Jean-Yves Franceschi

Curriculum Vitae

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Research

September 2018 –
August 2021

PhD, *Sorbonne Université, Laboratoire d'Informatique de Paris 6, team MLIA*, Paris, France, supervised by Sylvain Lamprier and Patrick Gallinari.

I am working on machine learning for spatio-temporal data, and especially on how to leverage differential equations and their links with neural networks in order to create performant prediction models for complex data, such as videos.

Inspired by such connections, I designed with colleagues a novel temporal model based on residual connections instead of recurrent neural networks that lead to state-of-the-art results for stochastic video prediction. This work was accepted to ICML 2020 [3]. We also leveraged a resolution technique for partial differential equations, the functional separation of variables, to propose a novel interpretation of spatiotemporal disentanglement, leading to a simple but performant disentangled predictive model. This work was accepted to ICLR 2021 [1].

Furthermore, we analyzed differential equations describing the temporal evolution of neural networks during training. In particular, thanks to the study of these differential equations, and leveraging the neural tangent kernel theory, we proposed a novel theoretical framework for the understanding of generative adversarial networks [2], which are performant generative model for both static and sequential data.

Finally, I am a teacher assistant at Sorbonne Université in Computer Science, and participated in organizing a reading group about spatio-temporal machine learning.

March 2017 –
July 2018

Research Internship, *Ecole Polytechnique Fédérale de Lausanne, Machine Learning and Optimization Laboratory*, Lausanne, Switzerland, 19 weeks, supervised by Martin Jaggi.

I worked on unsupervised scalable representation learning for time series. We designed a method combining an encoder based on causal dilated convolutions with a novel triplet loss employing time-based negative sampling, obtaining general-purpose representations for variable-length and multivariate time series in a scalable manner. This work was accepted to NeurIPS 2019 [4].

September 2017 –
February 2018

Research Internship, *Ecole Normale Supérieure de Lyon, Laboratoire de l'Informatique et du Parallélisme, team MC2*, Lyon, France, 25 weeks, supervised by Omar Fawzi.

I worked on theoretical aspects of machine learning, such as adversarial examples and convex optimization.

We bounded the ratio between the amplitude of adversarial perturbations (imperceptible perturbations altering the classification of an image) and classifiers robustness to random perturbations for linear classifiers, extended the result to more general classifiers, and experimentally verified it on state-of-the-art neural networks. This work was accepted to AISTATS 2018 [5].

Our work on convex optimization consisted in studying the precise query complexity of convex optimization problems (existing algorithms and lower bounds) and formalizing query complexity for convex optimization in the quantum setting.

February – June 2017	**Research Internship**, *Inria Antenne Lyon - La Doua, team Privatics*, Lyon, France, 20 weeks, supervised by Daniel Le Métayer.
	I worked on the emerging field of accountability of decision algorithms, more particularly on decision explanation (why did a classifier output a given result?) and fairness (how to detect and design fair classifiers?), with an emphasis on learning procedures. We produced a first attempt of a state-of-the-art review of the field.
May – July 2016	**Research Internship**, *University of Konstanz, Computer Graphics and Media Informatics working group*, Konstanz, Germany, 11 weeks, supervised by Abdalla Gaafar Ahmed and Oliver Deussen.
	I worked on blue-noise sampling in computer graphics. After a review of the topic and of the standard and state-of-the-art techniques, I worked on an in-development sampling method, studied it and proposed a variant improving its blue-noise properties. A paper related to this topic was published in IEEE TVCG [6].
June & July 2015	**Research Internship**, *Inria Sophia Antipolis, team Marelle*, Valbonne, France, 6 weeks, supervised by Yves Bertot.
	I worked on the integration of the "differential dynamic logic" – a logical system aiming to prove properties about physical systems – in the higher order proof system Coq. We managed to implement its basis and start a reflexion about how to modify this logic for a potential implementation to be convenient to write and use.

References

[1] *J. Donà*, **J.-Y. Franceschi**, S. Lamprier, and P. Gallinari. "PDE-Driven Spatiotemporal Disentanglement". In: *International Conference on Learning Representations*. 2021.

[2] **J.-Y. Franceschi**, *E. de Bézenac, I. Ayed*, M. Chen, S. Lamprier, and P. Gallinari. "A Neural Tangent Kernel Perspective of GANs". In: *arXiv:2106.05566* (2021).

[3] **J.-Y. Franceschi**, *E. Delasalles*, M. Chen, S. Lamprier, and P. Gallinari. "Stochastic Latent Residual Video Prediction". In: *Proceedings of the 37th International Conference on Machine Learning*. Vol. 119. Proceedings of Machine Learning Research. Virtual: PMLR, July 2020, pp. 3233–3246.

[4] **J.-Y. Franceschi**, A. Dieuleveut, and M. Jaggi. "Unsupervised Scalable Representation Learning for Multivariate Time Series". In: *Advances in Neural Information Processing Systems 32*. Curran Associates, Inc., 2019, pp. 4650–4661.

[5] **J.-Y. Franceschi**, A. Fawzi, and O. Fawzi. "Robustness of classifiers to uniform ℓ_p and Gaussian noise". In: *Proceedings of the Twenty-First International Conference on Artificial Intelligence and Statistics (AISTATS)*. Vol. 84. Proceedings of Machine Learning Research. Playa Blanca, Lanzarote, Canary Islands: PMLR, Apr. 2018, pp. 1280–1288.

[6] A. G. M. Ahmed, J. Guo, D. M. Yan, **J.-Y. Franceschi**, X. Zhang, and O. Deussen. "A Simple Push-Pull Algorithm for Blue-Noise Sampling". In: *IEEE Transactions on Visualization and Computer Graphics* 23.12 (Dec. 2017), pp. 2496–2508.

Teaching

September 2018 –
August 2021

Teaching Assistant, *Computer Science*, Sorbonne Université, Paris, France.
- 2020:
  - **Algorithmique I** (38.5h), 2nd year of Bachelor: tutorials covering algorithmics foundations (halting, correctness, complexity, trees, and graphs).
  - **Projet (application)** (38.5h), 2nd year of Bachelor: supervizing around 15 group projects to build an artificial intelligence for two-player games (Awele, Othello) in Python.
  - **Statistiques et informatique** (14h), 3rd year of Bachelor: supervizing around 30 group projects to design and analyze probabilistic strategies for the Battleship game, as an application of a statistics course.
  - **Programmation fonctionnelle** (21h), 2nd year of Bachelor: functional programming and OCaml practical works.
- 2019:
  - **Introduction à la programmation Objet** (19.25h), 2nd year of Bachelor: object-oriented programming and Java practical works.
  - **Projet (application)** (38.5h), 2nd year of Bachelor: supervizing around 15 group projects to build an artificial intelligence for two-player games (Awele, Othello) in Python.
- 2018:
  - **Introduction à la programmation Objet** (19.25h), 2nd year of Bachelor: object-oriented programming and Java practical works.

Education

2018
Ecole Normale Supérieure de Lyon Diploma, *Ecole Normale Supérieure de Lyon*, Lyon, France.

2017
Master of Science, Foundations of Computer Science, *Ecole Normale Supérieure de Lyon*, Lyon, France, *GPA : 4.00*.
Obtained with highest honors.[1]

2015
Bachelor of Science, Foundations of Computer Science, *Ecole Normale Supérieure de Lyon*, Lyon, France, *GPA : 4.00*.
Main and mandatory bachelor, obtained with highest honors.[1]

2015
Bachelor of Science, Mathematics and Applications, *Université Claude Bernard Lyon I*, Villeurbanne, France, *GPA : 3.50*.
Bachelor followed under the scope of a double degree, obtained with highest honors.[1]

2014
Admission to the Ecole Normale Supérieure de Lyon over a competitive exam.
The Ecole Normale Supérieure de Lyon is a French "Grande Ecole", *i.e.* a leading institution of higher education entrance to which is based on a competitive examination. It provides a four-year training designed for future researchers and scientists.

2012–2014
Scientific Classes préparatoires MPSI/MP, *Centre International de Valbonne*, Valbonne, France.
"Classes préparatoires" are a two-year intensive course preparing for the competitive entrance examinations to French "Grandes Ecoles". They provide a high-level scientific formation based on Mathematics (14 hours a week), Physics (10 hours a week), Computer Science (5 hours a week), English (3 hours a week) and Philosophy (2 hours a week), and require a consequent investment and a lot of personal work.

2012	**Baccalauréat scientifique**, Ajaccio, France.
	High-school diploma with a scientific major, obtained with highest honors.

Accomplishments

2015	Ranked 10th as a member of the ENSL1 team (Simon Mauras, Timothée Pécatte and myself) at the Southwestern Europe Regional Contest (SWERC) 2015 of the ACM-ICPC contest.
2017	Ranked 12th as a member of the ENSL2 team (Simon Mauras, Raphaël Monat and myself) at the Southwestern Europe Regional Contest (SWERC) 2017 of the ACM-ICPC contest.

Languages

French	Mother tongue	
English	Proficient	(B2 level)[1]
German	Intermediate	(B1 level)[1]

Computer Skills

Programming Languages

Intermediate	Java
Proficient	C, C++, Python, OCaml

Miscellaneous

Basic	SageMath, Maple, Mathematica, SQL
Intermediate	MPI, Qt, Coq Proof Assistant, Tensorflow
Proficient	LaTeX, PyTorch, JAX

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[1]GPA computed thanks to the following conversion tool: https://www.scholaro.com/gpa-calculator.
[1]See https://en.wikipedia.org/wiki/Common_European_Framework_of_Reference_for_Languages.