Trevor McInroe

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Education

MS in Data Science, Artificial Intelligence 2019 – 2022 (expected)
Northwestern University *GPA: 4.0/4.0*
Thesis: Representation Learning for Data-Efficient Deep Reinforcement Learning
Relevant coursework: Intelligent Systems and Robotics, Computer Vision, Artificial Intelligence

BBA in Economics 2014 – 2017
University of North Texas *GPA: 3.62/4.0, Major GPA: 4.0/4.0*
Relevant coursework: Data Analysis, Statistics, Calculus

Exploratory Major 2011 – 2013
Oral Roberts University
Recruited for the university golf team

Research Interest

I am interested in solving the challenges of applying reinforcement learning to real-world systems. These challenges include data efficiency, representation learning in high-dimensional state spaces, skill generalization, and planning. I believe that the successful development of real-world reinforcement learning can positively impact many areas like agriculture, disaster management, and autonomous transportation systems.

Research Experience

Visiting Researcher 2021 – Present
Autonomous Agents Research Group, University of Edinburgh
- Researching state abstractions for reinforcement learning via representation learning.
- Researching sample efficiency in multi-agent settings via learning to share parameters.
- Producing a conference paper and a journal paper.

Master's Thesis 2021 – Present
Northwestern University
- Research on self-supervised representation learning methods to improve the data efficiency of deep reinforcement learning algorithms.

Peer Reviewing Experience

Reviewer
- International Conference on Autonomous Agents and Multiagent Systems (AAMAS) 2022

Research Papers

★**McInroe, Trevor**, Lukas Schäfer, Stefano V. Albrecht. 2021. "Learning Temporally-Consistent Representations for Data-Efficient Reinforcement Learning". arXiv:2110.04935

Development of representation learning method, k-Step Latent, that produces state-of-the-art results in the PlaNet benchmark suite. Also, a thorough analysis and comparison of latent representations and encoders produced by various methods from the literature.

Research Projects

Master's Thesis: Representation Learning for Data-Efficient Deep Reinforcement Learning 2021
Sought to answer the question: "What makes a latent representation useful for reinforcement learning?" Explored this question within the context of learning continuous control on pixels. Determined that current methods treat this problem as a computer vision task instead of leveraging the sequential nature of reinforcement learning. Ultimately developed a representation learning method that exploits the temporal axis of the underlying Markov decision process.

Scaling Multi-Agent Reinforcement Learning with Selective Parameter Sharing 2021
Filippos Christianos, **Trevor McInroe**, Stefano V. Albrecht. *in progress.* "Scaling Multi-Agent Reinforcement Learning with Selective Parameter Sharing"

Before my involvement, a previous version of the paper was published at ICML. Dr. Albrecht invited me to extend the ICML paper for journal submission via including further experiments and analysis. My contributions to the paper include designing and implementing a custom cooperative multi-agent environment, implementing multi-agent algorithms that were not present in the ICML version of the codebase, and managing hyperparameter sweeps.

Analyzing the Hidden Activations of Deep Policy Networks: Why Representation Matters 2021
McInroe, Trevor, Michael Spurrier, Jennifer Sieber, and Stephen Conneely. 2021. "Analyzing the Hidden Activations of Deep Policy Networks: Why Representation Matters".

Analyzed the hidden activations of policy networks and revealed patterns that show how deep reinforcement learning agents learn to organize their internal representations. Performed a systematic study across agents that learn in high-dimensional space and agents that learn on latent representations from auxiliary models.

Removing Rain from Images with Densely-Connected Convolutional Networks 2020
McInroe, Trevor, Toshikazu Tanaka. 2020. "Removing Rain from Images with Densely-Connected Convolutional Networks". Published via Toyota's internal review process.

Designed and implemented a convolutional encoder-decoder with novel "block" structure that exploits both high-level and fine-grained information in images. The model improved the performance of downstream classification and detection models across a multitude of tasks. Short form of paper available upon request.

Anomaly Detection Algorithm for Updating High-Definition Maps 2020
Developed a system that ingests high-dimensional telemetry data and performs anomaly detection on driver behavior via seasonal and driver-profile distance matrices. System is currently being tested to support HD maps used by autonomous vehicles. Paper and code belong to funder, Toyota.

Creating Web Ads with Inverse Reinforcement Learning 2019
Designed an algorithm based on inverse reinforcement learning to learn expert's policy on shot-by-shot video characteristics. Once deployed, agent constructed various 30 second ads by drawing from a pool of one second video clips. Paper and code belong to funder, Keurig Dr Pepper.

Industry Experience

Machine Learning Engineer 2020 – Present
Toyota Connected North America Plano, TX, USA

- Novel research and implementation of state-of-the-art models in computer vision and reinforcement learning.
- Development of algorithms and models to assist autonomous vehicles.
- Implementation of learning algorithms that are suitable for edge-compute devices, such as those that can run on real-time data streams from autonomous vehicles.

Analyst 2017 – 2020
Quadratic Insights Dallas, TX, USA

- Developed an in-house reinforcement learning library for the team to meet specific needs of given projects.
- Developed mathematical learning models that solved problems such as real estate selection for nonprofits and optimizing ad buys across time, geography, and channel for international banks.

Relevant Coursework

Intelligent Systems and Robotics

- Used deep reinforcement learning to train movement and grasping policies of a simulation-based KUKA robotic arm.

Computer Vision

- Trained and deployed a convolutional model onto a hexapod robot that maps visual instructions from a human operator to robotic movements.

Optimization

- Studied and implemented optimization algorithms such as linear, nonlinear, multi-objective, and metaheuristic.

Mathematics

- Studied mathematics relevant to machine learning research, such as calculus, linear algebra, probability theory, and statistics.

Honors and Awards

President's List (x2)

- Perfect GPA (4.0/4.0) within a semester when at least 12 hours (4 courses) are taken; received twice during undergraduate studies.

Dean's List, Honor Roll (x4)

- GPA of at least 3.5/4.0 within a semester when at least 12 hours (4 courses) are taken; received four times during undergraduate studies.

Perfect GPA (4.0/4.0) in Master's program

- Maintained through 11 graduate courses at Northwestern University.

Technical Skills

Languages: Python, R, C++, Rust

Frameworks: PyTorch, TensorFlow, NumPy

Reinforcement learning libraries: Gym, PettingZoo, Unity ML-Agents, SuperSuit, Stable Baselines

Physics engines: MuJoCo, PyBullet, Brax

Developer tools: Git, Anaconda, Jupyter

Research tools: LaTeX, Overleaf, Zotero, Mendeley

Academic References

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Dr. Alianna Maren
Faculty Member, Northwestern University
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