# An Introduction to Graph Based Spam Review Detection

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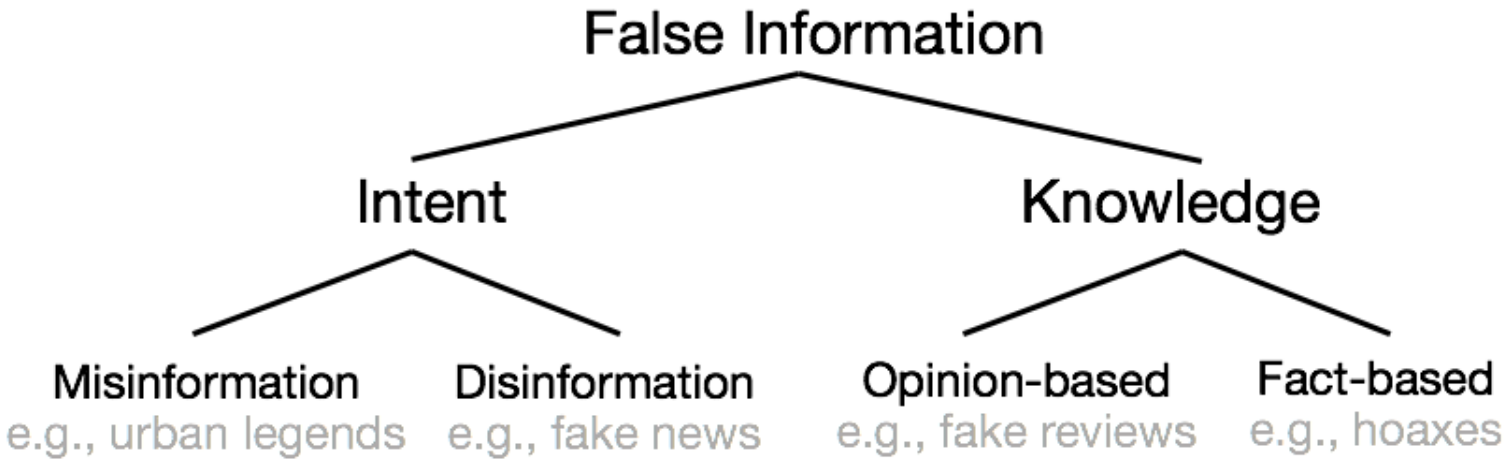
# Outline

1. Introduction
2. General Methods
3. SpEagle
4. Fraudar
5. FBox
6. FairJudge
7. Our paper

# 1. Introduction

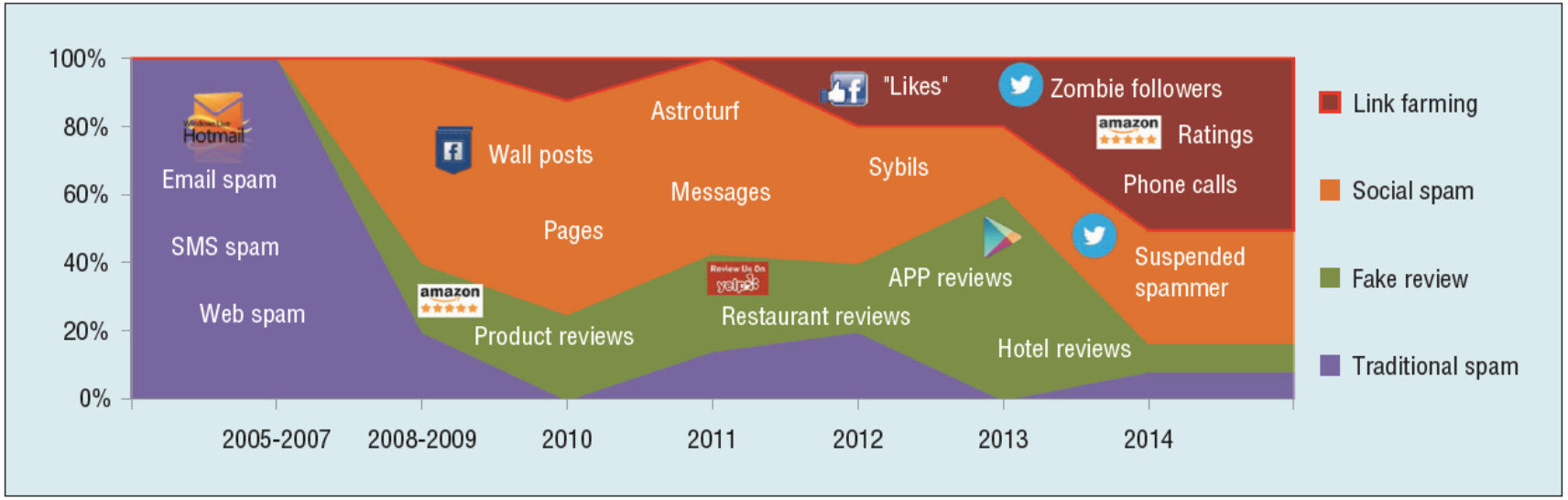
## Types of false information




Kumar, Srijan, and Neil Shah. "False Information on Web and Social Media: a Survey." *arXiv.org*, April 24, 2018.

# 1. Introduction

## Research Timeline




Jiang, Meng, Peng Cui, and Christos Faloutsos. "Suspicious behavior detection: Current trends and future directions." *IEEE Intelligent Systems* 31.1 (2016): 31-39.

# 1. Introduction

## Examples of fake reviews

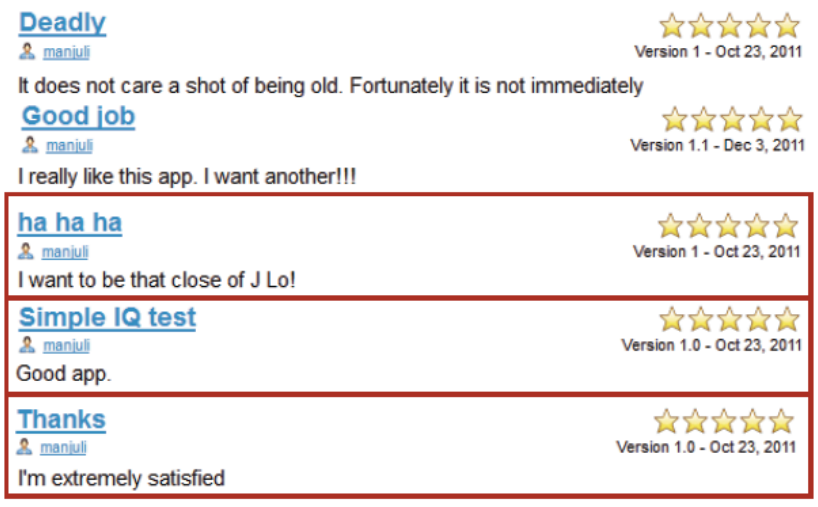
Ooh la la
Muguiwara78
Version 1 - Aug 25, 2011
Qd I see the head of my old guy, it scares me. At the same time, I will be like!

Satisfied
Muguiwara78
Version 1 - Aug 25, 2011
I'm extremely satisfied with my caricature. Well done.

ha ha ha
Muguiwara78
Version 1 - Aug 25, 2011
I want to be that close of J Lo!

Simple IQ test
Muguiwara78
Version 1.0 - Aug 25, 2011
Good app.

Thanks
Muguiwara78
Version 1.0 - Aug 25, 2011
I'm extremely satisfied



Deadly
manjuli
Version 1 - Oct 23, 2011
It does not care a shot of being old. Fortunately it is not immediately

Good job
manjuli
Version 1.1 - Dec 3, 2011
I really like this app. I want another!!!

ha ha ha
manjuli
Version 1 - Oct 23, 2011
I want to be that close of J Lo!

Simple IQ test
manjuli
Version 1.0 - Oct 23, 2011
Good app.

Thanks
manjuli
Version 1.0 - Oct 23, 2011
I'm extremely satisfied

Akoglu, Leman, Rishi Chandy, and Christos Faloutsos. “Opinion Fraud Detection in Online Reviews by Network Effects..” *Icwsm*, 2013.

# 2. General Methods

Current methods adopt three approaches below

- Textual features
- Behavior information
- Network structure

Kumar, Srijan, and Neil Shah. “False Information on Web and Social Media: a Survey.” *arXiv.org*, April 24, 2018.

# 2. General Methods

## Textual features

Avg. content similarity
Avg. review length in number of words
Percentage of ALL-capitals words
Percentage of capital letters
Review length in words
Ratio of 1st person pronouns (‘I’, ‘my‘, etc.)
Ratio of exclamation sentences containing ‘!’
Ratio of subjective words (by sentiWordNet)
Ratio of objective words (by sentiWordNet)
Description length (information-theoretic)

Rayana, Shebuti, and Leman Akoglu. *Collective Opinion Spam Detection: Bridging Review Networks and Metadata*. *The 21th ACM SIGKDD International Conference*, New York, New York, USA: ACM, 2015.

# 2. General Methods

## Behavior information

Max. number of reviews written in a day
Ratio of positive reviews (4-5 star)
Ratio of negative reviews (1-2 star)
Avg. rating deviation
Weighted rating deviation
Burstiness—spammers are often generate spams in short time.
Absolute rating deviation from product's average rating
Extremity of rating

Rayana, Shebuti, and Leman Akoglu. *Collective Opinion Spam Detection: Bridging Review Networks and Metadata*. *The 21th ACM SIGKDD International Conference*, New York, New York, USA: ACM, 2015.

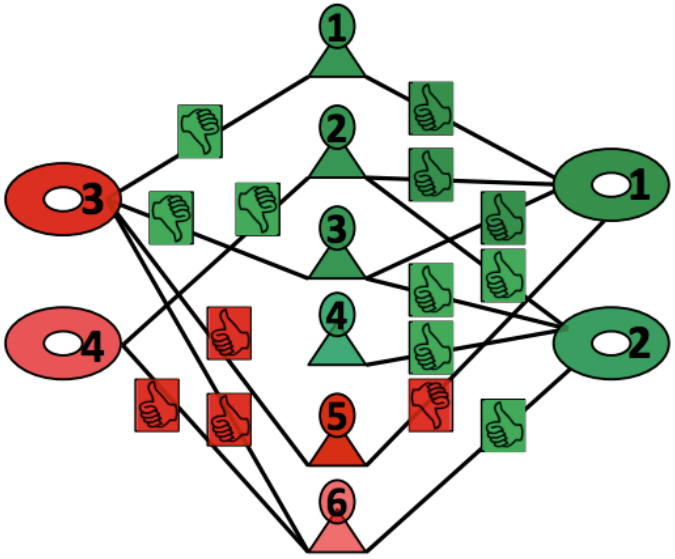
# 2. General Methods

Network structure

- SpEagle
- Fraudar
- fbox
- FairJudge

# 3. SpEagle

## Intuition

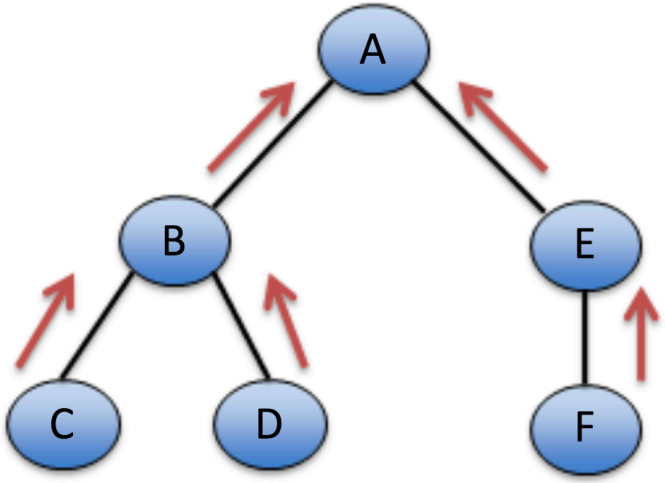



Akoglu, Leman, Rishi Chandy, and Christos Faloutsos. “Opinion Fraud Detection in Online Reviews by Network Effects..” *Icwsm*, 2013.

# 3. SpEagle

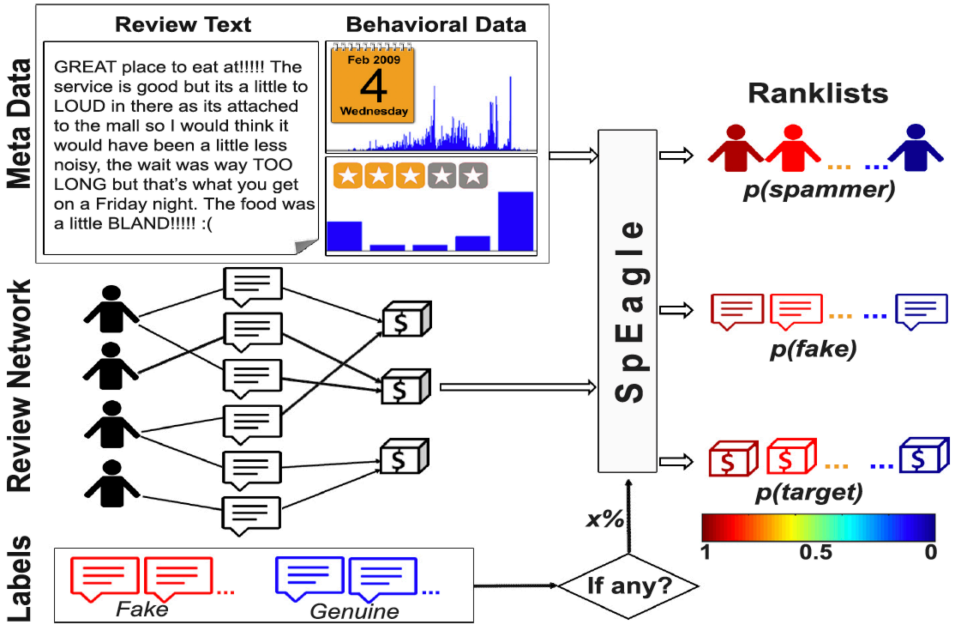
## Belief Propagation at Probabilistic Graph Model

$$m_{X \to Y}(Y) = \sum_{x} \phi_{XY}(x, Y) \prod_{W \in neighbor(X)/Y} m_{W \to X}(x)$$



# 3. SpEagle

## Model Illustration




Rayana, Shebuti, and Leman Akoglu. *Collective Opinion Spam Detection: Bridging Review Networks and Metadata*. *The 21th ACM SIGKDD International Conference*, New York, New York, USA: ACM, 2015.

# 4. Fraudar

- KDD 2016 Best Paper
- Detect dense blocks in the graph
- Camouflage resistant
- Scalability
- Efficient under real world setting
- Theory guarantee

Hooi, Bryan, Hyun Ah Song, Alex Beutel, Neil Shah, Kijung Shin, and Christos Faloutsos. “FRAUDAR - Bounding Graph Fraud in the Face of Camouflage..” *KDD*, 2016, 895–904

# 4. Fraudar

## Algorithm

density = \sum(suspicious score)/number of nodes
Construct priority tree
For node i in graph:
    Calculate density of each graph excluding i
    Find the largest density and store the graph after removing i
    Update priority tree
Find the largest density graph among all stored subgraph and mark them as spammer

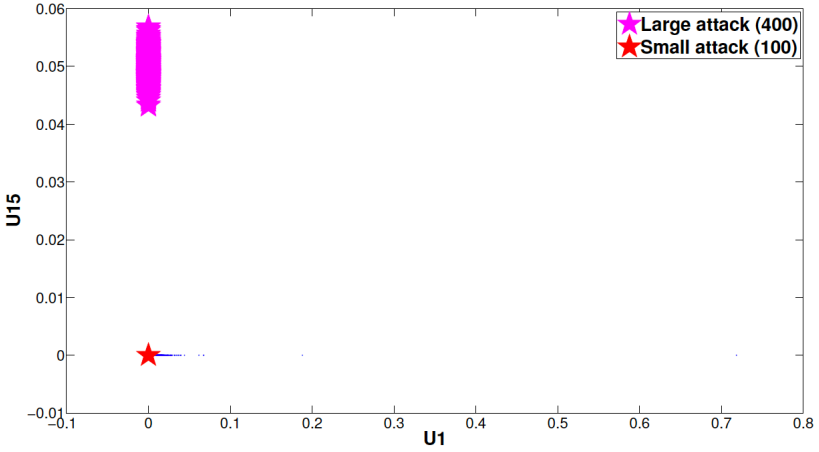
Hooi, Bryan, Hyun Ah Song, Alex Beutel, Neil Shah, Kijung Shin, and Christos Faloutsos. "FRAUDAR - Bounding Graph Fraud in the Face of Camouflage.." *KDD*, 2016, 895–904

# 5. fBox

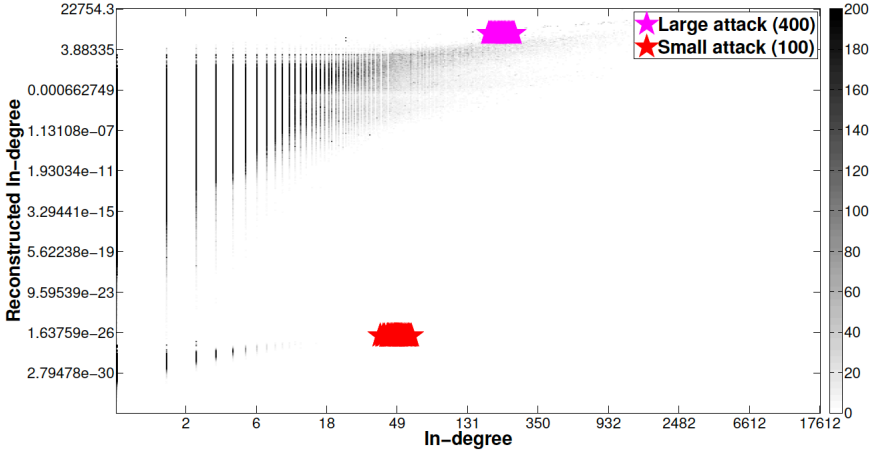
- Attacks under specific threshold will be missed for baseline methods
- Improve Singular Value Decomposition via reconstructing in/out degrees

Shah, Neil, Alex Beutel, Brian Gallagher, and Christos Faloutsos. “Spotting Suspicious Link Behavior with fBox - an Adversarial Perspective..” *Icdm*, 2014, 959–64.

# 5. fBox




(a) Spectral subspace plot




(b) ISRM

# 6. FairJudge

- Define three metrics:
  - Fairness of user
  - Reliability of rating
  - Goodness of product
- Iteratively update three scores above
- Provide theoretical guarantee
- Linear complexity

Kumar, Srijan, Bryan Hooi, Disha Makhija, Mohit Kumar, Christos Faloutsos, and V S Subrahmanian. “FairJudge - Trustworthy User Prediction in Rating Platforms..” *CoRR* cs.SI (2017).

# Thanks!