

The hardest sudokus (new thread)

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Re: The hardest sudokus (new thread)

by 999_Springs » Tue Mar 01, 2022 5:48 pm

mith wrote:

denis_berthier wrote:

mith wrote:

Indeed, these are two of the minimals from the 30c morph-dependent 11.9. The singles only get them to 29c though, whereas the other two minimals get back to 30c (and this is presumably why they are in T&E(2) - that 30th digit in the others takes at least two 11.8 steps, it's not trivial)

Applying isomorphisms or Singles can't change the T&E(n) classification of a puzzle.

I understand that. The point is that the two puzzles you mentioned are morphs of each other after singles, but the other two puzzles "aren't" - they have an extra digit. All four are minimals of the same 30c puzzle, but the first two only get to 29c with singles - that 30th digit is the difference.

All four can be made 11.9 with the right morph, but only the first two are not in T&E(2).

denis_berthier's pencilmark grids indicate that the sticking point after t&e(2) has **31** clues, not 29 or 30. the extra 2 clues are 3r1c1, which mith you indicated is the 30th clue in your pencilmark grid in [an earlier post](#), and an extra clue 6r5c9. in particular, this means that the 30th digit **is** included before the t&e(2) sticking point, which means i now have no idea why two of the puzzles would be in t&e(2) and two aren't

the 31st digit, 6r5c9, also raises another point: adding it to the puzzle gives a completed 6,8 UR in r45c59. if you were to swap the 6,8 UR around, you would get a puzzle that is NOT isomorphic to the original puzzle, but the pencilmark grids (ignoring the clues) are isomorphic, so any technique that removes a candidate from one puzzle will always remove the same candidate from the other puzzle (except for reverse bug-lites that rely on knowing what the original givens were, but they don't apply here).

here is the 31-clue state of the 11.9, that denis_berthier claims is not in t&e(2), in one-line format:

3.....1.....2.....3..458.6.....71.8..**6**23..**6**7..**8**827.61..61.23...7.381.6..

that has to mean that this puzzle is not isomorphic, and would also not be in t&e(2) - can someone check this?

3.....1.....2.....3..458.6.....71.6..**8**23..**8**7..**6**827.61..61.23...7.381.6..

is the second puzzle, or any of its minimal versions, in one or both of mith's lists of 11.8's? also what's its SE rating? i checked with skfr that the additional clue 6r5c9 reduces its skfr from 11.7 to 11.6 so it's unlikely that it is SE 11.9 but i don't have time to check it right now

edit: as champagne noted, adding the trivalue oddagon reduces the difficulty to human-solvable, so i'll try to find a manual solution and will post it as a puzzle in the puzzles forum if i do

Re: The hardest sudokus (new thread)

by mith » Tue Mar 01, 2022 5:56 pm

I've actually already found a manual solve; I'll throw the puzzle in the Puzzles forum to see what others come up with.

I hadn't noticed the pencilmark grids have another digit, nor that the "sticking point" digit is there. This warrants further investigation.

Re: The hardest sudokus (new thread)

by mith » Tue Mar 01, 2022 6:02 pm

The 31c with swapped 6 and 8 has 12 minimals (all 17c), none of which had been found by my scripts yet. I'll rate them now.

CODE: SELECT ALL

.....1.....2.....3..45.....1.23.....267.81..73.61.8...17.....6.8.....2..3..67..8ED=11.7/1..2/1..2

.....1.....2.....3..45..6.....71.....823..87..6.827.61..6...23...7.381.6...ED=11.7/1..2/1..2

.....1.....2.....3..45..6.....71.6...823..87..6.827..1..6...23...7.381.6...ED=11.7/1..2/1..2

.....1.....2.....3..45..1.23.....267.81..73.61.8...17.....62.3..7..868.....ED=11.7/1..2/1..2

.....1.....2.....3..45..6.23.....3781.6..82.7.61...68.....3.2..7..671.....8ED=11.7/1..2/1..2

.....1.....2.....3..45..6.23.....3781.6..82.7..1...68.....3.2..7..671..6...8ED=11.7/1..2/1..2

.....1.....2.34.23..156.....46...5.....6..78...56...4.24.1..3..3.14...25ED=11.6/1..2/1..2

.....1.....2.34.23..156.....46...5.....6..78...56...1..24.1..3..3.14...25ED=11.6/1..2/1..2

.....1.....23.....24...35...46.....4273...8.6.8..7...7.26..8..86..4...2.3..7...ED=11.7/1..2/1..2

.....1.....23.....24...35...46.....73...8.6.8.27...863.4...2.3..7...47..6..8ED=11.7/1..2/1..2

.....1.....23.....24...35...46.....73...8.6.8.27...86..4...2.3..7...47.26..8ED=11.7/1..2/1..2

.....1.....23.....24...35...46.....273...8.6.8..7...86..4...2.3..7...47.26..8ED=11.7/1..2/1..2

[edit]Ratings added, all 11.6-11.7/[edit]

This might be a new script to add at some point, though - look for completed rectangles (maybe larger unavoidable?) in a singles-expanded grid, and try minimizing both the original and with the rectangles flipped.

Re: The hardest sudokus (new thread)

by 999_Springs » Tue Mar 01, 2022 6:47 pm

very nice, we found a batch of new 11.6's-11.7's with the smallest possible amount of effort, mainly just by me eyeballing the pencilmark grid 🤪

mith wrote:

This might be a new script to add at some point, though - look for completed rectangles (maybe larger unavoidable?) in a singles-expanded grid, and try minimizing both the original and with the rectangles flipped.

no need to limit the search to just completed UR's. the general way of finding all equivalent puzzles that share the same pencilmark grid ignoring the clues is as follows. i'll demonstrate on your puzzle:

start with the puzzle you want

3.....1.....2.....3..458.6.....71.8..**6**23..**6**7..**8**827.61..61.23...7.381.6..

find the solution

354978261168542973927631845896354712471269358235187496582796134619423587743815629

find the complement (subtract them as 81-digit numbers with 0's for blanks)

.5497826.16854.9739276.18...9.3547124.2.935...51.49.5...9..34.94.587.4...5.29 (*)

find all solutions of this

354978261168542973927631845896354712471269358235187496582796134619423587743815629

354978261168542973927631845896354712471289356235167498582796134619423587743815629

find the complement of each one wrt (*)

3.....1.....2.....3..458.6.....71.6..**8**23..**8**7..**6**827.61..61.23...7.381.6..

3.....1.....2.....3..458.6.....71.8..**6**23..**6**7..**8**827.61..61.23...7.381.6..

and you get all possible puzzles. in this case there were only these two available, the original and the 6/8 flipped one.

this is exactly the same method that i used to manipulate the puzzles in the "maximum clues for each se rating" thread for the ratings 10.5-11.1 and 5.3. the [10.5-11.1](#)'s came from dobrichev's 48's and the [5.3](#) came from a 4.9 patterns game puzzle by champagne. naturally, this method for puzzle generation works best when the seeds have lots of clues, so you're more likely to get lots of possible solutions to the complements. it would be delightful if this same method could be used for hardest puzzle generation - i'd previously thought that this method would be fruitless because your starting seeds wouldn't have enough clues in them... until now 🤪

Last edited by 999_Springs on Tue Mar 01, 2022 6:50 pm, edited 1 time in total.

Re: The hardest sudokus (new thread)

by mith » Tue Mar 01, 2022 6:49 pm

Very nice, a lot simpler than anything I was going to come up with. Shouldn't be hard at all to script. 🤪 I'll call that script springs.sh or something

Re: The hardest sudokus (new thread)

by denis_berthier » Tue Mar 01, 2022 6:55 pm

999_Springs wrote:

that has to mean that this puzzle is not isomorphic, and would also not be in t&e(2) - can someone check this?

3.....1.....2.....3..458.6.....71.6..**8**23..**8**7..**6**827.61..61.23...7.381.6..

Right; not in T&E(2)

Re: The hardest sudokus (new thread)

by mith » Tue Mar 01, 2022 6:56 pm

In that case, the other two minimals from the first pencilmark grid should also not be?

That would give 16 minimal examples in total, from two (very closely related) 31c puzzles.

Re: The hardest sudokus (new thread)

by mith » Tue Mar 01, 2022 8:18 pm

Today's update, leaving the noteworthy ratings unhidden (11.8s plus the new 11.7 31c minimals):

CODE: SELECT ALL

.....1.....23.....4.56.....43..5.3752..8.5.47.8.2...8.....34..87...7.235...ED=11.8/1..2/1..2

.....1.....23.....14.56..7..6...86.5...741..78.....864..7..54..1...76..85...ED=11.8/1..2/1..2

.....1.....23.....4.56.....3..5.3725..8.5.4.78.2...8.4...34.8.7...7.253...ED=11.8/1..2/1..2

.....1.....23.....14.56..6.75...458.3...7.64..8..67.5...8.8...8...4.1..7...ED=11.8/1..2/1..2

.....1.....2.....3..4..2.356...3.72.8..75.6.82...8.5...3.5.86.7.62..7...ED=11.8/1..2/1..2

.....1.....2.....3..4..325.6...57.8.2...6.3.78...6.7...825...73.6.8.5...ED=11.8/1..2/1..2

CODE: SELECT ALL

.....12.....345.....3..6..768.....69..1...83.7.9...163.7...3.896.1...79...186...ED=11.7/1..2/1..2

.....1.....234.....2.56.17..8...5.2.19...98.72...91..75..7.589.1..82..51...ED=11.7/1..2/1..2

.....12.....345.....3..6..768.....69..1...83.7.9...163.7...39...186..7.896.1...ED=11.7/1..2/1..2

.....1.....234.....2.56.17..8...5.2.19...98.72...918.75..7.5.9.1..82..51...ED=11.7/1..2/1..2

.....12.....345.....13...6.78...381.9...79.36..8..197.68..3.7.9...69..31...ED=11.7/1..2/1..2

.....12.....345.....3..6..768.....69.31...83.7.9...16..7...39...186..7.896.1...ED=11.7/1..2/1..2

Hidden Text: Show

Hidden Text: Show

Re: The hardest sudokus (new thread)

by denis_berthier » Wed Mar 02, 2022 3:05 am

mith wrote:

In that case, the other two minimals from the first pencilmark grid should also not be?.

Yes. No calculations are needed.

If PM1 is included in PM2, then PM1 is harder than PM2 for any of my ratings and classifications. In particular, if PM2 is not in T&E(2), then PM1 can't be.

Re: The hardest sudokus (new thread)

by denis_berthier » Wed Mar 02, 2022 3:09 am

mith wrote:

Here are the 11.8s so far, 146 of them (25c-28c); expecting more, my scripts are going to have to play catch up again.

I have a problem with this list. Before it, I had noticed only 32 new ones. I may have missed a few posts, but probably not so many. Are there any morphs in the 146 list?

Actually, I have two more problems:

- I can't find the 32 ones in the 146 list; have you changed the minlex form?

- the lack of a name in your puzzles.

Re: The hardest sudokus (new thread)

by denis_berthier » Wed Mar 02, 2022 3:43 am

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I think we have a more general problem with the hardest list. (I'm speaking of the 11+ part, the rest is totally arbitrary.)

It appears that:

- morphs with different ratings are much more frequent than we thought;
- the minlex form is not necessarily the one that gives the desired rating (whichever we consider as desired, highest or lowest);
- non isomorphic puzzles may be fundamentally identical after Singles have been applied (let's say they are quasi-isomorphic).

The three cases raise the same question: should we keep several isomorphic or quasi-isomorphic puzzles in the collection?

My view is, every puzzle should have a short, unique and non-mutable name. Each creator could choose his own naming scheme, but I suggest merely using the order of finding (e.g. mith#007...). This is already the case in the current collection. But not in mith's new puzzles.

The collection should accept morphs and quasi-morphs that have different ratings, not necessarily in their minlex form (putting all the puzzles in minlex form would hide their original visible aspect).

In case there are several morphs or quasi-morphs, the collection should include the minlex form of the quasi-morph after Singles, with its own unique name.

Each of the puzzles should refer to the name of this unique quasi-morph obtained after Singles, in its minlex form. Example: instead of writing mith007, write mith007->mith012

Re: The hardest sudokus (new thread)

by mith » Wed Mar 02, 2022 3:47 am

I wasn't clear I guess - that was 146 new ones generated after finding the 11.9 and updating the database (I only update SER to the database once a day or so, as it locks the database and interferes with the other scripts). The "so far" was because I am expecting more (including the 6 posted today), not to imply it is a complete list of all 11.8s ever found.

I'll post a full list of the 11.8+ in my databases tomorrow; I can name mine by clue count and rowid for now, I haven't been naming them since there are so many. (I can't do purely on order found - I have multiple scripts running constantly and adding to a separate database by clue count, to keep the size of each manageable and avoid collisions.)

Re: The hardest sudokus (new thread)

by mith » Wed Mar 02, 2022 3:55 am

As for "quasi-morphs" as you call them, I have been planning for some time to track the expanded form (after singles) per puzzle. I do think it's worth grouping puzzles with the same expanded form together in some way, but will continue storing all minimals.

There is then the question of what to do about puzzles which are the same after "basics" but not after just singles. I don't have any stats on how frequently this is the case among the hard puzzles, but when we're talking about 11.x puzzles a cutoff at basics makes as much sense as a cutoff at singles to me.

Re: The hardest sudokus (new thread)

by denis_berthier » Wed Mar 02, 2022 4:53 am

mith wrote:

There is then the question of what to do about puzzles which are the same after "basics" but not after just singles. I don't have any stats on how frequently this is the case among the hard puzzles, but when we're talking about 11.x puzzles a cutoff at basics makes as much sense as a cutoff at singles to me.

Statistically, it will not make much difference. But sorry, definitely no: "basics" doesn't make any sense. "Basics" are not even closed under rule isomorphisms (they include Pairs but not X-Wings).

What could make sense is Singles+Whips[1]. However, there's a major difference. Applying Singles directly translates into a Sudoku puzzle. Adding whips[1] produces a sukaku (unless you forget part of the result of applying them).

Note that wrt to the lower SER ratings, nothing really makes sense.

CODE: SELECT ALL

1.0: Last value in block, row or column

1.2: Hidden Single in block

1.5: Hidden Single in row or column

1.7: Direct Pointing

1.9: Direct Claiming

2.0: Direct Hidden Pair

2.3: Naked Single

2.5: Direct Hidden Triplet

2.6: Pointing

2.8: Claiming

3.0, 3.2, 3.4: Naked Pair, X-Wing, Hidden Pair

3.6, 3.8, 4.0: Naked Triplet, Swordfish, Hidden Triplet

Re: The hardest sudokus (new thread)

by denis_berthier » Wed Mar 02, 2022 6:53 am

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I just checked. All the 146+ new 11.8s have a lot of Singles at the start. The question now is, how many really different puzzles does that make after Singles have been applied?
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