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Fundamentals of Error-Correcting Codes

A Computer Science portal for geeks. It contains well written, well thought and well explained computer science and programming articles, quizzes and practice/competitive programming/company interview ...

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Fundamentals of Error Correcting Codes is an in-depth introduction to coding theory from both an engineering and mathematical viewpoint. As well as covering classical topics, there is much coverage of techniques which could only be found in specialist journals and book publications. Numerous exercises and examples and an accessible writing style make this a lucid and effective introduction to coding theory for advanced undergraduate and graduate students, researchers and engineers, whether approaching the subject from a mathematical, engineering or computer science background.

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Using easy-to-follow mathematics, this textbook provides comprehensive coverage of block codes and techniques for reliable communications and data storage. It covers major code designs and constructions from geometric, algebraic, and graph-theoretic points of view, decoding algorithms, error control additive white Gaussian noise (AWGN) and erasure, and dataless recovery. It simplifies a highly mathematical subject to a level that can be understood and applied with a minimum background in mathematics, provides step-by-step explanation of all covered topics, both fundamental and advanced, and includes plenty of practical illustrative examples to assist understanding. Numerous homework problems are included to strengthen student comprehension of new and abstract concepts, and a solutions manual is available online for instructors. Modern developments, including polar codes, are also covered. An essential textbook for senior undergraduates and graduates taking introductory coding courses, students taking advanced full-year graduate coding courses, and professionals working on coding for communications and data storage.

This book discusses both the theory and practical applications of self-correcting data, commonly known as error-correcting codes. The applications included demonstrate the importance of these codes in a wide range of everyday technologies, from smartphones to secure communications and transactions. Written in a readily understandable style, the book presents the authors' twenty-five years of research organized into five parts. Part I is concerned with the theoretical performance attainable by using error correcting codes to achieve communications efficiency in digital communications systems. Part II explores the construction of error-correcting codes and explains the different families of codes and how they are designed. Techniques are described for producing the very best codes. Part III addresses the analysis of low-density parity-check (LDPC) codes, primarily to calculate their stopping sets and low-weight codeword spectrum which determines the performance of these codes. Part IV deals with decoders designed to realize optimum performance. Part V describes applications which include combined error correction and detection, public key cryptography using Goppa codes, correcting errors in passwords and watermarking. This book is a valuable resource for anyone interested in error-correcting codes and their applications, ranging from non-experts to professionals at the forefront of research in their field. This book is open access under a CC BY 4.0 license.

An unparalleled learning tool and guide to error correction coding Error correction coding techniques allow the detection and correction of errors occurring during the transmission of data in digital communication systems. These techniques are nearly universally employed in modern communication systems, and are thus an important component of the modern information economy. Error Correction Coding: Mathematical Methods and Algorithms provides a comprehensive introduction to both the theoretical and practical aspects of error correction coding, with a presentation suitable for a wide variety of audiences, including graduate students in electrical engineering, mathematics, or computer science. The pedagogy is arranged so that the mathematical concepts are presented incrementally, followed immediately by applications to coding. A large number of exercises expand and deepen students' understanding. A unique feature of the book is a set of programming laboratories, supplemented with over 250 programs and functions on an associated Web site, which provides hands-on experience and a better understanding of the material. These laboratories lead students through the implementation and evaluation of Hamming codes, CRC codes, BCH and R-S codes, convolutional codes, turbo codes, and LDPC codes. This text offers both "classical" coding theory—such as Hamming, BCH, Reed-Solomon, Reed-Muller, and convolutional codes—as well as modern codes and decoding methods, including turbo codes, LDPC codes, repeat-accumulate codes, space-time codes, factor graphs, soft-decision decoding, Guruswami-Sudan decoding, EXIT charts, and iterative decoding. Theoretical complements on performance and bounds are presented. Coding is also put into its communications and information theoretic context and connections are drawn to public key cryptosystems. Ideal as a classroom resource and a professional reference, this thorough guide will benefit electrical and computer engineers, mathematicians, students, researchers, and scientists.

Books on information theory and coding have proliferated over the last few years, but few succeed in covering the fundamentals without losing students in mathematical abstraction. Even fewer build the essential theoretical framework when presenting algorithms and implementation details of modern coding systems. Without abandoning the theoret

A complete introduction to the many mathematical tools used to solve practical problems in coding. Mathematicians have been fascinated with the theory of error-correcting codes since the publication of Shannon's classic papers fifty years ago. With the proliferation of communication systems, computers, and digital audio devices that employ error-correcting codes, the theory has taken on practical importance in the solution of coding problems. This solution process requires the use of a wide variety of mathematical tools and an understanding of how to find mathematical techniques to solve applied problems. Introduction to the Theory of Error-Correcting Codes, Third Edition demonstrates this process and prepares students to cope with coding problems. Like its predecessor, which was awarded a three-star rating by the Mathematical Association of America, this updated and expanded edition gives readers a firm grasp of the timeless fundamentals of coding as well as the latest theoretical advances. This new edition features: * A greater emphasis on nonlinear binary codes * An exciting new discussion on the relationship between codes and combinatorial games * Updated and expanded sections on the Vashamov-Gilbert bound, vanLint-Wilson bound, BCH codes, and Reed-Muller codes * Expanded and updated problem sets. Introduction to the Theory of Error-Correcting Codes, Third Edition is the ideal textbook for senior undergraduate and first-year graduate courses on error-correcting codes in mathematics, computer science, and electrical engineering.

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