Methods and programs for the generation of contextual finite geometries

Jessy Colonval, Henri de Boutray and Alain Giorgetti
Institut FEMTO-ST, Université de Bourgogne Franche-Comté, CNRS, Besançon, France

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Quantum computation is a new computational paradigm, very different from our traditional understanding of what an algorithm is. It requires quantum resources that are not conventional, such as entanglement and contextuality [HWVE14, JL03]. Understanding the contribution of these resources can provide important information on existing quantum algorithms, and facilitate the design of new quantum algorithms.

A contextual finite geometry is a finite geometry related to quantum contextuality [PGHS15]. We present several methods to build finite geometries, their implementation and their execution using intensive computing. The goal is to obtain a method of construction of many contextual finite geometries. The implementations are done in Magma [BCP97] and the calculations are performed on the Franche-Comte mesocenter. A first method constructs finite geometries from Pauli groups of any size and their tensor products [PS07]. A second method exploits a correspondence between Grothendieck's *dessins d'enfants* (child's drawings) and so-called quantum finite geometries [PGHS15]. A third method builds finite geometries from primitive groups of permutations [CdB19]. Particular attention has been given to ensuring that implementations are as reliable and reusable as possible.

References

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