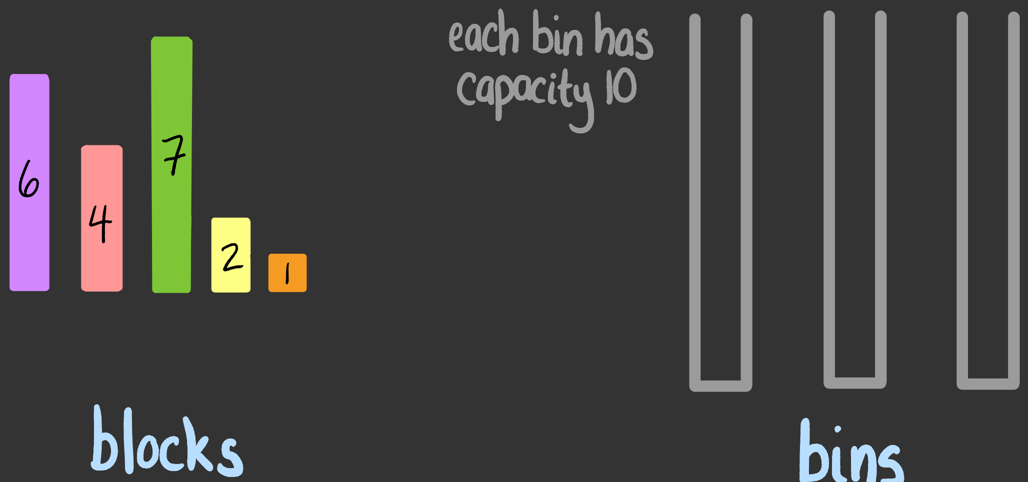
bin-packing workshop

12 sept 2022

CSCI 373

the bin-packing problem

find the minimum number of bins that can store a set of vertical blocks



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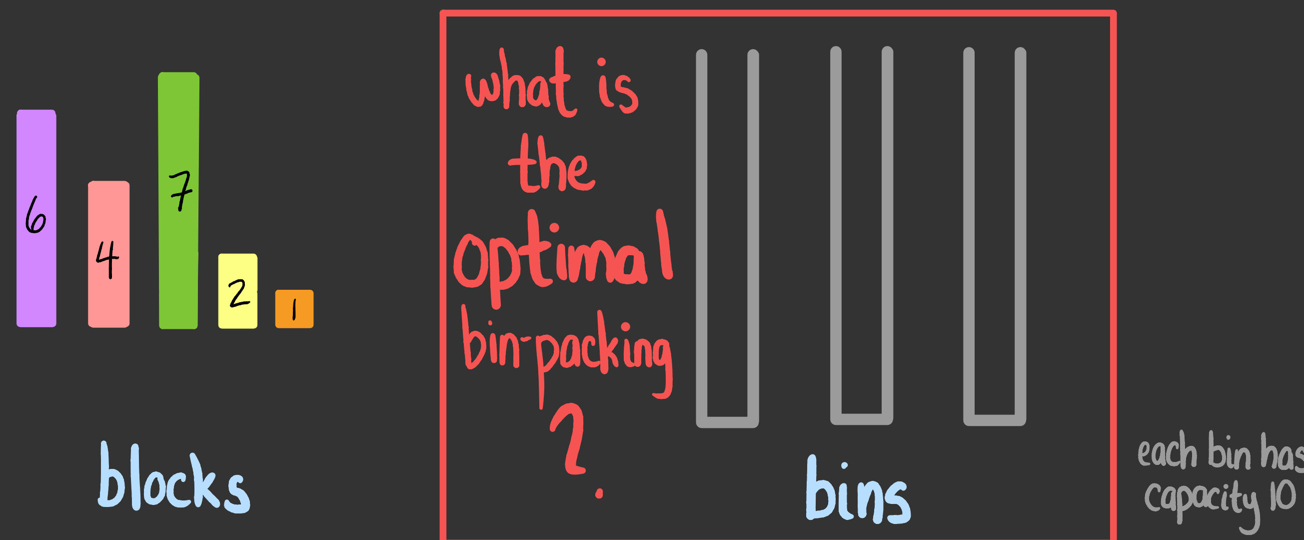

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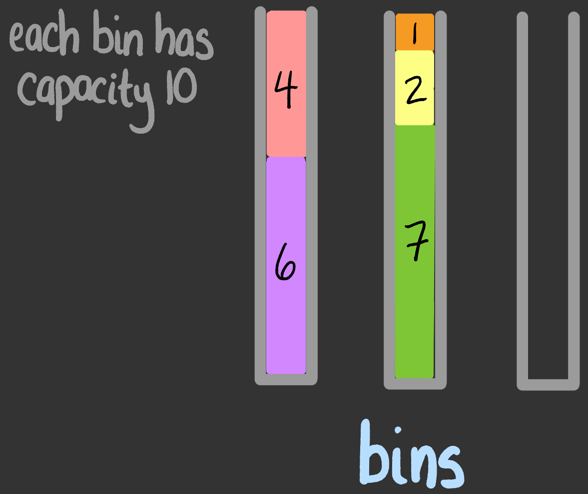
solution: 2 bins



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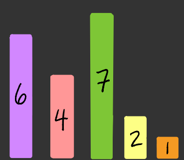
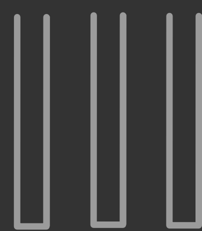


blocks

each bin has capacity 10



bins

but how do we formulate this as a state machine?

define a state machine as a tuple $(Q, \Sigma, \Delta, q_0, F)$ where:

- Q is a set of states
- Σ is a set of actions
- $\Delta \subseteq Q \times \Sigma \times Q$ is a set of permitted transitions
- $q_0 \in Q$ is the initial state
- $F \subseteq Q$ is a set of final states

$Q =$

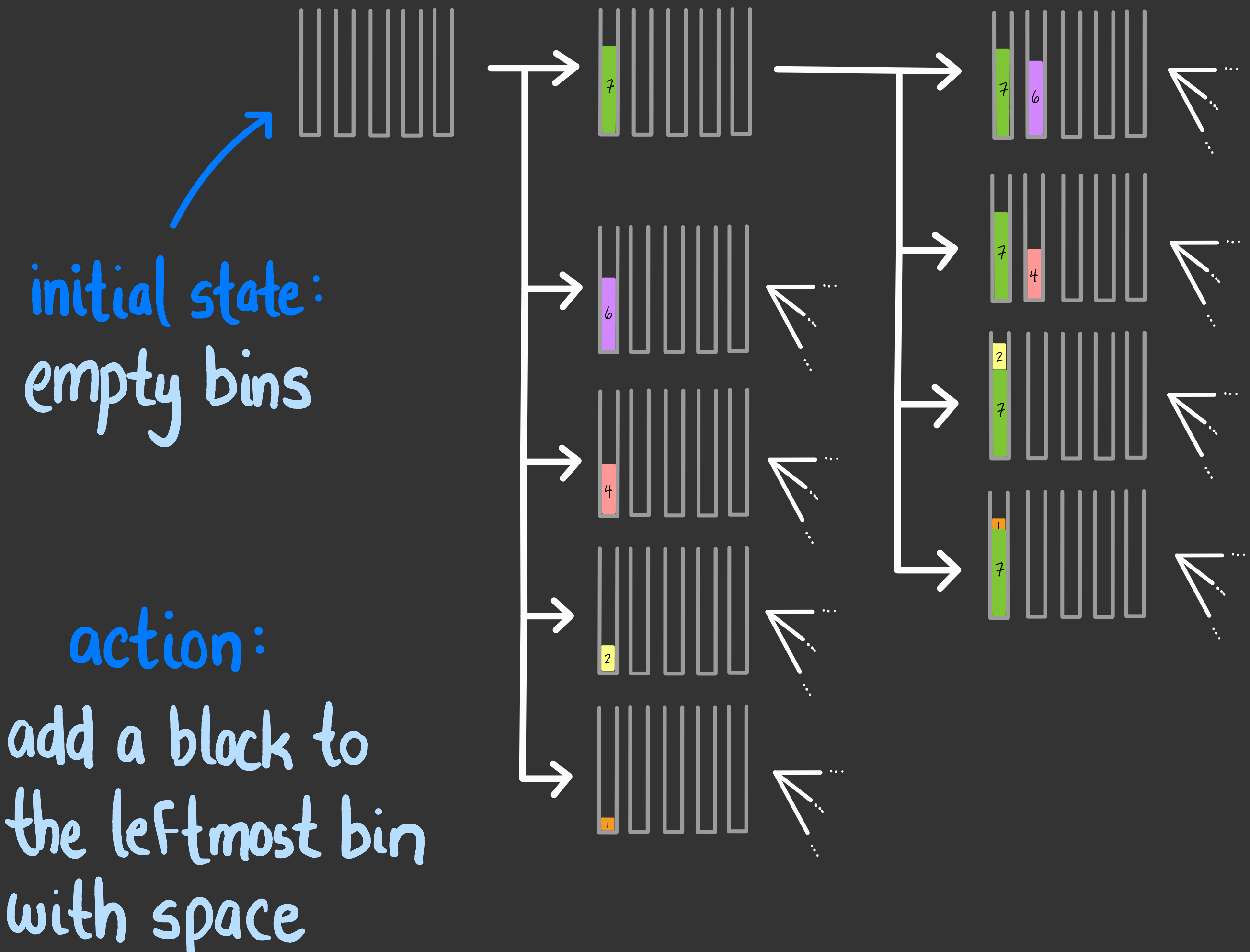
$\Sigma =$

$\Delta =$

$q_0 =$

$F =$

your answer here



initial state:
empty bins
action:
add a block to the leftmost bin with space
7
6
4
2
1

let $x_1, \ldots, x_5$ be the five blocks

let $|x_i|$ be the size of block i

define a bin as a permutation of a subsequence of $\langle 1,2,3,4,5 \rangle$

let B be the space of all bins

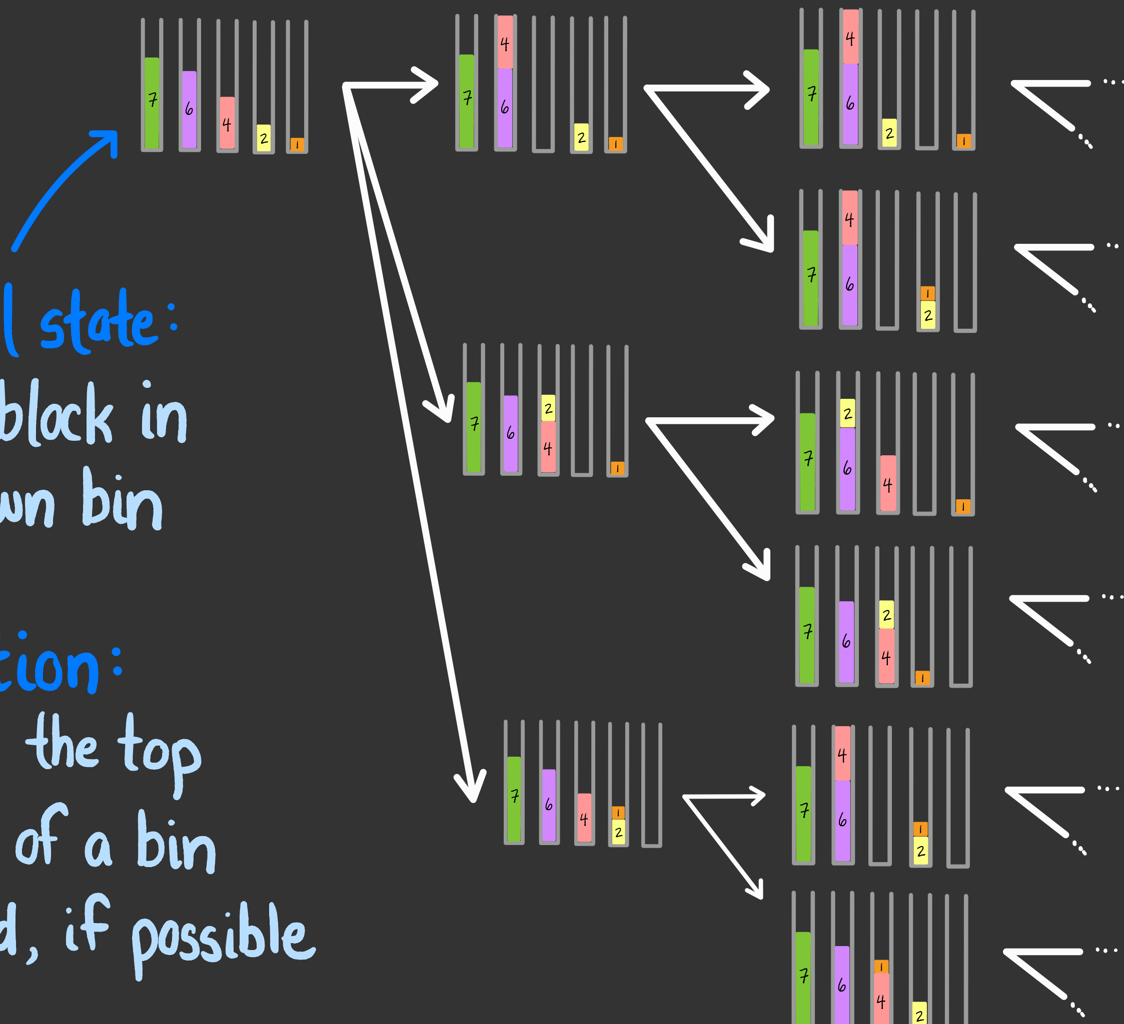
$$Q = \{ \langle b_1, \ldots, b_k \rangle \mid k \geq 1,\ i \neq j \Rightarrow b_i \cap b_j = \emptyset \}$$

$$\Sigma = \{ 1, \ldots, k \}$$

$$\Delta = \{ (\langle b_1, \ldots, b_k \rangle, i, \langle b_1, \ldots, b_{i-1} + [b_i[-1]], b_i[:-1], \ldots, b_k \rangle) \}$$

$$q_0 = \langle [x_1], [x_2], [x_3], [x_4], [x_5] \rangle$$

$$F = \{ \langle b_1, \ldots, b_k \rangle \in Q \mid \mathrm{sum}(b_i) \leq 10,\ \bigcup_{i=1}^{5} b_i = \{x_1, \ldots, x_5\} \}$$



initial state:

each block in its own bin

action:

move the top block of a bin leftward, if possible some considerations:

- is the search space cyclic?
- what is the maximum depth?
- is every final state reachable from the initial state?