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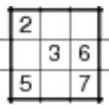
Aligned Pair Exclusion

From sudokuwiki.com, the puzzle solver's site



This is an interesting strategy, known by the short-hand as APE, since it overlaps with Y-Wings and XYZ-Wings but uses very different logic. APE logic will solve an XY-Wing (3 bi-values) and an XYZ-Wing (bi-value <-> tri-value <-> bi-value).
There are two types of APE - the normal APE and Extended APE.

Aligned Pair Exclusion - Type 1

The **Aligned Pair Exclusion** can be succinctly stated: **Any two cells aligned on a row or column within the same box CANNOT duplicate the contents of any two-candidate cell they both *see*.**

The Y-Wing strategy has some diagrams (see Figure 2) to show how cells can see other cells along the row, column or box and how they intersect or overlap. In Figure 1 **X** and **Y** are two cells and the yellow shading shows the common cells they can both 'see'.

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

APE 1: Load Example or : From the Start

Lets consider all the possible pairs of numbers in **X** and **Y**.
These are:

3 and 2 (in X and Y)
3 and 5
5 and 2
5 and 5
7 and 2
7 and 5

Now is obvious that 5 and 5 can't be a solution to **X** and **Y**. If any of the other pair solutions were true we'd be able to remove those solutions from the candidates in all the other yellow squares. The strategy asks us to look at all the bi-value cells **X** and **Y** can 'see'. Cells marked **A, B** and **C** containing 2/7 and 3/5 and 5/7 match some of the options we have for **X** and **Y**. Any of these pairs would remove ALL candidates from one of **A, B** or **C** which is illogical, captain. This means we can exclude them from possible solutions for **X** and **Y**. This leaves us with a shorter list:

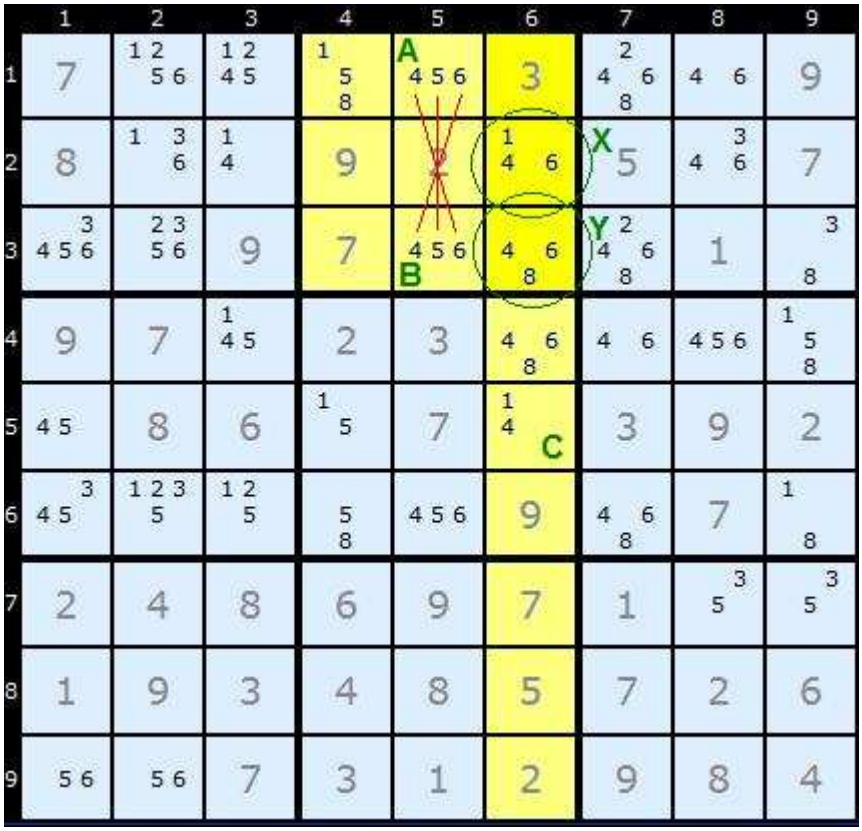
3 and 2 (in X and Y)
5 and 2

What are we left with? According to our new list **Y** can only take the value **2** so we can remove **5**.
We can also remove the **7** from **X**. This helps us solve the Sudoku.

Credits - **Rod Hagglund** first popularised this method. A good thread with a double example and walk-through is here

Aligned Pair Exclusion - Type 2

The **Extended Aligned Pair Exclusion** includes tri-values spread over two cells as part of the attack. **APE 2** Says that any two cells with only **abc** excludes combinations **ab**, **ac** and **bc** from the pair under consideration.



APE 1: Load Example or : From the Start

This example is very clear since the two-cell tri-value is convieniently 4/5/6 in both cells. (see next example for alternative tri-value formations).

Lets consider all the possible pairs of numbers in **X** and **Y** first. These are:

1 and 4 (in X and Y)
1 and 6
1 and 8
4 and 4 (impossible)
4 and 6
4 and 8
6 and 4
6 and 6 (impossible)
6 and 8

Cell R5C6 marked **C** removes a 1/4 pair.

Now the tri-value: These are 4/5, 4/6 and 5/6.Removing these from the possibles for **X** but **Y** leaves us:

1/4/6 remains in **X** but **Y** is reduced to 6/8. Why should this work? Well, 5 is not really part of the tri-value that effects our APE. The key combination is 4/6 and that does the damage. Pretend that **X** is 4 and **Y** is 6 (or the other way round). This would leave **A** and **B** both equalling 5. Thats illegal which is why 4/6 is a combination we can remove from possible pairs in **X** and **Y**.

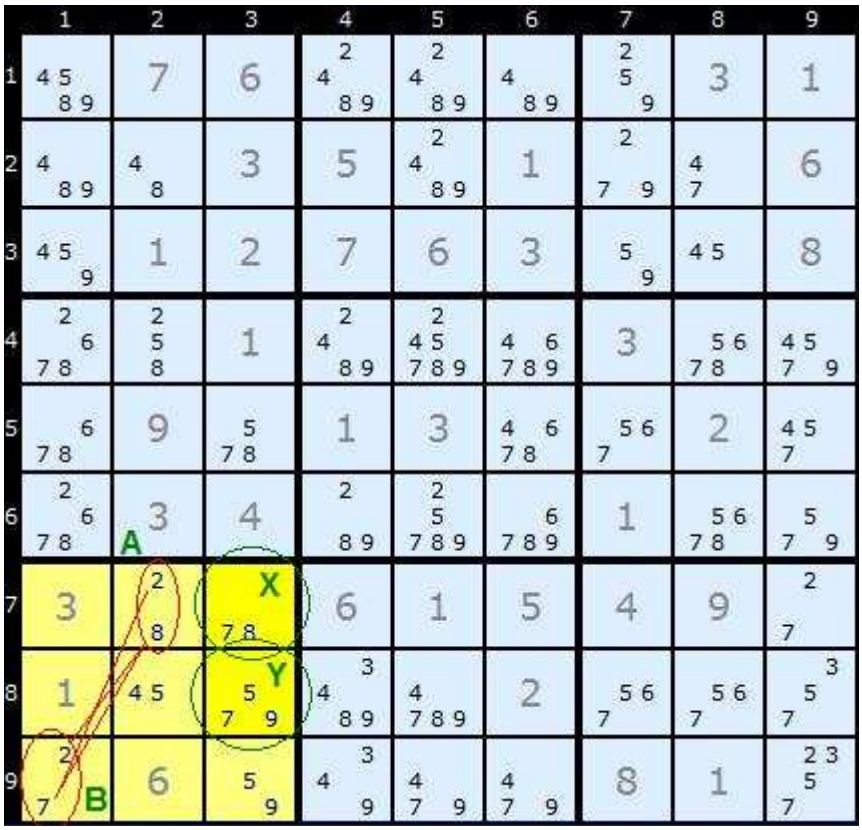
1 and 6 (in X and Y)
1 and 8
4 and 8
6 and 8

In this second example the tri-value contained in A and B is 2/7/8. The only common value is 2. Nevertheless, the abc combinations are 2/7, 2/8 or 7/8.

All the possible pairs of numbers in X and Y are.

7 and 5 (in X and Y)
7 and 9
8 and 5
8 and 7
8 and 9

Our one tri-value which matches these is 7/8. If we remove 7/8 from our list Y is reduced to 5 and 9. We get a naked pair and the rest of the Sudoku solves.



APE 2: Load Example or : From the Start

Credits: Myth Jellies came up with the insight for Type 2 (see bottom of this page)

Comments...

Monday 8-Feb-2010

... by: Phil Gooda

I actually managed to understand all this, except for one thing.....why bother, there is a far simpler soultion within that box? Let me demonstrate by considering ONLY that box and naming the cells as follows:

A B C
D E F
G H I ..... which means that my C is the X mentioned, and my F is the Y mentioned.

Cells B, C and G contain 3 numbers and only 3 numbers between them. Therefore those 3 numbers cannot appear in the other cells. Which immediately gives you the paired 5/9 in F and I, which means that E has to be 4. Why bother doing all the APE stuff?

Monday 25-Jan-2010

... by: Patrick Barnaby

An XY-Chain removes 7 from r8c8. A Bilocation Graph reveals a 2 at r7c2 and then you'll have a naked 7 and then a naked 8 and then quite a few hidden singles on the first and second rows. So this is easier than APE except the Bilocational graph techinque.

Thursday 12-Nov-2009

... by: Matt Lala

I love the site but some of the explanations need help. Or I guess I do. I think this is one of the less clear ones.

The rule you have says:
Any two cells aligned on a row or column within the same box CANNOT duplicate the contents of any two-candidate cell they both see.

If I take that literally in the first example... X in the first example can see the bivalues 25 and 37. It cannot duplicate the contents of those cells.

Therefore... it can't be 2,5,3 or 7? Obviously that's not what was meant.

Or is it... if the two aligned cells see some bivalue cells, and they both mutually share a certain candidate [that's part of those bivalue cells] then that shared candidate can go? But no, that's not it either.

If either if the cells see two bivalue cells, and those two bivalue cells both share a candidate with the cell under consideration... that shared one goes?

Does one actually have to enumerate the possibilities? This seems like something that can be spotted with a glance, if only it can be made clear the exact conditions needed.

Wednesday 30-Sep-2009

... by: Bernard Gervais

align pair type 2
I found more than one numerical solution for this example.
Best regards.
BG

Wednesday 30-Sep-2009

... by: Bernard Gervais

Excellent site, thank you.
for example 1, I use the unicity concept which pinpoints A4 = 1.
Best regards.

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Email Address - required for confirmation (it will not be displayed here)

Your comment or question

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