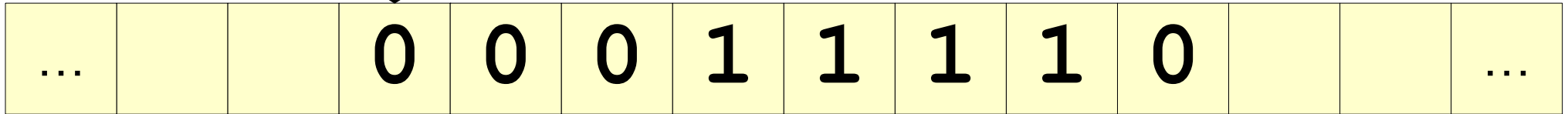


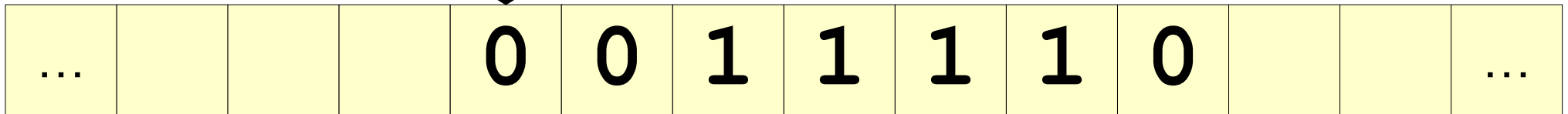
Another TM Design

- We've designed a TM for $\{0^n 1^n \mid n \in \mathbb{N}\}$.
- Consider this language over $\Sigma = \{0, 1\}$:
$$L = \{ w \in \Sigma^* \mid w \text{ has the same number of } 0\text{s and } 1\text{s} \}$$
- This language is also not regular, but it is context-free.
- How might we design a TM for it?

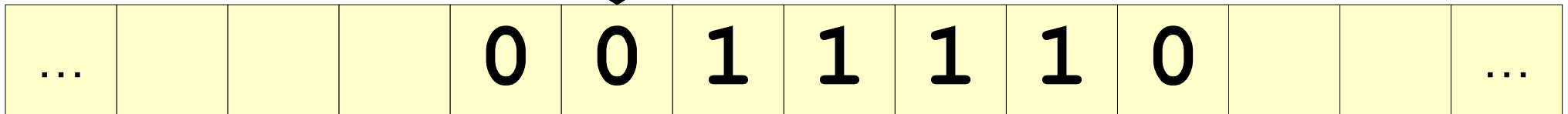
A Caveat



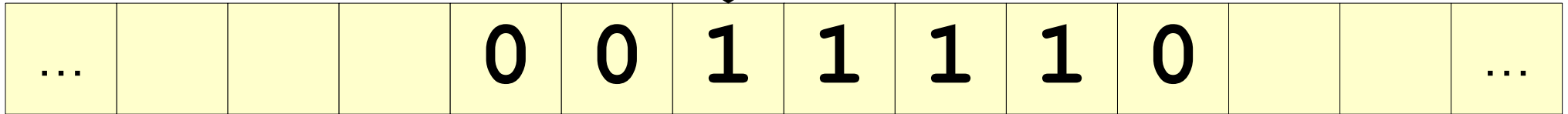
A Caveat



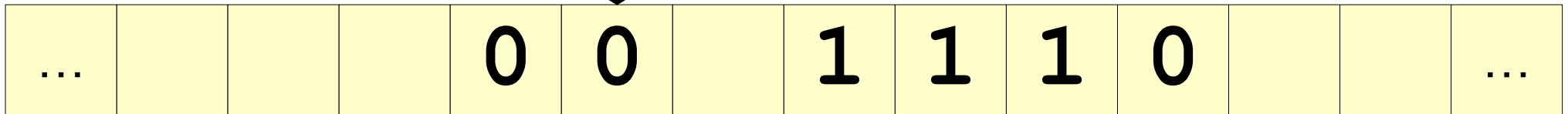
A Caveat



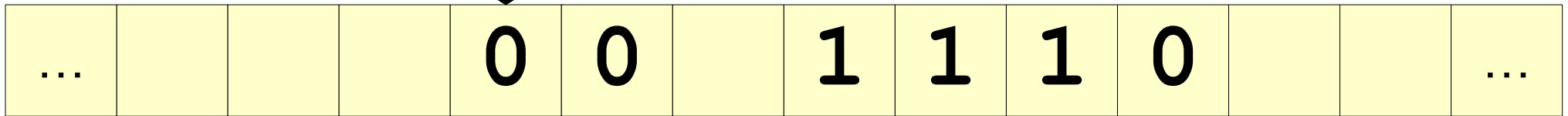
A Caveat



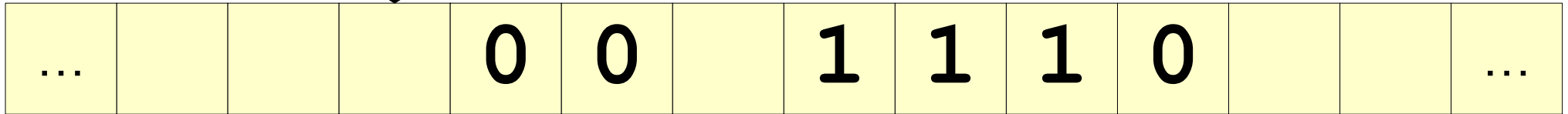
A Caveat



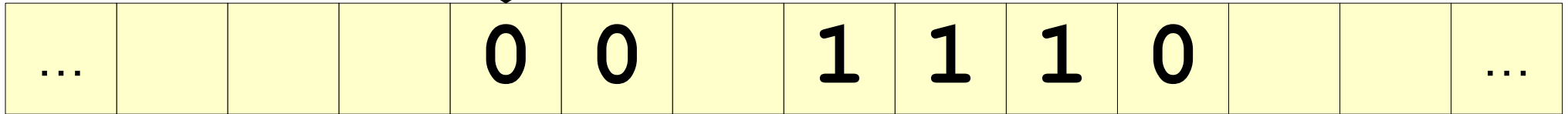
A Caveat



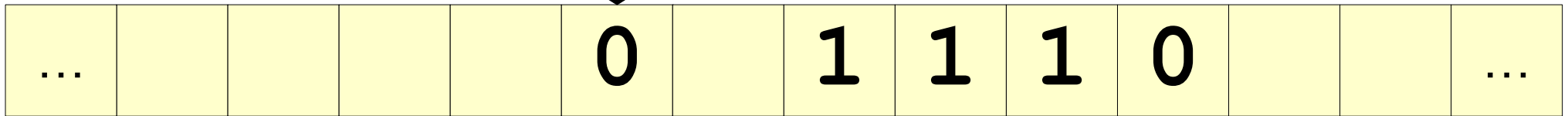
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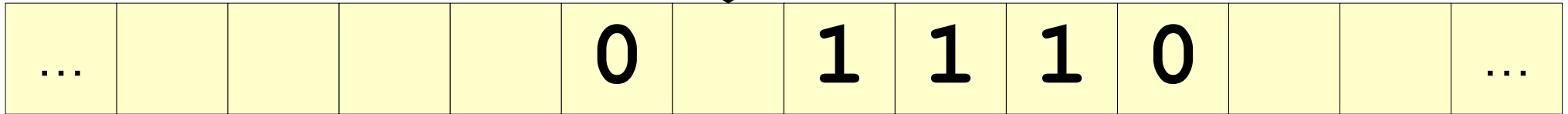
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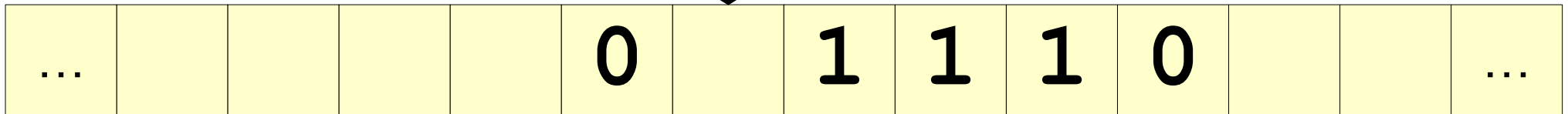
A Caveat



A Caveat

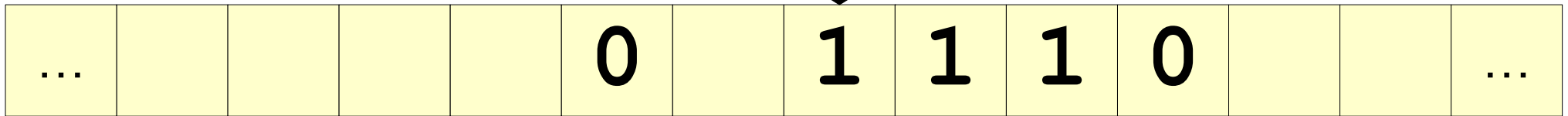


A Caveat

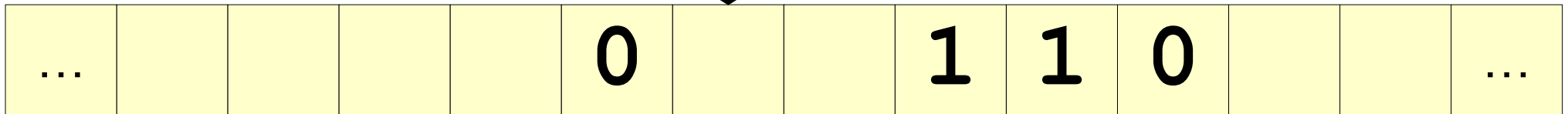


How do we know that
this blank isn't one of
the infinitely many
blanks after our input
string?

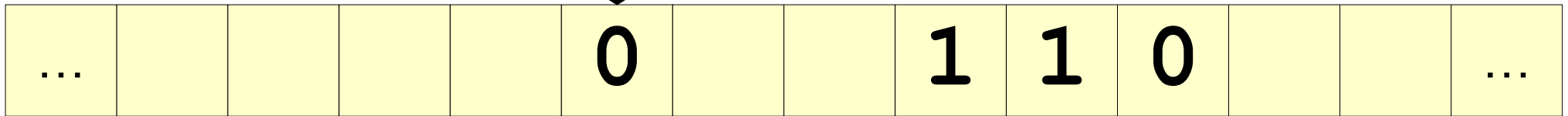
A Caveat



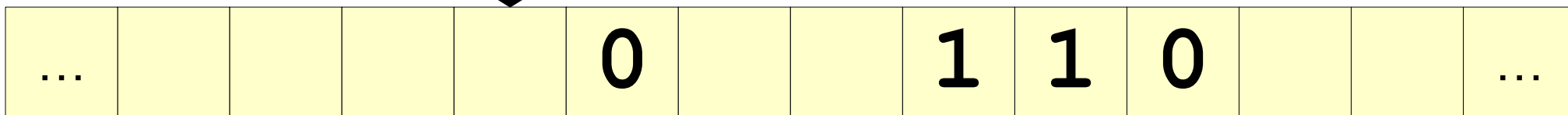
A Caveat



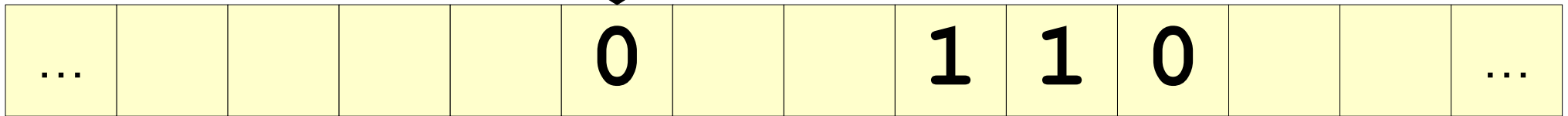
A Caveat



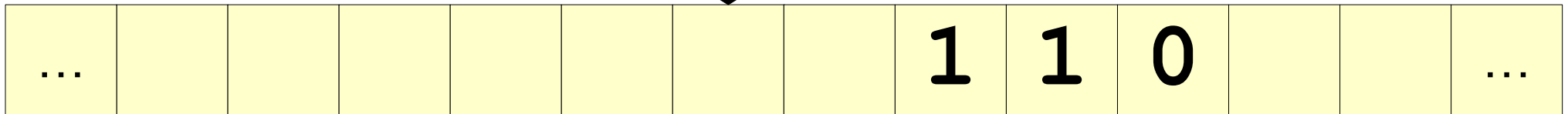
A Caveat



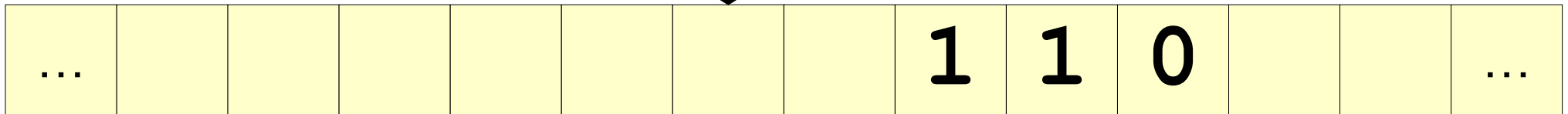
A Caveat



A Caveat

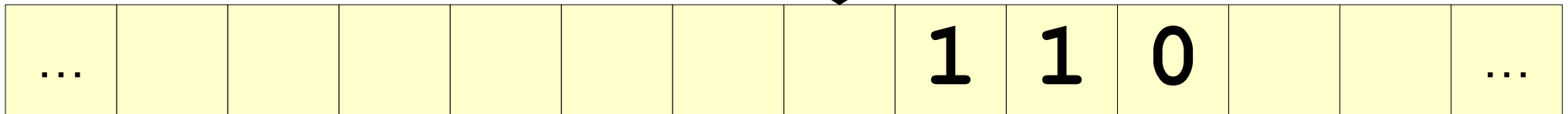


A Caveat

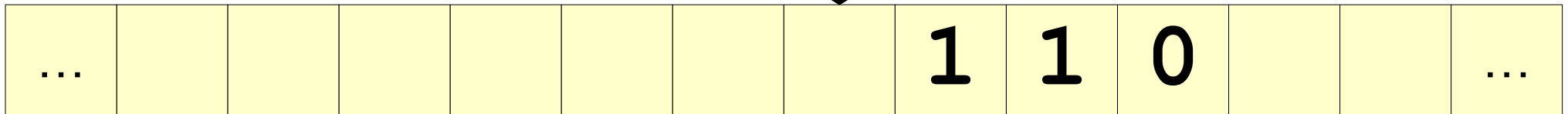


How do we know that this blank isn't one of the infinitely many blanks after our input string?

A Caveat

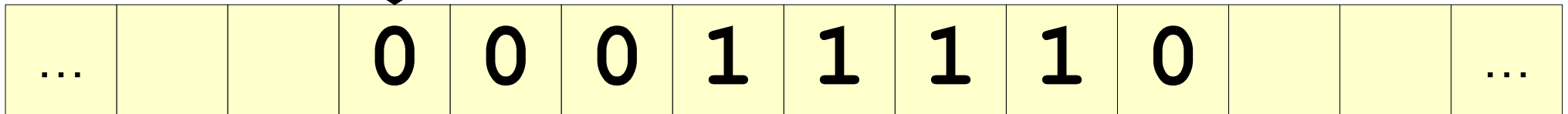


A Caveat



How do we know that this blank isn't one of the infinitely many blanks after our input string?

One Solution

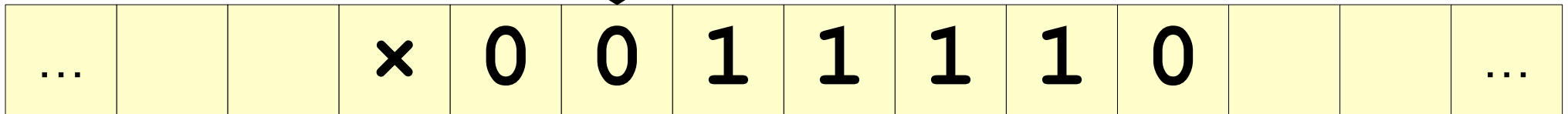


One Solution



...			x	0	0	1	1	1	1	0			...
-----	--	--	---	---	---	---	---	---	---	---	--	--	-----

One Solution

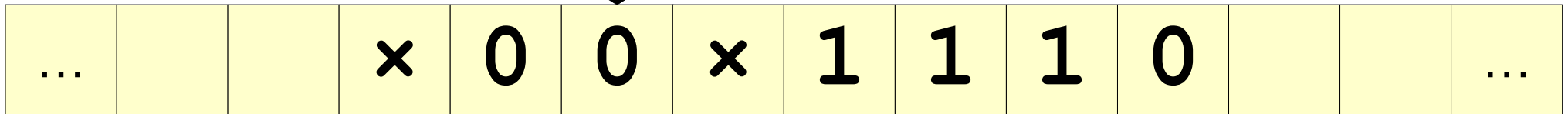


One Solution

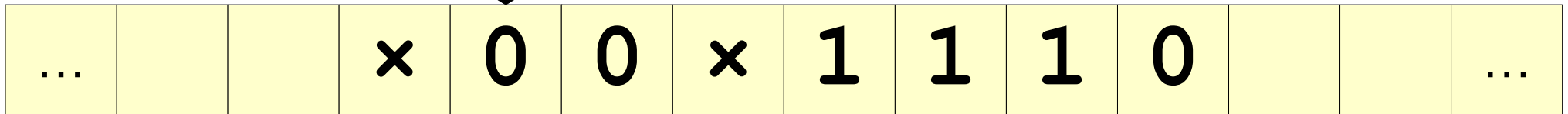


...			×	0	0	1	1	1	1	0			...
-----	--	--	---	---	---	---	---	---	---	---	--	--	-----

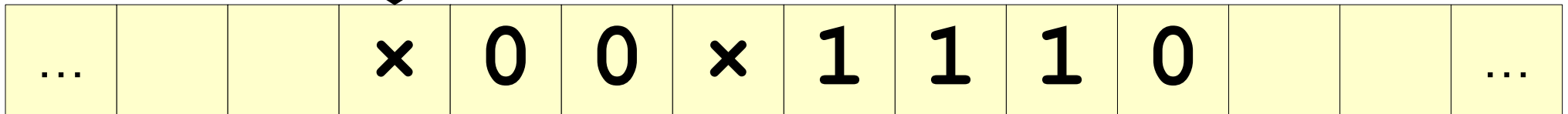
One Solution



One Solution



One Solution

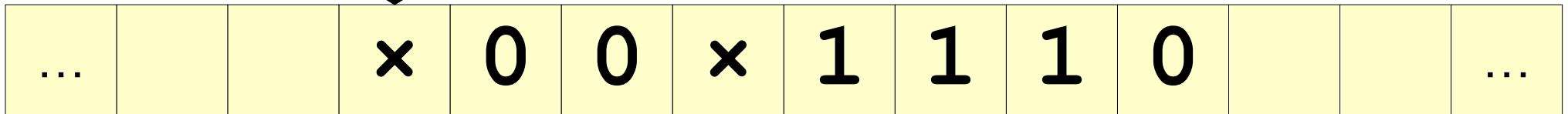


One Solution

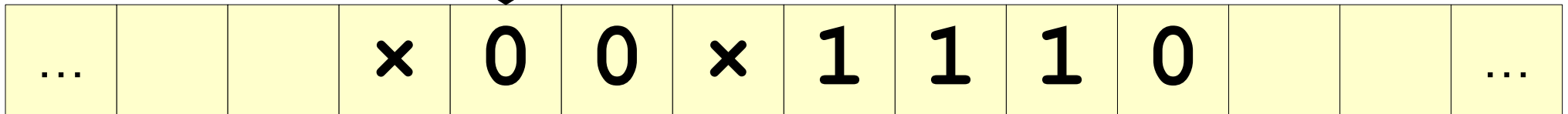


...			x	0	0	x	1	1	1	0			...
-----	--	--	---	---	---	---	---	---	---	---	--	--	-----

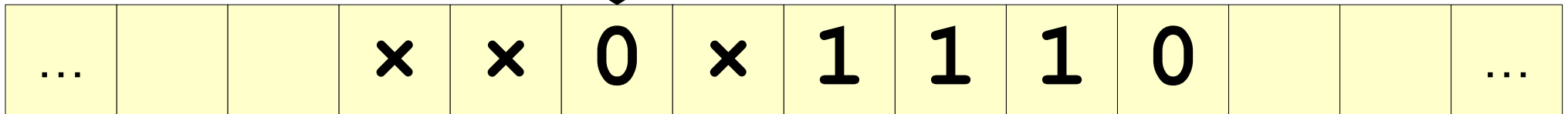
One Solution



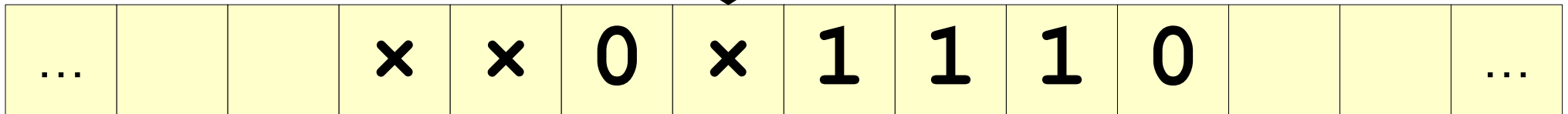
One Solution



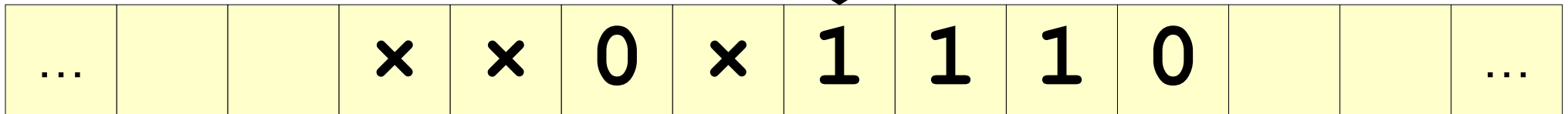
One Solution



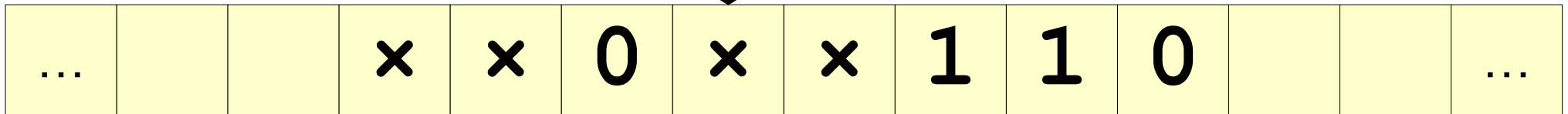
One Solution



One Solution



One Solution

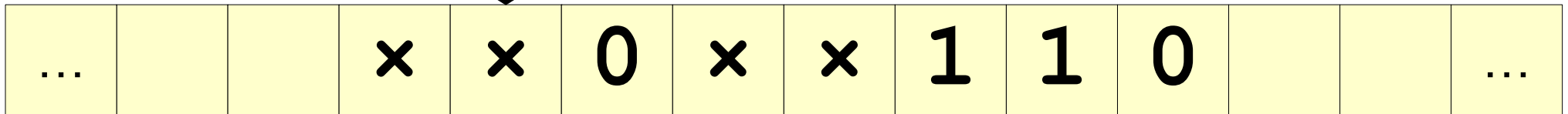


One Solution

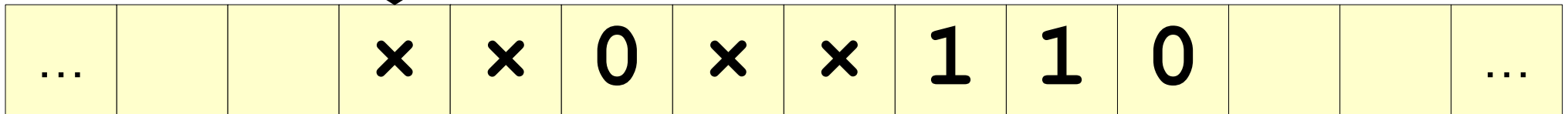


...			x	x	0	x	x	1	1	0			...
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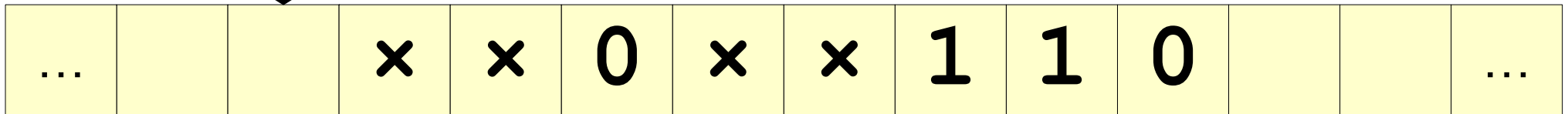
One Solution



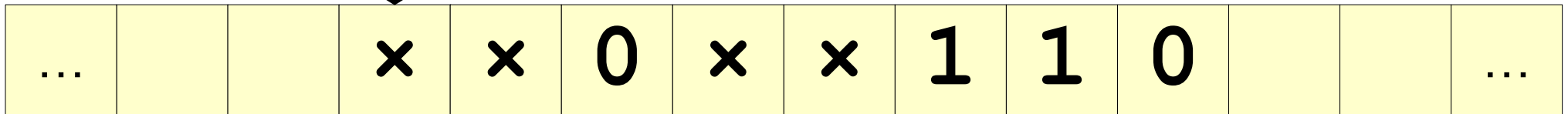
One Solution



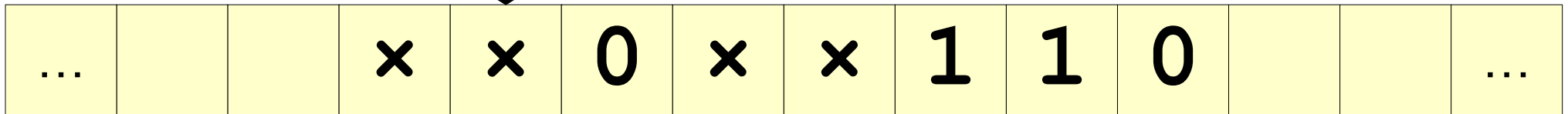
One Solution



One Solution



One Solution

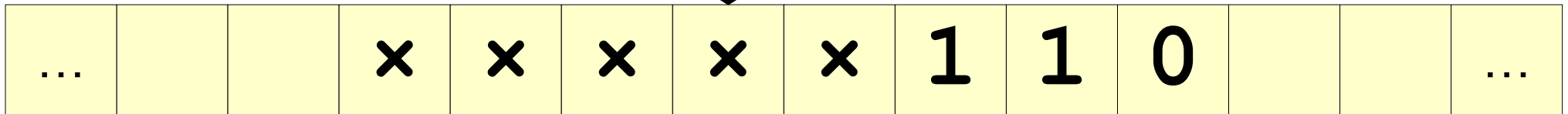


One Solution

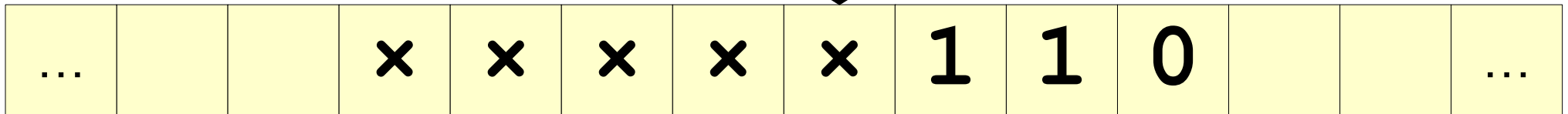


...			x	x	0	x	x	1	1	0			...
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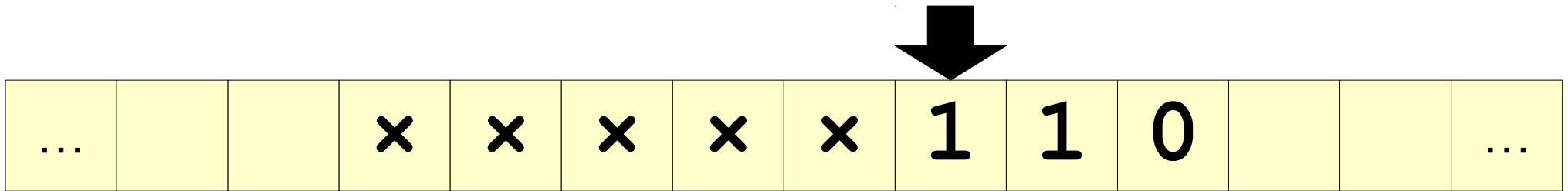
One Solution



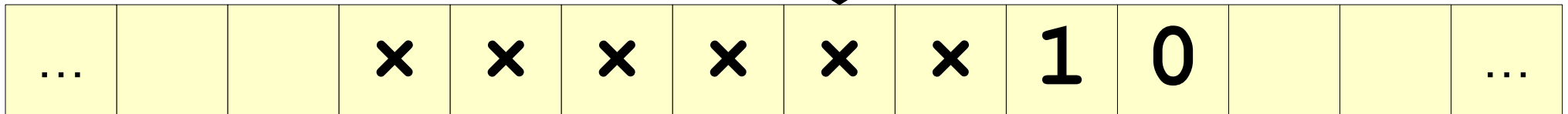
One Solution



One Solution



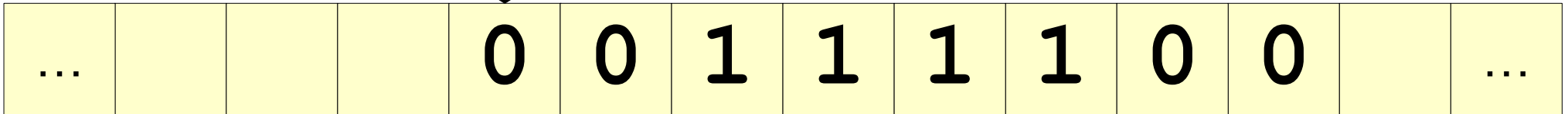
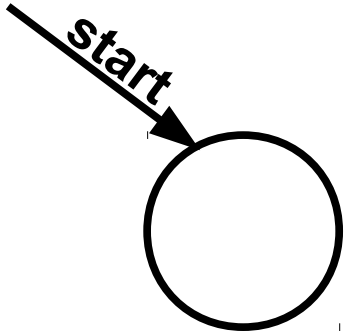
One Solution

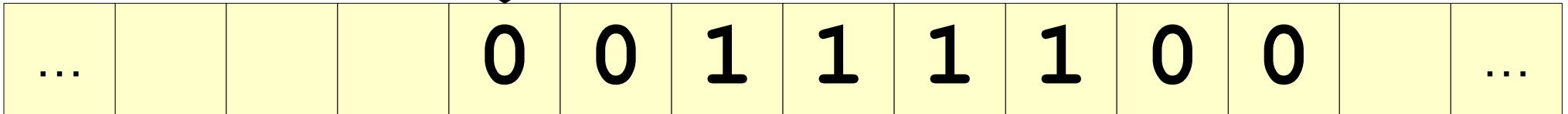
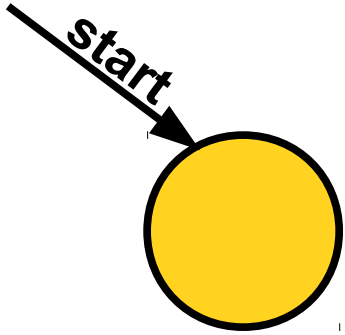


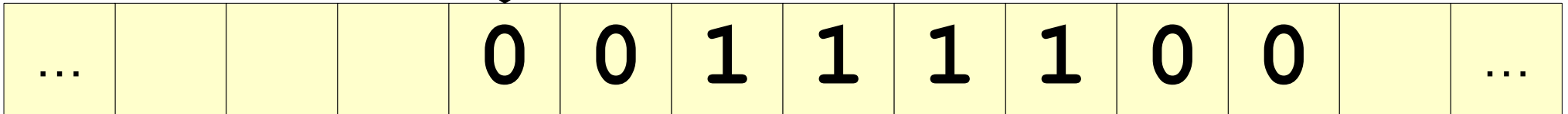
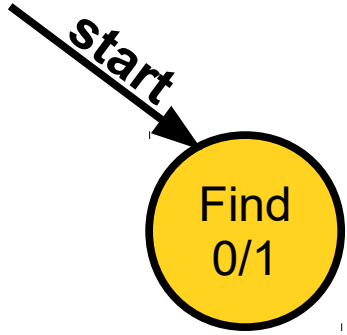
One Solution

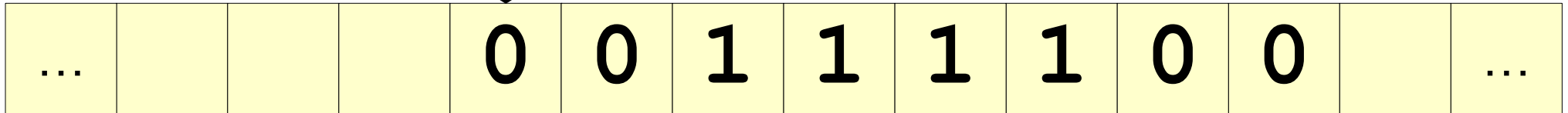
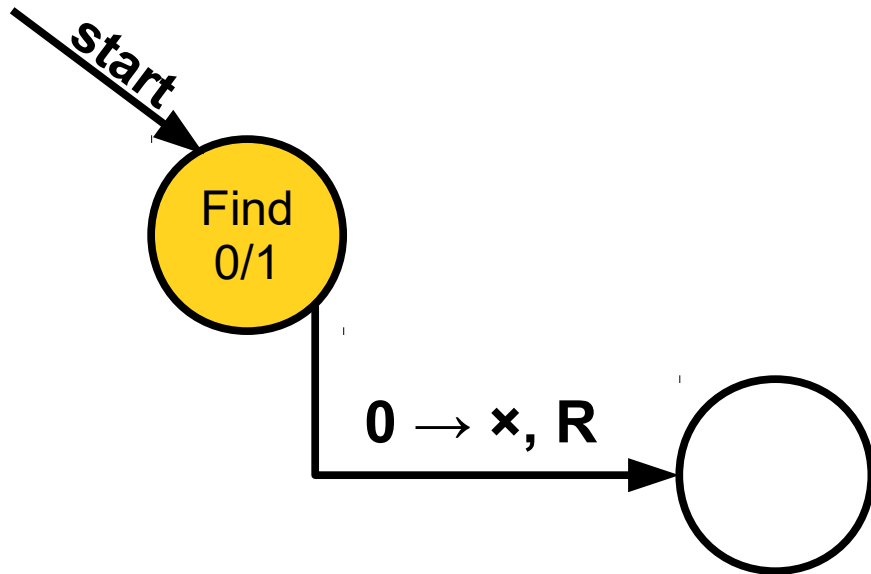


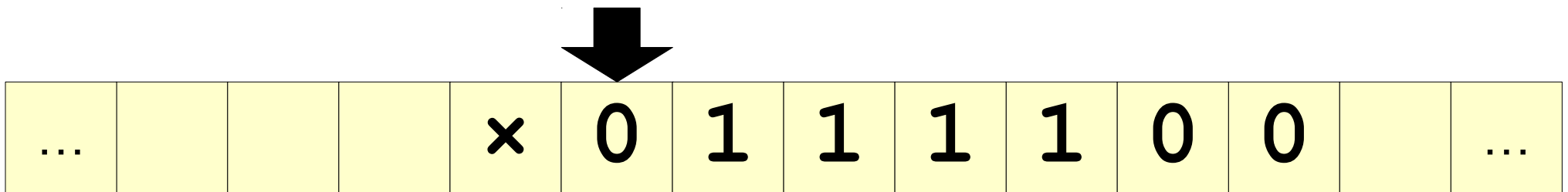
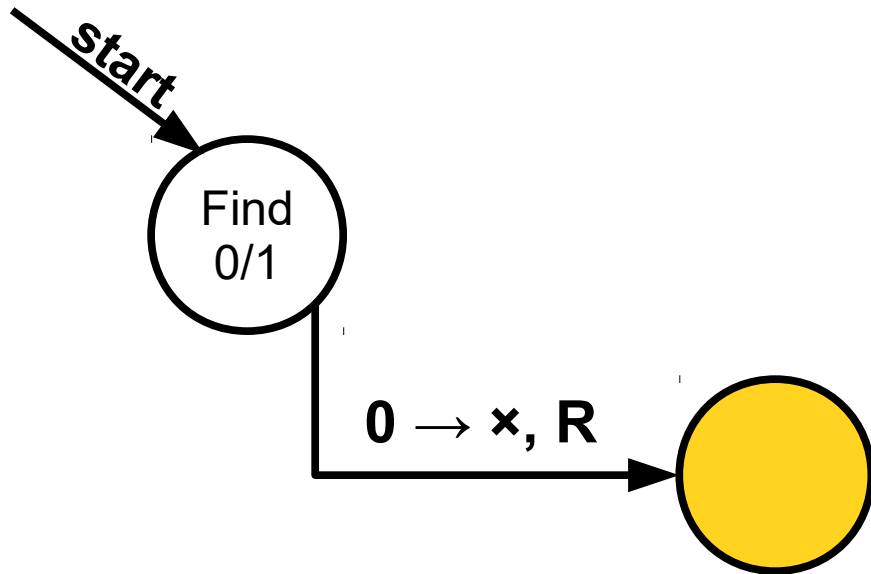
...			x	x	x	x	x	x	1	0			...
-----	--	--	---	---	---	---	---	---	---	---	--	--	-----

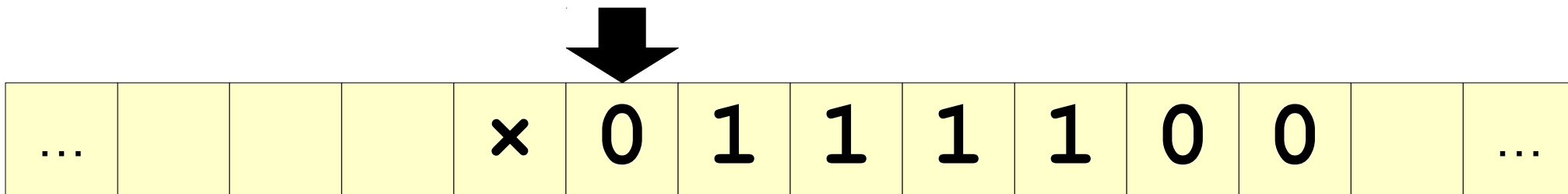
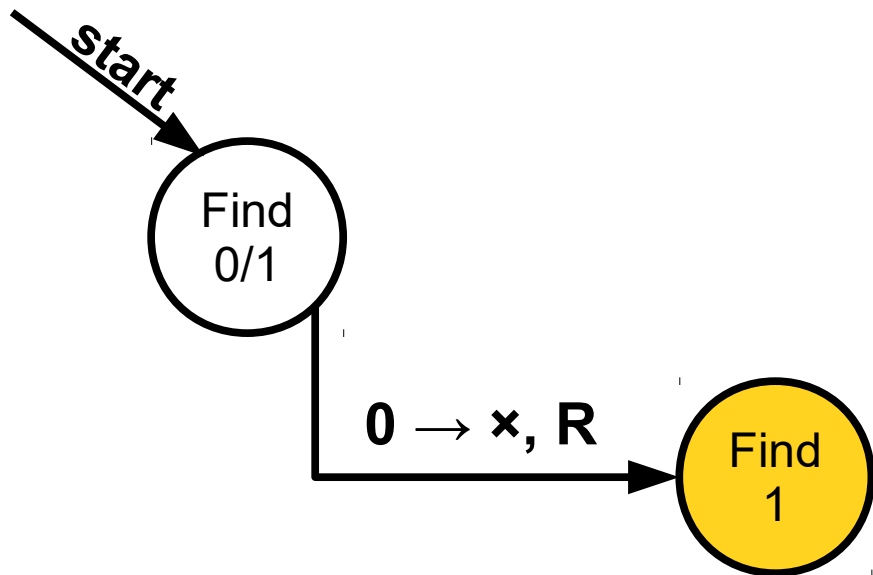


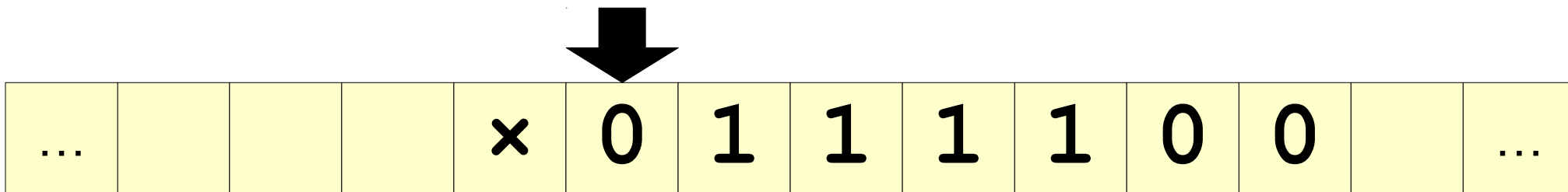
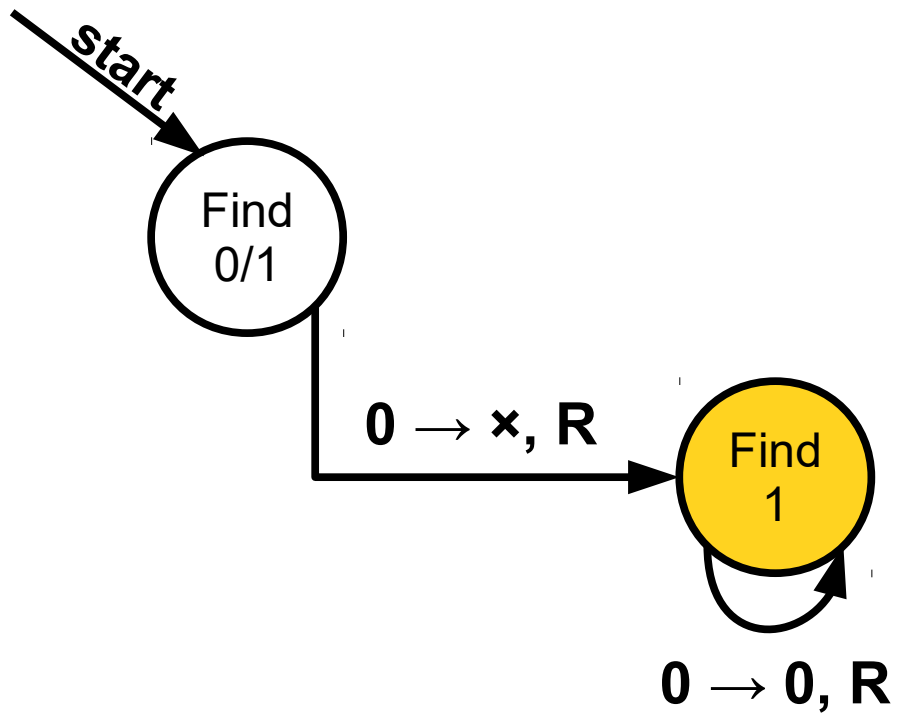


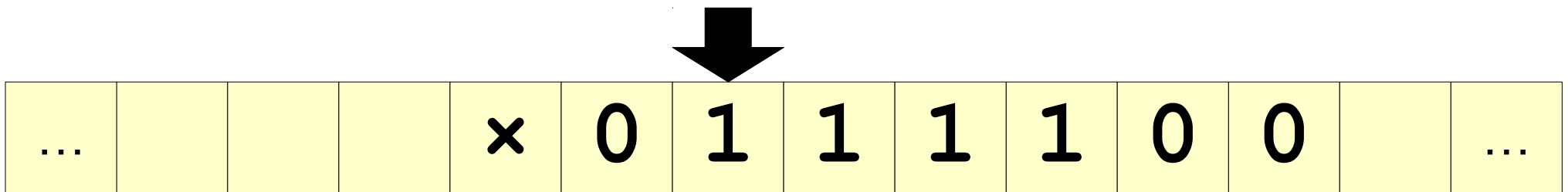
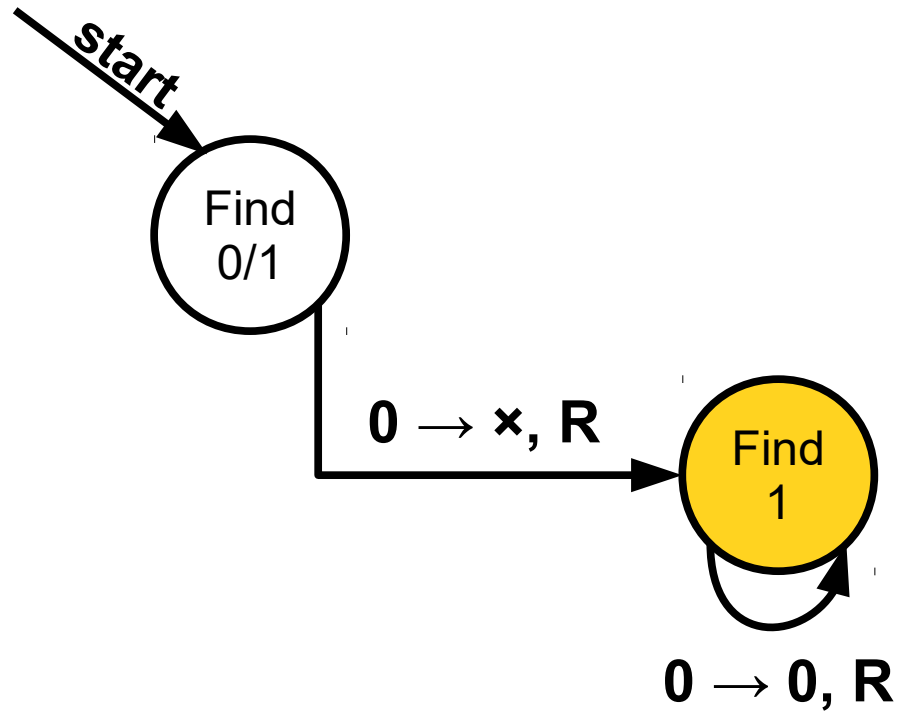


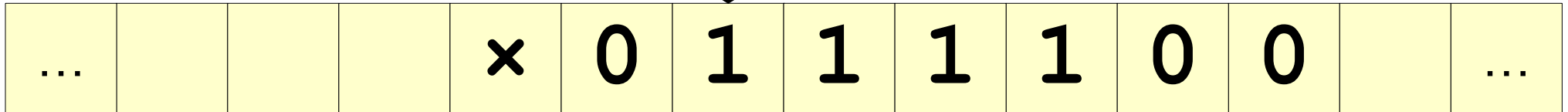
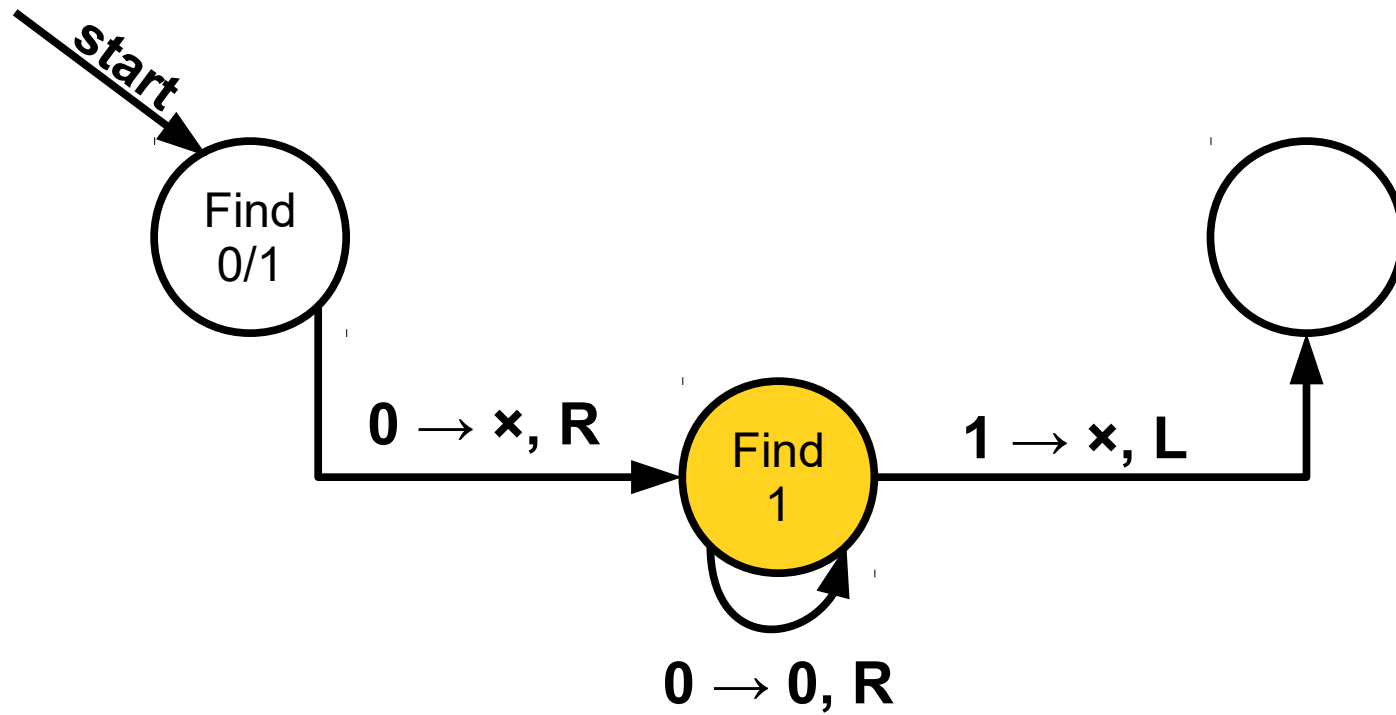


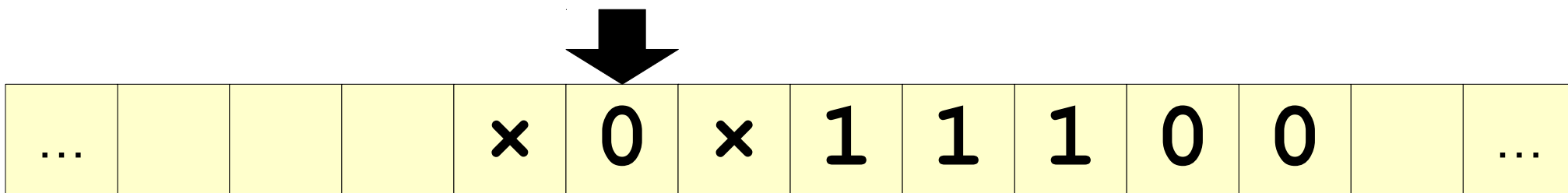
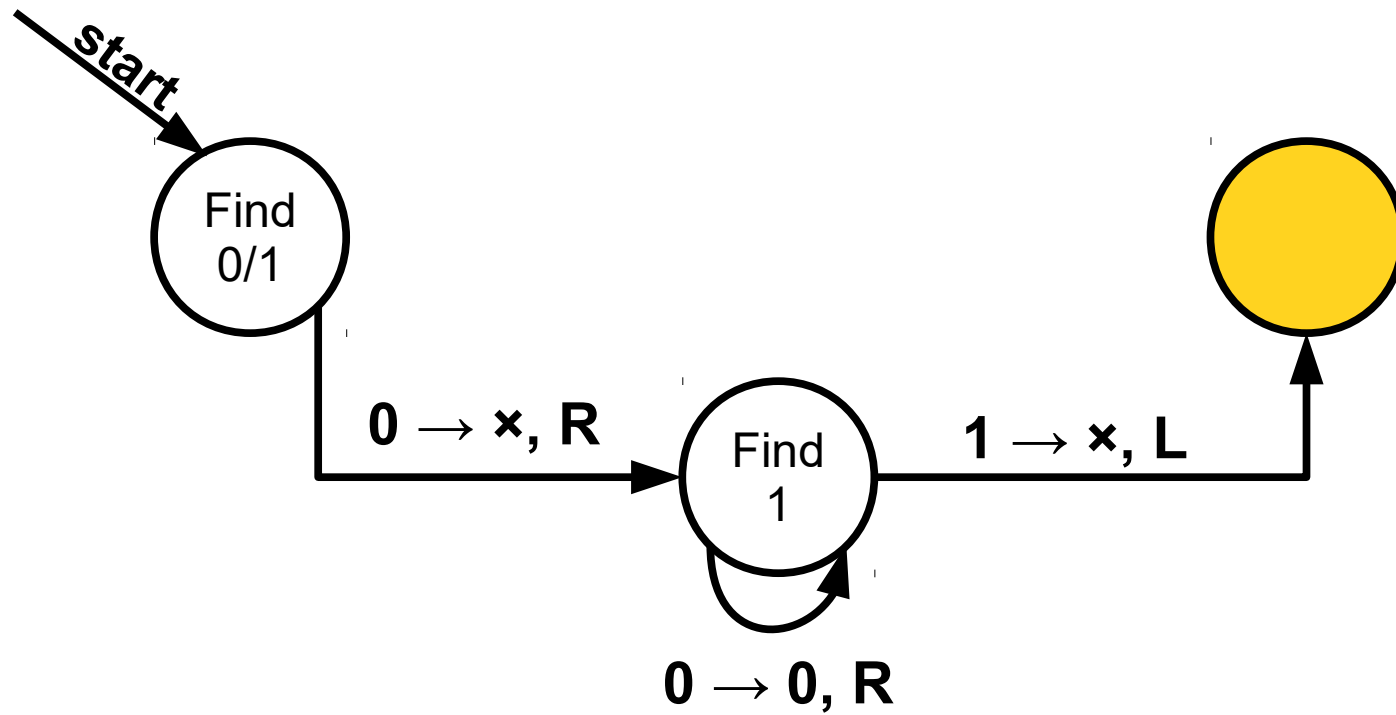


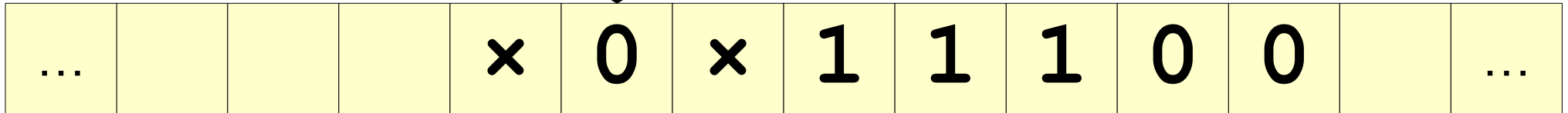
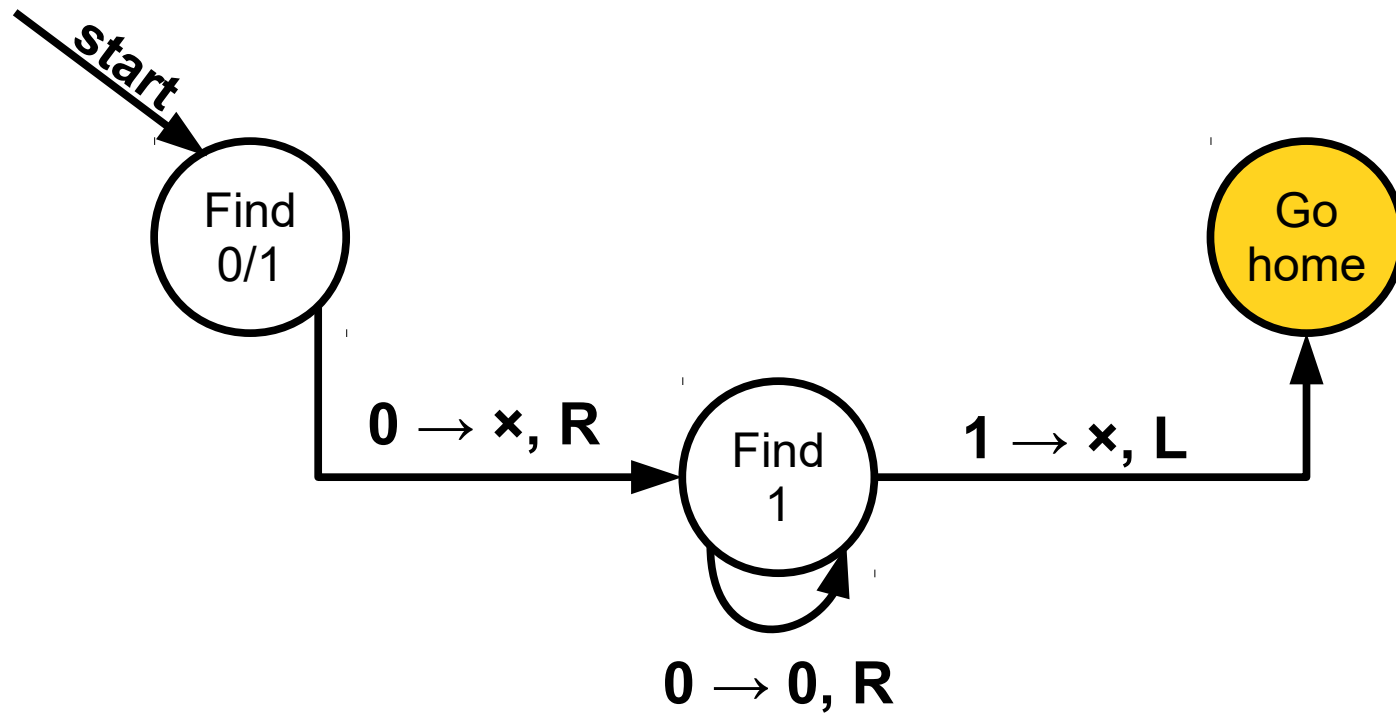


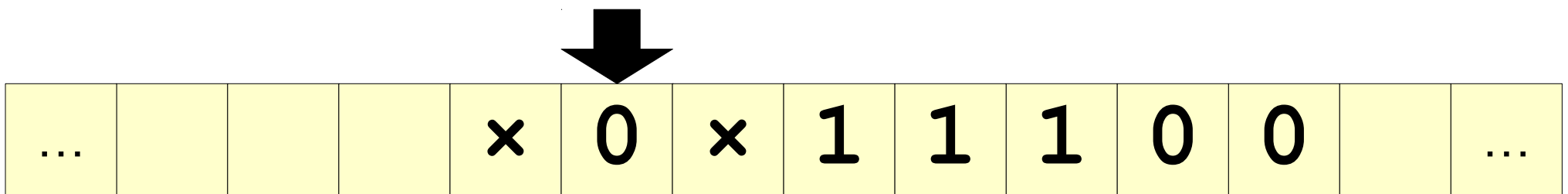
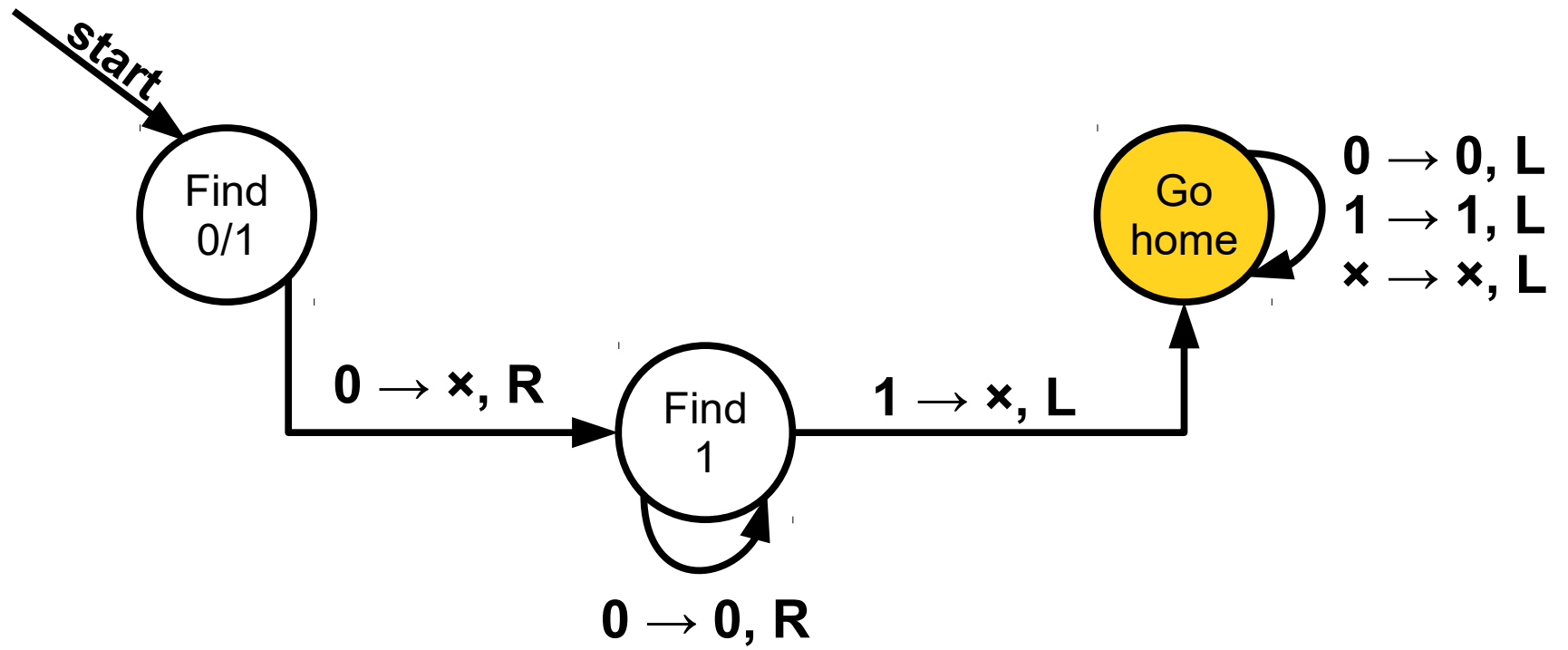


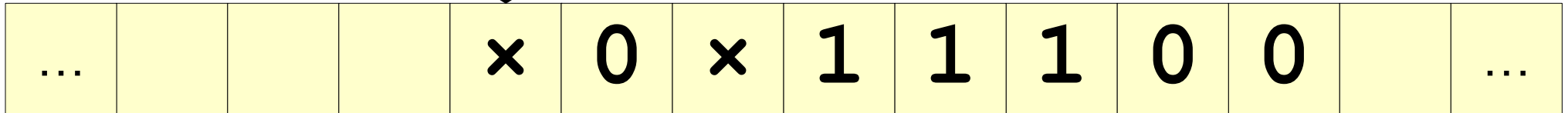
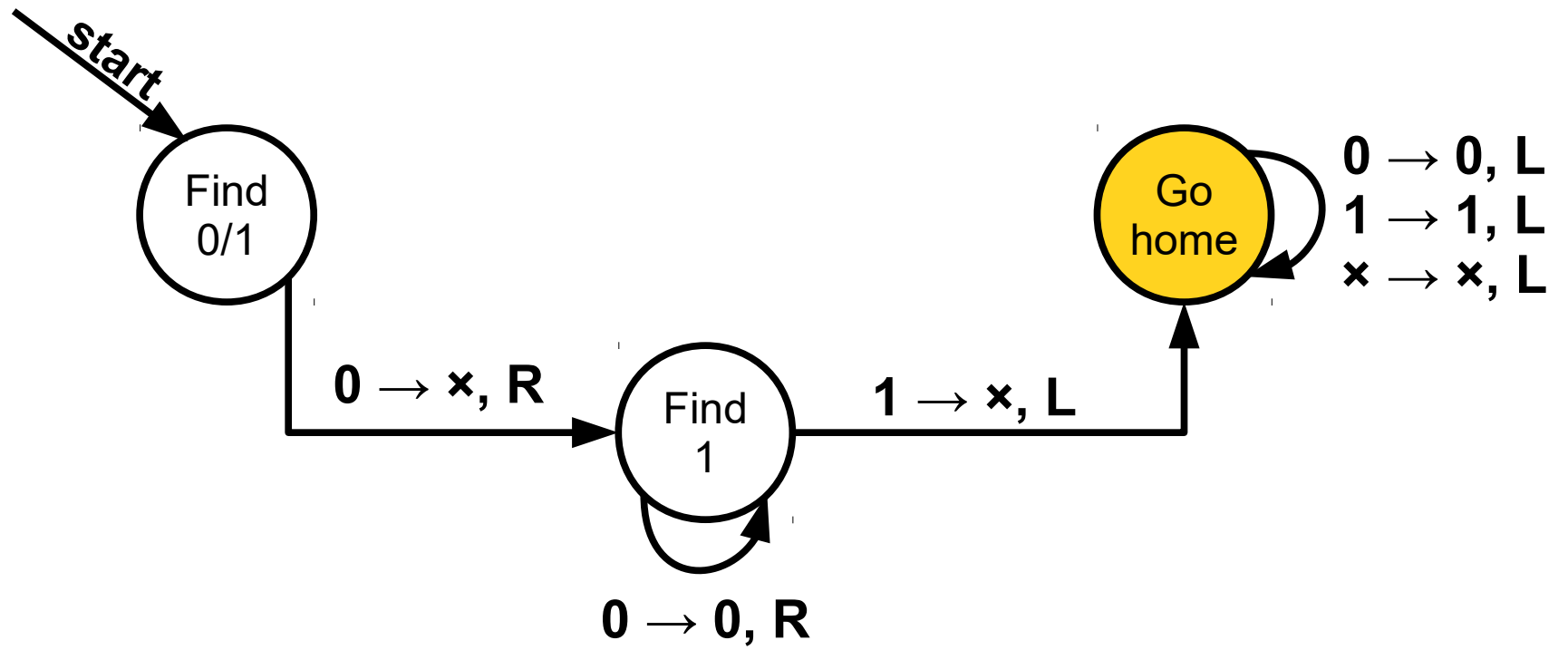


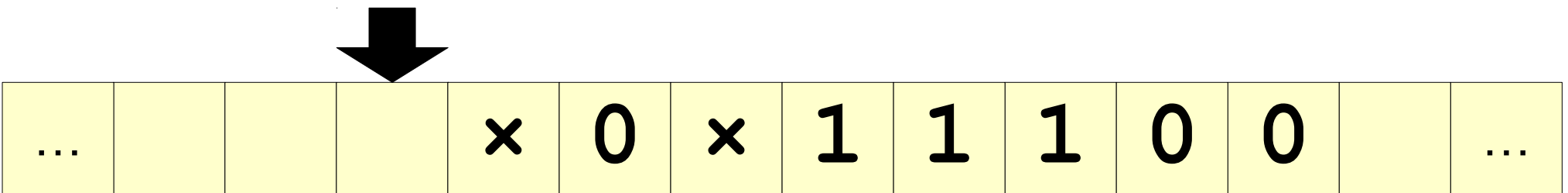
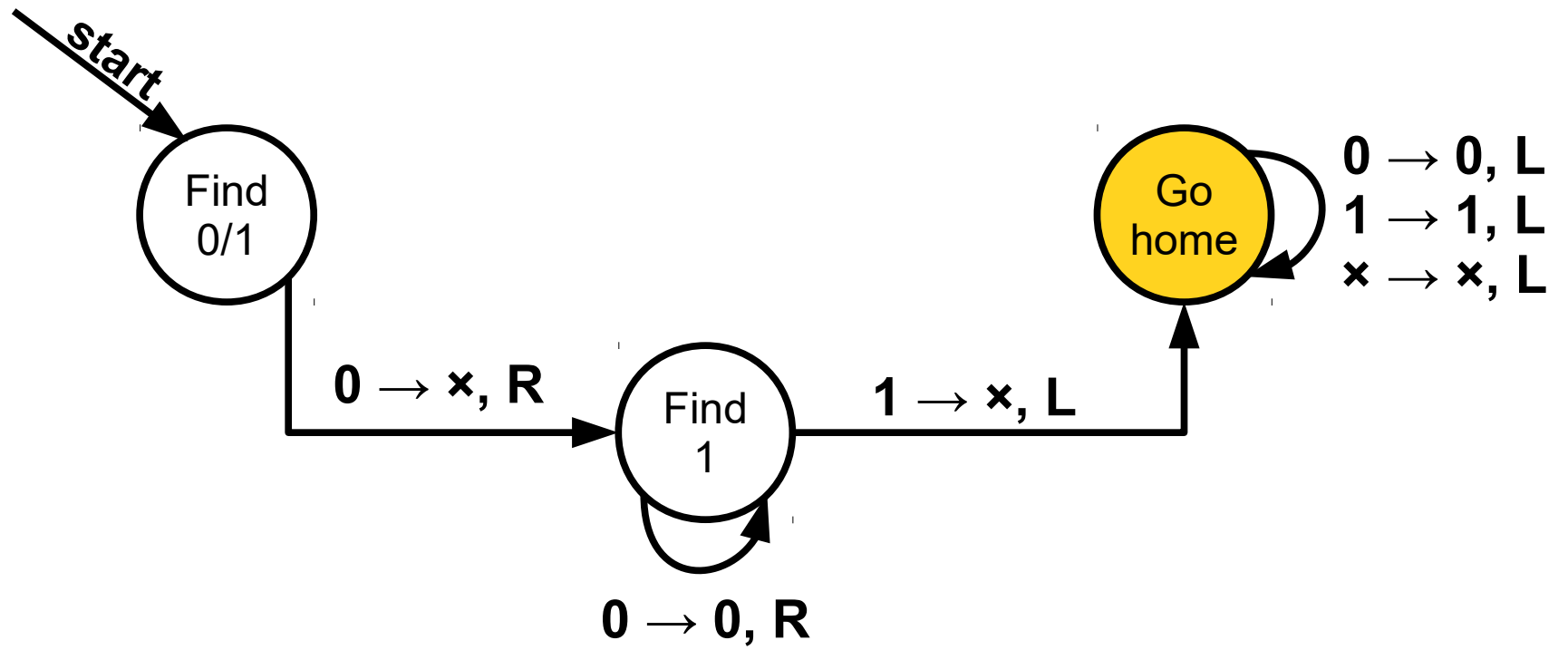


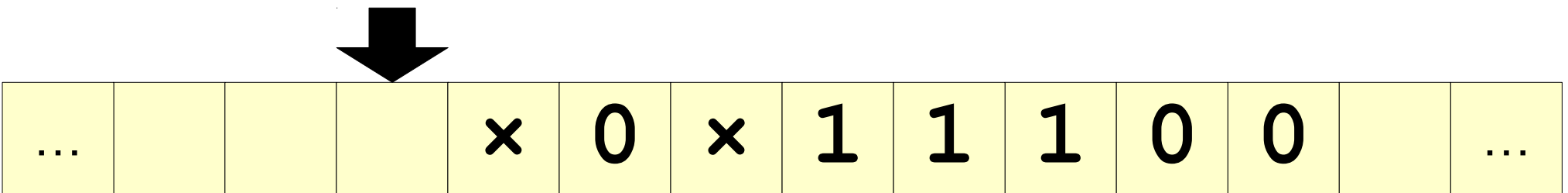
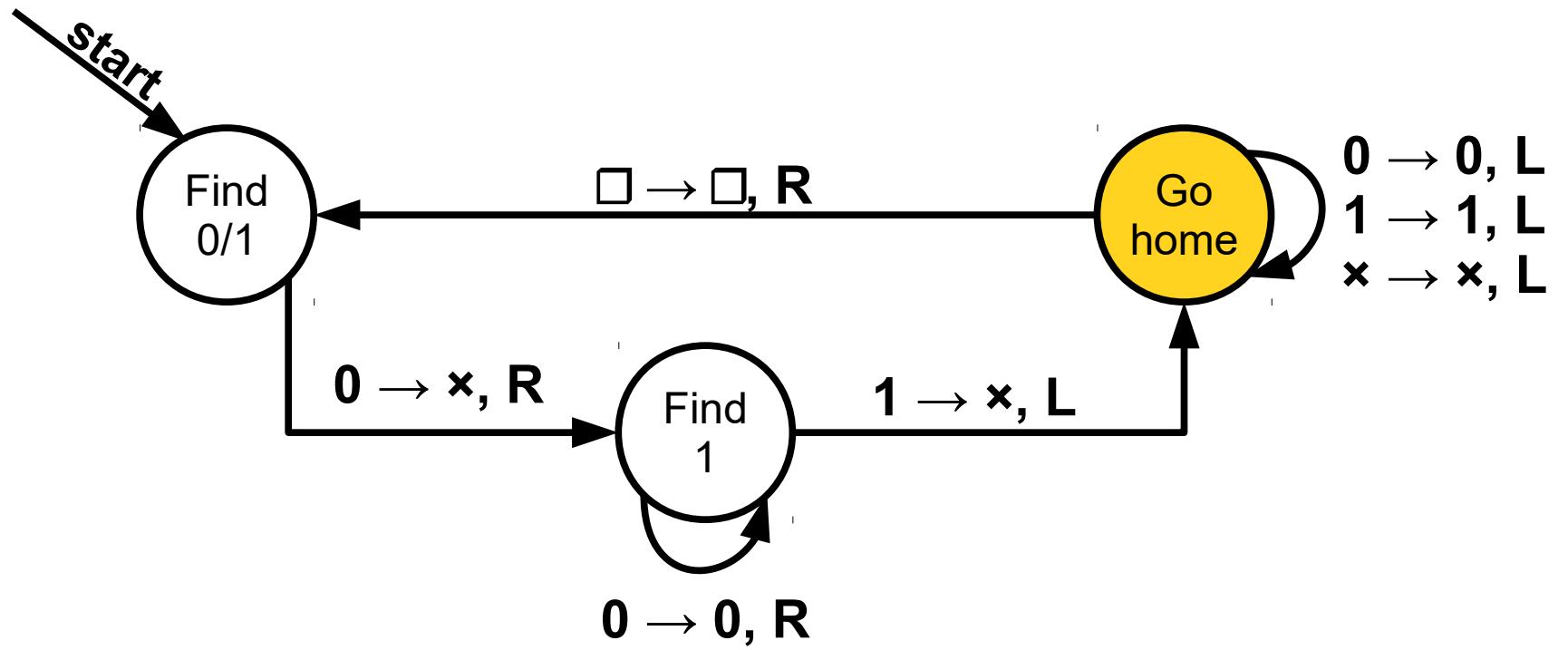


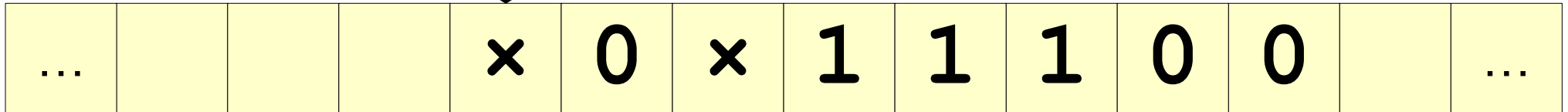
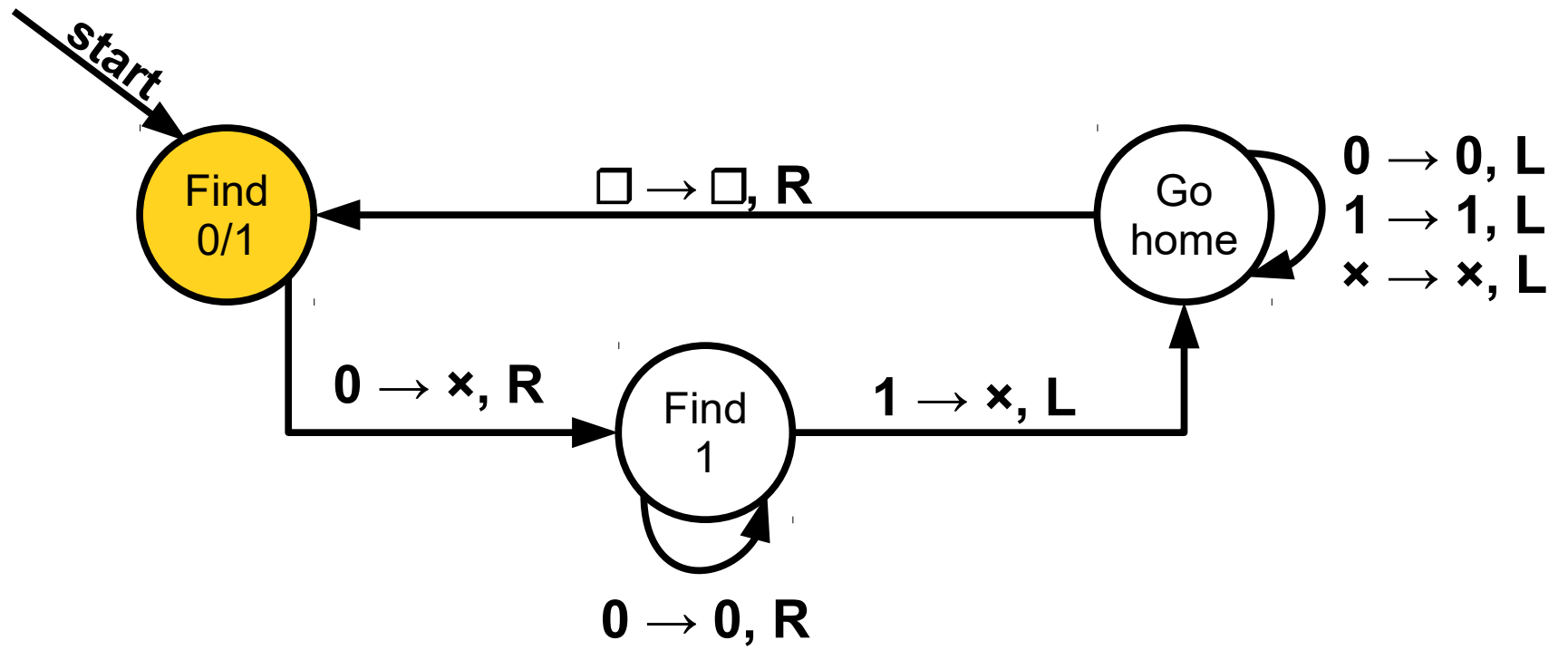


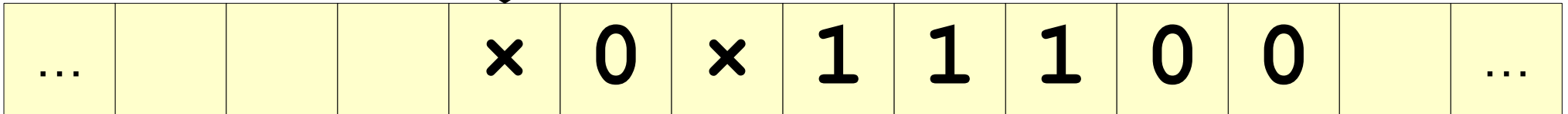
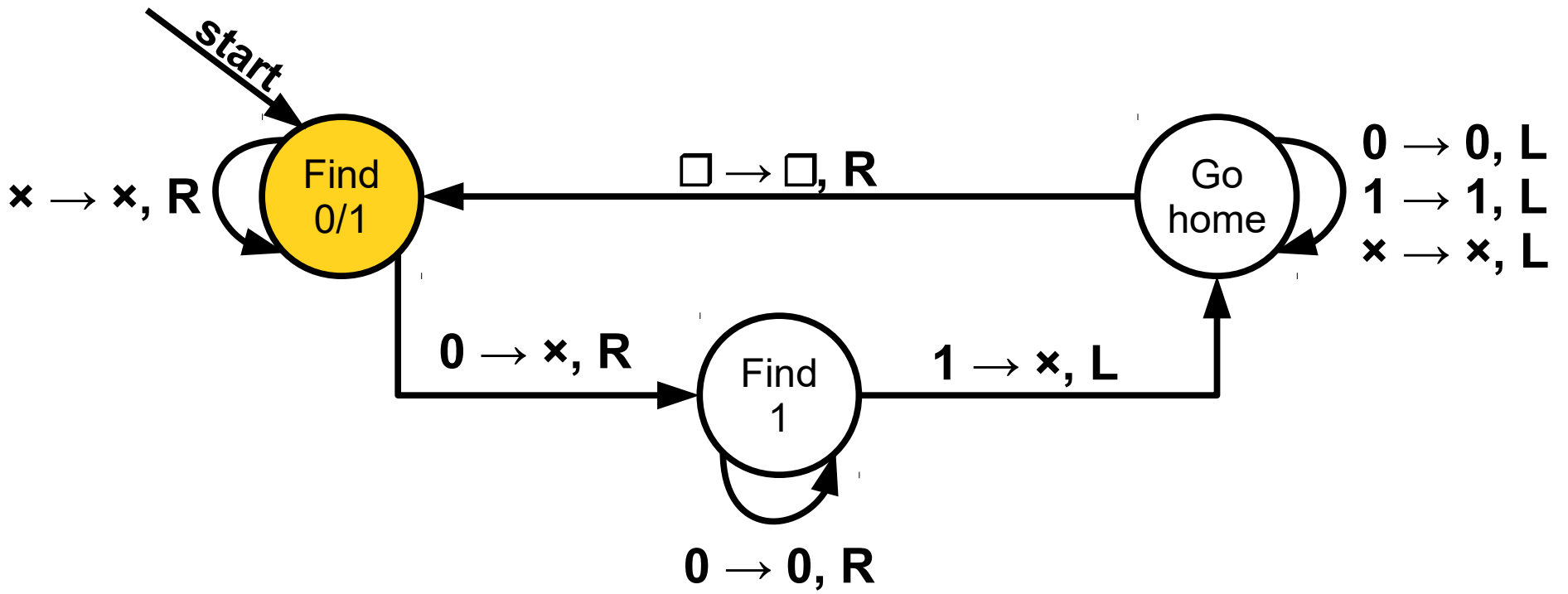


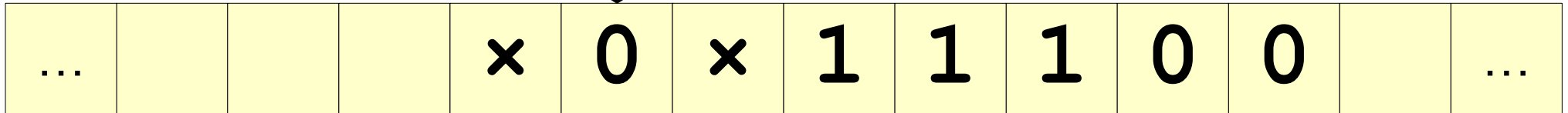
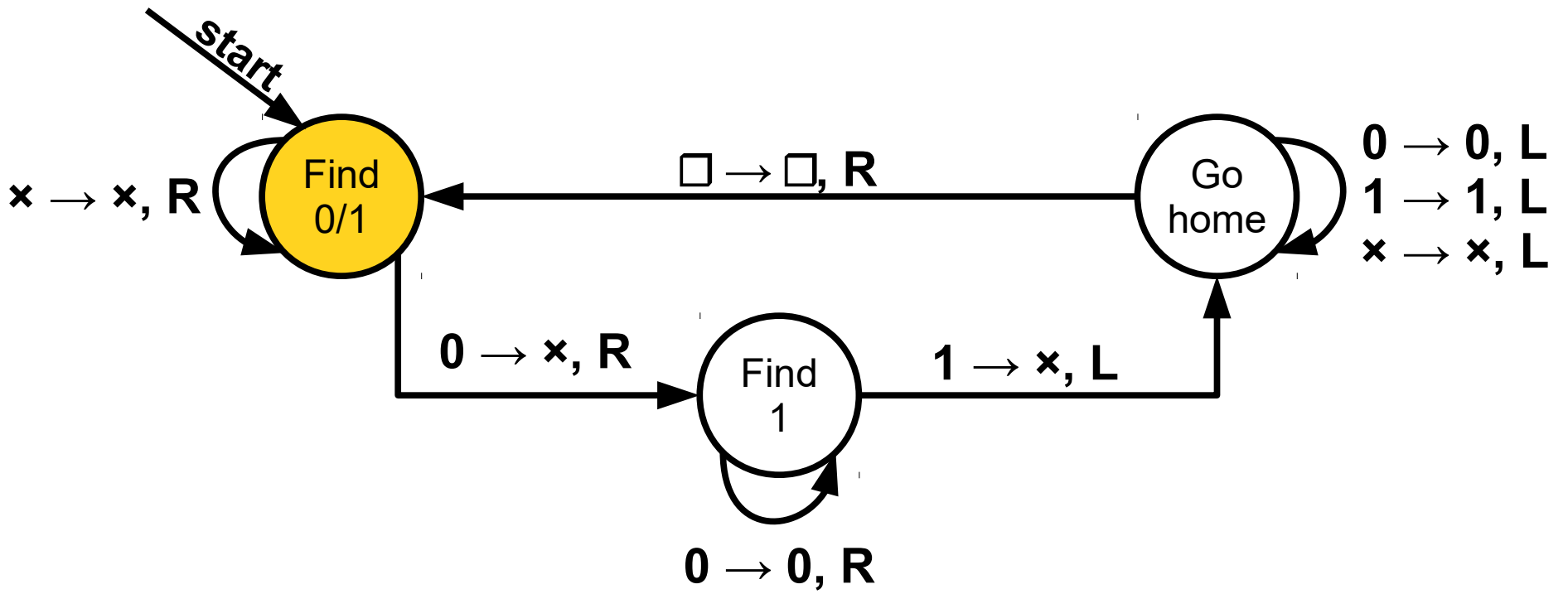


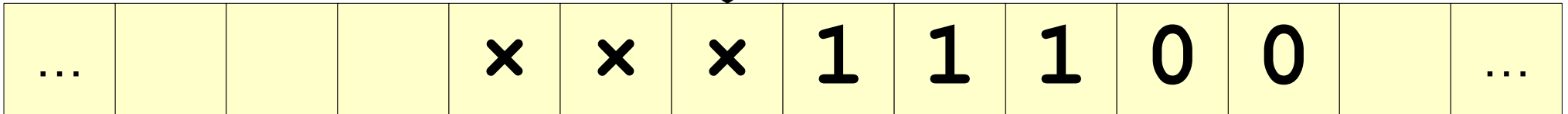
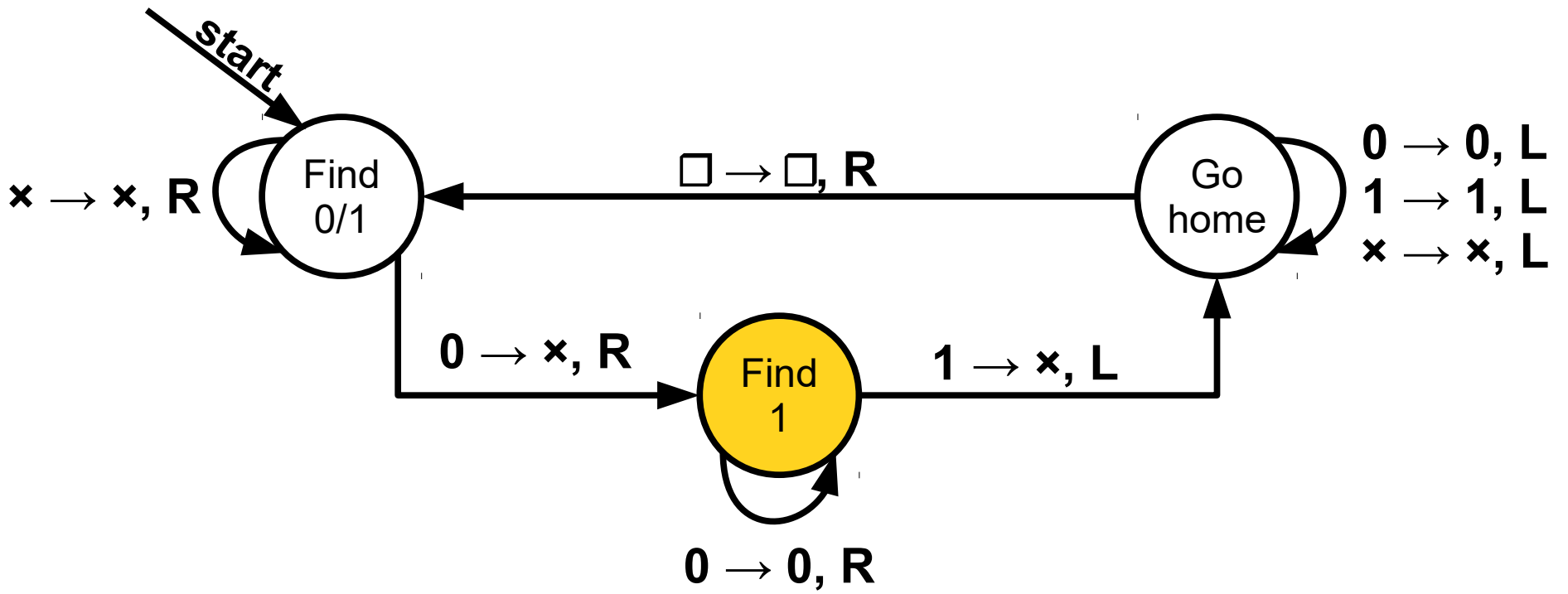


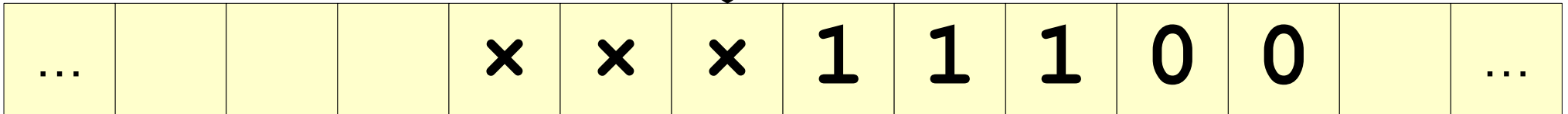
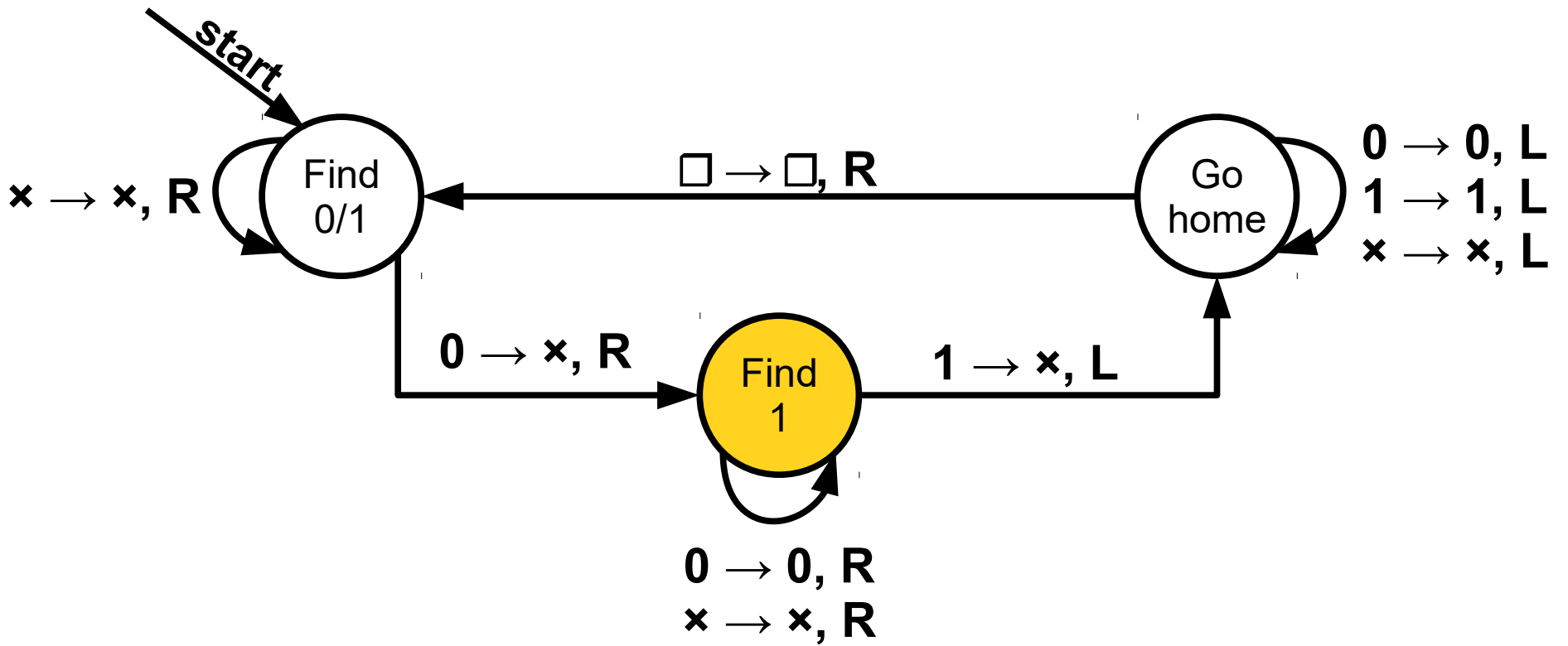


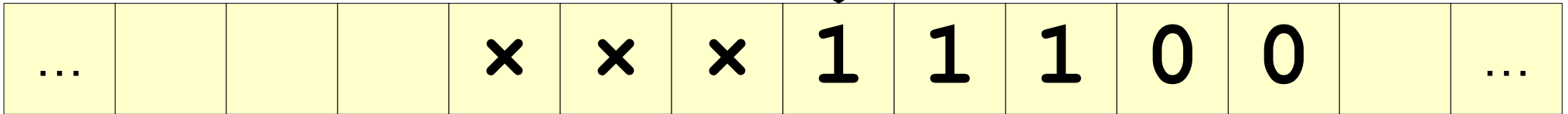
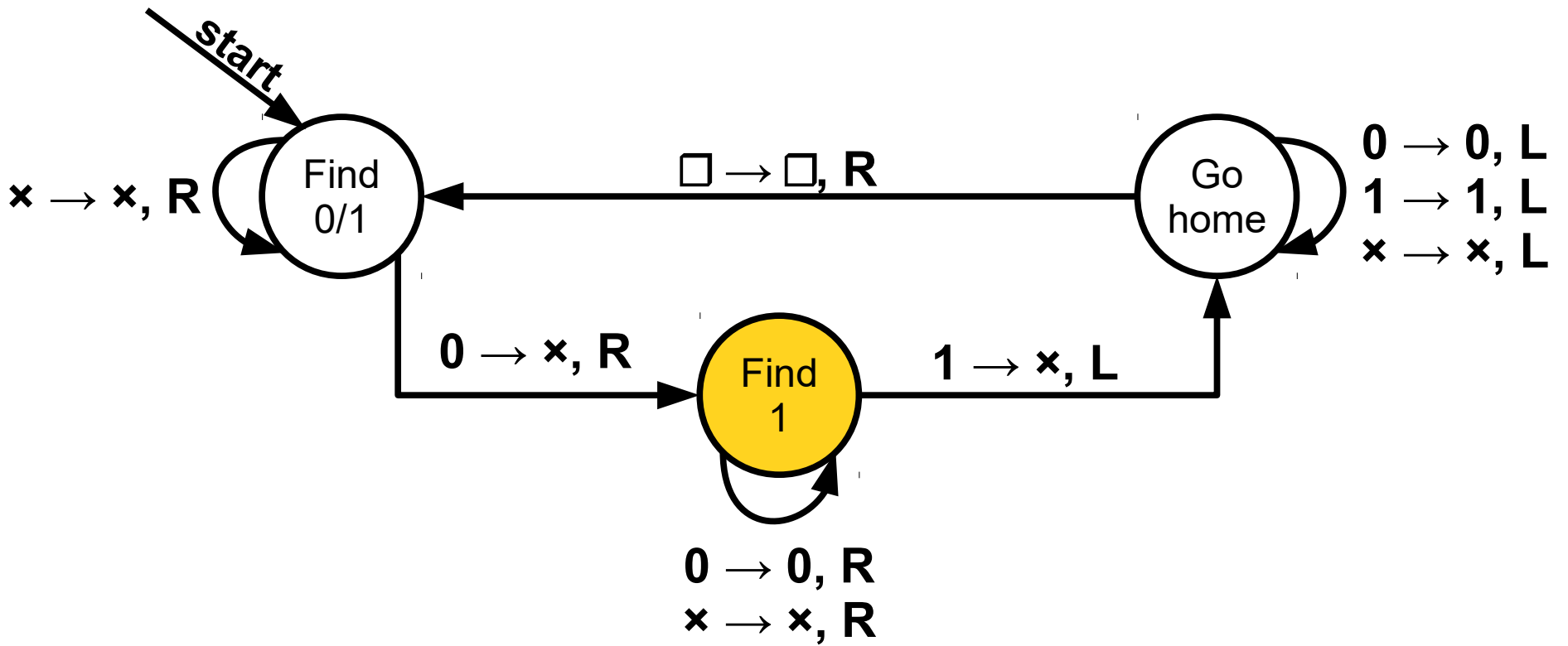


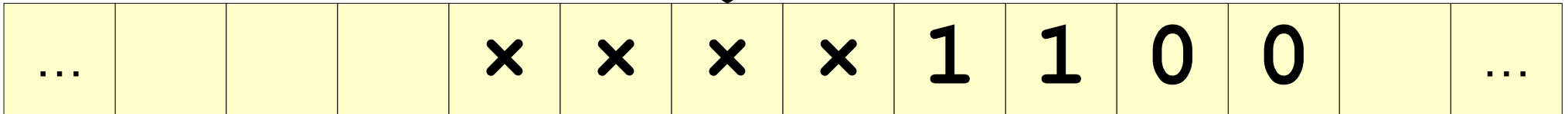
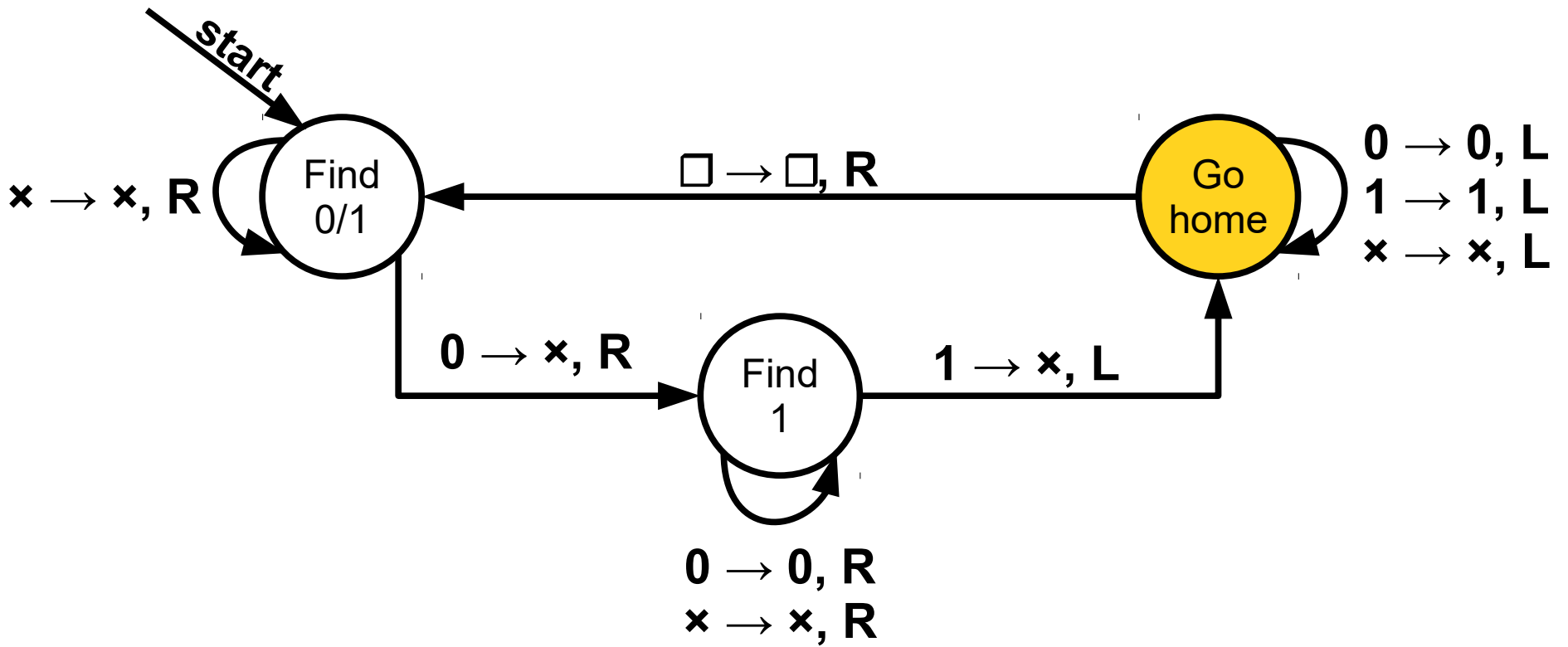


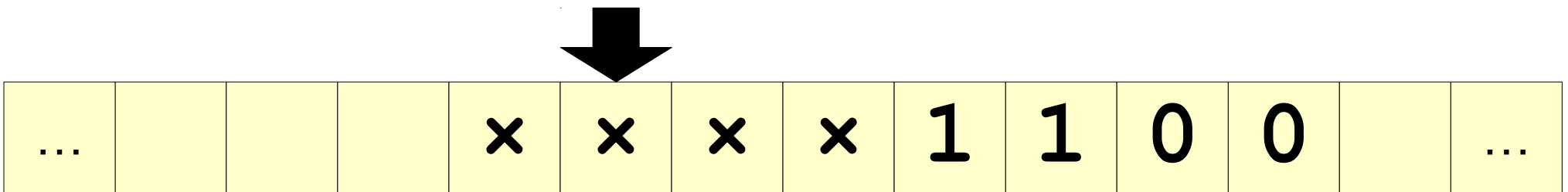
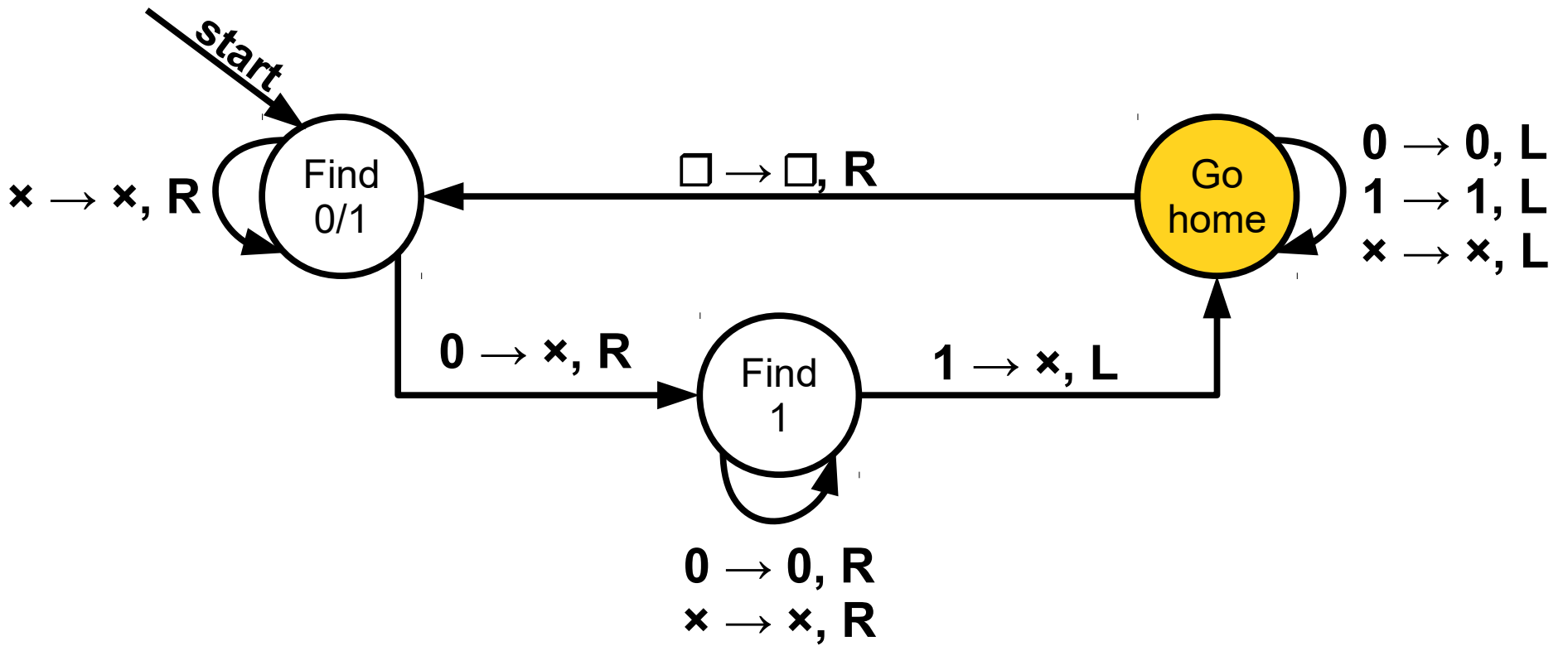


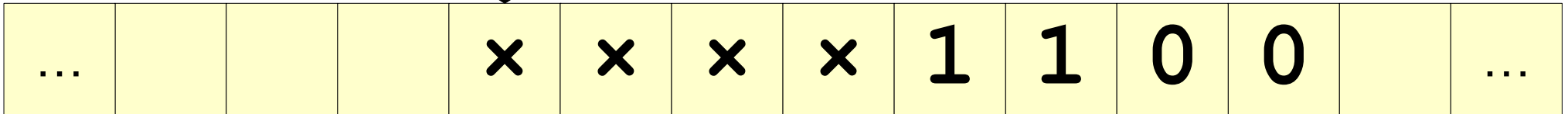
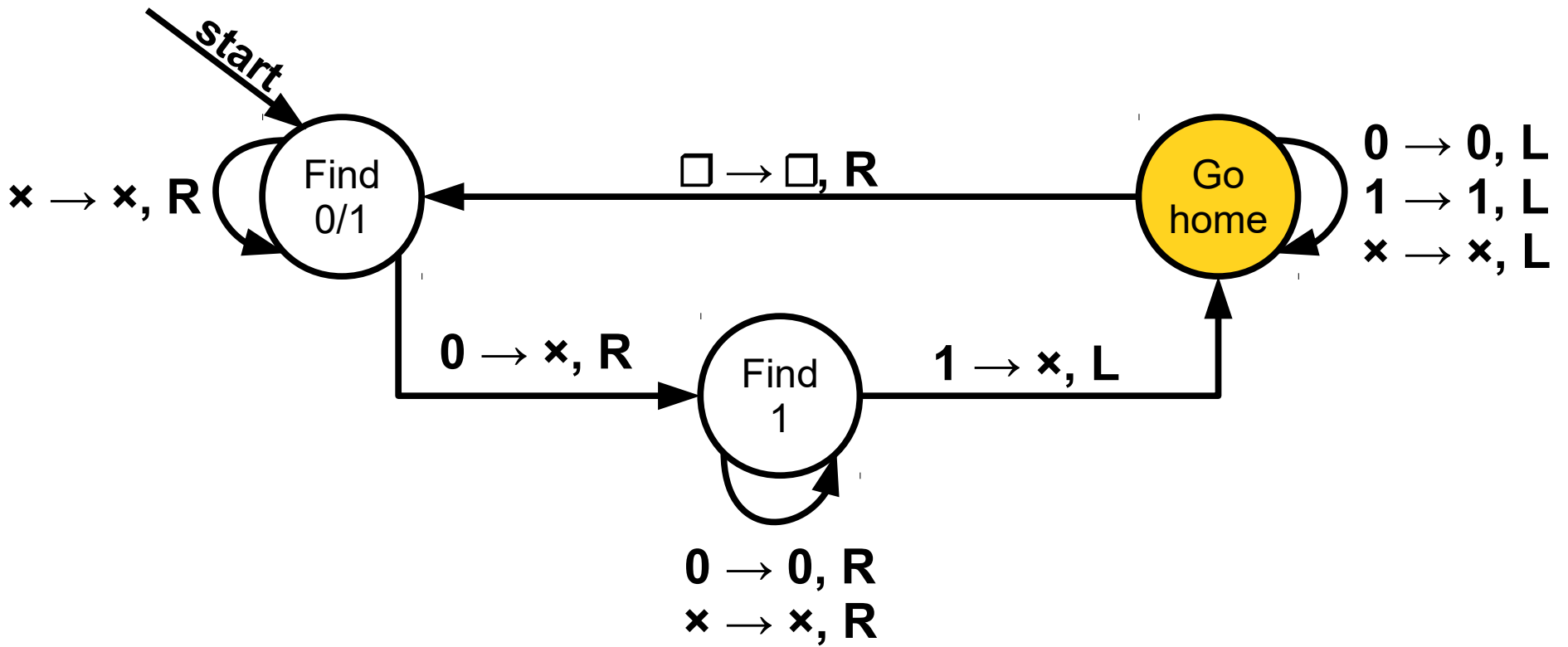


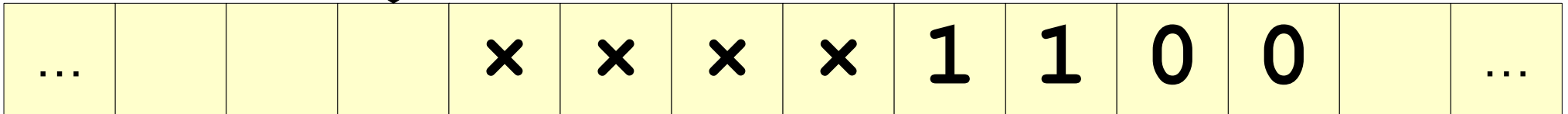
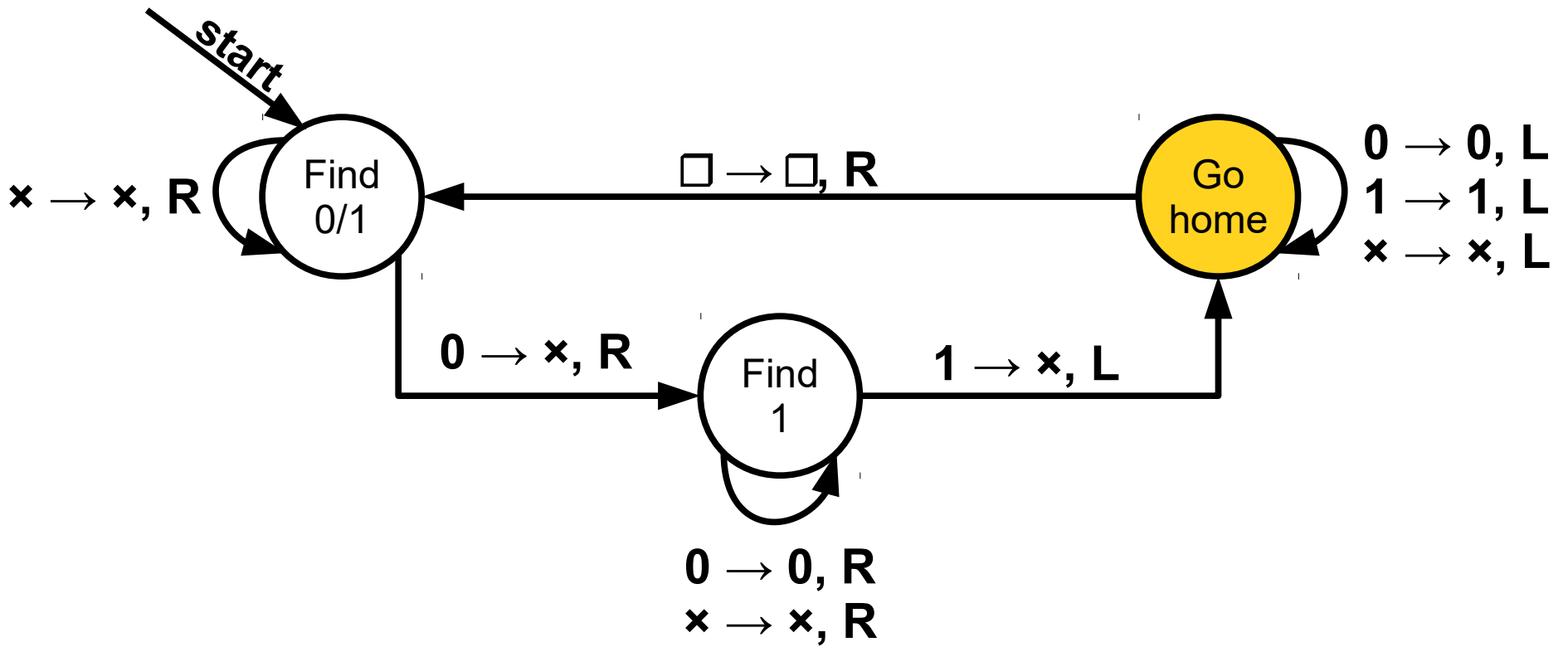


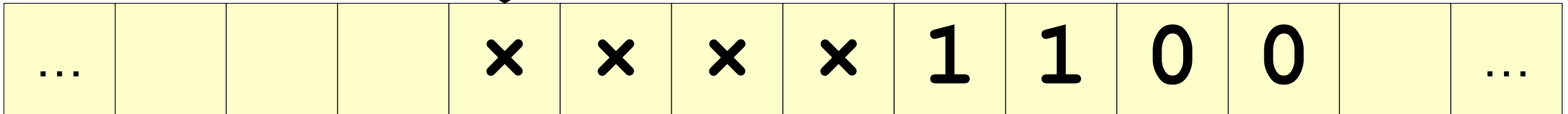
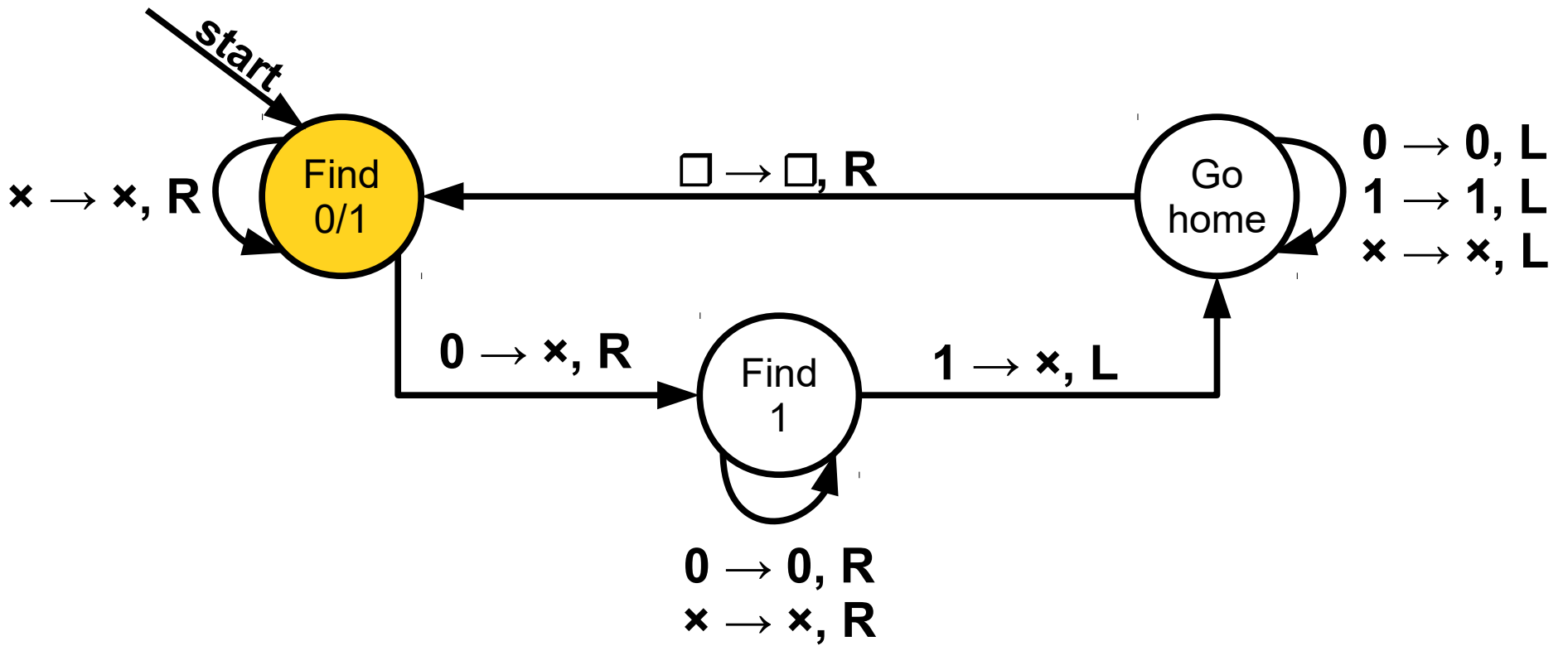


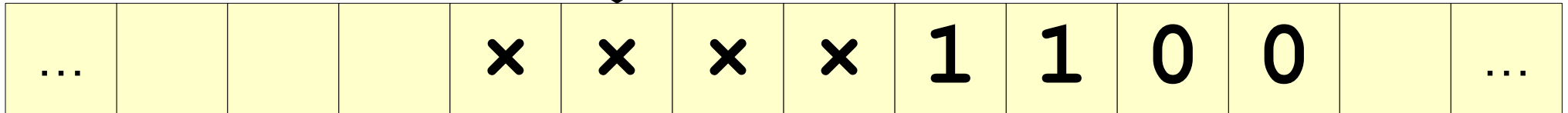
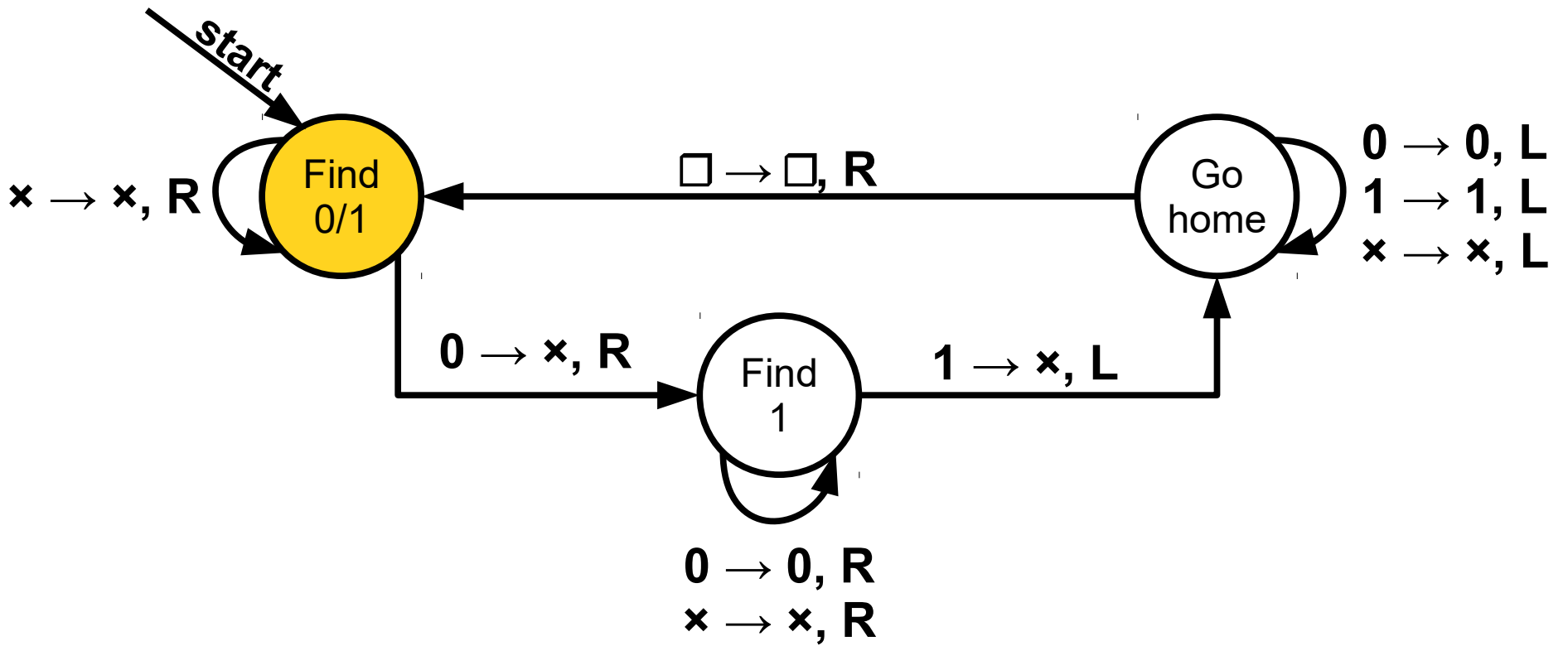


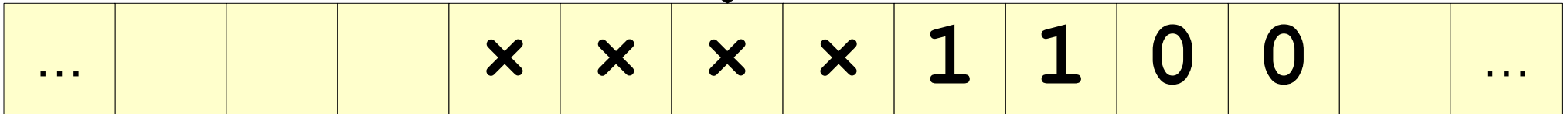
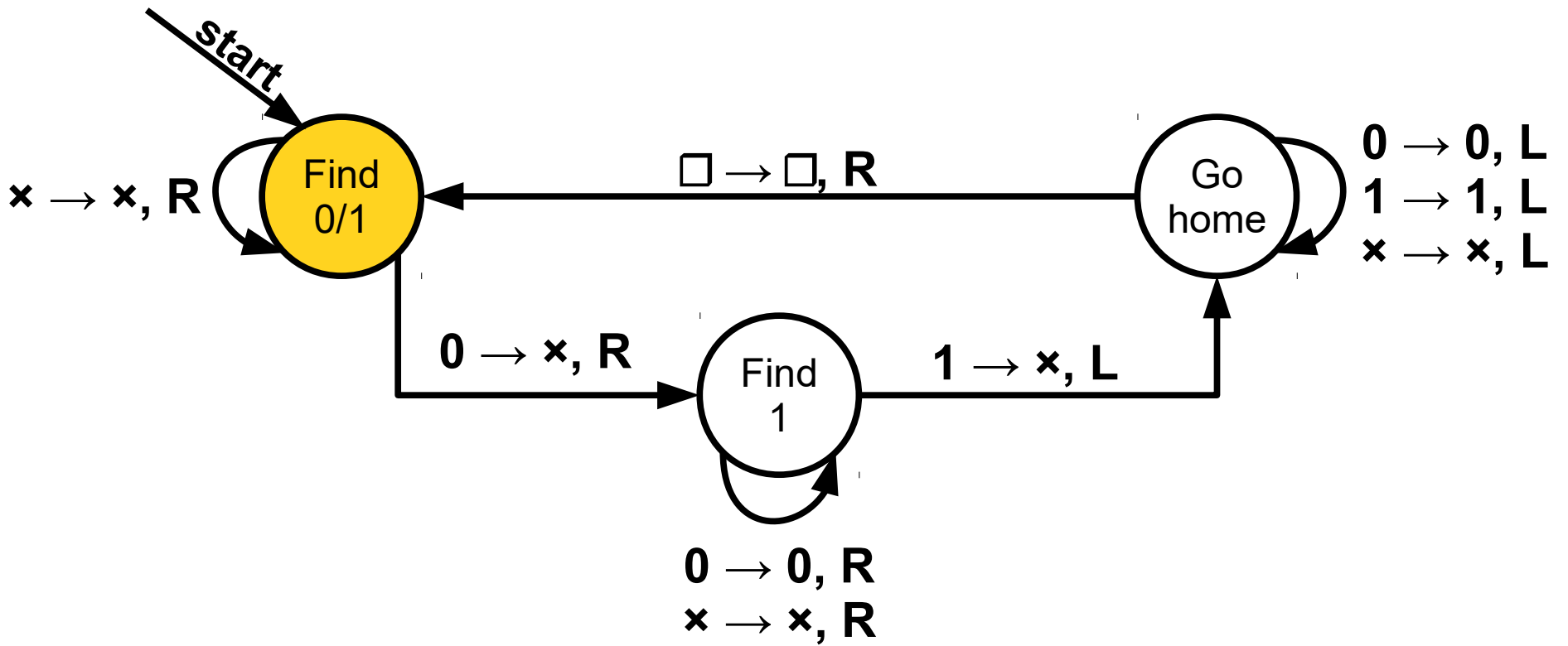


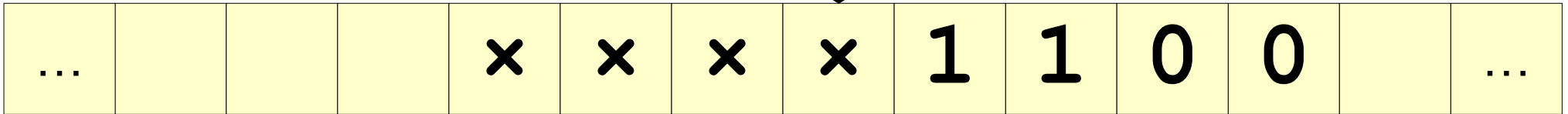
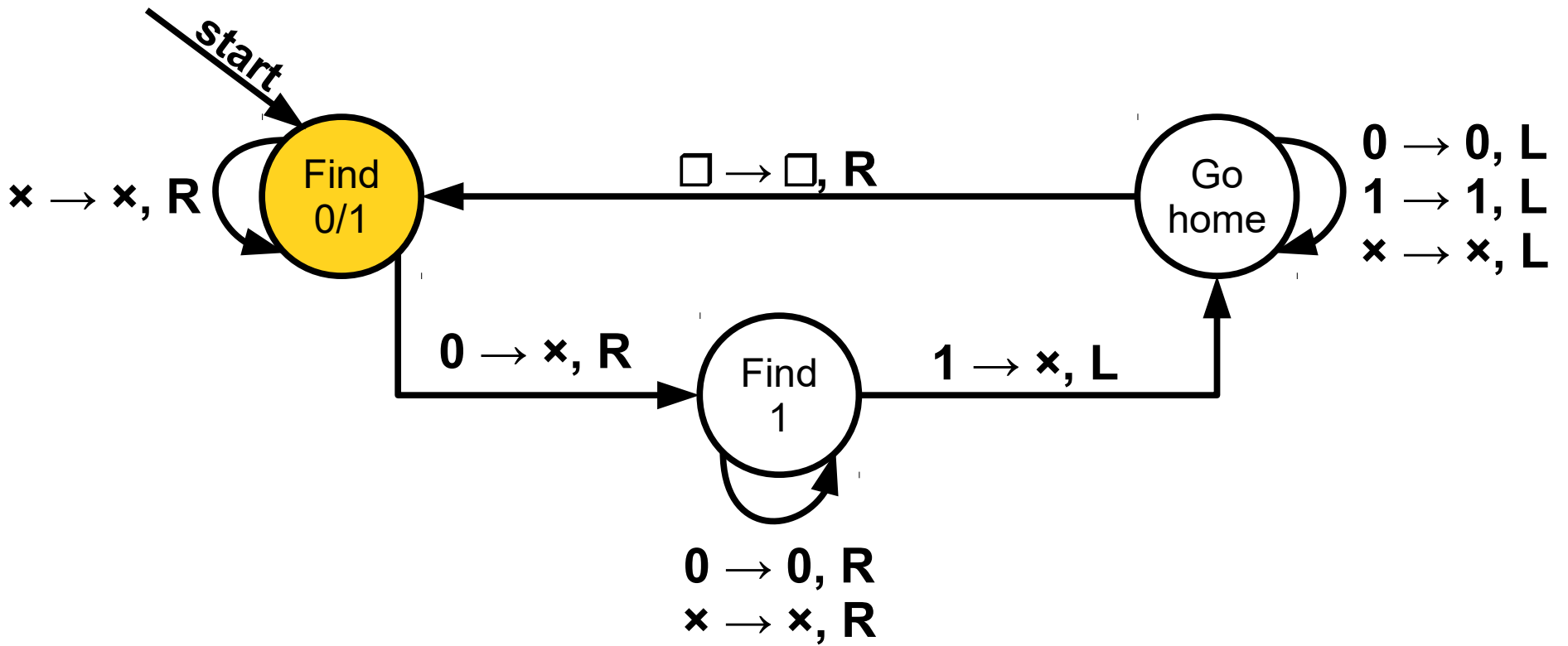


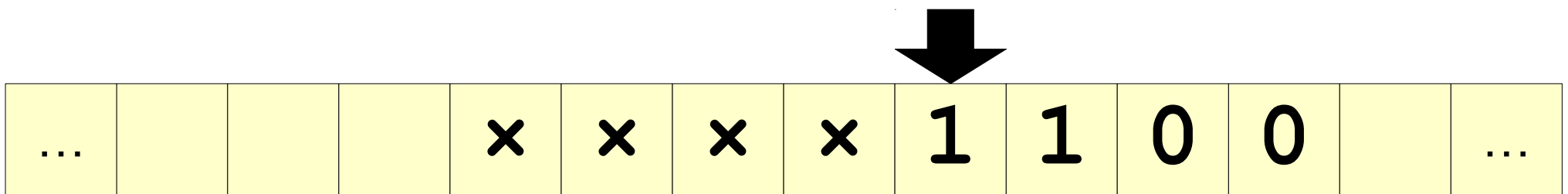
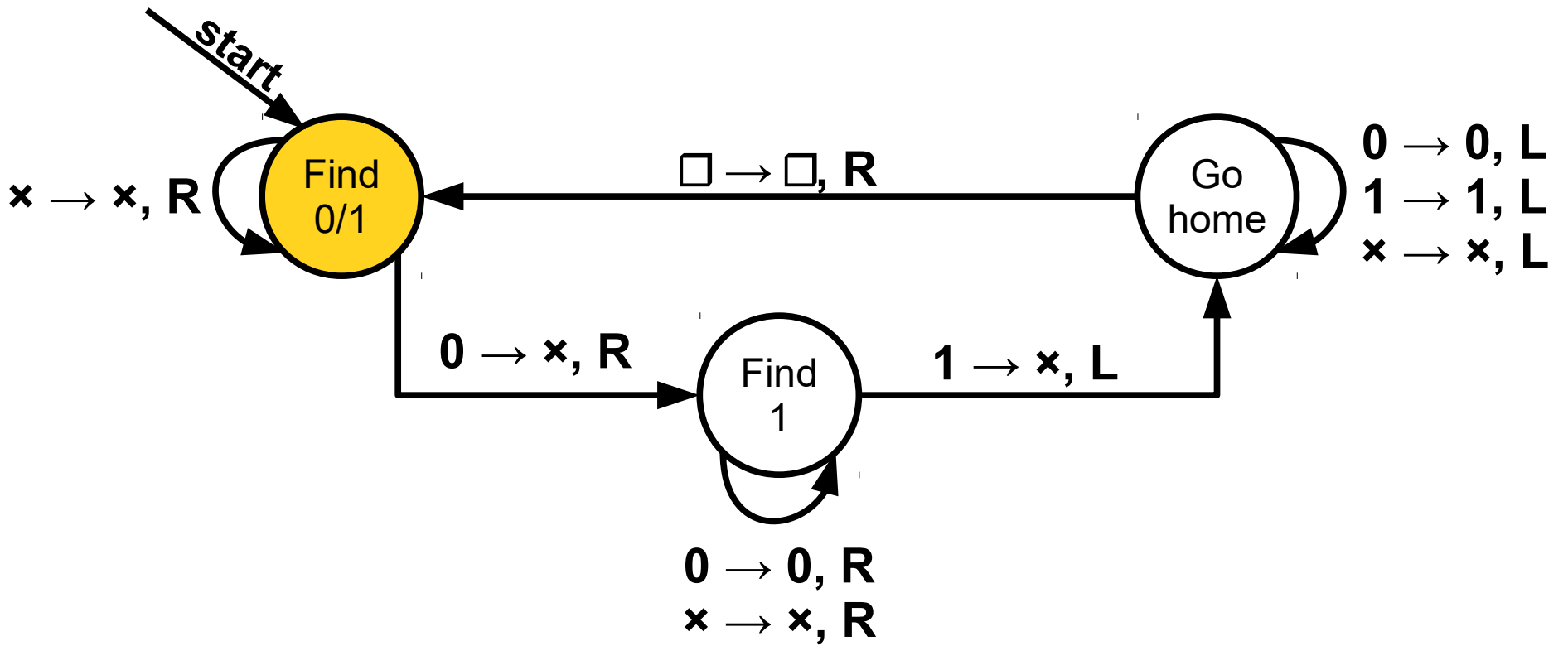


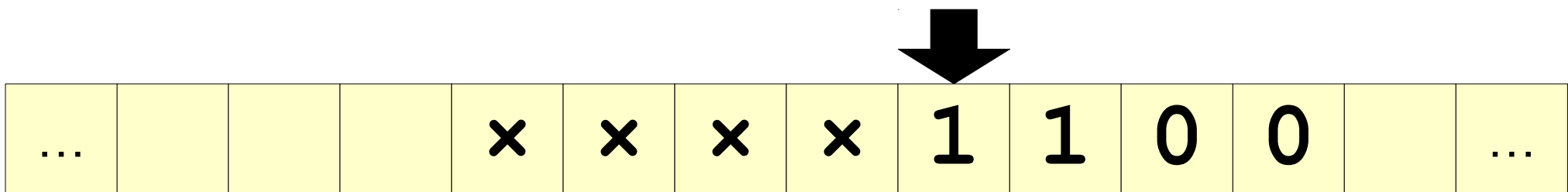
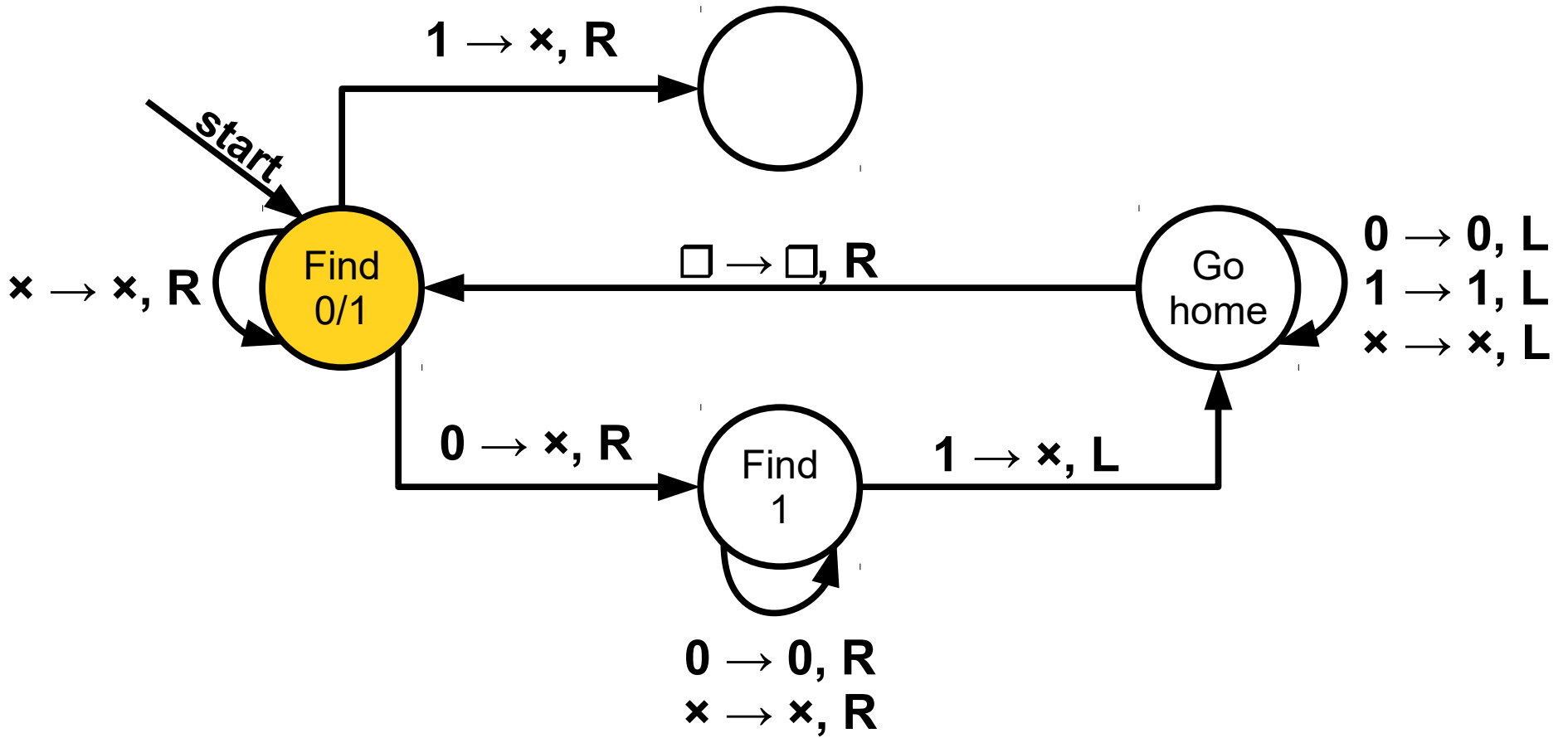


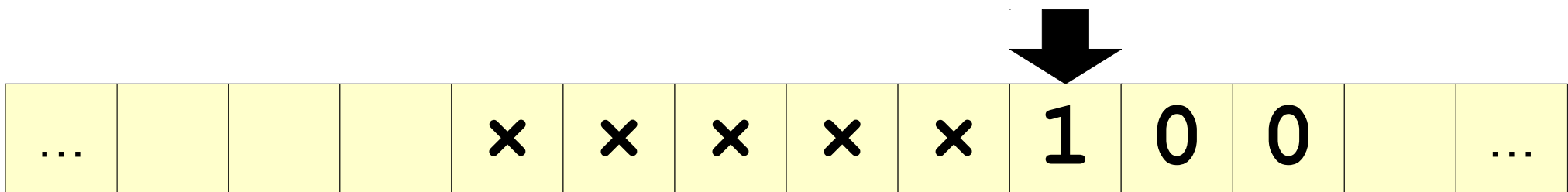
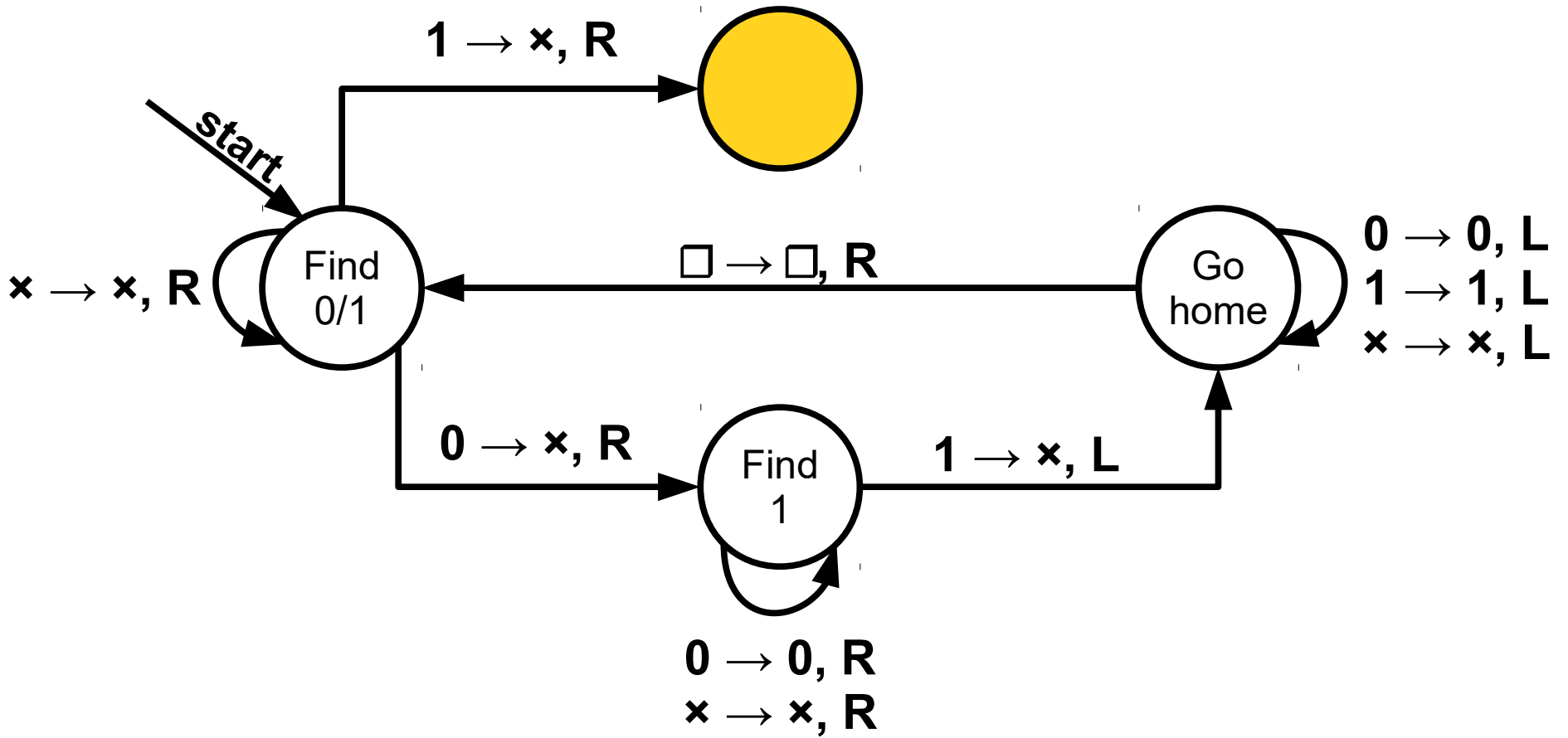


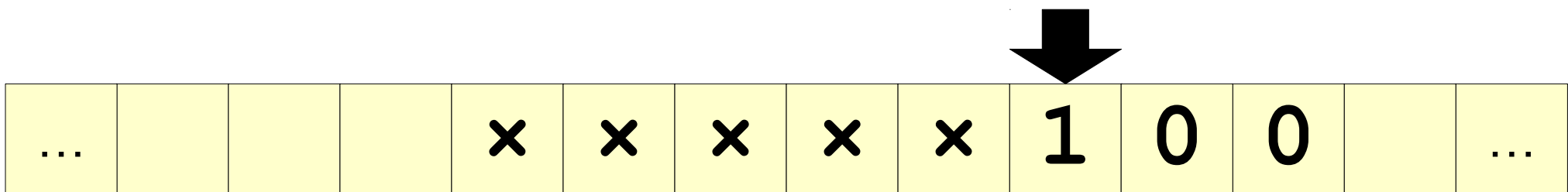
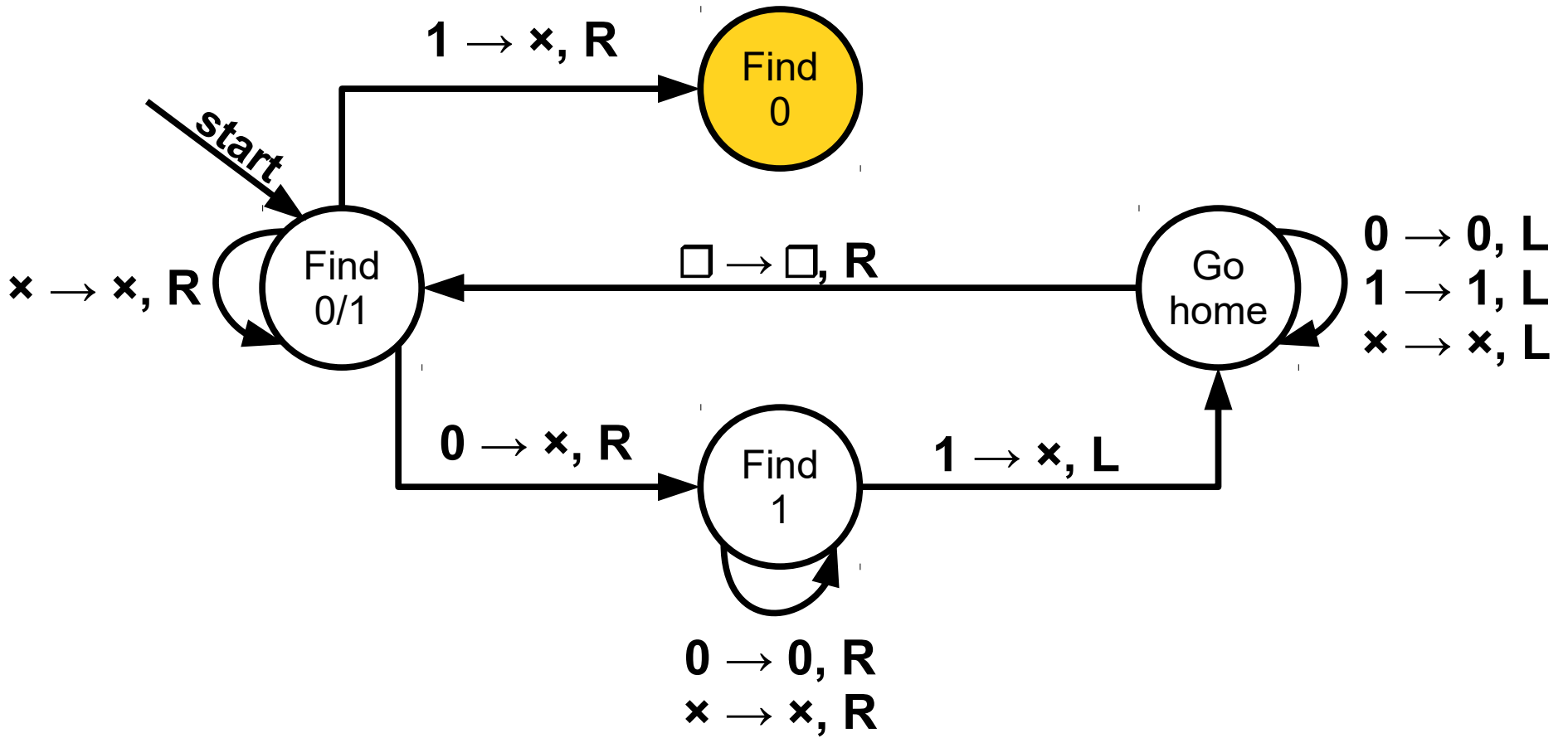


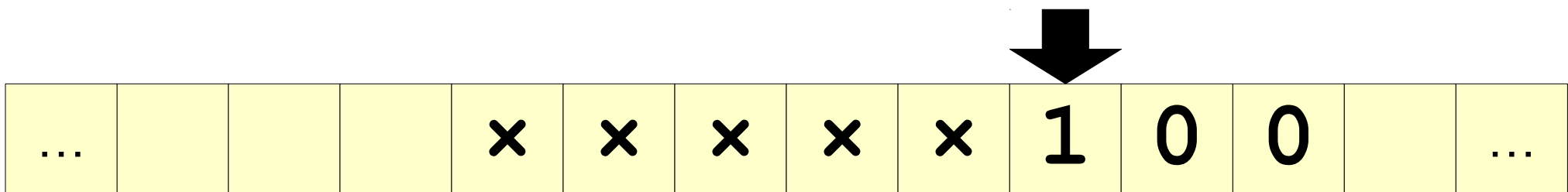
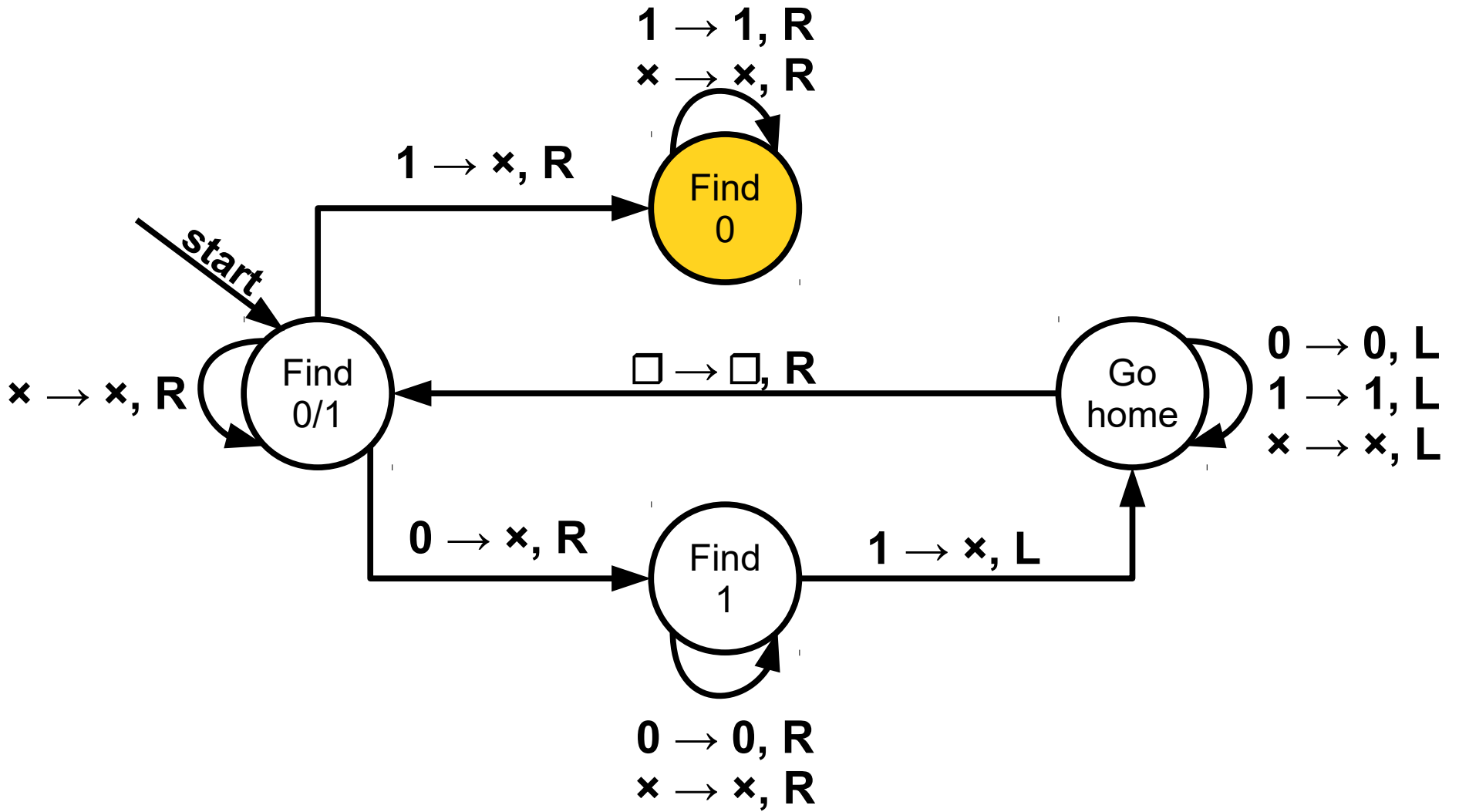


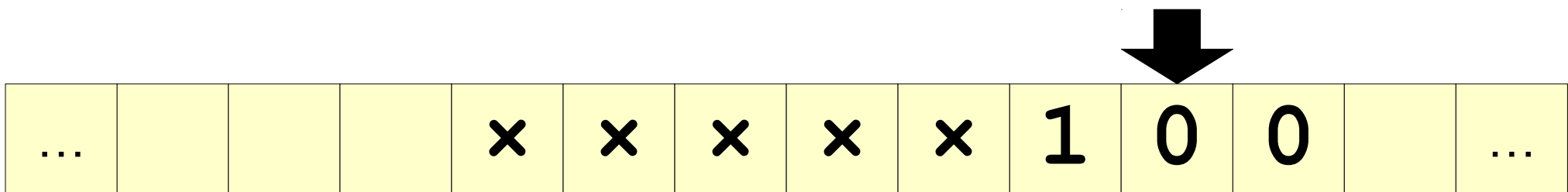
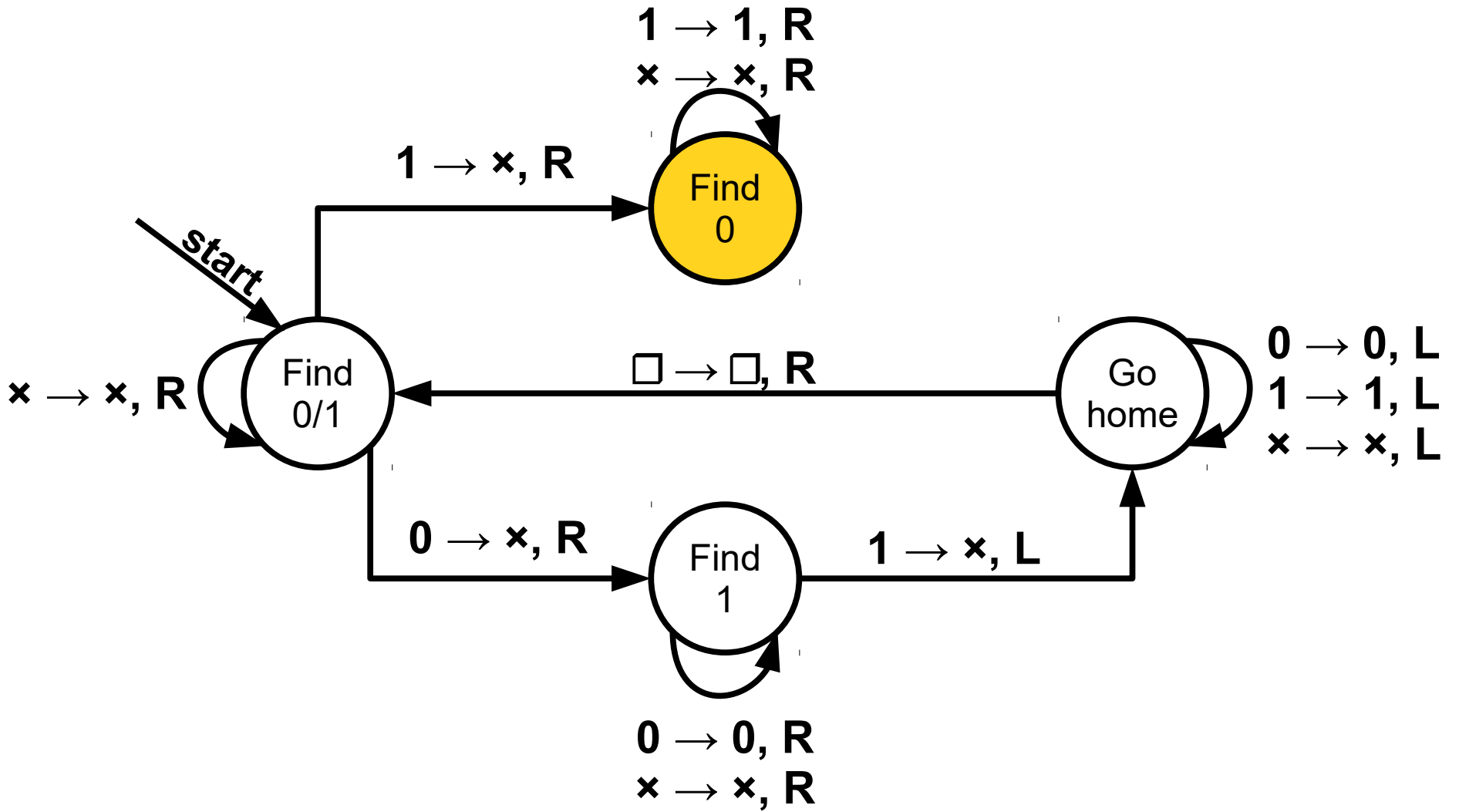


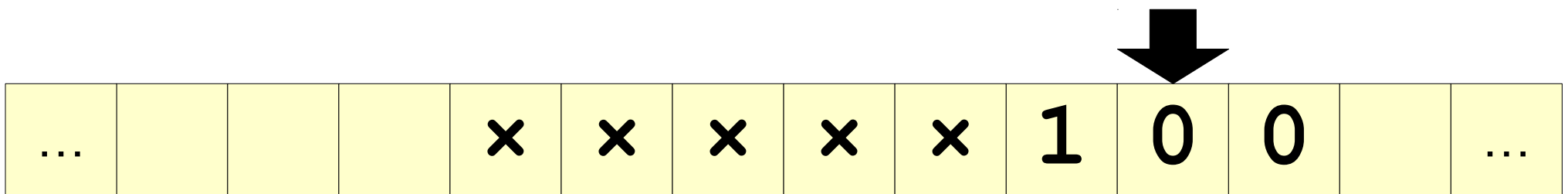
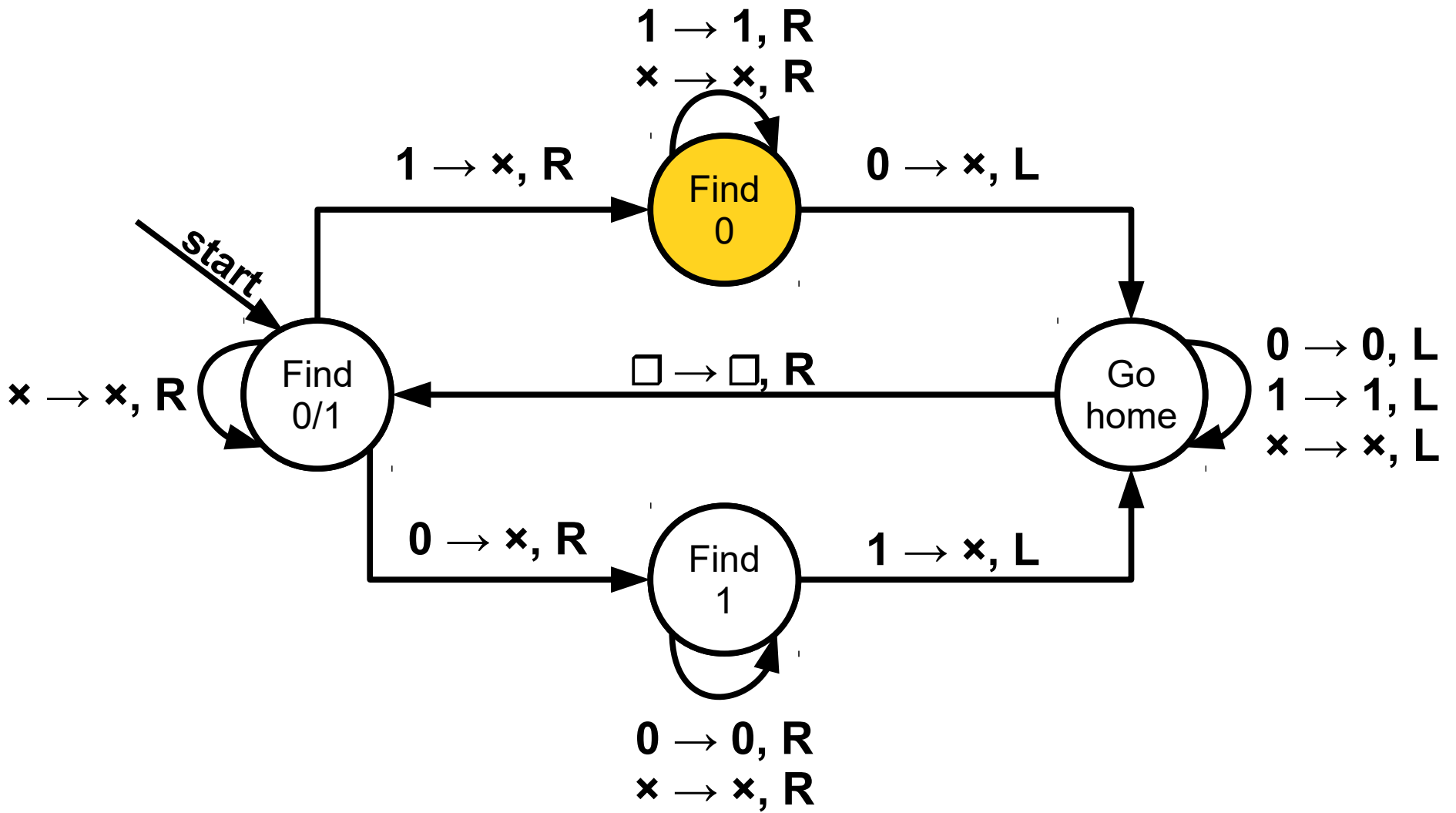


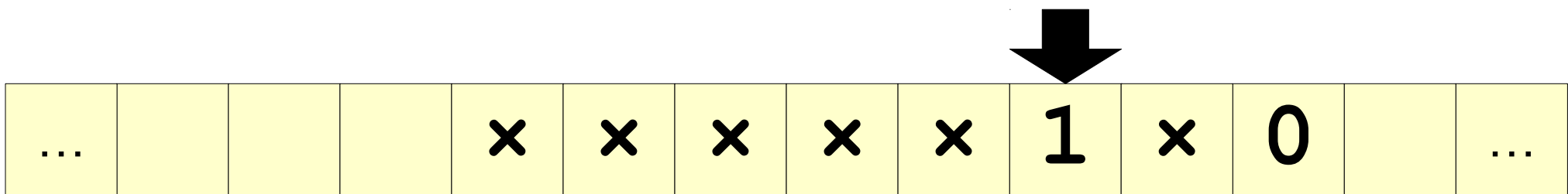
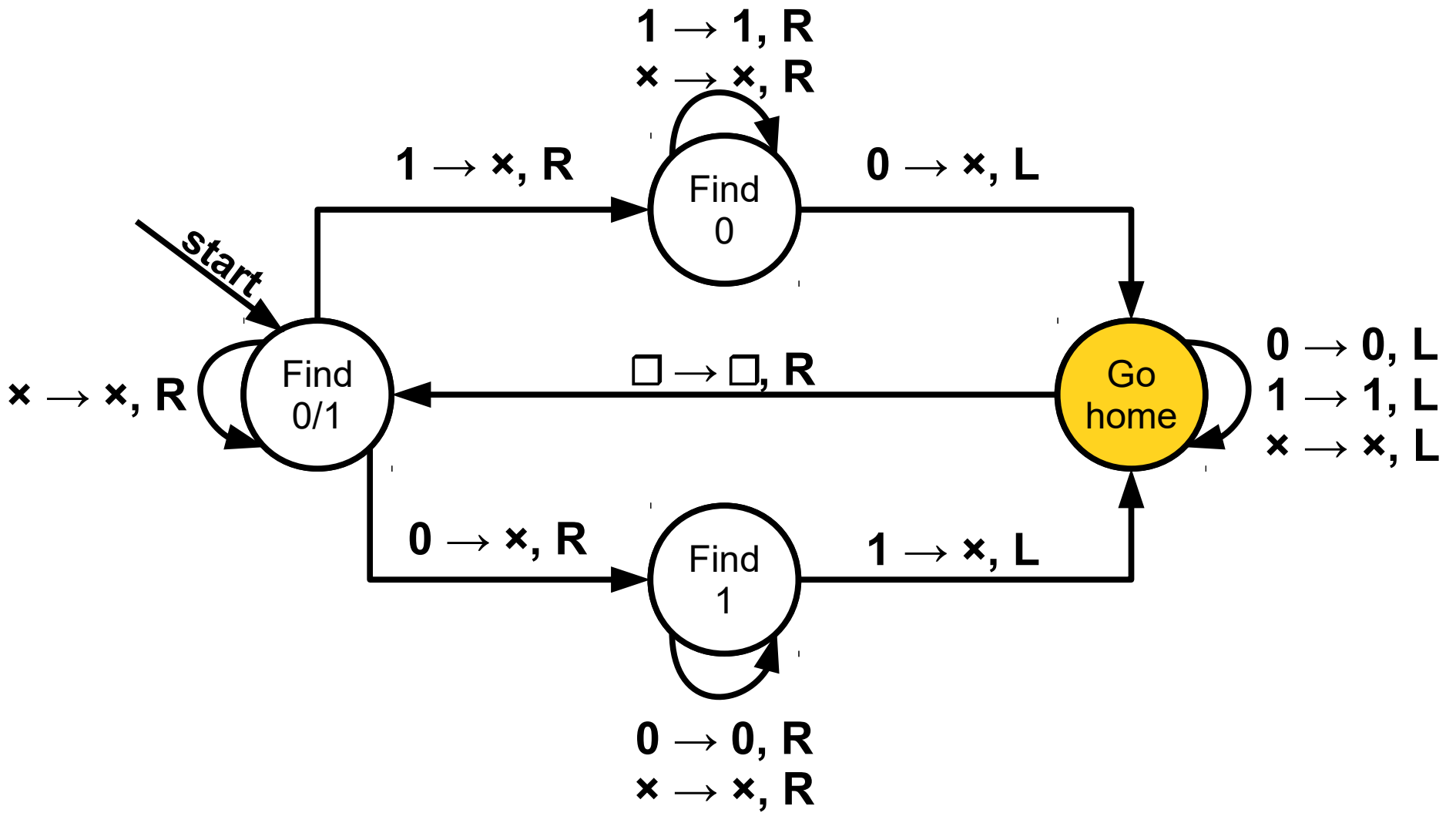


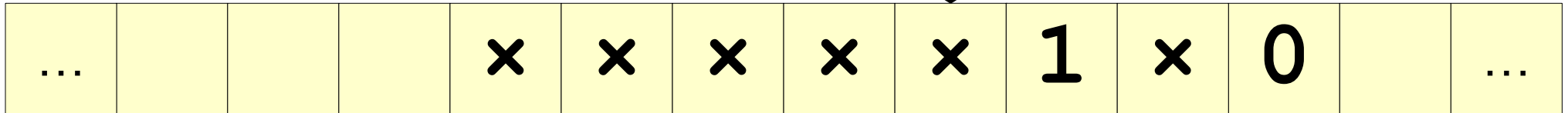
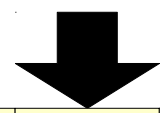
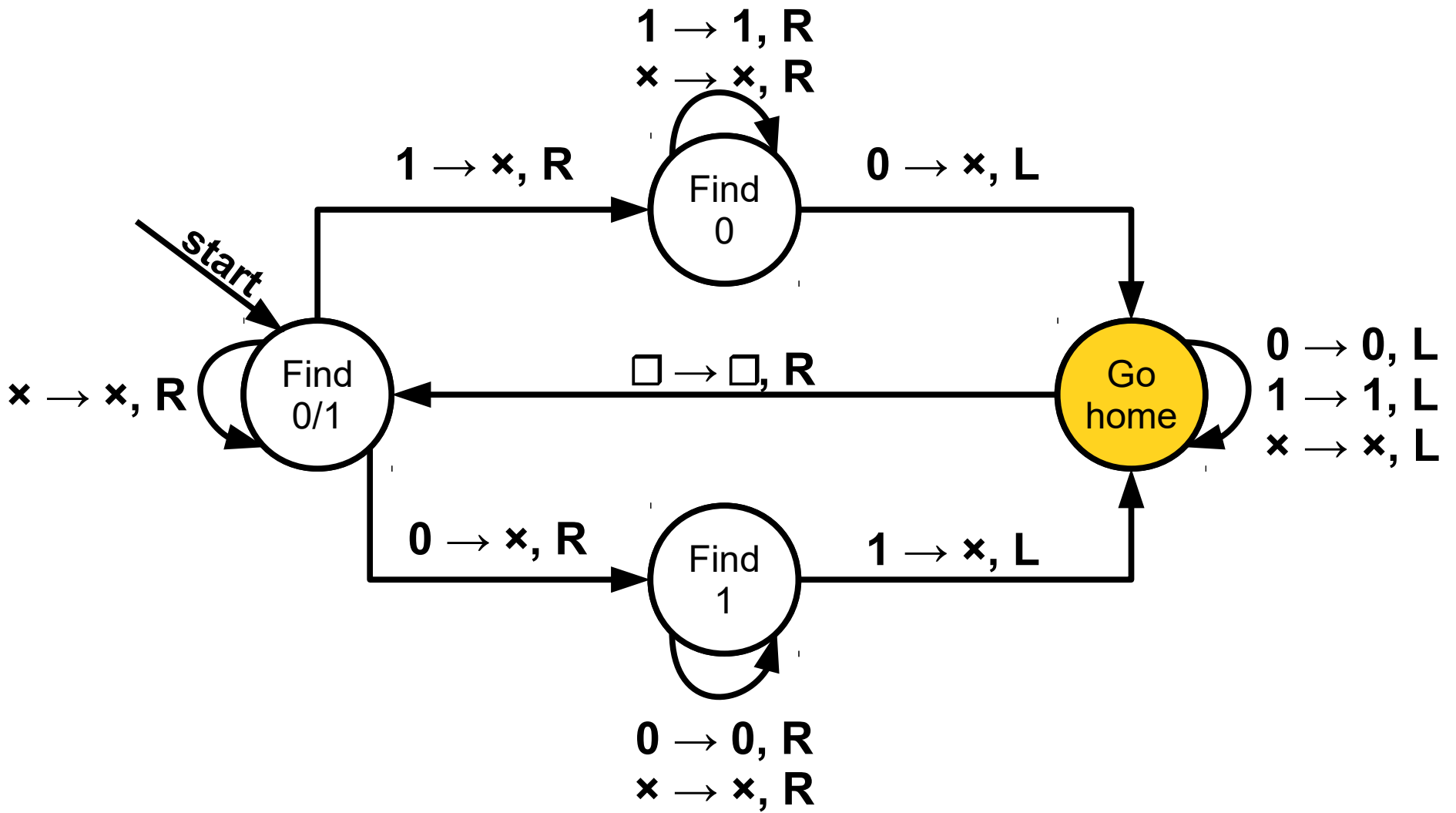


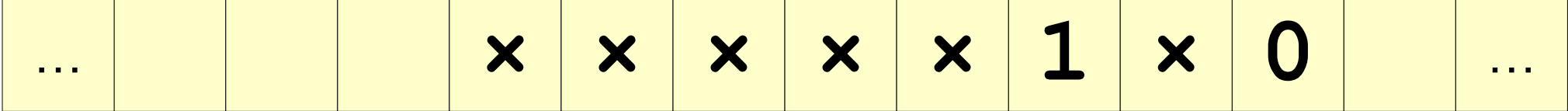
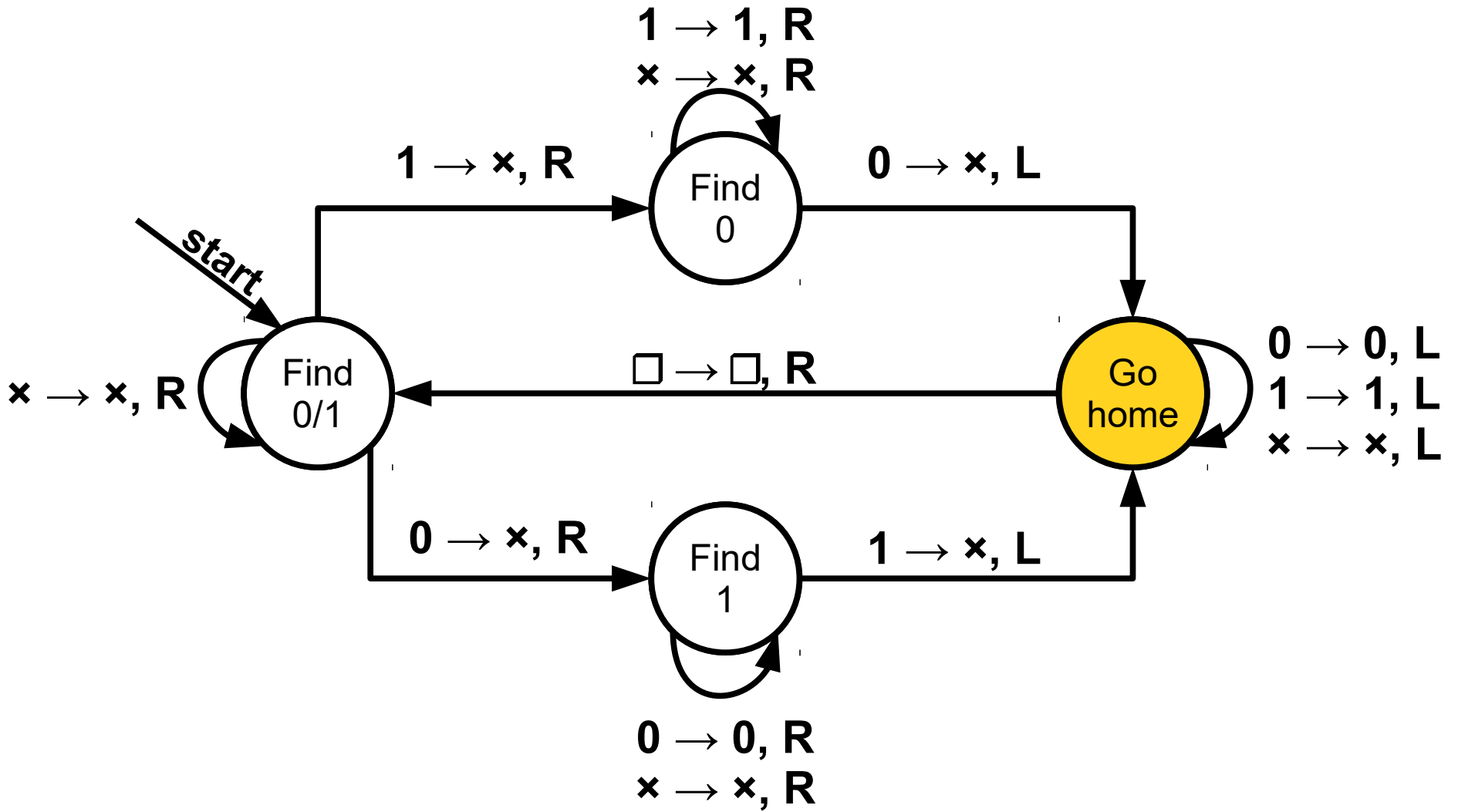


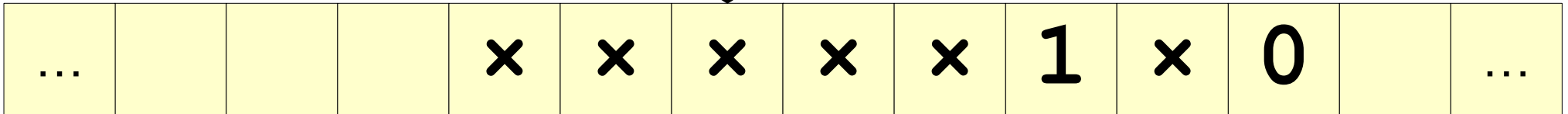
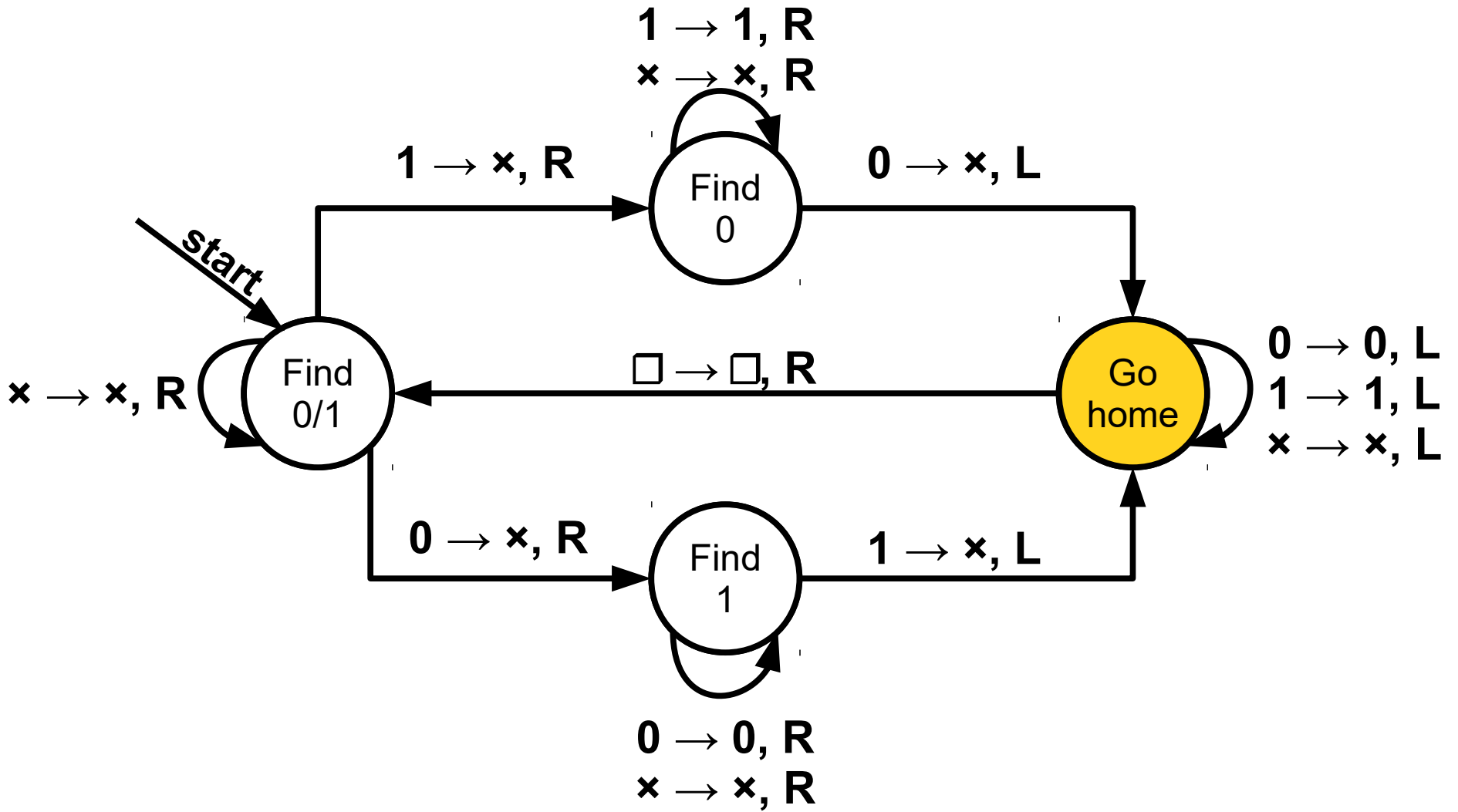


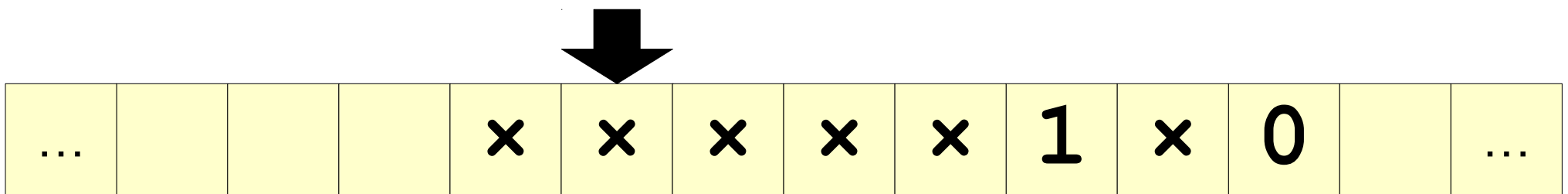
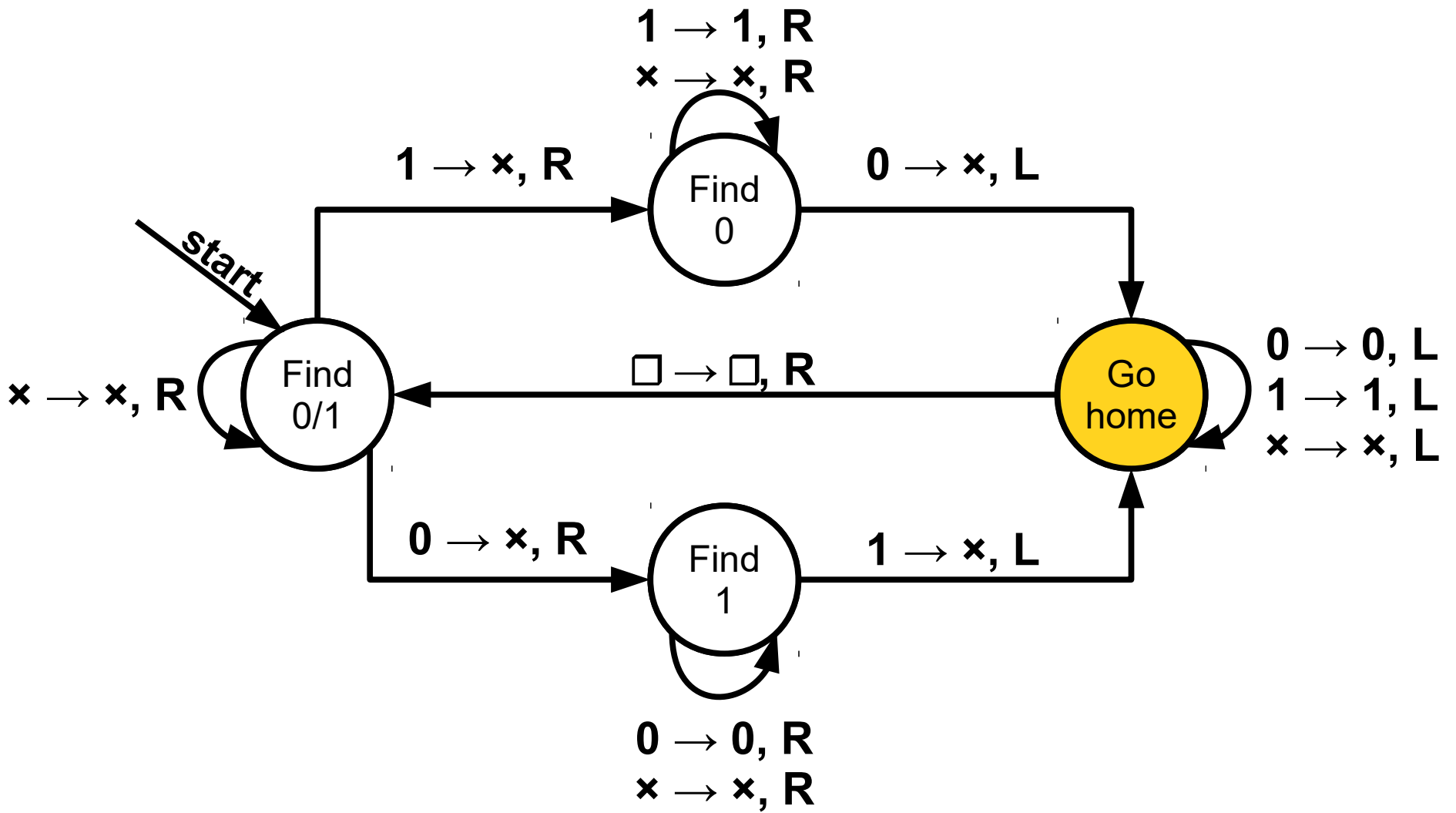


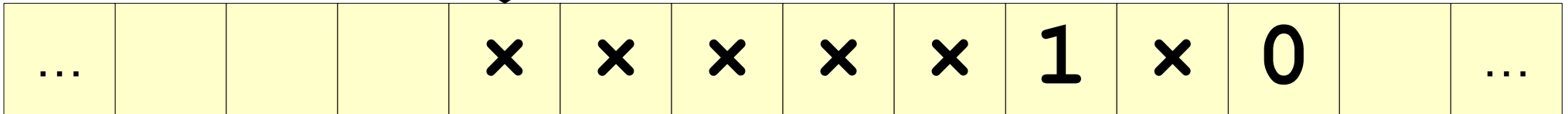
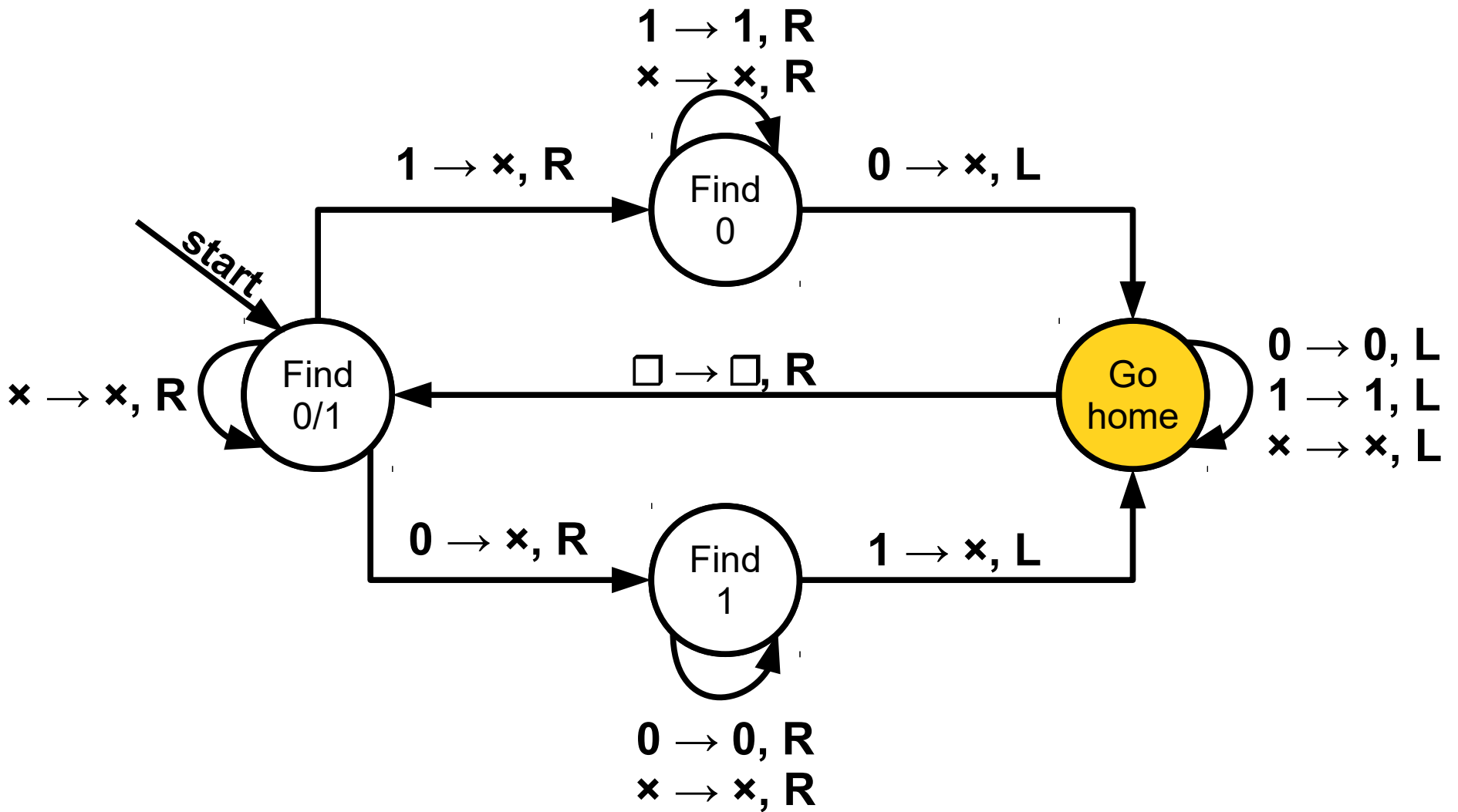


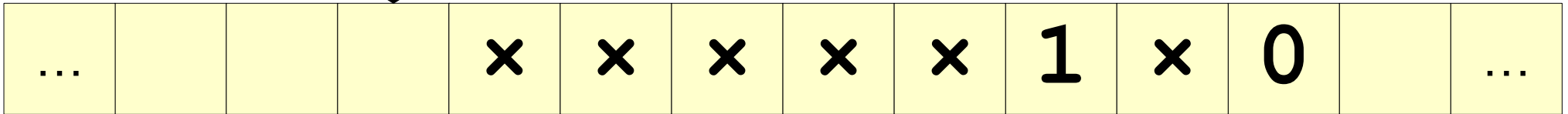
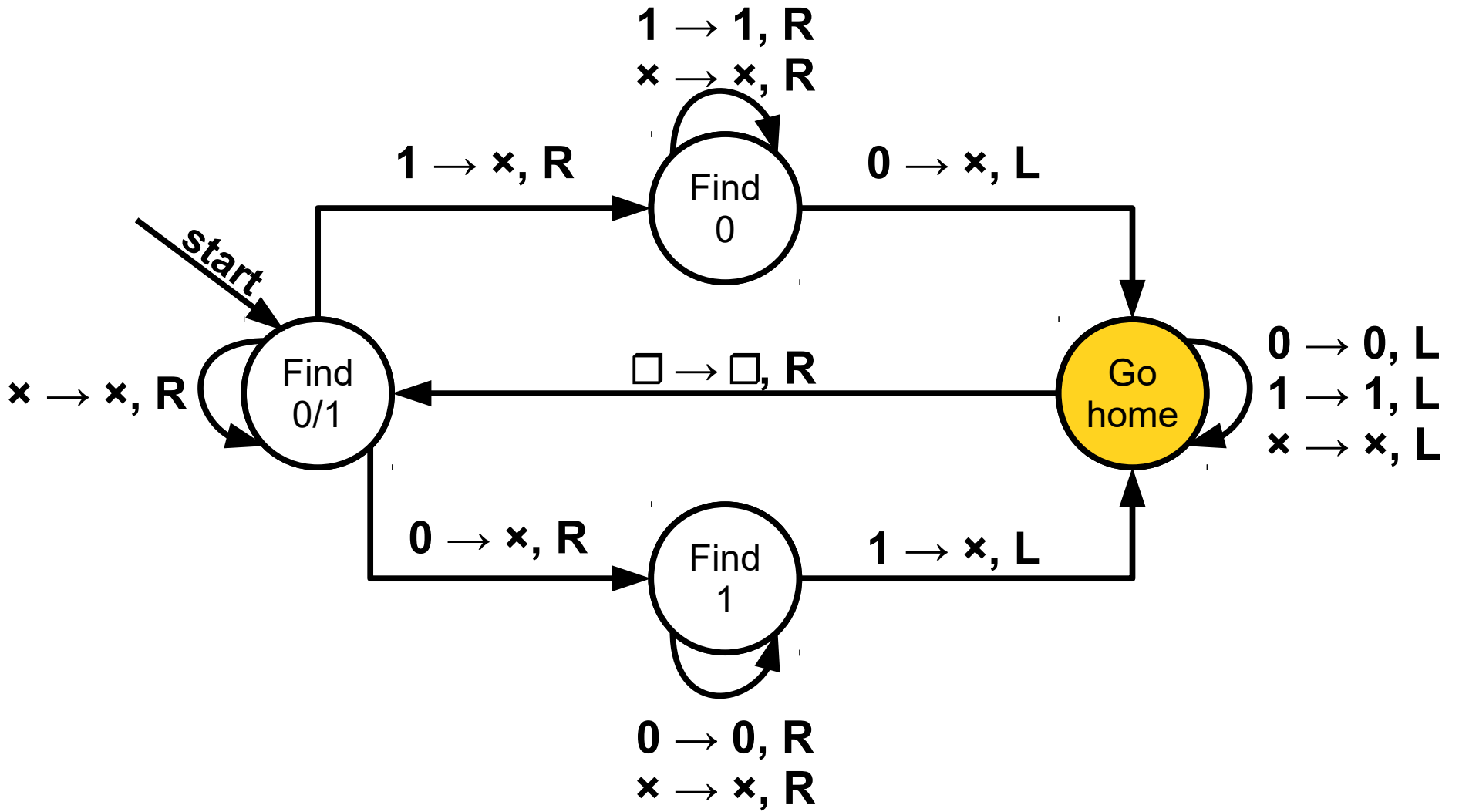


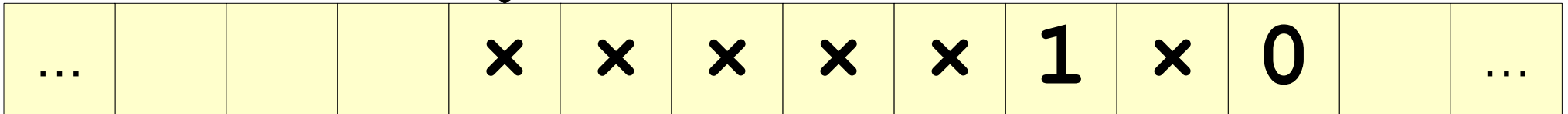
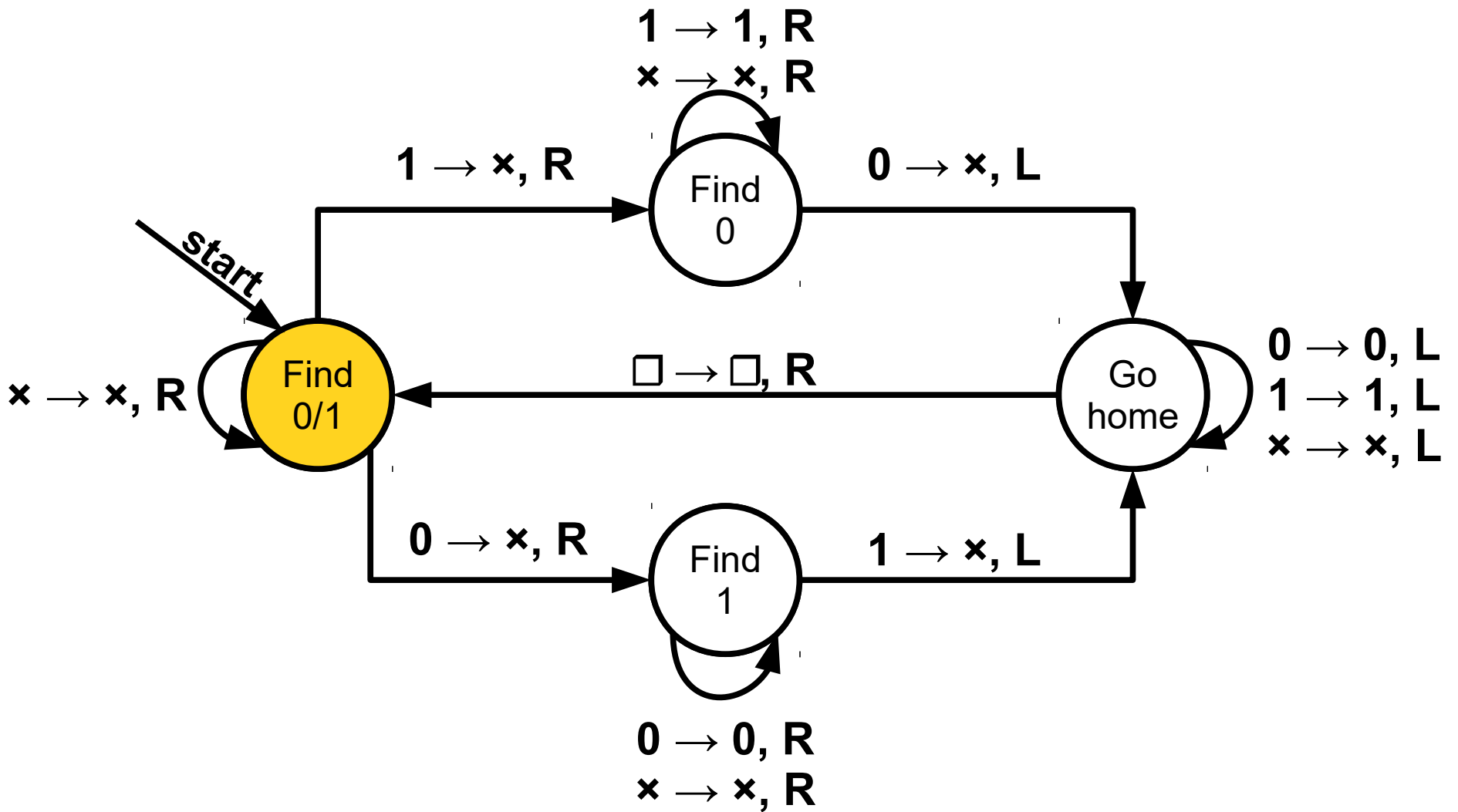


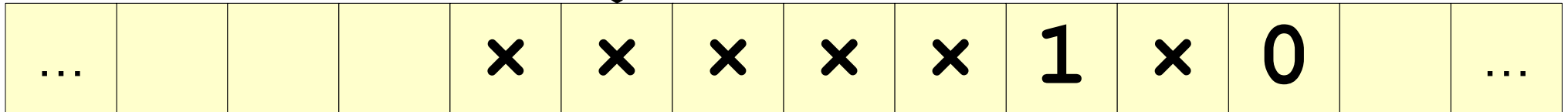
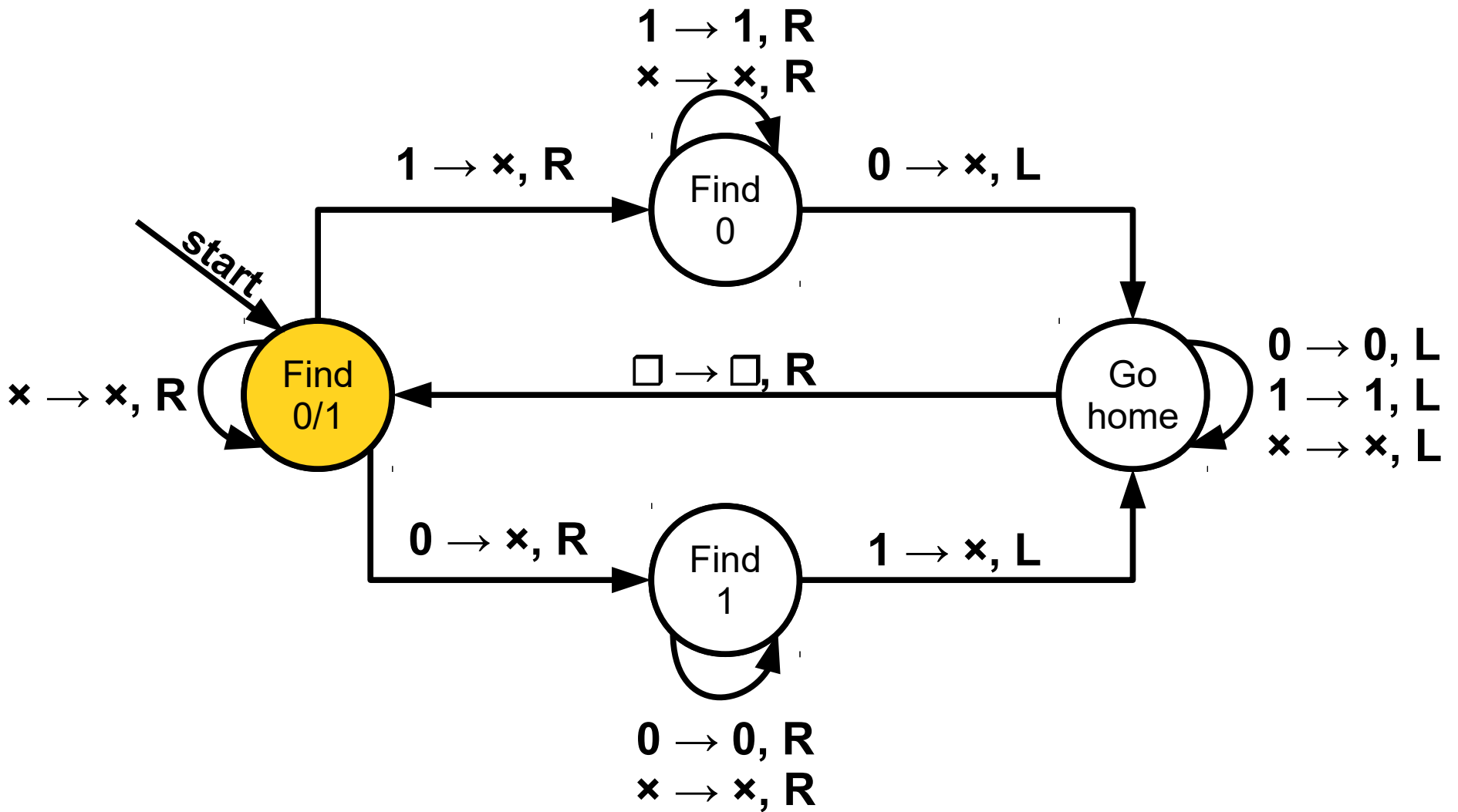


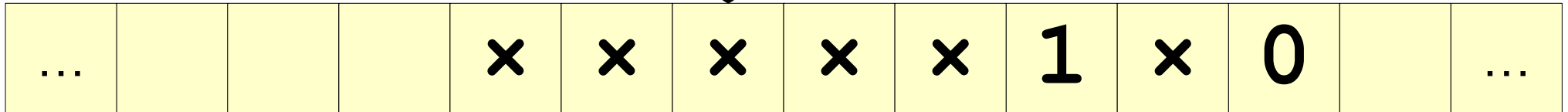
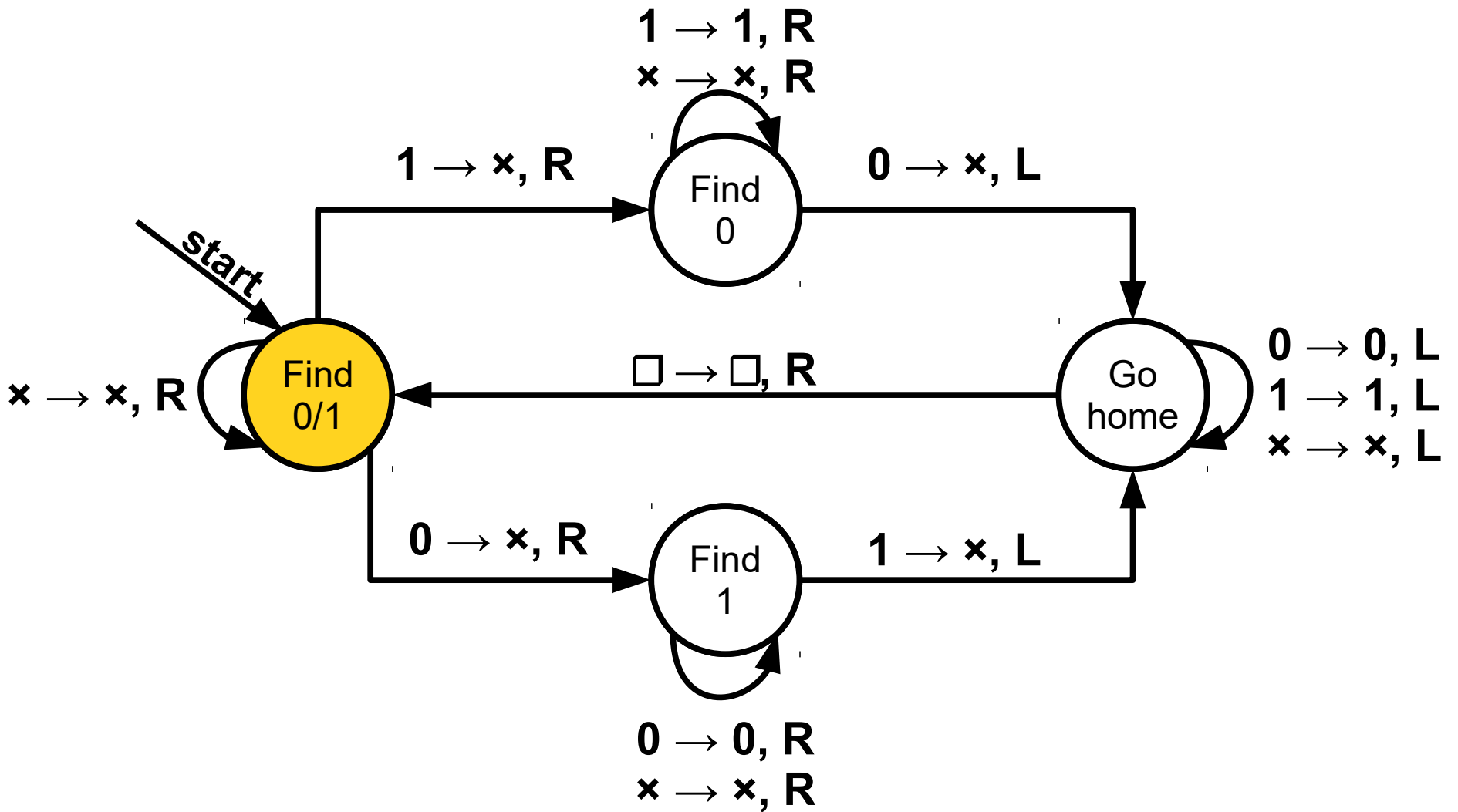


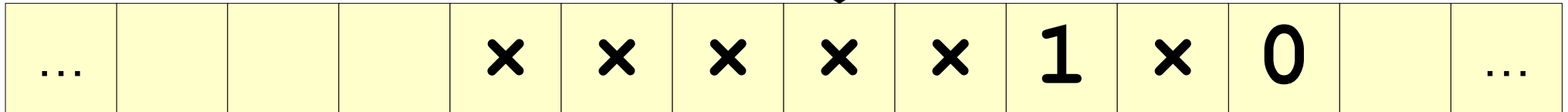
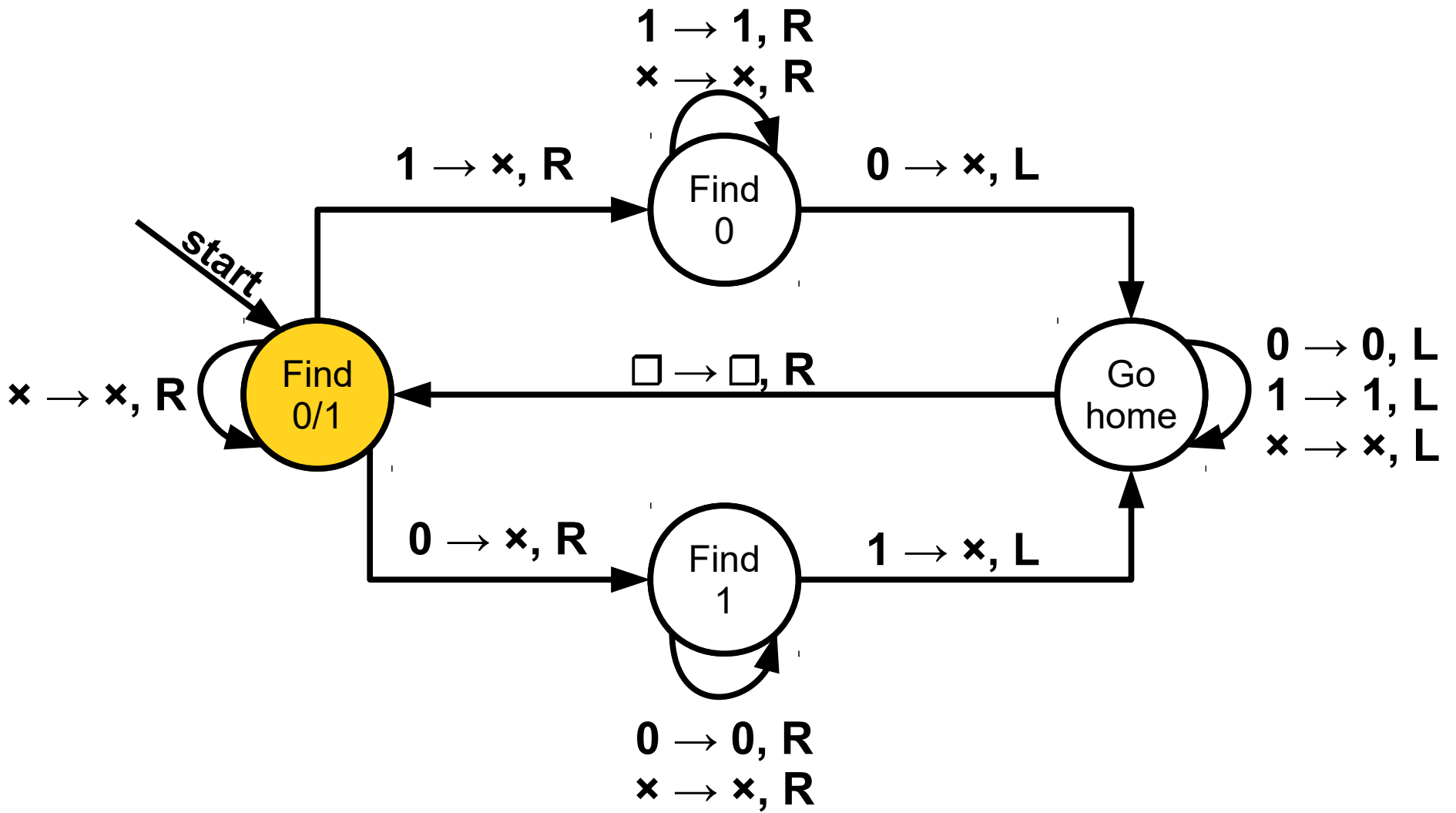


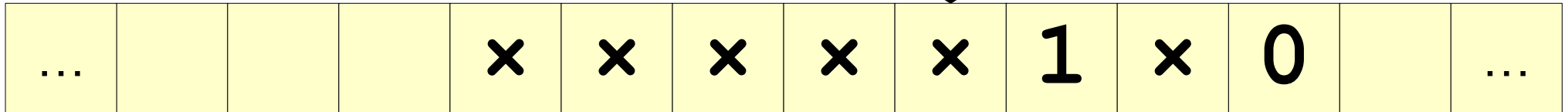
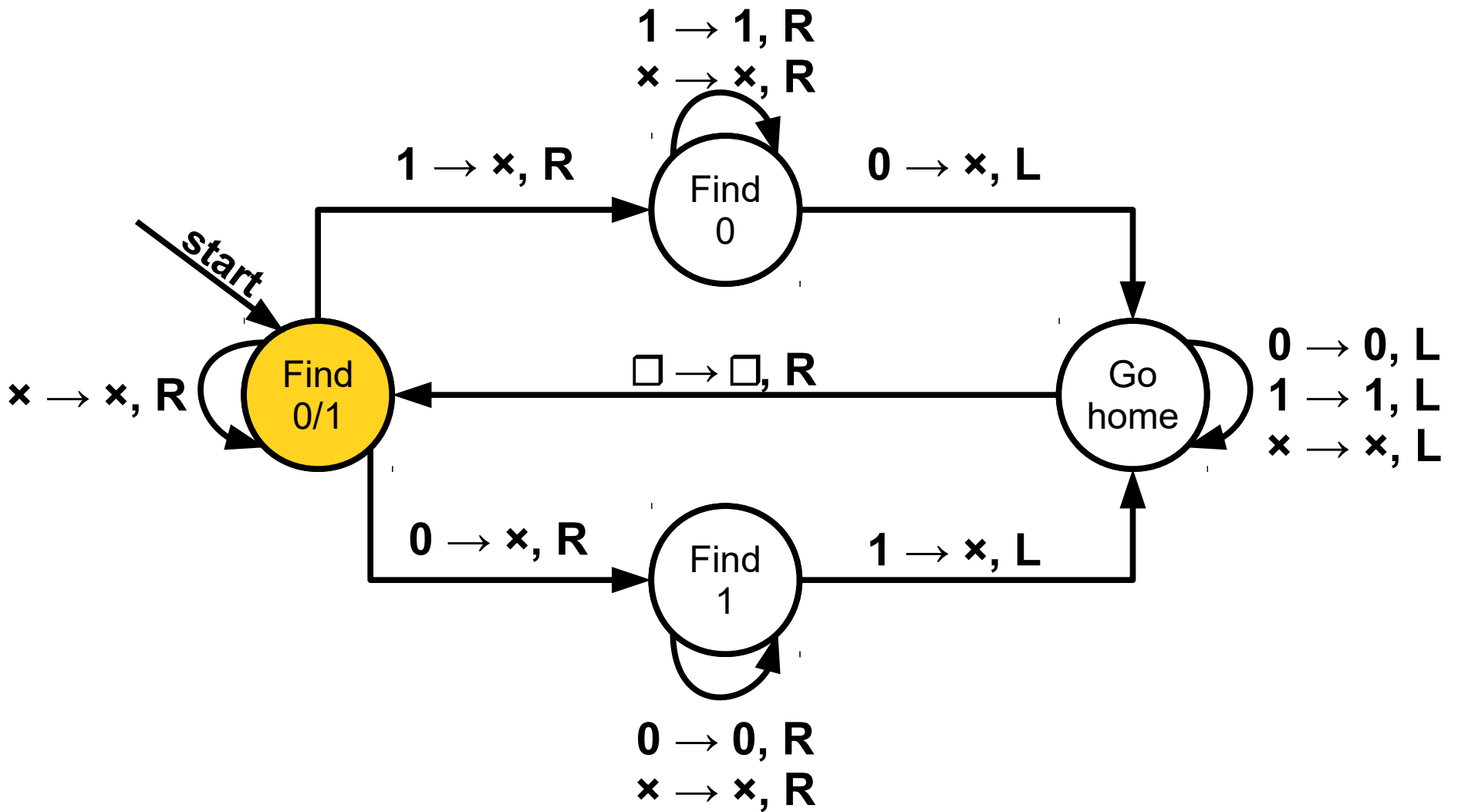


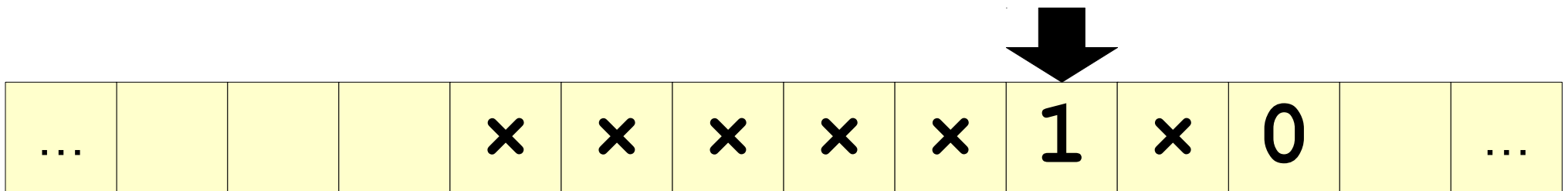
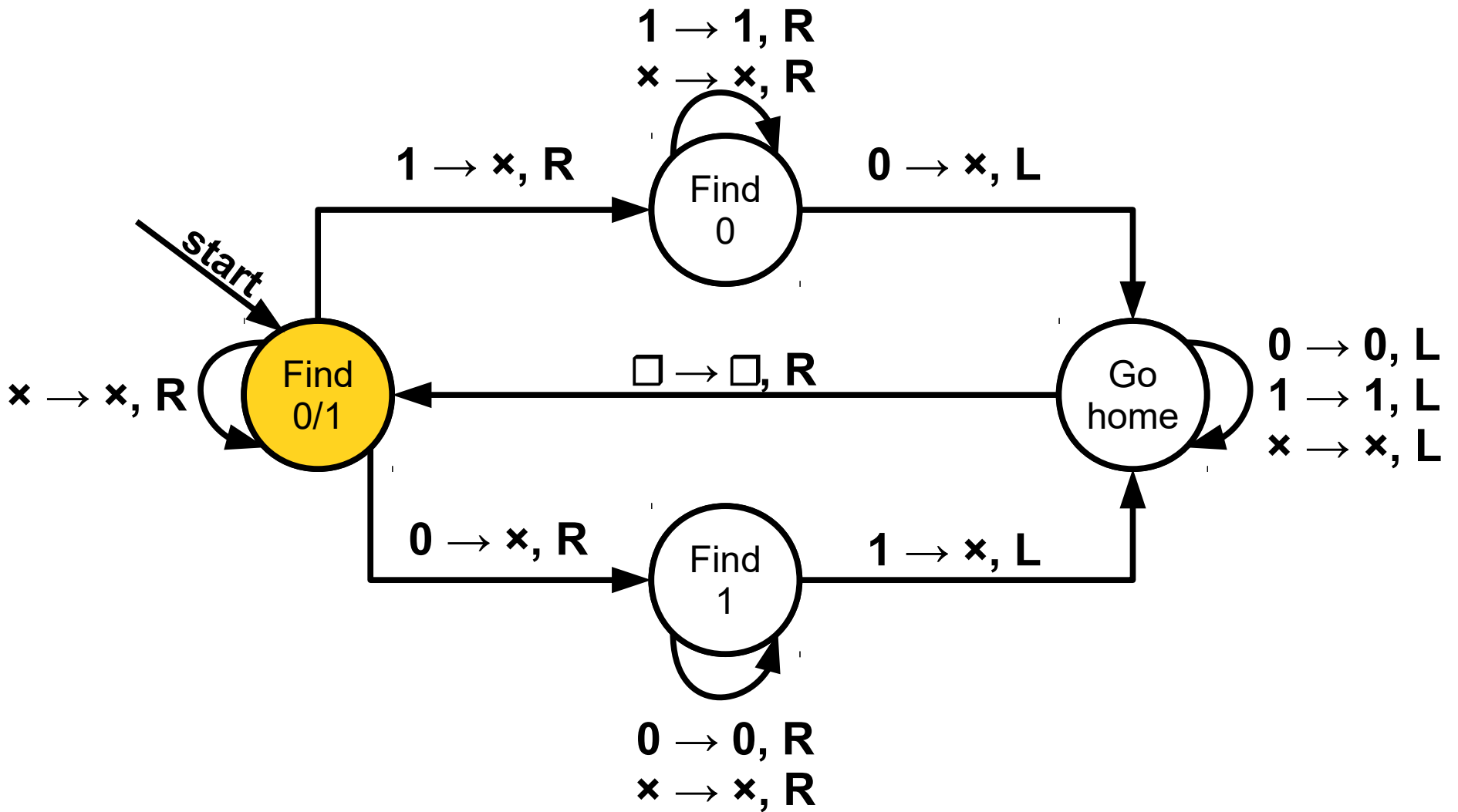


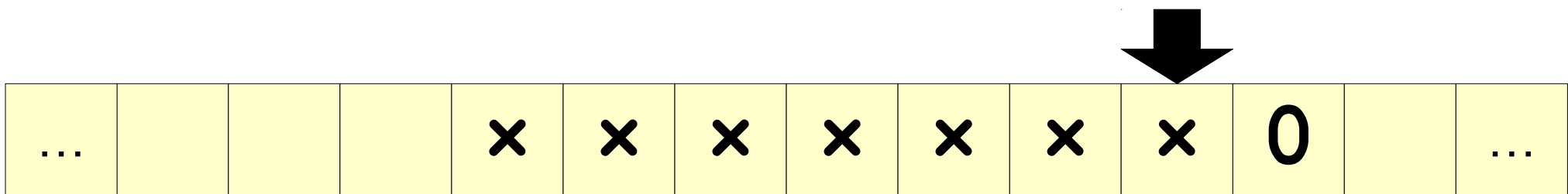
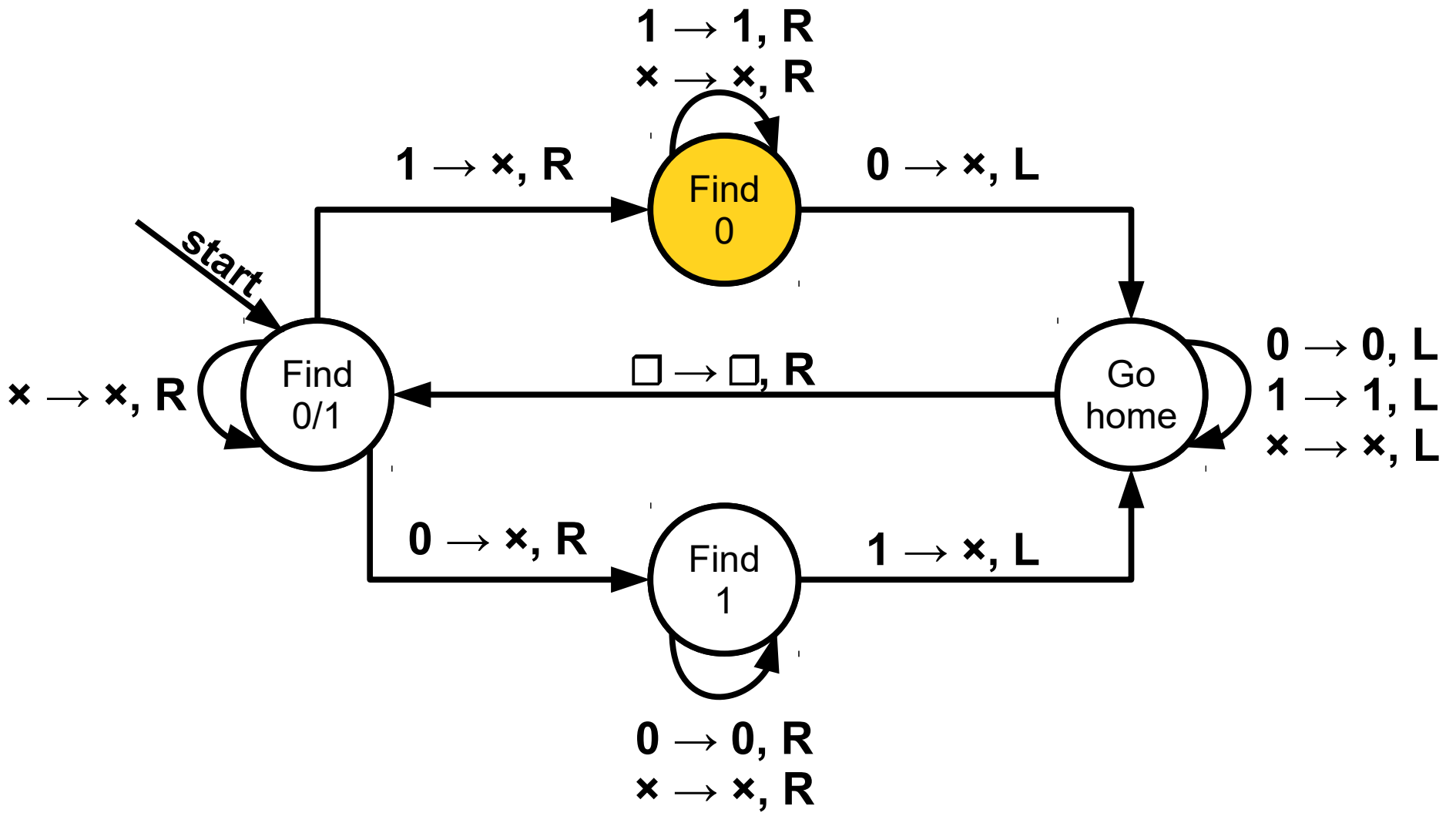


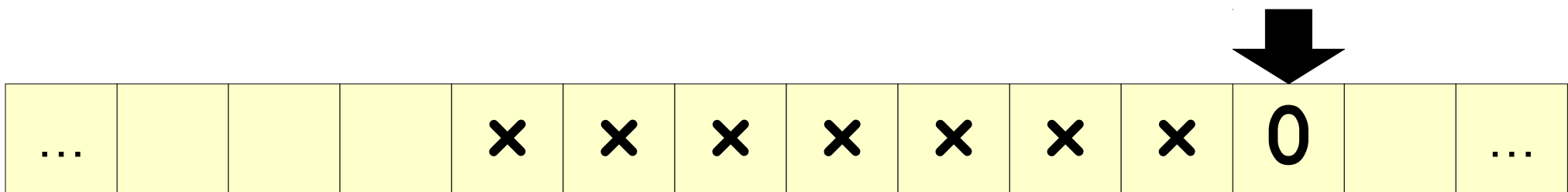
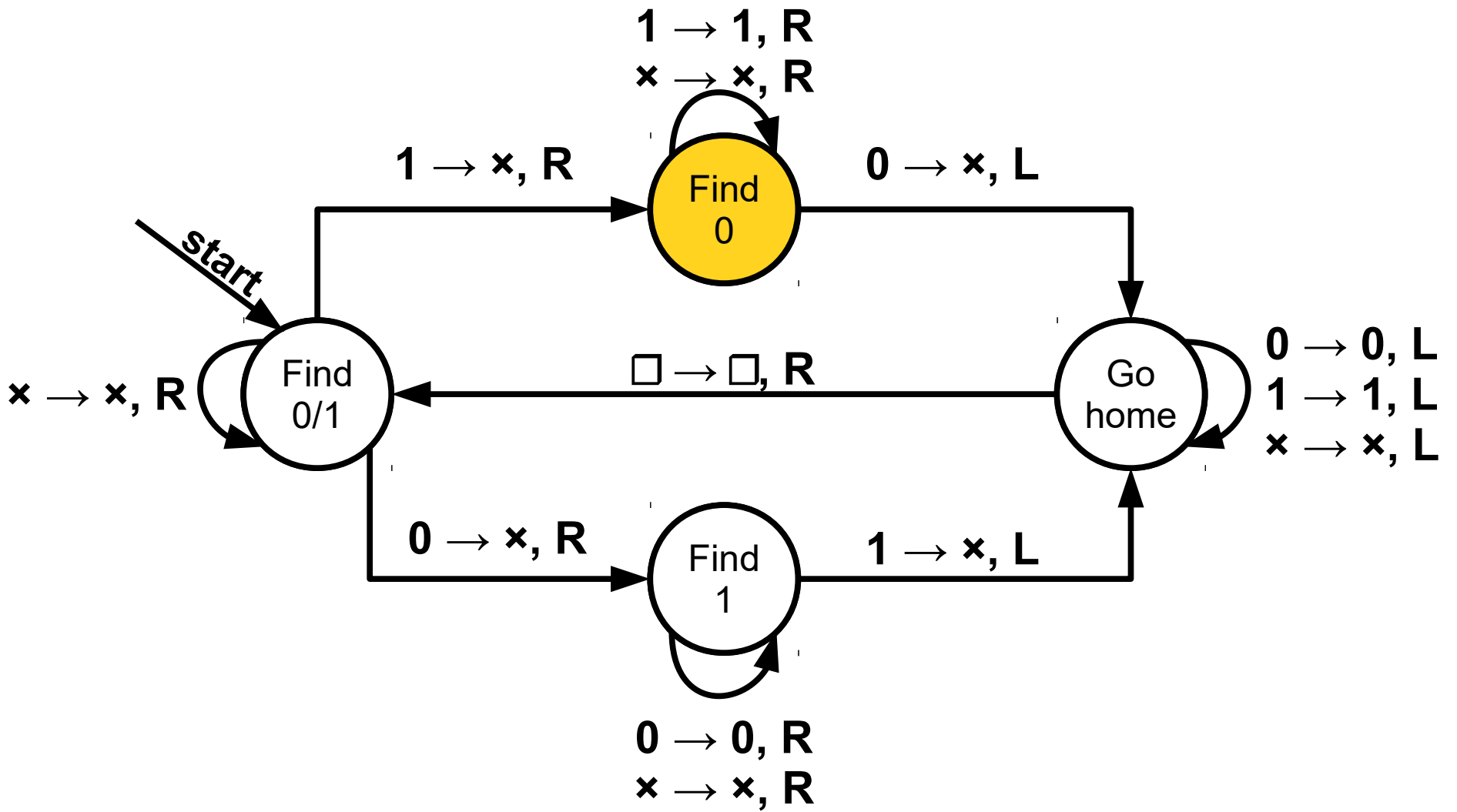


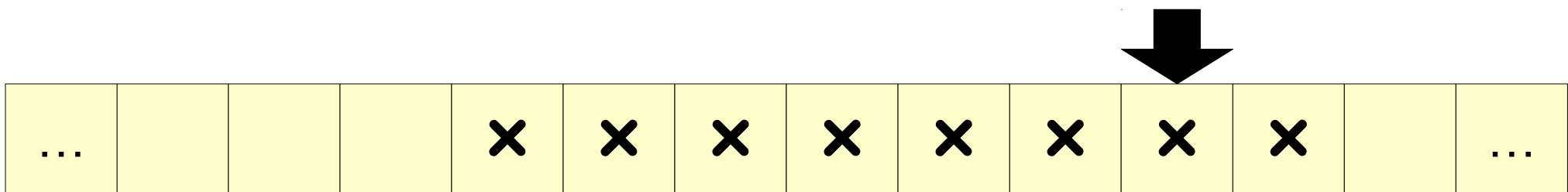
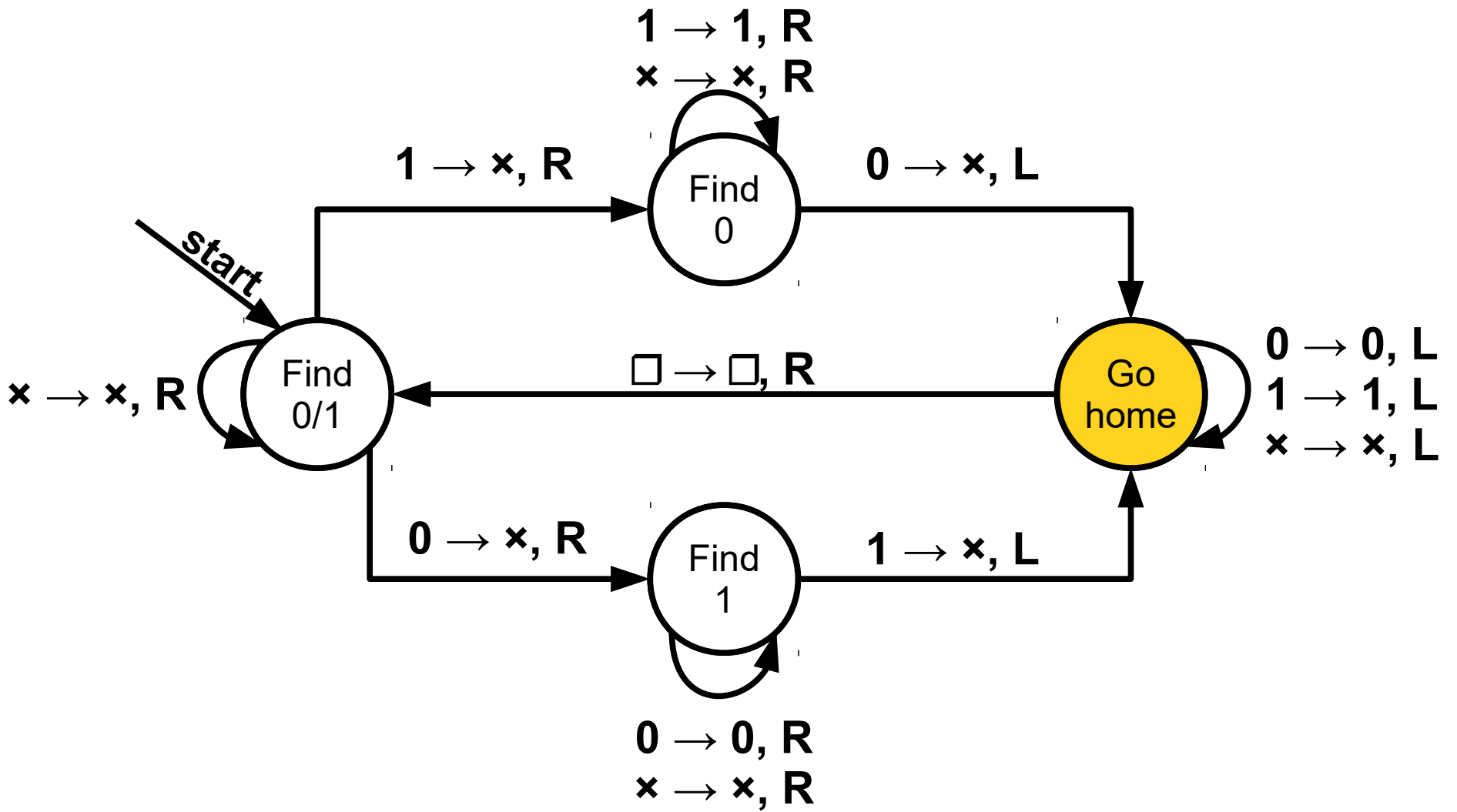


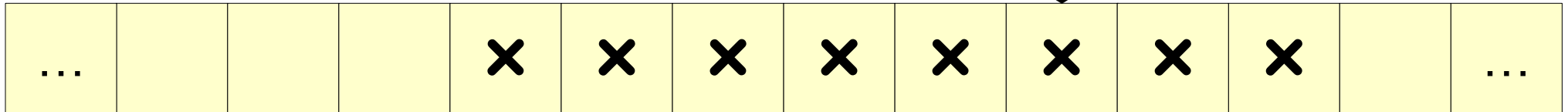
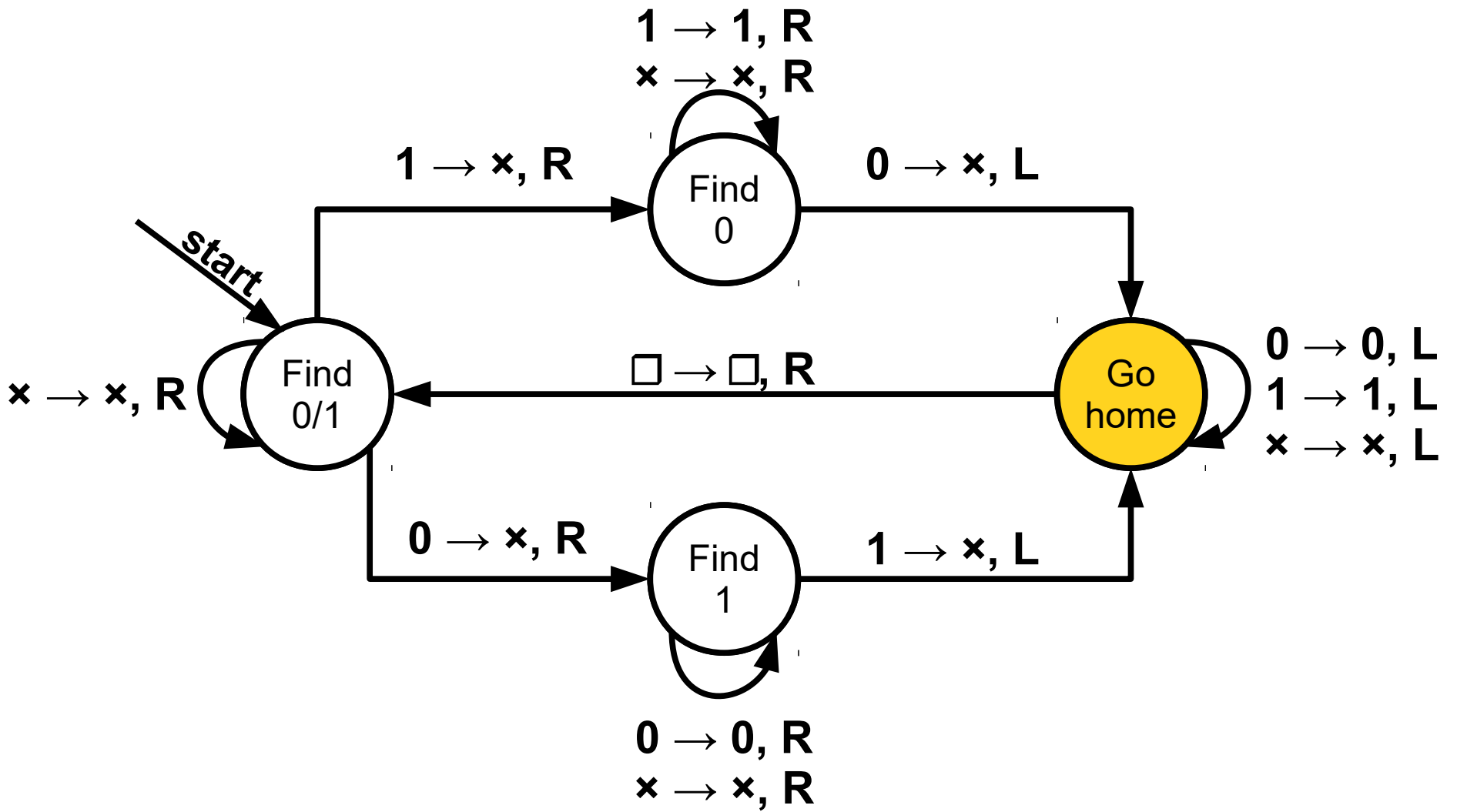


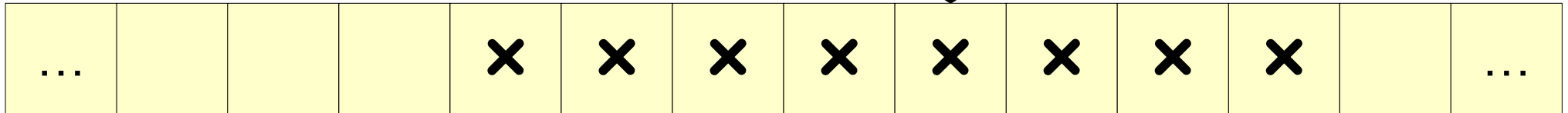
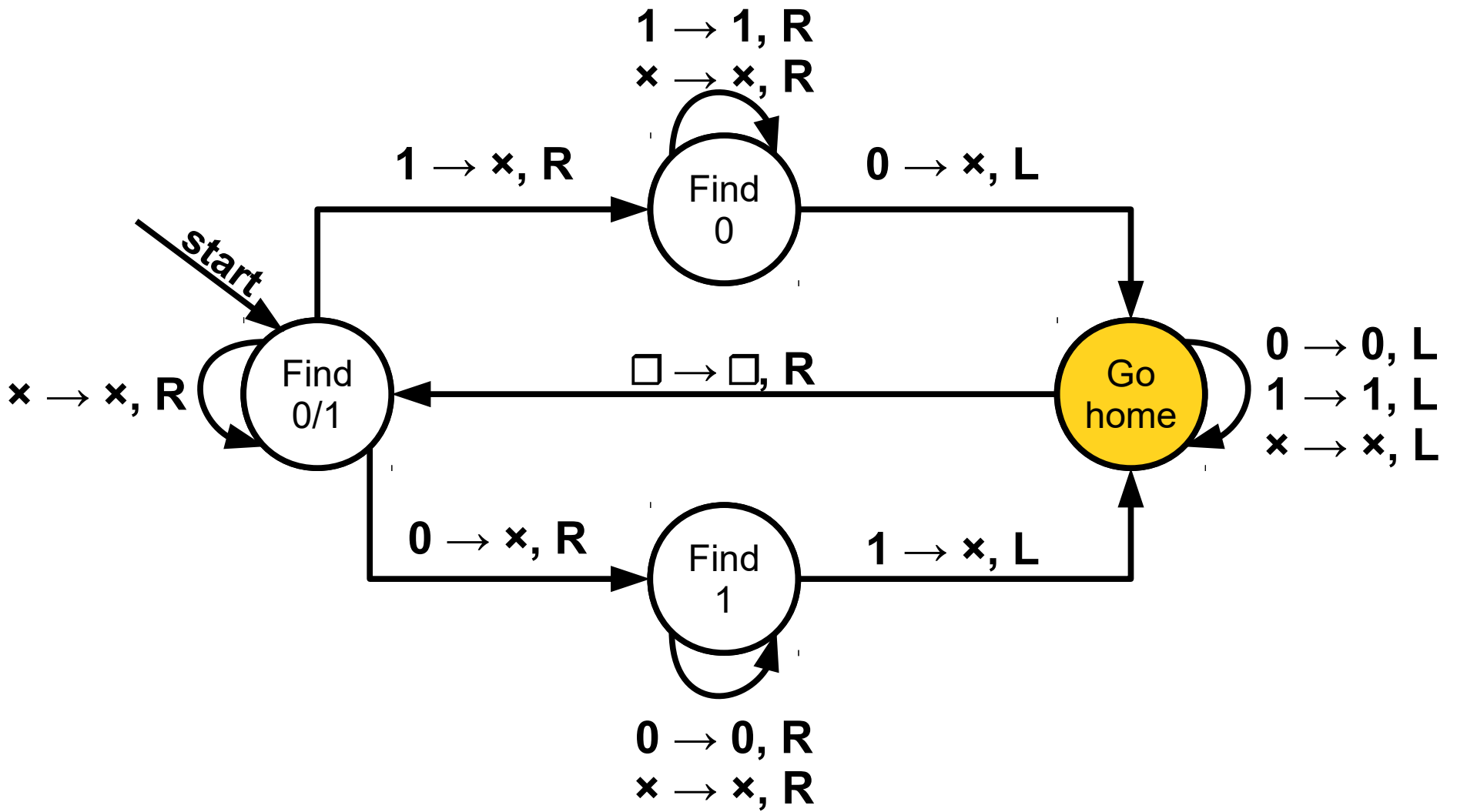


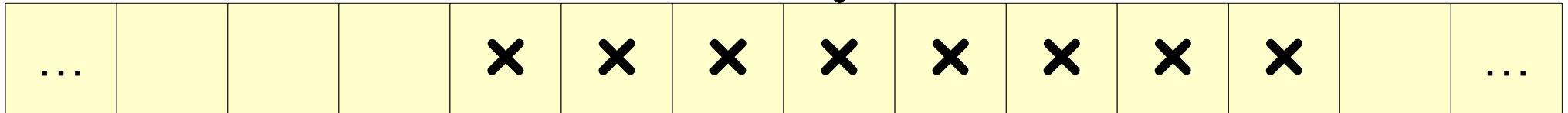
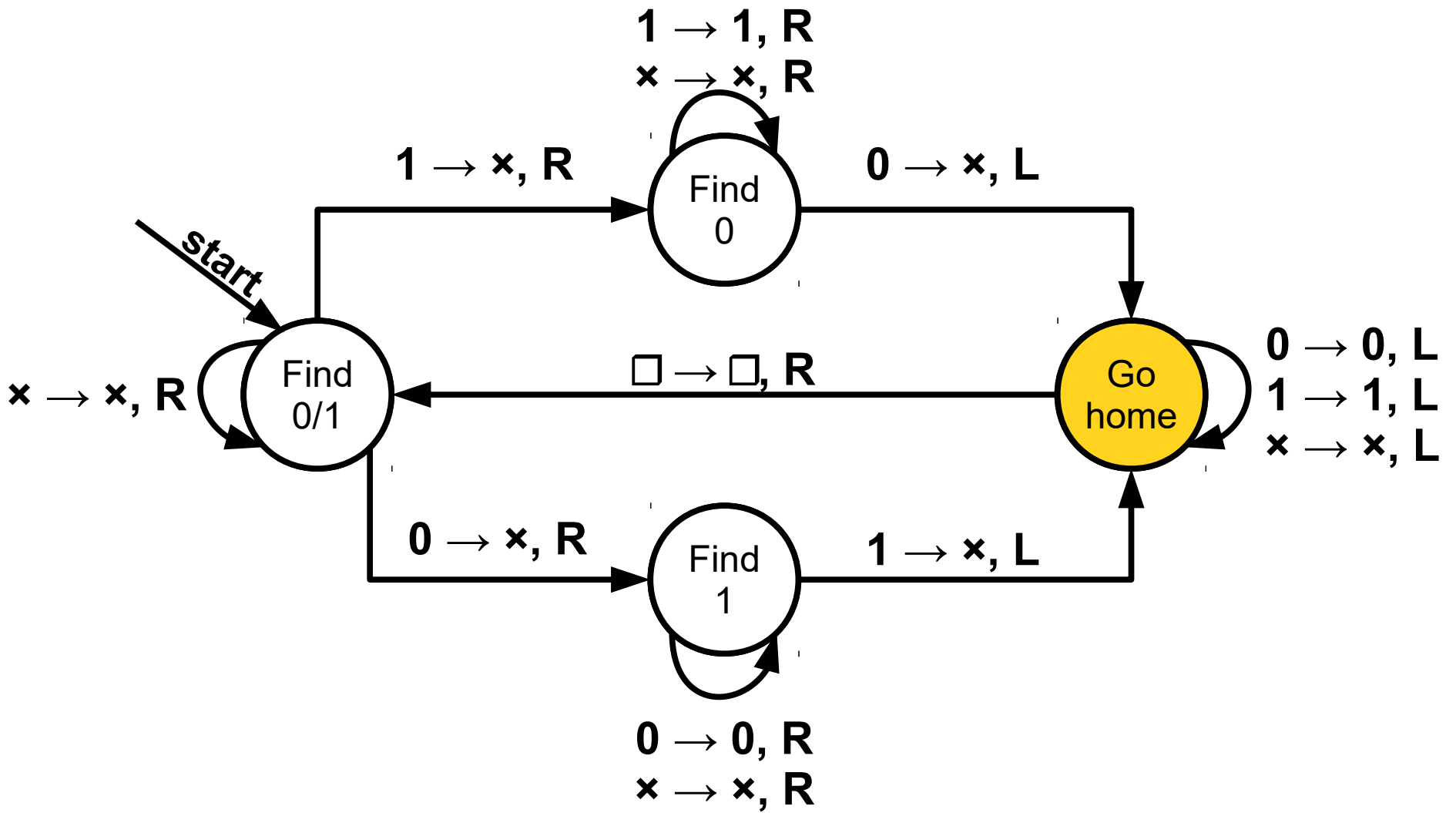


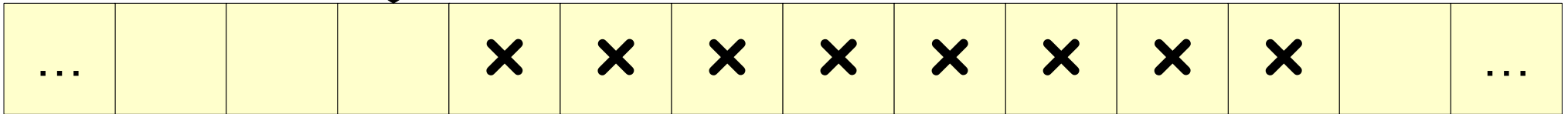
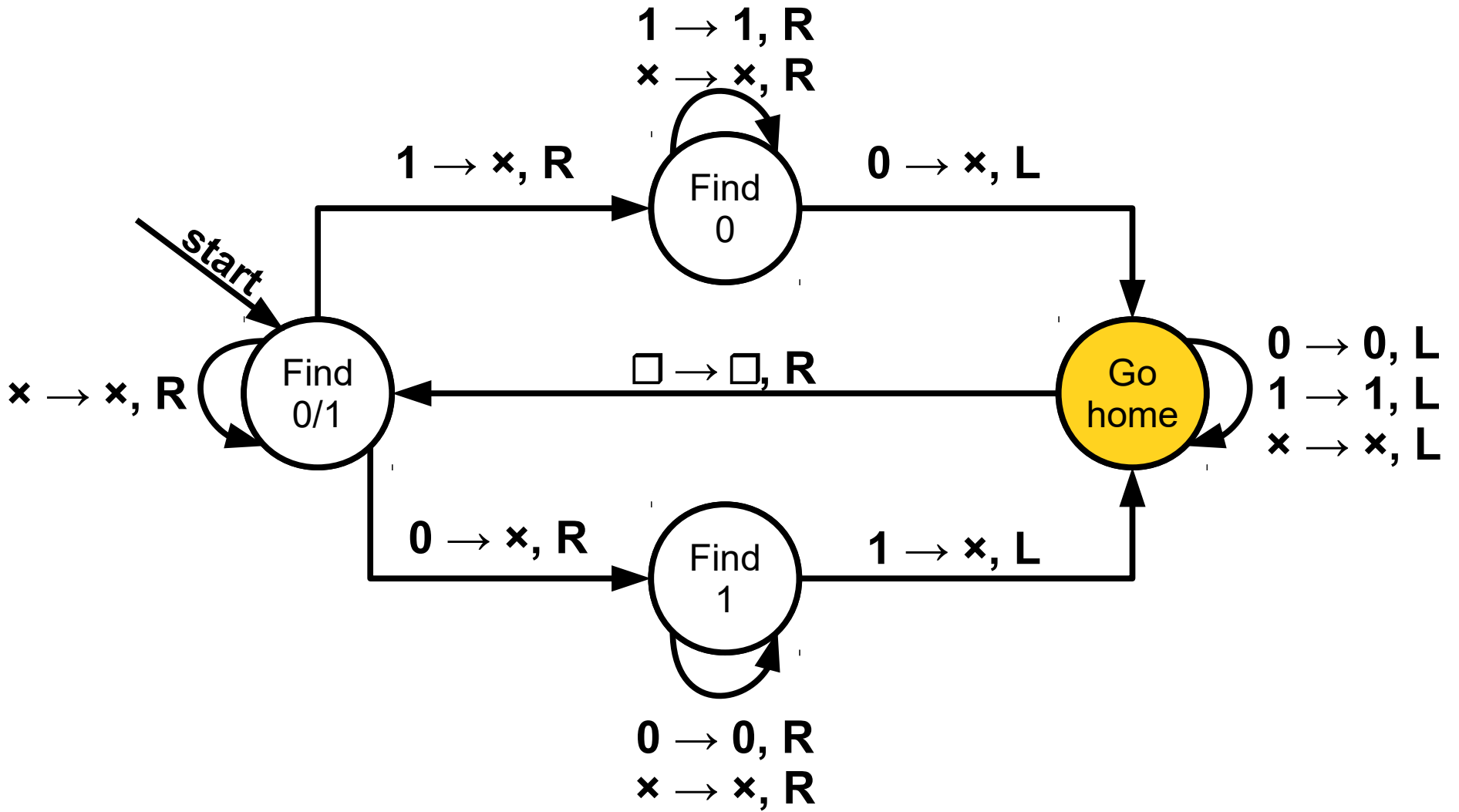


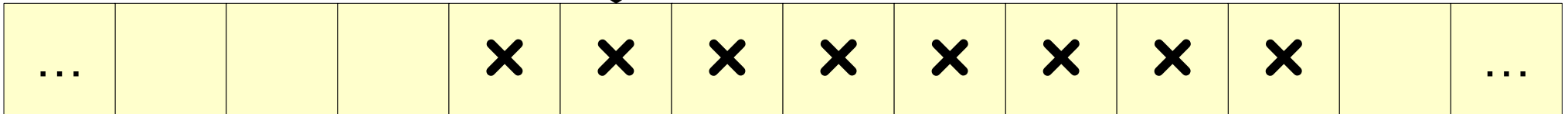
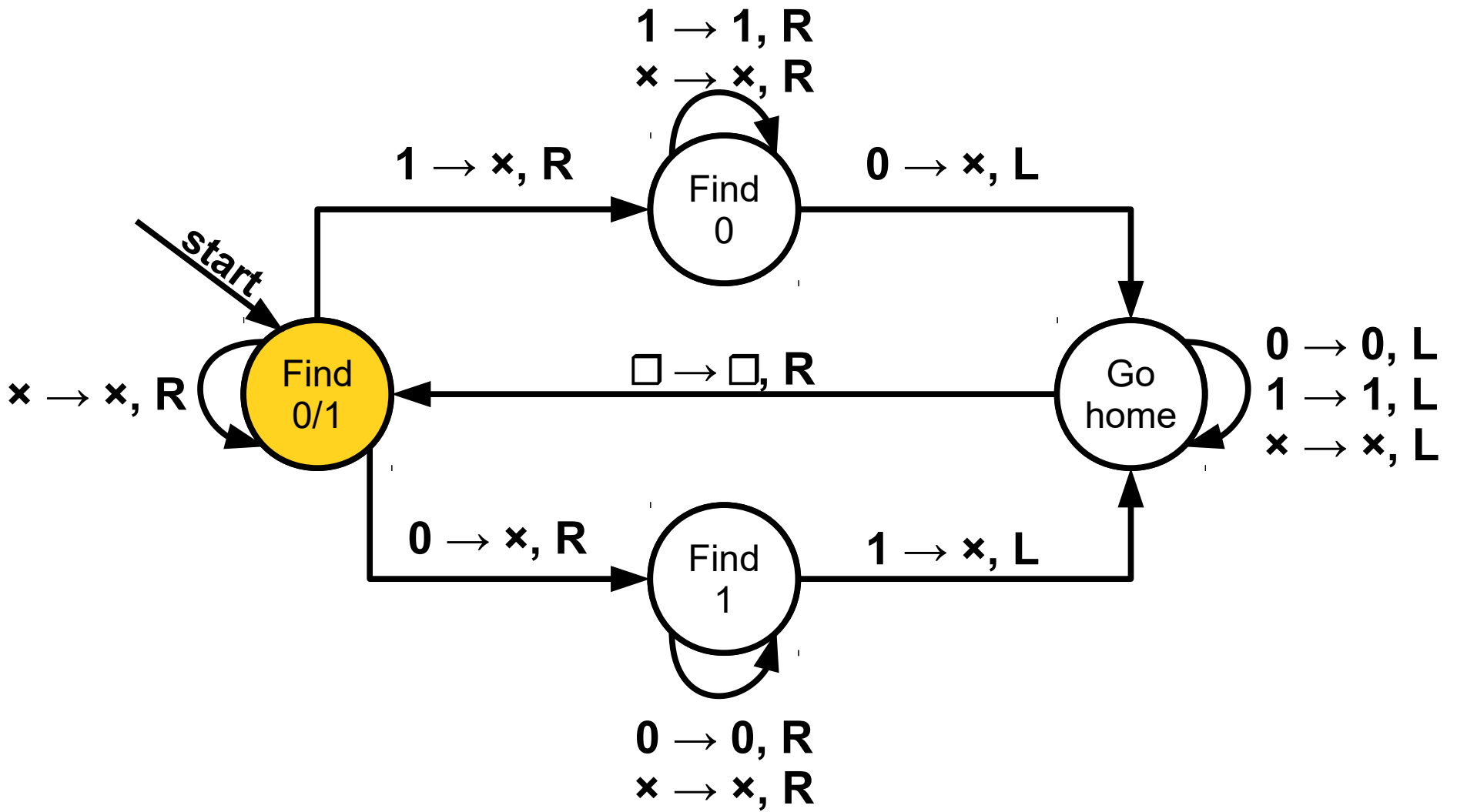


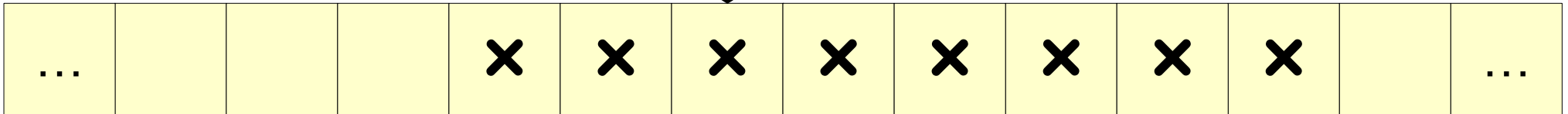
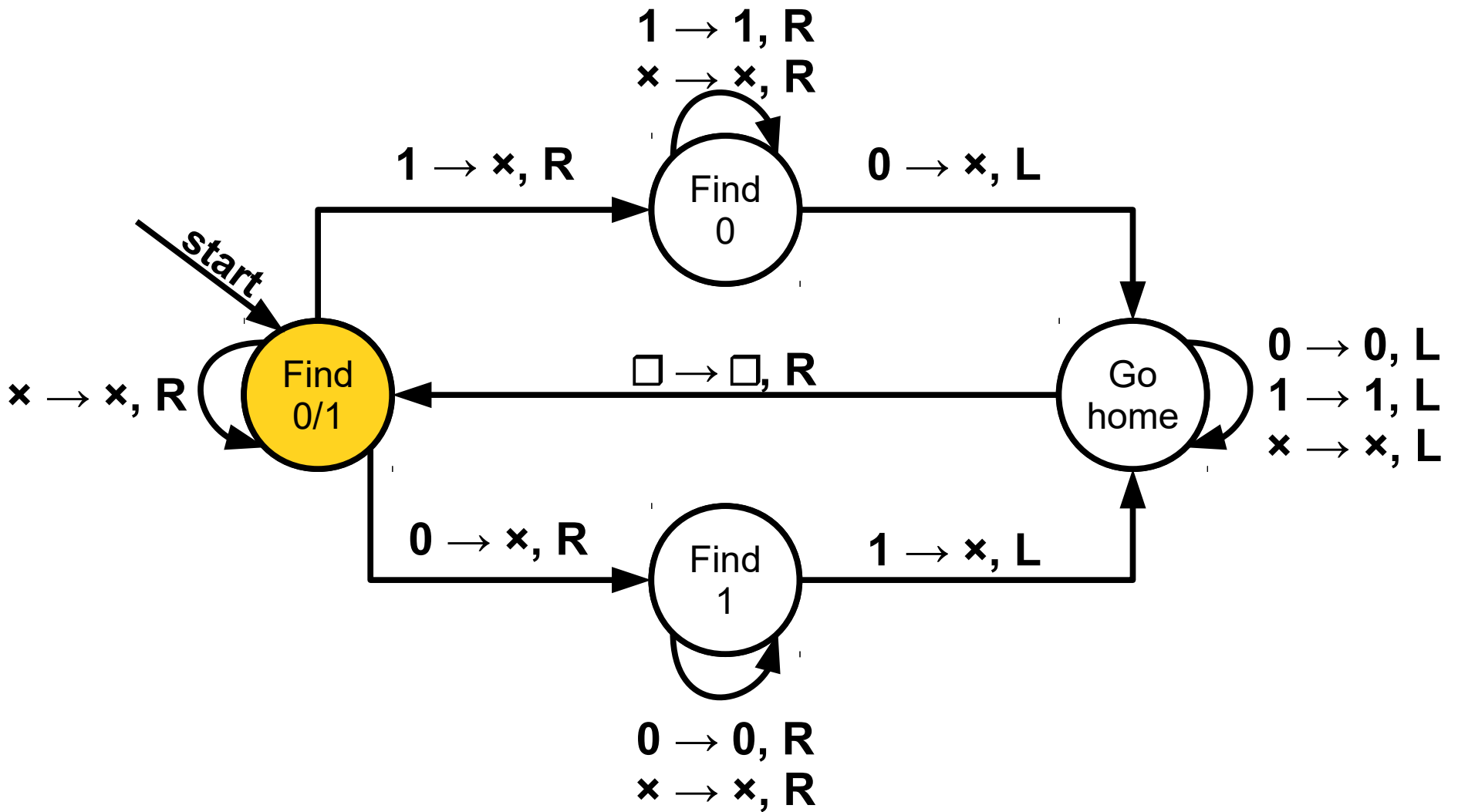


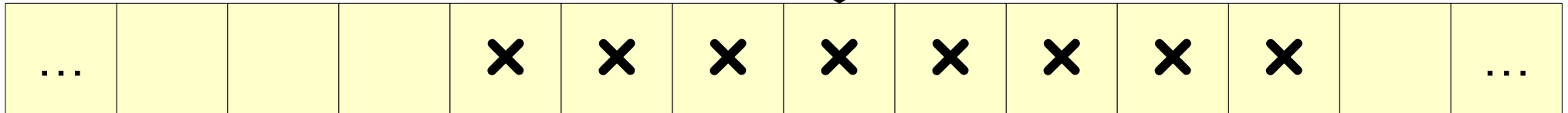
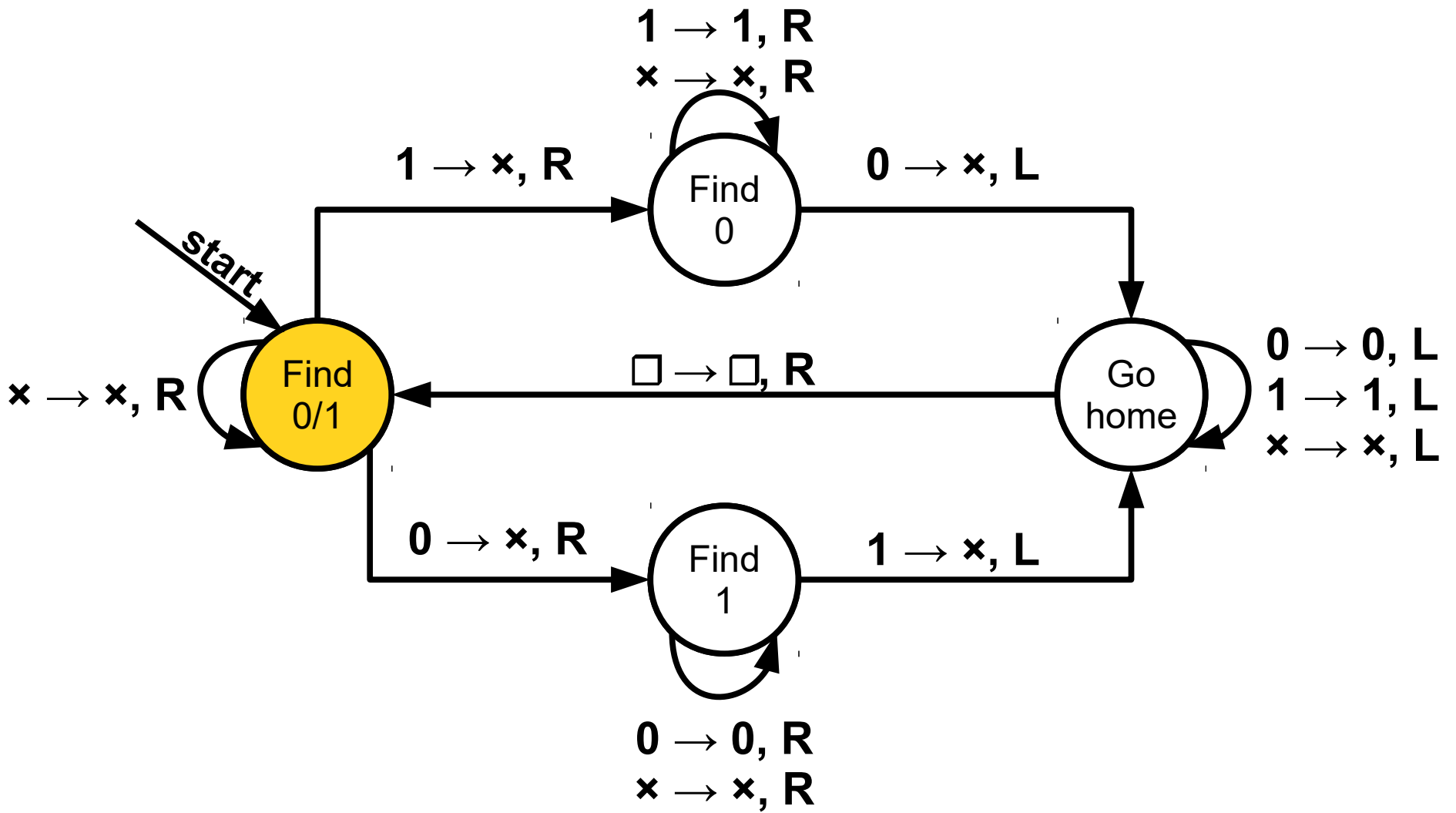


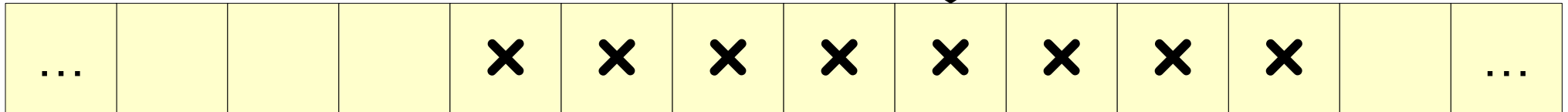
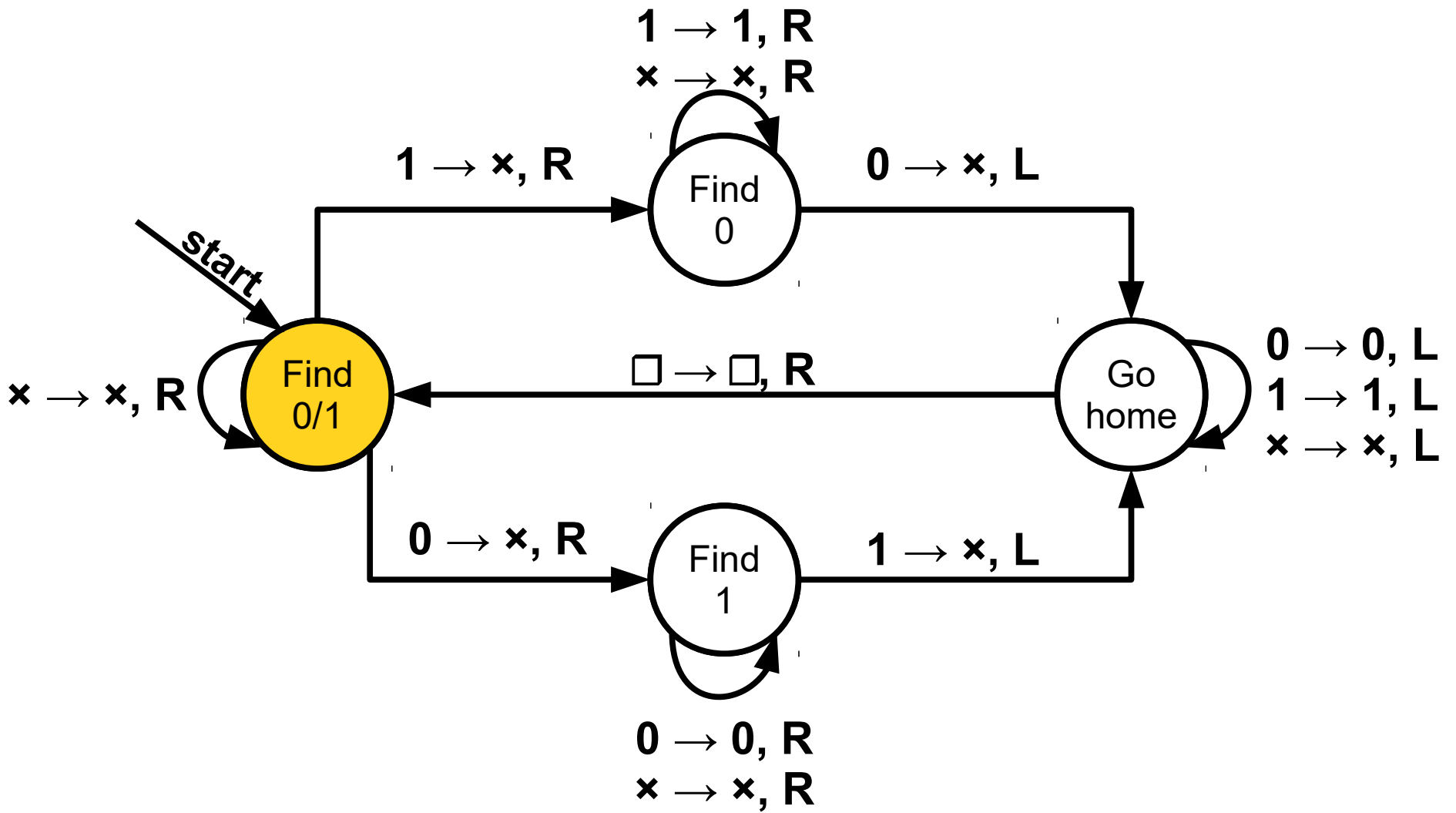


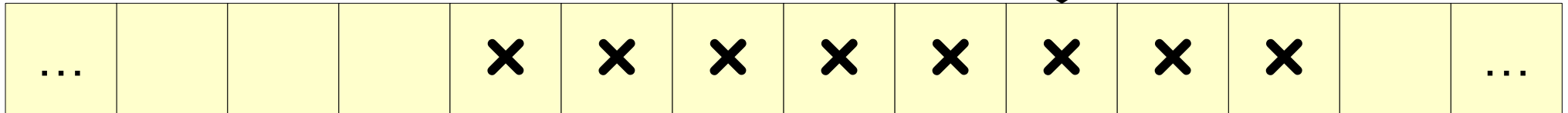
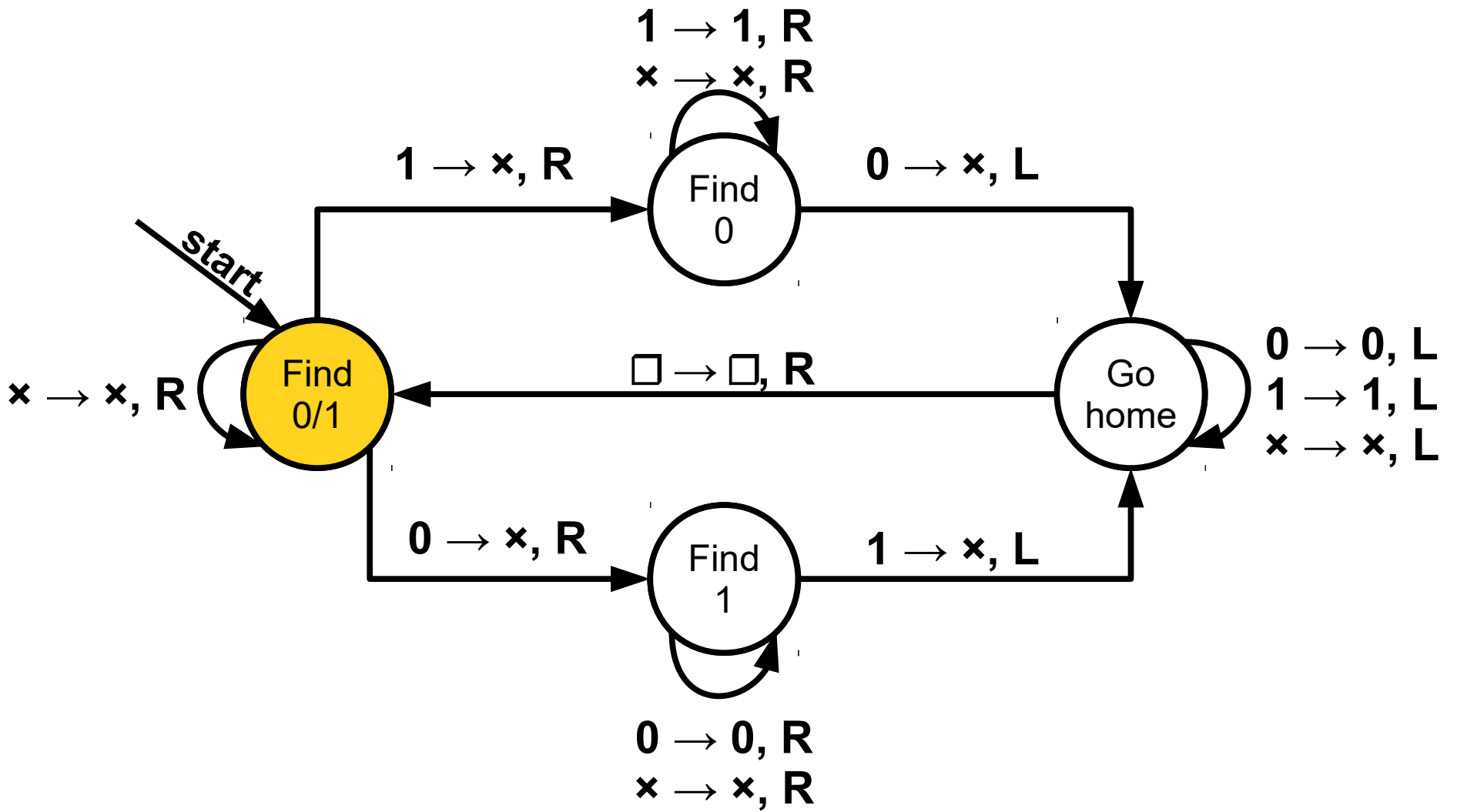


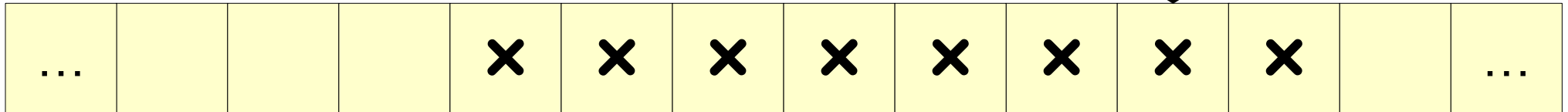
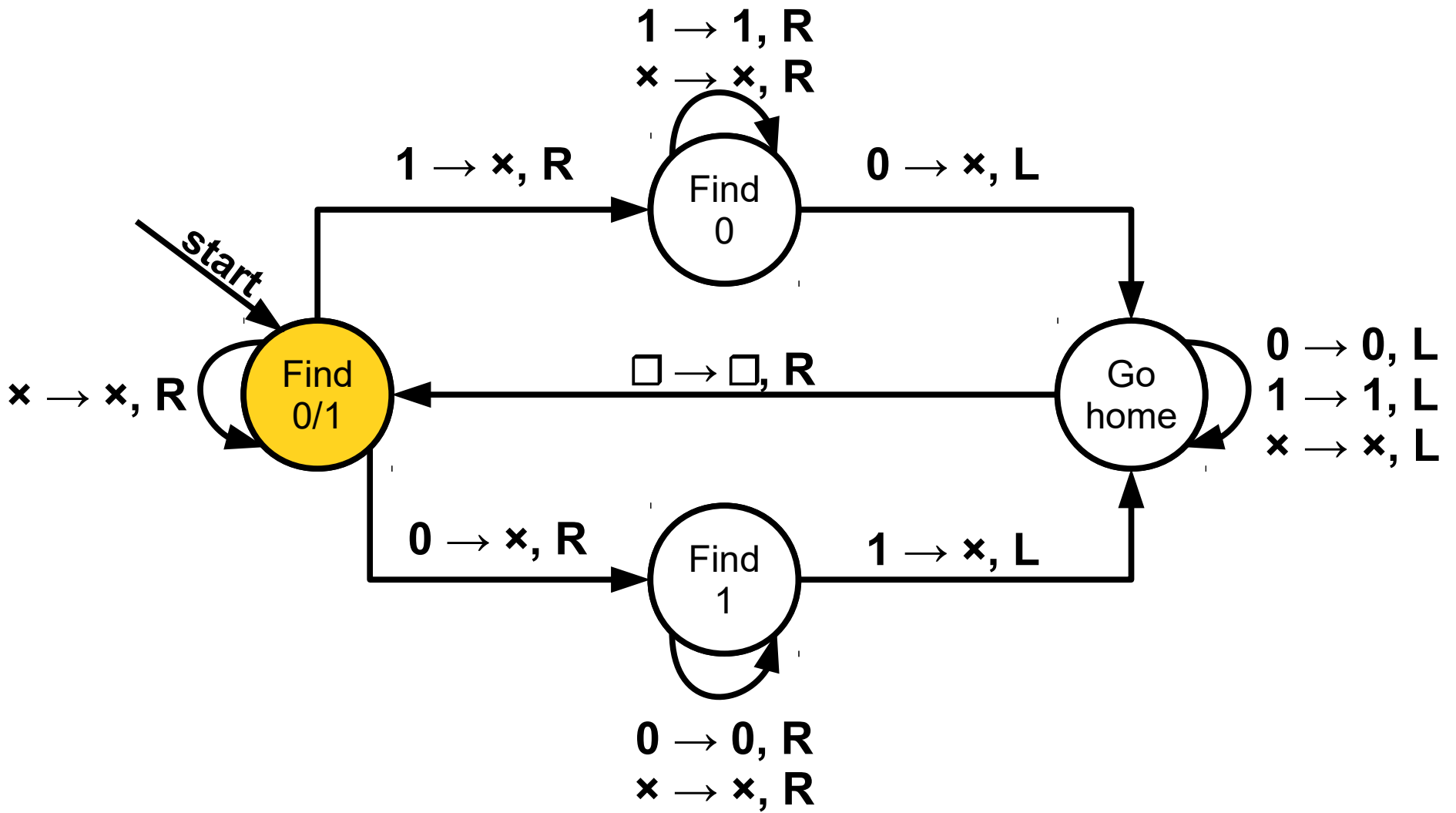


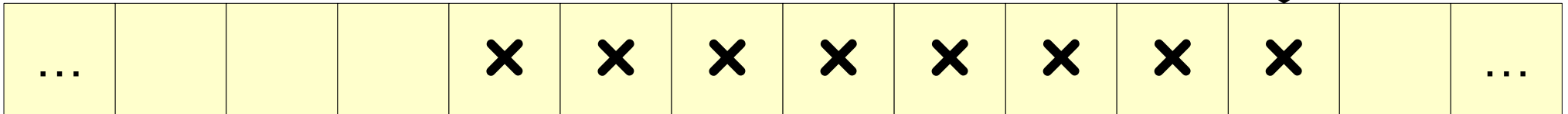
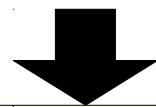
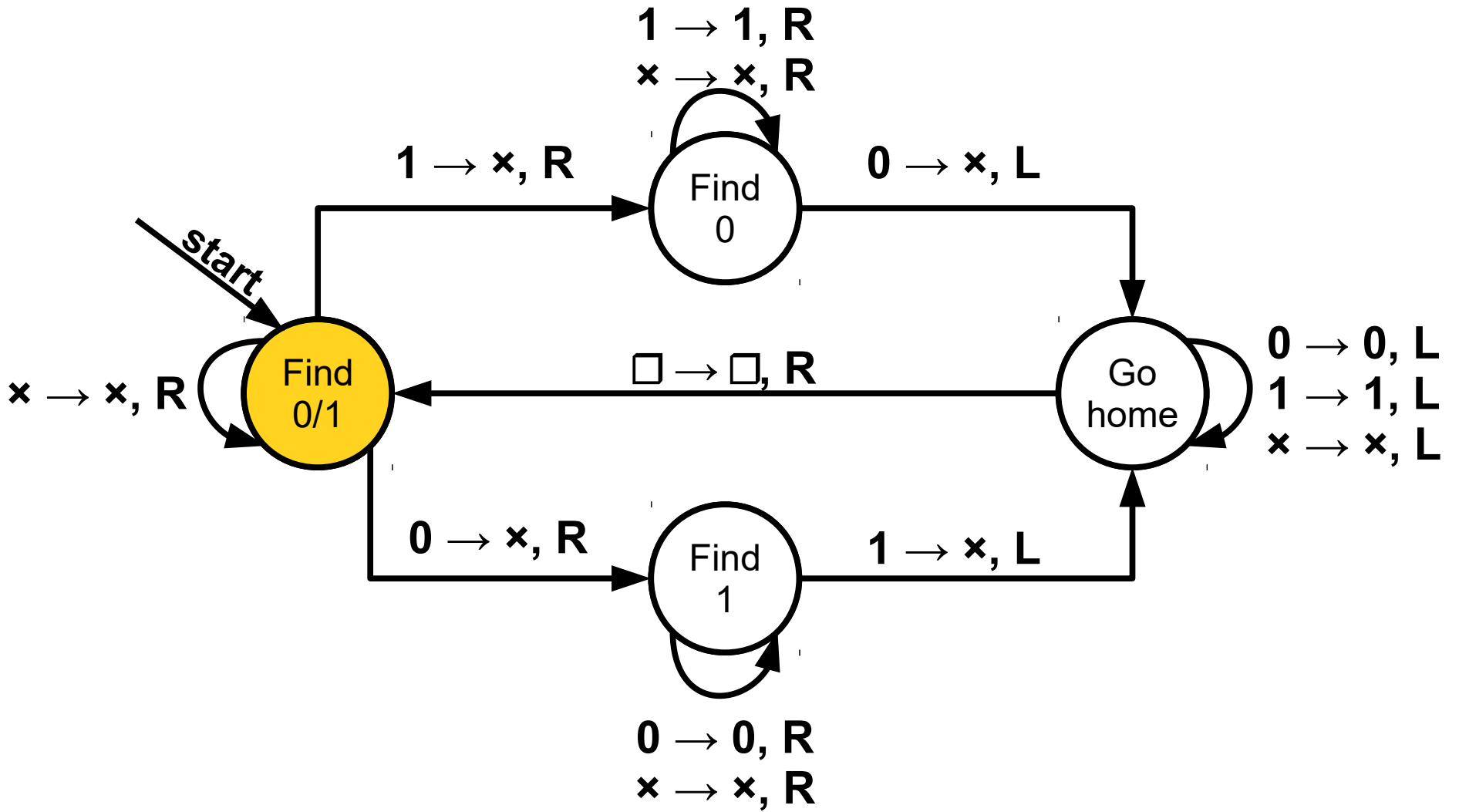


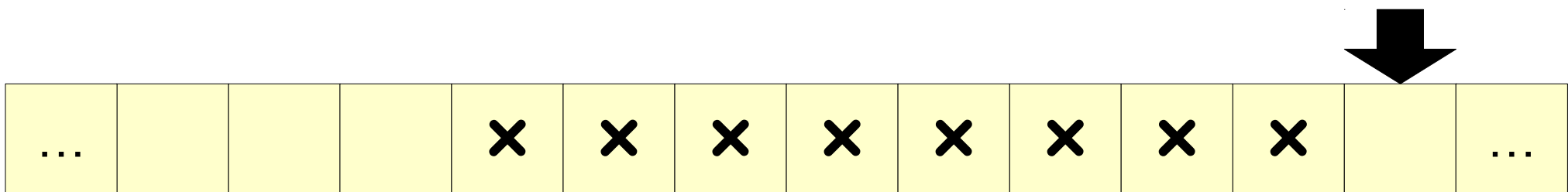
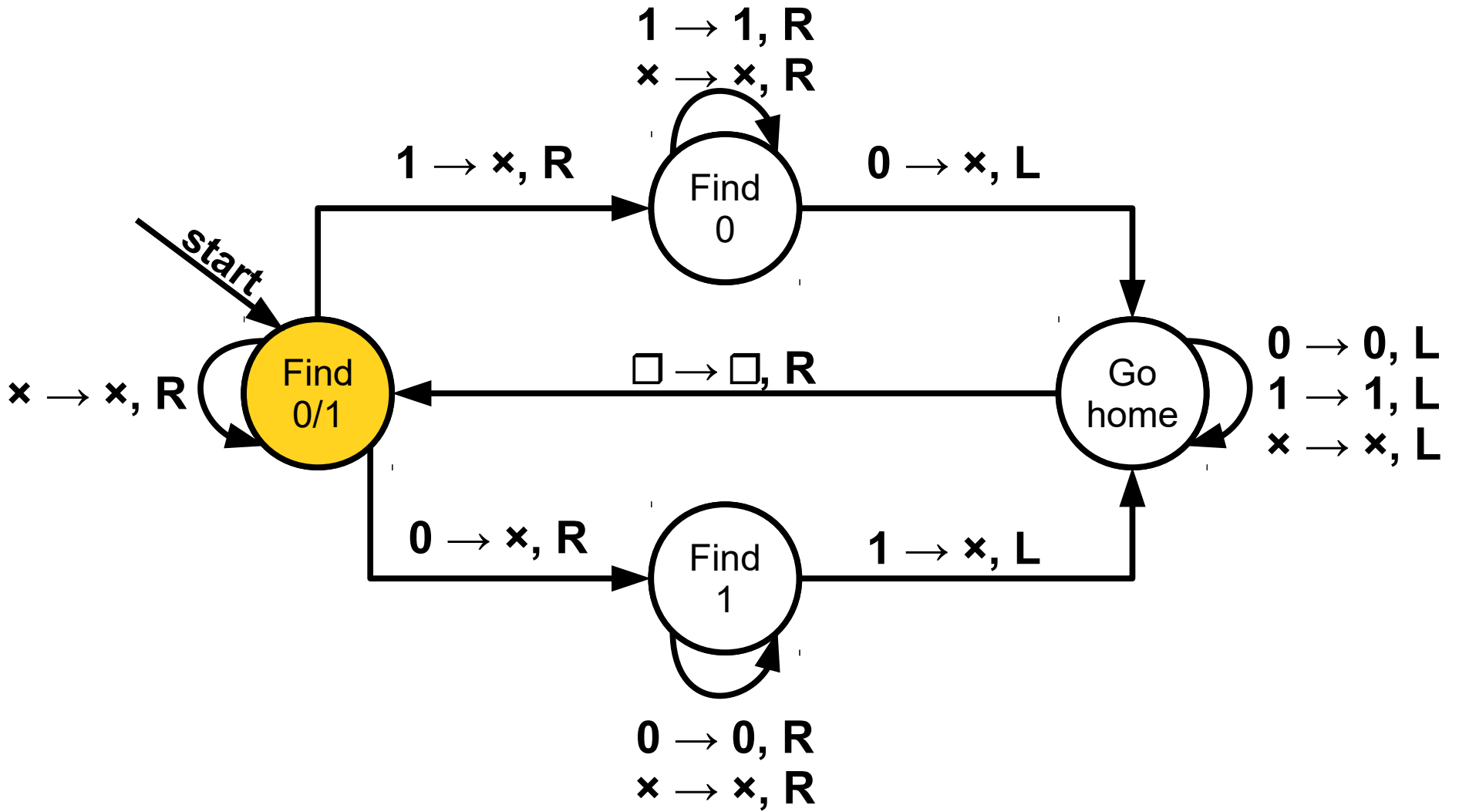


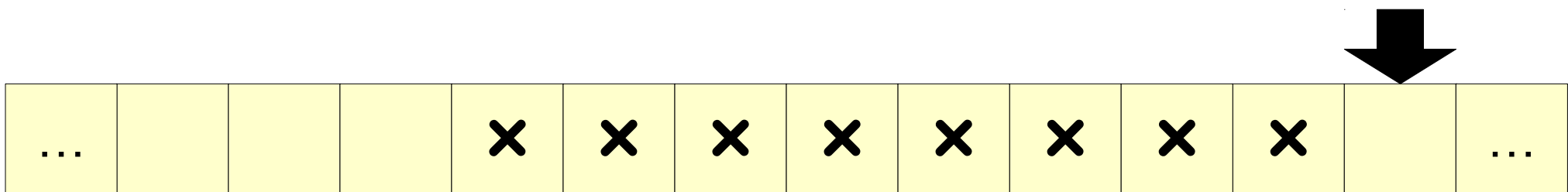
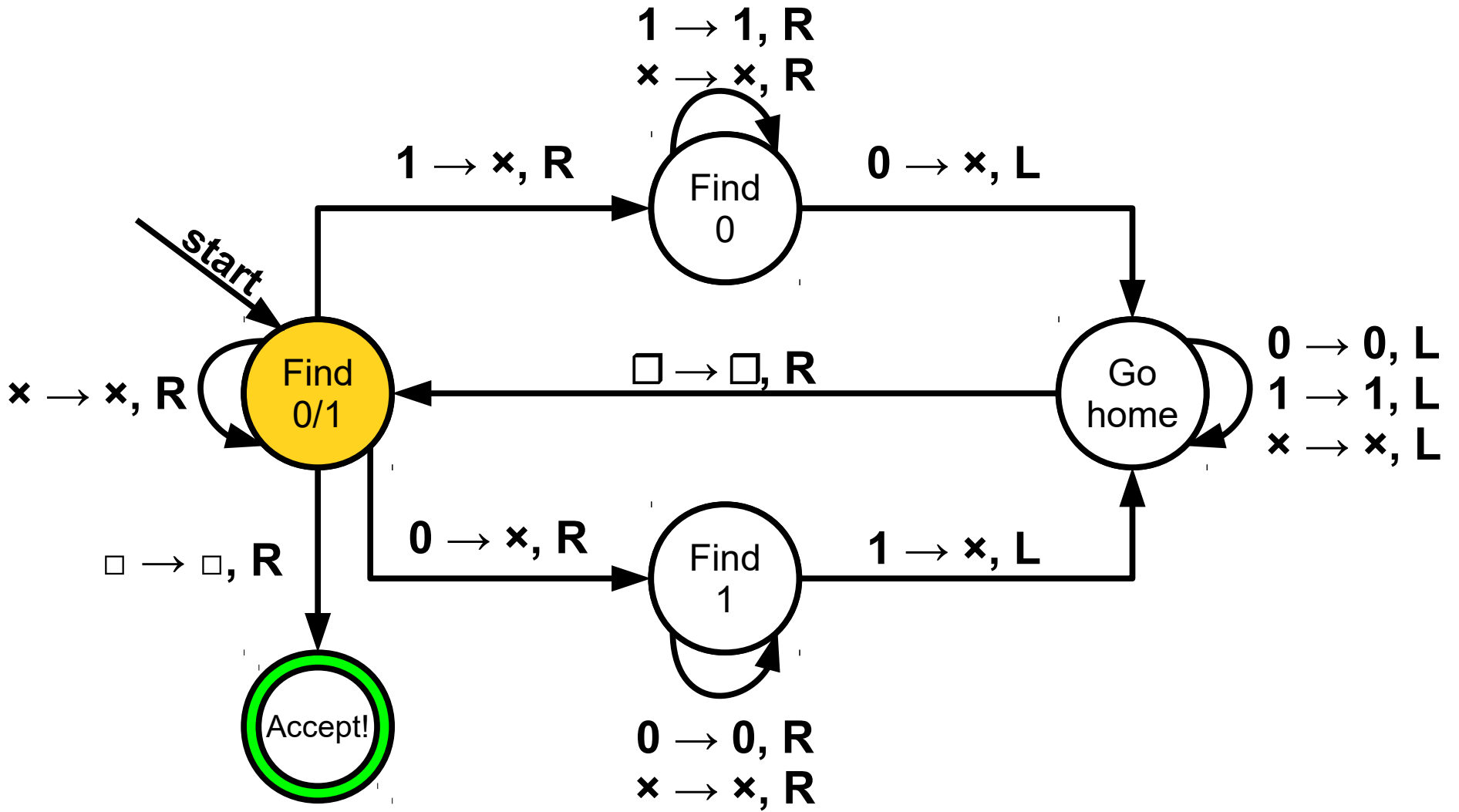


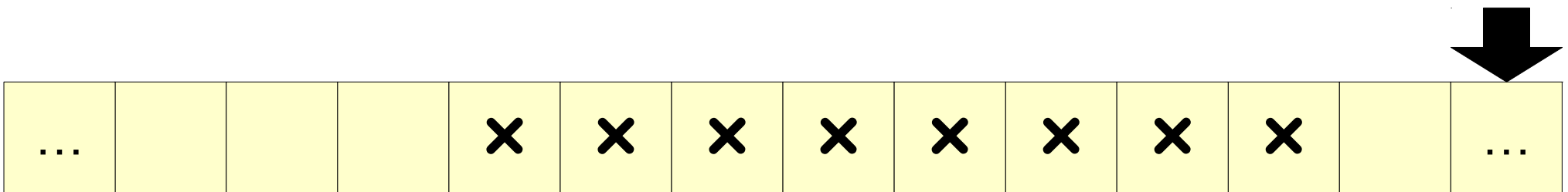
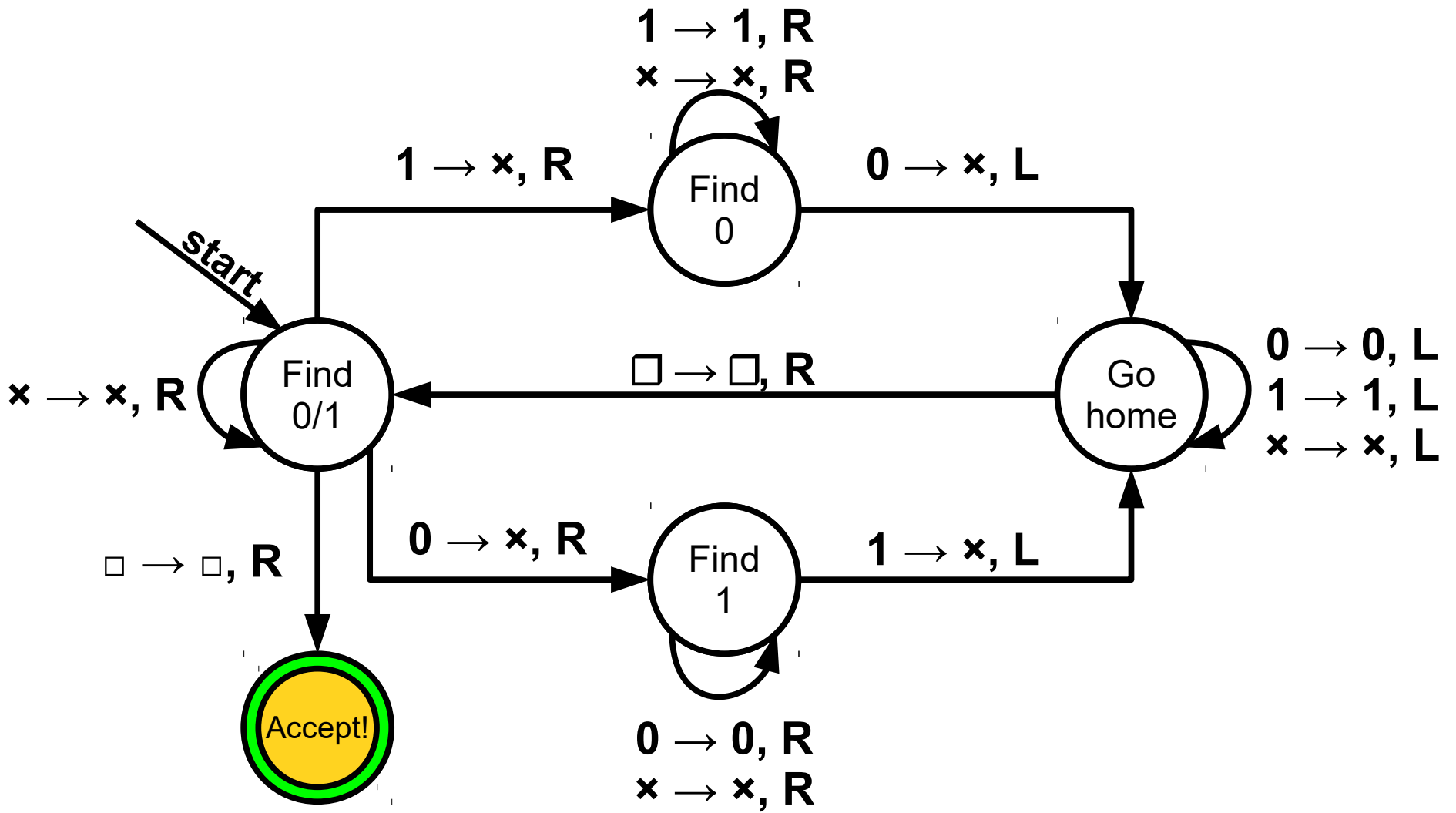


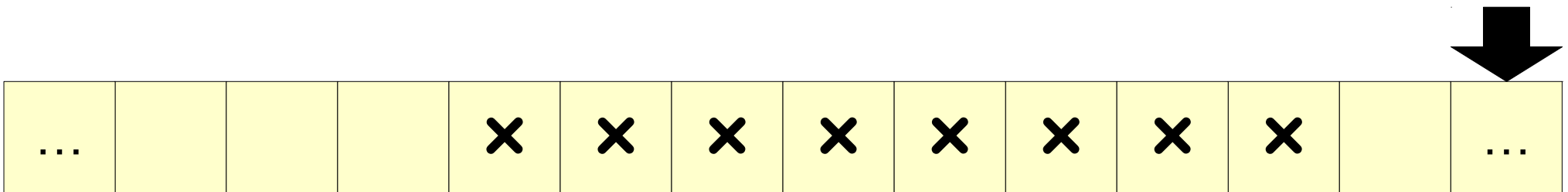
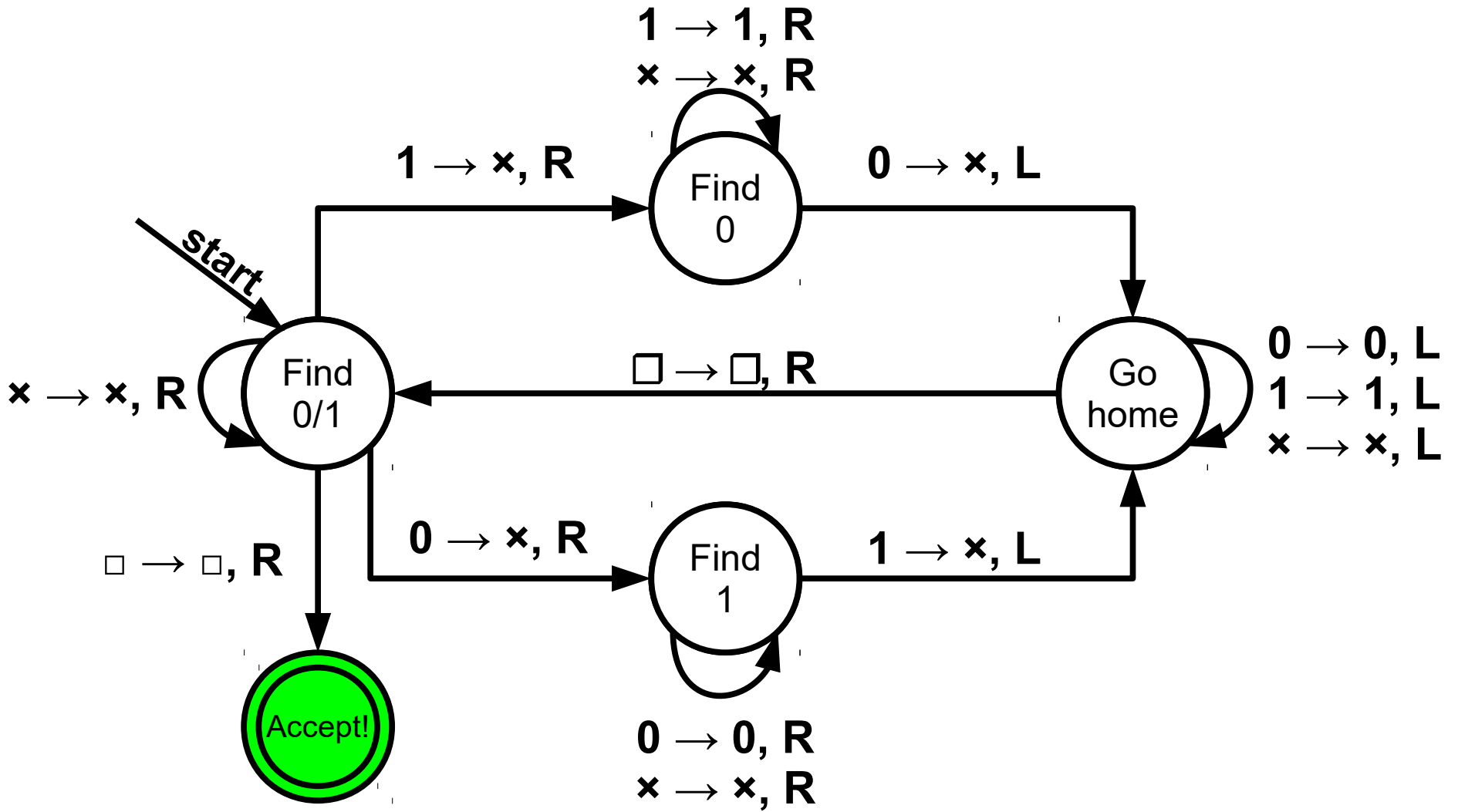


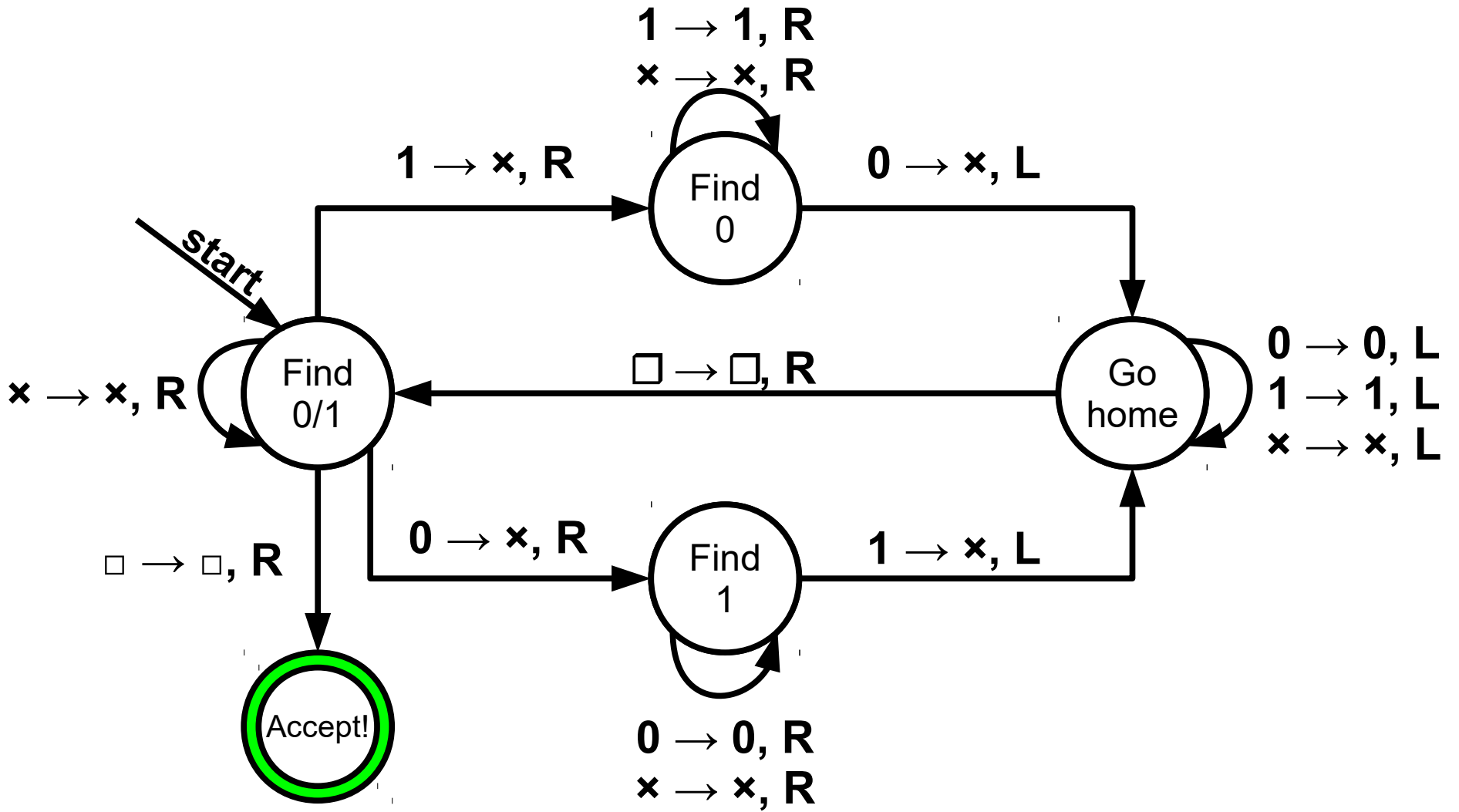


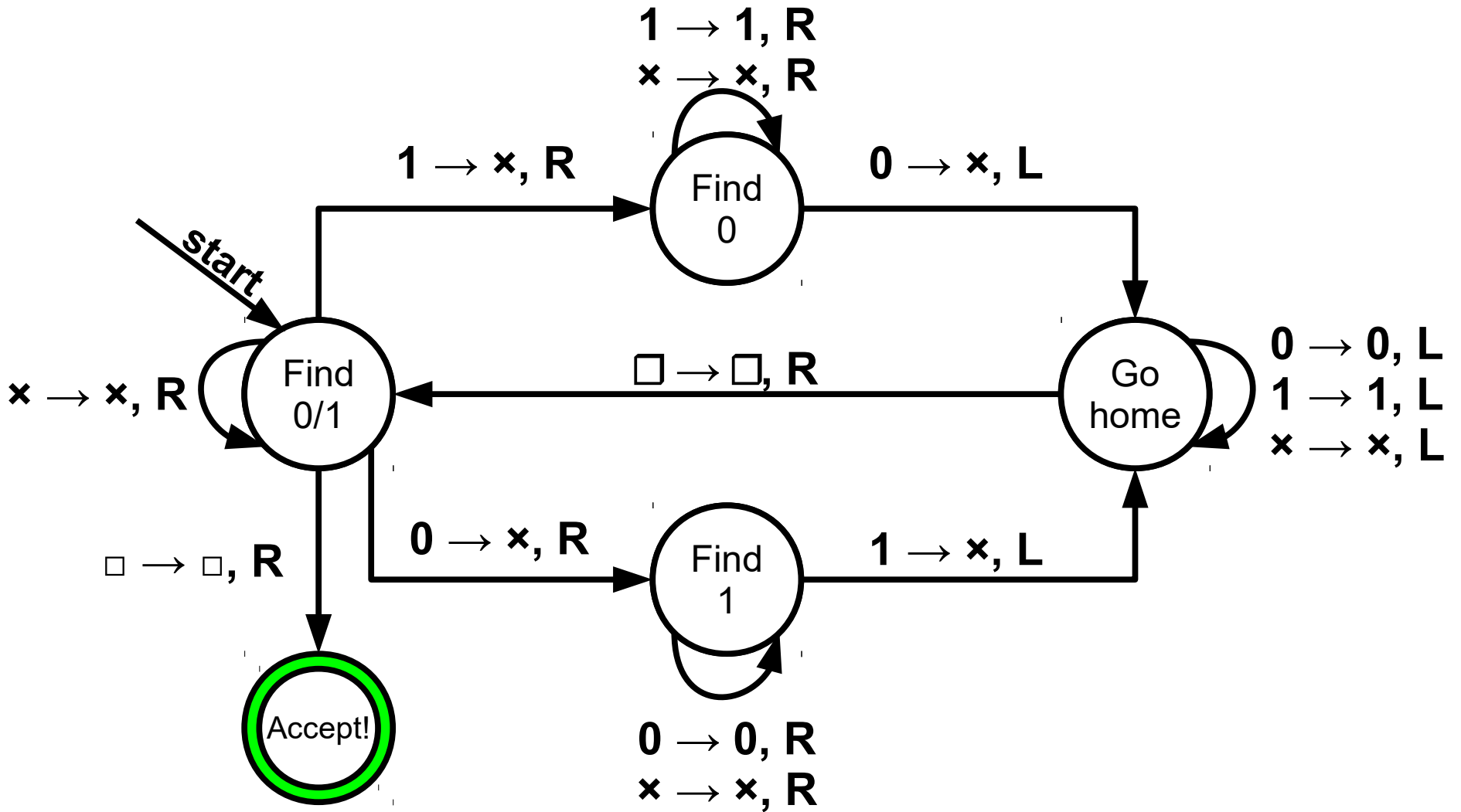




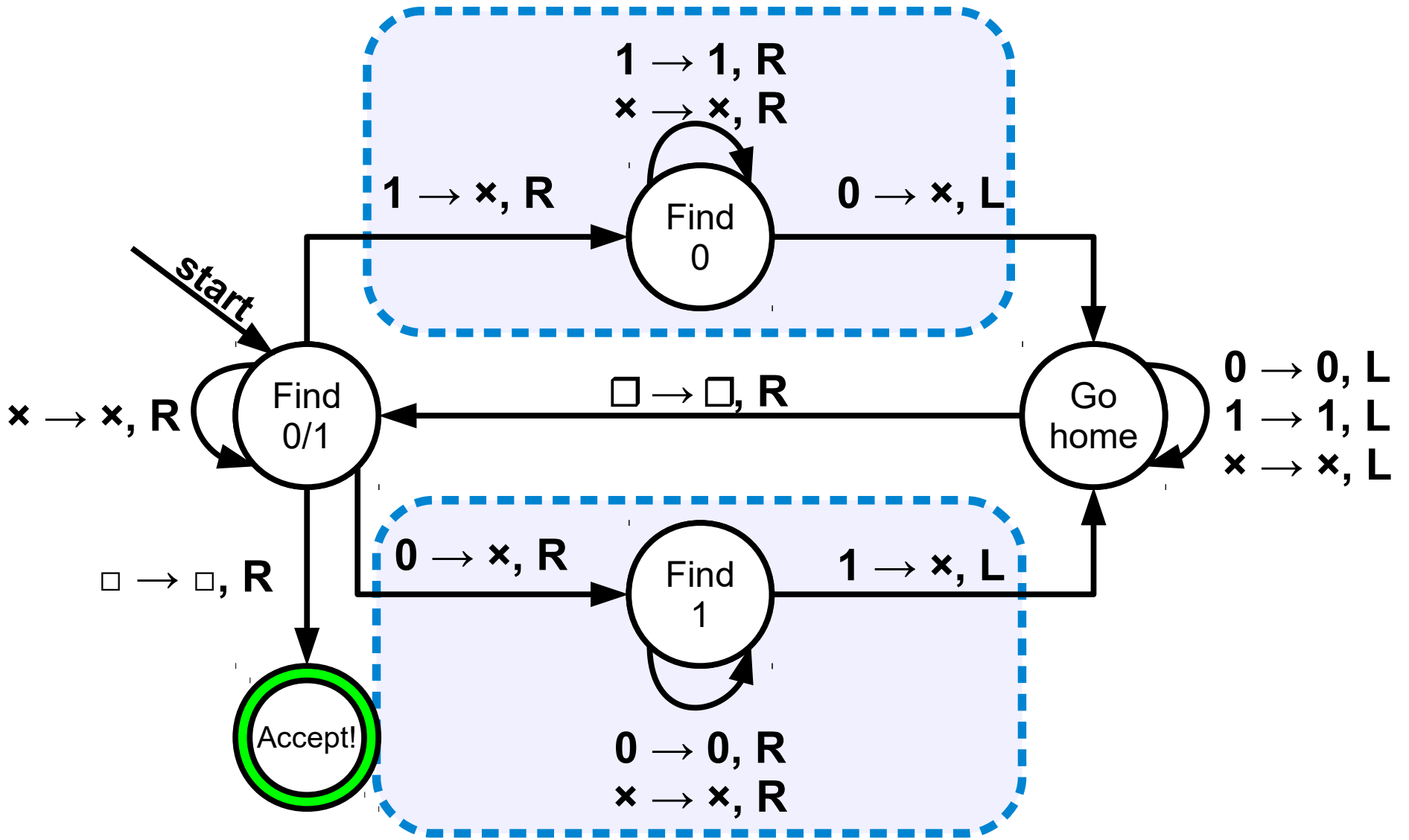








Remember that all missing transitions implicitly reject.



Constant Storage

- Sometimes, a TM needs to remember some additional information that can't be put on the tape.
- In this case, you can use similar techniques from DFAs and introduce extra states into the TM's finite-state control.
- The finite-state control can only remember one of finitely many things, but that might be all that you need!