

# Anas Barakat

Personal Webpage: [anasbarakat.github.io](https://anasbarakat.github.io) ◇ Email: [anas.barakat@inf.ethz.ch](mailto:anas.barakat@inf.ethz.ch)

## RESEARCH INTERESTS

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Stochastic optimization; (multi-agent) reinforcement learning; learning in games; machine learning

## PROFESSIONAL EXPERIENCE

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Feb. 2022 - **ETH Zurich, Department of Computer Science**  
Foundations of Data Science Postdoctoral Fellow  
Host: Prof. Niao He (Optimization & Decision Intelligence group)

## EDUCATION

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2018 - 2021 **Institut Polytechnique de Paris, Télécom Paris**  
Ph.D. in Applied Mathematics and Computer Science  
Thesis: Contributions to non-convex stochastic optimization and reinforcement learning.  
Advisors: Prof. Pascal Bianchi and Prof. Walid Hachem.  
Referees: Prof. Vivek S. Borkar, Prof. Sébastien Gadat.

2017 - 2018 **Université Paris Saclay**  
M.Sc. in Data Science (with highest honors)

2015 - 2018 **Télécom Paris**  
M.Sc. in Applied Mathematics and Computer Science, Engineering Degree  
Machine Learning track  
Top 5% ranking in one of the top french engineering schools

2013 - 2015 **Lycée Stanislas, Paris**  
Classes préparatoires (intensive courses of Mathematics and Physics)  
Post-secondary studies leading to the nationwide highly competitive exam  
for admission to a graduate-level engineering school (“Grande Ecole”)

## PUBLICATIONS

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### Under Review

- (C1) Pragnya Alatur\*, **Anas Barakat\***, Niao He,  
“Independent Policy Mirror Descent for Markov Potential Games: Scaling to Large Number of  
Players”,  
Equal contribution. *Submitted.*
- (C2) Kimon Protopapas, **Anas Barakat**,  
“Policy Mirror Descent with Lookahead”,  
*Under review.*
- (C3) **Anas Barakat**, Souradip Chakraborty, Peihong Yu, Pratap Tokekar, Amrit Singh Bedi, Niao He,  
“Reinforcement Learning with General Utilities: Scaling to Large State Action Spaces via Occu-  
pancy Measure Approximation”,  
*Under review.*
- (C4) Jiduan Wu, **Anas Barakat**, Ilyas Fatkhullin, Niao He,  
“Learning Zero-Sum Linear Quadratic Games with Improved Sample Complexity and Last Iterate  
Convergence”,  
*Under review in SIAM Journal on Control and Optimization.*

## Journal Publications

- (J1) **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.
- (J2) **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.

## Peer-Reviewed Conference Papers with Proceedings

- (C1) Philip Jordan, **Anas Barakat**, Niao He,  
“Independent Learning in Constrained Markov Potential Games”,  
*International Conference on Artificial Intelligence and Statistics (AISTATS)*, 2024.
- (C2) 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.
- (C3) **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.
- (C4) 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.
- (C5) **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.
- (C6) **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.

## Thesis

Anas Barakat, “Contributions to non-convex stochastic optimization and reinforcement learning”,  
PhD dissertation, Institut Polytechnique de Paris, 2021

Advisors: Prof. Pascal Bianchi and Prof. Walid Hachem.

Referees: Prof. Vivek S. Borkar, Prof. Sébastien Gadat.

Examiners: Prof. Robert M. Gower, Prof. Niao He, Prof. Edouard Pauwels.

## AWARDS AND SCHOLARSHIPS

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- 2022-2024    ETH Zurich Foundations of Data Science Postdoctoral Fellowship (2 years funding)
- Nov 2023    DAAD Postdoctoral Networking Tour in Artificial Intelligence (Postdoc-NeT-AI) fellow  
German Academic Exchange Service Program offering a one-week networking tour in Germany  
<https://www.daad.de/en/the-daad/postdocnet/>
- 2022        AISTATS 2022 Top 10 % reviewer.
- 9 Sep 2021    Dodu Prize <http://smail.emath.fr/spip.php?article624&lang=en>  
Best communication of a young researcher at the Optimization and Decision annual days,  
French Society of Applied and Industrial Mathematics (SMAI)  
Jury: M. Akian, P. Bich, J. Bolte, J-B. Caillaud, S. Gaubert, V. Leclerc,  
P. Mertikopoulos, F. Santambrogio (president of the jury), H. Zidani
- 2018-2021    Mines-Télécom Institute (IMT) Ph.D scholarship  
Future & Disruptive innovation research program  
Awarded to top 5% students of Télécom Paris and other IMT schools.
- 2015-2018    Moroccan Government Merit Scholarship  
Moroccan Ministry of Higher Education, Scientific Research and Professional Training  
Awarded to students in top french engineering and business schools.
- 2013-2015    Agency for French Education Abroad (AEFE) “Excellence-Major” scholarship  
Awarded by the French Ministry for Europe and Foreign Affairs to top foreign (non french)  
students from french high schools all over the world for pursuing high-level studies in France

## TALKS

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- Jul 2024    Invited talk, Fourth Symposium on Machine Learning and Dynamical Systems  
Fields Institute, Toronto, Canada  
“Stochastic optimization with momentum: convergence, fluctuations, and traps avoidance.”
- 28 Jul 2022    Invited talk, ICCOPT 2022  
Lehigh University, Bethlehem, USA
- 20 Dec 2021    Invited talk (online), 14th CMStatistics International Conference  
Session: “Dynamical systems in machine learning” organized by Anna Korba.  
King’s College, London, United Kingdom  
“Convergence and dynamical behavior of the ADAM algorithm for non-convex stochastic optimization.”
- 15 Oct 2020    Invited Seminar, “Image, Optimization and Probabilities” research group  
Bordeaux Institute of Mathematics (IMB), Bordeaux, France
- 21 Sep 2020    2nd Symposium on Machine Learning and Dynamical Systems  
Fields Institute for Research in Mathematical Sciences, online
- 7 Sep 2020    Mathematical Optimization and Decision (MODE) group days  
French Society of Applied and Industrial Mathematics (SMAI), online
- 17 Oct 2019    Mathematics of Optimization and Applications (MOA) annual days  
National Institute of Applied Sciences (INSA), Rennes, France

“Convergence of the ADAM algorithm from a dynamical systems viewpoint.”

12 Sep 2019 Junior Conference on Data Science and Engineering  
Centrale Supélec, Gif-sur-Yvette, France

29 Aug 2019 Francophone colloquium of Signal and Image Processing (GRETSI)  
Lille University, Lille, France

“Convergence analysis of a momentum algorithm with adaptive step size for non-convex optimization.”

14 Dec 2019 11th OPT Workshop on Optimization for Machine Learning  
Exchange Hotel Vancouver, Vancouver, Canada

“Convergence of the ADAM algorithm from a dynamical systems viewpoint.”

2 Oct 2019 Machine Learning in the Real World workshop  
Criteo, Paris, France

## PROFESSIONAL SERVICE

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### Reviewing

#### Journal reviewing

SIAM Journal on Optimization (SIOPT), Journal of Machine Learning Research (JMLR), Journal of Optimization Theory and Applications (JOTA), Systems & Control Letters, Mathematics of Control, Signals, and Systems (MCSS), IEEE Transactions on Image Processing.

#### Conference reviewing

Conference on Neural Information Processing Systems (NeurIPS 2023), International Conference on Machine Learning (ICML 2022), Conference on Learning Theory (COLT 2022), International Conference on Artificial Intelligence and Statistics (AISTATS 2022, top 10% reviewer; AISTATS 2024), IEEE Conference on Decision and Control (CDC 2023).

### Summer School Co-Organizer

Multi-Agent RL EPFL-ETHZ Summer School 2024 (20 000 CHF funding, accepted proposal), supported by Prof. Niao He and Prof. Volkan Cevher

### Session Organizer

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

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### **ETH Zurich**

Spring 2024 Teaching Assistant for ‘Optimization for Data Science’ and ‘Foundations of RL’.  
Instructor for a lecture about ‘Value-based methods’.

Spring 2023 Head Teaching Assistant for ‘Foundations of Reinforcement Learning’ (Prof. He).  
Instructor for 2 lectures within the course ‘Optimization for Data Science’ (Prof. He).

Fall 2022, 2023 Coordinator for the seminar course ‘Advanced Topics in Machine Learning’.

### **Télécom Paris**

Tutor and teaching assistant for the courses (more than 150 hours):

Fall 2018, 2019, 2020 Optimization for Machine Learning.

Fall 2018, 2019 Probabilities (instructor for discrete Markov chains); Statistics; Machine Learning.

## Ecole Polytechnique

Tutor for undergraduate students in Computer Science (about 20 hours):

Spring 2017 Design and Analysis of Algorithms; Advanced Programming

## ADVISING

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- 09/2023 - 01/2024 Kimon Protopapas, Master student semester project:  
*Policy Mirror Descent with Lookahead*, Under review
- 05/2023 - 12/2023 Philip Jordan, Master thesis:  
*Independent Learning in Constrained Markov Potential Games*, AISTATS 2024
- 10/2022 - 03/2023 Jiduan Wu, Master thesis:  
*Learning Zero-Sum Linear Quadratic Games with Improved Sample Complexity and Last-Iterate Convergence*; IEEE Conference on Decision and Control 2023
- 03/2022 - 09/2022 Harish Rajagopal, Master thesis:  
*Multistage Step Size Scheduling for Minimax Problems*.
- 04/2022 - 06/2022 Jiduan Wu, Master student semester project:  
*Mean Field Reinforcement Learning and Policy Gradient Methods for Linear Quadratic Zero-Sum Mean-Field Games*.
- 05/2021 - 10/2021 Julien Lehmann, Master thesis:  
*Analysis of a Target-Based Actor-Critic Algorithm with Linear Function Approximation*  
AISTATS 2022
- 10/2018 - 02/2019 Yuqing Wang and Zhengkang Shi, Master students final research and innovation project  
Collaboration: XLearn startup  
Topic: Development of an online job advising system learning skill titles' from users' profiles using Machine Learning methods

## LANGUAGES

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Arabic (native), French (native), English (fluent), Spanish (working level).

## HOBBIES

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Classical music : violonist in the "Académie de Musique de Paris" Orchestra (Paris) and Polyphonia Orchestra (Zurich), swimming

## REFERENCES

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### Niao He

Assistant Professor  
Optimization and Decision Intelligence group  
Department of Computer Science  
ETH Zurich

### Pascal Bianchi

Professor  
Signal, Statistics and Learning group  
Image, Data and Signal Department  
Télécom Paris, Institut Polytechnique de Paris

### Walid Hachem

Research Director  
Gaspard Monge Computer Science Laboratory  
French National Research Centre (CNRS)  
Gustave Eiffel University

### Edouard Pauwels

Professor  
Mathematics and Statistics Department  
Toulouse School of Economics  
University Toulouse 3 Paul Sabatier