

# 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.

**education** Ph.D., EECS, University of California, Berkeley.  
Advised by Prof. Benjamin Recht.  
Thesis: *Sample Complexity Bounds for the Linear Quadratic Regulator*.  
S.M., EECS, Massachusetts Institute of Technology.  
Advised by Prof. Samuel Madden.  
Thesis: *Fast Transactions for Multicore In-Memory Databases*.  
B.A., Computer Science, University of California, Berkeley.  
B.S., Mechanical Engineering, University of California, Berkeley.

**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 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 Sindhwani, 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 Sindhwani. (\* 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 Nikolai 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.