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Book Review

V. Boltyanski, H. Martini and V. Soltan, *Geometric Methods and Optimization Problems*. Combinatorial Optimization Series, Kluwer Academic Publishers, 1999, 429 pages.

As suggested by its title, the aim of this book is to demonstrate how convex geometry theory can be successfully used in a wide family of applied mathematics areas. Minkowski's convexity is an excellent example, since nowadays the theory of convex sets is a very important applied branch of mathematics.

This book is divided in three parts, devoted to Control Theory, Location Science, and Computational Geometry, respectively.

The first part exhaustively contains all the mathematical theory of optimal control, starting from the classical problem of mathematical programming and the abstract intersection problem and concluding with the maximum principle, which is a necessary condition for global optimality.

Of particular interest in this first chapter is the use of tents theory and the separation theory of convex cones, which leads to a generalization of the Kuhn–Tucker theorem.

In the second part the authors provide a mathematical approach to the class of location problems.

Location science is a quite interesting field involving researchers from eterogeneous education, such as Computer Science, Industrial Engineering, Mathematics, Economics, and Geography. The needed models for representing location problems have often a geometrical nature and analyzing them one can use theory of convex sets in normed spaces, optimization tools (linear/nonlinear programming) or also computational geometry.

The main problem treated in this second part of the book consists of optimally locate affine k-flats with respect to a given finite point set in n-dimensional Euclidean or other Minkowski spaces ($K \in \{0, 1, \ldots, n-1\}$). The famous Fermat–Torricelli problem is also considered, in which $k = 0$. For dealing with location problems, the authors propose geometric methods from the theory of convex sets in normed spaces and provide necessary conditions for optimally locate k-flats by transforming the original continuous problem into a discrete one.

The third part of this book shows how geometry theory can found application in Computer Science disciplines, such as for example Artificial Intelligent, Image Processing, Pattern Recognition, and so on.

The main scope of this chapter is to provide an exhaustive treatment of several convex partitioning problems. A new concept of convex partition is introduced: the convex $\mathcal{F}$-partition. It is a convex partition of a polygonal domain by linear cuts along directions from a given family $\mathcal{F}$. The authors show that the $\mathcal{F}$-partition problem on the minimum number of convex pieces is polynomially solvable if the number of directions in $\mathcal{F}$ is at most 2, and that it is $\mathcal{NP}$-hard otherwise.

Each of the three parts of this book concludes with an exhaustive list of references and contains a considerable number of exercises. In fact, the book is a valuable source for both researchers and students.

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