Information, Codes and Ciphers

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1 Introduction

1.1 Mathematical Model

To give a mathematical framework for digital data transmission, define

- a **source alphabet** $S = \{s_1, s_2, \ldots, s_q\}$ of q symbols

- a **code alphabet** A of r symbols probabilities $p_i = P(s_i)$

- a **code** that encodes each symbol s_i by a codeword which is a **string** of code symbols.

1.2 Assumed Knowledge

- Modular Arithmetic and the Division Algorithm

- Probability (Binomial Distribution and Bayes' Rule)

- Linear Algebra (Linear combination, independence, etc. . .)

1.3 Morse Code

Morse code is a **ternary** code (radix 3). Its alphabet is

1. • called **dot**

2. — called **dash**

3. p a **pause**

The codewords are strings of • and — **terminated** by p.

1.4 ASCII

American National **S**tandard **C**ode for **I**nformation **I**nterchange.

Binary code of fixed codeword length, namely 7, with $2^7 = 128$ encoded symbols.

The extended ASCII is a code like the 7-bit ASCII but with an extra bit in the front used as a check bit, requiring the number of 1's to be even.

1.5 ISBN

International **S**tandard **B**ook **N**umber.

They have 10 bits, with it's last bit being a check bit, requiring

$$\sum_{i=1}^{10} i x_i \equiv 0 \pmod{11}.$$

2 Error Detection and Correction Codes

Noise