Quantum Computation, Quantum Algorithms and Implications on Data Science

Mr. Nathan Kim, Mr. Jeremy Garcia, and Dr. David Han

University of Texas at San Antonio

Abstract

Quantum computing is a new revolutionary computing paradigm, first theorized in 1981. It is based on quantum physics and quantum mechanics, which are fundamentally stochastic in nature with inherent randomness and uncertainty. The power of quantum computing relies on three properties of a quantum bit: superposition, entanglement, and interference. Quantum algorithms are described by the quantum circuits, and they are expected to solve decision problems, functional problems, oracular problems, sampling tasks and optimization problems so much faster than the classical silicon-based computers. They are expected to have a tremendous impact on the current Big Data technology, machine learning and artificial intelligence. Despite the theoretical and physical advancements, there are still several technological barriers for successful applications of quantum computation. In this work, we review the current state of quantum computation and quantum algorithms, and discuss their implications on the practice of Data Science in the near future. There is no doubt that quantum computing will accelerate the process of scientific discoveries and industrial advancements, having a transformative impact on our society.