MoTraS - A Tool for Modal Transition Systems

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Outline

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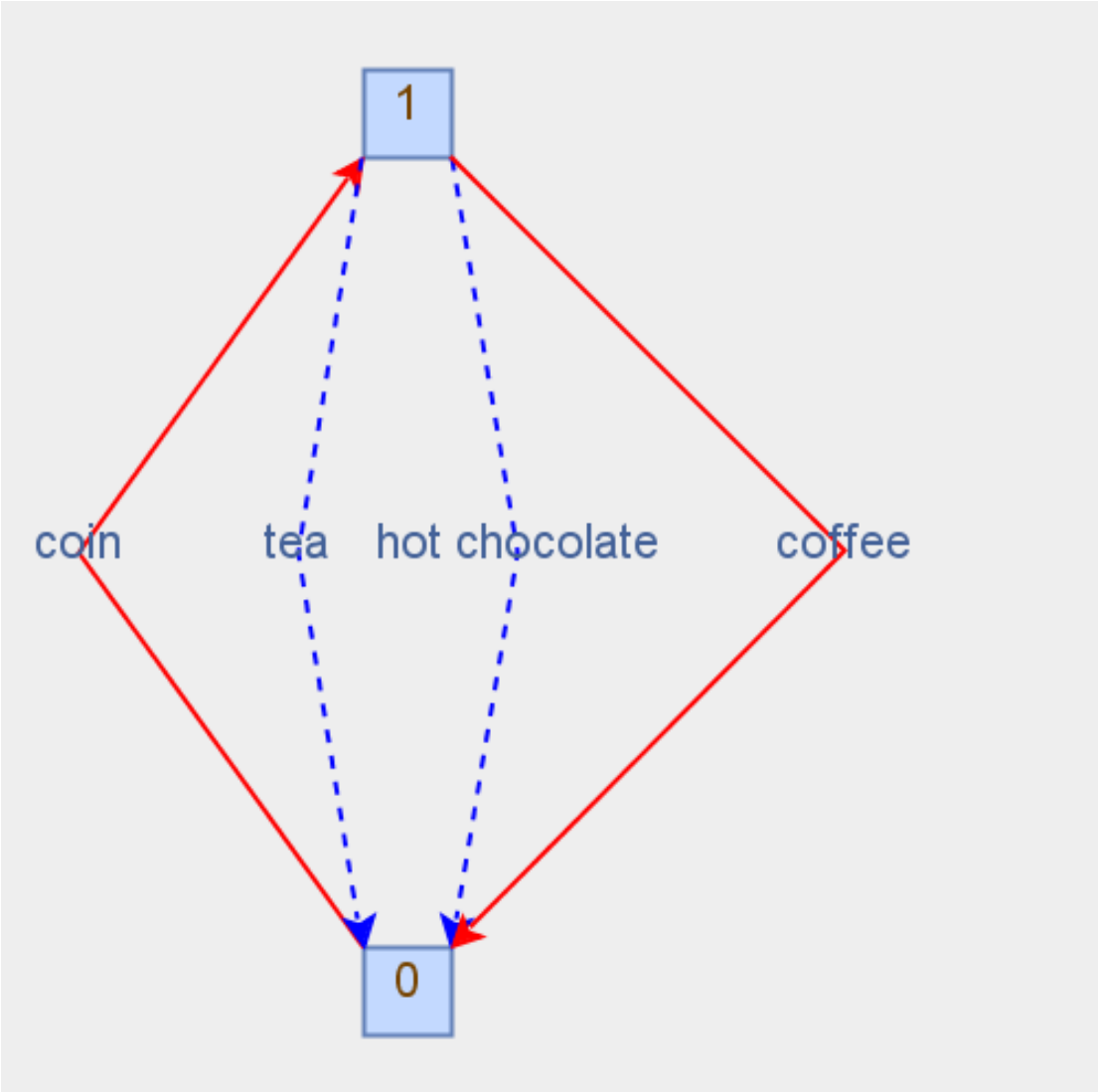
Modal Transition Systems (MTSs)

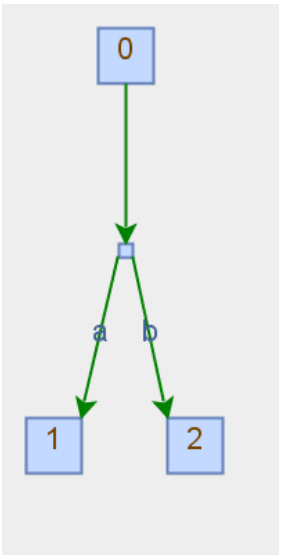
- Extension of Labeled Transition Systems (LTSs)
- A set of processes P
- The action alphabet Σ
- Two types of transitions:
  May-transitions $\dashrightarrow$ are allowed to be in every refinement of the given system
  Must-transitions $\longrightarrow$ are obliged to be in every refinement of the given system
- SPECIAL CASE: Deterministic Modal Transition Systems (dMTSs)

Example



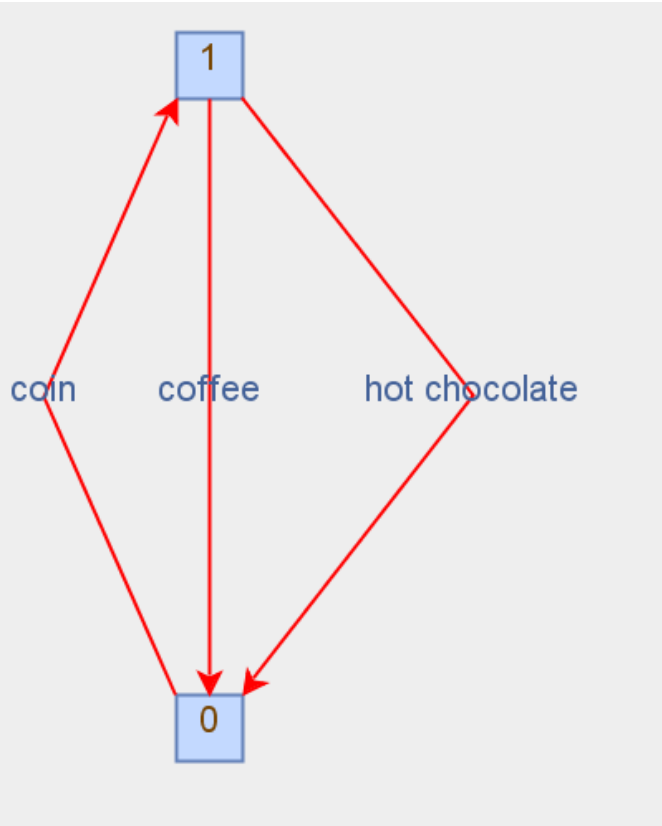
Disjunctive Modal Transition Systems (DMTSs)

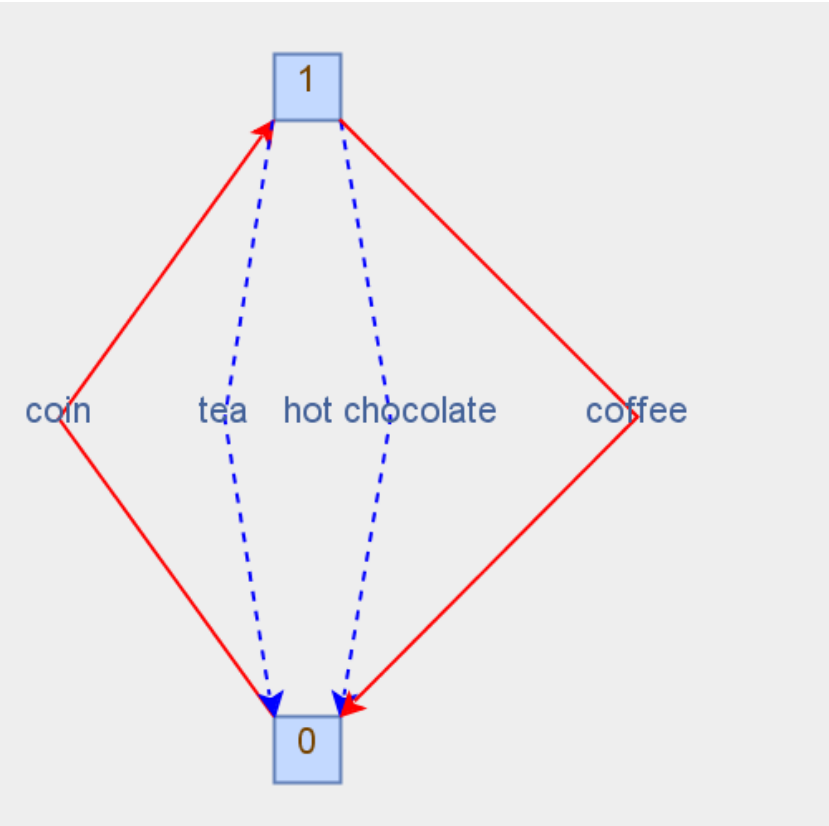
- Extension of MTSs
- Disjunctive transitions: A Set of must-transitions from which only one has to be realized in every refinement of the given system



Implementations

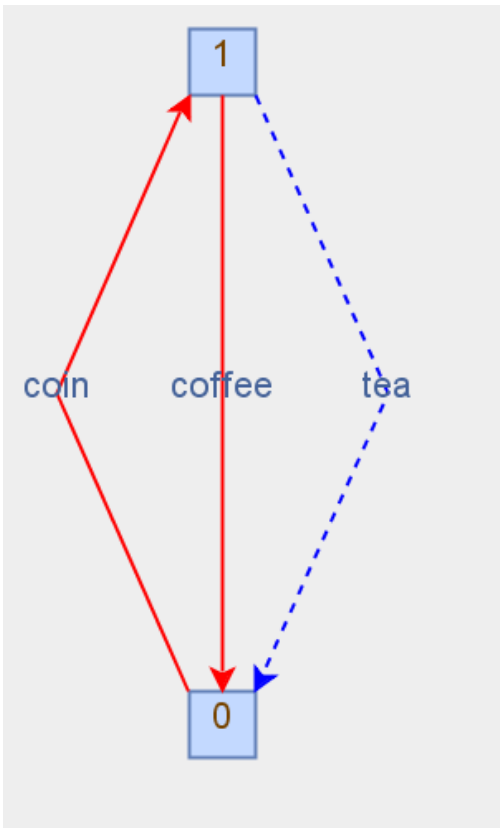
Each may-transition of the given system is either omitted or turned into a must-transition

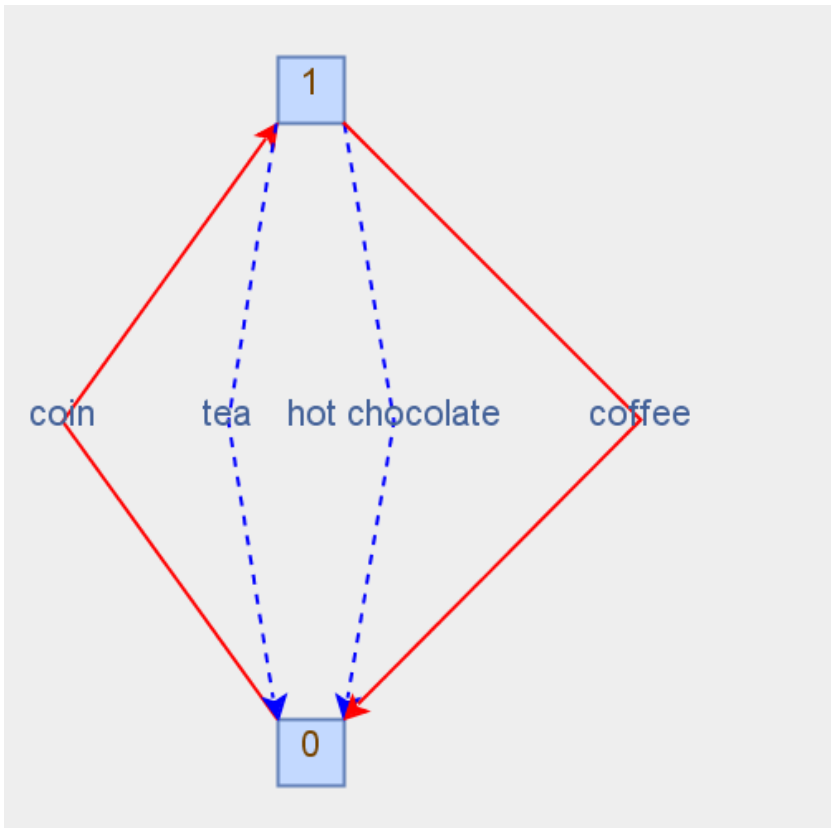




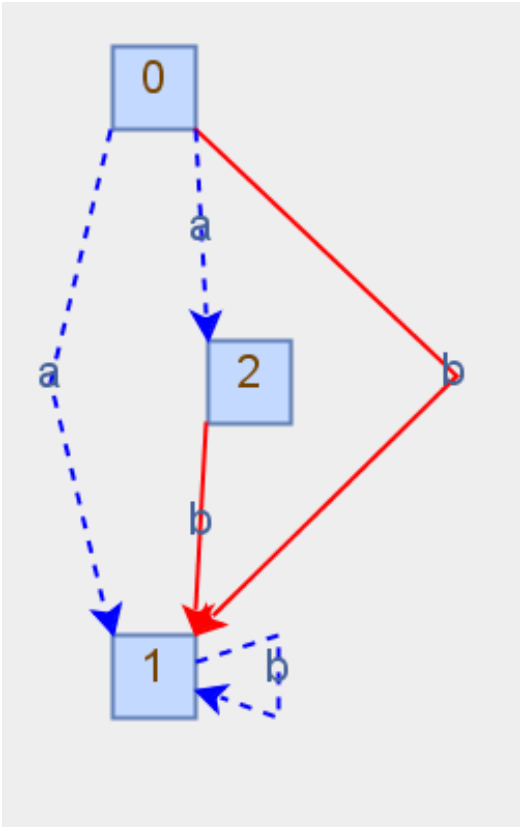
Refinements

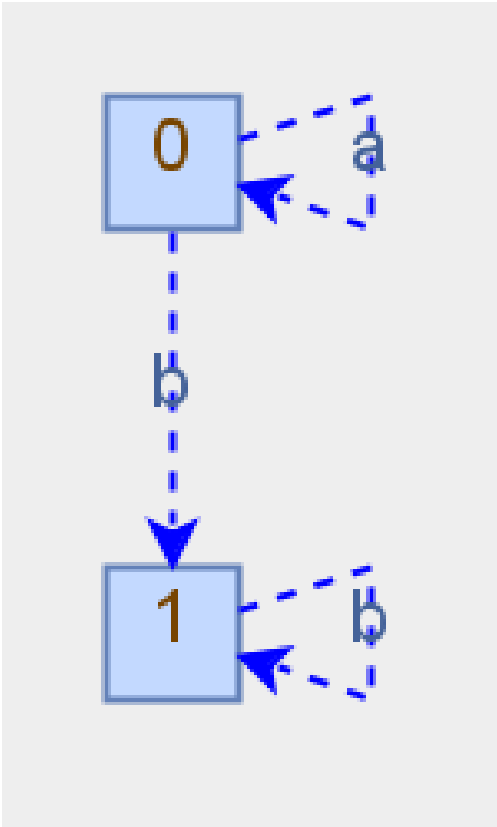
The refinement must contain every must-transition of the given system
AND
Every may-transition of the refinement system must be defined in the given (refined) system





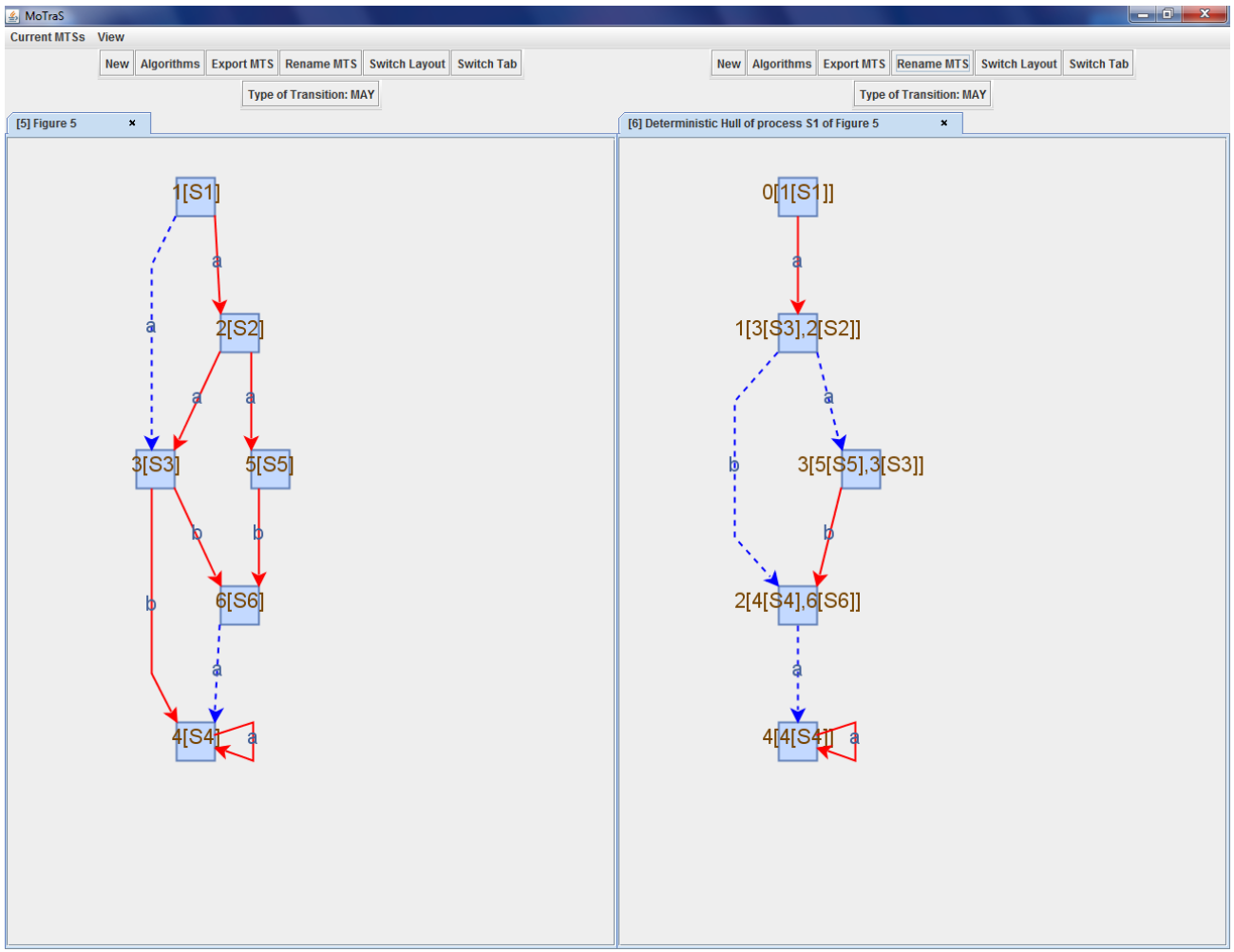
Refinements II





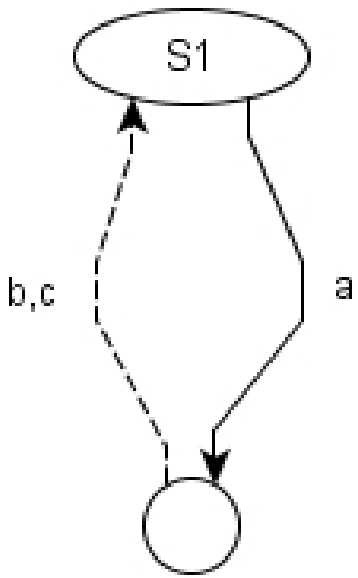
Deterministic Hull

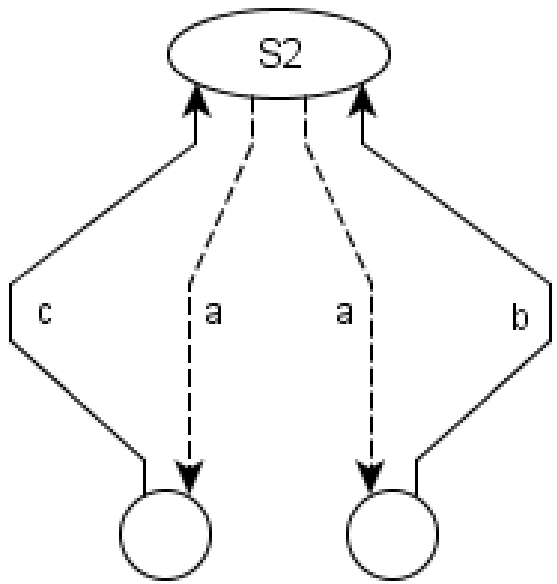
smallest (w.r.t. refinement) deterministic system refined by the original system

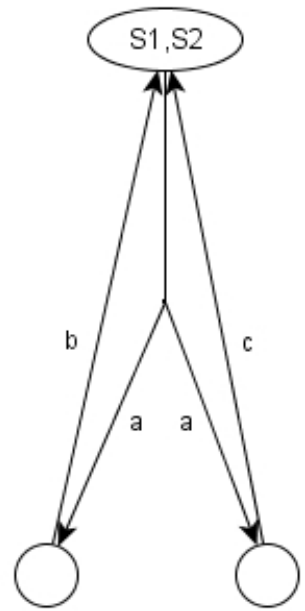


Conjunction

- greatest lower bound for a given set of processes w.r.t. the modal refinement
- not always expressible as MTS, but as DMTS

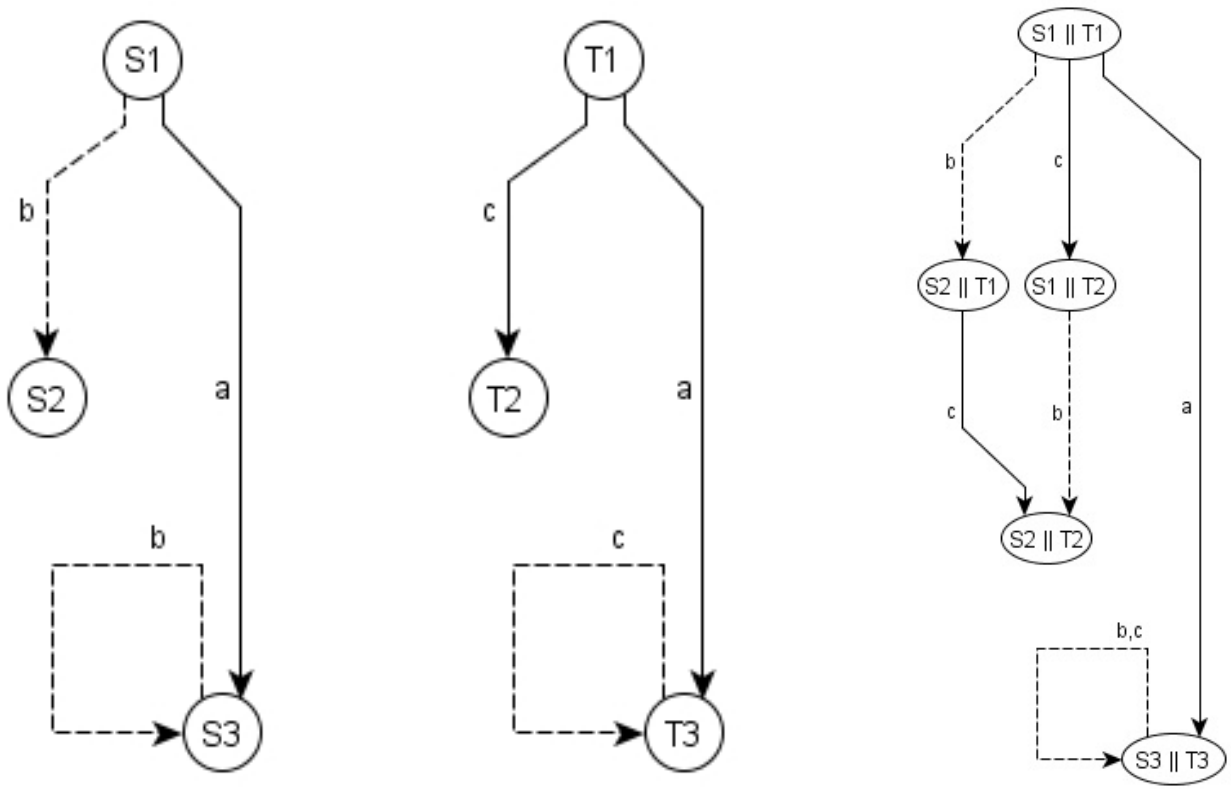






Composition

- synchronizing alphabet $\Gamma \subseteq \Sigma$
- sequential and synchronous scheduling of transitions
- Example with $\Gamma = \{a\}$:



Outline

Features

- single or double GUI
- drawing of MTSs and DMTSs
- import and export (various formats) of DMTSs
- random (d/D)MTS generator and MTS refinement generator
- runtime test for algorithms
- various sample MTSs

Algorithms

- Modal Refinement (two different algorithms)
- Smallest Common Implementation for dMTSs
- Greatest Common Implementation for DMTSs
- Deterministic Hull
- Composition
- Conjunction for DMTSs
- LTL Model Checking for DMTSs

MoTraS - a short demonstration ...

Outline

Two ways to check MR

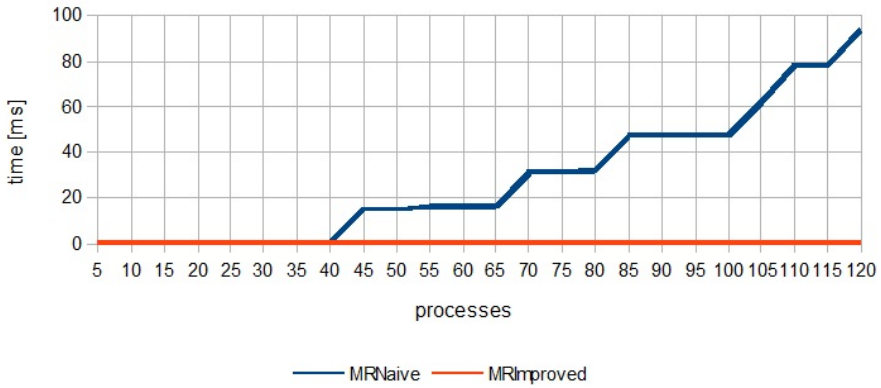
MRNaive

Fixed point computation over the whole Cartesian Product of the sets of processes

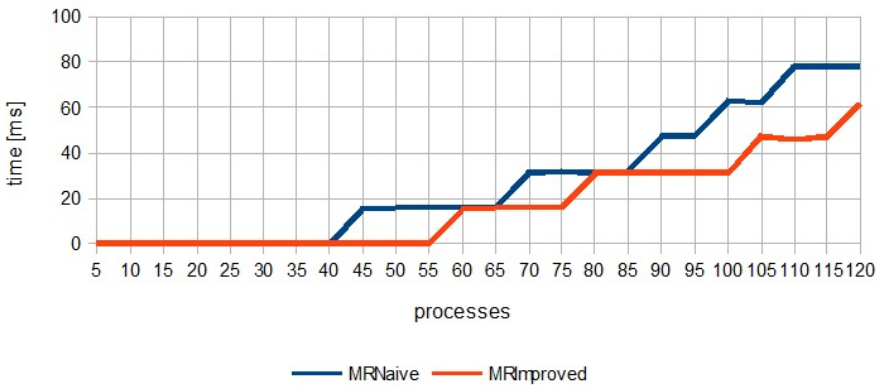
MRImproved

BFS to find all relevant pairs of processes and fixed point computation on the resulting set

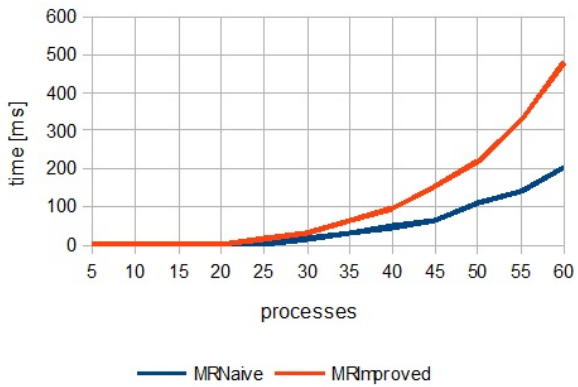
Runtime evaluation



(a) transitions-processes-ratio (TPR) $1.5n$



(b) TPR $2n$



(c) TPR $0.25n^2$

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Future Work

- Extension of algorithms for DMTSs
- Algorithms for checking Thorough Refinement
- Further optimizations of the algorithms

Thank you for your attention!