# Parth Milind Shettiwar

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## Education

**Indian Institute of Technology Bombay** — Mumbai, India
*Btech. in Electrical Engineering* — 2017–Current
*Minor in Computer Science and Engineering* — *GPA: 9.48/10*
*Minor in AI and Data Science*
*Honors in Electrical Engineering*

## Publications

- **Size Optimization for Intent Analysis in Voice Commanding**[Paper]
  ***Parth Shettiwar***, *Koushiki Chaudhuri, Ankit Jain, Shivam Goel, Abhirupa Mitra*
  Work Accepted in Short Paper Track at MLADS-Synapse 2020, Microsoft's internal ML, AI and Data Science conference

## Research and Internship Experience

**Non Stationary Bandits with Periodic Variation**[Paper] — *Mar '21 - May '21*
*Guide : Prof. D. Manjunath* — *IIT Bombay*

- Introduced a new setting in non-stationary bandits by considering the means of arms to vary in a **periodic** fashion.
- Proposed two new algorithms for the **perfectly periodic** setting, **D-PUCB** and **SW-PUCB**, relying on discounted and sliding window approaches respectively and showed a logarithmic regret, validated by their performance on synthetic data.
- Proposed a new algorithm **SW-NPUCB** for the setting when means of arms are **nearly periodic** and show its efficacy on real world data. Achieved state of art performance. Work was submitted to **RL for Real Life Workshop @ ICML 2021**.

**Deep Weakly-Supervised High Speed High Dynamic Range Video Generation**[Abstract][Video] — *Mar '20 - Present*
*Guide : Prof. Shanmuganathan Raman* — *IIT Gandhinagar*

- Devised the first weakly supervised deep learning framework to generate **high Frame Rate High Dynamic Range video** from a sequence of low Frame Rate alternating exposure Low Dynamic Range frames.
- Implemented **Video Frame Interpolation** Technique incorportaing **Depth** and **Flow** estimations to generate multiple high and low exposure LDR frames recursively at each time step.
- Implemented a Novel **Attention-based merge** network for generating HDR video frames using two exposure LDR images. Work was submitted to **SIGGRAPH Asia 2020**.

**Thesis: Few Shot Class Incremental Learning**[Code][Report] — *July '20 - Dec' 20*
*Guide : Prof. Subhasis Chaudhuri, Prof. Biplab Banerjee* — *IIT Bombay*

- Implemented an encoder-decoder **Nearest mean classfier** in a 5-way, 10 shot setup with Inter class, Reconstruction and Centre loss to achieve **98**% accuracy on omniglot dataset.
- Modelled the prototypes as **Gaussian** to ensure better clustering of samples in latent space to further improve the accuracy.
- Proposed and implemented a novel **GAN** based architecture with **distillation** loss to generate samples of previous classes to avoid **catastrophic forgetting** on complex datasets like Imagenet.

**Offline Voice Commanding in Microsoft Word App**[Code][Report] — *May '20 - July'20*
*Microsoft R&D India/Data Scientist Internship*

- Developed and Integrated a **Size Optimized Dynamically Downloadable** Entity Recognizer and Intent Classifier Model for enabling Offline Voice Commanding in Microsoft Word App
- Optimized the size of model by performing an extensive Size vs Accuracy Analysis of in-literature Language Models and achieved a **96**% test accuracy and model size hit incurred of meagre **12kb**.
- Developed a **custom tflite binary** supporting only the operations required by the model bringing its size down from 3.6mb to **268.9 kb**. Work Accepted in Short Paper Track at **MLADS-SYNAPSE 2020**.

***OSR* - Open Set Recognition using Side Information** [Code] — *May '19-July '19*
*Guide : Prof. Biplab Banerjee/Resarch Internship* — *IIT Bombay*

- Implemented Kernel Null Folley-Sammon Transform(**KNFST**) after learning a Discriminative Dictionary for sparse coding via Label Consistent K-SVD(**LC-KSVD**) to achieve >99.9% training accuracy on MNIST dataset
- Obtained a **latent space** having high discrimination amongst known classes by training a Neural Network upon **Triplet + Reconstruction + Classification** loss with the key features extracted by RESNET as an input
- Generated Pseudo Open Set samples from Open Set Prototypes using a **Conditional Wasserstein GAN**(CW-GAN) with Gradient Penalty trained on closed set visual samples using known **word2vec** prototypes as the condition

**Game Theoretic Approach to Optimal Network Allocation**[Code][Report] *Jan '20 - Jun '20*
*Guide : Prof. Prasanna Chaporkar/R&D* *IIT Bombay*

- Modelled and proved the NP-Hard **Optimal Network Allocation** problem as an **exact potential game**
- Proved the existence and uniqueness of the **stationary Gibbs distribution** of the **Markov Chain** defined by **Spatial Adaptive Play Algorithm(SAP) and Concurrent-SAP(C-SAP)**.
- Implementation and Graphical comparison of the convergence of potential functions of 3 Algorithms: **Best Response Dynamics(BRD), SAP and C-SAP** on a simulated aptly **randomized input** to emulate real-world scenario.

# Other Technical Projects

**Semantic Image Inpainting using DCGAN**[Code][Slides] *May '21*
*Guide: Prof.Suyash Awate | Course (Medical Image Computing)* *IIT Bombay*

- Performed image inpainting by finding an optimal latent vector lying on the latent image manifold and closest to the given corrupted image using **context** and **prior loss**.
- Performed **Poisson Blending** on the generated image to preserve the overall intensity values of the missing pixels

**3D Object Detection and Semantic Map Generation**(*Robotic Vision Scene Understanding Challenge 2021*) *April '21*
*Guide: Prof.Sharat Chandran | Course (Computer Vision)* [Code][Slides] *IIT Bombay*

- Using RGB and depth images from the traversal of bot, performed **3D object detection** leveraging object detection networks.
- Created a 3D **semantic map** of the environment with bounding boxes around each object using **3D NMS** algorithm

**Image Toonification** [Code][Slides] *March '21*
*Guide: Prof.Biplab Banerjee | Research Project* *IIT Bombay*

- **Cartoonised** real life images to the domain of **Anime** style images leveraging the network of **Cartoon GAN**.
- Initialised the Generator with an Image Abstraction technique employing **DoG** and **Bilateral** filters to get better results.

**Human Pose Transfer** [Code][Slides] *March '21*
*Guide : Prof. Shanmuganathan Raman/Research Internship* *IIT Gandhinagar*

- Leveraged the StyleGan Architecture to solve the problem of Human Pose Transfer by giving Pose information as style input.
- Used Perceptual, Pixel, Image Gan and Pose Gan loses to evaluate perforamce on Deep Fashio Dataset.

**Efficient Neural Machine Translation**[Code][Slides][Report] *Dec '20*
*Guide: Prof.Pushpak Bhattacharyya | Course (Speech, Natural Language Processing and the Web)* *IIT Bombay*

- Built a NMT model based on RNNsearch model with **minimal parameters** and **Time taken** for training on Multi30K dataset, to achieve a decent Bleu score as compared to a standard Transformer
- Implemented **Adverserial training** to avoid overfitting on dataset to further improve the Bleu score

**Maze Solver** [Code][Report] *Sept-Oct 2020*
*Guide: Prof.Shivaram Kalyanakrishnan | Course (Foundations of Intelligent and Learning Agents)* *IIT Bombay*

- Modelled a Maze as a Markov Decision Process with appropriate rewards and transitions.
- Found the shortest path from a given start point to multiple end points in a maze using Value Iteration algorithm.

**Chunk Tagger** [Code][Slides][Report] *Aug-Sept 2020*
*Guide: Prof.Pushpak Bhattacharyya | Course (Speech, Natural Language Processing and the Web)* *IIT Bombay*

- Classified the chunk tags of phrases using a Maximum Entropy Markov Model, Conditional Random field and Bi-LSTM.
- Performed extensive feature engineering incorporating morphological features to achieve >90% accuracy on conll2000 dataset.

**Image Inpainting using the Deep Image Prior** [Code] *Oct-Nov 2019*
*Guide: Prof. Biplab Banerjee | Course Project (Machine Learning for Remote Sensing-II)* *IIT Bombay*

- Exploited the inherent property of CNN to **reluctantly** fit on a noisy image when started with uniform noise to get off the **Prior term** and reconstruct the original image in a **zero-shot fashion**
- Developed an hour-glass(Encoder-Decoder) architecture with skip connections to maximise the **likelihood** term, subsequently producing the near original image even when **80% of random pixels** are removed.

**Adversarial Reprogramming of Neural Networks** [Code][Slides] *Oct-Nov 2019*
*Guide: Prof. Ajit Rajwade & Prof. Suyash Awate | Course Project (Digital Image Processing)* *IIT Bombay*

- Computed a adversarial perturbation added to all test inputs to reprogramme ImageNet classification model on CIFAR-10
- Illustrated the vulnerability in neural networks performing a adversary chosen task despite being not trained to do it originally

**Pipeline Processor IITB RISC** [Code][Report] *March '19*
*Guide : Prof.Virendra Singh |Course Project| Electrical Engineering Department* *IIT Bombay*

- Created a 16 bit **6-stage pipelined processor** based on **Little Computer Architecture** using **VHDL**.
- Implemented **Finite State Machines** for the execution of **15 instructions** with **single and double wide fetch execution**
- Created the **Memory**, **Register** and **Arithmetic Logic** units for storing and computation operations.

# Teaching

- **Teaching Assistant** at IIT Bombay in Collaboration with ERUDITUS Spring 2021
  *Course: Machine Learning and AI with python*
- **Teaching Assistant** at IIT Bombay Autumn 2020
  *Course: Machine learning -II for Remote Sensing (GNR 638)*

# Scholastic Achievements

- Awarded **AP grade**(Top 1%) for outstanding performance in both **Basic** and **Advance** level courses of **Machine Learning for Remote Sensing** *[2019]*
- Secured **All India Rank 170** in Joint Entrance Exam-Advanced(JEE) with a **perfect score** of **122/122** in Maths *[2017]*
- Recipient of the prestigious **Kishore Vaigyanik Protsahan Yojana (KVPY)** fellowship(SA Stream) with **All India Rank 275** *[2016]*
- Successfully cleared **NSEC** and appeared for **Indian National Chemistry Olympiad(INChO)** *[2016-17]*
- Successfully cleared **NSEA** and appeared for **Indian National Astronomy Olympiad(INAO)** *[2015-16]*
- Recipient of **National Talent Search Examination**(NTSE) fellowship *[2015]*
- Successfully cleared **NSEJS** and appeared for **Indian National Junior Science Olympiad** *[2014]*
- Achieved **International Rank 2** in 2015 and **Rank 3** in 2012 in **National Science Olympiad** conducted by Science Olympiad Foundation.

# Technical Skills

- **Programming Languages:** Python, C++, Java, VHDL, HTML, LaTeX
- **Libraries:** OpenCV, Keras, Tensorflow, PyTorch, sklearn, NumPy
- **Software Skills and Circuit Boards:** Android Studio, Quartus, Robot Operating System(ROS), Unity3D git, MATLAB, AutoCAD, SolidWorks, NGSpice, Arduino

# Key Courses Undertaken

**Machine Learning and applications**: Computer Vision and Lab, Medical Image Computing, Foundations of Intelligent and Learning Agents, Speech and Natural Language Processing and the Web, Advance Machine Learning, Machine Learning for Remote Sensing-I, Machine Learning for Remote Sensing-II, Fundamentals of Digital Image Processing

**Computer Science** :Introduction to Number Theory and Cryptography, Operating Systems, Data Structures and Algorithms, Computer and Network Security, Computer Networks, Design and Analysis of Algorithms

**Mathematics and Statistics** : A First Course in Optimization, Probability and Random Processes, Data Analysis and Interpretation, Markov Chain and Queuing Systems, Applied Mathematical Analysis in Engineering, Introduction to Stochastic Control, Decision Analysis and Game Theory

**Electrical** : Microprocessors, Electronic Devices and Circuits, Network Theory, Signals and Systems, Analog Circuits, Digital Systems, Power Electronics, Control Systems, Communication Systems, Electromagnetic Waves

# Position of Responsibility

**Coordinator | Unmesh Meshruwala Innovation cell** *[2017-18]*

- Part of the Localisation subsytem in **SEDRICA:Driverless Car** project at **Innovation cell**, **IITB**
- **Team member** in charge of planning, organizing and publicizing events under **Innovation Cell**
- Organised **Summer Induction Programme** which was attended by 100+ students including topics of mechatronics systems, localisation, path planning, image processing, sensor fusion and machine learninig.

# Extra Curricular Activities

- Got Selected and attended the **4th Summer School on Machine Learning** conducted by CVIT, IIIT-Hyderabad *[July'19]*
- **Selected for** and attended the **Inter IIT Table Tennis Camp** (The top 7 in institute) *[Nov-Dec '18]*
- **Second Runners up** in the General Championships of **Inter Hostel Table Tennis** open representing hostel and recognized as **Player of the Tournament** for the exceptional performance throughout *[2017]*
- Recognised as one of the **best presenters** on **Large Systems** and **Mathematics in Electrical Engineering** to students who came from different colleges of India under **TEQIP III**, an initiative by MHRD *[2018]*
- Podium finish in **Physics** and **Maths Bazinga** - Institute open Maths and Physics Competition of puzzling problems. *[2018]*
- Awarded **Champion of Champions Trophy** in All India **Vedic Maths** competition conducted by Ideal Play Abacus *[2013]*