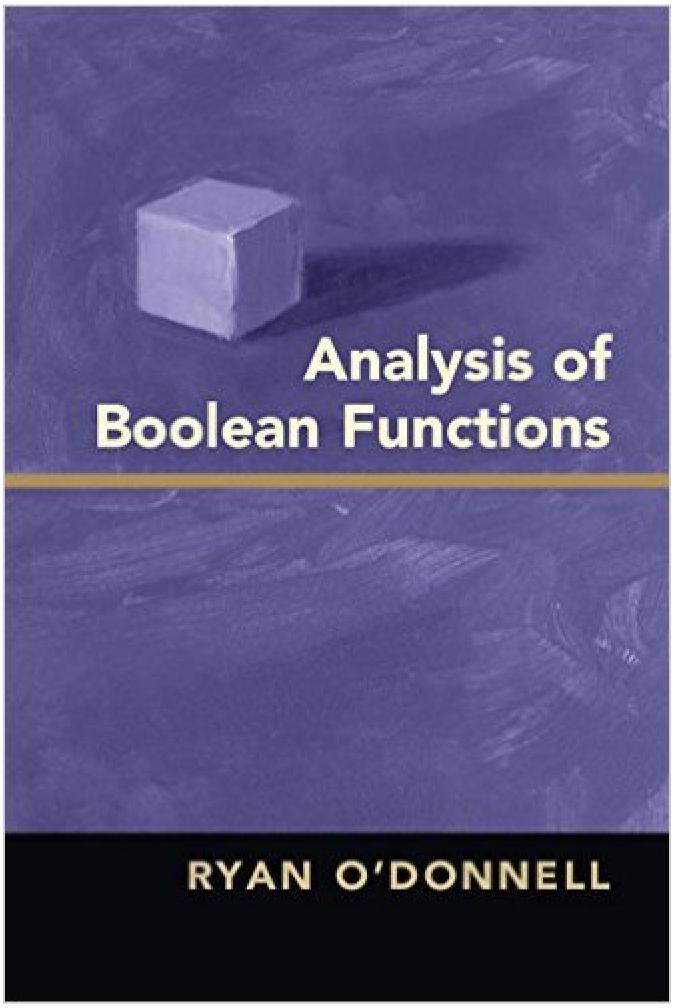
Analysis Of Boolean Functions



Synopsis

Boolean functions are perhaps the most basic objects of study in theoretical computer science. They also arise in other areas of mathematics, including combinatorics, statistical physics, and mathematical social choice. The field of analysis of Boolean functions seeks to understand them via their Fourier transform and other analytic methods. This text gives a thorough overview of the field, beginning with the most basic definitions and proceeding to advanced topics such as hypercontractivity and isoperimetry. Each chapter includes a "highlight application" such as Arrow's theorem from economics, the Goldreich-Levin algorithm from cryptography/learning theory, HÃ¥stad's NP-hardness of approximation results, and "sharp threshold" theorems for random graph properties. The book includes roughly 450 exercises and can be used as the basis of a one-semester graduate course. It should appeal to advanced undergraduates, graduate students, and researchers in computer science theory and related mathematical fields.

Book Information

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Customer Reviews

This book is mostly concerned with Fourier analysis of functions of the form f:^n-->, known as Boolean functions. These functions play a very important role in theoretical computer science and combinatorics. They are simple, elegant and yet they're expressive enough to capture most problems encountered in these fields.Ryan O'Donnell, a well-known expert in this area, gives a very accessible and highly motivated exposition of the topic. Indeed, some knowledge of probability theory and linear algebra is enough to get you started. In particular, **no prior knowledge of Fourier analysis is assumed.** Each chapter ends with a highlight section which is an exposÃ© of a usually important result using the techniques covered in that chapter. Already, by the end of the first chapter, the reader can appreciate an application of simple Fourier-analytic notions to the problem of function linearity testing. In later chapters, these highlight sections will consider constant-depth circuits, pseudorandomness, PCPs, the KLL theorem, decision tree complexity and much more. Additionally, in chapter 8, generalizations of Boolean functions to probability product spaces are considered. Finally, the last three chapters contain a wealth of information on hypercontractivity.Needless to say, this book is highly recommended to students and researchers in theoretical computer science and mathematics. Indeed there is no other book with a scope like this.An online version of the book is available athttp://www.contrib.andrew.cmu.edu/~ryanod/Nonetheless, it’s still a good idea to get the print version. There are more exercises for some chapters, expanded notes in some cases plus a much-needed symbol list and, of course, an index!

An excellent, clear and complete review of the area as of circa 2013. It is a great graduate text. Perhaps a bit dry, as the author was careful to provide very precise definitions and exact statements. Superb exercises at the end of chapters provide a range of challenges, from simple applications of definitions, through straightforward exercises, proving lemmas that are used in later chapters, to nontrivial extensions. The final chapters are cover advanced materials. Very highly recommended. [For calibration: I consider the Feynman Lectures a 5 star book]

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