A novel Heyawake idea?

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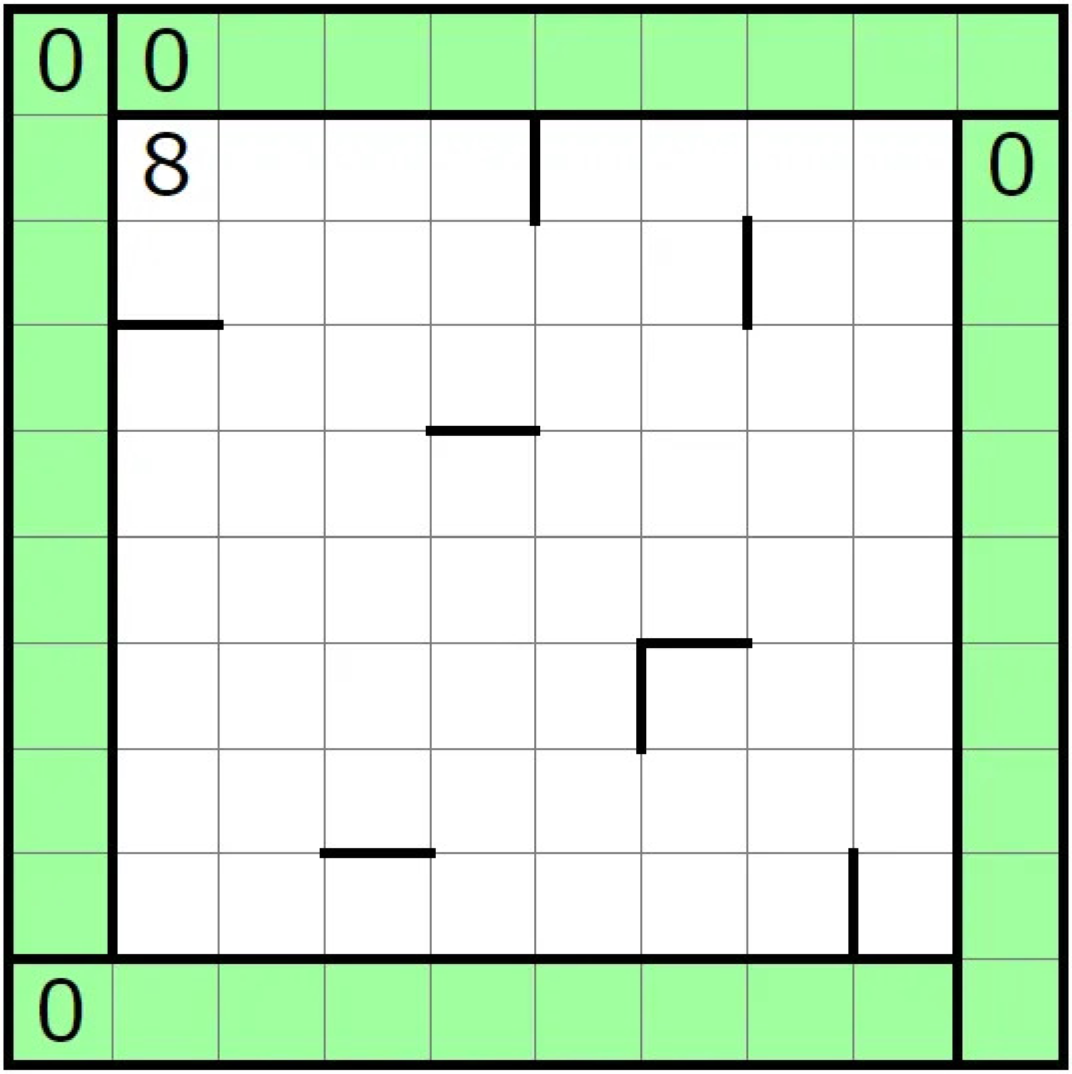
Hey you. You're finally *awake*.

I've recently come up with a "new" idea. Probably not actually new, but I've really not enough time to beat every existing Heyawake in puzz.link/db and PuzzleSuareJP; so as far as I'm concerned, it's somewhat novel. It's inspired by the **n-queens problem** — where you need to place *n* chess queens on an *n* by *n* chess board without making any two queens share the same row, column, or diagonal. This problem should have a familiar ring to many with a background in competitive programming. Without further ado, let me now present my attempt to "port" the n-queens problem to Heyawake:

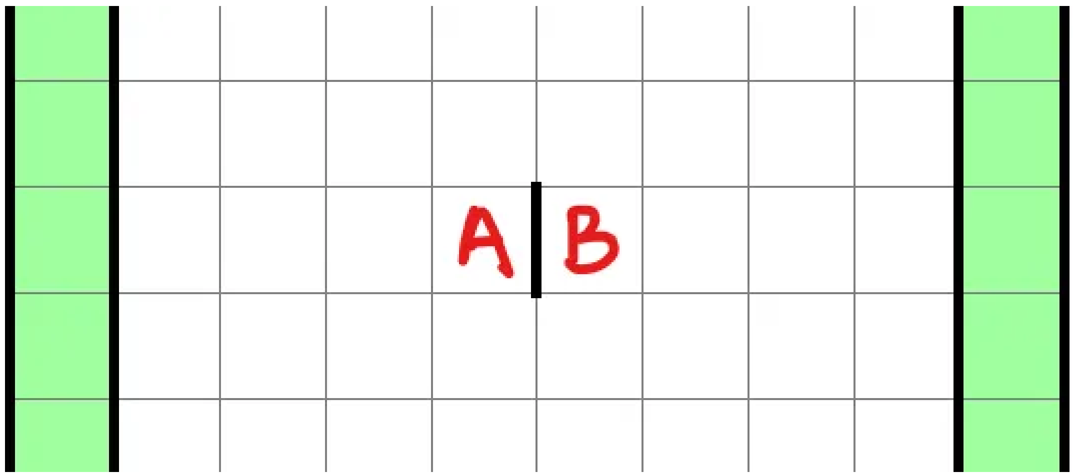
The simple problem



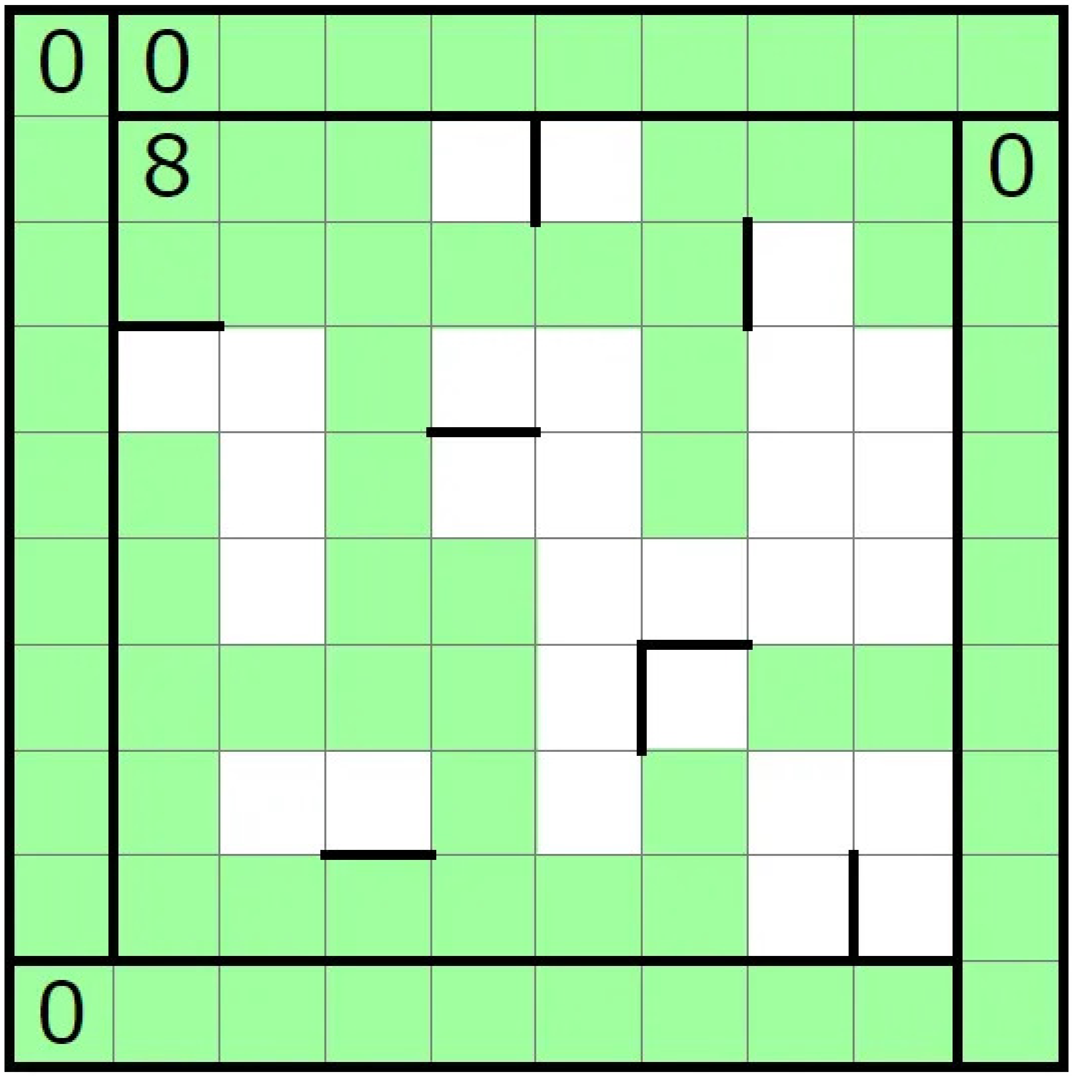
Play the puzzle on puzz.link

It captures the main idea, and is simple-looking, although a bit unconventional. The immediately obvious thing is that each row and each column of the big 8 room requires at least one black, since it is entirely surrounded by greens. However, there are only 8 blacks in total. Which means that each row and each column of the room contains exactly one black. (The diagonal rule in the n-queens problem could not possibly have been implemented, so I didn't.) The only question is where to put them.

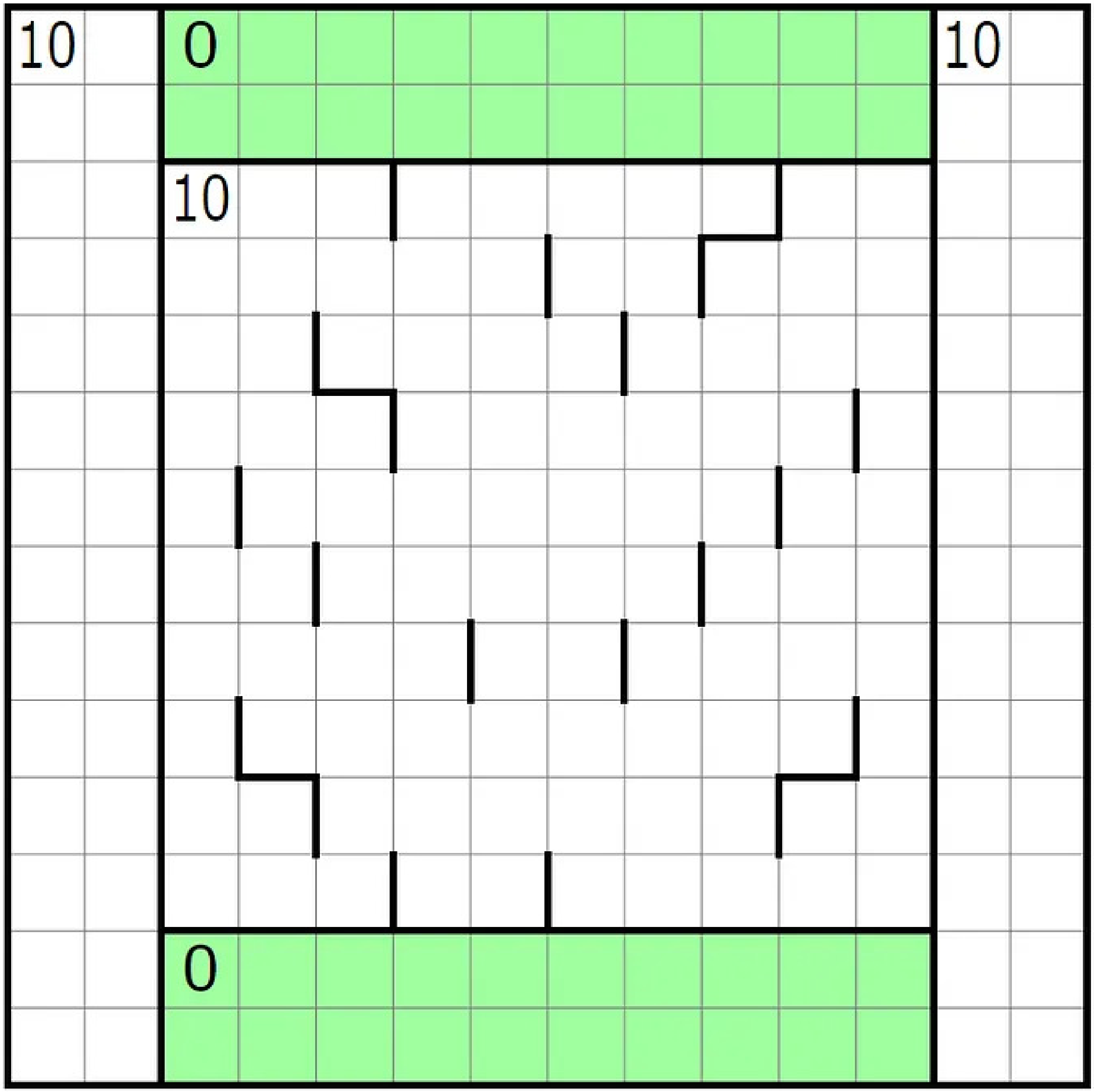
To answer this question only requires one observation: when you have a wall like in the figure below, either A or B must be the single black cell (it's not hard to see why).



With that, it should be easy to mark all the greens, and the puzzle should be promptly completed.



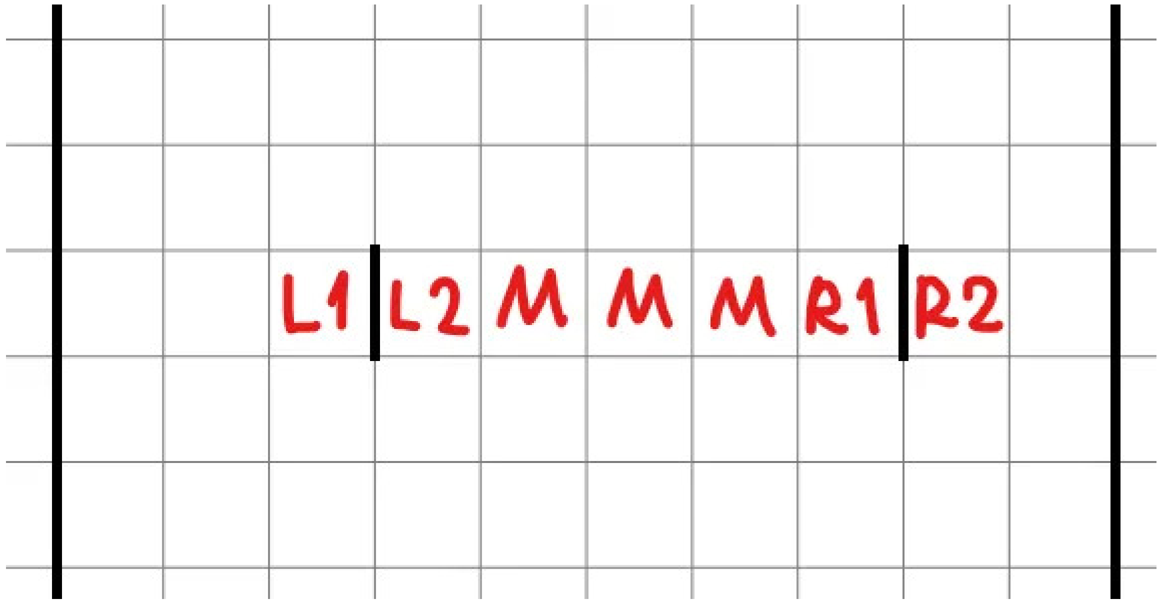
The harder problem



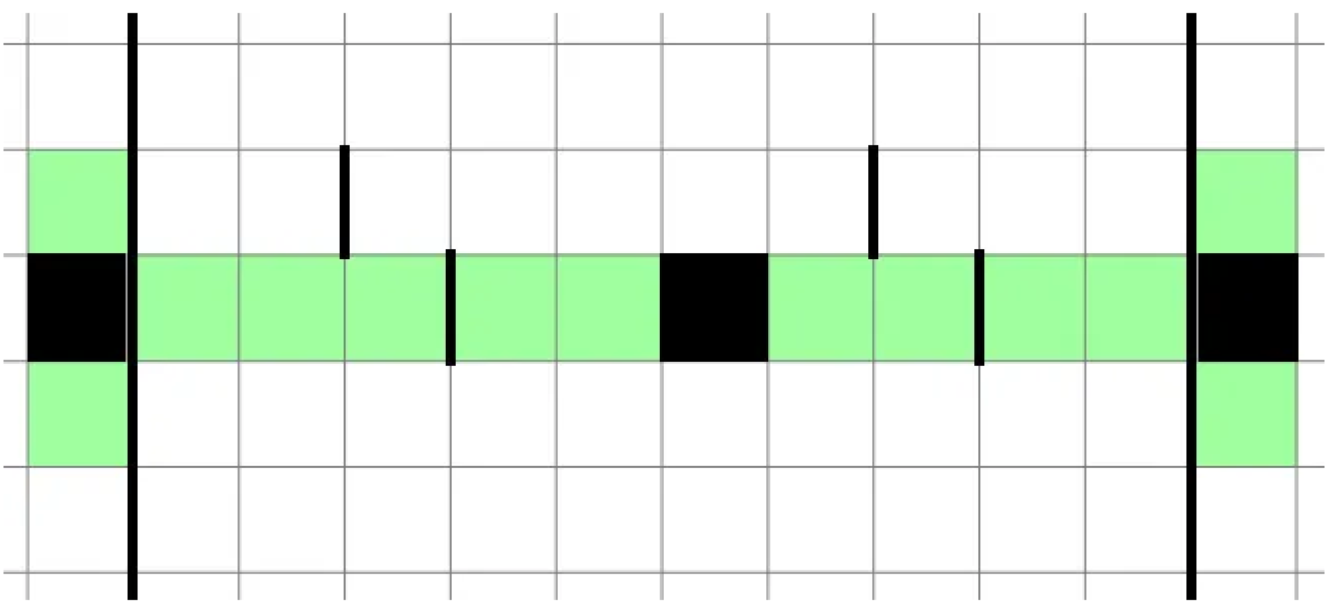
Play the puzzle on puzz.link

It’s much like the previous problem, but with a little twist. You can see each column must have one black, but what about the rows? Turns out there again must be at least one black in each row (were it not the case, Heyawake’s border rule would be violated), and since there are only 10 blacks in the big room to spare, each row must have exactly one black.

Now comes the slightly more sophisticated observation. When a row has two walls, where can the black cell go?

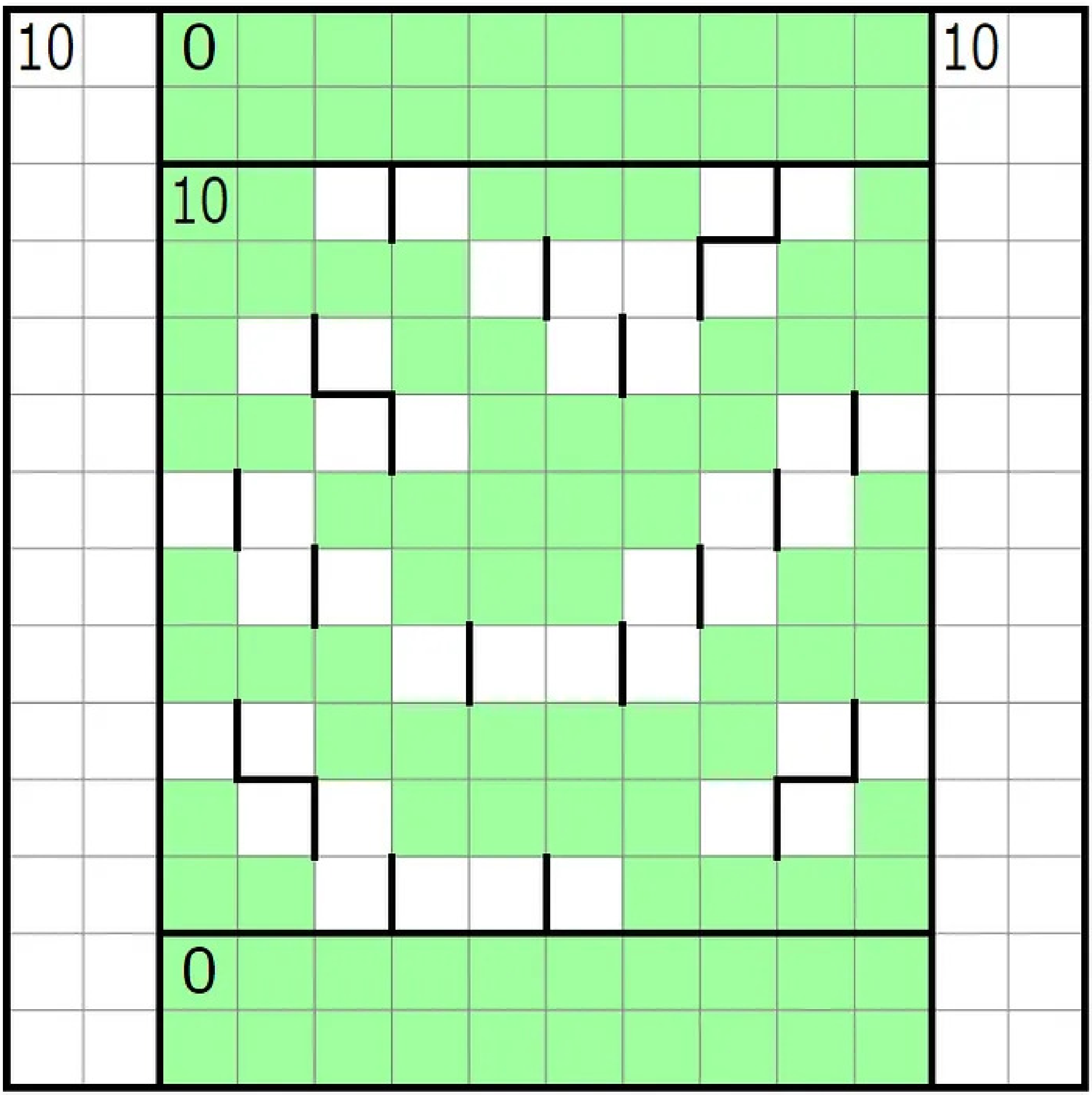


Seems that it can go to L1/L2, R1/R2, or any of the middle cells M (what would happen if it went anywhere else?). Now let's consider if it goes to M:

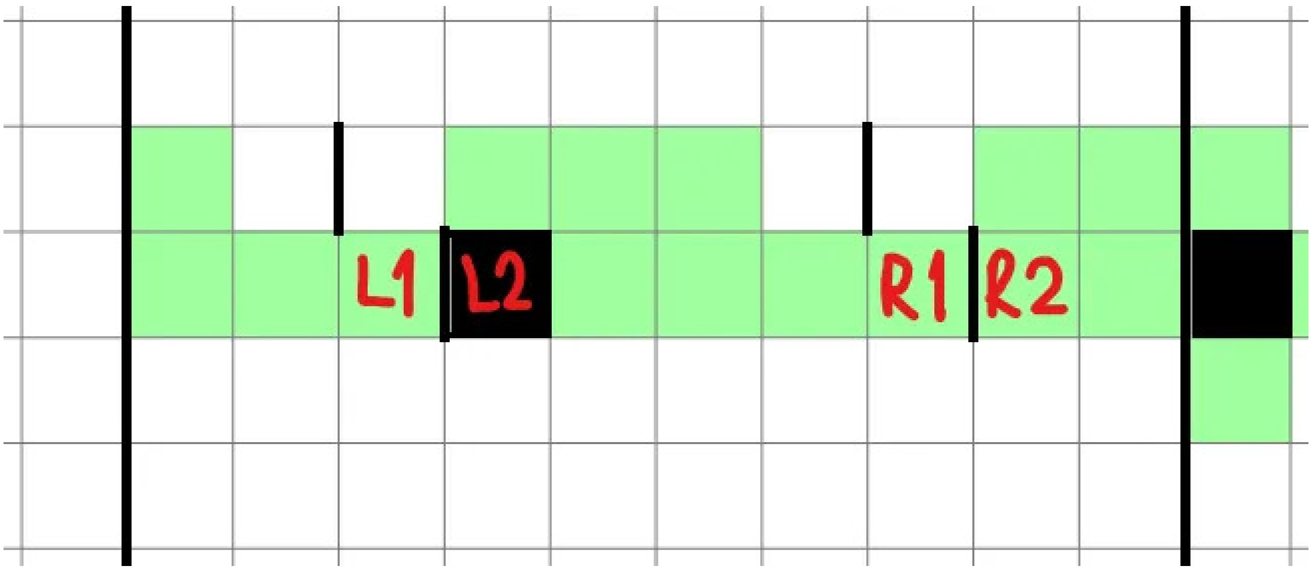


In this scenario, the left endpoint and right endpoint just outside of the room both have to be black, which causes both endpoints in the row above (or equivalently, below) to be green. Now, where would the black cell go in the row above? You can try every location, but there is not a single place where the black cell can go!

In essence, if a black cell goes to the middle cells in *any* row, there would be a contradiction. So there are only 4 cells in every row that can possibly house the black cell — namely L1, L2, R1 and R2.



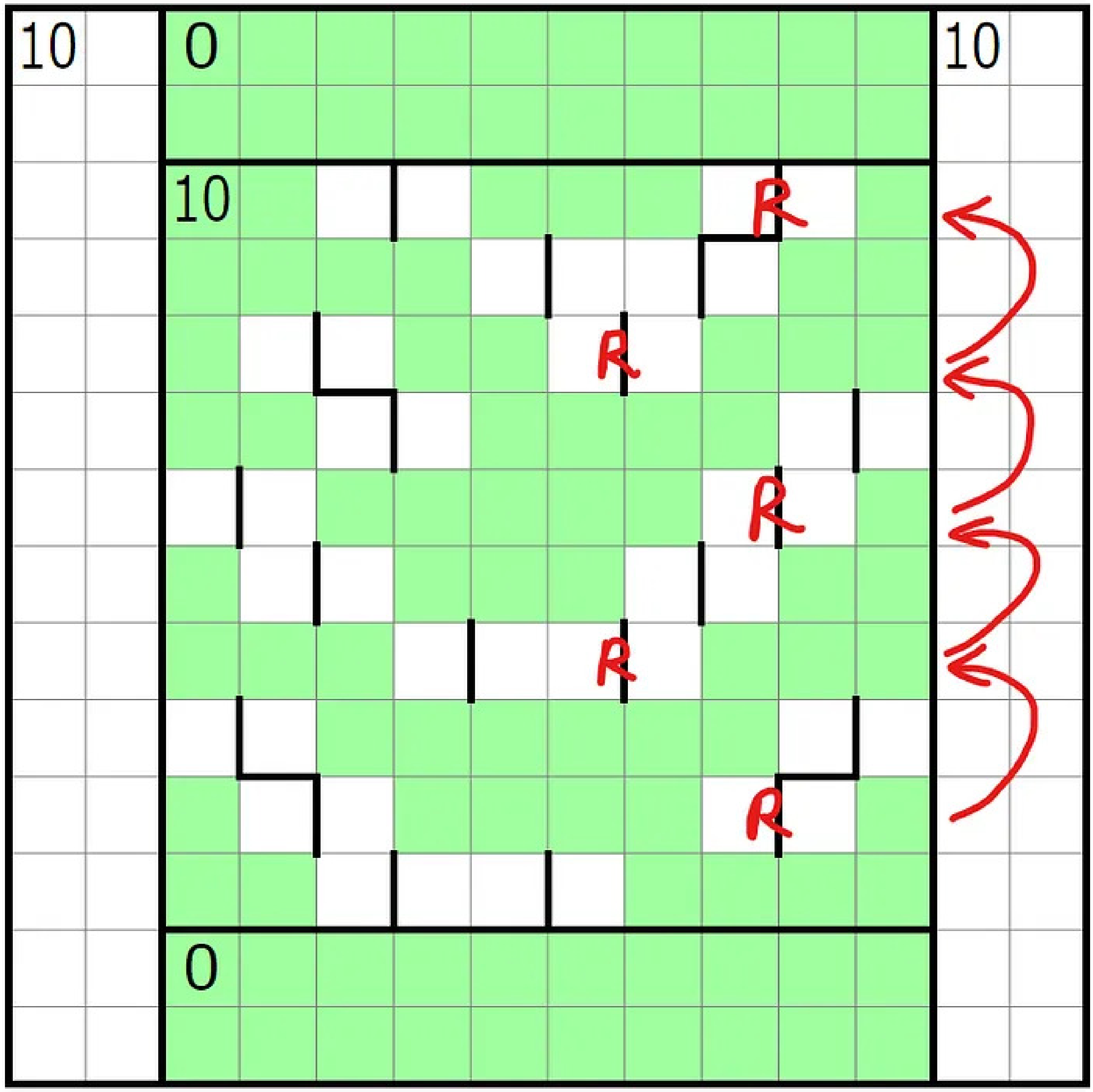
Is that enough information? Sadly, not quite. Another observation comes in handy. Consider what would happen if a row takes any of the L cells (in this case, L2) as black:



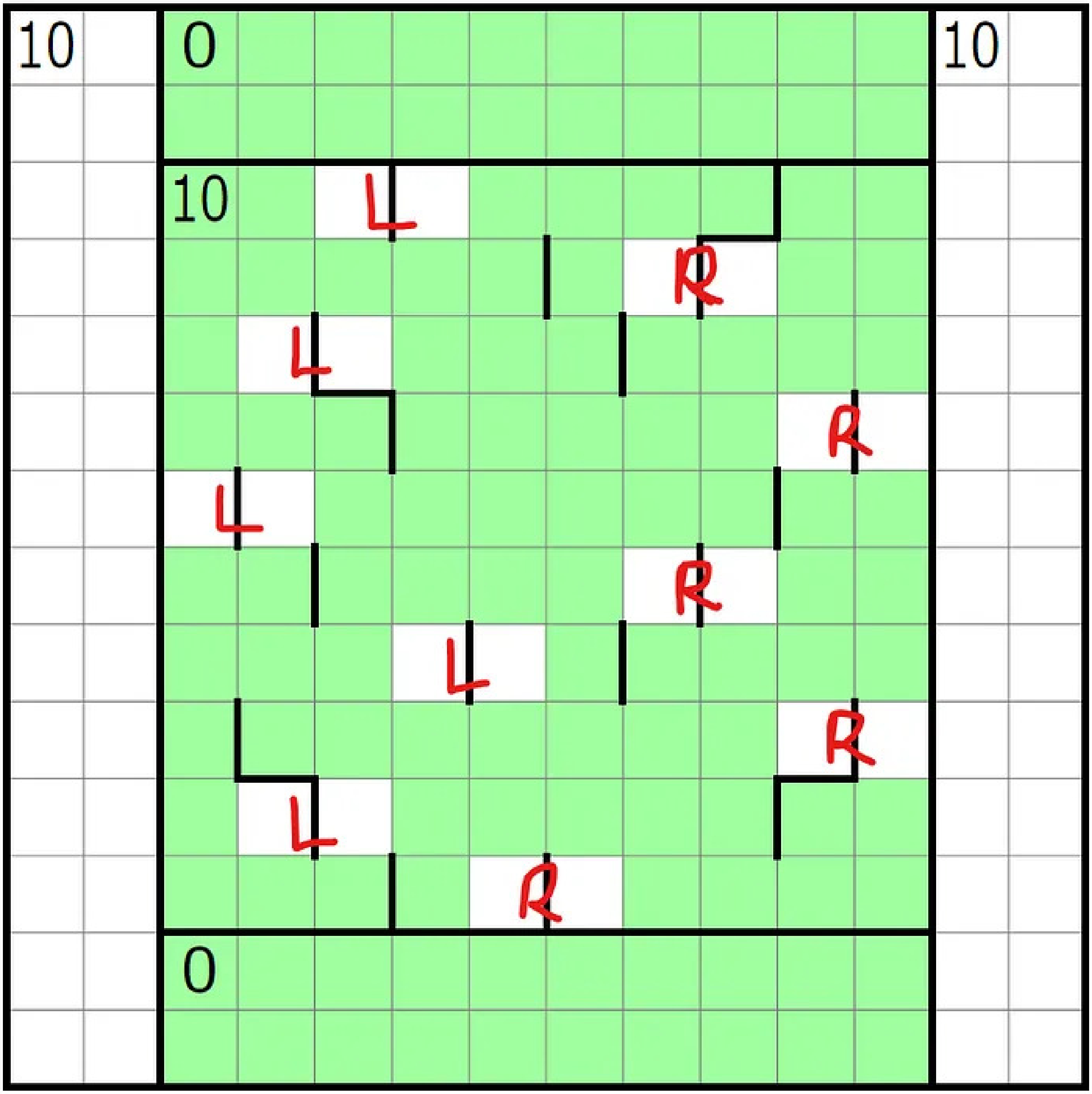
The right endpoint must be black. As a result, *the row above the current row* must take one of its R cells as black (what would happen if this weren't the case?), which in turn causes its left endpoint to be black, which causes *the row above that row* to take one of the Ls.

In order words, if a row takes L1/L2, the row above must take R1/R2, and vice versa. The rows must alternate!

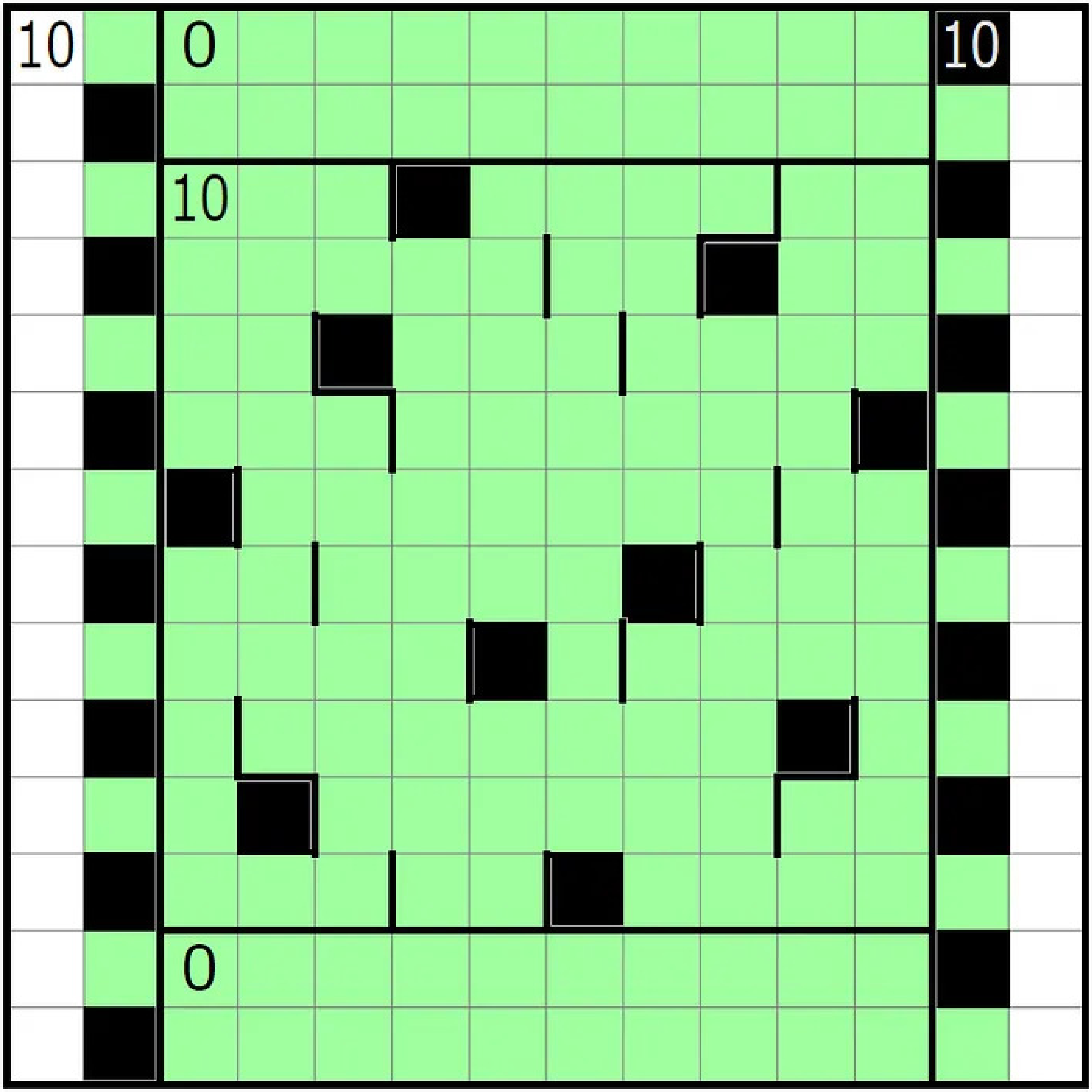
Going back to the puzzle, what happens if the 9th row takes R?



The 7th row must also take R, and then the 5th, then the 3rd, finally the 1st. That would spell disaster — you cannot cram 3 black cells into the 8th and 9th column! What that means is is that our assumption was wrong, and the odd-numbered rows must take L, and the even-numbered rows must take R.



Is that finally enough information? Yes, it is! Compounded with the horizontal walls, it is possible to uniquely determine the big 10 room. It creates interesting strips on both sides as well:



The rest of the puzzle is trivial, so I'll end my explanation here. I do hope that this idea has not previously been utilized too much, and I hope that you find it neat, despite the walls strewn all over the place.

Here's my twitter if you want to see more (occasional) Heyawake posts. Thank you plenty for reading.