ESIT 2018 Tutorials

Information theory in disguise

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Abstract

Shannon introduced the zero-error capacity of a discrete memoryless channel in 1956 as the largest rate at which errorless transmission of data is possible over the channel. In his paper he translated the problem of determining this rate into the language of graph theory. This led Claude Berge to the concept of perfect graphs and his celebrated conjectures, proved by Lovász and Chudnovsky, Robertson, Seymour and Thomas several decades later. The speaker, with various co-authors, generalised Shannon's graph capacity to hypergraphs, directed graphs, infinite per- mutation graphs and families thereof. In this way we are confronted with a wealth of known and new combinatorial problems of a similar nature, amounting to a theory of asymptotic growth of product structures. The limiting characteristics of these structures can be studied using information-theoretic functionals. It becomes clear, however, that the standard construction tools in the Shannon Theory, especially the method of random choice, are insufficient to obtain the optimal solutions for most of these problems.
Many of our questions have been around in other fields where experts often failed to recognise that information theory has the key to solve them. This tutorial will introduce the recent developments inspired by the early work of Shannon.