# Qualitative Spatial Reasoning over Line-Region Relations

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Knowledge Representation
Seminar Presentation

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# Snapshot Model

# 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

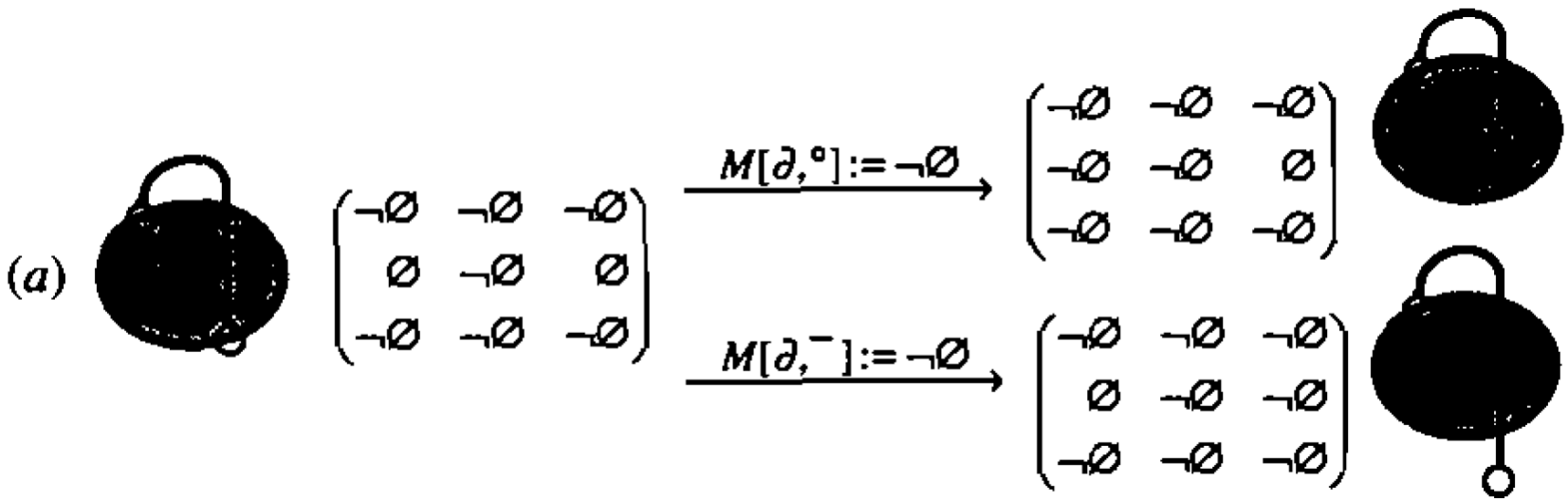
## Rule 1

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

## Formalization

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

## Example



# Moving the Line's Boundaries

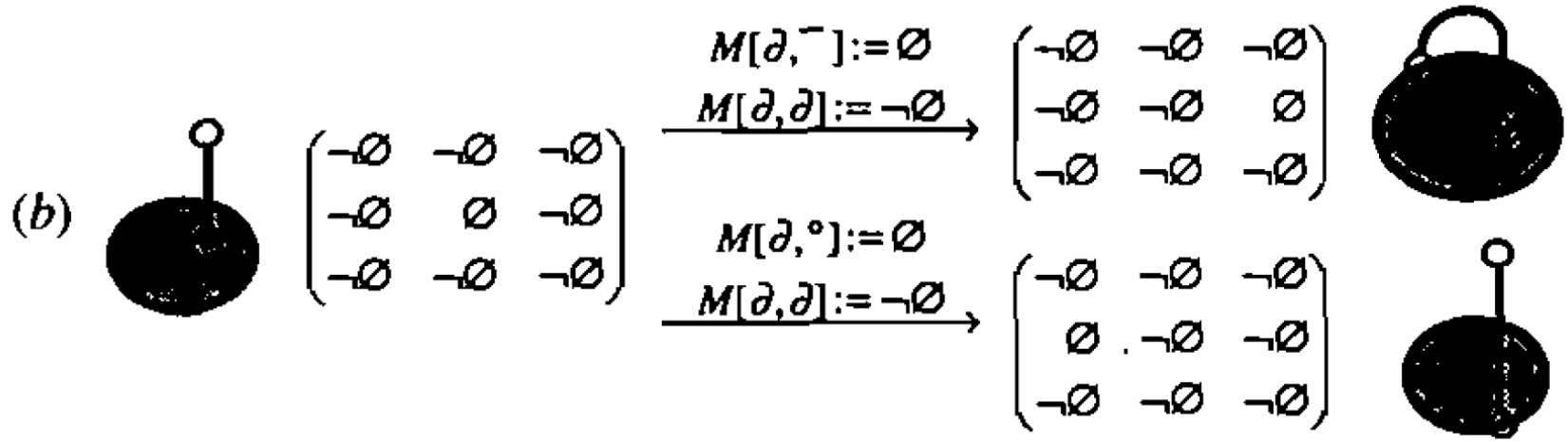
## Rule 2

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

## Formalization

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

## Example



# Moving the Line's Interior

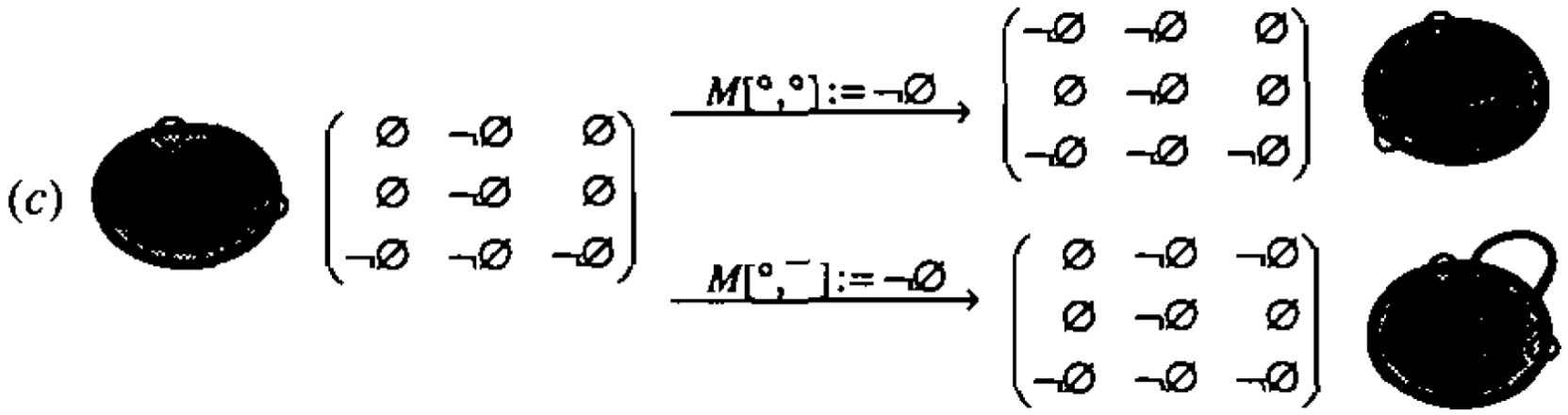
## Rule 1

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

## Formalization

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

## Example



# Moving the Line's Interior

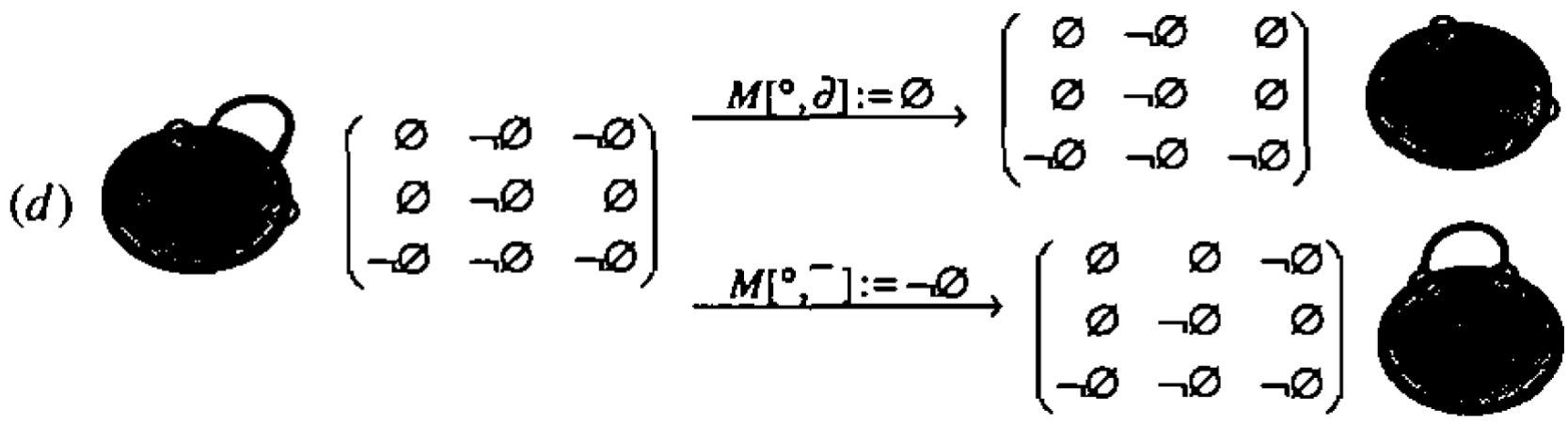
## Rule 2

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

## Formalization

$$\#M[^\circ, \_] = 2 \Rightarrow \forall i(M[^\circ, i] = \neg\varnothing) : M_N[^\circ, i] := \varnothing$$
$$\#M[^\circ, \_] = 3 \Rightarrow \forall i(i \neq \delta) : M_N[^\circ, i] := \varnothing$$

## Example



# Consistency Constraints

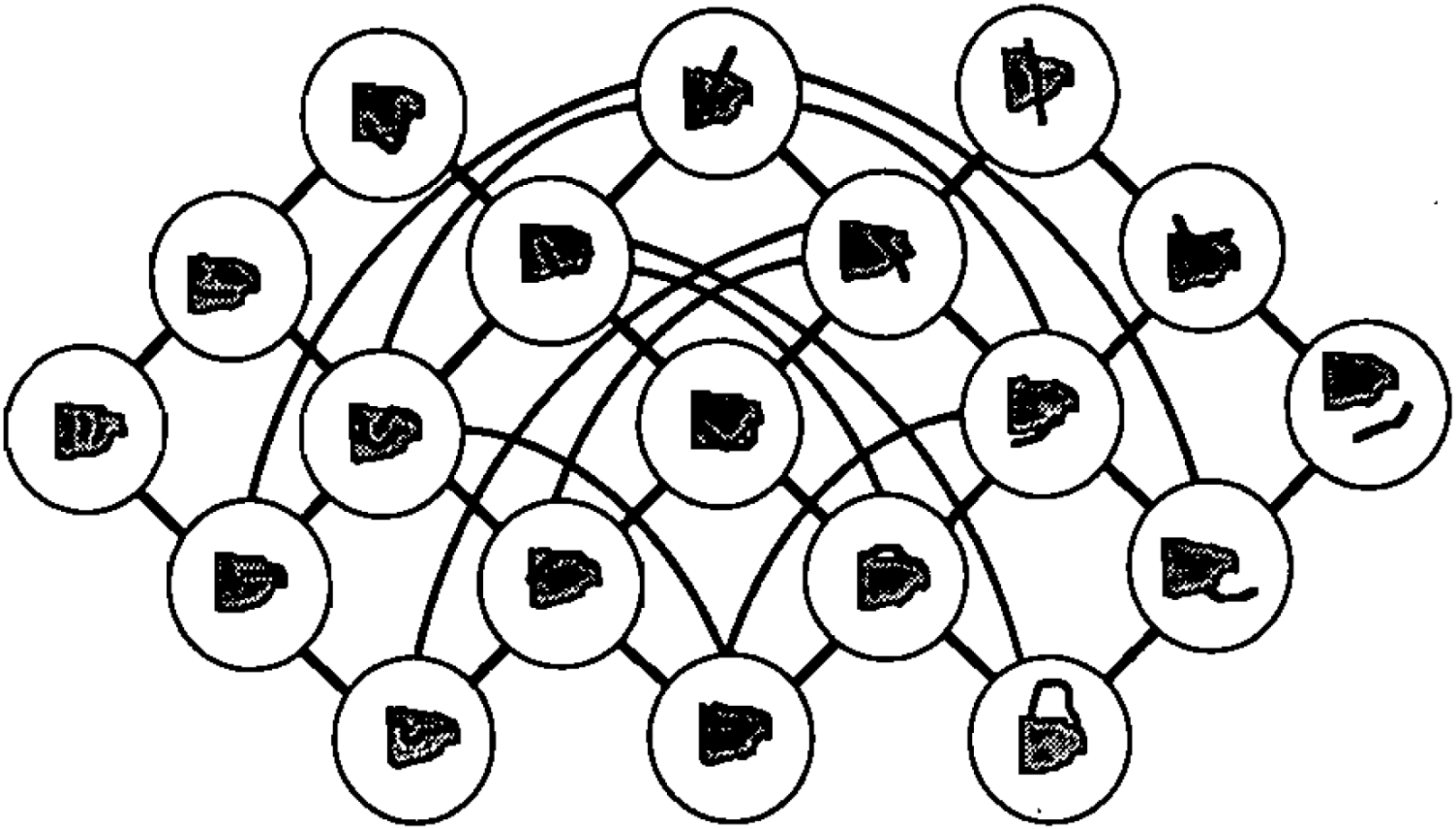
1. If the line's interior intersects with the region's interior *and* exterior, then the line's interior must also intersect with the region's boundary.

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

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.

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

# Resulting Neighborhood Graph



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# References