

The hardest sudokus (new thread)

Re: The hardest sudokus (new thread)

By nazaz » Tue Mar 01, 2022 10:30 am

denis_berthier wrote:
THE FOLLOWING TWO PUZZLES FOUND BY MITH ARE NOT IN T&E(2):

That's T&E on top of what set of resolution rules? Sorry, can't easily find the definition of T&E(2).

Re: The hardest sudokus (new thread)

By denis_berthier » Tue Mar 01, 2022 10:39 am

nazaz wrote:
denis_berthier wrote:
THE FOLLOWING TWO PUZZLES FOUND BY MITH ARE NOT IN T&E(2):

T&E(Singles, 2)

The precise definition of T&E(T, n), for any resolution theory T with the confluence property, can be found in my books CRT and PBCS (freely available on ResearchGate and in CSP-Rules on GitHub).

[Edit]:There's also something on this forum here: <http://forum.enjoysudoku.com/post62529.html?hilit=abominable#p62529>
But the presentation in previous references will be cleaner.

Re: The hardest sudokus (new thread)

By champagne » Tue Mar 01, 2022 12:25 pm

nazaz wrote:
That's T&E on top of what set of resolution rules? Sorry, can't easily find the definition of T&E(2).

As you, I don't know what is T&E(2), but here, the key point is the exotic pattern ("Thor's Hammer") used by mith as "seed".

Easy to spot, this pattern is still perfectly seen if the last posts of "Denis". This means that this pattern resists to the T&E(2), whatever is the content of it.

The very high rating in Sudoku Explainer shows also that the pattern is highly resistant to the classical chains and "chain nets" approach.

A true breakthrough in the list of exotic patterns.

This is good for the challenge of the highest SE rating. As for some previous exotic patterns as a double JE, it discards such grids from the challenge of the "hardest puzzle". (in fact, I think that most of the grids having an identified "exotic pattern" are discarded from the "hardest grid challenge").

Re: The hardest sudokus (new thread)

By 999_Springs » Tue Mar 01, 2022 2:06 pm

denis_berthier wrote:
One may be interested in the resolution states after T&E(2) has been applied to these two puzzles:
For1.....2.....3..45..6.....71.8.....23..67..8.827..1..6...23...7.381.6.. ED=11.9/1.2/1.2
CODE: SELECT ALL
Resolution state after T&E(2):
+-----+-----+-----+-----+-----+-----+
3	256	478	1	459	4579	4589	1	27	68	1	
145	456	458	1	156	47	2	1	39	678	39	
19	269	79	1	16	3	18	1	278	4	5	
+-----+-----+-----+-----+-----+-----+											
8	459	6	1	23	459	14	1	4579	1237	237	
459	7	1	1	23	8	459	1	3459	235	6	
2	3	459	1	1459	6	7	1	459	19	8	
+-----+-----+-----+-----+-----+-----+											
459	8	2	1	7	459	6	1	1	359	34	
6	1	459	1	459	2	3	1	58	5789	47	
7	459	3	1	8	1	459	1	6	259	249	
+-----+-----+-----+-----+-----+-----+											
141 candidates											
For1.....2.....3..45..1.23...267.81..73.61.8...17.6.....8.....2.3.87..6 ED=11.8/1.2/1.2											
CODE: SELECT ALL											
Resolution state after T&E(2):											
+-----+-----+-----+-----+-----+-----+											
3	467	258	1	459	4579	4569	1	27	68	1	
145	456	458	1	158	47	2	1	39	678	39	
19	79	289	1	18	3	16	1	267	4	5	
+-----+-----+-----+-----+-----+-----+											
8	459	1	1	459	2	3	1	56	5679	47	
459	2	6	1	7	459	8	1	1	359	34	
7	3	459	1	6	1	459	1	8	259	249	
+-----+-----+-----+-----+-----+-----+											
459	1	7	1	23	6	459	1	3459	235	8	
6	8	459	1	23	459	14	1	4579	1237	237	
2	459	3	1	1459	8	7	1	459	19	6	
+-----+-----+-----+-----+-----+-----+
141 candidates

these two pencilmark grids are isomorphic. starting from the first one, swap digits 6 and 8, rows 4 and 5, rows 7 and 8, bands 2 and 3, and columns 2 and 3, and you get the second one. so when it comes to solving them, they are exactly the same puzzle except for different hidden singles at the start. i would consider these as one puzzle and not two different ones

Re: The hardest sudokus (new thread)

By denis_berthier » Tue Mar 01, 2022 2:14 pm

denis_berthier wrote:
Here is probably the breakthrough of the year in Sudoku.
THE FOLLOWING TWO PUZZLES FOUND BY MITH ARE NOT IN T&E(2):
CODE: SELECT ALL
.....1.....2.....3..45..6.....71.8.....23..67..8.827..1..6...23...7.381.6.. ED=11.9/1.2/1.2
.....1.....2.....3..45..1.23...267.81..73.61.8...17.6.....8.....2.3.87..6 ED=11.8/1.2/1.2

This is not the end of the story.
If a puzzle is not in T&E(2), the next steps are asking:
- is it in gT&E(2) = T&E(W1, 1) ?
- is it in T&E(S2, 2) ? (where S2 is for Subsets of size 2, i.e. Naked, Hidden and Super-Hidden Pairs)
- is it in T&E(W2, 2) ?

We have:
the above 2 puzzles are not in gT&E(2)
the above 2 puzzles are not in T&E(S2, 2)
the above 2 puzzles are in T&E(W2, 2)

What this means is, these two puzzles are a totally unexpected great jump above any of the previously known puzzles.
SER is totally unable to detect such a difference.

[Edit]: Maybe not very important here, but the resolution states after applying T&E(2), gT&E(2) and T&E(W2, 2) are identical.

Last edited by denis_berthier on Tue Mar 01, 2022 3:21 pm, edited 1 time in total.

Re: The hardest sudokus (new thread)

By denis_berthier » Tue Mar 01, 2022 2:45 pm

999_Springs wrote:
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I was suspecting something like that. Thanks for finding the right iso.

[Edit]: This also shows that taking the isomorphisms into account only at the level of the givens leaves much room for this kind of hidden equivalence.

Last edited by denis_berthier on Tue Mar 01, 2022 3:24 pm, edited 1 time in total.

Re: The hardest sudokus (new thread)

By champagne » Tue Mar 01, 2022 3:06 pm

champagne wrote:
nazaz wrote:
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Easy to spot, this pattern is still perfectly seen if the last posts of "Denis". This means that this pattern resists to the T&E(2), whatever is the content of it.

The very high rating in Sudoku Explainer shows also that the pattern is highly resistant to the classical chains and "chain nets" approach.

A true breakthrough in the list of exotic patterns.

This is good for the challenge of the highest SE rating. As for some previous exotic patterns as a double JE, it discards such grids from the challenge of the "hardest puzzle". (in fact, I think that most of the grids having an identified "exotic pattern" are discarded from the "hardest grid challenge").

I quickly checked the effect of the exotic pattern.
.....1.....2.....3..45..6.....71.8.....23..67..8.827..1..6...23...7.381.6..

Applying 1 r6c4 ("Thor's Hammer"), you are down to a rating 8.3 not a hard puzzle...

Re: The hardest sudokus (new thread)

By mith » Tue Mar 01, 2022 4:08 pm

Wow, that is very much an unexpected result, Denis.

We've been dabbling over on discord with expanding the trivalue oddagon/Thor's Hammer pattern into a more general "chromatic pattern" investigation, though other examples haven't yet popped up in the hard puzzles search (or if they have, they haven't been noticed yet). It does feel like a genuinely novel technique with no clear relationship to other techniques, even exotic ones. I'll have to do a write-up of the topic at some point, I certainly have enough examples from the high SE high clue minimal puzzles.

Re: The hardest sudokus (new thread)

By mith » Tue Mar 01, 2022 4:11 pm

(High for 31c minimal is now 11.7, btw. I'm not currently running the 32c script, but may have to start it back up again now.)

Re: The hardest sudokus (new thread)

By mith » Tue Mar 01, 2022 4:19 pm

999_Springs wrote:
these two pencilmark grids are isomorphic. starting from the first one, swap digits 6 and 8, rows 4 and 5, rows 7 and 8, bands 2 and 3, and columns 2 and 3, and you get the second one. so when it comes to solving them, they are exactly the same puzzle except for different hidden singles at the start. i would consider these as one puzzle and not two different ones

Indeed, these are two of the minimals from the 30c morph-dependent 11.9. The singles only get them to 29c; 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!) The four puzzles in question (first two are the ones discussed above):

CODE: SELECT ALL
.....1.....2.....3..45..6.....71.8.....23..67..8.827..1..6...23...7.381.6.. ED=11.9/1.2/1.2
.....1.....2.....3..45..1.23...267.81..73.61.8...17.6.....8.....2.3.87..6 ED=11.8/1.2/1.2
.....1.....2.34..2.3156.....5.....4...6...78..6.....65...1..2.43..4...3...25 ED=11.8/1.2/1.2
.....1.....2.34..2.3156.....5.....4...6...78..6.....65.4.1..2.43..4...31..25 ED=11.8/1.2/1.2

Re: The hardest sudokus (new thread)

By mith » Tue Mar 01, 2022 5:06 pm

Here's my preferred morph of the 26c 11.9:

CODE: SELECT ALL
57.....9.....8.1.....168...4.....28.9...2.9416.....2....6.9.82.4...41.6... ED=11.9/1.2/1.2 "Loki"

Re: The hardest sudokus (new thread)

By denis_berthier » Tue Mar 01, 2022 5:24 pm

mith wrote:
Indeed, these are two of the minimals from the 30c morph-dependent 11.9. The singles only get them to 29c; 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.

Re: The hardest sudokus (new thread)

By mith » Tue Mar 01, 2022 5:30 pm

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; 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 *arent* - 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).

Re: The hardest sudokus (new thread)

By denis_berthier » Tue Mar 01, 2022 5:36 pm

mith wrote:
denis_berthier wrote:
mith wrote:
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I understand that. The point is that the two puzzles you mentioned are morphs of each other after singles, but the other two puzzles *arent* - 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).

OK, I see. Thanks for clarifying what you meant.

Re: The hardest sudokus (new thread)

By denis_berthier » Tue Mar 01, 2022 5:44 pm

mith wrote:
Wow, that is very much an unexpected result, Denis.

So unexpected that I couldn't believe it and I redid the calculations 3 times, checking each time that I had chosen the right rules.
Notice that the fact they don't belong to gT&E(2) was as big a shock.

This 11.9 puzzle is a big jump over two huge gaps at the same time.

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