Yingru LI

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Education

- **The Chinese University of Hong Kong, Shenzhen**, China 2018 –
  Ph.D. candidate *in Computer and Information Engineering.*
  Thesis direction: Efficient Reinforcement Learning
  Supervisor: Prof. ***Zhi-Quan (Tom) LUO***
- **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: Porf. *Kun HE*

Research Interests

- Sequential Decision-making and Reinforcement Learning.
- Algorithms Design and Analysis. Probabilistic Analysis. Random projection in sequential processes.
- Applications in Artificial Intelligence that could **benefit Humanity**.

Professional Experience

Research Position

- **The Chinese University of Hong Kong, Shenzhen**, China 2018 –
  Graduate Research Assistant with Presidential Fellowship with Prof. *Zhi-Quan (Tom) Luo*
- **Tencent AI**, Shenzhen, China 2019
  Research Intern in Agent Center with Dr. *Lei Han*
- **Department of Computer Science, Cornell University**, Ithaca, NY 2017
  Independent Research Assistant with Prof. *John Hopcroft*
- **Microsoft Research Lab - Asia**, Beijing, China 2016
  Research Intern in Theory Center. Dr. *Wei Chen*

Selected Research Project

- **Efficient Reinforcement Learning: Algorithm Design and Analysis**
  — **Key problem**: Data and computation efficiency is a key obstacle of RL for real-world problems.
  — **Algorithm**: (1) We design **efficient and scalable** RL algorithms for complex environments with hypermodel and approximate Thompson sampling [4], [5], which **demonstrates significant efficiency gain** in DRL benchmark problems (e.g. **only 15% data consumption and 5% model parameters** compared to SOTAs in Arcade Learning Environment). The approach is being applied to **real-world** communication environments. (2) We design distributed actor-critic RL agents, significantly stabilizing the optimization procedure when the off-policy data is reused, addressing the efficiency issue [6].
  — **Analysis**: We developed **new probability tools** [10]–[12] for the sequential random projection and sequential subspace embedding via stopping-time argument and self-normalized martingale, which can be regard as a **non-trivial extension to the renowned Johnson–Lindenstrauss (JL) lemma**. The tools are then applied to the regret analysis of hypermodel-based TS-type algorithms in bandit [12] and RL [4] environments, achieving **the same regret order** of TS and RLSVI with **cheap computation**.
- **Game-theoretic Decision-making under Uncertainty**
  — We design TS-type algorithms, leveraging the opponent's action information and the structure of utility, in a multi-agent scenario [2] with an unknown utility function. We develop a new **information-theoretic regret bound**. For some structured utility functions, the bound is only **logarithmic in the size of strategy space.** The method is applied to **real-world problems**, e.g., traffic routing and radar communication, **reducing the experimental budgets by more than an order of magnitude.**

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**, L. Liu, W. Pu, and Z.-Q. Luo, "Optimistic thompson sampling for no-regret learning in unknown games," in *Submitted to The 27th International Conference on Artificial Intelligence and Statistics (AISTATS)*, under review, 2023.
3. **Y. Li** and Z.-Q. Luo, "A value-targeted analysis of posterior sampling reinforcement learning with linear function approximation," in *Submitted to The 27th International Conference on Artificial Intelligence and Statistics (AISTATS)*, under review, 2023.
4. **Y. Li**, J. Xu, L. Han, and Z. Luo, "Efficient and scalable reinforcement learning via hypermodel," in *Submitted to The 12th International Conference on Learning Representations*, under review, 2023.
5. 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*, 2022.
6. Q. Wang, **Y. Li**, J. Xiong, and T. Zhang, "Divergence-augmented policy optimization," in *Advances in Neural Information Processing Systems*, vol. 32, 2019.

Workshop Papers

7. **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.
8. **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.
9. 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

10. **Y. Li**, "Revisiting random projection: A new unified analysis via high-dimensional hanson-wright inequality," To be submitted, 2023.
11. **Y. Li** and Z.-Q. Luo, "A probability tool for sequential random projection via martingale analysis," To be submitted, 2023.
12. **Y. Li** and Z.-Q. Luo, "An analysis of hypermodel and approximate thompson sampling," To be submitted, 2023.

Selected Scholastic Honors

- **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. **Report**: [1] Newspaper. [2] HUST Online.
- **Outstanding Achievements in terms of Academic Performance (Top** 1%**)**, by Huazhong University of Science and Technology, 2015.
- **National Scholarship**, by Huazhong University of Science and Technology

Selected Oral Presentations

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

Selected Oral Presentations (continued)

- **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).
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
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Professor *J. G. "Jim" Dai*
Leon C. Welch Professor
Cornell University
235 Rhodes Hall, 136 Hoy Road Ithaca, NY 14853
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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.