

**COM**

CITY  
UNIVERSITY OF  
HONG KONG

DEPARTMENT OF MEDIA AND COMMUNICATION (COM),  
COLLEGE OF LIBERAL ARTS AND SOCIAL SCIENCES (CLASS)

CityU

# **GE2234 Social Networks**

for Media, Business and Technological Applications

## **Lecture Note 5: Weak Ties**

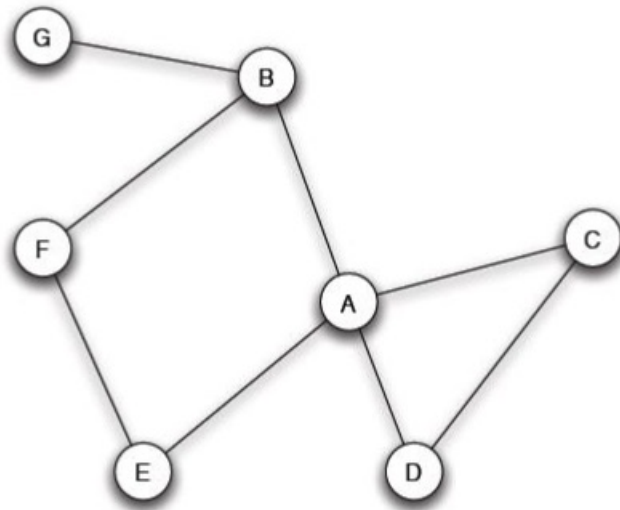
By Dr. Wang Xiaohui, Vincent

# Recap

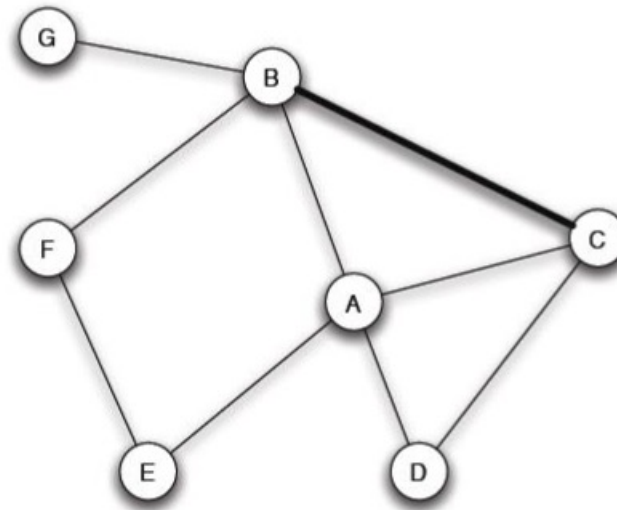
- Egocentric
- Partial and Full Networks
- Unimodal, Affiliation (bimodal), and
- Multimodal Networks

# Triadic Closure

- “If two people in a social network have a friend in common, then there is an increased likelihood that they will become friends themselves at some point in the future” (Rapoport, 1953)



(a) Before B-C edge forms.



(b) After B-C edge forms.

# Why will Triangles be Closed?

## ----Opportunity

- If A spends time with both B and C, then there is an increased chance that they will end up knowing each other and potentially become friends

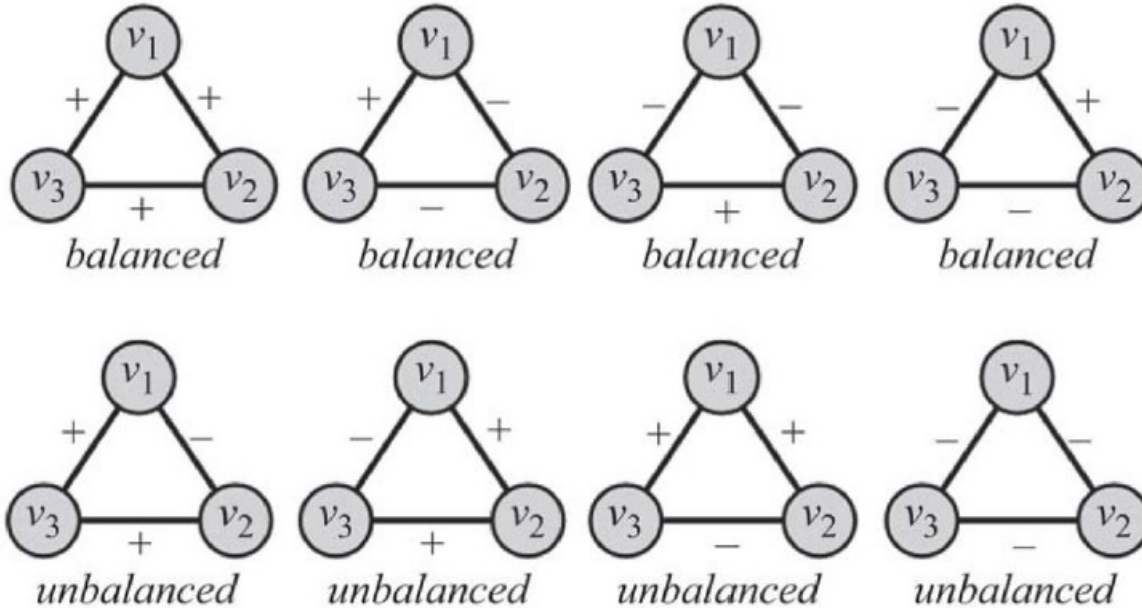
## ----Trust

- The fact that each of B and C is friends with A (provided they are mutually aware of this) gives them a basis for trusting each other that may be lacking in an arbitrary pair of unconnected people

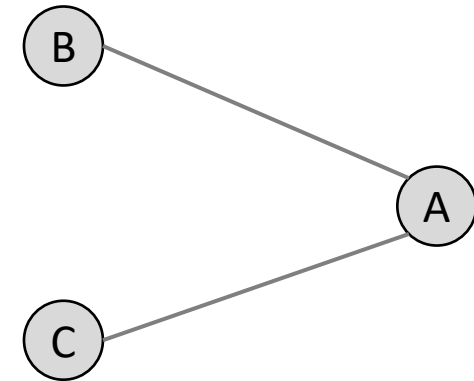
## ----Incentive

- It becomes a source of latent stress in these relationships if B and C are not friends with each other (Balance theory, Heider, 1958)

# Balance theory



- Balance theory argued that people preferred a balanced environment with the people around them (Heider, 1958).
- “It becomes a source of latent stress in these relationships if B and C are not friends with each other” (Balance theory, Heider, 1958)



# Clustering Coefficient

- Clustering coefficient is a measure of the triadic closure for undirected network (Watts and Strogatz, 1998).
- Clustering coefficient of a node  $A$  is defined as the probability that two randomly friend of  $A$  are friend with each other.

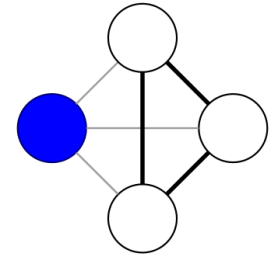
- Clustering coefficient for vertex

$$CC_i = \frac{2 |\{e_{jk}\}|}{k_i(k_i - 1)} \quad v_j, v_k \in N_i, e_{ij} \in E. \quad (2)$$

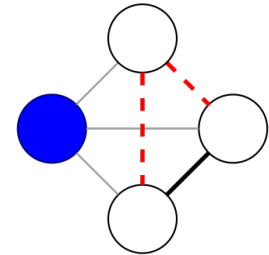
- Clustering coefficient for network

$$CC = \frac{1}{n} \sum_{i=1}^n CC_i. \quad (3)$$

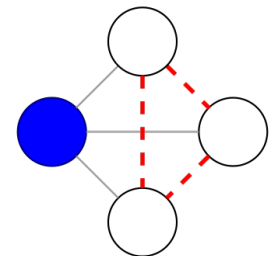
Cho & Fowler, 2010



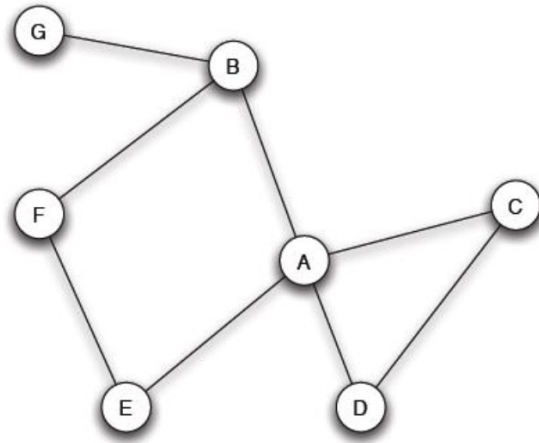
$$c = 1$$



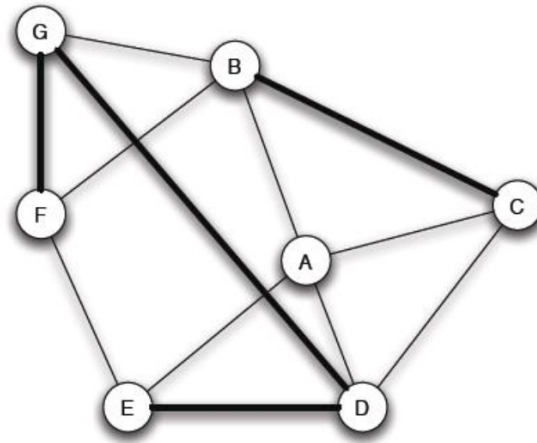
$$c = 1/3$$



$$c = 0$$



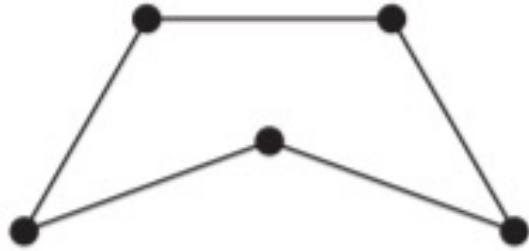
(a) Before new edges form.



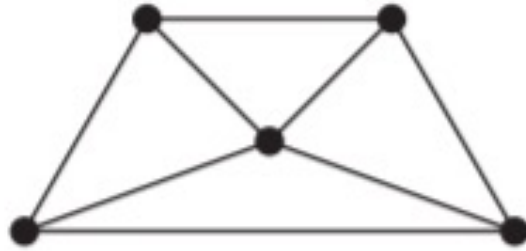
(b) After new edges form.

- A has four friends: B, C, D, E
- Six Possible Pairs between A's friends: B-C, B-D, B-E, C-D, C-E, D-E
- Local CC of A in left panel is equal to  $1/6$
- Local CC of A in right panel is equal to  $1/2$

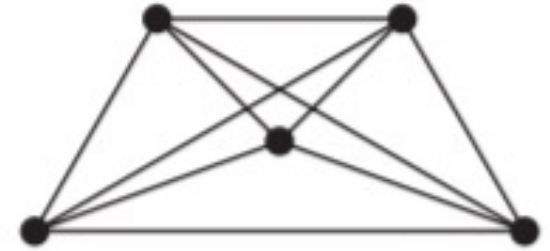




$$CC = 0$$



$$CC = 0.67$$



$$CC = 1$$

Clustering coefficient for the network  
Cho & Fowler, 2010

# Clustering Coefficient/Transitivity - Interpret

- clustering coefficient represents the personal network density of each node in a network.
- A node with high clustering coefficient indicates that the node is connected in dense pockets of interconnectivity, whereas one with low clustering has few pockets of interconnectivity.
- The tendency toward triadic closure is the basis for the strength of weak ties theory proposed by Granovetter (1973).
  - Weak ties are rare, Yet the scarcity of these weak ties makes them strong in terms of their information capacity.

# **The Strength of Weak Ties**

(Granovetter, 1973)

# From whom will you get useful Job-related information?

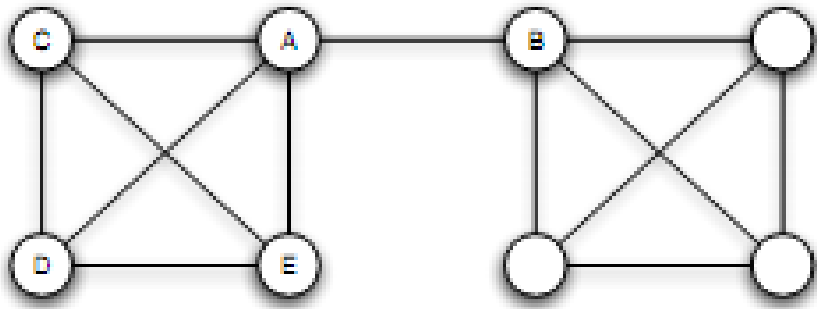
- An empirical study by Granovetter in late 1960s
- One of the most influential sociology papers ever written
- The Strength of Weak Ties (Granovetter, 1973)
- Result: Many people learned information leading to their current job through personal contacts, often described as *acquaintances* rather than *close friends*

Your close friends presumably have the most motivation to help you when you're between jobs, so why is it so often your more distant acquaintances who are actually to thank for crucial information leading to your new job?

Two issues involved:

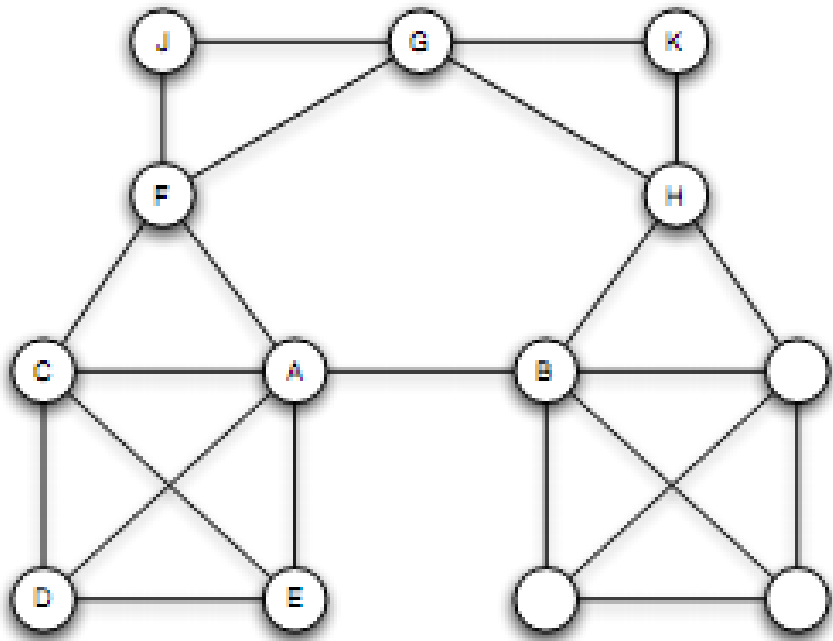
- Structural: the way these friendships span different portions of the full network;
- Interpersonal: local consequences that follow from a friendship between two people being either strong or weak

## Bridges and Local Bridges



- An edge between A and B is a *bridge* if deleting that edge would cause A and B to lie in two different components.
- AB the only “route” between A and B.
- Bridges are presumably extremely rare in real social networks.

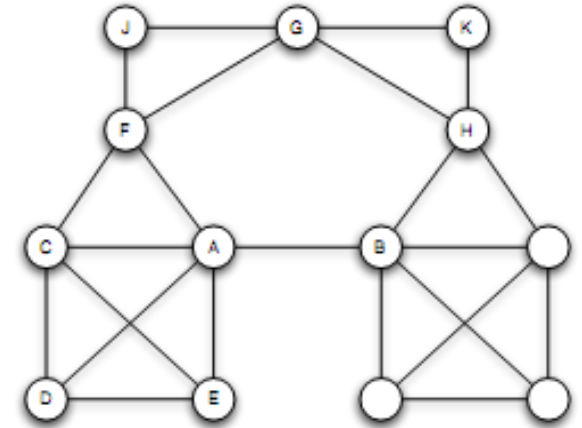
# Bridges and Local Bridges



- An edge between A and B is a **local bridge** if deleting that edge would increase the distance between A and B to a value strictly more than 2
- The definition of a local bridge already makes an implicit connection with triadic closure, in that the two notions form conceptual opposites: **an edge is a local bridge precisely when it does not form a side of any triangle in the graph.**

# Back to job seeking

- If you are going to get truly new information, it may come from a friend connected by a local bridge
- But why distant acquaintances?
  - Should the strength of local bridges be weaker than other ties?
- Tie strength refers to a general sense of closeness with another person:
  - **Strong ties:** the stronger links, corresponding to friends, dependable sources of social or emotional support
  - **Weak ties:** the weaker links, corresponding to acquaintances





# Does it answer Granovetter's job-seeking question?

- **Local bridges are weak ties**
- These are the social ties that connect us to new sources of information and new opportunities, and their conceptual “span” in the social network (the local bridge property) is directly related to their weakness as social ties.
- The individual who brings new information to you must have a weak link with you
- The strength of weak ties

**Local bridges bring innovative information**



**Local bridges are weak ties**



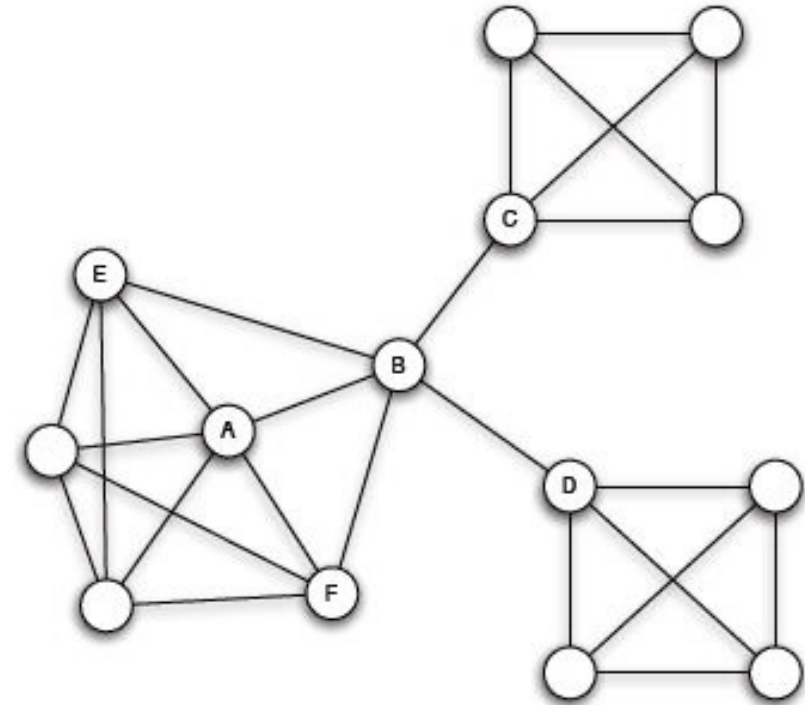
**The strength of weak ties**

# **Structural Holes and Good Ideas**

(Ronald Burt, 2004)

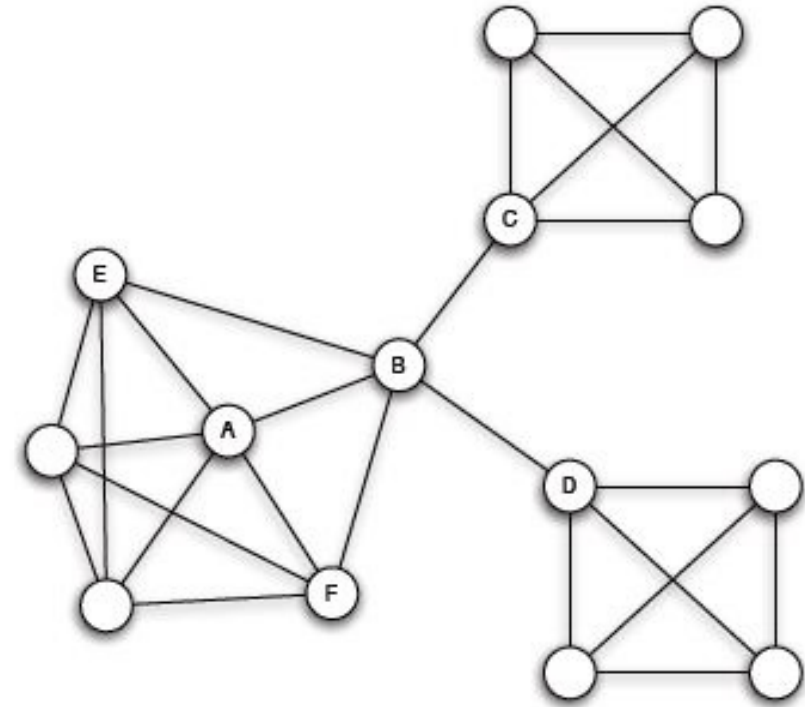
# Closure, Structural Holes and Social Capital

- Different roles that **nodes** play in this structure
- some nodes are positioned at the interface between multiple groups with access to boundary-spanning edges
- others are positioned in the middle of a single group.
- Access to edges that span different groups is not equally distributed across all nodes



# Embeddedness

- (clustering coefficient)
- Embeddedness of an edge: number of common neighbors of its endpoints
- **Local bridges are precisely the edges that have an Embeddedness of zero**
- All edges of node A have significant embeddedness



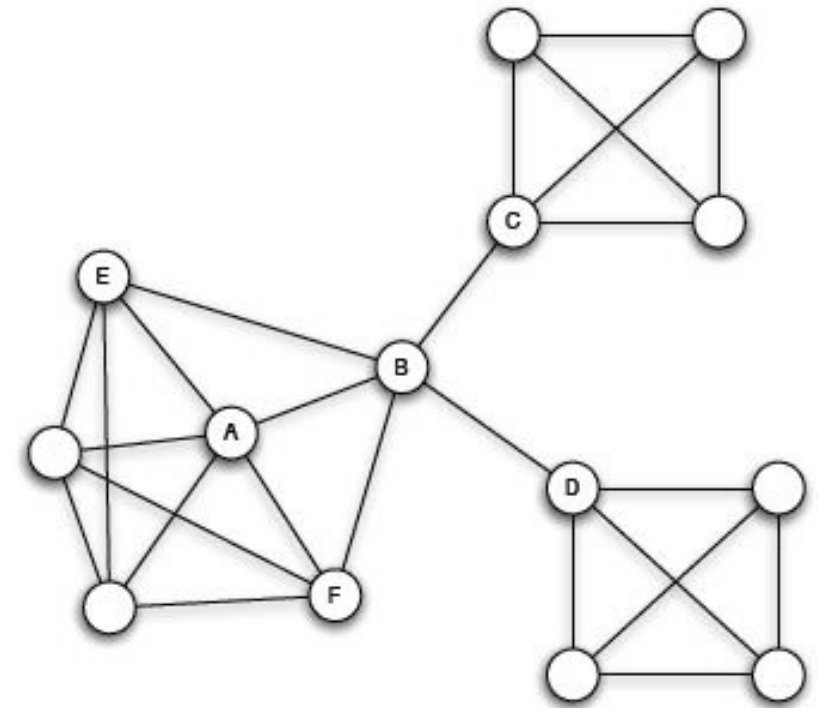
# Embeddedness

If two individuals are connected by an edge with high embeddedness:

- More closed triangles including these two individuals can be formed;
- This makes it easier for them to trust one another, and to have confidence in the integrity of the transactions (social, economic, or otherwise) that take place between them;
- In the event of misbehavior, there is potential for social sanctions and reputation consequences from their mutual friends.

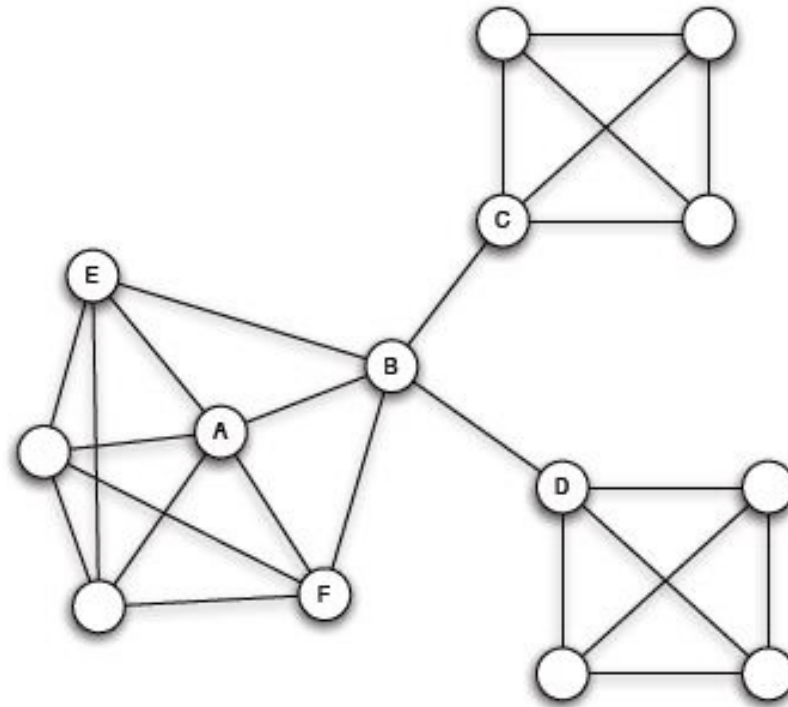
If two individuals are connected by an edge of low embeddedness (e.g., local bridge):

- No similar kind of deterring threat exists for edges, since there is no one who knows both people involved in the interaction.



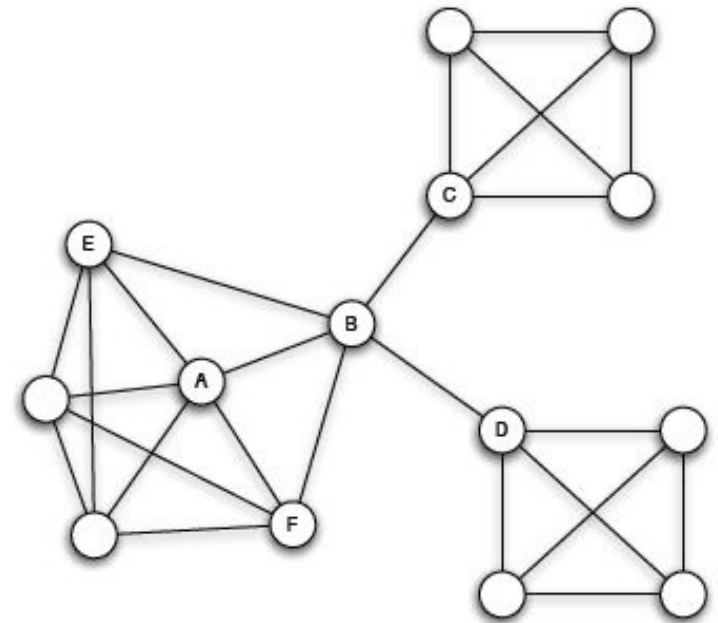
# Structural Hole (Ronald Burt)

- Node B in the left panel, with his/her multiple local bridges, spans a structural hole in the organization ----the “**empty space**” in the network between two sets of nodes that do not otherwise interact closely.



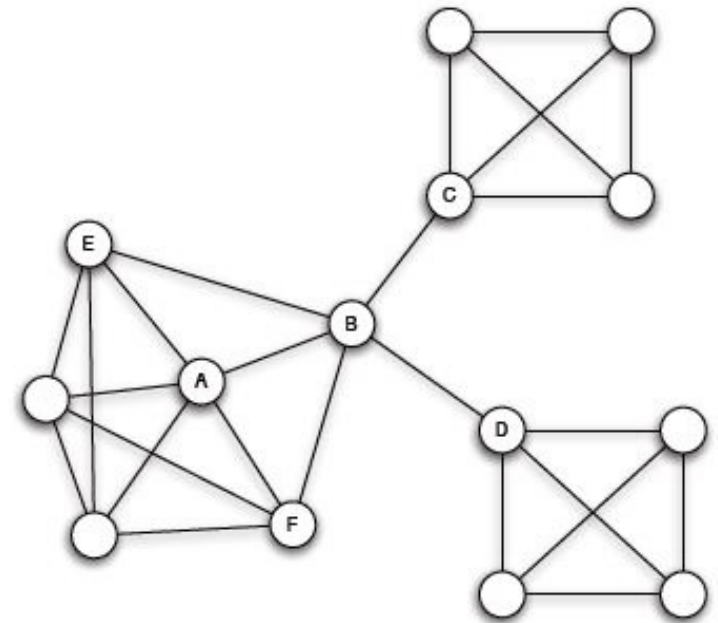
# Relative Advantages of Structural Holes

- B “spans a structural hole”
- Informational: B has access to information originating in multiple, non interacting parts of the network
- Innovative: An amplifier for creativity
- Source of power as a social “gate-keeping”



## A or B?

- There are trade-offs in the relative positions of *A* and *B*
- *B*'s position at the interface between group members that his/her interactions are less embedded within a single group, and less protected by the presence of multiple network neighbors
- On the other hand, this riskier position provides him/her with access to information residing in multiple groups, and the opportunity to both regulate the flow of this information and to synthesize it in new ways





# Closure versus Structural Holes as Social Capital

## Closure

- Proponents: Coleman, Putnam, World Bank
- Level: Group (typically at the level of the community)
- Leads to: Protection, cooperation, and sense of belonging but involves obligations and restrictive norms
- *Measures: High density, cohesion, and redundancy*

## Structural Hole

- Proponents: Burt, Lin
- Level: Individual
- Leads to: Power, influence, money, advancement, access, advantage
- *Measures: Low density, low redundancy, high betweenness*