# Semantics Hierarchy in Preference-Based Argumentation Frameworks

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# Preferences in Argumentation

How should preferences influence the evaluation of arguments?

- Tricky: several approaches with no consensus
- Limitations: depending on the strategy, some desirable semantic properties may be lost

We are interested in the *preservation* of semantic properties.

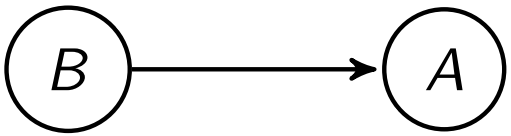
# Approach 1: Attack Removal

Consider $AF = (\{A, B\}, \{(B, A)\})$ (below) and suppose $A > B$

Approach 1: Discard the attacks

- Amgoud and Cayrol, 2002; Bench-Capon, 2003; Modgil, 2009

BEFORE




Complete: $\{\{B\}\}$

AFTER


Complete: $\{\{A, B\}\}$

# Approach 2: Reverse Attacks

Consider $AF = (\{A, B\}, \{(B, A)\})$ (below) and suppose $A > B$

Approach 2: Attacks to preferred arguments are reversed

- Amgoud and Vesic, 2009; Amgoud and Vesic, 2011

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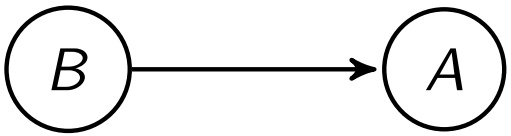


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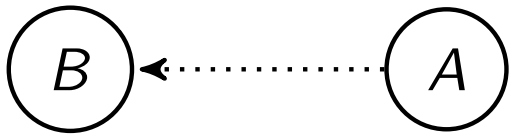


Complete: $\{\{A\}\}$

# Approach 3: Conditional Reversal

Consider $AF = (\{A, B\}, \{(B, A)\})$ (below) and suppose $A > B$

Approach 3: Attacks should be ignored only if it is symmetric

- Modgil and Prakken, 2013; Kaci et. al., 2018

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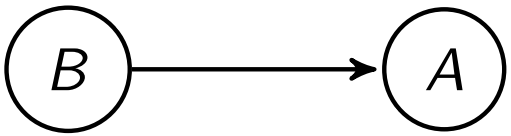


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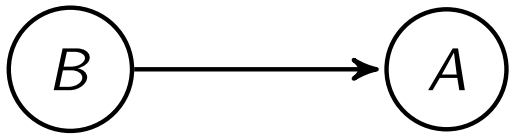


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# Approach 3: Conditional Inversion

Consider $AF = (\{A, B\}, \{(B, A), (B, A)\})$ (below) and suppose $A > B$

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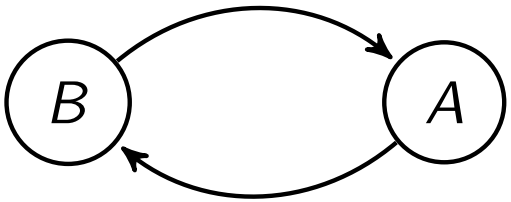
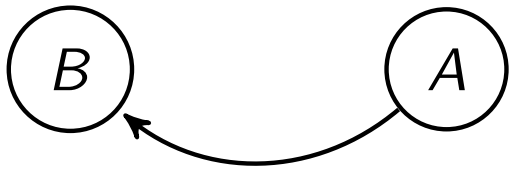



Complete: $\{\emptyset, \{A\}, \{B\}\}$

AFTER

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Approach 1: discard the attacks

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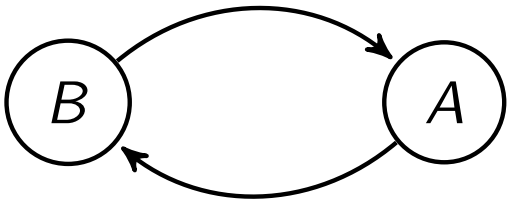


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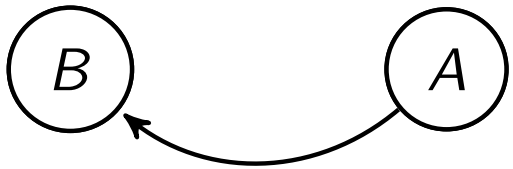


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Approach 2: Attacks to preferred arguments are inverted.

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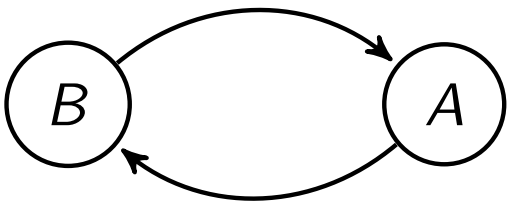


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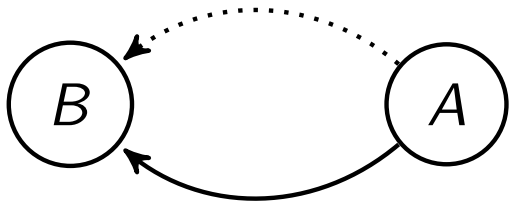


Complete: $\{\{A\}\}$

# Approach 4: Filter Extensions

Consider $AF = (\{A, B\}, \{(B, A), (B, A)\})$ (below) and suppose $A > B$

Approach 4: Select what extensions of $AF$ respect the preferences

- Wakaki, 2015

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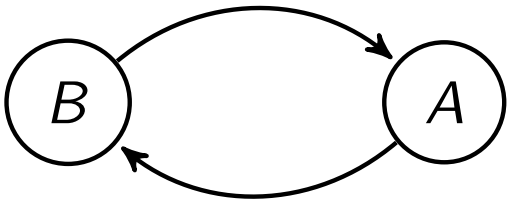


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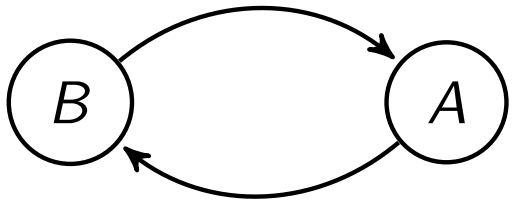


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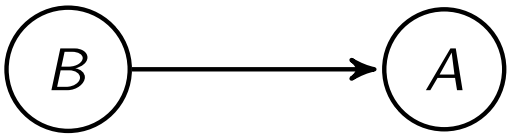


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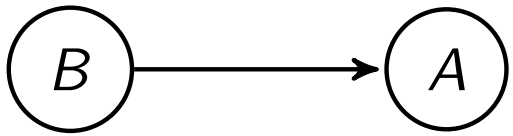


Complete: $\{\ \}$

# In Sum...

Changing the framework may break some things

- conflicting extensions may become admissible
- unattacked arguments may be defeated
- some semantics that are generally warranted may collapse

We are interested in the preservation of semantic properties.

In particular, we will be looking for relations between the original sets of extensions and the resulting sets of extensions.

# Our Work...

We focus on Amgoud and Vesic 2011

- A *PAF* is a tuple $(\mathtt{Ar}, att, \geq)$
- A semantic is characterized by a *dominance relation* $\succeq$ on $2^{\mathtt{Ar}}$
  - Extensions are the *maximal* elements of $(2^{\mathtt{Ar}}, \succeq)$
  - Defined *pref-grounded*, *pref-stable*, *pref-preferred*
- The pref-semantics *generalizes* a Dung AF-semantics if a "preferences-attacks agreement" preserves extensions

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Important notes

- The preferences "agree" with attacks if $A > B$ implies $(B, A) \notin att$
- $\succeq$ must satisfy some consistency postulates (conflict-freeness, conditional priorities between preferences and attacks)

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Our contributions (1/2)

- We characterized the *pref-complete* semantics $\succeq_c$

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## Definition (Pref-complete semantics)

Let $\mathfrak{T} = (\mathtt{Ar}, att, \geq)$ be a *PAF* and $\mathtt{E}, \mathtt{E}' \subseteq \mathtt{Ar}$. It holds that $\mathtt{E} \succeq_c \mathtt{E}'$ iff

- $\mathtt{E} \in \mathtt{CF}(\mathfrak{T})$ and $\mathtt{E}' \notin \mathtt{CF}(\mathfrak{T})$ or
- $\mathtt{E}, \mathtt{E}' \in \mathtt{CF}(\mathfrak{T})$ and $\mathtt{E} \subseteq \{a \in \mathtt{Ar} \mid d(a, \mathtt{E}, \mathtt{E}')\}$ and if $\mathtt{E} \subseteq \mathtt{E}'$, then $(\{a \in \mathtt{Ar} \mid d(a, \mathtt{E}, \mathtt{Ar})\} - \mathtt{E}) \subseteq (\{a \in \mathtt{Ar} \mid d(a, \mathtt{E}', \mathtt{Ar})\} - \mathtt{E}')$.

# Our Work...

We focus on Amgoud and Vesic 2011

- A *PAF* is a tuple $(\mathtt{Ar}, att, \geq)$
- A semantic is characterized by a *dominance relation* $\succeq$ on $2^{\mathtt{Ar}}$
  - Extensions are the *maximal* elements of $(2^{\mathtt{Ar}}, \succeq)$
  - Defined *pref-grounded*, *pref-stable*, *pref-preferred*
- The pref-semantics *generalizes* a Dung AF-semantics if a "preferences-attacks agreement" preserves extensions

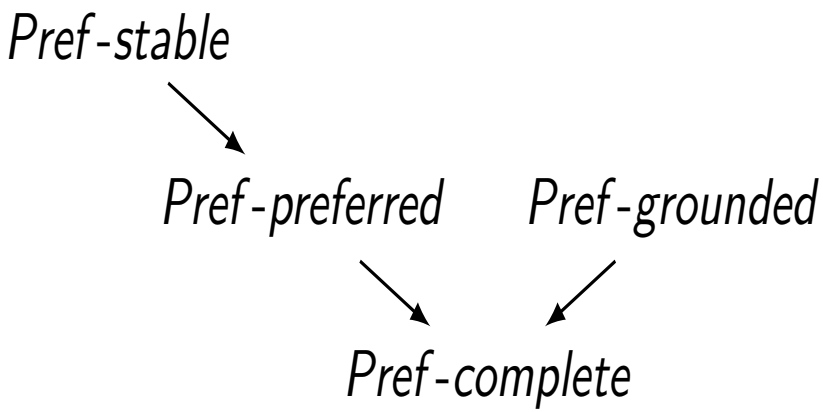
Our contributions (1/2)

- We characterized the *pref-complete* semantics $\succeq_c$
  - $\succeq_c$ satisfies the consistency postulates
  - extensions are instead given by *maximal upper bounds*
  - $\succeq_{c,\mathtt{ub}}$ generalizes Dung's complete semantics

# Our Work...

Our contributions (2/2)

- The original pref-semantics are particular cases of *pref-complete*, therefore establishing a central point towards semantics hierarchy
  - pref-grounded extension is the minimal pref-complete extension
  - pref-preferred extensions are the maximal pref-complete extensions
  - pref-stable extensions are the pref-complete extensions s.t. $\mathtt{E} \cup \mathtt{E}^{+} = \mathtt{A}r$



# Conclusion

- The literature is rich, but it lacks consensus on a standard approach.
- We contribute showing the preferential semantics of Amgoud and Vesic retain the usual hierarchy based on complete semantics

# References


Approach 1 (Attack Removal)

- Leila Amgoud and Claudette Cayrol. A reasoning model based on the production of acceptable arguments. Annals of Mathematics and Artificial Intelligence, 34(1-3):197215, 2002.
- Trevor JM Bench-Capon. Persuasion in practical argument using value-based argumentation frame-works. Journal of Logic and Computation, 13(3):429448, 2003.
- Sanjay Modgil. Reasoning about preferences in argumentation frameworks. Artificial intelligence, 173(9-10):901934, 2009.

Approach 2 (Reverse Attacks)

- Leila Amgoud and Srdjan Vesic. Repairing preference-based argumentation frameworks. In Proceed-ings of the 21st International Joint Conference on Artifical Intelligence, IJCAI09, page 665670, SanFrancisco, CA, USA, 2009. Morgan Kaufmann Publishers Inc.
- Leila Amgoud and Srdjan Vesic. A new approach for preference-based argumentation frameworks.Annals of Mathematics and Artificial Intelligence, 63(2):149183, 2011.

# References


Approach 3 (Conditional Inversion)

- Sanjay Modgil and Henry Prakken. A general account of argumentation with preferences.ArtificialIntelligence, 195:361397, 2013.
- Souhila Kaci, Leendert van der Torre, and Serena Villata. Preference in abstract argumentation. In7th International Conference on Computational Models of Argument (COMMA), volume 305, pages405412. IOS Press, 2018.

Approach 4 (Filter Extensions)

- Toshiko Wakaki. Preference-based argumentation built from prioritized logic programming. Journal of Logic and Computation, 25(2):251301, 2015.