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 ($\sim$8%) *v.s.* state-of-the-art without any cost
  - Proposed a novel probabilistic model to more accurately estimate position bias and designed an unbiased recommendation system based on it.
  - Implemented the data pipeline and machine learning algorithm for 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 ($\sim$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.
  - Designed the first algorithm in the world with theoretically guaranteed top-k robustness against ℓ_∞-norm attacks, where the theoretical proofs use Rényi differential privacy.
  - Implemented the proposed algorithm and tested its robustness, accuracy, and computational efficiency on neural network interpretation, image classification, and objective detection. (*PyTorch, TorchRay, TensorFlow,* MATLAB)
○ 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 **Certifiably Robust Interpretation via Rényi Differential Privacy** [**Link**] [**ArXiv**]
AAAI-23 (oral) *Ao Liu*, Xiaoyu Chen, Sijia Liu, Lirong Xia, and Chuang Gan

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

UAI-20 (oral) **How Private Are Commonly-Used Voting Rules?** [**PDF**]
Ao Liu, Yun Lu, Lirong Xia, and Vassilis Zikas

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

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

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

JAIR and **Learning to Design Fair and Private Voting Rules** [**PDF**]
IJCAI-23 (oral) 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

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

Nano-Micro **Controlling Ion Conductance and Channels to Achieve Synaptic-like Frequency Selectivity**
Letters 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

08/2017 – 12/2017 **Teaching Assistant** of MATH 1020: Calculus II

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