



# Practical Applications of Argumentation and Multiagent Systems for Semantics Integration in Distributed Environment

LIP6, May 2008.

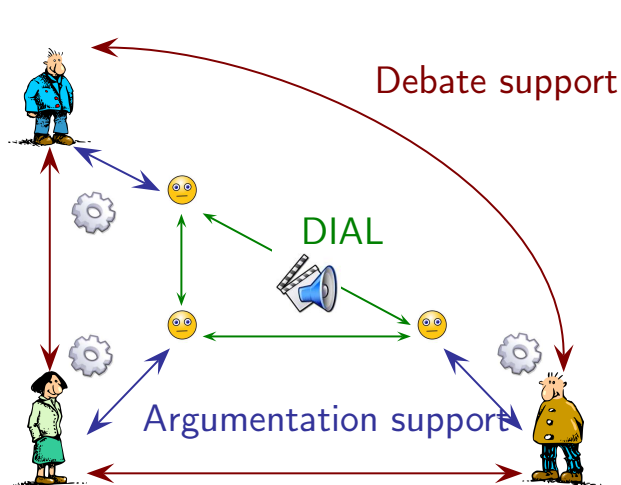
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# Motivations and challenges

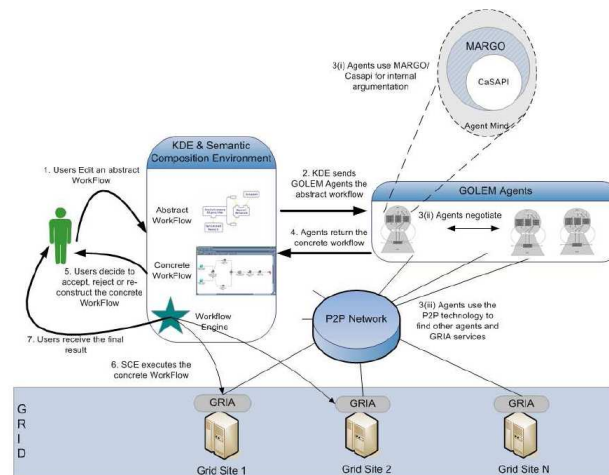


Requirement for application softwares in a global, complex, interconnected, and dynamic environments (services, industries, ...)

- Reusability, Interoperability, Flexibility, Adaptation.
- Efficiency, Autonomy, Intelligence, Scalability.
- Reliability, Fault-tolerance, Robustness, Security, Trust.



[Morge, ICC'07]



[Morge et al, EUMAS'07]



[Morge et al, AISB'07]

## Conflicts resolution for multiagent programming



Our multiagent systems are composed of autonomous **agents** (proactive/cognitifs) within distributed **environments** (non-deterministic, dynamic) **interacting** each other (with ACL) in accordance with **organizational rules** (commitments, contracts, norms).

### Conflicts arise in:

- ontologies i.e. concepts hierarchies;
- agent state-of-mind, i.e. beliefs, goals, decisions;
- agent's mind, i.e. the autonomy;
- coordination, i.e. the negotiation.

### Conflicts resolution:

- heterogeneous descriptions [Morge et al, AO07]
- epistemic/practical reasoning [Morge, AIL06], [Morge ArgMAS 07]
- dialectical agent architecture [Morge et al, ARGUGRID'08]
- dispute resolution [Morge, AIL06] [Morge et al, EUMAS'07]

# Outline



- Introduction
- ARGUGRID usecase
- Agent reasoning [Morge ArgMAS 07]
- Agent architecture [Morge et al, ARGUGRID'08]
- Negotiation [Morge et al, EUMAS'07]
- Summary

## ARGUmentation as a foundation for the semantic GRID



- Provide a new model for argumentative agents populating and evolving within a trusted grid.
- Provide a new model for the specification, creation, operation and dissolution of **Virtual Organizations** over the grid using argumentation.
- Design an architecture for the semantic grid to support argumentative agents and VOs.
- Develop a grid-based platform to support the implementation of models and architecture and assess the approach.
- Experiment with and evaluate the models, architecture and platform in the context of concrete applications for e-business.

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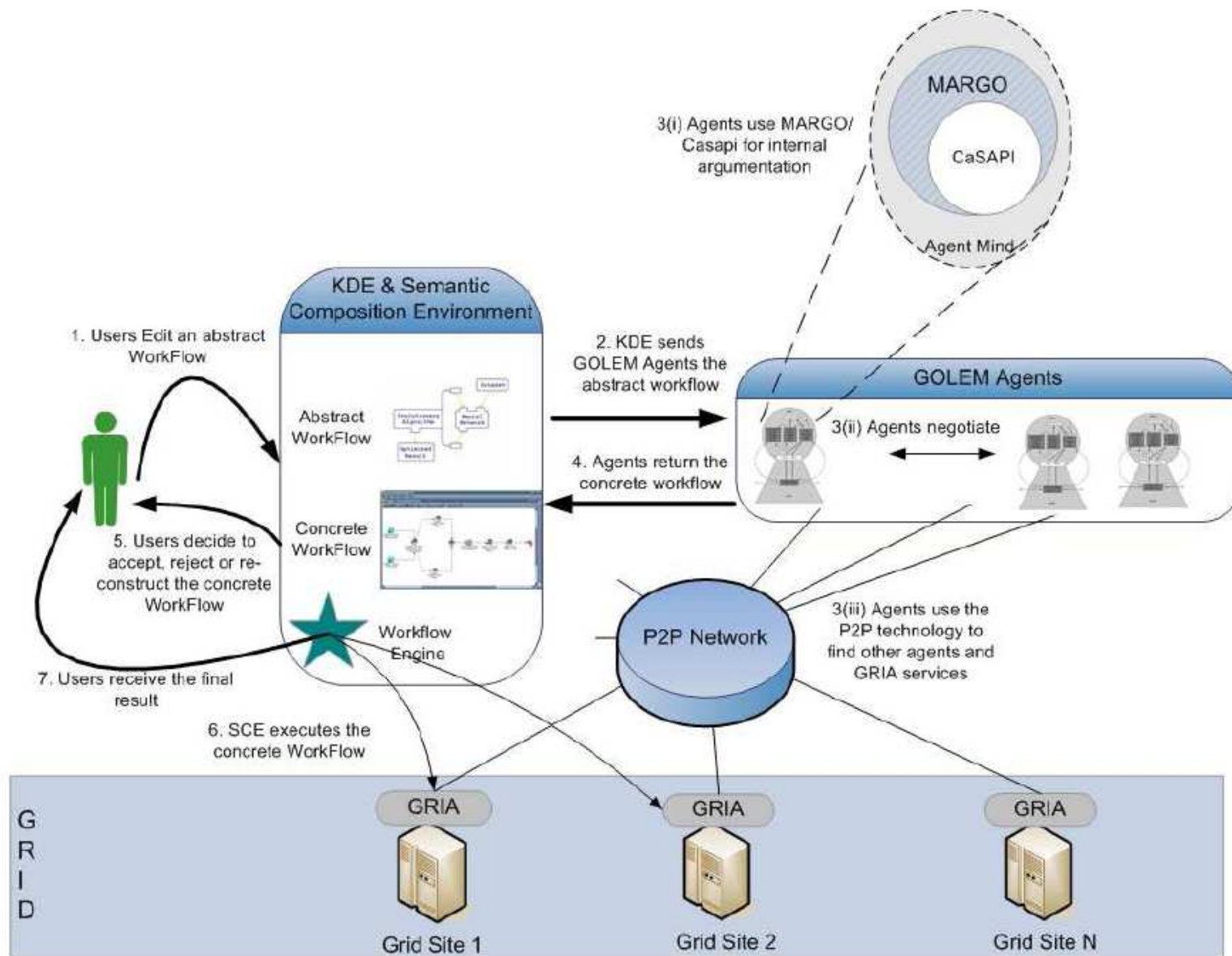
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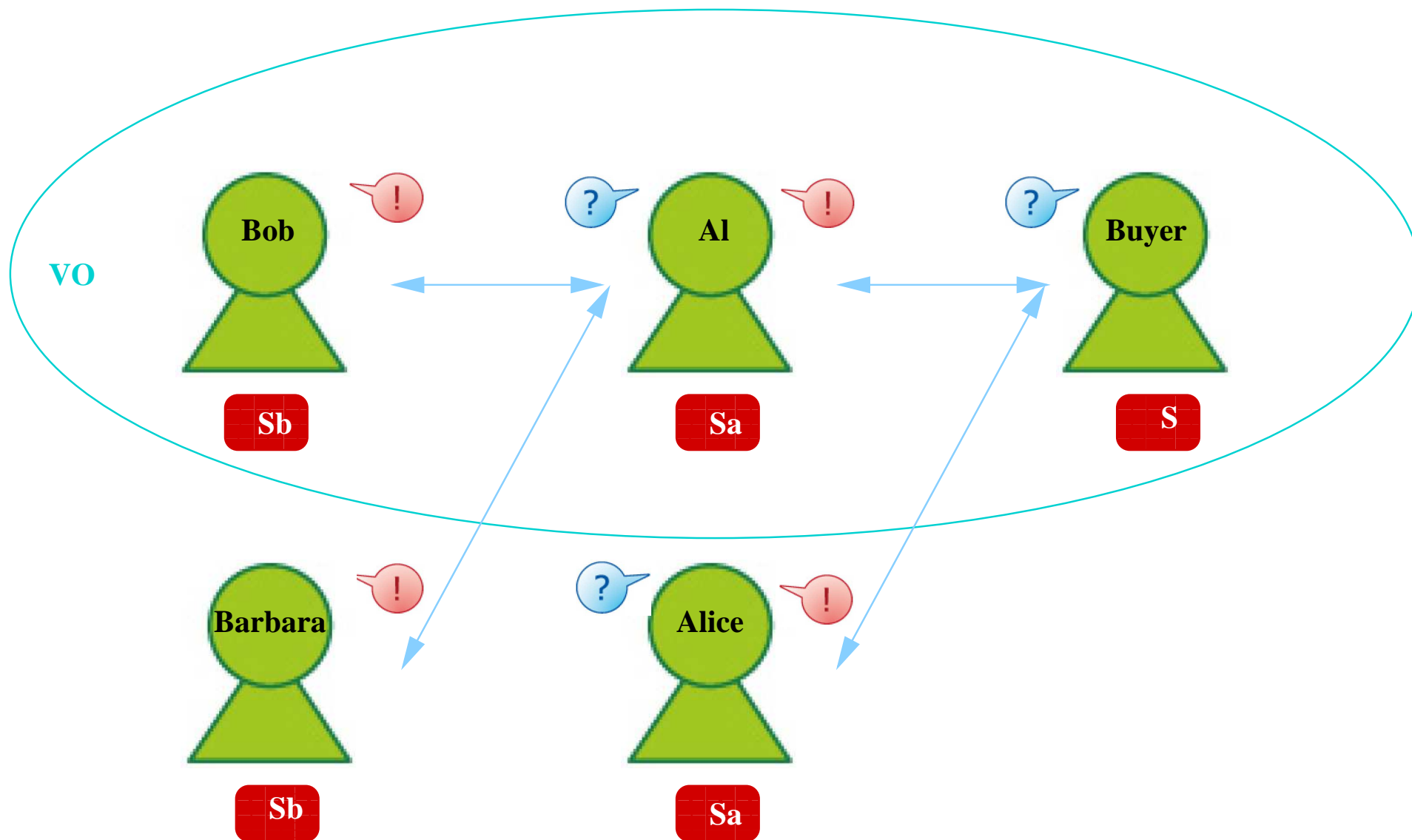
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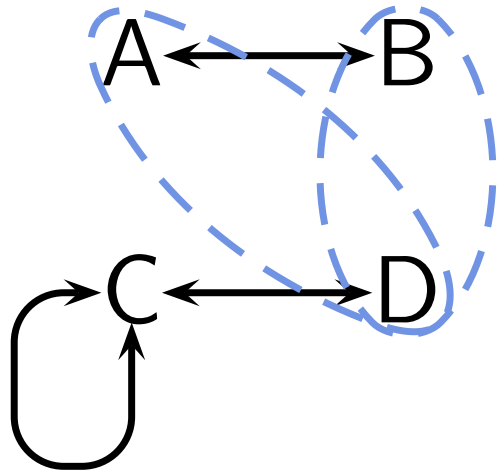
# Global Picture of the ARGUGRID platform



# E-procurement [ARGUGRID D1.2]



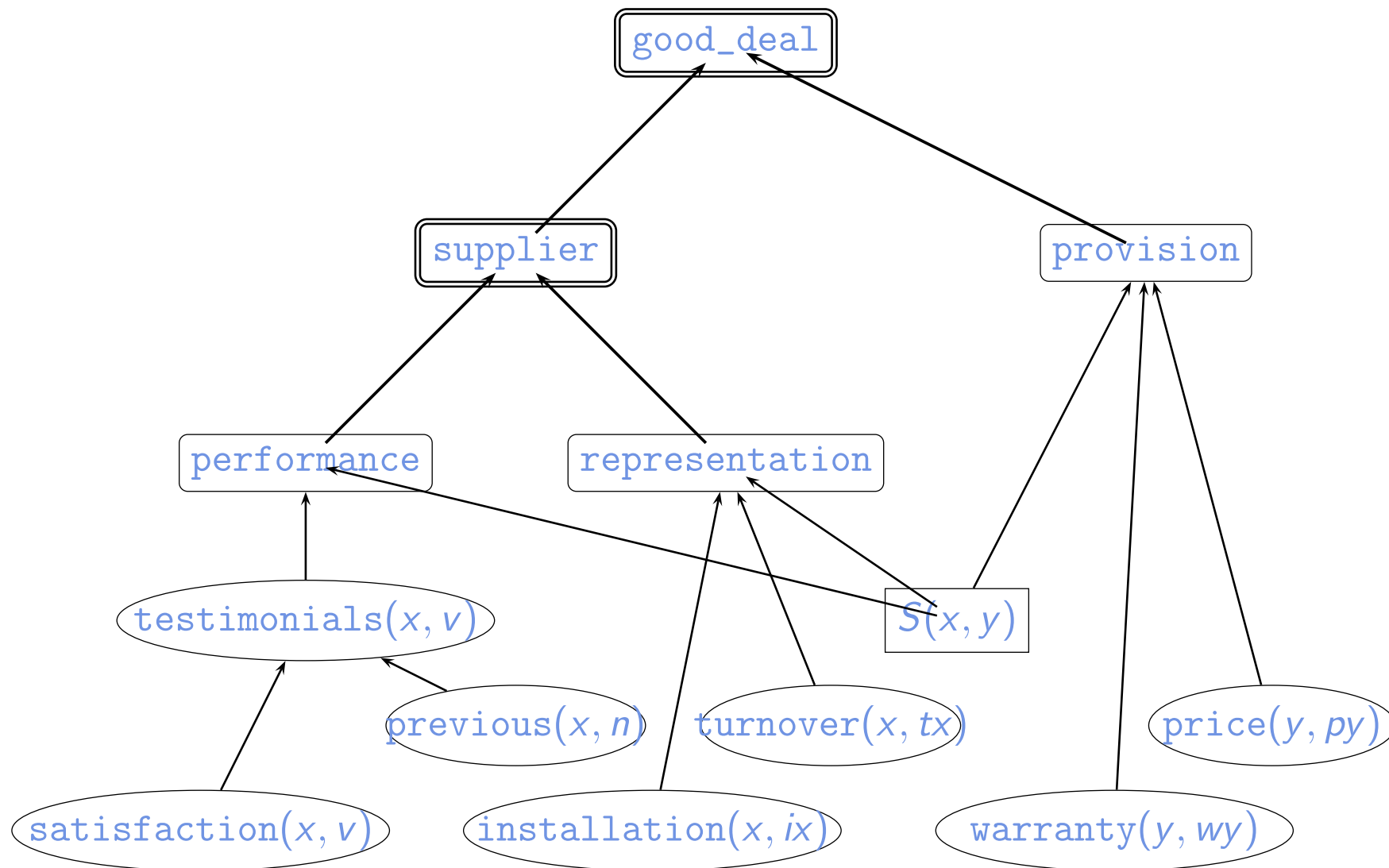
# Assumption-based argumentation for multi-criteria decision making [Morge ArgMAS 07]



- Which contract ?
- The service  $d$  provide by Bob.
- Why not the service  $c$ ?
- Since it's too expensive.
- Why not Barbara?
- Since Barbara will overcharge the price.

- Decision analysis (influence diagrams).
- Logic language (goals/decisions/beliefs).
- User's preferences (priorities/utilities/uncertainty).
- Suggested decisions (credulous semantics).
- Procedure implementation (<http://margo.sourceforge.net>).

# A model of multi-criteria decision problems with incomplete knowledge



# Knowledge, Goals, Decisions, and Priority



A decision framework is a tuple  $\mathcal{D} = \langle \mathcal{L}, \mathcal{A}sm, \mathcal{I}, \mathcal{T}, \mathcal{P} \rangle$ , where:

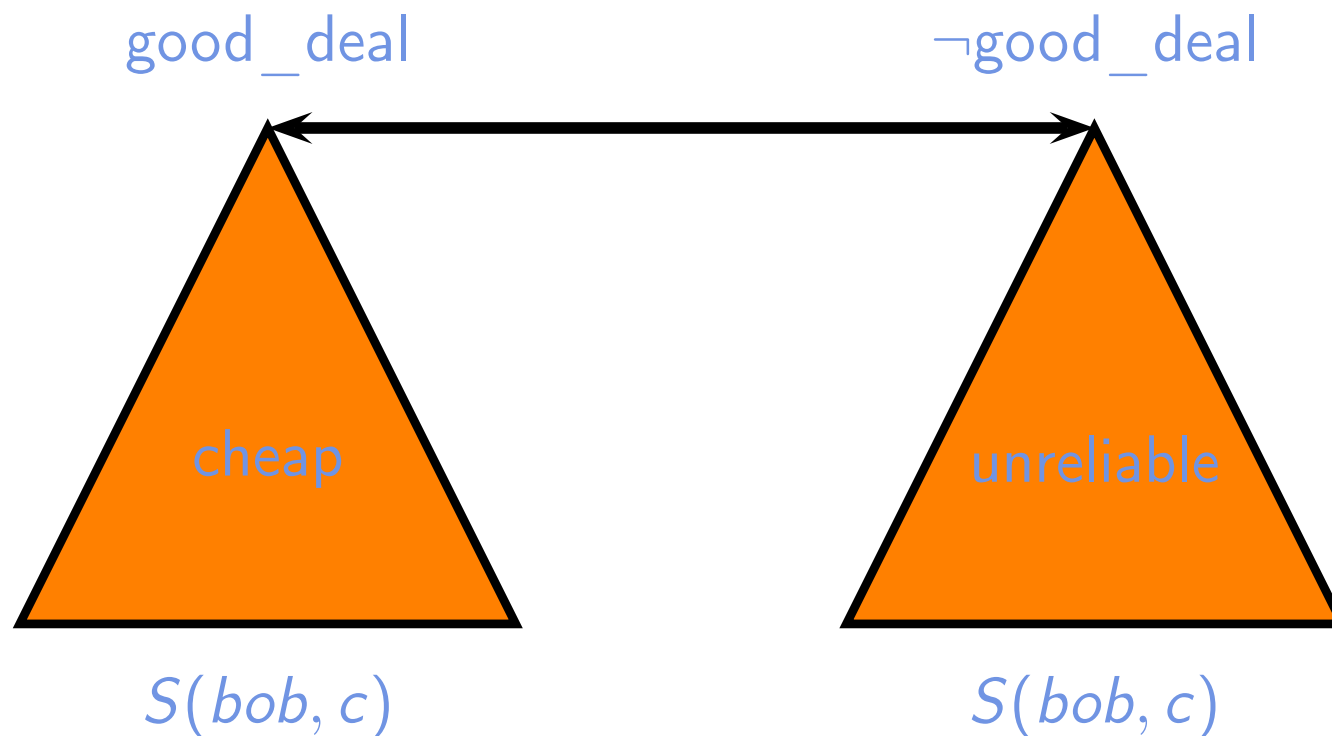
- $\mathcal{L}$  is the **language** which captures the state-of-mind (goals/decisions/beliefs);
- $\mathcal{A}sm$ , is a set of literals which are taken for granted if there is no evidence to the contrary, called **assumptions**;
- $\mathcal{I}$  is the **incompatibility relation**, i.e. a binary relation which captures the conflicts between the statements;
- $\mathcal{T}$  is the **theory** which gathers goal/decision/epistemic rules;
- $\mathcal{P} \subseteq \mathcal{T} \times \mathcal{T}$  is a preorder, called the **priority** relation, which captures
  - the uncertainty of beliefs,
  - the priority amongst goals,
  - and the expected utilities of the decisions.

## Rebutting and undermining attacks



Rebutting attack between conflicting conclusions:

- *The service d is a good deal because it is cheap;*
- *The service c is not a good deal because it is a mess.*

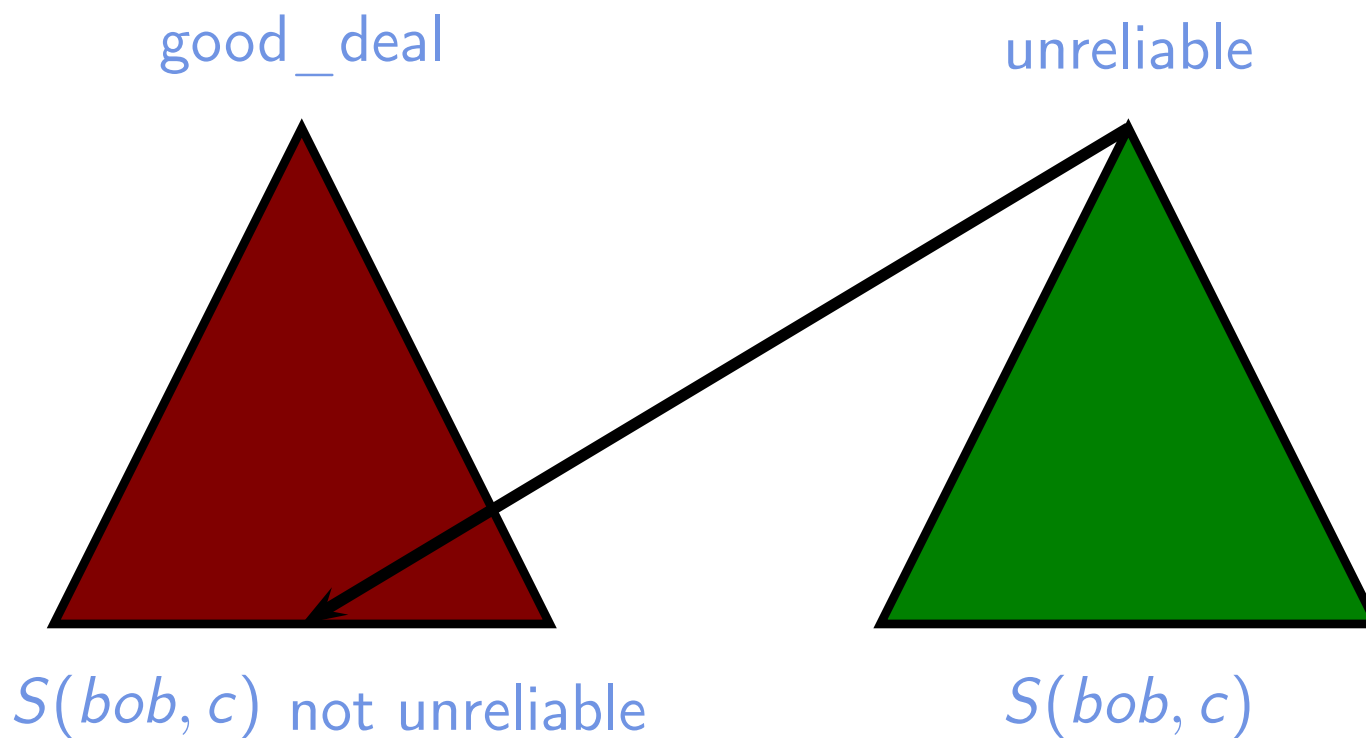


## Rebutting and undermining attacks



Undermining attack toward non-provable assumptions:

- *The service  $c$  is a good deal because it is cheap and it is not provable that it is a mess;*
- *The service  $c$  is a mess.*

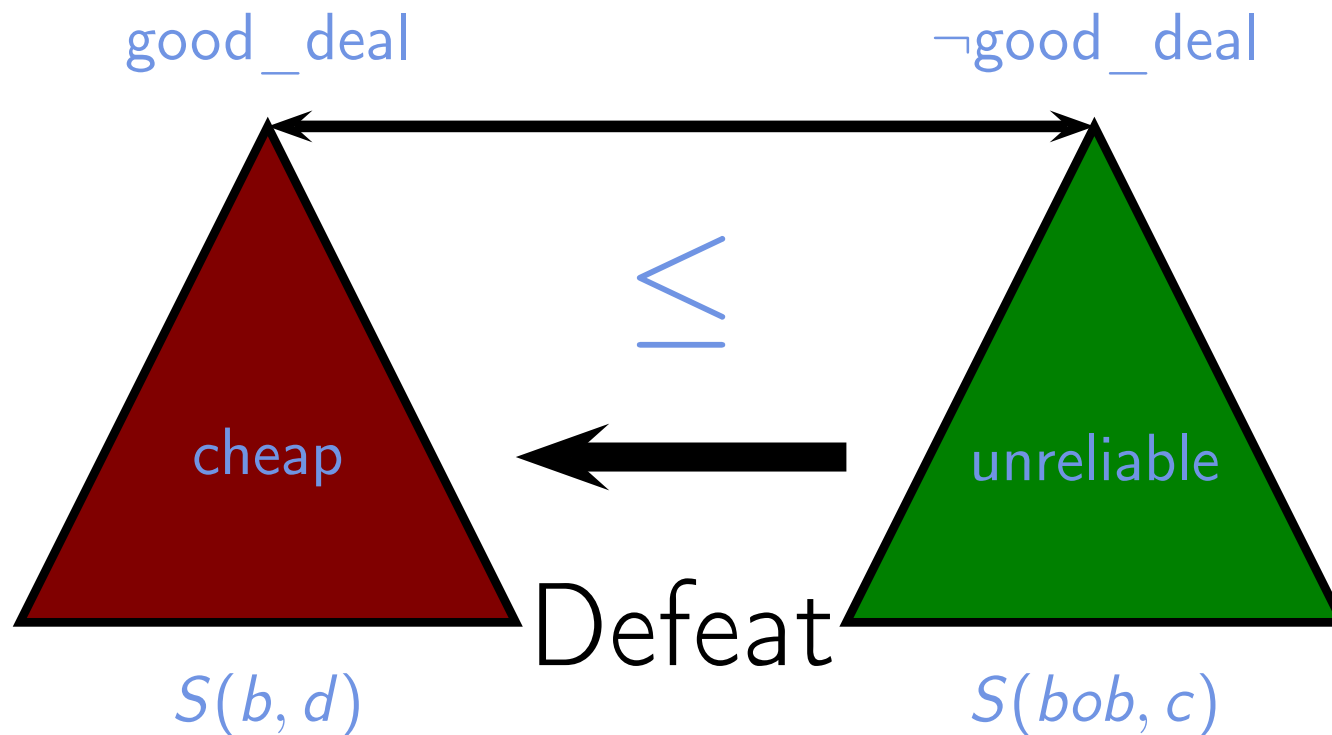


## The strengths of arguments

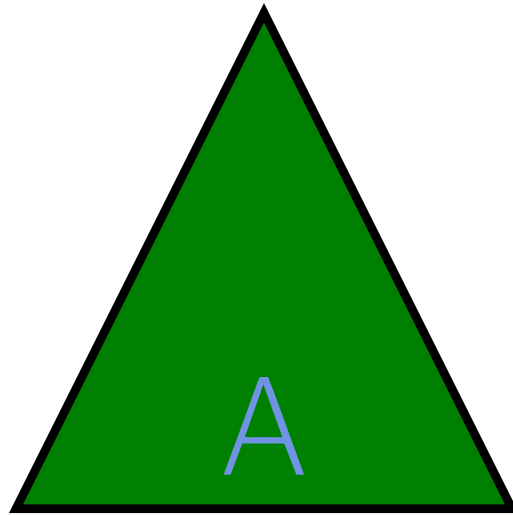


Qualitative or quantitative preferences, s.a.:

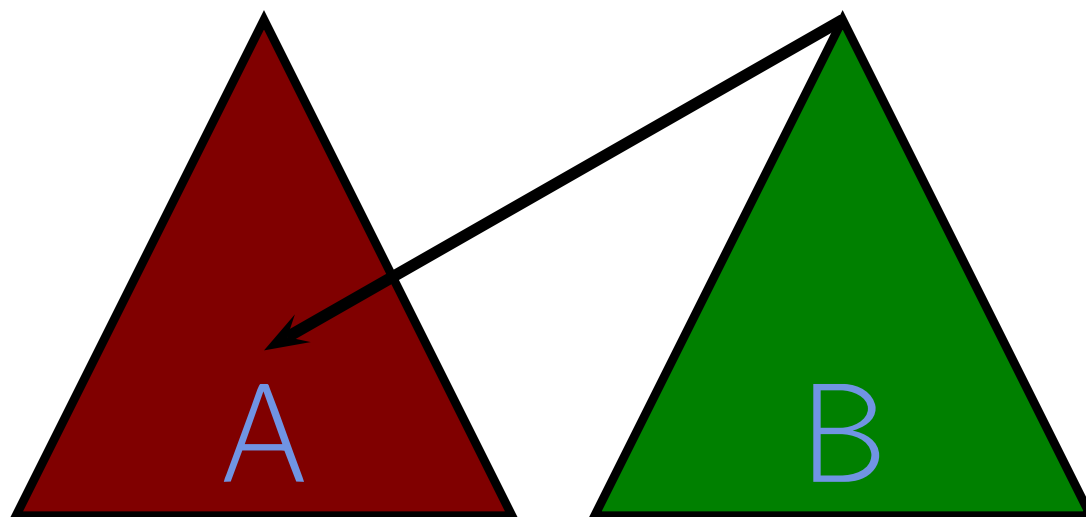
- the likelihood of beliefs.
- the priority amongst goals.
- the expected utilities of decisions.



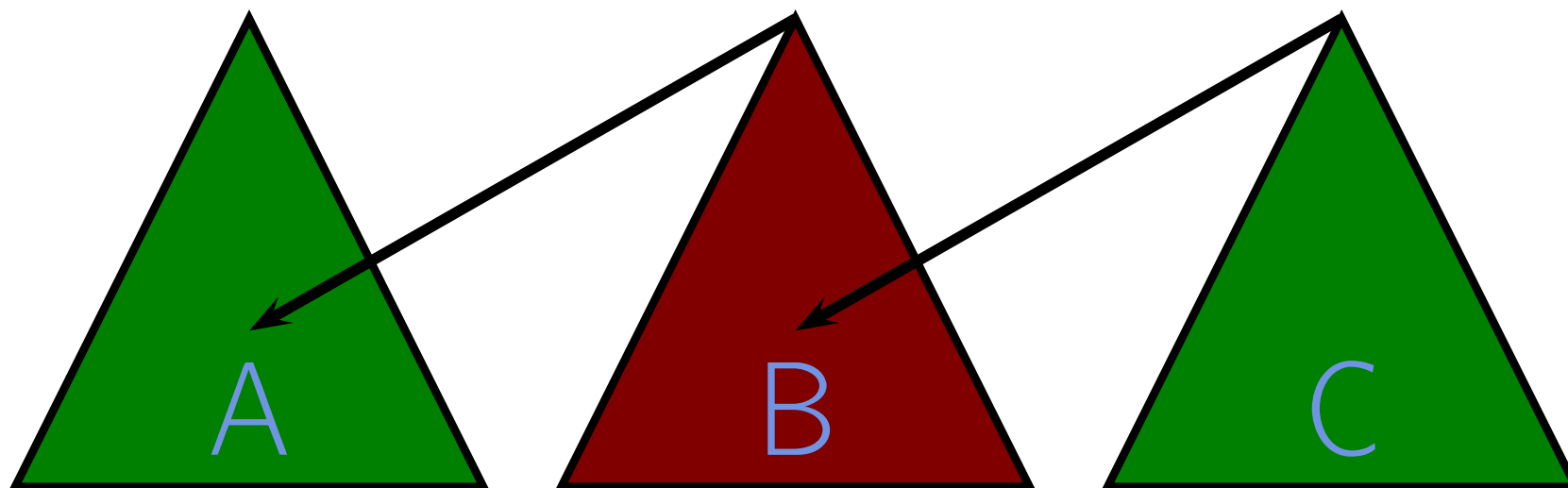
# Dialectical enquiry of MARGO



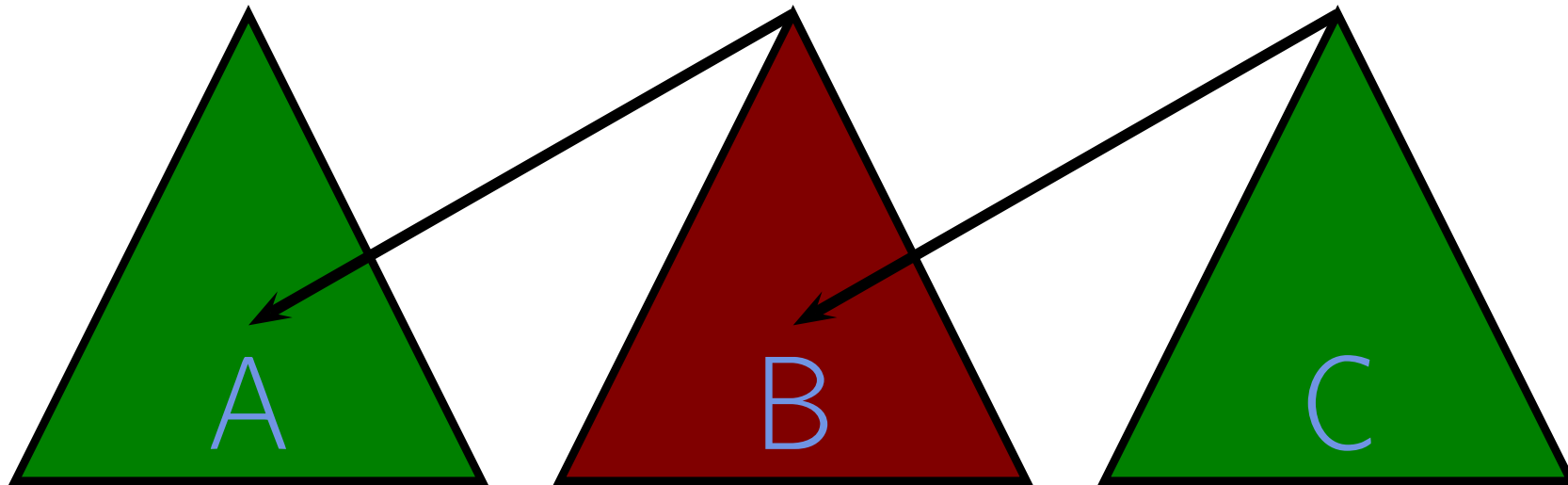
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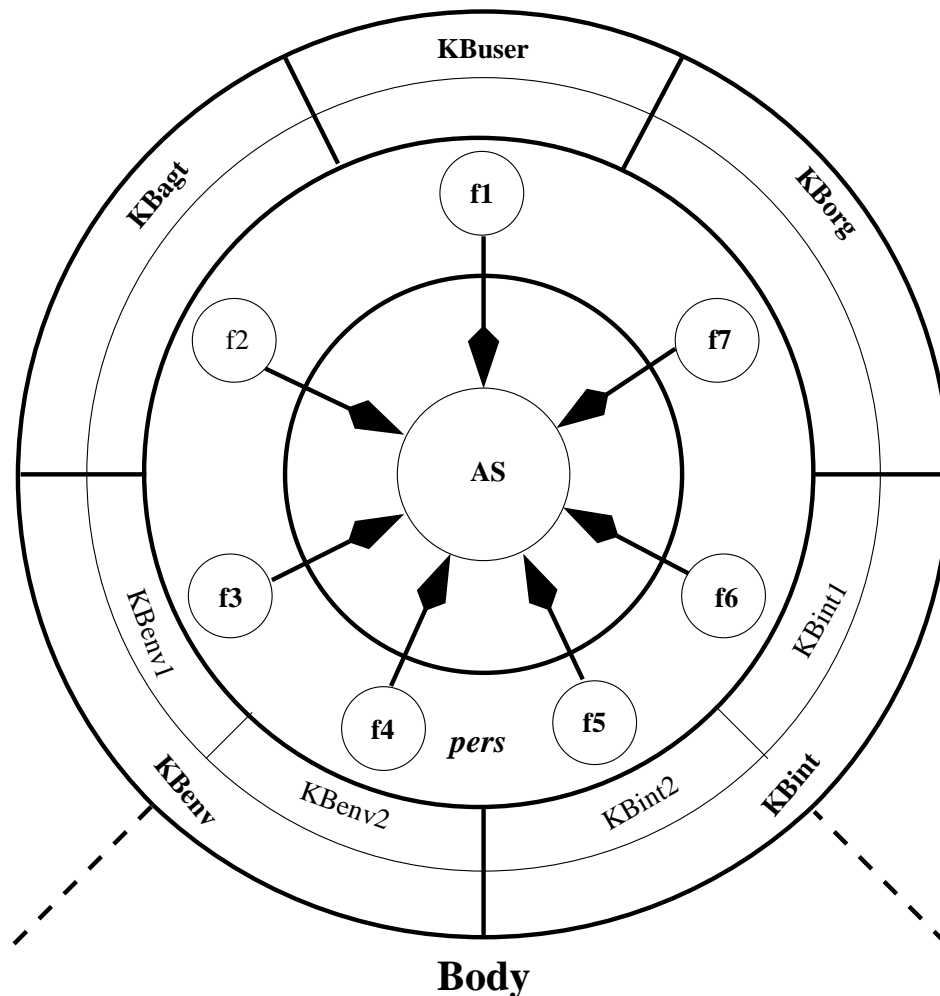
# Dialectical enquiry of MARGO



A (procedural) dialectical proof procedure:

- $\Leftrightarrow$  declarative model-theoretic semantic (soundness/completeness);
- interleaves arguments construction/dispute (efficiency);
- with game rule (turn-taking, burden of proof, backtraking);
- preference relaxation, assumptions (strategy).

# The V3A Architecture [Morge et al, ARGUGRID'08]



- Component-based architecture
- Vowels approach
- Dialogue amongst facets
- Personality-based resolution of conflicts
- High-level control of the autonomy and the behaviour

⇒ Self-adaptation in open MAS

## Deliberative steps for e-procurement [Morge et al, EUMAS'07]



step #	description	dialogue type
step 1	find potential providers	information-seeking
step 2	get providers' features	information-seeking
step 3	create shortlist	n/a
step 4	get services' quotes	information-seeking
step 5	choose winner	n/a
step 6	negotiate specific terms	argumentation-based negotiation

# Dialogue for conflicts explanation



## Lightweight Coordination Calculus:

- boot strap mechanism protocol/role/participants;
- pre/post conditions to prompt/update the decision/commitments;
- write once-execute everywhere.

```

a(requestor(g0, c, K), ag1) ::=
question(g0, c, K) ⇒ a(provider(g0, c, K), ag2) then
commit(ag2, [g0, c1, K1]) ← (assert(g0, c1, K1)
← a(provider(g0, c, K), ag2)) then
a(evaluator(g0, g0, c1, K1), ag2).
  
```

```

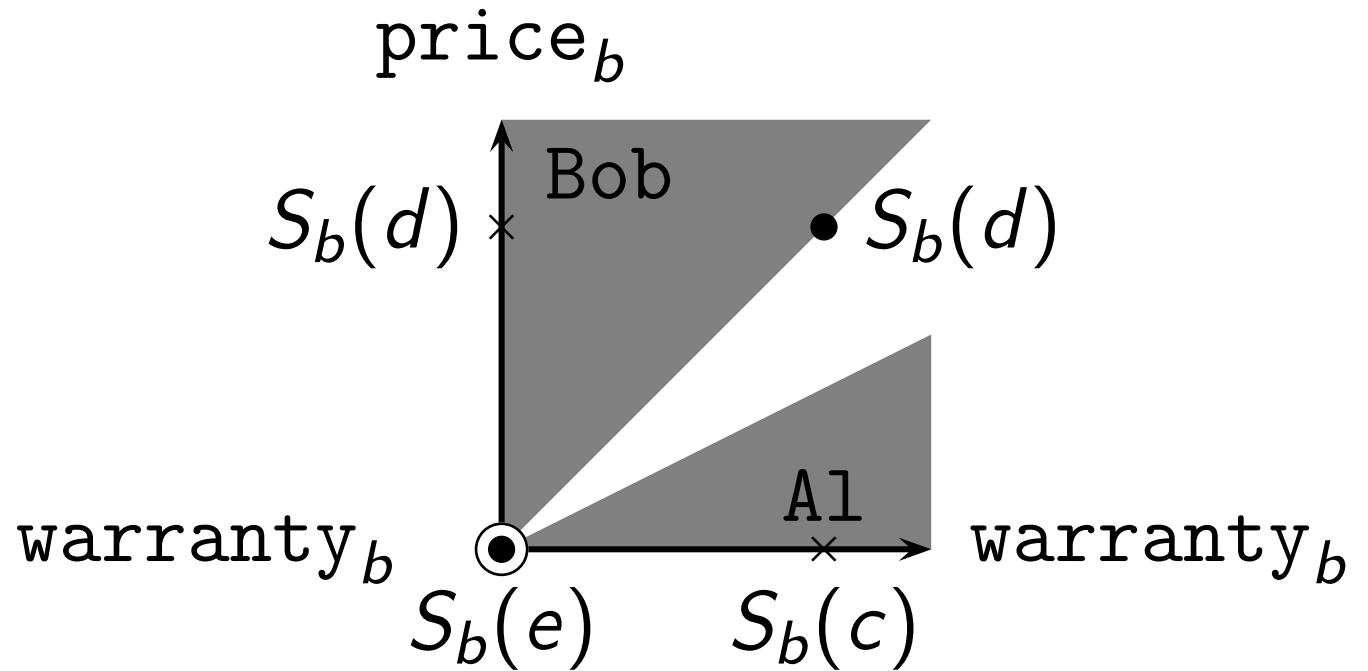
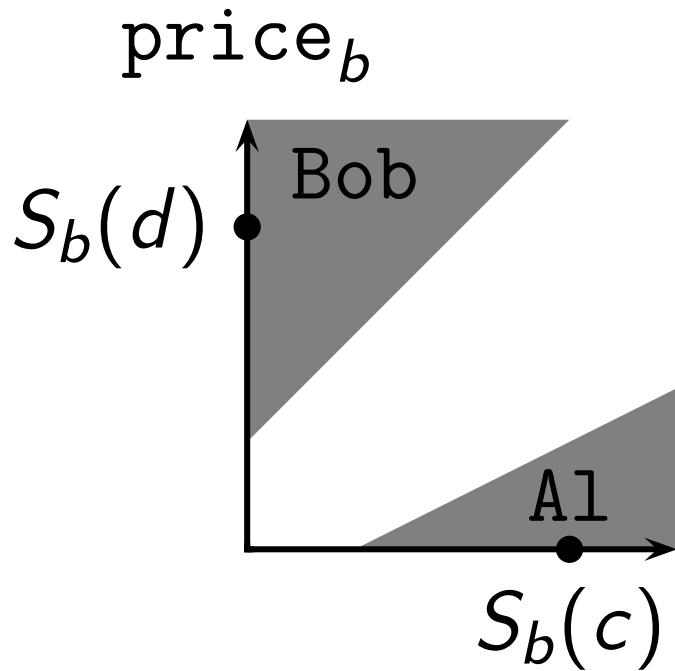
a(provider(g0, c, K), ag2) ::=
question(g0, c, K) ← a(requestor(g0, c, K), ag1) then
(assert(g0, c1, K1) ⇒ a(requestor(g0, c, K), ag1)) ←
(evaluate_contract(g0, c1, K1)) and
  
```

# Acceptability space of participants



After  $M_3$

At the end



# Dialectics for semantic integration in distributed environments



## Summary:

- Arguing for decision under uncertainty conflicts over agent's statements [Morge ArgMAS 07]
- Dialectical agent architecture conflicts over agent's motivations [Morge et al, ARGUGRID'08]
- Dispute for service composition conflict over agents' interests [Morge et al, EUMAS'07]

## Future works:

- Arguing for planning with normative/trust reasoning.
- Multi-thread prototype with experimental validation
- Game theory for interactive strategy

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