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 for publication at *Nature*)
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.

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 at *Nature*.

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.