On Approximation Resistance of Predicates

Subhash Khot

Department of Computer Science
Courant Institue of Mathematical Sciences
New York University
251 Mercer Street
New York NY-10012, USA.
khot@cs.nyu.edu

Abstract

Constraint satisfaction problems are some of the most well-studied NP-hard problems, 3SAT being a prominent example. It is known by Hastad's 1997 result that 3SAT is "approximation resistant" in the following sense: given a near-satisfiable instance, a trivial algorithm that assigns random boolean values to the variables satisfies 7/8 fraction of the constraints and no efficient algorithm can do strictly better unless P=NP!

3SAT is a CSP that corresponds to the ternary OR predicate. In general, a CSP has constraints given by some fixed predicate $P : \{0,1\}^k \mapsto \{\text{True}, \text{False}\}$ (on possibly negated variables) and the predicate is called approximation resistant if, on a near-satisfiable instance, it is computationally hard to perform strictly better than a random assignment.

The quest to understand approximation resistance has played a central role in the theory of probabilistically checkable proofs (PCPs) and hardness of approximation. This talk will give a survey of the topic, including recent work giving a complete characterization of approximation resistance (i.e. a necessary and sufficient condition on the predicate that makes the corresponding CSP approximation resistant).

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