



Aalto University
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Reducing controversy by connecting opposing views

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NIPS workshop on prioritising online content

Dec 9, 2017

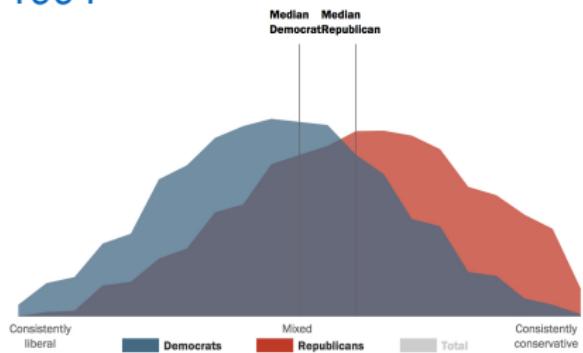
social media are changing our society



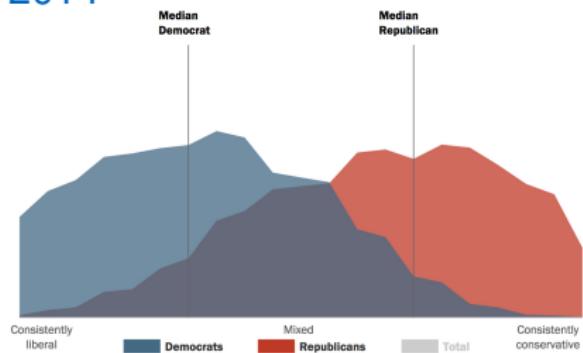
- + content democratization and easy access to information
- harassment, fake news, echo chambers, polarization, ...

polarization in US politics

1994

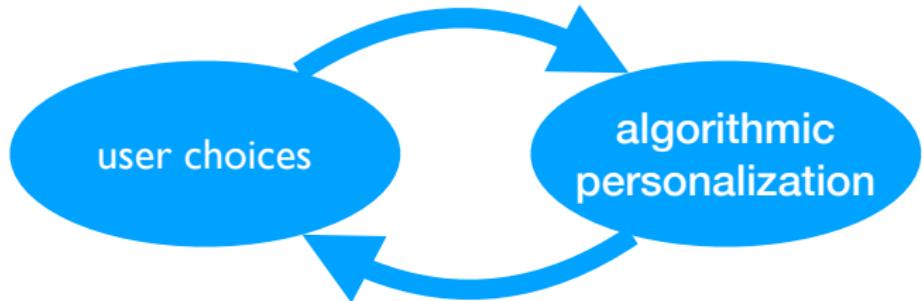


2014



PEW RESEARCH CENTER

the polarization cycle



related to the **filter bubble** and **echo chamber**

research questions

- can we identify polarized discussions in social media?

[Garimella et al., WSDM, 2016]

- can we design algorithms to help reduce polarization?

[Garimella et al., WSDM, 2017]

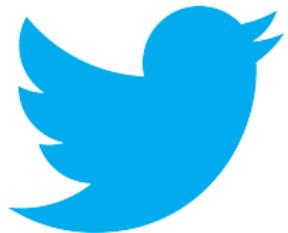
research question

identify and quantify polarization

K. Garimella, G. De Francisci Morales, A. Gionis, M. Mathioudakis, "*Quantifying controversy in social media*", ACM WSDM 2016

focus on twitter

- microblogging platform
 - launched in 2006
 - 300 million active users
- users post short messages — tweets





Tweets
36.2K

Following
45

Followers
40.9M

tweet

retweets

replies

connections



Donald J. Trump
@realDonaldTrump

Follow

My daughter Ivanka has been treated so unfairly by @Nordstrom. She is a great person -- always pushing me to do the right thing! Terrible!

4:51 PM - 8 Feb 2017

26,901 Retweets 140,751 Likes



95K

27K

141K



Tweet your reply



Tim Guinee
@TimGuinee - Feb 8
Replying to @realDonaldTrump

Surely @realDonaldTrump using his office to make money for his family is an ethics violation



Donald J. Trump
@realDonaldTrump

My daughter Ivanka has been treated so unfairly by @Nordstrom. She is a great person -- always pushing me to do the right thing! Terrible!

80

168

1.4K



(((*))) @missyk - Feb 9

neither @SenateMajLdr or @SpeakerRyan gives a crap, they only care if a Democrat sneezes in the wrong direction!

5

13

248



Tim Guinee
@TimGuinee - Feb 9

Mindboggling thievery justified by entitlement, false victimization and racism.



Heidi Blackburn @Blackbur14Heidi - Feb 11

I love President Donald Trump. What we have are adults that are acting like 2 year olds. Which is 😢 sad.!!

17

3

48



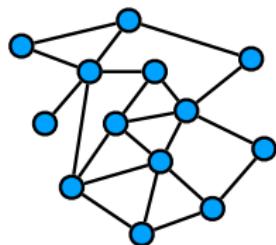
how can we identify polarization ?

ideas

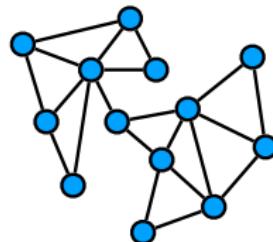
- content
 - do opposing sides say different things ?
- sentiment
 - do polarized topics exhibit wider range of emotions ?
- interactions
 - do people interact more with their own side ?

method template

- build an interaction graph
 - try several types
 - retweets, replies, connections
- is the interaction graph polarized?
- output polarization score

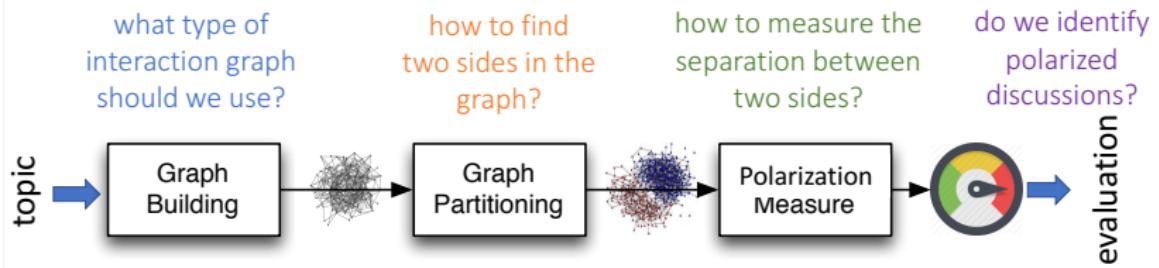


non polarized

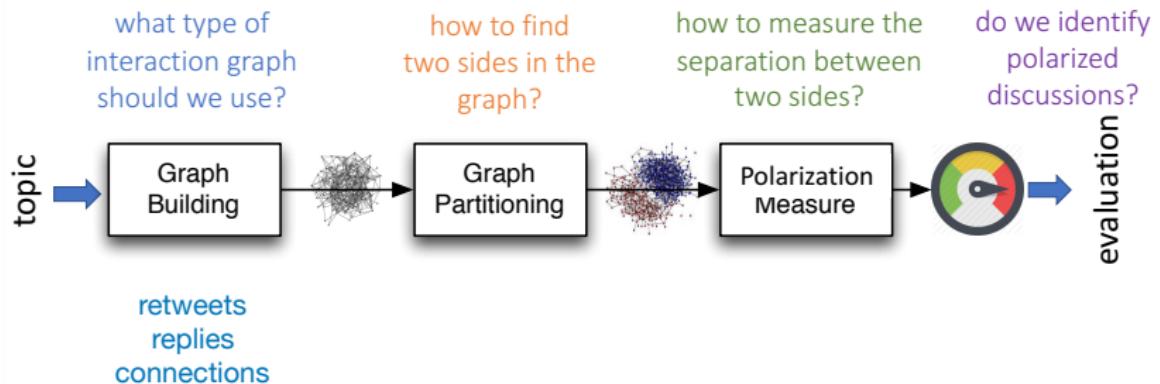


polarized
two sides well separated

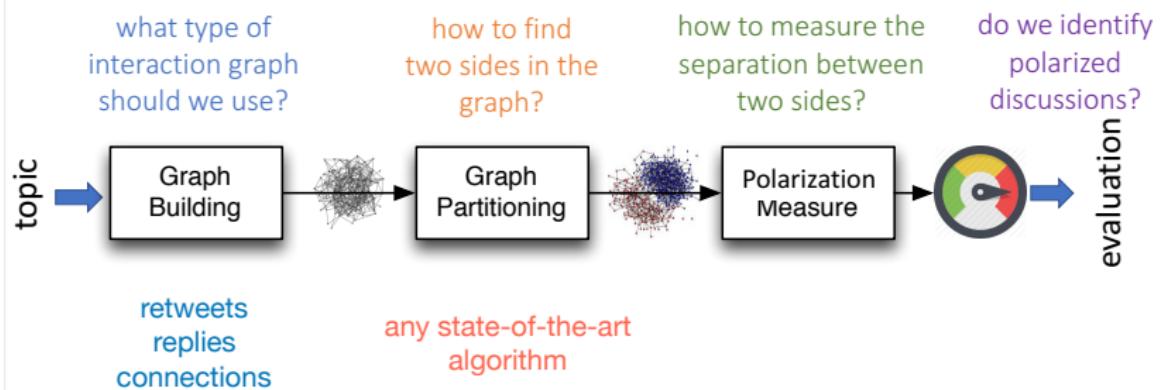
pipeline



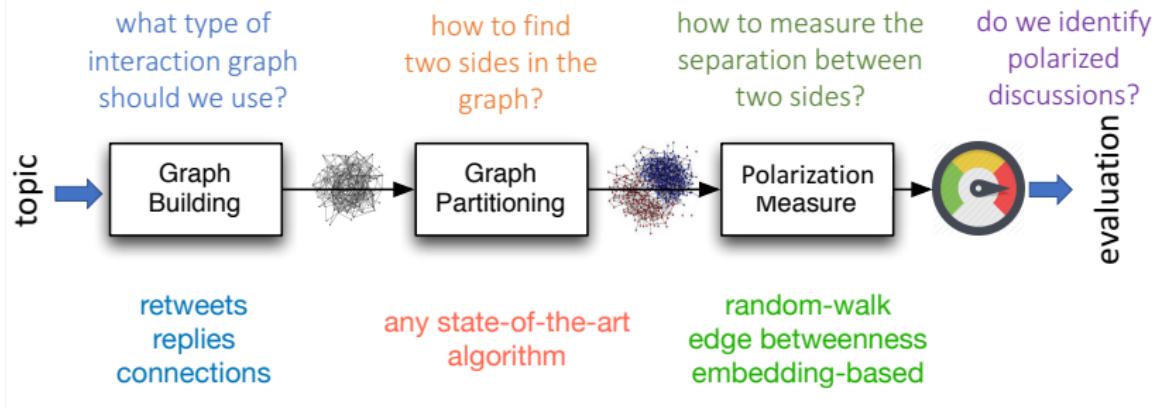
pipeline



pipeline



pipeline



random-walk controversy score (RWC)

- assume graph is partitioned in two sides, A and B
- consider a random walk that started at a random node and finished in a hub in $Y \in \{A, B\}$
- probability that random walk started in $X \in \{A, B\}$

$$P_{XY} = \Pr(\text{r.w. started in } X \mid \text{r.w. finished in } Y)$$

- random-walk controversy score (RWC)

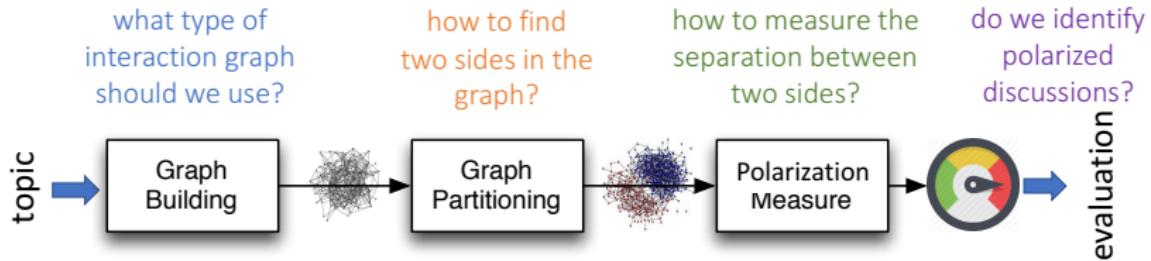
$$\text{RWC} = P_{AA}P_{BB} - P_{AB}P_{BA}$$

does not depend on cluster sizes and relative in-degrees

evaluation

- annotate **polarized** and **non-polarized** topics
- **polarized**
 - indian beefban, nemtsov protests, netanyahu US congress speech, baltimore riots, ukraine
- **non-polarized**
 - germanwings plane crash, sxsw, mother's day, jurassic world movie, national kissing day
- evaluate different settings on ground truth

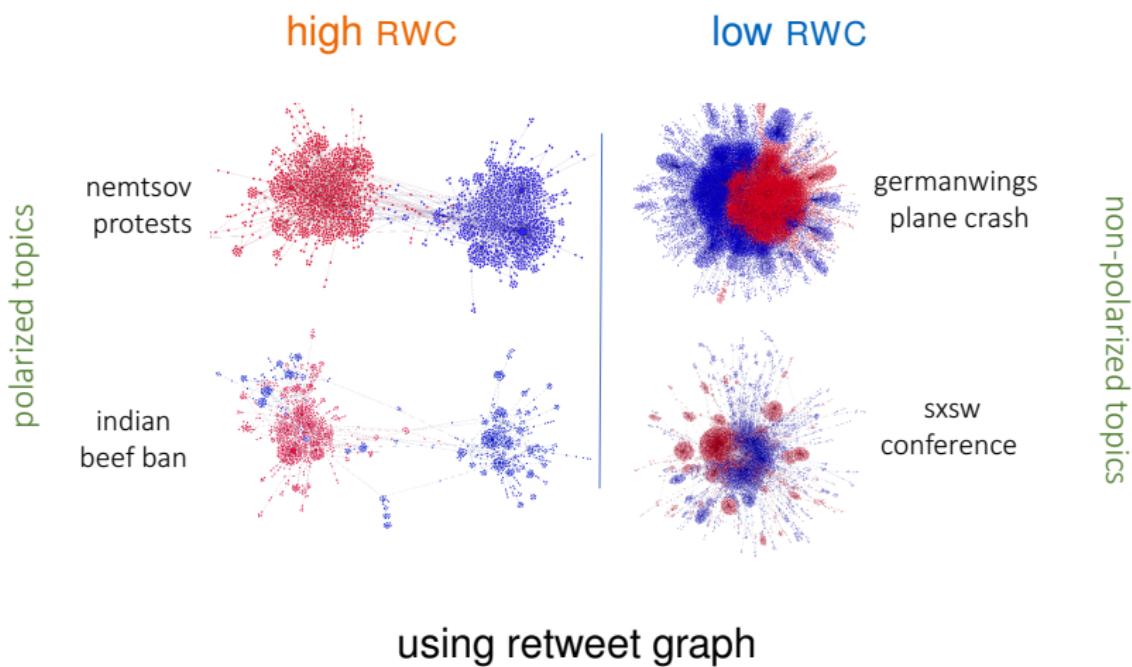
best performing setting



- retweet graph
- RWC

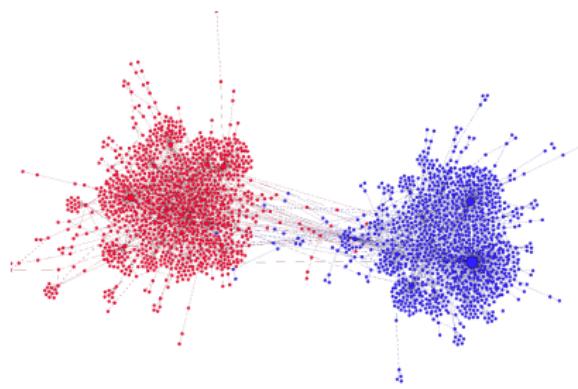
other good settings: edge betweenness score
sentiment variance

example of results

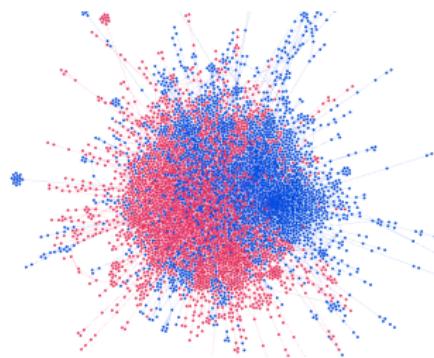


example of results

nemtsov protests



retweets



replies

research question

design algorithms to help reduce polarization

K. Garimella, G. De Francisci Morales, A. Gionis, M. Mathioudakis, *“Reducing controversy by connecting opposing views”*, ACM WSDM 2017

reducing polarization

how can we bridge the divide?

- assuming
 - polarization score measured by RWC
- we want to **reduce RWC**
- problem
 - add k edges that **maximally reduce RWC**

reducing polarization

- greedy algorithm
 - find the single best edge to reduce RWC
 - repeat k times
- inefficient
 - computing RWC requires $\mathcal{O}(\text{MMULT}(n))$
faster in practice with iterative computation
 - still, greedy requires $\mathcal{O}(n^2 \cdot k \cdot \text{MMULT}(n))$
- improvements
 - consider adding edges only between hubs
 - incremental RWC computation using
Sherman-Morrison formula

reducing polarization

- what does it mean “add k edges”?
- answer: recommendations
- but many recommendations are unlikely to be materialized
 - no point recommending D. Trump to retweet H. Clinton
- incorporate probability of accepting a recommendation
 - compute user polarity, and
 - acceptance probability as a function of user polarity

reducing polarization : real example



Christopher Waterson

@adizzle03

Animal lover. Second Amendment Originalist. Dad. Husband. Christian. Unapologetic @POTUS Trump Supporter. Snowflake hater. #MAGA

📍 New Jersey, USA

📅 Joined March 2010

polarity=-.99



((ImpeachTheCon))

@arquitetinha

Architecture | Innovation | Futurist | Fight apocalypse, lies & Idiocracy | Punch Nazis, Block Rt-Wng Nut-jobs & Drumpf zombie-cult-puppets | 2-state ☩ | ENFP

📍 New York, USA [also IL | BR]

📅 Joined September 2015

polarity=.95

reducing polarization : real example



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Snowflake hater. #MAGA

📍 New Jersey, USA

📅 Joined March 2010

polarity=-.99



Caitlin Frazier 

@CaitlinFrazier

audience @TheAtlantic, Episcopalian,
Sooner, said to be made of purple,
caitlinfrazier.com

📍 Washington DC

🔗 theatlantic.com

📅 Joined February 2010

polarity=.15

reducing polarization : results

		obamacare		guncontrol	
		node1	node2	node1	node2
ROV	mittromney		barackobama	ghostpanther	barackobama
	realdonaldtrump		truthteam2012	mmflint	robdelaney
	barackobama		drudge_report	miafarow	chuckwoolery
	barackobama		paulryanvp	realalexjones	barackobama
	michelebachmann		barackobama	goldiehawn	jedediahbila
ROV-AP	kksheld		ezraklein	chuckwoolery	csgv
	lolgop		romneyresponse	liamkfisher	miafarow
	irritatedwoman		motherjones	csgv	dloesch
	hcan		romneyresponse	jonlovett	spreadbutter
	klsouth		dennisdzm	drmartyfox	huffpostpol

conclusions

- **summary**
 - introduced a new score for quantifying controversy
 - studied problem of reducing controversy
- **future work**
 - incorporate language
 - extend to multiple-side controversies
 - go beyond twitter

thank you!

credits



Kiran
Garimella



Gianmarco
De Francisci Morales



Michael
Mathioudakis