ECONOMIC RATIONALITY AS AN ARGUMENTATION PRINCIPLE

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MOTIVATION I

- (Abstract) argumentation is a method of non-monotonic reasoning

- Hence, it can be considered a decision-support and decision automation approach

MOTIVATION II

- An influential formal principle of decision-making is economic rationality ("Rational Economic Man")

- Bounded rationality: **systematically** relaxing economic rationality (Simon, and famously Tversky & Kahneman)

→ Let's use abstract argumentation as a model of bounded rationality!

ECONOMIC RATIONALITY

- Assumptions of economic rationality, **ceteris paribus** (if everything else equal):

    - "Rational Economic Man" acts according to clear preferences

    - Has consistent preferences over time

CLEAR PREFERENCES

- Standard economic model for individual decision-making

- Chooses from $A = \{a, \ldots, n\}$

- Choice function: $A \rightarrow 2^A$

- Clear preferences: total order of all sets in 2^A

Rubinstein, Ariel. *Modeling bounded rationality.*

CONSISTENT PREFERENCES (REFERENCE INDEPENDENCE)

- Set of choice options A, A', such that $A \subseteq A'$

- Rational man's choices $A^* \subseteq A$ and $A'^* \subseteq A'$

- If $A'^* \subseteq A$ then $A^* = A'^*$

Rubinstein, Ariel. *Modeling bounded rationality.*

EXAMPLE I

- We go to a café, on the menu: `tea and coffee`

  - We choose `coffee`

- Next day, one the menu: `tea, coffee, and cookie`

  - We choose `tea and cookie`. Are we rational?

  - We choose `tea`. Are we rational?

SHORTCOMINGS

- **Ceteris paribus** assumption

- Ariel Rubinstein: *"The model has to be thought of as a reduced form derived from a more complete model, one that captures the decision maker's inference process."*

EXAMPLE II

- We want to determine the relevant citizenship (passports) of a client

- Example: case handling of immigration or tax administration

- We use decision management software (a real-world system)

- The decision models can be deployed to high-scalability engines such as jDMN

EXAMPLE II (CONTINUED)

- First, insert `NO` (Norwegian citizenship)
  → `NO` considered relevant

- Then, insert `UK` (UK citizenship) as additional option
  → neither `NO` nor `UK` relevant: not rational!

- Automated checks of decision management software don't detect this problem

Reference Dependence: Determine relevant citizenships

Inputs
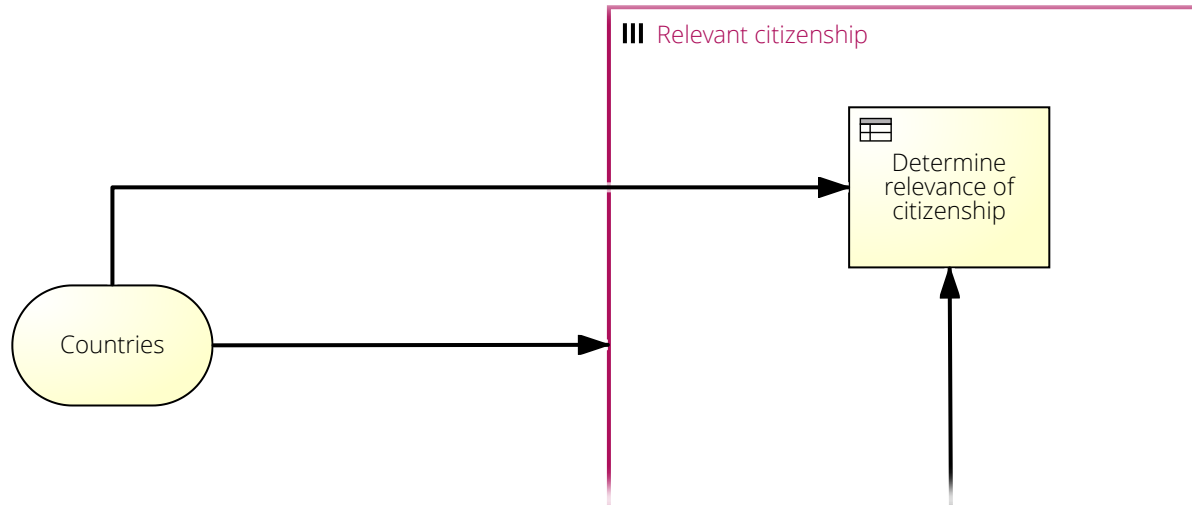
Countries

No Selection...

Wildcard mode: On

Outputs

Empty Output

Determine relevance of citizenship

ECONOMIC RATIONALITY & ABSTRACT ARGUMENTATION

- $AF = (AR, AT)$; arguments AR, e.g.: $\{a, b, c\}$, attacks AT, e.g.: $\{(a, b), (b, c)\}$

- Semantics $\sigma(AF)$ returns set of extensions $ES \subseteq 2^{AR}$

- Conclusion $E \in ES, E \subseteq AR$ **implies** preferences: $\forall S \in AR, E \geq S$

- Consistent preferences when **normally expanding** AF (Economics' *ceteris paribus* assumption)

NORMAL EXPANSION

- Given $AF = (AR, AT), AF' = (AR', AT')$ AF' normally expands AF iff:

  - $AR \subseteq AR', AT \subseteq AT'$

  - $(AT' \setminus AT) \cap (AR \times AR) = \{\}$

- Only add arguments and attacks, don't change attacks between existing arguments

- Denoted by $AF \preceq_N AF'$ (Baumann, Brewka)

REFERENCE INDEPENDENCE PRINCIPLES

- Given semantics $\sigma, AF = (AR, AT), AF' = (AR', AT')$

- **Strong**, iff σ must be universally defined and $\forall E \in \sigma(AF), \forall E' \in \sigma(AF')$ it holds true that:
  - $E' \nsubseteq AR$ or $E' = E$

- **Weak**, iff $\forall E \in \sigma(AF), \exists E' \in \sigma(AF')$ such that:
  - $E' \nsubseteq AR$ or $E' = E$

STRONG REFERENCE INDEPENDENCE IS UNREALISTIC TO OBTAIN
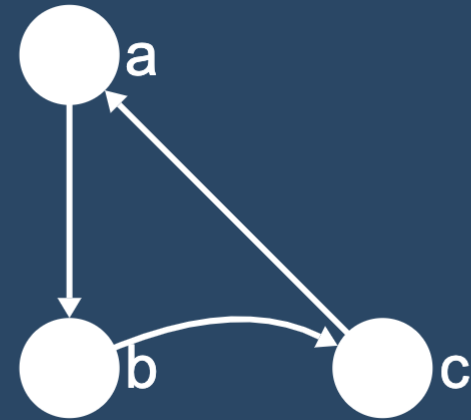
EXAMPLE III – WEAK REFERENCE INDEPENDENCE

- Decision: recommend launch of product p_a : yes or no?

- *Launch* denoted by argument a

- At first, we find no reason not to launch
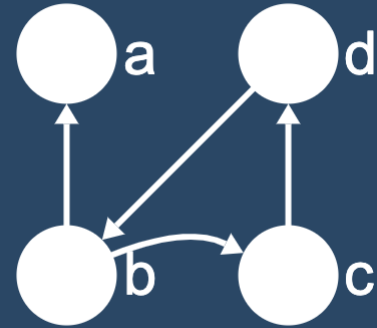
$$\rightarrow \text{recommend } a$$

EXAMPLE III

a

EXAMPLE III

Our boss asks us to collect more stakeholder opinions (arguments)

EXAMPLE III

EXAMPLE III

- If all newly added arguments are not valid conclusions, a should remain a valid conclusion.

- Because we make **clear decisions** we consider arguments either valid conclusions or not (no undecided arguments)

- Which semantics allow us to be economically rational in this scenario?

SEMANTICS FAMILIES

Family	Admissibility-Based	Weak Admissibility-Based	Naive-Based
Satisfied by any established semantics*	No	No	Yes
Satisfied by	-	-	Naive, CF2, presumably SCF2 and nsa(CF2)

* Could potentially be satisfied by a semantics that always returns the empty set and hence is in all families.

FURTHER RESULTS

- Preference-based and value-based argumentation do not ensure economic rationality

- Monotony implies reference independence, but reference independence is not the same as cautious monotony or rational monotony

- We present a dialogue reasoner that can enforce reference independence as well as cautious monotony * this afternoon at SAFA!

* Some tweaks are necessary to "port" this principle to abstract argumentation

OPEN QUESTIONS

- Undecided arguments: from a decision-making perspective we do not want to be undecided about actions; hence, relaxing (weak) reference independence to support undecided arguments requires more than abstract argumentation

- Our principle can provide a new perspective on argumentation and game theory

- From a practical perspective, we can investigate implications on business decision management

QUESTIONS?