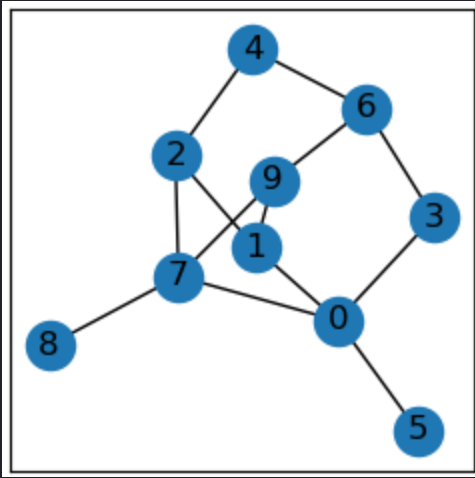


# Network Analysis 101: Basics

## Overview



A *network* is a set of *nodes* and *edges* that connect them.

*Network Analysis* is the study of the *\*structure\** of the network.s

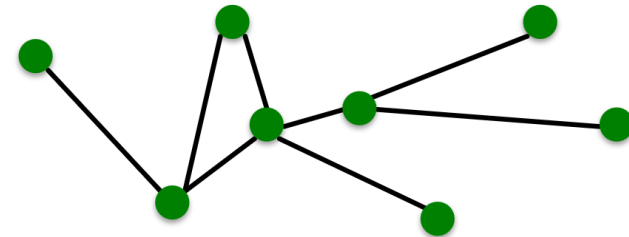
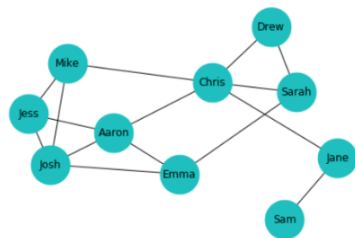
[https://en.wikipedia.org/wiki/Network\\_science](https://en.wikipedia.org/wiki/Network_science)

## The Structure and Function of Complex Networks

A real-world **network** is modeled in the computer as a **graph**:

- A set of **nodes** (or **vertices**, singular **vertex**)
- Some nodes are connected by **edges** (or **links**)
- Edges can be **undirected** or **directed**

Friends network  
(undirected)



- **Objects:** nodes, vertices
- **Interactions:** links, edges
- **System:** network, graph

$N$   
 $E$   
 $G(N,E)$

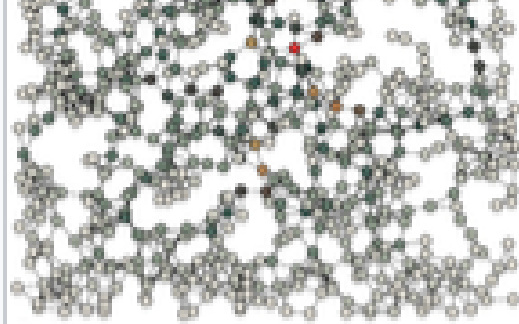
# Networks in the Real World

Networks are everywhere, such as:

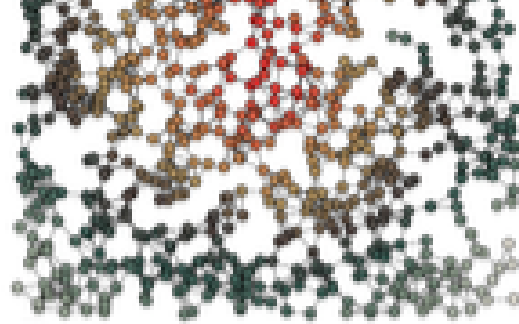
- Information, ie: the Web
- Social, ie: Twitter, Facebook
- Biological, ie: Ecosystems, Neuronal, Metabolism

<https://www.youtube.com/watch?v=yAtsm5xkb5c>

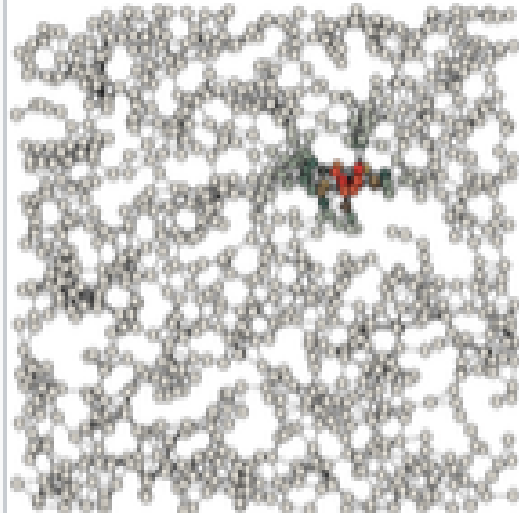
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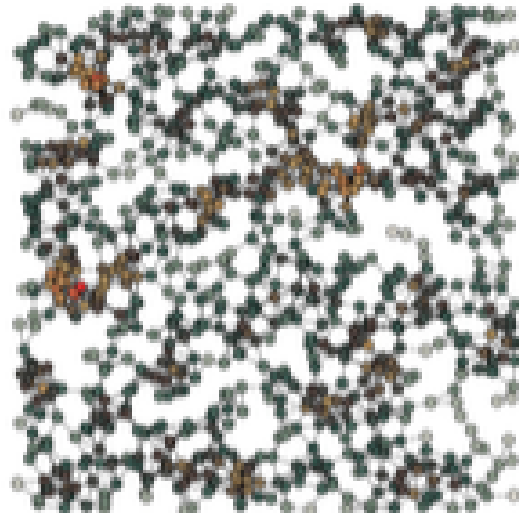
**A** Betweenness



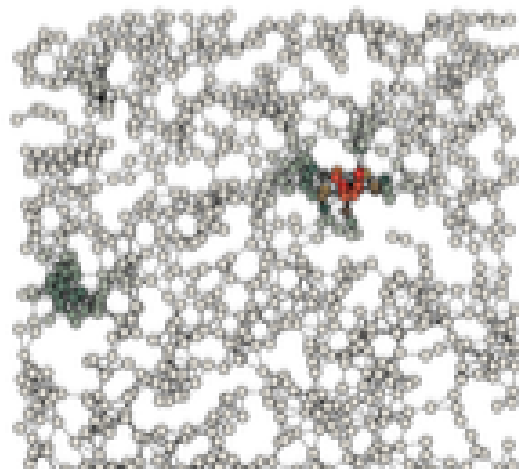
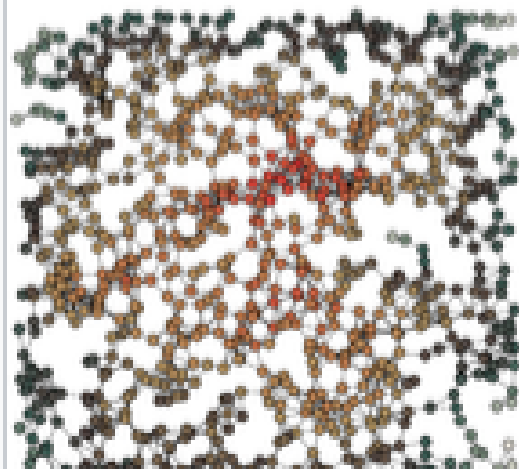
**B** Closeness



**C** Eigenvector



**D** Degree



The basic analytic statistics for networks are measures that focus on nodes and their "importance" in the network.

The technical term for this is **centrality** and thus these are *centrality measures*.

<https://en.wikipedia.org/wiki/Centrality>

A related wholistic measure is **density**.

## More Examples

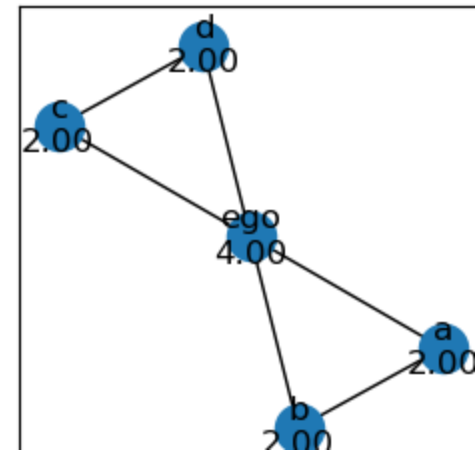
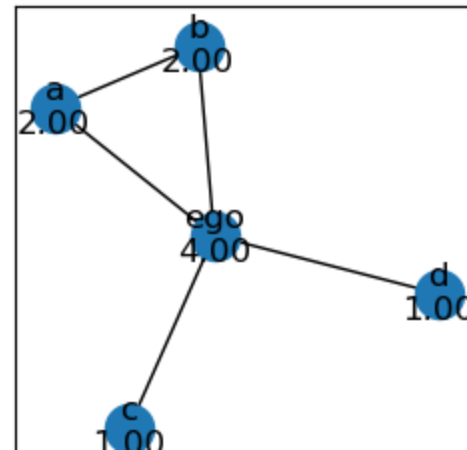
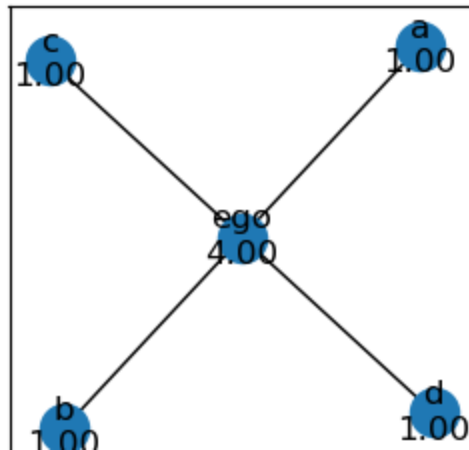
Here are more networks, which will be used in later measures also as the above network is pretty simple.

**Star**

**Clique**

**Bridge**

Degree

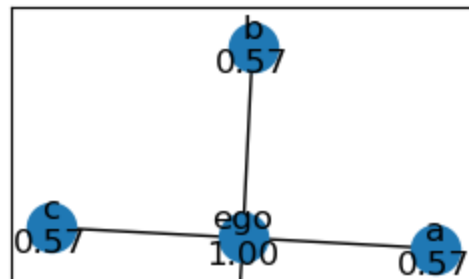


closeness would be defined as:

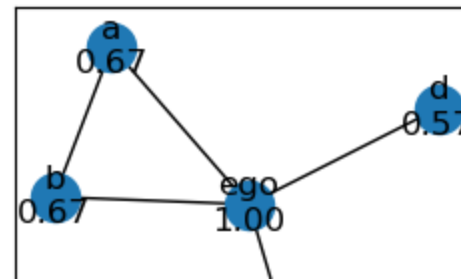
$$Cent_i^C = \frac{n - 1}{\sum l(i, j)}$$

## More Examples

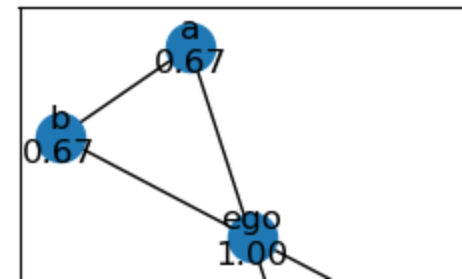
Star



Clique



Bridge

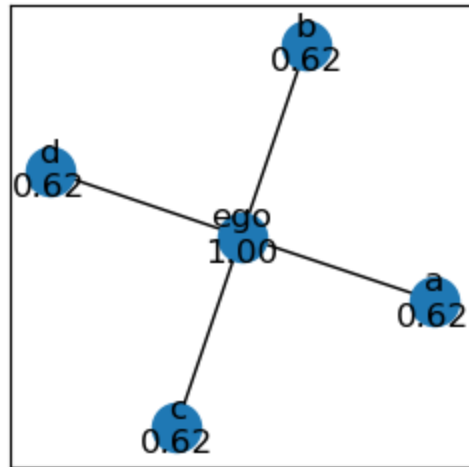


Closeness

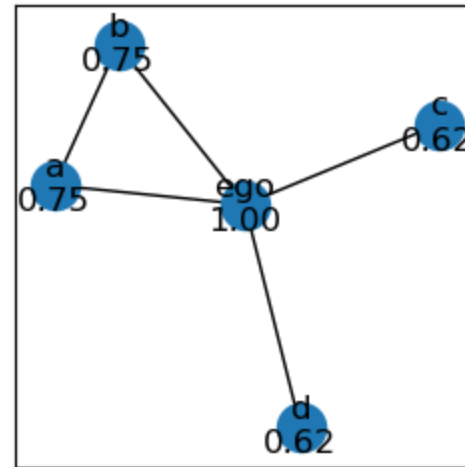
# Decay

## More Examples

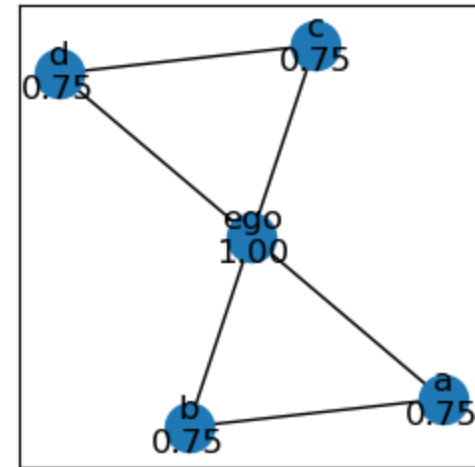
### Star



### Clique



### Bridge



Decay  
Centrality

\pagebreak

**Betweenness**

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# Basic Network Analysis: Synthetic

The basic synthetic, or wholistic, statistics on networks are measures meant to give information to the overall structure of the network.

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# Density

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# Clusters

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