Quantifying the Difference Between Argumentation Semantics

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Argumentation system

Argumentation system

(1)		(2)		(3)
Argumentation framework F	$+$	Semantics σ	$\Longrightarrow$	Acceptable sets of arguments $Ext_\sigma(F)$

Example:

$$c \longrightarrow b \longrightarrow a \quad + \quad \text{Stable semantics} \quad \Longrightarrow \quad \{\{c, a\}\}$$

Argumentation system

Given a Dung's argumentation framework $F = \langle A, R \rangle$, $S \subseteq A$ is

- conflict-free w.r.t. F if $\nexists a_i, a_j \in S$ s.t. $(a_i, a_j) \in R$
- admissible w.r.t. F if S is conflict-free and S defends each of its arguments against all of their attackers
- a naive extension of F if S is a maximal conflict-free set (w.r.t. $\subseteq$)
- a stable extension of F if S is conflict-free and S attacks each argument in $A \setminus S$

Argumentation system

Examples:

$$c \longrightarrow b \longrightarrow a \; + \quad \begin{array}{c}\text{Stable}\\ \text{semantics}\end{array} \quad \Longrightarrow \quad \{\{c, a\}\}$$

$$c \longrightarrow b \longrightarrow a \; + \quad \begin{array}{c}\text{Naive}\\ \text{semantics}\end{array} \quad \Longrightarrow \quad \{\{c, a\}, \{b\}\}$$

$$c \longrightarrow b \longrightarrow a \; + \quad \begin{array}{c}\text{Admissible}\\ \text{semantics}\end{array} \quad \Longrightarrow \quad \{\{c, a\}, \{c\}, \emptyset\}$$

Argumentation system

Argumentation system

(1)		(2)		(3)
Argumentation framework F	$+$	Semantics σ	$\Longrightarrow$	Acceptable sets of arguments $Ext_\sigma(F)$

In the context of the dynamics of argumentation systems, σ may have to be changed to a σ'

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Argumentation framework F	$+$	Semantics σ	$\Longrightarrow$	Acceptable sets of arguments $Ext_\sigma(F)$

In the context of the dynamics of argumentation systems, σ may have to be changed to a σ'

Possibly, σ' should be not too different from σ

Example

Argumentation system and acceptability requirement:

(1)		(2)		(3)
$c \longrightarrow b \longrightarrow a$	$+$	Stable semantics	$\Longrightarrow$	$\{\{a, c\}\}$

$\uparrow$

b in an acceptable set

Enforcement:

(1')		(2)		(3')
$d \longrightarrow c \longrightarrow b \longrightarrow a$	$+$	Stable semantics	$\Longrightarrow$	$\{\{d, b\}\}$

Example

Argumentation system and acceptability requirement:

(1)	(2)		(3)
$c \longrightarrow b \longrightarrow a$ +	Stable semantics	$\Longrightarrow$	$\{\{a, c\}\}$

$\uparrow$

b in an acceptable set

Enforcement:

(1)	(2')		(3')
$c \longrightarrow b \longrightarrow a$ +	Naive semantics	$\Longrightarrow$	$\{\{a, c\}, \{b\}\}$

Towards semantic change

Question

How to measure how different two semantics σ and σ' are?

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How to measure how different two semantics σ and σ' are?

Three types of difference measures:

$\Longrightarrow$ Property-based

$\Longrightarrow$ Relation-based

$\Longrightarrow$ Acceptance-based

Property-based difference measures

- Rely on the principles the semantics are defined on. E.g.:
  - admissible semantics: relies on conflict-freeness and admissibility
  - naive semantics: relies on inclusion-maximality for conflict-freeness

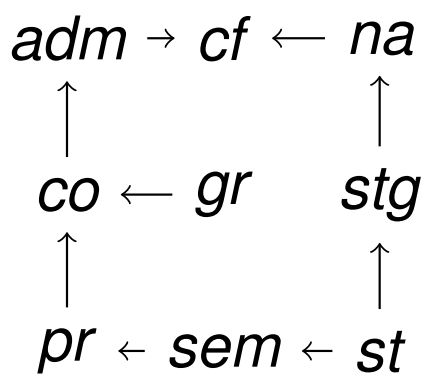
  $\Longrightarrow$ See the “SESAME” paper presented at SAFA 2016

- A weight can be assigned to each principle.

- Measure the difference between the principles the semantics are based on, and their possible weights.

Relation-based difference measures

- A certain relation between semantics is considered. E.g.:
  - the inclusion relation between extensions under the semantics
- This relation is represented as a graph. E.g.:



- The length of the shortest path between σ and σ' in this graph is measured.

Acceptance-based difference measures

- Unlike the two previous types of measures, these ones are relative to a given argumentation framework F.
- The sets of extensions $Ext_{\sigma}(F)$ and $Ext_{\sigma'}(F)$ are considered.
- The difference between these two sets (e.g. using the Hamming distance) is measured.

Conclusion and future work

- Toward semantic change:
  - 3 kinds of difference measures for semantics
  - These measures can be combined
  - A semantics σ may be "closer" to a σ' than a σ'' according to one measure, but not according to another measure
- Future work:
  - Application of these measures in the context of the revision of argumentation systems
  - In this context, study of the combination of these measures with measures for changes on argumentation frameworks