Asking the Right Question: Forcing Commitment in Examination Dialogues

T. J. M. Bench-Capon\textsuperscript{1}  S. Doutre\textsuperscript{2}  P. E. Dunne\textsuperscript{1}

\textsuperscript{1}Department of Computer Science, The University of Liverpool, U.K.

\textsuperscript{2}IRIT – Université Toulouse 1, France

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Overview

1. Examination dialogues

2. Frameworks
   - Argumentation framework
   - Value-based argumentation framework

3. Uncontested semantics

4. Conclusion
Examination dialogues: Dialogues designed not to discover what a person believes, but rather their reasons for holding their beliefs [Dunne \textit{et al} 05].

- Examples: traditional viva voce examinations, political interviews

Problem: \textbf{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 $\mathcal{H} = \langle \mathcal{X}, A \rangle$ where:

- $\mathcal{X}$ is a set of **arguments**
- $A \subseteq \mathcal{X} \times \mathcal{X}$ represents a notion of **attack**

Can be represented as a directed graph

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**Example**

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A3 ← A4  A5 → A6
A2 ↓      ↓  A1 ← A7
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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

$\mathcal{V} = \{v_1, v_2, v_3\}$
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 $v3 > v2 > v1$, $v2 > v1 > v3$, $v2 > v3 > v1$
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 \( A7 \)
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 \( \alpha \) induces a unique preferred extension within its underlying VAF.
Value-based argumentation framework - Semantics

Example

Preferred extensions:
- \( R = v2 > v1 \): \( \{A2, A4, A5, A7\} \)
- \( R' = v1 > v2 \): \( \{A2, A4, A5, A6\} \)
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:
  - $R = v_2 > v_1$: $\{A_2, A_4, A_5, A_7\}$
  - $R' = v_1 > v_2$: $\{A_2, A_4, A_5, A_6\}$

- Objectively acceptable arguments (w.r.t. $\emptyset$): $\{A_2, A_4, A_5\}$
Objectively acceptable arguments (w.r.t. $\emptyset$): \{A2, A4, A5\}

**Question:** “How is A5 defended?”

- “A7 defeats A6” $\Rightarrow$ commits to $v_2 > v_1$
- “A6 does not defeat A5” $\Rightarrow$ commits to $v_1 > v_2$

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

Let $\mathcal{H}^{(V)}$ be a VAF and $R$ an audience. A set of arguments, $S$ in $\mathcal{H}^{(V)}$ 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 $\mathcal{H}^{(V)}$ 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

\[
\begin{align*}
A_2 &\rightarrow A_1 & A_3 &\leftrightarrow A_4 & A_5 \\
A_2 &\rightarrow A_1 & & & A_6 \\
A_1 &\leftrightarrow A_4 & & & A_6 \\
\end{align*}
\]

- Preferred extensions:
  - \(v_2 > v_1\): \(\{A_2, A_4, A_5, A_7\}\)
  - \(v_1 > v_2\): \(\{A_2, A_4, A_5, A_6\}\)

- Objectively acceptable arguments: \(\{A_2, A_4, A_5\}\)

- Maximal uncontested extension: \(\{A_2, A_4\}\)

- Set of arguments to be challenged in an examination dialogue: \(\{A_5\}\)
## 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
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.