Rejecting the Null Hypothesis of Apathetic Retweeting of US Politicians and SPLC-defined Hate Groups in the 2016 US Presidential Election

Raazesh Sainudiin, Uppsala University / Combient AB

#SAISDS7
Rejecting the null hypothesis of apathetic retweeting of US politicians and SPLC-defined hate groups in the 2016 US Presidential election

Raazesh Sainudiin

Researcher, Department of Mathematics
Uppsala University, Uppsala, Sweden, and
Data Science Consultant, Combient AB, Stockholm


Joint with: Yogeeswaran, Nash and Sahioun, Dept. of Psychology, Univ of Canterbury, Christchurch, NZ
And contributors of Project MEP: Meme Evolution Programme:
Akinwande Atanda, Ivan Sadikov, Joakim Johansson, Mattias Gardell, Alma Kirlic, Olof Björck, Gabriel Unesi

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Questions and Experimental Design

Data and Statistics
  - Experimental design of twitter streams

Models and Methods

Results
Three Questions

(Q1) Is Trump preferentially retweeted by various types of hate groups or their leadership relative to other politicians (i.e., Clinton, Sanders, Cruz, or Ryan) against the null random network model of apathetic retweeting?
Three Questions

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- (Q2) What frequency of unique users retweeted both a politician and a hate group or its leadership more than expected under the null model?
Three Questions

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- (Q2) What frequency of unique users retweeted both a politician and a hate group or its leadership more than expected under the null model?
- (Q3) What is the joint distribution of the *degrees of separation* to each user from each of the five politicians and the eight most prolific hateful ideologies on Twitter, measured through the lengths of the most retweeted directed paths in the observed network?
Three Questions

- (Q1) Is Trump preferentially retweeted by various types of hate groups or their leadership relative to other politicians (i.e., Clinton, Sanders, Cruz, or Ryan) against the null random network model of apathetic retweeting?
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- (Q4) Did the US Hate Networks get help from “Russian Trolls”? — back to basics in the “Big Data” Age – Scientific Hypothesis Testing
Twitterverse

twitter is a micro-blogging service...
What is a tweet? retweet? reply-tweet, etc. (*status updates*)

Via public streams and REST APIs we collected ~22M status updates related to 5 politicians and 52 hate groups
(retrospective REST-based network augmentations).

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Definition (Hate Group):

The SPLC does not necessarily consider all groups or individuals on its “Extremist Files” as violent or engaged in criminal activities, but rather identifies any group or individual “whose beliefs or practices attack or malign an entire class of people, typically for their immutable characteristics”.

The database does not include foreign hate groups or extremist groups such as ISIS, Al Qaeda, or Boko Haram, as its focus is on American hate groups.

US Hate Groups by SPLC https://www.splcenter.org/fighting-hate/extremist-files

ACTIVE HATE GROUPS in the United States in 2015

https://www.splcenter.org/hate-map
US Hate Groups by SPLC [https://www.splcenter.org/fighting-hate/extremist-files](https://www.splcenter.org/fighting-hate/extremist-files)

ABOUT THE HATE MAP

All hate groups have beliefs or practices that attack or malign an entire class of people, typically for their immutable characteristics.

This list was compiled using hate group publications and websites, citizen and law enforcement reports, field sources and news reports. Groups that appear in the center of states represent statewide groups.

Hate group activities can include criminal acts, marches, rallies, speeches, meetings, leafleting or publishing.

[https://www.splcenter.org/hate-map](https://www.splcenter.org/hate-map)
US Hate Groups by SPLC
https://www.splcenter.org/fighting-hate/extremist-files

HATE GROUPS 1999-2015

https://www.splcenter.org/hate-map
18 US Hateful Ideologies by SPLC

https://www.splcenter.org/fighting-hate/extremist-files

Alternative Right
The Alternative Right, commonly known as the Alt-Right, is a set of far-right ideologies, groups and individuals whose core belief is that “white identity” is under attack by multicultural forces using “political correctness” and “social justice” to undermine white people and “their” civilization.

Anti-Immigrant
Anti-immigrant hate groups are the most extreme of the hundreds of nativist and vigilante groups that have proliferated since the late 1990s, when anti-immigration xenophobia began to rise to levels not seen in the United States since the 1920s.

Anti-LGBT
Opposition to equal rights for LGBT people has been a central theme of Christian Right organizing and fundraising for the past three decades – a period that parallels the fundamentalist movement’s rise to political power.

https://www.splcenter.org/fighting-hate/extremist-files/ideology
18 US Hateful Ideologies by SPLC

https://www.splcenter.org/fighting-hate/extremist-files

**Anti-Muslim**

Anti-Muslim hate groups are a relatively new phenomenon in the United States, most of them appearing in the aftermath of the World Trade Center terrorist attacks on Sept. 11, 2001. Earlier anti-Muslim groups tended to be religious in orientation and disputed Islam's status as a respectable religion.

**Antigovernment Movement**

The antigovernment movement has experienced a resurgence, growing quickly since 2008, when President Obama was elected to office. Factors fueling the antigovernment movement in recent years include changing demographics driven by immigration, the struggling economy and the election of the first...

**Black Separatist**

Black separatists typically oppose integration and racial intermarriage, and they want separate institutions -- or even a separate nation -- for blacks. Most forms of black separatism are strongly anti-white and anti-Semitic, and a number of religious versions assert that blacks are the Biblical...
18 US Hateful Ideologies by SPLC

https://www.splcenter.org/fighting-hate/extremist-files

Christian Identity
Christian Identity is a unique anti-Semitic and racist theology that rose to a position of commanding influence on the racist right in the 1980s. “Christian” in name only, the movement’s relationship with evangelicals and fundamentalists has generally been hostile due to the latter’s belief that...

General Hate
These groups espouse a variety of rather unique hateful doctrines and beliefs that are not easily categorized. Many of the groups are vendors that sell a miscellany of hate materials from several different sectors of the white supremacist movement.

Holocaust Denial
Deniers of the Holocaust, the systematic murder of around 6 million Jews in World War II, either deny that such a genocide took place or minimize its extent. These groups (and individuals) often cloak themselves in the sober language of serious scholarship, call themselves “historical revisionists...”

https://www.splcenter.org/fighting-hate/extremist-files/ideology
18 US Hateful Ideologies by SPLC

https://www.splcenter.org/fighting-hate/extremist-files

Ku Klux Klan
The Ku Klux Klan, with its long history of violence, is the most infamous — and oldest — of American hate groups. Although black Americans have typically been the Klan’s primary target, it also has attacked Jews, immigrants, gays and lesbians and, until recently, Catholics.

Neo-Confederate
The term neo-Confederacy is used to describe twentieth and twenty-first century revivals of pro-Confederate sentiment in the United States. Strongly nativist, neo-Confederacy claims to pursue Christianity and heritage and other supposedly fundamental values that modern Americans are seen to have...

Neo-Nazi
Neo-Nazi groups share a hatred for Jews and a love for Adolf Hitler and Nazi Germany. While they also hate other minorities, gays and lesbians and even sometimes Christians, they perceive “the Jew” as their cardinal enemy.

https://www.splcenter.org/fighting-hate/extremist-files/ideology
18 US Hateful Ideologies by SPLC

https://www.splcenter.org/fighting-hate/extremist-files

- **Phineas Priesthood**
  The Phineas Priesthood is not an actual organization; it has no leaders, meetings, or any other institutional apparatus.

- **Racist Music**
  Racist music groups are typically white power music labels that record, publish and distribute racist music in a variety of genres.

- **Racist Skinhead**
  Racist Skinheads form a particularly violent element of the white supremacist movement, and have often been referred to as the “shock troops” of the hoped-for revolution. The classic Skinhead look is a shaved head, black Doc Martens boots, jeans with suspenders and an array of typically racist...

https://www.splcenter.org/fighting-hate/extremist-files/ideology
18 US Hateful Ideologies by SPLC

[Link to SPLC page]

**Radical Traditional Catholicism**

“Radical traditionalist” Catholics, who may make up the largest single group of serious anti-Semites in America, subscribe to an ideology that is rejected by the Vatican and some 70 million mainstream American Catholics.

**Sovereign Citizens Movement**

The strange subculture of the sovereign citizens movement, whose adherents hold truly bizarre, complex antigovernment beliefs, has been growing at a fast pace since the late 2000s. Sovereigns believe that they get to decide which laws to obey and which to ignore, and they don’t think they should...

**White Nationalist**

White nationalist groups espouse white supremacist or white separatist ideologies, often focusing on the alleged inferiority of nonwhites. Groups listed in a variety of other categories - Ku Klux Klan, neo-Confederate, neo-Nazi, racist skinhead, and Christian Identity - could also be fairly...

[Link to SPLC page for ideology category]
US Presidential Election 2016 - Twitter Streams

Twitter Data — 3rd US Presidential Debate

Streaming Statistics
Running batches of 5 minutes for 6 hours 32 minutes 20 seconds since 2016/10/19 23:26:43 | 162 completed batches, 972542 records

Twitter Data — Last 2 Days Around the End of Election

Streaming Statistics
Running batches of 5 minutes for 1 day 22 hours 56 minutes since 2016/11/08 22:02:36 | 563 completed batches, 2041501 records

- public streams of @realDonaldTrump, @HillaryClinton, @BernieSanders, @tedcruz, SpeakerRyan and 52 spc-defined hategroups of their leadership
- collected data includes all mentions, replies, retweets, etc of these twitter accounts of interest for about 9 weeks around the 2016 US Presidential Election

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12 SPLC-defined hateful ideologies

- only 78% of hate groups identified by SPLC were active in Twitter
5 prominent Politicians in the USA

<table>
<thead>
<tr>
<th>Politician</th>
<th>in-degree</th>
<th>in-nbhd</th>
<th>out-degree</th>
<th>out-nbhd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Donald Trump</td>
<td>40</td>
<td>12</td>
<td>5,952,257</td>
<td>958,262</td>
</tr>
<tr>
<td>Hillary Clinton</td>
<td>225</td>
<td>121</td>
<td>2,774,111</td>
<td>943,995</td>
</tr>
<tr>
<td>Bernie Sanders</td>
<td>107</td>
<td>62</td>
<td>762,209</td>
<td>356,718</td>
</tr>
<tr>
<td>Paul Ryan</td>
<td>769</td>
<td>158</td>
<td>68,973</td>
<td>28,902</td>
</tr>
<tr>
<td>Ted Cruz</td>
<td>322</td>
<td>189</td>
<td>49,479</td>
<td>27,663</td>
</tr>
</tbody>
</table>
Dataset overview

Data collected around the 2016 US Presidential Election

- data = 2.7M tweets, 13.7M retweets, 22M status updates
Data collected around the 2016 US Presidential Election

- data = 2.7M tweets, 13.7M retweets, 22M status updates
- 4.4M distinct retweet-pairs: (original-Tweeter, Retweeter)
Data collected around the 2016 US Presidential Election

- data = 2.7M tweets, 13.7M retweets, 22M status updates
- 4.4M distinct retweet-pairs: (original-Tweeter, Retweeter)
- 2.5M unique users
SparkSQL: Twitter Experimental Designs via parquet single-column JSON string of each status update as one row
  - future-proofing evolving schema
  - input to generic SparkML pipelines

GraphX: Pregel-programmed Network Design
SparkML/lib: various standard algorithms
Spark Core: distributed sort and join

### Trump-Clinton Retweet Network — a few samples

<table>
<thead>
<tr>
<th>Retweeter</th>
<th>Original Tweet</th>
<th>Follows</th>
<th>Favourrts</th>
<th>Friends</th>
<th>Retweet</th>
<th>Retweet Enabled</th>
<th>Current Tweet</th>
</tr>
</thead>
<tbody>
<tr>
<td>@realDonaldTrump</td>
<td>China is cooking up conspiracy theories that the Olympics are rigged. <a href="Http://t.co/blankButTheyDontUnderstandWhy">Http://t.co/blankButTheyDontUnderstandWhy</a>...</td>
<td>null</td>
<td>137811</td>
<td>1468</td>
<td>true</td>
<td>false</td>
<td>RT  @realDonaldTrump: China is cooking up conspiracy theories that the Olympics are rigged. <a href="Http://t.co/blankButTheyDontUnderstandWhy">Http://t.co/blankButTheyDontUnderstandWhy</a>...</td>
</tr>
<tr>
<td>@realDonaldTrump</td>
<td>EXCLUSIVE: FBI Agents Say Comey 'Stood In The Way' Of Clinton Email Investigation <a href="Http://t.co/dx3BhIrVuAp">Http://t.co/dx3BhIrVuAp</a></td>
<td>null</td>
<td>16164</td>
<td>505</td>
<td>false</td>
<td>true</td>
<td>RT  @realDonaldTrump: EXCLUSIVE: FBI Agents Say Comey 'Stood In The Way' Of Clinton Email Investigation <a href="Http://t.co/dx3BhIrVuAp">Http://t.co/dx3BhIrVuAp</a></td>
</tr>
<tr>
<td>@HillaryClinton</td>
<td>Trump rally disruptor was once on Clinton's payroll <a href="Http://t.co/7WQLu0b46i">Http://t.co/7WQLu0b46i</a></td>
<td>null</td>
<td>13081</td>
<td>128</td>
<td>false</td>
<td>true</td>
<td>RT  @HillaryClinton: Trump rally disruptor was once on Clinton's payroll <a href="Http://t.co/7WQLu0b46i">Http://t.co/7WQLu0b46i</a></td>
</tr>
<tr>
<td>@HillaryClinton</td>
<td>Our progress is on the ballot. Tolerance is on the ballot. Democracy is on the ballot. Make a plan to vote...</td>
<td>null</td>
<td>6316</td>
<td>101</td>
<td>false</td>
<td>true</td>
<td>RT  @HillaryClinton: Our progress is on the ballot. Tolerance is on the ballot. Democracy is on the ballot. Make a plan to vote...</td>
</tr>
</tbody>
</table>
Retweet Network — (3% sample \#V = 1205, \#E = 29856)

Trump-Clinton Retweet Network weighted by Retweet counts

<table>
<thead>
<tr>
<th>User</th>
<th>Retweet Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>UserA</td>
<td>1234</td>
</tr>
<tr>
<td>UserB</td>
<td>5678</td>
</tr>
<tr>
<td>UserC</td>
<td>9012</td>
</tr>
</tbody>
</table>
Retweet Network — (3% sample #V = 1205, #E = 29856)

Trump-Clinton Retweet Ideological Network

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Strong Community Structure – samples of retweet networks

The 3rd US Presidential Debate 22K Retweet Network
Strong Community Structure – samples of retweet networks

5% random sampled retweet networks for October 19 2016
Strong Community Structure – samples of retweet networks

5% random sampled retweet networks for October 19 2016 – top 10
Strong Community Structure — samples of retweet networks

5% random sampled retweet networks for October 24 2016
Strong Community Structure – samples of retweet networks

5% random sampled retweet networks for October 24 2016 – top 6
Strong Community Structure – samples of retweet networks

5% random sampled retweet networks for November 15 2016
Models for Ideological Network Dynamics

- If arc $a_{i,j} = 1$ then we say $i$ ideologically concurs with $j$

- Just two retweet networks out of 4, 722, 366, 482, 869, 645, 213, 696 for 9 individuals!
- We want indegree and outdegree conditioned random networks to preserve observed heterogeneity
- This is the classical random directed configuration model – $H_0$: apathetic retweet network
- NEED: distributed computing using Apache Spark (fastest growing Apache project)
7 SPLC-defined hateful ideologies Retweet Proportions

A significant proportion of retweets by leaders of seven extremist ideologies have original tweets in Trump's ideological cluster.

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Trump’s Hateful Retweeters

Hateful ReTweeters of @realDonaldTrump

\[ \log_2(\text{Number of ReTweets of @realDonaldTrump}) \]

\[ \log_2(\text{Number of Retweets of an epic defined hate group}) \]

Pearson = 0.17, p = 1.1e-32

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Clinton’s Hateful Retweeters

Hateful Retweeters of @HillaryClinton

pearson = 0.21, p = 0.0064

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Trump’s Hateful Retweeters By Ideology

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Clinton’s Hateful Retweeters By Ideology

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Chi-square tests – do NOT account for network heterogeneity

<table>
<thead>
<tr>
<th>Ideology</th>
<th>Donald J Trump</th>
<th>Hillary R Clinton</th>
<th>Chi-Square Statistic</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alt-Right</td>
<td>1127 (90.7%)</td>
<td>116 (9.3%)</td>
<td>$X^2 = 822.30, p &lt; .0001$</td>
<td>R² = 0.662</td>
</tr>
<tr>
<td>Anti-Government</td>
<td>1455 (89.5%)</td>
<td>171 (10.5%)</td>
<td>$X^2 = 1013.93, p &lt; .0001$</td>
<td>R² = 0.623</td>
</tr>
<tr>
<td>Anti-Immigrant</td>
<td>15019 (88.6%)</td>
<td>1926 (11.4%)</td>
<td>$X^2 = 10116.65, p &lt; .0001$</td>
<td>R² = 0.597</td>
</tr>
<tr>
<td>Anti-LGBT</td>
<td>1621 (88.6%)</td>
<td>209 (11.4%)</td>
<td>$X^2 = 1089.48, p &lt; .0001$</td>
<td>R² = 0.595</td>
</tr>
<tr>
<td>Anti-Muslim</td>
<td>2293 (90.8%)</td>
<td>233 (9.2%)</td>
<td>$X^2 = 1679.97, p &lt; .0001$</td>
<td>R² = 0.665</td>
</tr>
<tr>
<td>Black-Separatist</td>
<td>1279 (54.9%)</td>
<td>1049 (45.1%)</td>
<td>$X^2 = 22.72, p &lt; .01$</td>
<td>R² = 0.009</td>
</tr>
<tr>
<td>Neo-Nazi</td>
<td>1039 (90.7%)</td>
<td>106 (9.3%)</td>
<td>$X^2 = 760.25, p &lt; .0001$</td>
<td>R² = 0.664</td>
</tr>
<tr>
<td>White-Nationalist</td>
<td>5103 (89.2%)</td>
<td>616 (10.8%)</td>
<td>$X^2 = 3520.40, p &lt; .0001$</td>
<td>R² = 0.616</td>
</tr>
<tr>
<td>Total</td>
<td>28992 (86.5%)</td>
<td>4509 (13.5%)</td>
<td>$X^2 = 18006.72, p &lt; .0001$</td>
<td>R² = 0.540</td>
</tr>
</tbody>
</table>
**Chi-square tests – do NOT account for network heterogeneity**

Restricting to retweeters who retweet at least 4 times

<table>
<thead>
<tr>
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<th>Donald J Trump</th>
<th>Hillary R Clinton</th>
<th>Chi-Square Statistic</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alt-Right</td>
<td>936 (98.7%)</td>
<td>12 (1.3%)</td>
<td>$X^2 = 900.61, p &lt; .0001$</td>
<td>0.950</td>
</tr>
<tr>
<td>Anti-Government</td>
<td>1388 (98.4%)</td>
<td>23 (1.6%)</td>
<td>$X^2 = 1320.50, p &lt; .0001$</td>
<td>0.936</td>
</tr>
<tr>
<td>Anti-Immigrant</td>
<td>12618 (96.6%)</td>
<td>442 (3.4%)</td>
<td>$X^2 = 11351.84, p &lt; .0001$</td>
<td>0.869</td>
</tr>
<tr>
<td>Anti-LGBT</td>
<td>1110 (96.0%)</td>
<td>46 (4.0%)</td>
<td>$X^2 = 979.32, p &lt; .0001$</td>
<td>0.847</td>
</tr>
<tr>
<td>Anti-Muslim</td>
<td>1866 (98.8%)</td>
<td>22 (1.2%)</td>
<td>$X^2 = 1801.03, p &lt; .0001$</td>
<td>0.954</td>
</tr>
<tr>
<td>Black-Separatist</td>
<td>494 (62.5%)</td>
<td>296 (37.5%)</td>
<td>$X^2 = 49.63, p &lt; .001$</td>
<td>0.062</td>
</tr>
<tr>
<td>Neo-Nazi</td>
<td>692 (99.4%)</td>
<td>4 (0.6%)</td>
<td>$X^2 = 680.09, p &lt; .0001$</td>
<td>0.977</td>
</tr>
<tr>
<td>White-Nationalist</td>
<td>3751 (98.0%)</td>
<td>76 (2.0%)</td>
<td>$X^2 = 3529.04, p &lt; .0001$</td>
<td>0.922</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>22855 (96.1%)</td>
<td>921 (3.9%)</td>
<td>$X^2 = 20234.71, p &lt; .0001$</td>
<td>0.851</td>
</tr>
</tbody>
</table>

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Directed Retweet Edges as Two Columns

Multi-edged Self-looped Retweet Network

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Sample from Directed Multi-edged Self-looped Configuration Model

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Sample from Directed Multi-edged Self-looped Configuration Model

Step 1: Cut

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Sample from Directed Multi-edged Self-looped Configuration Model

This random permutation of row #'s of observed outbound half-edges is: (1, 2, 3, 4, 5, 6, 7) → (7, 6, 5, 4, 3, 2, 1)
Sample from Directed Multi-edged Self-looped Configuration Model

Step 1: Cut

Step 2: Permute

Step 3: Rewire

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Sample from Directed Multi-edged Self-looped Configuration Model

Thus, we can sample from the scalable fault-tolerant Cut-Permuate-Rewire algorithm

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Sample from Directed Multi-edged Self-looped Configuration Model

Thus, we can sample from the scalable fault-tolerant Cut-Permute-Rewire algorithm.

Note that every node in the sample network has the same number of in and out edges as that of the original network.
Sample from Directed Multi-edged Self-looped Configuration Model

Thus, we can sample from the scalable fault-tolerant Cut-Permute-Rewire algorithm

Note that every node in the sample network has the same number of in and out edges as that of the original network.

Question: What is the probability of the sample network?
Sample from Directed Multi-edged Self-looped Configuration Model

Thus, we can sample from the scalable fault-tolerant Cut-Permute-Rewire algorithm.

Note that every node in the sample network has the same number of in and out edges as that of the original network.

Question: What is the probability of the sample network?

Answer: \( \frac{1}{\#\text{edges}} = \frac{1}{\#\text{retweets}} = \frac{1}{7}! \)

\[
= \frac{1}{(7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1)} = \frac{1}{(42 \times 60 \times 2)} = \frac{1}{(252 \times 2)} = \frac{1}{5040}
\]

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**Cut-Permute-Rewire** generates sample networks from the directed multi-edged self-looped random configuration model (Newman, Strogatz and Watts, 2001):

- **cutting** the directed edges representing the retweets in our observed retweet network into out-bound and in-bound half edges,
- **permuting** the in-bound half edges by sorting them according to pseudo-random numbers that are generated and associated with them and
- **rewiring** the original out-bound half edges with the permuted in-bound half edges using a distributed join.

The in-degree and out-degree of each node in the observed retweet network is preserved after these three steps. Interpret the independent and identical samples as those from the null model $H_0$ as the apathetic retweet model.
CutPermutedAndRewire generates sample networks from the directed multi-edged self-looped random configuration model (Newman, Strogatz and Watts, 2001):

- **cutting** the directed edges representing the retweets in our observed retweet network into out-bound and in-bound half edges,

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- **rewiring** the original out-bound half edges with the permuted in-bound half edges using a distributed join.

The in-degree and out-degree of each node in the observed retweet network is preserved after these three steps. Interpret the independent and identical samples as those from the null model $H_0$ as the apathetic retweet model — “this is not reality folks!”
An Empirical Geometric Retweet Network & Most Retweeted Directed Paths — is born when distributed

Dijkstra meets Poisson whose Expectation is Random Exponential with observed number of retweets as its mean parameter

From Directed Configuration Model to Geometric Retweet Network

Multi-edged Self-looped Retweet Network

Weighted Retweet Network

Geometric Retweet Network
with weights 1 / (1 + # retweets)

interpretation: In a Geometric Retweet Network, the shortest directed path from a to b is the "most retweeted path"
An Empirical Geometric Retweet Network & Most Retweeted Directed Paths — is born when distributed

Dijkstra meets Poisson whose Expectation is Random Exponential with observed number of retweets as its mean parameter
An Empirical Geometric Retweet Network & Most Retweeted Directed Paths — is born when distributed

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An Empirical Geometric Retweet Nework & Most Retweeted Directed Paths — is born when distributed

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$L_2 = \text{Landmark 2}$

$L_4 = \text{Landmark 1}$
An Empirical Geometric Retweet Nework & Most Retweeted Directed Paths — is born when distributed

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An Empirical Geometric Retweet Nework & Most Retweeted Directed Paths — is born when distributed

Dijkstra meets Poisson whose Expectation is Random Exponential with observed number of retweets as its mean parameter

SWDPL = shortest weighted directed path length via GraphX Pregel

\[
\text{SWDPL}(\otimes, L_1) = 3 \quad \text{SWDPL}(\otimes, L_2) = 1
\]

\[L_2 = \text{Landmark 2}\]

\[L_1 = \text{Landmark 1}\]
An Empirical Geometric Retweet Network & Most Retweeted Directed Paths — is born when distributed.

Dijkstra meets Poisson whose Expectation is Random Exponential with observed number of retweets as its mean parameter.

\[ L_2 = \text{Landmark 2} \]

\[ L_1 = \text{Landmark 1} \]

\[ \text{SWDPL}(\times, \ L_1) = 3 \]
\[ \text{SWDPL}(\times, \ L_2) = 1 \]
\[ \text{SWDPL}(+, \ L_1) = 4 \]
\[ \text{SWDPL}(+, \ L_2) = 3 \]

\[ \text{distance}(+, \times) = |3-4| + |1-3| = 3 \]
Empirical Geometric Retweet Network + distributed multiple-sources shortest paths vertex programs

→ The “Where Am I?” Operator in Evolving Population Ideological Trees and Forests

- choose a set $I$ of “influential” nodes of interest (choice is informed by the empirical out-neighborhoods and out-degrees typically)
- $I \mapsto$ most retweeted path lengths to several subsets of $I$
- $\mapsto$ Population Ideological Tree of Interest.
- $\mapsto$ Population Ideological Forest of Interest (due to multi-component retweet networks).
An Empirical Geometric Retweet Nework & Most Retweeted Directed Paths — is born when distributed
Dijkstra meets Poisson whose Expectation is Random Exponential with observed number of retweets as its mean parameter

From distance between every pair of users (based on a given set of Landmark accounts) we can obtain a retweet ideological tree of the population via Neighbor-Joining algorithm.
(Q3) Population ideological Tree & Degrees of Separation

Table 4. The top 15 groups of users according to their profiles of most retweeted path-lengths from the five politicians (DT = @realDonaldTrump, HC = @HillaryClinton, BS = @BernieSanders, PR = @SpeakerRyan, TC = @tedcruz) and eight hateful ideologies (AI = Anti-Immigrant, AM = Anti-Muslim, WN = White-Nationalist, AL = Anti-LGBT, AG = Anti-Govt, NN = Neo-Nazi, BS = Black-Separatist, AR = Alt-Right) given by their id, frequency, percentage of population and their classification given by the ideological tree with leaf nodes as the ids.

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(Q1) Relative frequency of retweets by any one of the hate groups or their leadership for any original tweet made by one of the politicians

Null distribution of the test statistic under the apathetic retweet network model.

<table>
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<tr>
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<th>Politician, observed test statistic: marginal interval for the region of acceptance at 0.001 significance level</th>
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<tr>
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<td>Donald Trump</td>
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<td>0.987 : (0.6008, 0.6013)</td>
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</table>
(Q2) Number of unique users who retweeted a politician and a hate group at least five times each

Fig. 1. Number of unique users who retweeted a politician and a hate group at least five times each (Note: The y-axis is in log-scale in powers of 10).
(Q2) Number of unique users who retweeted a politician and a hate group at least five times each

Null distribution of the test statistic under the apathetic retweet network model.

Table 3. Observed frequency of distinct users who retweeted a politician and a leader within a hate group at least 5 times each

<table>
<thead>
<tr>
<th>Ideology</th>
<th>Donald Trump</th>
<th>Hillary Clinton</th>
<th>Bernie Sanders</th>
<th>Paul Ryan</th>
<th>Ted Cruz</th>
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<tbody>
<tr>
<td>Anti-Government</td>
<td>*107 : (0, 1)</td>
<td>3 : (0, 3)</td>
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<td>*2 : (0, 1)</td>
<td>*4 : (0, 1)</td>
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<td>Anti-Immigrant</td>
<td>*2314 : (375, 498)</td>
<td>*54 : (373, 492)</td>
<td>*15 : (369, 485)</td>
<td>*204 : (47, 95)</td>
<td>*133 : (18, 54)</td>
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<td>Anti-LGBT</td>
<td>*121 : (0, 4)</td>
<td>1 : (0, 4)</td>
<td>1 : (0, 4)</td>
<td>*5 : (0, 3)</td>
<td>*23 : (0, 3)</td>
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<td>Anti-Muslim</td>
<td>*215 : (0, 3)</td>
<td>0 : (0, 3)</td>
<td>0 : (0, 3)</td>
<td>*13 : (0, 3)</td>
<td>*21 : (0, 3)</td>
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<td>Neo-Nazi</td>
<td>*45 : (0, 1)</td>
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<td>0 : (0, 1)</td>
<td>0 : (0, 1)</td>
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<tr>
<td>White-Nationalist</td>
<td>*548 : (0, 12)</td>
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<td>0 : (0, 10)</td>
<td>6 : (0, 8)</td>
<td>4 : (0, 7)</td>
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<tr>
<td>Black-Separatist</td>
<td>*69 : (653, 811)</td>
<td>*40 : (649, 808)</td>
<td>*22 : (645, 801)</td>
<td>*5 : (72, 128)</td>
<td>*1 : (28, 66)</td>
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<td>Alternative-Right</td>
<td>*22 : (0, 0)</td>
<td>0 : (0, 0)</td>
<td>0 : (0, 0)</td>
<td>0 : (0, 0)</td>
<td>*3 : (0, 0)</td>
</tr>
</tbody>
</table>
Table 4. The top 15 groups of users according to their profiles of most retweeted path-lengths from the five politicians (DT = @realDonaldTrump, HC = @HillaryClinton, BS = @BernieSanders, PR = @SpeakerRyan, TC = @tedcruz) and eight hateful ideologies (AI = Anti-Immigrant, AM = Anti-Muslim, WN = White-Nationalist, AL = Anti-LGBT, AG = Anti-Govt, NN = Neo-Nazi, BS = Black-Separatist, AR = Alt-Right) given by their id, frequency, percentage of population and their classification given by the ideological tree with leaf nodes as the ids.

<table>
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<tr>
<th>Ideological tree</th>
<th>id</th>
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<th>Hate Group</th>
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</table>

Razesh Sainudiin Meme Evolution Programme
Zooming into the Joint Degrees of Separation From each Politician and Hateful Ideology

Cumulative % of the monitored population who are within a given in-degree of separation from a politician and a hateful Ideology.

(degrees of separation from politician, degrees of separeation from leaders of Anti-Immigrant ideology)
Zooming into the Joint Degrees of Separation From each Politician and Hateful Ideology

Cumulative % of the monitored population who are within a given in-degree of separation from a politician and a hateful ideology.
Zooming into the Joint Degrees of Separation From each Politician and Hateful Ideology —

Cumulative % of the monitored population who are within a given in-degree of separation from a politician and a hateful Ideology.
Zooming into the Joint Degrees of Separation From each Politician and Hateful Ideology

Cumulative % of the monitored population who are within a given in-degree of separation from a politician and a hateful ideology.

(degrees of separation from politician, degrees of sepeation from leaders of White Nationalist ideology)

Razesh Sainudiin  Meme Evolution Programme
Zooming into the Joint Degrees of Separation From each Politician and Hateful Ideology

Cumulative % of the monitored population who are within a given in-degree of separation from a politician and a hateful Ideology.
Zooming into the Joint Degrees of Separation From each Politician and Hateful Ideology —

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Raazesh Sainudiin  Meme Evolution Programme

#SAISDS7
Zooming into the Joint Degrees of Separation From each Politician and Hateful Ideology —

Cumulative % of the monitored population who are within a given in-degree of separation from a politician and a hateful ideology.
Zooming into the Joint Degrees of Separation From each Politician and Hateful Ideology

Cumulative % of the monitored population who are within a given in-degree of separation from a politician and a hateful ideology.
During the 2016 US presidential election, there was significant debate on whether Donald Trump’s campaign was fuelled by hate and bigotry toward minority groups. We analyzed nearly 22 million communication events on Twitter to better understand the networks of retweeters of American hate groups and five key American politicians during the late stages of the election (Donald Trump, Hillary Clinton, Bernie Sanders, Ted Cruz, and Paul Ryan). Our data reveals that Twitter users linked to various American hate groups including Anti-Government, Anti-Immigrant, Anti-LGBT, Anti-Muslim, Neo-Nazi and White-Nationalist were more strongly linked to Trump over any other politician.
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On a seemingly highly hopeful note about the “American people”: Only a small fraction of those within 3 degrees of separation from @realDonaldTrump during the 9 week period are also within 3 degrees of separation from any hateful ideology!
Did Trolls from Russia have an effect on our test?
Trolls := the 2,752 Twitter accounts identified by Twitter as being tied to Russia’s “Internet Research Agency” troll farm
ANY GUESSES?
Did Trolls from Russia have an effect on our test?
Trolls := the 2,752 Twitter accounts identified by Twitter as being tied to Russia’s “Internet Research Agency” troll farm
ANSWER is NO via a non-Troll sub-graph robustness check: Out of the 12,984,331 retweets in our dataset, less than 0.1% were related to a troll account (293 were retweeted by and 12,347 were originally tweeted by a troll account) and out of 2,451,081 distinct users in our retweet network, only 172 were related to a troll account. Interestingly, removal of these troll-related retweets from the retweet network did not alter the statistical tests.
Generalizable Interactive Streaming-REST Design

A 10 Day Design for 2017 UK Election (post-Brexit)

- **Influencers of Interest**
  - politicians: Jeremy Corbyn (JC), Theresa May (TM), Angela Rayner (AR, Labour), Boris Johnson (BJ, Conservative)
  - journalists and bloggers: the Independent (In), the Daily Telegraph (Te), Robert Peston (RP, journalist and author), Piers Morgan (P, journalist, tv-personality), Keven Maguire (KM, journalist), Owen Jones (OJ, left, the guardian), Paul Mason (PM, left-wing journalist (the guardian etc.)), Louise Mench (LM, previously conservative mp now blogger), and Guido Fawkes (GF, right/liberal).

Population Ideological Tree ➔

Razesh Sainudiin  Meme Evolution Programme
2017 UK Election 10 Day Design – Population Ideological Tree

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</table>

Razesh Sainudiin Meme Evolution Programme
### Generalizable Interactive Streaming-REST Design

2017 UK Election 10 Day Design – Top 25 sorted Retweet Network Degrees

<table>
<thead>
<tr>
<th>Screen Name</th>
<th>Out-degree</th>
<th>Out-nbhd</th>
<th>In-degree</th>
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<td>@gdogfawkes</td>
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<td>@MayorofLondon</td>
<td>29303</td>
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</tr>
</tbody>
</table>

All the chosen influencers, except Boris Johnson – the second most RT’d conservative MP (59) – are in top 25.
What’s Happening at Project MEP Now?

- Working with Theologists at UU to bring field ethnographic domain expertise into monitoring and analysis systems around SE 2018 Election – Towards Twitter Societal Conversational Health Metrics
- Data Science boot-camps for researchers: https://lamastex.github.io/360-in-525/

- Customizable dynamically adaptable set of set of “landmark” accounts to define the desired notion of diversity in the population ideological forests
- “Where Am I?” Operator for a kind of “ideological weather report” that can be done by any Citizen “towards participatory democracy in the big data age!”
- Live Research on: Meme Evolution Programme  
Many thanks to:

- Databricks Academic Partners Programme and AWS Educate & Cloud Computing Credits for Research
- Research Chair in Mathematical Models of Biodiversity (for mathematical theorizing) held jointly by:
  - Veolia Environnement
  - French National Museum of Natural History, Paris, France and
  - Centre for Mathematics and its Applications, Ecole Polytechnique, Palaiseau, France.
- Code Contributors: Ivan Sadikov, Akinwande Atanda and Joakim Johansson
- Seeded by Hate? Characterizing the Twitter Networks of Prominent Politicians and Hate Groups in the 2016 US Election, Kumar Yogeeswaran, Kyle Nash, Rania Sahioun and Raazesh Sainudiin, 2017
  [http://lamastex.org/preprints/2017HateIn2016USAelection.pdf](http://lamastex.org/preprints/2017HateIn2016USAelection.pdf)
- See: Project MEP for more information: [http://lamastex.org/lmse/mep](http://lamastex.org/lmse/mep)