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DM63 - Heuristics for Combinatorial Optimization Problems – Lecture Notes

Lecture 7, Fall 2006

Lecture October 9

No difference was detected on the performances of construction heuristics for TSP developed in Task 1 between Euclidean instances with points uniformly sparse and Euclidean instances with points clustered.

Attention was given to the choice of data structures to represent and maintain a solution during a perturbative search.

We described Tabu Search (TS) and its variations: robust and reactive. We gave examples on the GCP and QAP.

Crucial for TS is the fast examination of the neighborhood to find the best neighbors. We saw methods to accomplish this task in $O(nk)$ in the GCP and in $O(1)$ in the QAP.

We added Dynasearch and Ejection Chains to Variable Depth Search as methods that enlarge the neighborhood by maintaining a low complexity in its examination.

We described Dynamic Local Search and its variant Guided Local Search.

Finally, we went through the mechanisms that underlie Iterated Local Search.

Bibliographical Notes

Tabu Search and Iterated Local Search are described in the articles 5 and 6, respectively, of the Course Notes.

A discussion and analysis on data structures for the TSP can be found here:

> M.L. Fredman, D.S. Johnson, L.A. McGeoch and G. Ostheimer, Data Structures for Traveling Salesmen. J. Algorithms, 18:3 (1995), pp. 432-479.

Dynasearch and Dynamic Local Search are described on pages 70 and 82, respectively, of the book by Hoos and Stützle. Pointers to further literature are also given there.

Exercises

Exercise 1

For a complex dynasearch move on the TSP we defined as independent a pair of 2-exchange steps if $i < j < k < l$. Show that this condition is necessary to guarantee feasibility of the tour obtained after executing a pair of 2-exchanges. (Hint: consider what happens if it is $i < k < j < l$ for the indexes of the 2-exchange moves that delete the edges $(\pi_i\pi_{i+1}), (\pi_j\pi_{j+1})$ and $(\pi_k\pi_{k+1}), (\pi_l, \pi_{l+1})$).

Exercise 2

Design and describe a Tabu Search for the TSP. Which are the tabu attributes? Which are the criteria that define a move tabu? Which are the memory requirements for efficiently checking the tabu status of solution components?

Exercise 3

In school scheduling one wants to produce a weekly timetable of courses. Each course is an activity with assigned a teacher, a set of attending students and a room. The problem consists in assigning a time period of the week (typically one hour) to every course such that courses are assigned to different time periods if:

- they are taught by the same teacher
- they can be held only in the same room
- they share students.

Show that this problem corresponds to a graph colouring problem and state which formulation, k-colouring or chromatic number, is more appropriate.