

# TOPICS IN GRAPH THEORY, RANDOM MATRICES, AND APPLICATIONS

MATH 388 - Spring 2010 - MonWed Phys. 227 - Mar 31st-Apr 28th

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We discuss topics and techniques in applied harmonic analysis that arise in the study of data sets in high-dimensions. The course is built by connecting several papers in the last several years addressing the study of data sets in high dimensions and machine learning from different point of views. The emphasis is on recent work, open problems, and mathematical techniques that have been used in this work, or may be used to attack some of the open problems. Topics:

- Metric space embeddings and manifold learning techniques: attempting to embed data sets in high-dimensions in low-dimensional spaces.
- Connections with graph theory: random walks, Laplacians. Continuous limits. Signal processing on graphs: Fourier and wavelet analysis. Short excursus on expanders and on graph sparsification.
- Random matrices. Applications to covariance estimation, infinite-dimensional kernels, fast algorithms for singular value decompositions.
- Reproducing Kernel Hilbert spaces and their applications in learning. Sampling Theorems. Excursus on sparsity and its applications in signal processing and learning.

