

5.215 min_nvalue

	DESCRIPTION	LINKS	GRAPH	AUTOMATON
Origin	N. Beldiceanu			
Constraint	min_nvalue(MIN, VARIABLES)			
Arguments	MIN : dvar VARIABLES : collection(var-dvar)			
Restrictions	$MIN \geq 1$ $MIN \leq VARIABLES $ required (VARIABLES, var)			
Purpose	<div style="border: 1px solid pink; padding: 5px;"> MIN is the minimum number of times that the same value is taken by the variables of the collection VARIABLES. </div>			
Example	<div style="border: 1px solid blue; padding: 10px; display: inline-block;"> $2, \left(\begin{array}{c} \text{var} - 9, \\ \text{var} - 1, \\ \text{var} - 7, \\ \text{var} - 1, \\ \text{var} - 1, \\ \text{var} - 7, \\ \text{var} - 7, \\ \text{var} - 7, \\ \text{var} - 7, \\ \text{var} - 9 \end{array} \right)$ </div>			
	In the example, values 1, 7, 9 are respectively used 3, 5, 2 times. So the minimum number of time MIN that a same value occurs is 2. Consequently the min_nvalue constraint holds.			
Symmetries	<ul style="list-style-type: none"> Items of VARIABLES are permutable. All occurrences of two distinct values of VARIABLES.var can be swapped; all occurrences of a value of VARIABLES.var can be renamed to any unused value. 			
Usage	This constraint may be used in order to replace a set of count or among constraints were one would have to generate explicitly one constraint for each potential value. Also useful for constraining the number of occurrences of the less used value without knowing this value in advance and without giving explicitly a lower limit on the number of occurrences of each value as it is done in the global_cardinality constraint.			
Reformulation	Assume that VARIABLES is not empty. Let α and β respectively denote the smallest and largest possible values that can be assigned to the variables of the VARIABLES collection. Let the variables $O_\alpha, O_{\alpha+1}, \dots, O_\beta$ respectively correspond to the number of occurrences of values $\alpha, \alpha + 1, \dots, \beta$ within the variables of the VARIABLES collection.			

The `min_nvalue` constraint can be expressed as the conjunction of the following two constraints:

```
global_cardinality (VARIABLES,
  ⟨val - α noccurrence - Oα,
    val - α + 1 noccurrence - Oα+1,
    ...
    val - β noccurrence - Oβ⟩),
min_n(MIN, 1, ⟨0, Oα, Oα+1, ..., Oβ⟩).
```

We use a `min_n` constraint (with its `RANK` parameter set to 1) instead of a `minimum` constraint in order to discard the smallest value 0.

See also

common keyword: `among` (*counting constraint*), `count`,
`global_cardinality` (*value constraint, counting constraint*), `max_nvalue`,
`nvalue` (*counting constraint*).

Keywords

application area: assignment.

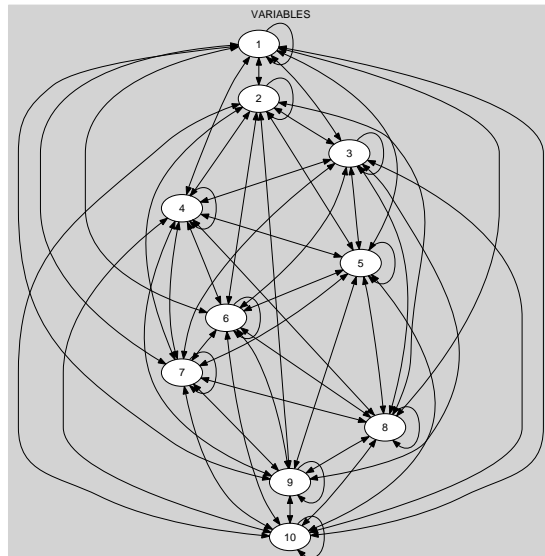
characteristic of a constraint: minimum, automaton, automaton with array of counters.

constraint type: value constraint, counting constraint.

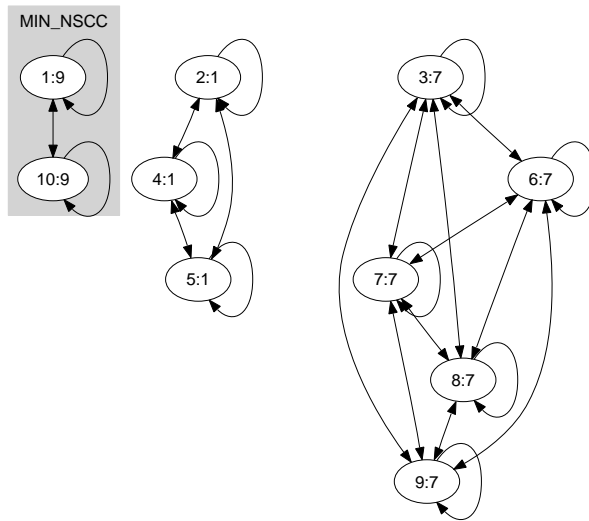
final graph structure: equivalence.

modelling: minimum number of occurrences.

Arc input(s)	VARIABLES
Arc generator	<i>CLIQUE</i> → <code>collection(variables1, variables2)</code>
Arc arity	2
Arc constraint(s)	<code>variables1.var = variables2.var</code>
Graph property(ies)	<u><i>MIN_NSCC</i></u> = MIN
Graph model	Parts (A) and (B) of Figure 5.413 respectively show the initial and final graph. Since we use the <i>MIN_NSCC</i> graph property, we show the smallest strongly connected component of the final graph associated with the Example slot.



(A)



MIN_NSCC=2

(B)

Figure 5.413: Initial and final graph of the min_nvalue constraint

Automaton

Figure 5.414 depicts the automaton associated with the `min_nvalue` constraint. To each item of the collection `VARIABLES` corresponds a signature variable S_i that is equal to 0.

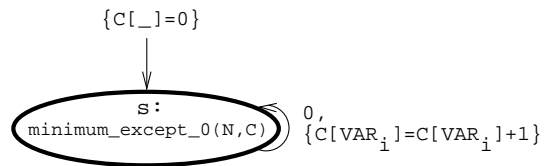


Figure 5.414: Automaton of the `min_nvalue` constraint

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