

The hardest sudokus (new thread)

Re: The hardest sudokus (new thread)
Dby [hendrik_monard](#) » Wed Feb 23, 2022 4:40 pm

A list of 511 11.7s.
As this message would exceed the maximum number of characters allowed, I am going to post a second message with 616 11.6s

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hendrik_monard
Posts: 50
Joined: 19 April 2021
Location: Leuven (Louvain) Belgium

Re: The hardest sudokus (new thread)

Dby [hendrik_monard](#) » Wed Feb 23, 2022 4:42 pm

This is the list with 616 11.6s

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hendrik_monard
Posts: 50
Joined: 19 April 2021
Location: Leuven (Louvain) Belgium

Re: The hardest sudokus (new thread)

Dby [mith](#) » Wed Feb 23, 2022 6:03 pm

Quite a haul 🤗 I'll check them against the DB later today.

mith
Posts: 862
Joined: 14 July 2020

Re: The hardest sudokus (new thread)

Dby [mith](#) » Thu Feb 24, 2022 10:51 pm

My most recent batch, with 6 11.7s (26c-27c):

```
CODE: SELECT ALL
[.....1.....234...1.5..62...3.....5...7.6.....89...4.....1.23.4.52...1.....63...64...
.....1..2.....3...45..6...7.....7...1...8.9.36...79...8.8.1.....91.6.8...7.39.....
.....1.....2.34.....4.56...14.56.2.4.12...3.5...63...73.....89...6...51.....2...
.....1...2.34.....4.56...14.56.2.4.1...3.5...63...73.....892.6...51.....2...
.....1.....2345...167..2...7236...2.1.8...73.8...31.8...27...6...6.8.....
.....12.....34.....567.....6.....1...35.26.8.5...182.3.68...2.3.2.....51.8.....
ED=11.7/1.2/1.2
ED=11.7/1.2/1.2
ED=11.7/1.2/1.2
ED=11.7/1.2/1.2
ED=11.7/1.2/1.2
ED=11.7/1.2/1.2
```

And 221 11.6s (25c-29c):

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hendrik, got yours added or updated as appropriate. There were some I had already posted as 11.6 - but a few of those you rated as 11.7, so I added your puzzle as the "db_puzzle" and later will run SE on them myself to see if there's a difference in our versions or if it's just the morph. Likewise, some of your 11.6s I had as 11.5s. (In both cases, I kept the lower rating.)

The majority were totally new, and some I had found but not run SE on (usually 11.0-11.1 skfr).

Aside from running SE on your puzzles which may have been rated in a different mode, I have some ideas to catch more of the 11.0-11.1 skfr puzzles that might rate more highly by SE (based on their "parent" puzzle), but I haven't had time to do either.

Re: The hardest sudokus (new thread)

Dby [mith](#) » Fri Feb 25, 2022 8:11 pm

Some more after adding in hendrik's... 58 11.7s (26c-29c):

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mith
Posts: 862
Joined: 14 July 2020

Numbers of puzzles with fixed SER

Dby [denis_berthier](#) » Sat Feb 26, 2022 5:44 am

The following refers to the current version of the hardest collection (ph_2010) and it doesn't take into account the new puzzles with high ratings. But that's irrelevant here because my point is about the lower end of the collection.

```
CODE: SELECT ALL
SER= 11.9 nb-puzzles= 9
SER= 11.8 nb-puzzles= 61
SER= 11.7 nb-puzzles= 138
SER= 11.6 nb-puzzles= 393
SER= 11.5 nb-puzzles= 1 071
SER= 11.4 nb-puzzles= 2 612
SER= 11.3 nb-puzzles= 15 127
SER= 11.2 nb-puzzles= 28 384
SER= 11.1 nb-puzzles= 184 734
SER= 11.0 nb-puzzles= 932 949
```

```
SER= 10.9 nb-puzzles= 274 400
SER= 10.8 nb-puzzles= 269 562
SER= 10.7 nb-puzzles= 77 364
SER= 10.6 nb-puzzles= 321 092
SER= 10.5 nb-puzzles= 739 524
SER= 10.4 nb-puzzles= 135 700
SER= 10.3 nb-puzzles= 120 851
SER= 10.2 nb-puzzles= 1
```

As you can see, the number of puzzles with a given SER in the collection increases as SER drops from 11.9 to 11.0, but it starts to decrease (in a very irregular way) after.
Of course, there is an obvious reason for this: only highest SER puzzles are reported and enter the collection.
It is well-known that the higher part of the collection is extremely biased, due to the search method (proximity search), to the search of variants for specific patterns (sk-loops) or pseudo-patterns (exocets).

However, the numbers of puzzles in the lower part of the above table (SER < 11.0) suggest a question, mainly to the people who created these puzzles (FLK, GP, dob) or decided to keep them in the collection or to exclude puzzles with similar ratings from it:

what criteria did you choose for inclusion in the collection for SER < 11.0 ?

Dby [1toBonly](#) » Sat Feb 26, 2022 9:05 am

champagne posted this some time ago: [here](#)

🗨 champagne wrote:
... For the 10.6 10.7, my filter would have skipped them (not pearl), ...

I'm guessing that the 10.x's were getting less updates to reduce/limit the size of the database.
Maybe a definitive answer will be posted soon...

1toBonly
Posts: 4075
Joined: 04 April 2018

Re: The hardest sudokus (new thread)

Dby [999_Springs](#) » Sat Feb 26, 2022 5:24 pm

from memory I think champagne's requirements for entry into his hardest database are diamonds 10.3+
or
pearls 10.5+
or
any puzzles SE 11.0+ or skfr 10.8+

999_Springs
Posts: 585
Joined: 27 January 2007
Location: In the toilet, flushing down springs, one by one.

Re: The hardest sudokus (new thread)

Dby [champagne](#) » Sun Feb 27, 2022 7:05 am

🗨 999_Springs wrote:
from memory I think champagne's requirements for entry into his hardest database are diamonds 10.3+
or
pearls 10.5+
or
any puzzles SE 11.0+ or skfr 10.8+

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

Correct except that the data base is "**potential**" hardest".
Also the puzzle must be minimal.

When I started this data base, the idea was to have sudokus having a chance to compete to be the hardest and to study "exotic patterns".

The cut off can be discussed, but usually, without an exotic pattern, the puzzle is tougher with more candidates. So the criteria is supposed to give still many candidates after basics.

I had no time recently to work on mith findings with more clues, and often basics at the start, but my bet would be that most of them have an exotic pattern.
and years later we have no definition of the "hardest" 🤔🤔

Re: The hardest sudokus (new thread)

Dby [denis_berthier](#) » Sun Feb 27, 2022 7:30 am

Regarding the number of candidates, which motivated my first question, I have computed them after Singles and whips[1] (doing it after only Singles wouldn't change much to the general conclusions).
(The precision is absurd, but I'm lazy to crop each result manually.)
"sd" means standard deviation.

```
CODE: SELECT ALL
SER= 11.9 nb-puzzles= 9 mean-nb-cands= 234.555555555556 sd-nb-cands= 5.7756406308573
SER= 11.8 nb-puzzles= 61 mean-nb-cands= 236.032786885246 sd-nb-cands= 6.97763925768015
SER= 11.7 nb-puzzles= 138 mean-nb-cands= 235.376811594203 sd-nb-cands= 9.29640954421292
SER= 11.6 nb-puzzles= 393 mean-nb-cands= 224.735386956743 sd-nb-cands= 15.2200649339413
SER= 11.5 nb-puzzles= 1 071 mean-nb-cands= 225.515406162465 sd-nb-cands= 11.8234560826402
SER= 11.4 nb-puzzles= 2 612 mean-nb-cands= 224.942189892802 sd-nb-cands= 12.0760459024426
SER= 11.3 nb-puzzles= 15 127 mean-nb-cands= 218.818484177959 sd-nb-cands= 15.0862417464236
SER= 11.2 nb-puzzles= 28 384 mean-nb-cands= 220.340684892898 sd-nb-cands= 14.1523597408146
SER= 11.1 nb-puzzles= 184 734 mean-nb-cands= 197.189391232798 sd-nb-cands= 26.9153506659259
SER= 11.0 nb-puzzles= 932 949 mean-nb-cands= 176.137465177623 sd-nb-cands= 20.4984525842759
SER= 10.9 nb-puzzles= 274 400 mean-nb-cands= 219.148897463557 sd-nb-cands= 12.5406060027526
SER= 10.8 nb-puzzles= 269 562 mean-nb-cands= 218.315942158922 sd-nb-cands= 13.1106080808684
SER= 10.7 nb-puzzles= 77 364 mean-nb-cands= 226.410811230927 sd-nb-cands= 9.8860107074916
```

Apart from the 11.7-11.9, it doesn't show any decrease in the number of candidates.
It shows some irregularity for SER = 11.1 and 11.0, but whether this is due to one more intrinsic problem of SER or to some bias in the collection is undecidable.

I've already shown long ago that there is no meaningful correlation between the number of clues and the SER (or W rating).
I've more recently shown that there's a larger, though not very meaningful correlation between SER (or W rating) and the number of candidates (after Singles or after whips[1]).
The above results for very high SER (≥ 11.0) confirm the general tendency, but they also show that the number of candidates is not a good predictor of difficulty.
As for the results for SER < 11.0, I think they are the result of a strong bias in the collection.

Re: The hardest sudokus (new thread)

Dby [mith](#) » Sun Feb 27, 2022 11:30 pm

Speaking of correlation between SER and clues...

Meet 11.9 #10 (and friends):

```
CODE: SELECT ALL
[.....1.....2.....3...45..6.....71.8...23..67...8.827...4..6...23...7.381.6...
.....1.....2.....3...4...2..56...37.682...5.27.8...2673...3.58.6...78...5...
.....1.....2.....3...4...2..56...37.682...5.27.8...2673...3.58.6...78...5...
.....1.....2.....3...4...2.356.7.3.6.82...5.72.8...26.7...3.5.86...78.5...
.....1.....2.....3...4...2.356...376.82...5.72.8...26.7...3.5.86...78.5...
.....1.....2.....3...4...2.356...376.82...5.72.8...26.7...3.5.86.7...
.....1.....2.....3...45..1.23...267.81...73.61.8...17.6...8...2.3.87...6
.....1.....2.....3...4...2..56.7.3...682...5.27.8...2673...3.58.6...78...5...
.....1.....2.....3...4...3.5.2...627.8...8...65.7.78.6...5.273...63.8.5...
.....1.....2.....3...4...5..67...6.28.5..83...7.2...58.6...6.35.7...72.83...
.....1.....2.....3...4...5..67...6.28.5..83...7.2...5..6...6.35.7.8.72.83...
.....1.....2.....3...4...3.5.2...627.8...8.3.65.7.78.6...5.27...63.8.5...
.....1.....2.....3...4...5.367...6.82.5..83.7...2...586...6.3.57...72...8...
.....1.....2.....3...4...5.367...6.82.5..83.7...2...5.6...6.3.57.8.72...8...
ED=11.9/1.2/1.2
ED=11.8/1.2/1.2
ED=11.8/1.2/1.2
ED=11.8/1.2/1.2
ED=11.8/1.2/1.2
ED=11.8/1.2/1.2
ED=11.8/1.2/1.2
ED=11.8/1.2/1.2
ED=11.8/1.2/1.2
ED=11.8/1.2/1.2
ED=11.8/1.2/1.2
ED=11.8/1.2/1.2
```

11.7s and 11.6s below:

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The new 11.9 is 26c, goes up to 29c with singles, and is pretty much obliterated by "Thor's Hammer".

Re: The hardest sudokus (new thread)

Dby [mith](#) » Sun Feb 27, 2022 11:36 pm

Actually, there's another single before the 11.9 steps, so it goes up to 30c.

mith
Posts: 862
Joined: 14 July 2020

Re: The hardest sudokus (new thread)

Dby [jovi_al01](#) » Sun Feb 27, 2022 11:40 pm

congrats on finding #10! :]

jovi_al01
Posts: 71
Joined: 26 July 2021

Re: The hardest sudokus (new thread)

Dby [mith](#) » Sun Feb 27, 2022 11:47 pm

Thanks; I think this one may be somewhat fragile in terms of morph. The three other minimal of the 30c are 11.8 after being minlexed. I'll have to try maxlex at some point.

mith
Posts: 862
Joined: 14 July 2020

Re: The hardest sudokus (new thread)

Dby [mith](#) » Mon Feb 28, 2022 1:57 am

I just ran SE on a random morph of one of the 27c minimal:

```
CODE: SELECT ALL
[.....1.....2.34...2.3156...5.....4...6...78...6.....65.4.1...2.43...4...31...25
8..2.3.....1.2.....4.....8.61.8...927.6...7...91.12....79.6...287...9..6...
ED=11.8/1.2/1.2
ED=11.9/1.2/1.2
```

It may be that all of them have some 11.9s and some 11.8s, depending on order of eliminations.

Small update as I was typing this - it finished two more morphs, here are three consecutive steps in each morph:

puzzle above: 11.6, 11.9, 11.8
second puzzle: 11.5, 11.9, 11.9
third puzzle: 11.6, 11.8, 11.8

