

5.37 balance_interval

	DESCRIPTION	LINKS	GRAPH	AUTOMATON
Origin	Derived from <code>balance</code> .			
Constraint	<code>balance_interval(BALANCE, VARIABLES, SIZE_INTERVAL)</code>			
Arguments	<pre> BALANCE : dvar VARIABLES : collection(var-dvar) SIZE_INTERVAL : int </pre>			
Restrictions	<pre> BALANCE ≥ 0 BALANCE ≤ max(0, VARIABLES - 2) required(VARIABLES, var) SIZE_INTERVAL > 0 </pre>			
Purpose	<p>Consider the largest set \mathcal{S}_1 (respectively the smallest set \mathcal{S}_2) of variables of the collection <code>VARIABLES</code> that take their value in a same interval $[\text{SIZE_INTERVAL} \cdot k, \text{SIZE_INTERVAL} \cdot k + \text{SIZE_INTERVAL} - 1]$, where k is an integer. <code>BALANCE</code> is equal to the difference between the cardinality of \mathcal{S}_2 and the cardinality of \mathcal{S}_1.</p>			
Example	<pre>(3, (6, 4, 3, 3, 4), 3)</pre> <p>In the example, the third argument <code>SIZE_INTERVAL = 3</code> defines the following family of intervals $[3 \cdot k, 3 \cdot k + 2]$, where k is an integer. Values 6,4,3,3 and 4 are respectively located within intervals $[6, 8]$, $[3, 5]$, $[3, 5]$, $[3, 5]$ and $[3, 5]$. Therefore intervals $[6, 8]$ and $[3, 5]$ are respectively used 1 and 4 times. The <code>balance_interval</code> constraint holds since its first argument <code>BALANCE</code> is assigned to the difference between the maximum and minimum number of the previous occurrences (i.e., $4 - 1$).</p>			
Typical	<pre> VARIABLES > 2 SIZE_INTERVAL > 1 </pre>			
Symmetries	<ul style="list-style-type: none"> Items of <code>VARIABLES</code> are <i>permutable</i>. An occurrence of a value of <code>VARIABLES.var</code> that belongs to the k-th interval, of size <code>SIZE_INTERVAL</code>, can be <i>replaced</i> by any other value of the same interval. 			
Usage	An application of the <code>balance_interval</code> constraint is to enforce a <i>balanced assignment</i> of interval of values, no matter how many distinct interval of values will be used. In this case one will <i>push down</i> the maximum value of the first argument of the <code>balance_interval</code> constraint.			
See also	specialisation: <code>balance</code> (variable/constant replaced by variable).			

Keywords

application area: assignment.

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

constraint type: value constraint.

final graph structure: equivalence.

modelling: interval, balanced assignment.

Arc input(s)	VARIABLES
Arc generator	<i>CLIQUE</i> \mapsto collection(variables1, variables2)
Arc arity	2
Arc constraint(s)	variables1.var/SIZE_INTERVAL = variables2.var/SIZE_INTERVAL
Graph property(ies)	RANGE_NSCC = BALANCE
Graph class	EQUIVALENCE

Graph model

The graph property **RANGE_NSCC** constrains the difference between the sizes of the largest and smallest strongly connected components.

Parts (A) and (B) of Figure 5.68 respectively show the initial and final graph associated with the **Example** slot. Since we use the **RANGE_NSCC** graph property, we show the largest and smallest strongly connected components of the final graph.

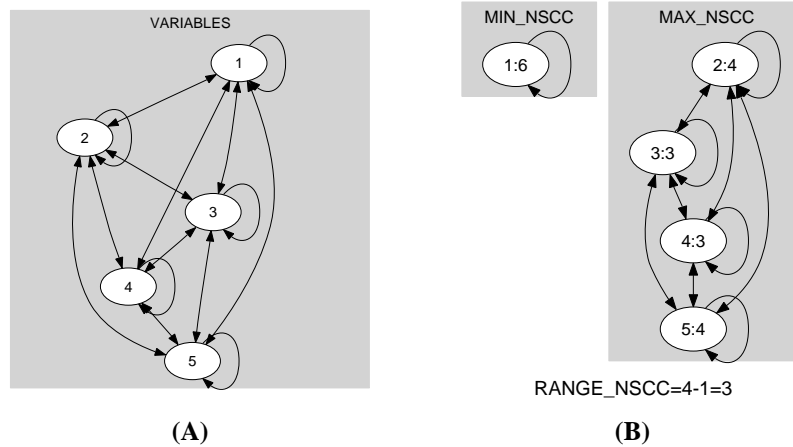


Figure 5.68: Initial and final graph of the `balance_interval` constraint

Automaton

Figure 5.69 depicts the automaton associated with the `balance_interval` constraint. To each item of the collection `VARIABLES` corresponds a signature variable S_i that is equal to 1.

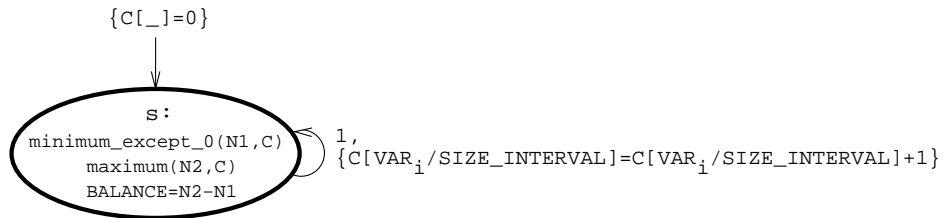


Figure 5.69: Automaton of the `balance_interval` constraint