Yingru LI

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Education

- **The Chinese University of Hong Kong, Shenzhen**, China   2018 –
  Ph.D. candidate in Computer and Information Engineering.
  Supervisor: *Zhi-Quan (Tom) LUO*   **Thesis direction**: Efficient Reinforcement Learning
  Committee: *Jim DAI*, *Xinyun CHEN*, *Baoxiang WANG*, *Benjamin VAN ROY* (Stanford & DeepMind)

- **Huazhong University of Science and Technology**, China   2017
  B.Eng. in Computer Science (Honors Program). **Outstanding Graduate**
  Thesis: Learning multi-channel influence in networks. Supervisor: *Kun HE*

Selected Scholastic Honors

- **Best Paper Award**, in Daoyuan Academic Forum, 2024.
- **SRIBD Ph.D. Fellowship** (Gold Class), by Shenzhen Research Institute of Big Data (SRIBD), 2023.
- **Presidential Ph.D. Fellowship**, by The Chinese University of Hong Kong, Shenzhen, 2019–2023.
- **Tencent Ph.D. Fellowship**, Jointly by Tencent & Chinese University of Hong Kong, Shenzhen, 2018.
- **Award of Excellence in Internship**, by Microsoft Research Lab, 2016.
- **Qiming Star Award** (top 5 overall undergraduates), by Huazhong University of Science and Technology, 2016. **Reports**: [1] Newspaper. [2] HUST Online.
- **National Scholarship** (Academic Excellence), by Huazhong University of Science and Technology

Research Interests

- Sequential Decision-making & Reinforcement Learning. Bayesian Uncertainty Quantification.
- Algorithms Design & Complexity Analysis. Mathematical Optimization.
- Applied Probability, Stochastic Processes & Sequential Analysis.
- Applications in AI, Robotics & Operations Research (OR) that could benefit Humanity.

Professional Experience

Selected Research Projects

- **Efficient Reinforcement Learning: Algorithm Design and Analysis**
  — **Challenge**: Addressing data and computational efficiency in RL for real-world applications.
  — **Algorithmic innovations**:
  (1) The proposed HyperAgent for complex environments pioneered the **first solution** blending practical efficiency ([5], [6]) with theoretical soundness [5]. Developed Hypermodel and Index Sampling (IS) schemes for computation-efficient, incremental posterior approximation over complex models without conjugacy and data-efficient control policy, leading to **significant efficiency gains** in deep RL benchmarks (requiring **only 15%** of data and **5%** parameters vs. SOTAs).
  (2) Advanced distributed actor-critic agents to **stabilize optimization with off-policy data reuse** [7].
  — **Analytical innovations**:
  (1) Formulated innovative probability tools ([11], [2]) for sequential random projection, establishing a **non-trivial martingale extension to the Johnson-Lindenstrauss (JL)** [11], pivotal for Hypermodel and IS analysis ([5], [12]), ensuring **provable scalable computation** with near-optimal **data efficiency**.
  (2) Conducted the **first prior-dependent analysis** [4], highlighting how integrating prior knowledge, such as historical data or pre-trained models, enhances RL agent efficiency before direct exploration.

Professional Experience (continued)

🔖 **Game-theoretic Decision-making under Uncertainty** — Developed TS-type algorithms for **multi-agent scenarios** with unknown utilities [3], leveraging opponent actions and utility structures. Introduced a **novel information-theoretic regret bound** that, for structured utilities, scales **logarithmically with strategy space size**, taming the curse of multi-agent. Applied to real-world traffic routing and radar communications, achieving **over tenfold reduction in experimental budgets**.

Research Positions

🔖 **The Chinese University of Hong Kong, Shenzhen**, China 2018 –
Graduate Research Assistant with Presidential Fellowship with Prof. *Zhi-Quan (Tom) Luo*

🔖 **Tencent AI & Robotics X**, Shenzhen, China 2019
Research Intern in Agent Center with Dr. *Lei Han*

🔖 **Department of Computer Science, Cornell University**, Ithaca, NY 2017
Research Assistant with Prof. *John Hopcroft*

🔖 **Microsoft Research Lab - Asia**, Beijing, China 2016
Research Intern in Theory Center. with Dr. *Wei Chen*

Research Publications

Journal Articles

1 K. He, **Y. Li**, S. Soundarajan, and J. E. Hopcroft, "Hidden community detection in social networks," *Information Sciences*, vol. 425, pp. 92–106, 2018.

Conference Proceedings

2 **Y. Li**, "Simple, unified analysis of johnson-lindenstrauss with applications," in *The 37th Annual Conference on Learning Theory (COLT)*, under review, 2024. arXiv: `2402.10232 [stat.ML]`.

3 **Y. Li**, L. Liu, W. Pu, and Z.-Q. Luo, "Optimistic thompson sampling for no-regret learning in unknown games," in *The 41st International Conference on Machine Learning (ICML)*, under review, 2024. arXiv: `2402.09456 [cs.LG]`.

4 **Y. Li** and Z.-Q. Luo, "Prior-dependent analysis of posterior sampling reinforcement learning with function approximation," in *The 27th International Conference on Artificial Intelligence and Statistics (AISTATS)*, 2024.

5 **Y. Li**, J. Xu, L. Han, and Z. Luo, "Hyperagent: A simple, scalable, efficient and provable reinforcement learning framework for complex environments," in *The 41st International Conference on Machine Learning (ICML)*, under review, 2024. arXiv: `2402.10228 [cs.LG]`.

6 Z. Li, **Y. Li**, Y. Zhang, T. Zhang, and Z.-Q. Luo, "Hyperdqn: A randomized exploration method for deep reinforcement learning," in *International Conference on Learning Representations (ICLR)*, 2022.

7 Q. Wang, **Y. Li**, J. Xiong, and T. Zhang, "Divergence-augmented policy optimization," in *Advances in Neural Information Processing Systems (NeurIPS)*, vol. 32, 2019.

Workshop Papers

8 **Y. Li**, L. Liu, W. Pu, and Z.-Q. Luo, *Optimistic thompson sampling for no-regret learning in unknown games*, ICML 2023 Workshop The Many Facets of Preference-Based Learning, 2023.

9 **Y. Li**, J. Xu, and Z. Luo, *Efficient and scalable reinforcement learning via hypermodel*, NeurIPS 2023 Workshop on Adaptive Experimental Design and Active Learning in the Real World, 2023.

10 Z. Li, **Y. Li**, Y. Zhang, T. Zhang, and Z.-Q. Luo, *Hyperdqn: A randomized exploration method for deep reinforcement learning*, NeurIPS 2021 Workshop Ecological Theory of Reinforcement Learning, 2021.

Articles in Preparation

11 **Y. Li**, "Probability tools for sequential random projection," 2024. arXiv: `2402.14026 [math.ST]`.

12 **Y. Li**, J. Xu, and Z.-Q. Luo, "Approximate thompson sampling via hypermodel and index sampling," To appear on arXiv, 2024.

Selected Oral Presentations

🔖 **HyperAgent: A Simple, Efficient and Scalable RL Framework for Complex Environments**
Best paper award in The third doctoral and postdoctoral Daoyuan academic forum, Jan. 13, 2024.
Incoming talk in Informs Optimization Society (**IOS**) Conference, Rice University, Mar. 2024.
Invited talk in International Symposium on Mathematical Programming (**ISMP**), Montréal, Jul. 2024.

🔖 **Towards AGI for Humanity through Efficient Reinforcement Learning**
Contributed Talk in Graduate Research Forum, Oct. 21, 2023.

🔖 **No-Regret Learning in Unknown Game with Applications**
Invited Talk in RL Theory Student Workshop at Nanjing University, Aug. 23, 2022.
Contributed Talk in The second doctoral and postdoctoral Daoyuan academic forum, Aug. 20, 2022.

🔖 **HyperDQN: A Randomized Exploration Method for Deep Reinforcement Learning**
Contributed Talk in **NeurIPS** Workshop Ecological Theory of Reinforcement Learning, Dec. 14, 2021

Miscellaneous Experience

Teaching Assistant

Fall 2018	🔖 **Stochastic Processes** (STA/DDA4001)		by *Prof. Jim Dai*
Spr. 2019	🔖 **Optimization II** (MAT3220)		by *Prof. Shuzhong Zhang*
Fall 2019	🔖 **Distributed and Parallel Computing** (CSC4005)		by *Prof. Yeh-Ching Chung*
Fall 2020	🔖 **Reinforcement Learning** (DDA6105/CIE6023)	by *Prof. Xinyun Chen* and *Jim Dai*
Spr. 2021	🔖 **Matrix Analysis** (CIE6002)		by *Prof. Tsung-Hui Chang*
Spr. 2022	🔖 **Deep Learning and Their Applications** (MDS6224)		by *Prof. Chen Chen*

Academic Services

Reviewer 🔖 Conference on Neural Information Processing Systems (NeurIPS), International Conference on Learning Representations (ICLR), ICLR 2024 Workshop on Bridging the Gap Between Practice and Theory in Deep Learning (BGPT).

Organizer 🔖 RL Seminar in The Chinese University of Hong Kong, Shenzhen. (Spring 2019, Summer 2020, Fall 2020, Spring 2021, Summer 2021, Fall 2021, Spring 2022, Fall 2022.)

Certifications

2017 🔖 **Neural Networks and Deep Learning**. An online non-credit course authorized by DeepLearning.AI and offered through Cousera.

References

Professor *Zhi-Quan (Tom) Luo*
X.Q. Deng Presidential Chair Professor
The Chinese University of Hong Kong, Shenzhen
2001 Longxiang Boulevard, Longgang District, Shenzhen 518172, China
✉ luozq@cuhk.edu.cn

Professor *J. G. "Jim" Dai*
Leon C. Welch Professor
Cornell University
235 Rhodes Hall, 136 Hoy Road Ithaca, NY 14853
✉ jim.dai@cornell.edu
Dean, School of Data Science
The Chinese University of Hong Kong, Shenzhen
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Thank you for reading!
Experience before Ph.D. study **is listed in the next page.**

Experience before Ph.D. Study

2007   ◫ **Special program for super-normal children**, Shenzhen middle school at BYD.

Research Position

2018   ◫ **SenseTime Group Ltd.**, Beijing, China
Computer Vision Trainee Researcher   with Dr. *Jing Shao*
Continual Learning for Image Classification with Deep Neural Networks: Algorithm design and implementation. Details in "Projects before Graduate Study".

2017   ◫ **Department of Computer Science, Cornell University**, Ithaca, NY
Independent Research Assistant   with Prof. *John Hopcroft*
Algorithms for Community Detection in Graphs and Social Influence Analysis. Part of the outcome was published in Information Science [1] and included in the undergraduate thesis. See details in "Projects before Graduate Study".

2016   ◫ **Microsoft Research Lab - Asia**, Beijing, China
Research Intern in Theory Center   with Dr. *Wei Chen*
Information and Influence in Social Networks: Learning and Optimization. Part of the outcome is in the undergraduate thesis. Details in "Projects before Graduate Study".

15-17   ◫ **Hopcroft Center on Computing Science**,
Huazhong University of Science and Techonology, China
Undergraduate Research Assistant   with Prof. *Kun He*

Projects before Graduate Study

2018   ◫ **Multi-label Continual Learning.** [**Github**] [**Report**] Concerning the catastrophic forgetting phenomenon in deep learning, we developed a distributed computation framework for continual and incremental learning in multi-label image classification. This project was initiated while working as a trainee researcher at SenseTime Research. We further proposed a new method called "Projection as Pareto Improvement" (PPI) method by formulating continual learning as a multi-objective optimization problem.

16–17   ◫ **Hidden Community Detection.** [**Github**] [**Journal**] Propose a new concept of hidden community for network analysis. Provide a meta-approach called HICODE for finding hidden communities. Several weakening methods are proposed to reduce the impact of the detected structure. The framework works iteratively to enhance detection of both dominant and hidden communities. Extensive experiments demonstrate the effectiveness of the proposed method.

   ◫ **Learning and Optimizing Social Influence.** [**Thesis**] A key task in social network analysis is learning, predicting, and optimizing social influence. Existing models with large numbers of parameters are hard to fit without massive data. We aim to reduce the effective parameters by modeling the multi-channel influence phenomenon. We primarily study the noisy-or-like nonlinear combination of multi-channel influence. Under this model, we derive the sample complexity lower bound and design an algorithm for learning the influence network.

15   ◫ First Prize in Parallel Computation and Application Contest (PAC2015), joint held by Intel and CCF-TCHPC.