HARVARD UNIVERSITY
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Mathematical Picture Language Seminar

Tuesday, May 11, 2021, at 10:00 (Boston)
15:00 (UK/Eire) 16:00 (C.Europe) 22:00 (China)

Zoom at: https://harvard.zoom.us/j/779283357?pwd=MitXVm1pYUlJVzZqT3lwV2pCT1ZUQT09

"Understanding the Linear Cross Entropy Benchmark through a Statistical Physics Model"

Xun Gao, Harvard University

Abstract: In a recent experiment, Google claimed to achieve quantum advantage based on sampling from random quantum circuits. To certify the correctness of the sampling task, they developed a linear cross-entropy benchmark (XEB) and made their claim based on achieving a high value of XEB. The implicit assumption made in Google's claim is that XEB approximates the fidelity well and hence could serve as a proxy in practice. However, it turns out that XEB can often deviate from fidelity, so it is crucial to understand how XEB and fidelity are related. I introduce a novel approach to analyze XEB through a mapping of random quantum circuits to a discrete classical statistical-physics diffusion-reaction model. By analyzing this model both qualitatively and numerically, we show that XEB usually overestimates fidelity These results indicate that one needs a new benchmark to certify quantum advantage.