Anas Barakat

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RESEARCH INTERESTS

Optimization; (multi-agent) reinforcement learning; game theory; machine learning

PROFESSIONAL EXPERIENCE

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

EDUCATION

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

Working/Submitted Papers

(C1) **Anas Barakat**, Souradip Chakraborty, Amrit Singh Bedi, Niao He,
"Reinforcement Learning with General Utilities: a Bilevel Approach for Scaling to Large Spaces",
Submitted, 2023.

(C2) Philip Jordan, **Anas Barakat**, Niao He,
"Independent Learning in Constrained Markov Potential Games",
Submitted, 2023.

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.

Conference Papers

(C1) Jiduan Wu, **Anas Barakat**, Ilyas Fatkhullin, and Niao He,
"Learning Zero-Sum Linear Quadratic Games with Improved Sample Complexity",
IEEE Conference on Decision and Control (CDC), 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.

PRESENTATIONS

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

Reviewing

Journal reviewing

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), IEEE Conference on Decision and Control (CDC 2023).

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

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

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).

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.
Fall 2019	Statistics: Linear Models.
Fall 2018	Machine Learning.

Ecole Polytechnique

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

Spring 2017	Design and Analysis of Algorithms.
	Advanced Programming.

ADVISING

05/2023 - 12/2023 Philip Jordan's Master thesis:
Independent and Simultaneous Nash Equilibria Learning for Markov Potential Games.

10/2022 - 03/2023 Jiduan Wu's Master thesis (with Ilyas Fatkhullin):
Learning Zero-Sum Linear Quadratic Games with Improved Sample Complexity and Last-Iterate Convergence.
Published in IEEE Conference on Decision and Control 2023

03/2022 - 09/2022 Harish Rajagopal's Master thesis (with Ilyas Fatkhullin):
Multistage Step Size Scheduling for Minimax Problems.

04/2022 - 06/2022 Jiduan Wu's semester project (with Siqi Zhang):
Mean Field Reinforcement Learning and Policy Gradient Methods for Linear Quadratic Zero-Sum Mean-Field Games.

05/2021 - 10/2021 Julien Lehmann's Master thesis:
Analysis of a Target-Based Actor-Critic Algorithm with Linear Function Approximation.
Published in AISTATS 2022

10/2018 - 02/2019 Master students final research and innovation project
6-months project of Yuqing Wang and Zhengkang Shi
Collaboration: XLearn startup
Topic: Development of an online job advising system learning skill titles' from users' profiles using Machine Learning methods

AWARDS AND SCHOLARSHIPS

2022	AISTATS 2022 Top 10 % reviewer.
9 Sep 2021	Dodu Prize http://smai.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. Caillau, S. Gaubert, V. Leclere, 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

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

HOBBIES

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.