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Discrete lattice gauge theory from neural-network quantum states

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First introduced by Carleo and Troyer in 2017, neural-network quantum states have achieved state-of-the-art results for approximating the ground-state wavefunction of spin-chain and lattice systems, and a variety of supervised learning problems. More recently, this approach has been extending to gauge theories using lattice gauge-equivariant convolutional neural networks (L-CNNs).

In this talk, after reviewing these developments, I will present new results on using L-CNNs and variational quantum Monte Carlo to approximate the ground state of Z_N lattice gauge theories in 2+1 dimensions. We will see that these networks can be used to study critical points and phase transitions while retaining exact gauge invariance. In particular, we will identify the confinement/deconfinement transition and critical exponents for Z_2, and the first-order phase transition for Z_3 gauge theory.

Presenter: ASHMORE, Anthony