Exploring Quantum Learning Models on Superconducting Devices

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Quantum computing promises to enhance machine learning and artificial intelligence. However, due to the unavoidable noise in real experiments, it is challenging to design and implement large-scale quantum learning models on real quantum devices.

Here, we report **an experimental demonstration of supervised quantum machine learning with programmable superconducting qubits**. We train quantum classifiers, which are built on variational quantum circuits consisting of ten transmon qubits featuring average lifetimes of 150 μs, and average fidelities of simultaneous single- and two-qubit gates above 99.94% and 99.4%, respectively, with both real-life images (for example, medical magnetic resonance imaging scans) and quantum many-body data. We demonstrate that these well-trained classifiers can achieve high performance on these high-dimensional datasets, with testing accuracy of up to 99%.

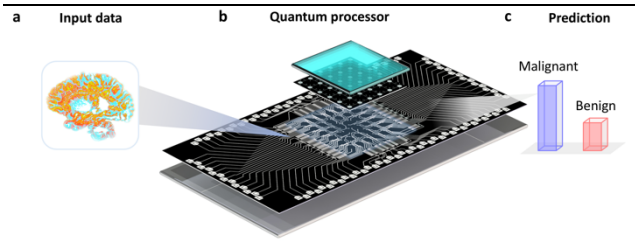

Figure 1: Schematic illustration of the model.

References

[1] Ren, **Li**, Xu, et al, Nature Computational Science 2, 711 (2022)
[2] **Li**, Lu, Deng, SciPost Physics Lecture Notes, 061 (2022)

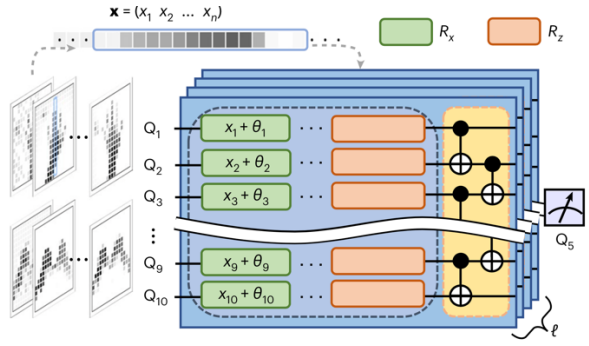

Figure 2: Learning classical data.

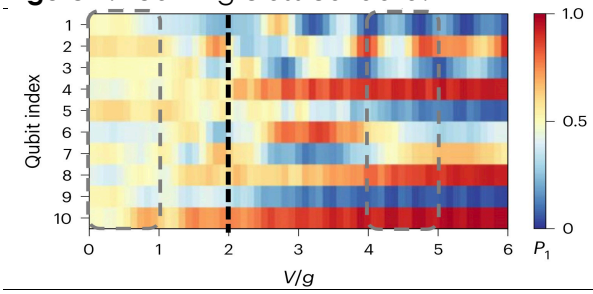

Figure 3: Learning quantum data.

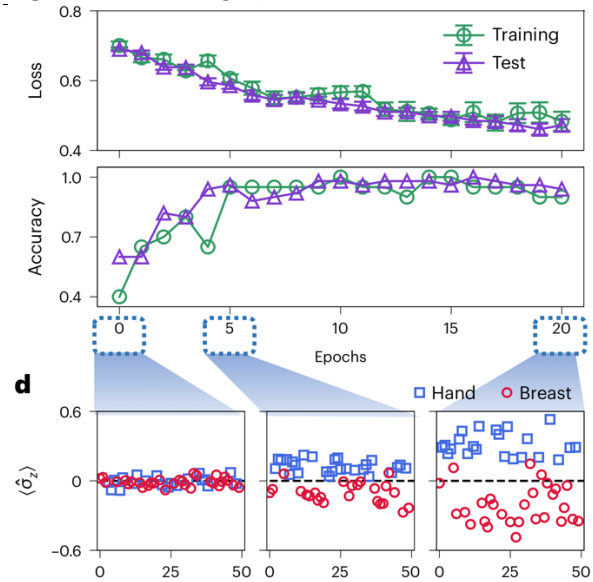

Figure 4: Results for learning classical data.

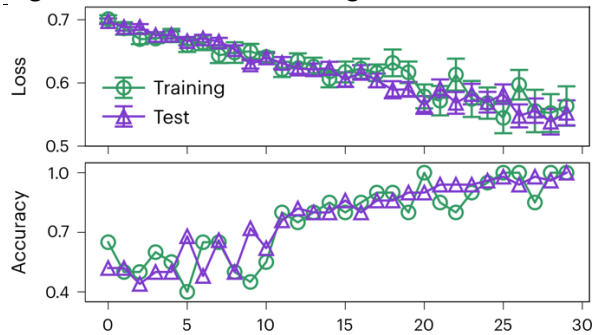

Figure 5: Results for learning quantum data.