

Justin Cui

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Research Interests

Natural Language Processing; Human–AI Interaction; Information Retrieval; Large Language Models;

Education

University of Toronto

BASc, Engineering Science – Machine Intelligence
cGPA: 3.94/4.0; CrsAvg: 93

09/2021 – 05/2026

Toronto, ON, CA

Relevant coursework:

- | | | |
|---|--|--|
| - Introduction to Machine Learning (A+, 92) | - Foundations of Computing (A+, 92) | - Linear Algebra (A+, 93) |
| - Probabilistic Reasoning (A+, 91) | - Matrix Algebra & Optimization (A+, 92) | - Calculus I (A+, 97) |
| - Artificial Intelligence (A+, 98) | - Ordinary Differential Equations (A+, 94) | - Calculus II (A+, 96) |
| - Systems Software (A+, 95) | - Probability & Statistics (A+, 95) | - Economic Analysis and Decision Making (A+, 93) |

Research Experience

Undergraduate Researcher

DGP Lab, University of Toronto (Advisor: Prof. Tovi Grossman)

Aug 2025 – Present

Toronto, ON, CA

- Proposed and led a human-centered **micro-learning system** that infers learning needs from everyday searches/chats and generates bandwidth-aware, scaffolded lessons; designed the modeling approach (**LLM integration** and **knowledge-graph sequencing**) and built the research prototype.
- Designed and ran a **controlled comparative study** against a reactive chat baseline; defined **hypotheses and metrics**, analyzed engagement and learning outcomes, and synthesized qualitative themes into design and deployment recommendations.

Undergraduate Researcher

Vector Institute (Advisor: Prof. Zhijing Jin)

Aug 2025 – Present

Toronto, ON, CA

- Led the design of a causal **DataAgent** that, given a natural language causal question, searches **Harvard Dataverse** and ranks datasets suitable for the intended estimation task; applied **causal estimation specific query reformulation** with **dense retrieval** and **multi field sparse matching** to improve relevance.
- Co-curated **CauSciBench**, a benchmark of 367 tasks from 100+ papers across nine disciplines; evaluated **end-to-end causal pipelines** from problem formulation to modeling and interpretation, showing the best model still had **~49% mean relative error** on real-paper tasks.

Undergraduate Researcher

Vector Institute (Advisor: Prof. Alán Aspuru-Guzik)

Apr 2025 – Present

Toronto, ON, CA

- Investigated **compositional diffusion models** for few-shot reasoning on 1D and 2D **Abstraction and Reasoning Corpus (ARC)** tasks, formulated **learning objectives** for different compositional modes.
- Built the **experimental pipeline and ablation suite** (multiple diffusion objectives and 1M–20M-param **UNets**); isolated contributions of architecture and objective choices to reasoning accuracy.

Undergraduate Researcher

Data-Driven Decision Making Lab, University of Toronto (Advisor: Prof. Scott Sanner)

Apr 2023 – Apr 2025

Toronto, ON, CA

- Co-led one of the first open-source **RAG-based** conversational recommenders with **semi-structured dialogue state tracking**: intent extraction, state updates, **late-fusion retrieval**, and **retrieval-augmented** natural-language recommendation and explanation.
- Proposed a **query-reformulation** method and curated a **cross-domain NL recommendation benchmark**; showed consistent **MAP@K** gains over baselines and analyzed when reformulations improve retrieval.

Industry Experience

Machine Learning Engineer Intern

Modiface

May 2024 – Apr 2025

Toronto, ON, CA

- Designed and implemented a **Stable Diffusion** pipeline on **GCP** for 3D facial dataset augmentation, processing 25M synthetic images and improving facial landmark prediction accuracy by **17%**.
- Optimized GenAI inference latency by 40%+ via **OpenVINO** integration for GAN/diffusion models.
- Built a supervised fine-tuning pipeline on 5k+ curated dialogue pairs, reducing API cost by **83%** versus in-context prompting.

Software Engineer Intern

May 2022 – Sep 2022

Voith Hydro

Montreal, QC, CA

- Automated material-spec analysis via **Python (pandas/NumPy)** to process CSV datasets and generate standardized reports, reducing manual review time.
- Built an internal infopoint centralizing resources for 150+ engineers; achieved a **95%** adoption rate in the first month.

Publications & Preprints

Retrieval-Augmented Conversational Recommendation with Prompt-based Semi-Structured Natural Language State Tracking

Sara Kemper*, **Justin Cui***, Kai Dicarantonio*, Kathy Lin*, Danjie Tang*, Anton Korikov, Scott Sanner

ACM SIGIR 2024. [paper].

LOOM: Personalized Learning Informed by Daily LLM Conversations Toward Long-Term Mastery via a Dynamic Learner Memory Graph

Justin Cui, Kevin Pu, Tovi Grossman

Submitted to PerFM @ AAAI 2026.

A Simple but Effective Elaborative Query Reformulation Approach for Natural Language Recommendation

Qianfeng Wen*, Yifan Liu*, **Justin Cui***, Joshua Zhang, Anton Korikov, George-Kirollos Saad, Scott Sanner

arXiv preprint 2025. [paper].

Multimodal Item Scoring for Natural Language Recommendation via Gaussian Process Regression with LLM Relevance Judgments

Yifan Liu*, Qianfeng Wen*, Jiazhao Liang*, Mark Zhao*, **Justin Cui**, Anton Korikov, Armin Toroghi, Junyoung Kim, Scott Sanner

Submitted to ACL Rolling Review (Oct 2025 cycle). Under review [paper].

CauSciBench: A Comprehensive Benchmark on End-to-End Causal Inference for Scientific Research

Sawal Acharya, Terry Jingchen Zhang, Andrew Kim, Anahita Haghighat, Sun Xianlin, Pepijn Cobben, Rahul Babu Shrestha, Maximilian Mordig, Jacob T. Emmerson, Furkan Danisman, Yuen Chen, Clijo Jose, Andrei Ioan Muresanu, **Justin Cui**, Jiarui Liu, Yahang Qi, Punya Syon Pandey, Yinya Huang, Bernhard Schölkopf, Mrinmaya Sachan, Zhijing Jin

Submitted to ICLR 2026. Under review [paper].

Honors & Awards

Engineering Science Research Opportunities (ESROP) Fellowship (\$7,000), Univ. of Toronto Faculty of Applied Science & Engineering, Apr 2025

[host: Vector Institute]

2025 ESROP-Global Research Fellowship (\$9,000), ETH Zurich, Switzerland, 2025

[Awarded a research position at ETH Zurich. Declined the offer to work at the Matter Lab instead.]

Wallberg Undergraduate Scholarship (\$1,500), University of Toronto, Aug 2024

[awarded annually to a top student, third year]

2023 ESROP-Global Research Fellowship (\$10,000), Technical University of Munich (TUM), Germany, 2023

[Awarded a research position at TUM. Declined the offer to work at D3M instead.]

NSERC Undergraduate Student Research Award (USRA) (\$7,500), Natural Sciences and Engineering Research Council of Canada, Mar 2023

[competitive research funding based on record and potential]

Wallberg Undergraduate Scholarship (\$1,500), University of Toronto, Aug 2022

[awarded annually to a top student, first year]

Fujino/Smith Emergence Scholarship (\$1,500), University of Toronto, Mar 2022

[top 1F EngSci student without entrance scholarship]

Dean's Honours List, Faculty of Applied Science & Engineering, University of Toronto, Dec 2021–Present
[every term of the degree]

Outstanding Cambridge Assessment Award, Cambridge Assessment International Education, Jun 2019
[highest mark worldwide in IGCSE Mathematics]

Volunteering

Conference Committee — Reviewer	Feb 2025 – Mar 2025
<i>SIGIR 2025</i>	<i>Padova, Italy</i>
– Reviewed demo submissions for scientific quality, novelty, and reproducibility.	
Engineering Science (Machine Intelligence) Review Committee — Class Representative	2024 - 2025
<i>University of Toronto</i>	<i>Toronto, ON, CA</i>
– Participated in the first major review for EngSci-MI since the major was founded; provided insights and feedback representing student perspectives.	
Engineering Intramurals Soccer Team Captain	2022 – 2025
<i>University of Toronto</i>	<i>Toronto, ON, CA</i>
– Organized team and led Engineering team to win UofT Soccer Intramurals.	
Community Soccer Host	Jul 2024 – Present
<i>GoodRec</i>	<i>Toronto, ON, CA</i>
– Organize weekly community matches; scheduling, safety, and field logistics.	
Junior Team Member	Oct 2019 – Jun 2021
<i>UNICEF Neu-Ulm</i>	<i>Neu-Ulm, Germany</i>
– Supported local youth initiatives and fundraising activities.	