

Narendra Mukherjee

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Employment

- July 2019- **Machine Learning Scientist**, *TripAdvisor*, Needham, MA.
- Bayesian and deep learning models of user-generated content and product recommendations for TripAdvisor's Experiences business
 - Worked alongside engineering to spearhead the adoption of a modern ML platform at TripAdvisor that can deploy containerized ML models and speed-up A/B testing

Education

- August 2019 **Ph.D. in Neuroscience and Quantitative Biology**, *Brandeis University*, Waltham, MA,
Dissertation title: Behaviorally relevant sensory cortical population dynamics in the rodent taste system.
•**HHMI International Predoctoral Fellow** (<15% applicants selected internationally)
- May 2012 **Integrated BS-MS in Biological Sciences**, *Indian Institute of Science Education and Research*, Kolkata, India,
Dissertation title: Optimality and Courtship Behaviour in Zebrafish, *Danio Rerio*.
•**Director's Gold Medal** (Best academic performance in a class of 80)

Technical Expertise

Software Expert: Python, Unix/Linux, SQL(Hive, BigQuery, Postgres), LaTeX, HPC environments, Docker.

Intermediate: R, MATLAB, PySpark.

Working knowledge: C++, HTML, Kubernetes.

Modelling Machine Learning: Standard models for regression/classification, neural networks (deep networks, CNNs, RNNs, autoencoders), probabilistic graphical models (clustering, time-series models like HMMs, LDA, probabilistic PCA), Bayesian inference (including nonparametric priors with MCMC and variational-EM), NLP (TF-IDF, Doc2Vec, Word2Vec, ULMFiT, Transformers/BERT), Learning-to-rank (LambdaRank, LambdaMART).

Statistics: Frequentist techniques (parametric/non-parametric), Bayesian statistics (Hierarchical models, MCMC), computational neuroscience models (e.g. point-process models, drift-diffusion model of decision-making).

Frameworks: numpy, scipy, scikit-learn, Tensorflow/Keras/PyTorch/FastAI, PyMC3, Datashader, Spark, XGBoost, LightGBM.

Open-source projects ([Github](#))

- Hardware
- Co-developed a Raspberry Pi-based hardware system to perform large-scale neural recordings in rodents.
 - Sampling rates of upto 40kHz from thousands of neural electrodes simultaneously.
 - Costs an order of magnitude less than any comparable commercially available solution.
 - Being used in 5 other neuroscience labs across the world - for details, please read our [Scipy 2017 paper](#).

- blech_clust
- HDF5-based data management software to store, process and analyze neural voltage recordings upto several terabytes in size.
 - Tested on machines ranging from personal laptops to distributed clusters and cloud-computing environments.
 - Uses parallel computing to speed up the neural "spike sorting" pipeline by at least 20x.

- bsaPy
- Bayesian Spectrum Analysis (BSA): Bayesian version of the short time Fourier Transform (STFT).
 - Improves frequency estimation in noisy time-series data by 10x compared to STFT.
 - Under development:** variational inference with an Indian buffet process (IBP)-based model with unknown/growing number of sinusoidal components.
 - Applied to decode food ingestion/rejection mouth movements from muscle recordings in rodents.

- PyHMM
- Variational inference in a fully Bayesian Hidden Markov Model (HMM).
 - Used to estimate massively high dimensional models of neural dynamics from limited data.
 - Under development:** Hierarchical Dirichlet Process (HDP)-based HMMs to model brain activity patterns with growing number of states.

Selected Publications (see expanded list on [website](#))

- 2019 **Mukherjee N.**, Wachutka J., Katz D.B. *Impact of precisely-timed inhibition of gustatory cortex on taste behavior depends on single-trial ensemble dynamics.* **eLife.** doi: doi.org/10.7554/eLife.45968.001
- 2019 Levitan D., Lin J-Y., Wachutka J., **Mukherjee N.**, Nelson S.B., Katz D.B. *Single and population coding of taste in the gustatory cortex of awake mice.* **Journal of Neurophysiology.** doi: doi.org/10.1152/jn.00357.2019
- 2018 Flores V.F, Parmet T., **Mukherjee N.**, Nelson S., Levitan D., Katz D.B. *The role of the gustatory cortex in incidental experience-evoked enhancement of later taste learning.* **Learning and Memory.** **25(11):** 587 - 600
- 2017 **Mukherjee N.**, Wachutka J., Katz D.B. *Python meets systems neuroscience: affordable, scalable and open-source electrophysiology in awake, behaving rodents.* **Proceedings of the 16th Python in Science Conference.** 97 - 104
- 2016 Sadacca B.F., **Mukherjee N.**, Vladusich T., Li J.X., Katz, D.B., Miller P. *The Behavioral Relevance of Cortical Neural Ensemble Responses Emerges Suddenly.* **Journal of Neuroscience.** **36(3):** 655 - 669

Grants and Awards

- 2017-2019 \$29,513 (estimated) towards cloud computing resources on the Jetstream supercomputer of the XSEDE program of the National Science Foundation (NSF) (as administrator).
- 2014-2017 \$70,000 per year towards tuition and fellowship from the Howard Hughes Medical Institute (HHMI) as part of the International Predoctoral Fellowship.
- 2014 Pulin Sampat Memorial Award for the Best Teaching Fellow in the Life Sciences, Brandeis University.

Invited Talks

- Upcoming **When features go missing, Bayes' comes to the rescue.**
- PyData Global, 2020
- 2018 **Discrete cortical population activity states underlie taste processing and consumption behavior.**
- Dept. of Mathematics and Statistics, Boston University, Boston, MA
 - Neuroscience Statistics Research Laboratory, Massachusetts Institute of Technology (MIT), Cambridge, MA
 - Jawaharlal Nehru Center for Advanced Scientific Research (JNCASR), Bangalore, India
- 2017 **Systems neuroscience with Python: peering into the "black box".**
- Boston Python Meetup Group, Cambridge, MA
- 2017 **Building affordable, scalable and open-source tools in Python to study behaviorally relevant neural population dynamics.**
- Center for Depression, Anxiety and Stress Research, McLean Hospital, Belmont, MA
 - Boston Python Meetup Group, Cambridge, MA