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Two Quantum to Classical Transitions for the Discrete Quantum Walk

Abstract

This talk is concerned with the discrete quantum walk on the infinite line. Quantum walks are of interest because of their role in the theory of quantum algorithms. They can be thought of as quantum analogues of classical Markov processes, which are used both in classical algorithm theory and also in some parts of statistical physics.

We would like to understand how and why the behaviour of the quantum walk is so different from that of the classical random walk, as that may improve our understanding of how and why some quantum algorithms are faster than their classical analogues. It may also give some insight into the optimal design of algorithms based on such walks. I will describe two different approaches to the classical limit for this system. These are obtained by modifying the "coin" subspace that controls the walk in two complementary ways, which show very different behaviours.

This is joint work with Andris Ambainis and Todd Brun.