Riccardo De Santi

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Main research interests:

- Sequential Decision Making Under Uncertainty: Reinforcement and Active Learning, Bayesian Optimization, Bandits.
- Automatic Scientific Discovery
- Others: Geometric Machine Learning, Combinatorial Optimization.

Education

Dec 2023 **Incoming PhD Student**, *AI Center, ETH Zürich*.
I have been awarded the ETH AI Center Doctoral Fellowship ($\sim$ 13/650 acceptance rate). I will advance my research related to Sequential Decision Making and Scientific Discovery, including areas such as Reinforcement Learning, Bayesian Optimization, and Active Learning. I will be supervised by professors Andreas Krause (Learning and Adaptive Systems group), Niao He (Optimization and Decision Intelligence group) and Kjell Jorner (Digital Chemistry).

Sep 2020 - Nov 2023 **M.Sc. Computer Science**, *ETH Zürich*.
Major: Machine Intelligence, Minor: Theoretical Computer Science.
Main topics: Machine Learning (ML) and Probabilistic ML, Reinforcement Learning, Algorithmic Game Theory, Causality, Causal Representation Learning, Statistical Learning Theory, Applied Category Theory, Mathematical Optimization.

Sep 2017 - Jul 2020 **B.Sc. Engineering of Computing Systems**, *Politecnico di Milano*.
Final grade: 110/110, cum laude. Main courses: Mathematical Analysis I and II, Physics, Linear Algebra and Geometry, Logic and (abstract) Algebra, Probability and Statistics, Algorithms and Principles of Theoretical CS, Advanced Algorithms and Parallel Programming, Operations Research, Automatic Control Theory.

Publications, Preprints, and In-Preparation

[1] (alphabetic), **Riccardo De Santi**, Alexander Marx, Mirco Mutti, Giorgia Ramponi, and Marcello Restelli. "Exploiting Causal Graph Priors with Posterior Sampling for Reinforcement Learning". In: *In preparation*.

[2] Pietro Maldini, Mirco Mutti, **Riccardo De Santi**, and Marcello Restelli. "Recursive History Representations for Unsupervised Reinforcement Learning in Multiple-Environments". In: *Decision Awareness in Reinforcement Learning Workshop and Pre-training: Perspectives, Pitfalls, and Paths Forward Workshop at ICML 2022*.

[3] Mirco Mutti*, **Riccardo De Santi***, Piersilvio De Bartolomeis, and Marcello Restelli. "Challenging Common Assumptions in Convex Reinforcement Learning". In: *Conference on Neural Information Processing Systems (**NeurIPS**) 2022, and Complex Feedback in Online Learning Workshop at ICML 2022*.

[4] Mirco Mutti*, **Riccardo De Santi***, and Marcello Restelli. "The Importance of Non-Markovianity in Maximum State Entropy Exploration". In: *International Conference on Machine Learning (**ICML**) 2022 (**Outstanding Paper Award**), and Workshop on Reinforcement Learning Theory ICML 2021*.

[5] Mirco Mutti*, **Riccardo De Santi***, Emanuele Rossi, Juan Felipe Calderon, Michael Bronstein, and Marcello Restelli. "Provably Efficient Causal Model-Based Reinforcement Learning for Systematic Generalization". In: *Workshop on Spurious Correlations, Invariance, and Stability at ICML 2022 and A Causal View on Dynamical Systems Workshop at NeurIPS 2022*.

* stands for equal contribution, i.e. shared first authorship

Invited Talks

September 2022 **The Role of Causal Structure in Unsupervised Reinforcement Learning**, *Technische Universität Dresden*, Dresden (Germany).

Research Experience

Oct 2022 - Feb 2023 **Graduate Student Researcher**, *University of Oxford*.
Developing theory and algorithms to introduce Group Theoretic Geometric Priors into Active Exploration Processes in Markov Chains. Supervised by prof. Michael Bronstein (University of Oxford, Twitter Research) and prof. Marcello Restelli (Politecnico di Milano).

Oct 2021 - Feb 2022 **Graduate Student Researcher**, *Imperial College London*.
Developed theory and algorithms to learn and exploit Causal Graphs in model-based Reinforcement Learning. Supervised by prof. Michael Bronstein (Imperial College London, Twitter Research) and prof. Marcello Restelli (Politecnico di Milano).

Jul 2019 - Feb 2021 **Undergraduate and Graduate Student Researcher**, *AirLab, Politecnico di Milano*.
Worked on the foundations of Unsupervised and Convex Reinforcement Learning supervised by prof. Marcello Restelli. Results of this collaboration have been awarded with the **Outstanding Paper Award** at ICML 2022.

Nov 2018 - Jul 2019 **Undergraduate Student Member**, *NECSTLab, Politecnico di Milano*.
Developed a software to manage biometric time series supervised by prof. Marco Domenico Santambrogio. Presented it at the Lawrence Berkeley National Laboratory and at Facebook HQ (Menlo Park, CA).

Industry and Entrepreneurial Experience

Aug 2018 - Sept 2018 **Internship, Software engineer**, *Netweb Software*.
Worked as a full-stack software engineer.

2015 - 2017 **Startup Project: iOS Mobile app - Dressly**.
Launched a social network app for the fashion industry developed from scratch within a team of three people. Tested and deployed on the App Store. Led a team of 7 people for 5 months.

Awards

July 2022 **Outstanding Paper Award at ICML 2022**.

July 2022 **DeepMind, ICML, and Synapse Travel Awards**.

Sept 2018 - July 2020 **Full-Fee Scholarship by Politecnico di Milano (2 years)** .
100% University main fee reduction due to GPA $>$ 29/30.

Nov-Dec 2018 **Won Competition at NECSTLab**.
Won (first place) a 2-months long competition held by a research lab of Politecnico di Milano. Developed a device and software to gather and analyse sleep data.

Volunteering

July 2022 - Present **Organizer of CS/AI Reading Group for LeadTheFuture**.
Interviewed researchers, including MIT professors, to introduce research topics such as of Computational Game Theory, Reinforcement Learning, and Domain Adaptation in ML, to a large audience of students.

Nov 2022 - Present **Mentor for LeadTheFuture**.
Helping italian students start their academic and research journeys.

(Selected) Projects

2021 **Statistical Learning Theory class projects**.
Implemented algorithms based on research papers in the areas of: Markov Chain Monte Carlo Sampling, Deterministic Annealing, Constant Shift Embedding, and Mean Field Theory. Got the maximum grade possible (6/6). Check here for details.

2020 **Probabilistic Artificial Intelligence class projects**.
Implemented algorithms in the areas of: Gaussian Processes, Bayesian Neural Networks, Bayesian Optimization, Actor Critic Reinforcement Learning. Got the maximum grade possible (6/6). Check here for details.

2020 **Software Engineering class project**.
Developed a multithreaded software version of a multiplayer board game. Got the maximum grade possible (30 cum laude/30) by satisfying advanced requirements. Check here for details.

2019 **Algorithms and Theoretical CS class project**.
Developed, analysed, and implemented an algorithm that uses RB-trees and other data structures to manage the creation of entities and relationships between them like an algorithm used in a social network would do. Got the maximum grade possible (30 cum laude/30) by satisfying the most challenging time and space complexity constraints among the ones proposed. Check here for details.