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Guillaume Wang

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RESEARCH INTERESTS

- **Theory for machine learning**: understanding the dynamics, optimization landscape, and generalization abilities of learning algorithms.
- **Convex and nonconvex optimization**.
- **Optimal transport** theory and applications to analysis of **particle methods** and **sampling**.

EDUCATION

2021 - present
EPFL, Switzerland
PhD in **Mathematics** advised by Prof. Lénaïc Chizat
Overall GPA: 5.71 (max: 6, min: 1) via 12 credits
Thesis: Particle methods for optimization over the space of measures

2019 - 2021
ETH Zurich, Switzerland
M.Sc. in **Computer Science**
Overall GPA: **5.80 (max: 6, min: 1)** via 114 credits
Selected courses: Guarantees for Machine Learning; Probabilistic Artificial Intelligence; Statistical Learning Theory; Neural Network Theory; Algorithms Lab

2016 - 2019
École polytechnique, France
Cycle Ingénieur polytechnicien
Overall GPA: **3.87 out of 4** via 166 credits
3rd year track: Computer Systems Design

RESEARCH EXPERIENCE

Oct. 2021 - present
PhD research, EPFL
Dynamics of Learning Algorithms chair, Prof. Lénaïc Chizat

- Analyzing particle-based algorithms for optimization over probability or signed measures, through the lens of **Wasserstein gradient flows**. Examples of amenable settings: gradient descent for 2-layer neural networks; **(mean-field) Langevin dynamics** for sampling (or entropy-regularized optimization with noisy gradients).
- Leveraging the **Wasserstein Fisher-Rao** geometry, from **unbalanced optimal transport**, for optimization. Example: particle gradient dynamics with weight updates for mixed Nash equilibria.
- Sharpening the analogy between differential or **Riemannian manifolds** and the manifold of probability measures equipped with the transport geometry.
- Analyzing **min-max** and **accelerated** optimization dynamics.

Apr. 2021 - Sep. 2021
Research internship, ETH Zurich
Statistical Machine Learning group, Prof. Fanny Yang

- Defined the "in-principle" **inductive bias of overparametrized models**; computed it for deep linear networks; showed it is non-convex for deep ReLU networks.
- Analyzed the statistical behavior of **min-ℓ_1-norm interpolation for linear regression on noisy data**. Surprisingly, it is asymptotically consistent.

  Results published at AISTATS 2022.

Sep. 2020 - Mar. 2021
Master's Thesis project, ETH Zurich
Chair for Mathematical Information Science, Prof. Helmut Bölcskei

Entropy numbers of nonlinear systems
Report: bit.ly/4harAX5 Slides: bit.ly/4eMEsBg

Summer 2019	**Short research internship**, Cornell University School of Civil and Environmental Engineering, Prof. Samitha Samaranayake Optimizing Commuter Welfare with Subsidies in Multimodal Transportation Report: bit.ly/36OjW1E Slides: bit.ly/3hUu0g4

PUBLICATIONS

[6] Wang, G. (2024). "A Higher-Order Otto Calculus Approach to the Gaussian Completely Monotone Conjecture". *arXiv preprint.*

[5] Wang, G.*, Mousavi-Hosseini, A.*, & Chizat, L. (2024). "Mean-Field Langevin Dynamics for Signed Measures via a Bilevel Approach". *To appear as NeurIPS 2024* ***spotlight****.*

[4] Wang, G., & Chizat, L. (2024). "Open Problem: Convergence of Single-Timescale Mean-Field Langevin Descent-Ascent for Two-Player Zero-Sum Games". *COLT 2024 open problems.*

[3] Wang, G., & Chizat, L. (2023). "Local Convergence of Gradient Methods for Min-Max Games under Partial Curvature". *NeurIPS 2023.*

[2] Wang, G., & Chizat, L. (2022). "An Exponentially Converging Particle Method for the Mixed Nash Equilibrium of Continuous Games". *arXiv preprint, to appear in Open Journal of Mathematical Optimization.*

[1] Wang, G.*, Donhauser, K.*, & Yang, F. (2022). "Tight Bounds for Minimum ℓ_1-Norm Interpolation of Noisy Data". *AISTATS 2022.*

*: equal contribution

SKILLS

Programming: Python and Julia (proficient). Experience in Java, C, C++, Caml.

Languages: French, Chinese (native); English (fluent); German (conversational).

LEADERSHIP & SERVICE

- **Organizing an informal reading group** on continuous optimization at EPFL since 2021.
  - Sample topics: stable manifold theorem; hypocoercivity; Schur-Horn and convexity theorems; Γ-calculus for diffusion processes.
- **Head teaching assistant** at EPFL for
  - Bachelor-level Analysis courses in Spring 2022, Fall 2022, Spring 2024, Fall 2024.
  - Master-level "Numerical Integration of SDEs" in Spring 2023.
- **Reviewer** for Journal of Machine Learning Research; Mathematics of Operations Research; Optimal Transport and Machine Learning workshop (NeurIPS 2023); NeurIPS 2024; ICLR 2025; AISTATS 2025.
- Webmaster of EPFL **SIAM student chapter** (Society for Industrial and Applied Mathematics) since 2022. siam.epfl.ch
- Board member of Ecole polytechnique's computer network student association, Binet Réseau, 2017-2018.

  Co-organized a task force dedicated to "Sigma", a multi-year development project to replace the old student website. Took part in full-stack web development and infrastructure design. Sigma is a group- and event-based social network, written in Node.js, React.js, and using GraphQL. sigma.binets.fr
- A blog about basic but interesting things encountered in my research: guillaumew16.github.io/blog

REFERENCES

Prof. Lénaïc Chizat	lenaic.chizat@epfl.ch	Assistant Professor at EPFL
Prof. Fanny Yang	fan.yang@inf.ethz.ch	Assistant Professor at ETH Zurich