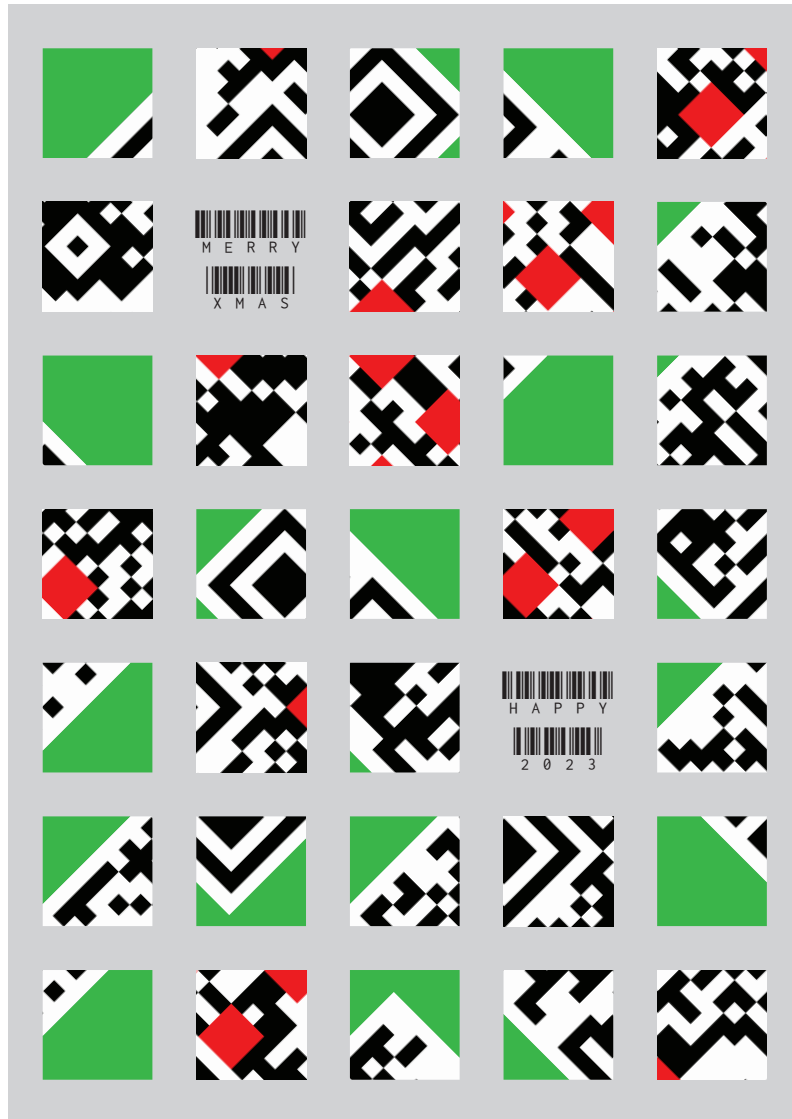


# Christmas puzzle 2022



Solution booklet



## Dear puzzler

This year I went for a more straightforward approach. And yes, for me straightforward still includes linking at least two puzzles together, because I love doing that too much to drop it entirely.

But let's be honest, a jigsaw is pretty straightforward. And the sudoku is one of the more popular variants out there, so chances were you'd already solved one before (that is, if you're into puzzling, which I am well aware not everyone is).

So I guess the word I'm looking for is approachable?

I really really wanted to do a jigsaw at some point, but with a twist. How about the pieces are all square? To make it fair, I needed a picture that would imply edges. I considered making 'the next puzzle' (probably a sudoku) the picture, but I didn't like that the grid aligned with the square pieces. This might lead to ambiguity. Rotating everything 45 degrees was a real breakthrough, and it inspired me to look for other 'square stuff'. The most visually striking result came from using a QR code. Really happy with how the front turned out; using barcodes for the holiday message was a cool finishing touch.

I don't want every other card to have a sudoku, but I do like them a lot, especially variant sudokus. Kropki sudokus, with their white and black dot clues, have an interesting abstract look, and I needed to avoid the clutter of number clues to allow for the arrows. I'd been brooding on using that trick for a long time - it's a very elegant way of turning numbers into black and white (odd/even is another, but that puts difficult constraints on the puzzle). Although in retrospect the arrows could have been a touch lighter, perhaps.

As I wrote this booklet I came to realise that a chain of four steps is perhaps not as straightforward as I initially felt... Hopefully the activities involved were not too cumbersome. As always though, (trying to) solve the card is *never* an expectation!

But since you're reading this, I guess you did (or at least tried). I hope you managed it, and more importantly, enjoyed it.

Here's one way to solve the card and get at the yummy creamy center.

## Step one. (Copy and) solve the jigsaw

In case it wasn't obvious, the front is a jigsaw. The pieces form a picture made up of black and white squares (more on the red later) and some of the pieces, like for instance this one, should give you a big hint that this might be QR-code related (also - these tend to crop up A LOT in my puzzles - they are SO useful as a puzzle element).



There really isn't much in the way of strategy for this one, so I'll just give the solution. But just in case it wasn't obvious - you'll need the backside too, so don't cut up the card, make a copy first. Well, it's your prerogative of course. I won't cry if you cut up my beautiful card, honest.



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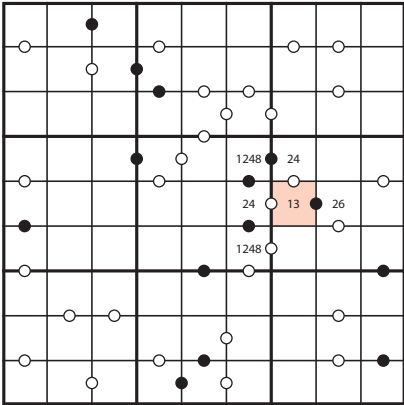
### Everything you never wanted to know about QR-Codes

A QR-Code visually encodes information so that it can be read even if a bit of it is damaged. Every black block is a 1 and every white block is a 0, but some of them are fluff to make the fixing possible. So to make a QR-Code unreadable, you have to damage it in the right way, like I did with the red squares.

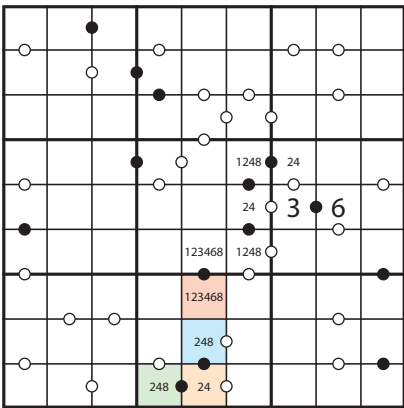
The size and complexity of a code varies with the size of the data in it, as well as how much damage it can fix, but some features are always there, to help the scanner orient itself. There will always be 3 large 'bulls-eye' squares in the corners. You can also find a smaller one in the remaining, bottom right, corner (the really large ones will have up to six more). There's also two 'dotted lines' connecting the 3 bulls-eyes - if those are even slightly damaged the code is irreparable. See if you can identify them!

## Step two. Solve the kropki sudoku

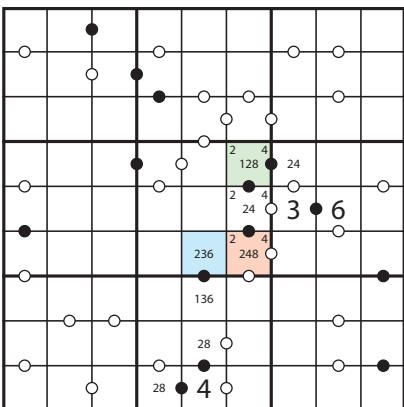
A kropki sudoku has no given digits (well usually) but instead gives you hints indirectly. A white dot is given between every pair of digits that differ by one, and a black dot between pairs of digits that differ by a factor of two. Many kropkis, like this one, state 'every possible dot is given' meaning the *absence* of a dot between two cells also carries information: the digits will certainly not differ by 1 or a factor of 2 in that case!



Ok, so how do we solve this? There's a few things you can always do in a kropki. First, 5, 7, and 9 can never appear next to a black dot. Second, a chain of 2 or 3 black dots *in a single box, row or column* can't contain a 3 or 6; the digits 1, 2, 4, and 8 must occur in order along the chain. If white dots also appear in the vicinity you can often limit the choices far enough to find a break in. This kropki is no different. The illustration shows the choices that remain for a few cells clustered around **R5C7**. While two possible digits remain, it is easy to see that filling in 1 would cause both R5C6 and R5C8 to be 2, which isn't allowed in the same row.



So, R5C7 must be 3, and that means R5C8 is a 6. Unfortunately we don't gain any knowledge about the other four cells. Luckily we can use the same trick elsewhere. You see, a 1 can never occur between two dots in the same box (3x3 area), row or column, and it doesn't matter if the dots are white or black: each of the two neighbouring cells would have to be 2. This is not so useful for, say, R2C8 right now, but eliminating 1 from **R8C5** and **R9C4** is. Those two cells can now also not be 4 (it would make a 4-2-1 chain), which means they are a 2/8 pair and **R9C5** is 4! These digits are no longer possible in **R7C5**, where only 1, 3, and 6 remain.



Now let's look in box 5 (the central one). First, the options for **R6C5** are reduced because of R7C5 - only 2, 3, and 6 remain. Then we can eliminate the 1 from **R6C6** (the 2/8 pair prevents R7C6 from being a 2) - and this means **R4C6** can no longer be a 4. Depending on what **R6C6** turns out to be, from bottom to top we'll have either 2-4-8, 4-2-1, or 8-4-2. Note that this always includes the 2 and the 4, so these form a virtual pair (we use corner notation) and now **R6C5** can no longer be a 2. On either side of the black dot now only 3/6 remain, although we don't know yet in what order.

### A word about notation

This booklet uses Snyder notation, introduced by Thomas Snyder and popularized by Cracking the Cryptic. In this example, 2 and 7 are the only possible digits remaining for the middle-top and center cells; they are grouped in the cells' centers to signify this. When we put a digit in the corner of several cells, this means these are the only cells the digit could possibly occur (in the example 1, 3, 4, 8, and 9 are such digits).

This allows both constraints to be tracked clearly and simultaneously. We also strive to avoid clutter by only noting down 'sufficiently' constrained candidates like this.

|   |   |    |     |
|---|---|----|-----|
| 4 | 8 | 27 |     |
| 9 |   |    |     |
|   |   | 27 | 1 3 |
|   |   |    | 8 9 |
| 1 | 3 | 1  | 9   |
| 4 |   |    |     |

Now let's look at the possibilities for **R4C4**. It's next to a black dot so 579 are out. 24 are also out because of the virtual 2/4 pair in column 6. 1 is out because the cell is between two dots in the same box. This leaves 368. This in turn limits the possibilities in **R4C5** to 2579 (4 is already in the column) and that means **R3C5** can only be 368 (not 1, because this cell is also between two dots in the same box). But we already have a 3/6 pair in column 5 so these can't occur in **R3C5** either, so it must be 8 (see diagram)!

Now **R4C5** reduces further to 79 and **R4C4** to 68.

But we can get more digits! The white-dot neighbours of the 8 must each be 7 or 9 (see diagram).

But if we put a 9 in **R3C6** there would be another 8 in **R3C7**, so **R3C6** is a 7, **R2C5** is a 9, and **R3C7** is a 6.

**R4C5** now also resolves to a 7, but unfortunately this doesn't help with **R4C4**. We can now limit **R5C4** to 59 though.

We get another 6 in **R2C6**. Now we look at the chain of black dots in box 2. The 8 in **R3C5** removes some options: **R3C4** can only be 124, **R2C4** only 24, and **R2C3** can only be 248.

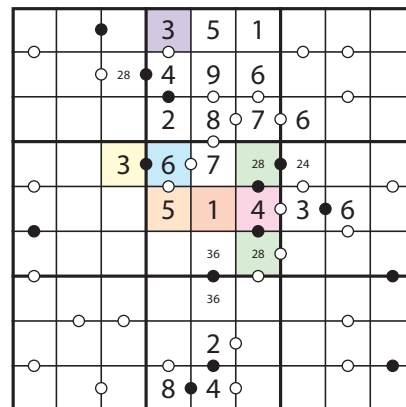
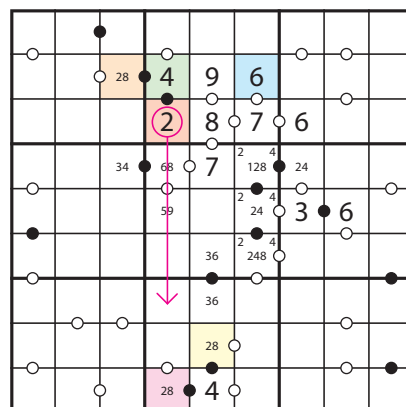
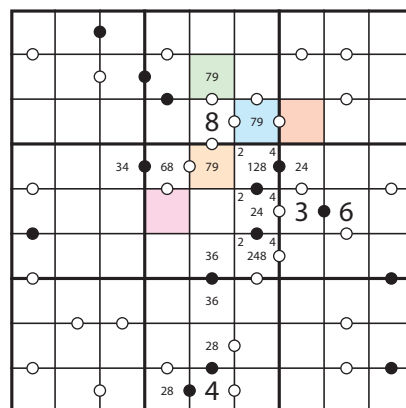
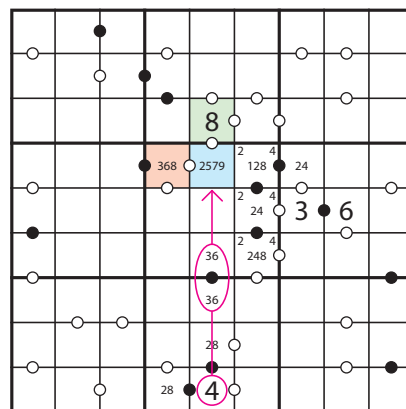
Now let's see where in box 2 the 4 could occur. Not in **R1C6** (because of the virtual 2/4 pair), nor in **R1C5**, and **R1C4** can only be 135. It also can't be put next to the 8 so only **R2C4** remains and **R3C4** is a 2; **R2C3** can only be 28 (see diagram).

This eliminates the 2 from **R9C4**, which must be an 8, and **R8C5** must be a 2.

Now we gain a lot of progress in box 5. First, **R4C4** can no longer be 8, so it is a 6 and **R4C3** and **R5C4** resolve to 3 and 5 respectively. **R5C5** could only be 15 (the only options left in the column) so that is now a 1 (and **R1C5**, the last open cell in the column, is a 5).

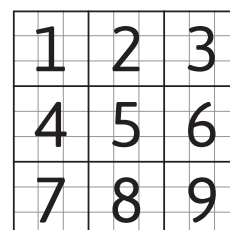
(This finishes off box 2 - **R1C4** can now only be a 3 after all.)

On the right side of box 5, either **R4C6** or **R6C6** is an 8, which means **R5C6** is definitely a 4. **R4C6** and **R6C6** become a 2/8 pair.



### Box numbering

Rather than refer to the 3x3 boxes as "top left" etc, the convention is to number them from left to right and from top to bottom (in reading order). So, the top left box is box 1, the central box is box 5, and the bottom middle box is box 8. It seems only fair that we use numbers to describe the parts of a sudoku, doesn't it?



|   |   |   |    |   |   |   |    |  |  |
|---|---|---|----|---|---|---|----|--|--|
|   |   | ● |    | 3 | 5 | 1 |    |  |  |
|   | ○ | ○ | 28 | ● | 4 | 9 | 6  |  |  |
|   |   |   |    | 2 | 8 | 7 | 6  |  |  |
|   |   | 3 | 6  | 7 | 2 | ● | 24 |  |  |
| ● |   |   | 5  | 1 | 4 | 3 | 6  |  |  |
|   |   |   | 9  | 3 | 8 |   |    |  |  |
|   |   |   | 1  | 6 | 9 |   |    |  |  |
|   |   |   | 7  | 2 | 3 |   |    |  |  |
|   |   |   | 8  | ● | 4 | 5 |    |  |  |

We still have to put a 9 in box 5 so that has to go into R6C4. Since box 2 and 5 now each have a 5 and a 9, we know these must occur in column 6 in box 8. The only option for the 9 is R7C6, and then the 5 can only go into R9C6, and R8C4 has to be a 7.

It's now obvious where to put the 1 and 3 in box 7. We can now also resolve the 2/8 pair in box 5, because of the 9 in R7C6.

Since we already have a 6 in columns 4 and 6, we now know that R7C5 must also be a 6, resolving the black dot. (Alternatively, the 6 in box 5 forces R6C5 to be a 3).

|   |   |   |    |   |   |   |   |   |  |
|---|---|---|----|---|---|---|---|---|--|
|   |   | ● |    | 3 | 5 | 1 |   |   |  |
|   | ○ | ○ | 28 | ● | 4 | 9 | 6 |   |  |
|   |   |   |    | 2 | 8 | 7 | 6 |   |  |
|   |   |   |    |   |   |   |   |   |  |
|   | 5 | 3 | 6  | 7 | 2 | 4 |   | 8 |  |
|   |   |   | 5  | 1 | 4 | 3 | 6 |   |  |
| ● |   |   | 9  | 3 | 8 | 7 | 5 |   |  |
|   |   |   | 1  | 6 | 9 |   |   |   |  |
|   |   |   | 7  | 2 | 3 |   |   |   |  |
|   |   |   | 8  | ● | 4 | 5 |   |   |  |

We can now also resolve R4C7 and R6C7 to 4 and 7 respectively. Now R6C8 can only be a 5 anymore.

Now we can put the 5 in box 4 as well - it can only be in row 4, but if we put it in R4C1, the only options for R5C1 are 4 or 6, both of which are already in row 5. So the 5 goes into R4C2.

The last 3 digits for row 4 are 1, 8, and 9. An 8 in R4C1 would put a 9 in R5C1, next to a black dot. The 8 also can't go next to the 4 in R4C7, or there would have to be a black dot there. So 8 goes into R4C9.

|   |   |   |    |   |   |   |   |   |  |
|---|---|---|----|---|---|---|---|---|--|
|   |   | ● |    | 3 | 5 | 1 |   |   |  |
|   | ○ | ○ | 28 | ● | 4 | 9 | 6 |   |  |
|   |   |   |    | 2 | 8 | 7 | 6 |   |  |
|   |   |   |    |   |   |   |   |   |  |
| 9 | 5 | 3 | 6  | 7 | 2 | 4 | 1 | 8 |  |
| 8 | 2 | 7 | 5  | 1 | 4 | 3 | 6 | 9 |  |
| ● |   |   |    |   |   |   |   |   |  |
| 4 | 6 | 1 | 9  | 3 | 8 | 7 | 5 | 2 |  |
|   |   |   | 1  | 6 | 9 |   |   |   |  |
|   |   |   | 7  | 2 | 3 |   |   |   |  |
|   |   |   | 8  | ● | 4 | 5 |   |   |  |

But now we also know the 9 goes into R4C1 (the 8 has no white dot next to it) and then all that remains for R4C8 is the 1. There is a white dot below the 9, so R5C1 is an 8, and then R6C1 has to be a 4.

The 7 in box 4 has to be in row 5, and it can't be next to the 8, so it goes in R5C3. And the 6 has to go in row 6, but it can't go below the 7, so it goes in R6C2. Thanks to the 1 in box 5 the 1 and 2 now can be placed in box 4 as well. This in turn resolves box 6.

Only the corner boxes left!

|   |   |   |    |   |   |   |   |   |   |
|---|---|---|----|---|---|---|---|---|---|
|   |   | ● |    | 3 | 5 | 1 |   | 2 | 7 |
|   | ○ | ○ | 28 | ● | 4 | 9 | 6 | 3 | 5 |
|   |   |   |    | 2 | 8 | 7 | 6 | 4 | 1 |
|   |   |   |    |   |   |   |   |   |   |
| 9 | 5 | 3 | 6  | 7 | 2 | 4 | 1 | 8 |   |
| 8 | 2 | 7 | 5  | 1 | 4 | 3 | 6 | 9 |   |
| ● |   |   |    |   |   |   |   |   |   |
| 4 | 6 | 1 | 9  | 3 | 8 | 7 | 5 | 2 |   |
|   |   |   | 1  | 6 | 9 |   | 7 | 4 |   |
|   |   |   | 7  | 2 | 3 |   | 8 | 6 |   |
|   |   |   | 8  | ● | 4 | 5 | 9 | 3 |   |

Now we look at the black dot between R8C9 and R9C9. We can eliminate 2, 4, and 8 from R9C9, because these digits are already in the row and/or column, but 1 is also impossible: it would force a 2 into R8C9 and there is already a 2 in row 8. So R8C9 must be a 6 and R9C9 must be a 3.

Now the only set of 3 consecutive digits that could go into column 8 in box 9 is 789 (top to bottom, because of the 9 in row 7) and in box 3 we get 234 for the 8th column (also top to bottom because of the 2 in row 3). There is now only one location left for the 4 in box 9 - R7C9.

Now R3C9 is a naked single - the only 2 digits not already in the row or column are 5 and 1, and the 5 can't go next to the 4. This in turn makes R1C9 a naked single (7) and the 5 goes into R2C9.

The puzzle collapses now. First we put the 8 and 9 in box 3. This resolves R2C3 to a 2, which in turn means R2C2 must be a 1. We complete the row with a 7. Since there is already a 3 in row 1, the 6 can't be next to the black dot and goes into R1C1. There is only one option for the black dot - 4/8, left to right.

Since we have a 1 in columns 2 and 3, as well as row 7, R89C1 must be a 1/2 pair, and the 2 can't go in row 8. This forces the 2 in box 9 into R7C7 and the 1 and 5 are now obvious (see diagram).

The rest is trivial - consider where the 3 and 4 go in box 7.

There's only one remaining spot for each of them and then it's just a simple matter of completing the last few dots and filling in each row or column with 8 digits in it. The complete solution is shown to the right.

|   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|
| 6 | 4 | 8 | 3 | 5 | 1 | 9 | 2 | 7 |
| 7 | 1 | 2 | 4 | 9 | 6 | 8 | 3 | 5 |
|   |   |   | 2 | 8 | 7 | 6 | 4 | 1 |
| 9 | 5 | 3 | 6 | 7 | 2 | 4 | 1 | 8 |
| 8 | 2 | 7 | 5 | 1 | 4 | 3 | 6 | 9 |
| 4 | 6 | 1 | 9 | 3 | 8 | 7 | 5 | 2 |
|   |   |   | 1 | 6 | 9 | 2 | 7 | 4 |
| 1 |   |   | 7 | 2 | 3 | 5 | 8 | 6 |
| 2 |   |   | 8 | 4 | 5 | 1 | 9 | 3 |

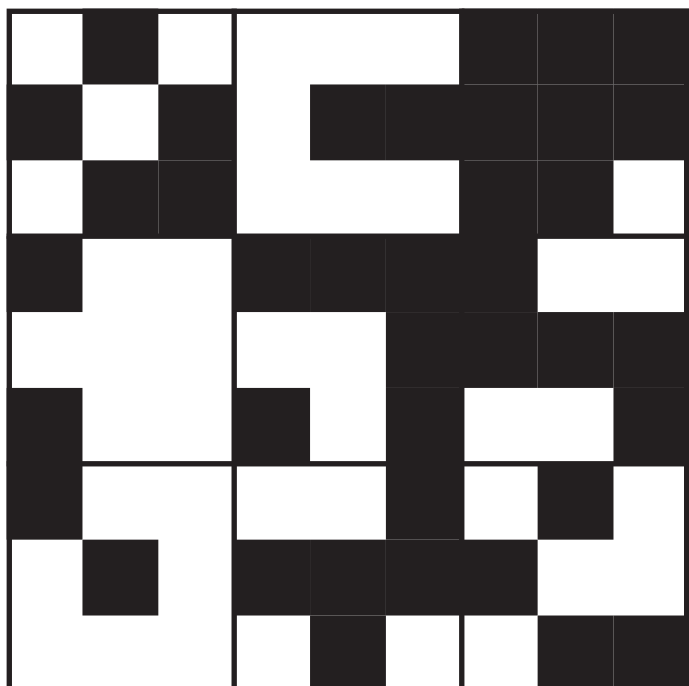
|   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|
| 6 | 4 | 8 | 3 | 5 | 1 | 9 | 2 | 7 |
| 7 | 1 | 2 | 4 | 9 | 6 | 8 | 3 | 5 |
| 5 | 3 | 9 | 2 | 8 | 7 | 6 | 4 | 1 |
| 9 | 5 | 3 | 6 | 7 | 2 | 4 | 1 | 8 |
| 8 | 2 | 7 | 5 | 1 | 4 | 3 | 6 | 9 |
| 4 | 6 | 1 | 9 | 3 | 8 | 7 | 5 | 2 |
| 3 | 8 | 5 | 1 | 6 | 9 | 2 | 7 | 4 |
| 1 | 9 | 4 | 7 | 2 | 3 | 5 | 8 | 6 |
| 2 | 7 | 6 | 8 | 4 | 5 | 1 | 9 | 3 |

### Step three. Follow the arrows

Now let's remove the kropki dots and reinstate the arrows. There is one arrow that starts outside the diagram, indicating the starting spot. This needs to be white. Then we follow the arrows, each time when the number goes up, the next cell becomes black, and whenever it goes down, the next cell becomes white. That shouldn't be too hard to figure out! Interesting: all 1's must necessarily be white, and all 9's black!

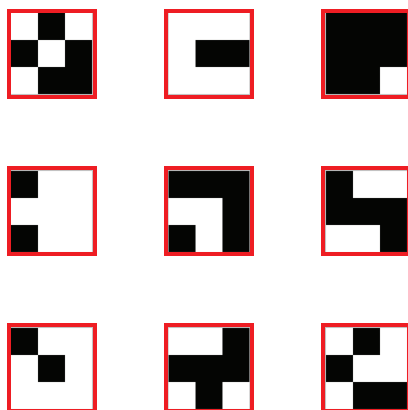
Below is the resulting colored diagram.

|   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|
| 6 | 4 | 8 | 3 | 5 | 1 | 9 | 2 | 7 |
| 7 | 1 | 2 | 4 | 9 | 6 | 8 | 3 | 5 |
| 5 | 3 | 9 | 2 | 8 | 7 | 6 | 4 | 1 |
| 9 | 5 | 3 | 6 | 7 | 2 | 4 | 1 | 8 |
| 8 | 2 | 7 | 5 | 1 | 4 | 3 | 6 | 9 |
| 4 | 6 | 1 | 9 | 3 | 8 | 7 | 5 | 2 |
| 3 | 8 | 5 | 1 | 6 | 9 | 2 | 7 | 4 |
| 1 | 9 | 4 | 7 | 2 | 3 | 5 | 8 | 6 |
| 2 | 7 | 6 | 8 | 4 | 5 | 1 | 9 | 3 |



## Step four. Fix the QR and scan

The QR code has 9 'holes' that are conveniently 3x3 units. If we split the sudoku apart into its boxes, we have the elements to fix the QR code:



+



Below is the repaired QR code; it should be scannable with any modern mobile phone. If you do, you get the following message:

Into the next year without worry or fear  
Let yesterdays sorrow yield to hopes for tomorrow

(I'm not a great poet but at least the sentiment is heartfelt)



## Conclusion

I was really proud of this one. The front looks christmassy as well as 'me', and the elements combine well. Another notch in the belt!

It's taken a while to make this booklet, you know how the new stuff is always way cooler than what's been already. And I bet you solved it all on your own anyway.

I've already started on the next one (to be perfectly frank, I'm always thinking about the next one, if anything, I have too many ideas sometimes) and... well we'll have to see how it pans out.

As always I hope you've enjoyed solving this card as much as I liked making it, and here's to the next one.