Anas Barakat

Personal Webpage: anasbarakat.github.io ◇ Email: barakat9anas@gmail.com

RESEARCH FOCUS

Keywords: Multi-Agent Learning, Reinforcement Learning, Optimization.

My research focuses on designing and analyzing principled learning algorithms for sequential decision-making in strategic, dynamic, and uncertain environments. Motivated by challenges and applications in machine learning and multi-agent systems, my work combines tools from game theory, reinforcement learning, stochastic optimization, and dynamical systems to understand and shape how autonomous agents learn to act, adapt, and collaborate in strategic and dynamic multi-agent environments.

ACADEMIC APPOINTMENTS

Singapore University of Technology and Design
Research Fellow — Fall 2024 -
Hosts: Prof. Georgios Piliouras and Prof. Antonios Varvitsiotis

ETH Zurich, Department of Computer Science
Foundations of Data Science Postdoctoral Fellow — Feb. 2022 - Aug. 2024
Host: Prof. Niao He

EDUCATION

Institut Polytechnique de Paris, Télécom Paris, Paris, France
Ph.D. in Applied Mathematics and Computer Science — Fall 2018 - Fall 2021
Advisors: Prof. Pascal Bianchi and Prof. Walid Hachem.
Thesis: Contributions to non-convex stochastic optimization and reinforcement learning
Committee: Profs. Vivek S. Borkar, Sébastien Gadat, Robert M. Gower, Niao He, and Edouard Pauwels

Université Paris Saclay, Paris, France
M.Sc. in Data Science (with highest honors) — Fall 2017 - Summer 2018

Télécom Paris, Paris, France
M.Sc. in Applied Mathematics and Computer Science — Fall 2015 - Summer 2018

Lycée Stanislas, Paris, France
Classes préparatoires — Fall 2013 - Summer 2015
Post-secondary studies in Mathematics and Physics leading to the nationwide highly competitive exam for admission to a graduate-level engineering school ("Grande Ecole")

RESEARCH PUBLICATIONS & PREPRINTS

Names of co-author students who were under my supervision at the time of writing the paper are underlined.

Preprints under Review

(1) **Anas Barakat**, John Lazarsfeld, Georgios Piliouras, Antonios Varvitsiotis. *Multi-Agent Online Control with Adversarial Disturbances.* Under review, 2025.

(2) **Anas Barakat**, Wayne Lin, John Lazarsfeld, Antonios Varvitsiotis. *Optimistic Online Learning in Symmetric Cone Games.* Under review, 2025.

(3) Olivier Lepel, **Anas Barakat**. *A Prospect-Theoretic Policy Gradient Algorithm for Behavioral Alignment in Reinforcement Learning.* Under review, 2025.

(4) **Anas Barakat**, Souradip Chakraborty, Peihong Yu, Pratap Tokekar, Amrit Singh Bedi. *Towards Scalable General Utility Reinforcement Learning: Occupancy Approximation, Sample Complexity and Global Optimality.* Under review, 2025.

Multi-Agent Learning

(1) Jiduan Wu, **Anas Barakat**, Ilyas Fatkhullin, Niao He. *Learning Zero-Sum Linear Quadratic Games with Improved Sample Complexity and Last Iterate Convergence.* To appear in SIAM Journal on Control and Optimization, 2025.

(2) Pragnya Alatur, **Anas Barakat***, Niao He. *Independent Policy Mirror Descent for Markov Potential Games: Scaling to Large Number of Players.* IEEE Conference on Decision and Control (CDC 2024). *Corresponding author.

(3) Philip Jordan, **Anas Barakat**, Niao He. *Independent Learning in Constrained Markov Potential Games.* International Conference on Artificial Intelligence and Statistics (AISTATS 2024).

(4) Jiduan Wu, **Anas Barakat**, Ilyas Fatkhullin, Niao He. *Learning Zero-Sum Linear Quadratic Games with Improved Sample Complexity.* IEEE Conference on Decision and Control (CDC 2023).

Reinforcement Learning

(1) Kimon Protopapas, **Anas Barakat**. *Policy Mirror Descent with Lookahead.* Advances in Neural Information Processing Systems (NeurIPS 2024).

(2) **Anas Barakat**, Ilyas Fatkhullin, Niao He. *Reinforcement Learning with General Utilities: Simpler Variance Reduction and Large State-Action Space.* International Conference on Machine Learning (ICML 2023).

(3) Ilyas Fatkhullin, **Anas Barakat**, Anastasia Kireeva, Niao He. *Stochastic Policy Gradient Methods: Improved Sample Complexity for Fisher-non-degenerate Policies.* International Conference on Machine Learning (ICML 2023).

(4) **Anas Barakat**, Pascal Bianchi, Julien Lehmann. *Analysis of a Target-Based Actor-Critic Algorithm with Linear Function Approximation.* International Conference on Artificial Intelligence and Statistics (AISTATS 2022).

Stochastic Optimization

(1) **Anas Barakat**, Pascal Bianchi, Walid Hachem, Sholom Schechtman. *Stochastic optimization with momentum: convergence, fluctuations, and traps avoidance.* Electronic Journal of Statistics 15 (2), 3892-3947, 2021.

(2) **Anas Barakat**, Pascal Bianchi. *Convergence Rates of a Momentum Algorithm with Bounded Adaptive Step Size for Nonconvex Optimization.* Asian Conference on Machine Learning (ACML 2020).

(3) **Anas Barakat**, Pascal Bianchi. *Convergence and Dynamical Behavior of the Adam Algorithm for Non-Convex Stochastic Optimization.* SIAM Journal on Optimization 31 (1), 244-274, 2021.

AWARDS AND SCHOLARSHIPS

- ETH Zurich Foundations of Data Science Postdoctoral Fellowship 2022-2024
- DAAD Postdoctoral Networking Tour in AI (Postdoc-NeT-AI) fellow Nov. 2023
- AISTATS Top 10 % reviewer 2022
- Dodu Prize, French Society of Applied and Industrial Mathematics (SMAI) Sep. 9th 2021
  Best communication of a young researcher at the Optimization and Decision annual days

Jury: M. Akian, P. Bich, J. Bolte, J-B. Caillau, S. Gaubert, V. Leclere, P. Mertikopoulos, F. Santambrogio (president of the jury), H. Zidani

- Mines-Télécom Institute (IMT) Ph.D scholarship 2018-2021
- Moroccan Government Merit Scholarship 2015-2018
- Agency for French Education Abroad (AEFE) "Excellence-Major" scholarship 2013-2015

RESEARCH TALKS

- Invited talk, Learning Theory and Applications Workshop 29 April 2025
  College of Computing and Data Science, Nanyang Technological University, Singapore
  Host: Themis Gouleakis.
- Online invited talk, Finance and RL Talks, FinRL core team & Melwy open AI lab 21 April 2025
  Host: Mostapha Benhenda.
- Online talk, Singapore University of Technology and Design research group 3 May 2024
  Host: Georgios Piliouras.
- Invited talk, Fourth Symposium on Machine Learning and Dynamical Systems 11 July 2024
  Fields Institute, Toronto, Canada.
- Invited talk, ICCOPT 2022, Lehigh University, Bethlehem, USA 28 Jul 2022
- Invited talk (online), 14th CMStatistics International Conference 20 Dec 2021
  Session: "Dynamical systems in machine learning" organized by Anna Korba
  King's College, London, United Kingdom
- Invited Seminar, *Image, Optimization and Probabilities* research group 15 Oct 2020
  Bordeaux Institute of Mathematics (IMB), Bordeaux, France
- 2nd Symposium on Machine Learning and Dynamical Systems 21 Sep 2020
  Fields Institute for Research in Mathematical Sciences, online
- Mathematical Optimization and Decision (MODE) group days 7 Sep 2020
  French Society of Applied and Industrial Mathematics (SMAI), online
- Mathematics of Optimization and Applications (MOA) annual days 17 Oct 2019
  National Institute of Applied Sciences (INSA), Rennes, France
- 11th OPT Workshop on Optimization for Machine Learning 14 Dec 2019
  Exchange Hotel Vancouver, Vancouver, Canada
- Machine Learning in the Real World workshop 2 Oct 2019
  Criteo, Paris, France
- Junior Conference on Data Science and Engineering 12 Sep 2019
  Centrale Supéléc, Gif-sur-Yvette, France
- Francophone colloquium of Signal and Image Processing (GRETSI) 29 Aug 2019
  Lille University, Lille, France

ACADEMIC SERVICE

- **Conference reviewing:** NeurIPS, ICML, ICLR, COLT, AISTATS, L4DC, IEEE CDC.
- **Journal reviewing:** Mathematical Programming, SIAM Journal on Optimization (SIOPT), Journal of Machine Learning Research (JMLR), Journal of Optimization Theory and Applications (JOTA), IEEE Transactions on Automatic Control (TACON), Stochastic Systems, Systems

& Control Letters, Mathematics of Control, Signals, and Systems (MCSS), Transactions on Machine Learning Research (TMLR), IEEE Control Systems Letters (IEEE L-CSS).

- **Organization of workshops, summer schools and conferences:**
  - Multi-Agent RL EPFL-ETHZ Summer School 2024 co-organizer (20 000 CHF funding, accepted proposal), supported by Prof. Niao He and Prof. Volkan Cevher.
  - ICCOPT 2022, session organizer and chair: *Policy Gradient and Actor-Critic Methods: Theoretical Analysis and New Opportunities*, in the Optimization for Data Science and Machine Learning cluster.
  - Workshop organizer: RL workshop for industrial partners (Airbus Defence & Space, Engie, Idemia, Safran and Valeo) of the Data Science & Artificial Intelligence for Digitalized Industry & Services research and teaching chair.

TEACHING

- **ETH Zurich**, Zurich, Switzerland
  - Teaching Assistant for 'Optimization for Data Science' and 'Foundations of RL' Spring 2024
  - Instructor for a lecture about 'Value-based methods' Spring 2024
  - Head Teaching Assistant for 'Foundations of Reinforcement Learning' (Prof. He) Spring 2023
  - Instructor for 2 lectures for 'Optimization for Data Science' (Prof. He) Spring 2023
  - Coordinator for the seminar course 'Advanced Topics in Machine Learning' Fall 2022, 2023
- **Télécom Paris**, Paris, France
  - Teaching Assistant for 'Optimization for Machine Learning' Fall 2018, 2019, 2020
  - Instructor for discrete Markov chains in 'Probabilities' Fall 2018, 2019
  - Teaching Assistant for 'Probabilities', 'Statistics', 'Machine Learning' Fall 2018, 2019
- **Ecole Polytechnique**, Paris, France
  - Tutor for undergraduate students in Computer Science (about 20 hours) Spring 2017 Design and Analysis of Algorithms; Advanced Programming

STUDENT MENTORING

- Olivier Lepel, Master thesis (03/2024-09/2024): *Beyond Expected Returns: A Policy Gradient Algorithm for Cumulative Prospect Theoretic Reinforcement Learning.*
- Kimon Protopapas, Master student semester project (09/2023-01/2024): *Policy Mirror Descent with Lookahead.* NeurIPS 2024.
- Philip Jordan, Master thesis (05/2023 - 12/2023): *Independent Learning in Constrained Markov Potential Games.* AISTATS 2024.
- Jiduan Wu, Master thesis (10/2022 - 03/2023): *Learning Zero-Sum Linear Quadratic Games with Improved Sample Complexity and Last-Iterate Convergence.* IEEE Conference on Decision and Control 2023.
- Harish Rajagopal, Master thesis (03/2022 - 09/2022): *Multistage Step Size Scheduling for Minimax Problems.*
- Julien Lehmann, Master thesis (05/2021 - 10/2021): *Analysis of a Target-Based Actor-Critic Algorithm with Linear Function Approximation.* AISTATS 2022.