Key metrics for benchmarking the speed and scalability of Quantum programs and Algorithmic performance comparison with different Quantum Hardware

by

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ABSTRACT

There has been a surge of advancements in the field of Quantum Computing ever since Shor's Factoring algorithm kickstarted it in the year 1994. With google's announcement of their 54-qubit sycamore processor in 2019, which is said to have achieved "Quantum Supremacy", the race to build a fast, scalable, and fault-tolerant quantum computer capable of executing useful algorithms faster than classical computers, is heating up across several tech giants, corporations and governments.

With several companies building quantum computers that are based on largely different physical processes such as trapped-ion, superconducting, photonic, silicon-based, and topological quantum computers, it becomes extremely important in defining metrics to determine the speed and scalability of Quantum programs, irrespective of the platforms they are executed.

While the metrics of volumetric benchmarking and CLOPS, introduced by IBM, give us a platform-agnostic way of comparing Quantum Hardware, there is no standard way to express the scalability of the hardware as well as the programs that are run in these platforms. This thesis is to study and explore other benchmarking techniques and validate the effect of quantum noise and error correction on these metrics. We will also discuss the performance and scalability of Quantum Machine Learning Algorithms using these metrics and error correction techniques.