

# DM86 Local Search Methods – Weekly Notes

Week 5, Spring 2006

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## Lecture March 2

We completed the presentation of a third Iterative Improvement Extension, that is, the Dynasearch method. As an example of this method we discussed the algorithm by Congram et al. for the SMTWTP.

We reviewed the main metaheuristic methods. We presented them grouped in three classes: Simple Methods, Hybrid Methods, Population-based Methods. To the first class belong Randomized Iterative Improvement, Probabilistic Iterative Improvement, Simulated Annealing, Tabu Search, Dynamic Local Search. To the second class belong Iterated Local Search, Greedy Randomized Adaptive Search Procedures and Adaptive Iterated Construction Search. To the third class belong Ant Colony Optimization and Evolutionary Computation Algorithm. Relevant metaheuristics which are particular cases of the above mentioned methods are Guided Local Search, Iterated Greedy, *MAX-MIN* Ant System and Memetic Algorithm. We saw examples of applications of these methods to the TSP and GCP, among them, relevant to be mentioned for their high performances, are the Iterated-LK and Memetic Algorithm for TSP and the TabuCol and Iterated Greedy for GCP.

As a minimal requirement for a metaheuristic is to perform better than the *null*-metaheuristic, that is, the randomized restart algorithm consisting in the restart of a randomized construction heuristic followed by iterative improvement (and possibly and extension thereof).

In the next lecture we will discuss further metaheuristic methods not included in the text book: Scatter Search and Path Relinking, Estimation of Distribution Algorithm and Cross Entropy. We will then focus on further examples of applications of the metaheuristics to TSP, GCP and SMTWTP. These are described in Chapter 8, in the survey on GCP by Chiarandini et al. and in Chapter 9 through pag. 438. Finally, we discuss few guidelines for the selection of metaheuristics. Time permitting, we start to discuss Timetabling applications.

## Exercises

### Exercise 1

The various metaheuristics described in the lecture can be classified according to different criteria, including: 1) trajectory methods vs. discontinuous methods; 2) Population-based vs. single-point search; 3) Memory usage vs. memory-less methods; 4) One vs. various neighborhood structures; 5) Dynamic vs. static objective function; 6) Nature-inspired vs. non-nature inspiration. Classify the metaheuristics discussed according to these criteria.

### Exercise 2

Show precisely how Ant Colony Optimization and Memetic Algorithm can be described using the definition of LS methods given in Lecture 1 and 2.