

Social Relations II

Social Computing

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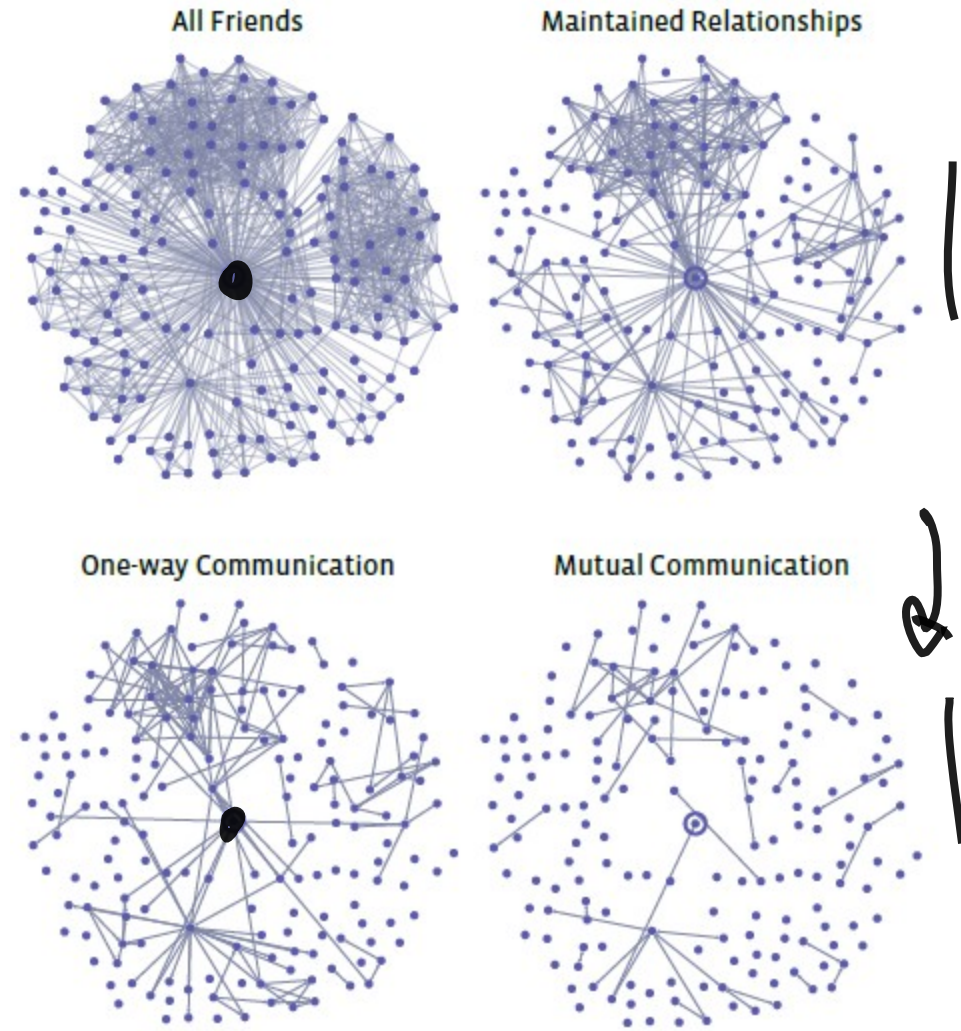
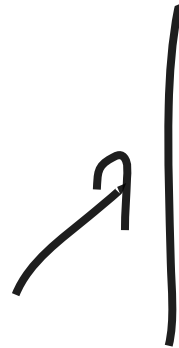
Lecture Topics

- Tie Strength in Real-World Nets
 - The case of Facebook and Twitter
 - Neighborhood Overlap
- Structural Holes

Tie Strength

- Links in networks have strength: E.g.
 - Friendship nets (close friends vs. acquaintances)
 - Telco nets (amount of time talking on the phone)
- We characterize edges / links as either:
 - Strong (corresponding to friends), or
 - Weak (corresponding to acquaintances)

Tie Strength- FB



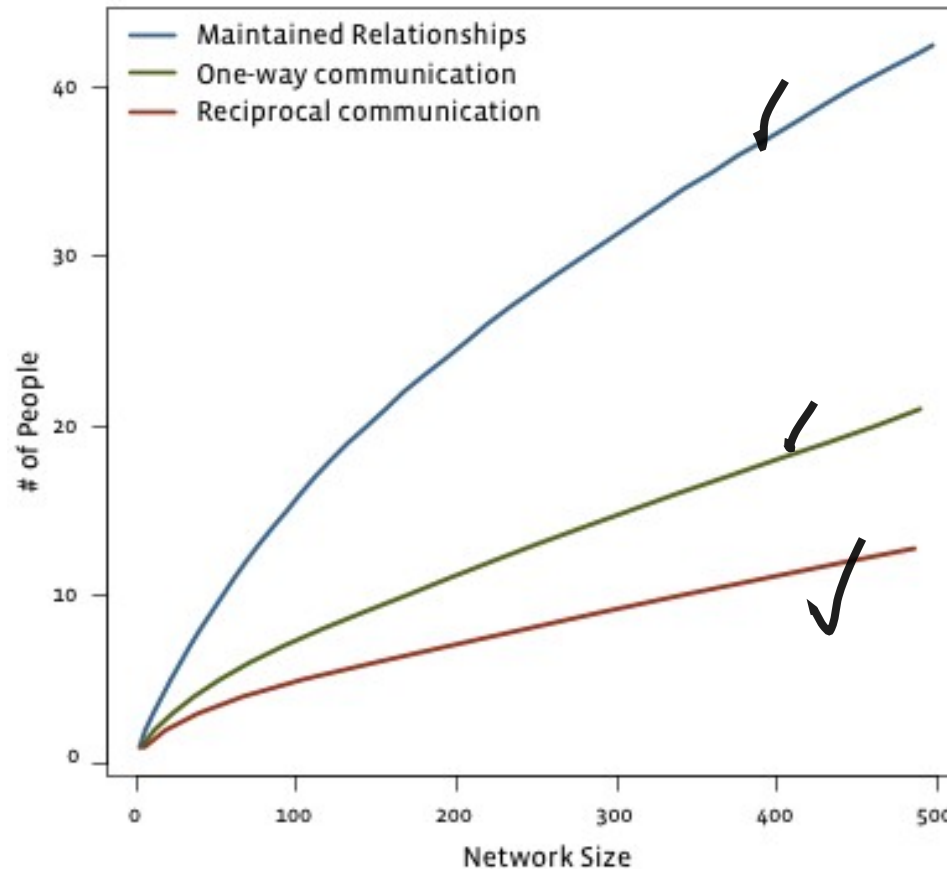
- **All Friends:** the largest representation of a person's network is the set of all people they have verified as friends.
- **Reciprocal Communication:** as a measure of a sort of core network, we counted the number of people with whom a person had had reciprocal communications, or an active exchange of information between two parties.
- **One-way Communication:** the total set of people with whom a person has communicated.
- **Maintained Relationships:** to measure engagement, we took the set of people for whom a user had clicked on a News Feed story or visited their profile more than twice.

Figure 3.8: Four different views of a Facebook user's network neighborhood

Tie Strength- FB- Cnt.

Number of users with whom a user communicate is generally under 20!

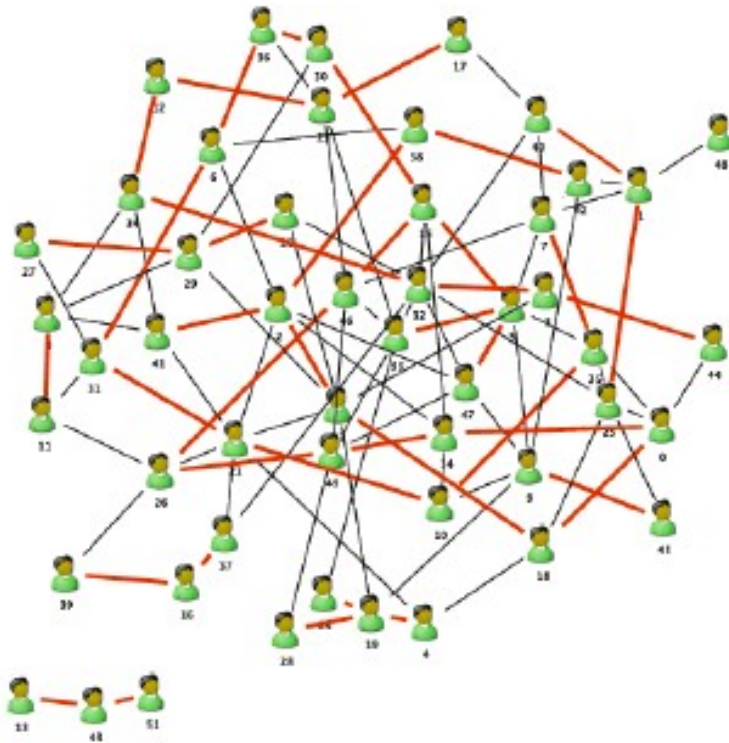
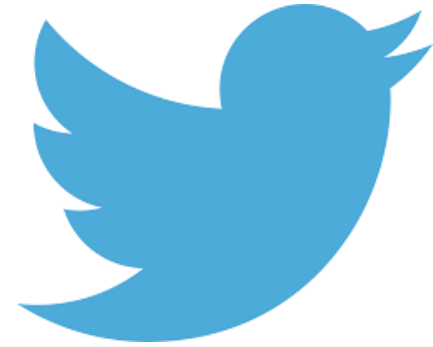
Number of users they follow even passively (e.g. by reading about them) is under 50!



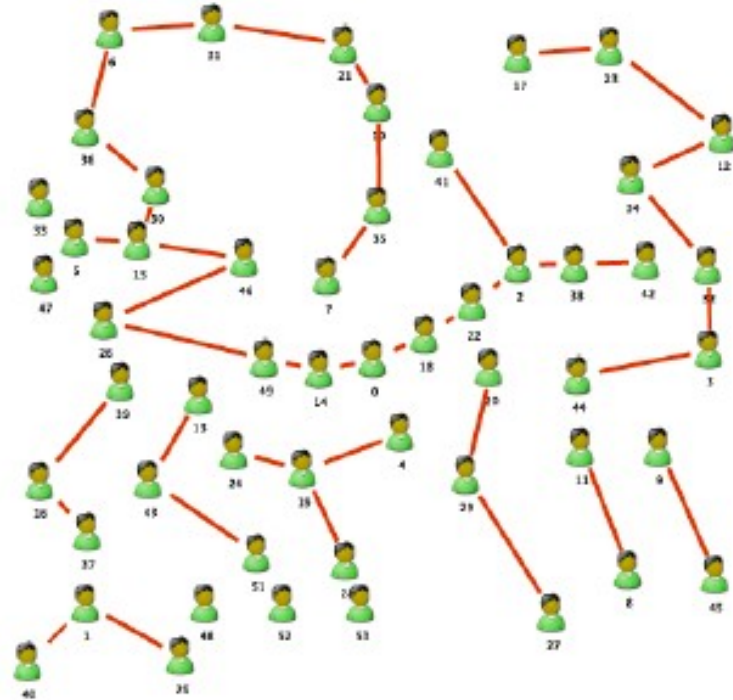
Number of friends on FB

Figure 3.9: The number of links corresponding to maintained relationships, one-way communication, and reciprocal communication as a function of the total neighborhood size for users on Facebook. (Image from [286].)

Tie Strength- Twitter

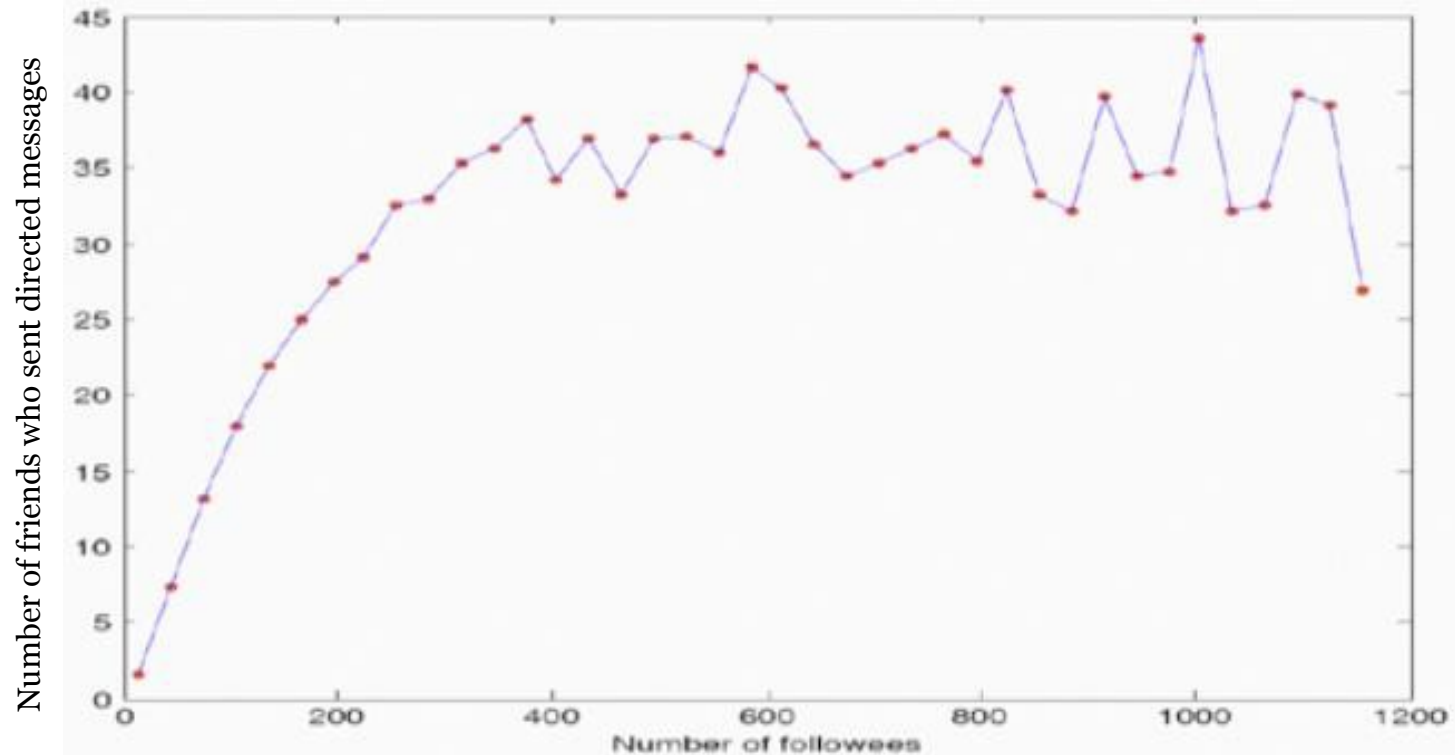
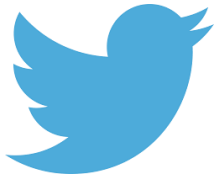


(a) All links are declared followees and the red links are actual friends.



(b) After removing the black links and reorganizing the network look simpler than before. This is the hidden network that matters the most.

Tie Strength- Twitter- Cnt.



Even for users who maintain very large numbers of weak ties on-line, the number of strong ties remains relatively modest, in this case stabilizing at a value below 50 even for users with over 1000 followees.

Tie Strength- Cnt.

- The relative scarcity of strong ties in environments like Facebook and Twitter:
 - Strong ties need to be maintained,
 - People will eventually reach a time limit,
 - Weak ties don't need to be maintained continuously!

Tie Strength in Real-World Nets

- Granovetter's theory was untested on real-world large-scale networks!
- They are available now!

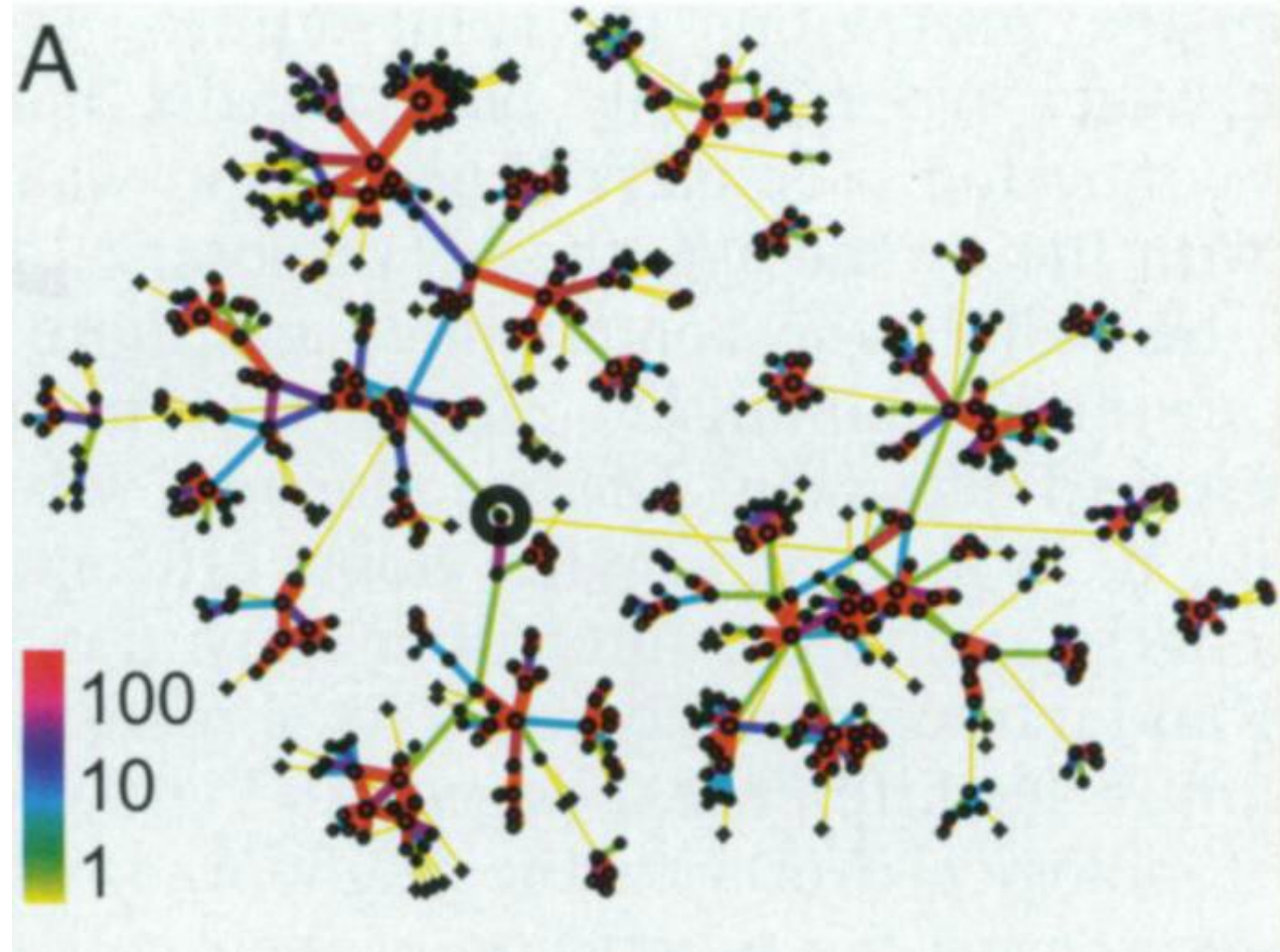
Tie Strength in Real-World Nets- Cnt.

- Onnela et al., (2007) studied who-talks-to-whom net:
 - A node is a user
 - An edge forms btw two users who made phone calls to each other in both directions (mainly personal communications)
 - 20% of the national population
 - 18-week observation period
- First Observation: a giant component covering 84% nodes!

Tie Strength in Real-World Nets- Cnt.

All nodes with distance less than six from the selected user (circled)

Real tie strengths:
the aggregate call
duration in minutes
(see color bar).



Tie Strength in Real-World Nets- Cnt.

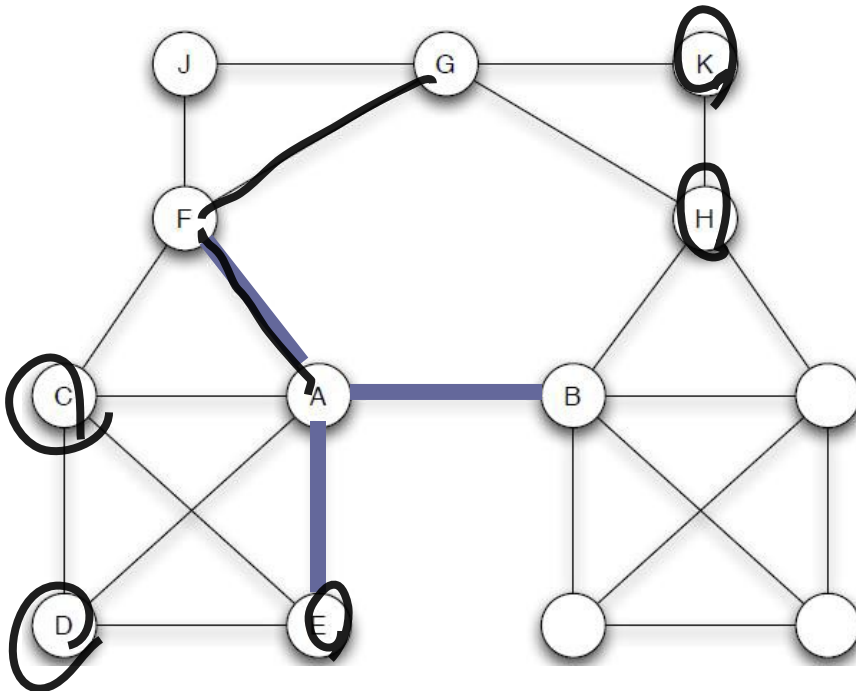
- Getting numerical quantities:
 - **Strength**
 - Determined by the total number of minutes spent on phone calls between two nodes.
 - **Local Bridges**
 - Define *neighborhood overlap* for each edge!

Tie Strength in Real-World Nets- Cnt.

- Neighborhood overlap of an edge connecting nodes A and B:

$$\frac{\text{number of nodes who are neighbors of both } A \text{ and } B}{\text{number of nodes who are neighbors of at least one of } A \text{ or } B'}$$

1/8



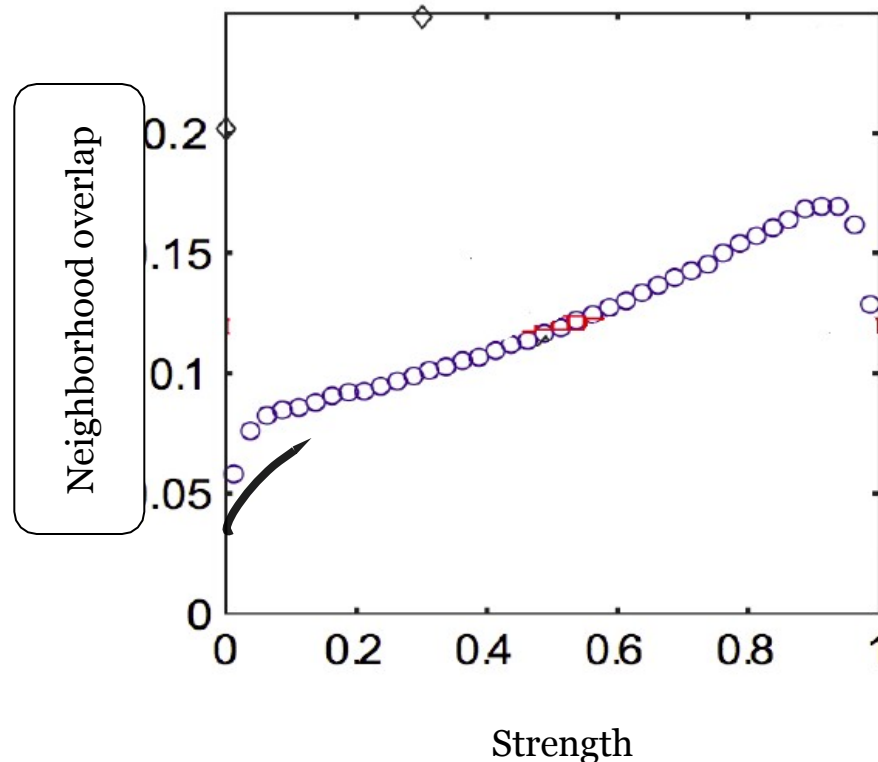
Don't count A and B here!

Nodes	Neighborhood overlap
A-E	2/4
A-G	1/8
A-B	0/8 (Overlap = 0 for local bridges)

Edges with very small neighborhood overlap can be considered as “almost” local bridges

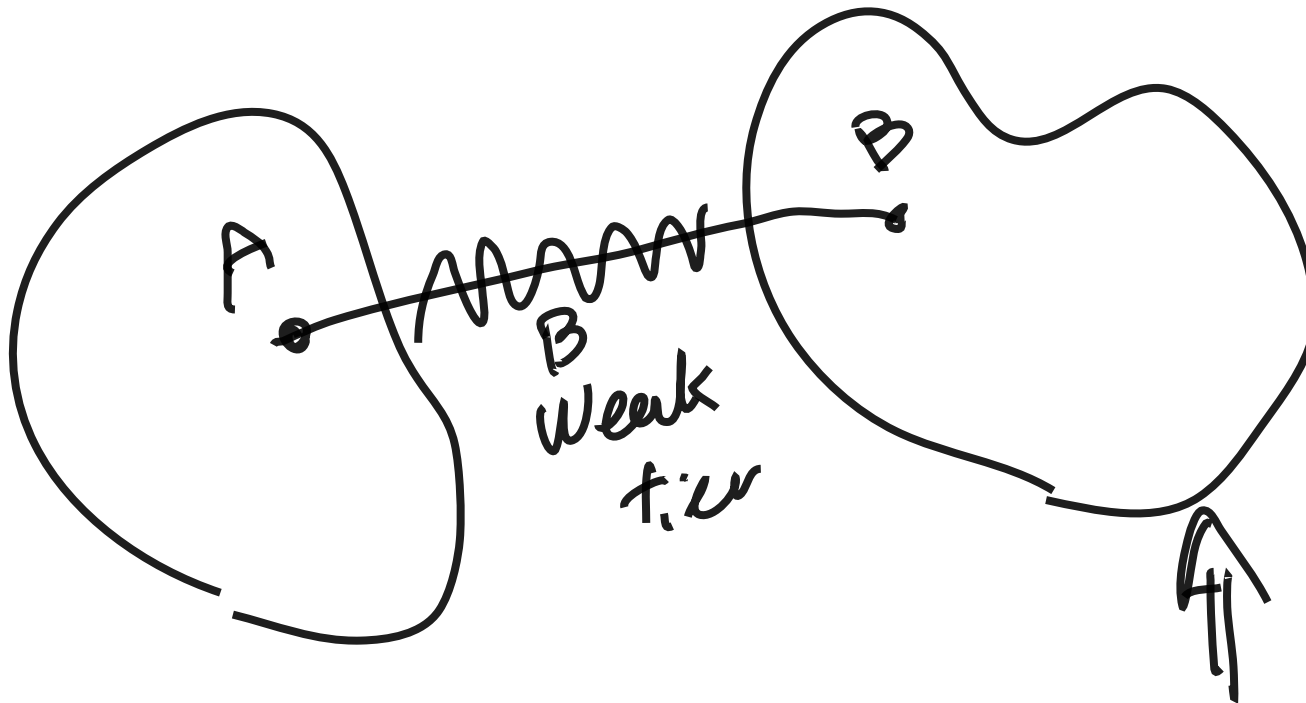
Question 1.- Cnt.

- How the neighborhood overlap of an edge relates to its tie strength?
 - Neighborhood overlap should grow as tie strength grows.



Question 2.- Cnt.

- How weak ties serve to link different communities?



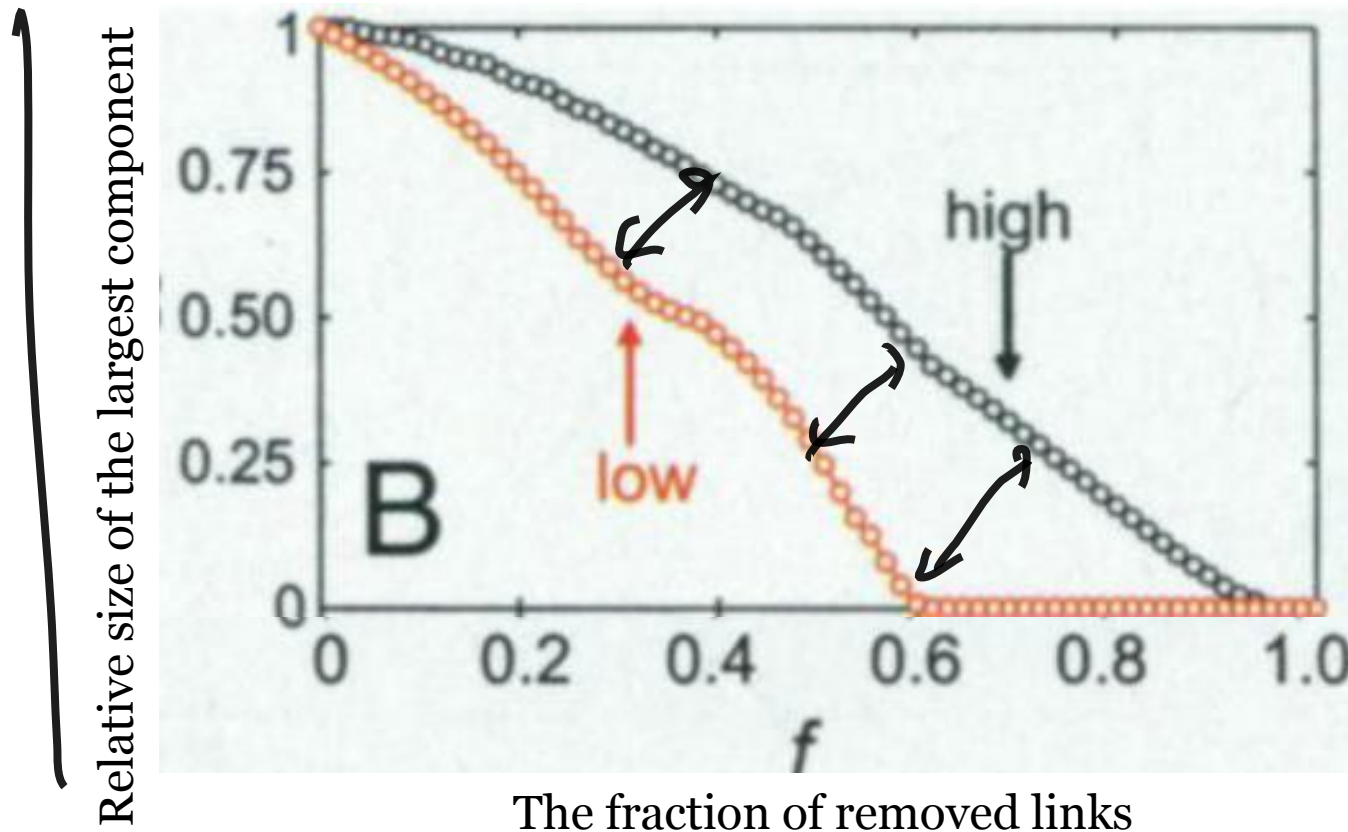
Question 2.- Cnt.

- How weak ties serve to link different communities?
- Indirect Analysis:
 - **Delete edges** from the network one at a time, starting with the **weakest ties first!**
 - The giant component shrank rapidly (its size decreases rapidly).

Question 2.- Cnt.

- How weak ties serve to link different communities?
- Indirect Analysis:
 - **Delete edges** from the network one at a time, starting with the **strongest ties first!**
 - The giant component shrank steadily (its size decreases gradually).

Question 2.- Cnt.



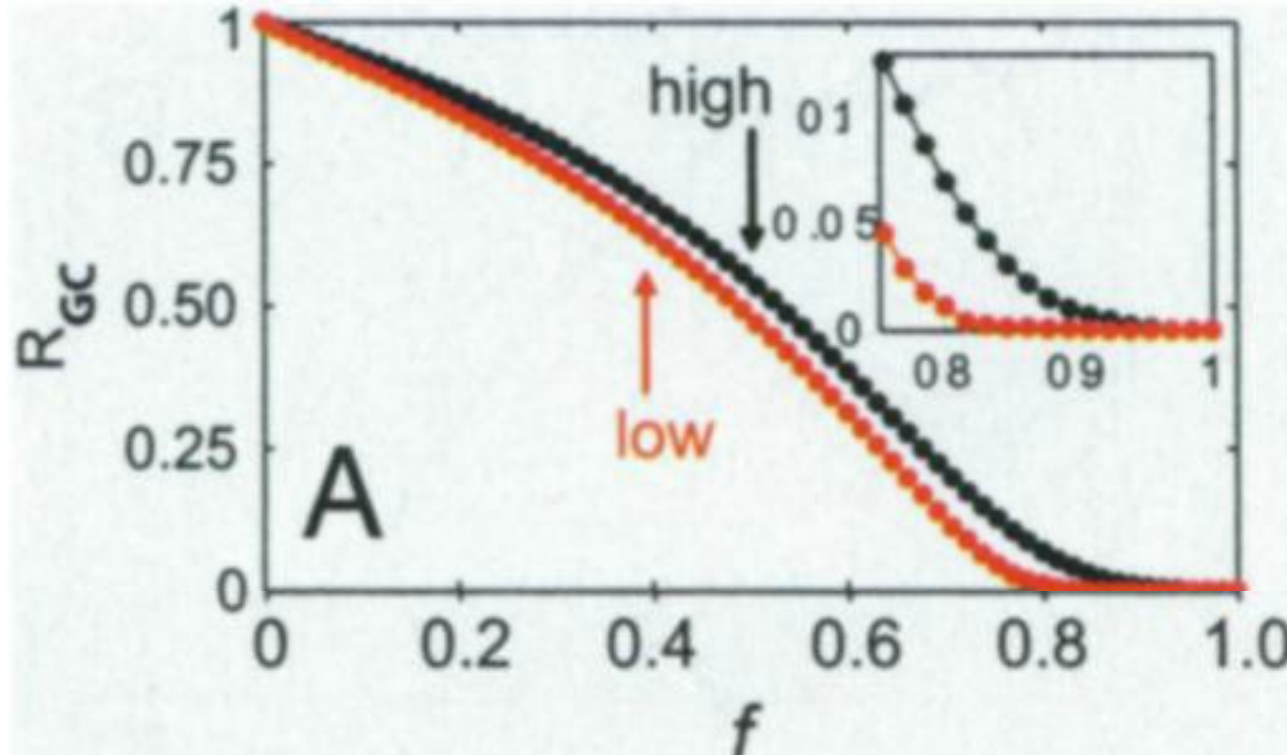
The removal of high overlap links leads to the network's gradual shrinkage.

The removal of the low overlap links leads to a breakdown of the network.

----- black curves: removing first the high-overlap ties
----- red curves: removing first the low-overlap ties

Question 2.- Cnt.

Relative size of the largest component



The fraction of removed links

The removal of high weight links leads to the network's gradual shrinkage.

The removal of the low weight links leads to a breakdown of the network.

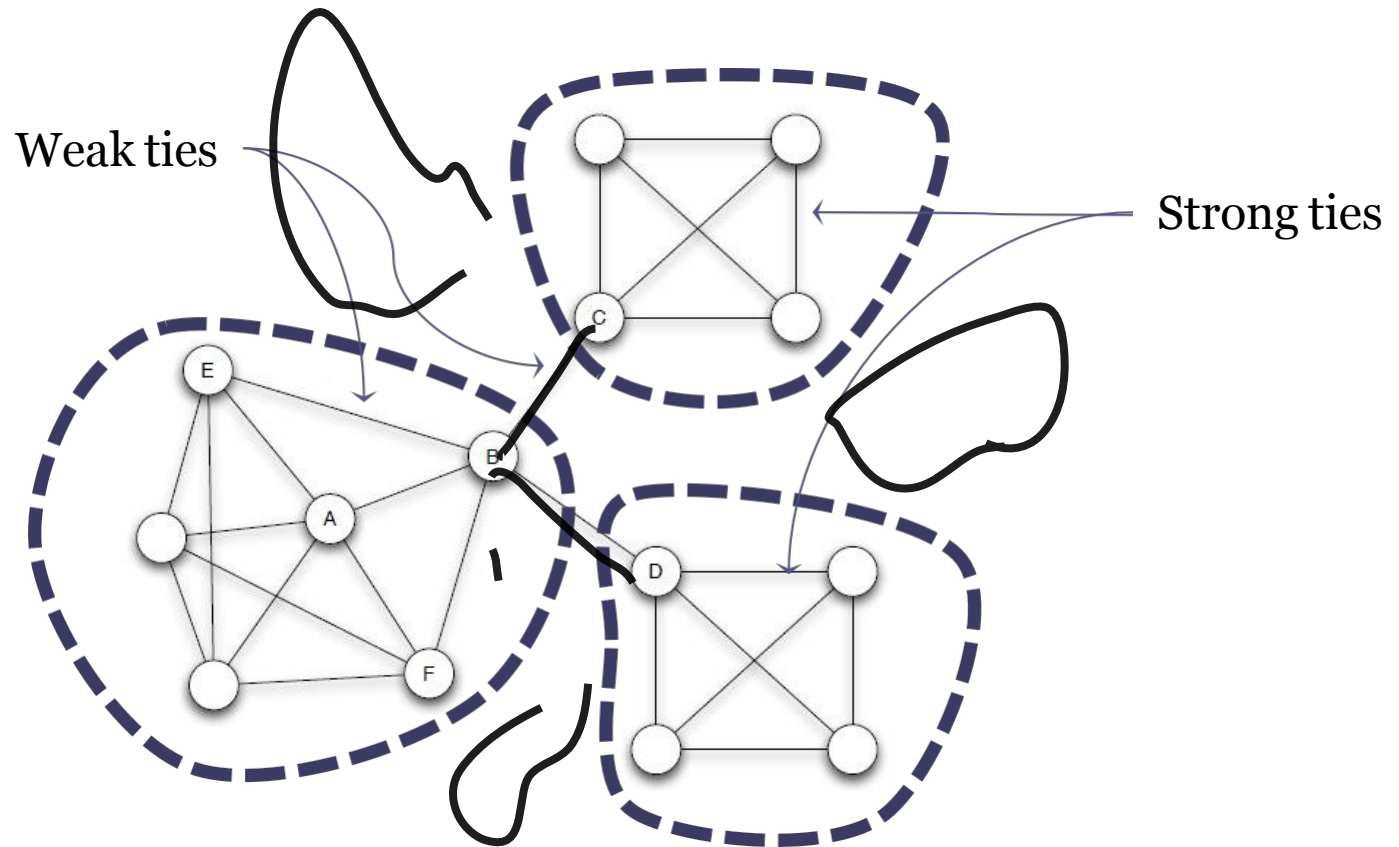
----- black curves: removing first the high-strength ties
----- red curves: removing first the low-strength ties

Question 2.- Cnt.

- Results are consistent with the expectation that
 - weak ties provide the more crucial connective structure for holding together disparate communities!

Structural Holes

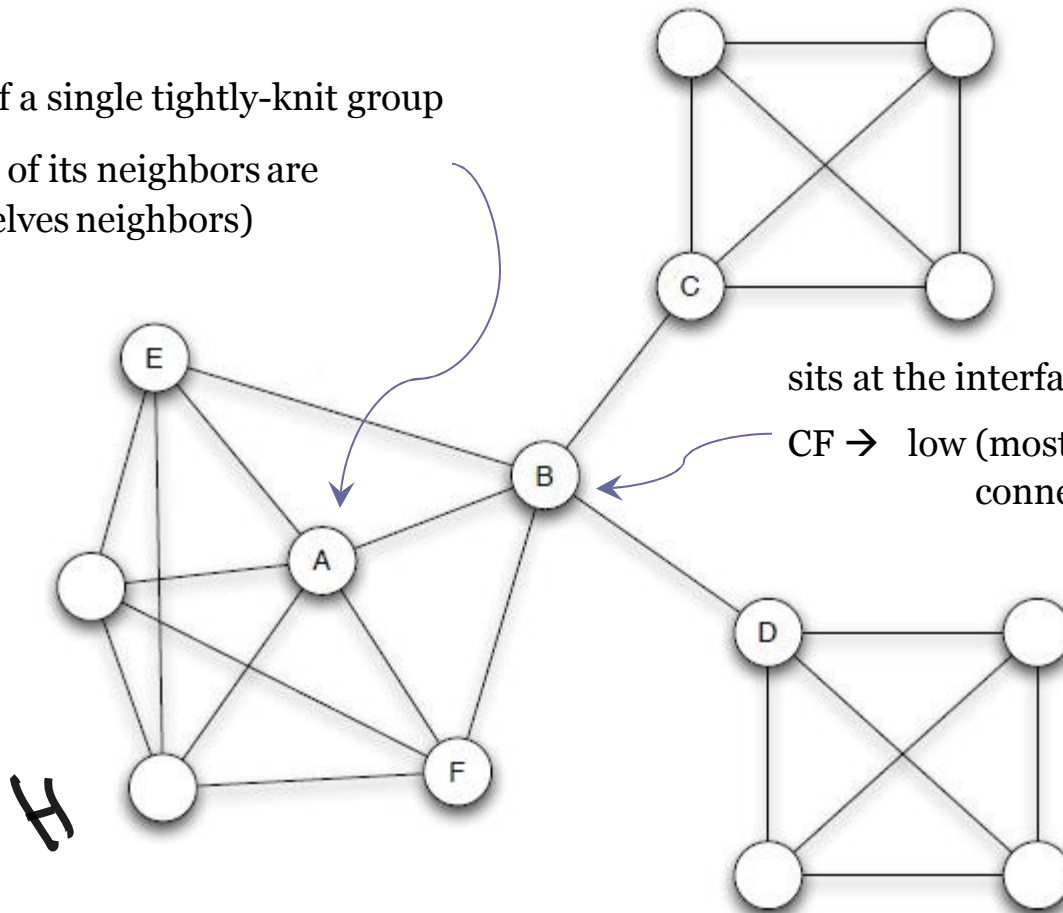
- A structural view of social networks: tightly-knit groups connected by weak ties



Structural Holes- Cnt.

sits at the center of a single tightly-knit group

CF \rightarrow high (most of its neighbors are themselves neighbors)



sits at the interface between several groups

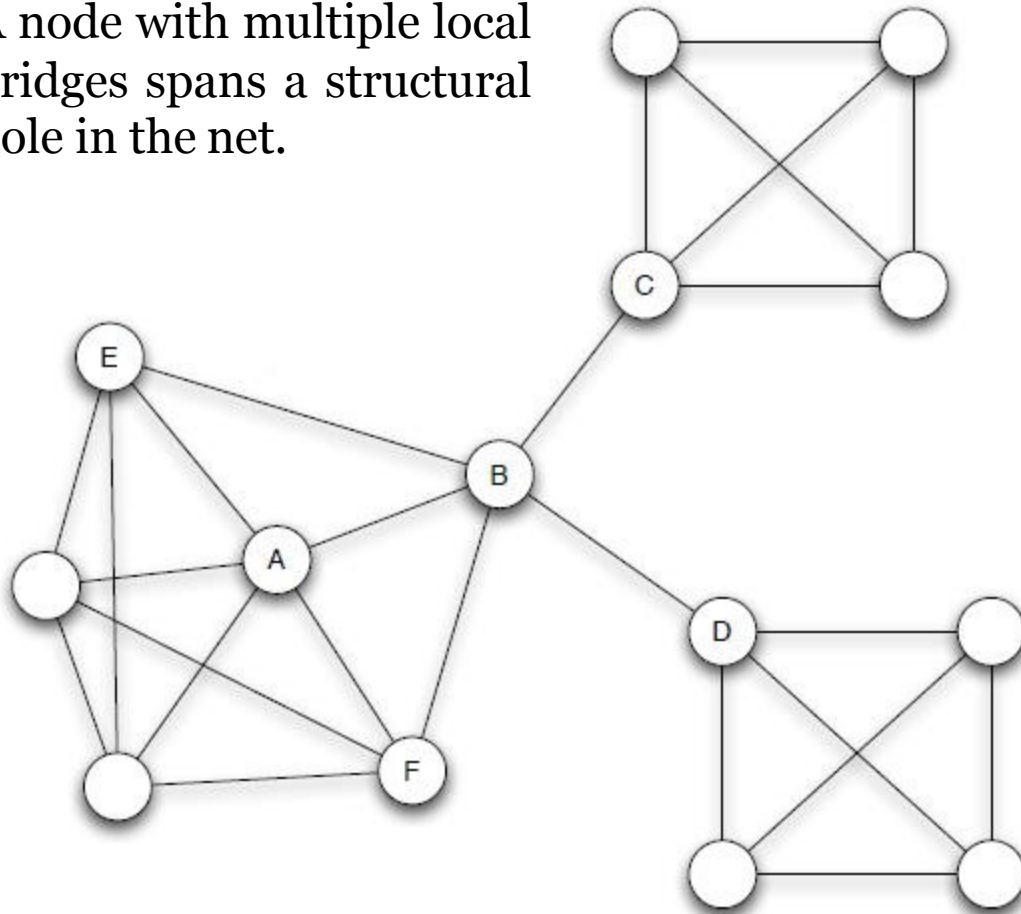
CF \rightarrow low (most of its neighbors are not connected to each other)

Empirical studies shows that an individual's success within a company is highly correlated to his/her access to local bridges!

Structural Holes- Cnt.

Structural hole: the “empty space” in the net btw 2 sets of nodes that don’t interact closely!

A node with multiple local bridges spans a structural hole in the net.



B has early access to info!

B is a gatekeeper and controls the ways in which groups learn about info. It has power!

B may try to prevent triangles from forming around the local bridges it is part of!

How long these local bridges last before triadic closure produces short-cuts around them?

Reading

- Ch.03 Strong and Weak Ties [NCM]
- Structure and tie strengths in mobile communication networks. Onnela, et al. National Academy of Sciences. 2007.