# A survey of trust and reputation systems for online service provision

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# Trust

**Reputation** trust: The subjective probability by which an individual, A, expects that another individual, B, performs a given action on which its welfare depends.

**Decision** trust: The extent to which one party is willing to depend on something or somebody in a given situation with a feeling of relative security, even though negative consequences are possible.

# Reputation

**Reputation:** What is generally said or believed about a person’s or thing’s character or standing.

Or: A collective measure of trust derived from local trust networks.

# Key issues in trust and reputations system research

The web has different challenges for these systems over the physical world:

- Easy to manufacture identities
- Easy to break protocol

However, there are some useful properties as well:

- Can distribute information over the whole network rapidly
- Information can be stored indefinitely with a small rate of loss

# Required properties of reputation and trust systems

- System entities must be long lived so that reputation and trust may build over time
- Ratings about current actions are tracked and distributed
- Ratings about past actions must guide future decisions

And a helpful but not necessary property:

- Trust should be transitive

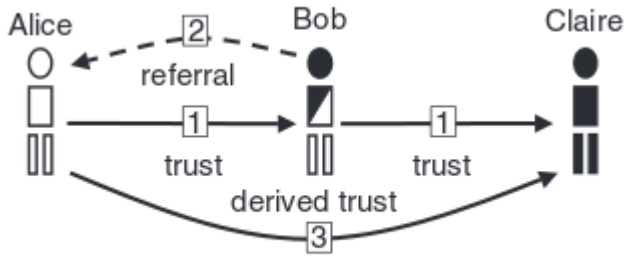


Fig. 1. Trust transitivity principle.

# Collaborative filtering vs collaborative sanctioning

**Collaborative filtering:** Individuals have subjective taste and the goal is to provide people with entities that satisfy their tastes.

**Collaborative sanctioning:** Individuals have an objective measure and the goal is to sanction entities which do not satisfy that measure.

# Centralized and distributed reputation systems

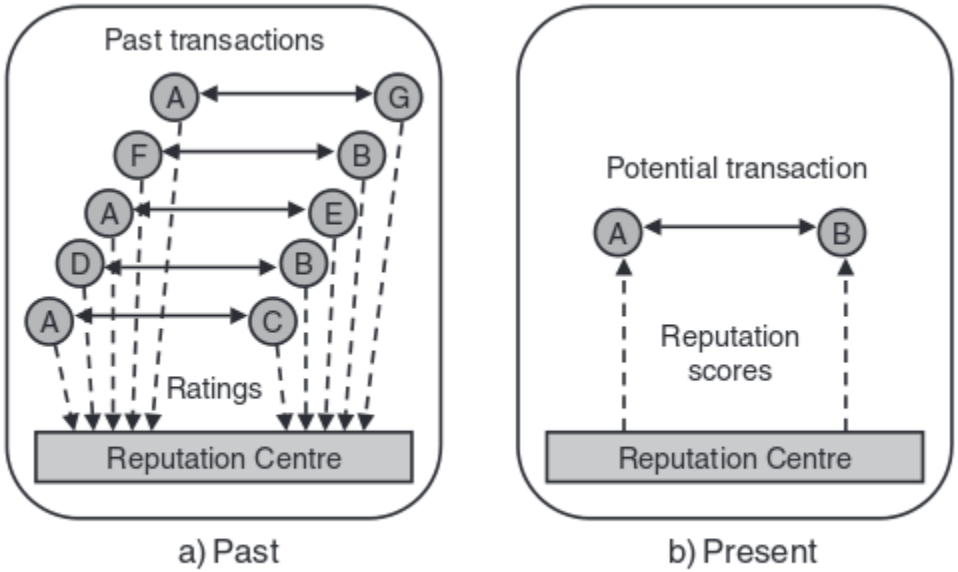


Fig. 3. General framework for a centralised reputation system.

# Centralized and distributed reputation systems

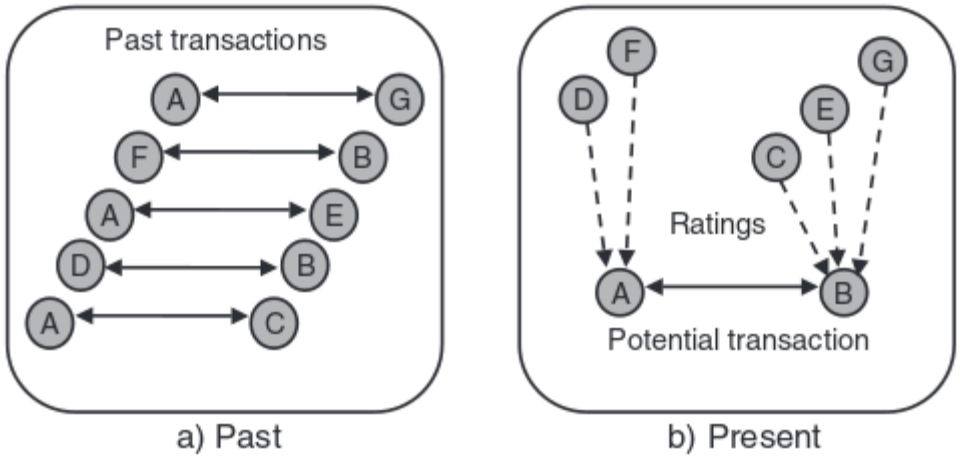


Fig. 4. General framework for a distributed reputation system.

# Trust classes

**Provision trust:** The relying party's trust in a resource or provider.

**Access trust:** The relying party's trust in other individuals accessing information which is the relying party's responsibility.

**Delegation trust:** The relying party's trust in another agent to act in their stead

**Identity trust:** The relying party's trust that another agent is who they say they are.

**Context trust:** They relying party's trust that the underlying systems and infrastructure are sufficient to support transactions and to provide a safety net.

# Categories of trust measures

| | Specific | General |
|---|---|---|
| Subjective | Survey questionnaires | eBay, voting |
| Objective | Product tests | Synthesized general score from product tests |

# Reputation Computation Methods and Examples

# Qualities of Good Reputation Engines

Accuracy for Long Term Performance

Weighted Toward Current Behaviour

Robustness Against Attacks

- Hardest to satisfy

Smoothness

- Adding any rating should not influence the score significantly

# Summation and averaging

Summation - positive ratings - negative ratings
eBay

Averaging - average of all rating
Amazon, Epinions

Weighted Averaging - weights determined by trustworthiness, age of rating, etc.

Pros
- Easy to understand and compute

Cons
- Vulnerable to ballot stuffing
- Doesn’t actually represent reputation very well
- Loses information

# Bayesian Systems

Begin with *a priori* estimate of reputation

Perform bayesian update after each new rating

Reputation represented by beta probability distribution

- Probability that future interaction will be positive

Pros

- Theoretically sound

Cons

- Quite complex, not accessible

# Discrete Trust Models

Rely on humans - native understanding of trust and reputation

Agents (humans) rate other agents as Very Trustworthy, Trustworthy, Untrustworthy, Very Untrustworthy

Accounts for different people being calibrated differently

Assumes agents don’t lie, just over or underrate

Alice rates Bob as Very Trustworthy
Carol has personal experience with Bob and found him to be Trustworthy (less than Very Trustworthy)

Carol assumes that Alice will in general overrate and considers this when looking at anything else Alice has rated

# Discrete Trust Models

Cons

- Hard to translate into efficient data structures and algorithms
- Required lookup tables (expensive) and heuristics (not provable)
- A lot of assumptions about human behavior

Pros

- Generally better than most other models
- Analogous to how humans work with trust

# Flow Models

Compute trust by transitive iteration through chains

Pros

Theoretically sound

Google uses it (PageRank)

Cons

Computationally expensive

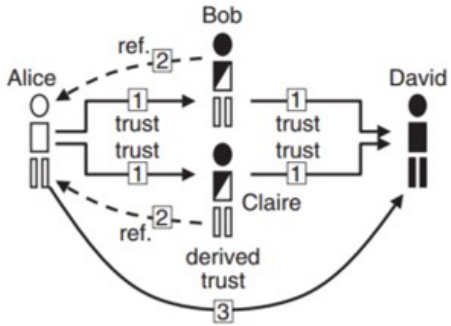


Fig. 6. Deriving trust from parallel transitive chains.

# Commercial Reputation Systems

# eBay

Buyers and sellers can rate each other

- Positive, negative or neutral (1, -1, 0)

Displays total of reputation scores for each user

- 3 different time windows: past 6 months, past month, past week

Cons

- Retaliation with negative ratings
- Ballot stuffing with fake transactions (uncommon due to transaction cost)
- Simple summation reputation computation
- 100 positive and 10 negative is the same as just 90 positive reviews

Pros

- Easy, Works

# Epinions

Provides product reviews and ratings to other websites for a fee (also advertising)

Pool of members who write product and shop reviews

Reviews are rated from Not Helpful to Very Helpful

Members Earn money through *Income Share Program* through the use of their reviews

- A portion of Epinions' income is split among members based on the utility of their reviews
- Formula not specified in detail

# Google

PageRank

Ranks a page by how many other pages are linking to it

- Weighted by reputation of linking page

Tough to influence (spam detection, etc)

A flow system

- Trust transitivity

# Scientometrics

Measuring research output and impact

Scientific papers cite each other - referral

To rank scientific papers, just count the referrals

Similar to Google’s PageRank

Decent, but sometimes misleading

# Common Problems (and some proposed solutions)

# Low Incentive For Providing Rating

Negative Incentives

- Providers resources are limited and you don’t want to share with others

Motivations for inaccurate ratings

- Fear of retaliation
- Being “nice”

Free Riding

Cash incentive - Epinions

# Bias Toward Positive Rating

Only 1% of eBay ratings are negative

Positive rating represents exchange of courtesies

Fear of retaliation or lawsuit

Solution

Assume unfair ratings can be detected with statistics, do that

Assume raters with low (externally determined) reputation are likely to give unfair ratings

# Change of Identities

Reputation systems assume that identities (or pseudonyms) are long lived

- Allows for reputation and rating to be meaningful

If someone loses too much reputation they can just change identity

- Not in the interest of the community

To counter this, some systems consider no reputation to be negative

- Unfairly punishes “good newcomers”

# Ballot Box Stuffing

More than the legitimate number of ratings is provided

Require registration (most systems)

Transaction cost (eBay)

Difficult to get rid of on theoretical level

# Bibliography

Jøsang, A., R. Ismail, C. Boyd (2005). A Survey of Trust and Reputation Systems for Online Service Provision, Decision Support Systems, 43(2):618-644.