The hardest sudokus (new thread)

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Re: The hardest sudokus (new thread)

Quote

by **coloin** » Thu Mar 10, 2022 8:52 pm

I looked at the first 1M puzzles in the file [SE 11.9-11.1]
Converted them to the morph of the puzzle in the minlex grid - 10 mins
Solved them with gridchecker - 10 seconds

There were 140000 different grid solutions
The maximum puzzles per grid solution was over 4000 - all predominately sk9! 11.1
82000 grid solutions had a single puzzle and the higher rated puzzles were more likely to be solitary.

I looked at this series of puzzles from the database [all from the same grid solution][sk8!-rated]

Hidden Text: Show

CODE: SELECT ALL

```
823006700050700030700030006200073060060100003030600007390020706003075907069030 ED=9.0/1.2/1.2    expanded non-minimal from them
```

NEW puzzles found with gridchecker removing redundant clues and rated with sk9!

CODE: SELECT ALL

```
.23..67..567...3.7...3....2....3.6...,1.....38.....,7....2...6...795..7..9.3.4 ED=11.5/1.2/1.2
.23..67..567...3.7.......2....3.6..6,1.....8....79.....2....6..3.795..7..69..4 ED=11.5/1.2/1.2
.23..67..567...3.7.......2....3.6...1.....38.....7....2...6..3.795..7..9.3.4 ED=11.5/1.2/1.2
.23..67..567...3.7.......2....3.6..6,1.....38.....7....2...6..3.795..7.89.3.4 ED=11.5/1.2/1.2
.23..67..567...3.7.......2....3.6..6,1.....38.....2.7...3.795..7.89.3.4 ED=11.5/1.2/1.2
.23..67..567....7..3....2....6..6,1...3.38.....2.7...3.795...69.3.4 ED=11.5/1.2/1.2
.23..67..567....7..3....2....5..6,1...3.38.....2.7...3.795...69.3.4 ED=11.5/1.2/1.2
.23..67..567....7..3....2....6..6,1...3.38.....2.7...3.795...69.3.4 ED=11.5/1.2/1.2
.23..6...567....7..3....2....6..6,1...3.38.....2.7...3.795...69.3.4 ED=11.5/1.2/1.2
```

coloin
Posts: 2225
Joined: 05 May 2005
Location: Devon

Re: The hardest sudokus (new thread)

Quote

by **coloin** » Thu Mar 10, 2022 11:02 pm

Possibly these puzzles have been found by singles expansion and reduction by **mith**

Hidden Text: Show

CODE: SELECT ALL

```
823006700050700030700030006200073060060100003030600007390020706003075907069030 ED=9.0/1.2/1.2   non-minimal expansion
```

Some more - all with the same minlex grid solution

CODE: SELECT ALL

```
.23..67..567...3.7...3....2....3.6...,1.....38.....7....2...6...795..7..9.3.4 ED=11.5/1.2/1.2
.23..67..567...3.7.......2....3.6..6,1.....8....79.....2....6..3.795..7..69..4 ED=11.5/1.2/1.2
.23..67..567...3.7.......2....3.6...1.....38.....7....2...6..3.795..7..9.3.4 ED=11.5/1.2/1.2
.23..67..567...3.7.......2....3.6..6,1.....38.....2.7...3.795..7.89.3.4 ED=11.5/1.2/1.2
.23..67..567....7..3....2....6..6,1...3.38.....2.7...3.795...69.3.4 ED=11.5/1.2/1.2
.23..67..567....7..3....2....5..6,1...3.38.....2.7...3.795...69.3.4 ED=11.5/1.2/1.2
.23..67..567....7..3....2....6..6,1...3.38.....2.7...3.795...69.3.4 ED=11.5/1.2/1.2
.23..6...567....7..3....2....6..6,1...3.38.....2.7...3.795...69.3.4 ED=11.5/1.2/1.2
```

mith
Posts: 862
Joined: 14 July 2020

Re: The hardest sudokus (new thread)

Quote

by **mith** » Fri Mar 11, 2022 5:09 pm

New 11.9 this morning (well, a pair of minimals from the same expanded grid). Unfortunately my internet is down, if it doesn't come back soon I'll attempt to transcribe on my phone. Looking into how morph dependent it is.

Re: The hardest sudokus (new thread)

Quote

by **mith** » Fri Mar 11, 2022 5:22 pm

CODE: SELECT ALL

```
. . . . . . . . 1
. . . . . 2 . . .
. . . 3 . . 4 5 .
. . 6 . . . . . .
. 7 1 . 8 . . . .
3 2 . . 6 7 . . 8
. 6 . . 2 3 . . .
. 8 3 7 . . 1 . .
7 . 2 8 1 . 6 . .
```

This should be the 26c minimal, if I haven't made a typo. The other is 27c.

Re: The hardest sudokus (new thread)

Quote

by **mith** » Fri Mar 11, 2022 5:42 pm

Still morph dependent. In stepping through with the SE GUI on the minlex form, it gets to a point where there are only 11.9 steps (about 6 of them), but with some morphs it is finding 11.8 steps leading to a more complicated solve path (up to the first digit placed). It could be that these 11.8 steps correspond to 11.9 steps in the other morphs, I'll have to investigate further.

It also occurs to me that there is no step found at this point (even in the 12+ range) which corresponds to the TH deduction (which makes sense if the DFC+DFC chains are in some way comparable to T&E(2) in complexity). I think there's a decent chance that this pattern is eventually going to break through the 12.0 barrier.

Re: The hardest sudokus (new thread)

Quote

by **mith** » Fri Mar 11, 2022 7:56 pm

Will have a couple more 11.8s at least from this as well - after the 11.9 step leading to the first single, it still needs an 11.8 after. I would add the minimals for this manually but it looks like my scripts already found them anyway.

Re: The hardest sudokus (new thread)

Quote

by **denis_berthier** » Sat Mar 12, 2022 12:16 am

> **mith wrote:**

CODE: SELECT ALL

```
. . . . . . . . 1
. . . . . 2 . . .
. . . 3 . . 4 5 .
. . 6 . . . . . .
. 7 1 . 8 . . . .
3 2 . . 6 7 . . 8
. 6 . . 2 3 . . .
. 8 3 7 . . 1 . .
7 . 2 8 1 . 6 . .
```

This should be the 26c minimal, if I haven't made a typo. The other is 27c.

Hi mith
This is a new puzzle not in T&E(2).
Like Loki, its is not in gT&E(2) either; but it is in T&E(W2, 2).

denis_berthier
2010 Supporter
Posts: 3334
Joined: 19 June 2007
Location: Paris

Re: The hardest sudokus (new thread)

Quote

by **mith** » Sat Mar 12, 2022 12:24 am

Thanks, Denis. Could you post a pencilmark grid after T&E(2)? I'm not currently set up to check it myself, and it would be interesting to see how far it can get.

mith
Posts: 862
Joined: 14 July 2020

Re: The hardest sudokus (new thread)

Quote

by **denis_berthier** » Sat Mar 12, 2022 12:26 am

> **mith wrote:**
> It also occurs to me that there is no step found at this point (even in the 12+ range) which corresponds to the TH deduction (which makes sense if the DFC+DFC chains are in some way comparable to T&E(2) in complexity). I think there's a decent chance that this pattern is eventually going to break through the 12.0 barrier.

I've tried this with the Loki case (digits changed):

CODE: SELECT ALL

```
+-------------------------------------------------------------------------------+
| 123456789 123456789 123456789 | 123456789 123456789 123456789 | 123456789 123456789 123456789 |
| 123456789 123456789 123456789 | 123456789 123456789 123456789 | 123456789 123456789 123456789 |
| 123456789 123456789 123456789 | 123456789 123456789 123456789 | 123456789 123456789 123456789 |
|-------------------------------+-------------------------------+-------------------------------|
| 123456789 123456789 123456789 | 123456789 123456789 123       |       123     123456789 123456789 |
| 123456789 123456789 123456789 | 123456789 123       123456789 |       123456789 123       123456789 |
| 123456789 123456789 123456789 | 123       123456789 123456789 |       123456789 123456789 123456789 |
|-------------------------------+-------------------------------+-------------------------------|
| 123456789 123456789 123456789 | 123       123456789 123456789 | 123       123456789 123456789 |
| 123456789 123456789 123456789 | 123456789 123       123456789 | 123456789 1234      123456789 |
| 123456789 123456789 123456789 | 123456789 123456789 123       | 123456789 123456789 123       |
+-------------------------------+-------------------------------+-------------------------------+
658 candidates.
```

The goal is to eliminate n4rbc8. CSP-Rules has a function for this: (tny-to-eliminate (nrc-to-label 4 8 8)), which works also with T&E.
However, even in T&E(3), this elimination is not obtained.

[Added]: big blunder late evening yesterday: of course n4rbc8 can't be eliminated; it's the value supposed to be asserted by the pattern.
I did the correct calculation (tny-to-eliminate (nrc-to-label 1 8 8)) (The other two values will be eliminated by the same procedure).
n1rbc8 can be eliminated by T&E(3) but not by T&E(2).
Indeed, it can be eliminated by T&E(W2, 2)
Notice that the way I've proceeded shows the elimination is totally independent of whatever can be in any of the cells other than the 4x3 ones defining the pattern.

Note: I can't see how this pattern could seriously be called bi-value oddagon; it doesn't have anything common with an oddagon. As for the name Thor's hammer, it is also totally unjustified (the shape depends on morphs) and it reminds me of some websites that give similarly absurd names to anything. I think this pattern deserves a serious name.

[Added]: because of forcing, it's difficult to compare SE chains to T&E.

.

Last edited by denis_berthier on Sat Mar 12, 2022 4:41 am, edited 2 times in total.

denis_berthier
2010 Supporter
Posts: 3334
Joined: 19 June 2007
Location: Paris

Re: The hardest sudokus (new thread)

Quote

by **denis_berthier** » Sat Mar 12, 2022 12:33 am

> **mith wrote:**
> Thanks, Denis. Could you post a pencilmark grid after T&E(2)? I'm not currently set up to check it myself, and it would be interesting to see how far it can get.

RS after T&E(2):

CODE: SELECT ALL

```
+-----------------------------------------------------------------------------+
| 256   3   478 | 459  4579 4589 | 27   68   1   |
| 456  145  458 | 156  47   2    | 38   678  39  |
| 269  19   79  | 16   3    18   | 278  4    5   |
|---------------+----------------+---------------|
| 8    459  6   | 23   459  15   | 4579 1237 237 |
| 459  7    2   | 459  6    459  | 1    8    3   |
| 1    6    459 | 1459 8    459  | 459  23   6   |
|---------------+----------------+---------------|
| 3    6    459 | 459  2    3    | 58   589  47  |
| 459  8    3   | 7    459  6    | 1    259  249 |
| 7    459  2   | 8    1    459  | 6    359  34  |
+-----------------------------------------------------------------------------+
```

The RS after gT&E(2) is the same.

Re: The hardest sudokus (new thread)

Quote

by **mith** » Sat Mar 12, 2022 3:43 am

Thanks, Denis. Like Loki, the pencilmark grid after T&E(2) has a rectangle on 68, giving a second expanded version. The pencilmark grid has 6 minimals, the grid with swapped 68 has 12 minimals, all from both are 26c-27c again.

The 31c after T&E(2) is SE 11.7, and the swapped version, are both 11.7, I'll run the minimals now.

mith
Posts: 862
Joined: 14 July 2020

Re: The hardest sudokus (new thread)

Quote

by **denis_berthier** » Sat Mar 12, 2022 4:56 am

Question to those who have studied this pattern and its proof.
Apart from:
- having a rectangle of 4 blocks (in two stacks and two bands);
- having in each block 3 cells in different rows and different columns, all having the same 3 digits and only these (except one and only one of these 12 cells that has an additional digit)
is there any additional condition about the alignments of the 12 cells?

The fact is, apart from examples, I've never seen a clear definition, nor a non context dependent proof.

[Edit1]: Thinking of this again.
Unless I miss some additional condition (which I don't think), it seems quite obvious to me that the special cell could have more than one additional candidate and that the proper conclusion is not "the additional candidate can be asserted" but "the 3 common candidates can be eliminated from the special cell".

[Edit2]: I was correct. Starting from:

CODE: SELECT ALL

```
+-----------------------------------------------------------------------------+
| 123456789 123456789 123456789 | 123456789 123456789 123456789 | 123456789 123456789 123456789 |
| 123456789 123456789 123456789 | 123456789 123456789 123456789 | 123456789 123456789 123456789 |
| 123456789 123456789 123456789 | 123456789 123456789 123456789 | 123456789 123456789 123456789 |
|-------------------------------+-------------------------------+-------------------------------|
| 123456789 123456789 123456789 | 123456789 123456789 123       |       123     123456789 123456789 |
| 123456789 123456789 123456789 | 123       123456789 123456789 |       123456789 123       123456789 |
| 123456789 123456789 123456789 | 123       123456789 123456789 |       123456789 123456789 123456789 |
|-------------------------------+-------------------------------+-------------------------------|
| 123456789 123456789 123456789 | 123       123456789 123456789 | 123       123456789 123456789 |
| 123456789 123456789 123456789 | 123456789 123       123456789 | 123456789 1234      123456789 |
| 123456789 123456789 123456789 | 123456789 123456789 123       | 123456789 123456789 123       |
+-------------------------------+-------------------------------+-------------------------------+
```

n1rbc8 can indeed be eliminated by the same T&E(W2, 2) (or the stronger T&E(3))
Notice that there is no ambiguity about which cell has eliminations: it's the only one in a different row and a different column from the other two cells in this block.

.

Last edited by denis_berthier on Sat Mar 12, 2022 7:24 am, edited 1 time in total.

denis_berthier
2010 Supporter
Posts: 3334
Joined: 19 June 2007
Location: Paris

Re: The hardest sudokus (new thread)

Quote

by **yzfwsf** » Sat Mar 12, 2022 7:22 am

> **denis_berthier wrote:**
>
> Question to those who have studied this pattern and its proof.
> Apart from:
> - having a rectangle of 4 blocks (in two stacks and two bands);
> - having in each block 3 cells in different rows and different columns, all having the same 3 digits and only these (except one and only one of these 12 cells that has an additional digit)
> is there any additional condition about the alignments of the 12 cells?
>
> The fact is, apart from examples, I've never seen a clear definition, nor a non context dependent proof.
>
> [Edit]: Thinking of this again.
> Unless I miss some additional condition (which I don't think), it seems quite obvious to me that the special cell could have more than one additional candidate and that the proper conclusion is not "the additional candidate can be asserted" but "the 3 common candidates can be eliminated from the special cell".
>
> The arrangement of three cells in each box is divided into diagonal or anti-diagonal arrangement. If the arrangement of 4 boxes is 3*diagonal + 1*anti-diagonal or 3*anti-diagonal + 1*diagonal, then such an arrangement of 12 cells is considered oddagon. The rules of diagonal and anti-diagonal are: find the two cells in the box where the row and column coordinates differ by 1, and the direction of the line between the two cells.

yzfwsf
Posts: 592
Joined: 16 April 2019

Re: The hardest sudokus (new thread)

Quote

by **denis_berthier** » Sat Mar 12, 2022 7:26 am

> **yzfwsf wrote:**
> The arrangement of three cells in each box is divided into diagonal or anti-diagonal arrangement. If the arrangement of 4 boxes is 3*diagonal + 1*anti-diagonal or 3*anti-diagonal + 1*diagonal, then such an arrangement of 12 cells is considered oddagon. The rules of diagonal and anti-diagonal are: find the two cells in the box where the row and column coordinates differ by 1, and the direction of the line between the two cells.

Indeed, we cross-posted, but as I showed in the 2nd edit of my previous post, there is some elimination rule that is much more general than this and doesn't care about diagonals or anti-diagonals.

denis_berthier
2010 Supporter
Posts: 3334
Joined: 19 June 2007
Location: Paris

Re: The hardest sudokus (new thread)

Quote

by **yzfwsf** » Sat Mar 12, 2022 7:57 am

CODE: SELECT ALL

```
+-----------------------------------------------------------------------------+
| 123456789 123456789 123456789 | 123456789 123456789 123456789 | 123456789 123456789 123456789 |
| 123456789 123456789 123456789 | 123456789 123456789 123456789 | 123456789 123456789 123456789 |
| 123456789 123456789 123456789 | 123456789 123456789 123456789 | 123456789 123456789 123456789 |
|-------------------------------+-------------------------------+-------------------------------|
| 123       123456789 123456789 | 123       123456789 123456789 | 123456789 123456789 123456789 |
| 123456789 123       123456789 | 123456789 123       123456789 | 123456789 123456789 123456789 |
| 123456789 123456789 123       | 123456789 123456789 123       | 123456789 123456789 123456789 |
|-------------------------------+-------------------------------+-------------------------------|
| 123       123456789 123456789 | 123       123456789 123456789 | 123456789 123456789 123456789 |
| 123456789 123       123456789 | 123456789 123       123456789 | 123456789 123456789 123456789 |
| 123456789 123456789 123       | 123456789 123456789 123       | 123456789 123456789 123456789 |
|-------------------------------+-------------------------------+-------------------------------|
| 123       123456789 123456789 | 123       123456789 123456789 | 123456789 123456789 123456789 |
| 123456789 123       123456789 | 123456789 123       123456789 | 123456789 123456789 123456789 |
| 123       123456789 123456789 | 123       123456789 123456789 | 123456789 123456789 123456789 |
+-----------------------------------------------------------------------------+
```

2*2 or 4+0, 0+4 is not a dead pattern, while 1+3 or 3+1 is a dead pattern.

yzfwsf
Posts: 592
Joined: 16 April 2019

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