



# **Qualitative Spatial Reasoning over Line-Region Relations**

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Knowledge Representation  
Seminar Presentation

# Agenda

## 9-Intersection

Snapshot Model

Smooth-Transition Model

Evaluation

Summary

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# Smooth-Transition Model

## Example

A pair of line-region relations that are conceptual neighbors (one can be obtained from the other via a "smooth transition")

## Counterexample

A pair of line-region relations that **not** are conceptual neighbors

# Formalization

## Possible Changes

A smooth transition can occur by:

- ▶ Moving around a line's boundary nodes

**Rule 1** Line's two boundary nodes intersect with same region part

**Rule 2** Line's two boundary nodes intersect with different region part

- ▶ Moving around a line's interior

**Rule 3** Extend line's interior-intersection partially

**Rule 4** Reduce line's interior-intersection partially

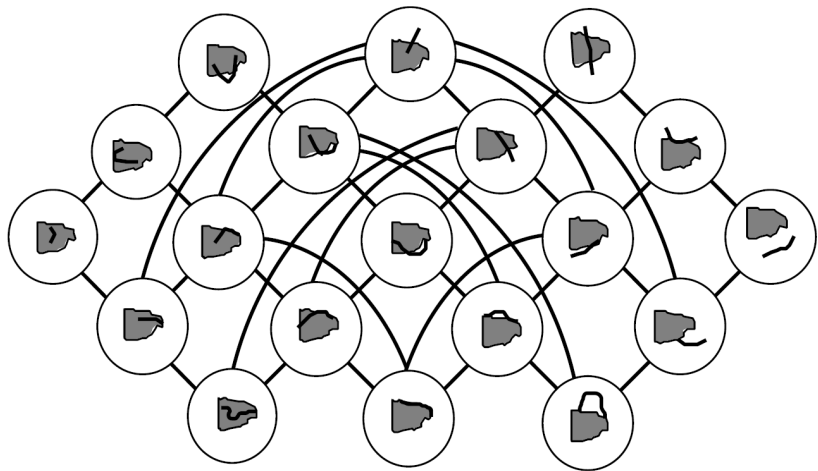
## Extent of a Line Part

Extent of a part  $i$ : Denoted by  $\#M[i, \_]$ ; number of non-empty intersections between  $i$  and the three parts of the second object. Define extent of a part  $i$  Draw 9-intersection model on the board for reference

- (Explain on the board) The extent of a line's interior with respect to a region is in the interval of 1 to 3, the extent of the line's boundary is either 1 (if both nodes are located in the same region part) or 2 (if the nodes are located in different parts of the region), and the extent of a line's interior is always 3.

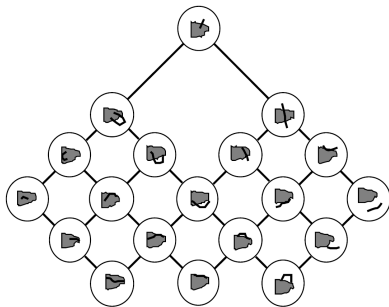


## Resulting Neighborhood Graph

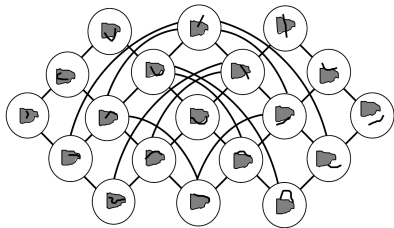


# Juxtaposition of Neighborhood Graphs

**Snapshot Model**



**Smooth-Transition Model**



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# Experiment

- ▶ reused data from previous human-subject experiments
- ▶ GOAL: Within the context of different models for conceptual neighbors, it is particularly enlightening to analyse how the subjects formed groups of similar relations.
- ▶ group spatial relations between line and region, road and park (parks were all the same size and shape)
- ▶ 28 subjects performing tasks
- ▶ 38 diagrams 2 geometrically distinct placements of the road corresponding to each of the 19 topologically distinct relations  
TODO Example from Mark1994
- ▶ each spatial relation could be grouped as many as 112 times (4 pairs times 28 subjects) with each other relation

# Participants

## Results

- ▶ The pairs that were neighbors by both snapshot and smooth-transition models were grouped from 0 to 78 times, with a mean of 33.6.
- ▶ Those pairs that were neighbors for smooth transitions-but not snapshots- were grouped between 0 and 66 times, with a mean of 17.3 (15.4 per cent).
- ▶ The two pairs that were snapshot neighbors-but not smooth transition neighbors- were grouped 10 and 16 times (mean = 14; 11.6 per cent).
- ▶ Perhaps most significant, however, is the fact that the 131 pairs that were neighbors by neither the snapshot model nor the smooth transitions were grouped an average of only 6.0 times by the subject (5.3 per cent of the maximum).
- ▶ Sixty pairs were never grouped by any of the 28 subjects nor any of the four possible stimulus pairs. The most frequently-grouped pair in this category was 54 times (48 per cent), but only 20 stimulus pairs with neither smooth

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- ▶ Introduced two models for the conceptual neighborhood of line-region relations (Snapshot model + Smooth transition model)
- ▶ Found out in human-subject experiments that: ...



# References