JAY HENNIG

jhennig@cmu.edu
214-803-3076

mobeets.github.io
github.com/mobeets

Education

Ph.D. student in Neural Computation and Machine Learning (2015 – present)
Machine Learning Dept. & Center for Neural Basis of Cognition, Carnegie Mellon University (CMU)
Advisors: Byron Yu, Steven Chase

B.S. in Pure Mathematics, with highest honors (2011)
University of Texas at Austin (UT)
Major GPA: 4.0/4.0; Overall GPA: 3.99/4.0

Research and Professional Experience

Graduate research (2015 – present)
Labs of Byron Yu and Steven Chase (Yu/Chase Lab)
Carnegie Mellon University; Pittsburgh, PA
- *Topic:* Studying learning and skill acquisition in motor cortex using brain-machine interfaces
- *Skills:* dimensionality reduction (PCA, FA); optimization (linear/ quadratic programs, evolutionary algorithms); data analysis and visualization (Python, Matlab)

Research assistant (2009 – 2011; 2013 – 2015)
Vision and Decision Lab, P.I. Dr. Alexander Huk (Huk Lab)
Center for Perceptual Systems
University of Texas at Austin; Austin, TX

Software developer and optimization consultant (2011 – 2013)
Biarri Optimisation, Biarri Networks
Melbourne, VIC, Australia

Research assistant (2005 – 2009)
Bioinformatics Lab, P.I. Dr. Alexander Pertsemlidis
UT Southwestern Medical Center; Dallas, TX

Relevant skills

- **Programming languages:** Expert in Python and Matlab; experienced with C++, Javascript, CSS, and SQL.
- **Machine Learning:** dimensionality reduction (PCA, FA); neural networks (VAEs, LSTMs); convex optimization; evolutionary algorithms

Publications

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

- *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

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

- *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 (Huk Lab, 2015)
Katz, L.N., Hennig, J.A., Cormack, L.K., Huk, A.C. (2015).
The Journal of Neuroscience. 35(28), 10212-10216. doi: 10.1523/JNEUROSCI.0032-15.2015. [full article]

- *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

<u>Signal Multiplexing and Single-Neuron Computations in Lateral Intraparietal Area During Decision-Making</u> (Huk Lab, 2010 – 2012)
Meister, M.LR. Hennig, J.A., Huk, A.C. (2013).
The Journal of Neuroscience, 33(6), 2254-2267. doi: 10.1523/ JNEUROSCI.2984-12.2013. [full article]

- *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

Predicting neural activity in behaviorally irrelevant dimensions [poster]

- Cosyne, 2016
- Society for Neuroscience Conference, 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 (VSS), 2010

Relevant Professional Projects

<u>Software development</u> (Biarri Optimisation, 2011 – 2013)

- *Summary:* I 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.

<u>Database and UI development</u> (Pertsemlidis Lab, 2008 – 2009)
- *Summary:* 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.

Academic Honors and Achievements

- 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)
- York-MITACS Vision Science Summer School York University (Toronto, ON; 2010)
- Valedictorian Scholarship (UT; 2008)
- Programming Leader, Association for Computing Machinery at Tufts (Tufts University; 2008)
- Valedictorian of Booker T Washington High School (Dallas, TX; 2007)

Extracurricular Achievements

- University of Pittsburgh Gamelan Ensemble (2017, 2019)
- Mentor to a Computer Science undergraduate (CMU; 2019)
- *Paper Trails,* a bi-monthly newsletter relating recent scientific research to non-scientific readers (https://mobeets.github.io/paper-trails/) (100+ subscribers; 2018 – present)
- *mpm*, a package manager for Matlab that I developed and maintain (https://github.com/mobeets/mpm) (2018 – present)
- *Speak Neuron,* an educational comic introduction to neural coding that I wrote and illustrated (https://mobeets.github.io/speak-neuron/) (2011 – 2014)
- 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, call sign KD5LXN (morse code and general license; 2000 – present)