5.212 meet_sboxes

DESCRIPTION LINKS LOGIC

Origin Geometry, derived from [305]

Constraint meet_sboxes(K, DIMS, OBJECTS, SBOXES)

Synonym meet.

Types

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

Arguments

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

Restrictions

required(VARIABLES, v)
|VARIABLES| = K
required(INTEGERS, v)
|INTEGERS| = K
required(POSITIVES, v)
|POSITIVES| = K
POSITIVES.v > 0
K > 0
DIMS ≥ 0
DIMS < K
required(OBJECTS, [oid, sid, x])
OBJECTS.oid ≥ 1
OBJECTS.oid ≤ |OBJECTS|
OBJECTS.sid ≥ 1
OBJECTS.sid ≤ |SBOXES|
required(SBOXES, [sid, t, l])
SBOXES.sid ≥ 1
SBOXES.sid ≤ |SBOXES|

Holds if, for each pair of objects (O_i, O_j), $i \neq j$, O_i and O_j meet with respect to a set of dimensions depicted by `DIMS`. 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 *meet* with respect to a set of dimensions depicted by `DIMS` if and only if the two following conditions hold:

Purpose

- For all shifted box s_i associated with O_i and for all shifted box s_j associated with O_j there exists a dimension $d \in$ `DIMS` such that (1) the start of s_i in dimension d is greater than or equal to the end of s_j in dimension d, or (2) the start of s_j in dimension d is greater than or equal to the end of s_i in dimension d (i.e., there is no overlap between the shifted box of O_i and the shifted box of O_j).
- There exists a shifted box s_i of O_i and there exists a shifted box s_j of O_j such that for all dimensions d (1) the end of s_i in dimension d is greater than or equal to the start of s_j in dimension d, and (2) the end of s_j in dimension d is greater than or equal to the start of s_i in dimension d (i.e., at least two shifted box of O_i and O_j are in contact).

Example

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

Figure 5.409 shows the objects of the example. Since all the pairs of objects meet the `meet_sboxes` constraint holds.

Symmetries

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

Remark One of the eight relations of the *Region Connection Calculus* [305].

See also **common keyword:** `contains_sboxes`, `coveredby_sboxes`, `covers_sboxes`, `disjoint_sboxes`, `equal_sboxes`, `inside_sboxes` *(rcc8)*, `non_overlap_sboxes` *(geometrical constraint,logic)*, `overlap_sboxes` *(rcc8)*.

Keywords **constraint type:** logic.

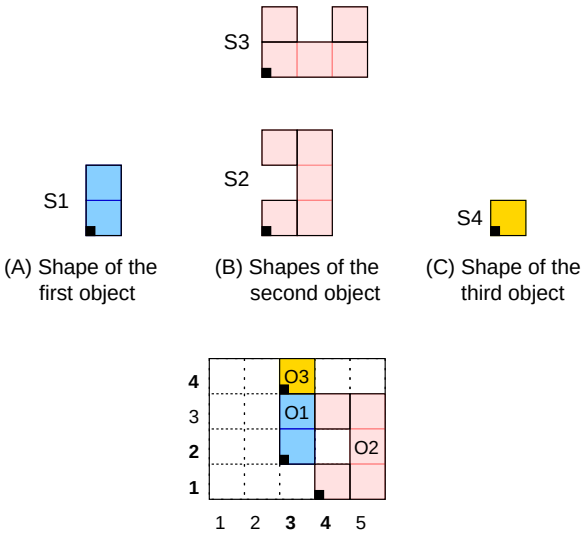

Figure 5.409: The three objects of the example

Logic

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