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Chapter 9

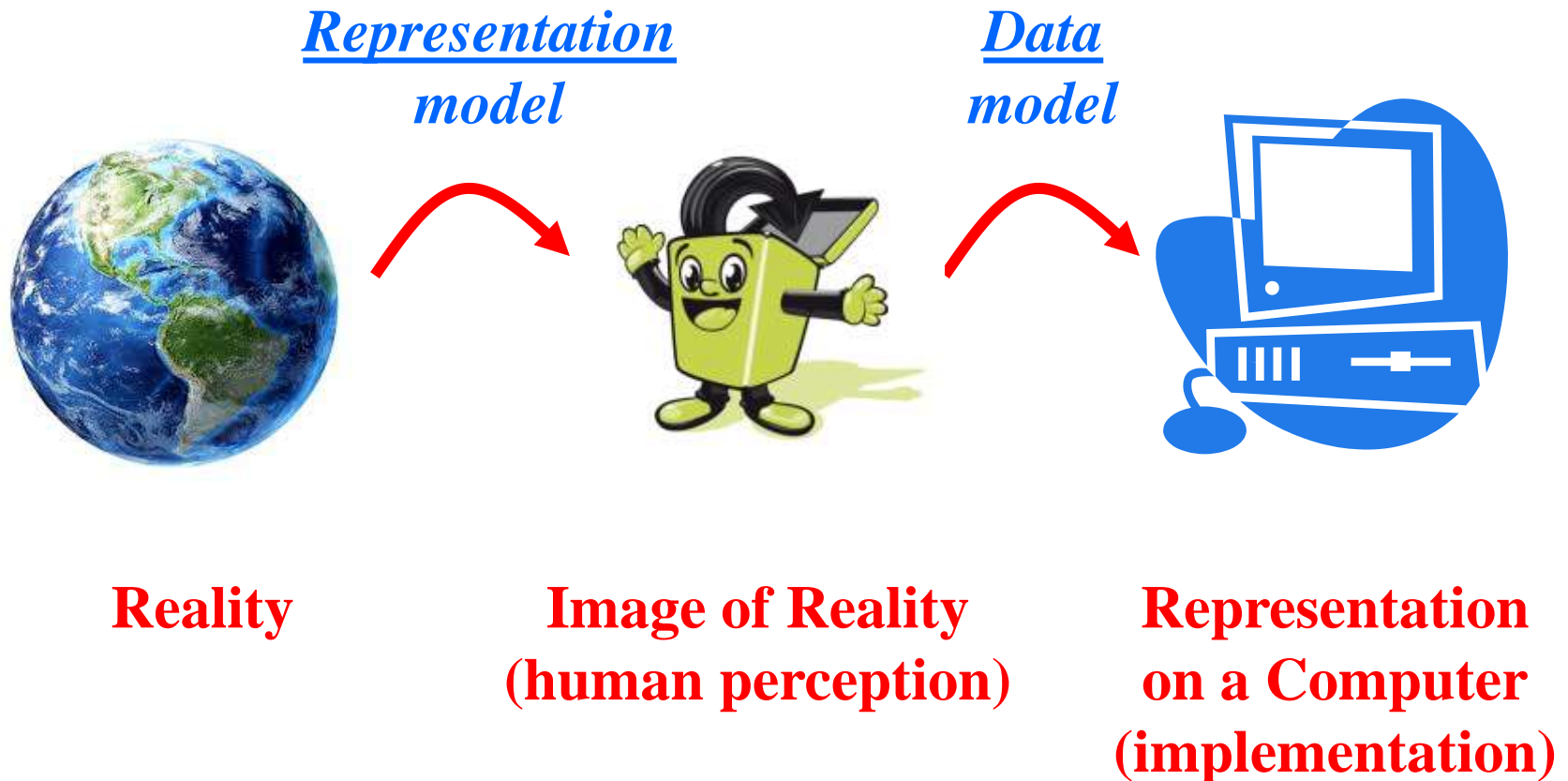
Geographic Representation Models

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Models...

- Representation of **Reality**...



Representation Models

- **Objectives...**
 - should answer two questions...
 - what is present?
 - where is it located?

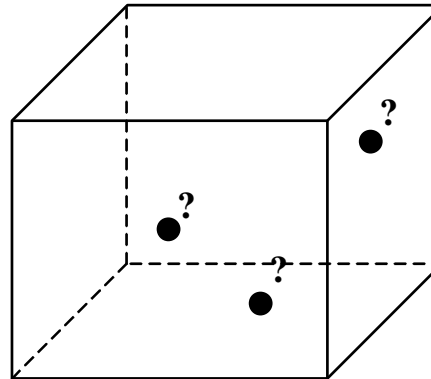
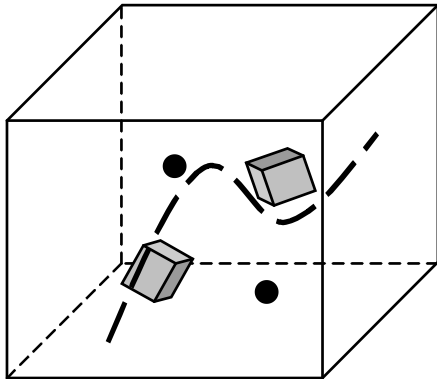


Representation Models

- **Models...**

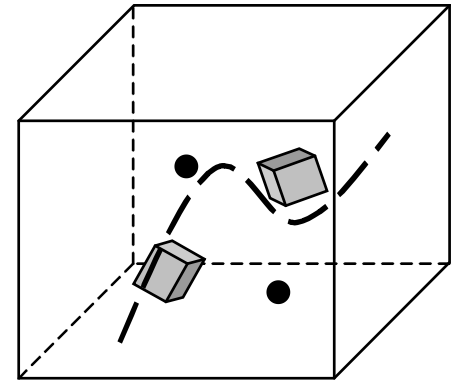
- two approaches...

- space as a set of discrete entities
- space as a continuous field



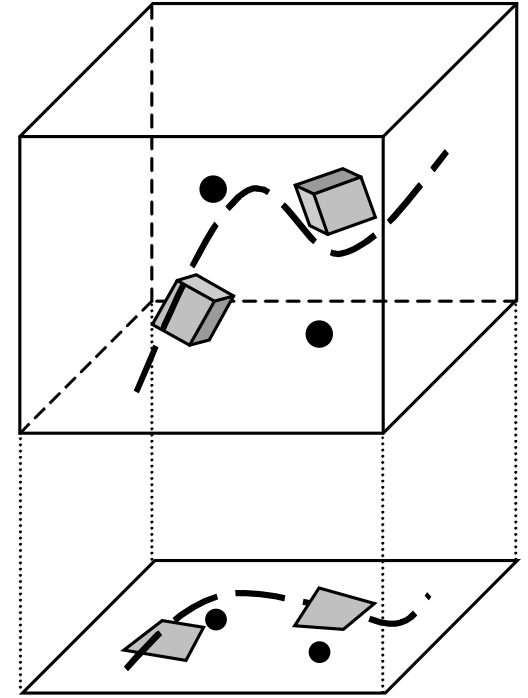
Representation Models

- Model 1...
 - space as a **set of discrete entities**
 - entities should be...
 - identifiable
 - relevant to the application
 - with sharp boundaries
 - describable (with attributes)



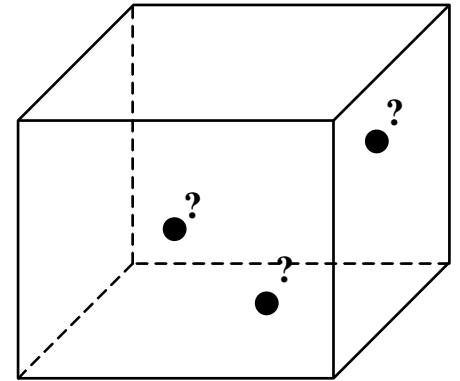
Representation Models

- Model 1...
 - space as a **set of discrete entities**
 - in 2D static space ...
 - entities are represented by...
 - » points
 - » lines
 - » polygons
 - based on an orthogonal or map projection in a 2D plane surface



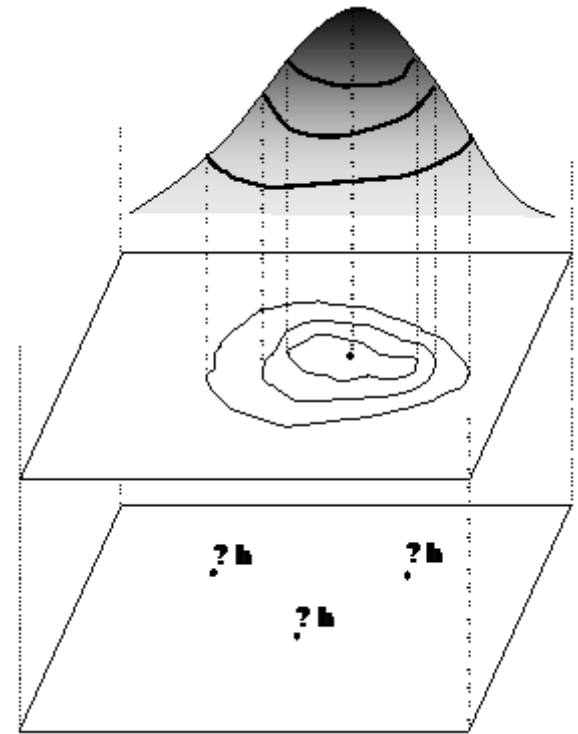
Representation Models

- Model 2...
 - space as a **continuous field**
 - each location of the field ...
 - is assigned one value for an attribute of interest
 - » elevation
 - » vegetation
 - » temperature
 - » humidity



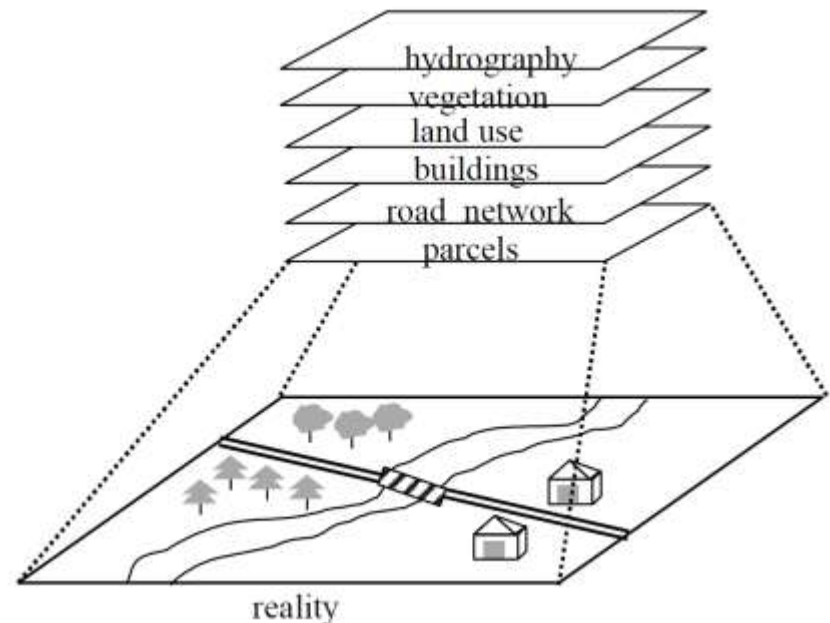
Representation Models

- Model 2...
 - space as a **continuous field**
 - fields are characterized by
 - what is changing
 - » e.g., elevation
 - how smoothly it changes
 - » e.g., steep slope



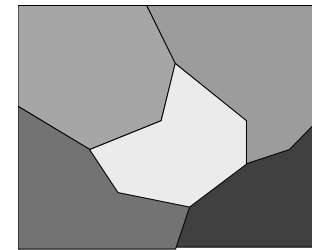
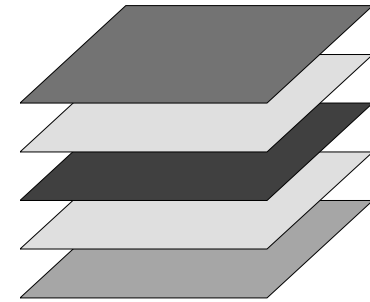
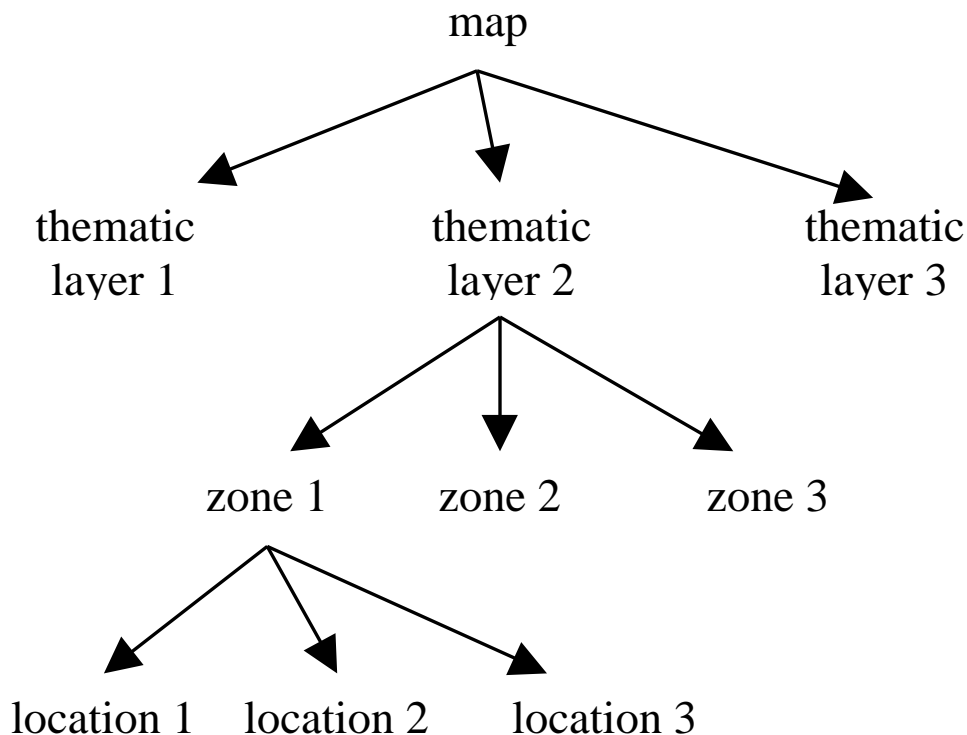
Representation Models

- **Thematic layers ...**
 - space is split into **sub-spaces**
 - each sub-space corresponds to a theme (thematic dimension)



Representation Models

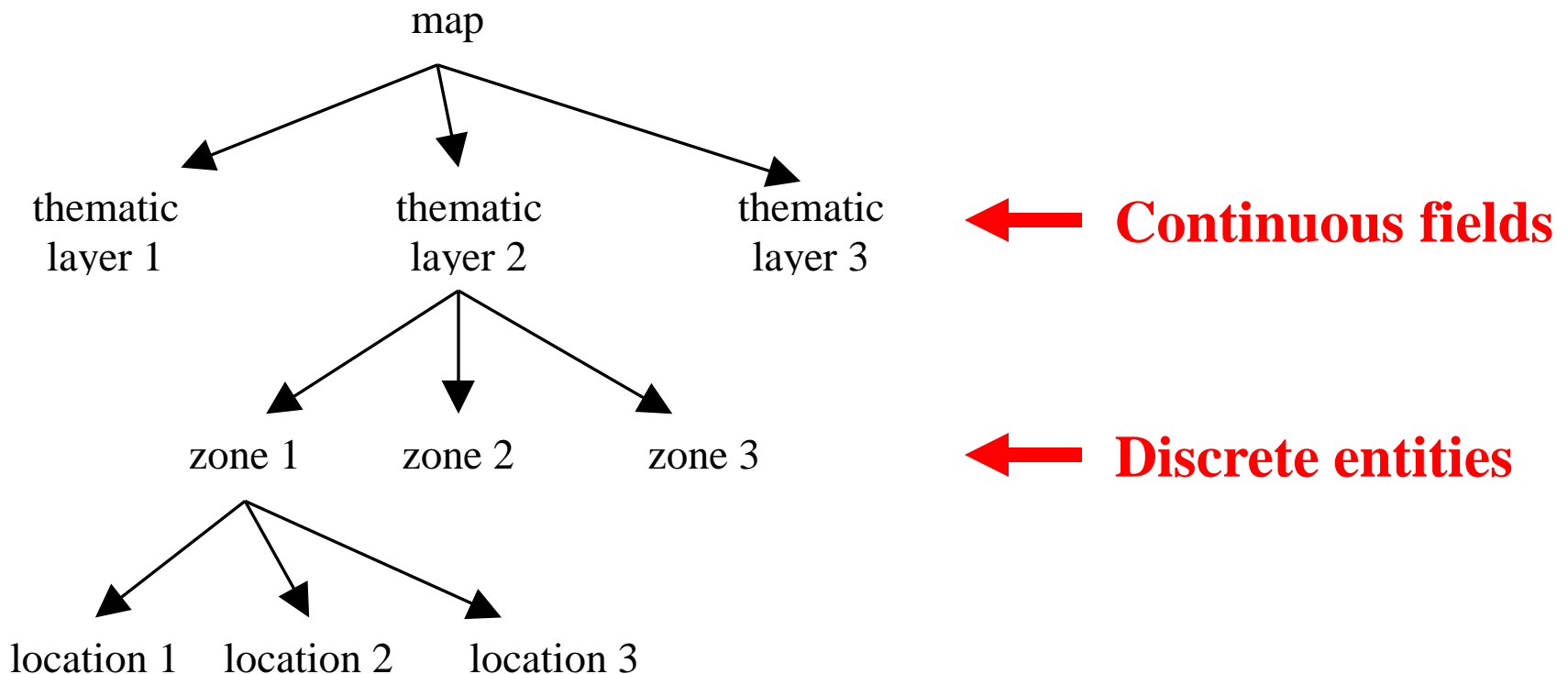
- Tomlin's Model...
 - geographic data forms a **hierarchy**



Representation Models

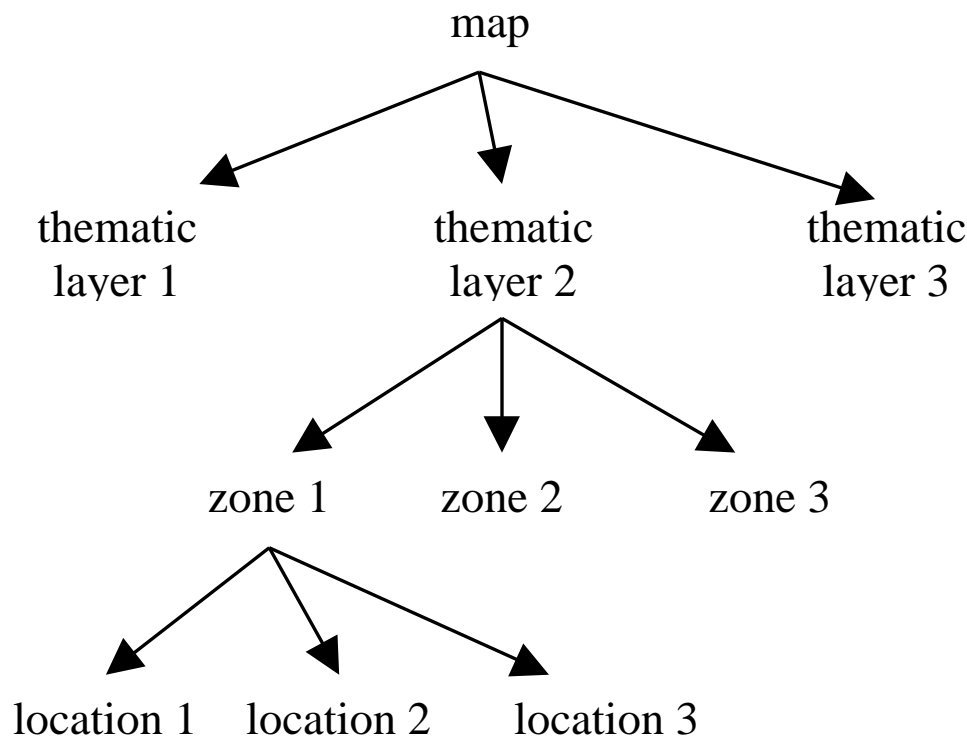
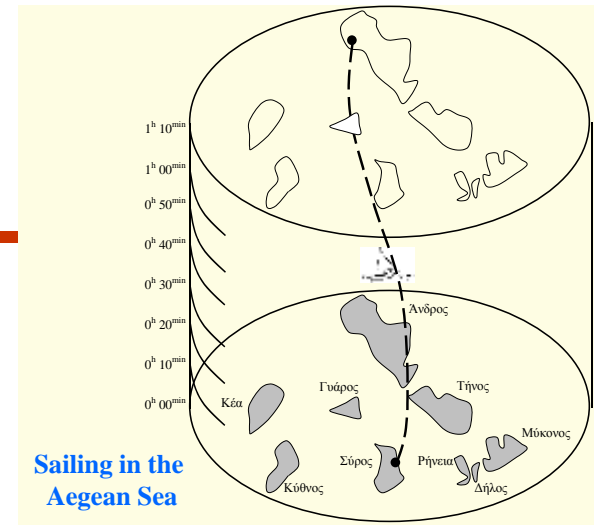
- Tomlin's Model...

- can represent both discrete entities and continuous fields...



Representation Models

- Tomlin's Model...
 - In a **dynamic** world ...

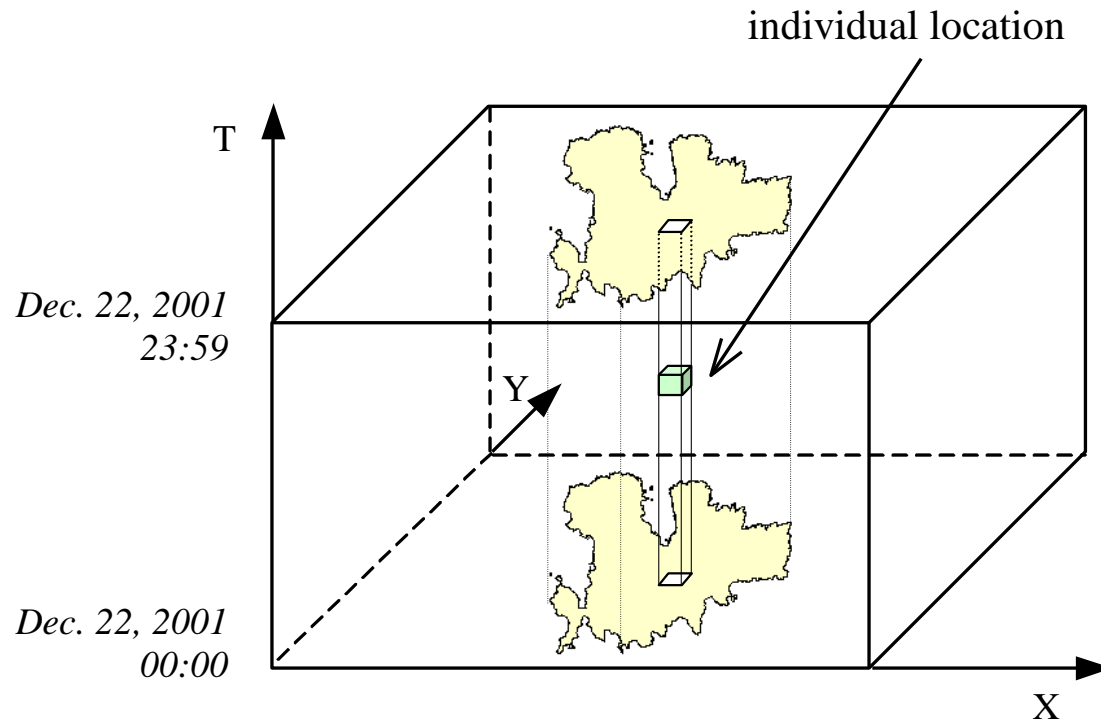


← **Space-time cubes
(2+1D modeling
space)**

← **Space-time locations**

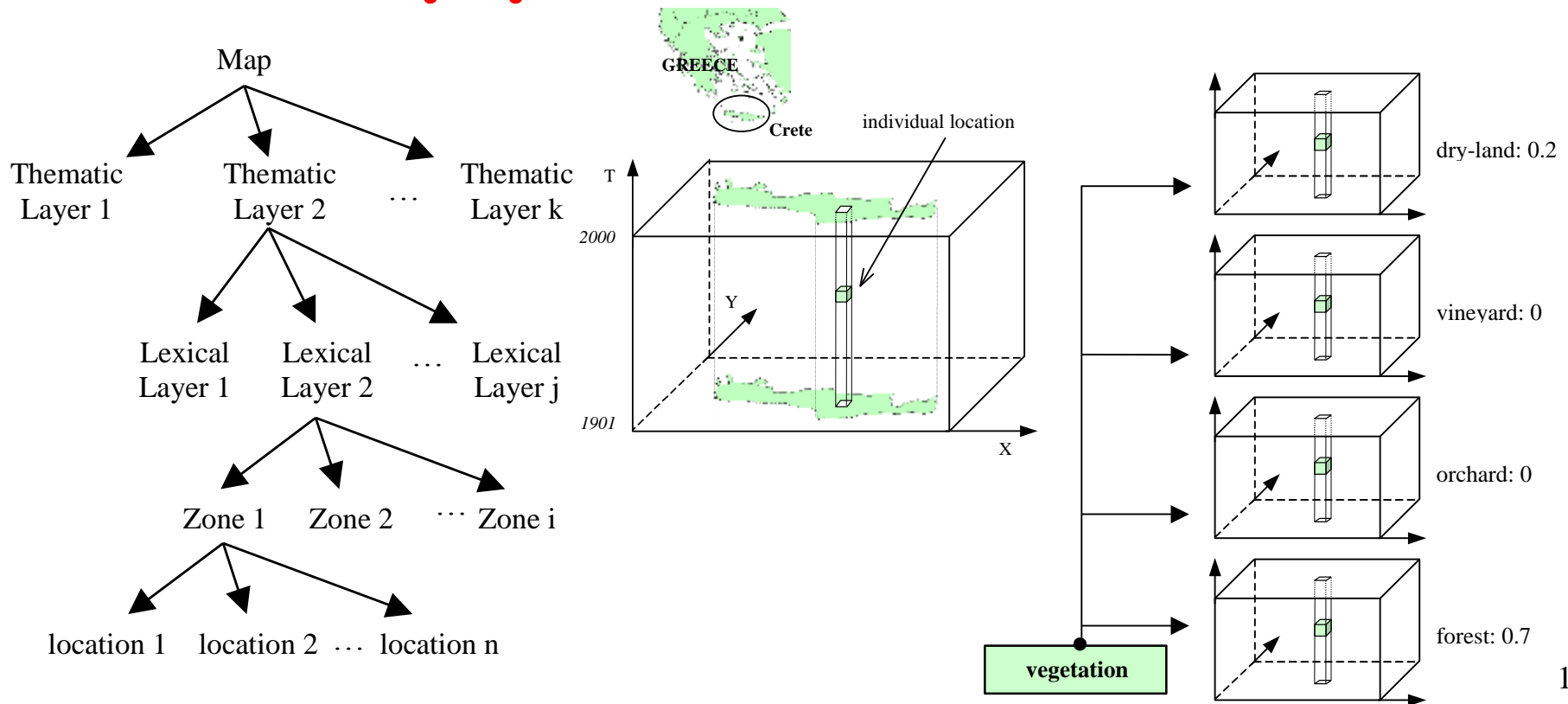
Representation Models

- Tomlin's Model...
 - In a **dynamic** world ...



Representation Models

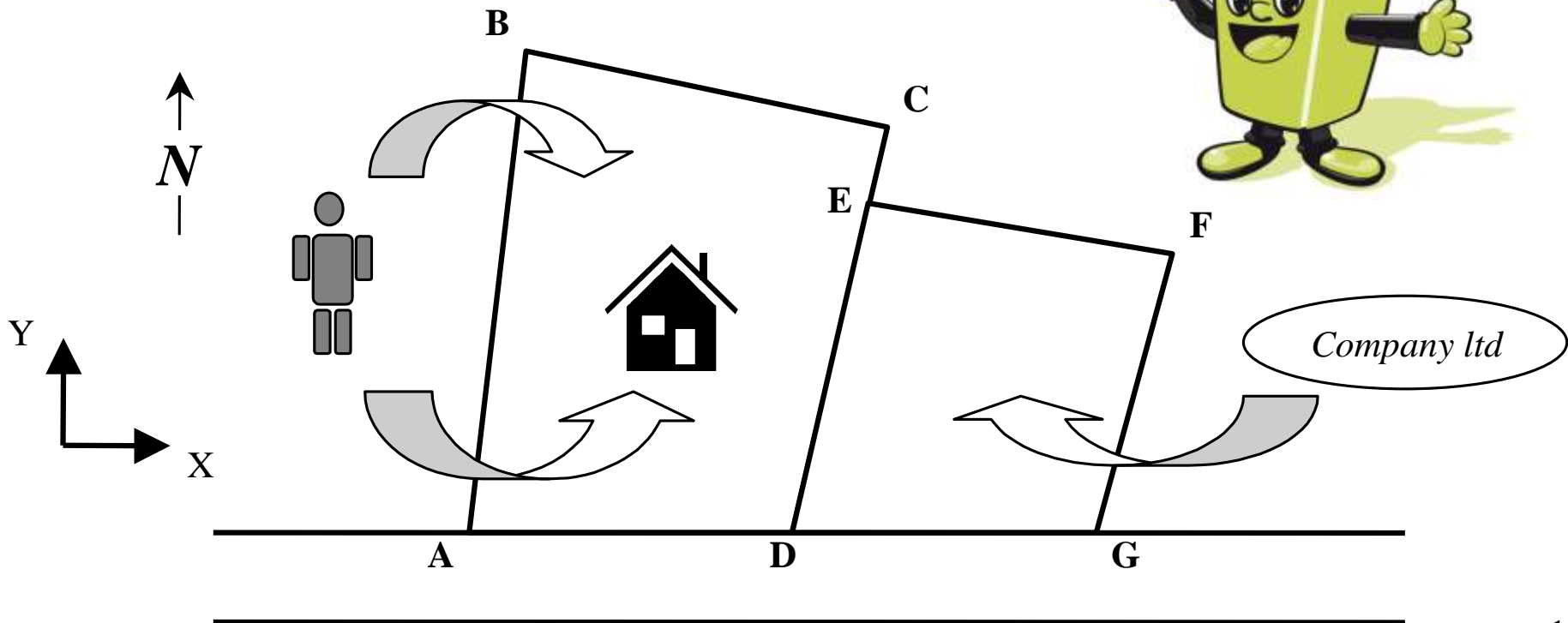
- Tomlin's Model...
 - In a **fuzzy dynamic** world ...



Representation Models

Entities?
Relations?

- We should be able to represent ...
 - Spatial **Entities** + Spatial **Relations**



Representation Models

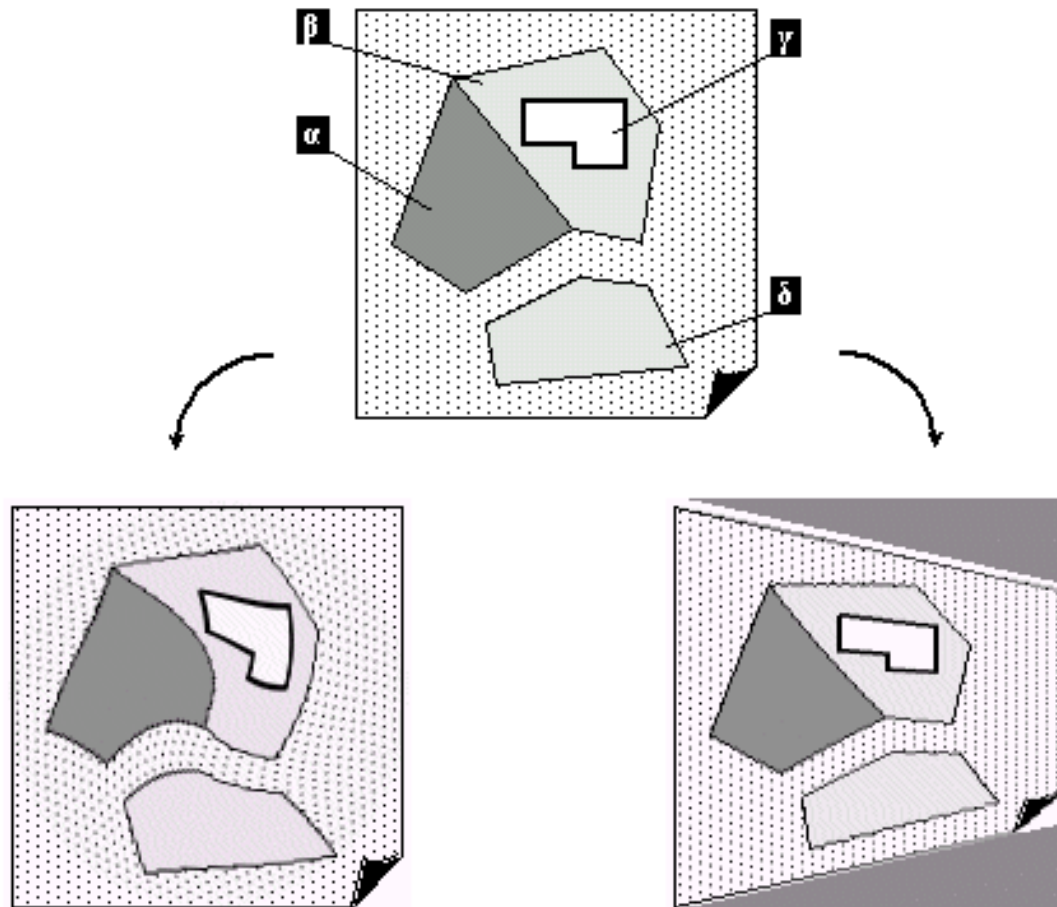
- **Spatial relations...**
 - they come from ...
 - the relative positions of geographic entities in space
 - most common ...
 - **topological** relations
 - neighbor, overlap, etc.
 - **order** relations (direction relations)
 - in_front_of, north_of, etc.
 - **metric** relations (distance relations)
 - near, far, etc.

Representation Models

- **Topological** relations...
 - topology ...
 - studies the geometric relations of objects that are preserved under any ...
 - translation,
 - rotation or (topological transformations)
 - scale change

Representation Models

- **Topological** relations...



Representation Models

- **Topological** relations...
 - a model for representing them ...
 - for two entities A, B
 - B_A, B_B the border lines
 - I_A, I_B the interior areas
 - check the four intersections

$$B_A \cap B_B \quad I_A \cap I_B \quad I_A \cap B_B \quad B_A \cap I_B$$

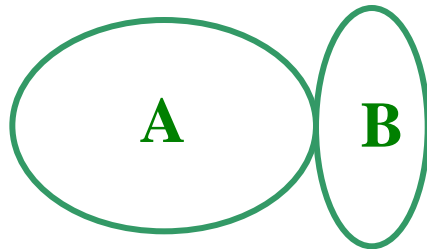
Representation Models

- **Topological** relations... (Egenhofer's relations)

	$E_A \cap E_B$	$I_A \cap I_B$	$B_A \cap I_B$	$I_A \cap E_B$
<i>A is disjoint from B</i>	\emptyset	\emptyset	\emptyset	\emptyset
<i>A meets B</i>	$\neq \emptyset$	\emptyset	\emptyset	\emptyset
<i>A overlaps B</i>	$\neq \emptyset$	$\neq \emptyset$	$\neq \emptyset$	$\neq \emptyset$
<i>A is inside B</i>	\emptyset	$\neq \emptyset$	$\neq \emptyset$	\emptyset
<i>A contains B</i>	\emptyset	$\neq \emptyset$	\emptyset	$\neq \emptyset$
<i>A covers B</i>	$\neq \emptyset$	$\neq \emptyset$	\emptyset	$\neq \emptyset$
<i>A is covered by B</i>	$\neq \emptyset$	$\neq \emptyset$	$\neq \emptyset$	\emptyset
<i>A is equal to B</i>	$\neq \emptyset$	$\neq \emptyset$	\emptyset	\emptyset

Representation Models

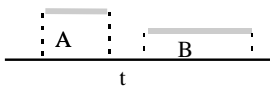
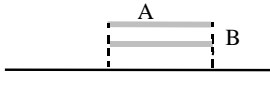
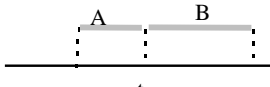
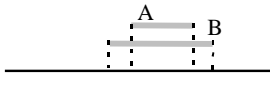
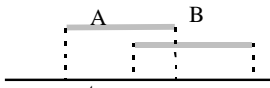
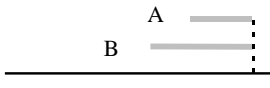

- **Topological** relations...
 - A 3x3 (or 9) intersection matrix ...
 - specifies the topological relationship
 - e.g., A TOUCH B

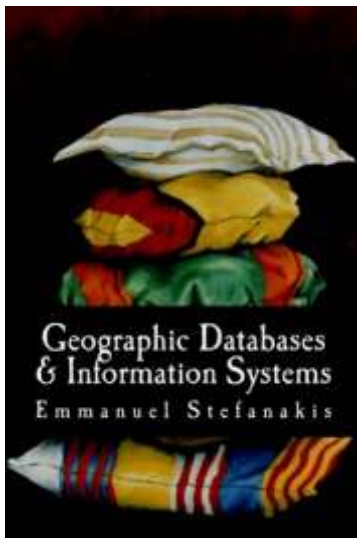


		B		
		b	i	e
A	b	1	0	1
	i	0	0	1
	e	1	1	1

Representation Models

- Temporal relations...** (Allen's relations)

Temporal relation	Definition
A before B	
A equal to B	
A meets B	
A during B	
A overlaps B	
A ends B	
A starts B	



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