

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

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Granovetter's
study (1960s)

Acquaintances, not
friends, hold critical
information about
job opportunities



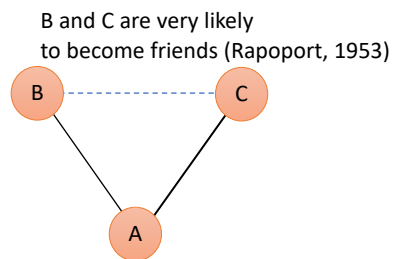
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Pieces in this question

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

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Triadic closure



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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 \leftrightarrow low (local) clustering coefficient (Bearman and Moody, 2004)

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Local bridge

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A network graph illustration on the left side of the slide, showing a complex web of interconnected nodes and edges in shades of pink and red.

Tie strength
&
Strong triadic closure
Property (STCP)


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(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.

A network graph illustration on the right side of the slide, showing a complex web of interconnected nodes and edges in shades of pink and red.

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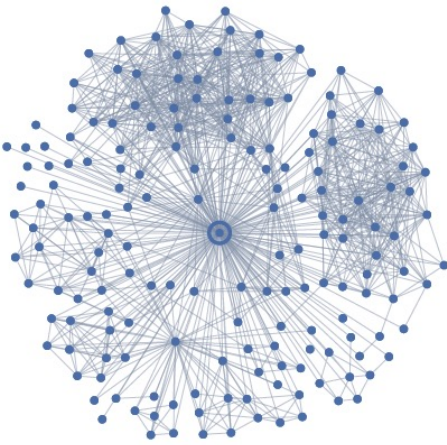


The strength of weak ties in the real world

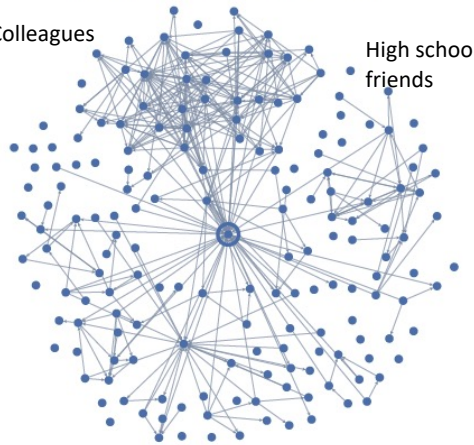
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Weak ties in Facebook (Marlow et al., 2009)

All Friends



Maintained Relationships



Colleagues High school friends

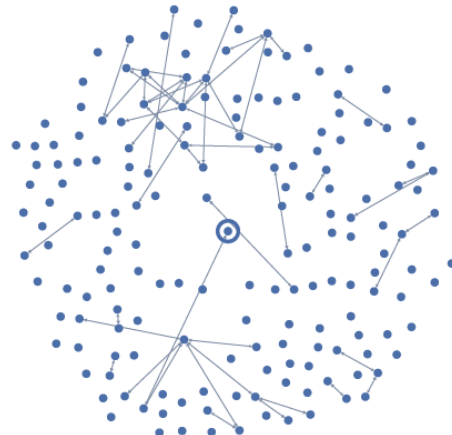
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Weak ties in Facebook (cont...)

One-way Communication

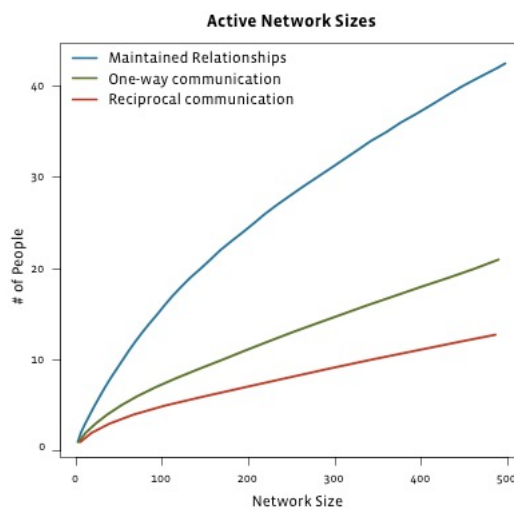


Mutual Communication



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



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Twitter (Huberman et al., 2009)

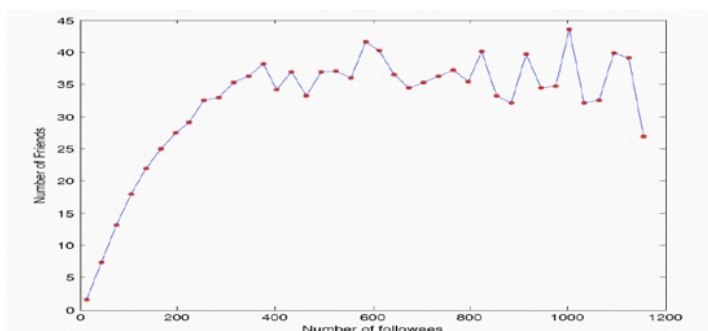


Figure 4: Number of friends as a function of the number of followees. The total number of friends saturates while the number of followees keeps growing due to the minimal effort required to add a followee.

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Are weak ties really powerful? Gladwell: “weak ties seldom lead to high-risk activism”

THE NEW YORKER

ANNALS OF INNOVATION
SMALL CHANGE
Why the revolution will not be tweeted.
BY MALCOLM GLADWELL
OCTOBER 4, 2010

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1. Jason Fagnoe: The Construction of a Twitter Aesthetic
2. George Padnos: Is Amazon Bad for Books?

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

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Counter-argument

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Pierre Omidyar by @pierreomidyar
 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 EDT | Updated: 12/01/2014 7:59 pm EDT



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Led Zeppelin Loses First Round in 'Stairway to Heaven' Lawsuit

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

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Counter-argument

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Andrew Lam by @andrewlam
 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

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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

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Counter-argument

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 Elshagheer

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."

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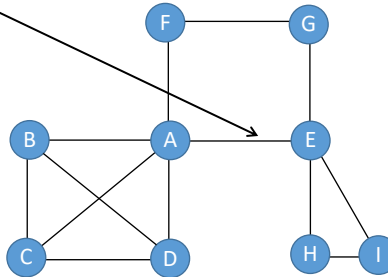
Review

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



Are local bridges important? Why?

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

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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.

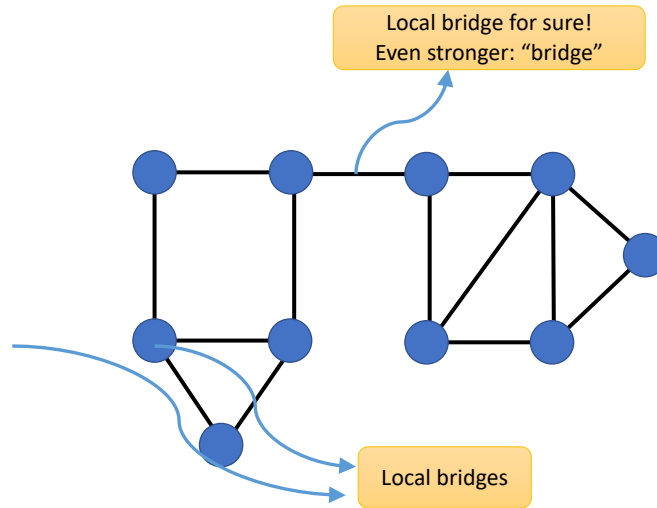
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Community detection in social networks using local bridges

Section 3.6 (Advanced)

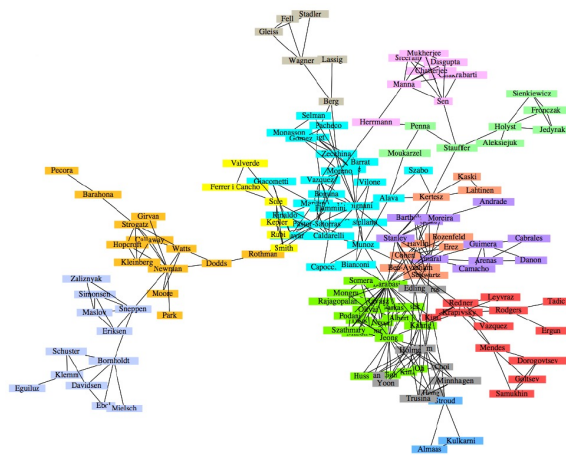
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How to use local bridge for community detection?



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Coauthorship network (Newman-Girvan, 2004)



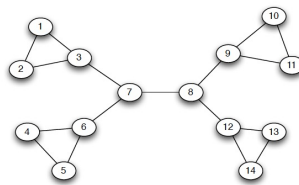
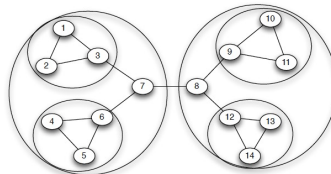
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Idea

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

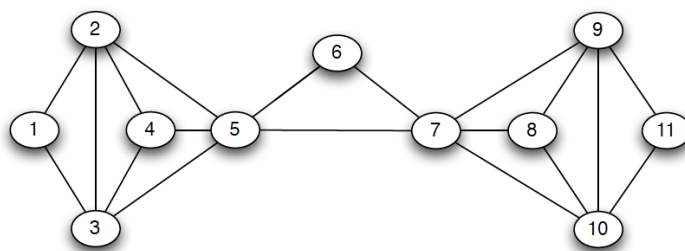
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But... which local bridge to delete first?

(a) *A sample network*(b) *Tightly-knit regions and their nested structure*

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Also... what if there's no local bridge?

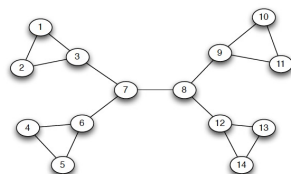


Need some form of "betweenness" measure for the edges!

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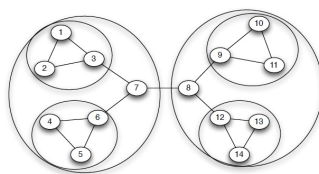
Girvan-Newman algorithm (2002)

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



(a) A sample network

Q. When should we stop?

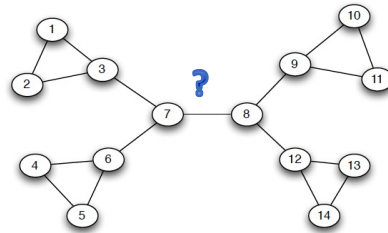


(b) Tightly-knit regions and their nested structure

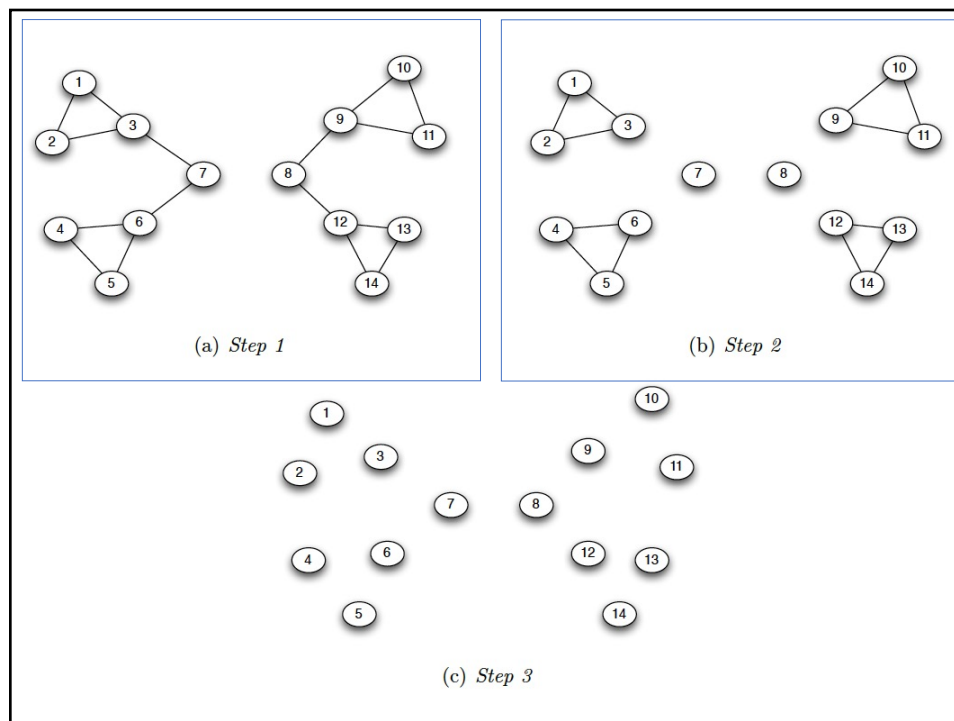
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Betweenness of an edge


- Every node is sending 1 gallon of water to every other node
- Water will only flow through the shortest paths
 - Equally distributed among multiple shortest paths
- Betweenness of an edge
= Quantity of water flowing through it



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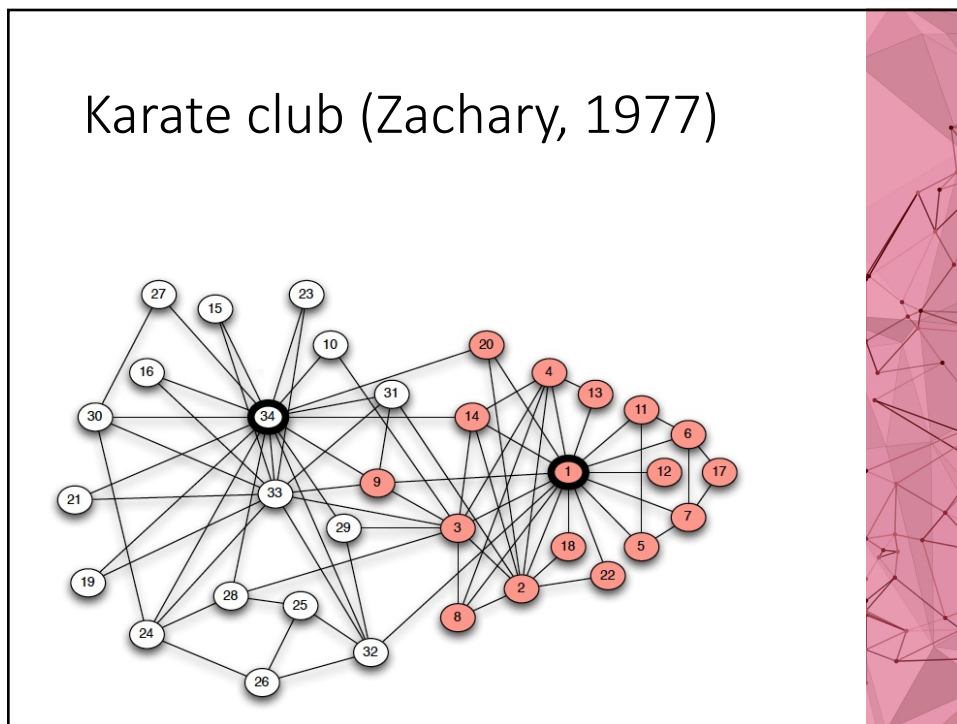


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How to compute the
betweenness of an
edge?

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