

Puranjay Datta

Curriculum Vitae

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Education

2019 – 2024 **Btech&Mtech**, *Electrical Engineering*, [Indian Institute of Technology, Bombay](#) **CGPA 9.42**.

2019 – 2024 **Minor**, *Computer Science*, [Indian Institute of Technology, Bombay](#).

2019 **Intermediate**, *Ratanbai Walbai Junior College, Maharashtra, India* 93.07%.

2017 **Matriculation**, *Smt Sulochanadevi Singhania School, Mumbai, India* 97%.

Research Interests

Robotics, Reinforcement Learning, Markov Chains, Stochastic Control, Game Theory

Drafts

- **Fianchetto: Speed, Belief, Guile, Caution to Win at Reconnaissance Blind Chess**

In preparation. With Mohammad Taufeeque, Nitish Tongia, Shivaram Kalyanakrishnan, Anvay Shah

- **Hierarchical Inference in Deep Learning applications at the Edge**

In preparation. With Jaya Prakash Champati, Sharayu Moharir

Research Experience

Autumn '23 **Hierarchical Inference using Online Learning**

Guide [Sharayu Moharir](#) | *Master's Thesis*

- Explored **optimal offloading strategy** between **small low-accuracy** ML models on edge devices and **large high-accuracy** ML models on edge servers using **hedge** online learning framework
- Converted from **continuous to the discrete** expert setting by using the Lipschitz nature of the loss function to eliminate the dependency on the **discretization** resulting in **linear adversarial regret**
- Improved the bound from $O(T^{\frac{2}{3}})$ for the hedge with partial restarts to $O(\sqrt{T \ln T})$ for our variant
- Surveyed literature pertaining to **Online Recursive Weighting** involving a non convex **Lipschitz loss**

Summer '23 **Transfer learning in NVIDIA isaacgym**

Guide [Hatem Abou Zeid](#) | *MITACS University of Calgary*

- Explored how the body shape of a **humanoid** impacts its motion using **NVIDIA's isaacgym**
- Analyzed different shapes in the **MuJoCo** simulator which influenced the different **reward** components
- Studied the application of **Adversarial Motion Priors** in training humanoid agents using motion datasets, investigating transfer learning to another task using **one-shot transfer learning**

Spring '23 **Networked Fairness in Cake Cutting**

Guide [Swaprava Nath](#) | *CS6002 Advanced Game Theory*

- Pioneered a novel approach to **cake-cutting with networked agents** for **envy-free allocations**
- Devised **moving-knife algorithms** for envy-free allocations on **cycle networks** up to 6 nodes and size 3 cliques connected by a bridge using **Austin Cut** and **Brams Taylor Zwicker** procedure
- Improved **Aziz and McKenzie's** tower of $6n'$'s bound to $O(n^{n^2})$ using an iterative Go Left Protocol
- Modified the different definition of **extractions and significant advantage** by taking $B = \frac{1}{n^2}$

Spring '23 **Enhancing the Neurips Reconnaissance Blind Chess Agent**

Guide [Shivaram Kalyanakrishnan](#) | *CS748 Advances in Intelligent and Learning Agents*

- Modelled as **POMDP** with Leela Chess Zero as a meta-learning expert and **policy rollout** of depth 2

- Developed a **Replay Buffer** to assess blunders and move scores to highlight Fianchetto bot's limitations
- Tested the **opponent modeling strategy** by training the weights of the **meta-expert LCzero engine**
- Adapted a new consistent scoring system $V(s)$ compared to $Q(s, a)$ with heuristics for speed up

Work Experience

Summer '22 **Evaluation of methods in base-band to generate efficient pre-distorted signal for Power Amplifier**

Guide [Jawaharlal Tangudu](#) | [Texas Instruments](#)

- Studied about **Generalized Memory Polynomial** model for Digital Predistortion of Power Amplifiers
- Implemented **Iterative Learning Control(ILC)** to identify the parameters of the digital predistorter
- Tried to improve the results of using the **Vector Switched Models(VSM)** by using **Volterra kernels**
- Compared the traditional Memory Polynomial Model with ILC based on metrics like **ACLR and SNR**

Key Projects

Spring '23 **Training a Generative model for Weak Supervision**

Guide [Sunita Sarawagi](#) | [CS726 Advanced Machine Learning](#)

- Trained using **Snorkel**, a generative model to capture the relationships among **labeling functions**
- Experimented on salary prediction, twitter sentiment analysis where a **discriminative model** like logistic regression, recurrent neural network was trained on these labels which improved the accuracy

Autumn '22 **Wavelets in Convolutional Neural Network**

Guide [Vikram M Gadre](#) | [EE678 Wavelets](#)

- Developed a sparse neural network combining **LSTM and wavelets** for predicting atmospheric profile
- Implemented **Level-2 decomposition** with **separate k-band, v-band** training to improve the accuracy

Summer '21 **Micro-doppler and Radar Signal Processing**

Guide [Prof Vikram M Gadre](#), [Shrikant Sharma](#)

- Researched about **bessel decomposition** of micro-doppler signals, estimation of **side band frequency**
- Tested different nonlinear equation solvers like **least square, root music, and annihilation filter**

Autumn '22 **Grouped Multiarm Bandits**

Guide [Prof Sharayu Moharir](#)

- Performed literature survey on **PAC** algorithms for best arm identification **multiarm bandit**
- Modified the **UCB/LCB** conditions to adapt to the grouped bandits with a minimum constraint
- Analyzed **stopping time complexity** of **D tracking** variant against **Hardness** measure

Spring '22 **Temperature Control using Pulse Width Modulator**

Guide [Prof Kushal Rajanikant Tuckley](#) | [EE-344 Electronic Design Lab](#)

- Created a PCB layout using **Eagle** software that was translated into a physical **working prototype**
- analyzed the negative feedback design Enhanced the user interface by creating a dynamic display of temperature sensor i.e **Negative Temperature Coefficient Thermistor** using **Arduino**.

Other Projects

Autumn'21 **Automatic test pattern generation and logic minimizer**

- Implemented **PODEM (Path-Oriented Decision Making)** to detect **stuck-at faults** using dfs
- Implemented the **Espresso** heuristic logic minimizer, utilizing **irredundant and reduce** logic operations

Spring'21 **Bank Queue Simulator on 8051 microprocessor**

- Simulated a dynamic bank queue with 4 counters using **embedded C** and **UART communication** on a **Pt-51 microcontroller** board which emulated customer and teller actions based on key presses

- Autumn'22 **Optimal Strategy in Cricket**
 - Implemented the key press using **Timer**, **serial interrupt (RI and TI flag)**, and **LCD commands**
- Spring'22 **Cryptography and Security Applications**
 - Implemented **Howard's policy iteration**, **Linear programming** to compute the optimal policy
 - Computed the best strategy for the batsman by formulating the last over of cricket as an **MDP**
- Spring'22 **Computer Vision-Optical Flow**
 - Compared side-channel attack **Differential Power Analysis** with **Phase-waveform** matching
 - Implemented Phase correlation to identify offset in **power trace** after attenuating noise using filters
- Spring'22 **Computer Vision-Optical Flow**
 - Tested the **Lucas Kanade Optical flow** on edge cases showcasing its strengths and weakness
 - Surveyed blogs on Corner detection(**Harris and Shi Tomasi**) and precipitation nowcasting applications

Scholastic Achievements

- 2023 Recipient of the **MITACS** Globalink Research Internship Fellowship
- 2019 Secured **All India Rank 460** in **IIT JEE-Advanced** out of 245,000 candidates
- 2019 Achieved **All India Rank 300** in **JEE Mains** out of 1.14 million candidates
- 2018 Secured **All India Rank 132** in Kishor Vaigyanic Protsahan Yojana (KVPY)
- 2019 Awarded Certificate of Merit for being among the **Statewise top 1%** in the **NSEC**

Position of Responsibility

- Spring '23 **NPTEL Digital Signal Processing and its Applications, IIT Bombay**
 - Guide [Vikram Gadre](#) | *IIT Bombay*
 - Prepared **solution** for **tutorial** problems and final examination based on **Z-transform**, **FFT**, **Filters**
 - Addressed **queries** on an **online forum**, providing assistance to a total of **4558 enrolled students**
 - Assisted Prof Vikram Gadre in an **online YouTube doubt session**, addressing students' queries
- Autumn '23 **Teaching Assistant**
 - Guide [Sharayu Moharir](#) | *EE325 Probability and Random Processes*
 - Responsible for **proctoring exams** and **grading** answer scripts for 200+ **Electrical Sophomores**

Technical Skills

- Programming C++, Embedded C, Python, Julia, Matlab, VHDL, Assembly Language, MIPS
- Libraries Matplotlib, NumPy, Pandas, $\LaTeX$, Tensorflow, OpenCV, Scikit-learn, OpenAI Gym, PyTorch, IsaacGym
- Others Git, Docker, skrl, MuJoCo, HTML, CSS, Javascript, Bootstrap, Quartus, AutoCAD, SageMath

Relevant Coursework

- Electrical Engineering Communication Systems, EM Waves, Analog Circuits, Digital Systems, Probability and Random Processes, Signal Processing, Electronic Devices & Circuits, Microprocessors, Wavelets
- Computer Science Data Structures and Algorithms, Logic for Computer Science, Design and Analysis of Algorithms, Game Theory and Algorithmic Mechanism Design, Advances in Intelligent and Learning Agents
- Probability & Statistics Introduction to Stochastic Optimization, A First Course in Optimization, Markov Chains and Queuing Systems, Introduction to Stochastic Control

Extracurricular Activities

- Won **silver medal** twice in **Chess Inter Hostel General Championship** in IIT Bombay.
- Engineered manually** controlled bot capable of negotiating obstacles in **XLR8 Competition**
- Represented my Hostel in **Table Tennis Inter-Hostel** General Championship in IIT Bombay