

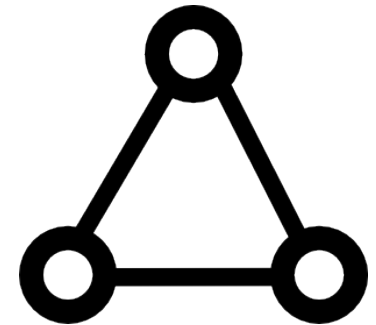
Deciphering the global organization of clustering in real complex networks

Pol Colomer-de-Simón, M. Ángeles Serrano, Mariano G. Beiró,
J. Ignacio Alvarez-Hamelin, & Marián Boguñá



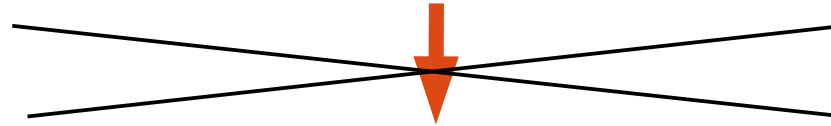
Clustering

- Real networks have a high presence of triangles
- Not generated by random models
- Effect on structural and dynamical properties

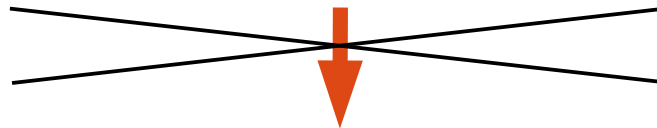


Clustering

Clustering



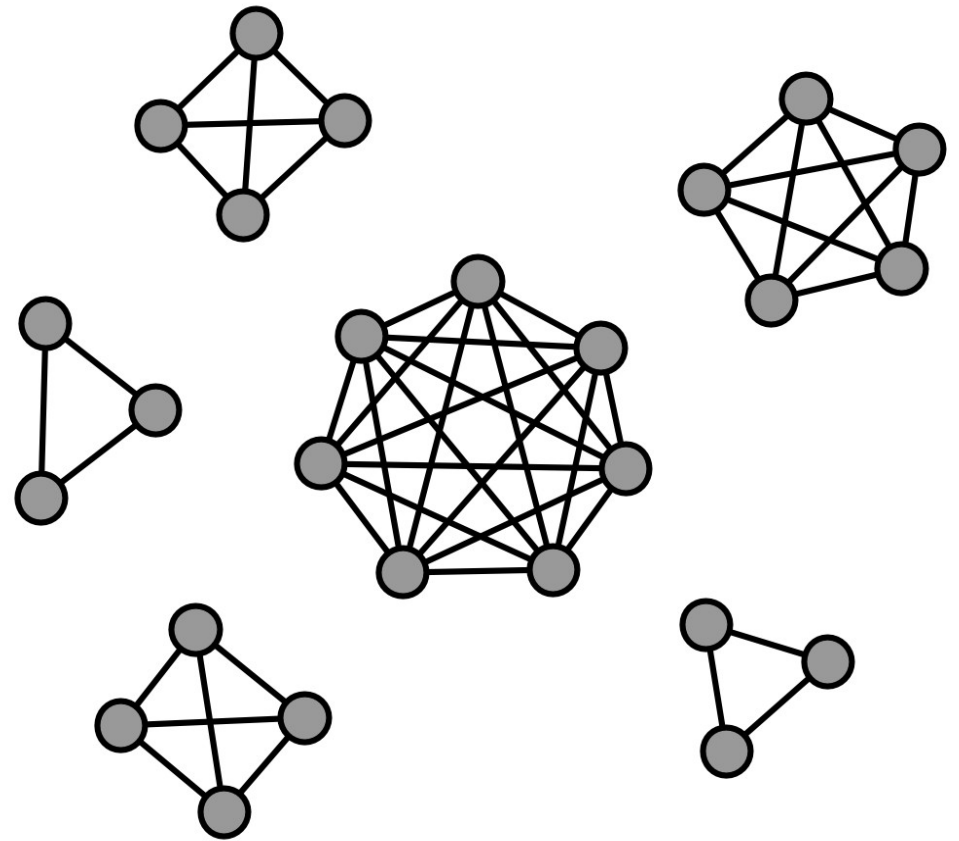
Locally tree like assumption



Analytical Solutions

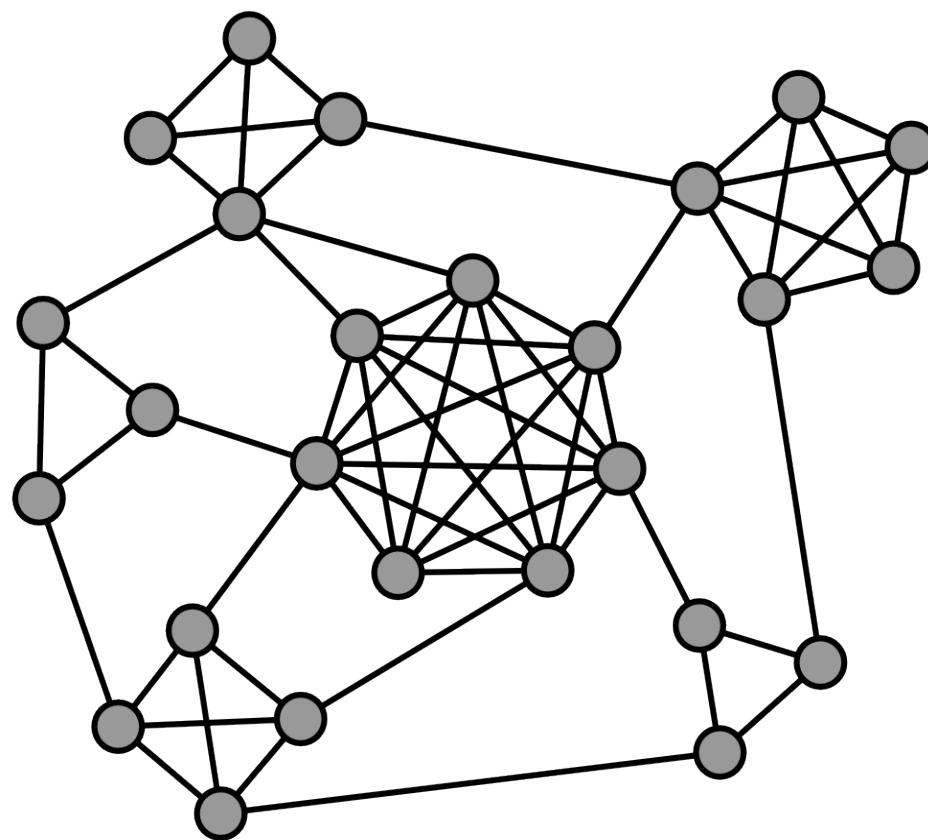
Clique-based models

- Fix $P(k)$
- Fix $\bar{C}(k)$
- Locally-Tree
at the clique-level
- Modular structure



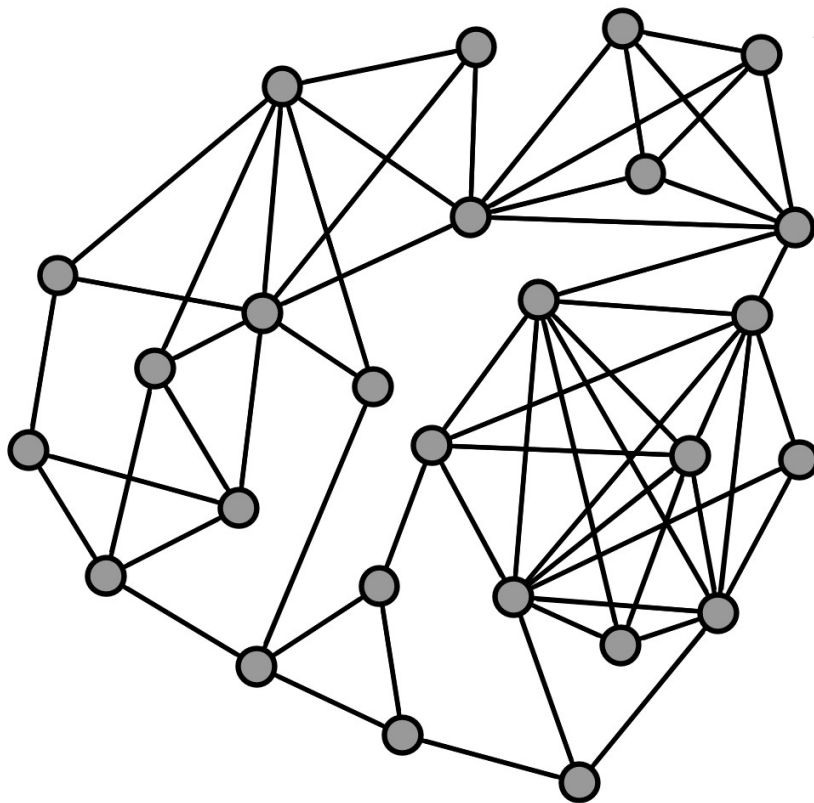
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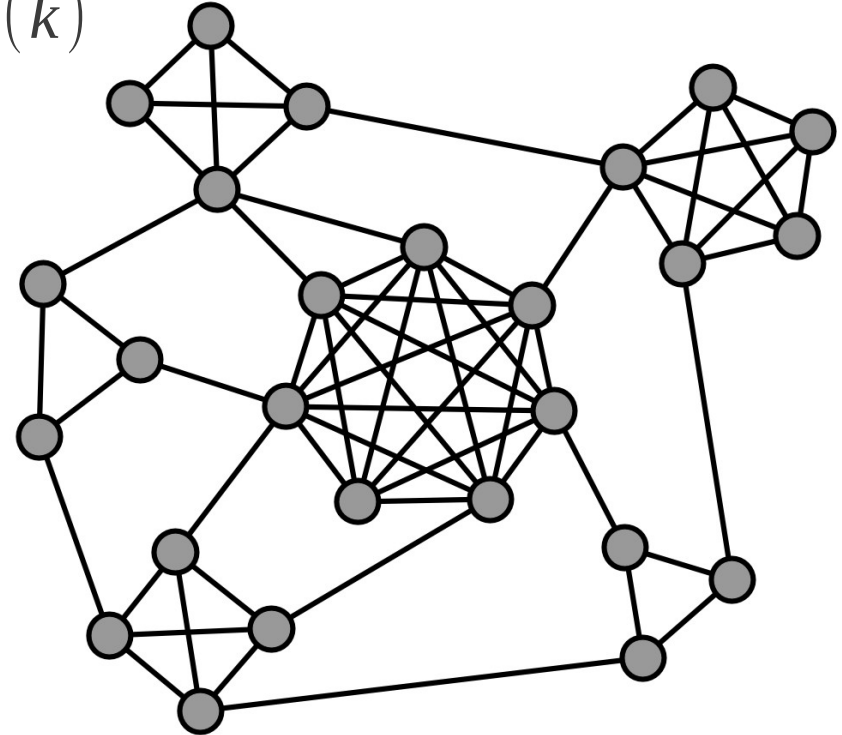


Where are Real Networks?

Maximally Random



Maximally Ordered



$$P(k), \bar{C}(k)$$

J. Gleeson

“Bond percolation on a class of clustered random networks”

Phys. Rev. E sept 2009

Maximally random model

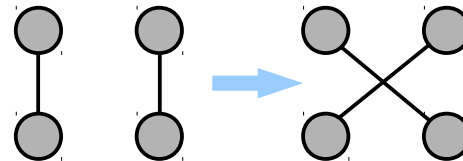
- Exponential graph

$$H = \sum_{k=k_0}^{k_c} |\bar{c}^*(k) - \bar{c}(k)|$$

- Fix $P(k)$
- Fix $C(k)$
- Maximally random



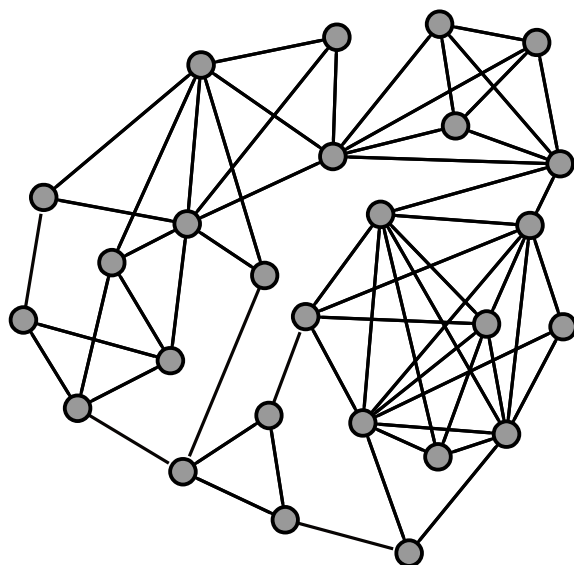
- Rewiring



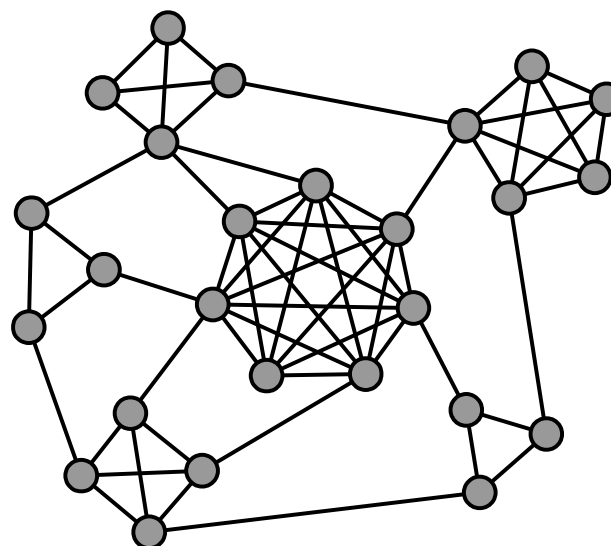
- Annealed Metropolis-Hastings

Where are Real Networks?

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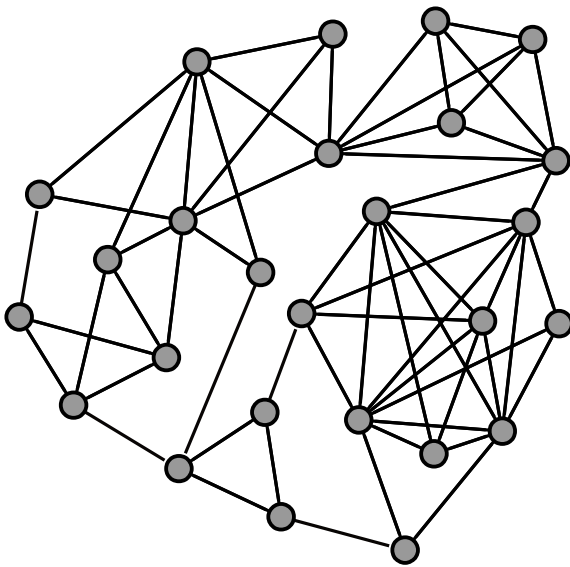


Maximally Ordered

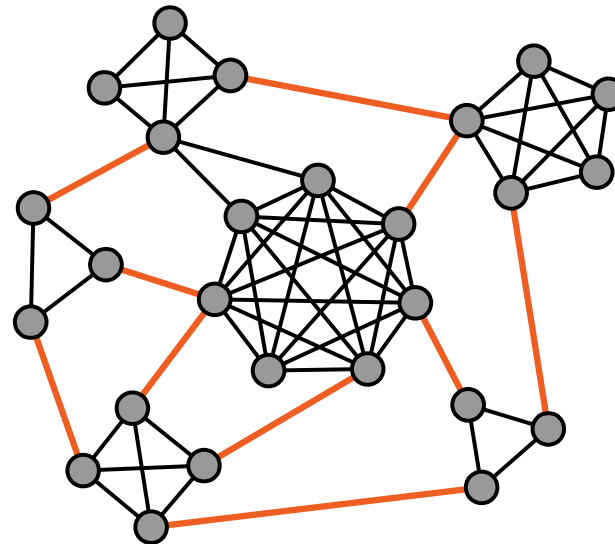


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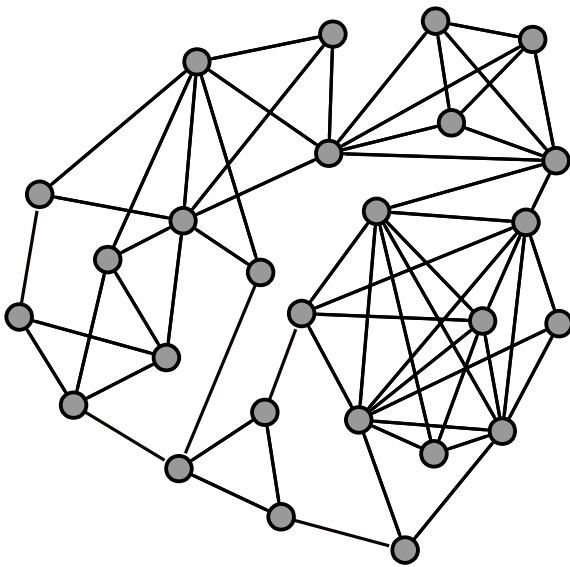


Maximally Ordered

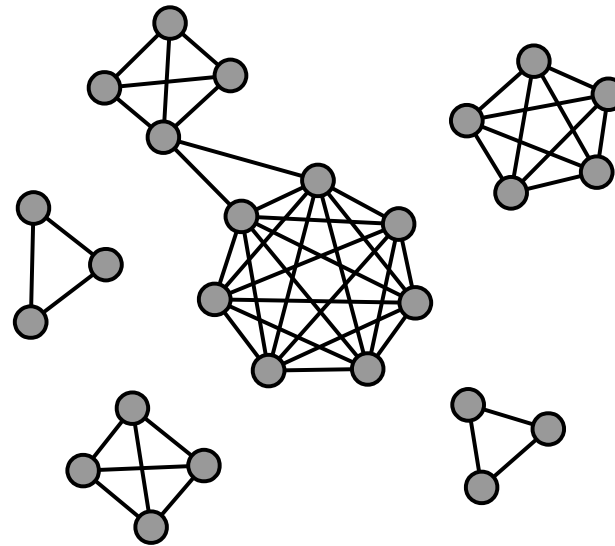


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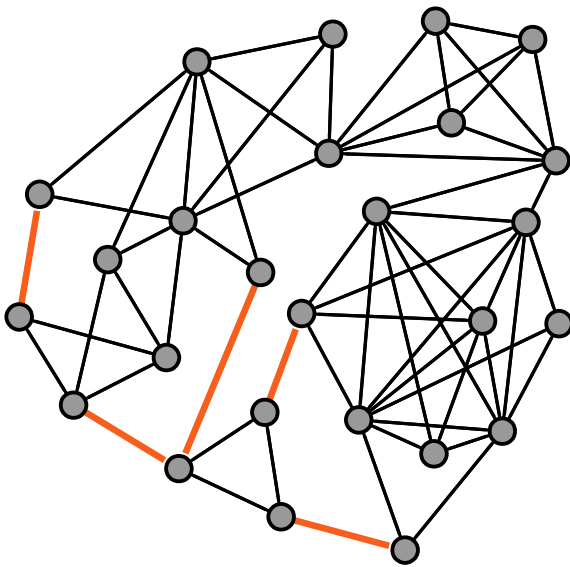


Maximally Ordered

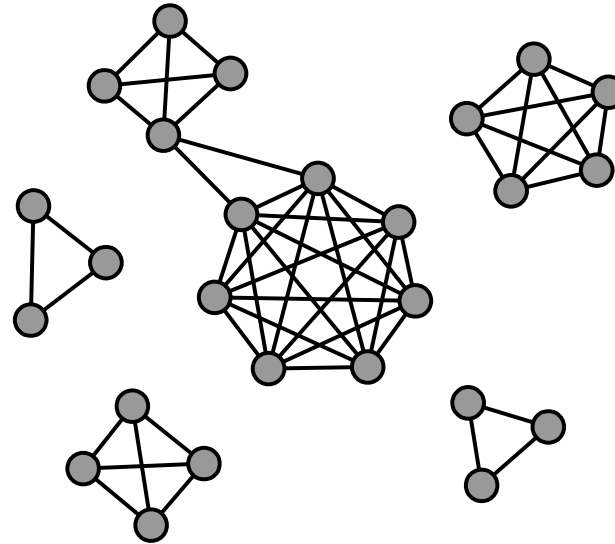


Where are Real Networks?

Maximally Random

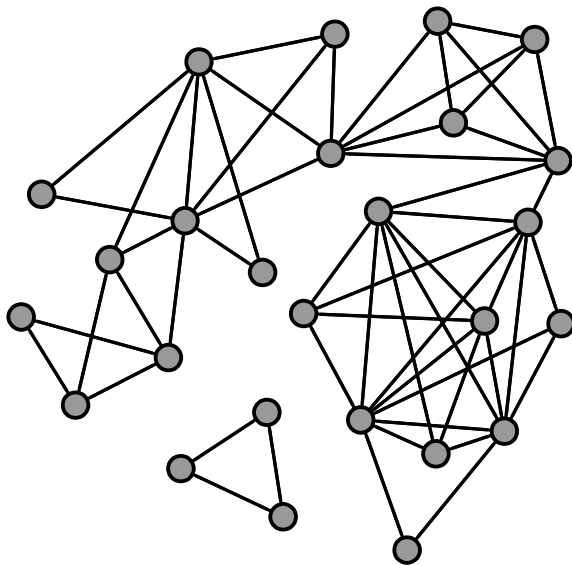


Maximally Ordered

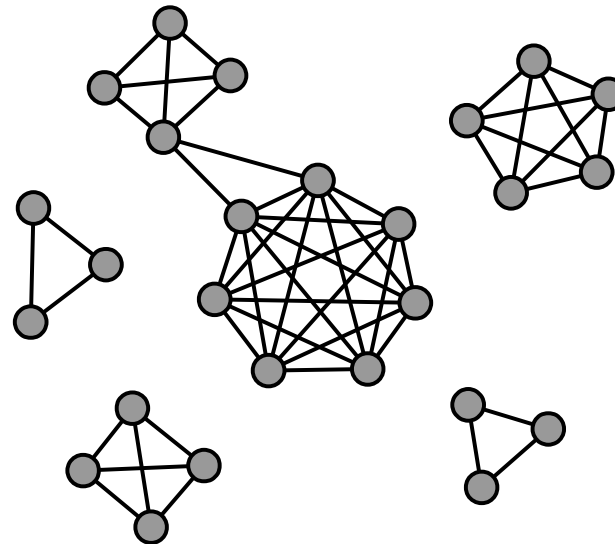


Where are Real Networks?

Maximally Random



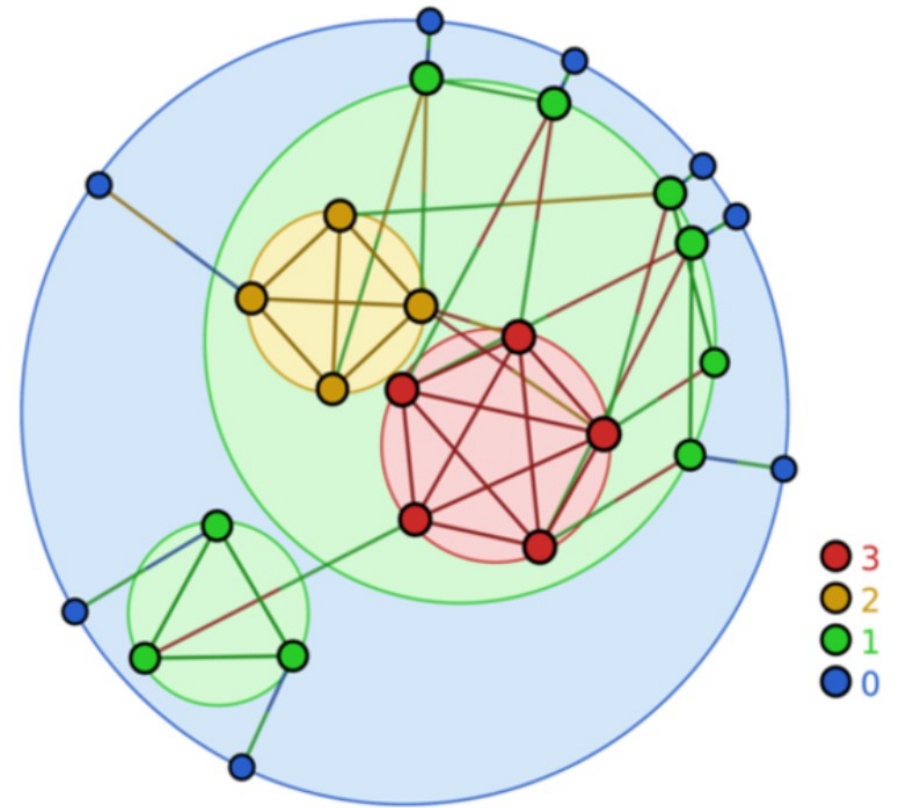
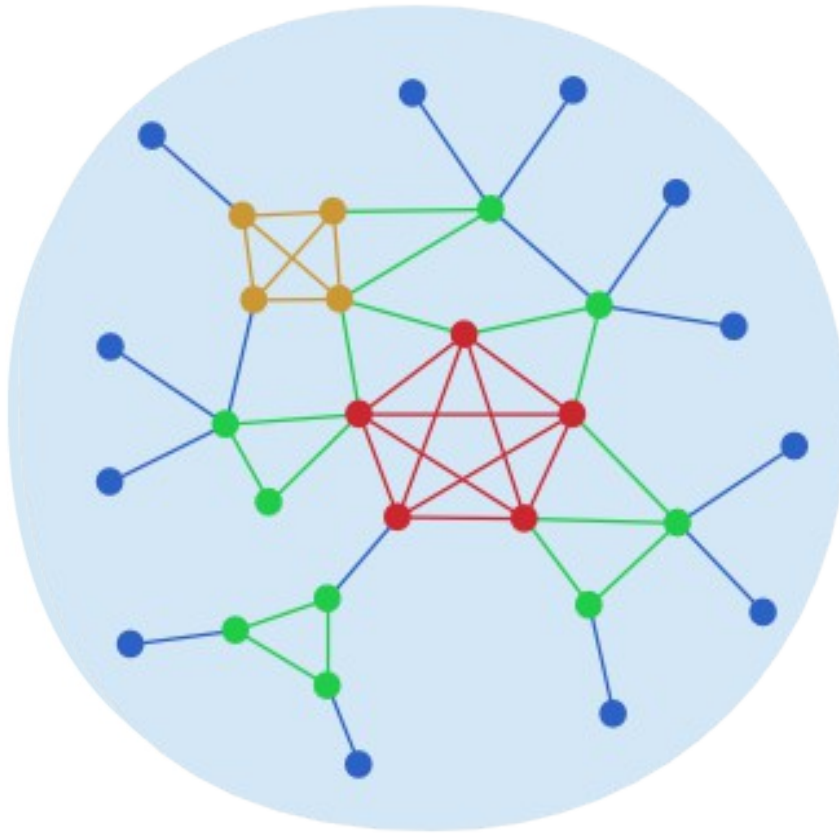
Maximally Ordered



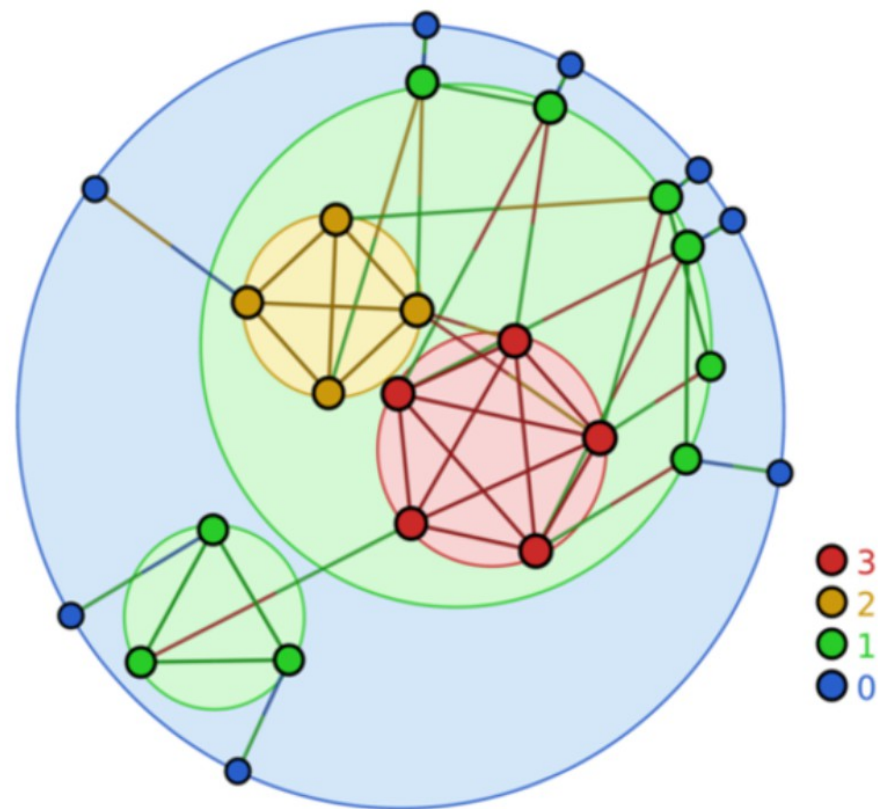
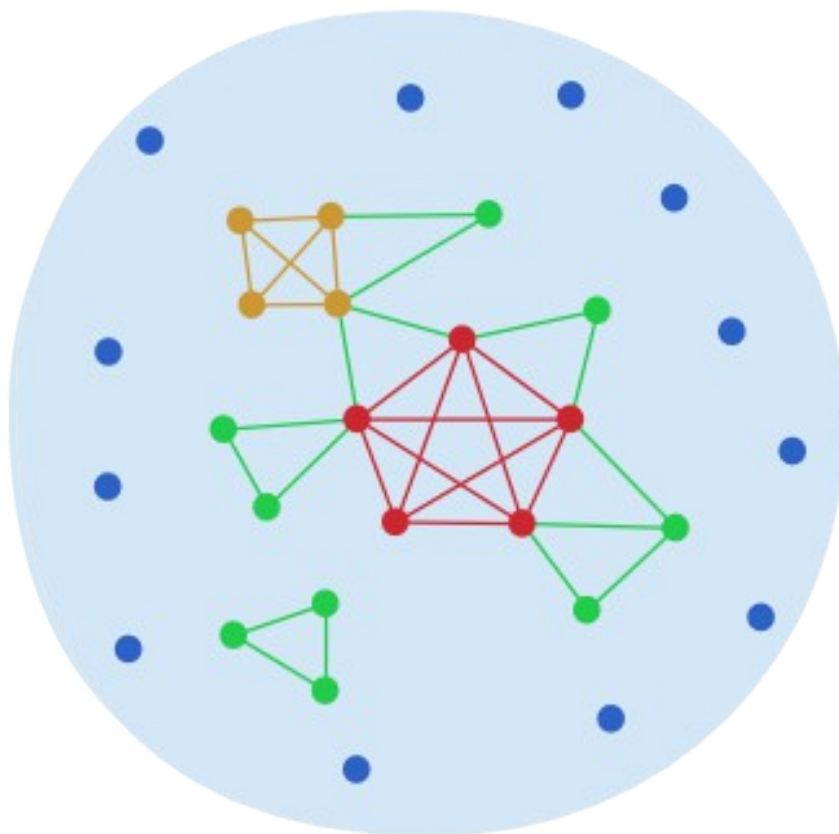
M-core decomposition

- Definition:
Maximal subgraph with all edges with multiplicity at least m
- Akin to the k-core decomposition
- We developed a visualization tool: LaNet-vi 3.0

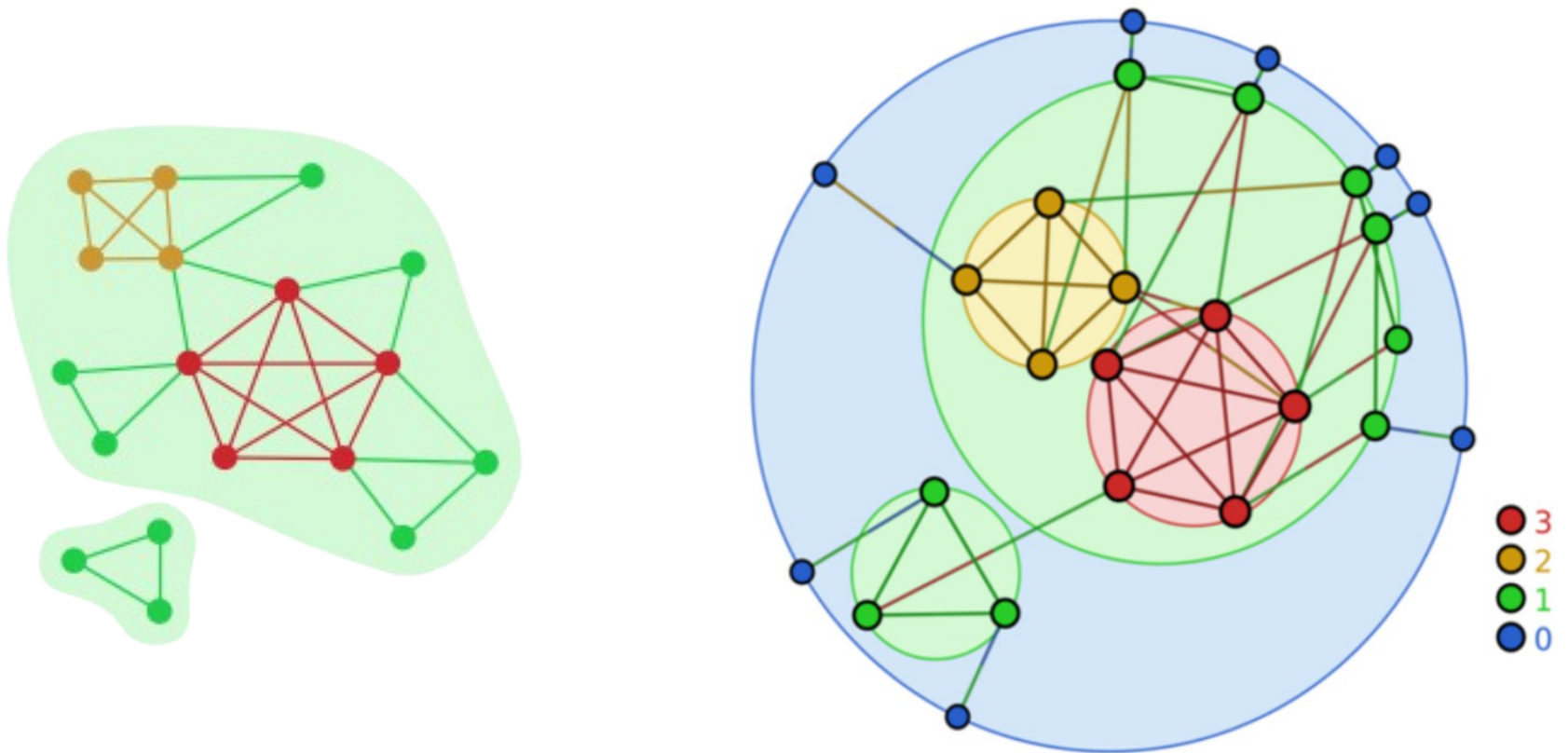
M-core and LaNet-vi 3.0



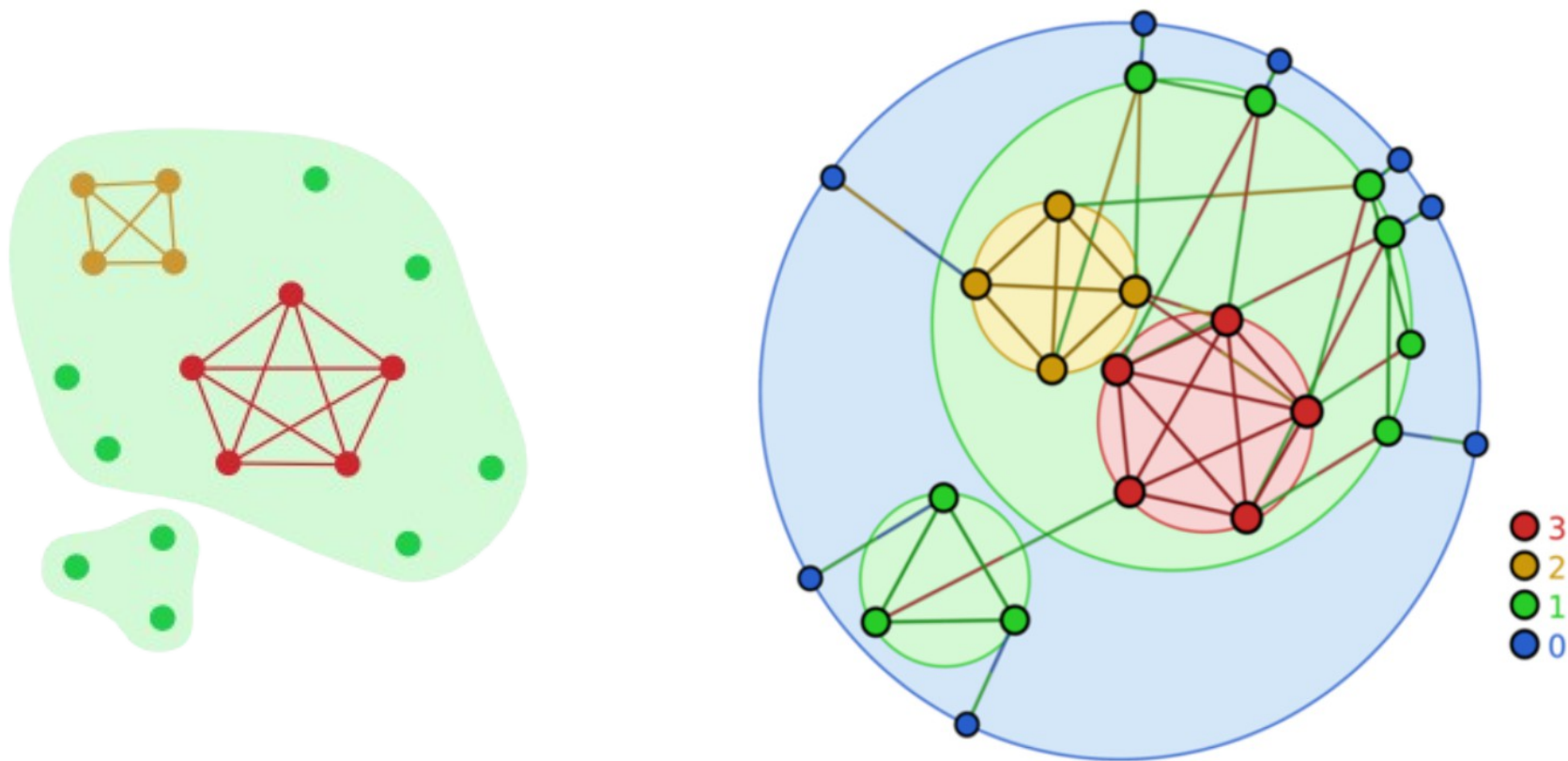
LaNet-vi 3.0



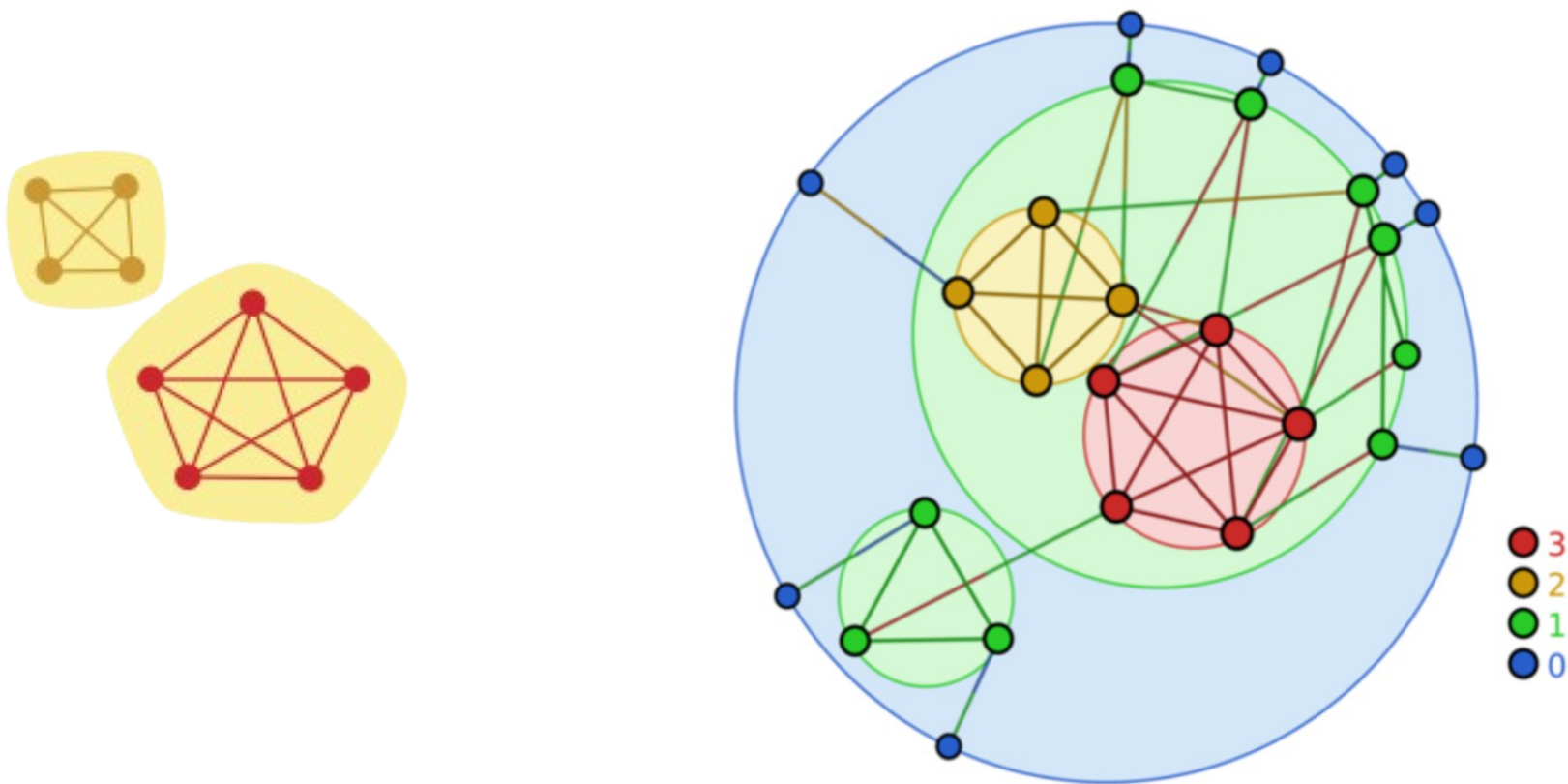
LaNet-vi 3.0



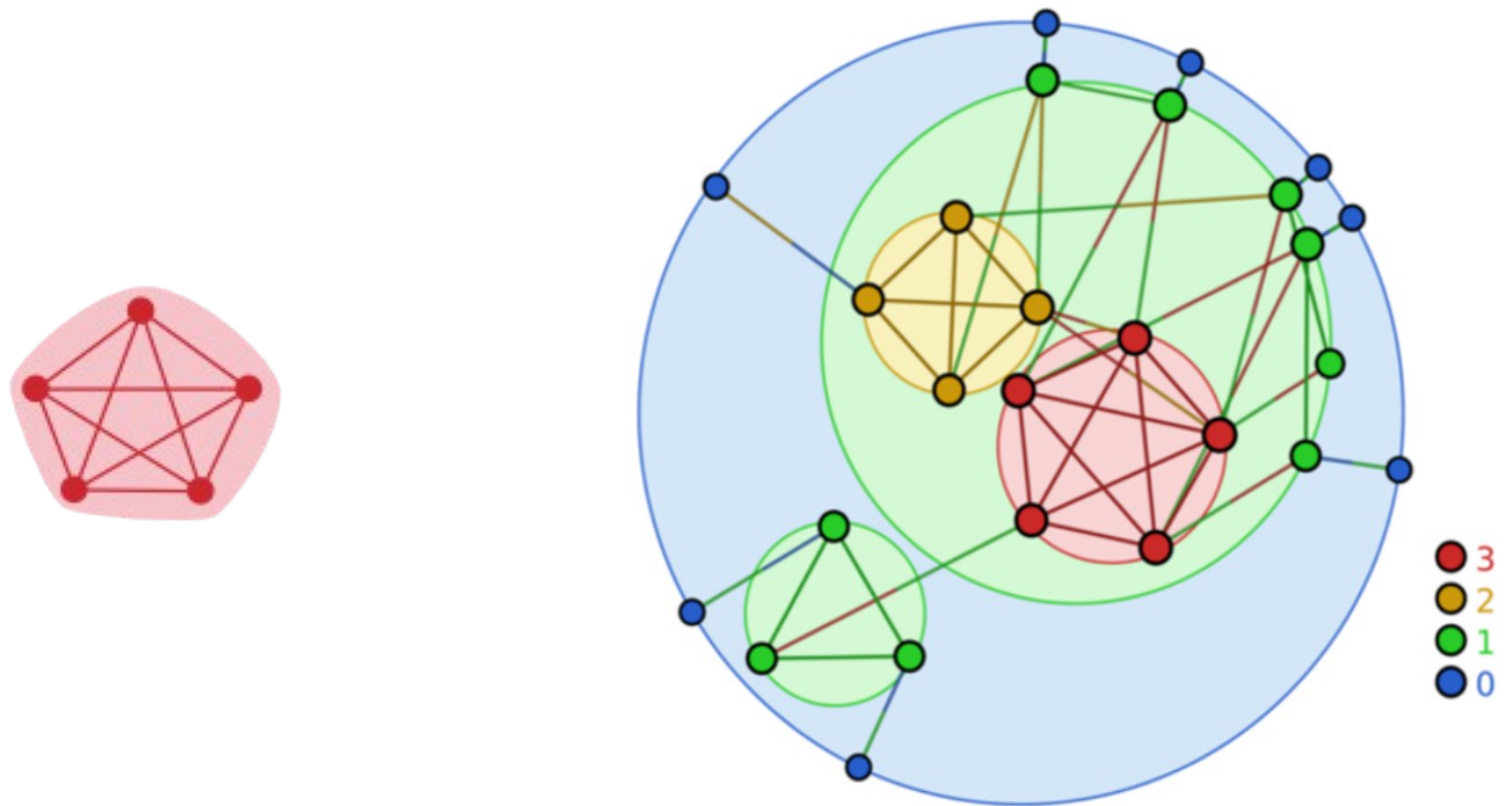
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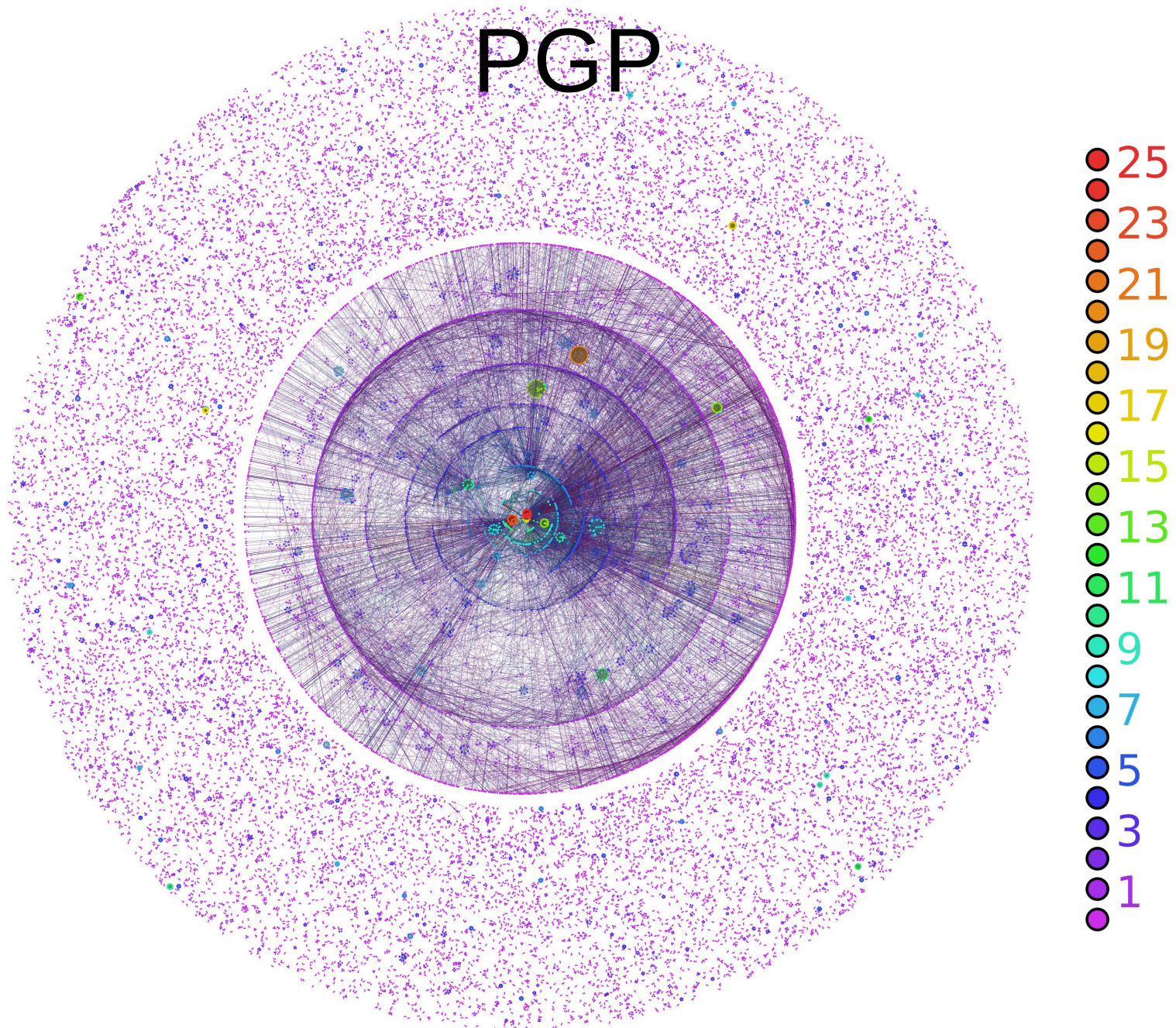


LaNet-vi 3.0



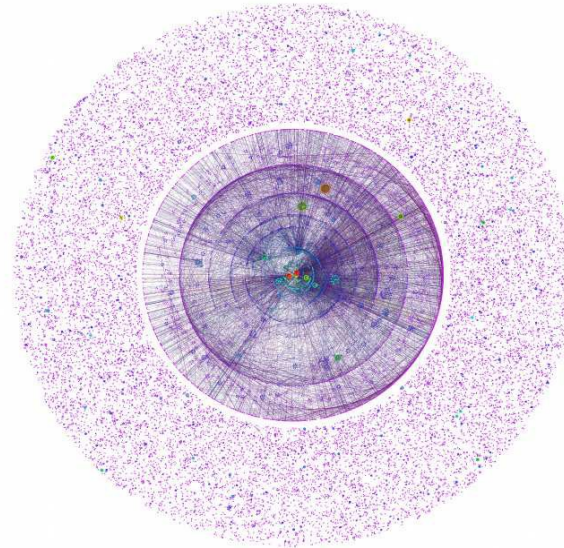
LaNet-vi 3.0



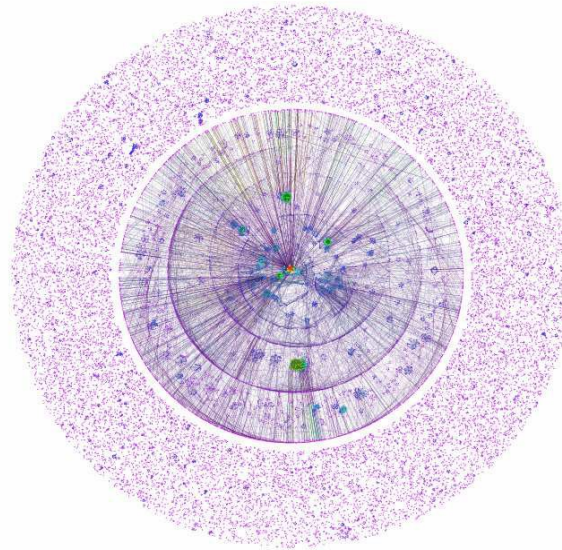


PGP

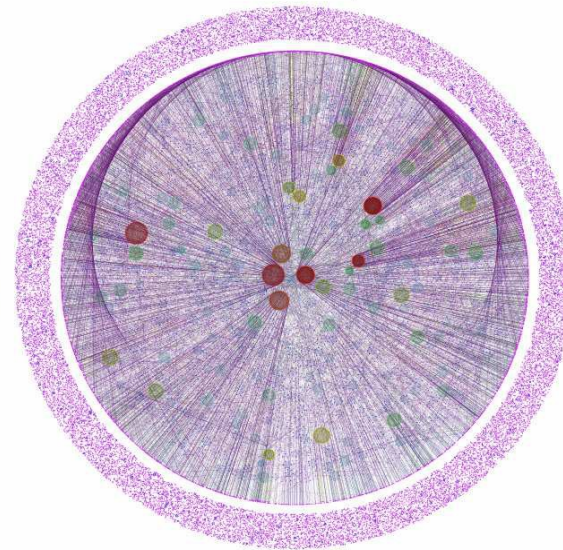
PGP



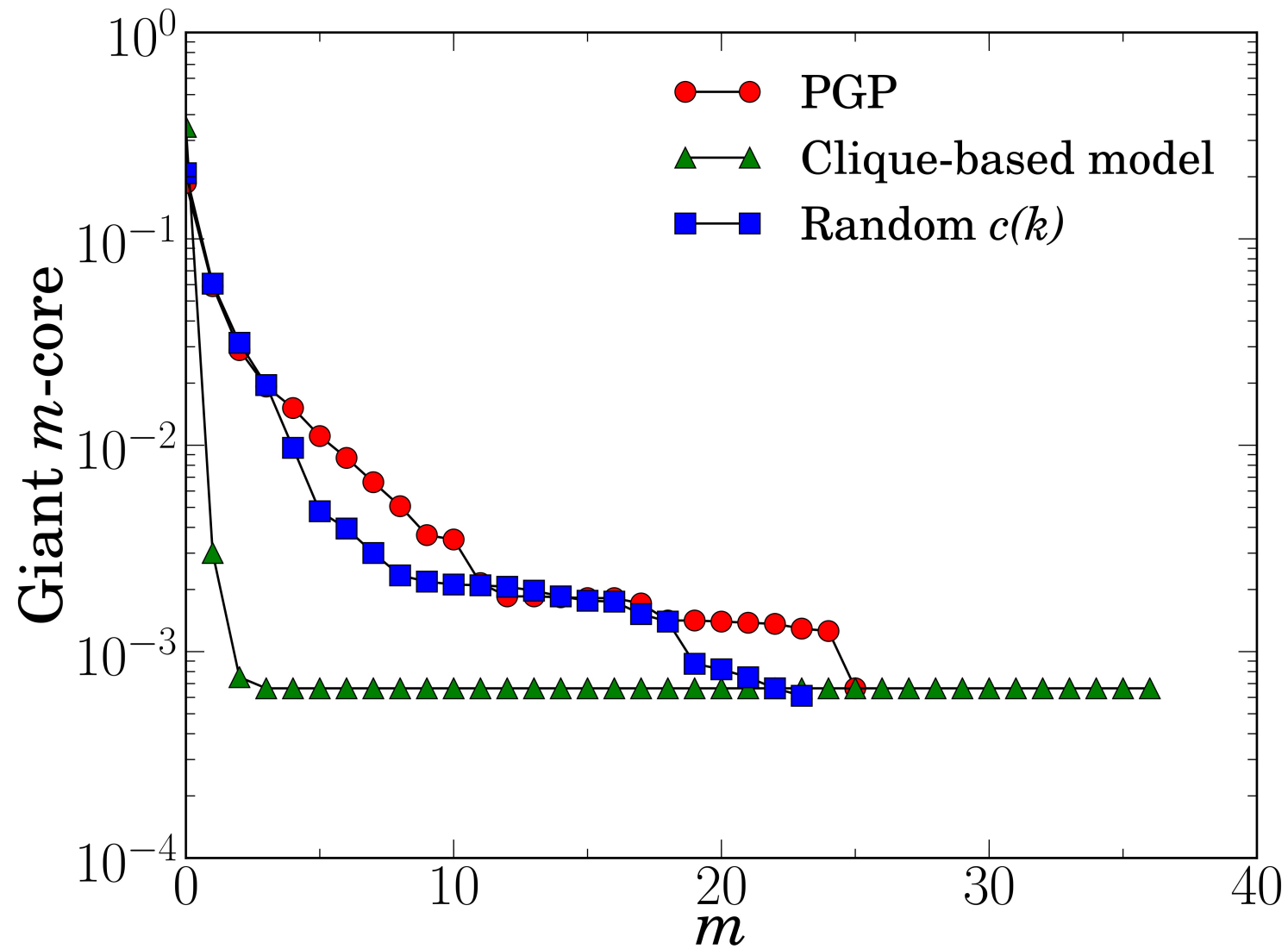
random



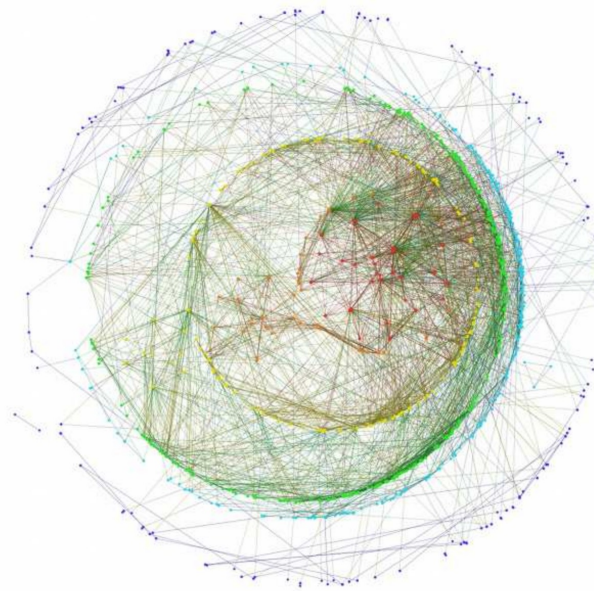
clique-based



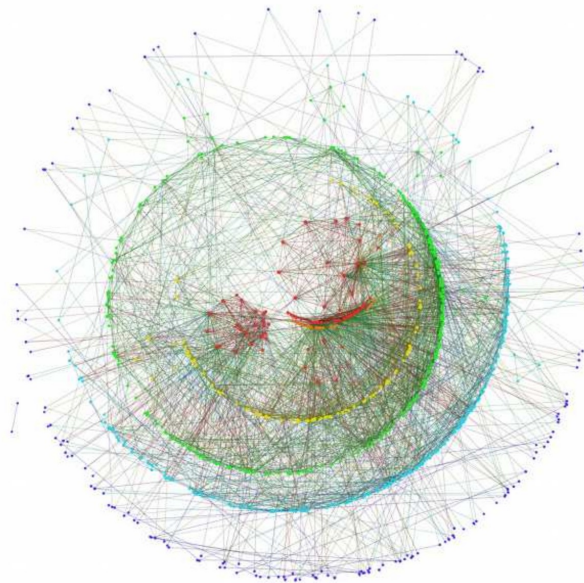
Giant Component



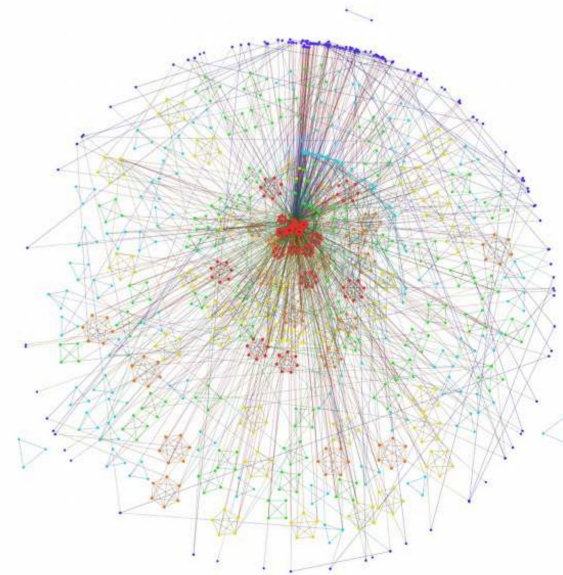
E. Coli



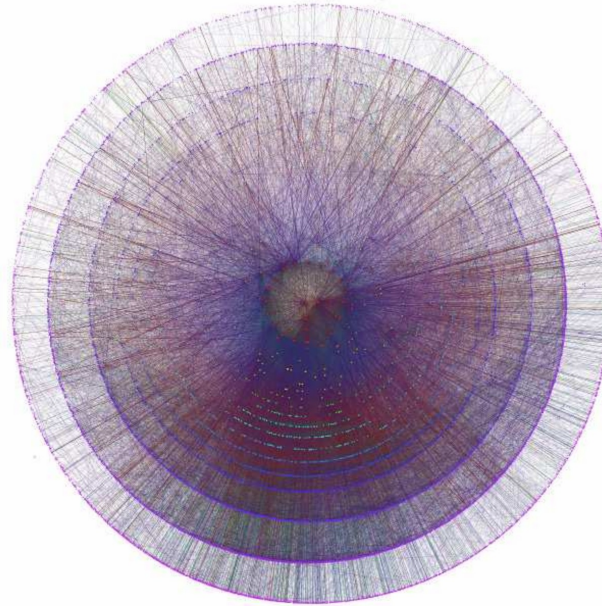
random



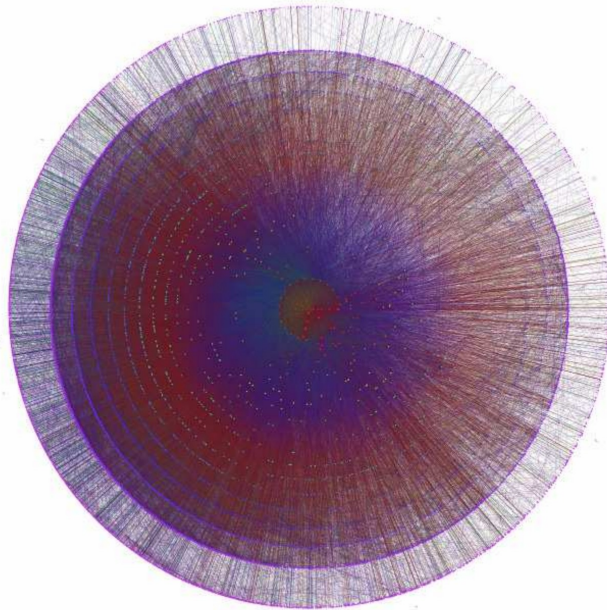
clique-based



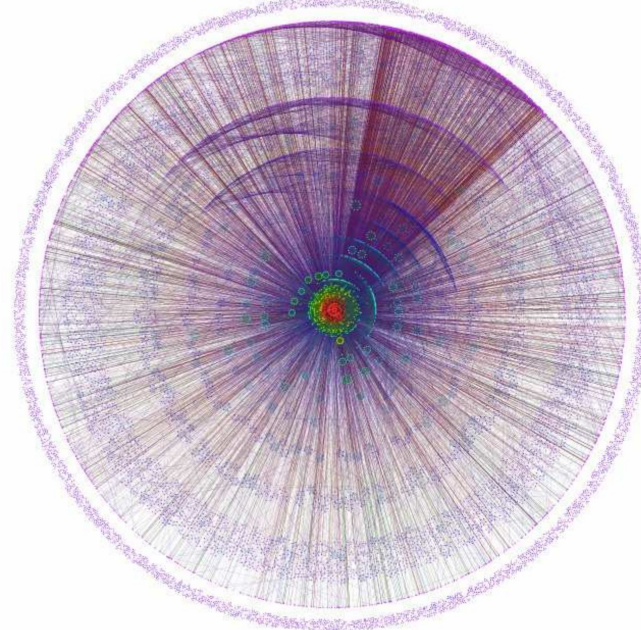
Internet AS



random



clique-based



Conclusions

- The m-core decomposition and our visualization tool helps to understand the global organization of networks.
- Real Networks are better reproduced by the maximally random ensemble.
- Global organization affects our predictions

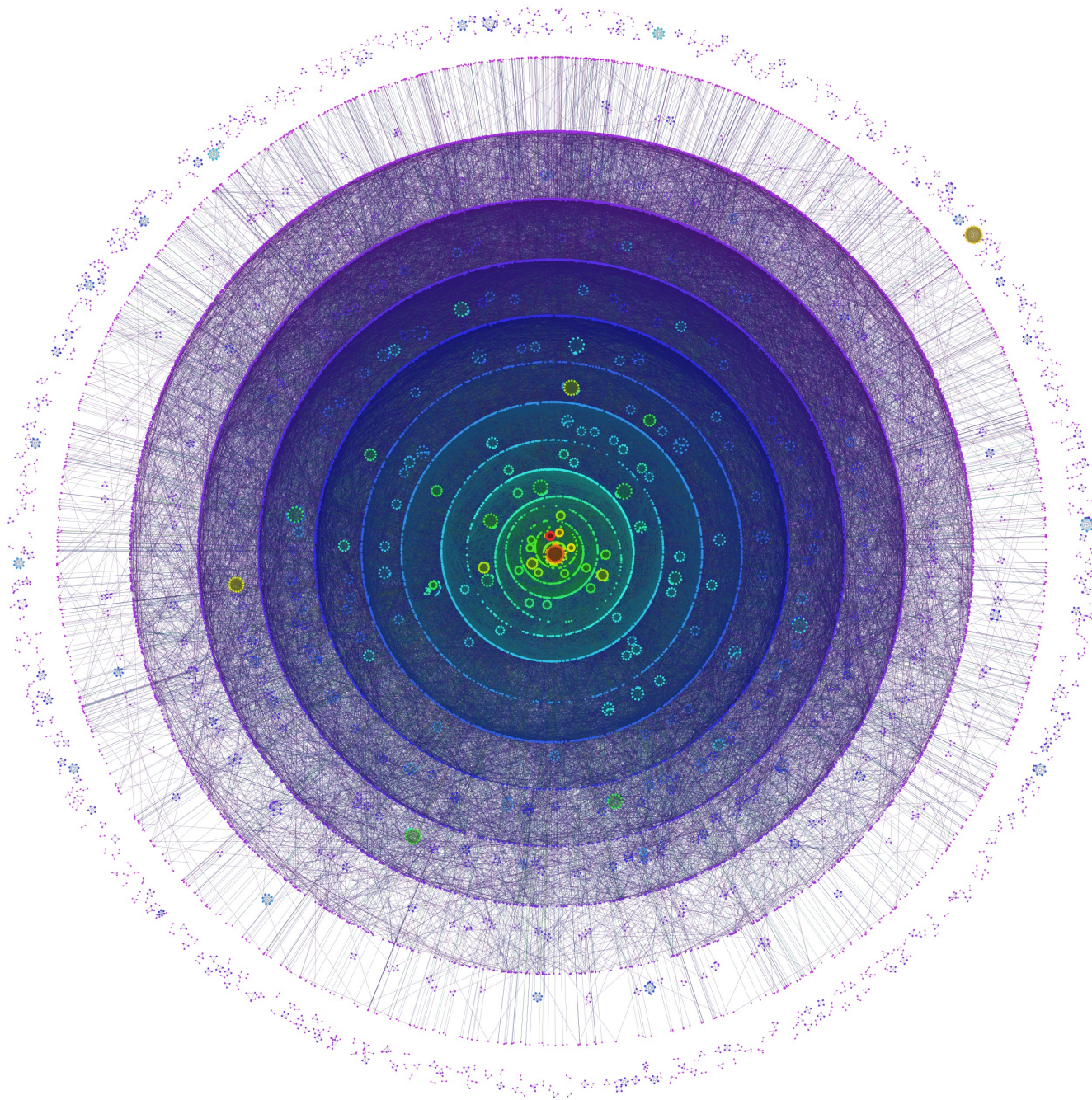
Paper:

<http://www.nature.com/srep/2013/130827/srep02517/full/srep02517.html>

Visualization tool LaNet-vi 3.0:

<http://sourceforge.net/projects/lanet-vi/>







The image features a large, circular network diagram. It consists of several concentric rings of nodes, with the outermost ring being the most densely populated. The nodes are connected by a web of thin, light-colored lines, creating a complex, interconnected pattern. The central area of the diagram is a dense cluster of nodes, with a few larger, more prominent nodes in the center. The overall color scheme is dominated by shades of purple, blue, and green, with some yellow and orange nodes visible in the central cluster. The text "THANK YOU" is overlaid in the center of the diagram.

THANK YOU



THANK YOU

