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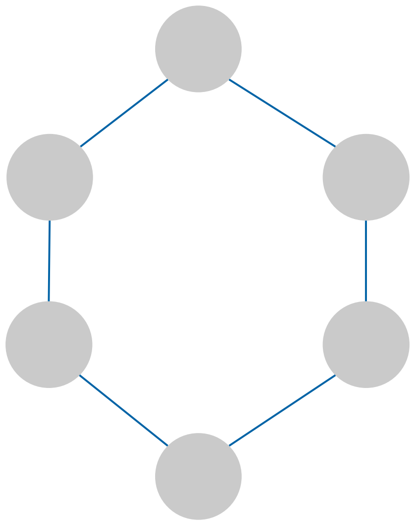
How to Support an Unknown Future: Preprocessing for Local Algorithms

Klaus-Tycho Foerster, Juho Hirvonen, Stefan Schmid, and Jukka Suomela. To appear @IEEE INFOCOM 2019

Coloring of rings (LOCAL model)



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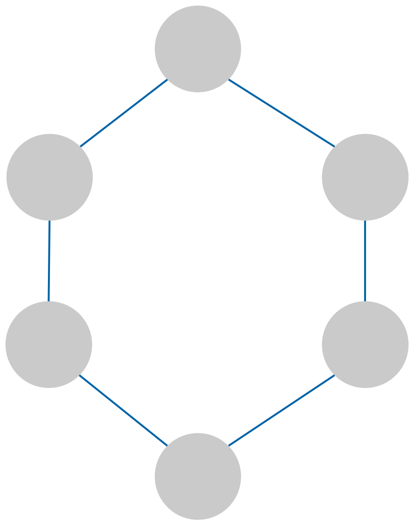

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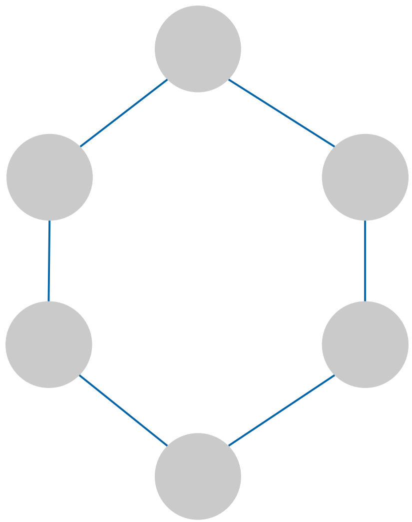

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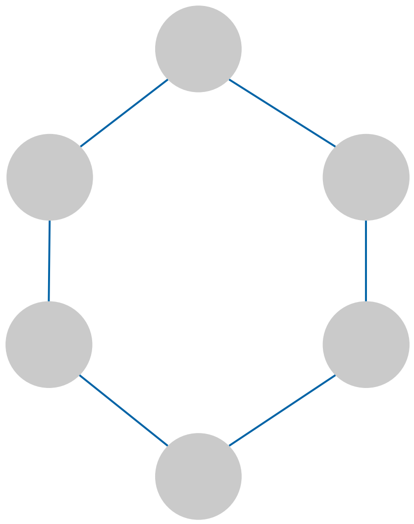

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- 3-coloring:
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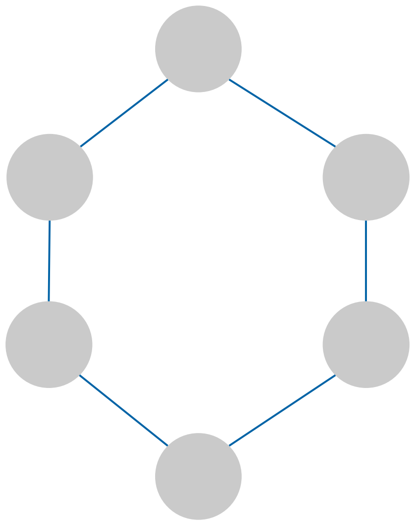

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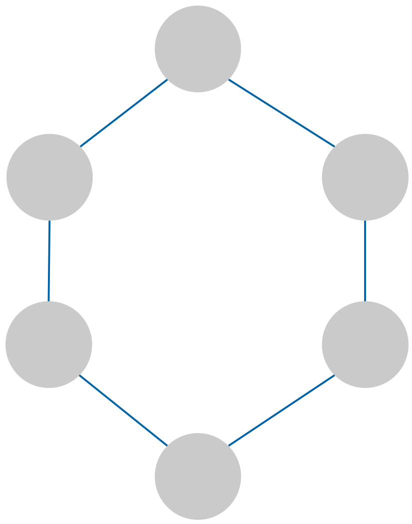

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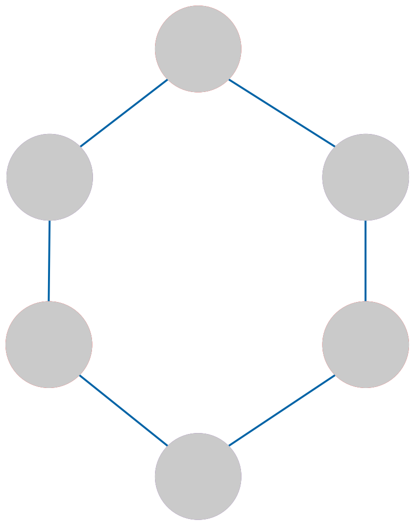

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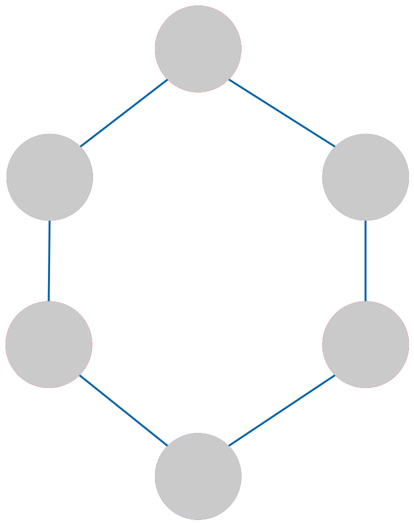

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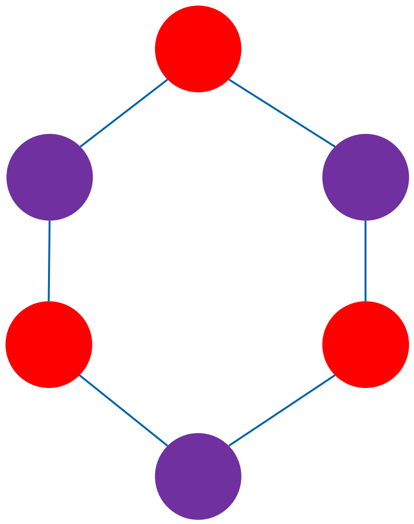

Coloring of rings (LOCAL model) – with Preprocessing & Subgraphs

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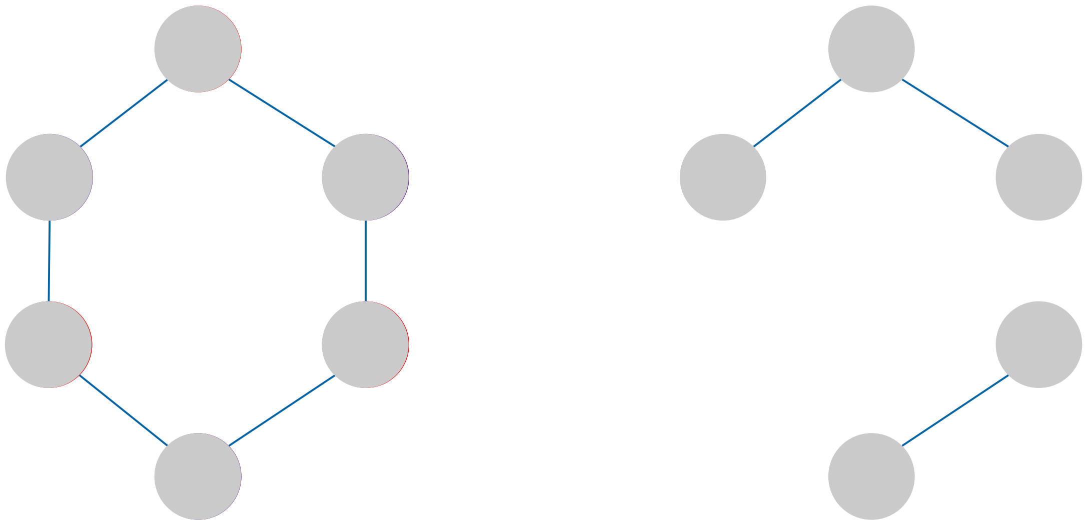

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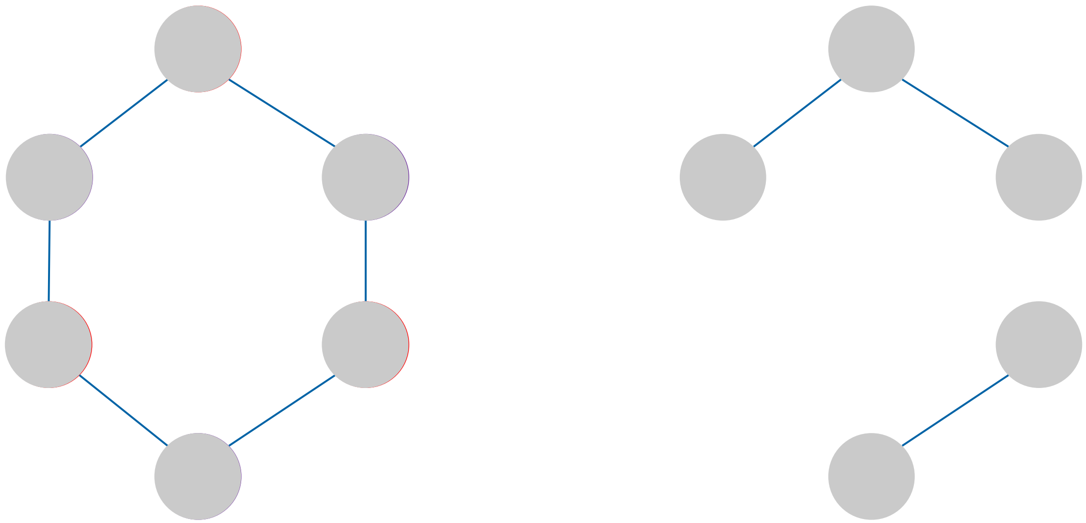

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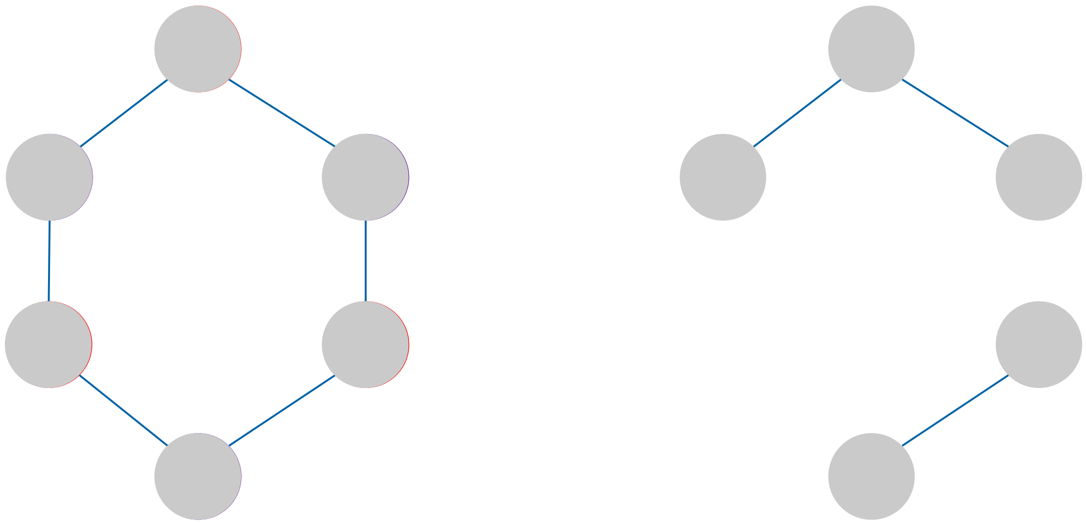

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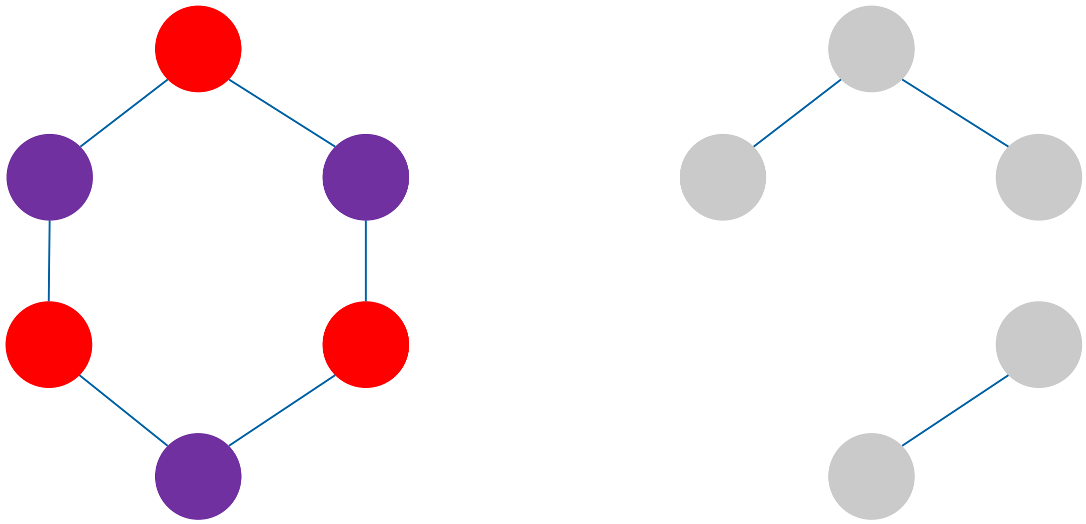

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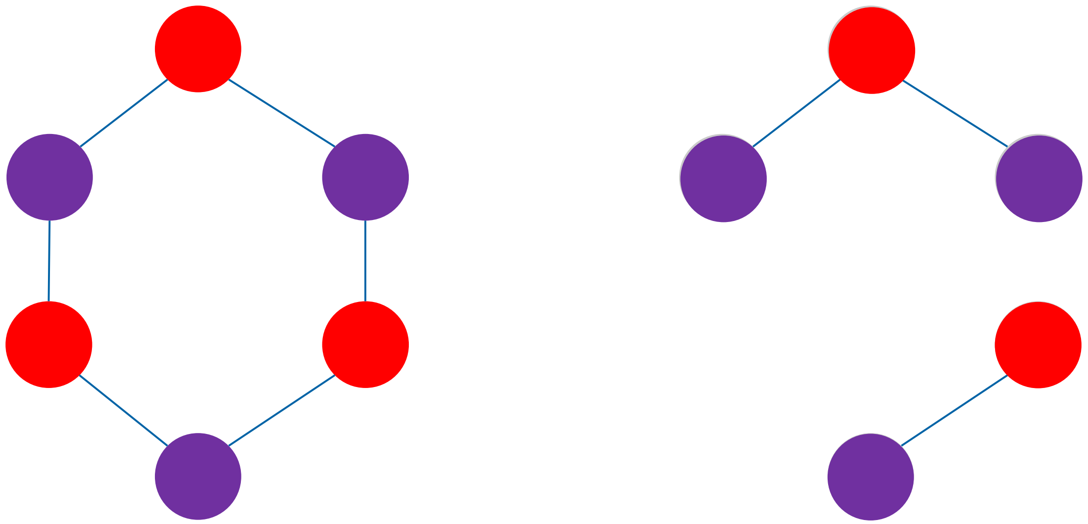

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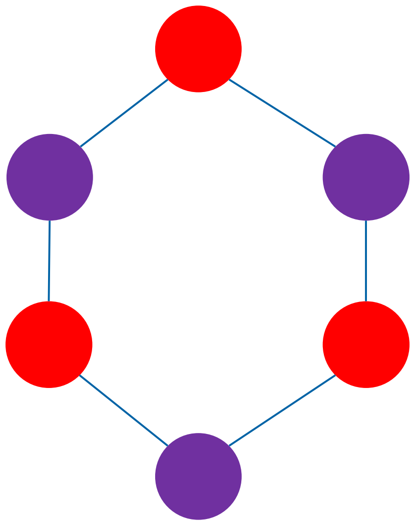

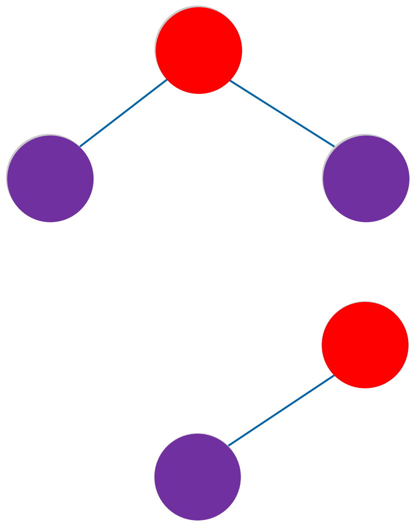

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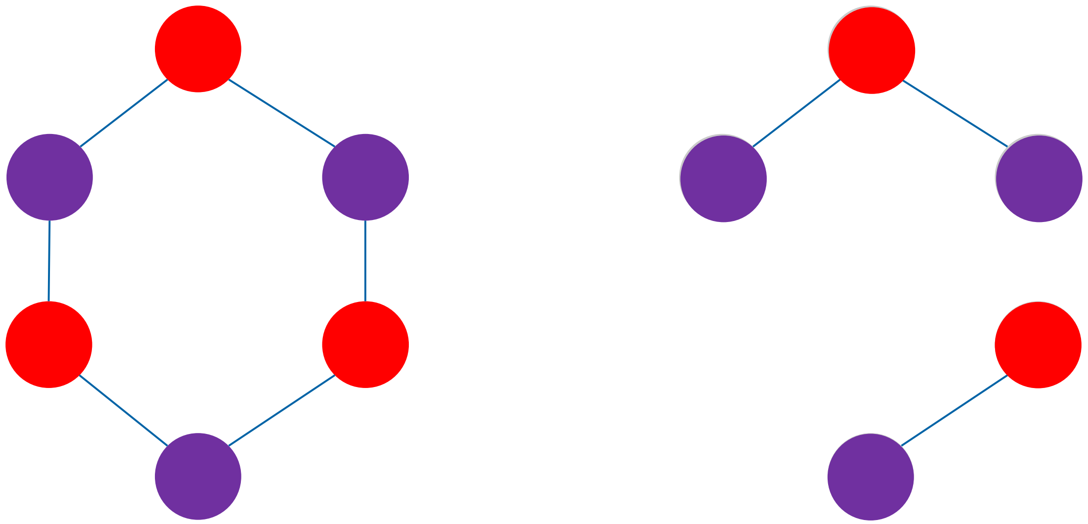

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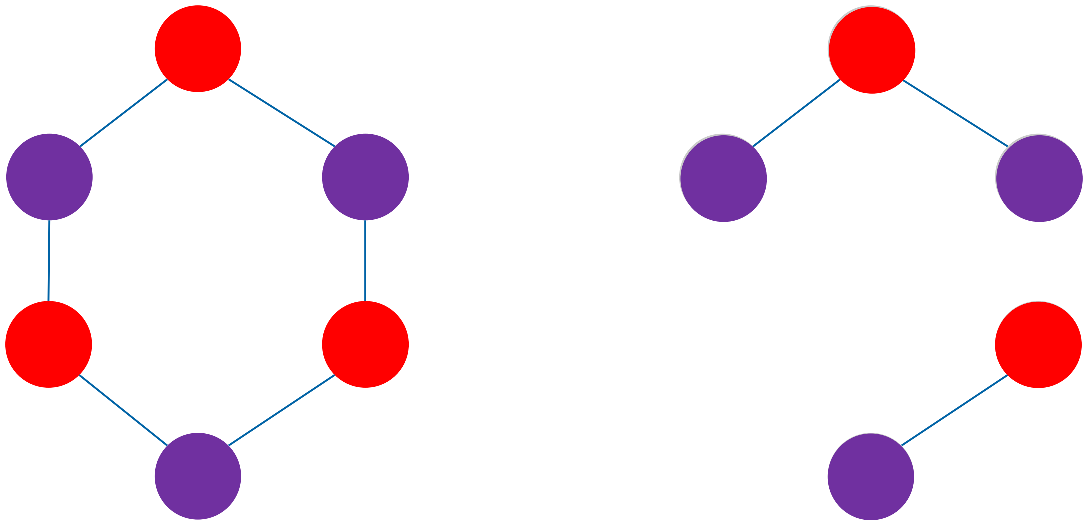
- What are further application scenarios?
- What else can we do with the SUPPORT of Preprocessing?



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- Case study: Software-Defined Networking, single (logically centralized) controller does not scale
  - Create many local controllers that can react quickly, that control small set of “dumb” nodes

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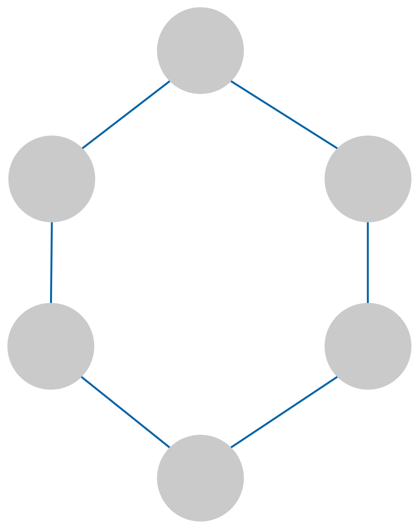

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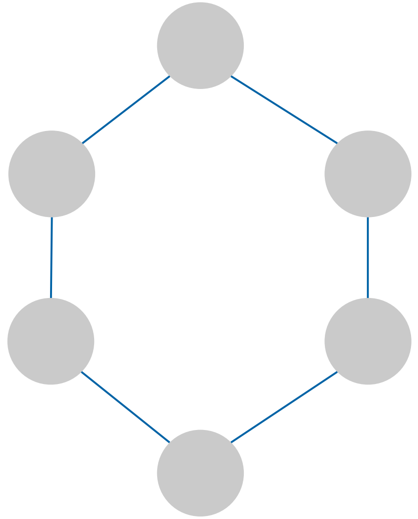

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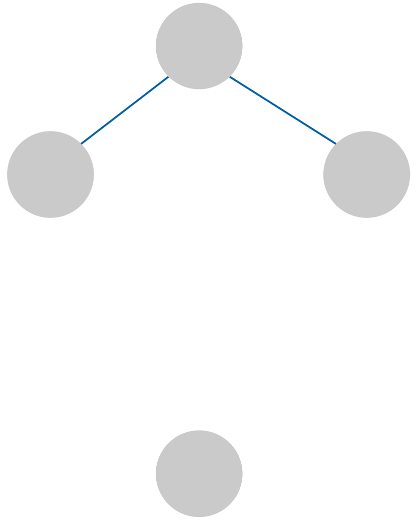

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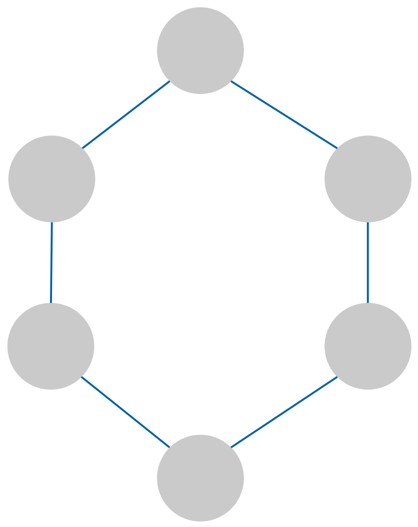

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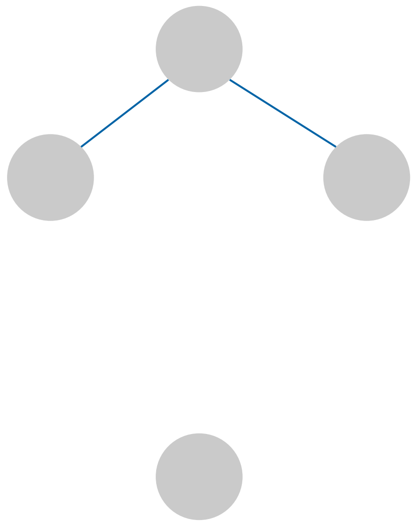

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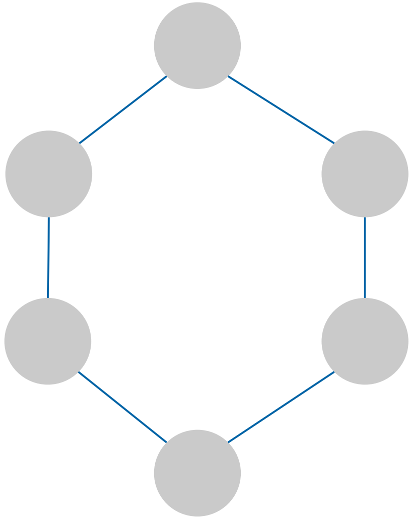

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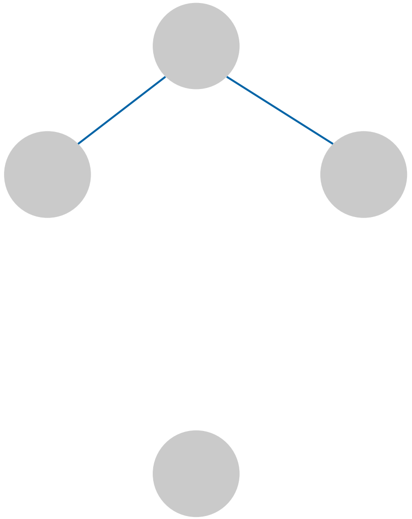

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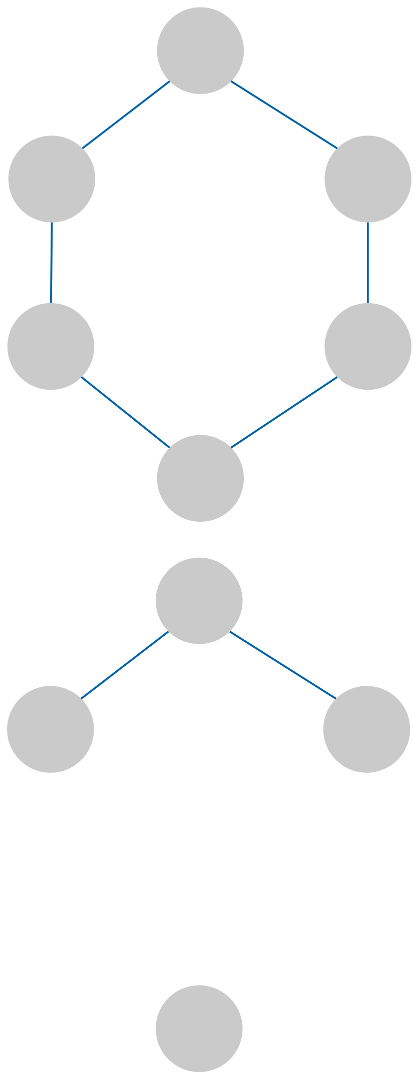

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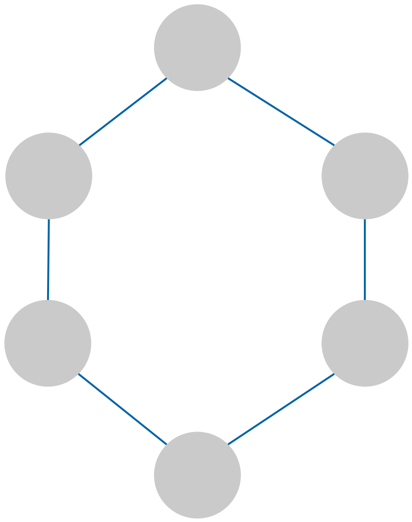

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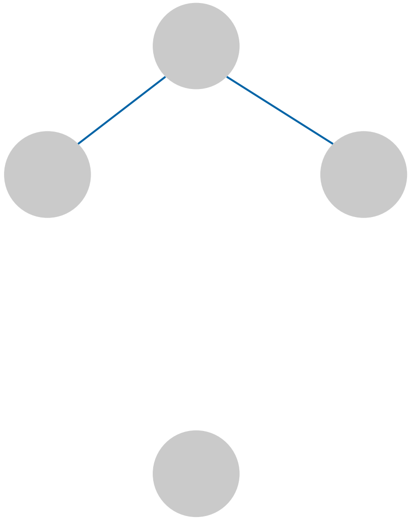

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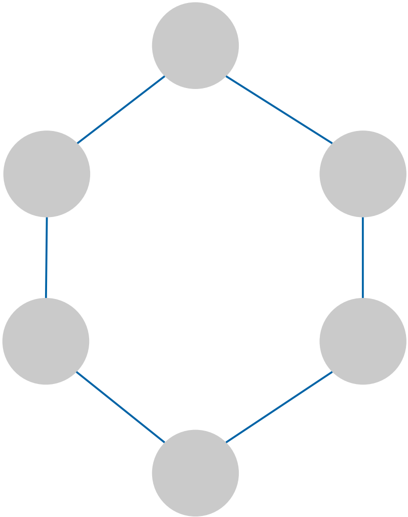

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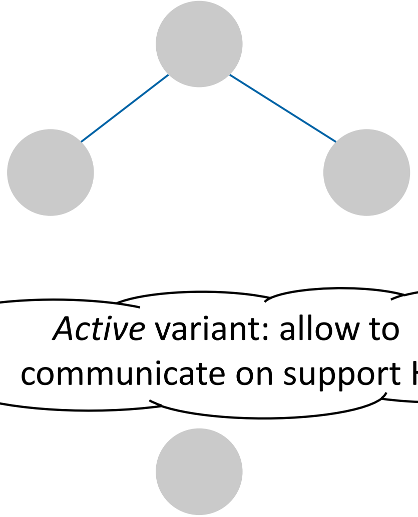
Active variant: allow to communicate on support H



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  - Not even for the *active* variant

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In *active* model:
Congested Clique

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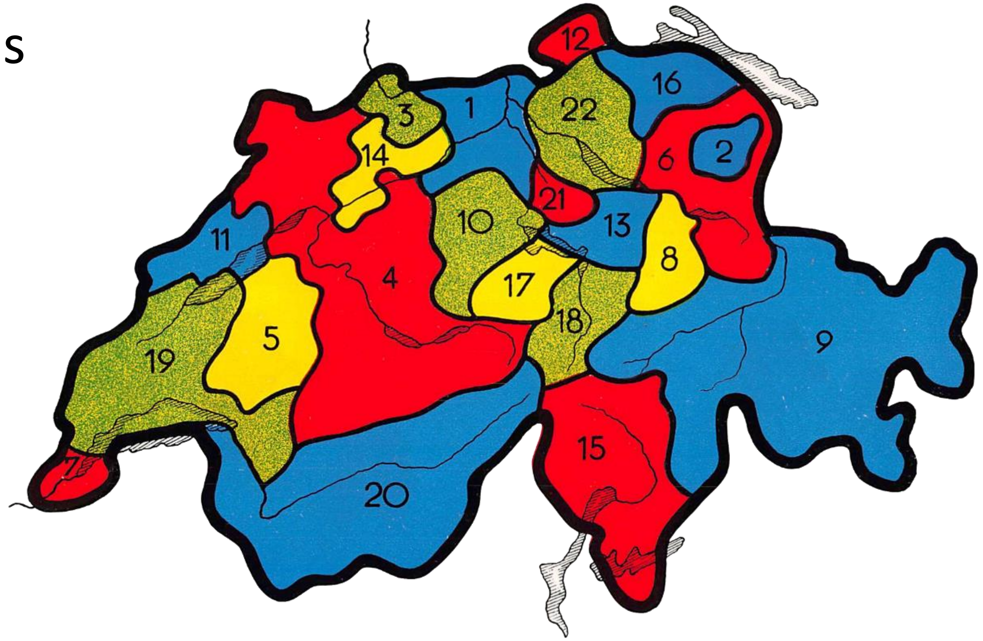
But: Restricted Graph Families are Useful ☺

- Real topologies are usually not complete graphs
- Case study: planar graphs
  - Remain planar under edge deletions
  - Are 4-colorable



„Geloeste und ungeloeste Mathematische Probleme aus alter und neuer Zeit" by Heinrich Tietze
http://www.math.harvard.edu/~knill/graphgeometry/faqg.html

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SUPPORTED speed-up:
1) precompute 4-coloring
2) reduce 4-colored pseudo-forest to 3 colors in 2 rounds

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- Also works for O(1)-genus graphs [extending work of Akhoondian Amiri et al.]

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  - Run clustering/optimization algorithms on components of constant size [constant time ☺]
- Also works for O(1)-genus graphs [extending work of Akhoondian Amiri et al.]
  - Also for planar graphs for maximum independent set & maximum matching

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  - Cannot be approximated by o(Δ/log Δ) in time o($\log_\Delta$ n) in the active SUPPORTED model

How to Support an Unknown Future: Preprocessing for Local Algorithms

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