN_K1_U06, IAN_K1_U07, IAN_K1_U08, IAN_K1_U11, IAN_K1_U17	oral exam, credit
U4	has an in-depth ability to test their program, search for errors and optimize it	IAN_K1_U03, IAN_K1_U05	oral exam, credit

Code	Outcomes in the area of:	Directional learning outcomes	Verification methods
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	oral exam, 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	
preparation for exam	30	
Total student workload	Hours 180	ECTS 6.0

* hour (lesson) means 45 minutes

Course content

No.	Course content	Learning outcomes for the course

No.	Course content	Learning outcomes for the course
1.	1. Pattern searching in text: prefix-suffixes, KMP method, Aho-Corasick automaton, Karp-Rabin algorithm, Karp-Miller-Rosenberg algorithm. 2. Suffix arrays: construction algorithms, longest common prefix array and optimal search algorithm, suffix trees and their relationship with suffix arrays. 3. Basic techniques of computational geometry: vector determinant, polar sorting, sweep line, convex hull algorithms, finding intersections of segments. 4. Further geometric algorithms: point-in-polygon test, representation of plane division, point location on a plane using layer method, kd-trees. 5. Linear programming, simplex method, duality. 6. Number theory problems: Euclidean algorithm, modular arithmetic, discrete logarithm, RSA algorithm. 7. Prime numbers, Miller-Rabin algorithm. 8. Fast Fourier Transform. 9. Computational complexity: NP class, NP-complete problems, examples of NP-completeness proofs, approximation algorithms.	W1, W2, U1, U2, U3, U4, K1

Extended information

Teaching methods:

conventional lecture, laboratory classes

Class type	Assessment forms	Course completion conditions
lecture	oral exam	Positive grade from the exam, covering the scope of ASD1 and ASD2 courses. Admission to the exam is conditional on a positive grade from the laboratory. The final grade is a weighted average of grades from ASD1 and ASD2 laboratories and the exam.
laboratory classes	credit	Laboratory completion based on assessment programs, homework assignments and tests.

Prerequisites and additional requirements

Algorithms and Data Structures 1, Discrete Mathematics

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