DOCTORAL (PHD) STUDIES

COURSE UNIT DESCRIPTION

Course unit title	Scientific areas	Faculty	Institute, department
Efficient Algorithms	Informatics (N 009)	Faculty of Mathematics and Informatics	Institute of Computer Science

Study method	Number of credits	Study method	Number of credits
Lectures		Consultations	2
Individual works	3	Seminars	2

Summary

Subject of the course is devoted to doctoral students' study of efficient algorithms, research work and practical work skills. It describes a wide range of important and ever-expanding algorithmic procedures that can be used by doctoral students in Informatics, Linguistics, Economics, Science, as well as in the management of databases, computer graphics, information management, digital and symbolic calculations, other tasks.

The topics include:

- Algorithms, algorithm roles in calculation, algorithm technology, asymptotic estimates (S. Gražulis)
- Divide-and-conquer paradigm, sorting algorithms, recursive trees, recursive expressions (S. Gražulis)
- Binary Search (S. Gražulis)
- Hash and hashing tables, advanced hashing (one-dimensional, multidimensional), grid algorithms (S. Gražulis)
- Dynamic programming, generic algorithms, aggregate analysis (T. Meškauskas)
- Multi-hierarchical structures, Red-black trees, B-trees, R-trees (S. Gražulis)
- Heap structure, Heapsort, Binomial and Fibonacci heap structures, Union-find sets (S. Gražulis)
- Elementary graph algorithms, Minimal spanning trees (S. Gražulis)
- Multi-thread algorithms, Multiple merge-sort sorting (T. Meškauskas)
- Quantum algorithms (L. Petkevičius)

Joining the topics there are a lot of practical tasks relevant to doctoral students' need.

Main literature

1. Robert Sedgewick. Algorithms, Parts 1-4 Addison-Wesley, 1999.
2. Robert Sedgewick. Algorithms, Part 5, Addison-Wesley, 2000.
3. Dinesh P. Mehta, Sartaj Sahni. Handbook of Data Structures and Applications, Chapman & Hall/CDC, 2005. (https://www.semanticscholar.org/paper/Handbook-of-Data-Structures-and-Applications-Mehta-Sahni/c022f6c00005f72517b0eb0461498a52fdeda541)
4.Thomas H. Cormen, Charles E. Leiserson, Ronald R. Rivest, Clifford Stein. Introduction to Algorithms. The MIT Press, Cambridge, MA, 2009 (https://mitpress.mit.edu/books/introduction-algorithms-third-edition)
5. Peter Brass. Advanced Data Structures, Cambridge University Press, 2008 (https://www.amazon.com/Advanced-Data-Structures-Peter-Brass/dp/0521880378)
6. Algimantas Juozapavičius. Efektyvūs Algoritmai, TEV, 2009.

7. Feynman, R. (1996) Feynman Lectures on Computation, Addison-Wesley Publishing Company, Inc. (https://openlibrary.org/books/OL987022M/Feynman_lectures_on_computation, https://www.taylorfrancis.com/books/mono/10.1201/9780429500442/feynman-lectures-computation-richard-feynman).
8. Shor, P. W. (1994) Algorithms for quantum computation: discrete logarithms and factoring. Proceedings 35th Annual Symposium on Foundations of Computer Science Series: SFCS-94, 124-134. IEEE Comput. Soc. Press. DOI: https://doi.org/10.1109/sfcs.1994.365700.
9. Yanofsky, N. S. & Mannucci, M. A. (2008) Quantum computing for computer scientists. Cambridge University Press. DOI: https://doi.org/10.1017/CBO9780511813887.

Lecturer(s) (name, surname)	Science degree	Main publications
Saulius Gražulis	prof.	https://elaba.mb.vu.lt/mif/?aut=Saulius+Gražulis
Tadas Meškauskas	prof.	https://elaba.mb.vu.lt/mif/?aut=Tadas+Meškauskas
Linas Petkevičius	doc.	https://elaba.mb.vu.lt/mif/?aut=Linas+Petkevičius