# ANIRUDH MUTHUSWAMY

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## EDUCATION

**Northeastern University,** Boston, MA **Expected May 2025**
**Master of Science in Artificial Intelligence** GPA: 4.0/4.0
*Related Courses*: Mobile Robotics, Programming Design Paradigms, Human-Computer Interaction, Advanced Perception
*Teaching Assistant* for CS4100/CS5100 – Foundations of Artificial Intelligence

**Vellore Institute of Technology,** Chennai, India **July 2022**
**Bachelor of Technology in Electronics and Computer Engineering**, GPA: 8.79/10.0
*Related Courses*: Machine Learning Algorithms, Computer Vision, Cloud and Distributed Computing, Data Analytics

## TECHNICAL SKILLS

**Programming Languages**: Python, Java, C++, CUDA, R, JavaScript, SQL
**Libraries**: NumPy, Pandas, Scikit-learn, VTK, XGBoost, Matplotlib, Seaborn, TensorFlow, PyTorch, OpenCV
**Tools & Technologies:** Git, AWS, Hadoop, Spark, Google Firebase, R Studio, Jupyter, Anaconda, Postman, 3DSlicer.

## RELEVANT WORK EXPERIENCE

**Medtronic** | *Boston, MA* **January 2024 – September 2024**
**Research and Technology Advanced Imaging Co-op**

**I. Simulation and Training Workflow for 3D Soft Tissue Registration:**

- Enhanced training codebase with optimized distributed training (utilizing in-house HPC) and asynchronous data loading techniques for improved efficiency and scalability of a 3D U-Net model while reducing training time by 85%.
- Simulated ground truth organ deformations using finite element analysis and Bio-Mechanical models for U-Net pre-training. Implemented a visualization script to interpolate output predictions in 3DSlicer.
- Reduced 3D registration error by 35%, by integrating multi-headed self and cross attention layers in vanilla 3D U-Net.

**II. Long-Range 3D Pixel Tracking Workflow:**

- Assessed Transformer and Optical Flow-based tracking algorithms for robust key point tracking on combination of open source and proprietary data, facilitating the registration of 3D models on soft tissue organs.
- Generated 3D point clouds from stereoscopic data using RAFT-Stereo for stereo reconstruction and depth estimation, incorporating camera intrinsic parameters.
- Accelerated long range 3D pixel tracking by creating a custom data loader, reducing memory usage by 75%.
- Collaborated within an Agile framework, contributing to bi-weekly sprints and weekly standup meetings to ensure seamless team coordination and project progress.

**Mitacs Globalink** | *Athabasca University, Alberta* **July 2021 – January 2022**
**Computer Vision Research Intern** | *Publication*

- Developed pipeline for Driver Distraction Detection leveraging 3 SOTA Deep CNNs and designed a Dynamic Ensemble Model with a VGG Based Autoencoder improving combined performance of the baseline models.
- Integrated evaluation pipeline with Grid and Average Weighted ensembles using the weights and biases library.
- Addressed bias through data balancing, augmentation, and hyperparameter tuning to enhance generalization.
- Improved model robustness with regularization and dropout, achieving benchmark classification accuracy of 89.13%.

## ACADEMIC PROJECTS AND RESEARCH

**Low-Rank Adaptation (LoRA) for Efficient Image Super-Resolution** | *Github* **September 2023 - October 2023**

- Implemented LoRA to optimize and fine-tune ESRGAN model, achieving an 81% reduction in trainable parameters while improving PSNR and SSIM metrics.
- Conducted extensive ablation studies, resulting in 35% decrease in inference time and computational requirements.

**Image Manipulation and Enhancement Application using Java** | *Github* **January 2023 - April 2023**

- Built and tested an application consisting of 15 image manipulation operations with a GUI built on Java Swing.
- Applied OOPs, SOLID principles, and Advanced Design Patterns (MVC, MVVM, Command, Facade) creating a robust and easily modifiable application that supports multi-format image import/export support.

**Detection of Skin Cancer Lesions using Dilated Residual Learning Networks** | *Publication* **January 2022 - July 2022**

- Proposed a two-stage approach involving segmentation and classification architectures for effective detection of 7 classes of skin diseases. The model outperformed pre-trained SOTA architectures tested on the same dataset by 12%.
- Carried out Image patching, morphological operations, and Pixel Wise transformation as preprocessing steps to bolster segmentation performance of residual learning and increase inter-class classification accuracy by 8%.

**Stacked CNN Ensemble for Breast Tumor Classification** | *Publication* **June 2021 - December 2021**

- Designed a Stacked Ensemble using 3 custom CNNs to classify breast tumors from ultrasound images (92.15% accuracy), incorporating precision-driven meta-learner and gaussian dropout layers reducing false negative rate.
- Employed an alternating pooling approach on the sub-networks and carried out Five-fold cross validation.