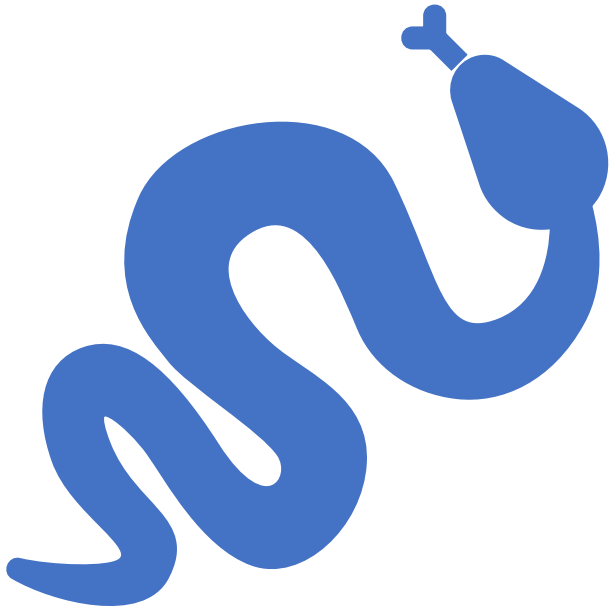
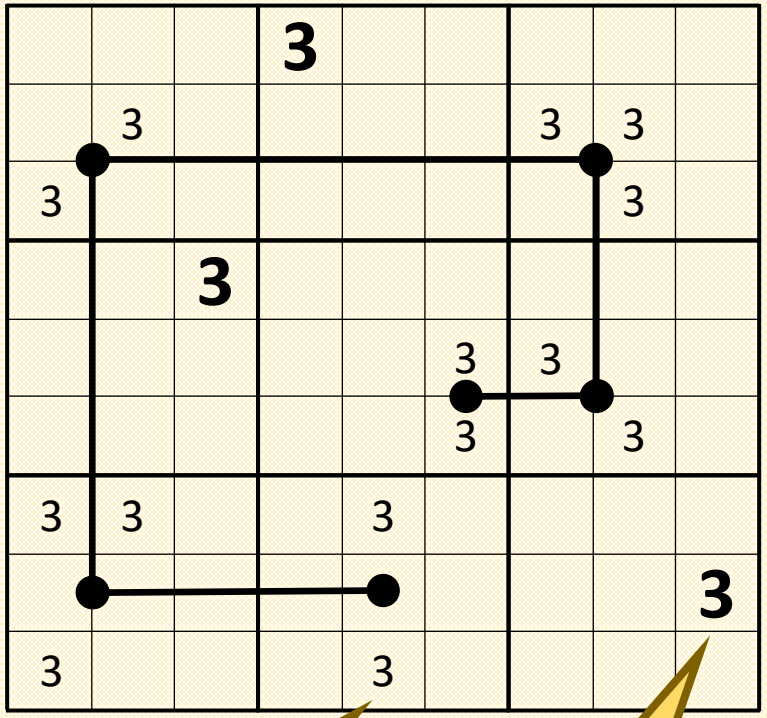
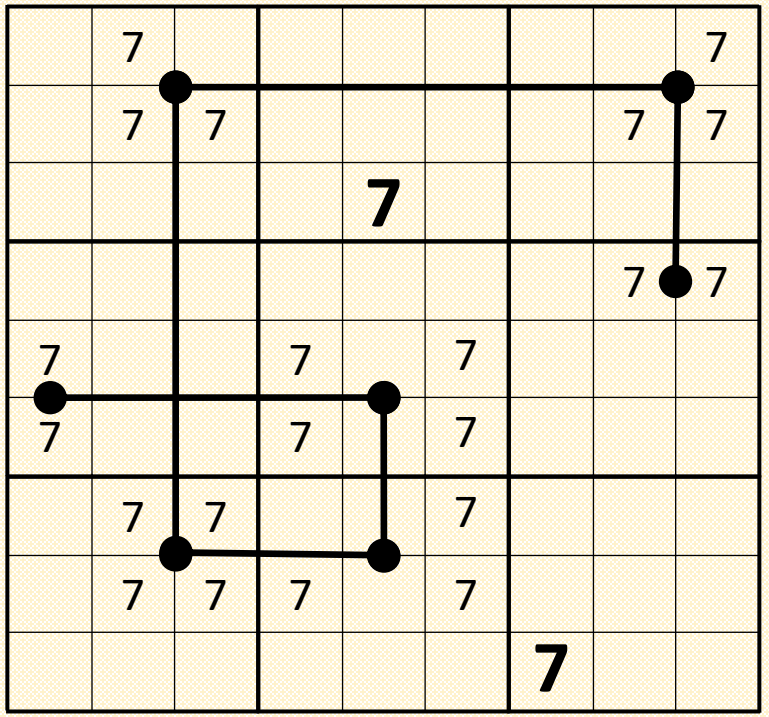


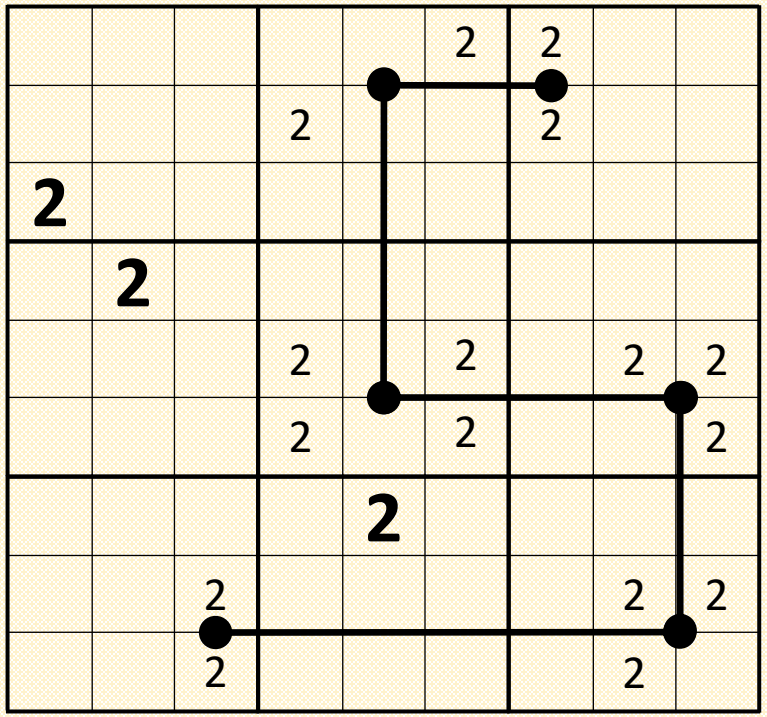
Serpentine Technique

For the solution of Sudoku Puzzles

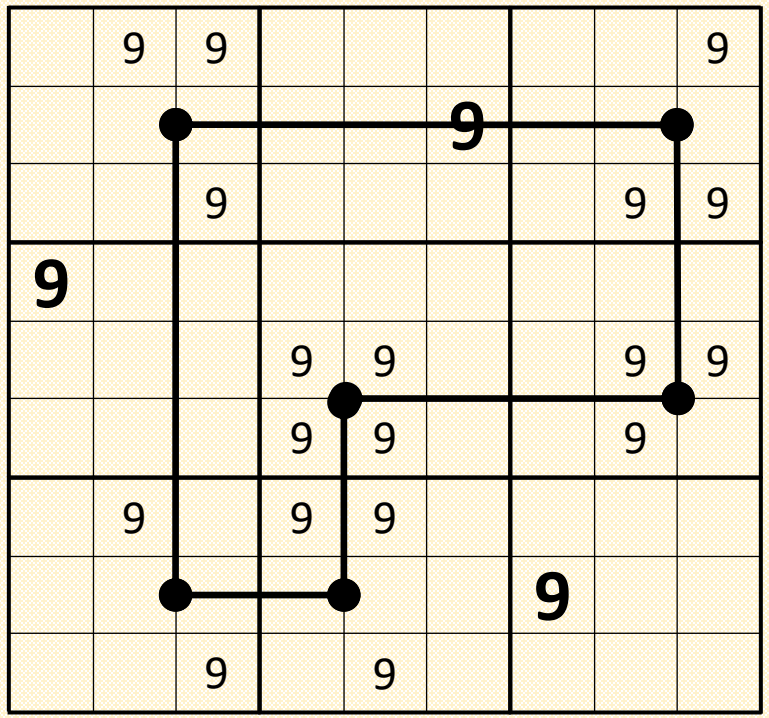
Vers. 3

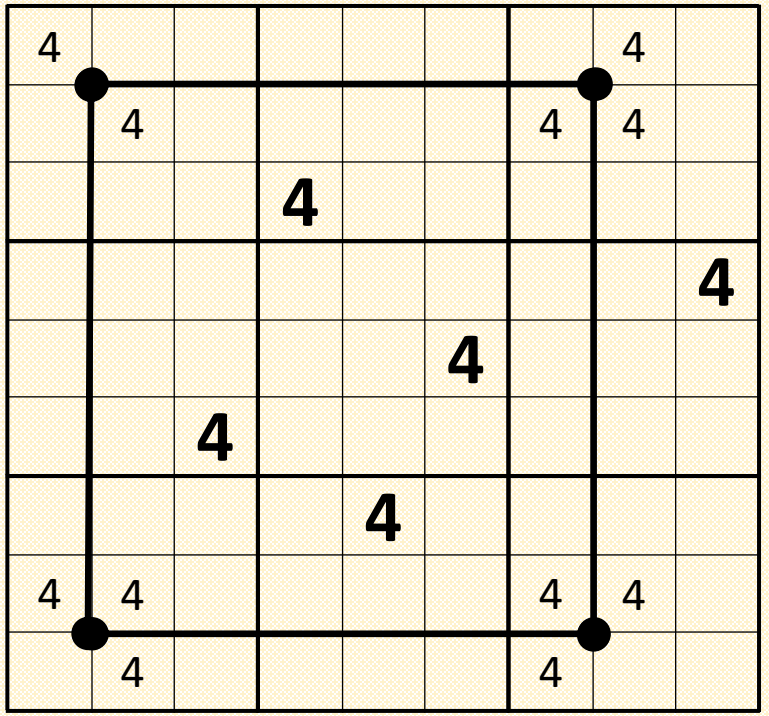


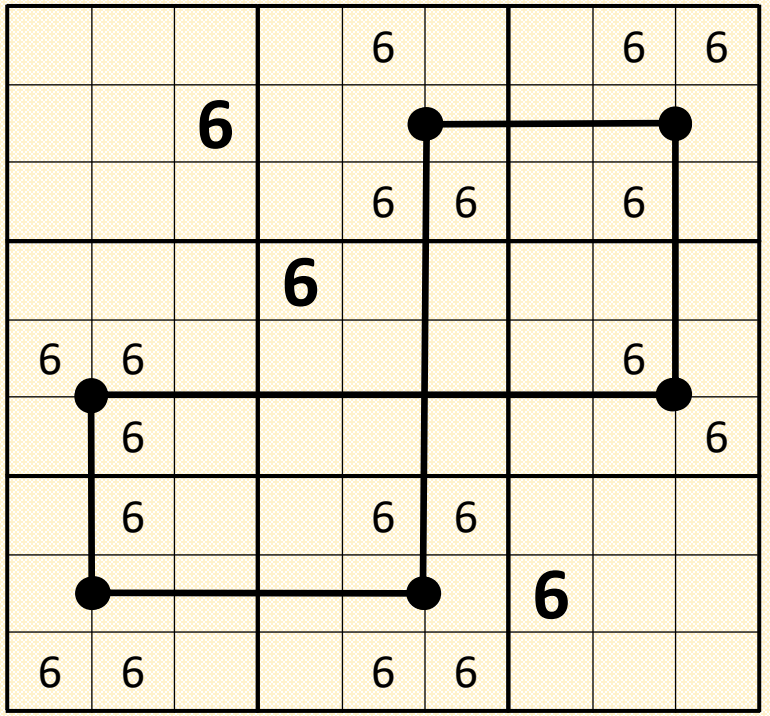




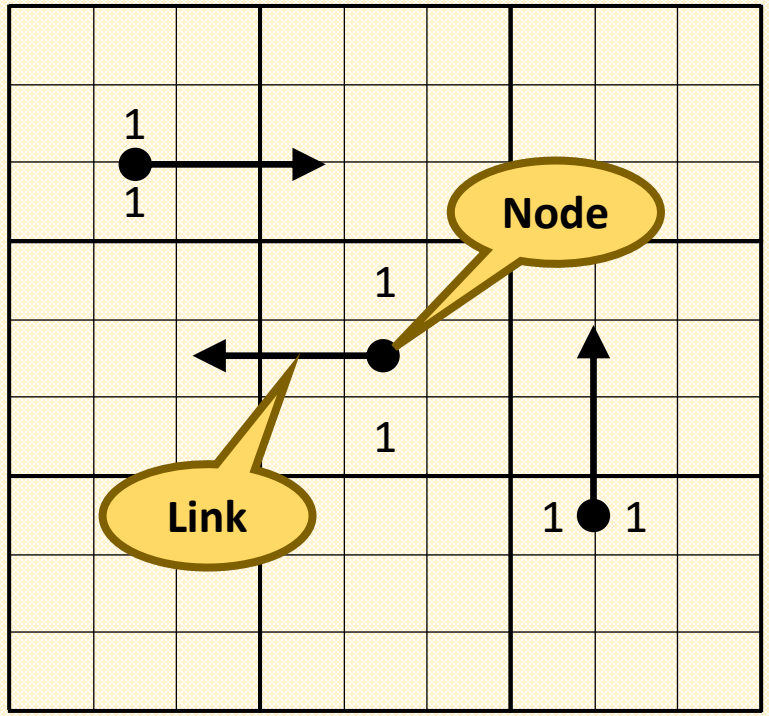
TYPICAL SERPENTS



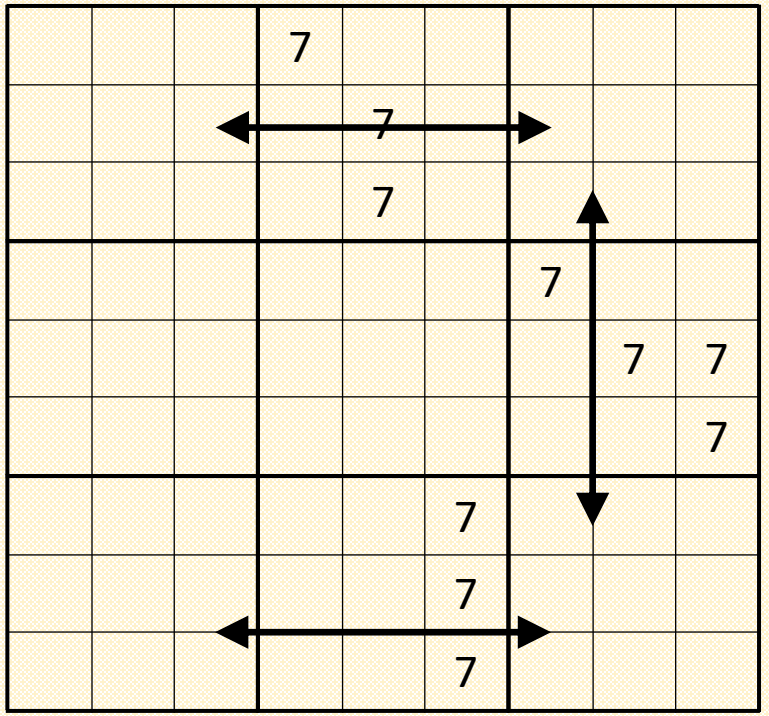




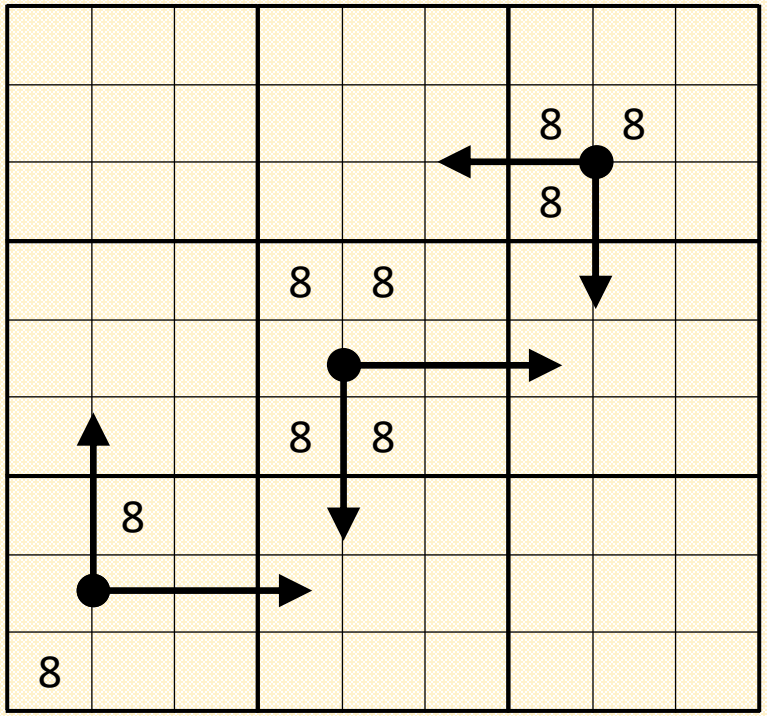
TYPICAL TAIL-BITING SERPENTS



Heads or tails



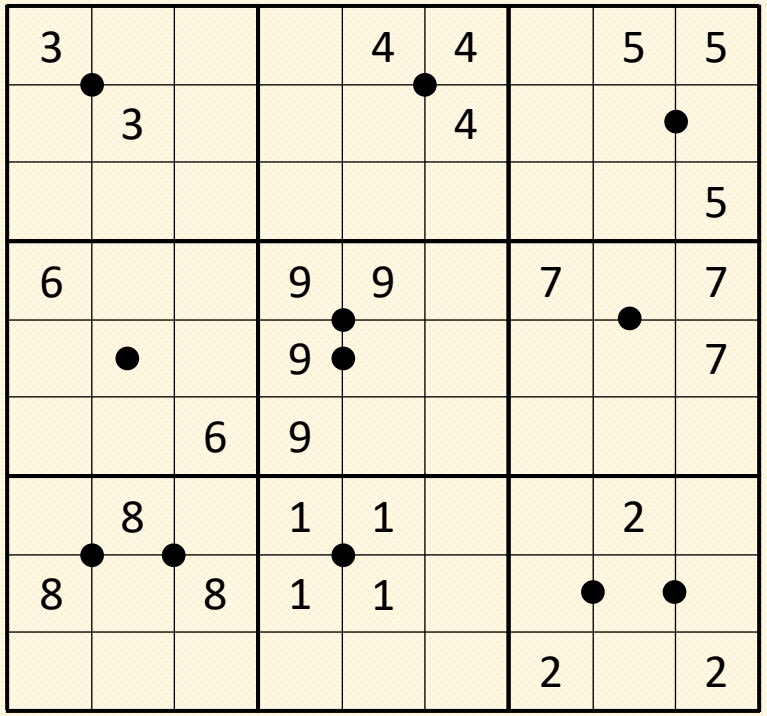
Passthroughs



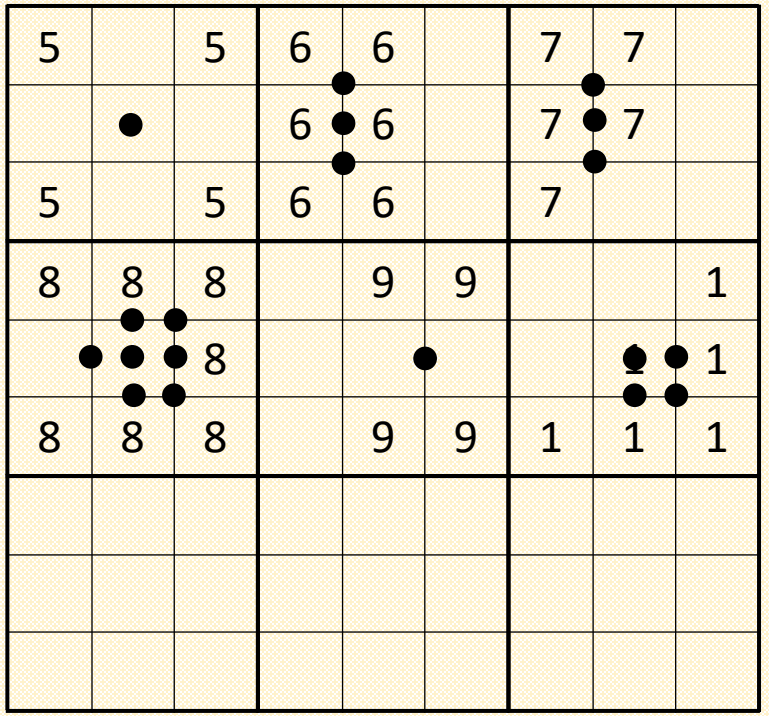
Turners

N.B. those formed of
3 or 4 cells can become
heads or tails.

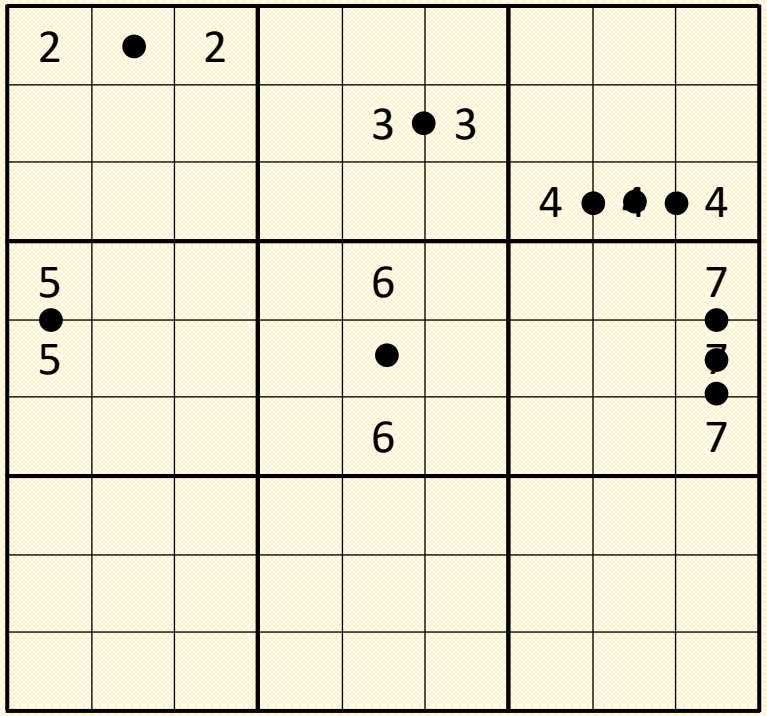
PARTS OF A SERPENT



Possible Turning Nodes



Possible Turning Nodes



Possible Head and Tail Nodes

Possible nodes are an aid to identifying serpents.

POSSIBLE NODES

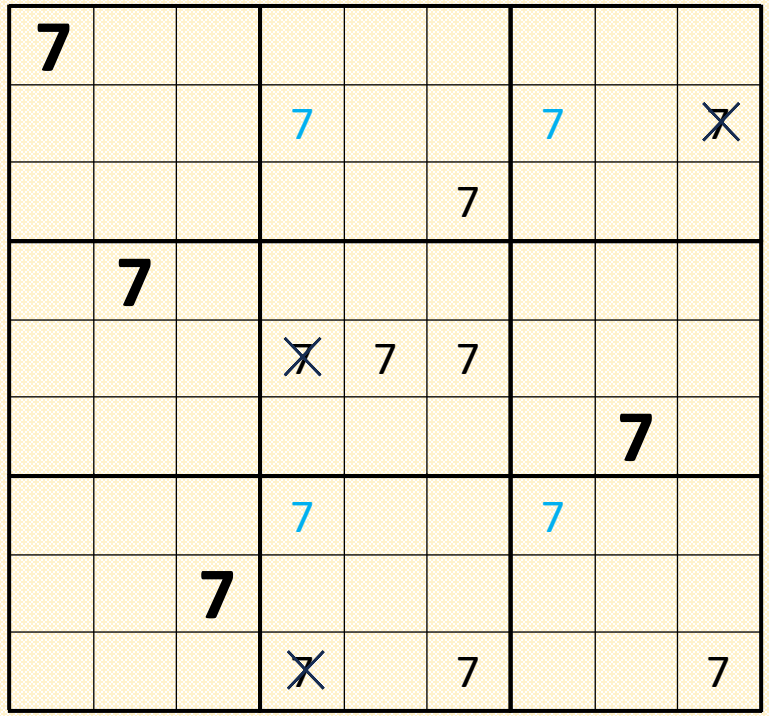
TECHNIQUE

BEGIN BY USING THESE SIMPLE TECHNIQUES

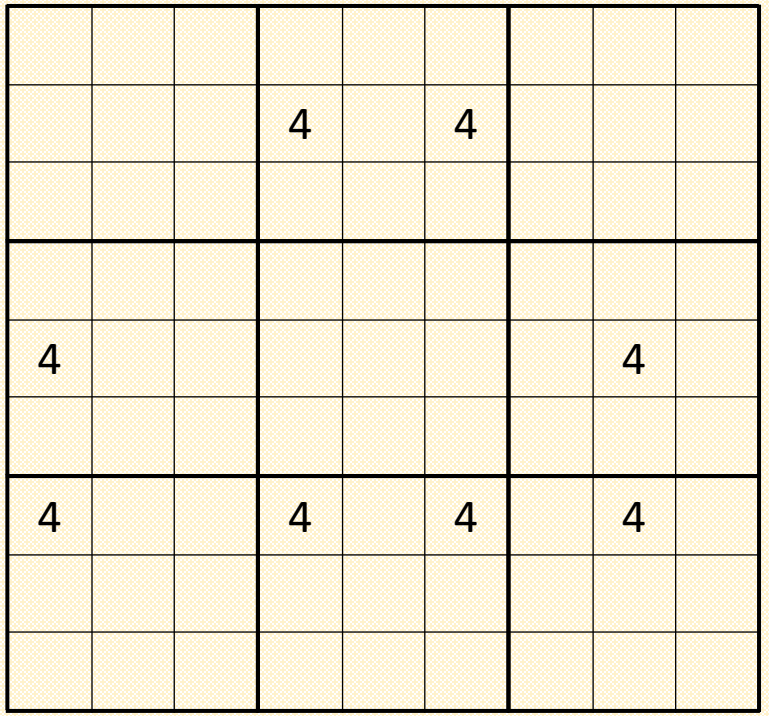
1. Candidates are numbers that a cell might contain. Firstly, look for and complete cells with obvious single candidates.
2. Note the possible candidates for every cell that remains empty.
3. If for any major square a candidate only appears in a single row or column, then this candidate can be deleted from the same row or column where it passes through the other two major squares.
4. If a candidate appears in only two rows or columns in a major square and only the same two rows or columns as the pass through a second major square, then it can be deleted from the same two rows or columns as tey pass through the third major square.
5. Look for two cells in a row, column or major square that have the same two candidates. Delete those candidates from the other cells in that row, column or major square.
6. Repeat step 3 for three cells with the same three candidates.
7. If no further progress can be made using the above techniques, then move on to the serpentine approach.

MOVE ON TO THE SERPENTINE APPROACH IF NECESSARY.

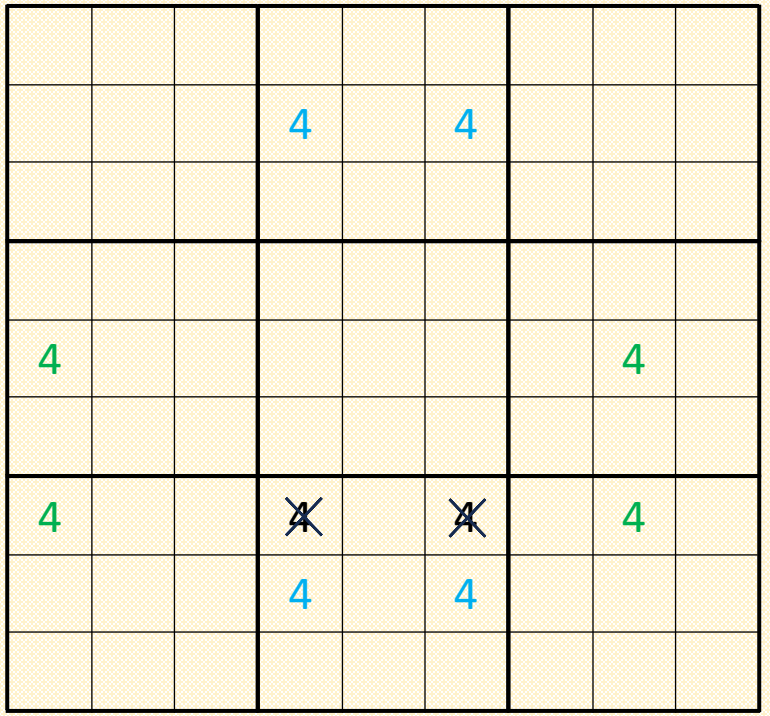
1. For each number mark the cells for which it is a candidate in a separate grid.
2. Check for any X-Wings or Clashes as described in the examples.
3. Find the longest serpent, i.e., one that covers as many major squares in the grid as possible. Serpents that are biting their tails (i.e., that form loops) are preferable. Identifying possible turner nodes in each major square helps to identify serpents.
4. Delete the candidate from cells that are not a part of the serpent, as described in the examples.
5. Further simplify the remaining candidates, as described in the examples.
6. In some cases, this will enable you to complete a cell. In other cases, it will remove one of two candidates from a cell leaving just one candidate. In yet other cases it will create simple pairs or triples.
7. Solution of the puzzle can then continue using the simple techniques described above.
8. If no further progress can be made try the serpentine technique again using another number.



An X-Wing comprises four candidates that form a rectangle. Other candidates in the rows and columns occupied by an X-Wing can be deleted.

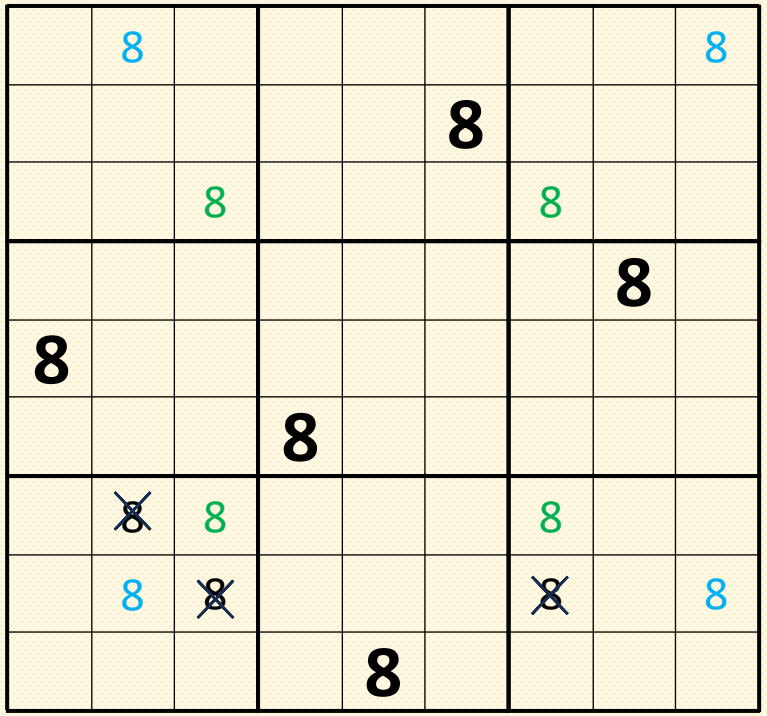


Arrangements of this type are ambiguous. Either one of the two sets of four candidates could be an X-Wing and they interfere with one another.

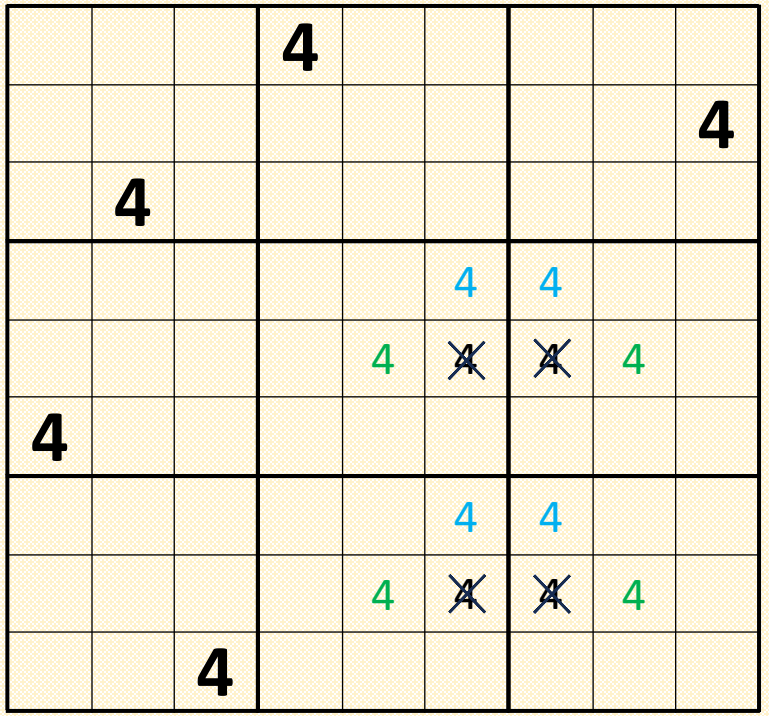


This arrangement is not ambiguous, however. The two sets of four candidates do not interfere with one another.

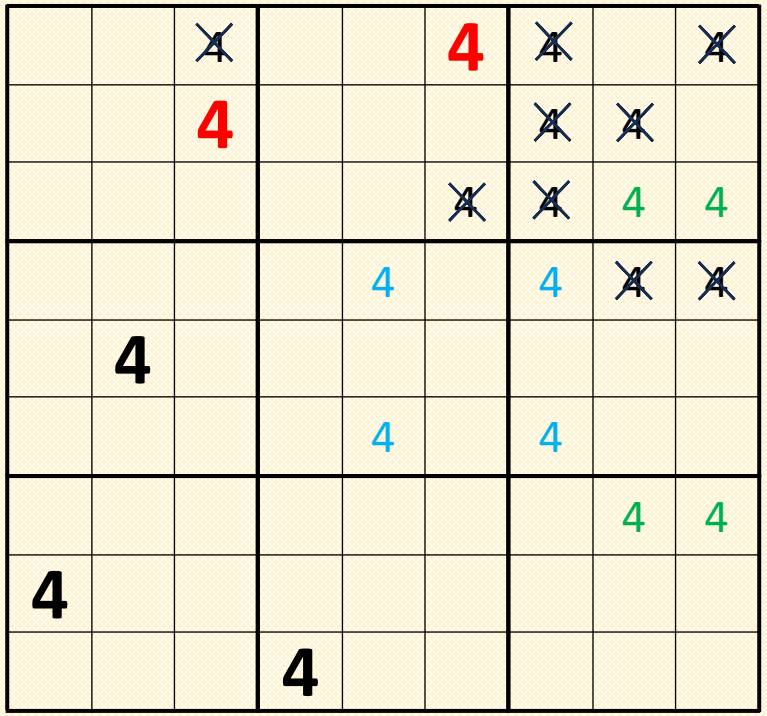
X-WINGS 1



M66



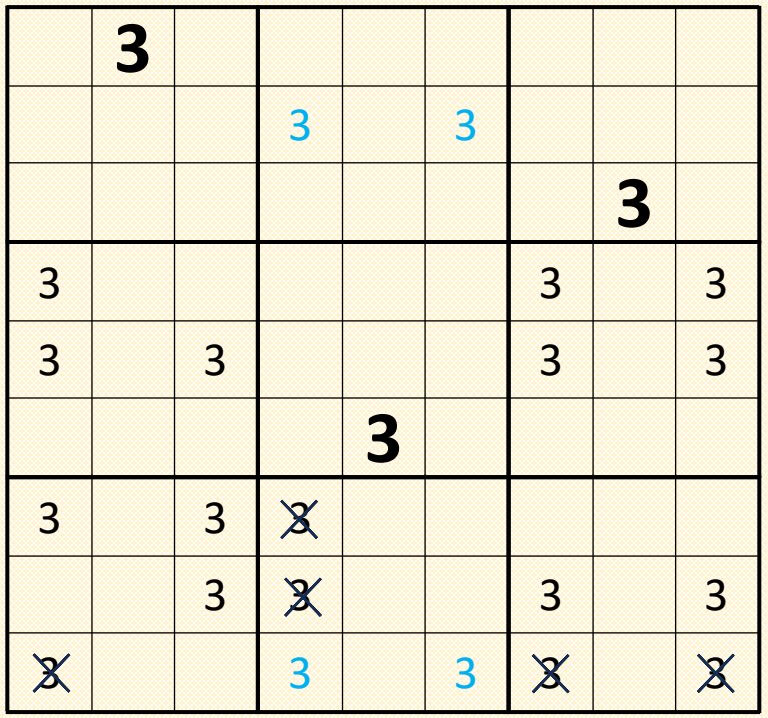
M66



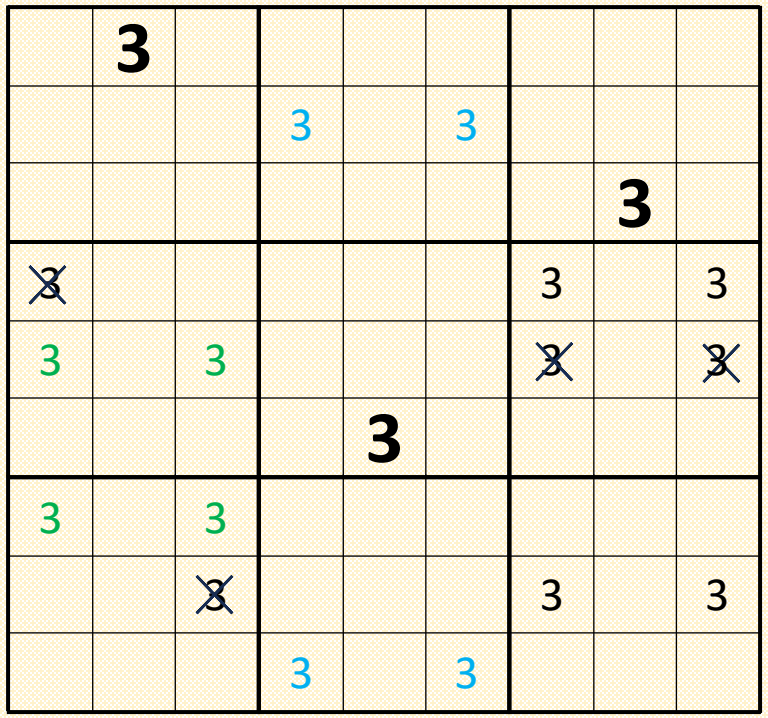
M71

Some apparent serpents can be combinations of X-Wings.
So, this possibility must be checked first.

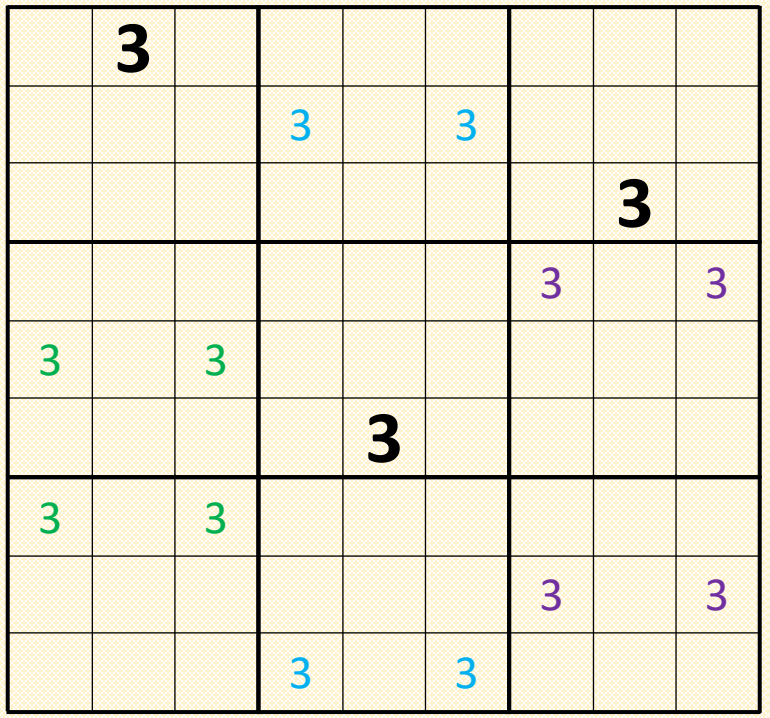
X-WINGS 2



Step 1 – X-Wing



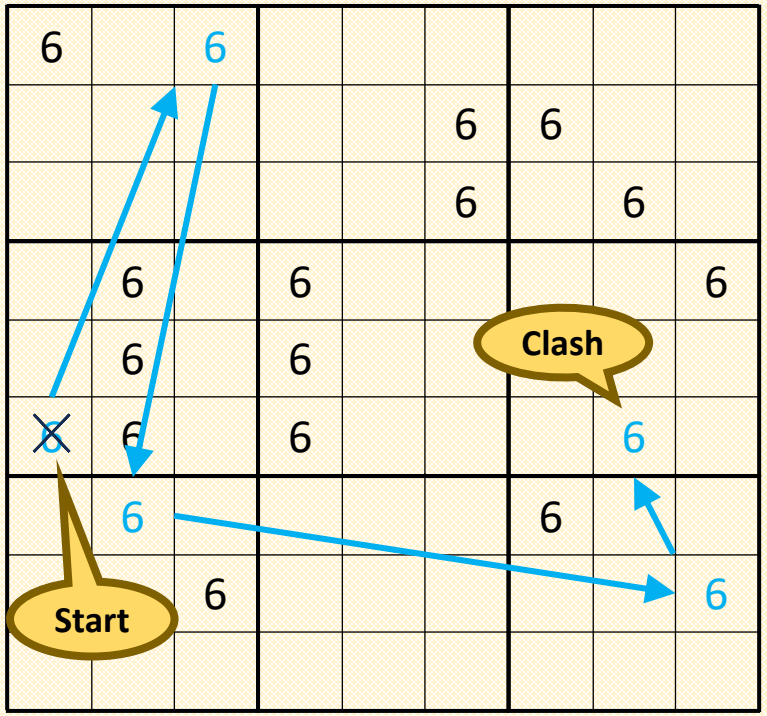
Step 2 – X-Wing

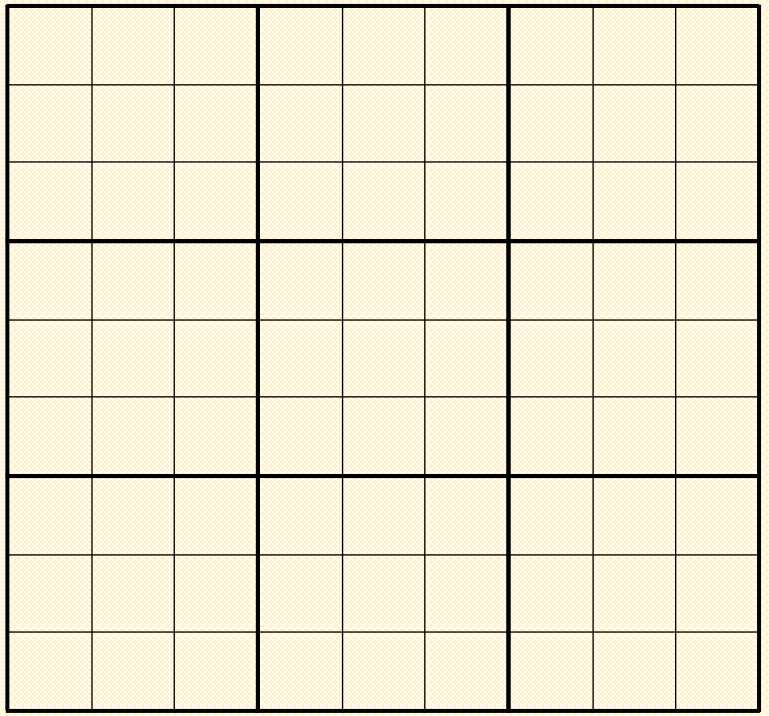


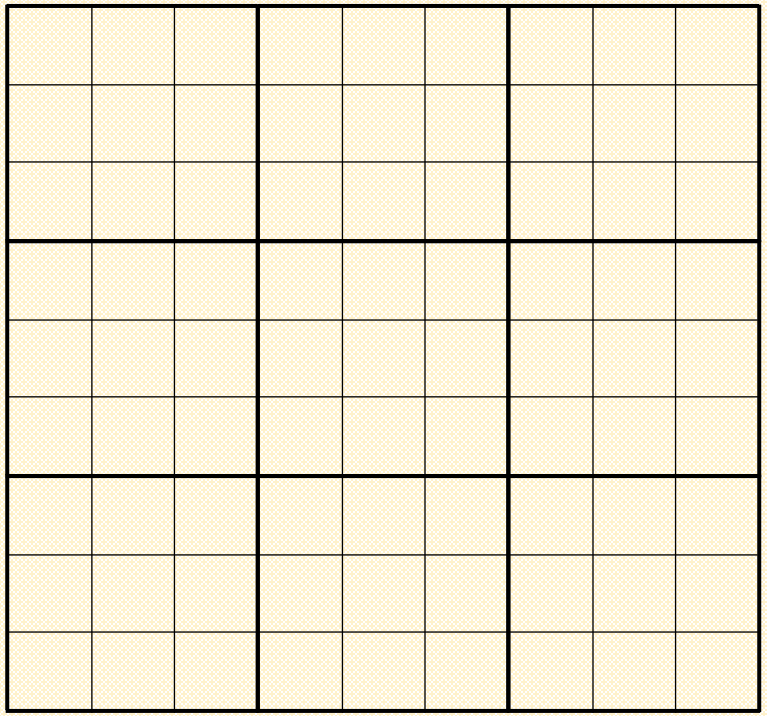
Final Result

X-WINGS 3

M49



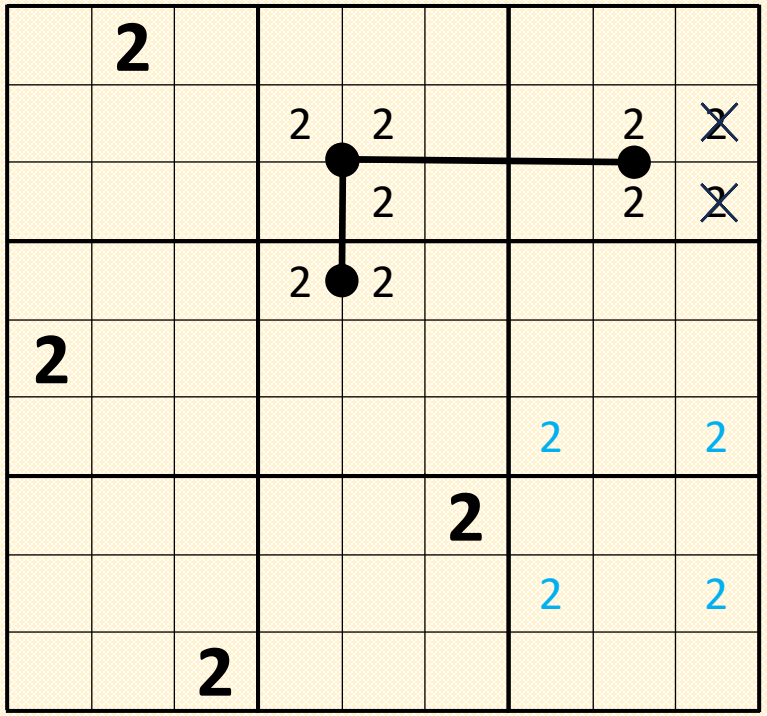




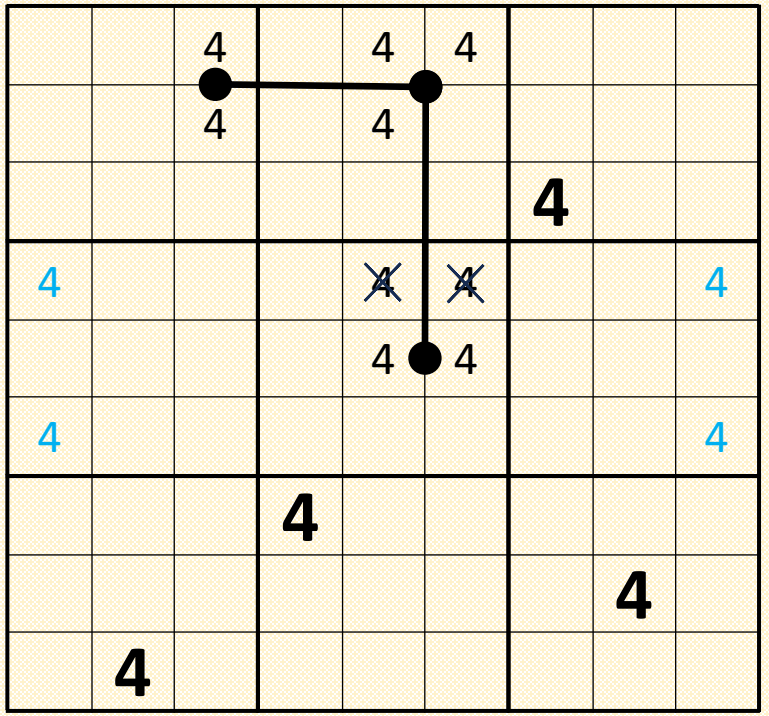
M72

6 can be deleted from the start
Because tracing its effect through
the grid results in a clash.

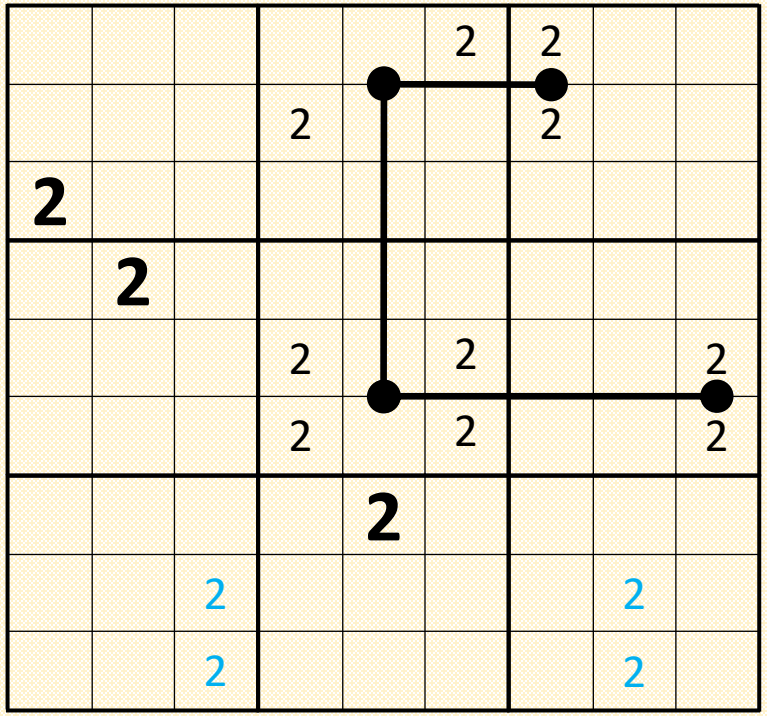
CLASHES



M65

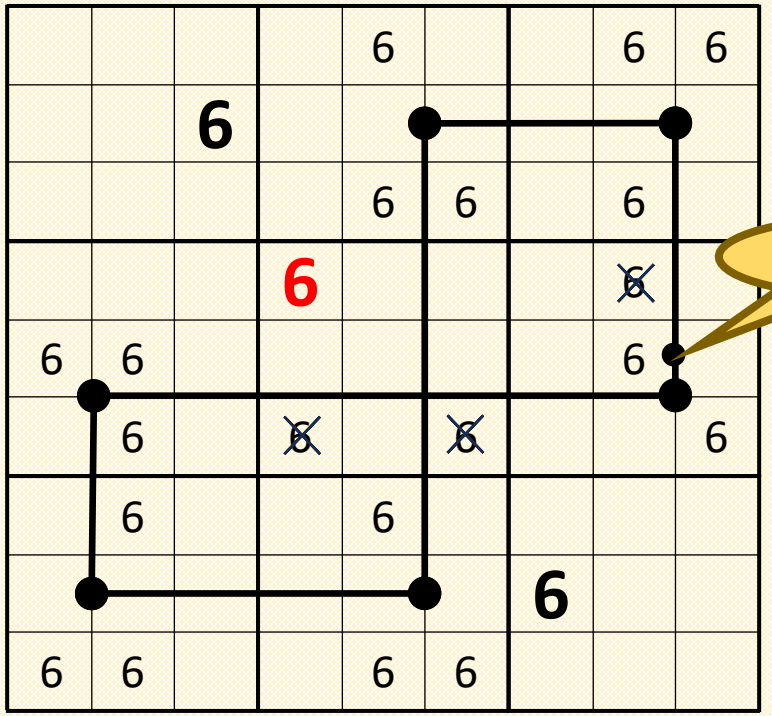


M63



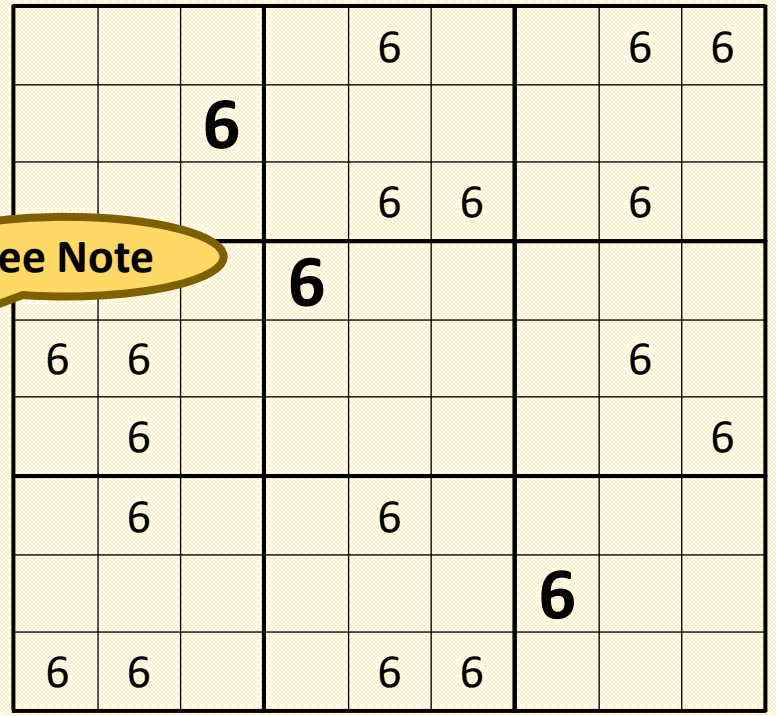
It is possible for a serpent and an X-wing to co-exist.
But they must not interfere with one another.

X-WINGS & SERPENTS

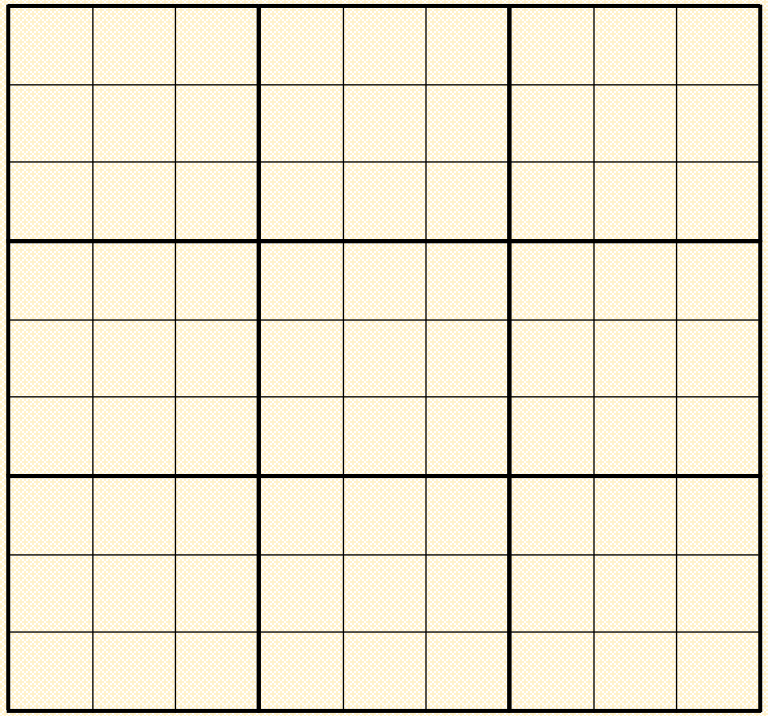


The red 6 is identified from the two passthroughs.

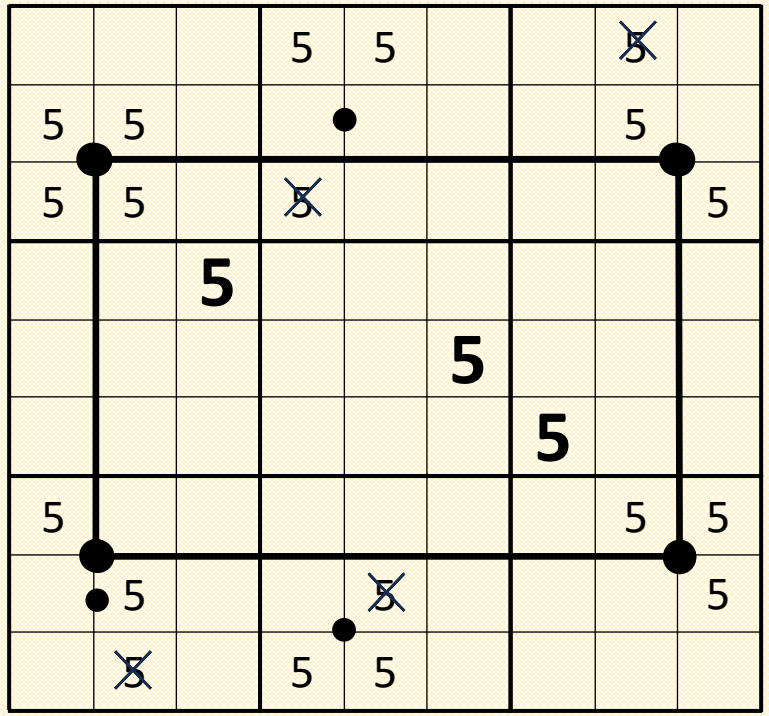
Note: The possible node ● is not used.



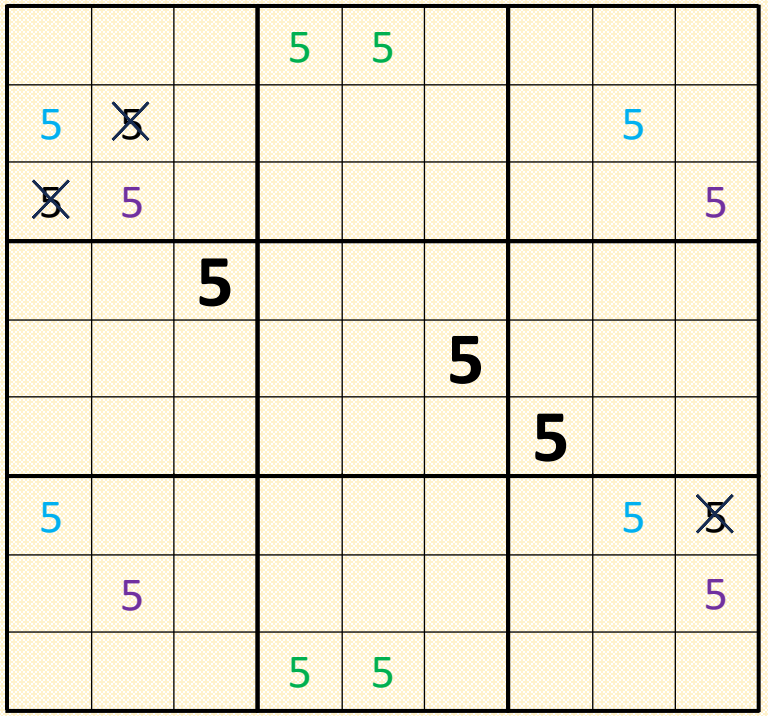
Result



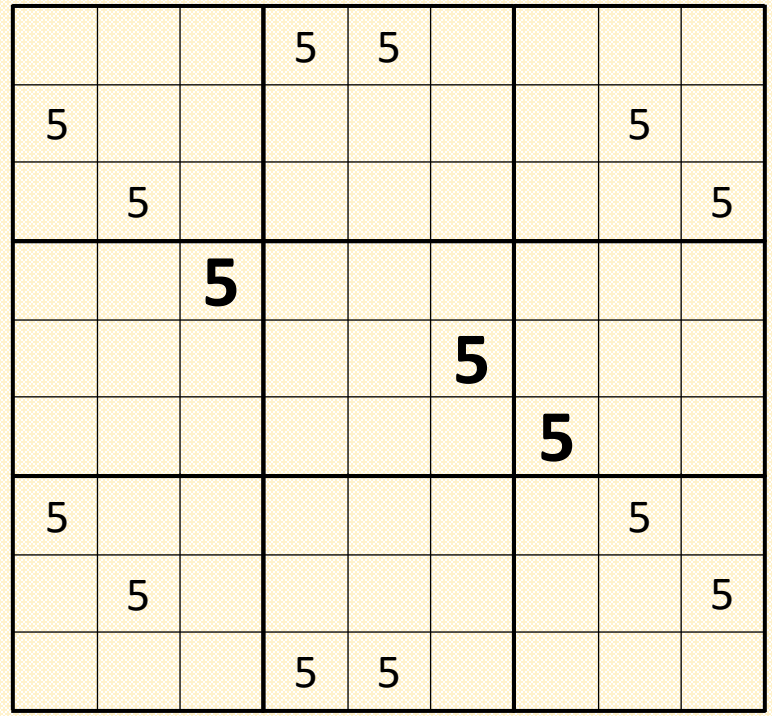
SERPENT EXAMPLE 1



Step 1 - Passthrough



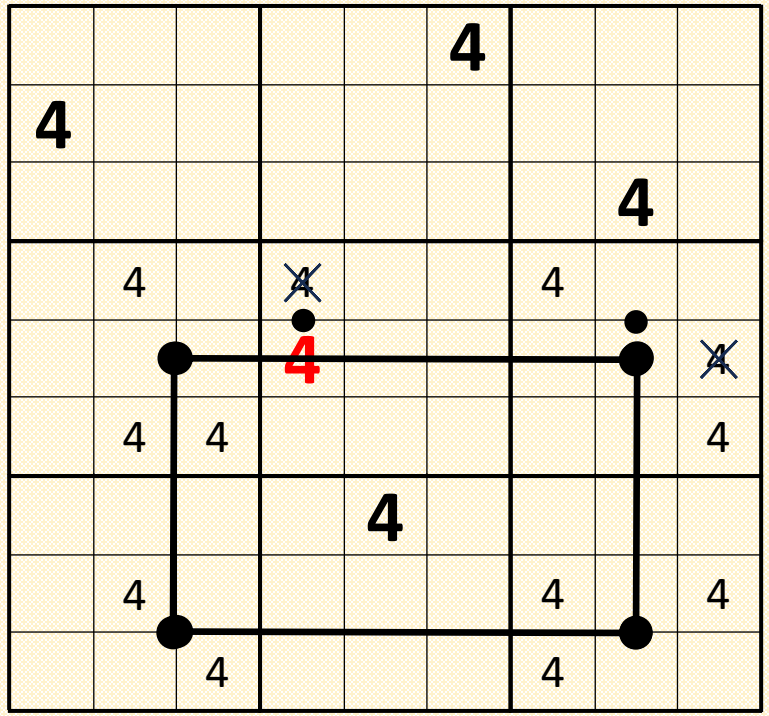
Step 2 – X-Wings



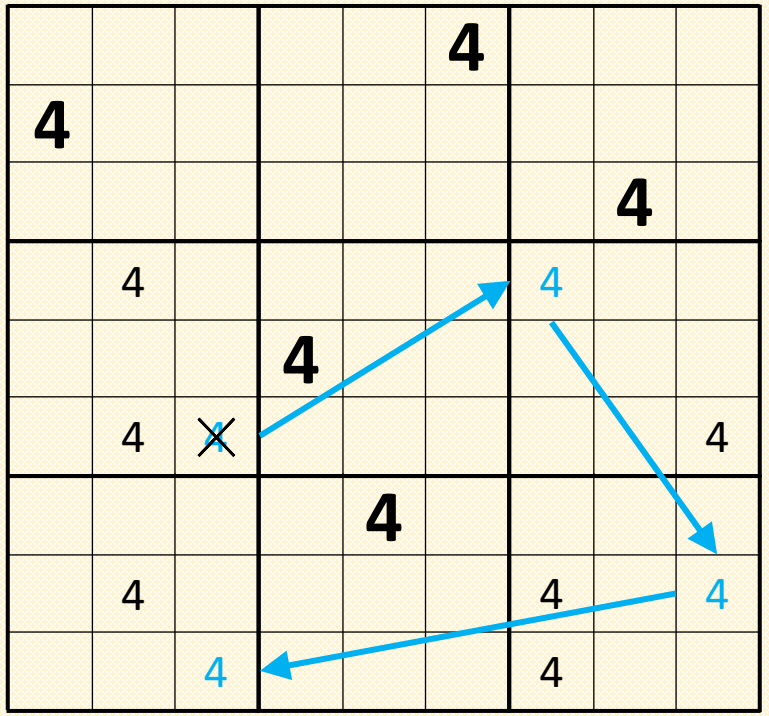
Result

SERPENT EXAMPLE 2

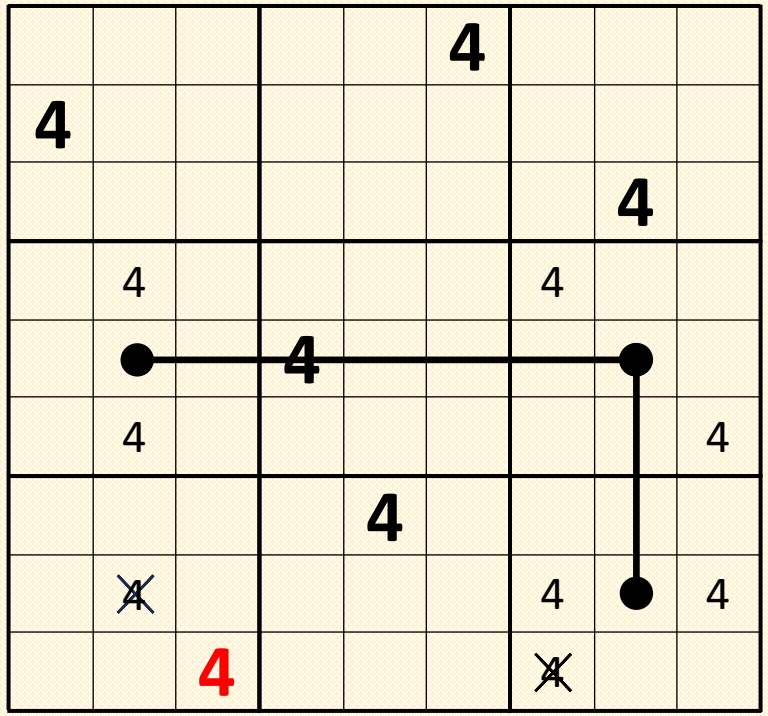
M25



Step 1 - Serpent



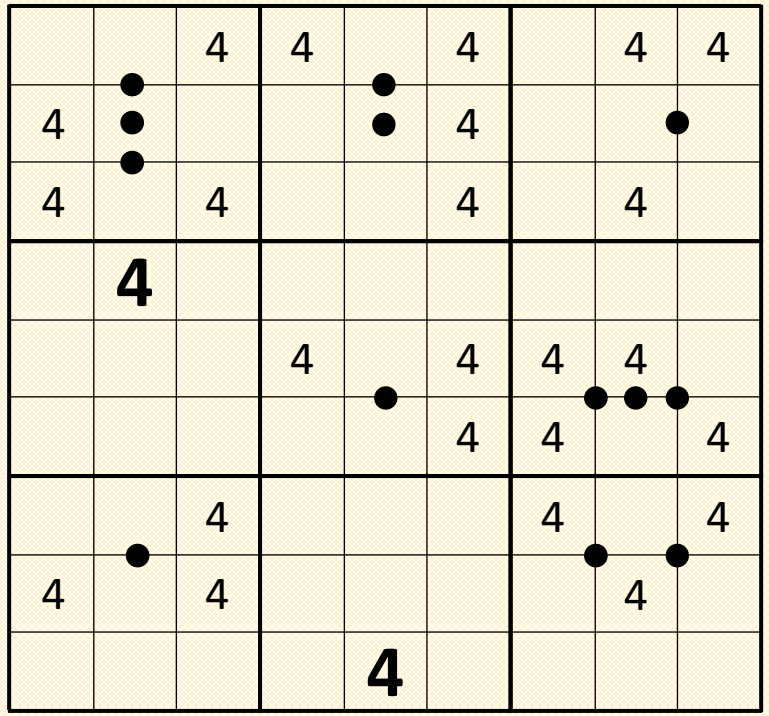
Step 2 – Eliminating Clashing Cells



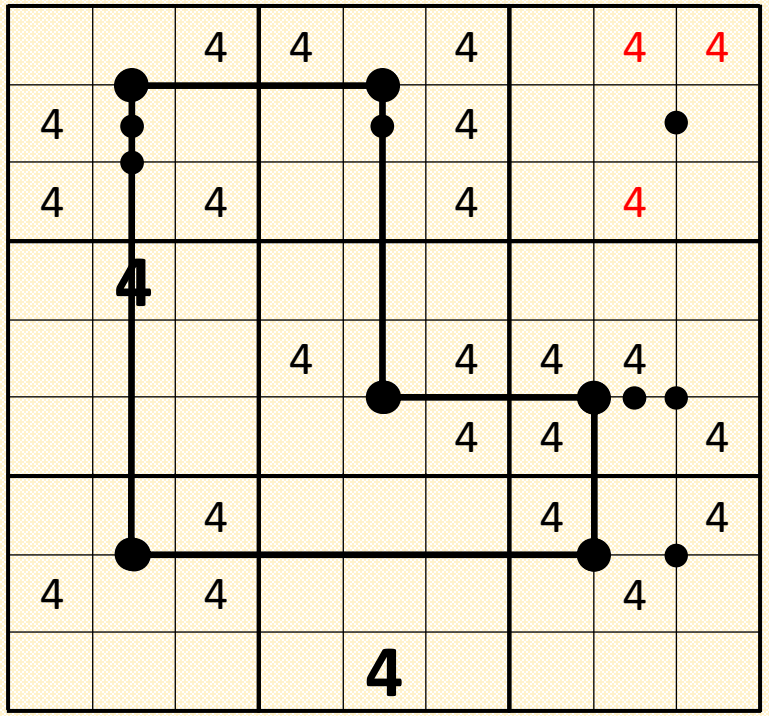
Step 3 – Complete Simplification

SERPENT EXAMPLE 3

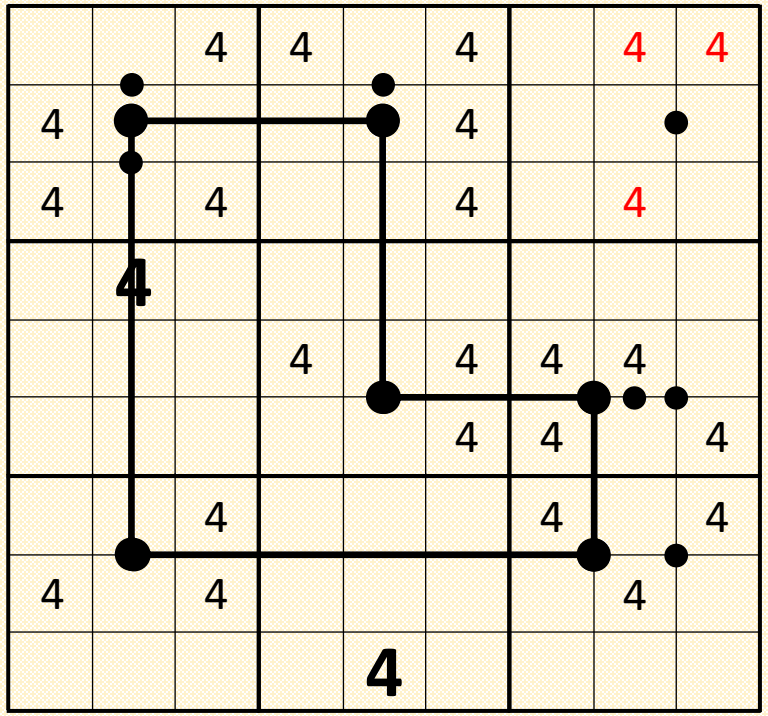
M60



Step 1 - Possible Nodes



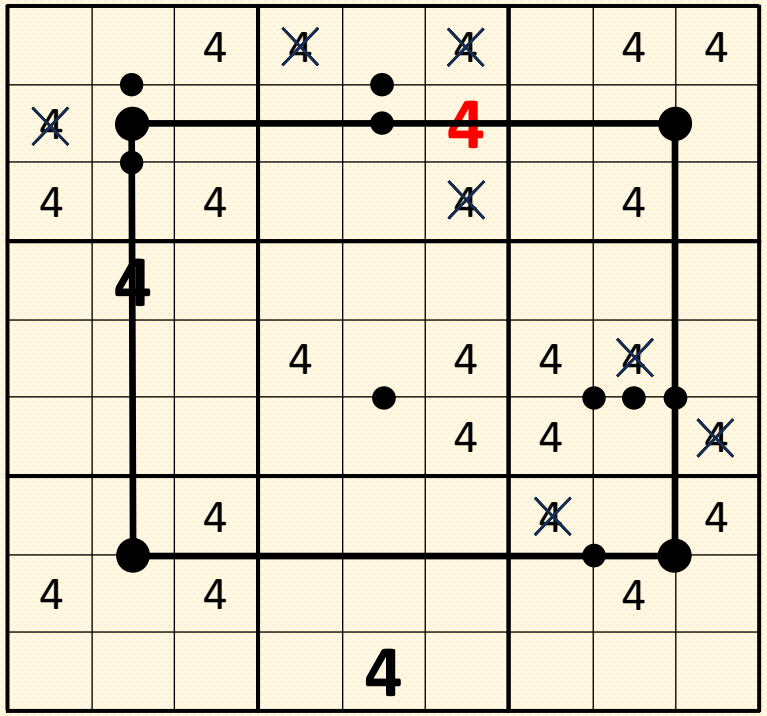
N.B., this is not a possible serpent because all the red 4s would be deleted.



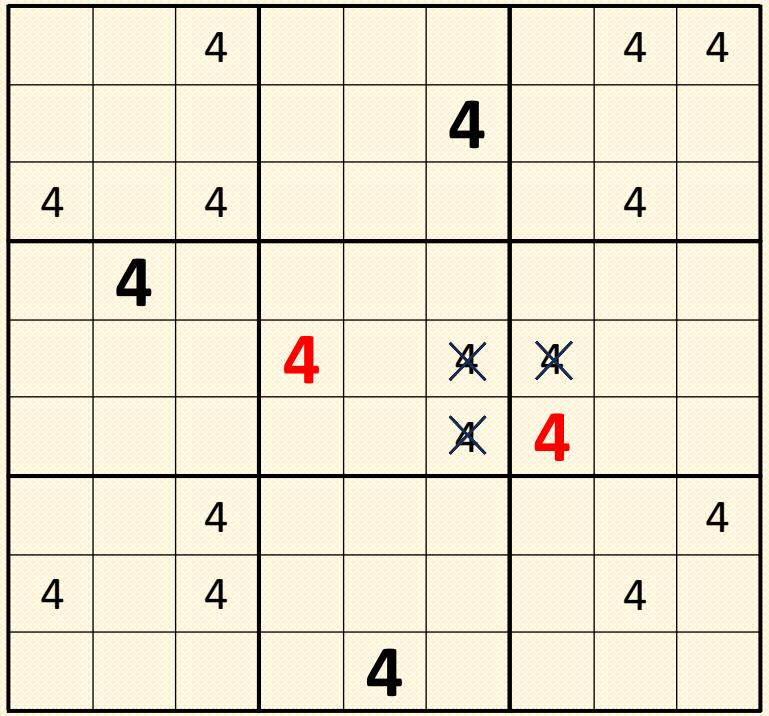
N.B., this is also not a possible serpent because all the red 4s would be deleted.

SERPENT EXAMPLE 4

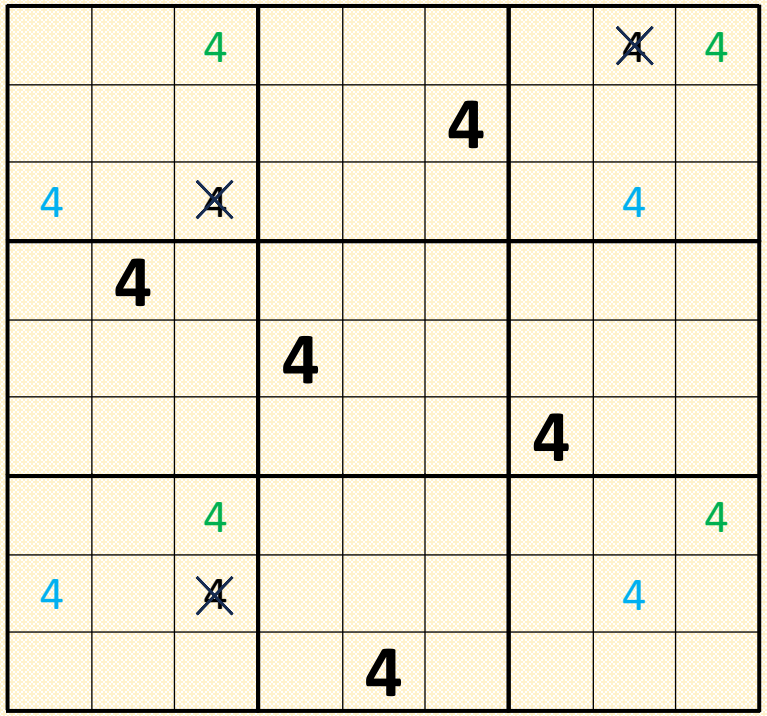
M59



Step 2 - Only Possible Serpent

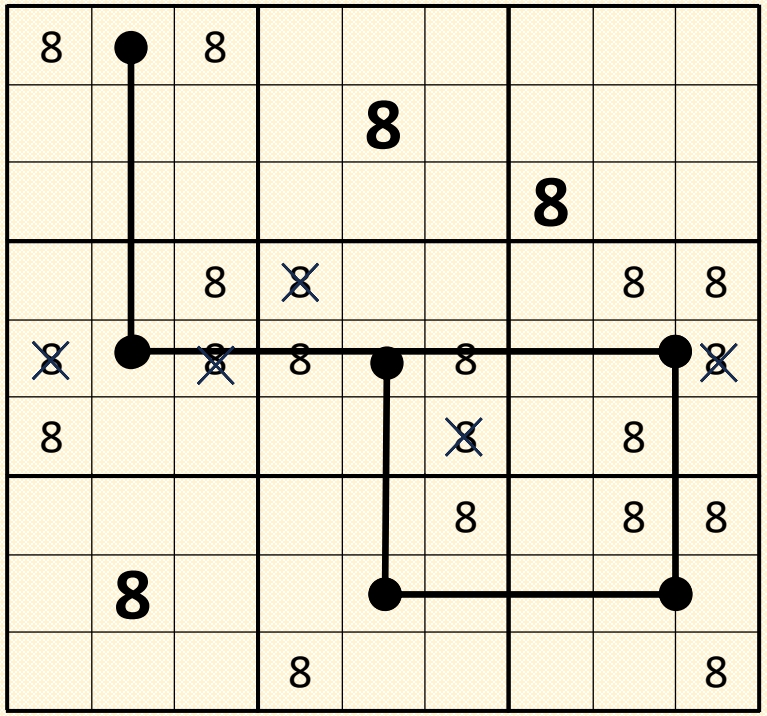


Step 3 - Continuation of solution

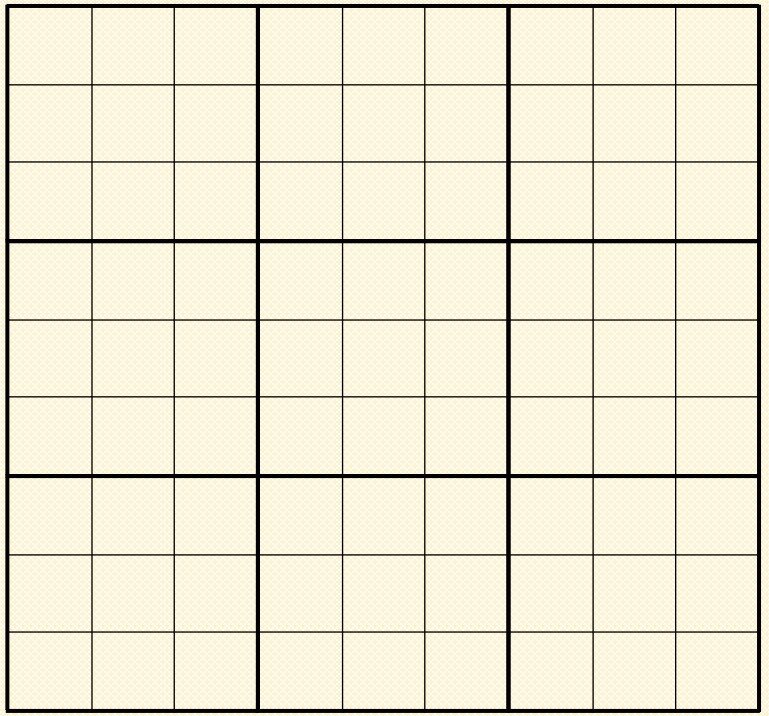


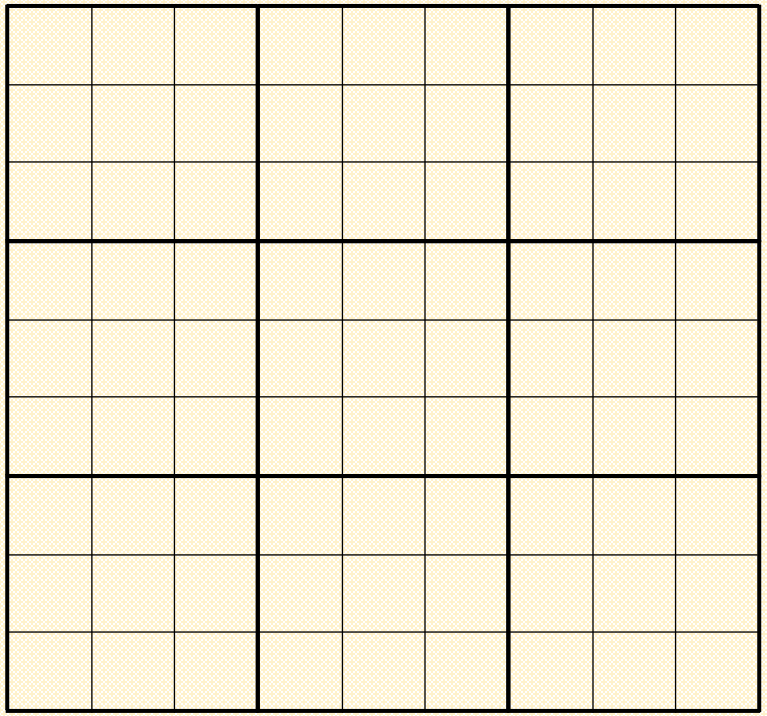
Step 4 - X-Wings

SERPENT EXAMPLE 4 (Contd.)

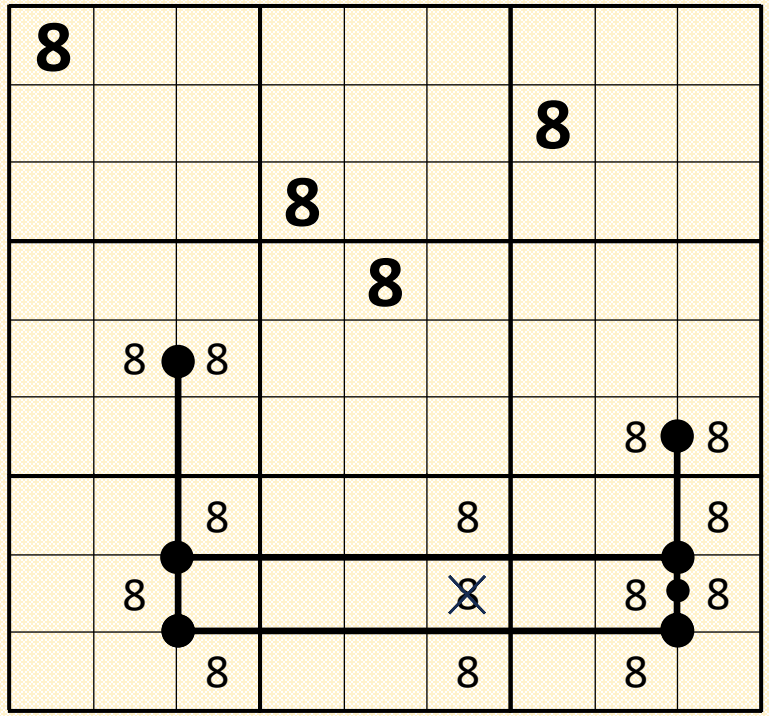


M63





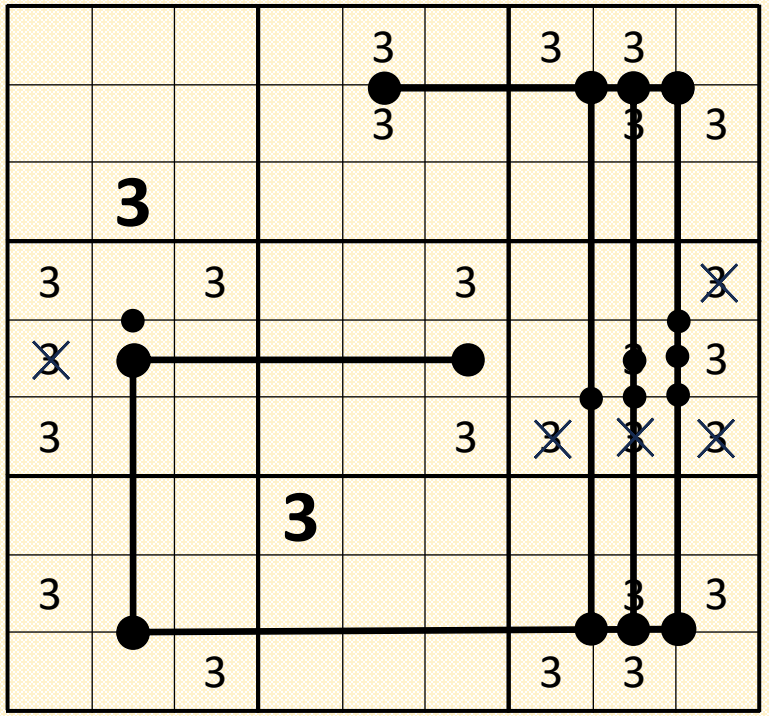
SERPENT EXAMPLE 5



Double Passthroughs

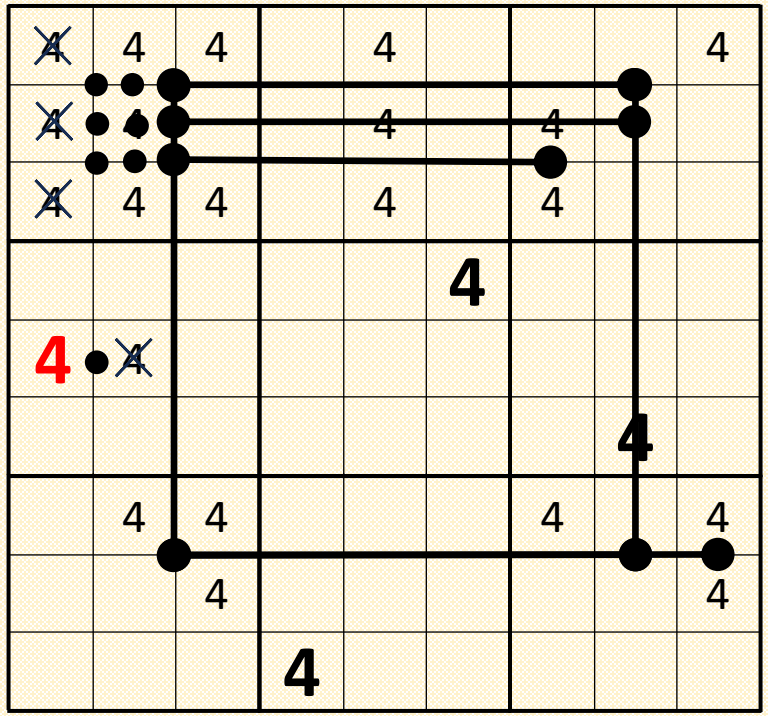
M43

The top passthrough yields the bottom 8 and the bottom passthrough yields the top 8. So, the central 8 can be deleted.



Passback

M43

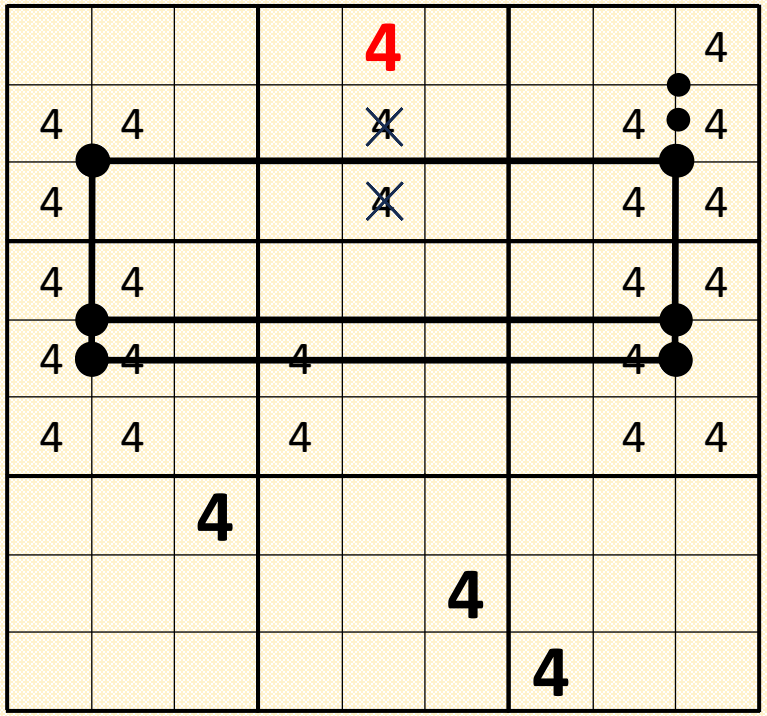


Passthrough

M53

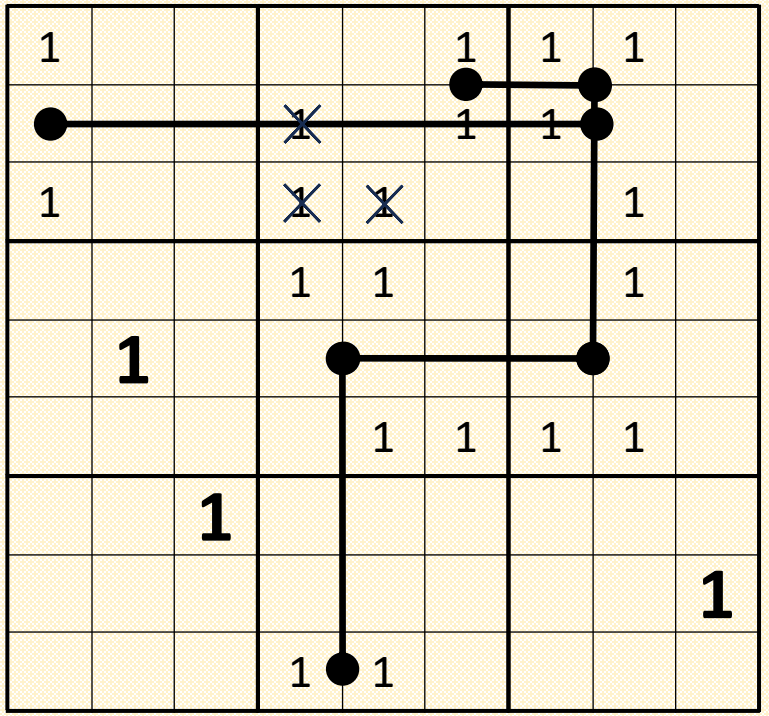
If all the possible serpents share common links, then these links can be used to delete candidates from cells.

MULTIPLE SERPENTS 1



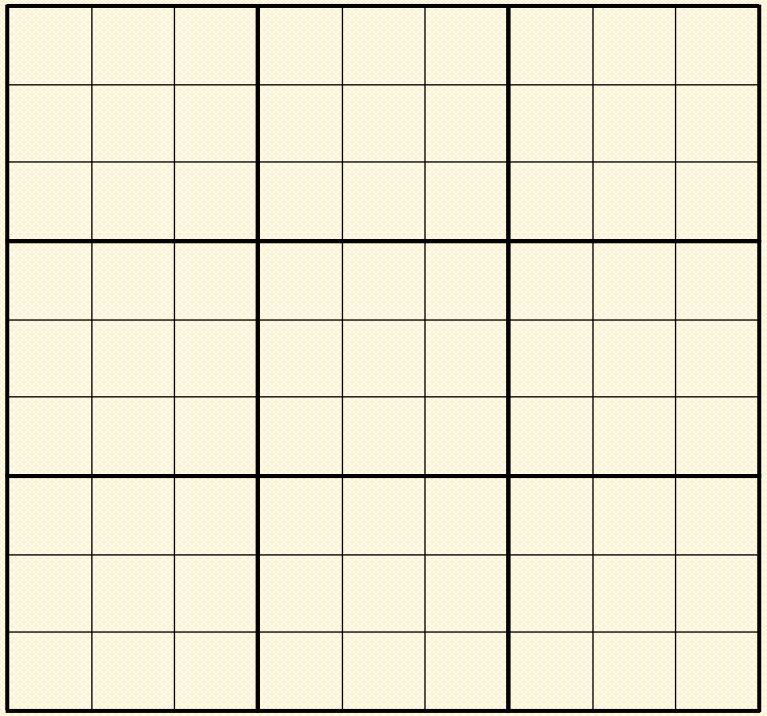
Passthrough

M64

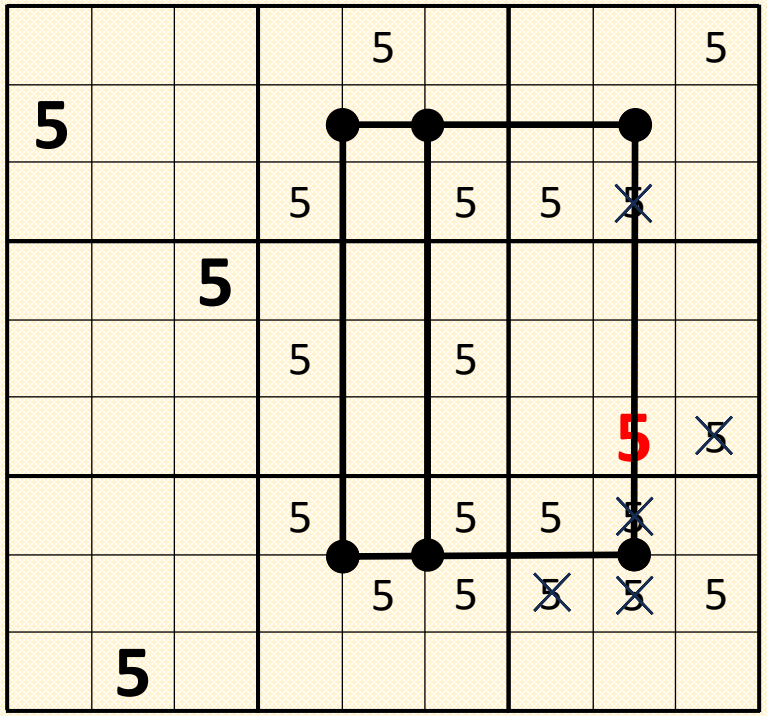


Passback

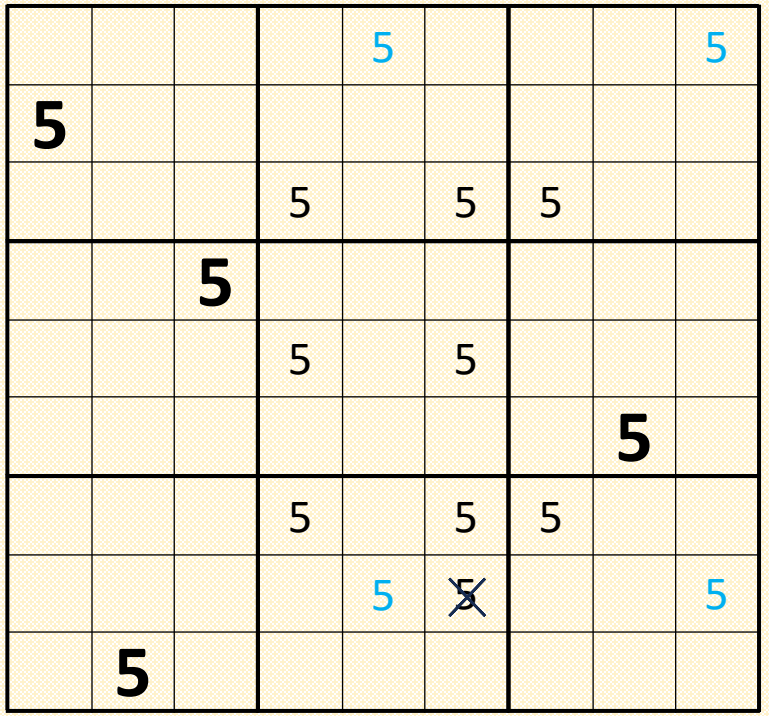
M63



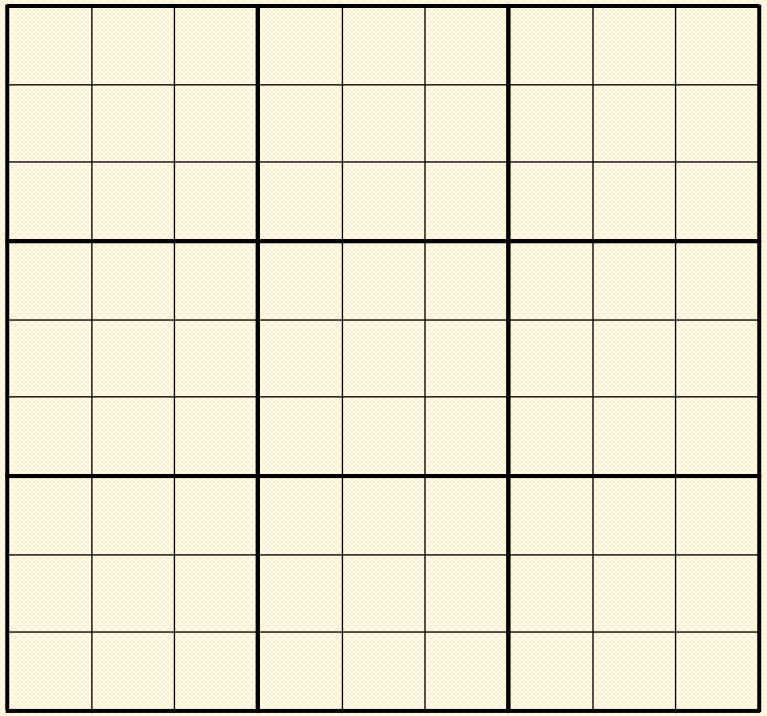
MULTIPLE SERPENTS 2



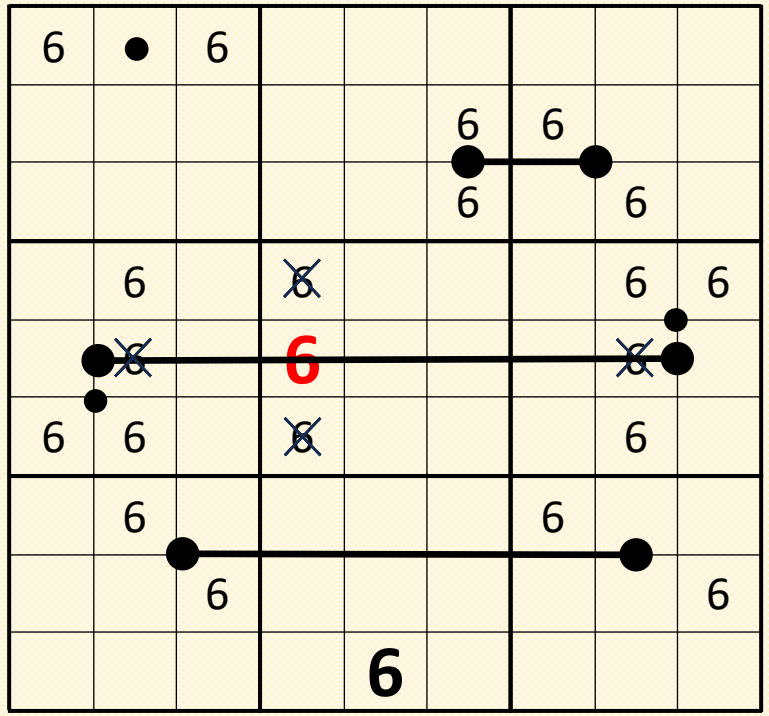
Step 1 - Possible Serpents

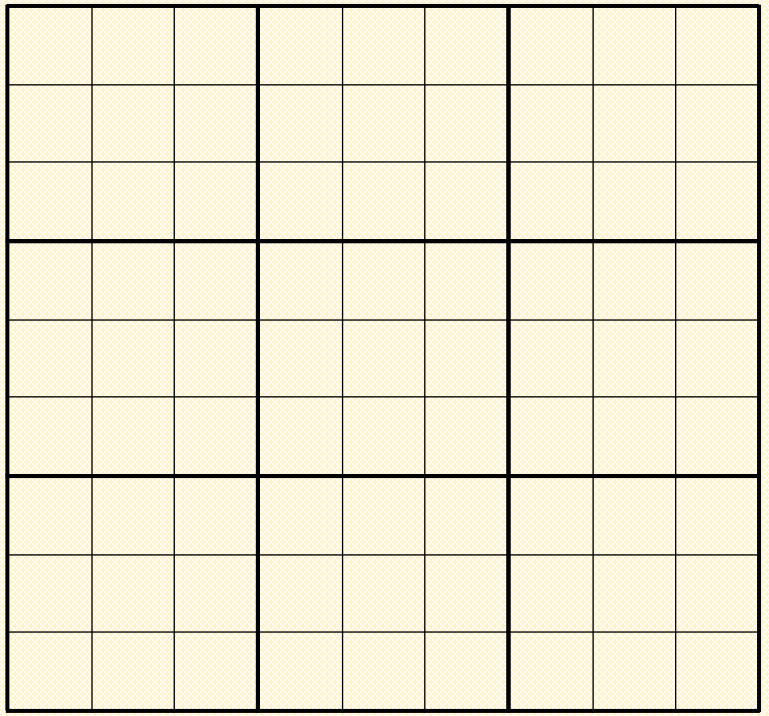


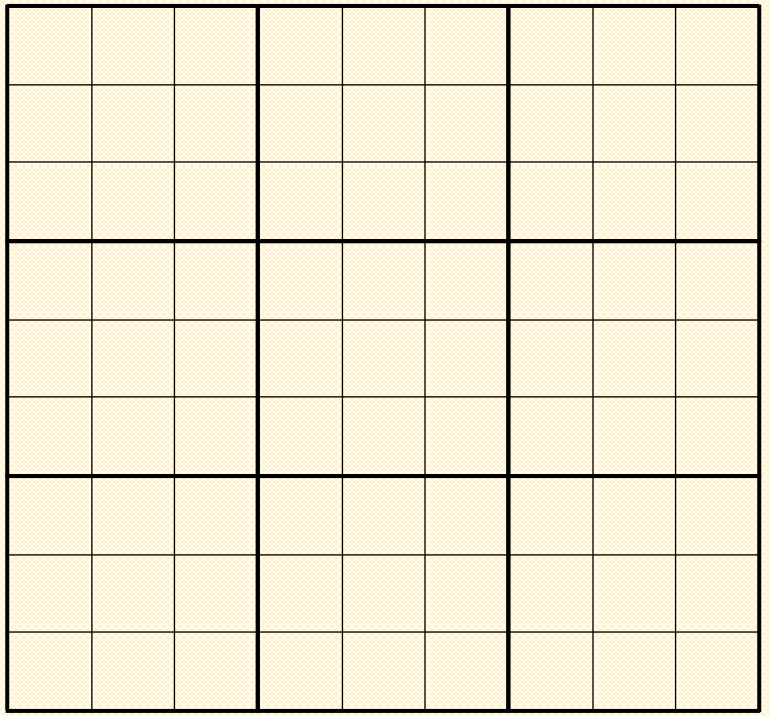
Step 2 – X-Wing



MULTIPLE SERPENTS 3







M72

The nodes are staggered in the columns of major squares but not in the rows. So, horizonal passthroughs are possible.

STAGGERED NODES