# The University of Chicago

# Department of Computer Science & Mathematics

# Combinatorics & Theory Seminar

**PRESENTS:**



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**Title:** “**On the Approximation Resistance of Balanced Linear Threshold Functions**”

**Abstract:** Constraint satisfaction problems (CSPs) are a central topic of study in computer science. A fundamental question about CSPs is as follows. Given a CSP where each constraint has the form of some predicate P and almost all of the constraints can be satisfied, is there a randomized polynomial time algorithm which is guaranteed to do significantly better in expectation than a random assignment? If so, then we say that the predicate P is approximable. If not, then we say that P is approximation resistant. In 2008, Raghavendra proved a dichotomy theorem for the hardness of CSPs. Either a standard semidefinite program (SDP) gives a better approximation ratio than a random assignment or it is unique games hard to do so. However, for any given CSP it may be extremely hard to decide which case holds. In fact, it is not even known whether it is decidable! This work shows that there exists a balanced linear threshold function (LTF) which is unique games hard to approximate, refuting a conjecture of Austrin, Benabbas, and Magen. This work also show that the almost monarchy predicate on k variables is approximable for sufficiently large k. In this talk, I will describe techniques for determining whether a predicate is approximable or unique games hard to approximate. On the approximation resistance side, I will discuss important special cases of Raghavendra's criterion which are sufficient for almost all predicates which are known to be approximation resistant. I will then briefly sketch how to construct a predicate which is a balanced LTF and is unique games hard to approximate. On the approximation side, I will describe the class of approximation algorithms which we must consider. I will illustrate this class of approximation algorithms by describing the approximation algorithm for the majority predicate and giving a simpler approximation algorithm for the monarchy predicate.

Tuesday, January 22, 2019

Ry. 251 @ 3:30 pm

(Refreshments will be served prior to the talk in Ry. 255 @ 3:15pm)