Learning, Testing, and Approximating Halfspaces

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Abstract

A halfspace is a Boolean function of the form $f(x) = sign(w \cdot x - \theta)$. Halfspaces (also known as linear threshold functions, weighted majority functions, threshold gates, Perceptrons, etc.) are a natural and well-studied class of Boolean functions.

We describe recent results on approximating, testing, and learning halfspaces. In more detail,

- Every halfspace can be approximated by a halfspace with small integer weights;

- There is an efficient algorithm for testing whether an unknown Boolean function is a halfspace (versus far from every halfspace);

- Halfspaces can be efficiently approximately reconstructed from approximations to their degree-0 and degree-1 Fourier coefficients (this corresponds to an efficient learning algorithm in the "restricted focus of attention" learning model).

The talk will emphasize the connections between these three results.

The talk is based in part on joint work with K. Matulef, R. Rubinfeld and R. O'Donnell, with R. O'Donnell, and with I. Diakonikolas.