



About the Beamer class in presentation making

A short story

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Definition 1 (Plant)

A plant automaton is a tuple $\mathcal{P} = (Q, \Sigma_c, \delta, q)$ where Q is a finite set of states, Σ_c is a set of controller commands, $\delta : Q \times \Sigma_c \mapsto 2^Q$ is the transition function and $q_o \in Q$ is an initial state.

Definition 2 (Controllers)

A controller (strategy) for a plant specified by $\mathcal{P} = (Q, \Sigma_c, \delta, q)$ is a function $C : Q^+ \mapsto \Sigma_c$. A simple controller is a controller that can be written as a function $C : Q \mapsto \Sigma_c$.

Definition 3 (Trajectories)

Let \mathcal{P} be a plant and let $C : Q^+ \mapsto \Sigma_c$ be a controller. An infinite sequence of states $\alpha : q[0], q[1], \dots$ such that $q[0] = q_0$ is called a trajectory of \mathcal{P} if

$$q[i+1] \in \bigcup_{\sigma \in \Sigma_c} \delta(q[i], \sigma)$$

and a C -trajectory if $q[i+1] \in \delta(q[i], C[\alpha[0..i]])$ for every $i \geq 0$. The corresponding sets of trajectories are denoted by $L(\mathcal{P})$ and $L_C(\mathcal{P})$.

For every infinite trajectory $\alpha \in L(\mathcal{P})$:

- ▶ $Vis(\alpha)$ denote the set of all states appearing in α
- ▶ $Inf(\alpha)$ denote the set of all states appearing in α infinitely many times

Definition 4 (Acceptance Condition)

Let $\mathcal{P} = (Q, \Sigma_c, \delta, q)$ be a plant. An acceptance condition for \mathcal{P} is

$$\Omega \in \{(F, \Diamond), (F, \Box), (F, \Diamond\Box), (F, \Box\Diamond), (\mathcal{F}, \mathcal{R}_n)\}$$

where $\mathcal{F} = \{(F_i, G_i)\}_{i=1}^n$ and F, F_i and G_i are certain subsets of Q referred as the good states. The set of sequences of \mathcal{P} that are accepted according to Ω is defined as follows:

$L(\mathcal{P}, F, \Box)$	$\{\alpha \in L(\mathcal{P}) : \text{Vis}(\alpha) \subseteq F\}$	α always remains in F
$L(\mathcal{P}, F, \Diamond)$	$\{\alpha \in L(\mathcal{P}) : \text{Vis}(\alpha) \cap F \neq \emptyset\}$	α eventually visits F
$L(\mathcal{P}, F, \Diamond\Box)$	$\{\alpha \in L(\mathcal{P}) : \text{Inf}(\alpha) \subseteq F\}$	α eventually remains in F
$L(\mathcal{P}, F, \Box\Diamond)$	$\{\alpha \in L(\mathcal{P}) : \text{Inf}(\alpha) \cap F \neq \emptyset\}$	α visits F infinitely often
	$\{\alpha \in L(\mathcal{P}) : \exists i \alpha \in$	α visits F_i infinitely often
$L(\mathcal{P}, \mathcal{F}, \mathcal{R}_n)$	$L(\mathcal{P}, F_i, \Box\Diamond) \cap L(\mathcal{P}, G_i, \Diamond\Box)\}$	and eventually stays in G_i

Definition 5 (*Controller Synthesis Problem*)

*For a plant \mathcal{P} and an acceptance condition Ω , the problem **Synth**(\mathcal{P}, Ω) is: Find a controller C such that $L_C(\mathcal{P}) \subseteq L(\mathcal{P}, \Omega)$ or otherwise show that such a controller does not exist.*

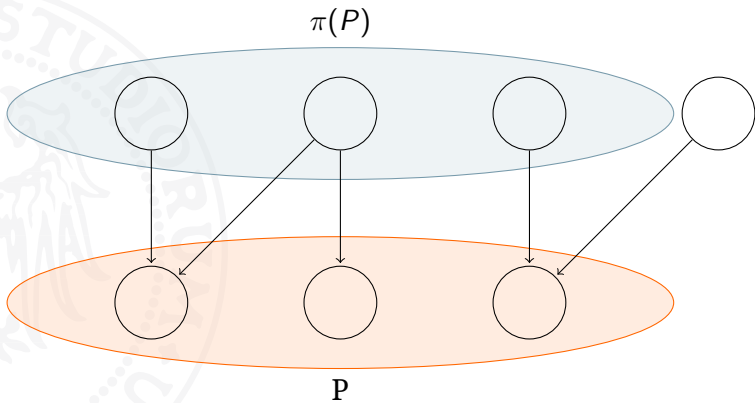
Definition 6 (Controllable Predecessors)

Let $\mathcal{P} = (Q, \Sigma_c, \delta, q)$ be a plant and a set of states $P \subseteq Q$. The controllable predecessors of P is the set of states from which the controller can "force" the plant into P in one step:

$$\{q : \exists \sigma \in \Sigma_c \cdot \delta(q, \sigma) \subseteq P\}$$

We define a function $\pi : 2^Q \mapsto 2^Q$, mapping a set of states $P \subseteq Q$ into the set of its Controllable predecessors:

$$\pi(P) = \{q : \exists \sigma \in \Sigma_c \cdot \delta(q, \sigma) \subseteq P\}$$



Theorem 1

*For every $\Omega \in \{(F, \diamond), (F, \square), (F, \diamond\square), (F, \square\diamond), (\mathcal{F}, \mathcal{R}_n)\}$ the problem **Synth**(\mathcal{P}, Ω) is solvable. Moreover, if (\mathcal{P}, Ω) is controllable then it is controllable by a simple controller.*