

Influence in Social Networks: Propagation in YouTube

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Social networks are collections of users and their interactions. Through these interactions, the decisions of members of a social network get influenced, and shaped. This factor is broadly referred as the word-of-mouth. Nowadays, successful advertising campaigns are those that increase the product awareness with the lowest cost. If targeted to the right people, viral advertisement (aka word-of mouth distribution) in social networks provides both of the requirements for a successful campaign (low cost and high awareness). This is possible due to the massive user participation in social networks and their connectedness. In our research, we look into discovering right people or communities (called influentials) for targeting the viral advertisement.

Web 2.0

- Users' networks facilitating the flow of ideas and knowledge by allowing the efficient generation, dissemination, sharing and editing/refining of informational content
- What it means to individuals?
 - participation, collaboration, conversation, community, connectedness, rich experiences
- What it means to businesses?
 - openness, collaboration, empowered and engaged customers, crowd sourcing (i.e., leveraging user content and ideas)



Social networks & businesses

- Why social networks?
 - Have huge user base
 - Users are motivated to contribute in social networks
 - Facilitate content distribution
 - Provide users with the power to communicate
- What is in it for businesses?
 - 68% of consumers consult friends before making purchase decisions
 - High potential advertisement environment (low cost, high gain)
 - Influence from family and friend exists in all steps of consumer decision making (CBB model)



Measuring Influence

- Social influence in Internet social networks is analogous to a directed graph
 - Direction of an edge is equivalent to the direction of the message traveling in the social network
 - Networks are dynamic, so influence should be analyzed for a certain past period of time
 - The number of interaction determines the link strength
 - Different types of relations have different influence values
 - The influence is important when it is distributed in the network
 - Influence exist where there is interaction
 - Influence is the result of content generation and content propagation

Influence Metrics

- Indegree: count of interactions from neighbours of node to it. Higher indegree means being more influenced

$$D_i(v) = \sum_{w \in S} \bar{e}(w, v)$$
- Outdegree: count of interactions from a node to its neighbours. Higher outdegree means being more influential (high outdegree with low indegree shows spamming)

$$D_o(v) = \sum_{w \in S} \bar{e}(v, w)$$
- Link strength: count of two-way interactions between a node and its neighbours. High link strength means more influence

$$R(w, v) = \frac{|\bar{e}(w, v)| + |\bar{e}(v, w)|}{D_o(w) + D_o(v)}$$
- In-Cluster: count of connections to by clusters. High in-cluster means more influence

$$C_i(v) = \frac{\sum_{w \in S} D_i(w)}{D_i(v) * (D_i(v) - 1)}$$
- Out-Cluster: Count of connections to clusters. Higher out-cluster means more influence

$$C_o(v) = \frac{\sum_{w \in S} D_o(w)}{D_o(v) * (D_o(v) - 1)}$$

Influence Values

- Influencing others is calculated by

$$Influencer(v) = \lceil \tanh(D_o(v)) \rceil * (\alpha_1 D_o(v) + \alpha_2 C_o(v)) * \sum_{t \in S} R(w, v)$$
- Being influenced is calculated by

$$Influenced(v) = \lceil \tanh(D_i(v)) \rceil * (\alpha_3 D_i(v) + \alpha_4 C_i(v)) * \sum_{t \in S} R(w, v)$$

Values for Businesses

- Improving advertisement campaigns by leveraging social networks
- Targeting only influentials helps the word being spread in the network as influentials influence others in their decisions
- Help in choosing the right type of social network for running the campaign

Influence Propagation & YouTube

- YouTube is the largest video sharing website: contains 43% of videos found on the Web
- YouTube is a social network
- YouTube defines friend and follower relationships in the same environment

Data Collection

- Crawled YouTube in a snowball sampling method
- Extracted friend and subscriber interactions in separate datasets
- Defined commenting can favoriting activities as sign of propagation
- Limitation: YouTube does not keep track of more than 7500 comments for each video
- Tackled by: separately analyzing a smaller dataset of videos with less than 7500 comments

Data Description	Friendship	Subscription
#Users	8,984	9,633
#Videos	113,562	332,296
#Friendship Links	8,986	40,358
Depth	5 hops	5 hops
Average Degree	2	7
Most # of Friends	26	103

Propagation Magnitude

- Only 133 thousand (out of 16.4 million) comments were from friends or their networks (reduction rate of 98.76%)

Propagation Magnitude	#Videos	%Propagated Videos	%Total Videos
1 hop	1289	96.84%	1.14%
2 hop	40	3.00%	0.04%
3 hop	2	0.16%	0.01%

- Only 27 thousand comments were from followers or their networks (reduction rate of 99.93%)

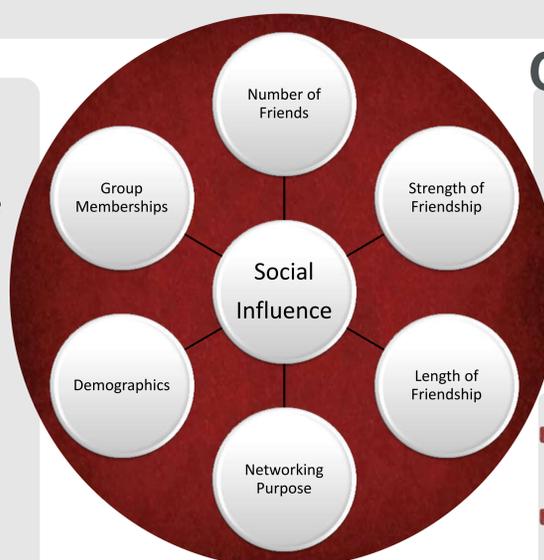
Propagation Magnitude	#Videos	%Propagated Videos	%Total Videos
1 hop	269	96.76%	0.88%
2 hop	9	3.24%	0.03%

Conclusions

- Propagation effects of people who are neither friends nor subscribers is more than friends or subscribers
- Lower propagation by subscribers than friends
- A few active users have the largest affect on propagation
- There is a low correlation between popularity and propagation in general

References

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Factors affecting influence