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Department of Statistics

DISSERTATION PROPOSAL

JONATHAN ESKREIS-WINKLER

Department of Statistics
The University of Chicago

Multiresolution Analysis on Discrete Spaces

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Jones 304, 5747 S. Ellis Avenue

ABSTRACT

In signal processing, multiresolution analysis permits the decomposition of signals into a sparse basis of wavelet functions. These representations summarize signals at different locations and different frequencies and describe certain types of discontinuous signals more efficiently and accurately than would be possible using a Fourier basis. Similarly, the eigen-decomposition is often ill-suited to represent matrices with multiscale structure or to summarize features of graphs that might include hierarchical, overlapping communities. Enter the decomposition of matrices by means of wavelet bases. The wavelet basis of a matrix has the advantage of describing both local and global features using a sparse representation. New developments in the multiresolution analysis of discrete spaces have opened the door to a number of new approaches to data analysis.

This talk considers two specific areas of application: kernel-based learning and network analysis. In large-scale cases of the former, it tends to be unwieldy to work with the full kernel matrix and we propose applying a recent technique for the multiresolution factorization of matrices to address computational bottlenecks. In the latter, we address several challenging questions which depend on information regarding both local and global graph structure. These include: community detection, label propagation, the construction of hierarchical stochastic block models, and graph visualization.

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