A machine-independent characterization of timed languages

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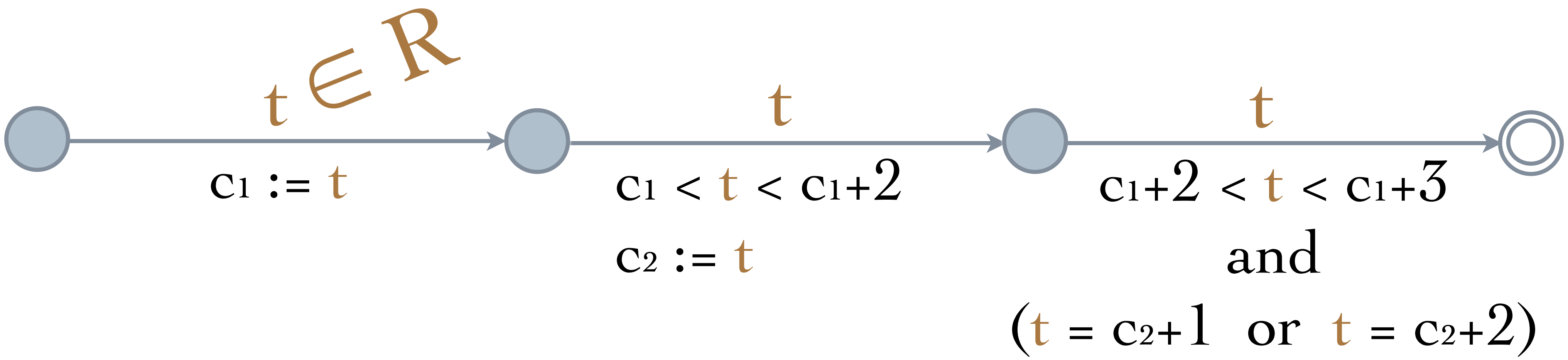
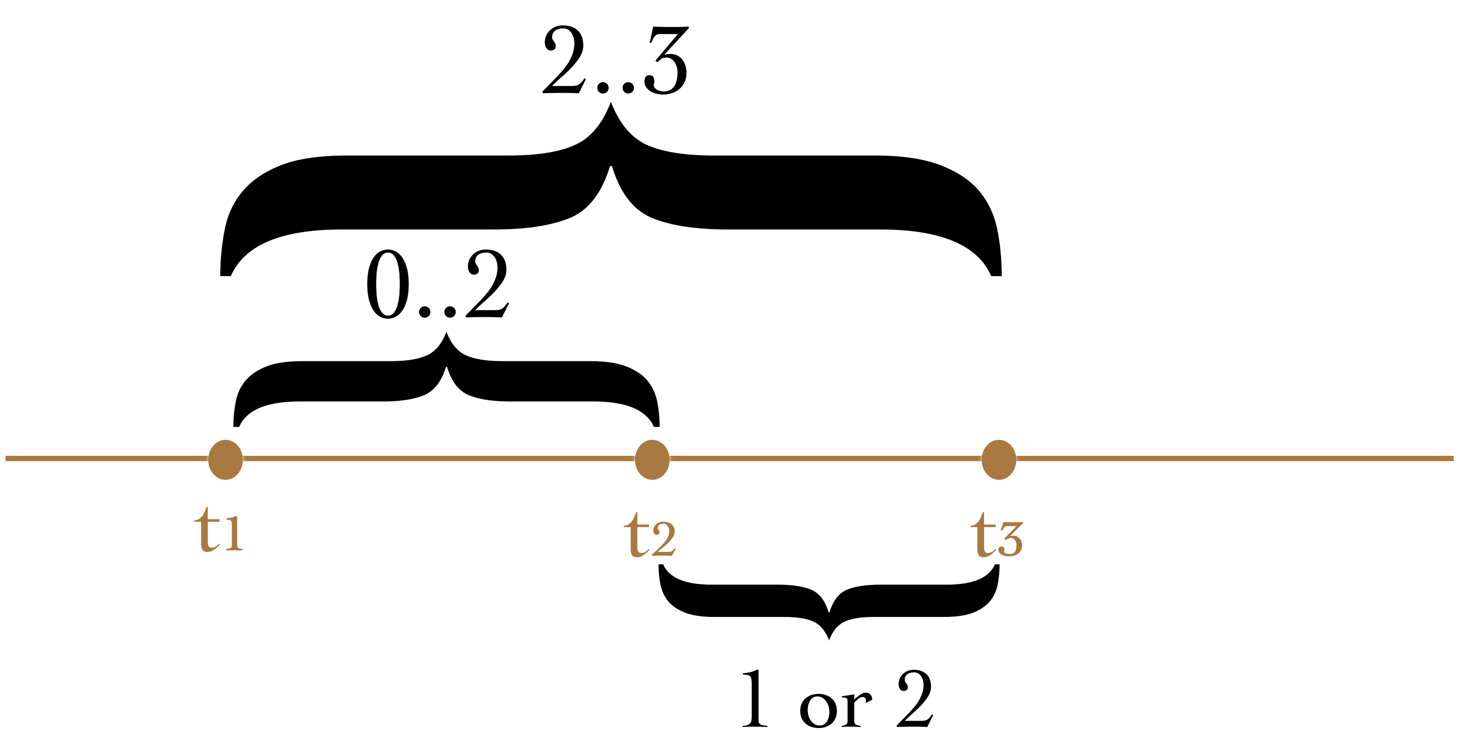
HIGHLIGHTS 2013

deterministic timed automata

with uninitialized clocks



the automaton accepts words $t_1\ t_2\ t_3 \in R^3$ such that



Myhill-Nerode theorem

let L be a language over a finite alphabet A

L is recognized by a DFA

iff

$\approx_L$ has finitely many equivalence classes

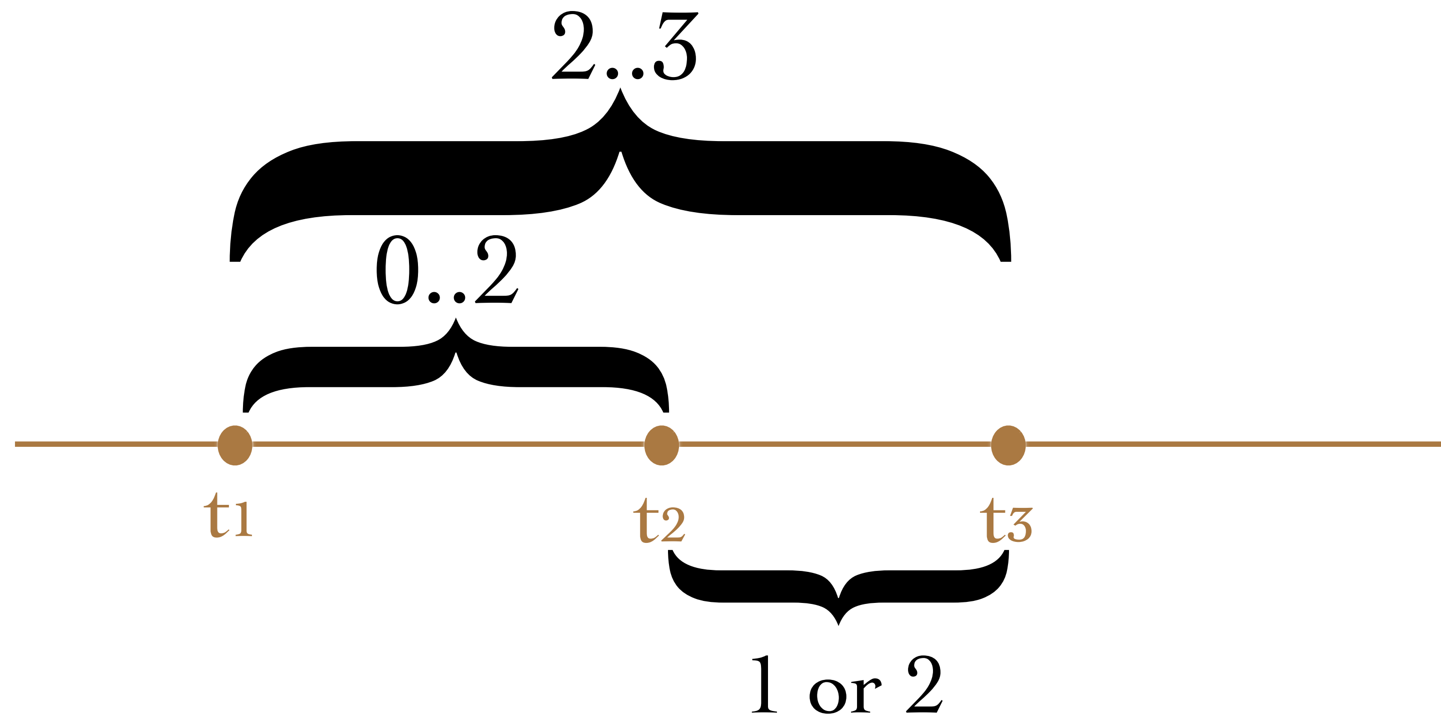
$w \approx_L u$ iff $\forall v\ (wv \in L$ iff $uv \in L)$

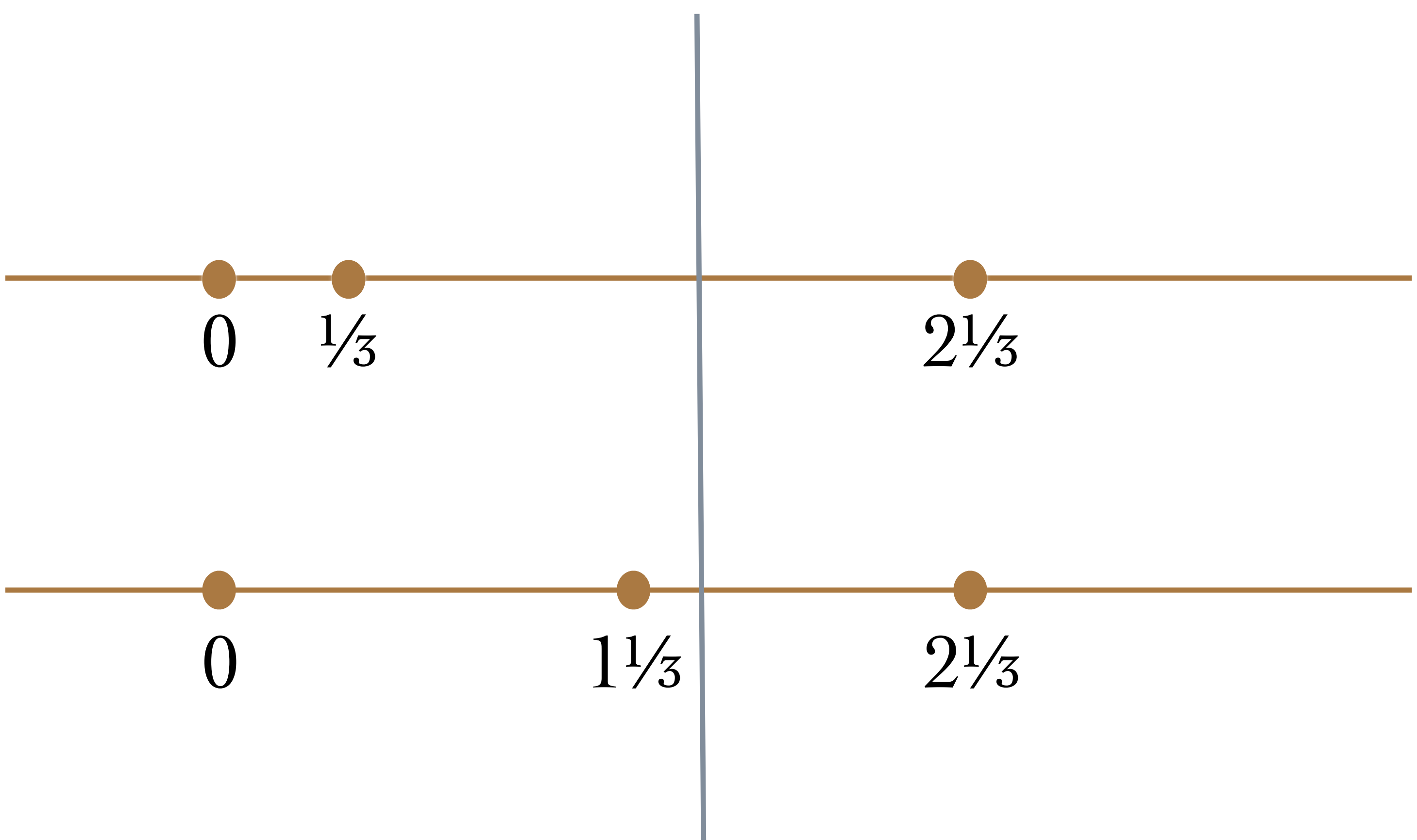
The same for deterministic timed automata?

Problems:

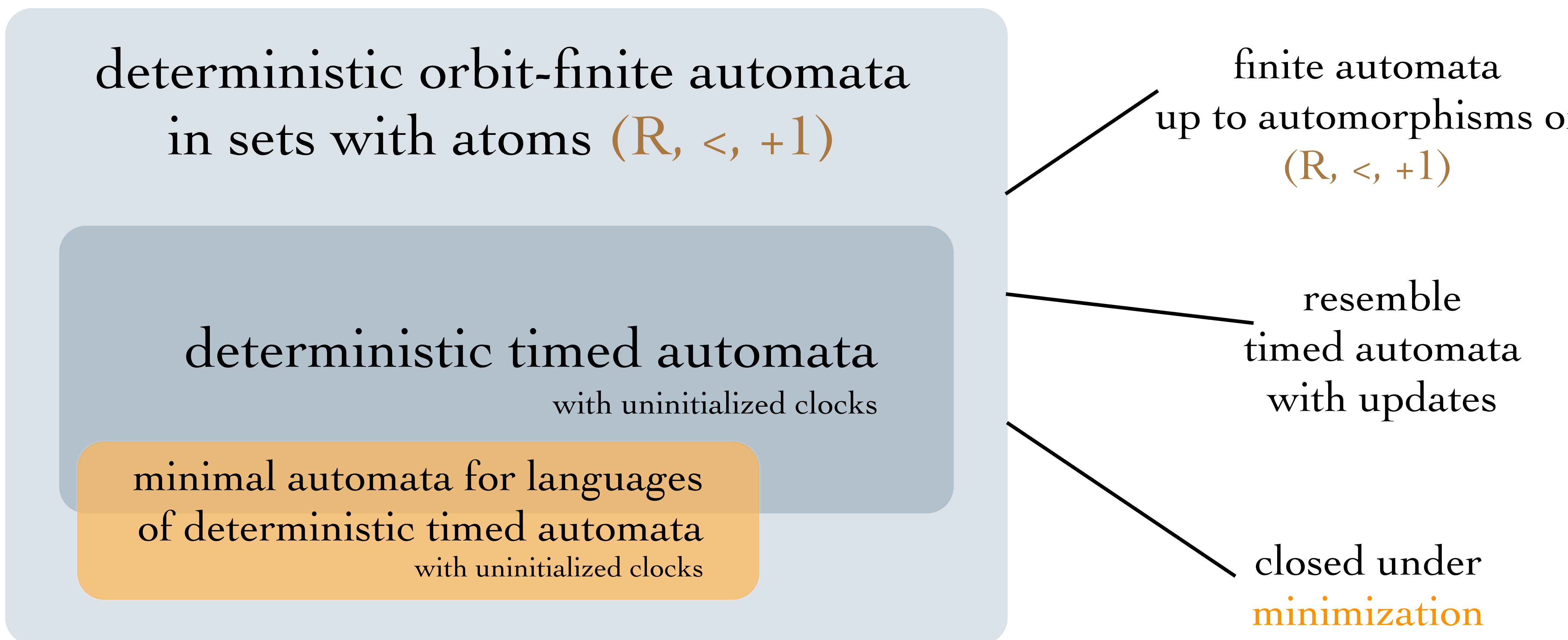
- infinitely many equivalence classes
- no canonical minimal timed automaton

deterministic timed automata
with uninitialized clocks
do not minimize





Solution: move to sets with atoms



Myhill-Nerode theorem for timed languages

let L be a language over $A \times \mathbb{R}$

such that

- L contains only increasing words
- L is invariant under $\mathrm{Aut}(\mathbb{R}, <, +1)$

L is recognized by a deterministic timed automaton

with uninitialized clocks

iff

- $\approx_L$ has orbit-finite set of equivalence classes
- L is forgetful

deterministic orbit-finite automata in sets with atoms $(\mathbb{R}, <, +1)$

deterministic timed automata

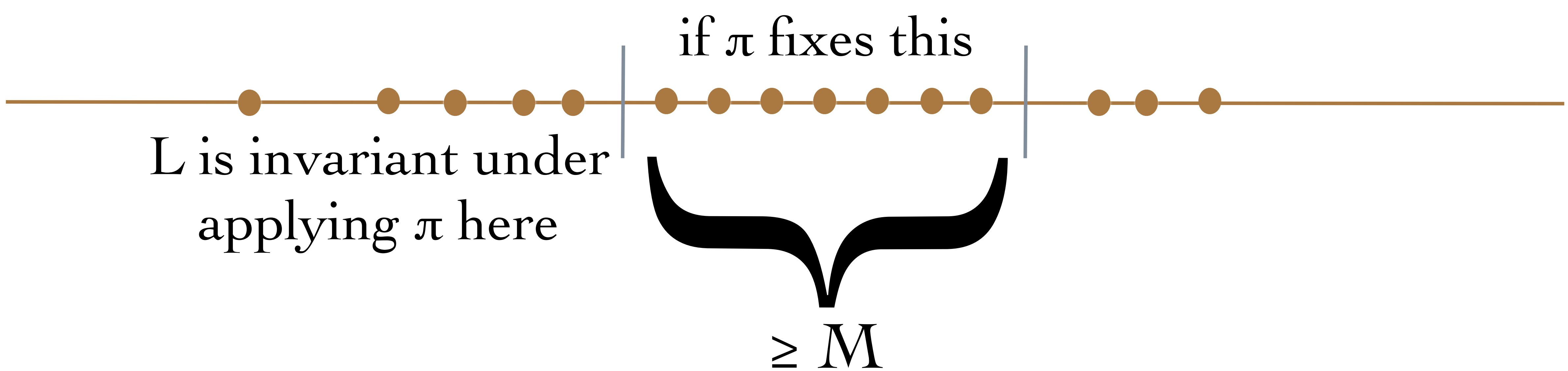
with uninitialized clocks

L is forgetful iff

there is $M \in \mathbb{R}$ such that

for every timed word
and $\pi \in \mathrm{Aut}(\mathbb{R}, <, +1)$

for every factorization



summary

- Myhill-Nerode theorem for timed languages
- superclass of deterministic timed automata closed under minimization

both result due to sets with atoms

Thank you!