Lane McIntosh

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RESEARCH INTERESTS

Theoretical Neuroscience and Machine Learning. Searching for general principles that underlie neural organization and encoding. Information processing in single neurons and neural circuits, information theory and far-from-equilibrium statistical mechanics.

EDUCATION

Ph.D., Neurosciences	Stanford University	2012-present
Ph.D. Minor, Computer Science	Stanford University	2012-present
M.A., Mathematics	University of Hawaii	2010-2012
B.A., Biological Sciences, Computational Neuroscience	University of Chicago	2006-2010

PROGRAMMING

Python, CUDA C/C++, MATLAB, R

SELECTED HONORS

Top 10% Poster Award for *A deep learning model of the retina*	Stanford University	2015
NSF Mind, Brain, and Computation Graduate Fellowship	Stanford University	2013-present
Departmental Merit Scholarship	University of Hawaii	2012
NSF SUPER-M Graduate Fellowship	University of Hawaii	2011-2012
Kotaro Kodama Scholarship	University of Hawaii	2011-2012
Graduate Teaching Fellowship	University of Hawaii	2010-2011
Innovative Funding Strategy Award	University of Chicago	2009
Lerman-Neubauer Junior Teaching Fellowship	University of Chicago	2008
NIH Neuroscience and Neuroengineering Fellowship	University of Chicago	2008
Bank of America Mathematics Award	SFC High School	2006
Valedictorian	SFC High School	2006

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., and Maheswaranathan, N. (2015, March). A deep learning model of the retina. Poster presented at the Stanford Computer Science Department Convolutional Neural Networks Winter Poster Session, Stanford, CA. Top 10

Ballard, I.* and McIntosh, L*. (2014, December). Video-based event recognition. Poster presented at the Stanford Computer Science Department Artificial Intelligence Fall Poster Session, Stanford, CA. *Co-first author.

McIntosh, L., Kastner, D., Manu, M., and Baccus, S. (2014, September). Efficient coding in nonlinear systems. Poster presented at the annual Stanford Biosciences Student Association Poster Session, Stanford, CA.

McIntosh, L. (2013, December). Learning predictive filters. Poster presented at the annual Stanford Machine Learning Fall Poster Session, Stanford, CA.

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

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

PROFESSIONAL MEMBERSHIPS	American Mathematical Society			
	NSF Center for Science of Information			
TEACHING	Math Tools for Neuroscientists	Lecturer	Stanford University	2015
	Introduction to Perception	TA	Stanford University	2014
	Precalculus	Lectuer	University of Hawaii	2012
	Precalculus	TA	University of Hawaii	2010-2011
	Biophysics and Chemical Biology	TA	University of Chicago	2008