Learning the capabilities of quantum computers using physics-informed neural networks

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The computational power of contemporary quantum processors is limited by hardware errors that cause computations to fail. In principle, each quantum processor's computational capabilities can be captured by a capability function. A capability function quantifies how well a processor can run each possible quantum circuit by mapping a circuit to the processor's success rate on that circuit, as quantified by, e.g., fidelity. However, capability functions are typically unknown and challenging to model. In this talk, I will present results on using purpose-built artificial neural networks to learn an approximation to a processor's capability function. These "physics-informed" neural networks efficiently encode how errors propagate through and interfere within circuits, enabling accurate capability predictions even in the presence of strongly coherent errors.

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