Trust in Online Environment

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Introduction

- Trust becomes important topic of research in many fields
- A complex word with multiple dimensions
- Hussain and Chang overviewed trust and reputation and found none satisfy context / time dependence and its dynamic nature
- Two generalized definitions of trust defined by Jøsang et al. Evaluation trust (also called Reliability trust) and decision trust
- Evaluation trust – defined as subjective probability
- An individual, A, expects that another individual, B, performs a given action on which its welfare depends

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- Decision trust captures broader concept of trust
- Decision trust - 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
- **Trust Models Based on Subjective Logic**
- Subjective logic - a type of probabilistic logic that explicitly takes uncertainty and belief ownership into account
- Arguments in subjective logic are subjective opinions about states in a state space

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- A binomial opinion applies to a single proposition
- Represented as a Beta distribution
- A multinomial opinion applies to a collection of propositions
- Represented as a Dirichlet distribution

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- Subjective logic defines a trust metric called *opinion*
- *Denoted by* $\omega_X^A = (\vec{b}, u, \vec{a})$, A's belief over a state space X
- $\vec{b}$ *represents* belief masses over the states of X
- *u represent uncertainty mass*
- $\vec{b}$ *, u € [0,1]*
- *Vector a represents* the base rates over X,
- It is used for computing the probability expectation value of a state x as E(x) = $\vec{b}(x) + \vec{a}(x)u$.
- Vector a determines how uncertainty contributes to E(x)
- Binomial opinions are expressed as $\omega_x^A = (b, d, u, a)$ where d denotes disbelief in x

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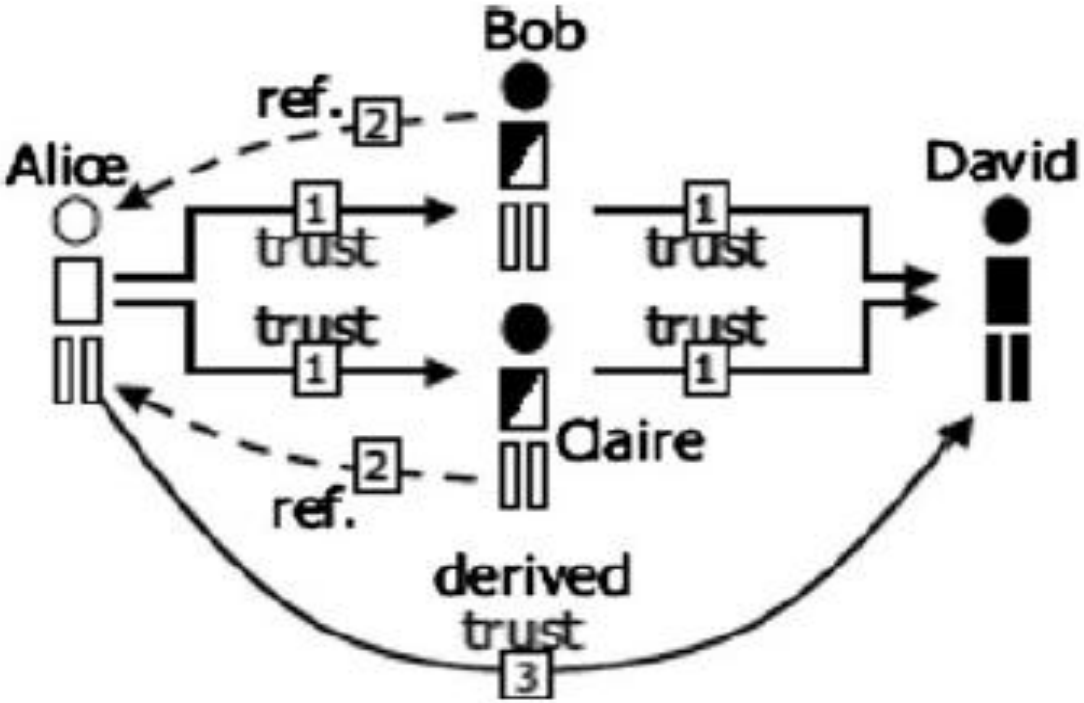
- Example: When statement x says "*David is honest and reliable", then the* opinion can be interpreted as reliability trust in David



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- When trust and referrals are expressed as subjective opinions, each transitive trust path computed with the *transitivity operator*
- Alice -> Bob -> David, Alice -> Claire ->David
- *Here referrals from Bob and Claire are* taken as a function Alice's trust in Bob and Claire respectively
- Paths are combined using cumulative or averaging fusion operator
- Whole thing can be expressed using operators in Subjective Logic
- Semantic constraints must be satisfied in order for the transitive trust derivation to be meaningful

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- A trust network for the example is expressed as:

$$[A,D] = ([A,B] : [B,D]) \Diamond ([A,C] : [C,D])$$

- "[A:B]" A trust relationship between A and B
- ":" transitivity of two arcs
- "$\Diamond$". fusion of two parallel paths
- Corresponding transitivity and fusion operator are "$\otimes$" "$\oplus$"

- Mathematical expressions for combining opinions about trust relationship for the example:

$$\omega_D^A = \left(\omega_B^A \otimes \omega_D^B\right) \oplus \left(\omega_C^A \otimes \omega_D^C\right)$$

- Arbitrarily complex trust networks can be analysed with TNA-SL (consists of network exploration method + trust analysis based on subjective logic)