Mihir Kulkarni

Aspiring PhD Candidate
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Research Interests

I am interested in Machine Learning, Reinforcement learning and Foundation Models and their application to Robotics and Multi-agent systems. In particular, my current fundamental & applied research interests are in **multi-agent reinforcement learning**, **Human-Robot interaction** and **optimization**. 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
CPS-Vida Lab, USC — *Los Angeles, CA*

- Exploring scalable, efficient learning-based solutions for Multi-agent systems with Prof. Jyo Deshmukh
- Worked with Multi-agent Path Finding problem, Online & Offline RL, Transformers, Imitation Learning, Large Language Models
- Submitted research work to CDC 2024, NeurIPS 2024, ICLR 2025

Graduate Research Assistant — Sept. 2024 – Present
LIRA lab, USC — *Los Angeles, CA*

- Working on Human-Robot Collaboration, intent inference, implicit communication methods with Prof. Erdem Biyik

Industry Experience

Software Engineer, Computer Vision — 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 Data extraction & visualization of sports broadcasts into 2-D bird's-eye view
- 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 Object Detection models – YOLOR, YOLOv5, YOLOv7 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 via Decision Transformers and LLM collaboration 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 than state-of-the-art
- Studied viability of LLM collaboration in cases of Distribution Shifts in MAPF
- Currently under review at *ICLR 2025*

Multi-agent Path Finding through RLHF Aug. 2024 – Dec. 2024

- Achieved State-of-the-art performance in the MAPF problem on Success Rates, Collision rates & Scalability
- Conducted multiple pre-training runs of agents using Imitation Learning and Curriculum learning
- Conducted extensive literature review on multiagent systems & learning-based methods for pathfinding
- Captured undesirable behavior of agents and finetuned the models on corrected trajectories

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, SAC
- Training robot policies to infer intent from human actions and adapt to achieve the best team performance

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
- Implemented advanced Deep Reinforcement Learning algorithms to optimize strategies – PPO, DQN
- Achieved Multi-agent collaboration in our mixed environment, competitive + collaborative

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
- Tracked objects with moving camera angles, changing lighting conditions, and low-resolution videos

Skills

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

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