Nicolas Christianson

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Research interests

I am broadly interested in decision-making under uncertainty, with a specific focus on designing new algorithms to enable deploying AI and machine learning to complex, real-world problems while ensuring provable guarantees on reliability and robustness. My research agenda spans theory and practice, with particular motivation from applications in energy and sustainability.

Keywords: decision-making under uncertainty, reliable machine learning, online algorithms, energy and sustainability

Education

California Institute of Technology. Pasadena, CA — June 13, 2025 (expected)
Ph.D. in Computing and Mathematical Sciences.
Advisors: *Adam Wierman and Steven Low*
NSF Graduate Research Fellow
PIMCO Graduate Fellow in Data Science
Resnick Sustainability Institute (RSI) Scholar

Harvard College. Cambridge, MA — 2020
A.B. *summa cum laude* in Applied Mathematics.

Industry Collaborations

Microsoft Research — 2023 – present
Developing new algorithms to reliably deploy machine learning to power grid contingency analysis in collaboration with Microsoft Research Special Projects group; resulted in a paper at L4DC 2025 (conference publication 1).

Amazon Prime Video — 2023 – 2024
Developed new algorithms for adaptive bitrate video streaming leveraging advancements in online optimization and learning. Yielded substantial improvements over the state-of-the-art and deployment to the Amazon Prime Video production environment, with results documented in a paper at SIGCOMM 2024 (conference publication 4).

Beyond Limits — 2022 – present
Developing algorithms for robust and efficient operation of real-world electricity/steam cogeneration resources in grids with high renewables penetration. Wrote a manuscript documenting results (journal paper 2) and incorporated the system model into SustainGym, an open-source library of sustainability-related benchmarks for reinforcement learning, documented in a paper at NeurIPS 2023 (conference publication 9).

Honors and Awards

Stanford Energy Postdoctoral Fellowship	2025
Ben P.C. Chou Doctoral Prize in Information Science and Technology	2025
Demetriades-Tsafka-Kokkalis Prize in Renewable Energy Sources	2025
PIMCO Graduate Fellowship in Data Science	2024
NSF Graduate Research Fellowship	2021
Phi Beta Kappa Junior 24	2019
John Harvard Scholarship	2017, 2019
Blair Research Fellowship (UPenn)	2018
Detur Book Prize	2017

Working Papers

** indicates equal contribution*
† indicates undergraduate I advised

1. **Risk-Sensitive Online Algorithms**
   Journal version in preparation
   Nicolas Christianson, Bo Sun, Steven Low, Adam Wierman
   Preliminary version accepted for presentation at COLT '24 (conference publication 3)
2. **End-to-End Conformal Calibration for Optimization Under Uncertainty**
   Under review
   ***Honorable Mention**, Best Poster Award at LANL Grid Science Winter School 2025*
   Christopher Yeh*, **Nicolas Christianson***, Alan Wu, Adam Wierman, Yisong Yue
   Preliminary version appeared at ICLR '23 Workshop on Tackling Climate Change with Machine Learning (workshop paper 1)
3. **Online Conversion with Switching Costs: Robust and Learning-Augmented Algorithms**
   Journal version under review
   Adam Lechowicz, **Nicolas Christianson**, Bo Sun, Noman Bashir, Mohammad Hajiesmaili, Adam Wierman, Prashant Shenoy
   Preliminary version accepted to ACM SIGMETRICS/IFIP Performance 2024 (conference publication 7)
4. **Learning for Online Scheduling with Competitive Fairness Guarantees**
   Accepted to ACM e-Energy 2025
   Pengfei Li, **Nicolas Christianson**, Jianyi Yang, Adam Wierman, Shaolei Ren
5. **Memoryless algorithms for learning-augmented online optimization with switching costs**
   In preparation
   Junxuan Shen†, **Nicolas Christianson**, Adam Wierman
6. **Learning Dynamic Graphs, Too Slow**
   Preprint
   Andrei A. Klishin, **Nicolas H. Christianson**, Cynthia S.Q. Siew, Dani S. Bassett

Conference Publications

1. **Fast and Reliable $N-k$ Contingency Screening with Input-Convex Neural Networks**
   *Learning for Dynamics & Control Conference (**L4DC**) 2025*
   Nicolas Christianson, Wenqi Cui, Steven Low, Weiwei Yang, Baosen Zhang
2. **Learning-Augmented Competitive Algorithms for Spatiotemporal Online Allocation with Deadline Constraints**
   ACM SIGMETRICS 2025
   Adam Lechowicz, **Nicolas Christianson**, Bo Sun, Noman Bashir, Mohammad Hajiesmaili, Adam Wierman, Prashant Shenoy
   Journal version: POMACS 2025 (journal publication 1)
3. **Risk-Sensitive Online Algorithms**
   *37th Annual Conference on Learning Theory (**COLT 2024**)*
   Nicolas Christianson, Bo Sun, Steven Low, Adam Wierman
   Journal version: In preparation (working paper 1)

4. **SODA: An adaptive bitrate controller for consistent high-quality video streaming**
   SIGCOMM 2024
   Tianyu Chen, Yiheng Lin, **Nicolas Christianson**, Zahaib Akhtar, Sharath Dharmaji, Mohammad Hajiesmaili, Adam Wierman, Ramesh K. Sitaraman
5. **Chasing Convex Functions with Long-term Constraints**
   *41st International Conference on Machine Learning (**ICML 2024**)*
   Adam Lechowicz, **Nicolas Christianson**, Bo Sun, Noman Bashir, Mohammad Hajiesmaili, Adam Wierman, Prashant Shenoy
6. **Online Algorithms with Uncertainty-Quantified Predictions**
   *41st International Conference on Machine Learning (**ICML 2024**)*
   Bo Sun, Jerry Huang†, **Nicolas Christianson**, Mohammad Hajiesmaili, Adam Wierman, Raouf Boutaba
7. **Online Conversion with Switching Costs: Robust and Learning-Augmented Algorithms**
   ACM SIGMETRICS/IFIP PERFORMANCE 2024
   Adam Lechowicz, **Nicolas Christianson**, Bo Sun, Noman Bashir, Mohammad Hajiesmaili, Adam Wierman, Prashant Shenoy
   Journal version: Under review (working paper 3)
8. **The Online Pause and Resume Problem: Optimal Algorithms and An Application to Carbon-Aware Load Shifting**
   ACM SIGMETRICS/IFIP PERFORMANCE 2024
   Adam Lechowicz, **Nicolas Christianson**, Jinhang Zuo, Noman Bashir, Mohammad Hajiesmaili, Adam Wierman, Prashant Shenoy
   Journal version: POMACS 2023 (journal publication 3)
9. **SustainGym: Reinforcement Learning Environments for Sustainable Energy Systems**
   *36th Annual Conference on Neural Information Processing Systems (**NeurIPS 2023**), Datasets and Benchmarks Track*
   Christopher Yeh, Victor Li, Rajeev Datta, Julio Arroyo, **Nicolas Christianson**, Chi Zhang, Yize Chen, Mohammad Mehdi Hosseini, Azarang Golmohammadi, Yuanyuan Shi, Yisong Yue, Adam Wierman
10. **Pricing Uncertainty in Stochastic Multi-Stage Electricity Markets**
    *62nd IEEE Conference on Decision and Control (**CDC 2023**)*
    Lucien Werner*, **Nicolas Christianson***, Alessandro Zocca, Adam Wierman, Steven Low
11. **Optimal robustness-consistency tradeoffs for learning-augmented metrical task systems**
    *26th International Conference on Artificial Intelligence and Statistics (**AISTATS 2023**)*
    Nicolas Christianson, Junxuan Shen†, Adam Wierman
12. **Smoothed Online Optimization with Unreliable Predictions**
    ACM SIGMETRICS 2023
    Daan Rutten, **Nicolas Christianson**, Debankur Mukherjee, Adam Wierman
    Journal version: POMACS 2023 (journal publication 4)
13. **Dispatch-aware planning for feasible power system operation**
    *22nd Power Systems Computation Conference (**PSCC 2022**)*
    Nicolas Christianson, Lucien Werner, Adam Wierman, Steven Low
    Journal version: EPSR 2022 (journal publication 5)

14. **Chasing Convex Bodies and Functions with Black-Box Advice**
*35th Annual Conference on Learning Theory (**COLT 2022**)*
Nicolas Christianson, Tinashe Handina, Adam Wierman

Journal Publications

1. **Learning-Augmented Competitive Algorithms for Spatiotemporal Online Allocation with Deadline Constraints**
Proc. of the ACM on Measurement and Analysis of Computing Systems; vol. 9, iss. 1, art. 8, pp. 1-49, 2025
Adam Lechowicz, **Nicolas Christianson**, Bo Sun, Noman Bashir, Mohammad Hajiesmaili, Adam Wierman, Prashant Shenoy
To appear at ACM SIGMETRICS '25 (conference publication 2)
2. **Robust Machine-Learned Algorithms for Efficient Grid Operation**
Environmental Data Science; vol. 4, art. e24
Nicolas Christianson, Christopher Yeh, Tongxin Li, Mehdi Hosseini, Mahdi Torabi Rad, Azarang Golmohammadi, Adam Wierman
Preliminary version appeared at NeurIPS '22 Workshop on Tackling Climate Change with Machine Learning (workshop paper 2)
3. **The Online Pause and Resume Problem: Optimal Algorithms and An Application to Carbon-Aware Load Shifting**
Proc. of the ACM on Measurement and Analysis of Computing Systems; vol. 7, iss. 3, art. 45, pp. 1-32, 2023
Adam Lechowicz, **Nicolas Christianson**, Jinhang Zuo, Noman Bashir, Mohammad Hajiesmaili, Adam Wierman, Prashant Shenoy
Also appeared at ACM SIGMETRICS/IFIP PERFORMANCE '24 (conference publication 8)
4. **Smoothed Online Optimization with Unreliable Predictions**
Proc. of the ACM on Measurement and Analysis of Computing Systems; vol. 7, iss. 1, art. 12, pp. 1-36, 2023
Daan Rutten, **Nicolas Christianson**, Debankur Mukherjee, Adam Wierman
Also appeared at ACM SIGMETRICS/IFIP PERFORMANCE '24 (conference publication 12)
5. **Dispatch-aware planning for feasible power system operation**
Electric Power Systems Research; vol. 212: 108597, 2022
Nicolas Christianson, Lucien Werner, Adam Wierman, Steven Low
Also appeared at PSCC '22 (conference publication 13)
6. **Optimizing the human learnability of abstract network representations**
Proceedings of the National Academy of Sciences; vol. 119, iss. 35: e2121338119, 2022
William Qian, Christopher W. Lynn, Andrei A. Klishin, Jennifer Stiso, **Nicolas H. Christianson**, Dani S. Bassett
7. **Architecture and evolution of semantic networks in mathematics texts**
Proceedings of the Royal Society A; vol. 476, iss. 2239: 20190741, 2020
Nicolas H. Christianson, Ann Sizemore Blevins, Dani S. Bassett
8. **Structural and Functional Influence of the Glycine-Rich Loop G^{302}GGGY on the Catalytic Tyrosine of Histone Deacetylase 8**
Biochemistry; vol. 55, iss. 48: 6718-6729, 2016
Nicholas J. Porter, **Nicolas H. Christianson**, Christophe Decroos, David W. Christianson

9. **Biochemical and Structural Characterization of HDAC8 Mutants Associated with Cornelia de Lange Syndrome Spectrum Disorders**
Biochemistry; vol. 54, iss. 42: 6501-6513, 2015
Christophe Decroos, **Nicolas H. Christianson**, Laura E. Gullett, Christine M. Bowman, Karen E. Christianson, Matthew A. Deardorff, David W. Christianson

Workshop Papers

1. **Decision-Aware Uncertainty-Calibrated Deep Learning for Robust Energy System Operation**
*Workshop on Tackling Climate Change with Machine Learning at **ICLR 2023***
Christopher Yeh, **Nicolas Christianson**, Steven Low, Adam Wierman, Yisong Yue
Full version: Under review (working paper 2)
2. **Robustifying Machine-Learned Algorithms for Efficient Grid Operation**
*Workshop on Tackling Climate Change with Machine Learning at **NeurIPS 2022***
Nicolas Christianson, Christopher Yeh, Tongxin Li, Mahdi Torabi Rad, Azarang Golmohammadi, Adam Wierman
Full version: Environmental Data Science (journal paper 2)

Selected Talks
∗ ***denotes invited***

Reliable AI-Augmented Algorithms for Energy
**Cornell University – ORIE Seminar.* February 2025
**MIT Sloan School of Management – OM Seminar.* January 2025
**Yale School of Management – Operations Seminar.* January 2025
**Johns Hopkins University – CS Seminar.* December 2024
**Columbia Business School – DRO Seminar.* December 2024

Reliable ML-Augmented Algorithms for Energy and Sustainability
**INFORMS Annual Meeting.* October 2024
**UMass Amherst – Systems and Sustainability Seminar.* October 2024
**Cornell ORIE – Young Researchers Workshop.* October 2024
**UC Berkeley – Energy Modeling, Analysis, & Control Group.* September 2024

Learning-augmented algorithms for online optimization and beyond
**Alberta Machine Intelligence Institute (Amii) AI Seminar.* July 2024

Risk-Sensitive Online Algorithms
Conference on Learning Theory (COLT). July 2024
Mathematical Modeling and Analysis Workshop, ACM SIGMETRICS. June 2024

Robust Machine-Learned Algorithms for Efficient Grid Operation
**CAST Annual Program Review, Caltech.* October 2023

Provable Guarantees on AI/ML for Metrical Task Systems and Classification
**UMass Amherst – CS Theory Seminar.* October 2023

Optimal Robustness-Consistency Tradeoffs for Learning-Augmented Metrical Task Systems
**INFORMS Annual Meeting.* October 2023

Chasing Convex Bodies and Functions with Black-Box Advice
**Asilomar Conference on Systems and Signals.* November 2022
**Harvard University – Na Li's Research Group.* October 2022

**UMass Amherst – Data Science Deep Dive Seminar.* October 2022
**INFORMS Annual Meeting.* October 2022
Conference on Learning Theory (COLT). July 2022

Dispatch-aware planning for feasible power system operation
Power Systems Computation Conference (PSCC). June 2022

Research Mentorship

Lukas Himmelreich (ETH Zurich M.Sc. '25) 2025
Topic: Risk-sensitive algorithms for peak-aware energy dispatch
Elizabeth Rogers (Harvey Mudd B.S. '26) 2025
Topic: Health-aware optimal power flow
Apoorva Thanvantri (Caltech B.S. '26) 2025
Topic: Improving electric vehicle aggregate flexibility with end-to-end learning
James Chen (Caltech B.S. '24) 2023 – 2024
Topic: Learning-augmented online optimization with ramp constraints
NSF Graduate Research Fellowship — Honorable Mention
Next step: MIT EECS PhD student
Junxuan (Helen) Shen (Caltech B.S. '24) 2022 – 2024
Topic: Learning-augmented algorithms for multiserver convex function chasing
Next step: MIT EECS PhD student
Jerry Huang (Caltech B.S. '24) 2022 – 2023
Topic: Online algorithms with uncertainty-quantified predictions
Next step: CMU CS PhD student

Teaching Experience

California Institute of Technology
→ *Teaching Assistant*
CS 146: Control and Optimization of Networks Spring 2024
CS 42: Computer Science Education in K-14 Settings Winter 2024
CS 146: Control and Optimization of Networks Winter 2023
CS 42: Computer Science Education in K-14 Settings Winter 2023

Harvard College
→ *Peer Tutor, Harvard Bureau of Study Counsel/Academic Resource Center*
Math 25a: Theoretical Linear Algebra and Real Analysis I Fall 2019
CS 181: Machine Learning Spring 2019
APMTH 50: Introduction to Applied Mathematics Spring 2019, Spring 2020
Math 132: Differential Topology Spring 2019
APMTH 106: Applied Algebra Fall 2018
STAT 110: Introduction to Probability Fall 2018
CS 51: Intro to Computer Science II Spring 2018, Spring 2019, Spring 2020
Math 25b: Theoretical Linear Algebra and Real Analysis II Spring 2018

→ *Course Assistant*
Math Ma: Introduction to Functions and Calculus I Fall 2017

Funding: Proposals and awards

Assisted in preparation of two proposals (PI: Adam Wierman) through Caltech's Center for Autonomous Systems and Technology, funded by Beyond Limits in 2022 and 2023. $230,000

NSF Graduate Research Fellowship, awarded 2021. $138,000

Professional Service

Workshop Organization

Co-Chair, Learning-augmented Algorithms: Theory and Applications at *ACM SIGMETRICS/IFIP PERFORMANCE 2024.* — June 2024

Journal Reviewing

IEEE Transactions on Automatic Control — 2025
IEEE/ACM Transactions on Networking — 2023, 2024

Conference and Workshop Reviewing

→ *Conferences*

Asilomar Conference on Signals, Systems, and Computers. — 2022, 2024
IEEE Conference on Decision and Control (CDC). — 2025
Learning for Dynamics & Control Conference (L4DC). — 2025
ACM SIGMETRICS. (subreviewer) — 2022, 2023, 2024
ACM e-Energy. (subreviewer) — 2023, 2024

→ *Workshops*

NeurIPS Workshop on Computational Sustainability — 2023

Internal Service

Student Member of Caltech CMS AI/ML Admissions Committee — 2022 – 2025
Caltech CMS Prelim Exam Preparation Coordinator — 2021 – 2022

Outreach

Pasadena Public Schools. Science Night volunteer — 2023 – 2025
Designing and organizing hands-on CS activities for elementary school students for "Science Nights" at public schools in and around Pasadena.

Caltech Accountability Partners Program. PhD application mentor — 2022 – 2025

iSTEM Scholars. Summer research mentor — 2021

Project SHORT. PhD application mentor — 2020 – present

Work Experience

Microsoft Research. Redmond, WA — Summer 2023
Research Intern
Intern in the Special Projects group, developing reliable machine learning methods to accelerate contingency analysis in energy grids while ensuring provable guarantees on performance.

KOACORE. Remote — Spring 2023
Machine Learning Lead and Consultant
Led development of proof-of-concept and product strategy for KOA-SUPPLY, an AI-driven healthcare supply chain marketplace which has since been acquired by Stead Impact Ventures and now operates as Cato.

The Boston Consulting Group. Boston, MA — Summer 2019
Summer Associate
Partnered with a top-10 global biopharmaceutical company to optimize its supply and manufacturing networks, using data and digital-driven techniques to forecast production needs and increase efficiency.

Covance. Princeton, NJ — Summer 2017
Data Science Intern
Developed statistical and machine learning models to forecast clinical trial patient recruitment.