Bharath Raj Nagoor Kani

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Education

Carnegie Mellon University
M.S. in Robotics (MSR) — *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 — *June 2015 – Apr 2019*

Experience

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

Building 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

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 70 stars on GitHub.
- Paper was published at the 2020 International Conference on Wireless Communications, Signal Processing and Networking (WiSPNET). [paper] [code]

Projects

Neural Radiance Fields (NeRF) in TensorFlow 2 for 360-Degree Inward-Facing Scenes

- Created an implementation of NeRF from scratch in TensorFlow 2 for 360-degree inward-facing scenes. [code]
- Includes implementation of components such as a function to find the nearest 3D point to N lines using least squares, inverse transform sampling to sample points along a ray given a piecewise constant probability distribution along the ray, and more.

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.
- Modified existing 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: ROS, RViz, TensorFlow, PyTorch, PCL, OpenCV, NumPy, SciPy, Shapely
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.
- Also, I 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.