# Trustlet, Open Research on Trust Metrics

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# Outline

1. Trust on the web

    definition and examples

2. Trustlet.org

    wiki for open research on trust metrics

3. Initial results

    on Advogato trust network

**trust** (trʌst) *n* **1** reliance worth, reliability, etc., lated adj: **fiducial. 2** a combined to control the obligation custody, charge, confidence or fai

Brit. a bundle of hay o weight of 36, 56, or 60 p trousse, from trousser, appare (unattested), from *torca* (una

What is Trust? Many definitions ...

Commonly cited

*"Trust (or, symmetrically, distrust) is a particular level of the subjective probability with which an agent will perform a particular action, both before [we] can monitor each action (or independently of his capacity of ever be able to monitor it) and in a context in which it affects [our] own action"*

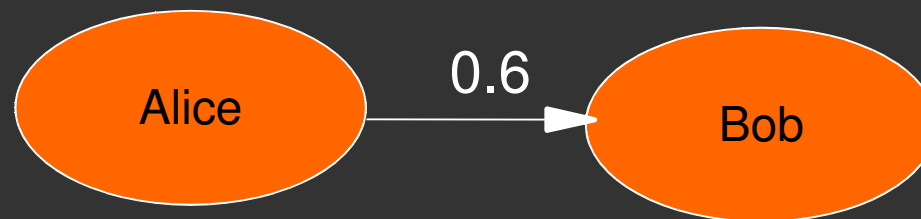Diego Gambetta, Can We Trust Trust? In "Making and Breaking Cooperative Relations". 2000

Here:
trust (statement) is explicit judgement given by a user about another user:

Example:
"I (Alice) trusts Bob as 0.6 in [0,1]"
Very general definition, fits many situations

Alice —0.6→ Bob

# Trust on the Web: gimme examples!

E-marketplaces: **Ebay.com**, Epinions.com, Amazon.com

News sites: **Slashdot.org**, Kuro5hin.org, Digg.com

Job sites: LinkedIn, Ryze, ...

Social networks: Myspace, Facebook, Flickr, Youtube, del.icio.us

Open Source Developer communities: Advogato.org, Affero.org

Couchsurfing, Hospitalityclub: host in your house unknown people?

P2P networks: eDonkey, Gnutella, JXTA

Network of personal weblogs (blogroll)

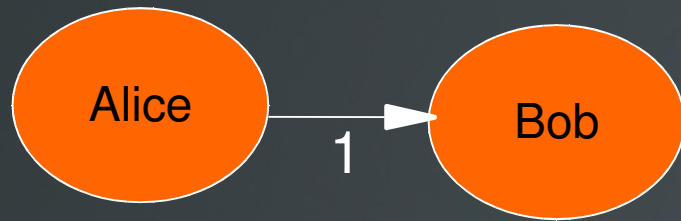Semantic Web: FOAF (Friend-Of-A-Friend) RDF format

Google (and Yahoo!): PageRank, TrustRank, ...

# Aggregate all the trust statements to produce a trust network.

Node ~ user
Direct edge ~ trust statement

Alice →1 Bob

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Direct edge ~ trust statement

*Properties of Trust:*
*- weighted (0=distrust, 1=max trust)*

# Aggregate all the trust statements to produce a trust network.

Node ~ user

Direct edge ~ trust statement

*Properties of Trust:*
*- weighted (0=distrust, 1=max trust)*
*- subjective*
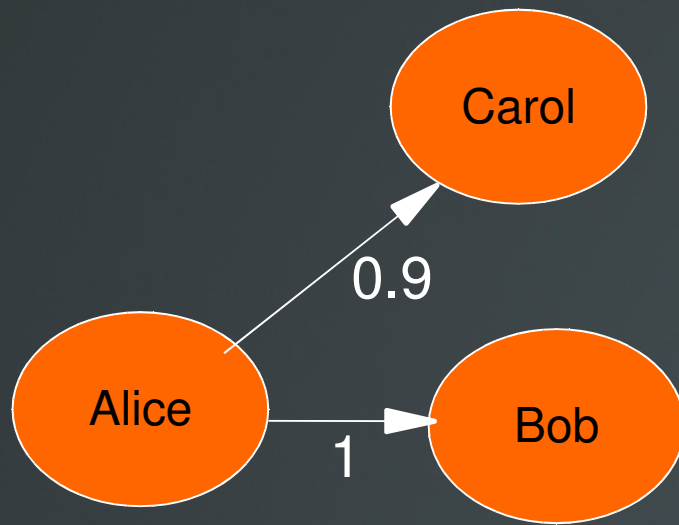
# Aggregate all the trust statements to produce a trust network.

Node ~ user
Direct edge ~ trust statement



*Properties of Trust:*
- *weighted (0=distrust, 1=max trust)*
- *subjective*
- *asymmetric*

# Aggregate all the trust statements to produce a trust network.

Node ~ user

Direct edge ~ trust statement
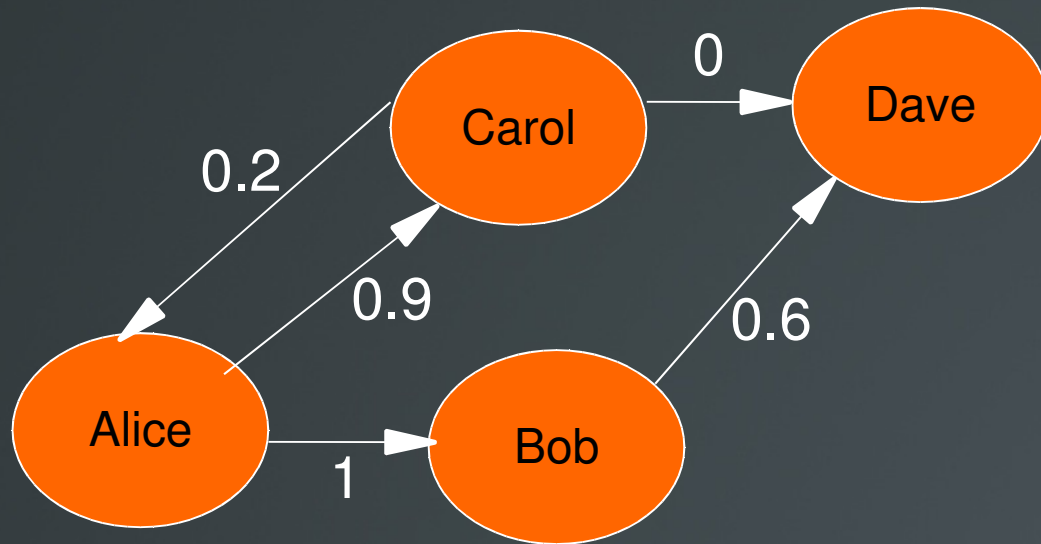


*Properties of Trust:*
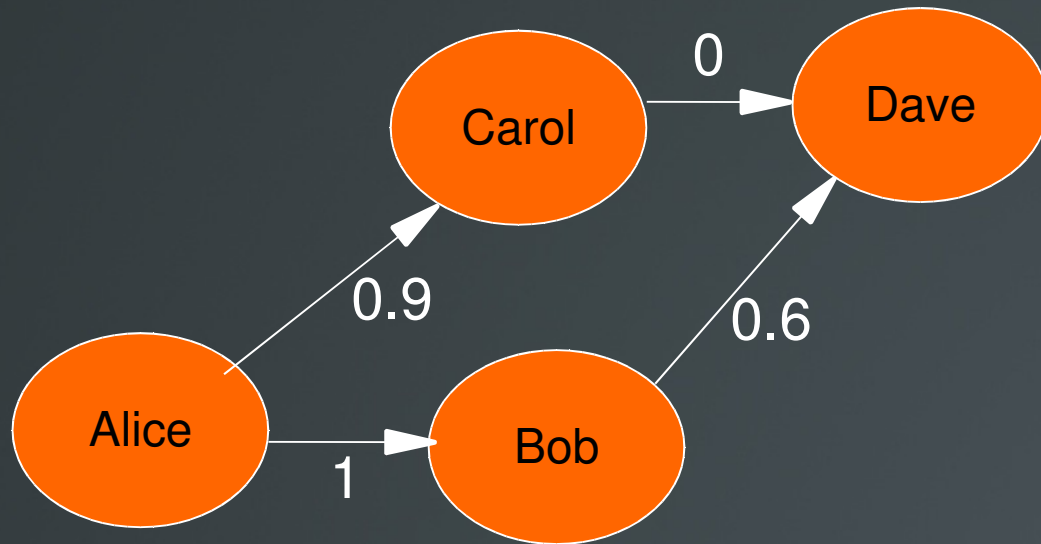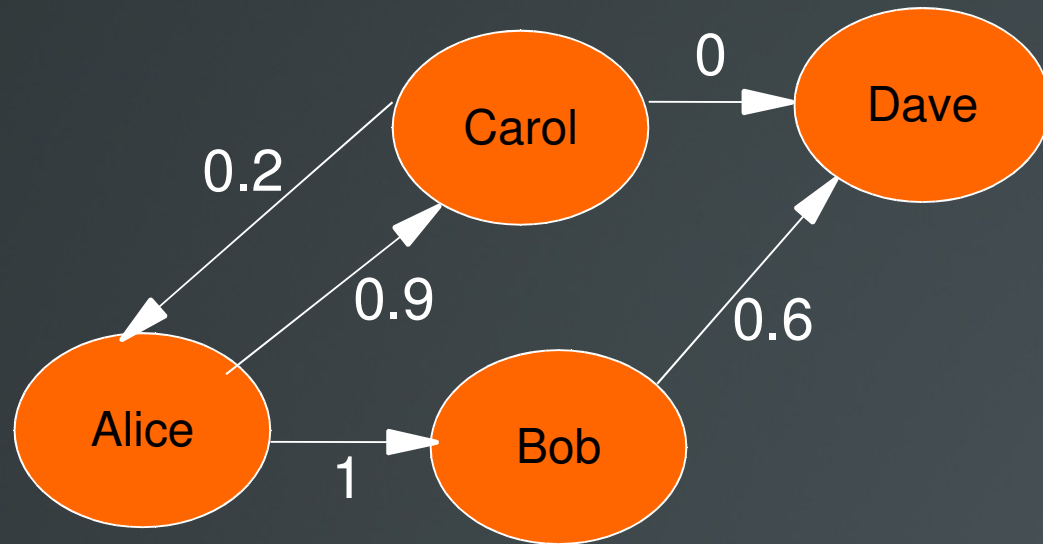- *weighted (0=distrust, 1=max trust)*
- *subjective*
- *asymmetric*
- *context dependent*

# What can we do with a trust network?
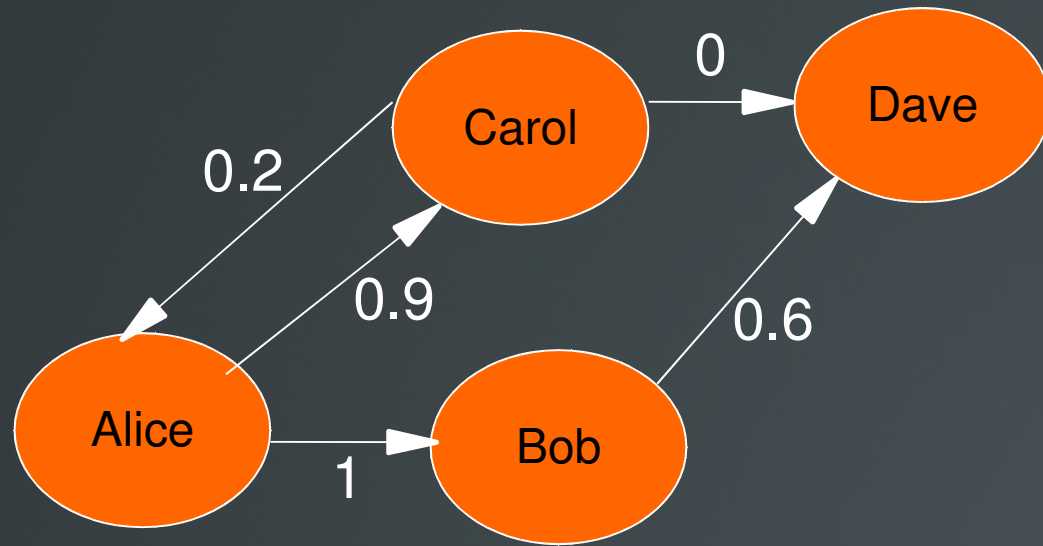
What can we do with a trust network?
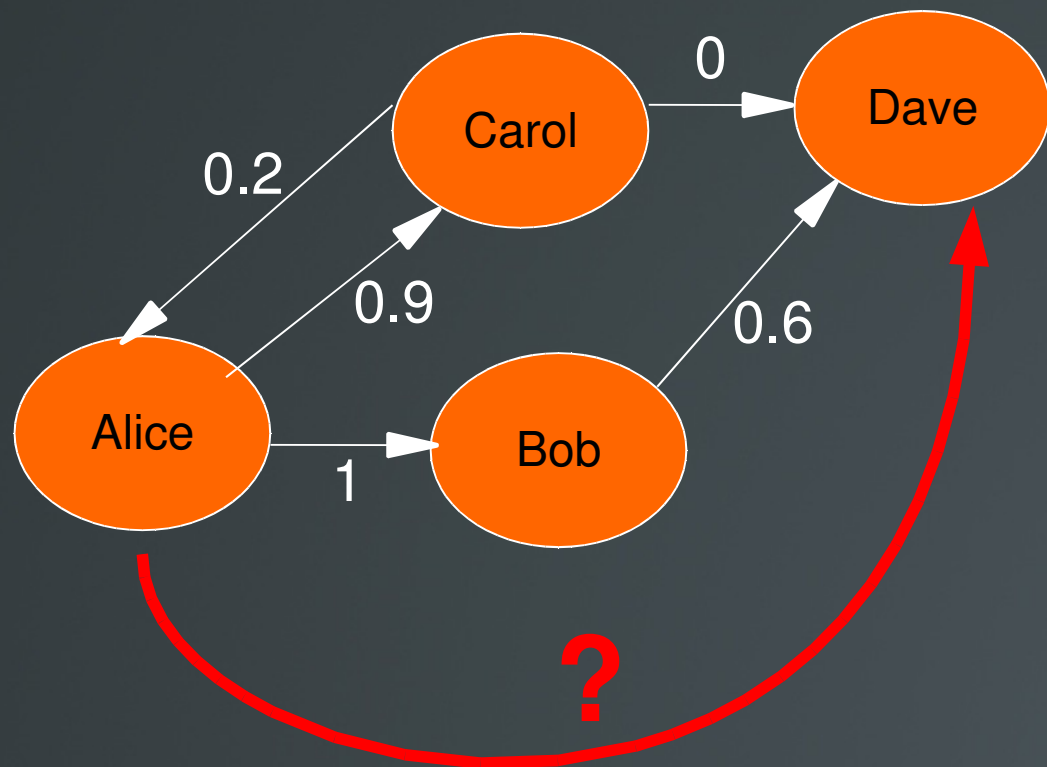
Predict how much I can trust unknown people!

T(Alice,Dave)=?

# Trust Metric!

## Uses <u>existing edges</u>
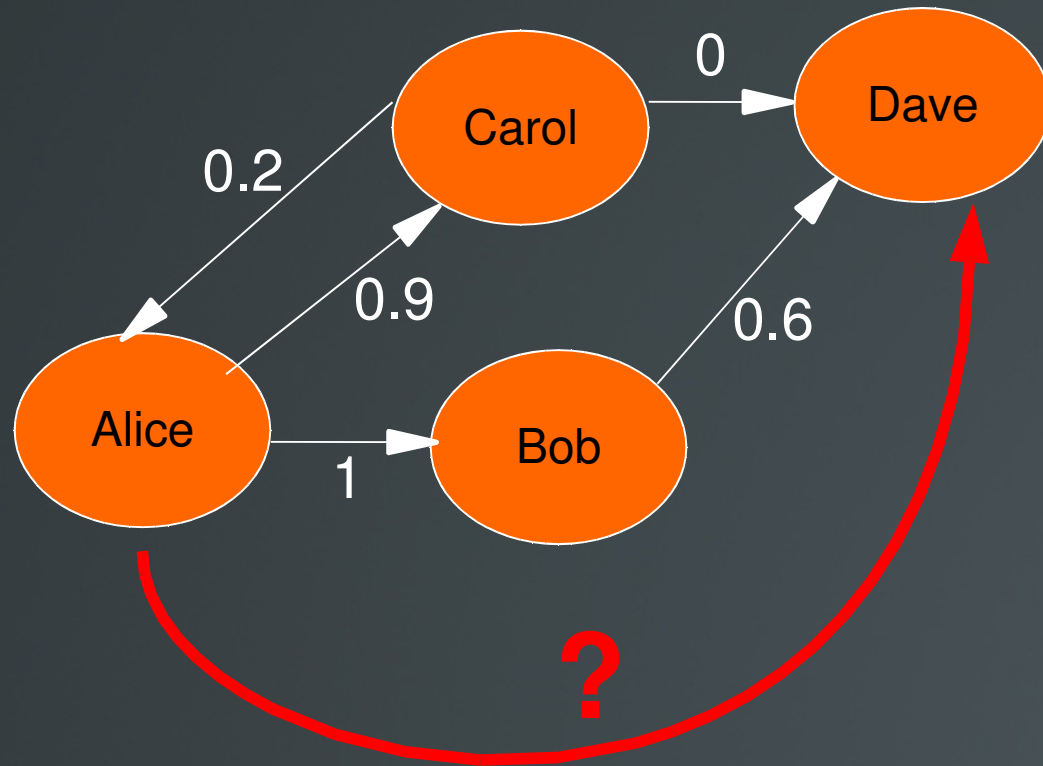
# Trust Metric!

Uses existing edges for <u>predicting values of trust for non-existing edges</u>,
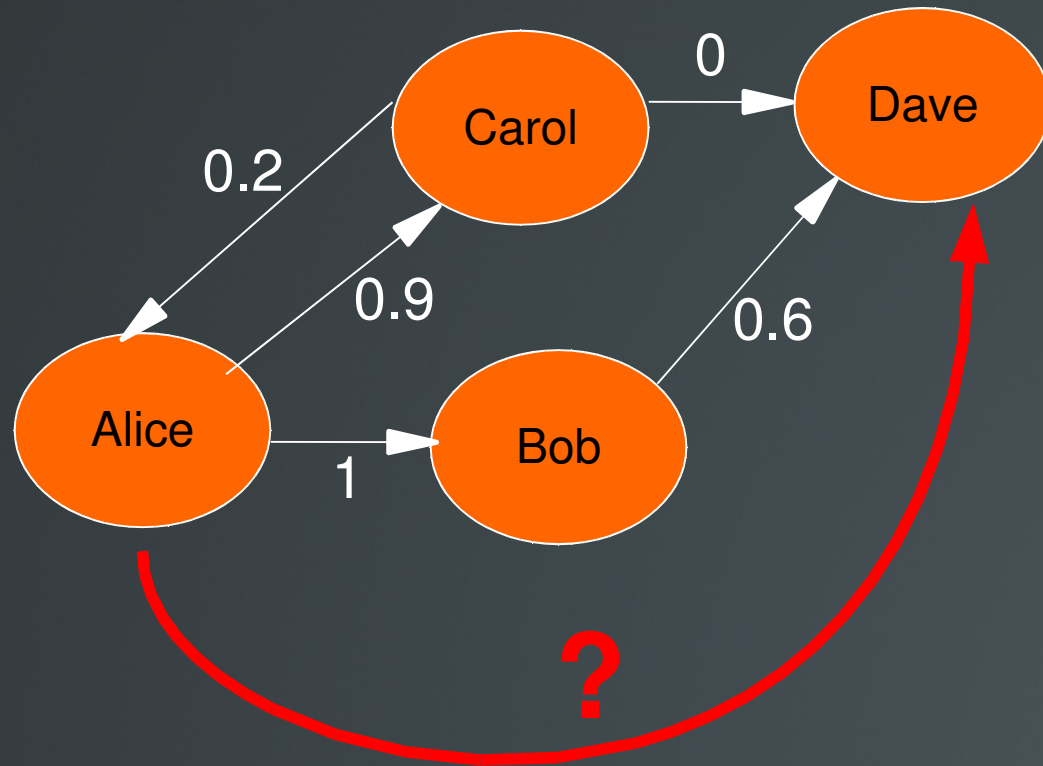
# Trust Metric!
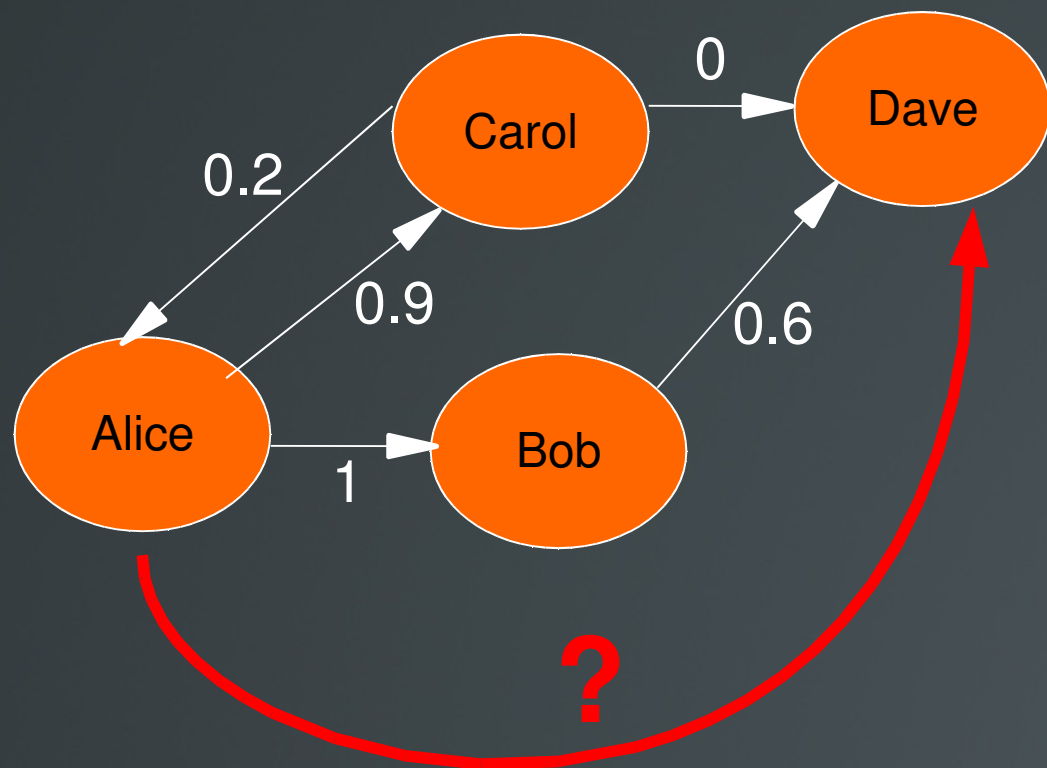
Uses existing edges for predicting values of trust for non-existing edges, thanks to <u>trust propagation</u> (if you trust someone, then you have some degree of trust in anyone that person trusts).

*Pagerank is a Trust Metric*

# Why are Trust Metrics useful?
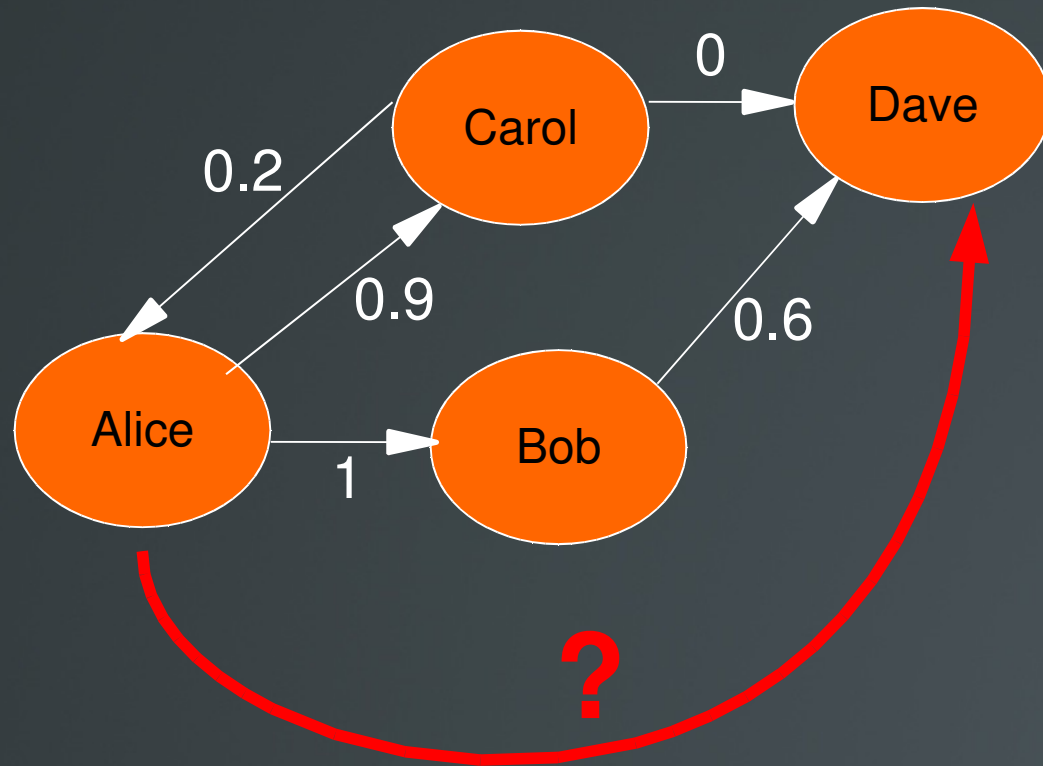
Now common to interact with strangers (ebay, ...)

Goal: Reduce uncertainty, by predicting how much each unknown people could be trusted.

# Local and Global Trust Metrics
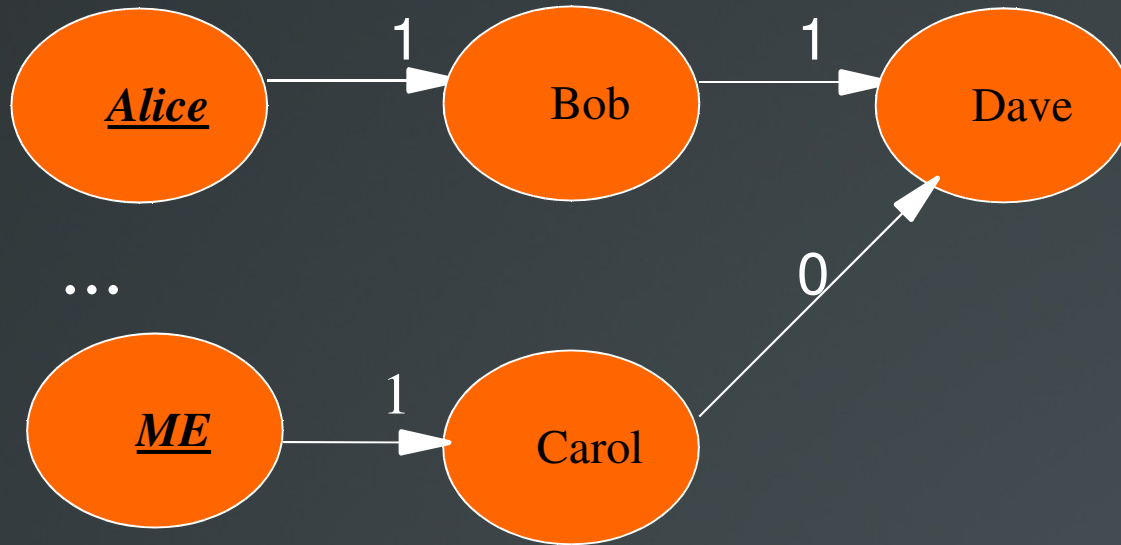


How much Dave can be trusted?
On average (by the community)?
By Alice?
And by ME?

# Local and Global Trust Metrics
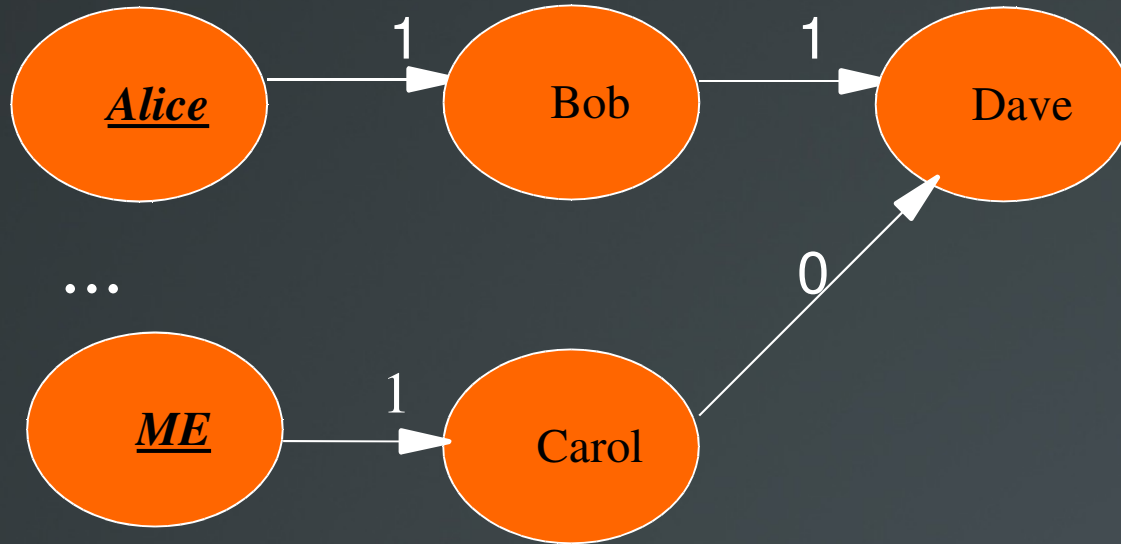


How much Dave can be trusted?
On average (by the community)?
By Alice?
And by ME?

## Global Trust Metrics:

"*Reputation*" of user is based on number and quality of incoming edges. *Dave* has just one predicted trust value (0.5).

PageRank (Google), eBay, Slashdot, ... Works badly for controversial people

## Local Trust Metrics

Trust is subjective --> consider personal views

Local can be more effective if people are not standardized.

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1. Trust on the web

   definition and examples

2. **Trustlet.org**

   **wiki for open research on trust metrics**

3. Initial results

   on Advogato trust network

# Trust Metrics Research

The problem: Everyone recreates from scratch a
"new" trust metric and tests it on a new or
synthetized dataset.
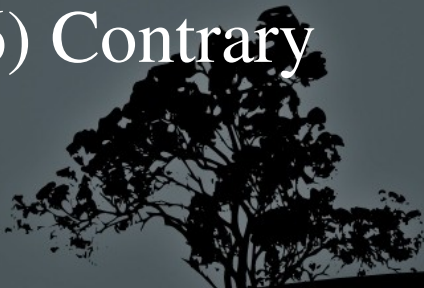
Sabater, J., and Sierra, C., Review on Computational Trust and Reputation
Models. Artificial Intelligence Review (2005)

"Finally, analyzing the models presented in this article we found that there
is a complete absence of test-beds and frameworks to evaluate and
compare the models under a set of representative and common
conditions. This situation is quite confusing, specially for the possible
users of these trust and reputation models. It is thus urgent to define a set
of test-beds that allow the research community to establish comparisons
in a similar way to what happens in other areas (e.g. machine learning)"

# How many Trust Metrics?

John Locke. An Essay concerning Human Understanding. **1680**

"Probability then being to supply the defect of our knowledge, the grounds of it are these two following: First, the conformity of anything with our own knowledge, observation and experience. Secondly, The testimony of others, vouching their observation and experience. In the testimony of others is to be considered: (1) The number. (2) The integrity. (3) The skill of the witnesses. (4) The design of the author, where it is a testimony out of a book cited. (5) The consistency of the parts and circumstances of the relation. (6) Contrary testimonies"

# Trustlet.org: the wiki!

The goal is to fix the problem

- collect trust metrics

- collect trust network datasets

- compare trust metrics on same datasets

- collect state of the art research (wiki pages)

Collaborative, open effort: freely editable **wiki** community

article | discussion | edit | history | protect | delete | move | watch
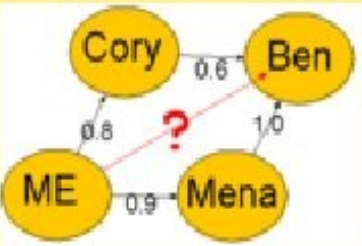
# Main Page

From TrustLet, a free, collaborative project for collecting and analyzing information about trust metrics.

Welcome to **TrustLet**, a cooperative environment for the scientific research of trust metrics on social networks. This is the wiki, where we review and understand trust and its related issues. You can also find more information about research on trust metrics, and the researchers involved in this. For this we mostly use the Creative Commons Attribution license. We are also working on Python code, available under the GNU General Public License, to compare all proposed **trust metrics** on the same datasets. See Science Commons for more information about our mode of research.

Currently we are working on 189 articles.

**cc science commons**

http://www.trustlet.org

## trust metrics

- algorithms
- evaluations
- applications
- software

## research

- papers
- working papers
- researchers
- conferences

## trust network datasets

- repositories elsewhere

## trust

- trustee

**menu**

- Main page
- Trust Metrics Evaluation
- Code
- Mailinglist

**wiki navigation**

- Recent changes
- Categories
- Random page

**search**

[ Go ] [ Search ]

**toolbox**

- What links here
- Related changes
- Upload file

# Trustlet.org: datasets

Empirical research

Some datasets already shared and released:

* advogato.org (daily snapshots)

    * squeakfoundation.org, kaitiaki.co.nz

* epinions.com (132000 users, 841000 trust statements)

Targetting others:

* wikipedia network of users

* http://www.trustlet.org/wiki/Trust_network_datasets
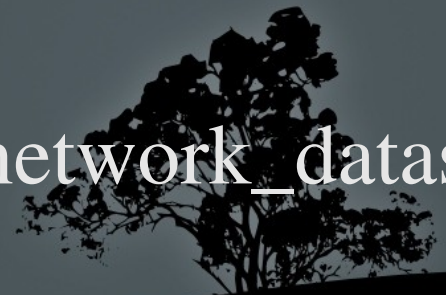
# Trustlet.org: Trust Metrics code

Empirical research: replicability, reusability

Collect implementation of different trust metrics

implemented in python,

released as Free Open Source Software (GPL license)

http://code.google.com/p/trust-metrics/

# Trustlet.org

Comparing different trust metrics on same datasets: preliminary work in next slides

# Trustlet.org

How is it going? Link to statistics

189 pages (531 including "talk" and "stub" pages)

2,405 page edits, since June 2007

23 registered users

Not being advertised. After this talk I plan to do advertise it in some mailing lists.

I know you now madly want to join ... wait few slides, ok? ;-)
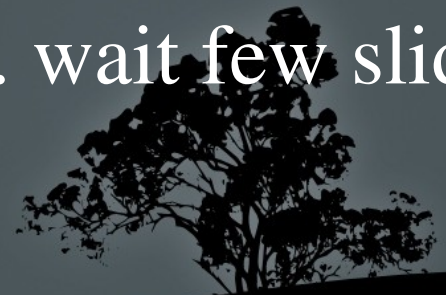
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   wiki for open research on trust metrics

3. **Initial results**

   **on Advogato trust network**

# Initial results

Comparison of different trust metrics on Advogato.org trust network

No definitive results

# Advogato trust network

Advogato.org, community site for Free and Open Source developers

Possible to express trust in other users on 4 levels:

- Master (1)

- Journeyer (0.8)

- Apprentice (0.6)

- Observer (0.4)

# Advogato

[ **Home** | **Articles** | **Account** | **People** | **Projects** | **FAQ** ]

**raph** is currently certified at Master level.

Name: Raph Levien
Member since: N/A
Last Login: 2007-11-21 19:31:10

Homepage: http://www.levien.com/

**Notes:** I work on Advogato, Ghostscript, Ghilbert, and some other things.

If you're trying to reach me, all of my older email addresses have become massively infested with spam. The best one to use right now is <firstname>.<lastname>@gmail.com. Sorry if you've been trying and haven't been able to get through.

Technorati Profile

## Projects

- Lead Developer on mod_virgule
- Lead Developer on Gfonted
- Lead Developer on Gill
- Contributor on GIMP
- Lead Developer on libart
- Developer on Gdome

**New Advogato Features**

**FOAF updates**: Trust rankings are now exported, making the data available to other users and websites. An external FOAF URI has been added, allowing users to link to an additional FOAF file.

Keep up with the latest Advogato features by reading the Advogato status blog.

**Advogato**

raph certified others as follows:

ogle™ Custom Search    Search

**raph** is currently certified

Name: Raph Levien
Member since: N/A
Last Login: 2007-11-21 19

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Homepage: http://www.levi

**Notes:** I work on Advogato

If you're trying to reach me,
with spam. The best one to
you've been trying and hav

Technorati Profile

**Projects**

- Lead Developer on n
- Lead Developer on G
- Lead Developer on G
- Contributor on GIMP
- Lead Developer on li
- Developer on Gdome

- raph certified miguel as Master
- raph certified jacob as Journeyer
- raph certified macricht as Journeyer
- raph certified clahey as Journeyer
- raph certified rconover as Apprentice
- raph certified federico as Master
- raph certified stric as Journeyer
- raph certified timg as Journeyer
- raph certified notzed as Journeyer
- raph certified tigert as Journeyer
- raph certified lewing as Journeyer
- raph certified pat as Journeyer
- raph certified joedecker as Apprentice
- raph certified shawn as Journeyer
- raph certified hp as Journeyer
- raph certified timj as Journeyer
- raph certified andersca as Journeyer
- raph certified nether as Journeyer
- raph certified jrb as Journeyer
- raph certified vicious as Journeyer
- raph certified kenelson as Journeyer
- raph certified cipher as Journeyer
- raph certified rhult as Journeyer
- raph certified yosh as Journeyer
- raph certified DV as Journeyer
- raph certified jmacd as Journeyer

**Trust statements
expressed by
raph**

⟵

ew Advogato Features

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eep up with the latest
dvogato features by reading
e Advogato status blog.

Done

# Advogato trust network dataset

7294 users

52981 trust statements (17489 Master, 21977 Journeyer, 8817 Apprentice, 4698 Observers)

1 large connected component (70.5% of nodes)

Mean in/out-degree is 7.26

Mean shortest path length is 3.75

# Trust Metrics Evaluation
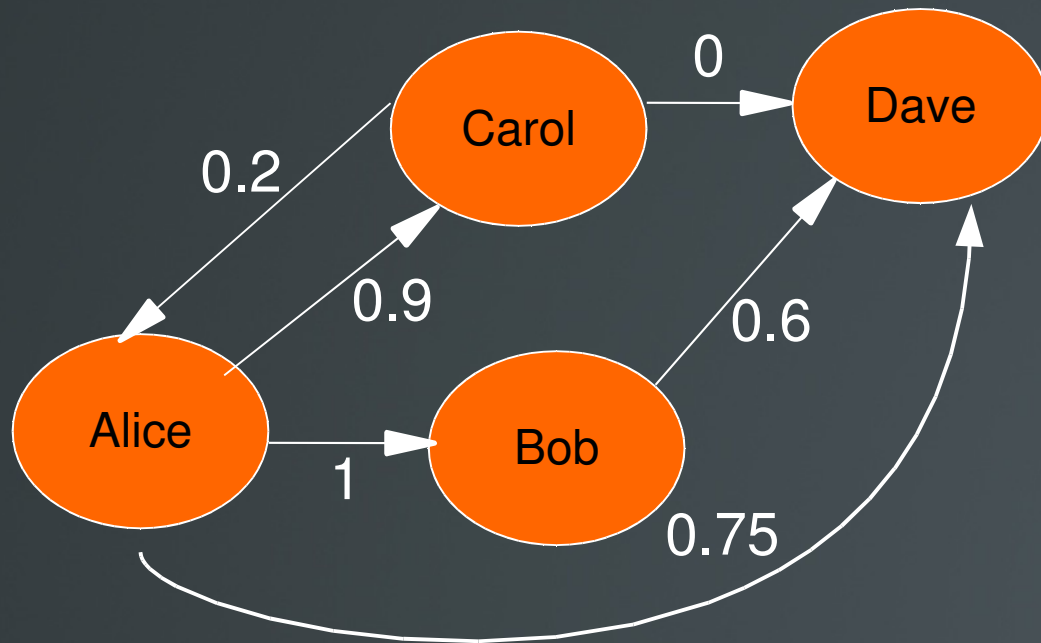
leave-one-out

# Trust Metrics Evaluation
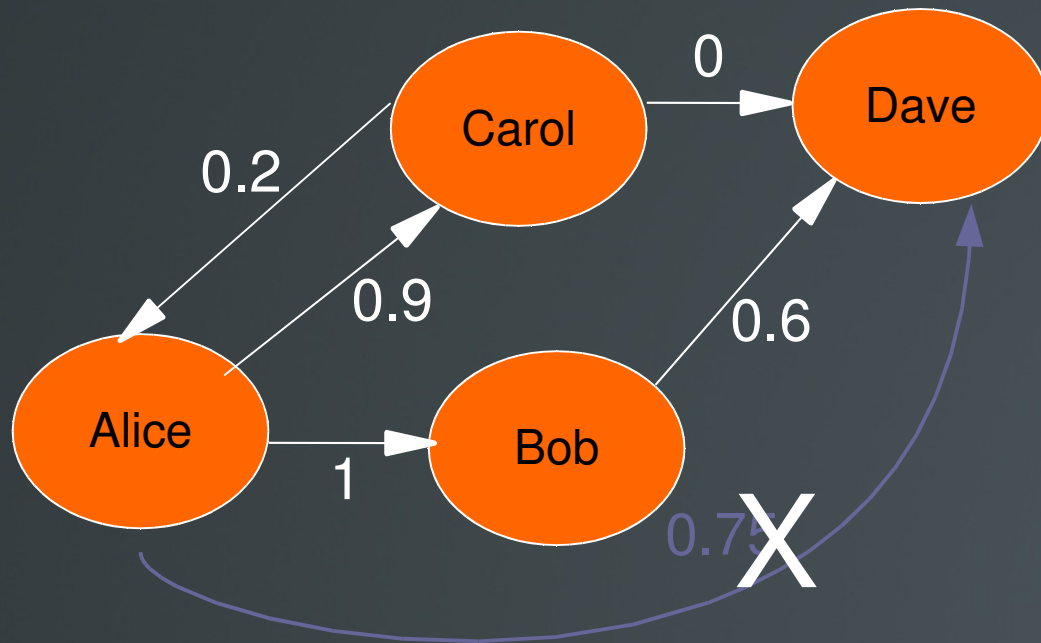
leave-one-out

1.Hide one trust statement
0.75

# Trust Metrics Evaluation
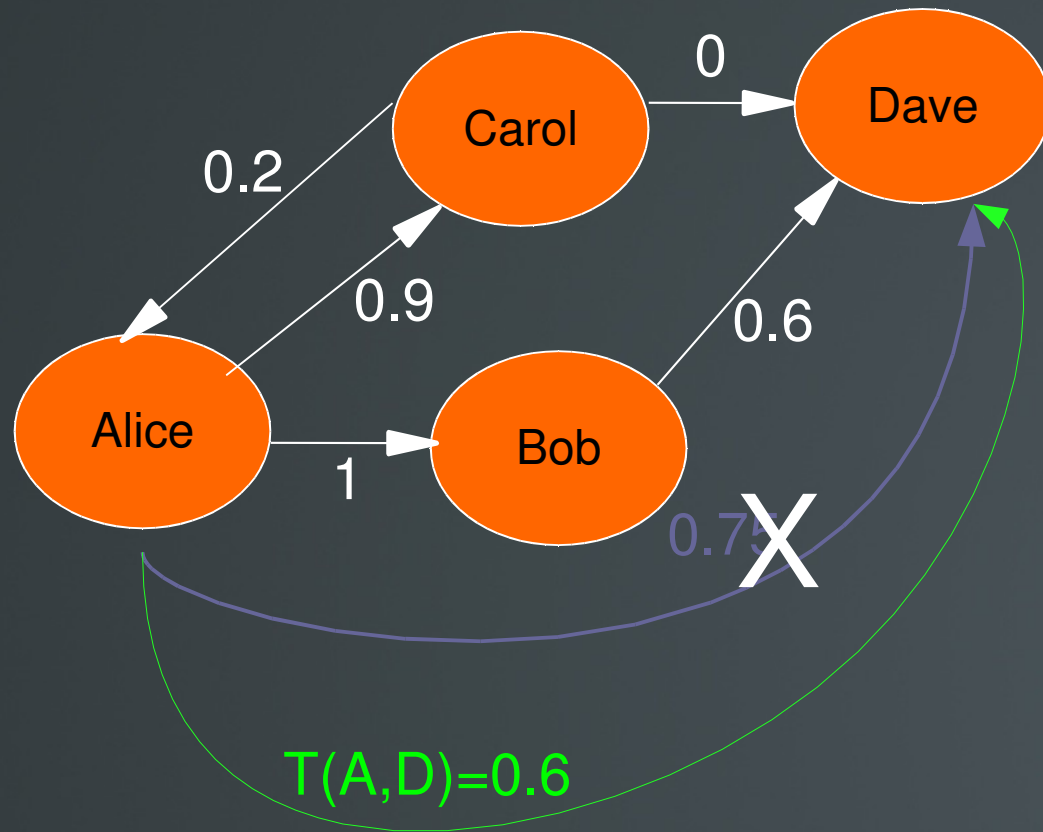
leave-one-out

1. Hide one trust statement 0.75
2. Predict it with a Trust Metric - T(A,D)=0.6

# Trust Metrics Evaluation
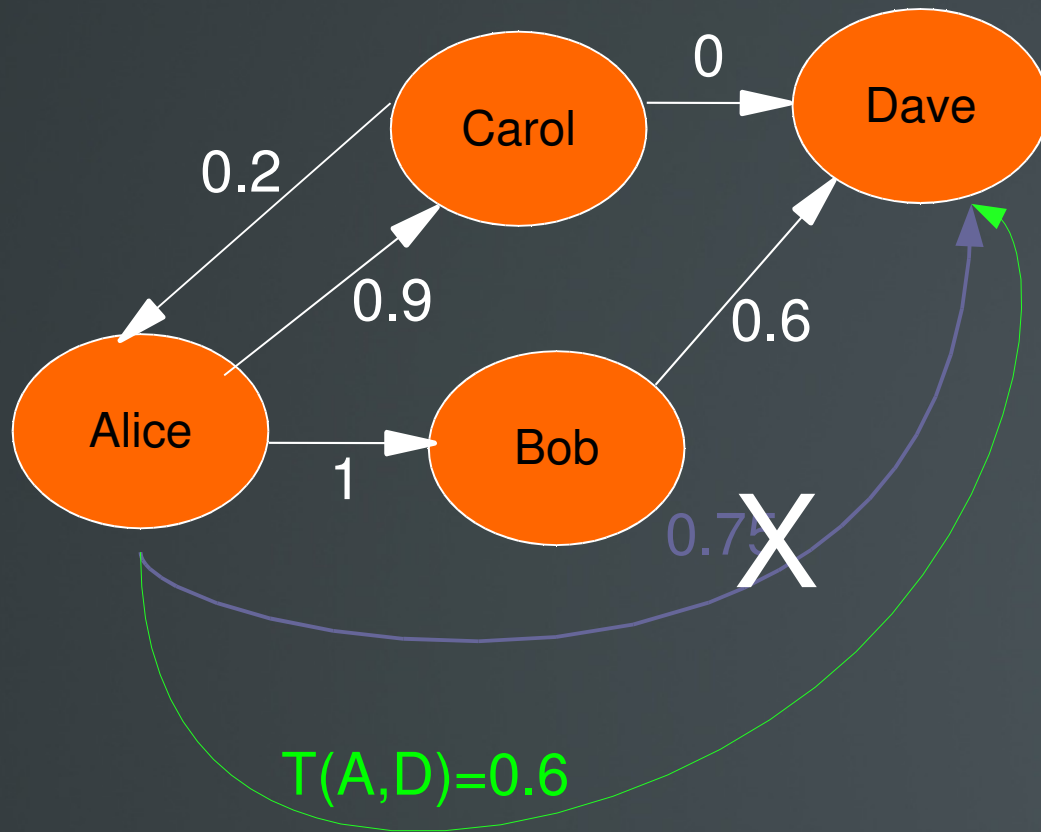
leave-one-out

1. Hide one trust statement 0.75
2. Predict it with a Trust Metric – T(A,D)=0.6
3. Compute error as difference |0.6-0.75| (or other measure)

# Trust Metrics Evaluation
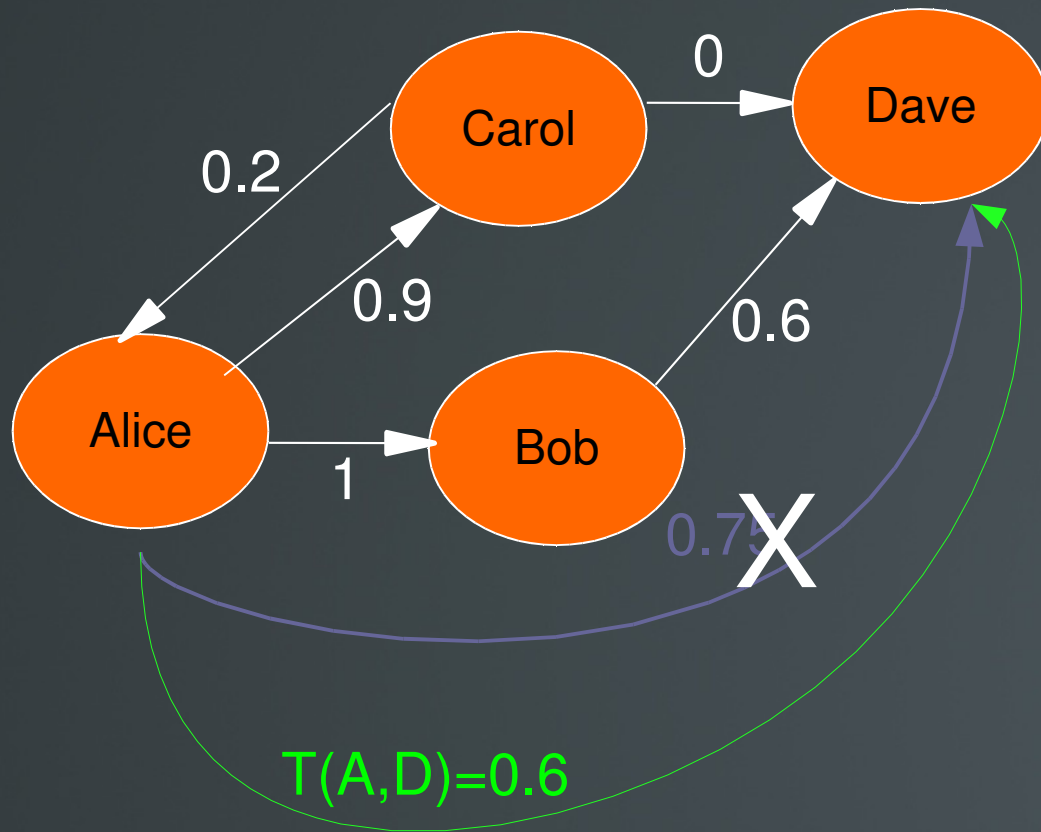


leave-one-out

1. Hide one trust statement 0.75
2. Predict it with a Trust Metric – T(A,D)=0.6
3. Compute error as difference |0.6-0.75| (or other measure)
4. Repeat the process for all trust statements and compute some mean error

# Trust Metrics evaluation Measures

MAE (Mean Absolute Error)

RMSE (Root Mean Squared Error)

Percentage of wrong preditions

Coverage (percentage of possible predictions)

# Compared Trust Metrics

Baselines (random, constant predictions)

Ebay (global)

PageRank

Advogato

    global

    local

MoleTrust (different propagation horizons)

MoleTrust

ME

|  | %wrong | MAE | RMSE | Coverage |
| --- | --- | --- | --- | --- |
| Random | 0.737 | 0.223 | 0.284 | 1.00 |
| Ebay | **0.350** | 0.086 | 0.156 | 0.98 |
| Moletrust2 | **0.366** | 0.090 | 0.160 | 0.80 |
| Moletrust3 | 0.376 | 0.091 | 0.161 | 0.93 |
| Moletrust4 | 0.377 | 0.092 | 0.161 | 0.95 |
| PageRank | 0.501 | 0.124 | 0.191 | 1.00 |
| AdvogatoLocal | 0.550 | 0.186 | 0.273 | 1.00 |
| AdvogatoGlobal | 0.595 | 0.199 | 0.280 | 1.00 |

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Ebay (global) slightly better than MoleTrust (local)

# Uhm ...

What about controversial users?

Controversial users are users which are judged in very diverse way by the members of a community.

Would local trust metrics perform better than global ones?

Evaluate on edges going into users with at least 10 incoming edges and standard deviation in received certifications greater than 0.2 (#edges from 52981 to 2030)

Evaluate on edges going into controversial users

| | %wrong | MAE | RMSE |
|---|---|---|---|
| Random | 0.799 | 0.266 | 0.325 |
| AlwaysMaster | **0.462** | 0.186 | **0.302** |
| Ebay | 0.778 | 0.197 | 0.240 |
| OutA | 0.614 | 0.147 | 0.199 |
| OutB | 0.724 | 0.215 | 0.280 |
| Moletrust2 | 0.743 | 0.195 | 0.243 |
| Moletrust3 | 0.746 | 0.194 | 0.241 |
| Moletrust4 | 0.746 | 0.195 | 0.242 |
| PageRank | 0.564 | 0.186 | 0.275 |
| AdvoLocal | 0.518 | 0.215 | 0.324 |
| AdvoGlobal | 0.508 | 0.216 | 0.326 |

# Evaluate on edges going into controversial users

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AlwaysMaster seems the best one for %wrong and very bad for RMSE!

Results depending on evaluation measure?!?

Evaluate on edges going into controversial users

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OutA is the best for RMSE!
"observer" has a different semantics.
Difficult to evaluate!

Evaluate on edges going into controversial users

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Ebay (global) and
Moletrust2 (local)
similar also on controversial
users!

# Ongoing work

* Analyzing in more detail controversial users (thresholds)

* Studying network of wikipedia users (and comparing it with other networks)

# Join the collaborative effort at trustlet.org!

- edit pages (anonymously or register!)

- help collecting and releasing trust network datasets

- share a trust network dataset

- play with datasets

- share your implementation of a trust metric

- help spread the word: email your peers, mailing lists, forums, post on your blog, link, ...

# Thank you!

# Questions?

# License of the presentation

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# Advogato Trust Network dataset: more statistics

There are 17489 Master judgments, 21977 for Journeyer, 8817 for Apprentice and 4698 for Observers. The dataset is comprised of 1 large connected component, comprising 70.5% of the nodes, the second largest component contains 7 nodes. The mean in- and out-degree (number of incoming and outgoing edges per user) is 7.26. The mean shortest path length is 3.75. The average cluster coefficient [4] is 0.116. The percentage of trust statements which are reciprocated (when there is a trust statement from A to B, there is also a trust statement from B to A) is 33%.

Evaluate on edges going into controversial users

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Evaluate on edges going into controversial users

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|---|---|---|---|---|
| Random | 0.799 | 0.266 | 0.325 | 1.00 |
| AlwaysMaster | 0.462 | 0.186 | 0.302 | 1.00 |
| AlwaysJourneyer | 0.801 | 0.202 | 0.238 | 1.00 |
| AlwaysApprentice | 0.943 | 0.296 | 0.320 | 1.00 |
| AlwaysObserver | 0.794 | 0.414 | 0.477 | 1.00 |
| Ebay | 0.778 | 0.197 | 0.240 | 0.98 |
| OutA | 0.614 | 0.147 | 0.199 | 0.98 |
| OutB | 0.724 | 0.215 | 0.280 | 0.92 |
| Moletrust2 | 0.743 | 0.195 | 0.243 | 0.80 |
| Moletrust3 | 0.746 | 0.194 | 0.241 | 0.93 |
| Moletrust4 | 0.746 | 0.195 | 0.242 | 0.95 |