

# Jeremy McMahan

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## Education

2018–2025 **PhD in Computer Science**, *University of Wisconsin-Madison*

- **Minor:** Mathematics
- **Thesis:** *Safe Multi-Agent Reinforcement Learning in Polynomial Time*
- **Advisor:** Prof. Jerry Zhu
- **Distinctions:** LEAP Fellow, IFDS Competitive Assistantship

2018–2020 **MS in Computer Science**, *University of Wisconsin-Madison*

- **Thesis:** *A D-competitive algorithm for the Multilevel Aggregation Problem with Deadlines*
- **Advisor:** Prof. Shuchi Chawla
- **Distinctions:** CS Departmental Scholarship

2016–2018 **BS in Mathematics and Computer Science**, *University of Illinois Urbana-Champaign*

- **Thesis:** *Spectral Graph Isomorphism*
- **Advisor:** Prof. Alexandra Kolla
- **Distinctions:** Ranked #1 in Mathematics and Computer Science

## Research Interests

Topics Algorithms under Uncertainty, Approximation Algorithms, Combinatorial Optimization, Algorithmic Game Theory, Reinforcement Learning.

Summary Designing scalable and provable approximation algorithms for optimization under uncertainty, bridging classical combinatorial techniques with modern stochastic and learning-based settings, including applications in constrained multi-agent reinforcement learning.

## Research Experience

2020–2025 **Graduate Research Assistant**, *University of Wisconsin-Madison*  
*Affiliation:* Institute for Foundations of Data Science (IFDS)  
*Advisors:* Jerry Zhu and Shuchi Chawla

### Optimization under Uncertainty

- **Constrained Reinforcement Learning:** Designed the first polynomial-time approximation algorithms for general Constrained MDPs, *subsuming* many standard constraint types where no efficient algorithms previously existed, and proved matching hardness results. Leveraged new combinatorial constraint characterizations, packing-covering duality, graph algorithms, and strategic rounding. (*ICML '25, NeurIPS '24, AISTATS '24*)

- **Stochastic Optimization:** Designed the first adaptive approximation algorithms for the Pandora's Box problem with correlated values, utilizing approximation-preserving reductions and adaptive dynamic programming. (*APPROX '23*)
- **Online Scheduling:** Designed the first D-competitive algorithm for the Online Multilevel Aggregation Problem with Deadlines, establishing the state-of-the-art competitive ratio via an online subtree-recursive approach, charging arguments, and new characterizations of optimal service times. (*Preprint*)

## Game-Theoretic Foundations of MARL

- **Safe and Robust Equilibria:** Developed the first polynomial-time algorithms for computing safety-driven “Anytime-Constrained” equilibria, adversarial defense equilibria, and uncertainty-robust equilibria for Markov Games by leveraging linear programming characterizations of equilibria, dynamic programming approximation techniques, and convex analysis. (*ICML '25, ICML '24, AAAI '24*)
- **Adversarial Attacks and Equilibria Analysis:** Developed the first optimal, polynomial-time algorithms for offline reward poisoning, online adversarial attacks, and offline misinformation attacks on Markov games by leveraging new characterizations of the sensitivity and uniqueness of Markovian equilibria, along with LP-duality, to reduce complex bi-level formulations. (*ICML '24, RLC '24, AAAI '24, AAAI '23*)
- **Incentivized Exploration:** Developed a mechanism design framework to align myopic agents with social welfare goals in multi-armed bandit settings by selectively revealing information in phases based on a charging argument and a characterization of first-best outcomes. (*GAMES '20*)

## Publications

\* *Indicates equal contribution. Authorship order follows venue conventions (Alphabetical for Theory, Contribution-based for ML).*

### Refereed Conference Proceedings

ICML '25 **Polynomial-Time Approximability of Constrained Reinforcement Learning**  
*Jeremy McMahan*

ICML '25 **Anytime-Constrained Equilibria in Polynomial Time**  
*Jeremy McMahan*

NeurIPS '24 **Deterministic Policies for Constrained Reinforcement Learning in Polynomial Time**  
*Jeremy McMahan*

RLC '24 **Inception: Efficiently Computable Misinformation Attacks on Markov Games**  
*Jeremy McMahan, Young Wu, Yudong Chen, Xiaojin Zhu, Qiaomin Xie*  
[Oral]

ICML '24 **Roping in Uncertainty: Robustness and Regularization in Markov Games**  
*Jeremy McMahan, Giovanni Artiglio, Qiaomin Xie*

ICML '24 **Minimally Modifying a Markov Game to Achieve any Nash Equilibrium and Value**  
*Young Wu, Jeremy McMahan, Yiding Chen, Yudong Chen, Xiaojin Zhu, Qiaomin Xie*

CogSci '24 **Various Misleading Visual Features in Misleading Graphs: Do they truly deceive us?**  
*Jihyun Rho, Martina A Rau, Shubham Kumar Bharti, Rosanne Luu, Jeremy McMahan, Andrew Wang, Jerry Zhu*

AISTATS '24 **Anytime-Constrained Reinforcement Learning**  
*Jeremy McMahan, Xiaojin Zhu*

AAAI '24 **Optimal Attack and Defense for Reinforcement Learning**  
*Jeremy McMahan, Young Wu, Xiaojin Zhu, Qiaomin Xie*  
[Oral]

AAAI '24 **Data Poisoning to Fake a Nash Equilibrium for Markov Games**  
*Young Wu, Jeremy McMahan, Xiaojin Zhu, Qiaomin Xie*

APPROX '23 **Approximating Pandora's Box with Correlations**  
*Shuchi Chawla\*, Evangelia Gergatsouli\*, Jeremy McMahan\*, Christos Tzamos\**  
[Oral]

AAAI '23 **Reward Poisoning Attacks on Offline Multi-Agent Reinforcement Learning**  
*Young Wu, Jeremy McMahan, Xiaojin Zhu, Qiaomin Xie*  
[Oral]

GAMES '20 **Noble Deceit: Optimizing Social Welfare for Myopic Multi-Armed Bandits**  
*Ashwin Maran\*, Jeremy McMahan\*, Nathaniel Sauerberg\**

**Preprints and Working Papers**

Preprint **Optimally Installing Strict Equilibria**  
*Jeremy McMahan, Young Wu, Yudong Chen, Xiaojin Zhu, Qiaomin Xie*

Preprint **A D-competitive Algorithm for the Multilevel Aggregation Problem with Deadlines**  
*Jeremy McMahan*

## Software and Research Artifacts

Python / **Anytime-Constrained RL Library**, [\[GitHub Link\]](#)

Jupyter A dedicated library of optimization solvers and Gymnasium wrappers for Anytime-Constrained MDPs, accompanying the AISTATS '24 paper. Includes a full benchmarking suite comparing the efficacy of our proposed methods.

Python / **Knapsack Approximations Suite**, [\[GitHub Link\]](#)

Jupyter A comprehensive benchmarking framework comparing classical approximation algorithms against deep learning heuristics for large-scale Knapsack problems.

Python / **Optimal Attack and Defense for RL**, [\[GitHub Link\]](#)

Jupyter Reference implementations for multi-surface optimal attacks on RL agents, demonstrated on Mini-Grid environments. Reproduces experimental results from the AAAI '24 paper.

Python / **Optimal Offline Poisoning Attacks on MARL**, [\[GitHub Link\]](#)

Jupyter Reference implementations for linear-programming based optimal attacks on offline MARL agents, accompanying the AAAI '23 paper.

## Selected Talks

### From Knapsacks to Self Driving: FPTAS Recipes for Constrained Reinforcement Learning

- UMD College Park (MARL Seminar) March 2025
- UW-Madison (Theory Seminar) November 2024

### Optimal Attack and Defense for Reinforcement Learning

- UW-Madison (Theory Seminar) February 2025
- UW-Madison (Computer Vision Roundtable) January 2024

## Teaching Experience

### Primary Instructor

Summer 2022 **CS 577: Introduction to Algorithms**, *University of Wisconsin-Madison*

- Responsible for curriculum design, lecture delivery, course structure, and student evaluation for a class of 100 students.
- Designed original lecture slides, lecture notes, lecture videos, and problem sets focusing on the design of efficient algorithms and rigorous proofs of correctness.
- Managed one TA and grader.

### Head Teaching Assistant

Spring 2021, 2022 **CS 540: Introduction to Artificial Intelligence**, *University of Wisconsin-Madison*

- Coordinated the administrative and grading workflow for a large-scale course with 500 students, 8 TAs, and over 20 graders and peer mentors.
- Developed standardized grading rubrics and course structures in addition to the standard teaching assistant duties.
- *Instructors: Ilias Diakonikolas, Sharon Li, Fred Sala, and Jerry Zhu*

### Guest Lecturer

Spring 2025 **CS 839: Game Theory, Optimization & Learning**, *University of Wisconsin-Madison*

- Designed and presented two lectures on the theory of multi-agent reinforcement learning.
- *Instructor: Manolis Vlatakis*

Summer 2021, 2022 **New Horizons in Theoretical Computer Science Summer School, ACM SIGACT**

- Designed lectures spanning complexity theory basics, interactive proofs, and Markov-chain Monte Carlo methods.
- *Instructors: Antonio Blanca, Nicole Immorlica, Yael Kalai, Jelani Nelson, and Ashia Wilson*

### Graduate Teaching Assistant

Fall 2020, 2021 **CS 540: Intro to Artificial Intelligence**, *University of Wisconsin-Madison*  
*Instructors: Anthony Gitter, Josiah Hanna, Yin Li, Yingyu Liang, and Daifeng Wang*

Spring 2019, 2020 **CS 577: Introduction to Algorithms**, *University of Wisconsin-Madison*  
*Instructors: Shuchi Chawla, Dieter van Melkebeek, and Christos Tzamos*

Fall 2019 **CS 301: Introduction to Data Science**, *University of Wisconsin-Madison*  
*Instructor: Tyler Caraza-Harter*

Fall 2018 **CS 524: Introduction to Optimization**, *University of Wisconsin-Madison*  
*Instructor: Steve Wright*

## Awards and Honors

2021–2025 **LEAP Fellow**, *CMD-IT / NSF Alliance*

Selected for the NSF-funded *Leadership, Excellence, Access, and Pathways* (LEAP) Alliance, focused on diversifying future faculty leadership in computing.

2022–2024 **IFDS Competitive Research Assistantship**, *Institute for Foundations of Data Science (IFDS)*

Awarded a competitive research position to conduct interdisciplinary work at the intersection of data science and optimization.

2023 **UW CS Graduate Instructor Award**, *University of Wisconsin-Madison*  
Recognition for excellent performance as a primary instructor.

2019–2022 **The "Golden Brick" Teaching Award**, *University of Wisconsin-Madison*  
A student/instructor-voted honor for most effective teaching. *Won consecutively for every year served as a TA (4+ years).*

2018–2019 **CS Departmental Scholarship**, *University of Wisconsin-Madison*  
Merit-based scholarship awarded to incoming PhD students.

2018 **Most Outstanding Major Award**, *University of Illinois Urbana-Champaign*  
Awarded to the **#1-ranked student** in Mathematics and Computer Science.

## Professional Service

2024 – 2025 **Conference Reviewer**

NeurIPS (2024, 2025), ICML (2024, 2025), AISTATS (2025), RLC (2024)

### Leadership & Organization

2023–2025 **Co-Organizer, *Machine Learning Lunch Meetings (MLLM) Seminar*,**

University of Wisconsin-Madison

Organized weekly research seminars for the ML community, which included managing speaker invitations, scheduling, and logistics for internal and external presenters.

### Outreach & Mentorship

2021–2022 **Planning Committee & Teaching Assistant, *ACM SIGACT, New Horizons in Theoretical Computer Science Summer School***

A week-long summer school aimed at inspiring undergraduates from underrepresented backgrounds to pursue careers in TCS.

- Served on the planning committee.
- Mentored students during technical sessions and social events.
- Developed and presented lessons on selected TCS topics.

## Technical Skills

Languages **Python, Julia, C/C++, Mathematica, SageMath, L<sup>A</sup>T<sub>E</sub>X, Bash**

Libraries **Gymnasium, Gurobi, SciPy, PyTorch**