

The TROOTH Recommendation System



Keno Albrecht
Roger Wattenhofer

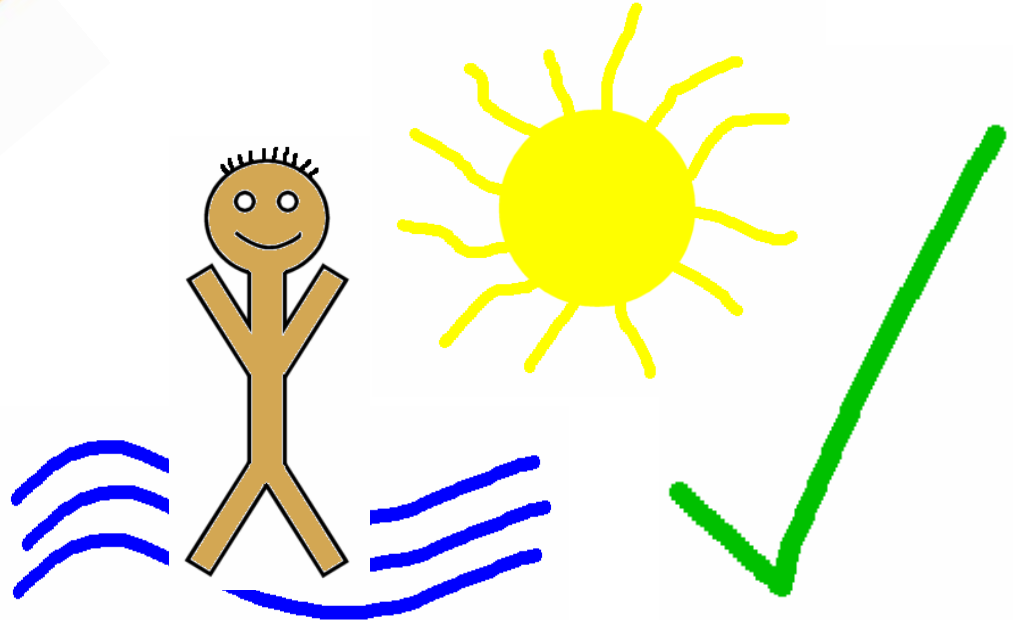
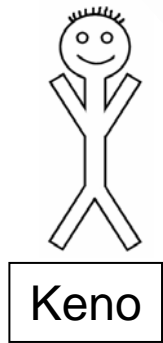
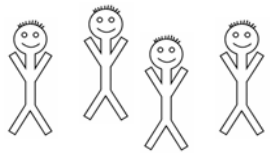
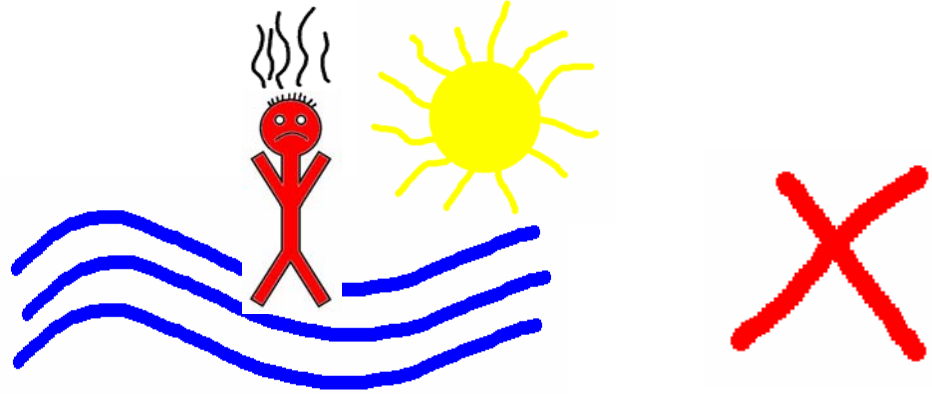
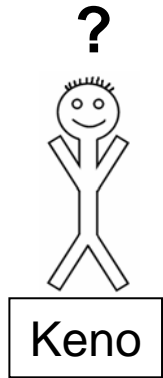
ETH

Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Distributed
Computing Group

The logo for the Distributed Computing Group. It features a circular network diagram with several nodes connected by edges. The edges are colored in red, green, and blue, representing different network components or data flows. The text 'Distributed Computing Group' is positioned to the left of the diagram.

Motivation



Motivation



- Taking advice of friends makes “vacation” more pleasant.
- In general: Listening to somebody with more experiences is a great idea.
- But listening to strangers also bears some problems: beware of liars!

Recommendation of Books



Customers who bought this also bought

[Eldest \(Inheritance, Book 2\) by Christopher Paolini](#)

[Harry Potter Paperback Boxed Set \(Books 1-5\) by J. K. Rowling](#)

[Harry Potter and the Goblet of Fire \(Book 4\) by J.K. Rowling](#)

[Harry Potter and the Prisoner of Azkaban \(Book 3\) by J.K. Rowling](#)

[The Opal Deception \(Artemis Fowl, Book 4\) by Eoin Colfer](#)

[Explore similar items:](#) in [Books](#), in [DVD](#)

[© Amazon.com]

Reputation of Users

Seller information

[the_antiquarium](#) ([136](#) ★) **me**

Feedback Score: 136

Positive Feedback: 100%

Member since Apr-12-00 in United States

[Read feedback comments](#)

[Add to Favorite Sellers](#)

[Ask seller a question](#)

[View seller's other items](#)

[© Ebay.com]

Rating of Software



Download Now

Editor's rating



Average user rating



(96 votes) [Rate it!](#)

Downloads

426,714



Popular

Publisher

[Search for Extraterrestrial Intelligence Home](#)

Date added

January 5, 2006

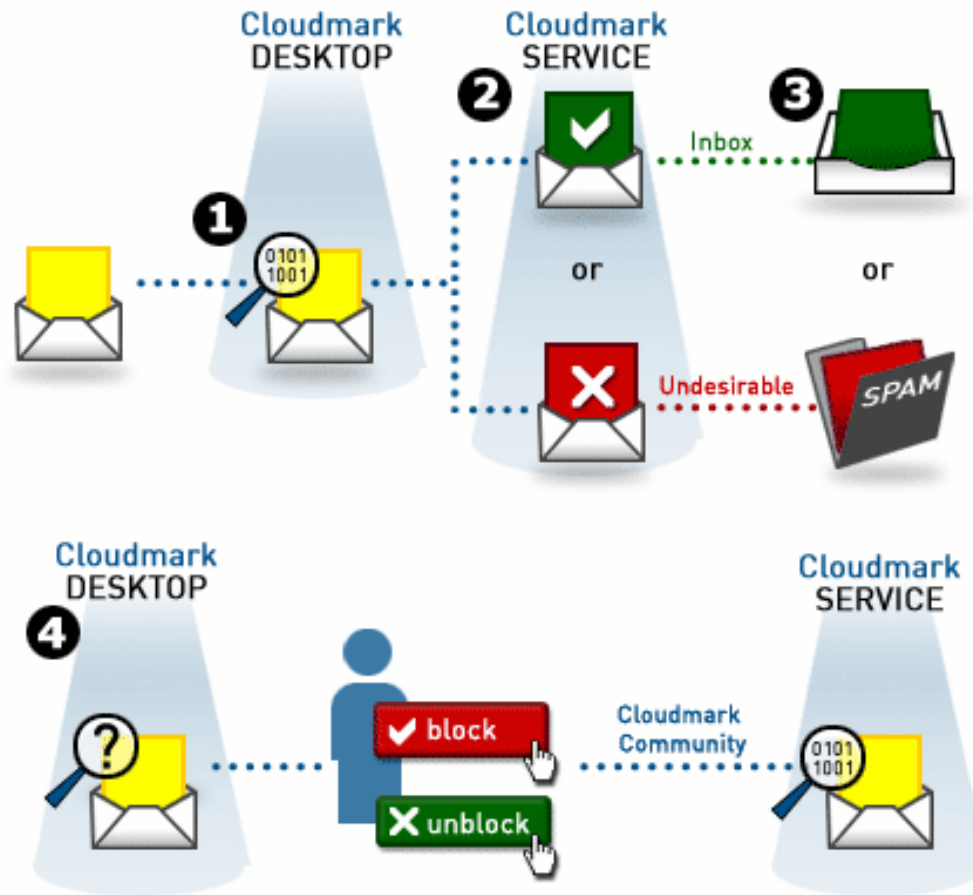
[© Cnet.com]

Popularity of Topics & Web Pages

log blogging **blogs** books **business** cms comics con
development diy download education film finance firefox
s gtd hardware history **howto** html **humor** im:
links **linux** literature **mac** maps math media mp3 **mus**
dcast **politics** productivity **programming** python rai
ping **software** tech **technology** tips tool **too**
lesion webdev wiki **windows** wordpress work writing

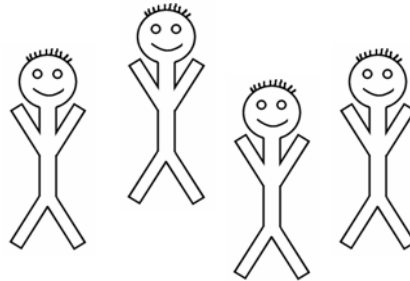
[© del.icio.us]

Legitimacy of Emails



[© Cloudmark.com]

Recommendation Systems



Learn from people's experiences.

Different Flavors of Voting



- What? Users & “items”
- How? Implicit & explicit voting
- Why? Recommendation, rating, trust
- Where? Server-side vs. client-side data

→ Derive future decisions from past ones

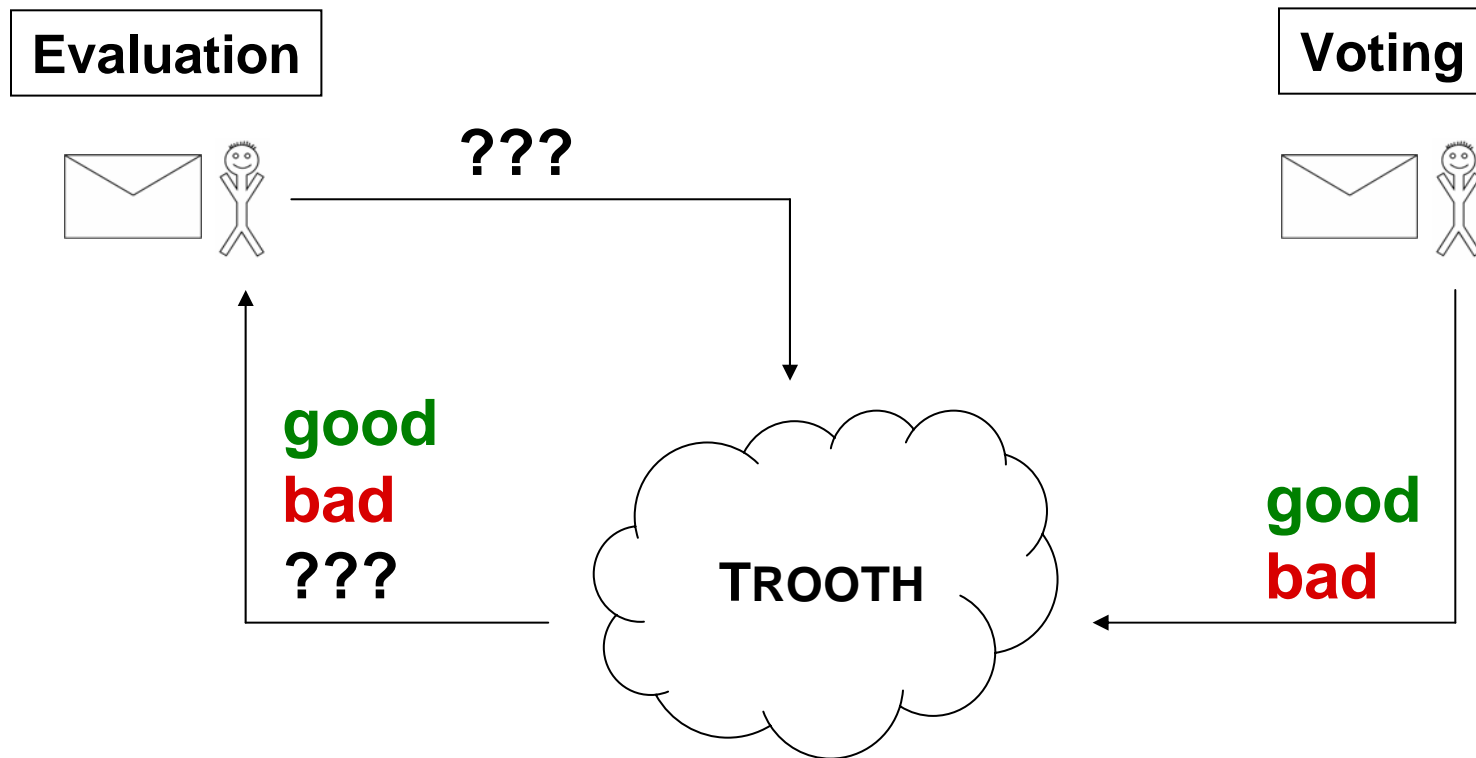
TROOTH



- Implicitly create trust values for users by explicitly rating items.
- Store few data on servers; evaluate items on clients.
- Derive decision about items by considering ratings of most trusted users.

Overview

- Items are either *good*, *bad*, or *unknown*.
- Users classify items to be *good* or *bad*.



Simple Evaluation



- If a majority of all users votes *good* (*bad*), the item is *good* (*bad*), otherwise unknown.
- More general:

$$\text{eval}(\text{Votes}) = \begin{cases} \textit{good} & \text{if } h_g < \rho_g \leq 1, \\ \textit{bad} & \text{if } 0 \leq \rho_g < h_b, \\ \textit{unknown} & \text{if } h_b \leq \rho_g \leq h_g. \end{cases}$$

Weighted Evaluation

- Consider users with different trust values, separating them into *good* and *bad* users.
- Weight votes with trust values before evaluating item.
- Additive Increase, Multiple Decrease:

$$\forall u \in U^i : \quad t'_u := \begin{cases} t_u + inc & \text{if } v_u^i = e^i, \\ t_u \cdot dec & \text{if } v_u^i \neq e^i. \end{cases}$$

TROOTH - Assumptions



- Evaluation of items is subjective.
- Users are not good/bad but just have different opinions.
- Implicitly separate users into groups of similar interests.
- Trust those people most who are in the same group.

TROOTH - Organization



- Users have unique IDs organized as ring.
- Store (item,user,vote)-tuples server-side.
- Calculate user specific trust values and final evaluation client-side.

TROOTH – Voting & Evaluation



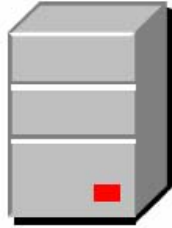
- **Voting:** When a user votes for an item, she sends her opinion (*good* or *bad*) to the TROOTH server and locally adapts the trust values for other users who voted for the same item.
- **Evaluation:** To classify an item, *good* and *bad* votes from the server are weighted with the client-side stored trust values.

TROOTH - Voting



Item	User	Vote
1	0	<i>good</i>
1	1	good
1	4	good
1	22	bad
1	83	good
1	114	bad
1	189	good
1	242	good
2	1	bad
...

Trooth Server



Trooth Client "0"



← vote (1, 0, bad)

→

(22, bad)
 (114, bad)
 (1, good)
 (4, good)
 (242, good)

User	Trust
1	0.3
22	12.0
114	2.7
242	4.4

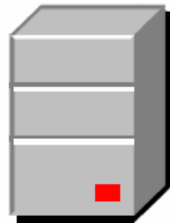
User	Trust
1	<i>0.15</i>
4	<i>0.5</i>
22	<i>13</i>
114	<i>3.7</i>
242	<i>2.2</i>

TROOTH - Evaluation



Item	User	Vote
2	1	bad
2	4	good
2	22	good
2	83	bad
2	114	good
2	129	good
2	189	bad
2	242	bad

Trooth Server



Trooth Client "0"



← eval(2, 0)

User	Trust
1	0.15
4	0.5
22	13
114	3.7
242	2.2

(1, bad)
 (189, bad)
 (242, bad)
 (4, good)
 (22, good)
 (114, good)


User	Trust	Vote
189	1	bad
242	2.2	bad
22	13	good
114	3.7	good

} 1 + 2.2 = 3.2 bad

} 13 + 3.7 = 16.7 good

=> 16.7 / 19.9 = 0.84 > h_g => **good**

TROOTH - Discussion

- 
- Configurable on client-side
 - Number of “known” users is bounded
 - Voting for same type of items
 - High burdens for malicious users
 - Voting for same type of items as victim
 - Impact only in direct neighborhood
 - Play by the rules for a long time
 - Spamoto:
 - SAAS uses challenge/response to assign IDs
 - Votes are signed

Conclusion & Future Work



- TROOTH is a robust, partially decentralized, collaborative, and personalized recommendation system.
- Server-side data could be stored in P2P system
- System is open-source and available for download as part of the Spamoto spam filter system: <http://www.spamoto.net>.

Questions?



???

