Polar Codes and Other Concepts

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0.1 Error Correcting Codes

Basic idea is to add redundant bits to the original bit stream.
Code Rate $R = \dfrac{k}{n}$ where $n > k$.

The limit to the number of errors that can be corrected is given by *Shannon's Theorem*.

0.1.1 Shannon's Theorem

Given a noisy channel with channel capacity C and information transmitted at a rate R, then if $R < C$ there exist codes that allow the probability of error at the receiver to be made arbitrarily small.

0.1.2 Channel Capacity

It is the tight upper bound on the rate at which information can be reliably transmitted over a communication channel.

0.1.3 Shannon-Hartley Theorem

An application of the channel capacity concept to an additive white Gaussian noise (AWGN) channel with B Hz bandwidth and signal-to-noise ratio S/N is the Shannon–Hartley theorem:

$$C = B \log_2 \left(1 + \frac{S}{N} \right) \tag{1}$$

0.2 Hamming Code (7 4)

It is a linear error-correcting code that encodes four bits of data into seven bits by adding three parity bits. It is a member of a larger family of Hamming codes, but the term Hamming code often refers to this specific code that Richard W. Hamming introduced in 1950.