Sudoku Players' Forums

Rating rules / Puzzles. Ordering the rules

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Author	Message

eleven

Joined: 10 Feb 2008
Posts: 541

Posted: Sun Sep 20, 2009 5:57 pm Post subject: quote

Red Ed wrote:

To be clear, it's only correct if you replace

Code:

```
if the puzzle is minimal, report it,
```

with

Code:

```
if the puzzle is minimal, report it, else print "oops"
```

... i.e. making sure there is an output (even just "oops") at every attempt.

Ah yes, i have learned already, that its useful to count the number of tries.

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coloin

Joined: 06 May 2005
Posts: 1080
Location: Devon UK

Posted: Sun Sep 20, 2009 9:06 pm Post subject: quote

I agree with your comments regarding the bottom up generator. [top down generator has a fixed grid nb]
The puzzles as we have seen tend to be easier and would be in a "cluster" of other puzzles.....
I can see this cluster of puzzles which have grid solutions with common [non-given] clues.

In the bottom up generation we have subpuzzles with > 1 sol.

I am not sure how the program decides how to add clues, but manually we can do it advantageously

It is possible to make [an easy] puzzle where the subpuzzles have infered clues

infered clues - eg singles propagated even at the sub-puzzle stage.

here is an example of a sub-puzzle made manually by adding clues "advantageously"
"advantageously" = 1. only adding valid clues [obvious] [as you commented] and 2. adding clues which infer a clue

Code:

```
+---+---+---+
|.4.|...|.5.|
|...|..5|47.|
|..1|...|...|
+---+---+---+
|..7|...|..8|
|..6|.28|..9|
|3..|.9.|...|
+---+---+---+
|...|..3|...|
|52.|6..|7..|
|1..|..7|3..|
+---+---+---+ 22 clue sub-puzzle with 128 sols
```

Code:

```
+---+---+---+
|.4.|...|.5.|
|.3.|..5|47.|
|.51|...|...|
+---+---+---+
|297|...|..8|
|416|728|539|
|385|.9.|..7|
+---+---+---+
|.7.|..3|...|
|523|6..|7..|
|16.|..7|3..|
+---+---+---+ infered clues added
```

with another clue added at r8c6, and 2 superfluos clues removed we can get this small easy puzzle with 21 clues.

Code:

```
+---+---+---+
|...|...|.5.|
|...|..5|47.|
|..1|...|...|
+---+---+---+
|..7|...|..8|
|..6|.2.|..9|
|3..|.9.|...|
+---+---+---+
|...|..3|...|
|52.|6.4|7..|
|1..|..7|3..|
+---+---+---+
```

All puzzles with this sub-puzzle backbone will have these infered clues. They will tend to be easy - asuming that the backbone clues dont get pruned too much in the minimization

here are the 21 [n-1] subpuzzles from the above puzzle and a few of the infered clue counts

Code:

```
..............547...1........7.....8..6.2...93...9.........3...52.6.47..1....73..
#10
.......5.......47...1........7.....8..6.2...93...9.........3...52.6.47..1....73..
#15
.......5......5.7...1........7.....8..6.2...93...9.........3...52.6.47..1....73..
.......5......54....1........7.....8..6.2...93...9.........3...52.6.47..1....73..
.......5......547............7.....8..6.2...93...9.........3...52.6.47..1....73..
.......5......547...1.............8..6.2...93...9.........3...52.6.47..1....73..
.......5......547...1........7........6.2...93...9.........3...52.6.47..1....73..
.......5......547...1........7.....8....2...93...9.........3...52.6.47..1....73..
.......5......547...1........7.....8..6.....93...9.........3...52.6.47..1....73..
.......5......547...1........7.....8..6.2....3...9.........3...52.6.47..1....73..
.......5......547...1........7.....8..6.2...9....9.........3...52.6.47..1....73..
.......5......547...1........7.....8..6.2...93............3...52.6.47..1....73..
.......5......547...1........7.....8..6.2...93...9............52.6.47..1....73..
.......5......547...1........7.....8..6.2...93...9.........3....2.6.47..1....73..
.......5......547...1........7.....8..6.2...93...9.........3...5..6.47..1....73..
.......5......547...1........7.....8..6.2...93...9.........3...52...47..1....73..
.......5......547...1........7.....8..6.2...93...9.........3...52.6..7..1....73..
#9
.......5......547...1........7.....8..6.2...93...9.........3...52.6.4...1....73..
.......5......547...1........7.....8..6.2...93...9.........3...52.6.47.......73..
.......5......547...1........7.....8..6.2...93...9.........3...52.6.47..1.....3..
#38
.......5......547...1........7.....8..6.2...93...9.........3...52.6.47..1....7...
```

almost all have a lot of infered clues.

There are 18 more puzzles [all easy] [the so called "cluster"] possible to be made by adding a clue to the above subpuzzles [a {-1+1} on our original puzzle]

Actually if only one of the n-1 subpuzzles has a lot of infered clues the puzzle tends to be easy !

Hard puzzles dont tend to have many infered clues in their n-1 subpuzzles, and ultra hard puzzles esp

diamonds only have a few pm eliminations in the respective n-1 subpuzzles. In fact the eliminations in these are only observable by **t&e**.

We could make bigger [? harder] puzzles by deliberately not adding clues which infer clues.

Big minimal puzzles need room for the unavoidable set [for every clue] so therefore there may well be less of a tendancy for infered clues in the sub-puzzle of the puzzle.

C

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denis_berthier

Posted: Tue Sep 22, 2009 6:28 am Post subject: quote edit

Joined: 19 Jun 2007
Posts: 946
Location: Paris, France

HOW THE MEAN COMPLEXITY OF MINIMAL PUZZLES VARIES WITH THE NUMBER OF CLUES
(preliminary results)

I now have almost two hundred thousand minimal puzzles generated with the controlled-bias generator (before its optimisation for speed, for those who have followed the "real distribution" thread). This is enough to get the following estimates for:

1) ***the correlation coefficient: SER vs #clues = 0.20***
Strangely enough, this is (still small but) higher than the 0.12 for the top-down generator (or any of the other kinds of generators previously mentioned in this thread).

2) ***the mean SER as a function of the number of clues***:

Code:

```
#clues        mean SER
22              3.22
23              3.32
24              3.60
25              3.96
26              4.41
27              4.93
28              5.49
29              5.96
```

What's noticeable, if you compare with the results for the other top-down generators (see previous posts or my web pages), is that:
- we still have a trend: more clues => harder in the mean
- the trend is larger (larger slope);
- for n < 25, the mean complexity is smaller than for the top-down generator;
- for n >= 25, the mean complexity is larger than for the top-down generator.

Detailed computations for the NRCZT are not yet finished, but they lead to very similar conclusions. This shouldn't be too surprising, as the correlation coefficient SER vs NRCZT is now 0.90.

Among other things, this shows that we number of clues is not the only parameter to take into account when computing mean complexity. We must be careful about other kinds of bias.

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eleven

Posted: Tue Sep 22, 2009 9:06 am Post subject: quote

Joined: 10 Feb 2008
Posts: 541

As i hopefully understand now, the bias from the fast generators comes from the fact, that these prefer puzzles in small clusters to those in big ones. This effect is stronger for bottom up than for top down generation.

Without having a statistical relevance, this is confirmed by a quick test. I made a {-1,+1} for 200 puzzles

each from the modified bottom up and the cb-top-down generators (here i dont have more). The result was 41773 to 61595 puzzles.

This would also mean, that the harder puzzles like to live in bigger clusters.
But this is not true for the hardest, for 10 from the current hardest list there were only 147 within {-1,+1}.

[Added:] Things seem to be more complicated. The difference mainly is due to the higher clue numbers from cb-top-down. With a fixed number of clues to 24 and 25 i got even more {-1,+1} puzzles for the bottom-up (and a bit less for the fast top-down) than for cb-top-down.
I will generate more puzzles and repeat that comparison then.

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coloin

Posted: Tue Sep 22, 2009 12:29 pm Post subject: quote

Joined: 06 May 2005
Posts: 1080
Location: Devon UK

Yes...ive noticed this effect.

The mean number of non - isomorphic minimal puzzles within {-1+1} and {-2+2} of any one puzzle is pretty specific to the clue count c.

Ive noticed that ultra hard puzzles [with c=21] have much less surrounding puzzles. I could easily do a confirm.

The easy puzzles should tend to have more, this may well be due to the {n-1} subpuzzle having infered clues/less grid solutions/more other ways to complete another puzzle by adding {+1}.

.....it may be when adding clues in the bottom-up generator you are more likely to end up amonst these

.....and then there is the effect of minimalization - maybe that is where the advantage comes in ?

C

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eleven

Posted: Tue Sep 22, 2009 10:13 pm Post subject: quote

Joined: 10 Feb 2008
Posts: 541

How could i miss another reason for the bottom-up bias, which obviously has more influence ?

The algorithm prefers the cells with more candidates left for a valid puzzle.
E.g. if you have 2 cells with possible candidates A=12345 and B=4, the probability, that a number in A is selected is 5 times higher.
But that means, that a number in cells with more candidates is preferred, iow more (than average in the cells) candidates are deleted by this selection. So what we get at the end is a puzzle with less candidates than we would randomly have, thus it is also easier on average. And the more candidates you eliminate, the less clues you will need.

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coloin

Posted: Tue Sep 22, 2009 11:06 pm Post subject: quote

Joined: 06 May 2005
Posts: 1080
Location: Devon UK

Apologies for hijacking denis's thead - I hope he doesnt mind.

Indeed.....althoiugh i am am not sure how the next clue is chosen - i chose clues which resulted in an insertion - ie ones which "saw" a bivalue.

If you chose a clue with more options you are biasing the selection to an extent - and also if you chose a clue witch reflects on a bivalue.....hmmmm

Did anyone consider the output when one completes [via bottom up] the puzzle - and it turns out to be minimal - as in the cb technique of denis/Ed ?

C

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denis_berthier

Posted: Wed Sep 23, 2009 7:27 pm Post subject: quote edit

Joined: 19 Jun 2007
Posts: 946
Location: Paris, France

> **eleven wrote:**
>
> How could i miss another reason for the bottom-up bias, which obviously has more influence ?
> The algorithm prefers the cells with more candidates left for a valid puzzle.
> E.g. if you have 2 cells with possible candidates A=12345 and B=4, the probability, that a number in A is selected is 5 times higher.
> But that means, that a number in cells with more candidates is preferred, iow more (than average in the cells) candidates are deleted by this selection. So what we get at the end is a puzzle with less candidates than we would randomly have, thus it is also easier on average.
> And the more candidates you eliminate, the less clues you will need.

I'm not sure to understand what you mean, but...
If the bottom-up algorithm is (as you first described it):
"randomly select a cell, then randomly select (with equal probabilities) a value for it in {1, 2, ... 9} (disregarding any knowledge of its remaining candidates)"
this doesn't introduce a bias.
It is equivalent to:
"randomly select a cell, then randomly select (with equal probabilities) one of its remaining candidates as its value"
because any non allowed value chosen in the first case would lead later to a puzzle with no solution.
[Edit]: This is true only for the classical bottom-up algorithm. It is false for the full bottom-up: in this case, it seems to be equivalent but it is not. It changes the probability of the subsequent extensions of the current puzzle (not their relative probabilities, but their global probability).

What would introduce a bias is:
"randomly select (with equal probabilities) one of the remaining candidates in 3D space (n, r, c)"

Last edited by denis_berthier on Thu Sep 24, 2009 3:44 am; edited 1 time in total

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coloin

Posted: Wed Sep 23, 2009 10:58 pm Post subject: quote

Joined: 06 May 2005
Posts: 1080
Location: Devon UK

Im sure we will have verification of how the various bottom-up generators chose the next clue soon.

I wasnt aware of the "restart if no solutions" route - it would make it much more inefficient - which it isnt.

Picking one of several clues which solves a puzzle - if and when they come available would be a huge bias ? is this another way of saying

> **denis wrote:**
>
> randomly select (with equal probabilities) one of the remaining candidates in 3D space (n, r, c)

The minimization process is where there definitly is a bias towards smaller c. More ways to remove clues and have a smaller puzzle as we already know.

This is a factor in the "top-down " generator too though....

The clue count and mean number of superfluos clues could be easily looked at. **gsf**'s program can count superfuos clues in non-minimal puzzles i believe.

http://magictour.free.fr/clusta.exe is an original clue counting program from **dukuso**

C

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denis_berthier

Posted: Thu Sep 24, 2009 3:49 am Post subject: quote edit

Joined: 19 Jun 2007

> **coloin wrote:**
>
> Picking one of several clues which solves a puzzle - if and when they come available would be

Posts: 946
Location: Paris, France

> a huge bias ? is this another way of saying
>
> **denis wrote:**
>
> > randomly select (with equal probabilities) one of the remaining candidates in 3D space (n, r, c)

No. What you say is: choose a single; what I say is: choose something not directly contradicted by the current state.
AFAIK, no generator uses any of these highly biased strategies.

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logel

Posted: Fri Oct 09, 2009 4:45 pm Post subject: Re: Rating rules / Puzzles. Ordering the rules quote

Joined: 04 Aug 2009
Posts: 5
Location: Germany

> **denis_berthier wrote:**
>
> > **RATING RULES / PUZZLES; ORDERING THE RULES**
> > **INTRODUCTION - MOTIVATIONS**
> > Several ratings of rules or puzzles are known and they generally lead to different classifications of puzzles.
> > Comparison of different ratings can't therefore be done on a puzzle by puzzle basis. They can only be statistical.
> > .

Reading this faily old thread, I find that the end is no nearer to an anwer as the beginning, al least what I am interested in.

Let me be a bit provocative:
Rating of rules or solution pathes is impossible without a consensus about what is the final result one wants to have. I can see a widespread mismatch of motivations, when reading this thread.

All agree, that just finding the solution alone is meaningless. T&E can do it in msec, but giving back no other information than just the solution.

Some want to crack every ultrahard board with "pure logic", regardless of the used methods.
Some restrict the used methods and try a systematic approach to classify sudokus by ordering the remaining rules (Denis). This is fine and deliveres a key figure, the maximun length of used chains of that type.
Some order all known methods and compute a magic number from the solution path of their solver.

All in all this seem unsatisfying to me, not that I have a better idea.
The statistical correlation of different ratings can show, that the rating stuff is settled OR that all followed the same basic idea. No one can decide this.

Its all about complexity. I think, there is no way other than to find a solver independant rating of any solution path. Than the minimal rating==complexity of a sudoku can be approximated, or you have to examine ALL possible pathes. Path rating must work with all known methods (seems hopeless).
To rate solution steps I can see only a few solver and method independant parameters: Number of candidates involved, number of true nodes involved (min,max), number of states (permutations) of true nodes.

Another problem is the low hitrate of complex methods. If a certain type of method only lead to an elimination at 1:10000 its of less value that one with 1:500. Solver usually give no info about the hit rates.

Finally I want to give an argument, that the maximum depth of chains and/or grids is NOT sufficient for path rating. I found examples where a large number of medium grade steps finally solve the grid, but one or to shots with longer chains at the right spots was leading to easy follow-ups. So the number and severity of solution steps make a reasonable rating.

I am not interested in logical minimalism but in minimal computational complexity. Please give me some hints, if I missed a discussion in that direction.

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eleven

Posted: Fri Oct 09, 2009 5:41 pm Post subject: Re: Rating rules / Puzzles. Ordering the rules quote

Joined: 10 Feb 2008
Posts: 541

logel wrote:

> I am not interested in logical minimalism but in minimal computational complexity. Please give me some hints, if I missed a discussion in that direction.

Now you have listed many of the rating problems, but i dont understand, what you want. A simple rating algorithm, which will be worse than the others ?

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David P Bird

Posted: Fri Oct 09, 2009 11:33 pm Post subject: quote

Joined: 17 Sep 2008
Posts: 169
Location: Middle England

logel wrote:

> All agree, that just finding the solution alone is meaningless. T&E can do it in msec, but giving back no other information than just the solution.
>
> I am not interested in logical minimalism but in minimal computational complexity.

These two statements seem somewhat contradictory - a T&E approach would be the simplest computationally.

Presumably you have some ideas of what defines a T&E approach, but study the various threads here and you will find there are many different shades of opinion. For example how many of the following would satisfy your personal criteria?

Case 1: Assume a single candidate or other Boolean condition is true or false and look for a contradiction to prove the assumption is wrong.
Case 2: Follow the outcomes when a candidate is both true and false and eliminate candidates that are false in both cases.
Case 3: Given N options one of which must be true, follow the outcomes of each one being true and eliminate candidates that are always false.

However, your post implies that you are really far more interested in finding an efficient scientific method than getting involved with such niceties. You make a good point on hit rates. So in the same spirit, which is preferable; using a scorned but reliable method, or exhaustively exploring all the scattered cell combinations that could combine to form a disjoint multi-digit locked set?

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PIsaacson

Posted: Sat Oct 10, 2009 1:17 am Post subject: quote

Joined: 02 Jul 2008
Posts: 229
Location: Campbell, CA

David P Bird wrote:

> ... So in the same spirit, which is preferable; using a scorned but reliable method, or exhaustively exploring all the scattered cell combinations that could combine to form a disjoint multi-digit locked set?

David,

I'll bite. Having coded an exhaustive and pathetically slow algorithm for locating disjoint locked sets I've got to ask: What's the implied faster, although apparently scorned, alternate reliable method? For my needs, the answer is obviously the faster reliable method, scorned or not...

Cheers,
Paul

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David P Bird

Posted: Sat Oct 10, 2009 8:04 am Post subject: quote

Joined: 17 Sep 2008
Posts: 169

PIsaacson wrote:

> What's the implied faster, although apparently scorned, alternate reliable method?

Posts: 169
Location: Middle England

I didn't have a particular "scorned reliable method" in mind because it depends on where you drew your acceptability lines in the first place!

I often find that my chain tracking exercises reveal a net based contradiction that I could use if only I relaxed my acceptability limits. As I'm reluctant to do that, in desperation I may assume there is a disjoint locked set to be found somewhere and spend ages looking for it. It's hardly an efficient scientific method is it? Furthermore, when we look for complex known patterns, the checking involved to confirm all the conditions are satisfied isn't a million miles away from a T&E approach to my way of thinking.

One test of a good method is whether or not it provides useful information for later use should it fail to provide an immediate deduction. This is where disjoint locked set hunts score particularly badly.

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