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DM63 - Heuristics for Combinatorial Optimization Problems – Lecture Notes

Lecture 6, Fall 2006

Lecture October 5

The results for the competition presented in the previous lectures were not correct. Moreover, the implementation that was best in the previous analysis was removed from the comparison because the quality of its solutions could not be verified. Finally, the implementation by Stützle was included as benchmark.
The new results show that for the Nearest Neighborhood heuristic all participants attain similar performance to those published in the literature. The growth rate in computation time due to instance size remain very similar among the different implementations.
To establish a winner of this task there will be further tests on clustered instances and on larger instances.
Participants are required to always output their best solution in a file called `solution` in the format of a column of numbers from $\{1, \ldots, n\}$ in the order of the visits in the tour. Moreover, the time needed to read an instance should be removed from the termination time given in output.

In the lecture we described the details of the Lin-Kernighan heuristic for TSP which falls in the family of Variable Depth Search algorithms. In the explanation of the algorithm a different graphical representation was used from the one used in the original article. This representation makes use of δ-paths.

The other part of the lecture has been dedicated to the metaheuristics: Randomized Iterative Improvement, Probabilistic Iterative Improvement and Simulated Annealing.

In the exercise section we discussed the Quadratic Assignment problem.

Bibliographical Notes

The Lin Kernighan heuristic is described in the original paper:

> S. Lin and B.W. Kernighan, An Effective Heuristic Algorithm for the Traveling Salesman Problem. Operations Research, 1973, Vol. 21 Issue 2, p498, 19p;

which is reachable electronically from the SDU Library and in Chapter 8 of the book by Hoos and Stẗzle.

Simulated Annealing is treated in the fourth article of the Notes.

In the next lecture we will see Tabu Search and Iterative Improvement from Articles 5 and 6 of the Notes.

Exercise

Consider an Iterative Best Improvement algorithm for solving the k-coloring problem under the approach k-fixed, complete improper colorings and one-exchange neighborhood. Let the evaluation function be defined by the number of violated constraints, ie, $|E^c|$ where $E_c = \{uv : uv \in E \text{ and } \varphi(u) = \varphi(v)\}$ and φ a coloring. We saw at the lecture that $O(|V|^2)$ is needed to compute the quality of a solution and $O(|V|^2 k)$ to examine at each step all the neighborhood and select the best move. How is it possible to reduce this last computation cost to $O(|V|k)$?