Mikhail Yurochkin

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Research Interests

Algorithmic Fairness; Out-of-Distribution Generalization; Optimal Transport; Model Fusion and Federated Learning

Education

Ph.D., Statistics   2013 – 2018
University of Michigan, Ann Arbor, MI, United States
- Thesis: "Geometric Inference in Bayesian Hierarchical Models with Applications to Topic Modeling"
- Advisor: Professor XuanLong Nguyen

Master of Arts, Statistics   2013 – 2015
University of Michigan, Ann Arbor, MI, United States

Bachelor's, Applied Mathematics and Physics   2009 – 2013
Moscow Institute of Physics and Technology, Moscow, Russia

Research Experience

Research Staff Member   June 2018 – Present
IBM Research and MIT-IBM Watson AI Lab, Cambridge, MA, United States
Machine Learning and Artificial Intelligence research.
- Leading research teams on Algorithmic Fairness, Federated Learning, Out-of-Distribution Generalization, and Optimal Transport projects. Our work is regularly published in top-tier Machine Learning and Artificial Intelligence venues.
- Founded a team of engineers to create AI Fairness software and demonstrations.
- Mentoring graduate students and collaborating with academic research groups, including Yuekai Sun's group at the University of Michigan and Justin Solomon's Geometric Data Processing group at MIT.
- Regularly representing IBM Research at conferences and workshops via invited talks and tutorial presentations.

Research Associate   May 2018 – June 2018
University of Michigan, Ann Arbor, MI, United States
- Led two research projects in collaboration with senior PhD students and faculty resulting in two NeurIPS 2018 submissions.
- Studied driving behaviors using Bayesian modeling in collaboration with the Toyota Research Institute.

Data science research intern   June 2017 – Aug 2017
Adobe, San Jose, CA, United States
- Proposed a method for jointly training a graph neural network and inferring the graph structure when the graph is unknown. Applied this method to forecasting number of visits to a major retailer's website across cities for improved marketing and sales.

Consultant for Statistics, Computing, and Analytics Research   Sept 2016 – Dec 2017
University of Michigan, Ann Arbor, MI, United States
- Assisted faculty and graduate students in areas such as biology, dentistry, marketing, political science, public health, and computer science in identifying and implementing appropriate statistical methodology for their data and research problems.

Science team intern   May 2016 – Aug 2016
LogicBlox/Predictix, Atlanta, GA, United States
- Proposed and implemented an explainable forecasting model based on Factorization Machines and Indian Buffet Process. Analyzed sales data from a major retailer using the proposed model and published a NeurIPS 2017 paper based on this work.

Graduate Student Research Assistant   July 2014 – April 2018
University of Michigan, Ann Arbor, MI, United States

- ○ "Geometric approaches to hierarchical and nonparametric model-based inference". Formulated topic modeling with Latent Dirichlet Allocation as geometric problem. Developed two new geometry based algorithms for topic modeling, significantly outperforming previous state-of-the-art techniques in terms of estimation speed. Second algorithm additionally can learn latent number of topics utilizing geometric structure of the problem. These results were published at NeurIPS 2016 and 2017. Gave multiple talks and poster presentations. My advisor included some of these results in the curriculum of a data science masters level class and a research oriented undergraduate level class.
- ○ "Data is Social: Exploiting Data Relationships to Detect Insider Attacks". Proposed Bayesian modeling approaches to identify insider attacks from SQL queries of a bank database. Worked in collaboration with PhD students and faculty from the University at Buffalo.

Teaching Experience

Graduate Student Instructor Sept 2013 – April 2016
University of Michigan, Ann Arbor, MI, United States
Taught labs, graded, held office hours:
- ○ Topics in Biostatistics Jan 2015 – April 2016
- ○ Applied Probability Sept 2014 – Dec 2014
- ○ Introduction to Statistics Jan 2014 – April 2014
- ○ Introduction to Probability Sept 2013 – Dec 2013

Publications

[1] S. Xue, Y. Sun, and **M. Yurochkin**. Calibrated Data-Dependent Constraints with Exact Satisfaction Guarantees. In *Advances in Neural Information Processing Systems (NeurIPS)*, 2022.

[2] D. Mukherjee, F. Petersen, **M. Yurochkin**, and Y. Sun. Domain Adaptation meets Individual Fairness. And they get along. In *Advances in Neural Information Processing Systems (NeurIPS)*, 2022.

[3] **M. Yurochkin** and Y. Sun. Communication-Efficient Model Fusion. In H. Ludwig and N. Baracaldo, editors, *Federated Learning: A Comprehensive Overview of Methods and Applications*, pages 145–176. Springer International Publishing, Cham, 2022.

[4] M. Agarwal, **M. Yurochkin**, and Y. Sun. Personalization in Federated Learning. In H. Ludwig and N. Baracaldo, editors, *Federated Learning: A Comprehensive Overview of Methods and Applications*, pages 71–98. Springer International Publishing, Cham, 2022.

[5] T. Shnitzer, **M. Yurochkin**, K. Greenewald, and J. Solomon. Log-Euclidean Signatures for Intrinsic Distances Between Unaligned Datasets. In *International Conference on Machine Learning (ICML)*, 2022.

[6] B.C. Kwon, U. Kartoun, S. Khurshid, **M. Yurochkin**, S. Maity, D. Brockman, A. Khera, P. Ellinor, S. Lubitz, and K. Ng. RMExplorer: A Visual Analytics Approach to Explore the Performance and the Fairness of Disease Risk Models on Population Subgroups. In *IEEE Visualization Conference (VIS) Short Papers*, 2022.

[7] I. Baldini, D. Wei, K. Ramamurthy, **M. Yurochkin**, and M. Singh. Your fairness may vary: Pretrained language model fairness in toxic text classification. In *Findings of ACL*, 2022.

[8] W. Stephenson, S. Ghosh, T. Nguyen, **M. Yurochkin**, S. Deshpande, and Broderick T. Measuring the sensitivity of Gaussian processes to kernel choice. In *International Conference on Artificial Intelligence and Statistics (AISTATS)*, 2022.

[9] F. Petersen, D. Mukherjee, Y. Sun, and **M. Yurochkin**. Post-processing for Individual Fairness. In *Advances in Neural Information Processing Systems (NeurIPS)*, 2021.

[10] M. Agarwal, **M. Yurochkin**, and Y. Sun. On sensitivity of meta-learning to support data. In *Advances in Neural Information Processing Systems (NeurIPS)*, 2021.

[11] S. Maity, D. Mukherjee, **M. Yurochkin**, and Y. Sun. Does enforcing fairness mitigate biases caused by subpopulation shift? In *Advances in Neural Information Processing Systems (NeurIPS)*, 2021.

[12] V. Huynh, N. Ho, N. Dam, X. Nguyen, **M. Yurochkin**, H. Bui, and D. Phung. On efficient multilevel Clustering via Wasserstein distances. *Journal of Machine Learning Research (JMLR)*, 2021.

[13] D. Mukherjee, A. Guha, J. Solomon, Y. Sun, and **M. Yurochkin**. Outlier-Robust Optimal Transport. In *International Conference on Machine Learning (ICML)*, 2021.

[14] S. Maity, S. Xue, **M. Yurochkin**, and Y. Sun. Statistical inference for individual fairness. In *International Conference on Learning Representations (ICLR)*, 2021.

[15] A. Bower, H. Eftekhari, **M. Yurochkin**, and Y. Sun. Individually Fair Rankings. In *International Conference on Learning Representations (ICLR)*, 2021.

[16] A. Vargo, F. Zhang, **M. Yurochkin**, and Y. Sun. Individually Fair Gradient Boosting. In *International Conference on Learning Representations (ICLR)*, 2021. Spotlight.

[17] **M. Yurochkin** and Y. Sun. SenSeI: Sensitive Set Invariance for Enforcing Individual Fairness. In *International Conference on Learning Representations (ICLR)*, 2021. Oral.

[18] M. Weber, **M. Yurochkin**, S. Botros, and V. Markov. Black Loans Matter: Distributionally Robust Fairness for Fighting Subgroup Discrimination. *NeurIPS Fair AI in Finance Workshop*, 2020. Spotlight Talk.

[19] L. Li, A. Genevay, **M. Yurochkin**, and J. Solomon. Continuous Regularized Wasserstein Barycenters. In *Advances in Neural Information Processing Systems (NeurIPS)*, 2020.

[20] S. Claici*, **M. Yurochkin***, S. Ghosh, and J. Solomon. Model Fusion with Kullback–Leibler Divergence. In *International Conference on Machine Learning (ICML)*, 2020.

[21] D. Mukherjee*, **M. Yurochkin***, M. Banerjee, and Y. Sun. Two Simple Ways to Learn Individual Fairness Metric from Data. In *International Conference on Machine Learning (ICML)*, 2020.

[22] S. Xue, **M. Yurochkin**, and Y. Sun. Auditing ML models for individual bias and unfairness. In *International Conference on Artificial Intelligence and Statistics (AISTATS)*, 2020.

[23] H. Wang, **M. Yurochkin**, Y. Sun, D. Papailiopoulos, and Y. Khazaeni. Federated Learning with Matched Averaging. In *International Conference on Learning Representations (ICLR)*, 2020. Oral.

[24] **M. Yurochkin**, A. Bower, and Y. Sun. Training individually fair ML models with sensitive subspace robustness. In *International Conference on Learning Representations (ICLR)*, 2020. Spotlight.

[25] **M. Yurochkin**, S. Claici, E. Chien, F. Mirzazadeh, and J. Solomon. Hierarchical Optimal Transport for Document Representation. In *Advances in Neural Information Processing Systems (NeurIPS)*, 2019.

[26] **M. Yurochkin**, M. Agarwal, S. Ghosh, K. Greenewald, and N. Hoang. Statistical Model Aggregation via Parameter Matching. In *Advances in Neural Information Processing Systems (NeurIPS)*, 2019.

[27] P. Monteiller, S. Claici, E. Chien, F. Mirzazadeh, J. Solomon, and **M. Yurochkin**. Alleviating Label Switching with Optimal Transport. In *Advances in Neural Information Processing Systems (NeurIPS)*, 2019.

[28] **M. Yurochkin**, Z. Fan, A. Guha, P. Koutris, and X. Nguyen. Scalable inference of topic evolution via models for latent geometric structures. In *Advances in Neural Information Processing Systems (NeurIPS)*, 2019.

[29] **M. Yurochkin***, A. Guha*, Y. Sun, and X. Nguyen. Dirichlet Simplex Nest and Geometric Inference. In *International Conference on Machine Learning (ICML)*, 2019. Long Talk.

[30] **M. Yurochkin**, M. Agarwal, S. Ghosh, K. Greenewald, N. Hoang, and Y. Khazaeni. Bayesian Nonparametric Federated Learning of Neural Networks. In *International Conference on Machine Learning (ICML)*, 2019.

[31] **M. Yurochkin**, S. Upadhyay, D. Bouneffouf, M. Agarwal, and Y. Khazaeni. Online Semi-Supervised Learning with Bandit Feedback. *ICLR Limited Labeled Data (LLD) Workshop*, 2019.

[32] **Mikhail Yurochkin**. *Geometric Inference in Bayesian Hierarchical Models with Applications to Topic Modeling*. PhD thesis, University of Michigan, 2018.

[33] **M. Yurochkin**, A. Guha, and X. Nguyen. Conic Scan-and-Cover algorithms for nonparametric topic modeling. In *Advances in Neural Information Processing Systems (NeurIPS)*, 2017.

[34] **M. Yurochkin**, X. Nguyen, and N. Vasiloglou. Multi-way Interacting Regression via Factorization Machines. In *Advances in Neural Information Processing Systems (NeurIPS)*, 2017.

[35] N. Ho, X. Nguyen, **M. Yurochkin**, H. Bui, V. Huynh, and D. Phung. Multilevel Clustering via Wasserstein Means. In *International Conference on Machine Learning (ICML)*, 2017.

[36] **M. Yurochkin** and X. Nguyen. Geometric Dirichlet Means algorithm for topic inference. In *Advances in Neural Information Processing Systems (NeurIPS)*, 2016.

Patents

- **M. Yurochkin**, D. Mukherjee, M. Banerjee, Y. Sun, and S. Upadhyay. Learning Mahalanobis Distance Metrics from Data. Filed on June 11, 2021.
- S. Upadhyay, **M. Yurochkin**, D. Mukherjee, Y. Sun, A. Bower, H. Eftekhari, A. Vargo, and F. Zhang. Training Individually Fair Machine Learning Algorithms via Distributionally Robust Optimization. Filed on March 25, 2021.
- Y. Khazaeni, E. Daly, C. Muise, and **M. Yurochkin**. Artificial Intelligence for Learning Path Recommendations. Filed on December 31, 2020.
- K. Greenewald, **M. Yurochkin**, M. Agarwal, S. Ghosh, N. Hoang and Y. Khazaeni. A method for combining pre-trained neural networks into a memory and computation efficient global model. Filed on September 20, 2019.
- S. Upadhyay, **M. Yurochkin**, M. Agarwal, D. Bouneffouf and Y. Khazaeni. Method for Online Partially Rewarded Learning. Filed on August 28, 2019.

Open-Source Software

- inFairness, Python package for Individual Fairness: `github.com/IBM/inFairness`
- Playground for comparing Group and Individual Fairness of toxic text detectors: `fairbert.vizhub.ai`

Talks

Tutorials

- AI Fairness through Robustness @ AAAI   2023
- Fairness of Machine Learning in Search Engines @ CIKM   2022
- AI Fairness @ MIT-IBM THINK Industry Day   2022

Invited Talks

- Practical Individual Fairness
  @ TrustML Young Scientist Seminars   2022
- Black Loans Matter: Fighting Bias for AI Fairness in Lending
  @ KDD Workshop on Machine Learning in Finance (Keynote)   2021
- Model fusion via single-round FL
  @ Enterprise-Strength Federated Learning, ICML Expo   2021

- Practical Individual Fairness algorithms
  - @ Toronto Machine Learning Summit 2021
  - @ ODSC West 2021
  - @ Foundations of Algorithmic Fairness (FAF) workshop 2021
  - @ Research Talks for Enel 2021
  - @ IBM Research, Cambridge Lab All-hands 2021
- Fusion of Heterogeneous Models in Federated Learning
  - @ The 2nd Annual Federated & Distributed/ Decentralized Machine Learning Conference ... 2021
- Federated Learning: Practice and Modern Algorithms
  - @ ODSC Europe 2021
- Invited panelist
  - @ Federated Learning, AI and Data Security Summit, HUB Security event ... 2021
- Fairness in mortgage lending
  - @ Tech for Racial and Social Justice, UW-Madison Data Science Bazaar ... 2021
- Individual Fairness through Robustness
  - @ Algorithmic fairness with statistical guarantees, CMStatistics session ... 2020
  - @ Global Data Science Community meet-up, UniCredit event 2020
- Fairness in AI
  - @ What's Next in AI: AI we can trust, MIT-IBM conference 2020
- Bayesian nonparametric fusion of heterogeneous models
  - @ IBM Research Cambridge seminar series 2019
- Geometric Inference in Bayesian Hierarchical Models with Applications to Topic Modeling
  - @ MIT Geometric Data Processing Group seminar 2018

Contributed Presentations

- Data Science Research Forum (poster) 2017
- Joint Statistical Meetings (speed session talk and poster) 2017
- Michigan Student Symposium for Interdisciplinary Statistical Sciences (talk) ... 2017
- Michigan Institute for Computational Discovery and Engineering Symposium (poster) ... 2016
- Michigan Student Symposium for Interdisciplinary Statistical Sciences (poster) ... 2016
- From Industrial Statistics to Data Science (poster) 2015

Awards

- Outstanding Technical Achievement Award (IBM internal) 2021
- EB1 Green Card (outstanding professor or researcher) 2021
- A-level Research Accomplishment (IBM internal) 2020
- Faces of IBM: AI Pioneer (IBM internal) 2020
- Outstanding Demonstration - Honorable Mention award .... NeurIPS 2020
- Reviewer award .... NeurIPS 2018, 2019
- Rackham Conference Travel Grant 2016, 2017
- Abramov scholarship (awarded to less than 5% students at MIPT) 2010

Mentorship

- Break Through Tech AI (BTAI) @ MIT, Project Advisor for a group of six students ... 2022-Present
- Hao Bang (Kevin) Yang, MIT Master's of Engineering (MEng) student ... 2022-Present
- Yuchen Zeng, MIT-IBM summer PhD student intern 2022
- Subha Maity, IBM Research Tech for Justice summer PhD student intern ... 2022
- Lilian Ngweta, IBM Research summer PhD student extern 2022
- Todd Zhou, Research Science Institute (RSI) high school student 2022

- o Luann Jung, MIT Master's of Engineering (MEng) student (with J. Solomon)   2021-2022
- o Yining Chen, MIT-IBM summer PhD student intern   2021
- o Haingoharijao Faniriniaina Ramandiamanana,
  African Master's in Machine Intelligence (AMMI) student (with J. Solomon and D. Palmer)   2020
- o Debarghya Mukherjee, MIT-IBM summer PhD student intern   2020
- o Hongyi Wang, IBM Research summer PhD student intern   2019

Professional Activities

Organization and Service

- o Practical Bayesian Methods for Big Data and Big Models workshop (co-organizer)
  @ MIT-IBM AI week   2019
- o Optimal Transport seminar (with Y. Mroueh)
  @ IBM Research AI seminar series   2019

Reviewer

- o Neural Information Processing Systems (NeurIPS)   2016-2022
- o Transactions on Pattern Analysis and Machine Intelligence (TPAMI)   2022
- o International Conference on Learning Representations (ICLR)   2018-2021
- o International Conference on Machine Learning (ICML)   2017-2019
- o Bayesian Analysis (BA)   2019
- o Journal of Machine Learning Research (JMLR)   2019
- o Journal of Computational and Graphical Statistics (JCGS)   2016

Media coverage

- o "New research helps make AI fairer in decision-making", IBM Research   2021
- o "Finding a good read among billions of choices", MIT News   2019
- o "Optimal Transport for Label Switching: Using Geometry to Solve Problems in AI", IBM Research   2019

Additional information

- o Personal webpage: `moonfolk.github.io`
- o LinkedIn: `www.linkedin.com/in/mikhail-yurochkin-a45659114`
- o GitHub: `github.com/moonfolk`
- o Google Scholar: `scholar.google.com/citations?user=QjBF9sUAAAAJ`