CHENYU ZHANG

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EDUCATION

Columbia University, New York, NY *2022 - 2023 (expected)*
M.S. Data Science
GPA: 4.00/4.00

Fudan University, Shanghai, CN *2018 - 2022*
B.S. Mathematics and Applied Mathematics
Honors Student of Su Buqing Top Talent Program

PUBLICATIONS

- **Chenyu Zhang**, Xu Chen, and Xuan Di. A single online agent can efficiently learn mean field games. *Twenty-Seventh International Conference on Artificial Intelligence and Statistics,* 2024. [Under review; unanimously positive reviews]
- **Chenyu Zhang**, Han Wang, Aritra Mitra, and James Anderson. Finite-time analysis of on-policy heterogeneous federated reinforcement learning. *The Twelfth International Conference on Learning Representations,* 2024. [Under review; top 10% review score] [Preprint]
- **Chenyu Zhang** and Rujun Jiang. Riemannian adaptive regularized Newton methods with Hölder continuous Hessians. *Mathematics of Operations Research,* 2023. [Under review] [Preprint]
- **Chenyu Zhang**, Rufeng Xiao, Wen Huang, and Rujun Jiang. Riemannian trust region methods for SC^1 minimization. *Journal of Scientific Computing,* 2023. [Under review] [Preprint]

WORKING PAPERS

- **Chenyu Zhang**, Fuzhong Zhou, Xu Chen, and Xuan Di. Online learning for graphon mean field games. [Ready to submit to ICML 2024]
- **Chenyu Zhang**, Xu Chen, and Xuan Di. Single-agent model-free methods for learning mean field games with automatic stabilization and linear function approximation. [Ready to submit to ICML 2024]
- **Chenyu Zhang**, Qi Cai, Zhuoran Yang, and Zhaoran Wang. On reward-free reinforcement learning for POMDPs with linear function approximation. [Ready to submit]

RESEARCH EXPERIENCE

Neural Networks *May 2023 - Present*
Research assistant, advised by Prof. John Wright *Dept. EE&APAM, Columbia University, NY*

- Identified constraints within neural tangent kernels and designing data-aware kernels for analyzing fully-connected neural networks.
- Analyzed limitations of Transformers and designing tailored attention mechanisms with tensor kernels and invariant similarity weights.
- Conducted a comprehensive empirical study on intrinsic dimension estimation of patch manifolds and deriving the optimal patch size for various vision tasks.

Mean Field Games *May 2023 - Present*
Research assistant, advised by Prof. Sharon Di *Dept. CEEM, Columbia University, NY*

- Pioneered the first fully online single-agent model-free methods for learning mean field games, complete with sample complexity guarantees.

- Advanced the online methods to eliminate the reliance on forward-backward passes used in prior work, thereby obviating the need for supplementary stabilization techniques.
- Designed multi-agent systems capable of efficiently handling large heterogeneous populations.

Federated Reinforcement Learning *September 2022 - Present*
Research assistant, advised by Prof. James Anderson *Dept. EE, Columbia University, NY*
Co-advised by Prof. Aritra Mitra *Dept. ECE, North Carolina State University, NC*

- Developed a novel on-policy federated reinforcement learning method and established its finite-time error bounds, demonstrating its linear convergence speedups with the presence of environmental heterogeneity.
- Conducted three simulations to corroborate the theoretical results and showcase the adaptability and robustness of the proposed methods.

Nonsmooth Nonconvex Manifold Optimization *October 2021 - September 2022*
Research assistant, advised by Prof. Rujun Jiang *Dept. Data Science, Fudan University, CN*
Co-advised by Prof. Wen Huang *Dept. Mathematics, Xiamen University, CN*

- Developed the first Riemannian trust-region method tailored for minimizing nonconvex functions on manifolds with a semismooth gradient field, complete with a comprehensive convergence analysis including global convergence and superlinear local convergence rate.
- Implemented the semismooth Riemannian trust-region method in solving augmented Lagrangian method subproblems on manifolds, demonstrating its superiority through two numerical experiments.
- Extended the methodology to formulate the Riemannian adaptive regularized Newton methods framework and established its sharp worst-case iteration and operation complexities.

Reinforcement Learning with Partial Observability *March 2021 - January 2022*
Research assistant, advised by Prof. Zhaoran Wang *Dept. of IEMS&CS, Northwestern University, IL*
Co-advised by Prof. Zhuoran Yang *Dept. of Stat&Data Science, Yale University, CT*

- Devised an innovative exploration mechanism to handle partial observability without reward feedback.
- Enhanced the mechanism by integrating linear function approximation, enabling its application to large and potentially infinite observation and state spaces.

RELEVANT COURSEWORK

Graduate Courses

Machine Learning	A	Reinforcement Learning*	A+
High-Dimensional Probability*	A	Probability and Statistics for Data Science	A+
Modern Control Theory*	A+	Algorithms for Data Science	A+
Exploratory Data Analysis	A+	Computer Systems	A

Selected Undergraduate Courses

Numerical Linear Algebra and Optimization†	A	Deep Learning	A
Numerical Solution to Differential Equations	A	Methods of Optimization	A
Functions of Complex Variable	A	Probability Theory	A
An Introduction to Differential Manifolds†	A-	Advanced Algebra	A
Computational Thinking	A	Fundamentals of Mechanics	A

Selected Seminars

Matrix Analysis	Convex Optimization
Heuristic Optimization Algorithms	Complex Analysis
Advanced Mathematical Analysis	Principles of Mathematical Analysis
Global Differential Geometry	Differential Manifolds and Differential Topology
Differential Geometry of Curves and Surfaces	Non-Euclidean Geometry and Point Set Topology

*Ph.D. level courses
†Honors courses

TEACHING EXPERIENCE

COMS 4771 Machine Learning *Fall 2023*
Teaching assistant, advised by Prof. Daniel Hsu *Dept. CS, Columbia University, NY*

ORCS 4529 Reinforcement Learning *Fall 2023*
Teaching assistant, advised by Prof. Shipra Agrawal *Dept. IEOR, Columbia University, NY*

EEOR 4650 Convex Optimization *Fall 2023*
Teaching assistant, advised by Prof. James Anderson *Dept. EE, Columbia University, NY*

CSOR 4231 Analysis of Algorithms *Spring 2023*
Teaching assistant, advised by Prof. Eleni Drinea *Dept. CS, Columbia University, NY*

SCHOLARSHIP & AWARD

- Honors Student of Top Talent Program, Fudan University *2022*
- Undergraduate Merit Scholarship, Fudan University *2018-2019, 2019-2020, 2020-2021, 2021-2022*
- Undergraduate Major Scholarship, Fudan University *2019-2020, 2020-2021, 2021-2022*
- The Chinese Mathematics Competitions - Second Class Award *2019*
- The Chinese Physics Competitions - Second Class Award *2019*
- Freshman Scholarship, Fudan University *2018*