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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: Unbiased Learning to Rank with a More Accurate Position Bias Estimator
- Significantly more accurate ( $\sim 8\%$ ) on predictions *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
- Delivered one academic paper (on top AI journal and conference) and two patents.
  - Significantly more robust ( $\sim 12\%$ ) and more accurate *v.s.* state-of-the-art without any cost. Note that we improved two trade-off properties at the same time.
  - Designed the first-ever algorithm with theoretically guaranteed top- $k$  robustness against  $\ell_\infty$ -norm attacks, where the theoretical proofs use Rényi differential privacy.
  - Implemented the proposed robust algorithm and tested its robustness, accuracy, and computational efficiency on various tasks, including neural network interpretation, image classification, and objective detection. (PyTorch, TorchRay, TensorFlow, MATLAB)

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## Skills

**Implementation** Python, C/C++, MATLAB, 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), AAAI (21 & 22), IJCAI-22

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## Selected Publications

- 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
- 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 *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

► [View All Publications at \[Personal Website\]](#) [\[Google Scholar\]](#)

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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