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MR2978563 (Review) 90-02 (90C27)
Goldengorin, Boris [Goldengorin, Boris I.] (RS-HSE2-ANA); Pardalos, Panos M. (1-FL-AO) $\star$ Data correcting approaches in combinatorial optimization.
Springer Briefs in Optimization.
Springer, New York, 2012. x+114 pp. €53.45. ISBN 978-1-4614-5285-0; 978-1-4614-5286-7
The book is devoted to the design and the analysis of so-called data correcting (DC) algorithms. A DC algorithm (typically applied to NP-hard optimization problems) is a branch-and-bound type algorithm, in which the input data are "heuristically corrected" at the various stages whereby two goals are pursued simultaneously. First, the modified input instance should belong to a (more) tractable subproblem. Second, the solution that is optimal for the corrected data should be within a prespecified (additive!) deviation from the solution that is optimal for the original data. The tools that are used in branch-and-bound algorithms and the additional tools used in DC algorithms work hand in hand. For instance, a data correction may allow for more excessive pruning (at the expense of another small additive deviation from optimality), or the branching element (plus data correction) can be chosen so as to get as close as possible to a tractable subproblem.
The book is organized as follows. In an introductory chapter, the DC approach is applied to realvalued functions (for illustrative purposes mainly) and to the Asymmetric Traveling Salesman Problem. Chapter 2 is concerned with the maximization of submodular functions. It presents theoretical results on the structure of local and global maxima and indicates how these results can be used for adding horsepower to the DC approach. It seems that many of these results were accessible before in Russian only (and some of them are entirely new). Chapter 3 presents the (full) DC algorithm for the maximization of submodular functions and explains how the theoretical insights from Chapter 2 are reflected in its design. Chapter 4 applies the DC approach to the Simple Plant Location Problem (SPLP) thereby building on the pseudo-Boolean approach to the SPLP (due to P. Hammer). In this application, the DC algorithm is combined with a procedure that reduces the input instance to a smaller "core instance". The book closes with a summary and finally points to some possible directions of future work. It should be mentioned that all central chapters of the book include experimental evaluations of the DC algorithms. The experimental results indicate that the DC approach is highly competitive to existing approaches, and often outperforms them.
The book should be of great interest to theoreticians and to practitioners. On one hand, it presents strong structural results (in particular the ones about submodular functions in Chapter 2), on the other hand it does a great job in algorithm engineering. The DC approach seems to come very close to a mature technology for (heuristically) solving a reasonably wide range of NP-hard combinatorial optimization problems.

Reviewed by Hans-Ulrich Simon

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