5.294 nvisible_from_start

DESCRIPTION LINKS AUTOMATON

Origin

Derived from a puzzle called skyscraper

Constraint

`nvisible_from_start(N, VARIABLES)`

Synonyms

`nvisible`, `nvisible_from_left`.

Arguments

```
N          : dvar
VARIABLES  : collection(var−dvar)
```

Restrictions

`required`(`VARIABLES`, `var`)
$\texttt{N} \geq \texttt{min}(1, |\texttt{VARIABLES}|)$
$\texttt{N} \leq |\texttt{VARIABLES}|$

Purpose

The i^{th} $(1 \leq i \leq |\texttt{VARIABLES}|)$ variable of the sequence `VARIABLES` is *visible* if and only if all variables before the i^{th} variable are strictly smaller than the i^{th} variable itself. `N` is the total number of visible variables of the sequence of variables `VARIABLES`.

Example

$(3, \langle 1, 6, 2, 1, 4, 8, 2 \rangle)$
$(1, \langle 8, 6, 2, 1, 4, 8, 2 \rangle)$
$(7, \langle 0, 2, 3, 5, 6, 7, 9 \rangle)$

The first `nvisible_from_start` constraint holds since the sequence 1 6 2 1 4 8 2 contains three visible items that respectively correspond to the first, second and sixth items.

Typical

$|\texttt{VARIABLES}| > 2$
`range`(`VARIABLES.var`) > 2

Symmetry

One and the same constant can be added to the `var` attribute of all items of `VARIABLES`.

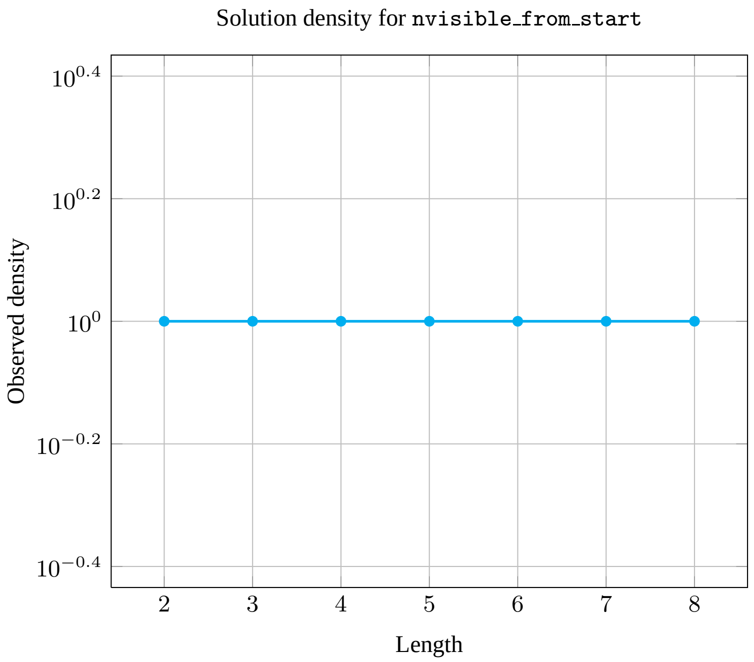
Arg. properties

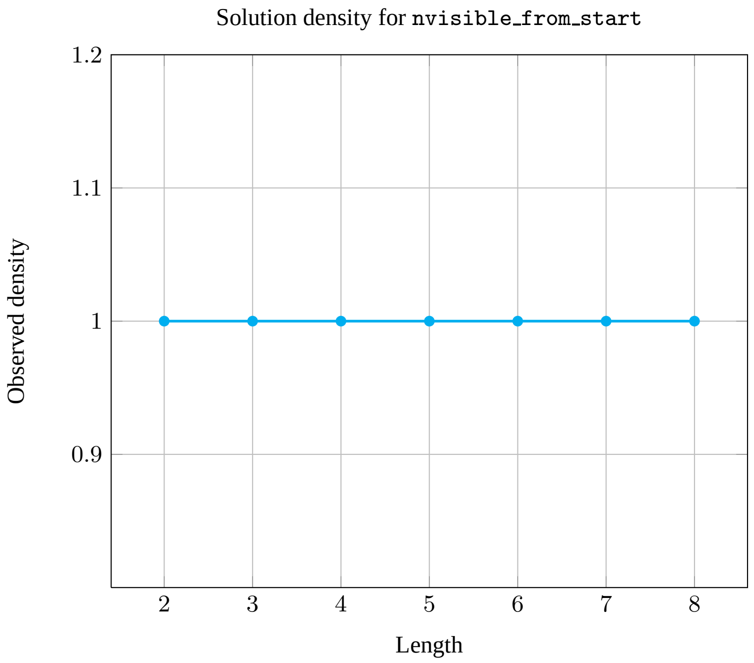
Functional dependency: `N` determined by `VARIABLES`.

Counting

Length (n)	2	3	4	5	6	7	8
Solutions	9	64	625	7776	117649	2097152	43046721

Number of solutions for `nvisible_from_start`: domains $0..n$

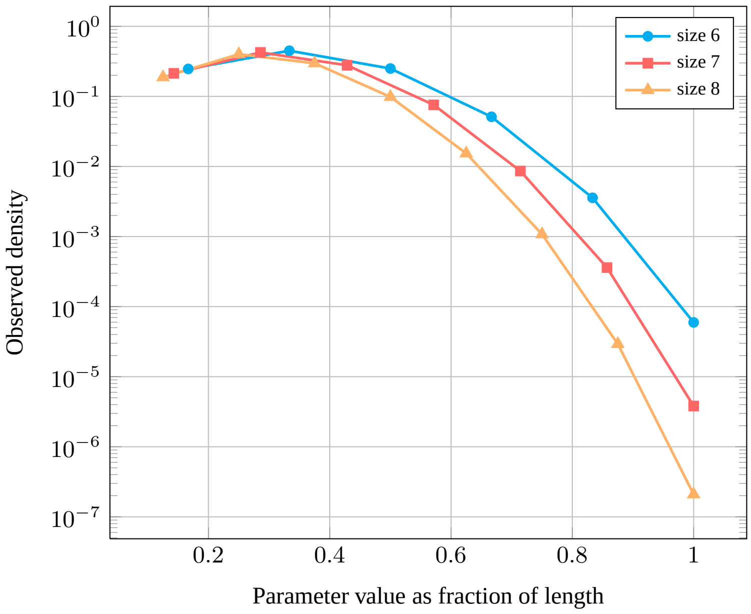

Solution density for nvisible_from_start
$10^{0.4}$
$10^{0.2}$
10^{0}
$10^{-0.2}$
$10^{-0.4}$
Observed density
2
3
4
5
6
7
8
Length

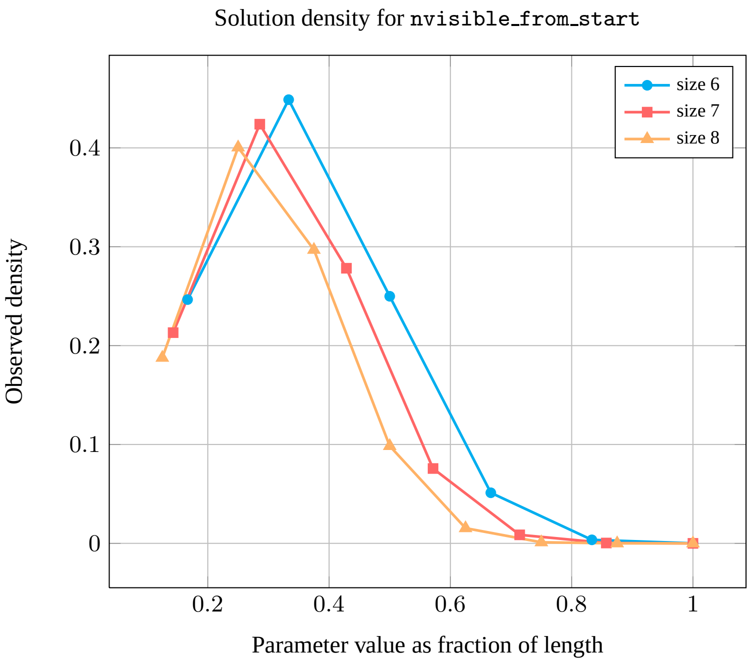

Solution density for nvisible_from_start
1.2
1.1
1
0.9
Observed density
2
3
4
5
6
7
8
Length

Length (n)		2	3	4	5	6	7	8
Total		9	64	625	7776	117649	2097152	43046721
Parameter value	1	6	30	225	2275	29008	446964	8080425
	2	3	30	305	3675	52794	889056	17238570
	3	-	4	90	1610	29400	583548	12780180
	4	-	-	5	210	6020	158760	4238367
	5	-	-	-	6	420	18060	661500
	6	-	-	-	-	7	756	46410
	7	-	-	-	-	-	8	1260
	8	-	-	-	-	-	-	9

Solution count for `nvisible_from_start`: domains $0..n$

Solution density for `nvisible_from_start`





See also

implied by: `increasing_nvalue`.

implies: `atleast_nvalue`.

related: `nvisible_from_end` *(count from the end of the sequence rather than from the start)*.

Keywords

combinatorial object: sequence.

constraint arguments: pure functional dependency.

modelling: functional dependency.

Automaton Figure 5.628 depicts the automaton associated with the `nvisible_from_start` constraint.

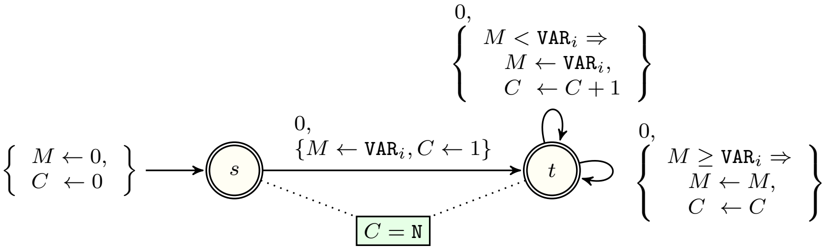

$\{M \leftarrow 0, C \leftarrow 0\}$
s
0, $\{M \leftarrow \mathtt{VAR}_i, C \leftarrow 1\}$
t
0, $\{M < \mathtt{VAR}_i \Rightarrow M \leftarrow \mathtt{VAR}_i, C \leftarrow C+1\}$
0, $\{M \geq \mathtt{VAR}_i \Rightarrow M \leftarrow M, C \leftarrow C\}$
$C = \mathtt{N}$

Figure 5.628: Automaton of the `nvisible_from_start` constraint with two counters M and C, where M records the largest value encountered so far, and C the number of visible values from the left hand side of the sequence $\mathtt{VAR}_1$, $\mathtt{VAR}_2$, $\ldots$, $\mathtt{VAR}_n$

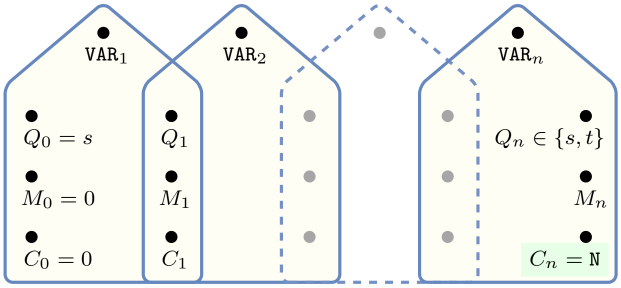


Figure 5.629: Hypergraph of the reformulation corresponding to the automaton (with two counters) of the `nvisible_from_start` constraint (since all states of the automaton are accepting there is no restriction on the last variable Q_n)