

# Social Media Analytics

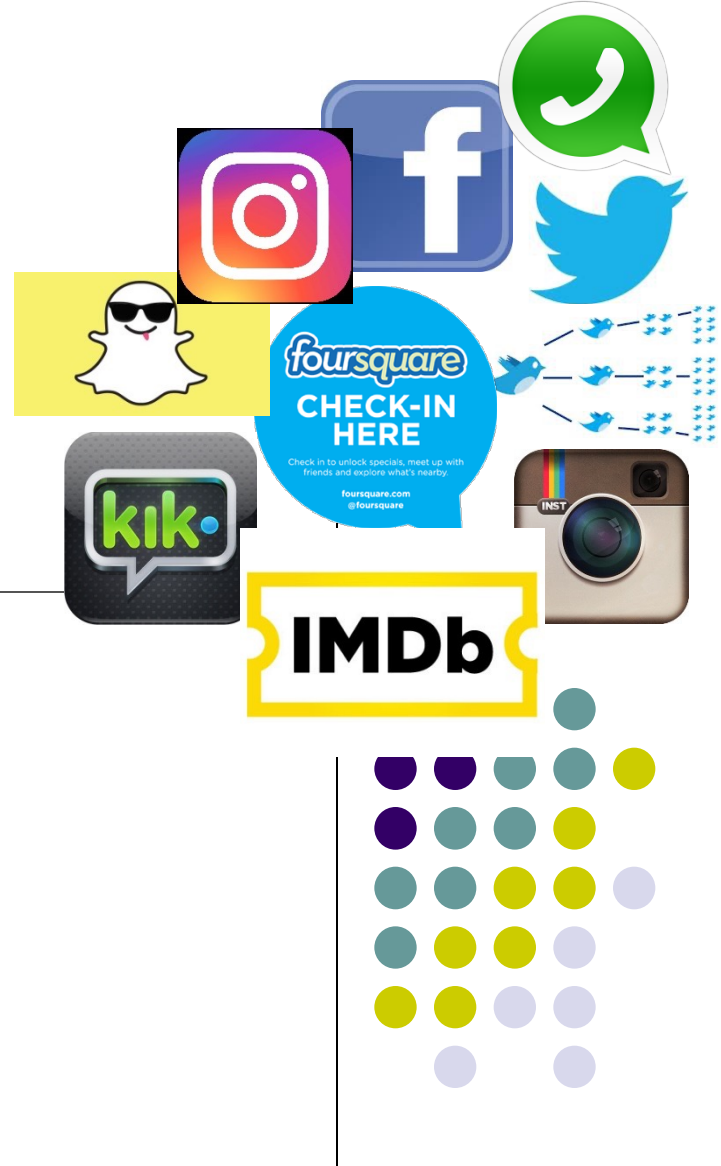
## Network Centrality Metrics

MSBA, Session 2, Jan 26, 2022

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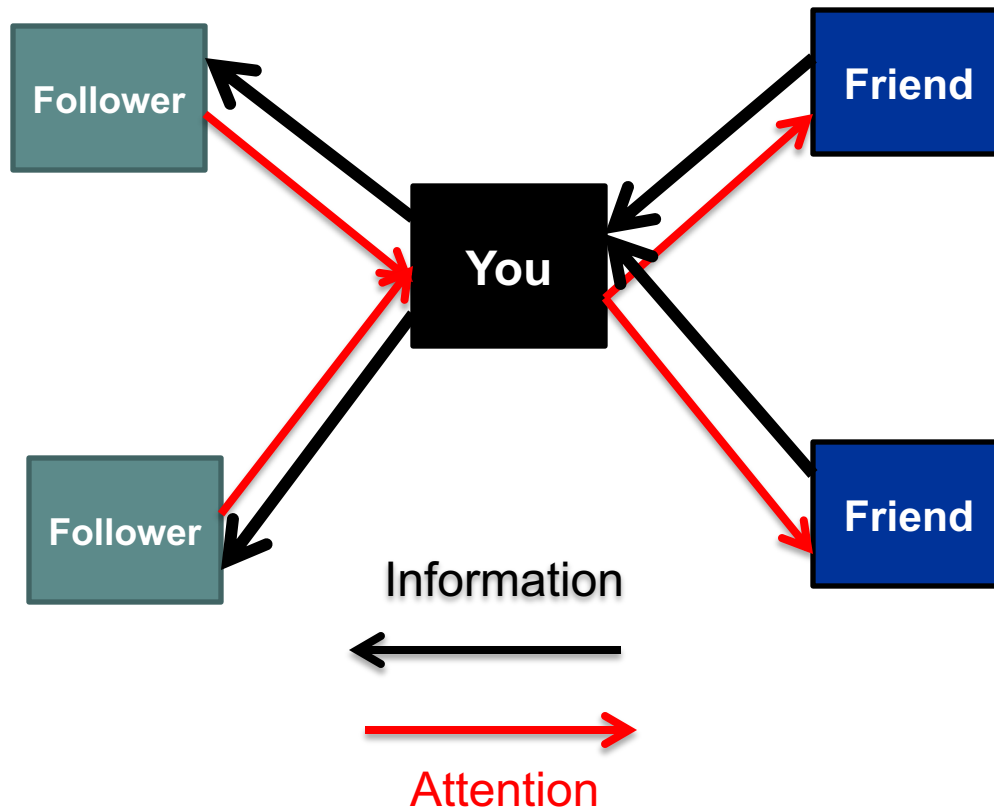


# Learning Objectives

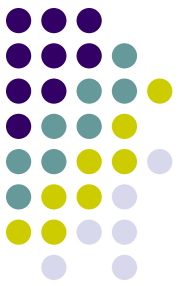


- How to create a network from conversations
- A social network platform's perspective
  - How to increase # connections & interactions
  - Metrics to track such growth
  - Targeting
- A user organization's perspective
  - Who are important for our brand or product?
  - Metrics to rank them
  - How to pursue them
  - How networked customers make decisions

# How to Create a Network From Conversations: The Case of Twitter



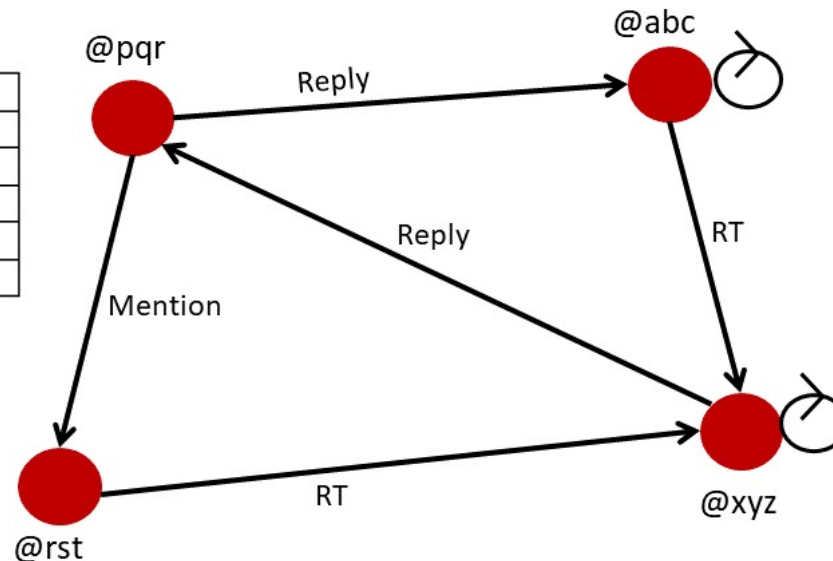
# Creating a Network from Tweets



#	User	Tweet	Type of attention
1	@xyz	#SaveTheChildren #SaveOurChildren keep spreading the word! Retweet if you like.	None (self-loop) @xyz → @xyz
2	@abc	RT @xyz: #SaveTheChildren #SaveOurChildren keep spreading the word! Retweet if you like.	Retweet @abc → @xyz
3	@abc	I would if I could get my entire family and some of my friends to start using a different platform #qanon	None (self-loop) @abc → @abc
4	@pqr	@abc wish I could do the same #qanon	Reply @pqr → @abc
5	@pqr	They are threatened by an awakened public @rst #WWG	Mention @pqr → @rst
6	@rst	RT @xyz #SaveTheChildren #SaveOurChildren keep spreading the word! Retweet if you like.	Retweet @rst → @xyz
7	@xyz	@pqr They are indeed threatened by an awakened public #WWG	Reply @xyz → @pqr

Tweets, retweets, mentions and replies

Attention provided by	Attention received by
@xyz	@xyz
@abc	@xyz
@abc	@abc
@pqr	@abc
@pqr	@rst



# Describing Your Network to an Advertiser



- What metrics can we use to describe the connectedness of the network?
  - Network-level metrics
    - Density
    - Average geodesic
    - Etc.
  - Node-level metrics

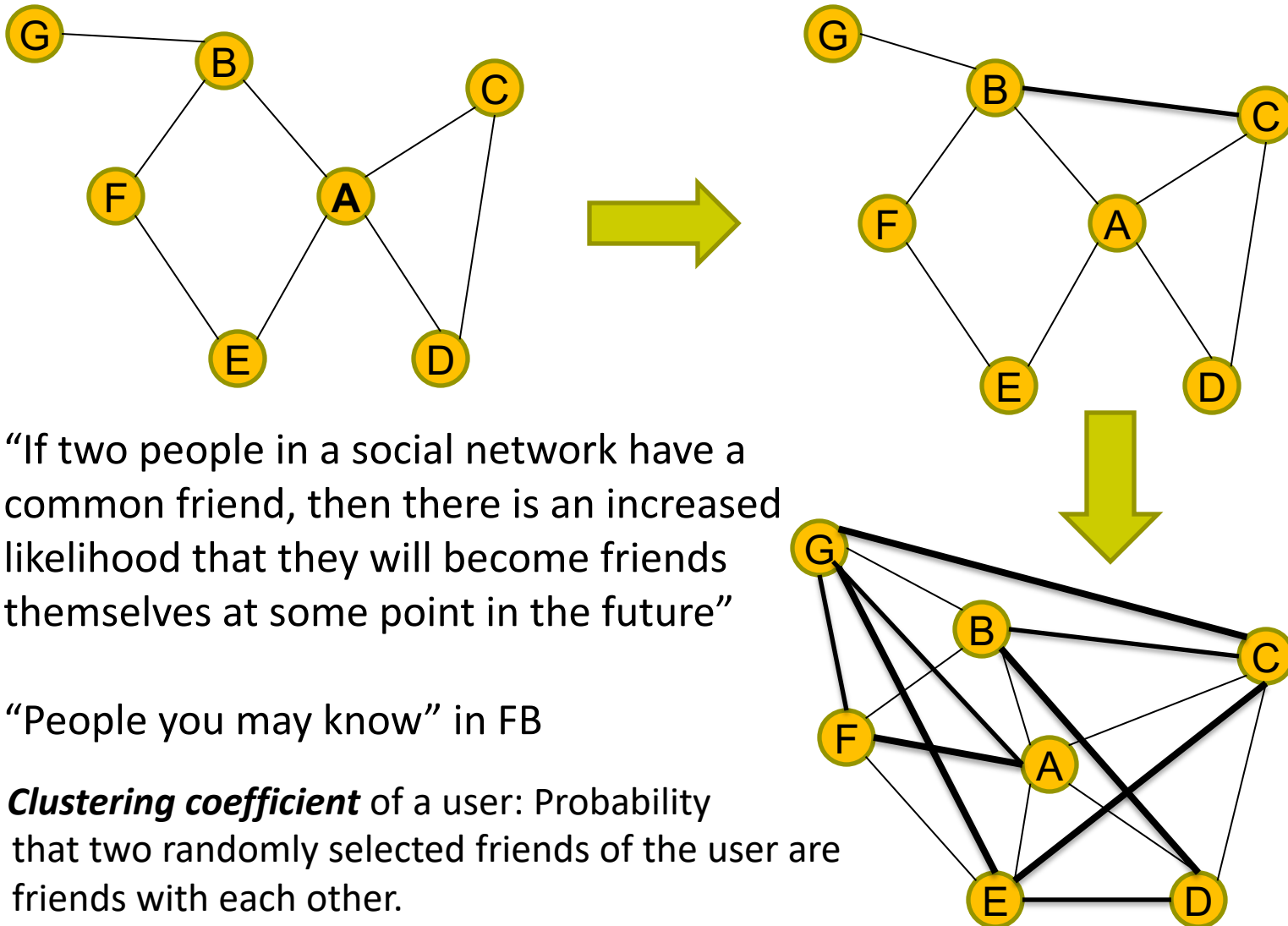
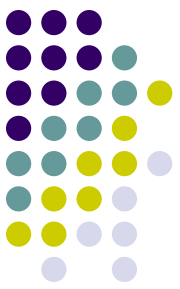


# How Networks Grow: A Reality Check

- “If you are friends with Alan, and friends with Betty, then it is likely that Alan and Betty will become friends as well, mostly because they already have something in common: You.”
- “You brought a friend to your favorite yoga studio and she started regularly attending class, even when you didn’t go.”

Source: <http://plainspokenlinguist.wordpress.com/2013/09/20/i-know-a-guy-the-power-of-triadic-closure/>

# Predicting Future Links (Edges) With “Triadic Closure”



- “If two people in a social network have a common friend, then there is an increased likelihood that they will become friends themselves at some point in the future”
- “People you may know” in FB
- **Clustering coefficient** of a user: Probability that two randomly selected friends of the user are friends with each other.

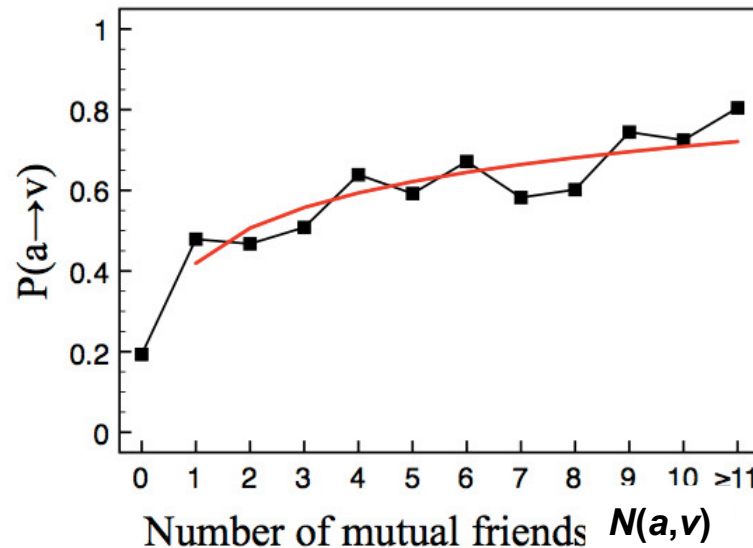
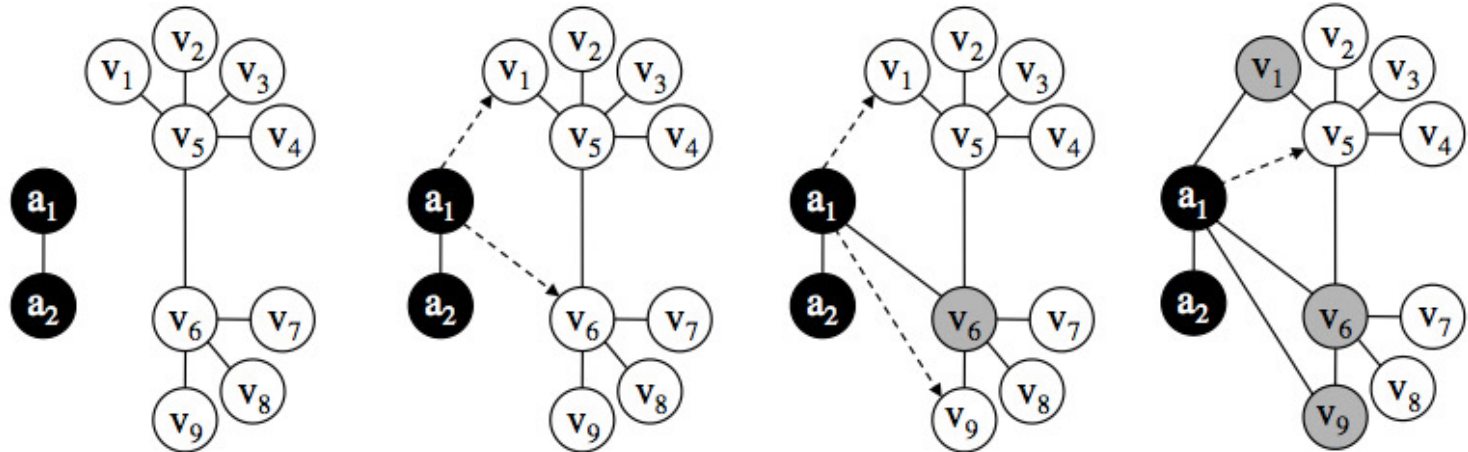
# Abusing the Triadic Closure Principle



UBC students wrote code that randomly sends friend requests

If accepted, then ...?

8,954 users requested, 3,055 accepted





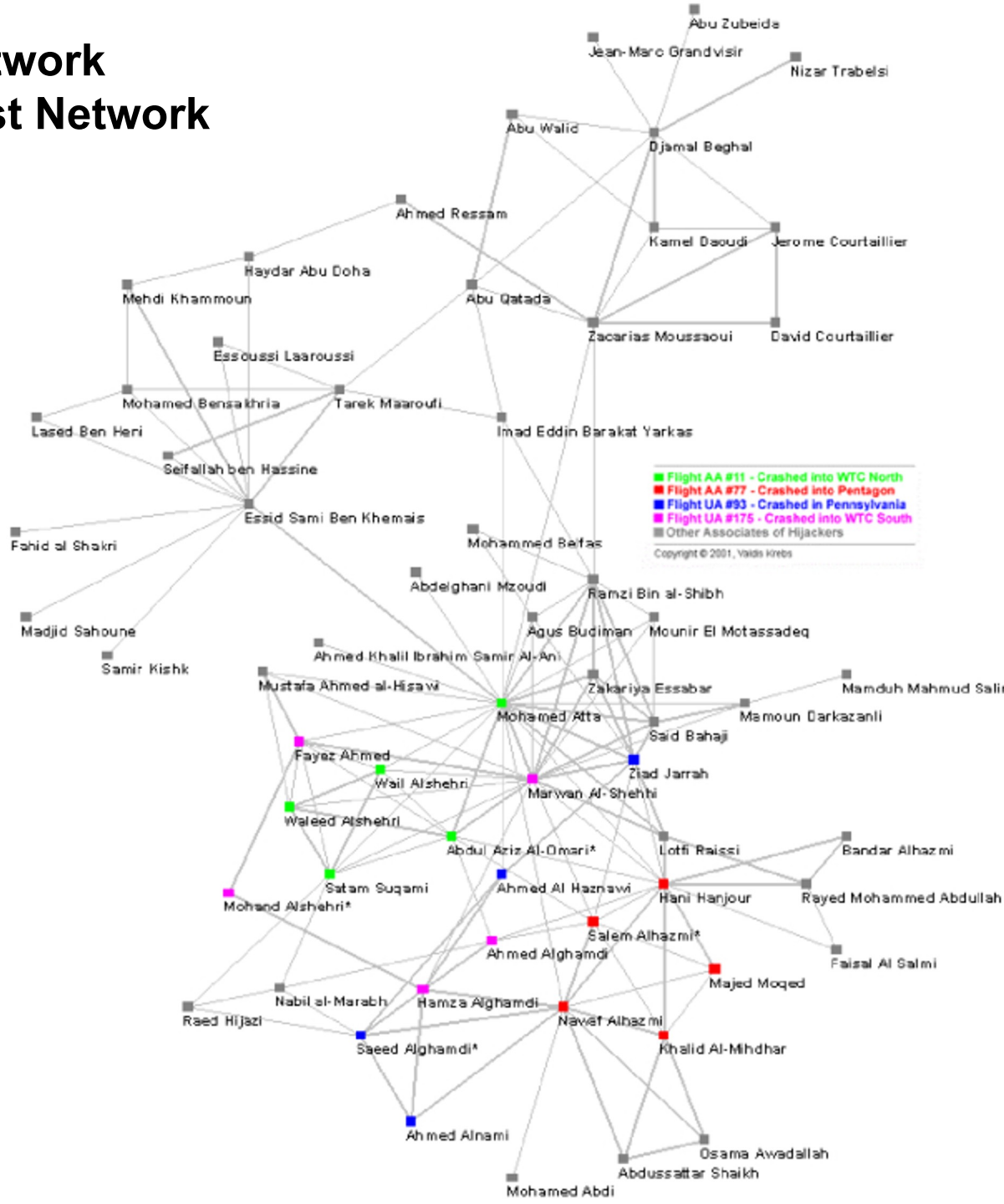


# Social Network Structure

- In addition to getting attention & being active, your position in a network matters
- E.g.,
  - Who are most popular?
  - Who can spread information quickly?
  - Who help connect diverse groups?
- Need to look into the structure of networks

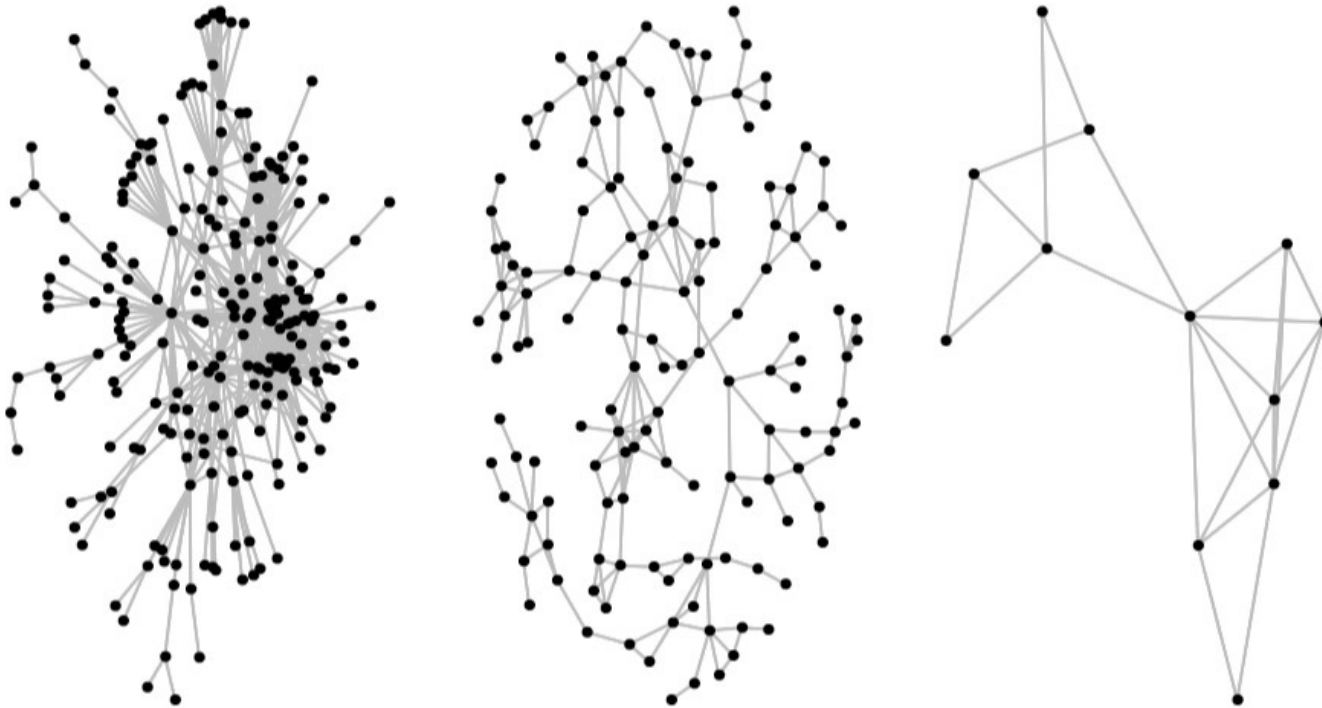
# Myriad Applications of Network Analytics: The 911 Terrorist Network

Who are central to the network?  
What was the role of M. Atta?  
How can we watch out against future attacks?





# Not All Networks Are Created Equal

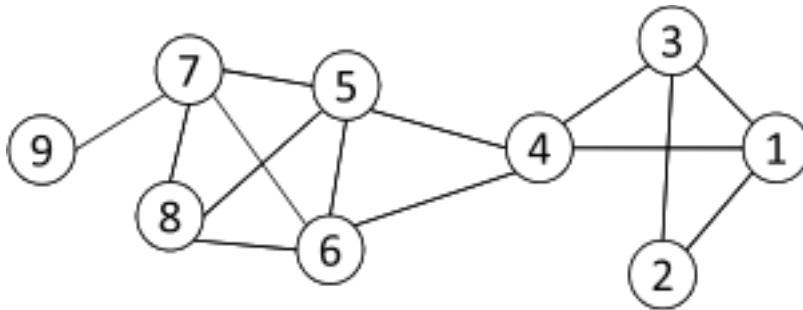


How do we summarize the essential properties of these networks?



# Metric 1: Degree Centrality

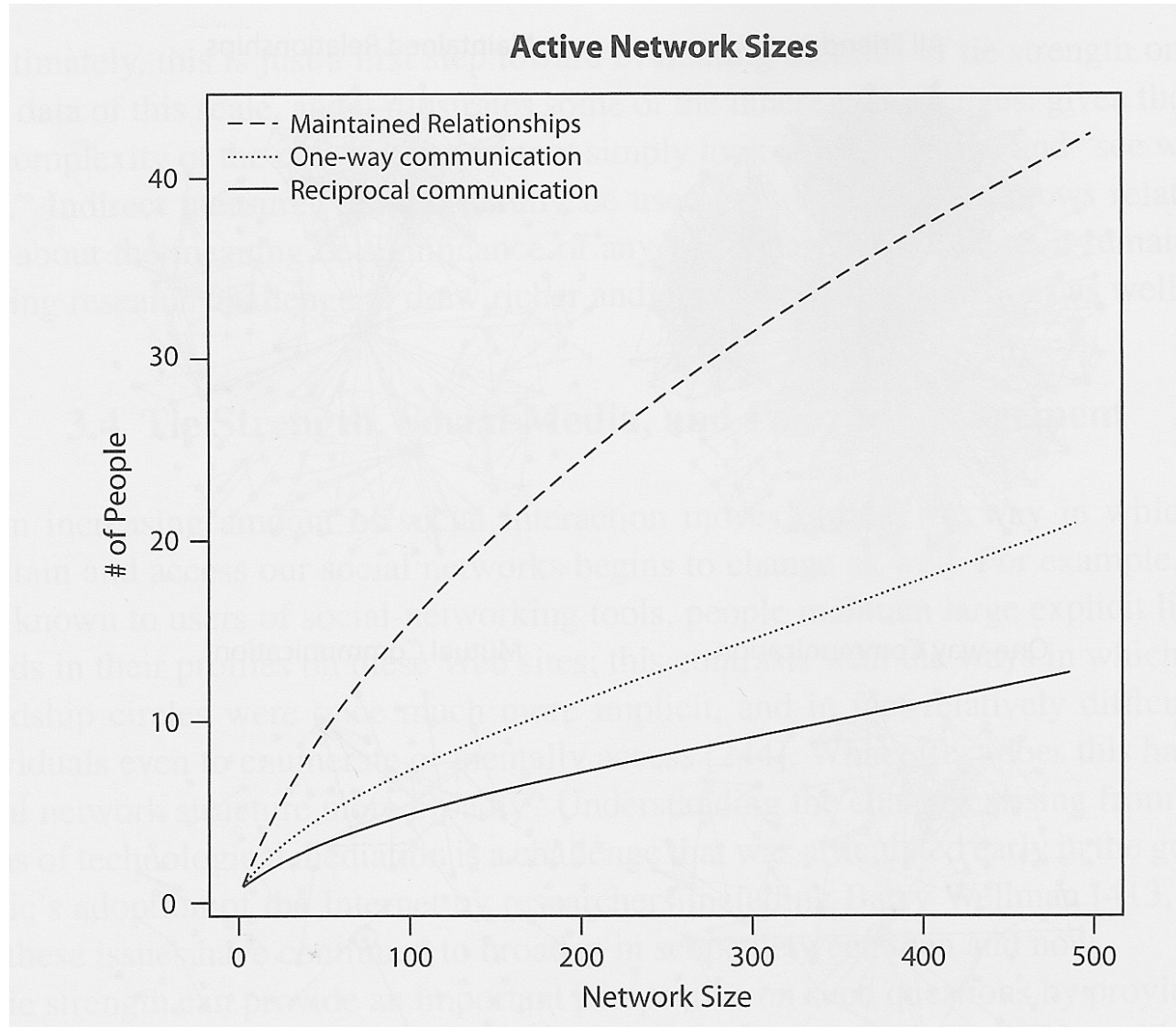
- Who are most popular? Most connected?
- Number of “edges” connected to a “node” or “vertex”
- Normalized Degree Centrality: Degree centrality/(n -1)



For node 1, degree centrality is 3;  
Normalized degree centrality is  
 $3/(9-1)=3/8$ .

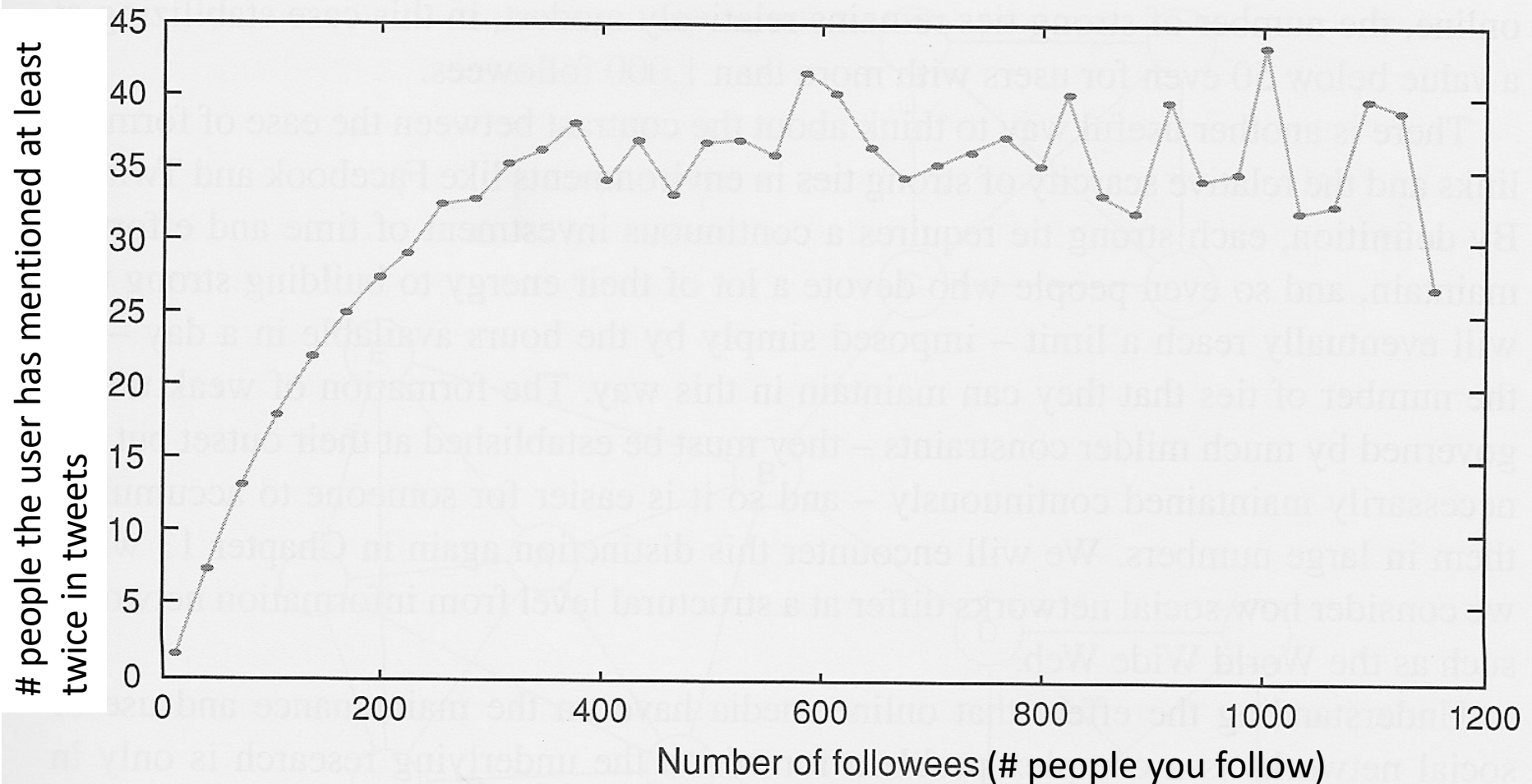
- In-degree and out-degree for directed networks (e.g., Twitter, email, etc.)
- Can degree be a useful metric?

# Is Degree a Good Indicator of Activity?



Source: Easley & Kleinberg, "Networks Crowds & Markets"

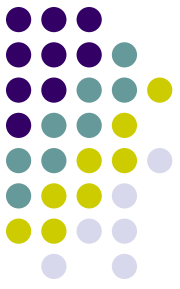
# Strength of Ties on Twitter



- What can we conclude here?

Source: Easley & Kleinberg, "Networks Crowds & Markets"

# Degree Centrality Metric for the Overall Network



Suppose  $d^*$  = highest degree in the network

$d_i$  = degree of node  $i$ , and  $N$  = number of nodes

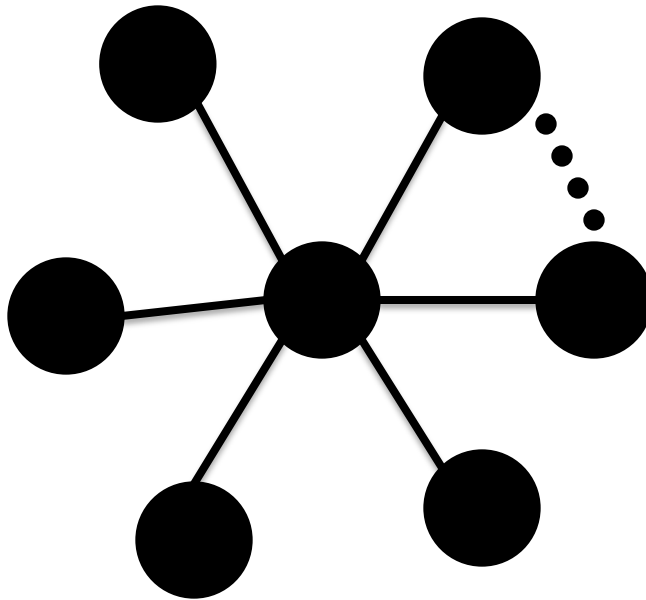
Network degree centrality: 
$$Cd = \frac{\sum_{i=1}^N x_i}{x_{max}}$$

where  $x_i = d^* - d_i$  and  $x_{max}$  = the (theoretical) highest possible value of the numerator (only a benchmark)

- What would the theoretical highest be?
- For which type of network?



# The Star Network



Star network with  $n$  nodes  
Degree centrality of central node  
 $= (n-1)$

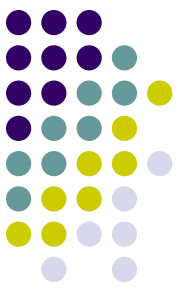


# “The Strength of Weak Ties”

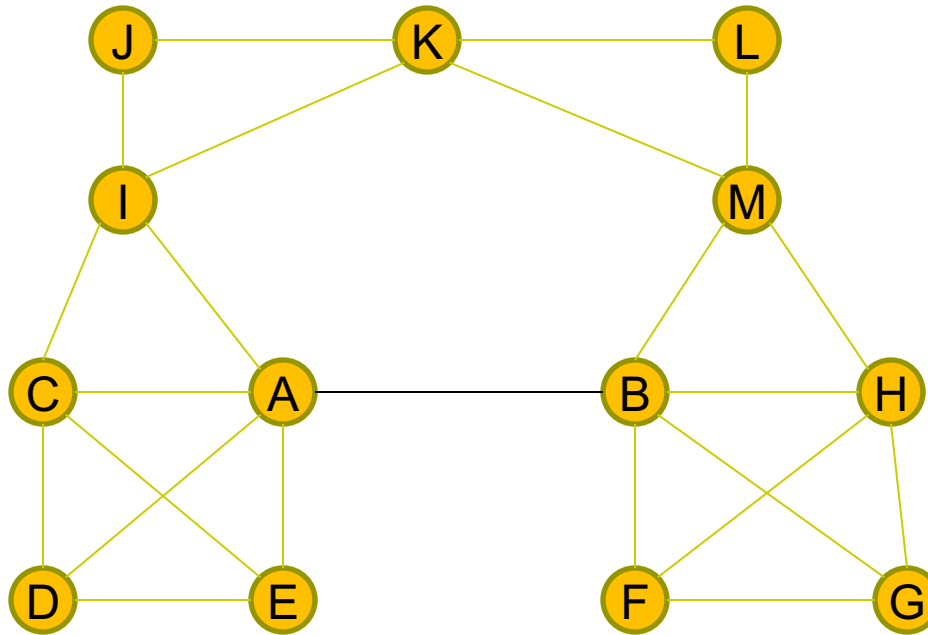
- Granovetter’s observations on job leads



- A has four friends, but the friendships are different
- A, C, D and E probably share “strong” ties
- B may belongs to a different, distant world
- A-B possibly represents a “weak” tie
- But may be a source of new information, ideas or insights
- Captured by the “betweenness” centrality metric



# Local Bridges & Their Significance



- $A, B$  is a *local bridge of span 4*
- Formal definition?
- Significance?

# “Smoother” Metrics to Capture Weak/Strong Ties & Local Bridges



- What can we use instead of 0/1 for tie strength?
  - E.g., to understand tie strength in a cell phone network
- Can we also redefine local bridges (0/1) to be  $[0, 1]$ ?
  - Suggestions?
  - Significance
- What can we say about strength of ties for A-B and B-C?

