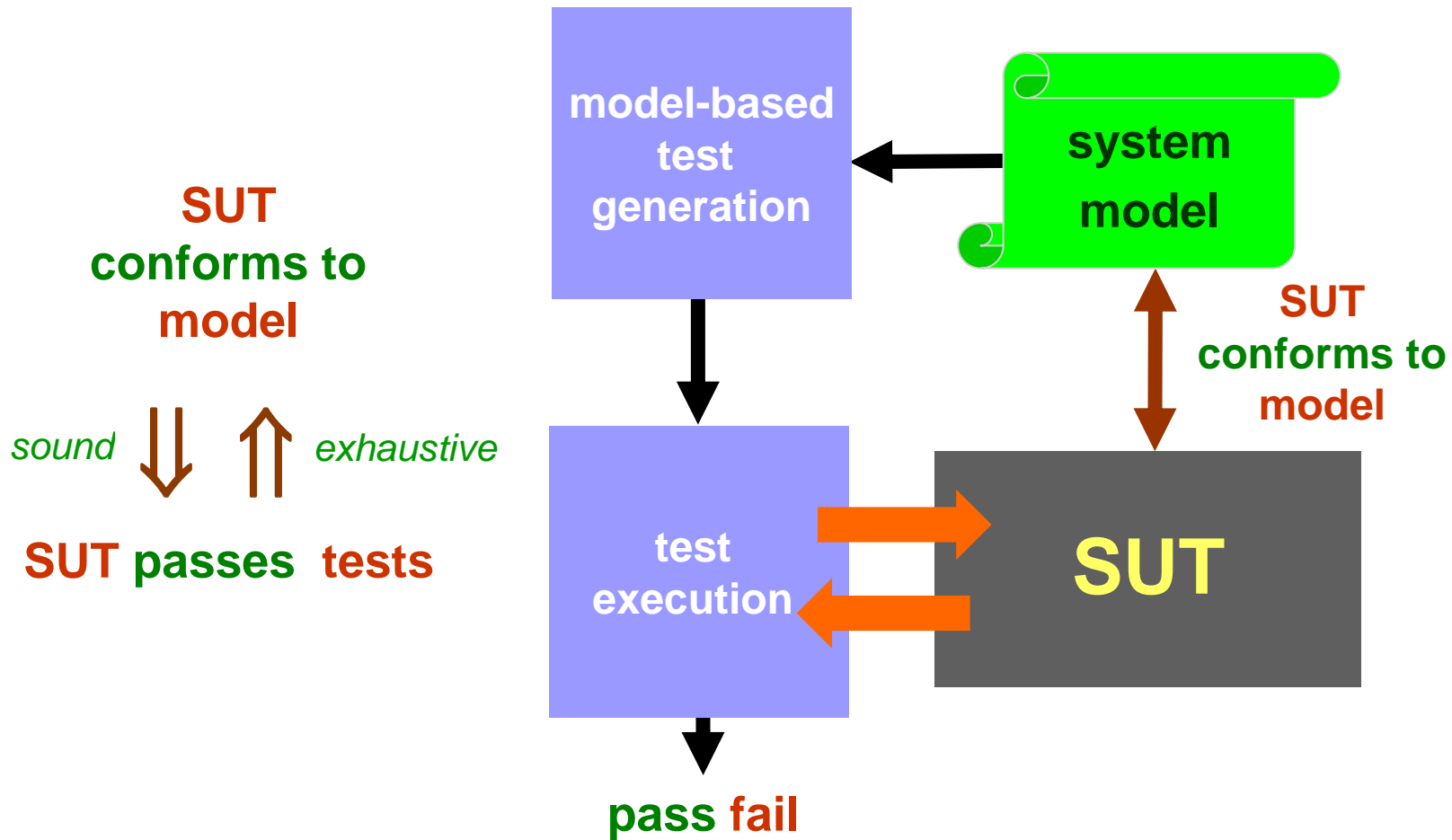
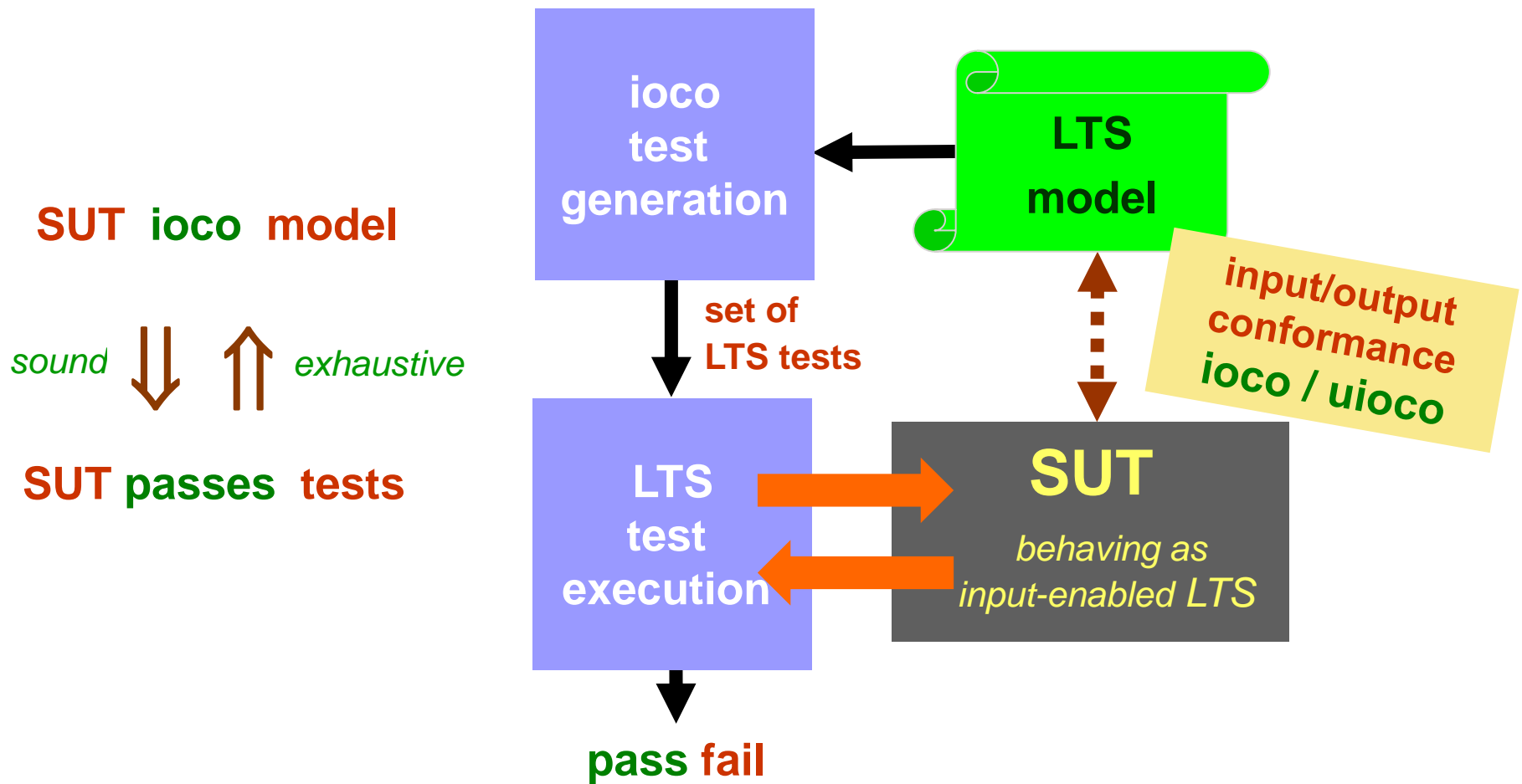


Model-Based Testing with Labelled Transition Systems

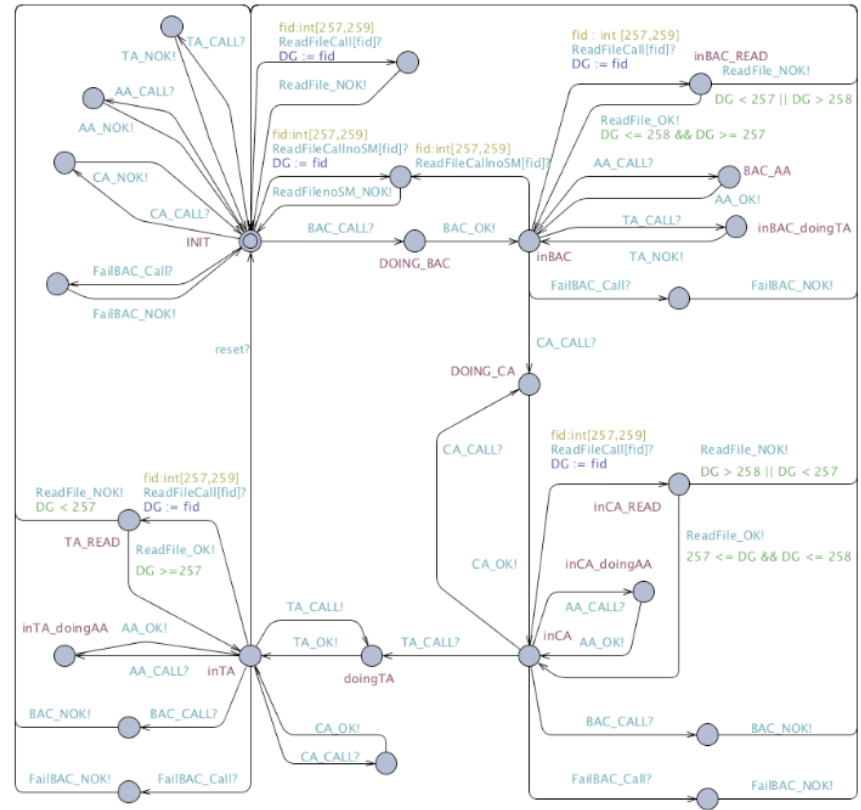
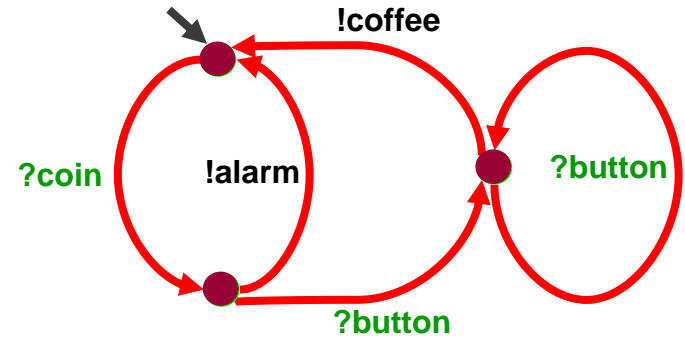
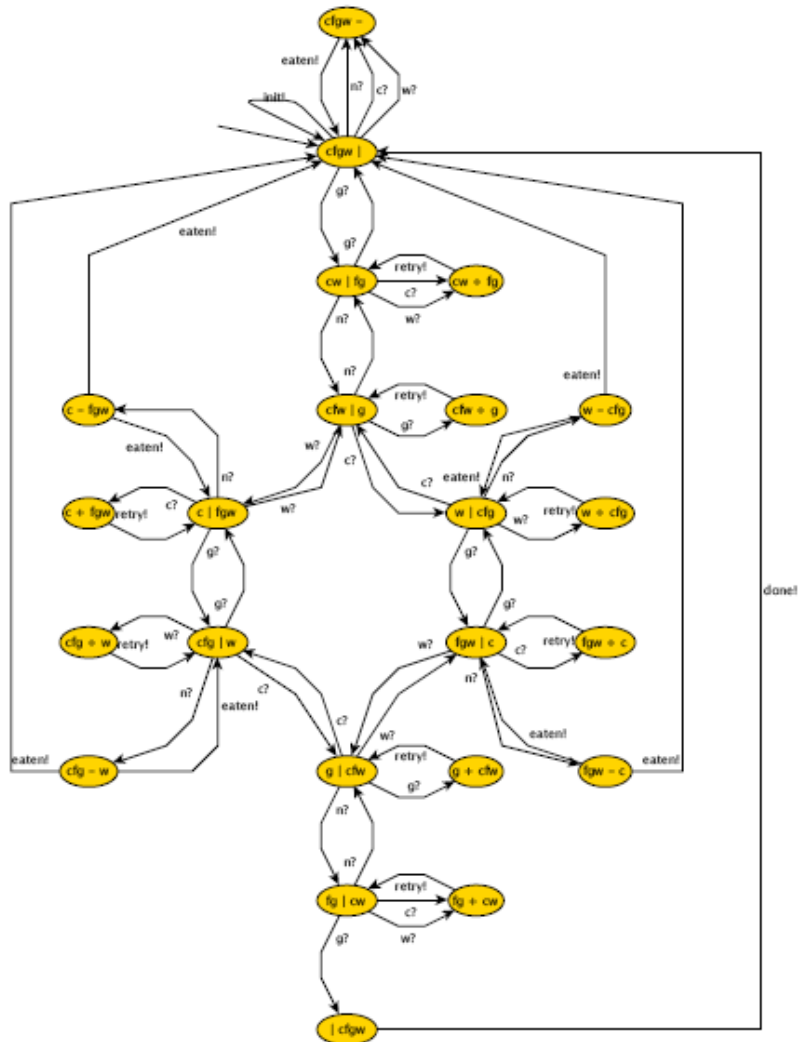
MBT : Model-Based Testing



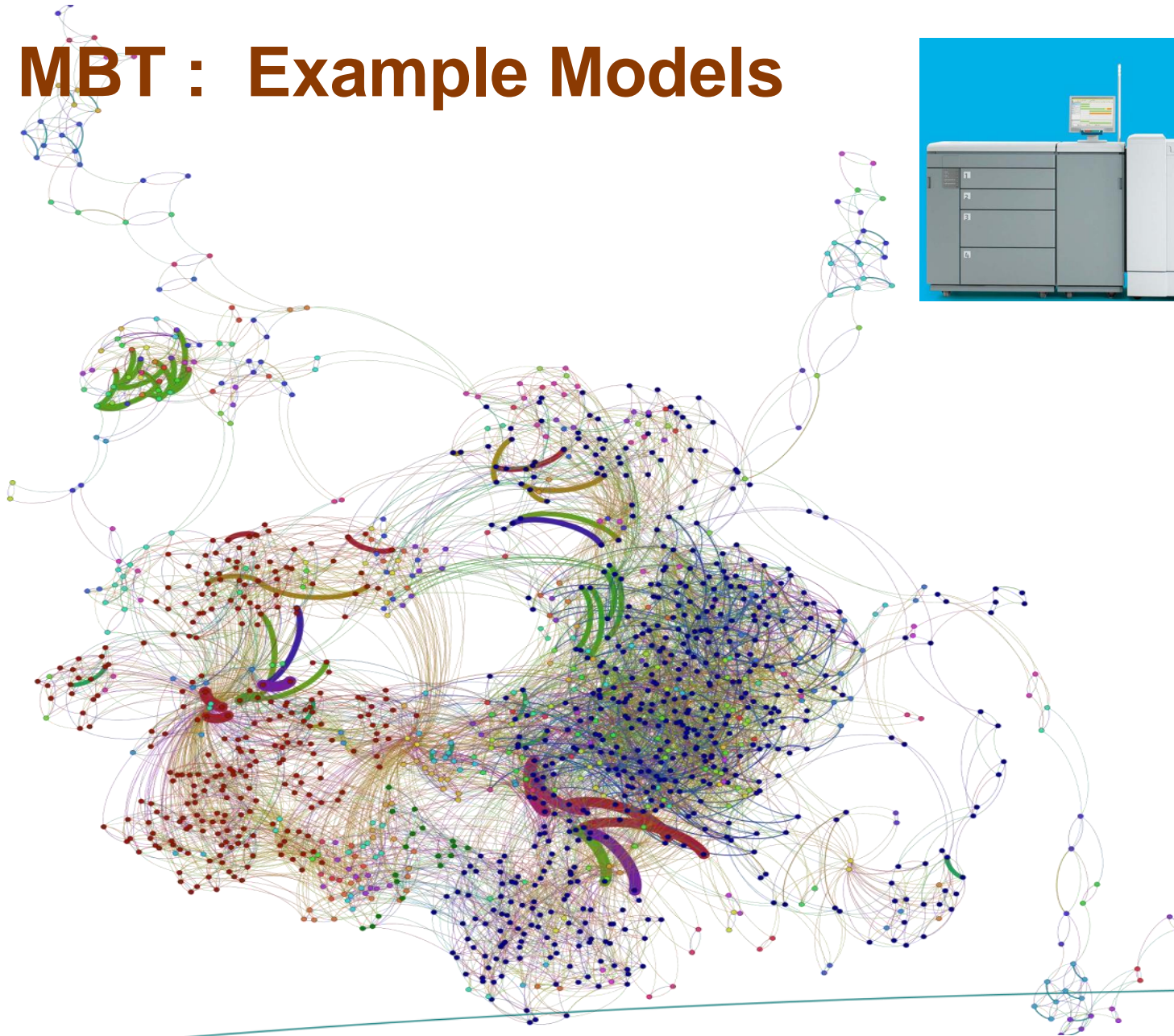
MBT : Labelled Transitions Systems



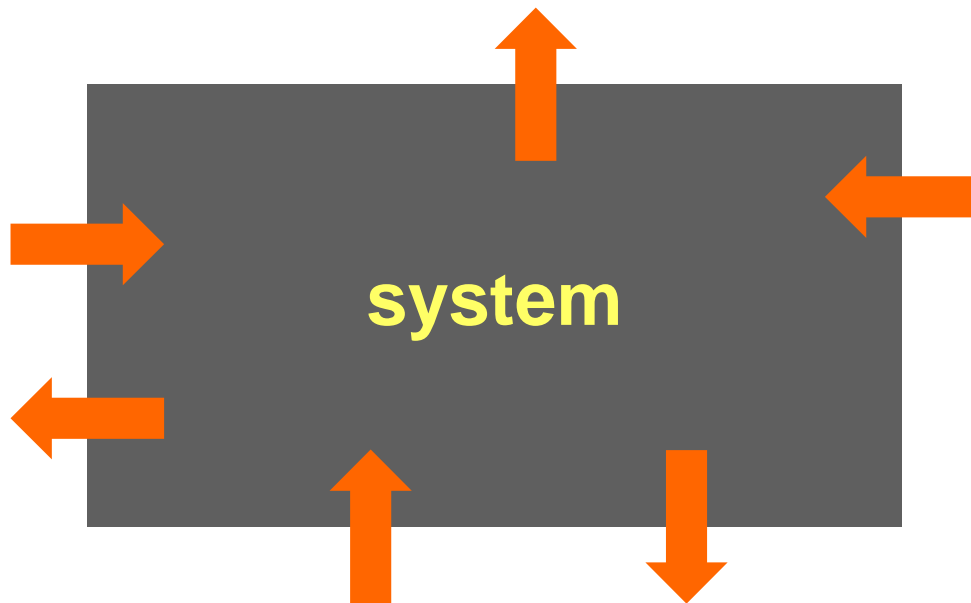
MBT : Example Models



MBT : Example Models



MBT : System Modelling



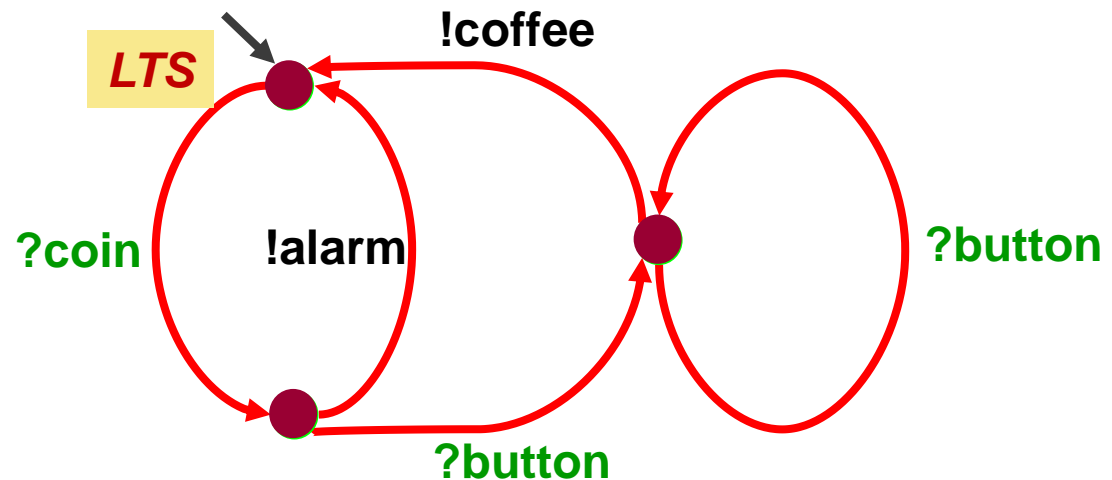
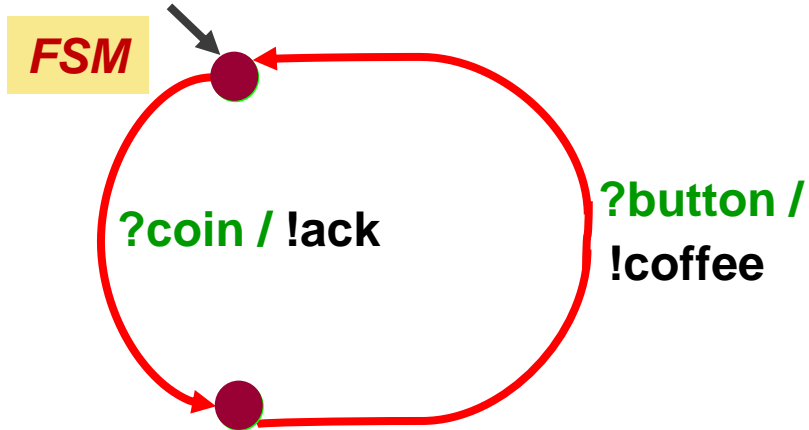
System

👉 black box

👉 inputs

👉 outputs

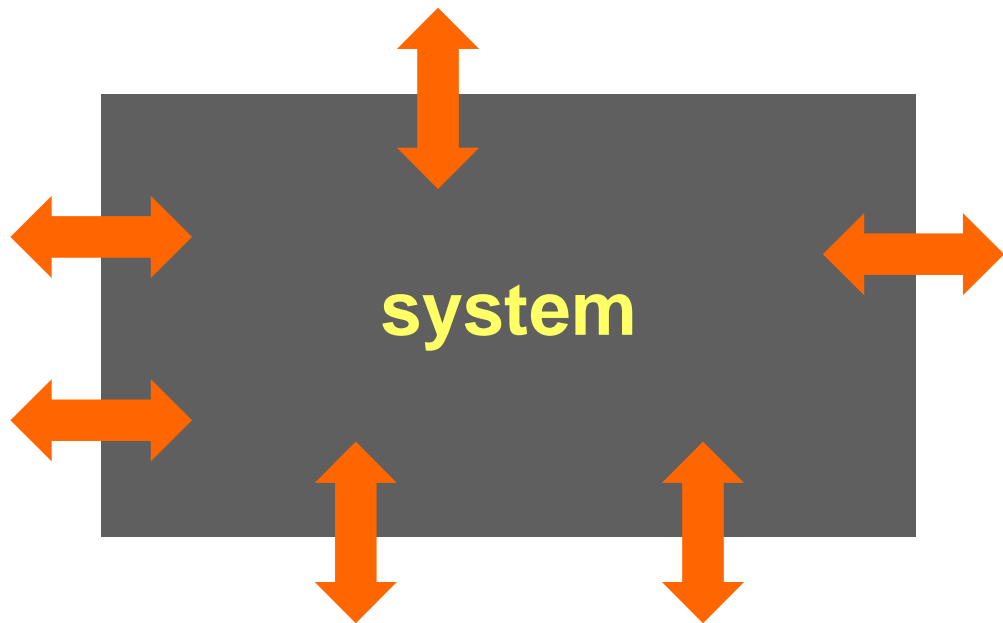
Models: FSM or LTS ?



Model-Based Testing :

Labelled Transition Systems

MBT : Abstract System Modelling



System

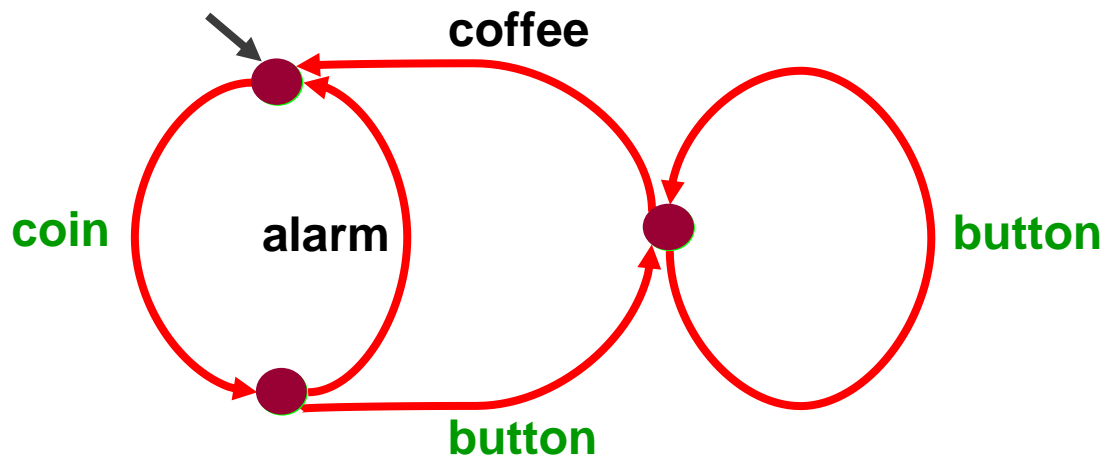
👉 black box

👉 abstract interactions

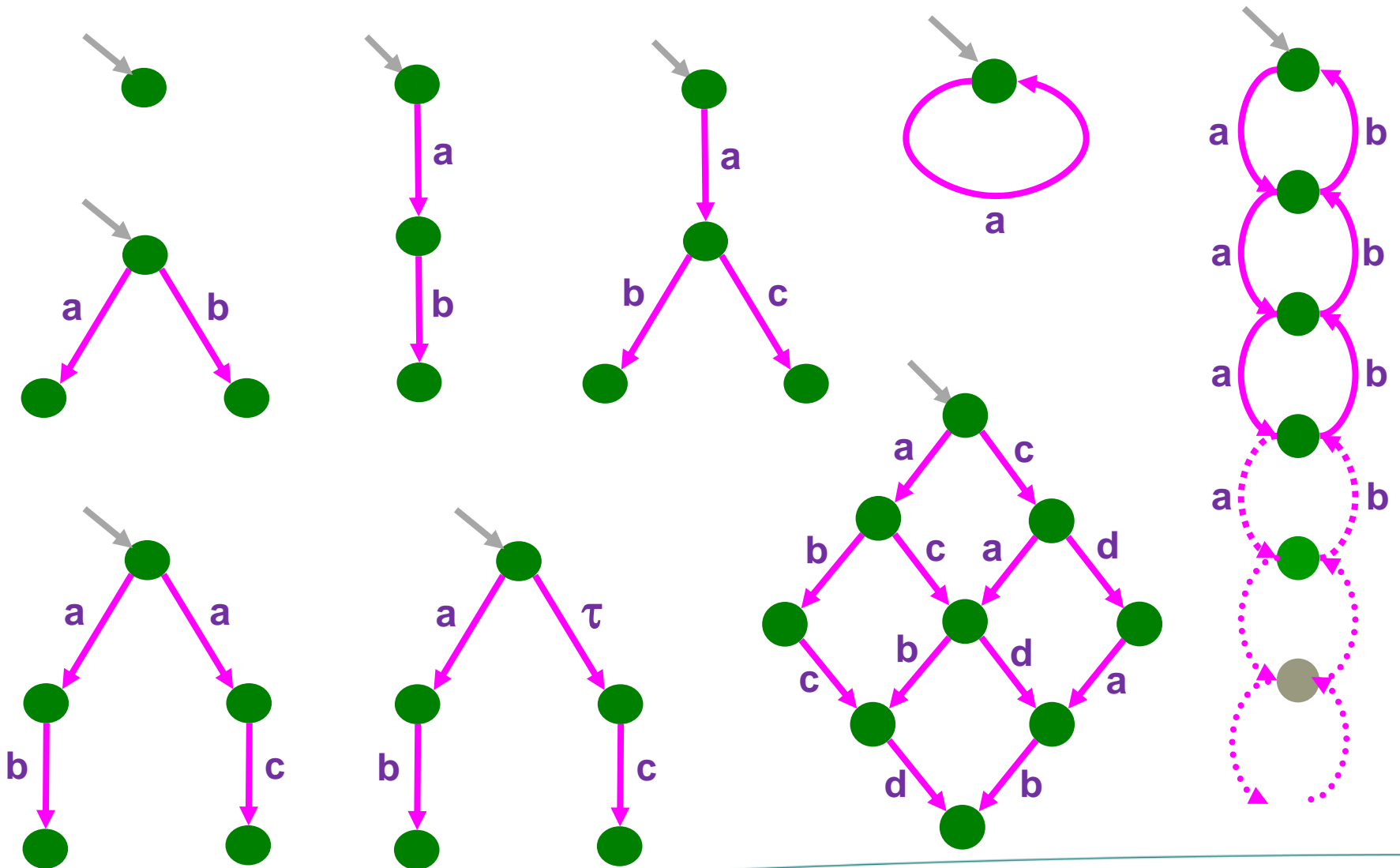
Models: Labelled Transition Systems

Labelled Transition System: $\langle S, L, T, s_0 \rangle$

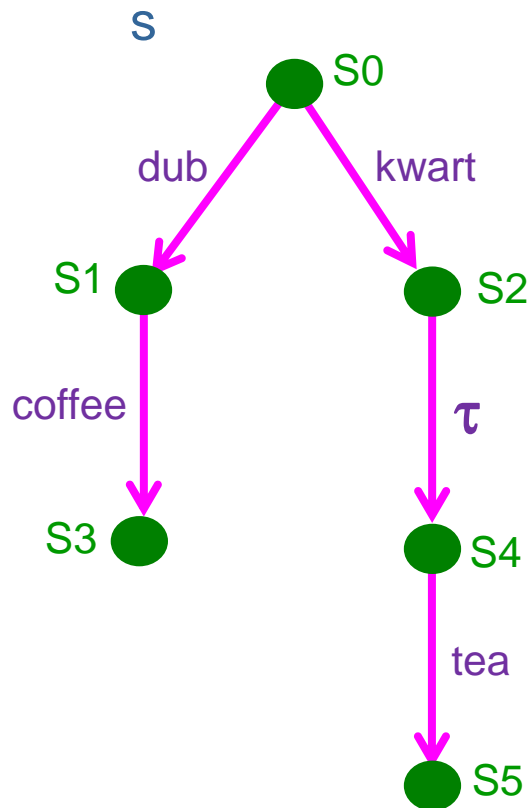
set of states S set of labels L transitions $T \subseteq S \times (L \cup \{\tau\}) \times S$ initial state $s_0 \in S$



LTS : Examples



LTS : Reasoning



$L = \{ dub, kuart, coffee, tea, soup \}$

$S0 \xrightarrow{dub} S1$

transition

$S0 \xRightarrow{dub\ coffee} S3$

transition
composition

$S0 \xRightarrow{kuart\ tea}$

executable
sequence

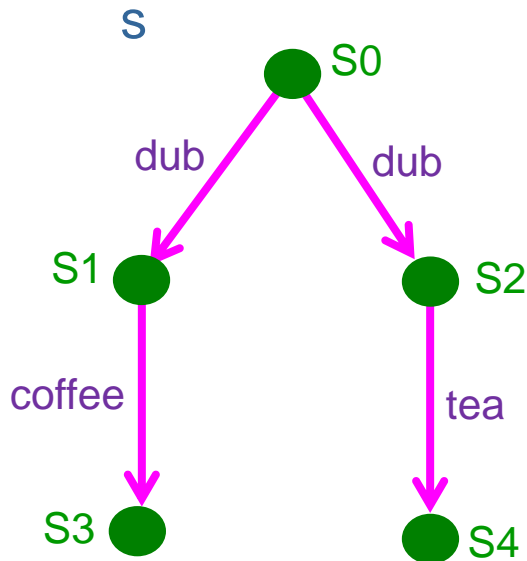
$S0 \xRightarrow{kuart\ soup}$

non-executable
sequence

$LTS(L)$

all transition
systems over L

LTS : Reasoning



$L = \{ \text{dub, kuart, coffee, tea, soup} \}$

Sequences of observable actions:

$$\text{traces}(s) = \{ \sigma \in L^* \mid s \xRightarrow{\sigma} \}$$

$$\text{traces}(s) = \{ \varepsilon, \text{dub}, \text{dub coffee}, \text{dub tea} \}$$

Reachable states:

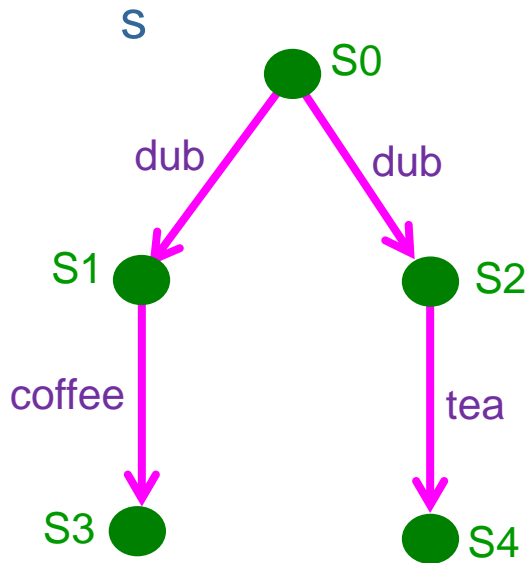
$$s \text{ after } \sigma = \{ s' \mid s \xRightarrow{\sigma} s' \}$$

$$s \text{ after dub} = \{ S1, S2 \}$$

$$s \text{ after dub tea} = \{ S4 \}$$

$$s \text{ after dub soup} = \emptyset$$

LTS : Reasoning



$L = \{ \text{dub, kuart, coffee, tea, soup} \}$

Refusals sets:

$s \text{ after } \sigma \text{ refuses } A \iff$

$\exists s' : s \xRightarrow{\sigma} s' \text{ and } \forall \mu \in A \cup \{\tau\} : s' \not\xrightarrow{\mu}$

$S0 \text{ after } \epsilon \text{ refuses } \{\text{coffee, tea}\}$

$S0 \text{ after dub refuses } \{\text{tea}\}$

$S0 \text{ after dub tea refuses } L$

$S0 \text{ after dub refuses } \emptyset$

not $S0 \text{ after dub refuses } \{\text{coffee, tea}\}$

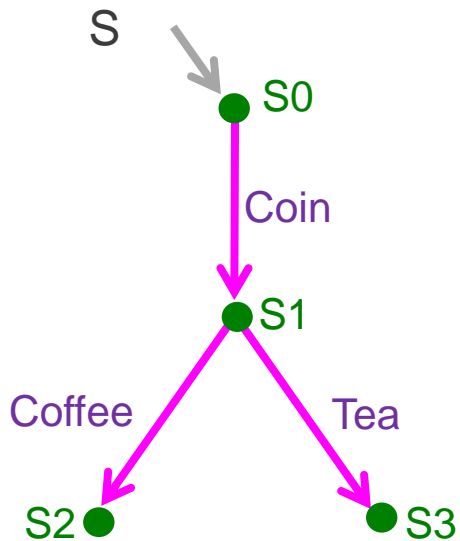
not $S0 \text{ after tea refuses } \emptyset$

Model-Based Testing :

Labelled Transition Systems

Representations

LTS : Representation

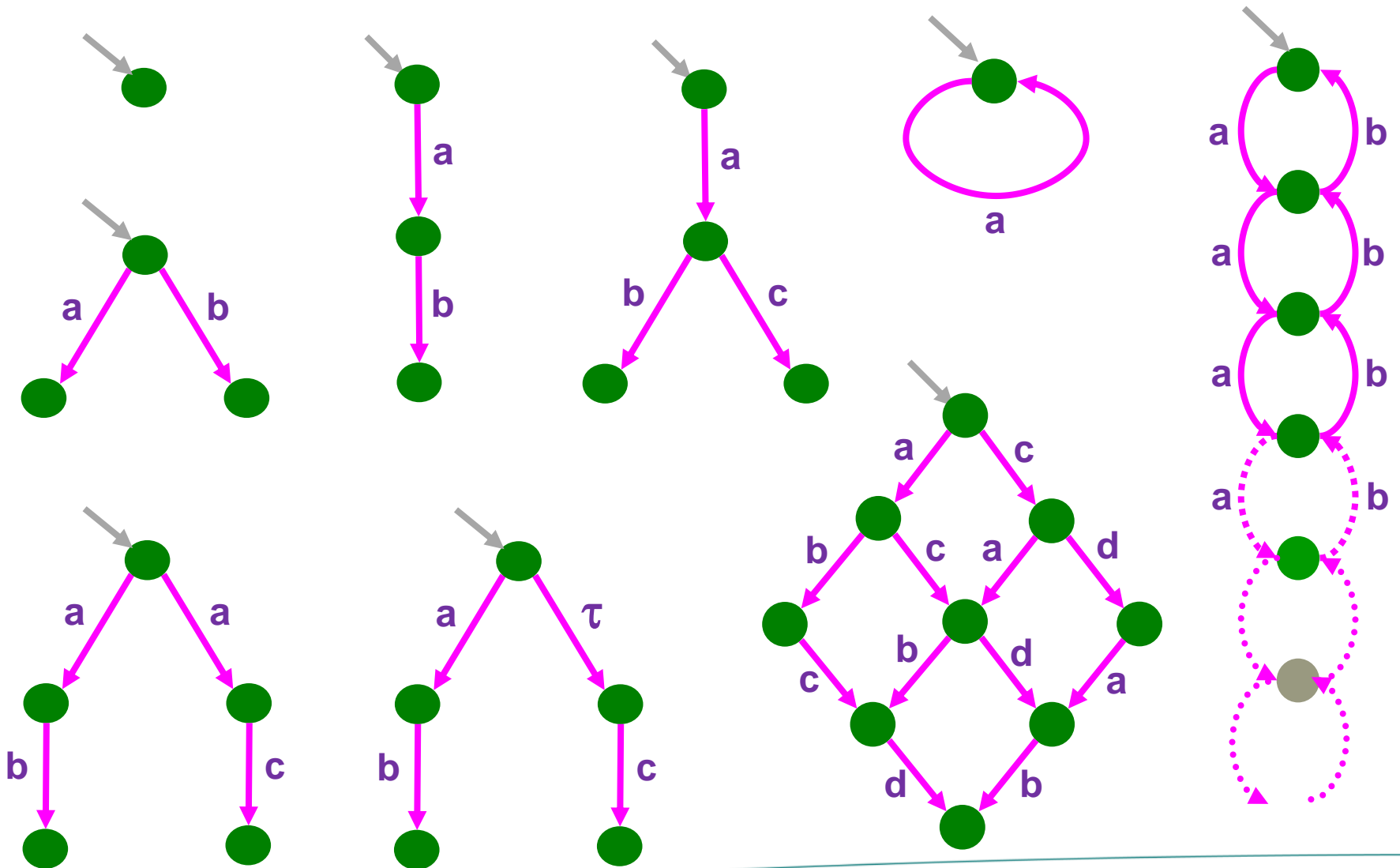


- Explicit : $\langle \{ S0, S1, S2, S3 \},$
 $\{ \text{Coin, Coffee, Tea} \},$
 $\{ (S0, \text{Coin}, S1),$
 $(S1, \text{Coffee}, S2),$
 $(S1, \text{Tea}, S3) \},$
 $S0 \rangle$

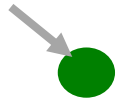
- Transition tree / graph
- Language :

$S ::= \text{Coin} \rightarrow (\text{Coffee} \# \text{Tea})$

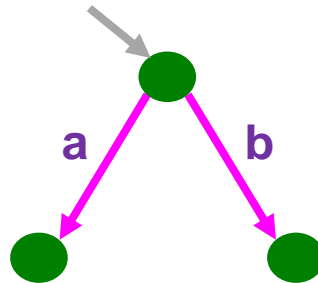
LTS : Examples



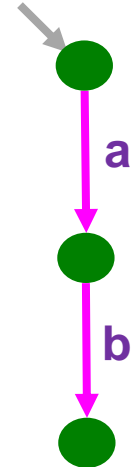
LTS : Representation



STOP

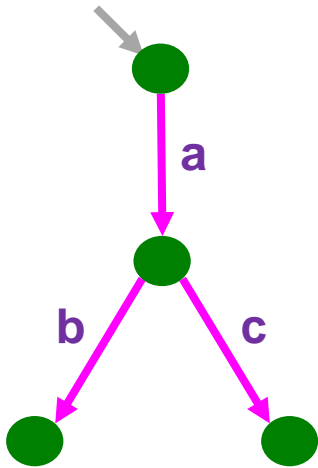


a ## b

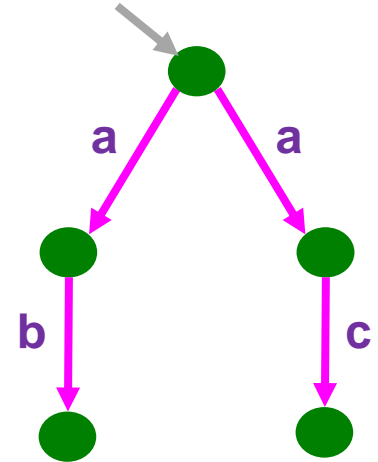


a >-> b

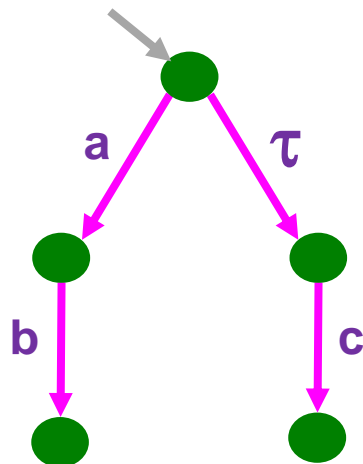
LTS : Representation



$a \multimap (b \ \#\ c)$



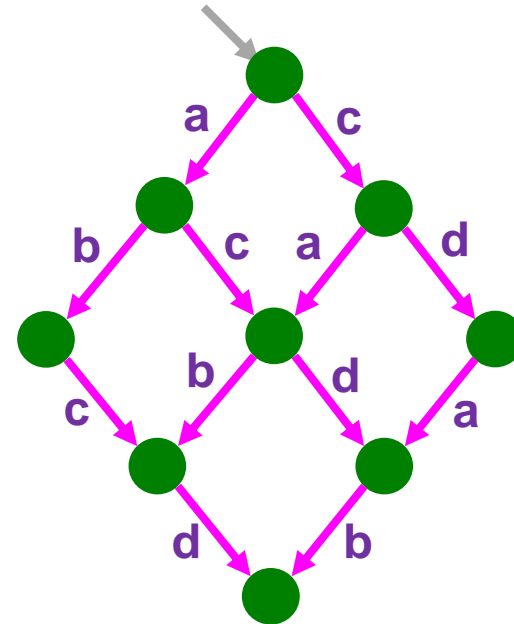
$a \multimap b \ \#\ a \multimap c$



$a \multimap b \ \#\ \text{ISTEP} \multimap c$

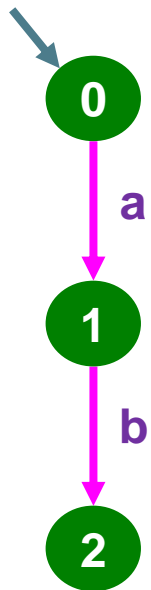
LTS : Representation

```
a >-> ( b >-> c >-> d ## c >-> ( b >-> d ## d >-> b ) )  
##  
c >-> ( d >-> a >-> b ## a >-> ( b >-> d ## d >-> b ) )
```

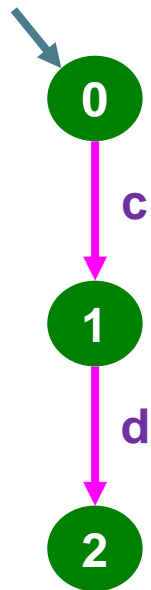


```
a >-> b ||| c >-> d
```

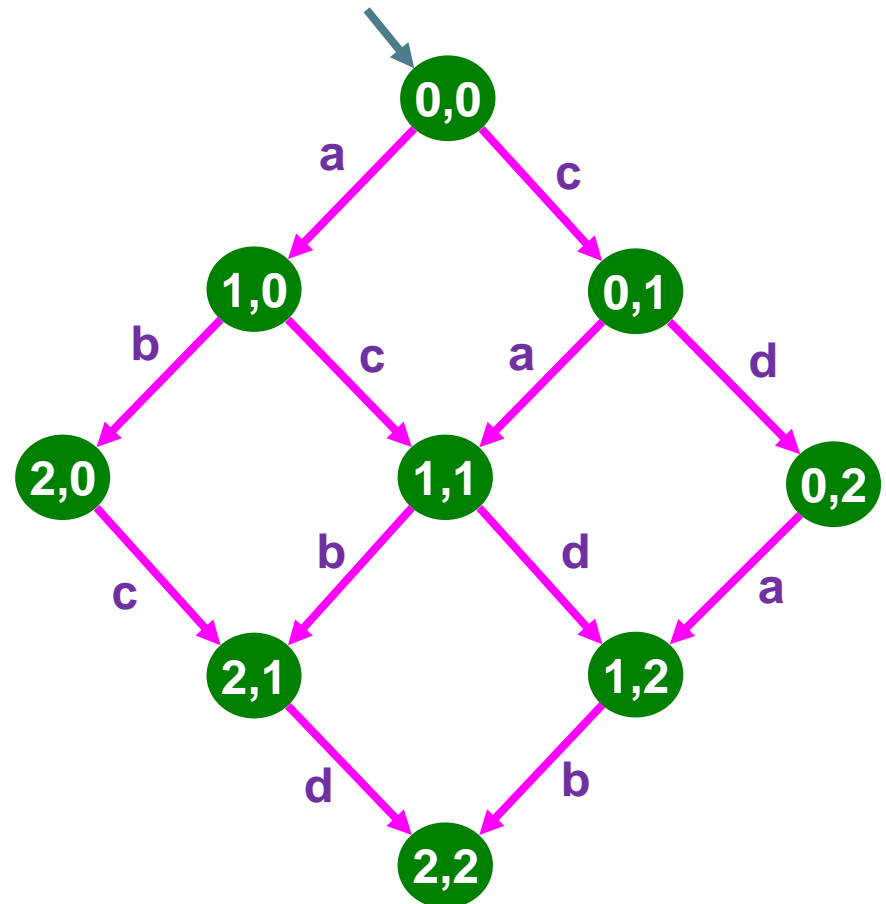
LTS : Representation



$a \rightarrow b$

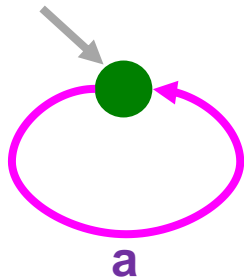


$c \rightarrow d$



$a \rightarrow b \quad ||| \quad c \rightarrow d$

LTS : Representation



P

where

$P ::= a \rightarrow P$

Q

where

$Q ::= a \rightarrow (b \mid \mid \mid Q)$

