Spectral Methods for Brain Imaging and Text Analysis

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Spectral learning algorithms have recently become popular in data-rich domains because they lead to statistical estimation algorithms which are fast, useful, and have strong theoretical properties. We propose a general spectral framework for analyzing brain imaging data that uses sparse matrix factorization to learn the boundaries of and connections between brain regions, using both the imaging data and prior neuroanatomical knowledge. We determine biologically-relevant, patient-specific functional parcels, which significantly improve classification of Mild Cognitive Impairment (MCI) over state-of-the-art competing approaches. We use similar spectral algorithms to learn "word embeddings" – low dimensional real vectors ('eigenwords') that capture the "meanings" of words from their contexts. Finally, we present preliminary results relating the words in a sentence presented to a subject (represented as eigenwords) to the subjects' brain images, providing a step towards determining how sentences are represented in the brain.

Biography: Dr. Lyle Ungar is a Professor of Computer and Information Science at the University of Pennsylvania, where he also holds appointments in several other departments in the Schools of Engineering and Applied Science, Business, Arts and Sciences and Medicine. Dr. Ungar received a B.S. from Stanford University and a Ph.D. from M.I.T. He has published over 200 articles and holds eleven patents. His current research focuses on developing scalable machine learning methods for data mining and text mining, including mining social media to better understand drivers of physical and mental well-being.

1. Joint work with Brian Avants, Paramveer Dhillon, Joao Sedoc and a host of others.