Abstract Argumentation, Implicit Conflicts

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Abstract

Abstract argumentation is all about the art of dealing with arguments and directed attacks between arguments. The justification status of sets of arguments is defined via several well established principles, called semantics. Traditionally attacks are also called conflicts. However, as it turns out non-trivial semantics provide an implicit concept of conflict that does not coincide with and can not be expressed through attacks. This work is all about the why and how of implicit conflicts.

Abstract Argumentation

An Argumentation Framework (AF) is an ordered pair $F = (X, A)$ where X is a set of arguments and $A \subseteq X \times X$ represents the attack relation. For $x, y \in X$ and $(x, y) \in A$ we say that x attacks y in F and write $x \rightarrowtail_F y$.
For $x \in X$ and $Y \subseteq X$ we say that $x \rightarrowtail_F Y$ (or $Y \rightarrowtail_F x$) if there is some $y \in Y$ such that $x \rightarrowtail_F y$ (or $y \rightarrowtail_F x$), analogue for $Y, Z \subseteq X$ and $Y \rightarrowtail_F Z$. For $Y \subseteq X$ we call $Y_F^+ = Y \cup \{x \in X \mid Y \rightarrowtail_F x\}$ the range of Y in F.
If the referred to AF F is obvious from context we might drop the subscript F in above definitions.

Argumentation Semantics

A semantics σ is a mapping assigning to each AF $F = (X, A)$ a collection of reasonable sets of arguments $\sigma(F) \subseteq \mathcal{P}(X)$, the set of σ-extensions of F. The intention being that for $S \in \sigma(F)$ we have that S represents a collection of arguments justified by some desired principles.
As basic principles we use conflict-freeness and self-defense or admissibility (*cf* and *adm*); further maximality (*naive* and *prf*, resp.), range-maximality (*stage* and *sem*, resp.), absoluteness (*stb*), and directionality (*cf2*).

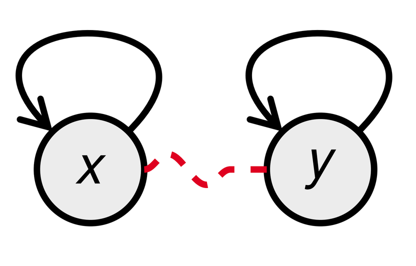
For $S \subseteq X$ we define:

$$S \in cf(F) \quad \text{if} \quad x, y \in S \Rightarrow x \not\rightarrowtail y$$
$$adm(F) \subseteq cf(F),$$
$$S \in adm(F) \quad \text{if} \quad x \rightarrowtail S \Rightarrow S \rightarrowtail x$$

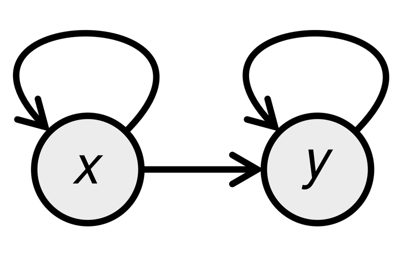
Implicit and Explicit Conflicts

Given some AF $F = (X, A)$, semantics σ and arguments $x, y \in X$. If for any $S \in \sigma(F)$, $x \in S$ implies $y \notin S$, If there is no $S \in \sigma(F)$ with $x, y \in S$, we say that x and y are in conflict in F for σ. If $(x, y) \in A$ or $(y, x) \in A$ we say that the conflict $\{x, y\}$ is explicit, otherwise the conflict is called implicit.
An AF $F = (X, A)$ is called analytic for σ if all conflicts of $\sigma(F)$ are explicit in F. F is called quasi-analytic if there is an analytic AF $G = (X, A_G)$ such that $\sigma(F) = \sigma(G)$. Finally F is called non-analytic if it is not quasi-analytic.

Quasi-Analytic, Analytic AFs

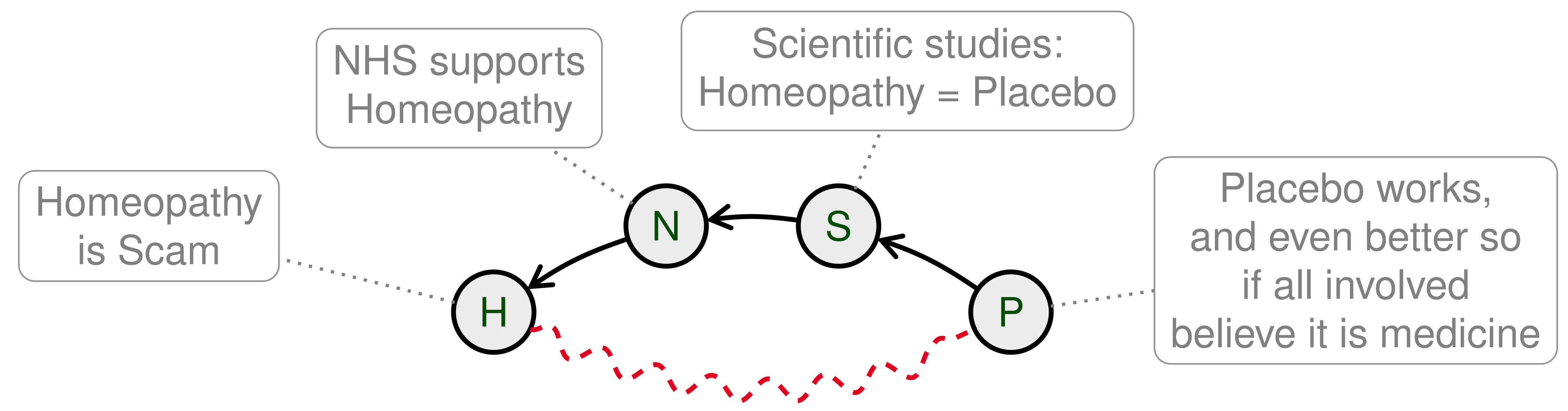


quasi-analytic AF



analytic AF

Natural Language Example, Pro and Contra of Homeopathy



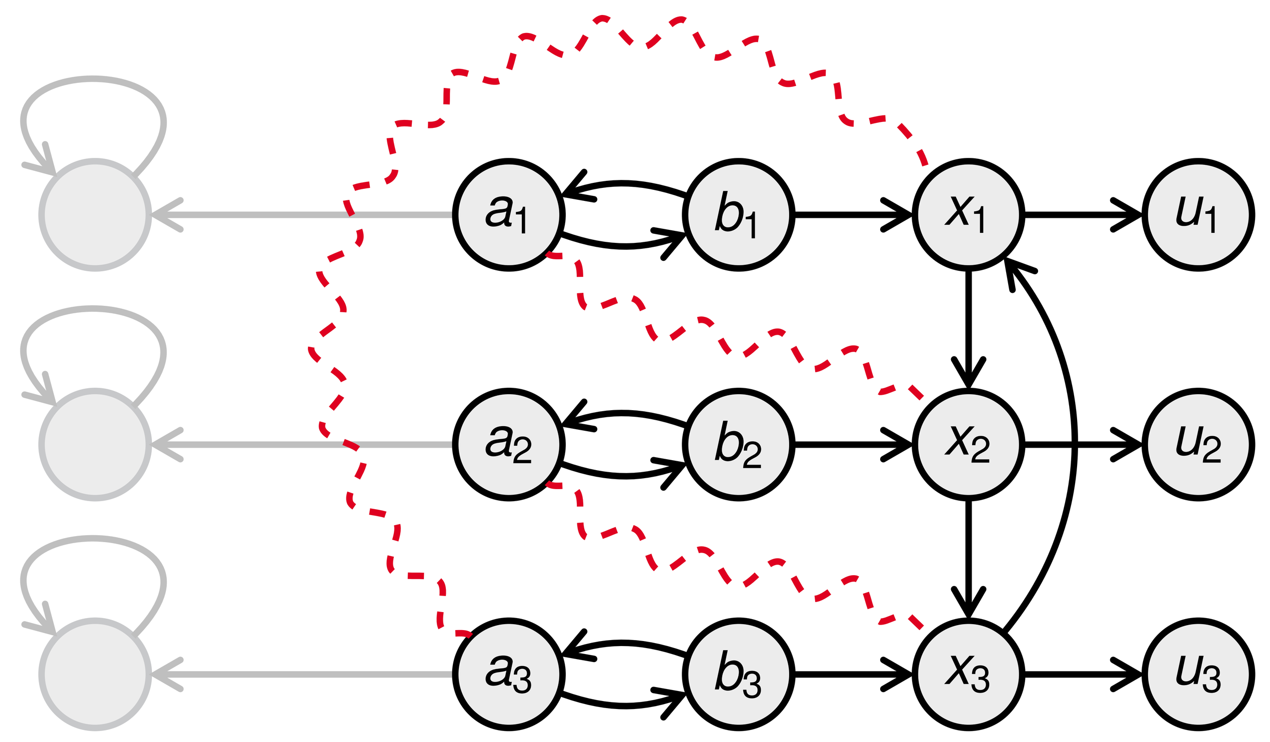
Observe that homeopathy might still be scam regardless of whether placebo works or not.

Preferred and Semi-stable Semantics allow non-analytic AFs

For $S, T \in adm(F)$ we define:

$$S \in prf(F) \quad \text{if} \quad S \subseteq T \Rightarrow S = T$$
$$S \in sem(F) \quad \text{if} \quad S^+ \subseteq T^+ \Rightarrow S^+ = T^+$$

Here $prf(F) = sem(F) = \{\{a_1, a_2, a_3\}, \{a_i, b_{\neq i}, x_i, u_{\neq i}\}, \{a_{\neq i}, b_i, x_{i+1}, u_{\neq i+1}\}\}$. The implicit conflicts $\{a_i, x_{i+1}\}$ can not be made explicit. Observe that $\{a_1, a_2, a_3\} \notin sem(F)$ and for *sem* indeed F is quasi-analytic.

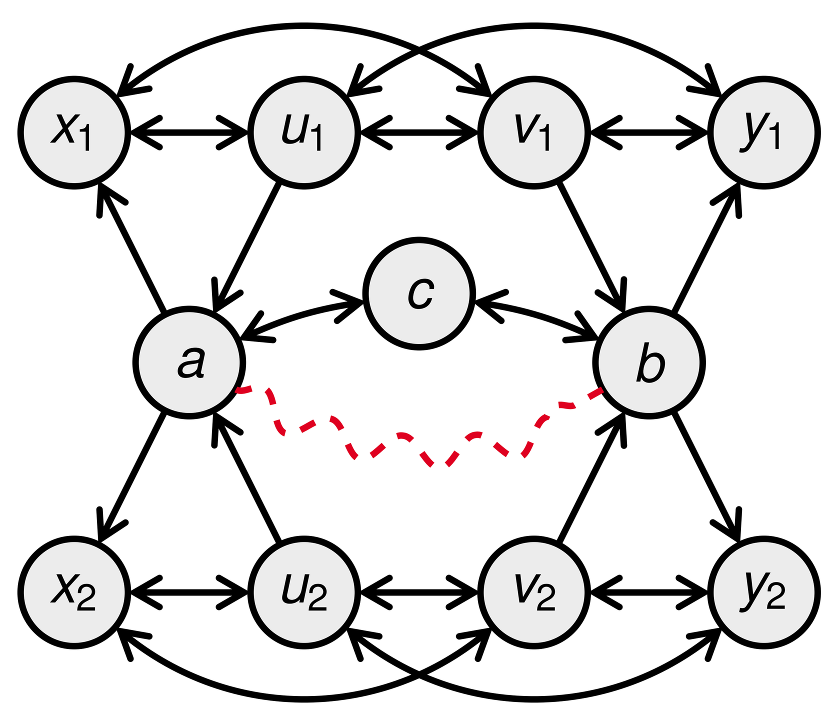


Stable Semantics allows non-analytic AFs

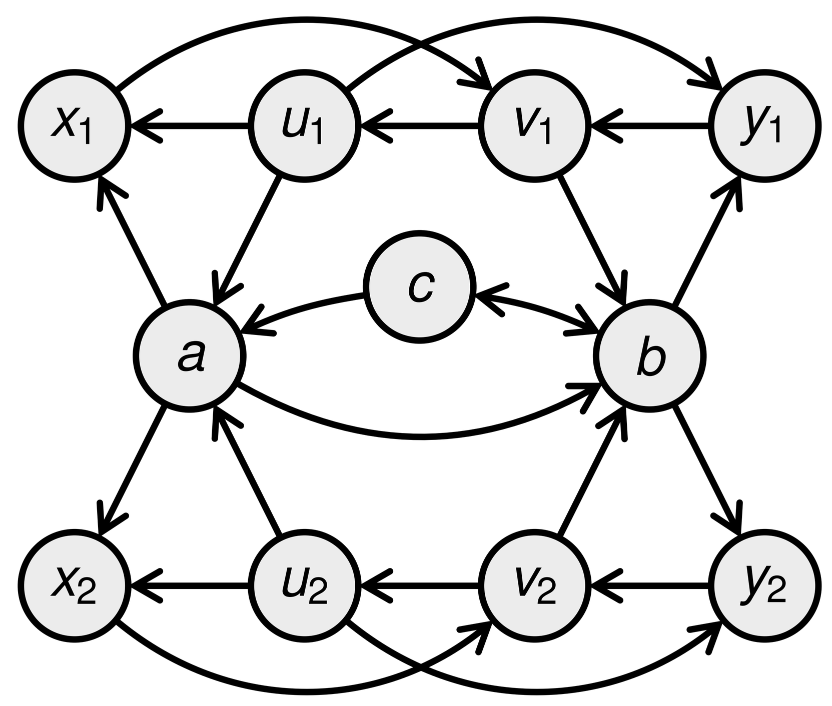
For $S, T \in cf(F)$ we define:

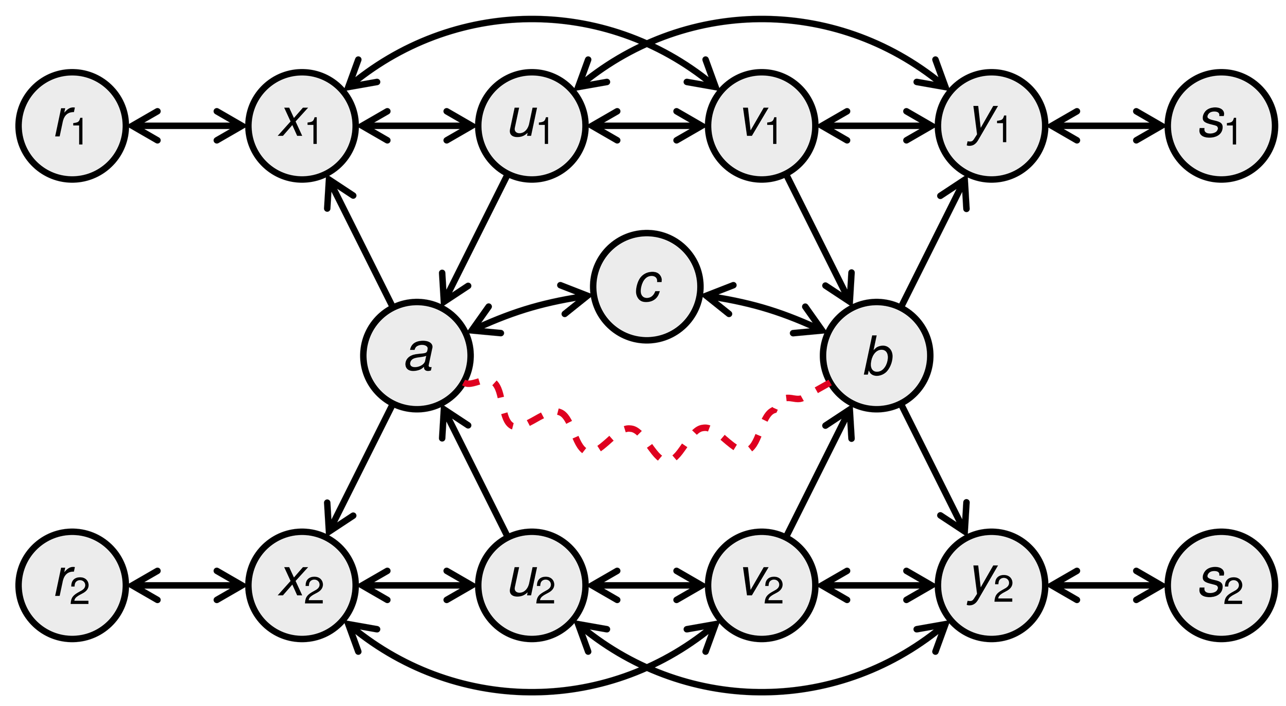
$$S \in stage(F) \quad \text{if} \quad S^+ \subseteq T^+ \Rightarrow S = T$$
$$S \in stb(F) \quad \text{if} \quad S^+ = X$$

Here one of the *cf* sets $\{a, y_1, y_2\}$ and $\{b, x_1, x_2\}$ becomes a stable extension as soon as the conflict $\{a, b\}$ becomes explicit. It can be shown that AFs that are quasi-analytic for *prf* or *sem* where $stb = prf$ or $stb = sem$ are also quasi-analytic for *stb*. Thus this AF serves as a witness also for *prf* and *sem*.



The case with Stage Semantics

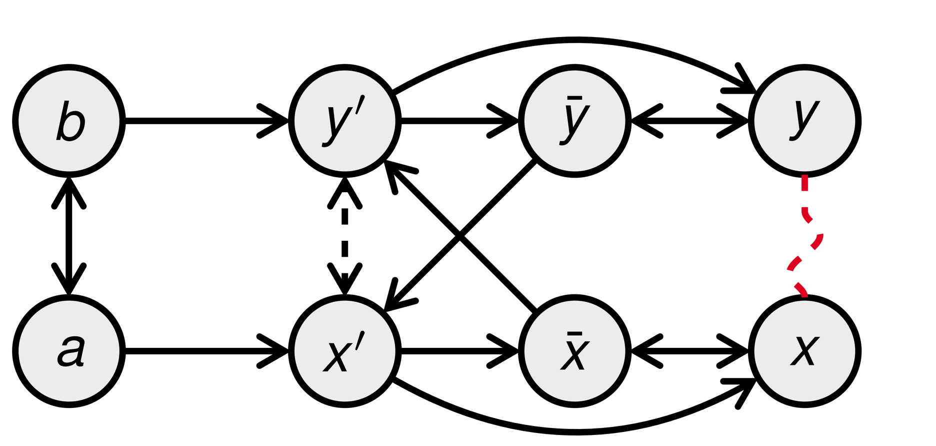




A Glimpse of CF2 Semantics

For $S, T \in cf(F)$ we define:

$$S \in naive(F) \quad \text{if} \quad S \subseteq T \Rightarrow S = T$$
$$cf2(F) \subseteq naive(F)$$
$$S \in cf2(F) \quad \text{if}$$
$$Y \overset{\rightarrow}{\not\leftarrow} Z, X = Y \oplus Z \Rightarrow S \cap Y \in cf2(F|_Y)$$



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