



Estimating Stability for Efficient Argument-based Inquiry

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Fraud Application

- **Trade fraud** (40.000 complaints/year)
- Intake agent for **handling complaints**
- **Topic of inquiry:** is the complainant a victim of trade fraud?

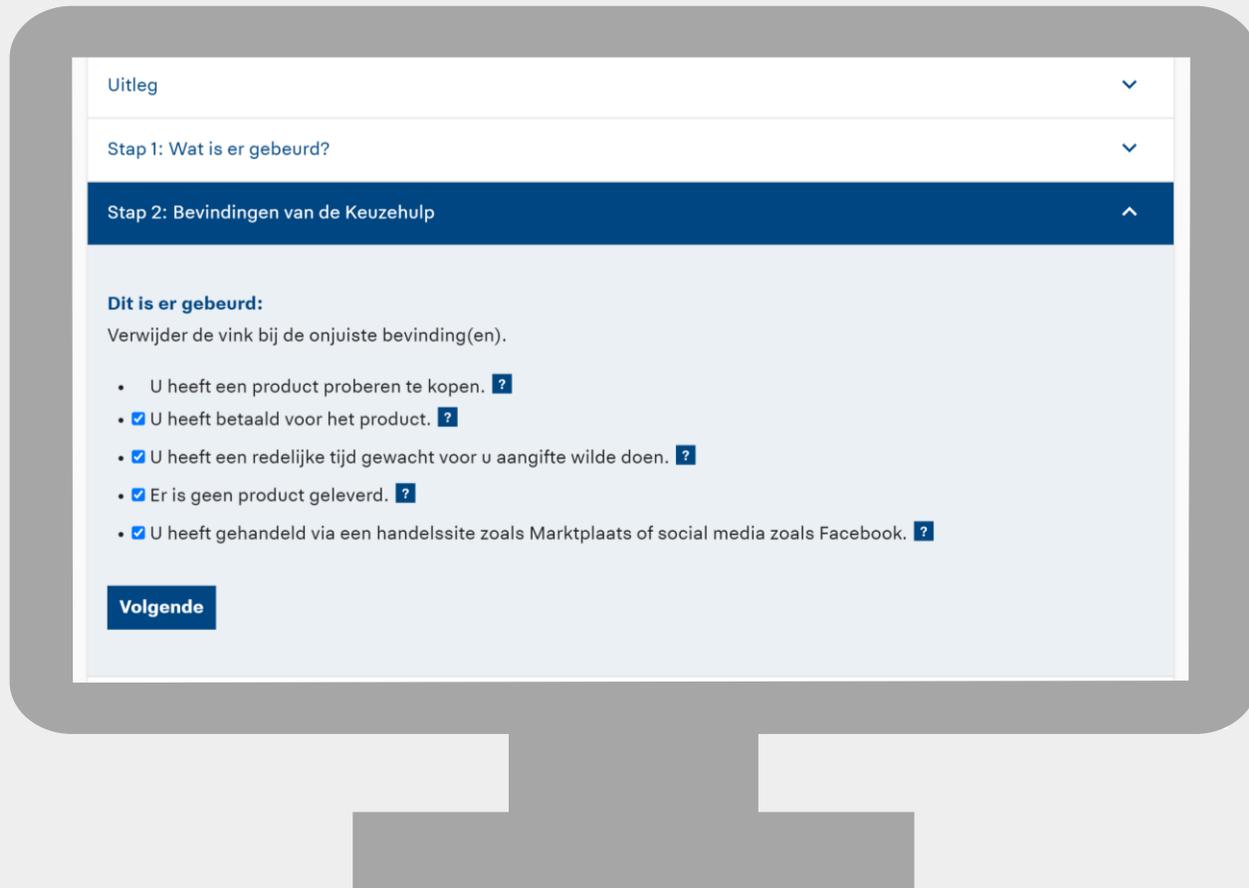




User inserts natural language text (in Dutch)

<https://aangifte.politie.nl/iaai-preintake/#/>





Information Extraction
module extracts
observations

<https://aangifte.politie.nl/iaai-preintake/#/>



Stap 1: Wat is er gebeurd? ▼

Stap 2: Bevindingen van de Keuzehulp ▼

Stap 3: Vragen over wat er is gebeurd ▲

Naar aanleiding van uw verhaal heeft de Keuzehulp nog enkele vragen.

Zou u een product per post toegestuurd krijgen? ? Ja Nee

Eventuele extra toelichting: 0 / 200

Heeft u een Track en Trace code van de verkoper ontvangen voordat u betaald heeft? ? Ja Nee

Eventuele extra toelichting: 0 / 200

Volgende

Information was not sufficient: user needs to answer additional questions

<https://aangifte.politie.nl/iaai-preintake/#/>



Stap 4: Ons advies

Ons advies: Aangifte doen ?

Op basis van uw verhaal raadt de Keuzehulp u aan om door te gaan met uw aangifte.

Klik hieronder op 'Doorgaan met aangifte'. U krijgt dan een formulier te zien waarin u verdere details, zoals adressen en betaalgegevens, kunt invullen.

Let op: uw aangifte is pas afgerond nadat u het volgende aangifteformulier heeft ingevuld en verzonden.

Wat u verder nog kunt doen ?

Naast het doen van aangifte (als dat van toepassing is) kunt u zelf proberen een oplossing te vinden met de verkoper.

- Mogelijk kan het [Juridisch loket](#) of de [Rechtstelefoon](#) u hierbij helpen.
- Op [consuwijzer.nl](#) vindt u praktische informatie over uw rechten.
- Op de [pagina "internetplichting" van de politie](#) vindt u meer informatie over internetplichting.
- Op de [pagina "internetplichting" van de politie](#) vindt u informatie over uw mogelijkheden als u een rechtsbijstandverzekering heeft.

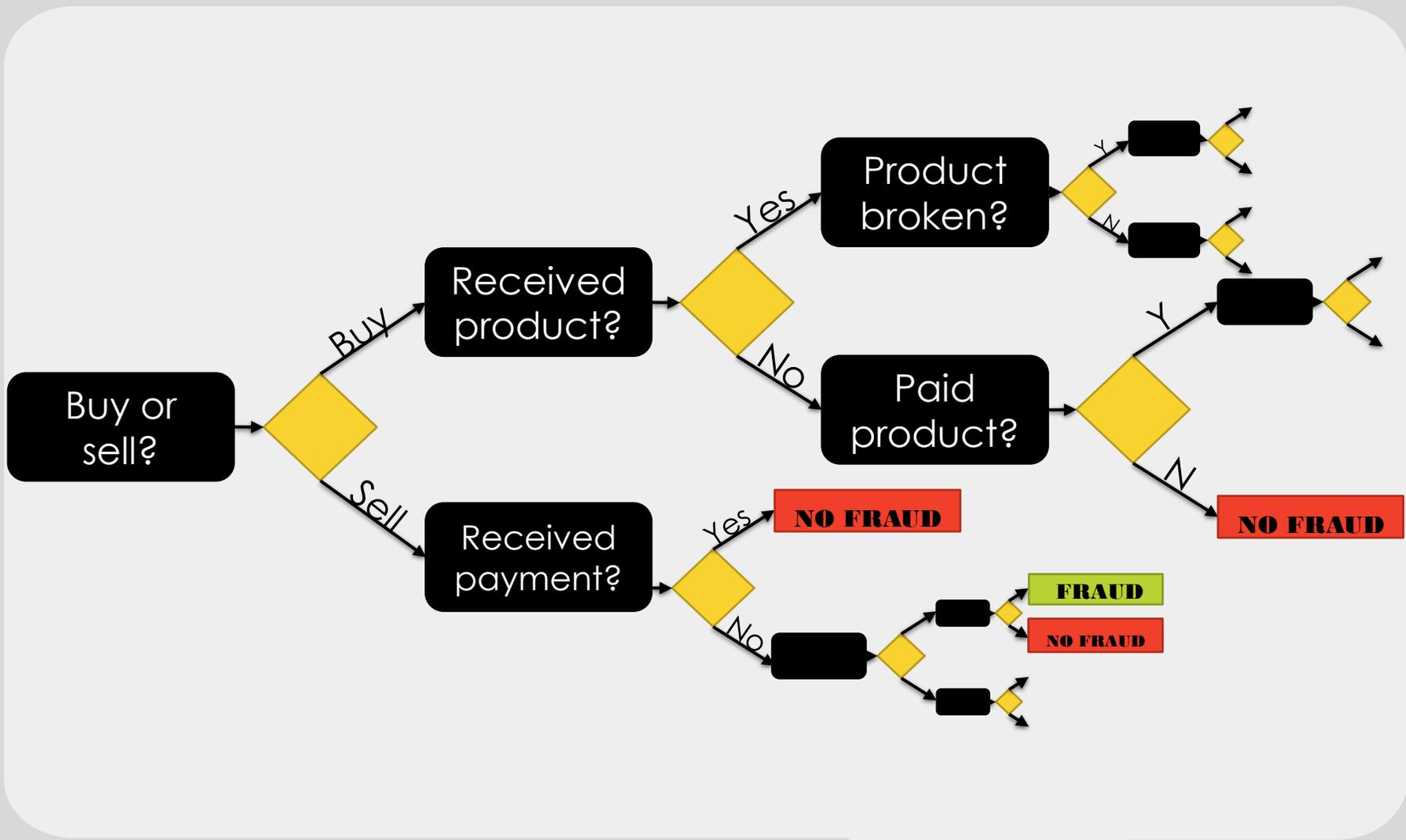
Ons advies volgt uit wat er is gebeurd:

- U heeft een product proberen te kopen. ?
- U heeft betaald voor het product. ?
- U heeft een redelijke tijd gewacht voor u aangifte wilde doen. ?
- Er is geen product geleverd. ?

Advice

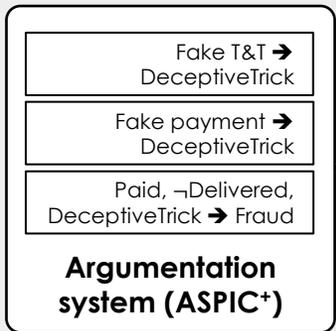
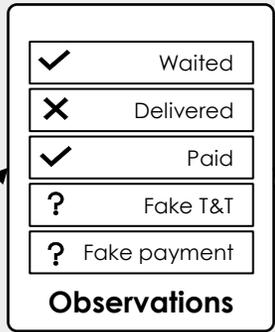
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Information
Extraction



Stability

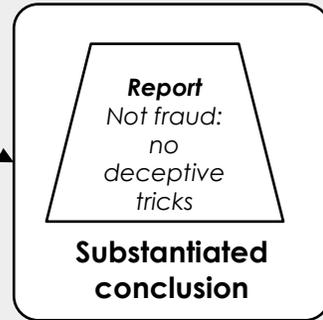
Update

Next
Question

Question
Policy

Claim is not
stable

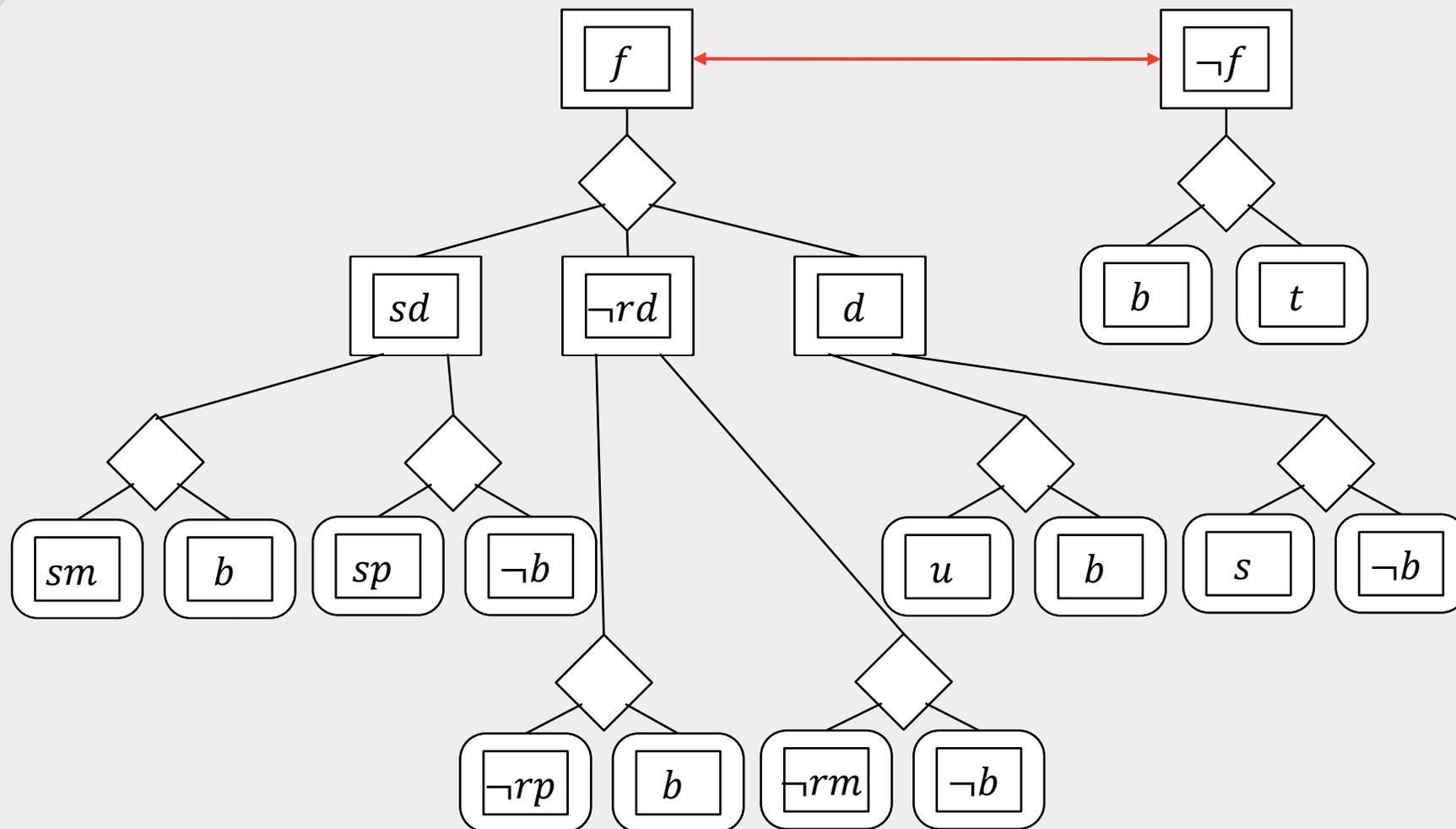
Claim
is stable



Argumentation Setup

- $AS = (\mathcal{L}, \mathcal{R}, \mathcal{Q}, \mathcal{K})$: argumentation setup, where:
 - \mathcal{L} : finite propositional language
 - \mathcal{R} : rules
 - **\mathcal{Q} : queryable literals**
 - \mathcal{K} : knowledge base

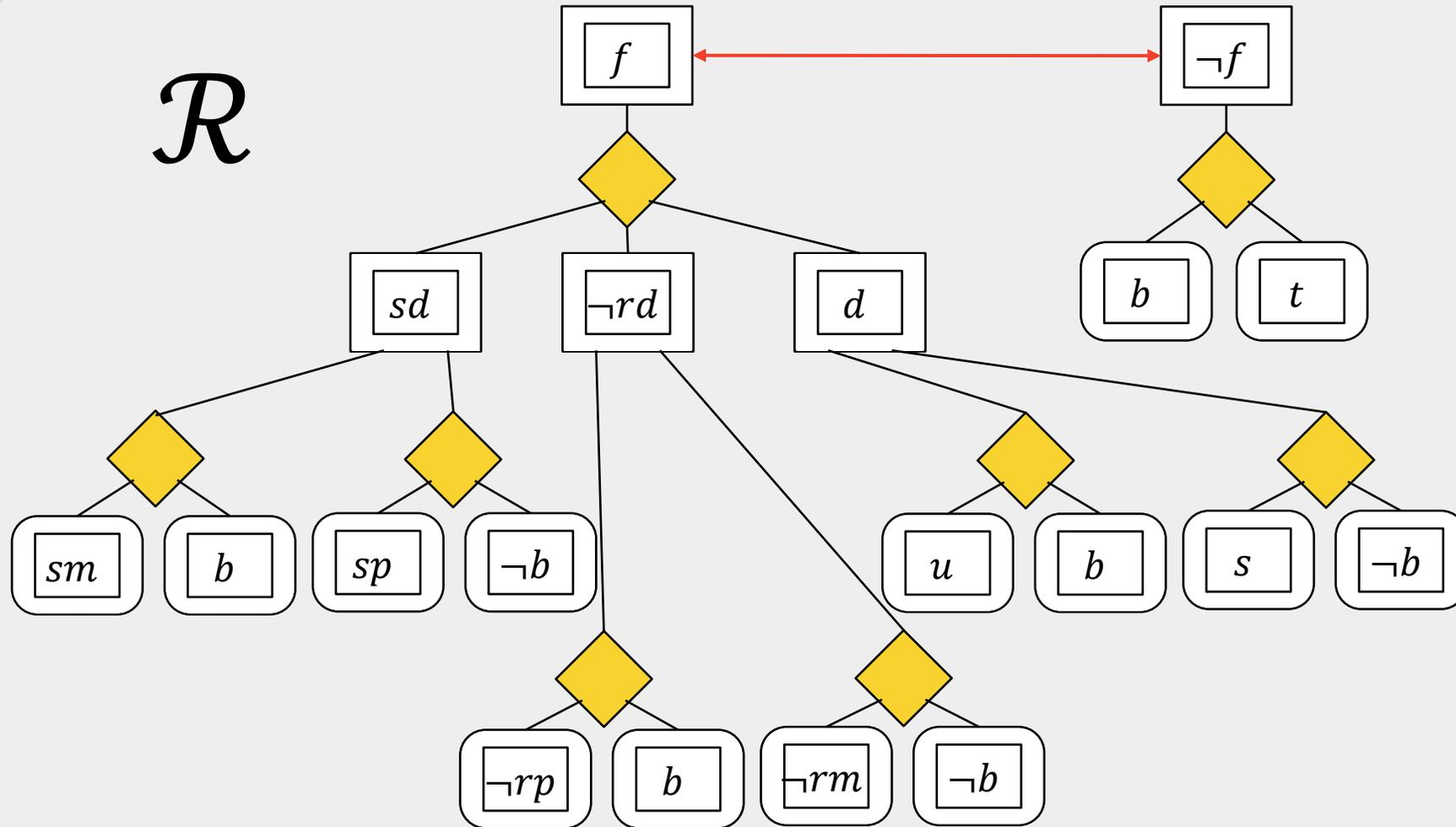




f: fraud
sd: sent delivery
rd: received delivery
d: deception
b: citizen tried to buy
t: trusted web shop
sp: sent product
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s: screenshot payment



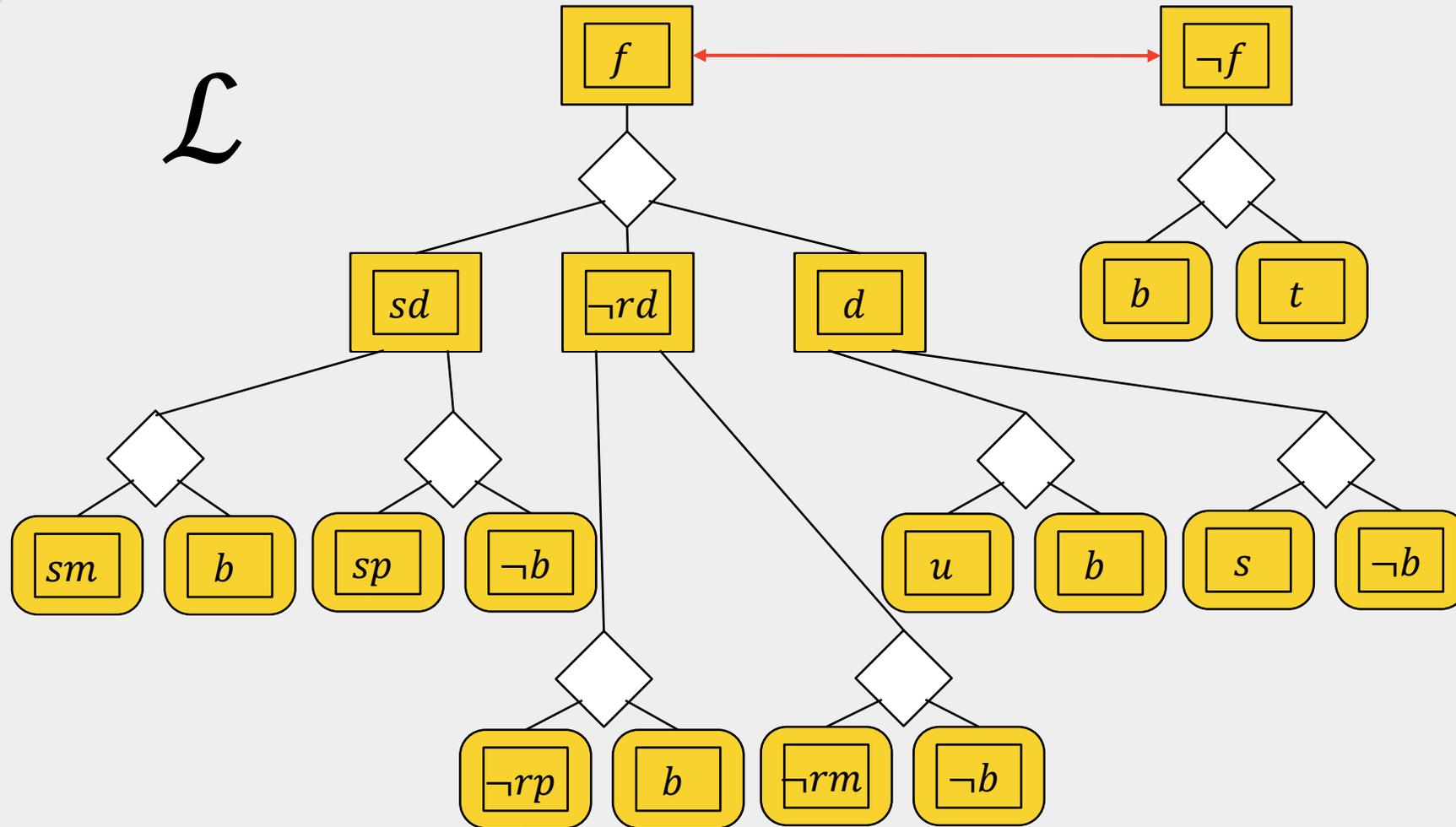
\mathcal{R}



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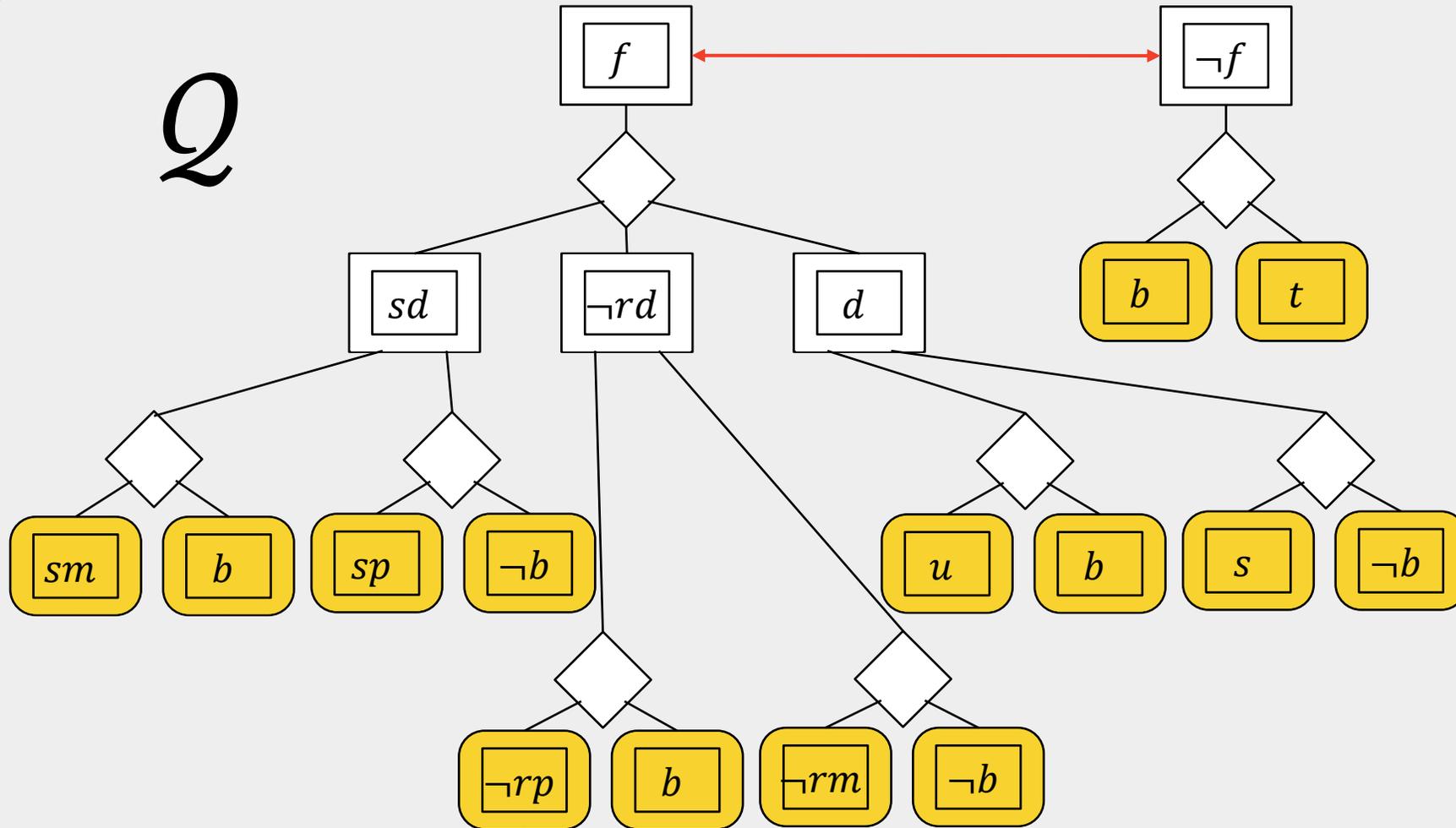
\mathcal{L}



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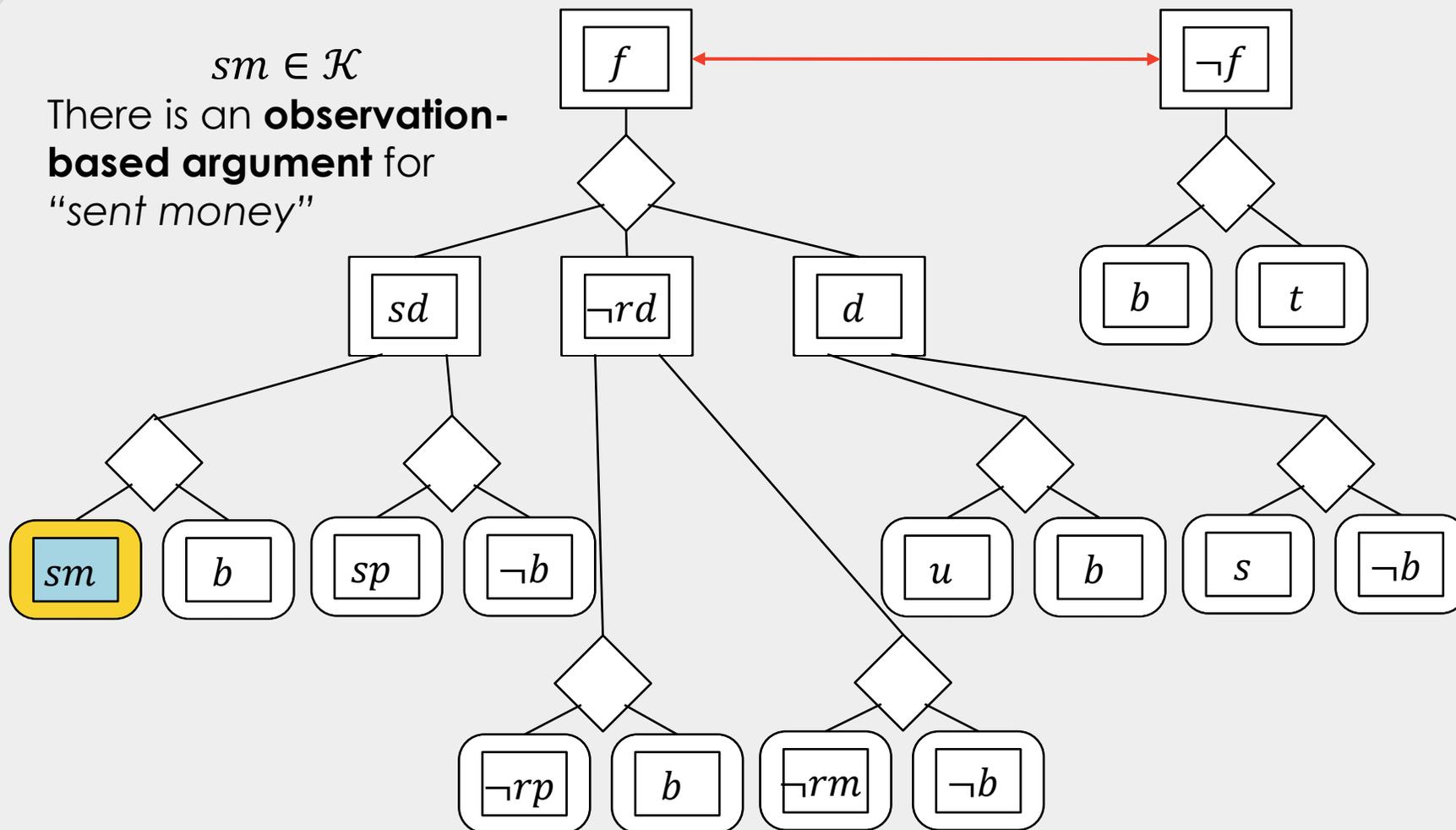
Q



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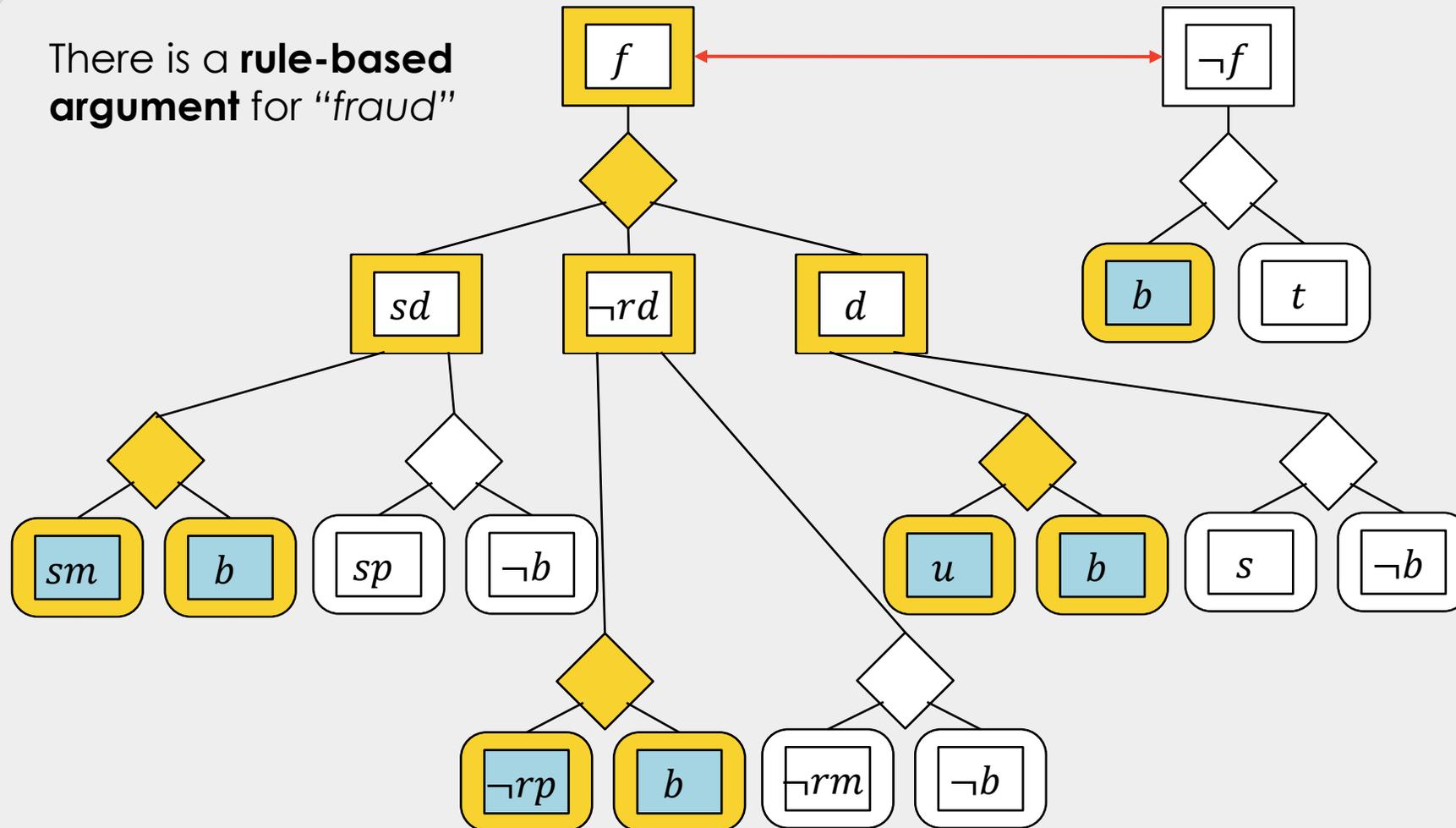
$sm \in \mathcal{K}$
 There is an **observation-based argument** for
 "sent money"



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There is a **rule-based argument** for "fraud"



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Attack

For two arguments $A, B \in \text{Arg}(AS)$ we say that A attacks B on B' iff A 's conclusion is c , there is a subargument $B' \in \text{sub}(B)$ such that $\text{conc}(B') = -c$ and $-c \notin \mathcal{K}$.

→ Rebuttal in ASPIC⁺

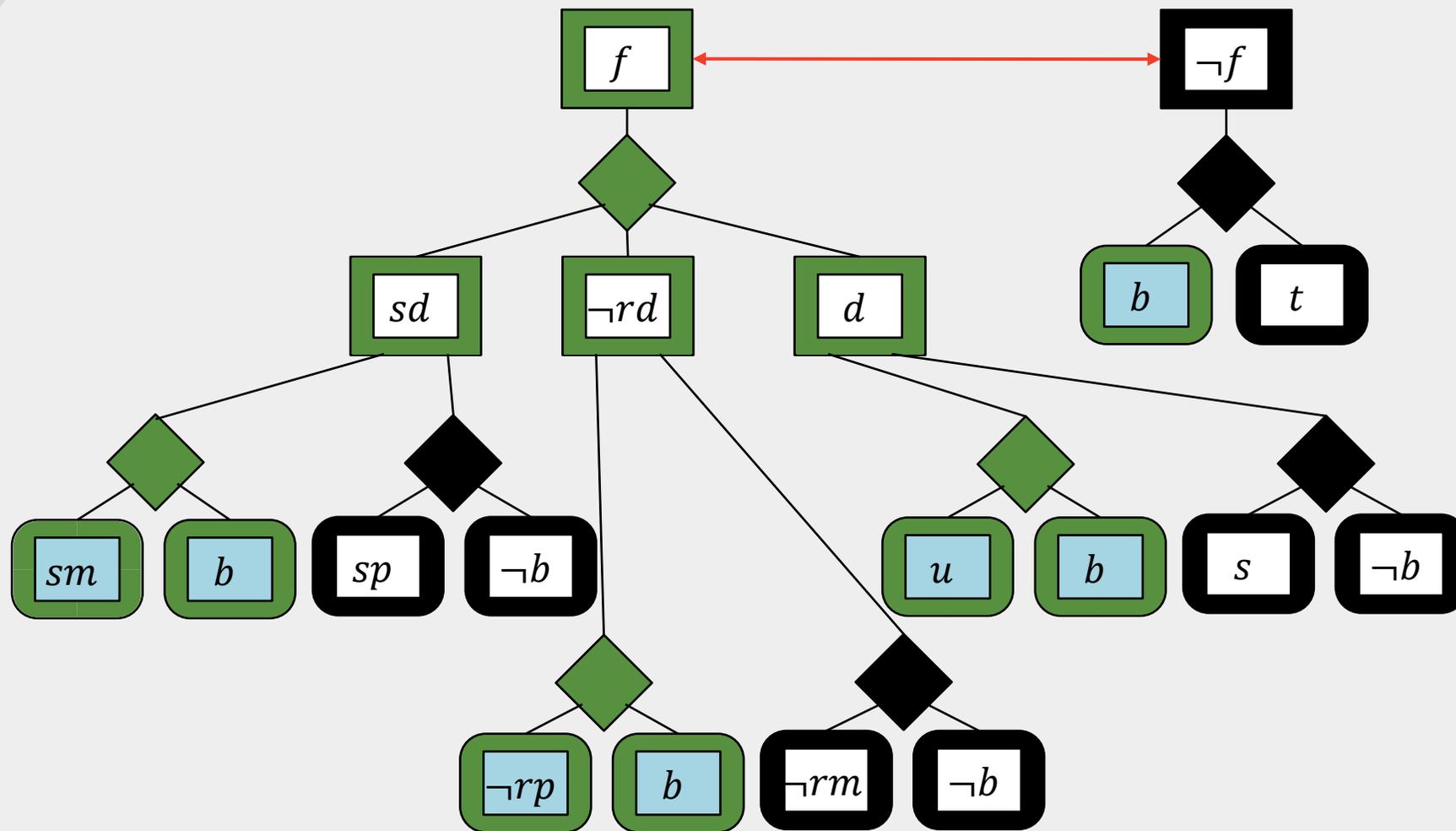
→ Observation-based arguments cannot be attacked



Claim acceptability statuses

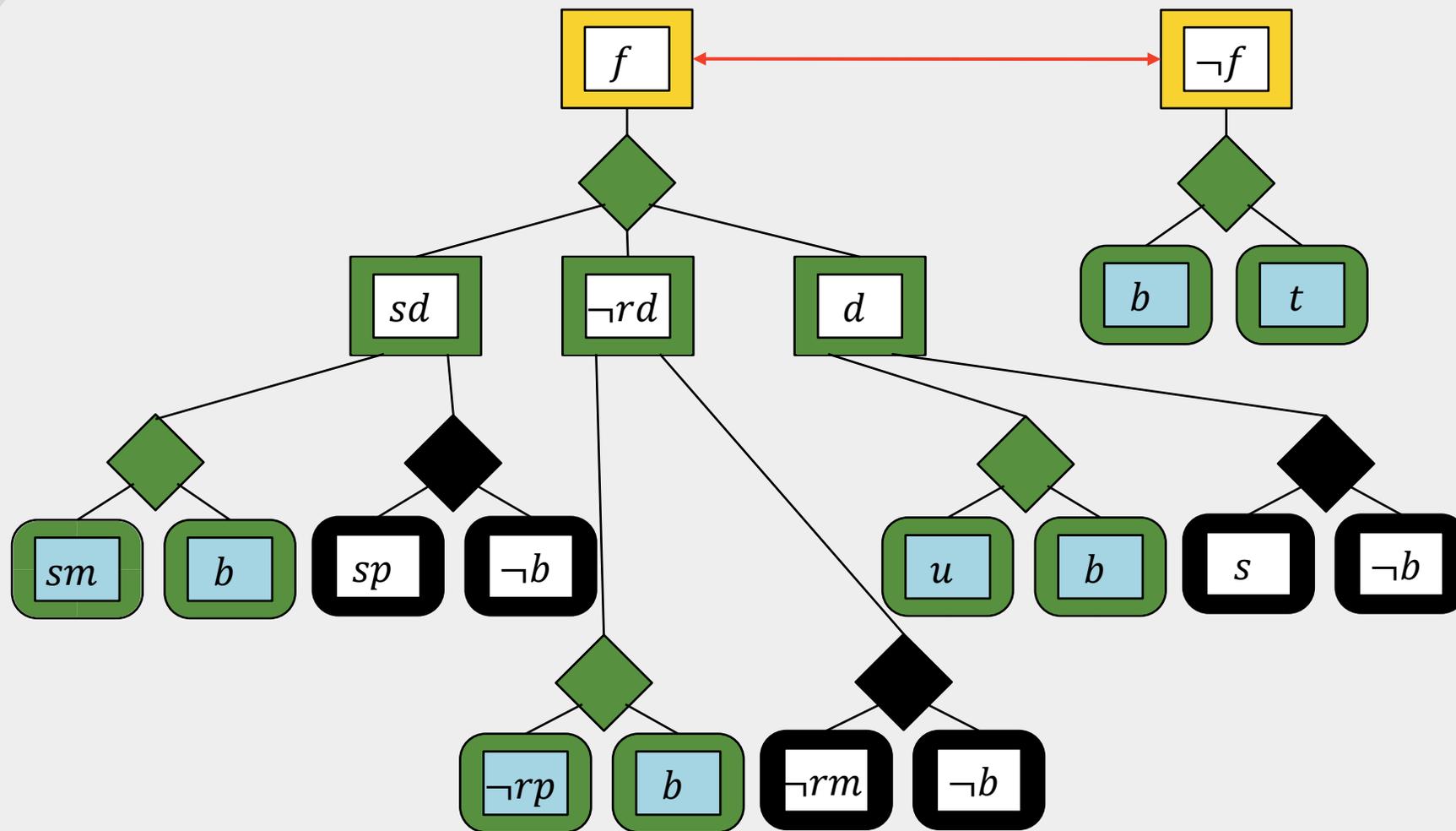
Unsatisfiable	There is no argument for l in $Arg(AS)$
Defended	There exists an argument for l in $Arg(AS)$ that is also in the grounded extension $G(AS)$
Out	There exists an argument for l in $Arg(AS)$ but each argument for l in $Arg(AS)$ is attacked by an argument in the grounded extension $G(AS)$
Blocked	There exists an argument for l in $Arg(AS)$, but no argument for l is in the grounded extension $G(AS)$ and at least one argument for l is not attacked by an argument in $G(AS)$





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Stability

Let $AS = (\mathcal{L}, \mathcal{R}, \mathcal{Q}, \mathcal{K})$ be an argumentation setup.

Future setup $F(AS)$ of AS : Every setup $AS' = (\mathcal{L}, \mathcal{R}, \mathcal{Q}, \mathcal{K}')$ s.t. $\mathcal{K} \subseteq \mathcal{K}' \subseteq \mathcal{Q}$ and \mathcal{K}' is consistent.

A literal $l \in \mathcal{L}$ is **stable** in AS iff

- for each $AS' \in F(AS)$, l is unsatisfiable in AS' ; or
- for each $AS' \in F(AS)$, l is defended in AS' ; or
- for each $AS' \in F(AS)$, l is out in AS' ; or
- for each $AS' \in F(AS)$, l is blocked in AS .



Complexity

Stability problem is **coNP-hard** (reduction UNSAT)

→ probably no **exact** solution in **polynomial time**

What can you do?

- **Exponential** algorithm for **exact** solution
- **Polynomial** algorithm for **approximate** solution



Complexity

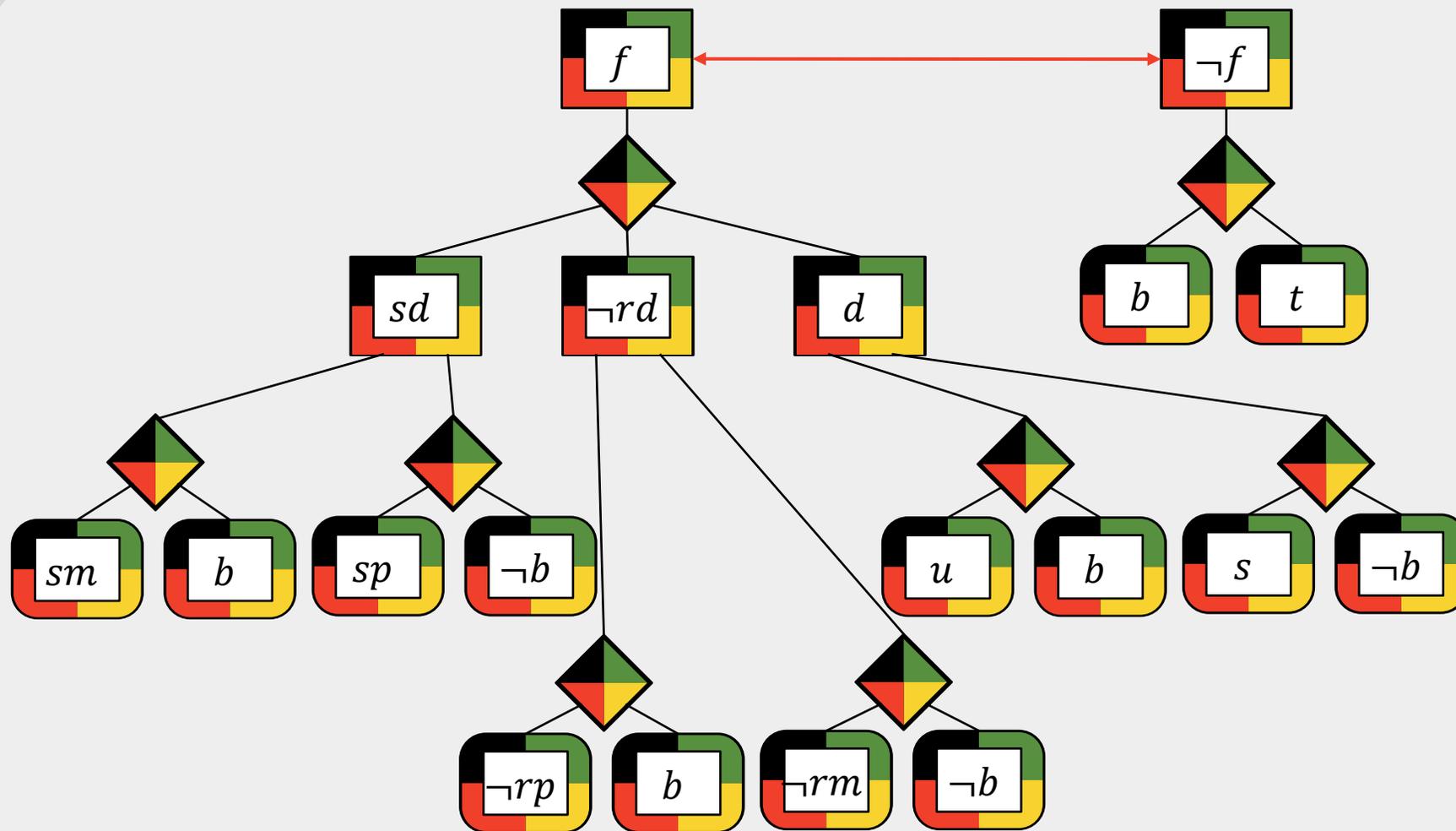
Stability problem is **coNP-hard** (reduction UNSAT)

→ probably no **exact** solution in **polynomial time**

What can you do?

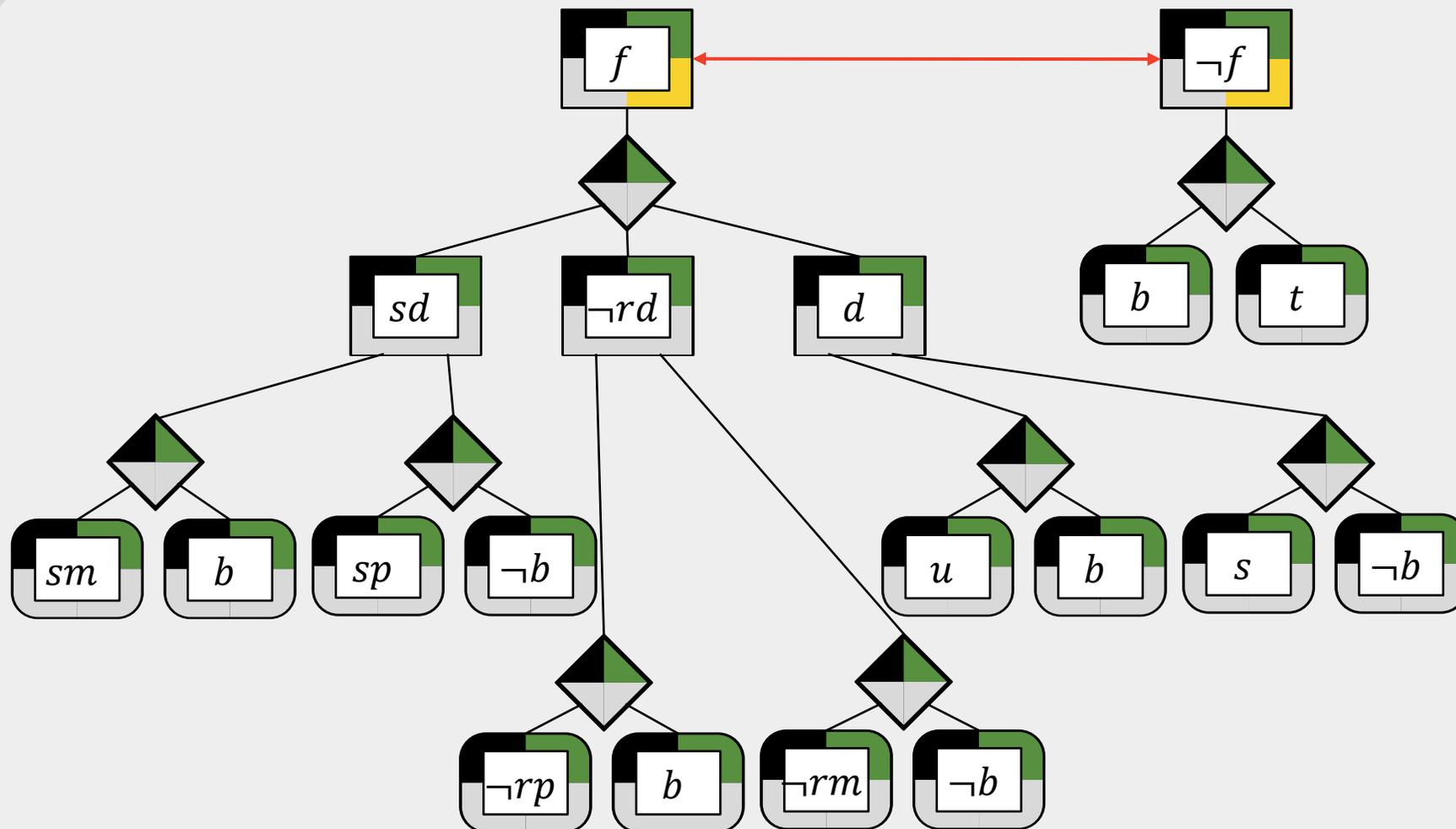
- **Exponential** algorithm for **exact** solution
- **Polynomial** algorithm for **approximate** solution





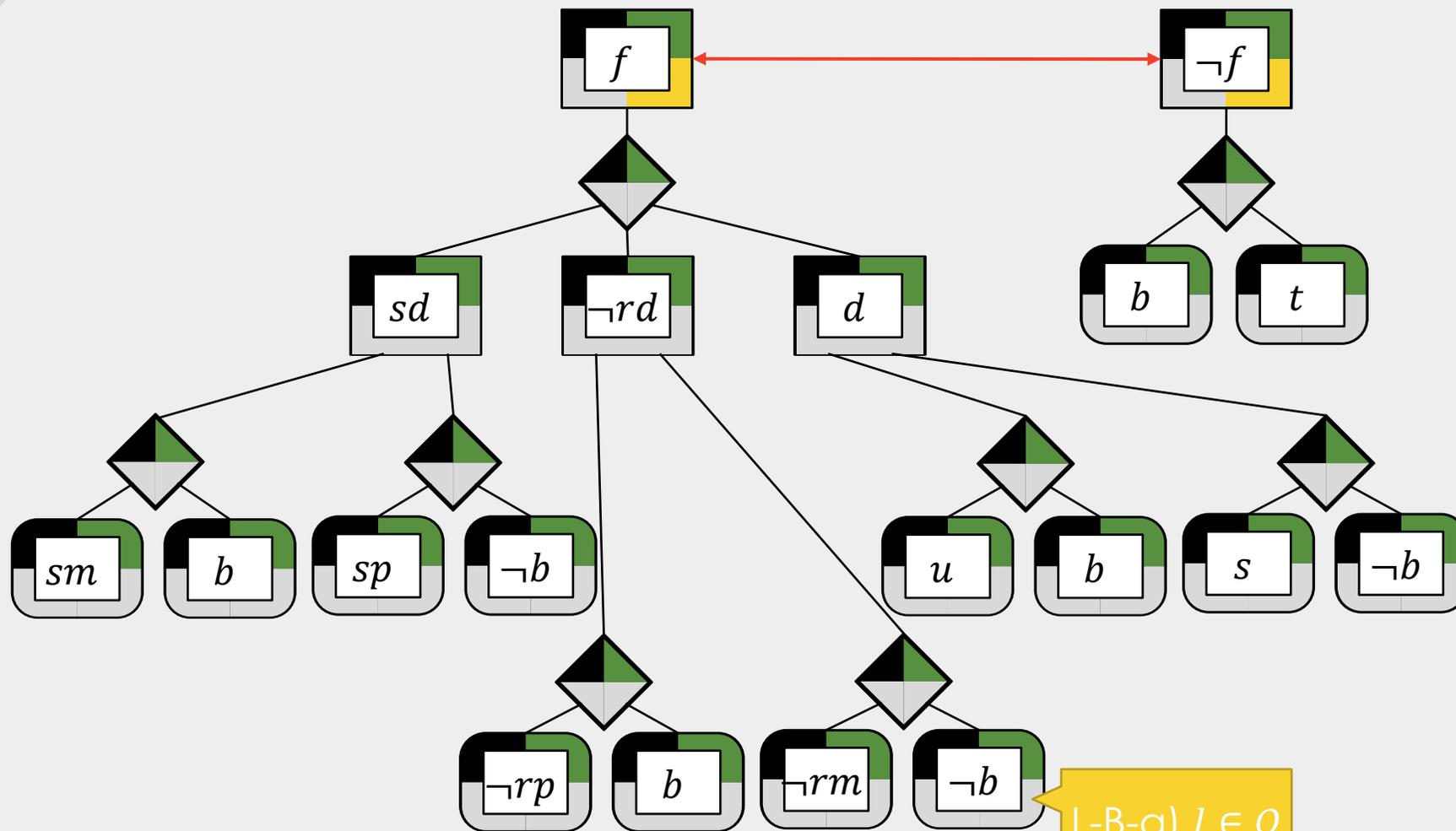
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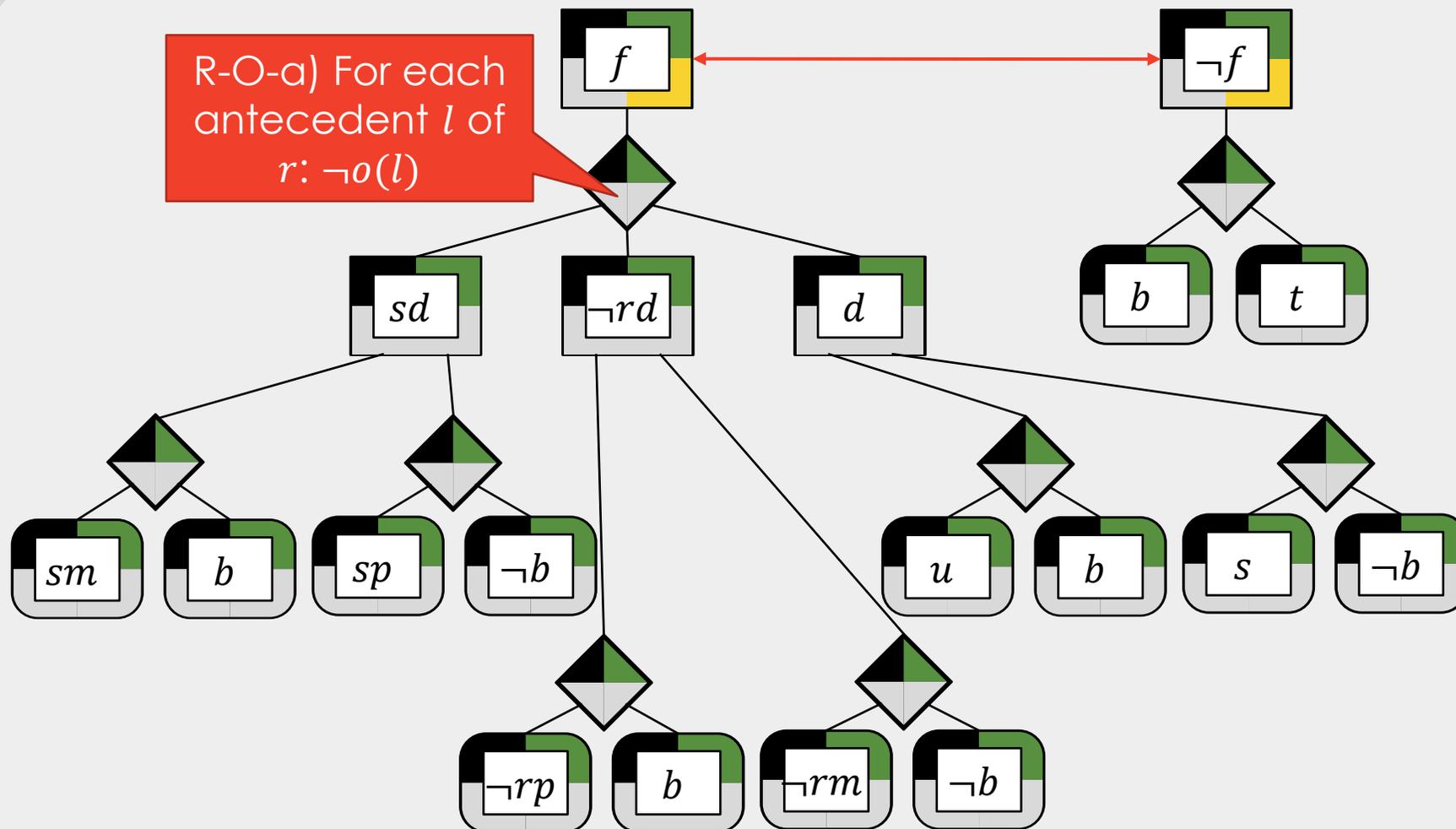
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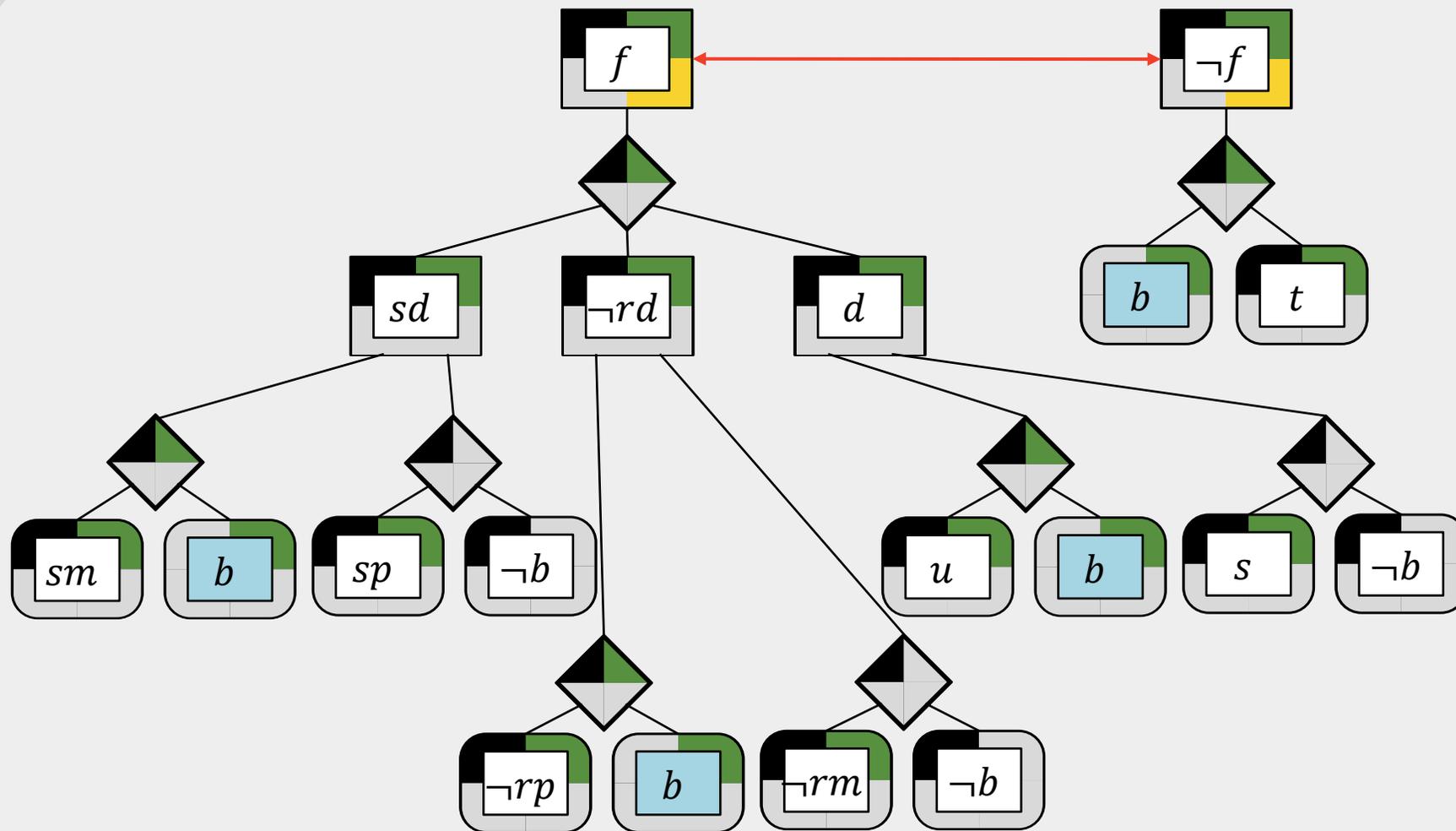
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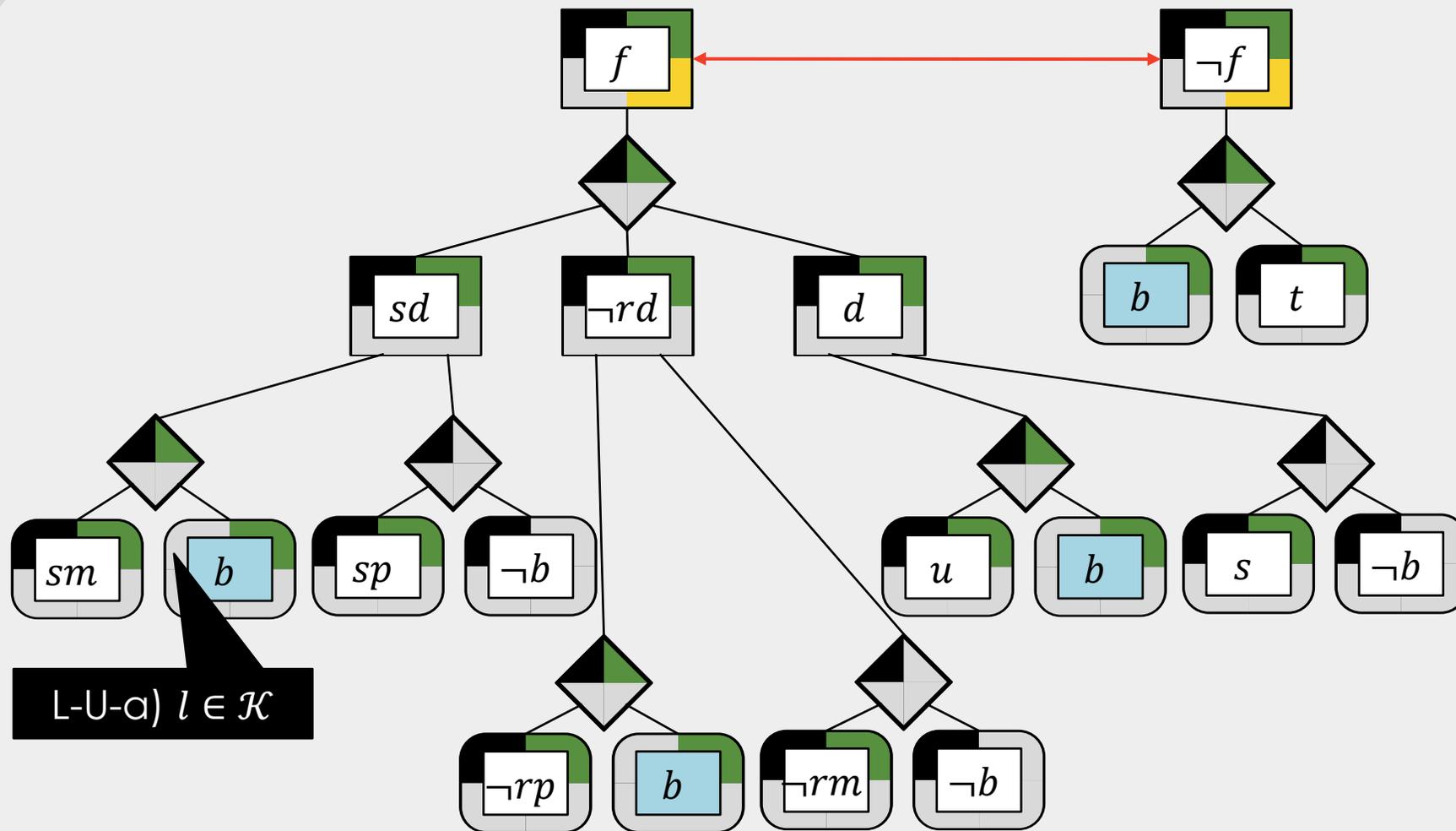
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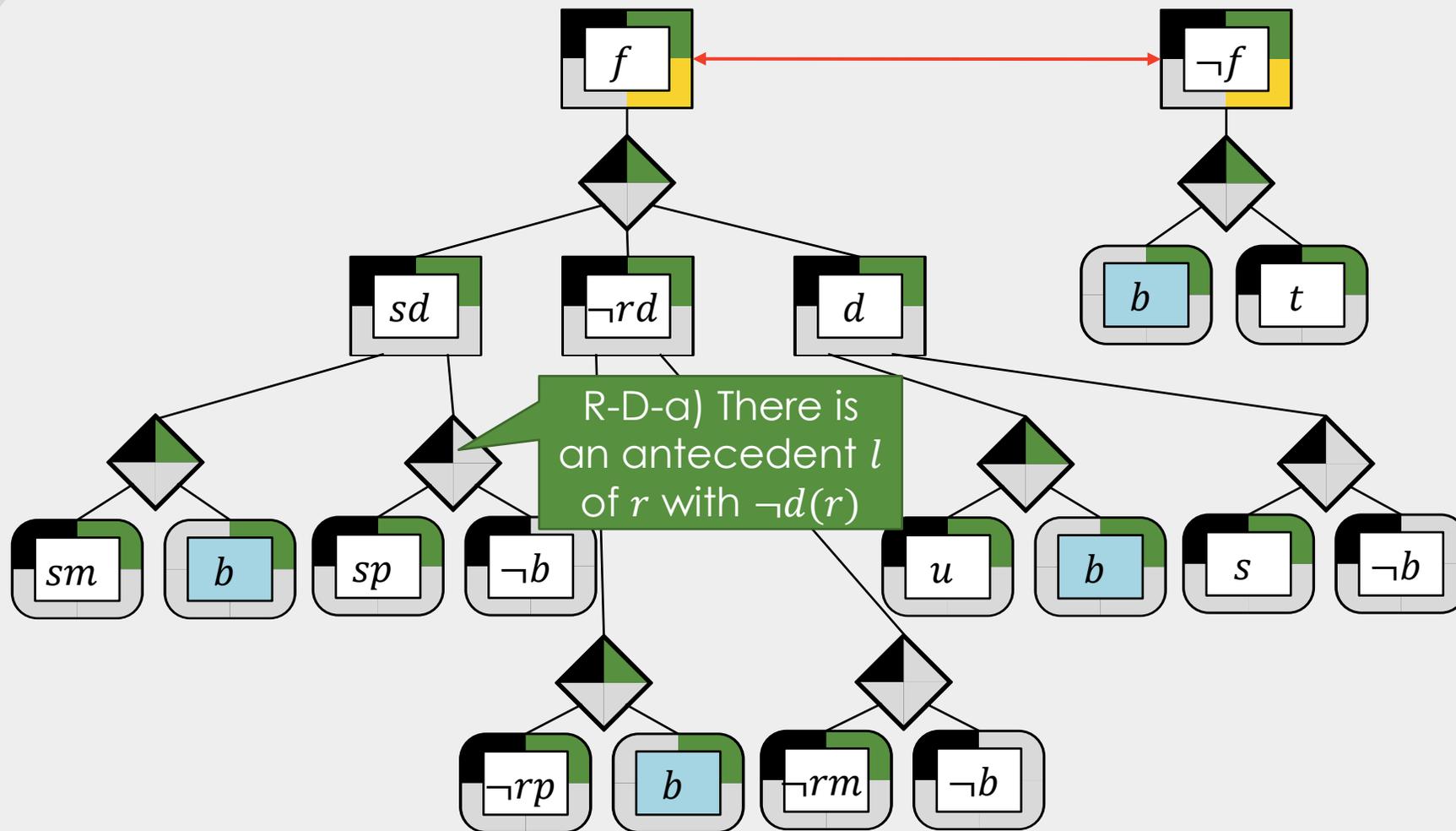
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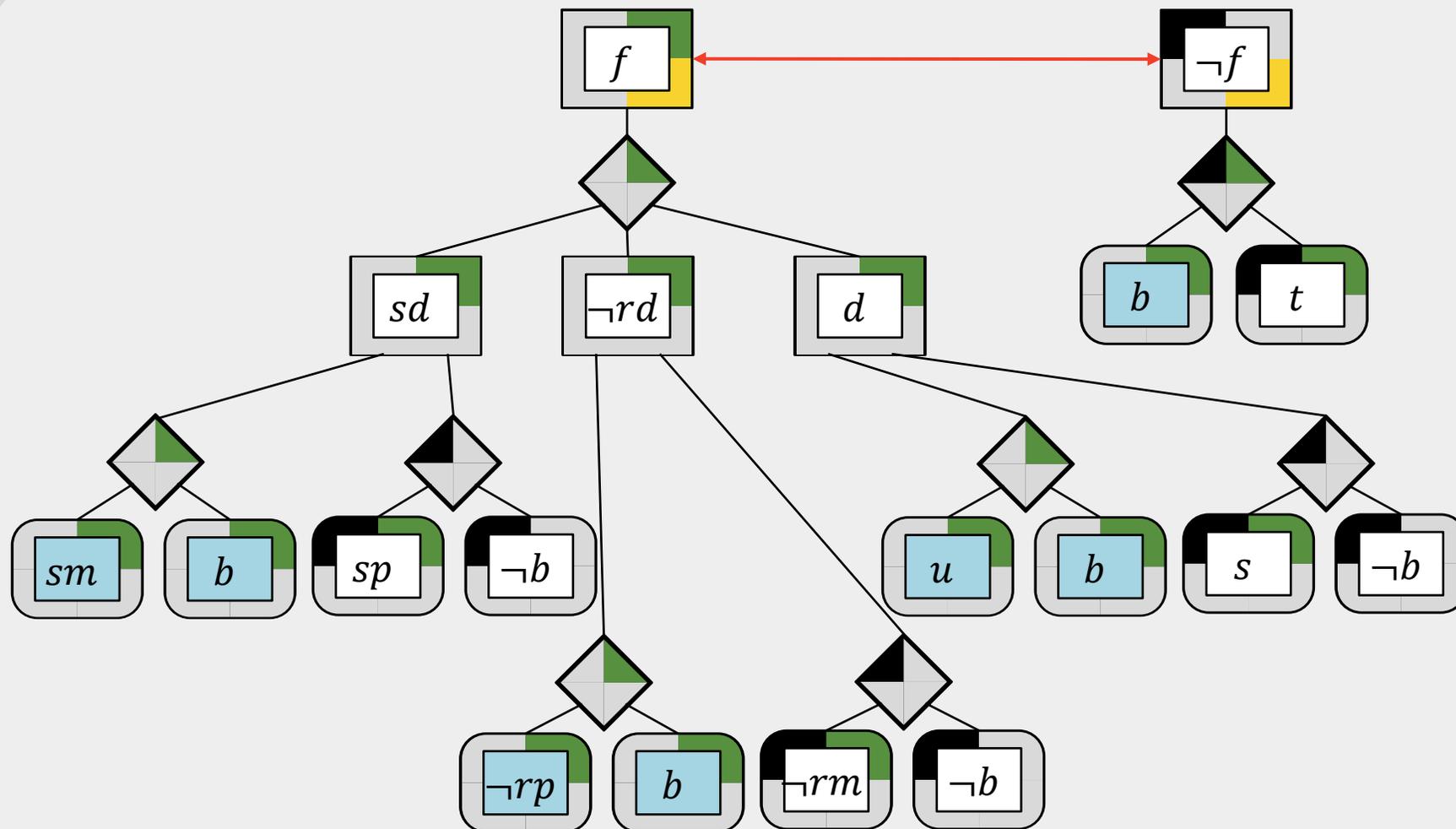
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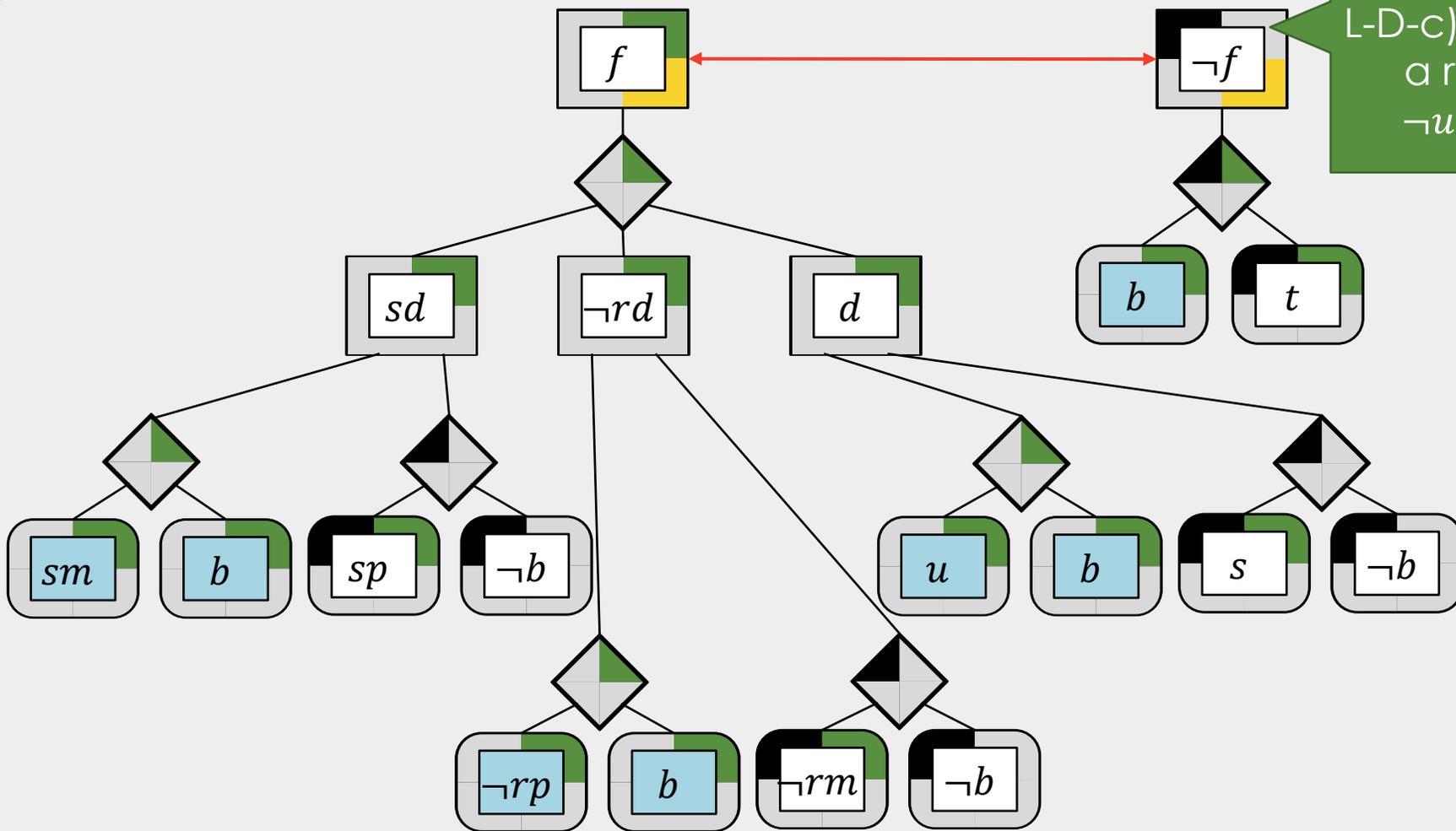
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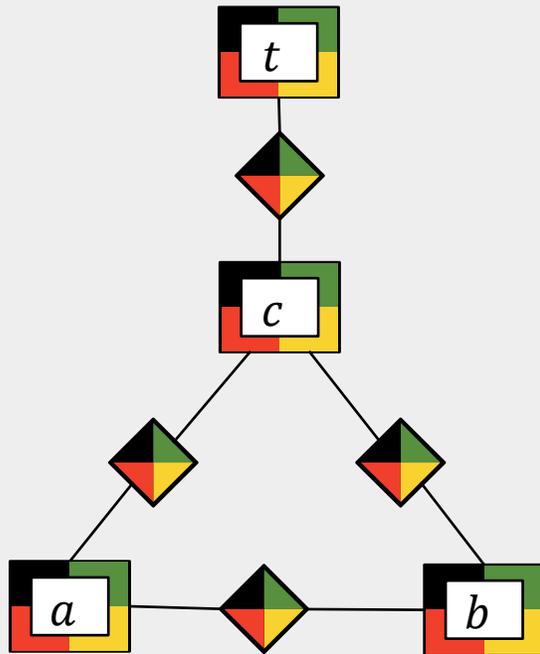


L-D-c) $l \notin \mathcal{Q}$ and there is a rule r' for f with $\neg u(r')$ and $\neg o(r')$

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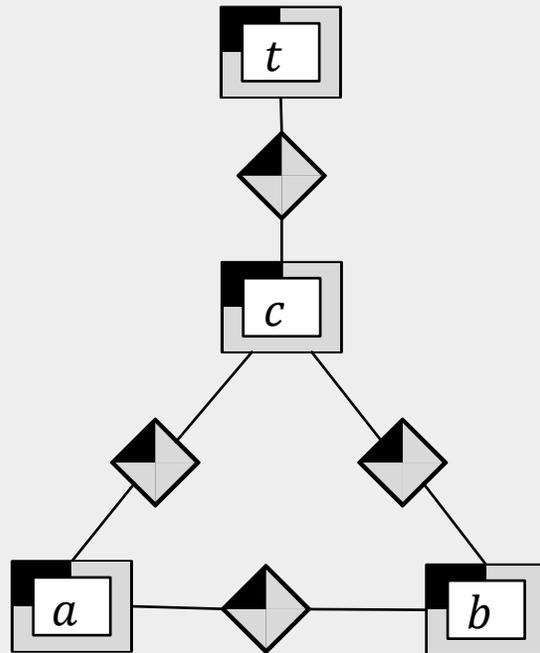
Preprocessing – support cycles



$$\mathcal{L} = \{a, b, c, t, \neg a, \neg b, \neg c, \neg t\}$$
$$\mathcal{R} = \{a \Rightarrow b, b \Rightarrow c, c \Rightarrow a, c \Rightarrow t\}$$
$$\mathcal{Q} = \mathcal{K} = \emptyset$$



Preprocessing – support cycles



$$\mathcal{L} = \{a, b, c, t, \neg a, \neg b, \neg c, \neg t\}$$
$$\mathcal{R} = \{a \Rightarrow b, b \Rightarrow c, c \Rightarrow a, c \Rightarrow t\}$$
$$\mathcal{Q} = \mathcal{K} = \emptyset$$



Properties of the algorithm

- Polynomial

Time complexity: $\mathcal{O}(|\mathcal{L}|^2 \cdot |\mathcal{R}| + |\mathcal{L}| \cdot |\mathcal{R}|^2)$.

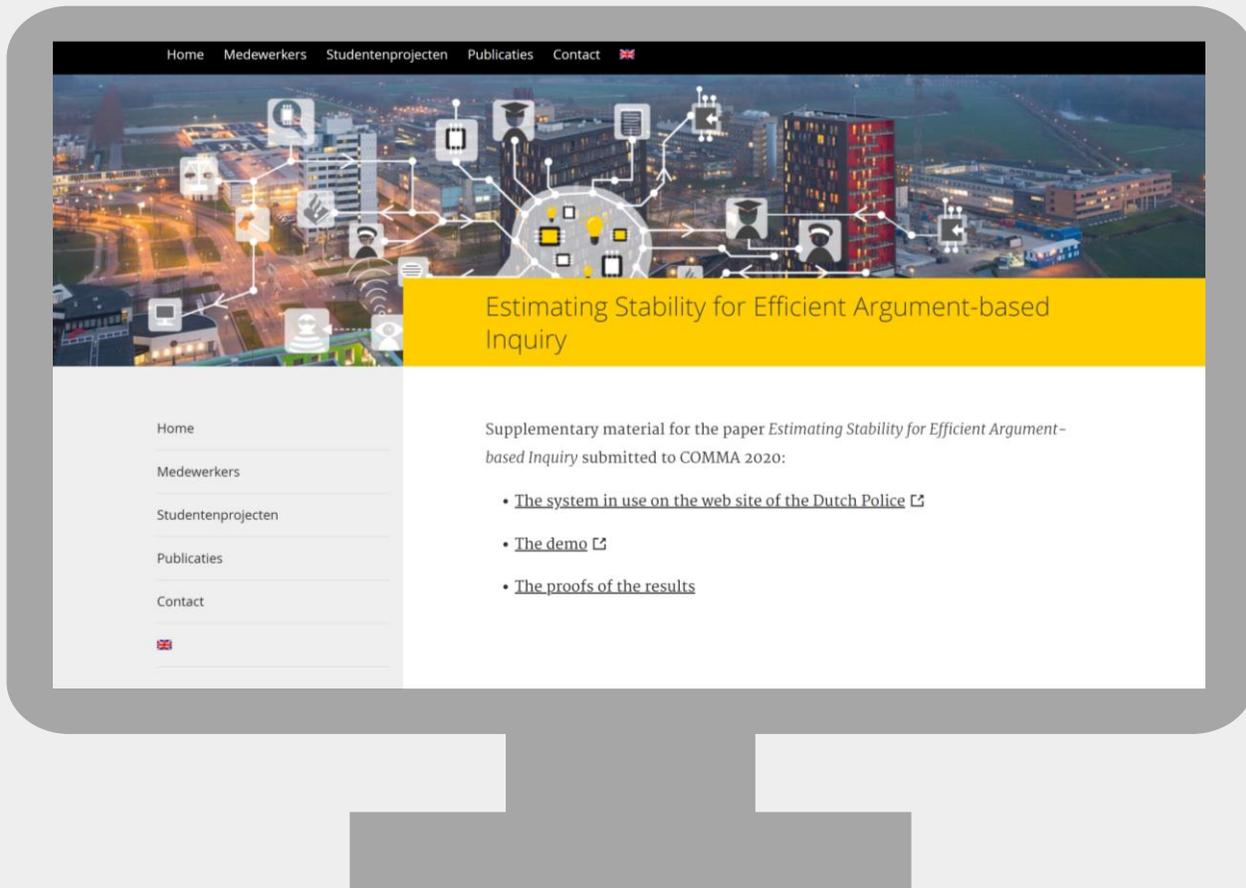
- Sound

If the algorithm says that l is stable in AS , then this is true.

- Complete... under certain conditions

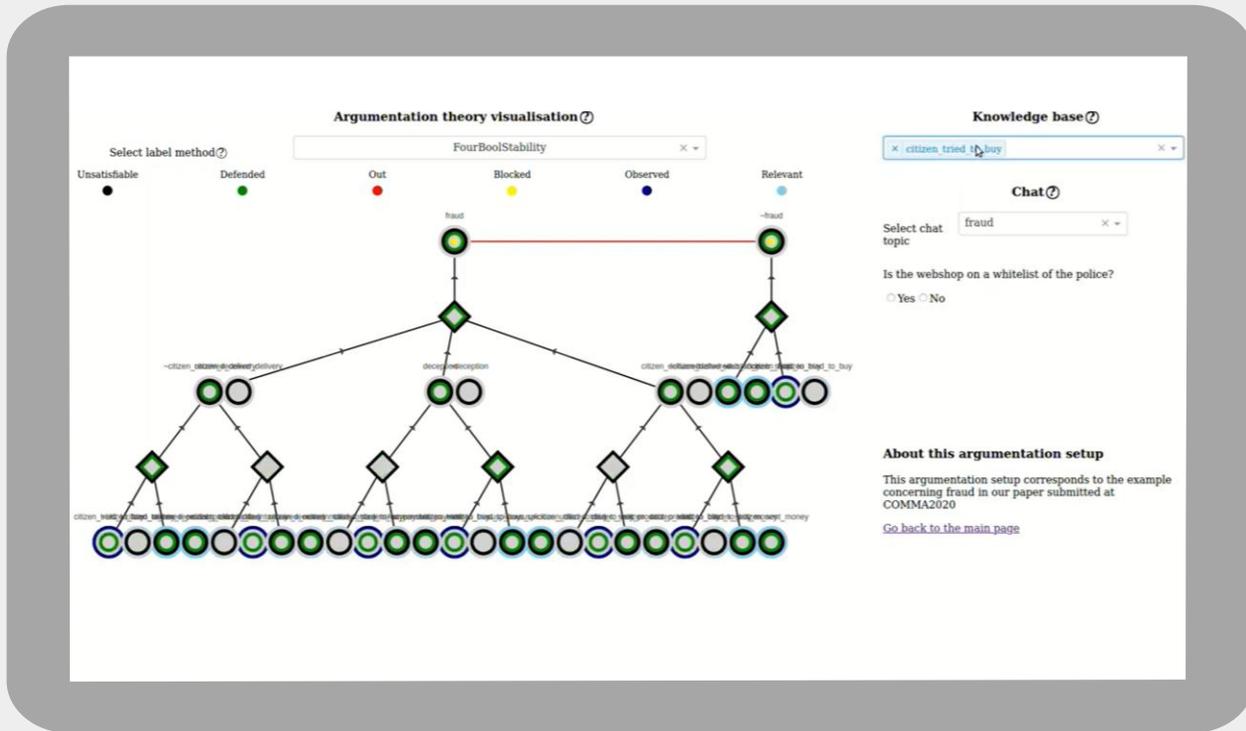
If l is stable in AS , then the algorithm finds this, provided that l is not *inconsistently attacked* or *inconsistently supported* in AS .





<https://nationaal-politielab.sites.uu.nl/estimating-stability-for-efficient-argument-based-inquiry/>





<https://argumentapp.herokuapp.com/>

