

Nicolas Zucchet

PHD STUDENT · ETH ZÜRICH

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Education

PhD student

ETH ZÜRICH

Zürich, Switzerland

09/2021 - now

- Doctoral student in artificial intelligence and computational neuroscience in the lab of Prof. Dr. Angelika Steger, jointly supervised by Dr. João Sacramento.

Computer science MSc

ETH ZÜRICH

Zürich, Switzerland

09/2019 - 04/2021

- Theoretical foundations of artificial intelligence (optimization, neuroscience, machine learning).
- Master thesis: "Equilibrium propagation for bilevel optimization", supervised by Dr. João Sacramento.

Ingénieur polytechnicien (MSc)

ÉCOLE POLYTECHNIQUE

Palaiseau, France

09/2016 - 08/2019

- Multidisciplinary education (applied mathematics, computer science, economics), specialization in deep learning and computer vision during the last two semesters.

Classe préparatoire aux grandes écoles (MPI*)

LYCÉE HOCHÉ

Versailles, France

09/2014 - 08/2016

- Intensive training for competitive entrance exams to french Grandes Écoles (fundamental mathematics, computer science, physics).

Professional experience

Student researcher

GOOGLE DEEPMIND

London, United Kingdom

09/2024-02/2025

- Research internship in the team of Dr. Soham De, studying the learning dynamics of language models.

Visiting student

UNIVERSITY OF BERN

Bern, Switzerland

05/2021 - 08/2021

- Probabilistic methods for continual learning, hosted by Prof. Dr. Jean-Pascal Pfister.

Research internship

PROPHESSEE

Paris, France

05/2019 - 08/2019

- Deep learning algorithms for event-based cameras in autonomous cars.

Software developer intern

AMADEUS

Sophia-Antipolis, France

06/2018 - 08/2018

- Design and development of continuous integration tools.

Publications

PREPRINTS

- [3] How do language models learn facts? Dynamics, curricula and hallucinations, **N. Zucchet**, J. Bornschein, S. Chan, A. Lampinen, R. Pascanu, S. De
- [2] Uncovering mesa-optimization algorithms in Transformers, J. von Oswald*, E. Niklasson*, M. Schlegel*, S. Kobayashi, **N. Zucchet**, N. Scherrer, N. Miller, M. Sandler, B. Agüera y Arcas, M. Vladymyrov, R. Pascanu and J. Sacramento.
- [1] Gated RNNs discover attention, **N. Zucchet***, S. Kobayashi*, Y. Akram*, J. von Oswald, M. Larcher, A. Steger†, J. Sacramento†.

CONFERENCE AND JOURNAL PAPERS

- [6] Recurrent neural networks: vanishing and exploding gradients are not the end of the story, **N. Zucchet**, A. Orvieto. 38th Conference on Neural Information Processing Systems (NeurIPS), 2024.
- [5] Online learning of long-range dependencies. **N. Zucchet***, R. Meier*, S. Schug*, A. Mujika and J. Sacramento. 37th Conference on Neural Information Processing Systems (NeurIPS), 2023.
- [4] The least-control principle for local learning at equilibrium. A. Meulemans*, **N. Zucchet***, S. Kobayashi*, J. von Oswald and J. Sacramento. 36th Conference on Neural Information Processing Systems (NeurIPS), 2022.
- [3] A contrastive rule for meta-learning. **N. Zucchet***, S. Schug*, J. von Oswald*, D. Zhao and J. Sacramento. 36th Conference on Neural Information Processing Systems (NeurIPS), 2022.
- [2] Beyond backpropagation: Bilevel optimization through implicit differentiation and equilibrium propagation. **N. Zucchet** and J. Sacramento. Neural Computation 34 (12), 2022.
- [1] Learning where to learn: Gradient sparsity in meta and continual learning. J. von Oswald*, D. Zhao*, S. Kobayashi, S. Schug, M. Caccia, **N. Zucchet** and J. Sacramento. 35th Conference on Neural Information Processing Systems (NeurIPS), 2021.

WORKSHOP PAPERS

- [1] Random initialisations performing above chance and how to find them. F. Benzing, S. Schug, R. Meier, J. von Oswald, Y. Akram, **N. Zucchet**, L. Aitchison[†], A. Steger[†]. OPT2022: 14th Annual Workshop on Optimization for Machine Learning (NeurIPS), 2022.

Talks

- Dec. 2024 **Learning in the brain: what can we learn from deep state-space models?**, Linderman's lab, Stanford.
- Jan. 2024 **Online learning of long-range dependencies**, Swiss Computational Neuroscience Retreat.
- Feb. 2023 **The least-control principle for local learning at equilibrium**, Swiss Computational Neuroscience Retreat.
- Nov. 2022 **The least-control principle for local learning at equilibrium**, Jean-Rémi King's Brain & AI group at Meta AI.
- July 2022 **Biologically plausible bilevel optimization**, Rafal Bogacz's group at Oxford.
- June 2022 **Bilevel optimization in neural networks**, MLSS^N 2022 lecture with J. Sacramento, A. Meulemans and S. Schug.
- Feb. 2022 **A contrastive rule for meta-learning**, Swiss Computational Neuroscience Retreat.

Teaching experience

- 2022-24 **Algorithms lab**, Teaching assistant (Master's course).
- 2022-24 **Algorithms and probability**, Teaching assistant (Bachelor's course).
- 2021 **Randomized algorithms**, Teaching assistant (Master's course).
- 2016-17 **High-school mathematics**, Full-time tutoring of high school students from deprived neighborhoods.

Mentoring

- 2023 **Kevin Lopez**, Master thesis, ETH Zürich (co-supervised with J. Sacramento).
- 2023-24 **Yanick Schimpf**, Bachelor thesis, ETH Zürich.
- 2022-23 **Qianqian Feng**, Research project, ETH Zürich (co-supervised with J. Sacramento).
- 2022 **Anja Surina**, Master thesis, ETH Zürich (co-supervised with J. Sacramento and S. Schug).

Community service

- 2023-25 **ICML**, Reviewer.
- 2023-25 **ICLR**, Reviewer.
- 2023-24 **NeurIPS**, Reviewer (Best reviewer award in 2024).
- 2025 **TMLR**, Reviewer.
- 2025 **COLM**, Reviewer.

Awards

2022 **Scholar award**, NeurIPS.