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

Education

Ph.D., Computer Science **Expected Fall 2023**
University of Toronto, Toronto, ON, Canada
- GPA: 4.0

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

M.Eng, Computational Science and Engineering **May 2017**
Harvard University, Cambridge, MA
- GPA: 3.92

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

BS, Mathematics **April 2013**
Brigham Young University, Provo, Utah
- GPA: 3.83

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

Publications

- **Killian, T.**, Chua, I., Ghassemi, M., "Mitigating Risks in Precision Supportive Care in Oncology through Dead-end Discovery". *in Preparation*
- **Killian, T.**, Parbhoo, S., Kanjilal, S., Ghassemi, M., "Disambiguating risk profiles between Septic and Acutely Hypotensive Patients". *in Preparation*
- Jeong, H., Nayak, S., **Killian, T.**, Kanjilal, S., Ghassemi, M., "Identifying Disparities in Sepsis Treatment by Learning the Expert Policy". *in Preparation*
- Hulkund, N., Suriyakumar, V., **Killian, T.**, Ghassemi, M., "Improving Robustness to Distribution Shift with Differential Privacy", *In Preparation.*

- **Killian, T.**, Zhang, H., Hartvigsen, T., Amini, A., "Continuous Time Evidential Distributions for Irregular Time Series.", *in Submission*
- Casper, S., **Killian, T.**, Hadfield-Menell, D., Kreiman, G., "White-Box Adversarial Policies in Deep Reinforcement Learning". *in Submission*
- Zhang, H., **Killian, T.**, Hartvigsen, T., Ghassemi, M., "Active Feature Selection in Time Series with Optimal Early Stopping". *in Submission*
- **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=oKlEOT83gI.
- **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

- *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"

Experience

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

- Developing robust representations of patient health, incorporating measures of uncertainty
- Investigating approaches to identify and avoid detrimental treatment decisions in high-risk clinical environments
- Pursuing research to enable robust knowledge transfer between healthcare institutions by combining causal inference and reinforcement learning
- Supervising junior students for research projects focused on Reinforcement Learning

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

- Extended distribution-free uncertainty quantification approaches 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 utility of self-supervised learning for representation of user health via measured 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.

Volunteer

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
- **AAAI**: 2018

Virtualization Chair **2021-Present**
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.