Lane McIntosh

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RESEARCH INTERESTS

Deep learning and theoretical neuroscience. Searching for general principles that underlie neural organization and encoding, and translating those principles into better computer vision systems.

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

SELECTED HONORS

Ruth L. Kirschstein National Research Service Award	NIH	2016-present
NSF Mind, Brain, and Computation Graduate Fellowship	Stanford University	2013-2016
NSF SUPER-M Graduate Fellowship	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

PhD Candidate, Stanford Neurosciences — Stanford, CA
Baccus and Ganguli Labs — January, 2013 - Present
Current research involves using deep learning models for systems identification in non-parametric, natural conditions. For neural circuits in early visual pathways, we recover unobserved biological components, use probabilistic methods to recover the scaling of noise from single-trial data, and demonstrate that principles of sequential efficient coding are at work.

MA student, UH Department of Mathematics — Honolulu, HI
Machine Learning Group (Advisor: Susanne Still) — August, 2010 - August, 2012
Includes graduate level coursework in mathematics and thesis research. Coursework focused on information theory, stochastic processes, graph theory, and traditional graduate algebra and analysis. MA thesis involved connecting thermodynamic efficiency to efficiencies in information processing in adapting model neurons.

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 (Advisor: Arnold Levine) — 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
Gallo Lab — 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.

Papers	McIntosh L*, Maheswaranathan N*, Nayebi A, Ganguli S, Baccus S. Deep Learning Models of the Retinal Response to Natural Scenes. To appear in *Neural Information Processing Systems* 2016.

McIntosh L*, Maheswaranathan N*, Nayebi A, Ganguli S, Baccus S. Deep Learning Models of the Retinal Response to Natural Scenes. To appear in *Neural Information Processing Systems* 2016.

Manu M*, McIntosh L*, Kastner D, Naecker B, Baccus S. Distinct spatial scales of synchronous inhibition increase information transmission in the retina. (In preparation.)

McIntosh L, Still, S. Thermodynamics of Prediction in Single Neurons. (In preparation.)

Selected Posters and Presentations

McIntosh, Lane*, Niru Maheswaranathan*, Aran Nayebi, Surya Ganguli, and Stephen Baccus. (planned: 2016, November). Deep Learning Models of the Retinal Response to Natural Scenes. Society for Neuroscience nanosymposium talk. San Diego, CA.

McIntosh, Lane. (2016, October). Understanding uncertainty in neural systems. **Presented** at Workshop on Machine Learning and Computer Vision talk and tutorial. Janelia Research Campus, Ashburn, VA.

McIntosh, Lane. (2016, June). Convolutional neural network models of the first stages of biological vision. IEEE Signal Processing Society **invited talk**, Sunnyvale, CA.

McIntosh, Lane*, Niru Maheswaranathan*, Aran Nayebi, Surya Ganguli, and Stephen Baccus. (2016, February). Convolutional Neural Network Models of the Retina. **Poster** at Computational and Systems Neuroscience, Salt Lake City, UT.

McIntosh, Lane*, Niru Maheswaranathan*, Aran Nayebi, Surya Ganguli, and Stephen Baccus. (2016, February). Deep Learning Models of the Retinal Response to Natural Scenes. **Poster** at Stanford Center for Image Systems Engineering Industry Affiliates Conference, Stanford, CA. **NVIDIA Best Poster Award**.

McIntosh, Lane, Mihai Manu, David Kastner, Benjamin Naecker, and Stephen Baccus. (2015, October). Distinct Inhibitory Spatial Scales Improve Information Transmission in the Retina. **Poster** at Society for Neuroscience, Chicago, IL.

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% poster award**.

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. **Presented** at HCTM Conference.

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

Selected Teaching

CS231n Conv. Neural Networks	TA	Stanford University	2016
Math Tools for Neuroscientists	Lecturer	Stanford University	2015, 2016
Introduction to Perception	TA	Stanford University	2014-2016
Precalculus	Lecturer	University of Hawaii	2012
Biophysics and Chemical Biology	TA	University of Chicago	2008