

## 5.25 arith\_or

|                     | DESCRIPTION   | LINKS | GRAPH | AUTOMATON |
|---------------------|---|-------|-------|-----------|
| <b>Origin</b>       | Used in the definition of several automata  |       |       |           |
| <b>Constraint</b>   | <code>arith_or(VARIABLES1, VARIABLES2, RELOP, VALUE)</code>   |       |       |           |
| <b>Arguments</b>    | VARIABLES1 : <code>collection</code> (var-dvar)<br>VARIABLES2 : <code>collection</code> (var-dvar)<br>RELOP : <code>atom</code><br>VALUE : <code>int</code>   |       |       |           |
| <b>Restrictions</b> | <code>required</code> (VARIABLES1, var)<br><code>required</code> (VARIABLES2, var)<br>$ VARIABLES1  =  VARIABLES2 $<br>$RELOP \in [=, \neq, <, \geq, >, \leq]$  |       |       |           |
| <b>Purpose</b>      | Enforce for all pairs of variables $var1_i, var2_i$ of the VARIABLES1 and VARIABLES2 collections to have $var1_i \text{ RELOP VALUE} \vee var2_i \text{ RELOP VALUE}$ .   |       |       |           |
| <b>Example</b>      | $\left( \begin{array}{l} \langle 0, 1, 0, 0, 1 \rangle, \\ \langle 0, 0, 0, 1, 0 \rangle, =, 0 \end{array} \right)$ <p>The constraint <code>arith_or</code> holds since, for all pairs of variables <math>var1_i, var2_i</math> of the VARIABLES1 and VARIABLES2 collections, there is at least one variable that is equal to 0.</p>  |       |       |           |
| <b>Typical</b>      | $ VARIABLES1  > 0$  |       |       |           |
| <b>Symmetry</b>     | Items of VARIABLES1 and VARIABLES2 are <code>permutable</code> ( <i>same permutation used</i> ).  |       |       |           |
| <b>See also</b>     | <b>specialisation:</b> <code>arith</code> (variable RELOP VALUE $\vee$ variable RELOP VALUE <i>replaced by</i> variable RELOP VALUE).   |       |       |           |
| <b>Keywords</b>     | <b>characteristic of a constraint:</b> automaton, automaton without counters, reified automaton constraint.<br><b>constraint network structure:</b> Berge-acyclic constraint network.<br><b>constraint type:</b> decomposition, value constraint.<br><b>filtering:</b> arc-consistency.<br><b>final graph structure:</b> acyclic, bipartite, no loop.<br><b>modelling:</b> disjunction. |       |       |           |

|                            |  |
|----------------------------|--|
| <b>Arc input(s)</b>        | VARIABLES1 VARIABLES2  |
| <b>Arc generator</b>       | <i>PRODUCT</i> (=) $\mapsto$ <i>collection</i> (variables1, variables2)  |
| <b>Arc arity</b>           | 2  |
| <b>Arc constraint(s)</b>   | variables1.var RELOP VALUE $\vee$ variables2.var RELOP VALUE   |
| <b>Graph property(ies)</b> | <b>NARC</b> =  VARIABLES1  |
| <b>Graph class</b>         | <ul style="list-style-type: none"> <li>• <b>ACYCLIC</b></li> <li>• <b>BIPARTITE</b></li> <li>• <b>NO_LOOP</b></li> </ul> |

**Graph model**

Parts (A) and (B) of Figure 5.45 respectively show the initial and final graphs associated with the **Example** slot. Since we use the **NARC** graph property, the arcs of the final graph are stressed in bold.

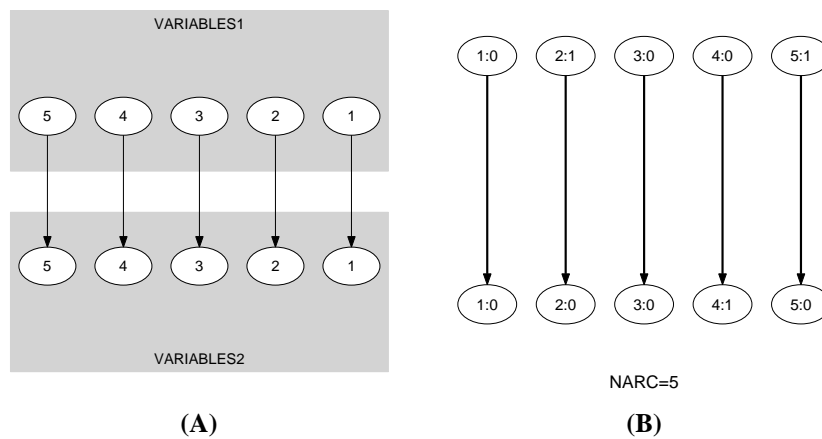
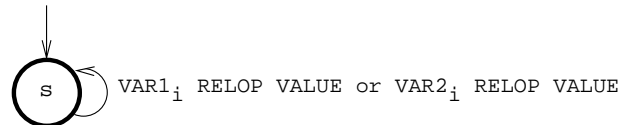
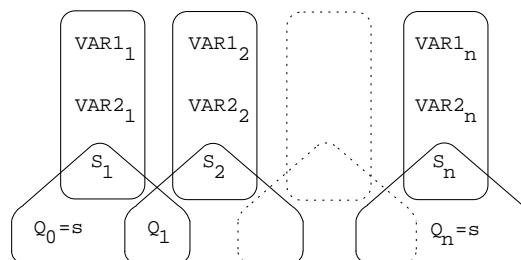


Figure 5.45: Initial and final graph of the **arith\_or** constraint

**Automaton**

Figure 5.46 depicts the automaton associated with the `arith_or` constraint. Let  $VAR1_i$  and  $VAR2_i$  be the  $i^{th}$  variables of the `VARIABLES1` and `VARIABLES2` collections. To each pair of variables  $(VAR1_i, VAR2_i)$  corresponds a signature variable  $S_i$ . The following signature constraint links  $VAR1_i$ ,  $VAR2_i$  and  $S_i$ :  $VAR1_i \text{ RELOP VALUE} \vee VAR2_i \text{ RELOP VALUE} \Leftrightarrow S_i$ . The automaton enforces for each pair of variables  $VAR1_i, VAR2_i$  the condition  $VAR1_i \text{ RELOP VALUE} \vee VAR2_i \text{ RELOP VALUE}$ .

Figure 5.46: Automaton of the `arith_or` constraintFigure 5.47: Hypergraph of the reformulation corresponding to the automaton of the `arith_or` constraint

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