Karim El-Refai

Berkeley, CA

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Education

University of California, Berkeley — Berkeley, CA

B.A. Computer Science, Honors | Cumulative GPA: 3.84 — *May 2025*

- **Undergraduate Coursework:** Foundations of LLMs, Intro to Machine Learning, Computer Graphics, Convex Optimization, Computer Architecture, Robotic Manipulation and Interaction, Nanorobotics, Data Structures and Algorithms, Advanced Algorithms, Discrete Math and Probability Theory, Designing Information Devices, Foundations of Data Science
- **Graduate Coursework:** Deep Reinforcement Learning (Top 11 out of 220 students)
- **Activities:** EECS Honors Program with a specialization in robotics, Upsilon Pi Epsilon Honors Society

Experience

Berkeley Artificial Intelligence Research (BAIR) Lab — Berkeley, CA

Undergraduate Researcher — *January 2022 – Present*

- Conducting research in robotic grasping and manipulation and computer vision techniques in 3D reconstruction and tracking advised by Professor Ken Goldberg
- Several published papers in IEEE Robotics conferences including IROS and CASE

Head Teaching Assistant for UC Berkeley Upperdiv/Graduate Robotics Courses — *January 2023 – Present*

- Running discussion sections and hosting office hours for the introductory upper-division/graduate robotics class of **300 students** and the advanced graduate robotics course of **100 students**
- Developed an entirely new robotics lab for students that takes them through the entire process of building complex robotics systems using object segmentation, PID control, and trajectory planning with bezier curves

Capital One — San Francisco, CA

Software Engineer Intern — *June 2023 – August 2023, June 2024 – August 2024*

- Spearheading the development of a feature to Capital One's car dealership platform, allowing for the generation of high-quality photo-realistic 3D models of cars with only a single video taken by a phone
- These models are then hosted online for customers to view, providing a unique online shopping experience
- Built a fullstack application with a React frontend and Flask backend to process data of millions of Capital One's customers and display results in an easily readable format, saving on average 7 work hours every week

Research

Gaussian Splatting for Tracking Human and Robot Manipulation of Objects - ICRA 2025 — *September 2024*

- Built a state-of-the-art computer-vision algorithm and robotic system for densely mapping and tracking objects in the real world for robots to work with humans on long-horizon tasks
- Implemented on a UR5 robot with a wrist-mounted depth camera and tested on a variety of tasks from cooking to automotive assembly
- Work sponsored by and done in collaboration with the Toyota Research Institute, under review for ICRA 2025

Language Embedded Gaussian Splatting for Mobile Robotics - Oral Presentation IROS 2024 — *June 2024*

- Heavily modified power and network system of mobile robot with custom 305 degree FOV camera setup to autonomously traverse large-scale environments (workspaces, kitchens, cafeterias) and build a 3D map of the environment with language-embeddings in real-time
- We use the language embeddings in the map to query the map for the presence of a given item and if it is present the robot will traverse to the object and retrieve it

Storytelling With Action Guidance - EMNLP 2024 — *June 2024*

- Reframing the task of storytelling with large language models (LLMs) to a search problem through a two-model feedback loop: one LLM generates story content, and another, auxiliary LLM, is used to choose the next best "action" to steer the story's future direction
- This approach produces stories that are **85% more preferred** than previous works and allows small open-source models, such as Llama-2-7B, to outperform GPT-3.5-Turbo

Automating Deformable Gasket Assembly - CASE 2024 — *March 2024*

- Tackles the task of automating gasket assembly where a robot must align and press a deformable gasket into a narrow channel from beginning to end with no human intervention which has substantial applications in manufacturing
- We use deep imitation learning from 250 human-teleoperated demos to train a diffusion-based visuomotor policy for our robot and compare it's efficacy against three procedural algorithms

Onboard Tracking of 160+ MPH Autonomous Racecars Using Multi-Input EKF — *May 2023*

- Developed a computer vision pipeline in C++ with ROS2 to preprocess incoming LiDAR and RADAR readings on fully autonomous race cars traveling 160+ mph at rates of 20Hz and 5.5Hz respectively
- Fused these sensor measurements with an extended Kalman filter that produces readings on a car's position, orientation and velocity at 200Hz with an average positional error of 17cm

Skills

- **Programming Languages**: Java, C, C++, Python, SQL, HTML, CSS, JavaScript, RISC-V
- **Tools & Libraries**: PyTorch, ROS, ROS2, OpenCV, Docker, Git, React, Tensorflow