

# Rafid Mahmood

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## Employment

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### Nvidia Corporation

AI Resident Researcher 2020–pres.

## Education

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### University of Toronto, Mechanical and Industrial Engineering

Ph.D Industrial Engineering 2015–2020  
Vector Institute for Artificial Intelligence Postgraduate Affiliate 2019–2020  
Thesis: Learning to Solve Optimization Problems with Hidden Components: Applications in Automated Treatment Planning  
Adviser: Professor Timothy C. Y. Chan

### University of Toronto, Electrical and Computer Engineering

M.A.Sc. Electrical Engineering 2013–2015  
Thesis: Rank Metric Convolution Codes with Applications in Network Streaming  
Adviser: Professor Ashish Khisti  
Honors B.A.Sc. Electrical Engineering 2008–2013

## Publications<sup>1</sup>

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### Working Papers and Pre-Prints

1. T. C. Y. Chan, D. L. O'Connor, **R. Mahmood**, D. Stone, S. Unger, R. K. Wong\*, and I. Y. Zhu, Milk Bank Batching Operations: A Data-driven Optimization Approach, *in preparation for Manufacturing & Service Operations Management*, 2022.  
– Preliminary version at The Journal of Nutrition.
2. A. Babier, T. C. Y. Chan, A. Diamant, and **R. Mahmood\***, Learning to Optimize with Hidden Constraints, *major revision in Management Science*, 2021.
3. T. C. Y. Chan, **R. Mahmood\***, and I. Y. Zhu\*, Inverse Optimization: Theory and Applications, *under review at SIAM Review*, 2021.

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<sup>1</sup>I use alphabetical author ordering for articles in operations research-style journals. The primary author is starred.

## Methodological Articles

1. **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.
2. 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.
  - **Honorable Mention (second place) at CORS 2018 Best Student Paper Competition.**
3. 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.
4. **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 the 2016 ISIT.
5. **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 the 2015 ISIT.
6. **R. Mahmood\***, A. Badr, and A. Khisti, Low Delay Network Streaming Under Burst Losses, *IEEE International Symposium on Information Theory (ISIT)*, 2898–2902, 2016.
7. **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.
8. 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

1. 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.
2. 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.
3. 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 the 2019 ICCR.

4. 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.
5. 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.
6. 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.
7. 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 the 2018 NeurIPS ML4H Workshop.

8. **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

1. 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), 2021.

## Presentations

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### Invited Seminars

CS Department, University of Calgary	2021
MSBE Group, University of Edinburgh Business School	2021
AOIS Department, Alberta School of Business	2020
Nvidia Research, Toronto AI Lab	2020
IE Department, University of Pittsburgh	2020
GERAD, Université de Montréal	2019

## Conferences<sup>2</sup>

<b>Low Budget Active Learning: An Integer Programming Approach</b>	
INFORMS Annual Meeting, Anaheim, CA, USA	2021
<b>Learning to Optimize with Hidden Constraints</b>	
(scheduled) 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
<b>An Ensemble Learning Framework for Inverse Linear Optimization</b>	
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
<b>Automated Treatment Planning with Generative Adversarial Networks</b>	
CORS Annual Conference, Saskatoon, SK, Canada	2019
MLHC Conference, Palo Alto, CA, USA	2018
<b>Convolutional Codes with Maximum Column Sum Rank for Network Streaming</b>	
IEEE ISIT, Hong Kong, HK, China	2015

## Teaching Assistantship

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<b>MIE 465: Analytics in Action</b>	2017–2019
Responsible for course creation in 2017.	
<b>MIE 1620: Linear Programming and Network Flows</b>	2018
<b>MIE 258: Engineering Economics and Accounting</b>	2016–2017
<b>ECE 363: Communication Systems</b>	2015

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<sup>2</sup>Presentations are categorized by the abbreviated main paper discussed. Actual titles may vary.

## Students Supervised

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### University of Toronto<sup>3</sup>

1. Rachel Wong, Machine Learning Regression Models to Predict Protein and Fat Content in Human Donor Milk, *Masters of Applied Science Thesis*, 2020. Co-supervised with Ian Y. Zhu.
2. Richard Chavez, Sliding Window Generative Adversarial Networks for Radiation Therapy, *Industrial Engineering 4th Year Thesis*, 2019. Co-supervised with Aaron Babier.
3. Michael Shin, Using Portfolio Theory to Optimize Selection of Daily Fantasy Basketball Contests, *Engineering Science 4th Year Thesis*, 2018. Co-supervised with Ben Potter.
4. Yusuf Shalaby, Inverse Optimization for Measuring Cancer Treatment Pathway Concordance, *Industrial Engineering 4th Year Thesis*, 2018. Co-supervised with Nasrin Youssefi.
5. Palmira Pereira, Netflix Prize Problem Using Inverse Optimization, *Masters of Engineering Thesis*, 2017.

## Awards

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1. University of Toronto Doctoral Completion Award, 2019–2020 (\$8 000).
2. Runners' Up, Health Care Operations Research Student Presentation Competition, CORS Annual Conference, 2019.
3. Postgraduate Affiliate Award, Vector Institute for Artificial Intelligence, 2019 (\$12 000).
4. Honourable Mention, Student Paper Competition: Open Category, CORS Annual Conference, 2018 (\$100).
5. Postgraduate Doctoral Scholarship, NSERC, 2017 (\$42 000).
6. First Place, Waterfront International Ltd. Quantathon, 2016 (\$7 500).

## Other Professional Experience

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**NHL Expansion Draft Optimizer** (<http://nhlexpansiondraft.com>) 2017, 2021  
 Back-end Software Developer (2017), Adviser (2021)

- Implemented an online tool demonstrating the power of optimization in simulating team choices for the 2017 and 2021 NHL Expansion Draft with the Vegas Golden Knights and Seattle Kraken, respectively.
- Our site received media coverage from *The Toronto Star*, *OR/MS Today*, and *The Seattle Times*.

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<sup>3</sup>All students were co-supervised with my adviser Timothy C. Y. Chan.

**OpenKBP Grand Challenge**, American Association of Physicists in Medicine    2019–2020  
Machine Learning Expert

- Released the OpenKBP Data Set, which is the first public-access data set (of 400 ML-generated treatments) to standardize research in automated planning.
- Organized the OpenKBP Grand Challenge, which was an international competition for predicting radiation therapy dose treatments in head-and-neck cancer.

**Opus One Solutions**, Toronto, ON, Canada    2019  
Independent Contract/Power Systems Optimization Expert

- Developed and implemented algorithms to solve optimal power flow, dispatch, and related power systems problems.

## Service

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### Academic

#### Ad-hoc Journal Referee

Health Care Management Science, European Journal of Operational Research

#### Ad-hoc Conference Referee

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

#### Conference Session Chair

INFORMS Annual Meeting 2021, CORS Annual Conference 2019

### University of Toronto

**Electrical and Computer Engineering Graduate Student Society**    2014–2015  
Treasurer

**Electrical and Computer Engineering Graduate Students Symposium**    2014  
Organizing Committee Member

## Personal

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Languages: English (fluent), French (beginner)

Citizenship: Canadian

Last updated: January 20, 2022

<http://rafidrm.github.io>