USC Dornsife College of Letters, Arts and Sciences
Department of Physics and Astronomy

Ming Hsieh Institute - Physics

Joint Seminar Series

USC Viterbi School of Engineering
Ming Hsieh Department of Electrical and Computer Engineering

A Categorical Perspective of Encoding Real-World Data in Quantum Computers

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SSL 202
2:00 pm

Abstract: The question of how to encode real-world data in quantum computer has a tremendous amount of importance in the quantum machine learning (QML) community. There are a few proposed metrics to quantify the efficacy of quantum feature maps with the most used criteria being 'expressibility' [1] and 'expressivity' [2]. However, as noted by the authors, there are shortcomings with these two techniques. Our empirical analysis of using the standard schemes of angle encoding, instantaneous quantum polynomial encoding (IQP), and amplitude encoding to perform machine learning tasks on different dataset reveals new insights into our metrics need to be considered when choosing a particular quantum encoding technique [3,4]. Using the perspective of category theory, we propose that quantum encoding techniques should preserve "structures" of classical data. Based on this insight, we proposed technique on comparing the entropy of a point-cloud against the analytic extension of von Neuman entropy applied to quantum operators [5], directly addressing one area of structure.

[1] S. Sim, P. D. Johnson, and Alán Aspuru-Guzik. Advanced Quantum Technologies 2, 12 (2019).
[2] M .Schuld, R. Sweke, and J. Jakob Meyer. Physical Review A 103, 3 (2021).
[3] A. Vlasic, and A. Pham, Quantum Information and Computation 23, 1091 (2023).
[4] G. D. Luca, A. Vlasic, M. Vitz, and A. Pham. arXiv:2408.13109 (2024)
[5] A. Vlasic, and A. Parzygnat, in preparation (2024).

Bio: Andrew earned a PhD in mathematics from the University of Illinois at Urbana-Champaign and has extensive experience in fundamental and applied research in the academia, DoD, and industry. Andrew has been a postdoc at Queen's University in Ontario, an acting funding officer at the Army Research Office, a senior data scientist at Bank of America, and is currently the fundamental research lead in the Quantum Research Group at Deloitte Consulting. If interested, view Andrew's portfolio on Google Scholar.

Hosted by
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