Zbl 0960.65149

Chazelle, Bernard

The discrepancy method. Randomness and complexity. (English)

[B] Cambridge: Cambridge University Press. xviii, 463 p. \$ 64.95; \sterling 40.00 (2000). [ISBN 0-521-77093-9/hbk]

The discrepancy method (DiscMeth) has to be understood not as a particular proof technique but merely as the common core of a large and varied set of problems. Under this name, one can find many powerful tools and techniques from the field of complexity theory and algorithm design, together with recent developments in areas as diverse as probabilistic algorithms, derandomization, communication complexity, searching, machine learning, pseudorandomness, computational geometry, optimization, computer graphics, and mathematical finance. The book tells the DiscMeth story by means of specific examples, including both upper bounds (algorithm design) and lower bounds (complexity theory).\par The fundamentals of DiscMeth are presented in the first three chapters, introducing the main tools and a pool of techniques to be used in the subsequent chapters. The book includes a variety of topics, such as communication complexity, pseudorandomness, rapidly mixing Markov chains, sampling, linear programming, circuit complexity, geometry, searching, linear selection, and matroid optimization, all the approaches being defined in a clear mathematical and self-contained manner. As the author says, the book is addressed to ``anyone who is curious about algorithms, complexity, and their relation to classical mathematics", and also to ``everyone with a taste for theoretical computer science".\par The idea of DiscMeth is increasingly encapsulated within the 11 chapters of the book, that have the following titles: Combinatorial discrepancy (Chap. 1); Upper bound techniques (Chap. 2); Lower bound techniques (Chap. 3); Sampling (Chap. 4); Geometry searching (Chap. 5); Complexity lower bounds (Chap. 6); Convex hulls and Voronoi diagrams (Chap. 7); Linear programming and extensions (Chap. 8); Pseudorandomness (Chap. 9); Communication complexity (Chap. 10); Minimum spanning trees (Chap. 11).\par Each chapter ends with interesting bibliographical notes, while the book ends with three useful appendices: Probability theory (App. 1); Harmonic analysis (App. 2); Convex geometry (App. 3).

[**Neculai Curteanu (Iasi)**]

MSC 2000:

*65Y20 Complexity and performance of numerical algorithms
68-02 Research monographs (computer science)
65-02 Research monographs (numerical analysis)
68T05 Learning and adaptive systems
68T20 Problem solving
65C50 Other computational problems in probability
68Q25 Analysis of algorithms and problem complexity
68U05 Computational geometry, etc.
90C05 Linear programming
65K05 Mathematical programming (numerical methods)
91B28 Finance etc.

Keywords: textbook; discrepancy method; complexity theory; algorithm design; probabilistic algorithms; derandomization; communication complexity; searching;

machine learning; pseudorandomness; computational geometry; optimization; computer graphics; mathematical finance; Markov chains; sampling; linear programming; circuit complexity; Voronoi diagrams

Cited in Zbl. reviews...