Argumentation with Preferences

Ways to account for preferences:

- Encode within existing components
- Discard attacks
- Compare extensions
1. Encode preferences within existing components

- Preferences as assumptions [Kowalski and Toni, 1996]
- (Sets of) sentences into assumptions and rules [Thang and Luong, 2014]
1. Encode preferences within existing components

- Preferences as assumptions [Kowalski and Toni, 1996]
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Issues:
- concision
- modularity
- generalizability
2. Discard attacks

Given \((\text{Args}, \leadsto, \leq)\): if \(A \leadsto B\) and \(A < B\), then \(A \not\leadsto B\).
2. Discard attacks

Given \((\text{Args}, \rightsquigarrow, \leq)\): if \(A \rightsquigarrow B\) and \(A < B\), then \(A \not\rightsquigarrow B\).

- Abstract Argumentation

- Structured argumentation
2. Discard attacks

Given \((\text{Args}, \leadsto, \preceq)\): if \(A \leadsto B\) and \(A \prec B\), then \(A \not\leadsto B\).

- Abstract Argumentation

- Structured argumentation

Issues:
- conflict-freeness
- restrictions
3. Compare extensions

Lift preferences to the extension level from:
- the argument level [Amgoud and Vesic, 2011] (AA);
- the object level [Wakaki, 2014] (ABA).
3. Compare extensions

Lift preferences to the extension level from:
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- the object level [Wakaki, 2014] (ABA).

Issues:
- absence of extensions
- ‘wrong’ extensions
- preference aggregation
Omissions

- Bipolar Argumentation Frameworks [Amgoud et al., 2004]
- [Villata et al., 2012]: AA with prioritized support
- [Dunne et al., 2011]: weighted attacks, inconsistency budget
- [Booth et al., 2013]: arguments with properties, motivational states, weighting relation
Attack Reversal in Abstract Argumentation

Proposed for AA: (Rich) PAFs [Amgoud and Vesic, 2014].

Given \((Args, \rightsquigarrow, \leq)\): if \(A \rightsquigarrow B\) and \(A < B\),
then \(A \not\rightarrow B\) and \(B \rightarrow A\).
Attack Reversal in Abstract Argumentation


Given \((Args, \leadsto, \leq)\): if \(A \leadsto B\) and \(A \prec B\),

then \(A \not\leftrightarrow B\) and \(B \leftrightarrow A\).

Example

\(Args = \{A, B\}, A \prec B\):

\((Args, \leadsto, \leq)\)

\(A \leadsto B\)

\((Args, \leftrightarrow)\)

\(A \not\leftrightarrow B\)

\(B \leftrightarrow A\)
Attack Reversal in Structured Argumentation

- Assumption-Based Argumentation (ABA) [Bondarenko et al., 1997, Dung et al., 2009, Toni, 2014]

- ABA$^+$ [Čyras and Toni, 2016a, Čyras and Toni, 2016b]: ABA with preferences over assumptions
ABA

- ABA framework \((\mathcal{L}, \mathcal{R}, \mathcal{A}, \neg)\):
  - deductive system \((\mathcal{L}, \mathcal{R})\);
  - assumptions \(\mathcal{A} \subseteq \mathcal{L}\);
  - contrary mapping \(\neg : \mathcal{A} \rightarrow \mathcal{L}\).
- Tree-like deductions \(S \vdash^R \varphi\)
- Attacks as deductions for contraries
- Semantics: extensions as sets of assumptions
ABA$^+$

- ABA$^+$ framework ($\mathcal{L}, \mathcal{R}, \mathcal{A}, \neg, \leq$):
  - ABA framework ($\mathcal{L}, \mathcal{R}, \mathcal{A}, \neg$);
  - transitive binary $\leq$ on $\mathcal{A}$. 

New attack relation $\Rightarrow <$:
- if $A \Rightarrow B$ (‘on $\beta \in B$’) and no $\alpha \in A$ with $\alpha < \beta$,
  then $A \Rightarrow < B$;
- if $A \Rightarrow B$ (‘on $\beta \in B$’) and some $\alpha \in A$ has $\alpha < \beta$,
  then $B \Rightarrow < A$. 

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ABA$^+$: Assumption-Based Argumentation with Preferences
ABA$^+$

- ABA$^+$ framework $(\mathcal{L}, \mathcal{R}, \mathcal{A}, \overline{-}, \leq)$:
  - ABA framework $(\mathcal{L}, \mathcal{R}, \mathcal{A}, -)$;
  - transitive binary $\leq$ on $\mathcal{A}$.

- New attack relation $\rightsquigarrow <$:
  - if $A \rightsquigarrow B$ (‘on $\beta \in B$’) and no $\alpha \in A$ with $\alpha < \beta$,
    then $A \rightsquigarrow < B$;
  - if $A \rightsquigarrow B$ (‘on $\beta \in B$’) and some $\alpha \in A$ has $\alpha < \beta$,
    then $B \rightsquigarrow < A$.  

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ABA$^+$: Assumption-Based Argumentation with Preferences
ABA vs. $ABA^+$

Formally

- $A \subseteq A$ attacks $B \subseteq A$ just in case:
  - $A' \vdash^R \beta$, for some $\beta \in B$ and $A' \subseteq A$, for some $\beta \in B$ and $A' \subseteq A$, or
  - $B' \vdash^R \alpha$, for some $\alpha \in A$ and $B' \subseteq B$, and $\exists \beta' \in B'$ with $\beta' < \alpha$. 

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ABA$^+$: Assumption-Based Argumentation with Preferences
ABA vs. ABA$^+$

Formally

- $A \subseteq A \prec$-attacks $B \subseteq A$ just in case:
  - either $A' \vdash^R \beta$, for some $\beta \in B$ and $A' \subseteq A$, and $\forall \alpha' \in A'$ we have $\alpha' \not\prec \beta$;
ABA vs. ABA$^+$

Formally

- $A \subseteq A \prec-\text{attacks} \ B \subseteq A$ just in case:
  - either $A' \vdash^R_\beta$, for some $\beta \in B$ and $A' \subseteq A$, and $\forall \alpha' \in A'$ we have $\alpha' \nless \beta$;
  - or $B' \vdash^{R'}_\alpha$, for some $\alpha \in A$ and $B' \subseteq B$, and $\exists \beta' \in B'$ with $\beta' \prec \alpha$. 
Simple Example

\[ \mathcal{L} = \{\alpha, \beta, \overline{\alpha}, \overline{\beta}\}, \quad \mathcal{R} = \{\overline{\beta} \leftarrow \alpha\}, \quad \mathcal{A} = \{\alpha, \beta\} \]
Simple Example

\(\mathcal{L} = \{\alpha, \beta, \bar{\alpha}, \bar{\beta}\}, \ \mathcal{R} = \{\bar{\beta} \leftarrow \alpha\}, \ \mathcal{A} = \{\alpha, \beta\}, \ \alpha < \beta.\)
Cycle

\[ \mathcal{R} = \{ \overline{\beta} \leftarrow \alpha; \; \overline{\gamma} \leftarrow \beta; \; \overline{\alpha} \leftarrow \gamma \}, \; \mathcal{A} = \{ \alpha, \beta, \gamma \}, \]

ABA

\[
\begin{aligned}
\{ \alpha \} & \quad \quad \{ \beta \} \\
\{ \gamma \} & \quad \quad \{ \gamma \} \\
\{ \beta \} & \quad \quad \{ \beta \}
\end{aligned}
\]
\[
\mathcal{R} = \{\overline{\beta} \leftarrow \alpha; \; \overline{\gamma} \leftarrow \beta; \; \overline{\alpha} \leftarrow \gamma\}, \; \mathcal{A} = \{\alpha, \beta, \gamma\}, \; \gamma < \beta < \alpha.
\]
ABA$^+$ generalizes PAFs [Amgoud and Vesic, 2014]
Comparison

- ABA$^+$ generalizes PAFs [Amgoud and Vesic, 2014]
- p_ABA [Wakaki, 2014] does not generate new extensions
Comparison

- ABA\(^+\) generalizes PAFs [Amgoud and Vesic, 2014]
- p\(_-\)ABA [Wakaki, 2014] does not generate new extensions
- ASPIC\(^+\) [Modgil and Prakken, 2014]:
  - contraries vs. contradictories, c-classicality, contraposition
  - different if no contraposition
  - . . . in between . . .
  - conjecture: instance if flat, contraposition, with elitist
ABA with $\leq$ over assumptions:
reverses attacks by incorporating $<$ directly into $\leadsto$.

- conservative extension of ABA
- conflict preservation
- preference handling properties
- rationality postulates [Caminada and Amgoud, 2007]
- Fundamental Lemma holds with a weaker form of contraposition
Ongoing Work

- Relaxing contraposition
- Further comparison
  - contraposition: flat $\text{ABA}^+$ as an instance of $\text{ASPIC}^+$ with the elitist comparison?
  - likewise for Deductive Argumentation
    [Besnard and Hunter, 2014]?
  - map to PAFs with arguments as sets of assumptions
References I


References III


References IV

