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Analytic Information Theory

From Compression to Learning

Michael Drmota

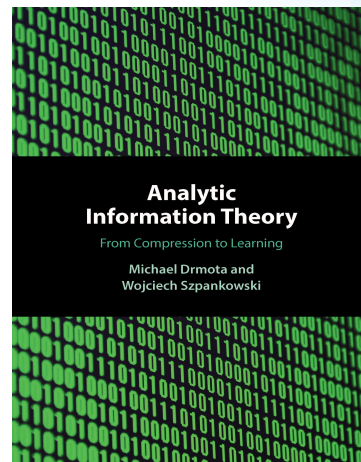
Technische Universität Wien, Austria

Wojciech Szpankowski

Purdue University, Indiana

Through information theory, problems of communication and compression can be precisely modeled, formulated, and analyzed, and this information can be transformed by means of algorithms. Also, learning can be viewed as compression with side information. Aimed at students and researchers, this book addresses data compression and redundancy within existing methods and central topics in theoretical data compression, demonstrating how to use tools from analytic combinatorics to discover and analyze precise behavior of source codes. It shows that to present better learnable or extractable information in its shortest description, one must understand what the information is, and then algorithmically extract it in its most compact form via an efficient compression algorithm. Part I covers fixed-to-variable codes such as Shannon and Huffman codes, variable-to-fixed codes such as Tunstall and Khodak codes, and variable-to-variable Khodak codes for known sources. Part II discusses universal source coding for memoryless, Markov, and renewal sources.

Part I. Known Sources: 1. Preliminaries; 2. Shannon and Huffman FV codes; 3. Tunstall and Khodak VF codes; 4. Divide-and-conquer VF codes; 5. Khodak VV codes; 6. Non-prefix one-to-one codes; 7. Advanced data structures: tree compression; 8. Graph and structure compression; Part II. Universal Codes: 9. Minimax redundancy and regret; 10. Redundancy of universal memoryless sources; 11. Markov types and redundancy for Markov sources; 12. Non-Markovian sources: redundancy of renewal processes; A. Probability; B. Generating functions; C. Complex asymptotics; D. Mellin transform and Tauberian theorems; E. Exponential sums and uniform distribution mod 1; F. Diophantine approximation; References; Index.



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'Drmota & Szpankowski's book presents an exciting and very timely review of the theory of lossless data compression, from one of the modern points of view. Their development draws interesting connections with learning theory, and it is based on a collection of powerful analytical techniques.'

Ioannis Kontoyiannis,
University of Cambridge



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