Bharath Raj Nagoor Kani

bharathrajn98@gmail.com | GitHub | Google Scholar | bharathrajn.com

Education

Carnegie Mellon University — Advisor: **Dr. Shubham Tulsiani**
M.S. in Robotics (MSR) – CGPA: 4.25/4.0 — *Aug 2022 – Present*

Sri Sivasubramaniya Nadar College of Engineering — Affiliated to **Anna University**
B.E. in Electronics and Communication Engineering (ECE) – CGPA: 8.4/10.0 — *June 2015 – Apr 2019*

Experience

Carnegie Mellon University
Graduate Research Assistant — *Oct 2022 – Present*

- Under the mentorship of Dr. Shubham Tulsiani at the Physical Perception Lab, I am currently exploring problems related to inferring 3D representations from partial observations.

Siemens Digital Industries Software
Engineering Services Engineer — *Jan 2022 – July 2022*
Associate Engineering Services Engineer — *May 2019 – Jan 2022*

Built models, algorithms and systems for myriad autonomous driving and general machine learning applications as part of the Intelligent Control Systems team. A few highlights are elaborated below:

- **Generative Models for Vehicle Trajectory Prediction:**
  - Researched and experimented with creating generative adversarial networks with a structured latent space for predicting the future trajectory for a given ego-vehicle.
- **Ego-Lane Estimation and Tracking; ROS based Perception Toolchain:**
  - Leveraged concepts from 3D geometry, machine learning, state estimation and more to create a fast and robust ego-lane estimation and tracking system that can effectively handle many challenging scenarios.
  - Designed and implemented integral parts of a ROS based toolchain which contains several nodes that can perform various tasks related to perception for autonomous driving.
- **Maximum Entropy Inverse Reinforcement Learning:**
  - Researched and implemented algorithms based on maximum entropy inverse reinforcement learning to model highway driving styles given expert demonstrations.
- **Unsupervised Variable Length Multivariate Time Series Data Clustering:**
  - Researched and implemented feature extraction techniques and experimented with dimensionality reduction techniques and clustering algorithms to cluster together driver types given multivariate time series data.

Publications

UpFusion: Novel View Diffusion from Unposed Sparse View Observations
Bharath Raj N., Hsin-Ying Lee, Sergey Tulyakov, Shubham Tulsiani

- UpFusion is a system that can perform novel view synthesis and infer 3D representations for an object given a sparse set of reference images *without* corresponding pose information.
- Currently under review at ICLR 2024. [project-page]

Exploring Techniques to Improve Activity Recognition using Human Pose Skeletons
Bharath Raj N., Anand Subramanian, Kashyap Ravichandran, Venkateswaran N.

- Explored the efficacy of using hand crafted feature extraction techniques and some train-time techniques such as keypoint dropout on improving human pose skeleton based activity recognition performance.
- Paper was published at the 2020 IEEE Winter Applications of Computer Vision Workshops (WACVW). Poster was presented at the HADCV'20 workshop at WACV 2020. [paper]

Single Image Haze Removal Using a Generative Adversarial Network
Bharath Raj N., Venkateswaran N.

- Created a conditional GAN based architecture to remove haze from images.
- Code and first version of the preprint were launched in 2018. Project currently has more than 100 stars on GitHub.
- Paper was published at the 2020 International Conference on Wireless Communications, Signal Processing and Networking (WiSPNET). [paper] [code]

Projects

Progressive Photon Mapping

- Created an implementation of the Progressive Photon Mapping algorithm in C++ as a project for the Physics-based Rendering course (15-668) in CMU.
- This enhanced the ability of an internal graphics renderer used in the course to handle light paths of type $L(S^+)D(S^+)$ and faithfully render caustic effects. [report]

Open Source Contributions to Kornia

- Contributed enhancements and fixes to Kornia, an open source differentiable computer vision library for PyTorch.
- One of my significant contributions to Kornia was the implementation of a Direct Linear Transform (DLT) based Perspective-n-Point (PnP) solver using PyTorch.

Deploying Tiny YOLOv2 on Jetson Nano using DeepStream

- Deployed a Tiny YOLOv2 ONNX model on NVIDIA Jetson Nano using the DeepStream SDK.
- Extended C++ code to enable it to parse the output of the TinyYOLOv2 model.
- Created a technical article about the project. The article is featured in the Jetson Community Resources page in the Deep Learning section. [link]

Activity Recognition System based on Human Pose Estimation

- Created a system to recognize the activity performed by humans in a given video. The system used an activity recognition algorithm that depended on human poses estimated by OpenPose.
- A custom BRIEF based multi-object tracker was used to track human poses across frames obtained from the given video.
- Custom feature extraction techniques were used to extract features from the tracked human poses. An LSTM was trained and used to recognize the activity from the extracted features.
- Multiprocessing and pipelining concepts were used to enhance the inference speed of the system. Of note, copies of a trained LSTM were used in multiple CPU processes to perform activity recognition of multiple humans in parallel.

Technical Articles

- Authored technical articles on various topics in machine learning and computer vision. A select few articles are mentioned below:
  - *Advances in Generative Adversarial Networks.* (*Jan 2019*, [link])
  - *An Overview of Human Pose Estimation with Deep Learning.* (*Apr 2019*, [link])

Technical Skills

Languages: Python, C++, C, JavaScript, MATLAB
Frameworks & Libraries: PyTorch, PyTorch3D, TensorFlow, PCL, OpenCV, NumPy, SciPy, Shapely, ROS, RViz
Developer Tools: Git, Docker, GCP, AWS

Community Experiences

Google Code-In Mentor | *CloudCV* *Oct 2018 – Dec 2018*

- Google Code-In is an event where students of the age group 13-17 contribute to open source organizations.
- As a mentor for the project Fabrik, I helped students complete their tasks and provided extensive code reviews and feedback.

Machine Learning Domain Head | *Tech Club SSN*

- Tech Club SSN is a student run organization of the ECE department of my college.
- As the machine learning domain head of Tech Club SSN during my final year of study, I conducted technical classes for my juniors, and organized events and hackathons.
- I also created a website for Tech Club SSN to display information about events and announcements.

Achievements

People's Choice Award | *Yet Another Hackathon (SVCE)* *August 2018*

- Presented a simple carry-on device created using a Raspberry Pi and an accelerometer sensor that can detect if a person has been assaulted and if so sends SMS alerts.

Runner Up | *Data Science Challenge (Exebit, IIT Madras)* *April 2018*

- Runner up in a 10 day online contest involving a highly skewed dataset to detect debit card fraud.

Runner Up | *AWS Deep Learning Hackathon (Shaastra, IIT Madras)* *Jan 2018*

- Trained an object detection algorithm that could detect a few hand signs.

First Place | *Project Presentation (SSN)* *August 2017*

- Presented a live demonstration of a convolutional neural network that could decode some simple captcha.