Shuze Chen

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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 INTERESTS

Experimentation, Reinforcement Learning and Operations Research.

RESEARCH EXPERIENCE

- **Efficient Experimentation for Long-term Outcomes**   Jan. 2024 - Present
  Advisor: Prof. David Simchi-Levi, MIT Data Science Lab
    - Systematically modeled and analyzed the experimentation problem for long-term outcomes in dynamic service systems, by incorporating the Markov Decision Process (MDP) framework.
    - Unified common model-based and model-free inference methods for MDPs under a fixed policy by showing they are asymptotically equivalent and normal. Using this result, we developed asymptotically normal estimators for A/B testing on MDPs with general treatments.
    - Proved the efficiency of our proposed estimators by introducing new proof techniques to establish variance lower bounds for statistical inference on MDPs.
    - Proposed Information Sharing (IS) techniques motivated by the practical prevalence of local treatments. Demonstrated how leveraging the structure of treatments can lead to almost linear variance reduction with the number of test arms.
    - Explored scenarios with access to offline historical datasets and designed estimators that achieve provably further variance reductions given the perfect information about the control arm.
    - Discovered the monotonic phenomenon of local treatments on MDPs and proved a theorem formally establishing this property, which implies consistent treatment effect across all states as well as bounded welfare loss.

- **Entanglement in Multi-agent Reinforcement Learning**   Feb. 2024 - Present
  Advisor: Prof. Tianyi Peng, DRO, Columbia Business School
    - Invented a novel framework called Markov Entanglement to study the decomposition of value functions in (coupled) multi-agent reinforcement learning. This framework is inspired from Quantum Entanglement in quantum physics.
    - Established a non-trivial sufficient condition for exact local value decomposition, applicable even when agents are coupled with one another.
    - Proposed how to mathematically quantify and measure the degree of entanglement for coupled multi-agent systems through solving an optimization problem.
    - Proved that the decomposition error for general policies is bounded by the measure of Markov Entanglement. Furthermore, we demonstrated the effectiveness and scalability of the local value decomposition by proving that its error does not scale with either the state space size or the action space size of the system.
    - Demonstrated how this cross-disciplinary framework enables decentralized and efficient policy evaluations in coupled multi-agent systems like ride-hailing platforms.

- **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 approximation, and presented provably efficient algorithms for fast convergence to Nash Equilibrium.
    - Proposed a preprocessing technique for strategic parameter selection by traversing the game tree, 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.
  - Integrate Just-in-Time Compilation and pure function to accelerate training for deep reinforcement learning.
  - Benchmark on popular deep reinforcement learning environments like Openai Gym, Mujoco and Minigrid.

- **SEAL Compiler**: Engineer a compiler from scratch for a C-like programming language SEAL.
  - Complete implementation of a modern compiler, from lexer and parser to assembly code generator that runs on Qemu RISC-V Simulater.
  - Optimizations implemented like tree-based register allocation 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

- 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, Shanghai Jiao Tong University   2021-2022

SERVICE

- **Conference Reviewer**: ICML 2024
- **Invited Talk**: INFORMS Annual Meeting 2024

SKILLS SUMMARY

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