

5.148 `elements_sparse`

	DESCRIPTION	LINKS	GRAPH
Origin	Derived from <code>element_sparse</code> .		
Constraint	<code>elements_sparse</code> (ITEMS, TABLE, DEFAULT)		
Arguments	ITEMS : <code>collection</code> (index-dvar, value-dvar) TABLE : <code>collection</code> (index-int, value-int) DEFAULT : <code>int</code>		
Restrictions	<code>required</code> (ITEMS, [index, value]) ITEMS.index ≥ 1 <code>required</code> (TABLE, [index, value]) TABLE.index ≥ 1 <code>distinct</code> (TABLE, index)		
Purpose	All the items of ITEMS should be equal to one of the entries of the table TABLE or to the default value DEFAULT if the entry ITEMS.index does not occurs among the values of the index attribute of the TABLE collection.		
Example	$\left(\begin{array}{l} \left\langle \begin{array}{ll} \text{index} - 8 & \text{value} - 9, \\ \text{index} - 3 & \text{value} - 5, \\ \text{index} - 2 & \text{value} - 5 \end{array} \right\rangle, \\ \begin{array}{ll} \text{index} - 1 & \text{value} - 6, \\ \left\langle \begin{array}{ll} \text{index} - 2 & \text{value} - 5, \\ \text{index} - 4 & \text{value} - 2, \\ \text{index} - 8 & \text{value} - 9 \end{array} \right\rangle, 5 \end{array} \end{array} \right)$		
	The <code>elements_sparse</code> constraint holds since:		
	<ul style="list-style-type: none">• The first and third items (items $\langle \text{index} - 8 \text{ value} - 9 \rangle$ and $\langle \text{index} - 2 \text{ value} - 5 \rangle$) of its ITEMS collection respectively correspond to the fourth and second item of its TABLE collection.• The index attribute of the second item of its ITEMS collection (i.e., value 3) does not correspond to any index of the TABLE collection. Therefore the value attribute of the second item of the ITEMS collection is set the the default value 5 given by the last argument of the <code>elements_sparse</code> constraint.		
Typical	<code> ITEMS > 1</code> <code>range</code> (ITEMS.value) > 1 <code> TABLE > 1</code> <code>range</code> (TABLE.value) > 1		

Symmetries

- Items of ITEMS are [permutable](#).
- Items of TABLE are [permutable](#).
- All occurrences of two distinct values in ITEMS.value, TABLE.value or DEFAULT can be [swapped](#); all occurrences of a value in ITEMS.value, TABLE.value or DEFAULT can be [renamed](#) to any unused value.

Usage

Used for replacing several [element](#) constraints sharing exactly the same sparse table by a single constraint.

Reformulation

Let I_k and V_k respectively denote $\text{ITEMS}[k].\text{index}$ and $\text{ITEMS}[k].\text{value}$ ($k \in [1, |\text{ITEMS}|]$). The `elements_sparse`(ITEMS, TABLE, DEFAULT) constraint can be expressed in term of $|\text{ITEMS}|$ reified constraints of the form:

$$\begin{aligned} & ((I_k = \text{TABLE}[1].\text{index} \wedge V_k = \text{TABLE}[1].\text{value}) \vee \\ & (I_k = \text{TABLE}[2].\text{index} \wedge V_k = \text{TABLE}[2].\text{value}) \vee \\ & \dots \\ & (I_k = \text{TABLE}[|\text{TABLE}|].\text{index} \wedge V_k = \text{TABLE}[|\text{TABLE}|].\text{value})) \vee \\ & ((I_k \neq \text{TABLE}[1].\text{index}) \wedge \\ & (I_k \neq \text{TABLE}[2].\text{index}) \wedge \\ & \dots \\ & (I_k \neq \text{TABLE}[|\text{TABLE}|].\text{index}) \wedge \\ & (V_k = \text{DEFAULT})). \end{aligned}$$
See also

common keyword: [elem](#), [element](#) (*data constraint*), [element_sparse](#) (*sparse table*).

implied by: [element_sparse](#).

part of system of constraints: [element_sparse](#).

Keywords

characteristic of a constraint: [derived collection](#).

constraint type: [data constraint](#), [system of constraints](#).

filtering: [arc-consistency](#).

modelling: [table](#), [shared table](#), [sparse table](#), [sparse functional dependency](#).

Derived Collections

```

col ( DEF-collection(index-int, value-int), )
  [item(index - 0, value - DEFAULT)]
col ( TABLE_DEF-collection(index-dvar, value-dvar),
      [ item(index - TABLE.index, value - TABLE.index),
        item(index - DEF.index, value - DEF.value) ] )

```

Arc input(s)

ITEMS TABLE_DEF

Arc generator*PRODUCT* \mapsto collection(items, table_def)**Arc arity**

2

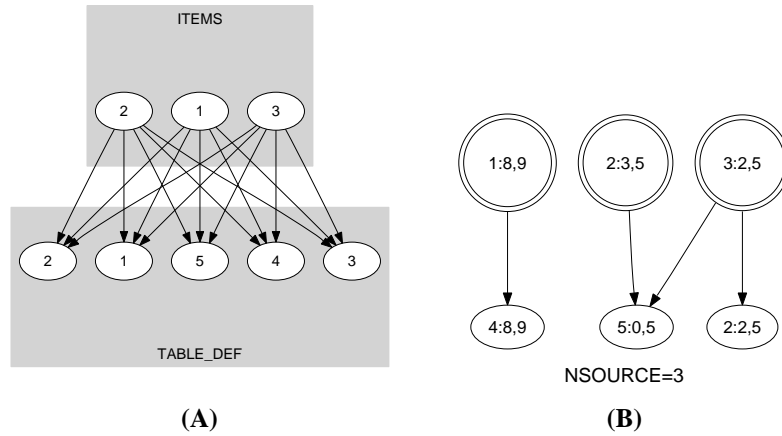
Arc constraint(s)

- items.value = table_def.value
- items.index = table_def.index \vee table_def.index = 0

Graph property(ies)NSOURCE = |ITEMS|**Graph model**

An item of the ITEMS collection may have up to two successors (see for instance the third item of the ITEMS collection of the **Example** slot). Therefore we use the graph property **NSOURCE** = |ITEMS| for enforcing the fact that each item of the ITEMS collection has at least one successor.

Parts (A) and (B) of Figure 5.341 respectively show the initial and final graph associated with the **Example** slot. Since we use the **NSOURCE** graph property, the vertices of the final graph are drawn with a double circle.

Figure 5.341: Initial and final graph of the `elements_sparse` constraint**Signature**

On the one hand note that ITEMS is equal to the number of sources of the initial graph. On the other hand note that, in the initial graph, all the vertices that are not sources correspond to sinks. Since isolated vertices are eliminated from the final graph the sinks of the initial graph cannot become sources of the final graph. Therefore the maximum number of sources of the final graph is equal to ITEMS. We can rewrite **NSOURCE** = |ITEMS| to **NSOURCE** \geq |ITEMS| and simplify NSOURCE to **NSOURCE**.

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