Sean Bittner

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EDUCATION

Columbia University, New York, New York, USA

- Ph.D., Neurobiology and Behavior — Aug 2016 – May 2021 (expected)
  - Focus: Machine learning, theoretical neuroscience.
  - Advisor: John Cunningham, Cumulative GPA: 3.95 / 4.0
- M.Phil., M.A., Neurobiology and Behavior — Aug 2016 – May 2019

Carnegie Mellon University, Pittsburgh, Pennsylvania, USA

- B.S., Electrical and Computer Engineering — Aug 2012 – May 2016
  - Minor in Neural Computation, Cumulative GPA: 3.80 / 4.00

RESEARCH EXPERIENCE

Center for Theoretical Neuroscience, Columbia University

- Ph.D. Candidate, Neurobiology and Behavior — Feb 2019 – present
  - Developed novel method enabling statistical inference in theoretical neuroscience: emergent property inference (EPI). Enhanced theories of neural computation with EPI.
    - Supervisor: John Cunningham
- Ph.D. Student, Neurobiology and Behavior — Aug 2016 – Feb 2019
  - Produced a novel two-network architecture, exponential family networks (EFNs), for learning statistical *models* rather than single distributions as in traditional VI.
    - Supervisor: John Cunningham
  - Evaluated dynamical systems hypotheses of neural population activity in motor cortex during cyclic pedaling using a novel trajectory prediction algorithm and RNNs.
    - Supervisors: John Cunningham, Larry Abbott, Mark Churchland

ECE Department, Carnegie Mellon University

- Undergraduate Research Assistant — May 2014 – Aug 2016
  - Characterized population activity structure according to neuron-type composition.
    - Supervisors: Byron Yu, Steven Chase, and Matthew Smith
  - Produced fast algorithm for connectivity inference from calcium fluorescence activity.
    - Supervisor: Jelena Kovačević

AWARDS & SCHOLARSHIPS

- Methods in Comp Neuro Course Scholarship - Marine Biological Laboratory — Jul 2018 – Aug 2018
- International Conference on Machine Learning Travel Award — Aug 2017
- National Science Foundation Graduate Research Fellowship — Aug 2016 - May 2020
- Frank J Marshall Scholar Award - CMU, ECE — May 2016
  Awarded to a graduating senior demonstrating outstanding scholastic and research achievement.
- Undergraduate Research Fellowship - Center for the Neural Basis of Cognition — May 2015 – Aug 2016
- ThinkSwiss Research Scholarship - Swiss Federal Government — Jun 2015 – Aug 2015
  Funded internship at Translational Neural Engineering Lab at École Polytechnique Fédérale de Lausanne.

OTHER WORK EXPERIENCE

National Robotics Engineering Center, Pittsburgh, PA, USA

- Software Development Intern, DARPA Robotics Challenge — Jun 2013 – Nov 2013
  - Developed hardware diagnostic tool for humanoid robot CHIMP.
    - Supervisors: David Stager and Clark Haynes

PROGRAMMING

- Languages: Python (Tensorflow, Torch), Matlab, R, C, C++. Validation: Travis CI, pytest, codecov.
- Sole developer: dsn, efn, and tf_util (cunningham-lab). Github: https://srbittner.github.io/.

PUBLICATIONS

[6] S Bittner, A Palmigiano, A Piet, C Duan, C Brody, K Miller, and JP Cunningham. “Interrogating theoretical models of neural computation with deep inference.” bioRxiv (2019): 837567.
(In review at Nature Neuroscience, link)

[5] A Russo, R Khajeh, S Bittner, S Perkins, JP Cunningham, LF Abbott, and M Churchland “Neural trajectories in the supplementary motor area and primary motor cortex exhibit distinct geometries, compatible with different classes of computation.” bioRxiv (2019): 65000.
(In review at Neuron, link)

[4] S Bittner and JP Cunningham. "Approximating exponential family models (not single distributions) with a two-network architecture." ICML Workshop on Invertible Neural Networks and Normalizing Flows (2019). (link)

[3] A Russo, S Bittner, S Perkins, J Seely, B London, A Lara, Andrew Miri, N Marshall, A Kohn, T Jessell, LF Abbott, JP Cunningham, and M Churchland. "Motor cortex embeds muscle-like commands in an untangled population response." Neuron 97.4 (2018): 953-966. (link)

[2] S Bittner, R Williamson, A Snyder, A Litwin-Kumar, B Doiron, M Smith, S Chase, and B Yu. "Population activity structure of excitatory and inhibitory neurons." PloS one 12.8 (2017). (link)

[1] S Bittner, S Chen, and J Kovačević. Fast algorithm for neural network reconstruction." In Proc. IEEE Int. Sympo. Biomed. Imag., Brooklyn, NY, Apr. 2015. (link)

INVITED TALKS

[4] "Interrogating theoretical models of neural computation with deep inference." Computational Neuroscience Journal Club, Princeton University, Princeton, NJ, Nov. 2019.

[3] "Degenerate solution networks (DSNs) for theoretical neuroscience." Group for Neural Theory, École normale supérieure, Paris, France, Feb. 2019.

[2] "Controlling for known structure in population neural recordings using maximum entropy processes (MEPs). Bernstein Network Workshop on Dimensions of Neural Coding, Computation and Communication, Berlin, Germany, Sept. 2018.

[1] "Maximum entropy processes for population-level hypothesis testing." Jazayeri Lab Meeting, Massachusetts Institute of Technology, Boston, MA, July 2018.

SELECTED ABSTRACTS

[5] S Bittner, A Piet, C Duan, A Palmigiano, K Miller, C Brody, and JP Cunningham. Examining models in theoretical neuroscience with degenerate solution networks. Bernstein Network Computational Neuroscience Conference, Berlin, Germany, 2019.

[4] S Bittner and JP Cunningham. Degenerate solution networks (DSNs) for theoretical neuroscience. CoSyNe, Lisbon, Portugal, 2019.

[3] S Bittner and JP Cunningham. Controlling for known structure in population neural recordings using maximum entropy processes (MEPs). Bernstein Conference, Berlin, Germany, Sept. 2018.

[2] S Bittner, R Williamson, A Snyder, A Litwin-Kumar, B Doiron, S Chase, M Smith, and B Yu. Effects of excitatory versus inhibitory neuron sampling on outputs of dimensionality reduction. CoSyNe, Salt Lake City, Utah, Feb. 2016.

[1] S Bittner, R Williamson, A Litwin-Kumar, B Doiron, and B Yu. Dimensionality reduction on membrane potentials from neural populations. School on Neurophysiology for Neural and Biomedical Engineering, Zermatt, Switzerland, Aug. 2015.

OUTREACH/ ADVOCACY

ECE Outreach, Carnegie Mellon University — Aug 2013 – May 2016

- Taught programming and circuit building to high school students.

Columbia University Neuroscience Outreach — Aug 2016 – present

- Developed interactive lessons for Saturday Science to educate children in the local community about the brain and careers in STEM.
- Developed organization website (link).

Diversity and Inclusion Committee, Center for Theoretical Neuroscience — Aug 2019 – present

- Organized educational workshop.
- Presented research on gender-based discrimination in science.

INTERESTS

Basketball, the outdoors, Rocket League, cooking.

REFERENCES

- **Professor John Cunningham**, Associate Professor of Statistics, Columbia University
  email: jpc2181@columbia.edu
- **Professor Larry Abbott**, William Bloor Professor of Theoretical Neuroscience, Columbia University
  email: lfa2103@columbia.edu
- **Professor Mark Churchland**, Assistant Professor of Neuroscience, Columbia University
  email: mc3502@columbia.edu