Informed Search

CS5804 Introduction to Artificial Intelligence
Virginia Tech

function TREE-SEARCH(*problem*) **returns** a solution, or failure

initialize the frontier using the initial state of *problem*

loop do:

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choose a leaf node and remove it from the frontier

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expand the chosen node, adding the resulting nodes to frontier

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FIFO: Breadth-first
LIFO: Depth-first

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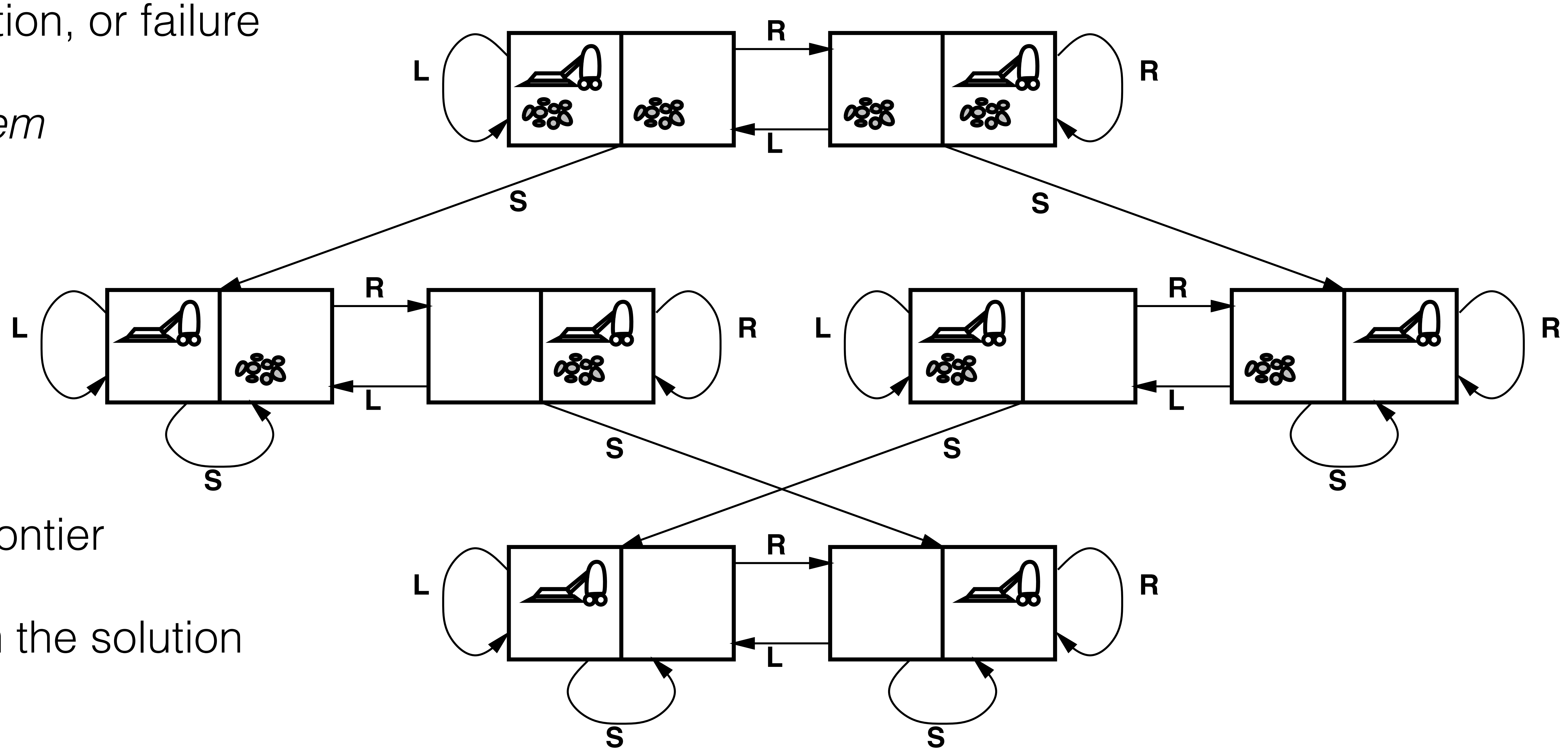

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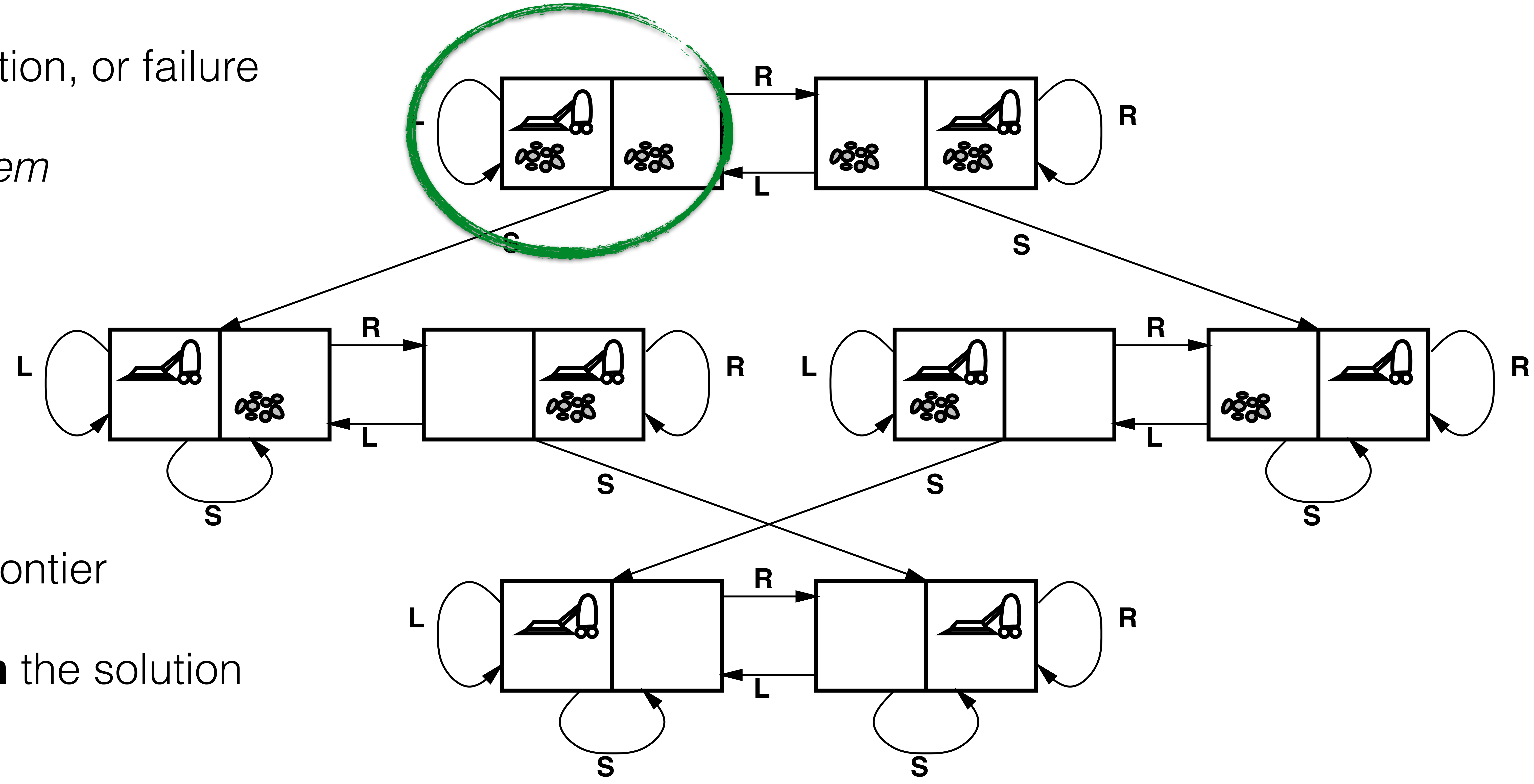

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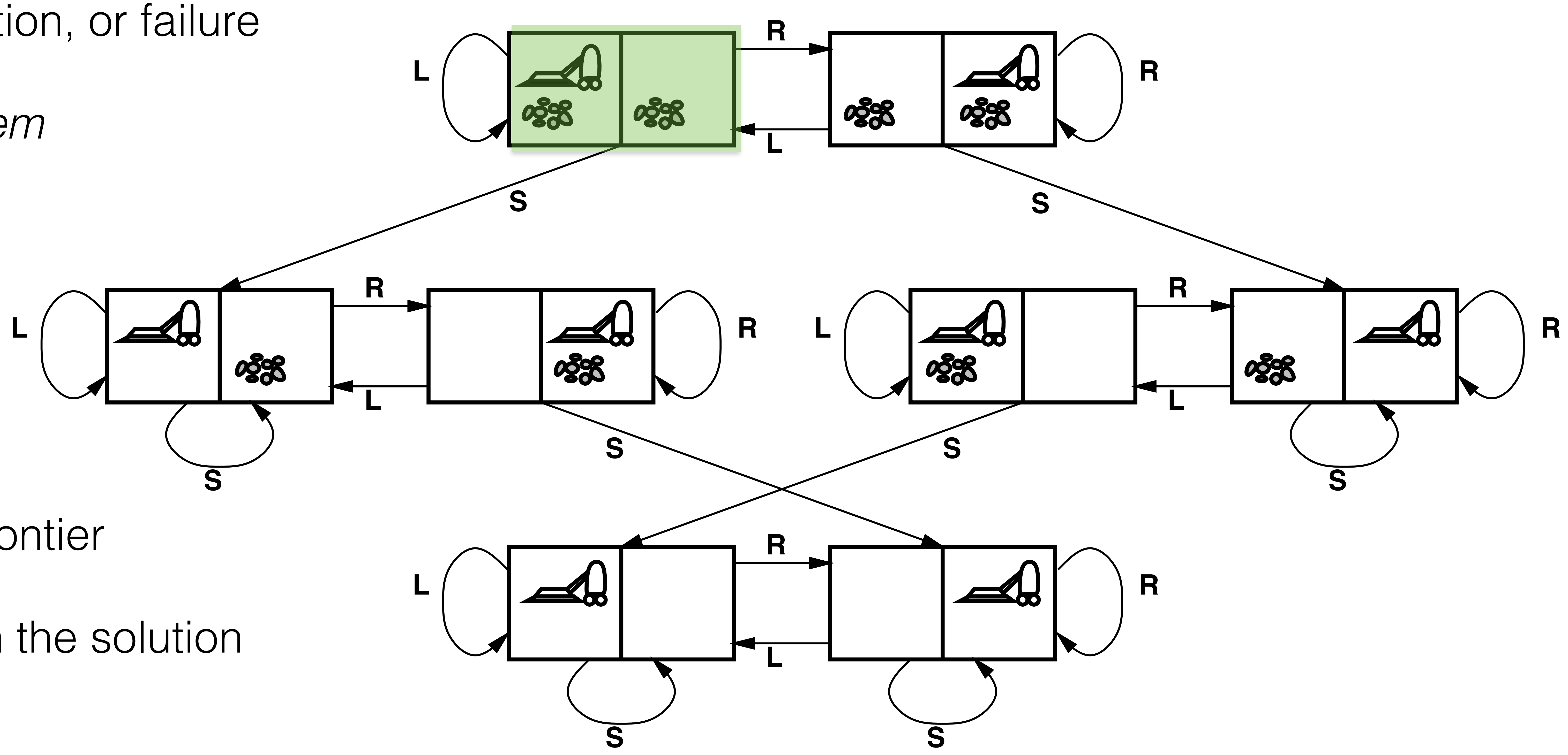

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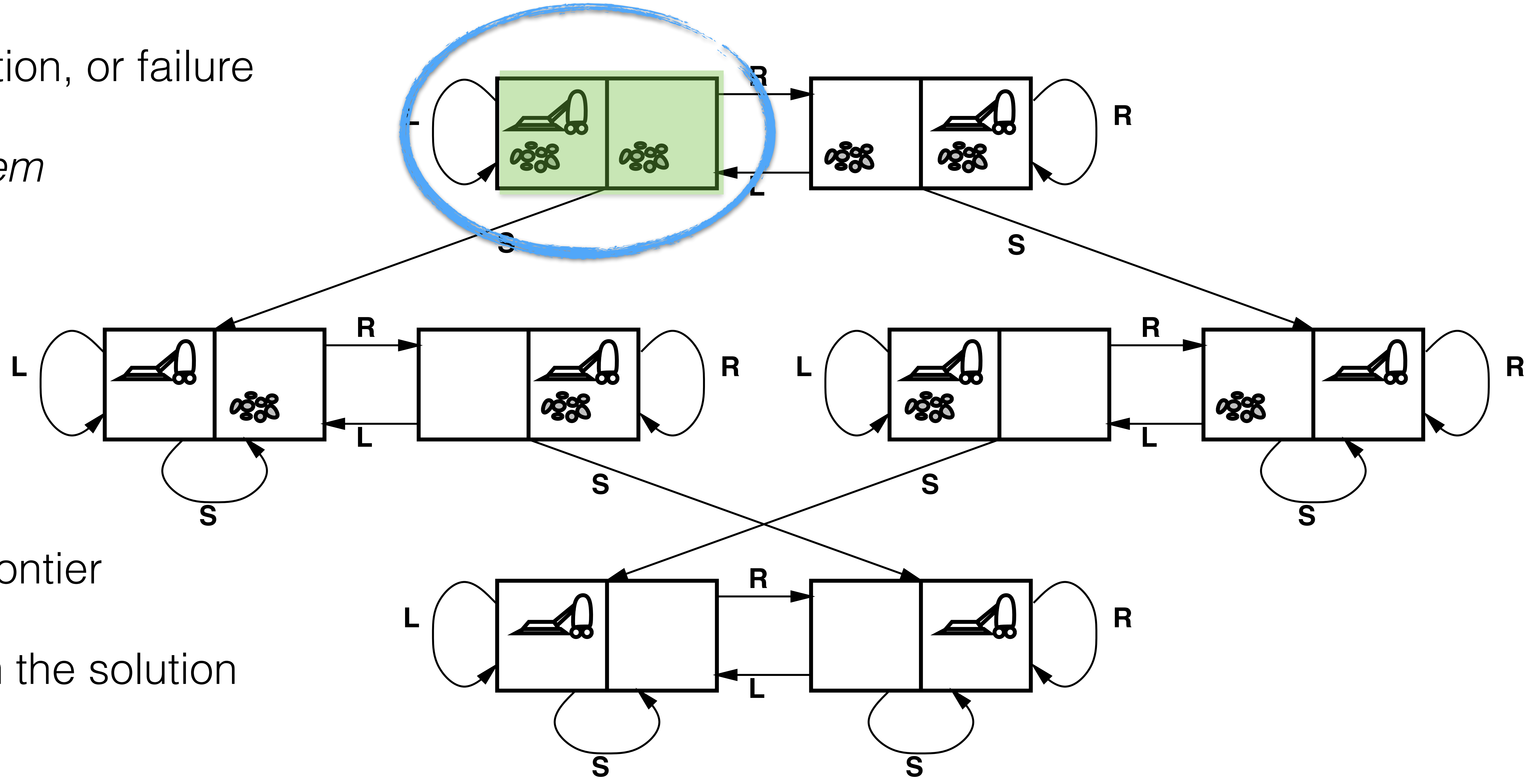

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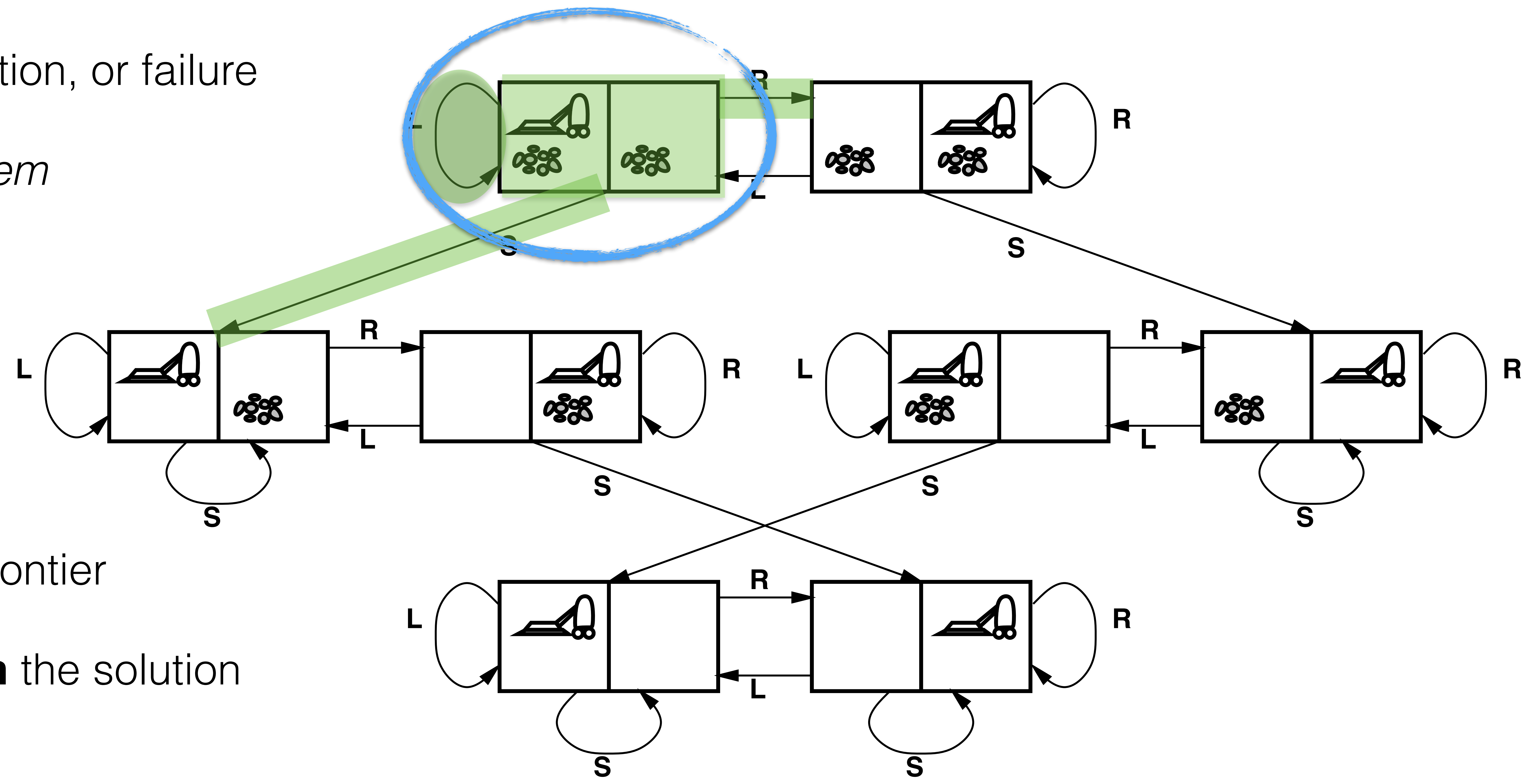

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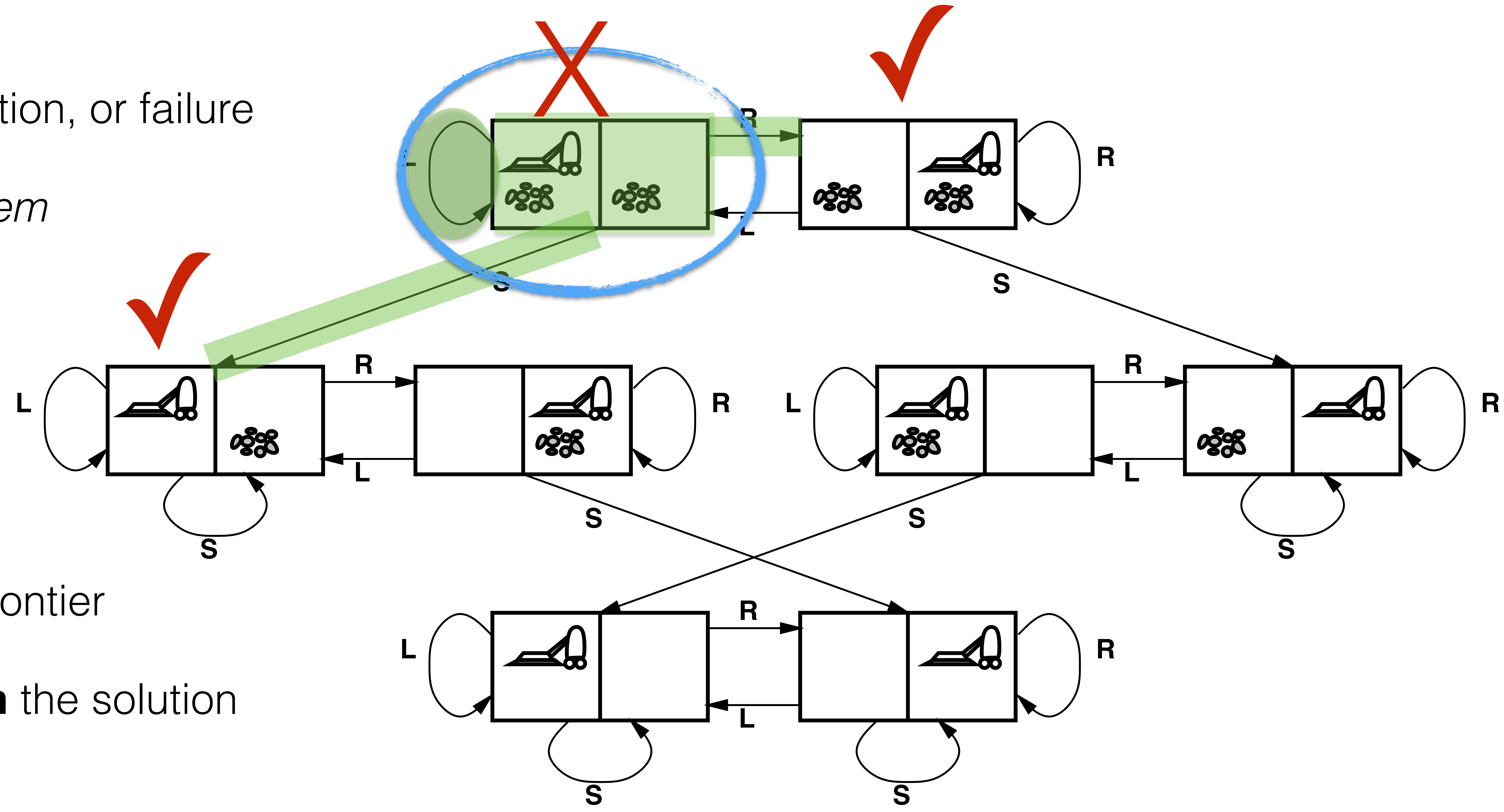

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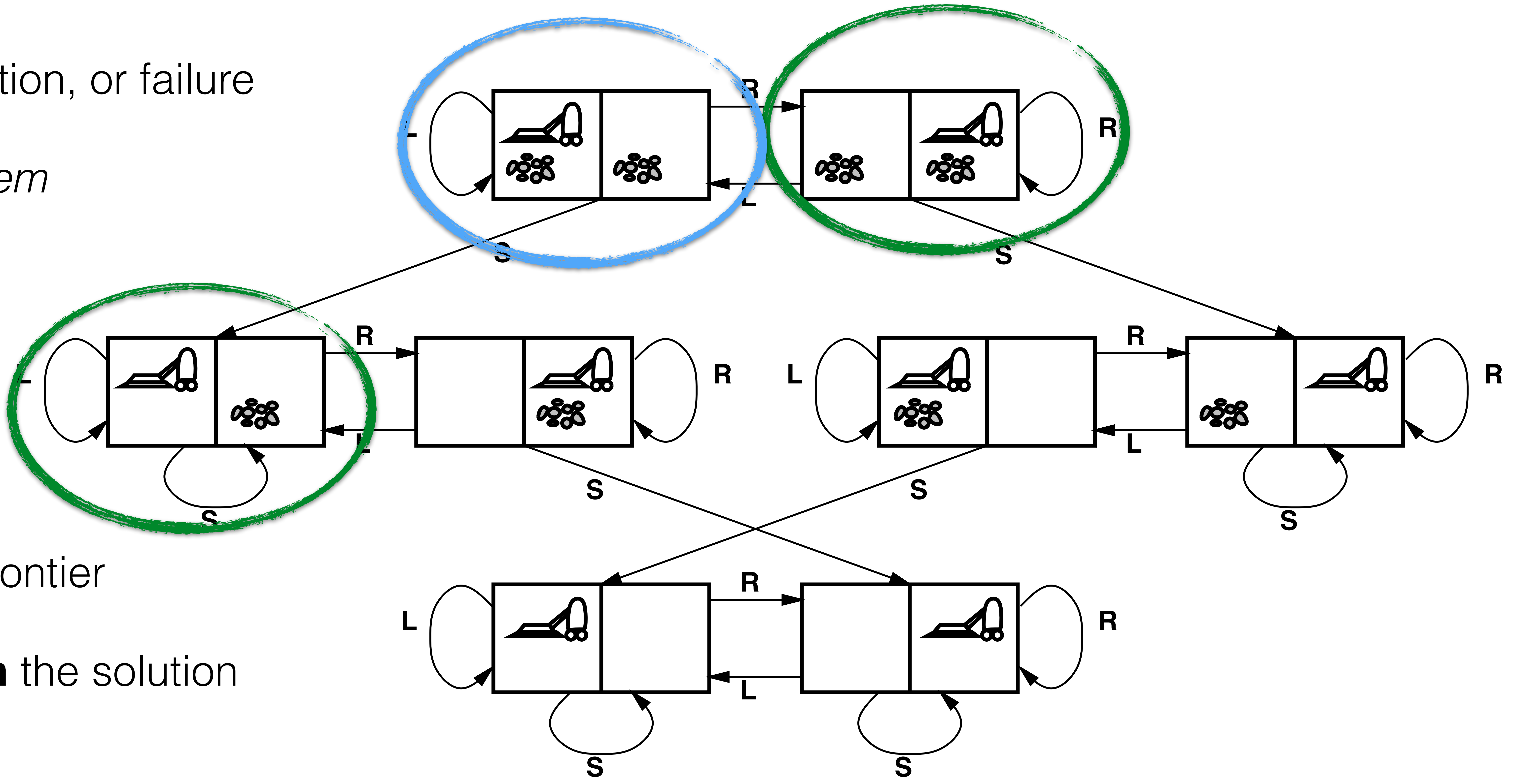

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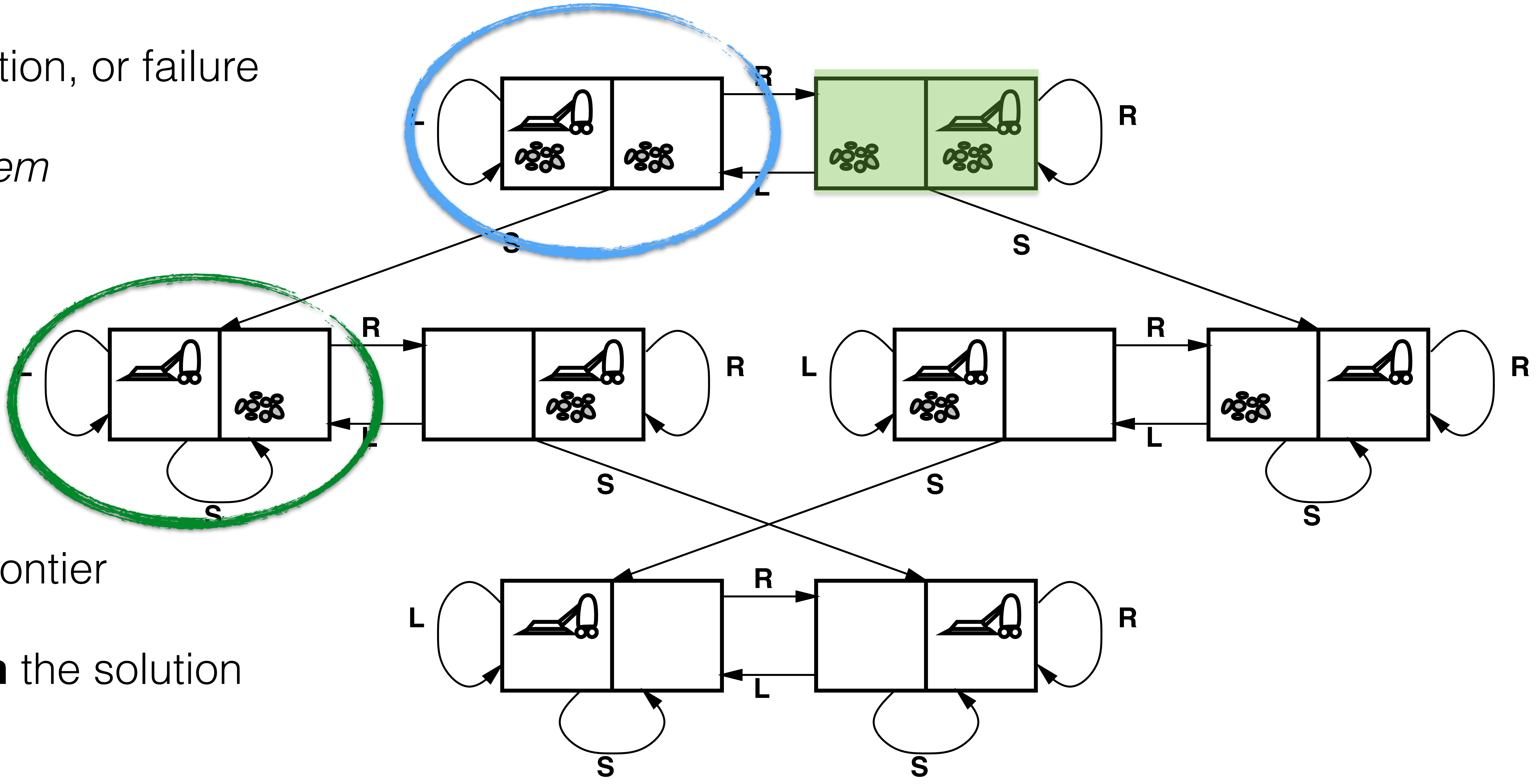

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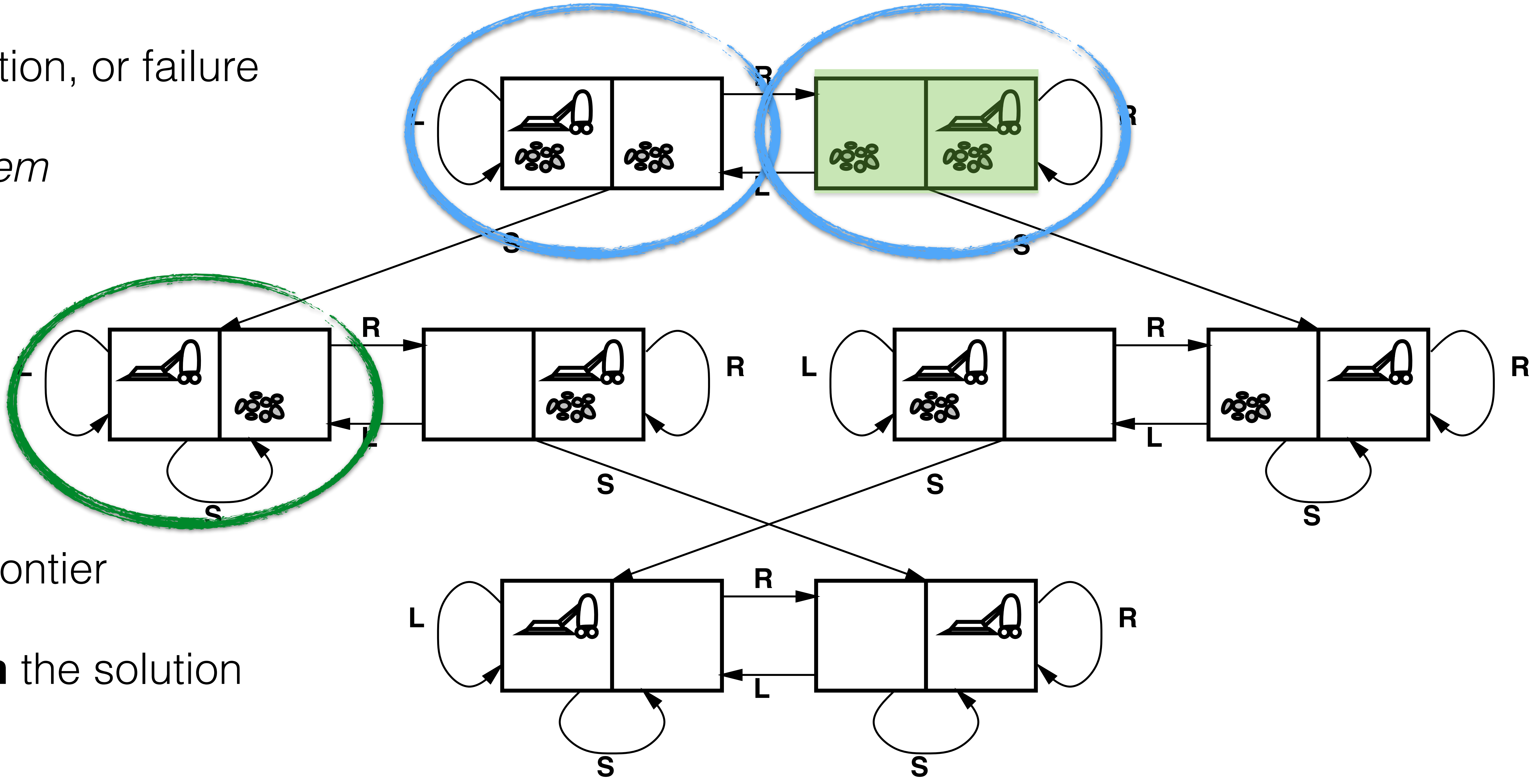

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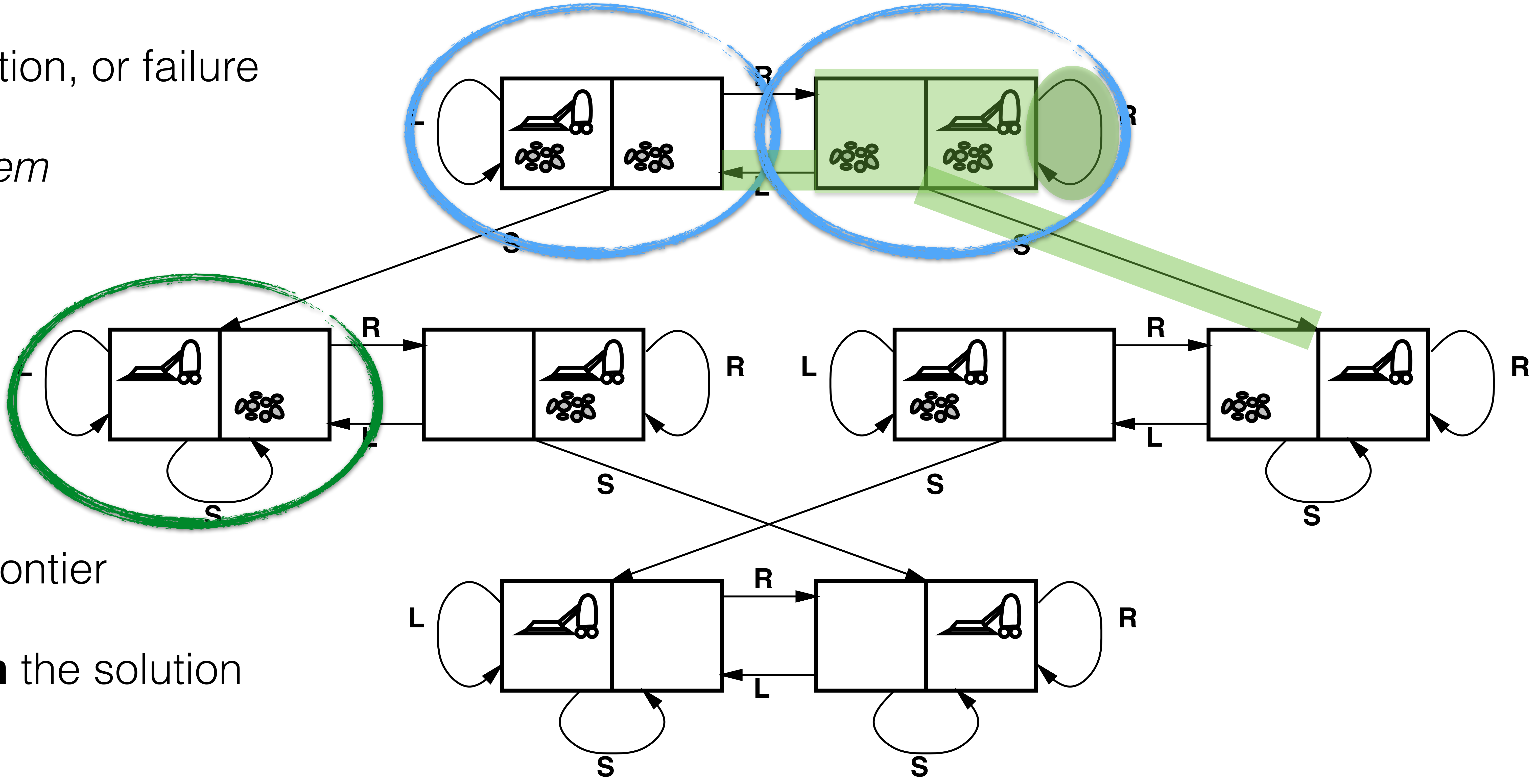

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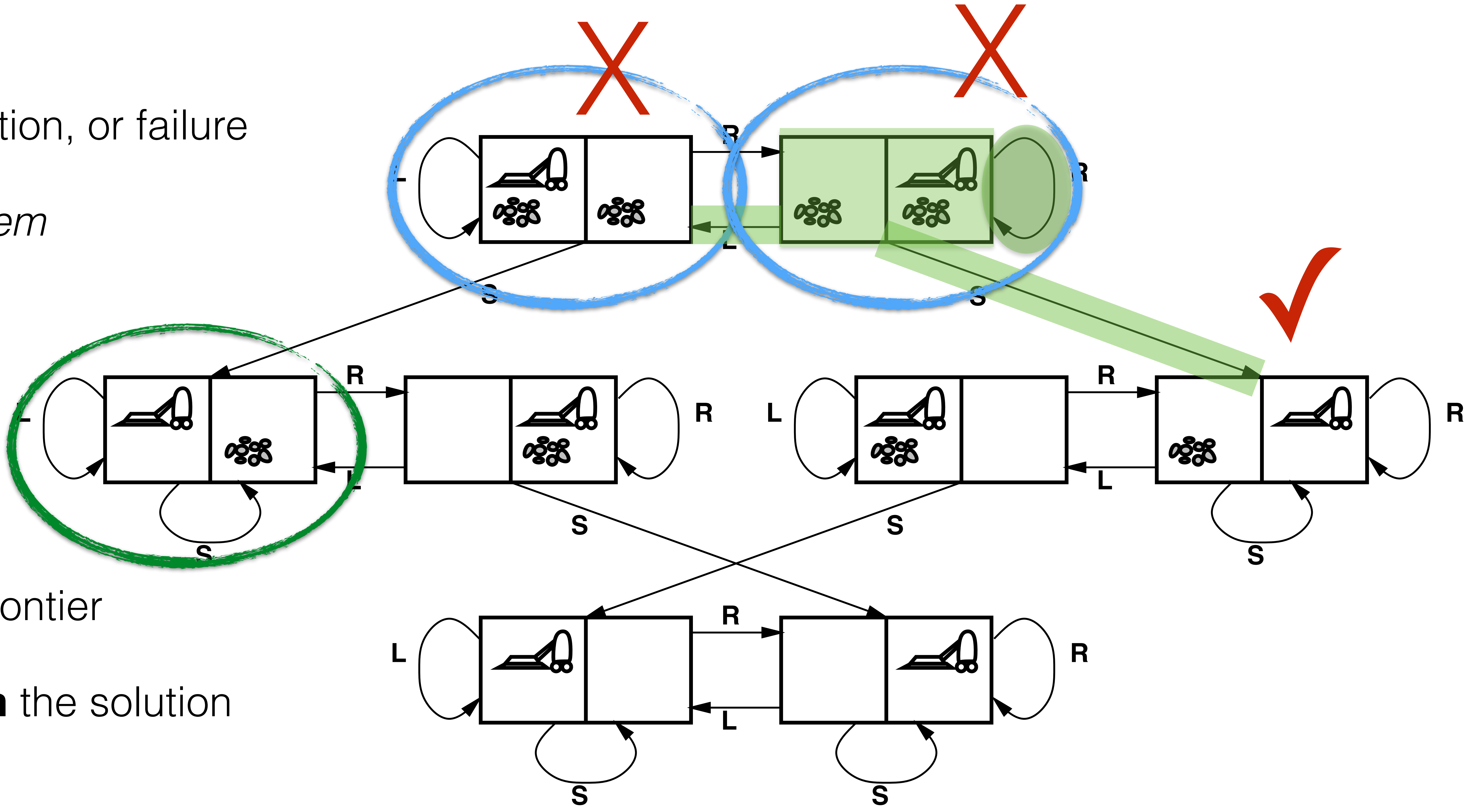

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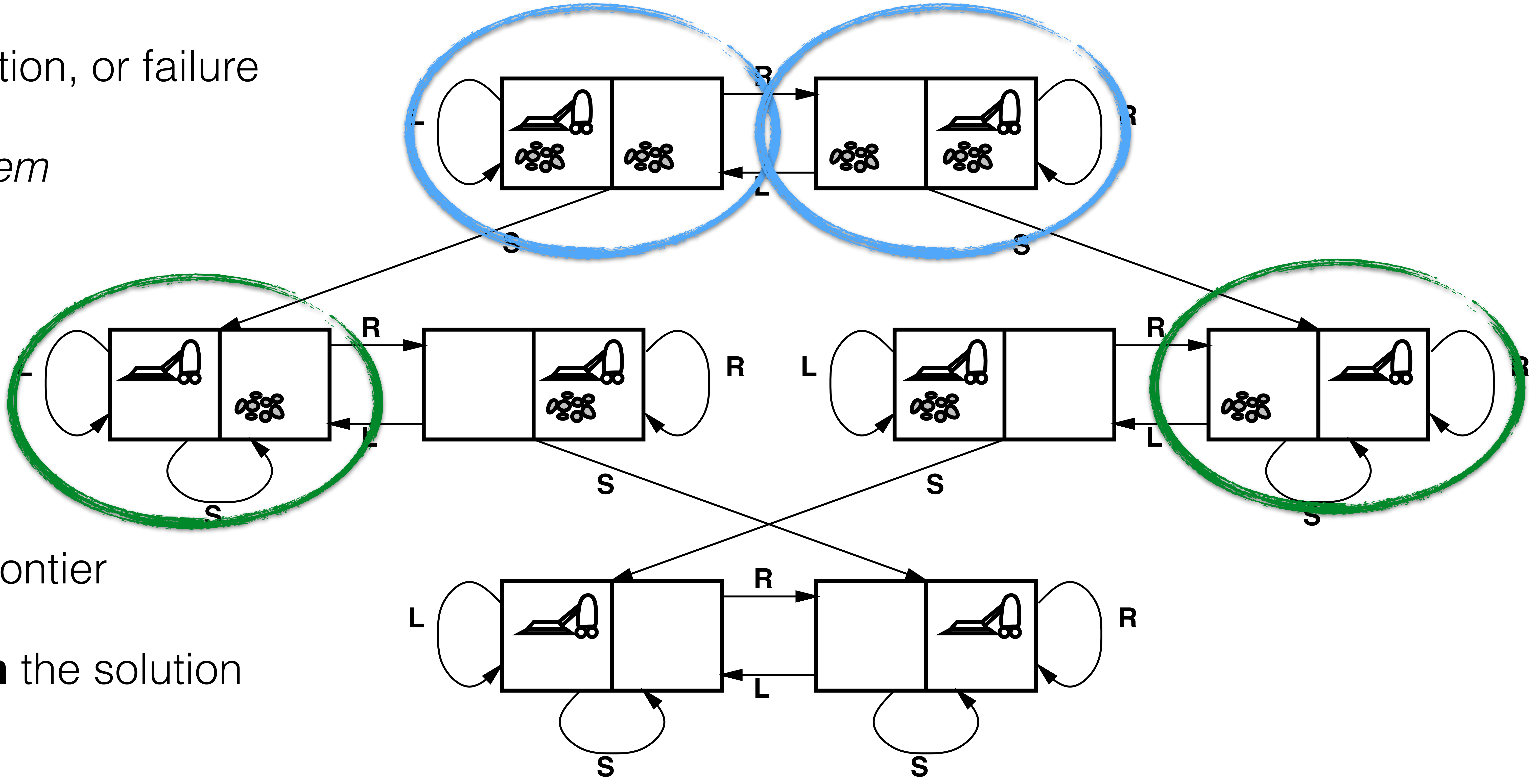

Search Algorithm Properties

- Completeness
- Optimality
- Time complexity
- Space complexity

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- Optimality: uniform cost
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- Space complexity: BFS O(b^d), DFS O(bm), iterative deep. O(bm)

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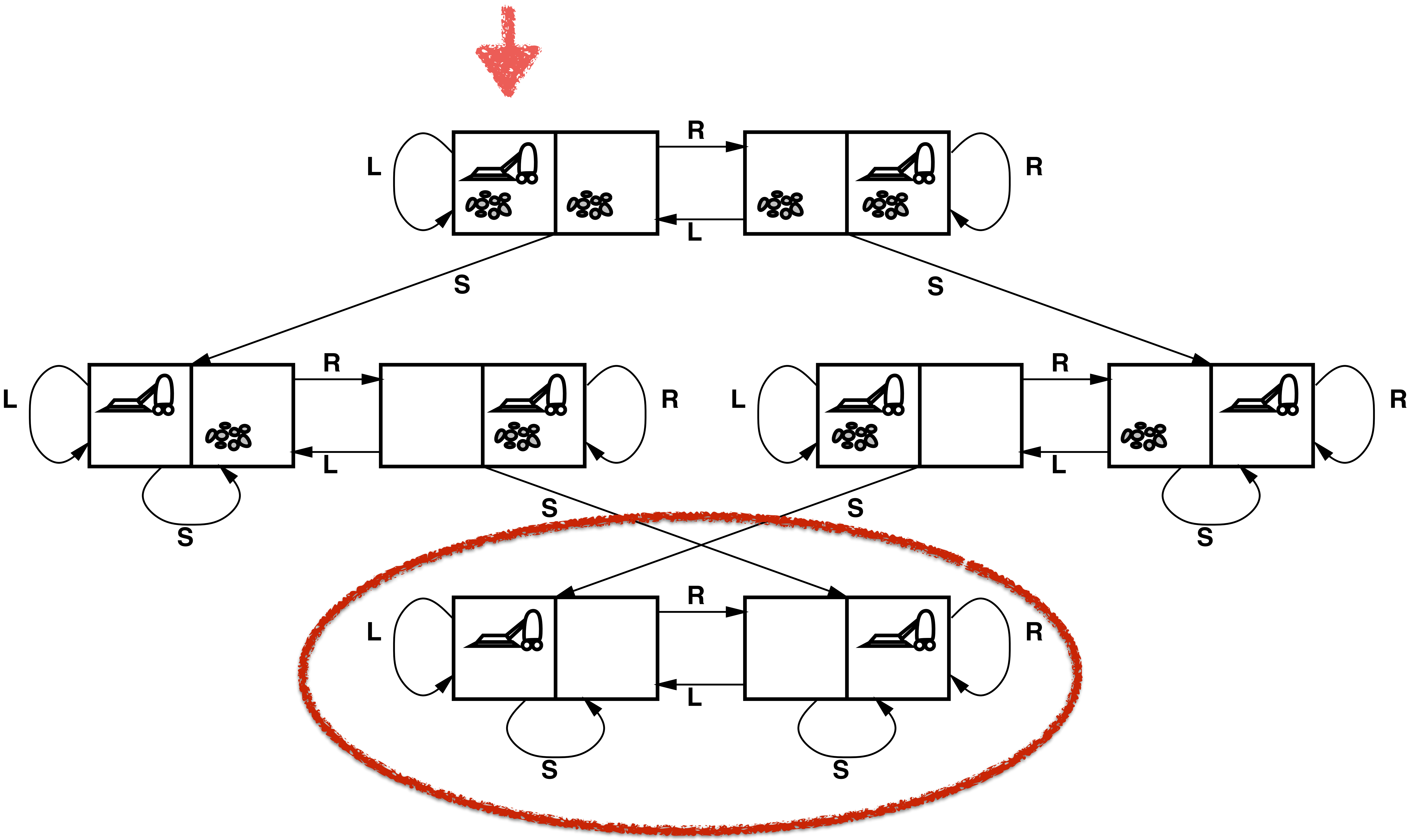
tree vs graph search?

Search Algorithms

- Breadth-first family
    - Breadth-first search
    - Uniform-cost search

- Depth-first family
    - Depth-first search
    - Depth-limited search
    - Iterative-deepening search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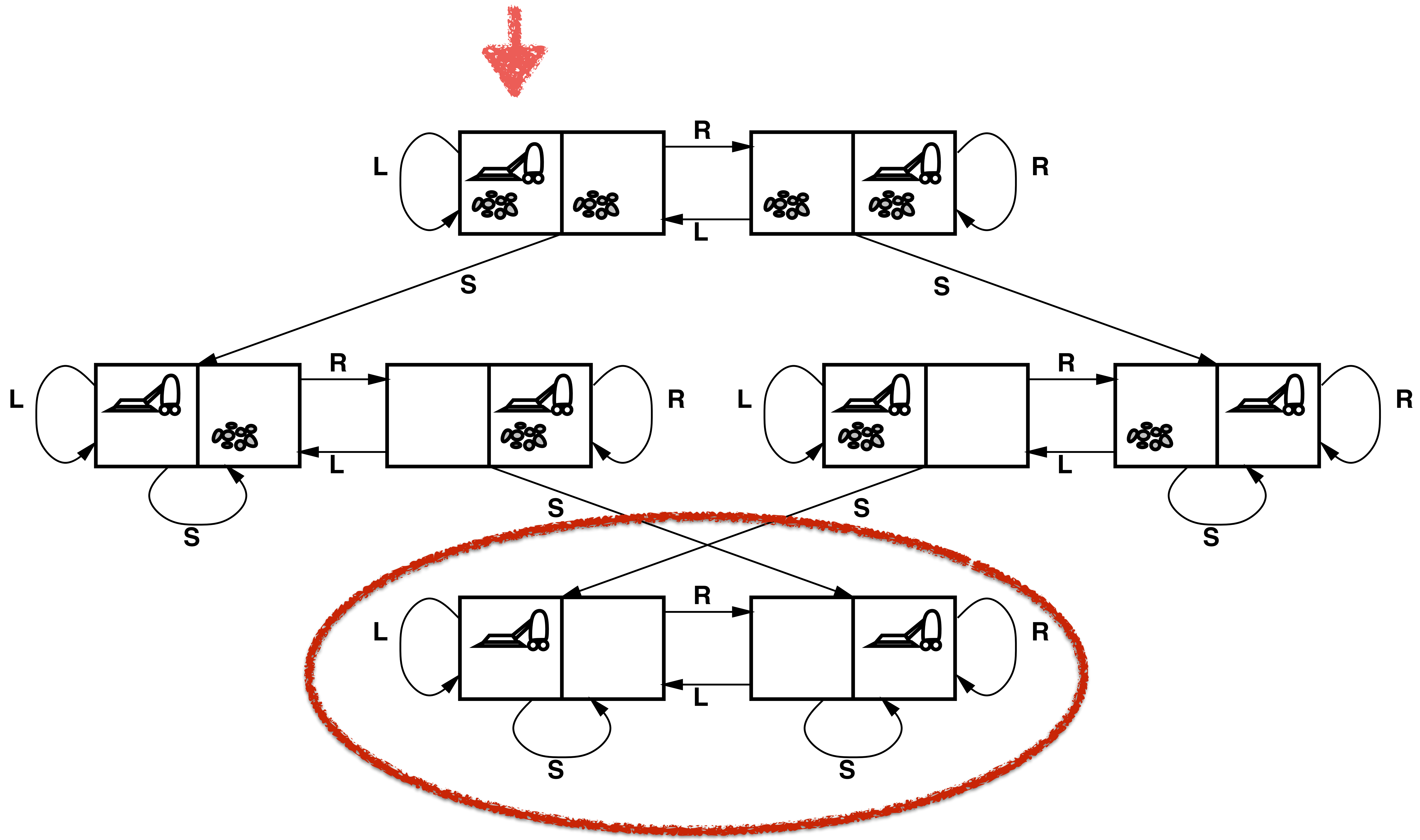

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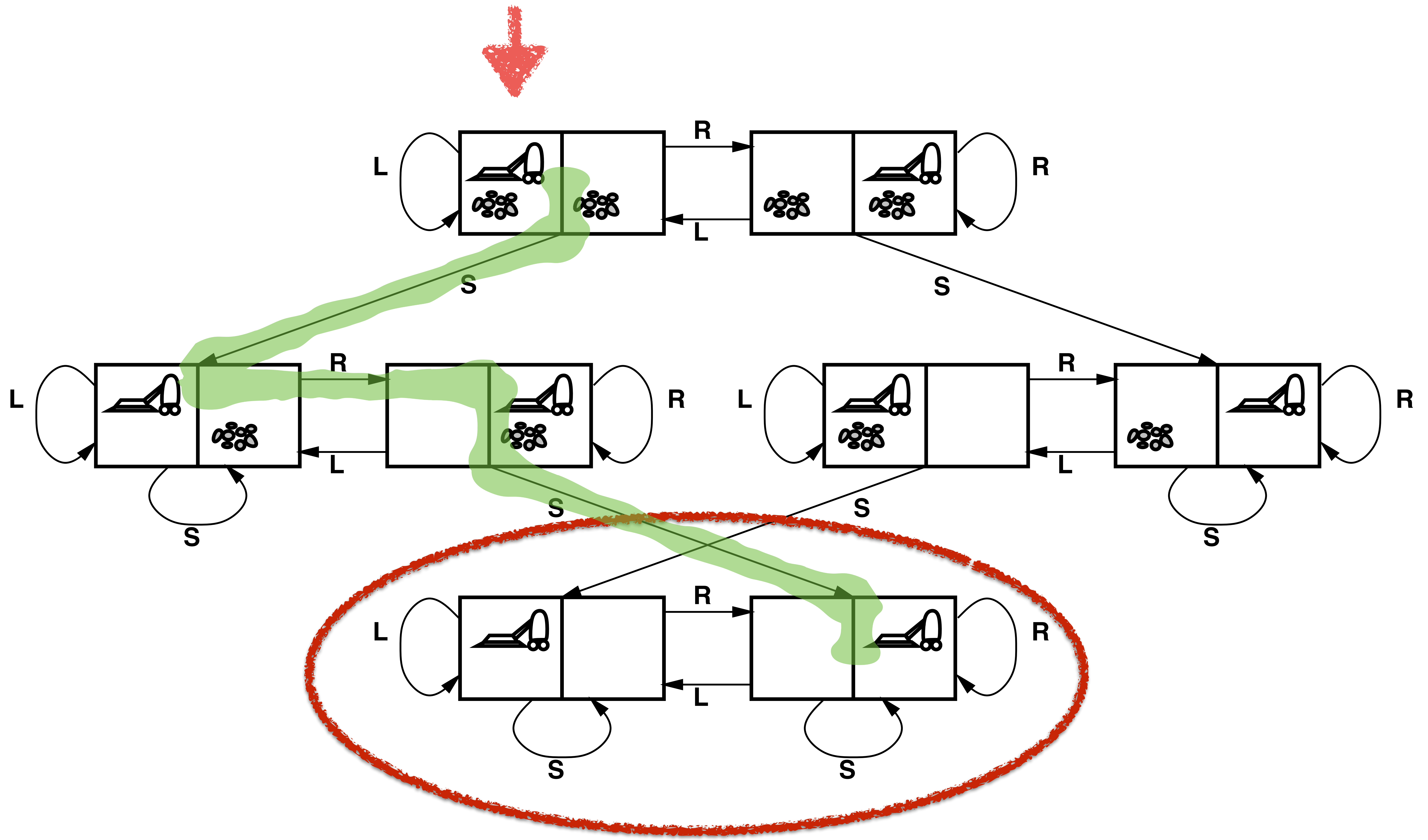
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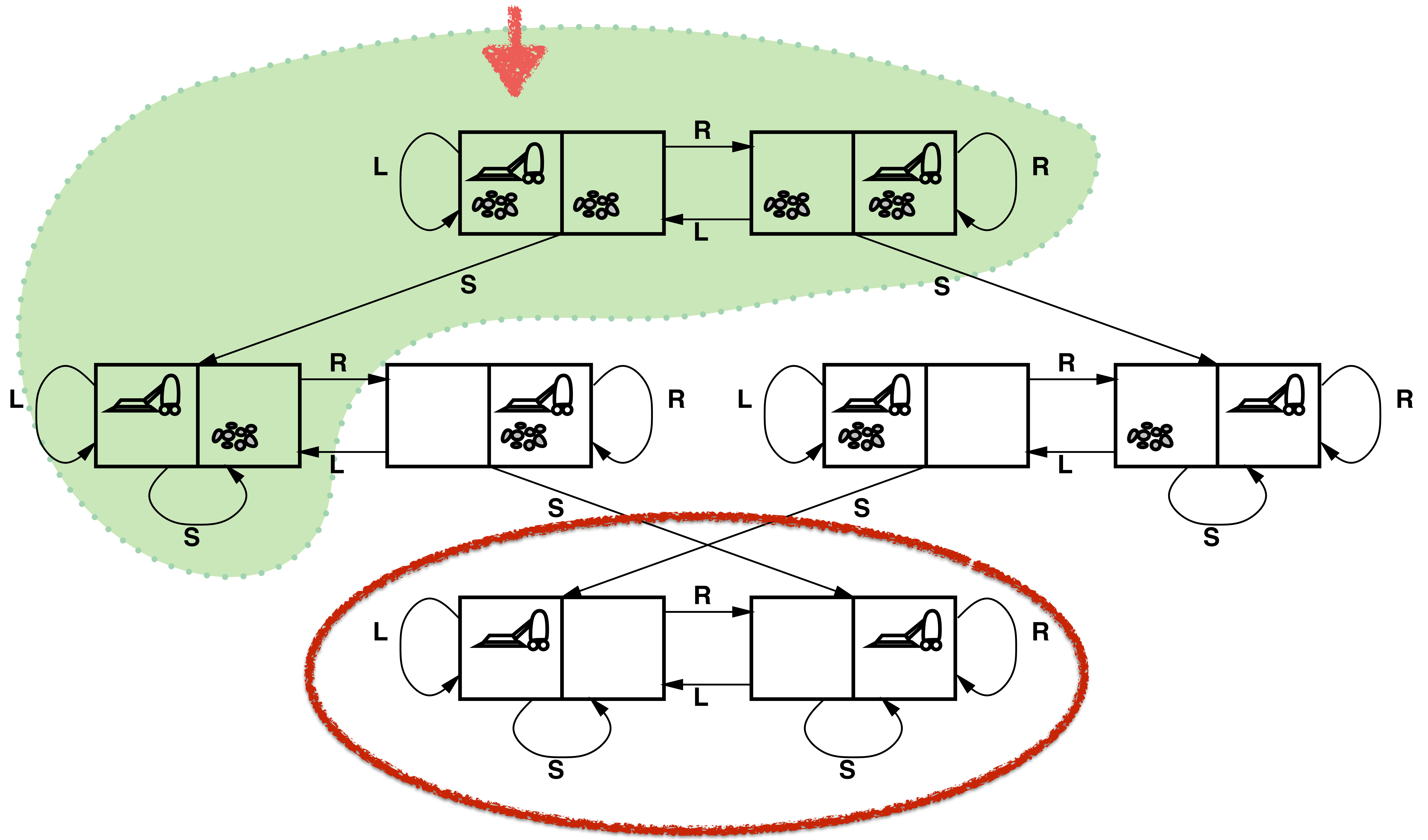

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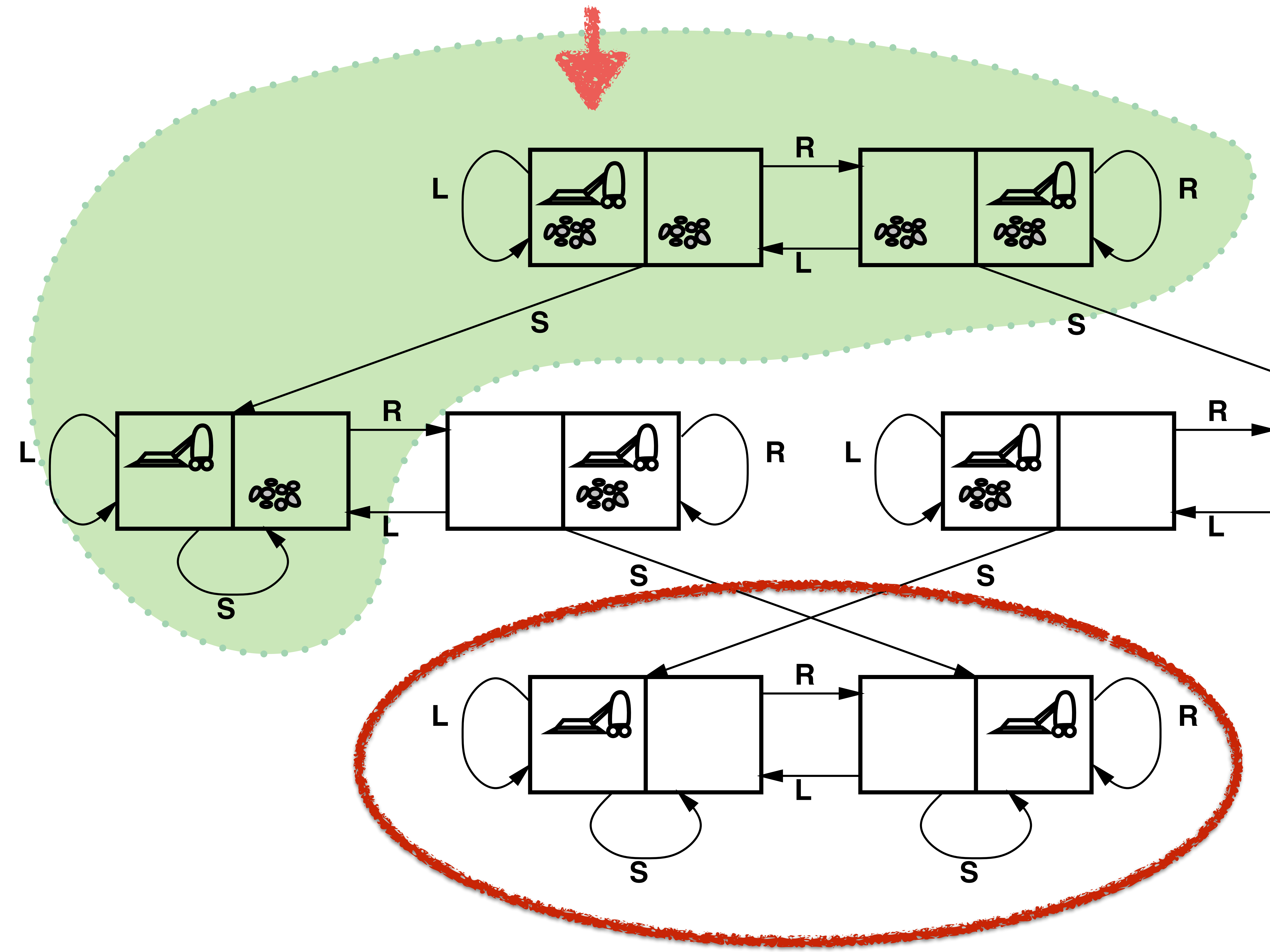
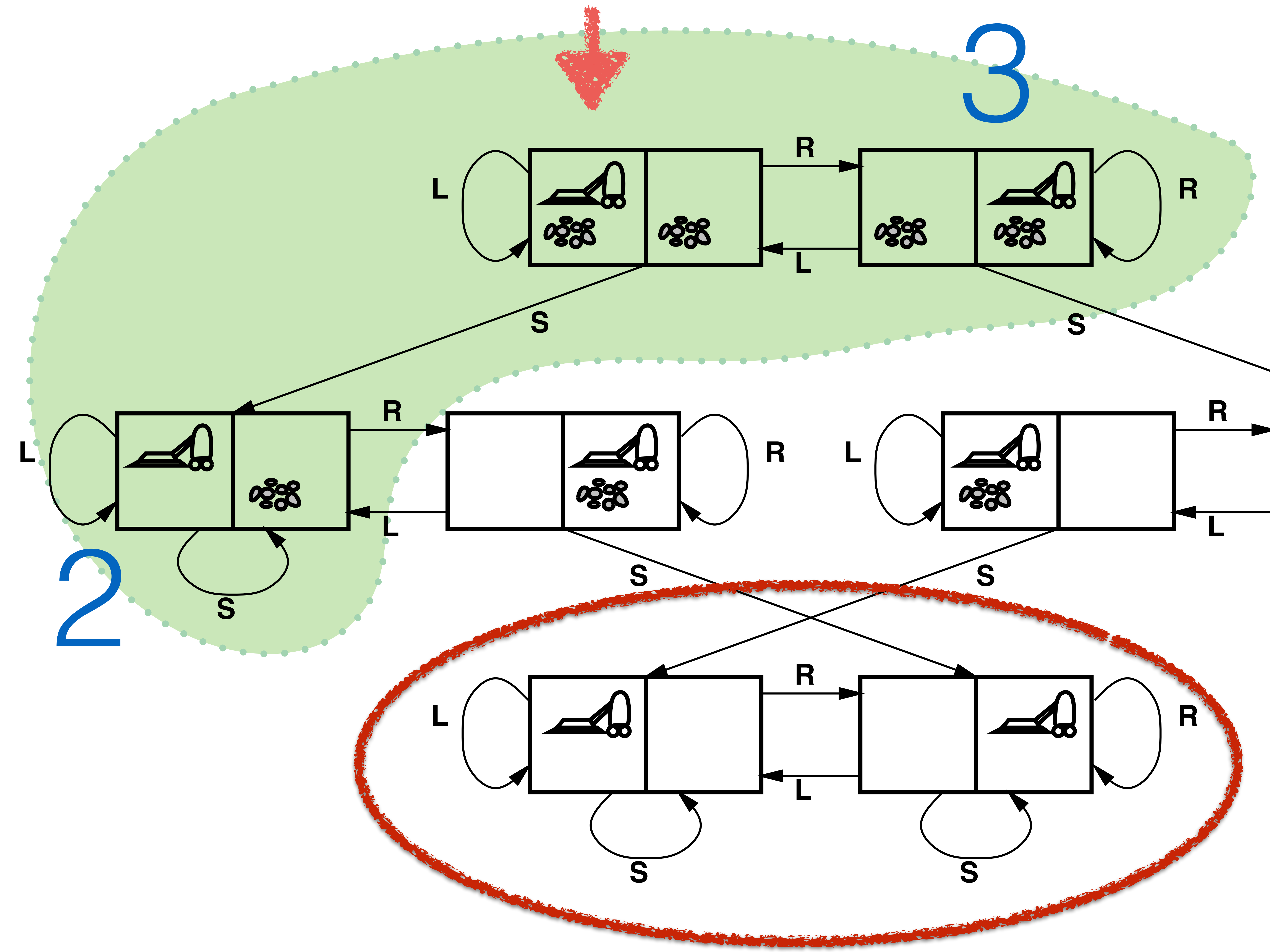
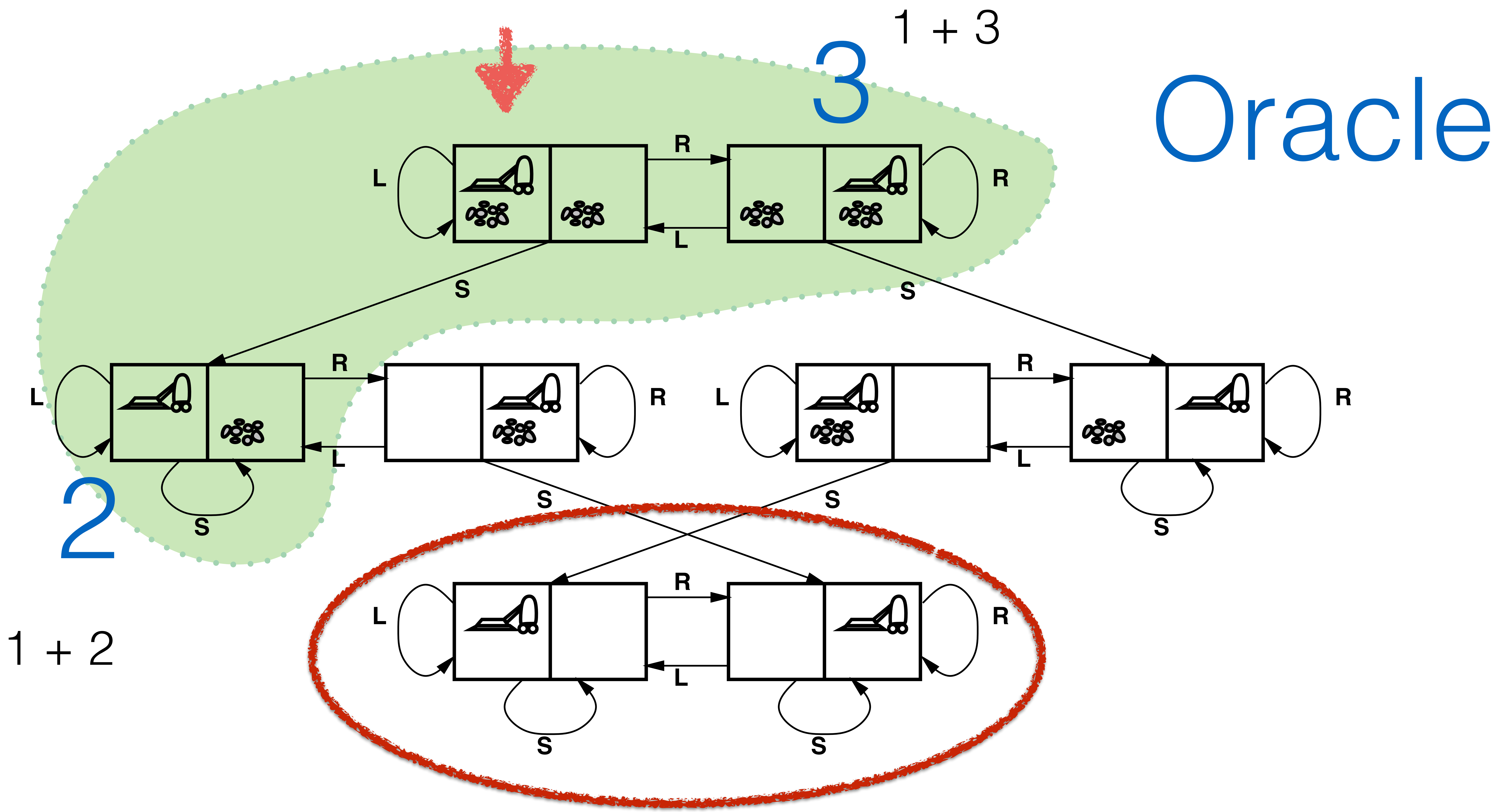
Oracle





Oracle



1 + 3
3
Oracle
L
R
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L
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2
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S
1 + 2
L
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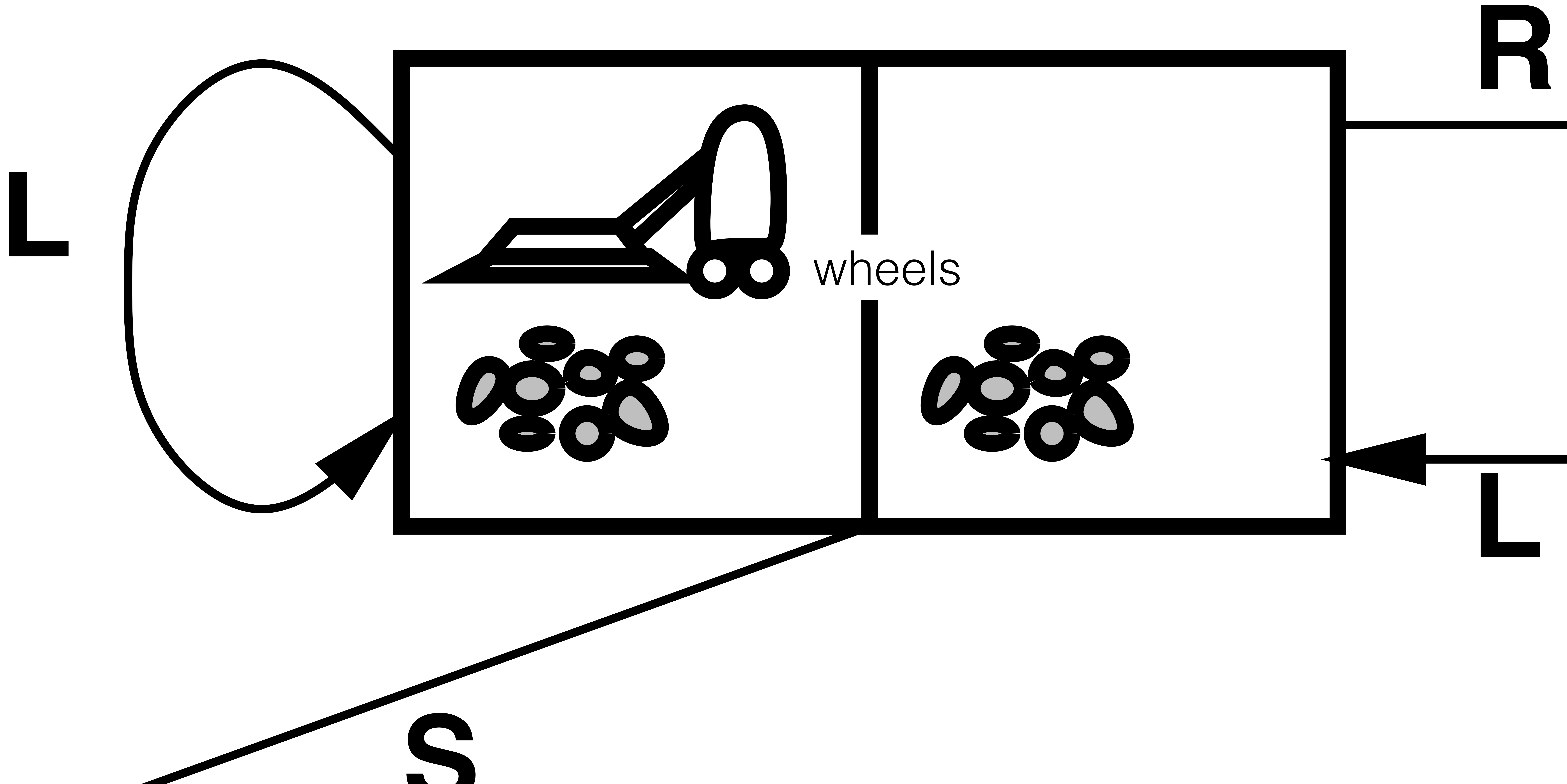
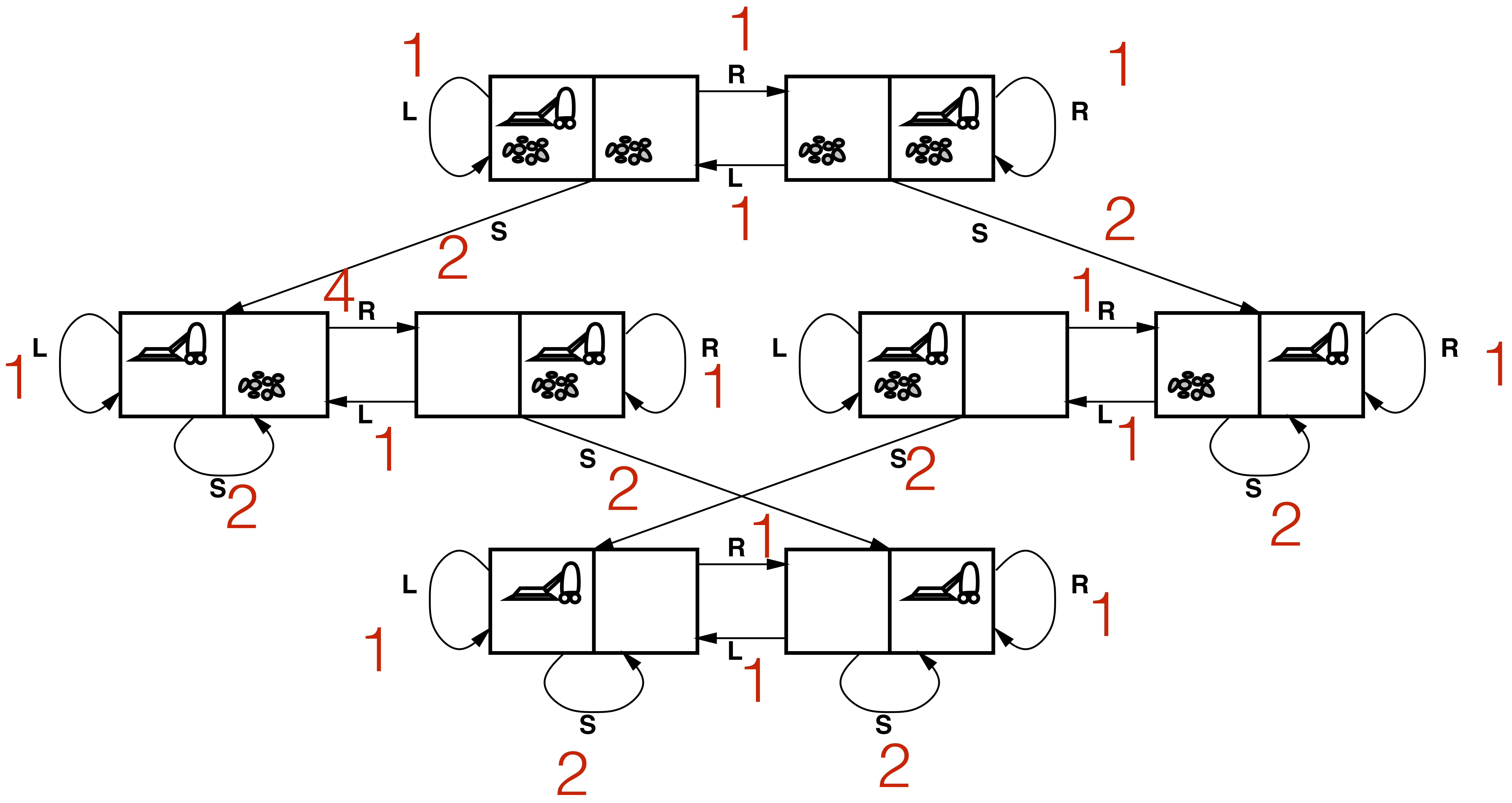
R
L
S
S



L
wheels
R
L
S



1
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R
R
L
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4
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L
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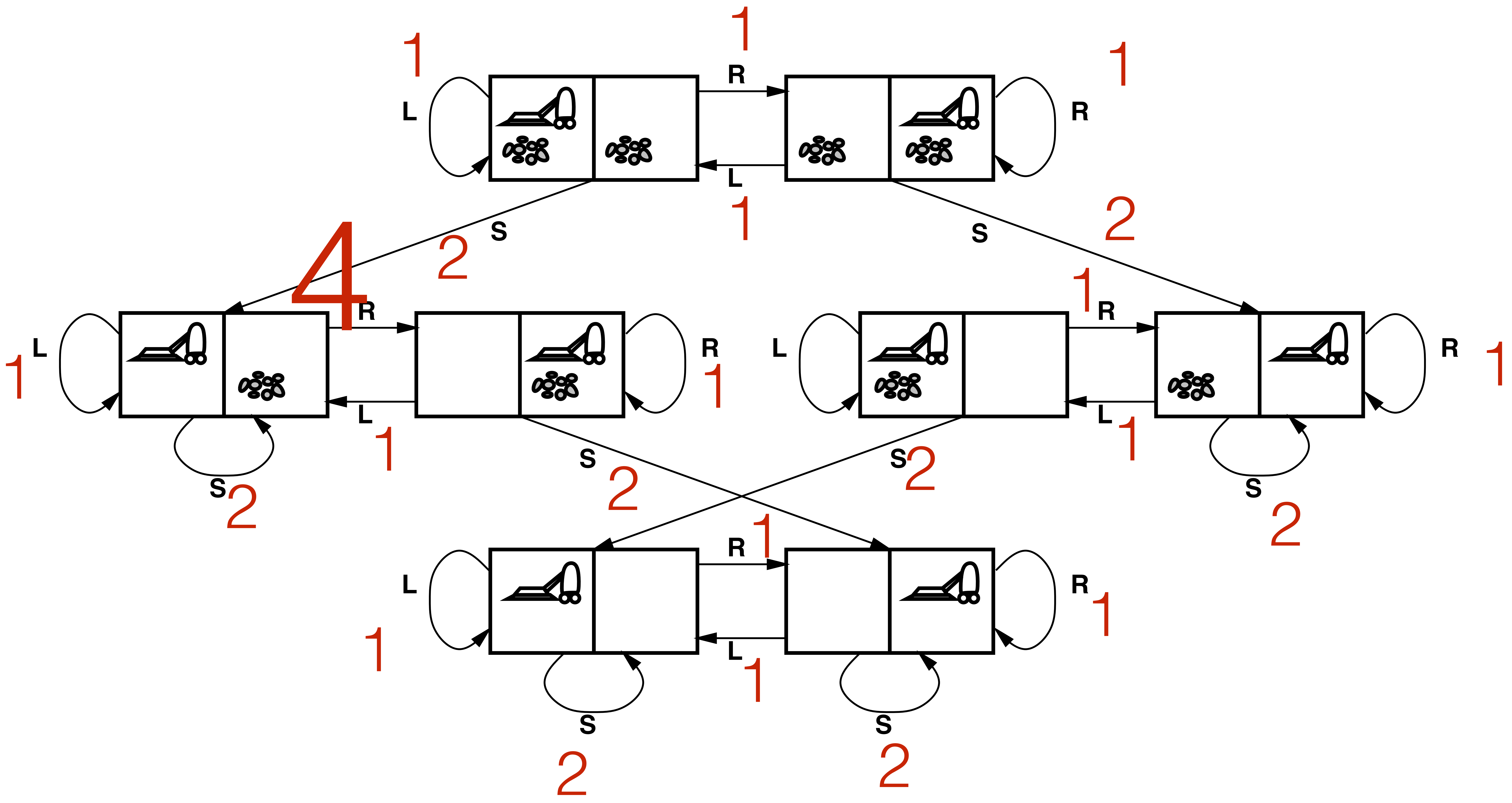

1
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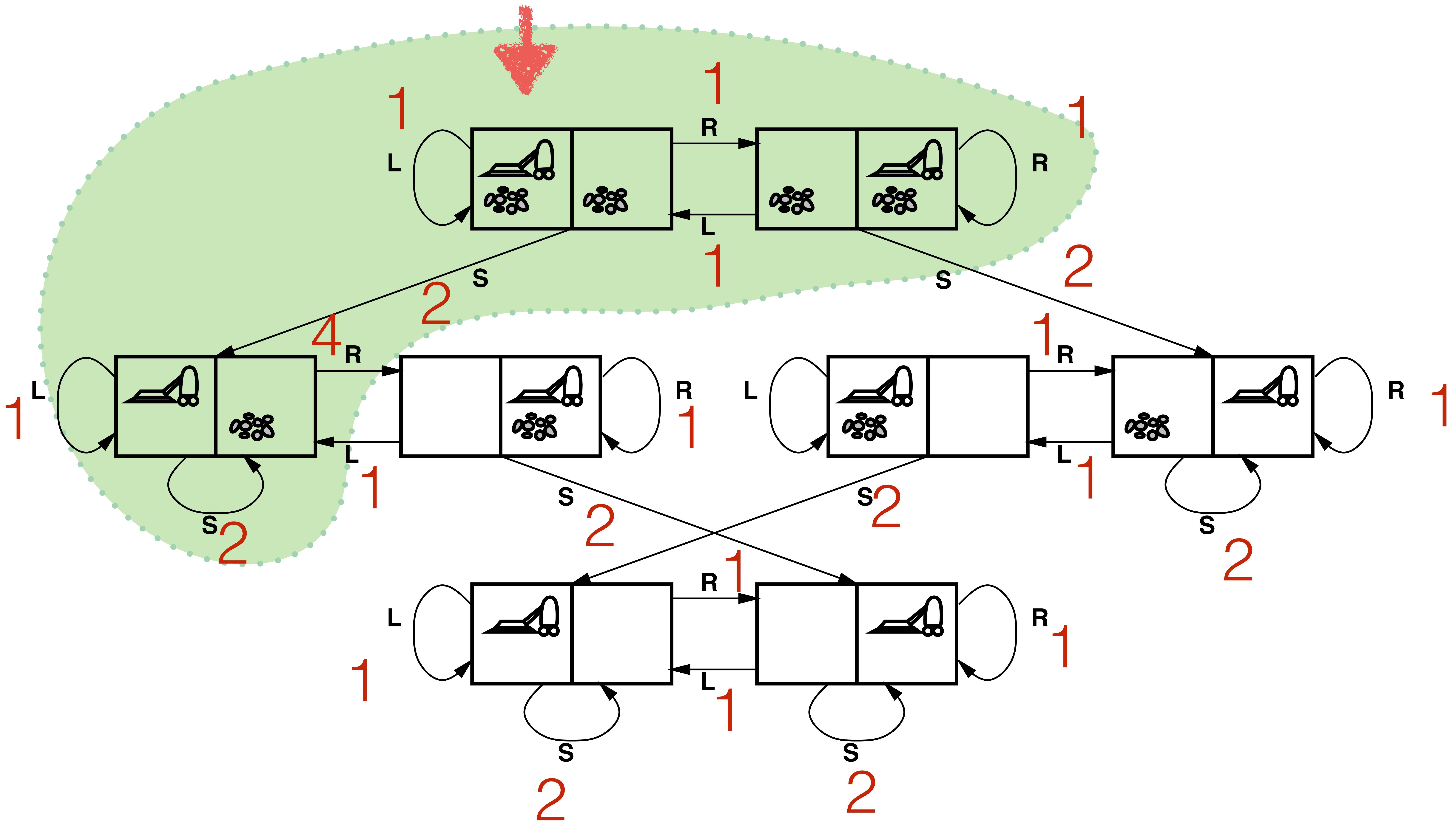

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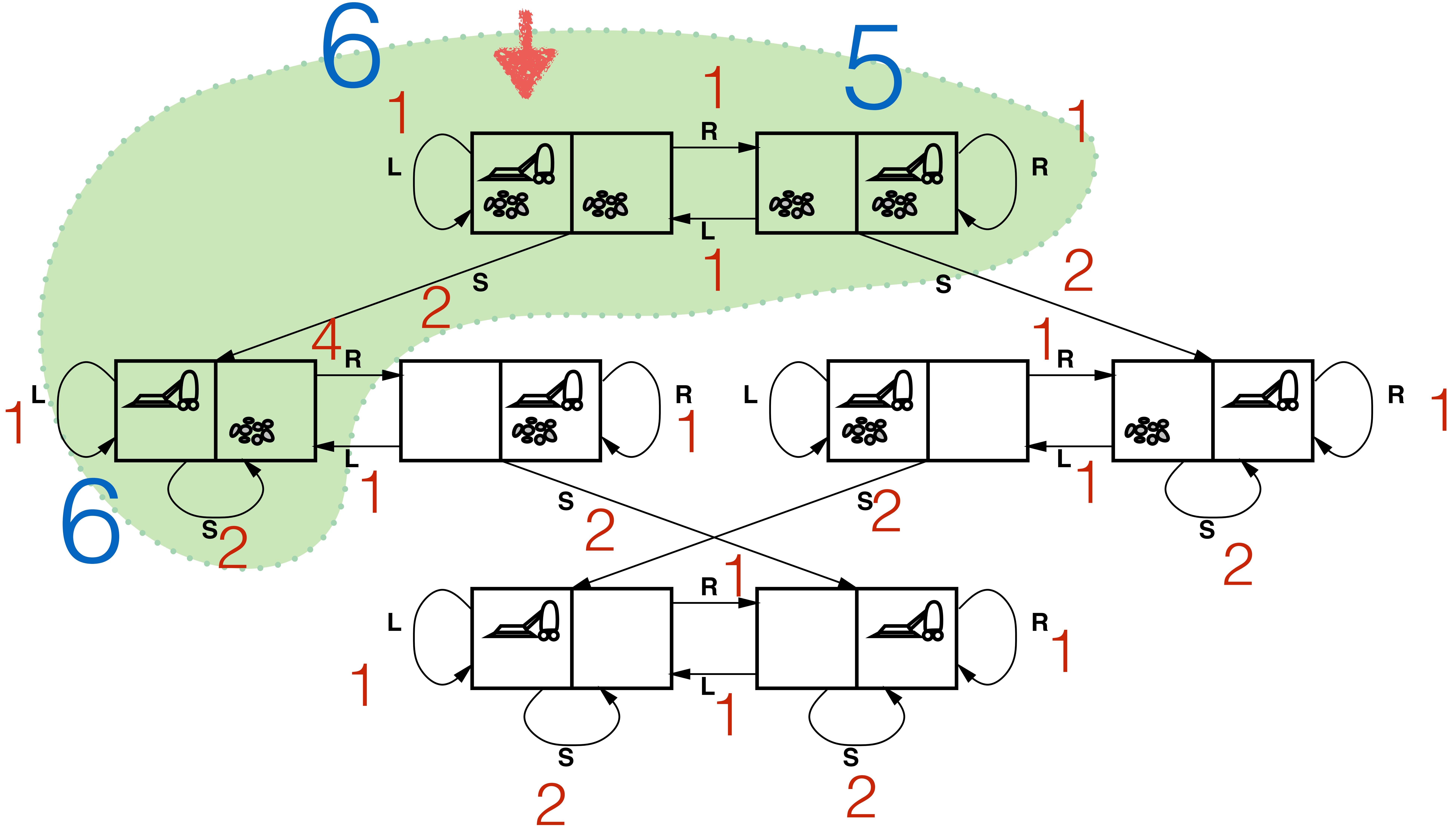
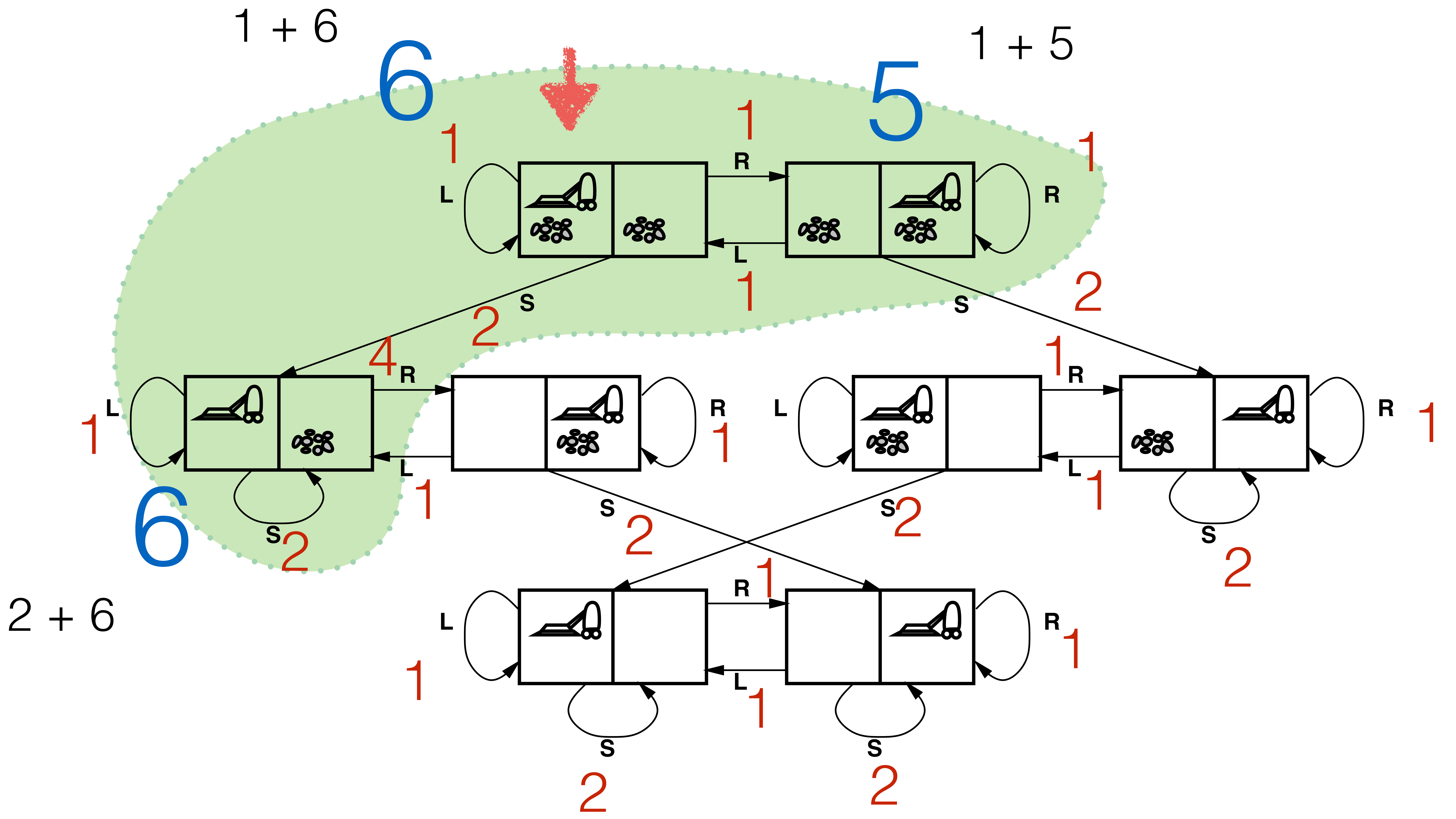
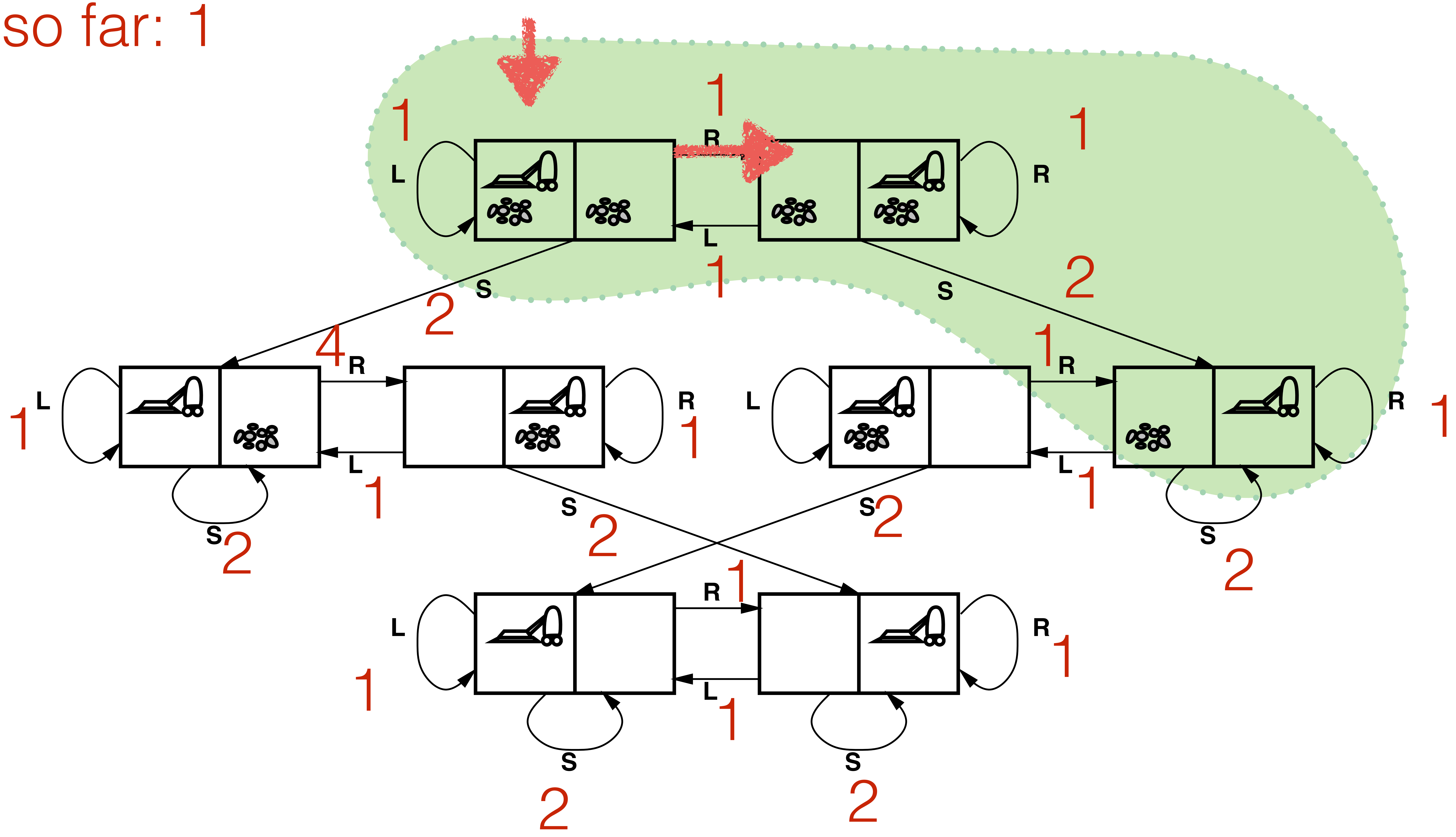


6
5
6
L
R
S


1 + 6
6
1 + 5
5
2 + 6
6
R
L
S

cost so far: 1



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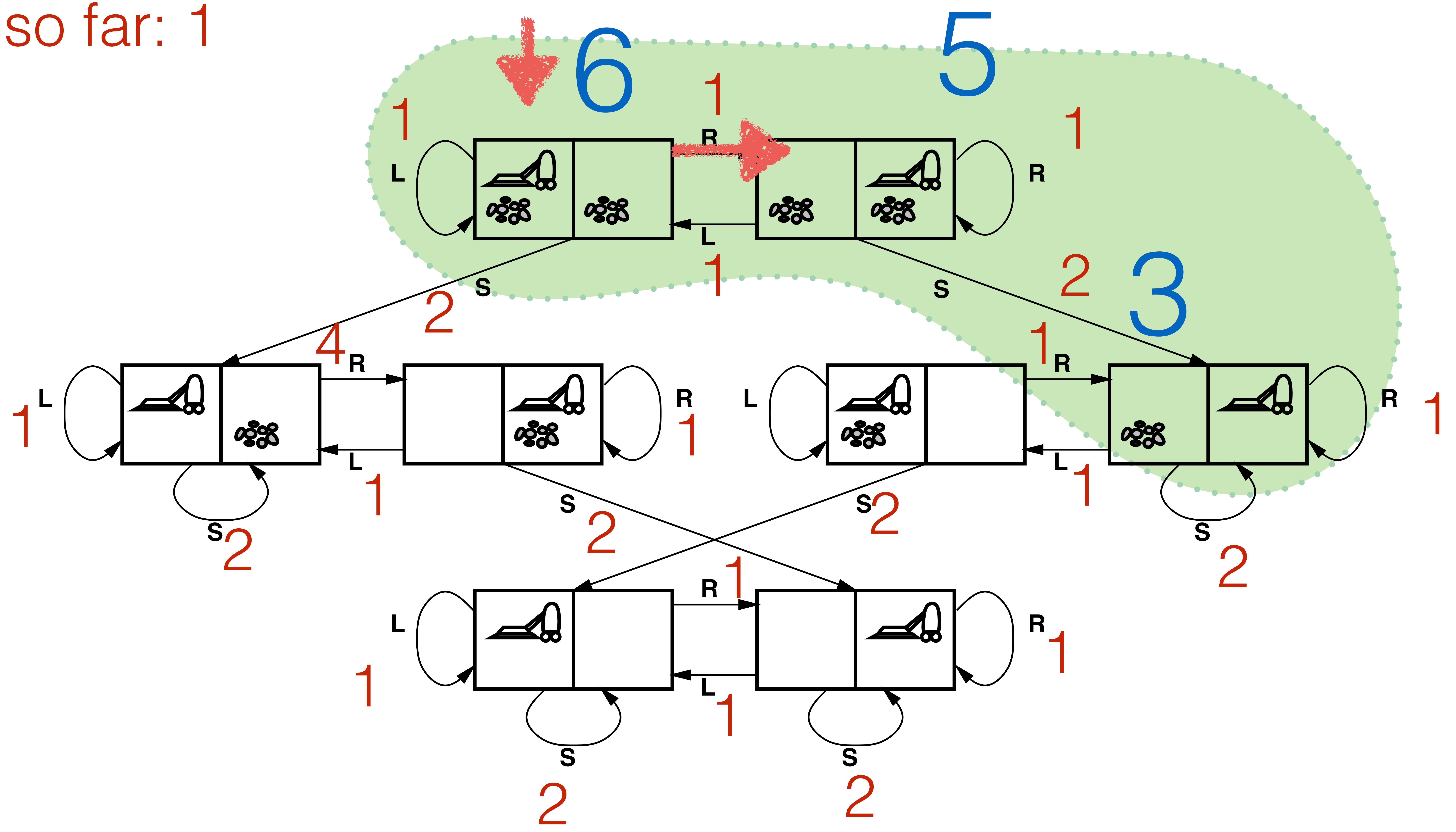

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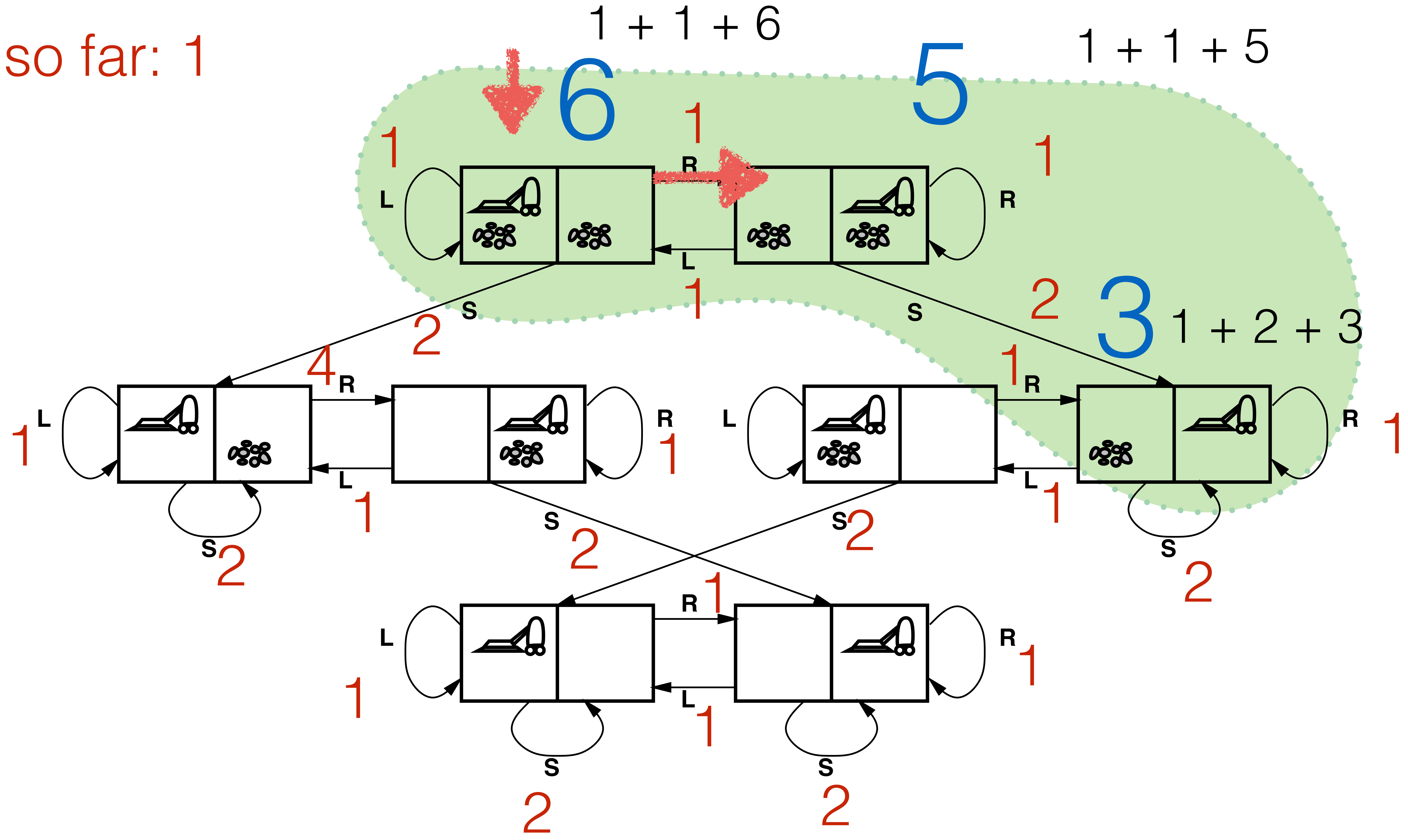
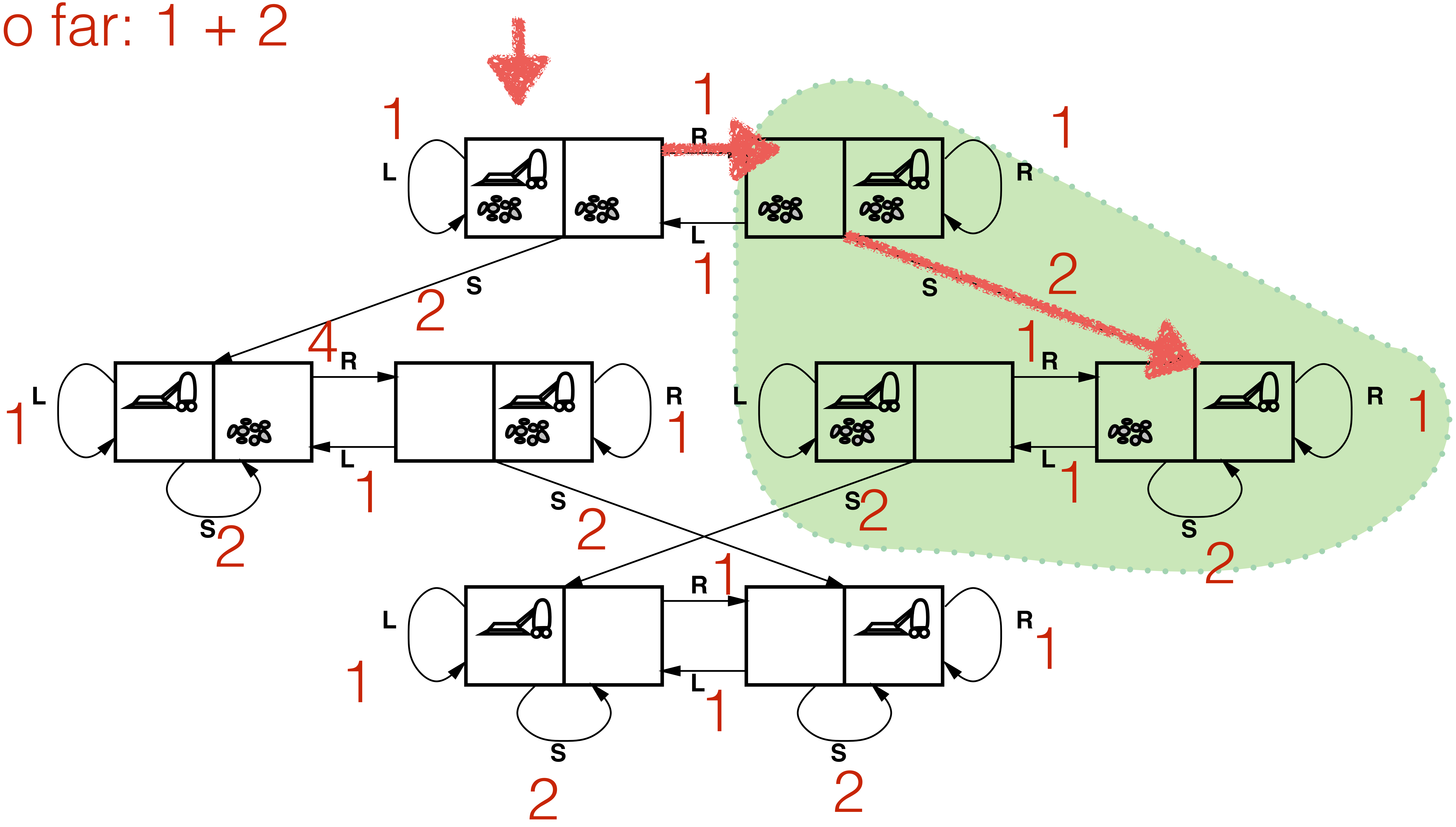


cost so far: 1 + 2



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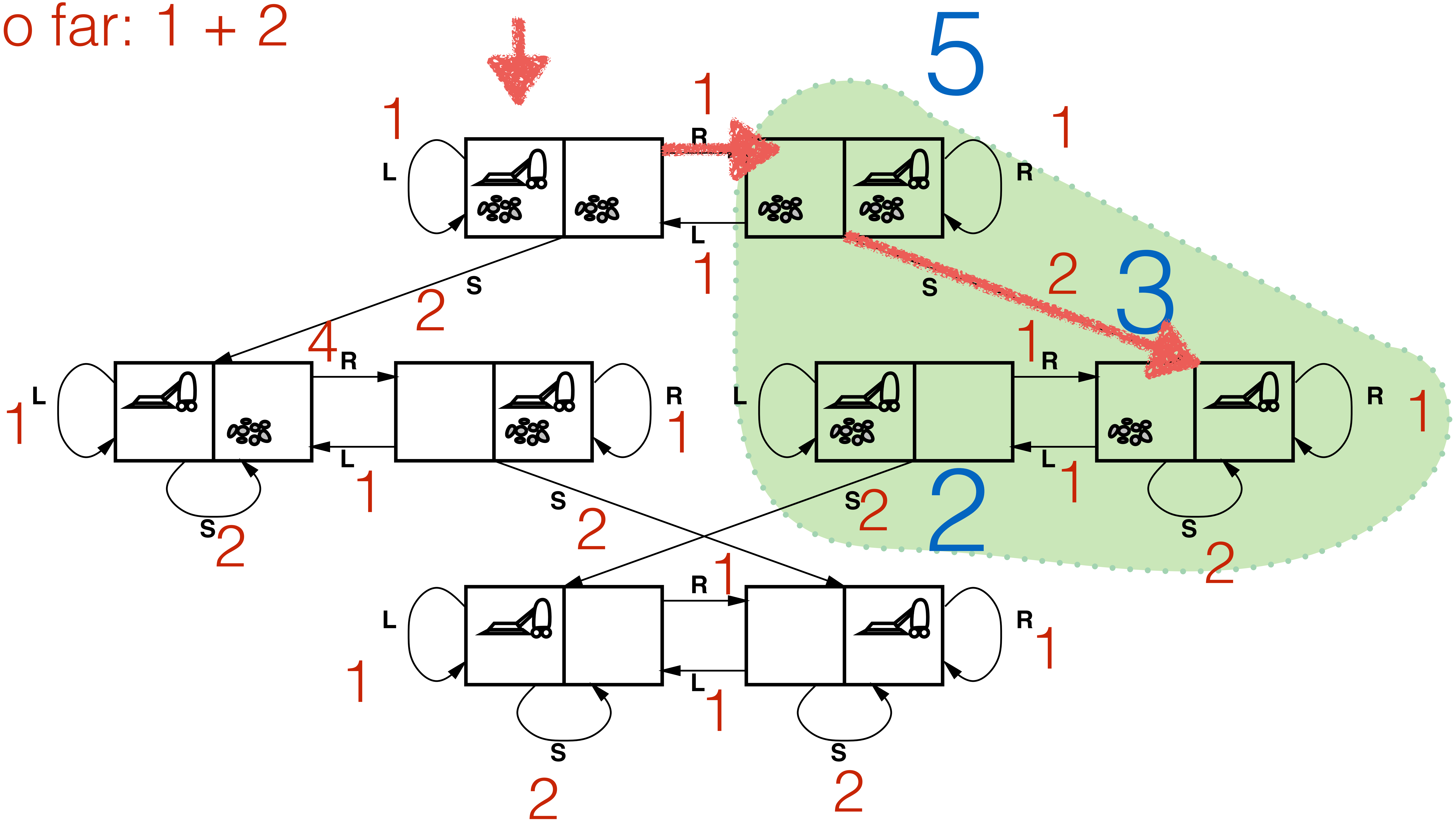
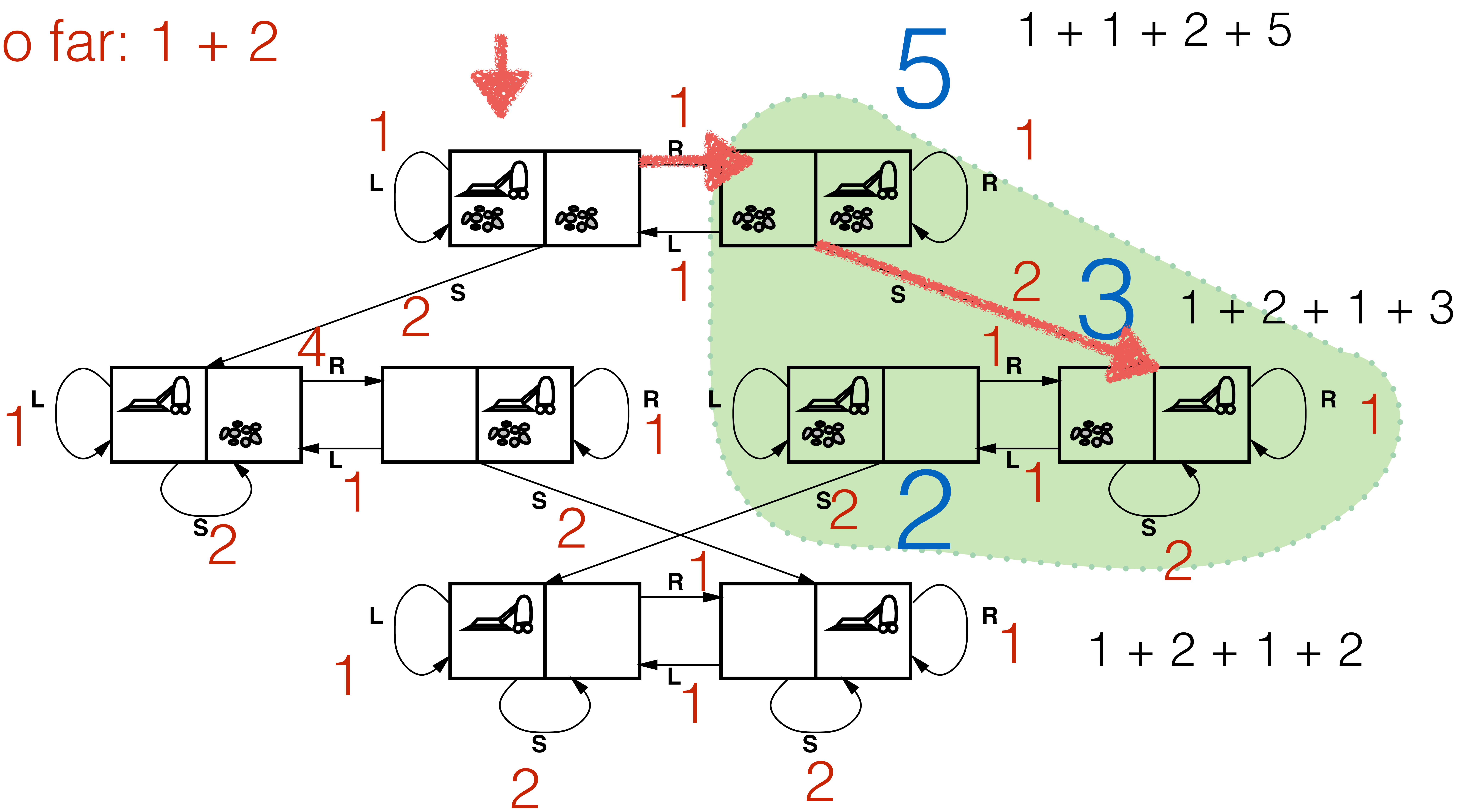
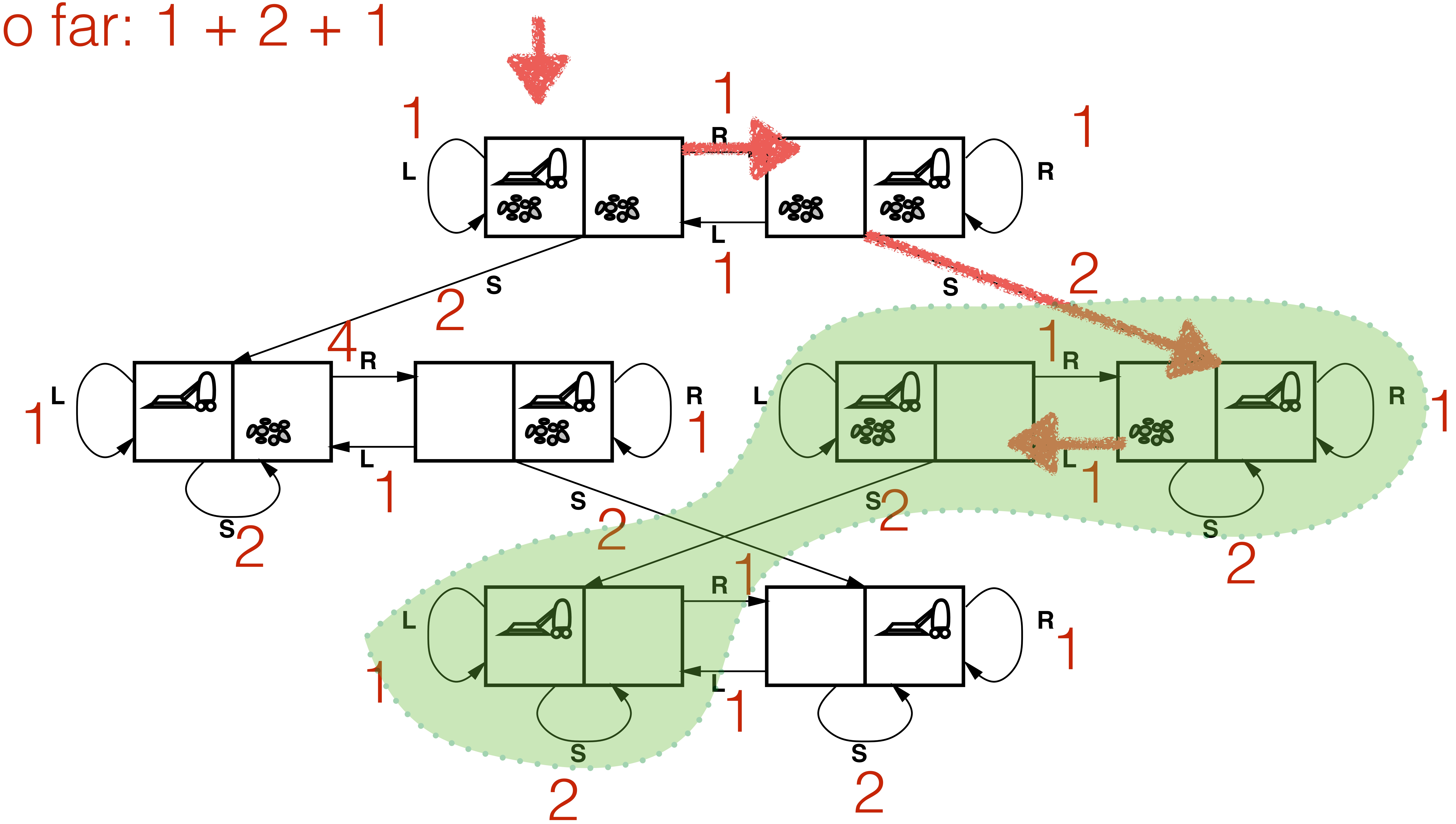


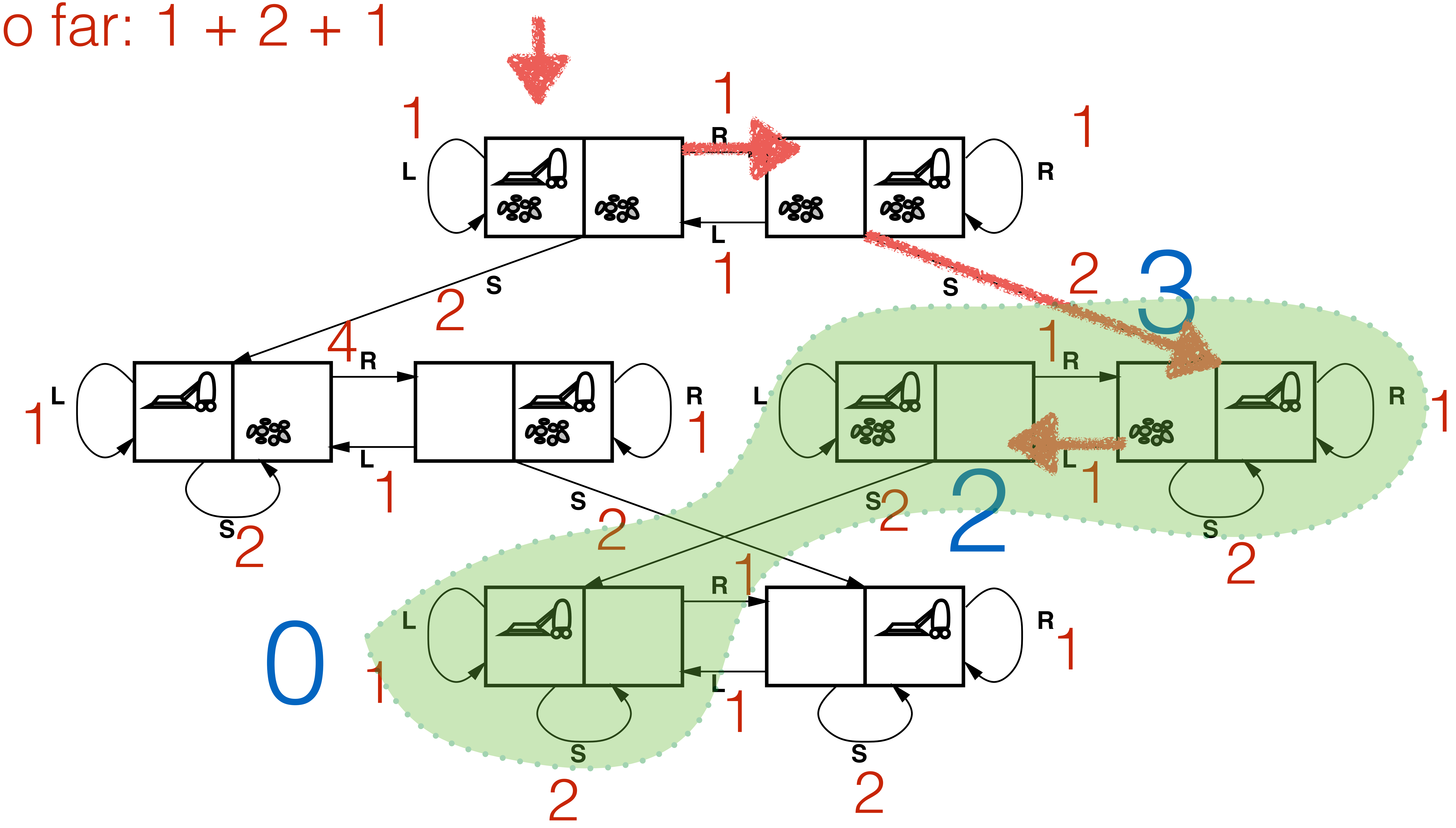
cost so far: 1 + 2



cost so far: 1 + 2 + 1



cost so far: 1 + 2 + 1



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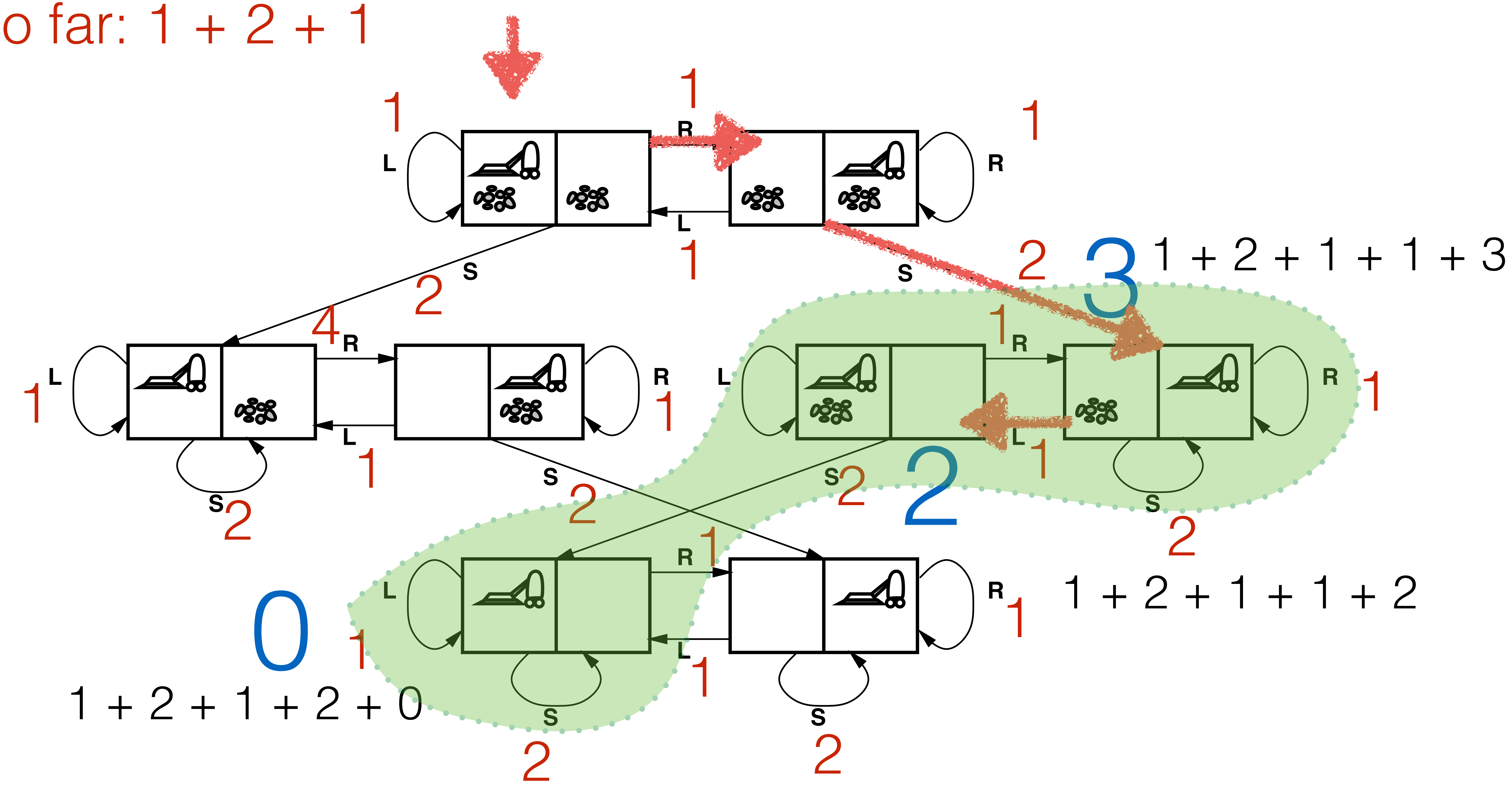
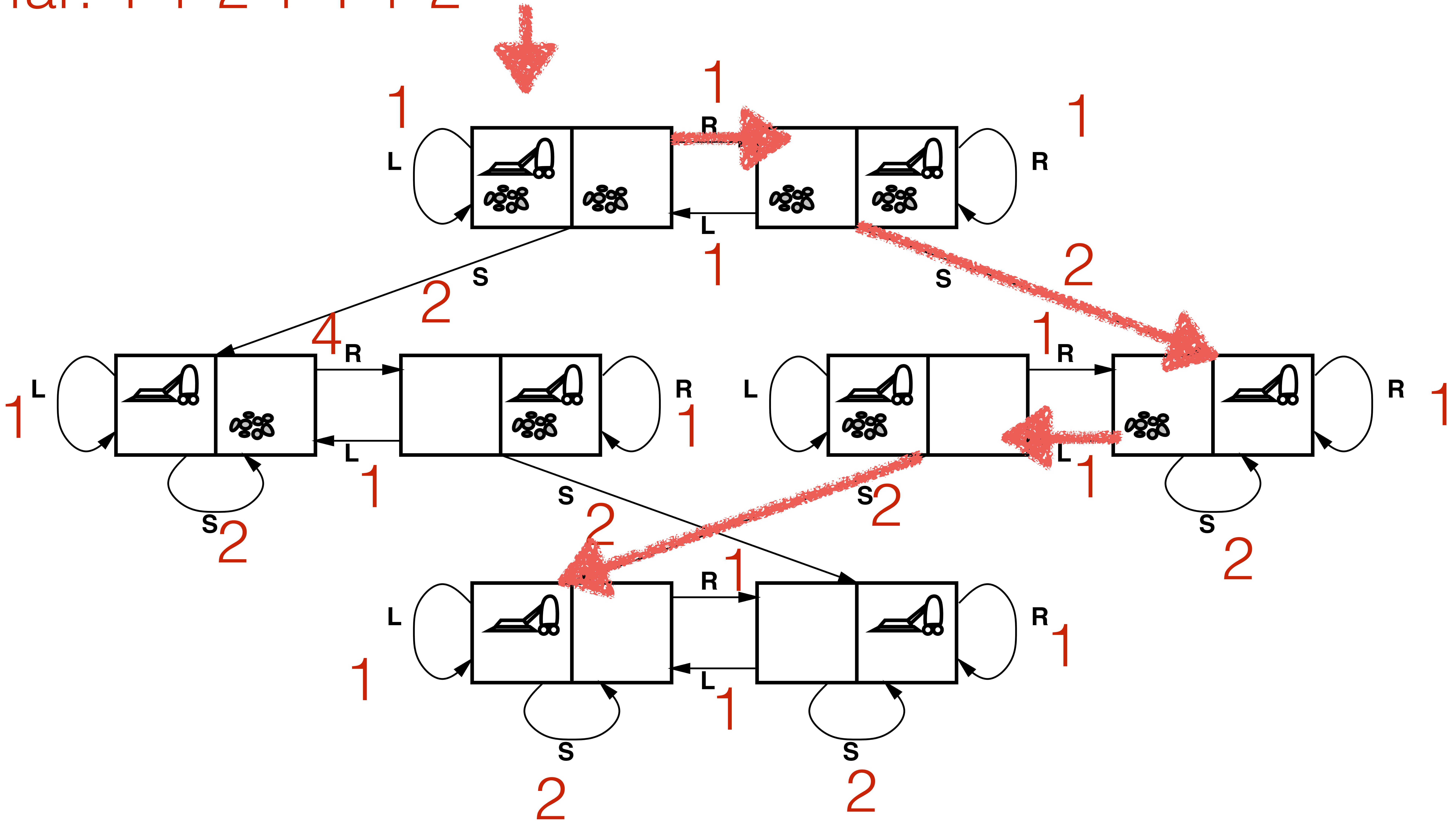


cost so far: 1 + 2 + 1 + 2



A* Search

- Expand node in frontier with best evaluation function score **f(n)**
  - **f(n) = g(n) + h(n)**
  - **g(n) :=** cost to get from initial state to **n**
  - **h(n) :=** heuristic estimate of cost to get from **n** to goal
- Completeness, optimality, and time & space depend on **h**