Conflicts and Negotiations in Single Function Agent Based Design Systems

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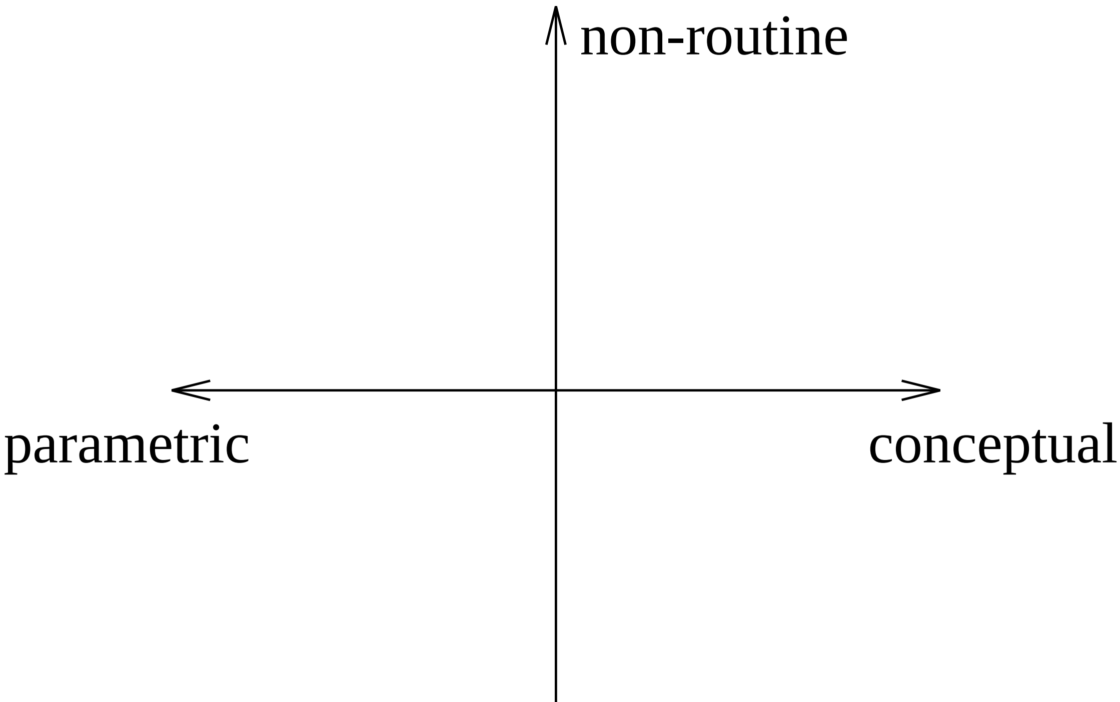
Outline:

- Introduction
- Previous Work
- The SiFA Paradigm
- Extensions to the Paradigm
- Conflicts
- Negotiations
- Implementation of COSINE
- Conclusions

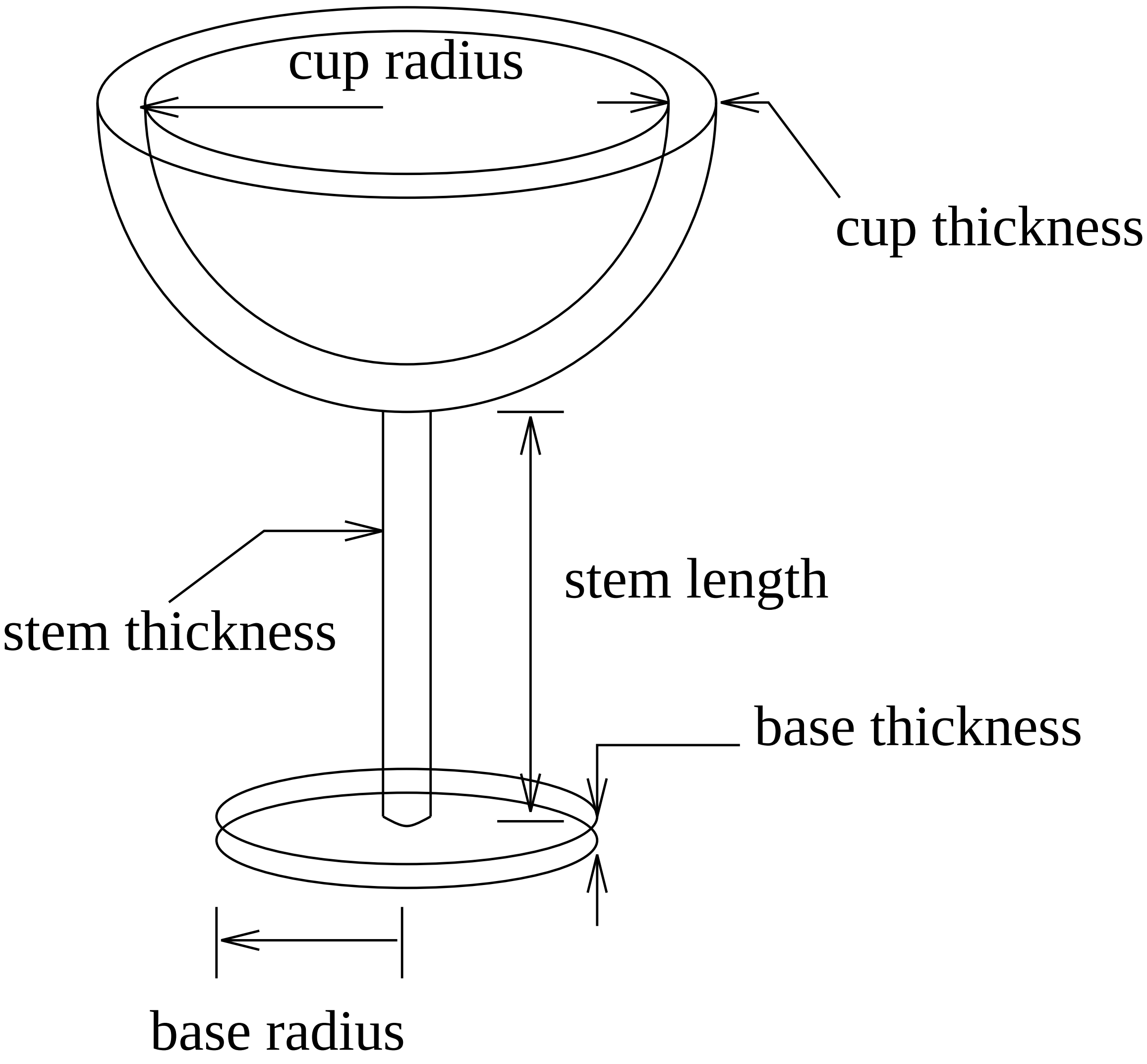
Introduction

- Design problems
- Multi-agent design systems
- Single function agents
- Conflicts and negotiation

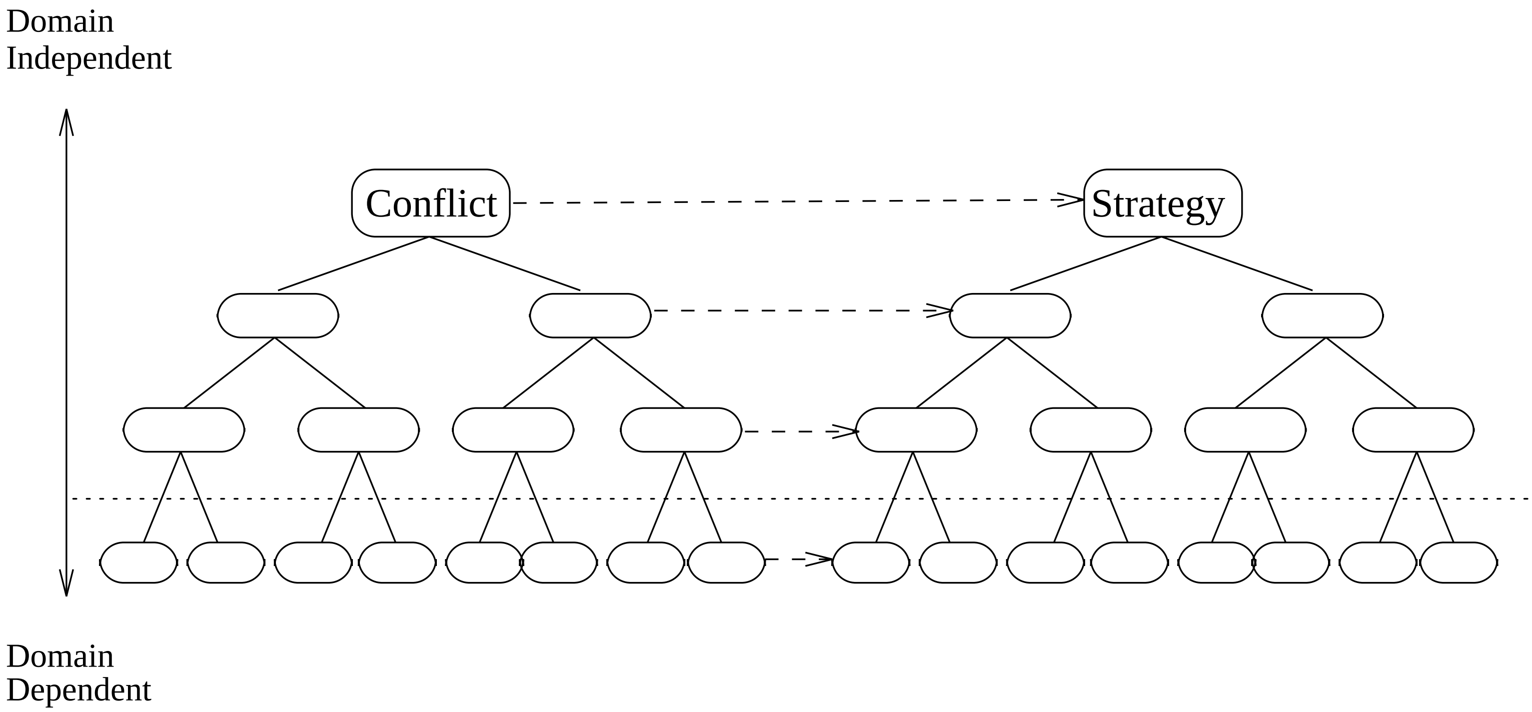
The space of design problems



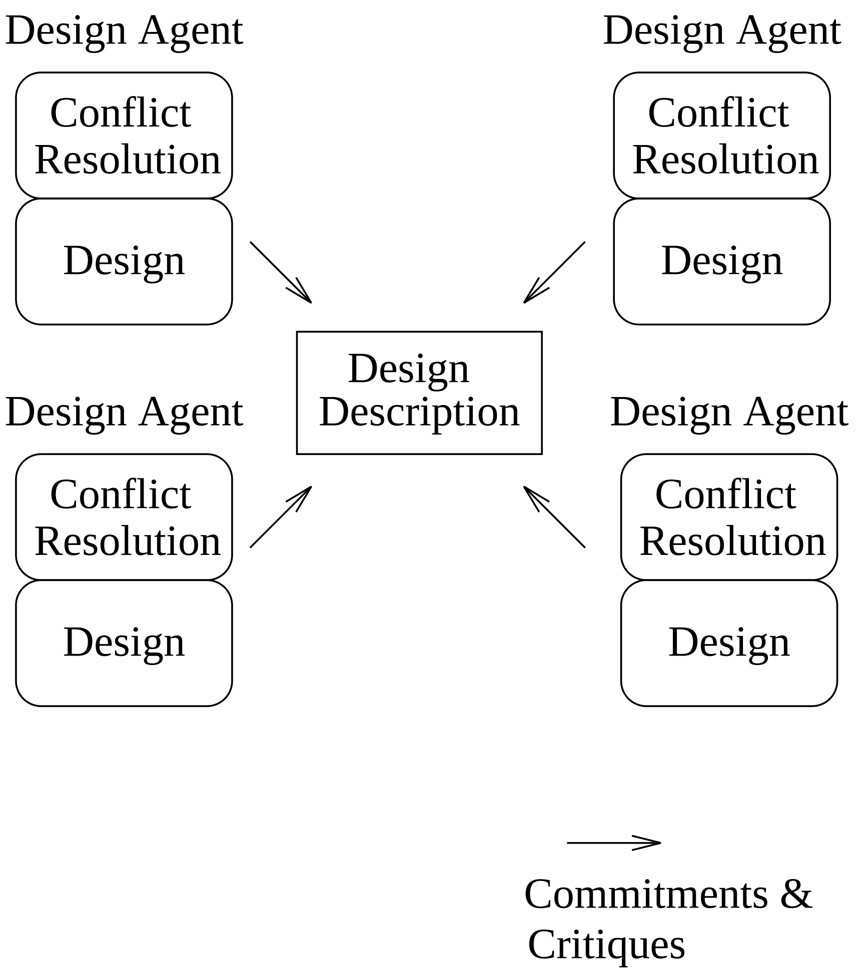
The wine glass in COSINE



Klein's conflict hierarchy



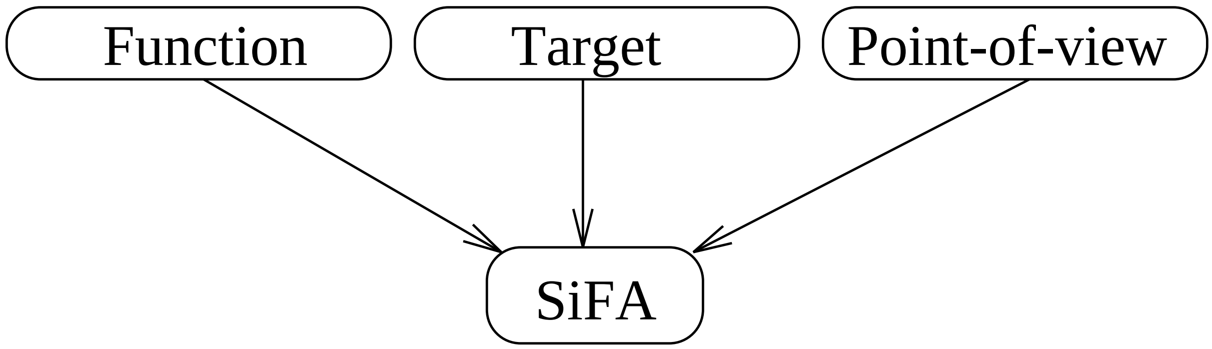
Components of an agent in Klein's model



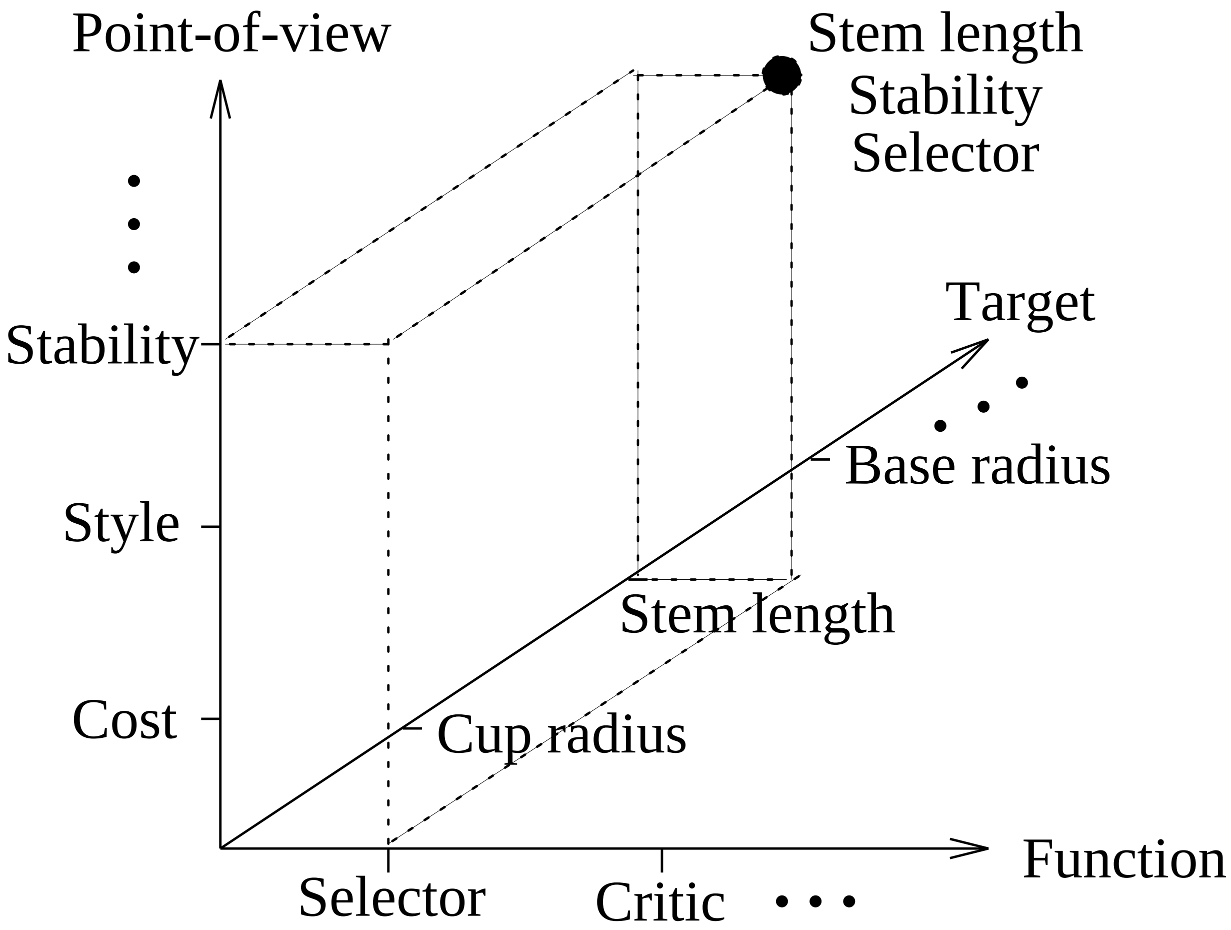
Conflicts in I3D+

Type	Agent1 Goal	Agent2 Goal	Global Goal	Result
1	X	Y	Z	Either
2	X	Y	X	Agent1
3	X	Y	Y	Agent2
4	X	Y	X,Y	Either
5	X	X	Z	Either
6	X	X	X	Either

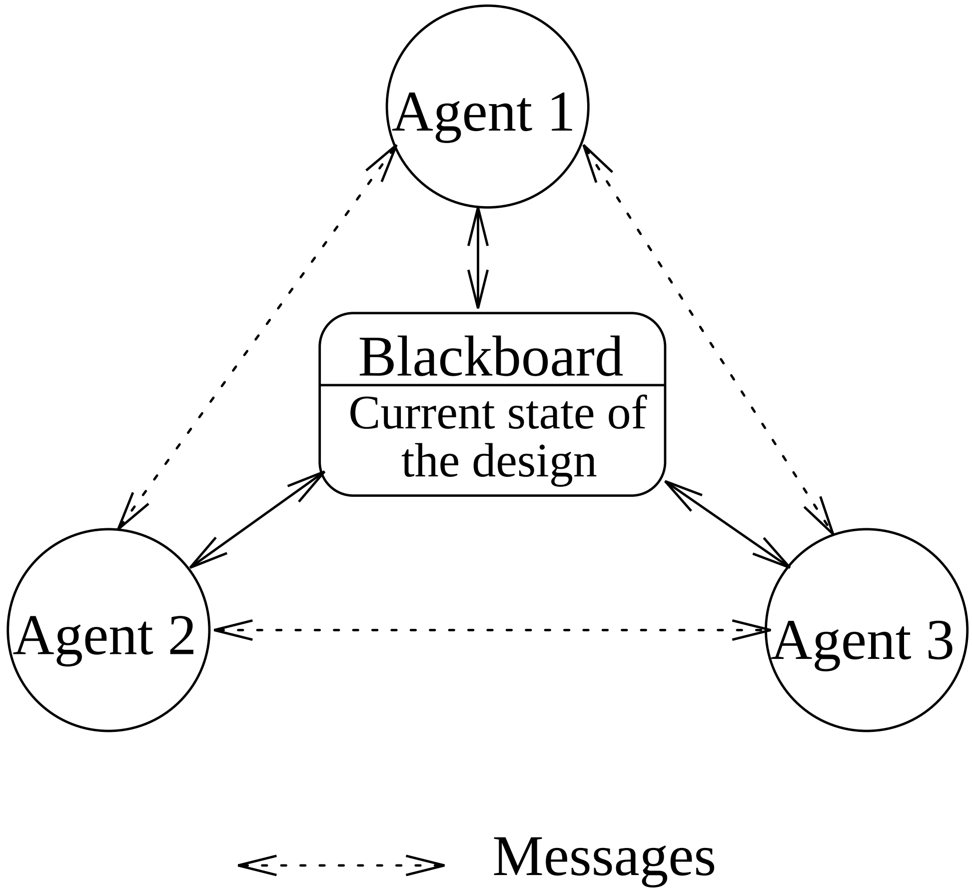
COMPONENTS OF A SIFA



Space of SiFAs



COMMUNICATION AND DATA FLOW



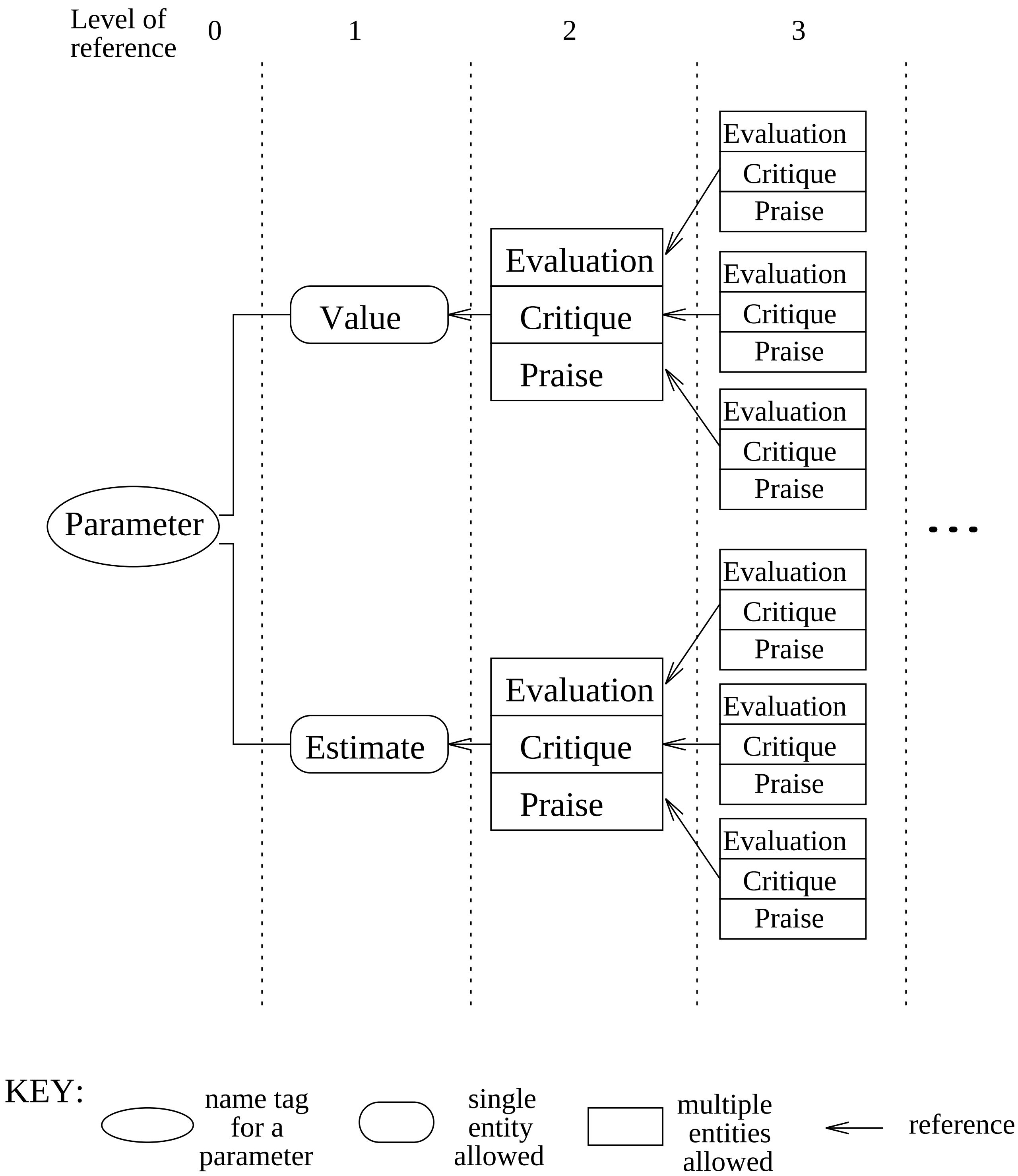
Matrix of conflict types

	Sel.	Est.	Eval.	Critic	Praiser	Sugg.
Selector	√√	√	√			√
Estimator	√	√				
Evaluator	√√	√√	√			
Critic	√	√	√	√	√	
Praiser	√			√	√	√
Suggestor	√	√	√	√	√	√

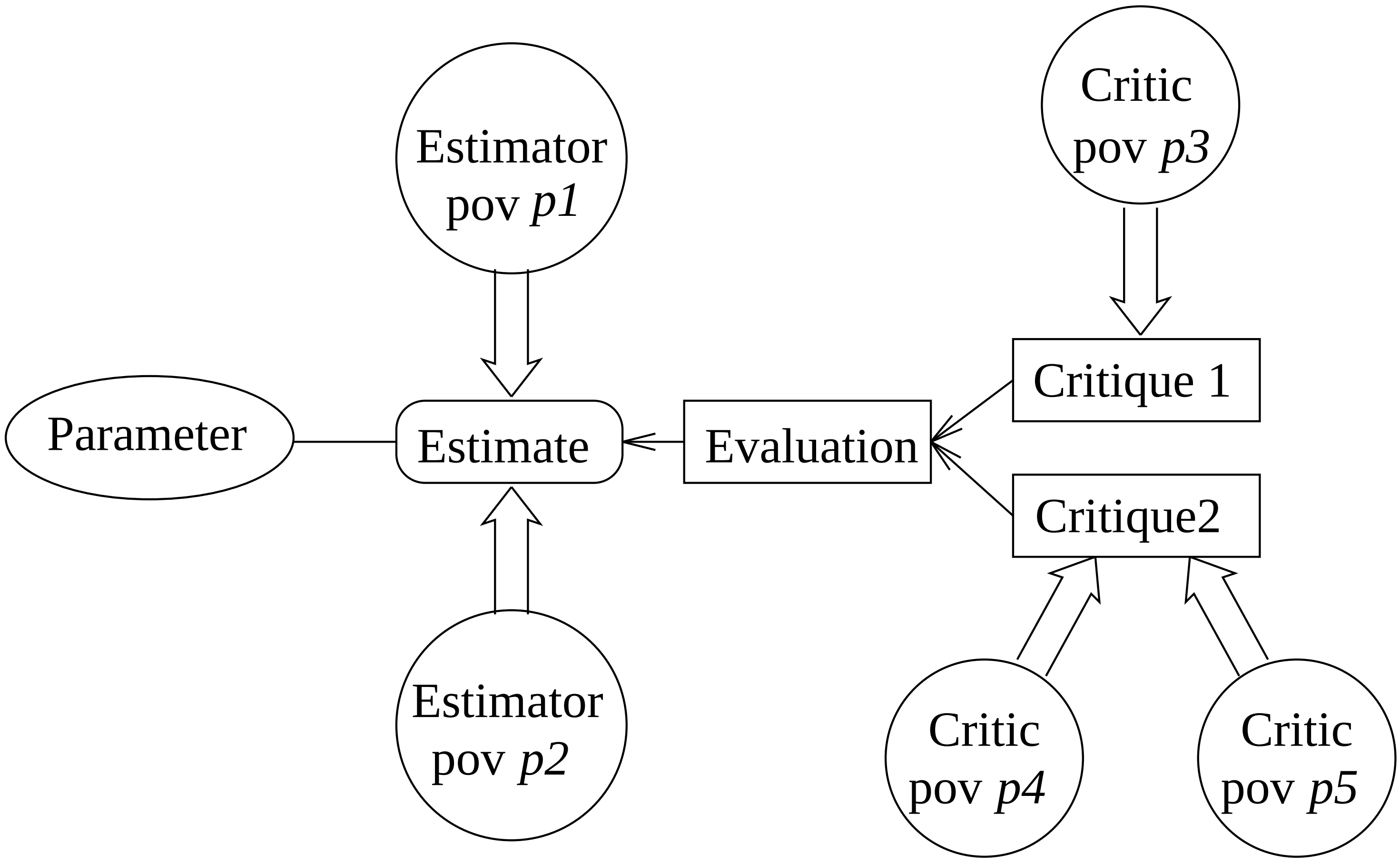
Extensions

- The parameter block
- Targets of agents
- Knowledge contained in a SiFA
- Selector/Advisor merging
- User requirements

The parameter block



Three critics



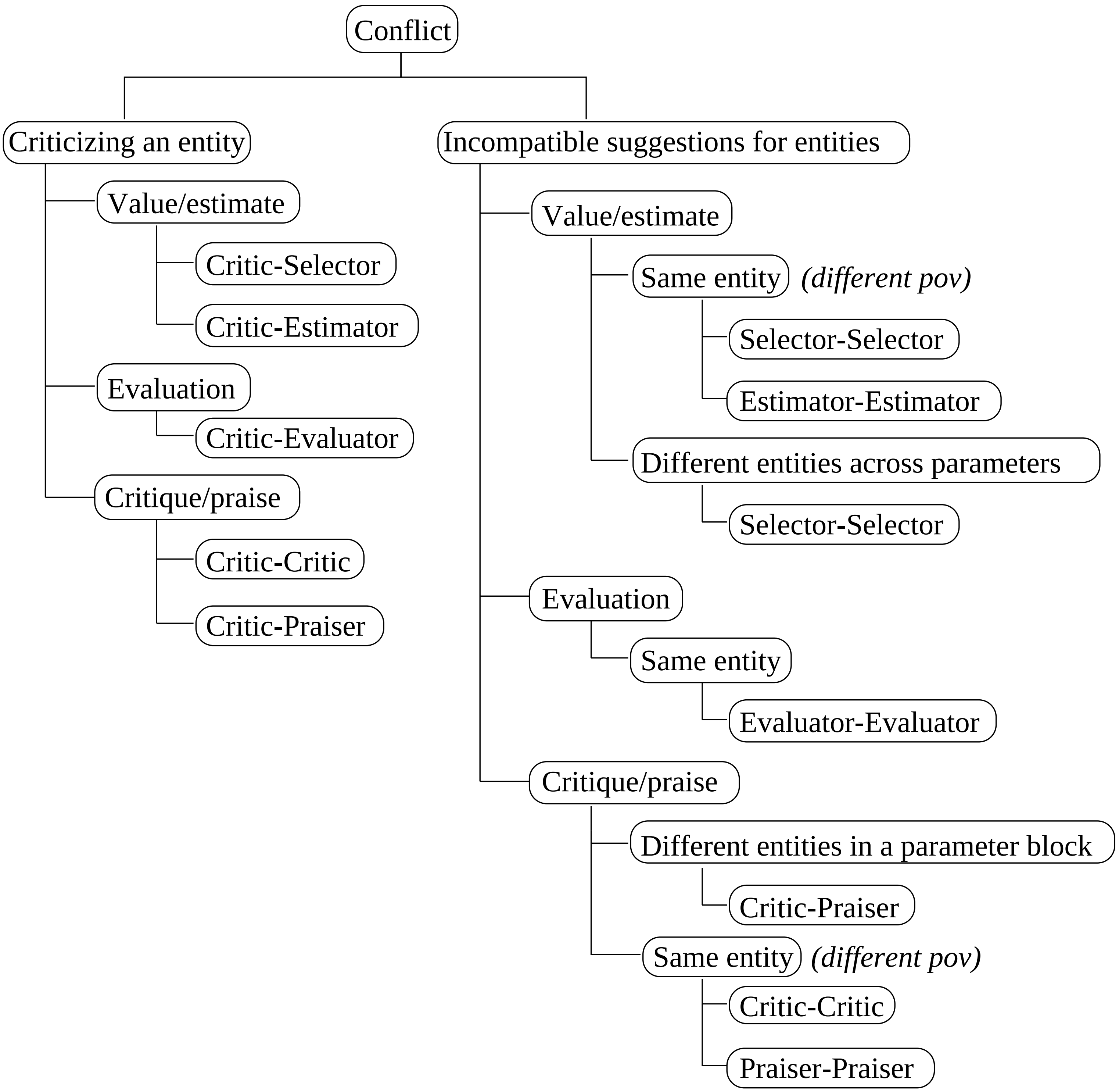
Knowledge in a SiFA

Single Function Agent
Design
Redesign
Conflict Indication
Conflict Detection
Conflict Classification
Negotiation Strategy Selection
Negotiation Strategy Refinement
Negotiation Strategy Execution

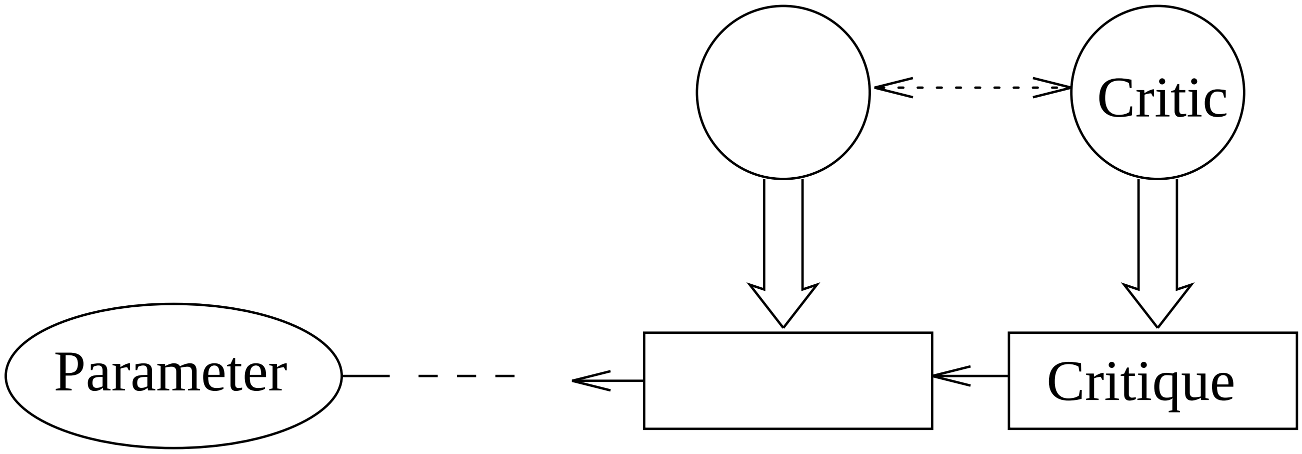
Conflicts

- The conflict hierarchy
- Incomplete knowledge
- Domain Independence

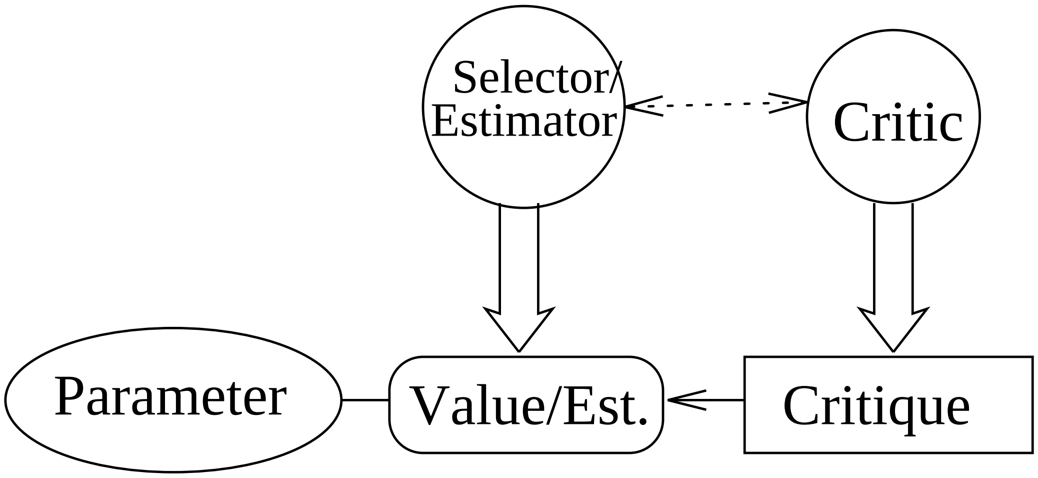
The conflict hierarchy



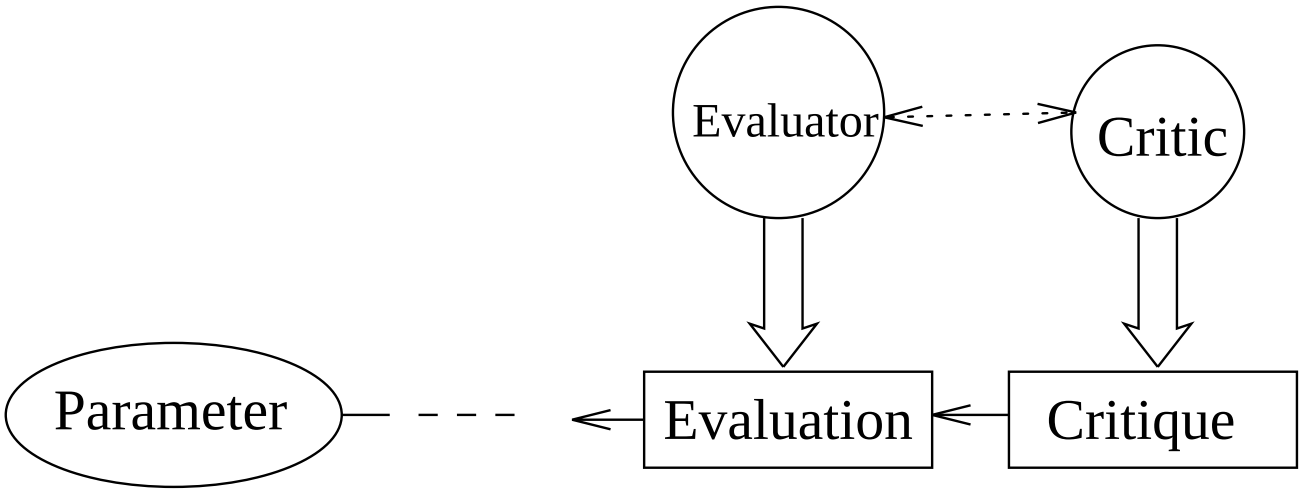
A critic



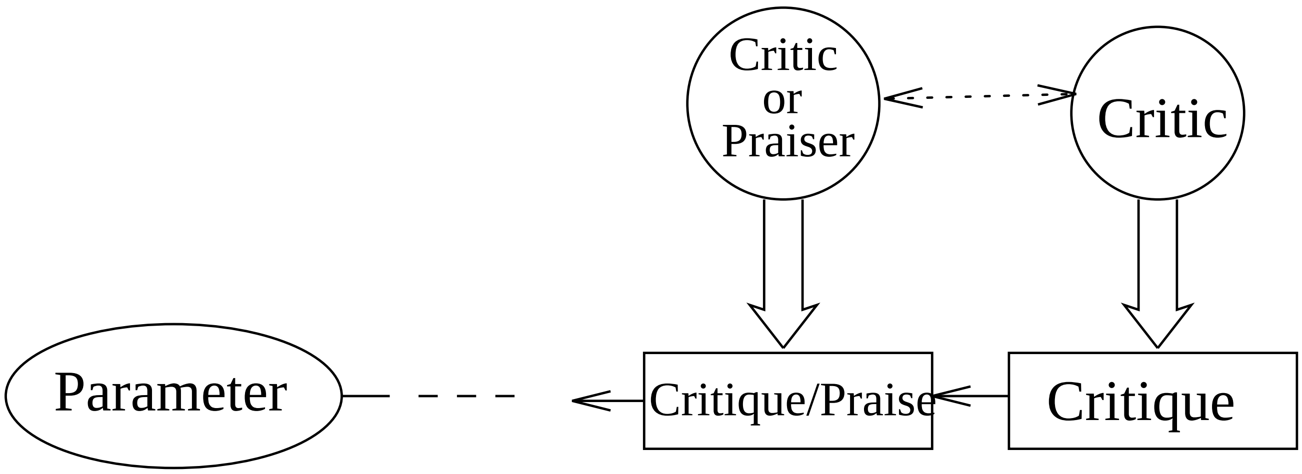
Criticism of a value/estimate



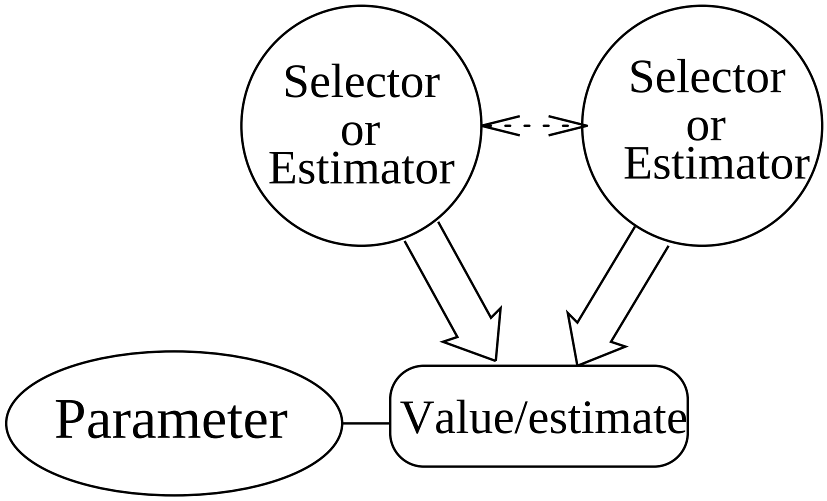
Criticism of an evaluation



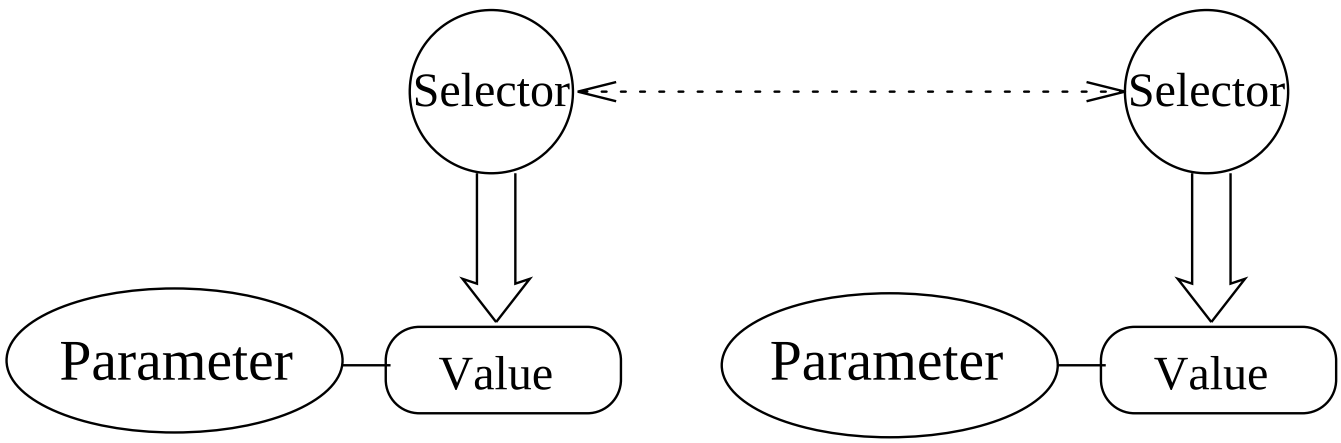
Criticism of a criticism/praise



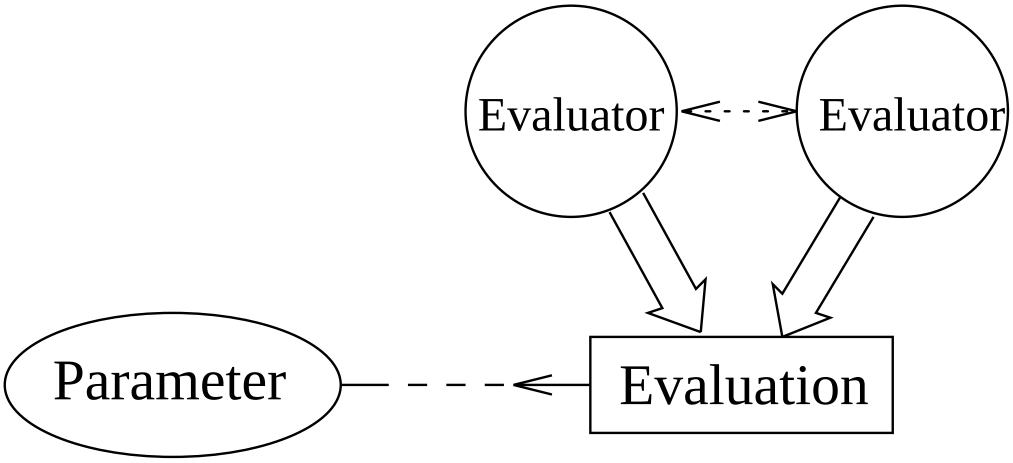
Incompatibility involving one value/estimate



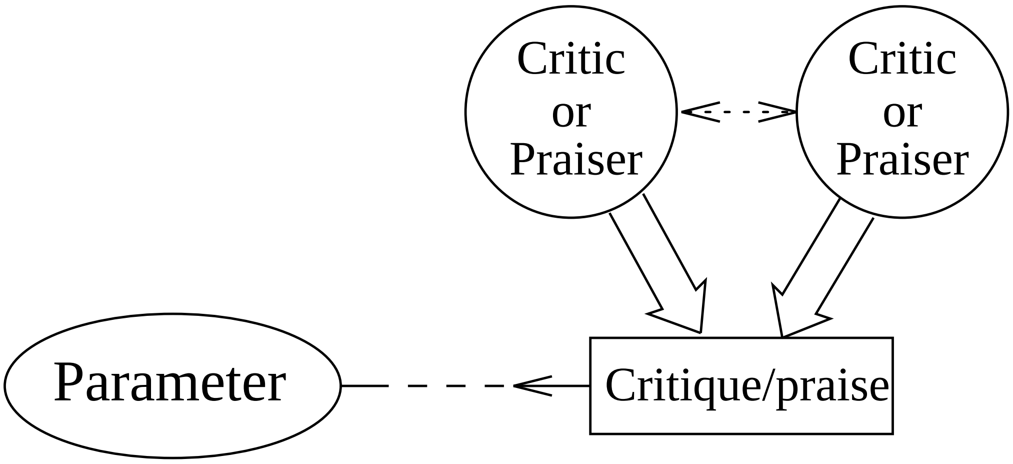
Incompatibility across parameter blocks



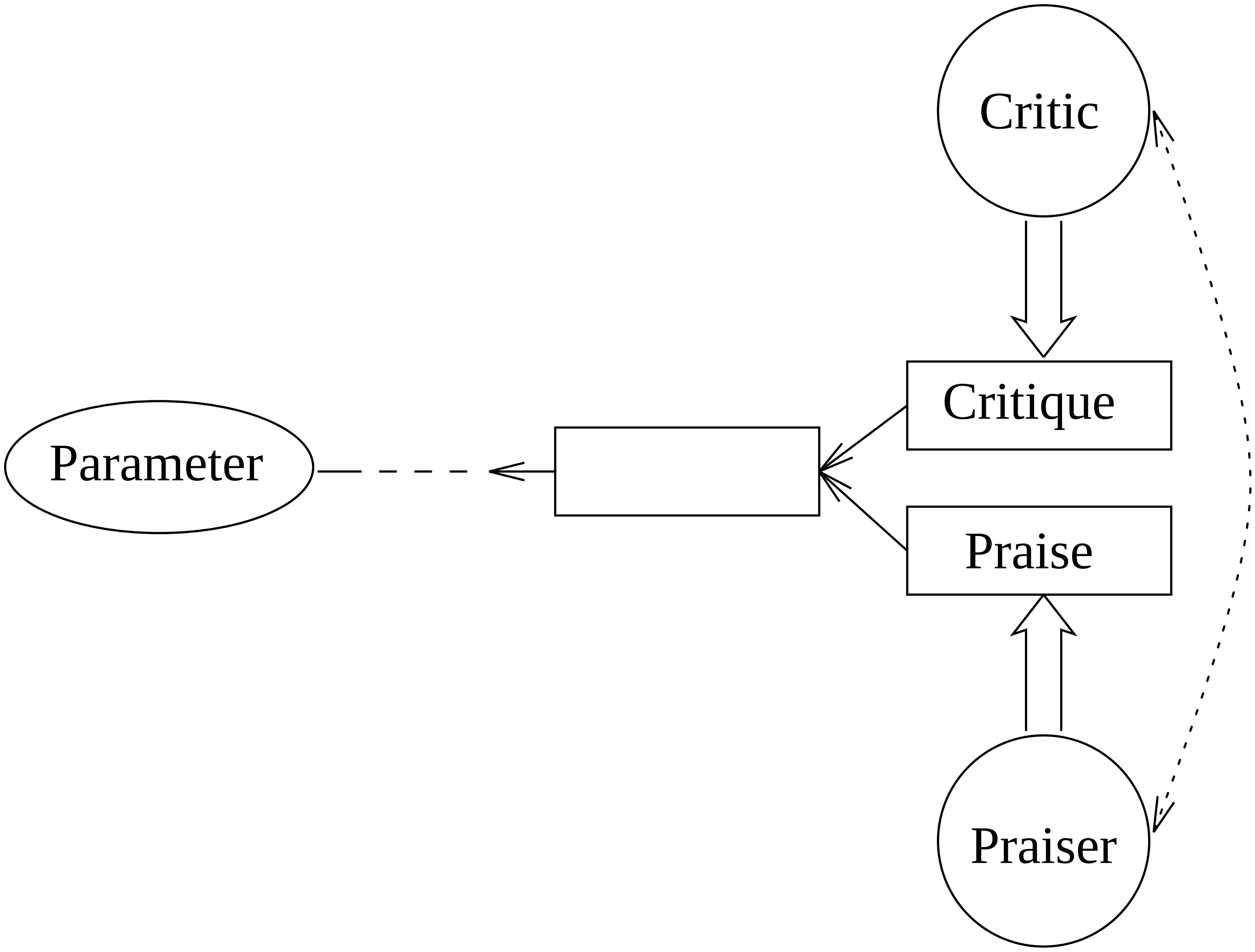
Incompatibility involving one evaluation



Incompatibility involving one criticism/praise



Incompatibility between two entities



Negotiations

- Conflict indication
- Conflict detection
- Conflict classification
- Negotiation strategy selection
- Negotiation strategy refinement
- Negotiation strategy execution
- Changing negotiation modes
- Emergent behavior

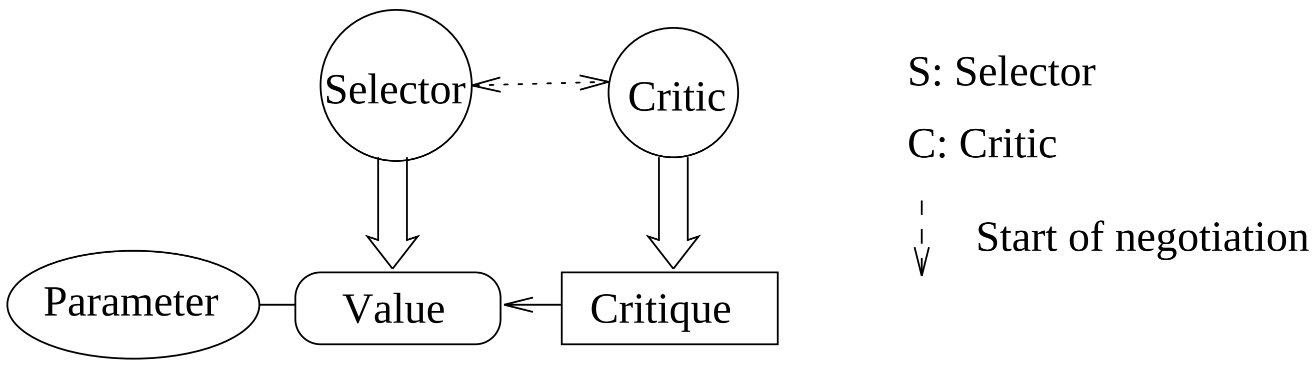
An "ask alternative" message

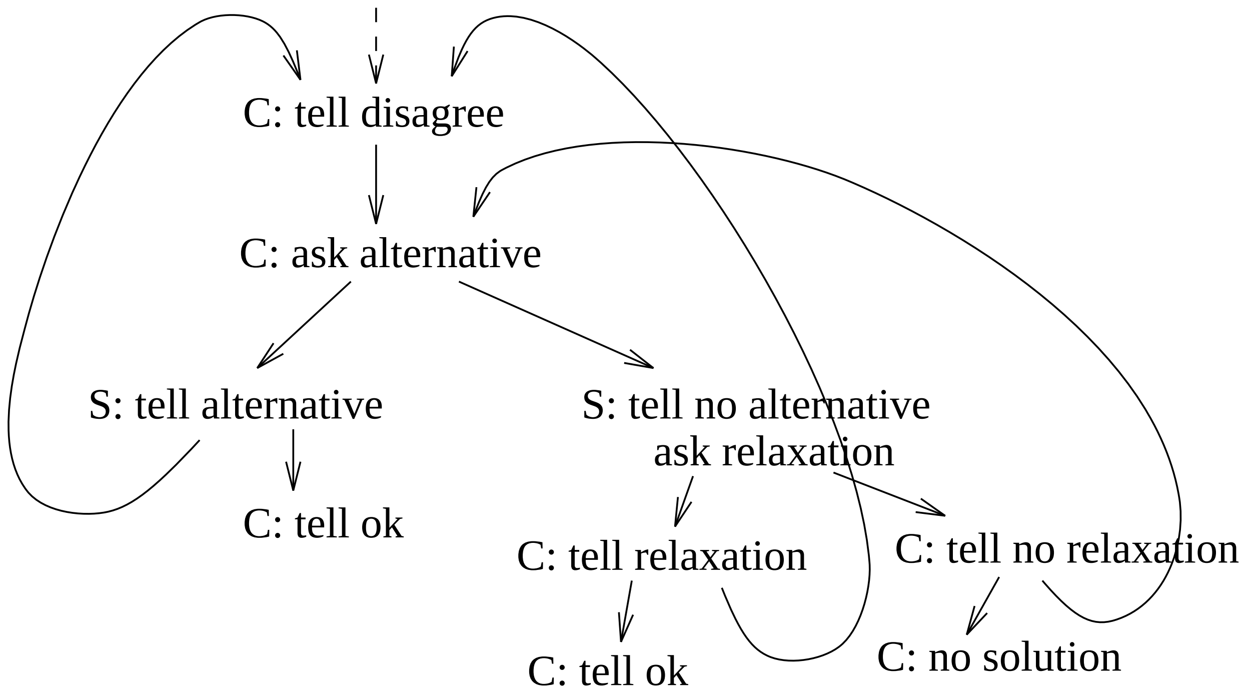
Primitive	Ask
From	Cup radius Stability Critic
To	Cup radius Stability Selector
Subject	Cup radius Value
Slot 1	Alternative
Slot 2	

A "tell no alternative" message

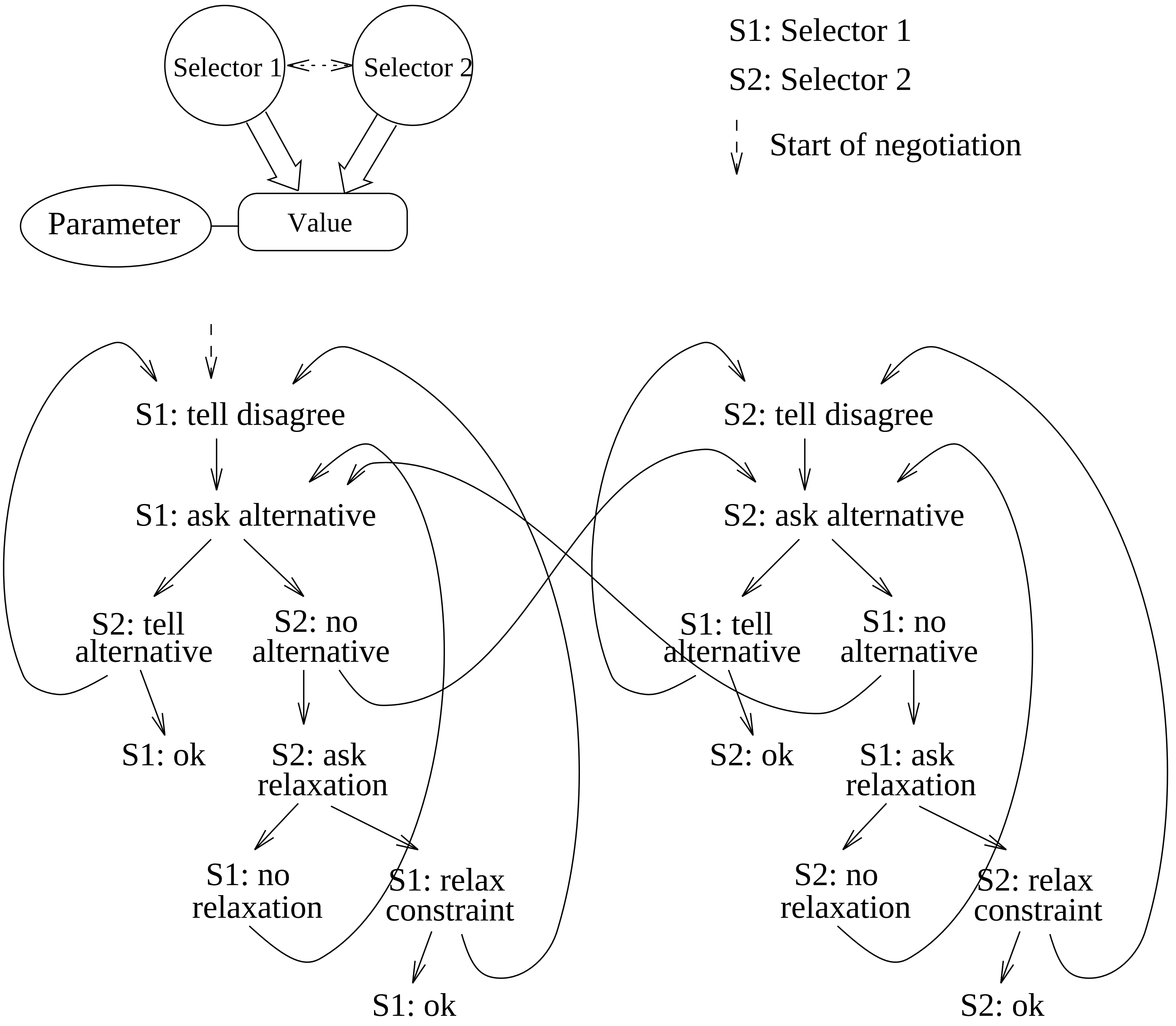
Primitive	Tell
From	Cup radius Stability Selector
To	Cup radius Stability Critic
Subject	Cup radius Value
Slot 1	Alternative
Slot 2	none

Selector-Critic negotiation graph

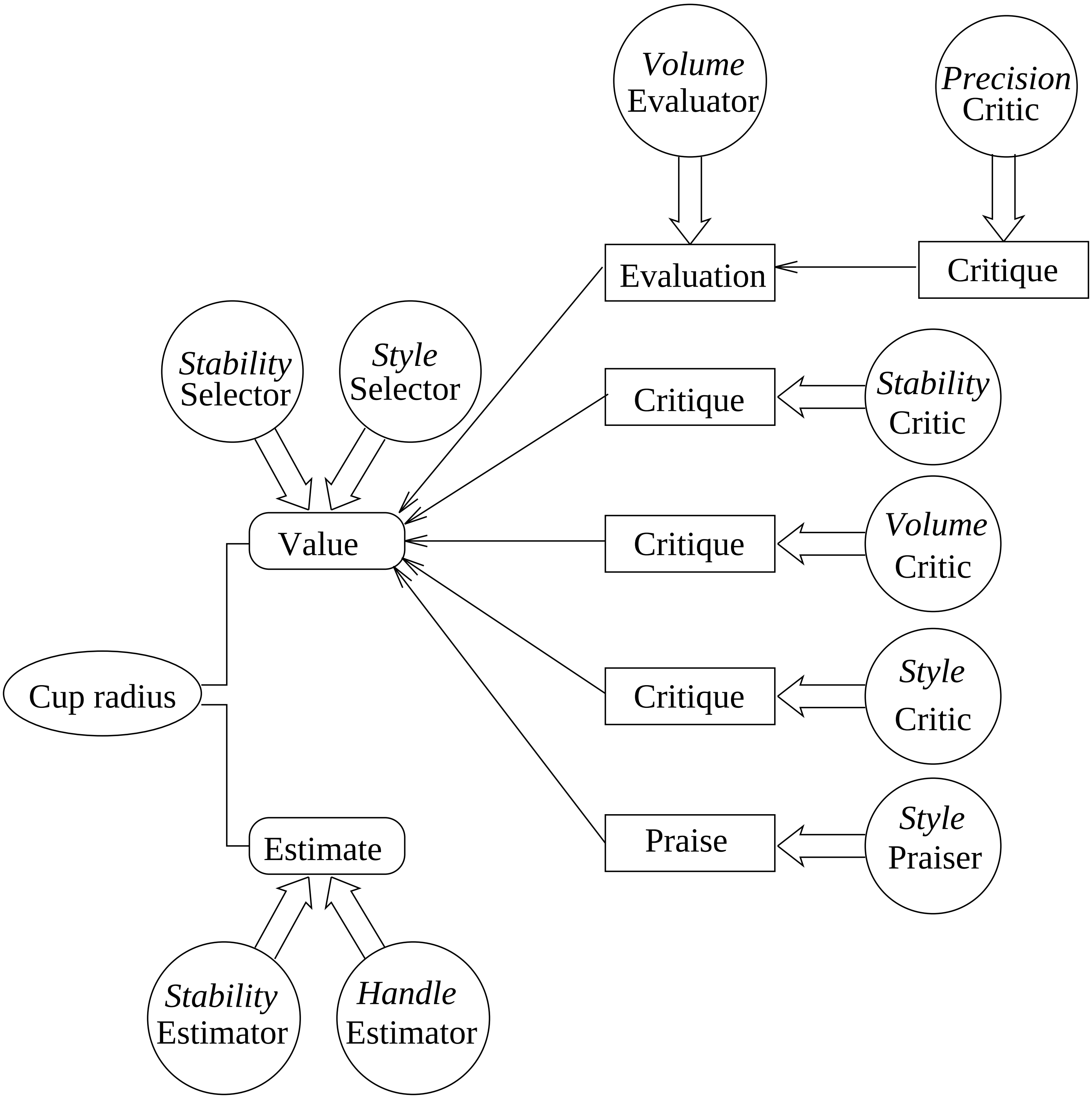




Selector-Selector negotiation graph



IMPLEMENTED AGENTS IN COSINE



Criticism of a Value

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Cup Radius Value Stability Critic: Conflict detected with Cup
Radius Stability Selector.

Cup Radius Value Stability Critic: Criticism asserted. Cup radius
value is too high from stability pov.

Cup Radius Value Stability Critic: Ask Cup Radius Stability
Selector for an alternative value.

Cup Radius Stability Selector: No alternative values.

Cup Radius Stability Selector: Ask Cup Radius Value Stability
Critic to relax constraints.

Cup Radius Value Stability Critic: Constraint relaxed.

Cup Radius Value Stability Critic: Criticism retracted. Cup
radius value is not too high from stability pov anymore.

Cup Radius Value Stability Critic: Conflict with Cup Radius
Stability Selector resolved.
```

Criticism of an Evaluation

Cup Radius Value Volume Evaluator: Evaluation asserted. Cup radius value is good from a volume pov.

Cup Radius Value Evaluation Precision Critic: Conflict detected with Cup Radius Value Volume Evaluator.

Cup Radius Value Evaluation Precision Critic: Criticism asserted. Cup radius value evaluation is too imprecise.

Cup Radius Value Evaluation Precision Critic: Ask Cup Radius Value Volume Evaluator to offer a more precise evaluation.

Cup Radius Value Volume Evaluator: Changing to precision evaluation mode.

Cup Radius Value Volume Evaluator: Evaluation asserted. Cup radius value's quality is 88 percent.

Cup Radius Value Evaluation Precision Critic: Criticism retracted. Cup radius value evaluation is not imprecise anymore.

Cup Radius Value Evaluation Precision Critic: Conflict with Cup Radius Value Volume Evaluator resolved.

Future Research

- High level entities
- Negotiation strategies
- History keeping
- Learning
- Automatic generation of SiFAs

Conclusions

- Extensions to the paradigm, the study of conflicts, and the negotiation model make SiFA's more powerful

- The new SiFA paradigm is a tool for further research