

5.148 group_skip_isolated_item

	DESCRIPTION	LINKS	GRAPH	AUTOMATON
Origin	Derived from <code>group</code> .			
Constraint	$\text{group_skip_isolated_item} \left(\begin{array}{l} \text{NGROUP,} \\ \text{MIN_SIZE,} \\ \text{MAX_SIZE,} \\ \text{NVAL,} \\ \text{VARIABLES,} \\ \text{VALUES} \end{array} \right)$			
Arguments	<pre> NGROUP : dvar MIN_SIZE : dvar MAX_SIZE : dvar NVAL : dvar VARIABLES : collection(var-dvar) VALUES : collection(val-int) </pre>			
Restrictions	<pre> NGROUP ≥ 0 MIN_SIZE ≥ 0 MAX_SIZE ≥ MIN_SIZE NVAL ≥ MAX_SIZE NVAL ≥ NGROUP NVAL ≤ VARIABLES required(VARIABLES, var) required(VALUES, val) distinct(VALUES, val) </pre>			
Purpose	<p>Let n be the number of variables of the collection <code>VARIABLES</code>. Let X_i, X_{i+1}, \dots, X_j ($1 \leq i < j \leq n$) be consecutive variables of the collection of variables <code>VARIABLES</code> such that the following conditions apply:</p> <ul style="list-style-type: none"> • All variables X_i, \dots, X_j take their value in the set of values <code>VALUES</code>, • $i = 1$ or X_{i-1} does not take a value in <code>VALUES</code>, • $j = n$ or X_{j+1} does not take a value in <code>VALUES</code>. <p>We call such a set of variables a <i>group</i>. The constraint <code>group_skip_isolated_item</code> is true if all the following conditions hold:</p> <ul style="list-style-type: none"> • There are exactly <code>NGROUP</code> groups of variables, • The number of variables of the smallest group is <code>MIN_SIZE</code>, • The number of variables of the largest group is <code>MAX_SIZE</code>, • The number of variables that take their value in the set of values <code>VALUES</code> is equal to <code>NVAL</code>. 			

Example

$$\left(\begin{array}{c} \text{var} - 2, \\ \text{var} - 8, \\ \text{var} - 1, \\ 1, 2, 2, 3, \left\langle \begin{array}{c} \text{var} - 7, \\ \text{var} - 4, \\ \text{var} - 5, \\ \text{var} - 1, \\ \text{var} - 1, \\ \text{var} - 1 \end{array} \right\rangle, \\ \langle 0, 2, 4, 6, 8 \rangle \end{array} \right)$$

Given the fact that groups are formed by even values in $\{0, 2, 4, 6, 8\}$ (i.e., values expressed by the `VALUES` collection), and the fact that isolated even values are ignored, the `group_skip_isolated_item` constraint holds since:

- Its first argument, `NGROUP`, is set to value 1 since the sequence 2 8 1 7 4 5 1 1 1 contains only one group of even values involving more than one even value (i.e., group 2 8).
- Its second and third arguments, `MIN_SIZE` and `MAX_SIZE`, are both set to 2 since the only group of even values with more than one even value involves two values (i.e., group 2 8).
- The fourth argument, `NVAL`, is fixed to 2 since it corresponds to the total number of even values belonging to groups involving more than one even value (i.e., value 4 is discarded since it is an isolated even value of the sequence 2 8 1 7 4 5 1 1 1).

Typical

```
NGROUP > 0
MIN_SIZE > 0
NVAL > MAX_SIZE
NVAL > NGROUP
NVAL < |VARIABLES|
|VARIABLES| > 1
range(VARIABLES.var) > 1
|VALUES| > 0
|VARIABLES| > |VALUES|
```

Symmetries

- Items of `VARIABLES` can be [reversed](#).
- Items of `VALUES` are [permutable](#).
- An occurrence of a value of `VARIABLES.var` that belongs to `VALUES.val` (resp. does not belong to `VALUES.val`) can be [replaced](#) by any other value in `VALUES.val` (resp. not in `VALUES.val`).

Usage

This constraint is useful in order to specify rules about how rest days should be allocated to a person during a period of n consecutive days. In this case `VALUES` are the codes for the rest days (perhaps one single value) and `VARIABLES` corresponds to the amount of work done during n consecutive days. We can then express a rule like: in a month one should have at least 4 periods of at least 2 rest days (isolated rest days are not counted as rest periods).

See also

common keyword: [change_continuity](#), [group](#),
[stretch_path](#) (*timetabling constraint, sequence*).

used in graph description: in.

Keywords

characteristic of a constraint: automaton, automaton with counters.

combinatorial object: sequence.

constraint network structure: [alpha-acyclic constraint network\(2\)](#),
[alpha-acyclic constraint network\(3\)](#).

constraint type: timetabling constraint.

final graph structure: strongly connected component.

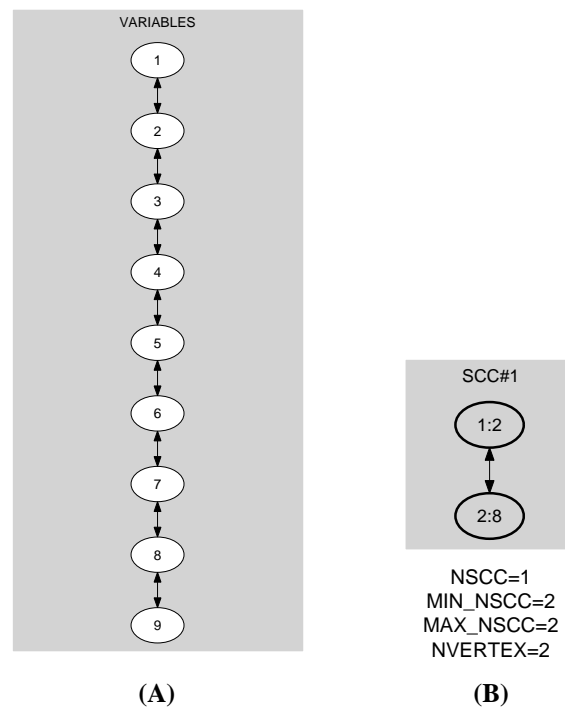
miscellaneous: obscure.

Arc input(s)	VARIABLES
Arc generator	<i>CHAIN</i> \mapsto <code>collection(variables1, variables2)</code>
Arc arity	2
Arc constraint(s)	<ul style="list-style-type: none"> • <code>in(variables1.var, VALUES)</code> • <code>in(variables2.var, VALUES)</code>
Graph property(ies)	<ul style="list-style-type: none"> • <code>NSCC</code> = NGROUP • <code>MIN_NSICC</code> = MIN_SIZE • <code>MAX_NSICC</code> = MAX_SIZE • <code>NVERTEX</code> = NVAL

Graph model

We use the *CHAIN* arc generator in order to produce the initial graph. In the context of the **Example** slot, this creates the graph depicted in part (A) of Figure 5.294. We use *CHAIN* together with the arc constraint `variables1.var ∈ VALUES ∧ variables2.var ∈ VALUES` in order to skip the isolated variables that take a value in `VALUES` that we do not want to count as a group. This is why, on the example, value 4 is not counted as a group. Part (B) of Figure 5.294 shows the final graph associated with the **Example** slot. The `group_skip_isolated_item` constraint of the **Example** slot holds since:

- The final graph contains one strongly connected component. Therefore the number of groups is equal to one.
- The unique strongly connected component of the final graph contains two vertices. Therefore `MIN_SIZE` and `MAX_SIZE` are both equal to 2.
- The number of vertices of the final graph is equal to two. Therefore `NVAL` is equal to 2.

Figure 5.294: Initial and final graph of the `group_skip_isolated_item` constraint

Automaton

Figures 5.295, 5.297, 5.298 and 5.300 depict the different automata associated with the `group_skip_isolated_item` constraint. For the automata that respectively compute `NGROUP`, `MIN_SIZE`, `MAX_SIZE` and `NVAL` we have a 0-1 signature variable S_i for each variable VAR_i of the collection `VARIABLES`. The following signature constraint links VAR_i and S_i : $VAR_i \in \text{VALUES} \Leftrightarrow S_i$.

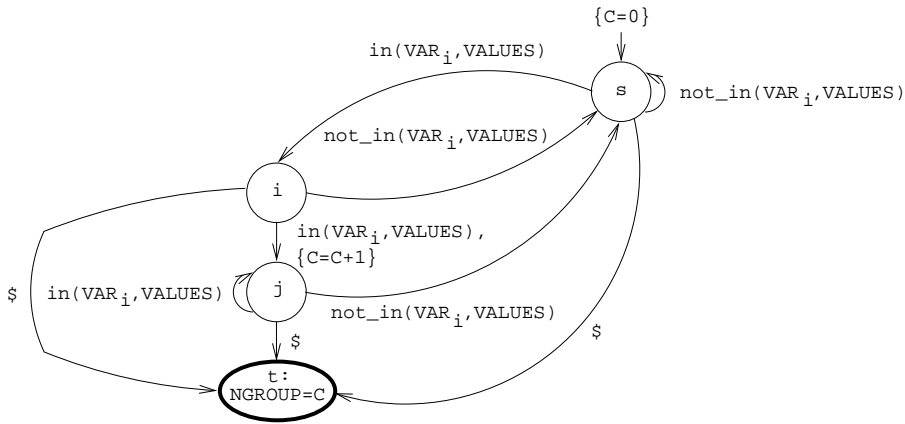


Figure 5.295: Automaton for the `NGROUP` parameter of the `group_skip_isolated_item` constraint

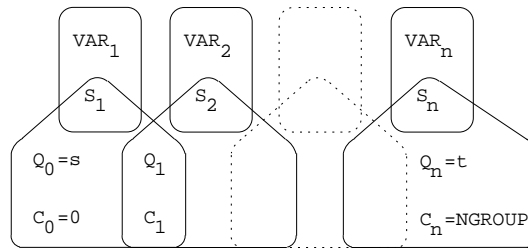


Figure 5.296: Hypergraph of the reformulation corresponding to the automaton of the `NGROUP` parameter of the `group_skip_isolated_item` constraint

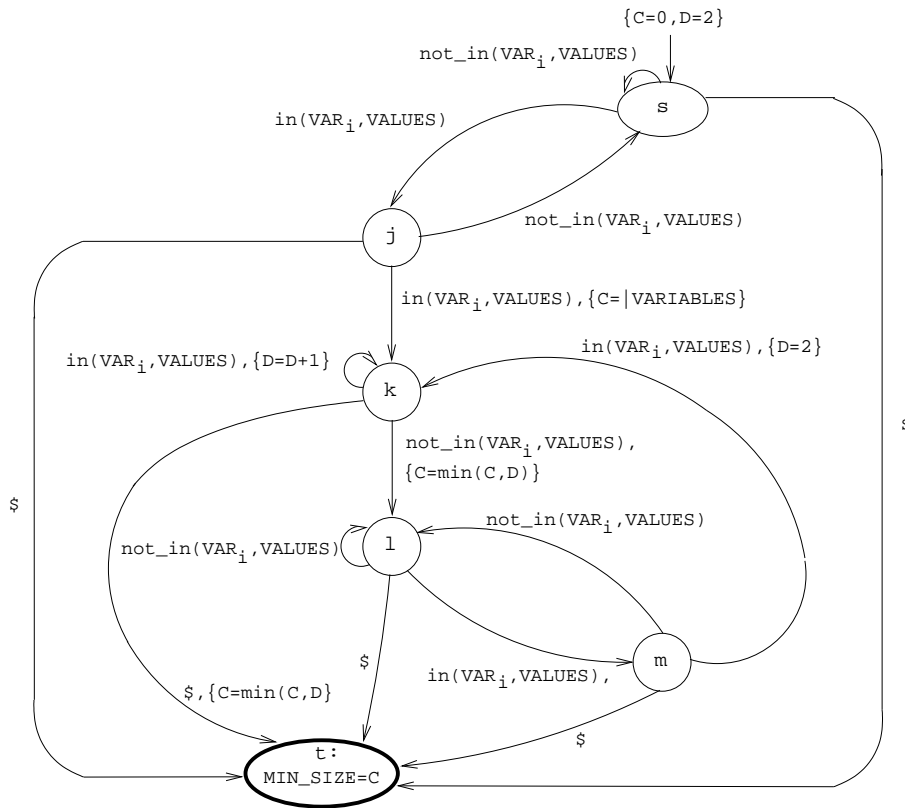


Figure 5.297: Automaton for the MIN_SIZE parameter of the group_skip_isolated_item constraint

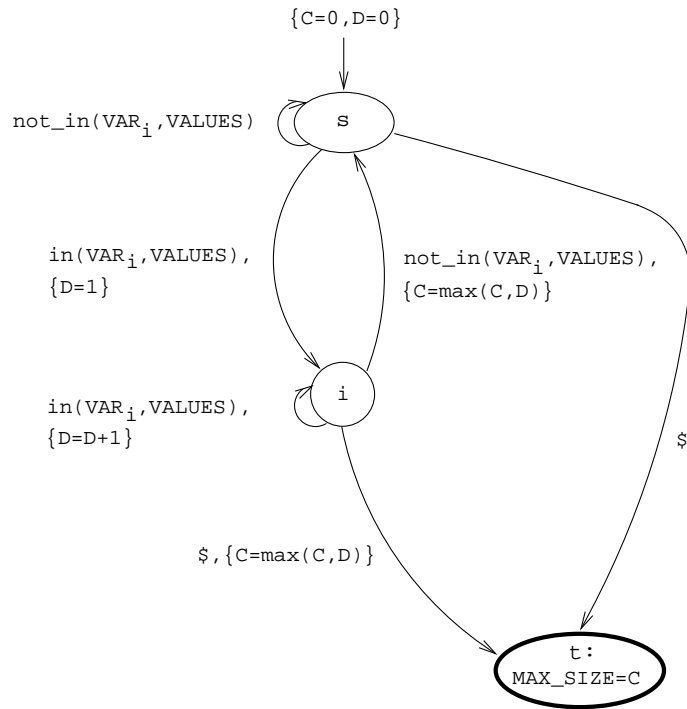


Figure 5.298: Automaton for the MAX_SIZE parameter of the group_skip_isolated_item constraint

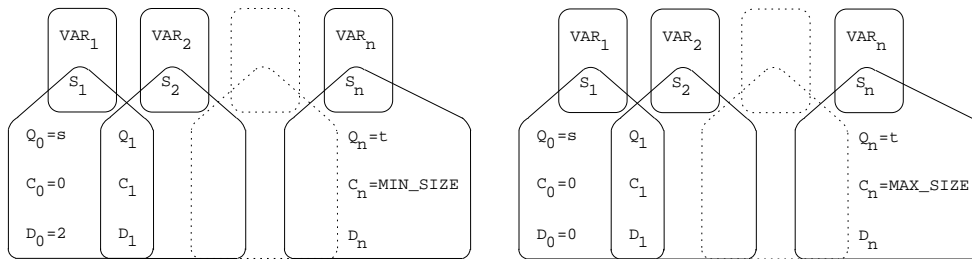


Figure 5.299: Hypergraphs of the reformulations corresponding to the automata of the MIN_SIZE and MAX_SIZE parameters of the group_skip_isolated_item constraint

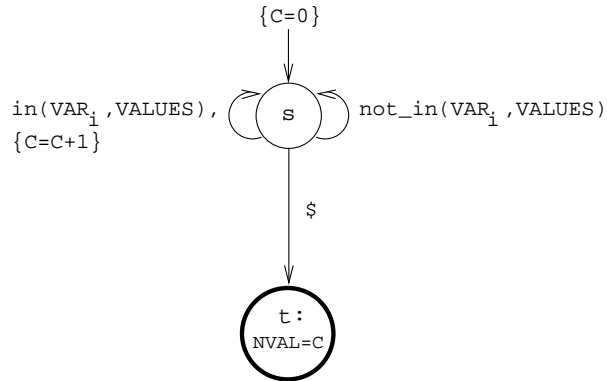


Figure 5.300: Automaton for the NVAL parameter of the group_skip_isolated_item constraint

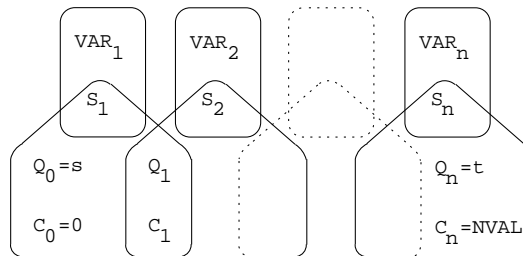


Figure 5.301: Hypergraph of the reformulation corresponding to the automaton of the NVAL parameter of the group_skip_isolated_item constraint

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