Ari Morcos

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EDUCATION

Harvard University **2011 — Present**
Ph.D. candidate in neuroscience
Anticipated thesis defense: May 2016

University of California, San Diego **2008 — 2011**
B.S., Physiology and Neuroscience

RESEARCH EXPERIENCE

Ph.D. research

Harvard Medical School, laboratory of Dr. Christopher Harvey **2012 – Present**

Primary thesis work (completed and under review)
Developed a novel evidence accumulation task for head-restrained mice in virtual reality and used calcium imaging of activity in large neuronal populations along with advanced and new computational analyses to study the neuronal population activity dynamics underlying decision-making. Using machine learning approaches that had not been applied to neuroscience data sets previously, we analyzed the dynamics of population activity during single trials and identified multiple major features of the population activity, including a distributed code among heterogeneous individual neurons, history signals for past events lasting seconds, and structured trial-trial variability that was predictive of past and future activity patterns. Together our results provide data that contradict the long-standing models of evidence accumulation and that propose a novel model of computation based on large-scale neuronal population dynamics.

Current work (neuroscience)
Modeling neural population activity dynamics using artificial recurrent neural networks (RNNs), and probing the flexibility of such networks and their generalization to novel classification tasks.

Non-linear manifold learning using autoencoders to determine how task-relevant information is represented in the activity of neuronal populations in cortex.

Using convolutional neural networks with spatial transformers to motion correct *in vivo* two-photon calcium images.

Current work (machine learning)
Training LSTM RNNs to extract character relationships from literary summaries with the goal of automatically generating semantic networks.

Undergraduate research

Salk Institute for Biological Studies, laboratory of Fred H. Gage **01/2009 – 12/2010**
Research Assistant
Researched the role of REST in adult neurogenesis

AWARDS, HONORS, AND FELLOWSHIPS

Stuart and Victoria Quan Pre-Doctoral Fellowship **2013—Present**
Department of Neurobiology, Harvard Medical School

NSF Graduate Research Fellowship Honorable Mention **2013**

Amylin Pharmaceuticals Research Scholar **2009—2010**

Howard Hughes Summer Research Fellow **2009**

Alliance for Affordable Services Scholar **2009**

PUBLICATIONS AND PRESENTATIONS

Morcos AS and Harvey CD. "History-dependent variability in population dynamics during evidence accumulation in cortex." Manuscript under review.

Kim HJ, Denli AM, Wright R, Baul TD, Clemenson GD, **Morcos AS**, Zhao C, Schafer ST, Gage FH, and Kagalwala MN, "REST Regulates Non-Cell-Autonomous Neuronal Differentiation and Maturation of Neural Progenitor Cells via Secretogranin II," *J. Neurosci.*, vol. 35, no. 44, pp. 14872–14884, 2015.

Morcos AS, Kagalwala MN, Denli AM, Gage FH. "The role of REST/NRSF in adult neurogenesis." Program No. 31.4. 2010 Neuroscience Meeting Planner. San Diego, CA: Society for Neuroscience, 2010. Online.

Morcos AS. "Understanding the Protein-Protein Interplay of NRSF (REST) In Regulating Transcription." UCSD Undergraduate Research Conference, San Diego, CA, 2009.

Morcos AS. "Mechanisms and applications of adult neurogenesis." *Saltman Quarterly* 6 (2009): 35-36.

TEACHING EXPERIENCE

Harvard Medical School **2012**
Teaching assistant, MATLAB/Quantitative Methods Bootcamp
Brief introduction to MATLAB/programming and statistics for incoming graduate students

RELEVANT COURSEWORK

NB204, Neurophysiology of Central Circuits, Harvard University 2012

CS281, Advanced Machine Learning, Harvard University 2015

RELEVANT ONLINE COURSEWORK

Machine Learning, Stanford via Coursera 2014

Mining Massive Datasets, Stanford via Coursera 2014

Algorithms: Design and Analysis, Part I, Stanford via Coursera 2014

Databases, Stanford Online 2015

Intro to Theoretical Computer Science, Udacity 2015

Introduction to Big Data with Apache Spark, Berkeley via edX 2015

Scaleable Machine Learning, Berkeley via edX 2015

REFERENCES

Available upon request.