Mathis Hardion

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mhardion

Recent master's graduate in mathematics and data science, set to begin a PhD position next September to research entropic optimal transport, gradient flows and applications. Currently focused on writing an article based on my master thesis, I am seeking for part-time opportunities to complement this research activity.

Interests

Optimal Transport and its Entropic Regularization, Gradient Flows in Metric Spaces, Machine Learning & Statistics, MCMC methods, Optimization, Topological and Geometric Data Analysis

Education

2023 - 2024 **Master MVA (Mathematics, Vision, Learning)**
École Normale Supérieure de Paris-Saclay (Gif-sur-Yvette, France)
Research-oriented degree in data science through a mathematical lens, wide spectrum of courses followed in the above domains of interest.
Thesis: Gradient Flows in the Geometry of the Sinkhorn Divergence (report, defense slides).
Supervisor: Hugo Lavenant (Bocconi University).

2020 - 2024 **MSc in Applied Mathematics**
Télécom Paris (Palaiseau, France)
Specialization in Stochastic Modelling and Numerical Analysis, Signal Processing and Machine Learning.

2018 - 2020 **Classe Préparatoire au Grandes Écoles (MPSI, MP*)**
Lycée Carnot (Dijon, France)
Intensive two-year program giving rigorous training in preparation for national competitive exams allowing entry into top French graduate schools. Specialization in Mathematics, Physics and Computer Science.

Research experience

2024 (6 months) **Research Intern**
Bocconi University (Milan, Italy)
Gradient Flows in the Geometry of the Sinkhorn Divergence: derivation of the differential equation corresponding to the gradient flow of a potential energy, its main properties and long-time behavior, numerical implementation and comparison with the Wasserstein case. Entropic Optimal Transport, Gradient Flows, Functional Analysis, Riemannian Geometry, RKHS, Numerical Optimization & Visualization (Python).

2023 (2 months) **Front Office Support**
Axpo Solutions AG (Brussels, Belgium)
Constrained algorithmic financial optimization of multi-asset heat, power and CO2 production schedules for greenhouses. Applied research, Mathematical modelling, Numerical optimization (python, LP/MILP, Simulated annealing, Evolutionary algorithm), FTP communication, Predictive price curve evaluation and comparison.

Research projects

Some of my academic reports and presentations made during my MSc can be found in the "Research" section of my website, including the following:

Reports:

Neural Optimal Transport
Variational Learning of Inducing Variables in Sparse Gaussian Processes
Generalized Sliced Distances for Probability Distributions
Sparse representation of multivariate extremes with applications to anomaly detection
Mean Curvature Motion of Point Cloud Varifolds

Presentations:

Riemanniann Manifold Hamiltonian Monte Carlo
FibeRed: Fiberwise Dimensionality Reduction of Topologically Complex Data with Vector Bundles

Other work experience

2021 (2 months) **Education Intern**

Learning Robots (Gif-sur-Yvette, France)

Design and improvement of high-school and post-secondary level practical sessions and videos teaching artificial intelligence algorithms and ethics through robots. Development of new features for the AlphAI robot and software (Python).

Computer skills

Proficient: Python (`pytorch`, `matplotlib`, `numpy`, `pandas`, `scipy`, `sklearn`, `cvxpy`, etc.), LaTeX, Git

Intermediate: R, C++, Java

Languages

French: Native

English: Proficient (C1)

German: Intermediate (B2)