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 lie in AI reasoning and decision-making and my goal is to create AI systems that effectively process the information in the world in order to fast-forward scientific progress. My work includes algorithmic work on and the scaling up of decision-making via success-conditioned sequence models, automatic prompt-engineering (language models that learn to control themselves), and the creation of a family of strong open-weights language models for reasoning which serve as a strong foundation for the next wave of reasoning research.

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*

Publications

Llemma: An Open Language Model For Mathematics
Zhangir Azerbayev, Hailey Schoelkopf, **Keiran Paster**, Marco Dos Santos,
Stephen McAleer, Albert Q. Jiang, Jia Deng, Stella Biderman, Sean Welleck
Poster at ICLR 2024. (https://arxiv.org/abs/2310.10631)

OpenWebMath: An Open Dataset of High-Quality Mathematical Web Text
Keiran Paster, Marco Dos Santos, Zhangir Azerbayev, and Jimmy Ba
Poster at ICLR 2024. (https://arxiv.org/abs/2310.06786)

STEVE-1: A Generative Model for Text-to-Behavior in Minecraft
Shalev Lifshitz*, **Keiran Paster***, Harris Chan, Jimmy Ba, Sheila McIlraith
NeurIPS 2023 Spotlight. (https://openreview.net/pdf?id=YkBDJWerKg)

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. (https://arxiv.org/abs/2211.01910)
Presented at the Foundation Models for Decision Making Workshop at NeurIPS 2022 (**Oral**).
Presented at the Workshop on Machine Learning Safety at NeurIPS 2022.

Return Augmentation gives Supervised RL Temporal Compositionality
Keiran Paster*, Silviu Pitis*, Sheila McIlraith, Jimmy Ba
Preprint. (https://openreview.net/pdf?id=q5olkWCt7nl)
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)

Work Experience

Google Research | *Student Researcher* **2023**
- Worked with the Google Deepmind Blueshift and Gemini teams on data-efficiency for LLMs.

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.

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.

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

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).

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.