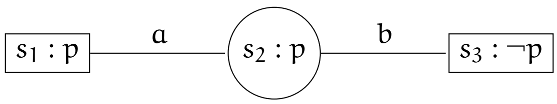
Dynamic Epistemic Logic

Multipointed models and ontic effects

Multipointed models

Definition 1 *Let* $\langle M, \sim, V \rangle$ *be an epistemic model and* $\emptyset \neq S_d \subseteq S$. *Then* (M, S_d) *is a multipointed model. If* $S_d = \{s\}$ *then* (m, S_d) *is a global state. If* S_d *is closed under indistinguishability for some agent* a *(i.e. if* $s \in S_d$ *and* $s \sim_a s'$ *implies* $s' \in S_d$, *then* (m, S_d) *is local for agent* a. *Given a global state* $(m, \{s\})$, *the associated local state for agent* a *is* $(m, \{s' \in S | s \sim_a s'\})$.

Example 1



Note: Bisimulation definition has to be adapted to related designated worlds in one model to designated worlds in the other model

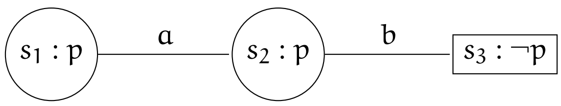
Definition 2 $m, S_d \models \phi$ *iff* $m, s \models \phi \ \forall s \in S_d$

Note: If m, S_d is local for some agent a, then $m, S_d \models K_a\phi$ iff $m, S_d \models \phi$

Definition 3 *Let* $m = \langle M, \sim, pre \rangle$ *be an action and* $\emptyset \neq S_d \subseteq S$. *Then we call* (m, S_d) *a multipointed action model*

Definitions of local/global/associated local (action) model stay the same.

Example 2



Note: Action (m, S_d) behaves similarly to the nondeterministic choice over different events $(m, s_1) \vee (m, s_2) \vee .... \vee (m, s_n)$ if $S_d = \{s_1, s_2, ..., s_n\}$

Example 3

The associated local action for b The associated local action for b

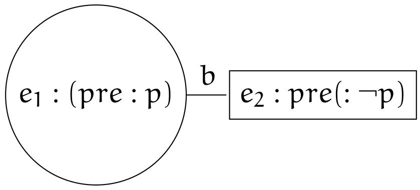


Figure 1: Read

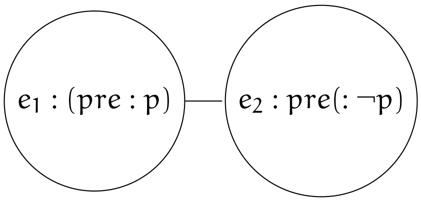


Figure 2: Read

Ontic effects

Definition 4 *An action model with ontic effects* $m = \langle S, \sim, \mathrm{pre}, \mathrm{eff} \rangle$ *is an action model* $\langle S, \sim, \mathrm{pre} \rangle$ *together with a function* $\mathrm{eff} : S \rightarrow \mathcal{L}_{KC}(P, A)$ *where* $\mathrm{forall} s \in S$ *eff(s) is a conjunction of atoms from p and negated atoms from P.*

Note:Corresponds to add and delete lists in STRIPS planning
Note: Can again be multipointed

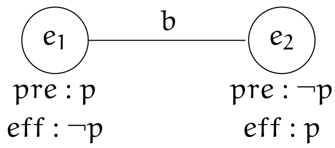


Figure 3: Toggle-p

Definition 5 *Let* $M = \langle S, \sim, V \rangle$ *be an epistemic state with designated worlds* $S_d \subseteq S$ *and* $m' = \langle S', \sim', \mathrm{pre}, \mathrm{eff} \rangle$ *be an epistemic action with designated events* $S'_d \subseteq S'$*. Then the product update* $(M, S_d) \bigotimes (m', S'_d)$ *is the state* (M'', S''_d) *where:*
$M'' = \langle S'', \sim'', V'' \rangle$ *with:*
$S'' = \{s, \mathcal{S}') \in S \times S' | M, s \models \mathrm{pre}(\mathcal{S})\}$
$(s, \mathcal{S}') \sim''_a (t, \mathcal{T})$ *iff* $s \sim_a t$ *and* $\mathcal{S}' \sim_a \mathcal{T}$ *for all agents*
$V''(p) = \{(s, \mathcal{S}) \in S'' | (M, s \models p \land \mathrm{eff}(\mathcal{S}') \not\models \neg p) \lor \mathrm{eff}(\mathcal{S}') \models p\}$

Definition 6 (m', S'_d) *is applicable in local states* (M, S_d) *iff* $\forall s \in S_d$ *there is atleast some* $\mathcal{S}' \in S'$ *with* $M, s \models \mathrm{pre}(\mathcal{S}')$