Reputation Systems II

Sybil Attack, BlogRank, B2Rank, EigenRumor, MailRank, TrustRunk

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Outline

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Sybil Attack

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- Graph of trust-weighted edges

- n honest nodes + adversary

- overall trust value on attack edges (honest-malicious) is limited

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Question: whether splitting adversarial node into many is beneficial for acquiring higher reputation (rank)?

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Answer: double the graph.

Positive Results (1/3)

General form of trust flow reputations:

$$r(x) = \max_{\mathcal{P}_{tx}} \bigoplus_{p \in \mathcal{P}_{tx}} trust(p)$$

Notation:

- t is pre-trusted node
- $\mathcal{P}_{xy}$ is a family of disjoint paths from t to x

Positive Results (2/3)

Assumptions:

1. Extending path nonincreases the *trust*(p)

2. $\oplus$ and *trust* are monotone to number of paths and edges values, respectively

3. Splitting a path into two does not increase $\oplus$ value

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4. $\oplus = $ max

Positive Results (3/3)

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Proof?

SybilGuard (1/2)

- Assume number of attack edges is $A = o(\sqrt{n}/\log n)$

- System is distributed, honest nodes follow the same protocol

- Can an honest node t identify (w.h.p.) $2A + 1$ nodes in such a way that at most A of them are powered by adversary?

SybilGuard (2/2)

- For every node fix a bijective mapping from in-edges to out-edges

- Take a walk from t of length at most $\sqrt{n}\log n$ using bijection routing

- At some point make a random switch, than continue another $\sqrt{n}\log n$ steps using backwalk routing

- Report a point. Repeat, until $2A+1$ points are collected

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Claim
w.h.p. at most A reported nodes are malicious

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Ranking Blogs

Ranking Blogs: Factors

- Entities: blogs, posts, communities, comments, brand names, external websites

- Frineds, blogroll, subscriptions, hyperlinks, visitors, clicks, votes

- Time

- Tags

BlogRank

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Wait a minute, for which graph? Linked blogs:

- Hyperlinks, blogrolls
- Common commentors/authors, tags, co-references to news

B2Rank

$$B2Rank(x) = BlogReputation \times PostQuality$$

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- Blogroll links are weighted by activity level (frequency of blogging and commenting)

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PostQuality is average for PageRank-style score of blog posts

- Post-to-post links are weighted by referring post activity and time difference

EigenRumor (1/2)
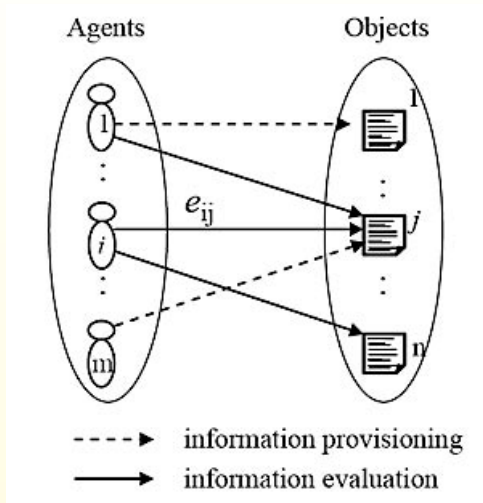
Picture from "The EigenRumor Algorithm for Ranking Blogs" paper

EigenRumor (2/2)

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- $\bar{r}$: reputation score for posts
- $\bar{a}, \bar{h}$: authority and hub scores for bloggers
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Solution: iterative algorithm for $\bar{r}$:
$\bar{r} = (\alpha P^T P + (1 - \alpha) E^T E)\bar{r}$

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Reputations For Fighting Spam

Combining Two Scores

- Hyperlink graph

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- Compute reputations a-la PageRank

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Conclusions

Challenges

- Measurable objectives?

- Model for input data?

- Dynamic aspects of reputations?
  Digg-style ranking?

- Price of attack?

- Ranking in social networks?

- Ranking in RDF data?

- Billion dollar question: how to avoid arms race?

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Ongoing project: http://businessconsumer.net

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Thanks for your attention!
Questions?