Puranjay Datta | **19D070048**
Electrical Engineering | **Dual Degree (B.Tech. + M.Tech.)**
Indian Institute of Technology Bombay | **Gender: Male**
Specialization: Communication & Signal Processing | **DOB: 14/12/2001**

Examination	University	Institute	Year	CPI / %
Graduation	IIT Bombay	IIT Bombay	2024	9.34
Intermediate	HSC	Ratanbai Walbai Junior College of Science	2019	93.08%
Matriculation	ICSE	Smt. Sulochanadevi Singhania School	2017	97.00%

Pursuing **Minor degree** in the Department of **Computer Science and Engineering**

SCHOLASTIC ACHIEVEMENTS

- Achieved **Department Rank 7** out of 70 students in Electrical Engineering Dual Degree *(2023)*
- 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 *(2019)*
- Secured **All India Rank 132** in Kishor Vaigyanic Protsahan Yojana **(KVPY)** and awarded fellowship *(2018)*
- Awarded Certificate of Merit for being among the **Statewise top 1%** in the **NSEC** and qualified to **INCHO** *(2019)*

INTERNSHIPS

Transfer learning in NVIDIA isaacgym
(May'23 - Present)

MITACS University of Calgary, Canada — *Guide : Prof Hatem Abou Zeid*

- Explored how the body shape (scaling hands and legs) of a **humanoid** impacts its motion using **NVIDIA's isaacgym**
- Analyzed different shapes in the **MuJoCo** simulator which influenced the different **reward** components like velocity
- Studied the application of **Adversarial Motion Priors** in training humanoid agents using motion datasets, investigating how the acquisition of skills in one task can lead to accelerated learning in another task using **one-shot transfer learning**

Predistortion signal for Power Amplifier
(May'22 - July'22)

Texas Instruments, Bengaluru — *Guide : Prof Jawaharlal Tangudu*

- Studied about **Generalized Memory Polynomial (Volterra kernels)** Model for **Digital Predistortion** of Power Amplifiers
- Experimented with **Iterative Learning Control, Vector Switched Models** on industrial amplifiers for various bandwidths
- Compared the performance of Memory Polynomial Model with Iterative Learning Control based on **ACLR, SNR** metrics

RESEARCH PROJECTS

Neurips Reconnaissance Blind Chess Agent
(Jan'23 - Present)

CS 748 Advances in Intelligent and Learning Agents — *Guide : Prof Shivaram Kalyanakrishnan*

- Developed **Replay Buffer** to assess blunders, move scores to highlight the Fianchetto bot's limitations in **threat detection**
- Tested the **opponent modeling** strategy which involved training the weights of the **Leela Chess Zero** engine to anticipate the opponent's moves and verified it playing games on the **Reconnaissance Blind Chess server** against different bots
- Adapted a new scoring system based on the **Q value of position** instead of the **P value** as a score for different moves

Networked Fairness in Cake Cutting
(Apr'23 - Present)

CS 6002 Advanced Game Theory — *Guide : Prof Swaprava Nath*

- Pioneered a novel approach to traditional **cake-cutting with networked agents** for efficient **envy-free allocations**
- Extended existing algorithm for **binary trees**, incorporating an extra edge at level 1 while maintaining fairness complexity
- Devised **moving-knife algorithms** for envy-free allocations on **cycle networks** in cake cutting up to 6 nodes and size 3 cliques connected by a bridge using **Austin Cut** and **Brams Taylor Zwicker** procedure, optimizing the cut counts

Inference using Online Learning
(May'23 - Present)

Master's Thesis — *Guide : Prof Sharayu Moharir*

- Formulated a variant of **hierarchical deep learning inference** at the edge for binary classification and explored the impact of employing two distinct **hedge experts** for predictions by creating a synthetic dataset mimicking ML models
- Investigated the effects of **false positives, false negatives, true positives, and true negatives** on the total loss incurred
- Studied adaptive hedge involving the **learning rate doubling trick** for optimal expert learning using **mixability gap**

Multiarm Bandits
(Aug'22 - May'23)

Supervised Research Exposition — *Guide : Prof Sharayu Moharir*

- Performed literature survey on **Probably Approximately Correct** algorithms for best arm identification **multiarm bandit**
- Implemented the **successive elimination and median elimination** algorithm and tried it for different epsilon and deltas
- Modified the **Upper & Lower confidence bound** conditions to adapt to the grouped bandits with a minimum constraint
- Analyzed **stopping time complexity** of **D tracking** variant against **Hardness** measure using helpful arm characterization

ACADEMIC PROJECTS

Training a Generative model for Weak Supervision | *CS 726 Advanced Machine Learning* *(Apr'23 - May'23)*

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

Wavelets in Convolutional Neural Network | *EE 678 Wavelets* *(Sept'22 - Nov'22)*

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

Shadow Removal and Detection | *EE 610 Image Processing* *(Sept'21 - Nov'21)*

- Implemented the **water-filling diffusion** algorithm and k-means to equalize the global and local shadow background
- Trained a **Stacked CGAN** on an **Image shadow triplets (ISTD)** dataset with annotations in the form of the **shadow mask**

Reinforcement Learning in Cricket | *CS 747 Foundations of Intelligent and Learning Agents* *(Sept'22 - Nov'22)*

- Implemented **Howard's policy iteration (HPI), Linear programming** to compute the optimal value function and policy
- Computed the best strategy for the batsman by formulating the last over of cricket as an **MDP using the HPI**

Micro Doppler and Radar Signal Processing | *Research Programme(SURP)* *(June'21 - July'21)*

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

Temperature Control using Pulse Width Modulator | *EE 344 Electronic Design Lab* *(Feb'22 - May'22)*

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

Automatic test pattern generation and logic minimizer | *EE 677 Foundation of VLSI CAD* *(Sept'21 - Nov'21)*

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

Bank Queue Simulator on 8051 microprocessor | *EE 337 Microprocessors Laboratory* *(Apr'21 - May'21)*

- 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 from a connected keyboard
- Implemented the key press of the token using **Timer, serial interrupt (RI and TI flag), and LCD commands**

Stream Cipher | *EE 720 Introduction to Number Theory and Cryptography* *(Sept'21 - Nov'21)*

- Created a **68-bit** scaled-down version of Trivium Cipher in **SageMath** to generate **pseudo-random bits** using IV and key
- Analyzed **linear complexity** profile using the **Berlekamp Massey** Algorithm which expressed the predictability of cipher

POSITION OF RESPONSIBILITY

TEACHING ASSISTANT | NPTEL Digital Signal Processing and its Applications, IIT Bombay *(Jan'23 - Apr'23)*

- Prepared objective-type questions for assignments and final examination based on Z transform, FFT, DFT, Filters
- Addressed queries regarding assignments on an online forum, providing assistance to a total of 4558 enrolled students
- Assisted an online YouTube doubt session with Prof Vikram Gadre, aiding in addressing students' queries

TECHNICAL SKILLS

- **Programming Languages:** 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, GNURadio

KEY COURSES UNDERTAKEN

- **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

EXTRA-CURRICULARS

- Won **gold medal** in Inter Department and **silver medal** twice in **Chess Inter Hostel General Championship** *(2022)*
- Engineered **bluetooth** controlled bot capable of negotiating different kinds of obstacles in **XLR8 Competition** *(2019)*
- Represented my Hostel in **Table Tennis General Championship** and completed a year-long **NSO TT** program *(2022)*