Narendra Mukherjee

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narendra-mukherjee

Employment

July 2019- **Machine Learning Scientist**, *TripAdvisor*, Needham, USA.

•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, USA,

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, USA
- Neuroscience Statistics Research Laboratory, Massachusetts Institute of Technology (MIT), Cambridge, USA
- 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, USA

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, USA
- Boston Python Meetup Group, Cambridge, USA

Personal

Citizenship India

Languages Hindi (native), Bengali (native), English (native/bilingual), Dutch (elementary)

Hobbies Long-distance road cycling, Travelling, Cooking