Ritesh Goru

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EDUCATION

BACHELOR OF TECHNOLOGY | INDIAN INSTITUTE OF TECHNOLOGY BOMBAY
Jul '16 - May '20

Department of Electrical Engineering — CGPA - 8.95/10.0

Bachelor's degree with **honors** in **Electrical Engineering** and a **minor** degree in **Computer Science**

PUBLICATIONS

- Priyadarshini K, **Ritesh Goru**, Siddhartha Chaudhuri, Subhasis Chaudhuri, ***Batch Decorrelation for Active Metric Learning***, Accepted to **IJCAI-PRICAI 2020**

WORK EXPERIENCE

INTELLIGENT SYSTEMS LABORATORY | PURDUE UNIVERSITY
May '19 - Jul '19

Prof. Juan Wachs | **Deep Imitation Learning for robotic Surgery** — Purdue Undergraduate Reseach Intern

- Automated Surgical pick and place task with the **DaVinCi** robot - a teleoperable surgical system used in laparoscopy
- Conducted literature survey on **Reinforcement, Imitation learning** and their emerging applications in robotics
- Recorded the joint and image data of the robot using **ROS** framework and used **VGG19** for image feature extraction
- Designed an end-to-end **Behavioral Cloning** based fusion model using **LSTM** and **Convolutional Neural Networks**
- Incorporated a **custom loss** for time-series based outputs, significantly improving task completion rate
- Presented the work in **SURF Symposium** and showcased it to **Intuitive Surgical** (Creators of the DaVinci robot)

RESEARCH EXPERIENCE

DEEP ACTIVE LEARNING FOR DISTANCE METRIC LEARNING
Jul '19 - May '20

Prof. Subhasis Chauduri — R & D Project

- Presented a novel active learning strategy for training **distance metric** based **triplet** datasets using batch decorrelation
- Proposed a new similarity metric for triplets based on the **orientation** of the triplets in the **embedded space**
- Demonstrated **consistent improvement** while using batch decorrelation with various distance measures
- Compared with **BADGE** (ICLR'20) and got a significant improvement over the algorithm across various perceptual datasets

DISTRIBUTED SGD WITH STRAGGLER MITIGATION
Jul '19 - May '20

Prof. Vivek Borkar and Prof. Nikhil Karamchandani — Undergrad Thesis

- Simulated a **distributed system of Neural networks** with possible communication according to a given graph in Pytorch
- Implemented an algorithm based on **metropolis-hastings** scheme and randomised **non-linear gossip** for SGD
- The algorithm effectively **reduces** the **wall-clock time** for SGD, even in the presence of multiple stragglers
- Evaluated the algorithm with various **heavy tailed delays** among the nodes and in presence of stragglers

SELF DRIVING CAR, TEAM SEDRICA | COMPUTER VISION LEAD
Nov '17 - May '20

Developing India's first driverless car specific to Indian road conditions | Mahindra RISE Challenge — UMIC-IITB

*One of **11 finalists** out of **259** teams (IV Level); Received a **Mahindra E2O** for further development*

Object Detection

- Built a Semantic Segmenter based on the FCN as described in the paper of **Linknet** for Road and Lane segmentation
- Modified **RetinaNet** for real-time **Traffic Sign, Traffic Light, Pedestrian, Vehicle, Speed-bump** detection
- Trained an image classifier using **transfer learning** based on **resnet50, resnet152** and benchmarked it on **gtsrb** dataset
- Trained **Yolo V2, V3** detection algorithms and made custom datasets for speed bump and traffic lights

Object Tracking

- Implemented a model-based approach for object tracking from 3D-Lidar Data using **Rao-blackwellised** particle filter
- Constructed an **occupancy grid** with a **recursive update** for coarse and fine clustering of 3D-Lidar Data

Integration

- Built a complete package to test all the algorithms on both real-time over live feed and offline over images and videos
- Built custom pubsub in **ROS** and fused the outputs with localisation module for **Motion Planning** & **Decision Making**

PERCEPTUAL DISTANCE METRIC LEARNING FOR ODOR DATA
Dec '18 - Jan '19

Prof. Subhasis Chauduri
R & D Project

- Modelled the **similarity** of **odor data** using a **deep metric learning** approach (**PerceptNet**)
- Incorporated the **uncertainty** of perceptual similarity response in the modelling process
- Evaluated the performance of the method by projecting data in lower dimension space using **t-SNE** and **PCA** methods

KEY PROJECTS

STUDENT DESIGN CHALLENGE | ASME
Nov '16 - Nov '17

Overall first in World finals *out of 8 teams from 4 countries held at* ***Tampa, Florida***

- Represented IITB in a team of 10 to build a bot capable of performing **five distinct tasks** for a robot pentathalon
- Designed a **Ball Screw** subsystem for the weight lifting task and simulated its stress analysis in **ANSYS**
- Headed the **electrical subsystem** and programmed microcontrollers used in control of all other subsytems
- Designed the circuit boards required using **EAGLE** and modelled the wire routing in **Solidworks electrical**

HIGHER ORDER OPTIMISERS FOR DEEP LEARNING| ADVANCED DEEP LEARNING
Mar '20 - May '20

Prof. Balamurugan Palaniappan
Course Project

- Extended the **Curve Ball** which approximates Newton's method using Hessain Vector Products for **Multistep** methods
- Applied approximation to multistep methods - 3,4-step Newton and variants of **Ostrowski**'s method (6,7,8 order)
- Analysed the **convergence** against standard Optimisers such as Adam, SGD and SGD with momentum

ACTION RECOGNITION USING RECURRENT ATTENTION| DEEP LEARNING
Aug '18 - Nov '18

Prof. Balamurugan Palaniappan
Course Project

- Extended Google DeepMind's paper on **Recurrent Models of Visual Attention** for action classification in videos
- Used **REINFORCE**, a **policy gradient** algorithm to predict a timestamp around which network should pay **attention**, in contrast to processing the whole video, **reducing the computational time** by a substantial amount
- Used **optical flow** to compute **motion features** from a set of frames around a given time instant

PYRAMINX SOLVER USING AUTODIDACTIC ITERATION| LEARNING AGENTS
Aug '19 - Nov '19

Prof. Shivaram Kalyankrishnan
Course Project

- Trained a **DRL agent** to solve Pyraminx, a regular tetrahedron style Rubik's cube with God's number 11
- Used autodidactic iteration (ADI), a supervised learning algorithm which trains a joint value and **policy network**
- Augmented ADI with Greedy breadth first search and **Monte Carlo Tree Search** (MCTS) solvers

MULTI SENSORY FUSION | AUTOMATIC SPEECH RECOGNITION
Aug '19 - Nov '19

Prof. Preeti Jyoti
Course Project

- Implemented a multisensory, self supervised sound localisation model based on paper **Audio-Visual Scene Analysis with Self-Supervised Multisensory Features** in Pytorch
- Trained the model to localise the source of sound in video by synchronizing audio and video in the sample clip
- Employed **Class Activation Map** (CAM) to detect hotspots in the video which correlated with source of sound

SENTENCE PARSING USING RECURSIVE NEURAL NETWORKS| MACHINE LEARNING
Aug '18 - Nov '18

Prof. Sunita Sarawagi
Course Project

- Applied a NN recursively to build a **parsed tree-structure** based on the phrasal category prediction of words
- Converted the **Penn Treebank** dataset to a binary form using **Chomsky Normal form** and **Unary Collapsing**
- Reduced the syntactic phrasal tags to 6 subcategories and used pre-trained **word embeddings** for training

SUPER RESOLUTION USING WEINER FILTER | IMAGE PROCESSING
Oct '19 - Nov '19

Prof. S.N. Merchant
Course Project

- Formulated various approximate transformations for **sub-sampling** and applied weiner filter for super-resolution
- Compared this with bi-linear estimation and single image adaptive wiener filter methods

FASTER COARSE ACQUISITION OF IRNSS DATA| DIGITAL SIGNAL PROCESSING
Mar '19 - Apr '19

Prof. V.M. Gadre
Course Project

- Using the data collected from IRNSS **Satellite** enchanced coarse acquisition by analysing the signal in fourier domain
- Implemented circular-convolution in frequency domain which outperformed serial search by a factor of 70

AUDIO ENCRYPTION AND DECRYPTION | ANALOG LAB — Mar '18-Apr '18

Prof. Siddharth Tallur — Course Project

- Encrypted an input signal by adding a **chaotic noise** generated by a **3rd order chaotic oscillator**
- Decrypted at the receiving end using an oscillator and a **coupler (initial condition)**
- Simulated the entire system on **NGSPICE** and implemented it on board using TL072 OPAMPs

IITB RISC PROCESSOR | MICRO PROCESSORS — Oct '18 - Nov '18

Prof. Virendra Singh — Course Project

- Designed and implemented a 16-bit, 6-stage **pipelined RISC processor** based on Turing complete ISA in VHDL
- Encoded a total of 15 instructions with three machine-code formats, good enough to solve complex problems

TALKS AND LECTURES

- Delivered a lecture series on **Introduction to Machine Learning** to the freshmen of IIT Bombay
- Invited to deliver a speech on autonomous drones at the **Milennovation TED Talks** event, organized by **JPMorgan Chase & Co. India**, that was attended by over **2000 employees** and broadcast at JPMC offices **nationwide**

AWARDS AND ACHIEVEMENTS

- Awarded **AP** grade for outstanding performance in **Deep learning: Theory and Practice** course '18
- Awarded **Institute Technical Special Mention** for the contribution to Team SeDriCa and UMIC IIT Bombay '18
- Secured All India Rank **903**, **469**, **129** in **IIT JEE-Advanced**, **JEE-Mains paper-1,2** respectively '16
- Recipient of the prestigious Kishore Vigyanik Protsahan Yojana (**KVPY**) Fellowship in basic sciences '15
- Awarded National Talent Search Examination Fellowship (**NTSE**) by NCERT, Govt. of India '14
- Awarded **Hostel Technical Special Mention** for exemplary contribution towards hostel technical culture '18

TECHNICAL SKILLS

Programming Languages	Python, C/C++, MATLAB/Octave, R, Bash, VHDL, Julia, HTML, JS
Programming Libraries	Pytorch, TensorFlow, Keras, OpenCV, Flux, Turing
Software/Platforms	ROS, ANSYS, EAGLE, NGSPICE, AutoCAD, SolidWorks, Git, Quartus, LaTeX

KEY COURSES UNDERTAKEN

Mathematics	Stochastic Optimization, Markov Chains & Queuing systems, Numerical Analysis, Calculus, Linear Algebra, Differential Equations, Complex Analysis, Probability and Random Processes
Computer Science	Advanced Deep Learning, Advanced Machine Learning, Automatic Speech recognition, Learning Agents, Digital Image Processing, Operating Systems, Data Structures & Algorithms
Electrical Engineering	NLD, Optimal Control, DSP, Control Systems, Digital & analog communications, Network Theory, Analog Circuits, Digital Systems, Power Systems, Micro Processors, EM Waves

EXTRACURRICULAR ACTIVITIES

- Successfully completed Summer School of Sports in **Football** held in summer at IIT Bombay May'17-Jun'17
- Volunteered for **Green Campus**, National Social Service scheme, IIT Bombay Aug'16-Apr'17
- Pre-finalist in Andhra Pradesh state **Spell-bee** conducted by Sakshi India '13
- Stood first in the district of East Godavari, AP in **Quiz** Competition and second in **Map Pointing** test '13