Matteo Bettini

Researcher in multi-agent learning

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Matteo Bettini
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Interested and experienced in reinforcement learning, multi-robot systems, and graph neural networks

Education

2021–Mar 2025 **PhD in Computer Science**, *University of Cambridge*
Thesis: Neural diversity in multi-agent systems, Supervisor: Prof. Amanda Prorok
- Published 8 research papers [1–8] at top conferences (e.g., ICML, ICLR, AAMAS) and journals (JMLR)
- Focus on studying [4], measuring [9], and controlling [1] behavioral diversity in multi-agent reinforcement learning
- Created and maintained *VMAS* [5] (320+ stars), a vectorized simulator and task collection written in PyTorch
- Deployed and demonstrated research on a fleet of Cambridge Robomaster autonomous mobile ground robots [8]

2020–2021 **MPhil in Advanced Computer Science**, *University of Cambridge*
Distinction, GPA: 87.09/100, Supervisor: Prof. Amanda Prorok
Thesis on transport network design for multi-agent routing using genetic algorithms and reinforcement learning

2017–2020 **BEng in Computer Engineering**, *Politecnico di Milano*
110 Cum Laude/110 (Honors), GPA: 29.16/30
Project on software engineering: reinvented board game "Santorini" in Java with online multiplayer and 3D graphics

Experience

Work

Jun–Oct 2023 **Meta, PyTorch**, *Machine Learning Engineer Intern (PhD)*, London
Worked in the TorchRL team on PyTorch and facebook-research open-source projects, leading to 2 publications [2, 3]
- Integrated multi-agent in the PyTorch reinforcement learning library *TorchRL* (2.2k+ stars), becoming 2nd contributor
- Developed and maintained *BenchMARL* (250+ stars), a facebook-research multi-agent reinforcement learning library

Jun–Sep 2021 **Amazon Web Services (AWS)**, *Software Development Engineer Intern*, Cambridge
Worked in the EC2 team using Rust to implement an interactive serial console for Xen-based EC2 instances
- Learned and used the Rust language with cryptographic and asynchronous programming libraries
- Implemented an encrypted CoAP client-server and tested on docker rapid development environment

Teaching

2021–present **University of Cambridge**, *Teaching Assistant and Supervisor*, Cambridge
- *Teaching assistant*, demonstrator, and robot manager for "Introduction to Robotics" bachelor and master course
- *Thesis supervisor* for MPhil students, guiding them in conducting research and producing a master dissertation
- *Supervisor* and material curator for undergraduate courses, tutoring 19 students in small-sized groups

Organization

2024-present **The Alan Turing Institute**, *Organizer*, London
- Organized the UK Multi-Agent Systems Symposium, a one-day event in King's College London with 200 attendees
- Managing the multi-agent systems interest group and mailing list with 650+ participants

2023 **ICRA Workshop on Multi-Robot Learning** , *Contributions Committee*, London

Outreach

2024-25 **Lead The Future**, *Mentor*
Mentored 5 high-achieving STEM Italian students and professionals in a non-profit organization focused on *Give Back*

2023, 2024 **Computer Science Open Day**, *Volunteer*, University of Cambridge
Explained and demoed multi-robot reinforcement learning to 100+ kids of all ages via live and interactive experiments

Awards and recognition

2024 Hughes Hall College (University of Cambridge) travel grant - 500£
2021 Graduated with Distinction from the University of Cambridge
2017–2020 Achieved 30 Cum Laude/30 (Honors) for 13 of 25 exams at Politecnico di Milano and graduated Cum Laude
2017–2020 Merit-based scholarship at Politecnico di Milano - 50% tuition reduction
2017 Best Freshmen of Politecnico di Milano Award - 1500€

Skills

Programming Python, Java, Rust, C, JavaScript, VHDL
Systems Linux, MacOS, ROS, SLURM, HPC, Docker

AI Libraries PyTorch, scikit-learn, NumPy, SciPy, TorchRL, TorchGeometric, TensorFlow, Pandas, matplotlib

Selected projects

- **BenchMARL**: created the facebook-research BenchMARL library (250+ stars, 5k+ downloads) to standardize benchmarking in multi-agent reinforcement learning, published at JMLR and presented at NeurIPS [2]
- **Controlling behavioral diversity**: introduced the first method able to control behavioral diversity in multi-agent learning, showing the emergence of unprecedented and more efficient diverse strategies [1]
- **TorchRL**: second contributor of the PyTorch reinforcement learning library (2.2k+ stars, 340k+ downloads), spanning multiple domains of data-driven decision-making (model-based/free, LLM RLHF, POMDPs) [3]
- **Heterogeneous robot learning**: crystallized the role of heterogeneity in multi-robot reinforcement learning through simulations and real-world experiments, demonstrating the intrinsic resilience of diverse robots [4]
- **Vectorized multi-agent simulator (VMAS)**: implemented and maintained VMAS (320+ stars, 31k+ downloads), a batched PyTorch multi-agent simulator and task collection for collective learning [5]
- **Multi-robot navigation**: deployed and demonstrated collective learning in a zero-shot sim-to-real setting on a fleet of custom Cambridge Robomaster holonomic ground robots equipped with NVIDIA Jetsons [8]

Selected publications

[1] **Matteo Bettini**, Ryan Kortvelesy, and Amanda Prorok. Controlling Behavioral Diversity in Multi-Agent Reinforcement Learning . In *International Conference on Machine Learning (ICML)*, 2024.

[2] **Matteo Bettini**, Amanda Prorok, and Vincent Moens. BenchMARL: Benchmarking Multi-Agent Reinforcement Learning . *Journal of Machine Learning Research (JMLR)*, 25, 2024.

[3] Albert Bou, **Matteo Bettini**, Sebastian Dittert, Vikash Kumar, Shagun Sodhani, Xiaomeng Yang, Gianni De Fabritiis, and Vincent Moens. TorchRL: A data-driven decision-making library for PyTorch . In *International Conference on Learning Representations (ICLR)* - ***Spotlight (top 5%)***, 2024.

[4] **Matteo Bettini**, Ajay Shankar, and Amanda Prorok. Heterogeneous Multi-Robot Reinforcement Learning . In *Autonomous Agents and Multiagent Systems (AAMAS)*, 2023.

[5] **Matteo Bettini**, Ryan Kortvelesy, Jan Blumenkamp, and Amanda Prorok. VMAS: A Vectorized Multi-Agent Simulator for Collective Robot Learning . In *Distributed Autonomous Robotic Systems (DARS)*, 2022.

[6] Amanda Prorok and **Matteo Bettini**. Heterogeneous Teams . *Encyclopedia of Robotics*, 2024.

[7] Steven Morad, Ryan Kortvelesy, **Matteo Bettini**, Stephan Liwicki, and Amanda Prorok. POPGym: Benchmarking Partially Observable Reinforcement Learning . In *International Conference on Learning Representations (ICLR)*, 2023.

[8] Jan Blumenkamp, Ajay Shankar, **Matteo Bettini**, Joshua Bird, and Amanda Prorok. The Cambridge RoboMaster: An Agile Multi-Robot Research Platform . In *Distributed Autonomous Robotic Systems (DARS)*, 2024.

[9] **Matteo Bettini**, Ajay Shankar, and Amanda Prorok. System Neural Diversity: Measuring Behavioral Heterogeneity in Multi-Agent Learning . *arXiv preprint arXiv:2305.02128*, 2023.

[10] **Matteo Bettini** and Amanda Prorok. On the properties of path additions for traffic routing . *IEEE International Conference on Intelligent Transportation Systems (ITSC) Workshop on Co-Design and Coordination of Future Mobility Systems*, 2022.

Languages

English Full proficiency (*TOEFL IBT 112/120)* Italian Native

Invited talks

BenchMARL: Benchmarking Multi-Agent Reinforcement Learning

2024 ○ Distributed and Collaborative Intelligent Systems and Technology (DCIST) Collaborative Research Alliance (CRA)
2023 ○ InstaDeep knowledge sharing session - *InstaDeep*

Multi-Agent Simulation and Learning in TorchRL

2023 ○ Artificial Intelligence Research Group Talks (Computer Laboratory) - *University of Cambridge* -
2023 ○ Multi-agent Reinforcement Learning Reading Group - *University of Maryland, College Park*

Heterogeneous Multi-Robot Reinforcement Learning

2022 ○ Distributed and Collaborative Intelligent Systems and Technology (DCIST) Collaborative Research Alliance (CRA)

Courses taught

2021-22, 2022-23 **Introduction to Robotics** , *MPhil, Part III, Part II in Computer Science*, University of Cambridge
Teaching assistant, grader, demonstrator, mini-project supervisor, and robot fleet manager

2021-22, 2022-23 **Concepts in Programming Languages** , *Part IB in Computer Science*, University of Cambridge
Creation & grading of personalized supervision sessions for 19 undergraduate students in groups of 2

Thesis supervision

2023 **Alex Shaw**, *MPhil in Machine Learning and Machine Intelligence*, University of Cambridge
Evaluating Benefits of Heterogeneity in Constrained Multi-Agent Learning

2023 **Sepand Dyanatkar**, *MPhil in Advanced Computer Science*, University of Cambridge
Resilience via Communication in Multi-Agent Reinforcement Learning

Reviewer duty

2024 CoRL, MRS, Neurocomputing, Encyclopedia of Robotics, IROS

2023 IROS, RA-L, ICRA, The International Journal of Robotics Research