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EDUCATION

Examination	University/Institute	Year	CPI/%
BTech + MTech (Dual) in Computer Science	IIT Kharagpur	2017-2022	**9.91/10.0**
Class XII CBSE	Birla High School, Kolkata	2017,	95.8/100
Class X CBSE	Birla High School, Kolkata	2015,	10.0/10.0

FIELDS OF INTEREST

Reinforcement learning, Robotics, Computer Vision, Adversarial Attacks, Explainable AI

INTERNSHIPS

- **LocusLab, Carnegie Mellon University** *May 2020 - Current*
  Advisor: Prof Zico Kolter
  Research Areas: **Adversarial Attacks, Random Smoothing, Data Poisoning, Feature Visualization**
  - Created visualizations to accentuate class labels by **extracting class specific visually compelling features** from a pretrained classifier.
  - Used **PGD under L2 norm** to modify the images to minimize noise and to ensure that only the most important features are obtained.
  - Utilised **randomized smoothing** to perpetually align the gradients to the visual features rather than adversarial noise. Additionally integrated **deep dream** and **Tikhonov Regularization** to further enhance features.
  - Trained poisoned classifiers using several techniques including HTBD attacks. Detected the poisoned classifiers in the **trojai dataset**.
- **INKLab, University of Southern California** *April 2020 - Current*
  Advisor: Prof Xiang Ren
  Research Areas: **Visual Commonsense Reasoning, Knowledge Graphs, Graph Neural Networks, Visual Question Answering, Visual Linguistic Encoding**
  - Worked on **VCR dataset** which is a VQA dataset where **common sense inferences have to be drawn from images to answer the questions**.
  - Incorporated additional commonsense knowledge in the form of **knowledge graphs** to improve the capacity to deduce inferences.
  - Used **scene graphs** for better visual understanding and **grounding of the visual objects and actions to the knowledge graph**.
  - These graphs were processed using **Graph Relation Networks** and **Language Conditioned Graph Networks** respectively.

PUBLICATIONS

- **Traffic Sign Classification using Hybrid HOG-SURF Features and Convolutional Neural Networks**, International Conference on Pattern Recognition Applications and Methods 2019, Prague, Czech Republic.
- **Real-time Lane Detection, Fitting and Navigation for Unstructured Environments**, International Conference on Image, Video Processing and Artificial Intelligence 2019, Shanghai, China.

RESEARCH EXPERIENCE AND PROJECTS

- **Autonomous Ground Vehicles Research Group** *March 2018- current*
  Software Team Member
  Advidor: Prof. Debashish Chakraborty
  Objectives: To develop novel solutions for a level 3 autonomous vehicle. Following projects were undertaken.

Traffic Sign Detection *May 2019*

Research Areas: **Computer Vision, Deep Learning**
- Solved the sparse availability of datasets on Indian Traffic Signs using a **two stage detection-classification system**.
- Used an **object tracker** to increase the speed to above 50 FPS on a low end system. Also predicted the distance of the sign from the vehicle.

Frenet Optimal Trajectory Planner *December 2018 - current*

Research Areas: **Planning, Controls, Reinforcement Learning**
- Implemented a local planner that uses the **Frenet-Seret Frame** to **minimise jerk** and **time taken** to converge to the global path.
- Efficient for **urban and highway maneuvers**. Integrated an RL agent to reduce the sampling inefficiency and improve exploration.
- Successfully tested on an Ackermann-drive vehicles on the **gazebo and Carla simulators** as well as on a real vehicle.

Dynamic motion planning system using Reinforcement Learning *May 2019 - December 2019*

Research Areas: **Reinforcement Learning, Planning, Controls**
- Developed **motion planning system that works on top of a robot controller**, making it very adaptable to different systems.
- Agent generates waypoints simply using the 2D obstacle map, current vehicle location and velocity and the final goal.

Lane Segmentation *May 2019 - December 2019*

Research Areas: **Computer Vision, Deep Learning**

- Performed Lane Segmentation, which creates a **binary segmentation map for the presence of lane markers** in a city landscape.
- Implemented Dataset Augmentation using **Domain Adaptation** with **GANs** to generalise in different environmental conditions.
- Implemented **Embedding-Loss GAN and self-attention Context Aggregation Networks** for generating the segmentation maps.

- **Explainable AI** *May 2019 - Current*

Advisor: Prof Abir Das

Research Areas: **Explainable AI, Reinforcement Learning, Computer Vision, Deep Learning**

- Generated Explanations (or saliency maps) that **identify the most important regions in an image as with respect to a classifier**.
- An **RL agent intelligently searches** for these important patches which are **linearly combined** to get the final Saliency Maps.
- Improvement over **RISE** that uses large number of random masks ($\sim$ 5000) but this uses only ($\sim$100) intelligently sampled masks.

COURSE PROJECTS

- **Just Another Rather Very Intelligent Chatbot** *March 2019*

Software Engineering Project *Research areas and tools:* **Deep Learning, Language models, Android Development, DBMS**

- A chatbot application that can **detects and analyses the emotions of the user** and **generates appropriate replies**.
- Used **naive Bayes classifier** and **LSTM based sentiment analysis** for emotion classification and **seq2seq models** for text generation.

COMPETITIONS

- **Intelligent Ground Vehicles Competition, Michigan** *Oakland University, Michigan* *2018 and 2019*

Runners Up

- Developed an **autonomous ground vehicle for a constraint environment**. Were the first team to qualify for the final round.
- Worked on local planners (**TEB Planner** and **DWA Planner**), Lane Detection algorithms, Curve Fitting (RANSAC and **MLESAC**), Navigation and Obstacle Avoidance algorithms (using classical computer vision techniques).

- **PAN IIT Hackathon** *IIT Delhi* *2019*
  - Was a **part of the Junior-Most team to qualify for the Final Round**. Developed a software tool using AI to solve a **socio-economic problem**.
  - The tool predicts the crop to be sown in a region based on previous climate history and economics. Performed time series modeling using LSTMs to produce the results.

RELEVANT COURSES

- **University**
  Machine Learning, Deep Learning, Algorithms and Data Structures*, Operating Systems*, Computer Networks*, Software Engineering*, Probability and Statistics, Compilers*, Computer Organisation and Architecture* *(* denotes courses with lab components)*
- **Open CourseWork**
  Machine Learning, Stanford University Convolutional Neural Networks, Stanford University, Introduction to Reinforcement Learning, DeepMind, Deep Reinforcement Learning, UC Berekeley

TECHNICAL SKILLS

- **Languages** - Python, C, C++, java
- **Relevant libraries and Frameworks** - pytorch, Tensorflow, ScikitLearn, opencv, ROS, OpenAI-gym, git, Carla, gazebo
- **Operating systems** - Windows, Linux/Unix

ACHIEVEMENTS

- **Among the top 3 students the entire 2017 batch in the institute.**
- **Class of 1970 Alumni (US) Association Prize** for **best student in order of merit** among third year B.Tech.(Hons.)/B.Arch.(Hons.) courses securing highest CGPA *2019*
- **IIT Kharagpur Alumni (California Chapter) Award** for being the **best student in order of merit** among third year B.Tech.(Hons.)/B.Arch.(Hons.) courses securing highest CGPA *2019*
- **Student Par Excellence Award by Computer Science & Engineering Dept** *2018*
- Selected for the prestigious **IUSSTF - Viterbi Program** *2019*
- **KVPY Fellowship Award** *2017*
- **Qualifying for the National Round of World Robot Olympiad** *2016*