Rathour Param Jitendrakumar | **190070049**
Electrical Engineering | **Dual Degree (B.Tech. + M.Tech.)**
Indian Institute of Technology Bombay | **Gender: Male**
Specialization: Control and Computing | **DOB: 07/10/2001**

Examination	University	Institute	Year	CPI / %
Graduation	IIT Bombay	IIT Bombay	2024	9.03
Intermediate	CBSE	St. Tukaram National Model School Latur	2019	96.60%
Matriculation	CBSE	Podar International School Latur	2017	10

Pursuing a **Minor** in **Computer Science & Engineering**

Scholastic Achievements

- Achieved a perfect **10 SPI** during the 8th and 9th semesters at IIT Bombay with 36 and 48 credits, respectively *(2023)*
- Awarded an **AP** grade for exceptional performance in the Advanced Computer Architecture course at IIT Bombay *(2023)*
- Secured **All India Rank 926** in Joint Entrance Examination (**JEE**) **Advanced** among 161 thousand candidates *(2019)*
- Secured **99.9%** percentile in Joint Entrance Examination (**JEE**) **Main** among 1.1 million candidates *(2019)*
- Recipient of the National Talent Search (**NTS**) Scholarship received by the top 1000 students in the country *(2017)*
- Awarded Academic Excellence Scholarship (**AES**) by SOF given to a **single student** per class in each state *(2017)*
- Recipient of the Maharashtra Talent Search (**MTS**) Scholarship with **State Rank 11, 10,** and **16** respectively *(2015-17)*

Work Experience

NVIDIA | GPU Subsystem

Guide: Raghuram L

ASIC Intern | Modeling the **NVLink** pipe ID in the GPU performance simulator *(May 2022 - Jul 2022)*

- Explored **PerfSim** building blocks, knobs, debugging, and architectural & performance testing of models in C++
- Worked on enhancing the NVLink interconnect performance model to incorporate multiple pipes per High-Speed Hub
- Integrated a 1-D arbiter class template to the NVLink performance model while thoroughly maintaining its functionality

Key Projects

Visual Learning and Recognition of 3-D Objects from Appearance *(Oct 2023 - Nov 2023)*

Guide: Prof. Ajit Rajwade *(CS663 | Fundamentals of Digital Image Processing | Course Project)*

- Implemented a high-performance training and testing pipeline for object detection and pose estimation using **Python**
- Utilised Principal Component Analysis **(PCA)** and cubic interpolation to construct parametric manifolds for each object
- Conducted a comprehensive study across objects with varying complexities to determine **optimal** hyperparameter values
- Achieved an object recognition accuracy of **99.172%** and a mean pose error of **6.872**° by using the **COIL-100** dataset

Efficient Cache Replacement Policy using Reinforcement Learning *(Sep 2023 - Nov 2023)*

Guide: Prof. Biswabandan Panda *(CS683 | Advanced Computer Architecture | Course Project)*

- Implemented Reinforcement Learned Replacement (RLR), an eviction policy based on age, hit and type priority of cache-lines
- Designed Micro-Armed Bandit-based (MAB) replacement, utilising **temporal homogeneity** in the action space of policies
- Evaluated both policies in **ChampSim** using 49 memory intensive traces from **SPEC** 2017 benchmarks and achieved an overall IPC speedup over LRU of **5%** for RLR and **1.2%** for MAB with LRU, SHiP, SRRIP, DRRIP in its action space

Intelligent and Learning Agents *(Jul 2021 - Nov 2021)*

Guide: Prof. Shivaram Kalyanakrishnan *(CS747 | Foundations of Intelligent and Learning Agents | Course Project)*

- Implemented and compared ε-greedy, **UCB**, KL-UCB and Thompson Sampling for a stochastic multi-armed bandit framework
- Performed **MDP Planning** using Value Iteration, Howard's Policy Iteration and Linear Programming with **PuLP** in Python
- Propelled up a car placed at the bottom of a sinusoidal valley using **Sarsa** with **Tile Coding** in the **OpenAI** Gym environment

Autonomous Robotic Systems and Control *(Jan 2023 - May 2023)*

Guide: Prof. Debasattam Pal *(EE615 | Control and Computing Lab | Course Project)*

- Realised **path planning** and **obstacle avoidance** of autonomous mobile robots in **MATLAB** using Vector Field Histogram
- Executed **sensor fusion** using complementary & **Kalman filter** for estimating the orientation of inertial measurement units
- Implemented stabilisation of Rotary Inverted Pendulum using Swing-Up Control and **Linear-Quadratic Regulator** Control

Coded Computing for Straggler Mitigation, Security and Privacy *(Sep 2021 - Nov 2021)*

Guide: Prof. Nikhil Karamchandani *(EE605 | Error Correcting Codes | Course Project)*

- Investigated polynomial coding and Lagrange Coded Computing (LCC) techniques to mitigate fundamental bottlenecks in **Large-Scale Distributed Computing** for computing matrix multiplications and evaluating arbitrary multivariate polynomials
- Explored applications of LCC in secure & private **Multi-Party Computing** (MPC) and **privacy-preserving** machine learning

Dining Philosophers: A Synchronisation Problem *(Jan 2022 - May 2022)*

Guide: Prof. Mythili Vutukuru *(CS347 | Operating Systems | Course Project)*

- Modelled the threads by creating custom semaphores using condition variables and mutex abstractions of **pthreads** API
- Devised and implemented two solutions by using **semaphores** and **condition variables** each and proved their correctness

Pushdown Timed Automata: Theory and Practice *(May 2022 - Dec 2022)*

Guide: Prof. Akshay S. *(CS490 | Research and Development | Academic Project)*

- Conceptualized modelling problems for Pushdown Timed Automata (PDTA) from Embedded Systems and WCET Benchmarks
- Conducted intensive review of various tools for the simulation and **reachability analysis** of Pushdown Automata & PDTA
- Developed methodology to extract Pushdown Systems of **Boolean** and **Remopla** programs using **Moped** Model Checker

Computational Commutative Algebra and Geometry *(Jul 2022 - Nov 2022)*

Guide: Prof. Debasattam Pal *(Supervised Research Exposition)*

- Investigated into the theory and computation of **Gröbner Bases** for Ideals in a polynomial ring $k[x_1, \ldots, x_n]$ over a field F
- Explored the algebraic and geometric applications of Gröbner Bases in solving Ideals, Varieties and Nullstellensatz problems
- Implemented fast solvers for system of linear & polynomial equations and Sudoku in **SageMath** using Elimination Theory

Data-Driven Dynamical Systems *(Jan 2023 - May 2023)*

Guide: Prof. Vivek Borkar *(EE736 | Stochastic Optimization | Course Project)*

- Reviewed the paradigms of Koopman Theory, Dynamic Mode Decomposition (**DMD**) and Extended DMD with control
- Examined the ideas for discovering governing equations from data by Sparse Identification of Nonlinear Dynamics (**SINDy**)
- Investigated into Compressed Sensing and **Sparse Regression** techniques for solving the intermediate stages of SINDy

Distributed Deep Learning *(Mar 2020 - Jul 2020)*

Institute Technical Summer Project (ITSP) *(Institute Technical Council, IIT Bombay)*

- Developed a Hierarchically-Distributed Deep CNN learning model for training **super-high-resolution datasets** via spatial segmentation of each sample and observed an increase in **training speed** and a decrease in **memory utilisation** per node
- Verified the approach by using Kaggle's **Retinal OCT** dataset and analysed loss of information due to spatial segmentation

Positions of Responsibility

IIT Bombay Racing | Electrical Subsystem

A cross-functional team of 70+ students which designs, fabricates and assembles an Electric Race Car for Formula Student (FS) UK

Junior Design Engineer | LV Safety Subsystem *(Sep 2020 - May 2021)*

- Simulated the LV Safety board on **LTSpice** and verified the working of RTDS, brake light, and error blocks of the subsystem
- Explored Electromagnetic Interference (**EMI**) reduction techniques to be incorporated into PCB designs of the subsystem
- **Mentored** 3 trainees in understanding the subsystem through the FS rulebook, circuit design tasks, and LTspice simulations

Trainee | Electrical Subsystem *(Jan 2020 - Aug 2020))*

- Investigated the Electronic Control Unit (**ECU**) subsystem, working with RPM and position sensors and realised the working of the steering, acceleration pedal and brake sensors of the car with **Arduino IDE** (Integrated Development Environment)
- Acquired knowledge of Controller Area Network (**CAN**) protocol & Data Acquisition (**DAQ**) system and their implementation, programmed code for wireless communication using **LPC1768 Mbed** microcontroller and **XBee** module

Teaching Assistant | IIT Bombay

Computer Programming and Utilisation | **CS101** *(Autumn 2020, Autumn 2021, Spring 2022, Autumn 2022)*

- Academically guided **50** students and cleared their doubts through weekly doubt sessions, labs and personal interaction
- Prepared and evaluated examinations & lab problems and conducted Hindi help sessions for students facing language barriers
- Brainstormed **60+ practice problems** for CS101, shared via a personal **webpage** with tips and resources to boost interest

Multivariable Control | **EE640** *(Autumn 2023)*

- Academically guided **40+** students, clearing their doubts through tutorials and assisting the instructor in course logistics

Mentor | Summer of Science *(Summer 2021, Summer 2022, Summer 2023)*

Topics: Linear Algebra, Data Structures and Algorithms, Cryptography, Reinforcement Learning *(Maths and Physics Club, IIT Bombay)*

- Mentored **six students** in exploring the subject, cleared their doubts, reviewed and evaluated their reports & presentations

Technical Skills

Languages	C, C++, Python, Julia, MATLAB, Scilab, LaTeX, HTML, CSS, SQL, Embedded C, VHDL, MIPS, 8086
Frameworks	Git, Docker, SageMath, Qiskit, NumPy, SciPy, pandas, scikit-learn, OpenCV, TensorFlow, Keras, Jekyll
Software	Simulink, EAGLE, SPICE, Intel Quartus, Keil μVision, GNURadio, Adobe Illustrator, SOLIDWORKS

Key Courses Undertaken

Electrical	Advanced Computer Architechture, Digital Systems, Signal Processing, Information Theory and Coding
Computer Science	Operating Systems, Computer Networks, Data Structures, Design and Analysis of Algorithms, Advanced Image Processing†, Intelligent and Learning Agents, Formal Methods in Machine Learning
Mathematics	Linear Algebra, Large Sparse Matrix Computations, Game Theory and Algorithmic Mechanism Design, Probability and Random Processes, Stochastic Optimisation, Logic, Number Theory and Cryptography
Bootcamps	Data Analytics, Scientific Computation and Mathematical Modelling, Quantum Computing, Tinkering

†*to be completed by May 2024*

Extracurriculars

Volunteering	• Conducted an institute-wide **Computer Programming** session (TSC) attended by 100+ students *(2022)* • Contributed to Career Counselling Campaign for 12,000+ indigent students by **Abhyuday** *(2019)* • **Mentored** JEE students during the **COVID-19** crisis as a part of **CovEd Education** *(2020)*
Miscellaneous	• Composed articles on exciting labs and scientific content as an **Editor** of Department Newsletter *(2020)* • Completed a year-long **training program** as **NCC Cadet** under 2 MER NCC at IIT Bombay *(2019)* • Part of the **Inter-Department E-Sports** Fest winning squad representing the **Smashkarts** team *(2022)*