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Separating quantum and classical computing: rigorous proof and practical application

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Curriculum Vitæ

From 2016 to 2020 Simon Marshall attended the University of Warwick for an integrated Masters in Maths and Physics. His thesis dissertation concerned the dynamics of cooling metal droplets under James Sprittles in the Maths department. He also completed undergraduate research on quantum collapse models under George Knee and Animesh Datta.

In 2020 he began his PhD in the applied quantum algorithms group in Leiden, under Vedran Dunjko. Initially, his research concerned quantum machine learning and circuit-cutting techniques, but toward the end focused on more complexity theoretical topics. During his PhD studies, he took courses in machine learning for quantum experiments, scientific integrity and scientific conduct, among others.

List of publications

This thesis is based on the following papers:

- [141] S. C. MARSHALL, S. AARONSON & V. DUNJKO Improved separation between quantum and classical computers for sampling and functional tasks, arXiv:2410.20935 (2024).
- [142] S. C. MARSHALL, C. GYURIK & V. DUNJKO On Bounded Advice Classes, arXiv:2405.18155 (2024).
- [143] S. C. MARSHALL, C. GYURIK & V. DUNJKO, High Dimensional Quantum Machine Learning With Small Quantum Computers, *Quantum*, **7**, 1078, 2023.
- [144] S. C. MARSHALL, J. TURA & V. DUNJKO, All this for one qubit? Bounds on local circuit cutting schemes, arXiv:2303.13422, 2023.
- [35] S. JERBI, C. GYURIK, S. C. MARSHALL, R. MOLTENI & V. DUNJKO, Shadows of quantum machine learning, *Nature Communications*, **15**(1), 5676.

In the course of their PhD, the author has additionally authored the following articles that are not included in this thesis:

- [145] S. C. MARSHALL & J. H. KIRCHNER, Understanding polysemanticity in neural networks through coding theory, arXiv:2401.17975, 2024.

List of publications

- [146] S. JERBI, C. GYURIK S. C. MARSHALL, H. J. BRIEGEL & V. DUNJKO, Parametrized quantum policies for reinforcement learning, *Advances in Neural Information Processing Systems*, **34**,28362–28375, 2021.
- [147] S. AARONSON, S. GREWAL, V. IYER, S. C. MARSHALL & R. RAMACHANDRAN, PDQMA = DQMA = NEXP: QMA With Hidden Variables and Non-collapsing Measurements, arXiv:2403.02543, 2024.