

# Anas Barakat

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## PROFESSIONAL APPOINTMENT

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

## 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.

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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### Journal publications

- (J1) **Anas Barakat**, Pascal Bianchi, Walid Hachem, and Sholom Schechtman,  
“Stochastic optimization with momentum: convergence, fluctuations, and traps avoidance”,  
*Electronic Journal of Statistics* 15 (2), 3892-3947, 2021.
- (J2) **Anas Barakat** and Pascal Bianchi,  
“Convergence and Dynamical Behavior of the Adam Algorithm for Non-Convex Stochastic Optimization”,  
*SIAM Journal on Optimization* 31 (1), 244-274, 2021.

### Refereed conference papers

- (C1) Jiduan Wu, **Anas Barakat**, Ilyas Fatkhullin, and Niao He,  
“Learning Zero-Sum Linear Quadratic Games with Improved Sample Complexity”,  
*Submitted, 2023*.
- (C2) **Anas Barakat**, Ilyas Fatkhullin, and Niao He,  
“Reinforcement Learning with General Utilities: Simpler Variance Reduction and Large State-Action Space”,  
*International Conference on Machine Learning (ICML), 2023*.
- (C3) Ilyas Fatkhullin, **Anas Barakat**, Anastasia Kireeva, and Niao He,  
“Stochastic Policy Gradient Methods: Improved Sample Complexity for Fisher-non-degenerate

Policies”,  
*International Conference on Machine Learning (ICML)*, 2023.

- (C4) **Anas Barakat**, Pascal Bianchi and Julien Lehmann,  
“Analysis of a Target-Based Actor-Critic Algorithm with Linear Function Approximation”,  
*International Conference on Artificial Intelligence and Statistics (AISTATS)*, 2022.
- (C5) **Anas Barakat** and Pascal Bianchi,  
“Convergence Rates of a Momentum Algorithm with Bounded Adaptive Step Size for Nonconvex Optimization”,  
*Asian Conference on Machine Learning (ACML)*, 2020.
- (C6) **Anas Barakat** and Pascal Bianchi,  
“Convergence de l’algorithme Adam du point de vue des systèmes dynamiques”,  
*Francophone Colloquium of Signal and Image Processing (GRETSI)*, 2019.

### 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.

## TALKS AND POSTERS

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### Talks

“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, 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

## **Posters**

“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.”

8 Oct 2019    International Workshop on Machine Learning and Artificial Intelligence  
Télécom Paris, Paris, France

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

5 Aug 2019    International Conference on Continuous Optimization (ICCOPT)  
Technical University (TU) of Berlin, Berlin, Germany

24 June 2019    Data Science Summer School (DS3)  
Ecole Polytechnique, Palaiseau, France

## **PROFESSIONAL SERVICE**

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### **Refereeing**

#### **Journal refereeing**

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 refereeing**

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).

### **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.

## **RESEARCH INTERNSHIP**

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04/2018 - 09/2018    **Télécom Paris**  
Topic: Adaptive gradient algorithms for first-order optimization  
Supervisor: Prof. Pascal Bianchi  
Funding: French National Research Center (CNRS)

## **TEACHING EXPERIENCE**

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### **ETH Zurich**

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

### **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).<br>Statistics. |
| Fall 2019             | Statistics: Linear Models.  |
| Fall 2018             | Machine Learning.   |

### Ecole Polytechnique

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

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|-------------|---|
| Spring 2017 | Design and Analysis of Algorithms.<br>Advanced Programming. |
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### MENTORING EXPERIENCE

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| 10/2022 - 03/2023 | Supervision of Jiduan Wu's Master thesis (with Ilyas Fatkhullin):<br><i>Learning Zero-Sum Linear Quadratic Games with Improved Sample Complexity and Last-Iterate Convergence.</i>   |
| 03/2022 - 09/2022 | Supervision of Harish Rajagopal's Master thesis (with Ilyas Fatkhullin):<br><i>Multistage Step Size Scheduling for Minimax Problems.</i>   |
| 04/2022 - 06/2022 | Supervision of Jiduan Wu's semester project (with Siqi Zhang):<br><i>Mean Field Reinforcement Learning and Policy Gradient Methods for Linear Quadratic Zero-Sum Mean-Field Games.</i>   |
| 05/2021 - 10/2021 | Supervision of Julien Lehmann's Master thesis:<br><i>Analysis of a Target-Based Actor-Critic Algorithm with Linear Function Approximation.</i>   |
| 10/2018 - 02/2019 | Supervision of two Master students final research and innovation project<br>6-months project of Yuqing Wang and Zhengkang Shi<br>Collaboration: XLearn startup<br>Topic: Development of an online job advising system learning skill titles' from users' profiles using Machine Learning methods |

## AWARDS AND SCHOLARSHIPS

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- 2022            AISTATS 2022 Top 10 % reviewer.
- 9 Sep 2021    [Dodu Prize http://smi.emath.fr/spip.php?article624&lang=en](http://smi.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

## 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 conducted by Jean-Philippe Sarcos (50 musicians and more than 100 singers), music theory diploma and violin diploma.