Huaze (Patrick) Liu

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EDUCATION

Harvey Mudd College Claremont, CA

B.S., Computer Science & Mathematics | Major GPA: 3.91 | Dean's List *Aug 2022 - May 2026*

Selected Coursework: Data Structures, Algorithms, Computer Vision, Neural Networks, Machine Learning, Reinforcement Learning, Optimization[1], Advanced Systems Engineering, Digital Signal Processing, State Estimation.

SKILLS

Programming Language: Python • C++ • C • Java • CSS • SQL • MATLAB • R

Software: Visual Studio • GitHub/Git • Unix/Linux • ROS/ROS2 • Webots • CARLA • Docker • Jupyter • Unity

Technical Skills: Computer Vision • Sensor Fusion • Robotics Manipulation • Robotics Navigation • Algorithms • Robotics Control • Reinforcement Learning

EXPERIENCE

Undergraduate Research Intern | MADD Lab | Website

Harvey Mudd College *Claremont, CA, July 2024 - Present*

- Engineered a Vision-Language Model-based traffic context scoring system to adapt GPS measurement weights, reducing position RMSE by 16.8 percent under 40 m noise and six-to-eight satellite scenarios.
- Developing a multimodal map anomaly detection framework that fuses image and LiDAR semantic segmentation with contrastive learning and KL-divergence to flag meaningful scene changes in urban environments.

Undergraduate Research Intern | Spike Lab | Website

Pomona College *Claremont, CA, April - Dec. 2024*

- Developed Recurrent Spiking Neural Networks (RSNN) using Evolutionary Algorithms to optimize temporal task training and capturing recurrent plasticity.
- Implemented custom loss functions to integrate biological neuron dynamics with classification performance.
- Analyzed weight changes across RSNN layers, identifying key differences between EA and BackProp training.

Teaching Assistant

Harvey Mudd College *Claremont, CA, January 2024 - Present*

- Held weekly tutoring sessions and graded homework for CSCI070 – Data Structures & Program Development (2024 Spring, 2024 Fall), CSCI153 – Computer Vision (2024 Fall, 2025 Spring, 2025 Fall), and ENGR207 – Digital Signal Processing (2025 Spring).

Research Intern | Lab for CATS (Cognition & Attention in Time & Space)

Harvey Mudd College *Claremont, CA, August 2023 - May 2024*

- Investigated the effects of padding-induced non-veridical representation on CNN performance with Mask R-CNN reveal significant spatial performance degradation near image boundaries.

UCSF ci2 Summer Fellowship | Biomagnetic Imaging Laboratory | Website

Univ. of California, San Francisco *San Francisco, CA, May - August, 2023*

- Preprocessed fMRI functional connectomes using MATLAB CONN toolbox and data reduction algorithms.
- Built and trained ML models (SVM, Gradient Boosting, Random Forest) for Tinnitus classification using fMRI connectomes and MEG brain maps.
- Tested models built for Tinnitus classification against a baseline Graph-CNN (GCNN), achieving 72.4% accuracy.

PROJECTS

A Vision-based Localization and Path Planning Robot System | Language: Python | Report *Mar. - May 2025*

- Developed a vision-based search TurtleBot 4, implementing and comparing EKF and UKF for state estimation and target tracking in Webot Simulation Software.
- Used the A* algorithm to compute and follow an optimal path to the GPS coordinates.

[1] *Optimization* is a graduate-level course at Claremont Graduate University taught by Prof. Marina Chugunova.

A Multi-Objective Acquisition Function of Bayesian Optimization | Language: Python | Report *Mar. - May 2025*

- Developed a novel, lightweight multi-objective acquisition function (Scalarized-UCB) for Bayesian Optimization to tune machine learning model hyperparameters.
- Tested by benchmarking on SVM and CNN models, reducing latency by 8% at equivalent accuracy compared to standard methods.

A Study of Vision Transformer for Traffic Object Detection | Language: Python | GitHub Repo *Nov. - Dec. 2024*

- Fine-tuned DETR (Object Detection with Vision Transformer), Deformable DETR, and RT-DETR on the KITTI dataset, integrating custom metrics, class-wise AP, and inference time analysis.
- Achieved 71.0% mAP (50) and 43.5% mAP (50:95) with 18.1ms inference time, showcasing efficient transfer learning and real-time performance.

Dynamic Time Warping with Confidence Intervals | Language: Python | GitHub Repo *April - May 2024*

- Applied Dynamic Time Warping (DTW) with dynamic programming to develop new metrics and visualizations for alignment confidence in time series.
- Enhanced signal alignment reliability using "valley width" in cost matrices and sliding window comparisons with the FlexDTW algorithm.

Real-Time Object Detection Software | Language: Python | GitHub Repo *Oct. - Dec. 2023*

- Worked with three members to create an efficient YOLO v.1 model that classifies objects using bounding boxes
- Conducted extensive testing using the PASCAL VOC dataset to achieve advanced predictions (65% mAP)

Spampede Game | Language: Java | GitHub Repo *April - May 2023*

- Designed a custom "Snake Game" UI and backend functionality in Java using the MVC software design pattern.
- Developed an automated game mode that prompts the AI to find optimal paths using BFS algorithms.

Connect-Four Board Game | Language: Python, JavaScript, CSS | GitHub Repo *Nov. - Dec. 2022*

- Built a full-stack Connect Four app with a Flask backend and React frontend.
- Integrated AI for automated gameplay and RESTful APIs for client-server interaction.

AWARDS & SCHOLARSHIP

- Harvey Mudd College Shanahan Projects Fund – Awarded **$11,000** for the development of an underwater autonomous pool-cleaning system. *October 2024 – May 2025*
- Harvey Mudd College Student Travel Grant – Awarded **$1,000** to attend the 38th International Technical Meeting of the Satellite Division of the Institute of Navigation (ION GNSS+) in Baltimore, Maryland. *April – May 2025*

PUBLICATIONS

Liu, H., Mohanty, A. (2025). A Framework for Map Uncertainty Using Contrastive Learning. Abstract accepted for peer-reviewed full paper submission at the 38th International Technical Meeting of the Satellite Division of the Institute of Navigation (ION GNSS+ 2025).

Mohanty, A., **Liu, H**. (2024). A Case Study of Large Language Models for Urban Scene Classification for Improving GNSS Positioning Accuracy (Research Abstract). Abstract accepted for peer-reviewed full paper submission at IEEE/ION PLANS, Salt Lake City, USA.

Qu, I., **Liu, H.**, Li, J., Zhu, Y. (2024). Evolutionary algorithms support recurrent plasticity in spiking neural network models of neocortical task learning (Poster). Bernstein Conference, Frankfurt, Germany. https://doi.org/10.12751/nncn.bc2024.128.