Remarque

Next time: From Nov. 13, 2019 to Dec. 16, 2019

Summary

Information theoretic methods. Chain rule and data processing. Strong data processing. Applications to statistics and combinatorial statistics. Lower bounds in computer science and probability.

Content

This course will overview how techniques and ideas originating in information theory have been used (classically and recently) for deriving sharp impossibility results in various disciplines. We will start with a basic introduction of entropy, KL divergence and mutual information and see how their simple properties (convexity, chain rule, data processing) lead to impressive results in combinatorics and probability (e.g., counting subgraphs, bounding permanents and volumes of orthogonal projections in Euclidean spaces). We will apply basic IT methods for lower bounding the risk (error) in statistical problems. The second part of the course is focused on studying the strong data processing inequality (SDPI), which bounds the amount of loss of the mutual information upon traversing through a noisy channel. As applications we will discuss: Ising and Potts models on trees, random colorings on trees, community detection, spiked Wigner model, $Z_2$-synchronization, fault-tolerant computing and distributed estimation. This wide range of domains can be treated in a surprisingly unified way via the concept of SDPI.

Resources

Websites

• http://people.lids.mit.edu/yp/homepage/data/itlectures_v5.pdf