DCS/CSCI 2350: Social & Economic Networks

What is the effect of different types of edges? Can we use it to detect communities in a network?

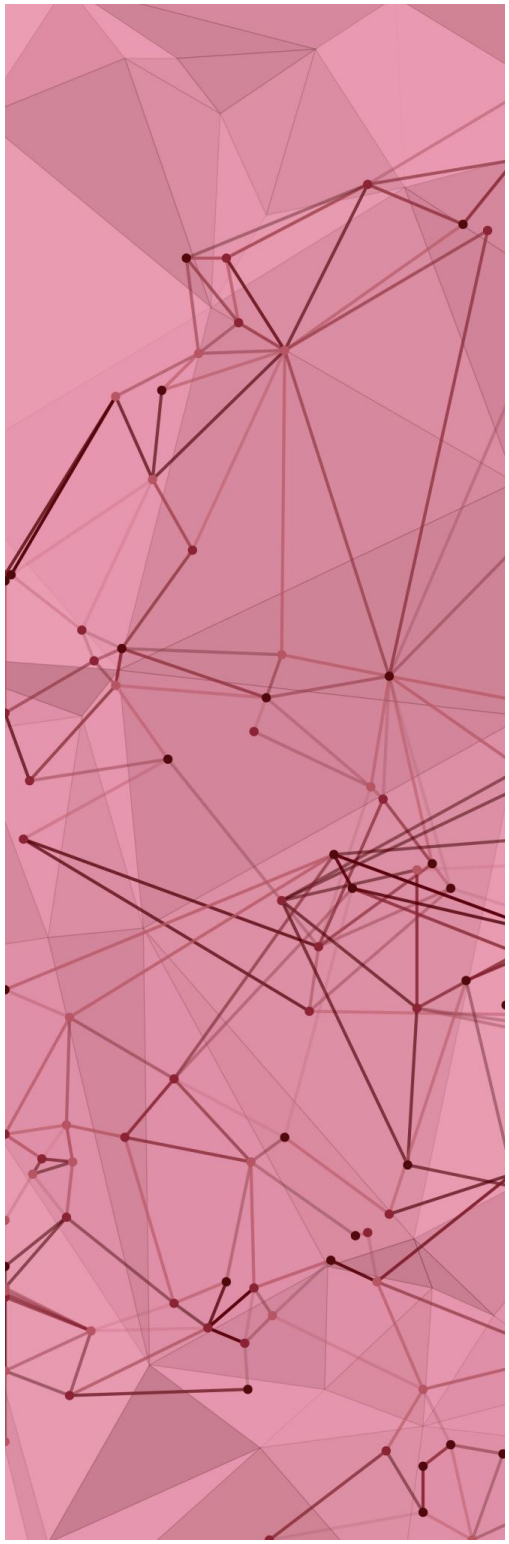
"The strength of weak ties"

Reading: Ch 3 of Easley-Kleinberg

Mohammad T. Irfan

Granovetter's study (1960s)

Acquaintances, not friends, hold critical information about job opportunities

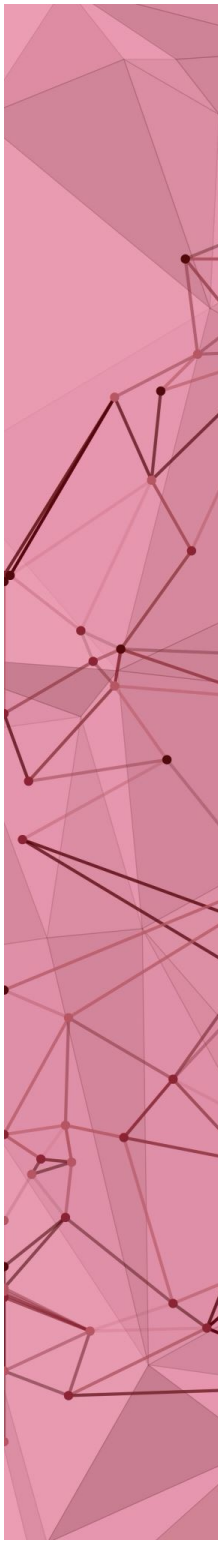


Local --- Global

What's the personal/interpersonal implication of network structure?

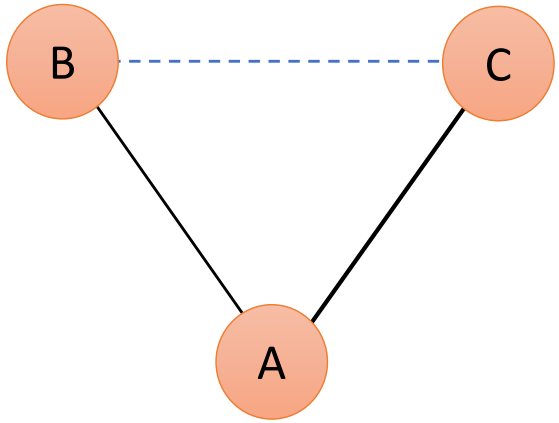
Pieces in this question

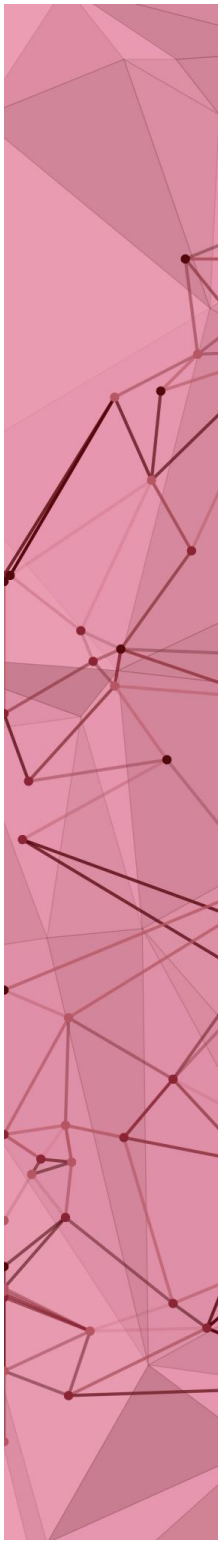
- Triangle and “triadic closure”
- “Bridge” and “local bridge”
- Strong vs weak ties
- Strong triadic closure property (STCP)



Triadic closure

B and C are very likely
to become friends (Rapoport, 1953)



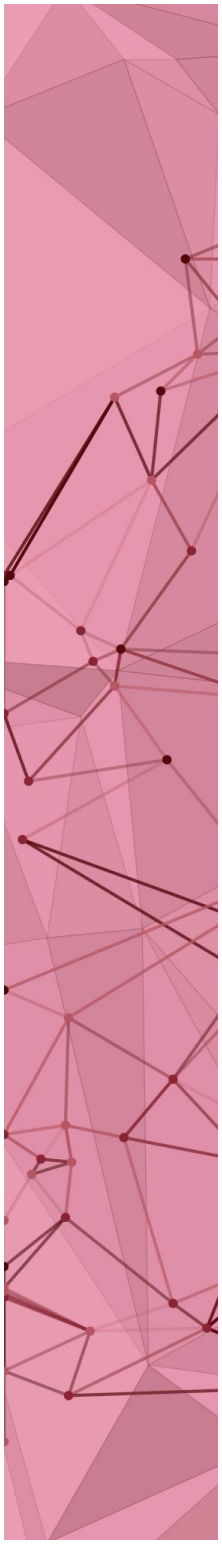


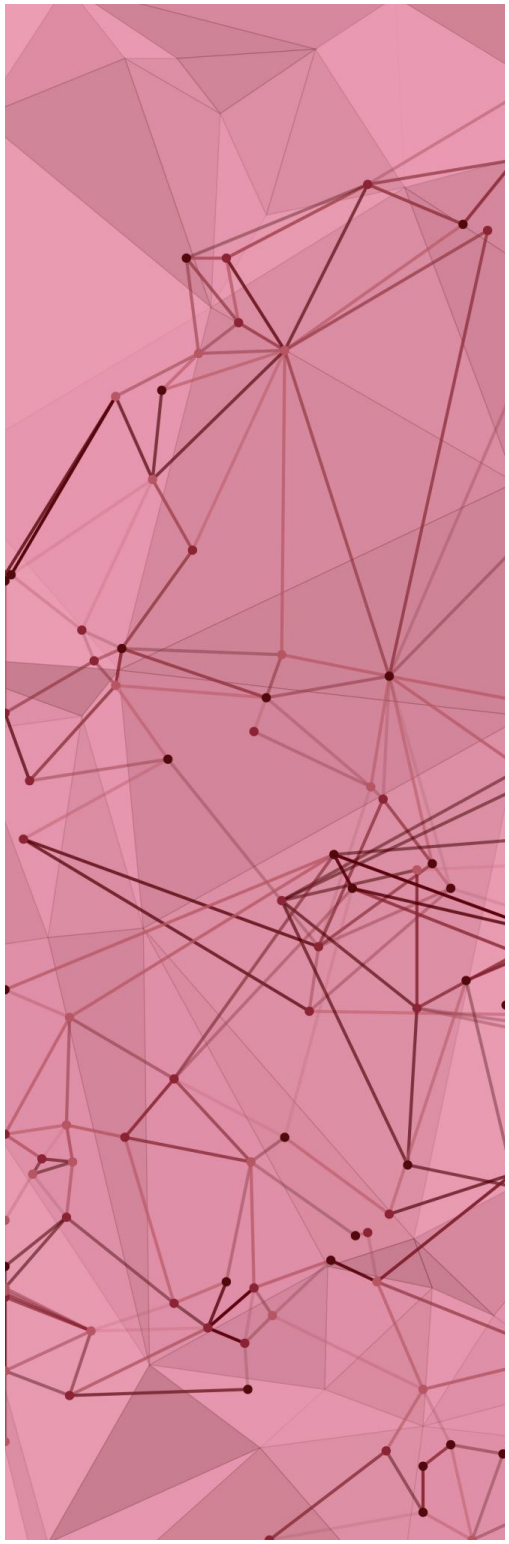
Triadic closure

- Triadic closure increases clustering coeff. (why?)

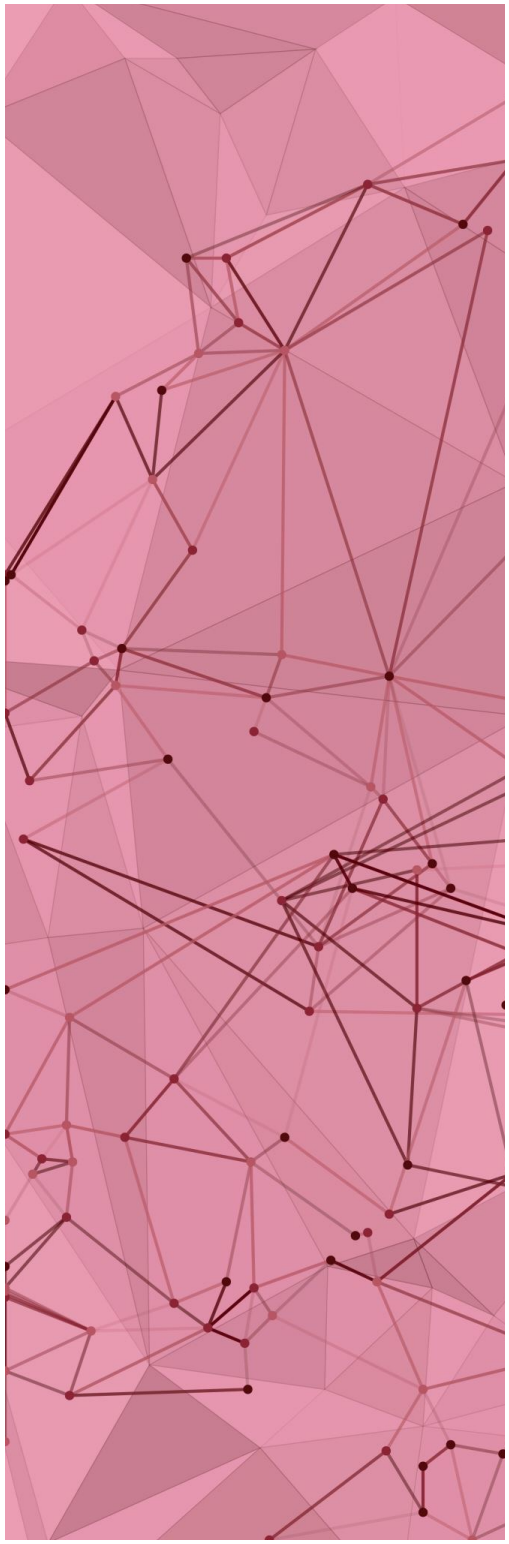
- Reasons why triadic closure happens:

1. Opportunity for B and C to meet
2. B and C can trust each other
3. A wants to reduce stress by making B and C friends
   - Teen suicide <--> low (local) clustering coefficient (Bearman and Moody, 2004)





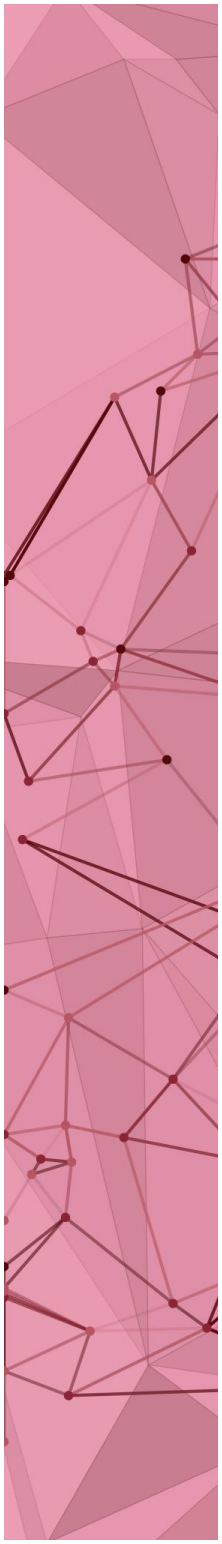
Local bridge

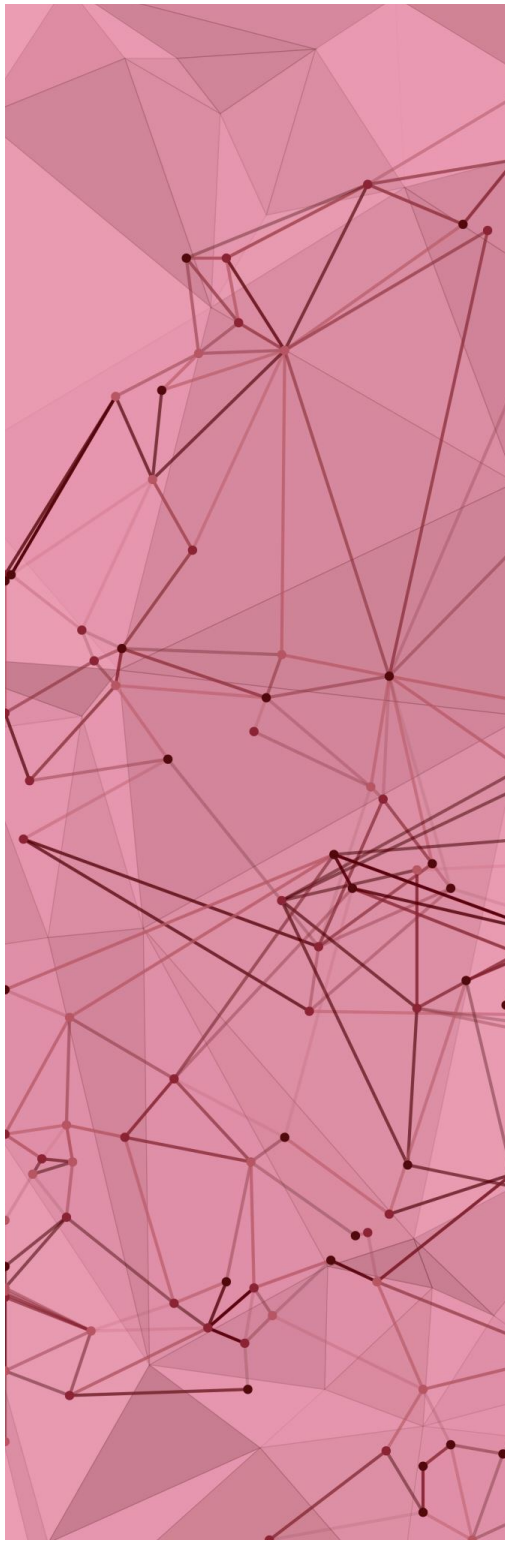


Tie strength
&
Strong triadic closure Property (STCP)

(Granovetter's theorem) The strength of weak ties

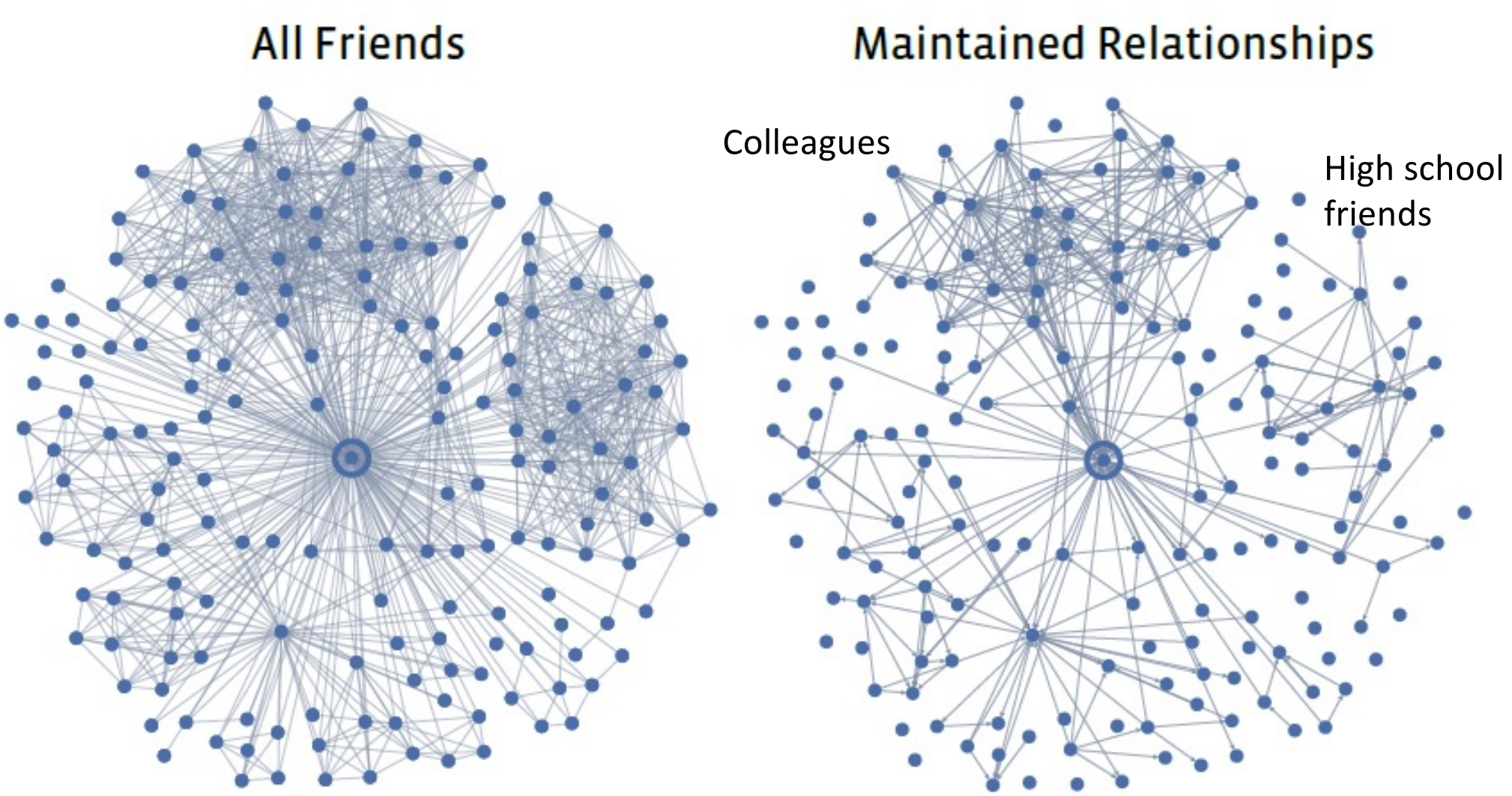
- If a node A satisfies STCP and has at least 2 strong ties, then any local bridge it's involved in must be a weak tie.
- Proof.





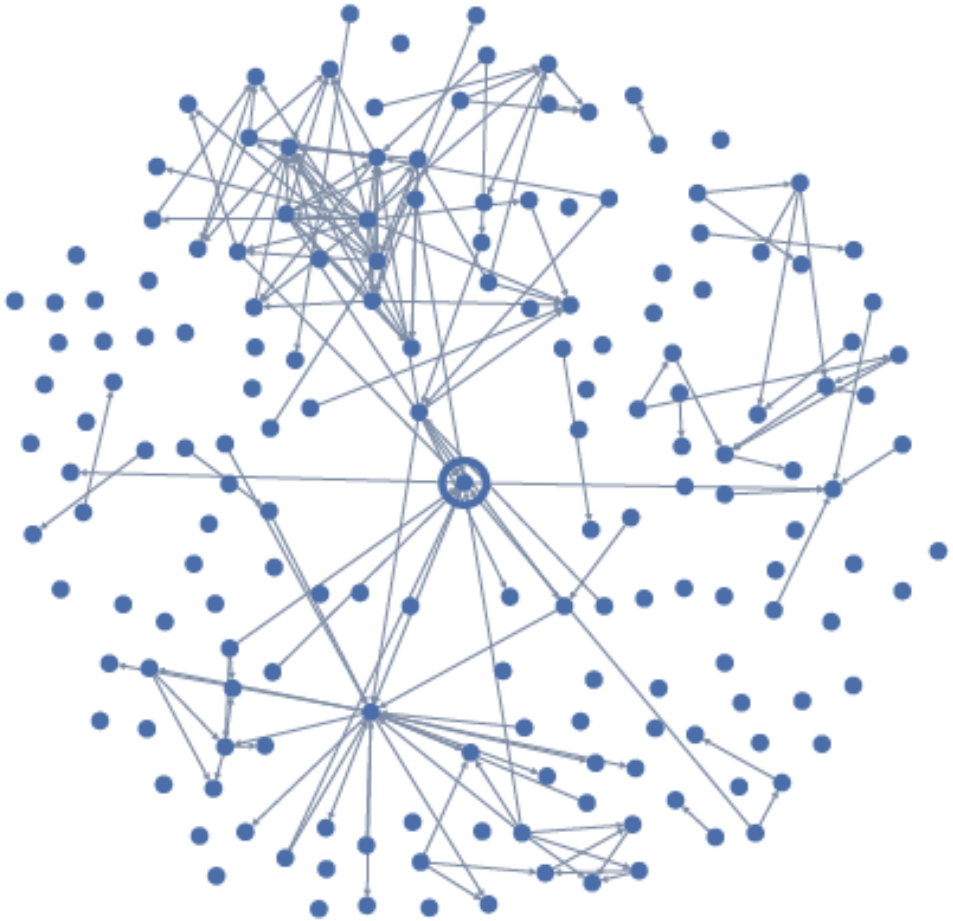
The strength of weak ties in the real world

Weak ties in Facebook (Marlow et al., 2009)

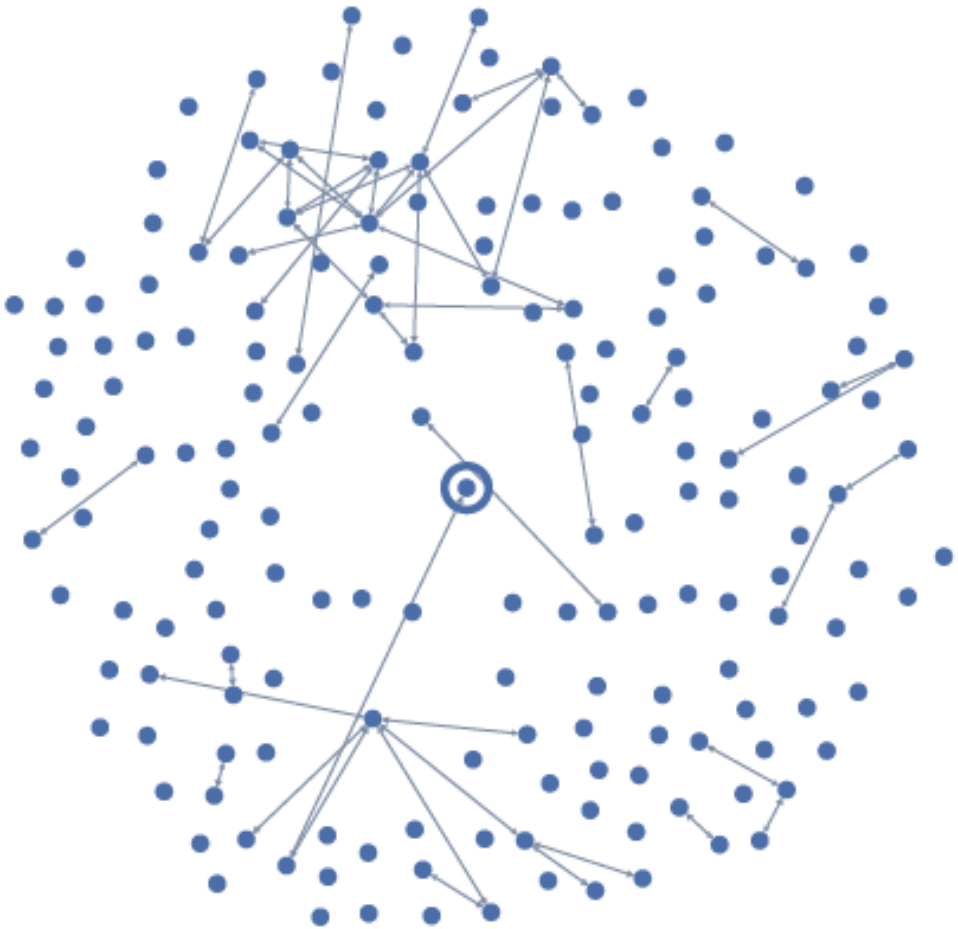


Weak ties in Facebook (cont...)

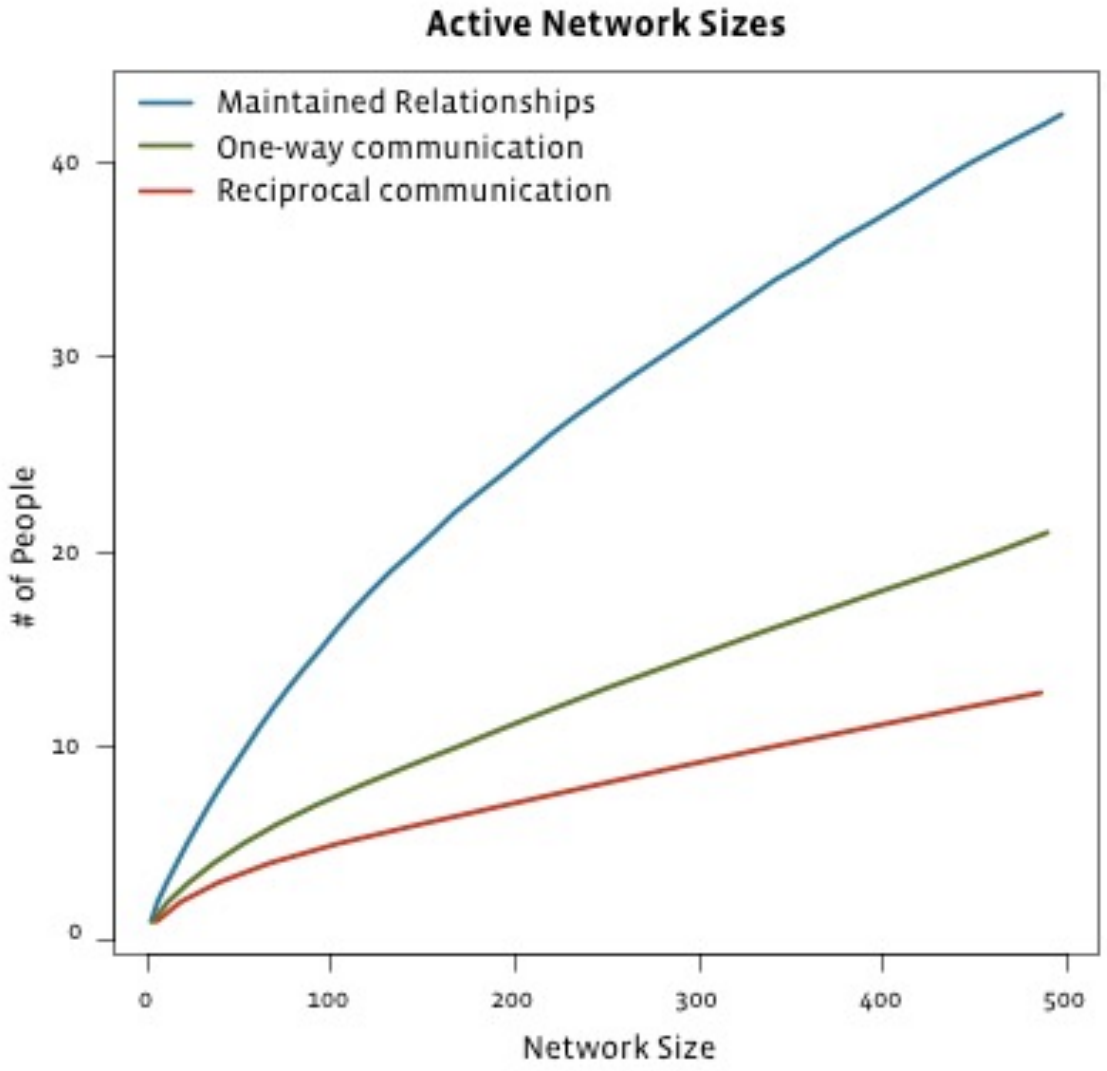
One-way Communication



Mutual Communication



Weak ties (passive network) – What's the use?



Twitter (Huberman et al., 2009)

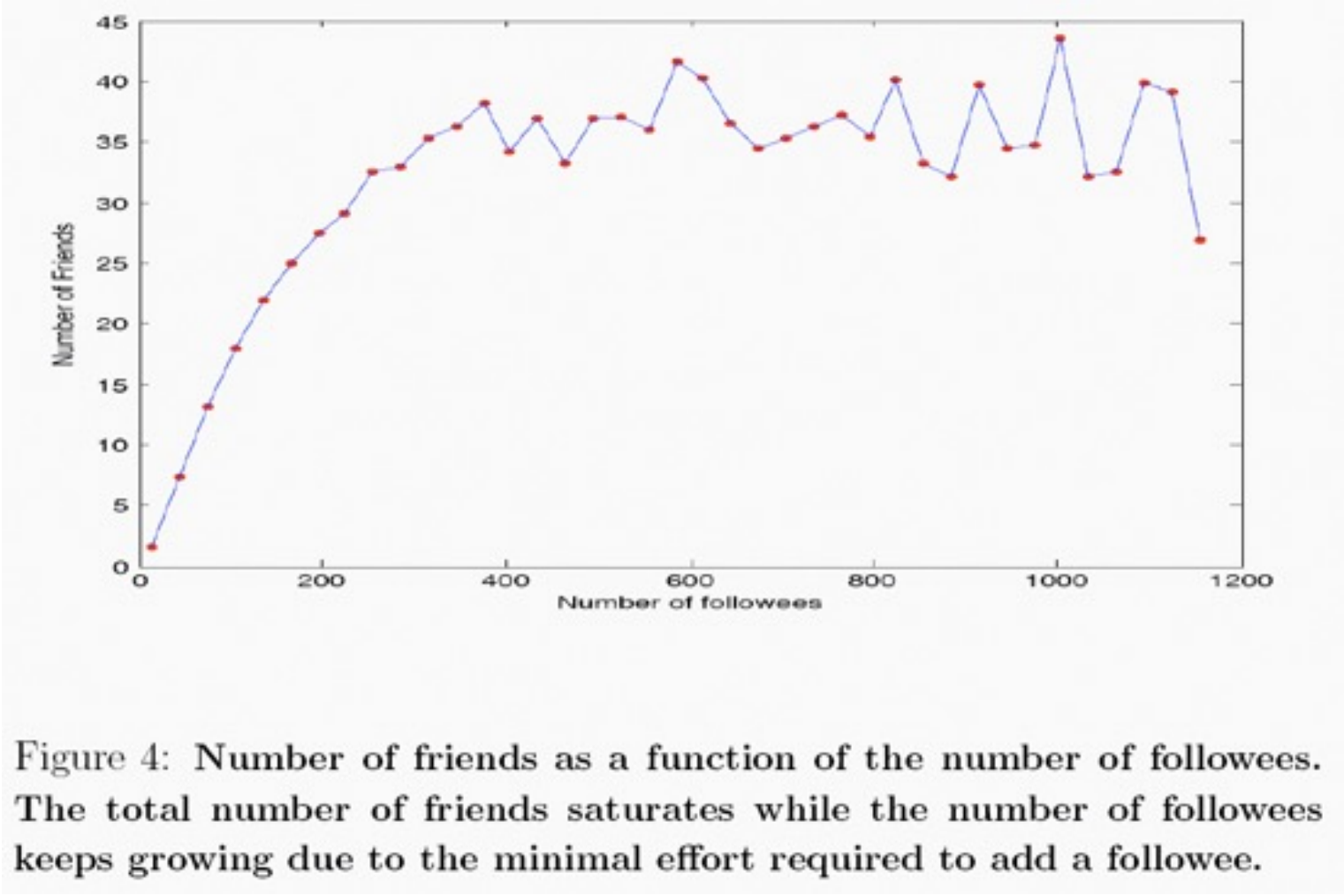


Figure 4: **Number of friends as a function of the number of followees. The total number of friends saturates while the number of followees keeps growing due to the minimal effort required to add a followee.**

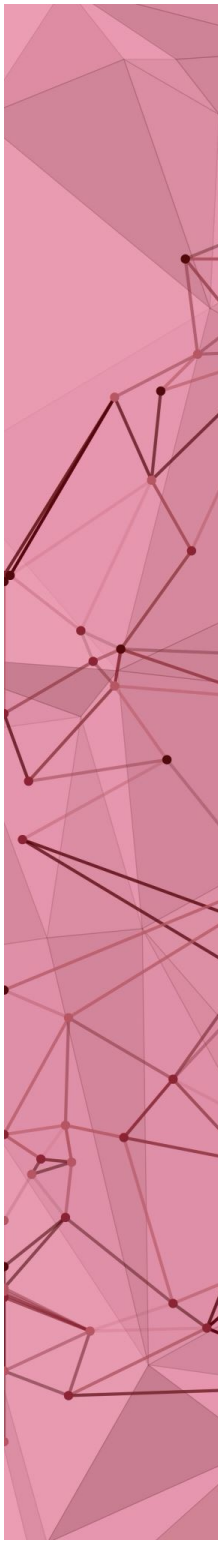
Are weak ties really powerful?

Gladwell: “weak ties seldom lead to high-risk activism”

The evangelists of social media don’t understand this distinction; they seem to believe that a Facebook friend is the same as a real friend and that signing up for a donor registry in Silicon Valley today is activism in the same sense as sitting at a segregated lunch counter in Greensboro in 1960. “Social networks are particularly effective at increasing motivation,” Aaker and Smith write. But that’s not true. Social networks are effective at increasing *participation*—by lessening the level of motivation that participation requires. The Facebook page

Counter argument: the strength of weak ties

Weak ties influence what we see, how we think, and what actions we take.



THEWORLDPOST
A PARTNERSHIP OF THE HUFFINGTON POST AND BERGGRUEN INSTITUTE

Pierre Omidyar Become a fan
CEO and publisher of Honolulu Civil Beat, Founder of eBay

Social Media: Enemy of the State or Power to the People?

Posted: 02/27/2014 12:11 pm EST | Updated: 12/01/2014 7:59 pm EST

Pierre Omidyar is the founder and chairman of eBay; and publisher and CEO of First Look Media.

At a recent series of events in Beijing hosted by the Berggruen Institute, I was asked to speak about social media and the potential harm and good associated with it.

My view is pretty straightforward -- I believe that social media is a tool of liberation and empowerment. That may seem fairly audacious when a good portion of the Western world is using Facebook and Twitter to post pictures of what they had for

Andrew Lam Become a fan
Author and editor, New America Media

From Arab Spring to Autumn Rage: The Dark Power of Social Media

Posted: 09/14/2012 3:44 pm EDT | Updated: 11/14/2012 5:12 am EST

In 2010 *Time* Magazine's prestigious Person of the Year title went to two individuals. While its readers picked Julian Assange, founder of Wikileaks, the magazine's pick was Mark Zuckerberg, founder of Facebook.

"Facebook is now the third largest country on earth and surely has more information about its citizens than any government does," the magazine noted. "Zuckerberg, a Harvard dropout, is its T-shirt-wearing head of state."

Assange, founder of the whistleblower website WikiLeaks, on the other hand, undermined entire nation states' public narratives of themselves by providing a

UW TODAY

September 12, 2011

New study quantifies use of social media in Arab Spring

Catherine O'Donnell

In the 21st century, the revolution may not be televised – but it likely will be tweeted, blogged, texted and organized on Facebook, recent experience suggests.

A rebel waves a Libyan flag while standing atop a tank gun. ***Hussein Elkhafaifi***

After analyzing more than 3 million tweets, gigabytes of YouTube content and thousands of blog posts, a new study finds that social media played a central role in shaping political debates in the Arab Spring. Conversations about revolution often preceded major events, and social media has carried inspiring stories of protest across international borders.

"Our evidence suggests that social media carried a cascade of messages about freedom and democracy across North Africa and the Middle East, and helped raise expectations for the success of political uprising," said Philip Howard, the project lead and an associate professor in communication at the University of Washington. "People who shared interest in democracy built extensive social networks and organized political action. Social media became a critical part of the toolkit for greater freedom."

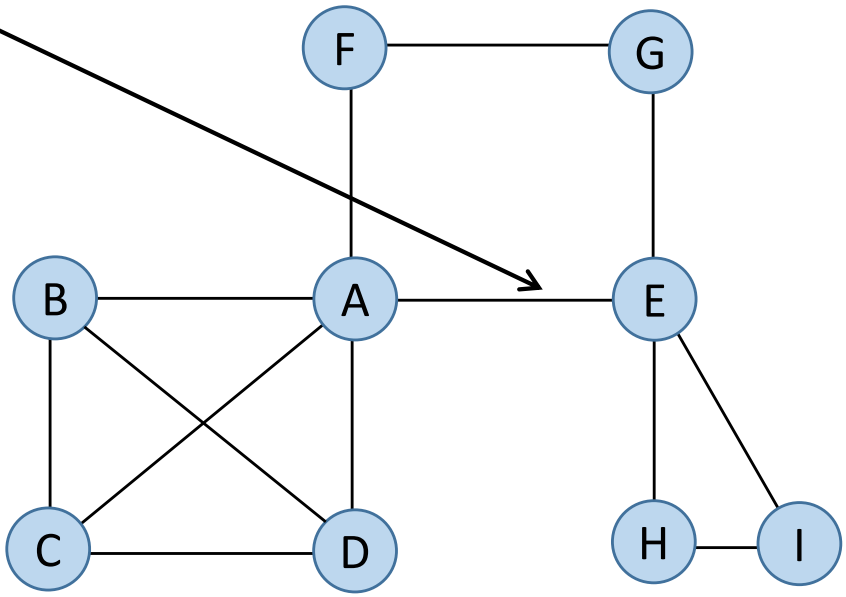
Review

Local bridge

An edge which is not a side of any triangle

⇔An edge whose endpoints do not have any common neighbor

⇔An edge whose deletion causes the distance between its endpoints to be >= 3



Why are local bridges important?

Under **STCP**, every local bridge must be a "weak" tie

Review

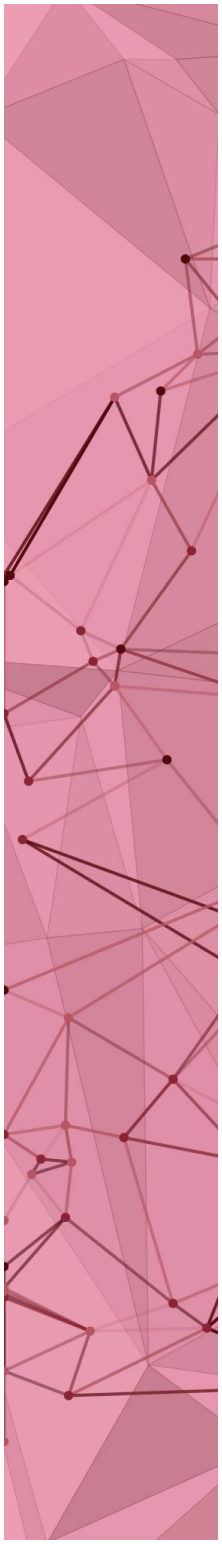
(Granovetter's theorem) The strength of weak ties

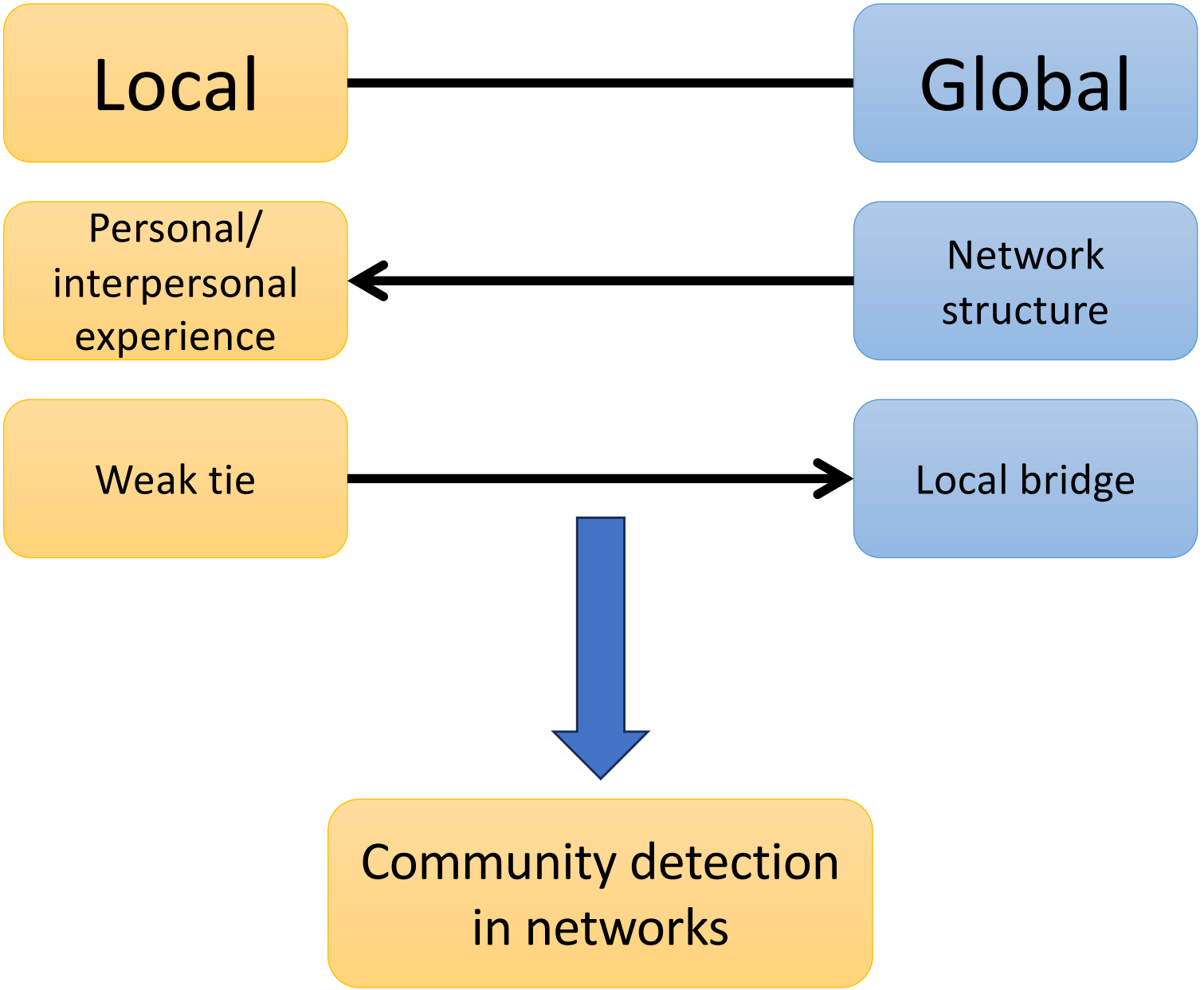
If a node A satisfies STCP

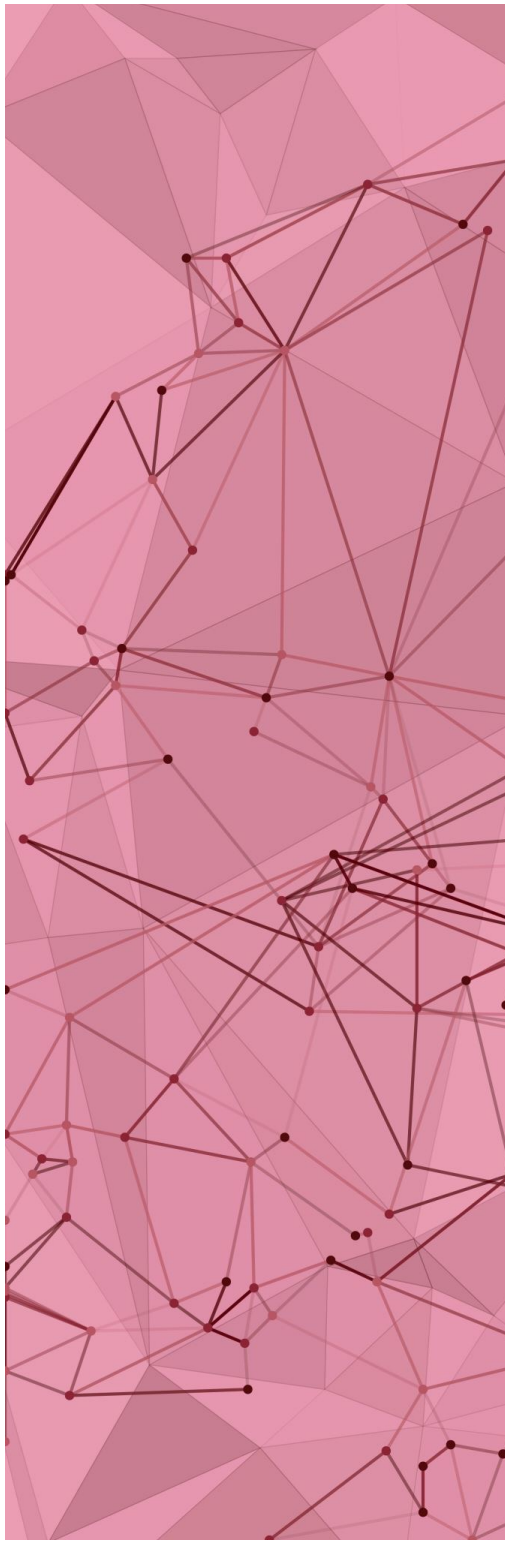
and has at least 2 strong ties,

then any local bridge it's involved in

must be a weak tie.



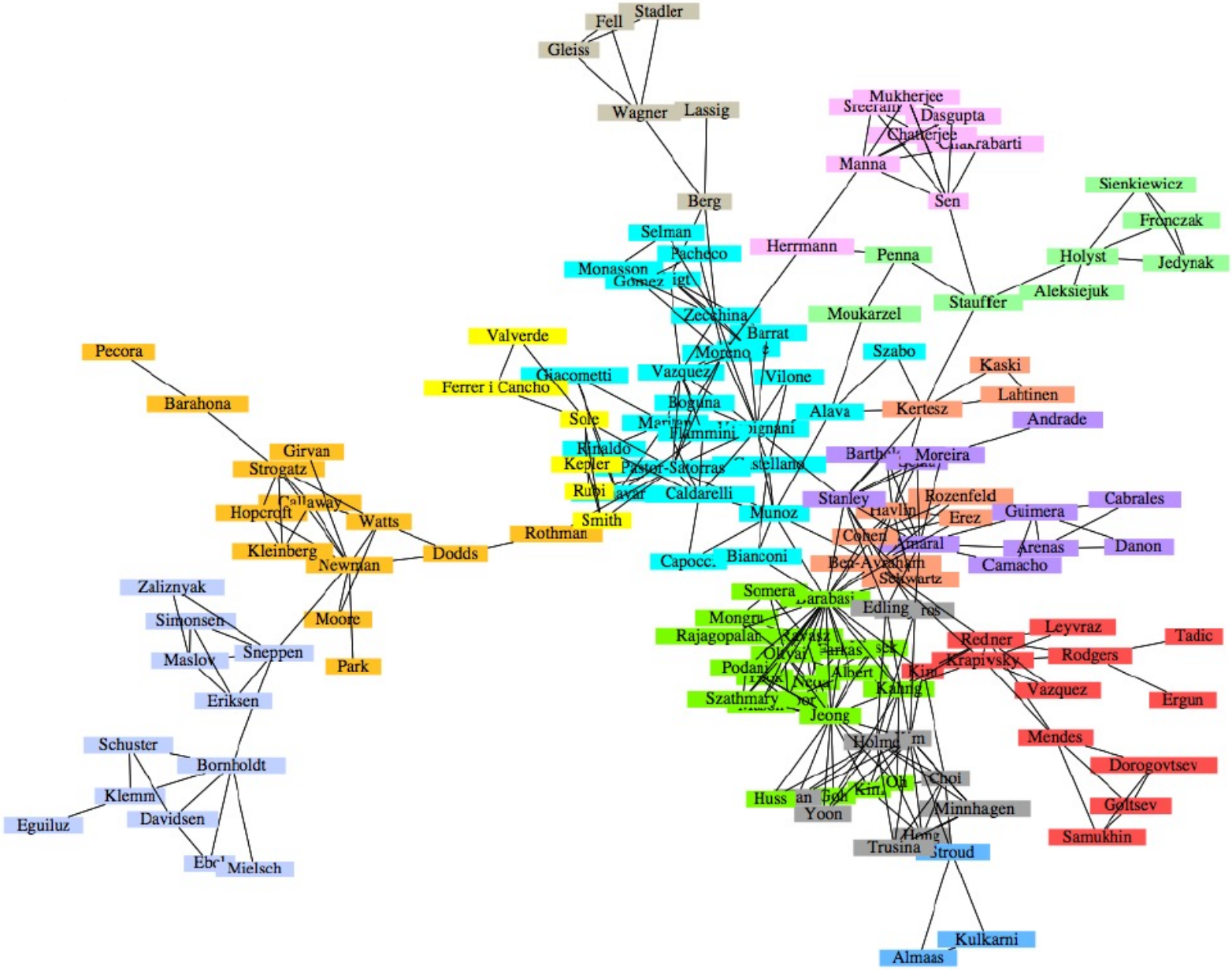

Local
Global
Personal/ interpersonal experience
Network structure
Weak tie
Local bridge
Community detection in networks



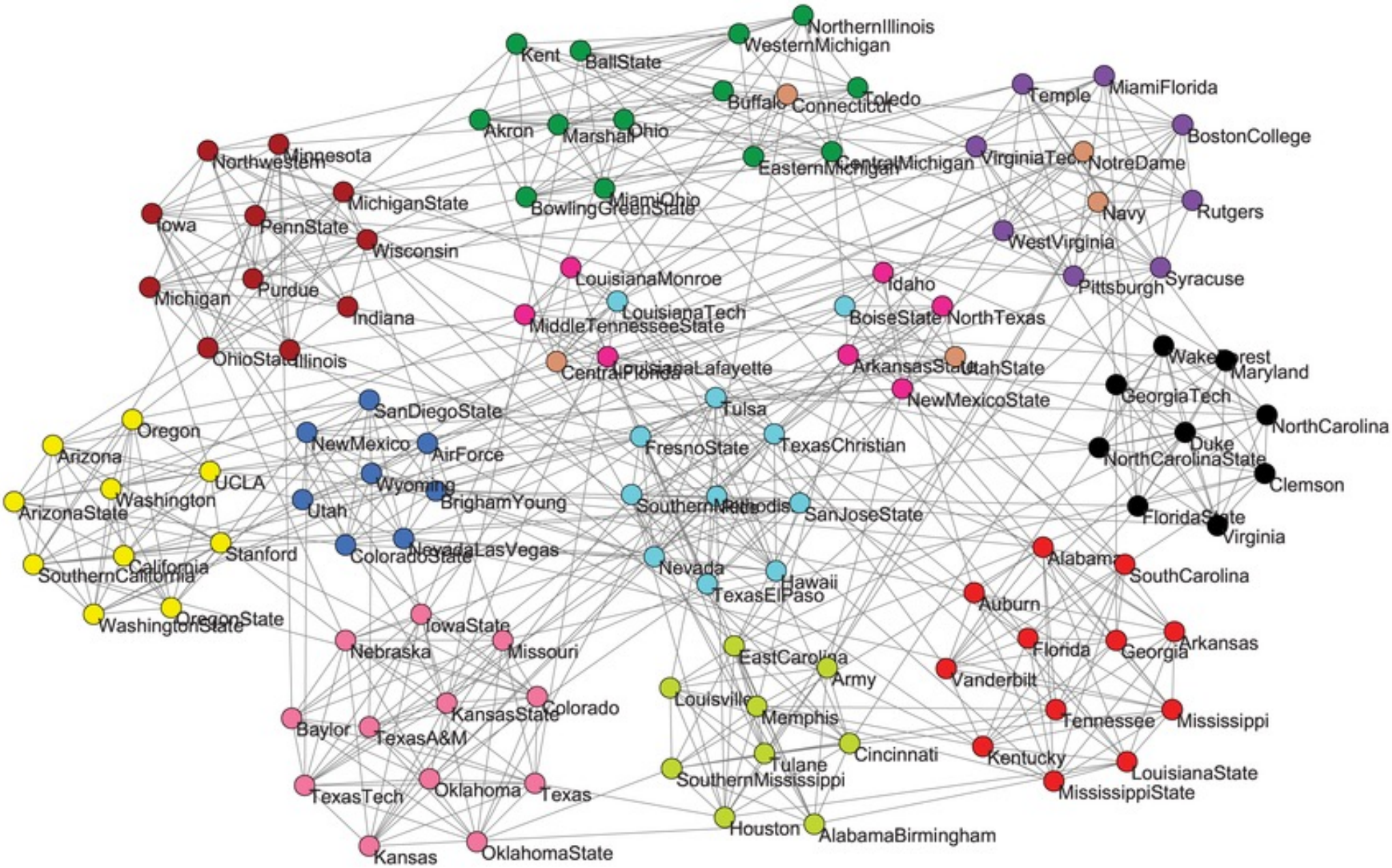
Community detection in social networks using local bridges

Section 3.6 (Advanced)

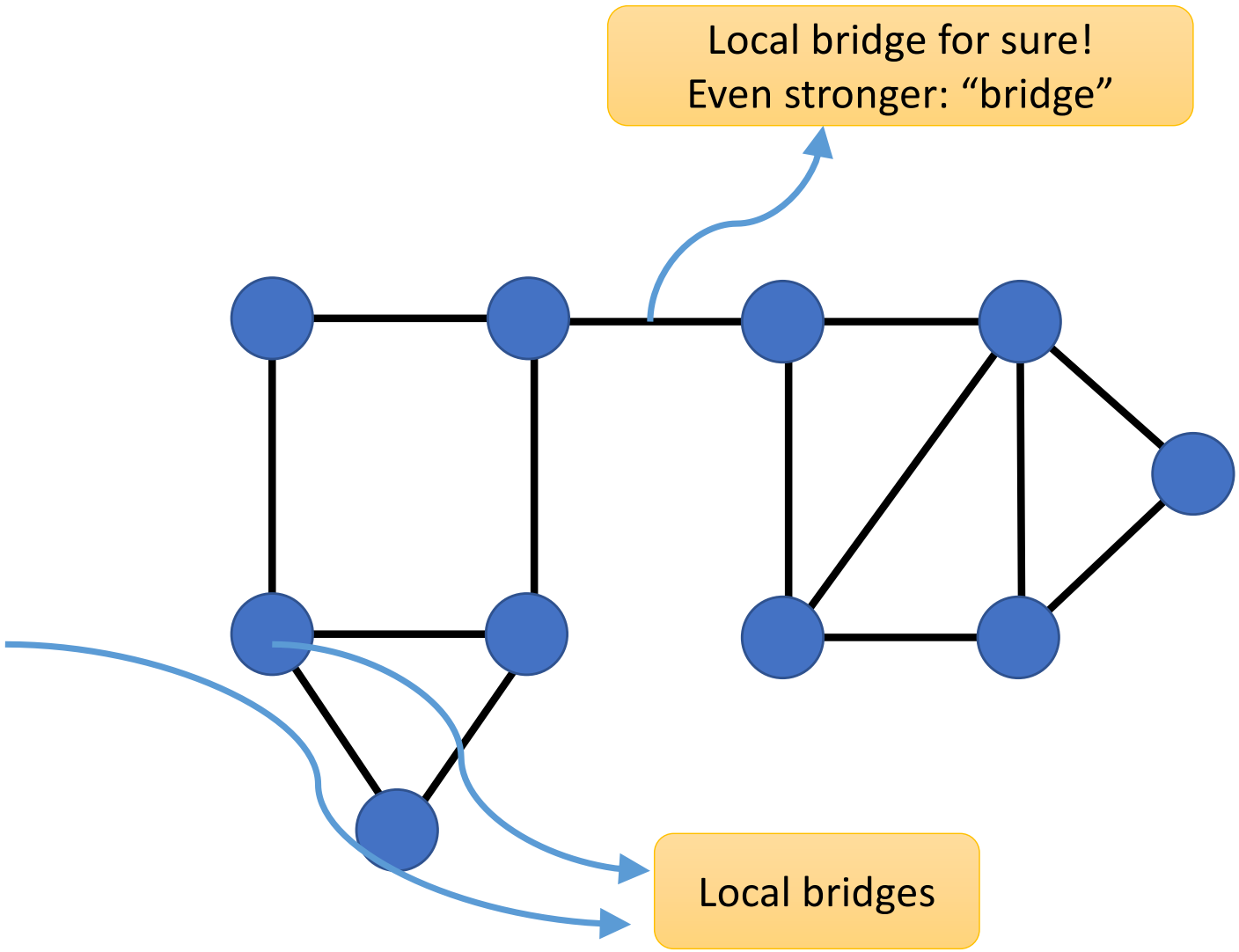
Coauthorship network (Newman-Girvan, 2004)



NCAA college football (Huang et al., 2011)

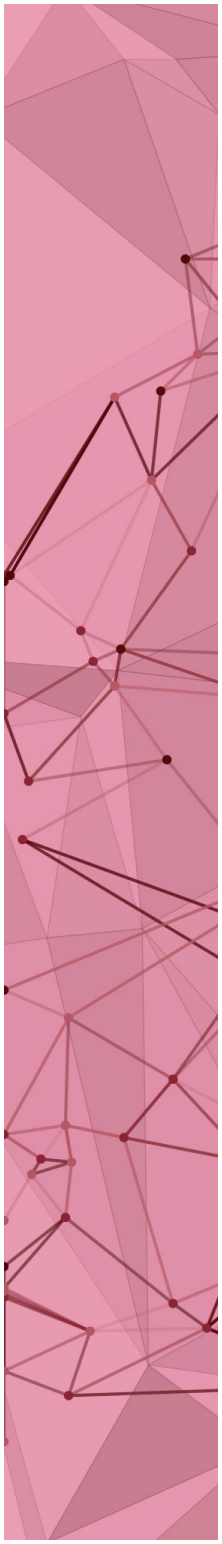


How to use local bridge for community detection?

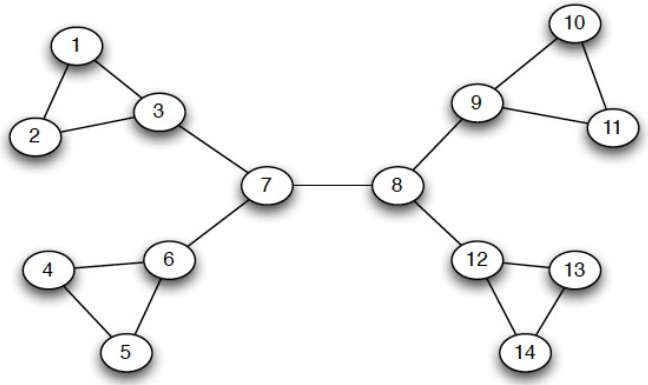


Idea

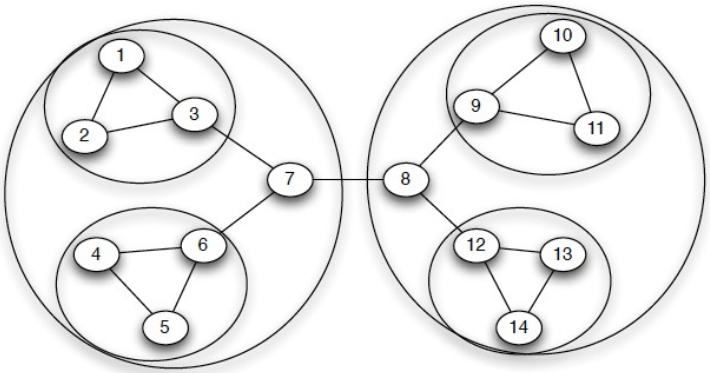
- Delete local bridges one after another
- Get connected components
  - close-knit communities
- Divisive graph partitioning
  (as opposed to agglomerative)



But… which local bridge to delete first?

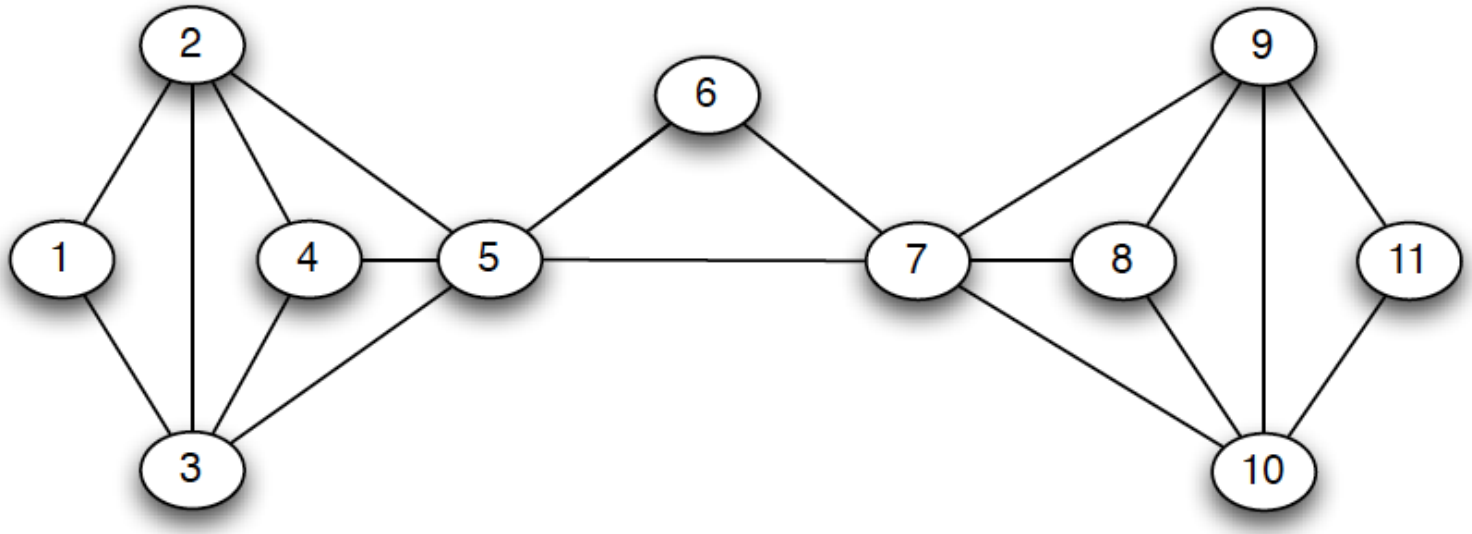


(a) *A sample network*



(b) *Tightly-knit regions and their nested structure*

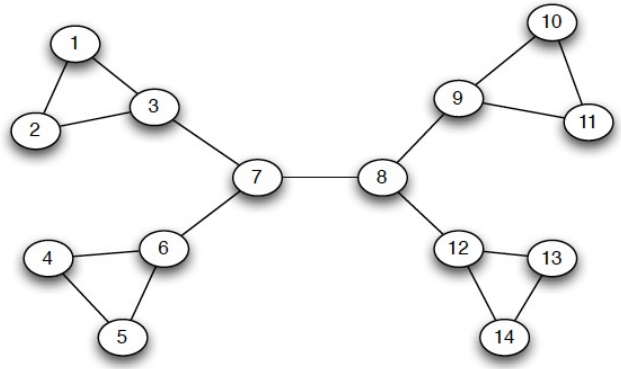
Also… what if there's no local bridge?



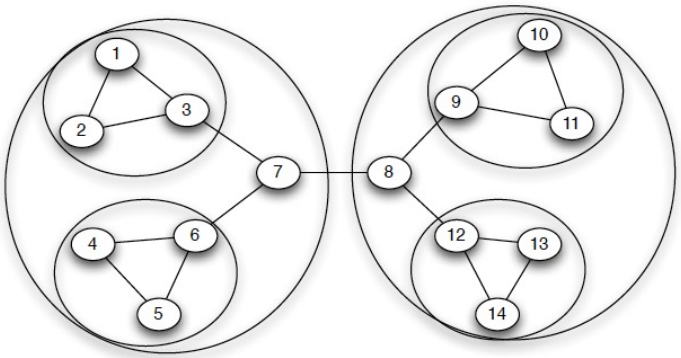
Need some form of "betweenness" measure for the edges!

Girvan-Newman algorithm (2002)

- Calculate the betweenness of each edge
- Successively delete the edge(s) with the highest betweenness (and recalculate betweenness)



(a) *A sample network*

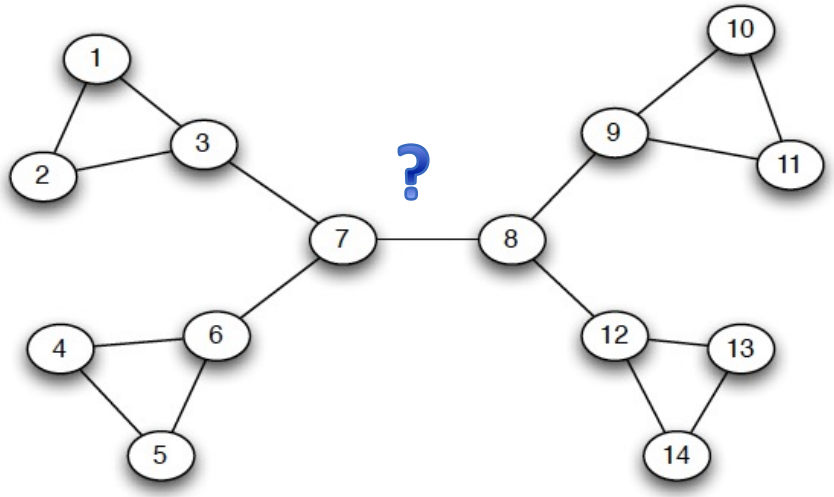


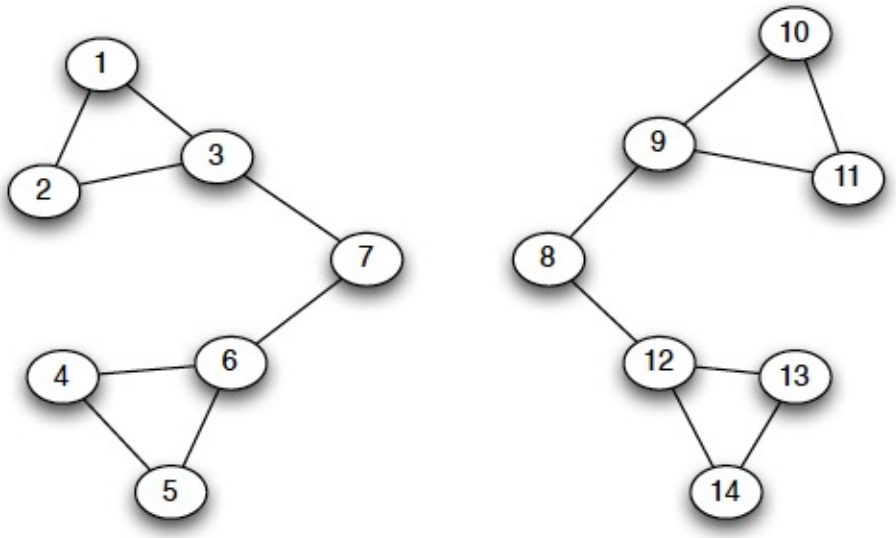
(b) *Tightly-knit regions and their nested structure*

Q. When should we stop?

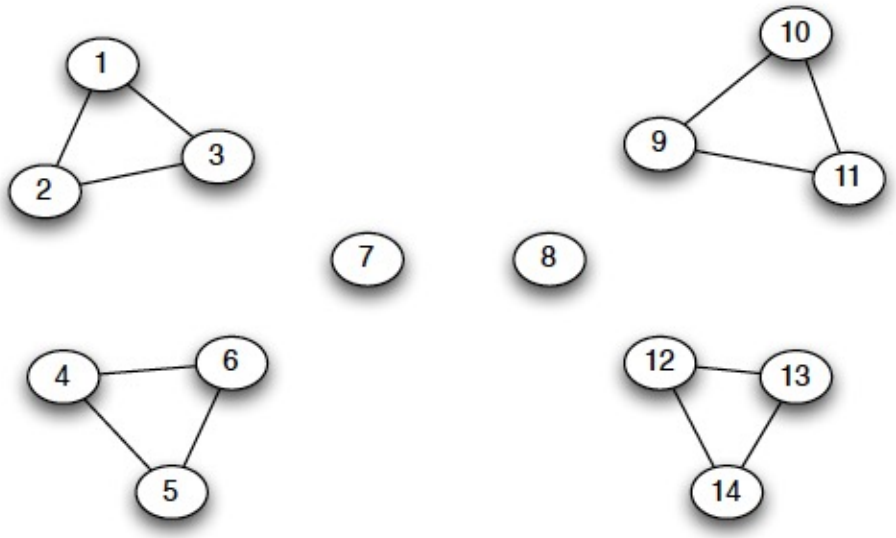
Betweenness of an edge

- Every node is sending 1 gallon of water to <u>every other node</u>
- Water only flows through shortest paths
  - Equally distributed among multiple shortest paths
- Betweenness of an edge
  = Quantity of water flowing through it

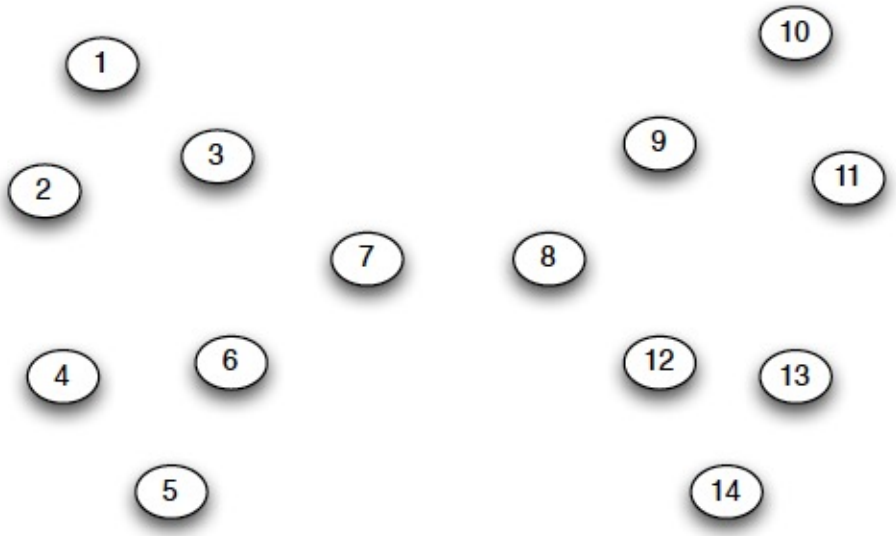




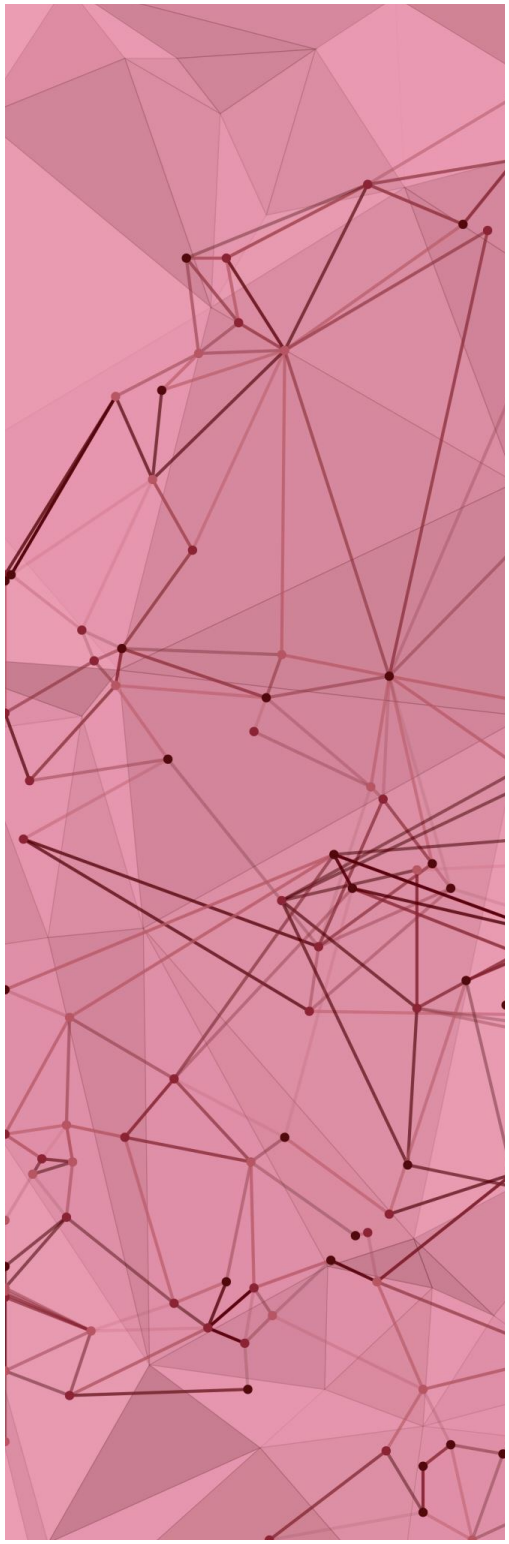
(a) *Step 1*



(b) *Step 2*



(c) *Step 3*



How to compute the betweenness of an edge?

Karate club (Zachary, 1977)
Output of Girvan-Newman algorithm