

RESEARCH INTERESTS

My research focuses on enhancing data-driven decision-making in complex real-world operational environments, using tools from **Reinforcement Learning**, **Experimentation** and **Online Learning**.

EDUCATION

- **Shanghai Jiao Tong University** Shanghai, China
Undergraduate in Computer Science Sep. 2021 - present
 - GPA : 4.1/4.3, Ranking : 1/17
 - Member of **John Hopcroft Honors Class**, an elite CS program at SJTU for top 5% of students, with a focus on **Theoretical Computer Science**.

RESEARCH EXPERIENCE

- **Efficient Experimentation for Long-term Causal Effects** Jan. 2024 - Present
Advisor: Prof. David Simchi-Levi, MIT Data Science Lab
 - Systematically modeled and analyzed the experimentation problem for long-term causal effects in dynamic service systems by incorporating the Markov Decision Process (MDP) framework.
 - Developed asymptotically normal estimators for A/B testing on MDPs with general treatments and proved their asymptotic efficiency.
 - Proposed the Information Sharing (IS) technique and demonstrated how it leads to almost linear variance reduction with the number of test arms.
- **Entanglement in Multi-agent Reinforcement Learning** Feb. 2024 - Present
Advisor: Prof. Tianyi Peng, DRO, Columbia Business School
 - Investigated a generic policy evaluation problem in (coupled) multi-agent dynamic systems.
 - Invented a novel theoretical framework called Markov Entanglement to study local value decomposition. This framework is inspired by Quantum Entanglement in quantum physics.
 - Demonstrated that Markov Entanglement is a sufficient and necessary characterization for exact local value decomposition.
 - Proposed how to mathematically quantify the degree of entanglement for coupled multi-agent systems and proved that the value decomposition error under general policies is bounded by the measure of Markov Entanglement.
- **Solving Extensive-form Games with Linear Function Approximations** July 2023 - Nov. 2023
Advisor: Prof. Shuai Li, John Hopcroft Center, Shanghai Jiao Tong University
 - Designed algorithms for imperfect-information extensive-form games (IIEFGs) with linear function approximations, and presented provably efficient convergence to Nash Equilibrium.
 - Proposed a preprocessing technique for strategic parameter selection, achieving empirically improved convergence rate while maintaining worst-case performance guarantees.

PREPRINTS

1. **Experimenting on Markov Decision Processes with Local Treatments**
with David Simchi-Levi and Chonghuan Wang.
<https://arxiv.org/abs/2407.19618>
2. **Towards provably efficient learning of extensive-form games with imperfect information and linear function approximation**
with Canzhe Zhao, Weiming Liu, Haobo Fu, Qiang Fu, Shuai Li.
In Submission.

ACADEMIC PROJECTS

- **JaxRL**: A pure Jax implementation of state-of-the-art deep reinforcement learning algorithms like PPO, TD3, SAC, DQN etc.
 - Integrated Just-in-Time Compilation and pure function to accelerate training for deep reinforcement learning.
 - Benchmarked on popular deep reinforcement learning environments like OpenAI Gym, Mujoco and Minigrid.
- **SEAL Compiler**: Engineered a compiler from scratch for a C-like programming language SEAL.
 - A complete implementation of a modern compiler, from lexer and parser to assembly code generator, capable of running on Qemu RISC-V Simulator.
 - Implemented optimizations like tree-based register allocations and constant folding etc.

HONORS AND AWARDS

- National Scholarship of China (Top 0.2% nationwide) 2021-2022
- Fan Hsu-Chi Scholarship (15 winners each year, Shanghai Jiao Tong University) 2022-2023, 2023-2024
- Han-Ying-Ju-Hua Scholarship (15 winners each year, Shanghai Jiao Tong University) 2022-2023
- Zhiyuan Honorary Scholarship (Top 5%, Shanghai Jiao Tong University) 2021-2022, 2022-2023, 2023-2024
- A-class Academic Excellence Scholarship (Top 1%, Shanghai Jiao Tong University) 2021-2022

INVITED TALK

- “RL for Ride-hailing—On the Markov Entanglement”, INFORMS Annual Meeting 2024

SKILLS SUMMARY

- **Programming Languages**: C/C++, Python
- **Frameworks**: Pytorch, Jax