

## Quantum Science &amp; Technology

## Interpretable Quantum Advantage in Neural Sequence Learning

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In-person: EEB 248

**Abstract:** Quantum neural networks have been widely studied in recent years due to their potential practical utility and recent results showing their ability to efficiently express certain classical data. However, analytic results to date rely on assumptions and arguments from complexity theory. As a result, there is little intuition regarding the source of the expressive power of quantum neural networks or for which classes of classical data any advantage can be reasonably expected to hold. In this study, we examine the relative expressive power between a broad class of neural network sequence models and a class of recurrent models based on quantum mechanics. We demonstrate that quantum contextuality is the source of an unconditional memory separation in the expressivity of the two model classes. Using this intuition, we study the relative performance of our introduced model on a standard translation dataset exhibiting linguistic contextuality. Our quantum models outperform state-of-the-art classical models, even in practice. Finally, I will briefly discuss future directions of quantum neural networks and their potential connections to concepts in condensed matter physics, such as Berry phase and spin glass.



**Biography:** Xun Gao is an assistant professor at University of Colorado Boulder and an associate fellow at JILA. He got his PhD from Tsinghua University under the supervision of Luming Duan. Then he was a postdoc at Harvard University from Mikhail Lillian's group. His research interests are quantum computational advantage and quantum machine learning.

Hosted by: Quntao Zhang, Wade Hsu, Mengjie Yu, Jonathan Habif & Eli Levenson-Falk