Technische Universität
Darmstadt

Telecooperation Lab
Prof. Dr. Max Mühlhäuser

TK3: Ubiquitous (& Mobile) Computing

Chapter: Trust

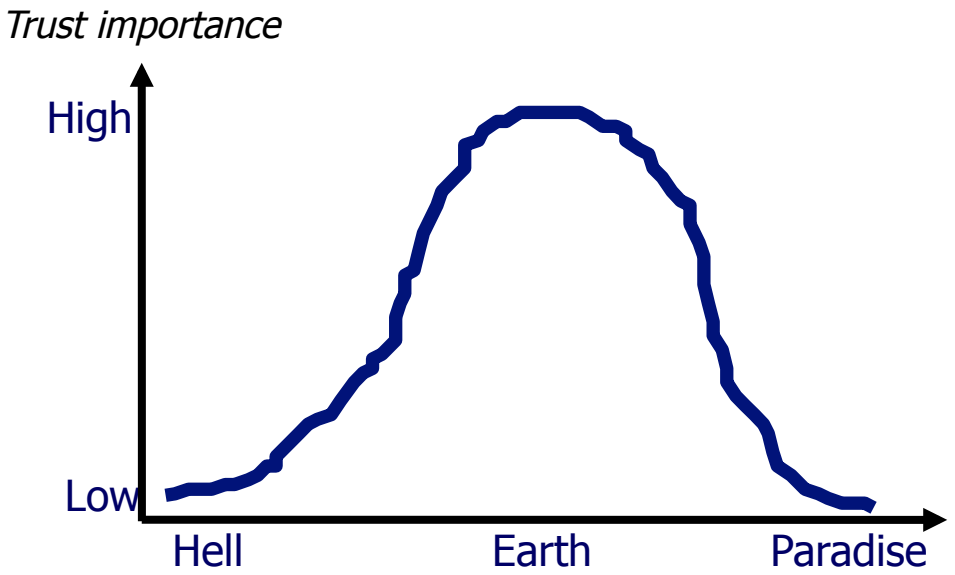
Lecturer: Sascha Hauke
(Sheikh M. Habib, Sebastian Ries)

TRUST

Outline:

- Part I — 45 mins
  - Introduction to trust
  - Trust modeling
- Part II — 45 mins
  - Computational trust methods
  - Computational trust evaluation

Introduction



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CASED

Source: Audun Josang, Security and Trust: What's the connection?, Keynote at Privacy Security & Trust, St.Andrews, New Brunswick, Canada, October 2005

Trust: What is it… and why do we need it?

Me

Truster

Some act of reliance

Engagement

Something at stake

Risk

Someone/something else

Trustee

Our definition:

Trust /trʌst/

noun

the justified willingness to engage with an entity in the presence of risk

Trust:
What is it… and why do we need it?

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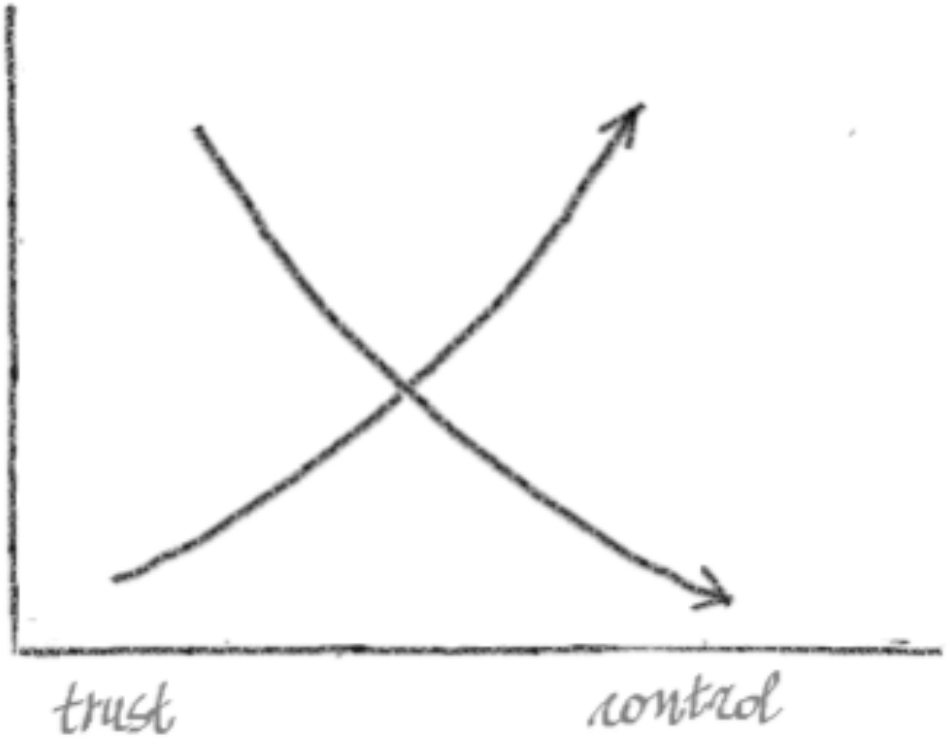
Trust ⟷ Control



Our definition:

Trust /trʌst/
noun

the justified willingness to engage with an entity in the presence of risk (without being able to control its actions)

Trust: What is it… and why do we need it?

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What does that mean?

How do we measure "justified willingness"?

We'll get back to that in a bit!

Our definition:

Trust /trʌst/
noun

the justified willingness to engage with an entity in the presence of risk (without being able to control its actions)

Trust: What is it… and why do we need it?

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2011: Compromised CAs in PKI

AP PHOTO/SCOTT HEPPELL

2013: Mislabeling meat

2013: NSA Prism scandal

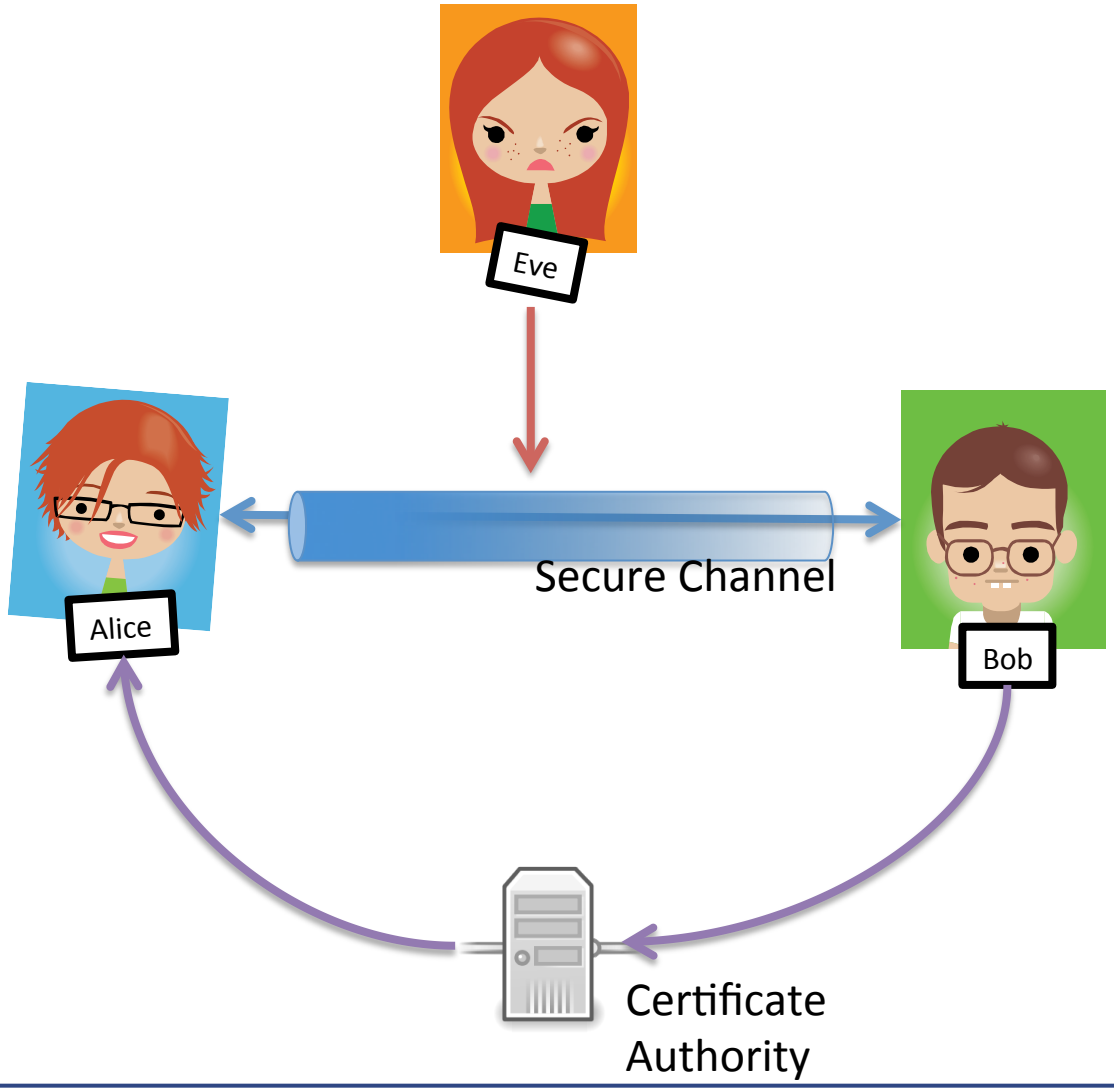
Trust, Untrust, Distrust and Mistrust

Now that we know what trust is (kinda), some more terminology:

- **Untrust**: (a measure of) how little a trustee is trusted
- **Distrust**: (a measure of) how much the truster believes that the trustee will actively work against them in a given situation
- **Mistrust**: misplaced trust (so, you trusted the trustee, but shouldn‘t have)

Stephen Marsh and Mark R. Dibben: Trust, Untrust, Distrust and Mistrust – An Exploration of the Dark(er) Side, iTrust 2005

Why trust when we have security?



Why trust when we have security?

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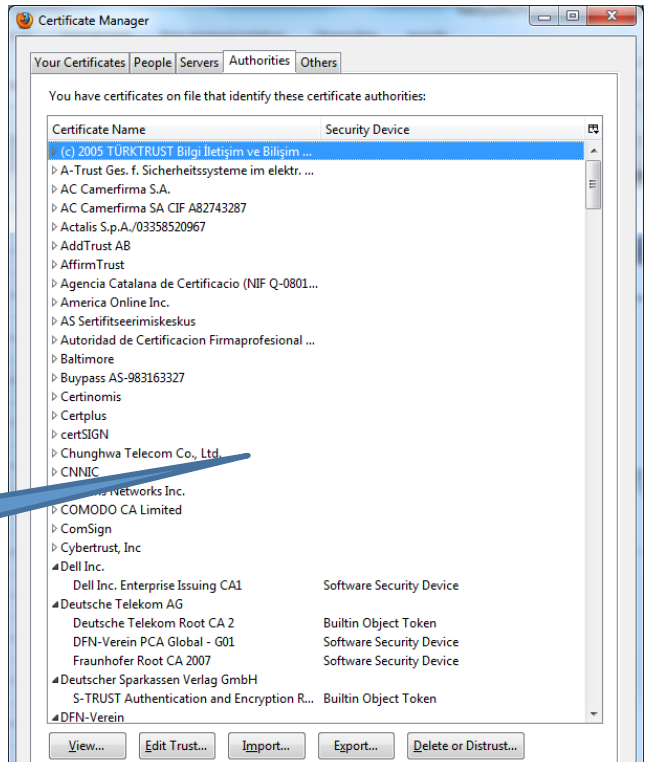
- IT security provides Confidentiality/Integrity/Authenticity for transport of data over space & time
  + authorization, authentication, non-repudiation

that is, IT security „secures“ path to Bob

However, you still have to put trust in quite a few things:

- Bob is who he says he is and is trustworthy*,
- the CA issues correct certificates,
- the secure channel is implemented correctly,
- the cryptographic assumptions actually hold,
- …

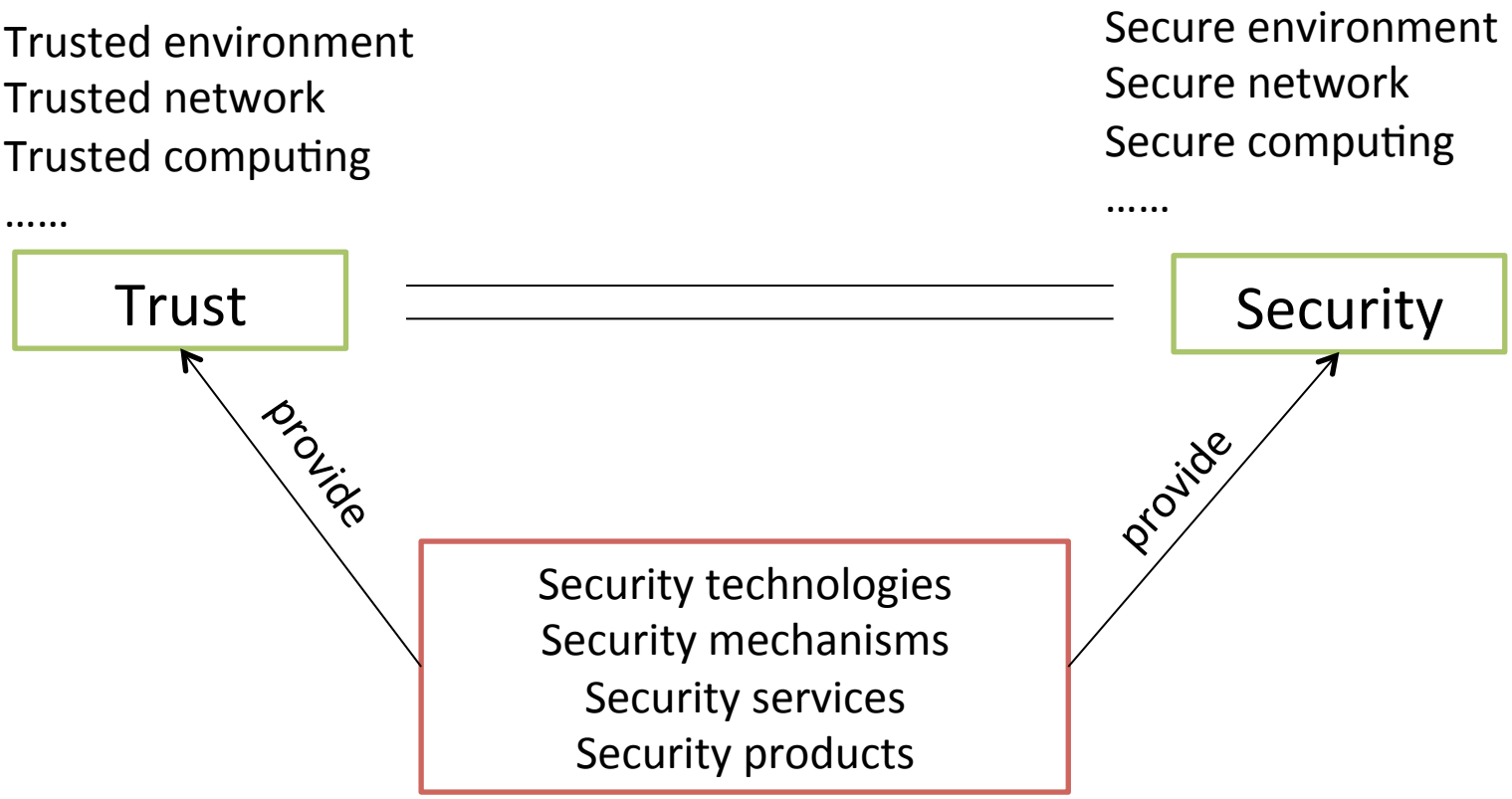


Did you ever have a look at the Certificate Mgr. of your browser?

* he is willing and capable to do what he promises

Trust in Security: Babylon reigns

(?) “Trust is synonymous to Security” [Chang, Dillon, Hussain (2006)]



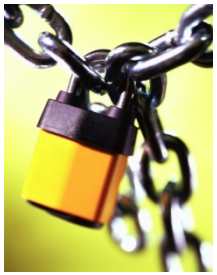
Terminologies

(Computational)

Trust

subjective

Soft trust[1]/security[2]



Security

objective

Hard trust[1]/security[2]

Trusted Computing

(system's behavior)

[1] **[V2009]** [2] **[RJ96]**

Trust: How to compute the darn thing

Me

Truster

Truster has

Expectation

Trustee acts

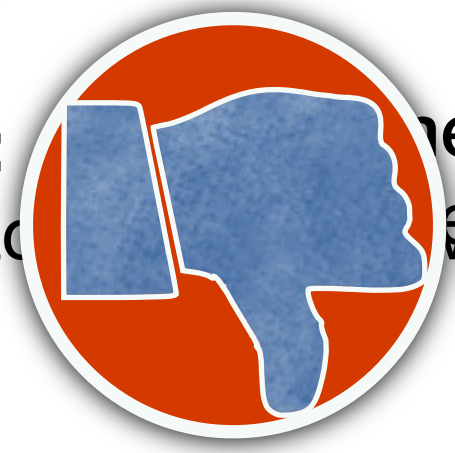
Fulfillment

Someone/something else

Trustee

Expectation:

Before the fac



after the fact

Trust: How to compute the darn thing

Me

Truster

Truster has

Expectation

Trustee acts

Fulfillment

Someone/something else

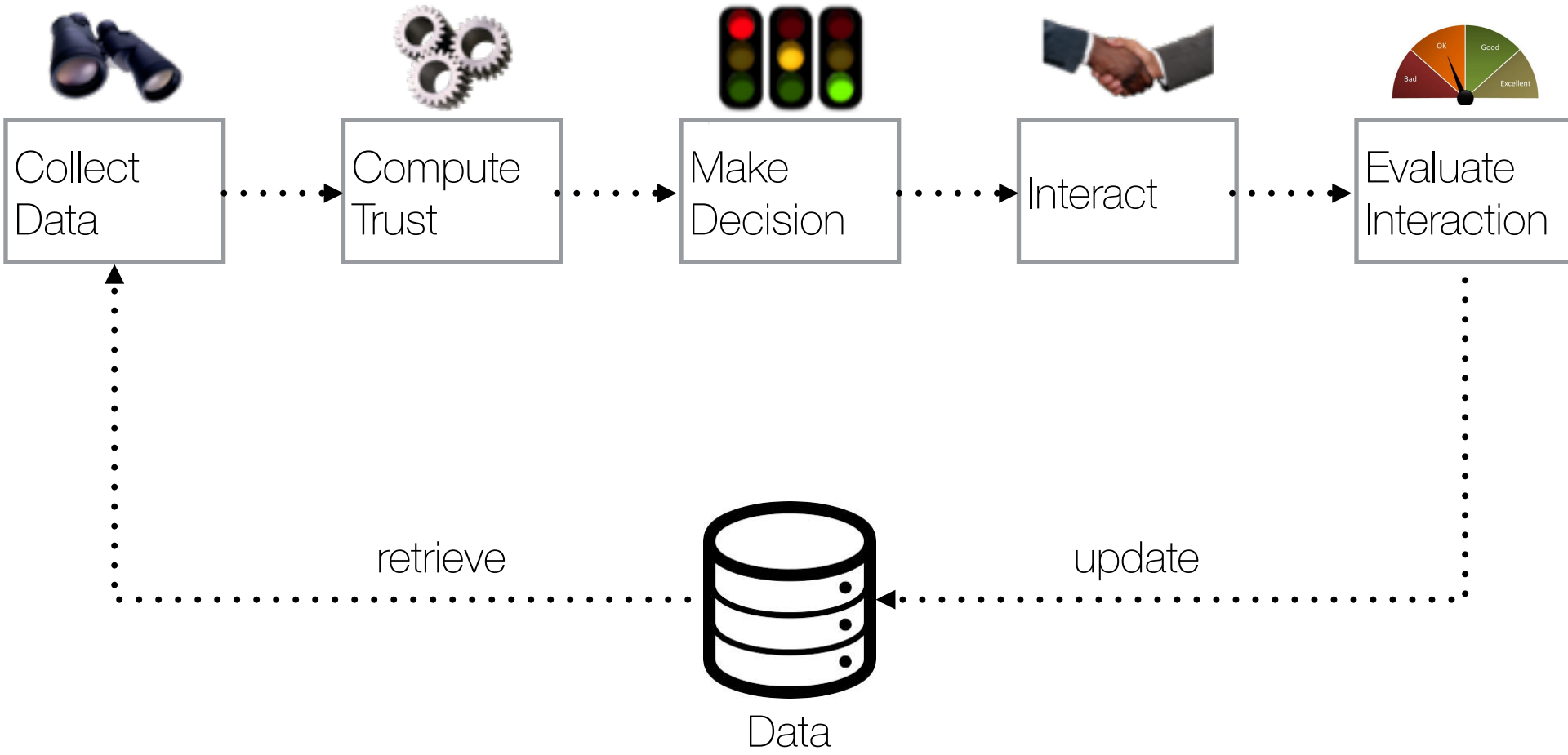
Trustee

~~*Jøsang's definition:*~~

Reliability Trust

Reliability trust is defined as the trusting party's probability estimate p of success of the transaction.

Trust: How to compute the darn thing



Trust: How to compute the darn thing

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Experiences

2011 👍
2012 👍
2013 👎
2014 👍

Trustworthiness
(inherent quality)

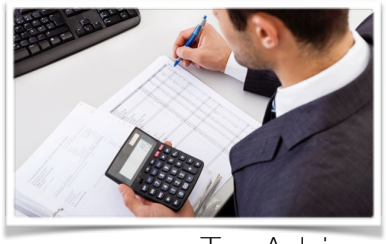
- benevolence
- competence
- integrity

Zertifizierte Steuerberater-Kanzlei nach DIN EN ISO 9001:2008 — Steuerberaterverband Westfalen-Lippe e.V. — StBV — TÜV SÜD ISO 9001

Berufshaftpflicht & Vermögensschadenhaftpflichtver

Me
Truster

Question:
How much can I **trust**?*



Tax Advisor
Trustee

middle-aged
Frankfurt-based
since 1987
family business

Attributes/ Features

Friends
Recommenders

Dominik's recommendation
3x 👍 0x 👎

Florian's recommendation
5x 👍 2x 👎

* Context: … my tax advisor to file my taxes correctly?

Trust: How to compute the darn thing

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No or little experience

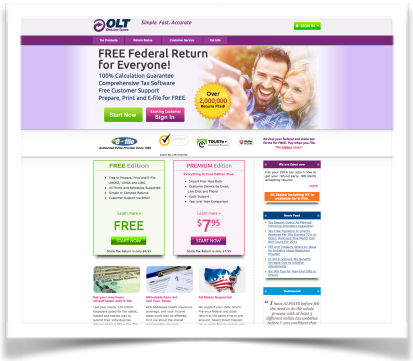
Me

Truster

ONLINE

Trustworthiness
(inherent quality)

Question:
How much can I **trust**?*



Tax Advisor

Trustee

"Strange" attributes

Norton SECURED powered by Symantec

TRUSTe Certified Privacy

IRS e-file

Over 2,000,000 Returns Filed!

Attributes/ Features

Many but little known

"Friends"

Recommenders

Online recommendation 1

3x 0x

Online recommendation n

15x 2x

Trust: How to compute the darn thing

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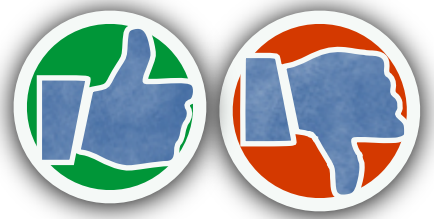
TRUST:

Reliability trust is defined as the trusting party's probability estimate p of success of the transaction.

trust value = estimate of the probability of



binomial model

$$\omega := (t, c)$$

certainty value = estimate of the reliability of $t = \tilde{p}$

Data base for inference: repeated interactions

Trust: How to compute the darn thing

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A simple version of the *CertainTrust* computation

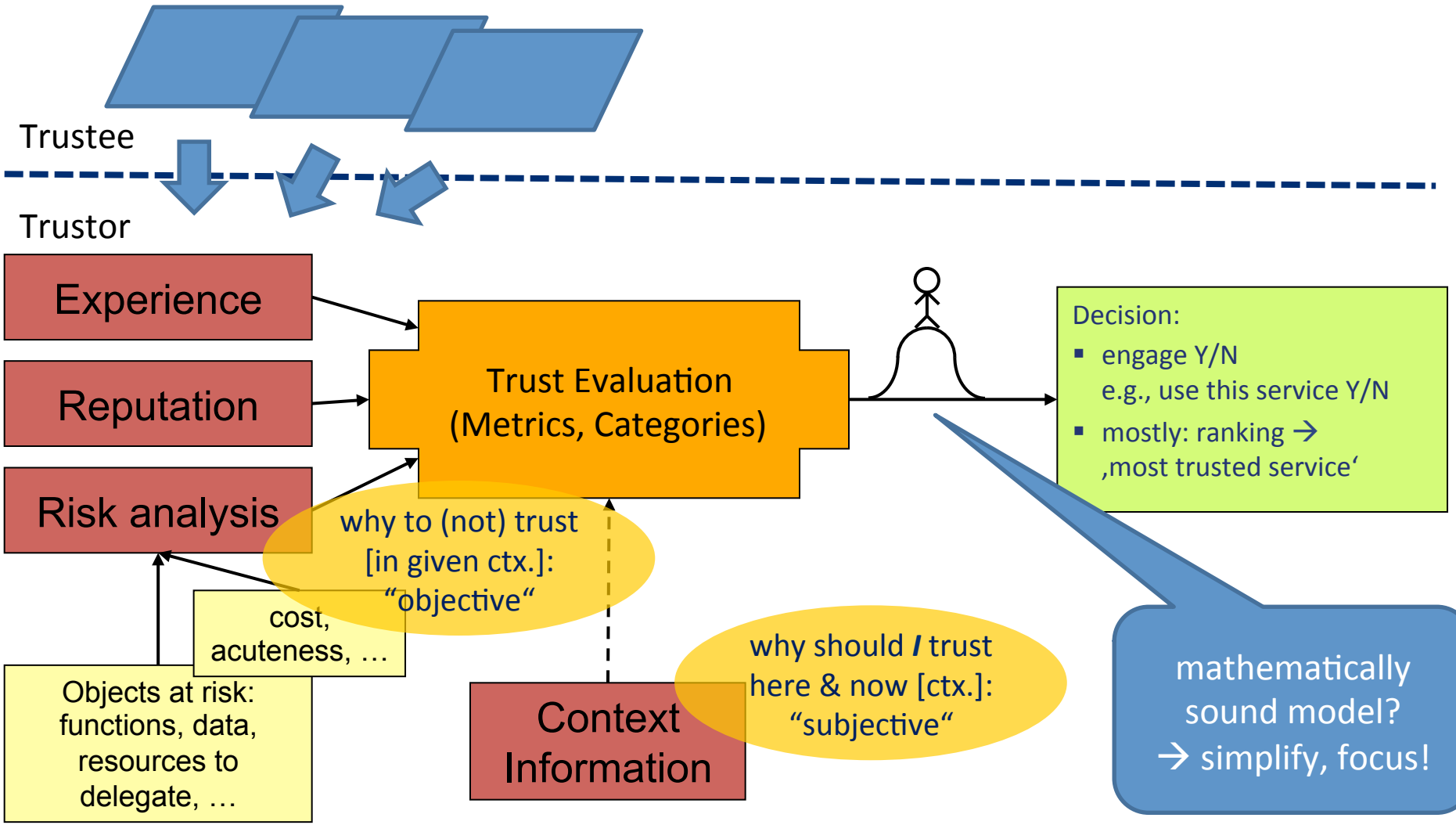
$$t = \frac{\#\,\text{👍}}{\#\,\text{👍} + \#\,\text{👎}}$$

$$c = \frac{\#\,\text{👍} + \#\,\text{👎}}{\#\,\text{👍} + \#\,\text{👎} + 1}$$

$$\omega := (t, c)$$

Data base for inference: repeated interactions

Preliminary Model



Summary

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- Bayesian trust models provide sound **mathematical basis** for trust computation
- Belief approach provides **intuitive representation** of trust
- Operators explicitly deal with **uncertainty** and **conflict** within the computation of probabilities

Concluding remarks

- Computational trust are applicable to situations where
  - risk and uncertainty matters
  - security primitives are not sufficient
- Computational trust operators enable
  - trustworthiness evaluation in distributed environments under uncertainty
  - human-system/service , system/service-human, system/service-system/service
- Belief approach is a good choice for trust evaluation
  - explictly deals with uncertainty associated with probabilities
  - estimate the future behaviour based on past evidence

References

[CDH06] Elizabeth Chang, Tharam Dillon, Farookh K. Hussain, **Trust and Reputation for Service-Oriented Environments**, John Wiley & Sons Inc., 2006

[HHRM12] Sheikh M. Habib, Sascha Hauke, Sebastian Ries, and Max Mühlhäuser, **Trust as a Facilitator in Cloud Computing: A Survey**, Journal of Cloud Computing: Advances, Systems and Applications, SpringerOpen, June 2012.

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[BLB04] Sonja Buchegger and Jean-Yves Le Boudec**. A Robust Reputation System for Peer-to-Peer and Mobile Ad-hoc Network**s, P2PEcon 2004.

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References

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[Additional materials]

***Tutorial on Subjective Logic: http://folk.uio.no/josang/sl/SubLog-FUSION2011.pdf**

***Demos on Subjective Logic: http://folk.uio.no/josang/sl/**

***Tutorial on CertainLogic: http://www.netsys2013.de/documents/Tutorial-Habib.pdf**

***Demos on CertainTrust and CertainLogic:**
http://www.tk.informatik.tu-darmstadt.de/de/research/smart-security-and-trust/demonstrators-certaintrust/

***CertainTrust (including CertainLogic operators) SDK:**
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