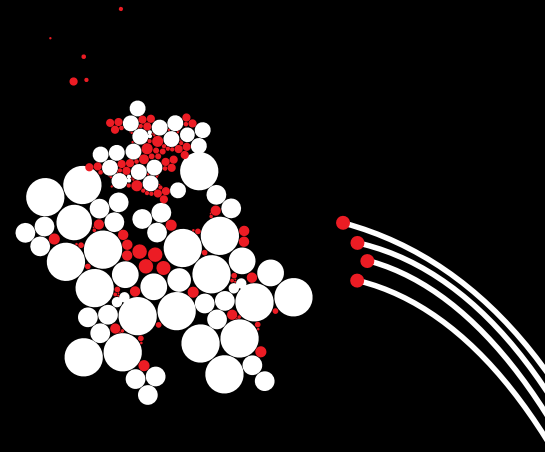
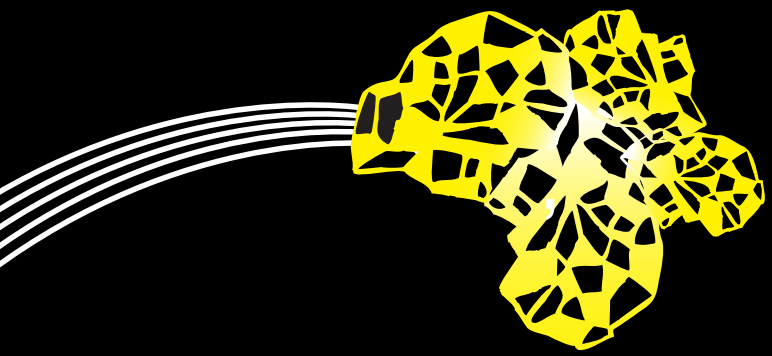
UNIVERSITY OF TWENTE.

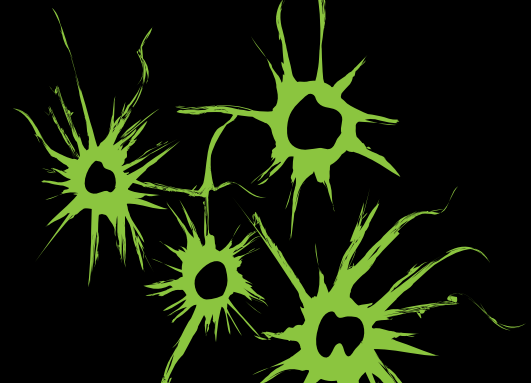


Time for Quiescence:
Modelling quiescent behaviour in testing via time-outs in timed automata

Laura Brandán Briones
Marcus Gerhold
Petra van den Bos
Marielle Stoelinga



ICTSS 2025



In this presentation...

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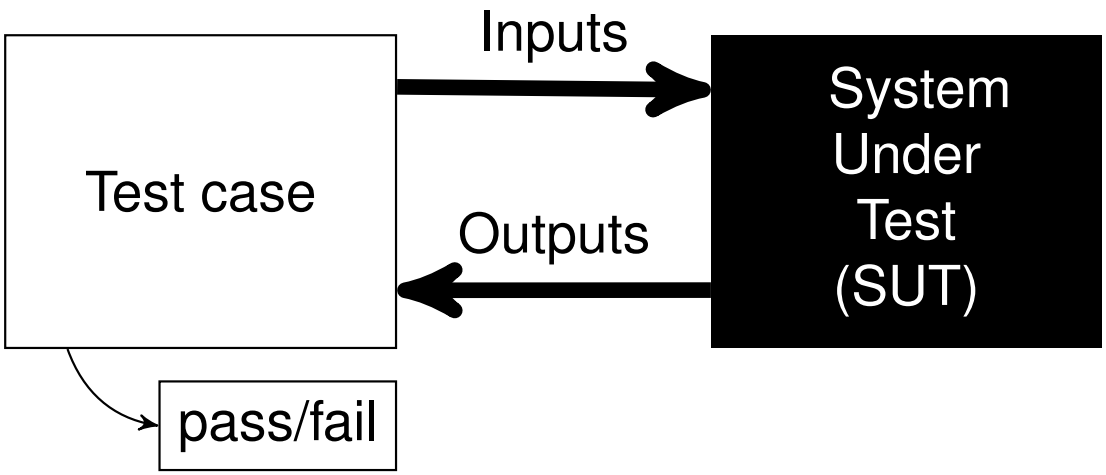
Test execution



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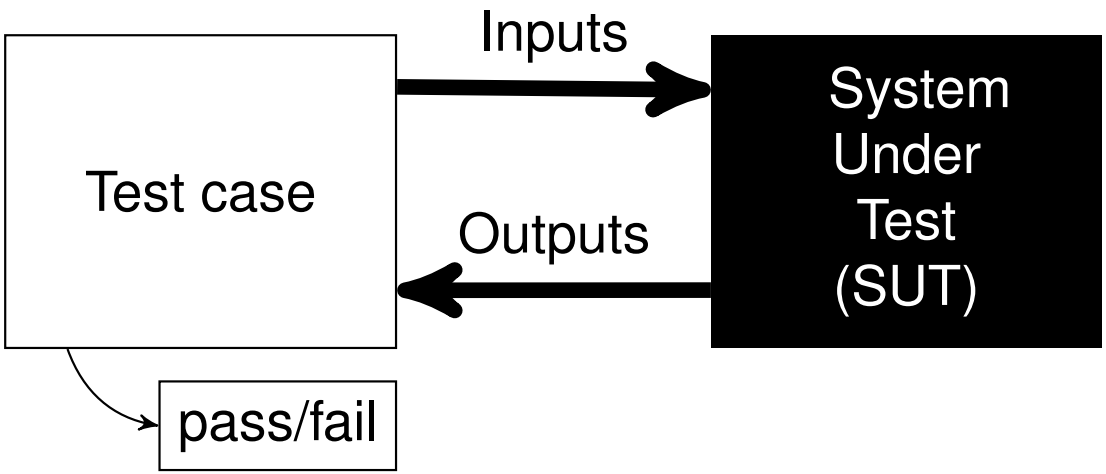

- The test case performs three types of actions:
  - Supply a chosen input *i*

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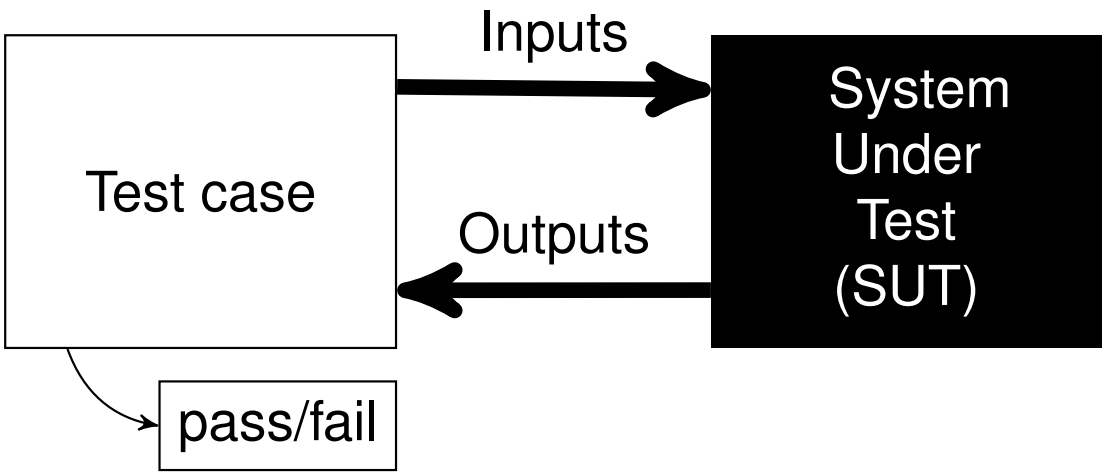

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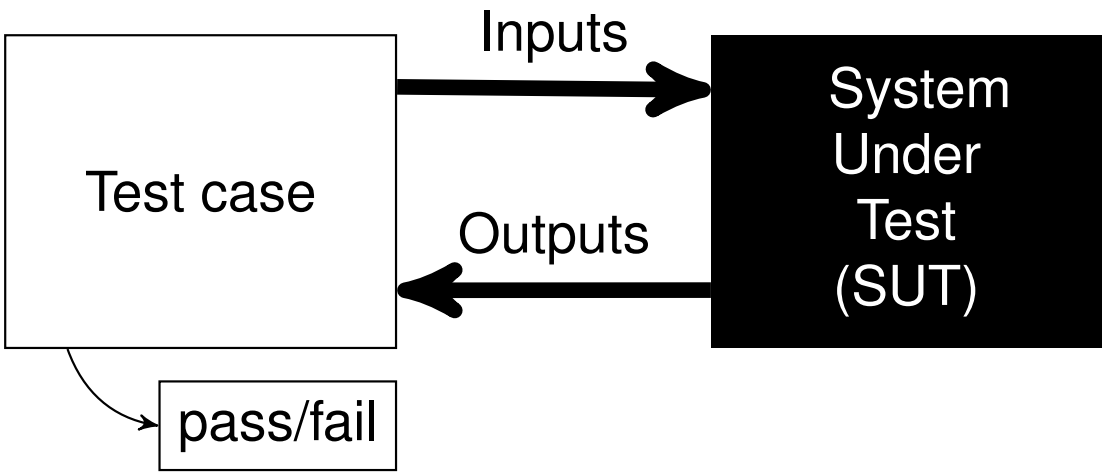

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Quiescence in practice: test execution example

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Quiescence in practice: test execution example

- Test case: Wait to observe some output o
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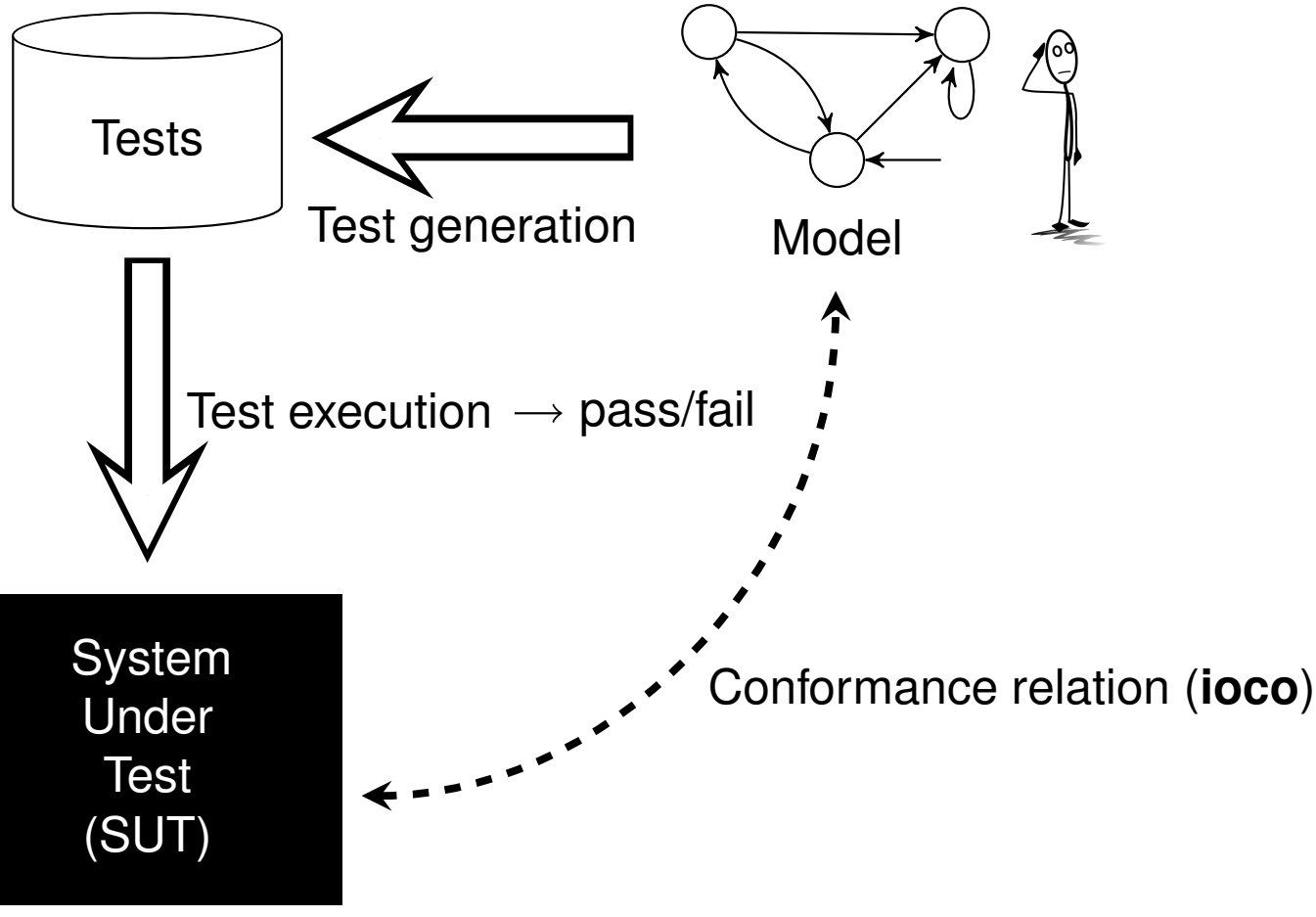
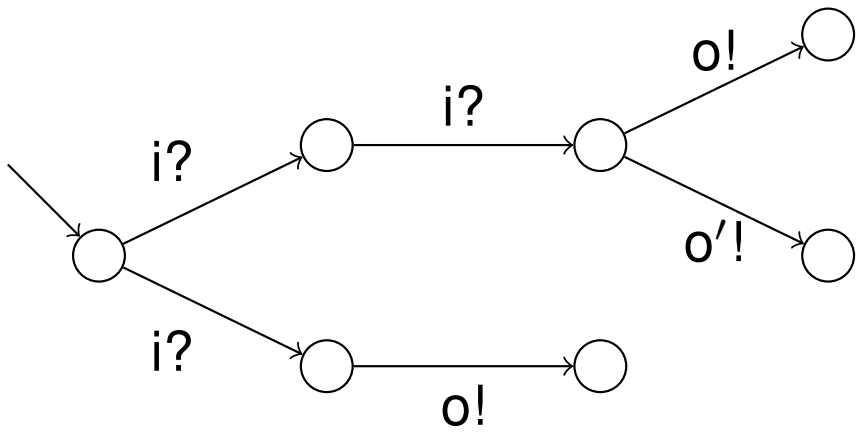
- After time-out M: conclude that SUT is quiescent

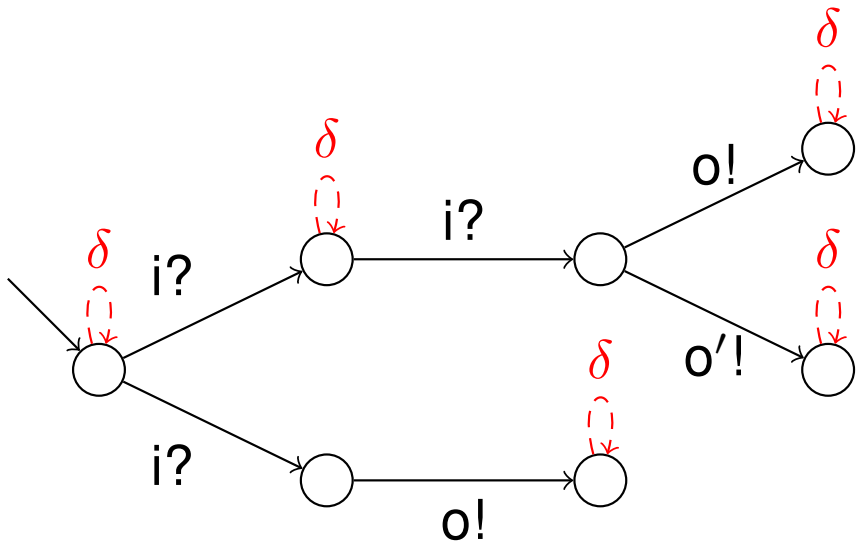
Model-based testing



Labeled Transition Systems (LTS)

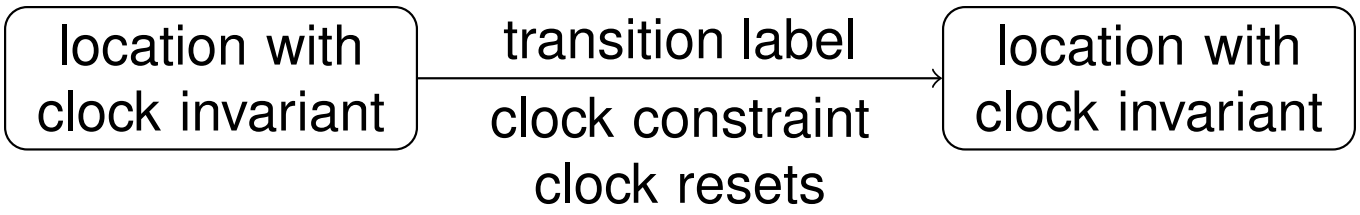


Labeled Transition Systems (LTS) with quiescence (δ)

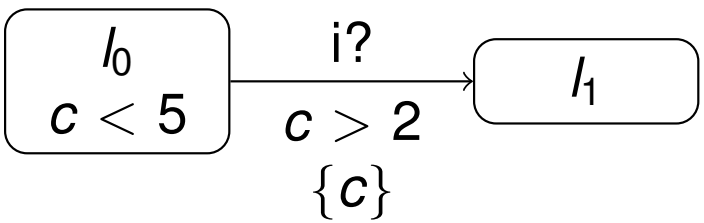


Timed automata (TA)

- TA transition format:



- TA transition example:



Contributions

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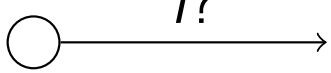
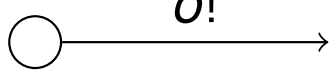
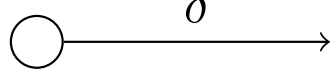
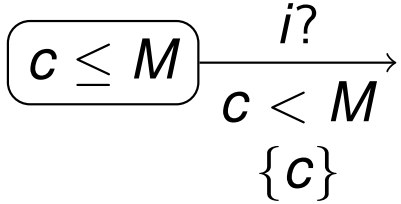
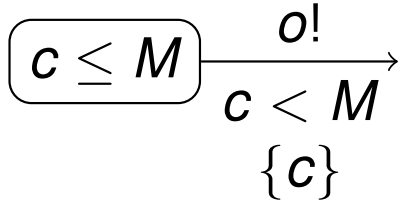
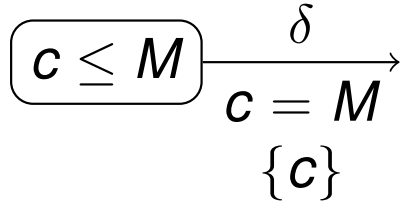
1. TA-ification χ^M

LTS Transition			
TA transition after χ^M			

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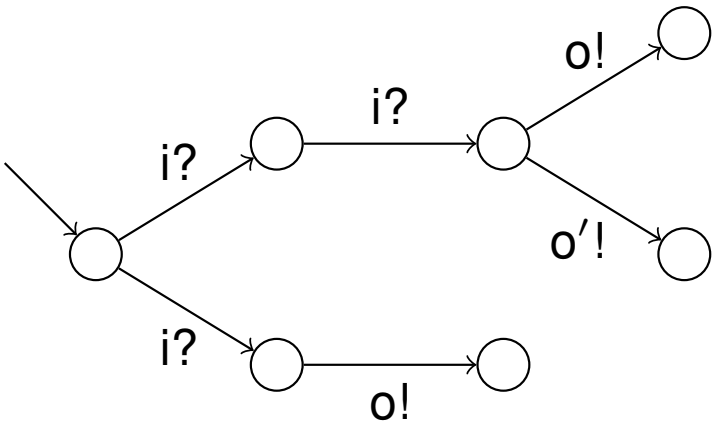

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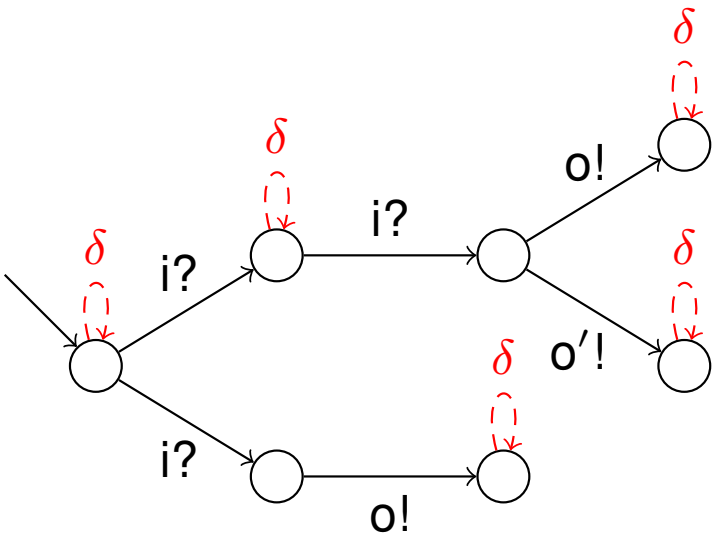

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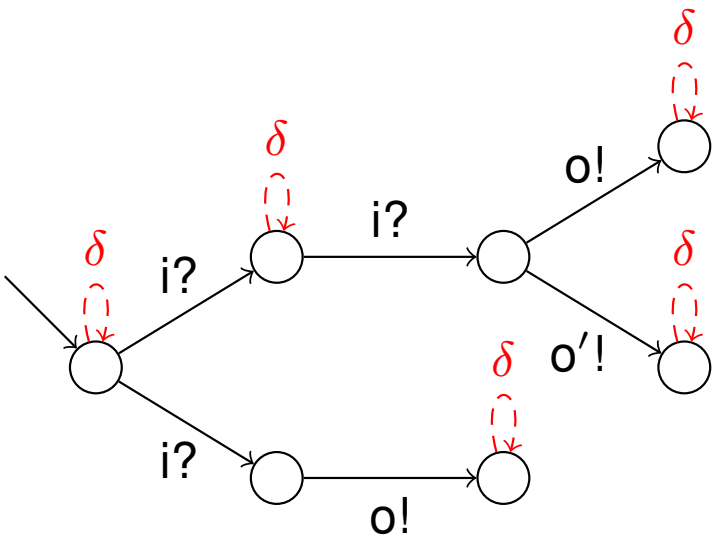
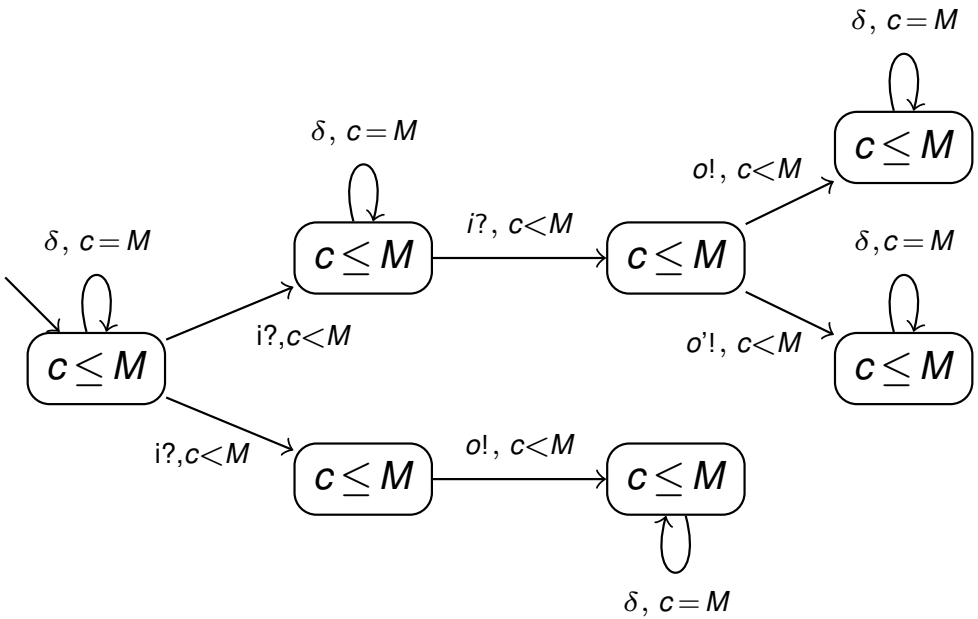
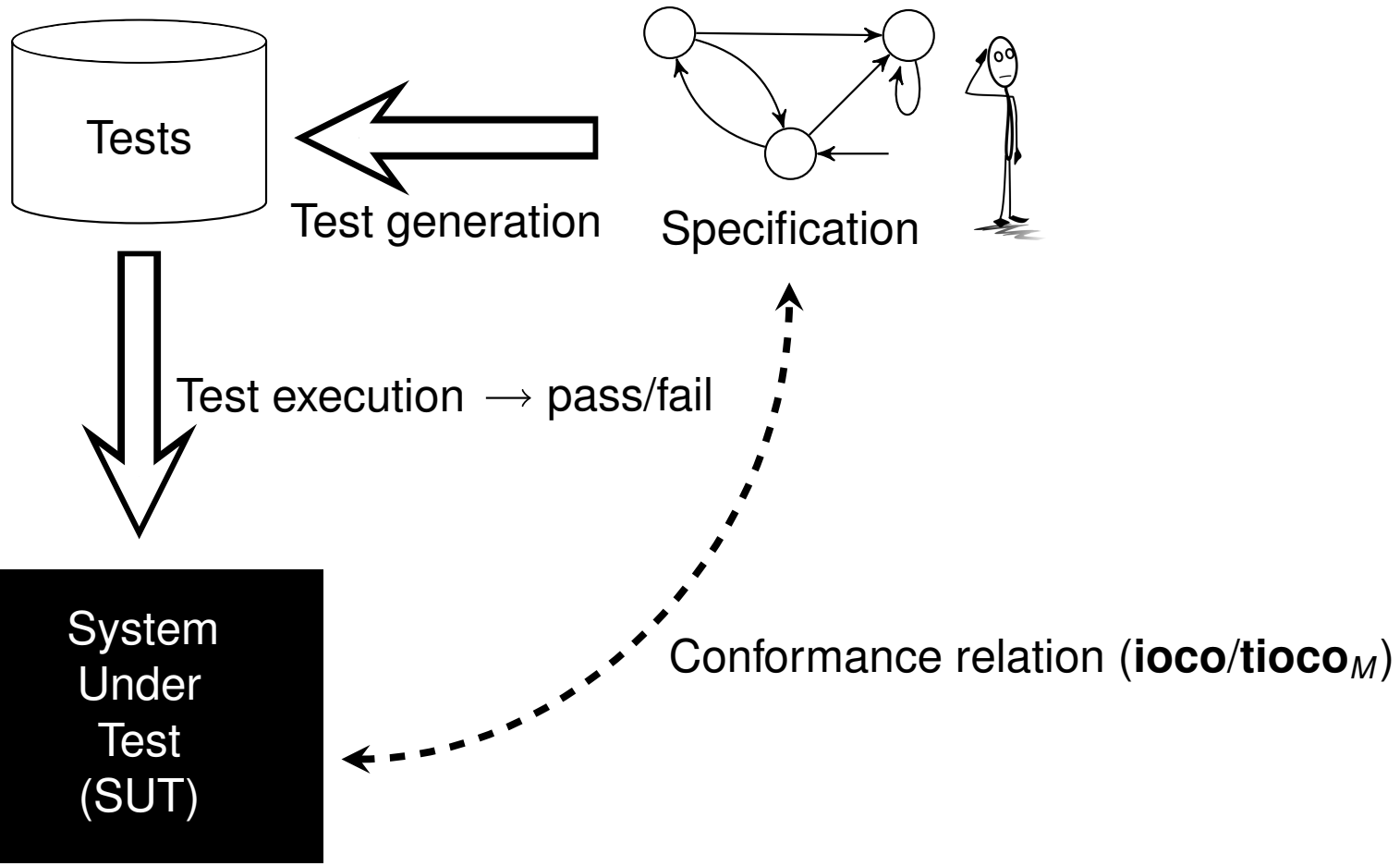




2. Model-Based Testing with **ioco/tioco**$_M$



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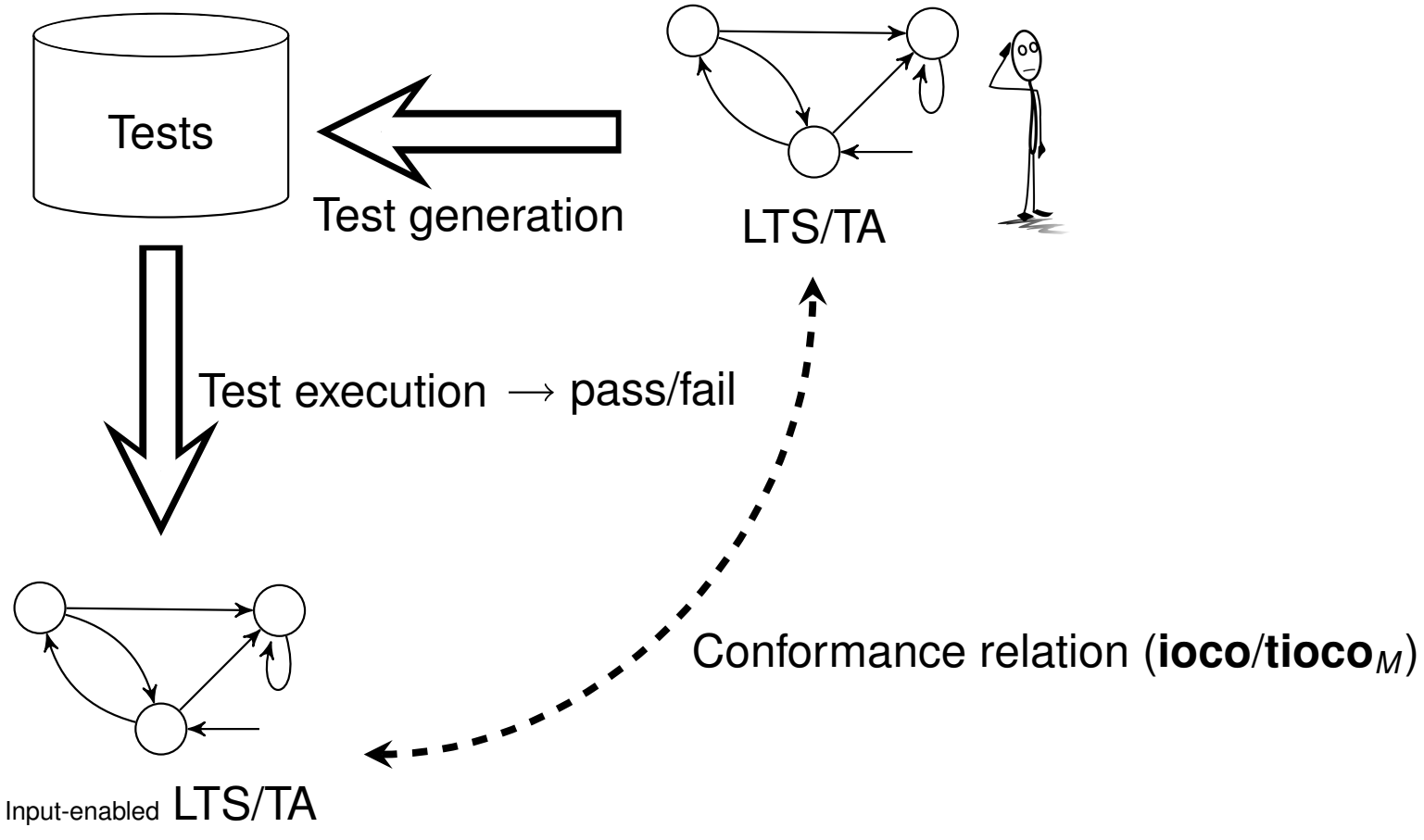

2. **ioco** and **tioco**$_M$

- $\mathcal{A}_I$ **ioco** $\mathcal{A}_S$ iff
  - $\forall\, \sigma \in \mathit{Straces}(\mathcal{A}_S)$: **out**($\mathcal{A}_I$ **after** σ) $\subseteq$ **out**($\mathcal{A}_S$ **after** σ)

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- $\mathit{Sttraces}_M(\mathscr{A})$: timed traces $(d_0, a_0)(d_1, a_1)\ldots(d_n, a_n)$ of TA $\mathscr{A}$
- $\mathscr{A}_I$ **tioco**$_M$ $\mathscr{A}_S$ iff
  - $\forall\, \rho \in \mathit{Sttraces}_M(\mathscr{A}_S) : \mathbf{out}_M(\mathscr{A}_I \textbf{ after}_M \rho) \subseteq \mathbf{out}_M(\mathscr{A}_S \textbf{ after}_M \rho)$.

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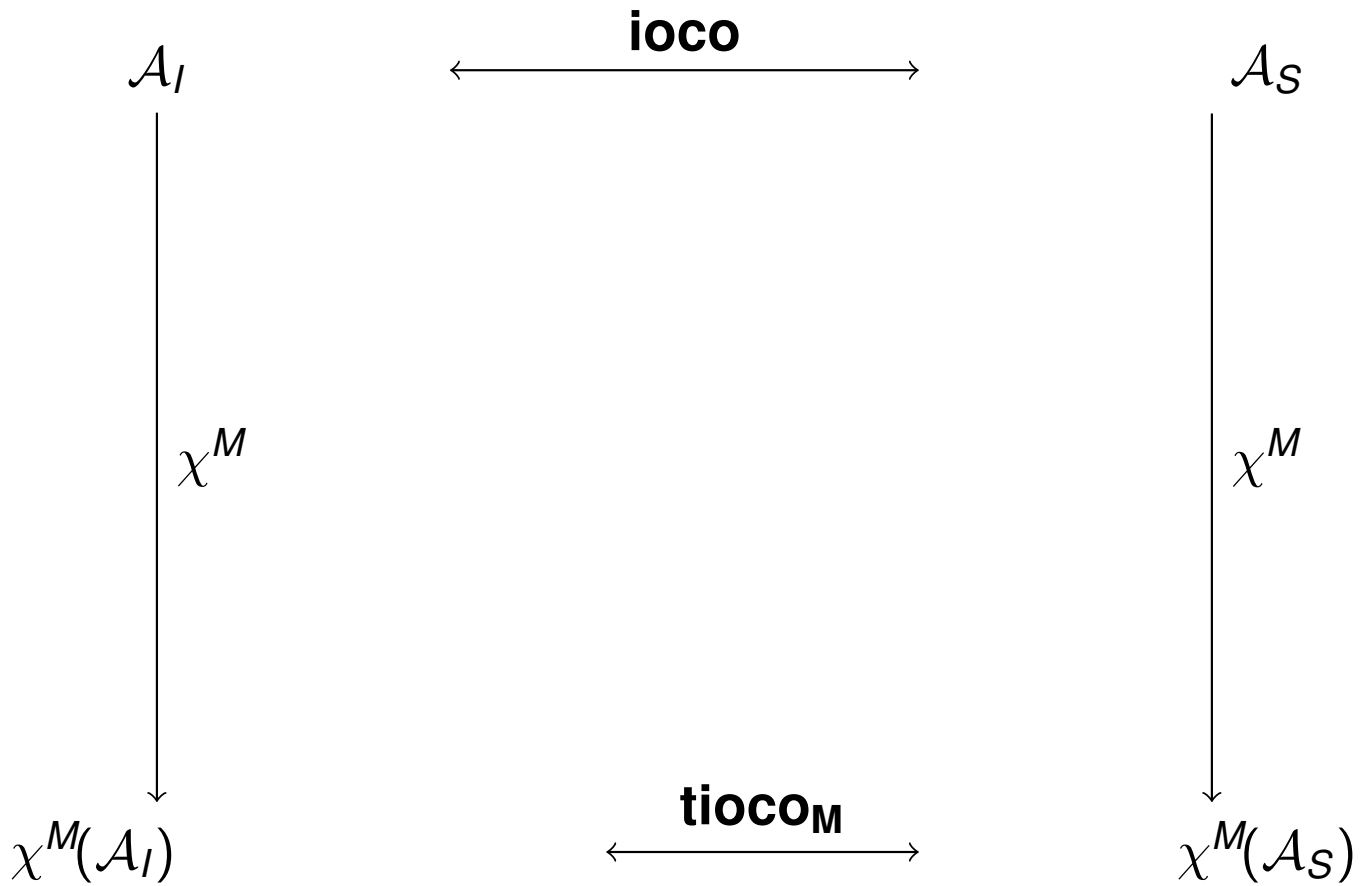

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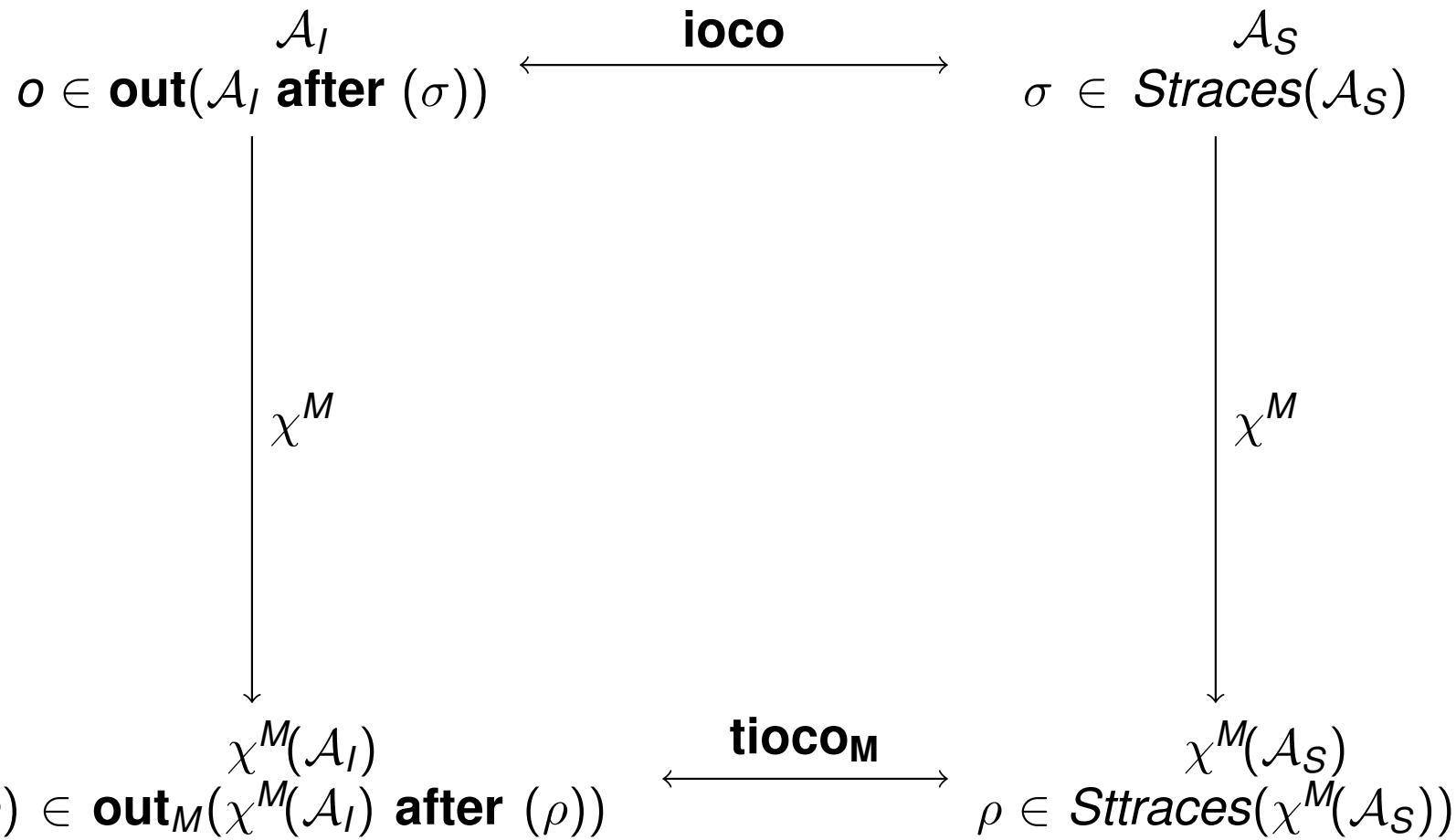
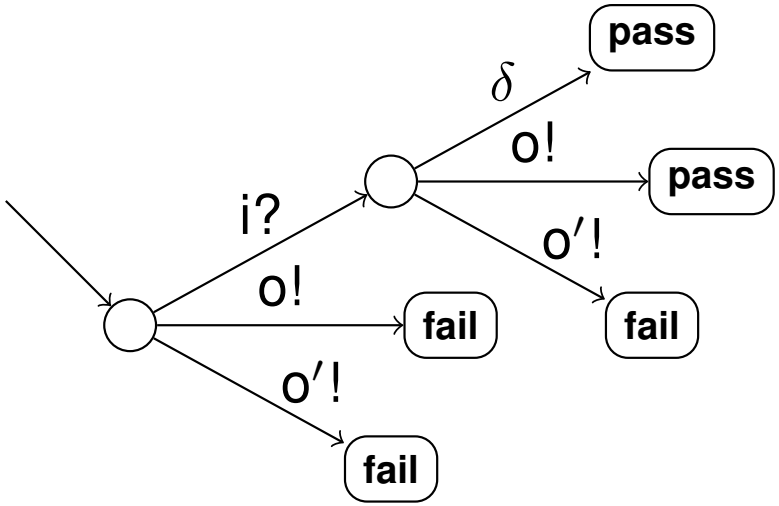
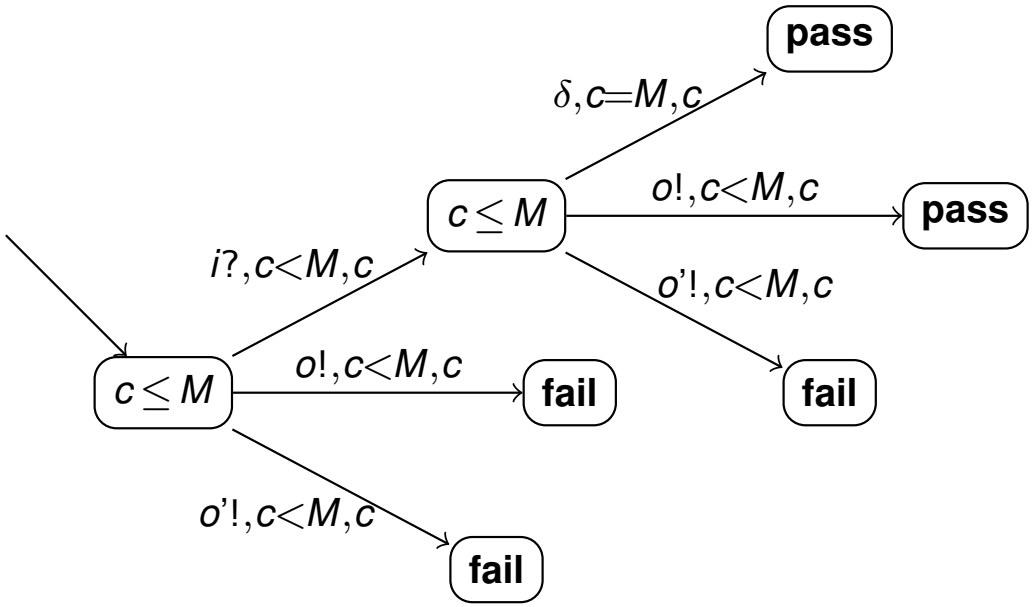


3. Test case and Timed test case example





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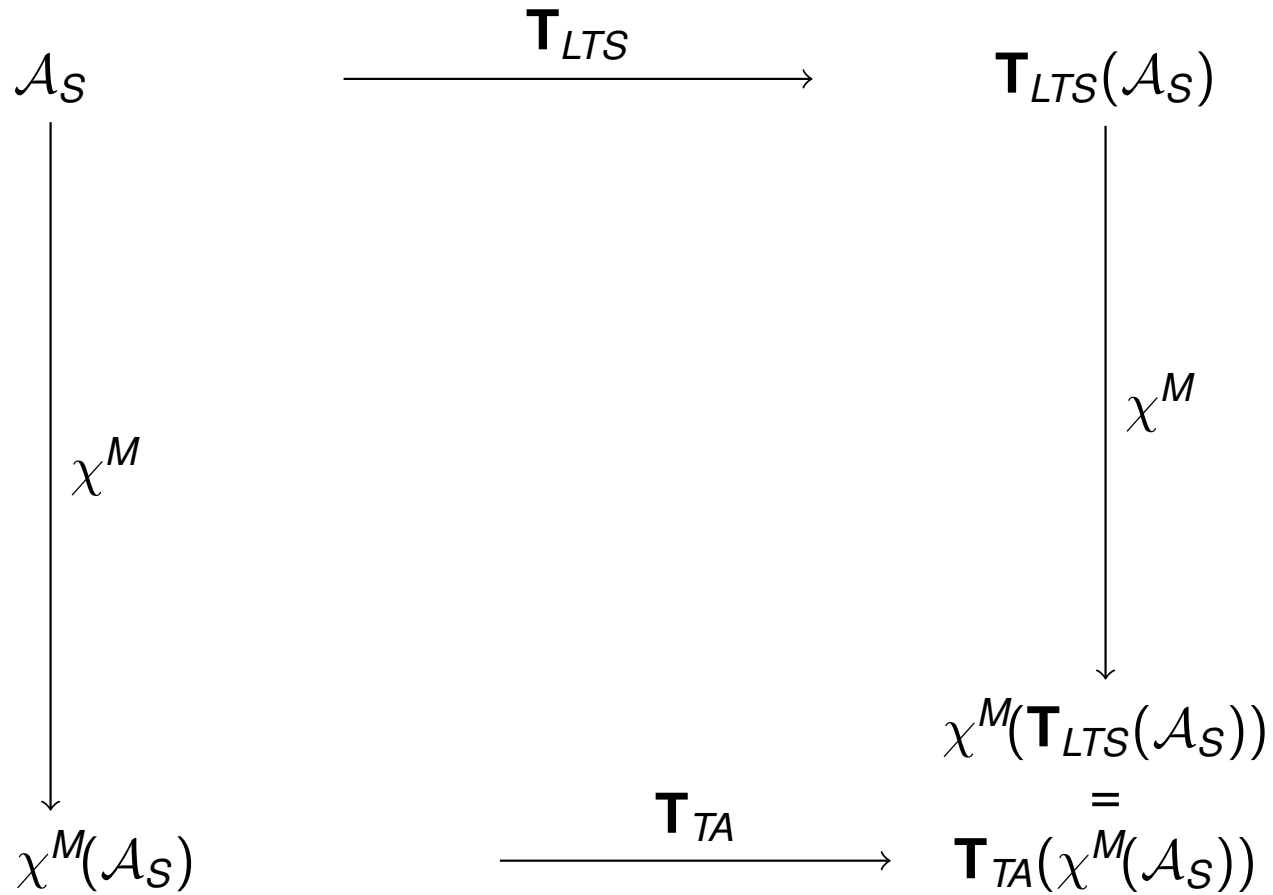
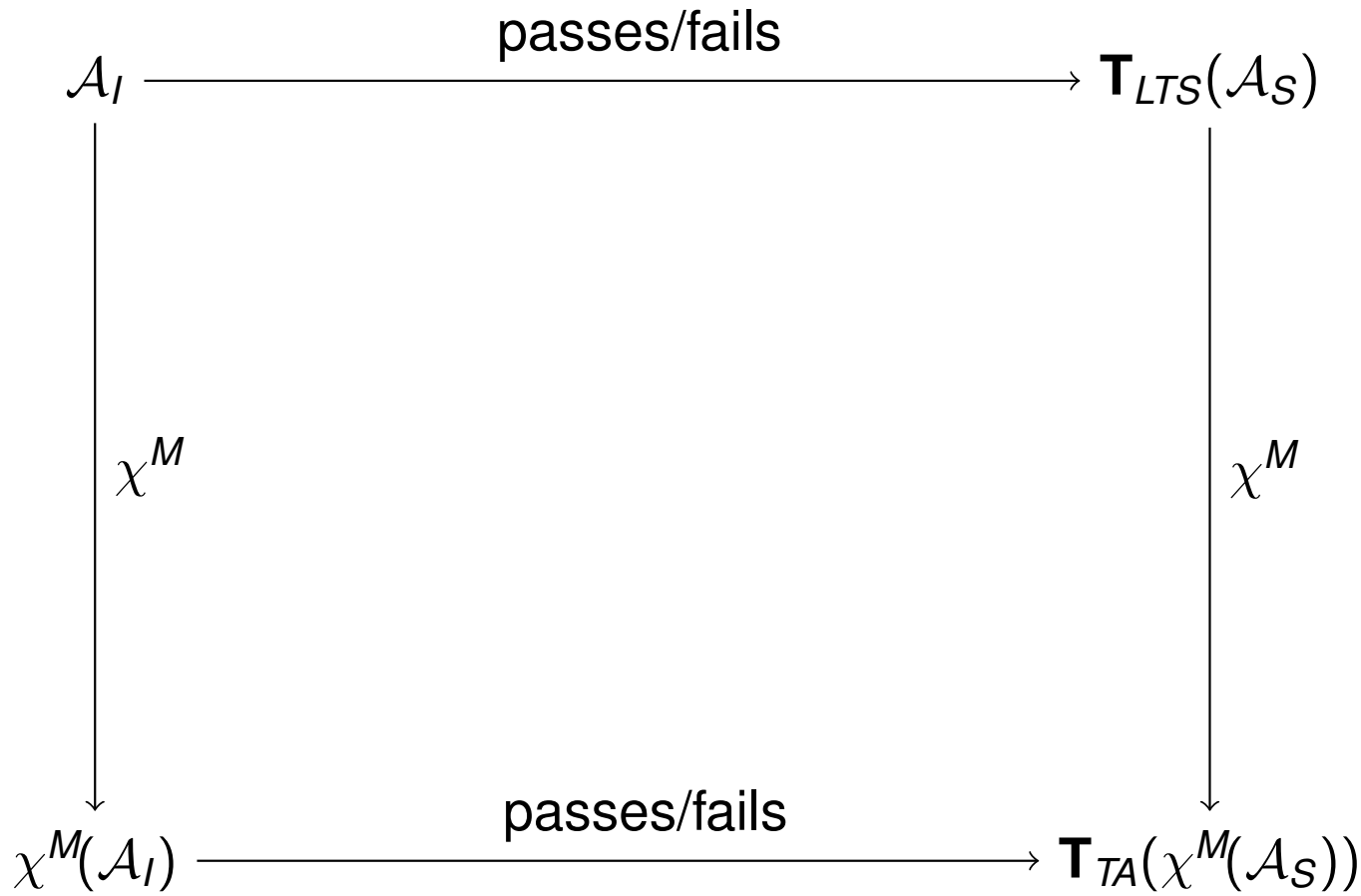


4. Verdict preservation in test execution

Thm: $\mathcal{A}_I$ passes/fails $\mathbf{T}_{LTS}(\mathcal{A}_S) \implies \chi^M(\mathcal{A}_I)$ passes/fails $\mathbf{T}_{TA}(\chi^M(\mathcal{A}_S))$



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