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Title: Quantum fine-grained complexity

One of the major challenges in computer science is to establish lower bounds on the resources, usually time, that are needed to solve computational problems. This holds in particular for computational problems that appear in practise.

One way towards dealing with this situation is the study of fine-grained complexity where we use special reductions to prove time lower bounds for many diverse problems based on the conjectured hardness of some key problems. For example, computing the edit distance between two strings, a problem that has a practical interest when determining the genetic distance between species based on their DNA, has an algorithm that takes $O(n^2)$ time. Using a fine-grained reduction, it can be shown that faster algorithms for edit distance also imply a faster algorithm for the Boolean Satisfiability (SAT) problem (that is believed to not exist). This is evidence that the current edit distance algorithms are optimal. Another problem, besides SAT, that is used as a basis for these reductions is the 3SUM problem.

The situation in the quantum regime is no better; almost all known lower bounds for quantum algorithms are defined in terms of query complexity, which doesn't help much for problems for which the best-known algorithms take super-linear time. Therefore, employing fine-grained reductions in the quantum setting seems a natural way forward. However, translating the classical fine-grained reductions directly into the quantum regime is not always possible for various reasons. In this talk, I will present some recent results in which we circumvent these challenges and prove quantum time lower bounds for some problems in BQP conditioned on the conjectured quantum hardness of SAT (and its variants) and the 3SUM problem.

This is based on joint work with Bruno Loff, Subhasree Patro, and Florian Speelman