CV: Oliver Richardson

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| oричardson.github.io

SUMMARY

I am a postdoctoral fellow at l'Université de Montréal and Mila, advised by Yoshua Bengio. Everything interests me!—but especially mathematical foundations of agents, knowledge representation, reasoning, and notions of naturality and elegance. I have an unusually broad academic background, and love making pretty things out of math & code. Before getting into research, I made video games.

EDUCATION

PhD in Computer Science (2024)

Cornell University; advised by Joseph Y Halpern. Minor in applied mathematics. Member of the CS Theory, Information Theory, Machine Learning (ML), and Programming Languages (PL) groups. Dissertation: *A Unified Theory of Probabilistic Modeling, Dependence, and Inconsistency.*

MS in Computer Science (2021)

Cornell University; attained during the PhD.

MPhil in Advanced Computer Science (2018)

University of Cambridge. Diagrammatic Reasoning, under Mateja Jamnik.

BS in Biology (Cell & Molecular), Honors BS in Computer Science, BS in Mathematics (2017)

University of Utah.
Minors in Chemistry, Physics, and Cognitive Science. Cumulative GPA: 3.86.

AREAS OF EXPERTISE

Probabilistic Graphical Models, Machine Learning, Information Theory, Causality, Modal Logic, Category Theory, Semantics of Programming Languages, Decision Theory, Approximation Algorithms, Convex Optimization.

SELECTED LEAD-AUTHOR PUBLICATIONS

Learning with Confidence [ORAL @ UAI'25]

Oliver E Richardson. *An axiomatic characterization of a notion of confidence that arises when updating beliefs; unifies concepts such as learning rate, Kalman gain, weight of evidence, inverse temperature.*

Qualitative Mechanism Independence [NEURIPS'24]

Oliver E Richardson, Spencer Peters, Joseph Y Halpern.
A bridge between causality and information theory, via a definition of what it means for a distribution to be compatible with an arbitrary directed hypergraph.

Inference for Probabilistic Dependency Graphs [UAI'23]

Oliver E Richardson, Joseph Y Halpern and Christopher De Sa.
Polynomial inference algorithm for PDGs of bounded treewidth, through exponential conic programming. A linear reduction from PDG inference to the problem of approximating a PDG's degree of inconsistency. (Selected as a Spotlight.)

Loss as the Inconsistency of a PDG: Choose your Model, not your Loss Function [ORAL @ AISTATS'22]

Oliver E Richardson.
A "universal" loss function by measuring the inconsistency of the appropriate PDG. Yields a visual proof language for relationships between learning objectives.

See oрichardson.github.io/research for a full list & links.

WORK EXPERIENCE

Potdoctoral Fellow at l'Université de Montréal 2024—

Working on the foundations of Probabilistic Modeling, under Yoshua Bengio. Member of the CAIA research collaboration between UK ARIA, Oxford, and the U of Singapore.

CIFAR LMB Reporter SPRING 2025

Wrote the report for the April 2025 CIFAR meeting on Learning in Brains and Mahcines.

ML Alignment and Theory Scholars (MATS) Mentor JAN 2026–

Graduate Research Assistant 2018–2025

Graduate Teaching Assistant 2018–2023

for Artificial Intelligence (CS 4700), Reasoning about Uncertainty (CS 6766), Reasoning about Knowledge (CS 6764, 2022), Decision Theory (CS 5846/ECON 6760).

CHAI/BAIR Research Collaborator SUMMER 2021

Exploring metrics for goal-directedness in reward functions, alternate foundations for reward-free reinforcement learning. Investigating stability of RL / IRL loops.

Senior Summer Camp Counselor SUMMER 2017

Developed and lead activities for a leadership-focused camp group at the Jewish Community Center in Salt Lake City. Material for the program included voting mathematics, government simulations, and improv games.

Application Engineer for Canyons School District SUMMER 2016

Maintained district webpages. Built new applications from scratch, and re-wrote others to simplify them. Also made form-building utilities to to simplifty the process of making a front-end portal, and a datatables view independently for each project. Learned both front and back-end web development. (HTML5, CSS, ColdFusion, interface with and set up databases, use JQuery and plugins (e.g. datatables).

Lab Aide at the University of Utah NanoFab 2013–2014

Developed *Judgement Day* Testing Suite 2011

Software developped for Utah School Districts. Allows teachers to create and aminister tests, aggregates data, and has analysis tools. *Features complex question types: diagram drawing, matching, MAZE; supports feedback, and anonymous peer grading.*

Peer-Reviewed Publications

[1] Oliver E Richardson. Loss as the inconsistency of a probabilistic dependency graph: Choose your model, not your loss function. *AISTATS '22*, 151, 2022.

[2] Oliver E Richardson. Learning with confidence. In *Proceedings of the Forty-First Conference on Uncertainty in Artificial Intelligence*, UAI '25. JMLR.org, 2025.

[3] Oliver E Richardson and Joseph Y Halpern. Probabilistic dependency graphs. *AAAI '21*, 2021.

[4] Oliver E Richardson, Joseph Y Halpern, and Christopher De Sa. Inference in probabilistic dependency graphs. *UAI '23*, 2023.

[5] Oliver E Richardson, Spencer Peters, and Joseph Y Halpern. Qualitative mechanism independence. In A. Globerson, L. Mackey, D. Belgrave, A. Fan, U. Paquet, J. Tomczak, and C. Zhang, editors, *Advances in Neural Information Processing Systems*, volume 37, pages 69471–69504. Curran Associates, Inc., 2024.

[6] Mariam Thalos and Oliver Richardson. Capitalization in the st. petersburg game: Why statistical distributions matter. *Politics, Philosophy & Economics*, 13(3):292–313, 2014.

Non-Archival Papers

Superintelligent Agents Pose Catastrophic Risks: Can Scientist AI Offer a Safer Path? *with SAIFH (LawZero) members* — FEBUARY 2025

Yoshua Bengio, Michael Cohen, Damiano Fornasiere, Joumana Ghosn, Pietro Greiner, Matt MacDermott, Sören Mindermann, Adam Oberman, Jesse Richardson, Oliver Richardson, Marc-Antoine Rondeau, Pierre-Luc St-Charles, David Williams-King.
https://arxiv.org/abs/2502.15657

The Local Inconsistency Resolution Algorithm
[PRESENTED AT THE SPIGM AND LLW WORKSHOPS @ ICML'23]

Sole Author. Introduce parameterized PDGs, and a generic algorithm for resolving inconsistency. Show how GANs, message passing, adversairal training, the EM algorithm, and more, are instances of an intuitive approach to resolving inconsistency in parametric PDGs.

Mixture Languages [PRESENTED AT THE LAFI Workshop @ POPL'23]

Co-author: Jialu Bao. An alternate continuous-time notion of concurrency, and a programming language whose semantics are given in such terms.

Complexity & Scale: Understanding the Creative [IACAP'14]

Sole-author student paper, presented at the International Association for Computing and Philosophy conference (IACAP) in Thesaloniki, Greece.

An approach to explaining novelty and creativity based on information theory: integrate (Kolmogorov) complexity of embeddings across scale.

Other Notable Research Projects

[*Masters Thesis*] on Diagrammatic Reasoning *with Mateja Jamnik* — 2017–2018

Title: *Shapes, Proofs, and Programs: A Unified Theory of Diagrammatic Reasoning.* Began as a web portal for DIAMOND, Mateja's diagrammatic reasoning system, but became a theoretical unification of several diagrammatic representations for proofs. I introduce "woven diagrams" as a mixed topological / geometric representation that can be interpreted as programs or proofs.

[*UGrad Thesis*] on Trigonal Tropical Curves *with Aaron Bertram* — '15–'17

A tropical geometry project regarding hypereliptic and trigonal graphs and their divisors; classification of "general" such curves. Showed that the twist of a trigonal curve as a ruled surface is visible from its tropical graph.

Selected Programming Projects

See repositories at http://gitlab.com/zaytuna and http://github.com/orichardson for code and a more complete listing.

- My Website: orichardson.github.io
- Varsha's and My Wedding Website: orichardson.github.io/voli
- For the CS Department at Cornell: The Buddy system, and the anonymous TA Hour reporting systems for collecting data about TA workloads.
- Swipe-based interface for a "retroactive calendar" and analytics
- 3D software renderer and Game Engine with Gouroud and textured pixel-by pixel shading
- Blender-style 3D stick figure animation creator for custom game engine
- Top-down RTS engine with path-finding, dynamic lights, fog of war, particle effects
- 2D rigid-body physics engine, used in a platformer and ice hocky games
- Computer Algebra System
- Reaction/Diffusion Morphogenesis simulations
- Submittal Tracking Software for Stacy Witbeck Co. during internship in conjunction with UTA Trax.
- Graphical Calendar and assignment organizing software / contact book
- 2D games
  - Othello + AI
  - Diabolical Bomb Tetris
  - Slime Volleyball with AI
  - Nano-wars RTS re-imagining (single-player only).
  - Battery-filling Tower Defense Game
  ⋯
- GameJam 2015: *Lingering* – what happens after you beat the final boss?

[*UGrad Thesis*] on Supersense Classification *with Vivek Srikumar* — '16–'17

Improvements upon state-of-the art preposition supersense classification by jointly predicting supersense labels for nouns and verbs; found joint encoding to inform features.

Effect of Representation on Recall *with Sen Cheng* — SUMMER 2016

DAAD RISE (German Exchange) Research Project: simulations regarding the interaction between episodic and semantic memory, in the Cheng Computational Neuroscience lab in Bochum.

Mathematical Neurobiology REU *with Sean Lawley* — 2014–2015

Looked at and made changes to a model of facilitated diffusion along microtubules; also improved upon a system of ODEs designed to capture precise timing in a neural network model, by generalizing it to a continuous neural field and removing the global inhibitory constraint.

Organic Chemistry Game *with Holly Sebahar* — 2014–2015

Java project to replace homework in ochem classes with an automated system. Everything in the game is made of particles, that come together to form different shapes. When objects are far away, they are 'delocalized', and appear like normal game objects, but then re-arrange to form molecules when the player approaches. Project was lost with a bent thumb drive.

AWARDS AND HONORS

January 2025	Best Reviewer Award, AISTATS 2025. (full list of honorees.)
March 2016	DAAD RISE Award *German foreign exchange program research stipend*
March 2016	Putnam Award *Highest Score on the Putnam Exam at the University of Utah*
March 2016	Undergraduate Problem Solving Contest, first place *Local Math Competition at the University of Utah*
September 2016	University of Utah Marshall Scholarship Endorsee
October 2016	University of Utah Churchill Scholarship Endorsee
October 2016	ACM-ICPC, Rocky Mountain regional — second place at site, sixth overall *The International Collegiate Programming Contest is a timed coding challenge with teams of three people. The Rocky Mountain includes the mountain time zone of US and Canada*
March 2015	Intermountain Math Contest, Second Place *Like the Putnam Exam, except slightly easier and local to Utah schools*
April 2015	College of Engineering Computing Faculty Scholarship
March 2015	Susan B. Christianson Memorial Mathematics Scholarship
April 2015	Mathematical Contest in Modeling (MCM) Honorable Mention *The MCM is a four-day-long competition with teams of three people, to write a 20-50 page paper in applied mathematics*
October 2015	ACM-ICPC, Rocky Mountain regional — second place at site, fifth overall
April 2015	College of Engineering Computing Faculty Scholarship
April 2014	Honors College Faculty Scholarship
April 2013	University of Utah Honors at Entrance Award *Awarded for academic achievement in high school, provides full tuition waivers for all 8 semesters at the University of Utah*
2012	SLVSEF Symantec Software Award ($10,000) *First Place Symantec Award at the Salt Lake Valley Science and Engineering Fair, for gesture recognition based on convolutional NNs in the era of decision trees*
2012	First Place in the Utah State Math Contest

SERVICE

Computer Science Graduate Organization (CSGO) Secretary
2020–2022

Secretary of the student government body that advocates for CS graduate student interests and plans events.

Grad Seminar Czar
2019–2024

Organizer for the weekly seminar for CS graduate students at Cornell.

Graduate TA Reporting System
2021–2024

Developed and maintained an anonymous system TA Hour Reporting System for graduate students in the CS department.

Reviewer for CS PhD Applications
2023

Camp Einstein Volunteer
SUMMER 2015

Taught science on the Navajo Reservation to elementary students. For a week, volunteers orchestrate hands-on science experiments using household items.

Science Cohort Mentoing and Tutoring
2013–2016

I lived in a community in which I taught programming and provided tutoring in math, physics, organic chemistry, and computer science.

Reviewing

- NeurIPS 2024, 2025
- AISTATS 2022, 2024, 2025
- ICLR 2025

SOCIETIES & ENGAGEMENT

Cornell University

Secretary for the CSGO (4 terms).
Grad Seminar Organizer (9 terms).

University of Cambridge

Hack Cambridge
Trinity Math Society
Churchill College Football Team
Churchill College Frisbee Team
Cambridge Show Choir

University of Utah

Hack the U
ACM ICPC Programming Competition
U of U Undergrad Problem Solving Contest
Putnam Exam
Global Game Jam
Mathematical Contest in Modeling (MCM)
Philosophy Club
RoboUtes
The Utah Robotic Mining Project

TECHNICAL PROFICIENCIES

Programming Languages:
LaTeX ∗ python ∗ Scala ∗ Java ∗ C++ ∗ C# ∗ HTML/CSS/javascript ∗ OCaml ∗ Lisp

Libraries & Programs:
git ∗ SQL ∗ numpy ∗ sklearn ∗ pytorch ∗ z3 ∗ emacs ∗ gimp ∗ Blender

ASSORTED

Languages: English (obviously). Proficient in French and German. Some training in Hindi, Japanese, and Arabic.

Music: 25 years of improvization, 16 years of formal piano traning. Novice guitarist.

Sports: Soccer, ultimate, racquetball, climbing, skiing, skating, squash, biking.