Relations between Syntax and Semantics

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Preliminary Properties

An argumentation semantics σ is called

1. basic, if it accepts some argument(s) for some AFs;
2. language independent, if the names of arguments do not matter;
3. component independent, if for any AFs F, G that do not share any arguments we have $\sigma(F \cup G) = \{S \cup T \mid S \in \sigma(F), T \in \sigma(G)\}$;
4. fair, if it is basic, language independent and component independent.

Collapse and Perfection

- **Definition**: A semantics σ is said to collapse for some AF F if $\sigma(F) = \emptyset$.
- **Lemma**: For fair argumentation semantics the notions of crash, interference, contaminating AFs and collapse are equivalent.
- **Definition**: AFs that never collapse for any induced sub-AFs and semantics σ are called σ-perfect.

Syntax and Semantics

Relations between intution and formal knowledge are moody deities.

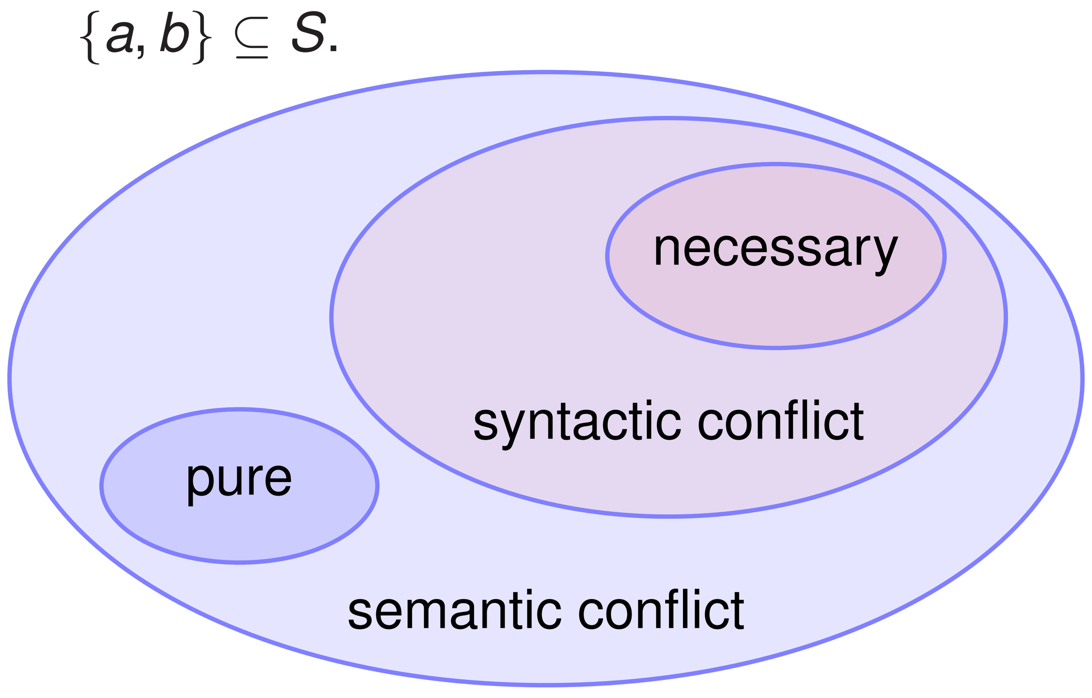
I spent the last couple of years acquiring intuitive knowledge in abstract argumention – main purpose: giving proofs or counter-examples for syntactic and semantic assumptions.

My works on conflict and perfection have to be seen as first attempts in making this intuitive knowledge formally available for a wider audience.

Syntactic/Semantic Conflicts

Given AF $F = (A, R)$, semantics σ, extension set $\mathbb{S} = \sigma(F)$ a pair (a, b) with $a, b \in A$ is called

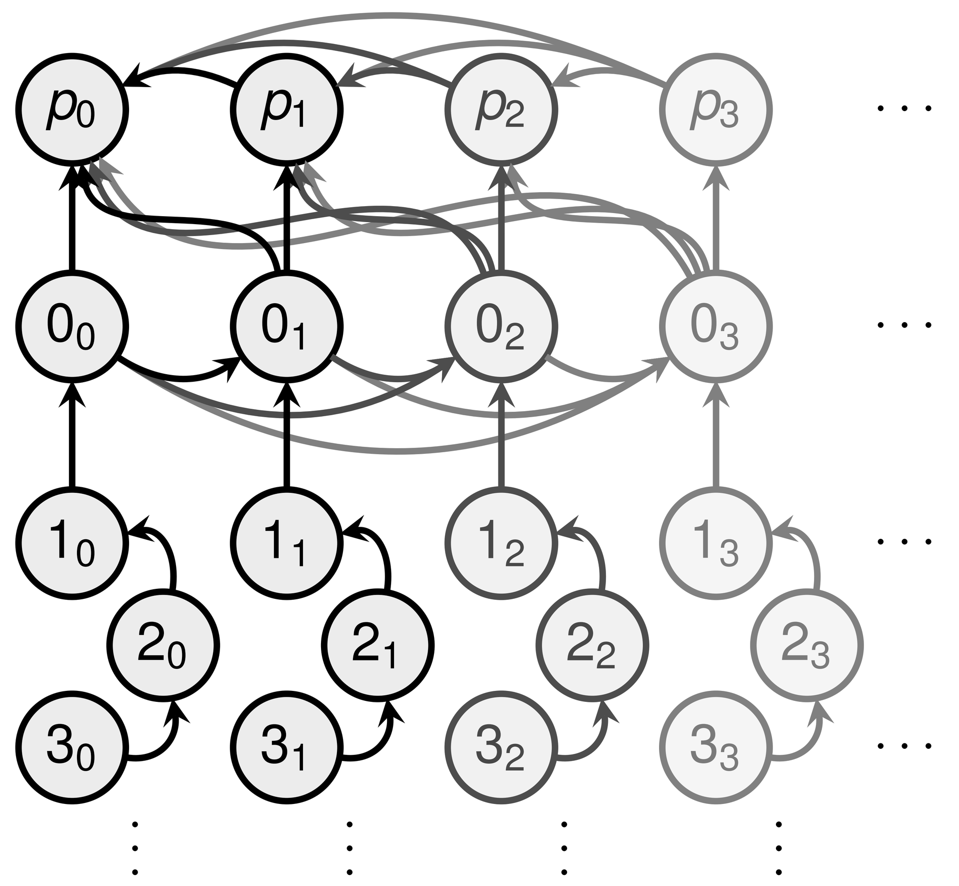
- a syntactic conflict $[a, b]_F$, if $\{(a, b), (b, a)\} \cap R \neq \emptyset$;
- a semantic conflict $[a, b]_{\mathbb{S}}$, if there is no $S \in \mathbb{S}$ with $a, b \in S$;
- compatible $\{a, b\}_{\mathbb{S}}$, if there is $S \in \mathbb{S}$ with $\{a, b\} \subseteq S$.



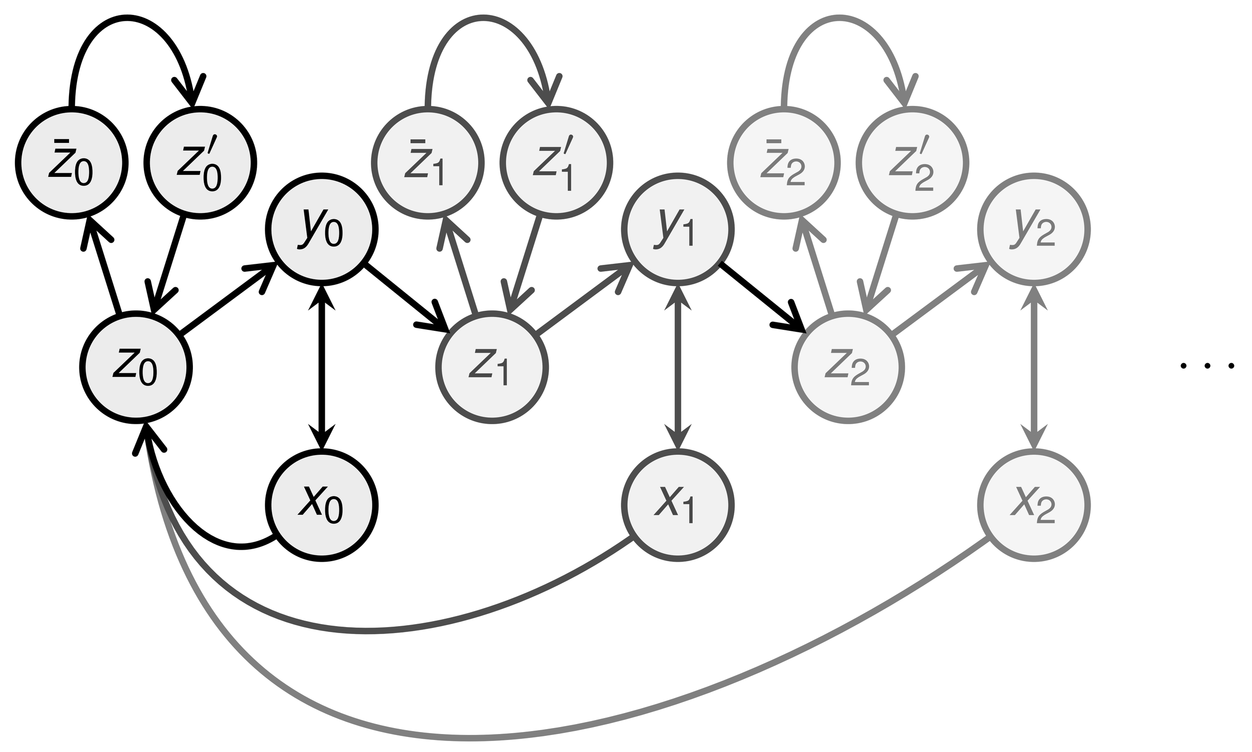
Given σ-realizable extension set $\mathbb{S}$ and semantic conflict $[a, b]_{\mathbb{S}}$, the conflict is called

- necessary syntactic, if every realization F ($\sigma(F) = \mathbb{S}$) has $[a, b]_F$;
- pure semantic, if no realization F has $[a, b]_F$;
- a necessary attack, if for every realization F we have $(a, b)_F$.

Examples of Collapse



A cycle-free AF without stage, semi-stable or stable extensions.



Loop-free planar AF with all (but one) finitary arguments and no semi-stable extension.

Theorem: Stage-Perfection

Given AFs $F \subset^1 G$ where G results from F by addition of a single argument and arbitrary attacks from or to this argument.

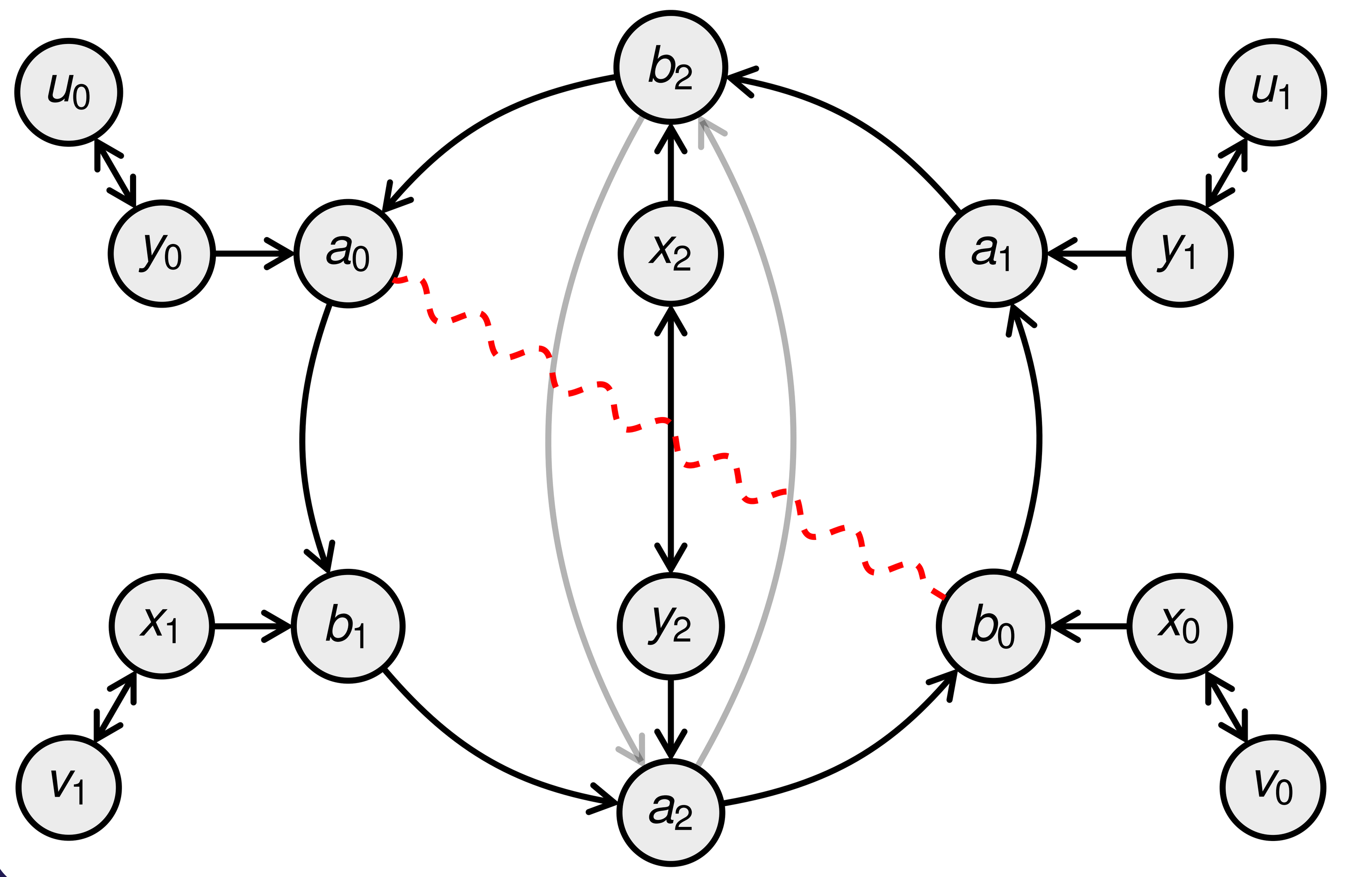
$F = (A_F, R_F)$
$G = (A_G, R_G)$
$A_F \subset A_G, R_F \subset R_G$
$|A_F| + 1 = |A_G|$
$R_G \cap (A_F \times A_F) = R_F$

If F is stage-perfect, then so is G.

Follow-Up: Stage-Perfection

- AFs where all but finitely many arguments have only finitely many attackers are stage-perfect.
- Symmetric AFs with finitely many self-attacking arguments are stage and semi-stable-perfect.
- Planar AFs are stage-perfect (Conjecture).

A-purity



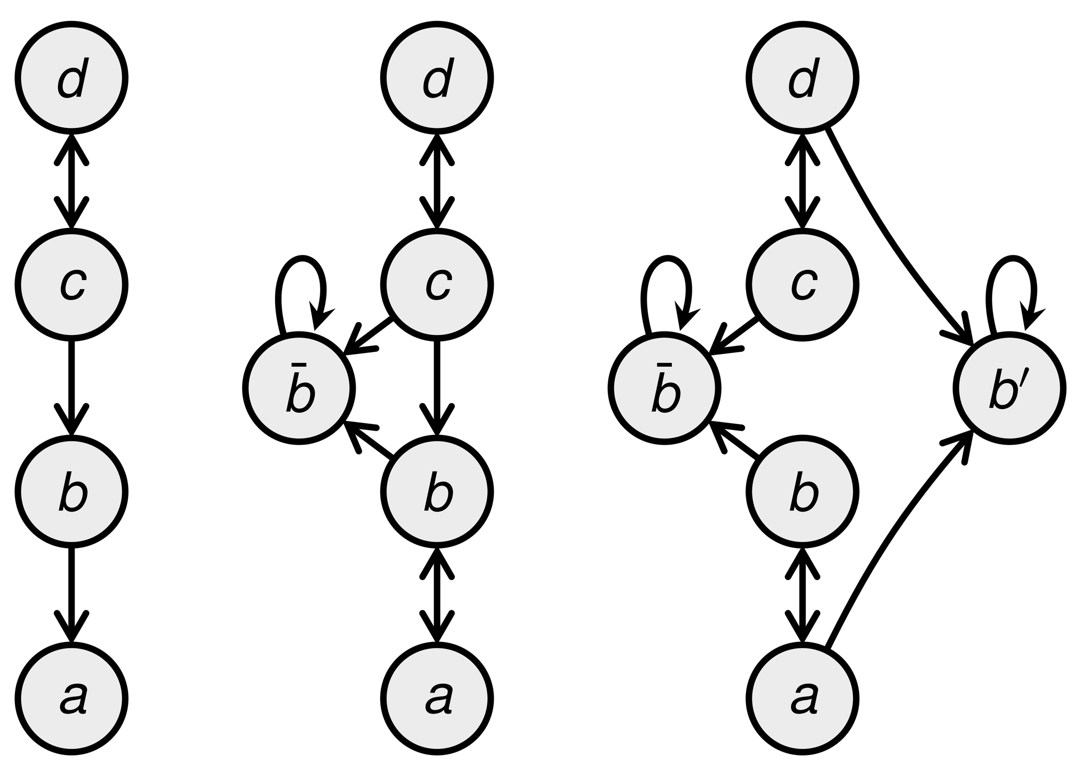
Given AF $F = (A, R)$ and semantics σ, a semantic conflict $[a_0, b_0]_{\sigma(F)}$ is called A-pure if there is no AF $G = (A, S)$ with $\sigma(F) = \sigma(G)$ and syntactic conflict $[a_0, b_0]_G$.

The conflict $[a_0, b_0]$ to the left is A-pure for admissible, complete, preferred, semi-stable, stable, stage, cf2, stage2 semantics.

Theorem: Necessary Attacks

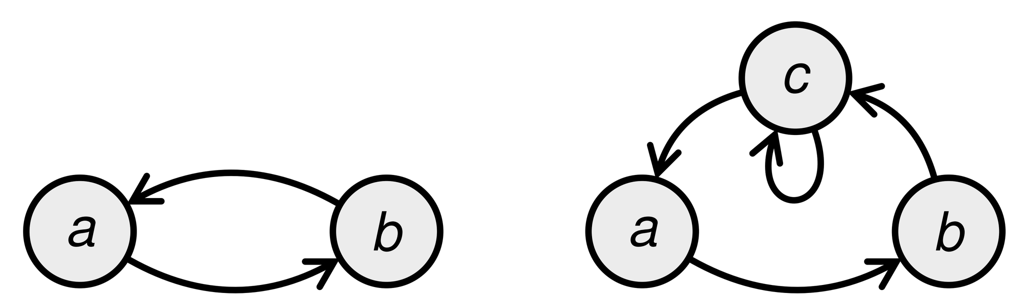
Given σ-realizable extension set $\mathbb{S}$ and conflict $[a, b]_{\mathbb{S}}$, the conflict is a necessary attack iff,

- for σ = *stable*, there is $a \in S \in \mathbb{S}$ such that $S \setminus \{a\}$ is compatible with b;
- for $\sigma \in \{$ *preferred*, *semi-stable* $\}$, there are $S, T \in \mathbb{S}$ with $a \in S, b \in T$ and compatibilities $S \setminus \{a\}, b$ as well as $T \setminus \{b\}, a$.



For stable from left to right: original AF, enforcing of (a, b), and purging of (c, b).

Necessary Stage Conflicts



Stage has the same necessary conflicts as stable, but no necessity of direction (=attacks).

References

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[3] Phan Minh Dung. On the acceptability of arguments and its fundamental role in nonmonotonic reasoning, logic programming and n-person games *Artif. Intell.*, 77(2):321–357, 1995.