# Taylor W. Killian

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## Research Interests

Computational and mathematical strategies for efficient and effective *decision making* in the presence of uncertainty: particularly in the use of *transfer learning* within *causal inference*, *reinforcement learning* and *healthcare*.

## Education

**Ph.D., Computer Science** **Expected June 2023**
*University of Toronto*, Toronto, ON, Canada

*Advisor:* Marzyeh Ghassemi

**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

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## Skills and Languages

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

## Awards

- ICML, Top Reviewer Award, 2019
- 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

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## Experience

**Graduate Research Assistant** **August 2019 - present**
*Department of Computer Science, University of Toronto & Vector Institute*

- Participating in clinical collaborations with St. Michael's Hospital
- Investigating approaches to identify and overcome 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

**Teaching Assistant** **August 2019 - present**
*Department of Computer Science, University of Toronto*
- Part of teaching staff for: CSC311 Introduction to Machine Learning, CSC2541: Machine Learning in Healthcare
- Developed and administered assignments and exams as well as coordinated and advised student's final projects
- Worked with and instructed students, answering questions about course material

**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

**Undergraduate Research Assistant** **June 2010 - May 2013**
*Department of Mechanical Engineering, Brigham Young University*

- Published research on fluid activated passive dampening as primary author
- Furnished analytical and mathematical support to experimental techniques

**Office of Naval Research NREIP Intern** **Summer 2011**
*Naval Surface Warfare Center, Dahlgren, Virginia*

**Language Instructor (Swedish)** **December 2009 - June 2010**
*Missionary Training Center, Church of Jesus Christ of Latter-day Saints*

## Volunteer

**Program Committee/Reviewer**
*AAAI 2018, NeurIPS ML4H Workshop 2017-Present, ICML 2019-Present, NeurIPS 2019*

**Technical Recruiter, Campus Recruiting** **December 2014 - July 2019**
*Human Resources, MIT Lincoln Laboratory*

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

**Missionary, Sweden Stockholm Mission** **March 2007 - March 2009**
*The Church of Jesus Christ of Latter-day Saints*

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## Publications

- Silva, A., Gombolay, M., **Killian, T.**, Jimenez, I., Son, S.-H., "Optimization Methods for Interpretable Differentiable Decision Trees Applied to Reinforcement Learning", *To Appear, June 2020 The 23rd International Conference on Artificial Intelligence and Statistics (AISTATS)*
- **Killian, T.**, Futoma, J., Oberst, M., Tennennholtz, G., Gottesman, O., Joshi, S., Parbhoo, S., Prasad, N., Pitis, S., Madras, D., Creager, E., Wang, Y., Ghassemi, M., d'Amour, A., Doshi-Velez, F., Shalit, U., Murphy, S., "A Survey of Connections between Reinforcement Learning and Causal Inference (v1.0)", **2019** *in preparation*
- **Killian, T.**, Ghassemi, M., Joshi, S., "Counterfactual Policy Transfer", **2019** *in preparation*
- **Killian, T.**, Ng, N., Ghassemi, M., "Demystifying Clinical Multi-Objective Decision Processes via Grounded Language Learning", **2019.** *in preparation*
- **Killian, T.**, Subramanian, J., Fatemi, M., Ghassemi, M., "Evaluation of Patient State Embedding Models", **2019.** *in preparation*
- **Killian, T.**, Goodwin, J., Brown, O. & Son, S-H., "Kernelized Capsule Networks", *1st Workshop on Understanding and Improving Generalization in Deep Learning*, ICML 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*, FAIM 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. 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 (pp. 6245-6250). (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). (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.

Pre-prints

- Rodriguez, I., **Killian, T.**, Son, H-S. & Gombolay, M., "Interpretable Reinforcement Learning via Differentiable Decision Trees", arXiv preprint arXiv:1903.09338. (2019).
- Goodwin, J., Brown, O., **Killian T.**, & Son, H-S., "Learning Robust Representations in Active Sensing", arXiv preprint arXiv:1811.10714. (2018).
- **Killian. T.**, Konidaris, G. & Doshi-Velez F., "Transfer Learning Across Patient Variations with Hidden Parameter Markov Decision Processes." arXiv preprint arXiv:1612.00475. (2016).

Presentations

- 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*, FAIM 2018.
- **Killian. T.**, Daulton, S., Konidaris, G. & Doshi-Velez, F., "Robust and Efficient Transfer Learning using Hidden Parameter Markov Decision Processes." *NIPS 2017.* Long Beach, CA. December 6, 2017. **Oral presentation in the RL, Algorithms and Applications session**
- **Killian. T.**, Doshi-Velez, F. & Konidaris, G., "Robust and Efficient Transfer Learning using Hidden Parameter Markov Decision Processes." *31st AAAI Conference.* San Francisco, CA. February 7, 2017.
- **Killian. T.**, & Doshi-Velez, F., "Accounting for Patient Variation when Predicting Effective Treatment Policies." *MIT Lincoln Laboratory PED Seminar Series.* Lexington, MA. July 12, 2016.
- **Killian. T.**, Bryson, J., Bird, JC., Huey, J., Truscott, T.T., "Self Healing Soap Films." *65th Annual Meeting of the American Physical Society Division of Fluid Dynamics.* San Diego, CA. November 21-23, 2012.
- **Killian. T.**, Klaus, R. & Truscott, T.T., "Harnessing sloshing as a passive dampener." *64th Annual Meeting of the American Physical Society Division of Fluid Dynamics.* Baltimore, MD. November 20-22, 2011.
- **Killian. T.**, Klaus, R. & Truscott, T.T. , "Sphere rebound suppression from sloshing," *75th Annual Meeting of the American Physical Society.* Dallas, TX. March 2011.

## Posters/Videos

- [Poster] **Killian, T.**, Goodwin, J., Brown, O. & Son, S-H., "Kernelized Capsule Networks", *1st Workshop on Understanding and Improving Generalization in Deep Learning*, ICML 2019.
- [Poster] 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*, FAIM 2018.
- [Poster] **Killian. T.**, Daulton, S., Konidaris, G. & Doshi-Velez, F., "Robust and Efficient Transfer Learning using Hidden Parameter Markov Decision Processes." *NIPS 2017.* Long Beach, CA. December 6, 2017.
- [Poster] **Killian. T.**, Konidaris, G. & Doshi-Velez, F., "Robust and Effective Transfer Learning using Hidden Parameter Markov Decision Processes." *31st AAAI Conference.* San Francisco, CA. February 7, 2017
- [Poster] **Killian. T.**, Konidaris, G. & Doshi-Velez, F., "Transfer Learning Across Patient Variations with Hidden Parameter Markov Decision Processes." *NIPS Workshop on Machine Learning for Healthcare.* Barcelona, Spain. December 9, 2016.
- [Poster] **Killian. T.**, & Doshi-Velez, F., "Accounting for Patient Variation in the Development of Optimal Treatment Policies." *2nd Annual Harvard IACS Project Showcase.* Cambridge, MA. May 10, 2016.
- [Poster] **Killian. T.**, Hanus, D., & Doshi-Velez, F., "Inferring missing data & accounting for patient variation to predict effective HIV treaments." *5th Annual New England Machine Learning Day.* Cambridge, MA. May 6, 2016.
- [Video] **Killian. T.**, Huey, J., Bryson, J., & Truscott, T.T., "Self healing soap films," *65th Annual Meeting of the American Physical Society Division of Fluid Dynamics.* San Diego, CA. November 18-20, 2012. **http://arxiv.org/abs/1210.3797**
- [Poster] Jafek, A., Langley, K., **Killian. T.** & Truscott, T.T., "Bouncing in puddles," *64th Annual Meeting of the American Physical Society Division of Fluid Dynamics.* Baltimore, MD. November 20-22, 2011.
- [Poster] Klaus, R., **Killian. T.** & Truscott, T.T., "Sphere rebound suppression from sloshing," *63rd Annual Meeting of the American Physical Society Division of Fluid Dynamics.* Long Beach, CA. Nov 2010.

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## Projects

- **Weighted k-Centers, Optimal Facility Location** Using 2010 US Census data for the state of Massachusetts, we augmented Metric k-centers and Lloyd's algorithms to optimally place a constrained number of distribution centers. https://github.com/twkillian/am205-project
- **Stochastic Inference of Boston Bike-share Data** With data from the Hubway bike-sharing system from the 2012 season, we performed second order analyses to develop intuition about how to augment or improve the system. https://github.com/am207Hubway
- **Two-Stage Supermodular Minimization for Dictionary Selection** Developed preliminary approaches to solve dictionary selection under a supermodular assumption.
- **Automated Anomaly Detection in Surveillance Video** Attempted to provide real-time processing and identification of anomalous behavior in surveillance video, utilizing contemporary methods of parallel computing. https://github.com/cs205-surveillance
- **Quantitative Evaluation of Player Performance** Evaluated the transfer market of international soccer and the perception of player value. Developed a merit-based scoring metric, used to measure player impact in matches they participated in. This impact score was used to infer what value they would have on the transfer market. https://github.com/cs109-FIFA

- **Contextual Bandits in Highly Dynamic Non-stationary Environments** Developed a novel environment with non-stationary rewards and evaluated the performance of Thompson sampling and other basic algorithms for contextual bandits. https://github.com/twkillian/nonstationary_contextual_bandits