

# STEPHEN TU

**research interests** I study problems in the intersection of machine learning, optimization, and control theory. My recent work focuses on both learning from temporally dependent data, and controlling distribution shift in imitation learning, with specific emphasis on applications in robotics.

**education** Ph.D., EECS, University of California, Berkeley. Spring 2019.  
Advised by Prof. Benjamin Recht.  
Thesis: *Sample Complexity Bounds for the Linear Quadratic Regulator*.

S.M., EECS, Massachusetts Institute of Technology. Spring 2013.  
Advised by Prof. Samuel Madden.  
Thesis: *Fast Transactions for Multicore In-Memory Databases*.

B.A., Computer Science, University of California, Berkeley. Fall 2010.

B.S., Mechanical Engineering, University of California, Berkeley. Fall 2010.

**publications** *Visual Backtracking Teleoperation: A Data Collection Protocol for Offline Image-Based Reinforcement Learning*. In submission, 2022.

David Brandfonbrener, **Stephen Tu**, Avi Singh, Stefan Welker, Chad Boodoo, Nikolai Matni, and Jake Varley.

*Learning from many trajectories*. In submission, 2022.

**Stephen Tu**, Roy Frostig, and Mahdi Soltanolkotabi.

*Learning Model Predictive Controllers with Real-Time Attention for Real-World Navigation*. CoRL 2022.

Xuesu Xiao, Tingnan Zhang, Krzysztof Choromanski, Edward Lee, Anthony Francis, Jake Varley, **Stephen Tu**, Sumeet Singh, Peng Xu, Fei Xia, Sven Mikael Persson, Dmitry Kalashnikov, Leila Takayama, Roy Frostig, Jie Tan, Carolina Parada, and Vikas Sindhwani.

*Learning with little mixing*. NeurIPS 2022.

Ingvar Ziemann and **Stephen Tu**.

*TaSIL: Taylor Series Imitation Learning*. NeurIPS 2022.

Daniel Pfrommer, Thomas T.C.K. Zhang, **Stephen Tu**, and Nikolai Matni.

*Adversarially Robust Stability Certificates can be Sample-Efficient*. L4DC 2022.

Thomas T.C.K. Zhang, **Stephen Tu**, Nicholas M. Boffi, Jean-Jacques E. Slotine, and Nikolai Matni.

*On the Sample Complexity of Stability Constrained Imitation Learning*. L4DC 2022.

**Stephen Tu**, Alexander Robey, Tingnan Zhang, and Nikolai Matni.

*The role of optimization geometry in single neuron learning*. AISTATS 2022.

Nicholas M. Boffi, **Stephen Tu**, and Jean-Jacques E. Slotine.

*On the Generalization of Representations in Reinforcement Learning*. AISTATS 2022.

Charline Le Lan, **Stephen Tu**, Adam Oberman, Rishabh Agarwal, and Marc G. Bellemare.

*Nonparametric adaptive control and prediction: theory and randomized algorithms*. JMLR, Vol. 23, No. 281, 2022.

Nicholas M. Boffi, **Stephen Tu**, and Jean-Jacques E. Slotine.

*Learning Robust Output Control Barrier Functions from Safe Expert Demonstrations* In submission, 2021.

Lars Lindemann, Alexander Robey, Lejun Jiang, **Stephen Tu**, and Nikolai Matni.

- Learning Robust Hybrid Control Barrier Functions for Uncertain Systems.* ADHS 2021.  
Alexander Robey, Lars Lindemann, **Stephen Tu**, and Nikolai Matni.
- Regret Bounds for Adaptive Nonlinear Control.* L4DC 2021.  
Nicholas M. Boffi\*, **Stephen Tu**\*, and Jean-Jacques E. Slotine. (\* equal contribution.)
- Safely Learning Dynamical Systems from Short Trajectories.* L4DC 2021.  
Amir Ali Ahmadi, Abraar Chaudhry, Vikas Sindhvani, and **Stephen Tu**.
- Learning Hybrid Control Barrier Functions from Data.* CoRL 2020.  
Lars Lindemann, Haimin Hu, Alexander Robey, Hanwen Zhang, Dimos V. Dimarogonas, **Stephen Tu**, and Nikolai Matni.
- Learning Stability Certificates from Data.* CoRL 2020.  
Nicholas M. Boffi\*, **Stephen Tu**\*, Nikolai Matni, Jean-Jacques E. Slotine, and Vikas Sindhvani. (\* equal contribution.)
- Learning Control Barrier Functions from Expert Demonstrations.* CDC 2020.  
Alexander Robey, Haimin Hu, Lars Lindemann, Hanwen Zhang, Dimos V. Dimarogonas, **Stephen Tu**, and Nikolai Matni.
- Observational Overfitting in Reinforcement Learning.* ICLR 2020.  
Xingyou Song, Yiding Jiang, **Stephen Tu**, Yilun Du, and Behnam Neyshabur.
- From Self-Tuning Regulators to Reinforcement Learning and Back Again.* CDC 2019.  
Nikolai Matni, Alexandre Proutiere, Anders Rantzer, and **Stephen Tu**
- A Tutorial on Concentration Bounds for System Identification.* CDC 2019.  
Nikolai Matni and **Stephen Tu**
- Finite-time Analysis of Approximate Policy Iteration for the Linear Quadratic Regulator.* NeurIPS 2019.  
Karl Krauth\*, **Stephen Tu**\*, and Benjamin Recht. (\* equal contribution.)
- Certainty Equivalence is Efficient for Linear Quadratic Control.* NeurIPS 2019.  
Horia Mania, **Stephen Tu**, and Benjamin Recht.
- The Gap Between Model-Based and Model-Free Methods on the Linear Quadratic Regulator: An Asymptotic Viewpoint.* COLT 2019.  
**Stephen Tu** and Benjamin Recht.
- On the Sample Complexity of the Linear Quadratic Regulator.* FoCM, Vol. 20, 2020.  
Sarah Dean, Horia Mania, Nikolai Matni, Benjamin Recht, and **Stephen Tu**.
- Minimax Lower Bounds for  $\mathcal{H}_\infty$ -Norm Estimation.* ACC 2019.  
**Stephen Tu**\*, Ross Boczar\*, and Benjamin Recht. (\* equal contribution.)
- Safely Learning to Control the Constrained Linear Quadratic Regulator.* ACC 2019.  
Sarah Dean, **Stephen Tu**, Nikolai Matni, and Benjamin Recht.
- Regret Bounds for Robust Adaptive Control of the Linear Quadratic Regulator.* NeurIPS 2018.  
Sarah Dean, Horia Mania, Nikolai Matni, Benjamin Recht, and **Stephen Tu**.
- Least-Squares Temporal Difference Learning for the Linear Quadratic Regulator.* ICML 2018.  
**Stephen Tu** and Benjamin Recht.
- Learning Without Mixing: Towards A Sharp Analysis of Linear System Identification.* COLT 2018.  
Max Simchowitz, Horia Mania, **Stephen Tu**, Michael I. Jordan, and Benjamin Recht.
- On the Approximation of Toeplitz Operators for Nonparametric  $\mathcal{H}_\infty$ -norm Estimation.* ACC 2018.  
**Stephen Tu**, Ross Boczar, and Benjamin Recht.

*Breaking Locality Accelerates Block Gauss-Seidel.* ICML 2017.

Stephen Tu, Shivaram Venkataraman, Ashia C. Wilson, Alex Gittens, Michael I. Jordan, and Benjamin Recht.

*Cyclades: Conflict-free Asynchronous Machine Learning.* NeurIPS 2016.

Xinghao Pan, Maximilian Lam, Stephen Tu, Dimitris Papailiopoulos, Ce Zhang, Michael I. Jordan, Kannan Ramchandran, Christopher Ré, and Benjamin Recht.

*Low-rank Solutions of Linear Matrix Equations via Procrustes Flow.* ICML 2016.

Stephen Tu, Ross Boczar, Max Simchowitz, Mahdi Soltanolkotabi, and Benjamin Recht.

*Machine Learning Classification over Encrypted Data.* NDSS 2015.

Raphael Bost, Raluca Ada Popa, Stephen Tu, and Shafi Goldwasser.

*Fast Databases with Fast Durability and Recovery through Multicore Parallelism.* OSDI 2014.

Wenting Zheng, Stephen Tu, Eddie Kohler, and Barbara Liskov.

*Anti-Caching: A New Approach to Swapping in Main Memory OLTP Database Systems.* VLDB 2014.

Justin DeBrabant, Andrew Pavlo, Stephen Tu, Michael Stonebraker, and Stan Zdonik.

*Speedy Transactions in Multicore In-Memory Databases.* SOSP 2013.

Stephen Tu, Wenting Zheng, Eddie Kohler, Barbara Liskov, and Samuel Madden.

*Processing Analytical Queries over Encrypted Data.* VLDB 2013.

Stephen Tu, M. Frans Kaashoek, Samuel Madden, and Nickolai Zeldovich.

*The HipHop Compiler for PHP.* OOPSLA 2012.

Haiping Zhao, Iain Proctor, Minghui Yang, Xin Qi, Mark Williams, Guilherme Ottoni, Charlie Gao, Andrew Paroski, Scott MacVicar, Jason Evans, and Stephen Tu.

*The Case for PIQL: A Performance Insightful Query Language.* SoCC 2010.

Michael Armbrust, Nick Lanham, Stephen Tu, Armando Fox, Michael Franklin, and David Patterson.

*PIQL: A Performance Insightful Query Language For Interactive Applications.* SIGMOD 2010 Demo.

Michael Armbrust, Stephen Tu, Armando Fox, Michael Franklin, David Patterson, Nick Lanham, Beth Trushkowsky, and Jesse Trutna.

**work  
experience** Research Scientist. Robotics at Google. 9/2019–Present.

Research learning to control applications in robotics.

Open sourced and maintain trajax, a differentiable optimal control library: <https://github.com/google/trajax>.

Manager: Vikas Sindhwani.

Software Engineering Intern. Google Brain. Summer 2017.

Worked on projects related to trajectory optimization and learning Lyapunov functions from data.

Hosted by Vikas Sindhwani.

Developer. Data-microscopes team, Qadium. Summer 2014.

Wrote the first implementation of data-microscopes, a Bayesian non-parametric library for Python.

Project page: <https://datamicroscopes.github.io/>

Software Engineering Intern. HPHP team, Facebook. 4/2011–8/2011.

Implemented various performance improvements in Facebook's PHP source-to-source translator.

Software Engineering Intern. Datacenters team, Facebook. 1/2011–4/2011.

Worked on deploying a row level consistency checker for Facebook's distributed MySQL deployment.

Software Engineering Intern. Intuit. Summer 2009.

Built tools for encoding tax specifications in XPath.

Lead Programmer. RSSP-IT, UC Berkeley. 2008-2010.

Maintained various internal tools for managing the residential dorm network at UC Berkeley.

invited  
talks

Foundations of AI Seminar, University of Southern California, Fall 2022.

Title: *Independent learning from sequential data.*

Intelligent Robot Motion Lab, Princeton University. Spring 2022.

Title: *Learning from many trajectories.*

Foundations and mathematical guarantees of data-driven control summer school, ETHZ-EPFL.  
Summer 2021.

Title: *Learning and Control with Safety and Stability Guarantees for Nonlinear Systems.*

CAN Lab, New York University. Fall 2020.

Title: *Learning Stability Certificates from Data.*

Research Seminar. TU Darmstadt. Summer 2020.

Title: *Learning Stability Certificates from Data.*

CDC Tutorial, 2019.

Title: *Concentration Inequalities for System Identification.*

INFORMS Conference, 2019.

Title: *Finite-time Analysis of Approximate Policy Iteration for the Linear Quadratic Regulator.*

Amazon, Palo Alto. Summer 2019.

Title: *Safe and Reliable Reinforcement Learning for Continuous Control.*

Facebook AI Research, Menlo Park. Spring 2019.

Title: *Safe and Reliable Reinforcement Learning for Continuous Control.*

Robot Locomotion Group, Massachusetts Institute of Technology. Spring 2019.

Title: *Safe and Reliable Reinforcement Learning for Continuous Control.*

Machine Learning Seminar, University of Washington. Spring 2019.

Title: *Safe and Reliable Reinforcement Learning for Continuous Control.*

Google DeepMind, London. Spring 2019.

Title: *Safe and Reliable Reinforcement Learning for Continuous Control.*

Google Brain Robotics, Mountain View. Spring 2019.

Title: *Safe and Reliable Reinforcement Learning for Continuous Control.*

Computer Science Colloquium, Princeton University. Spring 2019.

Title: *Safe and Reliable Reinforcement Learning for Continuous Control.*

Microsoft Research, New York City. Spring 2019.

Title: *Safe and Reliable Reinforcement Learning for Continuous Control.*

Stanford Information Systems Laboratory. Spring 2018.

Title: *Finite Sample Guarantees for Control of an Unknown Linear Dynamical System.*

Simons Institute. Fall 2017.

Title: *A Lyapunov Analysis for Accelerated Block Gauss-Seidel.* (Lightning talk)

SIAM Conference on Optimization. Spring 2017.

Title: *Convergence and Geometry of Non-convex Matrix Sensing.*

Microsoft Research, Redmond. Summer 2013.

Title: *Speedy Transactions in Multicore In-Memory Databases.*

teaching

Graduate Student Instructor. CS 189–*Introduction to Machine Learning*, UC Berkeley. Fall 2018.

Graduate Student Instructor. CS 189–*Introduction to Machine Learning*, UC Berkeley. Fall 2016.

**awards** 2021: NeurIPS 2021 Outstanding Reviewer.  
2018: Google PhD Fellowship in Machine Learning.  
2011: CRA Undergraduate Research Award Honorable Mention.

**service** Reviewer for OSDI 2014, NeurIPS (2016, 2018, 2019, 2021, 2022), ICML 2019, ACC 2019, AISTATS 2019, COLT 2019, CoRL 2022, and JMLR.  
2022: Mentor for Google's CS Research Mentorship Program.