Codes, graphical models, distributed algorithms **

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Prerequisiti: Basic courses on calculus, linear algebra, probability.

Tipologia di esame: 5 weekly homeworks.

Aim: The goal of this course is twofold. We will first give a quick introduction to channel coding theory with a special emphasis on low density parity check codes and iterative decoding techniques which have been developed in the last 15 years and have allowed to concretely achieve the fundamental Shannon limit. Iterative decoding is an instance of the so-called Belief Propagation (BP) algorithm whose range of possible applications is much wider than just coding. In short, BP is a low-complexity algorithm which allows to compute (in an approximative way) the marginals of a stochastic process defined on a graph. BP can be applied to solve a variety of problems in artificial intelligence, statistical inference, estimation, combinatorics. In the second part of the course we will consider such more general instances of BP algorithm, we will establish some theoretical results and we will investigate some connections with statistical mechanics.

Topics:

1. [6h] Codes for reliable transmission over noisy digital channels. Maximum-a-posteriori (MAP) decoding. Shannon theorem. Some important channels: the binary symmetric channel (BSC), the binary erasure channel (BEC), the Gaussian channel. Complexity of a coding scheme. Linear binary codes, syndromes, minimum distances, weight enumerators, spectra, theoretical bounds. Examples of specific codes and ensembles of codes.


** Corso mutuato dalla Scuola di Dottorato in “Ingegneria dell’Informazione”
References:


