Jun Zhang

University of Michigan, USA

Probability normalization, marginalization, and maximum entropy inference: An information geometric approach

Information Geometry is the differential geometric study of the manifold of probability models, where each probability distribution is just a point on the manifold. Instead of using metric for measuring distances on such manifolds, these applications often use " divergence functions " for measuring proximity of two points (that do not impose symmetry and triangular inequality), for instance Kullback-Leibler divergence, Bregman divergence, f-divergence, etc. In this talk, I will present an information geometric analysis of probability normalization, marginalization, and maximum entropy inference. Normalization and marginalization of probability measures will be analyzed using the KL divergence function, and discussed in the context of "probability transport" where joint distributions of random variables are order-dependent in general. Maximum entropy inference will be shown to lead to exponential family of probability distributions in the classical case (for Shannon entropy), and to their deformed-exponential family for more general entropy functions. The IG perspective highlights the duality of " natural parameter " (parameter that defines a probability model) and " expectation parameter. "

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