On the complexity of finding large odd induced subgraphs and odd colorings

Ignasi Sau

LIRMM, Université de Montpellier, CNRS, Montpellier, France

Joint work with **Rémy Belmonte**

University of Electro-Communications, Chofu, Japan

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Outline of the talk

1. Introduction
2. Our results
3. Some proofs
4. Further research

Next section is...

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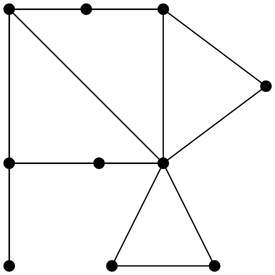

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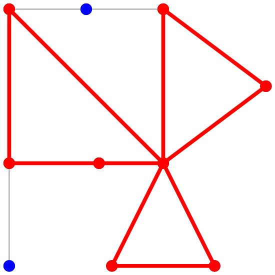

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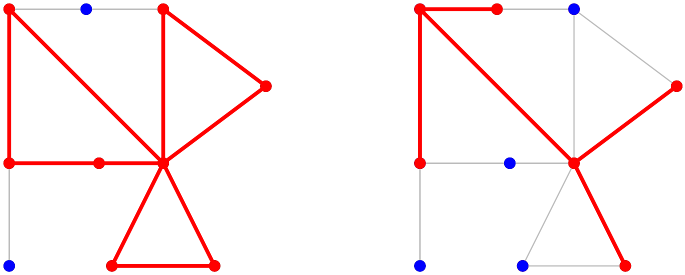

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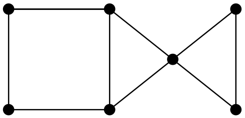

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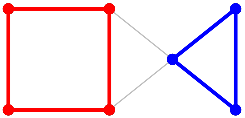

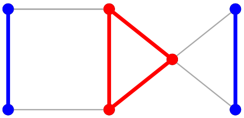

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Corollary

Every graph G contains an even induced subgraph with at least $|V(G)|/2$ vertices.

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$\boxed{\text{What about } \text{mos}(G) \text{ and } \chi_{\text{odd}}(G)?}$

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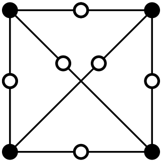

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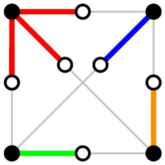

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$\boxed{\text{Our goal}}$ Computational aspects of the parameters mos and χ_{odd}.

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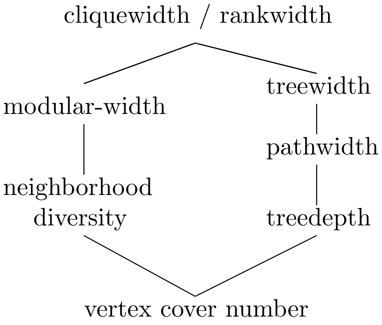

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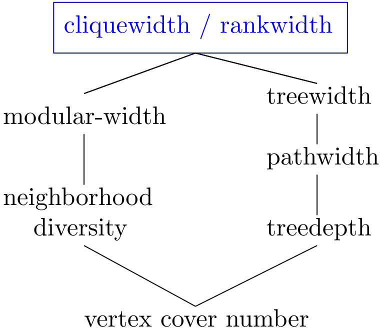

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- Inspired by algorithms of [Bui-Xuan, Telle, Vatshelle. 2010-2011-2013]
- First algorithms in time $2^{o(\mathrm{rw}^2)} \cdot n^{\mathcal{O}(1)}$ for an NP-hard problem.
- Is the function $2^{\mathcal{O}(\mathrm{rw})}$ optimal under the ETH? ($\nexists 2^{o(n)}$ algo for 3-SAT)
  - For deciding whether $\chi_{\mathrm{odd}}(G) \leq q$, our NP-hardness reduction implies that $\nexists\ 2^{o(n)}$ algo under the ETH $\Rightarrow$ $\nexists\ 2^{o(\mathrm{rw})} \cdot n^{\mathcal{O}(1)}$ ✓
  - For computing $\mathrm{mes}(G)$ and $\mathrm{mos}(G)$, existing NP-hardness reduction implies only that $\nexists\ 2^{o(\sqrt{n})}$ algo under the ETH. [Cai, Yang. 2011]

    We provide a linear NP-hardness reduction for $\mathrm{mes}(G)$ and $\mathrm{mos}(G)$, hence $\nexists\ 2^{o(n)}$ algo under ETH $\Rightarrow$ $\nexists\ 2^{o(\mathrm{rw})} \cdot n^{\mathcal{O}(1)}$ ✓

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- Our bound implies that $c_k \geq \frac{1}{k+1}$.

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- Note that cographs are exactly P_4-free graphs.
  We show that χ_{odd} is unbounded for P_5-free graphs.

skip

Next section is...

Theorem

For an integer $q \geq 1$, *deciding whether* $\chi_{\mathrm{odd}}(G) \leq q$ *is*

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For $q = 1$ the problem is trivial: G needs to be an odd graph itself.

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- $\chi_{\text{odd}}(G) \leq 2 \iff$ the above system is feasible.

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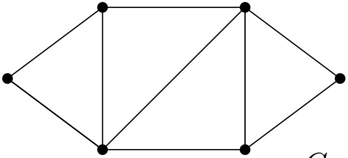

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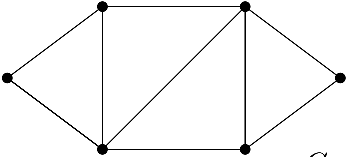

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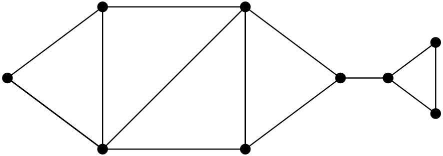

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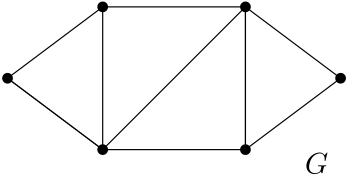

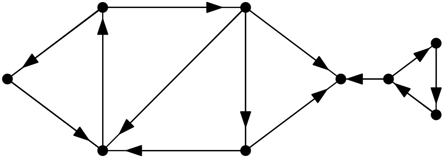

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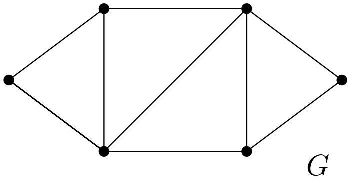

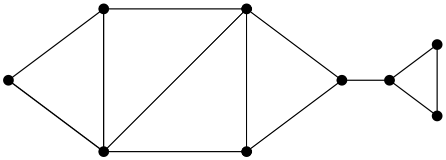

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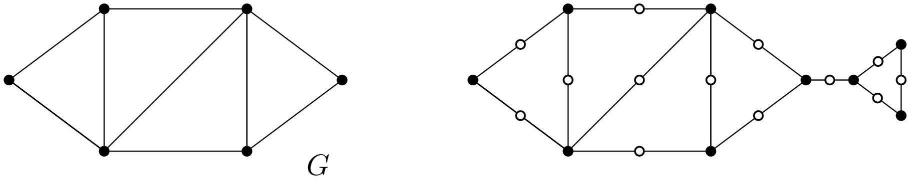

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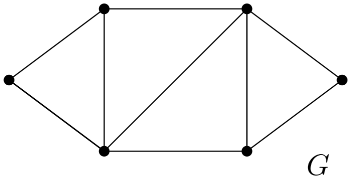

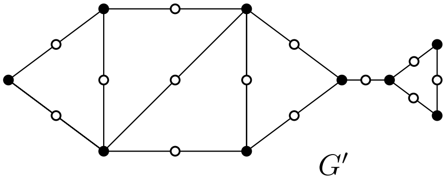

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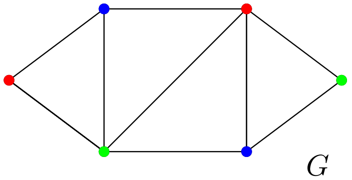

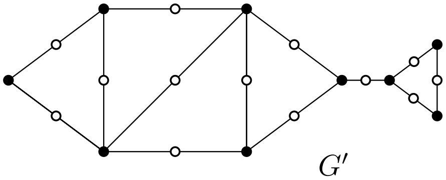

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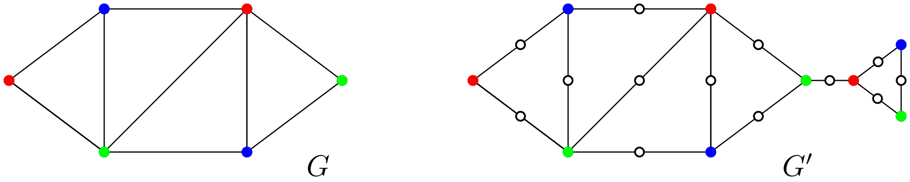

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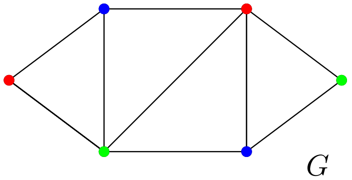

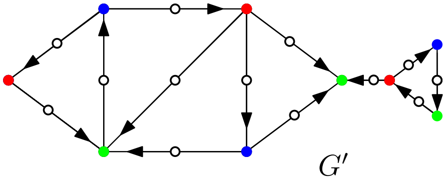

Deciding whether $\chi_{\mathrm{odd}}(G) \leq q$ is NP-complete if $q \geq 3$.

We reduce from q-COLORING. Suppose $q = 3$.

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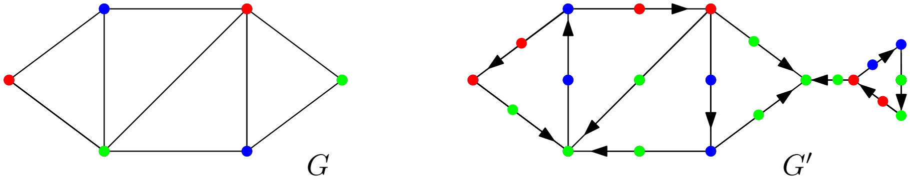

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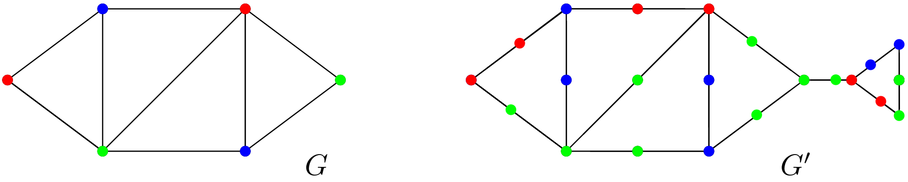

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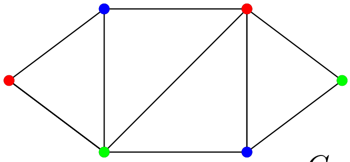

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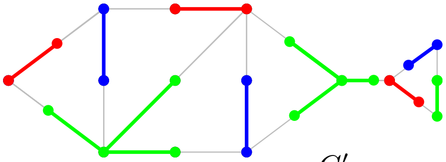

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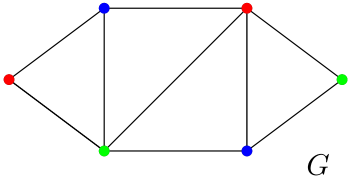

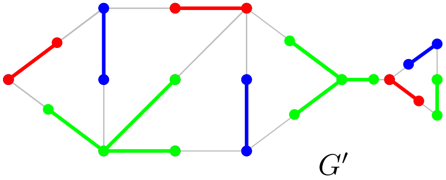

Thus, G is 3-colorable $\iff$ $\chi_{\text{odd}}(G') \leq 3$.

skip

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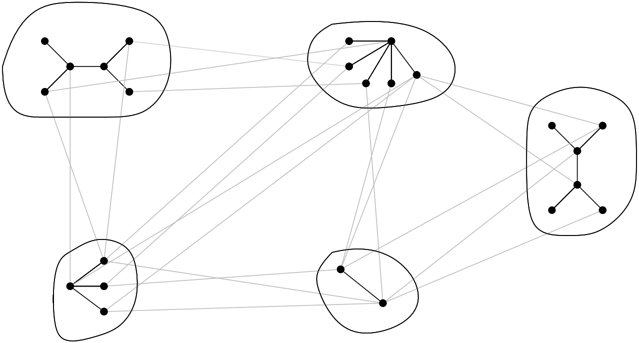

Given G, consider a partition of $V(G)$ into induced odd trees.

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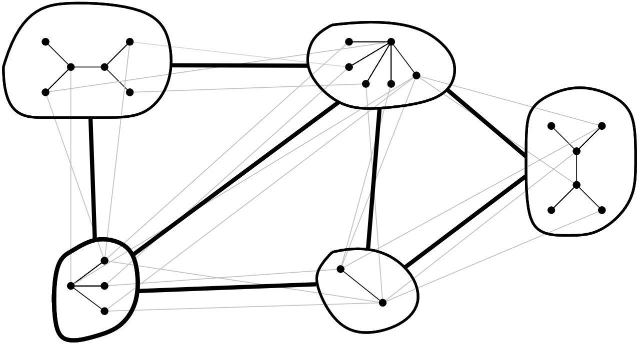

Let G' be obtained from G by contracting each tree to a single vertex.

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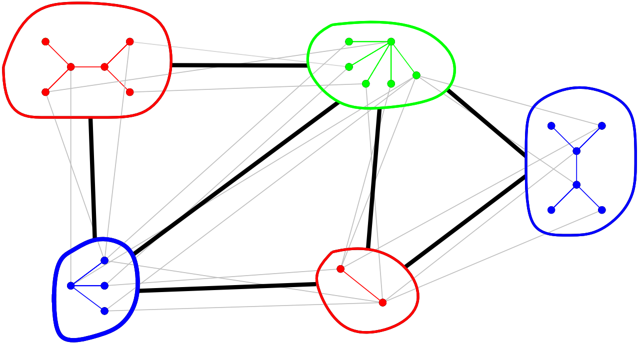

Consider a proper vertex coloring of G' using $\chi(G')$ colors.

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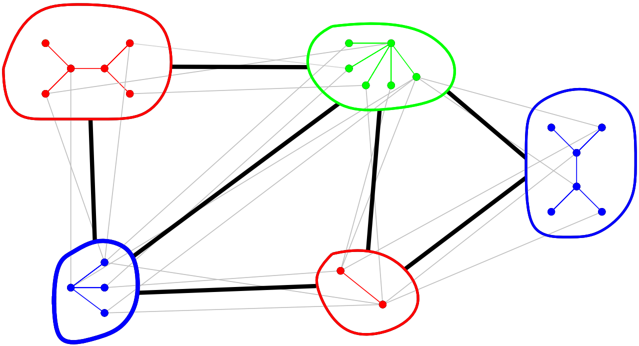

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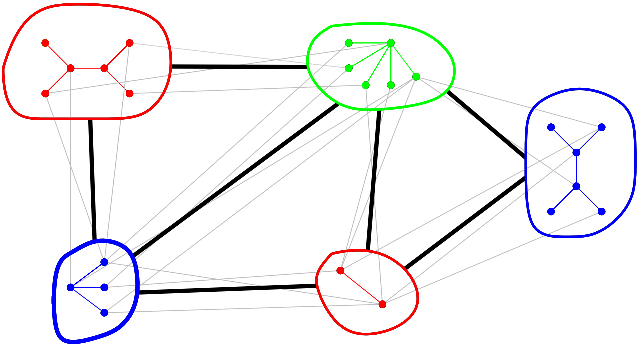

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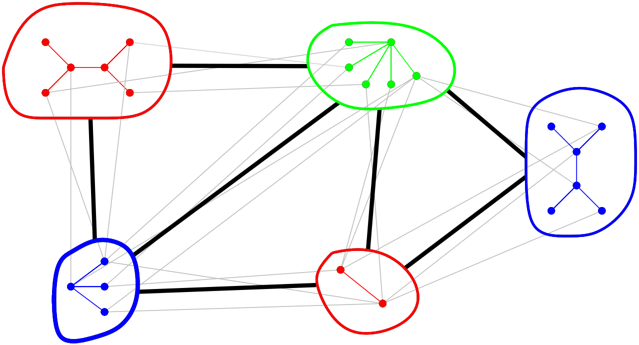

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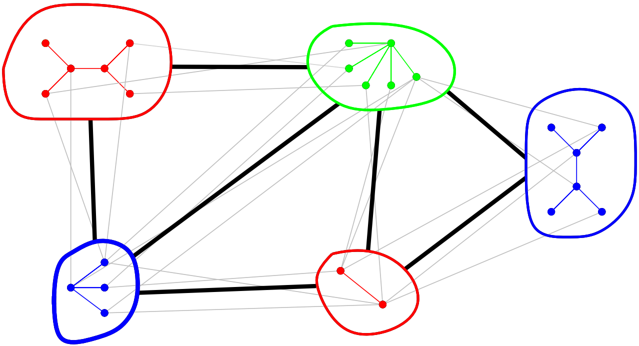

Bound is tight: let G be subdivided n-clique with $n \equiv 0, 3 \pmod 4$. ⏩ skip

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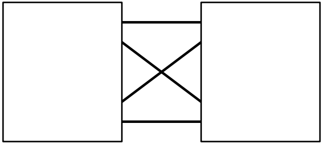

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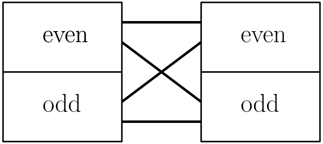

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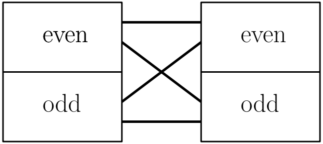

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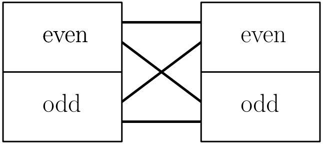

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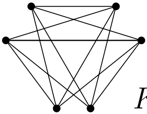
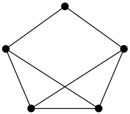


$K_{2,2,2}$



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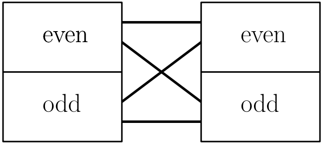

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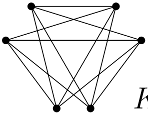

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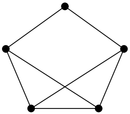

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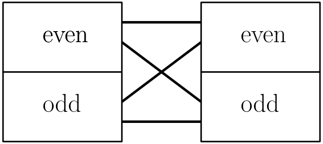

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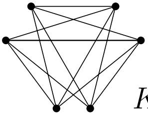

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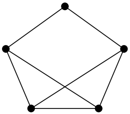

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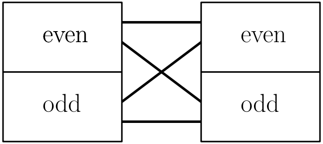

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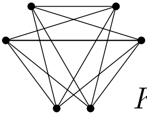

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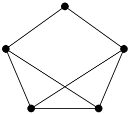

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Next section is...

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Gràcies!