



Book Review

Ibrahim H. Osman and James P. Kelly (eds.), *Meta-Heuristics: Theory and Applications*. Kluwer Academic Publishers, Dordrecht/Boston/London, 1996, x+690 pages. ISBN 0-7923-9700-2, US\$ 192.50.

This book is based on a reviewed collection of papers presented at the Meta-Heuristics International Conference (Breckenridge, Colorado, USA, 22–26 July 1995).

Meta-heuristics – as the name suggests – is a general search principle or algorithm framework that can be applied in a context-dependent manner to find good approximate solutions to (complicated) optimization problems. In this sense, the concept has specific relevance with respect to mathematical programming models which are notoriously difficult to solve: combinatorial optimization, (continuous or mixed integer) global optimization, stochastic programming, and other areas provide an abundance of examples.

The book discusses several types of meta-heuristics that have found a variety of applications in the area of combinatorial optimization. Similar to many global optimization problems in character, discrete programming models are often very simple to state, but may prove extremely difficult (NP-hard) to solve. This fact directly calls for good heuristic approaches, for model-sizes arising in practice.

In Chapter 1, Osman and Kelly – the editors of the volume – provide a concise overview of the currently most popular ideas in meta-heuristics. These include the following broad classes of approaches (that can be tailored to specific problems, and may also direct the operation of respective subordinate algorithms):

- classical neighbourhood (local) search;
- genetic algorithms;
- neural networks;
- simulated annealing;
- tabu search;
- threshold algorithms;
- problem-space methods.

The introductory discussion is concluded with a fairly extensive collection of further references to the subject.

Following the review chapter, the book is divided into seven major parts, each consisting of several chapters, written by experts in this emerging field of research. This structure is summarized below.

- Genetic algorithms are discussed in Chapters 2–5. These contributions have been prepared respectively by D. Levine; Z. Michalewicz; H. Mühlenbein and H-M. Voigt; M. Yagiura and T. Ibaraki.
- Networks and graphs are the subject of Chapters 6–8, by G. Craig, M. Krishnamoorthy, and M. Palaniswami; R. Marti; Y.M. Sharaiha and R. Thaiss.
- Scheduling and control problems are discussed in Chapters 9–15, by H. Abada and E. El-Darzi; P. Brucker and J. Hurink; M. Dell’Amico, S. Martello, and D. Vigo; G.P. Henze, M. Laguna, and M. Krarti; H.E. Mausser and S.R. Lawrence; H. Ramalhinho Lourenço and M. Zwijnenburg; T. Yamada and R. Nakano.
- Simulated annealing is the main subject of Chapters 16–19, by M.A. Fleischer and S.H. Jacobson; J.-L. Lutton and E. Philippart; N.M. Sadeh and S.R. Thangiah; M.B. Wright and R.C. Marett.
- Tabu search – apparently, the most popular subject treated in this volume – is discussed in Chapters 20 to 34. The contributors to this part are: A.S. Al-Mahmeed; R. Battiti, G. Tecchioli, and P. Tonella; D. Castelino and N. Stephens; M. Dell’Amico and F. Maffioli; K.A. Dowsland; F. Glover and G.A. Kochenberger; F. Glover, J.M. Mulvey, and K. Hoyland; S. Hanafi, A. Freville, and A. El Abdellaoui; A. Løkketangen and F. Glover; L. Sondergeld and S. Voß; M. Toulouse, T.G. Crainic, and M. Gendreau; F.T. Tseng; V. Valls, M. Ángeles Perez, and M. Sacramento Quintanilla; D. L. Woodruff; M. Zachariasen and M. Dam.
- The traveling salesman problem is studied in Chapters 35–37, written respectively by I. Charon and O. Hudry; H.M.M. ten Eikelder, M.G.A. Verhoeven, T.W.M. Vossen, and E.H.L. Aarts; J.-Y. Potvin and F. Guertin.
- Finally, vehicle routing problems are investigated in Chapters 38 to 41, by R.W. Eglese and L.Y.O. Li; H. Ghaziri; C. Rego and C. Roucairol; P. Toth and D. Vigo.

The book covers an impressive range of applied research. In addition to interesting and useful discussions of methodology, application areas discussed include the following (in the sequence of their appearance in the book):

- set partitioning problems;
- machine scheduling;
- minimum spanning trees;
- bipartite drawing;
- shortest path;
- time-tabling;
- sequencing;
- single processor scheduling;

- optimal control of thermal energy storage;
- resource-constrained project scheduling;
- job-shop scheduling;
- parallel processing;
- telecommunication links;
- compound (multi-objective) combinatorial problems;
- vehicle routing problems (in several versions);
- data communication networks;
- vector quantization (coding);
- frequency assignment;
- equicut problem;
- pallet loading;
- multi-dimensional knapsack problem;
- dynamic stochastic control in finance;
- mixed integer programming;
- balancing hydraulic turbine runners;
- cooperative multi-thread parallel searches;
- selecting the best r elements from an array;
- generalized restricted vertex coloring;
- multiple product (newspaper) delivery problem;
- traveling salesman problem (in several versions);
- constrained arc routing.

Completing this review, a few critical comments are also in order. The chapters on methodology and applications could have been classified in a more consistent fashion. If this were not easy (which seems to be the case), then even a simple division of the materials into chapters on theory/methodology and applications would have been appropriate (possibly creating parts within these broad categories). Minimally, even a simple alphabetical sequence of the contributed papers (by their first authors) could have been sufficient. Furthermore, at least a short subject index could have been added, to assist readers in finding their way around this very interesting new field. There are also a few typos in the contributions, and the individual chapters do not have a unified formal appearance. These comments are relatively minor, however, and do not take away from the overall merit of the volume.

In summary, the book provides a useful overview of an emerging area of research. The individual chapters of the book discuss an interesting array of heuristic ideas and algorithms, with applications on this practically important field. The book is of interest for scientists and practicing professionals working in optimization, computer science, management science, industrial engineering, design, scheduling, production and distribution, energy, finance and telecommunication.

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