

The spread of misinformation in social media

Filippo Menczer

Center for Complex Networks and Systems Research
School of Informatics and Computing
Indiana University, Bloomington



Center for Complex Networks
and Systems Research



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Peter Todd
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Bossy Cracka @Junebug1952 · Sep 25

Obama Forbids FBI to use Religion in Identifying Terror Threats as ISIS OPENLY recruits in Mosques In.is/www.breitbart... **Obama IS a MUSLIM**

Expand

← Reply ↻ Retweet ★ Favorite ... More



Tara McClintick @BooksByTara · 6h

Thank GOD for "internet information" bc mainstream media hides what thousands know: Vaccines CAUSE autism #**CDCwhistleblower**



6



1



Maggie Hittie @MHittie · Nov 12

WE PAY 4 THIS! @SteveWorks4You: More targeting: Obama spent \$1M 4 project 2 **suspend conservatives'** TwitterAccounts washingtonexaminer.com/rep.-lamar-smi.....

Mousy Smell, Mousy Do | New Pig Flu | Evolution in Action

ScienceNews

MAGAZINE OF THE SOCIETY FOR SCIENCE & THE PUBLIC • OCTOBER 20, 2012

#Politicalspam

Tracking truthiness in the Twittersverse



Reckless on Ritalin

Great Plate Breakup

Voyager 1 Nears Solar System's Outer Limit

Outer Limit

Great Plate Breakup

Reckless on Ritalin

April 4 - April 10, 2010 | bloomberg.com

Bloomberg Businessweek

CONFESSIONS

OF A

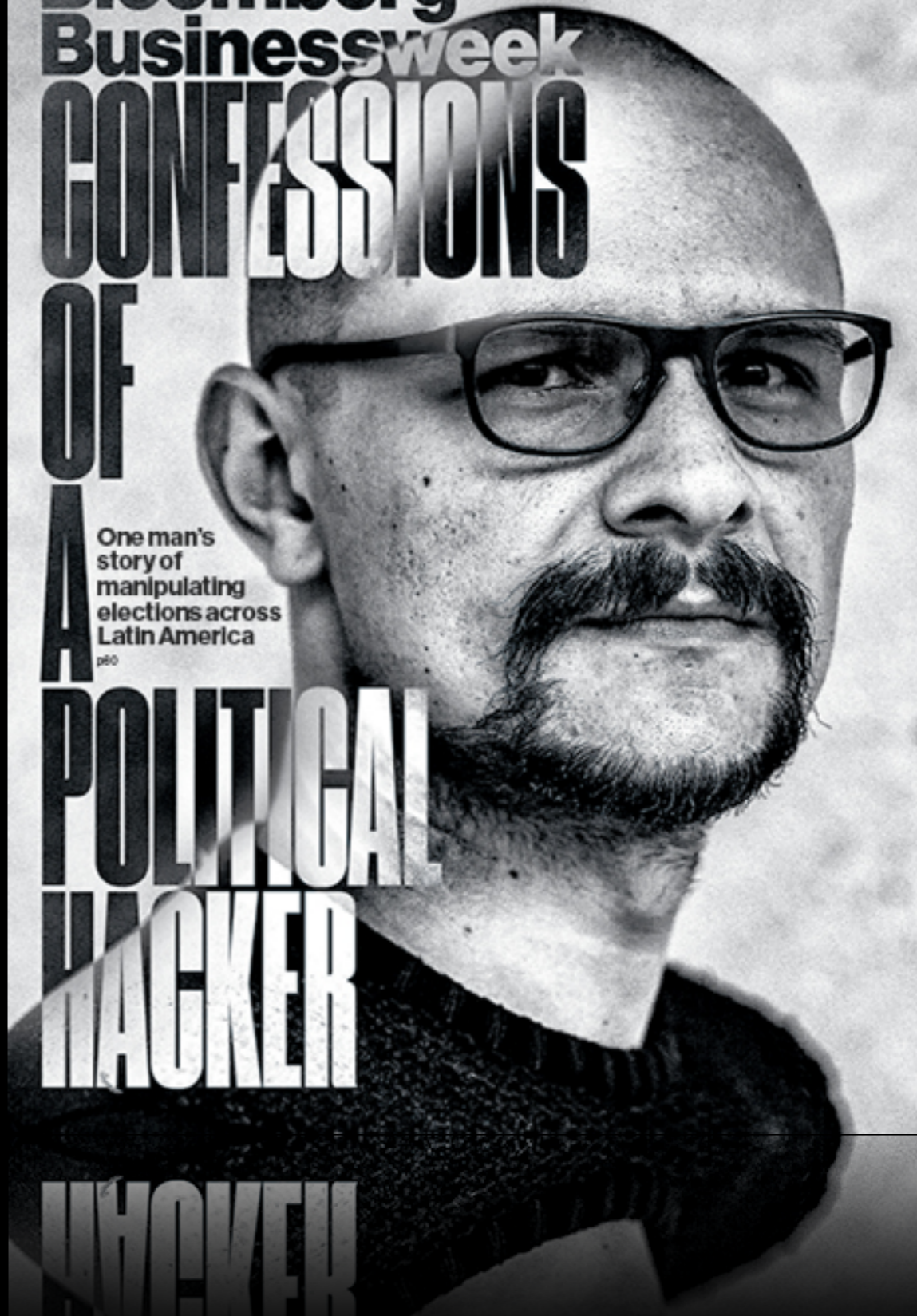
One man's story of manipulating elections across Latin America

p60

POLITICAL

HACKER

HACKER



1. Detection of misinformation
2. How misinformation spreads
3. Can the spread of misinformation be mitigated?

Observatory on Social Media

This website highlights the results of a broad research project aimed to study information diffusion in social media. Use our tools to explore how people spread ideas through online social networks.

Recent Papers from @TruthyAtIndiana

 **Truthy** @truthyatindiana 

Hoaxy: A Platform for Tracking Online Misinformation
#truthypaper @www2016ca @snow_workshop
cnets.indiana.edu/blog/2016/03/0...



Recent Talks from @TruthyAtIndiana

Congrats @clayadavis for best presenter prize at #www2016 Dev Day for #truthytalk on @TruthyBotOrNot via @jahendler



 Follow @truthyatindiana

1,586 followers

 Like

Share

0

Tools

The who, what, where, when, and how of social media data

BotOrNot



Check how bot-like a Twitter user behaves.

Trends



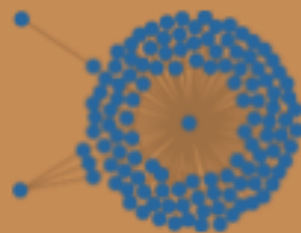
Compare when memes gain and lose popularity.

Movies



Generate movies of how conversations about a meme evolve over time.

Networks



Explore who is discussing a meme and what memes are related.

Maps



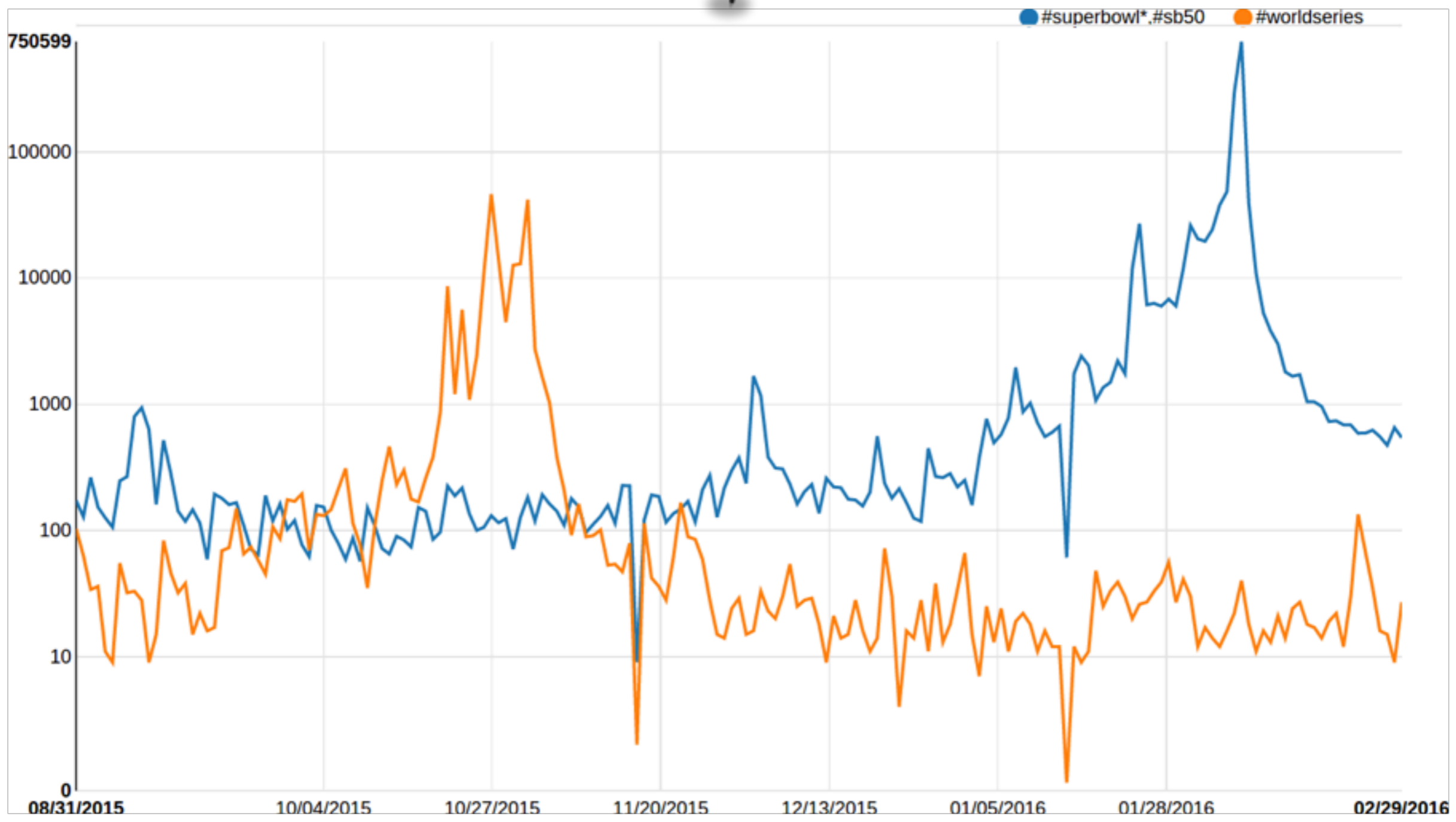
Examine where people are talking about a meme over time.

API



Query Truthy's data for your own analysis.

Coming Soon



Interactive Network Graph

Create a fully interactive network graph from a query to the OSoMe API

Try out one of these great queries:
[#theDress](#) [#IceBucketChallenge](#) [#Kittens](#)

Hashtag

Start Date

End Date

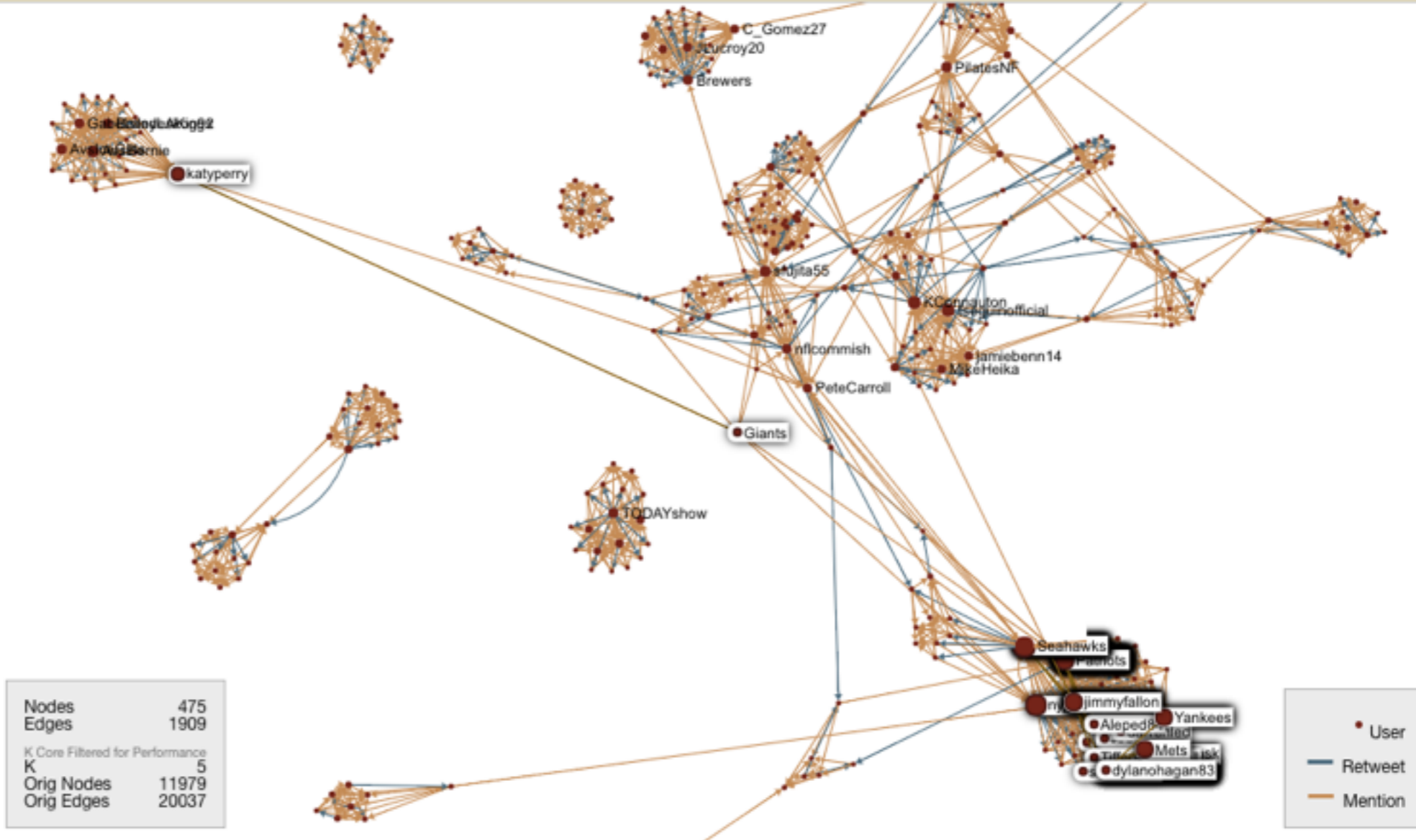
Network Type
 Retweets and Mentions
 Co-Occurrence

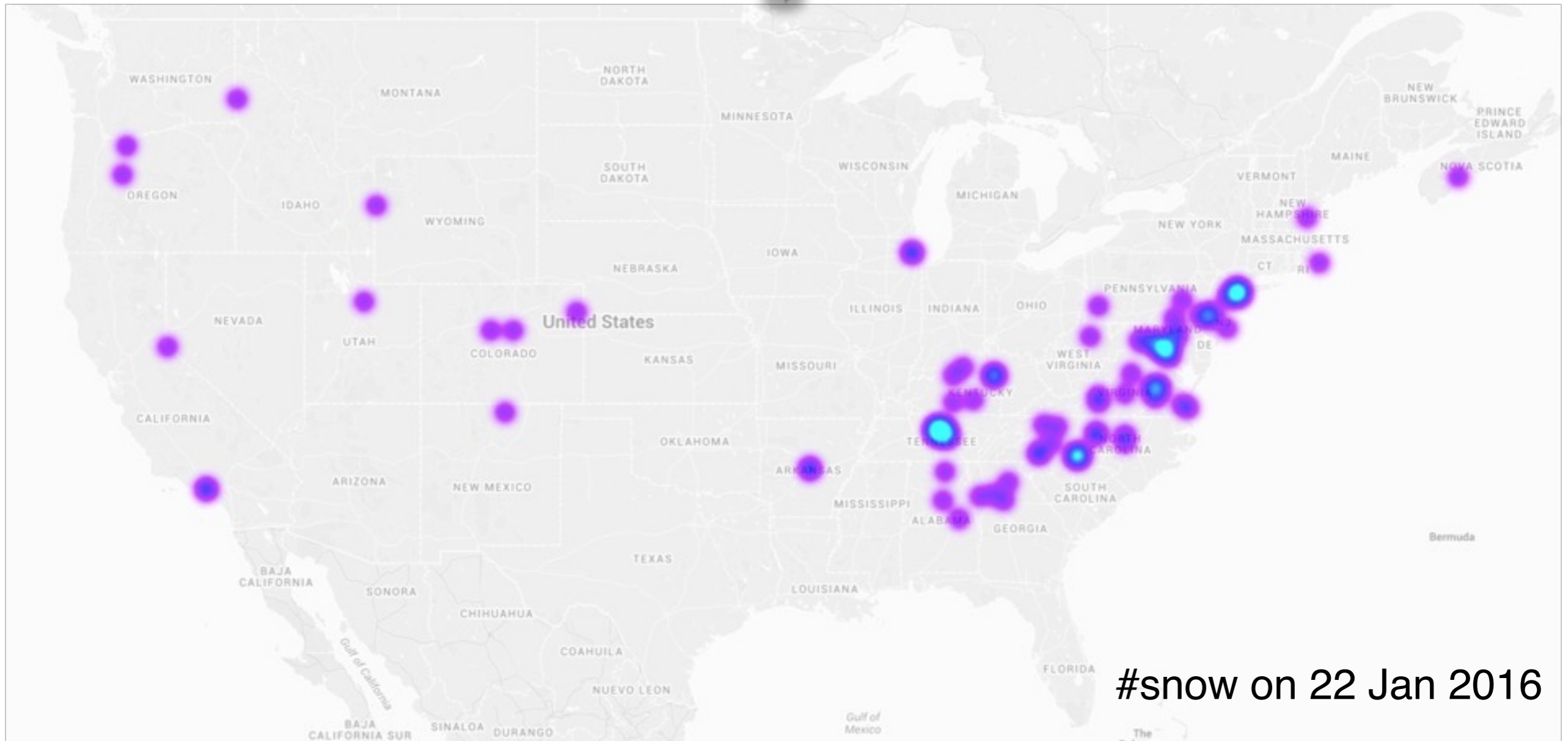
Generate Graph

Share

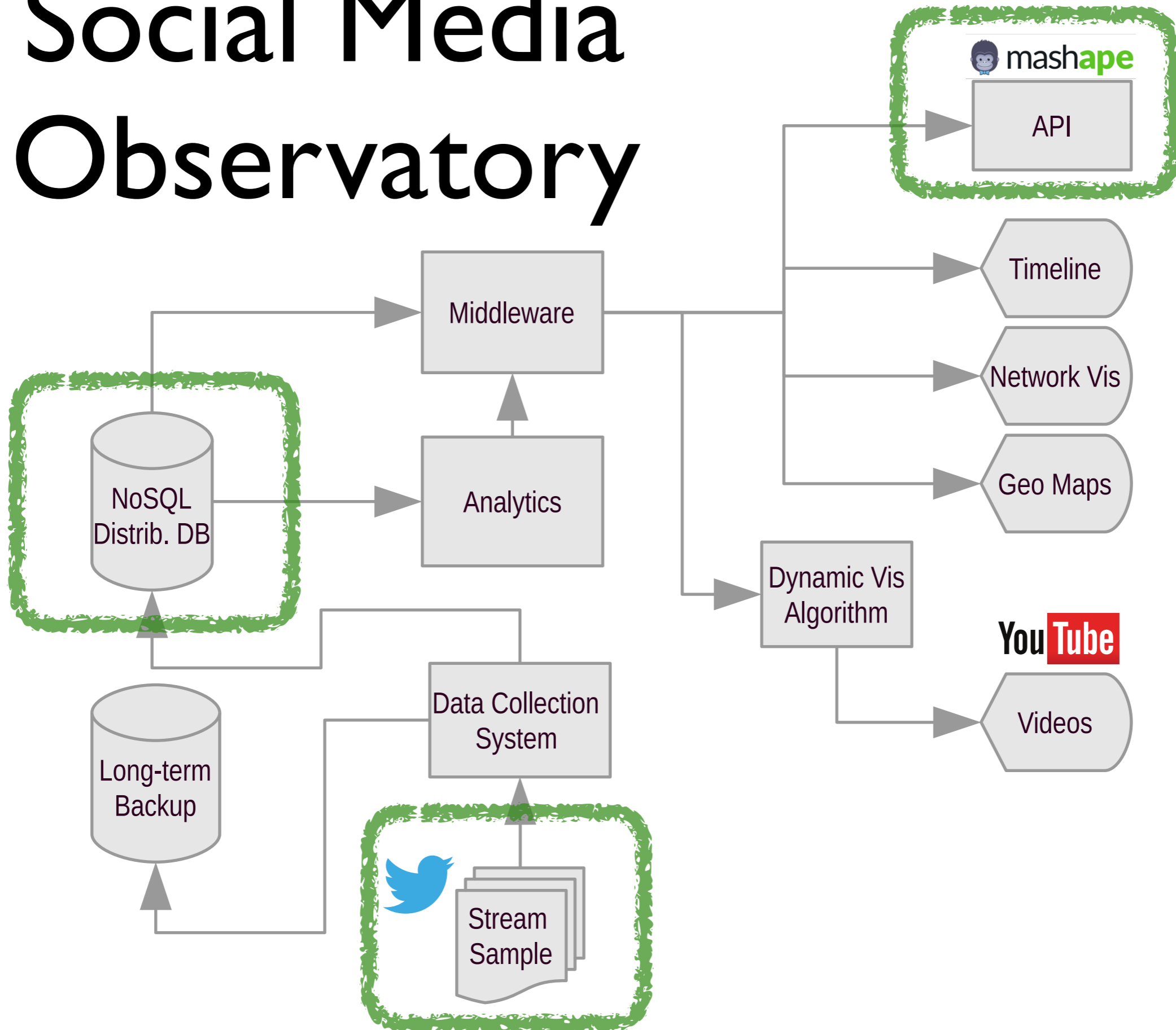
Generate PNG

Get JSON





Social Media Observatory



Meme List

Visualizations of Twitter's past 90 days

Here you find our collection of Memes (#hashtag, @user, http://url, or "phrase") from the past 90 days of Twitter communication.

For each meme, we calculate statistics and provide interactive interfaces that visualize the networks, allow you to identify interesting users, and download data.

For each meme we show here a user-generated definition from tagdef.com, a timeline of collected tweets, and the static diffusion network.

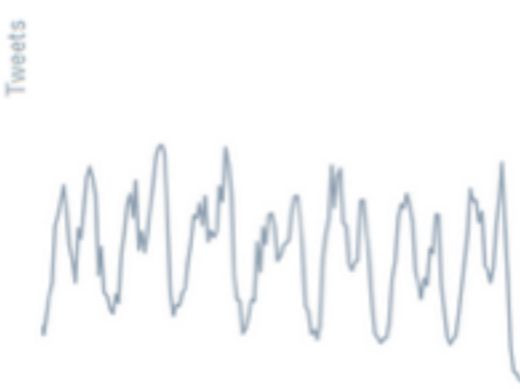

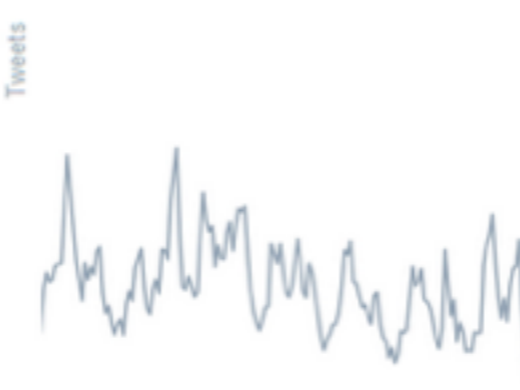

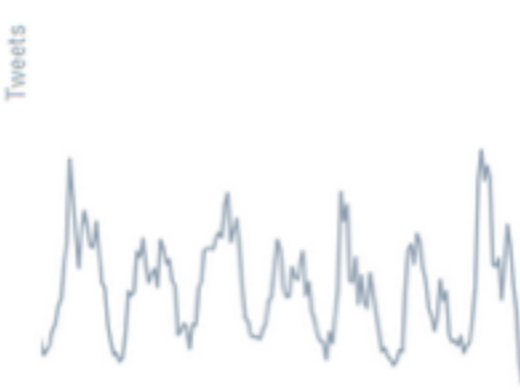
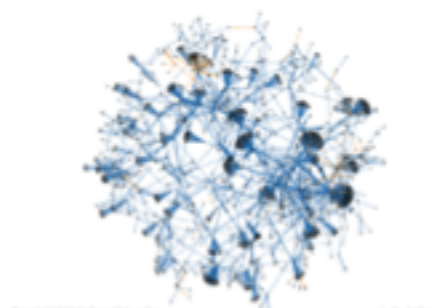
FREQUENTLY ASKED QUESTIONS

Filter and Sort Memes

Theme

Type

Sort

Meme	Timeline	Diffusion Network
#bahrain Middle East Country		
#syria A country in the Middle East that has fought throughout the times for its freedom. Lately from its d...		
#egypt An Arabic country in North Africa		

#p2 ↗

😊 57% positive sentiment

TOP USER-GENERATED DEFINITIONS FROM TAGDEF.COM

▲ Liberals on twitter
117
45
▼

Live Stream

 **JoeSixpackSays** RT [@andilinks](#): Aid and comfort to the Muslim Brotherhood is TREASON per Article 3 Sec III of the US Constitution. #gop #tcot #p2 #sgp #o ...
about 1 minute ago · reply · retweet · favorite

 **Ares1369** No Kidding: Gov't Issues Study of Study of Studies #tcot #p2 #ows #tlot #obama theblaze.com/stories/no-kid... via [@theblaze](#)
59 seconds ago · reply · retweet · favorite

 **Lisa editor** RT [@sellitman](#): Brilliant! RT [@Indie Obama](#):



Join the conversation

Interactive

Static

Users

Timeline

Map

Statistics

Movies

Cocurrence

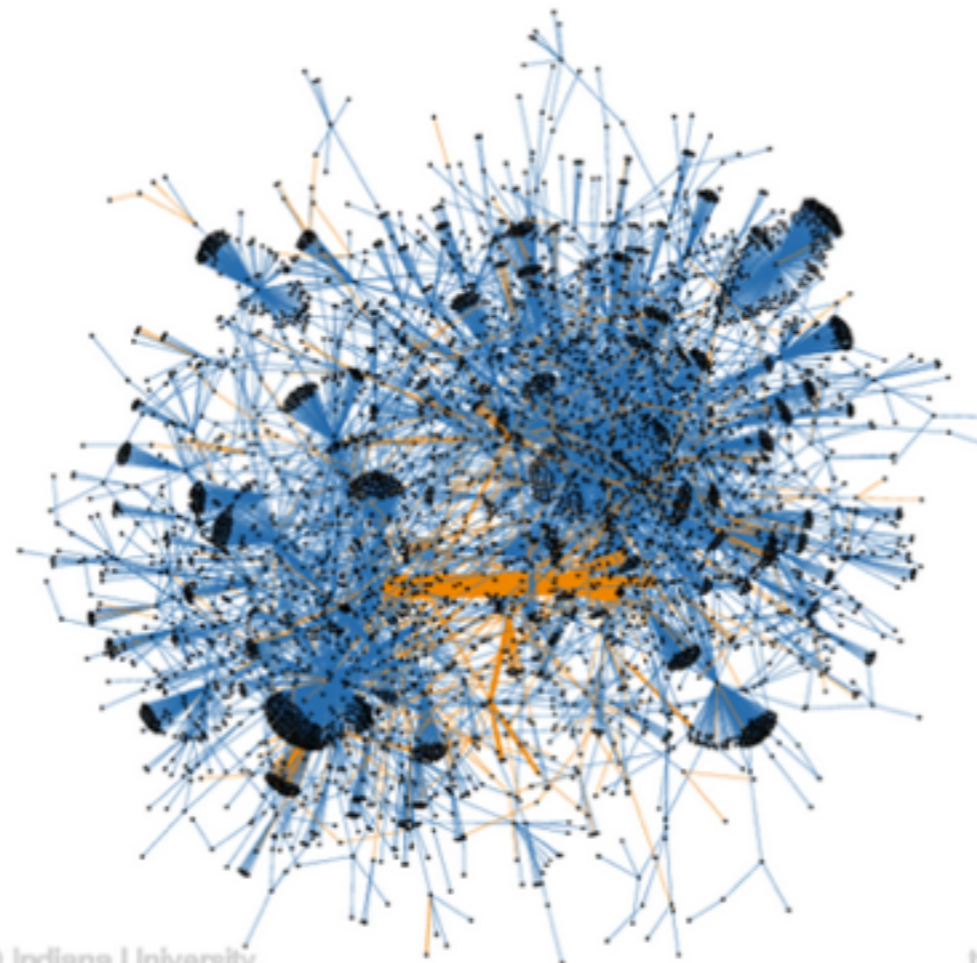
Download

Static Network

This static communication network shows how the meme is transmitted from user to user, by means of retweets (forwards) and mentions (direct messages).

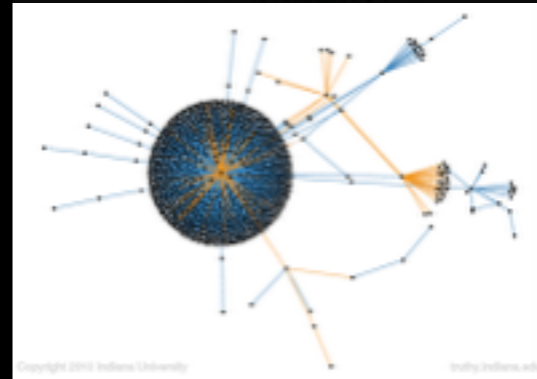
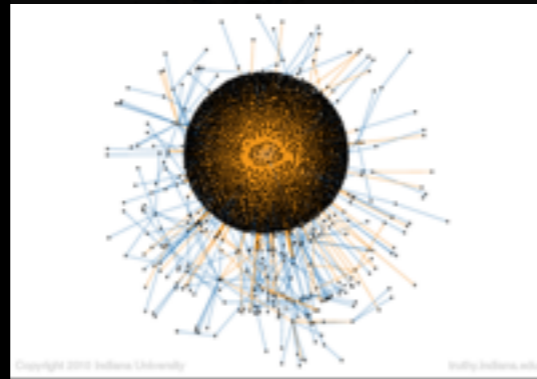
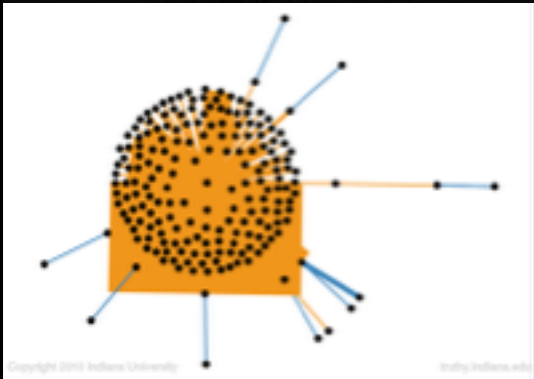
LEGEND

- User
- Retweet
- @Mention

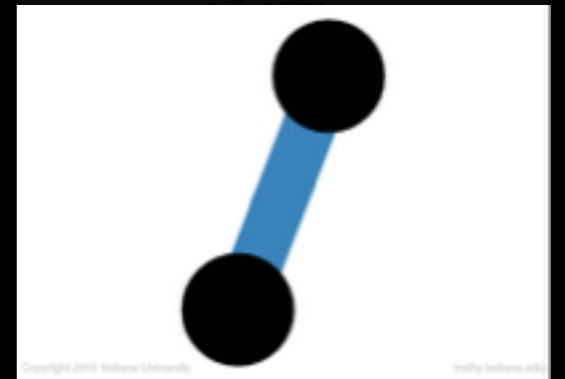
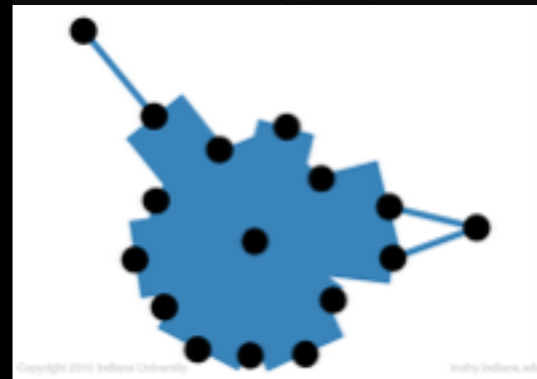
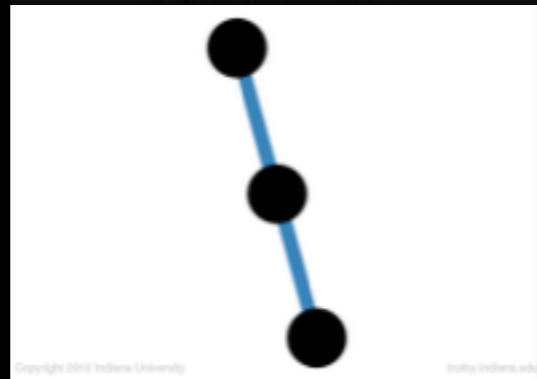
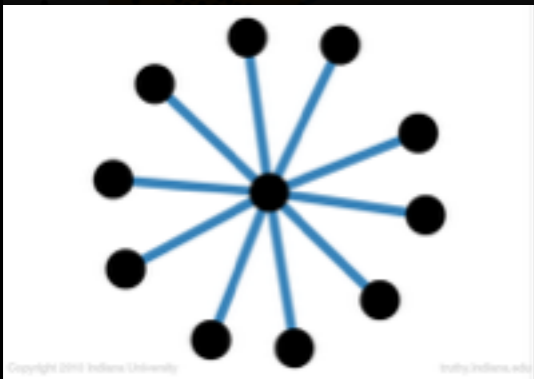




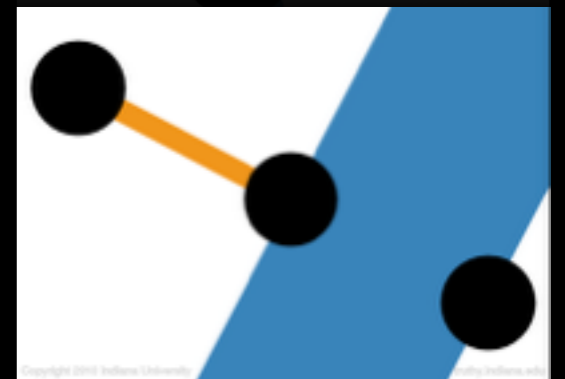
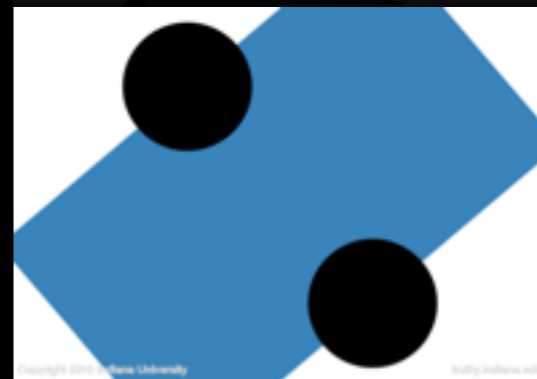
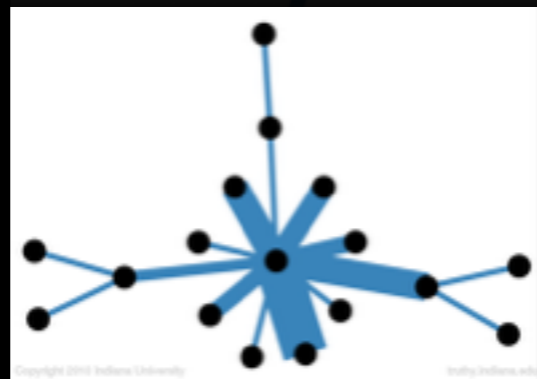
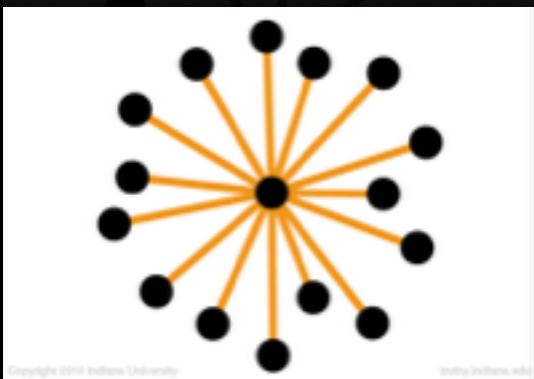
politics



celebrities



spam



astroturf

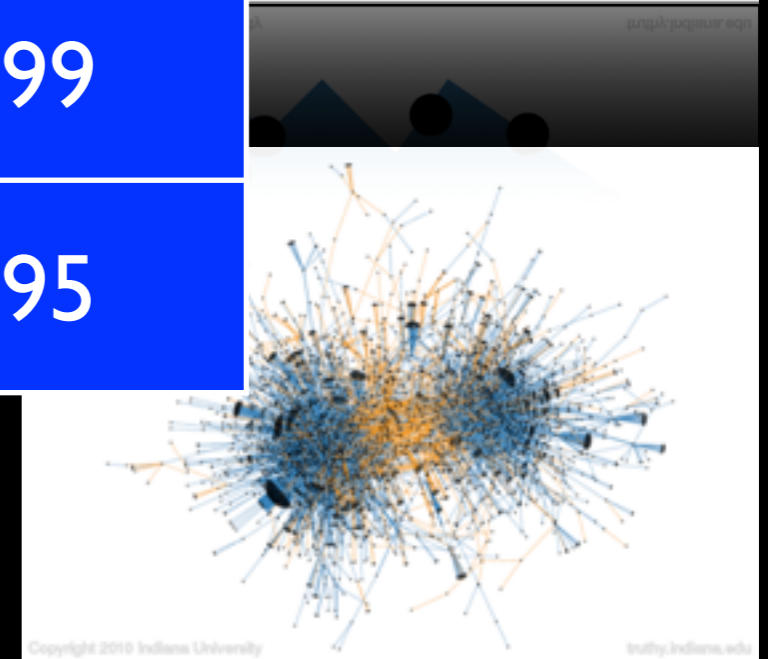
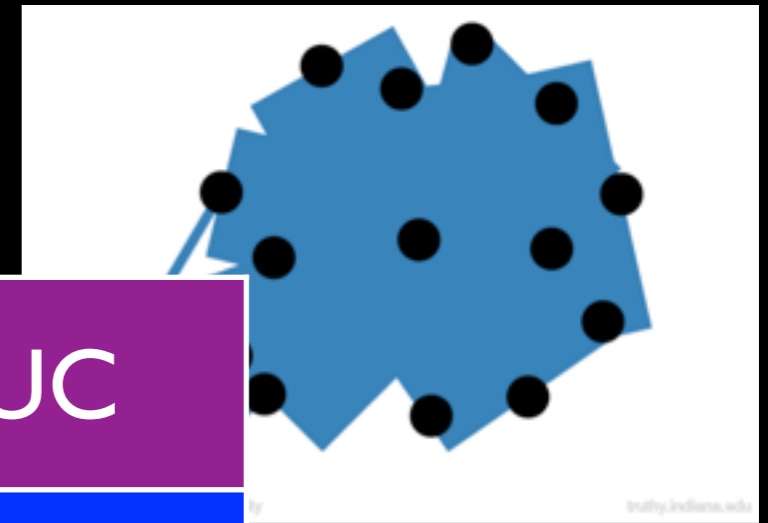
Astroturf Detection

nodes Number of nodes
 edges Number of edges
 mean_k Mean degree
 mean_s Mean strength
 mean_w Mean edge weight in largest connected com-

max_k(i, o)
 max_k(i, o)_user
 max_s(i, o)
 max_s(i, o)_user
 std_k(i, o)
 std_s(i, o)
 skew_k(i, o)
 skew_s(i, o)
 mean_cc
 max_cc
 entry_nodes
 num_truthy
 sentiment scores

Classifier	Accuracy	AUC
AdaBoost	96.4%	0.99
SVM	95.6%	0.95

The size of the largest connected component
 Number of unique injections
 Number of times 'truthy' button was clicked for the meme
 The six GPOMS sentiment dimensions



Nielsen's New Twitter TV Ratings Are a Total Scam. Here's Why.

Beejoli Shah
Filed to: SECOND SCREEN BULLSHIT 10/08/13 5:23pm

27,289 6 ★



POLITICO

Like Follow +1 Sign in / Register About

MAGAZINE ELECTIONS CONGRESS BLOGS POLICY VIDEO PHOTOS

WATCH LIVE: Pelosi holds weekly press conference

Pols have a #fakefollower problem

Share 508 Tweet 740 Share 14 Share 36 325



Christie, Obama, Clinton and McCain draw some of the most fake followers.

Mashable MUST READS SOCIAL MEDIA TECH BUSINESS ENTERTAINMENT US & WORLD WATERCOOLER MORE

The Curious Case of Cynk, an Abandoned Tech Company Now Worth \$5 Billion

3.6k
SHARES

Share on Facebook Share on Twitter



Ads by Google
Udacity investingtips - 9 tips til bedre investeringer. Få råd fra kendt Forbes ekspert!
www.fahinvestments.dk



GIZMODO

The Fembots of Ashley Madison

Annalee Newitz
Filed to: ASHLEY MADISON 8/27/15 5:05pm

82 ★



truthy.indiana.edu/botornot

Bot or Not?



A **Truthy** project

Check User

Enter a screen name or try one of these examples

bots: @jusbieberphotos, @dtufreak, @lao232, @stanbieberfan

humans: @onurvarol, @jabawack

Retrieving basic user data from Twitter



Retrieving user timeline from Twitter



Retrieving retweets/mentions from Twitter



Analyzing data with Truthy



About ~ seconds!

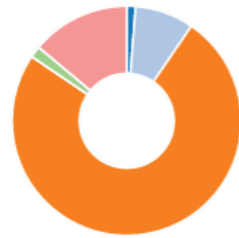
Real-time query
(Twitter search
API)

Real-time
feature (>1K)
extraction

Real-time
analysis and
classification

Content Retweet Tag Proportions

- Adverbs
- Verbs
- Nouns
- Modals
- Predeterminers
- Pronouns
- Interjections
- Adjectives



A

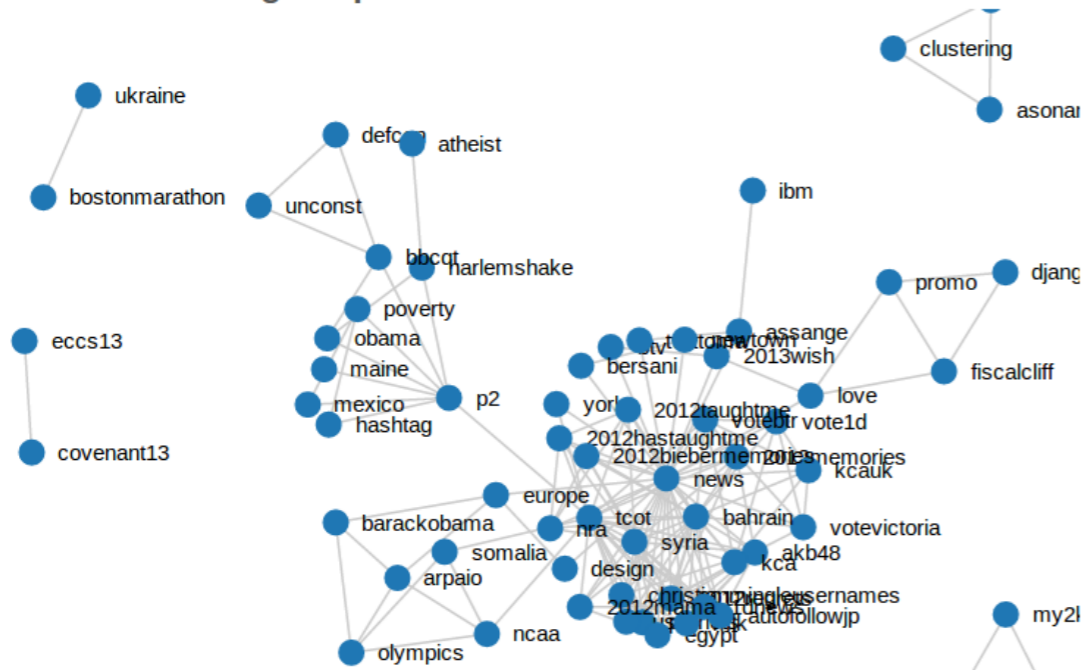
Friend Retweeted Languages

- en
- it



B

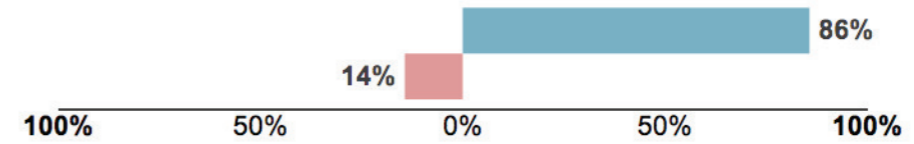
Network Hashtag Graph



C

Sentiment Tweet Emoticon

- Positive
- Negative

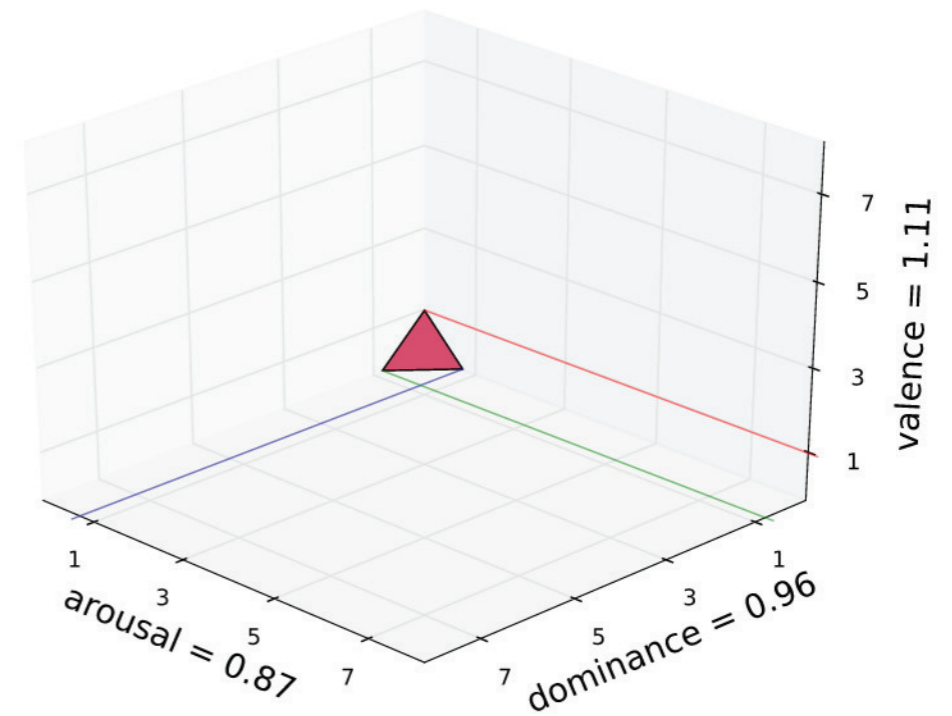


D

Sentiment Tweet Happiness



Sentiment Tweet Methods

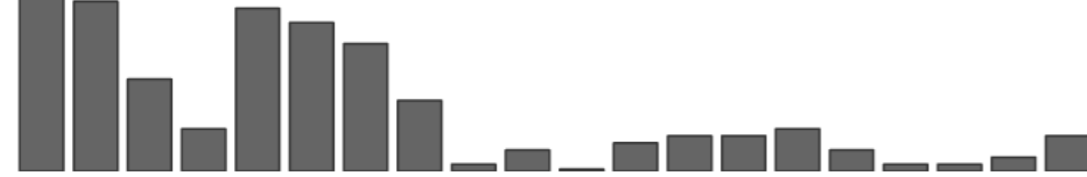


Temporal Retweet Timestamps



E

Temporal Tweet Timestamps





Emilio Ferrara
@jabawack

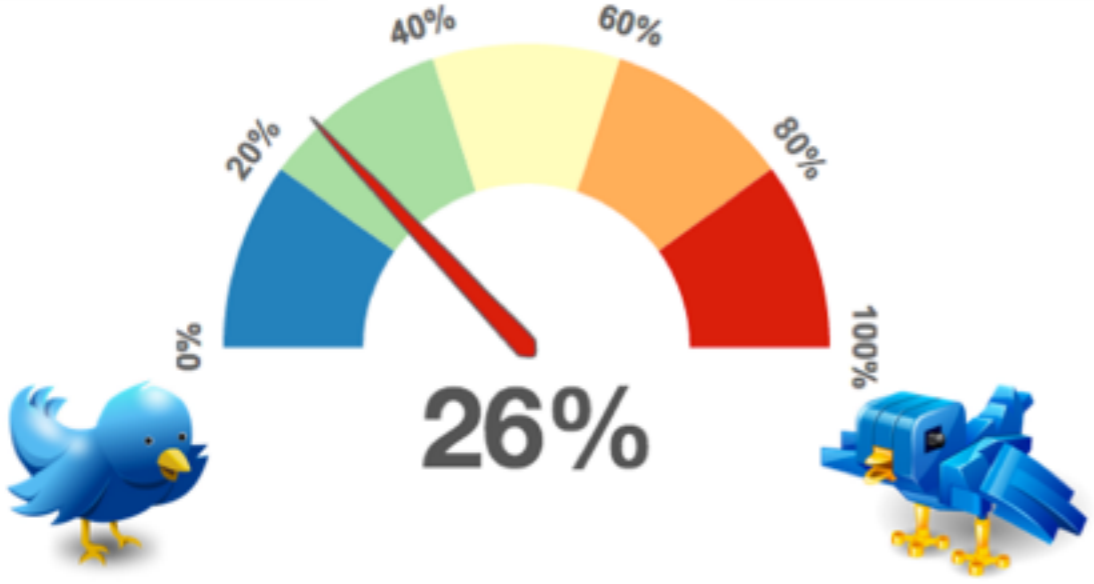


Justin Bieber Photos
@JusBieberPhotos

Classification

Tweet this report

Flag as incorrect

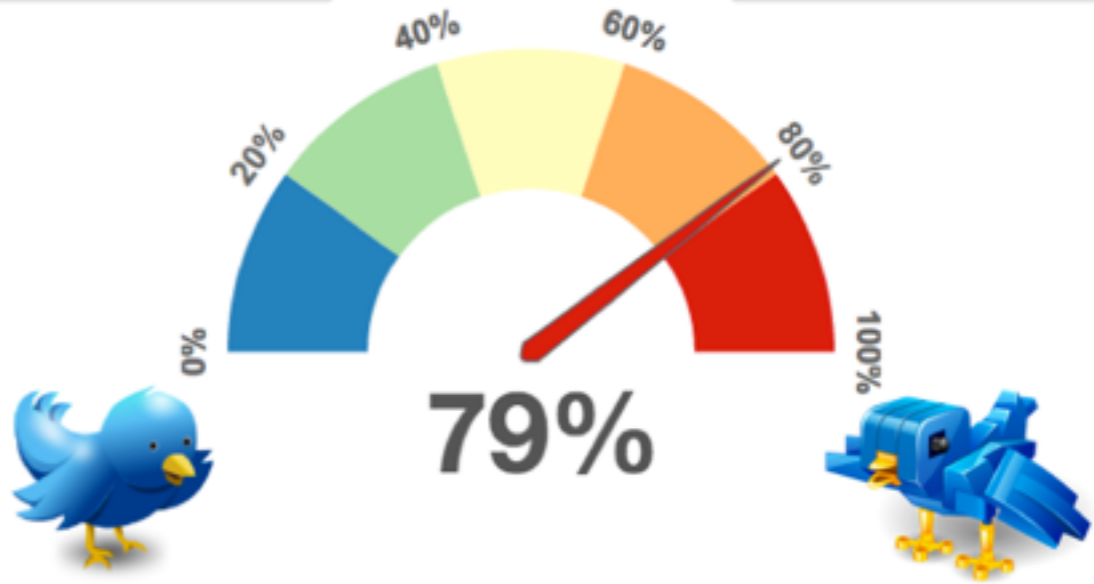


- Friend 37%
- User 4%
- Content 49%
- Temporal 28%
- Sentiment 27%
- Network 14%

Classification

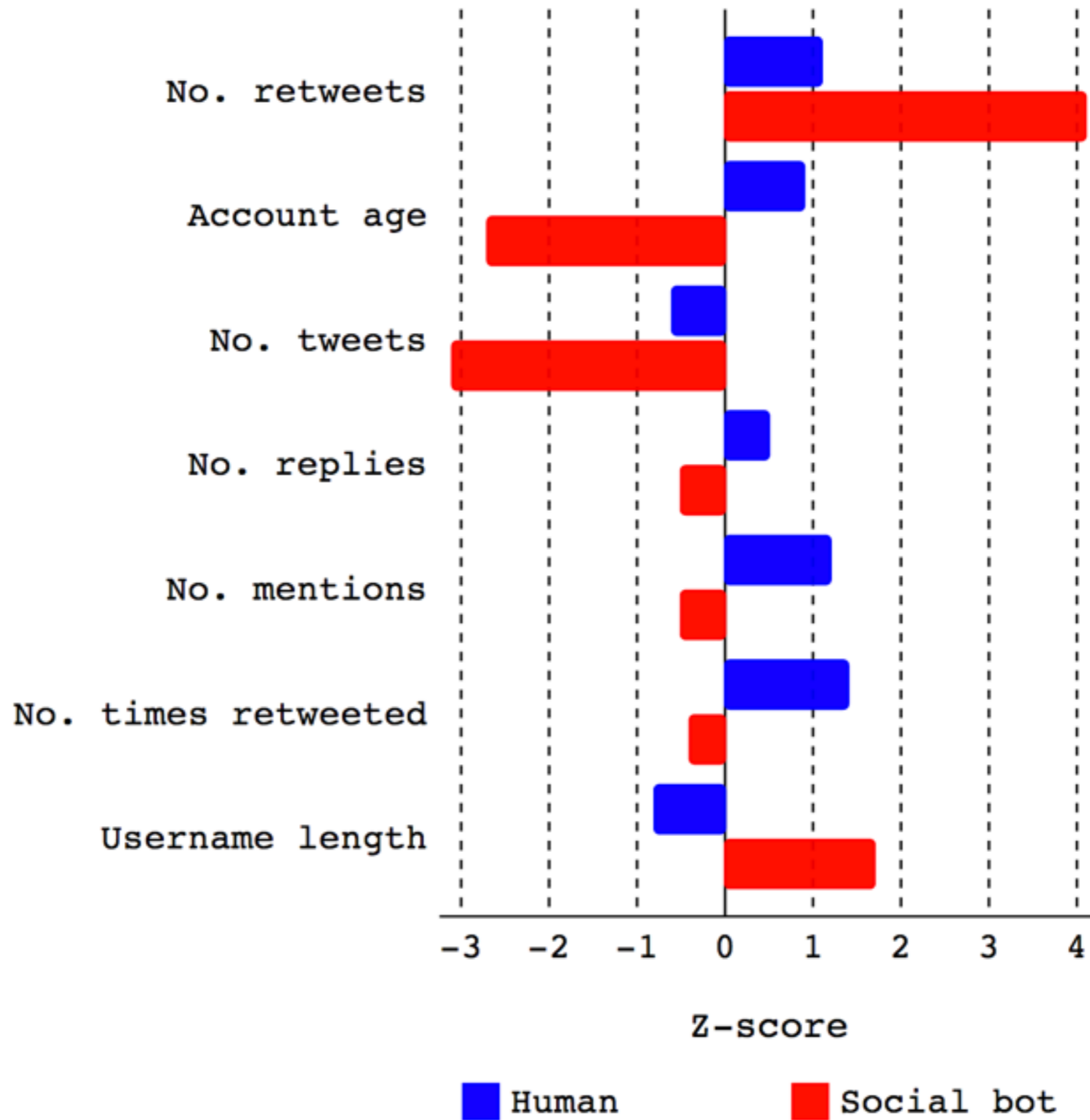
Tweet this report

Flag as incorrect



- Temporal 43%
- Network 40%
- Friend 73%
- User 81%
- Content 54%
- Sentiment 52%

AUC
0.95





BotOrNot Python API

A Python API for [Truthy BotOrNot](#).

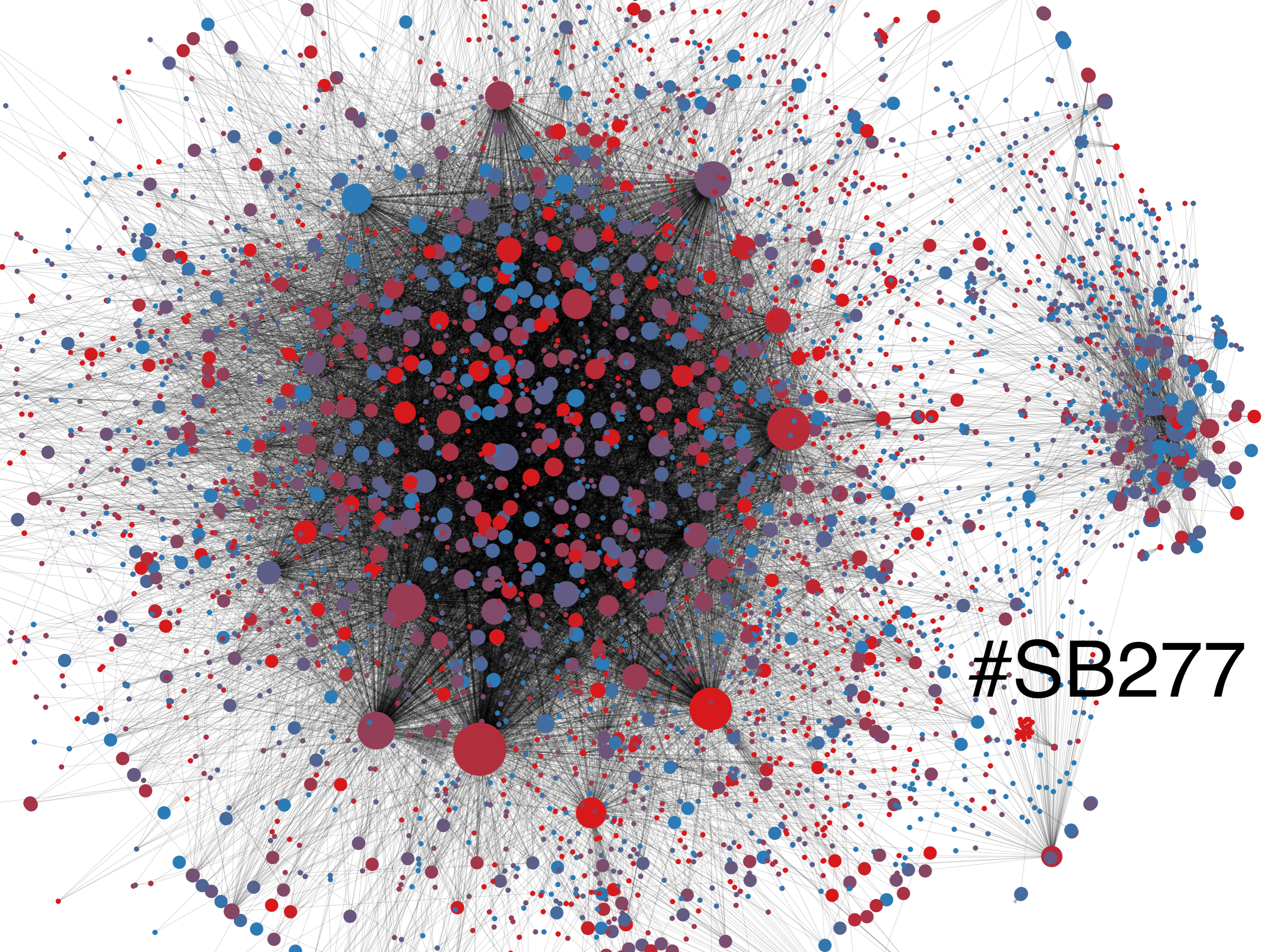
Behind the scenes, this uses the BotOrNot's HTTP endpoint as illustrated in [this notebook](#).

Quickstart

```
import botornot

twitter_app_auth = {
    'consumer_key': 'xxxxxxxx',
    'consumer_secret': 'xxxxxxxxxx',
    'access_token': 'xxxxxxxx',
    'access_token_secret': 'xxxxxxxxxx',
}
bon = botornot.BotOrNot(**twitter_app_auth)

bon.check_account('@clayadavis')
```

#SB277

1. Detection of misinformation
2. How misinformation spreads
(Truthy case study)
3. Can the spread of
misinformation be mitigated?



28 Aug



26 Aug

3 Sep



25 Aug 2014



28 Aug





Concerned American @ObamasMentors · Aug 26

Feds Spend \$1 Million to **track** "hate speech" on twitter, run by a FAR LEFT LIBERAL-An OBVIOUS ATTACK ON **CONSERVATIVES**-

freebeacon.com/issues/feds-cr...



Youxia88™ @Youxia88 · Aug 27

@jjauthor Only **conservatives** will be targeted. RT @FoxNews: **Feds** creating database to **track** hate speech on Twitter fxn.ws/1qoNlz9



f. lindsay @hidefullofHoney · Aug 28

#Truthy: How **Feds** Plan to **Track** Hate Speech (**Conservatives**) on Twitter (TWTR) @CNN @msnbc @ABCNews @CBSNews @NBCNews

invstplc.com/1nIDkO4



FEDS WANT TO SCOUR NET, MEDIA FOR 'HATE SPEECH'



...WHICH, OF COURSE, IS ANY SPEECH CRITICAL OF OBAMA & THE DEMOCRATS!!

FOX NEWS [INSIDER] The Official Blog of Fox News Channel

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- Expert: ISIS Could Pay Median Drug Cost to Attack U.S. Power Grid
- Report: Obama Admin Planning 3-Year Campaign Against ISIS
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- Trump: Obama Obama 'Yes Like Campaigning That's About It'
- Mysterious Respiratory Illness Sickness Kills in at Least 10 States
- Prince William & Kate Middleton Expecting Baby #2
- Parents: Deporter to Jail

COMMENT **SHARE**

'1984' in 2014? Fed Gov't Funds 'Truthy' Database to Monitor Hate Speech, Suspicious Memes



Professor Filippo Menczer
Indiana University

BY FOX NEWS INSIDER / AUG 28 2014 7:58 AM
AS SEEN ON FOX AND FRIENDS

28 Aug

The Washington Post

Opinions

The government wants to study 'social pollution' on Twitter

By Ajit Pai October 17, 2014

Ajit Pai is a member of the Federal Communications Commission



18 Oct

House science committee to examine NSF grant to study Twitter activity



24 Oct

National Journal

Kevin McCarthy Wants Academics to Stop Reading Your Tweets

Researchers scoff at the notion that their work is part of some government surveillance plot.

BY BILLY HOUDE



The Washington Times

The feds' 'truthy' new chill on free speech

The government's monitor of communication is no joke

By Andrew P. Napolitano -- Wednesday, October 22, 2014

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- Parents: Deporter to Jail

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Feds Creating Online Tracker to Search for 'Hate Speech' & 'Misinformation'



FEDS CREATING HATE SPEECH TRACKER

BY FOX NEWS INSIDER / AUG 26 2014 9 AM
AS SEEN ON THE REAL FILE

26 Aug

21 Oct

23 Oct

Behind the News CJR on the media

06:55 AM - September 3, 2014

How misinformation goes viral: a Truthy story

Conservative media's reaction to an Indiana University project shows how shoddy information can quickly become an online narrative

3 Sep

The Washington Post

Monkey Cage

No, the National Science Foundation is not building an Orwellian surveillance nightmare



By Henry Farrell October 22, 2014

22 Oct

Feds Creating Database to Track 'Hate Speech' on Twitter

\$1 Million study focuses on internet memes, 'misinformation' in political campaigns

BY: Elizabeth Harrington

Follow @LizWFD

August 25, 2014 3:30 pm

28 Aug

25 Aug 2014

US researchers studying how misinformation spreads smeared by Fox News as 'Orwellian'



FEDERALLY FUNDED DATABASE 'TRUTHY' AIMS TO 'MONITOR SUSPICIOUS MEMES'



Dean R. Riehm @deanriehm · Oct 21

dailycaller.com/2014/10/21/the... Oh , look who's back: it's those taxpayer-funded fascist anti-free speech thugs. #truthy @truthy @BDaddyLiberator



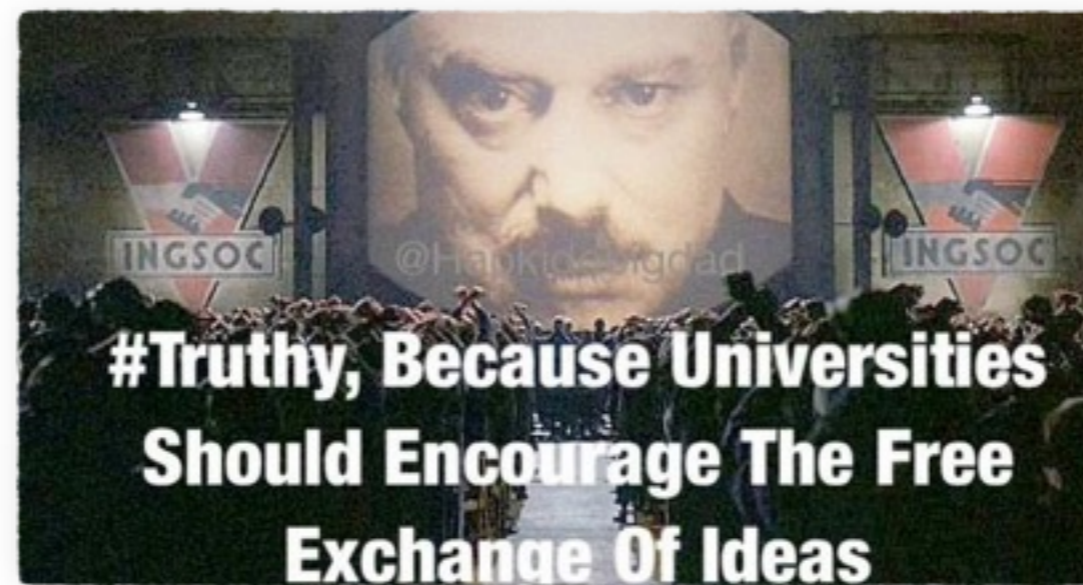
Leviathan Rising @govtblackhole · Oct 23

Big #Gov targets conservative #speech on Twitter. wapo.st/ZyAi9c
#freespeech #tlot #tcot #pjnet #teaparty #censorship #ccot #law



RockPrincess @Rockprincess818 · Oct 27

Secret Police.Obama's regime is funneling our tax dollars to radical anti-free speech groups using public services as his bag man #Truthy



FOX NEWS [INSIDER] The Official Blog of Fox News Channel

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BY FOX NEWS INSIDER 7 AUG 28 2014 7:54 AM
AS SEEN ON FOX AND FRIENDS

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By AJIT PAI October 17, 2014

Ajit Pai is a member of the Federal Communications Commission



18 Oct



10 Nov

Smith Investigates NSF-Funded Project Targeting Conservative Political Speech on Twitter

NOV 10 2014

House science committee to examine NSF grant to study Twitter activity

National Journal

Kevin McCarthy Wants Academics to Stop Reading Your Tweets

Researchers scoff at the notion that their work is part of some government surveillance plot.

BY BILLY HOUDE



24 Oct

3 Nov

Controversy over Truthy illustrates the power of social media to inform —and mislead

Science

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- Parents: Corporator to Feed

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AS SEEN ON THE REAL FILE

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August 25, 2014 3:30 pm

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25 Aug 2014



THE Arizona Luke @ArizonaLuke · Nov 10
 Govt Funded "Truthy Project" Boasts That It Suspended #tcot Twitter Accounts.
 #Censorship #FreeSpeech freebeacon.com/issues/house-c...



Laura LaRue @LaLaRueFrench75 · Nov 10
 @NSF Why are you having #Twitter accts suspended for #FreeSpeech & using my tax \$ to do it? freebeacon.com/issues/house-c... ow.ly/i/7xdiH



Mary Forbes @MaryForbes14 · Nov 11
 ICYMI Obama's Administration paid twitter trolls to target Conservatives for Twitter suspension drudge.tw/1uUSy2



Chuck DeVore @chuckdevore · Nov 11
 Oh, this is great, using almost \$1 million in tax \$ to suspend conservative Twitter accounts. freebeacon.com/issues/house-c... #tcot

BIG TRUTHY



IS WATCHING YOU



Red Alert Politics @RedAlert · Nov 11
 "Taxpayers deserve to know" how NSF decided to award a large grant to project suppressing free speech redalert.io/1tYqqRo



GENUG @GENUG · Nov 15
 Big Truthy Is Watching (Some of) You - ammoland.com/2014/11/big-tr... via @Ammoland #Obama's #fascist #censorship #project #monitoring #free #speech



Daniel Shoop @Shoopdj · Jan 17
 Indiana University Monitored 'Hate Tweets' in Aftermath of Truthy Scandal in.is/freebeacon.com... The Fed's version of "Free Speech".



Laura Van Overscheld @LauraVanOversch · Dec 27
 House Committee Demands Answers on Truthy Project in.is/freebeacon.com... #Filippo Menczer-self-appointed-free-speech-monitor-on-Twitter

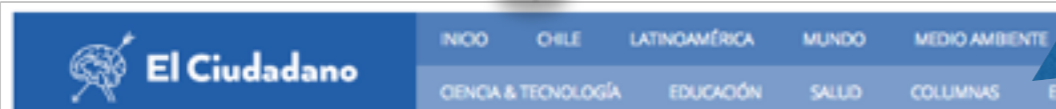


Silverbelle1008 @silverbelle1008 · Nov 11
 Scary lib out to shut down conservative free speech House Committee Demands Answers on Truthy Project freebeacon.com/issues/house-c...





Septe



La ciencia y la tecnología puestas al servicio de la persecución contra la libertad de expresión

Atentado contra la libertad de expresión: EE.UU. lanza una guerra millonaria contra los "memes sospechosos"

En EE.UU. se ha desarrollado un software que permite contrarrestar la "propaganda" y las "incitaciones al odio" en las redes sociales. Sin embargo, todos sabemos realmente los lamentables fines del desarrollo de este tipo de tecnologías.

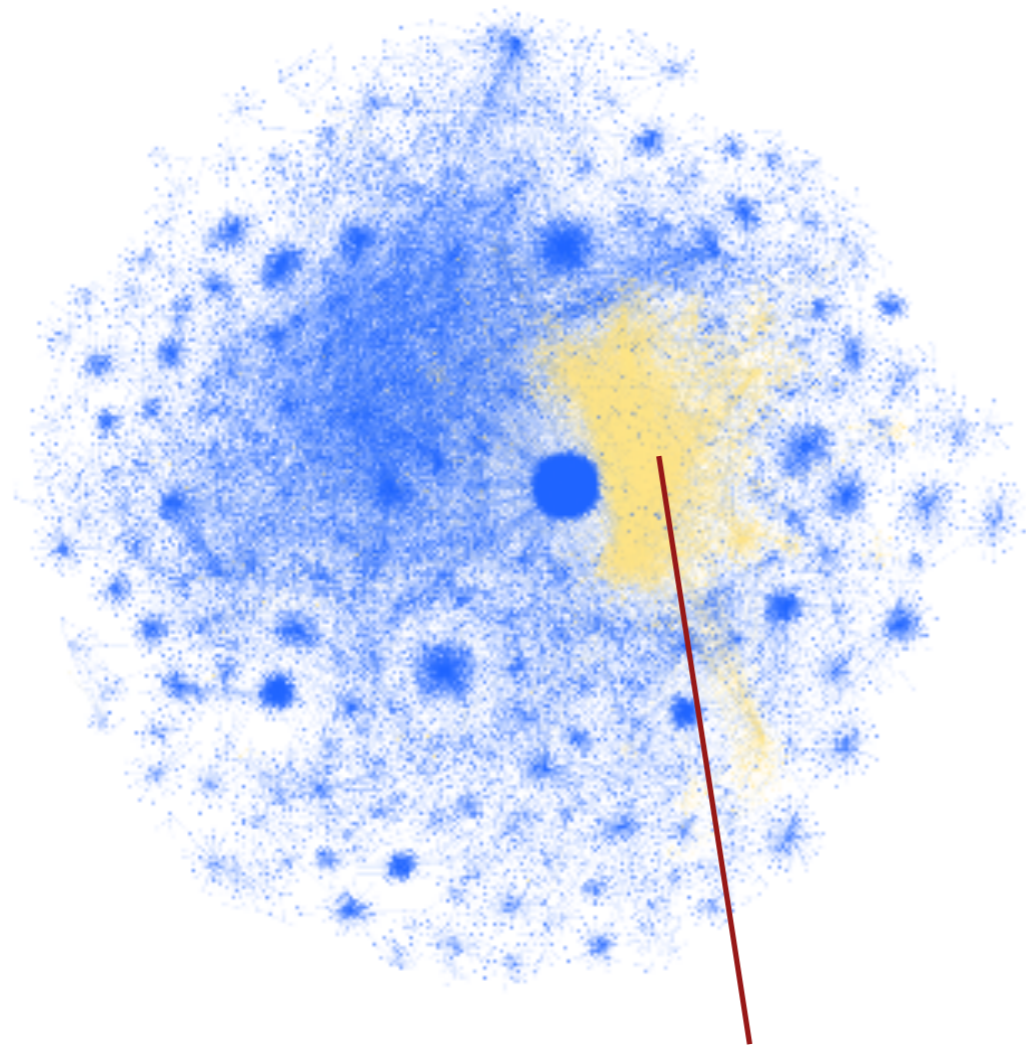
ANGELA BARRAZA RISSO
2 MARCH 23:03
#CIENCIA Y TECNOLOGÍA, #MUNDO

378 COMPARTIDOS

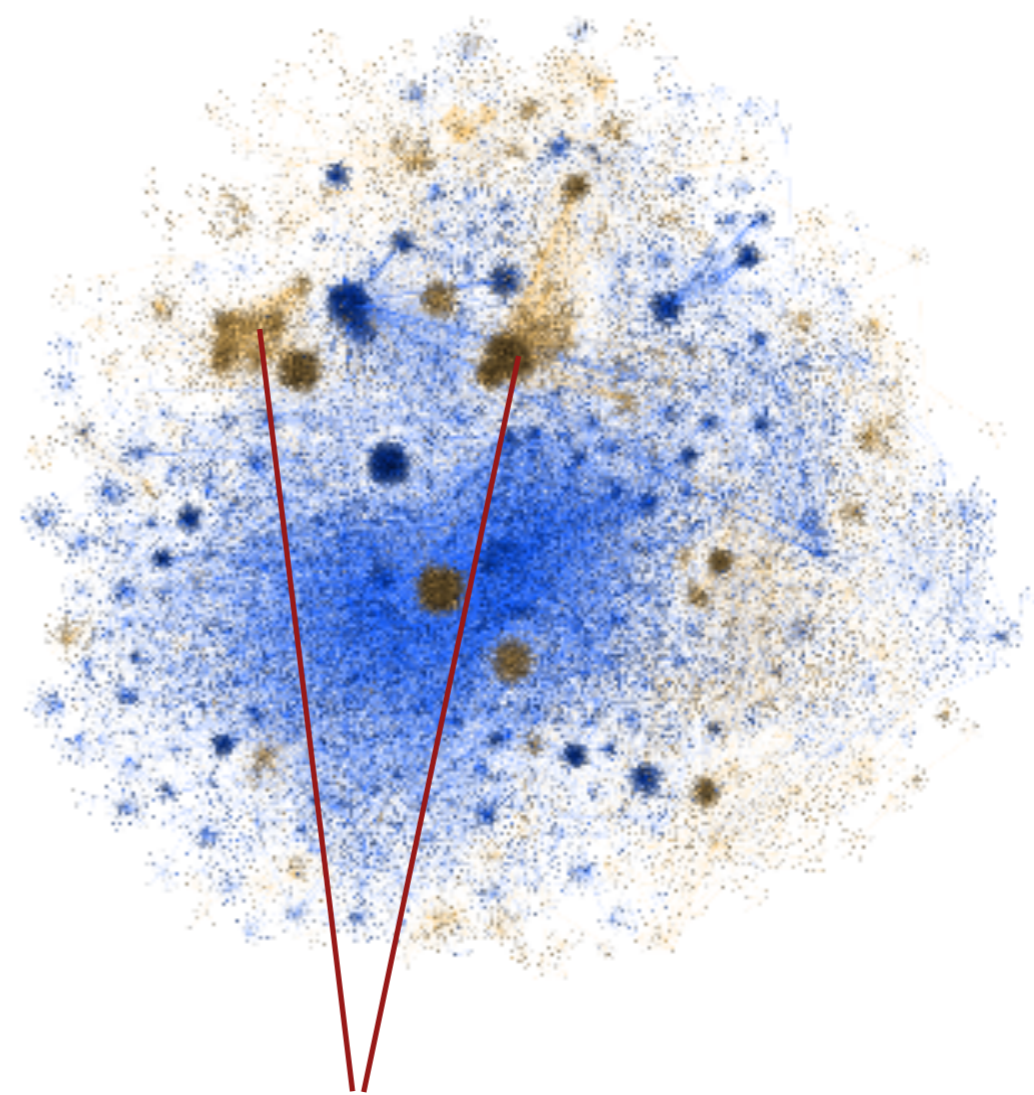
f t G+



Competition between hoaxes and fact checking



chemtrails

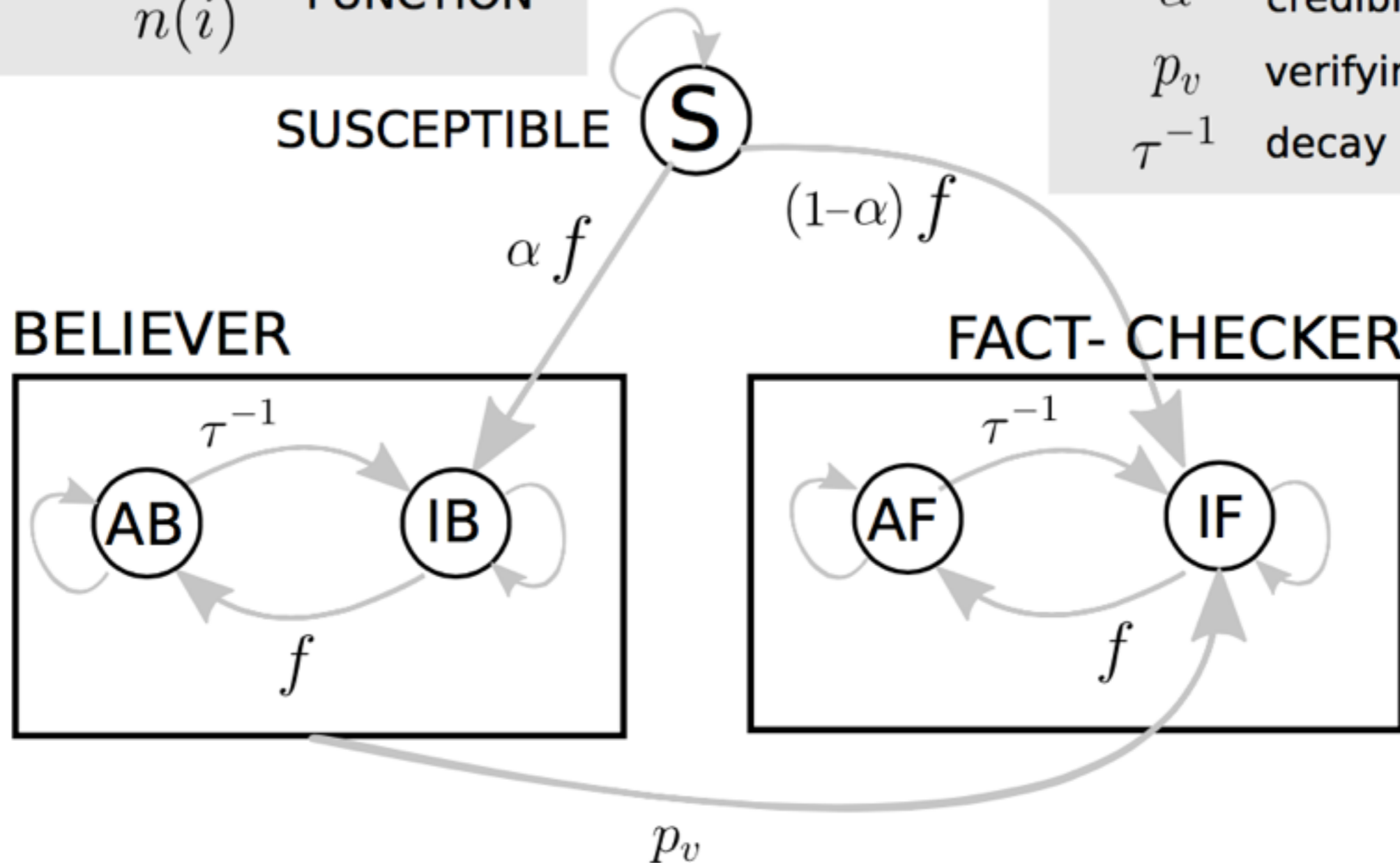


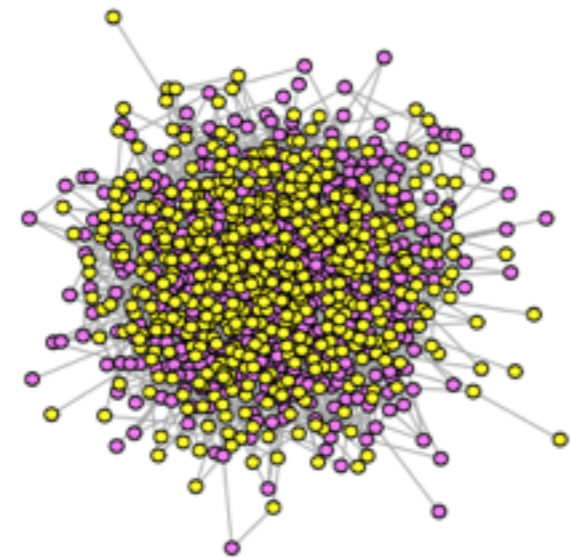
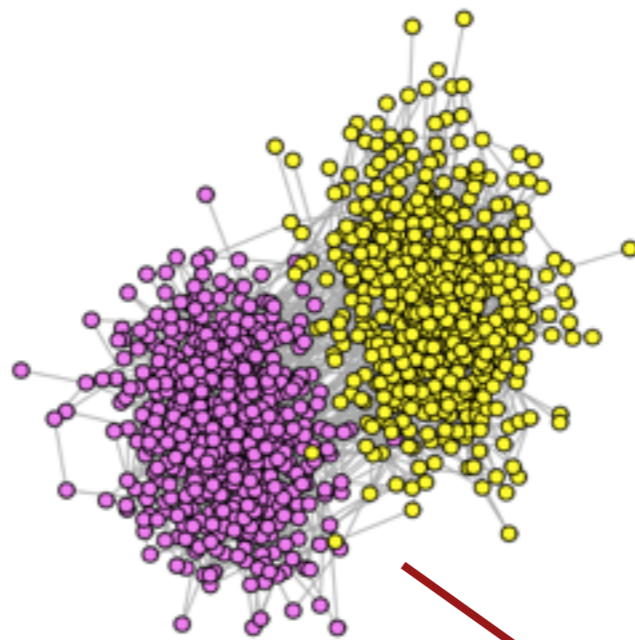
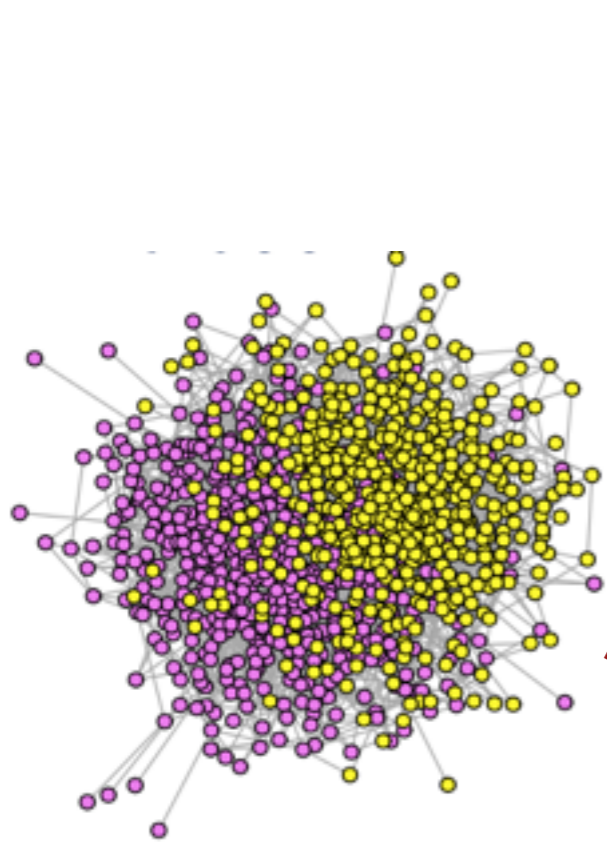
anti-vax

Hoax vs. fact checking: model

$$f_i = f = \frac{n^{AB}(i)}{n(i)} \text{ SPREADING FUNCTION}$$

$n(i)$ #neighbors of node i
 α credibility
 p_v verifying probability
 τ^{-1} decay

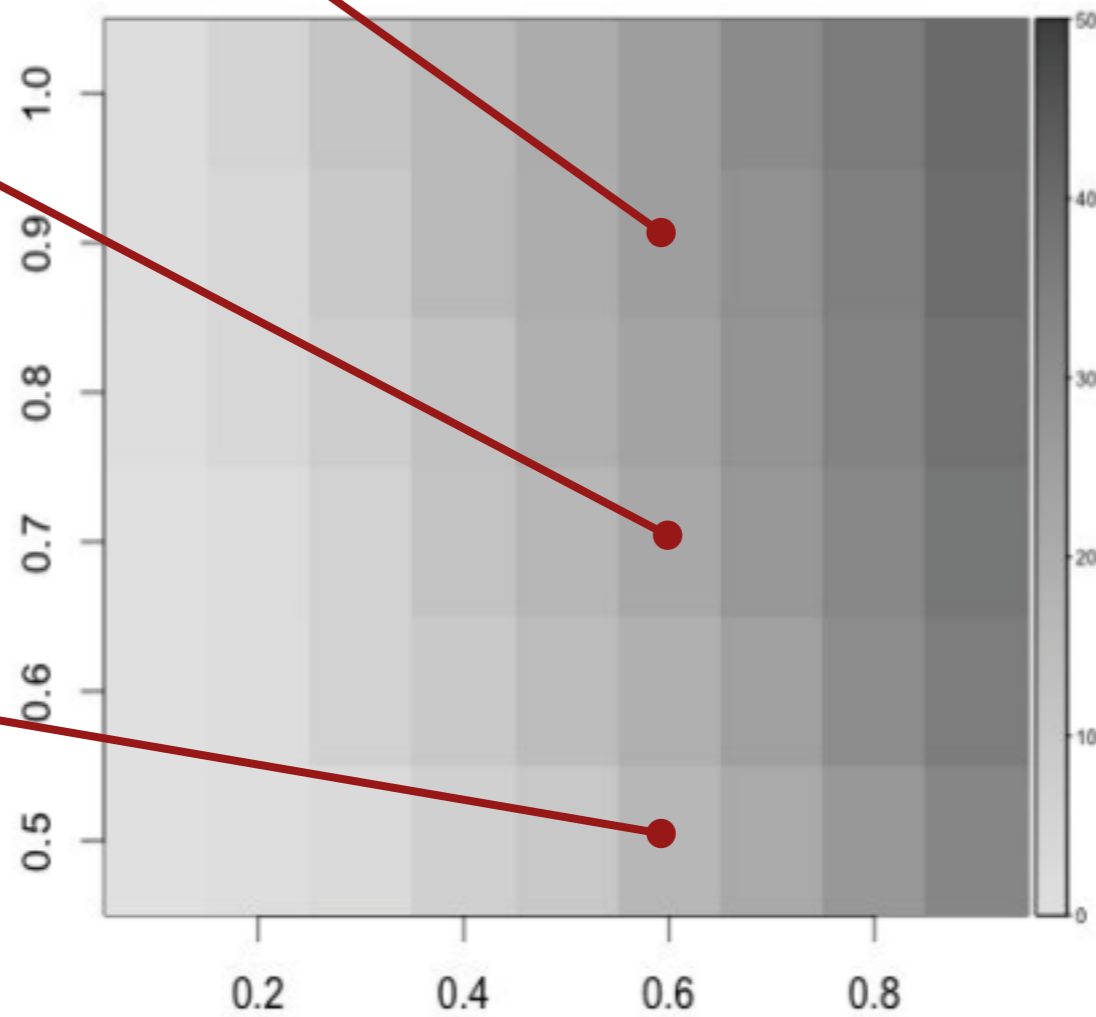




Number of active believers

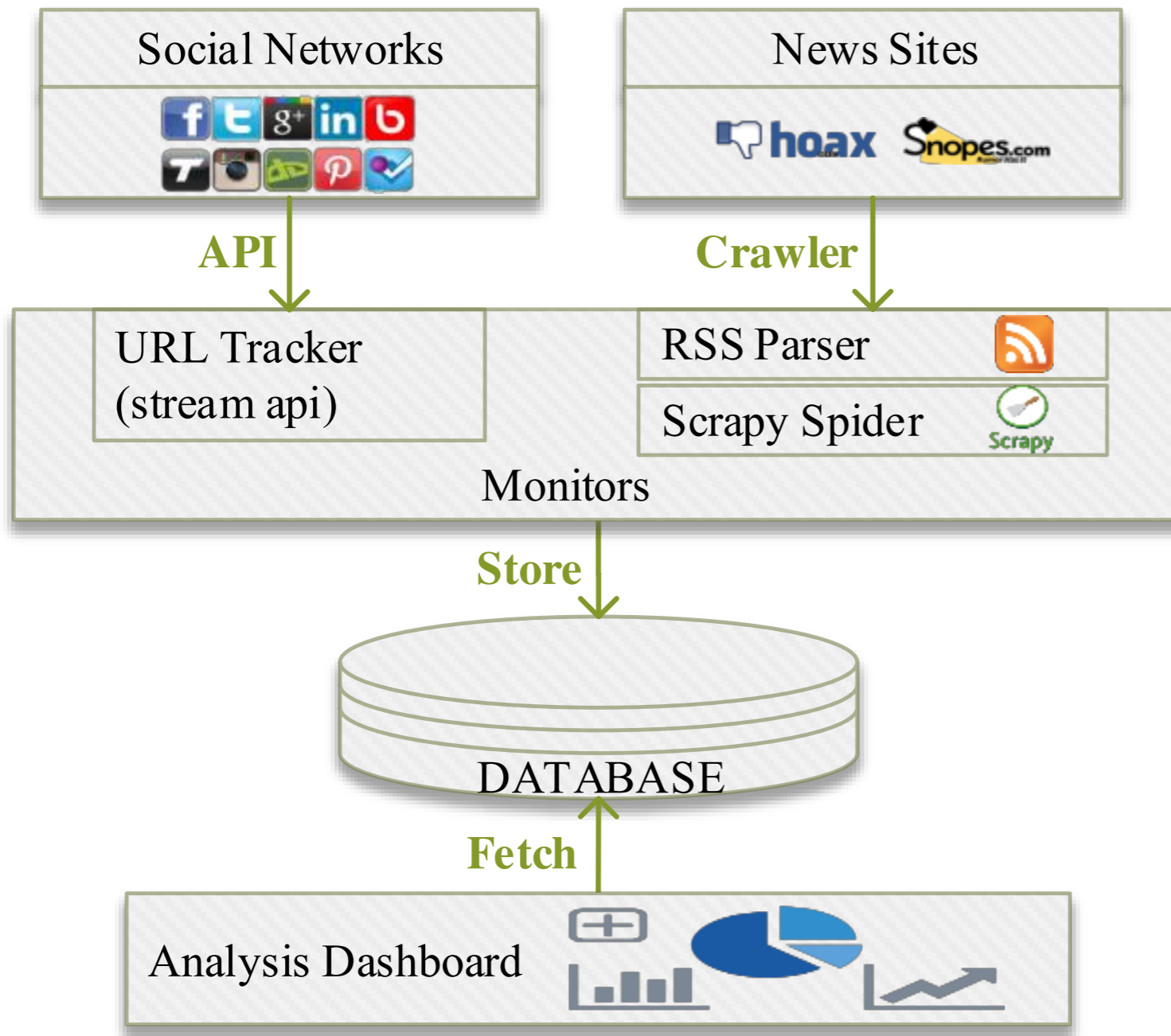


Segregation



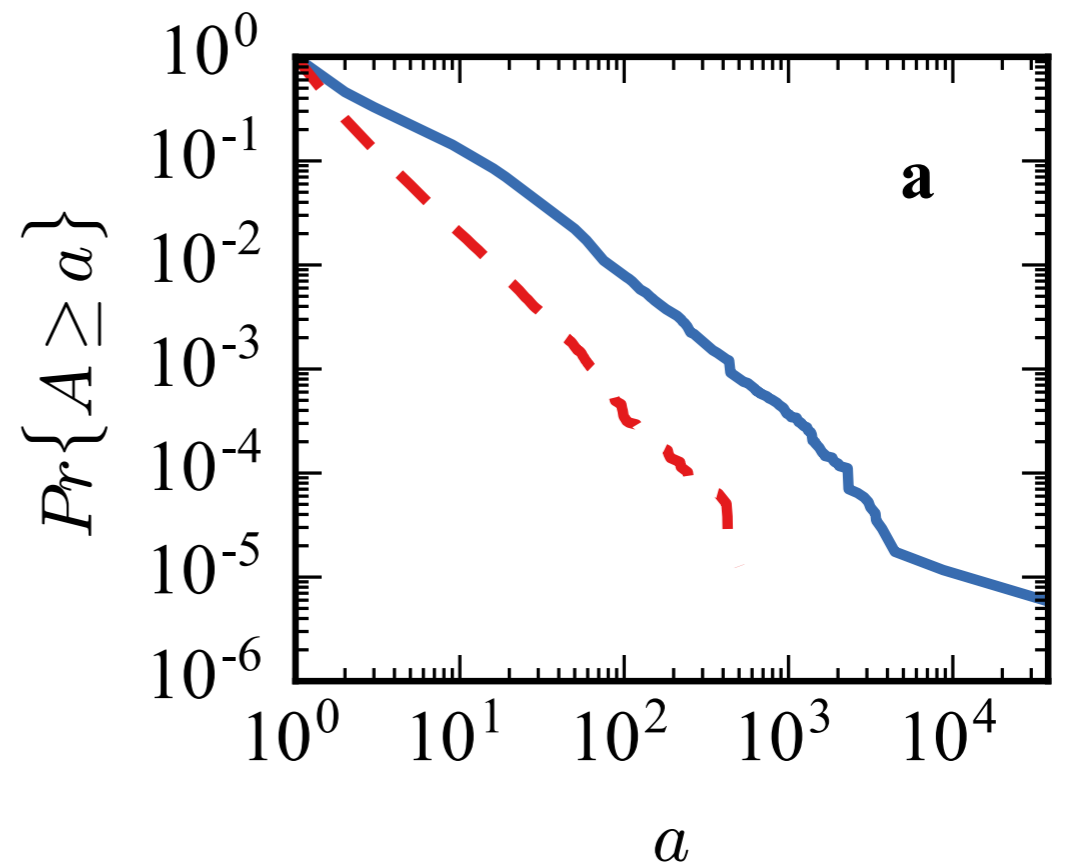
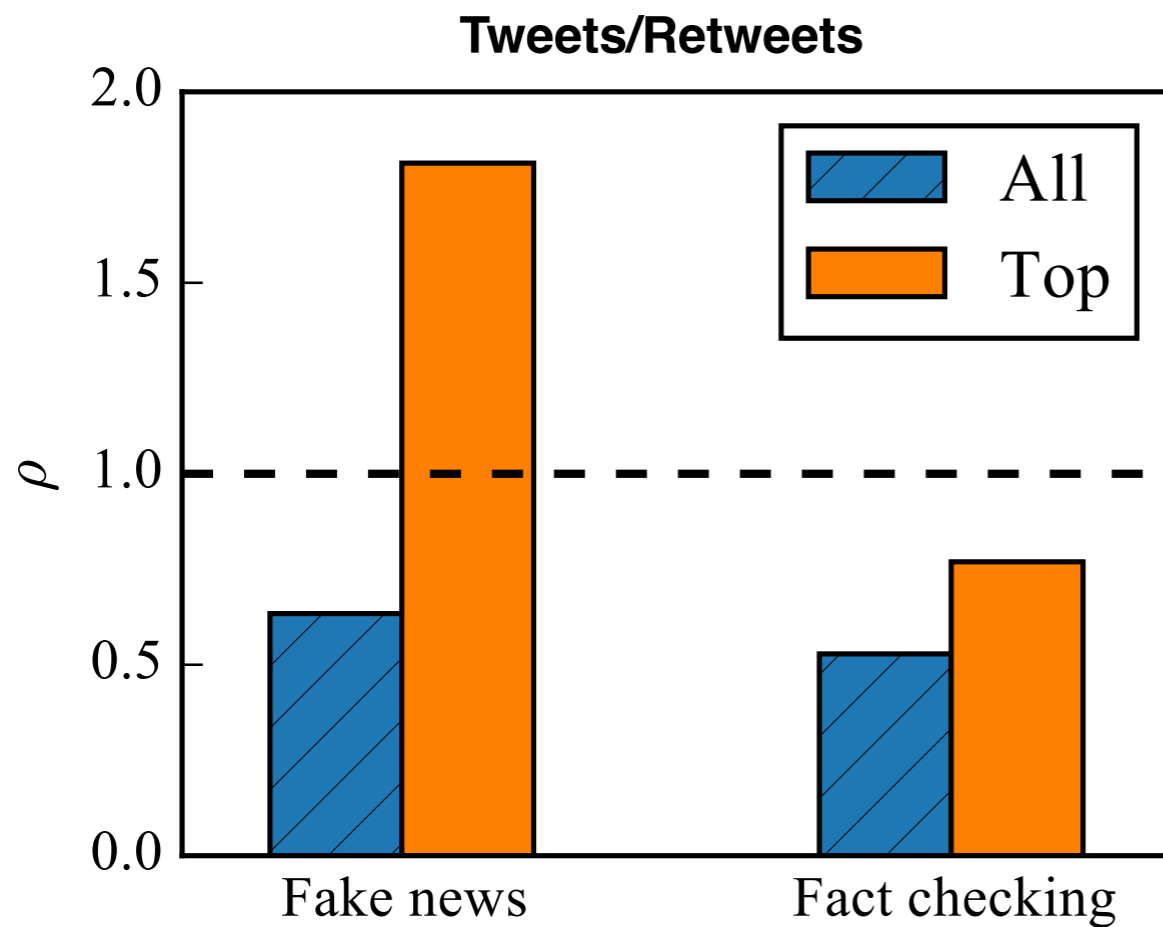
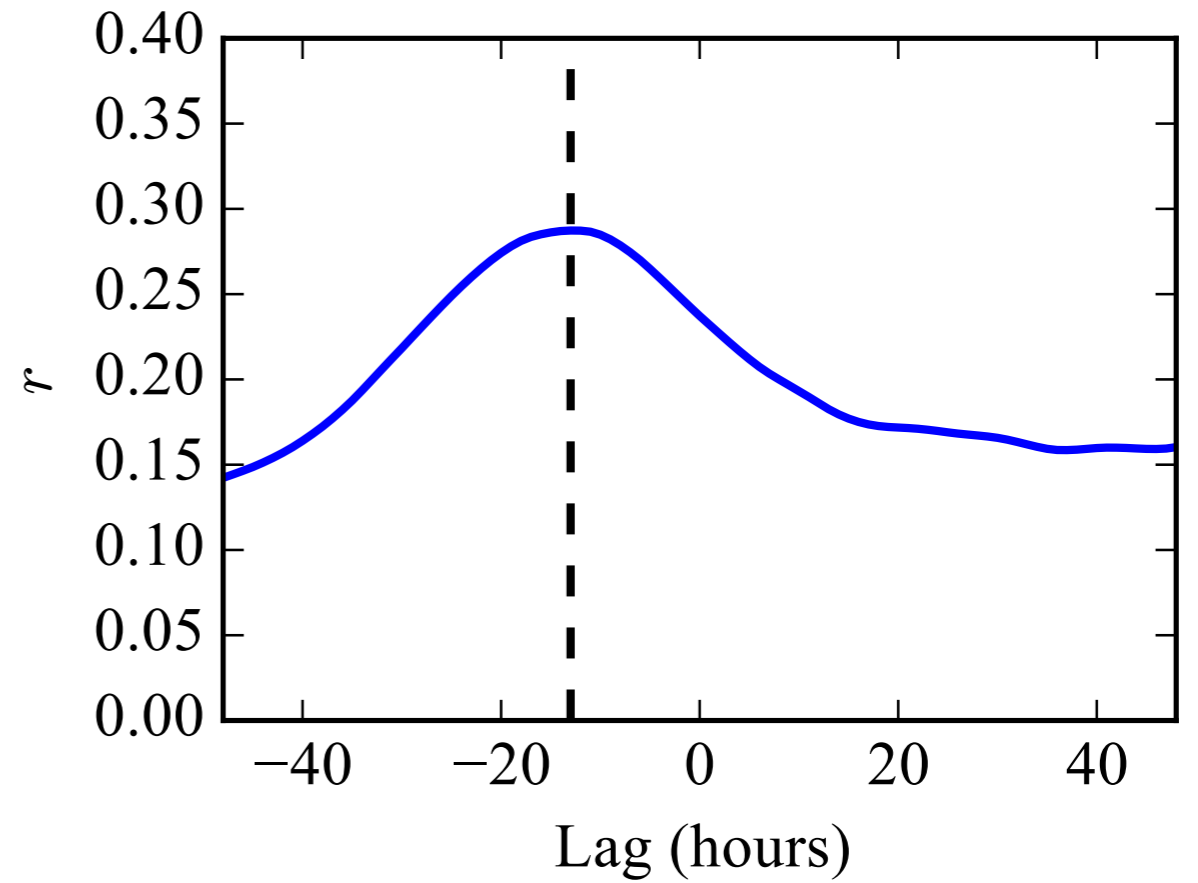
Credibility

Hoaxy

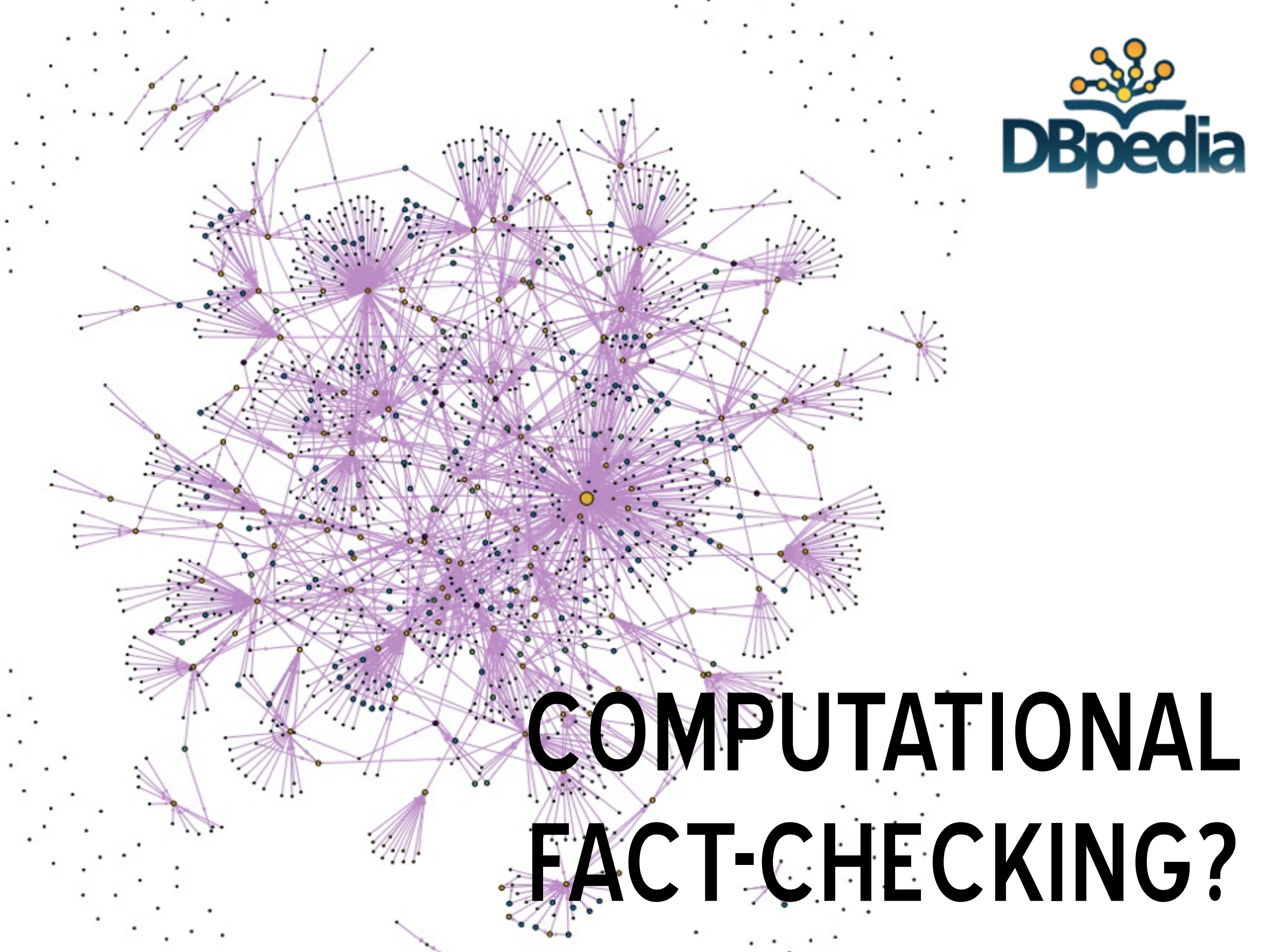


- [AmericanNews.com](#)
- [BigAmericanNews.com](#)
- [Cap News \(twitter.com/capnews\)](#)
- [ChristWire.org](#)
- [CivicTribune.com](#)
- [ClickHole.com](#)
- [CreamBMP.com](#)
- [DCGazette.com](#)
- [DailyCurrant.com](#)
- [DCClothesLine.com](#)
- [DerfMagazine.com](#)
- [DrudgeReport.com.co](#)
- [DuhProgressive.com](#)
- [EmpireNews.com](#)
- [EnduringVision.com](#)
- [Indecision Forever \(www.cc.com/indecision\)](#)
- [MSNBC.co](#)
- [MSNBC.website](#)
- [MediaMass.net](#)
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- [NewsBiscuit.com](#)
- [News-Hound.com](#)
- [NewsMutiny.com](#)
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- [Private-eye.co.uk](#)
- [RealNewsRightNow.com](#)
- [RileNews.com](#)
- [Sprotspickle.com](#)
- [TheNewsNerd.com](#)
- [TheUsPatriot.com](#)
- [WitScience.org](#)

source	sites	tweets	users	URLs
fake news	71	1,287,769	171,035	96,400
fact checking	6	154,526	78,624	11,183



1. Detection of misinformation
2. How misinformation spreads
3. Can the spread of misinformation be mitigated?

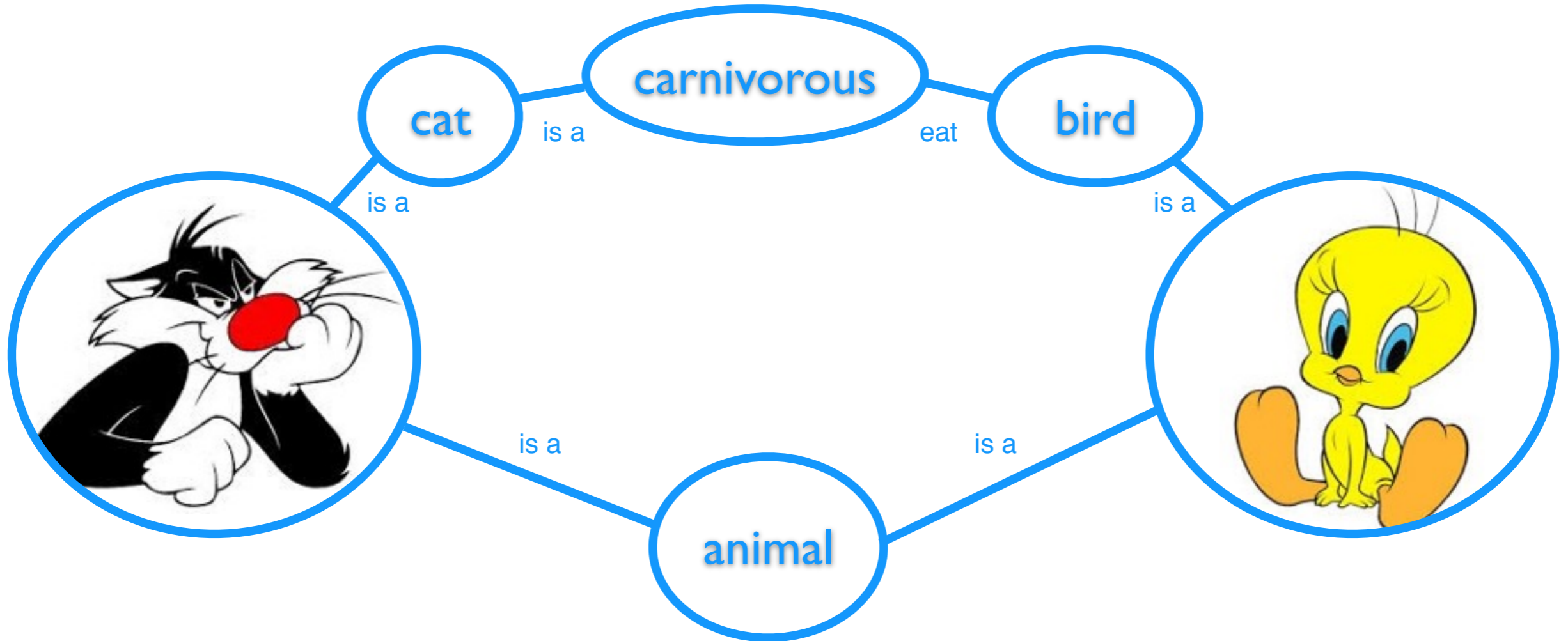


COMPUTATIONAL FACT-CHECKING?



Guen @guenxcv · 9 Sep 2013

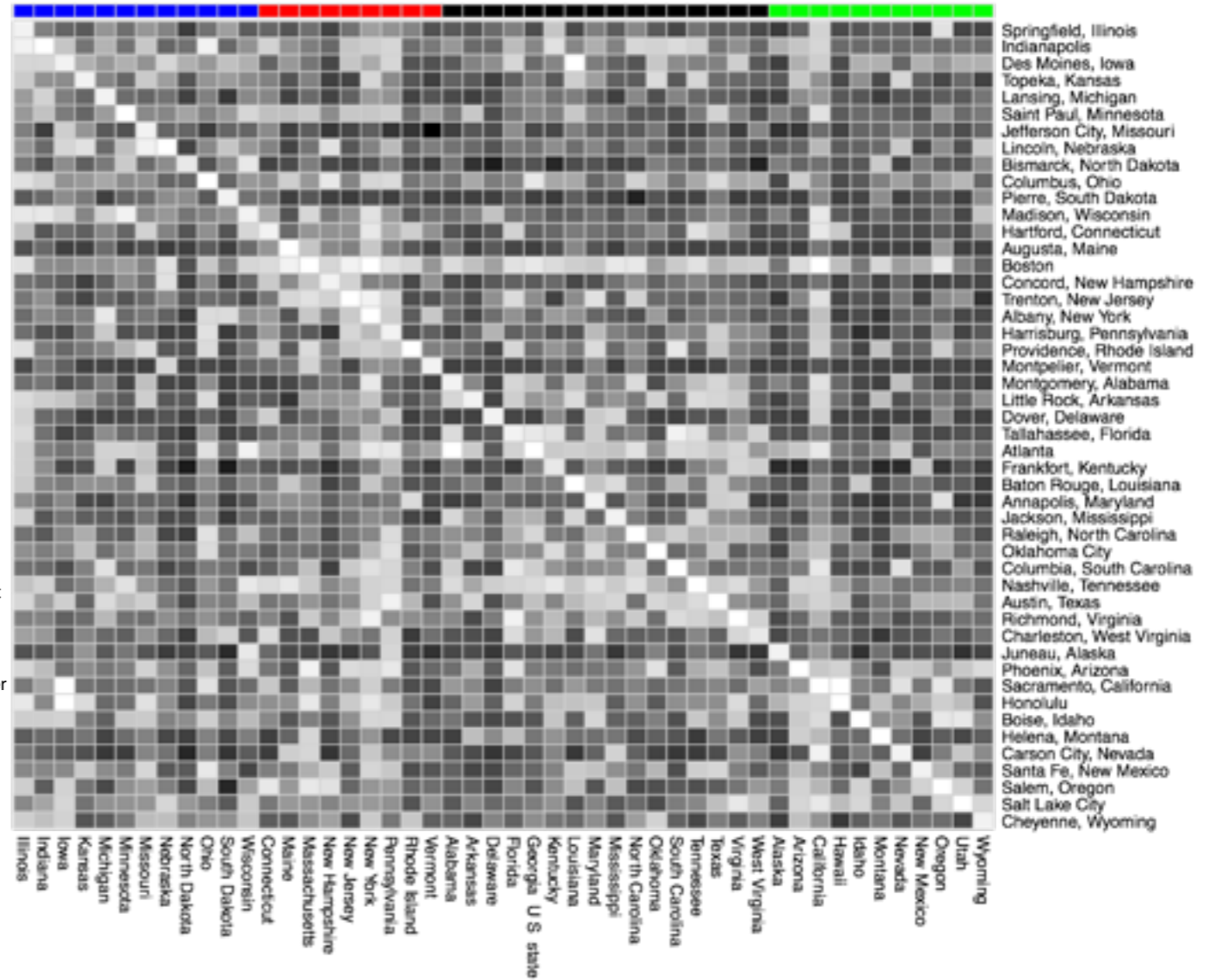
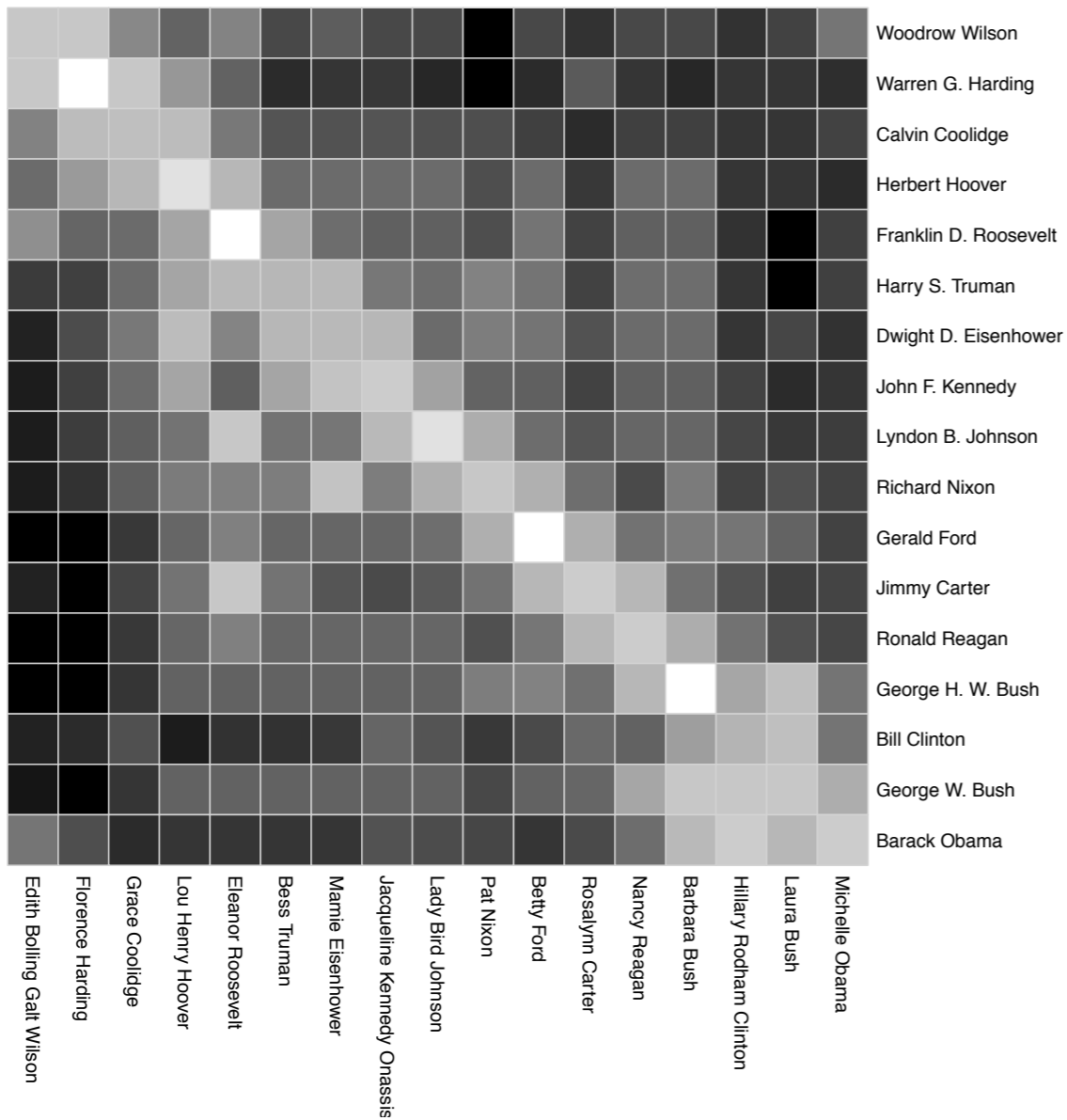
@maandreysf we doooo :(**sylvester wants to eat tweety!!!**



$$\mathcal{W}(P_{s,o}) = \mathcal{W}(v_1 \dots v_n) = \left[1 + \sum_{i=2}^{n-1} \log k(v_i) \right]^{-1}$$



is the spouse of





Bossy Cracka @Junebug1952 · Sep 25

Obama Forbids FBI to use Religion in Identifying Terror Threats as ISIS OPENLY recruits in Mosques in.is/www.breitbart.com **Obama IS a MUSLIM**

Expand

← Reply ↻ Retweet ★ Favorite ... More



Kathryn Master @KathrynMaster1 · Sep 24

@megynkelly **#Obama is a Muslim** who wants to turn America into Muslim Brotherhood controlled country. Pls research & do show on. Must stop him

💬 View conversation

← Reply ↻ Retweet ★ Favorite ... More



mary christie @peaceischrist · Sep 24

Husain Barack **Obama is a Muslim!** That is why he hates America, Christians, Israel etc! [#Obama](#) [@BarackObama](#) [@oreillyfactor](#)

Expand

← Reply ↻ Retweet ★ Favorite ... More

Barack Obama



U.S. President Barack Obama in front of the *Resolute* desk in the Oval Office of the White House, December 6, 2012

44th President of the United States

Incumbent

Assumed office
January 20, 2009

Vice President Joe Biden

Preceded by George W. Bush

United States Senator
from Illinois

In office
January 3, 2005 – November 16, 2008

Preceded by Peter Fitzgerald

Succeeded by Roland Burris

Member of the Illinois Senate
from the 13th District

In office
January 8, 1997 – November 4, 2004

Preceded by Alice Palmer

Succeeded by Kwame Raoul

Personal details

Born Barack Hussein Obama II
August 4, 1961 (age 52)
Honolulu, Hawaii, U.S.

Nationality American

Political party Democratic



Obama



Columbia University

**Association of
American Universities**



Canada



Stephen Harper



Calgary

Naheed Nenshi



Muslim



Islam

[\[hide\]](#)



Beliefs

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Practices

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Denominations

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Culture · Society

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Related topics

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[V](#) · [T](#) · [E](#)

Knowledge Linker

Knowledge Linker

Subject:

Bill Clinton

Predicate:

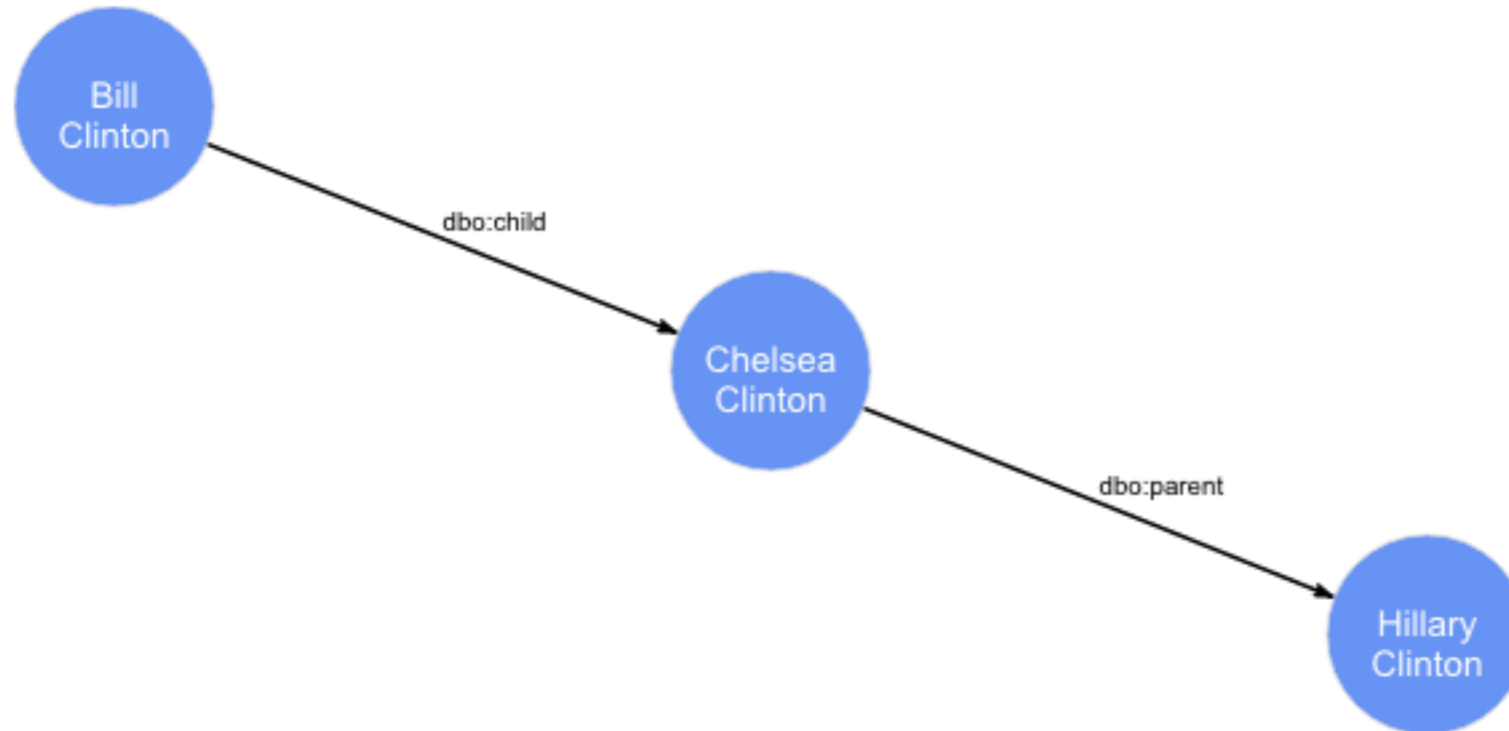
spouse

Object:

Hillary Rodham Clinton

Check

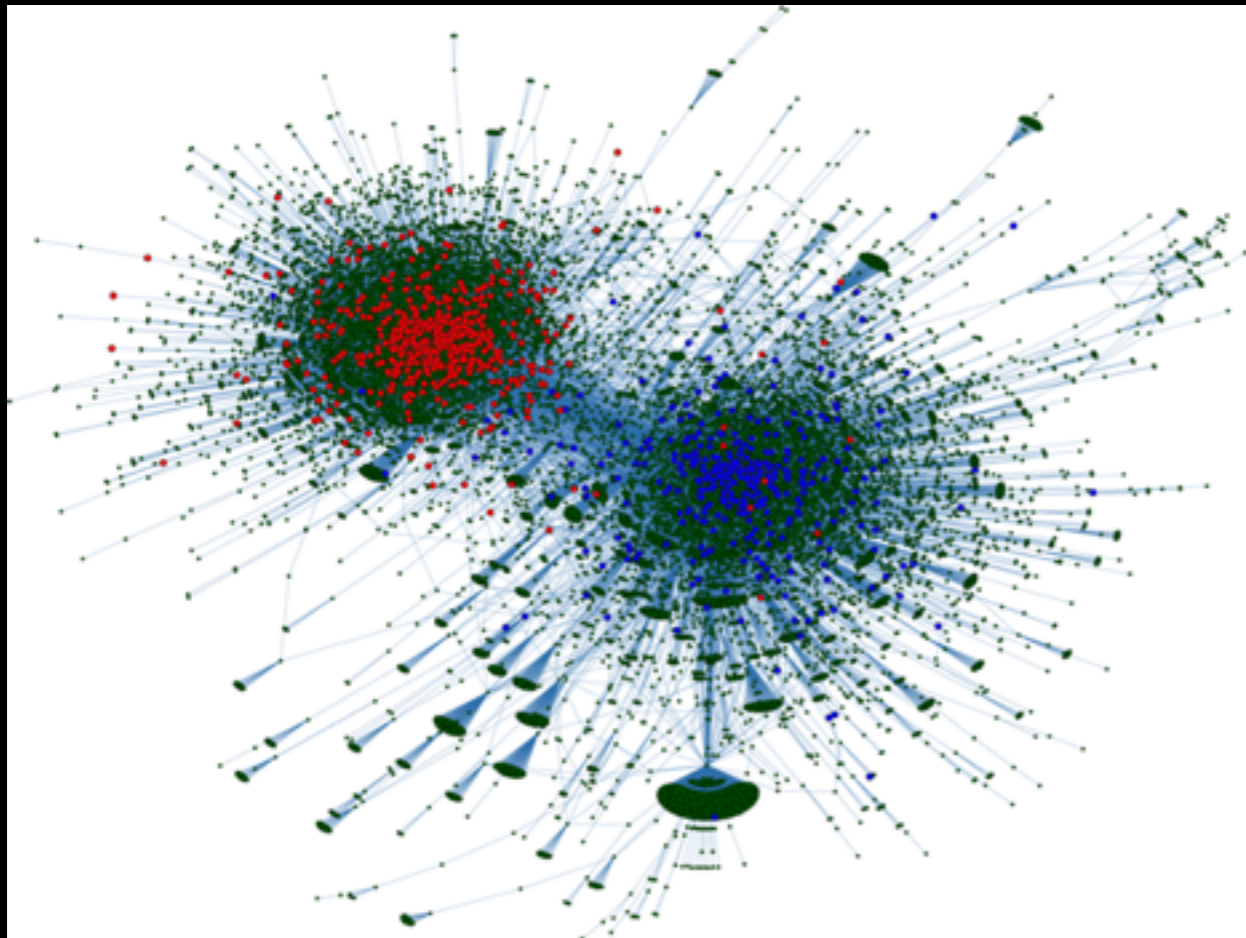
Most Informative Path:



DOES FACT-CHECKING WORK?

- ▶ **Echo chambers**
- ▶ **Selective exposure**
- ▶ **Confirmation bias**

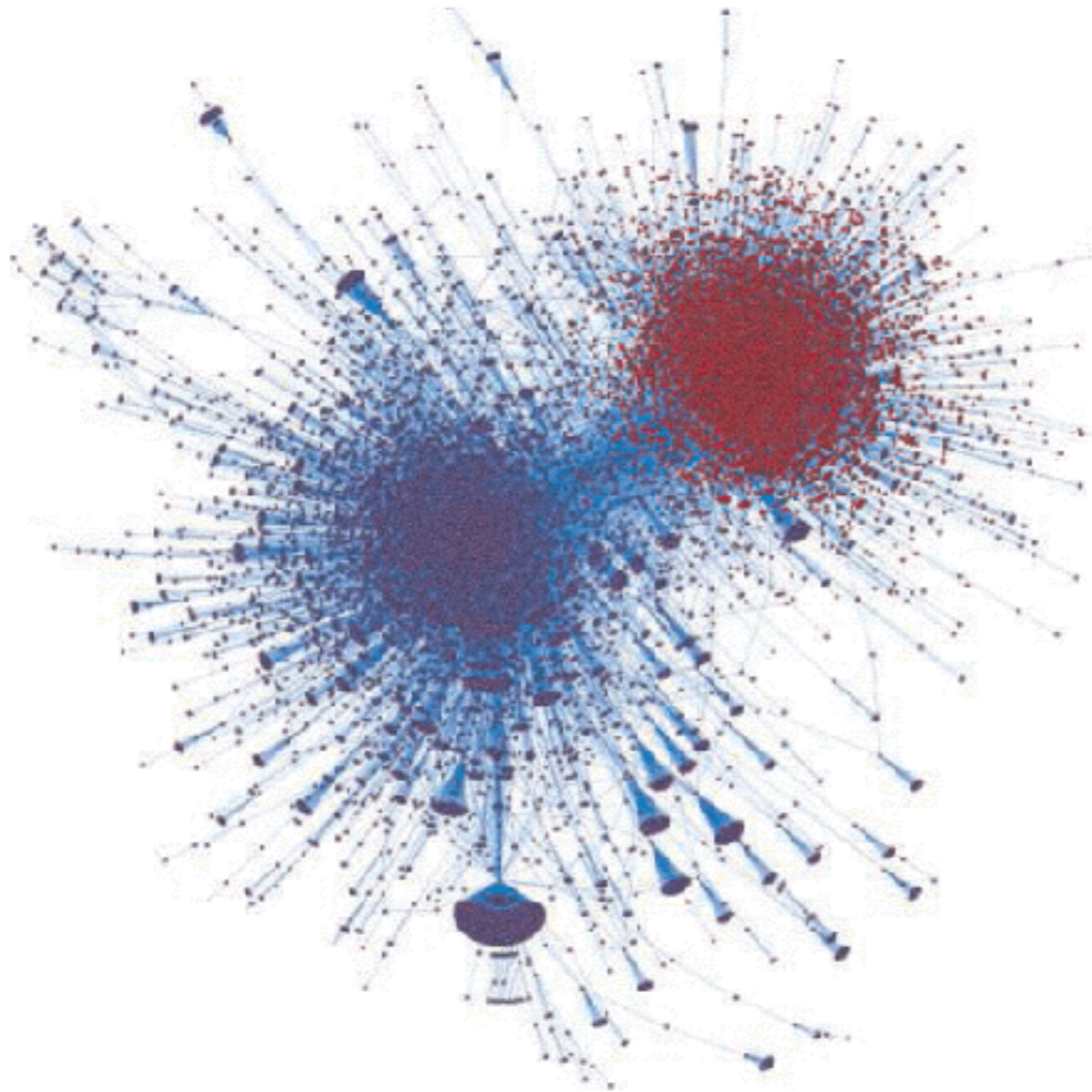
Predicting political alignment



Features	Accuracy
Text (TF-IDF)	79%
Hashtags	91%
Retweet network	95%
Tags + Network	95%

Social Scientists Wade Into the Tweet Stream

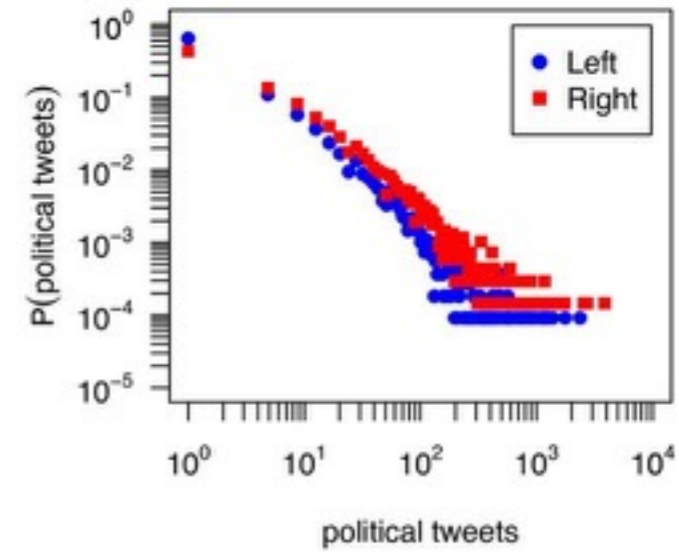
Science 30 September 2011:
vol. 333 no. 6051 1814-1815



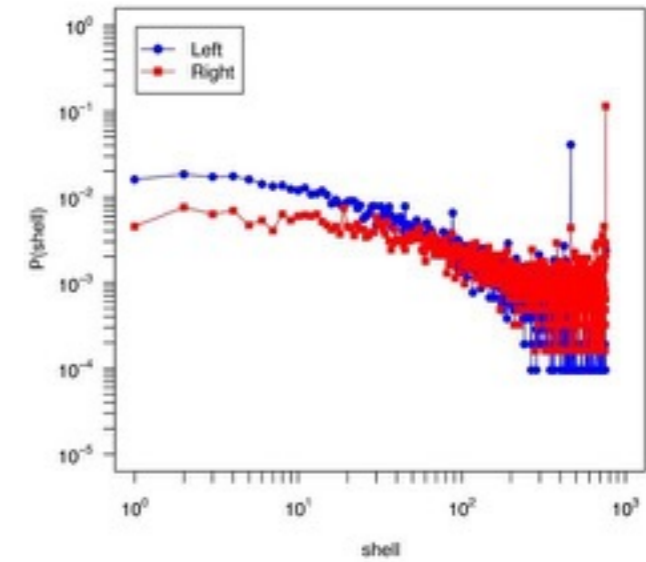
Echo chamber.

On Twitter, liberals (blue) and conservatives (red) network more with like-minded users, with less traffic crossing the political divide.

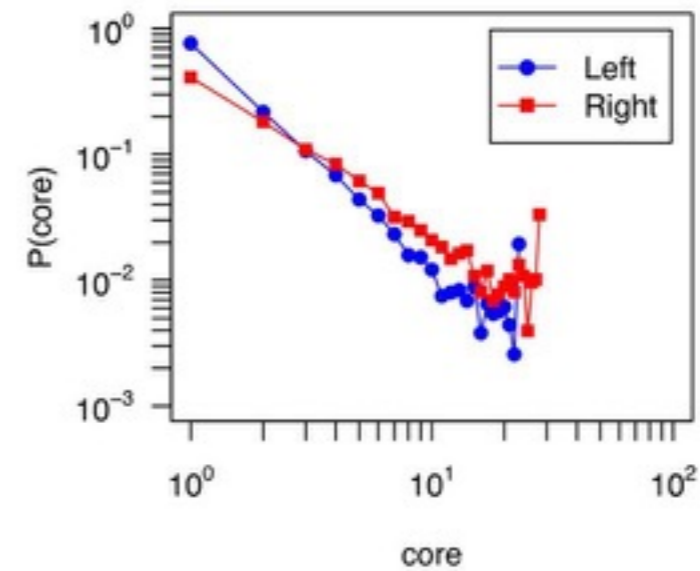
CREDIT: © 2011 TRUTHY PROJECT (TRUTHY.INDIANA.EDU), INDIANA UNIVERSITY



Activity



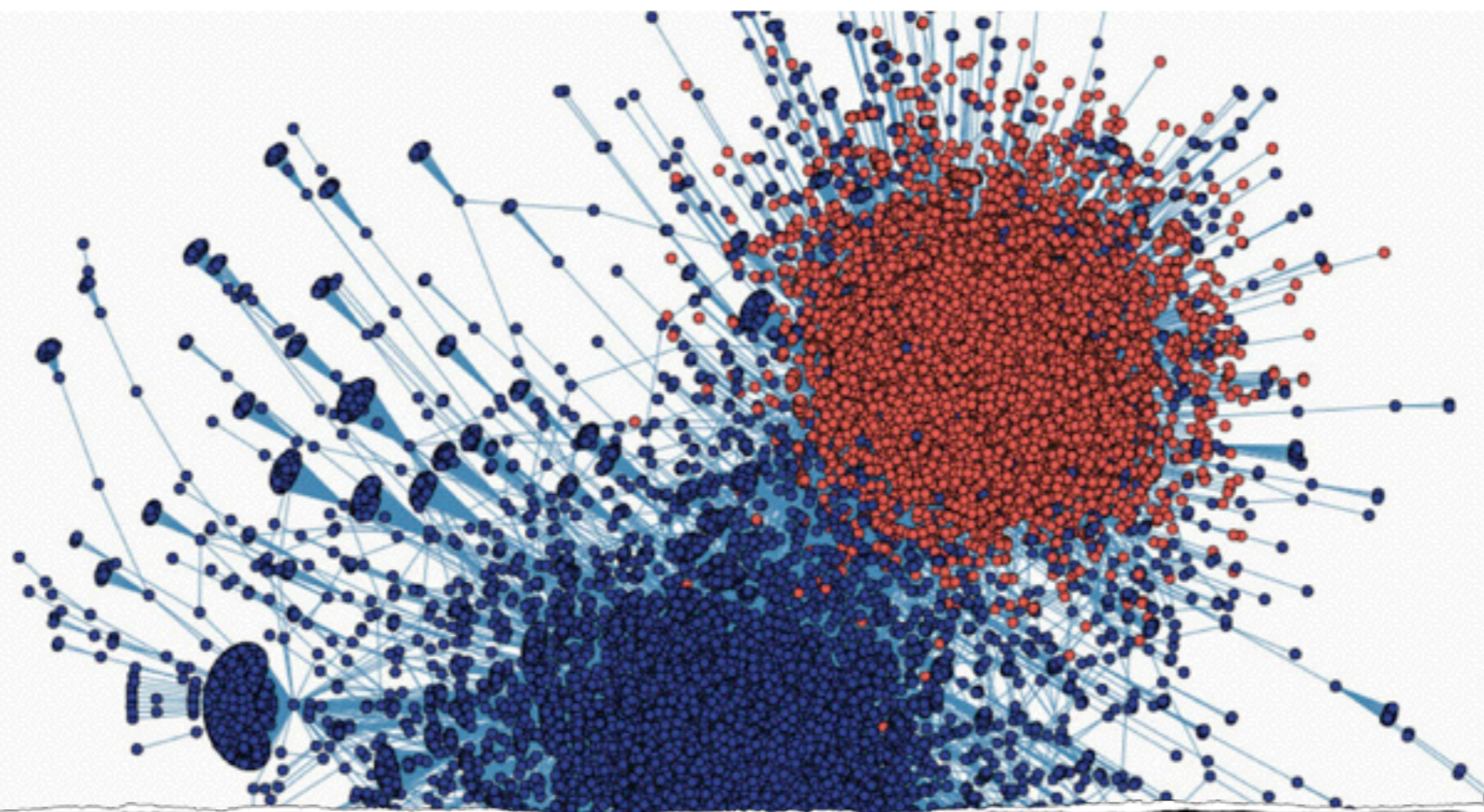
K-core
follower
network



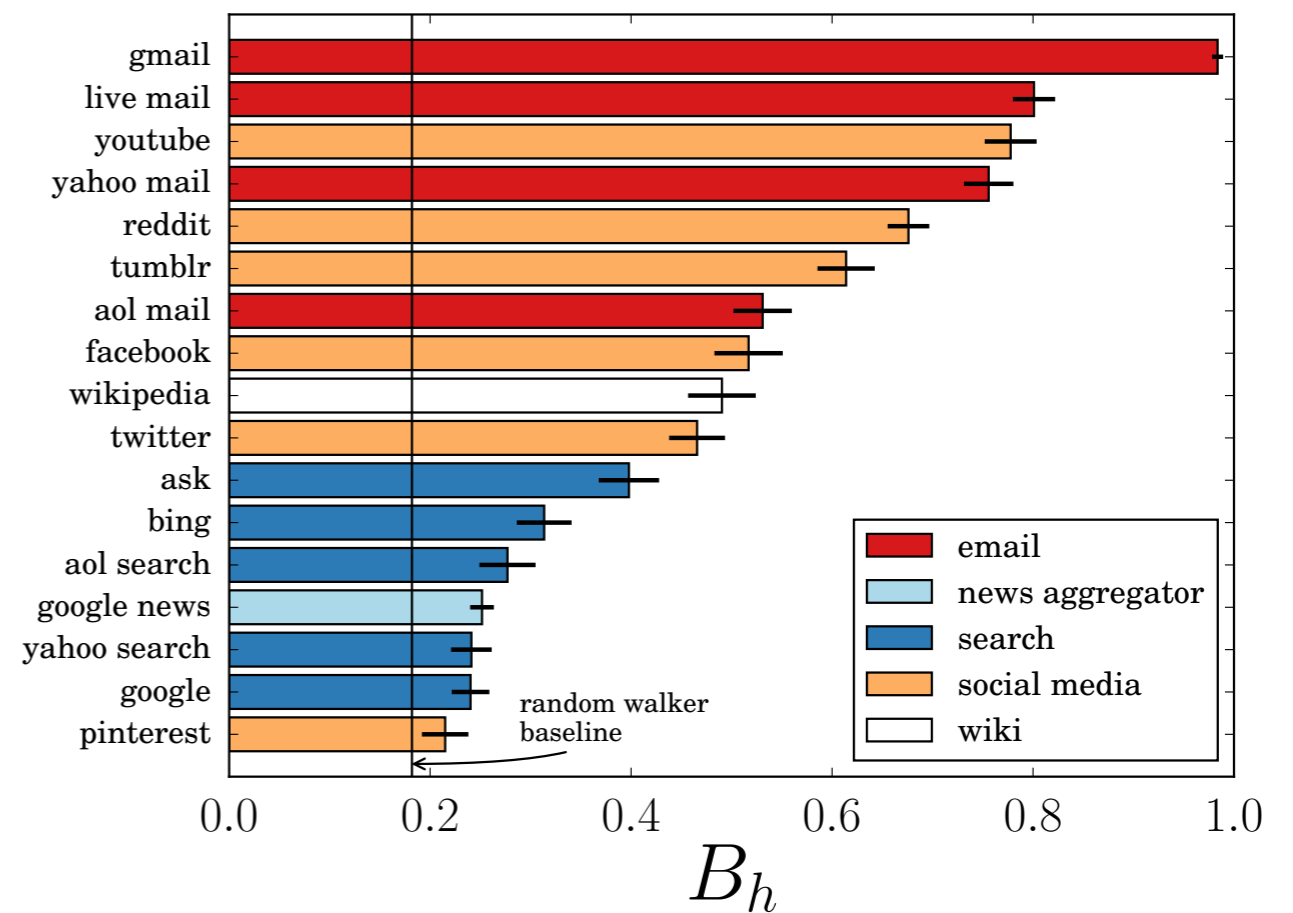
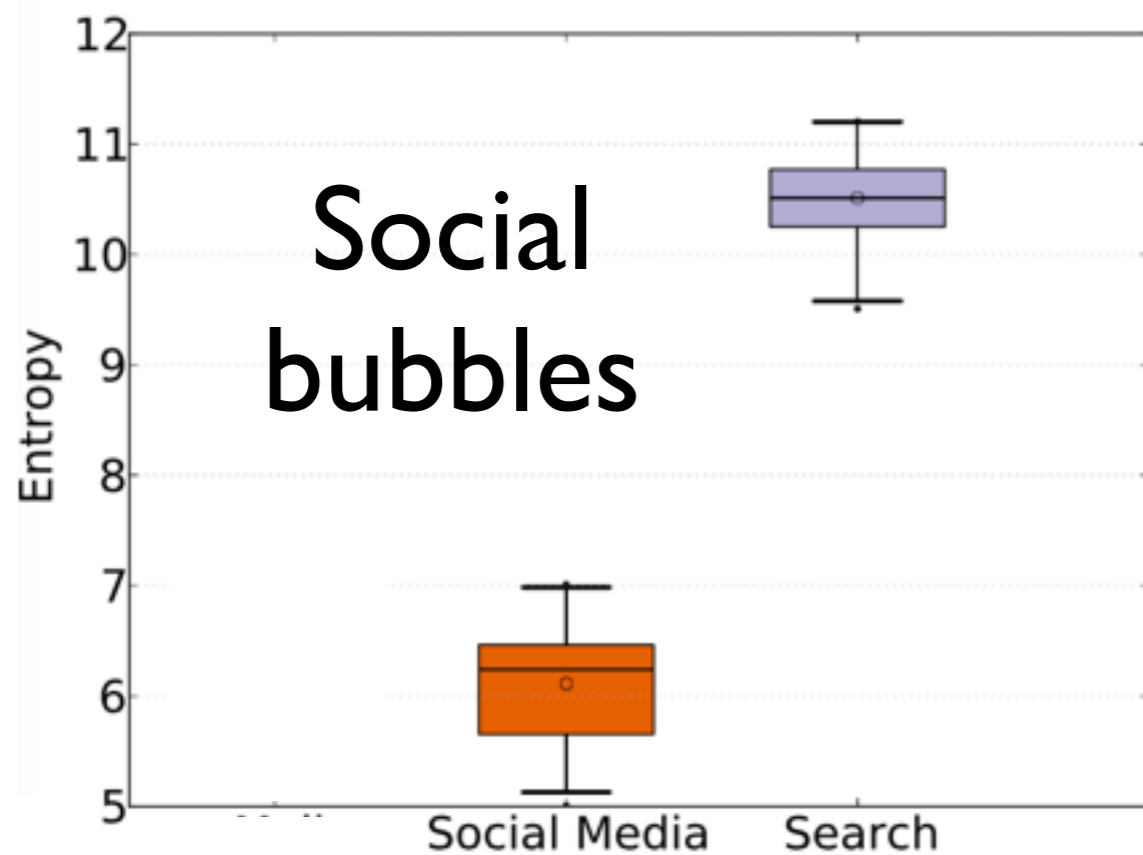
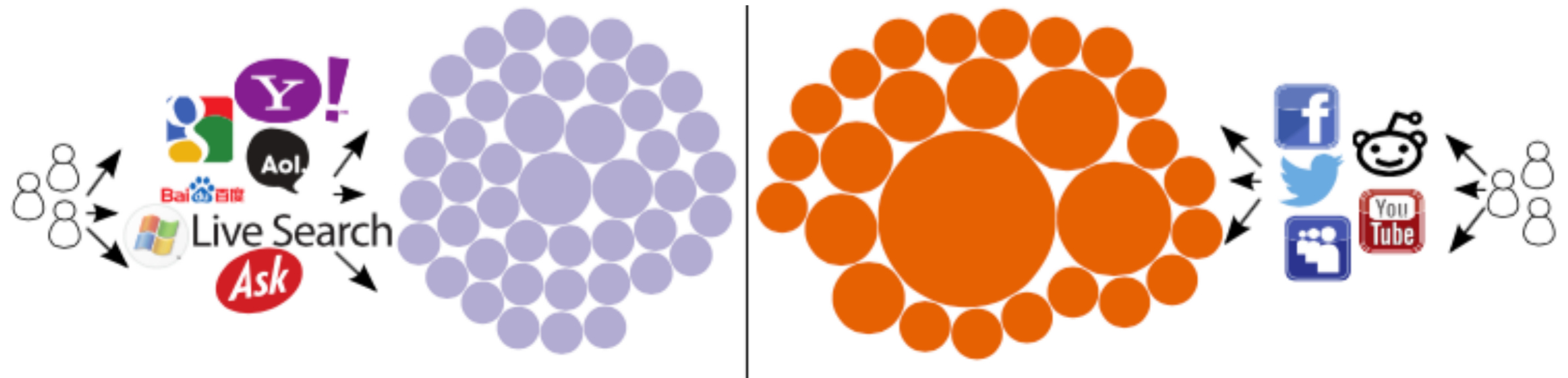
K-core
retweet
network

Infographic Of The Day: Does Twitter Make Our Politics Worse?

BY CLIFF KUANG Thu Jul 28, 2011

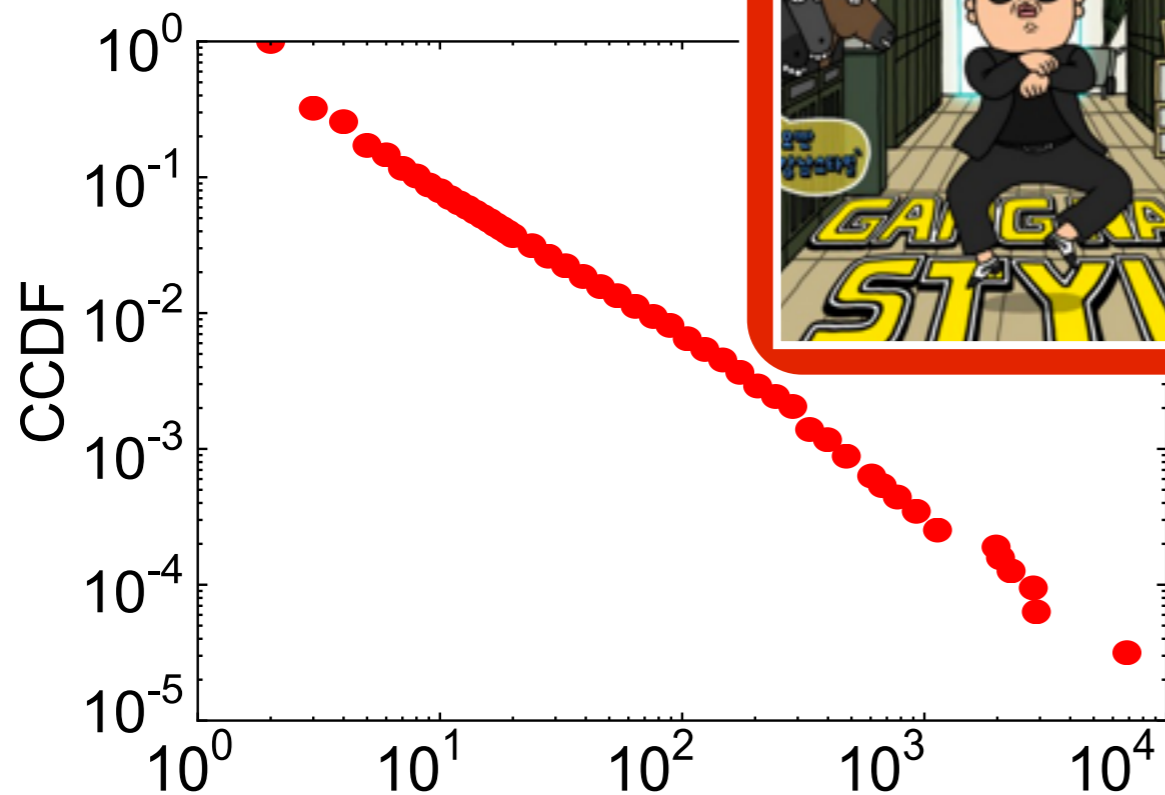


Homogeneous Exposure



COMPETITION FOR ATTENTION

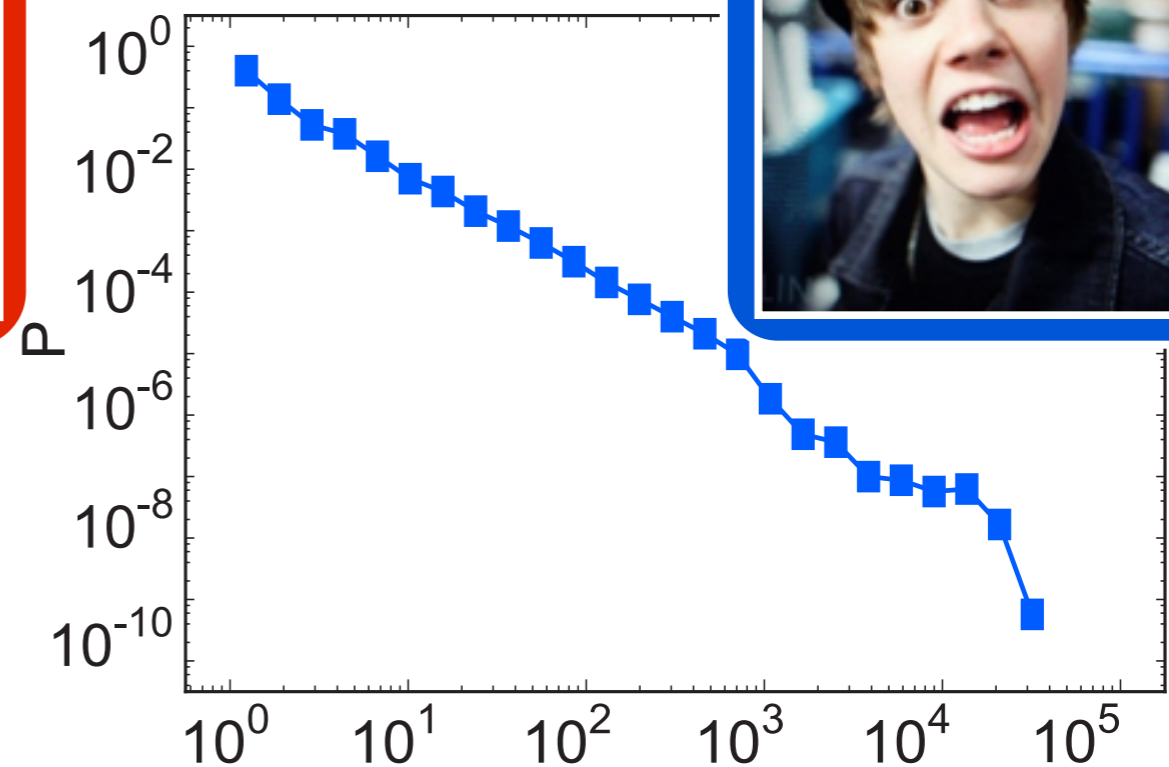
2B Views



Hashtag Popularity

daily retweets
[Twitter]

55M Followers



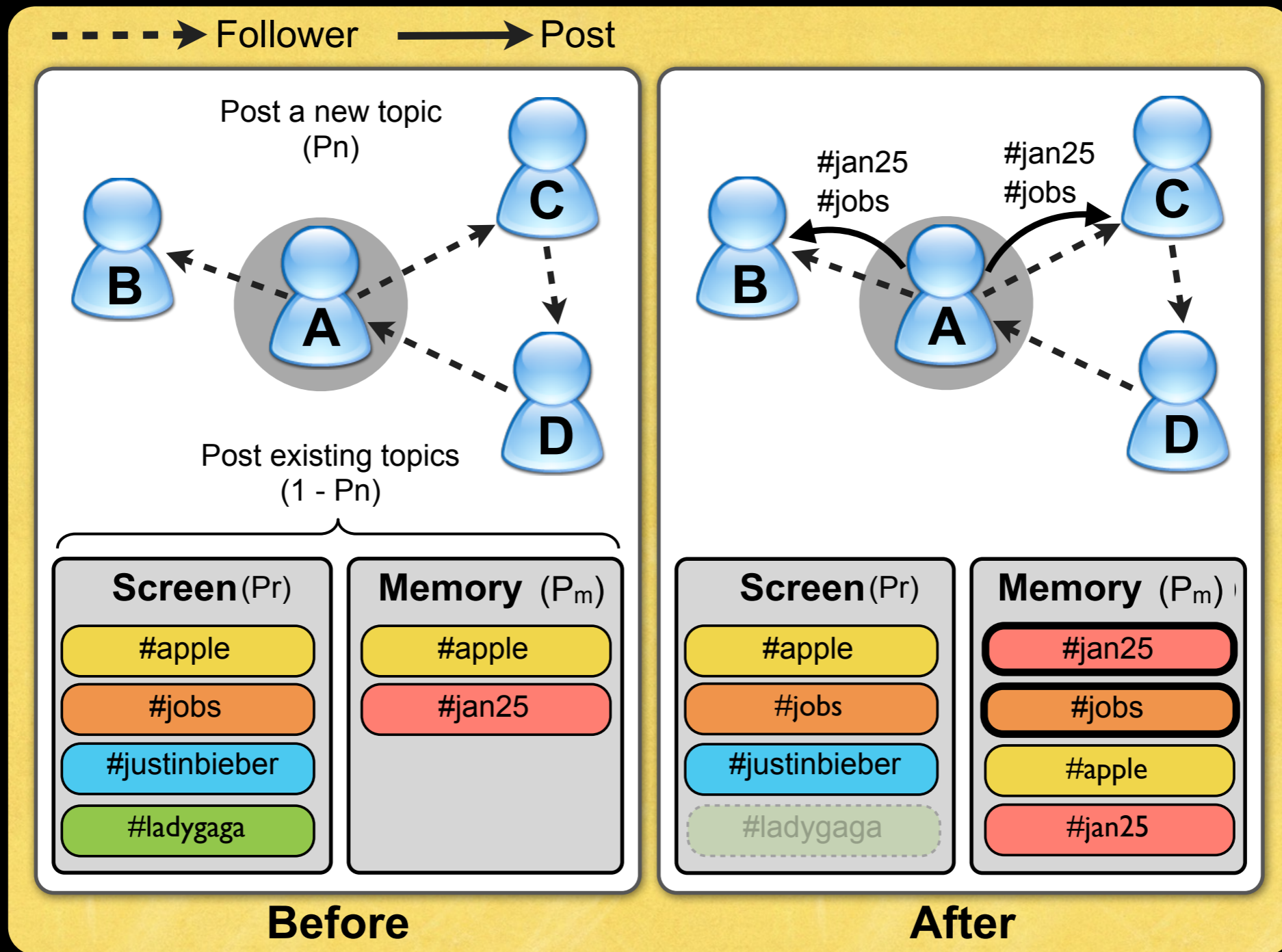
User Popularity

followers
[Yahoo! Meme]

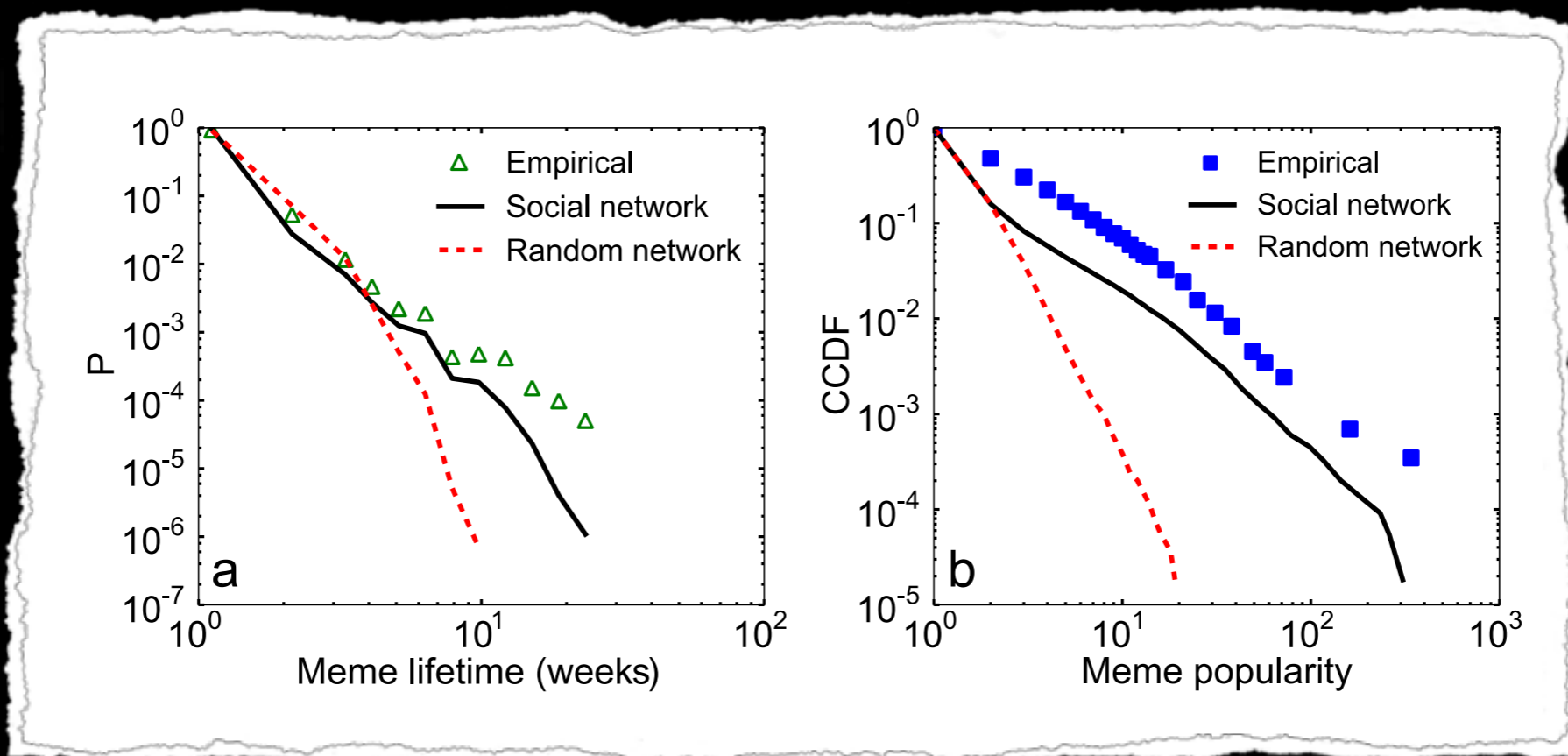


Can the *competition for limited user attention* help explain the broad heterogeneity of meme popularity and our vulnerability to misinformation?

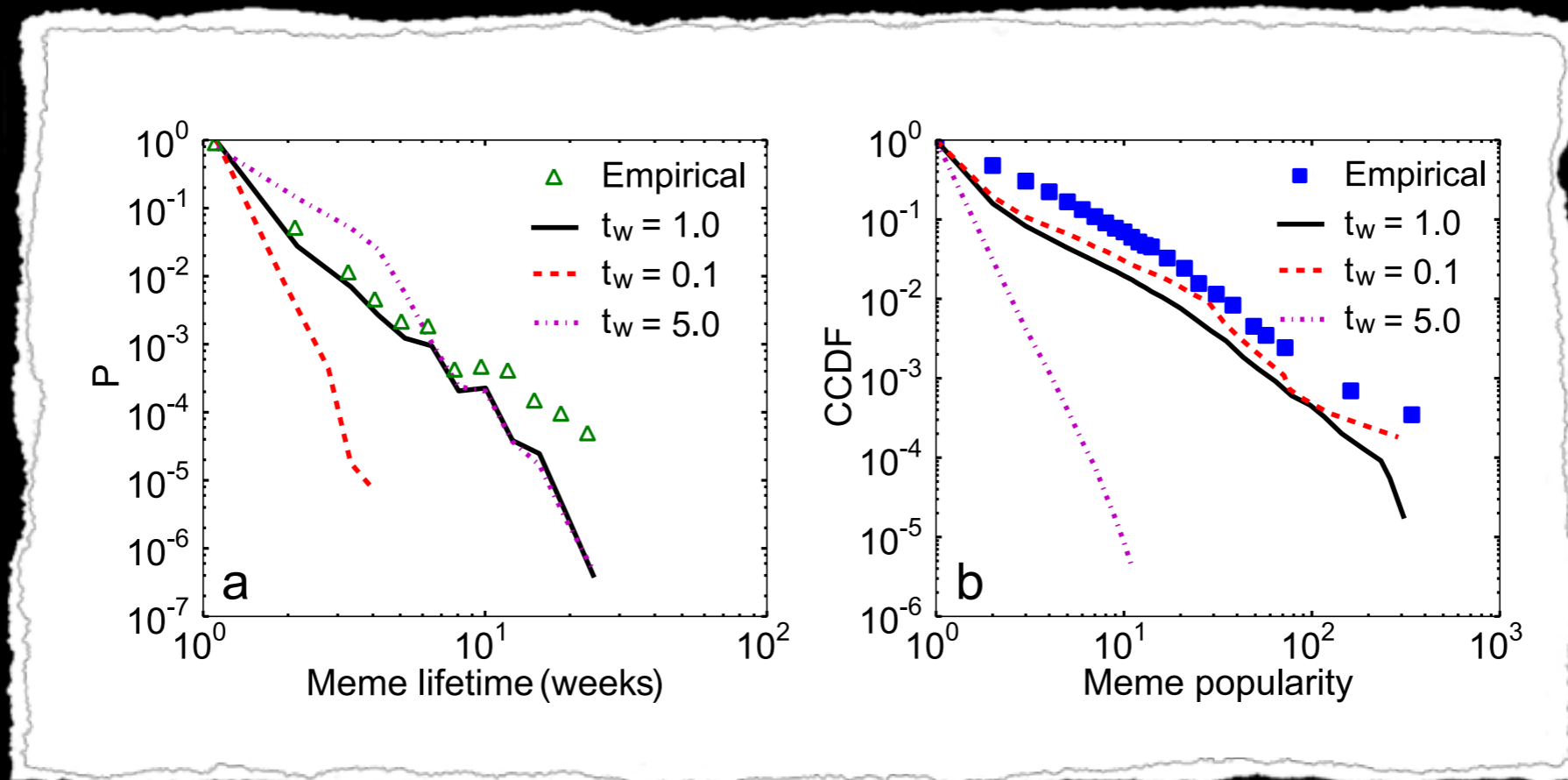
Toy agent-based model



Toy model predictions: Role of *social network*



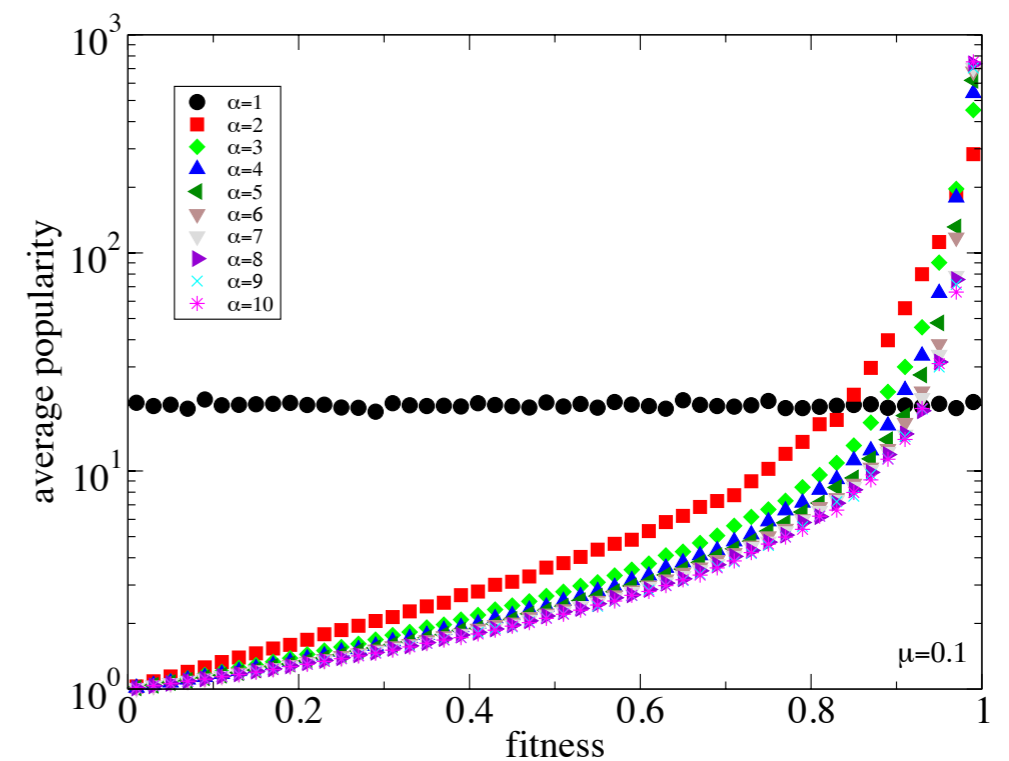
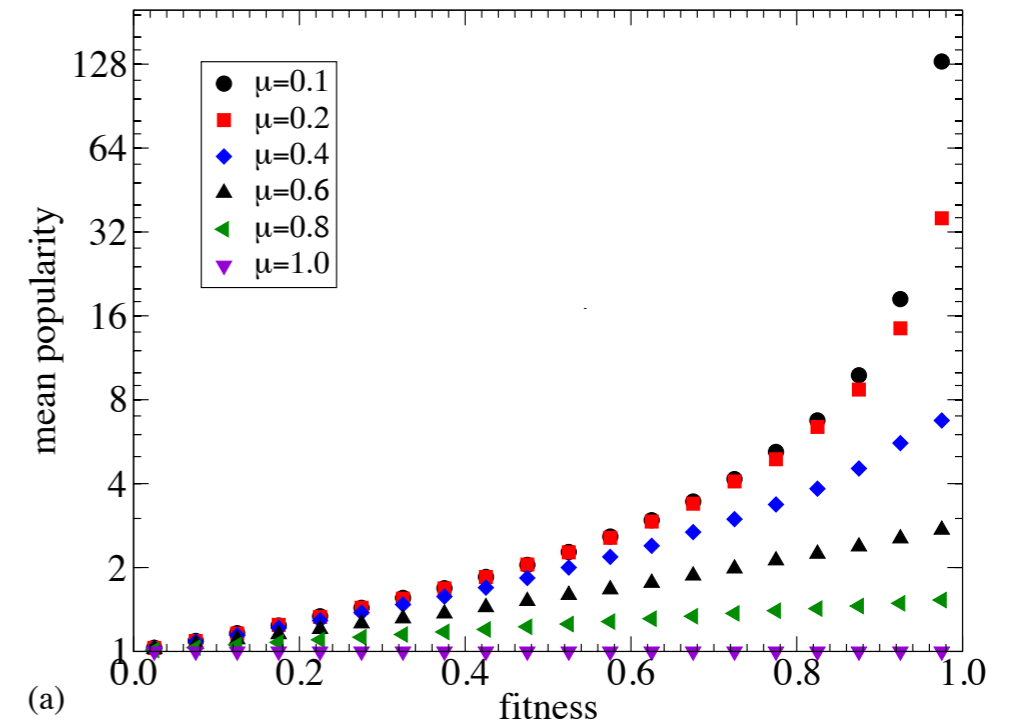
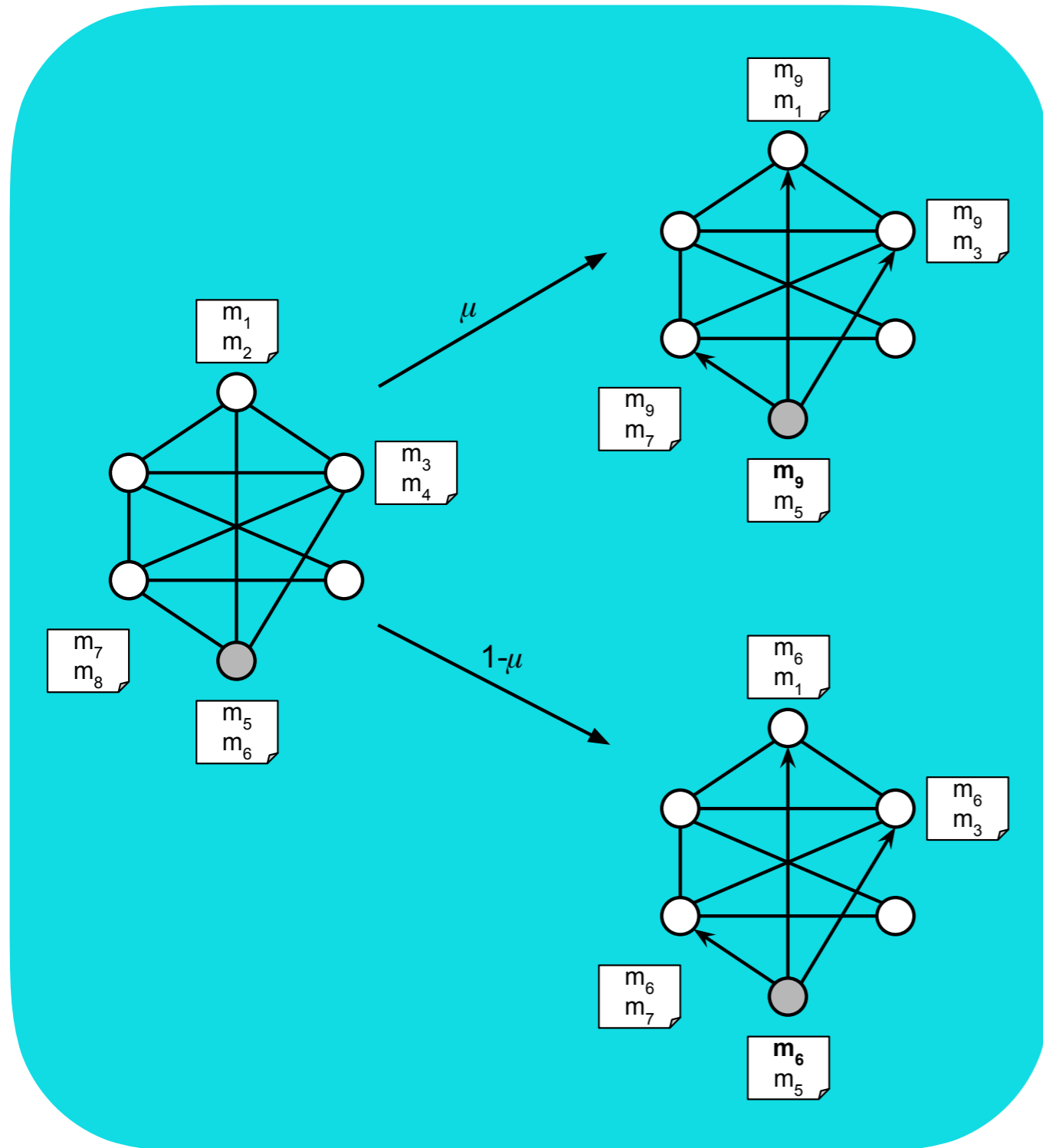
Toy model predictions: Role of *limited attention*



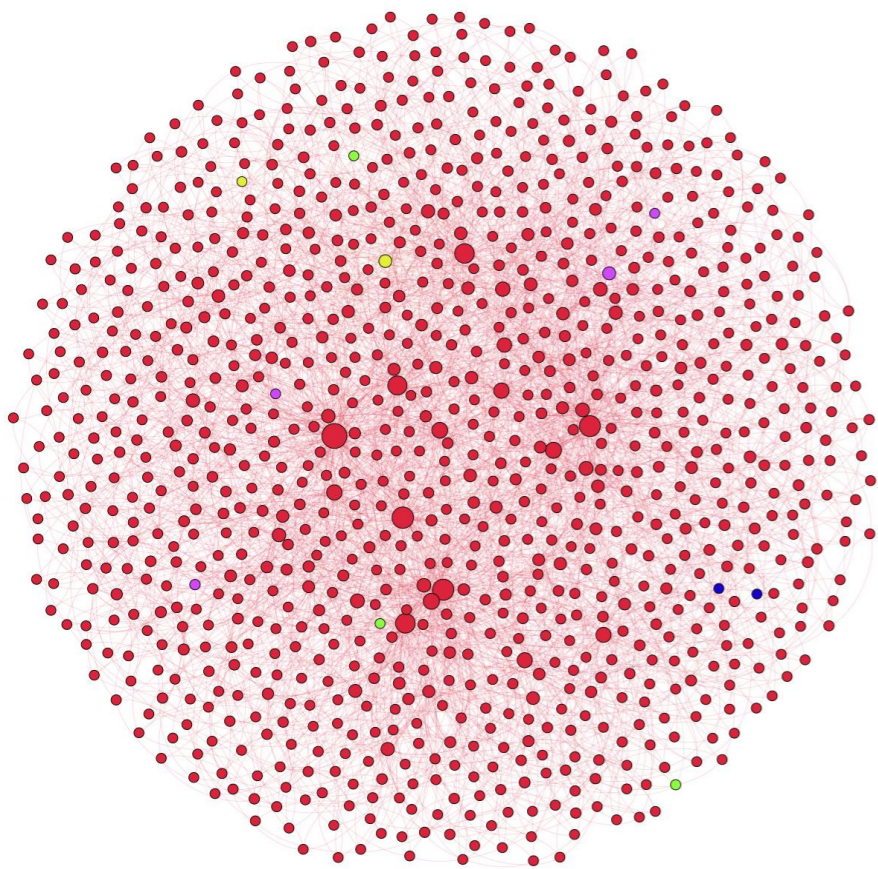
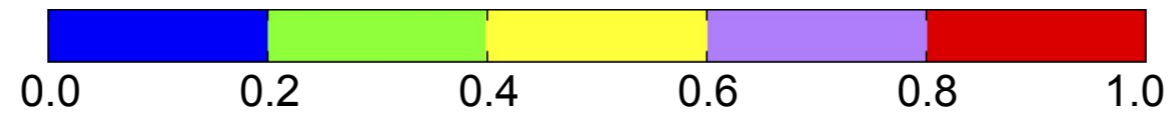


- Spread among agents with **limited attention on social network** is *sufficient* to explain meme virality
- *Not necessary* to invoke more complicated explanations based on intrinsic meme value or external factors

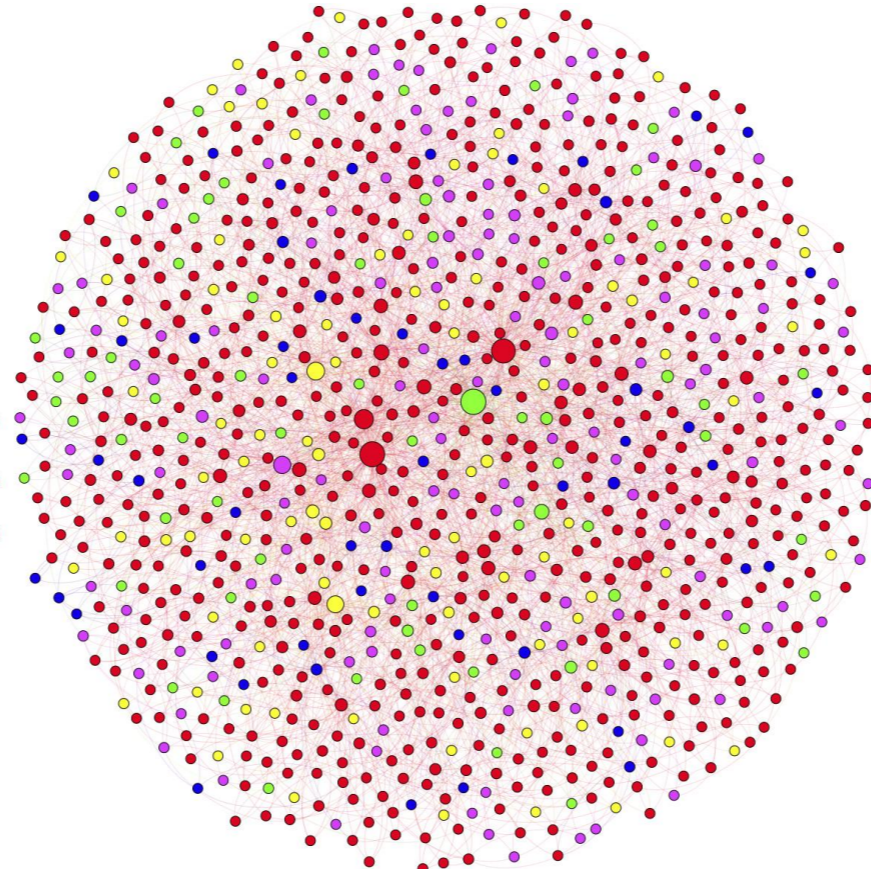
DO THE BEST IDEAS WIN?



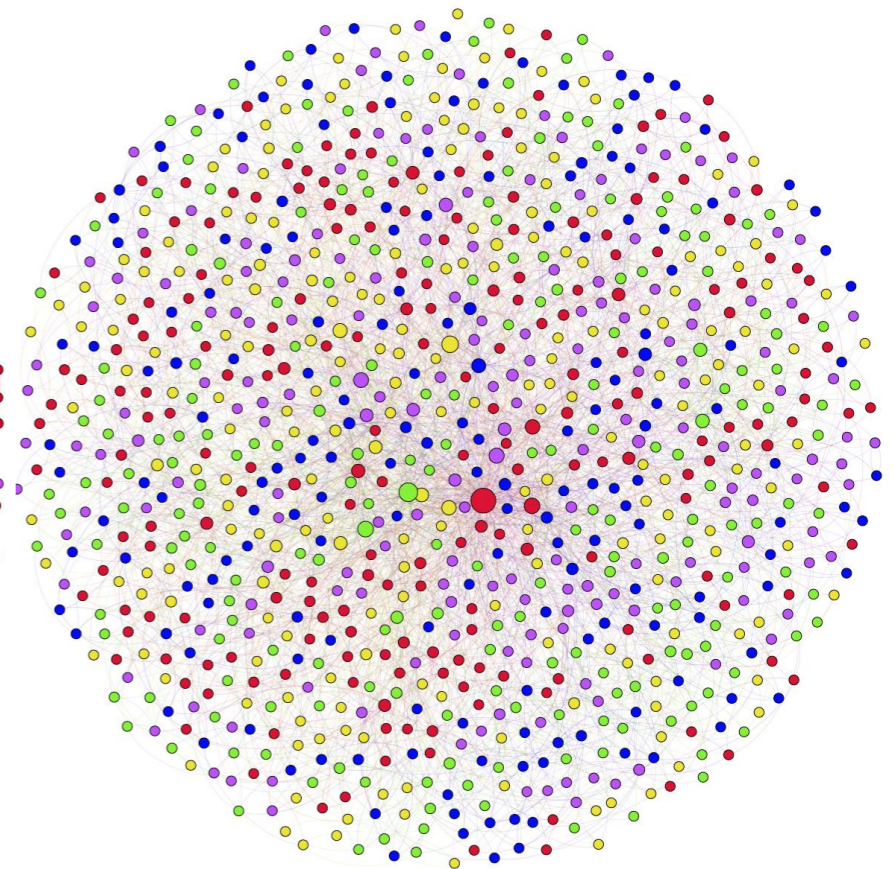
EFFICIENCY VS DIVERSITY



$\mu=0.01$



$\mu=0.2$



$\mu=0.9$

Intensity of competition



- Structural, temporal, content, and user features can be used to detect astroturf and social bots.
- Social media and traditional media work together to spread misinformation; gullible people are exposed through gullible connections.
- Social network structure and limited attention may amplify our natural biases and make us more vulnerable to misinformation.



Sandro
Flammini



Alex Vespignani



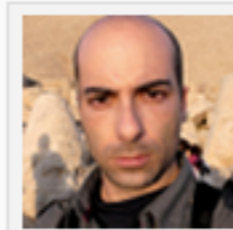
Johan Bollen



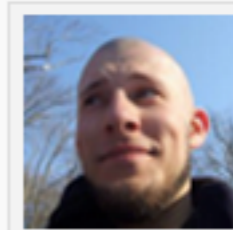
Emilio Ferrara



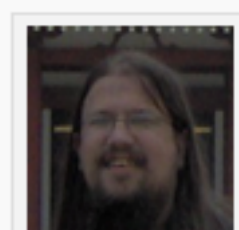
Diego
Fregolente



Giovanni Luca
Ciampaglia



Jacob
Ratkiewicz



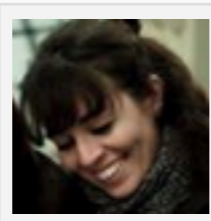
Mark Meiss



Lilian Weng



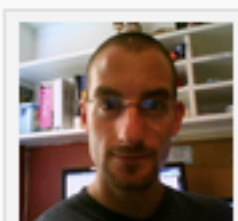
Michael
Conover



Marcella
Tambuscio



Karissa
McKelvey



Alex Rudnick

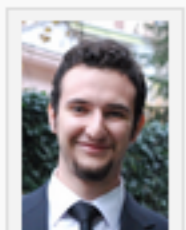


Bruno
Gonçalves

cnets.indiana.edu



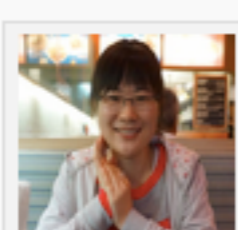
JAMES S.
MCDONNELL
FOUNDATION



Onur Varol



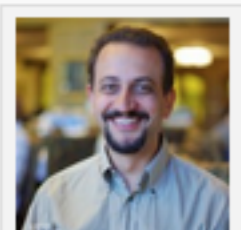
Prashant
Shiralkar



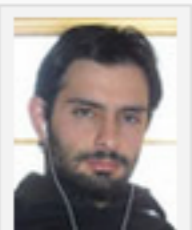
Xiaoyan Qiu



Dimitar
Nikolov



Giancarlo Ruffo



Nicola Perra



Przemyslaw
Grabowicz



Luca Aiello



Clayton Davis

Thanks!