Ankani Chattoraj

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EDUCATION

•**Doctor of Philosophy (PhD), Brain and Cognitive Sciences**　　　　**September 2015-August 2021 (expected)**
University of Rochester, Rochester, USA

•**Masters of Science, Applications of Mathematics (2nd in class)**　　　　**August 2012 - August 2014**
Chennai Mathematical Institute, Chennai, India

•**Bachelors of Science, Mathematics (Minor: Statistics and Computer Science)**　　　　**July 2009 - July 2012**
St. Xavier's College, Kolkata, India

EXPERIENCE

GRADUATE RESEARCH ASSISTANT　　　　**University of Rochester (2015 - 2021)**

--Led 3 end to end research projects: formulated testable scientific hypotheses, designed experiments, executed the experiments on human subjects and collected data, analyzed the data using statistical and mathematical tools and finally modeled empirical observations using concepts from machine learning.

--Collaborated with researchers from Mathematics, Computer Science and Social Sciences in 3 projects for social good.

--Delivered talks and presented posters across 10 conferences including **AAAI, NIPS/NeurIPS, COSYNE, CCN, NEUROMATCH, BERNSTEIN, VSS, COGSCI.**

• **Confirmation bias in visual perception and decision making**

--Designed ~7 varieties of psychophysics visual experiments using Psychtoolbox of MATLAB and EYELINK eye tracker to understand confirmation bias, forgetful bias, action selection bias, confidence judgements in perceptual decision making.

--Modeled perceptual biases in human behavior as a consequence of sampling-based approximate inference on a hierarchical generative model of the world that the brain has previously learnt, implemented using MATLAB.

--Analyzed human behavioral data of >100 subjects across 12 experiments using regression, significance testing, cross validation, bootstrapping, regularization etc.

• **A neural sampling based model of visual processing**

--Implemented a network of >100 leaky integrate-and-fire neurons in BRIAN and Python to test neural sampling hypotheses and demonstrated how biophysically realistic neurons can perform Gibbs sampling based probabilistic inference on a sparse linear Gaussian model of retinal input.

--Analytically resolved a debate in computational neuroscience of whether neural responses represent sampling code or parametric code by proving their equivalence in a sparse linear Gaussian model of retinal input.

• **Fair rating prediction models for public speeches**

--Developed first of a kind fair rating predictor system for public speaking with respect to speakers' race and gender, using counterfactual fairness and causal models on a corpus of 2383 TED talk data.

--Proposed a novel heterogeneity based metric to quantify quality of a speech in multimodal domain (verbal: transcript and non-verbal: facial gesture) and incorporated it into a fair rating prediction for speakers of TED talks.

• **Theoretical applications of Machine Learning**

--Designed a novel diversity based edge pruning method for feedforward neural networks based on Determinantal Point Processes which outperforms previously known diversity based pruning techniques and provided theoretical justifications of its performance by analyzing the generalization error bounds.

--Used the Lovasz theta function as a measure of diversity in graphs thereby incorporating it in Max-Cut, correlation clustering and document summarization algorithms.

TEACHING ASSISTANT

• **Undergraduate Research in**　　　　**University of Rochester, USA**
  Cognitive Science　　　　**(Fall 2018 - Spring 2019, Fall 2019 - Spring 2020)**

--Mentored undergraduates to reproduce scientific results from a published scientific article in the Fall semester.

--Advised the same undergrads to develop novel research ideas and produce a research manuscript in the Spring semester.

• **Action and Perception**　　　　**University of Rochester, USA (Fall 2018)**

--Gave 2 class lectures on neural mechanisms of visual illusions, helped professor in preparing and grading examinations.

• **Neural Mechanisms of Behavior**　　　　**University of Rochester, USA (Fall 2016, Fall 2017)**

--Organized weekly revision lectures for a class of ~200 students and trained 4 undergraduate TAs.

• **Machine Learning**　　　　**Chalmers University of Technology, Sweden (Spring 2015)**

--Organized guidance sessions for coding assignments and graded examinations for a class of ~50 students.

MENTORING

--Advised 7 undergraduates at University of Rochester (2015-present), leading to 5 conference and abstract submissions.

INTERNSHIPS/SUMMER SCHOOLS

• **Summer course in mining and modeling neuroscience data**　　　　**UC Berkeley, USA (CRCNS 2017)**

--Fit general linear models and applied dimensionality reduction (PCA) on neuronal data, implemented in Python.

• **Summer School in Computational Sensory-Motor Neuroscience**   University of Minnesota, USA (CoSMo 2017)

--Designed experiments using point-light walkers and used Bayesian models to understand biological motion perception in humans (ranked 2nd in group project competition), implemented in MATLAB. **Abstract**

• **Gene Regulatory Networks to draw relevant biological conclusions**   Jadavpur University, India (Summer 2014)

--Implemented the sparse candidate algorithm to learn Bayesian network structure from gene interactions with the goal to identify differences between cancer patients and healthy controls, using MATLAB . **Report**

SKILLS & COURSEWORK

PROGRAMMING: **MATLAB** (PsychToolbox, Eyelink) **, Python** (numpy, pandas, scikit-learn, Pytorch), **SQL**, **Tableau**

TECHNICAL SKILLS:

• **Experiments**: Design Experiments, Implement Psychophysical and Eye-tracking Experiments, Data Collection.

• **Modeling and Analysis**: Hierarchical Generative Models, Probabilistic Inference, Bayesian Inference, Approximate Inference, MCMC Methods, Causal Model, Counterfactual Fairness, Biological Neuron Model, Model Fitting, Model Comparison, Logistic, Ordinal, and Linear regression, Statistical Analysis, Optimization, Hypothesis testing, Significance testing, Cross Validation, Hyperparameter Search, Regularization, Bootstrapping, Supervised Learning, Deep Learning, PCA.

RELEVANT COURSEWORK:

• **Neuroscience/Cognitive Science**: Sensory Systems, Computational Neuroscience, Visual Perception, Cognition.

• **Computer Science**: Discrete Mathematics, Algorithms, Data Mining, Machine Learning.

• **Mathematics**: Linear Algebra, Calculus, Real and Complex Analysis, Topology, Probability and Statistics.

PUBLICATIONS

- **A. Chattoraj**, M. Snarskis, R M. Haefner. Relating confidence judgements to temporal biases in perceptual decision-making - **COGSCI 2021 (Selected for talk)**. **Paper**
- **A. Chattoraj***, S. Shivkumar*, Y S. Ra, R M. Haefner. A confirmation bias due to approximate active inference - **COGSCI 2021 (Selected for talk)**. **Paper** (also **VSS 2020 Paper**, **Talk at Neuromatch 2020**)
- R. Acharyya, **A. Chattoraj***, B. Zhang*, S. Das, D. Stefankovic. Understanding diversity based neural networks pruning in teacher-student setup - **Neural Compression ICLR 2021 Workshop**. **Paper**
- R. Acharyya, **A. Chattoraj***, B. Zhang*, S. Das, D. Stefankovic. Diversity based edge pruning of neural networks using determinantal point process - **Neural Compression ICLR 2021 Workshop**. **Paper**
- **A. Chattoraj***, R. Acharyya*, S. Das, I. Tanveer, E. Hoque. Removing racial bias in TED talk ratings by awareness of verbal and gesture quality - **Responsible AI ICLR 2021 Workshop**. **Paper**
- R. Acharyya**, S. Das, **A. Chattoraj**, I. Tanveer**. FairyTED: A fair rating Predictor for TED talk data **-** **AAAI 2020 (Selected for oral presentation in AI for Social Impact)**. **Paper**
- **A. Chattoraj***, S. Shivkumar*, R D. Lange*, R M. Haefner. A probabilistic population code based on neural samples **-** **NeurIPS 2018 (Selected for oral presentation, 1% acceptance rate)**. **Paper**
- **A. Chattoraj***, R. Acharyya*, S. Shivakumar*, R. Ali*, I. Tanveer*. To be or not to be? A spatial predictive crime model for Rochester - **UP-STAT 2018** (**Won 3rd position in the data competition)**. **Paper**
- R D. Lange, **A. Chattoraj**, Ralf M. Haefner. On the computational basis of the confirmation bias - **Bounded Optimality and Rational Metareasoning NIPS 2015 Workshop.** **Paper**
- FD Johansson, **A Chattoraj**, C Bhattacharyya, D Dubhashi. Weighted theta functions and embeddings with applications to max-cut, clustering and summarization - **NIPS 2015**. **Paper**

SHORT PAPERS/ABSTRACTS/MANUSCRIPTS

- R D. Lange, **A. Chattoraj**, J M. Beck, J L. Yates, R M. Haefner. A confirmation bias in perceptual decision-making due to hierarchical approximate inference. (Journal paper under review). **CCN 2018 Paper**, **COSYNE 2017 Paper**, **Paper**
- R D. Lange, **A. Chattoraj***, S. Shivkumar*, R M. Haefner. Bayesian encoding and decoding as distinct perspectives on neural coding. (Journal paper under review). **Paper**
- R Acharyya*, S. Das*, **A. Chattoraj**, O. Sengupta, I. Tanveer. Detection and mitigation of bias in TED talk rating (Preprint). **Paper**
- **A. Chattoraj***, R. Acharyya*, S. Das, I. Tanveer, E. Hoque. Fairness in rating prediction by awareness of verbal and gesture quality of public speeches (Conference paper under review). **Paper**
- **A. Chattoraj**, R D. Lange, R M. Haefner. Using the perceptual confirmation-bias to study learning and feedback in fovea and periphery (Journal version in prep.). **VSS 2020 Paper**, **CCN 2019 Paper**
- **A. Chattoraj**, R D. Lange, S. Wu, R M. Haefner. A neural sampling based model of early visual processing based on leaky integrate-and-fire neurons (Journal version in prep.). **Bernstein 2019 Paper**, **COSYNE 2018 Paper**

LEADERSHIP EXPERIENCE

• Cultural Secretary of BAGR **(Bengali Association of Greater Rochester)**   **Summer 2018 - Spring 2019**

• Organized a national level annual seminar at St Xavier's College **(ANALYTICA)**   **2009, 2010 and 2011**

• Organized an annual collegiate festival at Chennai mathematical Institute **(FIESTA)**   **2013**

• Participated and performed Indian music and dance in >15 cultural and charity events in Rochester   **2015 - Present**