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Course A: Entropy and counting

Entropy is a notion coming from information theory; it was introduced by Claude Shannon in the 1940s. It quantifies the expected amount of information contained in a realisation of a discrete random variable. In particular, if X is a uniformly chosen random element of a finite set S , then the entropy of X is the logarithm of the cardinality of S . This simple observation allows one to rephrase counting problems in the language of entropy, which opens up the possibility of applying methods and tools from information theory. In recent years, such approach was applied very successfully to a range of combinatorial problems.

In this course, we will introduce the notion of entropy and derive several useful identities and inequalities. We will then demonstrate the power of these inequalities by presenting several applications of the ‘entropy method’ in combinatorics.