

Announcements

- Dr. Ruha Benjamin's visit: Thursday, 11/2
 - Student conversation: 4:20-5:20 in Mills 127
 - Talk: 7:30pm in Mills Events Space (2nd floor)
Race to the Future? Reimagining the Default Settings of Technology & Society
- Assignments 3 & 4 due this week
 - Assignment 4: Video lecture on comparing network models (Canvas -> Modules -> Video Lectures)
- Office hours: Tue & Wed, 3-5:30pm (Mills 209)
- LA hours: Thursday, 7-9pm (Mills 105)

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DCS/CSCI 2350 Social & Economic Networks

How do diseases, behavior, opinion, technology, etc. propagate in a network?

Cascading Behavior in Networks

Reading: Ch 19 of EK

Mohammad T. Irfan

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How Does Our Social Network Influence Our Behavioral Choices? NSF Core Research Grant

“No man is an island” wrote the poet John Donne in 1624, meaning whether we like it or not, we are all connected. It’s an assertion that rings truer than ever in today’s networked world, and it’s a central theme of the research currently being done by computer scientist Mohammad Irfan and his colleagues.

Assistant Professor of Digital and Computational Studies (DCS) and Computer Science (CS) Irfan recently helped to secure around half a million dollars in funding for an exciting multiyear project exploring human interactions in networks. The research could have implications for many fields, he says, from public health to energy pricing to finance to the analysis of congressional voting patterns.

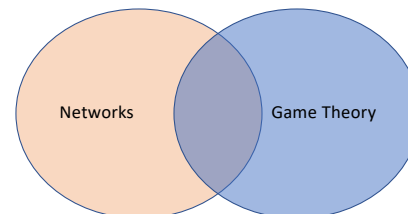
The award was made by the National Science Foundation (NSF) and done in collaboration with Luis E. Ortiz of the University of Michigan—Dearborn, for a multiyear research initiative. It’s all part of a core NSF program called Information and Intelligent Systems, says Irfan, who is the project director (while Bowdoin is the lead organization.)



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My recent research

- Influence in networks
- Cascades and overexposure
- Influence in residential segregation



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Diffusion of innovations

- Studied in sociology since 1940s
- One's choice influences others

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Types of diffusion

- Indirect/informational effects – social learning
 - Photo/video going viral
- Direct-benefit effects
 - Technology adoption– Xbox/PS5, phone, fax, email, FB

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Examples

- Adoption of hybrid seed corn in Iowa
 - Ryan and Gross, 1943
- Adoption of tetracycline by US doctors
 - Coleman, Katz, and Menzel, 1966

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Shared ingredients in examples


- Indirect effects
- Adoption was high-risk, high-gain
- Early adopters had higher socioeconomic status
- Social structure was important– visibility of neighbors' activity

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Success factors of diffusion

Diffusion of Innovations—
Everett Rogers (1995)

- Complexity
- Observability
- Trialability
- Compatibility



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#TheDress
(February 2015)



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Hush puppies (1995)

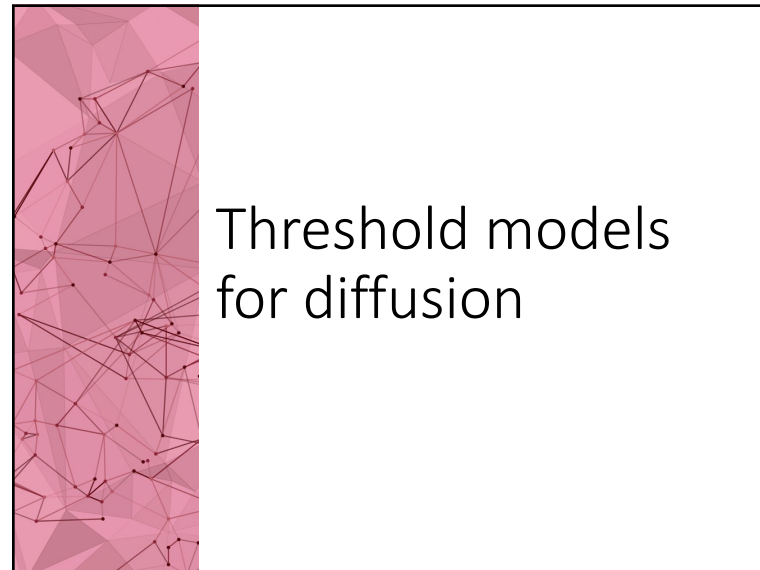


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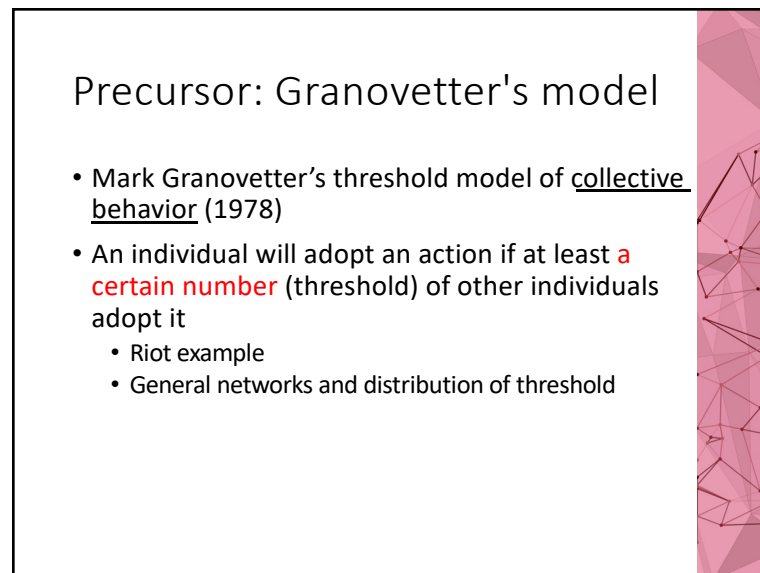
Next

- Modeling diffusion
- Connection with the things we know
 - The strength of weak ties
 - Clustering

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(Side note)

- Collective behavior: Relatively spontaneous, unstructured, extra-institutional behavior of a fairly large number of individuals. (Goode)
 - Residual field in sociology
- Collective action: People acting together in pursuit of common interests. (Tilly)
 - 1990s to date

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Contagion Model

Stephen Morris, 2000

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Initial adopters

Granovetter's model: the persons with threshold = 0 are the initial adopters

vs.

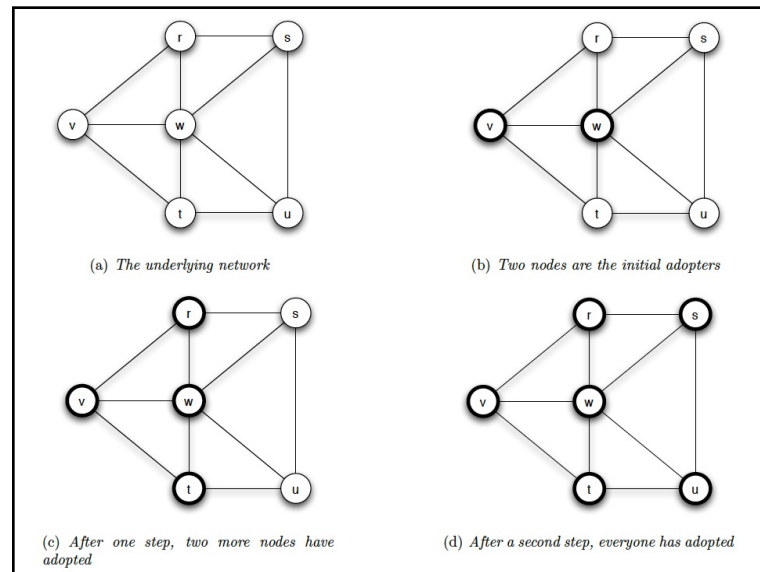
We can set initial adopters without any regard for their threshold (Modeling assumption by Kleinberg et al.)

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Example: switching from B to A

- Initially, everyone does B
- Payoff parameters: $b = 2$, $a = 3$
- Threshold for switching to A, $q = 2/5 = 40\%$
- We will set two initial adopters of A and "play out" the diffusion

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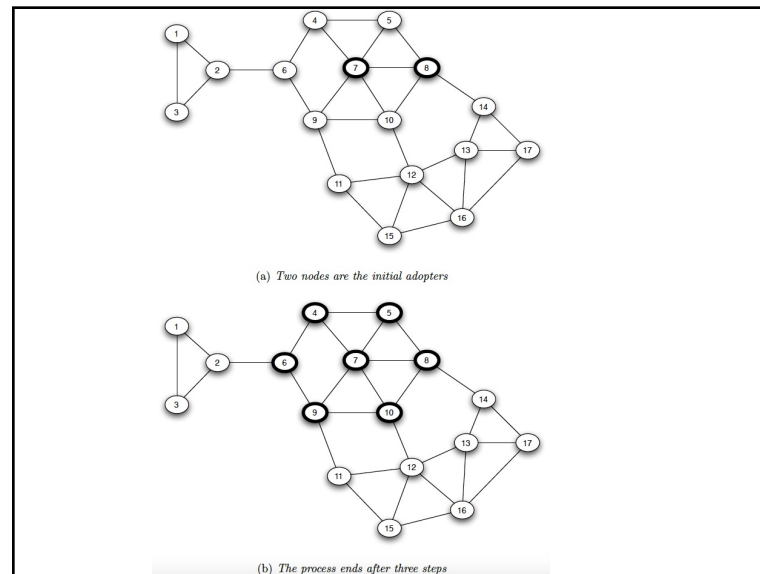


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Complete cascade

- **Def.** A set of initial adopters causes a "complete cascade" if everyone adopts the new action at the end of diffusion.
 - Always happens?

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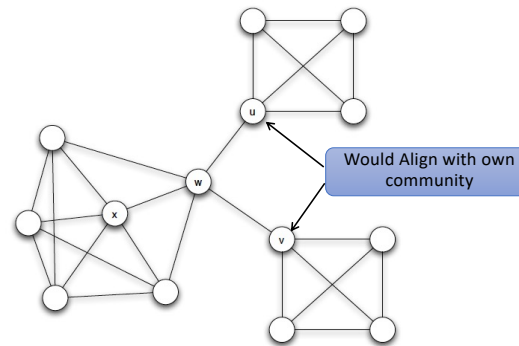
What are the factors for a widespread diffusion?

- Initial adopters
- Network structure
- Threshold value q
 - Quality of product– payoff parameters a and b
- Example: viral marketing

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Diffusion and strength of weak ties

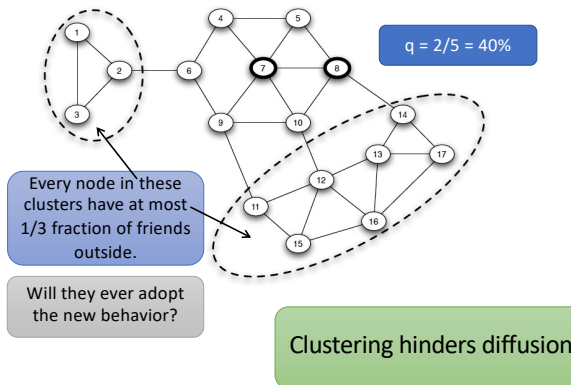
- Weak ties are conveyors of information
- But cannot “force” adoption of behavior



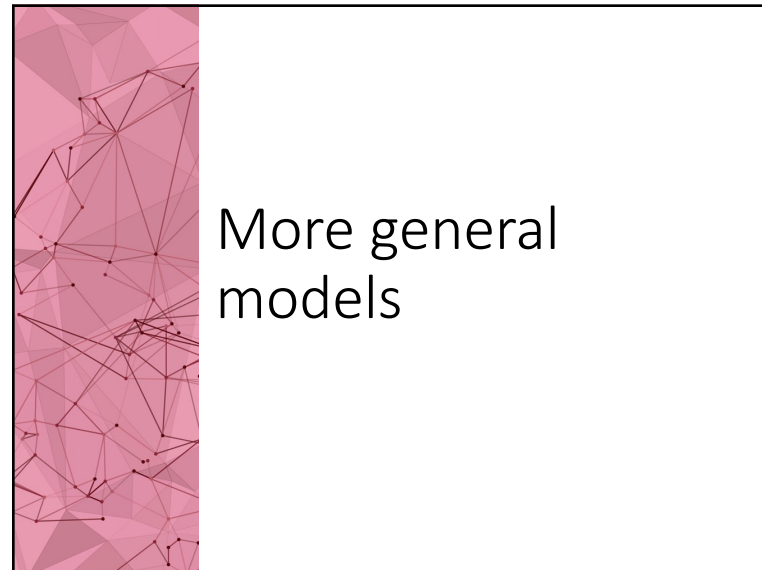
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Diffusion and clustering

- Does clustering help or hinder diffusion?



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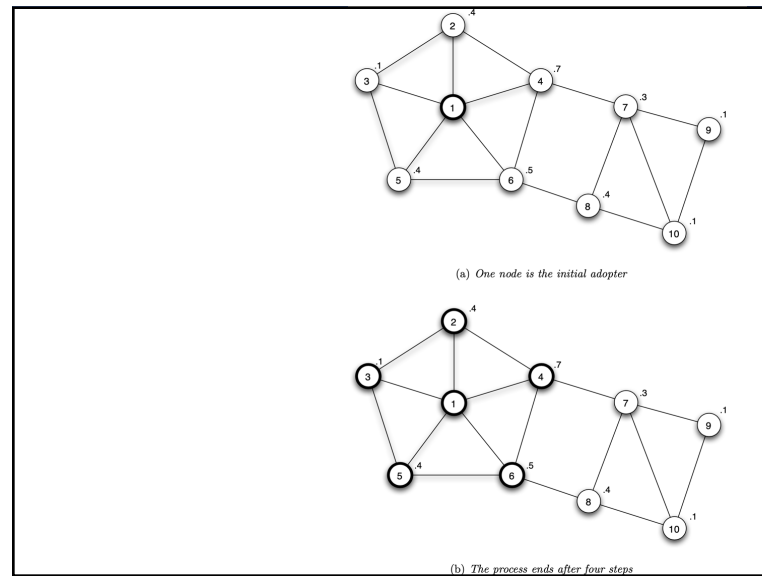
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Cascades with
heterogeneous thresholds

		w	
		A	B
v	A	a_v, a_w	$0, 0$
	B	$0, 0$	b_v, b_w

- Node v 's threshold = $b_v / (a_v + b_v)$
- Same calculation as before

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Further extension:
linear threshold model

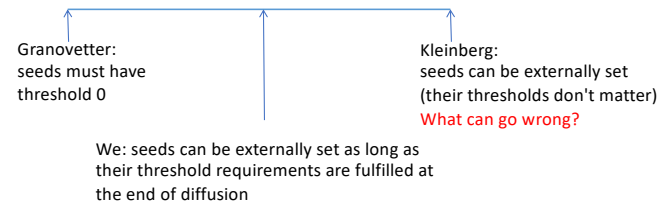
All friendships are not the same!
=> influence

Reference: Handout

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Influence games (Irfan & Ortiz, 2014)

- Thresholds are heterogeneous
- Directed, asymmetric network
- Each edge: labeled with influence factor
- Relationships can be positive or negative
- Initial adopters or seeds



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