Noah Guzmán

Curriculum Vitæ

nguzman313@gmail.com 714-659-0043
LinkedIn Google Scholar GitHub

Education

Aug. 2019 – present **Ph.D. Student in Computation and Neural Systems** California Institute of Technology
Thesis Advisor: Dean Mobbs
No degree expected

Sept. 2016 – May 2019 **Combined B.Sc./M.Sc. in Neuroscience, Minor in Mathematics** Brandeis University
Thesis: *Degeneracy, neuromodulation, and phase response properties in model pyloric neurons*
Thesis Advisor: Eve Marder

Research Experience

May 2020 – present **Ph.D. Student, The Fear Lab** California Institute of Technology

- Developed Bayesian inverse reinforcement learning algorithms to investigate ecologically realistic human decision-making using the probabilistic programming language Stan and its Python interface CmdStan.
- Designed experimental human decision-making tasks in the form of browser-based video games implemented using HTML and 2D computer graphics in the p5.js JavaScript library. Deployed the task websites as Google Firebase apps and collected data to Google Firestore databases.
- Recruiting hundreds of participants for experiments using the Prolific platform.
- Collecting survey data from hundreds of experimental subjects using the SurveyJS JavaScript library, Google Forms, and the Qualtrics platform.
- Constructing theory-driven hierarchical Bayesian models of human behavioral data and fitting the models using Hamiltonian Monte Carlo methods in Stan and CmdStan.

Jan. 2020 – Apr. 2020 **Rotation Student, Lois Lab** California Institute of Technology

- Performed spectral analysis of hundreds of hours of zebra finch song recordings in Python and the software program Sound Analysis Pro.
- Employed Python implementations of dimensionality reduction algorithms (UMAP, tSNE) and clustering algorithms (k-NN, HDBSCAN) to visualize and quantify changes in zebra finch song syllables following reversible brain lesions and sensory input perturbations.

Sept. 2019 – Dec. 2019 **Rotation Student, Hong Lab** California Institute of Technology

- Performed hundreds of microsurgical preparations of *Drosophila melanogaster* for brain imaging during olfaction experiments.
- Acquired hours of two-photon calcium imaging data of *Drosophila melanogaster* antennal lobe response to odor mixtures.
- Analyzed calcium imaging data using the Python toolbox CaImAn.

Jan. 2017 – Aug. 2019 **Research Assistant, Marder Lab** Brandeis University

- Developed a novel metric to quantify degeneracy in both empirical and theoretical dynamical systems using time-delay embedding and mutual information.
- Designed single-compartment and multicompartment conductance-based models of crustacean neurons and central pattern generators. Programmed implementations of these models in Java, Python, and Julia. Conducted computational stability, bifurcation, and phase-response analyses of these models in Java and Python.
- Conducted parameter estimation of thousands of high-dimensional dynamical systems models to match model behavior to empirical data using a genetic algorithm implemented with concurrent programming in Java.

Aug. 2015 – Aug. 2016 **Research Assistant, Tsai Lab** California State University Long Beach

- Conducted dozens of semi-quantitative 1D and 2D Western blots using image processing software Fiji to search for sexually dimorphic protein expression in mouse brain tissue samples and carried out MALDI-TOF mass spectrometry on candidate proteins.
- Performed dozens of quantitative protein assays (BSA, Lowry, Bradford, ELISA) on mouse brain tissue samples.

Teaching Experience

Winter Term, 2021–2022 **Bi 23: A Visual Introduction to Dynamical Neuroscience** California Institute of Technology

This course was a one-time offering geared toward both undergraduate and graduate biology students hoping to learn more about the use of dynamical systems theory in neuroscience. Assuming only a minimal mathematical background, the curriculum focused on building intuition from visual diagrams rather than symbolic mathematics. After covering a foundation in basic concepts from dynamical systems theory, students were introduced to its application in dynamical modeling in neuroscience from the cellular to the network level. Students were also introduced to ideas from the philosophy of biology and the philosophy of mathematical modeling in the sciences. I designed, developed, and taught the course curriculum in addition to leading student discussions.

Publications

Theses

1. **Guzmán, N.** (2019). Degeneracy, neuromodulation, and phase response properties in model pyloric neurons. Retrieved from `https://hdl.handle.net/10192/36774`.

Journal Articles

2. Mobbs, D., Wise, T., Suthana, N., **Guzmán, N.**, Kriegeskorte, N., & Leibo, J. Z. (2021). Promises and challenges of human computational ethology. *Neuron, 109*(14), 2224–2238.

Conference Posters

3. **Guzmán, N.**, Alonso, L., & Marder, E. (2018). Exploring robustness in small circuits of conductance based model neurons using landscape optimization, San Diego, CA: Society for Neuroscience. (313.03)

Awards

May 2019 **John Lisman '66 Memorial Award for Excellence in Neuroscience Research** Brandeis University

The John Lisman '66 Memorial Award for Excellence in Neuroscience Research is a prize dedicated to the memory of Brandeis neuroscientist Dr. John Lisman. The prize is awarded to undergraduate students in neuroscience who have made outstanding contributions to the field in the course of their honors thesis research.

Fall 2017 - Summer 2019 **Computational Neuroscience Traineeship ($ 22,000)** National Institutes of Health

The Computational Neuroscience Training Program is a competitive grant from the National Institutes of Health (NIH) awarded to undergraduate students performing theoretical and computational work in the neurosciences at Brandeis University. (Advisor: Eve Marder)

Fall 2015 - Summer 2016 **CSULB BUILD Associates Program ($ 12,000)** National Institutes of Health

The BUILD Associates Program at California State University Long Beach is a competitive research training program and grant funded by the National Institutes of Health (NIH). Students awarded the grant are paired with a faculty mentor for a year-long intensive research training program. (Mentor: Houng-Wei Tsai)

Skills

Programming and Markup Languages

Java, Python (Pandas, CmdStan, Scikit-learn, Numpy, PyTorch, Tensorflow, sqlite3, Matplotlib), Stan, Julia (Flux, Turing, Plots, Plotly), HTML, JavaScript (p5.js, SurveyJS), Mathematica, MATLAB, Shell scripting (Bash, SLURM), SQLite, Idyll, LaTeX, Markdown.

Software and Services

Linux, Unity, Fiji, Sound Analysis Pro, Microsoft Office Suite, Google Firebase, Amazon Web Services, Git, Qualtrics, Prolific.

Mathematics and Statistics

linear algebra, multivariable calculus, group theory, topology, nonlinear dynamical systems theory, time delay embedding, regression analysis, maximum likelihood estimation, bootstrapping, Bayesian statistics, hierarchical modeling, amortized inference, fractal and multifractal analysis, conductance-based modeling, genetic algorithms, support vector machines, deep neural networks, recurrent neural networks, reinforcement learning, stochastic processes, dimensionality reduction algorithms, clustering algorithms, decision trees, ensemble methods.

Other Skills

Spanish (conversational), graphic/UX/UI design (Figma, Inkscape, TikZ)