

Spreading phenomena

Introduction to Network Science

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Topic 16

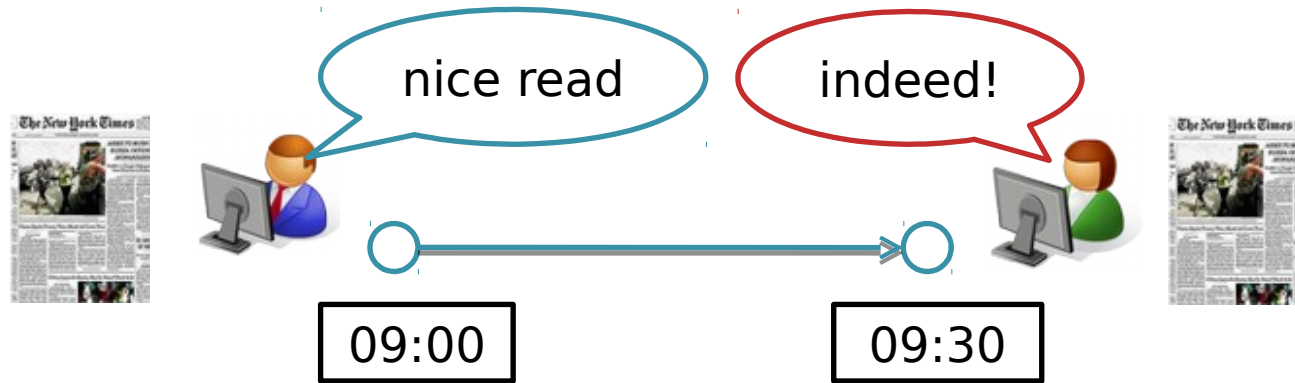


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Sources

- Easley and Kleinberg (2010): Networks, Crowds, and Markets [Ch 19](#)
- Carlos Castillo, Wei Chen, Laks V. S. Lakshmanan (2012): Information and Influence Spread in Social Networks, [KDD Tutorial](#).
- Carlos Castillo (2017): [Social influence](#) slides

Social influence



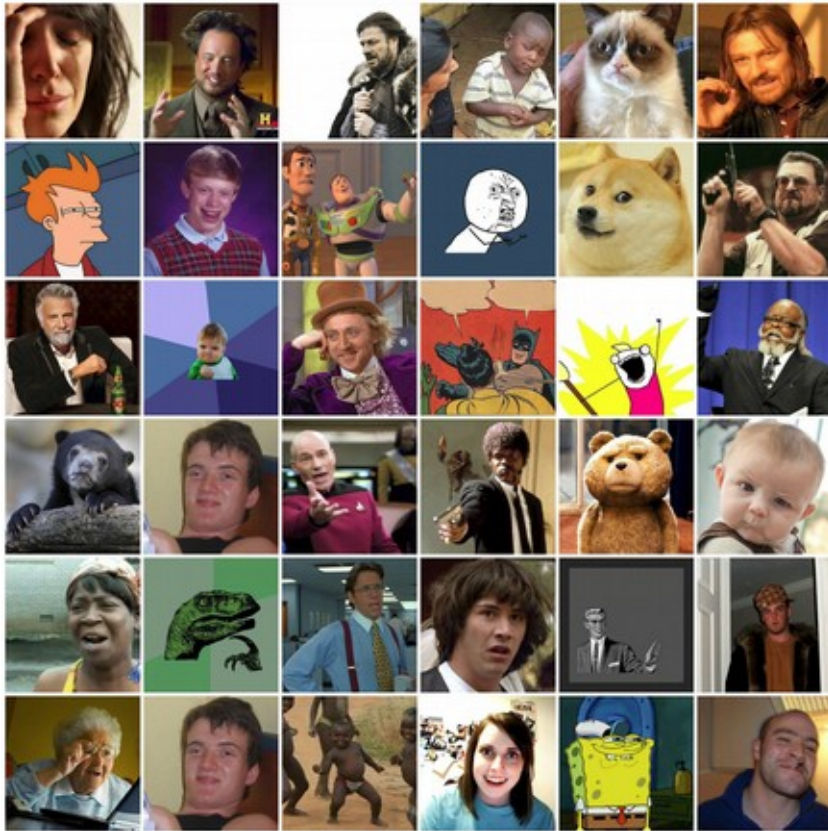
People are **connected** and perform **actions**

↓
friends, fans,
followers,
etc.

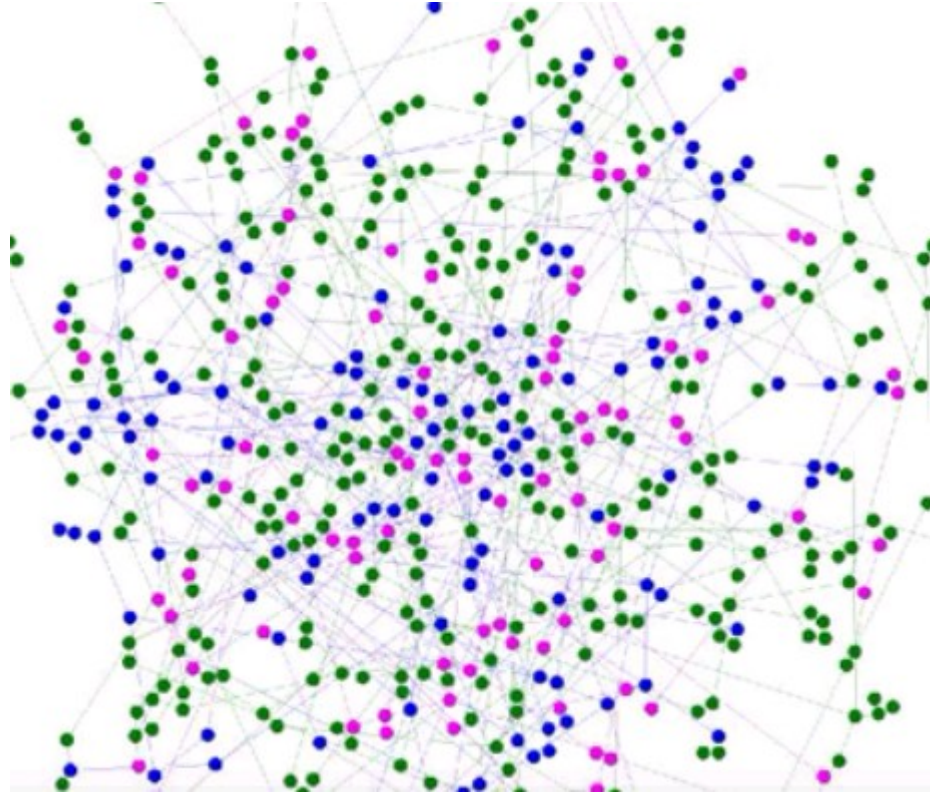
↓
comment, link, rate, like,
retweet, post a message,
photo, or video, etc.

“The Selfish Gene” by Richard Dawkins (1976)

Chapter 11: “Memes: the new replicators”

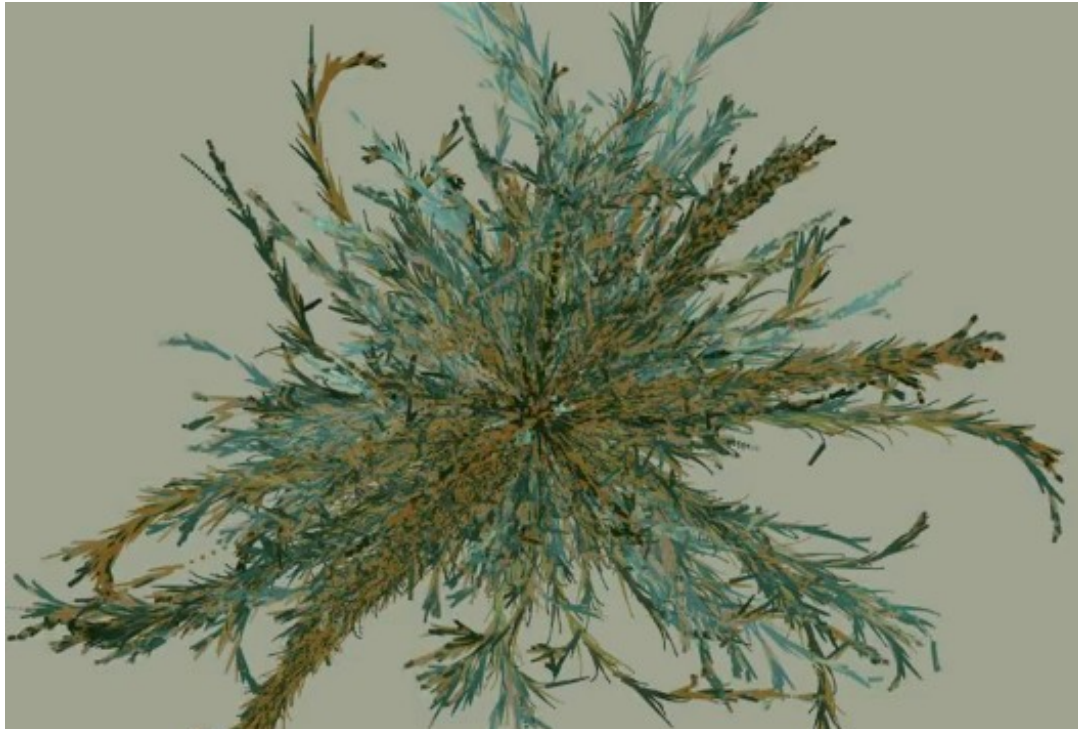


Contagion in graph

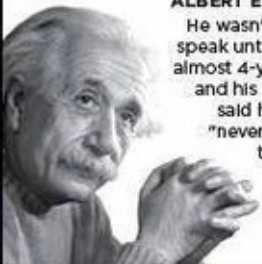
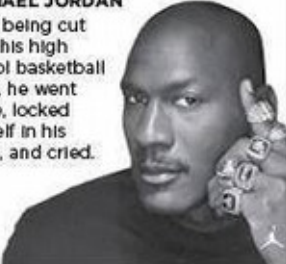

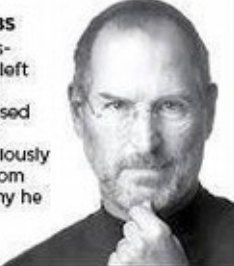




<https://www.youtube.com/watch?v=WWTmRIDsydA>

Spread of a Meme ("Famous Failures")

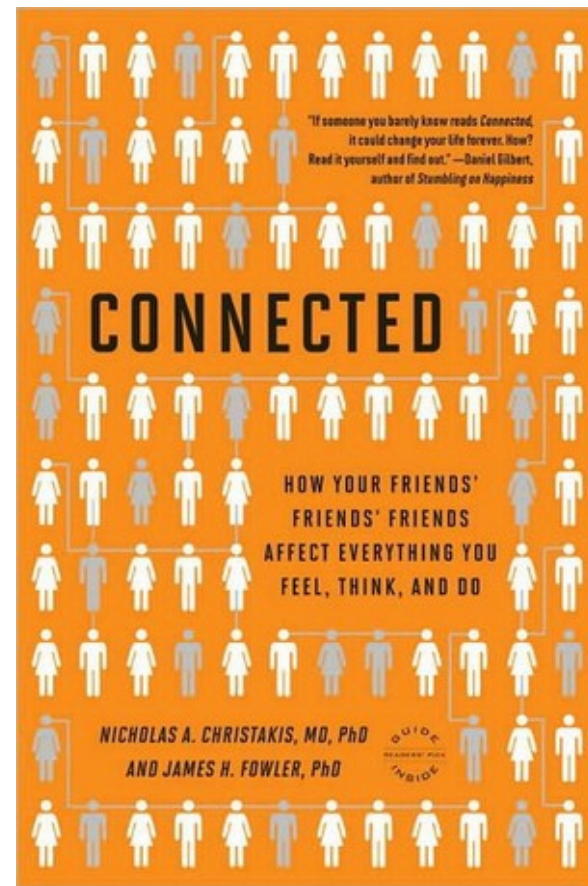


<https://vimeo.com/50730795>

FAMOUS FAILURES	
 <p>ALBERT EINSTEIN He wasn't able to speak until he was almost 4-years-old and his teachers said he would "never amount to much"</p>	 <p>MICHAEL JORDAN After being cut from his high school basketball team, he went home, locked himself in his room, and cried.</p>
 <p>WALT DISNEY Fired from a newspaper for "lacking imagination" and "having no original ideas."</p>	 <p>STEVE JOBS At 30-years-old he was left devastated and depressed after being unceremoniously removed from the company he started.</p>
 <p>OPRAH WINFREY Was demoted from her job as a news anchor because she "wasn't fit for television."</p>	 <p>THE BEATLES Rejected by Decca Recording Studios, who said "We don't like their sound—they have no future in show business."</p>
IF YOU'VE NEVER FAILED, YOU'VE NEVER TRIED ANYTHING NEW	

Non-trivial examples

- **Back pain:** spread from West to East in Germany after fall of Berlin Wall
- **Suicide:** well known to spread throughout communities on occasion
- **Sexual “scripts”:** expected sequences of behaviors during intimate situations
- **Politics:** the denser your connections, the more intense your convictions

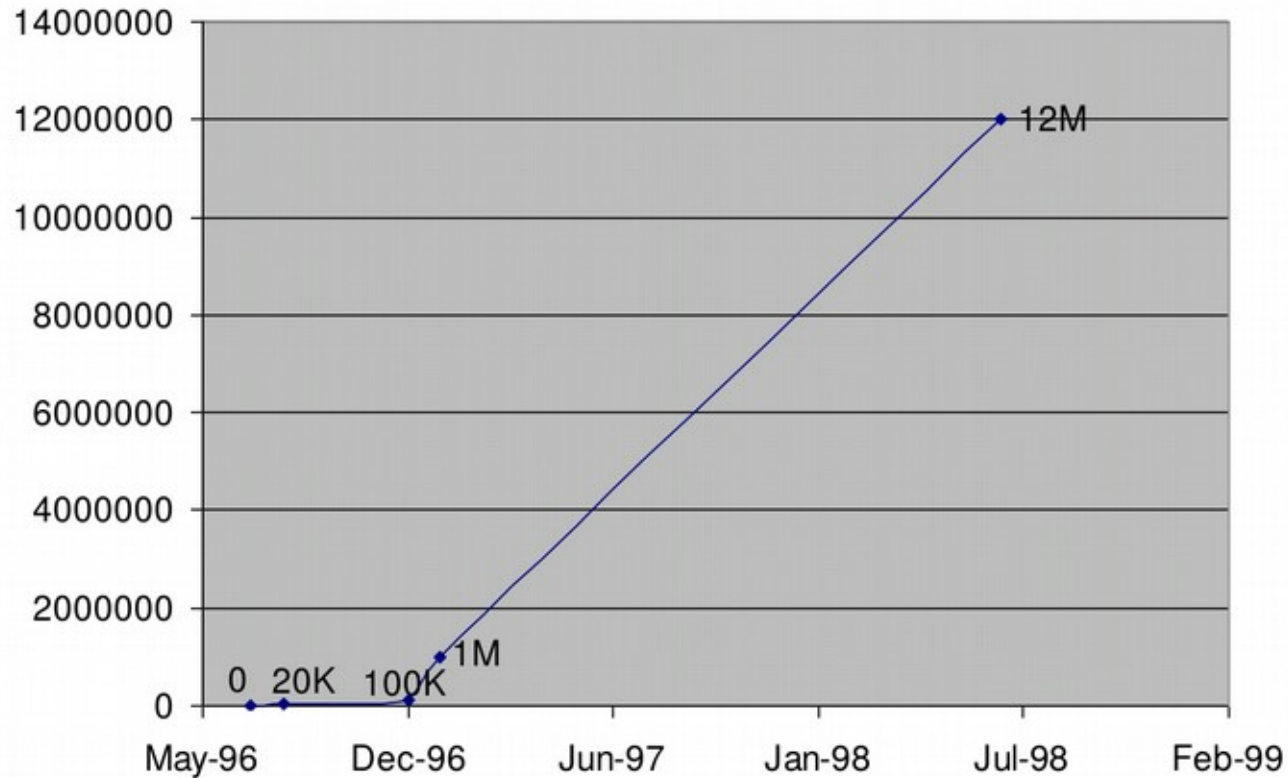


Viral marketing

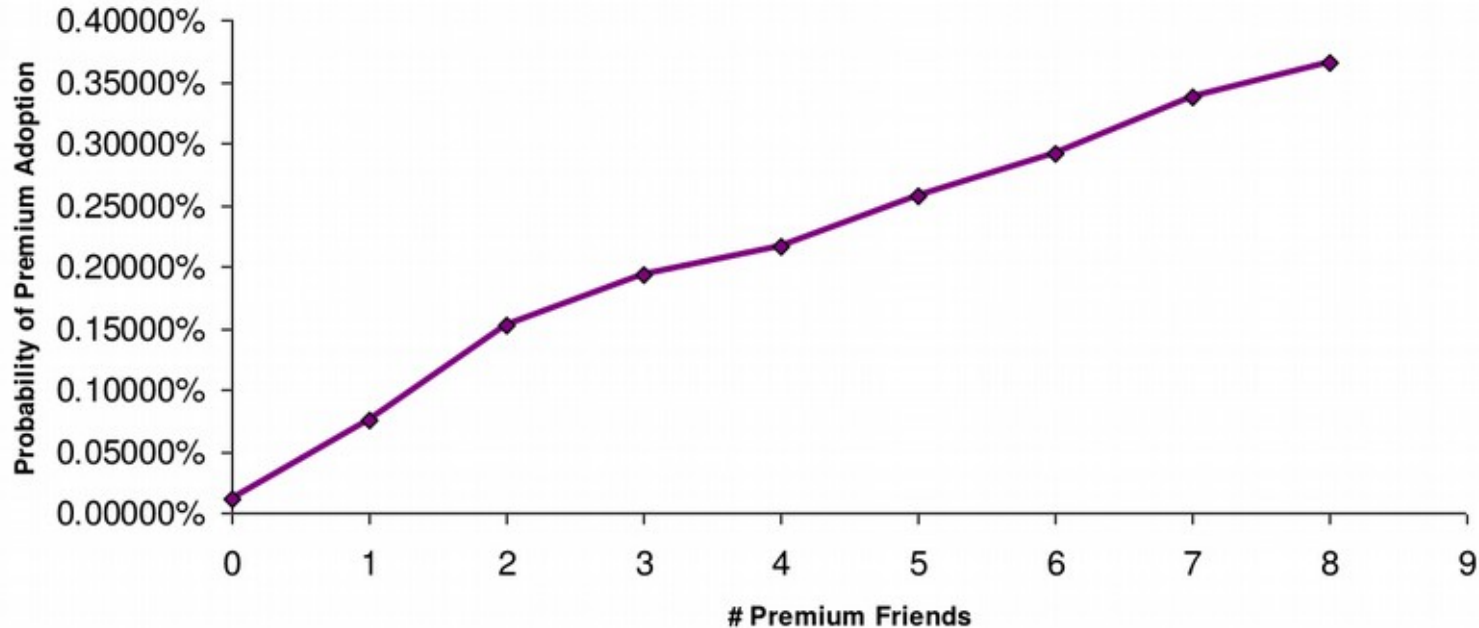
Viral Marketing Online

- Early example: Hotmail
 - Jul 1996: Hotmail.com started service
 - Aug 1996: 20K subscribers
 - Dec 1996: 100K
 - Jan 1997: 1 million
 - Jul 1998: 12 million
- Bought by Microsoft for \$400 million
- At the end of each email sent there was a message to subscribe to Hotmail.com: “Get your free email at Hotmail”

Hotmail users



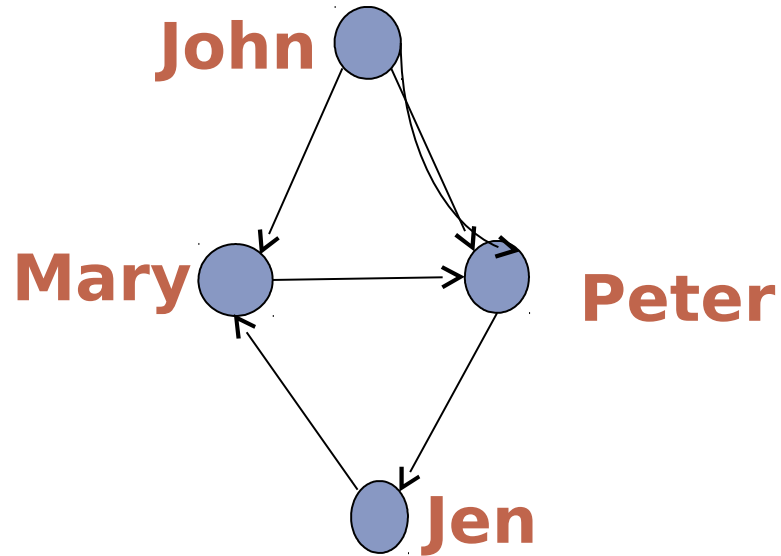
Peer pressure (pay “premium” subscription)



Models of influence

What are our observables?

Graph: users,
links/ties



Log: user, action,
time

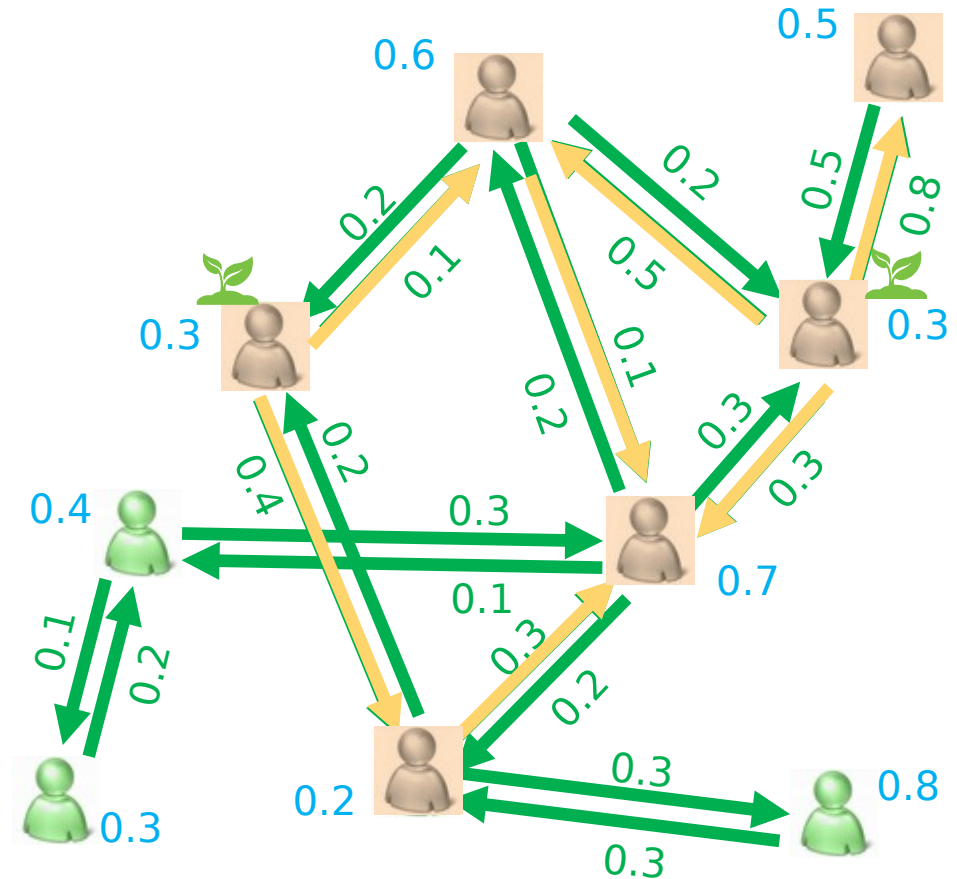
User	Action	Time
John	Rates with 5 stars <i>"The Artist"</i>	June 3 rd
Peter	Watches <i>"The Artist"</i>	June 5 th
Jen

Two main models

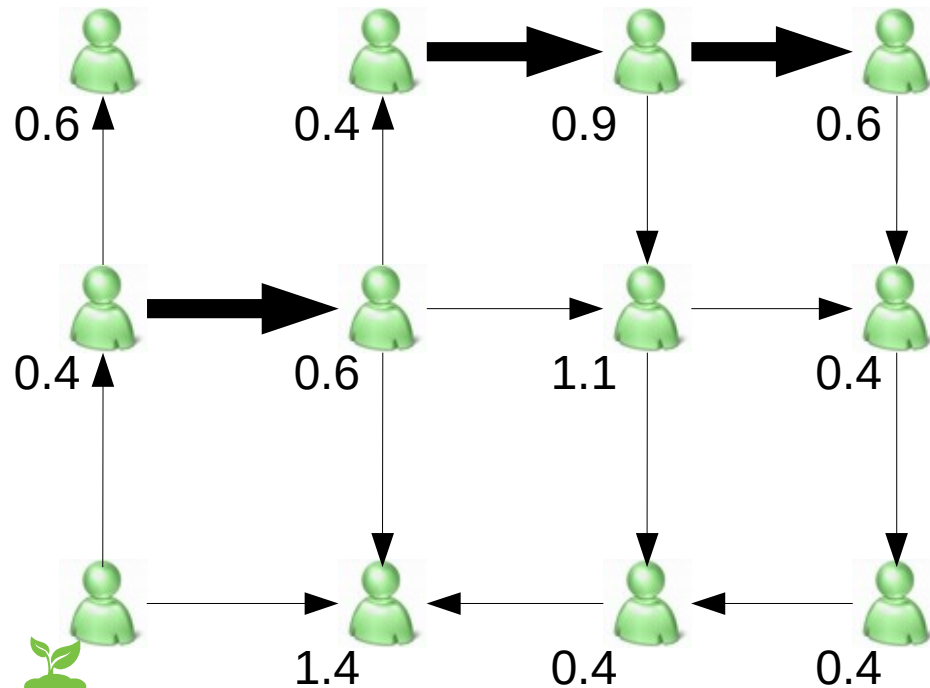
- Linear threshold model
- Independent cascade model

Linear threshold model

- Nodes have thresholds
- Arcs have weights
- Nodes that receive weighted influence equal or above their threshold become active



Try it!



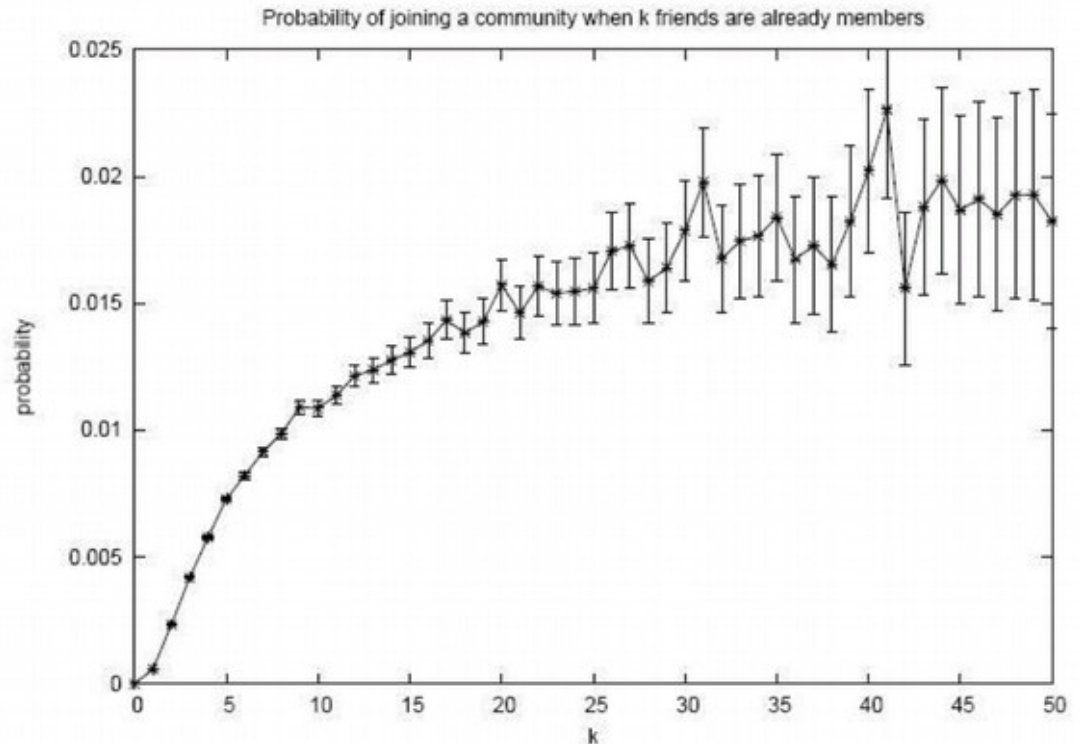
Thick arrows have weight 1.0

Thin arrows have weight 0.5

Execute linear threshold model starting from seed node

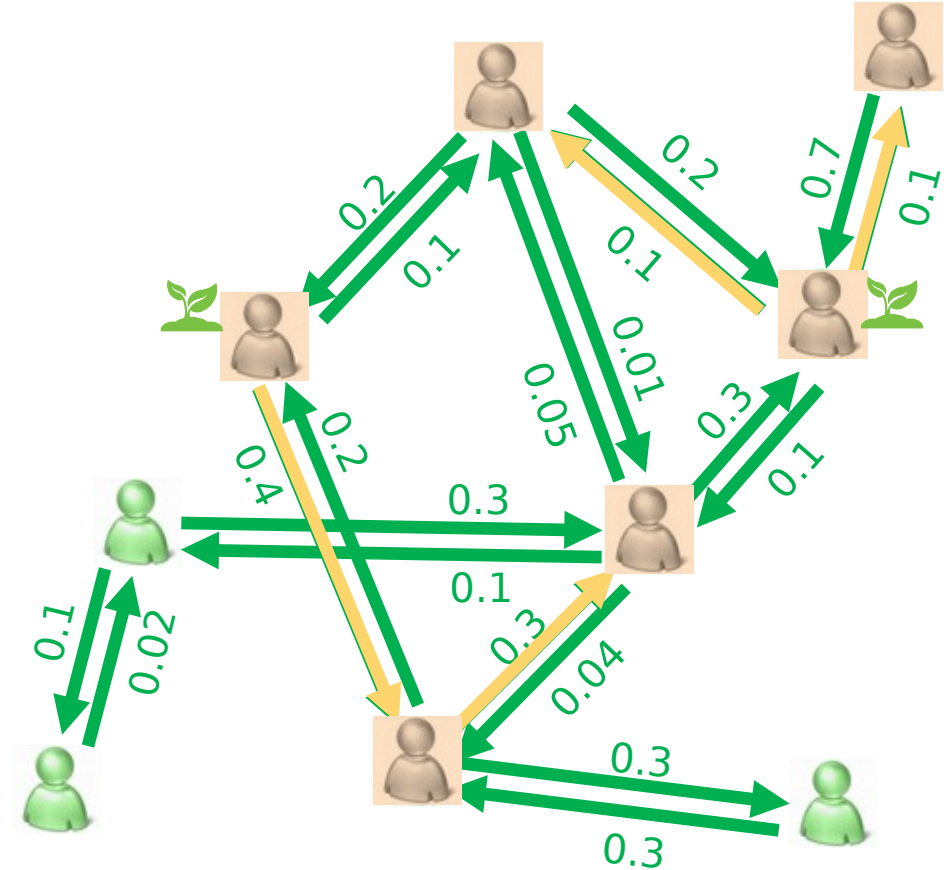
Linear threshold model

Is the linear threshold model compatible with this observation?



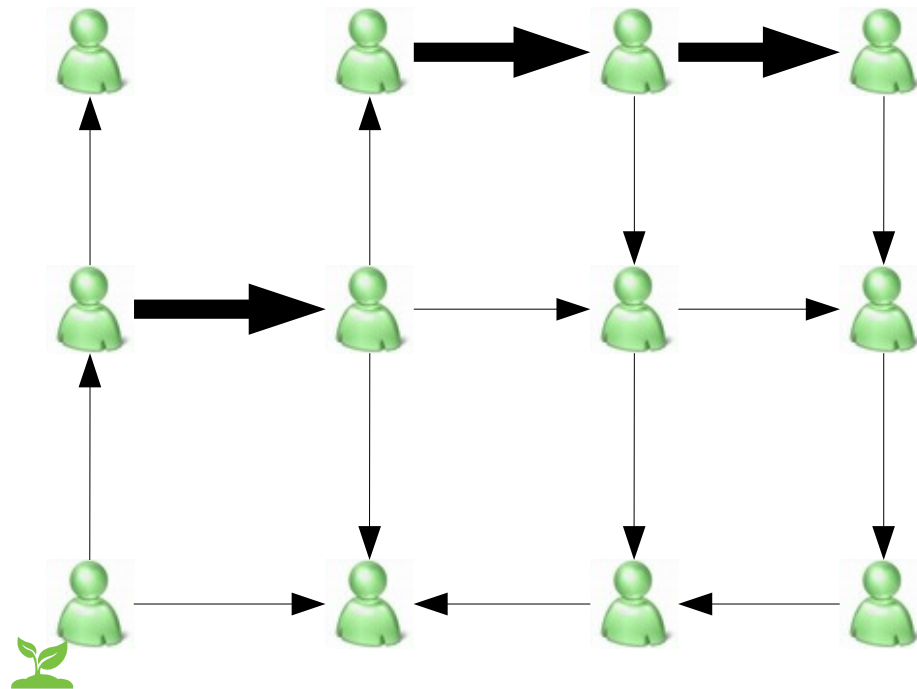
Independent cascade model

- No thresholds
- Each node, when activating, has one chance of activating each of their neighbors
- Probability of succeeding represented by arc weights



[Kempe, Kleinberg and Tardos, KDD 2003]

Try it! (you need a coin or 1d4)



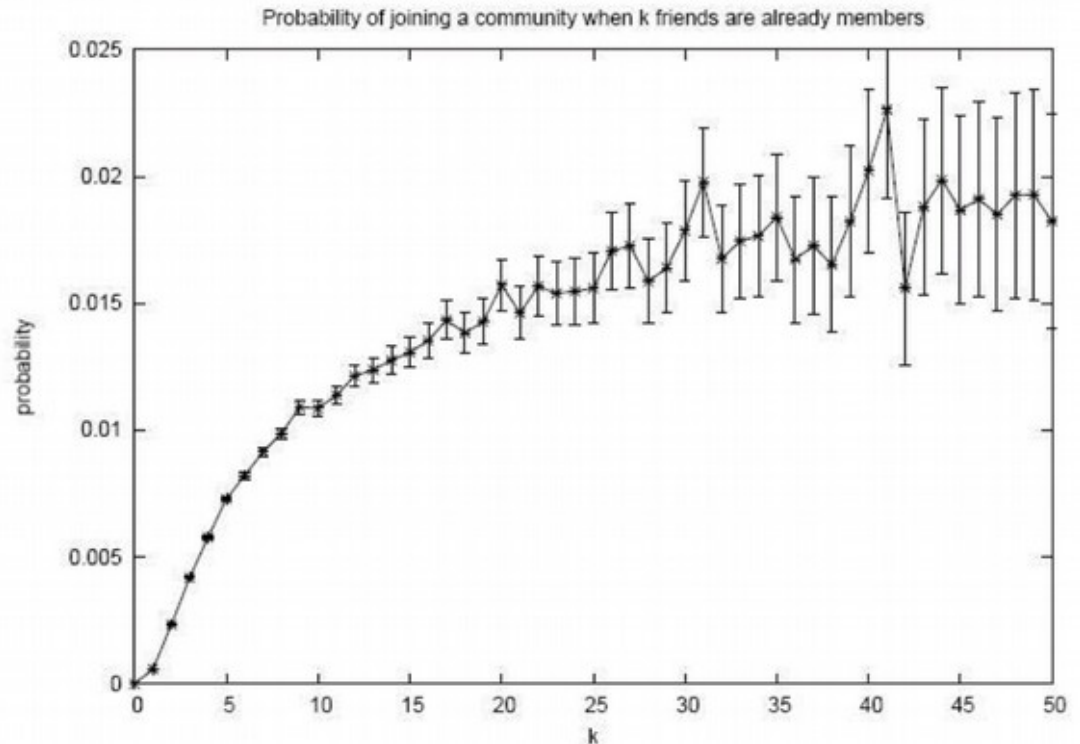
Thick arrows have probability 0.75

Thin arrows have probability 0.5

*Execute
independent
cascade model
starting from seed
node*

Independent cascade model

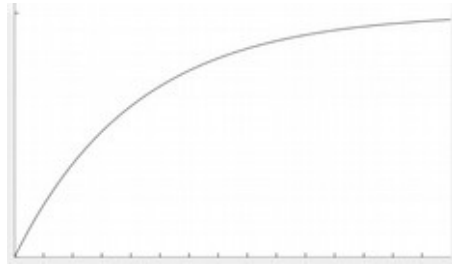
Is the
independent
cascade model
compatible with
this observation?



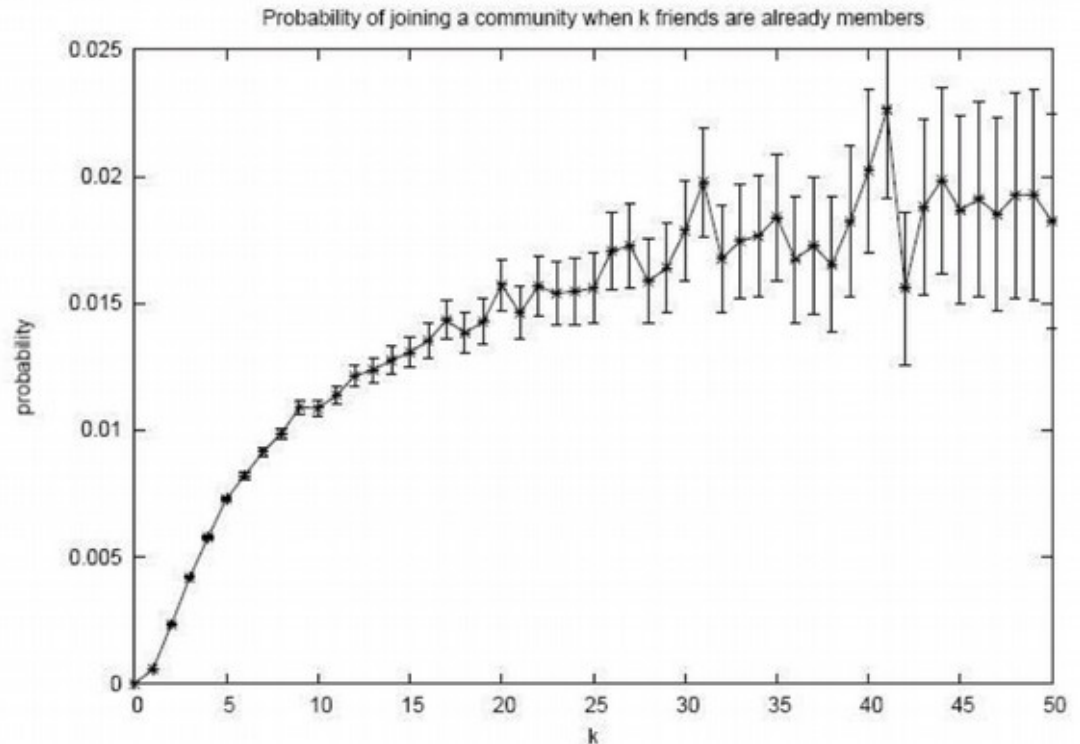
Independent cascade model

Is the independent cascade model compatible with this observation?

Hint:



$$1 - q^k \text{ for } 0 < q < 1$$



What are these models assuming?
(List as many assumptions as you can)

Influencers and Viral Marketing

The promise of “influencers”

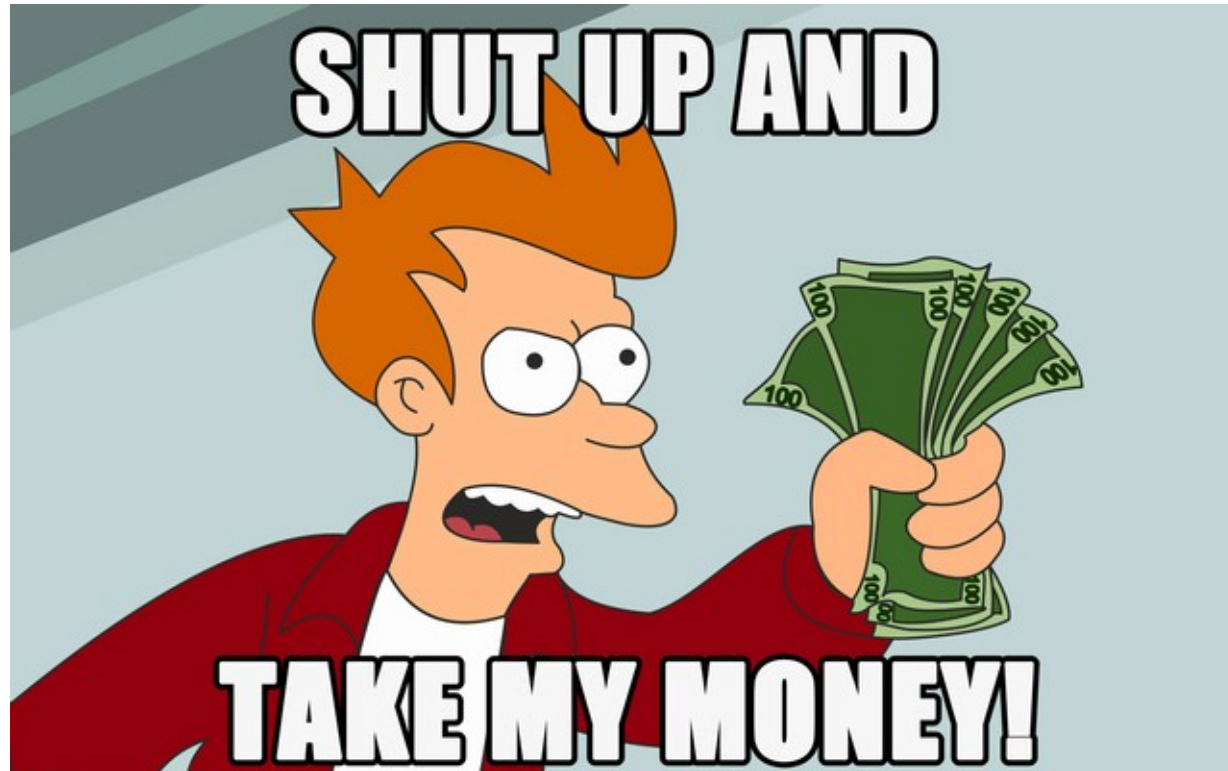
Influencers **increase** brand awareness.
product conversions
through WoMM

Influencers **advocate** a brand

Influencers **influence** purchasing actions



Viral marketing went through a
stage of ...



Can social influence really drive viral cascades?

- Watts et al. challenge the traditional notions and intuitions about SI causing viral spread
- Social epidemics are not always responsible for dramatic, possibly sudden social change
- Influence is hard to prove
- Do not dismiss influence altogether

How useful is viral marketing?

- Hard to predict which campaign will succeed virally
- Lack of predictability makes VM hard to implement;
- The magic might not be in a small number of influentials
- “Big seed” marketing is a predictable, practical alternative

Example: Huffington Post

- Ad agency buys all of the ad slots for a week
- Displays attractive videos with options for easy sharing
- Gets 7x more views due to social referrals, but ...
- None of the videos “goes viral” (grows exponentially in views) at any time



Watch "Gun Free"



Watch "Meth - David"

Summary

- Influence phenomena exist
- They can be modeled
 - And to some extent “predict” **after** they happen
- They are hard to create/engineer