Bharath Raj Nagoor Kani

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Education

Cornell University — Advisor: **Dr. Noah Snavely**
Ph.D. in Computer Science — *Aug 2024 – Present*

Carnegie Mellon University — Advisor: **Dr. Shubham Tulsiani**
M.S. in Robotics (MSR) – CGPA: 4.19/4.0 — *Aug 2022 – May 2024*

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

Intel
Research Scientist Intern — *May 2024 – Aug 2024*

- Explored memory efficient learning based 3D representations for real-time rendering.

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 — ECCV 2024
Bharath Raj Nagoor Kani, Hsin-Ying Lee, Sergey Tulyakov, Shubham Tulsiani — [project-page] [paper] [code]

- UpFusion is a system that can perform novel view synthesis and infer the 3D representation of an object given a sparse set of reference images *without* corresponding pose information.

Exploring Techniques to Improve Activity Recognition using Human Pose Skeletons — HADCV Workshop, WACV 2020
Bharath Raj N., Anand Subramanian, Kashyap Ravichandran, Venkateswaran N. — [paper]

- 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.

Single Image Haze Removal Using a Generative Adversarial Network — WiSPNET 2020
Bharath Raj N., Venkateswaran N. — [paper] [code]

- Created a conditional GAN based architecture to remove haze from images.

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 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 that recognizes the activity performed by humans in a given video. The system used human pose skeletons estimated by OpenPose and an LSTM model to predict the activity.
- A custom BRIEF based multi-object tracker was used to track human poses across frames obtained from the given video.
- Multiprocessing and pipelining concepts were used to enhance the inference speed of the system.

Technical Articles

- Authored technical articles on various topics in machine learning and computer vision. Some selected articles:
  - *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

Graduate Teaching Assistant | *Carnegie Mellon University* *Jan 2024 – May 2024*

- Served as a TA for the Spring 2024 offering of Learning for 3D Vision. Co-lead the development of a new assignment that introduced 3D gaussian splatting and score distillation sampling.

Undergraduate AI Mentoring Program | *Carnegie Mellon University* *Oct 2023 – May 2024*

- Mentoring a student by conducting regular 1:1 meetings to help them get acquainted with relevant AI research and tools that can be applied to their fields of interest.

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

- Mentored students of the age group 13-17 to contribute to the open source project Fabrik by providing extensive code reviews and feedback.

Machine Learning Domain Head | *Tech Club SSN* *Jun 2018 – Apr 2019*

- Conducted technical classes, and organized events and hackathons as the machine learning domain head of Tech Club SSN, a student run organization of the ECE department of my undergraduate institution.
- 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)* *January 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.