Damien Ferbach

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Education

Mila, Université de Montréal *2024 – Present*
PhD in Computer Science Supervisors: **Gauthier Gidel, Courtney Paquette**

- GPA: 4.3/4.3

Paris-Saclay University, Orsay Mathematics Institute and ENS *2021 – 2023*
Master in Mathematics

- 1st year: cursus in general Mathematics.
- 2nd year: specialization in probability theory, statistics and optimization.

Ecole Normale Supérieure, Paris *2020 – 2021*
Bachelor in Theoretical Physics

Lycée Hoche, Versailles *2018 – 2020*
Preparatory class in maths and physics (MPSI/MP)*

- **Ranked 1st national** at Ecole Polytechnique, the 1st French engineering school.
- Two year intensive program to prepare for the entrance exams of French engineering schools.

Awards and Scholarships

Best Poster Award *2025*
Jury prize for best poster at the first scientific day of DIRO, Université de Montréal.

Quebec Research Fund Scholarship, Nature and Technology (FRQ) *2025-2028*
Awarded a PhD Scholarship of 91.667 Canadian dollars ($\sim$ 66.491 US dollars) over 4 years.

Ecole Normale Supérieure of Paris entrance exam *2020*
Ranked 9^{th} *in national entrance exam*

Ecole Polytechnique entrance exam *2020*
Ranked 1^{st} *in national entrance exam*

International Physics Olympiad Preparation *2019*
Following a written examination, I was selected with around 15 students, to participate in the French experimental preparation for the International Physics Olympiads (IPhO).

Concours général de physique *2018*
Ranked 5th national (2nd accessit)
Most prestigious *national* competition in Physics for French high school students.

Concours général de mathématiques *2018*
Ranked 14th national (Mention)
Most prestigious *national* competition in Mathematics for French high school students.

French Olympic preparation to the International Mathematics Olympiads *2018*
Following a written examination, I was selected for a selective program to train and select the French national team for the International Mathematics Olympiads (IMO).

Industry Experience

Quantitative Research Intern, G-research *Summer 2022*
Personal Initiative Supervisor: **Guillaume Papa**

- 10-weeks internship in the high-frequency trading team.

- Designed improved learning algorithms on tabular data.

Publications

* denotes equal contributions.

[1] **Damien Ferbach**, Katie Everett, Gauthier Gidel, Elliot Paquette, Courtney Paquette, *Dimension-adapted Momentum Outscales SGD*, preprint — link

[2] **Damien Ferbach**, Quentin Bertrand, Joey Bose, Gauthier Gidel, *Self-Consuming Generative Models with Curated Data Provably Optimize Human Preferences*, Neural Information Processing Systems (NeurIPS), 2024, **Spotlight** ($\sim 3\%$ of submitted papers) — link

[3] **Damien Ferbach**, Baptiste Goujaud, Gauthier Gidel, Aymeric Dieuleveut, *Proving Linear Mode Connectivity of Neural Networks via Optimal Transport*, International Conference on Artificial Intelligence and Statistics (AISTATS), 2024 — link

[4] **Damien Ferbach***, Christos Tsirigotis*, Gauthier Gidel, Joey Bose, *A General Framework for Proving the Equivariant Strong Lottery Ticket Hypothesis*, International Conference on Learning Representations (ICLR), 2023 — link

Invited Talks

CRM Workshop: Random matrices and high-dimensional learning dynamics
Dimension Adapted Momentum Outscales SGD — June 2025

Google Deepmind *Dimension Adapted Momentum to Outscale SGD* — April 2025

RMT-ML-OPT Seminar, McGill *Scaling Laws of Stochastic Momentum Algorithms* — April 2025

Research Experience

Visiting Researcher, Mila *Fall 2023*
Personal Initiative Supervisor: **Gauthier Gidel**

I worked on a project to understand the impact of training generative models iteratively on their own synthetic data. More precisely, we show that human curation of the synthetic data acts as an implicit alignment of the model to high reward regions, grounding what is done in practice to finetune Large Language models (work published at NeurIPS 2024 with spotlight).

Research Intern, Ecole Polytechnique *Spring 2023*
Master internship Supervisor: **Aymeric Dieuleveut**

I worked on linear mode connectivity of neural networks. We showed that over-parametrized models are naturally connected by low-loss linear paths in parameter space modulo permutations of the hidden neurons. We use high dimensional optimization theory and mean field limit of shallow neural networks to give precise asymptotic on the width required (work published at AISTATS 2024).

Research Intern, Mila *Spring 2022*
Master internship Supervisor: **Gauthier Gidel**

I worked on the lottery ticket hypothesis. We showed that it is possible to find a pruning mask on over-parametrized neural networks to approximate a smaller target network. We performed extensive experiments on equivariant networks for different group of permutations (translations, permutations, rotations) to show the practicality of our theory (work published at ICLR 2023).

Research Intern, Physics Laboratory of Ecole Normale Supérieure *Summer 2021*
Bachelor internship Supervisor: **Takis Kontos**

Experimental research internship on quantum physics. I studied a resonance cavity with adaptive frequency for the detection of axions (a particle predicted by quantum theory that could explain dark matter). The cavity contained a superconductor Josephson Junction that was cooled down in a dilution refrigerator.

Experimental Physics Intenship, Ecole Normale Supérieure de Cachan *Spring 2019*

Personal initiative

Experimental internship to prepare for the International Physics Olympiads. The topics included the diffraction of electrons through a cristal, wave theory, electricity, and kinetics.

Community Service

Peer-Reviewing 2023-Present

I served as a reviewer for top-tier Machine Learning conferences.
Reviewer: AISTATS 2024, ICLR 2024.

Organizer: Reading group on high-dimensional optimization, Mila Summer 2024