MILLEN KANABAR

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EDUCATION

Indian Institute of Technology, Bombay   *August 2018 - August 2023*
B.Tech in Electrical Engineering,
M.Tech in Electrical Engineering (Specialization: Communication and Signal Processing),
GPA: 9.24/10

ACADEMIC ACHIEVEMENTS

· Ranked 4th in a batch of 54 Students specializing in Communication and Signal Processing   *(Present)*
· Awarded the Undergraduate Research Award-01 for work done with Prof. Jayakrishnan Nair in the
  second and third academic years   *(2021)*

RESEARCH INTERESTS

· Information Theory   · Stochastic Optimization   · Data Privacy   · Statistical Learning

PUBLICATIONS

Journal

· Millen Kanabar and Jonathan Scarlett. *"Mismatched Rate-Distortion Theory: Ensembles, Bounds,
  and General Alphabets"*, (preprint), under review at IEEE Transactions on Information Theory

Conference Papers

· Millen Kanabar and Jonathan Scarlett. *"Multi-User Random Coding Techniques for Mismatched Rate-
  Distortion Theory"*, presented at *IEEE ISIT 2022*, Espoo, Finland
· Millen Kanabar and Jayakrishnan Nair. *"Sizing and management of storage and demand response in
  the renewables-rich smart power grid."*, (notes paper) presented at ACM e-Energy 2021, Torino, Italy
  (Online)
· Aniruddha Ranade, Millen Kanabar, et al. *"Survey and Analysis of Payloads for Missions on PSLV's
  Orbital Platform."*, presented at the AIAA SciTech Forum 2021, Nashville, TN, USA (Online)
· Virul Katla, Millen Kanabar et al. *"An Approach to Star Tracker Design for Nano-Satellite Applica-
  tions"*, (extended abstract) presented at NCSSTA 2020, Thiruvananthapuram, India (Online)

RESEARCH EXPERIENCE

Estimation Under Partial Differential Privacy   June 2022 - Present
With Prof. Nikhil Karamchandani and Prof. Bikash Dey, IIT Bombay   *Master's Thesis*

· Proposed modifications to existing algorithms for the Private Multi-Group Aggregation setting based
  on the k-RAPPOR and Hadamard Response schemes for differentially private distribution estimation
· Showed that the improvement to the Q&A scheme based on k-RAPPOR decreases the normalised MSE
  in the moderate privacy regime, albeit at a higher communication cost
· Generalised the aggregate estimation problem to the discrete joint distribution estimation problem
  under local differential privacy requirement w.r.t. only one of two variates
· Proved that this notion of 'partial' differential privacy leads to the same expected risk as the fully
  private case, up to a constant factor

Coding for Private Information Retrieval
With Prof. Nikhil Karamchandani and Prof. Bikash Dey, IIT Bombay

August 2021 - June 2022
Research Project

· Attempted to find the capacity of private information retrieval (PIR) via the selection MAC when channel state information is not known to either the user, or to the servers, or both
· Derived a lower bound for the total read cost across servers in the canonical PIR setting
· Conducted a literature survey on PIR, private distributed computing, and private federated learning and noted the relationships between these paradigms

Multi-User Coding for Mismatched Rate-Distortion Theory
With Prof. Jonathan Scarlett, National University of Singapore

May 2021 - February 2022
Summer Internship

· Established achievable rate-distortion bounds for a minimum-distortion encoder with a mismatched distortion metric using structured codebooks created via superposition or expurgated parallel coding
· Provided examples where the matched rate-distortion curve is achieved by a mismatched encoder using structured codebooks, but cannot be using standard, unstructured ones
· Derived dual expressions for the distortion-rate functions in the mismatched encoding setting achieved using constant composition coding and i.i.d. coding

Demand Response in Renewable Energy Grids
With Prof. Jayakrishnan Nair, IIT Bombay

January 2020 - February 2021
Research Project

· Modelled the storage in a demand response-enabled renewable-rich grid as a Markov-modulated finite fluid buffer where the net flow is also a piecewise constant function of the buffer occupancy
· Determined the asymptotics of Loss of Load Probability (LOLP) and Loss of Load Rate (LOLR) of such a system w.r.t battery size and characterized the associated cost borne by the utility
· Conducted a case study based on data obtained from NYISO and the NREL WIND toolkit to validate results obtained from the analysis of the system and proposed an algorithm for hierarchical optimization

OTHER PROJECTS

IIT Bombay Student Satellite Program
Student Project

February 2019 - October 2021
Controls, Payload, Electrical and Systems Engineer

· Studied attitude estimation algorithms and worked on determining a reasonable system-wide timestep for accurate simulation of magnetically actuated satellite dynamics as a controls engineer
· Surveyed and analysed the feasibility of payloads such as active thermal control and ozone layer monitoring for experimenting on-board Stage 4 of ISRO's PSLV as a member of the payload subsystem
· Reviewed, implemented, modified, and tested the performance of fixed-threshold based sequential star centroiding algorithms for the team's star tracker as an electrical engineer
· Spearheaded a team of 25 students in building the star tracker, taking technical and administrative decisions and ensuring compliance with QA practices as the system lead

Rare Event Simulation Techniques
Course Project - EE 736: Introduction to Stochastic Optimization

Spring 2021
Instructor: Prof. Vivek Borkar

· Examined the use of importance sampling as a variance reduction technique for Monte Carlo simulations and characterized good proposal distributions by observing the properties of the zero-variance estimator
· Explored schemes to adaptively learn the zero-variance measure as well as the use of exponentially twisted distributions as proposal distributions and reviewed applications of importance sampling in various fields such as reliability analysis, queueing systems, and network analysis
· Studied techniques for simulating systems involving heavy-tailed random variables and their applications in financial engineering

GRADUATE-LEVEL COURSEWORK

· Stochastic Optimization	· Information Theory and Coding
· Advanced Probability and Random Processes	· Markov Chains and Queueing Systems
· Estimation And Identification	· Wireless & Mobile Communication
· Error Correcting Codes	· Finite Fields
· Optimal Control	· Cryptography and Number Theory

TECHNICAL SKILLS

Languages: C, C++, Python, R, VHDL   **Software:** MATLAB, LaTeX, ns-3, SageMath, cvx

POSITIONS OF RESPONSIBILITY

Mentor, Department Academic Mentorship Program   2022-23
Student Mentorship Program, IIT Bombay

· Selected into a team of 48 mentors based on a rigorous process involving personal interviews and peer review, tasked with helping 6 sophomores strike a balance between academics and extracurriculars
· Actively involved in bridging the student-faculty gap and making students' academic experience better

Teaching Assistant   Autumn 2022, Spring 2023
EE 325 - Probability and Random Processes, EE 6106 - Online Learning and Optimization

· Responsible for grading exam papers and assignments, conducting vivas, and exam invigilation
· Conducted tutorials and sessions to help students revise concepts and improve problem-solving

Mentor, Summer of Science 2022   Summer 2022
Institute Technical Council, IIT Bombay   *Summer Program*

· Successfully mentored two students for a three-month-long reading project on Information Theory
· Provided resources, solved doubts, and interfaced between the Institute Technical Council and students

MISCELLANEOUS ACTIVITIES

Conferences and workshops

· Gave a paper presentation at the 2022 IEEE International Symposium on Information Theory (ISIT), Aalto University, Espoo, Finland
· Volunteered at and attended the 2022 IEEE Information Theory Workshop at IIT Bombay
· Attended the tutorials and sessions at ACM SIGMETRICS/IFIP Performance 2022 (IIT Bombay) and the JTG/IEEE ITSoc Summer School 2022 (IIT Mandi)

Music:

· Certified for proficiency in playing the tabla, up to the Madhyama Pratham (Intermediate, Part 1) certification, and in Indian classical vocal singing up to the Praveshika Purna (Matriculation) certification by the Akhil Bharatiya Gandharva Mahavidyalay Mandal

Quizzing

· Represented IIT Bombay at the third Inter-IIT Cultural Meet, 2018, as a part of the 6-member Quizzing and Word Games contingent, winning the third prize in Word Games
· Represented IIT Bombay the fourth Inter-IIT Cultural Meet, 2019, as a part of the 20-member Quizzing contingent