

Quantum Speedup and Limitations on Matroid Property Problems

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Problems & Ideas

- Quantum Query Complexity and Algorithm for Matroid Property Problems:
 - Compute the girth, the number of circuits(bases, flats, hyperplanes) of matroid.
 - Determine whether a matroid is uniform, Eulerian or paving.
- Ideas: Quantum Search Algorithm, Quantum Adversary Method.

Main Contributions

- Contributions:
 - The quantum query complexity of computing the girth and the number of circuits(bases, flats, hyperplanes) is $\Omega(\sqrt{\binom{n}{\lfloor n/2 \rfloor}})$.
 - The quantum query complexity for determining whether a matroid is uniform or Eulerian is $\Omega(\sqrt{\binom{n}{\lfloor n/2 \rfloor}})$.
 - There is a quantum algorithm takes $O(\sqrt{\binom{n}{\lfloor n/2 \rfloor}})$ queries to determine uniform, and $O((\log n) \cdot \sqrt{\binom{n}{\lfloor n/2 \rfloor}})$ queries to compute the girth.
 - There is a quantum algorithm takes $O(\sqrt{\binom{n}{\lfloor n/2 \rfloor}})$ queries to determine paving, and any quantum algorithm needs at least $\Omega(\sqrt{\binom{n}{\lfloor n/2 \rfloor}/n})$.