

# Parth Dodhia

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## RESEARCH INTERESTS

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Reinforcement Learning, Machine Learning, Optimization, Probability and Statistics

## EDUCATION

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Indian Institute of Technology (IIT) Bombay, Mumbai, India

Aug '18-present

Bachelor of Technology, Electrical Engineering, *Expected: Summer 2022*

- **Honours** in Electrical Engineering, **Minor** in Computer Science and Engineering
- **Cumulative Performance Index (CPI)** : 9.86/10

## SCHOLASTIC ACHIEVEMENTS

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- Ranked **1<sup>st</sup>** in the Electrical Engineering department among **150** students
- Awarded Institute Academic Prize and Urvis Medh Memorial Prize **twice** for outstanding academic performance
- Received the Quadeye Excellence Scholarship based on academic achievements and quantitative reasoning skills
- Awarded **4 AP** (Advanced Performer) grades for extraordinary performance in Differential Equations, Digital Signal Processing, Network Theory, and Physical Chemistry
- Secured All India Rank **203** in **JEE Advanced** examination among **0.15 million** candidates
- Secured All India Rank **333** in **JEE Mains** examination among **1.1 million** candidates
- Nominated for **INSPIRE** fellowship by **Govt. of India** for being in **top 1%** of HSC board

## PUBLICATIONS

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- S. Chandak, V. S. Borkar and P. Dodhia, "Concentration of Contractive Stochastic Approximation and Reinforcement Learning", *arXiv (2021)*, 2106.14308. *Submitted to Stochastic Systems.*

## RESEARCH EXPERIENCE

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Contractive Stochastic Approximation

Aug '21-present

Mentor : Prof. Vivek Borkar | IIT Bombay

- Derived a tail-error concentration bound for contractive stochastic approximation with Martingale difference and Markov noise using a Martingale concentration inequality, and applied it to asynchronous Q-learning and TD (0)
- Working on extending it to Q-learning on POMDPs by learning environment dynamics from observations in an offline setting, using encoder-decoder neural networks with agent states as latent variables
- Simulating the Q-learning scheme on agent's aleatoric states for the discounted Linear Quadratic Gaussian problem

Adaptive Frank-Wolfe algorithm

Dec '20-present

Mentor : Tavor Baharav, Prof. Mert Pilanci | Stanford University

- Reviewed literature on best arm identification in Multi-Armed Bandits and formulated finding the largest element in a matrix-vector product as a Multi-Armed Bandit problem by treating each element in the sum as an unbiased estimator
- Simulated Sequential Halving, LUCB and successive elimination algorithms to identify largest element in fixed budget and fixed confidence settings on synthetic data and observed orders of magnitude of computational gains from the exact method
- Applied adaptive algorithms to solve for greedy selection in the Frank-Wolfe algorithm for constrained Lasso optimization and showed significant computational gains on synthetic and real-world datasets

Data Subset Selection

Aug '21-present

Mentor : Prof. Abir De | IIT Bombay

- Estimating parameters of a linear system with unknown latent states from a subset of a large number of observations
- Implementing a modified version of the Luenberger observer algorithm with greedy subset selection for simultaneous state and parameter estimation

## Self Supervised Contextual Bandits

Jul '21-present

Mentor : *Prof. Manjesh Hanawal | IIT Bombay*

- Tackling online image and text classification as a contextual multi-armed bandit problem using LinUCB and KernelUCB as baseline algorithms
- Experimenting with the use of various self-supervision techniques along with bandit training on NeuralUCB to improve performance in the initial stages when less data is available

## INTERNSHIPS

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**Cartoon Stylization of Images** | *AI-Big Data Lab, Samsung Electronics, South Korea*

Jun '21-Jul '21

- Extended CartoonGAN and AnimeGAN TensorFlow models for cartoon stylization of images with minimal train data
- Proposed the use of Differentiable Data Augmentation, and ideated cartoon stylization with different artist styles as a Transfer Learning task to slash required train set size by 90%

**Climate Word Classifier** | *Centre for Analytical Finance, Indian School of Business, Hyderabad*

Apr '20-May'20

- Fine-tuned GloVe vectors on IPCC climate reports using hyperopt to tune hyper-parameters, and used K-means clustering on obtained word-vectors to create an unsupervised climate-word classification dataset
- Implemented a PyTorch bi-directional LSTM word-classifier and tackled class imbalance using weighted cross-entropy loss to achieve Kappa score of 0.75 on the test set

## ACADEMIC PROJECTS

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**Channel Coding via Neural Mutual Information Estimation** | *Introduction to Machine Learning*

Spring '21

- Implemented TensorFlow neural network based communication systems for channels with unknown statistics
- Used Mutual Information Neural Estimator for training and matched QAM performance on AWGN channel

**Maze Solver** | *Foundations of Intelligent Learning Agents*

Fall '20

- Implemented Policy Iteration, Value Iteration and Linear Programming solutions to MDPs using Python
- Encoded given mazes as MDPs with suitable transition probabilities and rewards to find shortest paths

**Obstacle Avoidance Game** | *Microprocessors Lab*

Spring '21

- Simulated Google Chrome's Dinosaur Game on Pt-51 micro-controller and LCD with UART keyboard input
- Exploited interrupt priorities to tackle adversarial continuous inputs and ideated switch controlled difficulty levels

## KEY COURSES

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- **Electrical Engineering**- Digital Communication, Controls Systems, Digital Signal Processing, Microprocessors, Communication Systems, Electromagnetic Waves, Signal and Systems, Analog Circuits, Digital Systems
- **Computer Science**- Foundations of Intelligent and Learning Agents, Introduction to Machine Learning, Online Machine Learning, Design and Analysis of Algorithms, Data Structures and Algorithms, Computer Programming and Utilization
- **Mathematics and Statistics**- Advanced Probability and Random Processes, Optimization, Data Analysis and Interpretation, Calculus, Linear Algebra, Differential Equations, Complex Analysis

## TECHNICAL SKILLS

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- **Programming Languages and Libraries** : C++, Python, PyTorch, Tensorflow, MATLAB
- **Softwares** : Keil  $\mu$ Vision, Scilab,  $\text{\LaTeX}$ , NgSpice, Quartus, Eagle, AutoCAD, Xcircuit

## MENTORSHIP

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**Department Academic Mentor and Institute Student Mentor**

Jun'20-present

- Guiding freshmen and sophomore students to help them excel in academics and thrive in the institute
- Helping junior students plan courses, cope with the curriculum and overcome academic difficulties

## EXTRA CURRICULAR ACTIVITIES

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- Volunteered as an instructor for 'SHALA 2020', a free online Machine Learning course for college students
- Completed a one year course of **Lawn Tennis** under **National Sports Organisation**
- Awarded **Black Belt** in Kung fu and Aikido by **Fudoshin Martial Arts School**