Embedded Systems

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Place/Transition Petri Nets

A Place/Transition Petri net is a tuple

$$(P, T, F, K, W, M)$$

where:

- P is a nonempty finite set of places
- T is a nonempty finite set of transitions
- $P \cap T = \emptyset$
- $F \subseteq (C \times E) \cup (E \times C)$ is a flow relation
- $K : P \to \mathbb{N}^+ \cup \{\infty\}$ is a capacity function
- $W : F \to \mathbb{N}^+$ is a weight function
- $M : P \to \mathbb{N}$ is a marking

Activated transitions

A transition $t \in T$ is activated w.r.t. a marking M if:

❶ $(\forall p \in {}^\bullet t) \quad M(p) \geq W(p,t)$

❷ $(\forall p \in t^\bullet) \quad K(p) \geq M(p) + W(t,p)$

Next marking

$$M'(p) = \begin{cases} M(p) - W(p,t) & \text{if } p \in {}^\bullet t \setminus t^\bullet \\ M(p) + W(t,w) & \text{if } p \in t^\bullet \setminus {}^\bullet t \\ M(p) - W(p,t) + W(t,w) & \text{if } p \in {}^\bullet t \cap t^\bullet \\ M(p) & \text{otherwise} \end{cases}$$

$$\underline{t}(p) = \begin{cases} -W(p,t) & \text{if } p \in {}^\bullet t \setminus t^\bullet \\ +W(t,w) & \text{if } p \in t^\bullet \setminus {}^\bullet t \\ -W(p,t) + W(t,w) & \text{if } p \in {}^\bullet t \cap t^\bullet \\ 0 & \text{otherwise} \end{cases}$$

$$M'(p) = M(p) + \underline{t}(p)$$

Place invariants

$R \subseteq P$ is a place invariant if

$$(\forall t \in T) \quad \left[\sum_{p \in R} \underline{t}(p) \right] = 0$$

which is equivalent to

$$(\forall t \in T) \quad \left[\sum_{p \in P} \underline{t}(p) \times c_R(p) \right] = 0$$

where c_R is the characteristic function of R

Thus, to formally generate all place invariants one needs to solve a diophantine linear system in $|T|$ equations and $|P|$ unknowns