ALLOY 6

A MATTER OF TIME

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ALLOY 6
Lesson objectives

To understand how Alloy 5 deals with **dynamic modeling**

To understand which are the **limitations** of the **dynamic modeling** in Alloy 5 and why Alloy needed a **new version**

To understand which are the **new features** introduced in **Alloy 6**

Alloy 6: an **implicit**, built-in notion of **(discrete) time**

1. Linear temporal logic
2. Mutable signatures and fields
3. Temporal operators
4. Time horizon
5. New visualizer

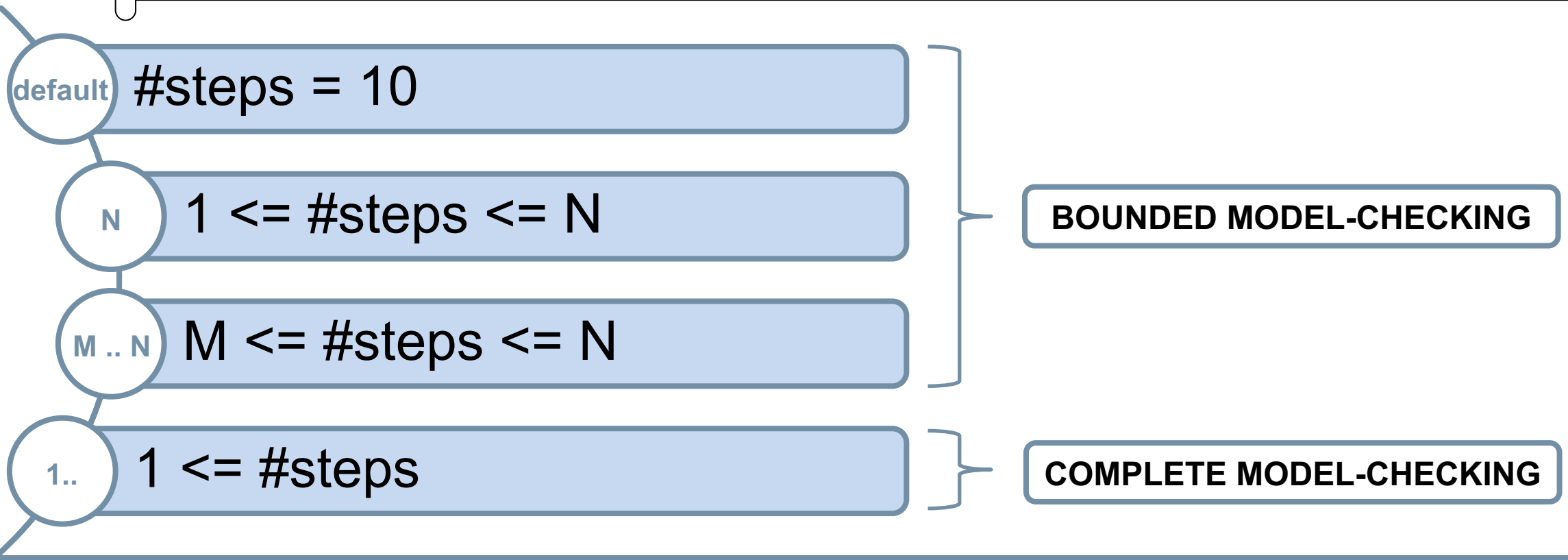
TIME HORIZON
Number of steps

TIME HORIZON: the possible number of transitions of lasso traces to explore

default	#steps = 10	`for 10 steps`
N	1 <= #steps <= N	`for N steps`
M .. N	M <= #steps <= N	`for M .. N steps`
1..	1 <= #steps	`for 1 .. steps`

TIME HORIZON
Model-checking

TIME HORIZON: the possible number of transitions of lasso traces to explore



Quiz 4

Time Horizon

https://forms.office.com/e/SXfQ5ByiNJ

5 min.

TIME HOIZON
Quiz solutions

1. What is the time horizon in Alloy used for?
   - ❑ To specify the upper bound on the number of transitions in a lasso trace
   - ❑ To specify the lower bound on the number of transitions in a lasso trace
   - ❑ To specify the exact number of transitions in a lasso trace
   - ❑ To specify the type signature names in plain scopes
2. What is a lasso trace?
   - ❑ An infinite and non-repeating sequence of transitions
   - ❑ A finite and non-repeating sequence of transitions
   - ❑ An infinite and periodic sequence of transitions
   - ❑ A finite and periodic sequence of transitions
3. What is the purpose of the steps keyword in Alloy?
   - ❑ To specify the upper bound on the number of transitions in a lasso trace
   - ❑ To specify the lower bound on the number of transitions in a lasso trace
   - ❑ To specify the exact number of transitions in a lasso trace
   - ❑ To specify the type signature names in plain scopes
4. What is the difference between complete model-checking and bounded model checking?
   - ❑ Complete model-checking checks over all possible traces without bounding them upfront, while bounded model checking only checks a subset of possible traces with an upper bound on the number of transitions.
   - ❑ Complete model-checking checks only a subset of possible traces with an upper bound on the number of transitions, while bounded model checking checks over all possible traces without bounding them upfront.
   - ❑ Complete model-checking checks only the first and last states in a lasso trace, while bounded model checking checks all states in a lasso trace.
   - ❑ Complete model-checking and bounded model checking are the same thing.

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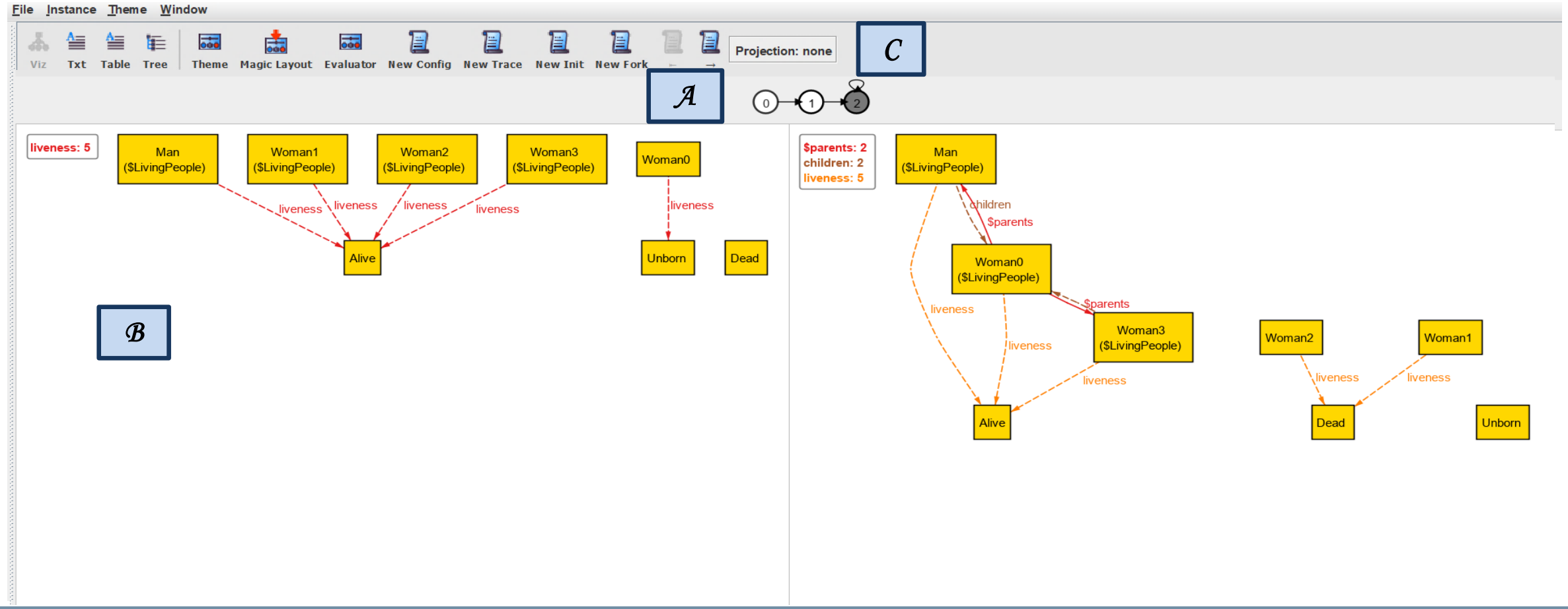
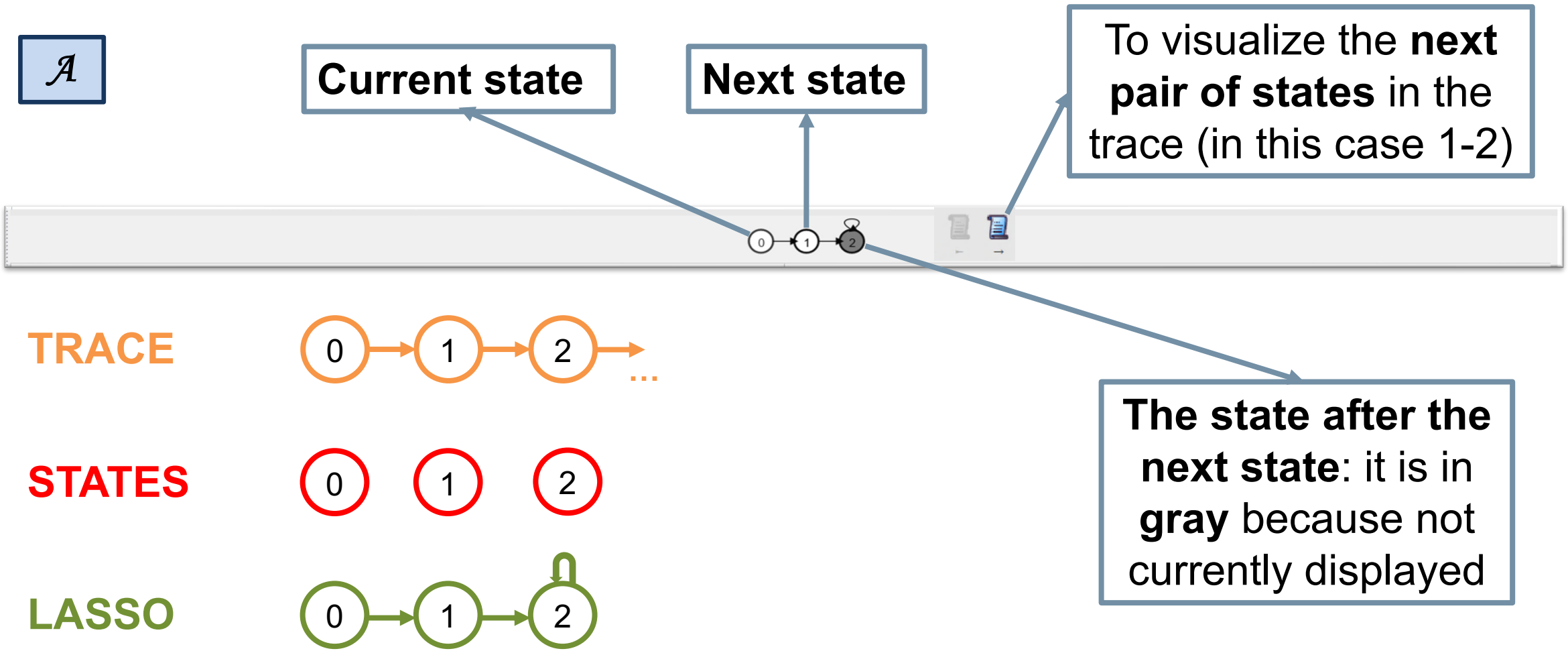
NEW VISUALIZER

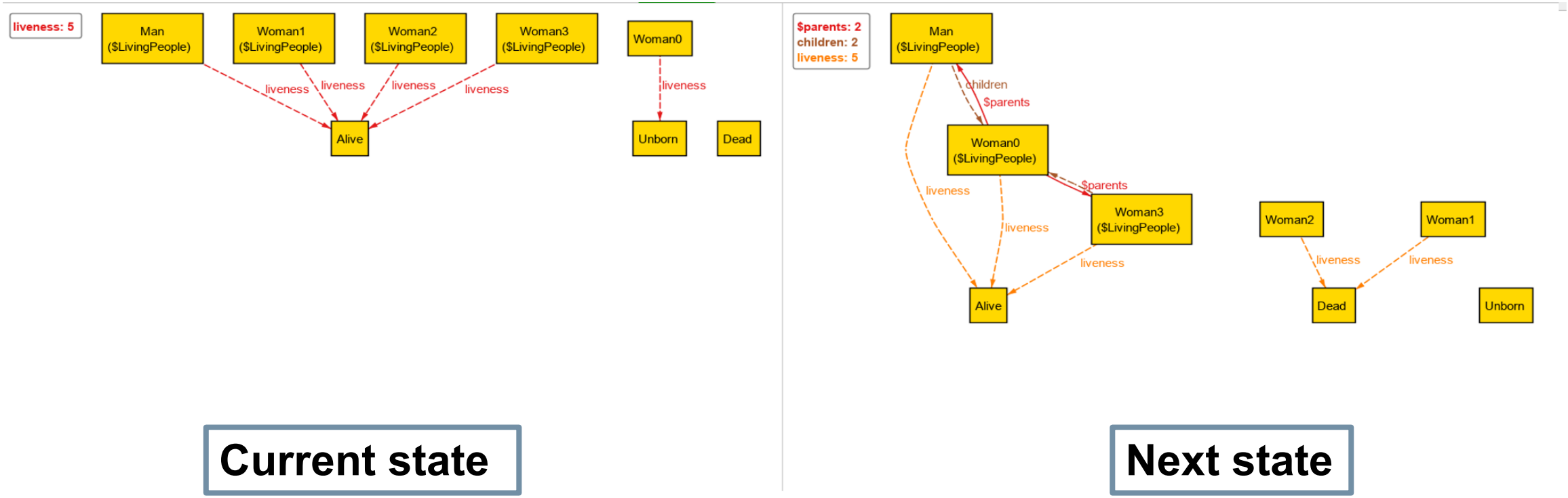


NEW VISUALIZER
Trace, states, lasso



$\mathcal{B}$

The visualizer shows a **step-pair**

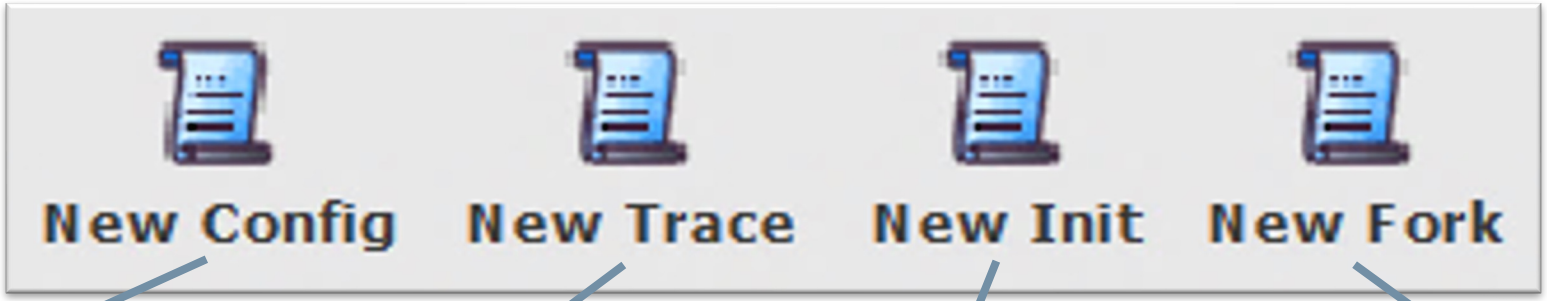


Current state

Next state

NEW VISUALIZER
New generating options

C



yields a trace where the **configuration changed**

yields a **new trace** under the **same configuration**

yields a trace with a **different initial state**, under the **same configuration**

yields a **new trace** that is **similar to the current** one until the currently-displayed state but **differs afterwards**

Quiz 5

New Visualizer

https://forms.office.com/e/TWVpieWMCF

5 min.

1. What does the visualizer show?
   - ❑ All possible states of the system
   - ❑ The current state and the next state
   - ❑ All past states of the system.
   - ❑ The entire behavior of the system.
2. What is lasso in the visualizer?
   - ❑ A sequence of states that terminates.
   - ❑ A sequence of states that loops back to a previous state.
   - ❑ A sequence of states that terminates or loops back to a previous state.
   - ❑ A sequence of states that cannot be represented in the visualizer.
3. What does the "New Fork" option do?
   - ❑ Finds a new behavior trace from the existing configuration and initial state.
   - ❑ Finds a new initial state and behavior trace.
   - ❑ Fixes the present state and states before and finds a new next state.
   - ❑ Changes the immutable parts of the model and finds a new behavior trace.

3. What is the purpose of the "New Init" option?
   - ❑ To find a new behavior trace from the existing configuration and initial state.
   - ❑ To change the immutable parts of the model and find a new behavior trace.
   - ❑ To fix the immutable relations and find a new initial state and behavior trace.
   - ❑ To fix the present state and states before and find a new next state.
4. What happens when you select the "New Config" option?
   - ❑ The visualizer finds a new initial state and behavior trace.
   - ❑ The visualizer shows a popup message.
   - ❑ The visualizer changes the immutable parts of the model and finds a new behavior trace.
5. When does the visualizer show the old layout with a "New Instance" button?
   - ❑ When the model is entirely dynamic.
   - ❑ When the model is entirely static.
   - ❑ When there are too many forks in the visualizer.
   - ❑ When the model has too many states to fit in memory.

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Lesson summary

- Two ways to deal with dynamic modeling in Alloy 5:
  - **Odering module**
  - **Time signature**

To understand how Alloy 5 deals with **dynamic modeling**

- Limitations of dynamic modeling in Alloy 5:
  - Cannot tell **deadlocks**
  - No **liveness property**
  - No built-in **notion of time**

To understand which are the **limitations** of the **dynamic modeling** in Alloy 5 and why Alloy needed a **new version**

- New features introduced in Alloy 6:
  - **Linear temporal logic**
  - **Mutable signatures and fields**
  - **Temporal operators**
  - **Time horizon**
  - **New visualizer**
  - **Concurrency**

To understand which are the **new features** introduced in **Alloy 6**