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(I) Quantum enhanced sampling: an essential tool for today's quantum computing practitioner

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In the distant future we expect to be using large-scale, nearly perfect quantum computers that aid in drug discovery, break RSA encryption, and outperform supercomputers in certain machine learning tasks. Today we have access to small quantum computers afflicted by noise and error. Somewhere between these two extremes lies a momentous event for the field known as quantum advantage: solving a computational problem of practical value, using a quantum computer in an essential manner. With what tools must we equip ourselves in order to reach quantum advantage as soon as possible? This talk will introduce quantum enhanced sampling, a tool for speeding up a critical component of many near-term quantum algorithms: estimation of quantities encoded in quantum operations. This helps to bridge the gap between several near-term quantum algorithms and their far-term counterparts. We will motivate the need for this tool through recent examples in quantum machine learning and quantum chemistry. Then we will give a pedagogical introduction to quantum enhanced sampling methods. Finally, we will show results demonstrating the performance of this method and will discuss the implications for near-term quantum computing.

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