5.124 disjoint_sboxes

DESCRIPTION LINKS LOGIC

Origin Geometry, derived from [338]

Constraint disjoint_sboxes(K, DIMS, OBJECTS, SBOXES)

Synonym disjoint.

Types

```
VARIABLES  :  collection(v−dvar)
INTEGERS   :  collection(v−int)
POSITIVES  :  collection(v−int)
```

Arguments

```
K         :  int
DIMS      :  sint
OBJECTS   :  collection(oid−int, sid−dvar, x − VARIABLES)
SBOXES    :  collection(sid−int, t − INTEGERS, l − POSITIVES)
```

Restrictions

$|\text{VARIABLES}| \geq 1$
$|\text{INTEGERS}| \geq 1$
$|\text{POSITIVES}| \geq 1$
required(VARIABLES, v)
$|\text{VARIABLES}| = \text{K}$
required(INTEGERS, v)
$|\text{INTEGERS}| = \text{K}$
required(POSITIVES, v)
$|\text{POSITIVES}| = \text{K}$
$\text{POSITIVES.v} > 0$
$\text{K} > 0$
$\text{DIMS} \geq 0$
$\text{DIMS} < \text{K}$
increasing_seq(OBJECTS, [oid])
required(OBJECTS, [oid, sid, x])
$\text{OBJECTS.oid} \geq 1$
$\text{OBJECTS.oid} \leq |\text{OBJECTS}|$
$\text{OBJECTS.sid} \geq 1$
$\text{OBJECTS.sid} \leq |\text{SBOXES}|$
$|\text{SBOXES}| \geq 1$
required(SBOXES, [sid, t, l])
$\text{SBOXES.sid} \geq 1$
$\text{SBOXES.sid} \leq |\text{SBOXES}|$
do_not_overlap(SBOXES)

Purpose

Holds if, for each pair of objects (O_i, O_j), $i \neq j$, O_i and O_j are disjoint 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 t, 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.
Two objects O_i and object O_j are *disjoint* with respect to a set of dimensions depicted by DIMS if and only if for all shifted box s_i associated with O_i and for all shifted box s_j associated with O_j there exists at least one dimension $d \in$ DIMS such that (1) the origin of s_i in dimension d is strictly greater than the end of s_j in dimension d, or (2) the origin of s_j in dimension d is strictly greater than the end of s_i in dimension d.

Example

$$\left\langle 2, \{0,1\}, \left\langle \begin{array}{lll} \texttt{oid}-1 & \texttt{sid}-1 & \texttt{x}-\langle 1,1\rangle, \\ \texttt{oid}-2 & \texttt{sid}-2 & \texttt{x}-\langle 4,1\rangle, \\ \texttt{oid}-3 & \texttt{sid}-4 & \texttt{x}-\langle 2,4\rangle \end{array} \right\rangle, \left\{ \begin{array}{lll} \texttt{sid}-1 & \texttt{t}-\langle 0,0\rangle & \texttt{l}-\langle 1,2\rangle, \\ \texttt{sid}-2 & \texttt{t}-\langle 0,0\rangle & \texttt{l}-\langle 1,1\rangle, \\ \texttt{sid}-2 & \texttt{t}-\langle 1,0\rangle & \texttt{l}-\langle 1,3\rangle, \\ \texttt{sid}-2 & \texttt{t}-\langle 0,2\rangle & \texttt{l}-\langle 1,1\rangle, \\ \texttt{sid}-3 & \texttt{t}-\langle 0,0\rangle & \texttt{l}-\langle 3,1\rangle, \\ \texttt{sid}-3 & \texttt{t}-\langle 0,1\rangle & \texttt{l}-\langle 1,1\rangle, \\ \texttt{sid}-3 & \texttt{t}-\langle 2,1\rangle & \texttt{l}-\langle 1,1\rangle, \\ \texttt{sid}-4 & \texttt{t}-\langle 0,0\rangle & \texttt{l}-\langle 1,1\rangle \end{array} \right\rangle \right\rangle$$

Figure 5.278 shows the objects of the example. Since these objects are pairwise disjoint the disjoint_sboxes constraint holds.

Typical

$|\texttt{OBJECTS}| > 1$

Symmetries

- Items of OBJECTS are permutable.
- Items of SBOXES are permutable.
- SBOXES.l.v can be decreased to any value ≥ 1.

Arg. properties

Suffix-contractible wrt. OBJECTS.

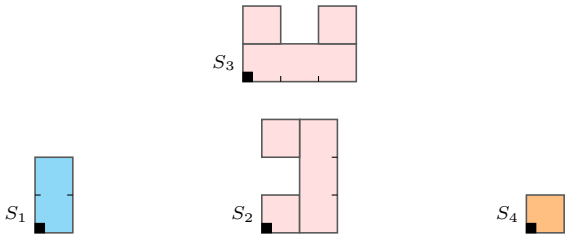
Remark

One of the eight relations of the *Region Connection Calculus* [338]. Unlike the non_overlap_sboxes constraint, which just prevents objects from overlapping, the disjoint_sboxes constraint in addition enforces that borders and corners of objects are not directly in contact.

See also

common keyword: contains_sboxes, coveredby_sboxes, covers_sboxes, equal_sboxes, inside_sboxes, meet_sboxes *(rcc8)*, non_overlap_sboxes *(geometrical constraint,logic)*, overlap_sboxes *(rcc8)*.

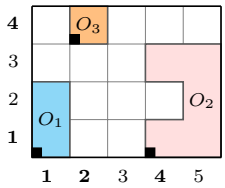
implies: non_overlap_sboxes.



(A) Shape of the first object

(B) Shapes of the second object

(C) Shape of the third object



OBJECTS

O_1:	oid $-$ 1	sid $-$ 1	x $-$ $\langle 1, 1\rangle$
O_2:	oid $-$ 2	sid $-$ 2	x $-$ $\langle 4, 1\rangle$
O_3:	oid $-$ 3	sid $-$ 4	x $-$ $\langle 2, 4\rangle$

(D) Three mutually disjoint objects

Figure 5.278: (D) the three mutually disjoint objects O_1, O_2, O_3 of the **Example** slot respectively assigned shapes S_1, S_2, S_4; (A), (B), (C) shapes S_1, S_2, S_3 and S_4 are respectively made up from 1, 3, 3 and 1 disjoint shifted box.

Keywords

constraint type: logic.

geometry: geometrical constraint, rcc8.

miscellaneous: obscure.

Logic

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