Mihir Kulkarni

Aspiring PhD Candidate
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Research Interests

I am interested in Machine Learning (ML), Reinforcement learning (RL) and Foundation Models and their applicability to Robotics and Multi-agent systems. In particular, my current fundamental & applied research interests involve **Multi-agent reinforcement learning** and **Human-Robot interaction**. I am excited about creating deployable, efficient and scalable learning-based methods for solving real-world problems.

Education

University of Southern California — Los Angeles, CA
Master of Science in Computer Science; GPA: 4.00/4.00 — *Aug. 2023 – May 2025*

Pune Institute of Computer Technology — Pune, India
Bachelor of Engineering in Electronics and Telecommunication; GPA: 3.92/4.00 — *Aug. 2018 – Apr. 2022*

Research Experience

Graduate Research Assistant — Feb. 2024 – Present
University of Southern California — *Los Angeles, CA*

- Exploring scalable, efficient learning-based solutions for Multi-agent systems with Prof. Jyo Deshmukh
- Working on Human-Robot interaction, intent inference, implicit communication methods with Prof. Erdem Biyik
- Worked with Multi-agent Path Finding problem, Online & Offline RL, Computer Vision for autonomous vehicles, Transformers, Imitation Learning, Large Language Models
- Submitted research work to CDC 2024, NeurIPS 2024, ICLR 2025

Industry Experience

Computer Vision Engineer — July. 2022 – June 2023
Thelios AI, LLC. — *Pune, India*

- Designed and Deployed end-to-end Video Analytics pipelines for various Sports - American Football, Volleyball
- Automated player tracking data extraction & visualization of sports broadcasts into 2-D bird's-eye view
- Parallelized inference for deep learning models decreasing average analysis time from 60 to 25 seconds per clip
- Engineered a scalable, iterative training pipeline with an integrated annotation tool that cut annotation time by 87.5%, increasing data collection
- Led a team of 6 interns for data annotations and training pipeline

Deep Learning Intern — March 2021 – June 2022
Thelios AI, LLC. — *Pune, India*

- Developed Pose Analysis for Player Performance Improvement, a CV-based tool for coaches and players
- Designed wholistic metrics to align products with business needs – tracking, play & action recognition
- Finetuned & compared state-of-the-art Object Detection models for specific data & use cases

AI development Intern — Feb 2020 – May 2020
ASCP GPUonCLOUD — *Pune, India*

- Built custom 3-stage Optical Character Recognition for Handwritten PDFs to Document conversion
- Finetuned a Text detector and localizer (EAST) on Handwritten PDF data and mapped outputs in order
- Trained a Convolutional Recurrent Neural Network (CRNN) for Text Recognition for English & Marathi letters

Projects

Multi-agent Path Finding with Offline Reinforcement learning April 2024 – Sept. 2024

- Developed a novel Offline RL approach for planning collision-free paths for multiple robots on a 2d grid world
- Decreased training time from 3 weeks to 3 hours with comparable success rates to state-of-the-art
- Studied viability of LLM for safe behaviors in cases of Distribution Shifts in MAPF
- Currently under review at *ICLR 2025*

Improving Intent Inference of Human in Human-Robot Interaction Sept. 2024 – Present

- Imitated and analyzed the limitations of human perception in human-robot collaboration domain, Overcooked
- Simulated realistic human policies with different fields of view and observation latency using PPO
- Training robot policies to infer intent from human actions and adapt to achieve the best team performance

Dynamic Trust Quantification in Perception Systems for Autonomous Driving Oct. 2024 – Present

- Developing logic-based monitors for determining trust and risk metrics in perception modules
- Integrated Real-time Object Detection, Depth Estimation, and Multi-object tracking in CARLA simulator
- Exploring applicability of Vision-Language-Action models for decision making for Autonomous Driving

Multi-object Tracking for Sports Nov. 2022 – May 2023

- Designed an in-house muti-object tracker for players, ball, and aspects of the football field
- Achieved 98% accuracy for players – small, blurry, fast-moving, and similar objects
- Tracked objects with moving camera angles, changing lighting conditions, and low-resolution videos

Pose Analysis for Player Performance Improvement Aug. 2021 – March 2022

- Developed a Computer Vision based feedback system for players to achieve target body posture during gameplay
- Built a predictive model to classify the quality of shots based on biomechanical analysis and keypoint data
- Trained an action recognition model classifying tennis shots based on keypoint data and images

Monopoly++: Collaborative Monopoly using Deep Reinforcement Learning Jan. 2024 – May 2024

- Developed a Gym environment for Monopoly modified for collaboration to study Multi-agent behavior
- Trained Deep RL policies with PPO, SAC, DQN for different reward structures and group objectives
- Achieved Multi-agent collaboration in our mixed environment (Competitive + Collaborative)

Skills

Tools: Python, C/C++, PyTorch, Tensorflow, CleanRL, stable-baselines, HuggingFace, CUDA, ROS2, OpenCV, Scikit-learn, Docker, Distributed Computing
Core Competencies: Algorithms, Reinforcement Learning, Computer Vision, Machine Learning, Deep Learning, Foundation Models, Multi-agent Systems, Human-Robot Collaboration
Relevant Coursework: Analysis of Algorithms, Robot Learning, Deep Learning, Applied Natural Language Processing, Robotics, Machine Learning, Data Structures and Algorithms, Digital Image and Video Processing, Mechatronics

Extracurricular

Mentor Mar. 2022 – June 2023
Mentors without Borders *Remote*

- Mentored underprivileged students from Africa and Asia for the Non-profit Organization (MWB)
- Taught fundamentals of programming and basic concepts of Machine Learning

Member Aug. 2018 – June 2022
Association of Computer Machinery (ACM) *Pune, India*

- Delivered lectures on Machine Learning and its applications as a part of the ML team

References

Prof. Jyotirmoy Deshmukh (jdeshmuk@usc.edu)
Prof. Erdem Biyik (biyik@usc.edu)
Dr. Sunil Kulkarni (sunil.kulkarni@sportsseam.com)