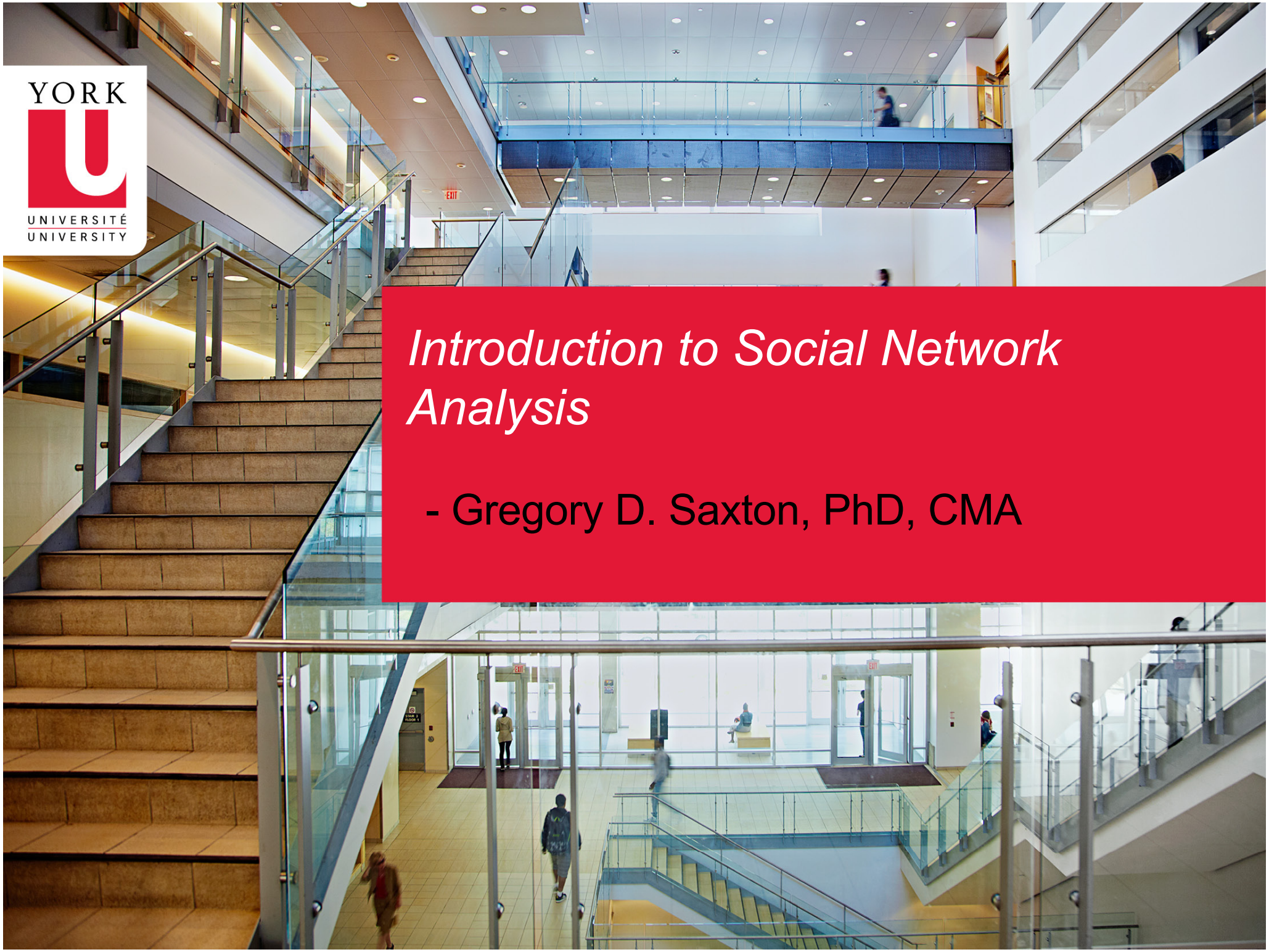
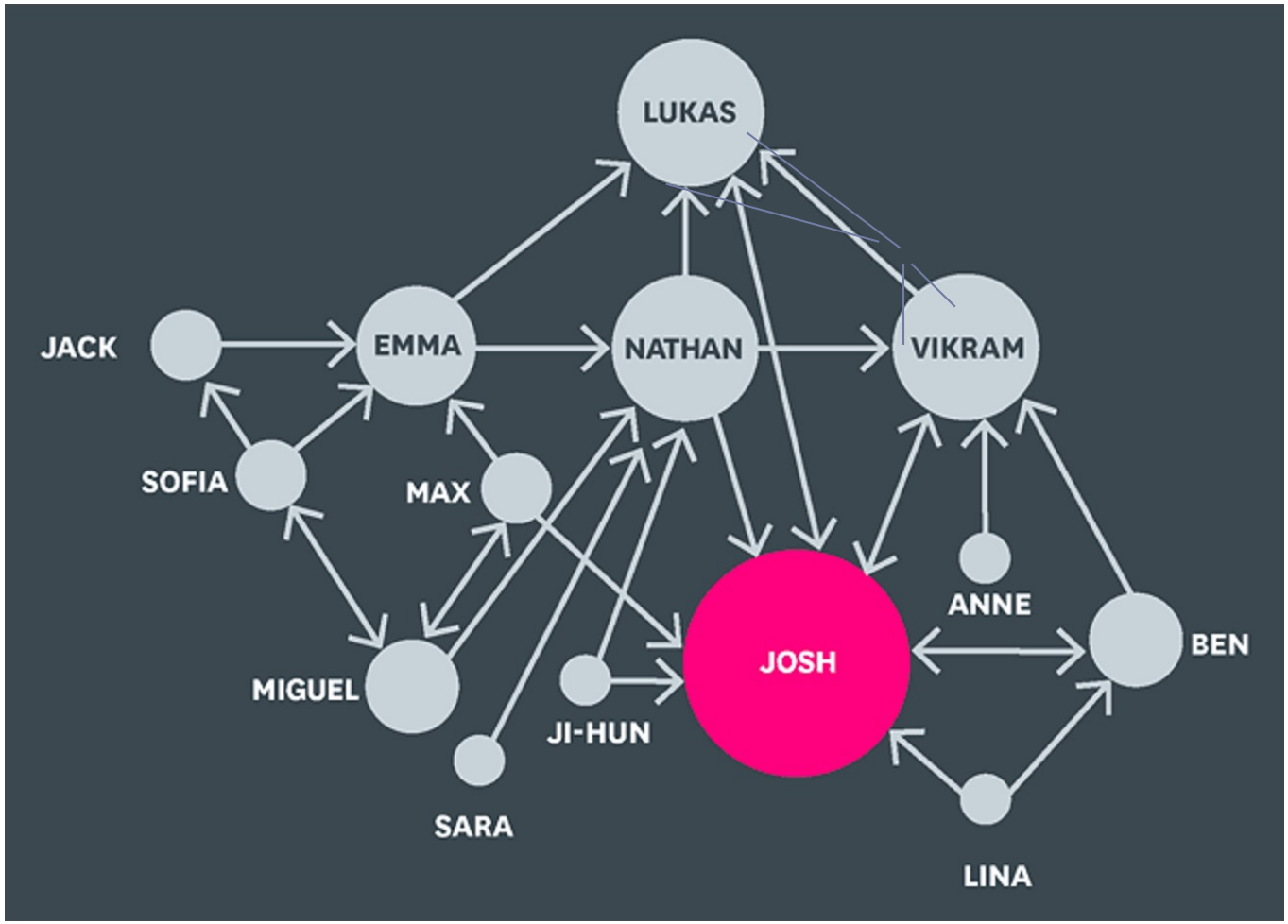


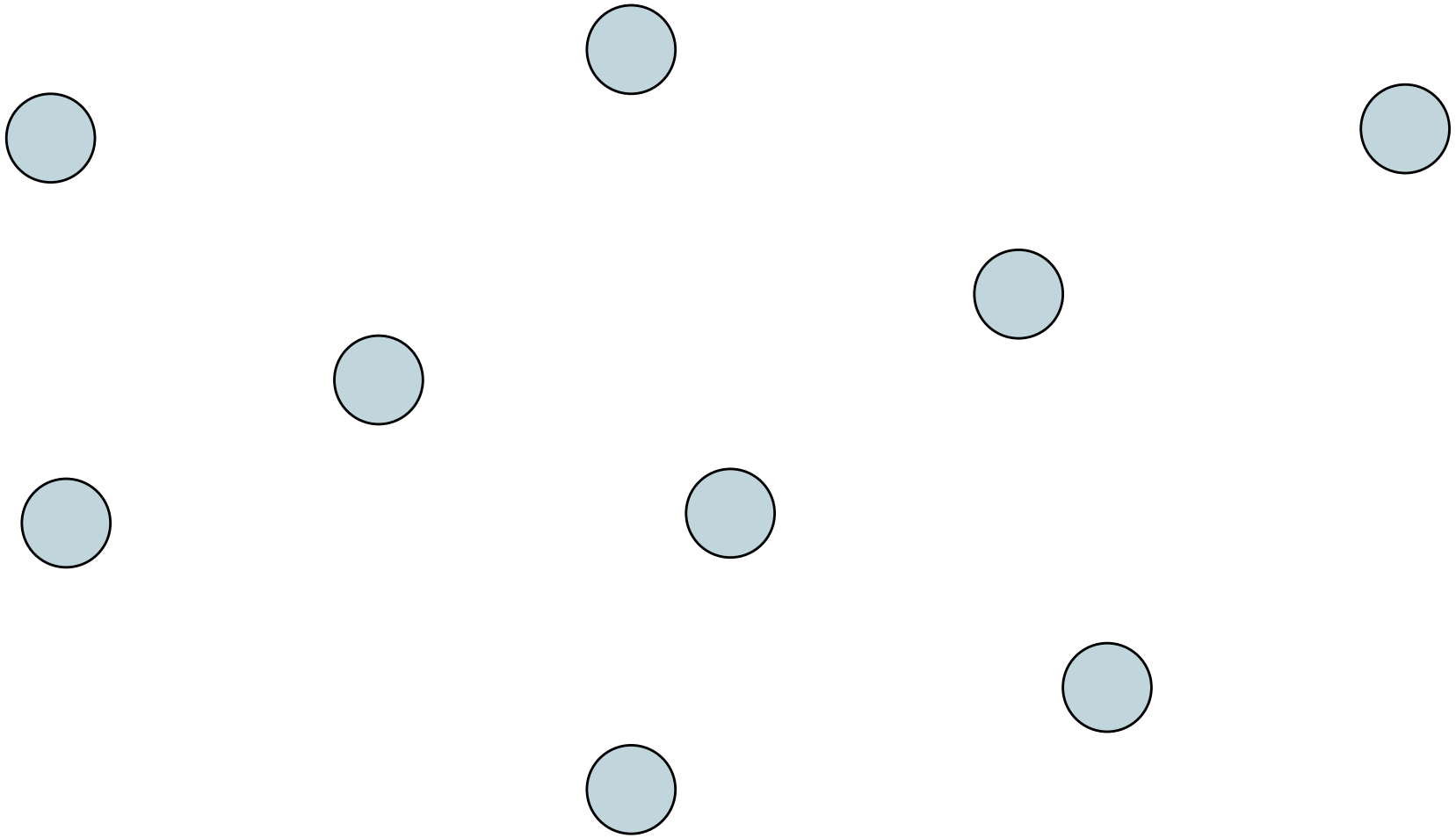
Introduction to Social Network Analysis

- Gregory D. Saxton, PhD, CMA

A Social Network

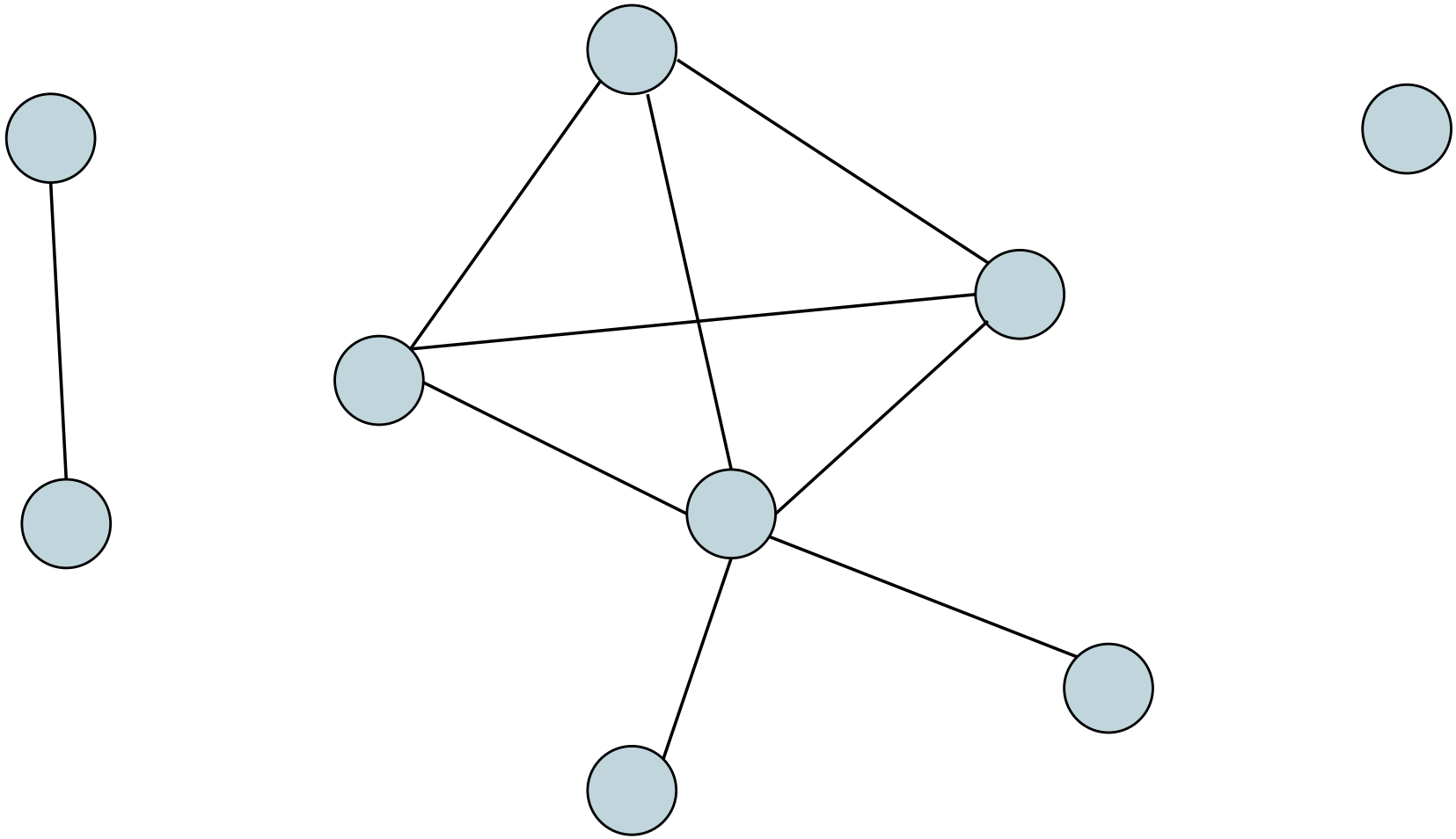


Network Terminology: Nodes



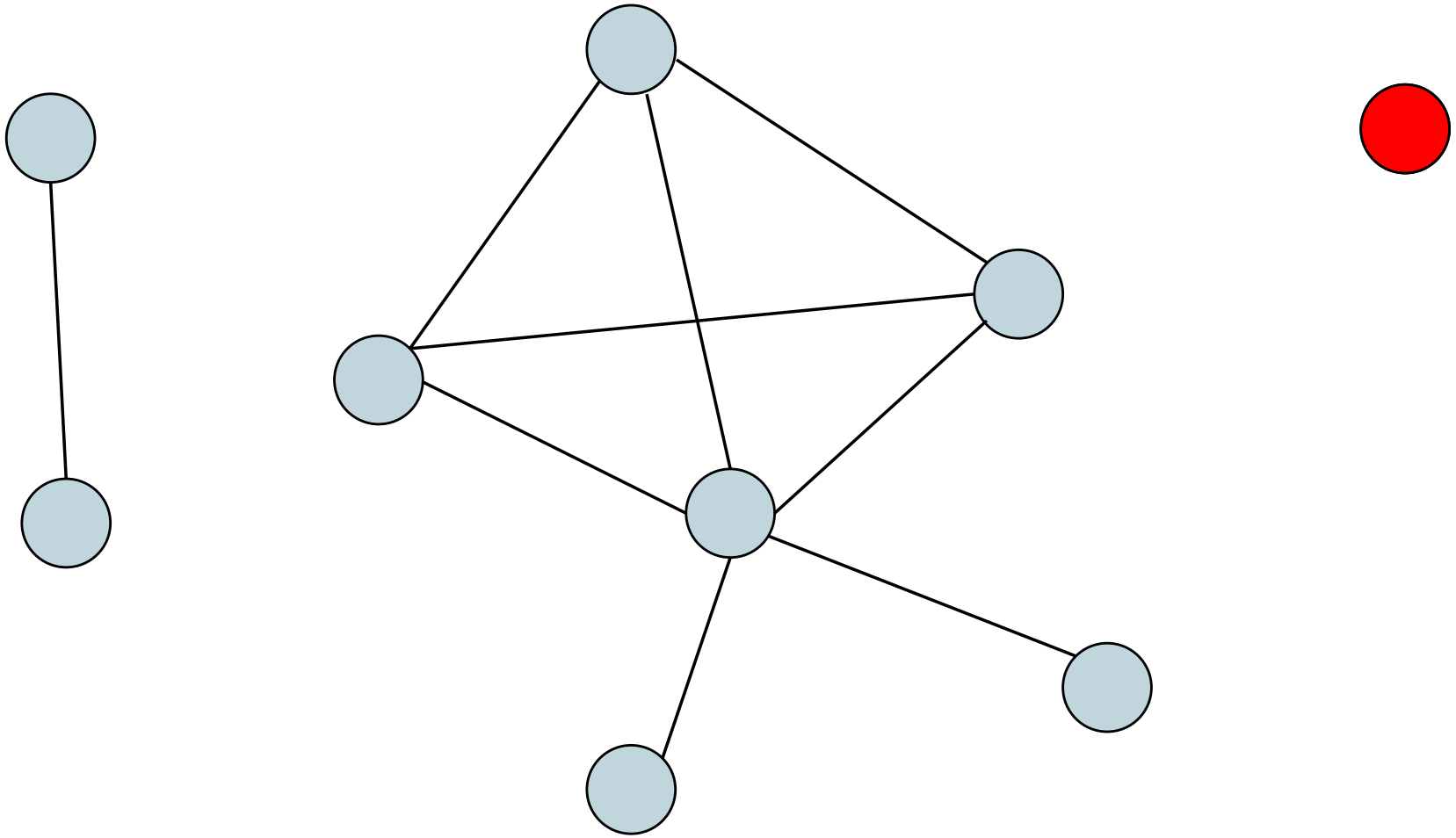
Aka “vertex” (plural vertices) – the actors in your network (people, things, etc.)

Network Terminology: Edges



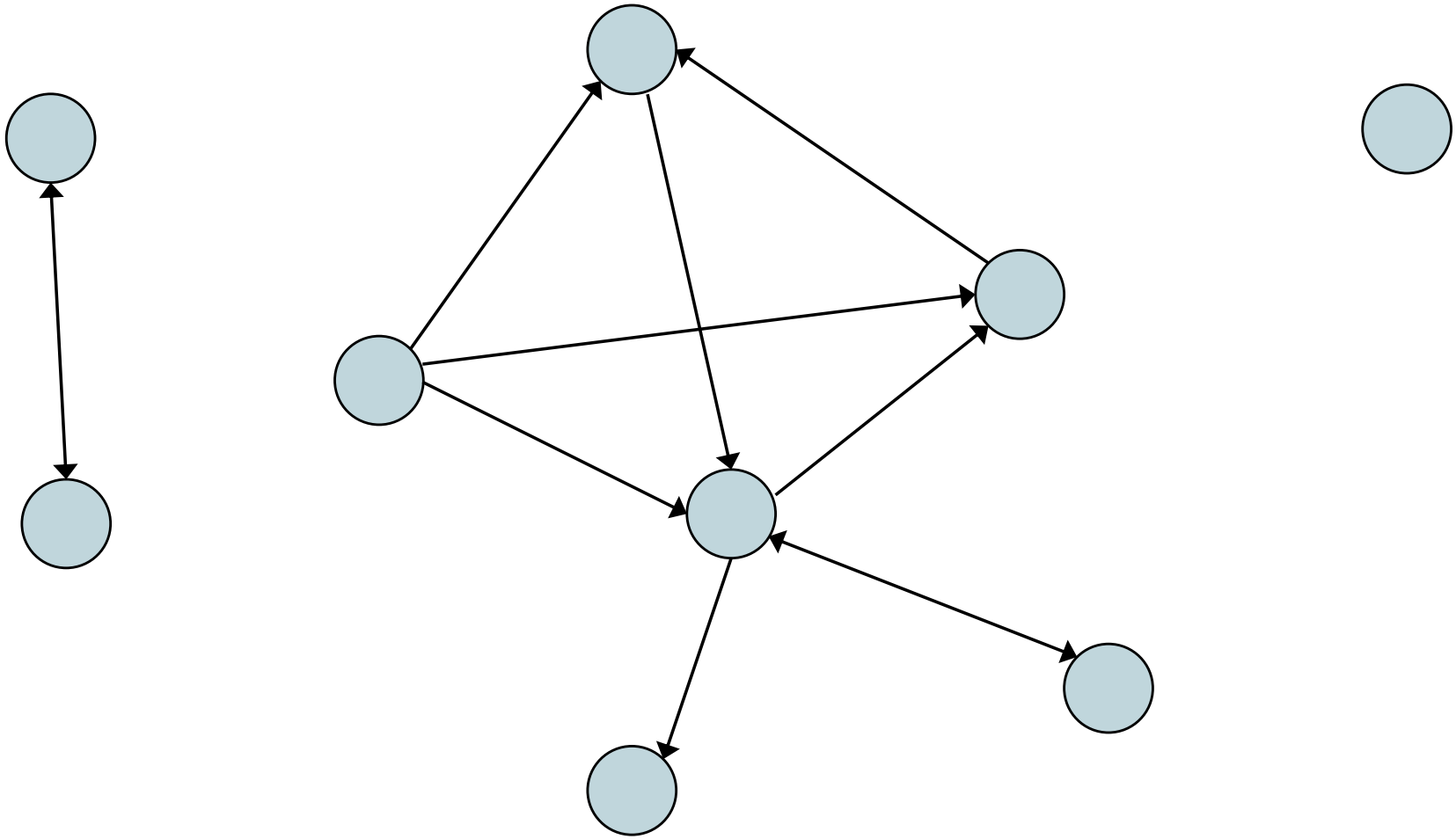
An edge is a connection between the nodes (e.g., gossip, loans, COVID-19)

Network Terminology: Isolates

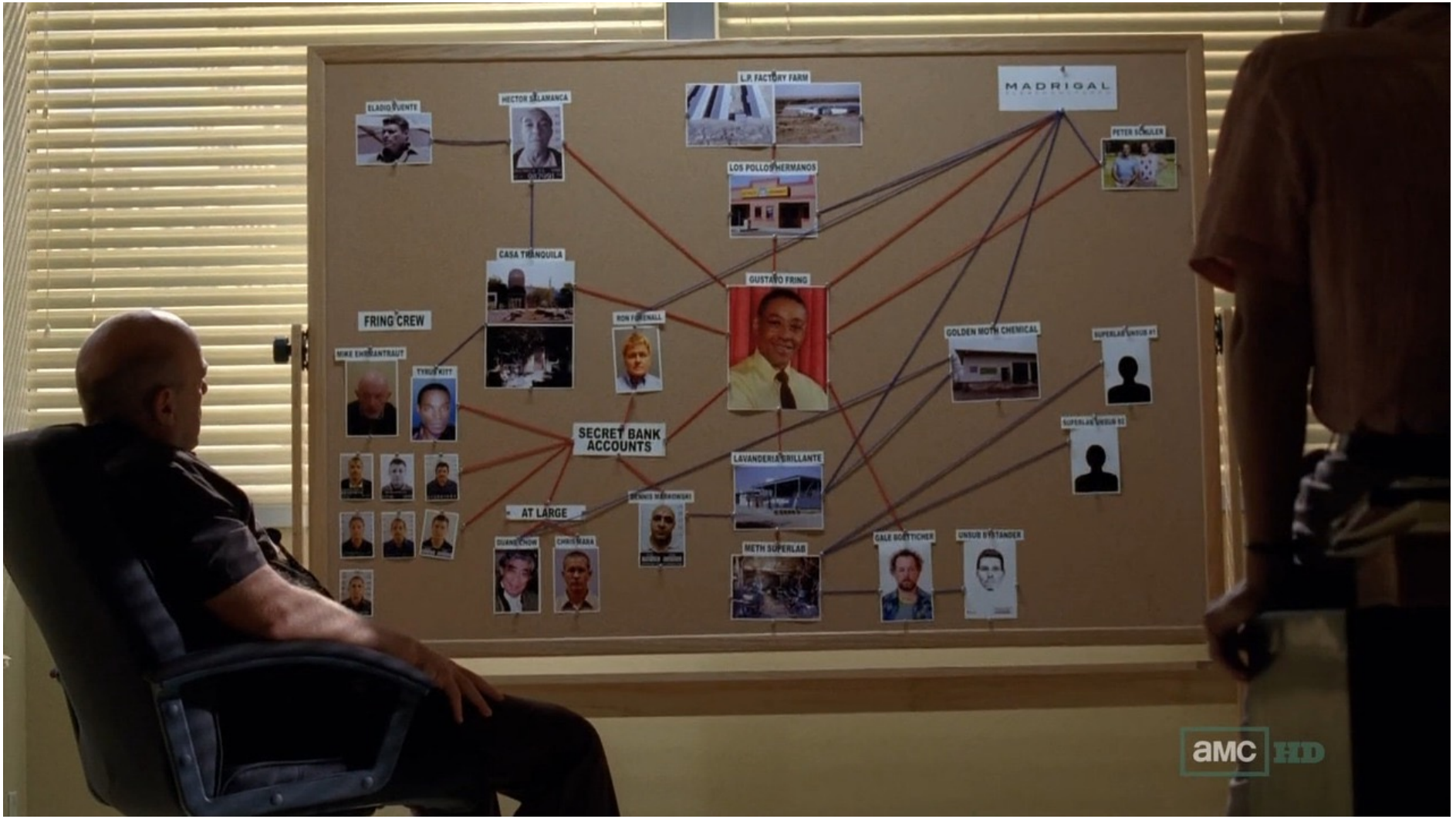


An isolate is a node not connected to any other nodes

Network Terminology: Directed Network



A directed network is one in which the direction of the connection matters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HECTOR SALAMANCA
L.P. FACTORY FARM
MADRIGAL
PETER SCHULER
LOS POLLOS HERMANOS
CASA TRANQUILA
GUSTAVO FRING
FRING CREW
RON FORTENALL
GOLDEN MOTH CHEMICAL
SUPERLAB UNSUB #1
MIKE EHRMANTRAUT
TYRUS KITT
SECRET BANK ACCOUNTS
LAVANDERIA BRILLANTE
SUPERLAB UNSUB #2
AT LARGE
DENNIS MARKOWSKI
DUANE DUNN
CHRIS MARA
METH SUPERLAB
GALE BOETTICHER
UNSUB BYSTANDER
amc HD

Blockchain: The Open Electronic Ledger

A World of Networks

- Many new phenomena "make more sense when viewed through the lens of network structures."
- Carbon analogy: graphite or diamond?
- Networks *matter* – they have structures that influence behavior and outcomes
- "Network analysts see the world as a collection of interconnected pieces."

“Can’t See The Forest for the Trees”?

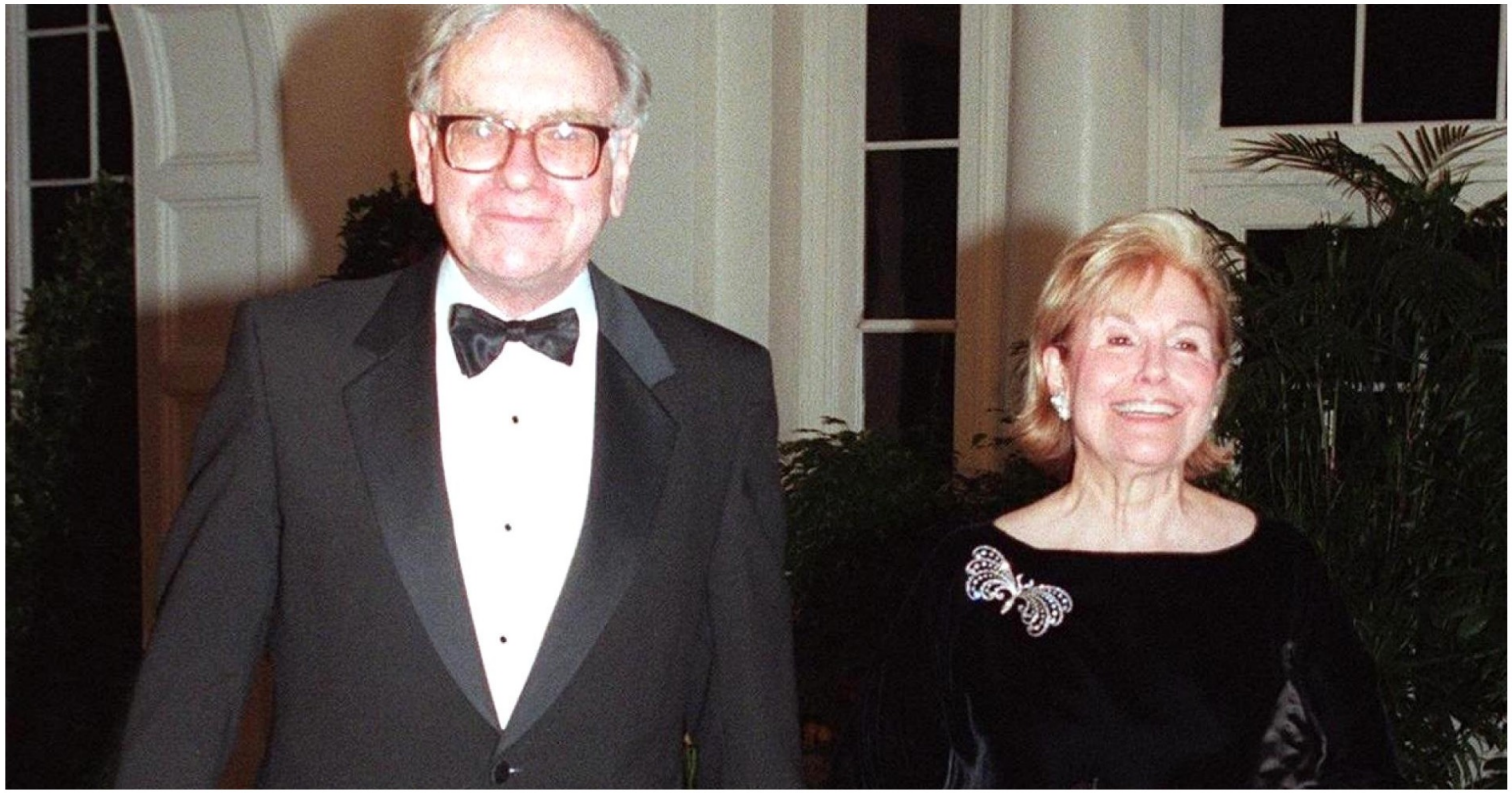
A network perspective can help – and can help you identify the most important “trees”

The problem? It’s not intuitive

CAREERS

Warren Buffett and Sheryl Sandberg agree on the most important decision you will ever make

Kathleen Elkins | @kathleen_elk | 11:12 AM ET Tue, 7 Feb 2017

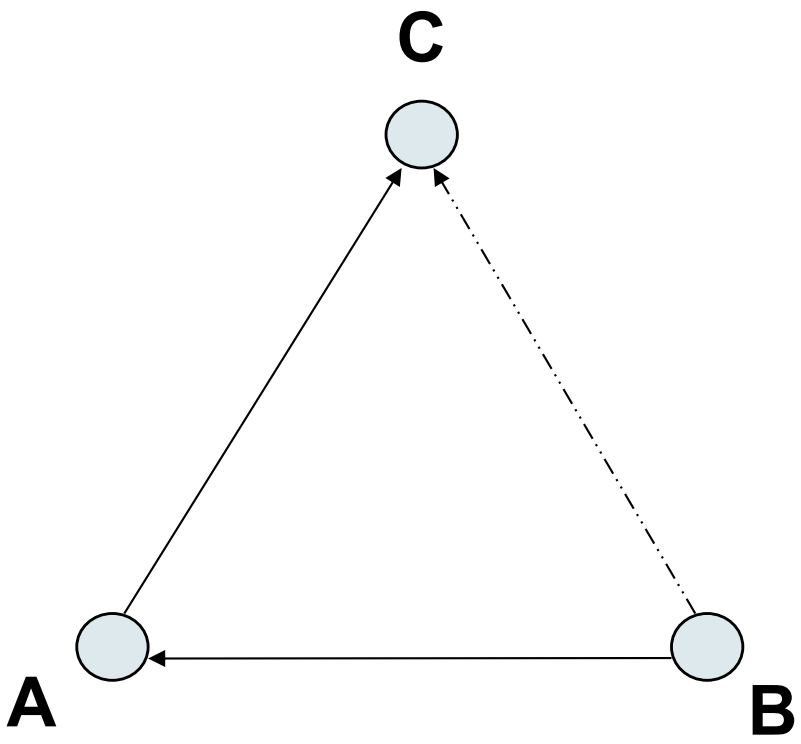


Chris Kleponis | Getty Images

Warren Buffett (L), chairman and CEO of Berkshire Hathaway, arrives with his wife Susan at the White House for a state dinner.

"You are the average of the five people you spend the most time with"
- Jim Rohn

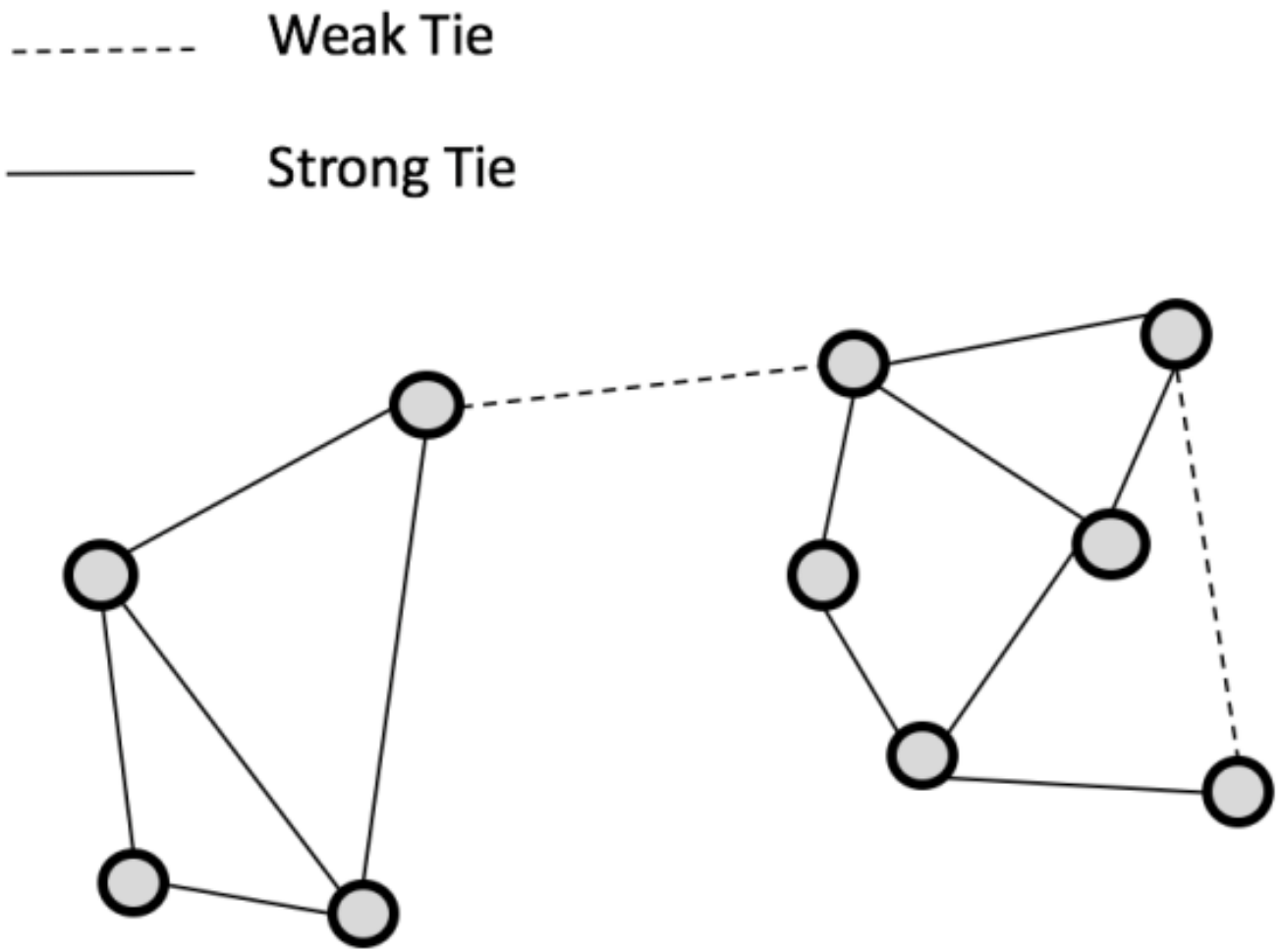
Transitivity



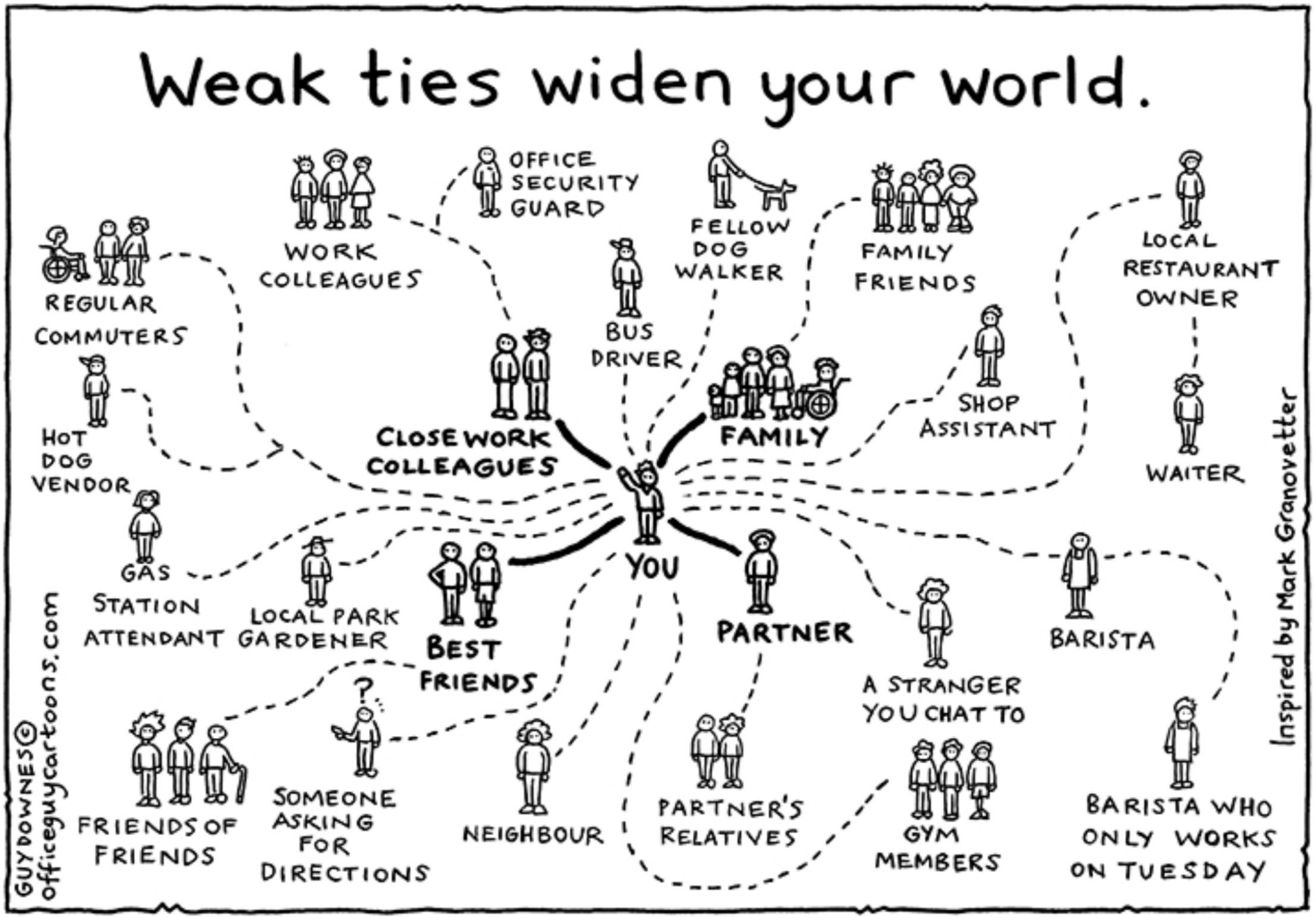
Homophily

"Birds of a feather flock together"

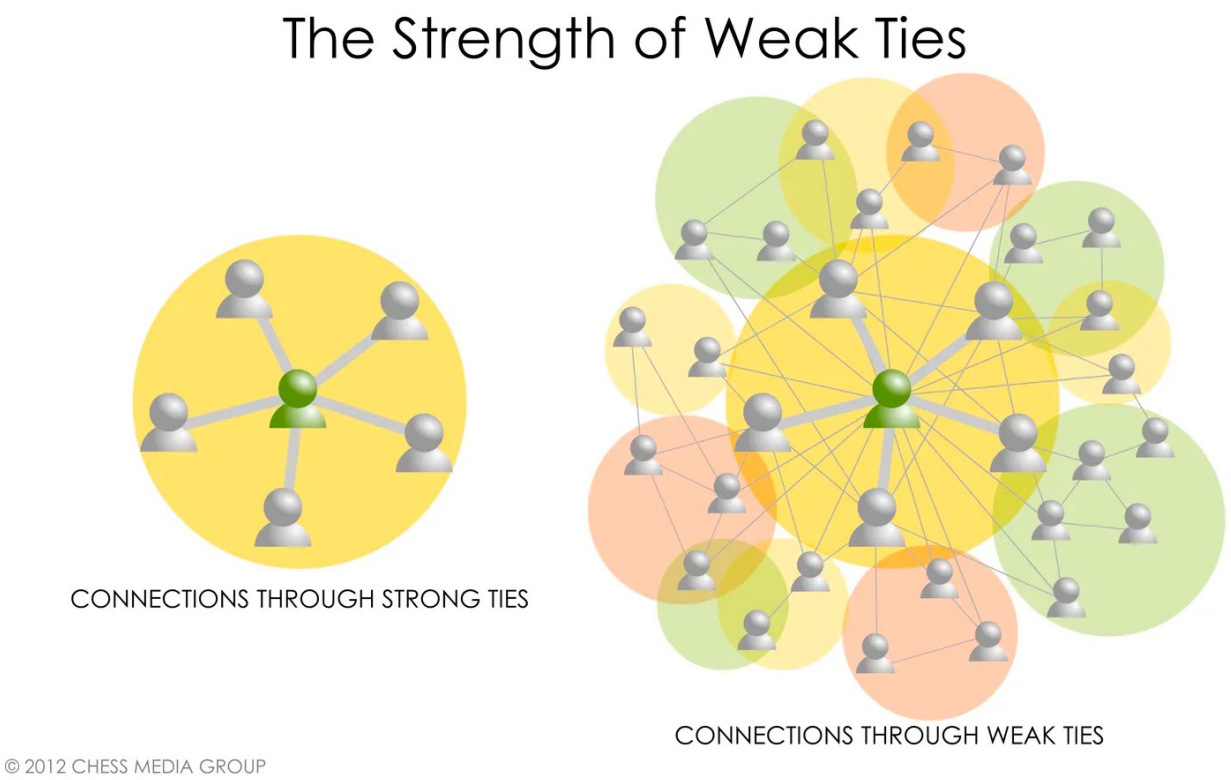
Granovetter: The Strength of Weak Ties



Granovetter: The Strength of Weak Ties



Granovetter: The Strength of Weak Ties



FORBES > LEADERSHIP

Why Every Employee Should Be Building Weak Ties At Work

Jacob Morgan Contributor ⓘ

I write about and explore the future of work!

MITSloan
Management Review

SUMMER 2015

How Twitter Users Can Generate Better Ideas

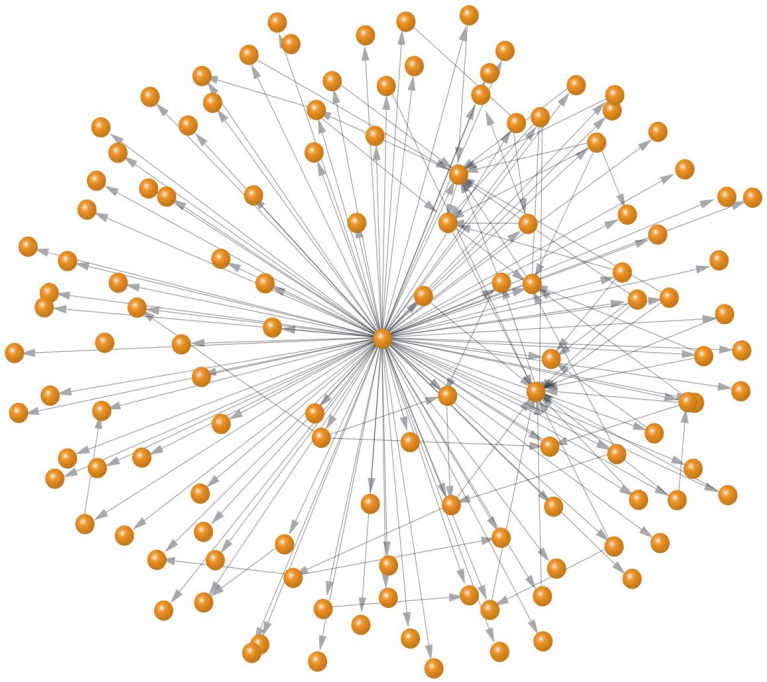
Salvatore Parise
Eoin Whelan
Steve Todd

New research suggests that employees with a diverse Twitter network — one that exposes them to people and ideas they don't already know — tend to generate better ideas.

COMPARING TWO TWITTER NETWORKS

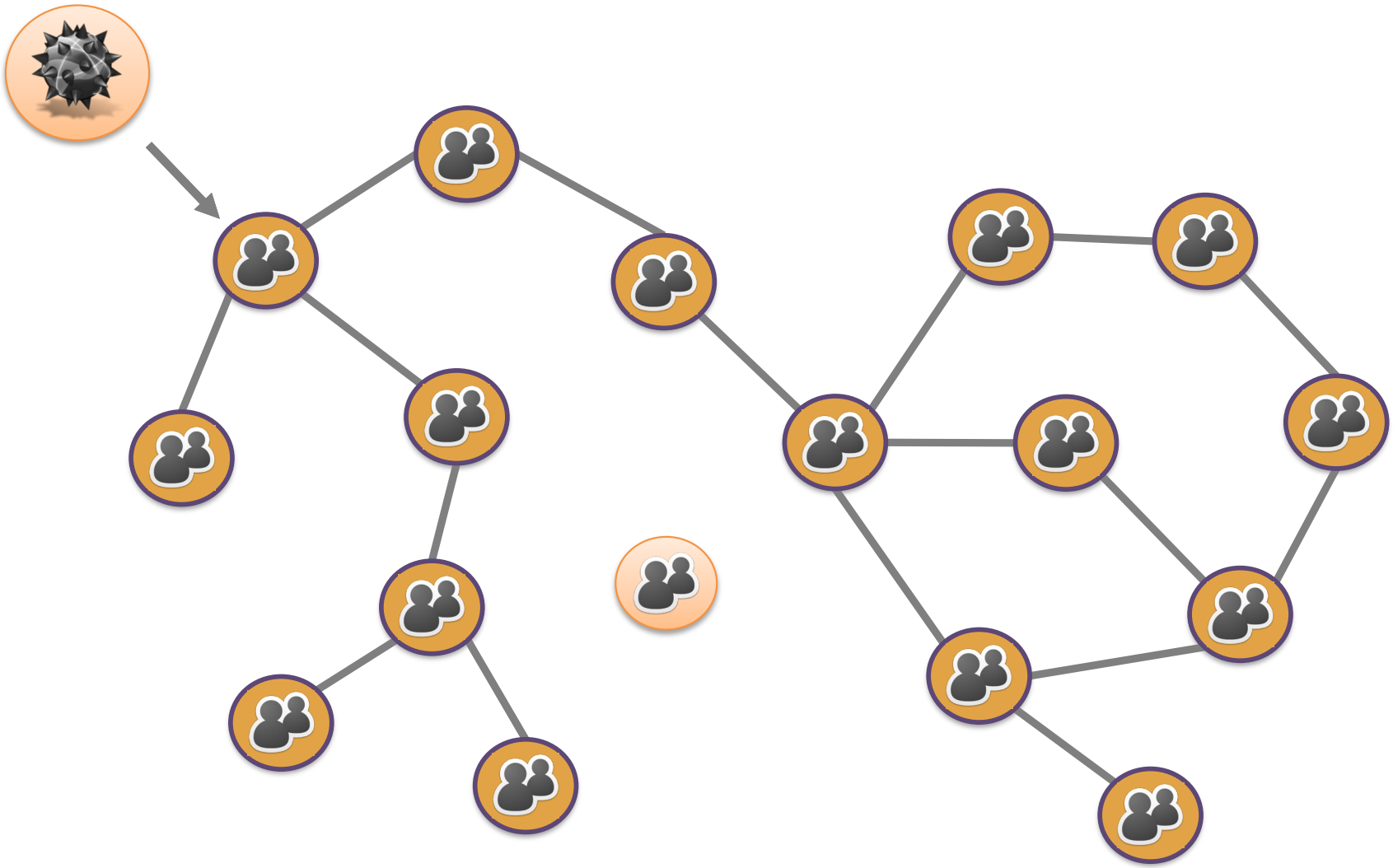
Although employees A and B follow approximately the same number of Twitter accounts, A's network is far more diverse than B's. For the most part, the people employee A follows are not following each other, which is more conducive to innovation and better idea generation. Compact Twitter networks like employee B's provide redundant information and are less conducive to ideation.

Employee A's Twitter Network

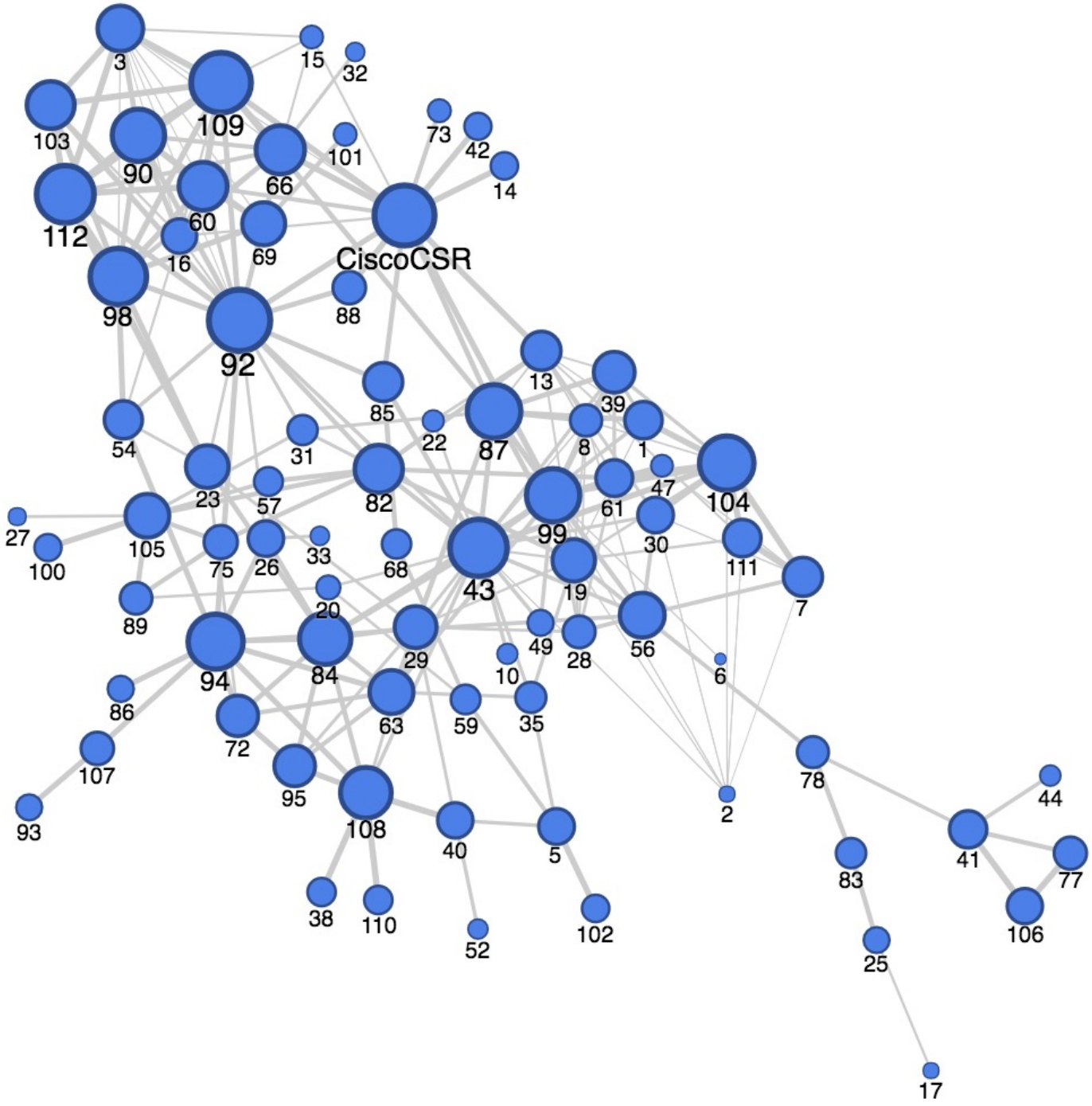


Employee B's Twitter Network

Diffusion and contagion in networks



Air Conditioners in Philadelphia Row Houses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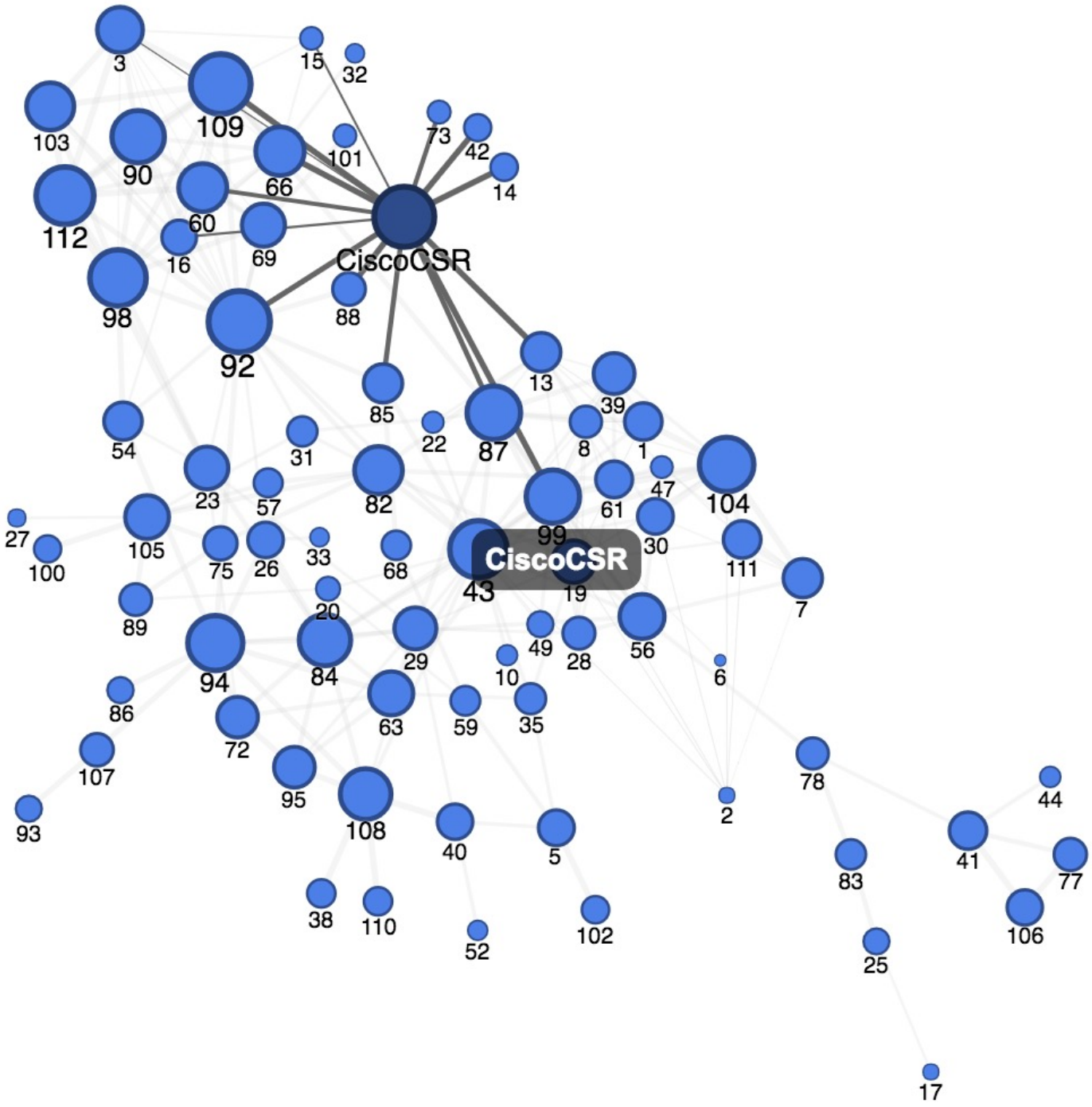
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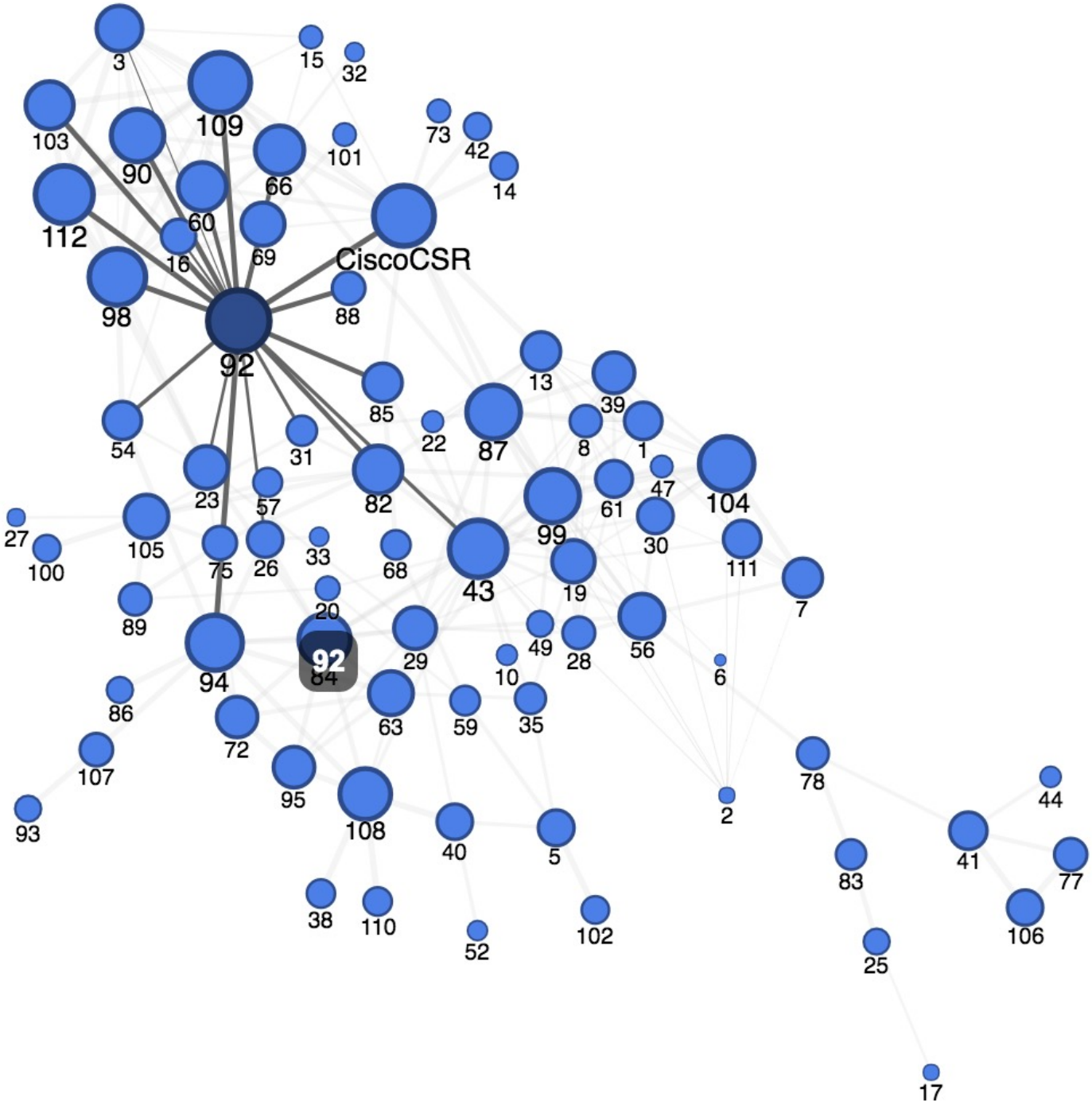

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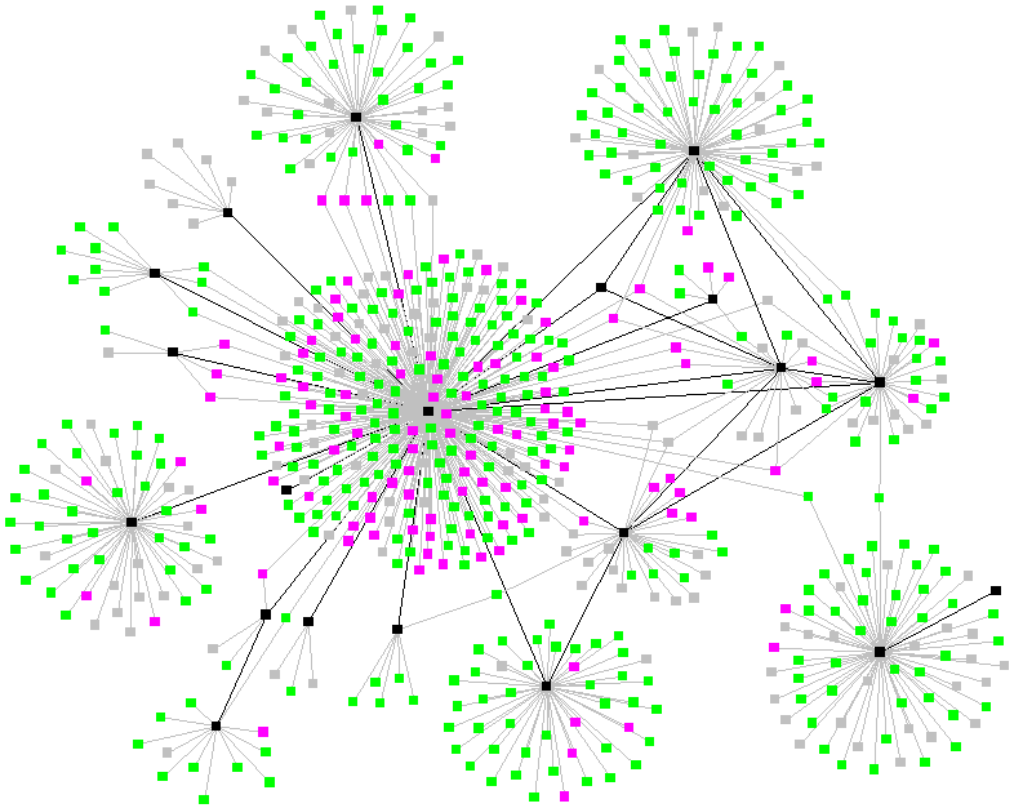
Spread of TB



Black nodes are persons with clinical disease (and are potentially infectious), pink nodes represent exposed persons with incubating (or dormant) infection and are *not* infectious, green represent exposed persons with no infection and are *not* infectious. The infection status is unknown for the grey nodes. Unfortunately the 'social butterfly' in this community, the black node in the center of the graph, is also the most infectious -- a *super spreader*. http://www.orgnet.com/contagion.html

Chains of Affection: The Structure of Adolescent Romantic and Sexual Networks[1]

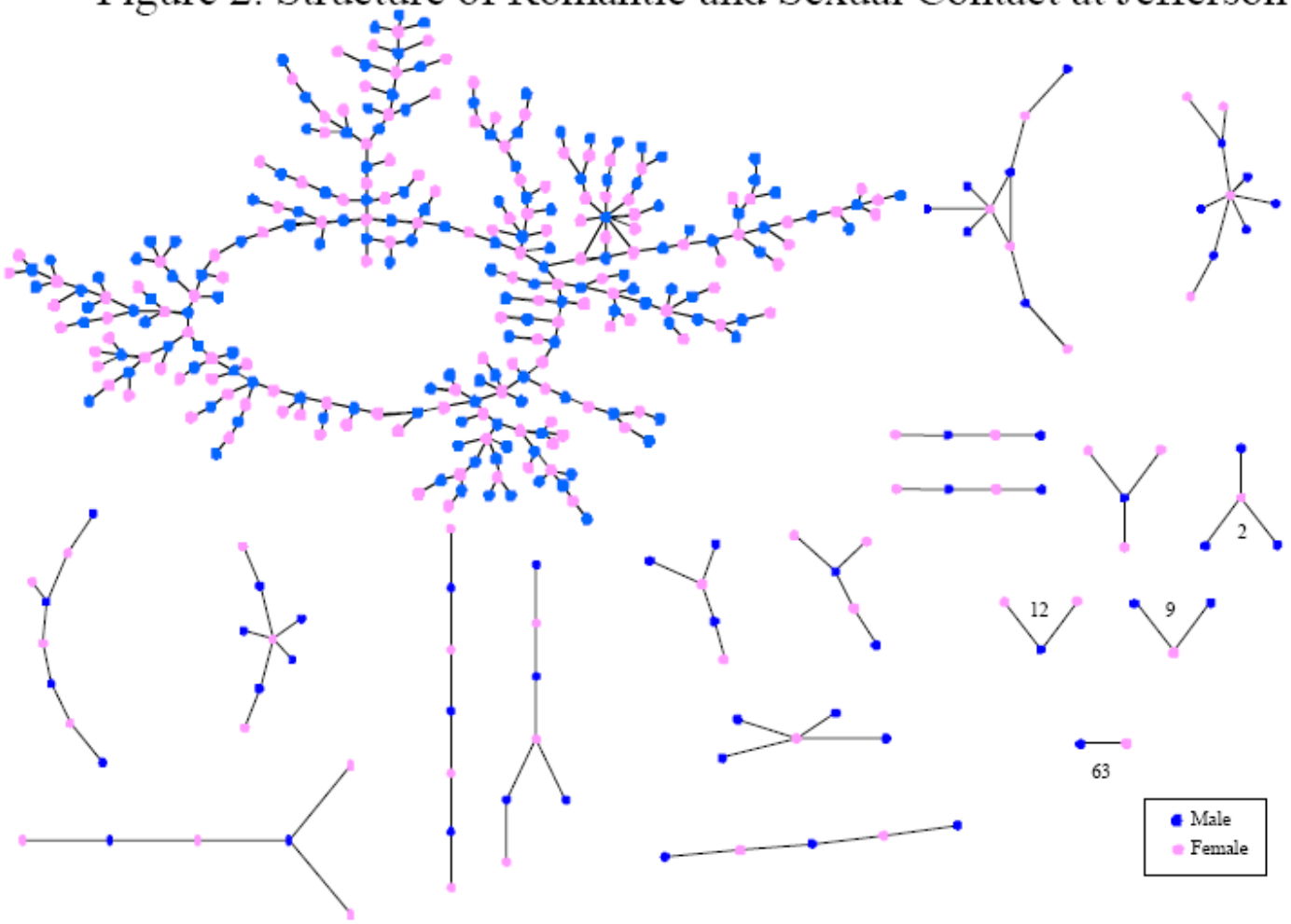
Peter S. Bearman
Columbia University

James Moody
Ohio State University

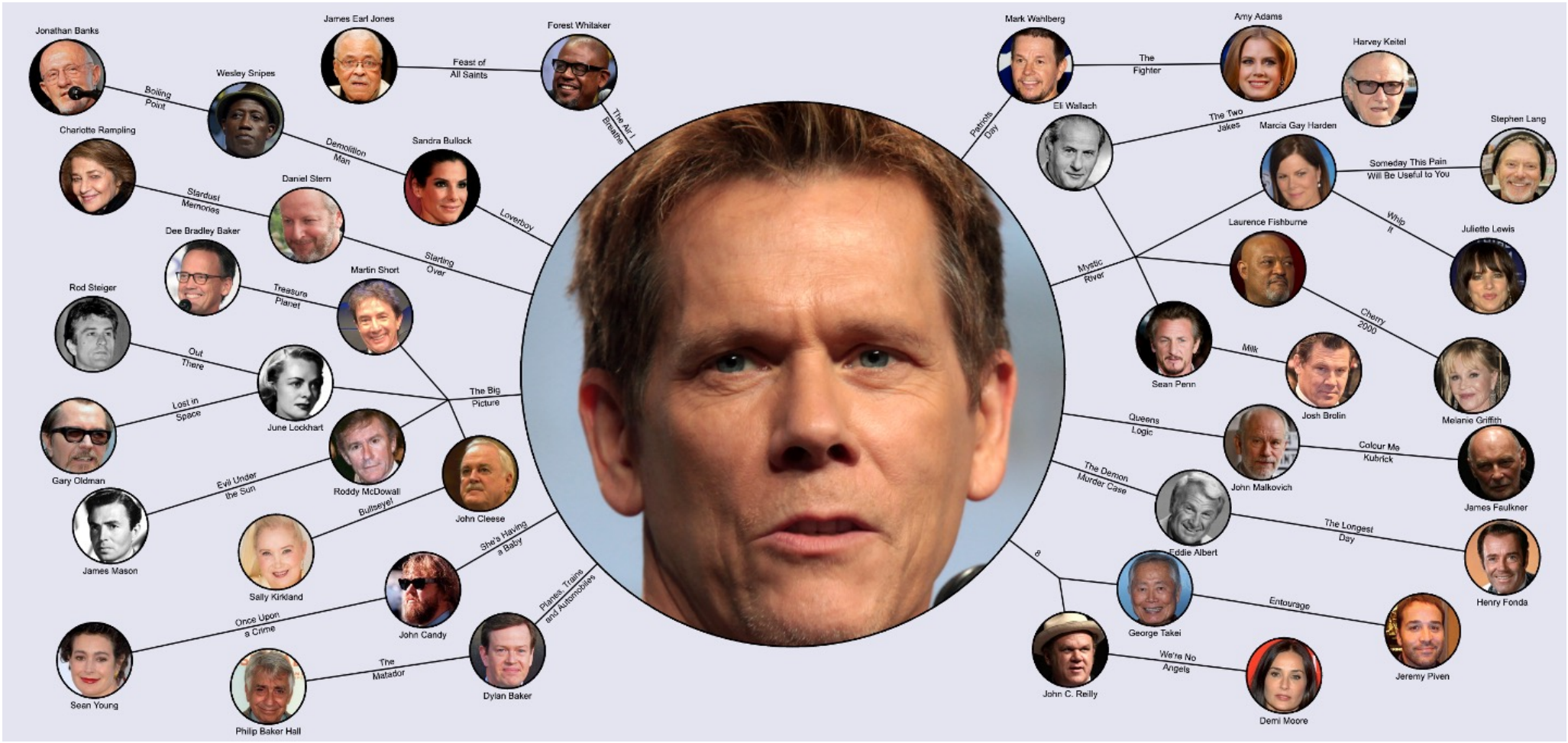
Katherine Stovel
University of Washington

This article describes the structure of the adolescent romantic and sexual network in a population of over 800 adolescents residing in a midsized town in the midwestern United States. Precise images and measures of network structure are derived from reports of relationships that occurred over a period of 18 months between 1993 and 1995. The study offers a comparison of the structural characteristics of the observed network to simulated networks conditioned on the distribution of ties; the observed structure reveals networks characterized by longer contact chains and fewer cycles than expected. This article identifies the micromechanisms that generate networks with structural features similar to the observed network. Implications for disease transmission dynamics and social policy are explored.

Figure 2. Structure of Romantic and Sexual Contact at Jefferson



Small World Phenomenon

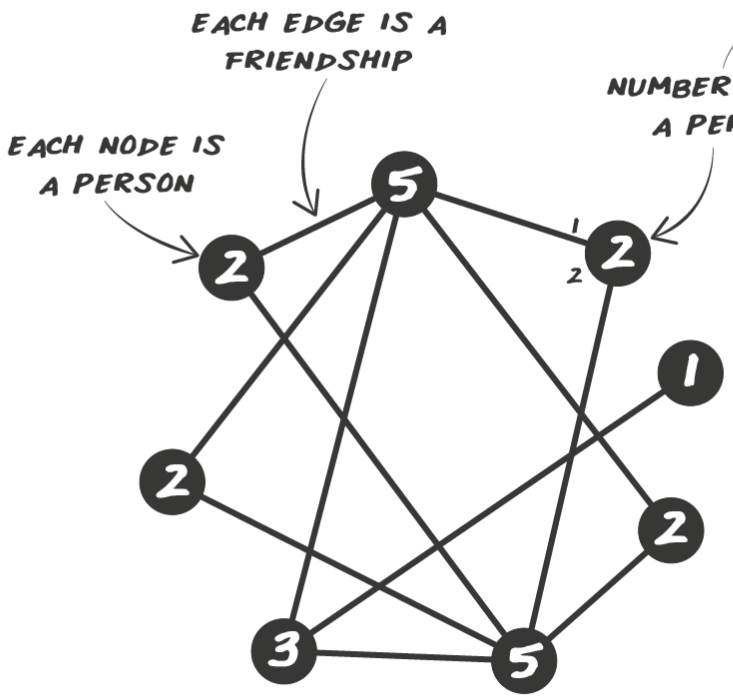


The Friendship Paradox

The Reliants Project.

FELD'S FRIENDSHIP PARADOX

"WHY YOUR FRIENDS HAVE MORE FRIENDS THAN YOU DO"



FRIENDS	FRIENDS OF FRIENDS
5	2+2+3+2+2=11
2	5+5=10
1	3=3
2	10
5	11
3	11
2	10
2	10
TOTAL: 22	TOTAL: 76

$$\frac{22 \text{ FRIENDS}}{8 \text{ PEOPLE}} = \frac{2.8}{\text{FRIENDS}}$$

$$\frac{76 \text{ FRIENDS OF FRIENDS}}{22 \text{ FRIENDS}} = \frac{3.5}{\text{FRIENDS}}$$

PEOPLE WITH MORE FRIENDS ARE ALWAYS MORE LIKELY TO BE PART OF A PERSON'S FRIEND GROUP...

...SO THE AVERAGE NUMBER OF FRIENDS EACH PERSON HAS IS ALWAYS LESS THAN THE AVERAGE FRIENDS THEIR FRIENDS HAVE.

The Friendship Paradox

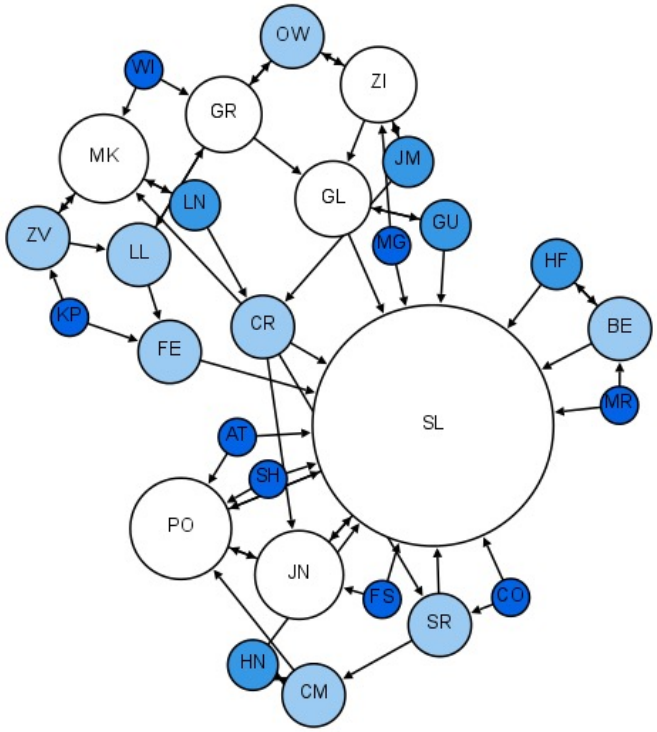
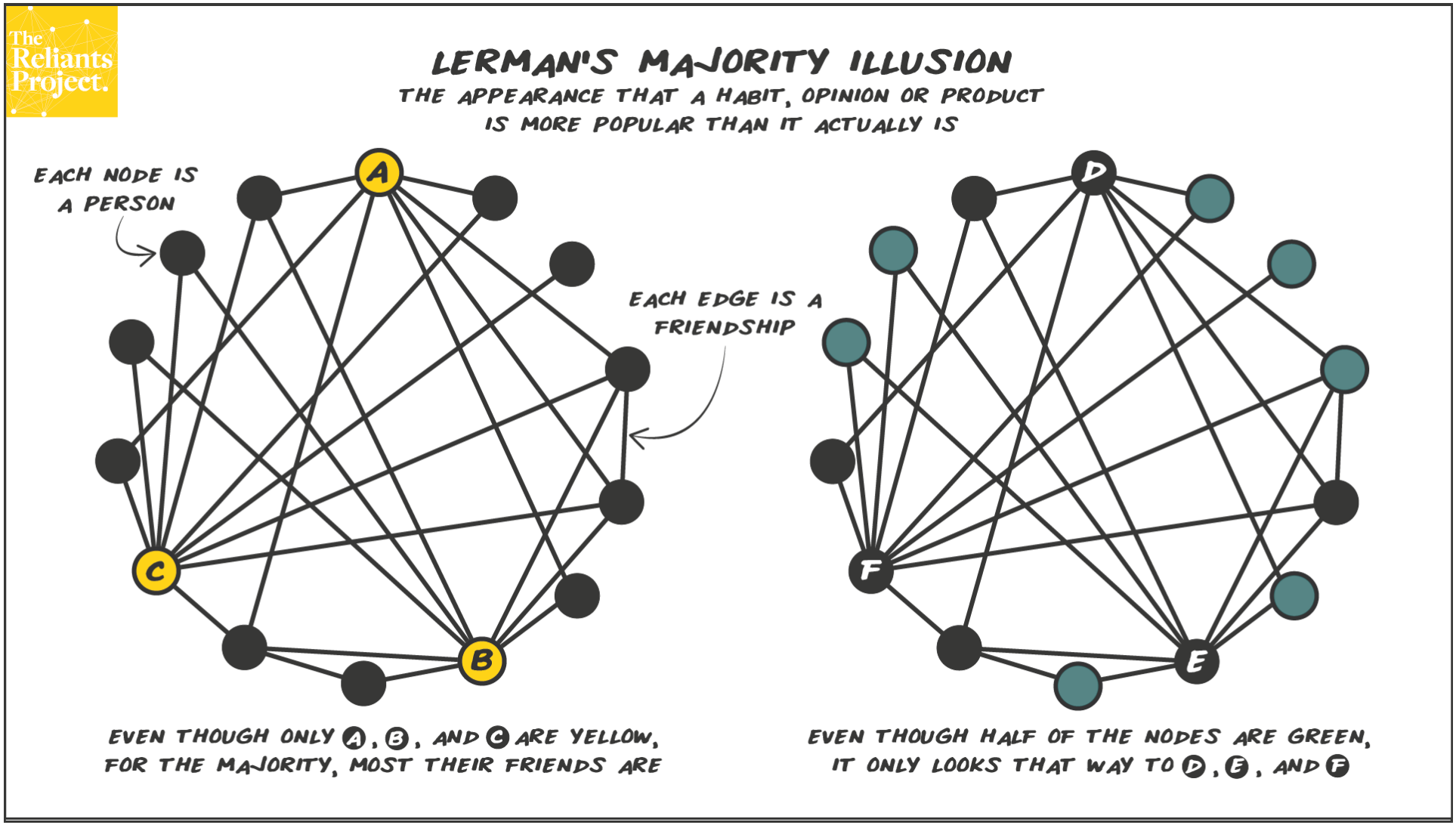


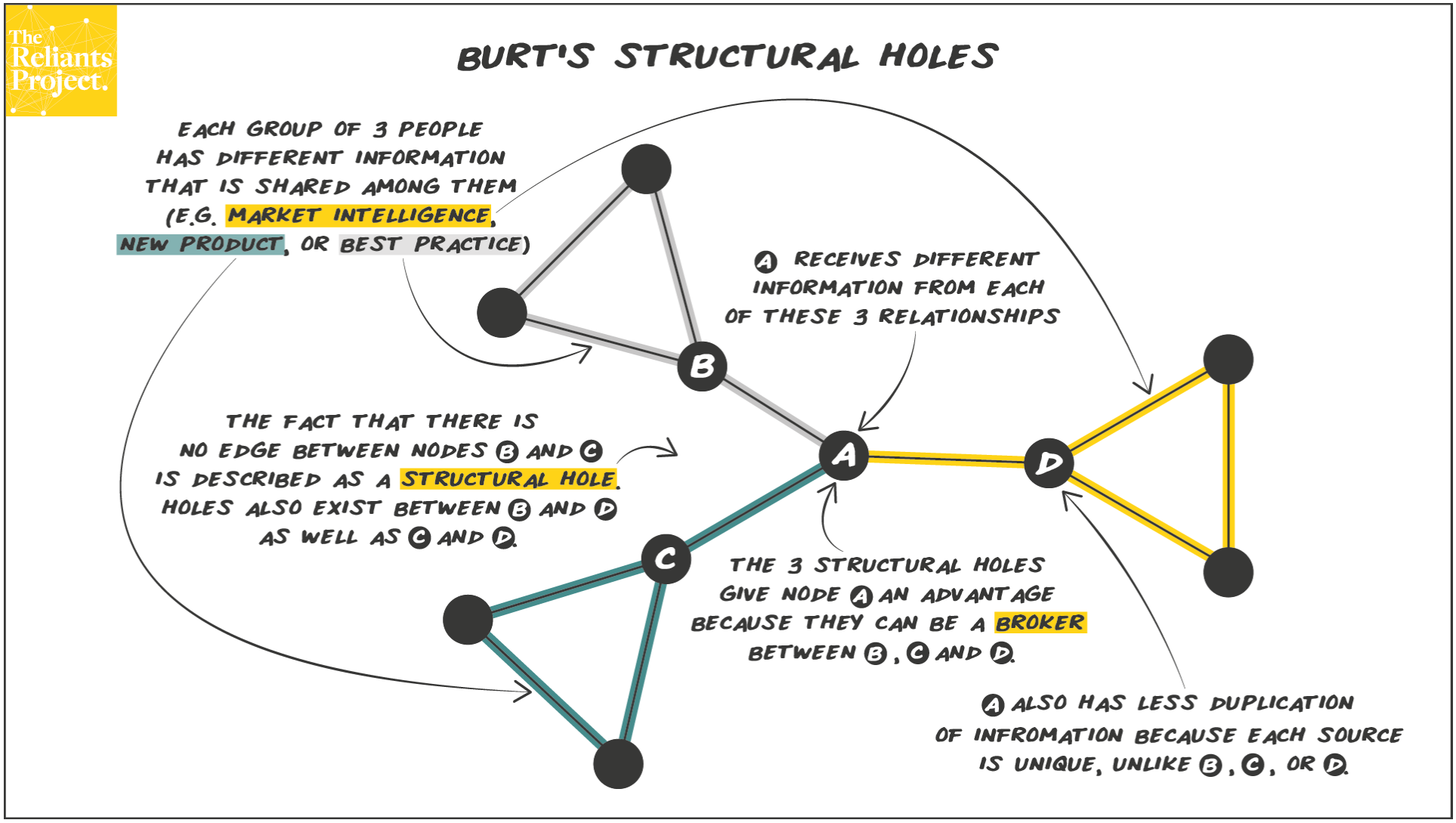
Diagram of a social network of 7-8-year-old children, mapped by asking each child to indicate two others they would like to sit next to in class. The majority of children have fewer connections than the average of those they are connected to.

- On average, an individual's friends have more friends than that individual

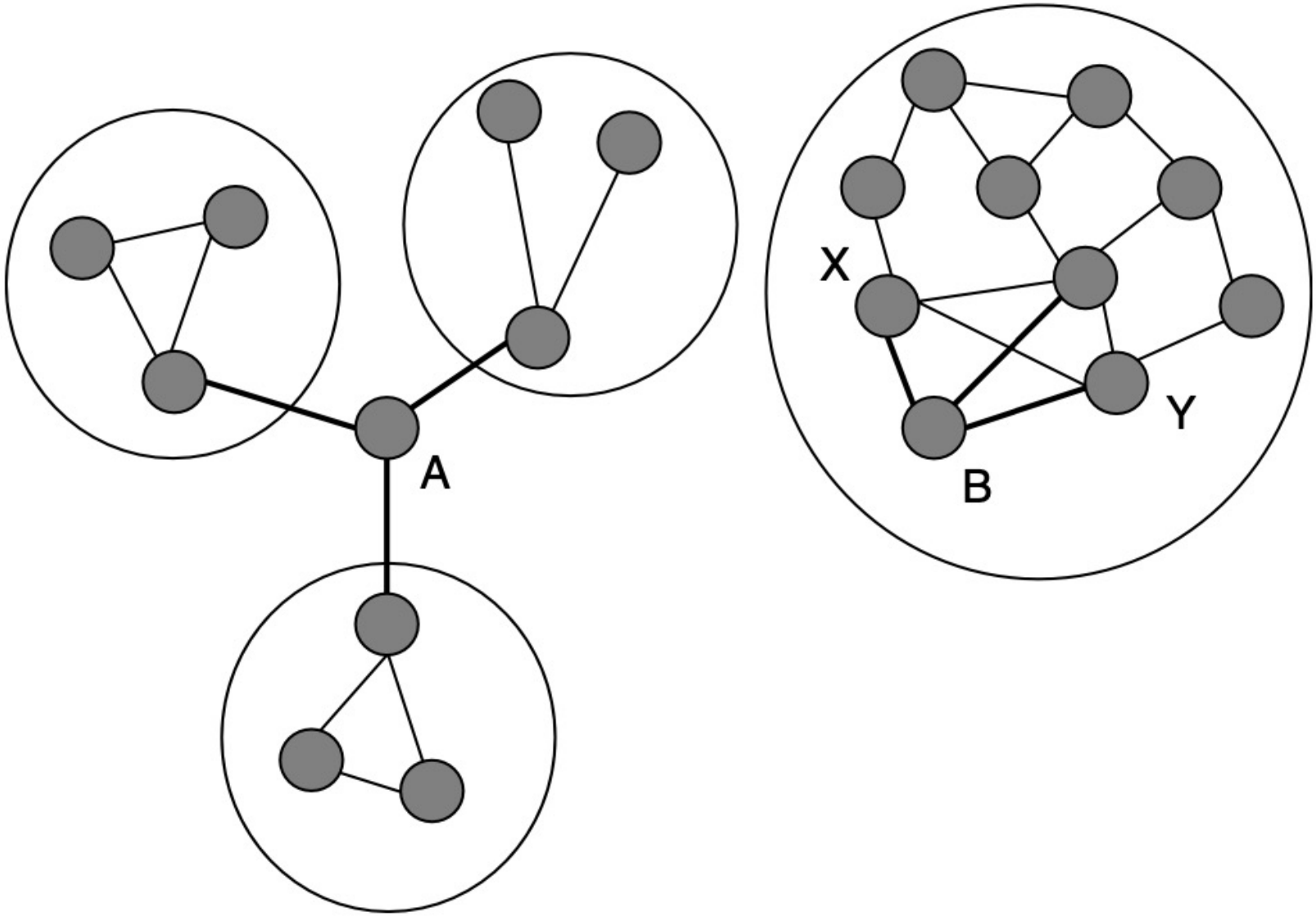
The Majority Illusion Paradox



Structural Holes

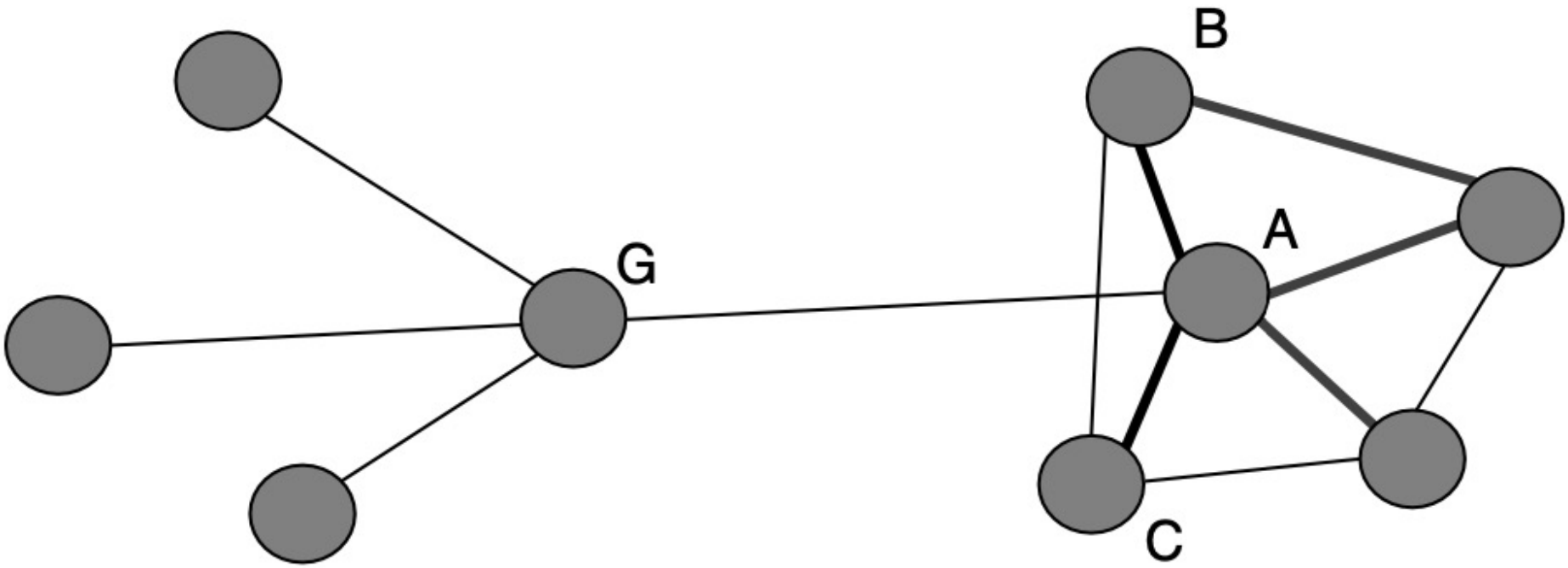


Node A's Ego Network Has More Structural Holes than B's



Borgatti, S. P., & Halgin, D. S. (2011). On Network Theory.
Organization Science, *22*, 1168–1181.

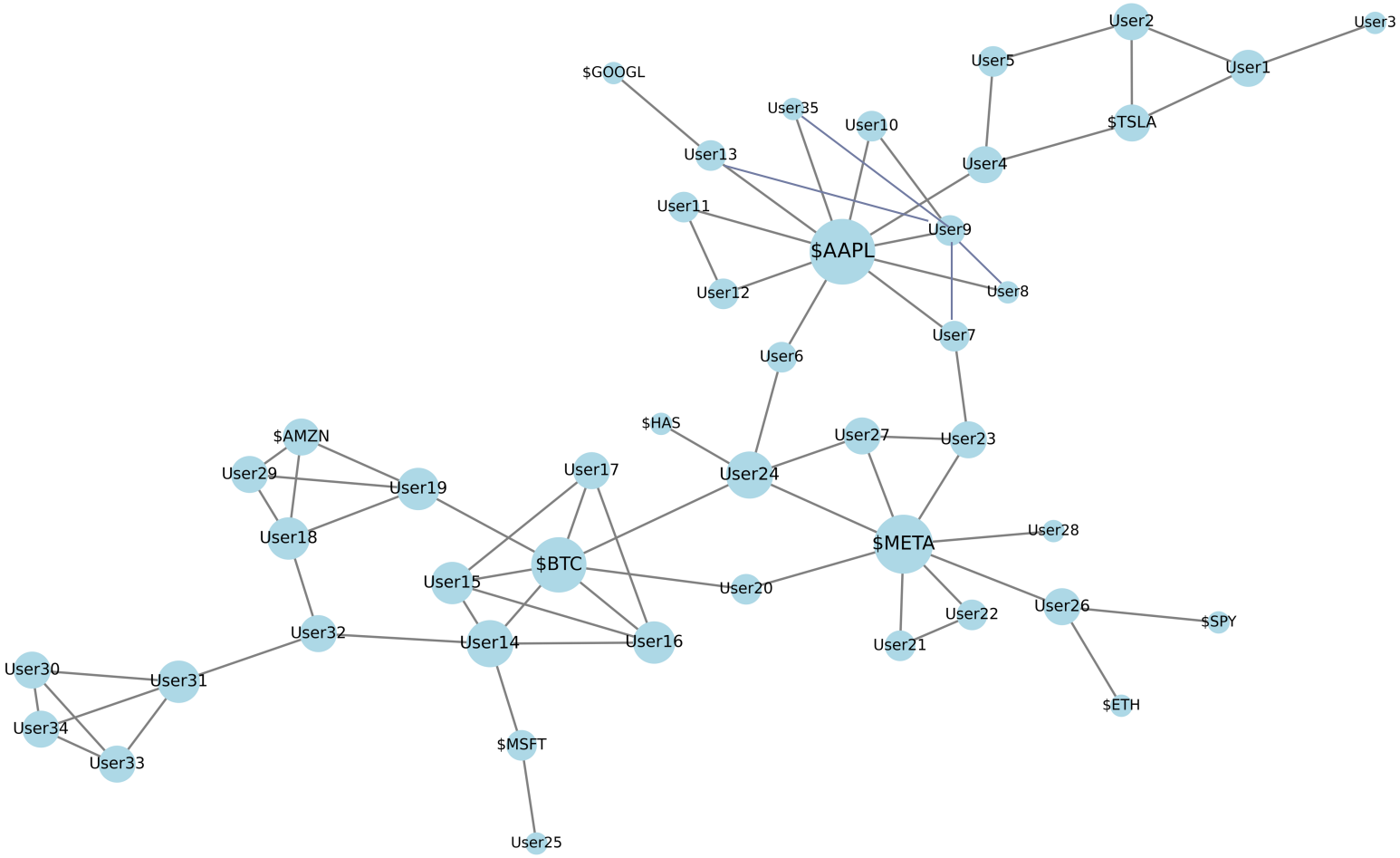
Network “Bridges”



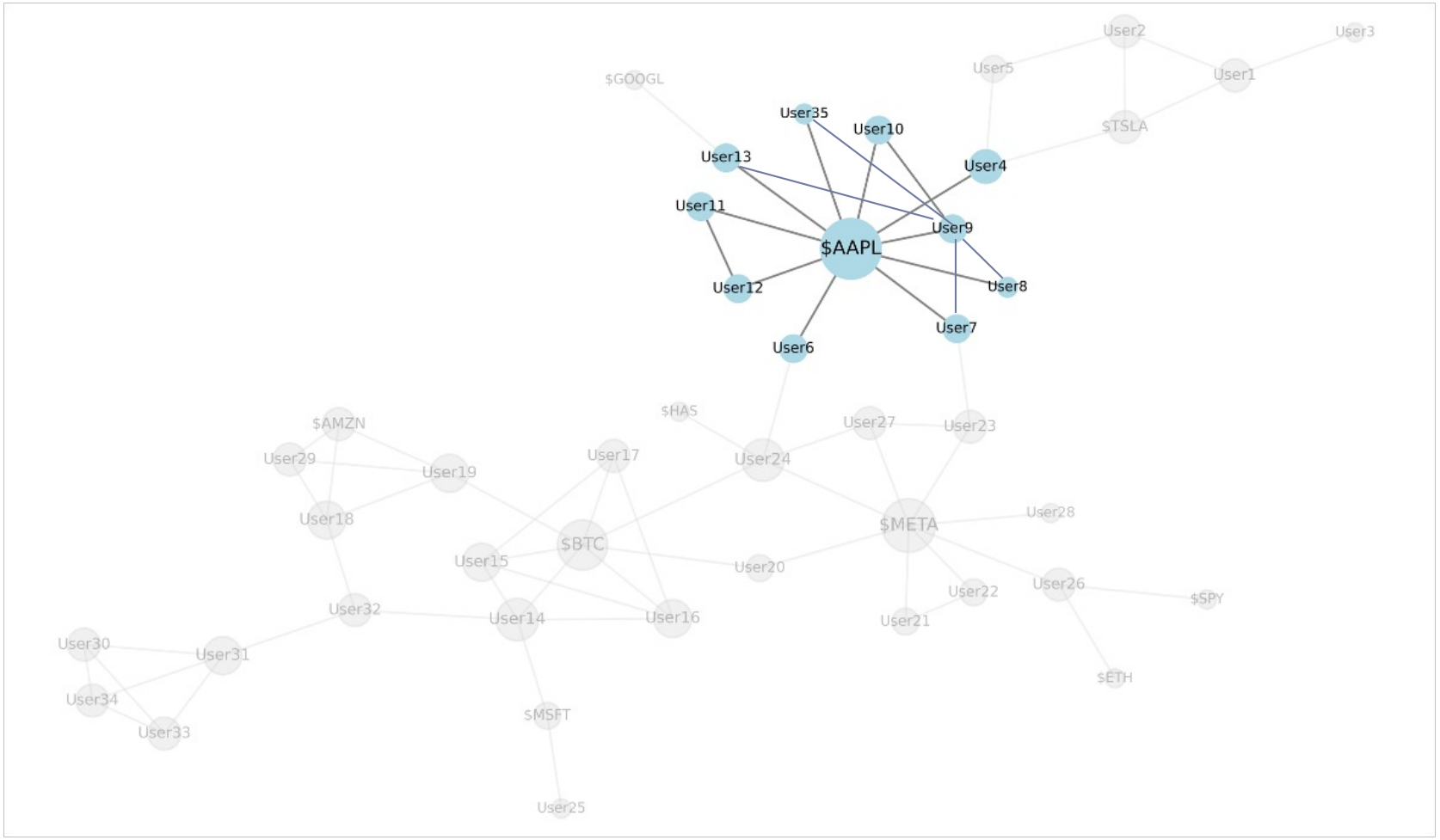
Removing the A–G tie disconnects the network.

Borgatti, S. P., & Halgin, D. S. (2011). On Network Theory.
Organization Science, *22*, 1168–1181.

Whole Network



Ego Network


User2
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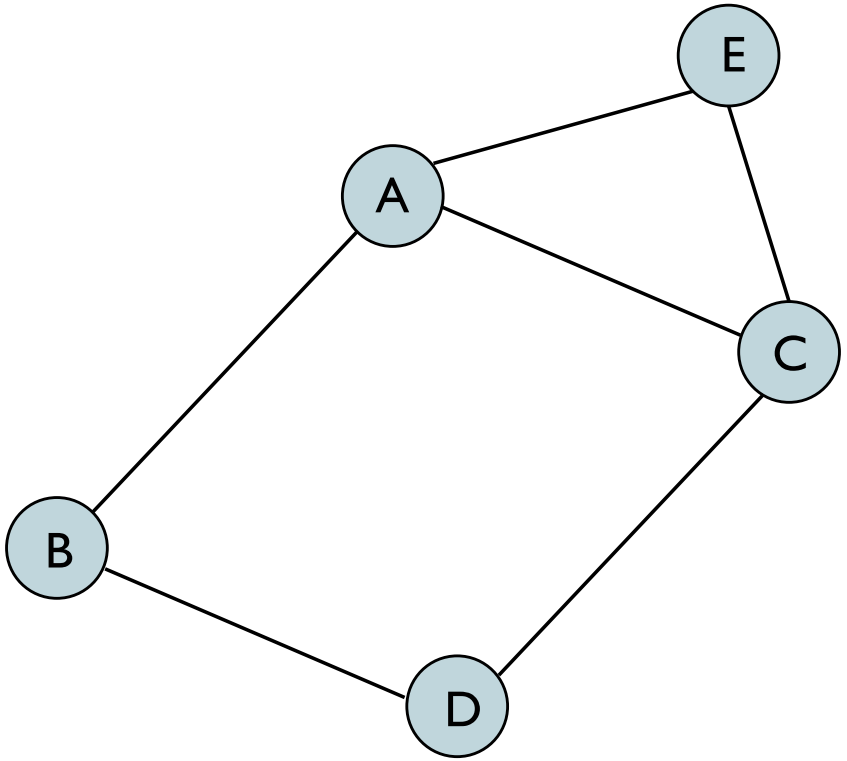
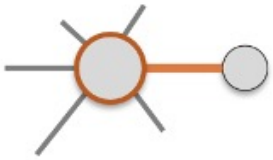
Network Dataset: Adjacency Matrix



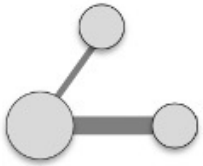
	A	B	C	D	E
A	–	1	1	0	1
B	1	–	0	1	0
C	1	0	–	1	1
D	0	1	1	–	0
E	1	0	1	0	–

Goals of Network Visualization

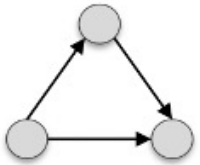
Key actors and links



Relationship strength

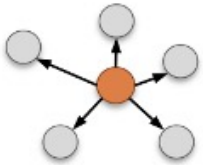


Structural properties



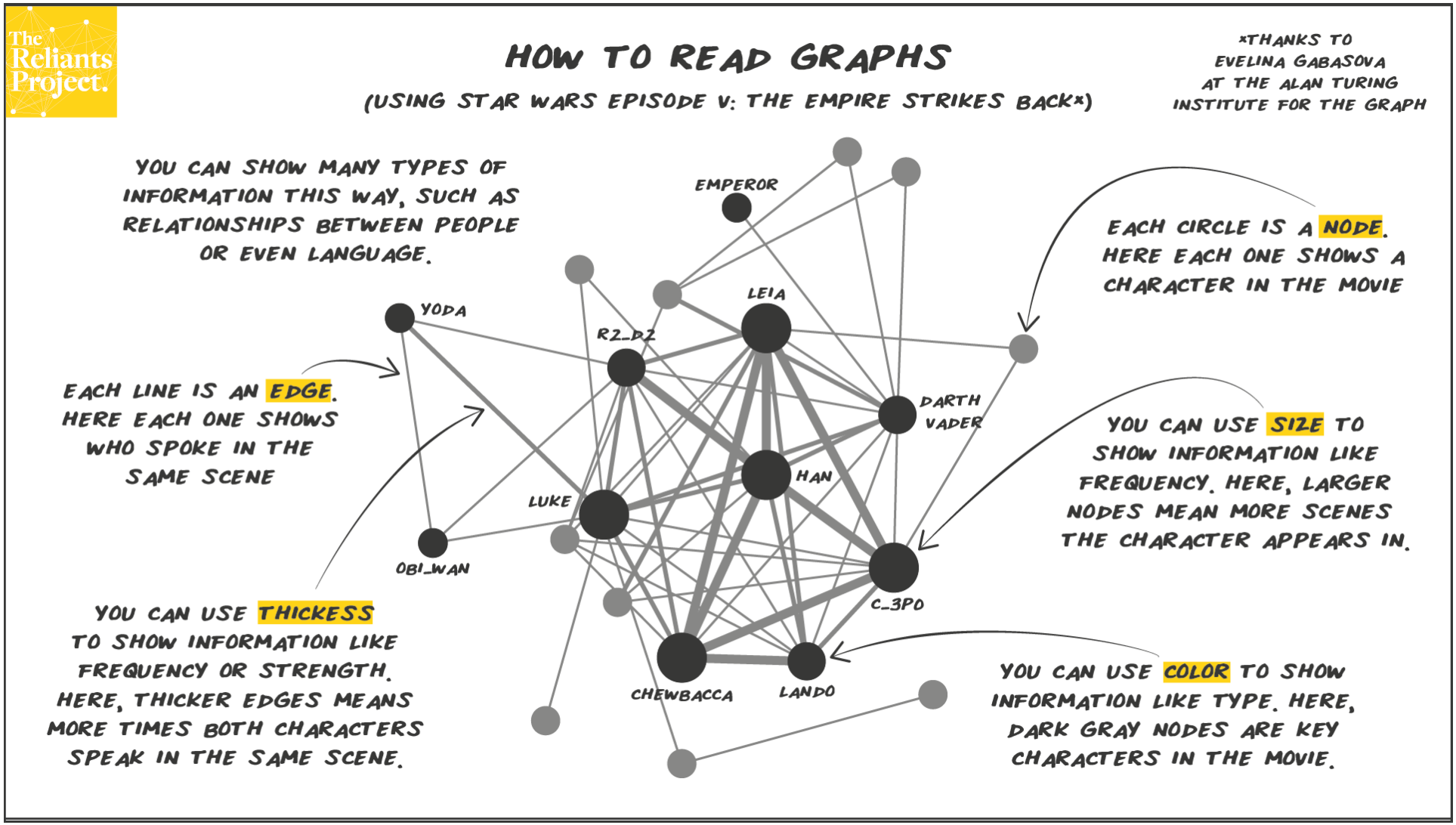
Communities

Diffusion patterns

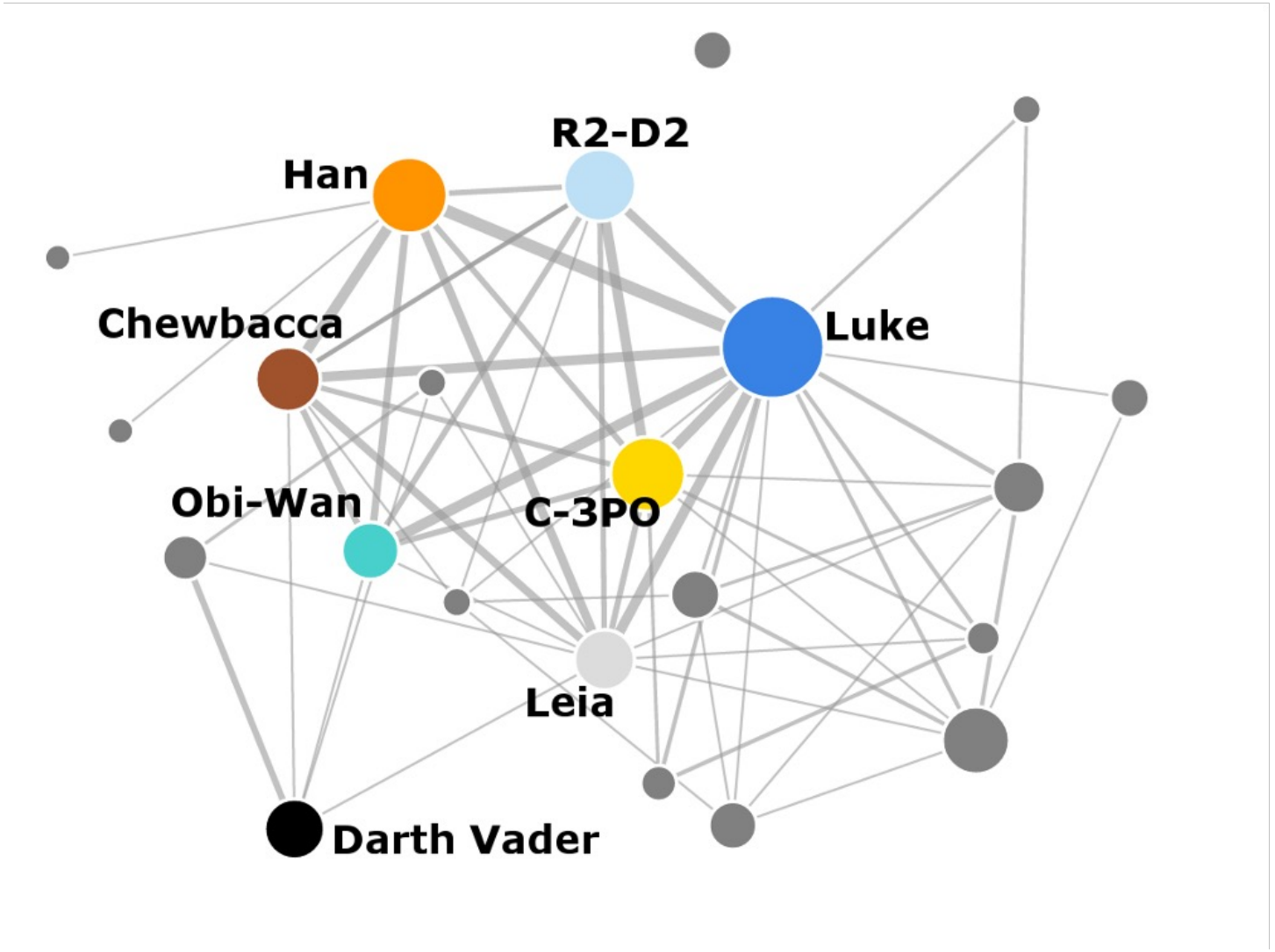


Network evolution

Network Graphs



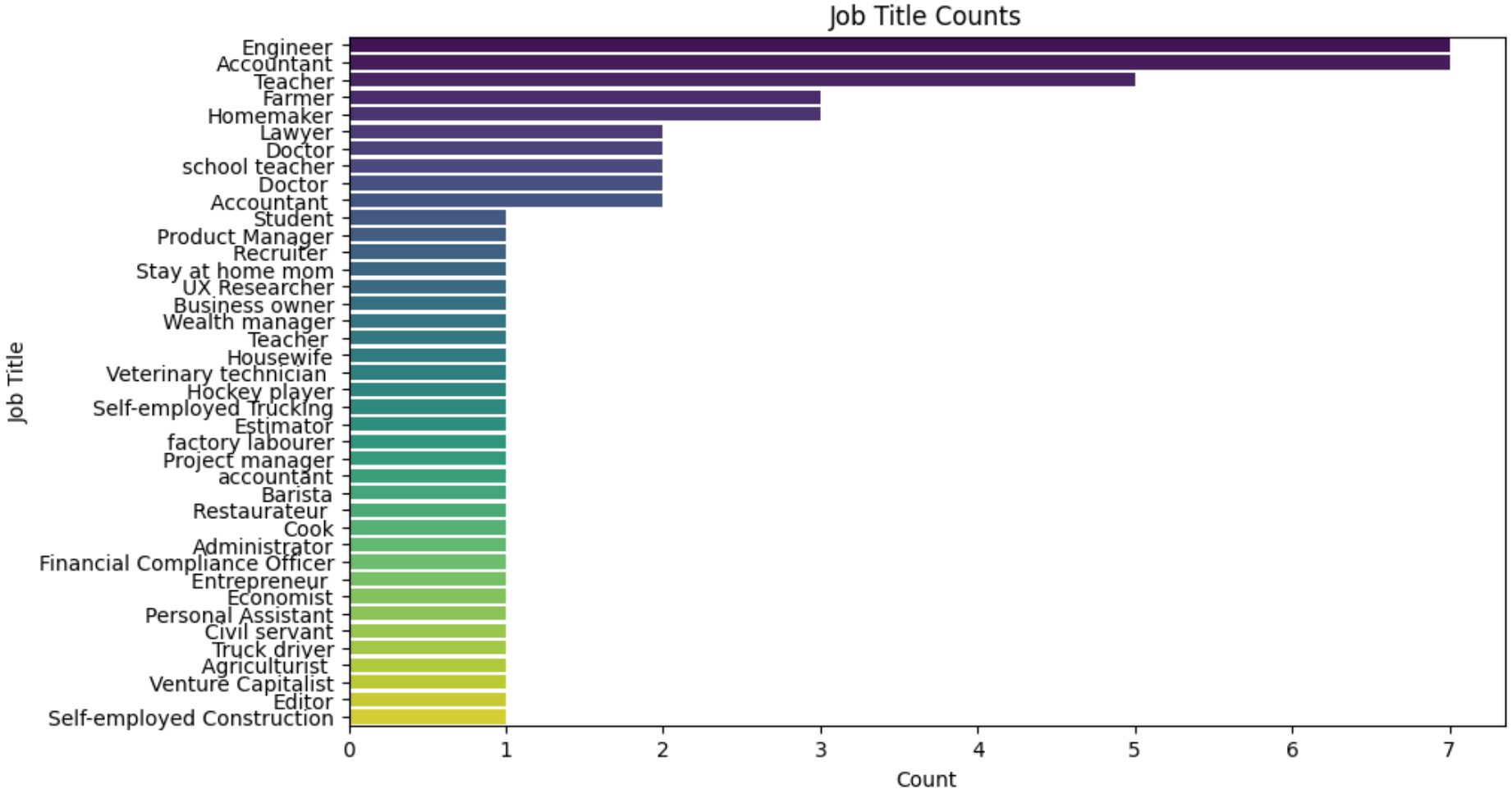
Star Wars, Episode IV: A New Hope



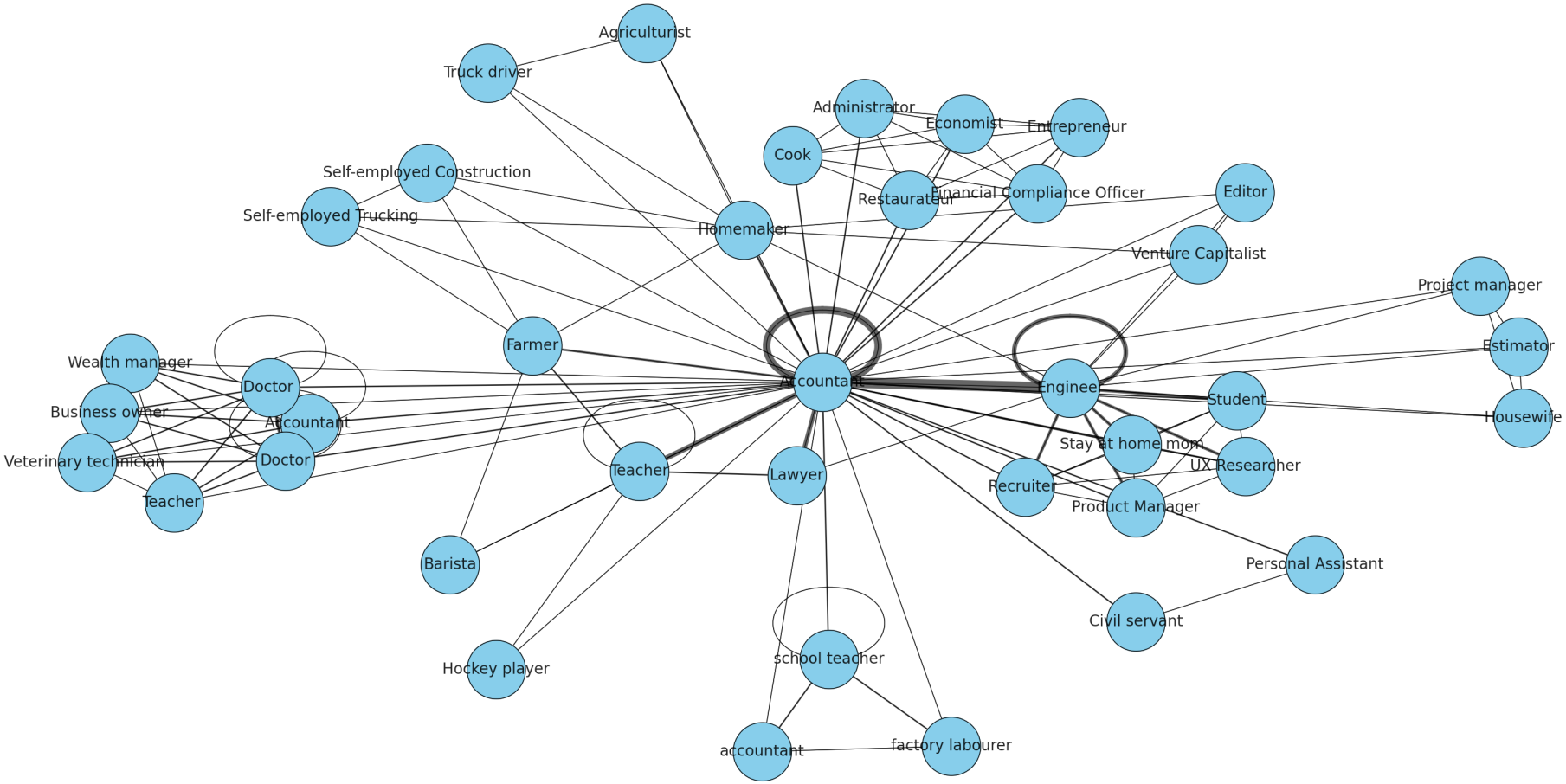
Network Questionnaire

- For a demonstration of social network analysis, please list the main job/career of your parents and siblings. There are places to enter up to 10 people. For example, if one of your parents is a medical doctor, your other parent was an accountant, and your brother is a plumber, you would put "Doctor" in the first [Your answer] box, "Accountant" in the second [Your answer] box, and "Plumber" in the third [Your answer] box. Order does not matter. Below you will see a sample response from a hypothetical person who enters information for two parents and two siblings, followed by the actual survey. Please note I am not collecting any names or email addresses nor will I save the data after this presentation. I will show the anonymized results during the presentation Friday. Hit "Submit" when you are done. Thanks!

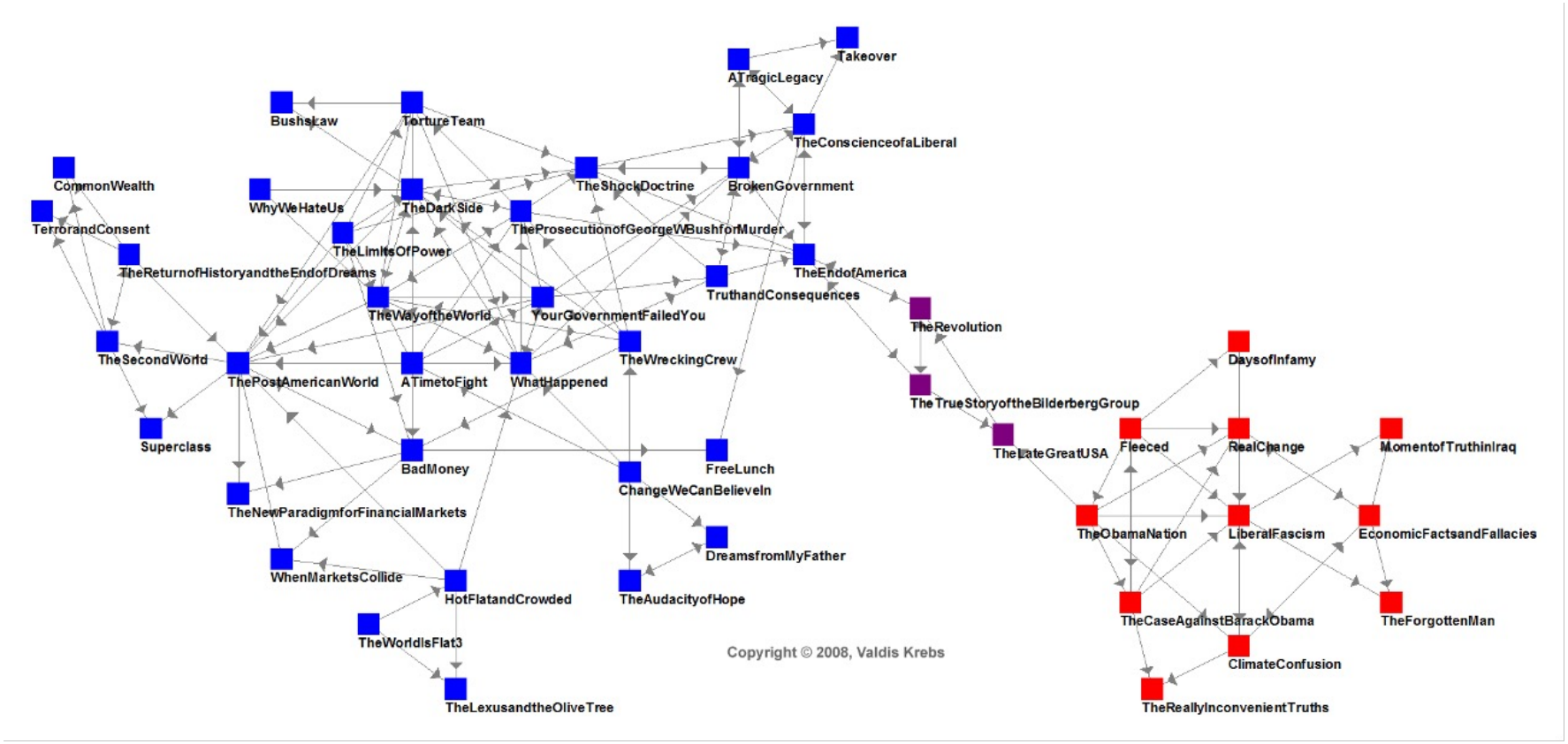
Family Careers Network



Family Careers Network



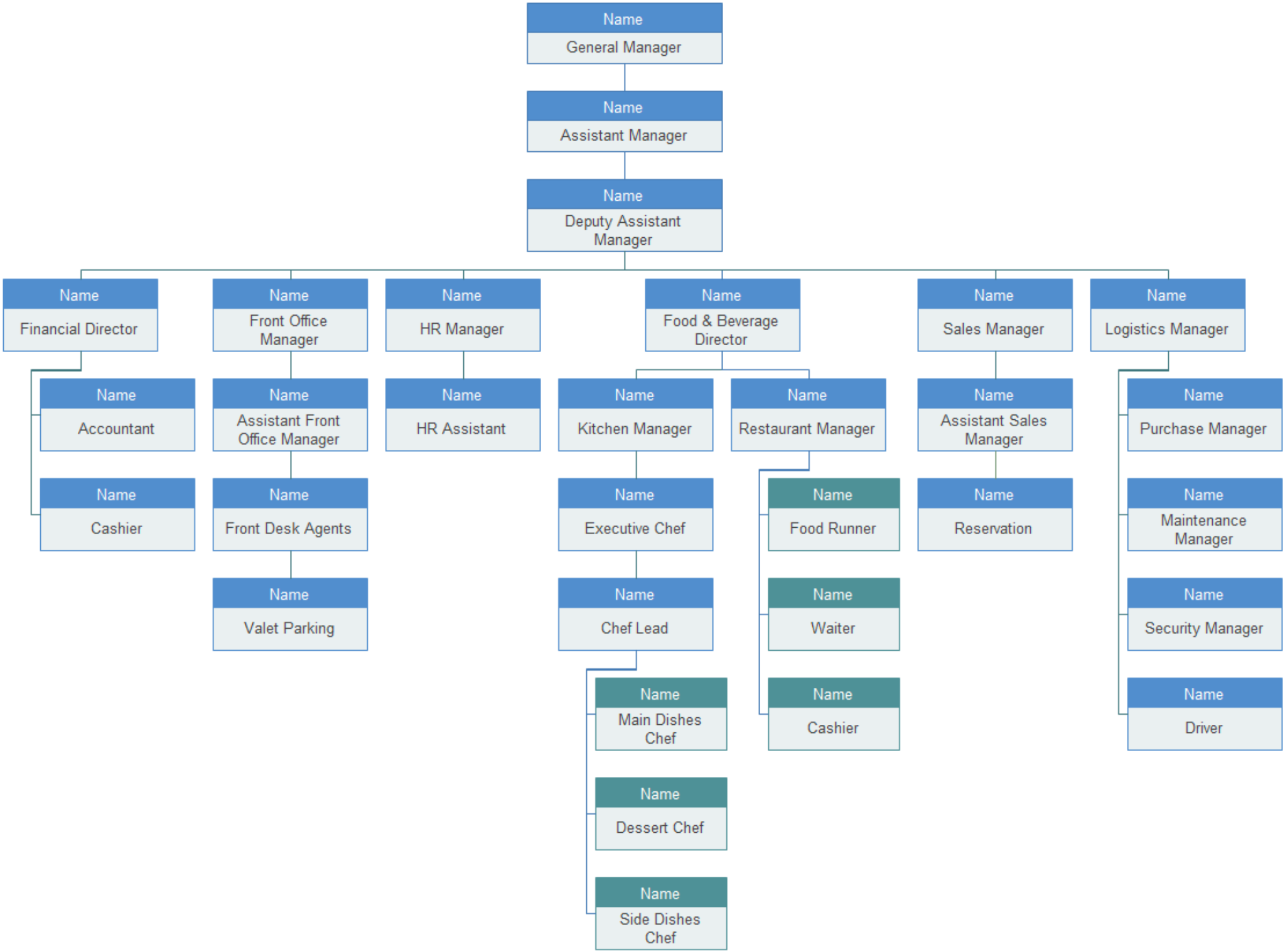
Communities – Political Books Purchased on Amazon August 2008



Based on the pattern of connections between the books in the map above, the most influential political books at the end of the summer 2008 are: *What Happened* (White House spokesman Scott McClellan's tell-all) and *The Post American World* (Fareed Zakaria's book on the rise of regional powers -- neither addressed the ongoing election. http://www.orgnet.com/divided.html

The Value of SNA?

- "Network science is not just another tool we can use. It's an eye-opening way of looking at reality."
- Goes against *linear thinking* that is often predominant in organizations and everyday life


Name
General Manager
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Assistant Manager
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Deputy Assistant Manager
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Financial Director
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Accountant
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Cashier
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Front Office Manager
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Assistant Front Office Manager
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Front Desk Agents
Name
Valet Parking
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HR Manager
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HR Assistant
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Food & Beverage Director
Name
Kitchen Manager
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Executive Chef
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Chef Lead
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Main Dishes Chef
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Dessert Chef
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Side Dishes Chef
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Restaurant Manager
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Food Runner
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Waiter
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Cashier
Name
Sales Manager
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Assistant Sales Manager
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Reservation
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Logistics Manager
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Purchase Manager
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Maintenance Manager
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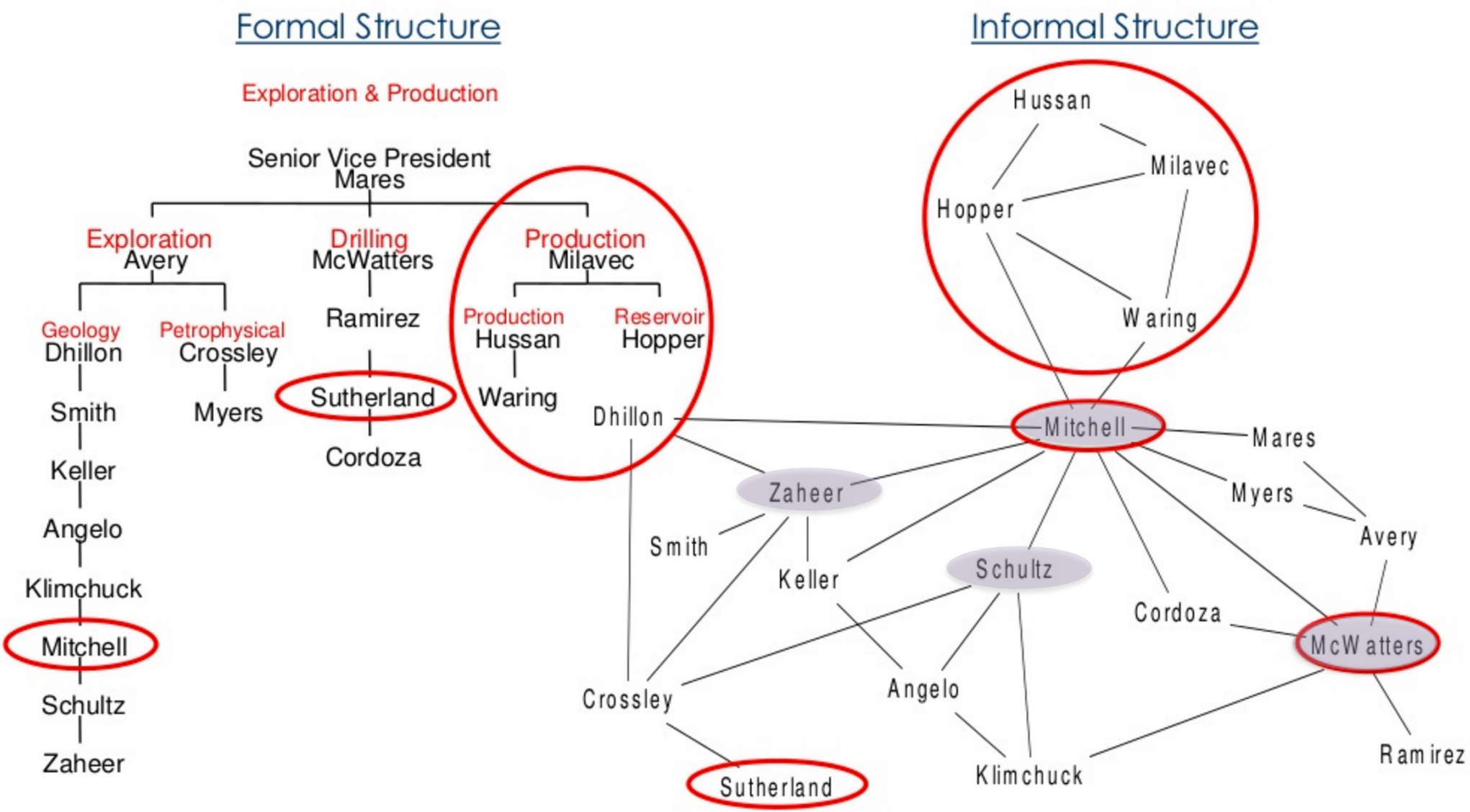
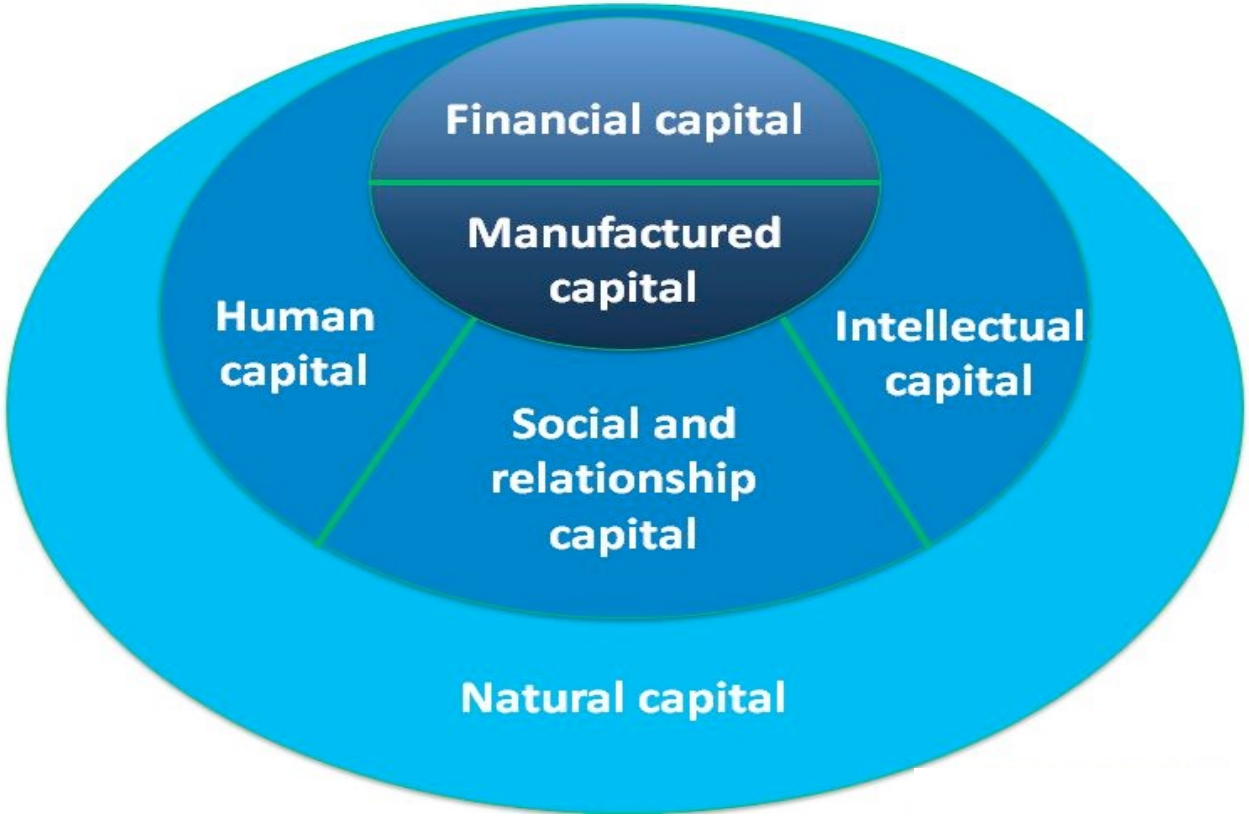
Security Manager
Name
Driver

Hierarchical vs. Network View

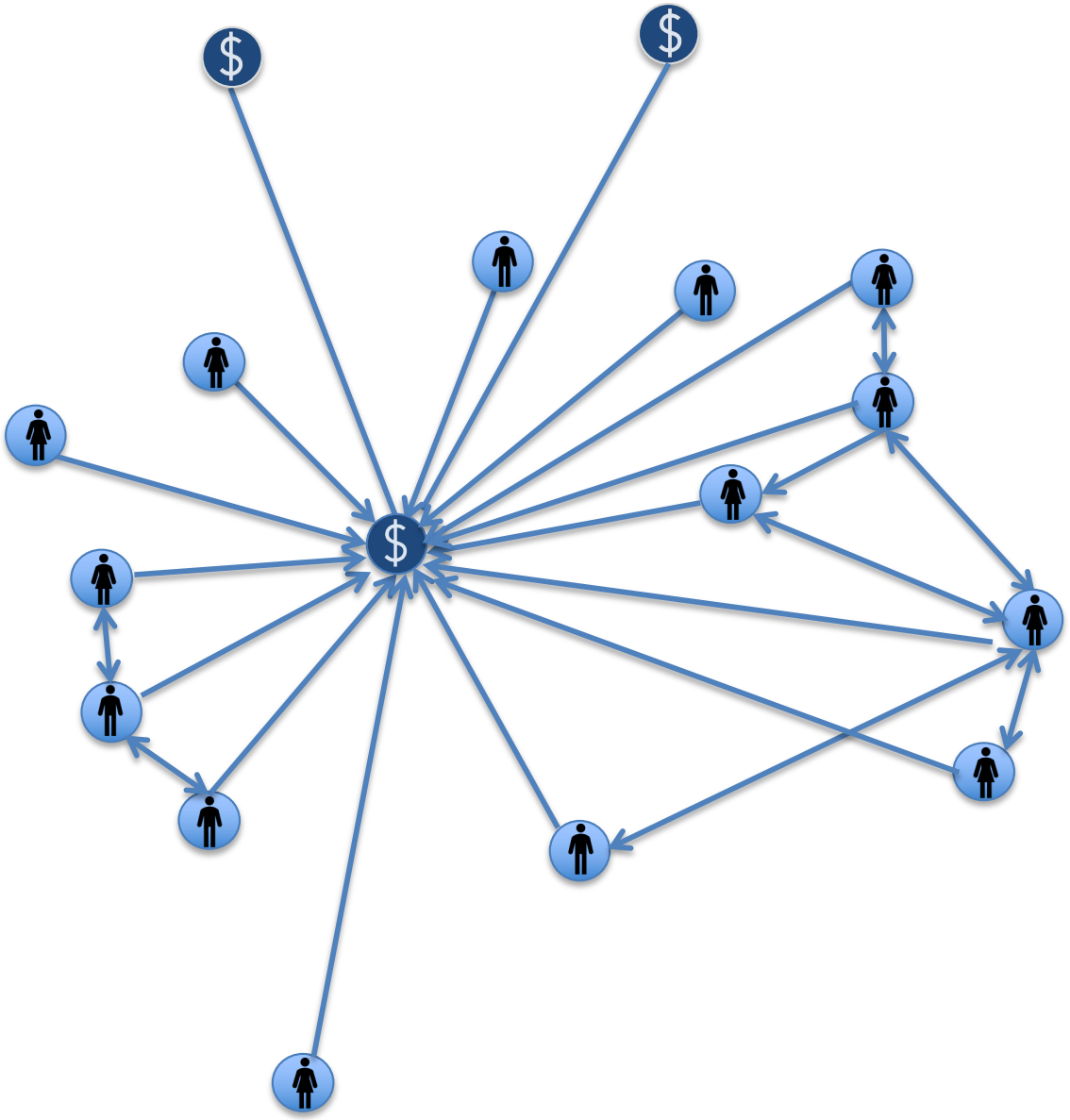


Network *Resources*

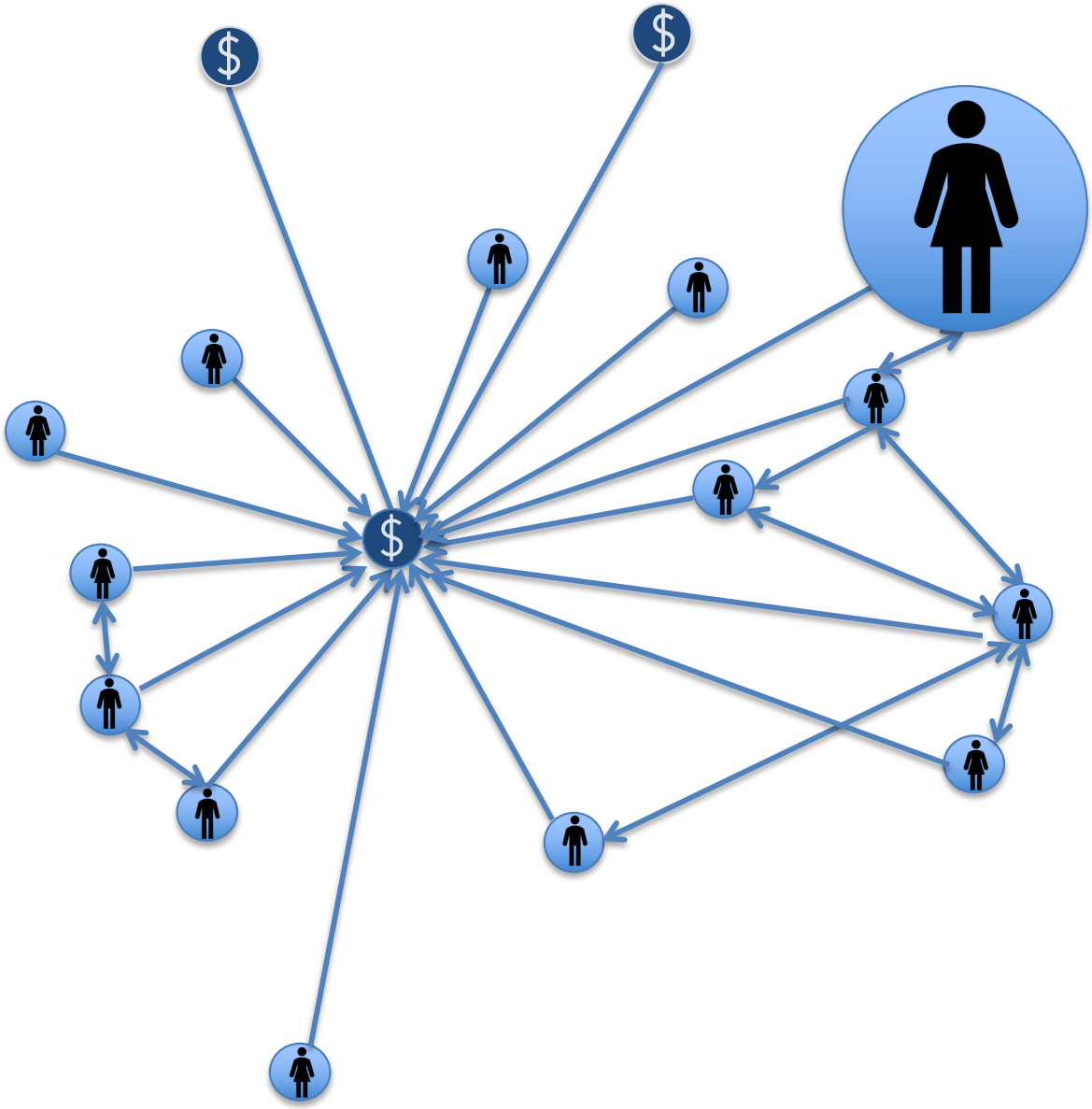
- There can be *resources* in a network – *social capital*



Embedded Resources & Influence

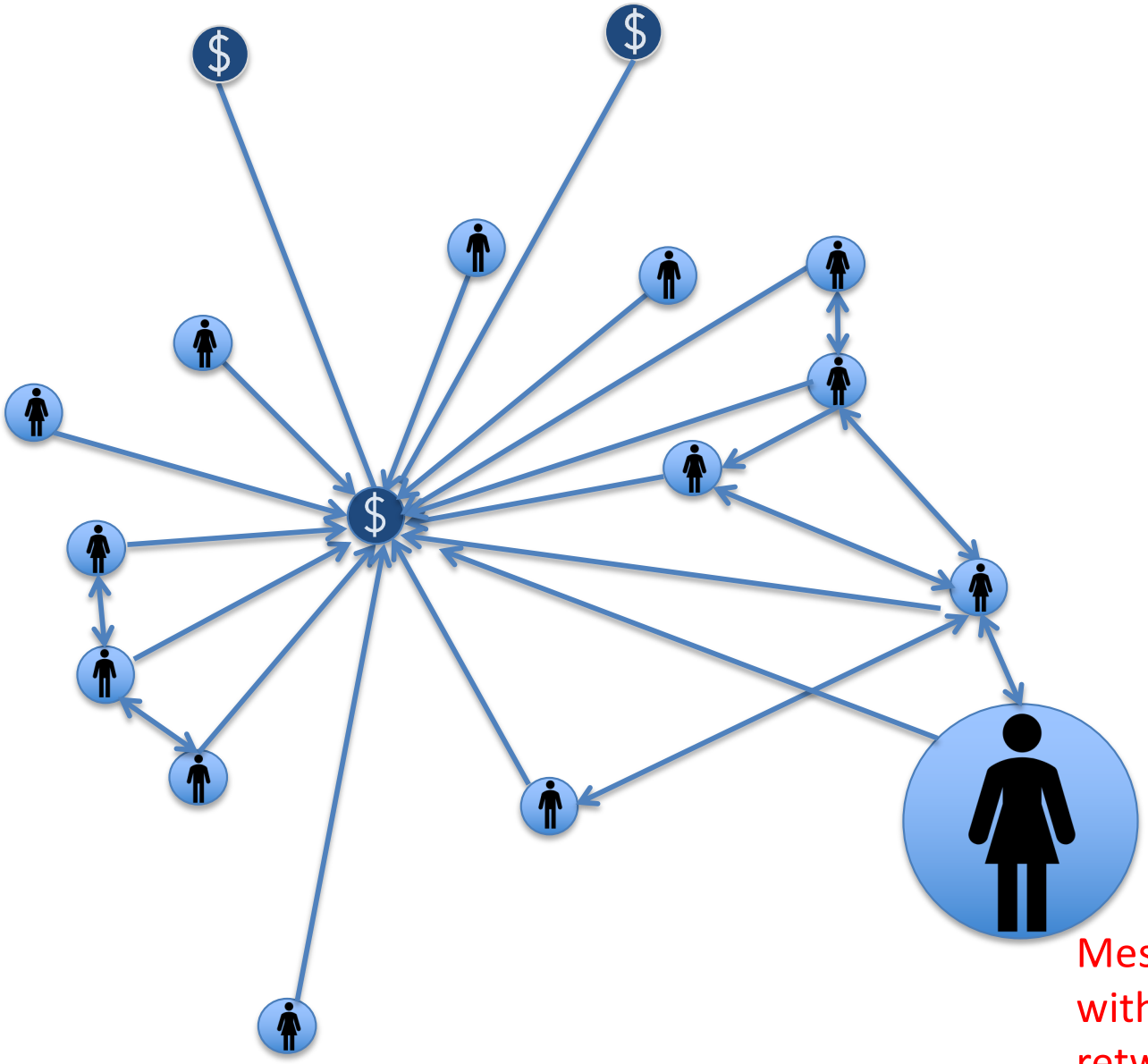


Embedded Resources & Influence



Message sender with 100,000 followers is more valuable

Embedded Resources & Influence



Message sender with high # of retweets is more influential

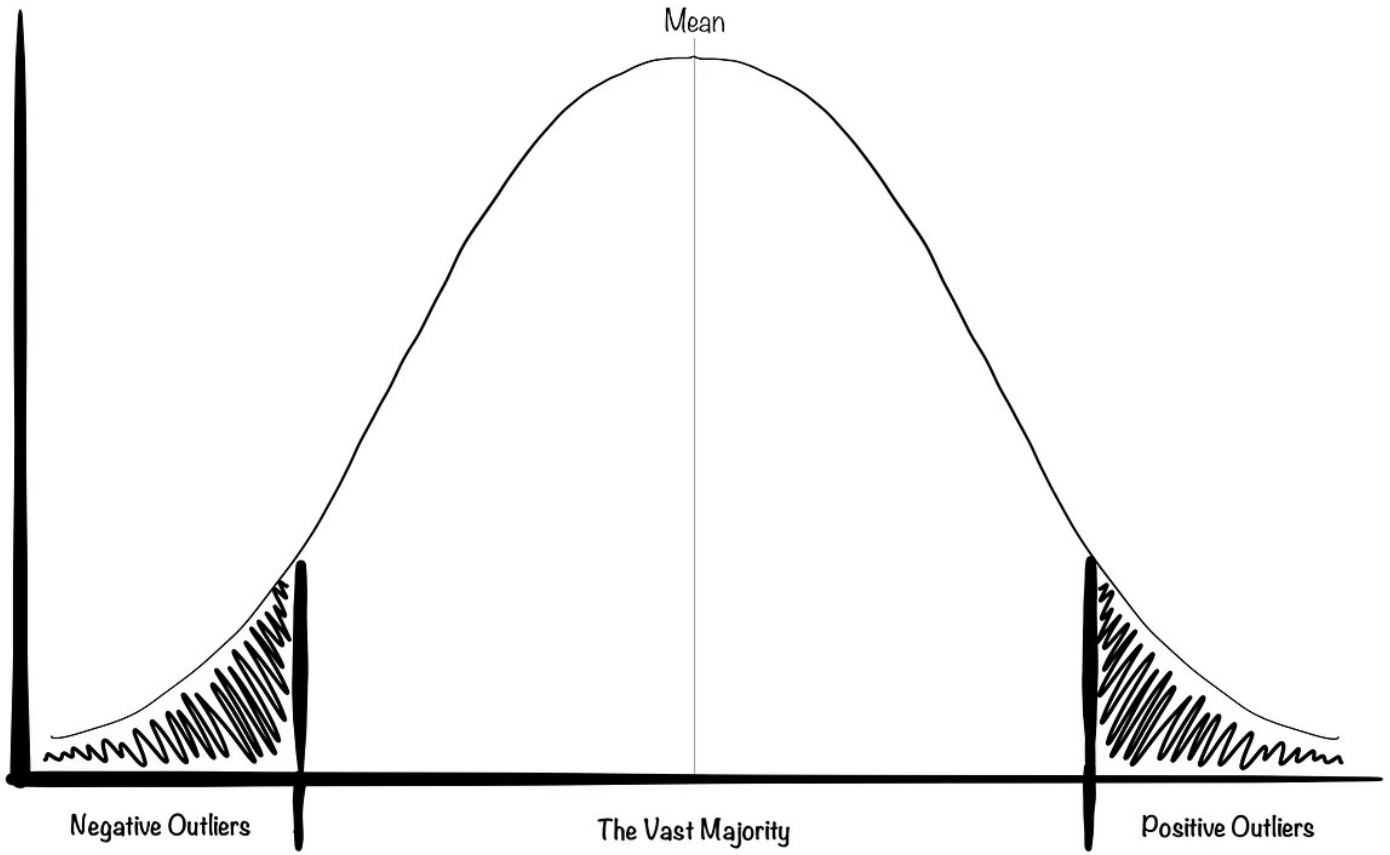
The Value of Social Connections

- "It's not what you know, it's who you know"
  - Yes, but…
- Success also depends on "How different the people you know are from each other" (Burt)
- "It's not who you know, but how you know them" (Wellman)
- "It's not who you know, it's the resources possessed by those who you know"

Power Laws

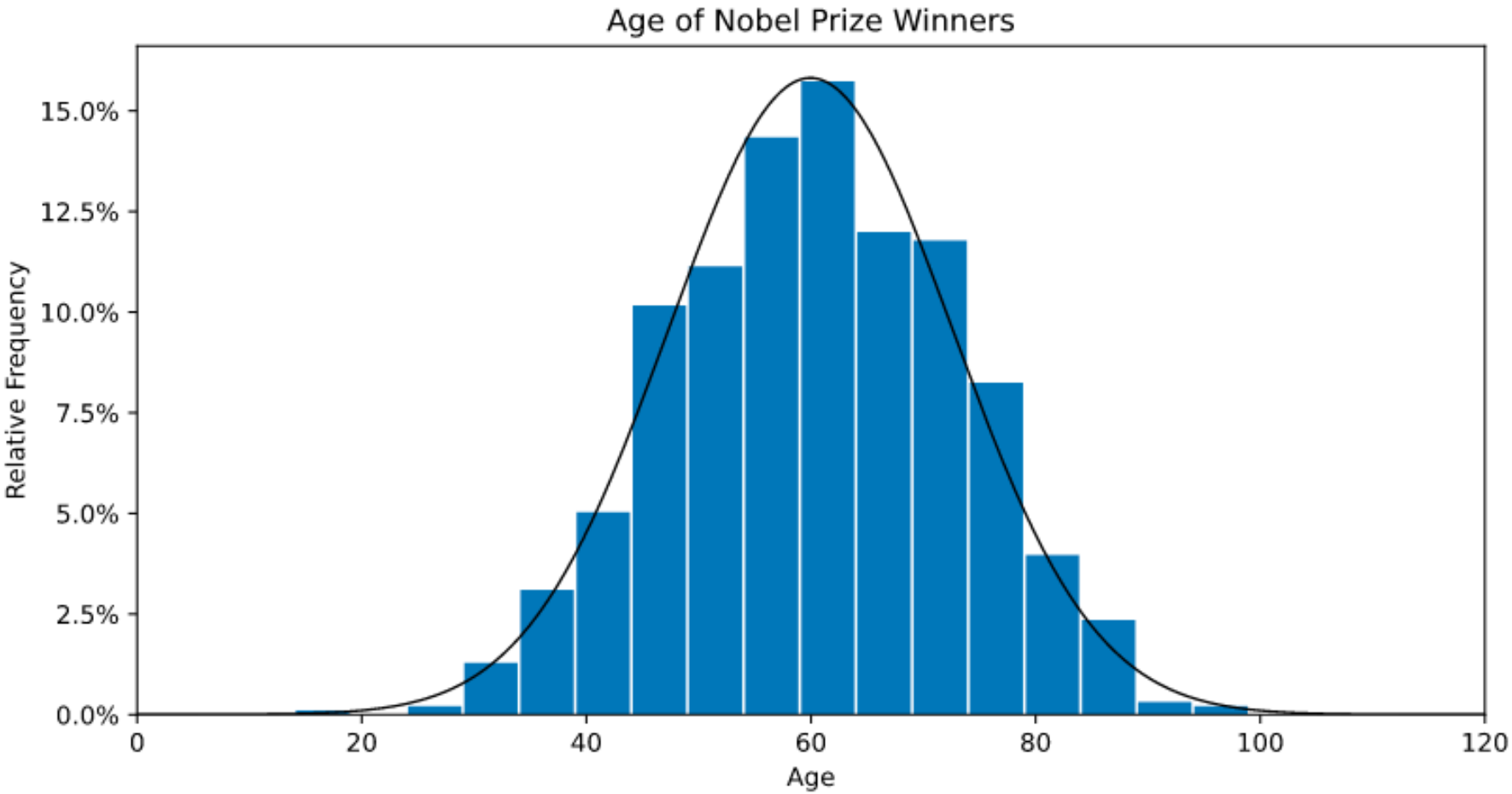
- "The power law is the shape of our age" (Anderson)
- Also called Pareto distribution
- Shape is $y = 1/x$
- Power laws arise under conditions of
  1. Variety
  2. Inequality
  3. Network effects

Normal Distribution

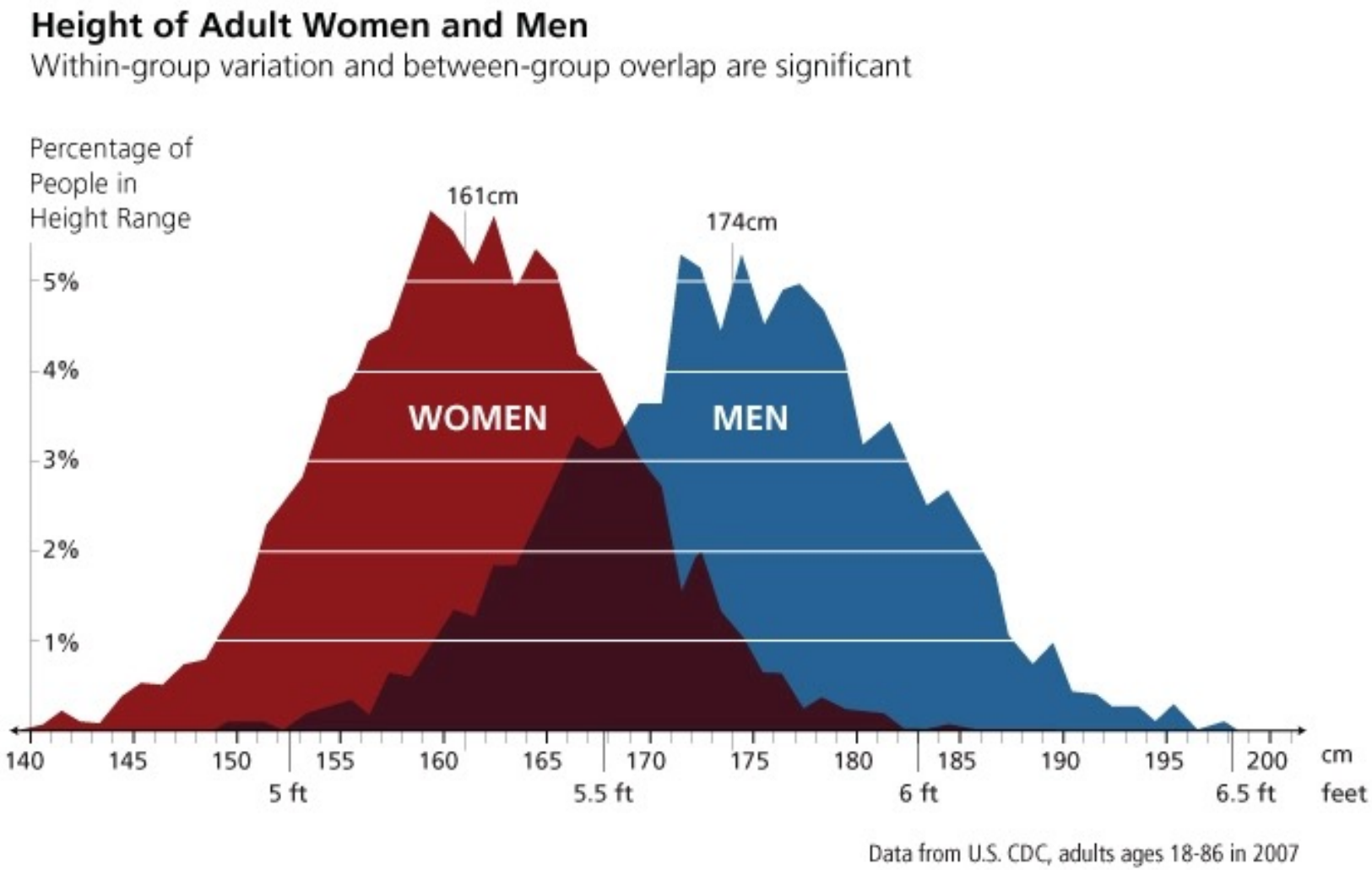


thestartup.substack.com

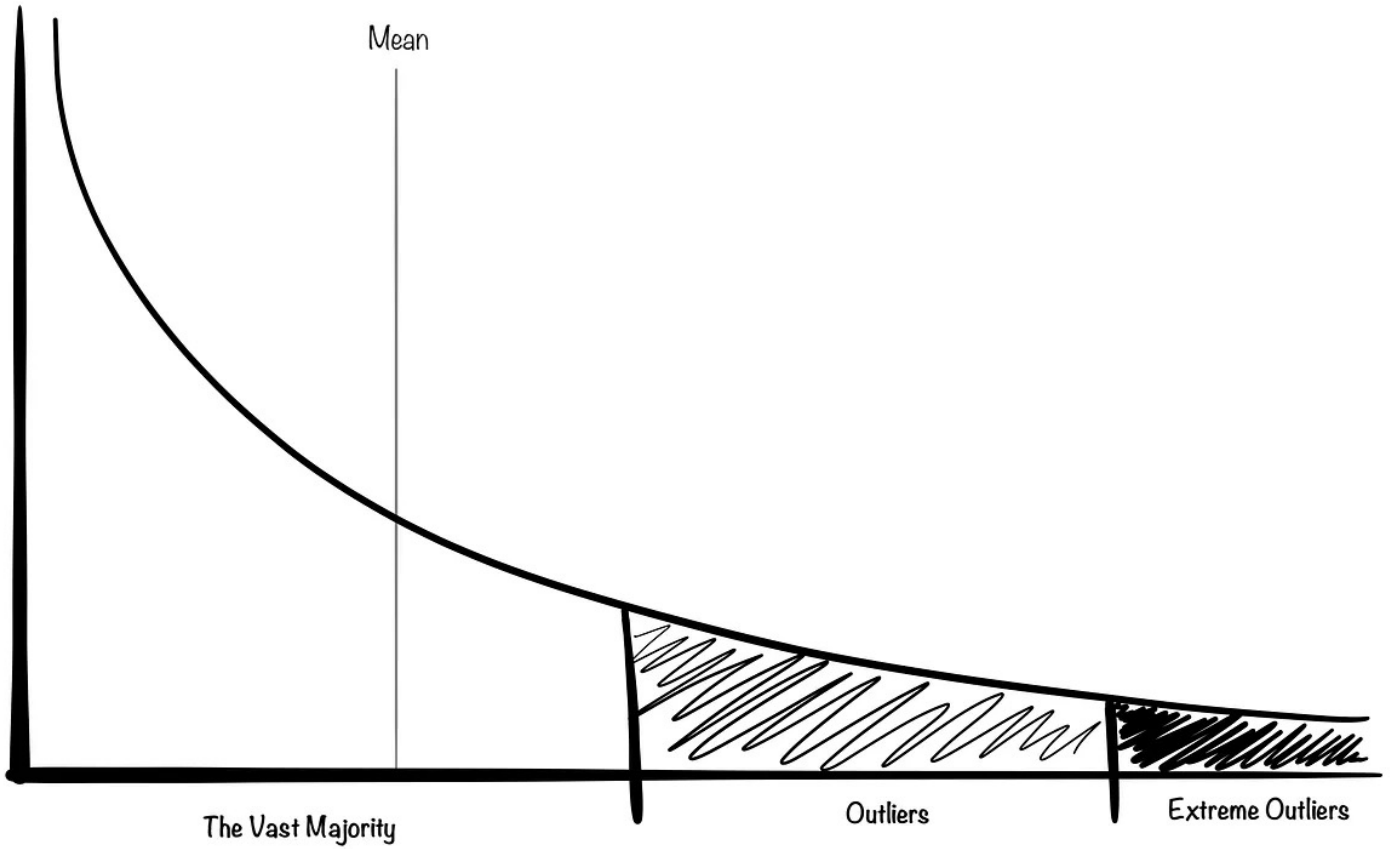
Normal Distribution



Normal Distribution

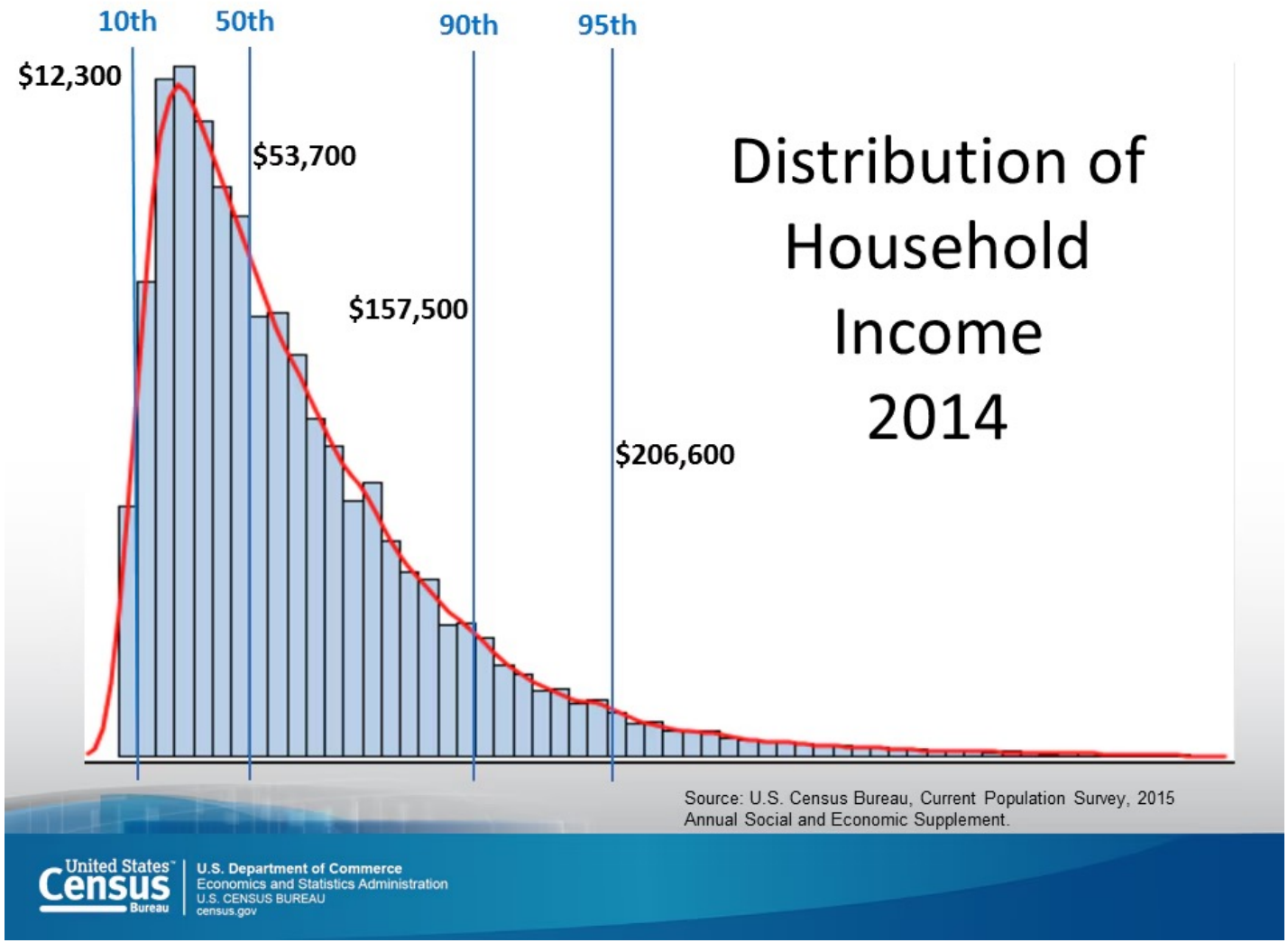


Power Law Distribution

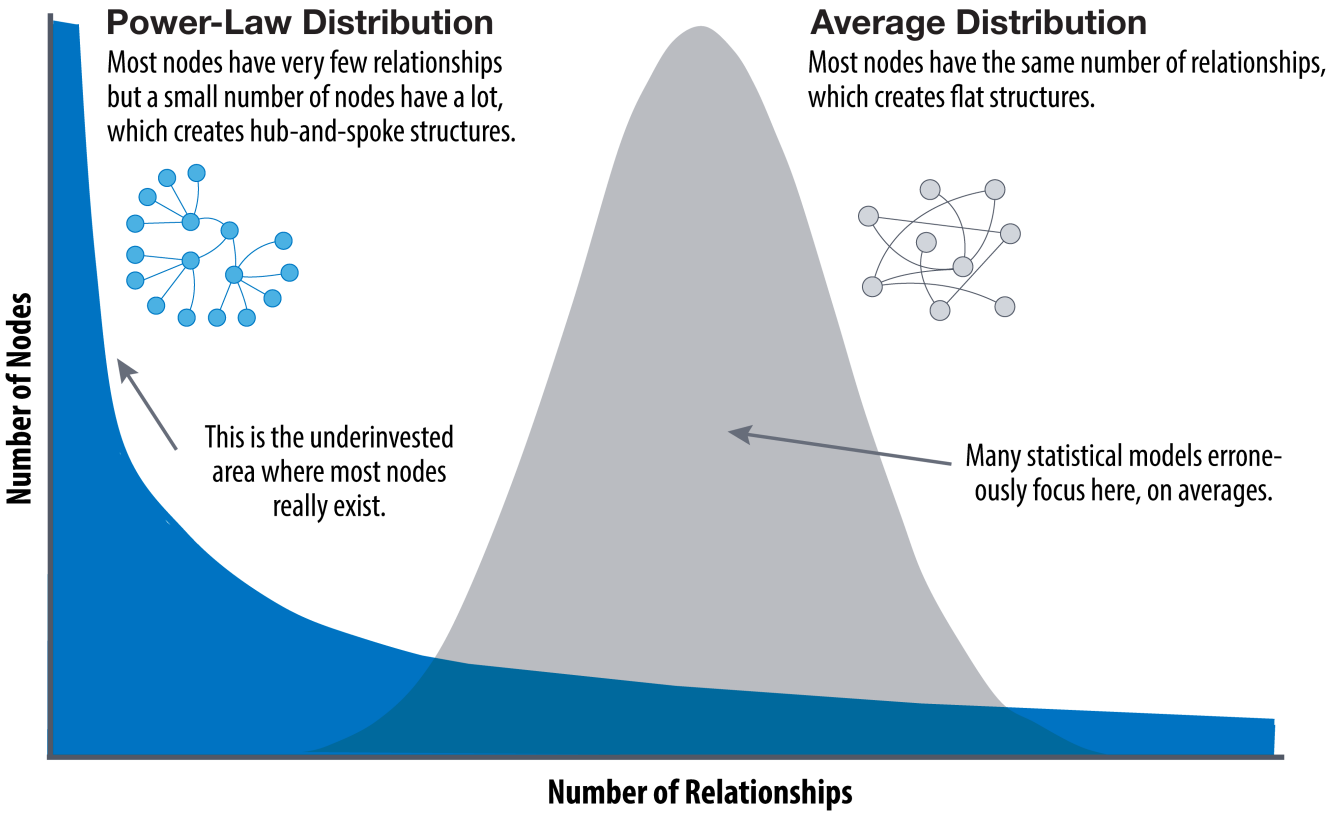


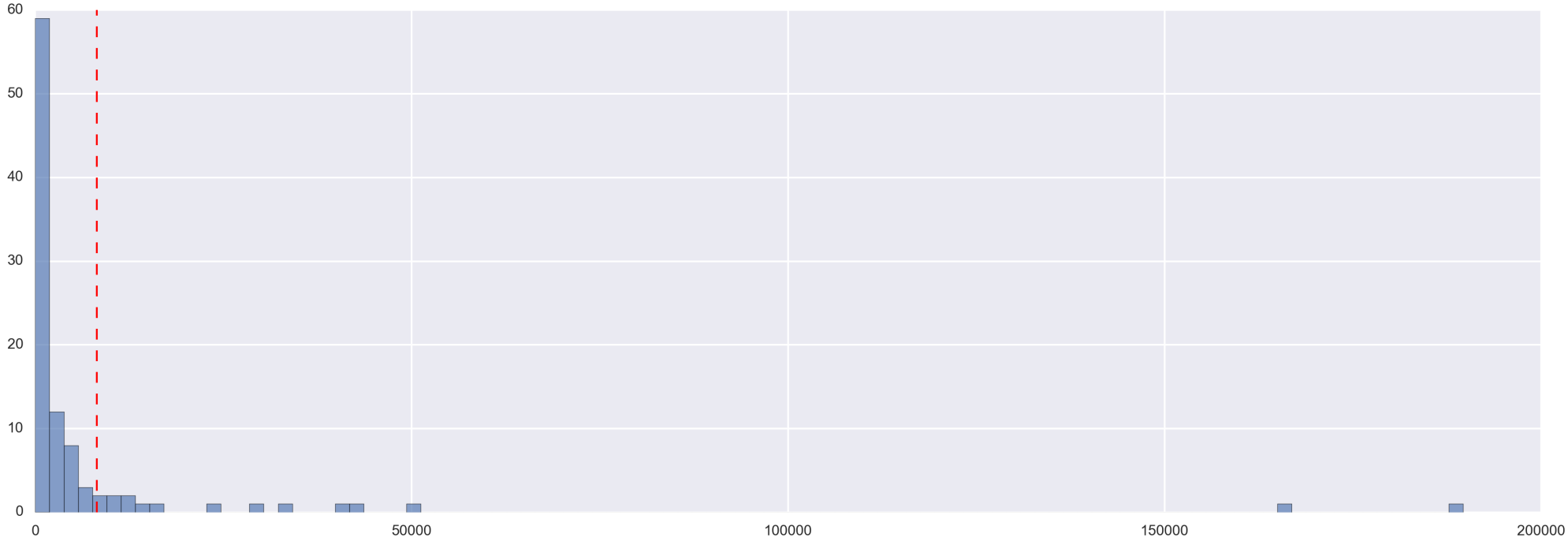
thestartup.substack.com

Power Law Distribution



Power Law Distribution





Followers of Twitter accounts of 100 Organizations of the *NPTimes 100* list

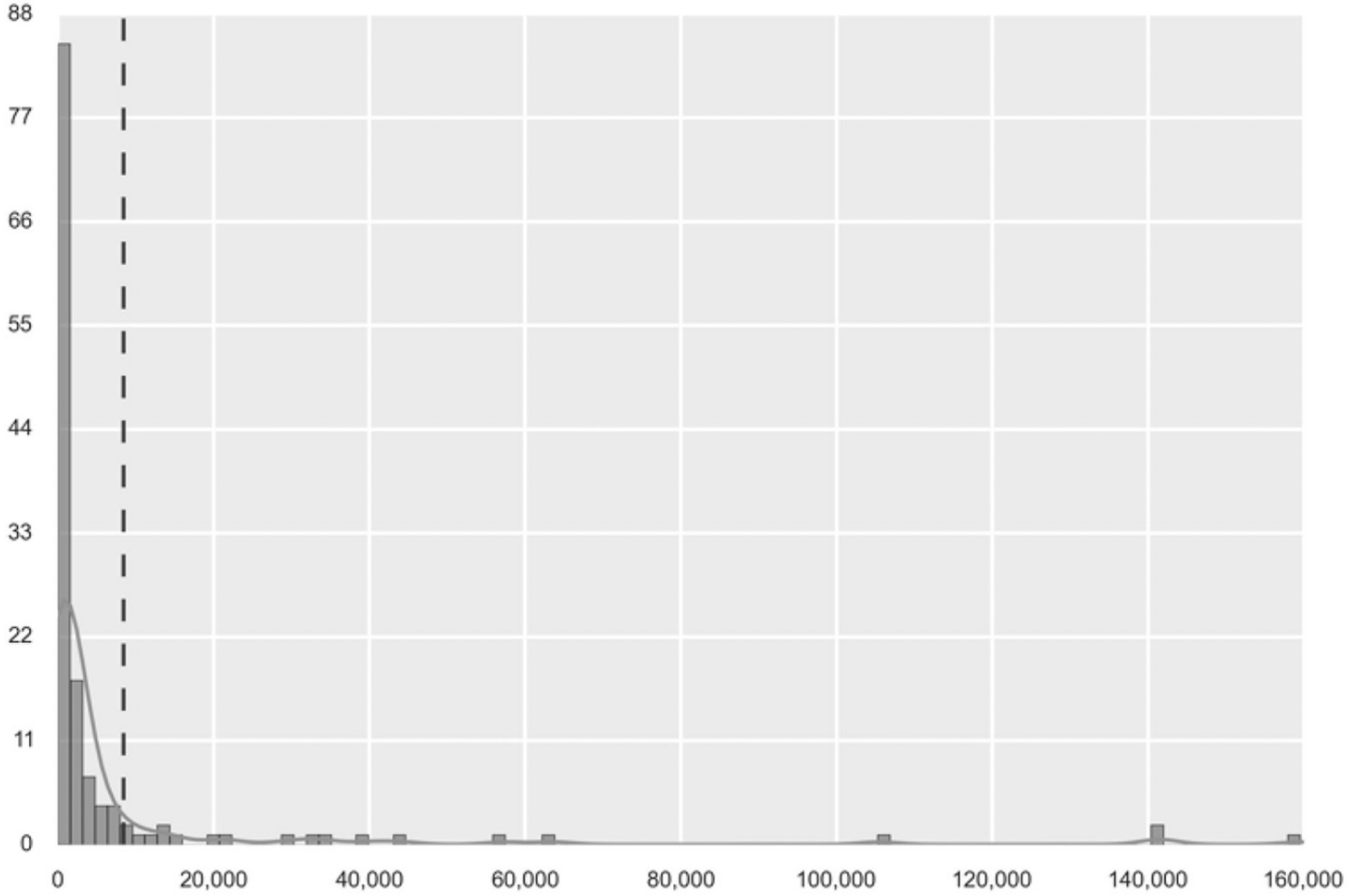


Fig. 2. Histogram, number of Twitter followers of 135 North American Mining Firms, April 2015. Note: Dashed vertical line shows mean value of 8,429 followers; the solid curved line is the kernel density line, or line that reflects the non-parametric probability density function.

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Accounting, Organizations and Society

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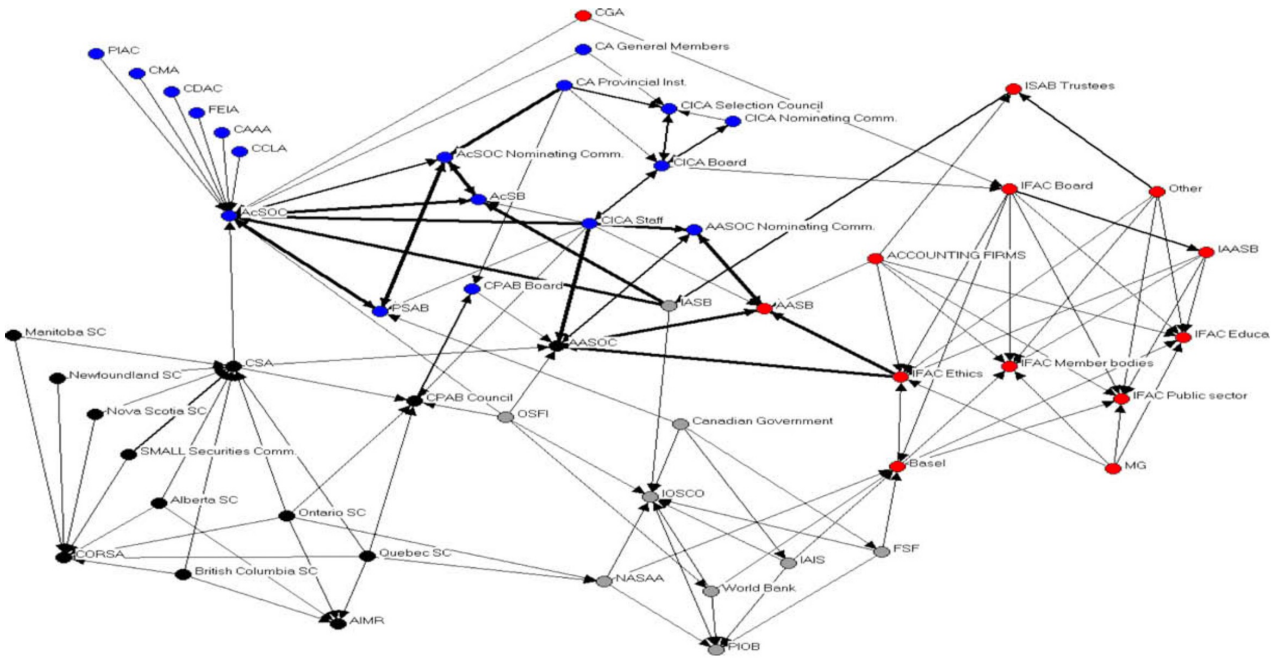
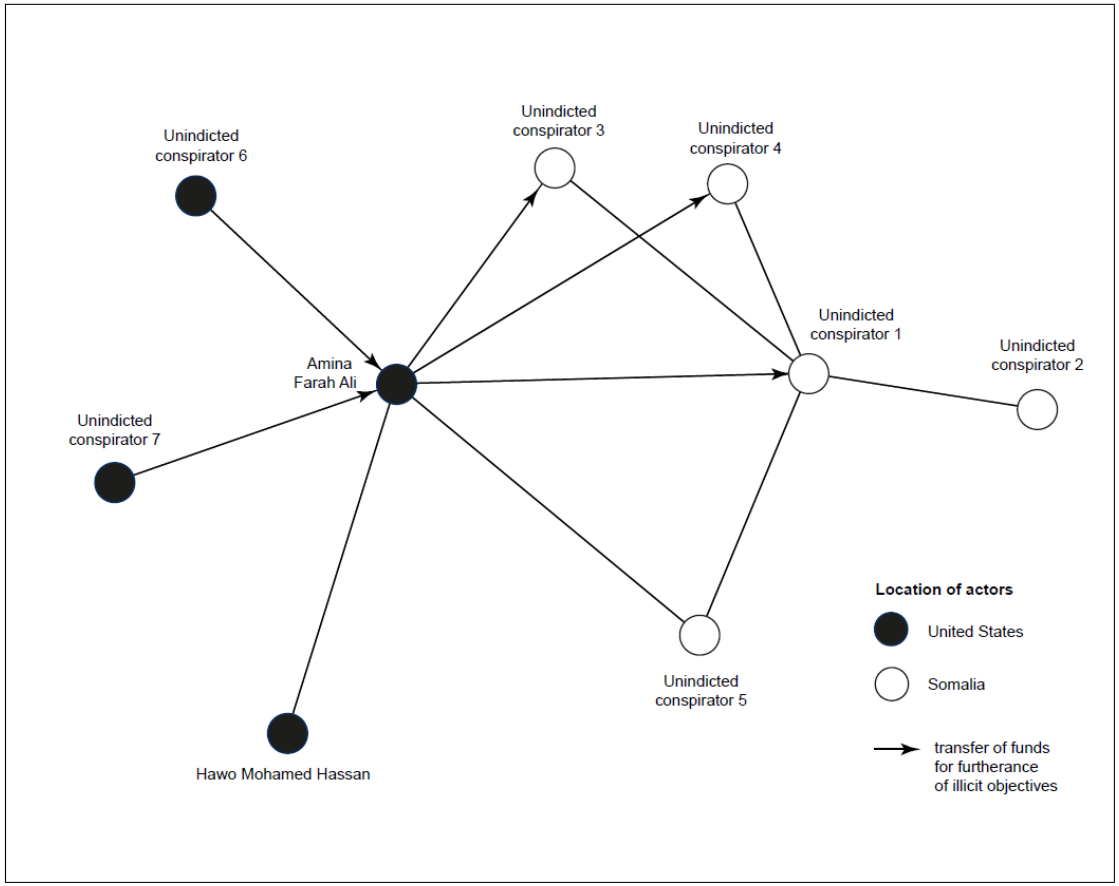
Regulatory networks for accounting and auditing standards: A social network analysis of Canadian and international standard-setting

Alan J. Richardson

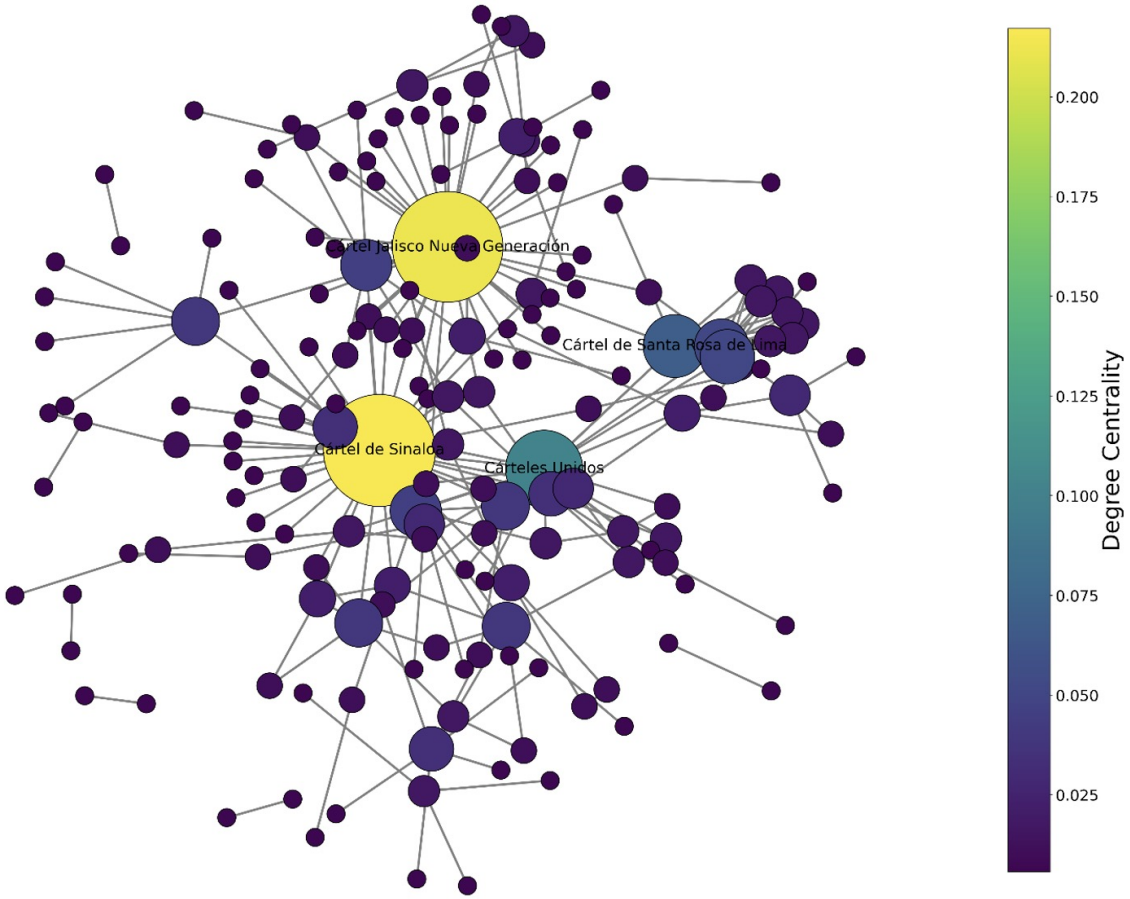
Schulich School of Business, York University, Toronto, Ontario, Canada M3J 1P3



Terrorist Financing Network



Mexico's Organized Crime Network (2021)



Note This network includes 176 nodes and 226 edges. Only the most central nodes (degree centrality) were labeled.
Source Contreras Velasco et al., 2023. Elaboration based on Lantia Consultores 2021 data.

Cosa Nostra Network

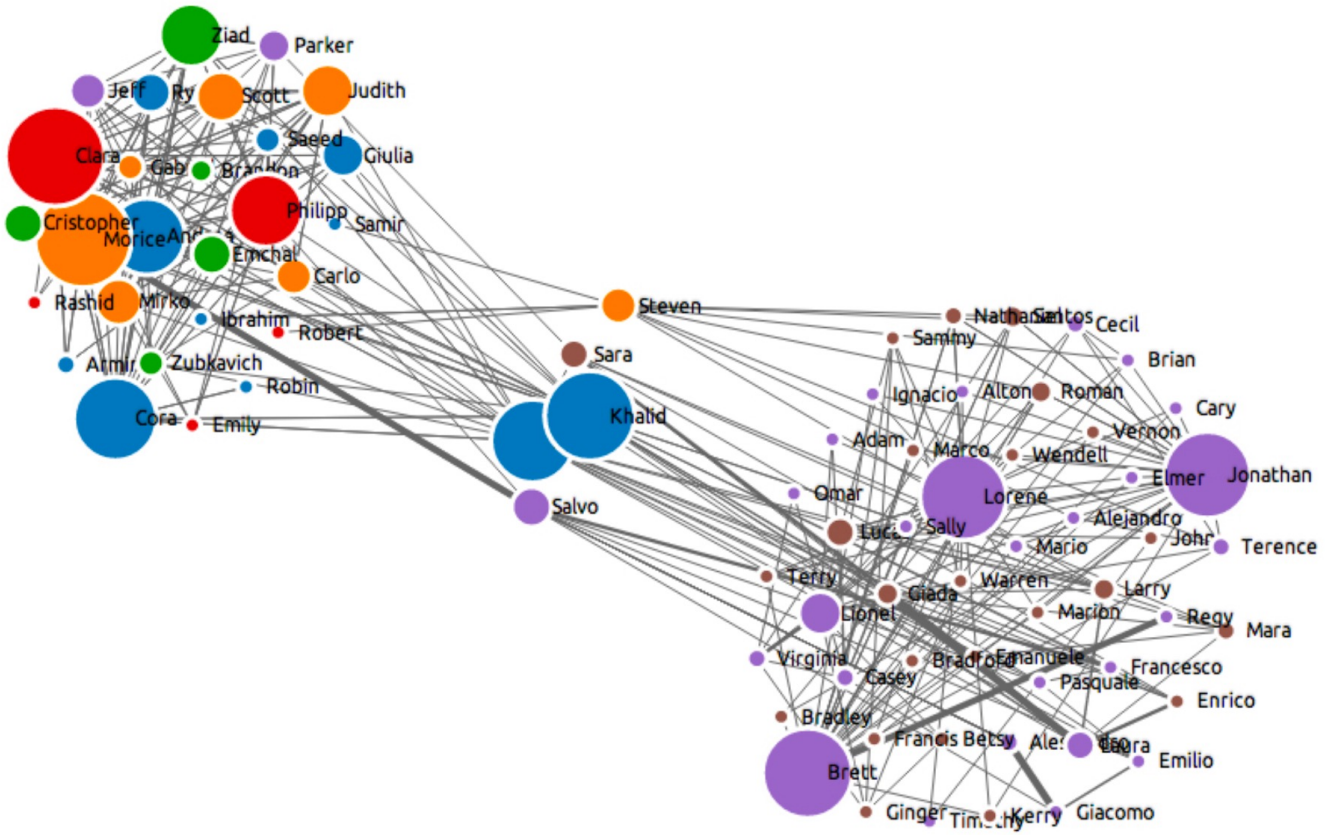
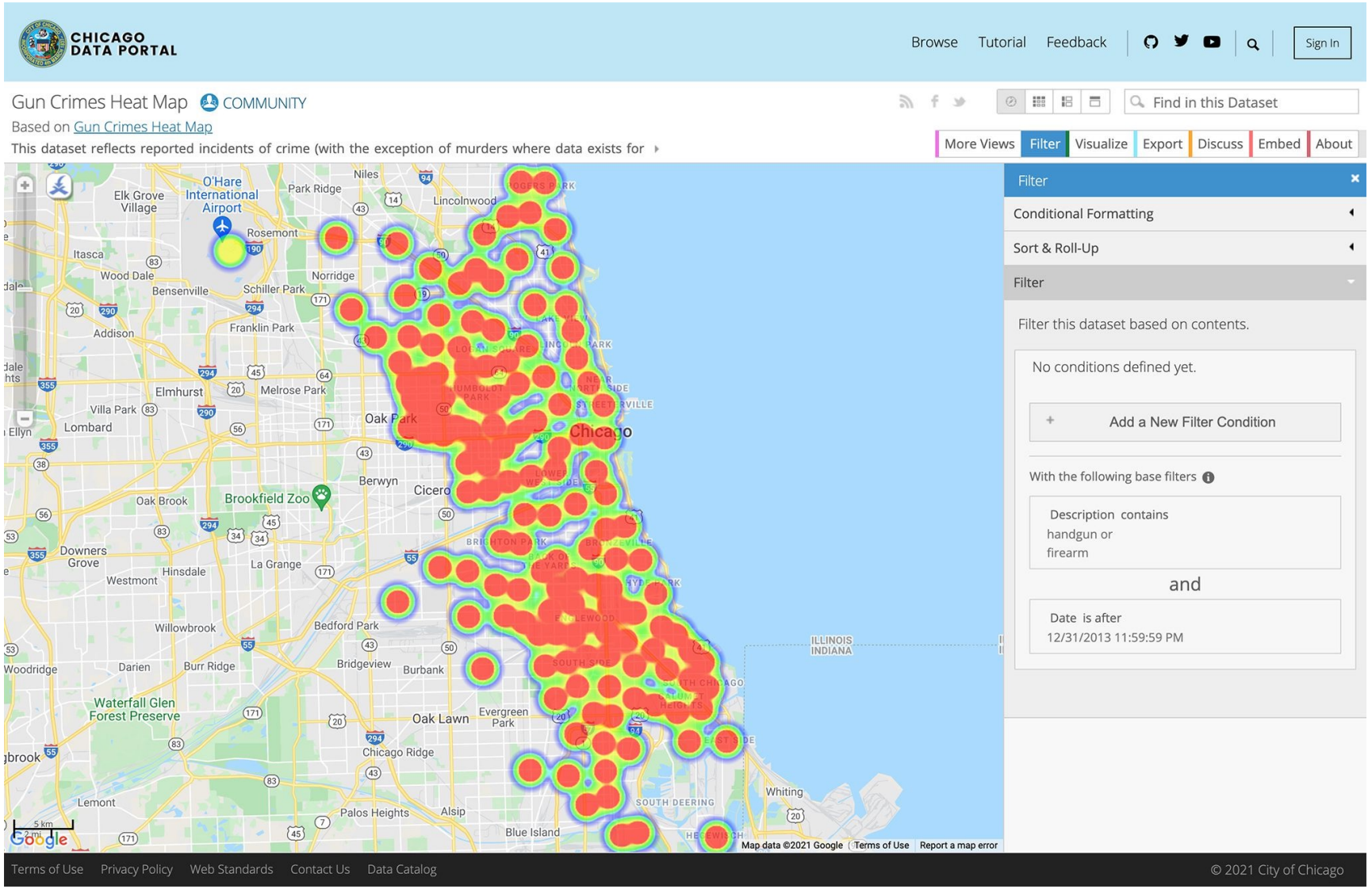
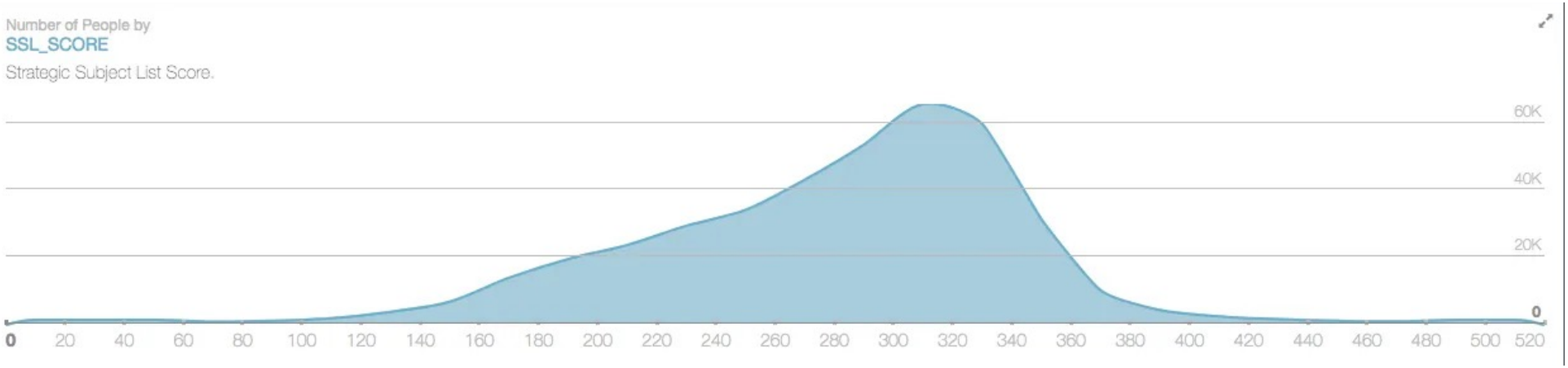


FIGURE 3. A criminal network during an internal struggle for a change at the top of the organization. The visualization layout applies diverging forces to nodes according to the group they belong to, thus resulting in the configuration depicted here. Dimension of nodes is proportional to their degree; color illustrates the criminal environment.

Chicago's "Heat List"

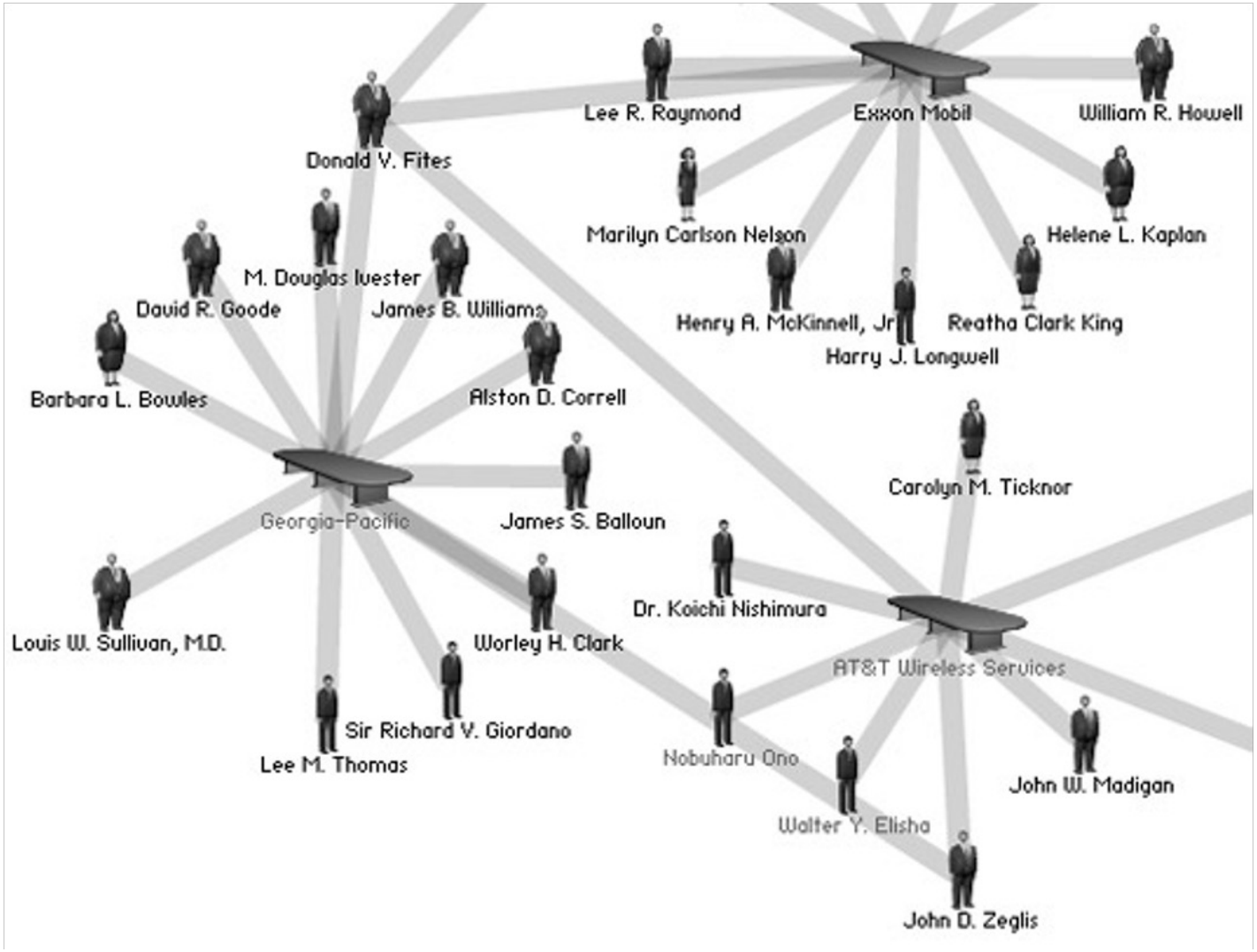


Chicago's "Heat List"

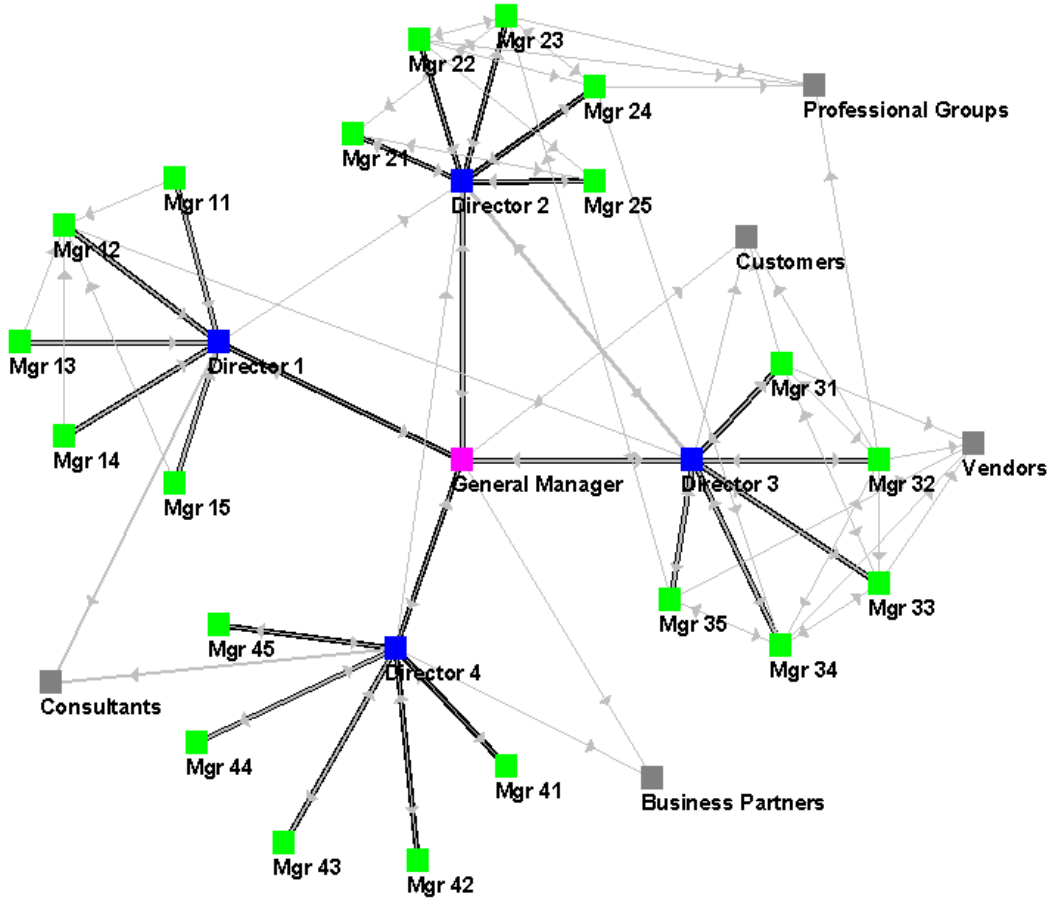


The Strategic Subjects List is, according to *Special Order S09–11*, supposed to "rank individuals with a criminal record according to their probability of being involved in a shooting or murder, either as a victim or an offender." Individuals are ranked on a score between 1 and 500, and the scores are recalculated every day. The social network of individuals — as defined by co-arrests — was previously a core factor in the SSL model.

Interlocking Directorates in the Corporate Community



Management hierarchy of a major corporation and decision-making conversations



What do the decision-making links reveal about this organization?
Some advice flows along formal ties [within the hierarchy], while other advice flows along informal ties [outside of the hierarchy].

- There is strong triangle of input and feedback amongst Directors 2 and 3 and the General Manager. These strong, trusting ties have grown and solidified over many years of working together.

- Director 1 is new to the organization. Manager 12 was hoping to get this position, but Corporate strongly pushed for Director 1. Notice that Manager 12 is still locally influential in the decision-making network. Director 1 does *not* include input from direct reports in decision-making [remember A --> B means that A seeks out B] !

- Director 4 is about to retire. He used to run this division when it was much smaller. Unlike Director 1, Director 4 *does* include inputs from his staff.

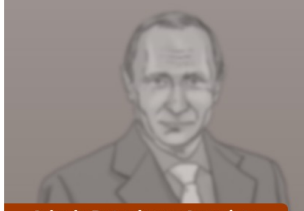
- The decision-making patterns in the departments of Directors 2 and 3 are quite different from the pattern of links in the departments of Directors 1 and 4. Directors 2 and 3 seek information from all levels of the organization -- their departments show both vertical and horizontal flows. Several managers in these departments [23, 24, 34, and 35] are boundary spanners -- connecting to others outside of their immediate group. Departments 2 and 3 are an example of participatory decision-making -- including inputs from up and down the hierarchy, as well as inside and outside the department.

- *Who do you see as the most influential person[s] in shaping decisions in this organization?*

http://www.orgnet.com/decisions.html

https://boazaugustin.wordpress.com/category/marketing-strategy/

Panama Papers The Power Players



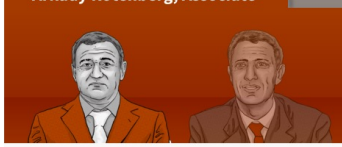
Vladimir Putin

President of Russia (2000–2008) (2012-present); Prime Minister of Russia (2008-2012)

Associates in the data: ***Arkady and Boris Rotenberg***

Related countries

Russian Federation
Finland
Switzerland

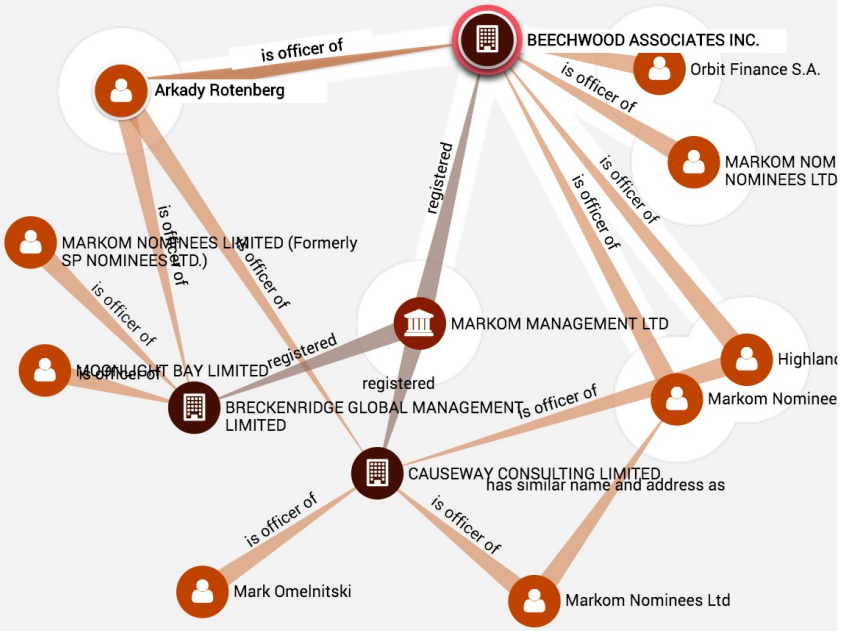


Arkady Rotenberg, *Associate*

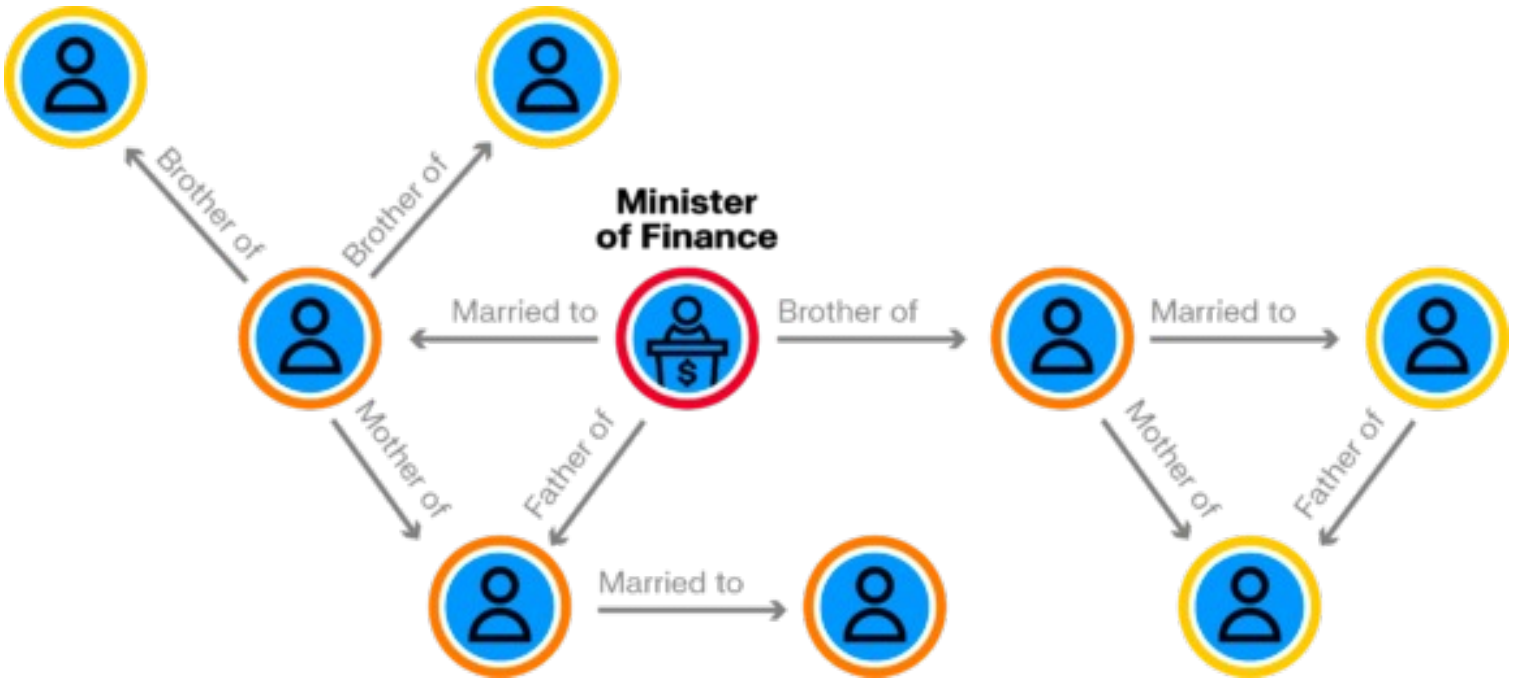
Billionaire brothers Arkady and Boris Rotenberg had the incredible good fortune of being childhood friends of Russian President Vladimir Putin. As teenagers, they bonded with Putin over Sambo, a Russian martial art, and judo. Arkady Rotenberg has insisted that they don't get preferential treatment from Putin, but during his tenure as Russian leader the brothers have amassed a multibillion dollar fortune in part through lucrative contracts with state and state-owned companies . In March 2014, they were placed under U.S. sanctions for providing support to, and benefiting from, "Putin's pet projects" including "approximately $7 billion in contracts for the Sochi Olympic Games."

Embed

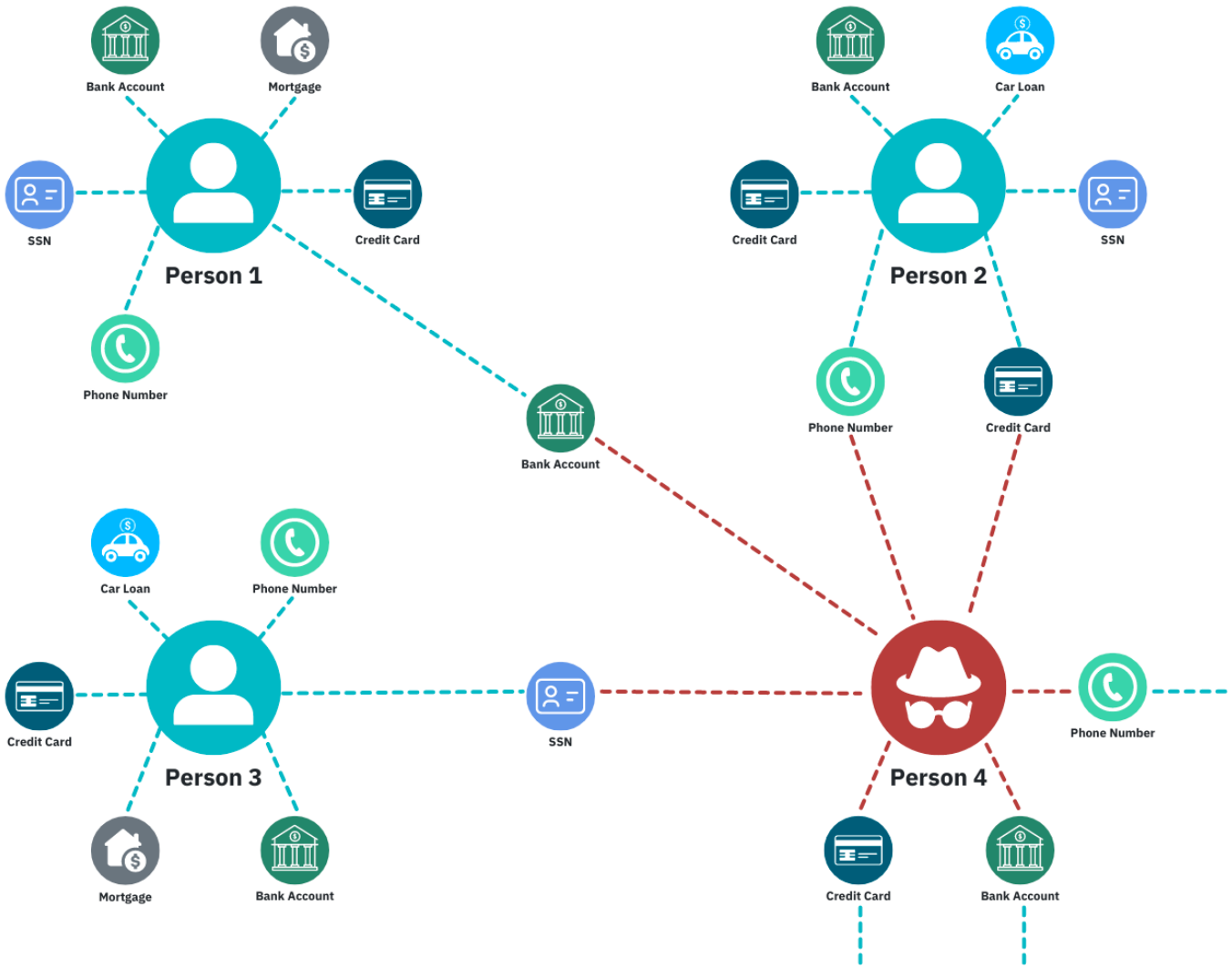
Explore the data: **Arkady Rotenberg**



Identify Politically Exposed Persons



Link Analysis for Fraud Detection



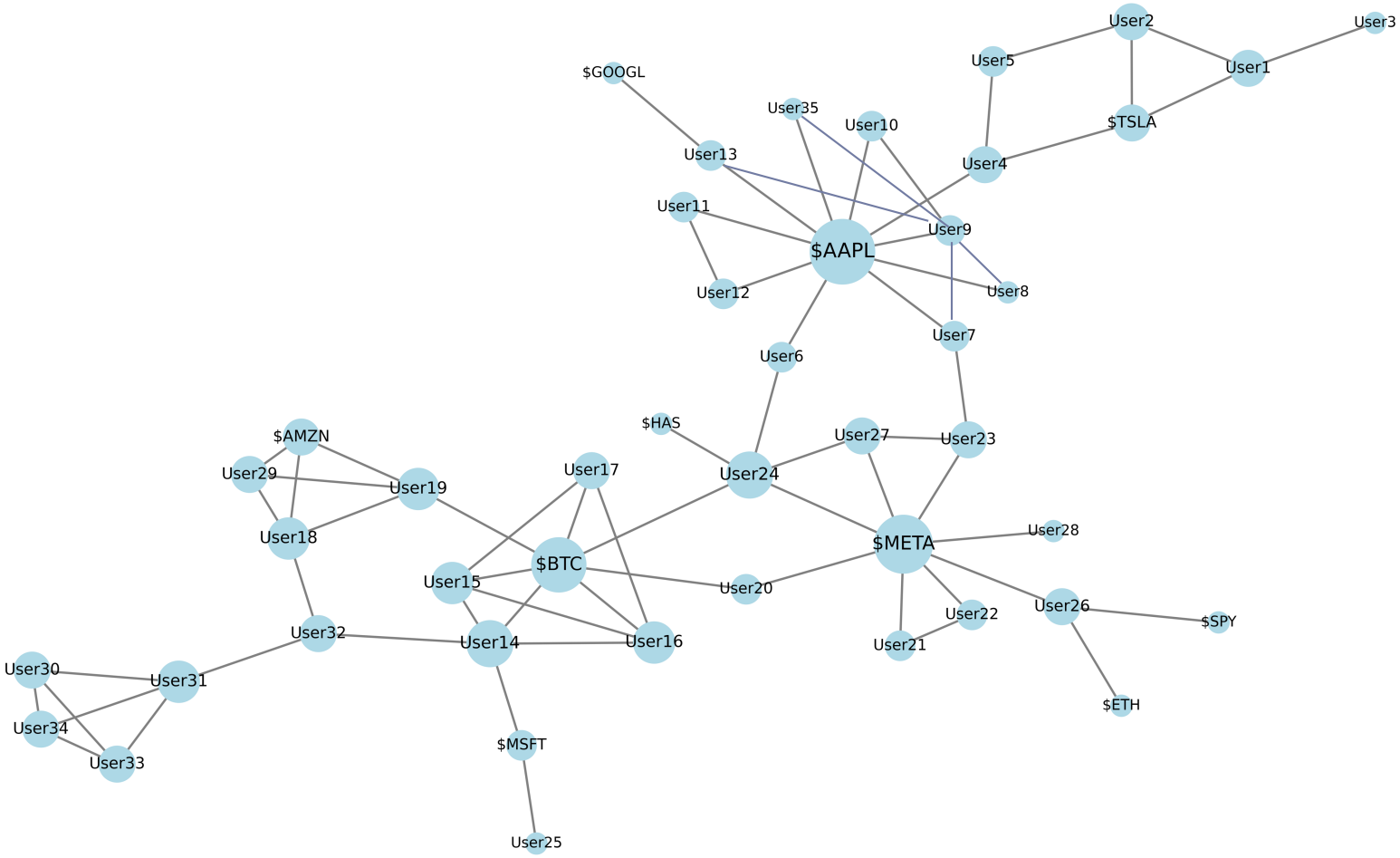
Applications in Business and Accounting

- Audit and Fraud Detection
- Audit Networks and Auditor Independence
- Corporate Governance Networks
- Help Identify Key Players and Cliques During M&A
- Institutional Investor Networks
- Charity Mega Donors and Diffusion of Innovation
- Identify Key Influencers in Organizational Network
- Analyze Consumer Behavior and Segmentation
- Assess Reputational Risk from New Clients
- Identify Key External Stakeholders Mobilizing Against Company
- Strategic Planning Tool
- Exploring Professional Networks
- Understanding Propagation of Organizational Culture and Ethics

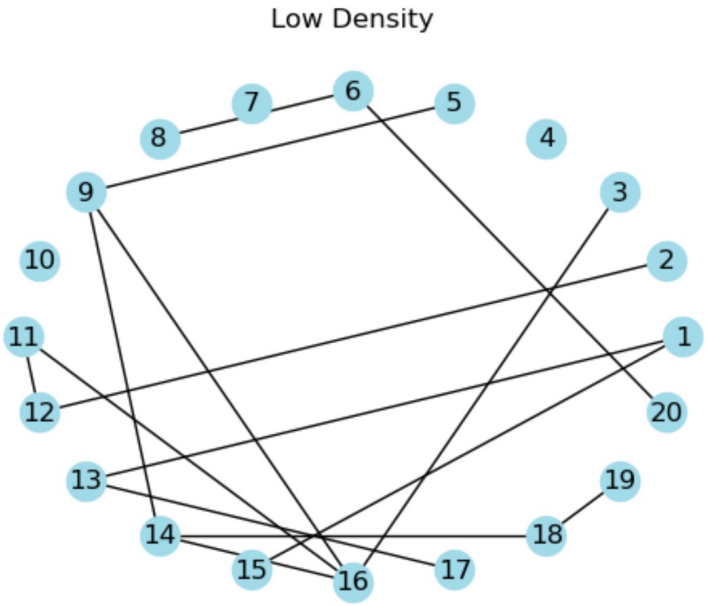
Key Network Analysis Research Questions

- What or who is in the network?
  - These are the *nodes*
- What is the connection?
  - These are the *edges* → you need *relational* data
- Whole network or ego network?
- What are you trying to find out?
  - Identify key actors?
  - Find bottlenecks in information flows?
  - Examine change over time?
  - Look for important sub-groups/communities/cliques?

Whole Network



Density


Low Density
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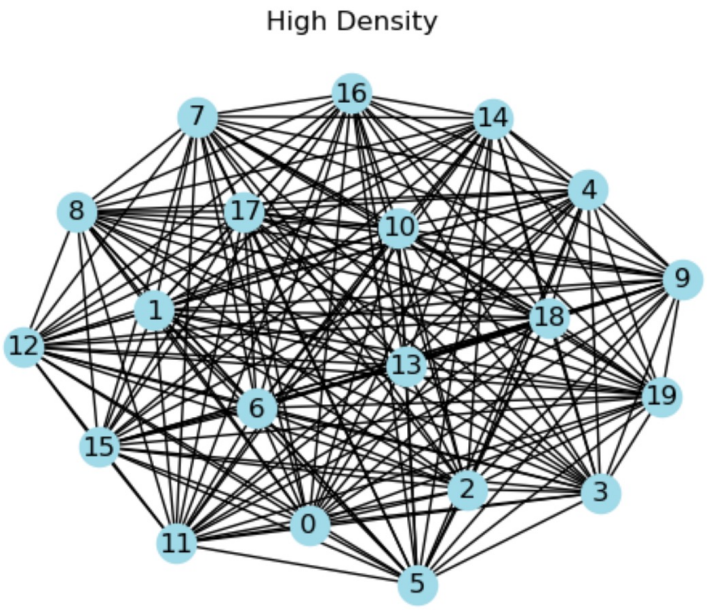
High Density
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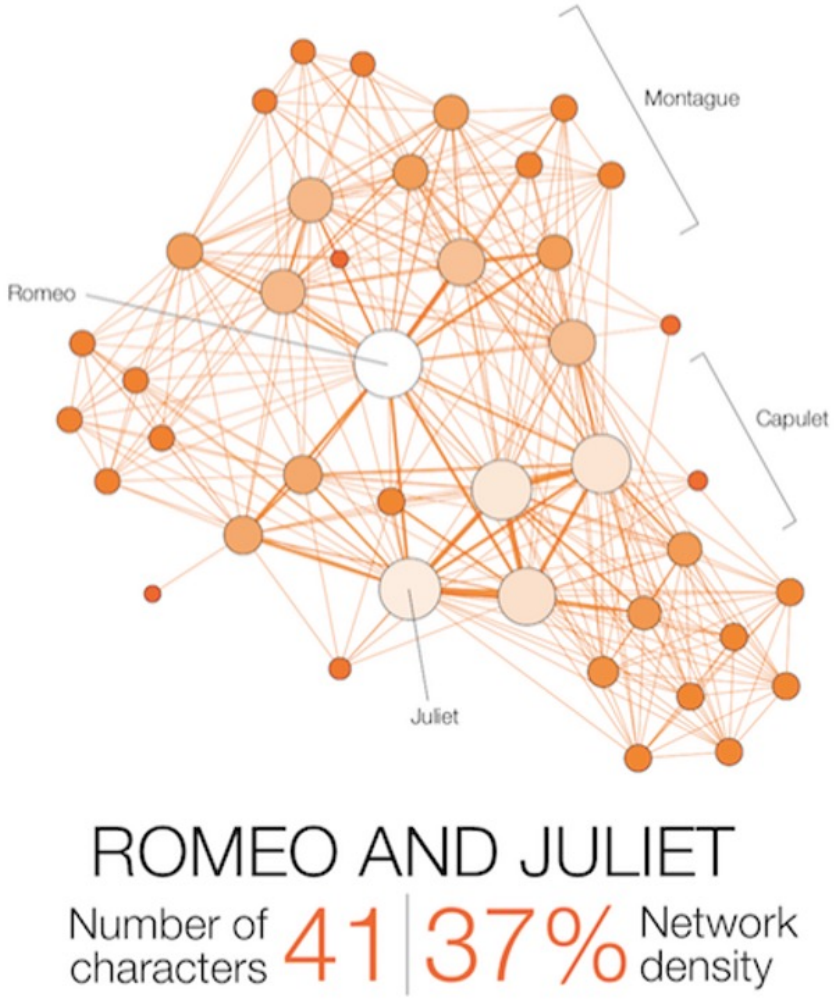
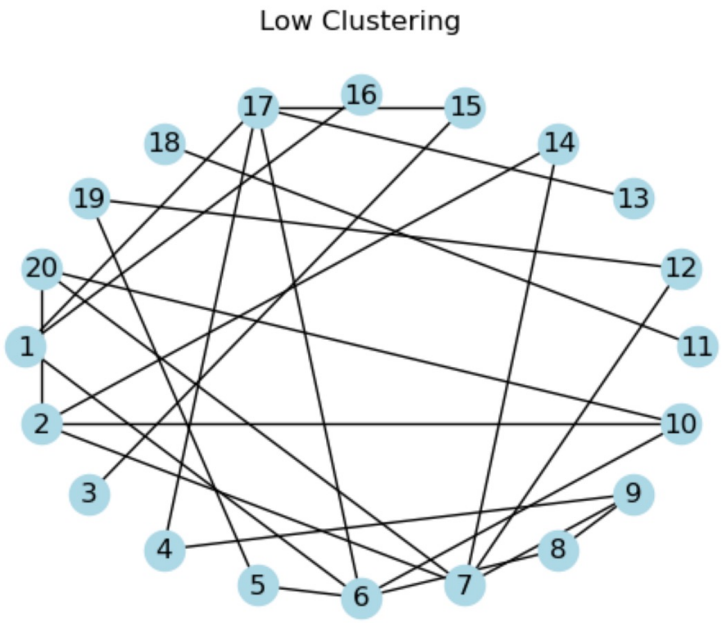
Density


Montague
Romeo
Capulet
Juliet
ROMEO AND JULIET
Number of characters
41
37%
Network density

Clustering


Low Clustering
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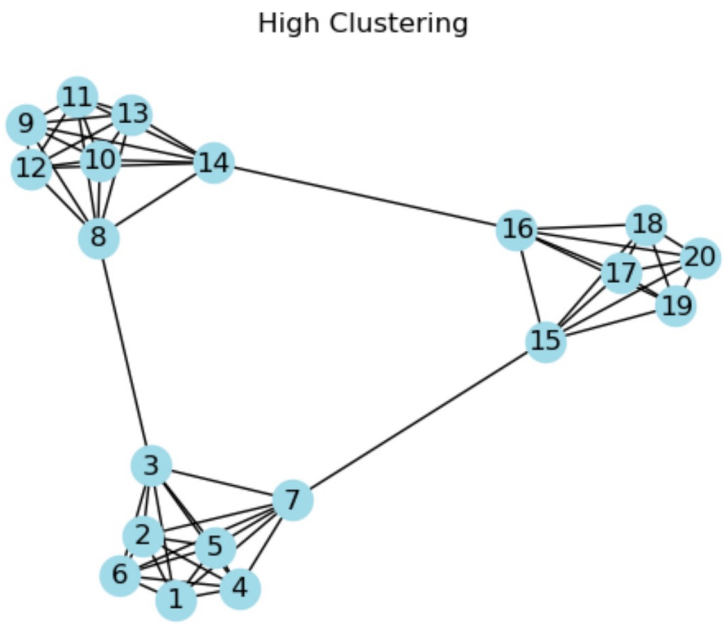
High Clustering
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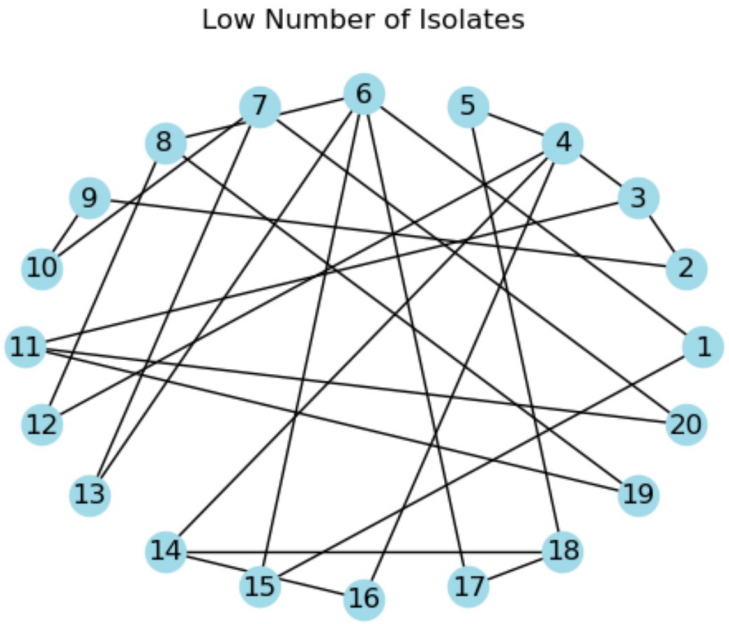
Isolates


Low Number of Isolates
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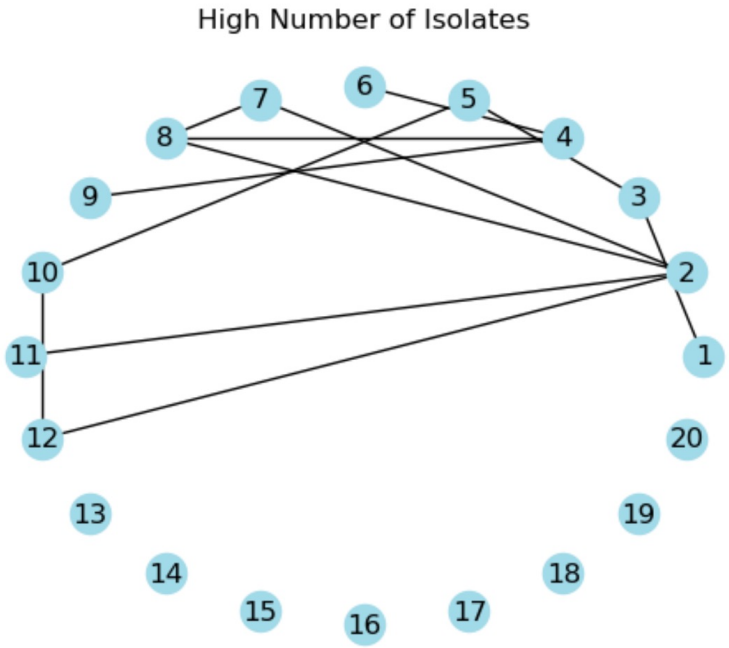
High Number of Isolates
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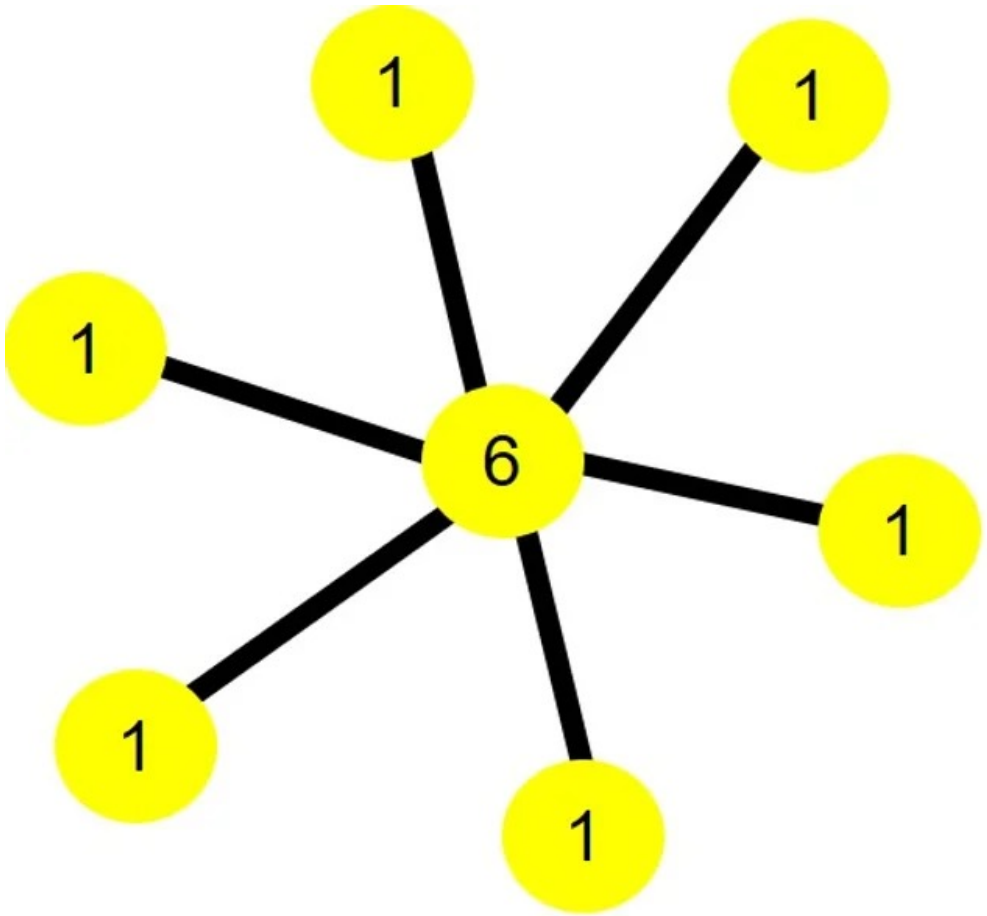
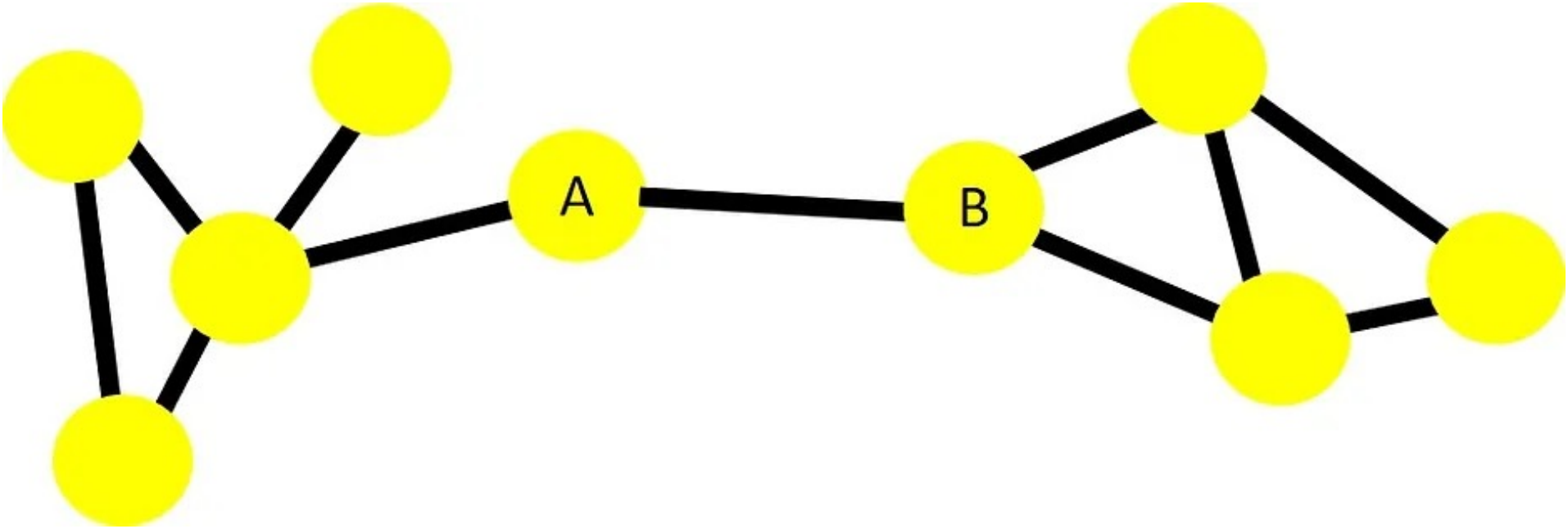
Centrality

- Can help find the "hubs" and "key players"
- Not necessarily the same as *activity*
- Multiple centrality measures

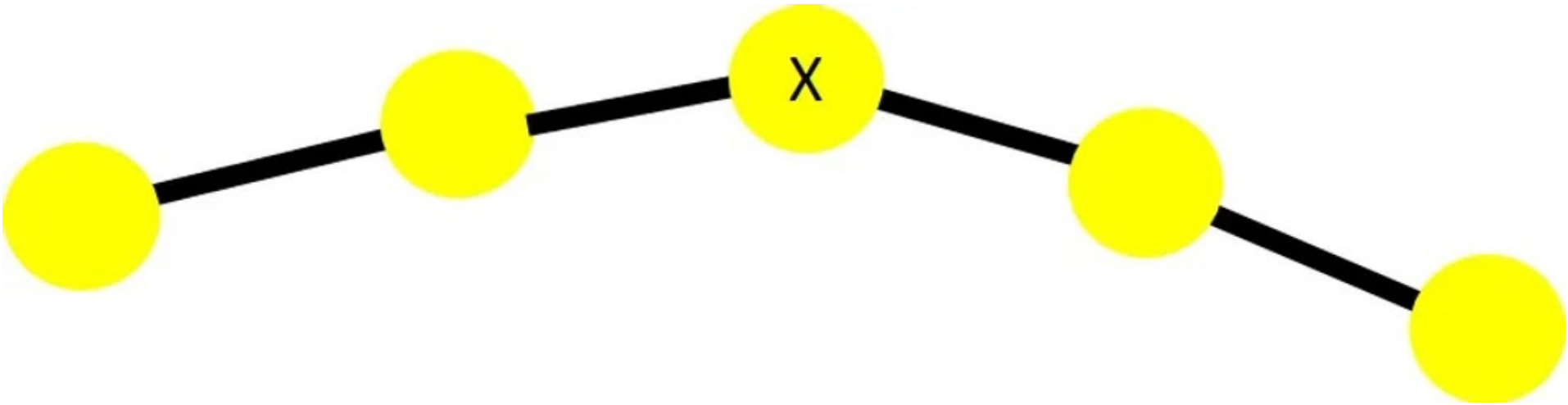
Degree Centrality



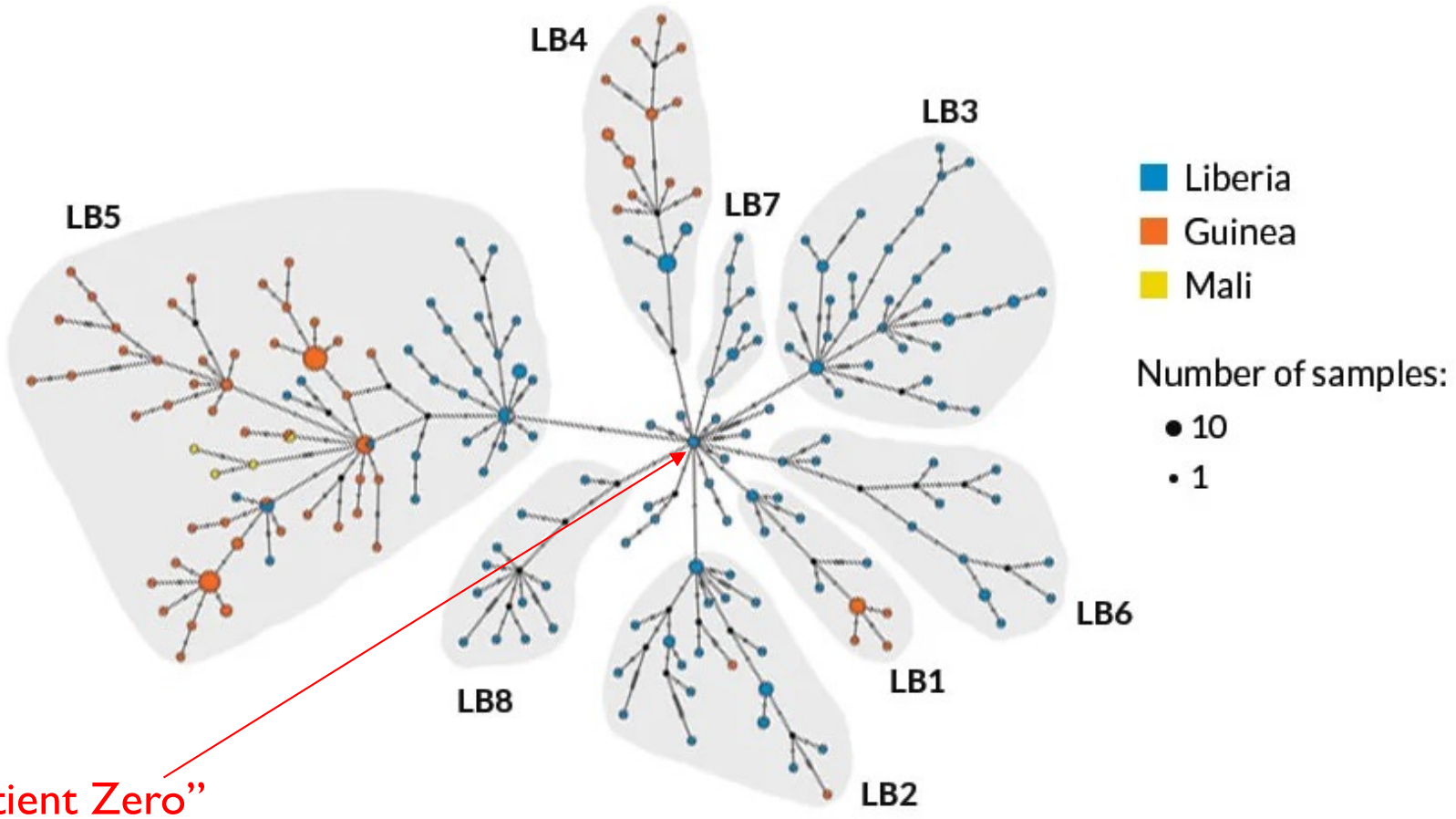
Betweenness Centrality



Closeness Centrality

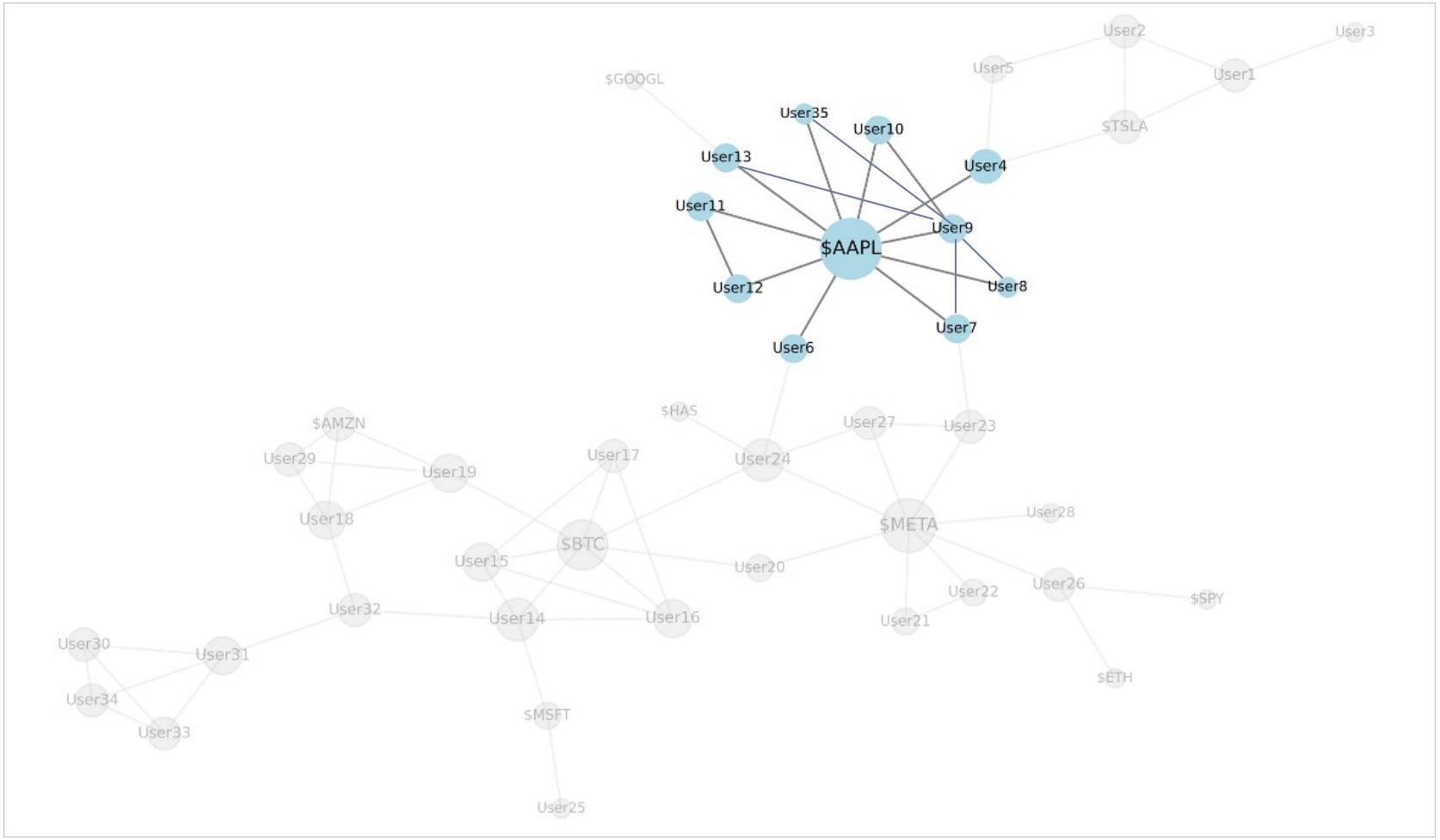


Closeness Centrality: Ebola Example



Employees with high closeness centrality also make good cyber-attack targets – the attack is easier to spread!

Ego Network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User12
User8
User7
User6
$HAS
User27
User23
$AMZN
User29
User19
User17
User24
User18
$META
User28
$BTC
User15
User20
User26
$SPY
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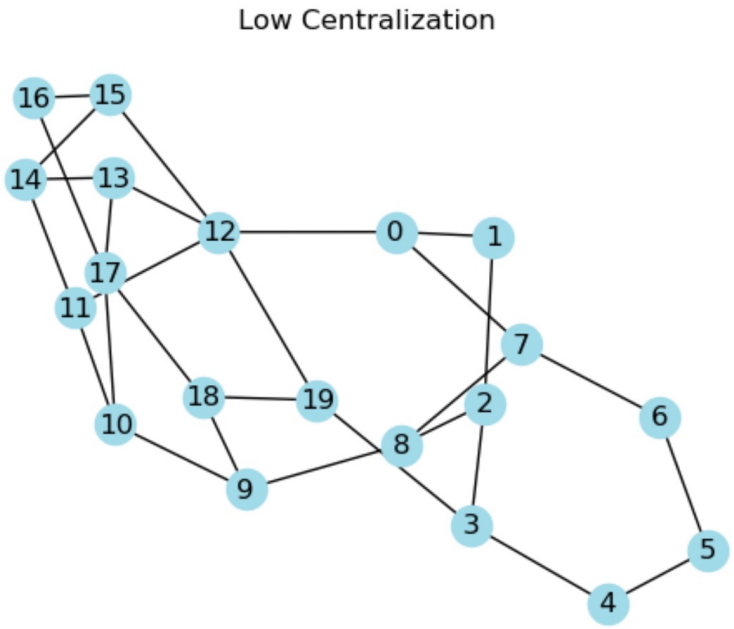
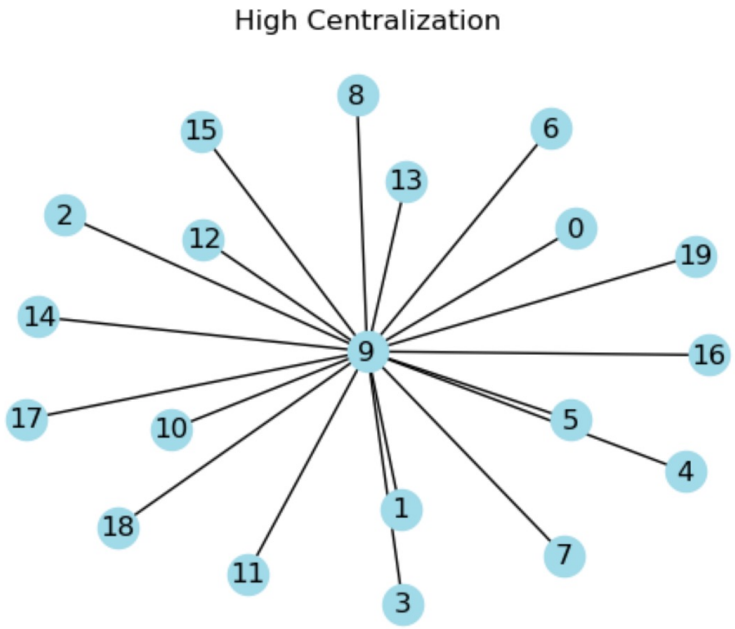
User34
User33
$MSFT
$ETH
User25

Centralization





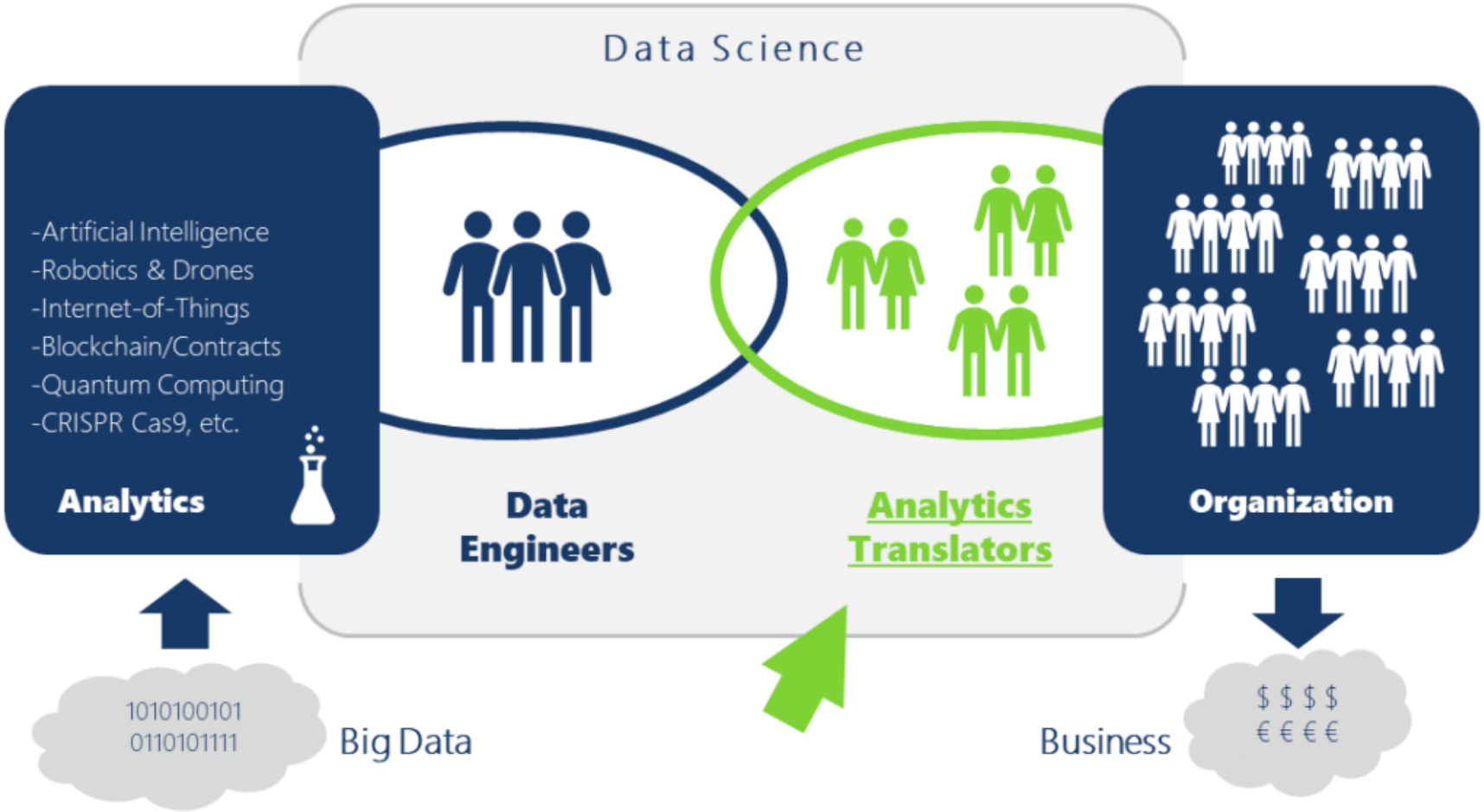
The Benefits of SNA for Organizations

SNA proves particularly valuable in inter or intra-organizational environments for several reasons:

- **Identifying Key Players:** Through measures like degree centrality or betweenness centrality, SNA helps identify who are the most connected or understanding the power dynamics within the network.
- **Mapping Knowledge Transfer:** In an organizational context, SNA can help identify influential entities in the network, crucial for information dissemination or change management initiatives.
- **Improving Communication:** By visualizing the communication pathways, SNA can help identify communication bottlenecks or isolated entities, which can then be addressed to improve information flow and collaboration.
- **Understanding Group Dynamics:** SNA can shed light on the various cliques or clusters within a network, revealing subgroups and alliances that might be invisible otherwise. This can help in managing team dynamics or in who the knowledge holders are and how knowledge spreads within the network. This can inform strategies for knowledge management and innovation.

Benefits of SNA for Accountants

- Integrating social network analysis into their analytical toolkit can empower CPAs to gain deeper insights into the dynamics of their clients' organizations, detect risks more effectively, and make more informed decisions.


Data Science
-Artificial Intelligence
-Robotics & Drones
-Internet-of-Things
-Blockchain/Contracts
-Quantum Computing
-CRISPR Cas9, etc.
Analytics
Data Engineers
Analytics Translators
Organization
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Big Data
Business
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Network Lessons for Everyone

- Be careful which network you insert yourself in
  - Could lead to bad behaviors
  - This includes work: what are the side effects of working in a bar? Or being a police officer?
- Strengthen your ties with your inner circle (close friends and family)
- Cultivate weak ties
  - A portfolio of strong and weak ties is useful to individuals in a network society
- One's position in social networks matters
  - e.g., *centrality* vs. # of connections
- People who can bridge networks (i.e., fill *structural holes*) are valuable.
- Get people to link to you – especially those with high centrality
- Transitive thinking
- Pay it forward
  - Reciprocating can be *specific* (quid pro quo) or *diffuse* (generalized)
- "Performance drives success, but when performance can't be measured, networks drive success." — Albert-Laszlo Barabási

Resources for Learning More

- **Books**
  - *Social Network Analysis: Methods and Applications* by Stanley Wasserman and Katherine Faust
  - *Introduction to Social Network Methods* by Robert Hanneman and Mark Riddle.
    - https://faculty.ucr.edu/~hanneman/nettext/
  - *Analyzing Social Networks* by Stephen Borgatti, Martin Everett, and Jeffrey Johnson
  - *Networks, Crowds, and Markets: Reasoning about a Highly Connected World* by David Easley and Jon Kleinberg
    - https://www.cs.cornell.edu/home/kleinber/networks-book/
- **Software**
  - *Networkx* (Python), *igraph (R), Gephi, etc.*
  - https://kumu.io/
- **Web**
  - https://www.reddit.com/r/networkscience
  - https://www.reliantsproject.com/category/concepts/
  - https://en.snapod.net/ NETfrix - Network Science Podcast
- **Online Courses**
  - *Social Network Analysis* (Coursera) – UC Davis https://www.coursera.org/learn/social-network-analysis
  - *Applied Social Network Analysis in Python* (Coursera) – University of Michigan https://www.coursera.org/learn/python-social-network-analysis
  - *Introduction to Network Analysis in Python* (DataCamp) – https://www.datacamp.com/courses/introduction-to-network-analysis-in-python

The Structure of Twitter $Cashtag Networks and Market Reaction to Earnings News

- Ahmed*, T., Hasan*, M., Niyirora, J., Saxton, G. D., Wong, P., & Zhang*, J.

The Structure of Twitter $Cashtag Networks and Market Reaction to Earnings News

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Abstract

Networks pervade our social and professional lives, ranging from golfing partnerships and lunch ties to inter-locking board-of-director relations, Facebook friendships, and LinkedIn connections. A core premise of the field of social network analysis is that information flows are heavily influenced by network *structure*, including the extent to which the network is dominated by a few key actors, how inter-connected network members are, and the prevalence of sub- groups and cliques. We apply this logic to the stock market, analyzing the ego network structure of Twitter cashtag discussion networks for stocks in the S&P 1,500 index.

Research Question

- We look at cashtag *ego networks* (see Figure 1).
- Each publicly-traded firm has its own user-generated ego network on Twitter/X, with messages and users connected by the inclusion of the same cashtag in a tweet. For instance, investors interested in discussing Hasbro stock (ticker: HAS) will include the $HAS cashtag in their tweets. The collection of $HAS tweets forms the HAS-focused cashtag network.
- Using concepts from *social network analysis,* we ask whether the structure of these cashtag ego networks – specifically, their centralization, density, clustering, and prevalence of isolates – affects market reactions to quarterly earnings announcements.
- To help visualize the four structural characteristics, Figure 2 shows hypothetical ego networks with low and high values on each dimension.

Ego Networks vs. Whole Networks

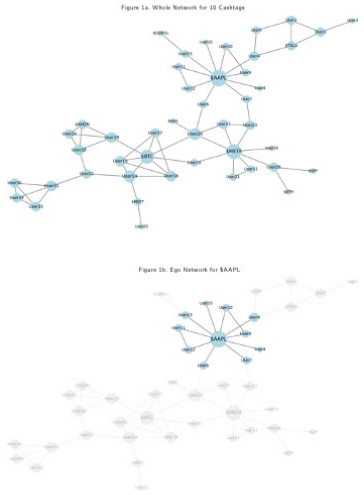

Figure 1. Hypothetical Whole Network and Constituent Ego Network

Note: Figure shows a simplified hypothetical *whole network* (top) comprising 10 cashtags and the subset *ego network* (bottom) with a single node – the $AAPL cashtag – at its core.

Four Dimensions of Network Structure

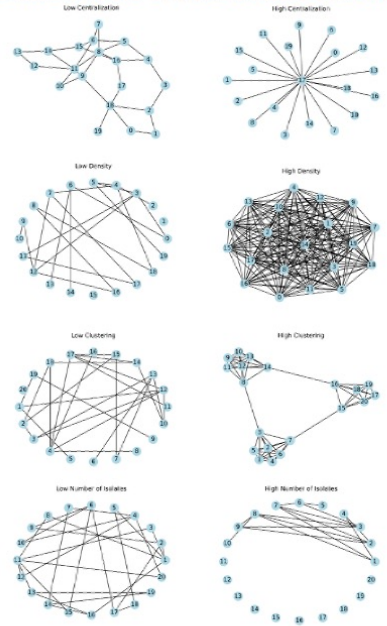

Figure 2. Hypothetical Ego Networks with Low and High Values on Four Key Structural Dimensions

Note: Each of the above networks has 20 users connected to the cashtag "ego," but the structure of each network is distinct. We have removed the ego (i.e., the cashtag) from the above graphs, given that by definition the ego is the central node in its own network.

Hypotheses

- H1: Abnormal returns are negatively related to network centralization.
- H2: Abnormal returns are negatively related to network density.
- H3: Abnormal returns are positively related to network clustering.
- H4: Abnormal returns are positively related to the presence of isolates.

Method

- We examine market reactions to 4,313 quarterly earnings announcement events in 2018 for S&P 1,500 firms.
- The independent variables come from cashtag tweets (e.g., $AAPL for Apple stock) on Twitter/X.
- Using *social network analysis* tools, we work in Python to generate measures of network *Centralization, Density, Clustering,* and *Proportion of Isolates* for each network over the 3-day period (t-1 to t+1) around each event window.
- We then estimate the following regression model for firm *i* and earnings announcement *t:*

$$CAR_{it} = \beta_0 + \beta_1 Centralization + \beta_2 Density + \beta_3 Clustering + \beta_4 Isolates + \sum Controls \quad (1)$$

Main Results

Table 3. Network Structure and Market Reaction to Earnings News

	$CAR_{[-1,+1]}$ (1)	$CAR_{[-1,+1]}$ (2)	$CAR_{[-1,+1]}$ (3)	$CAR_{[-1,+1]}$ (4)	$CAR_{[-1,+1]}$ (5)
Centralization	-0.06**				-0.04*
	(0.01)				(0.02)
Density		-0.70**			-0.80**
		(0.09)			(0.2)
Clustering			0.02**		0.02**
			(0.006)		(0.007)
Isolates				0.02*	-0.003
				(0.007)	(0.01)
SUR	0.02	0.02	0.02	0.02	0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Analyst Coverage	-0.0002	-0.0004+	-0.0004+	-0.0002	-0.0005*
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
News Coverage	0.0002	0.0001	0.0002*	0.0003*	0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Size	0.00010	0.00009	-0.001	0.0003	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Book-to-Market	0.01**	0.01**	0.02**	0.01**	0.02**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Number of Shareholders	0.00009	-0.00009	0.00009	-0.000006	0.00009
	(0.0005)	(0.0005)	(0.0006)	(0.0006)	(0.0006)
Institutional Ownership	0.01+	0.02*	0.02*	0.02+	0.02*
	(0.008)	(0.008)	(0.009)	(0.008)	(0.009)
Abnormal Tweets	0.0009**	0.0008**	0.0007**	0.0008**	0.0008**
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Industry Fixed effects	Yes	Yes	Yes	Yes	Yes
Constant	-0.02*	-0.02*	-0.04**	-0.04**	-0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Observations	4313	4313	3876	4313	3876
Adjusted R^2	0.049	0.056	0.044	0.040	0.058

Table presents results from robust regressions of equation (1) on non-directed versions of the *t-1* to *t+1* cashtag networks, where the dependent variable $CAR_{[-1,+1]}$ is the cumulative abnormal return around the firm's earnings announcement date. Control variables are as defined in Appendix A. Standard errors are shown in parentheses. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$

Findings

- Our finding that abnormal market returns are negatively associated with network centralization and density suggests that markets favour decentralized information flows that eschew dominance by a few influential actors. Conversely, the positive relationships with the presence of unconnected isolates and sub-group clusters indicate the value of diverse, polycentric sources of information.
- Additional analyses looking at interactions with earnings surprise, as well as tests based on *directed networks* and networks with high vs. low numbers of followers, confirm the central findings.

Take-away message

- Our findings underscore the intricate relationship between the flow of information through cashtag networks and market reactions to earnings news.
- These results highlight the importance of understanding network structures in predicting stock market movements, offering novel insights into the behavioral aspects of financial markets.

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Thank you

Social Network Analysis Topics

Some ideas to get you thinking

SNA in the Social Sciences

- Effect of network structure on individual behavior and outcomes
  - Job leads, smoking, health, disease, relationships, mental health
  - Health behaviors, spread of disease, diffusion of health interventions
  - Theories: social capital, diffusion of innovation, role of networks in social support
- Impact of network structure on communication patterns
- Role of lobbying and funding networks on political decisions
- Role of networks on consumer behavior
- Education networks and peer influences, learning communities, and the spread of educational innovations
- Understanding how social networks influence environmental behaviors, conservation efforts, and the diffusion of sustainable practices
- Analyzing the role of networks in the spread of information during crises, the coordination among different organizations, and the mobilization of resources and support

SNA in Other Business Fields

- **Organizational Networks:** SNA helps in understanding how information flows within an organization, identifying key influencers, and optimizing team structures for better collaboration and efficiency.
- **Innovation and Knowledge Transfer:** Analyzing networks to understand how ideas and knowledge move across individuals and organizations, facilitating innovation diffusion within industries or clusters.
- **Supply Chain Management:** Mapping out the network of suppliers, manufacturers, and distributors to identify critical nodes, improve efficiency, and assess risks within the supply chain.
- **Market Analysis:** Understanding the relationships between different market actors, including competitors, customers, and suppliers, to identify market structures, competitive dynamics, and potential collaboration or merger opportunities.
- **Consumer Behavior and Segmentation:** Analyzing social networks to understand consumer influence patterns, identify brand ambassadors, and tailor marketing strategies based on the social structures of target customer segments.
- **Human Resource Management:** Using SNA to identify leadership potential, evaluate communication patterns among employees, and design more effective organizational structures.

SNA for Accountants

Social network analysis (SNA) can be a valuable analytical tool for CPAs in various ways:

- **Fraud Detection**: SNA can help CPAs detect potential fraud by analyzing patterns of communication and connections within networks. Suspicious relationships or transactions can be identified through anomalies in network structures.
- **Risk Assessment**: CPAs can use SNA to assess risks associated with clients or business partners by examining their network connections. This can provide insights into potential reputational risks or exposure to fraudulent activities.
- **Client Relationship Management**: SNA can aid CPAs in understanding the strength and nature of relationships within their client base. By analyzing communication patterns and interactions, CPAs can identify key influencers, decision-makers, and potential opportunities for business development.
- **Knowledge Sharing and Collaboration**: CPAs can leverage SNA to enhance knowledge sharing and collaboration within their firms. By mapping communication networks, CPAs can identify individuals or teams with valuable expertise and facilitate collaboration among them.
- **Identifying Key Stakeholders**: SNA can help CPAs identify key stakeholders and influencers within an organization or industry. Understanding the structure of stakeholder networks can inform strategic decision-making and stakeholder engagement efforts.
- **Optimizing Workflow and Processes**: By analyzing communication and collaboration networks, CPAs can identify bottlenecks, inefficiencies, and opportunities for streamlining workflows and processes within their firms.
- **Talent Management**: SNA can assist CPAs in talent management by identifying high-performing individuals or teams and understanding their collaboration networks. This can inform decisions related to training, promotion, and team composition.
- **Compliance Monitoring**: CPAs can use SNA to monitor compliance with regulations and internal policies by analyzing communication patterns and connections within organizations. This can help identify potential compliance risks and areas for improvement.
- **Mergers and Acquisitions**: SNA can provide valuable insights during mergers and acquisitions by analyzing the networks of the organizations involved. CPAs can assess cultural compatibility, identify key personnel, and anticipate integration challenges through network analysis.
- **Strategic Planning**: SNA can inform strategic planning efforts by mapping out the networks of competitors, clients, and other stakeholders. CPAs can identify emerging trends, competitive threats, and opportunities for strategic partnerships through network analysis.
- Integrating social network analysis into their analytical toolkit can empower CPAs to gain deeper insights into the dynamics of their clients' organizations, detect risks more effectively, and make more informed decisions.

SNA in Quantitative Academic Accounting Research

- **Audit and Fraud Detection:** Applying SNA to analyze transactions and relationships within financial data to identify unusual patterns, potential fraud, and collusion networks. Also applicable to tax evasion.
- **Audit Networks and Auditor Independence:** Using SNA to examine ties between auditors and firms. Studying the *social* ties of auditors could also shed light on auditor performance.
- **Corporate Governance:** Investigating the networks of board members and executives across companies to understand governance structures, potential conflicts of interest, and the impact of these networks on corporate policies and performance.
- **Financial Markets Analysis:** Studying the networks of investors, institutions, and markets to understand the flow of capital, market sentiment, and the impact of interconnectedness on financial stability and risk.
- **Management Accounting:** Analyzing internal networks to improve cost control, performance measurement systems, and resource allocation within an organization.
- **Regulatory Compliance and Risk Management:** Using SNA to understand the relationships and transactions between entities to ensure compliance with regulations and to identify and manage risks associated with financial networks.
- **Inter-organizational Networks:** Examining the alliances, joint ventures, and partnerships between firms to assess the strategic implications of these networks on industry structure and competitive advantage.
- **Institutional Investor Networks:** Applying SNA to firms' network ties to large institutional investors.
- **Charity Mega-Donors:** Impact on programs and budgets of nonprofit organizations linked to large donors.
- **Diffusion of Innovation:** Analyzing networks to understand how accounting policies and practices spread across individuals and organizations. For example, one could examine the role of institutional investors, activist groups, and regulatory bodies in promoting ESG practices.

SNA in Qualitative Academic Accounting Research

- In qualitative research, Social Network Analysis (SNA) can be a powerful tool for accounting scholars to uncover nuanced insights into the relational dynamics and contextual factors that influence accounting practices and financial decision-making. Here are several examples of how SNA could be utilized in qualitative accounting research:
- **Exploring Professional Networks** - Accounting scholars could use SNA to explore the informal and formal networks among professionals in the accounting field, such as auditors, corporate accountants, and regulatory bodies. By analyzing these networks qualitatively, researchers can understand how professional relationships, mentorship, and peer influences shape practices, ethical standards, and the diffusion of new accounting methods.
- **Understanding Organizational Culture and Ethics** - SNA can help in examining the social networks within an organization to understand how organizational culture and ethics are propagated among employees. Qualitative analysis of these networks can reveal how norms and values related to transparency, accountability, and ethical behavior are maintained or challenged within the firm.
- **Investigating Governance and Oversight Networks** - Researchers can use SNA to study the networks of governance structures, including boards of directors and their connections to other companies and industries. Qualitative investigations can provide insights into how these networks influence corporate governance practices, conflict of interest, and the effectiveness of oversight mechanisms.
- **Analyzing Collaboration and Knowledge Sharing -** SNA can be applied to study how knowledge about accounting practices and innovations is shared within and across organizations. Through qualitative analysis, scholars can explore the role of collaborative networks in fostering innovation, compliance with evolving standards, and the adoption of best practices in accounting.
- **Studying the Impact of Regulation -** By mapping out the networks of regulatory bodies, accounting firms, and the entities they regulate, researchers can qualitatively analyze how regulations are interpreted, implemented, and negotiated within these networks. This approach can provide deep insights into the regulatory process, compliance challenges, and the dynamics of regulatory change.
- **Examining Financial Fraud and Compliance Networks -** SNA can be used to qualitatively investigate the networks involved in financial fraud and compliance, including the interactions between perpetrators, whistleblowers, regulators, and victims. This research can uncover patterns of behavior, collusion, and the social dynamics that facilitate or deter fraud.
- **Delving into Inter-organizational Networks** - Accounting scholars could explore the networks of collaboration and competition between firms, such as through joint ventures, alliances, and consortia. Qualitative SNA can help in understanding how these inter-organizational networks affect financial strategies, risk management practices, and the collective response to market changes.
- **Investigating the Role of Technology in Accounting Networks** - Researchers might use SNA to qualitatively explore how accounting software and platforms facilitate or hinder connections among accountants, clients, and regulatory entities. This can provide insights into the role of technology in shaping accounting practices and client relationships.
- In qualitative research, SNA offers a framework to not only map out the structure of these networks but also to delve into the quality of relationships, the meanings attributed to these connections, and the context in which these networks operate. Through interviews, observations, and document analysis, accounting scholars can enrich their understanding of the complex social dynamics that underpin the accounting profession and practice.