

15-396

Science of teh Interwebs

What's on the Final?

Overview

~~Networks I: Centrality + Prestige~~

Networks II: Structural Balance

Networks III: Innovation Diffusion

Identity and Privacy I

Identity and Privacy II

Revolts and Thresholds

Random Graphs

Preliminaries of Game Theory

Auctions Network Traffic

Sponsored Search

Web Search I

Web Search II

Recommendation Systems

Voting

P2P

Watermarking

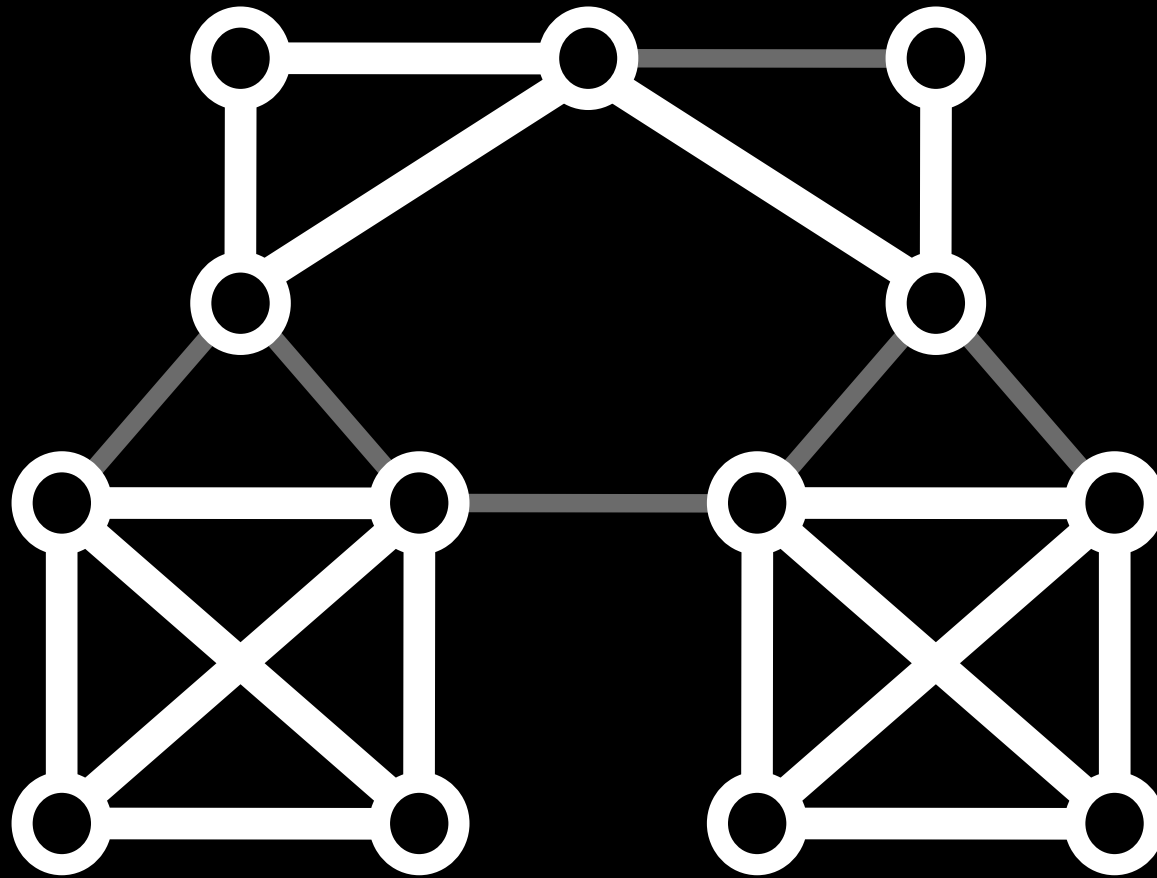
Crowdsourcing

MapReduce

~~Natural Language Processing~~

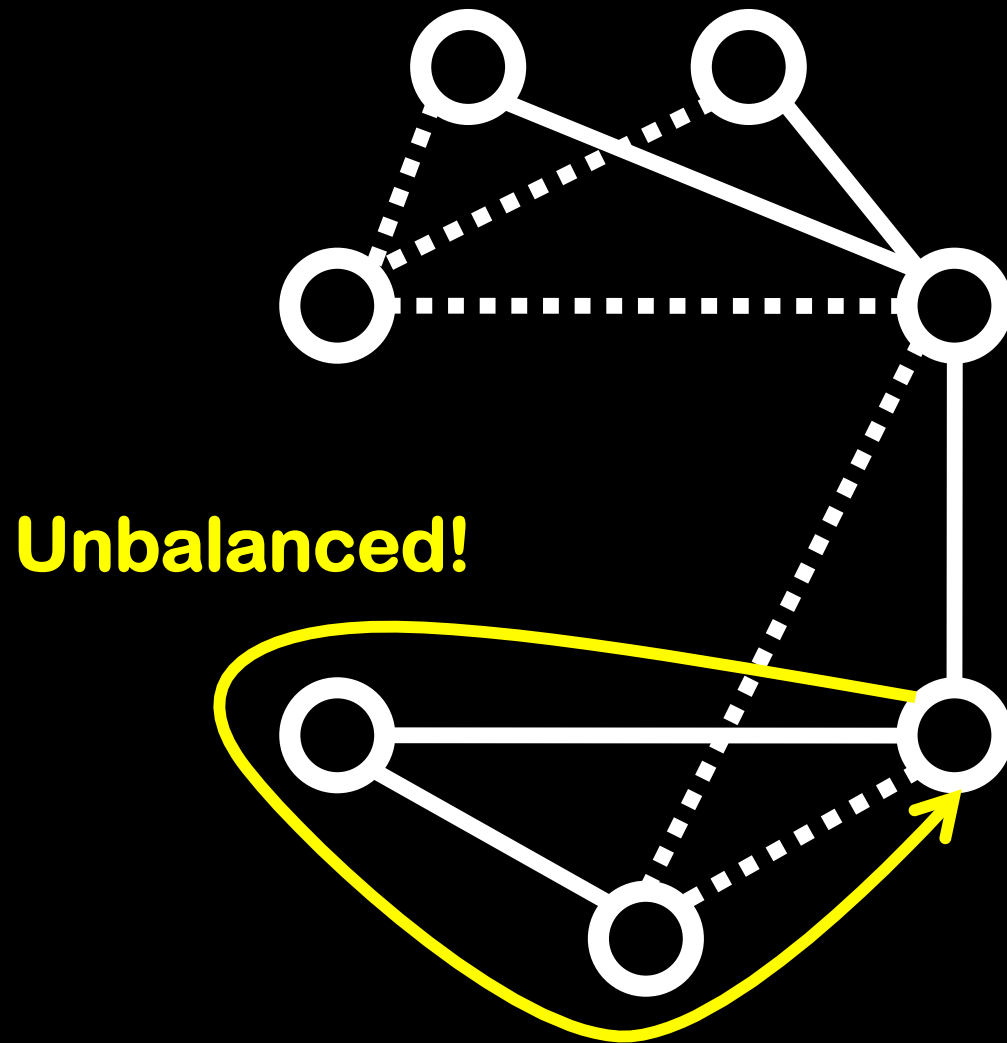
You can vote one lecture off!

Social Network Theory



Does this network satisfy the strong triadic closure?

Is this Graph Balanced?



Definition: A cycle is balanced if the product of its signs is positive

Definition: A graph is balanced if all its cycles are balanced

Clusters Stop Cascades

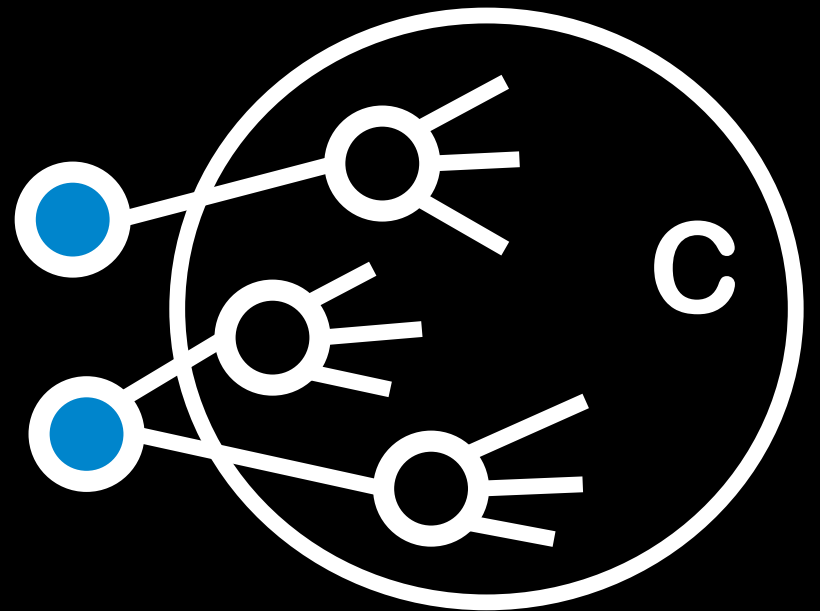
Theorem: Let S be an initial set of adopters of A . Assume the nodes all apply a threshold q to decide whether to switch to A .

If $G-S$ contains a cluster of density greater than $(1-q)$, then S cannot cause a cascade

Proof (by contradiction):

Let t be the first time that a node in C adopts A

But, by time $t-1$ some other node in C must have adopted A



Only Clusters Stop Cascades

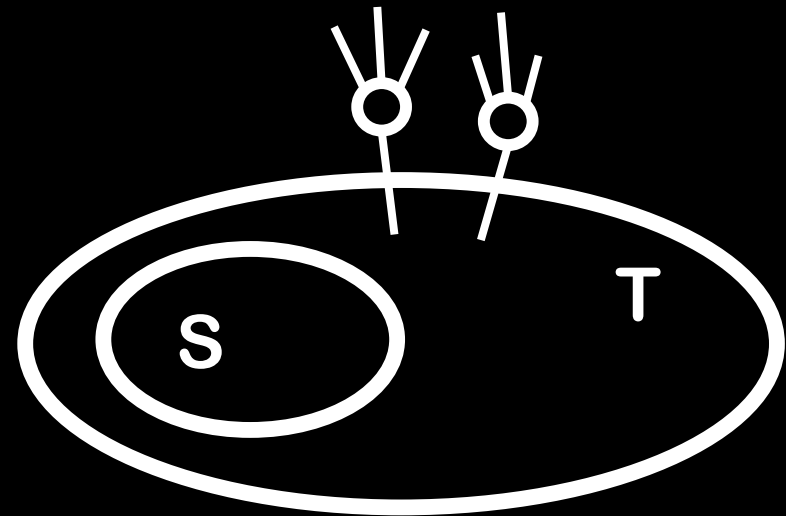
Theorem: If a set S of initial adopters fails to cascade with a threshold q , then there is a cluster in $G-S$ of density greater than $(1-q)$.

Proof:

T = set of nodes that eventually adopt A

If $v \in G-T$, less than a q fraction of its neighbors are in T

Which means that more than a $(1-q)$ fraction of its neighbors are in $G-T$



Game Theory

		Firm 2	
		H	L
Firm 1	H	2,2	0,3
	L	3,2	5,1

(L,H) will be played

		Player 2		
		L	M	R
Player 1	t	3,3	2,2	2,1
	m	2,2	1,2	3,1
	b	1,2	3,1	2,3

Neither player has a dominant strategy

Nash Equilibrium

A pair of strategies (s_1^*, s_2^*) is in Nash Equilibrium if s_1^* is a Best Response by player 1 to s_2^* , and s_2^* is a Best Response by player 2 to s_1^* .

		Player 2		
		L	M	R
Player 1	t	3,3	2,2	2,1
	m	2,2	1,2	3,1
	b	1,2	3,1	2,3

		Player 2	
		L	R
Player 1	U	1,1	4,0
	D	2,1	1,3

**($p=2/3, q=3/4$)
is an
equilibrium!**

Player 1 is only willing to randomize if the expected payoffs of U and D are equal:
 $q+4(1-q)=2q+(1-q)$, so $q=3/4$

Bidding your true value is a dominant strategy in a second price sealed bid auction

v_i = bidder i 's value for the object

b_i = bidder i 's bid for the object

A bidder's **strategies** are bids as functions of their values

The payoff to bidder i with value v_i and bid b_i is:

$$\begin{cases} v_i - \max_{j \neq i} b_j & \text{if } b_i > \max_{j \neq i} b_j \\ 0 & \text{otherwise} \end{cases}$$



v_i = bidder i 's value for the object

b_i = bidder i 's bid for the object



$$\text{Payoff} = \begin{cases} v_i - \max_{j \neq i} b_j & \text{if } b_i > \max_{j \neq i} b_j \\ 0 & \text{otherwise} \end{cases}$$

Theorem: Bidding $b_i = v_i$ is a dominant strategy

If $b_i > v_i$ bidder i could get object and pay more than what she values it for (and thus go negative)

If $b_i < v_i$ bidder i could fail to obtain the object; obtaining the object can get her positive payoff

How does Google Ads Work?

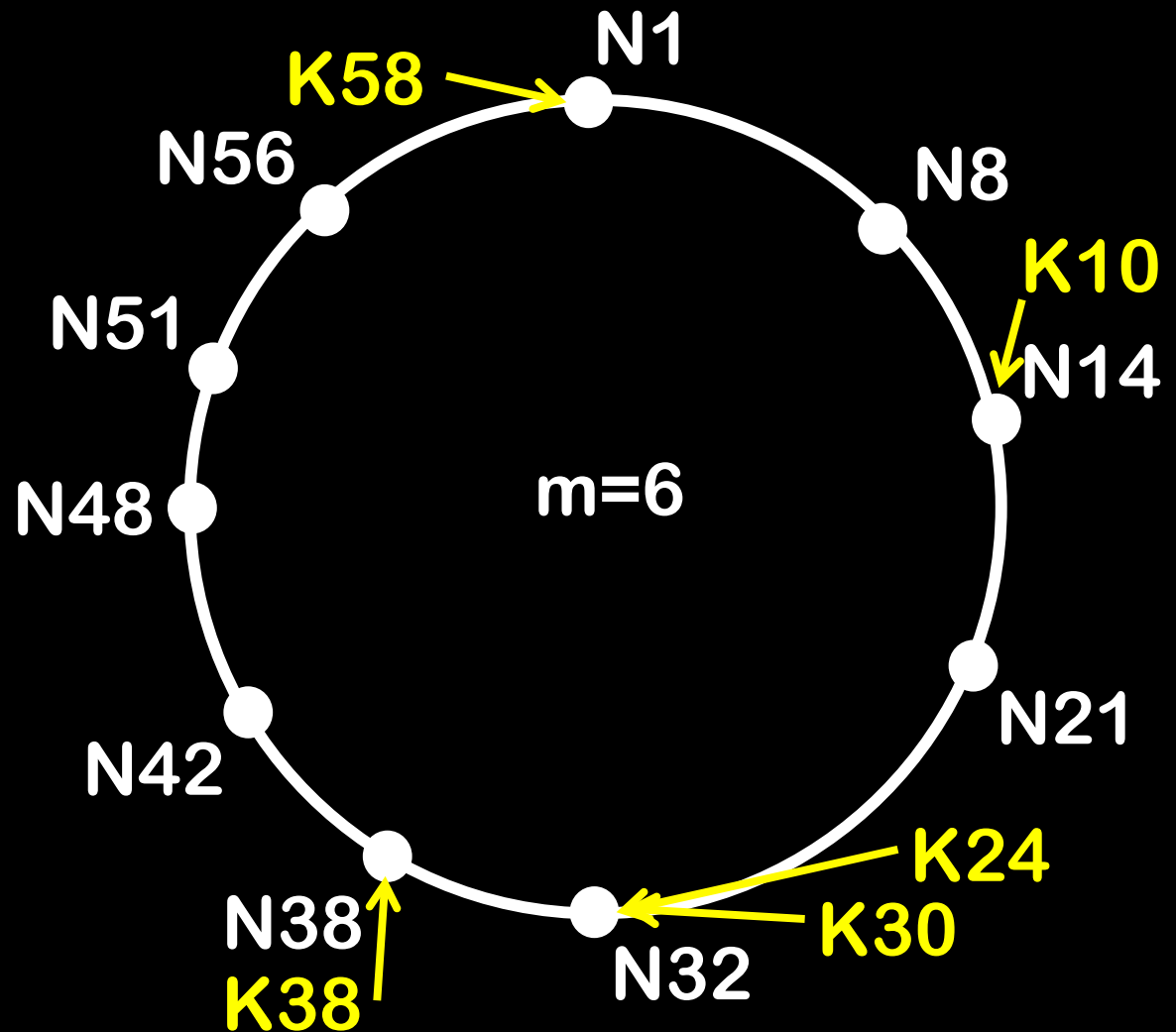
How is it different from VCG?

How Does PageRank Work?

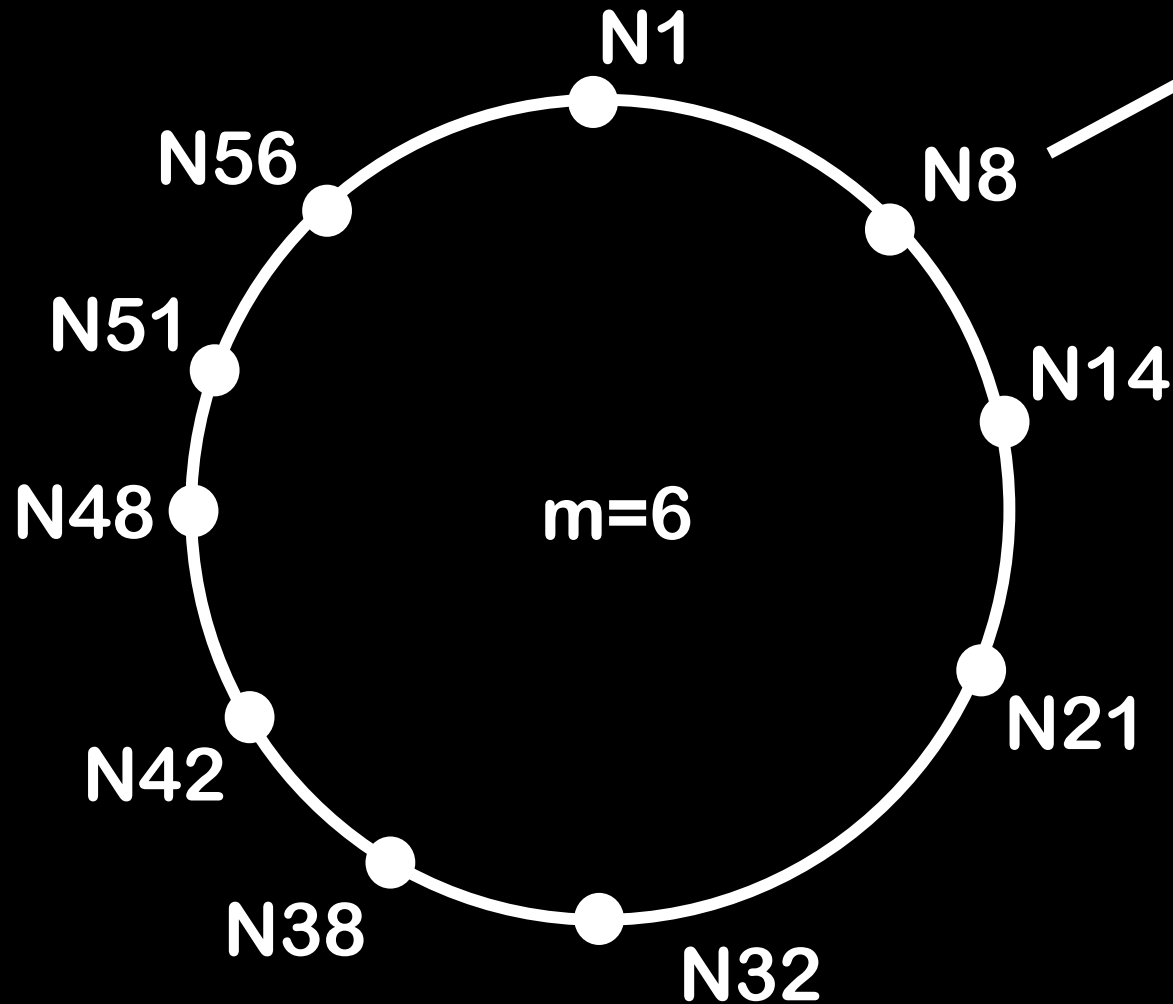
The Chord Ring

A ring with positions numbered 0 to 2^m-1

Key k is assigned to node successor $(k) = \text{node}$ whose identifier is equal to or follows the identifier of k



The i^{th} entry of node n will contain the address of successor($n+2^i$)



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No Networks I or NLP!

What We Wanted From the Class

Not too much work for you

A blend of theory and practice

Get you to experiment with real life systems

Next Steps

The skills required in industrial CS jobs have changed significantly over the last decade.

We touched on topics that most of you will see again in the 'real' world.

Look a bit deeper at an area that you found particularly interesting.

Build something great!

g2g

ttyl