

Scientific Modeling Computer Laboratory

# Project: Time Evolving Networks

Fourth Bi-weekly Presentation

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# Previously

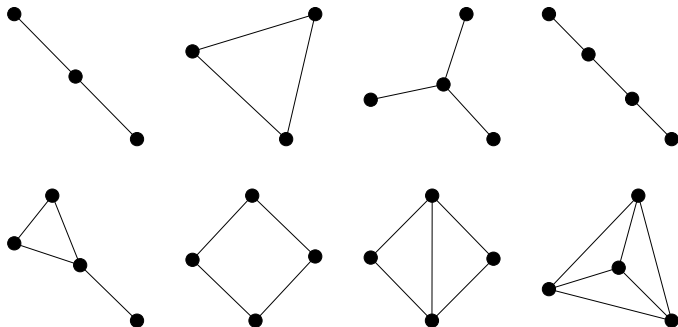
- ▶ What is MTMT?  
Hungarian Repository of Scientific Works
- ▶ How to acquire data?  
ReST API Queries
- ▶ What part of the data is needed?  
Authors for a given publication

## Previously: Motifs I.

**Motifs** are little graph with a given structure. The search for these graphlets are the entrance for **group searching**.

**Unfortunately**, the more nodes a motif has, the more expensive it becomes to find them.

## Previously: Motifs II.



## Z-score I.

**Z-score** is the way to measure the significance of a motif by comparing the original network to its randomised counterparts.

$$z = \frac{\langle m_i \rangle_g - \langle m_i \rangle_{rand}}{\sigma_{rand}} \quad (1)$$

## Z-score II.



# Problems with Motif Searching

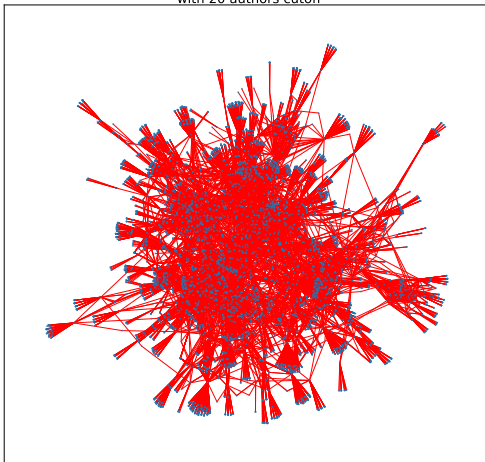
The VF2 algorithm behind motif searching scales with the network size with  $O(n^3)$

Solutions:

- ▶ Multiprocessing
- ▶ Subgraph with comparable size to the original graph

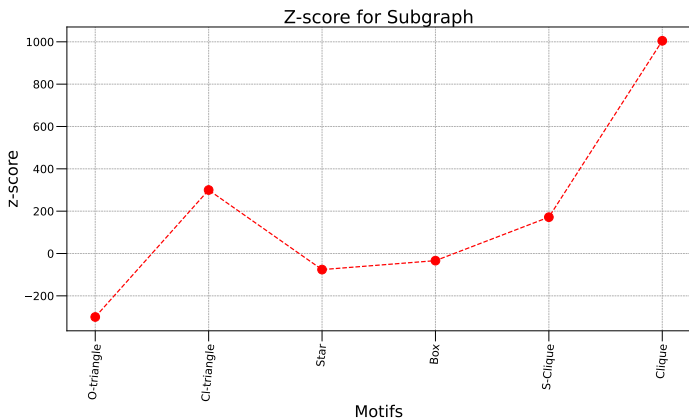
# Subgraph I.

Graph Representation of the Subgraph of the Co-Author Network  
with 20 authors cutoff





## Subgraph II.



# Greedy Modularity I.

**Greedy modularity** is a hierarchical clustering based community searching method.

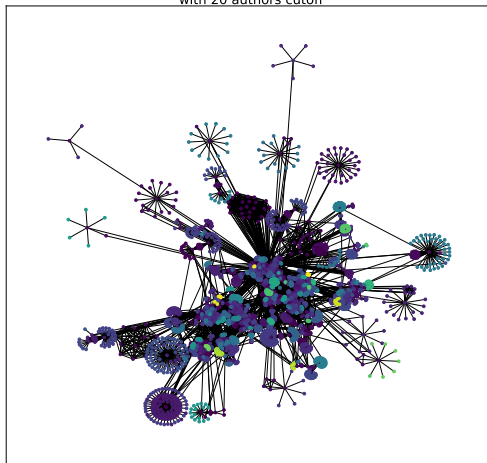
- ▶ Join nodes together depending on distance measure
- ▶ Measure modularity and do this until it reaches as maximum.

Pros	Cons
Much faster than motif finding	Every node will be part of a community

$$Q = \sum_{c=1}^n \left[ \frac{L_c}{m} - \gamma \left( \frac{k_c}{2m} \right)^2 \right] \quad (2)$$

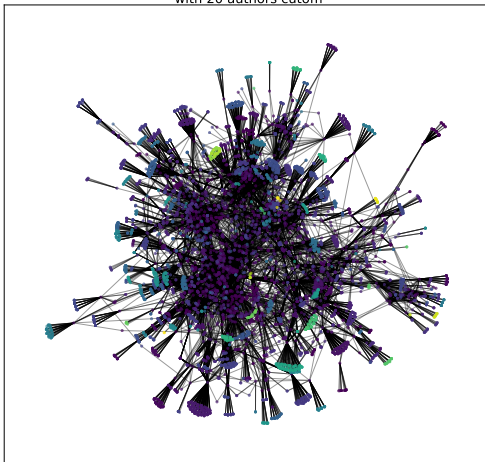
# Communities I.

Groups in the Subgraph  
with 20 authors cutoff



## Communities II.

Groups In the Subgraph  
with 20 authors cutoff



# References

- [1] Albert-László Barabási. “Network Science”. In: <http://networksciencebook.com> (2012).
- [2] Aric A. Hagberg, Daniel A. Schult, and Pieter J. Swart. *Exploring network structure, dynamics, and function using NetworkX, in Proceedings of the 7th Python in Science Conference (SciPy 2008)*. 2008.
- [3] Xiaoming Liu et al. *Co-Authorship Networks in the Digital Library Research Community*. 2005.
- [4] Aaron Clauset, M. E. J. Neumann, and Cristopher Moore. “Finding community structure in very large networks”. In: (2004).

Thank you for your attention!