

Catherine Weaver

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🎓 Education

Ph.D. Mechanical Eng. 2024
U.C. Berkeley

PI: Masayoshi Tomizuka

Minors: Optimization &
Artificial Intelligence

M.S. Mechanical Eng. 2021
U.C. Berkeley

B.S. Mechanical Eng. 2019
Purdue University
GPA 3.98
Highest Distinction
Spanish Language Minor

🔧 Programming

Languages and Libraries

- Python ●●●●●
- PyTorch ●●●●●
- Tensorflow ●●●●○
- C/C++ ●●●●○
- MATLAB ●●●●●
- Simulink ●●●●○
- Excel VBA ●●●●○
- LaTeX ●●●●●
- HTML ●●●○

Skills

- Environment control (conda, Docker)
- Version control (Github)
- Coding style guidelines and typing (MyPy)
- Cloud computing (AWS)
- GPU training (CUDA)

📄 Summary

- Future Ph.D. from UC Berkeley developing state-of-the-art machine learning and control algorithms for practical, continuous time systems
- Experience pushing the limits of artificial intelligence with high-quality, highly-collaborative code at Sony AI
- Over two years of cumulative experience in industry in control systems, computer science, product development, and manufacturing

👛 Professional Experience

Mechanical Systems Control Lab – UC Berkeley

4.5 years

Graduate Student Researcher

August 2019 – Present

- Conducted 5-year research project in collaboration with Sony AI to advance learning-based control algorithms for autonomous racing in the challenging, high-fidelity simulator Gran Turismo Sport
- Implemented and improved many cutting edge, popular ML and RL algorithms by leveraging my deep understanding of their mathematical derivation and theoretical basis for algorithmic choices
- Tackled **learning from human demonstrations** by leveraging RL with generative adversarial networks and proposed a new imitation-based decision transformer with corrective online rollouts
- Derived a novel hierarchical RL algorithm with learned skills that shows significant improvement over existing methods in **long-horizon** robotic manipulation (Fetch), maze (D4RL), and racing (Gran Turismo) tasks
- Effectively communicated in regular research presentations and seminars for various audiences and exhibited high-quality technical writing and editing of applications and scientific papers
- Showed leadership and long-term vision when mentoring 4 graduate students visiting from other universities that resulted in multiple publications and continuous improvement of a unified control system

Sony AI America | Boston, MA (Remote)

7 months

Research Scientist Intern

May - December 2021

- Proposed a novel motion primitive formulation for online racing trajectory planning, resulting in ongoing collaboration with top robotics researchers and paper submission to competitive controls conference
- After inspecting company's existing **racing MPC** implementation, suggested and executed algorithmic improvements that increased tracking performance and decreased lap-time by 4 seconds
- Merged multiple branches with new features to a Github repository with 30+ contributors and wrote code that adhered to **unit testing, typing, and style** requirements to pass peer and manager code reviews

Zimmer Biomet – Warsaw IN

18 months

Development Engineering Co-op

August – December 2017

- Led **design verification** for small-scale pilot project, and presented department's verification reports to Quality and Regulatory departments

Engineering Co-op

August – December 2016

- Determined process time requirements and troubleshooted an electronic form to allow non-standard address lines and automatic drop downs

Manufacturing Engineering Co-op

May – August 2015, January – May 2016

- Statistically characterized process capability with historical measurements and composed re-work steps for non-conforming products

Jain Research Lab – Purdue University

19 months

Undergraduate Researcher

May 2017 – May 2019

- Created a thermodynamic model of a hydrogen fuel cell and water storage system resulting in a conference article as well as a first author presentation on a rule-based controller for the system

Select Algorithms

- Model Predictive Control (MPC, iLQR)
- Reinforcement Learning (SAC, PPO)
- Imitation Learning (GANs, GAIL)
- Time-series segmentation (HDPHMM)
- Sequence Modeling (Decision Transformer)
- Attention Mechanisms (VAE)
- Hierarchical RL (Options, Skills, Goals)

Awards

- Graduate Research Fellowship, *National Science Foundation* (2019-22)
- Berkeley Fellowship for Graduate Study, *UC Berkeley* (2019-21)
- H. William Bottomley Research Scholarship, *Dept. of Mech. Eng., Purdue University* (2019)
- Office of Undergraduate Research Scholarship, *Purdue University* (2018-19)
- Trustees Scholarship, *Purdue University* (2014-19)

Select Courses

Graduate (UC Berkeley)

- Advanced Robotics
- Reinforcement Learning
- Machine Learning
- Game Theory
- Advanced Controls (I & II)
- Nonlinear systems
- Vehicle Dynamics
- Probability & Optimization

Undergraduate (Purdue)

- Renewable Energy
- Thermodynamics (I & II)
- Heat Transfer
- Circuit Analysis
- Machine Design
- Fluid Dynamics

Publications

1. **Weaver, C.**, Tang, C., Hao, C., Kawamoto, K., Tomizuka, M. Zhan, W. "Transformer-Assisted Adversarial Imitation Learning for Autonomous Racing." *Under Preparation*.
2. Hao, C., Tang, C., Bergkvist, E., **Weaver, C.**, Sun, L., Zhan, W., Tomizuka, M. "Outracing Human Racers: Model-based Trajectory Planning and Control for Time-trial Autonomous Racing" *IEEE Transactions on Intelligent Vehicles*. *Awaiting Review*. arxiv.org/abs/2211.09378
3. Hao, C.*, **Weaver C.* (*Equal Contribution)**, Tang, C., Kawamoto, K., Tomizuka, M. Zhan, W. "Skill-Critic: Refining Learned Skills for Reinforcement Learning", *IEEE Robotics and Automation Letters* 2023. *Awaiting Review*. sites.google.com/view/skill-critic
4. **Weaver, C.**, Capobianco, R., Wurman, P., Stone, P. "Real-time Trajectory Generation via Imitation Learning of Dynamic Movement Primitives for Autonomous Racing" *American Control Conference*, 2024. *Awaiting Review*. sites.google.com/berkeley.edu/racingdmp/home
5. Su., S., Hao, C., **Weaver, C.**, Tang, C., Zhan, W. Tomizuka, M. "Double-Iterative Gaussian Process Regression for Modeling Error Compensation in Autonomous Racing" *IFAC World Congress*, 2023. arxiv.org/abs/2305.07740
6. Bird, T., **Weaver, C.**, and Jain, N. "Switched Linear Model of a Stratified Hot Water Tank for Control of Micro-CHP Systems" *Proceedings of the ASME 2019 Dynamic Systems and Control Conference*, ASME, 2019 October 9-12, Park City, UT. (*Energy Systems Technical Committee Best Paper Award*) dx.doi.org/10.1115/DSCC2019-9236

Masters Report

- **Weaver, C.** "Racing strategy analysis using Bayesian Nonparametric Segmentation and Functional Clustering and Alignment," Masters Report submitted in partial fulfillment of M.S. in Mechanical Engineering. University of California, Berkeley. 2021.

Poster Sessions and Presentations

1. **Weaver, C.** and Hao, C. "Trajectory Planning and Model-Predictive Control of Autonomous Racing Vehicles" Presentation at NorCal Control Workshop, 2021 January 22, virtual (via Stanford University).
2. **Weaver, C.**, and Jain, N. "Rule-Based Control of Micro-Combined Heat and Power Systems." Poster session presented at: Undergraduate Expo, International Mechanical Engineering Congress and Exposition, ASME, 2018 November 12; Pittsburgh, PA.

Professional Service and Teaching

Expanding Your Horizons Conference – UC Berkeley

Event Co-Chair

May 2021 – May 2023

- **2 years in charge of organizing annual STEM conference for 300+ students**
- Managed 40 planning committee volunteers and 150 day-of-volunteers
- Organized volunteers into 7 different committees and delegated tasks appropriately to manage Food, Finance, Programs, Transportation, etc.

Logistics Committee Chair (2020-21), Committee Member (2019-20)

Graduate Instructor – Statistics and Data Science

August - December 2023

School of Mechanical Engineering, UC Berkeley

- Led 4 hour-long Python-based lab sections each week on statistics and machine learning topics to upper-level undergraduates

Instructor – Creative Engineering and Robotics / AI Robotics

July 2021

Summer Institute for the Gifted, UC Berkeley

- Instructed two intensive, hands on courses for gifted students (each class was 3hrs/day for 3 weeks)