

The New Sudoku Players' Forum

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The hardest sudokus (new thread)

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Re: The hardest sudokus (new thread)

Dby denis_berther - Mon Feb 28, 2022 2:46 am

Hi Mith,
Great results.
Great examples also of the SER problem with morphs.

🗨️ With write:
Speaking of correlation between SER and clues...

I can't see anything related to this correlation. 26 or 27 clues = 64.7% of all the minimal puzzles in unbiased stats.

My Macs are busy on other calculations, but I'll rate (wrt BpB) all these new 11.9 or 11.8 puzzles later.

Re: The hardest sudokus (new thread)

Dby denis_berther - Mon Feb 28, 2022 3:07 am

BTW, the new 11.9 has "only" 209 candidates after Singles and whips[1].
Any search strategy for finding the highest SER that relies on additional pre-filters may fail to find some of the highest.
The recent findings showed this has been the case with adding some criterion related to the q1 or q2 ratings.
But it'd also be the case if one keeps only puzzles with too high numbers of candidates as starting points for proximity search.

Last edited by denis_berther on Mon Feb 28, 2022 10:44 am, edited 2 times in total.

Re: The hardest sudokus (new thread)

Dby champagne - Mon Feb 28, 2022 7:52 am

🗨️ With write:
Speaking of correlation between SER and clues...

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

Hi mith,

Great job. My last update of my own data base is now 2 years old.
From what I know of Sudoku Explorer, to produce such high ratings with more clues, you must have a highly interleaved system. This is usually linked to an exotic pattern.
With so any fresh stuff, I intend to mark a pause in what I am doing an to scan your (an others) new findings.
Do you have a summary of all 11.x up to date somewhere?

BTW, I have also to update my list of exotic patterns with the last published
And surely, we have no correlation between the number of candidates and the rating.
No need to refer to statistics, all of us know that the 17 clues and the 18 clues have no very high ratings, although they have big number of candidates.
EDIT! I checked my last data base of potential hardest I can add that no 19 had been found at that time with a rating >=11.0
and as far as I know, the main criteria for fresh seeds for a vicinity search has been when I worked on this topic the SER of old grids.

Last edited by champagne on Mon Feb 28, 2022 2:29 pm, edited 2 times in total.

Re: The hardest sudokus (new thread)

Dby denis_berther - Mon Feb 28, 2022 9:03 am

🗨️ champagne wrote:
And surely, we have no correlation between the number of candidates and the rating.
No need to refer to statistics, all of us know that the 17 clues and the 18 clues have no very high ratings, although they have big number of candidates.

That's where some basic knowledge of statistics could help you avoid such false claims.
The mean number of candidates for the 17s (even after eliminating those that are solved by whips[1]) is much lower than those presented above.
Open the most elementary book of stats to learn what "mean" means.

To be more precise, one has (not taking into account the 17s that are in W1, for which nb-cands is 0):
CODE: SELECT ALL
mean-nb-cands= 118.39 sd-nb-cands= 66.30

Re: The hardest sudokus (new thread)

Dby hendrik_monard - Mon Feb 28, 2022 1:35 pm

🗨️ With write:
Speaking of correlation between SER and clues...
Meet 11.9 #10 (and friends):

Hi mith,

Fantastic finding. Congratulations.
So my forecast of September 30th (see <http://forum.enjoysudoku.com/post310478.html#p310478>) was not so unrealistic after all.

Re: The hardest sudokus (new thread)

Dby hendrik_monard - Mon Feb 28, 2022 4:22 pm

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

Hi mith,

I calculated the SER of the canonical isomorph of your new 11.9, and got the following result:
.....1.....2.....3..45..6.....718.....23..67..8..827..1..6.....23.....7381..6..ED=11.9/1.2/1.2
98.76.5.7.4.5.....6.....5.8.7.4..79.45.6.6.98.....8.....9.3.2....4..ED=11.8/1.2/1.2

Re: The hardest sudokus (new thread)

Dby mith - Mon Feb 28, 2022 4:41 pm

🗨️ denis_berther wrote:
BTW, the new 11.9 has "only" 209 candidates after Singles and whips[1].
Any search strategy for finding the highest SER that relies on additional pre-filters may fail to find some of the highest.
The recent findings showed this has been the case with adding some criterion related to the q1 or q2 ratings.
But it'd also be the case if one keeps only puzzles with too high numbers of candidates as starting points for proximity search.

Indeed, my previous q2 filters would have easily missed this one (49386 q2, 46752 q1).

(The correlation comment was just that the new 11.9 is 26c; expandable to 30c; vs. the 21c-23c previously known ones. The higher clue counts were just not well explored previously.)

🗨️ champagne wrote:
Great job. My last update of my own data base is now 2 years old.
From what I know of Sudoku Explorer, to produce such high ratings with more clues, you must have a highly interleaved system. This is usually linked to an exotic pattern.

Yes, the initial breakthrough on the high clue front was finding the trivale oddagon pattern ("Thor's Hammer"), pointed out by marek previously in this thread. Essentially all of the high clue puzzles found (including some variant of the pattern, and there have been a huge number of them from that initial seed).

In all cases I've looked at, there is a pattern of 6 digits in three boxes (after basics), one of which sees the other two, such that the empty cells span all three rows and columns, and along with a fourth box (completing the rectangle of boxes with 4 or 5 digits, such that some complements of the four box are impossible due to the parity of the permutations of missing digits). It shouldn't be all that hard to search for in existing puzzles, I just haven't written code to do it yet. It may also be possible to use the pattern as a starting point for generating puzzles, vs. neighborhood searching on existing puzzles.

Aside from the trivale oddagon "exotic" pattern, there have been some other more specific non-3-colorable patterns discovered (Shy's Patto Patto pattern being the one that comes to mind), so a generalized search for patterns with chromatic number 4 could be fruitful.

🗨️ With so any fresh stuff, I intend to mark a pause in what I am doing an to scan your (an others) new findings.
Do you have a summary of all 11.x up to date somewhere?

I have been planning to get an update posted soon anyway. I still need to find some time to process jovi_al's two puzzle batches (a bunch of 19c puzzles, including some new 10.X, and a large collection of DJE puzzles as well unchecked), as well as the pattern game. I think it may also be useful to the neighborhood search iterate a bit longer with the new finds - I woke up this morning to a new batch of 139 11.8s (!), which more than doubles what was in the database. (I'll post those shortly.)

🗨️ EDIT! I checked my last data base of potential hardest I can add that no 19 had been found at that time with a rating >=11.0
and as far as I know, the main criteria for fresh seeds for a vicinity search has been when I worked on this topic the SER of old grids.

The high for 19c remains at 10.5 (three puzzles using gfr minlex, though I am aware of at least one coloin puzzle which is a 10.5 with the right morph). When I publish an update, I will include any 10.2+ of 19c and 35c-36c, since no 11s have been found there. (Edit: while typing - I hadn't checked in a while, but I did finally generate some minimal 37c, two of which are skf 10+. I'll have to rate those as well.)

Re: The hardest sudokus (new thread)

Dby mith - Mon Feb 28, 2022 4:43 pm

🗨️ hendrik_monard wrote:
🗨️ With write:
Thanks, I think this one may be somewhat fragile in terms of morph. The three other minimals of the 30c are 11.8 after being minlexed. I'll have to try maxlex at some point.

Hi mith,

I calculated the SER of the canonical isomorph of your new 11.9, and got the following result:
.....1.....2.....3..45..6.....718.....23..67..8..827..1..6.....23.....7381..6..ED=11.9/1.2/1.2
98.76.5.7.4.5.....6.....5.8.7.4..79.45.6.6.98.....8.....9.3.2....4..ED=11.8/1.2/1.2

This doesn't surprise me; I ran a few more morphs, and it was essentially 50-50 on whether it rated 11.9 or 11.8. I'm going to take a close look at these puzzles to see what exactly is going on with the rating.

Re: The hardest sudokus (new thread)

Dby mith - Mon Feb 28, 2022 4:46 pm

Both 37c puzzles rate at 10.2 SER:

CODÉ: SELECT ALL
.....1..23..45..24..5..6..3.....75..8.....38.7..6..8..6..435.....6..47..38..7853..46..4.....8.....5..7..ED=10.2/1.2/1.2
.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10.....11.....12.....13.....14.....15.....16.....17.....18.....19.....20.....21.....22.....23.....24.....25.....26.....27.....28.....29.....30.....31.....32.....33.....34.....35.....36.....37.....ED=10.2/1.2/1.2

Re: The hardest sudokus (new thread)

Dby mith - Mon Feb 28, 2022 4:49 pm

This is the state of the max SER by clue count (for minimals), with the new 11.8s filling in at 25c and 28c:

CODÉ: SELECT ALL
19c - 10
20c - 23186
21c - 13.8
22c - 13.8
23c-23c - 11.9
24c-26c - 13.8
26c - 11.9 (morph dependent)
27C-30c - 11.9
31c - 13.6
32c - 11.5
33c - 11.3
34c - 11.1
35c-36c - 10.6
37c - 10.2

Re: The hardest sudokus (new thread)

Dby mith - Mon Feb 28, 2022 6:27 pm

I've verified in the GUI that when all 11.8 steps are applied just before the 30th digit is placed, the 11.8s aren't needed.

At this point in the solve, there are four 11.8 steps; I'm assuming they are sorted by complexity, as the command line path seems to take the top step in each case.

Command line -3r1c8,-3r2c1,single 3r1c1 and next steps are 11.9
Other 11.8s:
-3r1c (together with 3r1c8, this would just give the single again, so this is not responsible for the difference)
-2r1c (this gives a pointing pair which eliminates the next 11.8 candidate; after the single from the other elims, tops out at 11.8)
-2r5c (likewise, gives claiming which eliminates the previous 11.8)

When starting with the single, these two steps are present in the GUI, but now at 11.9. Presumably the 11.8 version is being pruned here, but that would have to be verified by disabling the pruning.

I have already verified this for one of the other minimals, but there must definitely be 11.9 morphs of all four. So either we still have 9 11.9s, or we have 13 (at least - the other 11.8s generated in this neighborhood should also be checked).

Pencilmark grid of the 30c; if anyone wants to investigate further:

CODÉ: SELECT ALL
.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10.....11.....12.....13.....14.....15.....16.....17.....18.....19.....20

