Lane McIntosh

Contact Information

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Research Interests

Theoretical Neuroscience. Searching for general principles that underlie early sensory coding. Information processing in single neurons and neural circuits, information theory and far-from-equilibrium statistical mechanics.

Education

Stanford University, Stanford, California

Ph.D. Student, Neurosciences (September 2012 - present)

Mentor: Stephen Baccus (Department of Neurobiology)
Co-Mentor: Surya Ganguli (Department of Applied Physics)
Committee: Tom Clandinin, William Newsome

University of Hawaii, Honolulu, Hawaii

M.A., Mathematics (May 2012)

Thesis: Information Processing and Energy Dissipation in Neurons
Committee: Susanne Still, George Wilkens, JB Nation, Robert Little; GPA 3.7/4.0

University of Chicago, Chicago, Illinois

B.A., Biological Sciences (Neurobiology), Computational Neuroscience (June 2010)

General Honors; Dean's List 2006-2010, GPA 3.53/4.00

Honors and Awards

Mind, Brain, and Computation Traineeship (Stanford University, 2013-14)

National Science Foundation IGERT Graduate Fellowship (NSF, 2013-14)

Departmental Merit Scholarship (University of Hawaii, 2012)

National Science Foundation SUPER-M Graduate Fellowship (NSF, 2011-12)

Kotaro Kodama Scholarship (University of Hawaii, 2011-12)

Graduate Teaching Fellowship (University of Hawaii, 2010-11)

2008-2009 Innovative Funding Strategy Award (University of Chicago, 2009)

Lerman-Neubauer Junior Teaching Fellowship (University of Chicago, 2008)

NIH Neuroscience and Neuroengineering Fellowship (National Institutes of Health, 2008)

Bank of America Mathematics Award (Bank of America in Southern California, 2006)

President's Gold Educational Excellence Award (White House, 2006)

California Scholarship Federation Gold Seal Bearer (CSF, 2006)

Advanced Placement Scholar with Distinction (College Board, 2006)

Valedictorian (Santa Fe Christian High School, 2006)

Testing

GRE	Quantitative	800/800	94^{th} percentile
	Verbal	700/800	97^{th} percentile
	Analytical	6.0/6.0	99^{th} percentile

Academic Experience

Stanford Neurosciences — Stanford, CA

Baccus Laboratory — *January, 2013 - Present*

Dynamic predictive coding is the idea that, for a given stimulus point, neural circuits use nearby points in space and time to predict the local intensity and then adapt to that prediction. I am working to make this idea more rigorous both from theoretical and experimental perspectives. In the realm of theory, I am working with Surya Ganguli to derive filters that optimally maximize predictive information in a neural system. Experimentally, I aim to test hypotheses about what lateral inhibition is sufficient for dynamic predictive coding.

Stanford Neurosciences — Stanford, CA

Ganguli Theoretical Neuroscience Group — *August, 2012 - December, 2012*

The concept that neurons maximize mutual information to increase their dynamic range and information capacity dates back to the 1980s. However, although feedback is ubiquitous in the brain, this "infomax" principle has yet to be generalized to channels with feedback. During this rotation project, I worked on generalizing infomax to cases with feedback.

UH Department of Mathematics — Honolulu, HI

Machine Learning Group — *August, 2010 - August, 2012*

Includes graduate level coursework in mathematics and thesis research. Coursework has focused on information theory, stochastic processes, graph theory, and traditional graduate algebra and analysis.

University of Chicago — Chicago, IL

MacLean Computational Neuroscience Lab — *March, 2010 - August, 2010*

Research on neural circuits in Jason MacLean's 2-photon lab; developed an optogenetics software platform and electrophysiological cell classifier.

Institute for Advanced Study — Princeton, NJ

Simons Center for Systems Biology — *June, 2009 - September, 2009*

Research in bioinformatics looking at SNP-linkages in populations of sub-Saharan Africa; developed data mining software for gene copy number variation.

National Institutes of Health — Chicago, IL

Neuroscience and Neuroengineering Summer Fellowship — *June, 2008 - August, 2008*

Research in David Gallo's memory lab; analyzed fMRI data collected at Harvard and found cerebellar involvement in and coordination of episodic memory tasks.

Biotechnology Experience

Prometheus Technologies — San Diego, CA

Co-founder — *December, 2010 - January, 2012*

Developed new ways of delivering personal genomic information to the non-sequenced public via linkages in SNPs underlying unambiguous phenotypes.

Archinoetics — Honolulu, HI

Internship — *September, 2010 - September, 2012*

Provided neurobiology expertise for federal DoD- and Navy-funded contracts related to brain-computer interfaces and monitoring mental states. Projects included writing a review on the physiological dynamics of stress, creating better diagnostic tools for Post Traumatic Stress Disorder, and developing image processing components of in-house computer vision software.

Cytori Therapeutics — San Diego, CA

Regenerative Cell Technology Internship — *June, 2006 - August, 2007*

Research in adult stem cell differentiation; experimented with RNAi and super-cooling techniques.

Submitted Papers

Greenbaum B, Chan C, Naqvi A, McIntosh L, Levine A. A Novel Directional Method to Assess Selection in Copy Number Variants.

Papers in Preparation

McIntosh L, Still, S. Thermodynamics of Prediction in Single Neurons.

McIntosh L, Matthews R. Dynamics of Stress: Review.

Presentations

McIntosh L, Brown J. Graph Theory and the Art of Searching. HCTM Conference. (Scheduled for February, 2012)

McIntosh L, Gallo D. Memory Retrieval and Monitoring in the Cerebellum. NIH Research Brief and Presentation. (August, 2008)

Professional Memberships

American Mathematical Society

NSF Center for Science of Information

Teaching

MATH 135: Precalculus, University of Hawaii **July, 2012 - August, 2012**
Instructor
Taught a precalculus class of 35 students.

MATH 140: Precalculus, University of Hawaii **August, 2010 - May, 2011**
Teaching Assistant
Involved lecturing about 60 undergrads twice a week in precalculus.

BIOS 20244: Biophysics and Chemical Biology, UChicago **March, 2008 - June, 2008**
Lerman-Neubauer Junior Teaching Fellow
Involved some lecturing; last class in the advanced AP5 undergraduate biology sequence.

Programming Languages

High Proficiency: Python, MATLAB
Intermediate Proficiency: R, Perl, Java, Ruby