

ASHISH BORA

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INTERESTS Machine Learning - algorithms, optimization, architectures, and applications.

EDUCATION **University of Texas at Austin** 2015-Present
Pursuing Masters (expected Dec 2017) and Doctorate in Computer Science GPA : 3.93/4.0
Indian Institute of Technology Bombay, India 2011-2015
Bachelor of Technology (Honors) in Electrical Engineering Major GPA : 9.64/10.0 (Rank 4)
Minor in Computer Science Minor GPA : 9.60/10.0

PUBLICATIONS

- Ashish Bora, Ajil Jalal, Eric Price, Alex Dimakis. **Compressed Sensing using Generative Models**. *International Conference on Machine Learning, 2017*.
- Ashish Bora, Sugato Basu, Joydeep Ghosh. **Graphical RNN models**. *arXiv preprint, 2016*.
- Ashish Bora, Vivek S. Borkar, Dinesh Garg and Rajesh Sundaresan. **Edge Conductance Estimation Using MCMC**. *Allerton Conference on Communication, Control, and Computing 2016*.
- Ashish Bora, Arjun Rao and Bipin Rajendran. **Mimicking the worm - an adaptive spiking neural circuit for contour tracking inspired by C. Elegans Thermotaxis**. *International Joint Conference on Neural Networks, 2014*.

RESEARCH EXPERIENCE **Compressed Sensing using Generative Models** Nov'16-Feb'17
Joint work with: Ajil Jalal, Prof. Eric Price, Prof. Alex Dimakis

- We use generative models to represent structure instead of the standard sparsity assumption
- If the generative model is L -Lipschitz, then $O(k \log L)$ random Gaussian measurements suffice for an ℓ_2/ℓ_2 recovery guarantee using our method
- Using variational autoencoder and generative adversarial networks we show that our method can use 5-10x fewer measurements than Lasso for the same accuracy

Graphical RNN Models May'16-Aug'16
Joint work with: Dr. Sugato Basu, Prof. Joydeep Ghosh

- Proposed a new framework for learning from data with spatio-temporal structure
- Our framework builds on powerful capabilities of recurrent neural networks, while offering several ways to incorporate domain knowledge, much like a graphical model
- Demonstrated improved performance for a weather prediction task

Edge Conductance Estimation using MCMC Jul'14-May'15
Joint work with: Prof. Vivek Borkar, Prof. Rajesh Sundaresan, Dr. Dinesh Garg

- Devised an MCMC based algorithm for efficient estimation of effective edge conductances
- Our algorithm is memory efficient, makes very few computations per step, uses only local information, and can be easily distributed and parallelized
- Provided probabilistic (PAC) guarantees on algorithm performance by deriving sample complexities using tools from the theory of Markov chains and concentration inequalities

Bio-inspired Spiking Neural Networks for 2-D contour tracking May'13-Jan'14
Joint work with: Arjun Rao, Prof. Bipin Rajendran

- Inspired by C. Elegans thermotaxis, designed a model for exploration and tracking dynamics
- Designed a SNN with time-dependent adaptive plastic synapses to realize these dynamics
- Our neural circuit can identify isotherms with $\sim 60\%$ higher probability than the theoretically optimal memoryless Levy foraging, and sparse spiking enables energy-efficient implementations

TECHNICAL SKILLS

- **Programming Languages:** Python, C++, MATLAB
- **Packages and Tools:** TensorFlow, Torch

INTERNSHIPS	<p>Software Engineering Intern, Google Brain <i>May'17-Aug'17</i> <i>Google Research, New York. Host: Dr. Jeffrey Pennington.</i></p> <p>Working on understanding and improving training of recurrent neural networks for tasks with very long range dependencies.</p> <p>Software Engineering Intern, Google Research <i>May'16-Aug'16</i> <i>Machine Intelligence Group, Mountain View, California. Host: Dr. Sugato Basu.</i></p> <p>Proposed Graphical RNN models as a framework to model spatio-temporal data. Memory efficient implementation using truncated backpropagation through time in TensorFlow. Improved performance on a weather prediction task.</p> <p>Quantitative Analyst Intern, Goldman Sachs <i>May'14-July'14</i> <i>Controllers Modeling, Finance Division, Bangalore, India</i></p> <p>For the task of finding nearest consistent correlation matrix from many incomplete and inconsistent data sources, obtained a provably optimal algorithm using Dykstra's cyclic projection idea. Implemented the algorithm and gained 40x speedup.</p>
COURSE PROJECTS	<p>Learning to Learn by Gradient Descent by Reinforcement Learning <i>Fall 2017</i></p> <ul style="list-style-type: none"> • Deep Reinforcement Learning agent to output the learning rate for each SGD optimization step • Demonstrated generalization on a family of quadratic optimization problems <p>Low-supervision Visual Learning through Cooperative Agents <i>Spring 2016</i></p> <ul style="list-style-type: none"> • Proposed to create a supervisory signal by asking an agent to find one image from a collection • To exploit this signal, proposed a system of two agents which play a partial information cooperative game to complete the disambiguation task • Modeled each agent as a Convolutional Neural Network and demonstrated learning with an image attribute based dialog system <p>Description to Algorithm Category <i>Spring 2016</i></p> <ul style="list-style-type: none"> • Given a natural language description of an algorithmic programming problem, the task is to find the algorithm category (e.g. Dynamic Programming), that will be used to solve the problem • Used LSTM on word2vec embeddings of input text to output a score for each category <p>Automatic Traffic Surveillance System using videos <i>Autumn 2013</i></p> <ul style="list-style-type: none"> • Adaptive background estimation via online Gaussian mixture model fitting • Moving object detection using background subtraction, thresholding, median filtering, morphological closing and connected component analysis
RELEVANT COURSEWORK	<p>Probability: Measure Theory, Advanced Probability and Random Processes, Markov Chains and Queuing Systems, Markov Decision Processes</p> <p>Optimization: Linear and Integer Programming, Stochastic Optimization, Discrete Optimization, Convex Optimization</p> <p>Algorithms: Data Structures and Algorithms, Discrete Structures, Design and Analysis of Algorithms, Randomized Algorithms, Communication Complexity</p> <p>Machine Learning: Foundations of Machine Learning, Large scale Machine Learning, Neural Networks for Machine Learning, Probabilistic Graphical Models, Deep Learning Seminar, Reinforcement Learning</p> <p>Applications: Image Processing, Computer Vision, Visual Recognition, Speech Processing, Natural Language Processing</p>
SCHOLASTIC ACHIEVEMENTS AND AWARDS	<ul style="list-style-type: none"> • Received the Undergraduate Research Award for the work on bio-inspired neural networks • Awarded an AP grade (given for exceptional performance) in two courses : <i>Linear Algebra</i> and <i>Advanced Probability and Random Processes</i> • Scored a perfect Semester Performance Index in 3 out of 8 semesters at IIT Bombay • Secured All India Rank 58 in <i>AIEEE-2011</i> out of about 1.1 million candidates • Secured All India Rank 400 in <i>IITJEE-2011</i> out of about 460,000 candidates • Recipient of the <i>National Talent Search Scholarship 2007</i> awarded to less than top 1% applicants