

Refining concepts of attack

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In Dung's Framework

- Attacks always succeed
- An argument can be defended only by attacking its attackers
- This is reasonable for questions of belief
 - We are seeking certainty
 - We cannot *choose* what is true

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But This is not Appropriate For all Uses of Argument

- Sometimes we do have a choice
- So personal preference, temperament and context may lead us to ignore an attack
- Typical in
 - Practical reasoning
 - Politics
 - Law, etc

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Augmented Frameworks I

- Over the past decade there have been a wide range of proposals for addressing these issues –
 - Preference-based AFs* (PAF) (Amgoud & Cayrol)
 - Value-based AFs* (VAF) (Bench-Capon)
 - Extended AFs* (EAF) (Modgil)
 - AFs with recursive attacks* (AFRA) (Baroni et al.)
 - Weighted argument systems* (WAS) (Dunne et al.)
 - Variable-strength attacks* (AFV) (Simari et al.)
 - Bipolar frameworks* (BAF) (Cayrol et al.)
- and so on

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Augmented Frameworks II

- We examine some of these over the next section of this tutorial.
- Despite the range of formalisms, we first observe that these can be treated in a “*uniform*” manner: each starts from the basic AF structure $\langle X, A \rangle$ and augments this using some additional structure (T).
- The differences between the formalisms derives from the exact structure of T and how it determines appropriate semantics relative to $\langle X, A \rangle$.

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Augmented Frameworks III

- PAF – $T \subseteq X \times X$ defines a preorder relation on *arguments in attacks*.
- VAF – $T = \langle V, \eta \rangle$ with $V = \{v_1, v_2, \dots, v_k\}$ a set of *values* and $\eta : X \rightarrow V$
- EAF – $T \subseteq X \times A$ defines *attacks on attacks* by arguments.
- AFRA – $T \subseteq X^* \setminus \{\epsilon, X\}$ allowing already defined attacks to be attacked and *further attacks on these ...*
- WAS – $T : A \rightarrow \mathbb{R}^+$ defines a *weight* for each attack.
- AVF – $T = (P, \{\approx, ?, \gg, \ll\})$ with $P : A \rightarrow \{1, 2, \dots, k\}$ and each $p \in \{\approx, ?, \gg, \ll\}$ a binary relation over $\{1, 2, \dots, k\}$.

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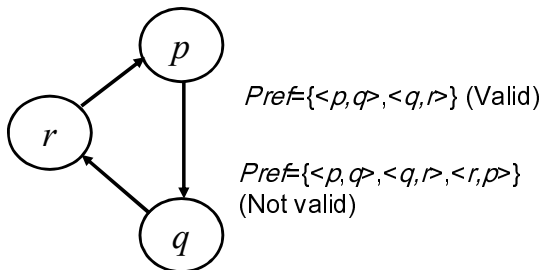
Preference-Based Frameworks

- Presented in Amgoud & Cayrol (AMAI, 34:197–215, 2002)
- Extend from $\langle X, A \rangle$ to $\langle X, A, Pref \rangle$
- $Pref \subseteq X \times X$ is a *preference relation*
- $\langle x, y \rangle \in Pref$ means
“*argument x is preferred to argument y*”
- Preference relations must be *transitive* defining an *ordering* i.e. without *cycles*.

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Example



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Conflict-free and admissible sets

- Adding preferences means that an attack by x on y may *sometimes fail* – to succeed $\langle y, x \rangle \notin Pref$ must hold.
- This leads to notion of *successful attack* of x on y as $\langle x, y \rangle \in A$ and $\langle y, x \rangle \notin Pref$
- So obtain new definition of *conflict-free* and *admissible sets*, S

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Problems

- Preference schemes are based on abstract relationship over *arguments*
- No assumptions of *where* preferences originate or *why* they may change.
- Each different preference relation must be seen “in isolation” even though there may be some underlying connections.

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Value-Based Frameworks I

- From Bench-Capon (JLC, 13:429–448, 2003)
 - Extend from $\langle X, A \rangle$ to $\langle X, A, V, \eta \rangle$
 - $V = \{v_1, \dots, v_j\}$ finite set of *values*
 - $\eta : X \rightarrow V$ maps arguments to values.
 - A VAF is instantiated w.r.t. to *audiences*
 - α - an ordering of V
- $v_i >_{\alpha} v_k$ – the *value* v_i is ranked above the *value* v_k by the audience α

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Value-Based Frameworks II

- One consistency condition: every cycle in $\langle X, A \rangle$ contains at least 2 distinctly valued arguments.
- Attacks succeed relative to *audiences*.
- Concept of “successful attack” by x on y is now: $\langle x, y \rangle \in A$ and it is not the case that $\eta(y) >_{\alpha} \eta(x)$

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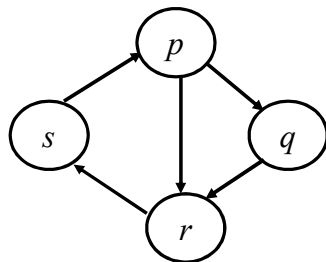
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Value-Based Frameworks III

- The attack $\langle x, y \rangle$ succeeds if
“the value promoted by y does not outrank the value promoted by x for the audience α .”
- The sub-graph of $H(X, A)$ that contains only successful attacks w.r.t. α has no cycles: unique, non-empty preferred extension $\equiv$ grounded extension.

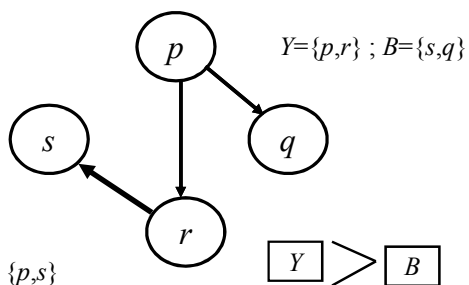
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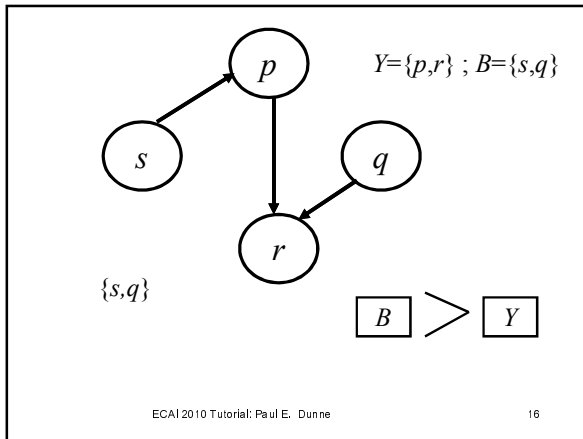
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Properties of audiences I

- Argument *values* do not change for different audiences
- The *ranking* of values does.
- An argument may be accepted by *every* audience (*Objective Acceptance*)
- or only by *some* audiences (*Subjective*)
- or by *no* audience (*Indefensible*)

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Properties of audiences II

- Deciding into which of these categories a given argument falls is “hard”.
- Deciding if a value ordering is *critical* is “even harder”.

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Extended Argumentation Frameworks I

- From Modgil (AIJ, 173:901–934, 2009)
- PAFs capture attacks that fail by explicitly indicating that “*x is preferred to y when y attacks x*”.
- VAFs capture failing attacks via “*x endorses a value of greater importance than that endorsed by y*”.
- These statements encapsulate “*arguments about attacks*”.

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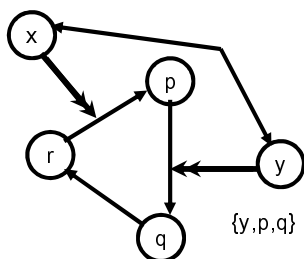
Extended Argumentation Frameworks II

- EAFs make this fact explicit within the augmented AF structure.
- An EAF is specified by $\langle X, A, D \rangle$ where $D \subseteq X \times A$ indicates attacks on attacks by arguments.
- One consistency condition: if $\langle p, \langle x, y \rangle \rangle$ and $\langle q, \langle y, x \rangle \rangle$ both in D then $\{\langle p, q \rangle, \langle q, p \rangle\} \subseteq A$.

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$\{x, p, r\}$ EAF admissible



$\{y, p, q\}$ EAF admissible

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EAF Semantics

- Although “*EAF conflict freeness*” is straightforward it turns out that acceptability of x w.r.t. S in $\langle X, A, D \rangle$ is rather more complicated than its counterpart in standard AFs.
- This is due to the fact that we need a suitable formalism when counterattacks $\langle z, y \rangle$ from z in S on attackers y of x are *themselves attacked* by elements, $\langle p, \langle z, y \rangle \rangle$ of D : p itself must be attacked (from within S) (but this counter could be *subject to attack in turn*).

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Reinstatement Sets I

- To deal with this, Modgil (2009) introduces the idea of a *reinstatement set for an attack* $\langle z, y \rangle$ w.r.t. S ($z \in S$).
- These are a subset, R , of attacks from A containing $\langle z, y \rangle$ and for which
$$\forall \langle p, q \rangle \in R, p \in S$$
$$\forall \langle p, q \rangle \in R \quad \forall \langle x, \langle p, q \rangle \rangle \in D \quad \exists \langle w, x \rangle \in R$$

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Reinstatement Sets II

- Using reinstatement sets, allows “ x is acceptable w.r.t. S ” (for conflict-free S) to be defined via
“for all attacks $\langle y, x \rangle$ there is some z in S with $\langle z, y \rangle$ in A and a *reinstatement set* for $\langle z, y \rangle$ w.r.t. S ”.
- This leads to natural analogues of the grounded extension, admissible, preferred and stable extensions within EAFs.

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Problematic aspects

- In AFs the *grounded extension* is contained in *every preferred extension*.
- This is *not* the case for EAFs.
- In AFs *every stable extension* is also a *preferred extension*.
- This is *not* the case for EAFs.
- We look at computational issues – algorithms & complexity – in the next section of the tutorial. These are recent work of (Dunne, Modgil & Bench-Capon, ECAI 2010).

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AFs with Recursive Attacks (AFRA) I

- Proposed in (Baroni, Cerutti, Giacomin, and Guida, ECSQARU, 2009).
- *EAFs* motivate concept that attacks may themselves be attacked.
- Argumentation is “*open-ended*”, in principle such attacks could be *attacked in turn*, and these attacks *attacked* and so on.
- *AFRAs* model “*recursive*” attack structures.

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AFs with Recursive Attacks (AFRA) II

- An AFRA is defined by $\langle X, A, R \rangle$ where R is a set of finite length sequences over X satisfying
 $A \subseteq R$ and
 $(z \cdot \alpha \in R \text{ with } |a| \geq 2) \Rightarrow \alpha \in R$
- It is convenient to present $\alpha \in A \cup R$ using the sequence of arguments defining it.
- For $\beta = z \cdot \alpha \in R$ we write $\text{src}(\beta) = z$ and $\text{trg}(\beta) = \alpha$

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AFRA Semantics

- Given as subsets of arguments *and* attacks (AuR).
- For $\alpha, \beta \in \text{XuAuR}$, α *attacks* β ($\alpha \rightarrow \beta$) if either:
 $\text{trg}(\alpha) = \beta$ or $\text{trg}(\alpha) = \text{src}(\beta)$
- In order for conflict to be present in S it is therefore required that S contains at least one member of AuR.
- AFRAs can be mapped directly to an AF whose arguments are XuAuR and with attack relation $\alpha \rightarrow \beta$.
- Hence, standard AF semantics can be translated directly to AFRA versions.

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AFRAs – Pros and Cons

- Pro: highly expressive, in principle, allowing very intricate attack structures to be described.
- Pro: intuitive semantics that map directly to standard AF form, e.g. analogue of reinstatement set not needed.
- Con: highly expressive, raising questions of representation (e.g. infinite structures on finite argument sets) and computation.

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Weighted argument systems (WAS) I

- A number of forms have been developed using the idea of assigning numerical weights to arguments and attacks, e.g. Barringer, Gabbay, Woods (2005).
- We consider that of Dunne, Hunter, McBurney, Parsons, and Wooldridge (AAMAS, 2009).
- Note also paper of Bistarella and Santini (ECAI 2010, Session 1E)

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Weighted argument systems (WAS) II

- Models the idea that “*some attacks are weaker than others*”.
- For example, “*evidence of subsidence*” is a “*stronger*” attack on an argument for buying a house than “*I don’t like the colour of the front door*”
- Use $\langle X, A, w \rangle$ where w associates (*positive*) real weights with each attack.

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Semantics of WAS

- Key notion is that of an “*inconsistency budget*” – a real value, K , indicating the maximum total weight of attacks that could be discounted within $\langle X, A, w \rangle$.
- Budget of $K=0$ reduces to standard AF.
- Non-zero budget induces a set of candidate AFs (the set of AFs produced by discarding attacks up to maximum allowed).
- Extension and admissibility semantics then correspond to the union of corresponding sets over all reduced AFs.
- Similar to resolution-based semantics but not limited to mutual attacks and without minimality requirement

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Properties

- Extensions are now qualified w.r.t. the budget specified.
- For grounded extension (and large enough budget), this leads to a *multiple-status semantics*.
- A subset, S , can *always* be made *admissible* given a *large enough budget*, however, we *cannot* ensure it will be *maximal*, i.e. a preferred extension.

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Pros and Cons

- Pro: weights arise in a number of natural contexts, e.g. statistical analysis of drug efficacy, bargaining, etc.
- Pro: notion of budget natural context for concession and negotiation.
- Con: multiple status of grounded semantics raises computational difficulties.
- Natural optimisation questions appear tractable only in very restricted settings.

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Summary

- Mechanisms for enriching the basic binary attack structure from AFs is one of the most fields in argumentation.
- The selection considered omits a number of important approaches, e.g. the treatment of "attack" as a relation between a set of arguments and a single argument.
- Each proposal has points in its favour and problematic aspects.
- As considered in the next section, many of these problems concern computational efficiency.

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