

# Matthew Schlegel

Affiliation: University of Alberta • E-Mail: [mkschleg@gmail.com](mailto:mkschleg@gmail.com) • Website: [mkschleg.github.io](https://mkschleg.github.io) • Updated: Aug, 2022

## Education

<b>University of Alberta</b> – Edmonton, Alberta, CA PhD in Computing Science	Present
<b>Indiana University</b> – Bloomington, IN Master of Science in Computer Science	May 2017
<b>Indiana University</b> – Bloomington, IN Bachelor of Science in Physics with Distinction Minors: Computer Science, Math, Music	May 2015

## Publications

### Journal

General Value Function Networks. **Matthew Schlegel**, Andrew Jacobsen, Andrew Patterson, Zaheer Abbas, Adam White, Martha White. Journal of Artificial Intelligence Research (JAIR). 2021.

### Conference

Continual Auxiliary Task Learning. Matthew K. McLeod, Chunlok Lo, **Matthew Schlegel**, Andrew Jacobsen, Raksha Kumaraswamy, Adam White, Martha White. Neural Information Processing System Conference (NeurIPS). 2021.

Structural Credit Assignment in Neural Networks using Reinforcement Learning. Dhawal Gupta, Gabor Mihucz, **Matthew Schlegel**, James E. Kostas, Philip S. Thomas, Martha White. Neural Information Processing System Conference (NeurIPS). 2021.

Importance Resampling for Off-Policy Prediction. **Matthew Schlegel**, Wesley Chung, Jian Qiang, Daniel Graves, Martha White. Neural Information Processing System Conference (NeurIPS). 2019.

Meta-descent for online, continual prediction. Andrew Jacobsen, **Matthew Schlegel**, Cameron Linke, Martha White, Adam White. AAAI Conference on Artificial Intelligence. 2019.

Context-dependent upper-confidence bounds for directed exploration. Raksha Kumaraswamy, **Matthew Schlegel**, Adam White, Martha White. Neural Information Processing System Conference (NeurIPS). 2018.

Adapting kernel representations online using submodular maximization. **Matthew Schlegel**, Yangchen Pan, Jiecao Chen, Martha White. International Conference on Machine Learning (ICML). 2017.

### Workshop

Predictions predicting predictions. **Matthew Schlegel**, Martha White. The Multi-disciplinary Conference on Reinforcement Learning and Decision Making, 2022.

A Baseline of Discovery for General Value Function Networks under Partial Observability. **Matthew Schlegel**, Adam White, Martha White. Reinforcement Learning under Partial Observability Workshop at NeurIPS. 2018.

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Stable predictive representations with general value functions for continual learning. **Matthew Schlegel**, Adam White, Martha White. Continual Learning and Deep Networks workshop at NeurIPS. 2016.

## Awards

### Grants

IVADO PhD Excellence Scholarship (\$100k)	2019-2023
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### Other Awards

Runner up for Early PhD Achievement Award	2018
University of Alberta Doctoral Recruitment Award (\$10k)	2017-2018
CL&DNs Workshop NeurIPS student travel award	2017
Dean's List (9 Semesters)	2010-2015
Founders Scholar (4 Semesters)	2011, 2012
John Philip Sousa Band Award	2010

## Research Experience

<b>BorealisAI</b> – Research Intern	September 2021 – December 2021
<b>University of Alberta</b> – Research Assistant	January 2019 – Present
<b>Huawei</b> – Research Intern	May 2018 – September 2018
<b>University of Alberta</b> – Research Assistant	August 2017 – May 2018
<b>Indiana University</b> – Research Assistant	May 2016 – July 2017

## Teaching Experience

CMPUT 397: Reinforcement Learning University of Alberta - Teaching Assistant	Fall 2020
CMPUT 466/551: Machine Learning University of Alberta - Teaching Assistant	Fall 2018, Fall 2019
CSCI B659: Reinforcement Learning Indiana University - Teaching Assistant	Spring 2017
CSCI C335: Computer Structures Indiana University - Teaching Assistant	Spring 2017
BIO L111: Foundations of Biology Indiana University - Teaching Assistant	Fall 2014

## Course Development

CMPUT 396: Machine Learning - Intermediate University of Alberta	Fall 2021
<ul style="list-style-type: none"><li>Helped develop course objectives and assignments (written and coding).</li></ul>	
CMPUT 267: Machine Learning - Basics University of Alberta	Fall 2021
<ul style="list-style-type: none"><li>Rewrote assignments.</li></ul>	

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## Presentations and Posters

### Conferences (Posters)

IJCAI	2021
NeurIPS	2019, 2021
AAAI	2019

**Tea Time Talk** — University of Alberta (RLAI) 2018, 2019, 2020, 2021

**Barbados Workshop on Reinforcement Learning** 2019

**Cognitive Neuroscience Seminar Series** 2019

**Startup Edmonton** - Talk November 14, 2018

- Presented to a non-technical audience on the formulation and use of General Value Functions focusing on work done in the University of Alberta's RLAI and BLINC labs.

**Deep Learning Reinforcement Learning Summer School** — Poster Summer 2018

- Presented a poster on the General Value Function Networks. See recent publications for more information.

## Community

**AI4Good Lab** — Lecture 2021, 2022

- Lectured on several topics: Markov decision processes, dynamic programming, value functions, Monte Carlo methods, and temporal-difference learning.

**ICLR Reviewer Mentorship Program** 2021

- Participated as a mentor for the ICLR (2022) reviewer mentorship program. Provided advice and comments for new reviewers.

**Making Minds Reading Group** July 2018 - January 2021

- Organized and planned the University of Alberta's "Making Minds Reading Group" (MMRG).

**Reinforcement Learning NeurIPS Social** 2019

- On the organizing committee for the first reinforcement learning social hosted at the International Conference for Neural and Information Processing Systems.
- Found sponsorship, planned event, managed relationship with the convention center.

**Indiana University** – Diversity and Inclusion Workshop Leader September 2015 – May 2017

- Create and present workshops, and other events to influence an inclusive environment within the School of Informatics and Computing as a part of the group Promoting Inclusion in Technology (PIT).

**Institute for International Business** – Program Assistant Summer 2014 and 2015

- Acted as a counselor for the Institute's flagship Global Social Entrepreneurship Institute. This 5-week immersive business, sponsored by the US State Department, targeted European University Students.

## Reviewing Experience

### Journals

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JMLR

TMLR

## Conferences

AAAI (2019, 2020, 2021)

AISTATS (2022)

COLLAs (2022)

ICLR (2019, 2020, 2021)

ICML (2019, 2021)

NeurIPS (2019, 2020, 2021)

## Workshops

Self-supervision for Reinforcement Learning, ICLR (2021)

Reproducibility Challenge, ICLR (2021, 2022)

Biological and Artificial Reinforcement Learning, NeurIPS (2019)

Optimization Foundations in Reinforcement Learning, NeurIPS (2019)

## Research Interests

### Predictions as cognition

I am keenly interested in the relationship of prior work in predictive cognition in the brain and current research in reinforcement learning, specifically the use and learning of general value functions (GVFs) as the fundamental building blocks of cognition. While predictions can be interesting on their own, my primary interest is in how predictions effect behavior. This can be through introspection (see “Continual Auxiliary Task Learning”), or representation/state building (see “General Value Function Networks”). The core posit is that prediction is a key aspect of cognition, and incorporating temporal prediction into our current architectures (primarily focused on observational inference) can lead to better reinforcement learning agents.

### Reinforcement Learning under Partial Observability

The deep learning revolution transformed reinforcement learning in many ways, leading to a wide set of problems on which RL algorithms can be applied. While many of these domains have been fully observable (or treated as such), partial observability can still pose problems when the domain isn't episodic and the length of temporal dependencies are unknown. In this setting, I believe a combination of predictive (see GVFNs) and postdictive (typically RNNs/Traces) to be the most promising approach. I am currently working to bring the two together in novel architectures.

### Off-policy Policy Evaluation

To learn many predictions online, it is beneficial to learn about behaviors which are not currently being followed, this is where off-policy policy evaluation comes in. The main contribution of this line of work has been the importance resampling algorithm, which manages to empirically reduce variance in many scenarios without interjecting significant bias or computation requirements, like VTrace or Weighted Importance Sampling respectively. I also have interests in understanding how RMSProp/AMSGrad type learning rate adaptation

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algorithms interact with off-policy learning, and in extending importance resampling to the case of many value functions with a shared representation.

## Discovery in Predictive Representations

Representations built from predictions (and really all methods using predictions to effect behavior) all face a common hurdle, the discovery problem. This is the creation and learning of useful predictions in an online process. My current work focuses on defining the base aspects of the problem, and describing a general framework to do discovery. This leads in two directions. The first is describing an ontology, or an ordering, of general value function question specification to be able to generate a diverse set of questions. The second is in credit assignment or the usefulness of a prediction in driving behavior.

## Technical Skills

- Proficient in several languages including Julia, Python, C/C++, R, Bash scripting, and others; with experience using various build environments including make, and cmake.
- Hands on experience with several machine learning, linear algebra, and miscellaneous libraries including Flux, Pytorch, Tensorflow, Eigen, SDL, and GNU Scientific Library.
- Demonstrated capabilities in writing and communication through published works, and several teaching and leadership experiences.