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Classical topology & quantum complexity

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Abstract

I will present work studying the complexity of a classic problem in computational topology, the homology problem: given a description of some space decide whether or not it contains a hole. The types of space I will consider are clique complexes of graphs, where a clique complex is a simplicial complex defined by the cliques of a graph. This is motivated by the practical applications of topological data analysis (TDA). The setting and statement of the homology problem are completely classical, yet I will show that the complexity is characterized by quantum complexity classes. This result provides some suggestion that the quantum TDA algorithm [LGZ16] cannot be dequantized. More broadly, it opens up new possibilities for quantum advantage in topological data analysis.