

# HUDK 4050: CORE METHODS IN EDM

# Test

# In the news

Entrepreneur

## Which Analytics Do You Really Need?

*Descriptive? Diagnostic? Predictive? Prescriptive? Here's how to design your own analytics agenda*



### TOP 5 DEEP LEARNING TRENDS THAT WILL DOMINATE 2019

npr one

### Facial Recognition Technology In Schools Prompts Privacy Questions

THE TRIBUNE

### Pilot program will give breakfast before standardized test

BBC

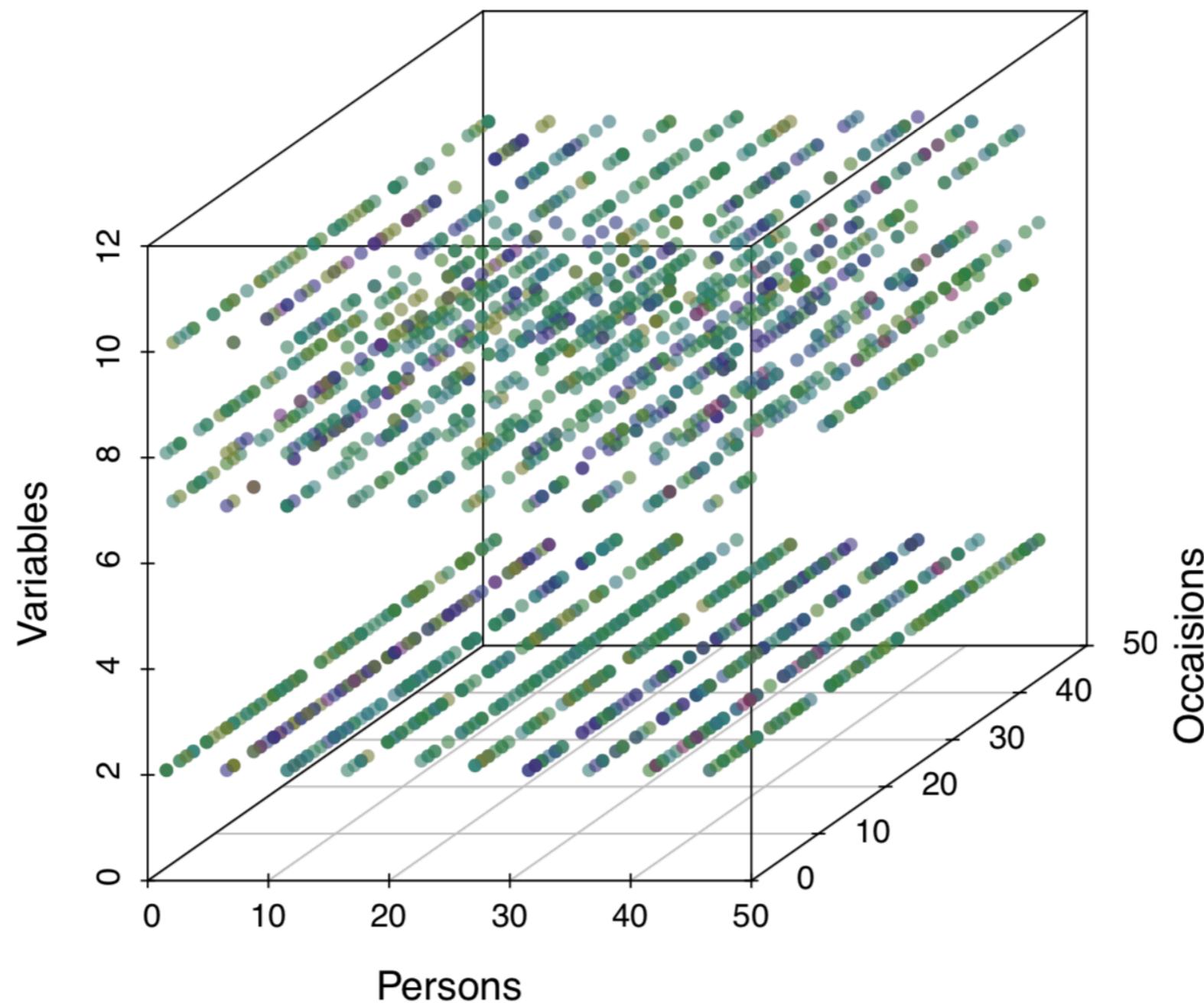
### Katrina McHugh: Pop charts... as you've never seen them before

# Events

Title	Date	Link
Deep Learning Class	6:00pm October 10	<a href="https://meet.meetup.com/wf/click?upn=pEcc35imY7Cq0tG1vyTt6zEs68RbcMfiPcajNHTKtn8v85yKXsc79lWp6i3R22LaVXDZrYiCAJqEMrfO8EGPlqDaktnq8WqaLm5b8XliqF-2BlrgxrjAPxgs1Z2-2B8C9ojJ5M0Lk9xWqxqZdpEis2Lf9D-2FUDhM6vsT3zlQkOm5MhU-2BRGvxK8R-2FvbClCknv3a120e8XE5LUSRqEf6uocoF8ohuTvNdx-2BC6PNyrQPTBQD6AWlLeBNQqpCDUxxbbZWzdORCrBLmqjC-2FOPahNlD0g023eCvaRvVhjcUStww2q-2BsfLvm1mKLGS7XWTXzn2CzssjI3fs1g-2F4663y5ID5Q61KtvREVidSz8e0mcqorpVExbFsFBLKB1kfVh19YoW8z-2FCEScVbDxlsISwigXUgKdbAinU1H5ilyTAyduo2Rc9E5MRfdqadYIdzYc3BF3zVuXvuszo0Fklyb-2Fm26yp1GBEUer4PaXfgfJKaWNzPPuQS26XYPhqmbnEz8Rgq5FroL6R9dO2CouLfr8KkGyduCWP34ncbHZq5VeAMcVe0-3D">https://meet.meetup.com/wf/click?upn=pEcc35imY7Cq0tG1vyTt6zEs68RbcMfiPcajNHTKtn8v85yKXsc79lWp6i3R22LaVXDZrYiCAJqEMrfO8EGPlqDaktnq8WqaLm5b8XliqF-2BlrgxrjAPxgs1Z2-2B8C9ojJ5M0Lk9xWqxqZdpEis2Lf9D-2FUDhM6vsT3zlQkOm5MhU-2BRGvxK8R-2FvbClCknv3a120e8XE5LUSRqEf6uocoF8ohuTvNdx-2BC6PNyrQPTBQD6AWlLeBNQqpCDUxxbbZWzdORCrBLmqjC-2FOPahNlD0g023eCvaRvVhjcUStww2q-2BsfLvm1mKLGS7XWTXzn2CzssjI3fs1g-2F4663y5ID5Q61KtvREVidSz8e0mcqorpVExbFsFBLKB1kfVh19YoW8z-2FCEScVbDxlsISwigXUgKdbAinU1H5ilyTAyduo2Rc9E5MRfdqadYIdzYc3BF3zVuXvuszo0Fklyb-2Fm26yp1GBEUer4PaXfgfJKaWNzPPuQS26XYPhqmbnEz8Rgq5FroL6R9dO2CouLfr8KkGyduCWP34ncbHZq5VeAMcVe0-3D</a>
Truth-Seeking in the Age of Disinformation	1:00pm October 12	<a href="https://events.columbia.edu/cal/event/eventView.do?b=de&amp;calPath=%2Fpublic%2Fcals%2FMainCal&amp;guid=CAL-00bb9e28-6652beba-0166-53fb55a4-000007e0events@columbia.edu&amp;recurrenceId=">https://events.columbia.edu/cal/event/eventView.do?b=de&amp;calPath=%2Fpublic%2Fcals%2FMainCal&amp;guid=CAL-00bb9e28-6652beba-0166-53fb55a4-000007e0events@columbia.edu&amp;recurrenceId=</a>
SVP of Data Science at Nielsen Marketing Cloud	1:45pm October 15	GDH 285
John Allspaw	6:30pm October 15	<a href="https://www.meetup.com/papers-we-love/events/254505298/?gj=wcs1_e&amp;rv=wcs1_e&amp;xtd=gatlbWFpbF9jbGlja9oAJDczMDVjZTlYLTQyMDAtNGU1Yi04M2FILWFkMjiIMGUzNGNjOA&amp;af=event&amp;af_eid=254505298&amp;cookie-check=9EgnX6p5vFcCifxZ">https://www.meetup.com/papers-we-love/events/254505298/?gj=wcs1_e&amp;rv=wcs1_e&amp;xtd=gatlbWFpbF9jbGlja9oAJDczMDVjZTlYLTQyMDAtNGU1Yi04M2FILWFkMjiIMGUzNGNjOA&amp;af=event&amp;af_eid=254505298&amp;cookie-check=9EgnX6p5vFcCifxZ</a>
Big Data for Intelligence Symposium	Washington DC, October 16 - 17	<a href="http://bigdatasymposium.dsigroup.org/">http://bigdatasymposium.dsigroup.org/</a>
People centric approach to optimize Data Science, Commercial impact and Leadership	10:30am November 14	<a href="https://events.columbia.edu/cal/event/eventView.do?b=de&amp;calPath=%2Fpublic%2Fcals%2FMainCal&amp;guid=CAL-00bb9e24-655b8449-0165-5e0ea7e9-00001957events@columbia.edu&amp;recurrenceId=">https://events.columbia.edu/cal/event/eventView.do?b=de&amp;calPath=%2Fpublic%2Fcals%2FMainCal&amp;guid=CAL-00bb9e24-655b8449-0165-5e0ea7e9-00001957events@columbia.edu&amp;recurrenceId=</a>

# Test Analysis

**Cattell Box**

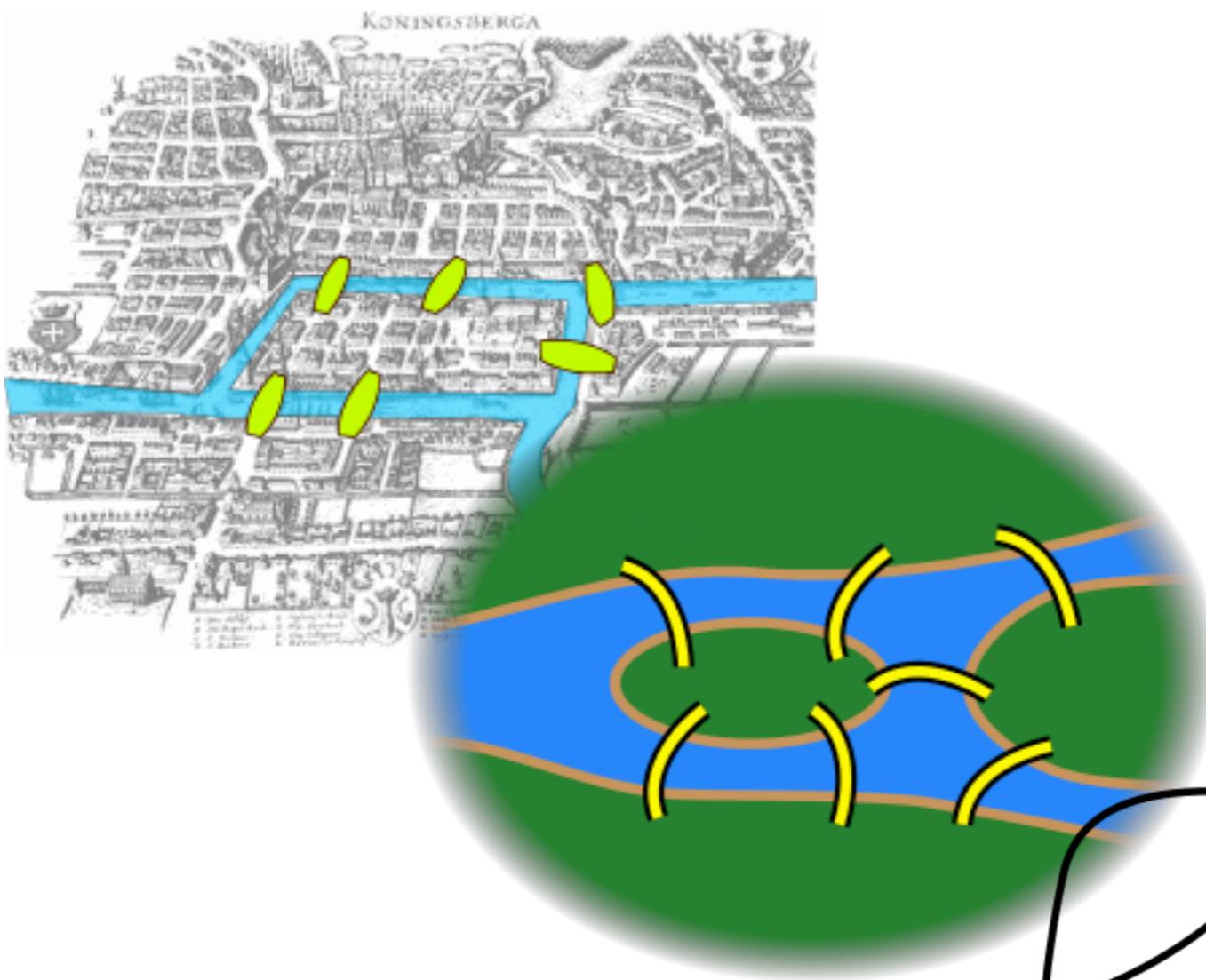


# Test Analysis Task

Generate a new plot  
using a combination of two  
or more axes of variation  
and the class data

# Social Network Analysis

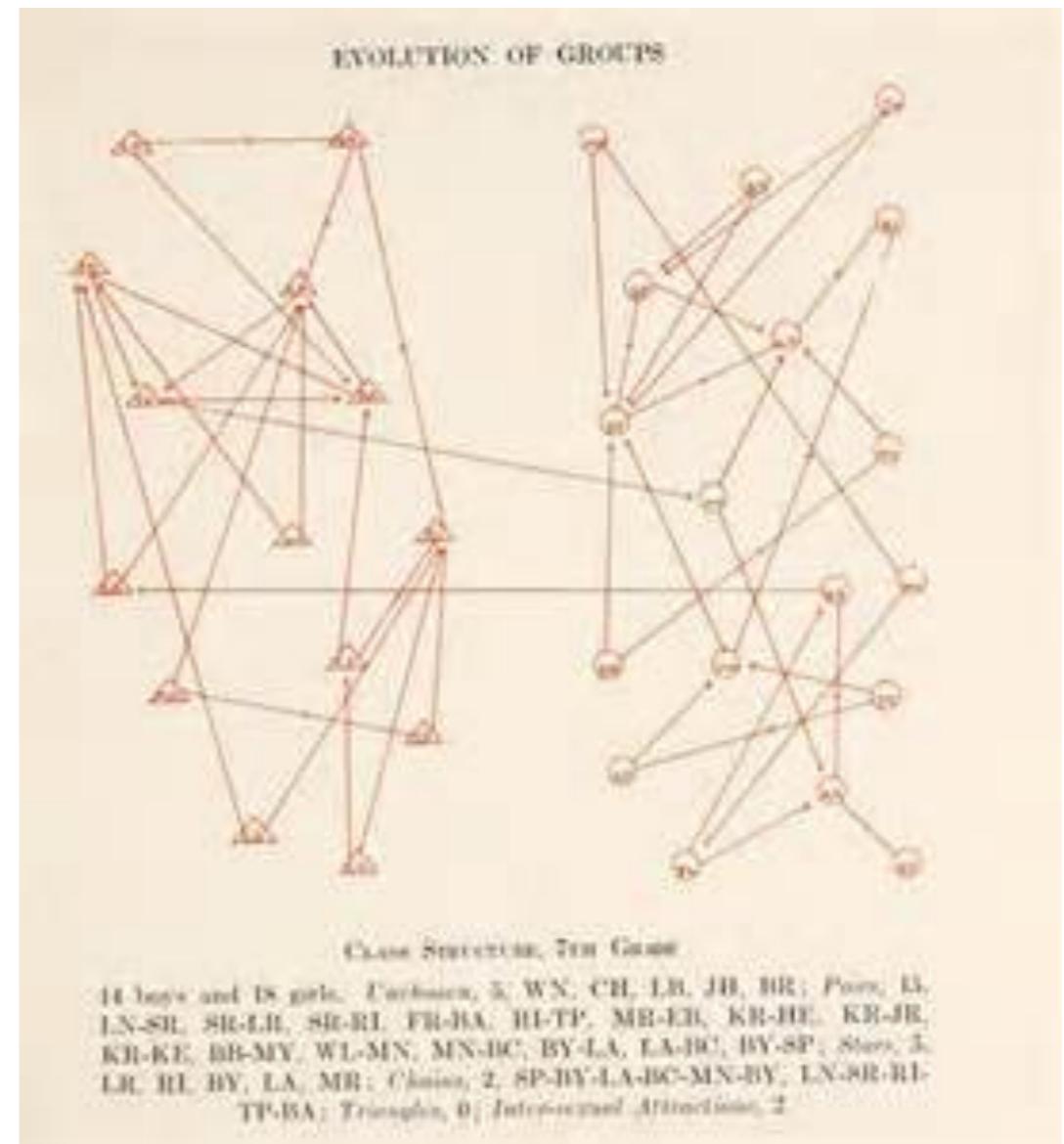
# History



Leonhard Euler

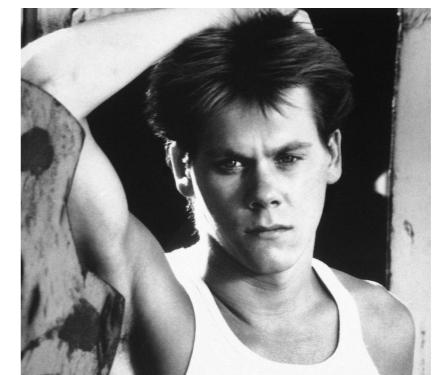
# Use in Education

- Helen Jennings & Jacob Levy Moreno
- Hudson School for Girls (1934)



# History

- Random network the size of the US (in 1950) would require at most two intermediaries to connect any two people (Kochen)
- Small World Experiments (Milgram)
  - Postcards sent to random people in Kansas
  - People instructed to send their postcard to a target person in Boston or someone that they think might know that person



# Use in Education

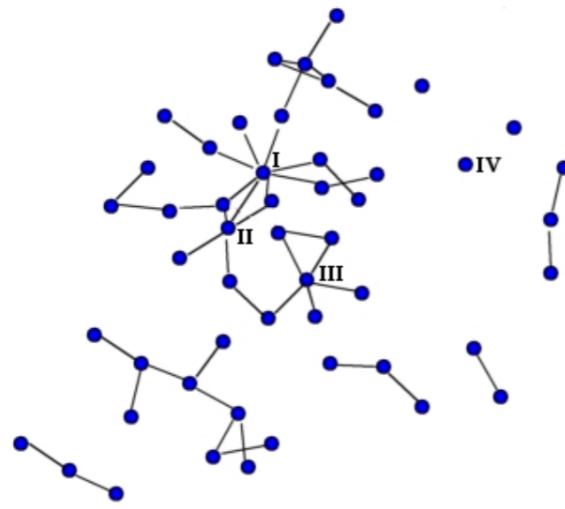


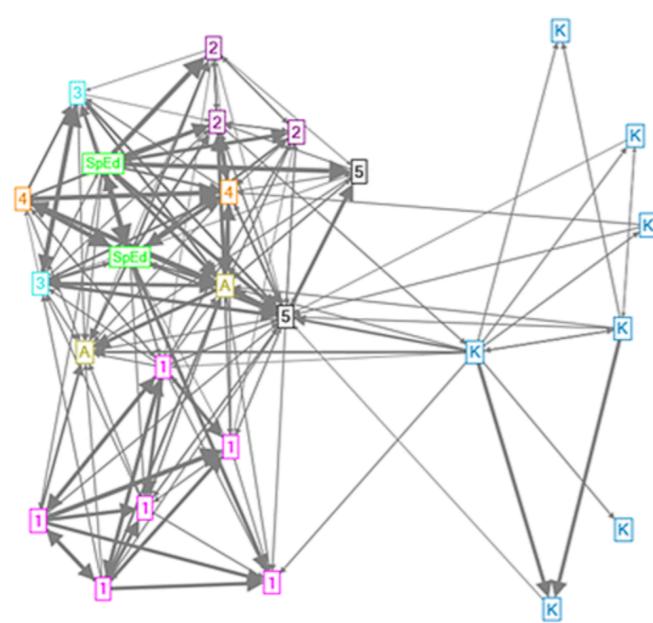
Figure 2. Sociogram of discussion forum interactions

Dawson (2008)

Centrality measures from forum posts correlate to student sense of belonging (mediated by external network)

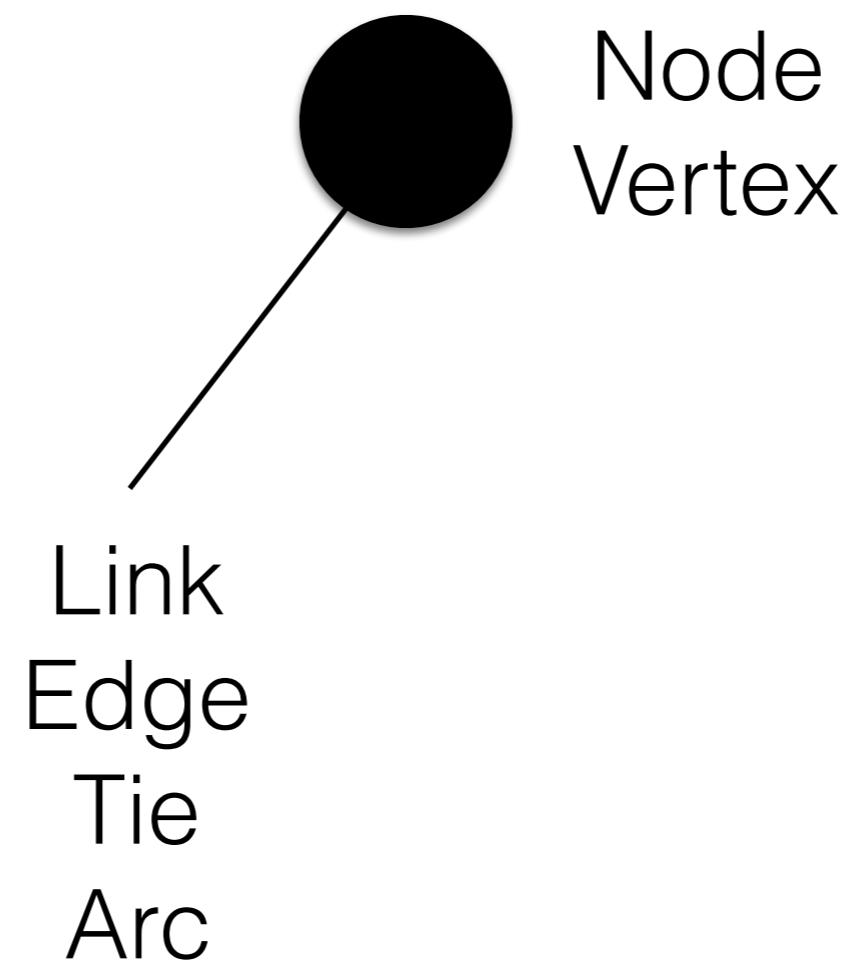
Smith, Trygstad, Hayes (2016)

SNA can be used to identify influential teachers within their peer group

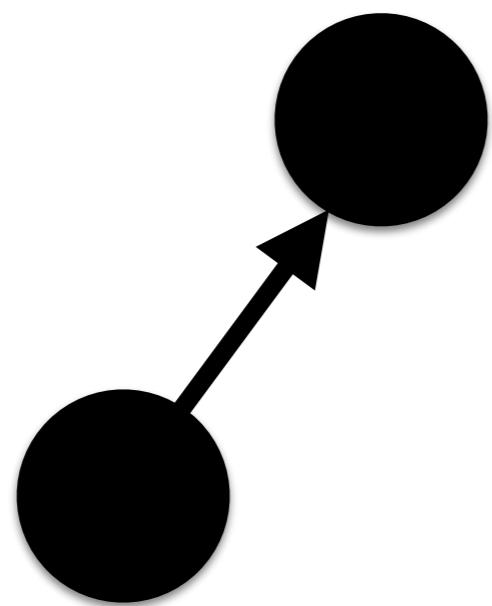


# Networks

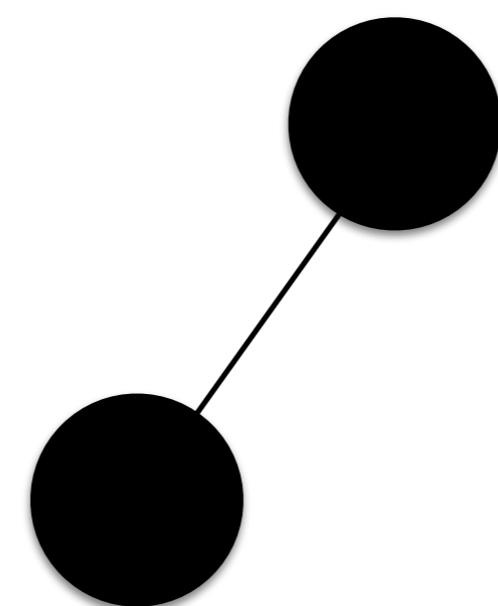
(Graphs)



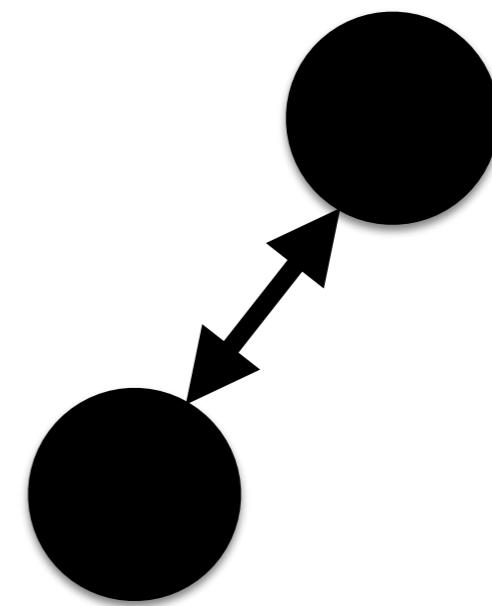
# Networks



Directed



Undirected

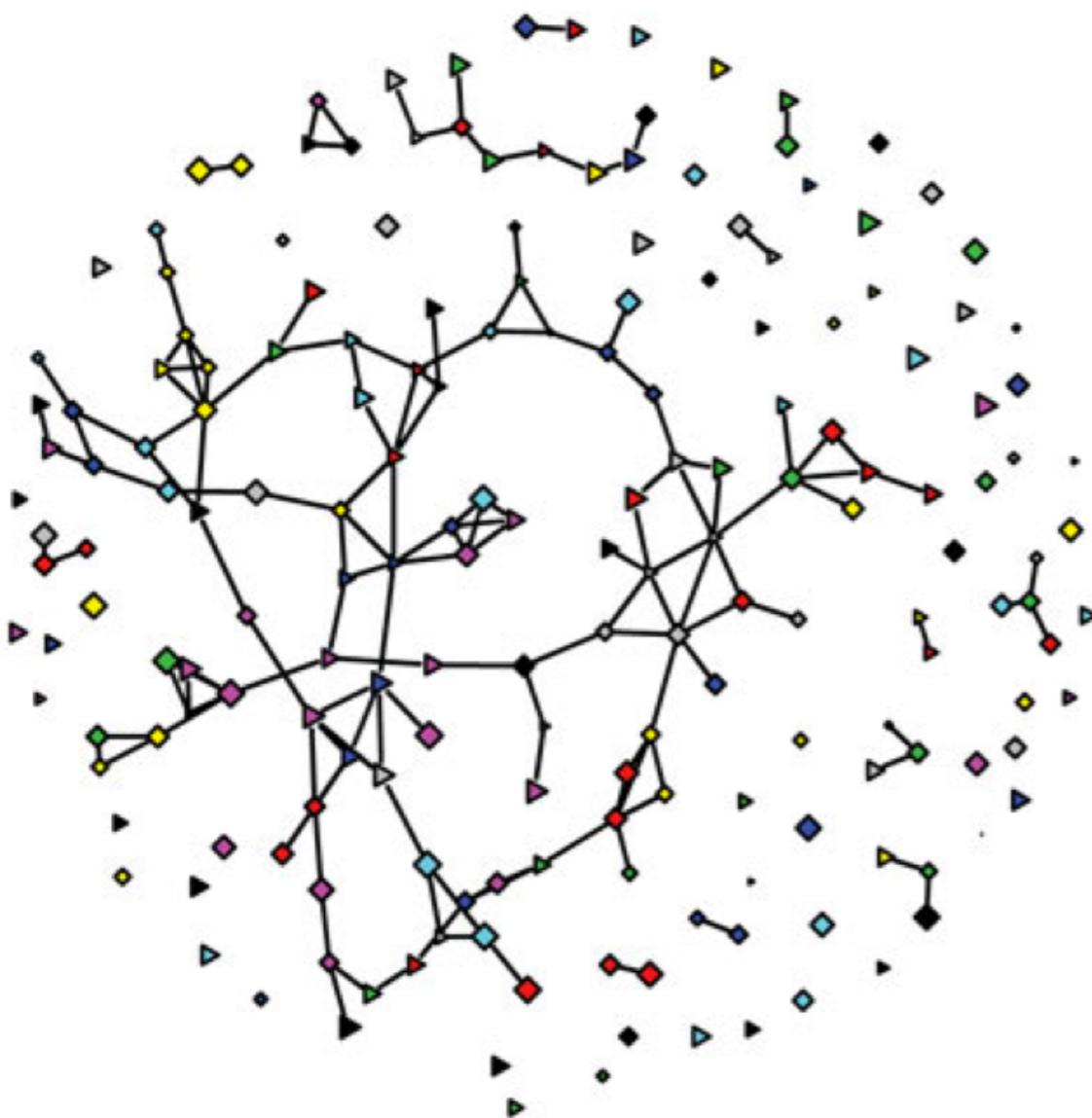


Reciprocal

# Degree

The number of links to other nodes in the network

Undirected



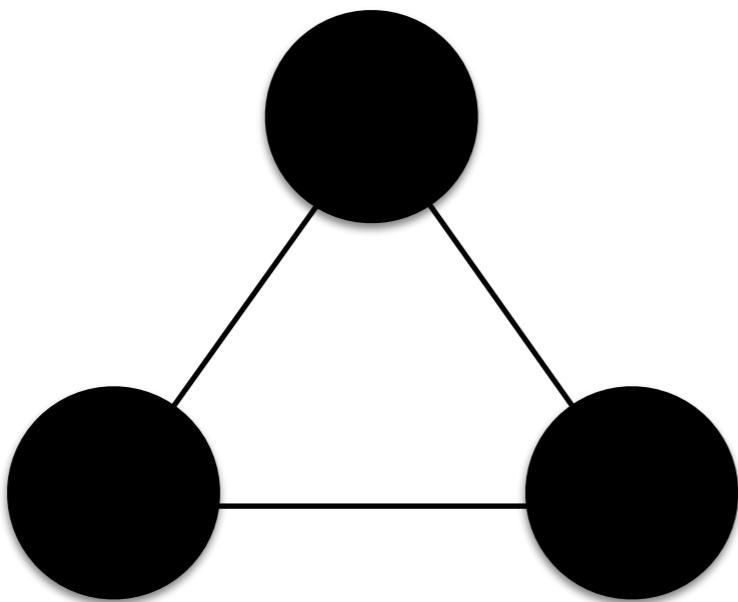
Directed



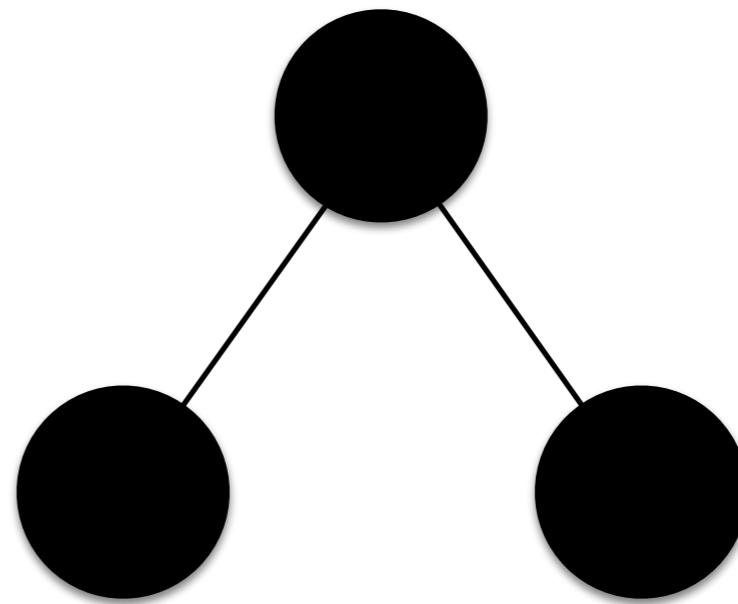
Indegree = Popularity  
Outdegree = No shame

# Density

How close is the graph to the maximal number of links



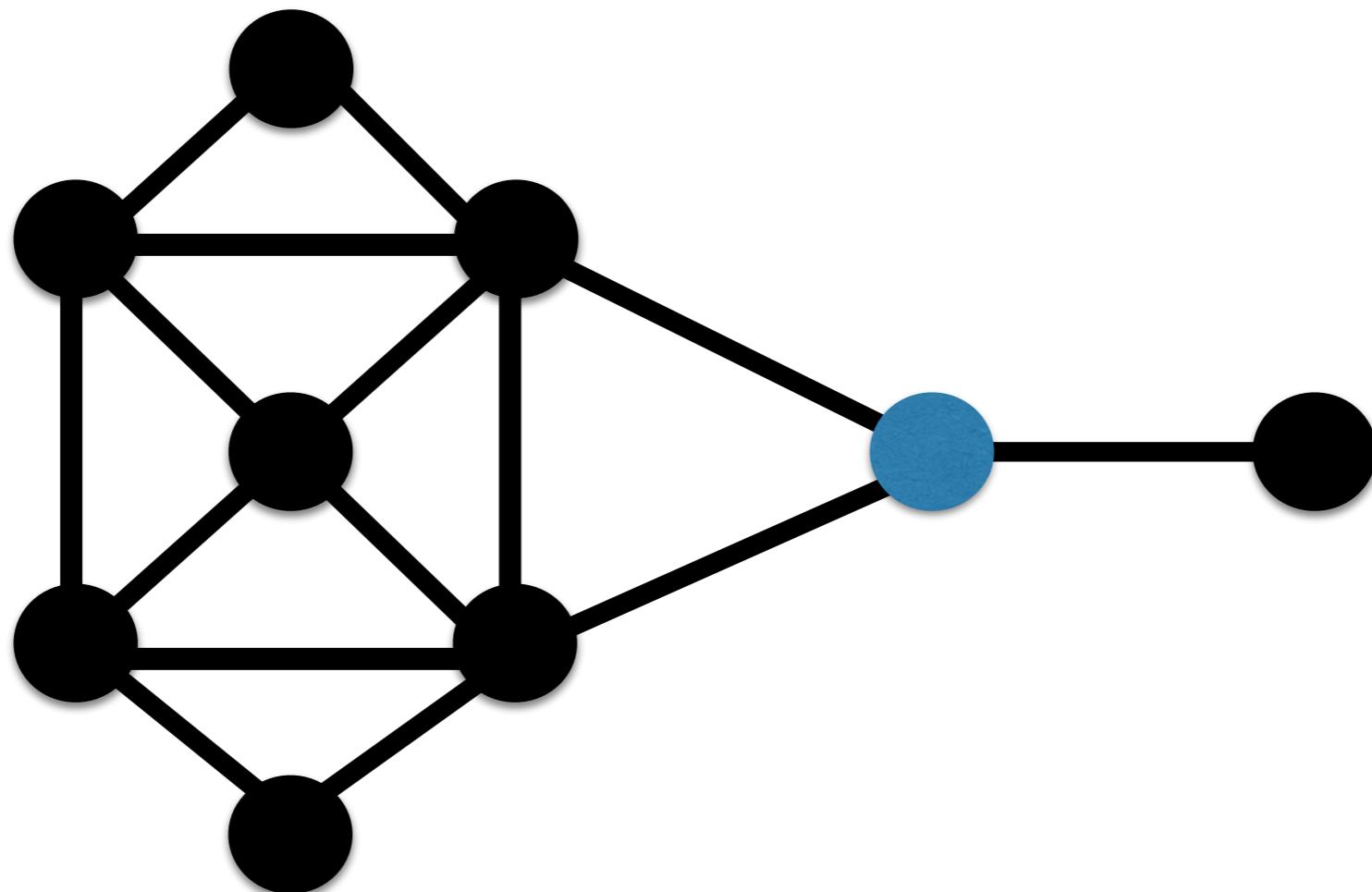
3 actual  
3 possible  
Density = 1



2 actual  
3 possible  
Density = 0.67

# Betweenness Centrality

The extent to which a node lies between other nodes



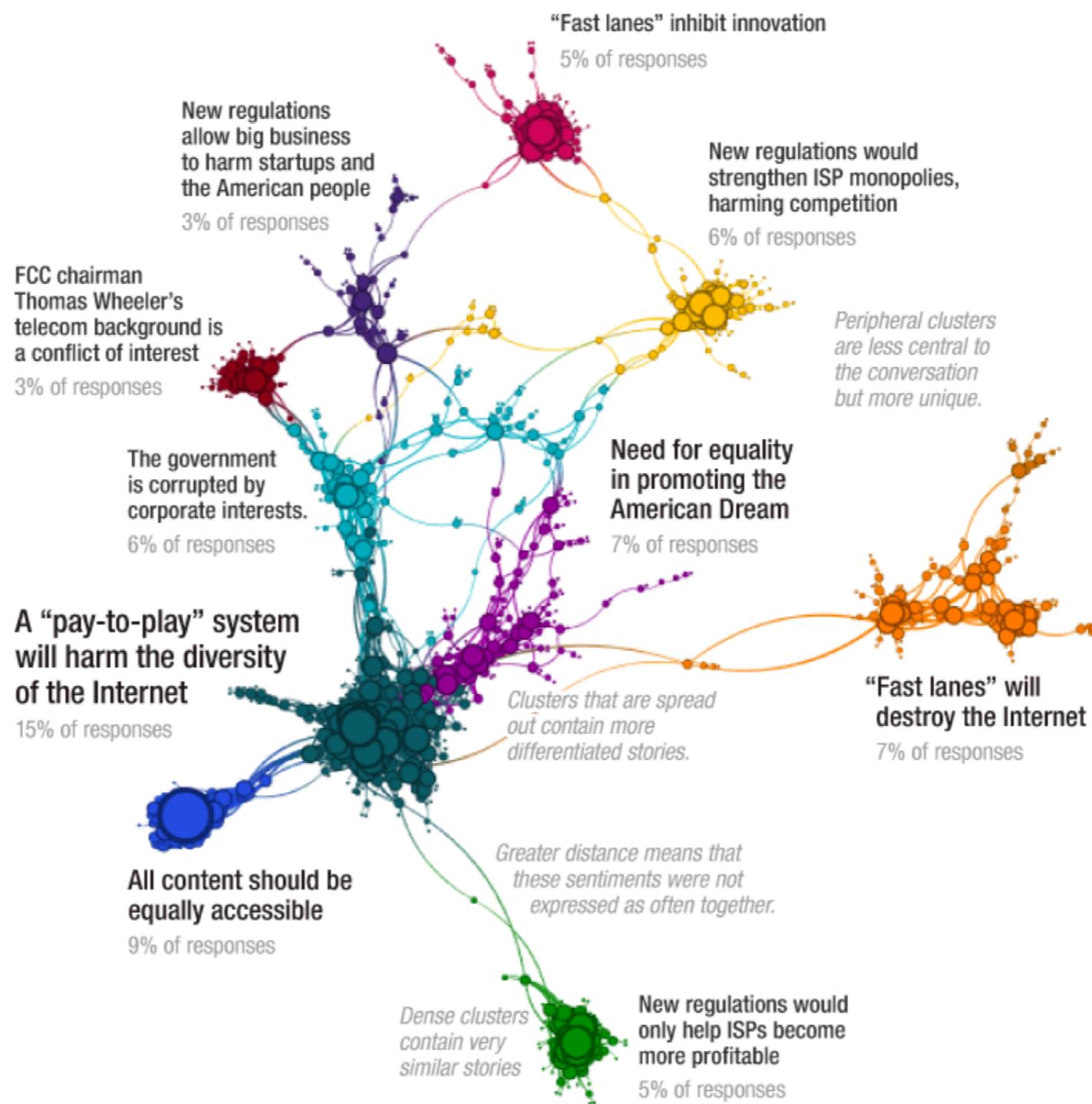
It is equal to the number of shortest paths from all nodes to all others that pass through that node

# Modularity

The fraction of the edges that fall within the given groups minus the expected such fraction if edges were distributed at random

$$\begin{aligned} Q_S &= \frac{1}{2\bar{w}} \sum_i \sum_j \left( \bar{w}_{ij} - \frac{\bar{w}_i \bar{w}_j}{2\bar{w}} \right) \delta(C_i, C_j) \\ &= \frac{1}{4w} \sum_i \sum_j \left( w_{ij} + w_{ji} - \frac{(w_i^{\text{out}} + w_i^{\text{in}})(w_j^{\text{out}} + w_j^{\text{in}})}{4w} \right) \delta(C_i, C_j) \\ &= \frac{1}{4w} \sum_i \sum_j \left[ \left( w_{ij} - \frac{w_i^{\text{out}} w_j^{\text{in}}}{2w} \right) + \left( w_{ji} - \frac{w_i^{\text{in}} w_j^{\text{out}}}{2w} \right) \right] \delta(C_i, C_j) \\ &= -\frac{1}{(4w)^2} \sum_i \sum_j (w_i^{\text{out}} - w_i^{\text{in}})(w_j^{\text{out}} - w_j^{\text{in}}) \delta(C_i, C_j) \\ &= Q_D - \frac{1}{(4w)^2} \sum_i \sum_j (w_i^{\text{out}} - w_i^{\text{in}})(w_j^{\text{out}} - w_j^{\text{in}}) \delta(C_i, C_j). \end{aligned}$$

# How do we make the network look nice?



# How do we make the network look nice?

Force directed graphing

- Attractive forces

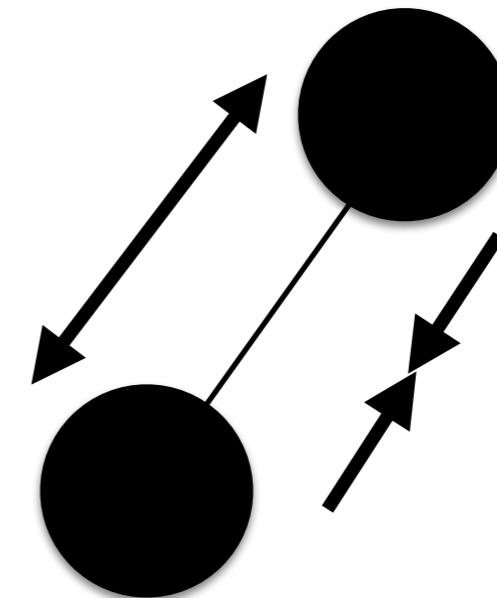
Springs

Hooke's Law:  $F = kX$

- Repulsive forces

Electrons

Coulomb's Law:  $|\mathbf{F}| = k_e \frac{|q_1 q_2|}{r^2}$



<https://youtu.be/YGDvR6CRwEc>

**<http://bit.ly/2gMIRKD>**