

RICE QUANTUM GROUP MEETING SEMINAR SERIES



<u>Presenter:</u>	Shah Saad Alam
Research Group:	Prof. Han Pu's group
Date:	October 28, 2022, Friday
Time:	4PM - 5PM
Venue:	SST 300

Seeing the Forest for the Trees: How Convolutional Neural Networks Approximate Quantum Spin Systems

Abstract:

Convolutional Neural Networks (CNNs) augmented with Monte Carlo methods have proven remarkably adept at numerically solving quantum spin systems, but the exact nature of the approximation they make is opaque. Well known in computer science as the "Curse of Dimensionality", the CNNs ability to use only linearly many parameters to successfully approximate an exponentially large solution is often a black box. In my talk, I'll explain several features of the CNNs' solution to a spin Hamiltonian. Doing so will involve bringing together ideas from both physics and statistics, such as physical symmetries, quantum entanglement and classical information entropy. I'll show how the CNN solution is best understood as a "motif" based ansatz, where the CNN uses local information to solve for the global solution. Finally, I will discuss how CNNs connect to families of other variational ansatzes in statistics and quantum physics such as Maximum Entropy and Correlator Product States.

Short Bio:

Shah Saad Alam is a senior graduate student in Prof. Han Pu's group. His research focuses on the theory of quantum spinor gases, one dimensional spin systems with strong interactions and using machine learning to gain insights into quantum matter. He obtained his MS at Rice University working in computational space plasma research. Prior to Rice University, he completed his undergraduate studies in Physics and Mathematics at Amherst College and did an honors thesis studying the spectra and prospects of laser cooling TIF molecules. In his spare time, he enjoys volunteering with student groups such as Rice GSA, PAGSA and Rice Pakistani Students Association. He also enjoys playing table tennis and biking and would love company for either of those activities.

Note: Snacks and Coffee will be served during the event Wine & cheese will be served after the talk. Everyone is welcome to stay around after the seminar for further informal discussions.