

RAJDEEP MUKHERJEE

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| scholar.google.com/citations?user=q5MaIsUAAAAJ |

Research Interests

- Deep reinforcement learning, generative world models, and representation learning for embodied and interactive agents (robots, UAVs, computer-use agents), including model-based control, offline RL, and unsupervised/self-supervised RL for robust long-horizon decision making in complex environments.
- Theoretical foundations of deep learning and reinforcement learning: nonconvex optimization and the dynamics of gradient-based training, generalization in overparameterized models, and sample-efficient exploration and planning in bandits and sequential decision-making, with an emphasis on algorithms that are both provable and practical.
- Probabilistic and decision-theoretic machine learning: Bayesian and graphical models, uncertainty quantification, and bandit/online learning formulations for sequential decision problems, with connections to economics, markets, and large-scale resource allocation.
- Multi-agent learning and game-theoretic reasoning in large systems, including learning in differentiable games, equilibrium computation, and mechanism/market design for strategic interactions among many adaptive agents.

Education

University of Michigan

B.S.E. in Computer Science with focus on Intelligent Systems and Minor in Mathematics
GPA: 3.555

Ann Arbor, MI

May 2026

Coursework: Machine Learning, Intro to Artificial Intelligence, Data Structures & Algorithms, Web Systems, Computer Organization, Human-Robot Systems, Applied Probability and Statistics, Reinforcement Learning, Computer Vision

Oakland University

B.S. Computer Science with specialization in Artificial Intelligence (Honors College)
School of Engineering and Computer Science
GPA: 3.92

Rochester, MI

April 2024

Publications

- [1] Balakrishnan Dharmalingam, **Rajdeep Mukherjee**, Brett Piggott, Guohuan Feng, Anyi Liu. *Aero-LLM: A Distributed Framework for Secure UAV Communication and Intelligent Decision-Making*. **ICCCN 2024**, 1st Int'l Workshop on Integrated Sensing, Communication, and Computing (IoT Systems).
- [2] Brett Piggott, Siddhant Patil, Guohuan Feng, Ibrahim Odat, **Rajdeep Mukherjee**, Balakrishnan Dharmalingam, Anyi Liu. *Net-GPT: A LLM-Empowered Man-in-the-Middle Chatbot for Unmanned Aerial Vehicle Networks*. **ACM/IEEE EdgeSP 2023**, in Proc. IEEE/ACM Symposium on Edge Computing.
- [3] Balakrishnan Dharmalingam, Ibrahim Odat, **Rajdeep Mukherjee**, Brett Piggott, Anyi Liu. *Heterogeneous Generative Dataset for UASes*. **IEEE MOST 2023**, pp. 229-230.

Manuscript in Preparation

- [1] **Rajdeep Mukherjee**, Tod Manlaibaatar. *EC-TSS: Edge-Consistent Temporal Stabilization*.

Research Experience

University of Michigan – Ann Arbor

Undergraduate Researcher (Human AI Lab)

Advisor: Professor Anhong Guo

September 2025 – Present

Ann Arbor, MI

- Systematically investigating SOTA computer-use agents (CUAs) under preregistered accessibility constraints (Keyboard-Only, Screen-Reader, High-Zoom), and quantifying failure modes to map the modality gap via controlled interventions.
- Building a capability-aware benchmark with rigorously defined metrics (success rate, latency, action/error counts, F1–F8 failure taxonomy) and reporting Wilson CIs and Cliff's δ in a fully reproducible evaluation suite.
- Prototyping a Long-Short Term Memory (LSTM) based Partially Observable Markov Decision Process (POMDP) decision policy that can potentially map capability-aware observations to reliable keyboard/screen-reader actions, trained via Supervised fine-tuning (SFT) followed by PPO (Proximal Policy Optimization) with action masking and compatibility regularization.

Oakland University

Research Assistant

Advisor: Professor Anyi Liu

September 2023 – April 2024

Rochester, MI

- Team Lead: Led research on [Aero-LLM](#), a distributed framework for secure UAV communication and intelligent decision-making. Co-authored the paper published at ICCCN: IEEE's 33rd International Conference on Computer Communications and Networks in July 2024.
- Designed and implemented the architecture of Aero-LLM, collected data using software-in-the-loop (SITL) and hardware-in-the-loop (HITL) environments.
- Fine-tuned several OPT/Llama2 LLMs using both SFT and RLHF achieving optimized model performance and enhanced decision-making capabilities for UAV communication systems.
- Conducted extensive experiments achieving high accuracy (> 82%), precision, recall, and F1 scores with minimal error rates.

Research Assistant

May 2023 – August 2023

- Researched and developed [Net-GPT](#): A LLM-Empowered Man-in-the-Middle Chatbot for Unmanned Aerial Vehicle and co-authored the paper published at EdgeSP: The Fifth ACM/IEEE Workshop on Security and Privacy in Edge Computing in December 2023.
- Designed and implemented attacks that enable Net-GPT to hijack benign UAVs and gain control over the communication session between UAVs and Ground Control Stations (GCS).
- Conducted extensive experiments to fine-tune LLMs, including Llama-2-7B and Llama-2-13B, showcasing the impressive predictive accuracy of 95.3% and 94.1%, respectively. Explored the trade-off between dataset quantity and the number of fine-tuning epochs.
- Evaluated the generative accuracy of Net-GPT and analyzed generative errors for different LLMs. Explored the cost-efficiency of data size and fine-tuning epochs. Results demonstrated the potential of LLMs in producing accurate network packets and simulating UAV-GCS communications.

Research Assistant

January 2023 – April 2023

- Researched and constructed a [Heterogeneous Generative Dataset for UASes](#) and co-authored the paper published by IEEE International Conference on Mobility, Operations, Services and Technologies (MOST) in May, 2023.

Professional Experience

Amazon Web Services (AWS)

May 2025 – August 2025

Software Development Engineering Intern (AI/ML)

Seattle, WA

- Shipped a production agentic LLM system that auto-generates configuration files with a simple user prompt 24x faster, boosting efficiency by 95.8% at 99%+ accuracy and engineered a modular, extensible architecture to be reused across adjacent projects.
- Built a multi-LLM inference harness to benchmark foundation models across accuracy, latency, and cost for experiment trials.
- Created a comprehensive synthetic dataset modeling real-world ambiguities and long-tail edge cases; used for both training and eval.
- Fine-tuned foundation models on synthetic and curated data to maximize exact-match performance and robustness with instruction tuning.

Projects

University of Michigan – Ann Arbor

January 2025 – May 2025

Undergraduate Researcher (EECS 545)

Ann Arbor, MI

Advised by: Professor Honglak Lee and Violet Fu

- Extended DeepSeek R1 for multimodality, adding audio via OpenAI Whisper and image/UI understanding via Llama 3.2 90B Vision; unified modalities into a single action schema for planning and tool use.
- Upgraded agent memory from episodic to persistent, cross-session recall by designing a FAISS vector store backed by Gemini text embeddings; implemented memory read/write hooks directly in the tool-use loop.
- Achieved results: WebShop accuracy 52% vs 45% (+7pp, +15.6% rel.); WebArena 24% vs 15% (+9pp, +60% rel.).

VTI Aero

January 2025 – April 2025

Research Fellow (PJTL at MCity)

Ann Arbor, MI

Advised by: Eric Wingfield, Douglas Moore, and Eric Muir

- Engineered a real-time, GPS-independent localization system by integrating advanced sensor fusion algorithms and on-board processing capabilities, enabling autonomous drone navigation and precise pose estimation without external positioning systems.
- Developed a design for an AI-driven voice command interface leveraging speech-to-text technologies and machine learning models to interpret and execute complex spoken instructions, enhancing user interaction and operational flexibility of the drone.

Retrospect AI

August 2024 – December 2024

Research Fellow (PJTL at MCity)

Ann Arbor, MI

Advised by: Eric Wingfield, Douglas Moore, and Michael Woon

- Developed a trajectory emulator in Python utilizing spline interpolation and parameterized paths, enabling real-time simulation of vehicle motion with acceleration and jerk constraints, processing 1000+ trajectory points per run with millisecond precision analyzing autonomous vehicle safety.
- Engineered a data processing pipeline that parsed and analyzed 5000+ data points from CSV input, generating six key motion analysis graphs (trajectory, velocity, acceleration, and jerk) to optimize vehicle trajectory planning and system performance evaluation.

Skills

Languages: Python, C, C++, Java, HTML, CSS, SQL, SQLite, JavaScript, MATLAB, TypeScript

Technologies: TensorFlow, PyTorch, Pandas, AWS, Flask, Hugging Face, JMavSim, PX4 Autopilot, Unreal Engine, NVIDIA Omniverse, Human-Robot Interaction, Git, REST APIs, React, DOM, CUDA, RAG, FAISS

Expertise: Deep Neural Networks (CNNs, RNNs, LSTM), Reinforcement Learning, Computer Vision, NLP, ML Optimization, System Design

Teaching Experience

Oakland University

January 2024 – April 2024

Computer Science and Engineering Dept. Grader

Rochester, MI

- Evaluated and graded assignments, quizzes, and examinations for undergraduate students in CSI 2470 – Introduction to Computer Networks.
- Aided in conducting interactive and engaging lab sessions, providing students with hands-on experience.
- Enabled student learning through personalized consultations, addressing queries on course content, assignments, and projects, fostering a supportive, collaborative environment.

Mathematics and Statistics Dept. Grader

September 2023 – December 2023

- Evaluated and graded assignments and quizzes for undergraduate students in MTH 1554 – Calculus I.
- Provide constructive feedback and guidance to students on their performance and areas of improvement.
- Collaborated with instructors and teaching assistants to ensure consistency and accuracy in grading while upholding academic integrity.

Honors & Awards

- Nominated for Hawaiian T-shirt Award at AWS SageMaker AI Summer 2025
Awarded to 3 employees in a 100+ employee team in a month for the most innovative/impactful project
- Dean's List at the University of Michigan – Ann Arbor Winter 2025
Given to students with at least 12 credits and 3.5+ GPA
- Dean's List at Oakland University Winter 2024
Given to students with at least 12 credits and 3.5+ GPA
- President's List at Oakland University Fall 2022, Winter 2023
Given to students with at least 12 credits and 3.9+ GPA
- Oakland University International Opportunity Award Fall 2022
International student merit scholarship