DOCTORAL SCHOOL OF INFORMATICS
COMPLEX EXAM SUBJECT

Design and Analysis of Algorithms (main subject)

1. Basic computational models (recursive functions, Turing machines, RAM-machines), their equivalence. Algorithmically not solvable problems.
2. Fundamentals of analysis of computer algorithms. Time and space complexity, asymptotical behaviour of functions, recurrences and three methods for solving recurrences (substitution method, recursion-tree method, master-method), probabilistic analysis.
3. Most important form practical point of view classes of problems: P, NP, NPC. The most important NP complete problems.
4. Sorting problem. Comparison sorts and the theoretical lower bounds for the number of comparisons. The most important comparison sorts (bubble sort, insertion sort, heap sort, quick sort, merging sort, sort trees) and their analysis.
5. Sorting in linear time, counting sort, radix sort, bucket sort.
6. External sorting. Two-way merging with three buffers, balanced and Fibonacci versions. General extended merge sort. Method for growing the lengths of runs, replacement selection for growing the lengths of runs
7. Sorting networks.
8. Selection problem. Maximum, minimum, simultaneous maximum and minimum, median and order statistic. Theoretical lower bounds for comparisons. Selection in expected linear time and worst-case linear time.
9. Searching problem. Hashing (direct address tables, hash tables, collision resolution by chaining, open addressing, construction of hash functions).
10. Searching problem. Linear and binary searching. Searching trees (basic version, optimal searching tree, AVL-trees, red-black trees, 2-3 trees, B-trees, splay-trees, tries).
11. Operations on strings. String-matching algorithms (brute-force, Boyer-Moore, Rabin-Karp, Dömölky-filter, string-matching automata). Longest common subsequence
12. Elementary graph-algorithms (breadth-first search, depth-first search, topological sort, strongly connected components).
13. Advanced graph-algorithms (minimal spanning trees, single-source shortest paths, all-pairs shortest paths).
14. Geometrical algorithms (algorithms on line segments, finding the convex hull, finding of closest pair of points).