

Taylor W. Killian

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RESEARCH
INTERESTS

Techniques for efficient and effective *sequential decision making* in the presence of uncertainty: particularly toward improved *robustness* and *generalization*, motivated by real world challenges.

SUBJECT AREAS

- Reinforcement Learning
 - Offline RL
 - Risk-sensitive RL
 - Model-based RL

- Representation Learning
- Causal Inference
- Approximate Bayesian Inference
- Health and Wellness

EDUCATION

Ph.D., Computer Science
University of Toronto, Toronto, ON, Canada

- GPA: 4.0

April 2024

Advisor: Marzyeh Ghassemi
Thesis: Clinically Motivated Sequential Decision Making under Uncertainty in Offline Settings

M.Eng, Computational Science and Engineering
Harvard University, Cambridge, MA

- GPA: 3.92

May 2017

Advisor: Finale Doshi-Velez
Thesis: Robust and Efficient Transfer Learning by Accounting for and Modeling Parameter Variation

BS, Mathematics
Brigham Young University, Provo, Utah

- GPA: 3.83

April 2013

SKILLS AND LANGUAGES

- Python
- Tensorflow, Pytorch, Jax
- LaTeX, MATLAB
- Java, CUDA, C++
- Fluent in Swedish

AWARDS

- ICML, NeurIPS, ICLR: Top Reviewer Award, 2019 - 22
- AAAI, Student Abstract Best Presentation, 2017
- MIT LL Lincoln Scholar, 2015-2017
- NDSEG Fellowship Award, 2013 (Declined)
- SMART Fellowship Finalist, 2011
- BYU ORCA Grant Recipient, 2010

EXPERIENCE

Postdoctoral Research Scientist
Apple Inc., Special Projects Group – Physical Intelligence

- Investigating highly efficient training approaches for RL in large-scale batch training.
- Investigating use of goal-conditioned, context based RL policies for multi-agent RL in self-play.
- Developing solutions for decision-making in partially observed, interactive settings.
- Investigating mechanisms for long-term memory to facilitate better personalization of large-language models.

December 2023 - Present

Graduate Research Assistant**August 2019 - April 2024***Department of Computer Science, University of Toronto & Vector Institute**Institute of Medical Engineering and Science, Massachusetts Institute of Technology*

- Developed robust representations of patient health, incorporating measures of uncertainty
- Introduced method to identify and avoid detrimental decisions in high-risk environments
- Pursued research to enable robust knowledge transfer between healthcare institutions by combining causal inference and reinforcement learning

Research Intern**May 2023 - September 2023***Apple Inc., AI/ML – Health AI**supervised by Nick Foti*

- Developed robust framework to efficiently adapt global recommendation policies, trained from heterogeneous data, to localized individual contexts.
- Instituted wide-reaching research agenda to investigate several avenues with which to integrate novel and contemporary Reinforcement Learning approaches across the Health AI team.

Research Intern**June 2022 - September 2022***Microsoft Research, Health Futures – BioML**supervised by Ava Amini*

- Extended distribution-free uncertainty quantification to continuous-time sequential settings
- Developed mechanism to estimate prediction confidence for irregularly sampled time-series, and guide feature selection for future measurement.

Research Intern**June 2021 - December 2021***Apple Inc., Health AI**supervised by Leon Gatys and Joern-Henrik Jacobsen*

- Explored self-supervised learning for representation of user health via physiological signals
- Established state-of-the-art learning architectures for broader use within the Health AI team
- Served as in-house technical expert on sequential decision making approaches

Student Researcher / Research Intern**May 2020 - December 2020***Google Research, Brain team**supervised by Marlos Machado and Marc Bellemare*

- Investigated the utility of embedding measurements of uncertainty in a Reinforcement Learning agent's state representation
- Executed large scale computational experiments on distributed servers

Teaching Assistant**August 2019 - May 2020***Department of Computer Science, University of Toronto*

- Part of teaching staff for:
 - CSC311 Introduction to Machine Learning
 - CSC2541 Machine Learning for Healthcare
- Developed and administered assignments and exams
- Worked with and instructed students, answering questions about course material
- Coordinated projects with clinical collaborators, organized and advised student groups

Associate Technical Staff**June 2017 - July 2019***Air, Missile and Maritime Defense Technology, MIT Lincoln Laboratory*

- Led effort to identify and develop areas for Laboratory investment in Artificial Intelligence

- Developed ML algorithms for efficient and accurate performance in low-data regimes
- Fused multiple information sources to reduce false-alarms in aviation passenger screening

Assistant Technical Staff

May 2013 - May 2017

Air, Missile and Maritime Defense Technology, MIT Lincoln Laboratory

- Evaluated the impact of technological and operational improvements to U.S. missile defenses
- Developed and performed data-driven analyses to identify U.S. DoD capability improvements
- Produced briefing materials to present to key U.S. DoD decision makers

Undergraduate Research Assistant

June 2010 - May 2013

Department of Mechanical Engineering, Brigham Young University

- Published research on fluid activated passive dampening as primary author
- Trained in methods of applied mathematics partnered with computation in MATLAB
- Furnished analytical and mathematical support to experimental techniques

Office of Naval Research NREIP Intern

Summer 2011

Naval Surface Warfare Center, Dahlgren, Virginia

- Designed and carried out experiment to study optimal nose shape for submerging projectiles
- Presented results to division commanding officers and staff.
- Obtained U.S. Department of Defense security clearance.

Language Instructor (Swedish)

December 2009 - June 2010

Missionary Training Center, Church of Jesus Christ of Latter-day Saints

- Prepared lessons to satisfy language and theological curriculum and individual student needs.
- Counseled with students to overcome individual concerns and problems.
- Instructed and evaluated language fluency and understanding of concepts.

PUBLICATIONS

- Landers, M., **Killian, T.**, Hartvigsen, T., “Deep Reinforcement Learning for Combinatorial Action Spaces Via Branch Value Estimation”. *in Preparation*
- **Killian, T.**, Mazouze, B., Talbott, W., Hjelm, D., Foti, N., “Multi-context Pretraining for Single-Life Adaptive Policies”. *in Preparation*
- **Killian, T.**, Zhang, H., Hartvigsen, T., Amini, A., “Continuous Time Evidential Distributions for Irregular Time Series.”, *arXiv 2307.13503*
- Casper, S., **Killian, T.**, Hadfield-Menell, D., Kreiman, G., “White-Box Adversarial Policies in Deep Reinforcement Learning”. *arXiv 2209.02167*
- **Killian, T.**, Parbhoo, S., Ghassemi, M., “Risk-Sensitive Dead-end Identification in Safety-Critical Offline Reinforcement Learning”, in *Transactions on Machine Learning Research*. January 2023. <https://openreview.net/forum?id=oKlE0T83gI>.
- **Killian, T.**, Ghassemi, M., Joshi, S., “Counterfactually Guided Off-policy Transfer in Clinical Settings”, *Conference on Health, Inference and Learning (CHIL)*. April 2022.
- Fatemi, M., **Killian, T.**, Subramanian, J., Ghassemi, M., “Medical Dead-ends and Learning to Identify High-Risk States and Treatments”, *Advances in Neural Information Processing Systems*. December 2021
- **Killian, T.**, Zhang, H., Subramanian, J., Fatemi, M., Ghassemi, M., “An Empirical Study of Representation Learning for Reinforcement Learning in Healthcare” *Machine Learning for Health Workshop, NeurIPS*, December 2020

- D’Costa, A., Denkovski, S., Malyska, M., Moon, S.Y., Rufino, B., Yang, Z., **Killian, T.**, Ghassemi, M., “Multiple Sclerosis Severity Classification From Clinical Text”, *The 3rd Clinical Natural Language Processing Workshop*, EMNLP 2020.
- **Killian, T.**, Subramanian, J., Fatemi, M., Ghassemi, M., “Learning Representations for Prediction of Next Patient State”, *1st Annual ACM Conference on Health, Inference and Learning*, April 2020. **Workshop Spotlight**
- Silva, A., **Killian, T.**, Jimenez, I., Son, S.-H., Gombolay, M. “Optimization Methods for Interpretable Differentiable Decision Trees Applied to Reinforcement Learning”, *The 23rd International Conference on Artificial Intelligence and Statistics (AISTATS)*, August 2020.
- **Killian, T.**, Goodwin, J., Brown, O. & Son, S.-H., “Kernelized Capsule Networks”, *1st Workshop on Understanding and Improving Generalization in Deep Learning, ICML*, July 2019.
- Yao, J., **Killian, T.**, Konidaris, G. & Doshi-Velez, F., “Direct Policy Transfer via Hidden Parameter Markov Decision Processes”, *The 2nd Lifelong Learning: A Reinforcement Learning Approach Workshop, ICML*, July 2018. **Selected for Oral presentation.**
- Jones, A., **Killian, T.**, Hurley, M., & Allen, R., “Artificial Intelligence and Machine Learning for Decision Support: Recommendations for Investment”, **Technical Report**, MIT Lincoln Laboratory, June 2018. *Paper not available for public release*
- **Killian, T.**, Daulton, S., Konidaris, G. & Doshi-Velez, F., “Robust and Efficient Transfer Learning in Hidden Parameter Markov Decision Processes”, *Advances in Neural Information Processing Systems*. December 2017 **Selected for an Oral presentation**
- **Killian, T.**, Konidaris, G. & Doshi-Velez, F., “Robust and Efficient Transfer Learning in Hidden Parameter Markov Decision Processes.” In *AAAI* (pp. 4949-4950). February 2017.
- **Killian, T.**, Klaus, R. & Truscott, T.T., “Rebound and jet formation of a fluid-filled sphere”, *Physics of Fluids* **24**, 122106 (2012), DOI:10.1063/1.4771985.

INVITED TALKS

- *19 April 2024 – Invited Talk, Stanford University – Brunskill Group*
“Pragmatic, Uncertainty Guided Reinforcement Learning”
- *22 September 2023 – Invited Talk, Brown University – bigAI*
“Pragmatic, Uncertainty Guided Reinforcement Learning”
- *13 September 2023 – Invited Talk, NYU Center of Data Science*
“A Pragmatic View of Offline Reinforcement Learning in Safety-Critical Scenarios”
- *22 August 2023 – Invited Talk, Distributional RL Book Launch, MILA*
“Distributional RL for Safety-Critical Offline Settings”
- *20 April 2023 – Invited Talk, Apple, Health AI*
“A Pragmatic View of Reinforcement Learning in Healthcare”
- *2 December 2022 – Invited Talk, NeurIPS 2022 Offline RL Workshop*
“Identification of Dead-ends in Safety-Critical Offline RL”
- *17 November 2022 – Guest Lecture, MIT 6.7950 – RL: Foundations And Methods*
“Context Matters: Leveraging Latent Information to Solve Families of MDPs”
- *10 July 2020 – Invited Talk, Vector Institute Friday Seminar (virtual)*
“Counterfactually Guided Policy Transfer in Clinical Settings”
- *20 February 2020 – Guest Lecture, UofToronto CSC 2541 – ML for Healthcare*
“Reinforcement Learning for Healthcare”
- *18 October 2017 – Guest Lecture, Harvard CS 282R – RL for Healthcare*
“Unwinding the DQN: Tips and Tricks”

- *12 June 2017 – Invited Talk, SMG: Boston, Site Visit*
“Experiences with Computational Science at Harvard”
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Program Committee/Reviewer

- **ICML:** 2019-Present
- **NeurIPS:** 2018-Present
- **CHIL:** 2020-Present
- **ICLR:** 2020-Present
- **TMLR:** 2022-Present
- **JMLR:** 2021-Present
- **NeurIPS ML4H Workshop:** 2017-Present
- **NeurIPS Offline RL Workshop:** 2020-Present
- **NeurIPS Deep RL Workshop:** 2020-Present
- **RLC:** 2023-Present

Organization Committee – 2024 RLC Workshops**2024**

“I Can’t Believe It’s Not Better!”: Failure Modes of Sequential Decision-Making in Practice
Finding the Frame: An RLC Workshop for Examining Conceptual Frameworks in RL

- Helped develop the successful proposal of two workshops for the inaugural RL Conference.
- Led ideation and writing of proposals, each focusing on unique points of failure in current research practices in RL
 - First, looking into ideas/concepts that do not scale or otherwise transfer from simulated, toy domains to real-world practice.
 - Second, identifying problematic dogmas in conceptual frameworks for RL and encouraging alternative formulations to unlock new algorithmic capabilities or intended use cases.

Virtualization Chair**2021-2022**

Machine Learning for Healthcare Symposium

- Helped lead the development of a standalone symposium, co-located with NeurIPS, in response to growth in interest among the research community
- Led the planning and execution of both a fully virtual event (2021) and hybrid hosting (2022)

Technical Recruiter, Campus Recruiting**December 2014 - July 2019**

Human Resources, MIT Lincoln Laboratory

- Organized campus information events to introduce Laboratory mission and aims
- Served as mentor and advocate for candidates seeking employment

Committee Member; PED Seminar Series**June 2015 - December 2017**

MIT Lincoln Laboratory

- Assisted in the organization and planning of seminar series focused on leveraging modern computation techniques to extract actionable insight
- Hosted leading researchers in Machine Learning and Artificial Intelligence

President, Student Advisory Committee**January 2011-December 2011**

Department of Mathematics, Brigham Young University

- Led effort to improve curriculum and increase collaboration between students and faculty.
- Planned and carried out activities to promote mathematics and educate BYU community.

Missionary, Sweden Stockholm Mission**March 2007 - March 2009**

The Church of Jesus Christ of Latter-day Saints

- Managed and oversaw the work and safety of 12 other missionaries in remote areas of Sweden.
- Trained 6 newly arrived missionaries in language, culture, and proselyting skills.
- Served full-time as a church representative identifying and meeting the needs of the community.