Mikhail Yurochkin

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Research Interests

- Algorithmic Fairness
- Model Fusion and Federated Learning
- Applications of Optimal Transport in Machine Learning
- Bayesian (nonparametric) modeling and inference

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

M.A., 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 a team of researchers and engineers on a Federated Learning project.
- Leading a Tech for Justice project on developing software and demonstrations for Individual Fairness algorithms developed in collaboration with Yuekai Sun's group at the University of Michigan.
- Leading a project with Justin Solomon's Geometric Data Processing group at MIT on new applications of Optimal Transport to machine learning problems.
- Collaborating with Tamara Broderick and her group at MIT on Gaussian Processes for Big Data.

Research Associate   May 2018 – June 2018

University of Michigan, Ann Arbor, MI, United States

Leading two research projects in collaboration with senior PhD students and faculty. This work led to two paper submissions to NeurIPS 2018. Contributing to project on analyzing driving behaviors using Bayesian modeling as part of collaboration between University of Michigan and Toyota Research Institute.

Data science research intern   June 2017 – Aug 2017

Adobe, San Jose, CA, United States

Explored various approaches for graph learning in the context of convolutional neural networks on graphs. Developed novel approach for deep learning on graph structured data which can automatically learn the latent graph representation. Applied developed techniques to forecasting number of visits to a major retailer's website across cities for improved marketing and sales. Submitted a patent application based on these results.

Consultant for Statistics, Computing, and Analytics Research   Sept 2016 – Dec 2017

University of Michigan, Ann Arbor, MI, United States

Individual appointments and walk-in consultations for faculty and graduate students. Assisted researchers in areas such as biology, dentistry, marketing, survey methodology, political science, public health, computer science, and more with identifying appropriate statistical methodology for the corresponding data and research question. Additionally helped with data collection and processing, software choice and implementation.

Science team intern May 2016 – Aug 2016

LogicBlox/Predictix, Atlanta, GA, United States

Developed novel machine learning approaches for analyzing sales data of a major retailer. Applied expertise in Bayesian modeling to propose, implement and test explainable retail demand forecasting model based on Factorization Machines and Indian Buffet Process. Published a paper at NeurIPS 2017 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 adviser 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

Teaching labs, grading, holding 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] 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.

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

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

[4] 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.

[5] 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.

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

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

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

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

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

[11] 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.

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

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

[14] 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.

[15] 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.

[16] 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.

[17] **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.

[18] **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.

[19] **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.

[20] 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.

[21] **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.

[22] **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.

[23] **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.

[24] **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.

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

[26] **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.

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

[28] 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.

[29] **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.

Talks

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, Camridge 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

Conference 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

Mentoring

- Luann Jung, MIT Master's of Engineering (MEng) student (with J. Solomon) — 2021-Present
- Yining Chen, MIT-IBM summer PhD student intern (with J. Solomon and Y. Sun) — 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 (with J. Solomon and Y. Sun) — 2020
- Hongyi Wang, IBM Research summer PhD student intern — 2019

Professional Activities

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) — 2016-2021
- International Conference on Learning Representations (ICLR) — 2018-2020
- 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

- "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

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