

Weak Pigeonhole Principles, Circuits for Approximate Counting, and Bounded-Depth Proofs

Albert Atserias

Abstract

I will start this talk by giving an overview of the status of the weak pigeonhole principle (WPHP) in proof complexity and the connection between this problem and some fundamental questions on the computational complexity of approximate counting. Then I will discuss some recent progress on the main remaining question about WPHP, namely whether the known quasipolynomial-size depth-2 proof is optimal in terms of size. We show that a relativized version of the WPHP that also has quasipolynomial-size depth-2 proofs does indeed require quasipolynomial size to prove in depth-2. To our knowledge, this gives the first example of a natural principle with matching but superpolynomial upper and lower bounds in a natural proof system.