

Statistical Inference and Statistical Mechanics

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Abstract

In this lecture, recent developments on connections between Markov processes and nonequilibrium statistical mechanical systems are discussed. A statistical mechanical analogy is developed for Markov processes and a local entropic measure of their true asymmetry is defined. Introducing partial observations, conditional and joint analogies are developed for Markov processes and their optimal filter. The former satisfies a variant of the second law of thermodynamics allowing entropy reduction in the presence of observations. Information supply and dissipation rates are computed for the filter and are shown to be intimately related to the rate of entropy flow of the joint system in its stationary state. Time reversal yields a dual system in which the signal and filter processes exchange roles. In general, the dual filter is a much simpler dynamical system.