

Stefanakis, E., 2014. *Geographic Databases and Information Systems*. CreateSpace Independent Publ. [In English], pp.386.

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## *Chapter 1*

# Nature of Geographic Data

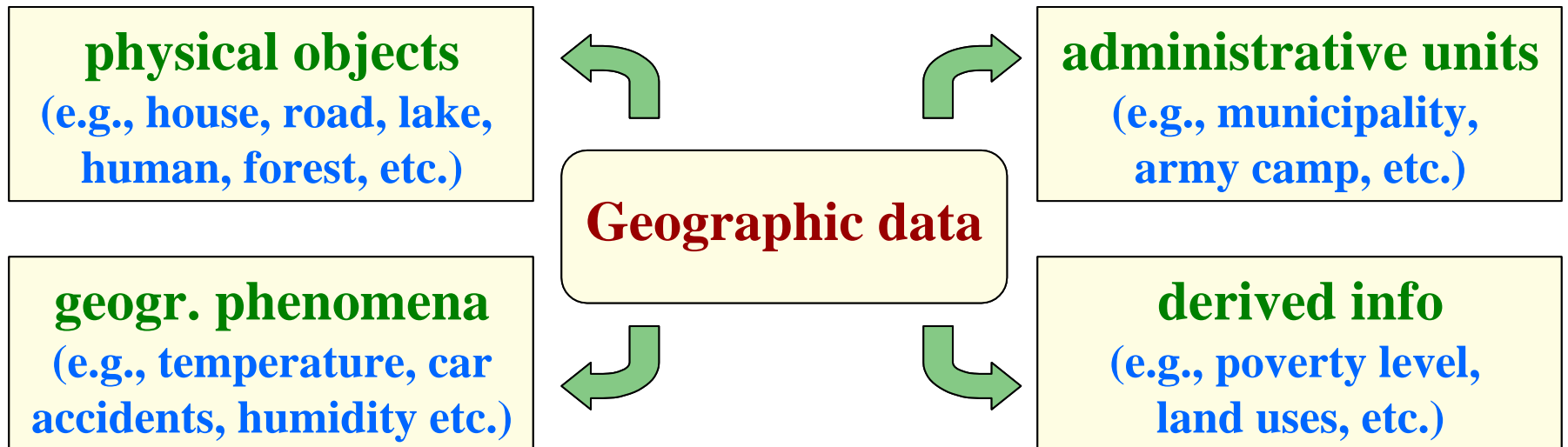
**Emmanuel Stefanakis**

<http://www2.unb.ca/~estef/>

# The nature of geographic data

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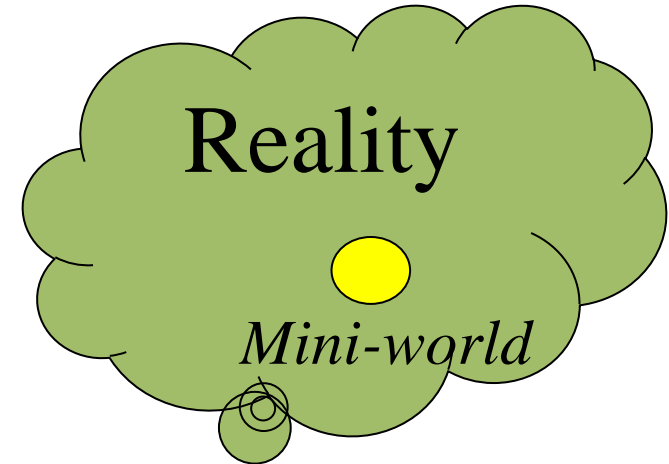
- Geographic data...
  - special category of data ...
    - distributed in space
    - changes over time



# Reality and Mini-world

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- Reality ...
  - is very complicated
- To describe the reality...
  - We usually focus into a small part of it
  - ... called “Mini-world”

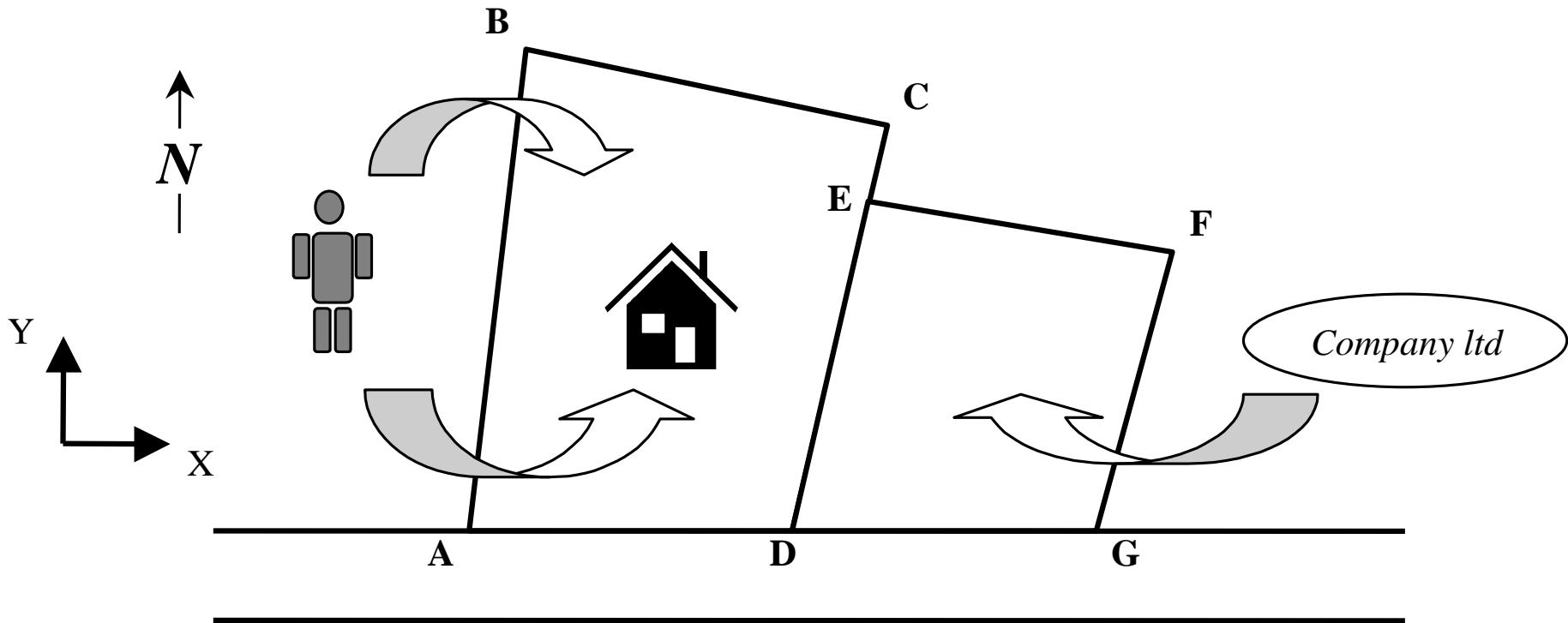


# Reality and Mini-world

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- Miniworld of Cadastre

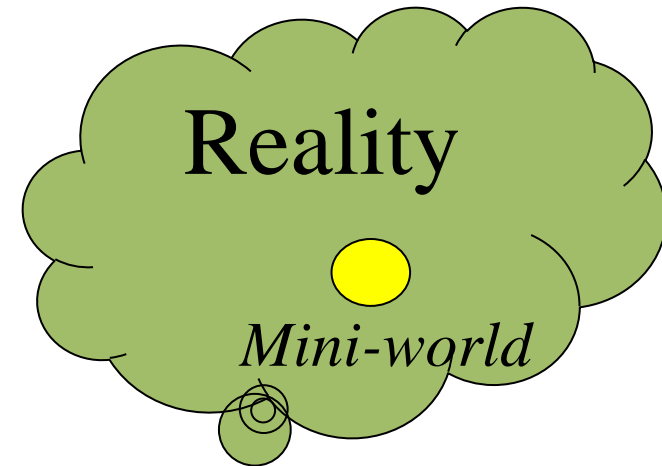
– example ...



# Reality and Mini-world

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- The miniworld...
  - split into small units (entities)
  - consists of entities
    - distinct and interrelated
- Entity ...
  - a unit or object with ...
    - physical or conceptual existence

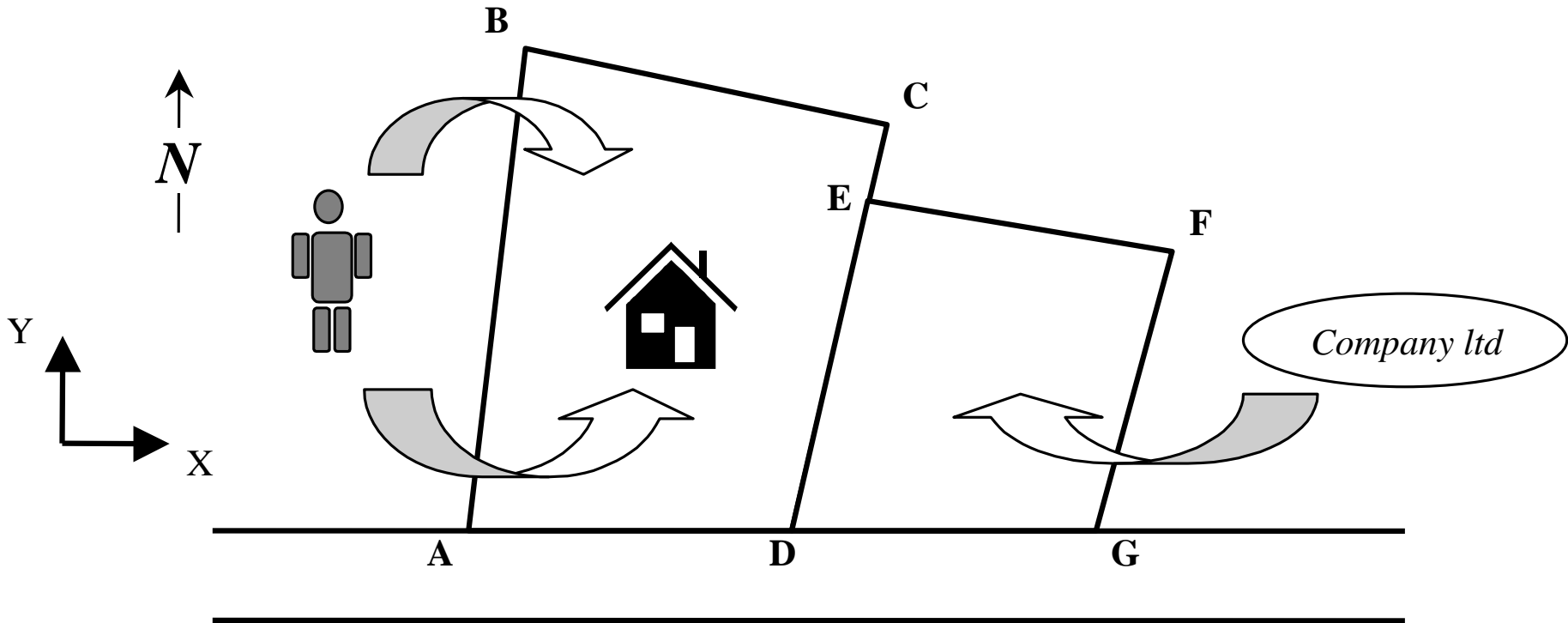


# Reality and Mini-world

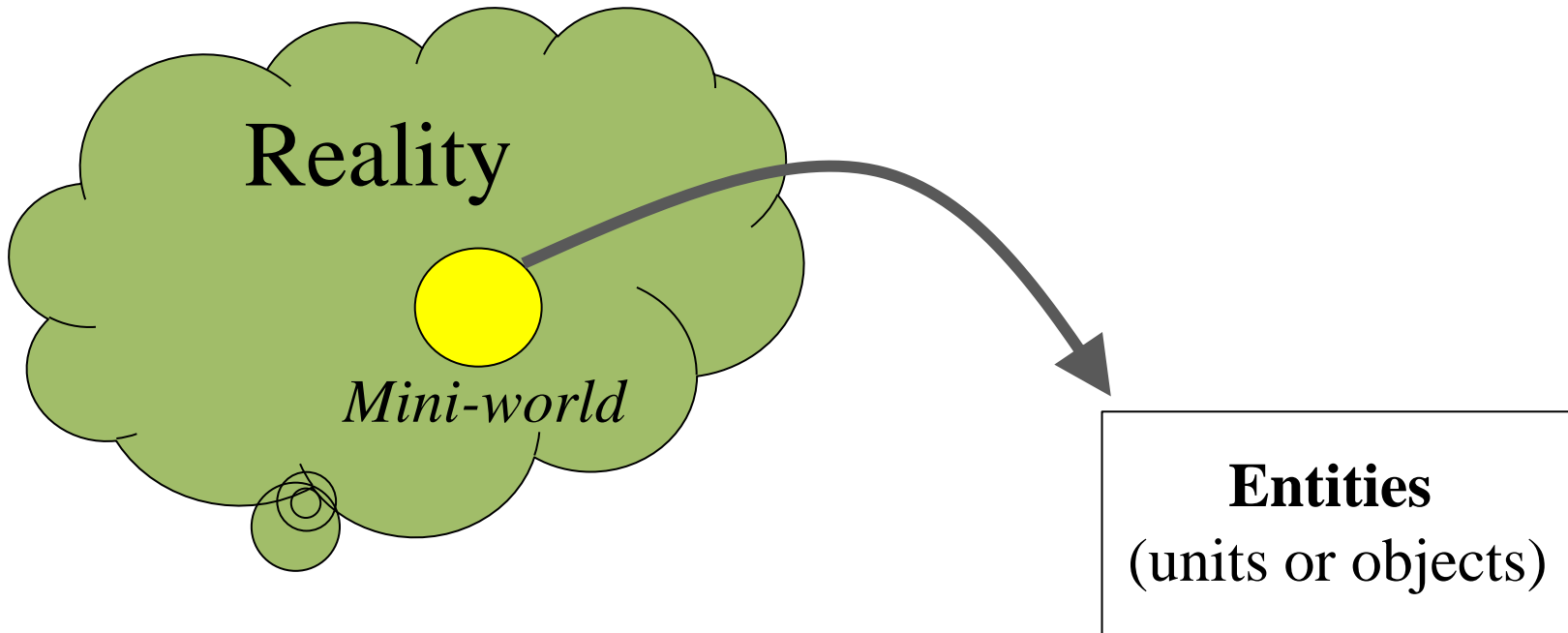
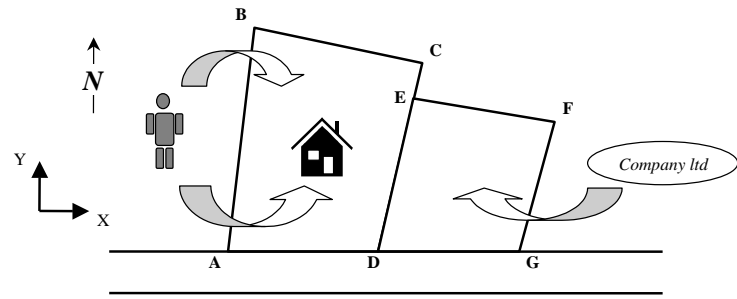
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- Miniworld of Cadastre...

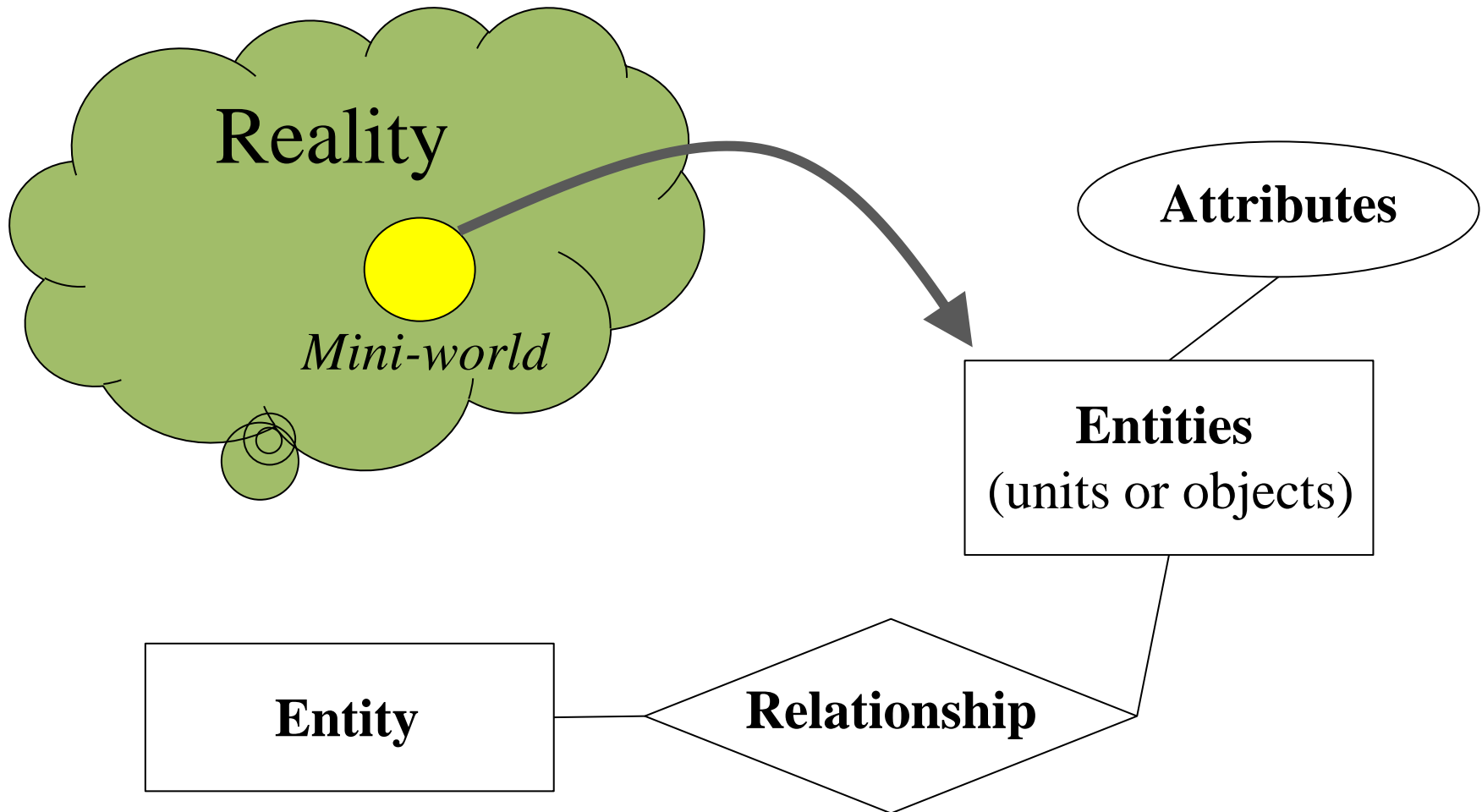
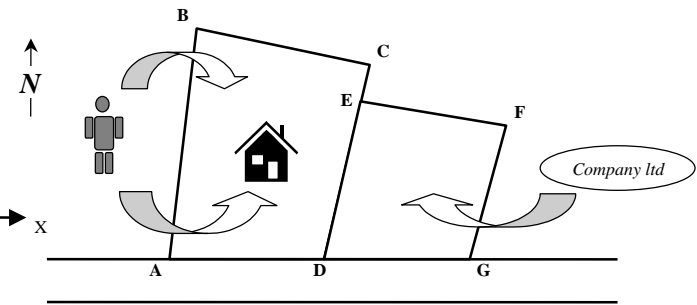
– example ...



# Reality and Mini-world



# Reality and Mini-world



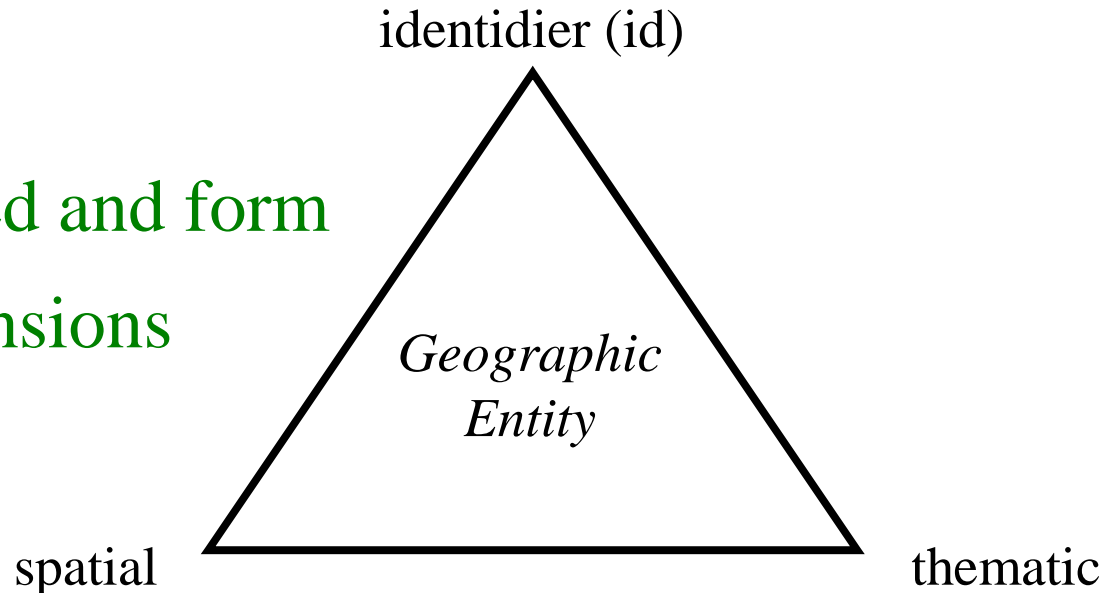


# Entities

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- An **entity** is described by...
  - a set of properties (attributes)
    - e.g., a house has an address, date of construction, number of rooms, etc.

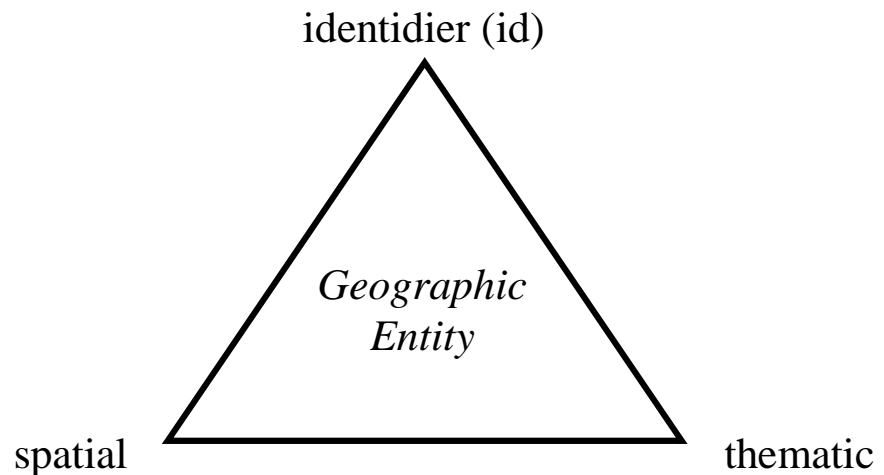
- Attributes...
  - are classified and form entity dimensions



# Entities and attributes

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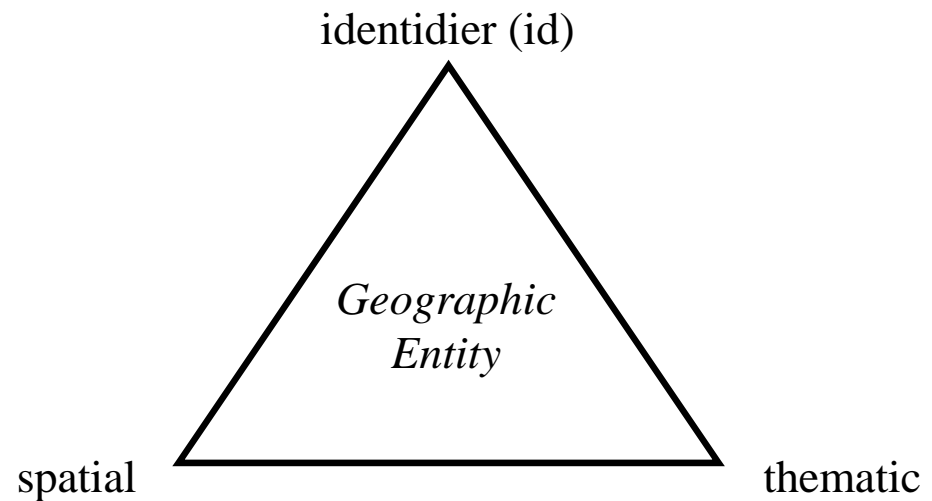
- Identifier (id) ...
  - a reference to entities
    - arbitrary names, geogr. names, numeric codes
  - the system assigning id's guarantees...
    - uniqueness, stability, precision, consistency



# Entities and attributes

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- Thematic dimension ...
  - all non-spatial properties of an entity
  - application dependent
  - ... multimedia objects (sound, pictures, movies)



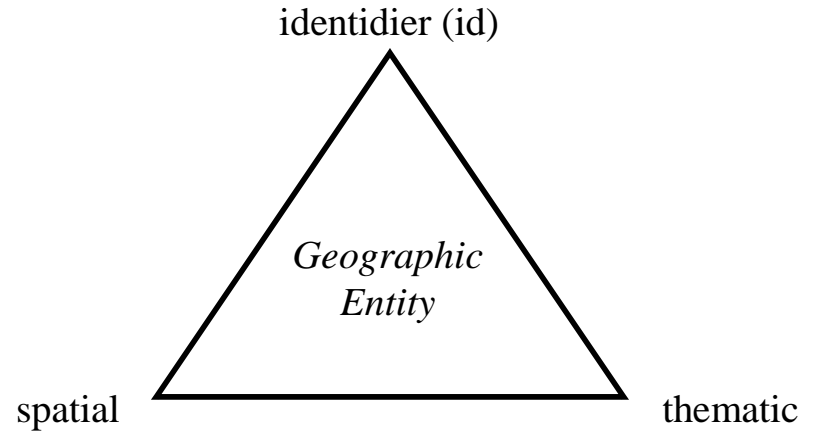
# Entities and attributes

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- Spatial dimension ...



- Geographic position
- Geometry
- Graphical Parameters
- Spatial relationships



# Entities and attributes

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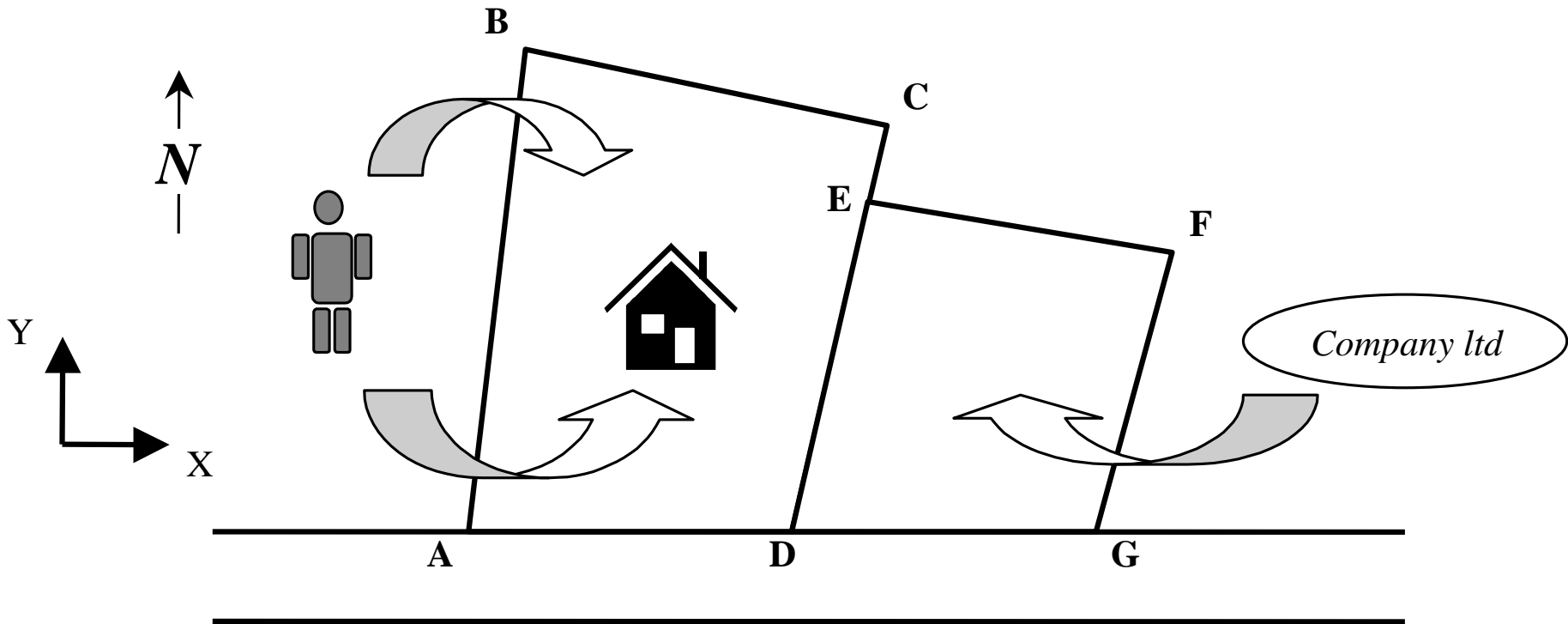
- Spatial dimension...
  - spatial properties describe entity's...
    - geographic position
      - where is it ? (coordinates, address, etc.)
    - geometry
      - which are its geometric properties ? (shape, area ...)
    - graphical parameters
      - how is it represented in a graphical representation ? (map symbols, etc.)
    - spatial relations with other entities
      - which are its topological, metric and direction relationships with other entities? (overlaps, near, north of, etc.)

# Reality and Mini-world

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- Miniworld of Cadastre...

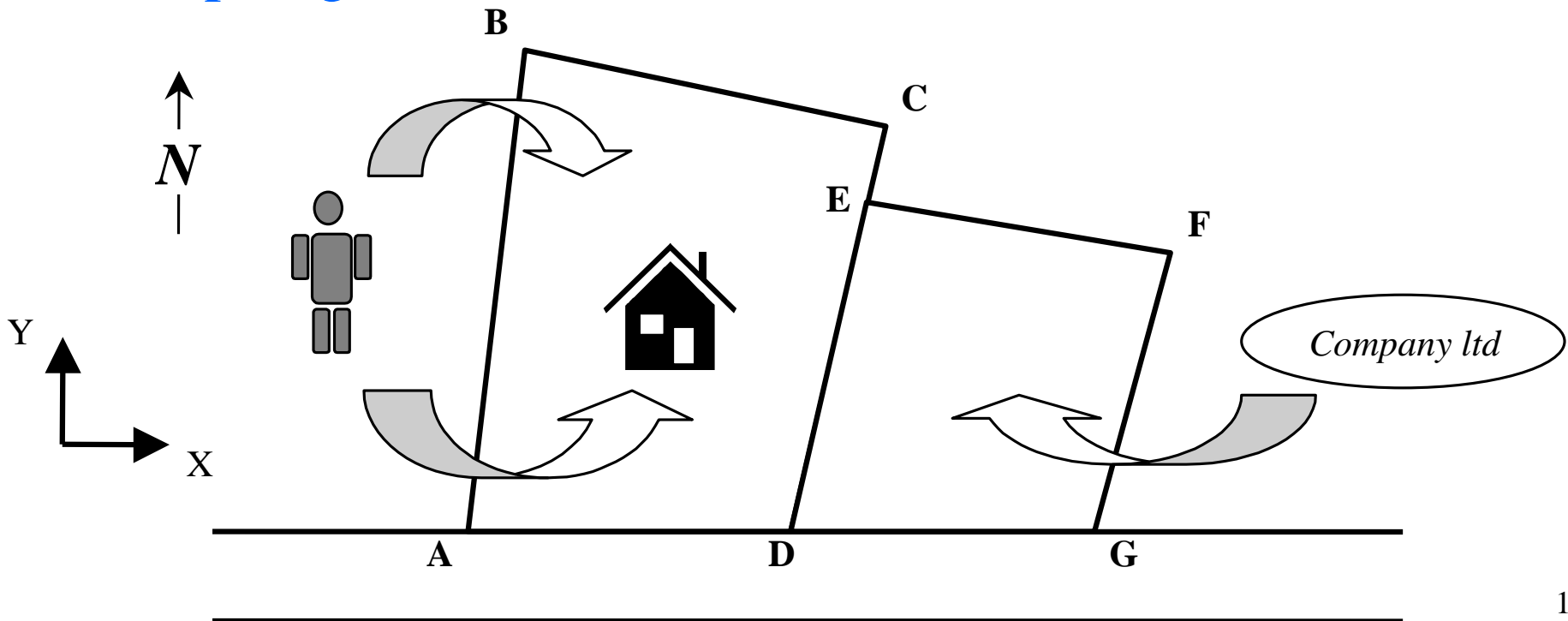
– example ...



# Spatial Relations

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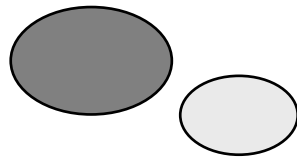
- Metric Relations
- Direction Relations
- Topologic Relations



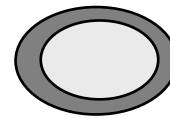
# Spatial Relations

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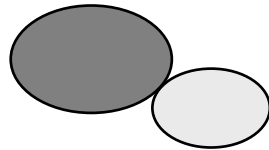
- Topologic Relations (Egenhofer's model)...



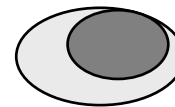
A is disjoint from B



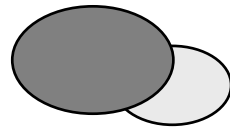
A contains B



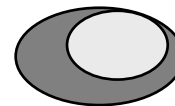
A meets B



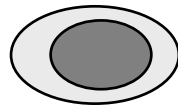
A covers B



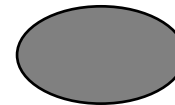
A overlaps B



A is covered by B



A is inside B



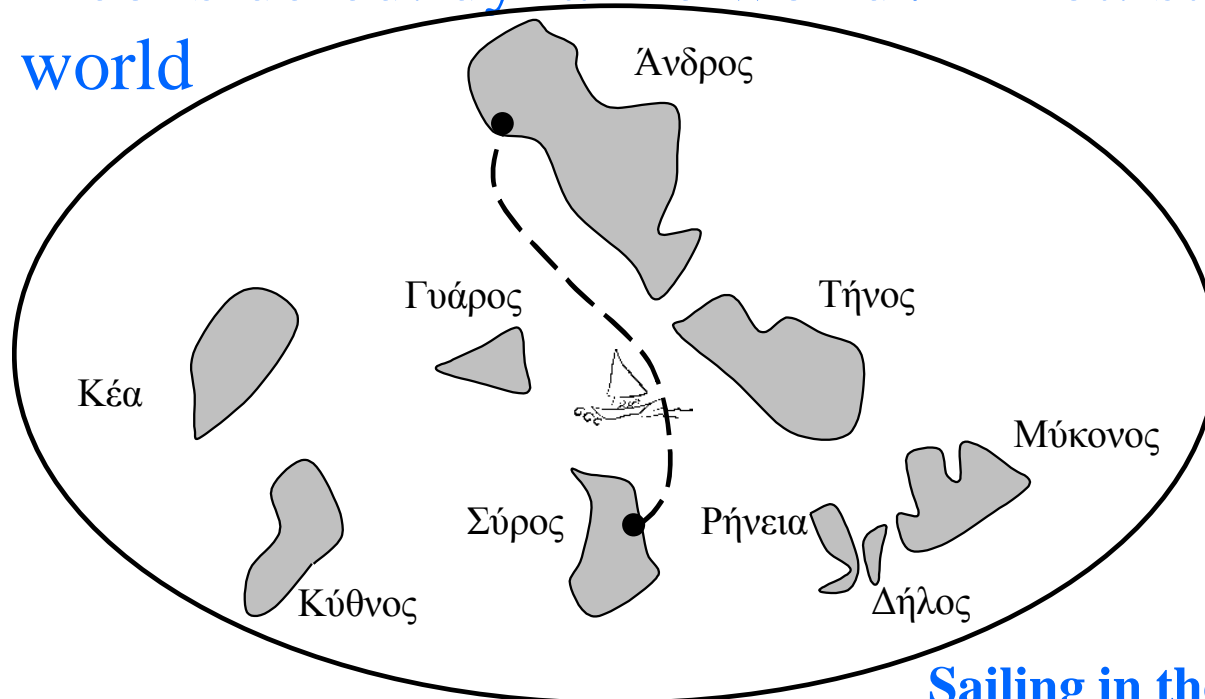
A is equal to B



# The nature of geographic data

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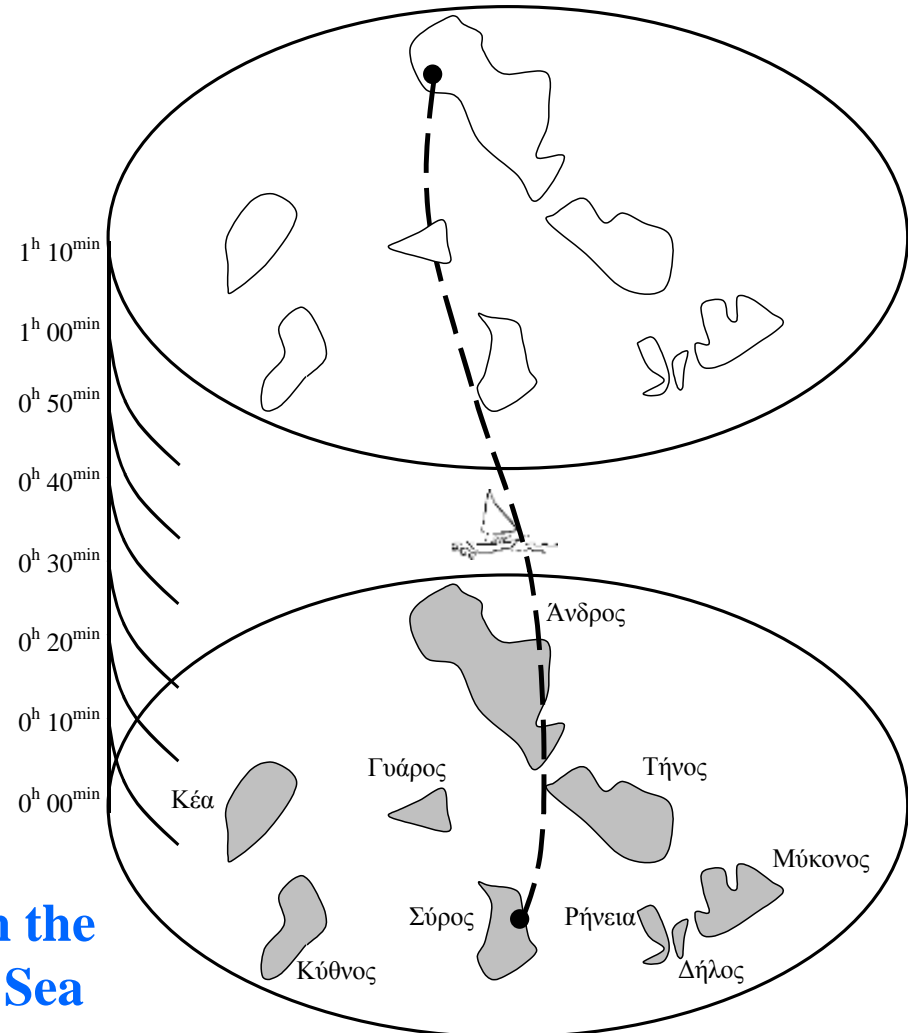
- Dynamic geographic entities ...
  - Attributes (spatial and thematic) change over time
- if considered: dynamic world / if not: static world



# The nature of geographic data

- Dynamic geographic entities ...
  - space-time (chorochronos)

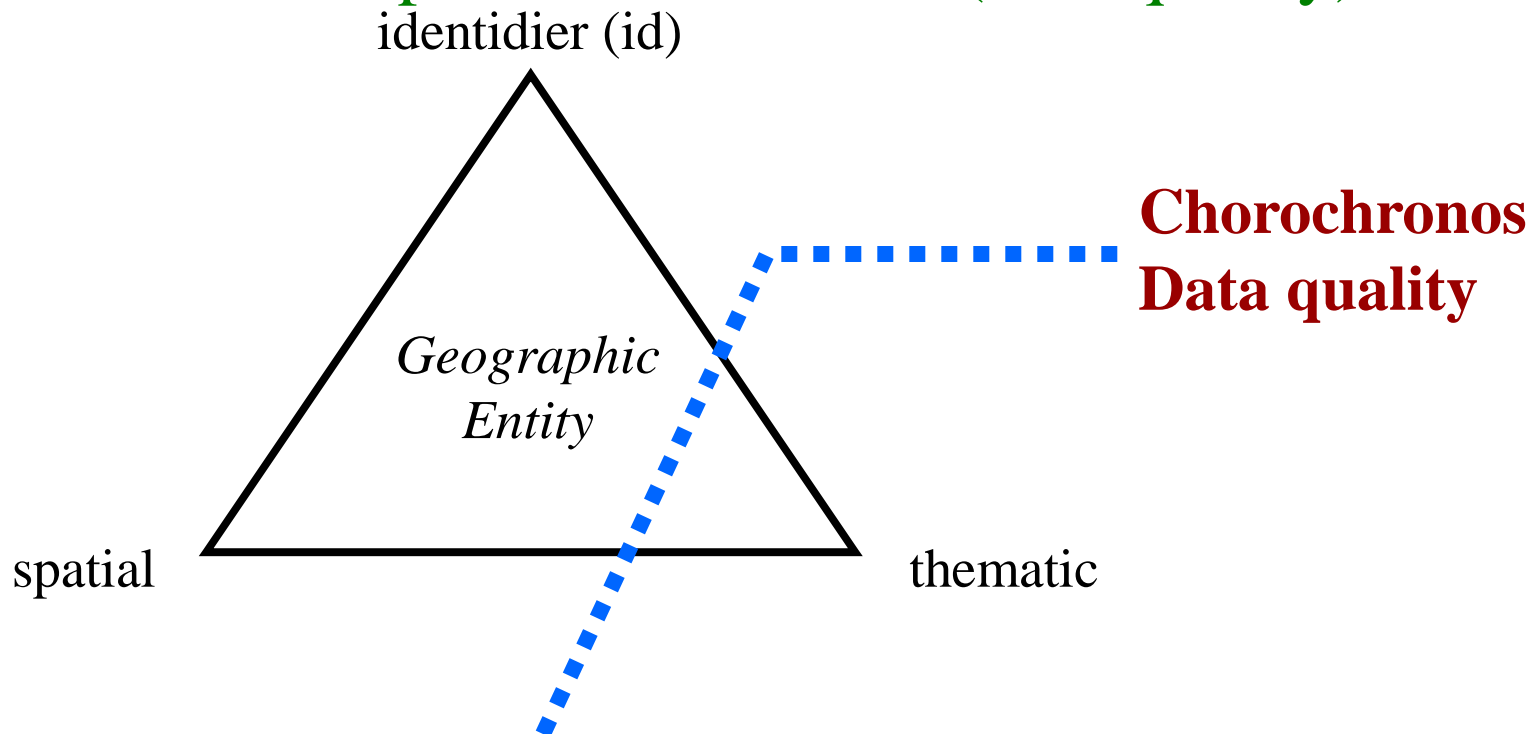
Sailing in the Aegean Sea



# The nature of geographic data

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- Geographic entities (properties)...
  - change over time (“chorochronos”)
  - are accompanied with errors (data quality)



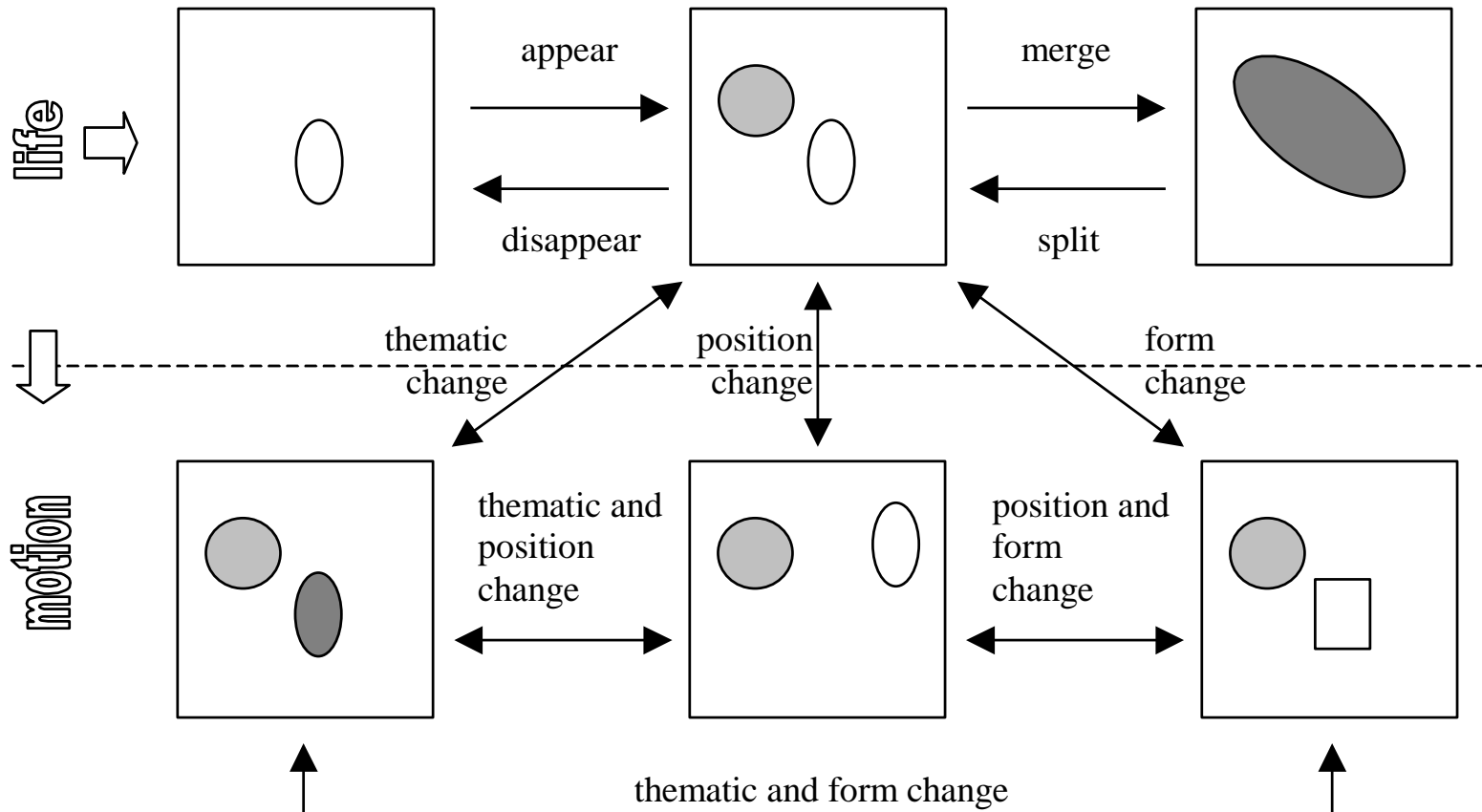
# The nature of geographic data

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- Dynamic geographic entities ...
    - two types of changes over time ...
      - life change
        - changes that affect the existence
      - motion change
        - changes in either spatial or thematic properties
- “life and motion of geographic entities”

# The nature of geographic data

- Life and motion of geographic entities ...



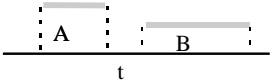
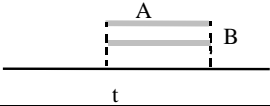
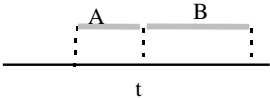
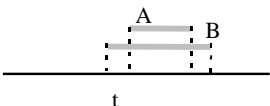
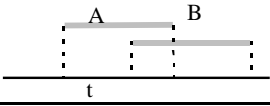
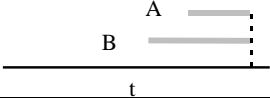

# The nature of geographic data

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- Temporal relationships...
  - between dynamic entities
  - numerous and complex
  - time ...
    - is linear and continuous
  - for a pair of instant phenomena
    - which one occurs first ?
  - for a pair of phenomena with duration
    - do they overlap ?

# The nature of geographic data

- Temporal relationships...

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

# The nature of geographic data

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- Data quality ...
  - values assigned to an entity properties ...
    - are collected by measurements
    - those measurements are accompanied by errors
  - data quality offers ...
    - a measure of how reliable is data
    - so that it is handled effectively



# Measurement...

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- Assignment of values...
- ...to the attributes of geographic entities

VALUES → ATTRIBUTES

# Levels of Measurements...

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- There are four levels/scales of measurements
  - NOMINAL
  - ORDINAL
  - CARDINAL
  - RATIONAL

# Levels of Measurements...

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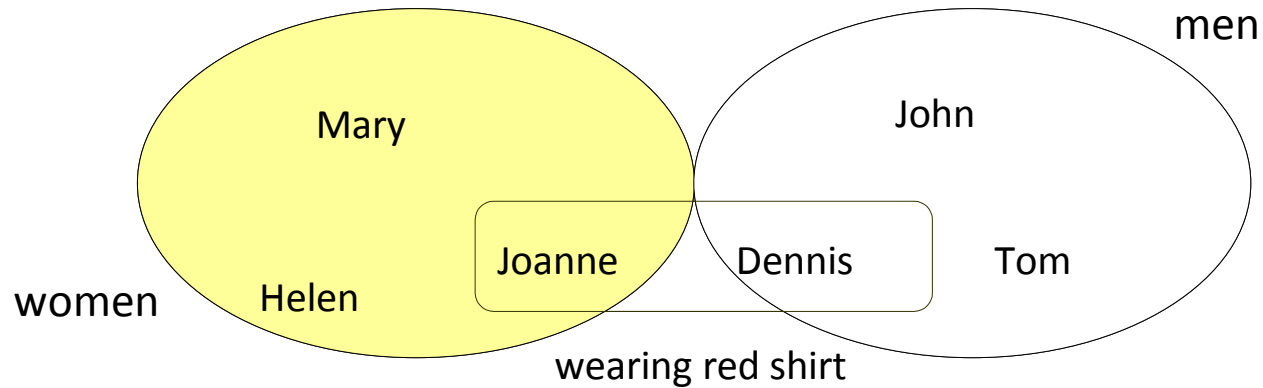
- **NOMINAL**
  - Assigns identifiers or names
- **ORDINAL**
  - Notion of ordering:
    - SOIL: 1:dry, 2:little wet, 3:wet, 4:very wet
- **CARDINAL** (judge about differences)
  - Arbitrary origin – arbitrary unit
    - A: 10° Celsius; B: 20°; C: 30°; D: 45° (twice as warm ???)
- **RATIONAL** (extract ratios)
  - Absolute origin – arbitrary unit
    - A: 50Kgr ; B: 100Kgr (double weight)

# Levels of Measurements...

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- Marathon Race....

– NOMINAL



# Levels of Measurements...

---

- Marathon Race....
  - ORDINAL

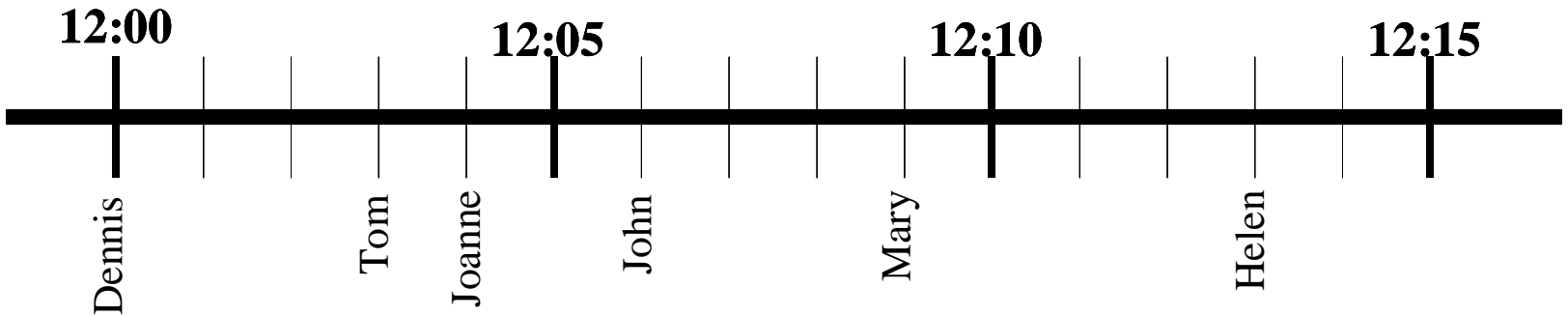
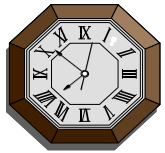
Order	Women	Men
1 <sup>st</sup>	Joanne	Dennis
2 <sup>nd</sup>	Mary	Tom
3 <sup>rd</sup>	Helen	John

# Levels of Measurements...

---

- Marathon Race....

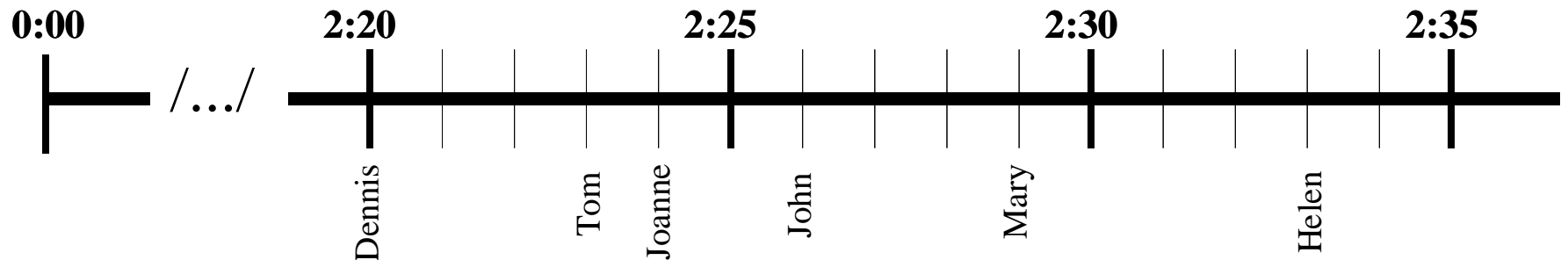
– CARDINAL



# Levels of Measurements...

---

- Marathon Race....
  - RATIONAL

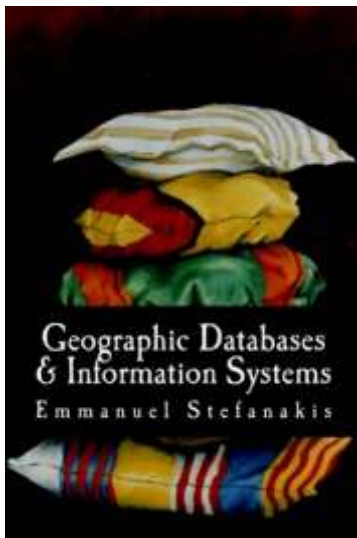


# Levels of Measurements...

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<b>Level</b>	<b>Properties</b>	<b>Valid operations</b>
Nominal	Identification, no subject of any ordering	equation (=)
Ordinal	Ordering without any notion of spaces between the classes.	ordering (>, <)
Cardinal	Continuous measurements, with specific distances from an arbitrary origin.	addition, subtraction, scale change
Rational	Continuous measurements, with specific distances from an absolute origin.	Multiplication, division (rates)





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