

Sep 22

- 1. Clusters of nodes in networks**
- 2. Scientific consensus**

Clusters of Nodes in Networks

Grouping nodes in networks

Why?

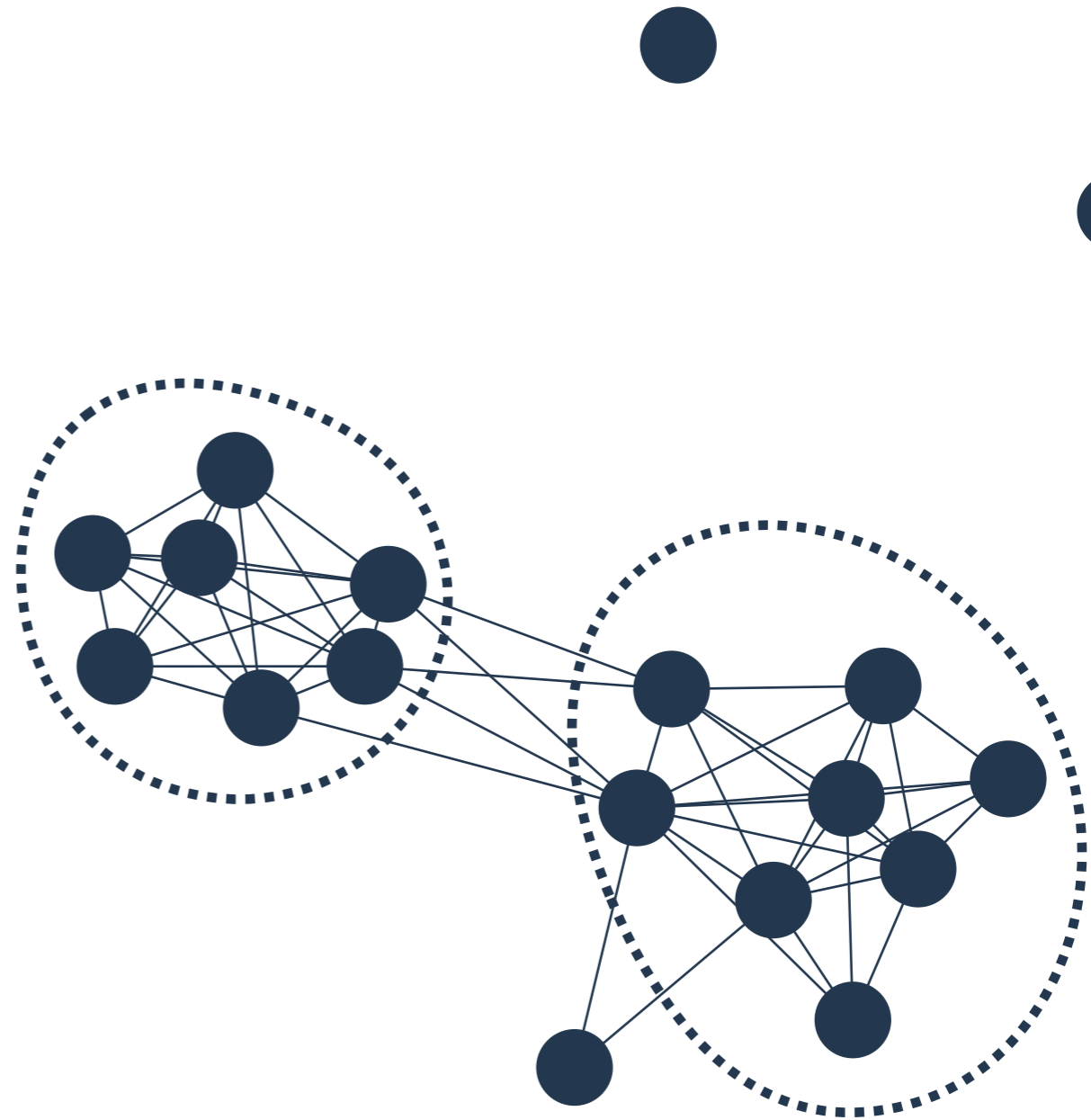
- ⋮ Groups are a basic theoretical component of social structure.
- ⋮ Cohesion, unity, identity, ...
- ⋮ Divisions, conflict, hierarchy, ...

How?

- ⋮ Generally: clusters are groups of nodes that tend to connect more to each other than to others

But what does that mean?

- ⋮ Embedded cliques
- ⋮ Overlapping/hierarchical groups
- ⋮ Partition of entire network



Clusters

Grouping nodes in networks

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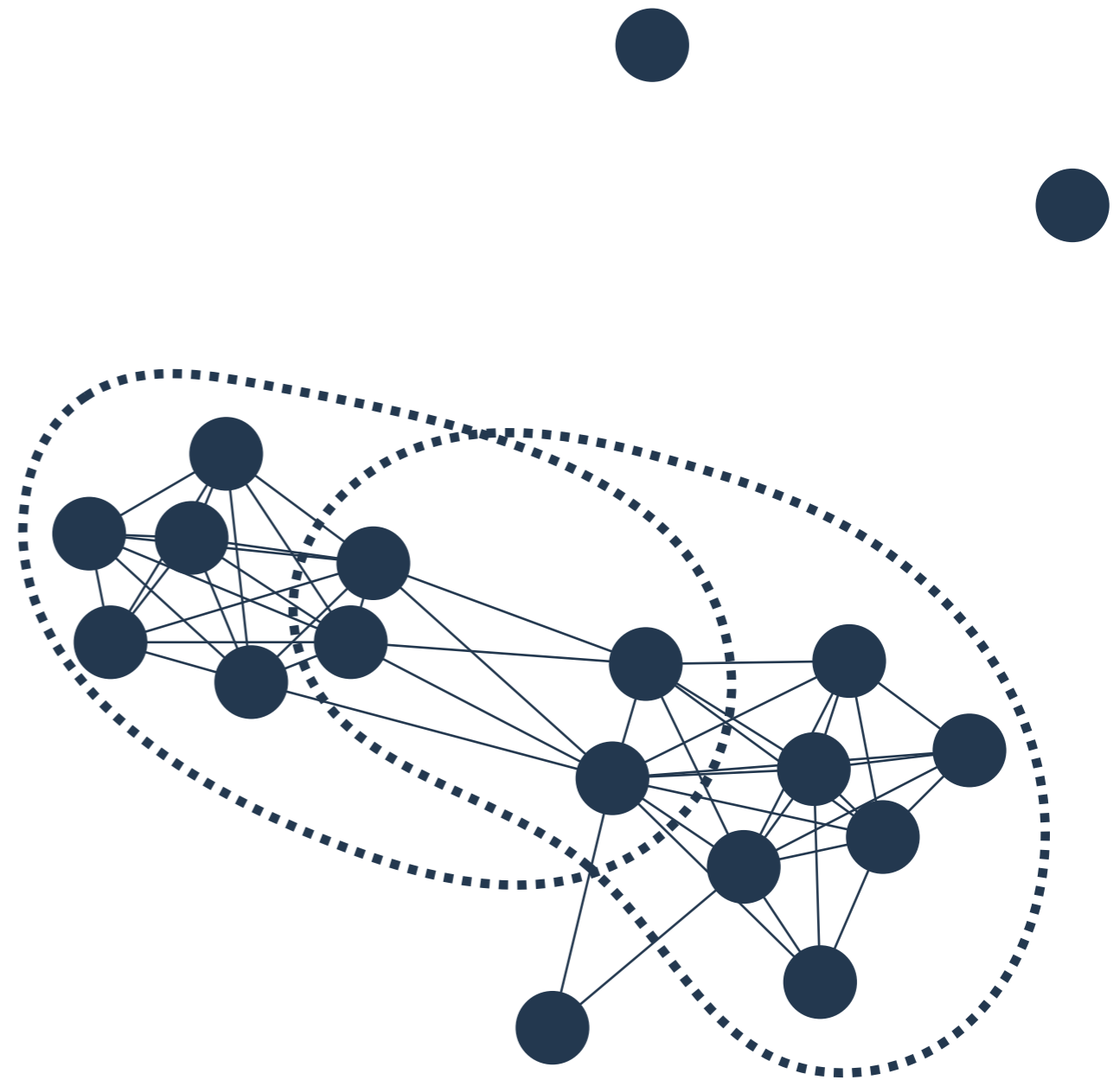
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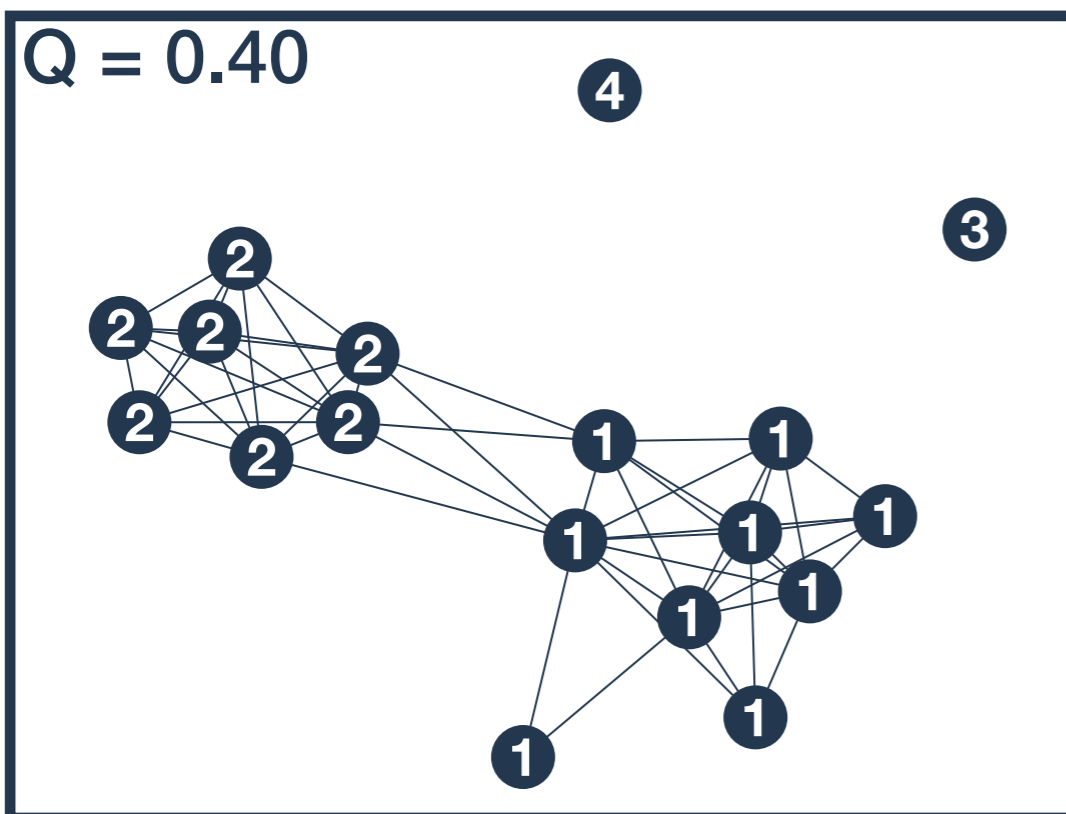
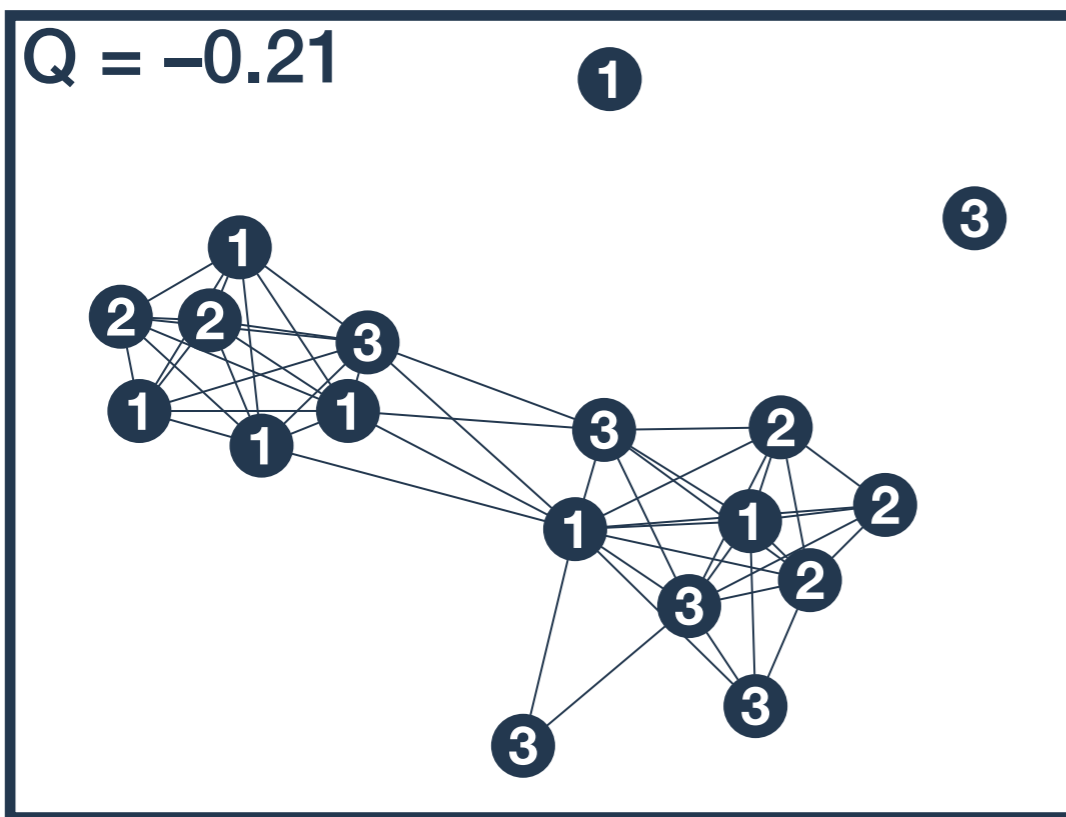
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Modularity



Modularity (Q) is one measure of ‘goodness’ of a partitioning

- ∴ If you are given a particular partitioning of a network, modularity measures how much edges tend to stay within a partition.
- ∴ Ranges from -0.5 (very bad fit) to 1.0 (very good fit)

Modularity maximization

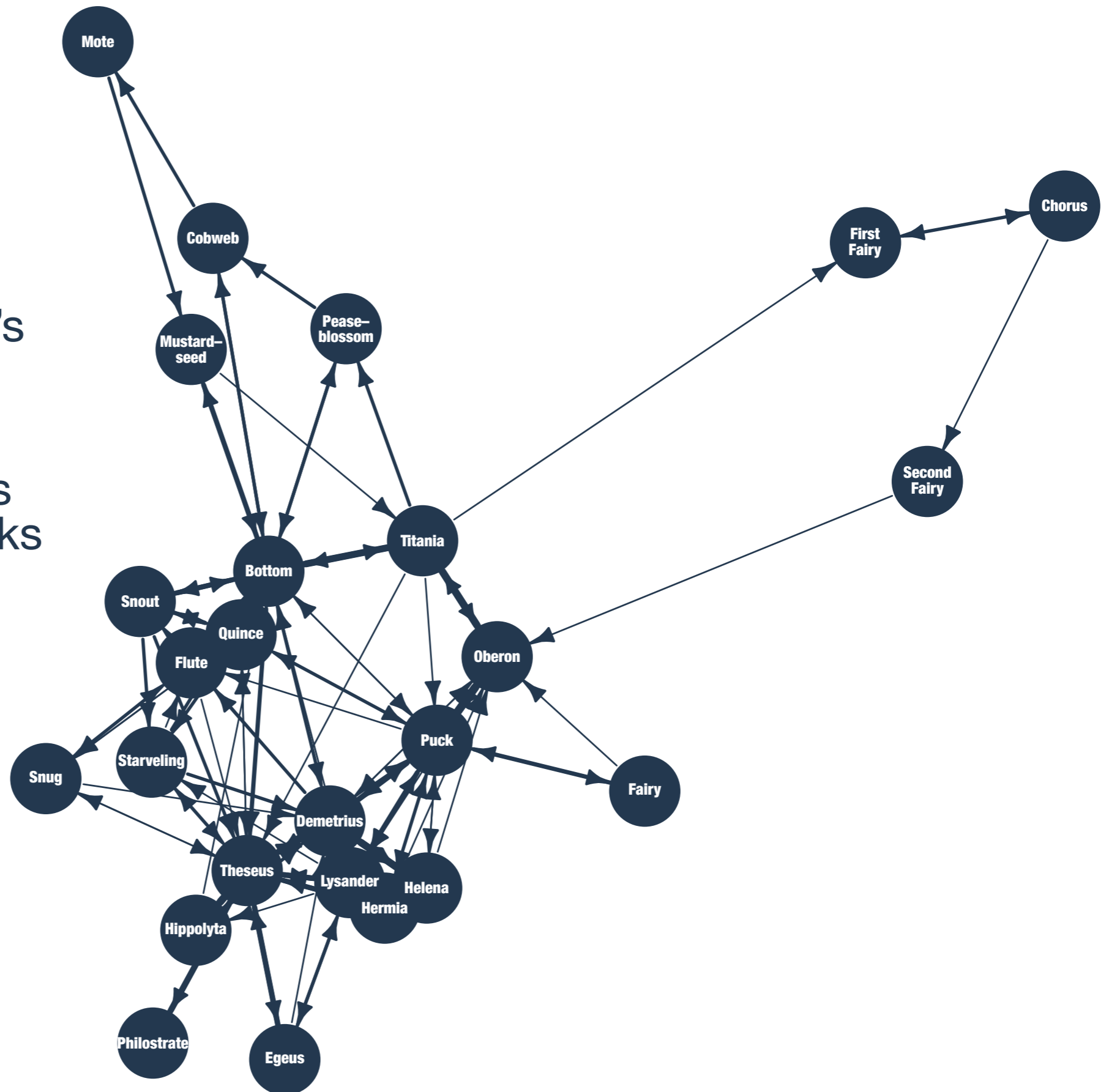
- ∴ Clustering strategy that finds the partitioning that has the highest possible modularity

Clustering algorithms

A Midsummer Night's Dream

Character network

- ⋮ Directed edges indicate number of times one character's line immediately preceded another's
- ⋮ E.g. Cobweb speaks and then Mote speaks
- ⋮ Rough proxy for interaction

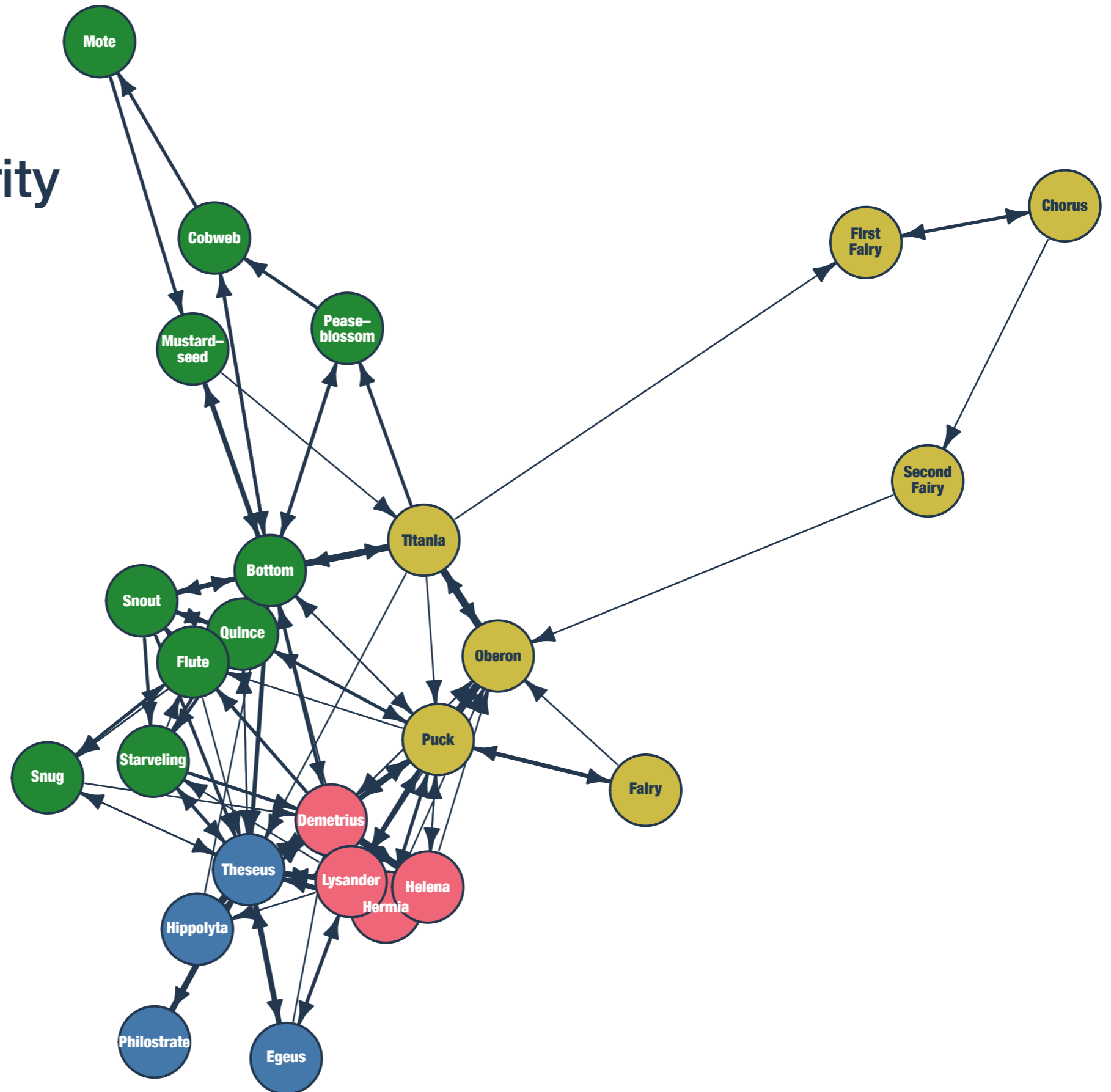


Clustering algorithms

A Midsummer Night's Dream

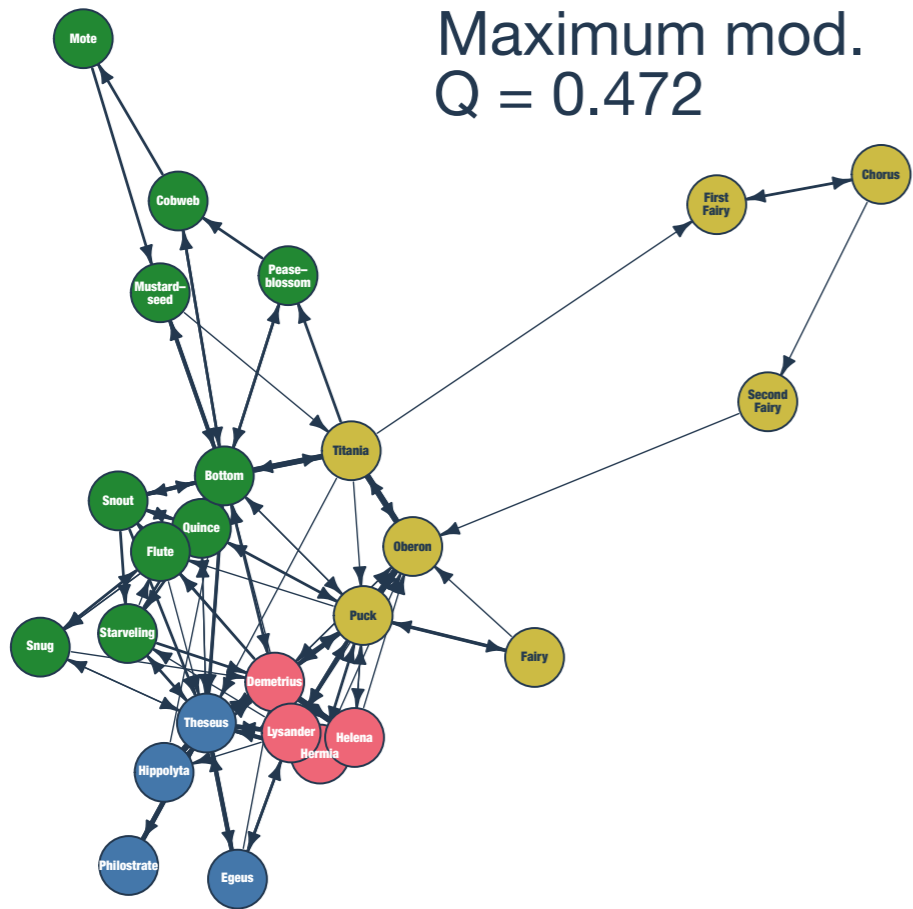
Maximum modularity clusters

$$Q = 0.472$$

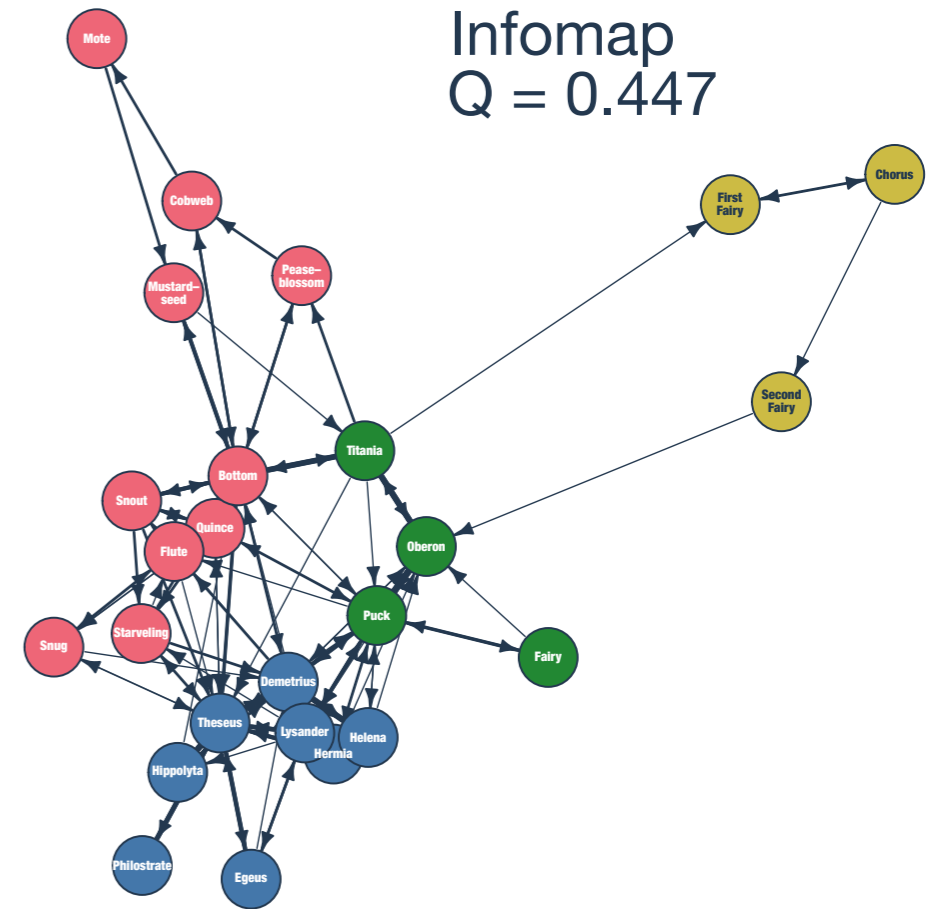


Clustering algorithms

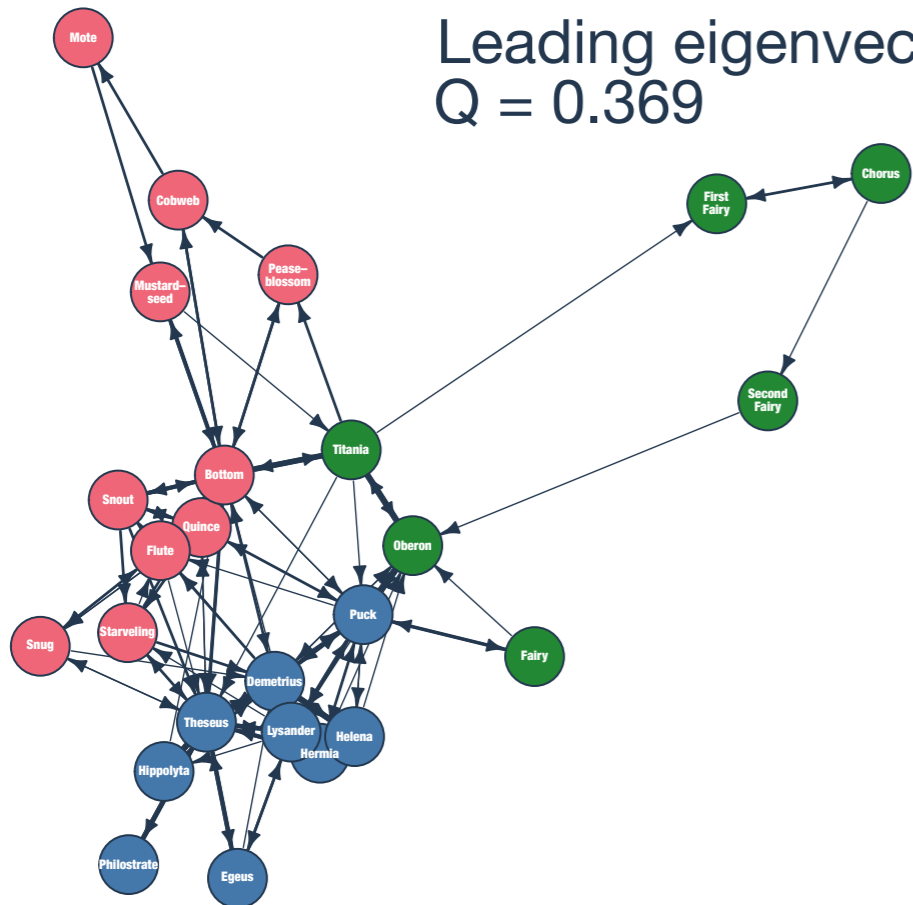
Maximum mod.
 $Q = 0.472$



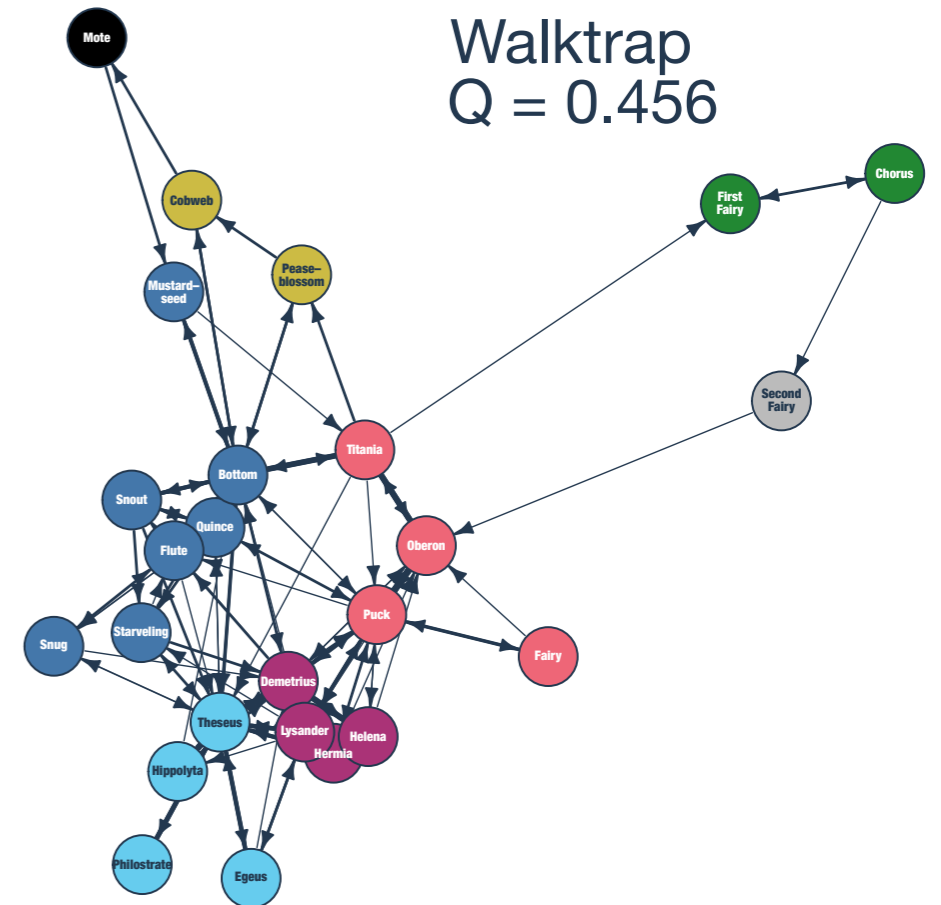
Infomap
 $Q = 0.447$



Leading eigenvector
 $Q = 0.369$

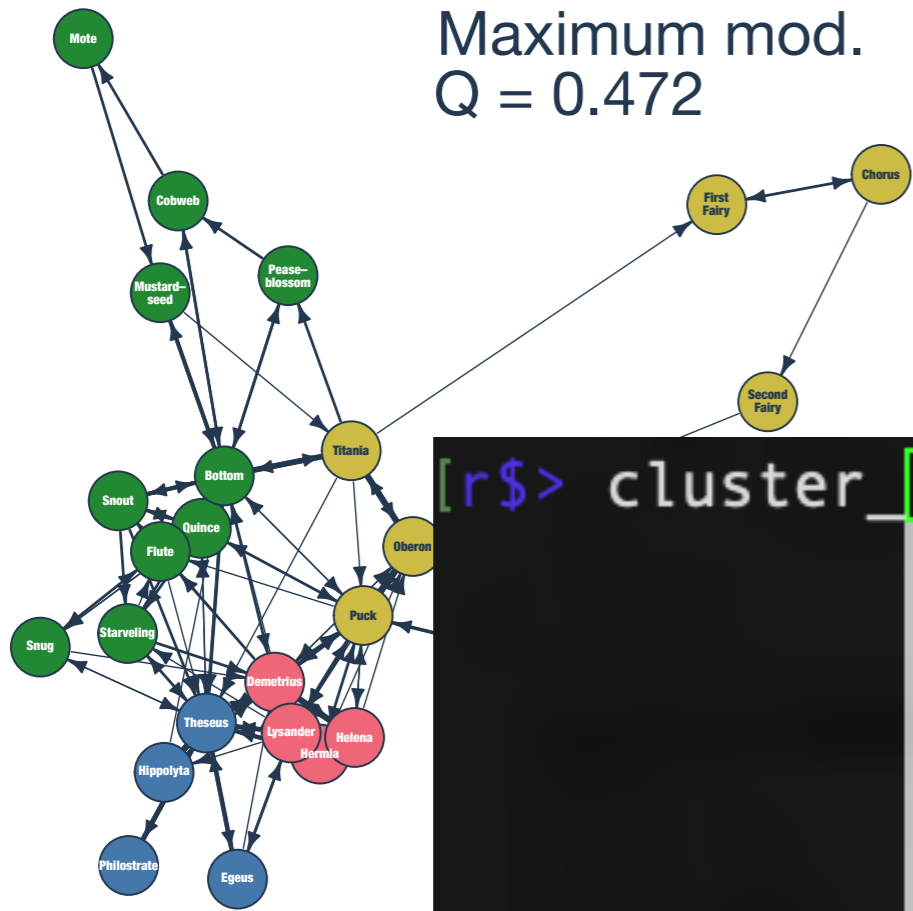


Walktrap
 $Q = 0.456$

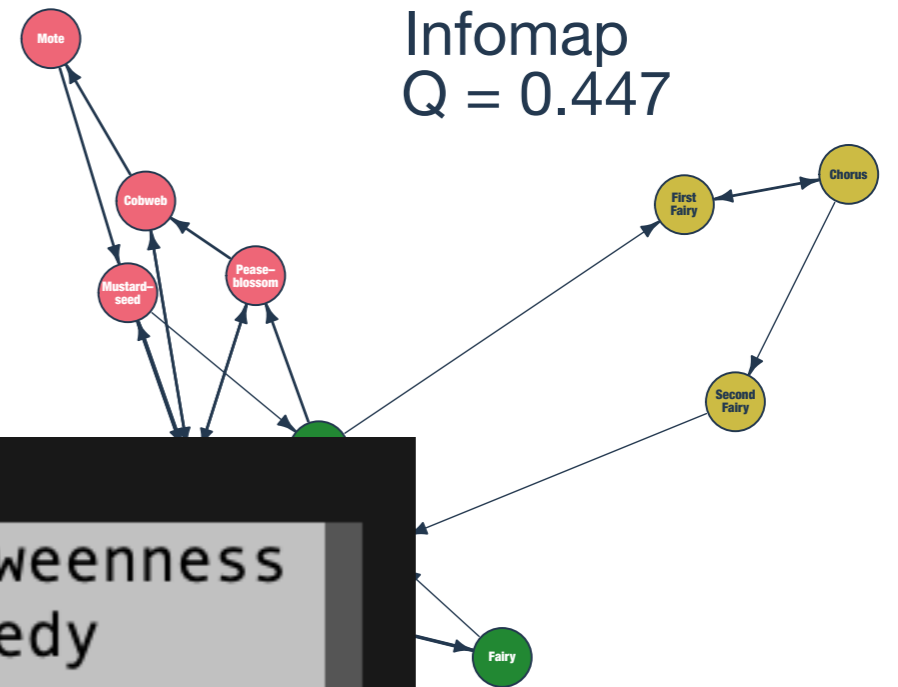


Clustering algorithms

Maximum mod.
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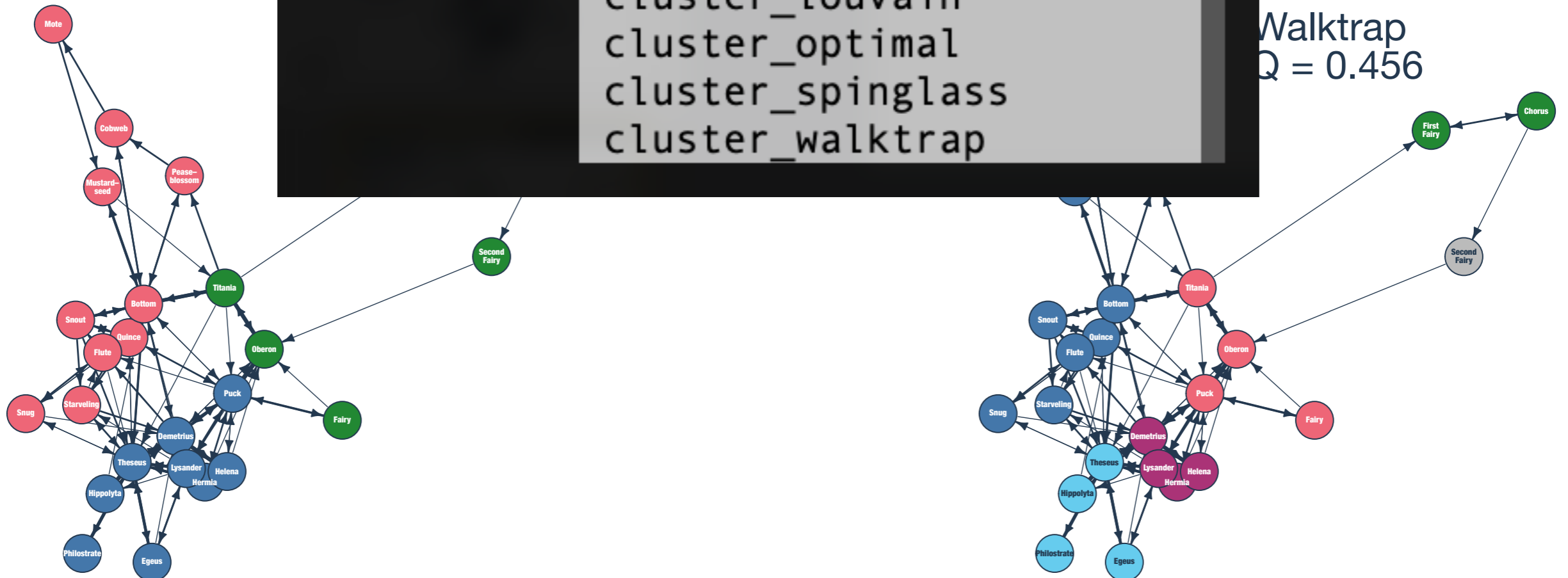


Infomap
 $Q = 0.447$



```
[r$> cluster_
cluster_edge_betweenness
cluster_fast_greedy
cluster_infomap
cluster_label_prop
cluster_leading_eigen
cluster_louvain
cluster_optimal
cluster_spinglass
cluster_walktrap
```

Walktrap
 $Q = 0.456$



Scientific Consensus

The Temporal Structure of Scientific Consensus Formation

Shwed and Bearman (2010)

Deep dive into the sociology of science

S&B:

- ∴ Scientific consensus is contingent on broader societal discourse
- ∴ Therefore there is not a uniform progression toward consensus
- ∴ S&B investigate this by using *citation networks* to measure consensus over time

Citation networks

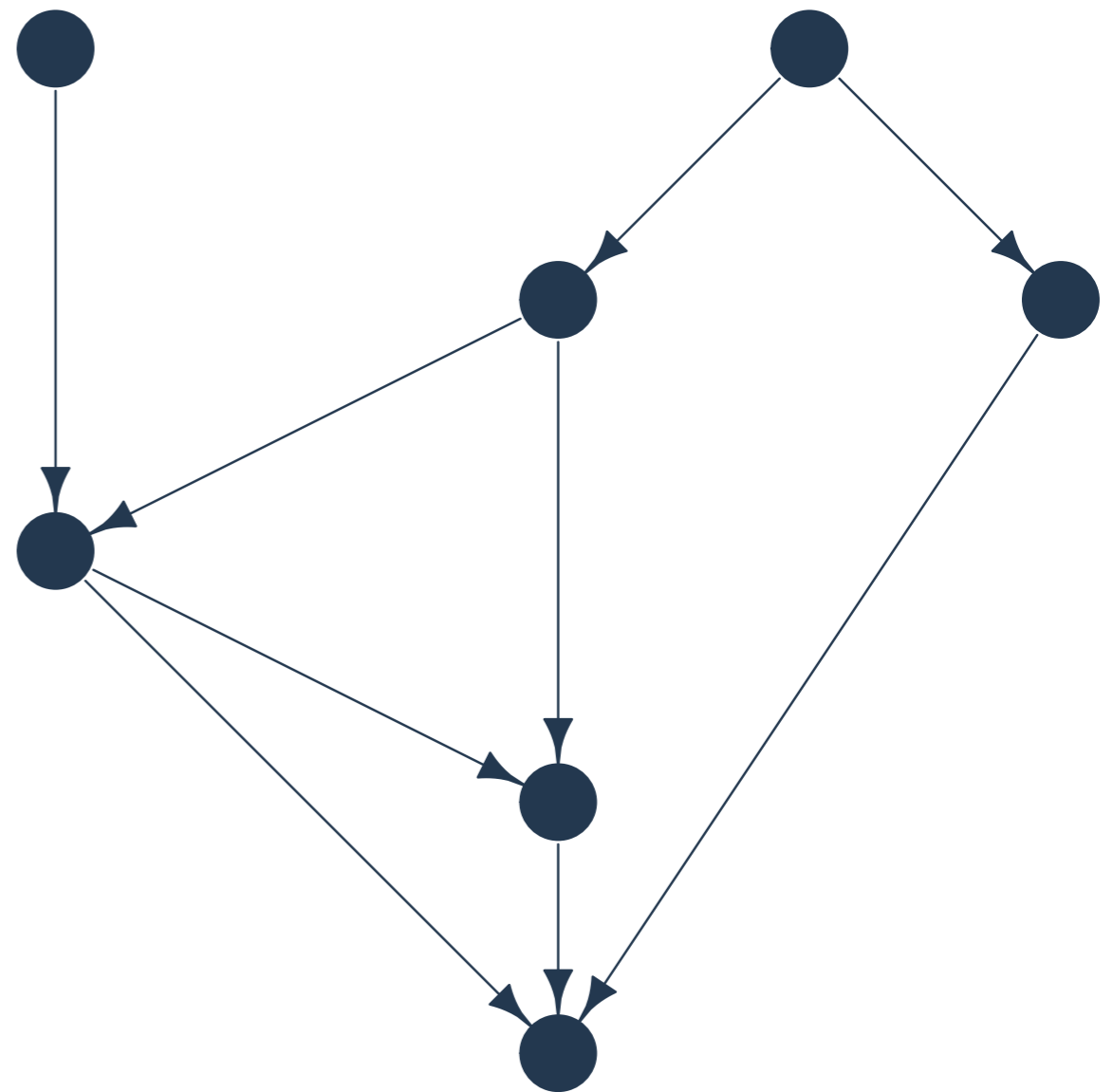
Measuring relations between scholarly publications

Citation network

- ∴ Vertices are publications (articles, books, conference papers, etc.)
- ∴ Directed edges represent citation
- ∴ Temporality imposes structure

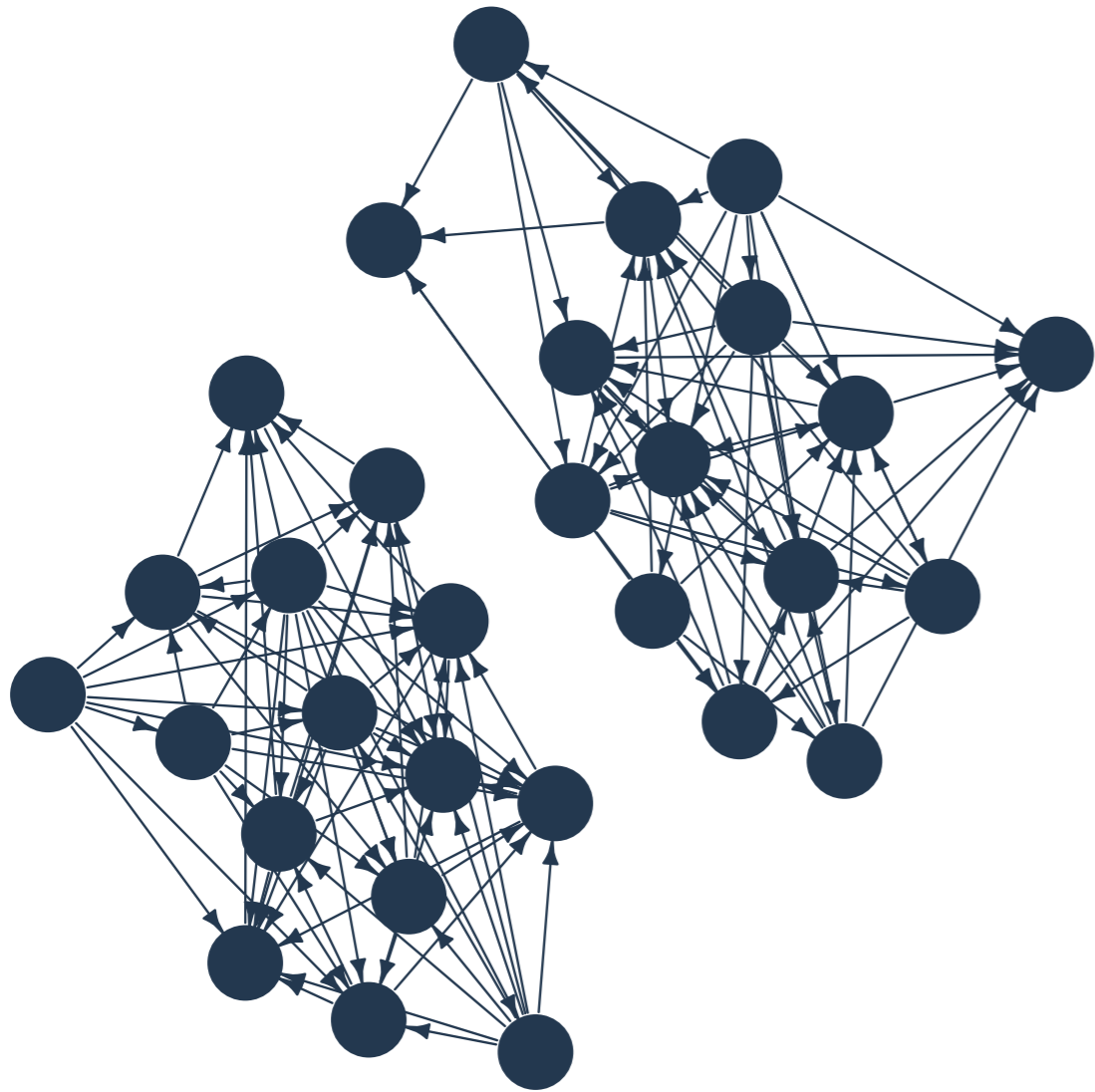
Citations as relations

- ∴ Scientific knowledge is not purely cumulative
- ∴ Citation indicates similarity of theories, methods, assumptions, etc.

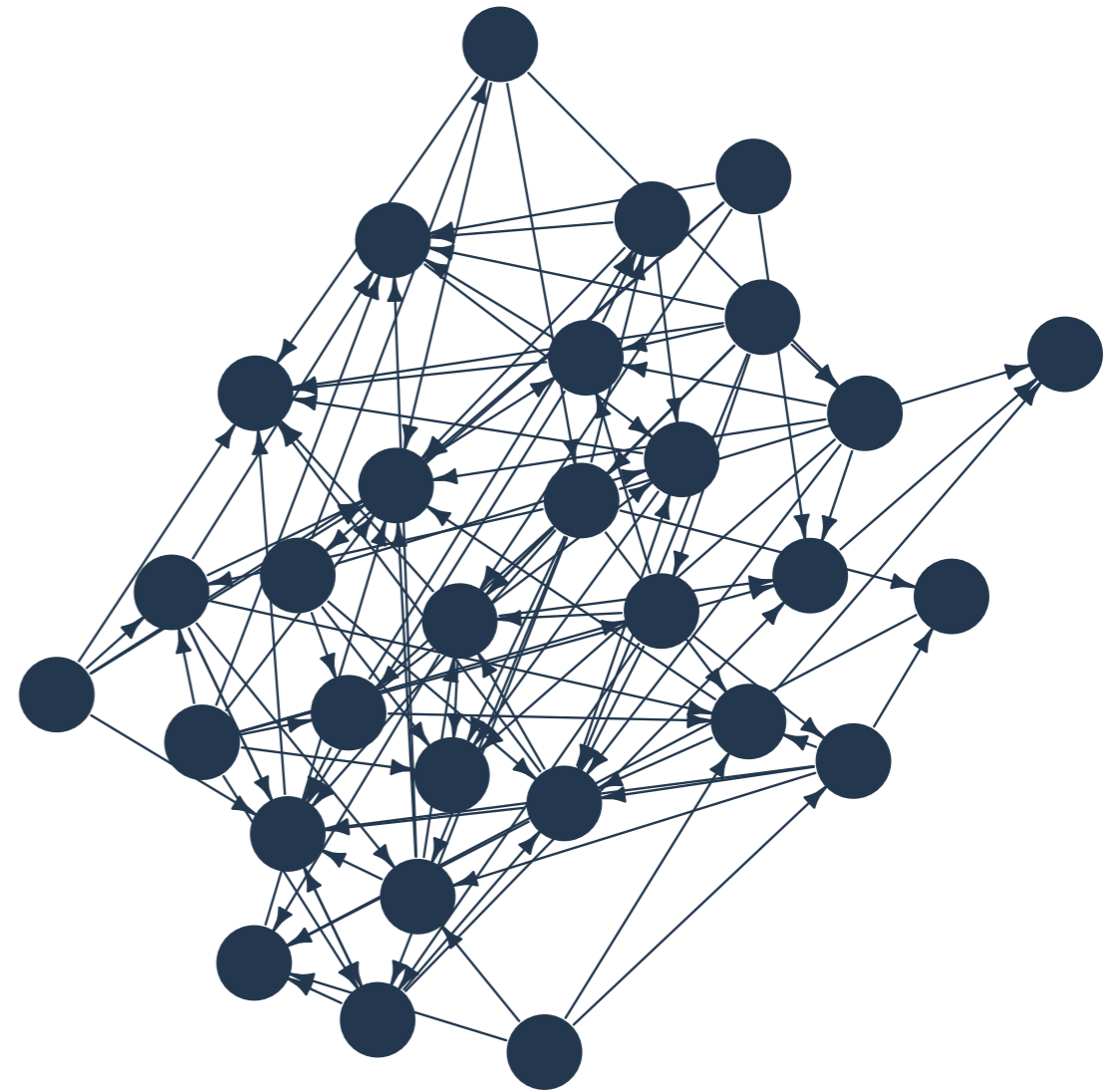


Measuring consensus

Two hypothetical citation networks



$Q = 0.5$
(epistemic rivalry)



$Q = 0.05$
(epistemic consensus)