Ao LIU

Ph.D. in Computer Science

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Personal Website
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Google Scholar

Summary

Research Interests Machine Learning (Recommendation Systems, Learning to Rank, Algorithm Design, etc.), Differential Privacy, Computational Social Choice, and Quantum Computation

Experience 1+ years of industry experience in personalization, recommendation systems, LLM, theoretical computer science, differential privacy, and adversarial robustness

Academia Published 20+ papers and received 250+ citations to date.
Reviewed 50+ papers for top AI conferences or journals.

Education

01/2018 – 05/2023 **Ph.D. in Computer Science,** Rensselaer Polytechnic Institute (RPI) Troy, NY
Thesis: *Group Decision Makings from Partial Preferences* **[Link]**

08/2015 – 05/2018 **M.Eng. in Material Engineering,** Rensselaer Polytechnic Institute (RPI) Troy, NY
Focus on optics and polymer physics, received Presidential Graduate Research Fellowship

08/2010 – 05/2014 **B.S. in Mathematics and Physics,** Tsinghua University Beijing, China
Minor in Computer Technology, and *in Academic Talent Program*

Experience

07/2023 – Present **Research Software Engineer** at **Google Core ML** Mountain View, CA
Design and Research More Efficient Transformers for Recommendation Systems

05/2022 – 08/2022 **Research Intern** at **Google Core ML** Mountain View, CA
Project: A More Accurate Position Bias Estimator for Unbiased Learning to Rank
- Significant prediction accuracy improvement (∼8%) *v.s.* state-of-the-art without any cost
  - Proposed a novel probabilistic model to more accurately estimate position bias. (*user-modeling*)
  - Designed an unbiased recommendation system based on the proposed probabilistic model and two-tower model. (*algorithm design, machine learning modeling*)
  - Implemented the data pipeline, machine learning algorithm, and the proposed unbiased recommendation system. Integrated all into Google codebase. (*Python, TensorFlow, C/C++*)

08/2018 – 12/2018 and 05/2019 – 08/2019 **Visiting Scholar** at **MIT-IBM Watson AI Lab** Cambridge, MA
Project: Certifiably Robust Interpretation via Rényi Differential Privacy
- Significant robustness improvement (∼12%) plus accuracy improvement *v.s.* state-of-the-art
  - Yes! We improved both robustness and accuracy, which usually are trade-offs in machine learning.
  - First in the world to theoretically prove Rényi differential privacy guarantees top-k robustness.
  - Designed a theoretically guaranteed robust algorithm to interpret neural networks for image classifications. (*differential privacy analysis, robustness analysis*)
  - Implemented the proposed robust interpretation algorithm and tested its robustness, accuracy, and computational efficiency on object detections. (*Python, PyTorch, TorchRay, TensorFlow*)
- Delivered one academic paper (on top AI journal and conference) and two patents.

Skills

Implementation Programming languages: *Python, C/C++,* MATLAB
Tools and platforms: *TensorFlow, PyTorch, TorchRay,* LaTeX

Design/ Theory *Algorithm design, Statistics, Time/Sample-complexity analysis, User-modeling, Markov chain Mount-Carlo, Privacy analysis, Robustness analysis, Model identifiability, Smoothed analysis*

Review Services

Journal Information Sciences, TMLR, ACM ToIS, Sankhya B

Conference NeurIPS (20,21,22&23), ICML (22,23&24), ICLR (23&24), AAAI (21&22), IJCAI-22

Selected Publication

TMLR **Smoothed Differential Privacy [PDF]**
Ao Liu, Yu-Xiang Wang, and Lirong Xia

UAI-23 **Accelerating Voting by Quantum Computation [PDF]**
Ao Liu, Qishen Han, Lirong Xia, and Nengkun Yu

AIJ and *AAAI-23* (oral) **Certifiably Robust Interpretation via Rényi Differential Privacy [Link] [ArXiv]**
Ao Liu, Xiaoyu Chen, Sijia Liu, Lirong Xia, and Chuang Gan

AAAI-23 (oral) **Differentially Private Condorcet Voting [PDF]**
Zhechen Li, *Ao Liu*, Lirong Xia, Yongzhi Cao, and Hanpin Wang

AAAI-22 **The Semi-Random Likelihood of Doctrinal Paradoxes [PDF]**
Ao Liu and Lirong Xia

IJCAI-22 (oral) **Learning Mixtures of Random Utility Models with Features from Incomplete Preferences**
Zhibing Zhao, *Ao Liu*, and Lirong Xia **[PDF]**

JAIR and *IJCAI-23* (oral) **Learning to Design Fair and Private Voting Rules [PDF]**
Farhad Mohsin, *Ao Liu*, Pin-Yu Chen, Francesca Rossi, and Lirong Xia

UAI-20 (oral) **How Private Are Commonly-Used Voting Rules? [PDF]**
Farhad Mohsin, *Ao Liu*, Pin-Yu Chen, Francesca Rossi, and Lirong Xia

ETRA-20 Adjunct **Let It Snow: Adding Pixel Noise to Protect the Users Identity [Link]**
Brendan John, *Ao Liu*, Lirong Xia, Sanjeev Koppal, and Eakta Jain

AAAI-19 (oral) **Near-Neighbor Methods in Random Preference Completion [PDF]**
Ao Liu, Qiong Wu, Zhenming Liu, and Lirong Xia

AAAI-19 (oral) **Learning Plackett-Luce Mixture from Partial Preferences [PDF]**
Ao Liu, Zhibing Zhao, Chao Liao, Pinyan Lu, and Lirong Xia

ETRA-19 (oral) **Differential Privacy for Eye-Tracking Data [PDF]**
Ao Liu, Lirong Xia, Andrew Duchowski, Reynold Bailey, Kenneth Holmqvist, and Eakta Jain

US Patent **Certifiably Robust Interpretation [PDF]**
Ao Liu, Sijia Liu, Bo Wu, Lirong Xia, Qi Cheng Li, and Chuang Gan

US Patent **Interpretation Maps with Guaranteed Robustness [PDF]**
Ao Liu, Sijia Liu, Abhishek Bhandwaldar, Chuang Gan, Lirong Xia, and Qi Cheng Li

J. Polym. Sci. B: Polymer Physics **Simulation of Pulse Responses of Lithium Salt-Doped Poly-Ethyleneoxide [Link]**
Ao Liu, F. Zeng, Y. Hu, S. Lu, W. Dong, X. Li, C. Chang, and D. Guo

Nano-Micro Letters **Controlling Ion Conductance and Channels to Achieve Synaptic-like Frequency Selectivity**
Siheng Lu, Fei Zeng, Wenshuai Dong, *Ao Liu*, Xiaojun Li, and Jingting Luo **[Link]**

Awards and Teaching

09/2019 – 05/2022 **RPI-IBM AI Horizon Scholarship**

09/2016 – 05/2017 **RPI Presidential Graduate Research Fellowship [Certificate]**

01/2023 – 05/2023 **Teaching Assistant** of **CSCI 4150: Introduction to AI** (Instructor: Lirong Xia)

04/2021 **Guest Lecture** at **CSCI 4967/6967: Economics and Computation**

08/2017 – 12/2017 **Teaching Assistant** of **MATH 1020: Calculus II** (Instructor: David A. Schmidt)