Rana A. Barghout

✉ rana.barghout@mail.utoronto.ca
🌐 *https://ranaabarghout.github.io/*

Education

Sept 2021–Aug 2026
PhD, Chemical Engineering & Applied Chemistry, *University of Toronto & Vector Institute*, Toronto, ON
Thesis: "Deep learning for improving metabolic modeling and strain engineering"
Supervisors: R. Mahadevan & B. Sanchez-Lengeling
Abstract: Exploration of SOTA deep learning & optimization to enhance computational metabolic modeling across scales.
Skills: Python (PyTorch, Pyomo, RDKit, Scikit-learn), Linux, MATLAB, SQL.

Sept 2016–May 2021
BASc, Chemical and Biological Engineering, *University of British Columbia*, Vancouver, BC
Dean's Honor List (3 years)

Research Experience

Sept 2021–Present
PhD Candidate, *Machine Learning for Genome-Scale Strain Fitness Prediction*, *University of Toronto*, Toronto, ON
- Designed and implemented CPI-Pred: deep learning model integrating protein language models & molecular embeddings to predict enzyme kinetics (kcat, K_M, K_I, kcat/K_M).
- Integrated ML-predicted parameters into genome-scale models via kinGEMs pipeline; improved gene lethality prediction by 3%.
- Conducted large-scale benchmarking on sequence-compound datasets; demonstrated out-of-distribution generalization improvements.

Sept 2020–Aug 2021
Undergraduate Thesis, *Integrating Machine Learning with Kinetic Models*, *University of British Columbia*, Vancouver, BC
- Developed decision tree and LSTM models to interpret xylose yield predictions from experimental data.
- Formulated and solved large-scale Pyomo and SciPy optimization problems to estimate kinetic parameters.
- Preprocessed and analyzed data with Scikit-learn, Pandas, TensorFlow, improving predictive accuracy by 10%.

Sept 2018–Apr 2019
Chemical Engineering Support (Co-op), *BC Research Inc.*, Vancouver, BC
- Optimized meso-scale experimental workflows; reduced data collection time by 50%.
- Conducted PIV fluid dynamics analysis for open-channel flumes; enhanced measurement accuracy.
- Delivered operational training on advanced PIV and sonic wave gauge systems; ensured compliance with WHMIS and laser safety.

Other Work Experience

Jan 2021–Present
Teaching Assistant, *Chemical Engineering & Applied Chemistry Depts.*, UofT & UBC, Courses: CHE204, CHE205, CHE305, CHE222, CHE322, CHE499, CHBE221.
- Led weekly tutorials for 70 students on dynamic modeling, process control, MATLAB & Python.
- Graded assignments/quizzes; improved learning outcomes for 140+ students.

Oct 2020–Apr 2021
Laboratory Assistant, *Dr. Louise Creagh Labs*, UBC,
- Prepared cell culture media and autoclaved bioreactors; maintained fed-batch systems for Pichia pastoris.
- Revised instructional materials for improved clarity and engagement.

Publications and Presentations

[1] R. Ahmed Barghout, L. Chinas, Z. Xu, B. Sanchez-Lengeling, and R. Mahadevan. *Bridging sequence and kinetics: utilizing multi-scale representations for genome-scale metabolic models.* Spotlight Talk. Singapore, Apr. 2025.

[2] R. Ahmed Barghout, M. Kirby, A. Zheng, L. Chinas Serrano, Z. Xu, and M. Mohammadi. "Machine Learning for Sequence to Function Approaches". In: *Machine Learning and Big-Data Enabled Biotechnology.* Ed. by H. Alper. Advanced Biotechnology Series. Forthcoming. Springer, 2025.

[3] J. Barraza, R. Ahmed Barghout, R. Almada, A. Jinich, and B. Sanchez-Lengeling. "Graph Data Modeling: Molecules, Proteins, Chemical Processes". In: *ACS In Focus (accepted)* (2025).

[4] Z. Xu, R. Ahmed Barghout, J. Wu, and D. Garg. *CPI-Pred: A General-Purpose Compound-Protein Interaction Prediction Model.* Submitted for review; preprint at `https://www.biorxiv.org/content/10.1101/2025.01.16.633372v1.full.pdf`. 2025.

[5] R. Ahmed Barghout, L. Chinas, and R. Mahadevan. "kinGEMs: Advancing enzyme-constrained genome-scale modeling with deep learning-predicted kinetic parameters". In: *COBRA Conference.* San Diego, CA, Oct. 2024.

[6] R. Ahmed Barghout, Z. Xu, and R. Mahadevan. "Enhancing compound-protein interaction prediction with confidence assessment". In: *AIChE Annual Meeting.* San Diego, CA, Oct. 2024.

[7] S. Betala, R. Ahmed Barghout, Z. Xu, and R. Mahadevan. "Screening protein sequences generated via conditional diffusion for enhanced fitness using a GNN-based functional predictor". In: *Machine Learning for Computational Biology Conference (MLCB).* Seattle, WA, Sept. 2024.

[8] R. A. Barghout, Z. Xu, S. Betala, and R. Mahadevan. "Advances in generative modeling methods and datasets to design novel enzymes for renewable chemicals and fuels". In: *Current Opinion in Biotechnology* 84 (2023), p. 103007. DOI: `10.1016/j.copbio.2023.103007`.

[9] Z. Xu, R. Ahmed Barghout, and R. Mahadevan. "Deep Learning-Based Protein Sequence-to-Function Prediction Framework". In: *Metabolic Engineering Conference (ME15).* Singapore, 2023.

[10] R. Ahmed Barghout. "Machine Learning for Kinetic Parameter Prediction in Organisms". In: *Canadian Chemical Engineering Conference.* Vancouver, BC, 2022.

[11] K. Haddadi, R. Ahmed Barghout, and R. Mahadevan. "KinMod database: a tool for investigating metabolic regulation". In: *Database* 2022 (2022). DOI: `10.1093/database/baac081`.

[12] J. Verrett, R. Qiao, and R. Ahmed Barghout. *Foundations of Chemical and Biological Engineering I.* Vancouver, BC: BCcampus, 2020.

Academic Community Involvement

Aug 2023–Jul 2025	**VP Logistics, GradSWE**, *UofT Faculty of Applied Science* ○ Led GradSWE podcast and executive coordination; secured funding via grant proposals; piloted, planned, and edited 'She Speaks STEM' podcast
Sept 2023–Apr 2024	**HR Recruitment Team Member**, *BridgeTO*, Toronto, ON Managed recruitment databases; aligned mentors with at-risk youth; standardized onboarding documentation.
Apr 2022–Apr 2023	**Mentorship Program Coordinator**, *CEGSA, UofT* Expanded participation by 33%; introduced Grad-4th Year peer matching; organized social events to strengthen networks.

Honors and Awards

Jan 2025	Diran Basmadjian Graduate Scholarship, UofT.
Dec 2022 & 2023	Rein Otson Memorial Graduate Scholarship, UofT.

Apr 2021	3MT First Place, UBC CHE Research Day.
Apr 2021	Short Research Presentation First Place, UBC.
Apr 2021	Thomas Bennett Scholarship, UBC.
Dec 2020	UBC International Community Achievement Award.
Nov 2020	Faculty of Applied Science International Student Scholarship, UBC.
Oct 2020	Trek Excellence Scholarship for International Students, UBC.
Apr 2020	CHBE Award in Breakthrough Innovations and Engineering Leadership.