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Summary of the Dissertation

The dissertation studies the Universality and Membership problems in quantum computing.

The Universality problem asks whether a given finite set of single qudit gates (gate set) is universal, namely whether we can approximate to arbitrary precision any other quantum gate by composition of such gates. In the Membership problem, instead, it is enough to approximate some other given quantum gate.

It is natural to change scenario and study the same problems for Lie algebras (more precisely, for *compact* Lie algebras, such as the set of hamiltonians), where the notion of composition of gates is replaced by that of linear combinations and nested commutators of the given vectors of the Lie algebra.

The thesis proceeds then to the solution of the Lie algebraic problems, and finally goes back to the Universality problem for quantum gates, for which *two* solutions are provided. The Membership problem for gates is also partially addressed.

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