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Education

July 2017– May 2022 *(expected)*
IIT Kharagpur, *Integrated Msc.*, Mathematics and Computer Science, ***CGPA : 9.28/10*** (**Rank : 2/56**)
Micro Specialisation : Optimization Theory and Applications

Publications

July 2021 **Independence-Based Learning of Structured-Decomposable Probabilistic Circuit Ensembles**
- Published at the *Tractable Probabilistic Models Workshop in UAI, 2021*

July 2021 **Graph representation learning for road type classification**
- Published in *Pattern Recognition Journal*

April 2021 **Multi Output Learning using Task Wise Attention for Predicting Binary Properties of Tweets : Shared-Task-On-Fighting the COVID-19 Infodemic**
- Published at the *NLP4IF workshop in NAACL, 2021*

November 2019 **A Prototype of an Intelligent Ground Vehicle for constrained environment: Design and Development**
- Published at the *International Conference on Control and Robots* (ICCR), 2019

August 2019 **Real-Time Lane Detection, Fitting and Navigation for Real-Time Applications in Unstructured Environments**
- Published at the *International Conference On Image,Video Processing and Artificial Intelligence* (IVPAI), 2019

December 2018 **Traffic Sign Classification Using Hybrid HOG-SURF Features and Convolutional Neural Network**
- Published at the *International Conference On Pattern Recognition Applications and Methods* (ICPRAM), 2019

Experience

August 2021 - Present **Masters Thesis Project**, *Guide : Prof. Buddhananda Banerjee, Prof. Radhendushka Srivastava*
- Working on **Changepoint Detection** in **Time Series**.
- Analysing the finite sample performance and power-curves of various statistics for detecting change in mean.

May 2021 - June 2021 **Applied Scientist Intern, Microsoft India**, *Mentor : Basil Abraham*
- Worked in the STCI Speech Group on **Audio-Visual Automatic Speech Recognition**.
- Developed a **proof of concept** for **improving Speech Recognition** performance under **noisy scenarios** by incorporating visual information in the model. Experimented with different architectures and feature incorporation approaches.
- Obtained a **6% relative WER improvement** over the baseline having no visual features after experimentation.

April 2020 - April 2021 **StarAI Lab, University of California, Los Angeles**, *Guide : Prof. Guy Van den Broeck*
- Worked on Structure-Learning of **Probabilistic-Circuits**, a class of **tractable probabilistic models**.
- Proposed a theoretical framework to reason about a circuit's performance in terms of the independences it captures.
- Developed a novel initialization strategy for EM-based circuit ensembles using the above framework.
- Developed a Julia codebase and a **GPU-Kernel** to obtain **10x improvment** in pairwise-mutual-information computation.
- The proposed algorithm obtained **State of the Art** results of **14/20 density estimation benchmarks**.
- Work accepted at the **Tractable Probabilistic Models Workshop, UAI'21**.

April 2020 - July 2020 **Computer Vision Lab, Linkoping University, Sweden**, *Guide : Prof. Michael Felsberg*
- Worked on the problem of **Graph Representation Learning** with the downstream task of **link-prediction**.
- Trained various variants of GraphSAGE, Graph-Attention-Networks, GraphGANs and Gated-Attention-Networks.
- Formulated and implemented a **DFS-based aggregation** scheme to capture community structures in graphs.
- Work accepted at **Pattern Recognition Journal**.

May 2018 - Present **Autonomous Ground Vehicle Research Group**, *Guide : Prof. Debashish Chakravarty*, [link]
- Team Autonomous Ground Vehicle (AGV) is a multi-disciplinary research group working on varied modules like Control Systems, Planning, SLAM, Computer Vision and Reinforcement Learning for autonomous vehicles.
- Implemented **MobileNet-SSD** for **traffic sign detection**. Proposed a two stage detection-classification approach using the German-Traffic Sign Benchmark to account for the sparse datasets on Indian Signs. Obtained **real-time** performance of **50+ FPS** by integrating the pipeline with the **Object Tracking Module**.[link]
- Trained **adversarial and non-adversarial models** for end-to-end **lane-detection and road-segmentation** for unstructured Indian roads. Pipeline worked at real-time speeds of **30+FPS on a 970mx GPU**. [report] [video]
- Designed and implemented the **planning and perception module** for autonomous mobile robots **Eklavya 6.0 and Eklavya 7.0** which could autonomously navigate in constrained environments while avoiding obstacles and following GPS waypoints. The entries won **runners up** in the autonomous navigation challenge in the **Intelligent Ground Vehicle Competition, 2018 and 2019**.[report] [video]

May - August 2019 **Google Summer Of Code**, *Mentors : Dhairya Gandhi, Elliot Saba*, [link to blog]
- Was among **15** students worldwide to be selected under **The Julia Language** for **GSoC 2019**.
- Worked on adding creating open-source implementations of computer-vision and reinforcement learning models in Julia.
- Implemented and trained **pix2pix**, **Cycle-GAN**, and **Image Captioning** networks in **julia from scratch**.
- Created a library for reinforcement learning with from scratch implementations of **PPO** and **TRPO**. Tested the implementations on the **Pendulum-v0** environment.
- Added the **Group Normalization** feature to **Flux.jl**, the machine learning library of **Julia**.

March - July 2018 **Kharagpur Robosoccer Students Group**, *Guide: Prof. Jayanta Mukopadhyay*, IIT Kharagpur,
- Worked on software strategies for a team of soccer playing robots for the **Small Size League** in **Robocup**.
- Implemented a **RRT*** planner for time-constrained and efficient planning.
- Implemented a **fuzzy logic** based **multi agent passing** mechanism for optimal pass assignment.

Notable Projects

Sep - Nov 2020 **CUDA-Based Object Detection Pipeline**, *Advisor: Prof. Soumyajit Dey*, IIT Kharagpur, [link]
- Created an object-detection pipeline using YOLO in C++ using CuDNN as backend.

Sep - Nov 2019 **Graph Visualising Software**, *Advisor: Prof. Bodhayan Roy*, IIT Kharagpur, [link]
- Developed a GUI based application to draw graphs and visualize graph algorithms using PyQt framework.

Jan - April 2019 **Intelligent Bus Service**, *Advisor: Prof. Sudhir Kumar Barai*, IIT Kharagpur, [link]
- Created an application for identifying the number of people in a bus using a camera feed for efficient planning and routing of buses. Used **transfer learning** to train a **Faster-RCNN** detector on a manually collected dataset.
- Peer reviewd as the **Best Term Project** among **65 students**.

Sep - Nov 2018 **Image Dehazing**, *Advisor: Prof. Partha Pratim Das*, IIT Kharagpur, [link]
- Implemented the paper "**Single Image Dehazing Using Dark Channel Prior**".
- Used a **guided filter** to improve the sharpness of the results.

May-June 2018 **Robotic Path Planning Algorithms**, *Self Project*, [link]
- Implemented **Dijkstra, A* Search, RRT** and **RRT*** for path finding in an environment with obstacles in C++.

Scholastic Achievements and Competitions

- **Runners-Up** in the "Shared-Task-On-Fighting the COVID-19 Infodemic" in the **NLP4IF workshop, NAACL'21**.
- **Inter IIT Technology Meet, 2021** : Part of the team winning **Bronze** in the Bosch Traffic Sign Recognition Challenge and the overall **Bronze winning contingent** of IIT Kharagpur.
- Part of the **National Finalist** team among 13 teams for the Mahindra Rise Prize Driverless Car Challenge.
- Part of **Runners-Up** team in the Auto-Nav Challenge at the Intelligent Ground Vehicle Competition, 2019.
- Hold a **Department Rank Of 2** among **56** students and academically among **top 5 percent** in a batch of **1300**.
- **Pan-IIT Hackathon'19** : Among the only UG sophomore team from the institute to qualify for the national final round.
- **Runners-Up** in Pixelation, a computer-vision hackathon in NSSC, 2018.
- **Second Runners-Up** in Fortress, a computer-vision hackathon in Kshitij'18, Asia's largest Techno-Management Festival.
- Cleared the **Indian National Chemistry Olympiad** [National rank **35/40000**].
- Cleared the **National Physics & Astronomy Olympiads** Stage-1. [**Top-1%(Country) / 40000**]
- Recipient of the prestegious **KVPY scholarship** [National rank **18 / 0.1million**].
- Recipient of the **Inspire scholarship** from the Government Of India.
- Placed **712 / 0.2million** in **JEE-Advanced, 2017** and **210 / 1.3million** in **JEE-Mains, 2017**.

Skills

Programming C, C++, Python, Julia, R, SQL, LaTeX

Libraries and tools OpenCV, STL, Numpy, Tensorflow, Pytorch, Scikit-Learn, CUDA, ROS, GDB

Course Work

Statistics and Optimization Probability&Statistics, Operations Research, Advanced Numerical Techniques, Regression and Time Series, Stochastic Processes, Non-Linear Programming, Optimization Methods in Finance

Mathematics Linear Algebra, Abstract Algebra, Discrete Mathematics, Partial Differential Equations, Real Analysis

Computer Science Design & Analysis of Algorithms, Object Oriented Systems, Machine Learning, Advanced Machine Learning, Operating Systems and Systems Programming, Computer Organization and Architecture, Computer Networks, Parallel Programming, Natural Language Processing, Image Processing, Soft-Computing Tools, Database Systems

Online CS231n, Reinforcement Learning by David Sliver, Financial Markets by Yale

Leadership and Extra Curriculars

- **Entertainment Cup Captain** of **Nehru Hall of Residence**. Managed a budget of INR 80k.
- Mentored 1st year freshers in a week long **IEEE certified Winter Workshop** on **Image Processing**.
- Won **Bronze** in Intra-University event **Open-IIT Instrumentals** for playing the keyboards.
- Wrote a blog on game development using Unity-3D capturing over **2k** views overall.