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**The learnability of critical distributions** DAVID SCHWAB, Northwestern University, JOHANNAH TORRENCE, University of Chicago, GIACOMO TORLAI, ROGER MELKO, University of Waterloo, STEPHANIE PALMER, University of Chicago — Many biological systems, including some neural population codes, have been shown empirically to sit near a critical point. Here we study the learnability of such codes. We first construct networks of interacting binary neurons with random, sparse interactions (i.e. a Erdos-Renyi graph) of uniform strength. We then characterize the discriminability of those interactions from data samples by performing a direct coupling analysis and thresholding the direct information between each pair of neurons to predict the presence or absence of an interaction. By sweeping through threshold values, we compute the area under the ROC curve as a measure of discriminability of the interactions. We show that the resulting discriminability is maximized when the original distribution is at its critical point. We next trained deep neural networks to discriminate between samples drawn from two nearby temperatures in the 2D Ising model. We find distinct signatures of decoding performance in the vicinity of the critical point.This technique may be useful for detecting phase transitions in models without an a priori identified order parameter.

David Schwab
Northwestern University

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