Seminar on Combinatorial Computing
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Quantum lower bounds by dualization

Mario Szegedy
Rutgers University, New Brunswick

Abstract

We reformulate the notion of quantum decision tree complexity in terms of inequalities (and equations) for a set of posititive matrices. Using the new formulation we show that:

1. Every quantum decision tree algorithm needs to use at most n quantum registers additional to the query registers.

2. For any function f, there is an algorithm that runs in polynomial time in terms the truth table of f, and computes the quantum decision tree complexity of f.

3. Using the dual of our system of inequalities we can treat lower bound methods on a uniform platform, which paves the way to their future comparison. In particular, we describe Ambainis's bound in our framework.

4. The output condition described in Ambainis's paper is not the most generic (i.e., we give examples when the entaglement matrix in the final step of some quantum decision tree algorithm has the condition stated by Ambainis, but the value of f cannot be determined from the system using a quantum measurement.) On the other hand, we find the generic requirement for the final entanglement matrix.

Joint with Howard Barnum and Mike Saks.

For further information contact Janos Pach at pach@cims.nyu.edu, or visit our website: http://www.math.nyu.edu/ pach/combinatorics_seminar.html