Programming Methods

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 : obligatory

Education cycle : 2022/23

Course code : UJ.WMIIANS.120.03269.22

Languages of instruction : Polish

Disciplines : Computer Science

ISCED classification : 0613 Software and applications development and analysis

USOS code : WMI.TCS.MP.OL

Course coordinator

Maciej Ślusarek

Course instructors

Maciej Ślusarek, Iwona Cieślik

Period Semester 2	Form of verification of learning outcomes exam Form of instruction and hours lecture: 30 laboratory exercises: 30	Number of ECTS credits 6.0

Learning outcomes for the course

Code	Outcomes in the field of	Field-specific learning outcomes	Verification methods

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Knowledge – The student knows and understands:			
W1	basic data structures (trees, graphs, hash tables) and methods of their implementation	IAN_K1_W04, IAN_K1_W06	written exam, credit
W2	selected techniques of algorithm construction	IAN_K1_W06	written exam, credit
W3	basic techniques of sorting and searching data	IAN_K1_W06	written exam, credit
Skills – The student can:			
U1	use basic data structures to describe simple problems presented in natural language	IAN_K1_U01, IAN_K1_U07, IAN_K1_U08	written exam, credit
U2	design and implement algorithms using basic data structures and selected programming techniques	IAN_K1_U03, IAN_K1_U05, IAN_K1_U06, IAN_K1_U07, IAN_K1_U08	written exam, credit
U3	write a program in a readable way, test it at a basic level, look for errors and optimize it	IAN_K1_U17	written exam, credit
U4	propose a solution for a simple algorithmic problem by choosing the appropriate method for its solution	IAN_K1_U11, IAN_K1_U21	written exam, credit
U5	orally and in writing present the development of a solution to a simple problem	IAN_K1_U21	written exam, credit
Social competences – The student is ready to:			
K1	precisely formulate questions that serve to deepen or supplement their own understanding of a given topic	IAN_K1_K01	written exam, credit

ECTS credits balance

Student activity form	Average number of hours* devoted to completed activity types
lecture	30
laboratory exercises	30
independent solving of computer tasks	60
preparation for classes	30
preparation for exam	30

Total student workload	Number of hours 180	ECTS credits 6.0

* hour (lesson) means 45 minutes

Program content

No.	Program content	Learning outcomes for the course
1.	1. Computational complexity of algorithms – definition, notation, comparison of complexity functions. The concept of an abstract data type (ADT). Basic data structures: list, stack, queue, priority queue, dictionary; array, pointer, cursor implementation. Examples: binary search, topological sorting, memory management. 2. Tree structures: trees, binary trees, representations, elementary and advanced traversal algorithms, binary search tree. 3. Amortized complexity, dynamic arrays, hashing (basics). 4. Graphs: representation, BFS and DFS traversal, connected components, cycles, topological sorting with DFS, Euler cycle. 5. Recursion, conversion to iteration, examples: DFS with stack, backtracking. 6. Divide and conquer method, fast multiplication, merge sort, master theorem (simplified version). 7. Quicksort, variants (Hoare, Lomuto), non-recursive version. 8. Binary heap, heapsort, order statistics, counting tree. 9. Radix sort, lower bound on sorting complexity. 10. Dynamic programming – introduction. 11. Greedy algorithms – introduction.	W1, W2, W3, U1, U2, U3, U4, U5, K1

Extended information

Teaching methods:

conventional lecture, laboratory exercises

Type of classes	Credit forms	Course credit conditions

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lecture	written exam	Positive grade from the exam. Admission to the exam under the condition of a positive grade from the laboratory. The final grade is the average of the laboratory grade and the exam.
laboratory exercises	credit	Laboratory credit based on credit programs, homework assignments, and tests.

Prerequisites and additional requirements

Programming Basics

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
2. D. Knuth, Sztuka programowania, tom 1 i 3, WNT, 2002
3. A.V.Aho, J.E.Hopcroft, J.D.Ullman, Projektowanie i analiza algorytmów, PWN 1985, Helion 2003.