

# Joshua Zhanson

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## Education

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**Carnegie Mellon University** School of Computer Science

Master of Language Technologies

QPA: 3.74/4.00

Advisor: Yonatan Bisk

Supported by **NSF Graduate Research Fellowship**

*Pittsburgh, PA*

*August 2022*

**Carnegie Mellon University** School of Computer Science

Bachelor of Science in Computer Science, Minor in Machine Learning

QPA: 3.95/4.00

Dean's List: Fall 2016 - Spring 2019

College & University Honors

*Pittsburgh, PA*

*May 2020*

Senior thesis: [\*Investigating and Robustifying Proximal Policy Optimization\*](#)

Advised by Emilio Parisotto, Adarsh Prasad, and Ruslan Salakhutdinov

## Research Projects

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### Learning Visual Representations through Embodied Interaction Exploration

*August 2020 - Present*

- Created Find One and Interaction Exploration environments in **Python** built on AI2THOR interactive embodied household robotics simulator to explore visual representation learning through embodiment
- Designed customizable ResNet visual encoders and LSTM policy model architectures in **Pytorch** for control with pixel inputs and outputs
- Implemented custom variants of reinforcement learning algorithms Advantage Actor-Critic and Proximal Policy Optimization with hogwild asynchronous multiprocessing training to allow running 8+ parallel environments
- Built multiprocessing autoencoder baseline, supervised topline, and visual probe experiment pipeline to evaluate quality of learned representations on datasets with 2M+ images generated from different heuristic agent policies in AI2THOR simulator

### [\*On Proximal Policy Optimization's Heavy-tailed Gradients\*](#)

*August 2019 - May 2020*

- Integrated gradient estimators from robust statistics into Advantage Actor-Critic and Proximal Policy Optimization deep reinforcement learning algorithms in **Python** and **Pytorch**
- Evaluated effect of different optimization heuristics on heavy-tailedness of policy gradient and likelihood ratio distributions throughout a training epoch using alpha-index estimator from robust statistics
- Discovered severe heavy-tailedness in off-policy gradients ( $\alpha \approx 1.0$ ) and likelihood ratios ( $\alpha \approx 1.2$ ) taken on same batch of data, prompting a reevaluation of the policy gradient reinforcement learning paradigm
- Accepted to **ICML 2021**

### [\*Proprioceptive Spatial Representations for Generalized Locomotion\*](#)

*June 2018 - July 2019*

- Developed JSONWalker environment for robot locomotion and GUI editor with **Python** to allow users to easily construct complex robot bodies in box2d physics simulator
- Wrote scripts in **Python** to randomly construct robot bodies and create datasets of 300 unique robot bodies
- Trained **PyTorch** convolutional models for control using a grid-based proprioceptive robot body state, outperforming baseline models by 20% success rate and solved 9% more unseen robot body configurations
- Accepted to **Workshop on Structure & Priors in Reinforcement Learning** at **ICLR 2019**

## Employment

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**Merit International, Inc.** (formerly Sigma Accolade, Inc.)

Software Engineer Intern

*Millbrae, CA*

*May 2018 - August 2018*

- Implemented a feature to allow organizations to prevent duplicate certifications issued to the same user by adding **React** components in **JavaScript** linked to the **Scala** backend with as-you-type **GraphQL** mutations and queries and **Cats** type abstractions for error handling and threading back-end errors to frontend UI

## Skills

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**Languages:** Python ~ C/C++ ~ Javascript ~ Scala ~ Standard ML ~ Java ~ Bash ~ Swift

**Technologies:** Pytorch ~ Tensorflow/Keras ~ OpenCV ~ Numpy ~ Pandas ~ Matplotlib/Seaborn ~ Docker ~ Git ~ React ~ GraphQL ~ Typelevel.Cats