

Peer and Authority Pressure in Information-Propagation Models



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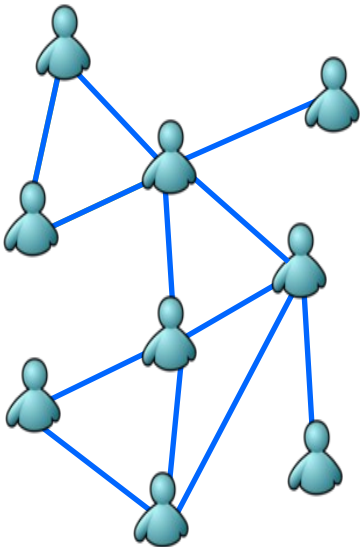
Information propagation

Information items propagate in a **network**

information items: news, product, rumors, viruses

Nodes adopt items and become **active**

Others remain **inactive**

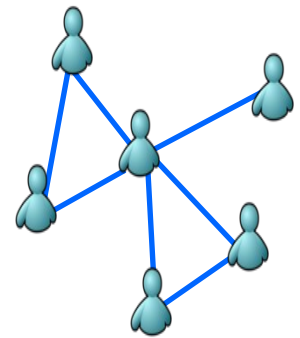


nodes: blogs, people, news-sites, countries

Peer propagation models

The **activation** of a node **depends on** the activation status of **its neighbors**

dependency: time, number
parameters of the peer model



Related work: network engineering

Assuming a network and the parameters of a peer model:

find the nodes to activate so as to maximize the expected spread of an information item [KKT'03]

find the nodes to immunize so as to minimize the expected spread of an information item [LKGFGV'07]

Related work: reverse network engineering

Assuming a network, the activation times of nodes:

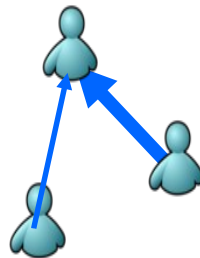
find the peer model's parameters

explain how the propagation really happened

Related work: reverse network engineering

Assuming a network, the activation times of nodes:

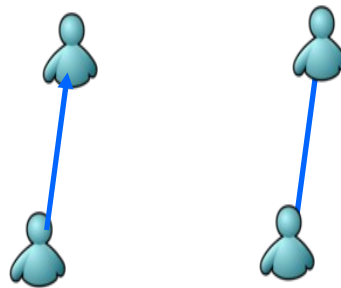
Infer strength of influence relationships
[RLK'10,GBL'10]



Related work: reverse network engineering

Assuming a network, the activation times of nodes:

Distinguish influence from correlation [AKM'08]



Beyond peer models

Peer models: friends are the only source of influence

Reality: multiple sources of influence

Beyond peer models: examples

choosing a mobile phone provider

adopting a fashion trend

picking a research theme to work on

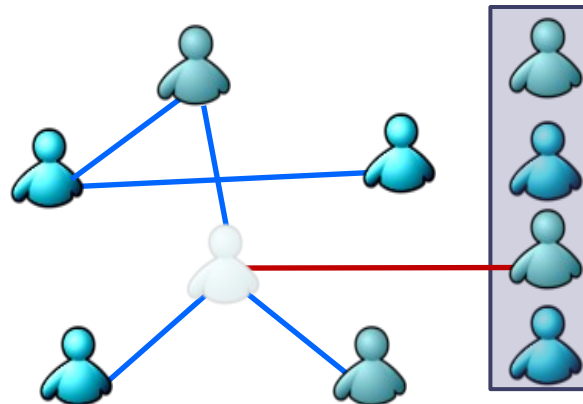
Our contribution: integrating peer and authority influence

Propagation is induced by **peer** and **authority** influence

authorities: entities that are not our friends but they influence us

Our contribution: integrating peer and authority influence

Propagation is induced by **peer** and **authority** influence



Our contribution: integrating peer and authority influence

Propagation is induced by **peer** and **authority** influence

For some information items **peer** or **authority** influence is more (or less) obvious

The problem

Given information item i and
a **network**,
a **set of authority nodes**,
and the **activation times of nodes**:

Quantify the effect of **peer** and **authority** influence
in the propagation of i

The model

The probability that a node becomes active depends on

- the number of active peers (x)
- the number of active authorities (y)
- the peer coefficient (α)
- the authority coefficient (β)
- the externality coefficient (γ)

$$P(x, y) = \frac{e^{\alpha \ln(x+1) + \beta \ln(y+1) + \gamma}}{1 + e^{\alpha \ln(x+1) + \beta \ln(y+1) + \gamma}}$$

The algorithm

By convex optimization, we find the maximum-likelihood estimates of **peer coefficient (α)** and **authority coefficient (β)**

If $\alpha > \beta$ **peer influence dominates**

If $\alpha < \beta$ **authority influence dominates**

Time-shuffle test

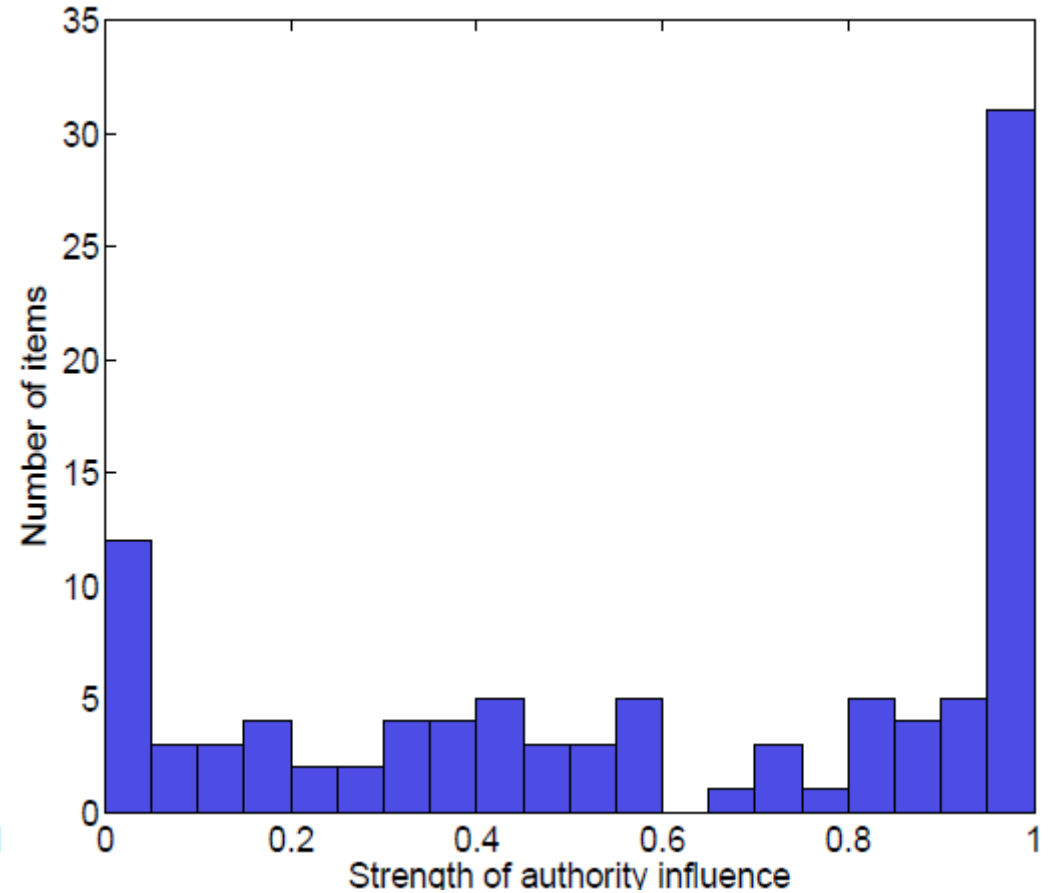
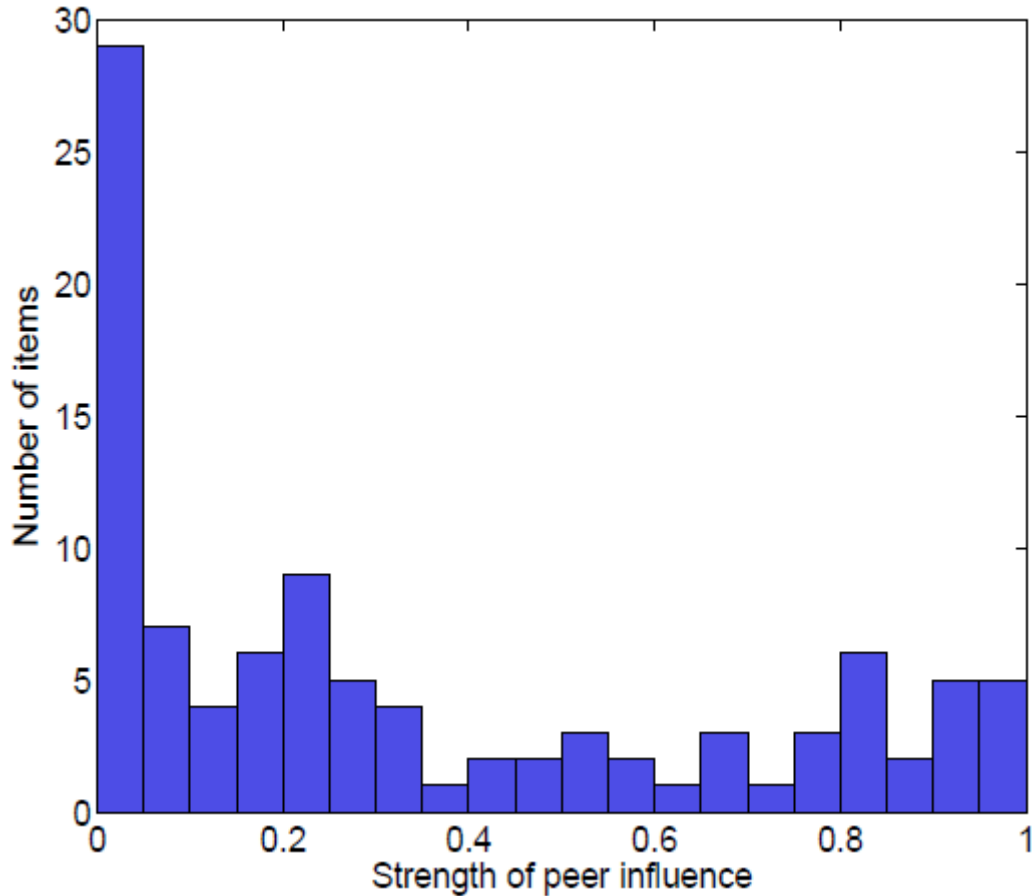
$\alpha > \beta$ **inadequate** to guarantee peer influence

Randomize the data (shuffling activation times)

Peer strength: fraction of times $\alpha > \alpha'$

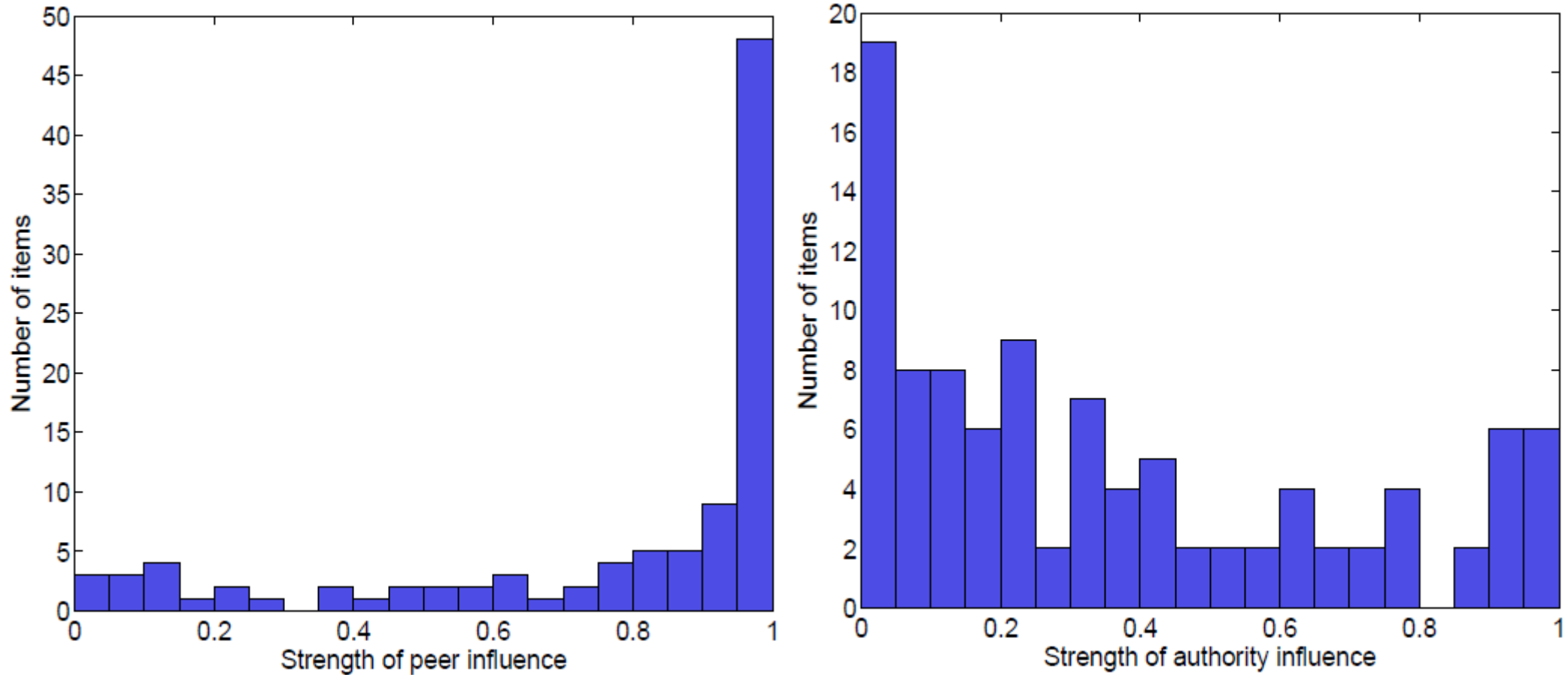
Authority strength: fraction of times $\beta > \beta'$

meme-tracker data: results



nodes: blogs, **authorities:** news-sites, **items:** memes

bibsonomy data: results



nodes: authors, **authorities:** authors, **items:** tags

Conclusions

Accounting for authority influence helps to better explain the signal

Media/news networks demonstrate evidence of authority influence

Co-authorship networks demonstrate stronger peer effects

Future work

Complex interactions between peers and
authorities

Automatic identification of authority nodes

Lifecycle of signals