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# Keith Levin

## Research Interests

Statistical methods for network data; high-dimensional statistics; pattern recognition; streaming and randomized algorithms; applications to speech recognition and neuroscience.

## Education

- 2017 **Ph.D., Computer Science**, *Johns Hopkins University*, Baltimore, MD.  
**Thesis:** *Graph Inference with Applications to Low-Resource Audio Search and Indexing*, under supervision of Professors Carey E. Priebe (JHU Applied Mathematics and Statistics), Vincent Lyzinski (JHU Applied Mathematics and Statistics) and Ben Van Durme (JHU Computer Science)
- 2016 **M.S.E., Computer Science**, *Johns Hopkins University*, Baltimore, MD.
- 2011 **B.S., Linguistics & Psychology**, *Northeastern University*, Boston, MA.

## Positions

- 2017-Present **Postdoctoral Research Fellow**, *University of Michigan Department of Statistics*, Ann Arbor, MI.  
Statistical methods for analyzing multiple networks, supervised by Elizaveta Levina.
- 2017 **Postdoctoral Researcher**, *Johns Hopkins University Department of Applied Mathematics and Statistics*, Baltimore, MD.  
Network inference: theory, methods and applications, supervised by Carey E. Priebe.
- 2012–2017 **Graduate Student**, *Johns Hopkins University Department of Computer Science*, Baltimore, MD.  
Ph.D. research on applying graph inference techniques to large-scale search problems in speech recognition. Additional research on streaming clustering algorithms.
- 2010–2012 **Avoke Caller Experience Analyst**, *Raytheon BBN Technologies*, Cambridge, MA.  
Compiled and analyzed call center data; prototyped topic model for call categorization; prototyped keyword spotting system for event detection.
- 2007–2011 **Research Assistant**, *Sentence Processing Laboratory, Department of Psychology, Northeastern University*, Boston, MA.  
Ran experiments, designed experimental stimuli, gathered and processed experimental data.
- 2009–2011 **Research Assistant**, *Speech Perception Laboratory, Department of Psychology, Northeastern University*, Boston, MA.  
Maintained laboratory equipment and records.

## Peer-reviewed Publications

- J. T. Vogelstein, E. W. Bridgeford, B. D. Pedigo, J. Chung, K. Levin, B. Mensh, and C. E. Priebe. Connectal coding: discovering the structures linking cognitive phenotypes to individual histories. *Current Opinion in Neurobiology*, 55:199–212, 2019.
- V. Lyzinski, K. Levin, and C. E. Priebe. On consistent vertex nomination schemes. *Journal of Machine Learning Research*, 20(69):1–39, 2019.
- C. M. Le, K. Levin, and E. Levina. Estimating a network from multiple noisy realizations. *Electronic Journal of Statistics*, 12(2):4697–4740, 2018.
- K. Levin, F. Roosta, M. W. Mahoney, and C. E. Priebe. Out-of-sample extension of graph adjacency spectral embedding. In *Proceedings of the International Conference on Machine Learning*, Stockholm, Sweden, 2018.
- A. Athreya, D. E. Fishkind, K. Levin, V. Lyzinski, Y. Park, Y. Qin, D. L. Sussman, M. Tang, J. T. Vogelstein, and C. E. Priebe. Statistical inference on random dot product graphs: a survey. *Journal of Machine Learning Research*, 18(226):1–92, 2018.
- K. Levin and V. Lyzinski. Laplacian eigenmaps from sparse, noisy similarity measurements. *IEEE Transactions on Signal Processing*, 65(8):1988–2003, 2017.
- S. Settle, K. Levin, H. Kamper, and K. Livescu. Query-by-example search with discriminative neural acoustic word embeddings. In *Proceedings of INTERSPEECH*, Stockholm, Sweden, 2017.
- V. Lyzinski, K. Levin, D. E. Fishkind, and C. E. Priebe. On the consistency of the likelihood maximization vertex nomination scheme: Bridging the gap between maximum likelihood estimation and graph matching. *Journal of Machine Learning Research*, 17(179):1–34, 2016.
- V. Braverman, H. Lang, K. Levin, and M. Monemizadeh. Clustering problems on sliding windows. In *Proceedings of the ACM-SIAM Symposium on Discrete Algorithms*, Arlington, VA, USA, 2016.
- V. Braverman, H. Lang, K. Levin, and M. Monemizadeh. Clustering on sliding windows in polylogarithmic space. In *Proceedings of the 35th IARCS Annual Conference on Foundations of Software Technology and Theoretical Computer Science*, Bangalore, India, 2015.
- K. Levin, A. Jansen, and B. van Durme. Segmental acoustic indexing for zero resource keyword search. In *Proceedings of the IEEE International Conference on Acoustics, Speech and Signal Processing*, Brisbane, Australia, 2015.
- K. Levin, K. Henry, A. Jansen, and K. Livescu. Fixed-dimensional acoustic embeddings of variable-length segments in low-resource settings. In *Proceedings of the IEEE Automatic Speech Recognition and Understanding Workshop*, Olomouc, Czech Republic, 2013.

A. Jansen, E. Dupoux, S. Goldwater, M. Johnson, S. Khudanpur, K. Church, N. Feldman, H. Hermansky, F. Metze, R. Rose, M. Seltzer, P. Clark, I. McGraw, B. Varadarajan, E. Bennett, B. Borschinger, J. Chiu, E. Dunbar, A. Fourtassi, D. Harwath, C. Lee, K. Levin, A. Norouzian, V. Peddinti, R. Richardson, T. Schatz, and S. Thomas. A summary of the 2012 CLSP workshop on zero resource speech technologies and models of early language acquisition. In *Proceedings of the IEEE International Conference on Acoustics, Speech and Signal Processing*, Vancouver, Canada, 2013.

## Preprints and Manuscripts

K. Levin, F. Roosta, M. Tang, M. W. Mahoney, and C. E. Priebe. Limit theorems for out-of-sample extensions of the adjacency and laplacian spectral embeddings. *Submitted, arXiv:1910.00423*, 2019.

K. Levin and E. Levina. Bootstrapping networks with latent space structure. *Submitted, arXiv:1907.10821*, 2019.

K. Levin, A. Lodhia, and E. Levina. Recovering low-rank structure from multiple networks with unknown edge distributions. *Submitted, arXiv:1906.07265*, 2019.

J. Yoder, L. Chen, H. Pao, E. Bridgeford, K. Levin, D. E. Fishkind, C. E. Priebe, and V. Lyzinski. Vertex nomination: The canonical sampling and the extended spectral nomination schemes. *Submitted, arXiv:1802.04960*, 2018.

K. Levin, A. Athreya, M. Tang, C. E. Priebe, and V. Lyzinski. A central limit theorem for the omnibus embedding. *Submitted, arXiv:1705.09355*, 2017.

## Teaching Experience

- Fall 2019 **Instructor**, *STATS426: Introduction to Theoretical Statistics*, University of Michigan, Department of Statistics.  
Upper-level undergraduate course on mathematical statistics.
- 2017-2019 **Instructor**, *STATS507: Data Analysis using Python*, University of Michigan, Department of Statistics.  
(4 times)  
Masters/Ph.D.-level survey of tools for large-scale data analysis in the Python ecosystem.
- 2016 (twice) **Teaching Assistant**, *EN 550.430: Introduction to Statistics*, Johns Hopkins University, Department of Applied Mathematics and Statistics.  
Upper-level undergraduate/first-year graduate course on mathematical statistics.
- Spring 2014 **Teaching Assistant**, *EN 600.363/463: Introduction to Algorithms*, Johns Hopkins University, Department of Computer Science.  
Upper-level undergraduate/first-year graduate course on analysis of algorithms.

## Presentations

- May, 2020 **SIAM Conference on Mathematics of Data Science Minisymposium on Machine Learning on Data with Low Dimensional Structures, Invited Talk, Title TBA.**

- Sep, 2019 **George Mason University Department of Statistics, Department Seminar**, *Limit theorems for out-of-sample extensions of spectral graph embeddings.*
- Sep, 2019 **University of Maryland College Park Department of Mathematics, Statistics Seminar**, *Limit theorems for out-of-sample extensions of spectral graph embeddings.*
- July, 2019 **Joint Statistical Meeting, Invited Talk**, *Matrix means for network estimation with applications to fMRI data.*
- July, 2019 **New Researchers Conference**, *Bootstrapping networks with latent space structure.*
- May, 2019 **NetSci Statistical Inference in Network Models**, *Testing treatment effects on network topology.*
- May, 2019 **New England Statistics Symposium, Invited Talk**, *Bootstrapping networks with latent space structure.*
- Mar, 2019 **University of Michigan Complex Systems Seminar**, *Recovering low-rank structure from multiple networks with unknown edge distributions.*
- Sep, 2018 **Mahoney Lab, University of California, Berkeley, Invited Talk**, *Out-of-sample extensions for spectral embeddings of graphs.*
- July, 2018 **Joint Statistical Meeting, Contributed Talk**, *Inferring low-rank population structure from multiple network samples.*
- Feb, 2018 **Boston University Department of Mathematics and Statistics, Statistics and Probability Seminar**, *Joint embedding of multiple random dot product graphs.*
- Nov, 2017 **IEEE International Conference on Data Mining, Data-Driven Discovery of Models Workshop**, *A central limit theorem for an omnibus embedding of random dot product graphs.*
- June, 2017 **MIT Lincoln Laboratory, Artificial Intelligence Technology and Systems Group, Invited Talk**, *Recent advances in vertex nomination.*
- May, 2017 **Mahoney Lab, University of California, Berkeley, Invited Talk**, *Recent advances in vertex nomination.*
- May, 2017 **Levina/Zhu Group, University of Michigan, Invited Talk**, *Laplacian eigenmaps from sparse, noisy similarity measurements.*
- Nov, 2015 **Johns Hopkins University Department of Applied Mathematics and Statistics, Student Seminar**, *Laplacian eigenmaps with noisy kernels.*
- Oct, 2014 **Johns Hopkins University Center for Language and Speech Processing, Student Seminar**, *Low-resource fixed-dimensional embeddings of variable-length speech audio segments.*
- Oct, 2013 **Mid-Atlantic Student Colloquium on Speech, Language and Learning**, *Toward faster audio search using context-dependent hashing.*

## █ Awards and Memberships

- 2013 **Best Student Paper**, *IEEE Automatic Speech Recognition and Understanding Workshop.*

**Member**, *American Statistical Association*.

**Member**, *Institute of Mathematical Statistics*.

**Member**, *Bernoulli Society*.

**Member**, *Association for Computing Machinery*.

**Member**, *Institute of Electrical and Electronics Engineers*.

## Professional Service

2016-present Reviewer: the Annals of Statistics, International Conference on Machine Learning, the R Journal, Journal of Computational and Graphical Statistics, Machine Learning, Pattern Recognition Letters, IEEE Pattern Analysis and Machine Intelligence (twice), Multivariate Behavioral Research

2019 Organizer: University of Michigan Department of Statistics Fall Preview Day

2015–2017 Johns Hopkins University Center for Language and Speech Processing Faculty Liason

2014–2016 Johns Hopkins University Computer Science Ph.D. Admissions Committee

## Mentoring

2018-2019 Oversaw two undergraduate statistics students in analyzing neuroscientific data from a study on addiction in a rat model.

2017-present Mentoring early-career domestic graduate student in project on network regression with application to schizophrenia fMRI data.

2018-2019 Oversaw undergraduate statistics student class project to predict schizophrenia diagnoses from fMRI data.

## Computing Skills

**Programming languages:** C/C++, Python, R, MATLAB, LISP, Java.

**High-performance computing:** Hadoop MapReduce, Google TensorFlow, Apache Spark, OpenMP, Message Passing Interface.

## Personal

United States citizen.