Rafid Mahmood

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Employment

University of Ottawa, Telfer School of Management

Assistant Professor 2023–pres.

NVIDIA Corporation

Senior Research Scientist 2022–pres.

AI Resident Researcher 2020–2022

Education

University of Toronto, Mechanical and Industrial Engineering

Ph.D Industrial Engineering 2015–2020

Vector Institute for Artificial Intelligence Postgraduate Affiliate 2019–2020

University of Toronto, Electrical and Computer Engineering

M.A.Sc. Electrical Engineering 2013–2015

Honors B.A.Sc. Electrical Engineering 2008–2013

Publications[1]

Working Papers and Pre-Prints

1. **R. Mahmood***, J. Lucas, J. M. Alvarez, S. Fidler, and M. T. Law, Optimizing Data Collection for Machine Learning, *under review in Journal of Machine Learning Research (JMLR)*, 2023.
   - Preliminary version at NeurIPS 2022.
2. V. Prabhu*†, D. Acuna, A. Liao†, **R. Mahmood**, M. T. Law, J. Hoffman, S. Fidler, and J. Lucas, Bridging the Sim2Real Gap with CARE: Supervised Detection Adaptation with Conditional Alignment and Reweighting, *under review*, 2023.
3. T. C. Y. Chan, **R. Mahmood**, D. L. O'Connor, D. Stone, S. Unger, R. K. Wong*†, and I. Y. Zhu, Got (Optimal) Milk? Pooling Donations in Human Milk Banks with Machine Learning and Optimization, *minor revision in Manufacturing & Service Operations Management*, 2023.
   - **Finalist at MSOM 2023 Practice-Based Research Competition.**
   - **Runners' Up (second place) at POMS 2023 College of Healthcare Operations Management (CHOM) Best Paper Award.**

[1] Some articles (e.g., INFORMS journals) were published with alphabetical author ordering. The primary author is denoted with *. Supervised students are denoted with †.

  - **Honorable Mention (third place) at CORS 2023 Practice Prize Competition.**
  - Presented at MSOM 2023 Healthcare SIG.
  - Preliminary version at The Journal of Nutrition.

4. T. C. Y. Chan, **R. Mahmood***, and I. Y. Zhu*, Inverse Optimization: Theory and Applications, *major revision in Operations Research*, 2022.

5. A. Babier, T. C. Y. Chan, A. Diamant, and **R. Mahmood***, Learning to Optimize Contextually Constrained Problems for Real-Time Decision Generation, *major revision in Management Science*, 2021.

Methodological Articles

6. **R. Mahmood***, J. Lucas, J. M. Alvarez, S. Fidler, and M. T. Law, Optimizing Data Collection for Machine Learning, *Neural Information Processing Systems (NeurIPS)*, 2022.

7. **R. Mahmood***, J. Lucas, D. Acuna, D. Li, J. Philion, J. M. Alvarez, Z. Yu, S. Fidler, and M. T. Law, How Much More Data Do I Need? Estimating Requirements for Downstream Tasks, *Computer Vision and Pattern Recognition (CVPR)*, 275–284, 2022.

8. **R. Mahmood***, S. Fidler, and M. T. Law, Low Budget Active Learning via Wasserstein Distance: An Integer Programming Approach, *International Conference on Learning Representations (ICLR)*, 2022.

9. A. Babier, T. C. Y. Chan, T. Lee, **R. Mahmood***, and D. Terekhov, An Ensemble Learning Framework for Model Fitting and Evaluation in Inverse Linear Optimization, *INFORMS Journal on Optimization*, 3 (2), 119–138, 2021.

   - Presented at CORS 2020 Canadian Healthcare Optimization Workshop.
   - **Honorable Mention (second place) at CORS 2018 Best Student Paper Competition.**

10. T. C. Y. Chan, A. Diamant, and **R. Mahmood***, Sampling from the Complement of a Polyhedron: An MCMC Algorithm for Data Augmentation, *Operations Research Letters*, 48 (6), 744–751, 2020.

11. **R. Mahmood***, A. Badr, and A. Khisti, Streaming Codes for Multiplicative-Matrix Channels with Burst Rank Loss, *IEEE Transactions on Information Theory*, 64 (7), 5296–5311, 2018.

    - Preliminary version at ISIT 2016.

12. **R. Mahmood***, A. Badr, and A. Khisti, Convolutional Codes with Maximum Column Sum Rank for Network Streaming, *IEEE Transactions on Information Theory*, 62 (6), 3039–3052, 2016.

    - Preliminary version at ISIT 2015.

13. **R. Mahmood***, A. Badr, and A. Khisti, Low Delay Network Streaming Under Burst Losses, *IEEE International Symposium on Information Theory (ISIT)*, 2898–2902, 2016.

14. **R. Mahmood***, A. Badr, and A. Khisti, Convolutional Codes with Maximum Column Sum Rank for Network Streaming, *IEEE International Symposium on Information Theory (ISIT)*, 2271–2275, 2015.

15. A. Badr*, **R. Mahmood**, and A. Khisti, Embedded MDS Codes for Multicast Streaming, *IEEE International Symposium on Information Theory (ISIT)*, 2276–2280, 2015.

Clinical Articles

16. A. Babier*, **R. Mahmood**, B. Zhang, V. G. L. Alves, A. M. Barragán-Montero, J. Beaudry, C. E. Cardenas, Y. Chang, Z. Chen, J. Chun, K. Diaz, H. D. Eraso, E. Faustmann, S. Gaj, S. Gay, M. Gronberg, B. Guo, J. He, G. Heilemann, S. Hira, Y. Huang, F. Ji, D. Jiang, J. C. J. Giraldo, H. Lee, J. Lian, S. Liu, K. Liu, J. Marrugo, K. Miki, K. Nakamura, T. Netherton, D. Nguyen, H. Nourzadeh, A. F. I. Osman, Z. Peng, J. D. Q. Muñoz, C. Ramsl, D. J. Rhee, J. D. Rodriguez, H. Shan, J. V. Siebers, M. H. Soomro, K. Sun, A. U. Hoyos, C. Valderrama, R. Verbeek, E. Wang, S. Willems, Q. Wu, X. Xu, S. Yang, L. Yuan, S. Zhu, L. Zimmermann, K. L. Moore, T. G. Purdie, A. L. McNiven, T. C. Y. Chan, OpenKBP-Opt: An International and Reproducible Evaluation of 76 Knowledge-Based Planning Pipelines, *Physics in Medicine and Biology*, 67 (18), 2022.

17. R. K. Wong*†, M. A. Pitino, **R. Mahmood**, I. Y. Zhu, D. Stone, S. Unger, D. L. O'Connor, and T. C. Y. Chan, Prediction of Protein and Fat Content in Human Donor Milk Using Machine Learning, *The Journal of Nutrition*, 2021.

18. A. Babier*, B. Zhang, **R. Mahmood**, K. Moore, T. Purdie, A. McNiven, and T. C. Y. Chan, OpenKBP: The Open-access Knowledge-Based Planning Grand Challenge and Dataset, *Medical Physics*, 48 (9), 5549–5561, 2021.

19. A. Babier*, **R. Mahmood**, A. McNiven, A. Diamant, and T. C. Y. Chan, The Importance of Evaluating the Complete Knowledge-Based Planning Pipeline, *Physica Medica: European Journal of Medical Physics*, 72, 73–79, 2020.

    – Preliminary version at ICCR 2019.

20. M. J. Crowson*, A. Hamour, **R. Mahmood**, A. Babier, V. Lin, D. Tucci, and T. C. Y. Chan, AutoAudio: Deep Learning for Automatic Audiogram Interpretation, *Journal of Medical Systems*, 44 (163), 2020.

21. M. J. Crowson*, P. Dixon, **R. Mahmood**, J. W. Lee, D. Shipp, T. Le, V. Lin, J. Chen, and T. C. Y. Chan, Predicting Post-Operative Cochlear Implant Performance Using Supervised Machine Learning, *Otology & Neurotology*, 41 (8), 1013–1023, 2020.

22. A. Babier*, **R. Mahmood**, A. McNiven, A. Diamant, and T. C. Y. Chan, The Importance of Evaluating the Complete Knowledge-based Automated Planning Pipeline, *International Conference on the Use of Computers in Radiotherapy (ICCR)*, 2019.

23. A. Babier*, **R. Mahmood**, A. McNiven, A. Diamant, and T. C. Y. Chan, Knowledge-based Automated Treatment Planning with Three-dimensional Generative Adversarial Networks, *Medical Physics*, 47 (2), 297–306, 2019.

    – Preliminary version at NeurIPS ML4H Workshop 2018.

24. **R. Mahmood***, A. Babier, A. McNiven, A. Diamant, and T. C. Y. Chan, Automated Treatment Planning in Radiation Therapy with Generative Adversarial Networks, *Machine Learning for Healthcare (MLHC)*, Proceedings of Machine Learning Research 85, 484–499, 2018.

    – **Runners' Up (second place) at CORS 2019 HCOR Student Presentation Competition.**

Media Articles

25. M. Shin*, Y. Shalaby*, A. Loa*, B. Potter*, T. C. Y. Chan, and **R. Mahmood**, Optimizer for the 2021 NHL Expansion Draft, *OR/MS Today*, 48 (5), 52–54, 2021.

Patents

26. **R. Mahmood**, J. Lucas, Z. Yu, J. M. Alvarez Lopez, S. Fidler, and M. T. Law, A Method for Estimating and Optimizing How Much Data Should Be Collected to Meet a Desired Performance, *US Patent Application Number 63/344007*, filed May 2022.
27. **R. Mahmood**, J. Lucas, D. A. Marrero, D. Li, J. Philion, J. M. Alvarez Lopez, S. Fidler, and M. T. Law, Estimating Optimal Training Data Set Size for Machine Learning Model Systems and Applications, *US Patent Application Number 18/318212*, filed May 2022.
28. **R. Mahmood**, S. Fidler, and M. T. Law, Optimized Active Learning Using Integer Programming, *US Patent Application Number 17/591039*, filed Feb 2022.

Presentations

Invited Seminars

(Scheduled) ICCV Tutorial on Learning with Noisy and Unlabeled Data for Large Models beyond Categorization	2023
University of Toronto Rotman School of Management	2023
University of Ottawa Center for a Responsible Wealth Transition (CRWT)	2022
Wilfrid Laurier University Lazaridis School of Business and Economics	2022
University of Ottawa Telfer School of Management	2022
University of Hong Kong IMSE Department	2022
Rutgers University ISE Department	2021
University of North Carolina Kenan-Flagler Business School	2021
University of Cincinnati Lindner College of Business	2021
University of Iowa IE + EE Department	2021
University of Calgary CS Department	2021
University of Edinburgh Business School	2021
University of Alberta Alberta School of Business	2020
NVIDIA Toronto AI Lab	2020
University of Pittsburgh IE Department	2020
Université de Montréal GERAD	2019

Conferences[2]

Optimizing Data Collection for Machine Learning

- *(Scheduled)* INFORMS Annual Meeting, Phoenix, AZ, USA 2023
- *(Scheduled)* MSOM Conference, Montréal, QC, Canada 2023

Got (Optimal) Milk? Pooling Donations in Human Milk Banks with Machine Learning and Optimization

- *(Scheduled)* MSOM Healthcare SIG Conference, Montréal, QC, Canada 2023
- POMS Conference, Orlando, FL, USA 2023

Low Budget Active Learning: An Integer Programming Approach

- CORS Annual Conference, Vancouver, BC, Canada 2022
- INFORMS Annual Meeting, Anaheim, CA, USA 2021

Learning to Optimize with Hidden Constraints

- POMS Conference, Orlando, FL, USA 2022
- CORS Annual Conference, Toronto, ON, Canada 2021
- INFORMS Annual Meeting, Washington, DC, USA 2020
- INFORMS Annual Meeting, Seattle, WA, USA 2019
- CORS Annual Conference, Saskatoon, SK, Canada 2019

An Ensemble Learning Framework for Inverse Linear Optimization

- INFORMS Health Care, Boston, MA, USA 2019
- CORS Annual Conference, Saskatoon, SK, Canada 2019
- CORS Annual Conference, Halifax, NS, Canada 2018
- INFORMS Annual Meeting, Houston, TX, USA 2017
- CORS Annual Conference, Quebec City, QC, Canada 2017
- INFORMS Annual Meeting, Nashville, TN, USA 2016

Automated Treatment Planning with Generative Adversarial Networks

- CORS Annual Conference, Saskatoon, SK, Canada 2019
- MLHC Conference, Palo Alto, CA, USA 2018

Convolutional Codes with Maximum Column Sum Rank for Network Streaming

- IEEE ISIT, Hong Kong, HK, China 2015

Teaching

University of Ottawa

MGT5301: Predictive Analytics 2023

ADM2304: Applications of Statistical Methods in Business 2023-2024

[2]Presentations are categorized by the abbreviated main paper discussed. Actual titles may vary.

Students Supervised

University of Ottawa

1. Maryam Vahabi, *PhD Thesis*, 2023–pres. Co-advised with Christopher Sun.
2. Shahryar Moradi, *PhD Committee*, 2023–pres.
3. Amirhossein Moosavi, *PhD Committee*, 2023–pres.

NVIDIA

4. Andrew Yuan-Hong Liao, *Research Scientist Internship*, 2022–2023. Co-mentored with David Acuna and James Lucas.
5. Viraj Prabhu, *Research Scientist Internship*, 2022. Co-mentored with David Acuna, Marc T. Law, and James Lucas.

University of Toronto[3]

6. Rachel Wong, *Masters of Applied Science Thesis*, 2020–2022. Co-mentored with Ian Y. Zhu.
7. Richard Chavez, *Industrial Engineering 4th Year Thesis*, 2019. Co-mentored with Aaron Babier.
8. Michael Shin, *Engineering Science 4th Year Thesis*, 2018. Co-mentored with Ben Potter.
9. Yusuf Shalaby, *Industrial Engineering 4th Year Thesis*, 2018. Co-mentored with Nasrin Youssefi.
10. Palmira Pereira, *Masters of Engineering Thesis*, 2017.

Grants

1. SSHRC Insight Development Grant, Co-Investigator, 2024–2026 ($68 000).
2. NSERC Discovery Grant, Principal Investigator, 2023–2027 ($160 000).
3. NSERC Discovery Grant ECR Launch Supplement, Principal Investigator, 2023–2024 ($12 500).
4. University of Ottawa SEED Funding Opportunity, Principal Investigator, 2023 ($20 000).
5. Telfer School of Management Start-up Grant, Principal Investigator, 2023-2024 ($40 000).

Awards

1. Finalist, Practice-Based Research Competition, MSOM Conference, 2023 (results in June).
2. Finalist, Practice Prize Award, CORS Annual Conference, 2023.
3. Runners' Up, College of Healthcare Operations Management (CHOM) Best Paper Prize, POMS Conference, 2023 ($250).
4. University of Toronto Doctoral Completion Award, 2019–2020 ($8 000).
5. Runners' Up, Health Care Operations Research Student Presentation Competition, CORS Annual Conference, 2019.

[3] All students were supervised under my doctoral adviser Timothy C. Y. Chan.

6. Postgraduate Affiliate Award, Vector Institute for Artificial Intelligence, 2019 ($12 000).
7. Honourable Mention, Student Paper Competition: Open Category, CORS Annual Conference, 2018 ($100).
8. Postgraduate Doctoral Scholarship, NSERC, 2017 ($42 000).
9. First Place, Waterfront International Ltd. Quantathon, 2016 ($7 500).

Other Professional Experience

NHL Expansion Draft Optimizer 2017, 2021

`http://nhlexpansiondraft.com`

Back-end Software Developer (2017), Adviser (2021)

We deployed a web app simulating the 2017 and 2021 NHL Expansion Drafts. Our site received media coverage from *The Toronto Star*, *OR/MS Today*, and *The Seattle Times*.

OpenKBP Grand Challenge 2019–2020

`https://www.aapm.org/GrandChallenge/OpenKBP/`

Machine Learning Expert

We organized an international competition for automating radiation therapy dose treatments in head-and-neck cancer, featuring 28 teams of 195 participants. We also released the public-access OpenKBP Data Set containing 400 treatments.

Opus One Solutions, Toronto, ON, Canada 2019

Power Systems Optimization Expert (Consultant)

Service

Ad-hoc Journal Referee

Computers and Operations Research; European Journal of Operational Research; Health Care Management Science; IEEE Transactions on Cybernetics; IISE Transactions

Ad-hoc Conference Referee

ICML 2021–2023; ICLR 2022–2023; NeurIPS 2020–2023; IEEE ISIT 2017, 2022; ACM CHIL 2020–2021; NeurIPS ML4H Workshop 2019–2020

Conference Session Chair

INFORMS Annual Meeting 2021–2023; CORS Annual Conference 2019, 2022

Personal

Languages: English (fluent), French (beginner)

Citizenship: Canadian