CENTRE DE RECHERCHES MATHÉMATIQUES

Tenseurs : information quantique, complexité et combinatoires quantiques

Tensors: Quantum Information, Complexity and Combinatorics

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**Matrix spaces and graphs**

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Suppose I give you a collection of *n \times n* matrices. Can you determine if some linear combination of them is an invertible matrix? If you can, that's phenomenal news—you can now prove circuit lower bounds that are currently completely out of reach.

Questions of this type, about linear combinations of matrices (or, equivalently, about matrix spaces—vector spaces whose elements are matrices) arise naturally in many different fields, including theoretical computer science, quantum information theory, abstract algebra, and even algebraic topology. In this talk, I'll focus on some surprising connections between matrix spaces and graphs: in a number of settings, it turns out that a linear-algebraic property of matrix spaces is equivalent to a corresponding property of graphs. These connections can be used to reinterpret and generalize classical theorems in algebra of Dieudonné and Gerstenhaber, and also yield applications in complexity theory and quantum information theory.

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