Abstract Argumentation, Implicit Conflicts

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PGR workshop 2015

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External Supervisor: Stefan Woltran

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Outline

Research Interests: Abstract Argumentation

Intertranslatability questions

- transformations between frameworks for comparison of semantics

Existence and possibly infinite domains

- existence of preferred extensions as AC of argumentation
- the case of finitary frameworks

Properties of Abstract Argumentation

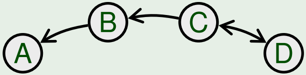
- (non)-analytic frameworks for selected semantics
- (non)-analytic extension sets for selected semantics

New Concepts of Argumentation

- meta-argumentation, arguing about arguments
- graded argumentation
- alternative notions of conflict

Motivation

Example (A first example)



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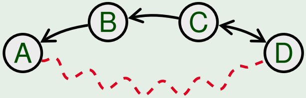

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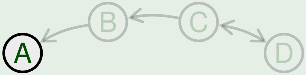

A Death penalty is legit.

Motivation

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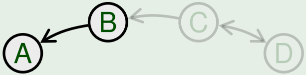

A Death penalty is legit.

B God does not want us to kill.

Motivation

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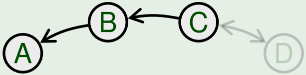

- A Death penalty is legit.
- B God does not want us to kill.
- C God does not exist.

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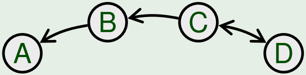

- A Death penalty is legit.
- B God does not want us to kill.
- C God does not exist.
- D Some people believe in God.

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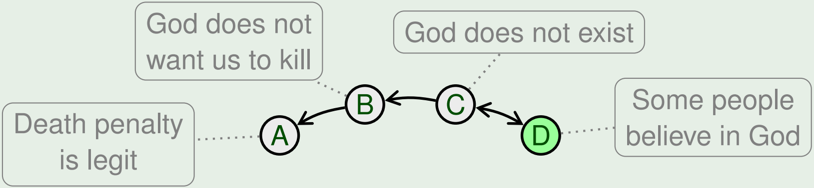

- D seems reasonable.

"Good" sets of arguments: ?

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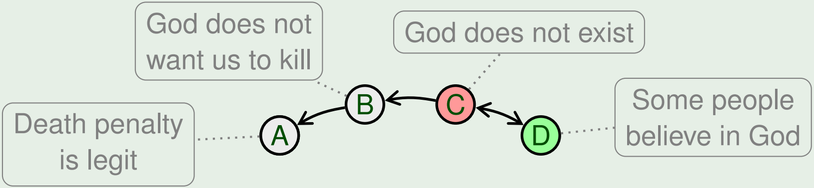

- D seems reasonable.
- But then C should be refuted.

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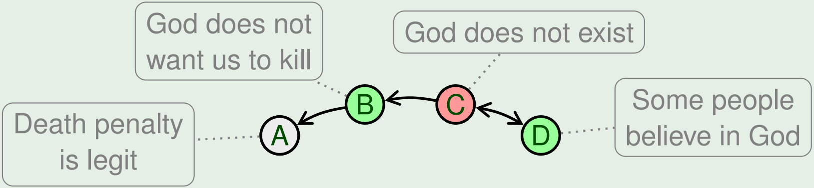

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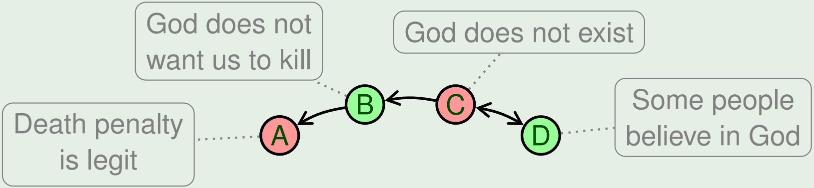

- D seems reasonable.
- But then C should be refuted.
- Then B seems reasonable.
- And A should be refuted.

"Good" sets of arguments: $\{B, D\}$

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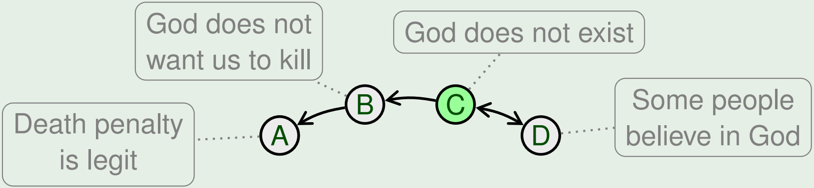

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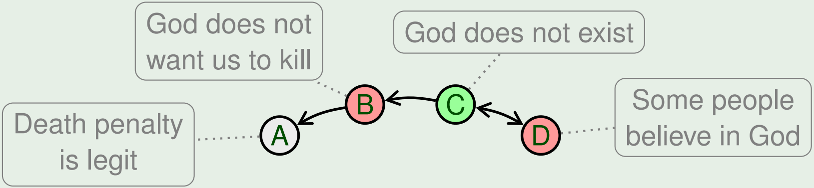

- C seems reasonable.
- But then B and D should be refuted.

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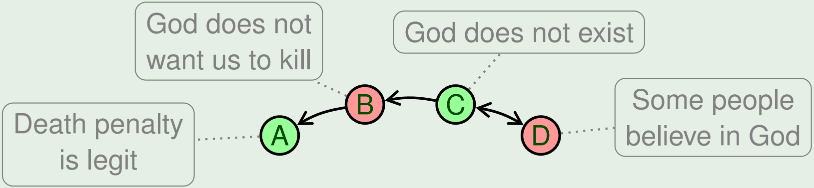

- C seems reasonable.
- But then B and D should be refuted.
- Now A seems like a good choice

"Good" sets of arguments: $\{B, D\}$, $\{A, C\}$

Motivation

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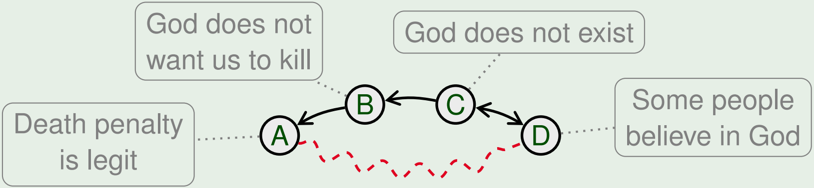

- A and D are implicitly in conflict.

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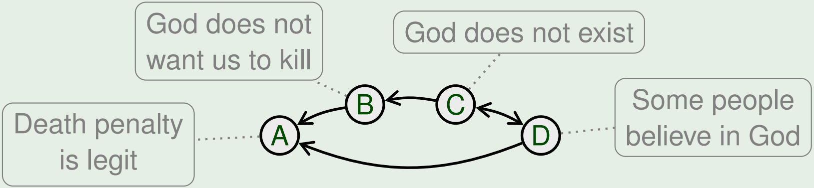

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- We can add an attack $D \rightarrowtail A$.

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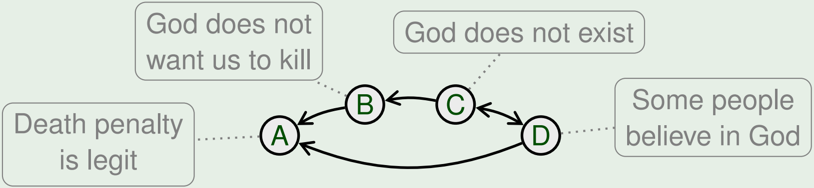

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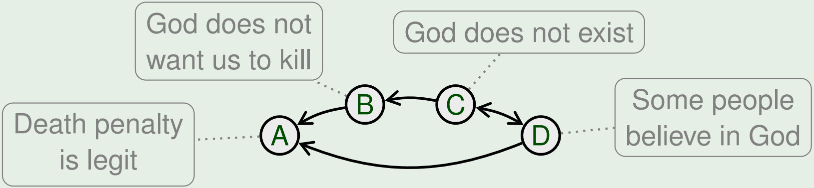


- A and D are implicitly in conflict.
- We can add an attack $D \rightarrowtail A$.
- Are syntactical transformations a semantical problem? ...
- **Can we get rid of any implicit conflicts?**

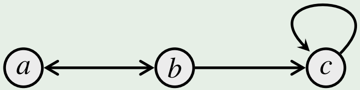
"Good" sets of arguments: $\{B, D\}$, $\{A, C\}$

Abstract Argumentation I

Definition (Argumentation Frameworks)

- An *argumentation framework (AF)* is a pair $F = (A, R)$.
- A is an arbitrary set of *arguments*.
- $R \subseteq (A \times A)$ is the attack relation.

Example



$F = (A, R)$ $\quad$ $A = \{a, b, c\}$ $\quad$ $R = \{(a, b), (b, a), (b, c), (c, c)\}$

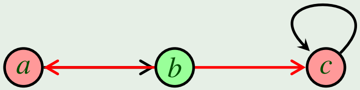
Abstract Argumentation II

Definition (Argumentation Semantics)

An *argumentation semantics* σ is a mapping.

- For $F = (A, R)$ we have $\sigma(F) \subseteq 2^A$;
- $E \in \sigma(F)$ is a σ-*extension*;
- $E \subseteq A$ is *conflict-free* ($cf(F)$) if $a, b \in E \implies (a, b) \notin R$;
- $E \in cf(F)$ is a *stable* extension if E attacks every outside argument:

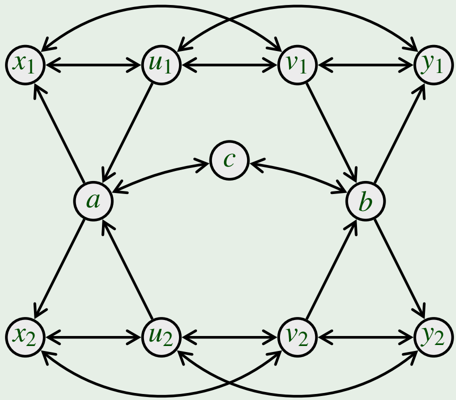
Example



$$stb(F) = \{\{b\}\}$$

AF with some stable extension

Example



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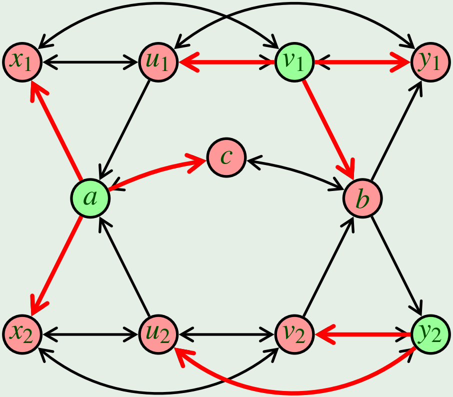

Outline

Implicit Conflicts, Formal Definition

Definition

Given AF $F = (A, R_F)$, semantics σ and arguments $a, b \in A$

- a and b are in *conflict* $\left|{a \atop b}\right|$ if $a \in S \in \sigma(F) \implies b \notin S$;

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- F is *analytic* if all conflicts are explicit;

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- F is *quasi-analytic* if there is some analytic AF $G = (A, R_G)$ with $\sigma(F) = \sigma(G)$;

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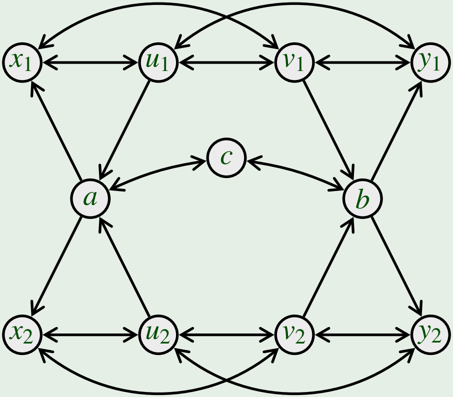
Conjecture (ECC)

For stable semantics every AF is quasi-analytic. [Baumann et al., 2014]
For any AF F there is an AF G without implicit conflicts but with the same arguments and same stable extensions.

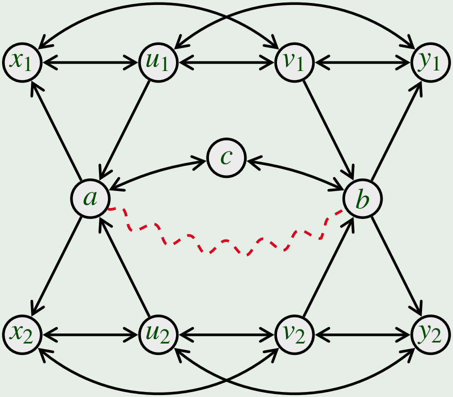
Some AF, consider stable semantics and ECC

Example



Some non-analytic AF for stable semantics

Example



Classes of AFs

Definition

An AF $F = (A, R)$ is called

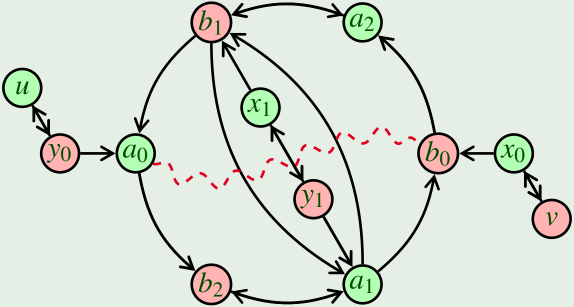
- *bipartite* if $A = B \cup C$, $B \cap C = \emptyset$ and $(x, y) \in R \implies (x \in B, y \in C)$ or $(y \in B, x \in C)$;
- *odd-cycle-free* if every cycle in F is of even length;
- *planar* if it can be drawn on a plane without crossing attacks.

Question

Does ECC at least hold for planar, bipartite, odd-cycle-free AFs?

Bipolar wheel of implicit conflict

Example



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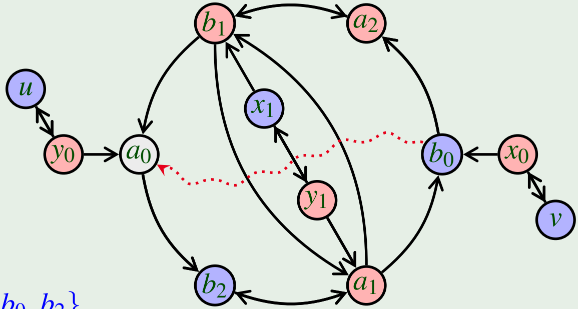

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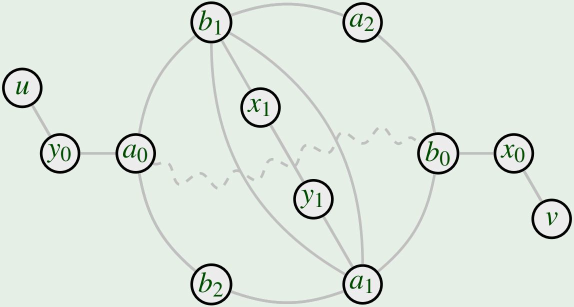

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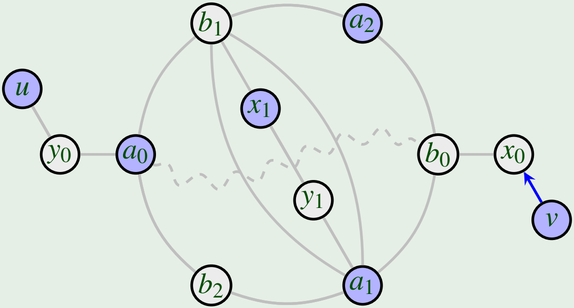

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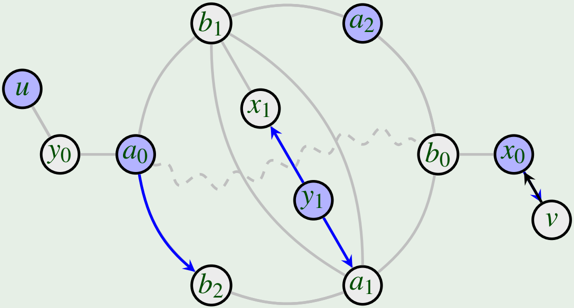

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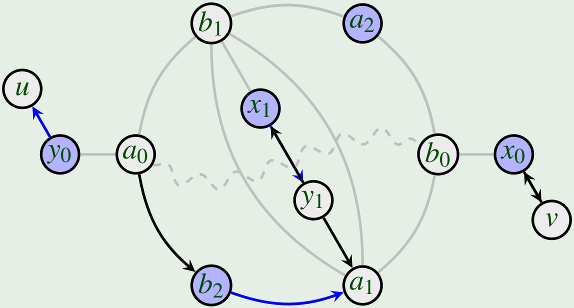

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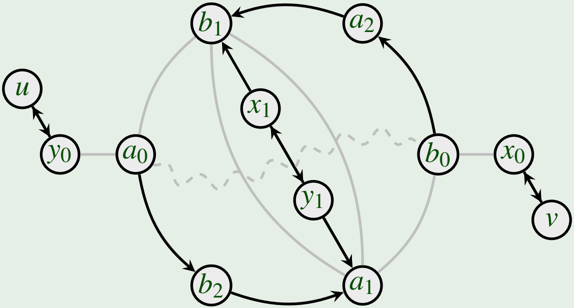

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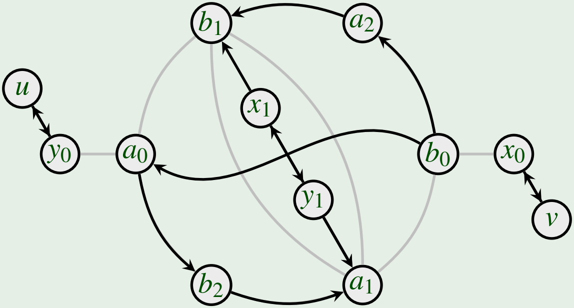

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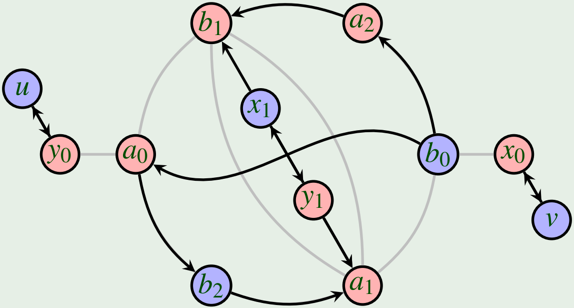

Wlog. assume $(b_0, a_0) \in G_R$.
What about $\{u, v, x_1, b_0, b_2\}$ now? Should not be an extension...

Outline

Summary

	naive	stable	pref	semi	stage	cf2
ECC holds	yup	nope	nope	nope	nope	nope
ECC holds in planar AFs	yup	nope	nope	nope	nope	nope
ECC holds in bip AFs	yup	nope	nope	nope	?	?
ECC holds in ocf AFs	yup	nope	nope	nope	?	?

Remark

Also some semantical AF classes where ECC holds have been identified, e.g. identifying arguments, extension-equality with naive semantics.

Future Work

Question

What about ECC in other classes of AFs, e.g. symmetric AFs? Is there a nice characterization of analytic AFs?

Question

What about ECC with other notions of conflict? E.g. rejected arguments could be seen as 1*-conflicting sets, while conflicts in this discussion could be seen as* 2*-conflicting sets.*

Question

What properties of sub-AFs guarentee ECC? In the case of infinite AFs does it suffice for every finite sub-AFs to be ECC?

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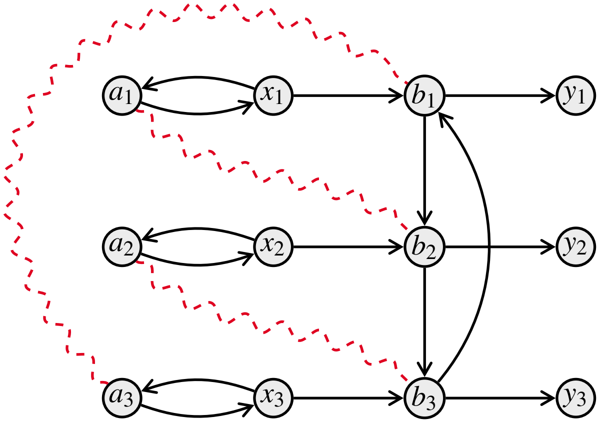
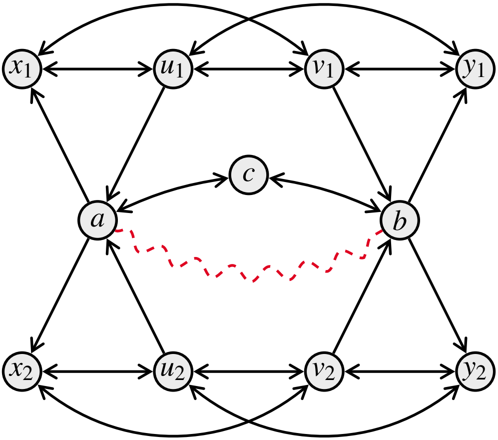
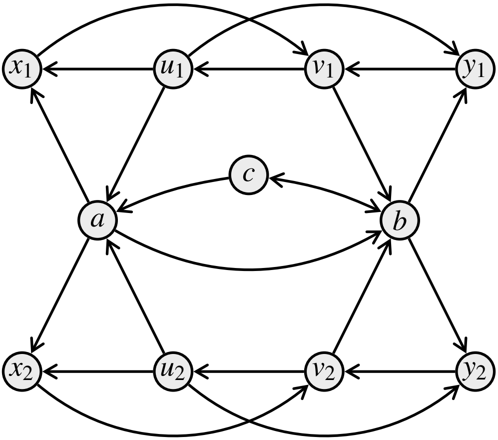
Non-analytic AF for preferred semantics



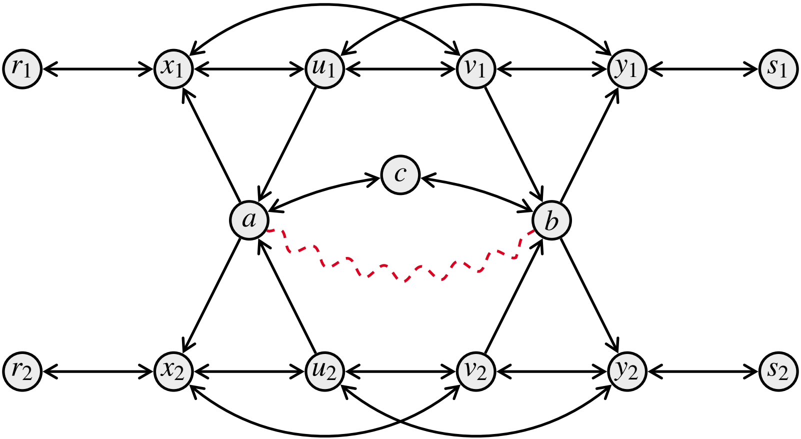
Non-analytic AF for stable semantics



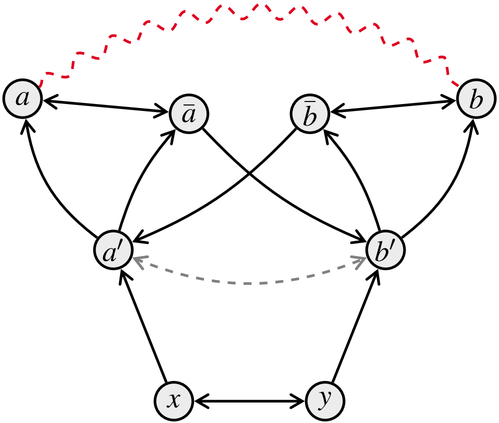
Analytic AF for stage semantics



Non-analytic AF for stage semantics



Non-analytic AF for cf2 semantics



Bipolar Bug of Implicit Conflict