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Estimating classical mutual information for spin systems and field theories using generative neural networks

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Mutual information is one of the basic information-theoretic measures of correlations between different subsystems. It may carry interesting physical information about the phase of the system. It is notoriously difficult to estimate as it involves sums over all possible system and subsystem states. In this talk, I describe a direct approach to estimate the bipartite mutual information using generative neural networks. Our method is based on Monte Carlo sampling. I demonstrate it on the Ising model using autoregressive neural networks and on the ϕ^4 scalar field theory using conditional normalizing flows. Our approach allows studying arbitrary geometries of subsystems. I discuss the validity of the expected area law which governs the scaling of the mutual information with the volume for both systems.

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