

Qualitative Spatial Reasoning over Line-Region Relations

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Knowledge Representation
Seminar Presentation

Agenda

Motivation

Definitions and Formalisms

- Lines and Regions

- Topological Parts of an Object

- 9-Intersection

Models of Conceptual Neighborhoods

- Snapshot Model

- Smooth-Transition Model

Evaluation

Conclusion

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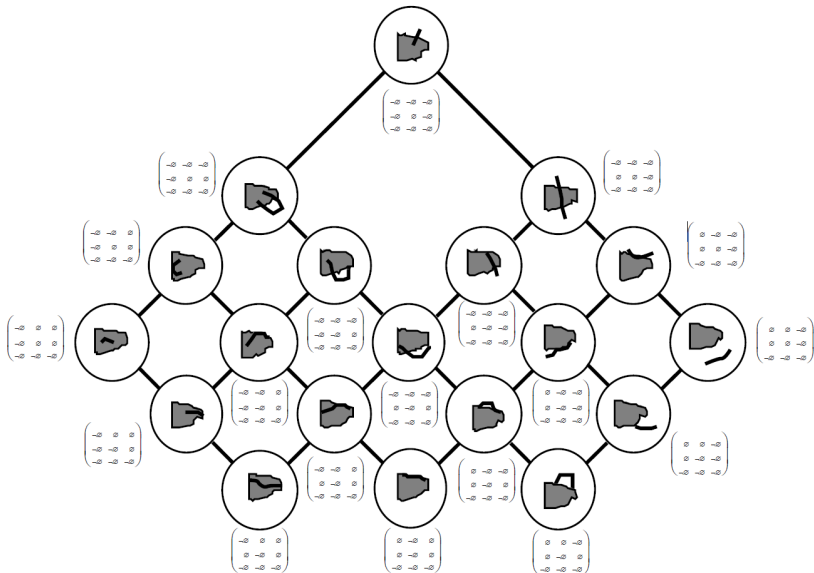
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Resulting Neighborhood Graph



Smooth-Transition Model

Smooth Transition

infinitesimally small deformation that changes the topological relation

Formalization based on

for lines and regions, such changes may be thought of as

1. Moving a line's boundary node from a region part into an adjacent part of the region.
2. Moving a line's interior partially from a region part into an adjacent part of the region.

a total of 4? rules Define extent of a part i

Moving the Line's Boundaries

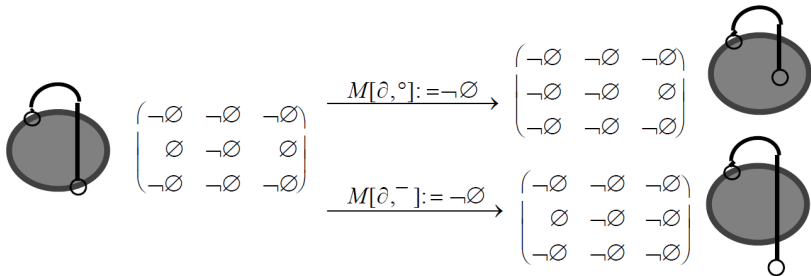
Rule 1

If the line's two boundaries intersect with the same region part, then extend the intersection to either of the adjacent region parts.

Formalization

$$\#M[\delta, _]=1 \Rightarrow \forall i(M[\delta, i] = \neg\emptyset) : M_N[\delta, \text{adjacent}(i)] := \neg\emptyset$$

Example



Moving the Line's Boundaries

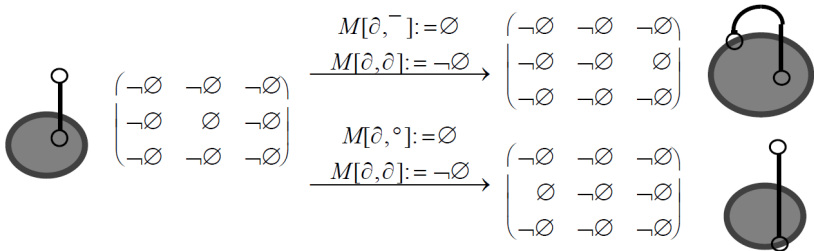
Rule 2

If the line's two boundaries intersect with two different region parts then move either intersection to the adjacent region part.

Formalization

$$\#M[\delta, _]=2 \Rightarrow \forall i(M[\delta, i] = \neg\emptyset) : M_N[\delta, i] := \emptyset \textbf{ and } M_N[\delta, \text{adjacent}(i)] := \neg\emptyset$$

Example



Moving the Line's Interior

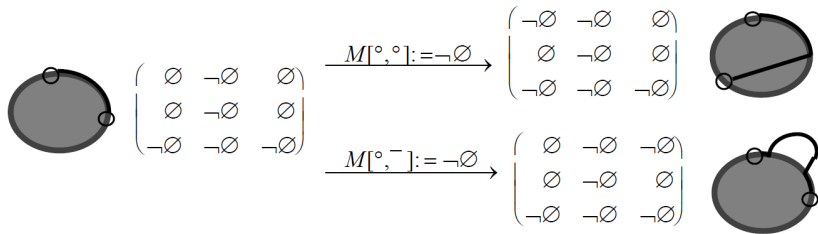
Rule 1

Extend the line's interior-intersection to either of the adjacent region parts.

Formalization

$$\forall i (M[\circ, i] = \neg\emptyset) : M_N[\circ, \text{adjacent}(i)] := \neg\emptyset$$

Example



Moving the Line's Interior

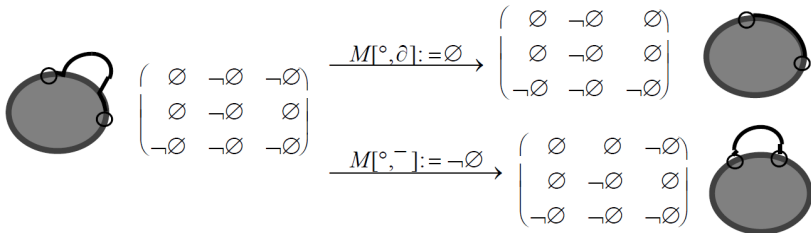
Rule 2

Reduce the line's interior intersection on either of the adjacent region parts.

Formalization

$$\begin{aligned} \#M[\circ, -] = 2 &\Rightarrow \forall i (M[\circ, i] = \neg\emptyset) : M_N[\circ, i] := \emptyset \\ \#M[\circ, -] = 3 &\Rightarrow \forall i (i \neq \delta) : M_N[\circ, i] := \emptyset \end{aligned}$$

Example



Consistency Constraints

1. If the line's interior intersects with the region's interior *and* exterior, then the line's interior must also intersect with the region's boundary.

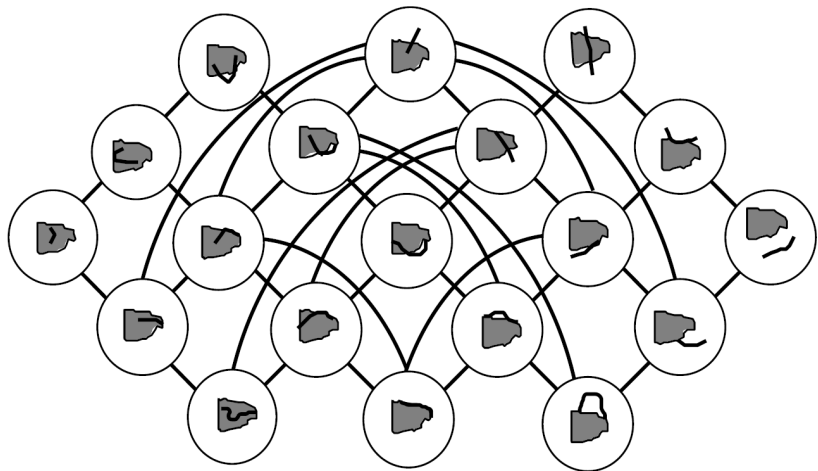
$$M[^\circ, ^\circ] = \neg\emptyset \text{ and } M[^\circ, ^-] = \neg\emptyset \Rightarrow M[^\circ, \delta] := \neg\emptyset$$

2. If the line's boundary intersects with the region's interior (exterior) then the line's interior must intersect with the region's interior (exterior) as well.

$$M[\delta, ^\circ] = \neg\emptyset \Rightarrow M[^\circ, ^\circ] := \neg\emptyset$$

$$M[\delta, ^-] = \neg\emptyset \Rightarrow M[^\circ, ^-] := \neg\emptyset$$

Resulting Neighborhood Graph



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