ERIC JOHNSON, PH.D.

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RESEARCH PROJECTS AND INTERESTS

Unsupervised Learning — High-Dimensional Data — Biological Data — Statistics

EMBEDR: A Statistical Approach to Dimensionality Reduction

Applying a statistical approach to quality assessment of dimensionality reduction algorithms (DRAs) reveals novel, biologically-relevant structures in scRNA-seq data sets. The approach summarizes embedding quality as p-values allowing for rigorous interpretation of DRA output. Initial findings published in Patterns.

A Principled Approach to scRNA-seq Analysis

A plethora of methods for normalizing, imputing, sorting, and slicing scRNA-seq data have been proposed over the last decade, but there is little consensus around which methods work well. Working with the Mani and Pincus groups and data from a unique set of experiments, we're spending the time to assess the extent to which we can apply and make use of various computational techniques for extracting information from these data sets.

Bayesian Circular-Linear Regression with Regularization

Developing a novel regression technique for modeling circular response variables on linear covariates using a Bayesian hierarchical model. Applications include predicting the time at which biological samples were drawn in order to create technologies capable of diagnosing circadian disorders.

Using Multi-Objective Optimization to Fit Models of *Drosophila* Clock Neurons

Using electrophysiology and RNA-sequencing of DN1 and LNv "clock" neurons in *Drosophila* to fit models at different circadian times with a multi-objective evolutionary algorithm. Data analysis, computer science, and advanced electrophysiological measurements are used to deduce models' structure and parameters. A novel feature extraction algorithm arising from this work was presented at Neuroscience 2019.

WORK AND EDUCATION

Postdoctoral Researcher   Minneapolis, Minnesota
Northwestern / University of Chicago   *April 2022 - Present*
- Developing novel computational techniques for analysis of scRNA-seq data from S. cerevisiae.
- Mentoring graduate students in the Mani and Pincus Groups

Ph.D. in Applied Mathematics   Evanston, Illinois
Northwestern University   *March 2022*
- Thesis: *Principled Analysis of High-Dimensional Data*
- Recipient of Outstanding Teaching Assistant Award in 2018

Master of Science in Applied Mathematics   Evanston, Illinois
Northwestern University   *May 2016*
- Coursework: Differential Equations, Asymptotics, Stochastic Methods, Genetics, Systems Biology

Research Scientist   New York, New York
Holland Lab at NYU   *May 2014 - May 2015*
- Managed, maintained, installed, and calibrated meteorological equipment for climatology experiments.
- Developed novel computational tools to infer wind speeds from infrared and visible images of the sky.

Bachelor of Science *Cum Laude* in Math and Physics   Abu Dhabi, United Arab Emirates
New York University Abu Dhabi   *May 2014*
- One of 150 students from around the world selected to pioneer a new high-caliber academic institution
- Al Khayr Senior Leadership Award Finalist, Student Government Class Rep. & Organizing Committee
- Senior Thesis: Wind-driven upwelling around grounded tabular icebergs
- Coursework: Cell Biology, Computational Physics, Numerical Methods, Complex Analysis

TEACHING EXPERIENCE

What Do Your Data Say? | *April 2020, Fall 2020, Spring 2022*

- A redevelopment of "A Course in Quantitative Biology" into a graduate-level course centered on empirical, computational, and statistical data analysis, primarily with applications to real biological data sets.
- Developed course goals and curriculum, taught in-person and online courses, created course website, wrote course notes, created introductory Python tutorial.
- Taught as an online 5-week bootcamp in April-May 2020 to ~600 students from around the world.

Lead Mathematics Tutor at *The Math Place* | *August 2016 - August 2021*

- Tutored individual Northwestern students in math and physics as part of a free service provided by SPS.
- Maintained tutoring schedule, managed other tutors' hours, developed student intake forms and student progress tracker, interfaced with course instructors to provide information about our services.

A Course in Quantitative Biology | *Fall 2017, 2018; Winter 2020*

- Taught and developed a graduate-level course surveying methods for the design and analysis of quantitative biological experiments.
- Developed assignments in which students replicate key figures from important papers in systems biology, bioinformatics, and genetics.

Teaching Assistant | *September 2016 - May 2017, Winter 2019, Winter 2020*

- Assisted in the instruction of undergraduate courses in calculus, differential equations, and numerical methods, as well as graduate courses on computational neuroscience and analyzing sequencing data.

PUBLICATIONS AND CONFERENCES

Johnson, E. M., Kath, W. & Mani, M. EMBEDR: distinguishing signal from noise in single-cell omics data. *Patterns* **3**, 100443 (2022).

Lee, J.; Lim, C.; Han, T.H.; Andreani, T.; Moye, M.; Curran, J.; **Johnson, E.**; Kath, W.L.; Diekman, C.O.; Lear, B.C.; et al. The E3 Ubiquitin Ligase Adaptor Tango10 Links the Core Circadian Clock to Neuropeptide and Behavioral Rhythms. *Proc. Natl. Acad. Sci. USA* **2021**, *118*, e2110767118.

Johnson, E. M., Kath W., & Mani M. EMBEDR: Separating signal from noise in sc data. Poster presented at: UCI Center for Multiscale Cell Fate Research Early Career Researcher Symposium; 2021 April 14-15; Online.

Johnson, E. M., Kath W., & Mani M. A general strategy for estimating uncertainty in dimensionality reduction reveals scale and structure in scRNA data. Poster presented at: Southeast Center for Mathematics and Biology 3rd Annual Symposium; 2020 Dec 7-10; Online.

Johnson, E. M., Freitag C., & Mani M. What do your data say? Tools for teaching quantitative approaches in the virtual classroom. Workshop presented at the NSF-Simons Center for Quantative Biology's Conference on Quantitative Approaches in Biology in collaboration with the Searle Center for Advancing Teaching and Learning; 2020 November; Online.

Johnson, E. M., Kath W. A feature extraction method for noisy electrophysiology data. Poster presented at: Neuroscience; 2019 Oct 19-23; Chicago, IL.

Stern, A. A., **Johnson, E. M.**, Holland, D. M., Wagner, T. J. W., Wadhams, P., Bates, R., . . . Tremblay, J.-E. (2015). Wind-driven upwelling around grounded tabular icebergs. Journal of Geophysical Research: Oceans, 120(8), 5820âĂŞ5835.

SKILLS

Languages	English, French
Programming Languages	Python, MATLAB, R, C++, MPI, CUDA, CRBasic