Asking the Right Question: Forcing Commitment in Examination Dialogues

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Overview

1. Examination dialogues
2. Frameworks
   - Argumentation framework
   - Value-based argumentation framework
3. Uncontested semantics
4. Conclusion

Examination dialogues

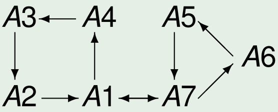
- Examination dialogues: Dialogues designed not to discover what a person believes, but rather their reasons for holding their beliefs [Dunne *et al* 05].
  - Examples: traditional viva voce examinations, political interviews

- Problem: which question to ask?
  - ⇒ the interviewee must not have the possibility to evade the issue
  - ⇒ the question must not offer a defence which makes no commitment to the underlying principles of the interviewee.

Argumentation framework - Definition

- [Dung95] An argumentation system is a pair $\mathcal{H} = \langle \mathcal{X}, \mathcal{A} \rangle$ where:
  - $\mathcal{X}$ is a set of arguments
  - $\mathcal{A} \subseteq \mathcal{X} \times \mathcal{X}$ represents a notion of attack
- Can be represented as a directed graph

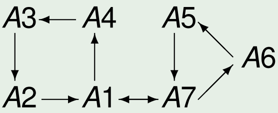
Example



Argumentation framework - Semantics

- A subset $S \subseteq \mathcal{X}$ is admissible if:
  1. S is conflict-free: there are not two arguments in S such that one attacks the other, and
  2. S defends all its elements: any argument $y \in \mathcal{X} \setminus S$ that attacks $x \in S$ is attacked by some $z \in S$.
- S is a preferred extension if it is a maximal (w.r.t. $\subseteq$) admissible set.

Example

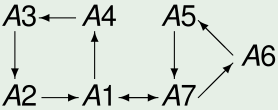


Preferred extensions: $\{A1, A3, A6\}$ and $\{A2, A4\}$

Argumentation framework - Semantics

- [Dung *et al* 06] S is an ideal extension if:
  1. S is admissible, and
  2. S is a subset of every preferred extension.

Example

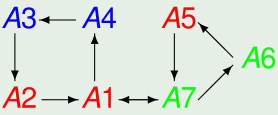


- Preferred extensions: $\{A1, A3, A6\}$ and $\{A2, A4\}$
- Ideal extension: $\emptyset$

Value-based argumentation framework - Definition

- [Bench-Capon03] A value-based argumentation framework (VAF) is a tuple $\mathcal{H}^{(\mathcal{V})} = \langle \mathcal{H}(\mathcal{X}, \mathcal{A}), \mathcal{V}, \eta \rangle$ where:
  - $\mathcal{H}(\mathcal{X}, \mathcal{A})$ is an argumentation framework
  - $\mathcal{V} = \{v_1, v_2, \ldots, v_k\}$ is a set of k values
  - $\eta : \mathcal{X} \rightarrow \mathcal{V}$ associates a value $\eta(x) \in \mathcal{V}$ with each argument $x \in \mathcal{X}$

Example

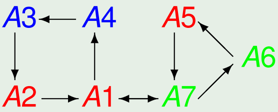


$$\mathcal{V} = \{v1, v2, v3\}$$

Value-based argumentation framework - Definition

- An audience is an ordering of $\mathcal{V}$ whose transitive closure is asymmetric.
- An audience is a specific audience if it yields a *total* ordering of $\mathcal{V}$.
- $\chi(R)$ denotes the set of the specific audiences consistent with the transitive closure of an audience R.
- $R = \emptyset$: universal audience

Example

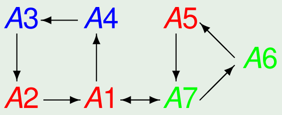


- $R =$ v2 > v1:
  $\chi(R)$ contains v3 > v2 > v1, v2 > v1 > v3, v2 > v3 > v1

Value-based argumentation framework - Definition

- An argument x defeats an argument y w.r.t. an audience R if x attacks y and the value of y is not preferred to the value of x according to R.

Example



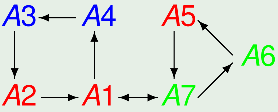
- $R = v2 > v1$:
  - *A6* defeats *A5*
  - *A5* does not defeat *A7*

Value-based argumentation framework - Semantics

- A subset $S \subseteq \mathcal{X}$ is admissible w.r.t. R if:
  - Conflict-free w.r.t. R: there are not two arguments in S such that one defeats the other w.r.t. R.
  - Defends w.r.t. R all its elements: any argument $y \in \mathcal{X} \setminus S$ that defeats $x \in S$ w.r.t. R is defeated w.r.t. R by some $z \in S$.
- S is a preferred extension w.r.t. R if it is a maximal (w.r.t. $\subseteq$) admissible set w.r.t. R.
- Every specific audience α induces a unique preferred extension within its underlying VAF.

Value-based argumentation framework - Semantics

Example

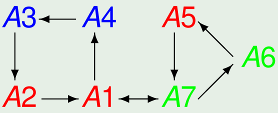


- Preferred extensions:
  - $R = \text{v2} > \text{v1}$: $\{A2, A4, A5, A7\}$
  - $R' = \text{v1} > \text{v2}$: $\{A2, A4, A5, A6\}$

Value-based argumentation framework - Semantics

- An argument is objectively accepted w.r.t. an audience R if it is in the preferred extension for *every* specific audience $\alpha \in \chi(R)$.

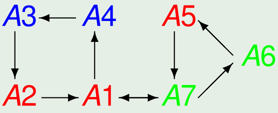
Example



- Preferred extensions:
  - $R = \text{v2} > \text{v1}$: $\{A2, A4, A5, A7\}$
  - $R' = \text{v1} > \text{v2}$: $\{A2, A4, A5, A6\}$
- Objectively acceptable arguments (w.r.t. $\emptyset$): $\{A2, A4, A5\}$

Value-based argumentation framework

Example



- Objectively acceptable arguments (w.r.t. $\emptyset$): $\{A2, A4, A5\}$
- Question: *"How is A5 defended?"*
  - *"A7 defeats A6"* $\Rightarrow$ commits to v2 > v1
  - *"A6 does not defeat A5"* $\Rightarrow$ commits to v1 > v2

$\Rightarrow$ Arguments objectively accepted but not part of a Dung admissible set are those arguments that may be fruitfully challenged in an examination dialogue.

Uncontested semantics

Definition

Let $\mathcal{H}^{(\mathcal{V})}$ be a VAF and R an audience. A set of arguments, S in $\mathcal{H}^{(\mathcal{V})}$ is an uncontested extension w.r.t. R if:

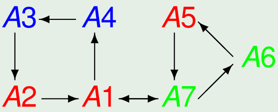
1. it is an admissible set in $\mathcal{H}$, and
2. every argument in S is objectively acceptable in $\mathcal{H}^{(\mathcal{V})}$ w.r.t. R

Property

For every VAF and audience R, there is a unique, maximal uncontested extension w.r.t. R.

Uncontested semantics

Example



- Preferred extensions:
  - v2 > v1: $\{A2, A4, A5, A7\}$
  - v1 > v2: $\{A2, A4, A5, A6\}$
- Objectively acceptable arguments: $\{A2, A4, A5\}$
- Maximal uncontested extension: $\{A2, A4\}$
- Set of arguments to be challenged in an examination dialogue: $\{A5\}$

Uncontested semantics - Properties

Theorem (Complexity)

Given a VAF, let U_R be its maximal uncontested extension w.r.t. an audience R:

- *Is a set an uncontested extension?* — *co-NP-complete*
- *Does an argument belongs to U_R?* — *co-NP-hard*
- *Is $U_R = \emptyset$?* — *NP-hard*
- *Is a set equal to U_R?* — *D_P-hard*

Conclusion

- Uncontested semantics for value-based argumentation frameworks:
  - Refines the nature of objective acceptability in value-based argumentation frameworks
  - Counterpart to the ideal semantics [Dung *et al* 06] for Dung's argumentation framework
- Starting point for examination dialogues: the objectively accepted arguments that do not belong to the maximal uncontested extension can be fruitfully challenged.