Sudoku Players' Forums

Strong inferences induced by the UR

new topic   post reply   **Sudoku Players' Forums Forum Index -> Advanced solving techniques**

Author	Message
ronk Joined: 02 Nov 2005 Posts: 2492 Location: Southeastern USA	▯ Posted: Wed Apr 08, 2009 6:28 am Post subject: Re: Strong inferences induced by the UR quote

storm_norm wrote:

> The trick is to notice what looks like a UR, but really can't take advantage of the common rules of URs to make any eliminations. AND its very important that the UR candidates are the ONLY candidates left in the floor cells. as in this grid
>
> **Code:**
> ```
> +--------+----------+-------+
> | 12 . . | 12345 . . | . . . |
> | .  . . | .     . . | . . . |
> | 12 . . | 12345 . . | . . . |
> +--------+----------+-------+
> | .  . . | .     . . | . . . |
> | .  . . | 13    . . | . . . |
> | .  . . | 25    . . | . . . |
> +--------+----------+-------+
> | .  . . | .     . . | . . . |
> | .  . . | .     . . | . . . |
> | .  . . | .     . . | . . . |
> +--------+----------+-------+
> ```
>
> it just so happens that there is another 1 and another 2 in column 4. both cannot be false at the same time (that will force the UR to exist, NO NO !!) This provides yet another strong inference to exploit
> UR12[(1)r5c4 = (2)r6c4]

Are we to assume the bivalues contain the <u>only</u> other UR digits in column 4?

storm_norm wrote:

> consider this grid and notice the UR {1,2} in r46c14
>
> **Code:**
> ```
> +--------+-------------+-------+
> | . . . | 3456789 . . | . . . |
> | . . . | 3456789 . . | . . . |
> | . . . | 12(3456). . | . . . |
> +--------+-------------+-------+
> | 12 . . | 12345   . . | . . . |
> | .  . . | .       . . | . . . |
> | 12 . . | 12345   . . | . . . |
> +--------+-------------+-------+
> | . . . | 3456789 . . | . . . |
> | . . . | 3456789 . . | . . . |
> | . . . | 3456789 . . | . . . |
> +--------+-------------+-------+
> ```

> as stated before, the extra UR candidates 1 and 2 in r3c4 exist in the same cell.
> From the rules of URs we can now eliminate the {3,4,5,6} from r3c4 because
> neither the 1 nor the 2 can be false at the same time.

Are we to assume r3c4 contains the <u>only</u> other UR digits in column 4? IOW what about r5c4?

Back to top   profile   pm

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storm_norm

Joined: 27 Feb 2008
Posts: 122

Posted: Wed Apr 08, 2009 3:06 pm   Post subject: quote

ronk said:

> **Quote:**
>
> Are we to assume the bivalues contain the only other UR digits in column 4?

each one of the UR digits must only appear once (or as a group) in the "house" which
contains the **roof cells**.
one of the examples I used in the posting for this type shows how a group can be strongly
inferenced.

> **Quote:**
>
> Are we to assume r3c4 contains the only other UR digits in column 4? IOW what about
> r5c4?

Yes.
each one of the UR digits must occur <u>only</u> once in the same "house" as the **roof cells**, AND
be contained in one cell.

Back to top   profile   pm

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champagne

Joined: 02 Aug 2007
Posts: 487
Location: France Brittany

Posted: Thu Apr 09, 2009 1:42 am   Post subject: quote

> **storm_norm wrote:**
>
> I agree that **ttt** does make very nice use of the AUR, but it should be noted that ttt's
> main use of the UR is in forming strong sets. .

I don't catch precisely your point. "ttt" diagrams, as far as I can see, are closer to AIC's nets
than to Alan Barker SLG's .

> **storm_norm wrote:**
>
> you say that you don't notice a difference in a puzzle's path if your solver employs the
> easier UR inferences?
> I can't deny or affirm that these inferences are ever needed in solving sudoku puzzles. I
> am leaning towards never.
> .

First of all, If I introduced UR strong inferences in my solver, it is because I am convinced it is
shortening some paths. I am just lacking time to find the most relevant examples and it did

not show in the puzzles I studied in between.

BTW, I introduced a very efficient UR pattern, the double XWing which is not so far form your

> **storm_norm wrote:**
>
> ### IV. An uncommon UR inference.
>
> **Code:**
> ```
> +--------+-----------+-------+
> | 12 . . | 12345 . . | . . . |
> | .  . . | .     . . | . . . |
> | 12 . . | 12345 . . | . . . |
> +--------+-----------+-------+
> | .  . . | .     . . | . . . |
> | .  . . | 13    . . | . . . |
> | .  . . | 25    . . | . . . |
> +--------+-----------+-------+
> +
> ```

The double XWing pattern is extremely efficient coupled with Exocets. You can find some examples of use in the bb " pattern" thread
http://www.sudoku.com/boards/viewtopic.php?t=6546;

It is not exactly designed to work as strong inferences in an AIC, but the underlying concept is the same.

Let us assume you have a UR unrestricted pattern

> **Code:**
> ```
> 12+  12+
> 12+  12+   (+ means any number of other digits)
> ```

Let's now consider that **you are just working on digits 1 and 2.**

If combining one candidate '1' and one candidate '2' (candidate or group of candidates) you are left with the double XWing, then the start is not valid.

Any invalid "And" has a corresponding "strong inference"

If you have a look at the bb thread, you will see that this is applied to the Exocet pattern., so it leads directly to the elimination of a super candidate. The search made by the solver uses a kind of Allan Barker model, but as far as I can see, in most cases, it could be an AIC net as well.

champagne

Back to top   (profile) (pm) (www)

storm_norm	Posted: Thu Apr 09, 2009 3:14 am Post subject: (quote)
Joined: 27 Feb 2008 Posts: 122	champagne,
	Quote:
	I don't catch precisely your point. "ttt" diagrams, as far as I can see, are closer to AIC's

nets than to Alan Barker SLG's

Yes, that is what I was saying. I read in another thread that ttt's AUR are used to make nets.

if the UR cells contain {1,2,3}, {1,2,4}, {1,2,5}, {1,2} then the 3,4 and 5 are considered to be a strong set because at least one is true in order to avoid the deadly pattern.
is this what you were thinking as well?
ttt is very adept at finding these relationships.

> **Quote:**
> First of all, If I introduced UR strong inferences in my solver, it is because I am convinced it is shortening some paths. I am just lacking time to find the most relevant examples and it did not show in the puzzles I studied in between.

hmm.
I think you are missing the point. Sure, its fine that you want to introduce the UR strong inference to your solver, but can you stand back and enjoy the usefulness of the pattern? Maybe step back and realize that these patterns sometimes **jump off the page** without the help of a solver? The sole inspiration of this thread was provoked by how my eyes are drawn to these inferences. For a manual solver, that is BIG NEWS! I am sure all kinds of statistics can be researched about just how effective or uneffective these moves are.
The point is that they are being discussed and hopefully educational.
----
your work on the double x-wing is quite interesting. Its probably the kind of powerful move that solvers like to hear about when it comes to really using a UR to its full potential. I will need to keep studying your work.

Back to top   [🔲 profile] [🔲 pm]

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champagne   🔲 Posted: Thu Apr 09, 2009 5:29 am   Post subject: [🔲 quote]

Joined: 02 Aug 2007
Posts: 487
Location: France Brittany

> **storm_norm wrote:**
> if the UR cells contain {1,2,3}, {1,2,4}, {1,2,5}, {1,2} then the 3,4 and 5 are considered to be a strong set because at least one is true in order to avoid the deadly pattern.
> is this what you were thinking as well?
> ttt is very adept at finding these relationships..

I agree that he is not at all afraid by complexity. I know at least another player doing similar things on a French forum.

> **storm_norm wrote:**
>
> > **Quote:**
> > First of all, If I introduced UR strong inferences in my solver, it is because I am convinced it is shortening some paths. I am just lacking time to find the most relevant examples and it did not show in the puzzles I studied in between.
>
> hmm.
> I think you are missing the point. Sure, its fine that you want to introduce the UR strong inference to your solver, but can you stand back and enjoy the usefulness of the pattern? ....The point is that they are being discussed and hopefully educational..

I choose in priority to enter in my solver what seems feasible for a player, so I do not see any contradiction. I agree that many of the pattern your describe bring direct eliminations or

assignments.

> **storm_norm wrote:**
>
> -
> your work on the double x-wing is quite interesting. Its probably the kind of powerful move that solvers like to hear about when it comes to really using a UR to its full potential. I will need to keep studying your work.

I hope it will help, although in the way I describe them, it seems more dedicated to Exocest patterns that I found mainly in puzzles classified as "Hardest".

champagne

Back to top   [profile] [pm] [www]

DonM   Posted: Thu Apr 09, 2009 11:23 am   Post subject: [quote]

Joined: 13 Jan 2008
Posts: 312

> **storm_norm wrote:**
>
> The sole inspiration of this thread was provoked by how my eyes are drawn to these inferences. For a manual solver, that is BIG NEWS!

Yes! 😃

Back to top   [profile] [pm]

ronk   Posted: Thu Apr 09, 2009 6:53 pm   Post subject: [quote]

Joined: 02 Nov 2005
Posts: 2492
Location: Southeastern USA

UR Type 3 patterns always have complementary naked and hidden sets. Occasionally the hidden set is a hidden pair.

Code:

```
top1465_0817
84..1...27.....8.....5.........5..3.65...9.....2.7...1.....628...6.....523....4..

After SSTS
8       4       359    | 379     1        37     | 3569    569     2
7       U26     15     | 2349    U26+934  234    | 8       15      39
139     U26     39     | 5       U26+8    28     | 139     47      47
--------------------+--------------------+--------------------
149     789     4789   | 2468    5        1248   | 69      3       4689
6       5       1348   | 1348    348      9      | 7       2       48
349     89      2      | 3468    7        348    | 569     4569    1
--------------------+--------------------+--------------------
5       1       479    | 3479    349      6      | 2       8       379
49      789     6      | 234789  2-3489   123478 | 139     79      5
2       3       789    | 1789    89       5      | 4       1679    679
```

The hidden set is <26> in r238c5 and the naked set is <3489> in r23579c5. The only UR digit external to UR(26)r23c25 in columns 2 and 5 is digit 2 in r8c5. Therefore r8c5=2.

But it's much better known as a Type 4 UR followed by a hidden single. 😃

Last edited by ronk on Thu Apr 09, 2009 8:55 pm; edited 1 time in total

Back to top   [profile] [pm]

storm_norm   Posted: Thu Apr 09, 2009 7:23 pm   Post subject: [quote]

Joined: 27 Feb 2008
Posts: 122

champagne,
this example was presented to me by another poster in the daily forum...
I wonder if this is the same type of inference you are making in your "double x-wing" work?

Code:

```
.------------------.------------------.------------------.
| 5     4    29    |A13    289   89   |#1-3   6    7     |
| 19    8    3     | 7     6     5    | 4     19   2     |
| 129   6    7     | 4     239   19   | 5     189  B38   |
:------------------+------------------+------------------:
| 2368  12   126   | 5     38    7    | 9     18   4     |
| 389   5    19    |U136   4     189  | 7     2    U368  |
| 389   7    4     |U136   389   2    | 13    5    U368  |
:------------------+------------------+------------------:
| 26    12   126   | 9     7     3    | 8     4    5     |
| 7     9    8     | 2     5     4    | 6     3    1     |
| 4     3    5     | 8     1     6    | 2     7    9     |
'------------------'------------------'------------------'
```

The 36UR is marked "U". It is important to note that the <6>s in this UR form an X-Wing. This means that any *external* <3>s in the UR columns will destroy the UR and thus have a strong inference. In this case:
36UR[(3)r1c4=(3)r3c9]
This strong inference alone performs an elimination! <3> is removed from r1c7, marked #. You won't find an AIC much shorter than that!

The x-wing on the 6's says that any existance of a 3 outside the UR in columns 4 and 9 would destroy the UR so at least one has to be true. both can't be false or the deadly pattern will exist.
in the above example, exactly one instance of 3 exists in columns 4 and 9 therefore creating the strong inference on them.

is this a simplified example of your "double x-wing" work?

Back to top   [profile] [pm]

champagne   Posted: Thu Apr 09, 2009 11:01 pm   Post subject: [quote]

Joined: 02 Aug 2007
Posts: 487
Location: France Brittany

> **storm_norm wrote:**
>
> champagne,
>
> is this a simplified example of your "double x-wing" work?

surely it is one, the simplest you can imagine.

As you write, in that situation, the XWing is already there for digit 6, but the logic is the same.

I guess some examples nearly as basic covering the 2 digits could be found, but it does not push in direct action. It just creates a strong inference.

EDIT: In fact we create usually a weak inference a&b not valid. The strong inference (to stay in line with the title of the thread) applies to ~a and ~b the complemetary values for 'a' and 'b'

One can express the same in an AIC form using the "strong set" 18 r56c49 for example, but it does not add anything to the very simple fact that 3r1c7 creates the deadly pattern double XWing, I agree with you.

champagne

Back to top   [profile] [pm] [www]

storm_norm   ☐ Posted: Fri Apr 10, 2009 2:41 am   Post subject: [quote]

Joined: 27 Feb 2008
Posts: 122

champagne said:

> **Quote:**
>
> > EDIT: In fact we create usually a weak inference a&b not valid. The strong inference (to stay in line with the title of the thread) applies to ~a and ~b the complemetary values for 'a' and 'b'

right, the strong inference is not *internal* but *external* to the UR with the x-wing.

Back to top   [profile] [pm]

ronk   ☐ Posted: Fri Apr 10, 2009 3:42 pm   Post subject: [quote]

Joined: 02 Nov 2005
Posts: 2492
Location: Southeastern USA

champagne wrote:

> I introduced a very efficient UR pattern, the double XWing ...

Other than limiting the shape to a rectangular pattern, how does "double x-wing" differ from "deadly pattern"?

Back to top   [profile] [pm]

champagne   ☐ Posted: Sat Apr 11, 2009 1:19 am   Post subject: [quote]

Joined: 02 Aug 2007
Posts: 487
Location: France Brittany

ronk wrote:

> **champagne wrote:**
>
> > I introduced a very efficient UR pattern, the double XWing ...
>
> Other than limiting the shape to a rectangular pattern, how does "double x-wing" differ from "deadly pattern"?

The "double XWing" **is a deadly pattern**.

The specificity in the Exocet process is that the deadly pattern comes out of a bi floor analysis (which is a strong limitation) with, as a start, one super candidate of the Exocet base.

As I could expect, storm_norm has shown in the above example that the same deadly pattern can be used in much simpler contexts.

champagne

Back to top   [profile] [pm] [www]

storm_norm   ☐ Posted: Fri Jul 17, 2009 4:41 pm   Post subject: [quote]
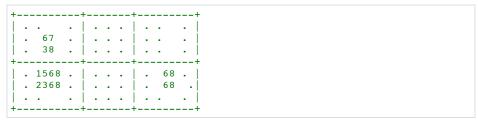
IV. Ucommon UR inferences.

Joined: 27 Feb 2008
Posts: 122

I am going to put this one under the uncommon UR inferences because it has to do with the same type of logic.

to repeat the scenario of an uncommon UR inference, consider the grid below...

Code:

```
+----------+-------+---------+
| . .    . | . . . | . .   . |
| . 67   . | . . . | . .   . |
| . 38   . | . . . | . .   . |
+----------+-------+---------+
| . 1568 . | . . . | . 68  . |
| . 2368 . | . . . | . 68  .|
| . .    . | . . . | . .   . |
+----------+-------+---------+
```

This section talked about how this scenario leads to a strong inference on the 6 in r2c2 and the 8 in r3c2 because if either of them are false then the UR68 is forced into r45c28 which is a no no.
----

the example I am adding is from a thread in Danny's forum which can be found here...
http://www.dailysudoku.com/sudoku/forums/viewtopic.php?
t=3798&sid=06be8b39ff855c8d1da2ffd3360c8f7f

the puzzle breaks down to a point after a xy-wing extension mentioned by Ted to this grid.

Code:

```
.--------------------.--------------------.--------------------.
| 17     17     45   | 8      6      2    | 39     49     35   |
| 68     568    9    | 1      4      3    | 58     7      2    |
| 48     3      2    | 9      7      5    | 1      48     6    |
:--------------------+--------------------+--------------------:
| 3      68     68   | 2      1      7    | 4      5      9    |
| 5      9      1    | 4      3      6    | 7      2      8    |
| 2      4      7    | 5      9      8    | 6      3      1    |
:--------------------+--------------------+--------------------:
| 45678  5678   4568 | 3      58     1    | 2      689    57   |
| 79     2      58   | 6      58     4    | 39     1      37   |
| 168    1568   3    | 7      2      9    | 58     68     4    |
'--------------------'--------------------'--------------------'
```

I am going to cut away the unrelated candidates so to more clearly show what is going on with the UR68 r79c28

and notice how that if the hidden pair of {68} in r24c2 is false and the 9 is false in r7c8 then the UR68 is forced to exist in the deadly pattern cells or r79c28

Code:

```
+----------+-------+---------+
| . .    . | . . . | . .   . |
| . 568  . | . . . | . .   . |
| . .    . | . . . | . .   . |
+----------+-------+---------+
| . 68   . | . . . | . .   . |
| . .    . | . . . | . .   . |
| . .    . | . . . | . .   . |
+----------+-------+---------+
| . 5678 . | . . . | . 689 . |
| . .    . | . . . | . .   . |
| . 1568 . | . . . | . 68  . |
+----------+-------+---------+
```

in other words, if the 9 is gone in r7c8, then the scenario exists as mentioned above that makes a strong inference on the 6's and 8's in the column 2. but this time the inference is equal to that of a **Hidden Pair**

continuing… the resulting strong inference can be written like this
UR68[(9)r7c8 = hp(68)r24c2]

Code:
```
.--------------------.--------------------.--------------------.
| 17      17     45  | 8      6      2    |*39     *49    *35  |
| 68     [68]5    9  | 1      4      3    |*58      7      2   |
| 48       3      2  | 9      7      5    | 1       48     6   |
:--------------------+--------------------+--------------------:
| 3      [68]    68  | 2      1      7    | 4       5      9   |
| 5        9      1  | 4      3      6    | 7       2      8   |
| 2        4      7  | 5      9      8    | 6       3      1   |
:--------------------+--------------------+--------------------:
| 45678  U5678  4568 | 3      58     1    | 2      U689    57  |
| 79       2     58  | 6      58     4    | 39      1      37  |
| 168    U1568    3  | 7      2      9    | 58     U68     4   |
'--------------------'--------------------'--------------------'
```

this chain can be formed…

(9)r1c7 = (9)r1c8 - UR68r79c28[(9)r7c8 = hp(68)r24c2] - (5)r2c2 = (5)r2c7 - (5=3)r1c9;
r1c7 <> 3

[profile] [pm]

ttt

Joined: 20 Oct 2006
Posts: 209
Location: vietnam
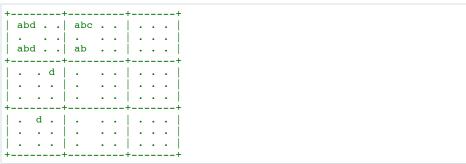
Posted: Fri Jul 17, 2009 7:53 pm   Post subject: [quote]

storm_norm wrote:
> IV. Ucommon UR inferences.
> **Code:**
> ```
> .--------------------.--------------------.--------------------
> --.
> | 17      17     45  | 8      6      2    | 39     49     35
> |
> | 68      568     9  | 1      4      3    | 58      7      2
> |
> | 48       3      2  | 9      7      5    | 1       48     6
> |
> :--------------------+--------------------+--------------------
> --:
> | 3       68     68  | 2      1      7    | 4       5      9
> |
> | 5        9      1  | 4      3      6    | 7       2      8
> |
> | 2        4      7  | 5      9      8    | 6       3      1
> |
> :--------------------+--------------------+--------------------
> --:
> | 45678   5678  4568 | 3      58     1    | 2       689    57
> |
> | 79       2     58  | 6      58     4    | 39      1      37
> |
> | 168     1568    3  | 7      2      9    | 58      68     4
> |
> '--------------------'--------------------'--------------------
> --'
> ```
>
> I am going to cut away the unrelated candidates so to more clearly show what is going on with the UR68 r79c28
> and notice how that if the hidden pair of {68} in r24c2 is false and the 9 is false in r7c8 then the UR68 is forced to exist in the deadly pattern cells or r79c28
> **Code:**

```
+-----------+-------+---------+
| . .    .  | . . . | . .   . |
| . 568  .  | . . . | . .   . |
| . .    .  | . . . | . .   . |
+-----------+-------+---------+
| . 68   .  | . . . | . .   . |
| . .    .  | . . . | . .   . |
| . .    .  | . . . | . .   . |
+-----------+-------+---------+
| . 5678 .  | . . . | . 689 . |
| . .    .  | . . . | . .   . |
| . 1568 .  | . . . | . 68  . |
+-----------+-------+---------+
```

in other words, if the 9 is gone in r7c8, then the scenario exists as mentioned above that makes a strong inference on the 6's and 8's in the column 2. but this time the inference is equal to that of a **Hidden Pair**
continuing... the resulting strong inference can be written like this UR68[(9)r7c8 = hp(68)r24c2]

In my opinion, I can't follow this… Because of bivalue (68)r4c2 then one of (6,8)r79c2 must be FALSE so we can't apply UR pattern (68)r79c28 in this case, we only apply UR pattern when it would be able to "TRUE".
The same for this with bilocation:

Code:

```
+---------+---------+-------+
| abd . .| abc . . | . . . |
| .   . .| .   . . | . . . |
| abd . .| ab  . . | . . . |
+---------+---------+-------+
| .   . d| .   . . | . . . |
| .   . .| .   . . | . . . |
| .   . .| .   . . | . . . |
+---------+---------+-------+
| .   d .| .   . . | . . . |
| .   . .| .   . . | . . . |
| .   . .| .   . . | . . . |
+---------+---------+-------+
```

I can't explain more by my poor English, sorry about that…

ttt

Back to top

profile   pm

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storm_norm

Posted: Fri Jul 17, 2009 8:13 pm   Post subject: quote

Joined: 27 Feb 2008
Posts: 122

can someone help ttt explain?

Back to top

profile   pm

Display posts from previous: All Posts ⬍   Oldest First ⬍   Go

newtopic   postreply   **Sudoku Players' Forums Forum Index -> Advanced solving techniques**

All times are GMT - 8 Hours
Goto page Previous **1**, 2, **3**, **4**, **5**, **6** **Next**

Page 2 of 6

Jump to: Advanced solving techniques ⬍   Go

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