



HARVARD UNIVERSITY
17 Oxford Street
Cambridge, MA 02138

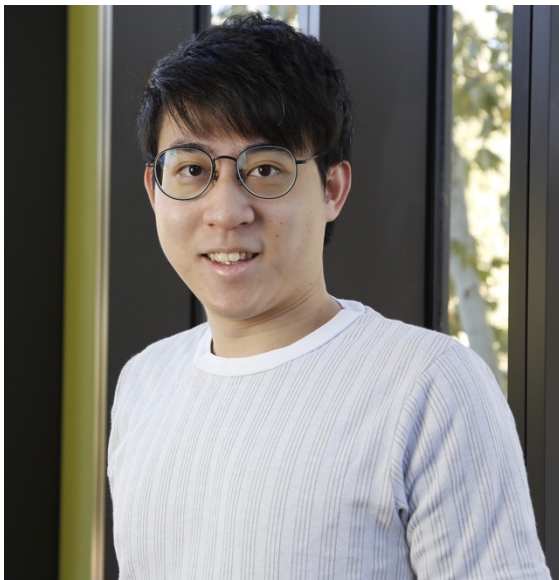
Mathematical Picture Language Seminar

Tuesday, March 22, at **9:30** a.m. EST



Zoom QR Code & Link:

<https://harvard.zoom.us/j/779283357?pwd=MitXVm1pYUIJVzZqT3lwV2pCT1ZUQTog>



Provably efficient machine learning for quantum many-body problems

Hsin-Yuan (Robert) Huang
California Institute of Technology

Abstract: Classical machine learning (ML) provides a potentially powerful approach to solving challenging quantum many-body problems in physics and chemistry. However, the advantages of ML over more traditional methods have not been firmly established. In this work, we prove that classical ML algorithms can efficiently predict ground state properties of gapped Hamiltonians in finite spatial dimensions, after learning from data obtained by measuring other Hamiltonians in the same quantum phase of matter. In contrast, under widely accepted complexity theory assumptions, classical algorithms that do not learn from data cannot achieve the same guarantee. We also prove that classical ML algorithms can efficiently classify a wide range of quantum phases of matter. Our arguments are based on the concept of a classical shadow, a succinct classical description of a many-body quantum state that can be constructed in feasible quantum experiments and be used to predict many properties of the state. Extensive numerical experiments corroborate our theoretical results in a variety of scenarios, including Rydberg atom systems, 2D random Heisenberg models, symmetry-protected topological phases, and topologically ordered phases.

<https://mathpicture.fas.harvard.edu/seminar>