

## 5.79 coveredby\_sboxes

	DESCRIPTION	LINKS	LOGIC
<b>Origin</b>	Geometry, derived from [305]		
<b>Constraint</b>	<code>coveredby_sboxes(K, DIMS, OBJECTS, SBOXES)</code>		
<b>Synonym</b>	<code>coveredby.</code>		
<b>Types</b>	VARIABLES : <code>collection(v-dvar)</code> INTEGERS : <code>collection(v-int)</code> POSITIVES : <code>collection(v-int)</code>		
<b>Arguments</b>	K : <code>int</code> DIMS : <code>sint</code> OBJECTS : <code>collection(oid-int, sid-int, x - VARIABLES)</code> SBOXES : <code>collection(sid-int, t - INTEGERS, l - POSITIVES)</code>		
<b>Restrictions</b>	<code>required(VARIABLES, v)</code> <code> VARIABLES  = K</code> <code>required(INTEGERS, v)</code> <code> INTEGERS  = K</code> <code>required(POSITIVES, v)</code> <code> POSITIVES  = K</code> <code>POSITIVES.v &gt; 0</code> <code>K &gt; 0</code> <code>DIMS ≥ 0</code> <code>DIMS &lt; K</code> <code>required(OBJECTS, [oid, sid, x])</code> <code>OBJECTS.oid ≥ 1</code> <code>OBJECTS.oid ≤  OBJECTS </code> <code>OBJECTS.sid ≥ 1</code> <code>OBJECTS.sid ≤  SBOXES </code> <code>required(SBOXES, [sid, t, l])</code> <code>SBOXES.sid ≥ 1</code> <code>SBOXES.sid ≤  SBOXES </code>		

**Purpose**

Holds if, for each pair of objects  $(O_i, O_j)$ ,  $i < j$ ,  $O_i$  is covered by  $O_j$  with respect to a set of dimensions depicted by DIMS.  $O_i$  and  $O_j$  are objects that take a shape among a set of shapes. Each *shape* is defined as a finite set of shifted boxes, where each shifted box is described by a box in a K-dimensional space at a given offset (from the origin of the shape) with given sizes. More precisely, a *shifted box* is an entity defined by its shape id sid, shift offset  $\tau$ , and sizes  $l$ . Then, a shape is defined as the union of shifted boxes sharing the same shape id. An *object* is an entity defined by its unique object identifier oid, shape id sid and origin  $x$ .

An object  $O_i$  is covered by an object  $O_j$  with respect to a set of dimensions depicted by DIMS if and only if, for all shifted box  $s_i$  of  $O_i$ , there exists a shifted box  $s_j$  of  $O_j$  such that:

- For all dimensions  $d \in \text{DIMS}$ , (1) the start of  $s_j$  in dimension  $d$  is less than or equal to the start of  $s_i$  in dimension  $d$ , and (2) the end of  $s_i$  in dimension  $d$  is less than or equal to the end of  $s_j$  in dimension  $d$ .
- There exists a dimension  $d$  where, (1) the start of  $s_j$  in dimension  $d$  coincide with the start of  $s_i$  in dimension  $d$ , or (2) the end of  $s_j$  in dimension  $d$  coincide with the end of  $s_i$  in dimension  $d$ .

**Example**

$$\left( \begin{array}{l} 2, \{0, 1\}, \\ \left\langle \begin{array}{l} \text{oid} - 1 \quad \text{sid} - 4 \quad x - \langle 2, 3 \rangle, \\ \text{oid} - 2 \quad \text{sid} - 2 \quad x - \langle 2, 2 \rangle, \\ \text{oid} - 3 \quad \text{sid} - 1 \quad x - \langle 1, 1 \rangle \end{array} \right\rangle, \\ \text{sid} - 1 \quad \tau - \langle 0, 0 \rangle \quad l - \langle 3, 3 \rangle, \\ \text{sid} - 1 \quad \tau - \langle 3, 0 \rangle \quad l - \langle 2, 2 \rangle, \\ \left\langle \begin{array}{l} \text{sid} - 2 \quad \tau - \langle 0, 0 \rangle \quad l - \langle 2, 2 \rangle, \\ \text{sid} - 2 \quad \tau - \langle 2, 0 \rangle \quad l - \langle 1, 1 \rangle, \\ \text{sid} - 3 \quad \tau - \langle 0, 0 \rangle \quad l - \langle 2, 2 \rangle, \\ \text{sid} - 3 \quad \tau - \langle 2, 1 \rangle \quad l - \langle 1, 1 \rangle, \\ \text{sid} - 4 \quad \tau - \langle 0, 0 \rangle \quad l - \langle 1, 1 \rangle \end{array} \right\rangle \end{array} \right)$$

Figure 5.161 shows the objects of the example. Since  $O_1$  is covered by both  $O_2$  and  $O_3$ , and since  $O_2$  is covered by  $O_3$ , the `coveredby_sboxes` constraint holds.

**Typical**

`|OBJECTS| > 1`

**Symmetries**

- Items of SBOXES are [permutable](#).
- Items of OBJECTS.x, SBOXES. $\tau$  and SBOXES.l are [permutable](#) (*same permutation used*).

**Remark**

One of the eight relations of the [Region Connection Calculus](#) [305]. The constraint `coveredby_sboxes` is a restriction of the original relation since it requires that each shifted box of an object is covered by one shifted box of the other object.

**See also**

**common keyword:** [contains\\_sboxes](#), [covers\\_sboxes](#), [disjoint\\_sboxes](#), [equal\\_sboxes](#), [inside\\_sboxes](#), [meet\\_sboxes](#) (*rcc8*), [non\\_overlap\\_sboxes](#) (*geometrical constraint, logic*), [overlap\\_sboxes](#) (*rcc8*).

**Keywords**

**constraint type:** logic.

**geometry:** geometrical constraint, rcc8.

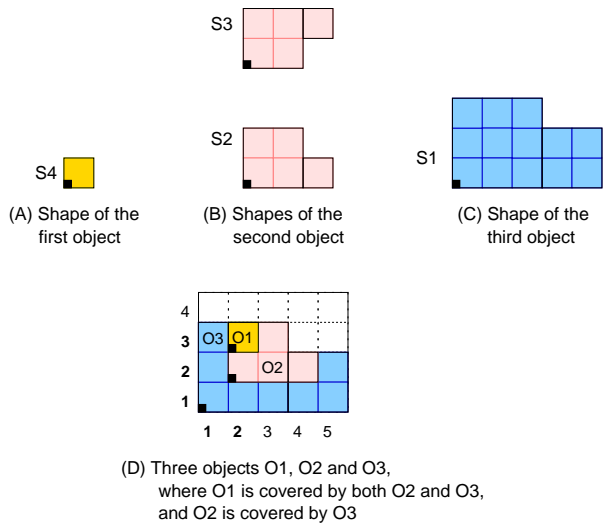


Figure 5.161: The three objects of the example

## Logic

- $\text{origin}(O1, S1, D) \stackrel{\text{def}}{=} O1.x(D) + S1.t(D)$
- $\text{end}(O1, S1, D) \stackrel{\text{def}}{=} O1.x(D) + S1.t(D) + S1.l(D)$
- $\text{coveredby\_sboxes}(\text{Dims}, O1, S1, O2, S2) \stackrel{\text{def}}{=} \left( \begin{array}{l} \forall D \in \text{Dims} \\ \left( \begin{array}{l} \text{origin} \left( \begin{array}{l} O2, \\ S2, \\ D \end{array} \right) \leq \\ \text{origin} \left( \begin{array}{l} O1, \\ S1, \\ D \end{array} \right) \end{array} \right) , \\ \wedge \\ \left( \begin{array}{l} \text{end}(O1, S1, D) \leq \\ \text{end}(O2, S2, D) \end{array} \right) \\ \exists D \in \text{Dims} \\ \left( \begin{array}{l} \text{origin} \left( \begin{array}{l} O2, \\ S2, \\ D \end{array} \right) = \\ \text{origin} \left( \begin{array}{l} O1, \\ S1, \\ D \end{array} \right) , \\ \wedge \\ \text{end}(O1, S1, D) = \\ \text{end}(O2, S2, D) \end{array} \right) \end{array} \right)$
- $\text{coveredby\_objects}(\text{Dims}, O1, O2) \stackrel{\text{def}}{=} \left( \begin{array}{l} \forall S1 \in \text{sboxes}([O1.\text{sid}]) \\ \exists S2 \in \text{sboxes}([O2.\text{sid}]) \\ \text{coveredby\_sboxes} \left( \begin{array}{l} \text{Dims}, \\ O1, \\ S1, \\ O2, \\ S2 \end{array} \right) \end{array} \right)$
- $\text{all\_coveredby}(\text{Dims}, \text{OIDS}) \stackrel{\text{def}}{=} \left( \begin{array}{l} \forall O1 \in \text{objects}(\text{OIDS}) \\ \forall O2 \in \text{objects}(\text{OIDS}) \\ O1.\text{oid} < \Rightarrow \\ O2.\text{oid} \\ \text{coveredby\_objects} \left( \begin{array}{l} \text{Dims}, \\ O1, \\ O2 \end{array} \right) \end{array} \right)$
- $\text{all\_coveredby}(\text{DIMENSIONS}, \text{OIDS})$

20070622

707