B: Bulldozer

Problem Author: Mees de Vries

Problem

Given a row of stack of blocks, how many 'bulldoze' operations are needed to level all the blocks.

Observations

- Each block can be 'buried' in two moves: push the bottom of the stack right, push the block left.
- It's never worse to do all burying operations at the end.
- All other blocks that start non-grounded end at an initially empty stack.
- Number the non-grounded blocks from left to right, where each stack is numbered bottom to top.
- The final solution has stretches of blocks that move left, stretches of blocks that move right, mixed with stretches of blocks that are buried.
- We have infinite space on the left and right, and the stretches of blocks that go there contain full stacks of blocks only.

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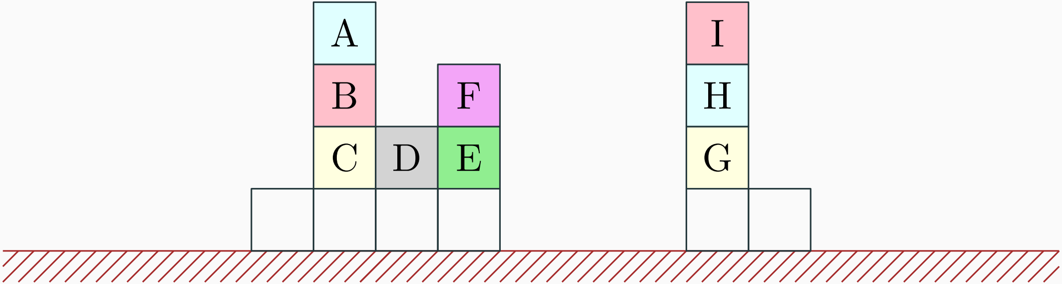

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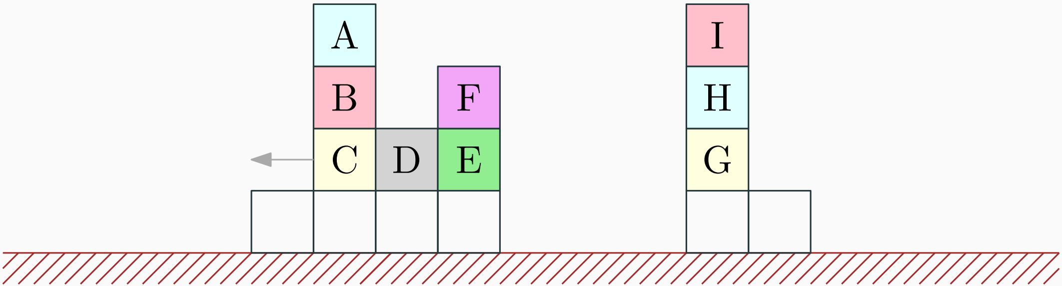

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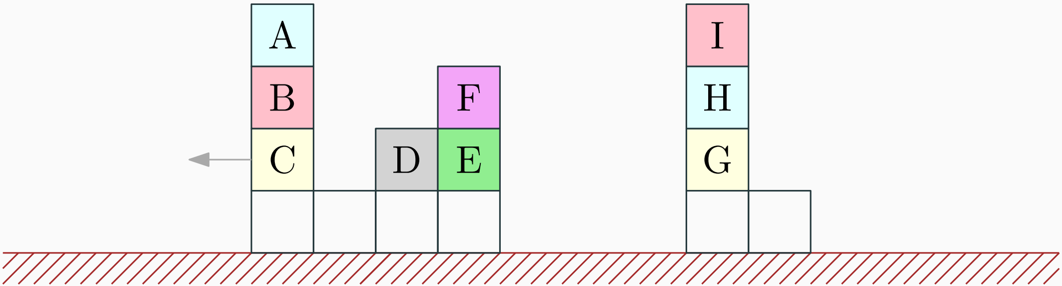

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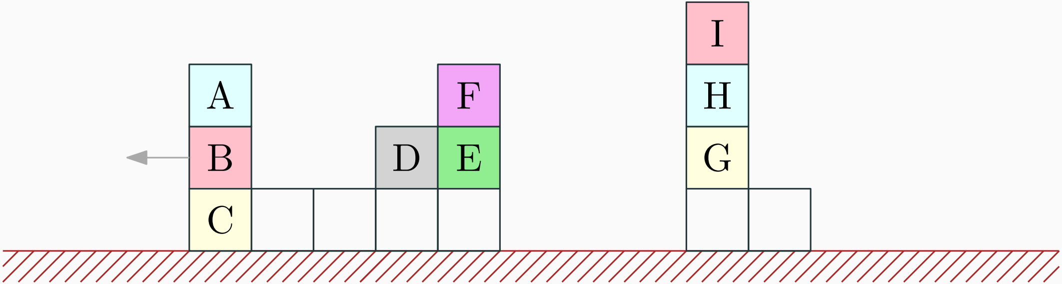

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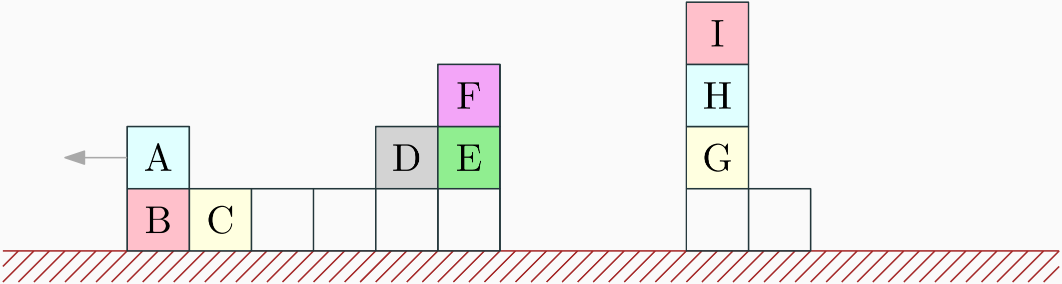

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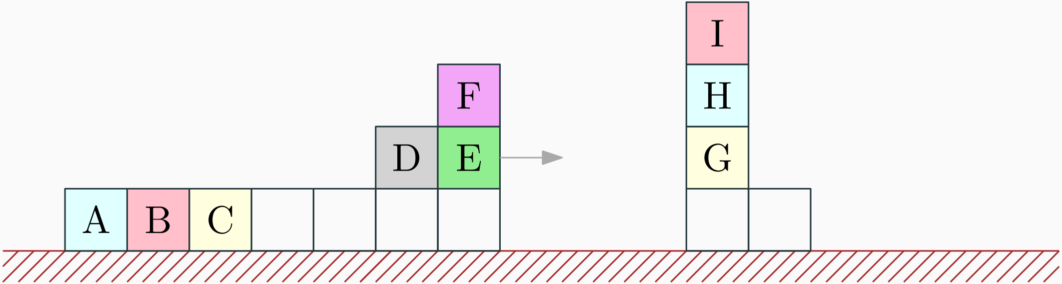

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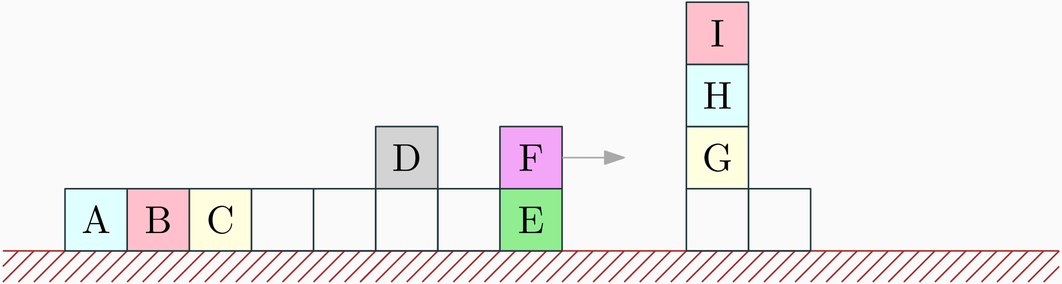

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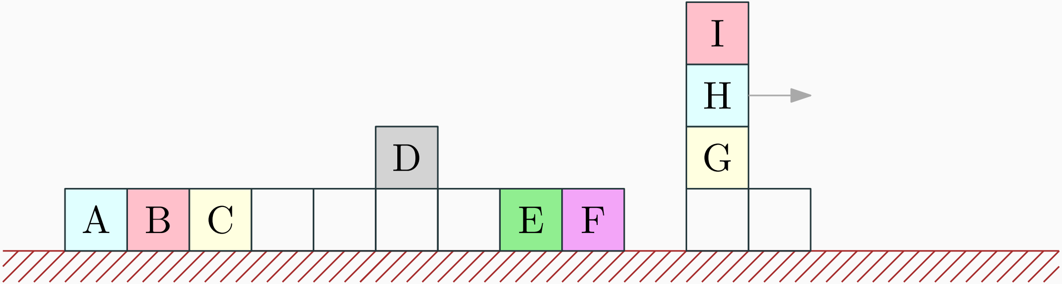

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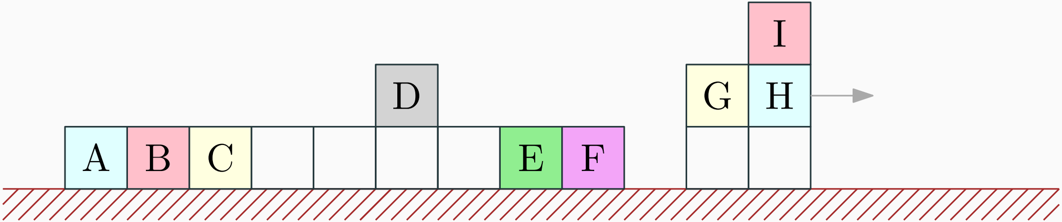

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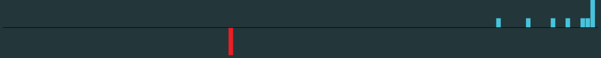

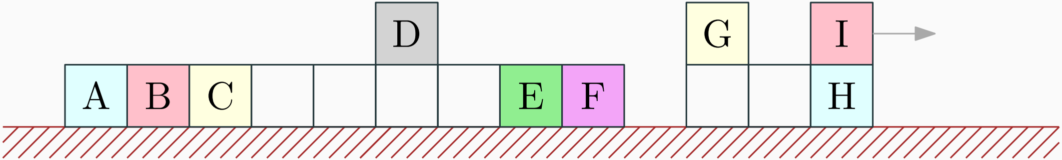

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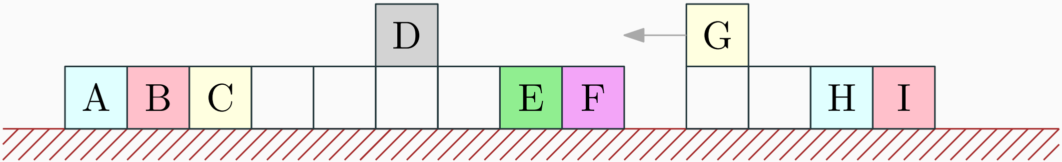

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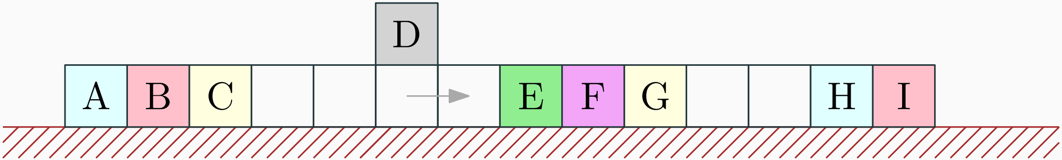

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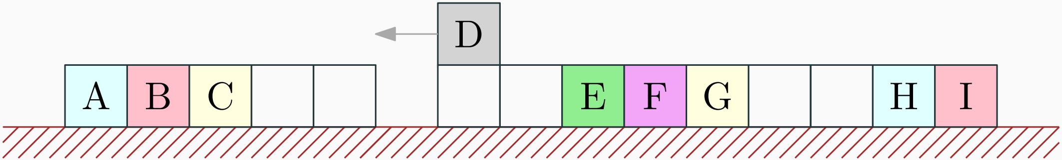

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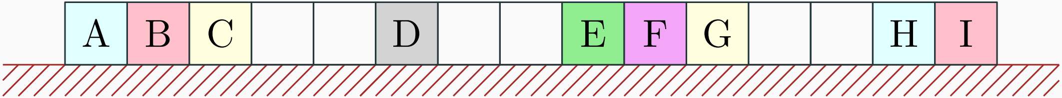

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Solution

- Make a weighted directed graph on the initial state of the blocks, with a start vertex on the far left and an end vertex on the far right. The shortest path will be the answer.
- For each empty stack S, find the block X that would end there when moving blocks from the left. Add an edge from X to S of cost K, the required number of moves for this.
- Similarly, find the block Y that would end at S when moving blocks from the right. Add an edge from S to Y of cost K.
- When block X ends in empty stack Y after K moves, all blocks in between are already levelled.
- Add an edge from the start vertex to the top of each stack: the cost of moving all in between blocks left.
- Add an edge from the bottom of each stack to the end vertex: the cost of moving all in between blocks right.
- For burying, add an edge between consecutive blocks of cost 2, but merge adjacent edges when possible to prevent adding $2 \cdot 10^{14}$ edges.

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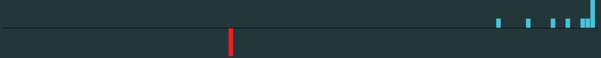

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