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: 9.43/10*
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

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**.

Few Shot Class Incremental Learning[Code][Report] *July '20 - Present*
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**.

Data Generation for Person Intrusion Detection Using Human Pose Transfer [Architecture] *Dec '19 - Jan '20*
Guide : Prof. Shanmuganathan Raman/Research Internship *IIT Gandhinagar*

- Proposed a novel **2-way GAN** for Human Pose Transfer conditioned on input image and a target pose.
- Extended the Progressive Attention Transfer Network by proposing **active Foreground and Background losses** to inherently generate target **FG binary masks**, for separately dealing with the FG and the BG paths.
- Used the framework for generating a large number of **fake human images** in different poses and varied backgrounds

***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

Efficient Neural Machine Translation *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 *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 *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 *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 *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

E-Voting using Blockchain *July '19*
Microsoft Codefundo++

- Created a **dApp** in **Geth** framework to build a secure and fast **Electronic Voting system** using **Blockchain** in **Solidity**
- Generated **Transaction ID** for **vote verification** after the voter votes from a region using a **ballot smart contract**

Coherent Optical Receiver *April '19*
Prof. Ashwin Gumasthe/Course Project (Computer Networks) *IIT Bombay*

- Simulated a **Coherent Optical Receiver** in Matlab performing Homodyne and Heterodyne Detection
- Studied the **Quantum Noise** properties of coherent detection

Pipeline Processor IITB RISC *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.

Emotion TV *May '18 - Jun '18*
Institute Technical Summer Project, IIT Bombay *IIT Bombay*

- Conceptualized and implemented recognition of two emotions -**Happy** and **Sad** using **Multi-Layered CNN**, to predict the current mood of the person after training on 200+ images dataset
- Speech recognition(using **Google API**), combined with **Text to Speech**(using **gTTS API**) to do nominal conversation

Teaching

- **Teaching Assistant** at IIT Bombay in Collaboration with ERUDITUS Spring 2021
Artifical Intelligence and Machine Learning(AI-ML)

- **Teaching Assistant** at IIT Bombay — Autumn 2020
  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]*
- Won **Bronze medal** 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]*
- Stood **1st** in **Physics Bazinga**(2018) and **3rd** in **Maths Bazinga**(2017) - Institute open Maths and Physics Competition of puzzling problems conducted by Maths and Physics Club
- Awarded **Champion of Champions Trophy** in All India **Vedic Maths** competition conducted by Ideal Play Abacus *[2013]*