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Data-driven discovery of relevant information in many-body problems: from spin lattice models to quantum field simulators

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Recent advancements in large-scale computing and quantum simulation have revolutionized the study of strongly correlated many-body systems. These developments have granted us access to extensive data, including spatially resolved snapshots that contain comprehensive information about the entire many-body state. However, interpreting such data poses in general significant challenges, often relying on various assumptions. In this talk, I will demonstrate how unsupervised machine learning offers a versatile toolkit to tackle these difficulties. Specifically, I will present an unsupervised approach based on intrinsic dimension and spectral entropies of principal components for automatic discovery of relevant information in many-body snapshots. As illustrations, I will showcase two examples: (i) investigating critical phenomena in classical Ising models, and (ii) ranking experimental observations in a quantum field simulation far from equilibrium.

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