Quantum Technology Initiative Journal Club

Report of Contributions

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Thursday 16 January 2025 16:00 (40 minutes)

TITLE: Quantum kernels to learn the phases of quantum matter
Link: https://arxiv.org/abs/2109.02686

ABSTRACT:
Classical machine learning has succeeded in the prediction of both classical and quantum phases of matter. Notably, kernel methods stand out for their ability to provide interpretable results, relating the learning process with the physical order parameter explicitly. Here, we exploit quantum kernels instead. They are naturally related to the \emph{fidelity} and thus it is possible to interpret the learning process with the help of quantum information tools. In particular, we use a support vector machine (with a quantum kernel) to predict and characterize second order quantum phase transitions. We explain and understand the process of learning when the fidelity per site (rather than the fidelity) is used. The general theory is tested in the Ising chain in transverse field. We show that for small-sized systems, the algorithm gives accurate results, even when trained away from criticality. Besides, for larger sizes we confirm the success of the technique by extracting the correct critical exponent ν. Finally, we present two algorithms, one based on fidelity and one based on the fidelity per site, to classify the phases of matter in a quantum processor.

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