# Integrating Dialectical and Accrual Modes of Argumentation

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# Outline of Talk

- *Metalevel Argumentation* :

  Dung's *dialectical* argumentation theory and its extensions formalised within metalevel Dung frameworks

- Accrual mode of argumentation abstractly characterised in terms of reasoning about preferences in metalevel frameworks $\Rightarrow$

  *dialectical argumentation semantics that integrates accrual*

# Metalevel Argumentation - a unifying formalism for abstract argumentation theories [1]

- Given a Dung AF $\Delta$ = (Args,Attacks)

| | |
|---|---|
| *there is an x ∈ Args that is in an extension of Δ and so* ***x is justified*** | *= j-x* |
| *there is an x ∈ Args that is not in an extension of Δ and so* ***x is rejected*** | *= r-x* |
| *there is an attack from x to y and so* ***x defeats y*** | *= xDy* |

The justified status of y ∈ Args is challenged by a defeat on y ⇒ *xDy 'meta-attacks' j-y*

if x is rejected then x does not defeat y ⇒ *r-x 'meta-attacks' xDy*

if x is justified then x is not rejected ⇒ *j-x 'meta-attacks' r-y*

1 S. Modgil and T.Bench Capon. **Metalevel Argumentation**. To appear in: *Journal of Logic and Computation*, (2010).

# Meta-argumentation

- MAF $\Delta_M$ is a tuple *<A, R, C, L, D>*

  - *<A, R>* is a Dung framework

  - *C* is a claim function mapping meta-arguments in *A* to sets of wff in a language *L*

  - Constraints *D* on meta-attack relation

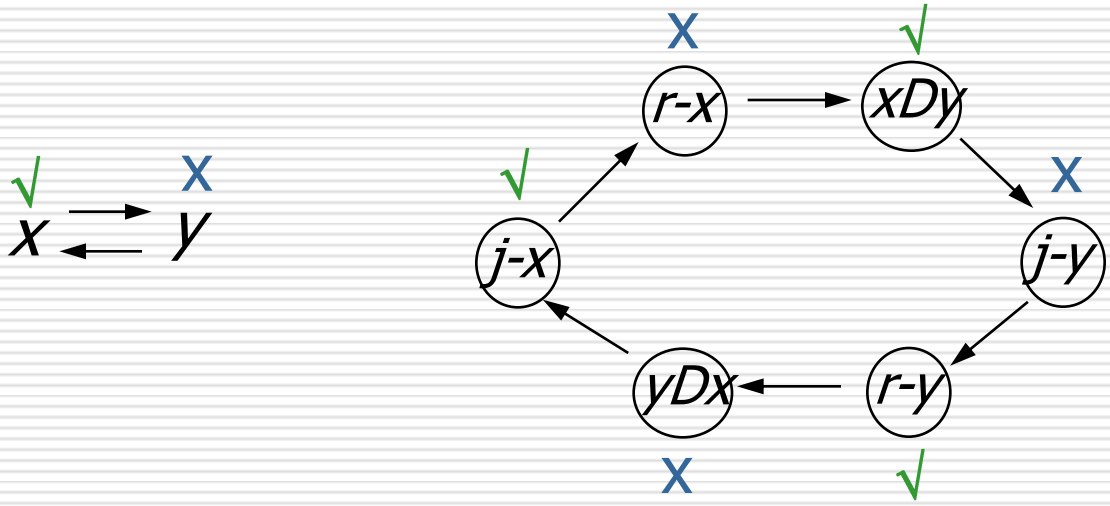
    if $l1 \in C(\alpha)$ and $l2 \in C(\beta)$ then $(\alpha,\beta) \in R$

    (e.g., if $justified(y) \in C(\alpha)$ and $defeat(x,y) \in C(\beta)$ then $(\beta,\alpha) \in R$)

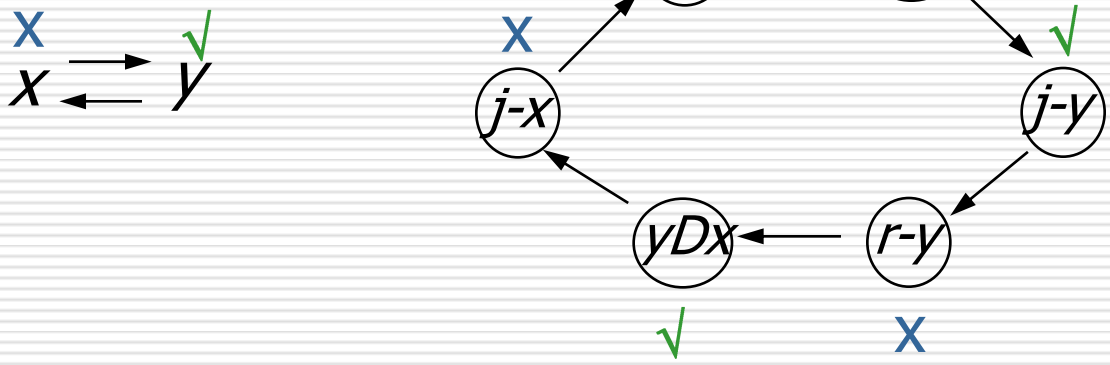
  constraints characterise reasoning used to evaluate justified arguments of object level framework s.t.

  *x is justified argument of object level framework Δ iff meta-argument claiming justified(x) is a justified argument of Δ's metalevel formulation $\Delta_M$*

# Example of meta-arguments and meta-attacks



# Example of meta-arguments and meta-attacks



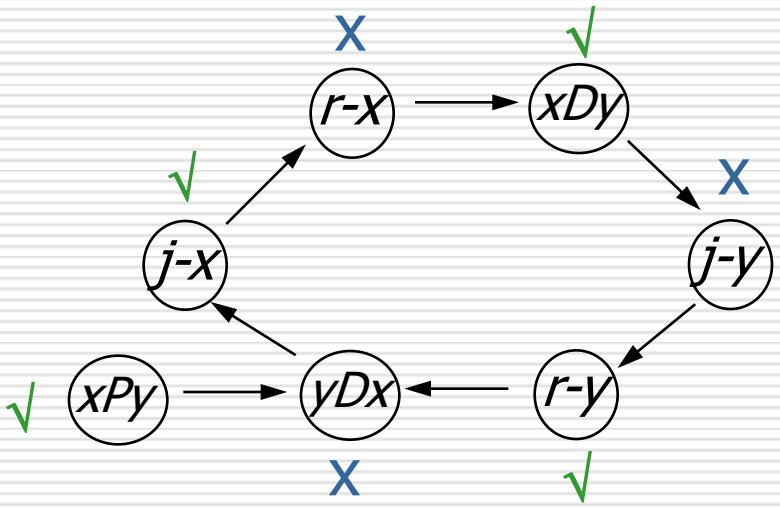
# Metalevel Characterisation of Preference Based Argumentation

$\Delta = (Args, Attack, \geq)$

$\Delta_M = \langle A, R, C, L, D \rangle$

$x \rightleftharpoons y$ $\quad x > y$

*meta-argument claiming preferred(x,y)*




*D4*: $( C(\alpha) = yDx , C(\beta) = xPy ) \Rightarrow (\beta,\alpha) \in R$

*x is a justified argument of Δ iff j-x is a justified argument of* $\Delta_M$

# Metalevel Argumentation

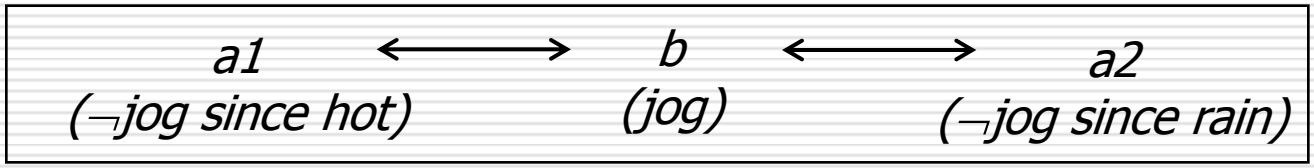
- Metalevel characterisations and correspondence theorems shown for [1]:
  - preference (Amgoud and Cayrol) and value-based argumentation (Bench-Capon)
  - hierarchical extended argumentation (Modgil)
  - collective attacks (Nielsen and Parsons)

  (abstract dialectical frameworks ?)

- Accrual can be abstractly modelled in terms of reasoning about preferences between sets of arguments in metalevel argumentation frameworks ….

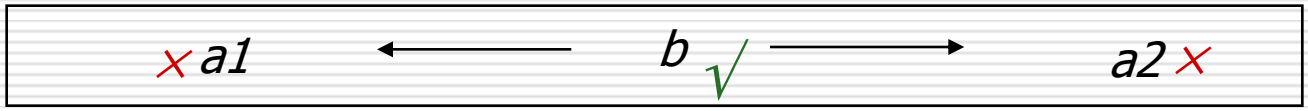
1 S. Modgil and T.Bench Capon. Metalevel Argumentation. To appear in: *Journal of Logic and Computation*, (2010).

# Accrual versus Dialectical Argumentation




*

*b > a1, b > a2*




***But combined*** weight of independent arguments for ¬*jog* outweighs b

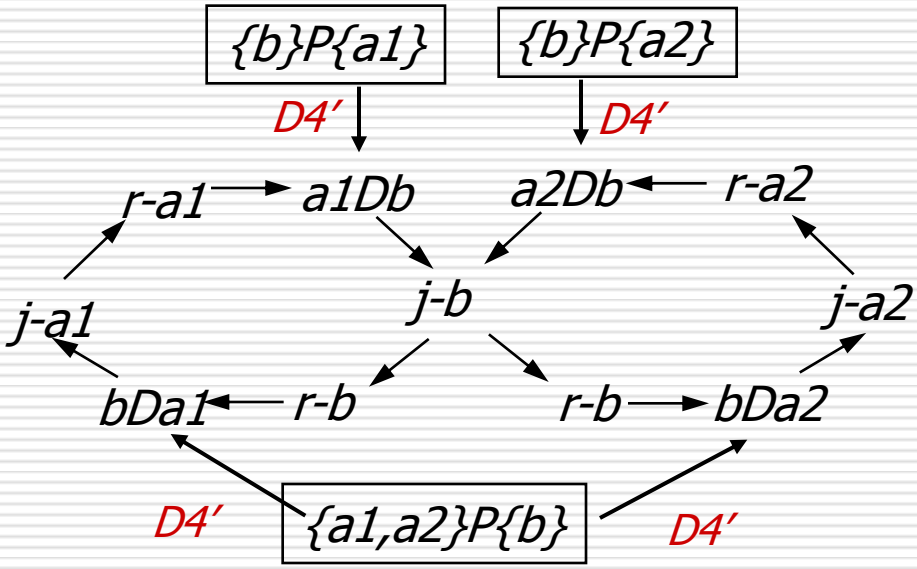
- we want a1 and a2 to be justified - problem with dialectical mode is only pair-wise relationships between arguments considered

- *knowledge representation* solutions combine rules ($h \wedge r \Rightarrow \neg jog$ )
- *inference rule* solutions license "super-arguments" (a1+a2)

* *Example from :* H. Prakken. A study of accrual of arguments, with applications to evidential reasoning. In:*Proc. 10th Int. Conf. on Artificial intelligence and law*, pages 85–94, 2005.

# Encoding accrual in metalevel frameworks

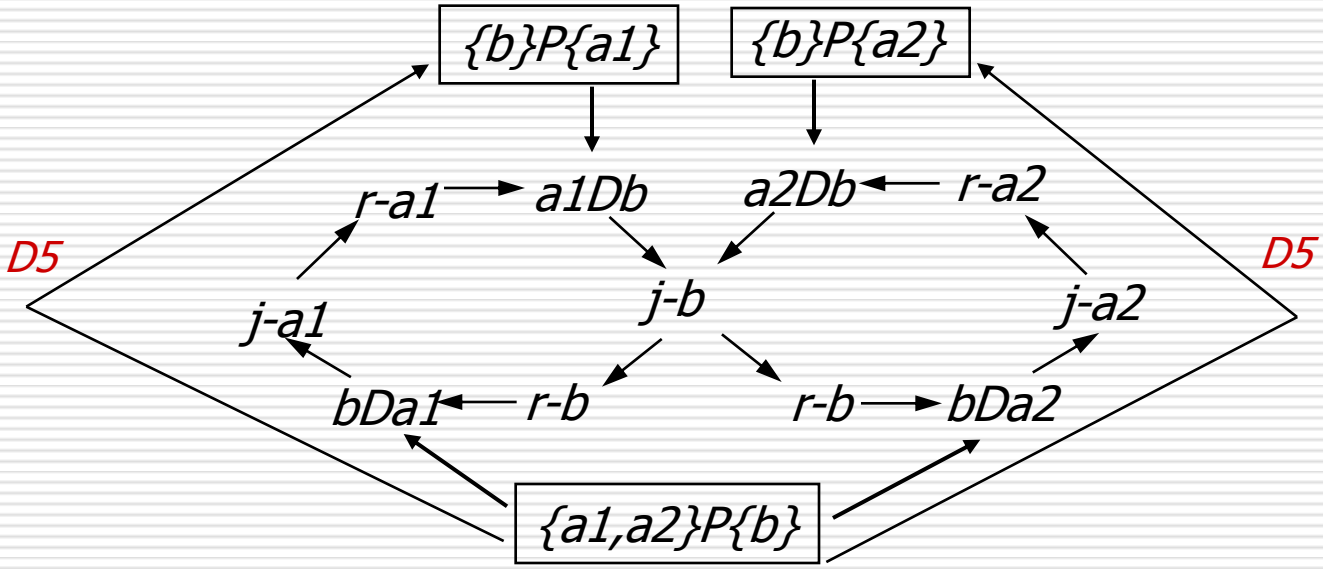
- Accrual modelled in terms of application of preferences in metalevel frameworks




Constraint D4′ states that meta-arg claiming $\{x_1 \ldots x_n\}P\{y_1 \ldots y_m\}$ meta-attacks meta-arg claiming yDx only if $x \in \{x_1 \ldots x_n\}$, $y \in \{y_1 \ldots y_m\}$

# Encoding accrual in metalevel frameworks

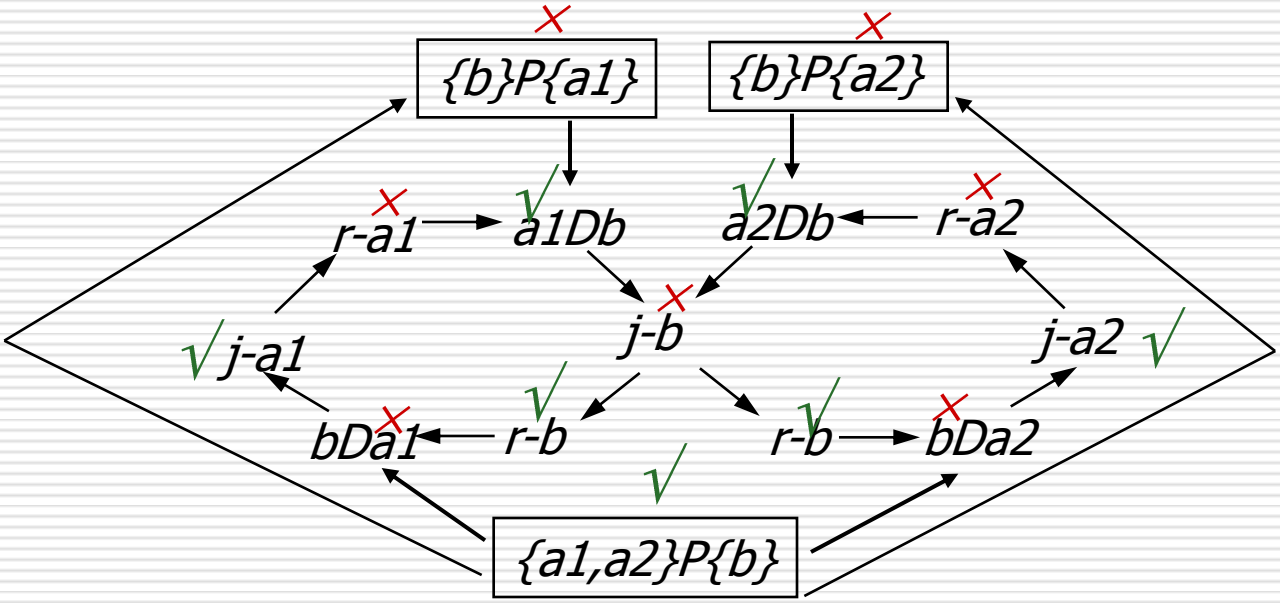
- Preferences defined by an accrual take precedence over the preferences defined by elements of the accrual * - encoded as constraint *D5* on metalevel attack relation




D5 : $Y'$P$X'$ meta-attacks $X$P$Y$ only if $Y \subseteq Y'$, $X \subseteq X'$ and $Y \subset Y'$ or $X \subset X'$

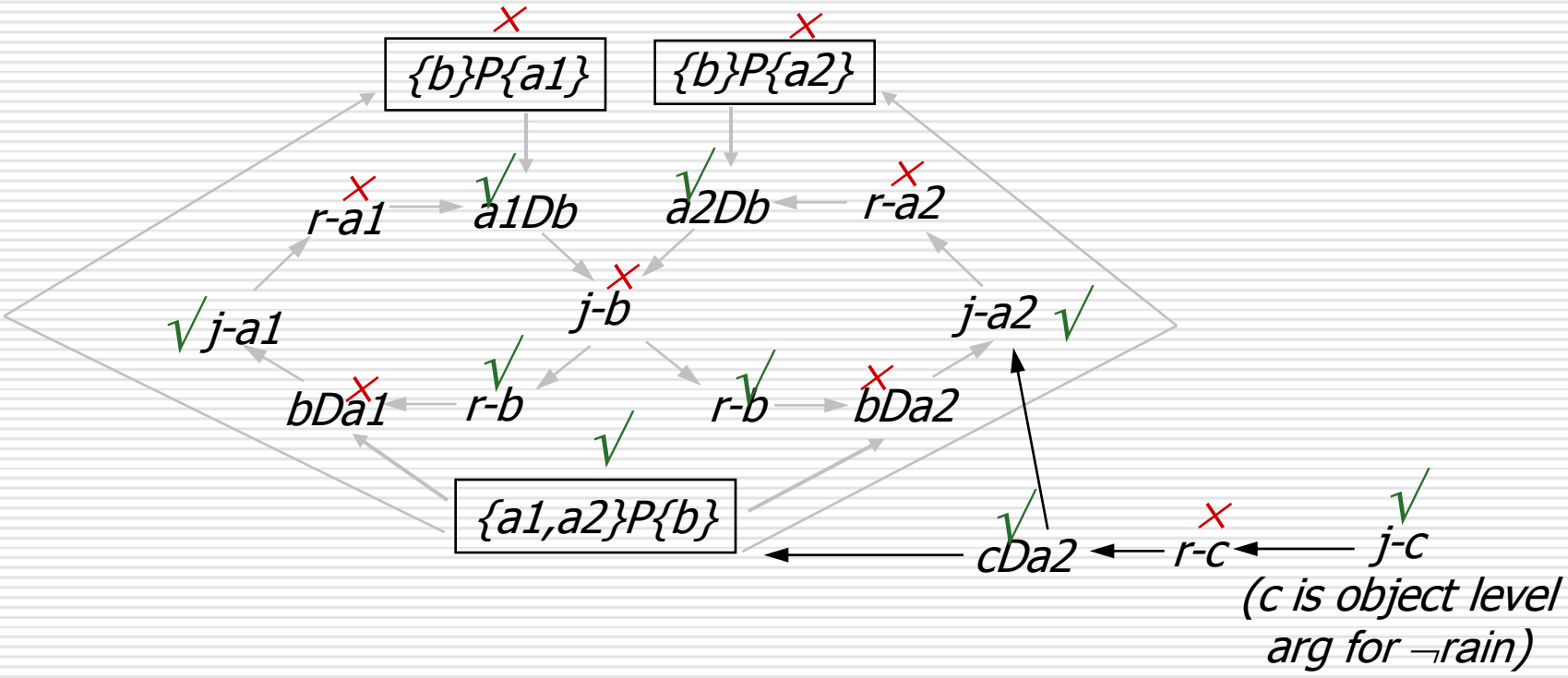
* cf Prakken's accrual principle that accrual's make their elements inapplicable $\Rightarrow$ super-argument a1+a2 justified, but a1 and a2 not justified

# Encoding accrual in metalevel frameworks



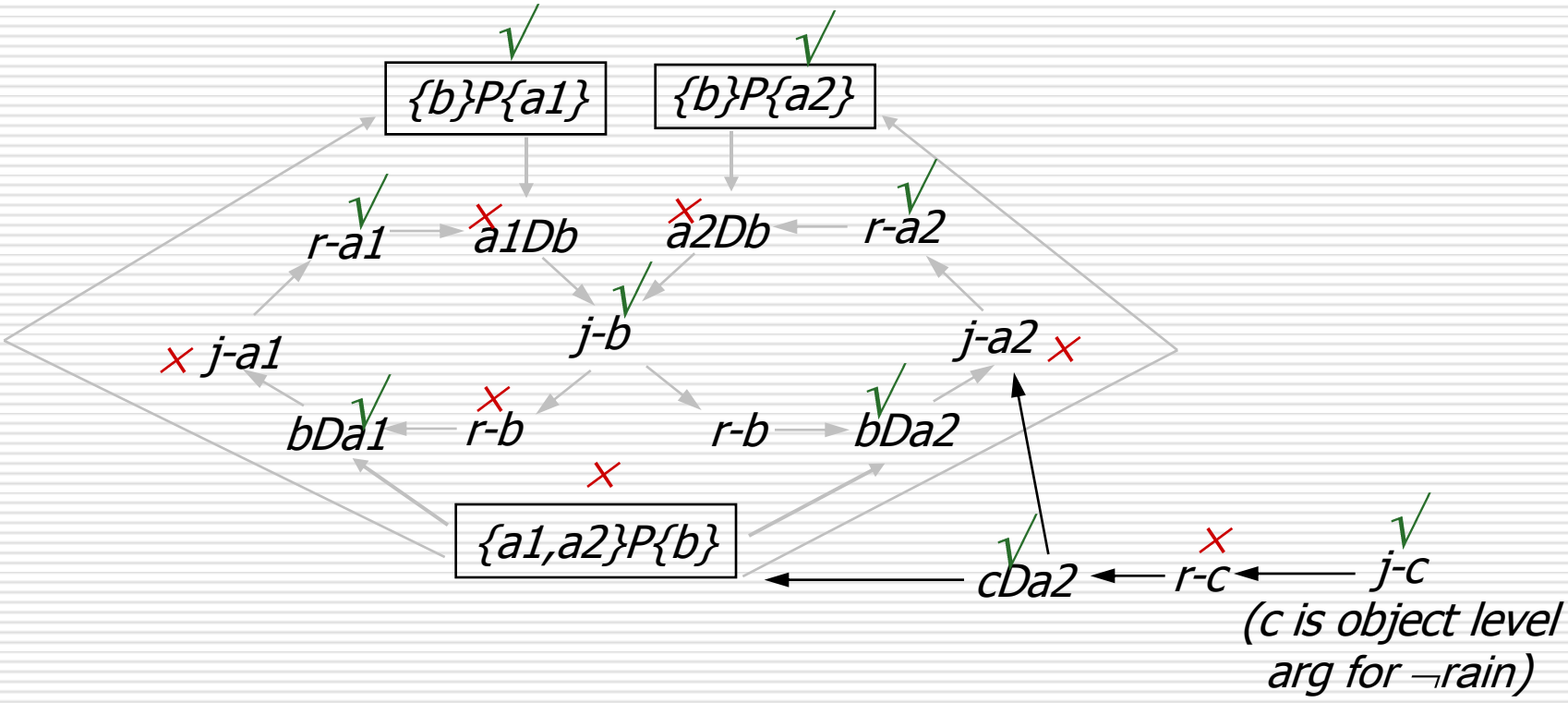
# Encoding accrual in metalevel frameworks

- Preferences defined by accrual invalidated if elements of accrual defeated * - encoded as constraint *D6* on metalevel attack relation




* cf Prakken's principle that "flawed arguments may not accrue"

# Encoding accrual in metalevel frameworks



# Example

- $y1 = [r1: b, r2 : b \Rightarrow a]$ , $y2 = [r3 : \Rightarrow a]$
  $z1 = [r4: c, r5 : c \Rightarrow \neg a]$ , $z2 = [r6 : \Rightarrow \neg a]$
  $\Rightarrow$
  meta-arguments claiming "justified(y1)" , "defeat(y1,z1)" etc.

  $p1 = [r7: e, r8 : e \Rightarrow (r5 \wedge r6) > (r2 \wedge r4)]$
  $\Rightarrow$
  meta-argument claiming "preferred( {z1,z2},{y1,y2} )"

  can accommodate object level arguments for contradictory preferences e.g., $p2 = [r8: f, r9 : f \Rightarrow (r2 \wedge r4) > (r5 \wedge r6)]$, $p3 = [r10 : \Rightarrow r9 > r8]$ (j-p3 attacks meta-arg claiming p1Dp2)

- Justified arguments of object level theory evaluated based on extensions of instantiated metalevel Dung framework

# Conclusions

Abstract formalisation of accrual in metalevel Dung frameworks in which

constraints on metalevel attack relation encode analogues of Prakken's

accrual principles:

- Avoids proliferation of rules in *KR* approach, many of which are somewhat artificial given that premises are entirely independent
- Respects individuality of accrued arguments in contrast to inference approach
- Integrates accrual within dialectical mode of argumentation $\Rightarrow$results and techniques (e.g., argument game proof theories) for Dung frameworks applied to metalevel frameworks integrating accrual