

Xiang Gao

UNDERGRADUATE STUDENT

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Education

Tsinghua University

Beijing, China

Aug. 2022 - present

- Senior of IIIS (Yao class)
- Graduated from The High School Affiliated to Renmin University of China
- Major: Computer Science
- Courses: C++ programming (GPA 4.0, A+), Calculus (GPA 4.0, A+), Computation theory (GPA 4.0), Advanced computer graphics (GPA 4.0), Distributed system and operating system (GPA 4.0), Game Theory (GPA 4.0), Computer system architecture (GPA 4.0), and Machine learning (GPA 3.6) etc.
- **Research Interest: (Multi-agent) Reinforcement Learning, Multimodal LLMs, Game Theory**
- GPA: 3.8/4.0.

Research Experience

Beijing, China

TAIC(TENTATIVE ANTICIPATORY INTENTION COMMUNICATION) - THE COMMUNICATION BETWEEN GOOD AGENTS ABOUT THEIR STRATEGIES IN RL

Oct. 2023 - Aug. 2025

- **Advisor: Prof. Zhixuan Fang (IIIS, Tsinghua University)**
- In traditional communication mechanisms in multi-agent RL, the messages are often about the observations.
- Aiming to integrate an agent's action tendencies into communication mechanisms to enhance cooperation among agents.
- To train the message generation network, we leverage the discrepancy between the estimated observation/action (derived from the message) and the real ones as a supervision signal, computing a loss for backpropagation.
- Evaluated on standard Multi-Agent Particle Environment (MPE) benchmarks, our approach demonstrates a strong ability to avoid local optima, effectively preventing agents from converging to sub-optimal policies.
- Achieved over 10% performance improvement across multiple MPE environments.
- Also interested in the effect of adversary agents in multi-agent systems.
- Responsible for the evaluation on most of the benchmark models.

Seattle, US

RHO LOSS FOR VLM2VEC - DATA SCHEDULING TO ACCELERATE THE TRAINING

Feb. 2025 - Aug. 2025

- **Advisor: Prof. Simon Shaolei Du (Paul G. Allen School, University of Washington)**
- Models like VLM2Vec can reach a good performance on different categories of tasks simultaneously, but the training process is quite long and some performance has space for improvements.
- Applying data scheduling methods (e.g. Rho loss) on VLM2Vec to accelerate the pretraining process.
- Using CLIP-like models as the teacher model to reduce the difference between loss in trained models and common comparative models.
- Modifying the codes for VLM2Vec to help integrating the selection process.
- Using distinct metrics to do the evaluation.

Seattle, US

COCO-FACET - A NEW SET OF BENCHMARK AND METHOD SHOWING THE SIGNIFICANCE OF PROMPTABLE EMBEDDINGS FOR ATTRIBUTE-FOCUSED IMAGE RETRIEVALS

Feb. 2025 - May 2025

- **Advisor: Prof. Simon Shaolei Du (Paul G. Allen School, University of Washington)**
- CLIP and similar models have good capabilities on matching image and text, but they lack flexibility when we only focus on some attributes of the images.
- Developed benchmarks demonstrating a >10% advantage of generative models over comparative models in text-to-image retrieval tasks.
- Evaluating the benchmarks with different baseline models (including the design of the interface to adapt the model to our data), the prompts can add about 5 percent to the final performance.
- Designing prompts in the generative-based models with human effort and LLM APIs, showing they both have some outperformances.
- Identifying some problems with the existed models on the retrieval tasks, including lack of robustness to deceptive attributes.

Remote, US

RISK SENSITIVE MARL - AN APPROACH TO MORE APPROPRIATE EQUILIBRIUM IN COORDINATION GAMES

Jul. 2025 - present

- **Advisor: Prof. Kaiqing Zhang (University of Maryland)**
- Investigated the limitations of traditional equilibrium concepts in coordination games when positive and negative payoffs exert asymmetric influences on agent behavior.
- Introduced exponential-form risk measures to explicitly account for such payoff asymmetry and align agent policies with risk-aware objectives.
- Theoretically characterized the sensitivity of Stackelberg equilibrium (SSE) to changes in the risk parameter within discretized game models.
- Analyzed and established convergence guarantees to risk-sensitive equilibria under replicator dynamics, softmax policy gradient, and natural policy gradient methods.

Publications

- [[Jiang, Gao and Fang(2025)] Jiang, J., **Gao, X.** & Fang, Z. (2025). *PreACT: Pre-Action Communication of Tentatives for Multi-Agent Coordination and Learning*. Submitted to machine learning conference and under review.
- [[Li, Gao and Du(2025)] Li, S., **Gao, X.** & Du, S. (2025). *Highlighting What Matters: Promptable Embeddings for Attribute-Focused Image Retrieval*. In *Neural Information Processing Systems (NeurIPS 2025)*. arXiv:2505.15877
- [[Luo, Xu, Gao, Fazel and Du(2026)] Luo, M., Xu, W., **Gao, X.**, Fazel, M. & Du, S.S. (2026). *Global Convergence of Four-Layer Matrix Factorization under Random Gaussian Initialization*. Submitted to machine learning conference and under review.

Course Project

BLOCKCHAIN - A CHAIN WITH MULTIPLE ATTENDERS AND FUNCTIONS

Beijing, China

Sep. 2024 - Jan. 2025

- **Instructor: Prof. Wei Xu (IIIS, Tsinghua University)**
- Implementing a Blockchain that keeps the longest chain as the main chain.
- Having multiple mechanisms to keep safety and multiple functions including a GUI for the whole system.
- Thanks to my collaborators Jingyi Lv and Wenjie Huang.

Beijing, China

Jun. 2024 - Aug. 2024

MULTICAST - A IMPLEMENTATION WITH GARNET

- **Instructor: Prof. Kaisheng Ma (IIIS, Tsinghua University)**
- In Routing networks, we may need to send the same messages from one sender to multiple receivers.
- Aiming to reduce the total amount of traffic, we can only copy the packets at the diverging points.

Activity

China

Sep. 2022 - present

- Participated in the 2023 Shanghai Jiaotong University-Tsinghua University-Peking University Computer Science "Growth Partner" International Summer School and communicated with outstanding scholars and students at home and abroad.
- Participated in the summer research camp of "Exploring Anhui and Visiting Cultural Heritage", and undertook research and publicity activities.
- Visited some alumni companies(e.g. Taichi Graphics) and laboratories(e.g. Shanghai AI lab) and communicated with the entrepreneurs and engineers. Got some ideas in Multi-agent RL when discussing with an engineer.
- Actively participated in the international exchange activities organized by the "Global Competence" organization on campus, and exchanged questions with Brazilian Ambassador to China Marcos Galvao.
- Participated in volunteering activities and chorus on and off campus many times.
- Willing to participate in class and department work and activities.

Awards

Tsinghua University

2023

- A freshman scholarship in college.