

# JIAN VORA

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## RESEARCH INTERESTS

Statistical machine learning, Deep generative models, Probabilistic reasoning, Trustworthy machine learning

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## EDUCATION

### Stanford University

*Master of Science in Computer Science with specialization in Artificial Intelligence*

Stanford, CA, USA

*Beginning Sept 2021*

### Indian Institute of Technology Bombay

*Bachelor of Technology in Electrical Engineering*

Mumbai, MH, India

*July 2017 – May 2021*

- Dual Minor in Computer Science and Machine Intelligence & Data Science (C-MInDS)
- Major GPA : 9.77/10.0, C-MInDS Minor GPA: 10.0/10.0

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## PUBLICATIONS, PREPRINTS, AND WORKING PAPERS

4. **Jian Vora**, Isabel Valera, Guy Van den Broeck, Antonio Vergari, **Play & Play Multimodal Generative Model Allowing Tractable Inference**, *Working Paper*
3. S. Jain, **Jian Vora**, I. Nair, D. Mehta, R. Shah, S. Gupta, S. Khyalia, S. Das, V. Riberio, S. Kalyankrishnan, **PAC Mode Estimation using PPR Martingale Confidence Sequences**, under review at *35th Conference on Advances in Neural Information Processing Systems (NeurIPS)*, 2021.
2. **Jian Vora**, Karthik S. Gurumoorthy, Ajit Rajwade, **Recovery of Joint Probability Distribution from One-Way marginals: Low rank Tensors and Random Projections**, accepted at *2021 IEEE Statistical Signal Processing (SSP) (SSP 2021)*.
1. **Jian Vora** and Ajit Rajwade, **Compressive Signal Recovery Under Sensing Matrix Errors Combined With Unknown Measurement Gains**, accepted at *ICASSP 2021 - 2021 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, 2021.

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## RESEARCH EXPERIENCE AND INTERNSHIPS

### PAC Mode Estimation using PPR Martingale Confidence Sequences

Jan 2021 – May 2021

*Guide: Prof. Shivaram Kalyankrishnan, Department of Computer Science and Engineering*

*IIT Bombay*

- Used the prior-posterior ratio (PPR) as an  $\alpha$  confidence sequence for mode estimation and performed simulations with the application of predicting the results of an election with the help of polls
- Proved the sample complexity for the same and showed that it matches with the lower bound. Showed two algorithmic versions - one vs one and one vs all and proved the optimality of the former for all problem instances

### Low Rank Joint Probability Density Tensor Recovery from Marginals

June 2020 – May 2021

*Guide: Prof. Ajit Rajwade, Department of Computer Science and Engineering*

*IIT Bombay*

- Employed the canonical polyadic model for representation of a low rank joint probability density tensor and formulated recovery of the same from marginals estimated from random projection of data
- Recovered the tensor using ideas from inverse radon transform, got better classification accuracies than standard discriminative models and better performance when compared to other generative models

### Multimodal Generative Modeling with Tractable Inference

April 2020 – Ongoing

*Guide: Prof. Guy Van den Broeck, Antonio Vergari, StarAI Lab*

*University of California, Los Angeles*

- Trained regularized autoencoders for each modality independently and employed a probabilistic circuit on the joint latent space as a generative model allowing linear time exact inference in the size of the circuit
- Optimised the leaves to allow for heterogenous statistical data types and explored various schemes for end-to-end training with the joint training of the autoencoders of all the modalities and the circuit on the latent space
- Explored various multimodal settings such as image-image(MNIST-SVHN), image-attributes(CelebA) and image-text(CUB) getting better results over a variety of metrics over the baseline multimodal VAE models

## Efficient Learning of a Mixture of Log-Concave Densities

Aug. 2020 – Jan. 2021

Guide: Prof. Vivek Borkar, Department of Electrical Engineering

IIT Bombay

- Proved that random lower dimensional projections of mixtures of log concave densities is gaussian mixture model in a total variation sense by using the initial result by Eldan and Klartag for a single isotropic log concave density
- Surveyed and implemented subspace clustering methods to find the directions where the densities concentrate before fitting a GMM on the projected space followed by invoking the JL Lemma

## Blind Calibration of Perturbations in Compressed Sensing

Dec. 2019 – June 2020

Guide: Prof. Ajit Rajwade, Department of Computer Science and Engineering

IIT Bombay

- Calibrated frequency offsets (gradient delays) and sensor gains (person in motion) in linear compressive measurement framework which occur in MRI signal acquisition for faithful signal reconstruction using a single snapshot
- Proved uniqueness of the solution up to a scalar and obtained theoretical bounds on the error of signal reconstruction by modelling the problem as a GMMV problem with additive signal dependent noise

## Spatio-Temporal Action Detection and Classification in Videos

May 2019 – July 2019

Guide: Dr. Martin Klinkigt, Hitachi Central Research Laboratory

Tokyo, Japan

- The project was based on the TRECVID ActEV'19 challenge by NIST, proposed a stage-wise architecture of object detection followed by tracking and activity classification on the VIRAT dataset
- Trained a deep-learning based Temporal Reasoning Network for activity classification achieving an accuracy of 95%; tested the one-vs-all classification approach and designed an event finite-state machine for temporal alignment

## KEY TECHNICAL PROJECTS

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### Continual Learning for Keyword Spotting | CS753: Automatic Speech Recognition

Spring 21

- Implemented various regularization schemes like EWC, LWF, CRA for domain adaptation for keyword spotting
- Performed a joint keyword spotting and speaker verification task as a part of an Interspeech challenge
- Awarded one of the best projects award (top 4 out of 40+ projects)

### Projection Efficient Sub-Gradient Descent | CS769: Optimization for Machine Learning

Spring 21

- Surveyed literature to find about existing bounds for the number of function and projection oracles calls
- Implemented a recent NeurIPS paper on a low-rank SVM problem which achieves lower PO call complexity

### StyleGAN for Music Generation | EE782: Advanced Machine Learning

Fall 20

- Converted audio signal to an spectrogram using recent work on generative modelling of audio data such as GanSynth and implemented a conditioning class feature in StyleGAN appended to the isotropic noise vector
- Modified the current StyleGAN architecture in order to allow for style transfer in audio signals

### Shortest Path in a Maze | CS747: Foundations of Intelligent and Learning Agents

Fall 20

- Modelled a 2D maze as an MDP with appropriate states, actions, rewards and transition probabilities
- Implemented various algorithms like Howard's Policy Iteration, Value Iteration and Linear Programming to find the best policy to be followed to minimize the number of steps between 2 given points while following the constraints

### Iris Recognition and Classification | CS663: Digital Image Processing

Fall 19

- Segmented pupil and iris from a dataset of eyes using binary thresholding and circular hough transform
- Implemented PCA for dimensionality reduction followed by LDA for classification achieving an accuracy of 86%

### Multicycle & Pipelined RISC Processors | EE309: Microcontrollers, EE224: Digital Systems

Fall 19

- Designed and implemented 6-stage pipelined and multicycle RISC processors in VHDL, consisting a total of 16 arithmetic, logical and branching instructions, and tested it on Altera DE0-Nano FPGA board
- Developed a robust model to handle hazards by integrating data forwarding and stalling units to reduce latencies

## TECHNICAL SKILLS

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**Programming Languages:** C++, Python, VHDL, MATLAB, Bash, HTML, Embedded C

**Machine Learning:** PyTorch, TensorFlow, Caffe, OpenCV, Numpy, Pandas, Matplotlib

**Software:** Docker, GNUPlot, L<sup>A</sup>T<sub>E</sub>X, Git, Scilab, SolidWorks, NGSpice, Arduino, Quartus, Modelsim

## MAJOR HONORS AND AWARDS

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- Awarded an option of branch change due to exceptional academic performance in the first year
- Selected for undergraduate research internship programs at Caltech (SURF) and NTU India Connect
- Achieved All India Rank 3 in ICSE 2015 out of 0.16 Million applicants
- Secured All India Rank 645 in JEE Advanced 2017 among 0.17 Million candidates
- Bagged the silver medal in Homi Bhabha Balvaidnyanik (top 0.4%) search for scientific and research aptitude
- Awarded the Inspire Scholarship by Govt. of Maharashtra for being in the top 1% in Class XII Examinations

## RELEVANT COURSEWORK

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**Computer Science:** Foundations of Learning and Intelligent Agents, Introduction to Machine Learning, Advanced Machine Learning, Theoretical Machine Learning, Data Structures and Algorithms, Digital & Advanced Image Processing, Cryptography and Network Security, Advances in Learning and Intelligent Agents, Automatic Speech Recognition, Operating Systems, Science of Information Learning and Statistics

**Mathematics and Statistics:** Probability and Random Processes, Data analysis, Linear Algebra, Calculus, Ordinary and Partial Differential equations, Complex analysis, Optimization for Machine Learning

**Electrical Engineering:** Signals and Systems, Control Theory, Analog and Digital Circuits, Communication Systems, Digital Signal Processing, Microcontrollers, Network Theory, Power Electronics, Electronic Devices

## TEACHING, MENTORING AND LEADERSHIP ROLES

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**Teaching Assistant** | *MA 111, Vector Calculus*

*Jan 2021 – Mar 2021*

- Responsible for taking weekly tutorial (problem solving) sessions for a batch of 50 students
- Involved in setting and correcting examinations and deciding logistics for an online mode of the course

**Manager** | *Electronics and Robotics Club, IIT Bombay*

*Apr 2019 – Apr 2020*

- Led a team of 17 members to boost the Electronics and Robotics culture across the institute
- Initiated and maintained a reading group VisionX for discussing and implementing recent research in the field on computer vision with members including professors, graduate and senior undergraduate students
- Conducted workshops and hackathons by various companies like Uber, Intel and Texas Instruments
- Mentored 3 month long technical summer projects taken up by freshmen and helped in their ideation

**Institute & Department Academic Mentor** | *Student Mentorship Program*

*Apr 2019 – May 2021*

- Responsible for mentoring a group of 12 freshmen students to ensure their academic and holistic development
- Responsible for co-ordinating with the department as a senior DAMP mentor, organised a lecture on mental health awareness and stress management, mentoring students to clear off their academic backlogs

## EXTRA CURRICULAR ACTIVITIES

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- Worked with NGO Asha , designed and taught a basic computer and English speaking course for on campus workers to enable them to be eligible for entry level jobs which require these basic skills
- Mentored 8 students under Summer of Science by providing them necessary guidance in machine learning; spoke at a 15 day long Machine Learning bootcamp with 250+ participants and developed assignments and projects
- Stood 1st among 25 groups in MHRD-TEQIP-3 Activity which involved presenting the topic “Mathematics in Engineering” to professors and students of other universities
- Represented Maharashtra in a quiz competition with the theme of Indian history at the national level