

# Mikhail Yurochkin

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## Research Interests

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

## Education

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**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

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**Research Staff Member** June 2018 – Present

*IBM Research and MIT-IBM Watson AI Lab, Cambridge, MA, United States*

Machine Learning and Artificial Intelligence research.

- Led research teams on Algorithmic Fairness, Federated Learning, Out-of-Distribution Generalization, and Optimal Transport projects resulting in regular top-tier publications, demonstrations, and software releases.
- Continuously mentored graduate students and collaborated 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 represented 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

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### Graduate Student Instructor

Sept 2013 – April 2016

University of Michigan, Ann Arbor, MI, United States

Taught labs, graded, held office hours:

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|-------------------------------|-----------------------|
| ○ 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

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- [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. SenSel: 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. Clatici\*, **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. Clatici, 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. Monteleiller, S. Clatici, 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

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- o **M. Yurochkin**, D. Mukherjee, M. Banerjee, Y. Sun, and S. Upadhyay. Learning Mahalanobis Distance Metrics from Data. Filed on June 11, 2021.
- o 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.
- o Y. Khazaeni, E. Daly, C. Muise, and **M. Yurochkin**. Artificial Intelligence for Learning Path Recommendations. Filed on December 31, 2020.
- o 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.
- o 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

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- o inFairness, Python package for Individual Fairness: [github.com/IBM/inFairness](https://github.com/IBM/inFairness)
- o Playground for comparing Group and Individual Fairness of toxic text detectors: [fairbert.vizhub.ai](https://fairbert.vizhub.ai)

## Talks

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- Tutorials**.....
- o AI Fairness through Robustness @ AAAI 2023
  - o Fairness of Machine Learning in Search Engines @ CIKM 2022
  - o AI Fairness @ MIT-IBM THINK Industry Day 2022
- Invited Talks**.....
- o Practical Individual Fairness
    - @ TrustML Young Scientist Seminars 2022
  - o Black Loans Matter: Fighting Bias for AI Fairness in Lending
    - @ KDD Workshop on Machine Learning in Finance (Keynote) 2021
  - o 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

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

## Professional Activities

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### Organization and Service.....

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

### Reviewer.....

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

## Media coverage

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

## Additional information

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○ Personal webpage:	<a href="https://moonfolk.github.io">moonfolk.github.io</a>
○ LinkedIn:	<a href="https://www.linkedin.com/in/mikhail-yurochkin-a45659114">www.linkedin.com/in/mikhail-yurochkin-a45659114</a>
○ GitHub:	<a href="https://github.com/moonfolk">github.com/moonfolk</a>
○ Google Scholar:	<a href="https://scholar.google.com/citations?user=QjBF9sUAAAAJ">scholar.google.com/citations?user=QjBF9sUAAAAJ</a>