

Learning Objectives

- After this segment, students will be able to
 - Describe the input of spatial data mining
 - List 3 common spatial data-types and operations
 - Use spatial operations for Feature Selection



Data-Types: Non-Spatial vs. Spatial

- Non-spatial
 - Numbers, text-string, ...
 - e.g., city name, population
- Spatial (Geographically referenced)
 - Location, e.g., longitude, latitude, elevation
 - Neighborhood and extent
- Spatial Data-types
 - Raster: gridded space
 - Vector: point, line, polygon, ...
 - Graph: node, edge, path



Raster (Courtesy: UMN)



Vector (Courtesy: MapQuest)

Relationships: Non-spatial vs. Spatial

- Non-spatial Relationships
 - **Explicitly** stored in a database
 - Ex. New Delhi **is the capital of** India
- Spatial Relationships
 - **Implicit**, computed on demand
 - Topological: meet, within, overlap, ...
 - Directional: North, NE, left, above, behind, ...
 - Metric: distance, area, perimeter
 - Focal: slope
 - Zonal: highest point in a country
 - ...



OGC Simple Features

- Open GIS Consortium: Simple Feature Types
 - Vector data types: e.g. point, line, polygons
 - Spatial operations :

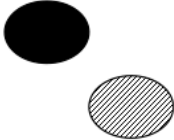
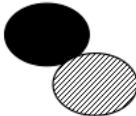


Operator Type	Operator Name
Basic Function	SpatialReference, Envelope, Boundary, Export, IsEmpty, IsSimple
Topological/Set Operations	Equal, Disjoint, Intersect, Touch, Cross, Within, Contains, Overlap
Spatial Analysis	Distance, Buffer, ConvexHull, Intersection, Union, Difference, SymmDiff

Examples of Operations in OGC Model

OGIS - Topological Operations

- Topology: 9-intersections
 - interior
 - boundary
 - exterior

Interior(B)	Boundary(B)	Exterior(B)	
$(A^{\circ} \cap B^{\circ})$	$(A^{\circ} \cap \partial B)$	$(A^{\circ} \cap B^{-})$	Interior(A)
$(\partial A \cap B^{\circ})$	$(\partial A \cap \partial B)$	$(\partial A \cap B^{-})$	Boundary(A)
$(A^{-} \cap B^{\circ})$	$(A^{-} \cap \partial B)$	$(A^{-} \cap B^{-})$	Exterior(A)

Topological Relationship				
	disjoint	meet	overlap	equal
9-intersection model	$\begin{pmatrix} 0 & 0 & 1 \\ 0 & 0 & 1 \\ 1 & 1 & 1 \end{pmatrix}$	$\begin{pmatrix} 0 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 1 & 1 \end{pmatrix}$	$\begin{pmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{pmatrix}$	$\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$

Research Needs for Data

- Limitations of OGC Model
 - Direction predicates - e.g. absolute, ego-centric
 - 3D and visibility, Network analysis, Raster operations
 - Spatio-temporal
- Needs for New Standards & Research
 - Modeling richer spatial properties listed above
 - Spatio-temporal data, e.g., moving objects

