

ASHISH BORA

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RESEARCH INTERESTS	Applications of Probability, Optimization and Algorithms in the domains of Machine Learning, Data Mining, and Scalable Algorithms
EDUCATION	University of Texas at Austin 2015-Present <i>Pursuing Masters and Doctorate in Computer Science</i> GPA : 4.0/4.0 Indian Institute of Technology Bombay, India 2011-2015 <i>Bachelor of Technology (Honors) in Electrical Engineering</i> Major GPA : 9.64/10.0 <i>Minor in Computer Science</i> Minor GPA : 9.60/10.0
PUBLICATIONS	<ul style="list-style-type: none">• [In Review] Ashish Bora, Vivek S. Borkar, Dinesh Garg and Rajesh Sundaresan, Edge Conductance Estimation Using MCMC• Ashish Bora, Arjun Rao and Bipin Rajendran, Mimicking the worm - an adaptive spiking neural circuit for contour tracking inspired by C. Elegans Thermotaxis, <i>International Joint Conference on Neural Networks, IEEE World Congress on Computational Intelligence 2014</i>
RESEARCH EXPERIENCE	Graduate Research Assistant Sept'15-Present <i>Guides: Prof. Sujay Sanghavi and Prof. Joydeep Ghosh, UT Austin</i> <ul style="list-style-type: none">• Investigating Deep Learning models to identify potential research directions• Experimenting with basic architectures in Theano Edge Conductance Estimation using MCMC Jul'14-May'15 <i>Guides: Prof. Vivek Borkar, IIT Bombay and Prof. Rajesh Sundaresan, IISc Bangalore</i> <ul style="list-style-type: none">• 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 guarantees on algorithm performance (PAC guarantee) by deriving sample complexities using tools from theory of Markov Chains and Concentration Inequalities Bio-inspired Spiking Neural Networks for 2-D contour tracking May'13-Jan'14 <i>Guide: Prof. Bipin Rajendran, IIT Bombay</i> <ul style="list-style-type: none">• Developed a framework for simulating Spiking Neural Networks using the aEIF model in Matlab• 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 a ~60% higher probability than the theoretically optimal memoryless Levy foraging, and sparse spiking enables energy-efficient implementations
PROFESSIONAL EXPERIENCE	Summer Analyst, Goldman Sachs May'14-July'14 <i>Controllers Modeling, Finance Division, Bangalore, India</i> <p>Finding Nearest Consistent Correlation Matrix from combination of many incomplete and inconsistent (some principal sub-matrices of interest being non positive semidefinite) data sources</p> <ul style="list-style-type: none">• Proved convergence, feasibility & non-optimality of an existing heuristic algorithm• Using tools from Convex geometry, reduced the problem to finding projection onto an intersection of finitely many simple, convex, compact sets in an Hilbert Space• Deployed Dykstra's Cyclic Projection to get an algorithm that provably converges to the optimal solution. Designed various regtests for checking correctness and optimality• Achieved 40x Speed Gain by leveraging Cholesky decomposibility criterion
TECHNICAL SKILLS	<ul style="list-style-type: none">• Programming Languages: Python, C++, MATLAB• Packages and Tools: Theano, CVX

TECHNICAL PROJECTS

Automatic Traffic Surveillance System using Traffic Videos

Autumn 2013

- Achieved adaptive, robust **background estimation** via online Gaussian Mixture Model fitting
- Achieved **moving object detection** using background subtraction, thresholding, median filtering, morphological closing and connected component analysis
- Developed an algorithm for **predictive tracking** of vehicles in the video by clustering instances of same vehicle across frames. Obtained the **total number of unique vehicles** in the video

Video stabilization

Spring 2014

- Robust estimation of sequence of affine transformations between **SIFT** feature points of consecutive frames using **RANSAC**
- **Mean filtering** to remove High-frequency noise

Approximate solvers for some NP-Hard problems

Summer 2013

- **Graph Coloring**: Branch and Bound, Constraint Programming and Local Search Techniques
- **Travelling Salesman Problem**: Greedy Heuristic followed 2-OPT neighborhood Local Search

Other Projects

- Support Vector Machine based **Spam Filter** using SpamAssassin Corpus
- Designed and implemented the **physics engine for the game of carom** in C++ involving predictive collision mechanics, friction and special handling near holes
- Designed and fabricated a portable **shaking movement to electricity** conversion device
- Implemented rate 1/2 Trellis Coded Modulation with **Viterbi Decoder** for error correction
- Created an application to **draw the development surface** of the intersection of various solids
- Modeled High Volume Stock Procurement as a **Markov Decision Process**
- Created a **Robotic Graph Plotter** using stepper motors driven by Arduino

RELEVANT COURSEWORK

Probability:	Measure Theory, Advanced Probability and Random Processes, Markov Chains and Queuing Systems, Markov Decision Processes
Optimization:	Linear and Integer Programming, Stochastic Optimization, Discrete Optimization, Convex Optimization
Algorithms:	Data Structures and Algorithms, Discrete Structures, Design and Analysis of Algorithms, Randomized Algorithms
Machine Learning:	Foundations of Machine Learning, Large scale Machine Learning, Neural Networks for Machine Learning, Probabilistic Graphical Models
Applications:	Image Processing, Computer Vision, Visual Recognition, Speech Processing, Natural Language Processing

LEADERSHIP

- **Department Academic Mentor:** Responsible for ensuring healthy academic environment and helping students to gain confidence in academics
- **Teaching Assistant (Linear Algebra):** Conducted weekly problem solving and doubt clarification sessions for about 40 freshmen

SCHOLASTIC ACHIEVEMENTS AND AWARDS

- Received the **Undergraduate Research Award** for the work on Bio-inspired Neural Networks
- Awarded an **AP grade** (given for exceptional performance) in two courses : *Linear Algebra* and *Advanced Probability and Random Processes*
- Scored a perfect Semester Performance Index in 3 out of 8 semesters at IIT Bombay
- Secured **All India Rank 58** in *AIEEE-2011* out of about 1.1 million candidates
- Secured **All India Rank 400** in *IITJEE-2011* out of about 460,000 candidates
- Recipient of the *National Talent Search Scholarship 2007* awarded to **less than top 1%** applicants

OTHER INTERESTS AND ACTIVITIES

- Like to solve mathematical puzzles and play table tennis
- Stood first in Math and Logic General Championship 2012 open for everyone at IIT Bombay
- Hobbyist guitarist, Performed in Surbahaar, the annual music night at IIT Bombay
- Open source contributions to the Textbook Companion Project hosted by FOSSEE, IIT Bombay
- Part of IIT Bombay's Guinness World Record for maximum number of people simultaneously solving the Rubik's Cube