The hardest sudokus (new thread)

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Re: The hardest sudokus (new thread)

QUOTE

by **mith** » Thu Aug 06, 2020 7:30 pm

Thought it worth mentioning after taking a more detailed look, the 21 clue 11.7 above has an skfr ER of 11.1; this is the biggest difference I've seen by quite a bit.

Here's some 23s with high q2; haven't run SE on them yet.

CODE: SELECT ALL

```
.......1.....2.....3.4..5..4...6...3.4.5.7.7...3.....8.9.....97.5..4.3.5.7..6.  q2=99328 skfr_ED=10.5/10.5/3.4
.......1.....2.....3.4..5..4...6...3.4.5.7.7...3.....8.9.....95.7..4.3.7.5..6.  q2=99328 skfr_ED=10.5/10.5/3.4
.......1.....2.....3.4..5..4...6...3.4...7.7...3.5...8.9.....95.7..4.3.7.5..6.  q2=99261 skfr_ED=11.2/1.2/1.2
```

(Obviously very similar puzzles.)

mith
Posts: 862
Joined: 14 July 2020

Re: The hardest sudokus (new thread)

QUOTE

by **mith** » Fri Aug 07, 2020 5:46 pm

Starting to get my new ones together in a spreadsheet to share. Here are the 20C puzzles with ER>=10.9.

CODE: SELECT ALL

```
.............123..1..245...........5..4.1..6..7...8..4..13..7..6.....9..8.....  ED=11.2/11.2/2.6 (DCFC+MFC) q1=95054 q2=96790
.............123..1..245...........4..5.1..6..7...8..2..43..7..6.....8..9.....  ED=11.2/11.2/2.6 (DCFC+MFC) q1=95044 q2=95824
.....1..2..3.4..5..6......4.78.....65..4..7...3..2....9..1..8...6..4..  ED=11.2/1.2/1.2  (DCFC+MFC) q1=95008 q2=96243
.....1..2..3.4..5.67.....8...31.....6..9..4...2..8.5....6.7...4..9..  ED=11.1/11.1/9.2 (DCFC+MFC) q1=15953 q2=95233
.....1..23..4.5.6.......7.2.....1.6..8.9..8..7..5...9...8.96..4..  ED=11.1/11.1/2.6 (DCFC+MFC) q1=96655 q2=95027
.....1..2..3.4..5..6.......7...5.8...7.64..5..6.8...7.3.....1..9.....2..  ED=11.1/1.2/1.2  (DCFC+MFC) q1=95027 q2=95597
.....1..2..3.4..5..6.......7..4..54..8..7.68.....9.....1.6.7..5.3.....2..  ED=11.1/1.2/1.2  (DCFC+MFC) q1=95449 q2=92585
.....1..23..4.5.6.....76.8...8..5...2.....9..784.....1...3...3.....9  ED=11.0/11.0/2.6 (DMFC+MFC) q1=95211 q2=95728
.....1..23..4.5.6.....6..7..78..5...9.....2.857...3.....9.1...3...  ED=11.0/11.0/2.6 (DCFC+MFC) q1=95137 q2=95184
.....1..23..4.5.6.....5..7...68..4...9.....2.867.....3....9.1....3...  ED=11.0/11.0/2.6 (DCFC+MFC) q1=95063 q2=95047
.....1..23..4.5.6.....5..7...68..4...9.....2.847.....3....9.1....3...  ED=11.0/1.5/1.5  (DCFC+MFC) q1=95069 q2=95156
.....1..2..3.4..5..6.......1..7...8.......8..13.2..3..78...5.6.....9..4...  ED=11.0/1.2/1.2  (DCFC+MFC) q1=95099 q2=95163
.....1..2..3.4..5..6.......7....3.1..2..72.8.....37...8.9.....5.6.....4..  ED=11.0/1.2/1.2  (DCFC+MFC) q1=15414 q2=51551
.....1..2..3..4.5..6...3......1..7...28...6..9..7......6.....5.9.5.4.8..  ED=10.9/10.9/2.6 (DCFC+MFC) q1=95117 q2=95803
.....1..2..3.4.5..6...3.....1.7...28..6.9..7......5.9.4.8..6.....5.  ED=10.9/10.9/2.6 (DCFC+MFC) q1=96557 q2=95803
.....1..23..4.5.6....6.7.....2.8.....8....39..7..5...1.9...86...4....  ED=10.9/10.9/2.6 (DCFC+FC)  q1=95134 q2=93462
.....1..2..3.4..5..6.....7....64..5..7.58....6..7...8.2.....3..9.....1  ED=10.9/1.2/1.2  (DCFC+MFC) q1=95038 q2=95235
.....1..23..4.5.6.....7..5...56..8...9.....2.758.....3....9.1...3...  ED=10.9/1.2/1.2  (DCFC+MFC) q1=95082 q2=95129
```

mith
Posts: 862
Joined: 14 July 2020

Re: The hardest sudokus (new thread)

QUOTE

by **mith** » Fri Aug 07, 2020 7:48 pm

Link to the spreadsheet (~1000 total puzzles right now at 20C and 21C): google drive link

Here are the 21C puzzles with ER>=11.6, Q1>=99000, or Q2>=99100 (including the two posted a few posts ago):

CODE: SELECT ALL

```
.......1.....2.3...4.5.6.7...2.8....7..6...50........16...4...5..1.7..8..3.....  ED=11.7/11.7/2.6  (DCFC+DFC) q1=95705 q2=97905
.......1...2..3.4..4..5.6.....4.7..41...38...9.....17...2.5..6...9....8..  ED=11.5/11.5/10.0 (DCFC+MFC) q1=97523 q2=99480
.......1.....2.3...4.5.6.7...2.8....7..6.1..9.....16.....4.5..1.7..8..3....  ED=11.4/1.2/1.2   (DCFC+MFC) q1=99131 q2=98848
.....234...1.5...6...7..8...3..4...98...8.2...9.1.......5.6.7...4  ED=11.2/11.2/9.2  (DCFC+MFC) q1=99244 q2=98766
.......1.....2.3...4.5..6...5....7.3....8..7.94.....65...9.1...8....2.67..  ED=10.6/10.5/2.6  (DCFC+FC)  q1=99071 q2=98769
.......1.....2.3...4.5.6...7....8..8.6....5..8.4..4...1..2.9.3....7..9.5..  ED=10.2/10.2/3.4  (DCFC+FC)  q1=99383 q2=99397
```

mith
Posts: 862
Joined: 14 July 2020

Re: The hardest sudokus (new thread)

QUOTE

by **mith** » Sat Aug 08, 2020 1:32 am

Added the 22C puzzles (~2000). Here are the ones with ER>=11.6, Q1>=99000, or Q2>=99100 (the first four were already posted).

CODE: SELECT ALL

```
.......1..2..3.4..4..5.6.....7.8..43.....1..9.5...9.....63.78....4....2.7.  ED=11.7/11.7/10.7 (DCFC+DFC) q1=95075 q2=97539
.......1.....2.34..3.5.6....6..7...7..8...9....1.4..8.5....3.1...9.4...3..2  ED=11.7/11.7/8.0  (DLFC+DFC) q1=95031 q2=97177
.......1.....2...34..5...36.....574.....8...2....46....7..7.5...6.9...6.1..  ED=11.7/11.7/2.6  (DCFC+DFC) q1=95012 q2=95198
.......1.....2.8..4..5.6..5...4.51...7..8..2....6..8...9..7..1.6..9....3...  ED=11.6/11.6/8.0  (DCFC+DFC) q1=95049 q2=98889
.......1...2.34.5...36......47.8...5..4..8..26.....45...9..3...82.4.  ED=11.0/1.2/1.2  (DCFC+MFC) q1=99042 q2=98758
.......1...1.2.34.5....6.....37.2..8.5..8..2..24...9..85.....3...58.4.  ED=10.9/1.2/1.2  (DLFC+MFC) q1=99231 q2=98889
.......1...1.2.34.5...36.2....78......5..7..2..24...9..75.....3...57.4.  ED=10.9/1.2/1.2  (DLFC+MFC) q1=99230 q2=98889
.......1...1.2.34.5...36.2....27.....8..5.2..24...9..58.....3...85.4.  ED=10.9/1.2/1.2  (DLFC+MFC) q1=99230 q2=98889
.......1...1.2.34.5...6.....37.25...8..5..2..24...9...58.....3...85.4.  ED=10.9/1.2/1.2  (DLFC+MFC) q1=99231 q2=98889
.......1.....2...13.4..5.....46..7...35.46.3.1...6..5..48.....9.5..6..  ED=10.9/1.2/1.2  (DLFC+MFC) q1=99091 q2=98879
.......1.....2....3.4..5.....6...46..7.3.7..3.4.5..7.6..4.3...5..7.89.....  ED=10.9/1.2/1.2  (DLFC+MFC) q1=99090 q2=98879
.......1.....2....3.4..5.....6...76..4.3.4..3.7.5..4.6..7.3...5..4.89.....  ED=10.9/1.2/1.2  (DLFC+MFC) q1=99090 q2=98879
.......1.....2...13.4..5.....64..7...35.64.3.1...4..5...68.....9.54.....  ED=10.9/1.2/1.2  (DLFC+MFC) q1=99091 q2=98879
.......1...1.2.34.5....6.....37.8..2.5..2..8..25.....84...9..3...52.4.  ED=10.9/1.2/1.2  (DLFC+MFC) q1=99218 q2=98850
.......1...1.2.34.5...36.....57.2...8..5..2..24...9..58.....3...85.4.  ED=10.9/1.2/1.2  (DLFC+MFC) q1=99024 q2=98774
.......1.....2.3...4..5.....6..76..4.3.4..3.7.5..4.6..7..3..5..4.89.....  ED=10.9/1.2/1.2  (DLFC+MFC) q1=99056 q2=98761
.....12....3..4..5.2.6.....1..4..6..7...5..8..9.....1..4.1...6.9...7...3..8..  ED=10.8/1.2/1.2  (DCFC+FC)  q1=99246 q2=99021
.......1...1.2.34.5...36.....78...4.5..4..7..25.....74....93...52.4.  ED=10.7/1.2/1.2  (DCFC+FC)  q1=99032 q2=98418
.......1...23.4..56..7......4...85..6...2..1..3...2.9..675....2..8..2.....  ED=10.5/1.2/1.2  (DLFC+FC)  q1=99386 q2=99391
.......1..1.2.34.5..6.7.....1.23.7..8.6..2..4.....6..9.5....2..8.7.2.....  ED=10.5/1.2/1.2  (DLFC+FC)  q1=99386 q2=99391
.......1.....2.34..5.6.2.....7....6...43..8.29.....78..2.23...61..9.....  ED=10.5/1.2/1.2  (DLFC+FC)  q1=99386 q2=99391
.......1.....2..3.4....5.6...5.6...3..4.7..8.....547..9...93.6.4.8.....  ED=10.5/1.2/1.2  (DCFC+FC)  q1=99377 q2=99140
.......1.....23..1.24....3..5..4.6..4.5..7..8.....5..1...4..6..9..8...74..  ED=10.5/1.2/1.2  (DCFC+FC)  q1=99099 q2=99108
.......1...1.2.34..3.5.6.....7..8...986...8...57....1..9.5..3..4.....2  ED=10.5/1.2/1.2  (DCFC+FC)  q1=96545 q2=99376
.......1...2.34..3.1.5.....6....2.4...5.7.8..2...6..79...94.2..5.8.....  ED=10.4/1.2/1.2  (DCFC+FC)  q1=99096 q2=98822
```

(The spreadsheet contains anything with at least D*FC+FC and either ER>=10.7 or Q2>=98500.)

mith
Posts: 862
Joined: 14 July 2020

Re: The hardest sudokus (new thread)

QUOTE

by **mith** » Sat Aug 08, 2020 6:32 pm

Added the 23C puzzles (<1000, I started these later). Here are the ones with D*FC+DFC (an 11.4 this time), Q1>=99000, or Q2>=99100. (The 11.3 and two 10.6s were posted previously.)

CODE: SELECT ALL

```
.......1.....2.....3.4..5.......6...7...4..3.6..3.7.5.36.5..7.8..9.....9.5.6..4.  ED=11.4/1.2/1.2  (DLFC+DFC) q1=95801 q2=98848
.......1.....2.....3.4..5...4...6...3.4...7.7...3.5...8.9.....95.7..4.3.7.5..6.  ED=11.3/1.2/1.2  (DCFC+MFC) q1=95821 q2=99261
.......1...2..3...4...5..2.....67...5..8..4.62..9..8...5.4...8...9..42..8...9.  ED=11.0/1.2/1.2  (DLFC+MFC) q1=99105 q2=99356
.......1...2.3..34.1.5.....6..4..7....8..81.4...5.48.3..5..5...98..7.......  ED=11.0/1.2/1.2  (DLFC+MFC) q1=97959 q2=99315
.......1.....2.....3.4..5..4...6...3.4.5.7.7...3.....8.9.....97.5..4.3.5.7..6.  ED=10.6/10.6/3.4  (DCFC+FC)  q1=96598 q2=99328
.......1.....2.....3.4..5..4...6...3.4.5.7.7...3.....8.9.....95.7..4.3.7.5..6.  ED=10.6/10.6/3.4  (DCFC+FC)  q1=96598 q2=99328
```

mith
Posts: 862
Joined: 14 July 2020

Re: The hardest sudokus (new thread)

QUOTE

by **mith** » Sun Aug 09, 2020 12:31 am

The first above has a slightly harder form:

CODE: SELECT ALL

```
.......1.....2.....3.4..5.3......6...7...4...6..3.7.5.36.5..7.8..9.....9.5.6..4.  ED=11.5/1.2/1.2 (DRFC+DFC) q1=95829 q2=99010
```

mith
Posts: 862
Joined: 14 July 2020

Re: The hardest sudokus (new thread)

QUOTE

by **mith** » Sun Aug 09, 2020 4:41 pm

A new 22C 11.8:

CODE: SELECT ALL

```
.......1.....2.3...4.5.6...3...1...4.78.....6..54.....4...7...9.....127...6.8..  ED=11.8/1.5/1.5 (DCFC+DFC) q1=98819 q2=97704
```

Here's a nicer looking morph:

CODE: SELECT ALL

```
+-------+-------+-------+
| . . 1 | 2 . . | 3 . . |
| . . . | 4 . . | 5 . . |
| . . . | . 6 . | . . . |
+-------+-------+-------+
| 2 . . | . . . | 1 . 3 |
| . 4 . | . . . | . 6 . |
| 1 7 . | . . . | . 8 . |
+-------+-------+-------+
| . 1 . | 7 . . | . . . |
| . 9 . | . 6 5 | . . . |
| 7 . . | 8 . . | 2 . . |
+-------+-------+-------+
..12..3.....4..5.....6...2.....1.3.4.....6.1.7.....8.1.7.....9..65...7..8..2..  ED=11.8/1.5/1.5
```

Last edited by mith on Sat Aug 29, 2020 12:12 am, edited 1 time in total.

mith
Posts: 862
Joined: 14 July 2020

Re: The hardest sudokus (new thread)

QUOTE

by **champagne** » Tue Aug 11, 2020 4:18 am

Hi mith,

I have heavy constraints this month. I'll check all this and the recent games in September.

champagne
2017 Supporter
Posts: 7269
Joined: 02 August 2007
Location: France Brittany

Re: The hardest sudokus (new thread)

QUOTE

by **eleven** » Tue Aug 11, 2020 6:19 pm

Great work anyway !
I did not expect, that still such hard 21 and 22 clue puzzles could be found.

The last one has a MSLS, which (manually can be found and) reduces the (Sukaku) rating to 8.3.

eleven
Posts: 2820
Joined: 10 February 2008

Re: The hardest sudokus (new thread)

QUOTE

by **mith** » Tue Aug 11, 2020 8:07 pm

I was wondering, is there a publicly available tool to look for MSLS, Exocet, and other techniques that SE does not incorporate?

(I'm nowhere near good enough to spot them manually.)

Was also wondering what feelings people have about how these techniques would be rated on the SE scale (presumably lower than Dynamic FCs in general?).

And no worries, champagne, I'll keep my spreadsheet updated in the meantime so it will all be in one place. Thanks for all the work maintaining the database!

mith
Posts: 862
Joined: 14 July 2020

Re: The hardest sudokus (new thread)

QUOTE

by **eleven** » Tue Aug 11, 2020 9:00 pm

> **mith wrote:**
> I was wondering, is there a publicly available tool to look for MSLS, Exocet, and other techniques that SE does not incorporate?

I know of YZF Sudoku (look at the end of the thread for current versions) and Phil's Sudoku Solver.

> (I'm nowhere near good enough to spot them manually.)

This is my imperfect method for MSLS, later in the thread SpAce gives deeper insight.

> Was also wondering what feelings people have about how these techniques would be rated on the SE scale (presumably lower than Dynamic FCs in general?).

I guess the answers will be very different. Personally i think SK loops are the easiest to be found (SE 7.5-8), then MSLS (8-8.5), and JExocets (8.5-9). But whatever you practice will become easier.

eleven
Posts: 2820
Joined: 10 February 2008

Re: The hardest sudokus (new thread)

QUOTE

by **mith** » Tue Aug 11, 2020 11:58 pm

Thanks! Of the D*FC+DFC puzzles I've posted so far, all but the 11.4 have MSLS (haven't checked to see how far the difficulty is lowered after the MSLS, yet). The 11.4 has an Exocet which eliminates one candidate; didn't see anything else easier in Phil's solver at least.

mith
Posts: 862
Joined: 14 July 2020

Re: The hardest sudokus (new thread)

QUOTE

by **Mathimagics** » Wed Aug 12, 2020 6:35 pm

Is there any correlation between lack of singles and SE rating?

Here are some 18-clue samples with (as far as I can tell), no singles at all. I don't have any rating software - it's against my religion

Sample-18C: Show

Mathimagics
2017 Supporter
Posts: 1902
Joined: 27 May 2015
Location: Canberra

Re: The hardest sudokus (new thread)

QUOTE

by **tarek** » Wed Aug 12, 2020 7:07 pm

> **Mathimagics wrote:**
> Is there any correlation between lack of singles and SE rating?
>
> Here are some 18-clue samples with (as far as I can tell), no singles at all. I don't have any rating software - it's against my religion

This is essentially how the race to find the hardest sudoku started back in 2006 ...

We started by finding the puzzles that didn't offer any singles (We called them Pearls & essentially would have a high EP rating). We then progressed to the (Diamonds) where even a single elimination wasn't available and these were puzzles with high ED ratings.

As far as I can see these puzzles would have a "busier" Starting Pencilmark grid making it more difficult to use the players conventional technique arsenal.

What it can't predict is "For how long will that Pencilmark grid remain busy?" after hitting it with a relentless set of advanced techniques. There are some techniques which are as complex as these puzzles (The advanced MSLS for instance) which break down several of these tough puzzles.

Because the "yardstick" of measuring difficulty remains debatable, you will find the most difficult puzzles end up several toughness criteria rather than being one dimensional.

Advanced players like these puzzles that attract a level of difficulty at their level as it they avoid the clutter of "Basic techniques" needed to bring the puzzle nearer to their desired interesting section.

Tarek

tarek
Posts: 3759
Joined: 05 January 2006

Re: The hardest sudokus (new thread)

QUOTE

by **Mathimagics** » Thu Aug 13, 2020 2:52 am

Thanks, Tarek!

Sampling 10 million 18C minimal puzzles suggests 1 in ~900 are pearls, BTW. That's pretty close to the 17C case (57, or 1 in 862)

Are there any instances of non-minimal pearls?

Mathimagics
2017 Supporter
Posts: 1902
Joined: 27 May 2015
Location: Canberra

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