Lecture 4

Modelling systems with delays and probabilistic transitions

Background

- Modelling complex systems can involve representing activities which have a time delay associated with them.
- There may also be probabilities associated with transitions which reflect the likellihood that the state transition will take place in a given time step.

Example

- Consider the problem of constructing a simple model of the status of a fleet of cars.
- A car can be in one of several states,
  - Garaged
  - InUse
  - Failed
  - UnderRepair
- Transitions between these states can be modelled occur on the basis of their similarity to a statistical distribution.

Modelling delay and probability

- We know that cars usually operate for a certain time before they fail.
- We also know that cars take a range of times to repair (depending on the fault).
- We know the amount of time a car spends garaged before it is placed into use.
- All these factors can be represented by attaching delays to a transition or place.

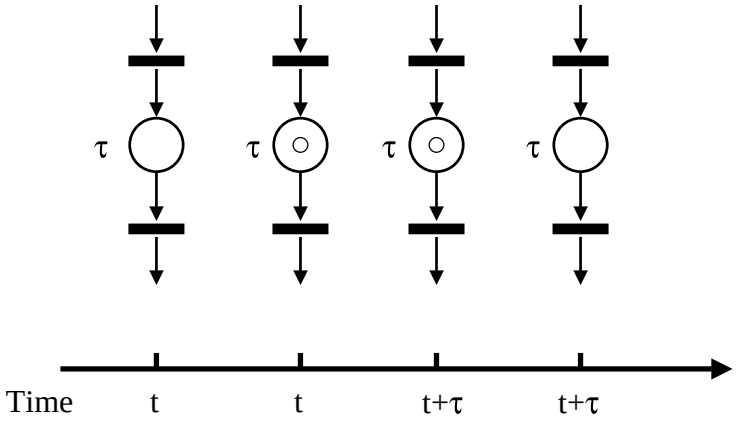
Adding Timing

- Two methods

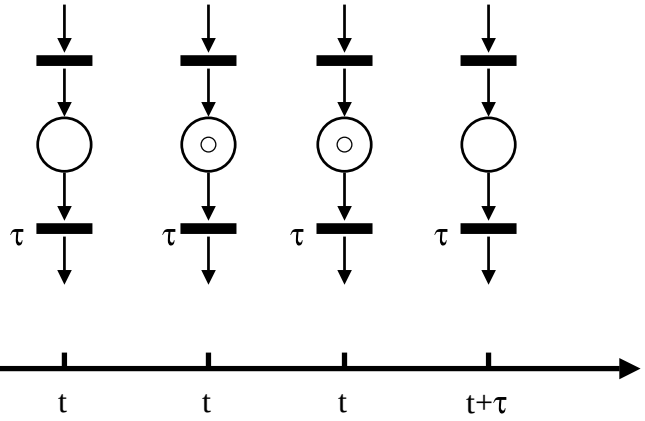
  (i) Place-Timed PN's (PTPN's)

  (ii) Transition-Timed PN's (TTPN's)

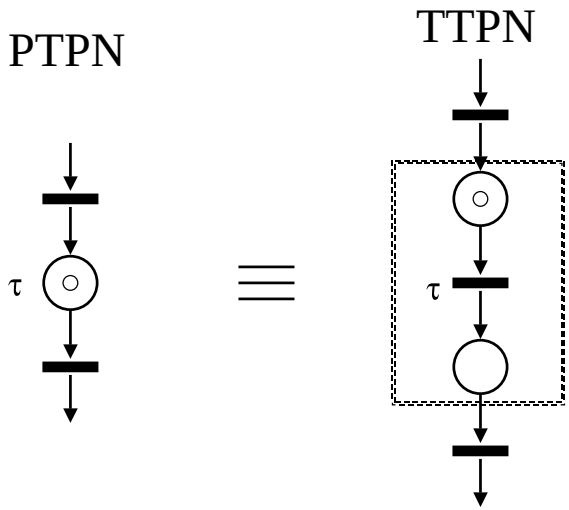
PTPN's



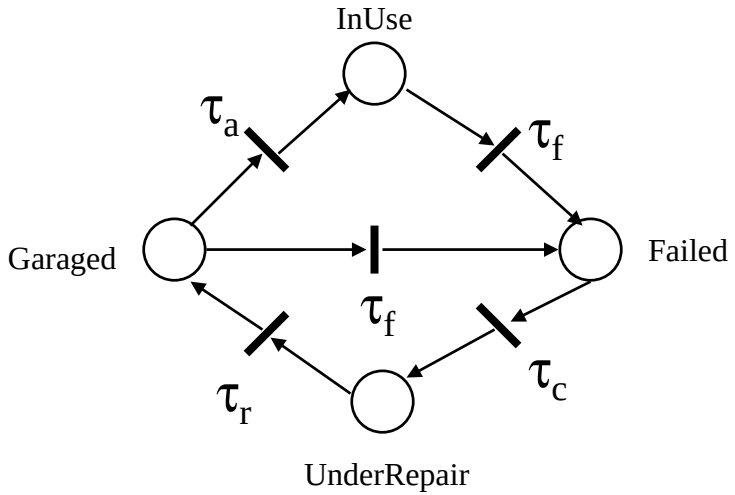
TTPN's



Equivalences



Example cont.



Where

$\tau_a = \exp(\lambda)$

$\tau_f = \text{geom}(\alpha)$

$\tau_r = \exp(\lambda)$

$\tau_c = \exp(\lambda)$