

## Earthquake III: Seismology solution guide

Normal sudoku rules apply. Treat digits in the grid as buildings of that height. After an earthquake, every building in the grid taller than 5 has fallen down. Each of those buildings fell in one of the four cardinal directions, extending in a straight line a distance equal to its height, beginning in a cell orthogonally adjacent to its original cell. (It starts *next* to its original cell, leaving 0 stories behind.)

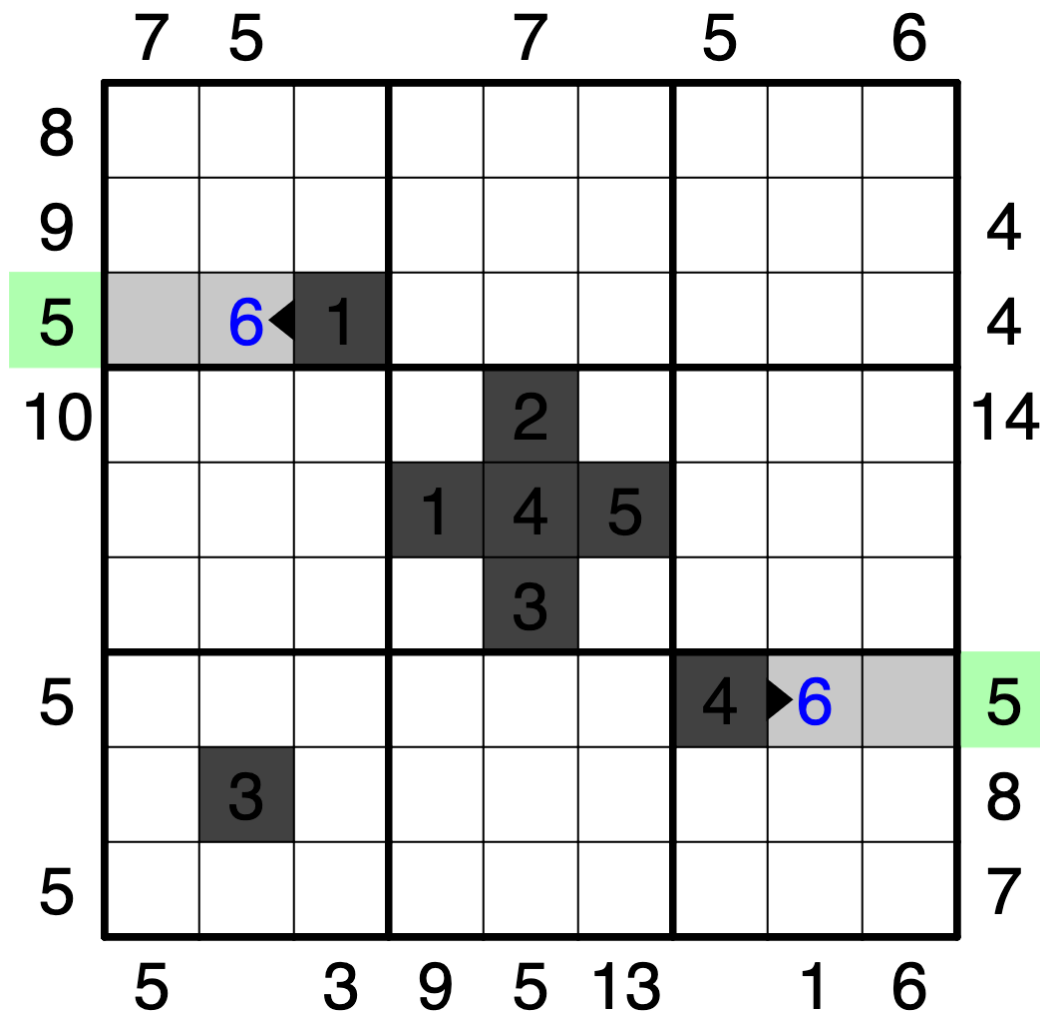
At least one story of each fallen building fell outside the grid, and the numbers outside the grid indicate how many total stories fell out in that direction from that row or column. Multiple buildings may contribute to each total, and a blank outside the grid is equivalent to a 0.

Cells in the grid that were hit by a fallen building were completely destroyed. The given digits are the only buildings still standing after the earthquake. Can you rebuild the city and return each building to its original height?

	7	5		7		5		6	
8									
9									4
5			1						4
10					2				14
				1	4	5			
					3				
5							4		5
		3							8
5									7
	5		3	9	5	13		1	6

### Step 1: Two 6s

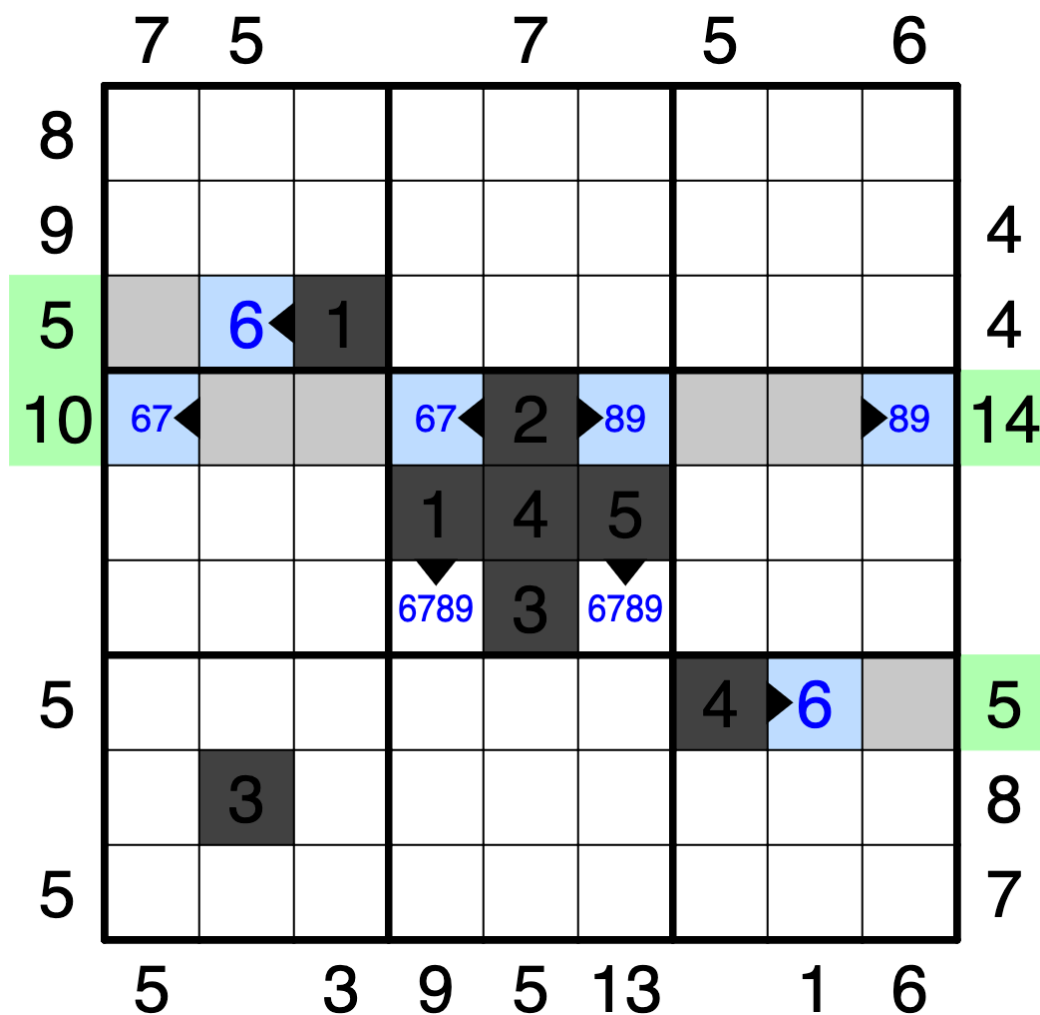
Two clues can only be satisfied in one way: the 5W at row 3 and the 5E at row 7. A 6 can be placed in r3c2 (falling west) and r7c8 (falling east).



## Step 2: Initial deductions about row 4 and box 5

A 6789 quadruple can be penciled into the four corners of box 5. Each of those buildings must fall, and can't fall across givens or fall out of the grid in a direction lacking a clue. Therefore, r4c4 must fall west, r4c6 must fall east, and r6c4 and r6c6 must both fall south.

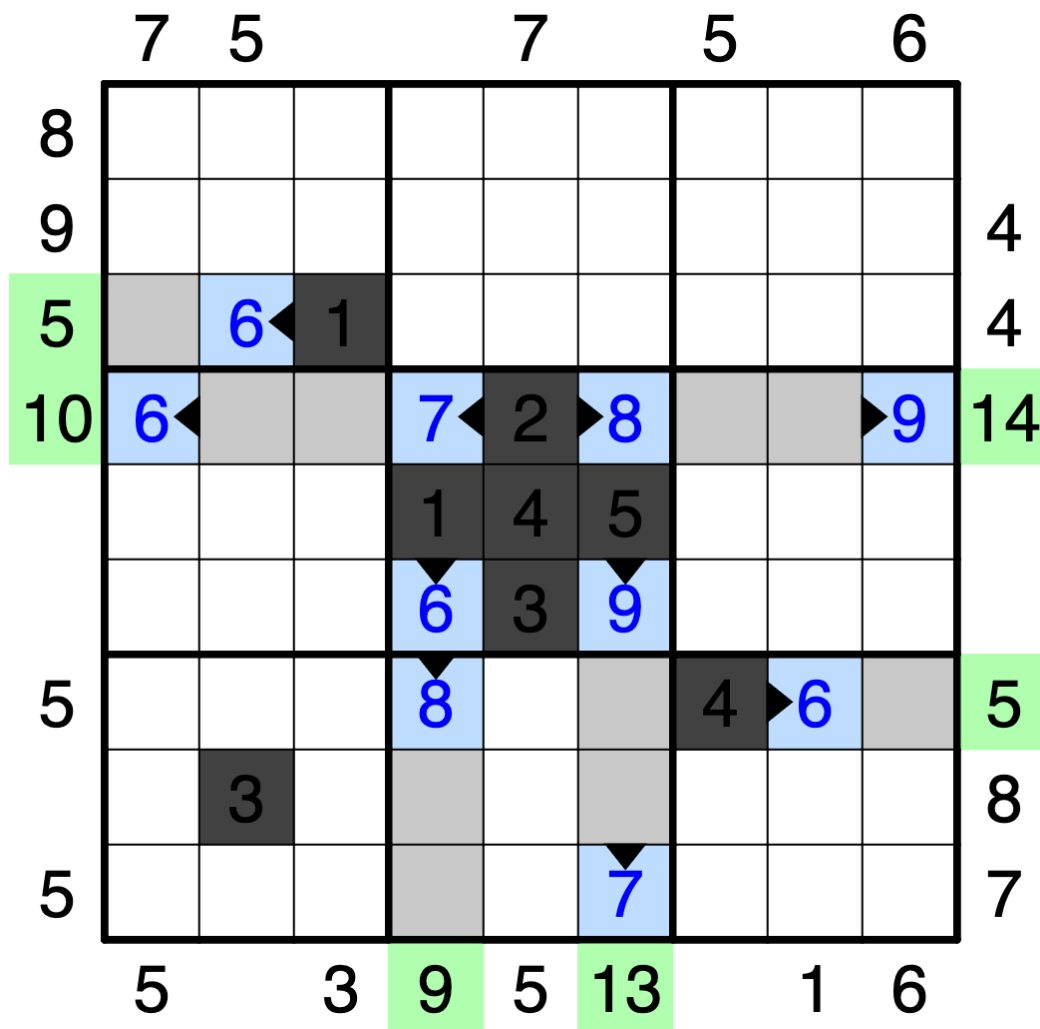
Both clues at row 4 are larger than 9, and therefore require at least two buildings to satisfy, which means they must each use exactly two buildings (since there are only four total buildings in row 4). One of the buildings for each clue must be the penciled cells in box 5. The building in r4c6 cannot be 6 or 7, or there would be more than 9 stories remaining in the clue (which would require 3 buildings), and so it must be 8 or 9, which pairs with an 8 or 9 in r6c9. The 6 or 7 in r4c4 then must pair with a 6 or 7 in r4c1 to complete the 10 clue.



### Step 3: Finishing box 5 and row 4

The 13S clue at column 6 is quite interesting now. It must include r6c6, which, by the same logic used for r4c6, cannot be a 6. The 13 clue cannot use both 8 and 9, or r4c6 would have no value, so it must use a 7. If r6c6 is an 8, then it would leave 8 stories remaining in the 13 clue, which could not be satisfied with a 7. Therefore r6c6 must be 7 or 9, which pairs with a 7 or 9 in r9c6. The 79 pair now in column 6 resolves the 89 pair in row 4.

Since the 9S at column 4 must include a building in r6c4, it cannot be satisfied by only one building and must use two. However, it cannot use both 6 and 7, or r4c4 would have no value. If r6c4 is a 7 or 9, the remaining 5 or 3 (respectively) stories in the 9S clue can't be satisfied by anything, so r6c4 must be a 6. This resolves the rest of box 5, row 4, and the 13S clue. An 8 may be placed in r7c4 to complete the 9S clue.



Box 8 now has a 7, which means that the only remaining way to satisfy the 5S clue at row 5 is a 6 in r8c5, falling south.

A 10x10 grid-based logic puzzle. The grid is divided into four 5x5 quadrants by a thick black cross. Numbers are placed in some cells, and arrows point from them to other cells. The numbers and arrows are as follows:

- Row 1: (1,1)=7, (1,2)=5, (1,4)=7, (1,6)=5, (1,8)=6
- Row 2: (2,1)=8, (2,2)=9, (2,4)=4, (2,6)=4, (2,8)=4
- Row 3: (3,1)=5, (3,2)=6, (3,3)=1, (3,4)=7, (3,5)=2, (3,6)=8, (3,7)=9, (3,8)=14
- Row 4: (4,1)=10, (4,2)=6, (4,3)=7, (4,4)=1, (4,5)=4, (4,6)=5, (4,7)=6, (4,8)=5
- Row 5: (5,1)=5, (5,2)=3, (5,4)=9, (5,5)=5, (5,6)=13, (5,7)=1, (5,8)=6
- Row 6: (6,1)=5, (6,2)=3, (6,4)=9, (6,5)=5, (6,6)=13, (6,7)=1, (6,8)=6
- Row 7: (7,1)=5, (7,2)=3, (7,4)=9, (7,5)=5, (7,6)=13, (7,7)=1, (7,8)=6
- Row 8: (8,1)=5, (8,2)=3, (8,4)=9, (8,5)=5, (8,6)=13, (8,7)=1, (8,8)=6
- Row 9: (9,1)=5, (9,2)=3, (9,4)=9, (9,5)=5, (9,6)=13, (9,7)=1, (9,8)=6
- Row 10: (10,1)=5, (10,2)=3, (10,4)=9, (10,5)=5, (10,6)=13, (10,7)=1, (10,8)=6

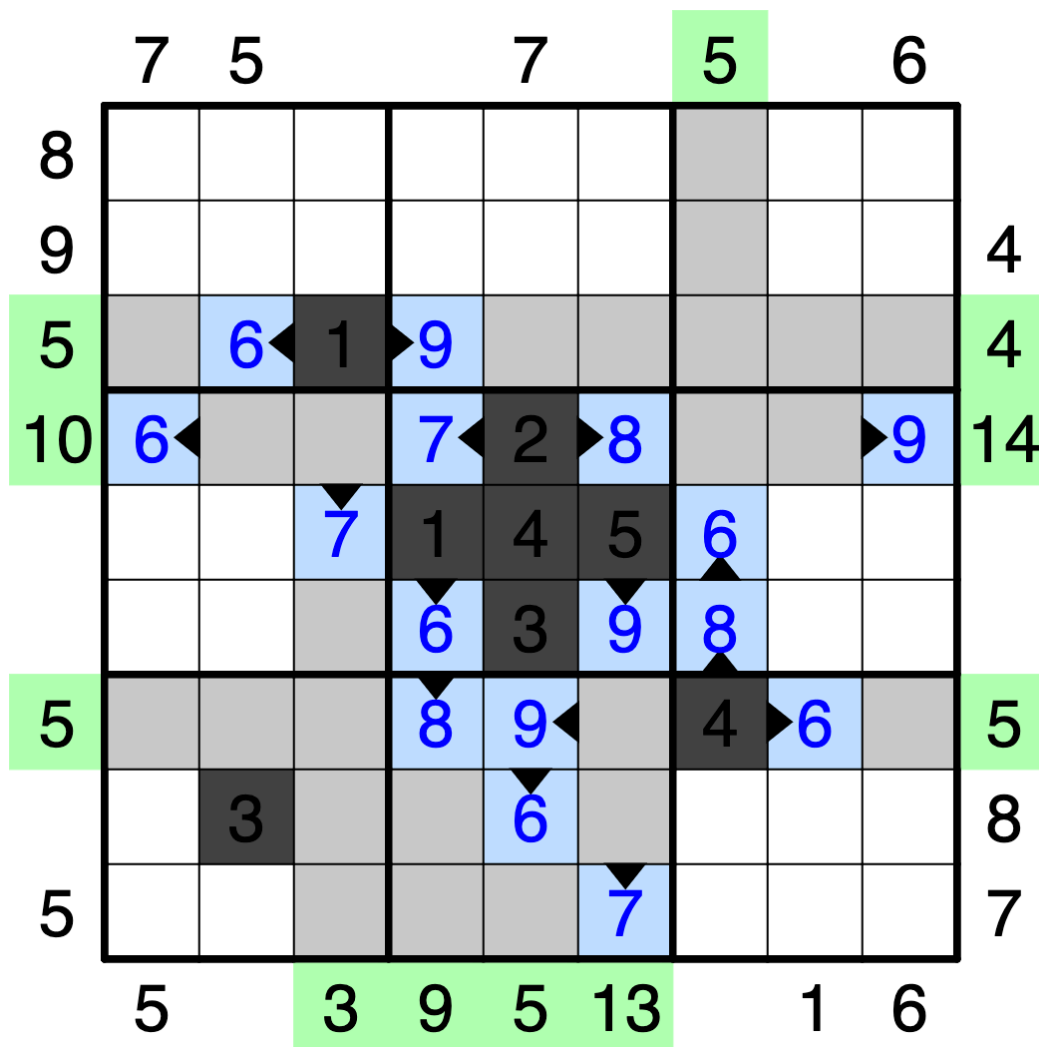
Arrows point from the following cells to the cells they indicate:

- (3,2) points left to (3,1)
- (3,4) points left to (3,3)
- (3,5) points right to (3,6)
- (3,8) points right to (3,7)
- (4,2) points left to (4,1)
- (4,4) points down to (5,4)
- (4,5) points down to (5,5)
- (4,6) points down to (5,6)
- (4,7) points right to (4,8)
- (5,4) points down to (6,4)
- (5,5) points down to (6,5)
- (5,6) points down to (6,6)
- (6,4) points down to (7,4)
- (6,5) points down to (7,5)
- (6,6) points down to (7,6)
- (7,4) points down to (8,4)
- (7,5) points down to (8,5)
- (7,6) points down to (8,6)
- (8,4) points down to (9,4)
- (8,5) points down to (9,5)
- (8,6) points down to (9,6)
- (9,4) points down to (10,4)
- (9,5) points down to (10,5)
- (9,6) points down to (10,6)

### Step 5: Constrained clues and cells

There are a lot of buildings placed in the bottom two-thirds of the grid, so the 3S clue at column 3 is quite constrained. In fact, it can only be satisfied by a 7 falling from south from r5c3.

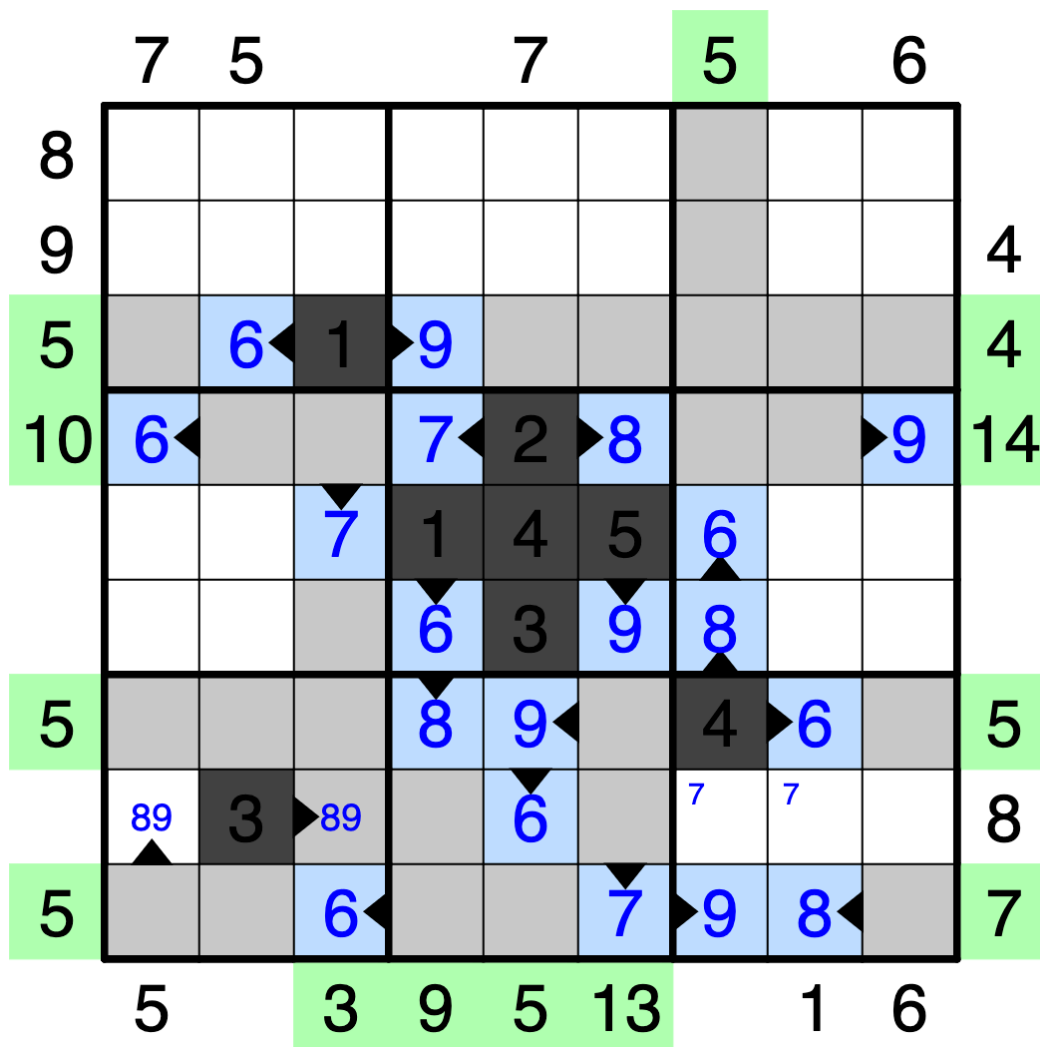
Now, there are two cells in the grid, r3c4 and r6c7, which must contain falling buildings, because they cannot be destroyed in any other way, and each can only fall in one direction. Column 4 still needs a 9, so r3c4 is a 9 falling east to satisfy the 4E clue. No building falling north from r6c7 can satisfy the 5N at column 7 by itself, so a second building is needed. Because row 4 is already full, there's nowhere to pair another building with a 7 in r6c7, so the only other option is an 8 paired with a 6 in r5c7.



## Step 6: Rows 8 and 9

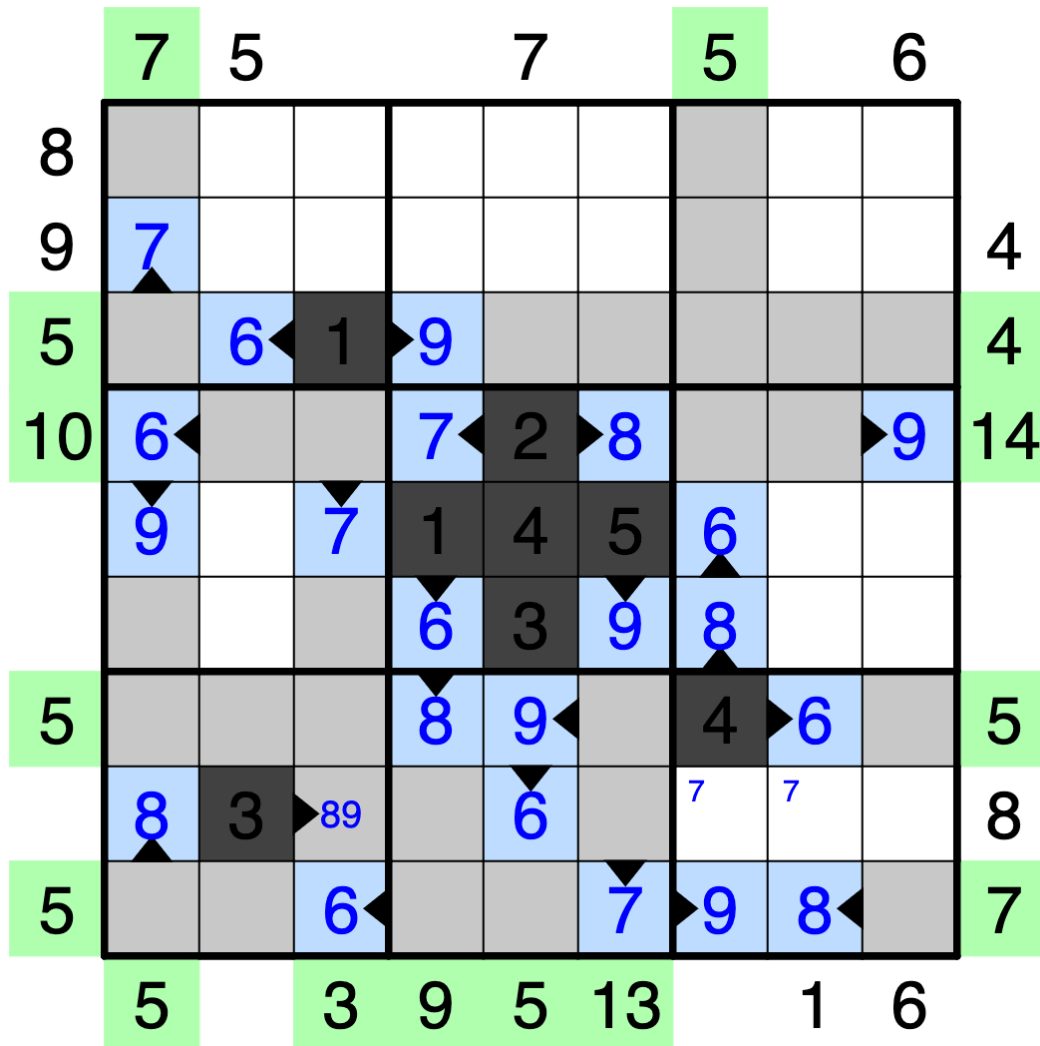
By sudoku, a 6 can be placed in r9c3. It can't fall east, because it would fall entirely inside the grid, so it must fall west. However, it only contributes 4 stories to the 5W clue, and the only building which could supply the final story is an 8 falling west from r9c8. The last building to place in row 9 is a 9, and it must satisfy the 7E clue by itself, so it falls east from r9c7.

Sudoku also gives an 89 pair in r8c1 and r8c3. Whichever of those is in r8c3 must fall east to the 8E clue, pairing with a 7 in r8c7 or r8c8. The building in r8c1 must fall north (falling south would overflow the 5S clue at column 1), and pair with something else in column 1 to satisfy the 7N clue, though it's not yet clear what.



## Step 7: Column 1

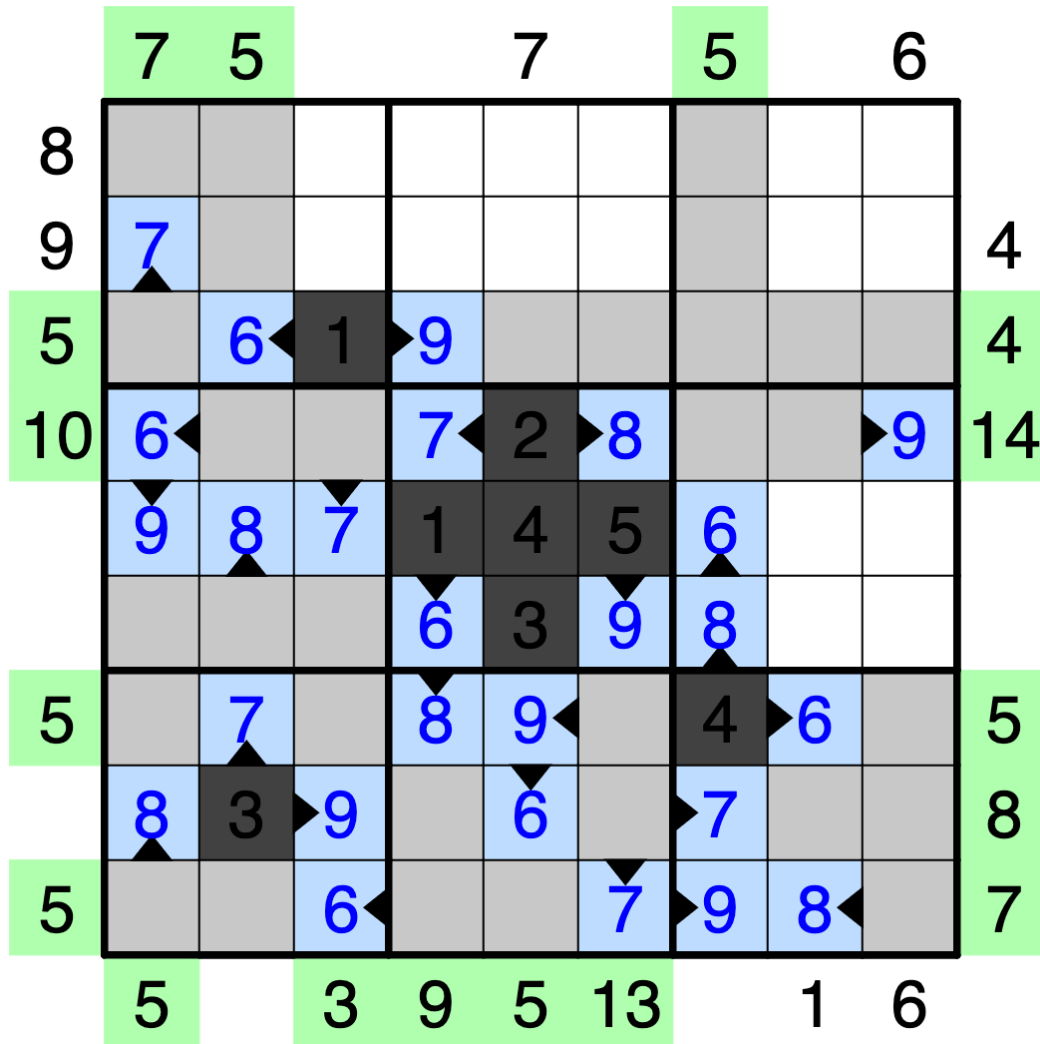
The 7N receives either 1 or 2 stories from the 8 or 9 (respectively) in r8c1. If the other building which completes the clue is the other 8 or 9, it would fall in r4c1, where a 6 has already been placed. Therefore it must pair with a 7 in r2c1 or r3c1. This leaves the other 8 or 9 in column 1 to satisfy the 5S clue by itself. Row 6 already has an 8, which disambiguates: a 9 can be placed in r5c1 falling south, an 8 in r8c1 falling north, and a 7 in r2c1 falling north to complete the 7N clue.





### Step 8: Row 8 and column 2

The 8 in r8c1 means that r8c3 is a 9, and pairs with a 7 falling east from r8c7 to complete the 8E clue at row 8. Sudoku places a 7 in r7c2, where it must fall north, and pair with an 8 falling north from r5c2 to complete the 5N clue at column 2.



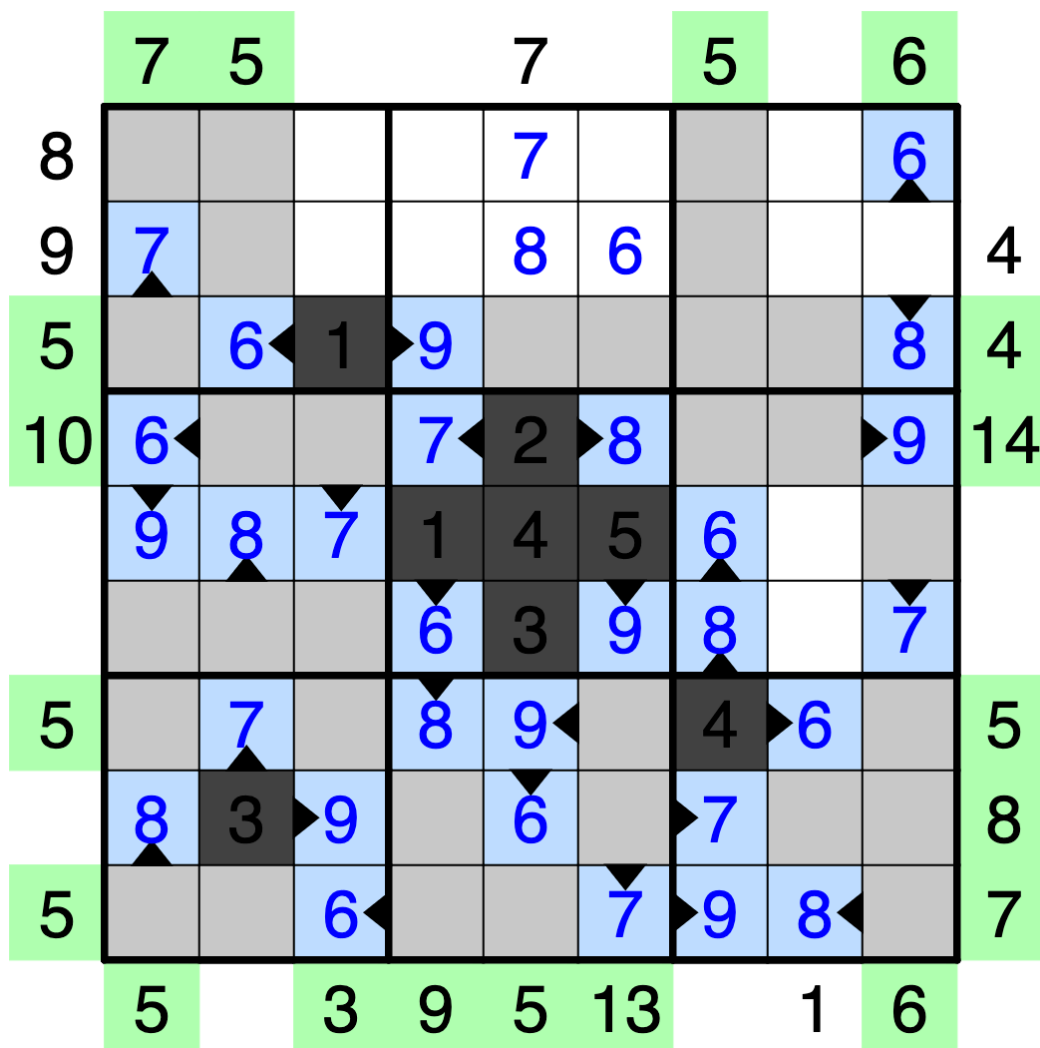
### Step 9: Column 9

Sudoku places a 7 in r6c8 or r6c9, but a 7 in r6c8 couldn't fall anywhere, so it must be in r6c9, falling north or south. The 6 and 8 in column 9 must both be in box 1. A 6 can't fall south out of the grid from box 1, so the 6 must fall north from r1c9 to fulfill the 6N clue, which leaves the 7 in r6c9 and an 8 in r3c9 to satisfy the 6S clue.

	7	5			7		5	6	
8								6	
9	7								4
5		6	1	9				8	4
10	6			7	2	8		9	14
	9	8	7	1	4	5	6		
			6	3	9	8		7	
5		7		8	9		4	6	5
	8	3	9		6		7		8
5			6			7	9	8	7
	5		3	9	5	13		1	6

## Step 10: Box 2

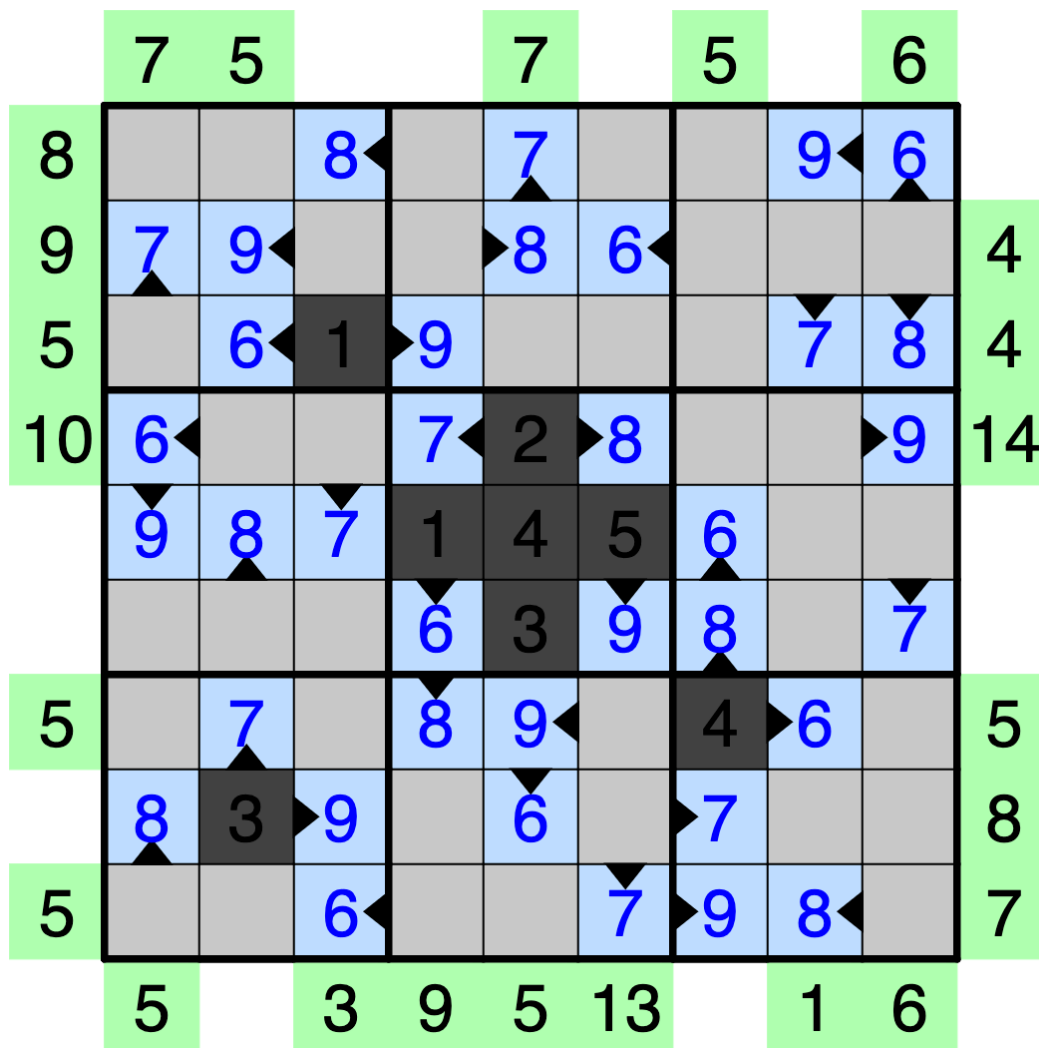
By sudoku, the 6 in box 2 must be in r2c6, where it can either fall east and contribute 3 stories to the 4E, or fall west and contribute 1 story to the 8W. Column 5 still needs a 7 and an 8, both of which must be in box 2. The 7N at column 5 can be satisfied by a 7 in r1c5 or an 8 in r2c5. Placing an 8 in r1c5 would prevent both of those, so 8 must be in r2c5, though at this point it could fall any of east, west, or north. Since the 4E at row 3 is already satisfied, a 7 placed in r3c5 couldn't fall anywhere, so it must be in r1c5, though it also could fall either west or north at the moment.



### Step 11: Loose ends

Sudoku places the final 8 in r1c3, where it must fall west and contribute 6 stories to the 8W clue at row 1. The last two stories for that clue must come from a 9 falling west from r1c8, leaving the 7 in r1c5 free to complete the 7N clue at column 5.

Three clues remain to be completed, with two buildings left to place. A 9 in r2c2 can fall west along with the 6 in r2c6 to complete the 9W clue, which allows the 8 in r2c5 to fall east for the 4E clue at row 2. Finally, the last building in the grid is a 7 placed in r3c8, falling south to satisfy the 1S clue at column 8. As a check, every non-given cell was destroyed.



**Step 12: Fin.**

All that remains is solving the 12345s with classic sudoku. The completed grid:

	7	5		7		5		6	
8	3	5	8	4	7	1	2	9	6
9	7	9	2	3	8	6	1	5	4
5	4	6	1	9	5	2	3	7	8
10	6	1	3	7	2	8	5	4	9
	9	8	7	1	4	5	6	3	2
	5	2	4	6	3	9	8	1	7
5	1	7	5	8	9	2	4	6	3
	8	3	9	5	6	4	7	2	1
5	2	4	6	3	1	7	9	8	5
	5		3	9	5	13		1	6