5.89 contains_sboxes

DESCRIPTION LINKS LOGIC

Origin Geometry, derived from [338]

Constraint contains_sboxes(K, DIMS, OBJECTS, SBOXES)

Synonym contains.

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

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

Purpose

Holds if, for each pair of objects (O_i, O_j), $i < j$, O_i contains 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 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.
An object O_i *contains* an object O_j with respect to a set of dimensions depicted by DIMS if and only if, for all shifted boxes s_j associated with O_j, there exists a shifted box s_i of O_i such that s_i contains s_j. A shifted box s_i *contains* a shifted box s_j if and only if, for all dimensions $d \in$ DIMS, (1) the start of s_i in dimension d is strictly less than the start of s_j in dimension d and (2) the end of s_j in dimension d is strictly less than the end of s_i in dimension d.

Example

$$\left\langle 2, \{0,1\}, \left\langle \begin{array}{lll} \texttt{oid}-1 & \texttt{sid}-1 & \texttt{x}-\langle 1,1\rangle, \\ \texttt{oid}-2 & \texttt{sid}-2 & \texttt{x}-\langle 2,2\rangle, \\ \texttt{oid}-3 & \texttt{sid}-3 & \texttt{x}-\langle 3,3\rangle \end{array} \right\rangle, \left\langle \begin{array}{lll} \texttt{sid}-1 & \texttt{t}-\langle 0,0\rangle & \texttt{l}-\langle 5,5\rangle, \\ \texttt{sid}-2 & \texttt{t}-\langle 0,0\rangle & \texttt{l}-\langle 3,3\rangle, \\ \texttt{sid}-3 & \texttt{t}-\langle 0,0\rangle & \texttt{l}-\langle 1,1\rangle \end{array} \right\rangle \right\rangle$$

Figure 5.217 shows the objects of the example. Since O_1 contains both O_2 and O_3, and since O_2 contains O_3, the contains_sboxes constraint holds.

Typical

$|\texttt{OBJECTS}| > 1$

Symmetries

- Items of SBOXES are permutable.
- Items of OBJECTS.x, SBOXES.t and SBOXES.l are permutable (*same permutation used*).

Arg. properties

Suffix-contractible wrt. OBJECTS.

Remark

One of the eight relations of the *Region Connection Calculus* [338]. The constraint contains_sboxes is a restriction of the original relation since it requires that each shifted box of an object is contained by one shifted box of the other object.

See also

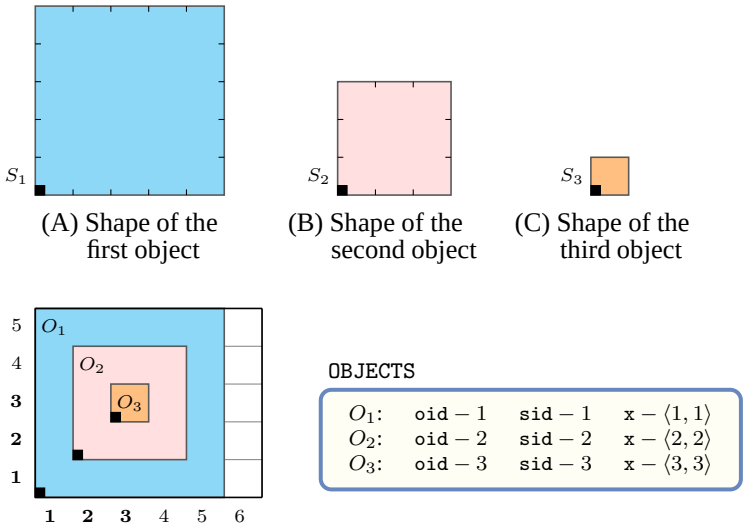
common keyword: coveredby_sboxes, covers_sboxes, disjoint_sboxes, equal_sboxes, inside_sboxes, meet_sboxes *(rcc8)*, non_overlap_sboxes *(geometrical constraint,logic)*, overlap_sboxes *(rcc8)*.

Keywords

constraint type: logic.

geometry: geometrical constraint, rcc8.

miscellaneous: obscure.



(A) Shape of the first object

(B) Shape of the second object

(C) Shape of the third object

(D) Three objects O_1, O_2, O_3, where O_1 both contains O_2 and O_3 and where O_2 contains O_3

Figure 5.217: (D) the three nested objects O_1, O_2, O_3 of the **Example** slot respectively assigned shapes S_1, S_2, S_3; (A), (B), (C) shapes S_1, S_2 and S_3 are made up from a single shifted box.

Logic

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