Agent Ontology Alignment Repair through Dynamic Epistemic Logic

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Summary

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- Repair alignments when failures occur via adaptation operators
- We introduce a formal framework to model this
- And prove that some adaptation operators are incorrect or redundant, and all are incomplete

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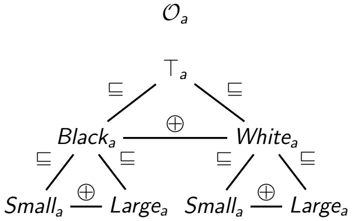

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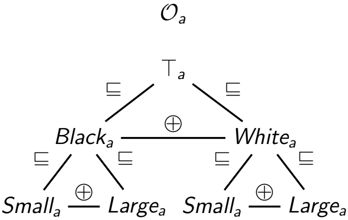

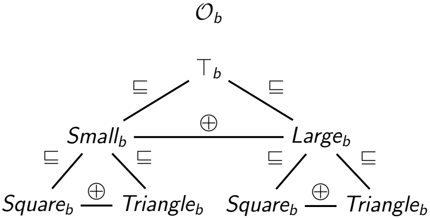

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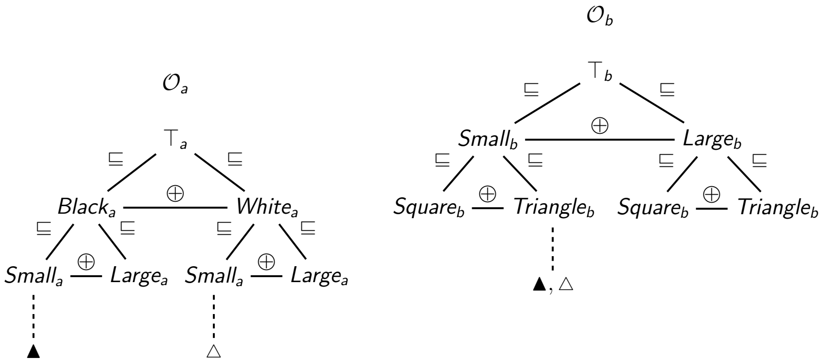

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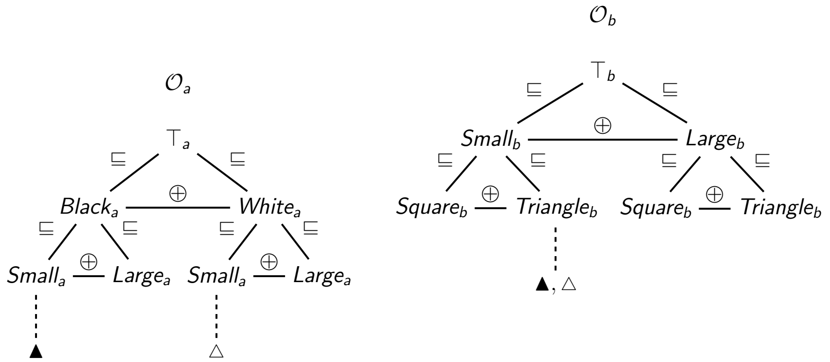

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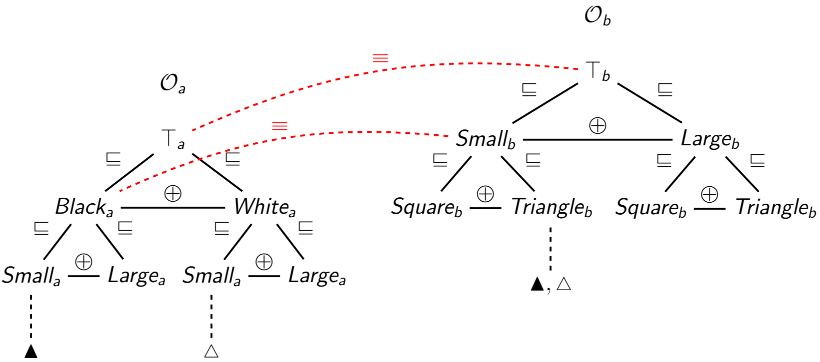

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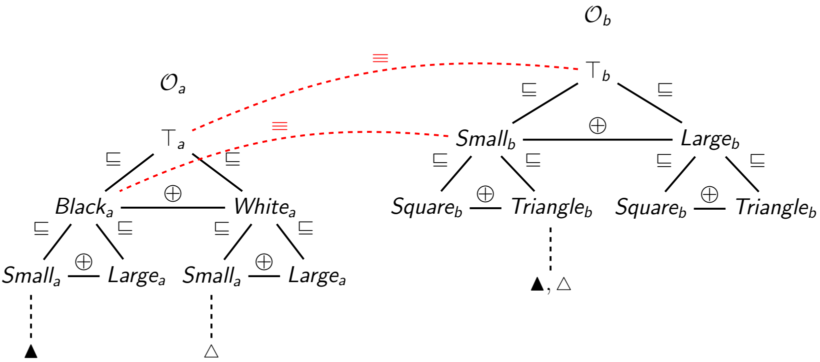

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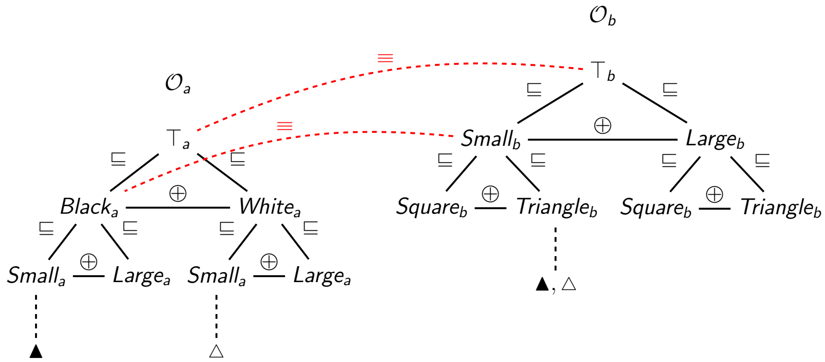

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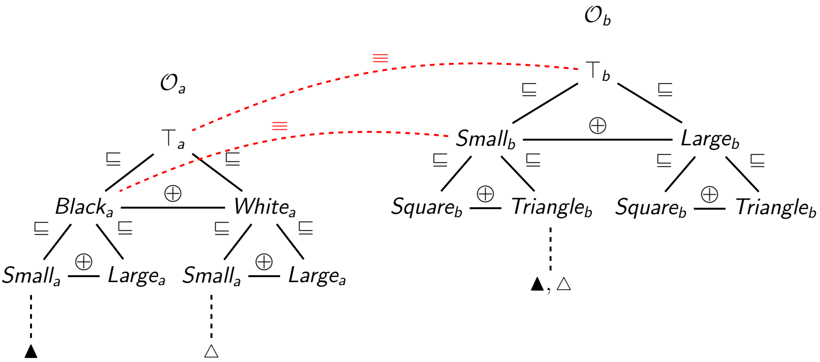
- Alignment Repair Game (ARG)



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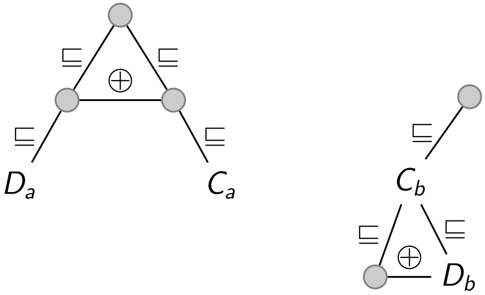

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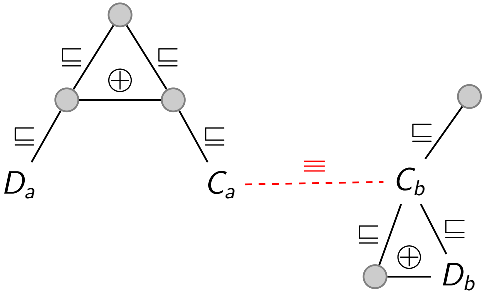

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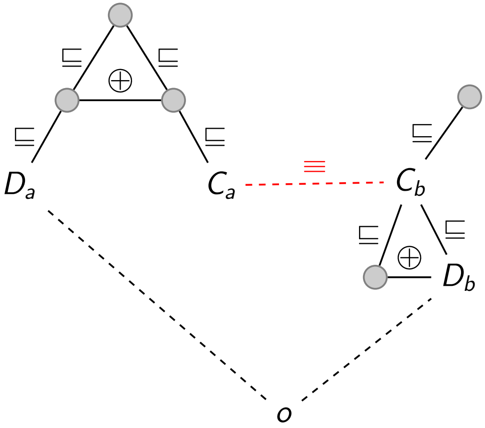

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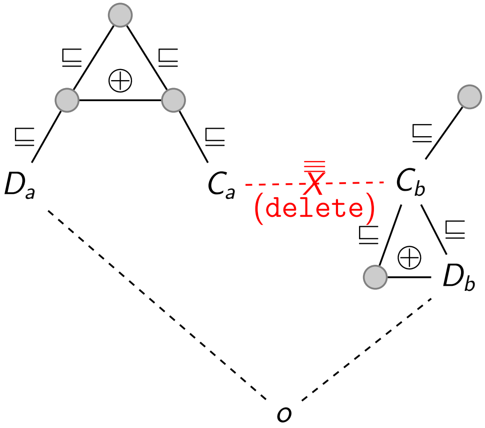

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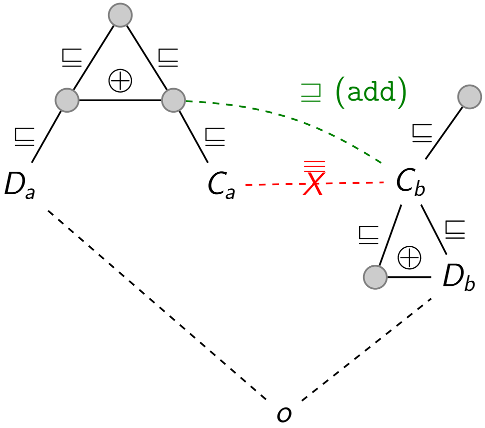

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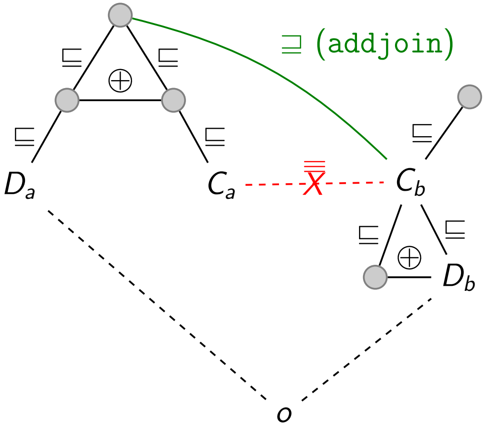

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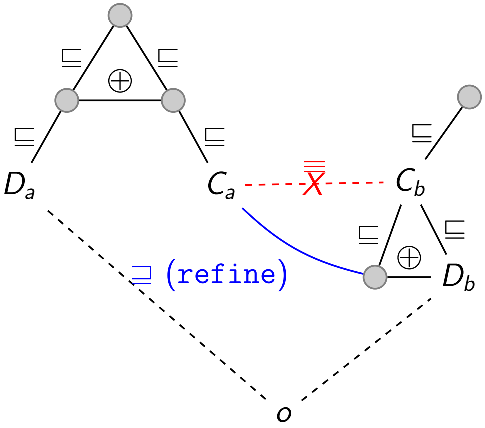

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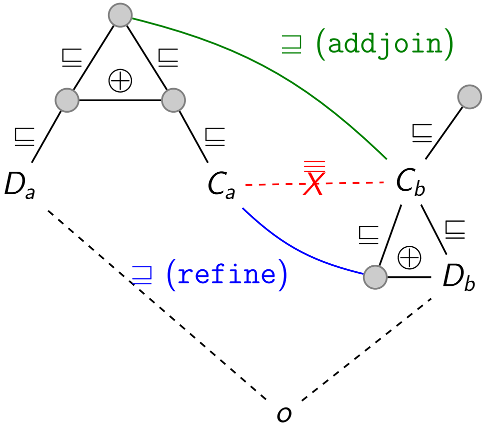

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- But it is an open question whether the adaptation operators are **formally correct**, **complete** or **redundant**?

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To formally establish the correctness, partial redundancy and incompleteness of the adaptation operators.

Dynamic Epistemic Ontology Logic (DEOL): Syntax

Definition (DEOL Syntax)

The *syntax*, $\mathcal{L}_{DEOL}$, of (multi-agent) DEOL is defined by:

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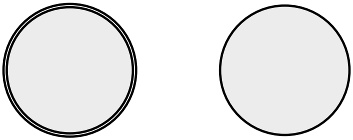
Dynamic Epistemic Ontology Logic (DEOL): Models



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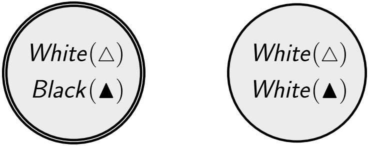

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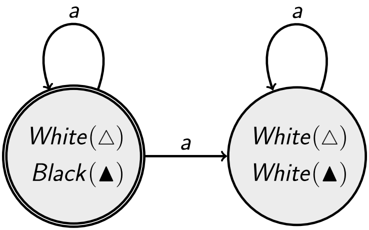

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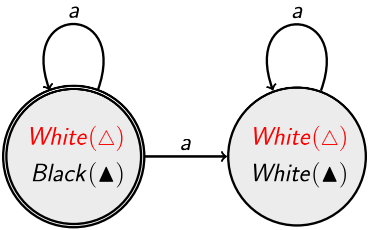

$K_a White(\triangle)$ "Agent a knows that △ belongs to the class White"

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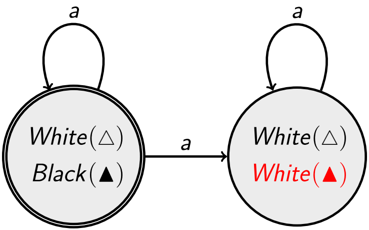

$B_a White(\blacktriangle)$ "Agent a believes that ▲ belongs to the class White"

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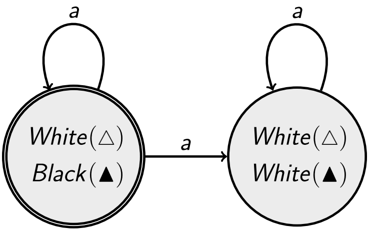

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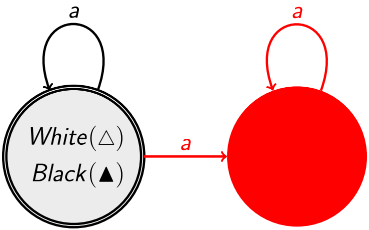

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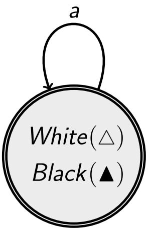

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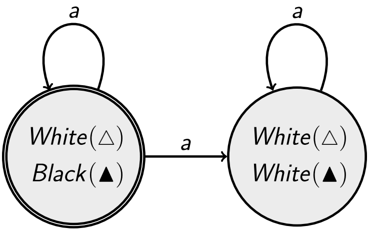

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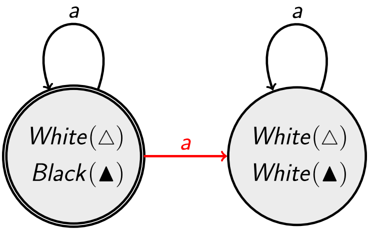

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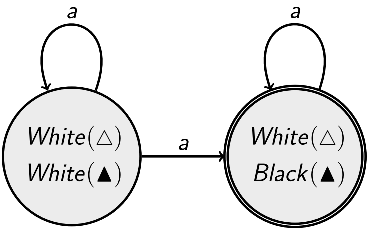

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$$\mathcal{M}, w \models [!\phi]\psi \quad \text{iff } \mathcal{M}^{!\phi}, w \models \psi$$

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Translation

ARG state (s)

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$$\text{ARG state } (s) \xrightarrow{z} \text{DEOL axioms}$$

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$$\text{ARG state } (\alpha(s))$$

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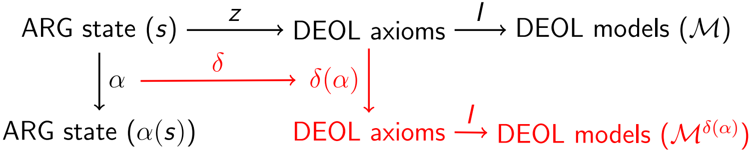

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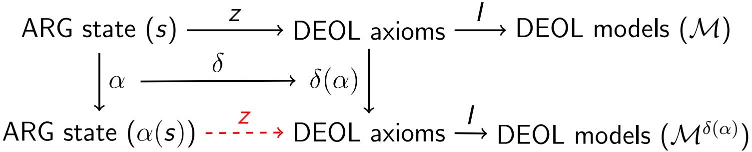

Semantics of ARG states

$$
\begin{array}{ccccc}
\text{ARG state } (s) & \xrightarrow{\color{red}{z}} & \text{DEOL axioms} & \xrightarrow{I} & \text{DEOL models } (\mathcal{M}) \\
\downarrow \alpha & \xrightarrow{\delta} & \delta(\alpha) \downarrow & & \\
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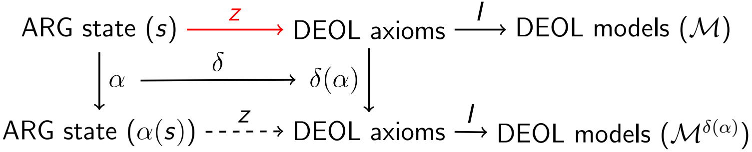

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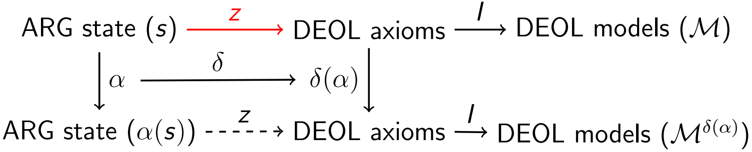

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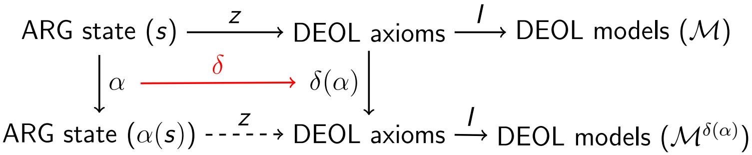
Public Signature Awareness (PSA) All signatures are known to all agents

Dynamics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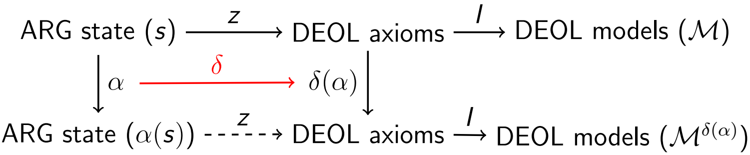

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$$!C_b(o);\ \text{if}\ \neg C_a(o)\ \text{then}\ \delta(\alpha_{\langle C_a, C_b, \sqsupseteq \rangle(o)})$$

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\delta(\texttt{refine}) &= \uparrow(C_a \not\sqsupseteq C_b \ \wedge\ \bigwedge\{C_a \sqsupseteq C_b^{sub}\})
\end{aligned}$$

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\delta(\texttt{refine}) &= \uparrow (C_a \not\sqsupseteq C_b \quad \wedge \; \bigwedge \{C_a \sqsupseteq C_b^{sub}\}) \\
\delta(\texttt{refadd}) &= \texttt{addjoin} \qquad \wedge \; \texttt{refine}
\end{aligned}$$

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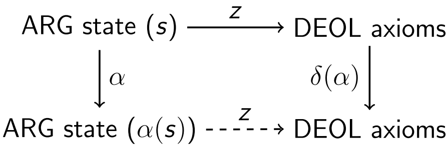

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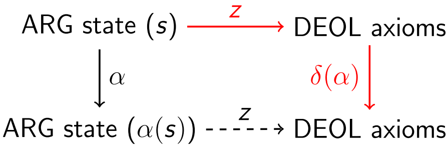

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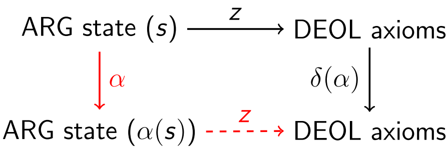

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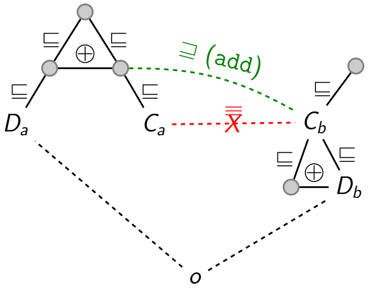

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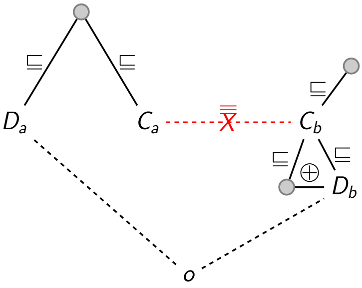

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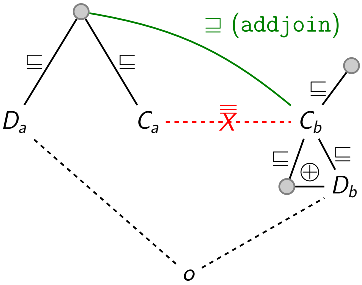

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$$
\begin{array}{ccc}
\text{ARG state } (s) & \xrightarrow{\;z\;} & \text{DEOL axioms} \\
\downarrow \alpha & & \delta(\alpha) \downarrow \\
\text{ARG state } (\alpha(s)) & \dashrightarrow^{z} & \text{DEOL axioms}
\end{array}
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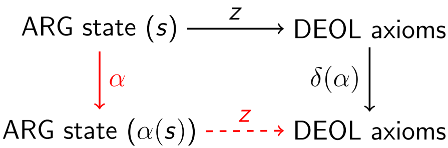

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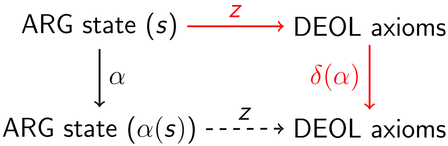

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After announcing $!C_b(o)$ the agents acquire knowledge $K_a(C_b(o))$ that is discarded in ARG. □

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- Agents in ARG do not posses full logical behavior

Thank you!