Shangtong Zhang

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RESEARCH INTEREST

The goal of my research is to solve sequential decision making problems in a scalable and reliable way. Currently, I focus on Reinforcement Learning (RL) as a solution method. In particular, I work on stochastic approximations for RL, theories and algorithms of RL, and applications by RL.

ACADEMIC EMPLOYMENTS

Assistant Professor — Aug 2022 - Present
Department of Computer Science
University of Virginia, VA, United States

Research Scientist Interns
Microsoft Research Montreal — Jun 2021 - Sep 2021
DeepMind London — Feb 2021 - Jun 2021
Microsoft Research Montreal — Jun 2020 - Aug 2020
Huawei Noah's Ark Lab Edmonton — May 2018 - Aug 2018

EDUCATION

Doctor of Philosophy, Computer Science — Oct 2018 - Jul 2022
University of Oxford, Oxford, United Kingdom
Advisor: Prof. Shimon Whiteson

Master of Science, Computer Science — Sep 2016 - Jul 2018
University of Alberta, Edmonton, Canada
Advisor: Prof. Richard S. Sutton

Bachelor of Science, Computing Science — Sep 2012 - Jul 2016
Fudan University, Shanghai, China

PUBLICATIONS

Advisees of SZ are underlined; * indicates equal contribution; † indicates equal supervision.
Google Scholar statistics: citations 1083, h-index 15.

Preprints

(P1) *Convergence Rate of Stochastic Approximations under Nonexpansive Mapping and Markovian Noise with Applications in Reinforcement Learning.*

Ethan Blaser, **Shangtong Zhang**.
In preparation to Journal of Machine Learning Research.

(P2) *On the Convergence of Linear Temporal Difference Learning with Arbitrary Features.*
Jiuqi Wang, **Shangtong Zhang**.
In preparation to Journal of Machine Learning Research.

(P3) *The ODE Method for Stochastic Approximation and Reinforcement Learning with Markovian Noise.*
Shuze Liu, Shuhang Chen, **Shangtong Zhang**.
arXiv:2401.07844, Jan 2024. Under review of Journal of Machine Learning Research.

(P4) *Direct Gradient Temporal Difference Learning.*
Xiaochi Qian, **Shangtong Zhang**.
arXiv:2308.01170, Aug 2023. Under review of Journal of Machine Learning Research.

(P5) *StarCraft II Unplugged: Large Scale Offline Reinforcement Learning*
Michael Mathieu*, Sherjil Ozair*, Srivatsan Srinivasan*, Caglar Gulcehre*, **Shangtong Zhang***, Ray Jiang*, Tom Le Paine*, Richard Powell, Konrad Zolna, Julian Schrittwieser, David Choi, Petko Georgiev, Daniel Kenji Toyama, Aja Huang, Roman Ring, Igor Babuschkin, Timo Ewalds, Mahyar Bordbar, Sarah Henderson, Sergio Gomez Colmenarejo, Aaron van den Oord, Wojciech M. Czarnecki, Nando de Freitas, Oriol Vinyals.
arXiv:2308.03526, Aug 2023. DeepMind technical report.

(P6) *Improving Monte Carlo Evaluation with Offline Data.*
Shuze Liu, **Shangtong Zhang**.
arXiv:2301.13734, Jan 2023. Submitted to International Conference of Machine Learning (ICML) 2024.

Invited Articles

(I1) *A New Challenge in Policy Evaluation.*
Shangtong Zhang.
Proceedings of the AAAI Conference on Artificial Intelligence (**AAAI**), vol. 37, no. 13, pp. 15465-15465, Feb 2023. New Faculty Highlights Program.

Refereed Journals

(J1) *Global Optimality and Finite Sample Analysis of Softmax Off-Policy Actor Critic under State Distribution Mismatch.*
Shangtong Zhang, Remi Tachet des Combes‡, Romain Laroche‡.
Journal of Machine Learning Research (**JMLR**), vol. 23, no. 343, pp. 1-91, Oct 2022. Impact factor: 5.177.

(J2) *Truncated Emphatic Temporal Difference Methods for Prediction and Control*
Shangtong Zhang, Shimon Whiteson.
Journal of Machine Learning Research (**JMLR**), vol. 23, no. 153, pp. 1-59, May 2022. Impact factor: 5.177.

(J3) *MLPack 3: A Fast, Flexible Machine Learning Library.*
Ryan Curtin, Marcus Edel, Mikhail Lozhnikov, Yannis Mentekidis, Sumedh Ghaisas, **Shangtong Zhang**
Journal of Open Source Software (**JOSS**), vol. 3, no. 26, pp. 726, Jun 2018. Impact factor: 5.2.

Refereed Conference Papers

(C1) *On the Convergence of SARSA with Linear Function Approximation.*
Shangtong Zhang, Remi Tachet des Combes, Romain Laroche.
Proceedings of the International Conference on Machine Learning (**ICML**) *in Proceedings of Machine Learning Research*, vol. 202, pp. 41613-41646, Jul 2023. Acceptance rate: 28%

(C2) *A Deeper Look at Discounting Mismatch in Actor-Critic Algorithms.*
Shangtong Zhang, Romain Laroche, Harm van Seijen, Shimon Whiteson, Remi Tachet des Combes.
Proceedings of the International Conference on Autonomous Agents and Multiagent Systems (**AAMAS**), pp. 1491, May 2022. Acceptance rate: 26%

(C3) *Learning Expected Emphatic Traces for Deep RL.*
Ray Jiang, **Shangtong Zhang**, Veronica Chelu, Adam White, Hado van Hasselt.
Proceedings of the AAAI Conference on Artificial Intelligence (**AAAI**), vol. 36, no. 6, pp. 7015-7023, Feb 2022. Acceptance rate: 15%.

(C4) *Breaking the Deadly Triad with a Target Network.*
Shangtong Zhang, Hengshuai Yao, Shimon Whiteson.
Proceedings of the International Conference on Machine Learning (**ICML**) *in Proceedings of Machine Learning Research*, vol. 139, pp. 12621-12631, Jul 2021. Acceptance rate: 21.5%.

(C5) *Average-Reward Off-Policy Policy Evaluation with Function Approximation.*
Shangtong Zhang*, Yi Wan*, Richard S. Sutton, Shimon Whiteson.
Proceedings of the International Conference on Machine Learning (**ICML**) *in Proceedings of Machine Learning Research*, vol. 139, pp. 12578-12588, Jul 2021.. Acceptance rate: 21.5%.

(C6) *Mean-Variance Policy Iteration for Risk-Averse Reinforcement Learning.*
Shangtong Zhang, Bo Liu, Shimon Whiteson.
Proceedings of the AAAI Conference on Artificial Intelligence (**AAAI**), vol. 35, no. 12, pp. 10905-10913, Feb 2021. Acceptance rate: 21.4%.

(C7) *Learning Retrospective Knowledge with Reverse Reinforcement Learning.*
Shangtong Zhang, Vivek Veeriah, Shimon Whiteson.
Advances in Neural Information Processing Systems (**NeurIPS**), vol. 33, pp. 19976-19987, Dec 2020. Acceptance rate: 20.1%.

(C8) *GradientDICE: Rethinking Generalized Offline Estimation of Stationary Values.*
Shangtong Zhang, Bo Liu, Shimon Whiteson.
Proceedings of the International Conference on Machine Learning (**ICML**) *in Proceedings of Machine Learning Research*, vol. 119, pp. 11194-11203, Jul 2020. Acceptance rate: 21.8%.

(C9) *Provably Convergent Two-Timescale Off-Policy Actor-Critic with Function Approximation.*
Shangtong Zhang, Bo Liu, Hengshuai Yao, Shimon Whiteson.
Proceedings of the International Conference on Machine Learning (**ICML**) *in Proceedings of Machine Learning Research*, vol. 119, pp. 11204-11213, Jul 2020. Acceptance rate: 21.8%.

(C10) *Deep Residual Reinforcement Learning.*
Shangtong Zhang, Wendelin Boehmer, Shimon Whiteson.
Proceedings of the International Conference on Autonomous Agents and Multiagent Systems (**AAMAS**), pp. 16111619, May 2020. Acceptance rate: 23%. **Best Paper Award**.

(C11) *Mega-Reward: Achieving Human-Level Play without Extrinsic Rewards.*
Yuhang Song, Jianyi Wang, Thomas Lukasiewicz, Zhenghua Xu, **Shangtong Zhang**, Andrzej Wojcicki, Mai Xu.
Proceedings of the AAAI Conference on Artificial Intelligence (**AAAI**), vol. 34, no. 4, pp. 5826-5833, Feb 2020. Acceptance rate: 20.6%.

(C12) *DAC: The Double Actor-Critic Architecture for Learning Options.*
Shangtong Zhang, Shimon Whiteson.
Advances in Neural Information Processing Systems (**NeurIPS**), vol. 32, pp. 2012-2022, Dec 2019. Acceptance rate: 21.2%.

(C13) *Generalized Off-Policy Actor-Critic.*
Shangtong Zhang, Wendelin Boehmer, Shimon Whiteson.
Advances in Neural Information Processing Systems (**NeurIPS**), vol. 32, pp. 2001-2011, Dec 2019. Acceptance rate: 21.2%.

(C14) *Distributional Reinforcement Learning for Efficient Exploration.*
Borislav Mavrin, **Shangtong Zhang**, Hengshuai Yao, Linglong Kong, Kaiwen Wu, Yaoliang Yu
Proceedings of the International Conference on Machine Learning (**ICML**) *in Proceedings of Machine Learning Research*, vol. 2019, pp. 4424-4434, Jue 2019. Acceptance rate: 22.6%.

(C15) *ACE: An Actor Ensemble Algorithm for Continuous Control with Tree Search.*
Shangtong Zhang, Hao Chen, Hengshuai Yao.
Proceedings of the AAAI Conference on Artificial Intelligence (**AAAI**), vol. 33, no. 1, pp. 5789-5796, Feb 2019. Acceptance rate: 16.2%.

(C16) *QUOTA: The Quantile Option Architecture for Reinforcement Learning.*
Shangtong Zhang, Borislav Mavrin, Linglong Kong, Bo Liu, Hengshuai Yao.
Proceedings of the AAAI Conference on Artificial Intelligence (**AAAI**), vol. 33, no. 01, pp. 5797-5804, Feb 2019. Acceptance rate: 16.2%.

(C17) *Crossprop: Learning Representations by Stochastic Meta-Gradient Descent in Neural Networks.*
Vivek Veeriah*, **Shangtong Zhang***, Richard S. Sutton.
Proceedings of the European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases (**ECML-PKDD**) *in Lecture Notes in Computer Science*, vol. 10534, pp. 445-459, Sep 2017. Acceptance rate: 27.1%.

(C18) *A Deep Neural Network for Modeling Music.*
Pengjing Zhang, Xiaoqing Zheng, Wenqiang Zhang, Siyan Li, Sheng Qian,
Wenqi He, **Shangtong Zhang**, Ziyuan Wang
Proceedings of the International Conference on Multimedia Retrieval (**ICMR**), pp. 379-386, Jun 2015. Acceptance rate: 31%.

Refereed Workshop Papers (Non-Archival)

(W1) *A Deeper Look at Experience Replay.*
Shangtong Zhang, Richard S. Sutton.
Deep RL Symposium at NIPS, Dec 2017.

(W2) *Comparing Deep Reinforcement Learning and Evolutionary Methods in Continuous Control.*
Shangtong Zhang, Osmar R. Zaiane
Deep RL Symposium at NIPS, Dec 2017.

(W3) *A Demon Control Architecture with Off-Policy Learning and Flexible Behavior Policy.*
Shangtong Zhang, Richard S. Sutton.
Hierarchical RL Workshop at NIPS, Dec 2017.

HONORS

KAUST Rising Stars in AI, 2024[1]
AAAI New Faculty Highlights, 2023
IFAAMAS Victor Lesser Dissertation Award (Runner-Up), 2022
Alf Weaver Junior Faculty Fellowship, UVA, 2022
ICLR Outstanding Reviewer, 2021
NeurIPS Reviewer Award, 2020
ICML Reviewer Award, 2020
AAMAS Best Paper Award, 2020
Light Senior Scholarship, St Catherine's College, University of Oxford, 2020
EPSRC Studentship, University of Oxford, 2018
EMC Scholarship, Fudan University, 2014

[1]Organized by Juergen Schmidhuber

SERVICES

Organizers
CPS Rising Star Workshop 2024, Co-Chair

Meta Reviewer & Area Chair
RL Conference 2024
ICLR 2024
AISTATS 2024
ACML 2022, 2023

Reviewer & Program Committee
Transactions on Pattern Analysis and Machine Intelligence (1)
Transaction of Machine Learning Research (2)
Journal of Machine Learning Research (3)
Artificial Intelligence Journal (2)
Transactions on Intelligent Systems and Technology (2)
IJCAI 2023
AISTATS 2022
NeurIPS 2020, 2021, 2022, 2023
ICML 2020, 2021, 2022, 2023
AAAI 2020, 2021, 2022, 2023
ICLR 2021, 2022, 2023
SIGCOMM 2022
Offline Reinforcement Learning Workshop at NeurIPS 2020, 2021, 2022
Deep Reinforcement Learning Workshop at NeurIPS 2019, 2020, 2021, 2022
Adaptive and Learning Agents Workshop at AAMAS 2019, 2020
Optimization Foundations for Reinforcement Learning Workshop at NeurIPS 2019
Reinforcement Learning for Real Life Workshop at ICML 2019, 2021
Reinforcement Learning for Real Life Workshop at NeurIPS 2022

Conference Session Chair
AAAI 2023, "Reinforcement Learning Theory & Algorithms"

Departmental Services
Faculty Search Committee, UVA CS 2023 - 2024
Graduate Admission Committee, UVA CS 2022 - 2024

SUPERVISION

Doctral Students
Ethan Blaser, NSF GRFP 2023 - Now
Jiuqi Wang 2023 - Now
Shuze Liu, post-qualification (Aug 2023) 2022 - Now

Master of Science Students
Kefan Song 2023 - Now
Licheng Luo 2023 - Now
Zhengkun Xiao. Then PhD student at University of Florida 2022 - 2023

Undergraduate Researchers
Xi (Cici) Wang 2023 - Now

Steve Zhou, BA CS Distinguished Major Program	2023 - Now
Pawan Jayakumar	2023 - Now
Ja-Zhua Cheng	2022 - Now

Research Interns

Jiuqi Wang, University of Alberta. Then PhD student at UVA	2022 - 2023
Xiaochi (Joe) Qian, University of Oxford	2022 - Now

PhD Committees

Sudhir Shenoy
Chuanhao Li
Kun Yang (Proposal)
Zeyu Mu (Proposal)
Ingy ElSayed-Aly (Proposal)
Matthew Landers (Qualification)
Amar Kulkarni (Qualification)

INVITED TALKS

Offline Reinforcement Learning: Current and Future	
AAAI New Faculty Highlight Program	Feb 2023
Breaking the Deadly Triad in Off-Policy Reinforcement Learning	
Department of Computer Science, University of Virginia	Mar 2022
School of Computing Science, Simon Fraser University	Feb 2022
Department of Electrical & Computer Engineering, University of Waterloo	Feb 2022
School of Informatics, University of Edinburgh	Oct 2021
Breaking the Deadly Triad with a Target Network	
Microsoft Research Summit	Oct 2021
Breaking the Deadly Triad in Reinforcement Learning	
RL team, DeepMind, hosted by Hado van Hasselt	Sep 2021
Off-Policy Evaluation	
Data Fest 2020, Open Data Science	Oct 2020
Off-Policy Evaluation and Control	
ByteDance AI Lab, Shanghai	Oct 2020
Coding Deep RL Papers	
NIPS MLTrain Workshop, Long Beach	Dec 2019
Off-Policy Actor-Critic Algorithms	
Latent Logic LTD, Oxford	Apr 2019

TEACHING

University of Virginia	
CS 6316: Machine Learning	Spring 2024
CS 4501: Optimization	Fall 2023
CS 6501: Topics in Reinforcement Learning	Fall 2022

OPEN SOURCE CODE

GitHub Repo: PyTorch Deep RL
A zoo of popular deep RL algorithms in PyTorch with **3k stars**.

GitHub Repo: Reinforcement Learning: An Introduction
Python implementation of the book *Reinforcement Learning: An Introduction* with **13.8k stars**.

Google Summer of Code (GSoC)
MLPack 2017
The Xapian Project 2014

FUNDING

* indicates Co-PI. † indicates senior personnel.

Awarded External Grants and Contracts

Sponsor	PI	Co-PI & Sr. Personnel	Total	My Share	Start	End
SLES: CRASH: Challenging Reinforcement-Learning Based Adversarial Scenarios for Safety Hardening						
NSF	Madhur Behl	**Shangtong Zhang***	$800K	$400K	12/01/2023	11/30/2026
III: Small: Moving Offline Learning to Rank Online, from Theory to Practice						
NSF	**Shangtong Zhang** Former PI: Hongning Wang	N/A	$500K	$500K	10/01/2021	09/30/2024
Total			$1.3M	$900K		

Proposed External Grants and Contracts

Sponsor	PI	Co-PI & Sr. Personnel	Total	My Share	Duration
CPS: Medium: Transferable Efficient Adaptive Sensing Mechanisms for Mobile Applications					
NSF	Afsaneh Doryab	**Shangtong Zhang***	$814K	$407K	07/01/2024 - 07/01/2027
RI: Small: Offline Data Informed Monte Carlo Evaluation					
NSF	**Shangtong Zhang**	N/A	$600K	$600K	09/01/2023 - 08/31/2026
Continual Reinforcement Learning with Predictive Knowledge					
Sony AI	**Shangtong Zhang**	N/A	$100K	$100K	09/01/2024 - 08/31/2025
Total			$1.5M	$1.1M	

Proposed Internal Grants

UVA Source	PI	Co-PI	Total	My Share	Duration
A Reinforcement Learning Safety Solution for Autonomous Drones					
Research Innovation Award	**Shangtong Zhang**	Chen-Yu Wei*	$60K	$30K	09/01/2024 - 08/31/2025
Total			$60K	$30K	