COMPUTATIONAL TRUST

PRINCIPLES FOR MATHEMATICAL REPRESENTATIONS AND ANALYSES OF TRUST

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TERMINOLOGICAL REMARKS

- Trust versus Reputation:

"Trust systems produce a score that reflects the relying party's subjective view of an entity's trustworthiness, whereas reputation systems produce and entity's (public) reputation score as seen by the whole community" (Jøsang et al. [2007])

- Therefore I take trust and reputation to be two distinct entities. While often the trustor decides to trust the trustee according to the trustee's reputations, the two notions should not be confused or conflated.

TERMINOLOGICAL REMARKS (CONT'D)

- What exactly do I mean with trust?
- My working definition of trust will be that of *decision trust*, as given in Jøsang [2007]:

"(Decision). Trust is the extend to which a given 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."

METHODOLOGY

- I started with 10 different surveys on computational trust from different time periods and different experts in the field:

Friedman et al. [2000]; Grandison & Sloman [2000]; Mui et al. [2002]; Stabb [2004]; Sabater-Mir & Sierra [2005]; Artz & Gil [2007]; Jøsang et al. [2007]; Lu et al. [2009]; Pinyol & Sabater-Mir [2011]; Cho et al. [2015].

- I produced a taxonomy of computational trust models based on those surveys.

METHODOLOGY (CONT'D)

- The taxonomy helped in selecting classic examples of trust models.
- The core features of the notion of trust employed by each exampled model were identified.
- All sets of core features were compared, in order to obtain overlapping features between the models.
- All the process was conducted at the most abstract level possible, i.e. specific calculations of the values were not considered at this stage.

TAXONOMY: STARTING POINT

- The models considered are all examples of trust models:

"…[T]rust implies a decision. Trust can be seen as a process of practical reasoning that leads to the decision to interact with somebody. Regarding this aspect, some models provide evaluations, rates, scores, etc. for each agent to help the decision maker with a final decision. Instead, others specify how the actual decision should be made. From our point of view, **only the latter cases can be considered trust models**." (Pinyol & Sabater-Mir [2011]: emphasis mine)

TAXONOMY: STARTING POINT (CONT'D)

- The models considered are all distributed models:

"The centralized approach saves all the rating procedure, storage of reputation, query of reputation, searching of comments to the computer server, while **the distributed approach** finishes all these jobs by agents themselves." (Lu et al. [2009]: emphasis mine)

TAXONOMY: MORE DISTINCTIONS

- On top of the basic features I assume, computational trust models might be:
- COGNITIVE or GAME-THEORETICAL models (Sabater-Mir & Sierra [2005]).
- Adapt for GENERAL or SPECIFIC applications (Pinyol & Sabater-Mir [2009]).
- Based only on INTERACTIONS or on SOCIAL/COGNITIVE FACTORS (Sabater-Mir & Sierra [2005], Artz & Gil [2007], Pinyol & Sabater-Mir [2009]).
  - Direct interaction can either be SOLITARY or SOCIAL (Pinyol & Sabater-Mir [2009]).

SELECTED TRUST MODELS

Given the taxonomy, I selected 7 different computational trust models:

	Marsh	C&F	Mui	Y&S	S&D	ForTrust	BDI Repage
Cognitive (C) or Game Theoretical (GT)	GT	C	GT	GT	GT	C	C/GT
General (G) or Specific (S)	G	G	G	S	G	G	G
Interaction (I) or Socio/Cognitive (SC)	I	SC	I	I	SC	SC	I
Solitary (Sol) or Social (Soc)	Sol	Sol	Soc	Soc	Soc	Sol	Soc

OVERLAPPING FEATURES OF THE MODELS

- Relational nature
- Subjectivity
- Measurability
- Context-dependency
- Decision-orientation
- Uncertainty

RELATIONAL NATURE OF TRUST

- Computational trust is a relation between two entities.
- The entities need not be single entities nor human entities.
- The properties of the relation are not fixed; trust **might be**:
  - Reflexive: self-trust.
  - Symmetric: mutual trust.
  - Transitive: referral trust.

SUBJECTIVITY OF TRUST

- Computational trust is inherently subjective.

"…[T]rust ultimately is a personal and subjective phenomenon that is based on various factors or evidence, and that some of those carry more weight than others. Personal experience typically carries more weight than second hand trust referrals or reputation…" (Jøsang et al. [2007]).

MEASURABILITY OF TRUST

- Computational trust must be measurable, i.e. computational trust always has a value.
- Values can either be qualitative (e.g. untrusted vs trusted) or quantitative (e.g. having trust value 0.8); it is always possible to draw parallels between qualitative and quantitative values. Often, quantitative values reflect intuitive qualitative assessments made by the agents involved.
- The number of values in play is not fixed; the values might be:
  - Discrete with varying finite degrees (this is always the case for qualitative values);
  - Continuous.

CONTEXT-DEPENDENCY OF TRUST

- Computational trust is context-sensitive.
- Different contexts require different computations for trust.
- Not all computational trust models are designed to deal with different context. In such cases, nonetheless, the context is given by the specific application of the model.

DECISION-ORIENTATION OF TRUST

- Trust involves a decision that has to be made.
- This feature of computational trust is in line with Luhmann (1979)'s sociological research on trust: trust is a tool to reduce the complexity inherent in the interactions of modern society.
- Trust helps us in making decision without having to look for increasing quantities of information: in this sense, trust is an aiding tool in the process of decision making.

UNCERTAINTY

- Computational trust involves scenarios where there is a lack of information or uncertainty about the information possessed.
- In a deterministic world with complete and perfect information, trust would lose its value, since the outcome of every interaction and decision would be deducible and, therefore, there would be no use for trusting decisions.

CONCLUSION

- What you should bring home from this talk:
- A general taxonomy, extracted from different surveys on computational trust: the taxonomy should help newcomers in the exploration of the field of computational trust.
- A precise idea on what features every *new model of computational trust* ought to possess in order to qualify as such.

THANKS