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## **Information theory and coding. From theory to applications**

### Chapter 1. Introduction

- 1.1. The Information Transmission Chain
- 1.2. How to Measure the Information in a Discrete System?

### Chapter 2. Sources of information

- 2.1. Discrete Sources
- 2.2. The Entropy of a Discrete Random Variable
- 2.3. The Joint Entropy of Two Random Variables
- 2.4. The Conditional Entropy
- 2.5. The Chain Rule of Entropy
- 2.6. Discrete Sources with Memory. Markov Chains
- 2.7. Continuous Sources of Information
- 2.8. Applications

### Chapter 3. Channels for information transmission

- 3.1. Discrete, Memoryless and Stationary Channels
- 3.2. Relative Entropy. Mutual Information
- 3.3. Capacity of Discrete Channels
- 3.4. Examples
- 3.5. Continuous Channels
- 3.6. Applications

### Chapter 4. Source coding

- 4.1. Uniquely Decodable Codes
- 4.2. Kraft - McMillan Inequality
- 4.3. Average Length of the Codewords
- 4.4. Efficiency and Redundancy of Encoding
- 4.5. Source Coding Theorem
- 4.6. Shannon-Fano Encoding
- 4.7. Huffman Binary Encoding
- 4.8. Applications

## Chapter 5. Channel coding

### 5.1. Fano's Inequality

### 5.2. Second Shannon's Theorem

## Chapter 6. Algebraic codes

### 6.1. Group Codes

### 6.2. Cyclic Codes

### 6.3. Applications

## Chapter 7. Convolutional codes

### 7.1 Encoding of Convolutional Codes

### 7.2 Decoding of Convolutional Codes Using the Majority Rule

### 7.3 State-machine Perspective of the Convolutional Encoding

### 7.4 Decoding of Convolutional Codes Using Trellis

### 7.5 A Step Further: Turbo Codes

### 7.6 Applications

## Chapter 8. Polar codes

### 8.1 Channel Combining

### 8.2 Channel Splitting

### 8.3 Case Study : The two-input channel $W_2$

### 8.4 The Polarization Phenomenon

### 8.5 Complexity of Encoding and Decoding

### 8.6 Applications

## A Probability theory review

## B Short algebra review

### B.1 Vector space

### B.2 Algebra

### B.3 Ideal

### B.4 Primitive polynomials