Social and Information Networks

Tutorial #7: Invocation in Online Political Interaction

University of Toronto CSC303
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Week 8: Mar 8-12 (2021)

Today's agenda

In lecture we've covered Chapter 19 of the textbook looking at Influence maximization, and we looked at the spread of news in Twitter.

Today:

- Questions from Lecture
- Invocation Graph
- Analysis of various trends
- Quercus Quiz

Questions?

Invocation Graph

- In class we saw how the transmission of news through twitter can be framed as being transmitted through a directed social graph of Twitter followers-followees
- Previously, we looked at representing connected information on the internet by represented webpages as nodes, and hyperlinks as edges
- Today we will be looking at a new graph introduced by Raghaven et al. (`https://arxiv.org/abs/1802.09597`) that combines aspects of both, the Invocation Graph

Invocation Graph: Definition

- In the Invocation Graph our set of vertices V represent *domains* (i.e. sources) that produces articles (e.g. The New York Times, Breitbart, etc...)
- For any two domains (e.g. $NYT, BB \in V$), we have an edges (BB, NYT) if a Twitter user replied to a tweet containing a NYT link with a BB link
  - i.e. A Twitter user has invoked BB in response to NYT
- Edges are weighted with the number of such invocations

[From Raghaven et al.]

Invocation Graph: Differences

- How does the invocation graph compare to the information graph of webpages connected by hyperlinks?

Invocation Graph: Differences

- How does the invocation graph compare to the information graph of webpages connected by hyperlinks?
- Much like hyperlinks these edges represent connected material
- Unlike hyperlinks, these connections are produced by readers rather than users
- The connection can be supportive, or adversarial
  - Adversarial connections demonstrate active processing of other viewpoints
- Additionally, the exact resources are abstracted away, leaving only interactions between related sources rather than individual webpages

Invocation Graph: Analysis

- To study the differences between right and left leaning domains in the months leading to the 2016 US election, Raghaven et al. weigh each domain (i.e. node) with the following political score:

$$s_T(x) = \frac{P_T(x|T)}{P_T(x|T) + P_T(x|C)}$$

- In the definition above, x is a domain, $P_T(x|T)$ is the empirical probability that a Twitter user tweets a URL from x the same day as they retweet Trump's official account, and $P_T(x|C)$ is the corresponding probability for Clinton's official account
- Thus $s_T(x) \in [0, 1]$, with higher values indicating support of Trump

Invocation Graph: Analysis

$$s_T(x) = \frac{P_T(x|T)}{P_T(x|T) + P_T(x|C)}$$

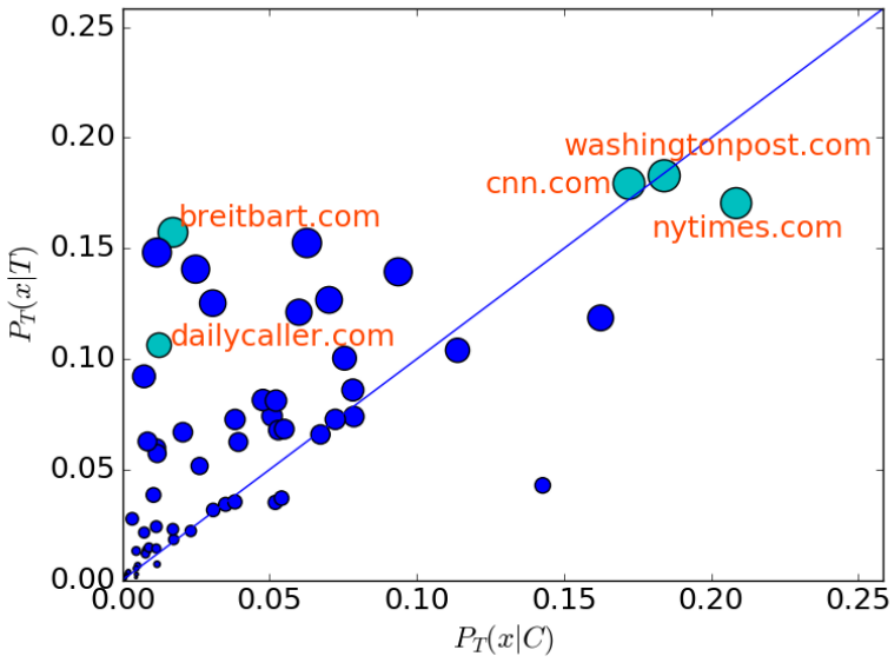

Figure 2: $P_T(x|C)$ vs. $P_T(x|T)$ for September 2016

[From Raghaven et al.]

Invocation Graph: Analyzing Outlinks

- With our political score, it is reasonable to suppose that edges between domains with similar scores are supportive, and edges between domains with very different scores are adversarial
- Question: For this reason, we'd like to know the typical political affiliation of the websites that a domain x is used to respond to. What could we use?

Invocation Graph: Analyzing Outlinks

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$$\mu_{out}(x) := \mathbb{E}[d_{out}(x, G)]$$

- Where $d_{out}(x, G)$ is the empiric distribution of political affiliation of outlinks of the node x in G.

Invocation Graph: Analyzing Outlinks

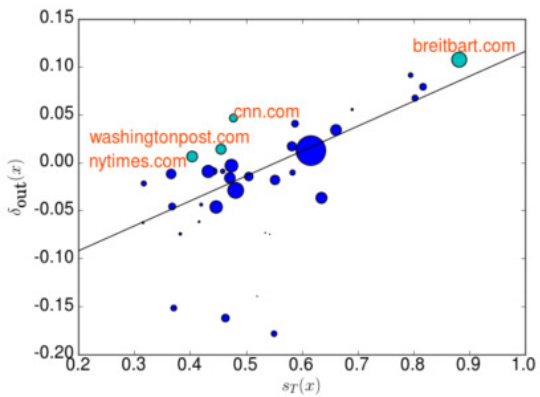
- For comparison, the authors compute $\mu_{out}(G \setminus x)$, a similar average for the interaction network with the domain x removed
- With this, they define the tendency of being used to respond to more Trump-affiliated links as

$$\delta_{out}(x) = \mu_{out}(x) - \mu_{out}(G \setminus x)$$

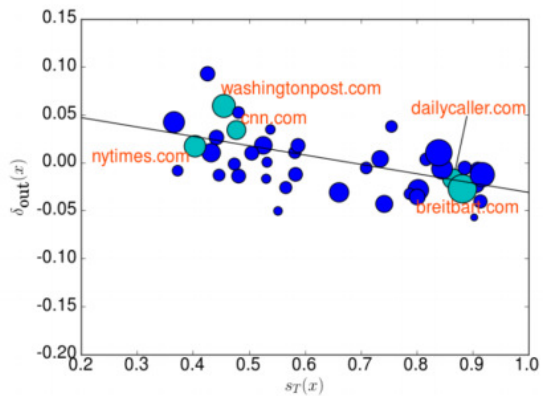
- Question What would it mean if $s_T(x)$ is correlated with $\delta_{out}(x)$? Does this seem likely?

Invocation Graph: Analyzing Outlinks

- Homophily would suggest a positive correlation
- The authors found that the correlation was initially positive, but transitioned to negative as the year progressed
- As the year progressed the amount of interaction across the political spectrum increased



(a) January 2016



(b) October 2016

Figure 3: Correlation between $s_T(x)$ and $\delta_{\text{out}}(x)$ for January and October

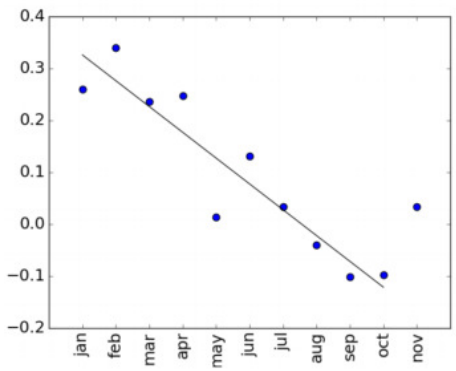


Figure 4: $a(G)$ for January-November

[From Raghaven et al.]

Quercus Quiz