

5.265 minimum_modulo

	DESCRIPTION	LINKS	GRAPH
Origin	Derived from minimum .		
Constraint	<code>minimum_modulo(MIN, VARIABLES, M)</code>		
Arguments	<pre> MIN : dvar VARIABLES : collection(var-dvar) M : int </pre>		
Restrictions	<pre> VARIABLES > 0 M > 0 required(VARIABLES, var) </pre>		
Purpose	<div style="border: 1px solid pink; padding: 5px;"> <p>MIN is a minimum value of the collection of domain variables VARIABLES according to the following partial ordering: $(X \bmod M) < (Y \bmod M)$.</p> </div>		
Example	<div style="border: 1px solid blue; padding: 5px; margin-bottom: 10px;"> <pre> (6, (9, 1, 7, 6, 5), 3) (9, (9, 1, 7, 6, 5), 3) </pre> </div> <p>The <code>minimum_modulo</code> constraints hold since MIN is respectively set to values 6 and 9, where $6 \bmod 3 = 0$ and $9 \bmod 3 = 0$ are both less than or equal to all the expressions $9 \bmod 3 = 0$, $1 \bmod 3 = 1$, $7 \bmod 3 = 1$, $6 \bmod 3 = 0$, and $5 \bmod 3 = 2$.</p>		
Typical	<pre> VARIABLES > 1 range(VARIABLES.var) > 1 M > 1 M < maxval(VARIABLES.var) </pre>		
Symmetry	Items of VARIABLES are permutable .		
Arg. properties	Functional dependency : MIN determined by VARIABLES and M.		
See also	comparison swapped : <code>maximum_modulo</code> . specialisation : <code>minimum</code> (variable mod constant replaced by variable).		
Keywords	<p>characteristic of a constraint: modulo, maxint, minimum.</p> <p>constraint arguments: pure functional dependency.</p> <p>constraint type: order constraint.</p> <p>modelling: functional dependency.</p>		

Arc input(s)	VARIABLES
Arc generator	$CLIQUE \mapsto collection(variables1, variables2)$
Arc arity	2
Arc constraint(s)	$\bigvee \left(\begin{array}{l} variables1.key = variables2.key, \\ variables1.var \bmod M < variables2.var \bmod M \end{array} \right)$
Graph property(ies)	$ORDER(0, MAXINT, var) = MIN$

Graph model

We use a similar definition that the one that was utilised for the `minimum` constraint. Within the arc constraint we replace the condition $X < Y$ by the condition $(X \bmod M) < (Y \bmod M)$.

Parts (A) and (B) of Figure 5.568 respectively show the initial and final graph associated with the second example of the **Example** slot. Since we use the **ORDER** graph property, the vertex of rank 0 (without considering the loops) associated with value 9 is outlined with a thick circle.

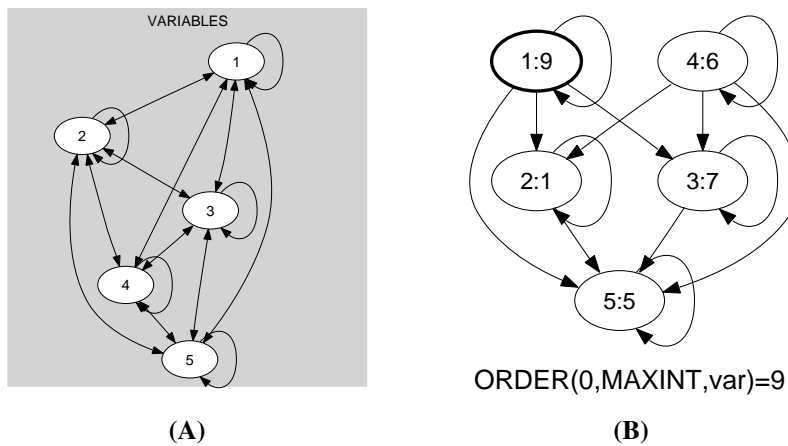


Figure 5.568: Initial and final graph of the `minimum_modulo` constraint