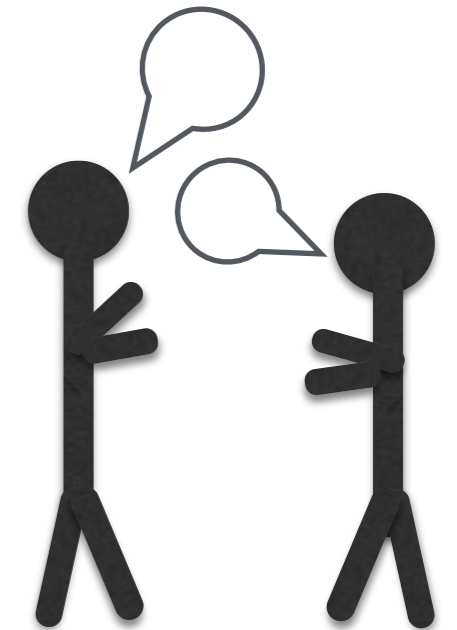
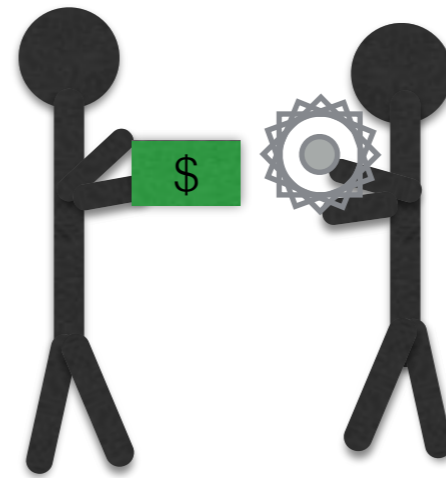


Share this: social networks and the spread of information

Kate Anderson
Grinnell, April 2015

Social Science and Human Interaction

- Trade
- Bargaining
- Learning
- Voting
- Opinion formation
- Job matching
- Team assembly
- Problem solving

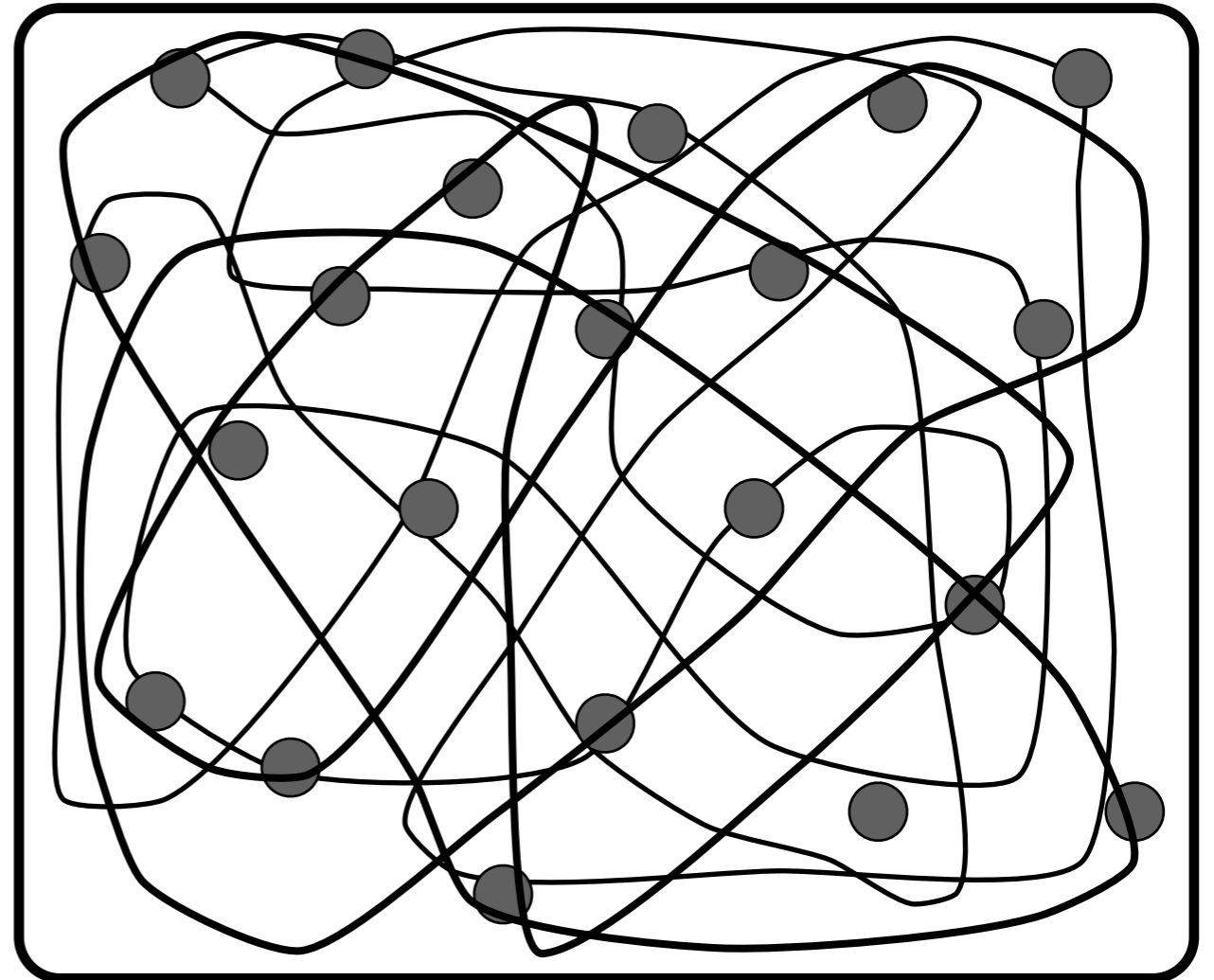


Social Science and Human Interaction

Many traditional social science models assume “Perfect Mixing”: everyone interacts with everyone else at random

In some contexts, this assumption is useful.

But in others, it kind of misses the point!





An example...

- My husband's geeky growth chart, created for our daughter's first birthday: geeky-dad.tumblr.com
 - March 15th, 2011: uploaded--1,500 downloads
 - March 28th, 2011: 2,500 downloads
 - March 29th, 2011: posted to metafilter
 - March 30th, 2011: 30,000 downloads
- To date, it has been downloaded over 60,000 times

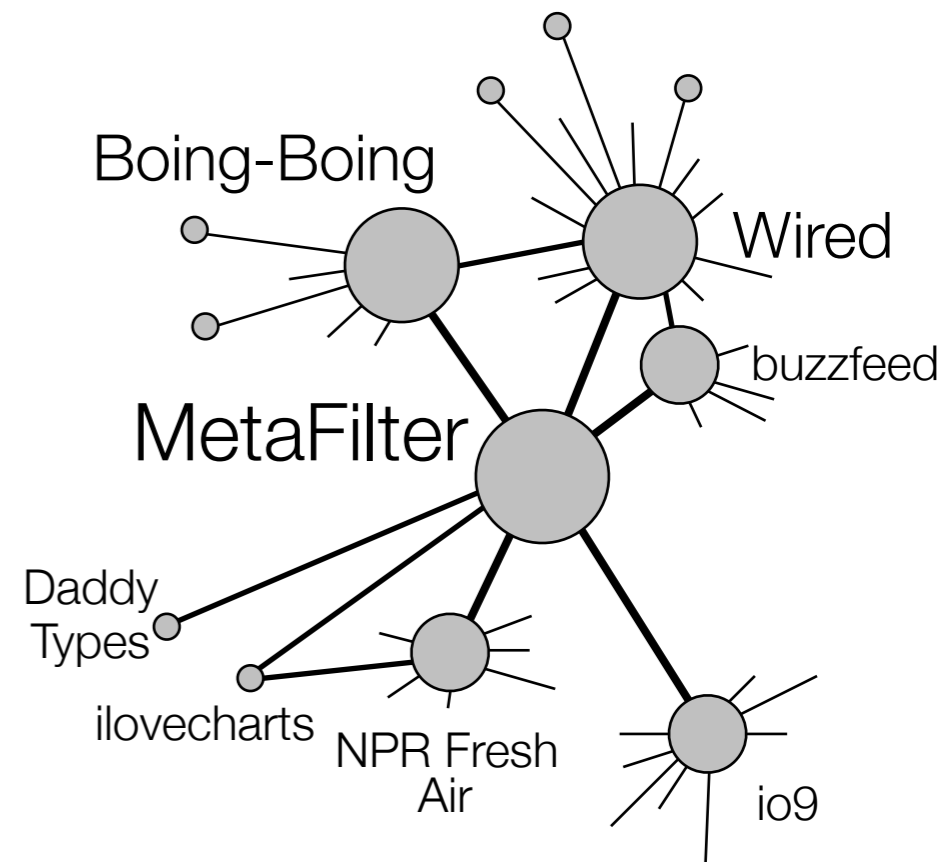


An example...

Perfect mixing is not the right way of looking at the spread of the growth chart

Not every person who posts the chart is equally important.

- We pay more attention to some people than others
- The big shots tend to pay attention to each other



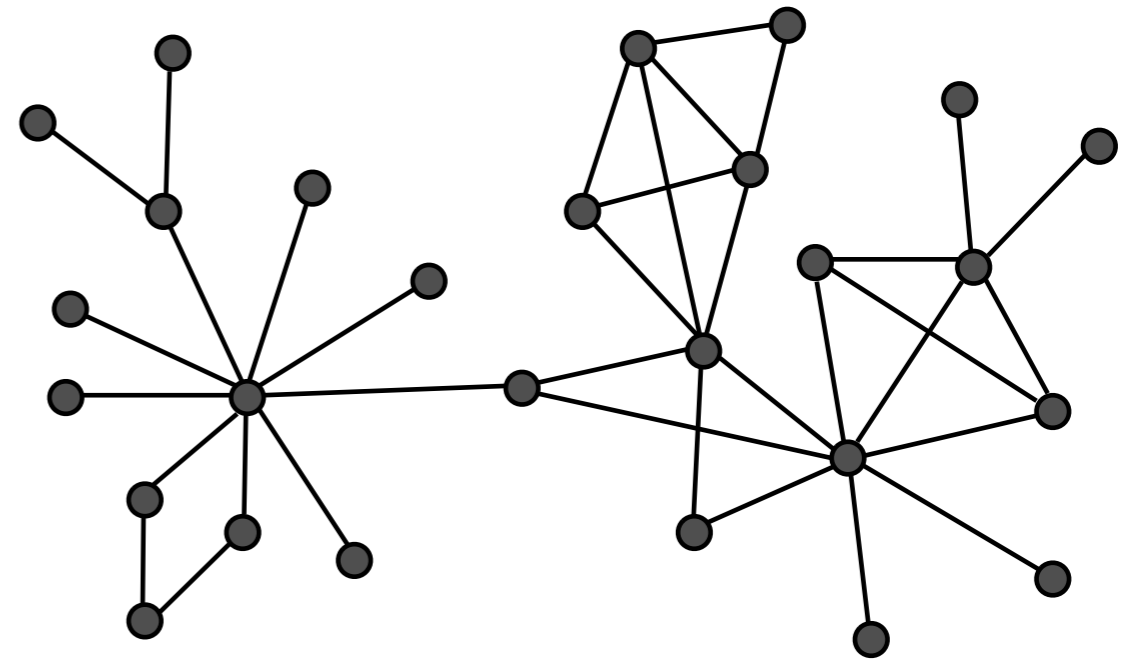
This heterogeneity has implications for how we understand the success of this chart!

Social Networks are a more complex model of how people interact...

Nodes: people, firms, organizations

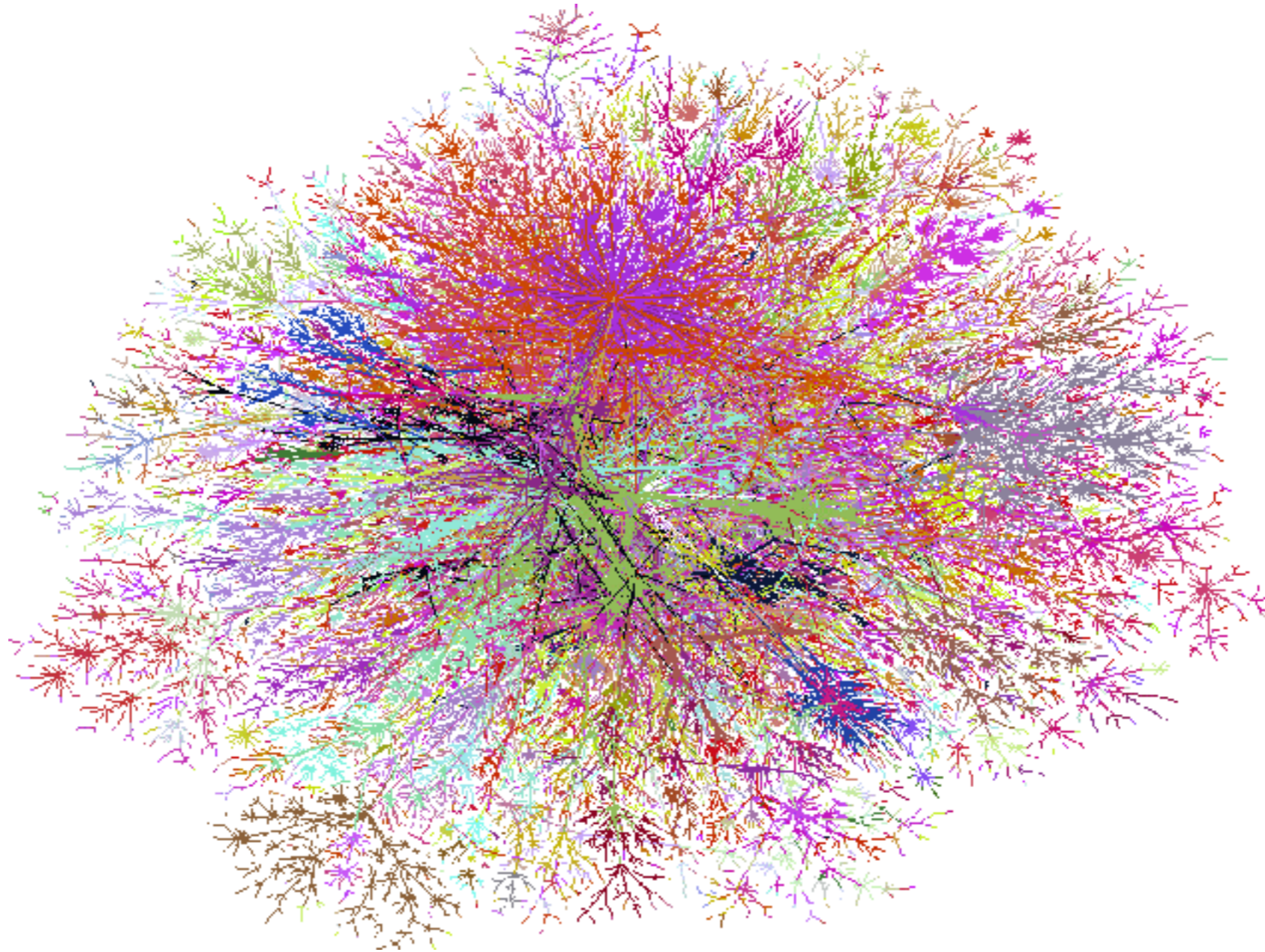
Edges: interactions

- Friendship
- Collaboration
- Buying and selling
- Political influence
- Geographical proximity



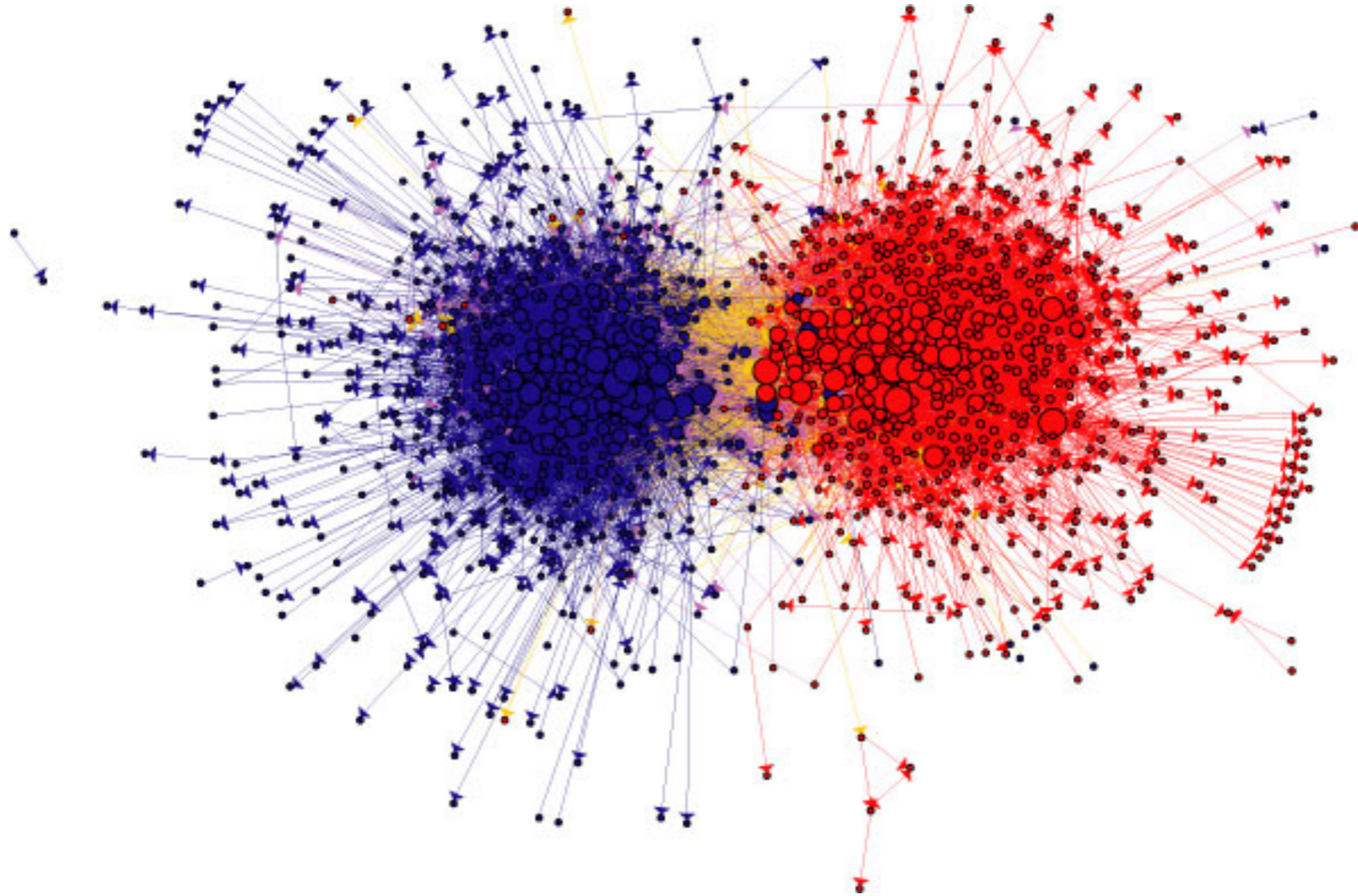
How you define a node and an edge depends on what you want to understand...

The Physical Internet



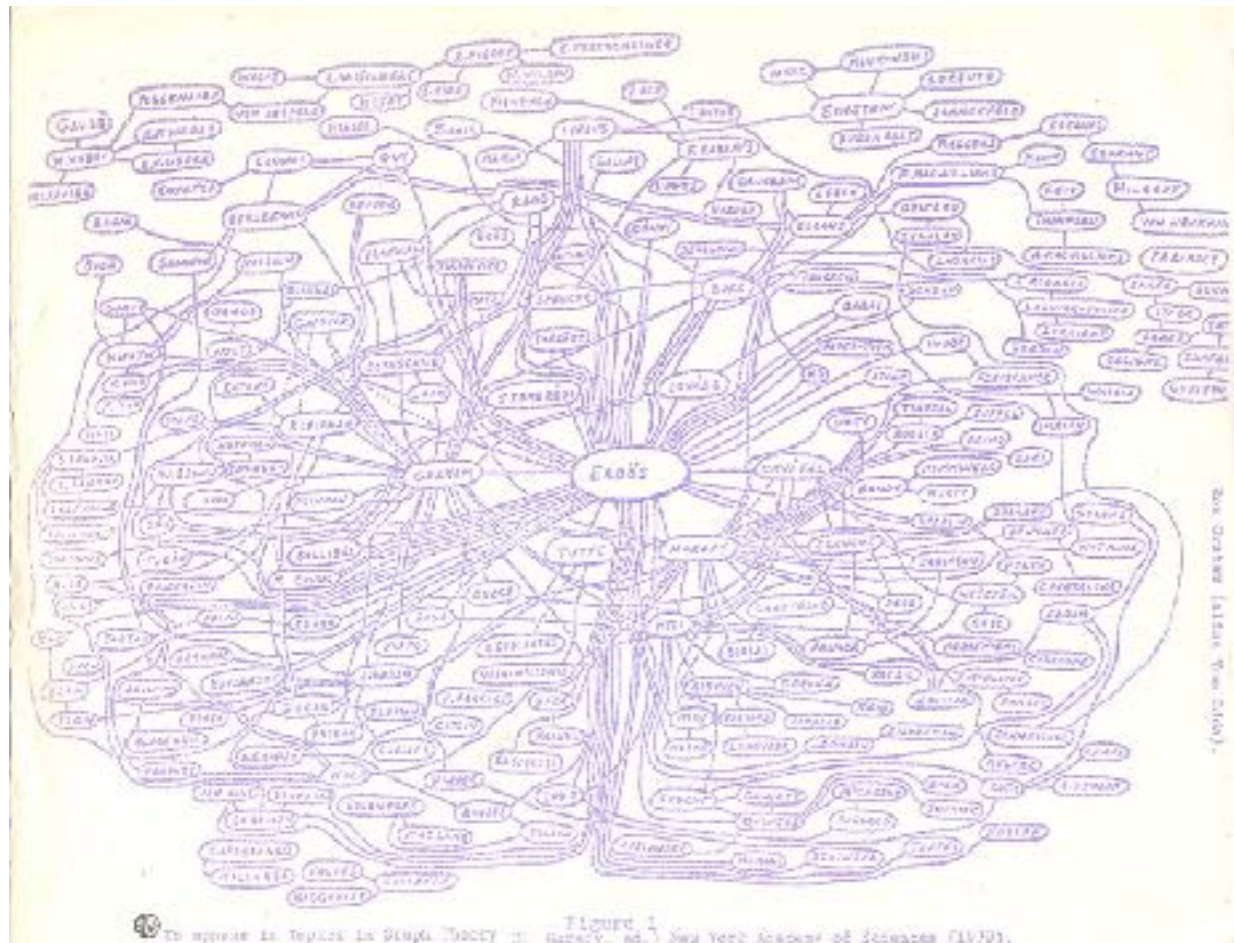
Source: Wired Magazine (1998)
Created by Bill Cheswick and Hal Burch

2004 Political Blogs



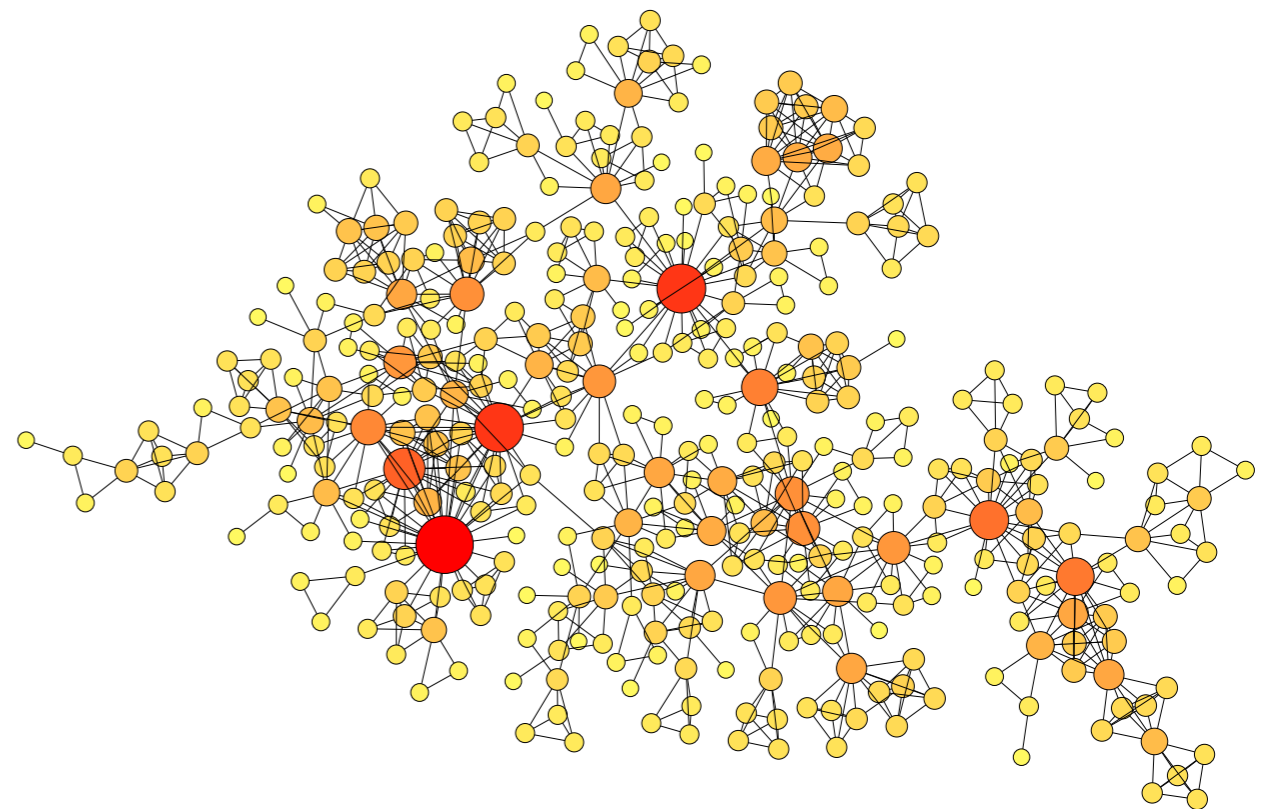
Ref: Lada Adamic and Natalie Glance (2005)

Coauthorship Networks



Mathematics

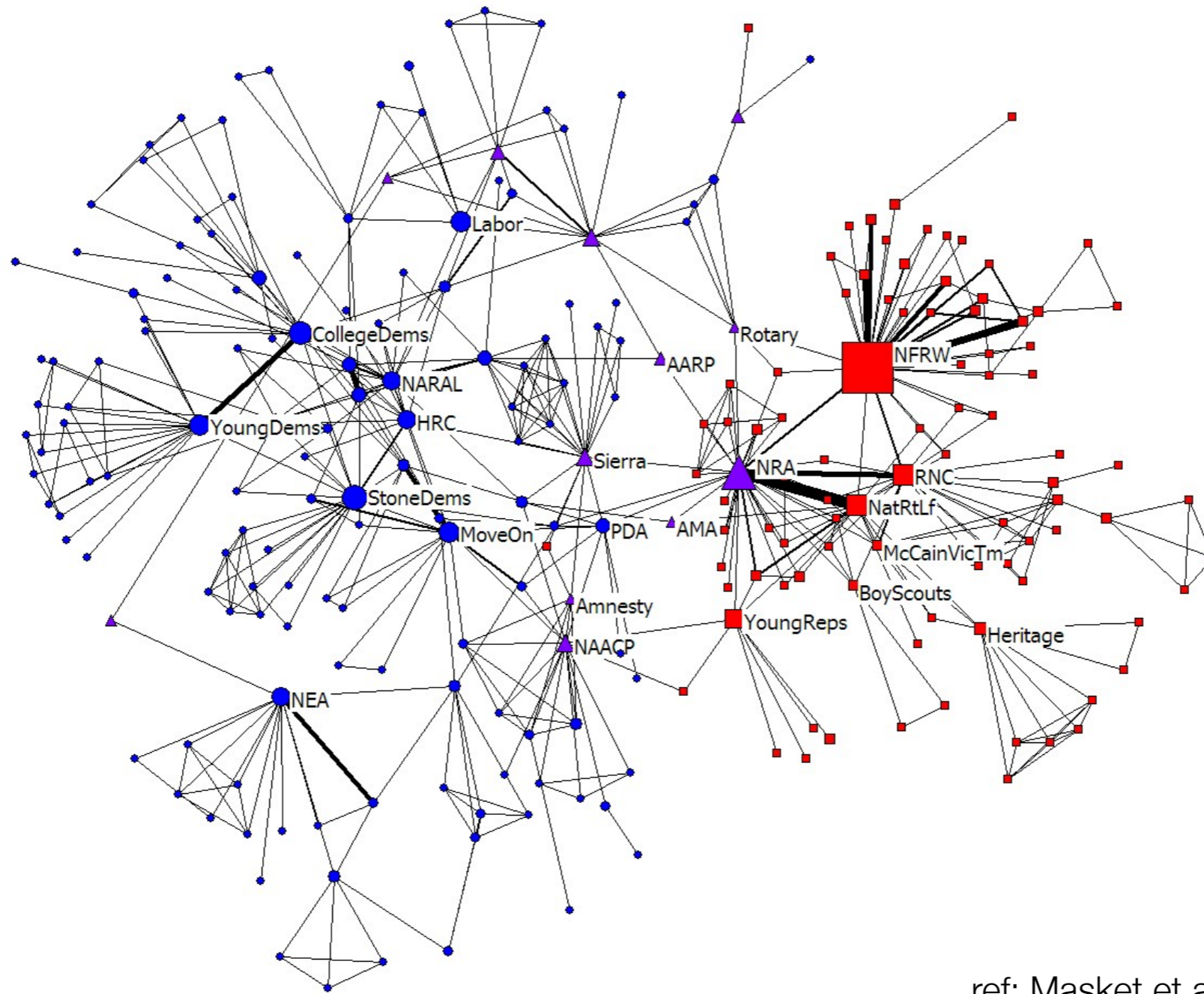
Ref: The Erdős Number Project, Jerry Grossman and Patrick Ion



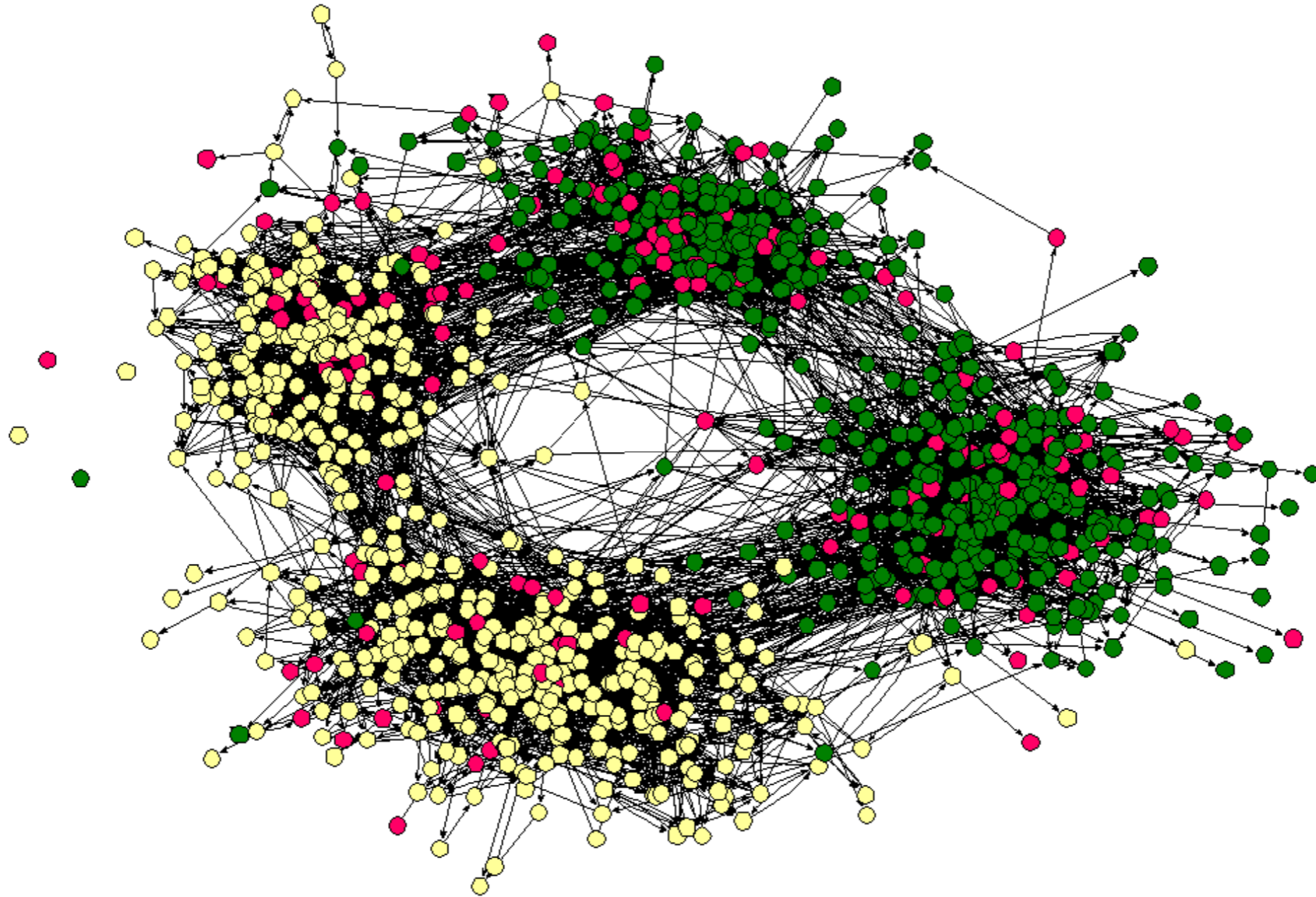
Network Science

Ref: MEJ Newman (2006)

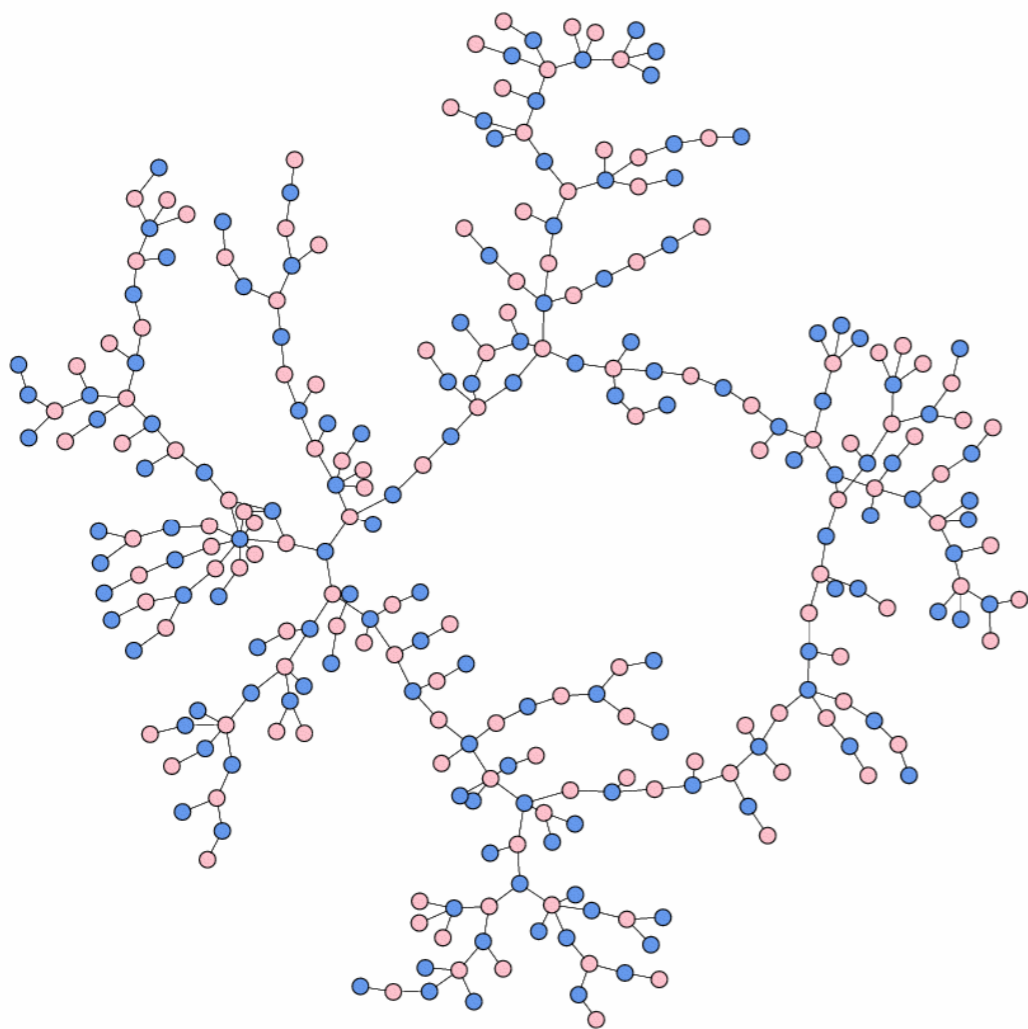
Organizational Co-membership



High School Friendships

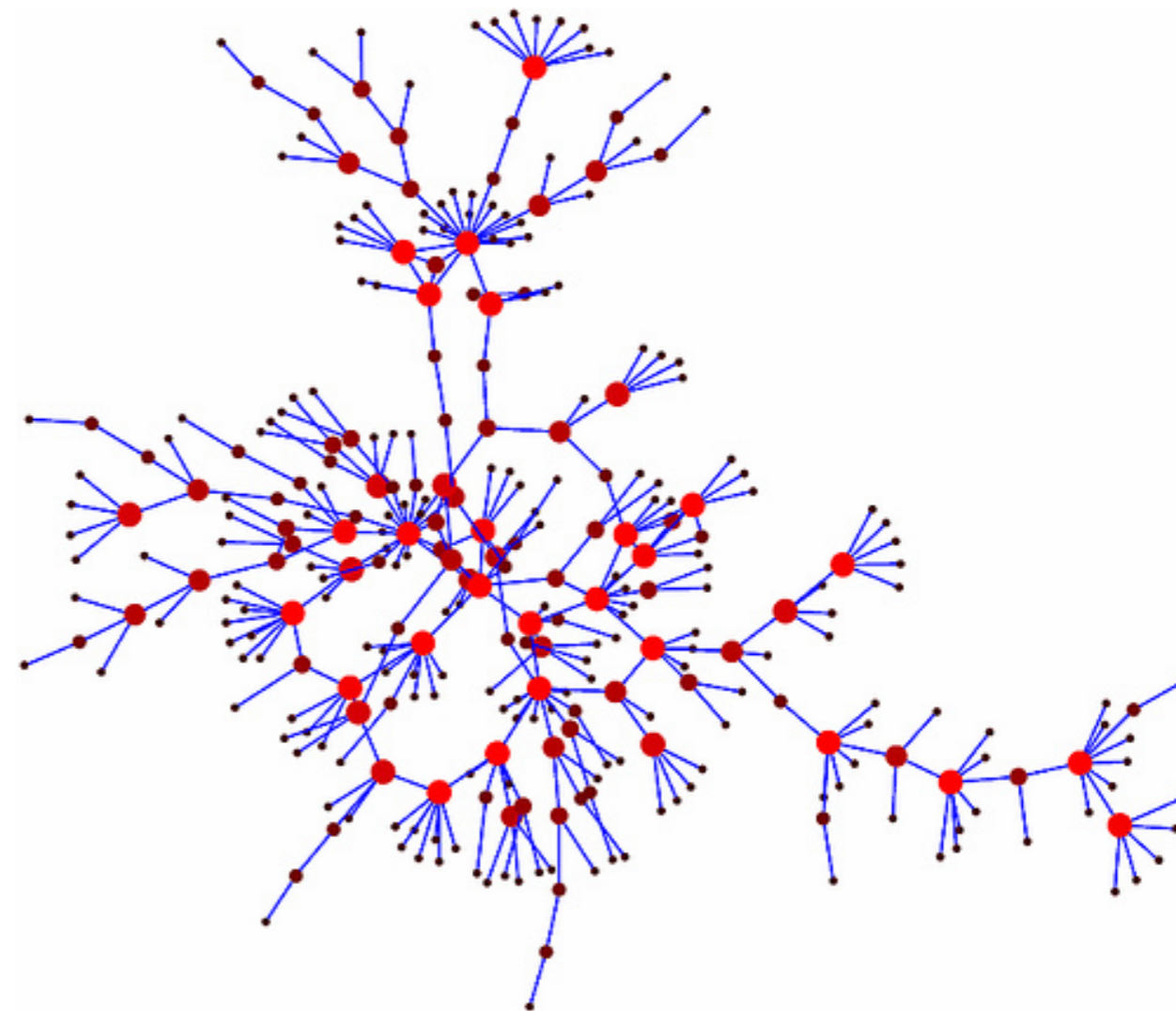


ref: James Moody (2001)



High School Dating

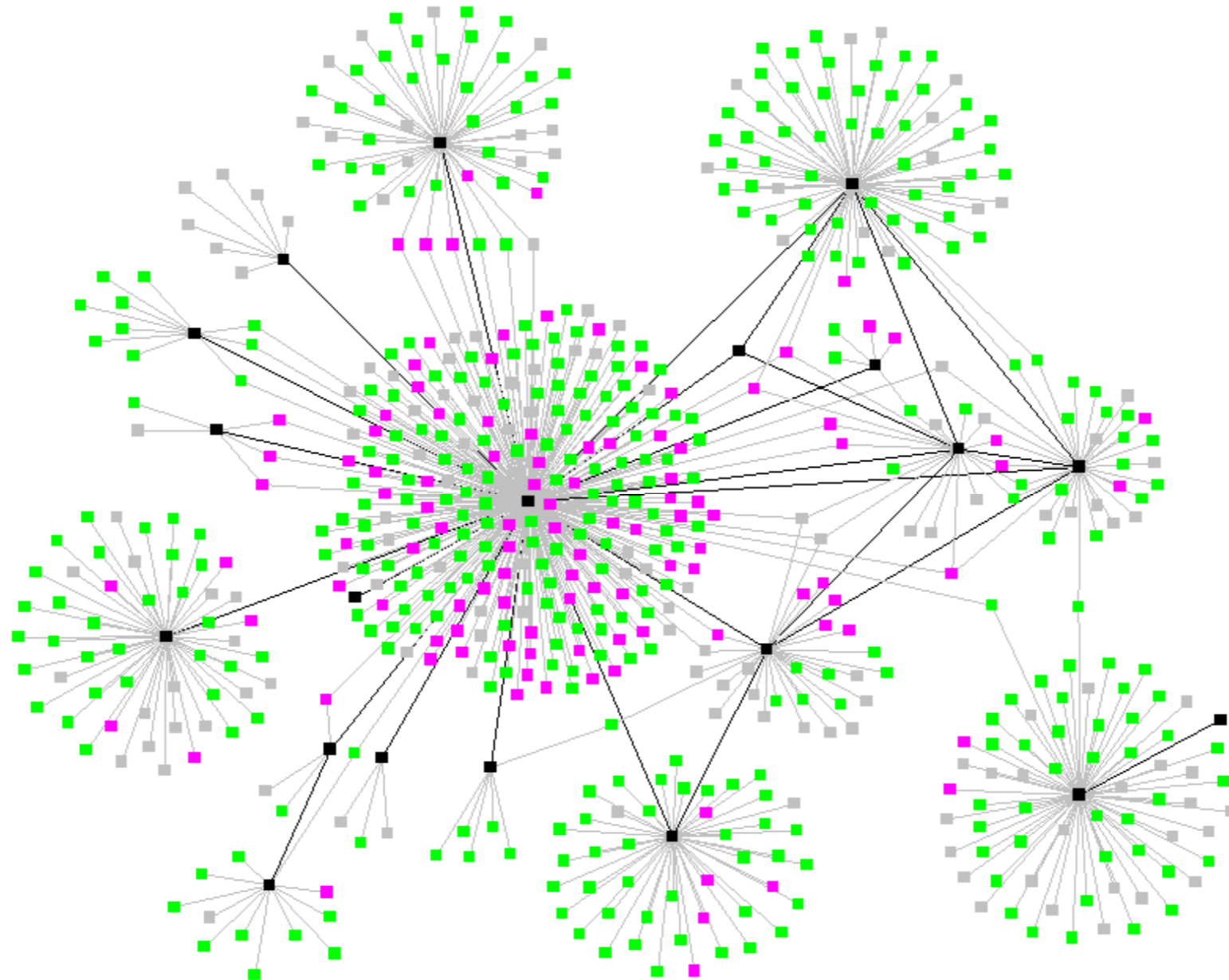
ref: Data by Bearman et al (2004)
Graphic by M.E.J. Newman



Sexual Contacts

ref: Potterat et al (2002)

All Personal Contacts

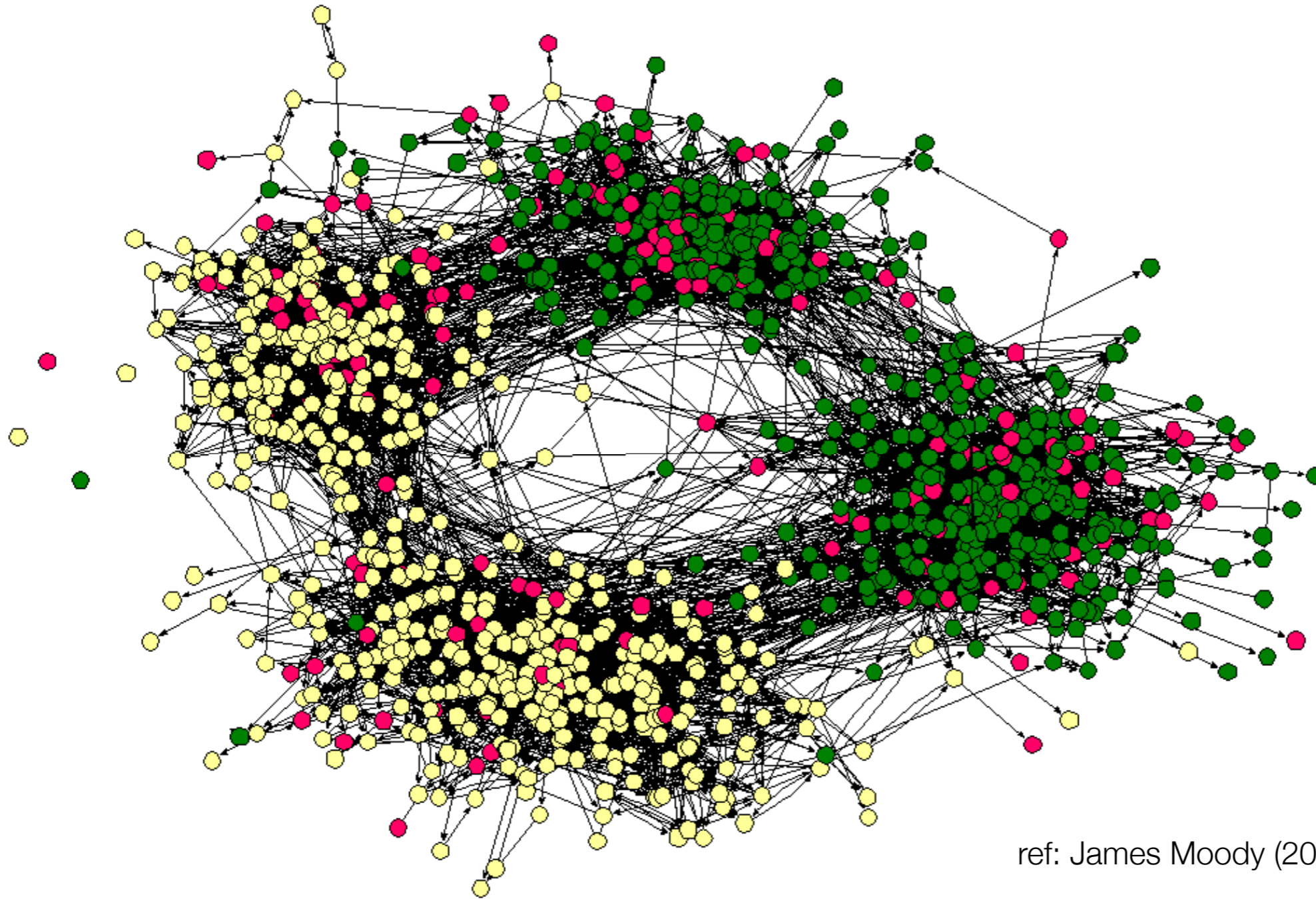


ref: orgnet.com

So how do social networks
help us understand social
processes?

Why study social networks?

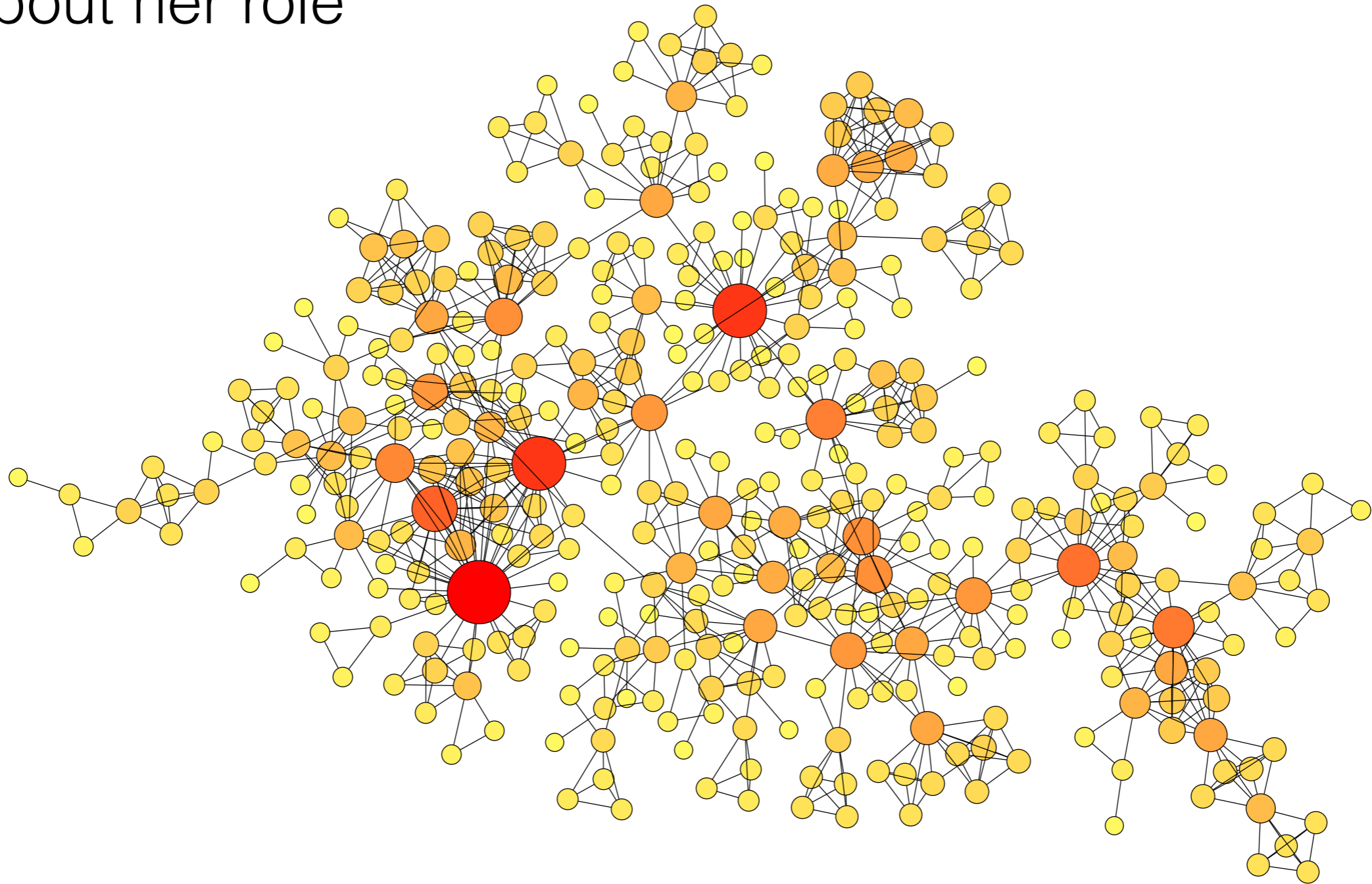
Network structure can tell us something about the behavior that generates it



ref: James Moody (2001)

Why study social networks?

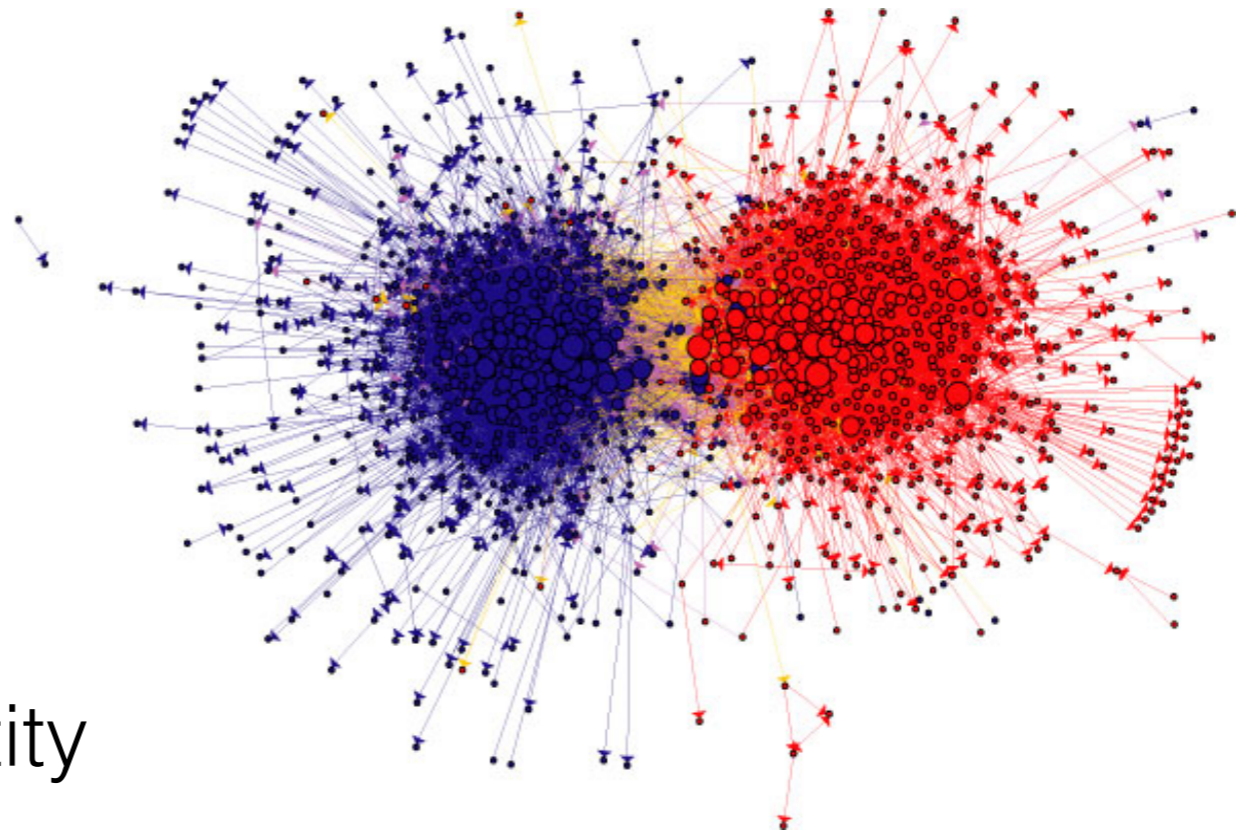
A person's place in the network can tell us something about her role



Why study social networks?

People use their social networks for all sorts of things we care about:

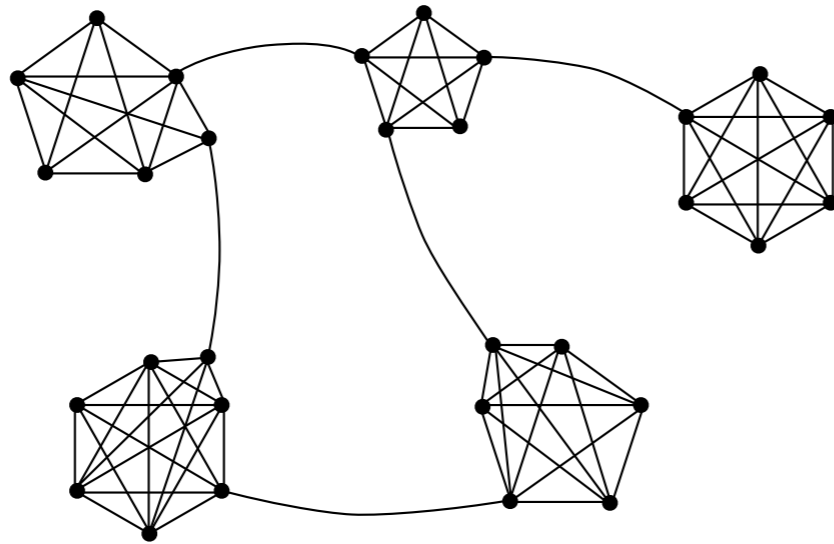
- Sharing information
- Establishing Trust
- Forming opinions
- Finding jobs
- Creating group identity
- Learning about new products and technologies



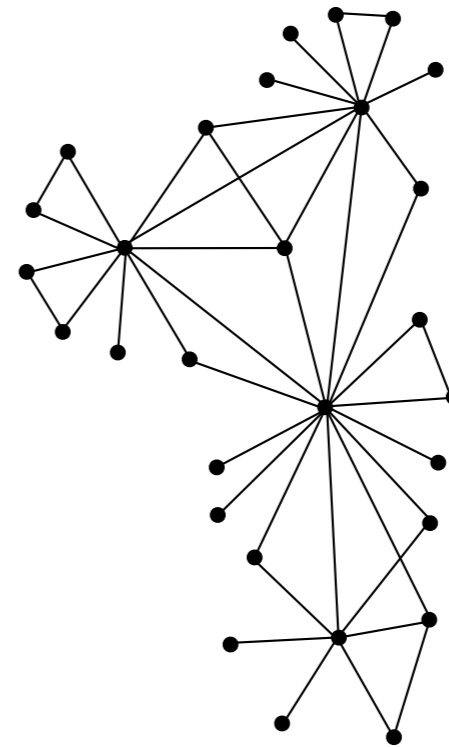
Why study social networks?

The structure of the social networks they use affects the outcome of those interactions

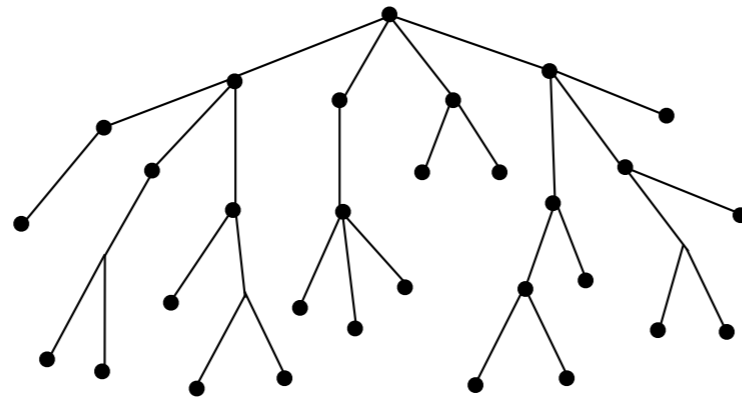
Silos



Decentralized



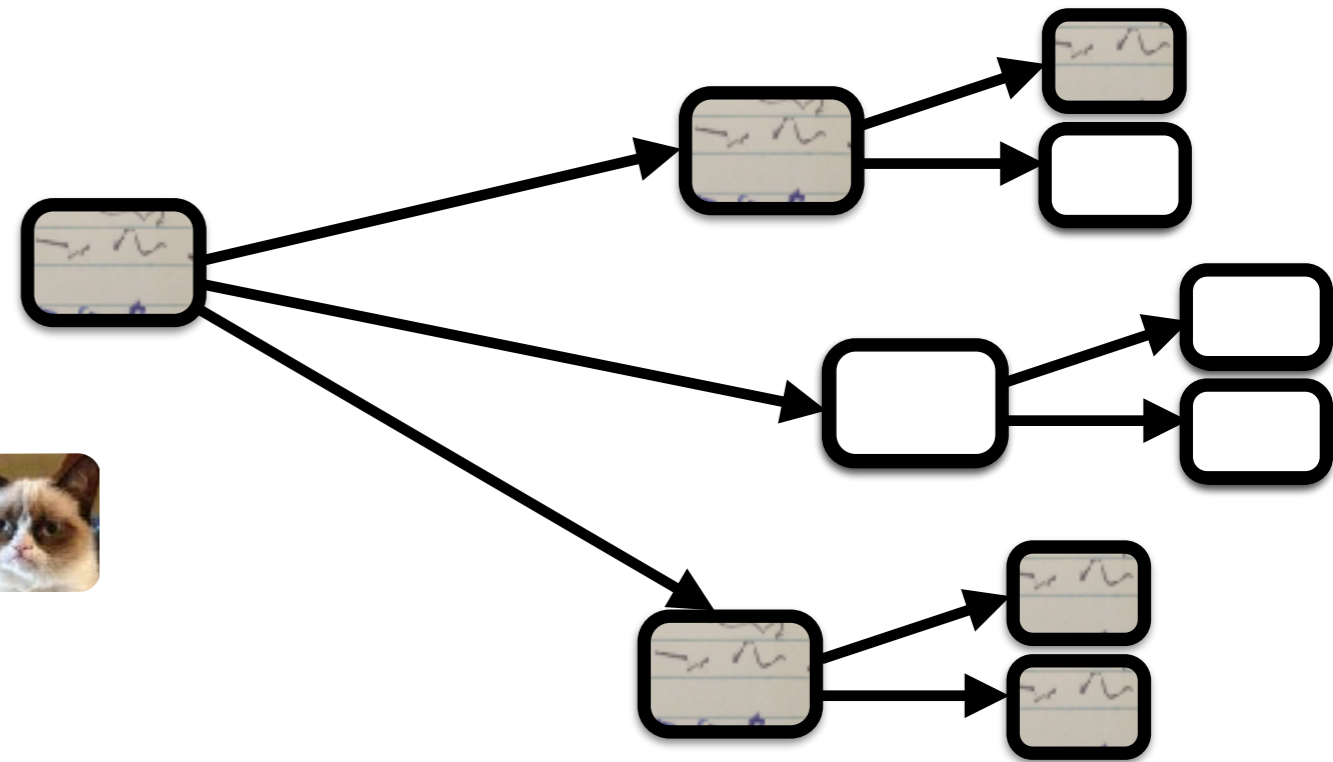
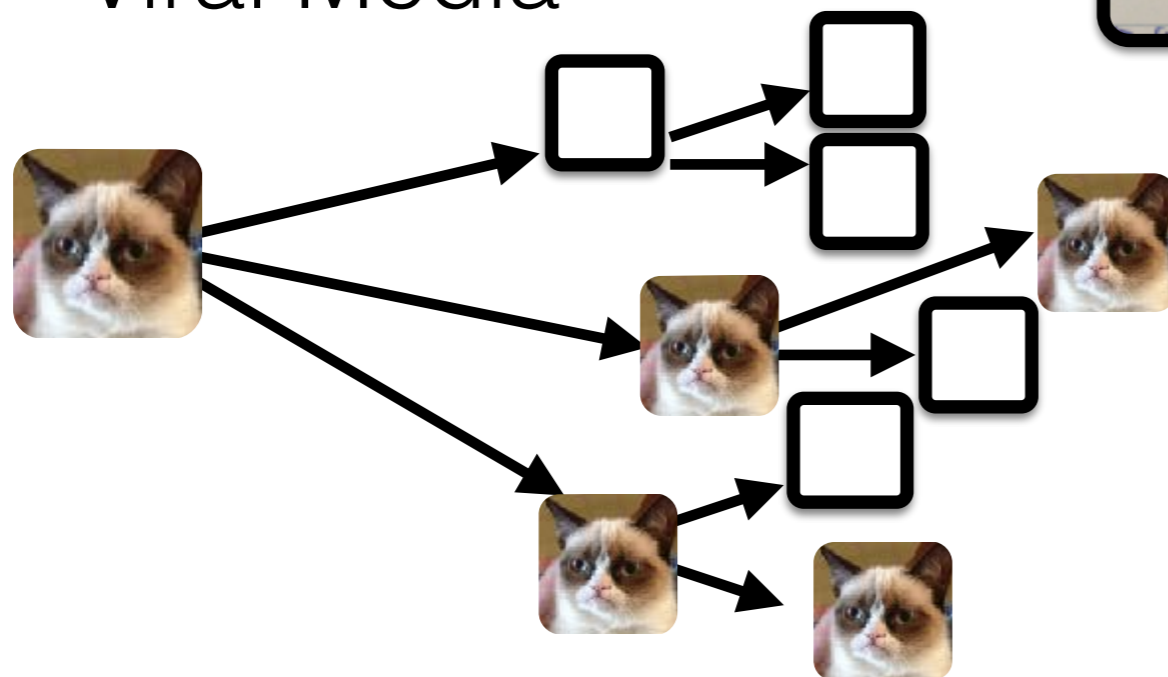
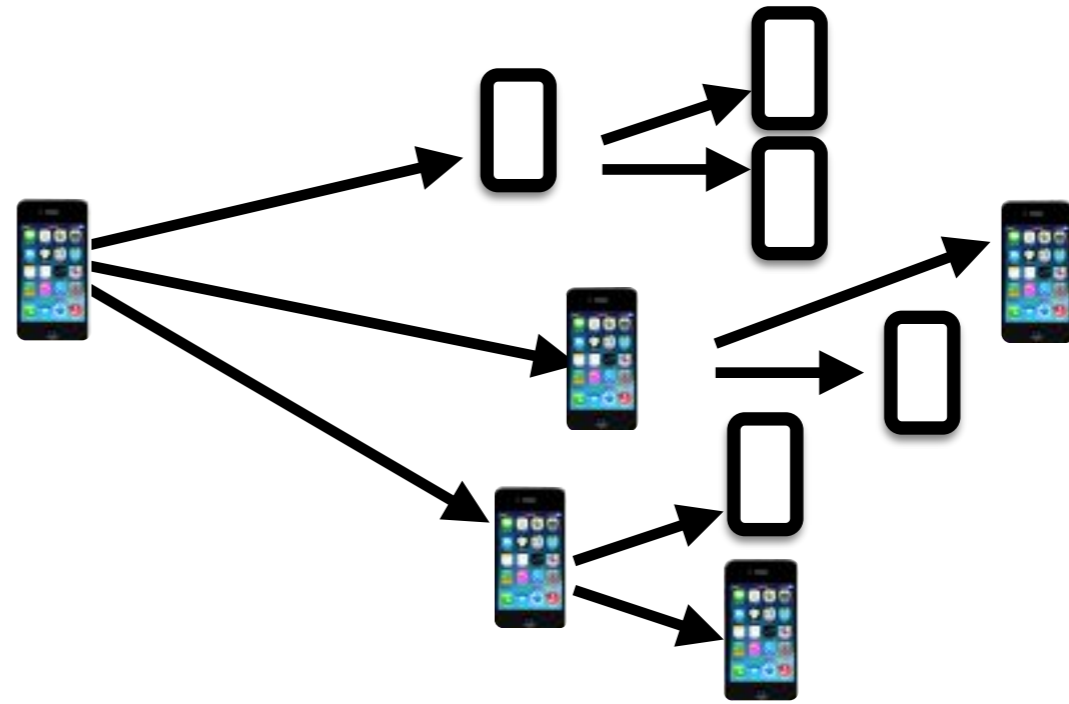
Hierarchy



And an individual's role affects her outcomes as well!

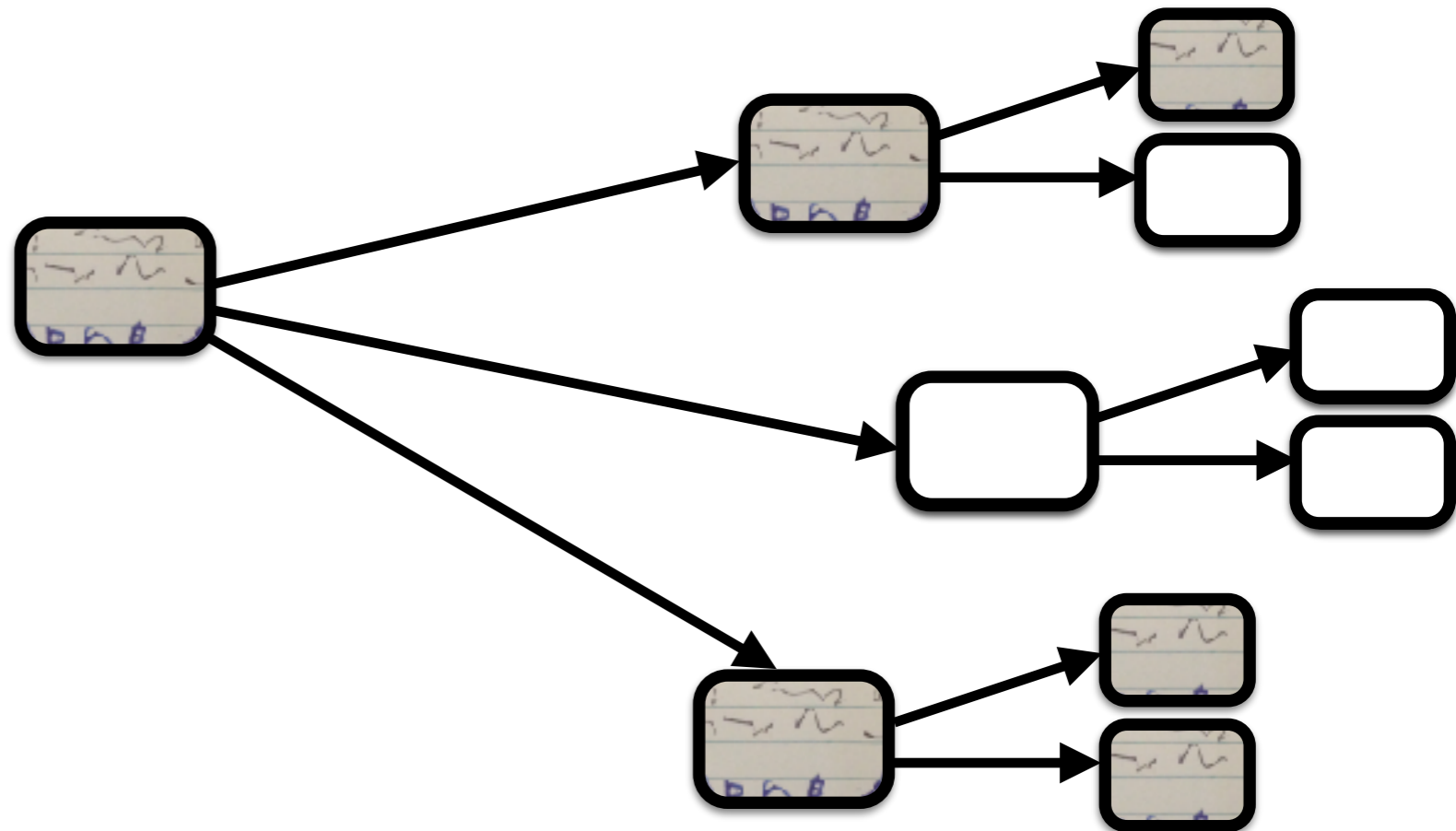
Information flow

- Job Openings
- New Technologies
- Rumors
- Reputation
- Fads
- Social Norms
- Viral Media



Information flow

- How does network structure affect how information flows?
- Can we identify tastemakers: people who are critical to information dispersion?
- How can we promote (or hinder) the spread of information?



Part 1: It's a small
world after all

How many degrees of Kevin Bacon?

Path Length = the number of “hops” in a given path between two nodes

Geodesic Distance = the shortest path between nodes

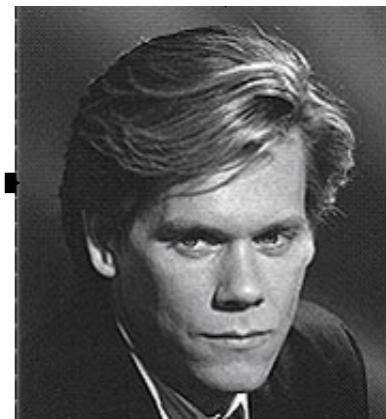
Geodesic distance is a measure of how “close” two nodes in the network are



Six Degrees of Kevin Bacon



John Cleese



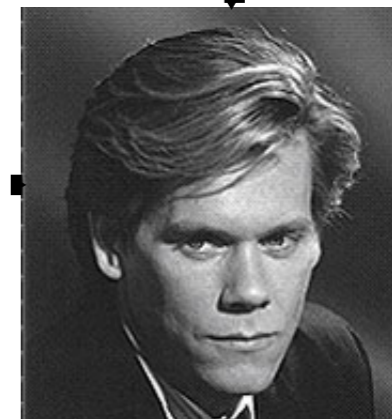
Kevin Bacon

Six Degrees of Kevin Bacon



John Cleese

The Big Picture
(1989)



Kevin Bacon

Six Degrees of Kevin Bacon

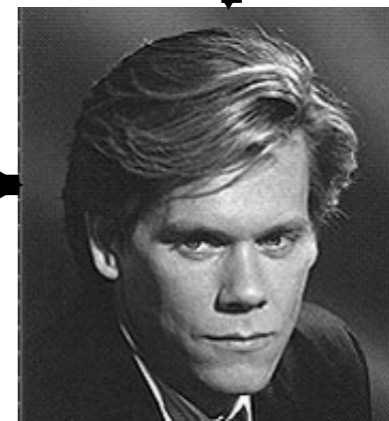


John Cleese

The Big Picture
(1989)



Neil Patrick Harris



Kevin Bacon



Six Degrees of Kevin Bacon



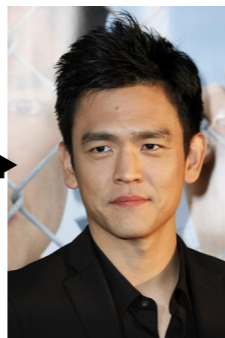
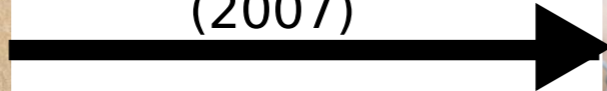
John Cleese

The Big Picture
(1989)

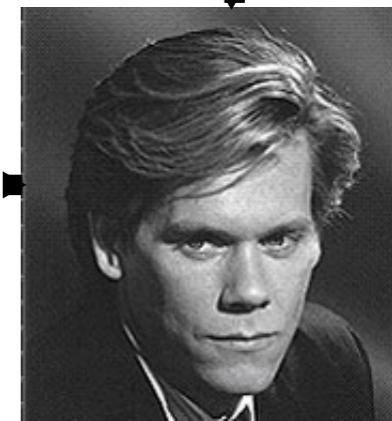


Neil Patrick Harris

Harold and Kumar go to White Castle
(2007)



John Cho



Kevin Bacon

Six Degrees of Kevin Bacon



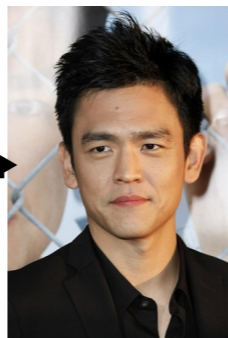
John Cleese

The Big Picture
(1989)



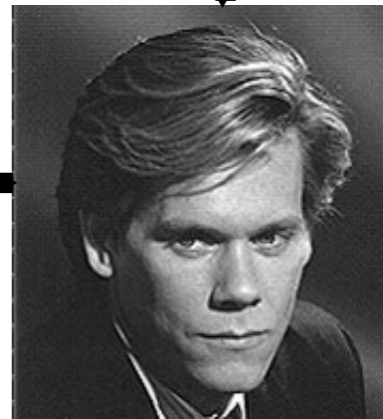
Neil Patrick Harris

Harold and Kumar go to White Castle
(2007)



John Cho

The Air I Breathe
(2007)



Kevin Bacon

Six Degrees of Kevin Bacon



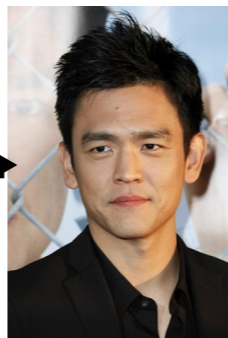
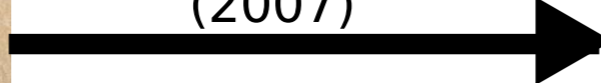
John Cleese

The Big Picture
(1989)



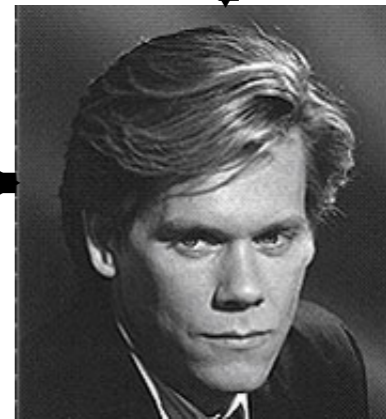
Neil Patrick Harris

Harold and Kumar go to White Castle
(2007)



John Cho

The Air I Breathe
(2007)



Kevin Bacon



Bob Hope

Six Degrees of Kevin Bacon



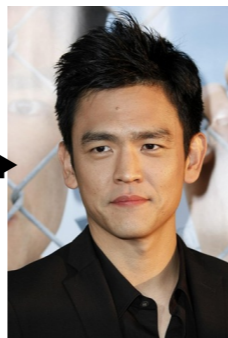
John Cleese

The Big Picture
(1989)



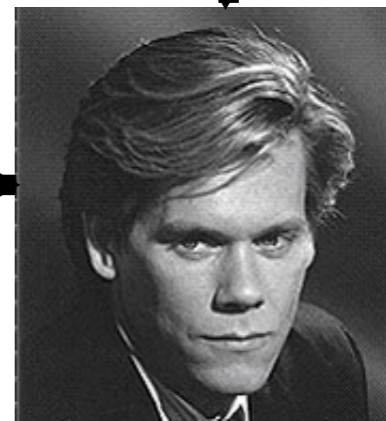
Neil Patrick Harris

Harold and Kumar go to White Castle
(2007)



John Cho

The Air I Breathe
(2007)

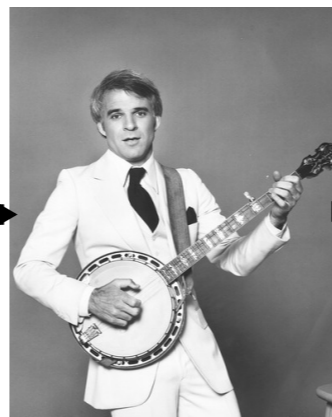


Kevin Bacon



Bob Hope

The Muppet Movie
(1979)



Steve Martin

Six Degrees of Kevin Bacon



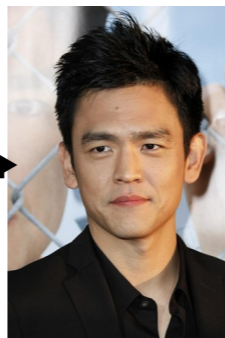
John Cleese

The Big Picture
(1989)



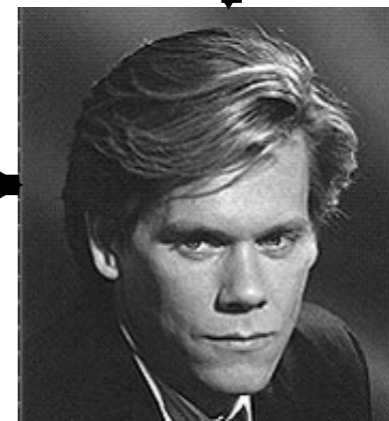
Neil Patrick Harris

Harold and Kumar go to White Castle
(2007)



John Cho

The Air I Breathe
(2007)

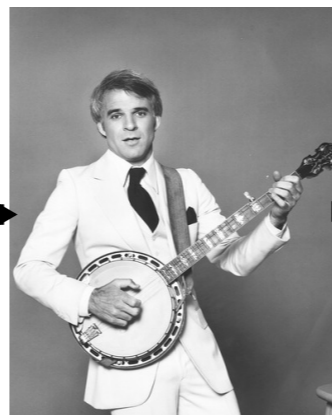


Kevin Bacon



Bob Hope

The Muppet Movie
(1979)



Steve Martin

Novocaine
(2001)

Six Degrees of Kevin Bacon



Rudolph Valentino

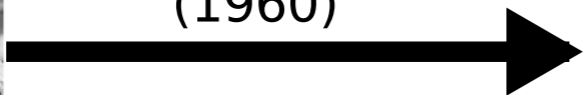


Character Studies
(1927)

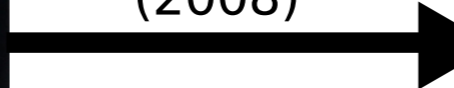


Buster Keaton

*The Adventures
of Huckleberry Finn*
(1960)



Frost/Nixon
(2008)

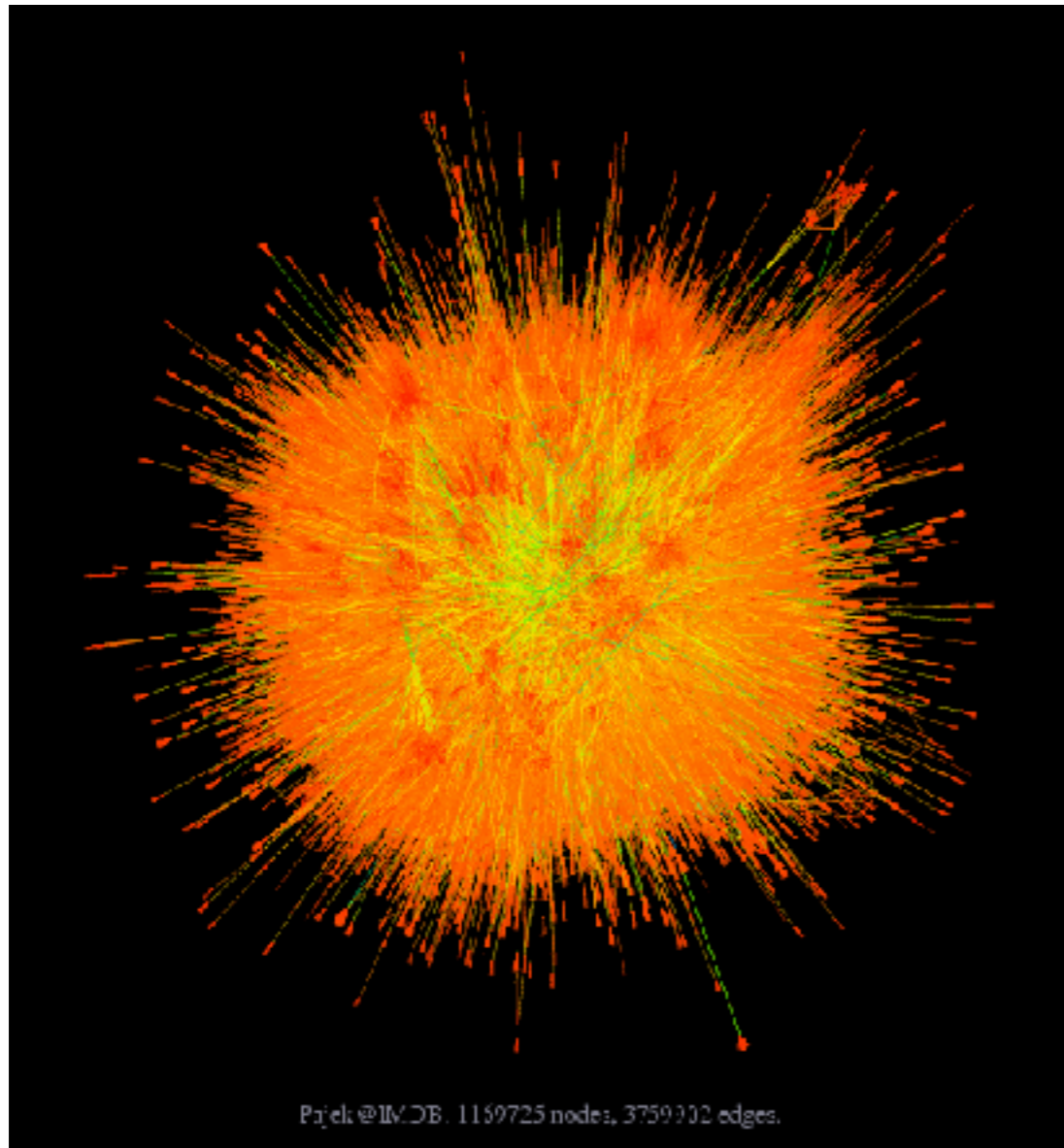


Kevin Bacon



Patty McCormack

Six Degrees of Kevin Bacon?



IMDB network (1888-2008)

IMDB network: >1 million actors

Longest path length: 8 links

Average path length: 2.7 links!

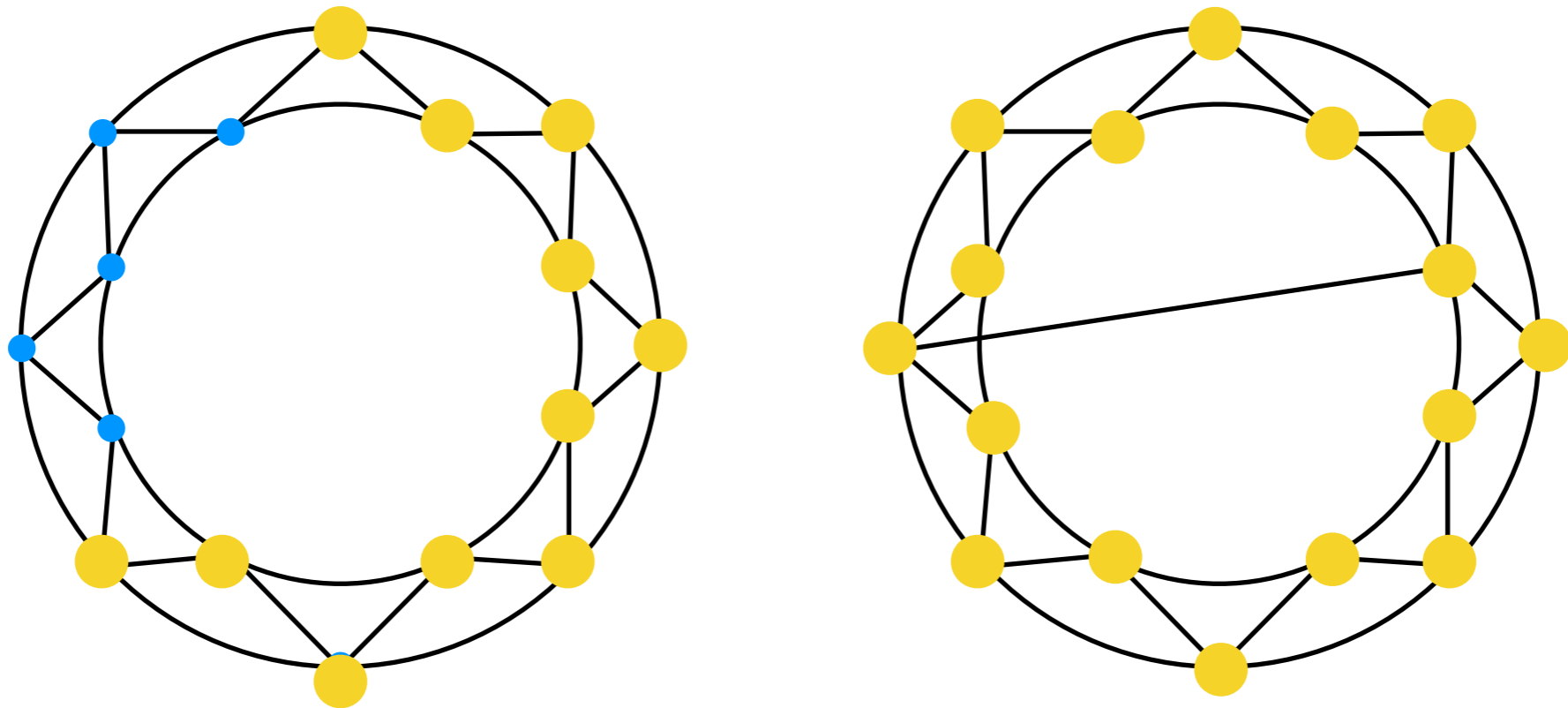
It turns out that most social networks have a small average path length

It's a small world after all!

Small Worlds and Information

Why does it matter that we live in a “small world”?

The world is “small” because a small number of long distance links connect people.

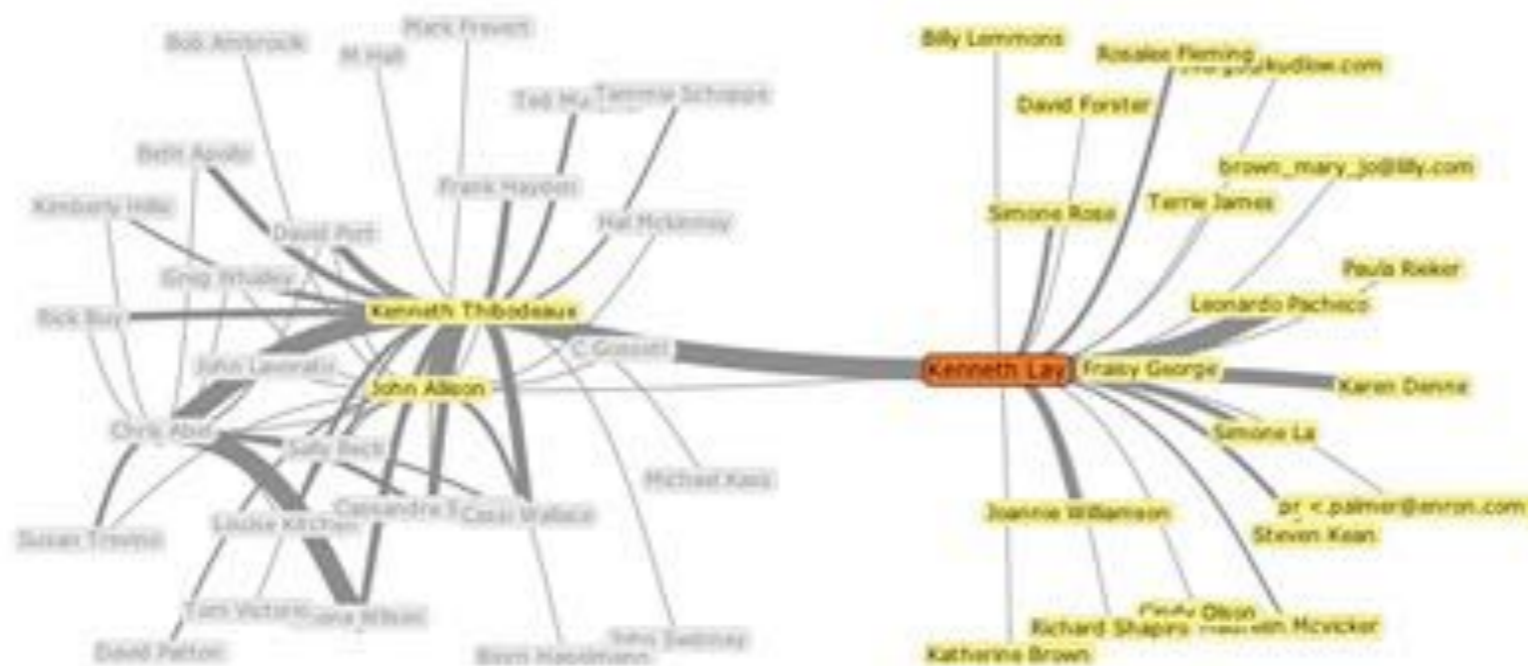


So in a small world, information travels fast!

Part 2: Weak is the
new strong

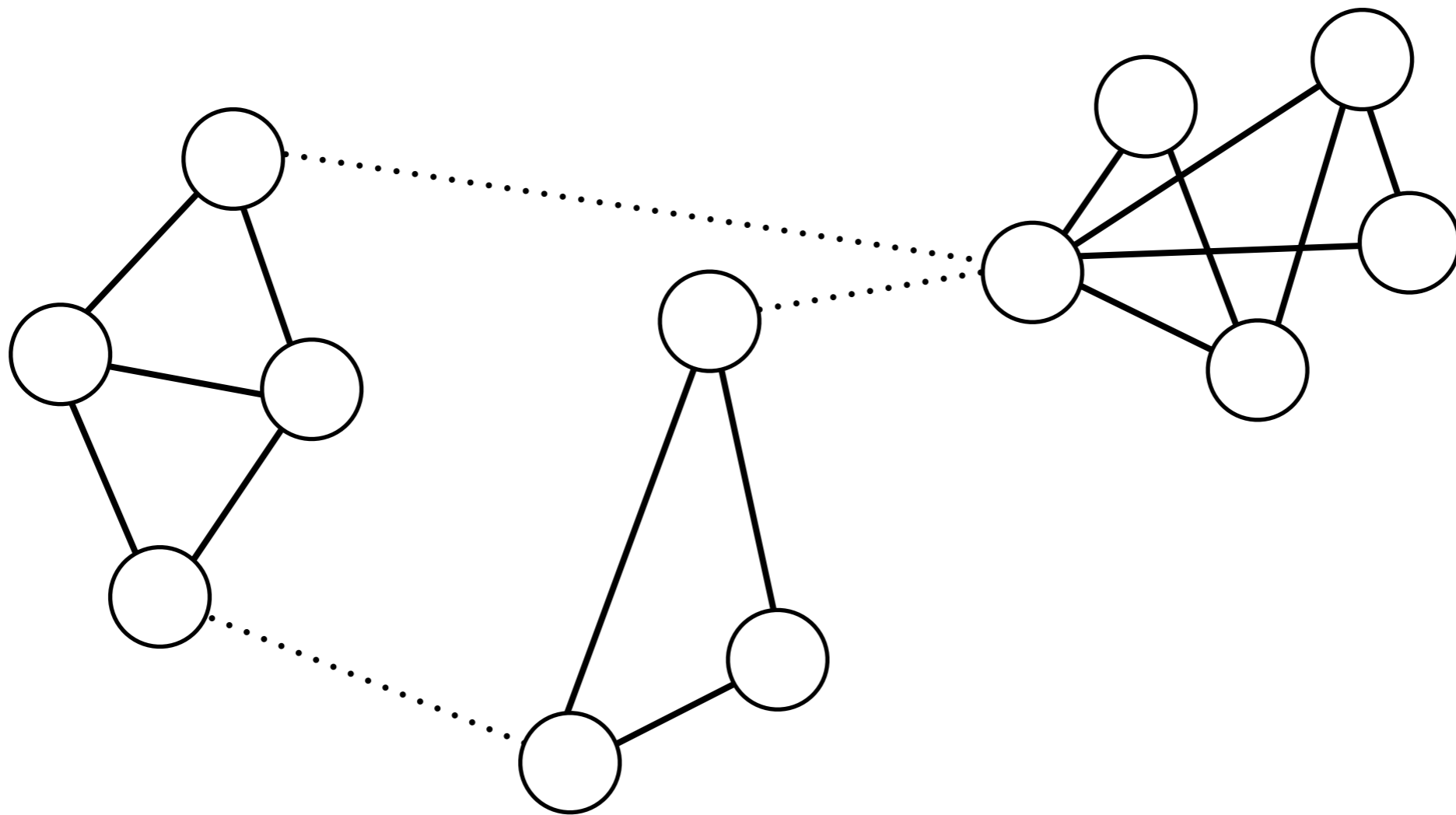
Tie Strength and Information

- Some ties are stronger than others:
 - Friendship > Acquaintance
 - More frequent contact \Rightarrow stronger ties



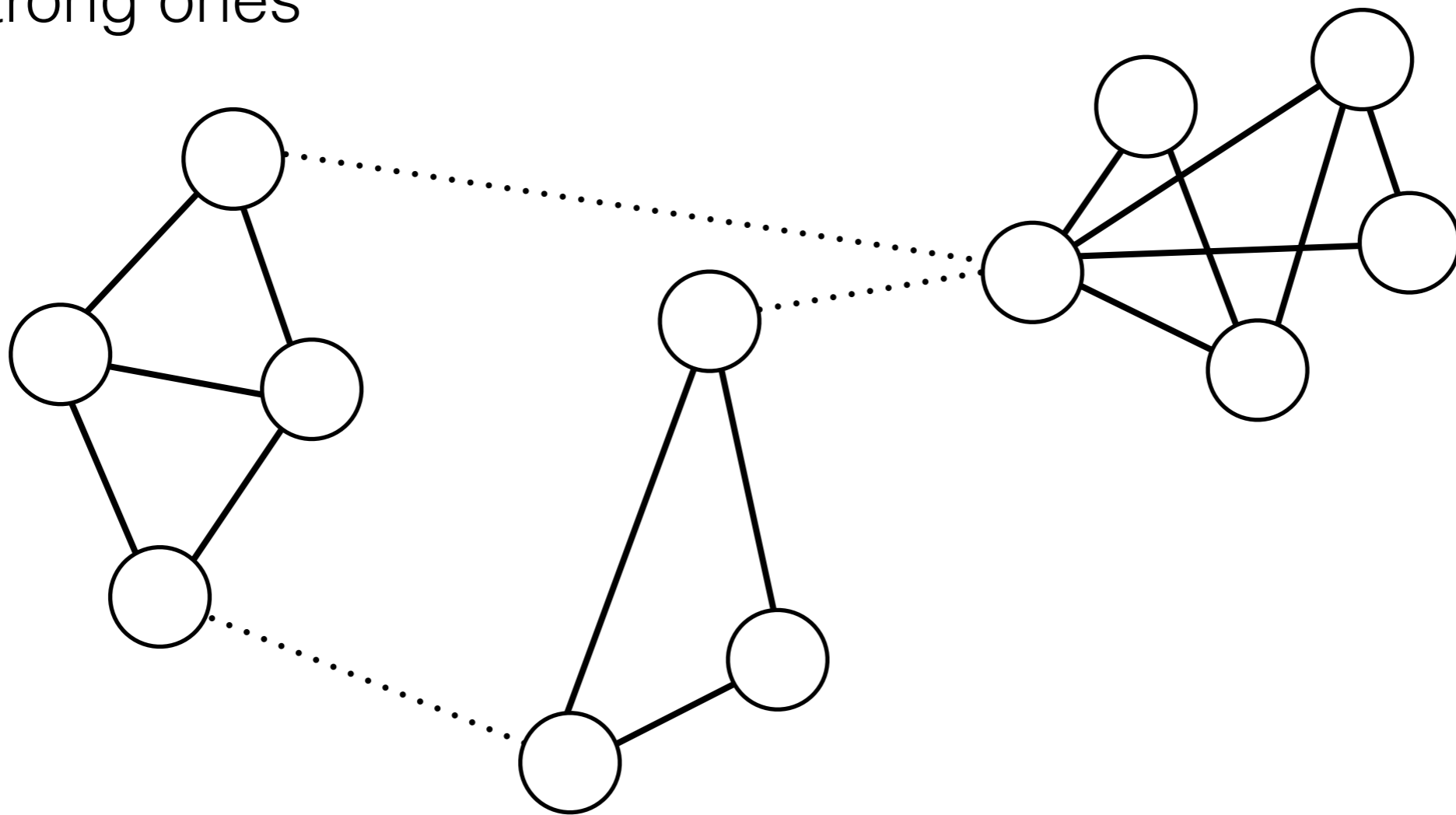
Tie Strength and Information

Question: If you were looking for a job, which would be the most valuable in your search: strong ties, or weak ties?



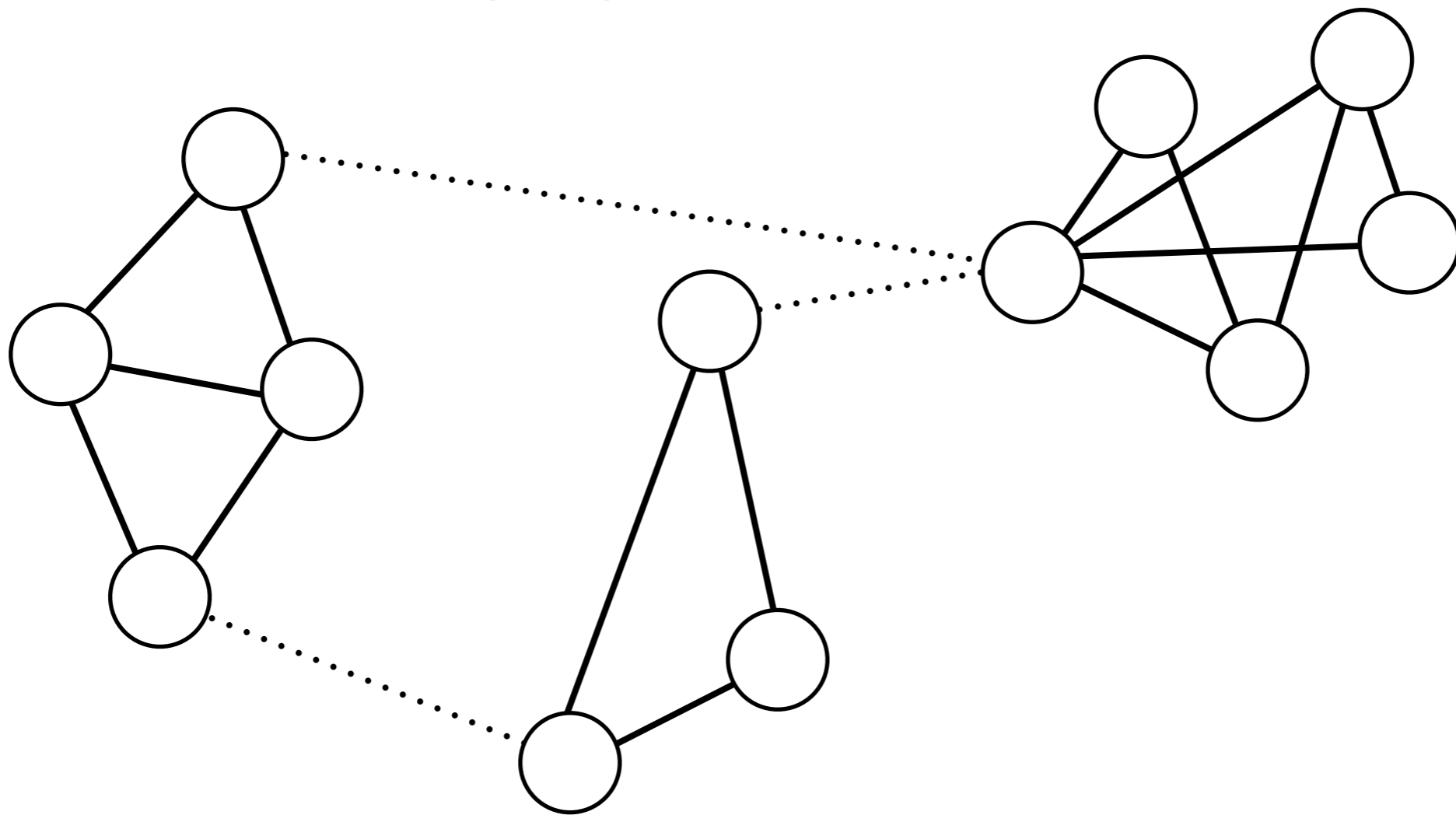
The Strength of Weak Ties (Granovetter)

Result: When you are trying get or spread information (eg: about job openings) weak ties are more important than strong ones



The Strength of Weak Ties (Granovetter)

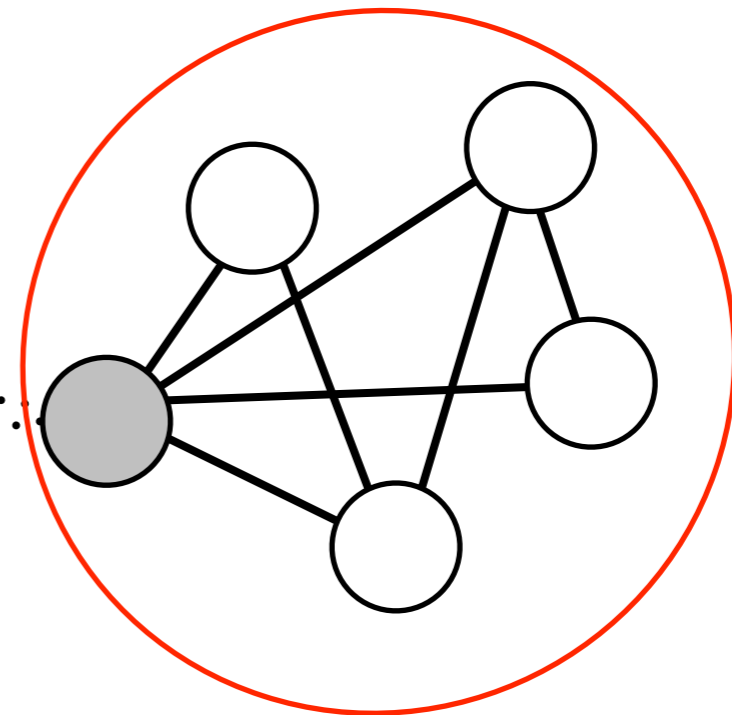
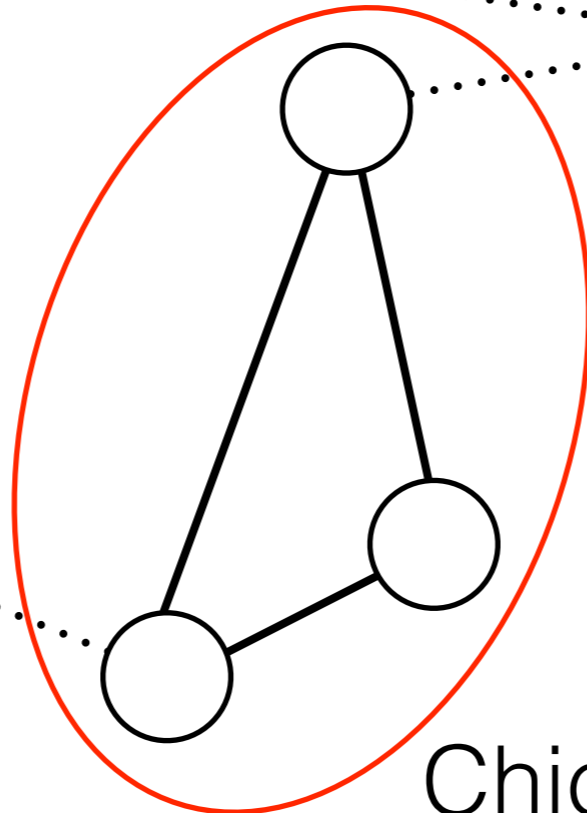
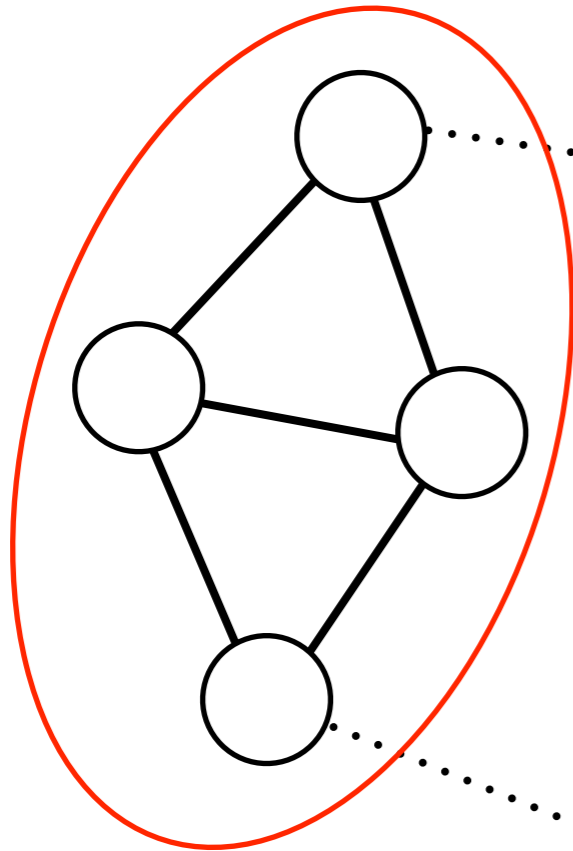
Intuition: Your strong ties are with people similar to you.
Those people all have similar information.



Weak ties tend to be “long distance” ties, which link you to people different than yourself...

The Strength of Weak Ties (Granovetter)

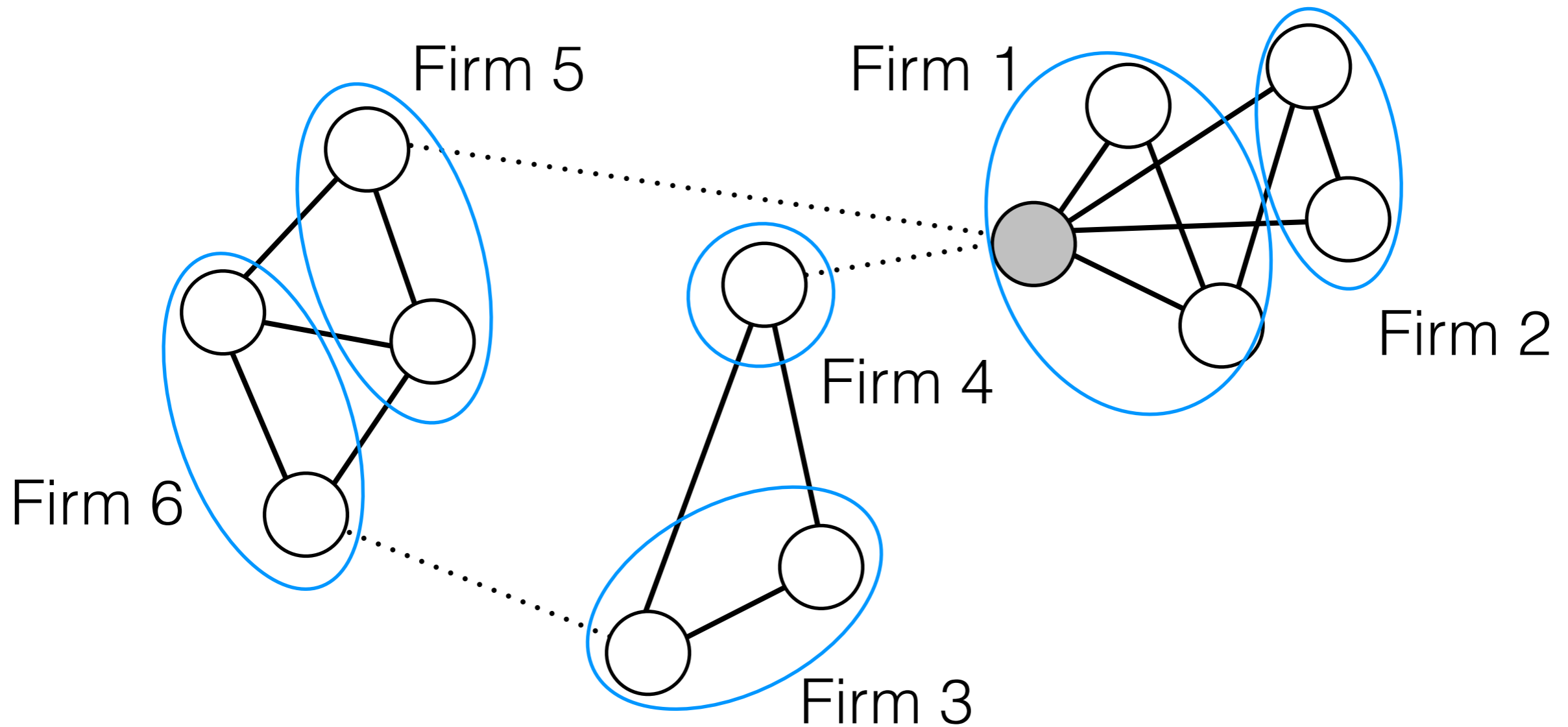
San Francisco



Boston

Chicago

The Strength of Weak Ties (Granovetter)



Part 3: Grinnell Plans

Grinnell [plans]

For those who don't know:

- [plans] is a homegrown Grinnell social network
- Each user has a page (their “plan”)
- Content is text-only
- If I put your username in square brackets on my plan (eg: [rebelsky]), it creates a link from my plan to yours, which is called “planlove”
- Planlove serves several purposes:
 - It allows people to ping each other: questions, conversations, moral support
 - It gives people a way to increase signal strength by suggesting that others read someone's plan

The social network

We can think of plans as a social network

- Nodes are plans users
- There is an edge from $A \rightarrow B$ if A planloves B

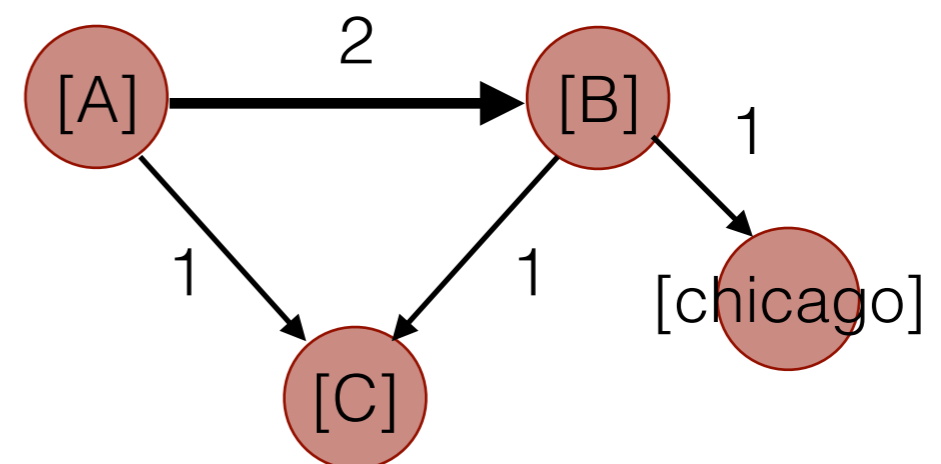
user [A]
Hi [B]! Hey [C]: did you see what [B] said?

user [B]
Hi [C]! I was thinking we should get together while I'm in [chicago]!

user [C]
I love cheese!

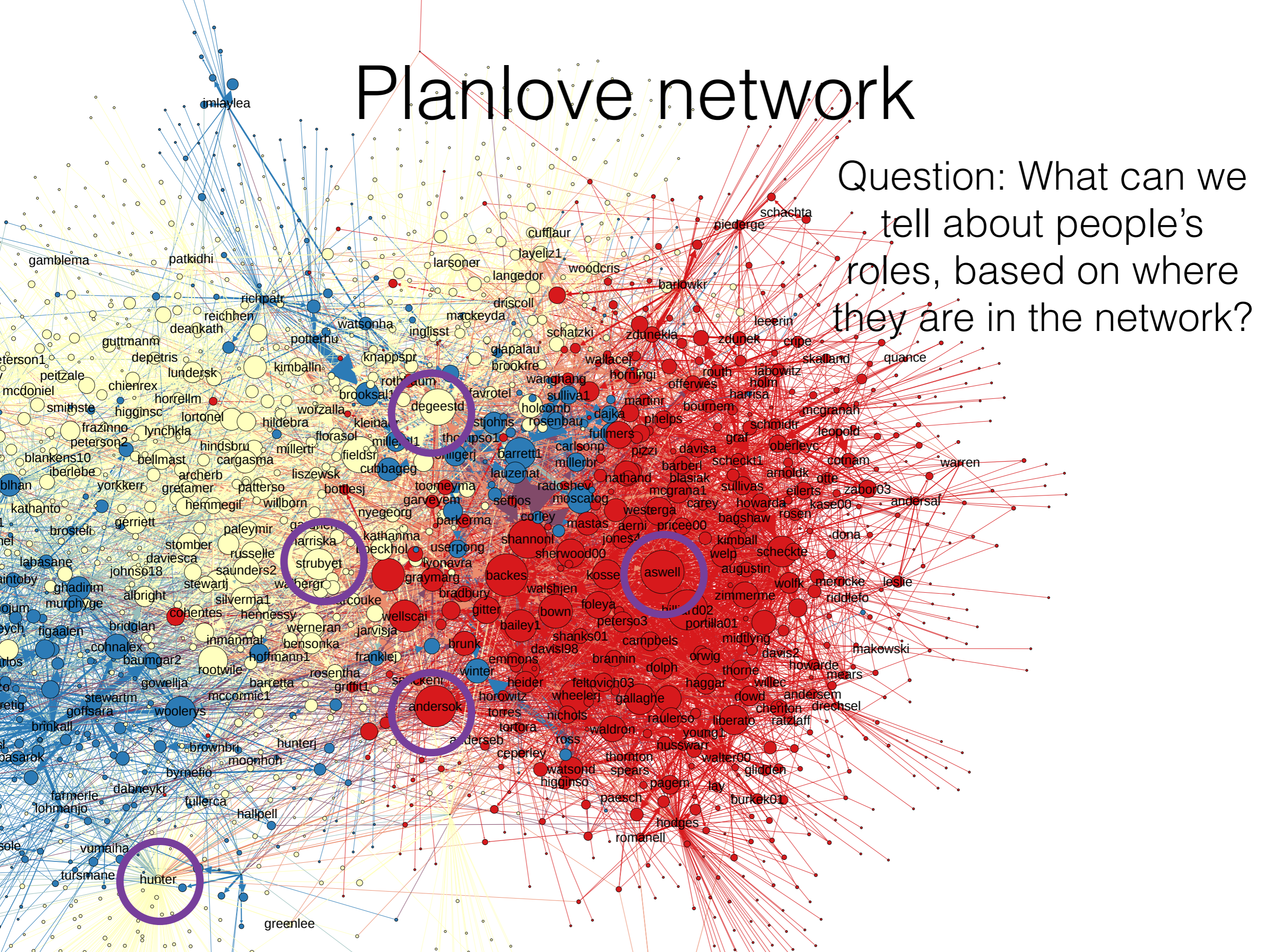
The links are *directed* (A can planlove B without B planloving A)

The links are *weighted* by the number of times A planloves B



Planlove network

Question: What can we tell about people's roles, based on where they are in the network?



Identifying Types of Plans Users

Factor 1: How much planlove do you give?
How much do you get?

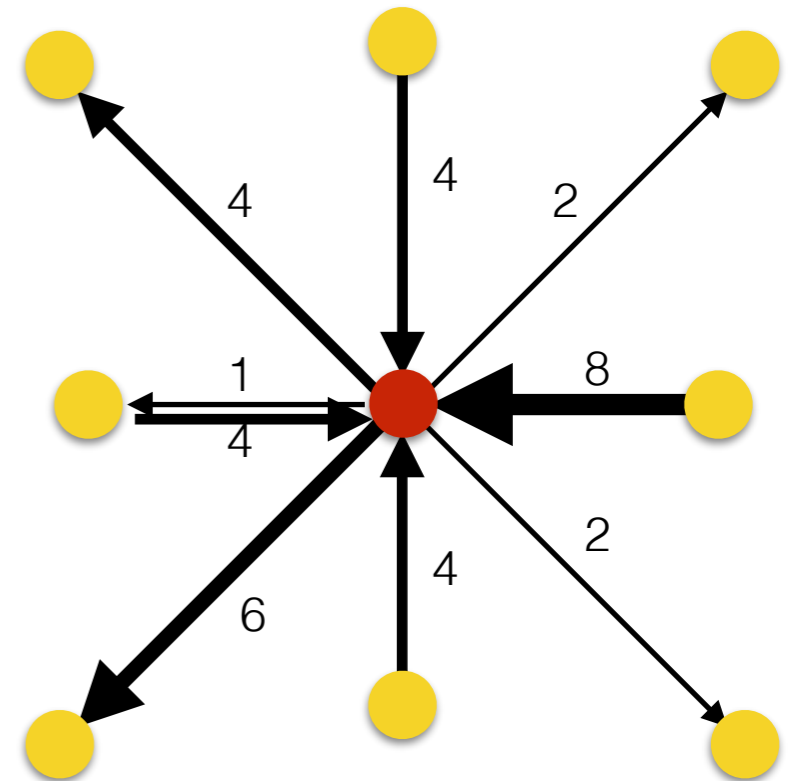
In our network:

Out degree = the number of distinct plans you have planloved

In degree = the number of distinct plans that have planloved you

Summing up the weights on the links gives a weighted degree

Weighted out/in degree = total amount of planlove given/ received



The red node has a weighted in degree of 20 and a weighted out degree of 15

Types of users: degree

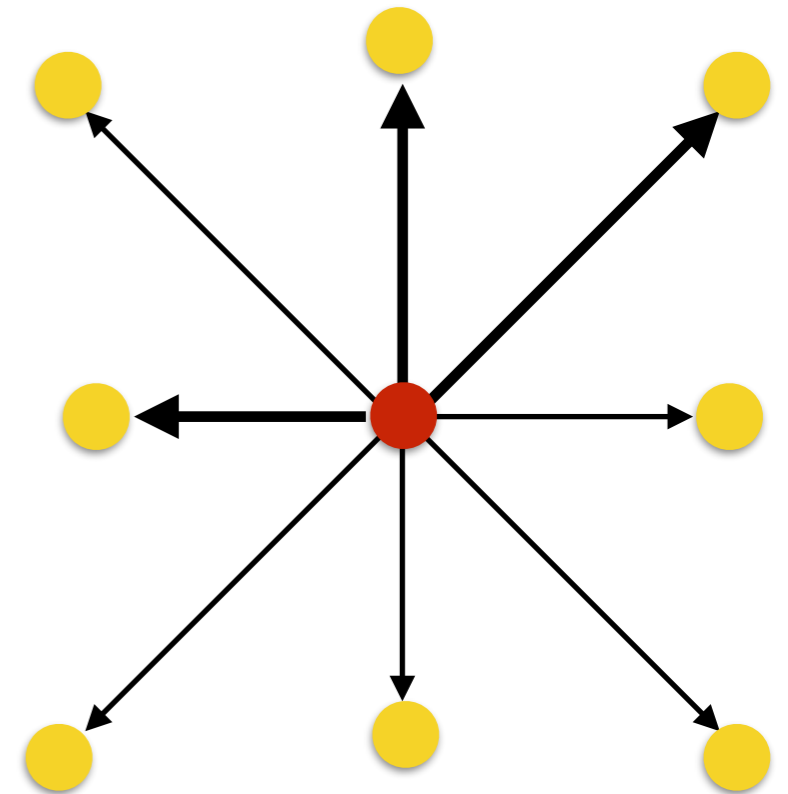
By comparing a person's in and out degree, we can see what kind of plans user they are.

Total degree (out and in) reflects engagement

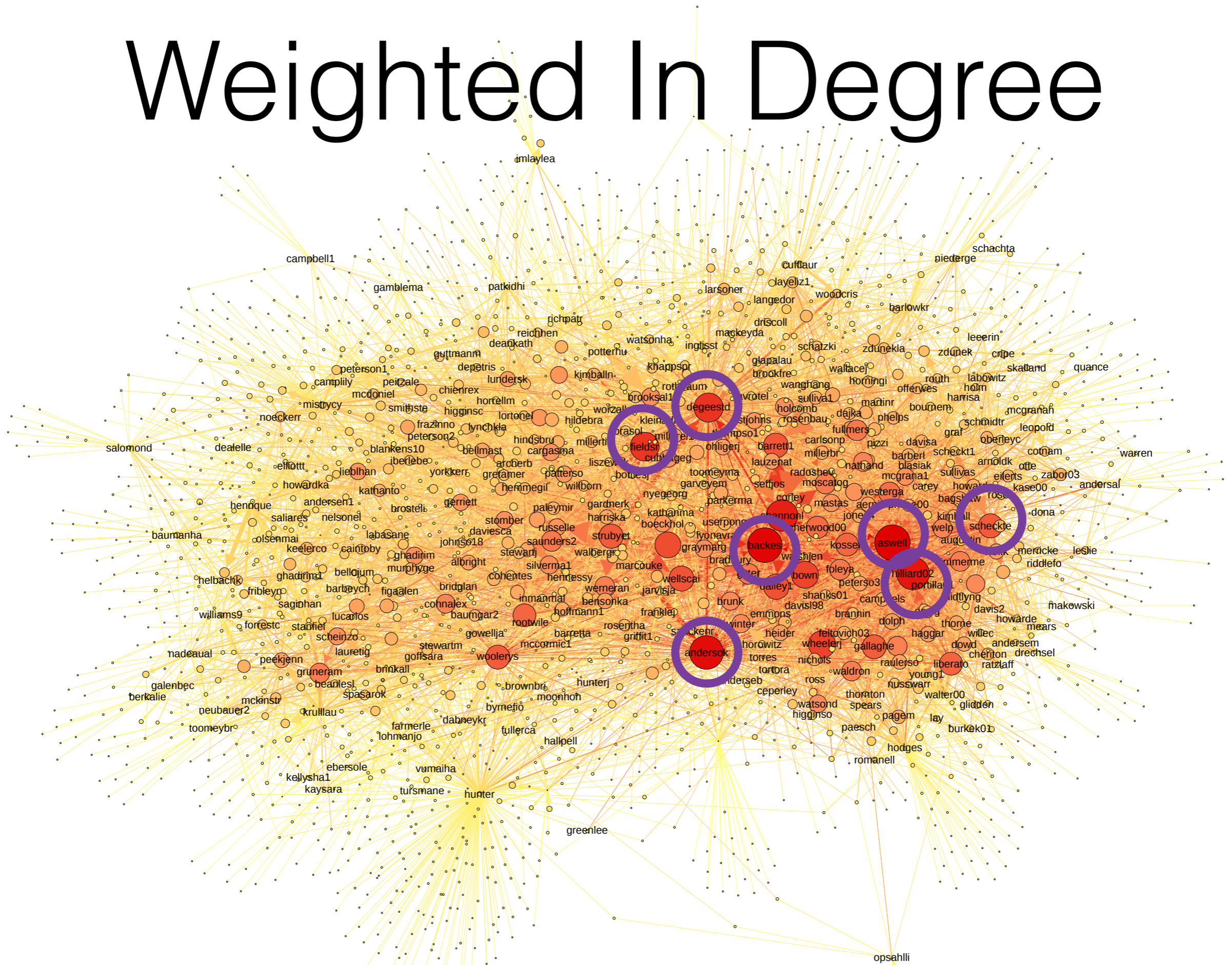
High in-degree → lots of readers

High out-degree → lots of engagement

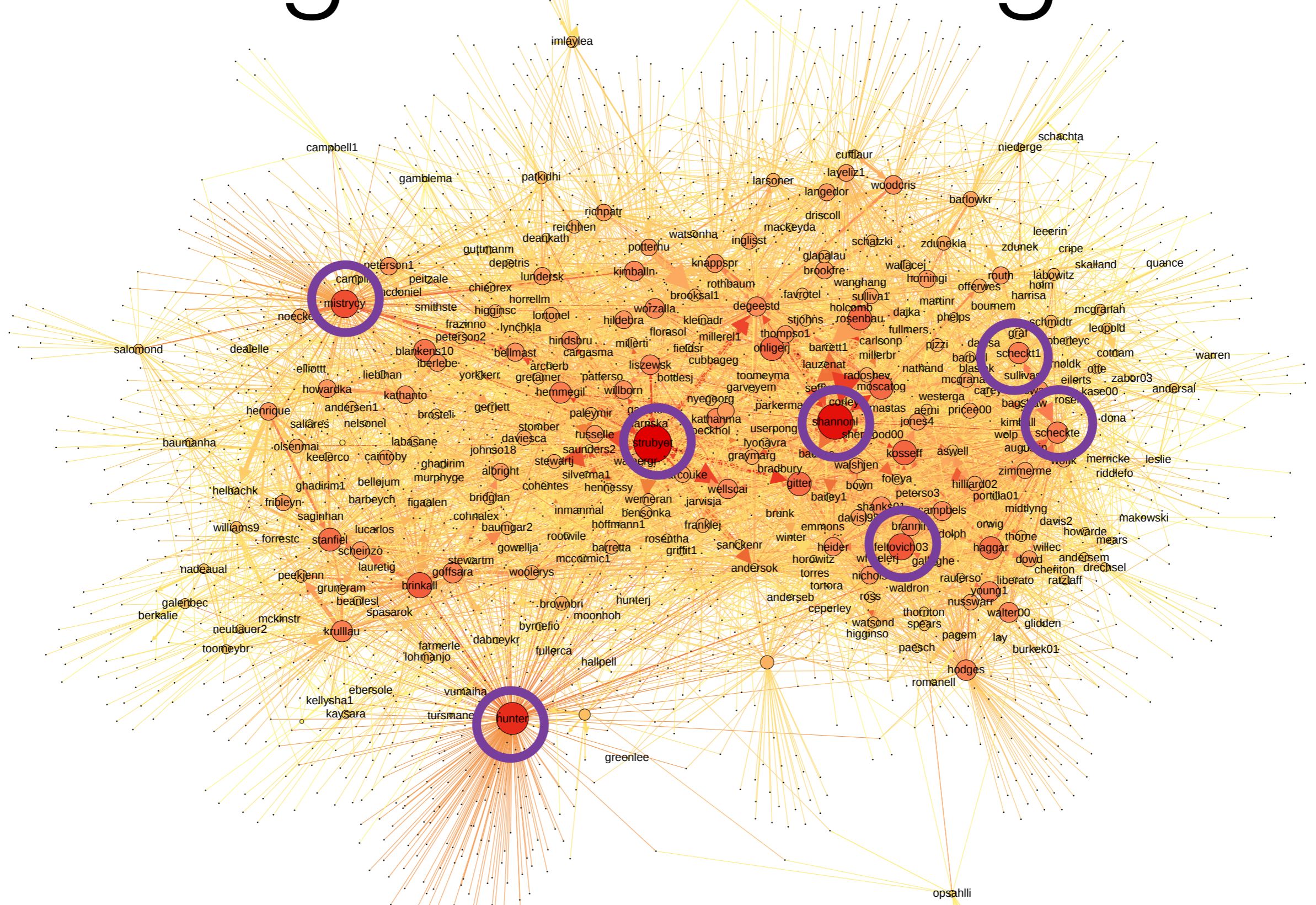
Lots of both → I LOVE YOU GUYS!!!



Weighted In Degree



Weighted Out Degree



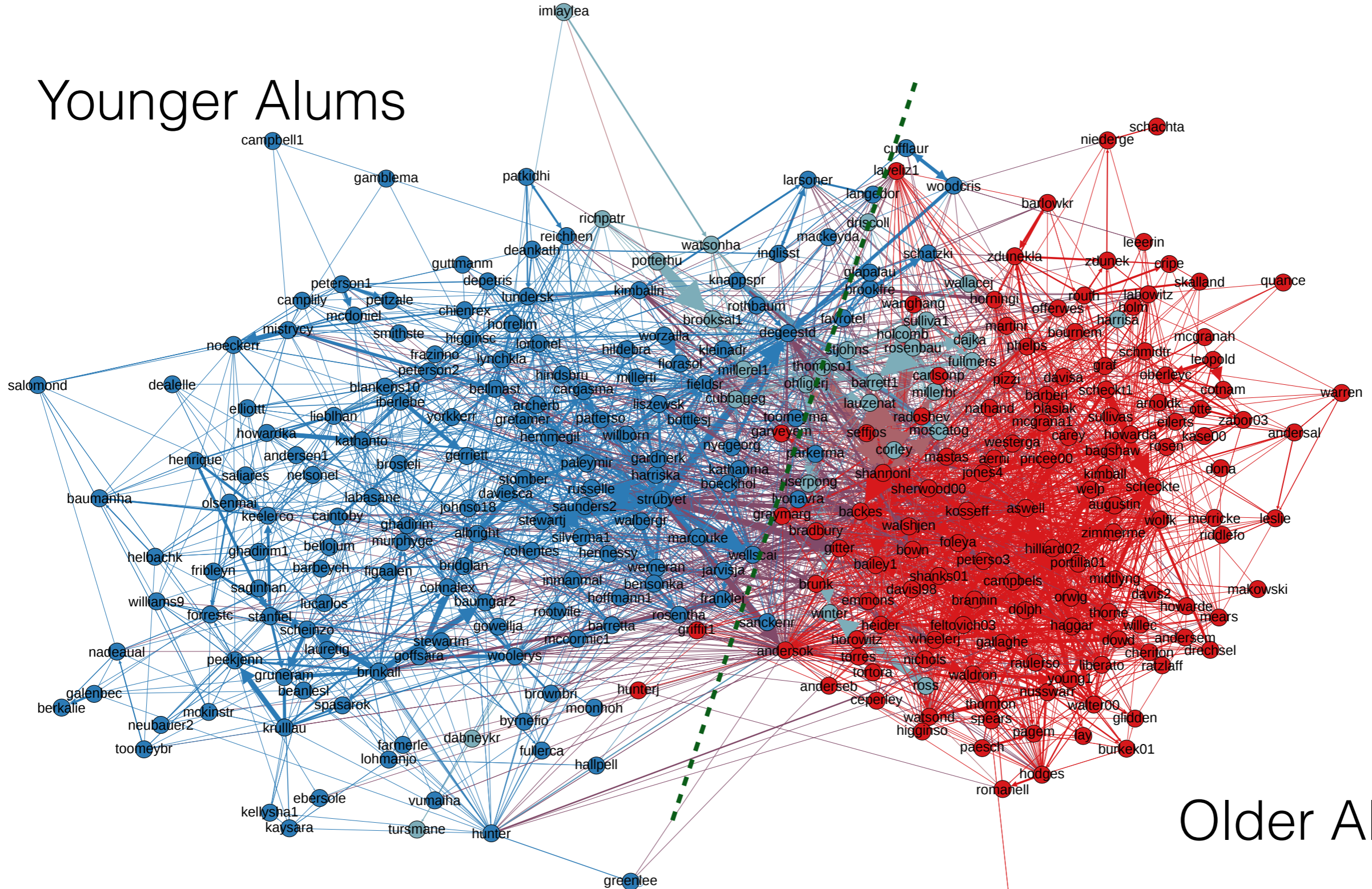
Centrality!

Network scientists have lots of different ways to measure who the most “central” people are in a network.

- *Degree centrality*: how many people do you connect to?
- *Betweenness centrality*: do you bridge between different communities?
- *Page rank*: if you click around on plans, how likely are you to reach a particular person’s plan?

Plans has two sub communities

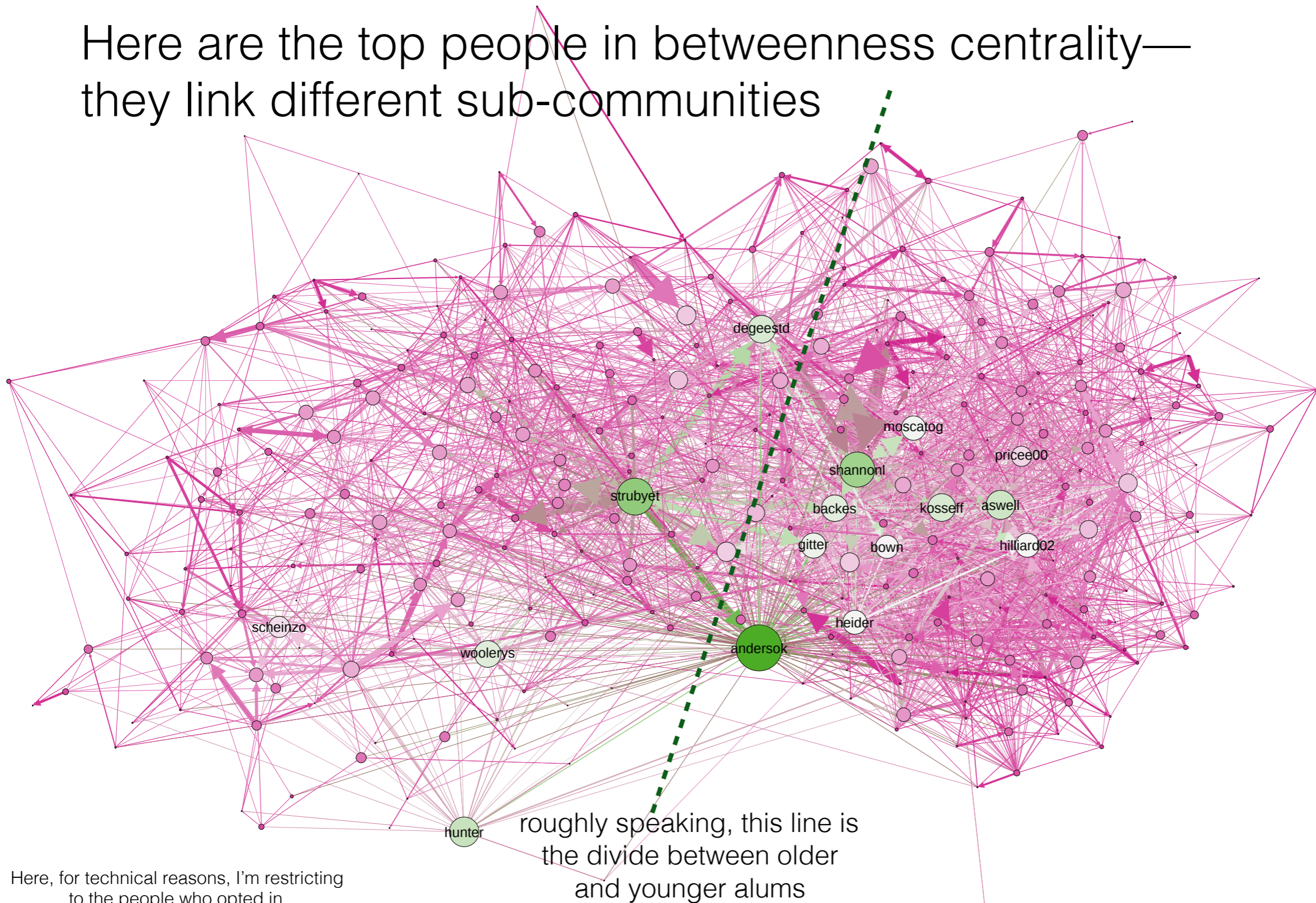
Younger Alums



Older Alums

Betweenness

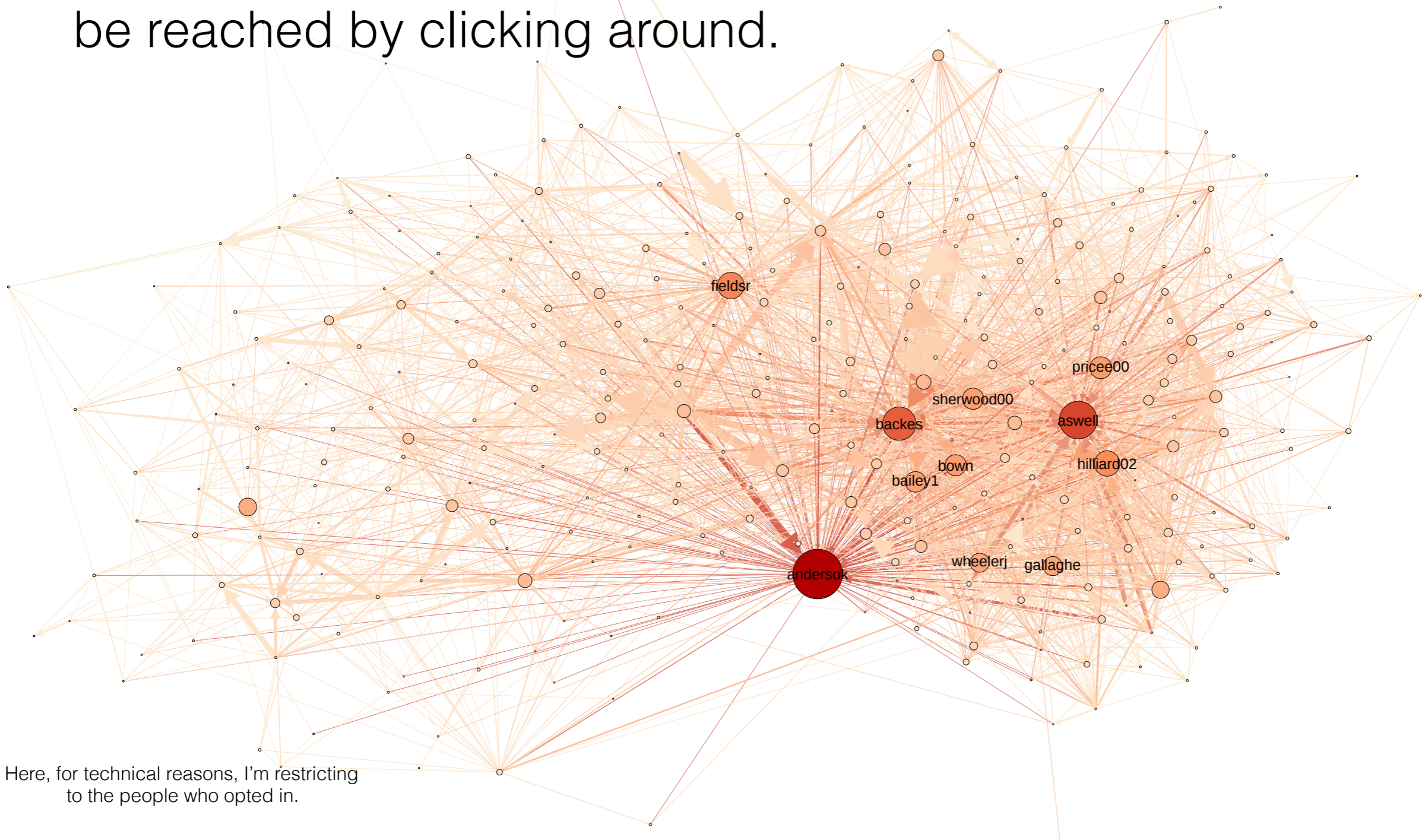
Here are the top people in betweenness centrality—
they link different sub-communities



Here, for technical reasons, I'm restricting
to the people who opted in.

Page Rank

And these are the people with the highest plans page rank — basically people with higher page rank are more likely to be reached by clicking around.



Here, for technical reasons, I'm restricting to the people who opted in.

Different Roles

People with different measures will play different roles in the network:

- *High In-Degree*: lots of engagement and conversation
 - [aswell], [backes], [hilliard02], [degeestd], [fieldsr], [scheckte], [hunter]
- *High Betweenness centrality*: they serve as a bridge between communities—conduits for information
 - [degeestd], [strubyet], [gitter], [shannonl], [rebelsky], [mascatog], [andersok]
- *Page rank*: plans that everyone will reach eventually—good for signal amplification
 - [bown], [aswell], [andersok], [backes], [sherwood00], [bailey1], [fieldsr], [wheelerj], [gallaghe]

Different Roles

So now, what if you want to control the flow of information? Who would you give it to?

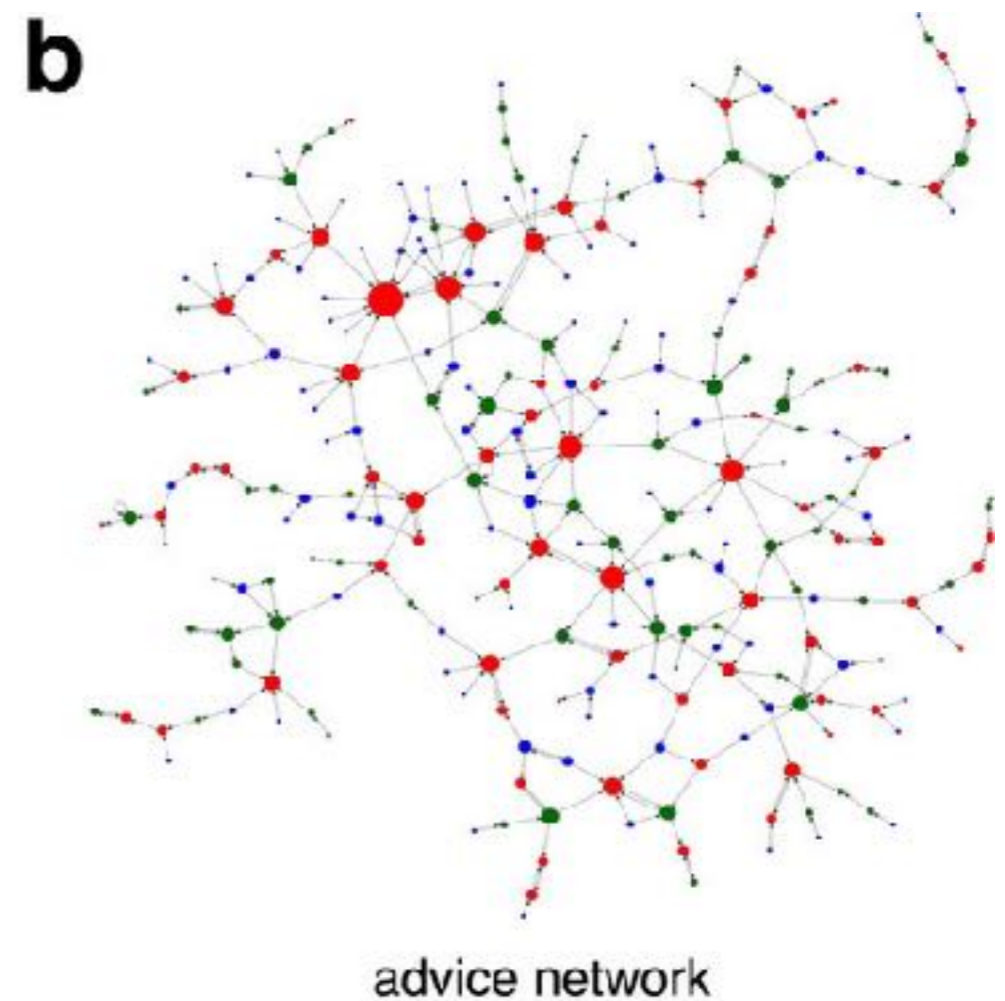
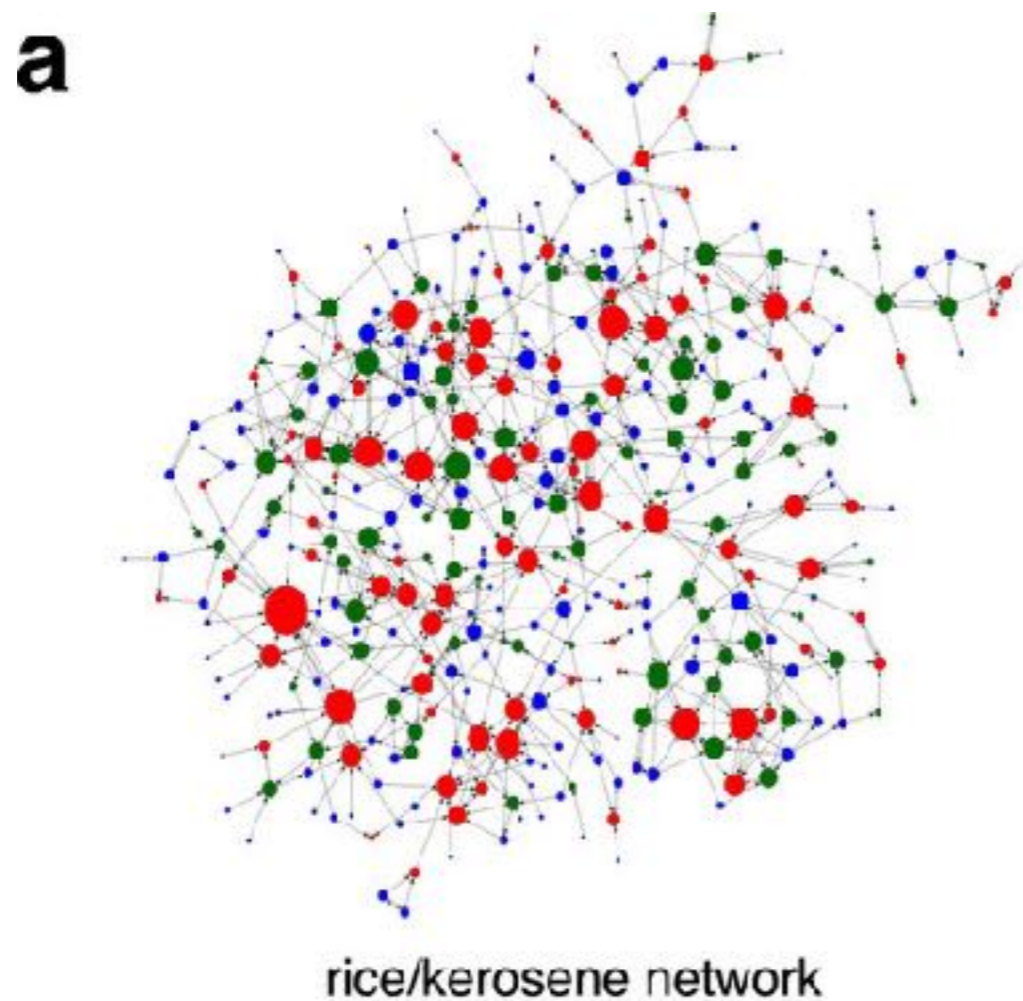
An important example: microfinance

- Information about micro finance is given to “leaders” in rural indian villages (injection points)
- In some villages, adoption rates are very high, and in others they are very low

So how do the NGOs better promote micro finance programs?

Different Roles

- Researchers interviewed households about their network connections



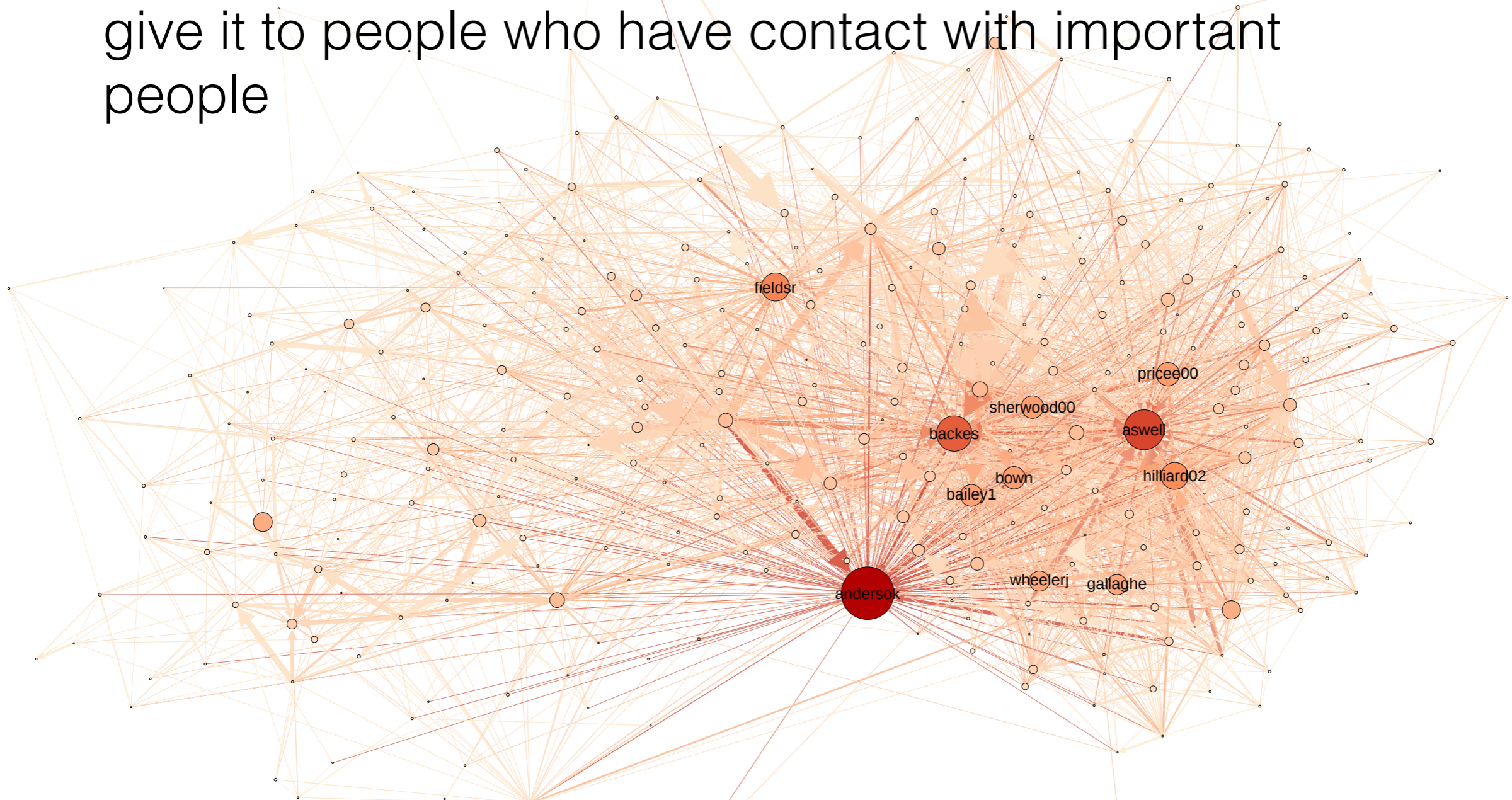
Banerjee et al (2013)

Different Roles

- In some villages, the people identified as “leaders” were central in the network. In others, they were not.
 - In villages where information was given to people with high centrality, adoption rates were high.
 - In villages where information was given to people who are more peripheral, adoption rates were low
- People were pretty good at predicting who would be central in their own network, given only their own limited information

Plans and Information

If you want to get people information about something, give it to people who have contact with important people



These people are visible, and their opinions hold more weight!

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