

5.81 crossing

	DESCRIPTION	LINKS	GRAPH
Origin	Inspired by [110].		
Constraint	<code>crossing(NCROSS, SEGMENTS)</code>		
Arguments	NCROSS : <code>dvar</code> SEGMENTS : <code>collection(ox-dvar, oy-dvar, ex-dvar, ey-dvar)</code>		
Restrictions	$NCROSS \geq 0$ $NCROSS \leq (SEGMENTS * SEGMENTS - SEGMENTS)/2$ <code>required(SEGMENTS, [ox, oy, ex, ey])</code>		
Purpose	NCROSS is the number of line-segments intersections between the line-segments defined by the SEGMENTS collection. Each line-segment is defined by the coordinates (ox, oy) and (ex, ey) of its two extremities.		

Example

$$\left(3, \left\langle \begin{array}{cccc} ox - 1 & oy - 4 & ex - 9 & ey - 2, \\ ox - 1 & oy - 1 & ex - 3 & ey - 5, \\ ox - 3 & oy - 2 & ex - 7 & ey - 4, \\ ox - 9 & oy - 1 & ex - 9 & ey - 4 \end{array} \right\rangle \right)$$

Figure 5.163 provides a picture of the example with the corresponding four line-segments of the SEGMENTS collection. The `crossing` constraint holds since its first argument NCROSS is set to 3, which is actually the number of line-segments intersections.

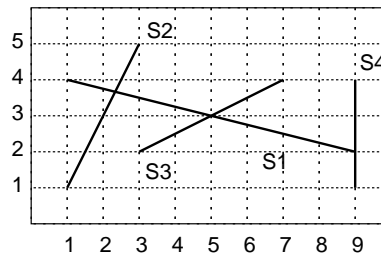


Figure 5.163: Intersection between line-segments

Typical

`|SEGMENTS| > 1`

Symmetries

- Items of SEGMENTS are [permutable](#).
- Attributes of SEGMENTS are [permutable](#) w.r.t. permutation $(ox, oy) (ex, ey)$ (*permutation applied to all items*).
- One and the same constant can be [added](#) to the ox and ex attributes of all items of SEGMENTS.
- One and the same constant can be [added](#) to the oy and ey attributes of all items of SEGMENTS.

See also

common keyword: [graph_crossing](#), [two_layer_edge_crossing](#) (*line-segments intersection*).

Keywords

final graph structure: [acyclic](#), [no loop](#).

geometry: [geometrical constraint](#), [line-segments intersection](#).

Arc input(s)	SEGMENTS
Arc generator	<i>CLIQUE</i> (\langle) \mapsto <code>collection</code> (s1, s2)
Arc arity	2
Arc constraint(s)	<ul style="list-style-type: none"> • $\max(s1.ox, s1.ex) \geq \min(s2.ox, s2.ex)$ • $\max(s2.ox, s2.ex) \geq \min(s1.ox, s1.ex)$ • $\max(s1.oy, s1.ey) \geq \min(s2.oy, s2.ey)$ • $\max(s2.oy, s2.ey) \geq \min(s1.oy, s1.ey)$ $\bullet \bigvee \left(\begin{array}{l} (s2.ox - s1.ex) * (s1.ey - s1.oy) - \prod \begin{pmatrix} s1.ex - s1.ox, \\ s2.oy - s1.ey \end{pmatrix} = 0, \\ (s2.ex - s1.ex) * (s2.oy - s1.oy) - \prod \begin{pmatrix} s2.ox - s1.ox, \\ s2.ey - s1.ey \end{pmatrix} = 0, \\ \text{sign} \begin{pmatrix} (s2.ox - s1.ex) * (s1.ey - s1.oy) - \\ (s1.ex - s1.ox) * (s2.oy - s1.ey) \end{pmatrix} \neq \\ \text{sign} \begin{pmatrix} (s2.ex - s1.ex) * (s2.oy - s1.oy) - \\ (s2.ox - s1.ox) * (s2.ey - s1.ey) \end{pmatrix} \end{array} \right)$
Graph property(ies)	NARC = NCROSS
Graph class	<ul style="list-style-type: none"> • ACYCLIC • NO_LOOP

Graph model

Each line-segment is described by the x and y coordinates of its two extremities. In the arc generator we use the restriction \langle in order to generate one single arc for each pair of segments. This is required, since otherwise we would count more than once a given line-segments intersection.

Parts (A) and (B) of Figure 5.164 respectively show the initial and final graph associated with the **Example** slot. Since we use the **NARC** graph property, the arcs of the final graph are stressed in bold. An arc constraint expresses the fact the two line-segments intersect. It is taken from [110, page 889]. Each arc of the final graph corresponds to a line-segments intersection.

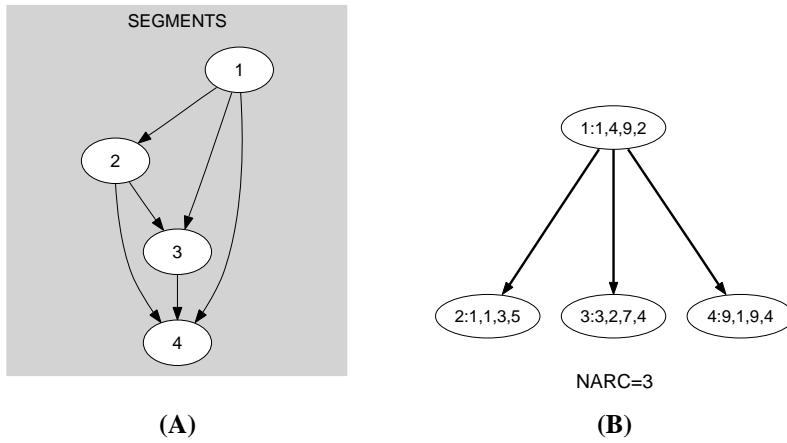


Figure 5.164: Initial and final graph of the crossing constraint