# Rethinking the Rationality Postulates for Argumentation-Based Inference

Henry Prakken

COMMA 2016

Berlin-Potsdam

September 15th, 2016

Universiteit Utrecht

rijksuniversiteit groningen

# Rationality postulates (Caminada & Amgoud AIJ 2007)

- Let $E$ be any acceptable set of arguments and
  - Conc($E$) = $\{\phi | \phi$ = Conc($A$) for son
- Then $E$ satisfies:
  - direct consistency iff Conc($E$) do not contain two formulas $\phi$ and $\neg\phi$
  - strict closure iff any $\phi$ deductively implied by Conc($E$) is in Conc($E$)
  - indirect consistency iff the strict closure of Conc($E$) is directly consistent

Assumes a deductive (i.e. strict) consequence notion

# The ASPIC+ framework

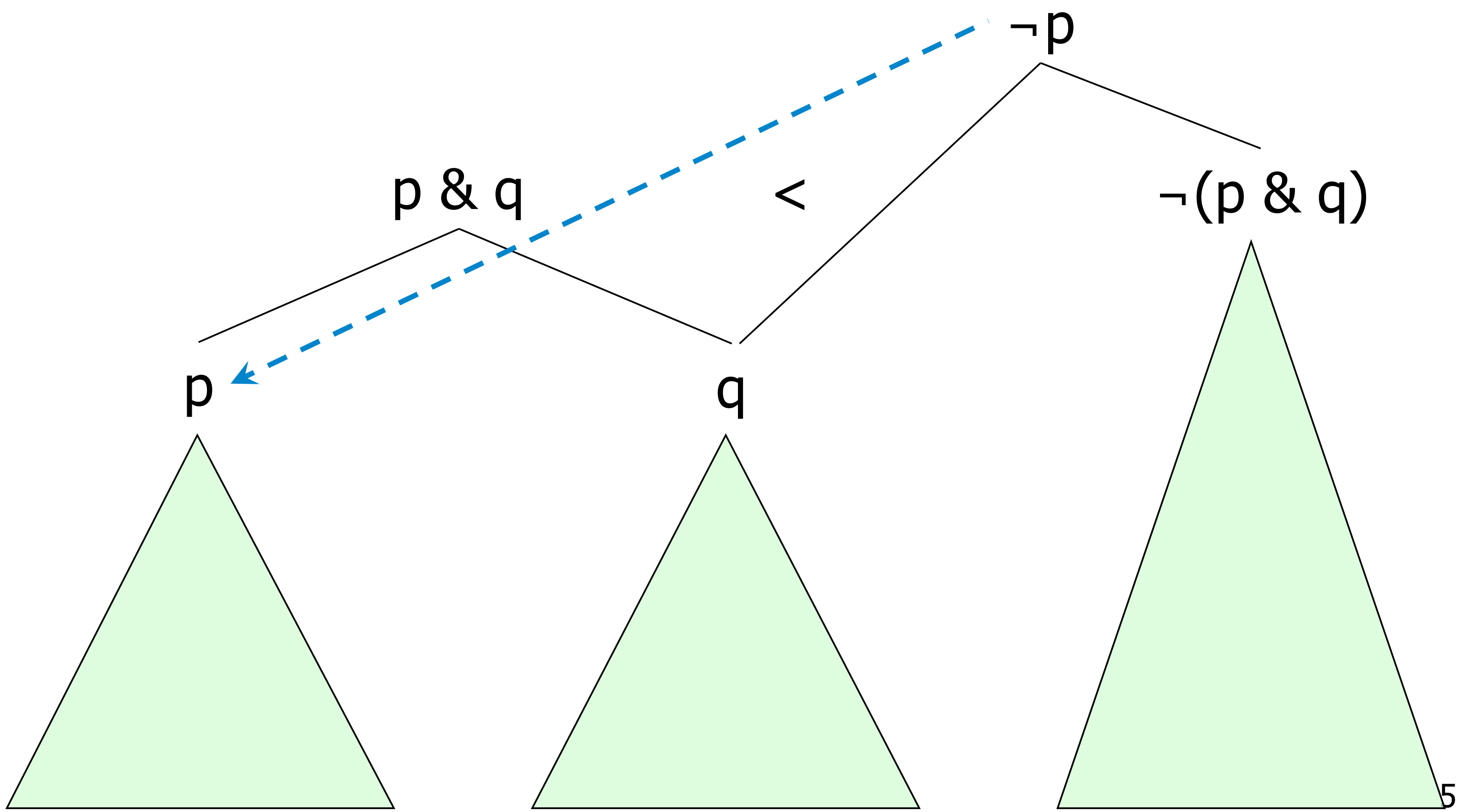
- Arguments: DAGs where
  - Nodes are statements in some logical language $\mathcal{L}$ containing $\neg$
  - Links are applications of inference rules
    - Strict rules $\rightarrow$
    - Defeasible rules $\Rightarrow$
- Constructed from consistent subsets of a knowledge base $\mathcal{K} \subseteq \mathcal{L}$
  - Certain premises $\mathcal{K}_n$ + uncertain premises $\mathcal{K}_p$
- Attack:
  - On uncertain premises
  - On defeasible inferences (undercutting)
  - On conclusions of defeasible inferences (rebutting)
- Defeat: attack + argument ordering
- Argument evaluation with Dung (1995)

**An argument is:**
Fallible if it can be attacked
Infallible otherwise

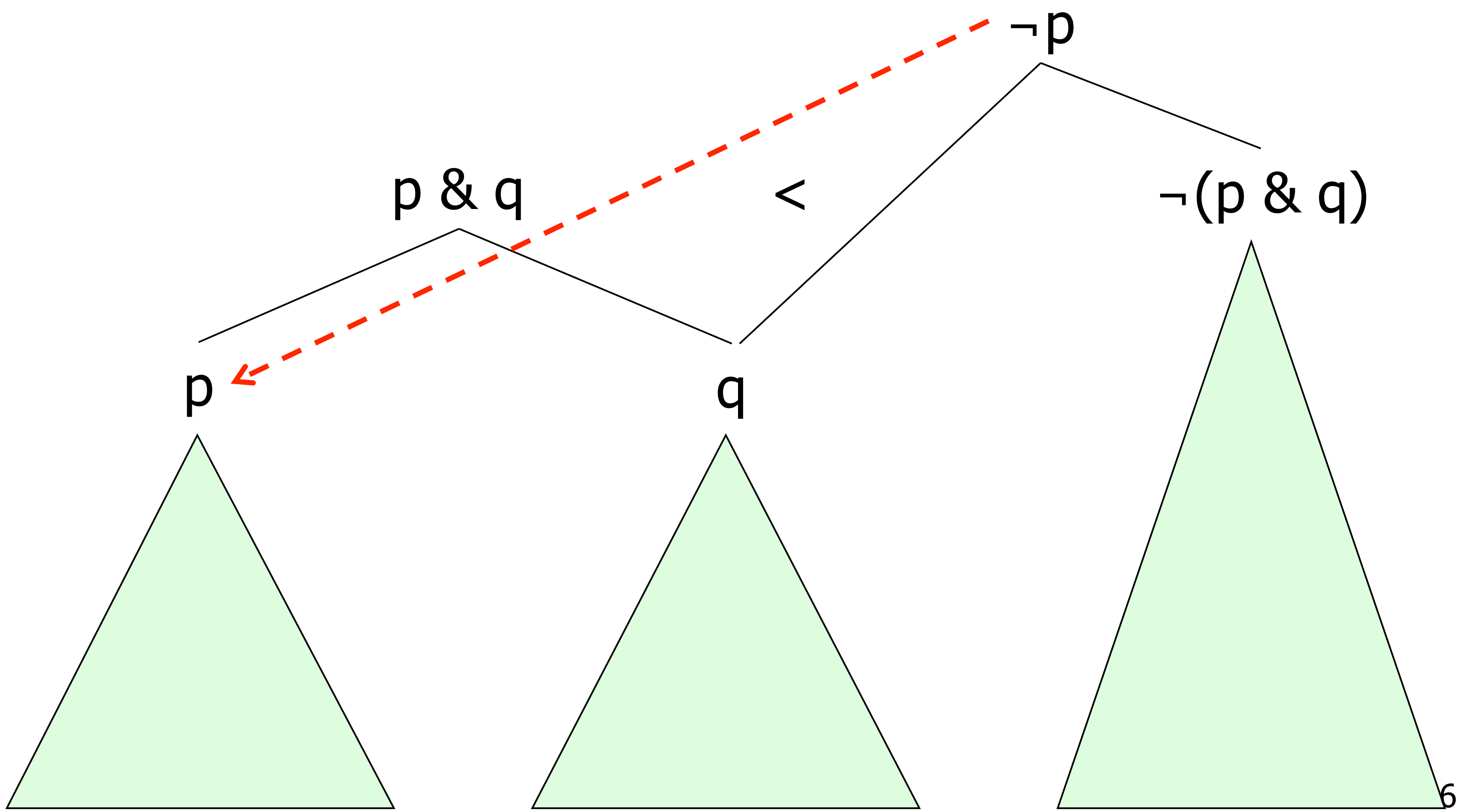
# Crucial insight

- That deduction preserves truth does not imply that deduction preserves justification
- So that deduction preserves justification should be independently argued
- But deduction applied to more than one fallible subargument can weaken an argument,
- Since it can aggregate the amount of fallibility of the subarguments

# contrapositive deductive reasoning



# Reasonable argument ordering



# The lottery paradox (Kyburg 1960)

- Assume:
  1. A lottery with 1 million tickets and 1 prize.
  2. The probability that some ticket wins is 1
  3. The probability that a given ticket $T_i$ wins is 0.000001.
- Suppose:
  - a highly probable belief is justified; and
  - what can be deduced from a set of justified beliefs is justified.
- Then {1,2,3} yields an inconsistent set of justified beliefs

# The lottery paradox in ASPIC+

T$_1$ will win and the other tickets will not win

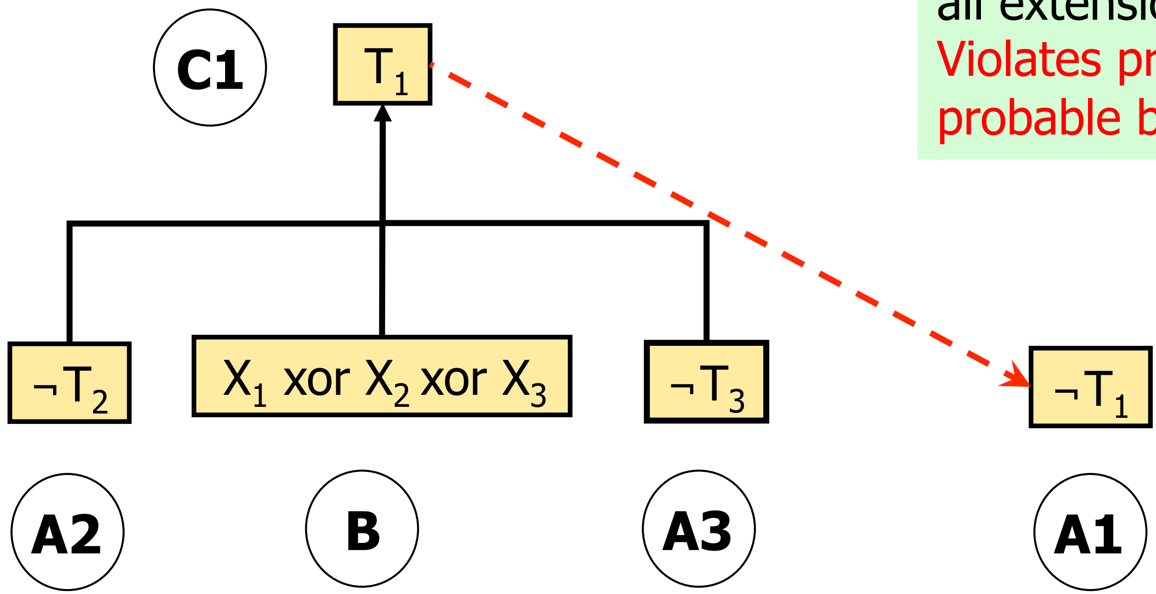
$\mathcal{K}_p = \{\neg T_1, \ldots, \neg T_{1.000.000}\}$
$\mathcal{K}_n = \{X_1 \text{ xor } \ldots \text{ xor } X_{1.000.000}\}$

$(\mathcal{R}_s = \{S \rightarrow \phi \mid S \mid\!-_{PL} \phi \text{ and } S \text{ is finite}\}$
$\mathcal{R}_d = \emptyset$

- Define: $\phi$ is justified iff some argument for $\phi$ is in all S-extensions

$$\mathcal{K}_p = \{\neg T_1, \neg T_2, \neg T_3\}$$
$$\mathcal{K}_n = \{X_1 \text{ xor } X_2 \text{ xor } X_3\}$$

**Option 1:**
C1 ≈ A1
But then for all i: Ci ≈ Ai
So none of {A1,A2,A3} are in all extensions
Violates principle that highly probable beliefs are justified

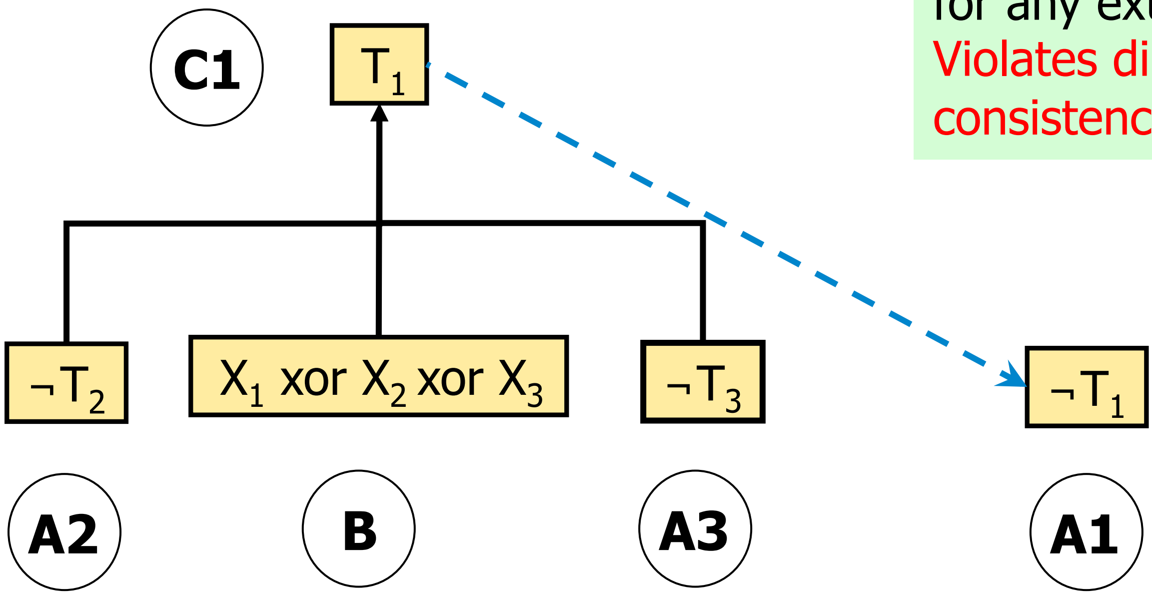


$\mathcal{K} = \{\neg T_1, \neg T_2, \neg T_3\}$

$= \{X_1 \text{ xor } X_2 \text{ xor } X_3\}$

Excluded by third condition on <

**Option 2:**
C1 < A1
But then for all i: Ci < Ai
So {A1,A2,A3,B,C1,C2,C3} $\subseteq$ E for any extension E
Violates direct and indirect consistency



# New rationality postulates

- Direct consistency should still hold
- Strict closure and indirect consistency should be restricted to any $S \subseteq E$ with at most one fallible argument.

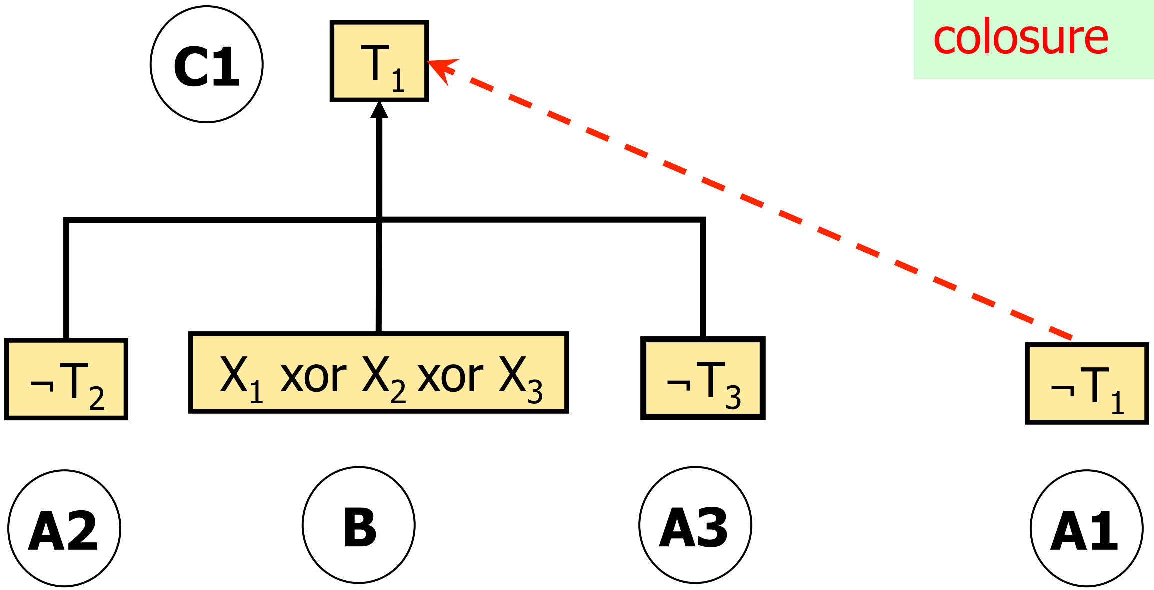
# Changes in ASPIC+

- Allow rebuttal on any strict inference applied to at least two fallible arguments
- Drop third condition on <

**Theorem:**
**If** strict reasoning contraposes,
and for any argument A, Premises(A) $\cup \mathcal{K}_n$ is indirectly consistent
and conditions (1) and (2) on < are satisfied
**Then**
direct consistency, restricted strict closure and restricted indirect consistency are satisfied

$\mathcal{K}_p = \{\neg T_1, \neg T_2, \neg T_3\}$
$\mathcal{K}_n = \{X_1 \text{ xor } X_2 \text{ xor } X_3\}$

**Option 2 again:**
Ci < Ai
Then for all i: Ci < Ai
So A1,A2,A3 and B are in extension E, but C1, C2 and C3 are not
Violates indirect but not direct consistency
Satisfies restricted strict colosure



# Added value of argumentation

- Deduction is still available in argument construction
  - Applications without attackers are still justified
  - Cannot be undercut
  - applications to a limited number of fallible subarguments can be justifed, depending on the argument ordering