JAY A. HENNIG

jhennig@cmu.edu   214-803-3076

mobeets.github.io   github.com/mobeets

EDUCATION

Carnegie Mellon University (CMU)   Aug 2015 - present
PhD student in Neural Computation and Machine Learning   *Overall GPA: 4.0/4.0*
Advisors: Byron Yu, Steven Chase

University of Texas at Austin (UT)   Aug 2008 - May 2011
B.S. Pure Mathematics, with highest honors   *Overall GPA: 3.99/4.0, Major GPA: 4.0/4.0*

TECHNICAL STRENGTHS

Programming/Software	Python, MATLAB, C++, Javascript, CSS, SQL, Git
Machine Learning	dimensionality reduction (PCA, FA); neural networks (VAEs, LSTMs); convex optimization; evolutionary algorithms

RESEARCH AND PROFESSIONAL EXPERIENCE

Graduate research   Aug 2015 - present
Advisors: Byron Yu and Steven Chase   *Carnegie Mellon University, Pittsburgh, PA*

· Topic: Studying learning and skill acquisition in motor cortex using brain-machine interfaces
· Skills: dimensionality reduction; optimization; data analysis and visualization

Research assistant   May 2009 - Aug 2011; May 2013 - Aug 2015
Advisor: Alexander Huk   *University of Texas at Austin, Austin, TX*

· Topic: Studying visual motion and decision making in visual area MT and decision area LIP

Software developer and consultant   Nov 2011 - May 2013
Biarri Optimisation   *Melbourne, VIC, Australia*

· Designed a linear programming formulation and developed a working implementation in C++ and Python to optimize the capacity of existing production facilities and the locations of new facilities. This tool was used by Australia Post, Australia's national postal service, to plan upgrades to their existing postal network.
· Contributed to development of a software tool, built in C++, for designing fiber optic networks to minimize materials cost. Used by NBN Co. as part of an Australian government project to provide high-speed Internet to 98% of the nation.

Research assistant   2005 - 2009
Advisor: Alexander Pertsemlidis   *UT Southwestern Medical Center, Dallas, TX*

· Using PostgreSQL and php, I designed and implemented a relational database and web interface for storing and accessing microRNA target prediction results and exon/intron boundaries in human, mouse, and rat genomes.

PUBLICATIONS

Constraints on neural redundancy   doi: 10.7554/eLife.36774
Hennig, J.A., Golub, M.D., ..., Batista, A.P., Yu, B.M., Chase, S.M.
eLife, 7 (2018): e36774.

- Summary: Millions of neurons in the brain control the activity of tens of muscles in the arm, meaning neural activity is redundant. We compared various hypotheses for how the brain deals with this redundancy by recording in primary motor cortex while subjects performed a brain-computer interface task.
- Roles: data analysis, fitting, and visualization; manuscript writing and editing

New neural activity patterns emerge with long-term learning doi: 10.1073/pnas.1820296116
Oby, E.R., Golub, M.D., Hennig, J.A., ..., Batista, A.P., Yu, B.M., Chase, S.M.
Proceedings of the National Academy of Sciences, 116.30 (2019): 15210-15215.

- Summary: We establish that new neural activity patterns emerge with learning, providing evidence that the formation of new patterns of neural population activity can underlie the learning of new skills.
- Roles: data analysis and visualization; manuscript writing and editing

A Classifying Variational Autoencoder with Application to Polyphonic Music Generation
Hennig, J.A., Umakantha, A. Williamson, R. C.
arXiv preprint arXiv:1711.07050

- Summary: We augment a neural network known as a variational autoencoder (VAE) to classify the observed data while also learning its latent representation. We show that when this network is combined with an LSTM and used to generate music, the network plays fewer incorrect notes than a standard VAE+LSTM.
- Roles: model fitting and visualization; manuscript writing and editing

A Distinct Mechanism of Temporal Integration for Motion through Depth doi: 10.1523/JNEUROSCI.0032-15.2015
Katz, L.N., Hennig, J.A., Cormack, L.K., Huk, A.C.
The Journal of Neuroscience. 35(28), 10212-10216.

- Summary: We compare the time-varying improvements in sensitivity during motion discrimination tasks in 2D and 3D, and find that the two are remarkably similar, however with a lower signal-to-noise ratio in 3D.
- Roles: data analysis, fitting, and visualization; manuscript writing and editing

Signal Multiplexing and Single-Neuron Computations in Lateral Intraparietal Area During Decision-Making doi: 10.1523/JNEUROSCI.2984-12.2013
Meister, M.LR., Hennig, J.A., Huk, A.C.
The Journal of Neuroscience, 33(6), 2254-2267.

- Summary: LIP cell responses simultaneously carry decision signals and decision-irrelevant sensory signals, and response types show a broader range of response motifs than previously considered.
- Roles: data analysis and visualization, in MATLAB; calculated time-varying choice probabilities and clustering of LIP response motifs

PRESENTATIONS

Neural Signal Processing: Introduction to Clustering [guest lecture]
Byron Yu's Neural Signal Processing graduate course (42-590/18-699) *CMU, Spring 2019*

- Topics covered: k-means, Gaussian mixture model

Constraints on neural redundancy [talk]
- Carnegie Mellon Center for Neural Basis of Cognition Retreat 2019

Predicting neural activity in behaviorally irrelevant dimensions [poster]

· Computational and Systems Neuroscience (Cosyne) 2016
· Society for Neuroscience Conference (SfN) 2016

Differential temporal integration of 2d and 3d motion [poster]

· UT Austin INS Neuroscience Symposium, 2015

Neural coding and decision making [talk]

· Melbourne Maths and Sciences Meetup, 2013

The aperture problem in three dimensions [poster]

· Workshop on Natural Environments Tasks and Intelligence (NETI), 2010
· Vision Sciences Society Conference (VSS), 2010

ACADEMIC ACHIEVEMENTS

McClelland Prize: Outstanding Paper Award for *Constraints on neural redundancy*, Center for the Neural Basis of Cognition (CMU, May 2019)

Andrew Carnegie Prize in Mind and Brain Sciences Fellowship (CMU, October 2018)

2nd place (with travel award) in the Qualcomm Neurohackathon (CMU, May 2016)

Presidential Fellowship in the Life Sciences, Richard King Mellon Foundation (CMU, 2015-2016)

Phi Beta Kappa (UT, 2011)

Valedictorian of Booker T Washington High School (Dallas, TX, 2007)

EXTRACURRICULAR

PhD Admissions Committee member, Machine Learning Department (CMU, 2020)

University of Pittsburgh Gamelan Ensemble, a music ensemble performing traditional and modern Javanese gamelan music (2017, 2019)

Mentor to a Computer Science undergraduate (CMU, 2019)

@tweeprint, a Twitter account archiving academic paper summaries called 'tweeprints' (2019-present)
https://twitter.com/tweeprint

Paper Trails, a bi-monthly newsletter (100+ subscribers) relating recent scientific research to non-scientific readers (2018)
https://mobeets.github.io/paper-trails/

mpm, a package manager for Matlab that I developed and maintain (2018-present)
https://github.com/mobeets/mpm

Speak Neuron, an educational comic introduction to neural coding that I wrote and illustrated (2011-2014)
https://mobeets.github.io/speak-neuron/

Campus Movie Fest's Best Drama for "The Usual", a ten-minute short film I wrote and directed (Tufts University; 2008)

NFAA YoungArts winner in Writing/Non-fiction (2007)

Amateur radio operator (morse code and general license; 2000-present)