The hardest sudokus (new thread)

Re: The hardest sudokus (new thread)

QUOTE

by **mith** » Fri Apr 22, 2022 1:04 am

First 39c with more than one guardian:

CODE: SELECT ALL

```
.....1..2.12....3.4.5..3.61...17265....895.1..51834....435..12.1.6...3.552.31..46  ED=11.6/11.6/3.4
.....1..2.12....3.4.5..3.61...17265....895.1..51834....235..14.1.6...3.554.31..26  ED=11.6/11.6/3.4
```

mith
Posts: 862
Joined: 14 July 2020

Re: The hardest sudokus (new thread)

QUOTE

by **denis_berthier** » Fri Apr 22, 2022 4:46 am

As for the solution, nothing special. First puzzle (the second is identical):
Solving with preferences for Tridagons, they appear first (after Subsets):

CODE: SELECT ALL

```
Resolution state after Singles and whip[1]:
 *-----------*-----------*-----------*
 | 36789 36789 789 | 479  456B 1   | 45789 789  2   |
 | 6789  1     2   | 478  456B 5B  | 45789 3    479 |
 | 4     789   5   | 279  28   3   | 789   6    1   |
 *-----------*-----------*-----------*
 | 389   389   489 | 1    7    2   | 6     5    3489 |
 | 2367  367   47  | 8    9    5   | 347   1    347  |
 | 2789  5     1   | 6    3    4   | 2789  789  789  |
 *-----------*-----------*-----------*
 | 789   4     3   | 5    6B   679B | 1     2    789  |
 | 1     789   6   | 24   24   789  | 3     789  5    |
 | 5     2     789 | 3    1    789  | 789   4    6    |
 *-----------*-----------*-----------*
142 candidates

hidden-pairs-in-a-row: r8b2=2 r4j1c4 c5j ==> r8c5r8, r8c4r8, r8c4r7
whip[1]: b8r7j9c6 ==> r2c6r7
whip[1]: b8r8j9c6 ==> r2c6r9

CPU: SELECT ALL
 *-----------*-----------*-----------*
 | 36789 36789 789 | 479  456B 1   | 45789 789  2   |
 | 6789  1     2   | 478  456B 5B  | 45789 3    479 |
 | 4     789   5   | 279  28   3   | 789   6    1   |
 *-----------*-----------*-----------*
 | 389   389   489 | 1    7    2   | 6     5    3489 |
 | 2367  367   47  | 8    9    5   | 347   1    347  |
 | 2789  5     1   | 6    3    4   | 2789  789  789  |
 *-----------*-----------*-----------*
 | 789   4     3   | 5    6B   679B | 1     2    789  |
 | 1     789   6   | 24   24   789  | 3     789  5    |
 | 5     2     789 | 3    1    789  | 789   4    6    |
 *-----------*-----------*-----------*

tridagon-link (horiz, same row) for digits 7, 8 and 9 in blocks:
        b3, with cells: r2c9 [link cell], r3c7, r1c8
        b6, with cells: r4c9, r6c9, r5c7, r5c1, r1c3
        b9, with cells: r7c9, r9c7, r9c3
        b7, with cells: r7c1, r9c3, r8c2
==> tridagon-link[2][row][b3, b6r2c1]
tridagon-forcing-whip-elim[13] based on tridagon-link(b4r2c9, b6r2c1)
 ...for r6c9:
 ...for b6r2c1: partial-whip[2]: r2b8{n8 n9} ==
 ==> r2c9#9
tridagon-forcing-whip-elim[14] based on tridagon-link(b4r2c9, b6r2c1)
 ...for b6r2c9:
 ...for b6r2c1: partial-whip[3]: r3b6{c2 c5} - c5b5{r1 r2} -
 ==> r1c2#9
whip[1]: b3b6r2c9. ] ==> r2c4#9
tridagon-forcing-whip-elim[14] based on tridagon-link(b4r2c9, b6r2c1)
 ...for b6r2c9:
 ...for b6r2c9: partial-whip[2]: r3b6{c2 c5} - c5b5{r1 r2} -
 ==> r1c2#9
whip[1]: b3b6r2c9. ] ==> r2c4#9
tridagon-forcing-whip-elim[14] based on tridagon-link(b4r2c9, b6r2c1)
 ...for b6r2c9:
 ...for b6r2c9: partial-whip[2]: r7b4{r2 r5} - r5b2{r7 r1} -
 ==> r1c1#9
```

hidden-single-in-a-block ==> r5c2=6

CODE: SELECT ALL

```
Resolution state #51:
 *-----------*-----------*-----------*
 | 36789 3789  789 | 479  456B 1   | 45789 789  2   |
 | 6789  1     2   | 478  456B 5B  | 45789 3    479 |
 | 4     789   5   | 279  28   3   | 789   6    1   |
 *-----------*-----------*-----------*
 | 389   389   489 | 1    7    2   | 6     5    3489 |
 | 237   6     47  | 8    9    5   | 347   1    34   |
 | 2789  5     1   | 6    3    4   | 2789  789  789  |
 *-----------*-----------*-----------*
 | 789   4     3   | 5    6789 679  | 1     2    789  |
 | 1     9     6   | 24   24   789  | 3     789  5    |
 | 5     2     789 | 3    1    789  | 789   4    6    |
 *-----------*-----------*-----------*
```

The end is in W11.

After R51, one can also use my newly coded functions for eleven's technique and the rules for its automatic start in relation with Tridagons. One finds a solution in 25 instead of W11:

CODE: SELECT ALL

```
***** STARTING ELEVEN'S REPLACEMENT TECHNIQUE in resolution state: *****
 *-----------*-----------*-----------*
 | 36789 3789  789 | 479  456B 1   | 45789 789  2   |
 | 6789  1     2   | 79   56B  5B  | 45789 3    479 |
 | 4     789   5   | 279  28   3   | 789   6    1   |
 *-----------*-----------*-----------*
 | 389   389   489 | 1    7    2   | 6     5    3489 |
 | 237   6     47  | 8    9    5   | 247   1    34   |
 | 2789  5     1   | 6    3    4   | 2789  789  789  |
 *-----------*-----------*-----------*
 | 789   4     3   | 5    6789 679  | 1     2    789  |
 | 1     789   6   | 24   24   789  | 3     789  5    |
 | 5     2     789 | 3    1    789  | 789   4    6    |
 *-----------*-----------*-----------*

AFTER APPLYING ELEVEN'S REPLACEMENT METHOD to digits 7, 8 and 9 in cells r7c1, r9c3 and r8c2,
the resolution state is:
 *-----------*-----------*-----------*
 | 36789 3789  789 | 479  456789 1 | 5789  789  2   |
 | 6789  1     2   | 79   5678 5B  | 5789  3    479 |
 | 4     789   5   | 279  28   3   | 789   6    1   |
 *-----------*-----------*-----------*
 | 3789  3789  4789 | 1    789  2   | 6     5    34789 |
 | 23789 6     4789 | 789  789  5   | 24789 1    34   |
 | 2789  5     1    | 4    3    6   | 2789  789  789  |
 *-----------*-----------*-----------*
 | 789   4     3    | 5    6789 679 | 1     2    789  |
 | 1     9     6    | 24   24   789 | 3     789  5    |
 | 5     2     789  | 3    1    789 | 789   4    6    |
 *-----------*-----------*-----------*
THIS IS THE PUZZLE THAT WILL NOW BE SOLVED.
DON'T FORGET TO DO THE RELEVANT DOIT REPLACEMENTS AT THE END, based on the original givens.

CPU: SELECT ALL

whip[1]: r8c7{c9 .} ==> r5c7#7, r4c9#7
whip[1]: r8c7{c9 .} ==> r8c9#7
fsnnd-x-wing-in-rows: n6{r3 r7}{c7 c8} ==> r2c6#9
whip[1]: c8n6{r9 .} ==> r7c5#9
fsnnd-x-wing-in-columns: n6{c3 c7}{r1 r8} ==> r6c1#9
whip[1]: r8n6{c9 .} ==> r8c8#6
z-chain[4]: r1n6{c3 c7} - c3n8{r8 n8} - r3c7{n8 n9} - r8c7{n9 .} ==> r1c7#7
z-chain[4]: r1n6{c3 c7} - r1n8{c7 n8} - b9n8{r8c8 r7c9} - b9n6{r7c9 .} ==> r1c7#9
whip[4]: r2n8{c7 c9} - c9n7{r2 r9} - c9n8{r9 r7} - r8c7{n8 .} ==> r2c7#7
z-chain[5]: r2n8{c7 c9} - c9n7{r2 r9} - c9n8{r9 r7} - r8c7{n8 n7} - r3c7{n7 .} ==> r1c4#9
z-chain[5]: r2c5{n8 n7} - r1c8{n7 n8} - b9n8{r8c8 r7c9} - b9n6{r7c9 r8c7} - r3n8{r7 .} ==> r1c4#9, r1c5#9
z-chain[5]: r3c7{n8 n7} - r8c7{n7 n8} - r3c2{n8 n7} - r1c3{n7 n8} - c8n9{r1 .} ==> r6c7#9
z-chain[5]: r3c7{n8 n7} - r8c7{n7 n8} - r3c2{n8 n7} - r1c3{n7 n8} - c8n9{r1 .} ==> r6c7#9
biv-chain[3]: r8n7{c8 c7} - r9c7{n7 n8} - r7n8{n8 n6} ==> r8c9#6
z-chain[4]: r1c3{n7 n9} - c8n9{r1 r8} - r8c9{n9 n7} - r3n7{c8 .} ==> r1c4#7, r1c4#7
biv-chain[3]: r1n4{n8 n4} - c5n4{r1 r8} - c8n8{r8 r3} ==> r3c9#8
biv-chain[3]: c8n7{r1 r8} - r8c9{n7 n8} - r2c8{n8 n6} - r1n6{c5 c1} - b1n3{r1c1 r1c2} ==> r1c2#7
biv-chain[3]: r1n4{n8 n4} - c5n4{r1 r8} - r8c1{n4 n6} ==> r8c9#6
biv-chain[3]: c8n8{r8 r6c8} - c8n8{r6 r7} - r7c9{n8 n9} ==> r2c9#9
biv-chain[3]: b6r7{c6c7 r6c9} - c9n9{r6 r7} - r8c7{n9 n7} ==> r3c7#7
biv-chain[3]: r3n7{c8 c7} - r8c7{n7 n8} - r2c8{n8 n6} ==> r2c5#6
singles ==> r2c5=6, r3c6=1, r3c9=8, r6c8=8, r6c9=7, r7c9=9, r8c7=7, r9c6=9, r8c8=7, r3c2=7
naked-pairs-in-a-row: r2{c1 c6}{n6 n8} ==> r2c9#9, r2c7#8, r2c5#6, r2c6#6, r2c4#8
site
  38945172
  72631859
  47582961
  93417268
  26398514
  85184267
  743586129
  186247395
  529319746

Now compare this solution to the original puzzle:

CODE: SELECT ALL

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

and observe on block b5 that (by mere chance), no permutation of digits 7, 8, 9 needs to be done.
```

denis_berthier
2010 Supporter
Posts: 3334
Joined: 28 June 2007
Location: Paris

Re: The hardest sudokus (new thread)

QUOTE

by **mith** » Sat Apr 23, 2022 3:43 am

Yes, SER reduces to B.3 after replacement.

An alternate path using an extended trivalue oddagon:

CODE: SELECT ALL

```
   +-------+-------+-------+
   | . . . | . . . | . . . |
   | . . . | . . . | . . . |
   | . . . | . . . | . . . |
   +-------+-------+-------+
   | . . . | . . . | . . . |
   | . . . | . . . | . . . |
   | . . . | . . . | . . . |
   +-------+-------+-------+
   | . . . | . . . | . . . |
   | . . . | . . . | . . . |
   | . . . | . . . | . . . |
   +-------+-------+-------+
```

After basics: if a is not 6, c is not 789 by trivalue oddagon in b1379. If a is 6, b is 8, and the extended pattern b1379+c6 is also not three colorable so c is again not 789. (Pretty simple after 4r2c9.)

mith
Posts: 862
Joined: 14 July 2020

Re: The hardest sudokus (new thread)

QUOTE

by **steven** » Sat Apr 23, 2022 9:47 pm

This pattern looks familiar to me (see here). Who has found it ?

steven
Posts: 2020
Joined: 23 February 2006

Re: The hardest sudokus (new thread)

QUOTE

by **International_DBA** » Sun Apr 24, 2022 8:09 am

I produce extreme sudokus from time to time but they take up a lot of computer time as for each one I have to reject 50 or 100 which are not hard enough.
I then post them on my blog, where (if I'm lucky) they get between 100 and 200 views each.
However, a couple of members in my Facebook group keep asking for very difficult puzzles.
Would you mind if I copied and published one of yours, please?
I will add a link to send people back to this thread if they want more.

International_DBA
Posts: 57
Joined: 07 December 2014

Re: The hardest sudokus (new thread)

QUOTE

by **mith** » Sun Apr 24, 2022 3:54 pm

> **steven wrote:**
> This pattern looks familiar to me (see here). Who has found it ?

I actually just found it thinking around figuring out what happens if 6r2c1, and realizing it was the 789 that was breaking. It does look like a morph of the first one in your post.

ryskouruba posted a few more versions of the idea, which are probably also morphs or at least very similar to the ones you've posted. I need to catch up in the chromatic thread.

mith
Posts: 862
Joined: 14 July 2020

Re: The hardest sudokus (new thread)

QUOTE

by **mith** » Sun Apr 24, 2022 4:39 pm

Finally found some 39c 11.7s:

CODE: SELECT ALL

```
....1.23..2.3.1.4.1.4256...21.64.14.853.582.4.3...731.6...21.....368963.4...  ED=11.7/11.7/8.3
....1.23..2.3.1.4.1.4256...21.64.14.853.582.3.4...731.6...21.....368964.5...  ED=11.7/11.7/8.3
....1.23..2.3.1.4.1.4256...21.64.14.853.582.3.4...761.5...21.....368934.6...  ED=11.7/11.7/8.3
```

mith
Posts: 862
Joined: 14 July 2020

(same puzzle other than some rectangle swaps)

Guardians in opposing boxes, but they collapse pretty quickly with the strong link:

5r6c3 = r4c123 - r4c9 =[b789b2356]= r1c5 - r789c5 = r8c4 => -5r8c3 (solvable with turbot fish from here)

Also noticed that occasionally the same puzzle is getting added to the database twice - presumably a timing thing between the scripts. Will have to figure out where that is happening, but fortunately not frequent and quick to find all the instances and remove duplicates.

Re: The hardest sudokus (new thread)

QUOTE

by **yzfwsf** » Sun Apr 24, 2022 11:23 pm

> **mith wrote:**
> Guardians in opposing boxes, but they collapse pretty quickly with the strong link:
>
> 5r6c3 = r4c123 - r4c9 =[b789b2356]= r1c5 - r789c5 = r8c4 => -5r8c3 (solvable with turbot fish from here)

5r4c9 = r1c5(Triplet Oddagon) - (5 = 27)r9c57 -(7 = 789)UR15r9b789 - (789 = 5)virtual ALS b6p15789 => r4c9=5, site

yzfwsf
Posts: 592
Joined: 16 April 2019

Re: The hardest sudokus (new thread)

QUOTE

by **hendrik_monard** » Sun May 15, 2022 3:39 pm

Before taking a leave I gathered my results of the past weeks:

54 new 11.8s:

CODE: SELECT ALL

```
9876.......958......4..83...27.7.9..8.5.26...896..2.3..29.3.67.8.73.     11/8/1.2/1.2
98.76.....9.8.....4..7..6.8.....7.9.8.....532.......54.79.8...6857.....7.8.73.64...  11/8/1.2/1.2
98.76.5..7.48..8....5.49..6..97...59.4..8..47.58.....7.3.....2.....8  11/8/1.2/1.2
98.76.5..7.48.....5.49..6..97...59.4..8..47.58.....7.3.....2.....8  11/8/1.2/1.2
98.76.7.5A.8..4A..9..5...6..8.A.9.A.7..9..5..7..9..2.....5...  11/8/1.2/1.2
98.76.7.5A.8..4A..9..5...6..8.A.9.A.7..9..5..7..9..2.....5...  11/8/1.2/1.2
98.76..7.5A.....4A.5.9..57..8..6.4..5.87..8..8..4.....72.....2.....9  11/8/1.2/1.2
98.76.5.4.7..5A..3.48.9.6.48..7.5..4.9...98.76.....9..3.....7  11/8/1.2/1.2
98.76.5.4.7..5A..3.48.9.6.48..7.5..4.9...98.76.....9..3.....7  11/8/1.2/1.2
98.76.5.7.5.4..8A..4...6.5.....79.4.75..8..98...45..3...9..2.....5...  11/8/1.2/1.2
98.76.5A.5A.8..4A..9..5...6..8.A.9.A.7..9..5..7..9..2.....5...  11/8/1.2/1.2
98.76.5A.5A.8..4A..9..5...6..8.A.9.A.7..9..5..7..9..2.....9  11/8/1.2/1.2
98.76..7.5A.....4A.5.9..57..8..6.4..5.87..8..8..4.....72.....2.....9  11/8/1.2/1.2
98.76.5..7.5.4..8A..4...6.5.....79.4.75..8..98...45..3...9..2.....5...  11/8/1.2/1.2
98.76.5..7.5.4..8A..4...6.5.....79.4.75..8..98...45..3...9..2.....4  11/8/1.2/1.2
98.76.5A.5A.8..4A..9..5...6..8.A.9.A.7..9..5..7..9..2.....4  11/8/1.2/1.2
98.76.5A.5A.8..4A..9..5...6..8.A.9.A.7..9..5..7..9..2.....9
```