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Quantum-enhanced Machine Learning: a sanity check

Machine learning is one of the fields that could benefit from near-term quantum computers: just the same way massively parallel digital computers enabled deep learning to scale up, quantum processing units (QPUs) are great at doing certain workloads. The problem is that the emergent field of quantum machine learning has been plagued with expectations that are unrealistic on contemporary quantum computers and relevance to the machine learning and AI communities has largely been overlooked. In this talk, we give a survey on what early quantum devices can contribute to machine learning. The primary algorithmic primitives are sampling, optimization, calculating kernel functions, and some variational problems efficiently which map to hybrid classical-quantum protocols. The main application areas in machine learning are probabilistic graphical models, in particular Boltzmann machines and deep variants thereof, quantum neural networks, and searches over discrete parameter spaces. These models have different strengths than the ones trained on digital computers, hence quantum machine learning plays a complementary role to classical techniques, rather than acting as a replacement. We will also highlight possible pathways forward that would make upcoming quantum architectures more relevant to AI research.