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Central limit theorems, large deviations and the renormalization group

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The Ising model at criticality is a paradigmatic example of random variables displaying strong correlations at all scales. While in the high and low temperature phases the collective properties of the system are described by the standard (Gaussian) central limit theorem, the critical point separating the two phases is captured by a scale invariant and universal asymptotic probability distribution. From a physicist point of view, the emergence of such probability distribution is understood using the renormalization group, which effectively describes the behavior of coarse-grained random variables.
In this talk, I will give a pedagogical overview of these concepts, using the probability distribution of the order parameter as an example of a non-trivial observable that can be computed using a functional version of the renormalization group. I will show that large deviations are universal, while very large deviation are non-universal. Furthermore, I will discuss how corrections-to-scaling can be rephrased in the langage of large deviations as a generalized Cramer's series.

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