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Phase transition in the spiked random tensors

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Abstract

The problem of detecting a deformation in a symmetric Gaussian random tensor is concerned about whether there exists a statistical hypothesis test that can reliably distinguish a low-rank random spike from the noise. Recently Lesieur et al. (2017) proved that there exists a critical threshold so that when the signal-to-noise ratio exceeds this critical value, one can distinguish the spiked and unspiked tensors and weakly recover the spike via the minimal mean-square-error method. In this talk, we will show that in the case of the rank-one spike with Rademacher prior, this critical value strictly separates the distinguishability and indistinguishability of the two tensors under the total variation distance. Our approach is based on a subtle analysis of the high temperature behavior of the pure p-spin model, arising initially from the field of spin glasses. In particular, the signal-to-noise criticality is identified as the critical temperature, distinguishing the high and low temperature behavior, of the pure p-spin model.