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## 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.

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## 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*

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## 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 **Visiting Scholar at MIT-IBM Watson AI Lab** Cambridge, MA  
and  
Project: Certifiably Robust Interpretation via Rényi Differential Privacy

05/2019 – 08/2019

- 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  $\ell_\infty$ -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.

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## Skills

**Implementation** Programming languages: *Python, C/C++, MATLAB*  
Tools and platforms: *TensorFlow, PyTorch, TorchRay, L<sup>A</sup>T<sub>E</sub>X*

**Design/ Theory** Algorithm design, Time&Sample-complexity analysis, User-modeling, MCMC, Statistics, Privacy analysis, Robustness analysis, Model identifiability, Smoothed analysis

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## Review Services

**Journal** Information Sciences, TMLR, ACM ToIS, Sankhya B

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

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## 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-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
- 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 *IJCAI-23* (oral) **Learning to Design Fair and Private 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
- 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 [\[Link\]](#)

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## Patents

- 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

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## 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