

5.32 atmost

	DESCRIPTION	LINKS	GRAPH	AUTOMATON
Origin	CHIP			
Constraint	<code>atmost(N, VARIABLES, VALUE)</code>			
Synonym	count.			
Arguments	N : <code>int</code> VARIABLES : <code>collection(var-dvar)</code> VALUE : <code>int</code>			
Restrictions	$N \geq 0$ <code>required(VARIABLES, var)</code>			
Purpose	At most N variables of the VARIABLES collection are assigned value VALUE.			
Example	$(1, \langle 4, 2, 4, 5 \rangle, 2)$ The <code>atmost</code> constraint holds since at most 1 value of the collection $\langle 4, 2, 4, 5 \rangle$ is equal to value 2.			
Typical	$N > 0$ $N < VARIABLES $ $ VARIABLES > 1$			
Symmetries	<ul style="list-style-type: none"> Items of VARIABLES are <code>permutable</code>. N can be <code>increased</code>. An occurrence of a value of VARIABLES.var can be <code>replaced</code> by any other value that is different from VALUE. 			
Systems	<code>occurrenceMax</code> in Choco , <code>count</code> in Gecode , <code>count</code> in JaCoP , <code>count</code> in SICStus .			
See also	common keyword: <code>among</code> (<i>value constraint</i>). comparison swapped: <code>atleast</code> . generalisation: <code>cumulative</code> (<i>variable replaced by task</i>). implied by: <code>exactly</code> ($\leq N$ replaced by $=N$). related: <code>roots</code> . soft variant: <code>open_atmost</code> (<i>open constraint</i>).			
Keywords	characteristic of a constraint: <code>automaton</code> , <code>automaton with counters</code> . constraint network structure: <code>alpha-acyclic constraint network(2)</code> . constraint type: <code>value constraint</code> . filtering: <code>arc-consistency</code> . modelling: <code>at most</code> .			

Arc input(s)	VARIABLES
Arc generator	<i>SELF</i> \mapsto collection(variables)
Arc arity	1
Arc constraint(s)	variables.var = VALUE
Graph property(ies)	NARC \leq N

Graph model

Since each arc constraint involves only one vertex (VALUE is fixed), we employ the *SELF* arc generator in order to produce a graph with a single loop on each vertex.

Parts (A) and (B) of Figure 5.60 respectively show the initial and final graph associated with the **Example** slot. Since we use the **NARC** graph property, the loops of the final graph are stressed in bold.

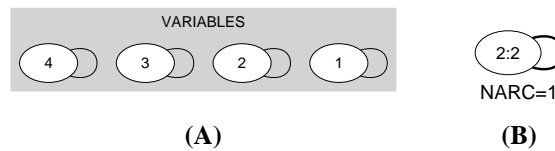


Figure 5.60: Initial and final graph of the atmost constraint

Automaton

Figure 5.61 depicts the automaton associated with the atmost constraint. To each variable VAR_i of the collection VARIABLES corresponds a 0-1 signature variable S_i . The following signature constraint links VAR_i and S_i : $VAR_i = VALUE \Leftrightarrow S_i$. The automaton counts the number of variables of the VARIABLES collection that are assigned value VALUE and finally checks that this number is less than or equal to N.

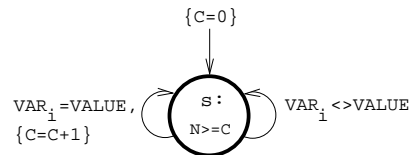


Figure 5.61: Automaton of the atmost constraint

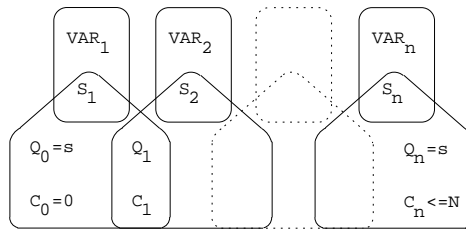


Figure 5.62: Hypergraph of the reformulation corresponding to the automaton of the atmost constraint

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