

Information Theory and Coding - Solved Problems

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Preface

The aim of the book is to offer a comprehensive treatment of information theory and error control coding, by using a slightly different approach than in existed literature. There are a lot of excellent books that treat error control coding, especially modern coding theory techniques (turbo and LDPC codes). It is clear that understanding of the iterative decoding algorithms require the background knowledge about the classical coding and information theory. However, the authors of this book did not find other book that provides simple and illustrative explanations of the decoding algorithms, with the clearly described relations with the theoretical limits defined by information theory. The available books on the market can be divided in two categories. The first one consists of books that are specialized either to algebraic coding or to modern coding theory techniques, offering mathematically rigorous treatment of the subject, without much examples. The other one provides wider treatment of the field where every particular subject is treated separately, usually with just a few basic numerical examples.

In our approach we assumed that the complex coding and decoding techniques cannot be explained without understanding the basic principles. As an example, for the design of LDPC encoders, the basic facts about linear block codes have to be understood. Furthermore, the functional knowledge about the information theory is necessary for a code design—the efficiency of statistical coding is determined by the First Shannon theorem whereas the performance limits of error control codes are determined with the Second Shannon theorem. Therefore, we organized the book chapters according to the Shannon system model from the standpoint of the information theory, where one block affects the others, so they cannot be treated separately.

On the other hand, we decided to explain the basic principles of information theory and coding through the complex numerical examples. Therefore, a relatively brief theoretical introduction is given at the beginning of every chapter including a few additional examples and explanations, but without any proofs. Also, a short overview of some parts of abstract algebra is given at the end of the corresponding chapters. Some definitions are given inside the examples, when they appear for the first time. The characteristic examples with a lot of illustrations and tables are

chosen to provide a detail insight to the nature of the problem. Especially, some limiting cases are given to illustrate the connections with the theoretical bounds. The numerical values are carefully chosen to provide the in-depth knowledge about the described algorithms. Although the examples in the different chapters can be considered separately, they are mutually connected and the conclusions in one considered problem formulates the other. Therefore, a sequence of problems can be considered as an “illustrated story about an information processing system, step by step”. The book contains a number of schematic diagrams to illustrate the main concepts and a lot of figures with numerical results. It should be noted that the in this book are exposed mainly the problems, and not the simple exercises. Some simple examples are included in theoretical introduction at the beginning of the chapters.

The book is primarily intended to graduate students, although the parts of the book can be used in the undergraduate studies. Also, we hope that this book will also be of use to the practitioner in the field.

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