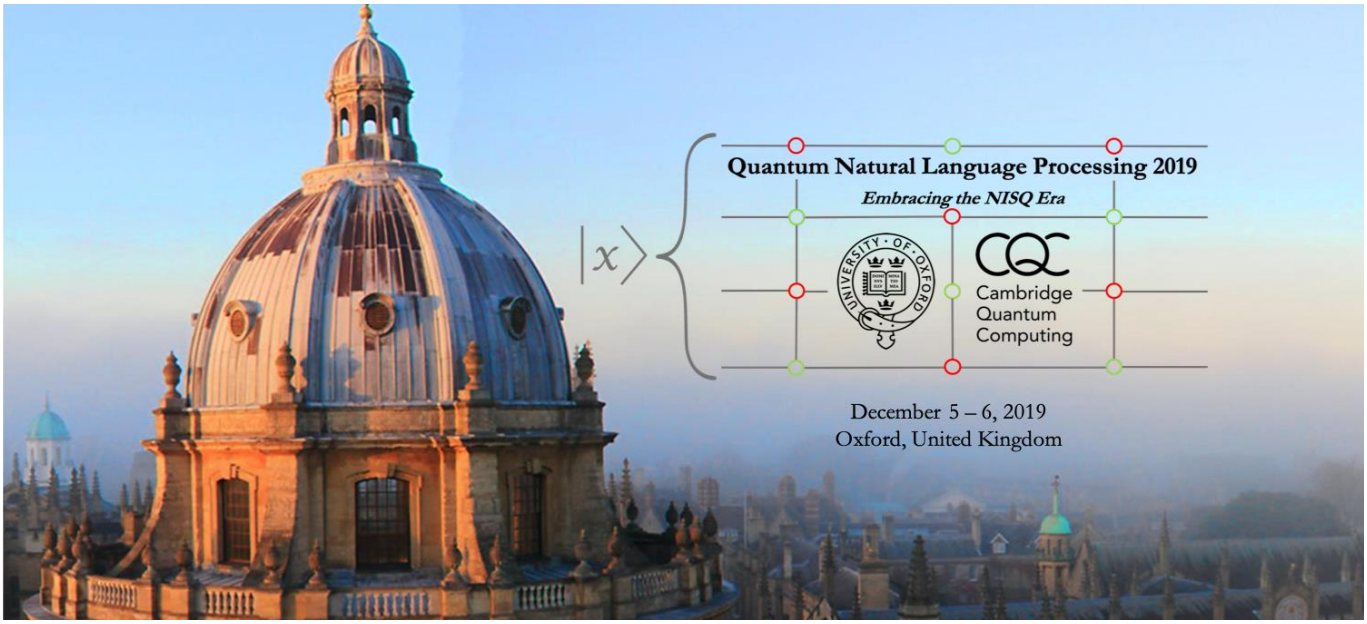

Speaker: Jens Eisert

Title: Rigorous statements on near-term quantum computing

Abstract:

Recent years have witnessed an enormous interest in assessing the potential of noisy intermediate scale quantum (NISQ) devices. Significant progress has indeed been made in the development and the understanding of variational hybrid methods that have both a classical and a quantum component, specifically in variational quantum eigensolvers and quantum approximate optimization algorithms. In this talk, we will ask questions of what statements one can expect to be shown with rigorous methods in this emergent field of near-term quantum computing, and what "proof pockets" are within reach. The main part of the talk will be concerned with a stochastic gradient descent method for hybrid quantum-classical optimization that features a recovery guarantee: It overcomes the prejudice that in order to estimate gradients, one should measure expectation values [1]. Instead, single-shot measurements are significantly more efficient, while maintaining convergence. We will also briefly discuss questions of expressivities, exploring the expressive power of circuits, with surprising exponential separations featuring here [2]. If time allows, we will discuss in an outlook how one could close the conceptual and mathematical loopholes when showing a quantum advantage ("supremacy") [3].

[1] Stochastic gradient descent for hybrid quantum-classical optimization, R. Sweke, F. Wilde, J. Meyer, M. Schuld, P. K. Fährmann, B. Meynard-Piganeau, J. Eisert, arXiv:1910.01155.
[2] Expressive power of tensor-network factorizations for probabilistic modeling, with applications from hidden Markov models to quantum machine learning, I. Glasser, R. Sweke, N. Pancotti, J. Eisert, J. I. Cirac, arXiv:1907.03741.
[3] Closing gaps of a quantum advantage with short-time Hamiltonian dynamics, J. Haferkamp, D. Hangleiter, A. Bouland, B. Fefferman, J. Eisert, J. Bermejo-Vega, arXiv:1908.08069.