Zhiyuan Li

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Education

- **University of Toronto** — Toronto, Ontario
  Bachelor of Engineering Science & Robotics Specialization; Major GPA: 3.90 — *Sep 2022 – Apr 2027*

Research Experience

- **Huawei Technologies, Noah's Ark Lab — Embodied AI** — Toronto, Ontario
  Research Assistant — *May 2025 – Present*
  - Conducted research on **Vision-Language-Action (VLA) models** such as **Pi0** for robotic manipulation in visually cluttered environments, studying perception–action coupling and **robustness degradation caused by distractors**. Designed experiments using UR5e and Franka robots, with ROS integration for policy execution from learned VLA models.
  - Explored **long-horizon symbolic planning** via **Plan-to-Evolve (P2E)** frameworks. Fine-tuned and conducted experiments on large language models including **Qwen3** and **LLaMA 3/4** using **PDDL-based domains** with **Chain-of-Thought** reasoning, and compared against multiple baselines such as majority voting and self-distillation. Integrated real-robot experiments combining **VLA** and motion planners that bridge **symbolic planning** with low-level continuous controls.
  - Contributed to a real-robot prototype of **Mem2Ego**, a global-to-egocentric memory architecture for **long-horizon embodied navigation**. Integrated **V-SLAM** and **Nav2** within ROS2 for agent-guided navigation, and conducted comparisons against classical baselines such as random exploration and heuristic-based exploration.
  - Served as one of the lead engineers on the **The North Star** team participating in the **Behavior Challenge** at the **NeurIPS 2025 Workshop**. Designed a **finite-state machine** pipeline integrating computer vision (object detection and pose estimation via **SAM6D**), **VLA-based execution** (via **Pi0**), and **classical robot motion planning**, enabling task execution across **50+ household tasks** in the **Isaac Sim** environment. Achieved **4th place** in the challenge.
  - **Associated Publications:**
    - *Distracted Robot: How Visual Clutter Undermines Robotic Manipulation*, arXiv:2511.22780, submitted to ICRA.
    - *Improving Robotic Manipulation Robustness via NICE Scene Surgery*, arXiv:2511.22777, submitted to ICRA.
    - *Plan2Evolve: LLM Self-Evolution for Improved Planning Capability via Automated Domain Generation*, arXiv:2509.21543, submitted to ICLR.
    - *Mem2Ego: Empowering Vision-Language Models with Global-to-Ego Memory for Long-Horizon Embodied Navigation*, arXiv:2502.14254, submitted to ICRA.
- **University of Toronto Continuum Robotics Laboratory** — Toronto, Ontario
  Undergraduate Research Assistant (Part-time) — *Feb 2024 - April 2025*
  - Conducted in-depth research on **state estimations for continuum robotics**, focusing on **constraints and degrees of freedom** in various actuation methods. Special emphasis was placed on **tendon-driven continuum robots (TDCR)**, where the **Clarke transformation** was extended to general models and used to unpack the system's constraints accurately.
  - Analyzed **TDCR forward kinematics** from first principles, evaluating the **influence of hardware factors** such as material stiffness, size effects, disk radius, and tendon length. Performed extensive testing on physical continuum robots, comparing their performance with simulations, and **introduced corrective factors** to improve the accuracy of the models.
  - Developed and simulated **TDCR models** using tools such as **MuJoCo** and **Pyplot**. Utilized physics engines to create specialized functions for modeling continuum robots. Documented the results and findings through blog posts on the **OpenCR project**, demonstrating how these simulations can be generalized for broader applications.

Personal Projects

- **Day Travel Map**:
  - Developed a **GIS map application** in **C++** designed for frequent commuters, featuring real-time route display and user-input capabilities on local devices. The application provided an intuitive interface for users to enter destinations, calculate routes, and view travel data, enhancing everyday navigation in Toronto.
  - Implemented a **shortest path** feature between intersections using the **A* Algorithm** combined with the **ezgl API**, ensuring **100% accuracy** in route calculations and achieving a **sub-1 second** response time for paths across Toronto. This optimization significantly enhanced the application's efficiency and usability for real-time navigation.
  - Applied the **Multi-Dijkstra Algorithm** and **Greedy Algorithm** to solve the **Traveling Salesman Problem** (TSP), optimizing multiple travel routes. Improved the solution's performance by integrating advanced optimization techniques such as **Three-Opt** and **Shift-Perturbation**, leading to faster, more accurate routing. The solution ranked within the **top 20%** for runtime efficiency in a school competition.
- **Mahjong AI**:
  - Used **Pytorch with LSTM model** to train an AI system for playing Mahjong under the Japanese M-League rules, capable of analyzing played tiles and suggesting the optimal move. Incorporated **offensive and defensive strategies** to adapt to dynamic gameplay and assist users in decision-making.
  - Developed a **real-time game integration** feature by connecting the system to web-based Mahjong platforms using **HTTP requests**. Enabled automatic reading of game state and tile information, providing users with immediate insights and optimal move recommendations during gameplay.

Awards

- **Putnam Math Contest**: Personal score 42 and Rranking **Top 154**. **Top 3** member of Top 5 Winning Team.
- **CEMC Math Contests**: Euclid 2-time Honor Roll (Rank 77), Hypatia, Fermat, CSMC Honor Roll (Rank 100)
- **AMC/AIME Math Contest**: AMC 2-time Honour Roll(Top 0.1%), AIME 2-time Honour Roll (Top 0.1%)
- **Canadian Mathematics Olympiad**: Invited participant.
- **University of Toronto Undergrad Mathematics Contest**: **Top 1** among all participants from all years, all campus.