Josep Lumbreras Zarapico

josep.lumbreras@u.nus.edu @qJosepLumbreras Josep Lumbreras
Google Scholar

Professional summary

I am a PhD candidate specializing in rigorous theoretical results at the intersection of Reinforcement Learning and Quantum Information. One of my main lines of research is the application of stochastic bandits to quantum learning tasks, as well as contributions to the classical problem of stochastic bandits. Additionally, I work on the generalization of Hidden Markov Models and Partially Observable Markov Decision Processes into quantum and general probabilistic theories. Although my work is primarily theoretical, it is driven by practical applications, aiming to contribute both to academic advancements and real-world implementations into fields such as recommender systems, stochastic processes prediction and more generally artificial intelligence.

Education

Sep 2020– ongoing — **Ph.D. in Physics** in Centre for Quantum Technologies, National University of Singapore.
Thesis title (provisional): *The exploration-exploitation dilemma when learning properties of quantum states.*

Sep 2019 – Jul 2020 — **Master in Astrophysics, Particle Physics and Cosmology** in University of Barcelona.
Thesis title: *Chaos in two dimensional conformal field theories.*

Sep 2013 – Jan 2019 — **Bachelor's degree, Mathematics** in University of Barcelona.
Thesis title: *Efficient unitary approximations in quantum computing: the Solovay-Kitaev Theorem.*

Bachelor's degree, Physics in University of Barcelona.
Thesis title: *Scaling of the energy and entropy errors in quantum circuits.*

Employment History

Jan 2022 – Jun 2022 — **Visiting Researcher.** *Quantum Information group (GIQ) Autonomous University of Barcelona.* I worked with Prof. Andreas Winter on separations of stochastic processes generated by finite memeory systems including classical (hidden markov models), quantum and general probabilistic models.

Dec 2019 – July 2020 — **Research intern.** *Institute of Cosmos Sciences, University of Barcelona.* I received a research collaborator grant from ICCUB in order to do my master thesis. In this project, I studied the phenomena of quantum chaos in 2-dimensional conformal field theories under the supervision of Dr. Tomeu Fiol.

Sep 2018 – Aug 2019 — **Research intern.** *Barcelona Supercomputing Center.* Project on the error scaling in variational quantum circuits under the supervision of Prof. Jose Ignacio Latorre.

Research Publications and Talks

Journal Articles

1. M. Fanizza, **J. Lumbreras**, and A. Winter, "Quantum theory in finite dimension cannot explain every general process with finite memory," *Communications in Mathematical Physics*, vol. 405, no. 2, pp. 1–24, 2024. DOI: https://doi.org/10.1007/s00220-023-04913-4.

2. **J. Lumbreras**, M. Terekhov, and M. Tomamichel, "Learning pure quantum states (almost) without regret," *arXiv preprint arXiv:2406.18370*, 2024.

3. S. Brahmachari, **J. Lumbreras**, and M. Tomamichel, "Quantum contextual bandits and recommender systems for quantum data," *(under review) arXiv preprint arXiv:2301.13524*, 2023.
4. M. Fanizza, N. Galke, **J. Lumbreras**, C. Rouzé, and A. Winter, "Learning finitely correlated states: Stability of the spectral reconstruction, dec," *(under review) arXiv preprint arXiv:2312.07516*, 2023.
5. **J.Lumbreras**, E. Haapasalo, and M. Tomamichel, "Multi-armed quantum bandits: Exploration versus exploitation when learning properties of quantum states," *Quantum*, vol. 6, p. 749, 2022. DOI: 10.22331/q-2022-06-29-749.
6. C. Bravo-Prieto, **J. Lumbreras**, L. Tagliacozzo, and J. I. Latorre, "Scaling of variational quantum circuit depth for condensed matter systems," *Quantum*, vol. 4, p. 272, 2020. DOI: 10.22331/q-2020-05-28-272.

Conference Proceedings

1. **J. Lumbreras** and M. Tomamichel, "Linear bandits with polylogarithmic minimax regret," in *To appear in 37th Annual Conference on Learning Theory (COLT 2024)*, 2024. DOI: https://doi.org/10.48550/arXiv.2402.12042.

Contributed talks without proceedings

1. **J. Lumbreras**, *Quantum theory in finite dimension cannot explain every general process with finite memory*, Institute of Physics Singapore Meeting, 2023.
2. **J. Lumbreras**, *Quantum theory in finite dimension cannot explain every general process with finite memory*, 18th Theory of Quantum Computation, Communication and Cryptography (TQC), 2023.
3. **J. Lumbreras**, *Multi-armed quantum bandits: Exploration versus exploitation when learning properties of quantum states*, Institute of Physics Singapore Meeting, 2022.
4. **J. Lumbreras**, *Multi-armed quantum bandits: Exploration versus exploitation when learning properties of quantum states*, 21th Asian Quantum Information Science Conference, 2021.
5. **J. Lumbreras**, *Multi-armed quantum bandits: Exploration versus exploitation when learning properties of quantum states*, Beyond IID in Information Theory 12, 2021.
6. **J. Lumbreras**, *Multi-armed quantum bandits: Exploration versus exploitation when learning properties of quantum states*, Quantum Techniques in Machine Learning, 2021.

Invited talks

1. **J. Lumbreras**, "Linear bandits with polylogarithmic minimax regret," Vincent Y. F. Tan seminar, ECE National University of Singapore, 2024.
2. **J. Lumbreras**, "Mulit-armed stochastic bandits and their applications to quantum information," Complexity Institute at the School of Physical and Mathematical Sciences, Nanyang Technological University, 2024.
3. **J. Lumbreras**, "Online learning of pure quantum states without regret," GIQ seminar, Autonomous University of Barcelona, 2023.
4. **J. Lumbreras**, "Multi-armed quantum bandits: Exploration versus exploitation when learning properties of quantum states," GIQ seminar (Universitat Autonoma de Barcelona), 2022.
5. **J. Lumbreras**, "Multi-armed quantum bandits: Exploration versus exploitation when learning properties of quantum states," Quantic seminar (Barcelona Supercom- puting center), 2022.
6. **J. Lumbreras**, "Multi-armed quantum bandits: Exploration versus exploitation when learning properties of quantum states," Quantum information group seminar, ETH, Zurich, 2022.

7 **J. Lumbreras**, "Multi-armed quantum bandits: Exploration versus exploitation when learning properties of quantum states," CQT CS seminar, National University of Singapore, 2022.

8 **J. Lumbreras**, "Multi-armed quantum bandits: Exploration versus exploitation when learning properties of quantum states," Jens Eisert QML seminar, Freie Universitat, Berlin, 2021.

9 **J. Lumbreras**, "Multi-armed quantum bandits: Exploration versus exploitation when learning properties of quantum states," Vincent Tan group seminar, National University of Singapore, 2021.

Skills

Languages — Full professional proficiency on English and native level at Spanish and Catalan.

Coding — Python, Wolfram Mathematica, LaTeX

Miscellaneous Experience

Journal and Conference Reviewer

Quantum, TQC, QIP, ICALP, NeurIPS, Qcrypt, IEEE Transactions on Information Theory.

References

Available on Request