

Mutual information in the Ising model from autoregressive neural networks

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Mutual information is one of the 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 of a classical spin system using autoregressive neural networks. It is based on Monte Carlo sampling. I demonstrate it on the Ising model as the testing ground. Our method allows studying arbitrary geometries of subsystems and can be generalized to classical field theories. I show that the expected area law which governs the scaling of the mutual information with the volume of the system, is satisfied for temperatures away from the critical temperature. I conclude with remarks about future prospects and possible generalizations.

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- [1] P. Białas, P. Korcyl and T. Stebel, [arXiv:2304.13412 [cond-mat.stat-mech]].
 - [2] P. Białas, P. Czarnota, P. Korcyl and T. Stebel, Phys. Rev. E **107**, no.5, 054127 (2023) [arXiv:2212.04955 [cond-mat.stat-mech]].
 - [3] P. Białas, P. Korcyl and T. Stebel, Comput. Phys. Commun. **281**, 108502 (2022) [arXiv:2203.10989 [cond-mat.stat-mech]].
 - [4] P. Białas, P. Korcyl and T. Stebel, Phys. Rev. E **107**, no.1, 015303 (2023) [arXiv:2111.10189 [cond-mat.stat-mech]].

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