Tutorial: Data-Driven Approaches towards Malicious Behavior Modeling

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Tutorial link: http://bit.ly/kdd2017

Web: A platform for everyone

Web allows...

- Web enables social interaction
- Web is no longer a static library that people passively browse
- Web is a place where people:
  - Act as prosumers, i.e., content producers and content consumers
  - Interact with other people:
    - Internet forums, Blogs, Social networks, Twitter, Wikis, Podcasts, Slide sharing, Bookmark sharing, Product reviews, Comments, …

Web and Social Media: Opportunities

- Any user can share and contribute content, express opinions, link to others

- <u>This means:</u> Can data-mine opinions and behaviors of millions of users to gain insights into:
  - Human behavior
  - Marketing analytics
  - Product sentiment

Applications: Real-time citizen journalism

- **Citizen journalism** provides more valuable information than newswire services
- Challenge:
  - Many redundant posts, users have to wade through hundreds of posts to locate useful information
- Goal:
  - Mine this data in real-time and produce well organized summaries

Applications: Reputation management

- **Consumer Brand Analytics**
  - What are people saying about our brand?

- **Marketing Communications**
  - Significant spending on marketing, advertising: Companies trying to position their products
  - Brand analytics helps to determine whether such campaigns are effective

- **Product reviews**
  - Automatically mine product reviews for information on product features, new requests, …
    - Easy to use, Light weight, Sturdy, Good price, …

…but there's also a dark side to the web

On the web…

Anyone can use multiple identities to put something on the internet.

From anywhere in the world.

They can say anything they like.

Leave it there as long as they like.

Change it whenever they feel like it.

Not everyone has good intentions…

How Trolls Are Ruining the Internet
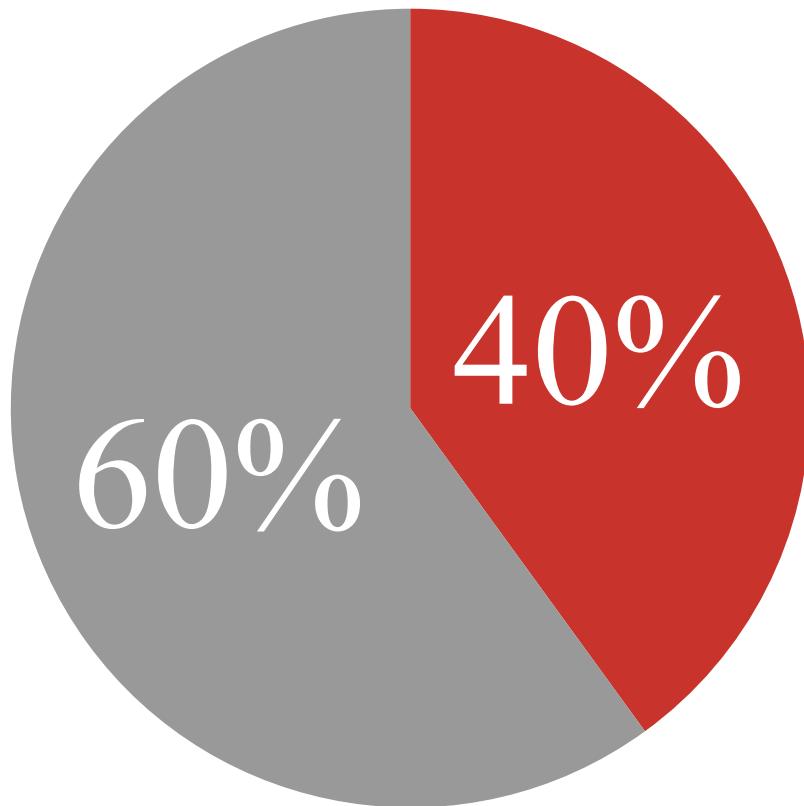
Wikipedia blocks hundreds of 'scam' sock puppet accounts

When Will the Internet Be Safe for Women?

FAKE NEWS IS ABOUT TO GET EVEN SCARIER THAN YOU EVER DREAMED

Fake reviews on the Play Store reportedly growing and getting smarter

Time (2016); The Atlantic (2016); BBC (2015), Vanity Fair (2017), Digital Trends (2017)

5

Malicious behavior is prevalent online

40%

60%

40% people have reported to have been harassed online

Malicious behavior is contagious

Trolling behavior increases after seeing already existing troll posts. ($p < 0.05$ using a mixed effects logistic regression model)

% Troll posts	Positive mood	Negative mood
Positive context	35%	49%
Negative context	47%	68%

Justin Cheng, Michael Burnstein, Cristian Danescu-Niculescu-Mizil, Jure Leskovec. Anyone Can Become a Troll: Causes of Trolling Behavior in Online Discussions. CSCW 2017.

Anonymity exacerbates the problem

"On the Internet, nobody knows you're a dog."

Malicious behavior has harmful effects
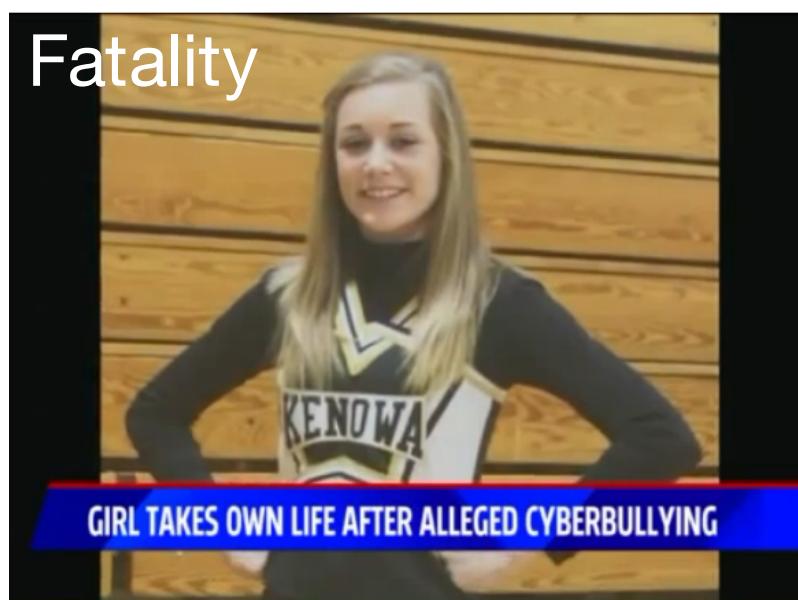
Distress

Harassment

Delinquent behavior

Fatality

GIRL TAKES OWN LIFE AFTER ALLEGED CYBERBULLYING

Akbulut et al. (2010), Wiener (1998), Hinduja and Patchin (2007, 2010)

Not everything on the web is true…

- Jackie Chan died in March 2011…according to numerous Facebook posts.

  The actor then had to release a statement, via his Facebook page, to prove that the rumors were false and that he was alive.

  Source: People.com
  http://www.people.com/people/article/0,,20477260,00.html

成龍 Jackie Chan
March 29, 2011

Jackie is alive and well. He did not suffer a heart attack and die, as was reported on many social networking sites and in online news reports.

Jackie is fine and is busy preparing for the filming of his next movie.

Like · Comment · Share   60,054   8,905   1,840
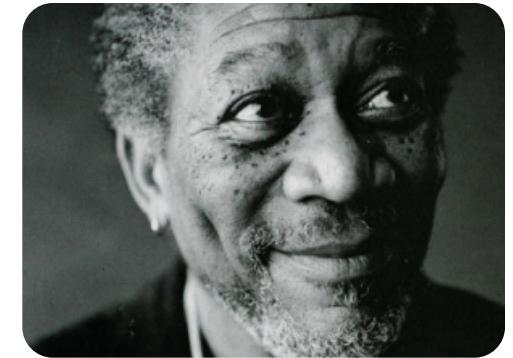
Not everything on the web is true…

- Morgan Freeman died in December 2010 and the news was credited to CNN… according to numerous "tweets" on Twitter.
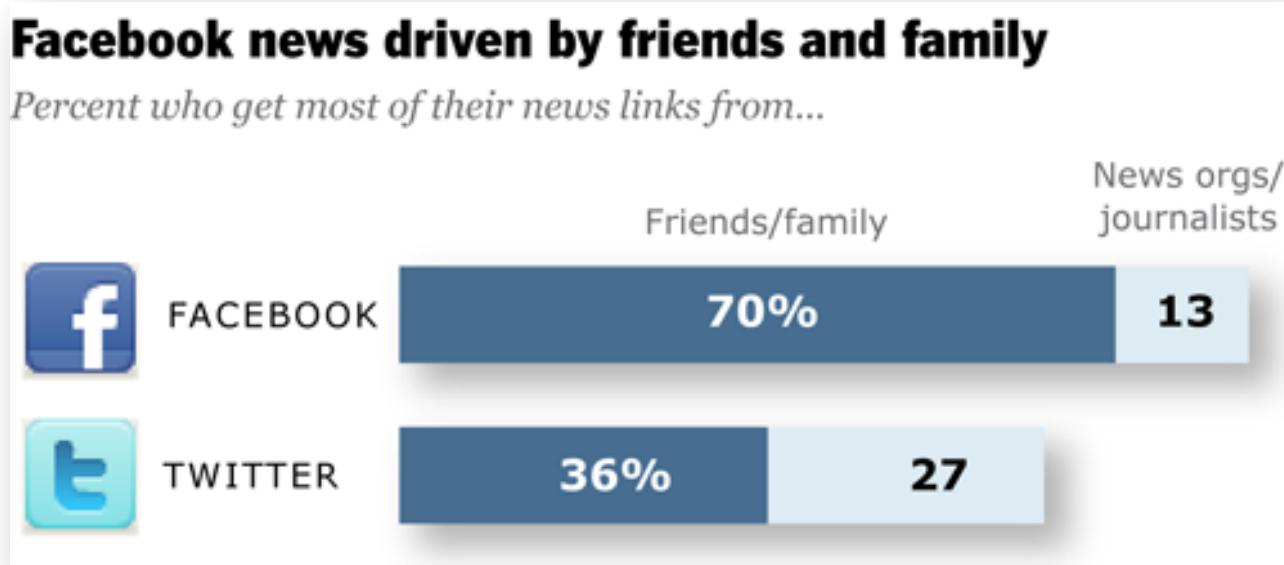
  CNN then had to clarify that they never reported the news and that Morgan Freeman was, in fact, alive.

  Source: Mediate
  http://www.mediaite.com/online/cnn-says-no-it-never-sent-out-tweet-reporting-death-of-actor-morgan-freeman-whos-alive/

CNN did not report Morgan Freeman death. Rumor is false. CNN will aggressively investigate this hoax.

3 minutes ago via web
Retweeted by 69 people

Reply   Retweet

CNN CNN

# Misinformation goes viral as people rely on social links for information

Facebook news driven by friends and family

Percent who get most of their news links from...

|	Friends/family	News orgs/ journalists
FACEBOOK	70%	13
TWITTER	36%	27
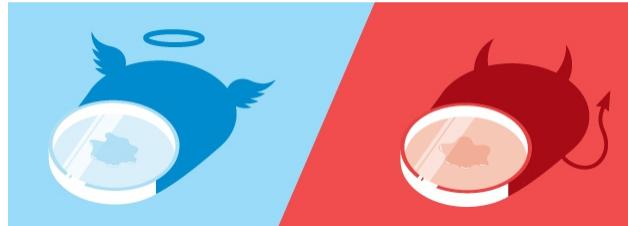
This tutorial:
Modeling and Detection of Malicious Behavior on the Web

Challenges in analyzing malicious behavior

Data imbalance

Smaller propotion of behavior (< 10%) is malicious

Limited labels

Little known information about malicious behavior

Deceptive behavior

Malicious behavior tends to masquerade as benign

VS Subrahmanian and Srijan Kumar. Predicting Human Behavior: The Next Frontiers. Science 2017.

Goals of this tutorial

- Discuss a set of methods for analyzing malicious behavior online

- Summarize insights obtained by various studies into different aspects of malicious behavior online:
  - Malicious users
  - Malicious content

Overarching takeaway

Malicious behavior differs from benign behavior both with respect to their properties and connectivity.

These differences can be used to create efficient computational methods to detect them.

Outline

Introduction

| Feature-based algorithms | Sockpuppets | |
| | Vandals | Hoaxes |

| Spectral-based algorithms | Visualization: "spokes", "blocks", "staircases" | |
| | Camouflage | Theoretical guarantee |

| Density-based algorithms | Ill-gotten Likes | Synchronized Behaviors |
| | Advertising campaigns | Social spam |
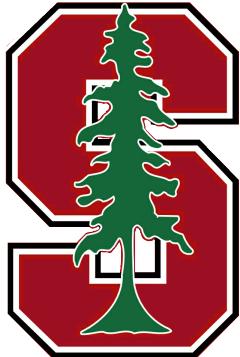
Conclusions and future directions

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Acknowledgement

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