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Grouped X-Cycles

From sudokuwiki.com, the puzzle solver's site

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Chaining strategies like [X-Cycles](#) use links that connect cells on the board. It is possible to expand on the idea of a "cell" to something a bit larger, namely a "group" of cells. I prefer the word "node" - which in 90% of cases will be a single cell - but can be two or three cells in the same unit. You might wonder how we can use more than one cell and think of it as a node between two links, but there is some cool logic here.

We must go all the way back to [Pointing Pairs and Pointing Triples](#). They attack cells along the row or column on which they are aligned. They also must be in the same box to be a coherent unit. Our "grouped" cells are just Pointing Pairs/Triples and we're going to use them as part of a chain or Nice Loop.

Clearing the clutter on an example board, in Figure 1, we have a spread of candidate 4s. All the lettered cells are also candidate 4. There is a continuous Nice Loop starting with A. B-C is a weak link, and so is D-E.

The interesting part is the set of cells [{X,Y,Z}](#). It does not matter which of X, Y, or Z (if any) is the solution; any of them will eliminate A and E. Likewise, if E is true, then all of XYZ are gone - and A is true. We can think of [{X,Y,Z}](#) as a single node for the purposes of our logic. This promotes the links from A and E to strong links, and the notation for this part of a loop is:

$4[F8]=4[D7|D8|D9]=4[D3]=$
 E X or Y or Z A

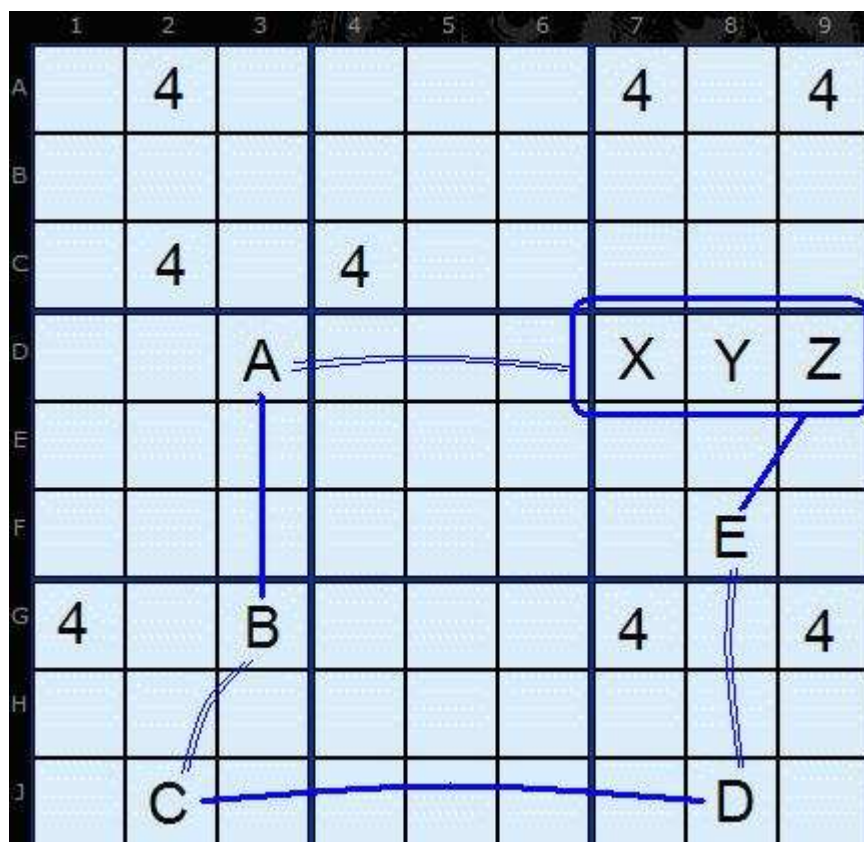


Figure 1: Grouped X-Cycle

The important characteristic is that the cells are all in the same box. One end of the chain (in this case, A) is pointed to by the node cells; the other (in this case, E) is usually within the same box as the node.

Nice Loop Rule 1

Check the article on [X-Cycles](#) for a review of Nice Loop Rule 1 in a cycle that does not contain Grouped Nodes.

Figure 2 invokes Nice Loop Rule 1. The output from the solver says:

X-CYCLE on 3 (Grouped Continuous Alternating Nice Loop, length 6):

$3[A1]-3[E1]=3[E9]-3[H9]=3[G7|H7]-3[A7]=3[A1]-$

The Grouped node is **{G7,H7}** and it points up column 7 to A7 (a weak link since there is another 3 at B7). Five 3s can be eliminated in one fell swoop since all 3s that are on units with links of weak inference can go.

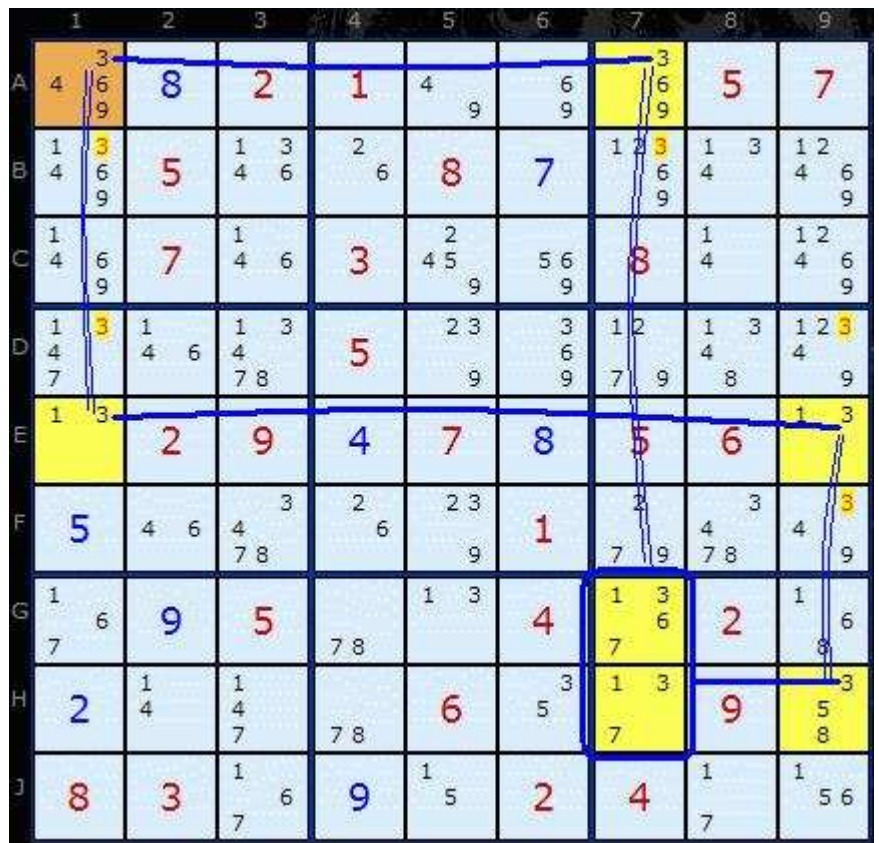


Figure 2: Grouped 3-Cycle: [Load Example](#) or : [From the Start](#)

This is a much more complex example, but it does show how powerful the strategy is in tackling a bottleneck on the board. The Nice Loop contains two Grouped nodes at **{G3,J3}** and **{G8,G9}**. The first is aligned on column 3 and *points* to **D3**. The second *points* along the row to **G2**. All other 8s in any unit shared by any of the Weak links can be removed (Nice Loop Rule 1).

X-CYCLE: 8 taken off E8 (link: D8 / H8)

X-CYCLE: 8 taken off E3 (link: G3 / D3)

X-CYCLE: 8 taken off F3 (link: G3 / D3)

X-CYCLE on 8 (Grouped Continuous Alternating Nice Loop, length 6):

$8[D3]=8[D8]-8[H8]=8[G8|G9]-8[G2]=8[G3|J3]-8[D3]=$



Figure 3: Grouped 8-Cycle: [Load Example](#) or : [From the Start](#)

Nice Loop Rule 2

Check the article on [X-Cycles](#) for a review of Nice Loop Rule 2 in a cycle that does not contain Grouped Nodes.

In Figure 4 we have a an X-Cycle on 1 (a 1-Cycle) with a group of two {A3,B3} usefully working together as a node. This allows us to create a chain linking the coloured cells on this diagram. From Rule 2 we can deduce that H9 must be a 1.

X-CYCLE on 1 (Grouped Discontinuous Alternating Nice Loop, length 5):
 $1[H9]=1[C9]-1[C2]=1[A3|B3]-1[H3]=1[H9]=$
 - Discontinuity is two strong links joined at H9, all other candidates (9) can be removed from that cell

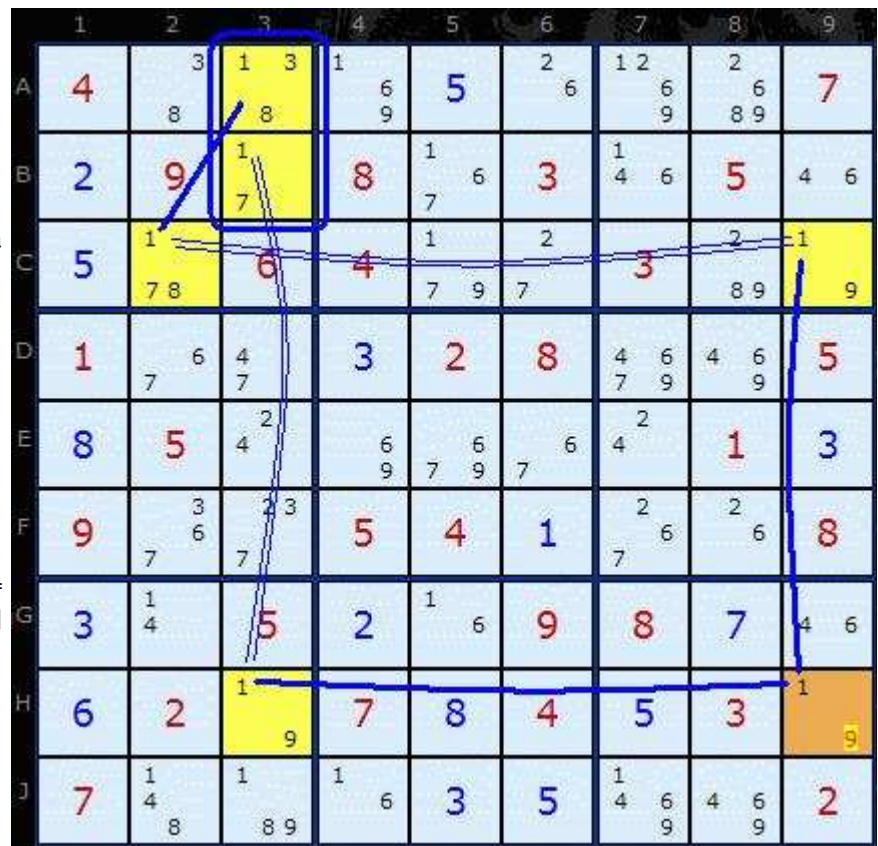


Figure 4: Grouped 1-Cycle: [Load Example](#) or : [From the Start](#)

In my second example in Figure 5 the chain is a little longer and bit more compact, but the grouped node {G4,G5} on 6 makes the chain possible.

X-CYCLE on 6 (Grouped Discontinuous Alternating Nice Loop, length 7):
 $6[C6]=6[C5]-6[J5]=6[G4|G5]-6[G8]=6[E8]-6[E6]=6[C6]=$
 - Discontinuity is two strong links joined at C6, all other candidates (8) can be removed from that cell

Rule 2 examples are probably the least likely of the three rules to be found. Most grouped X-Cycles will be two weak links and Rule 3, next.

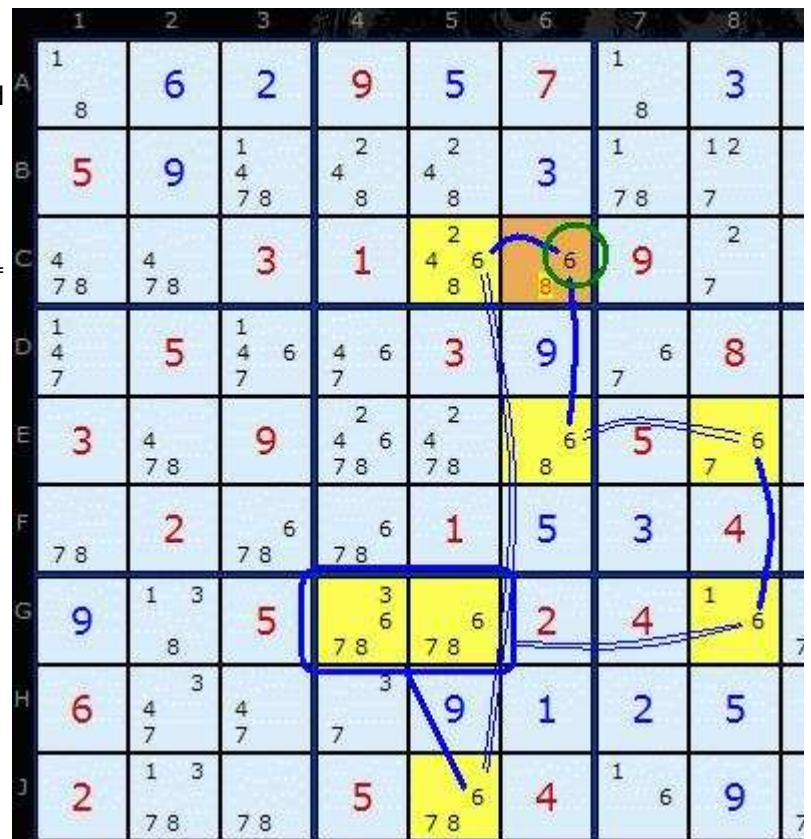


Figure 5: Grouped 6-Cycle: [Load Example](#) or : [From the Start](#)

Nice Loop Rule 3

I couldn't resist this example as it has two grouped nodes - {B1,C1} and {E7,F7}. Don't be confused about {F9} and {G9}, they are just adjacent yellow cells that have a weak link on 2. You can see plenty of other 2s in column 9, but a grouped node has to be in the same box.

Rule 3 tells us that two weak links joined at B7 then 2 can be removed from that cell.

X-CYCLE on 2 (Grouped Discontinuous Alternating Nice Loop, length 6):

$2[B7]-2[B3]=2[B1|C1]-2[G1]=2[G9]-2[F9]=2[E7|F7]-2[B7]-$

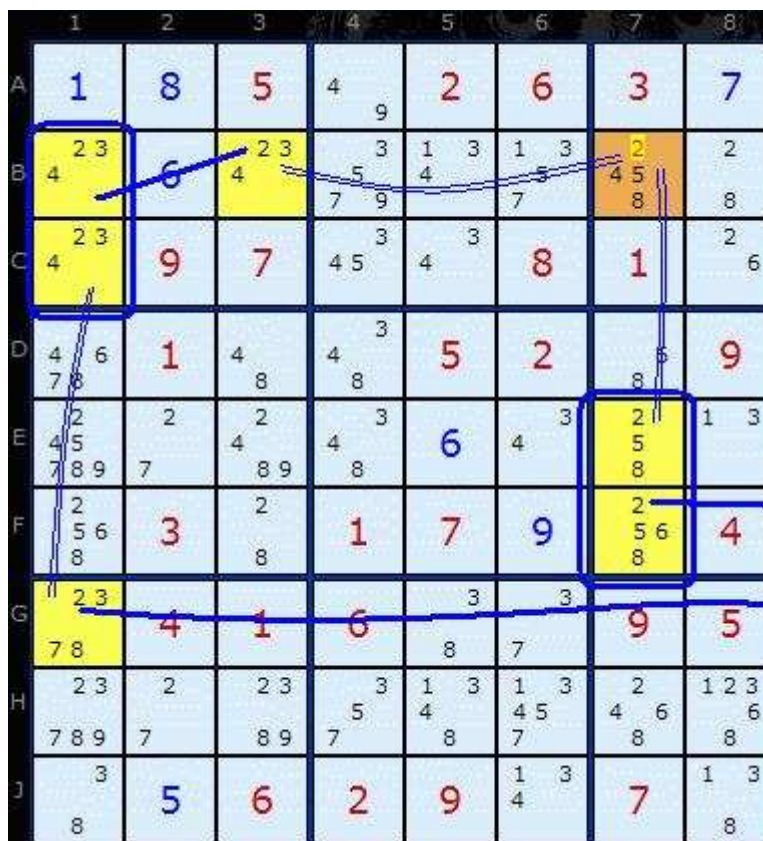


Figure 6: Grouped 2-Cycle: [Load Example](#) or : [From](#)

If you want to continue reading about this strategy family, the next chapter is entitled [Alternating Inference Chains](#).



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