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Towards Developing Quantum Proof of principle Applications for the Biological Sciences

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Abstract

There has been a growth of interest in the application of quantum computation and quantum simulation to the many intractable computational problems in the biological sciences. While theoretical results imply the value of quantum information processing (QIP) to many of the challenging problems resident in this research domain, such as molecular dynamics simulation, oncogenic mutational signature inference, and phylogenetic tree inference, a framework to guide the realization of quantum proof of principle applications has yet to be clarified. Here, we present such a framework, comprised of five components; Assessment, Complexity, Problem Instance, Hardware Implementation, and Validation, that has been assembled to fill this crucial gap and aims to orient domain practitioners as they begin exploring applications of QIP. While motivated by applications of quantum computing to the biology domain, the framework is sufficiently general that it may find use in other domains – guiding the development of quantum proof of principle applications across the many scientific domains that stand to benefit from this rapidly advancing technology.