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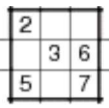
Avoidable Rectangles

From sudokuwiki.com, the puzzle solver's site



Avoidable Rectangles are a most unusual strategy - and, to this author's knowledge, the only one that makes use of solved cells. We are used to the idea that a solution kills all the other numbers of the same value along the row, column and box, meaning that all information about that cell has been used up. Apparently, this is not so.
To understand this strategy, we have to put ourselves in the shoes of the puzzle creator, not the puzzle solver.

Consider the solution in diagram to the right. We have four cells that are shaded. To create a sudoku puzzle, some removal process has to take place - some method of taking out numbers so that they can be filled in again by a puzzle solver. The crucial constraint is that the puzzle must have a unique solution. If the puzzle maker removed all four shaded cells, then there would be at least two solutions, since the 1 and the 2 are interchangeable in this situation.

	1	2	3	4	5	6	7	8	9
A	5	6	9	4	8	3	7	2	1
B	3	8	2	9	1	7	5	6	4
C	7	4	1	5	2	6	8	3	9
D	4	7	5	6	3	2	1	9	8
E	9	2	6	1	5	8	4	7	3
F	1	3	8	7	4	9	6	5	2
G	8	1	3	2	7	5	9	4	6
H	2	9	7	8	6	4	3	1	5
J	6	5	4	3	9	1	2	8	7

Avoidable Rectangle

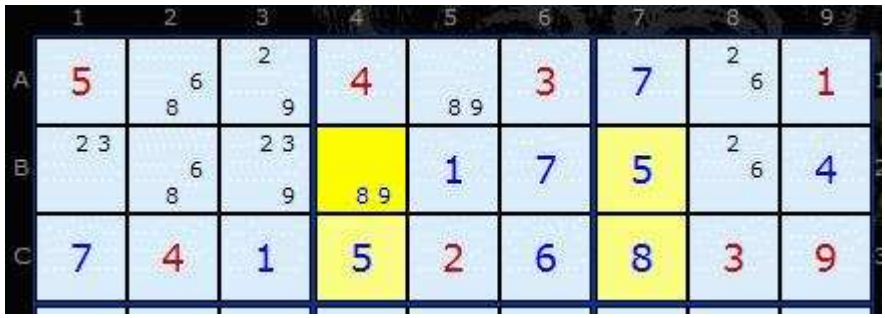
Notice that we are talking about a rectangle that crosses exactly two boxes. This is the same deadly pattern formation we're discussed with Unique Rectangles. If our four cells are in four boxes, the puzzle maker can remove all numbers, since they are not interchangeable. To the puzzle maker, the four shaded cells above are an "**unavoidable set**": he or she can't avoid leaving one or more of these numbers as a clue.

	1	2	3	4	5	6	7	8	9
A	5			4		3			1
B									
C		4			2			3	9

Avoidable Rectangle

There are millions of possible puzzles derivable from a completed sudoku board. The top third of the puzzle above is just one example. Notice, however, that at least one of the four cells (C5) from our example is a clue - which avoids creating a double solution .

The next picture shows the state of play (in the top third of a puzzle) near the end. From the point of view of the puzzle solver aware of “unavoidable sets”, we can spot a very interesting rectangle in **B4**, **C4**, **B7** and **C7**. It seems that we’ve found an interchangeable pair of 5s and 8s.



Avoidable rectangle

Work on the puzzle so far has fixed 5 in C4 and B7 and 8 in C7, but the final corner has two options - an 8 or a 9. If B4 really were an 8, then we’d have the same situation as in the case of the 1 and 2 where the puzzle maker was forced to leave a clue. Since our newly identified rectangle does not contain a clue in the corners, we can’t have an interchangeable pair here. The 8 is not a valid solution, so we can remove it and place a 9 in B4.

So the rule of Avoidable Rectangles is:

We can remove a candidate that forms a potential interchangeable pair with three other cells spread over two boxes where the three other cells are solved cells (not clues).

Extentions of this strategies are documented in my book The Logic of Sudoku.

Comments...

Saturday 12-Dec-2009

... by: paolo

can't get your example, but maybe I'm missing something.
In the last example IF YOU PUT 5 in B7-C4 and 8 in C7 this means that you had some reason to put that numbers there. In other words that 5s and 8 cannt be swapped. Otherwise they should not have been placed. So it is arbitrary to deduce from them the impossibility of having an 8 in B4.
I mean that (IMHO of course) you won't ever arrive in that position (last example) because you should have applied the UNIQUE RECTANGLE tecnique before, in case.
Hope my explanation is understandable.....

paolo

Thursday 17-Sep-2009

... by: Pritt Galford

Regarding your webpage about Avoidable Rectangles, I have a problem understanding your explanation. I think perhaps the problem arises not with your logic, but with the example instead.

Look at filled-in cells A3 & A9, and C3 & C9. They are an interrelated pair, thus allowing two solutions to the puzzle which is a no, no. There are others of the same problem in the example.

Also see the top 1/3rd of the puzzle of your last example on the same webpage. It has cell A5 with candidates 8 & 9 but nine is already filled in at J5.

Bottom line: I think your Avoidable Rectangle logic is correct and sound, but I'm finding there sure are a lot, in fact it's rather a common occurrence, especially in difficult Sudokus, to find multiple solutions which are violations of the unique solution rule. Your thoughts, please.

Andrew Stuart writes:

A3 & A9, and C3 & C9 are not four cells in two boxes. Avoidable Rectangles only apply if all four cells are in exactly two boxes. You will find that A3 & A9, and C3 & C9 are fixed by other numbers elsewhere and are not swappable.

Wednesday 12-Aug-2009

... by: Chuck Bruno

The "Avoidable Rectangles" stratagy is not one of the stratagies listed on the main page. Is this an oversite, or was this left out on purpose?

Thanks,

Chuck Bruno

Andrew Stuart writes:
OK now in the side menu

Sunday 26-Apr-2009

... by: Gary Maness

I have a question on this one. I recently used my own variation on this idea that involved 2 pairs that didn't quite form a rectangle. In fact two cells could see the forth but the third could only be seen by one of the others that I had solved. But using the same logic I thought that since there were no clues on any of those cells, if the target number, 8 were possible then there would be two solutions.

Do you have Sudoku Dragon? I can send you the partially solved puzzle. i am interested to know if this forms a rule or did I just get lucky! I mean, in your example, the two end cells, the 5's could see the forht cell and the first cell, the 8. In mine the end cells could the target, but only one could see the first cell.

I hope this makes sense. BTW, I LOVE this site. I have learned so much about the game. You should consider charging admission! I do plan on buying the Index.Dat program and the book when I can though.

Thanks a bunch.

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