

Measuring the Impact of Bot Accounts on Political Network Polarization

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Abstract

Social media platforms have been facing public criticism about their handling (monetizing) of online public sphere. Recent literature provides indubitable evidence of software-controlled accounts (a.k.a bots) being involved in political propaganda, trolling, voter disenfranchisement, and augmentation of the spread of negative, inflammatory, or misinforming content. In this work, we study their effect through the lens of political network polarization and quantify the network polarization change induced by bots. We study one month of Twitter activity data relating to gun debate and the tragic Stoneman Douglas High School shooting incident. The retweet network under study contains 3,282,592 nodes and 16,086,168 edges. We set up experiments and randomized controls to measure the change of network polarization due to the bot account activity.

For quantifying network polarization, we modify an existing random walk based controversy score for cases where political orientation of users is available a priori. For obtaining political orientation we use a simple left-right scale and place social media users on this scale based on news domains they share. We crawl political scale of left and right for news domains from a third party crowd-source platform. For users not sharing any content from the curated list of 1,241 news domains, we adopt a label propagation algorithm achieving above 97% accuracy and 95% F1-macro scores with 10 fold cross-validation. For bot detection, we register to Botometer API of Indiana University. Out of 260,813 queried accounts we observe 24,936 (10%) bot accounts.

First, we stress our experimental design with synthetically generated networks. As a generative model of polarized political retweet networks, we modify an existing directed scale-free graph model with political preference variables over nodes. First, we show that the polarization metric is robust to the size of network and presents a strong correlation with the political preference strength parameter (δ) of our model. Then, we show that random removals from these synthetic networks do not affect the polarization score of them.

Basing ourselves on the aforementioned robustness of our metric, we analyze the effect of removing bot accounts from the retweet (endorsement) network on Twitter. We show that removing bot accounts from the retweet network significantly reduces the distribution of polarization score ($p = 3.11e - 6$). As a sanity check we also randomly remove number of users equal to bot accounts from the network and see no significant change in the distribution of polarization score ($p = 0.2575$). Furthermore, we analyze hashtag-level network polarization and the change by removing bot accounts at that granularity. We build the retweet network of 100 most popular hashtags in our dataset. 63 of them experience decreased polarization when bot accounts are removed. 10 of them show no change in the distribution, and the rest shows increased polarization. We compare and contrast the content generated (e.g. sentiment cues, news domains) by bot accounts in these three cases. Our results provide a strong evidence of the role of bot accounts in creating more polarized endorsement networks.

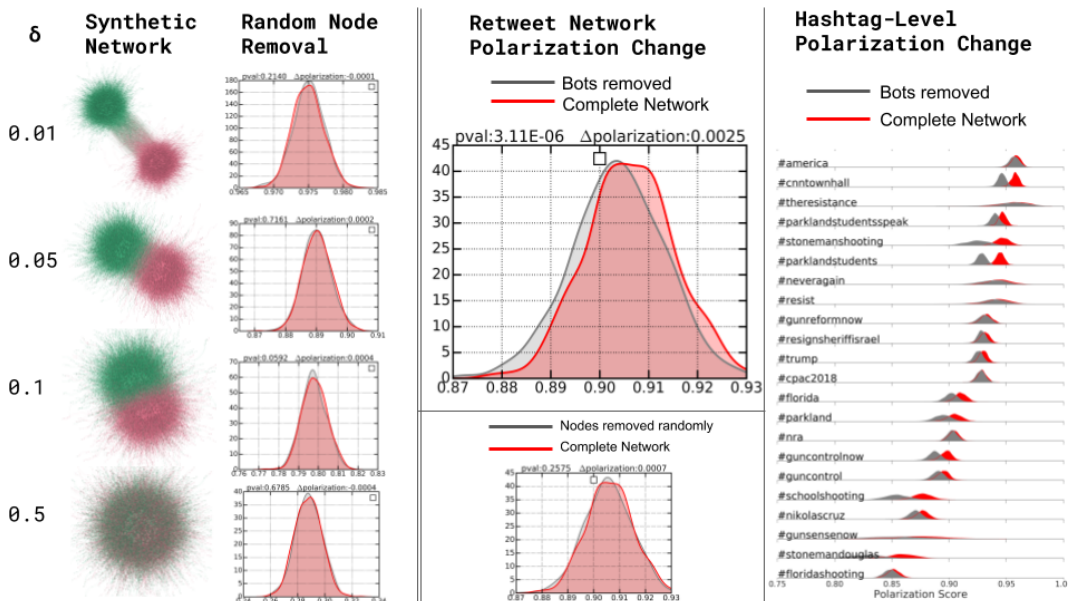


Fig. 1. On the left, We check the accuracy of the proposed polarization metric and its robustness to random node removals on various synthetically generated datasets. On the right, we show the network polarization decrease when bot accounts removed from Twitter on both holistic and hashtag levels.