

JIAN VORA

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RESEARCH INTERESTS

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

EDUCATION

Indian Institute of Technology Bombay

Mumbai, MH, India

Bachelor of Technology in Electrical Engineering

July 2017 – May 2021

- Dual Minor in Computer Science and Machine Intelligence & Data Science (C-MInDS)
- Major GPA : 9.76/10.0, C-MInDS Minor GPA: 10.0/10.0

PUBLICATIONS

1. **Jian Vora**, Karthik S. Gurumoorthy, Ajit Rajwade, **Recovery of Joint Probability Distribution from One-Way marginals: Low rank Tensors and Random Projections**, *2021 IEEE Statistical Signal Processing Workshop (SSP) (SSP 2021)*.
2. **Jian Vora** and Ajit Rajwade, **Compressive Signal Recovery Under Sensing Matrix Errors Combined With Unknown Measurement Gains**, *ICASSP 2021 - 2021 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), 2021*, pp. 5105-5109.

RESEARCH EXPERIENCE AND INTERNSHIPS

Low Rank Joint Probability Density Tensor Recovery from Marginals

June 2020 – May 2021

Guide: Prof. Ajit Rajwade (CSE Department, IIT Bombay), Karthik Gurumoorthy (Amazon)

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
- 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

- Confidence Sequences for Mode Estimation** | *CS748: Advances in Intelligent and Learning Agents* Spring 21
- Used the prior-posterior ratio (PPR) as an α confidence sequence for mode estimation and performed simulations with the application of predicting the results of election with the help of polls [To be submitted to NeurIPS 2021]
 - Proved the sample complexity for the same and showed that it matches with the lower bound
- 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
- 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

Programming Languages: C++, Python, VHDL, MATLAB, Bash, HTML, Embedded C
Machine Learning: PyTorch, TensorFlow, Caffe, OpenCV, Numpy, Pandas, Matplotlib
Software: Docker, GNUPlot, L^AT_EX, Git, Scilab, SolidWorks, NGSpice, Arduino, Quartus, Modelsim

MAJOR HONORS AND AWARDS

- Awarded the Advanced Performer(AP) grade in the course on Introduction to Stochastic Optimization
- 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

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

Teaching Assistant | *MA 111, Vector Calculus*

Jan 2021 – Apr 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*

Aug 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 Student Mentor & 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

- 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