Keiran Paster

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Interests

I am a PhD Student at the University of Toronto supervised by **Sheila McIlraith** and **Jimmy Ba**. My research interests are in the intersection of decision-making and sequence modeling. In particular, can the same approaches used for ChatGPT and image captioning be used to *plan*, *act*, and *reason*? My research has focused on the relationship between prediction and decision-making, ways in which sequence models fall behind other techniques such as reinforcement learning, and how to improve their performance so that they can surpass the performance of the data they are trained on and eventually contribute positively to human capability and knowledge.

Education

University of Toronto **Sep. 2019 – Present**
PhD Student in Computer Science - GPA 4.0 - Projected Graduation: 2024 *Toronto, ON*

University of California, Berkeley **Sep. 2015 – May 2019**
B.S. In Electrical Engineering and Computer Science - GPA 3.907 *Berkeley, CA*

John Burroughs High School **Sep. 2011 – May 2015**
Salutatorian, GPA: 4.7 *Burbank, CA*

Publications

STEVE-1: A Generative Model for Text-to-Behavior in Minecraft
Shalev Lifshitz*, **Keiran Paster***, Harris Chan, Jimmy Ba, Sheila McIlraith
Under Review. Preprint: (https://arxiv.org/abs/2306.00937)

Large Language Models are Human-Level Prompt Engineers
Yongchao Zhou*, Andrei Ioan Muresanu*, Ziwen Han*, **Keiran Paster**, Silviu Pitis, Harris Chan, Jimmy Ba
Poster at ICLR 2023.
Presented at the Foundation Models for Decision Making Workshop at NeurIPS 2022 (**Oral**).
Presented at the Workshop on Machine Learning Safety at NeurIPS 2022.

Combining Rewards from Intersecting Trajectories: Improving Return-Conditioned Offline RL with Return Augmentation
Keiran Paster*, Silviu Pitis*, Sheila McIlraith, Jimmy Ba
Under review at ICML 2023.
Presented at the Foundation Models for Decision Making Workshop at NeurIPS 2022.
Presented at the NeurIPS 2022 Deep RL Workshop.

You Can't Count on Luck: Why Decision Transformers Fail in Stochastic Environments
Keiran Paster, Sheila McIlraith, Jimmy Ba
Presented at the Decision Awareness in Reinforcement Learning Workshop at ICML 2022 (Poster).
Published at NeurIPS 2022. (https://arxiv.org/abs/2205.15967)

BLAST: Latent Dynamics Models from Bootstrapping
Keiran Paster*, Lev McKinney*, Sheila McIlraith, Jimmy Ba
Presented at the NeurIPS 2021 Deep RL Workshop. (https://openreview.net/forum?id=VwA_hKnX_kR)
Presented at the 5th Multidisciplinary Conference on Reinforcement Learning and Decision Making (Poster).

Learning Domain Invariant Representations in Goal-conditioned Block MDPs
Beining Han, Chongyi Zheng, Harris Chan, **Keiran Paster**, Michael R. Zhang, Jimmy Ba
Published at NeurIPS 2021. (https://openreview.net/forum?id=oepSB9bsoCF)

Planning from Pixels using Inverse Dynamics Models
Keiran Paster, Sheila McIlraith, Jimmy Ba
Presented at the NeurIPS 2020 Deep RL Workshop (**Oral**).
Published at ICLR 2021. (https://openreview.net/forum?id=V6BjBgku7Ro)

Equilibrium Finding via Asymmetric Self-Play Reinforcement Learning
Jie Tang*, **Keiran Paster***, Pieter Abbeel
Presented at the NeurIPS 2018 Deep RL Workshop. (http://goo.gl/AC3j44)

Relevant Coursework

- Convex Optimization
- Natural Language Processing
- Neural Net Training Dynamics
- Data Structures and Algorithms
- Combinatorial Algorithms
- Computer Graphics
- Computer Security
- Private Data Analysis
- Game Theory
- Linear Algebra
- Real Analysis
- Discrete Math
- Probability and Random Processes
- Information Theory
- Statistical Learning Theory

Awards

NSERC Postgraduate Scholarship | *NSERC* **2022 – 2025**
- The NSERC Postgraduate Scholarship provides financial support to high-calibre students engaged in a doctoral program in natural sciences or engineering.

Vector Research Grant | *Vector Institute* **2019 – 2022**
- The Vector Research Grant is given to graduate students to support their research in the development of knowledge and novel applications of machine learning and AI.

Faculty of Arts and Science Top (FAST) Doctoral Fellowship | *University of Toronto* **2019**
- This merit-based award is given to only one academically-excellent student in the Doctoral program each year.

High Honors, Dean's Honors List, Honors to Date | *UC Berkeley* **2019**
- High honors are awarded to the top 7 percent of the graduating class by grade point average in the college.

Member of Eta Kappa Nu (HKN) | *UC Berkeley* **2017**
- Eta Kappa Nu is the national Electrical and Computer Engineering honor society.
- Membership is restricted to the top quarter of the junior class.

Leadership

Mentor for Toronto Graduate Application Assistance Program | *University of Toronto* **2021**
- The Graduate Application Assistance Program (GAAP) aims to ensure all applicants to higher degree programs have someone to provide feedback on their application before submission.
- Mentored and reviewed the applications of two applicants.

Research Mentoring | *University of Toronto* **2021**
- Mentoring an undergraduate student doing research on model-based reinforcement learning.

Virtual Reality at Berkeley | *Director of Resources, Augmented Reality Interfaces Researcher* **2015 – 2017**
- Worked with a team to create an intuitive command system for drones in Unity using the Microsoft HoloLens.

Computer Science Club | *Founder, Java Teacher, President* **2014 – 2015**
- Taught the AP Computer Science curriculum to students at my high school.

FRC Robotics Team 980 | *Controls Team Leader* **2012 – 2014**
- Lead the team responsible for designing the controls systems for two competition robots.
- Designed and created an inexpensive driving system using PID control and automatic gear shifting.
- Won the LA Regional Creativity Award (2013) and was an LA Regional Finalist (2014).

Work Experience

University of Toronto | *TA for CSC413/2516, Neural Networks and Deep Learning* **2021**

- CSC413 is a course which gives an overview of both foundational ideas and recent advances in neural net algorithms.
- Taught a tutorial, wrote a homework assignment about self-attention and normalizing flow models, and graded student projects.

UC Berkeley | *UGSI for CS 189, Introduction to Machine Learning* **2019**

- Managed a class of 744 students, personally teaching a discussion section with 50 students. CS 189 is a proof-based class where students learn concepts like regression, classification, density estimation, dimensionality reduction, and clustering.

Robot Learning Lab | *Undergraduate Researcher* **2017 – 2019**

- Worked on deep reinforcement learning for playing real-time strategy games.
- Explored techniques to enable agents to quickly adapt to new opponent strategies.
- Created an algorithm that allows standard on-policy reinforcement learning algorithms to discover optimal policies in simple Poker games by taking gradient steps against a specialized opponent.

Google | *Software Engineering Intern* **2017**

- Integrated Gmail Ads data into a MapReduce pipeline that generates terabytes of clean training data by combining data from multiple sources.
- Helped with the development of several internal tools, including a Gmail Ads serving stack diagnostic tool, a user model viewer and editor, and a visual user event inspector.

Other Projects

Linear Programming and Policy Optimization | *Minimizing Expectations Class Project* **2021**

- Explored the relationship between interior point LP solvers and policy gradient methods for RL.
- Showed that some interior point methods can converge much faster in simple MDPs than existing RL algorithms.

Bayesian Cake Cutting | *Algorithms for Collective Decision Making Class Project* **2020**

- Created a novel problem formulation in which there is a prior over valuations of a good.
- Proved that there always exists an envy-free cut even when there is uncertainty over valuations.
- Introduced a new algorithm to find envy-free and efficient cuts for distributions of piecewise constant valuations.

Differential Privacy for Stochastic Multi-Armed Bandits | *Private Data Analysis Class Project* **2019**

- Designed and tested several differentially private algorithms for the stochastic multi-armed bandit problem.
- Found that my new algorithm, which only views new data after logarithmically-many time-steps, is empirically strong with low time-horizons.

Replanning in Deep Reinforcement Learning | *Learning to Search Class Project* **2019**

- Showed that a deep reinforcement learning agent can be improved by adding a few seconds of additional training before choosing an action.
- Verified the hypothesis that the performance improvement in a state is correlated with familiarity by estimating the amount of times the state was seen in training and comparing the selected action before and after additional training with that of an oracle agent.