it easier a task of going through all the enormous material included in the book. All the algorithms are box-framed and examples are carefully separated which also helps in acquiring and coding them.

However, there are many misprints which sometimes make getting through difficult (as, for instance, confusing denotations p_{i+} and p_i for the same marginal frequencies on p. 85 and the description of the five-cluster solution in the caption to Figure 5.4 (p. 281) contradicting to that in the tree presented). A potential reader may find it curious to try to develop a method for separation of the single cluster of the misprints in the book.

Overall, the author's claim that the book can be considered in a threefold way (as a reference and textbook and presentation of his own approach) seems correct. The monograph is a significant step in transforming clustering from a set of ad hoc techniques into a sound mathematically supported theory which is related to discrete mathematics, multivariate statistics, machnine learning, artificial intelligence, non-convex and combinatorial optimization. The material presented seems a set of benchmarks for further developments. The book should be recommended as an inspiring reading to the students and specialists in the fields listed above. The numerous algorithms suggested can be exploited by data analysis practitioners in various application areas.

M. LEVIN

C.A. Floudas, *Nonlinear and Mixed-Integer Optimization. Fundamentals and Applications*, Oxford University Press, 1995, 462 pp, 75 USD, ISBN 0-19-510056-5 (Topics in Chemical Engineering)

During the last two decades, the field of mixed-integer nonlinear optimization has been witnessing a dramatic growth, with substantial theoretical advances and algorithmic developments, and continuously increasing popularity, with a wide spectrum of applications in many areas of engineering, applied mathematics, applied science and operations research, such as process synthesis, scheduling, planning and design of processes/facilities, molecular design, process and control design and topology of transportation networks to name a few. With a large number of publications continuously appearing in major scientific journals, the apparent lack of a book documenting the fundamentals in mixed-integer nonlinear optimization was clearly felt. The book of C.A. Floudas, directed to researchers and users of mixed-integer nonlinear optimization, clearly bridges this gap - coming from a leading authority in the field, such an edition represents a documental milestone: it contains all major original results and mathematical developments in mixed-integer nonlinear optimization theory along with a number of important application areas in chemical engineering.

The book is effectively divided in three major parts - Part 1, covering fundamentals in nonlinear optimization, provides the necessary background to Part 2,

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which features an in-depth coverage of the theory of mixed-integer nonlinear optimization; application areas in process synthesis are then presented in Part 3. The organization and content of the material in each part makes the book self-contained, while links to other related works are well established throughout the text via a very extensive list of references and recommended books/articles for further reading per topic.

The first chapter of the book serves as an introduction to the type of generic mixed-integer nonlinear optimization formulations and how they naturally arise in the context of three illustrative applications. Part 1 then, consisting of three chapters, mainly focusses on the continuous nonlinear optimization part. An overview of convex analysis is given in Chapter 2; Chapter 3 outlines the optimality conditions for unconstrained and constrained optimization, while chapter 4 presents an excellent and thorough introduction to the basics of duality theory, the primal and dual problems, the perturbation function, the weak and strong duality theorems and the dulaity gap. In all three chapters, the emphasis is mainly placed on the presentation of the basic concepts which are of particular relevance in the context of mixed-integer nonlinear optimization theory (in Part 2) - proofs of theorems are not given, instead the reader is directed to other references. In this way, continuity and clarity in the presentation is fully preserved, while the use of remark points was felt to be very effective in providing further intuition, explanation and links to related material. In summary, part 1 establishes the right background of the continuous optimization essentials as a prelude to Part 2.

The next two chapters, of Part 2, detail the basic theory and algorithms for the solution of mixed-integer optimization problems. In chapter 5, key concepts in mixed-integer linear programming and the branch and bound method as a general solution framework are briefly outlined. Chapter 6 then provides an excellent guided tour to the fascinated world of mixed-integer nonlinear optimization with an in-depth and substantial (over 110 pages) presentation of the key theoretical and algorithmic developments. The chapter features: (i) a very instructive and detailed, yet remarkably transparent, portait of the Generalized Benders Decomposition algorithm of Geoffrion, and its variants, (ii) an in-depth and elaborate overview of the Outer Approximation family of algorithms, established by the pioneering and seminal work of Grossmann and co-workers at CMU, and (iii) an elegant and novel presentation of the Generalized Cross Decomposition approach of Van Roy and Holmberg. The clarity in the presentation of the material in this chapter is phenomenal - the critical penetration and detailed analysis of the presented theoretical developments goes far beyond a mere collection of documented works in mixed-integer nonlinear optimization literature: it establishes a key reference point for the science of mixed integer nonlinear optimization.

The last four chapters (Part 3) deal with application areas of mixed-integer nonlinear optimization in chemical engineering. Chapter 7 serves as an introduction to the general process synthesis problem and its many components - the emphasis here is on modelling via the use of 0-1 variables and posing the overall synthe-

sis problem within a mixed-integer nonlinear optimization framework. Chapter 8, with almost 120 pages, details a number of optimization-based developments for the synthesis of heat exchanger networks, featuring amongst others the important contributions of the works of Papoulias and Grossmann, Floudas and Grossmann, Yee and Grossmann and Ciric and Floudas. The presentation of the material enormously benefits from numerous detailed examples, elaborate remarks, modelling and solution strategy considerations as well as highlights of current trends/issues in this important area. In the final two chapters of the book, algorithmic approaches, developed at Princeton University, for the synthesis of distillation sequences and reaction networks are presented - again, the emphasis here is on illustrating how the methods and machinery of mixed-integer nonlinear optimization can be effectively applied to address these important engineering problems.

The book is written with clarity, flair and an impressive evidence of deep knowledge and insight of the field. It can comfortably be used as a textbook for advanced courses at both the undergraduate and postgraduate levels. It will undoubtedly become a classic standard reference in the field of nonlinear and mixed integer optimization - an outstanding book which is highly recommended.

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