Algorithms and Data Structures - course description

General information

Course name	Algorithms and Data Structures
Course ID	11.3-WK-MATP-ASD-L-S14_pNadGenGC85Q
Faculty	Faculty of Mathematics, Computer Science and Econometrics
Field of study	Mathematics
Education profile	academic
Level of studies	First-cycle studies leading to Bachelor's degree
Beginning semester	winter term 2020/2021

Course information

Semester	5
ECTS credits to win	5
Course type	optional
Teaching language	polish
Author of syllabus	dr Florian Fabiś

Classes forms

The class form	Hours per semester (full-time)	Hours per week (full-time)	Hours per semester (part-time)	Hours per week (part-time)	Form of assignment
Laboratory	30	2	-	-	Credit with grade
Lecture	30	2	-	-	Exam

Aim of the course

The knowledge and skills in basics of analysis of algorithms. The knowledge of and ability to implement sorting and selection algorithms, searching algorithms and elementary graph algorithms. The knowledge of NP-completeness problem and its practical aspects.

Prerequisites

Gaining of basic competences in analysis and linear algebra. Advanced computer operating skills. Skills in computer structured programming.

Scope

Lecture

1. Algorithms. Computational complexity of algorithms. Correctness of algorithms. Asymptotics. (4 h)

2. Techniques of constructing effective algorithms: divide and conquer , greedy methods, dynamic programming. (2 h)

3. Algorithms of sorting and searching. (4 h)

4. Data structures for dictionaries: characteristic vector, binary search trees, hashing. External searching - B-trees. The union problem for disjoint sets and its applications. (6 h)

5. Graph algorithms: computer representations of graphs, graph searching, minimum spanning trees, shortest paths in graphs, flows in networks. (4 h)

6. Text algorithms: pattern matching, suffix trees. (4 h)

7. Computational geometry: point localization, convex hull, sweeping. (4 h)

8. NP-completeness: the classes P, NP and NP-complete.

Laboratory

1. Determination of the computational complexity of algorithms. (4 h)
2. Testing of the correctness of algorithms. (4 h)
3. Algorithms of sorting and searching. (4 h)
4. Data structures for dictionaries. (6 h)
5. Graph algorithms. (6 h)
6. Text and computational geometry algorithms. (6 h)

Teaching methods

Lecture: problem lecture.
Laboratory: laboratory exercises in computer lab – implementation and testing of selected algorithms.
Each student is supposed to realize four projects during the semester. Each project will consist in implementation of the selected algorithm to solve a concrete practical task, writing a program for it, testing it and presenting a documentation in accordance with the assigned specification. On two out of the four projects the students will work in 2-3 person groups. Furthermore the students will write on classes programs implementing other algorithms.

Learning outcomes and methods of theirs verification

Outcome description	Outcome symbols	Methods of verification	The class form
Student knows the basic sorting, searching, graph, text and computational geometry algorithms and can implement them in programs.	• K_U26	• a test • an exam - oral, descriptive, test and other • an observation and evaluation of activities during the classes	• Lecture • Laboratory
Student is able to design and analyze algorithm according to specification assigned.	• K_W08	• a test • an exam - oral, descriptive, test and other • an observation and evaluation of activities during the classes	• Lecture • Laboratory
Student recognizes the problems that can be solved algorithmically and can make a problem specification.	• K_W08 • K_U26	• a test • an exam - oral, descriptive, test and other • an observation and evaluation of activities during the classes	• Lecture • Laboratory
Student knows and understands basic concepts and mathematical description used in the analysis of algorithms and the basic data structures for dictionaries and can implement them in programs.	• K_U25	• a test • an exam - oral, descriptive, test and other • an observation and evaluation of activities during the classes	• Lecture • Laboratory
Student is able to work in project team.	• K_K03	• an observation and evaluation of activities during the classes	• Laboratory

Assignment conditions

Lecture. Written examination verifying the education outcome in area of knowledge and skills.
Laboratory. Final grade is granted based on number of points received during studies. Points are received for written tests, active participation in classes and completed project. Final course grade consists of laboratory classes' grade (50%) and examination grade (50%). Positive grade from laboratory classes is the necessary condition for participation in examination. The positive grade from examination is the necessary condition for course completion.

Recommended reading

1. Aho A., Hopcroft J.E., Ullman J.D., : Projektowanie i analiza algorytmów komputerowych, PWN, Warszawa 1983.
2. Banachowski L., Diks K., Rytter W., Algorytmy i struktury danych, WNT, W-wa 1996.
3. Cormen T.H., Leiserson C.E., Rivest R.L., Wprowadzenie do algorytmów, WNT, Warszawa 1997.

Further reading

1. Aho A., Hopcroft J.E., Ullman J.D., : The Design and Analysis of Computer Algorithms.
2. Aho A., Hopcroft J.E., Ullman J.D., : Data structures and algorithms
3. T.H. Cormen, Ch.E. Leiserson, R.L. Rivest: Introduction to Algorithms, 2001, MIT Press.
4. Knuth D. E. : The Art of Computer Programming.
5. N. Wirth: Algorithms and Data Structured, 1985.
6. Błażewicz J. : Złożoność obliczeniowa problemów kombinatorycznych, WNT, Warszawa 1988.
7. P. Wróblewski: Algorytmy, struktury danych i techniki programowania, wyd. II popr., Helion, 2001.

Notes

Modified by dr Alina Szelecka (last modification: 18-09-2020 13:45)