Temple University Mathematics Colloquium

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will speak on

A geometric approach to understanding neural codes in recurrent networks

ABSTRACT: Synapses in many cortical areas of the brain are dominated by local, recurrent connections. It has long been suggested, therefore, that cortical networks may serve to restore a noisy or incomplete signal by evolving it towards a stored pattern of activity. These preferred activity patterns are constrained by the excitatory connections, and comprise the neural code of the recurrent network. In this talk I will briefly review the permitted and forbidden sets model for cortical networks, first introduced by Hahnloser et. al. (Nature, 2000), in which preferred activity patterns are modeled as permitted sets - that is, as subsets of neurons that co-fire at stable fixed points of the network dynamics. I will then present some recent results that provide a geometric handle on the relationship between permitted sets and network connectivity. This allows us to precisely characterize the structure of neural codes that arise from a simple learning rule. In particular, we find natural codes that can be learned from few examples, and that closely mimic receptive field codes that have been observed in the brain. Finally, we use our geometric description of permitted sets to prove that these networks can perform error correction and pattern completion for a wide range of connectivities.

Thursday, February 6, 2013
Lecture at 2:00 pm
Coffee, tea, and refreshments from 1:45 pm
Room 617, Wachman Hall
Department of Mathematics