SOCIAL SPAM DETECTION

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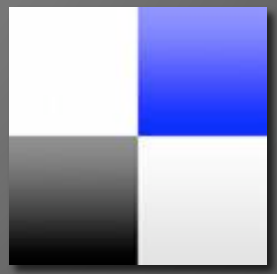
Bloomington

ISI Foundation

Social Applications

BibSonomy

myspace.com
a place for friends.



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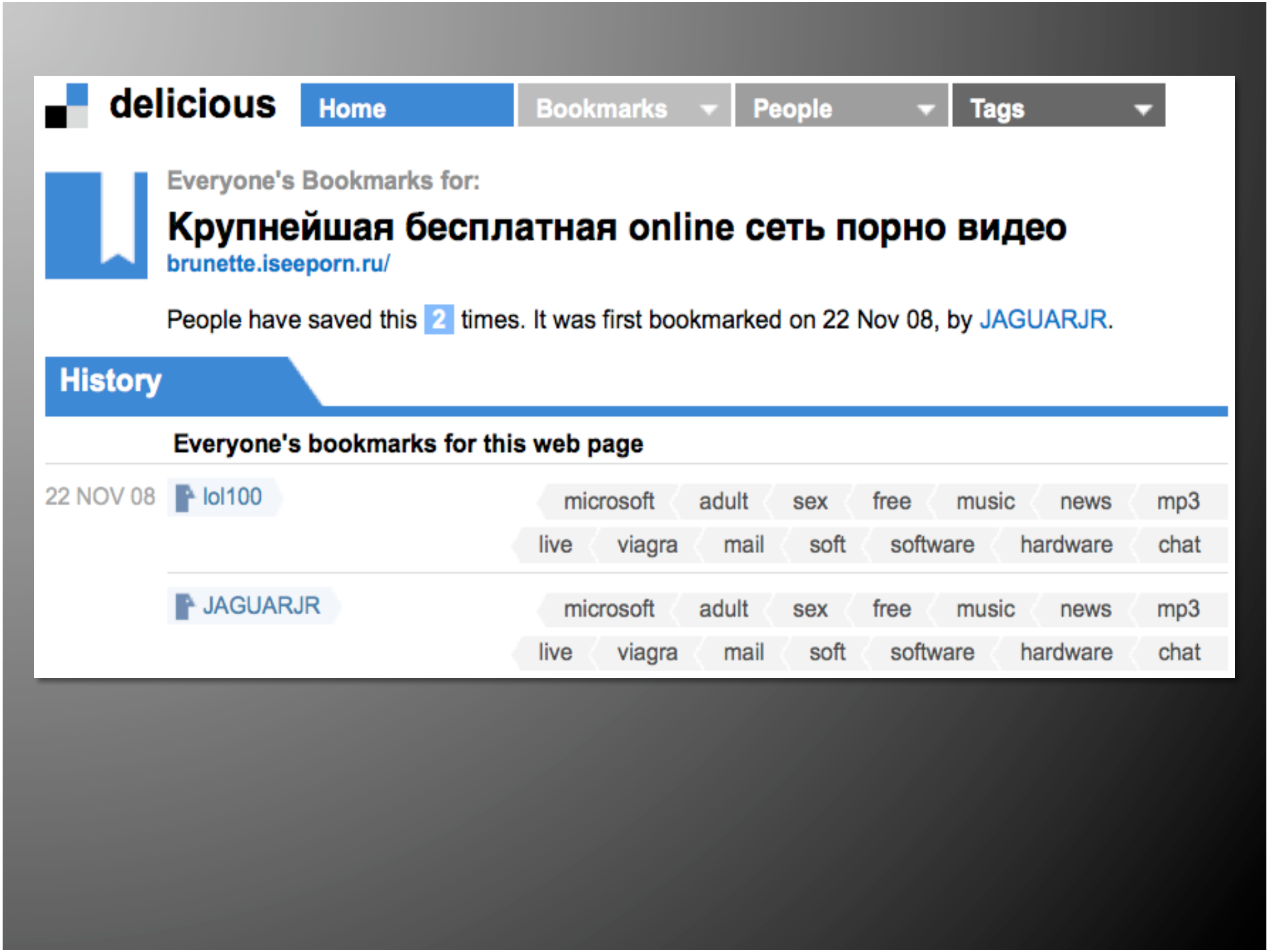
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8. Принцеса на горошине и Бахчисарайский фонтан | Мыслей нет
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YouTube – Desperate Housewives – Opening Credits Season 1
www.desperate-housewives.vip7.com ... desperate housewives wisteria lane teri hatcher marcia cross eva longoria (more) (less) ...

This entry was posted on Saturday, September 22nd, 2007 at 6:05 pm and is filed under TV. You can follow any responses to this entry through the RSS 2.0 feed. You can leave a response, or trackback from your own site.

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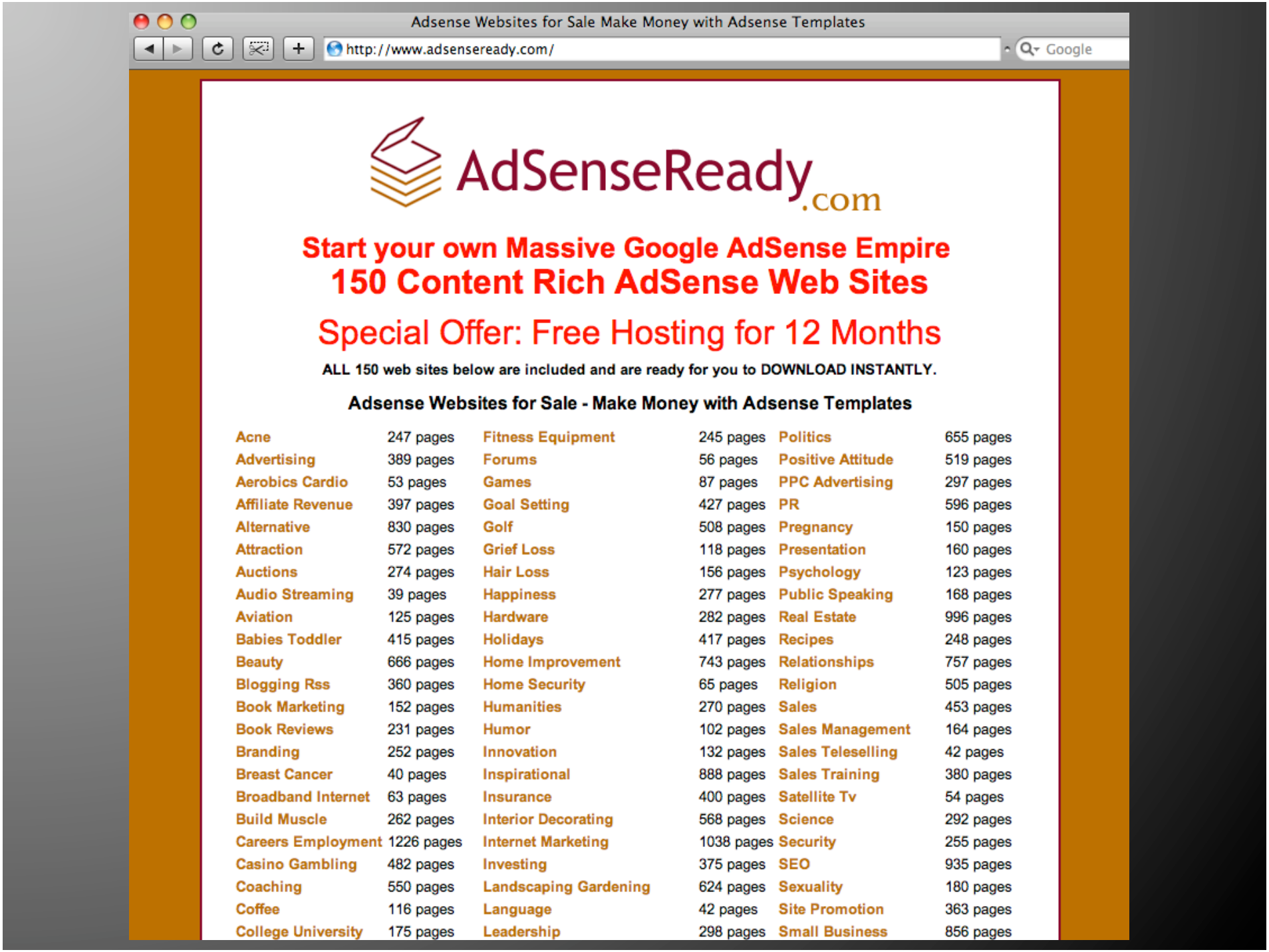
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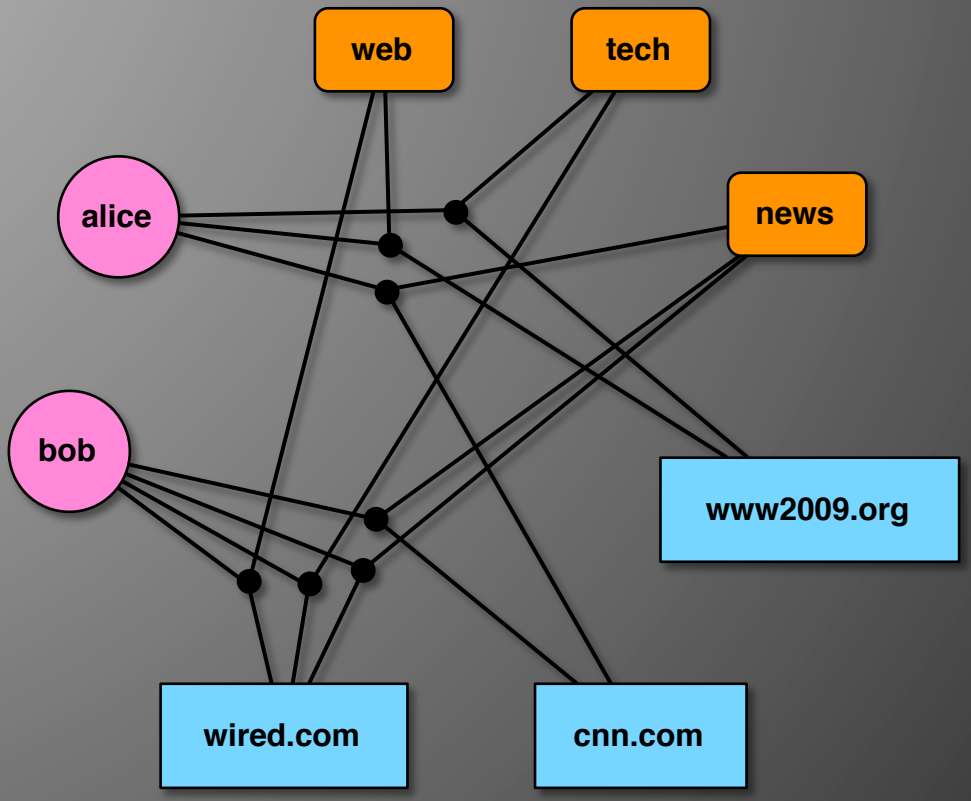
Who Wins? Who Loses?

- Beneficiaries
  - Spammer
  - Intermediary
- Non-beneficiaries
  - Systems: search engines, tagging
  - Information consumers
  - Original authors
- ?
  - Surfer
  - Advertisers

Agenda

- **Features**
  - **Folksonomy description**
  - **Feature descriptions**
    - **post level**
    - **resource level**
    - **user level**
- Feature analysis
  - Dataset description
- Social spam detection

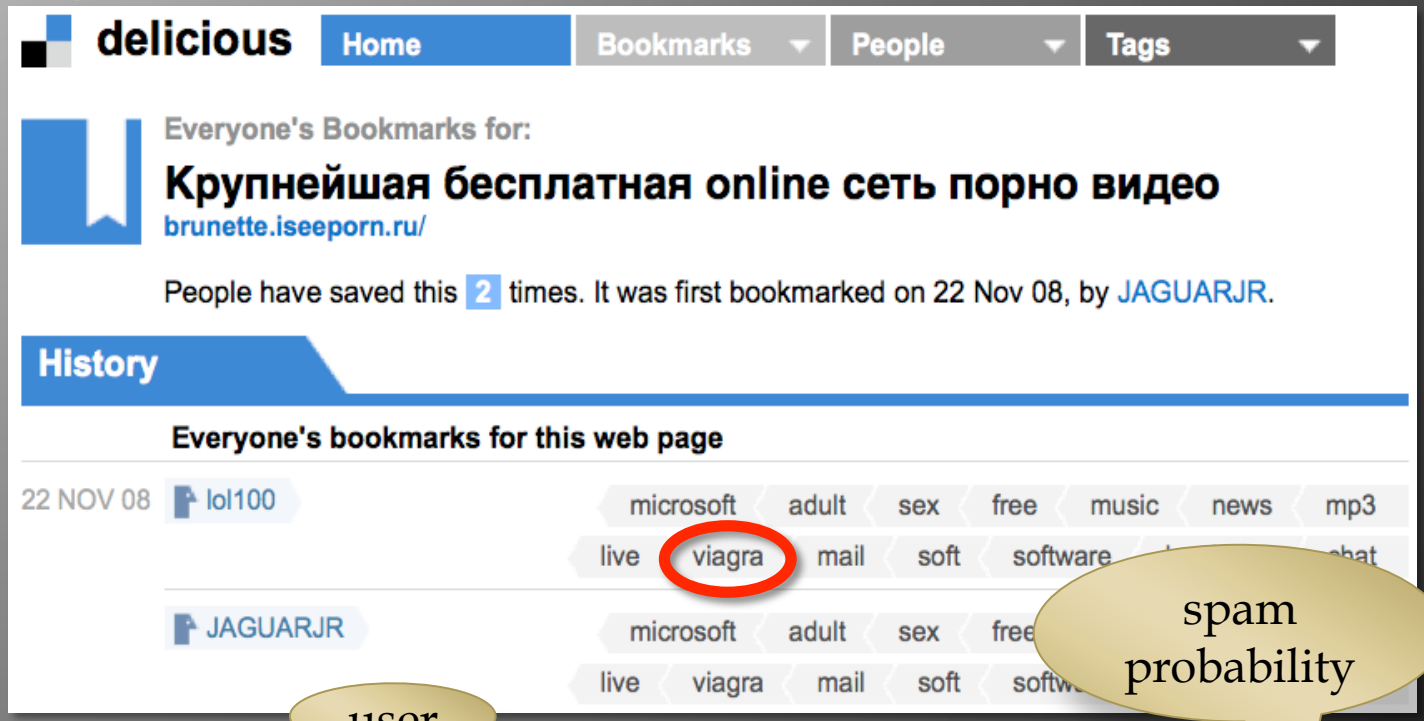
Folksonomy Definition



$$F = (U, T, R, Y), Y \subseteq U \times T \times R \text{ (the triples)}$$

Features: Post Level

- TagSpam



$$f_{TagSpam}(u,r) = \frac{1}{|T(u,r)|} \sum_{t \in T(u,r)} \Pr(t)$$

user

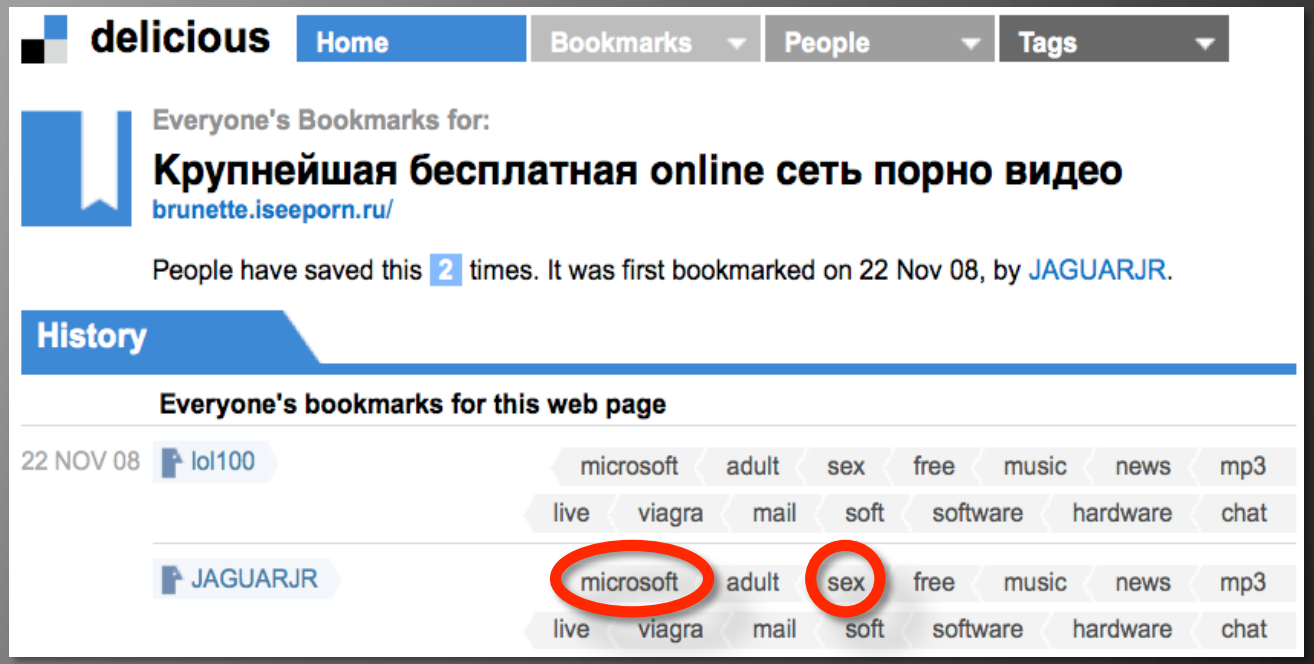
resource

post tags

spam probability

Features: Post Level

- TagBlur

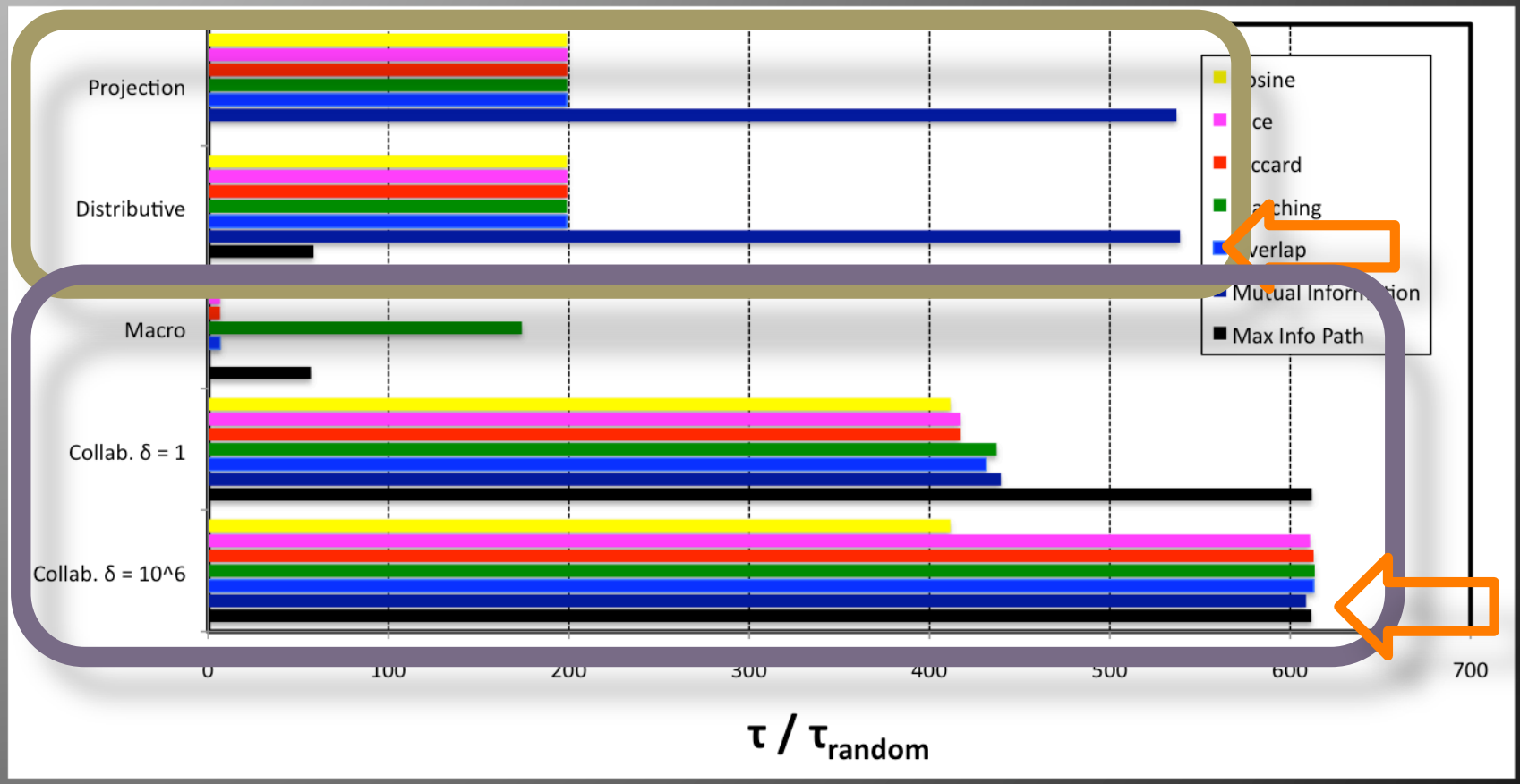


$$f_{TagBlur}(u,r) = \frac{1}{Z} \sum_{t_1 \neq t_2 \in T(u,r)} \frac{1}{\sigma(t_1,t_2)+\epsilon} - \frac{1}{1+\epsilon}$$

| tag pairs |

tag similarity

Tag Similarity



random $\tau = 10^{-4}$

WWW 2009
HT 2009

Features: Resource Level

- DomFp

shingle similarity

DOM fingerprint

spam probability

$$f_{DomFp}(r) = \frac{\sum_{k \in K} \sigma(k(r), k) \cdot \Pr(k)}{\sum_{k \in K} \sigma(k(r), k)}$$

Features: Resource Level

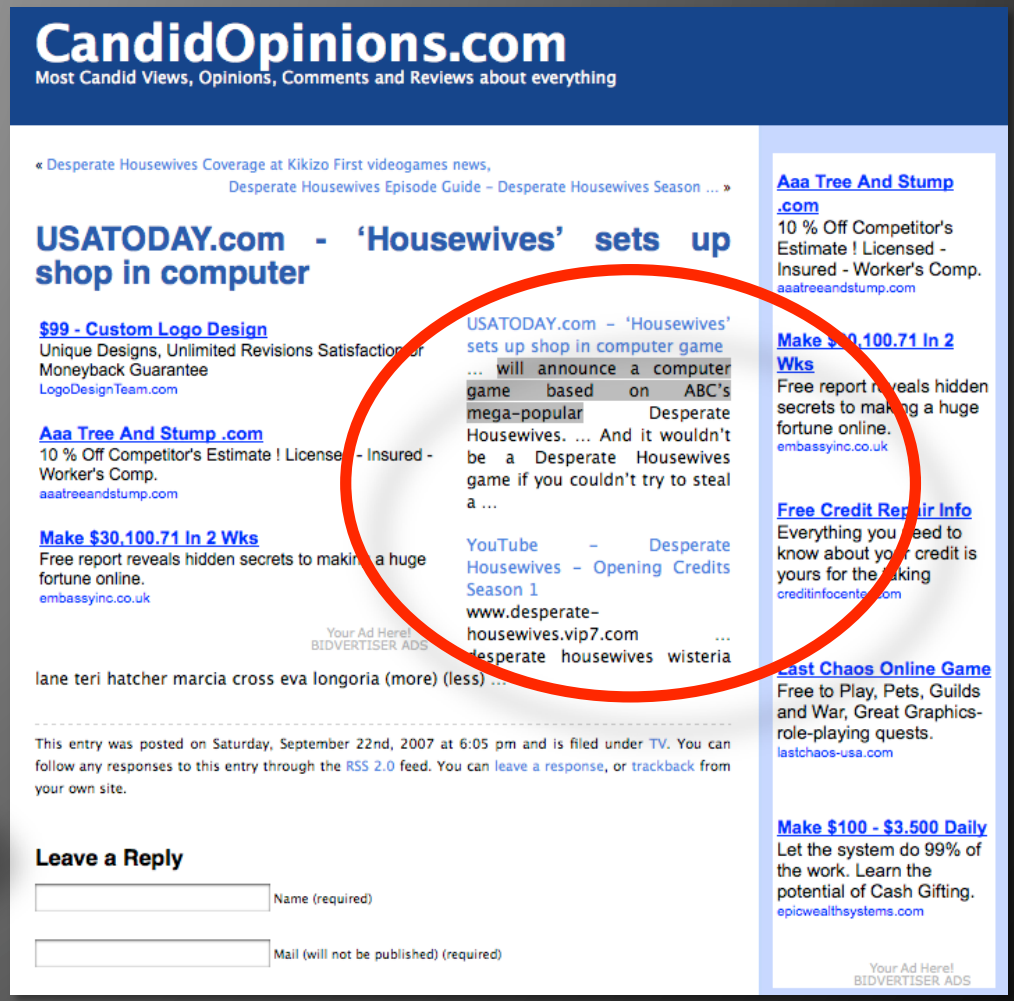
- NumAds

number of ads

$$f_{NumAds}(r) = g(r)/g_{max}$$

Features: Resource Level

- Plagiarism

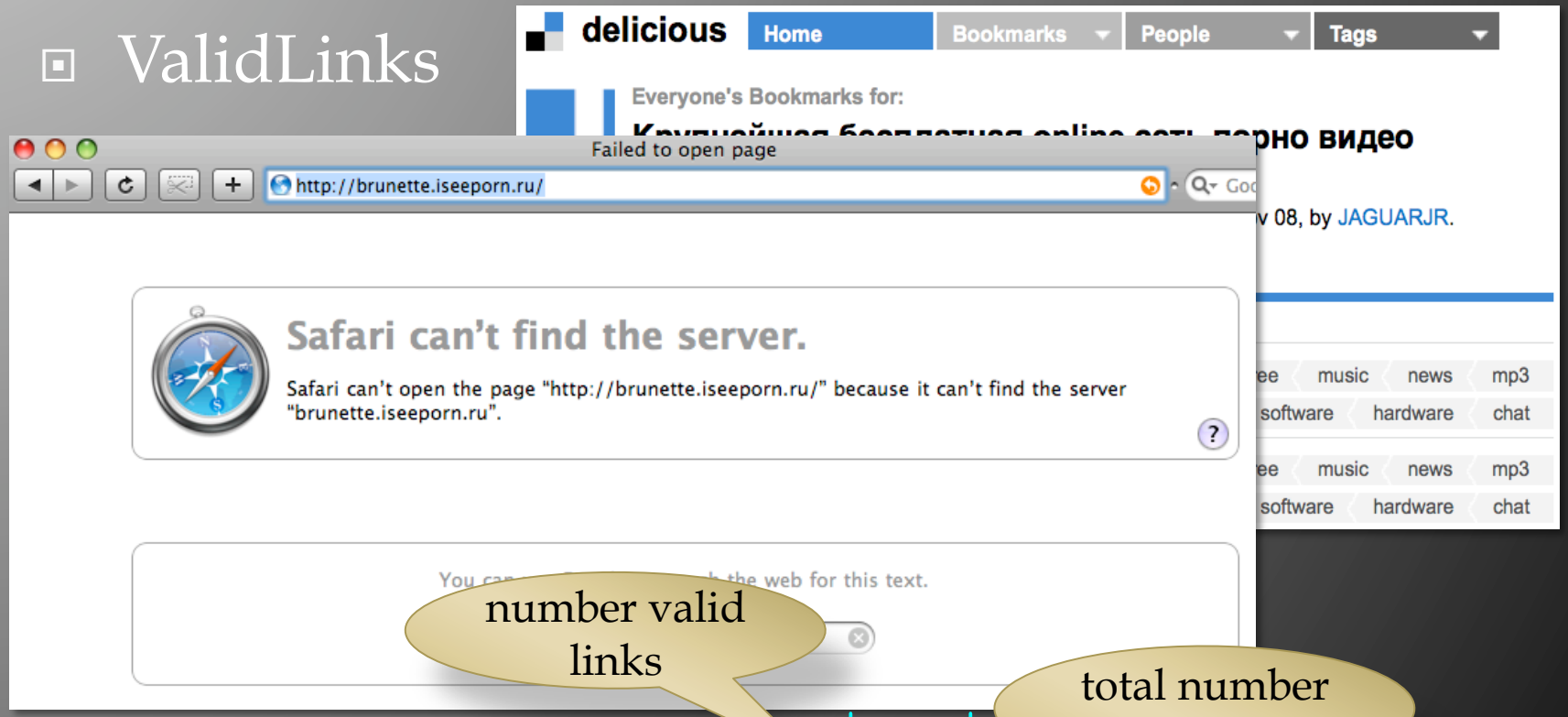


number of more authoritative sources matching exact phrase

$$f_{Plagiarism}(r) = y(r)/y_{max}$$

Features: User Level

- ValidLinks



number valid links

total number of links

$$f_{ValidLinks}(u) = \frac{|V_u|}{|R_u|}$$

BibSonomy Dataset

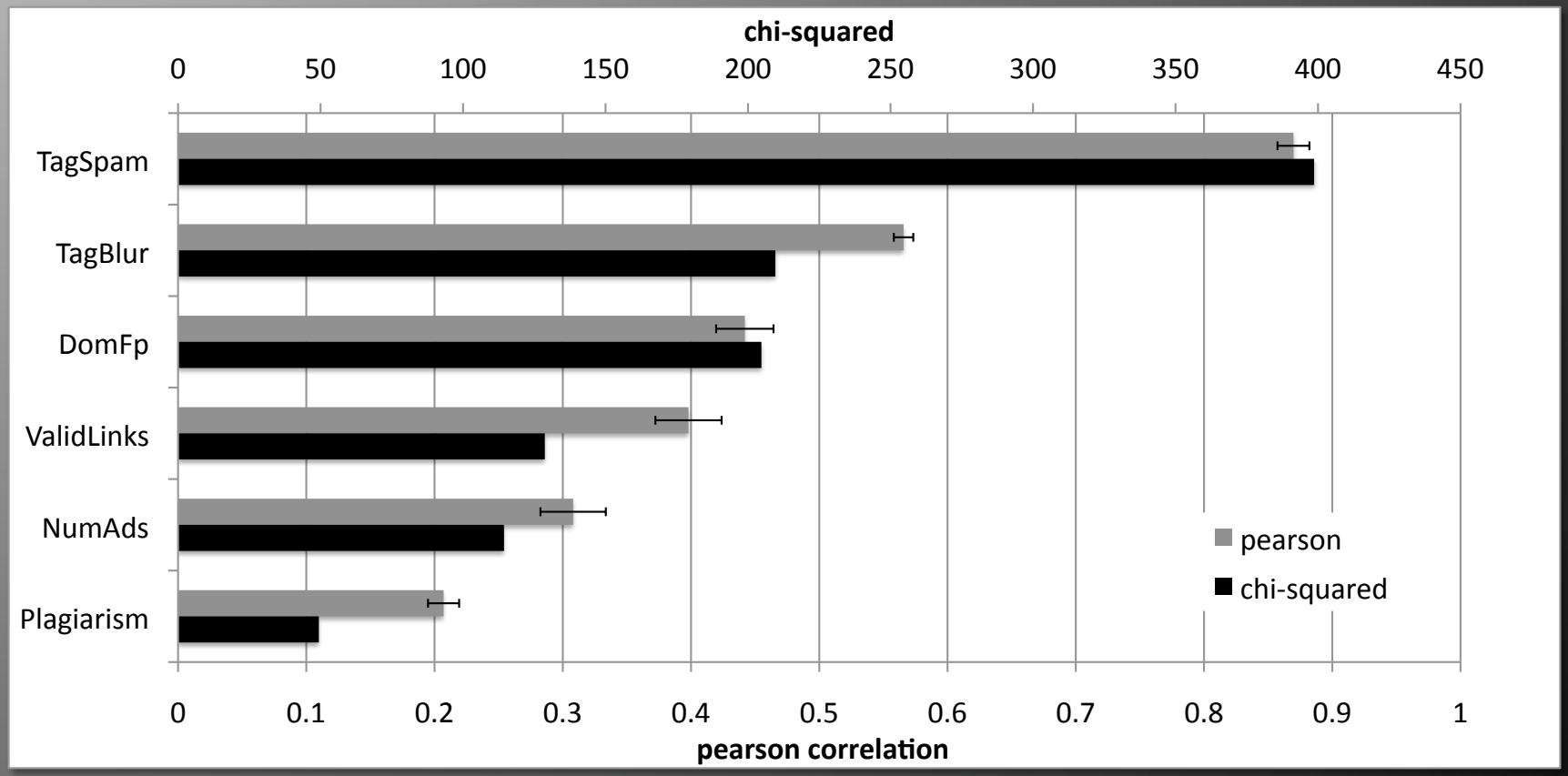
- BibSonomy.org
- Spam is labeled at user level
  - Aggregate for user level

$$f(u) = \frac{1}{|P(u)|} \sum_{(u,r) \in P(u)} f(u, r)$$

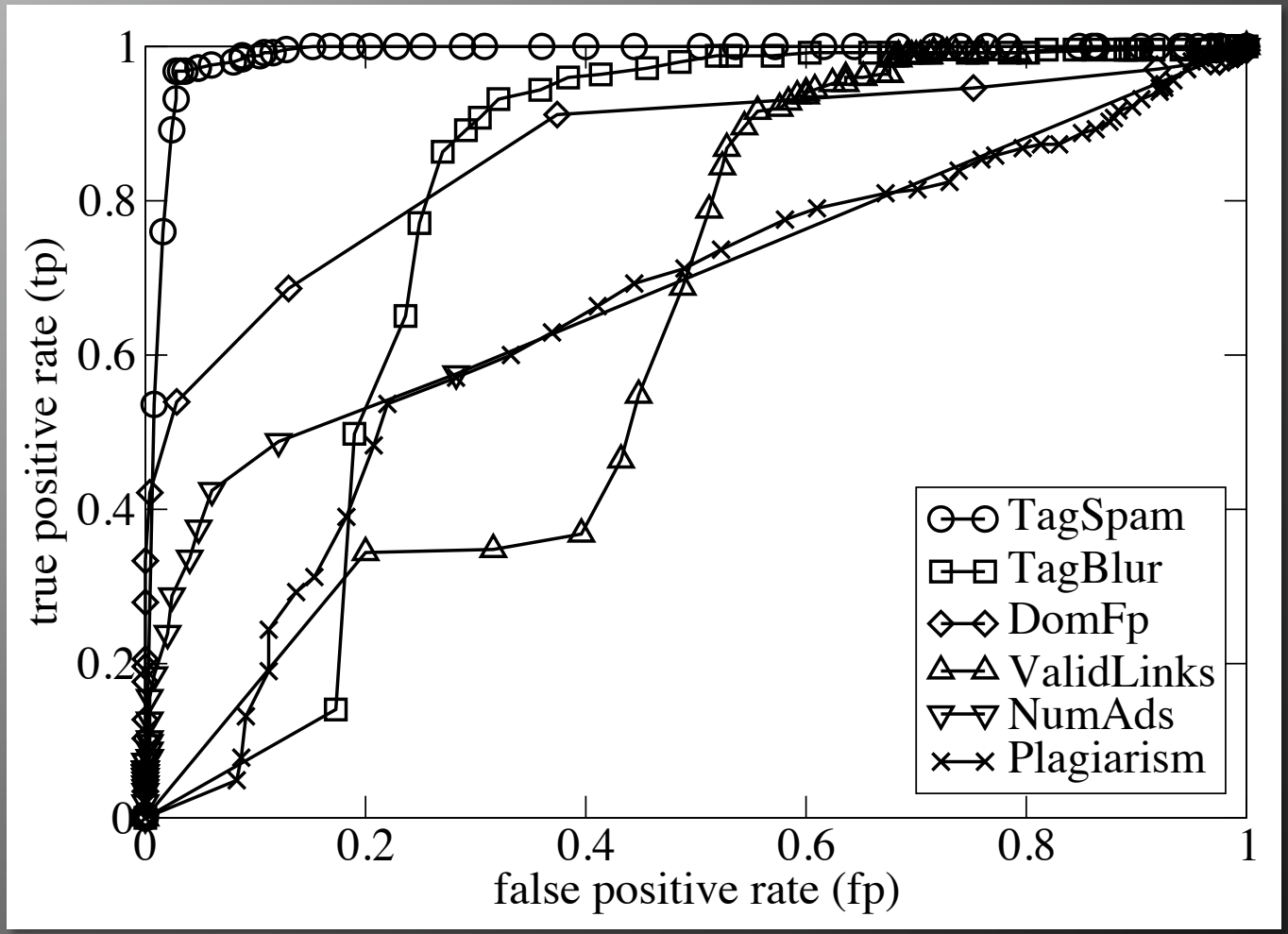
posts

- Sampled 1000 users
  - 500 spammers
- 500 users in training set/test set
  - 250 spammers

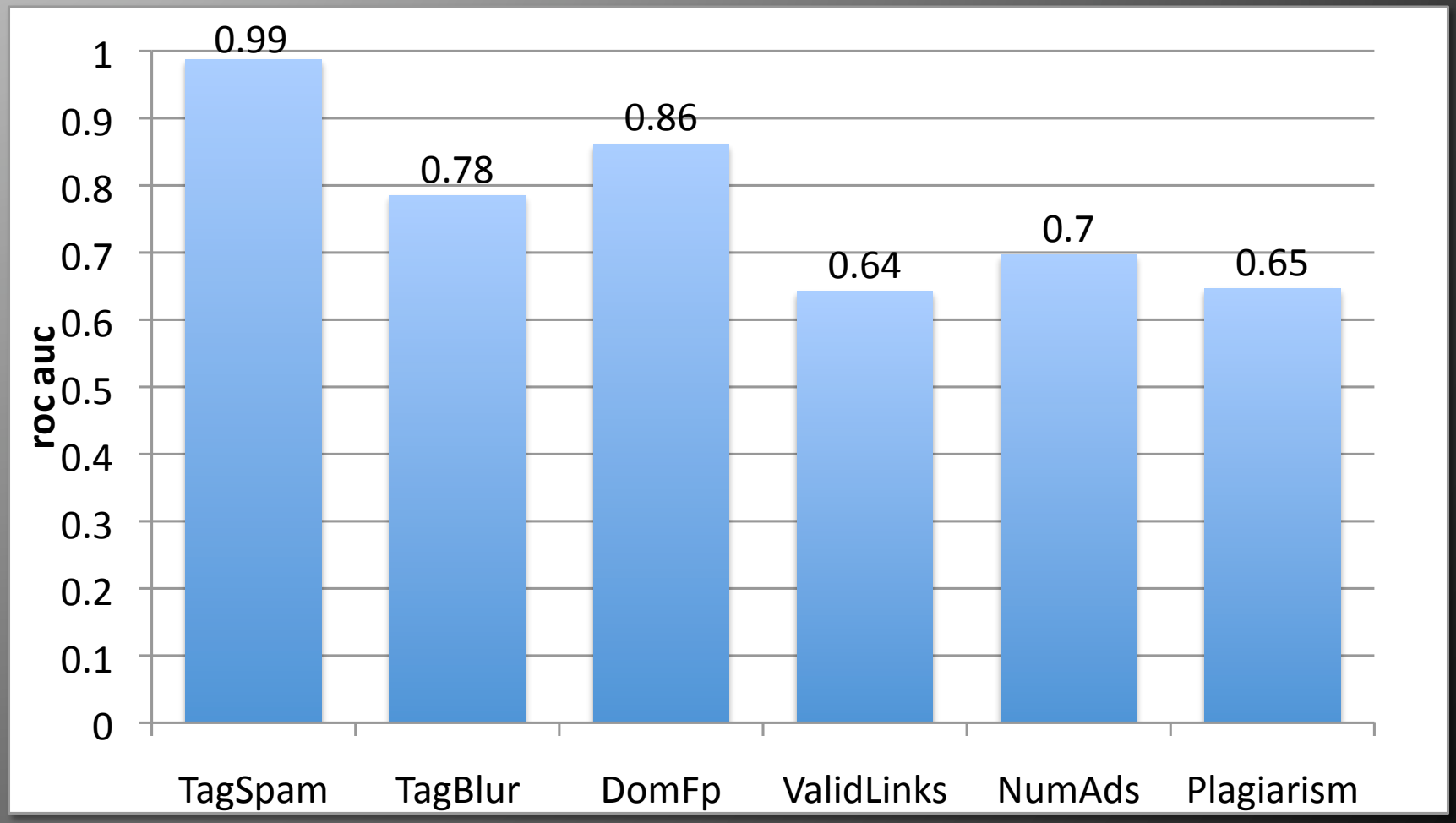
Feature Analysis: Discrimination Power



ROC Curves


true positive rate (tp)
false positive rate (fp)
0
0.2
0.4
0.6
0.8
1
TagSpam
TagBlur
DomFp
ValidLinks
NumAds
Plagiarism

AUC: Area Under ROC Curve



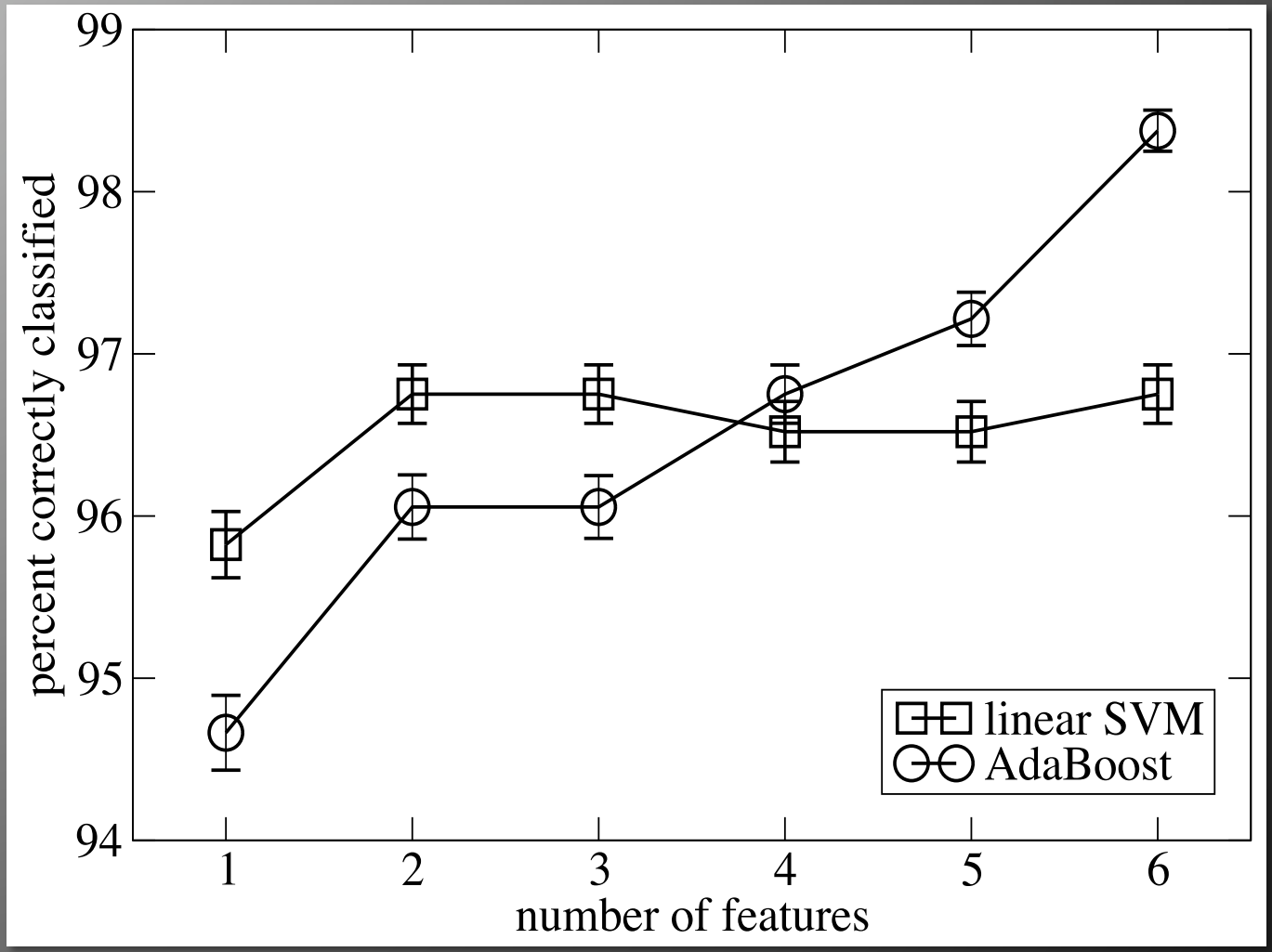
Social Spam Detection

Weka Classifier	Accuracy	FP	F_1
LogitBoost	**97.91%**	.018	**.978**
LWL	97.68%	**.013**	.975
AdaBoostM1	97.68%	.018	.975
ConjunctiveRule	97.68%	**.013**	.975
DecisionTable	97.68%	.018	.975
DecisionStump	97.68%	**.013**	.975
RandomCommittee	97.45%	.018	.973
RandomForest	97.45%	.018	.973
Bagging	97.22%	.022	.970
NNge	97.22%	.022	.970

Social Spam Detection

Features	linear SVM			AdaBoost		
	Accuracy	FP	F_1	Accuracy	FP	F_1
TagSpam	95.82%	.061	.957	94.66%	.048	.943
+ TagBlur	96.75%	.048	.966	96.06%	.044	.958
+ DomFp	96.75%	.048	.966	96.06%	.044	.958
+ ValidLinks	96.52%	.048	.964	96.75%	.026	.965
+ NumAds	96.52%	.048	.964	97.22%	.026	.970
+ Plagiarism	96.75%	.048	.966	**98.38%**	**.022**	**.983**

Social Spam Detection



Related Work

- Web/Email Spam
  - Attenberg and Suel 2008, Gyöngyi et al. 2004
- Social Spam
  - Heymann et al. 2007
- Spam Detection
  - Krause et al. 2008, Caverlee et al. 2008, Benevenuto et al. 2008, Koutrika et al. 2007
- ECML PKDD Discovery Challenge 2008
  - Held by BibSonomy team
  - Gkanogiannis and Kalamboukis 2008, Chevalier and Gramme 2008, Kim and Hwang 2008

Conclusions

- Identified/analyzed 6 features for spam detection
  - TagSpam alone achieves 0.99 ROC AUC outperforming ECML PKDD Discovery Challenge 2008
- Accuracy over 98% with AdaBoost
  - False-positive rate: 0.022
  - These results set the state of the art
    - could improve by combining with other features, e.g. Krause et al. 2008
- Limitations
  - Efficiency issues
  - Bootstrap issues

Feature Issues

- TagSpam
  - Depends on a set of labeled tags
- TagBlur
  - Depends on a notion of similarity/distances
  - Assumes spam does not dominate the folksonomy, affecting distances
- DomFp
  - Depends on a set of labeled fingerprints
  - Requires page download
- NumAds
  - Requires page download
- Plagiarism
  - Requires page download
  - Search engine cooperation
- ValidLinks
  - HEAD request per resource

THANK YOU!

- **Features**
  - **Folksonomy description**
  - **Feature descriptions**
    - **post level**
    - **resource level**
    - **user level**
- Feature analysis
- Social spam detection

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BibSonomy Team

http://www.bibsonomy.org