

# 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)

## Open-source projects

- 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.  
● Check out code on [Github](#).
- 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; check out project on [Github](#).
- 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; project is on [Github](#).

## 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.

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## 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
- 2012 **Mukherjee N.**, Nisha N.K., Yadav P., Sharma V.K. *A model based on oscillatory threshold and build up of a developmental substance can explain gating of adult emergence in fruit flies D. melanogaster.* **Journal of Experimental Biology.** **215(17):** 2960 - 2968

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## 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.
- 2008-2012 Innovation in Science Pursuit for Inspired Research (INSPIRE) Scholarship for Higher Education (SHE), DST, Govt. of India.

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## 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.** *Neuroscience Statistics Research Laboratory, Massachusetts Institute of Technology (MIT), Cambridge, MA*
- 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