Logics with Copy and Remove

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Information Change - Example

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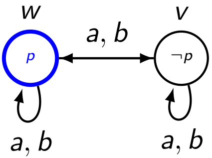

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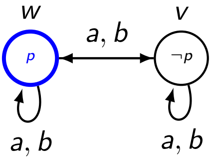

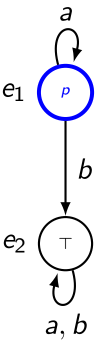

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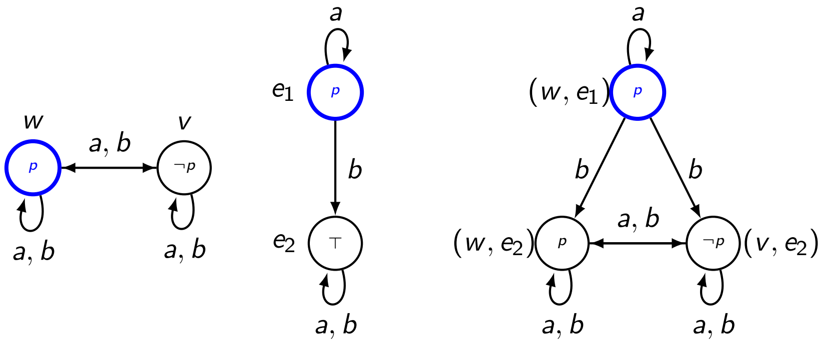

$\mathcal{M}, w \models [\mathcal{E}, e_1]p$ $\quad$ $\mathcal{E}, e_1$ $\quad$ $\mathcal{M} \otimes \mathcal{E}, (w, e_1) \models p$

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- New approach: define product updates in terms of two primitives: copy & remove.

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  - Copy, replicates the original model keeping the accessibility relation between different copies.
  - Remove, deletes paths on the accessibility relation.

The Logic - Syntax

Given PROP, an infinite and countable set of propositional symbols, and AGT, a finite set of agents, let us define the set FORM of $\mathcal{ML}(\mathsf{cp}, \mathsf{rm})$-formulas, together with a set PATH of path expressions.

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$$\mathrm{FORM} ::= \bot \mid p \mid \neg\varphi \mid \varphi \wedge \varphi' \mid \Diamond_a \varphi \mid \mathrm{rm}(\pi)\varphi \mid \mathrm{cp}(\bar{p}, q)\varphi,$$

where $\bar{p} = \langle p_1, \ldots, p_n \rangle \in \mathrm{PROP}^n$ not appearing in any occurrence of cp in φ, $q \in \bar{p}$, $a \in \mathrm{AGT}, \varphi, \varphi' \in \mathrm{FORM}$, and $\pi \in \mathrm{PATH}$.

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$$\text{PATH} ::= a \mid \pi; \pi' \mid \varphi?,$$

where $a \in \text{AGT}$, $\pi, \pi' \in \text{PATH}$ and φ is a **Boolean** formula.

The Logic - Paths & Updated Models $1/3$

Let $\mathcal{M} = \langle W, R, V \rangle$ a model and $\pi \in$ PATH. We define the set of π-paths $\mathcal{P}^{\mathcal{M}}(\pi)$ of $\mathcal{M}$ inductively as

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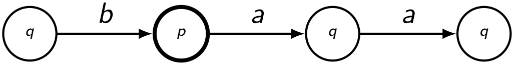
$p?; a; q?$



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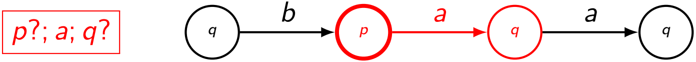

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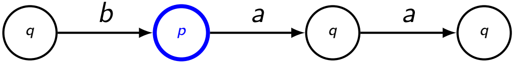

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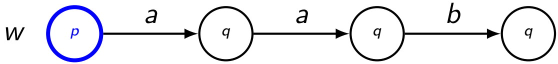

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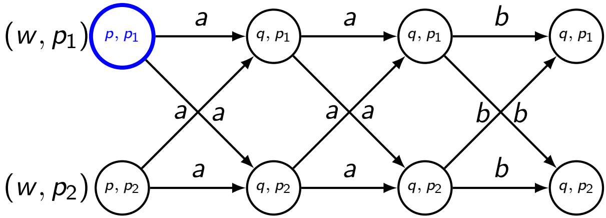
$\mathcal{M}_{\mathsf{cp}(\langle p_1,p_2 \rangle)}$



The Logic - Semantics

Given a pointed model $\mathcal{M}, w$ and a formula φ we say that $\mathcal{M}, w$ satisfies φ, and write $\mathcal{M}, w \models \varphi$, when

$$
\begin{array}{lll}
\mathcal{M}, w \models p & \text{iff} & w \in V(p) \\
\mathcal{M}, w \models \neg\varphi & \text{iff} & \mathcal{M}, w \not\models \varphi \\
\mathcal{M}, w \models \varphi \wedge \psi & \text{iff} & \mathcal{M}, w \models \varphi \text{ and } \mathcal{M}, w \models \psi \\
\mathcal{M}, w \models \Diamond_a \varphi & \text{iff} & \text{for some } v \in W \text{ s.t. } (w, v) \in R_a,\ \mathcal{M}, v \models \varphi \\
\mathcal{M}, w \models \mathsf{rm}(\pi)\varphi & \text{iff} & \mathcal{M}_{\mathsf{rm}(\pi)}, w \models \varphi \\
\mathcal{M}, w \models \mathsf{cp}(\bar{p}, q)\varphi & \text{iff} & \mathcal{M}_{\mathsf{cp}(\bar{p})}, (w, q) \models \varphi.
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φ is satisfiable if for some pointed model $\mathcal{M}, w$ we have $\mathcal{M}, w \models \varphi$.

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(Zig) if $(w, v) \in R_a$ then for some v', $(w', v') \in R'_a$ and vZv';

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Theorem (Invariance under bisimulation.)

$\mathcal{M}, w \leftrightarrows_{\mathcal{ML}(\mathrm{cp},\mathrm{rm})} \mathcal{M}', w'$ *implies* $\mathcal{M}, w \equiv_{\mathcal{ML}(\mathrm{cp},\mathrm{rm})} \mathcal{M}', w'$.

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Theorem

Let φ an $\mathcal{AML}$-formula, then φ and $\mathrm{Tr}(\varphi)$ are equivalent.

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Thanks!