Title: The Kikuchi Matrix Method: New Spectral Algorithms for Smoothed k-SAT and Applications to Combinatorics

Venue: KD101

Time: 5:15 PM, 1st November 2023.

Abstract:

In this talk, I will talk about a new class of spectral algorithms (i.e., algorithms based on the eigenvalues of an appropriately constructed matrix from the input) based on "Kikuchi" matrices for smoothed variants of the k-SAT problem and applications to combinatorial problems about the girth of hypergraphs.

Depending on time, I will discuss three applications of this technique:

Finding non-trivial algorithms for smoothed instances of k-SAT. Such smoothed instances, formulated first by Feige, are obtained by randomly perturbing the literal patterns in a worst-case instance with a small probability. The guarantees of the algorithm match the best-known running-time vs constraint-density trade-offs for the significantly special and easier case of random CSPs, Establish Feige's 2008 Conjecture that postulated an extremal girth vs density trade-off (a.k.a. Moore bounds) for k-uniform hypergraphs. This conjecture generalizes the Alon-Hoory-Linial irregular Moore bound (2002) conjectured by Bollobas in 1978. Proving a cubic lower bound on the block length of 3 query locally decodable codes improving on the prior best quadratic lower bound from the early 2000s due to Kerenedis and de Wolf. Based on joint works with Omar Alrabiyah (Berkeley), Tim Hsieh (CMU), Peter Manohar (CMU), Sidhanth Mohanty (Berkeley), and Venkat Guruswami (Berkeley).

Brief Bio:

Pravesh Kothari has been an Assistant Professor of Computer Science at Carnegie Mellon University since Sep 2019. In Jan'24, he will join the CS faculty at Princeton University and the School of Mathematics as a member of the Institute for Advanced Study. Earlier, he obtained his B. Tech from IIT Kanpur, his Ph.D. from the University of Texas at Austin (2016), and was a postdoctoral Research Instructor jointly hosted by Princeton University and the Institute for Advanced Study from 2016-19. Kothari's recent work has focused on algorithm design for problems with statistical inputs and connections to optimization, random matrix theory, and extremal combinatorics. His research has been recognized with a Simons Award for graduate students in Theoretical Computer Science, a Google Research Scholar Award, an NSF CAREER Award, and an Alfred P. Sloan Research Fellowship.