

T-79.5202 Combinatorial algorithms

Exam 9 May 2007 / Haanpää

Write on each answer sheet the name and code of the course, the exam date, and your name, study program, student number and signature.

1. (6 p.) Design a rank and unrank algorithm for three-element multisets, whose elements are positive integers (in a multiset the order of the elements is irrelevant, but an element may appear more than once). Compute the rank of $\{2, 6, 12\}$ and the unrank of 215.
2. (6 p.) Graph list coloring. We are given a graph and for each of its vertices a finite set of colors, with one of which the node must be colored. Design an algorithm for deciding whether it is possible to color the vertices of the graph so that the endpoints of each edge are of a different color. Discuss the efficiency of your algorithm.
3. (6 p.) Simulated annealing.
 - (a) Describe simulated annealing on a general level.
 - (b) When designing an algorithm based on simulated annealing for solving a specific problem, certain choices must be made in designing the algorithm. For each such choice, give two sensible options, when the problem to be solved is the graph coloring problem.
4. (6 p.) Consider a 5×5 square array. In how many nonisomorphic ways can one color three of the squares black, when two colorings are considered isomorphic, if one can be obtained from the other by rotating (in multiples of 90 degrees) or mirroring the array (over a horizontal, vertical, or diagonal axis)?