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
Research Focus: *Optics* and *Polymer Physics*

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 accuracy improvement (∼8%) *v.s.* state-of-the-art without extra computational resources.
  - Proposed a more accurate model for position bias in recommendation systems. (*user-modeling*)
  - Designed a new machine learning framework based on the proposed position bias model and two-tower model. (*algorithm design, statistics*)
  - Implemented a data pipeline to extract the required features from data. (*C/C++*)
  - Implemented the machine learning framework, tested on Yahoo! dataset and integrated it into Google codebase. (*Python, TensorFlow, GoogleTest*)

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 at the same time! Note that accuracy and robustness are trade-offs in machine learning.
  - Theoretically connected Rényi differential privacy and interpretation robustness.
  - Designed a new robust algorithm to interpret neural networks for image classifications.
  - Implemented the proposed robust algorithm and tested it on VOC2007 dataset for various properties, including robustness, accuracy, and computational efficiency. (*Python, PyTorch, TorchRay, TensorFlow*)
- Delivered one academic paper (on top AI journal) and two patents.

Skills

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

Design/ Theory *Algorithm design, Statistics, Time/Sample-complexity analysis, User-modeling, Markov chain Mount-Carlo (MCMC), Differential privacy analysis, Robustness analysis, Model identifiability.*

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 **Certifiably Robust Interpretation via Rényi Differential Privacy [Link] [ArXiv]**
Ao Liu, Xiaoyu Chen, Sijia Liu, Lirong Xia, and Chuang Gan
Also in proceedings of ***AAAI-23 Journal Track*** (oral presentation)

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 [PDF]**
Zhibing Zhao, *Ao Liu*, and Lirong Xia

JAIR **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

Awards and Teaching

09/2019 – 05/2022 **RPI-IBM AI Horizon Scholarship**
3-year scholarship supported by Rensselaer-IBM Artificial Intelligence Research Collaboration

09/2016 – 05/2017 **RPI Presidential Graduate Research Fellowship**
A One-Year Fellowship for Outstanding Graduate Students [Certificate]

Spring 2023 **Teaching Assistant** of **CSCI 4150: Introduction to AI**
Instructor: Lirong Xia

04/2021 **Guest Lecture** at **CSCI 4967/6967: Economics and Computation**
Topic: The Semi-Random Likelihood of Doctrinal Paradoxes

Spring 2023 **Teaching Assistant** of **MATH 1020: Calculus II**
Instructor: David A. Schmidt