

DM86 Local Search Methods – Weekly Notes

Week 6, Spring 2006

Lecture March 9

We continued the presentation of the Metaheuristic methods: Scatter Search and Path Relinking (SS/PR), Cross Entropy Method (CEM) and Estimation of Distribution Algorithm (EDP). A description (much more detailed than the one provided at the lecture) is given in three papers available from the Literature Section: Glover et al. (2000), de Boer et al. (2003) (sec. 1,2,2,3,2,4) and M. Pelikan et al. (1999). For the exam a knowledge of these methods limited to the elements given at the lecture is sufficient.

We then considered application examples of the metaheuristics to GCP and SMTWTP. In specific, on the GCP we sketched TS for complete and partial coloring approaches, the Novelty algorithm (an example of randomized iterative improvement), GLS, ILS, MA and SA (the description of this part can be found in the survey Chiarandini et al., 2005). On the SMTWTP we sketched the Iterated Dynasearch (ILS) and ACO (they are described in Chapter 9 of the text book). The knowledge of the characteristic components of the metaheuristics on these problems is required for the exam. Most of the application examples on the TSP were already discussed while introducing each metaheuristic (they are treated however extensively in Chapter 8 of the text book). In specific these are different applications of ILS, MA and ACO. At least one application of each of these must be known.

To conclude the part on metaheuristics we gave a classification according to the criteria given in Exercise 1 of the last week. Finally we provided application guidelines which can also be retrieved from the article by Hertz and Widmer (2003).

At the end of the lecture we rashly introduced the Timetabling activity. In the next lecture we will continue the presentation of Timetabling (there is no literature recommended for this) and start talking about Scheduling (text book Chapter 9), the second real life application we treat in the course.

Exercises

Exercise 1

For one of the two problems, TSP and GCP, use the algorithms implemented from the exercises of the previous lecture to implement straightforward metaheuristics at choice (tip: start testing the improvements achievable with iterated local search).

Exercise 2

Implement the three construction heuristics for the SMTWTP (earliest due date, modified due date, apparent urgency).

Test the algorithms running them once on each of the 125 instances made available from the Section “Course Resources”.

Determine which is the overall best heuristic after collecting one run of each heuristic on each of the 125 instance. Do this by normalizing the results among the instances with the error from the optimal solution.

[Note: a C code for reading the instances is available from the Section “Course Resources”. (No other language is supported for now. Sorry.)]

Exercise 3

Implement Iterative Improvement algorithms for the SMTWTP using the two neighborhoods: interchange N_X and insertion N_I (recall that insertions are obtainable through swaps).

In particular consider the following configurations:

- Iterative First Improvement on N_I
- Iterative First Improvement on N_X
- Iterative First Improvement on N_X followed by Iterative First Improvement on N_I
- Iterative First Improvement on N_I followed by Iterative First Improvement on N_X

By using the Modified Due Date heuristic to provide a starting solution, determine which is the best configuration on the 125 instances made available by collecting one single run of each configuration on each instance and normalizing the results by means of error from the optimal solution.

[Note: the instances and a C code for reading them are available from the Section "Course Resources". Implementation examples for the iterative improvement algorithms are available from the C program by Stützle, also available from download.]