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## *Chapter 10*

# Geographic Data Models

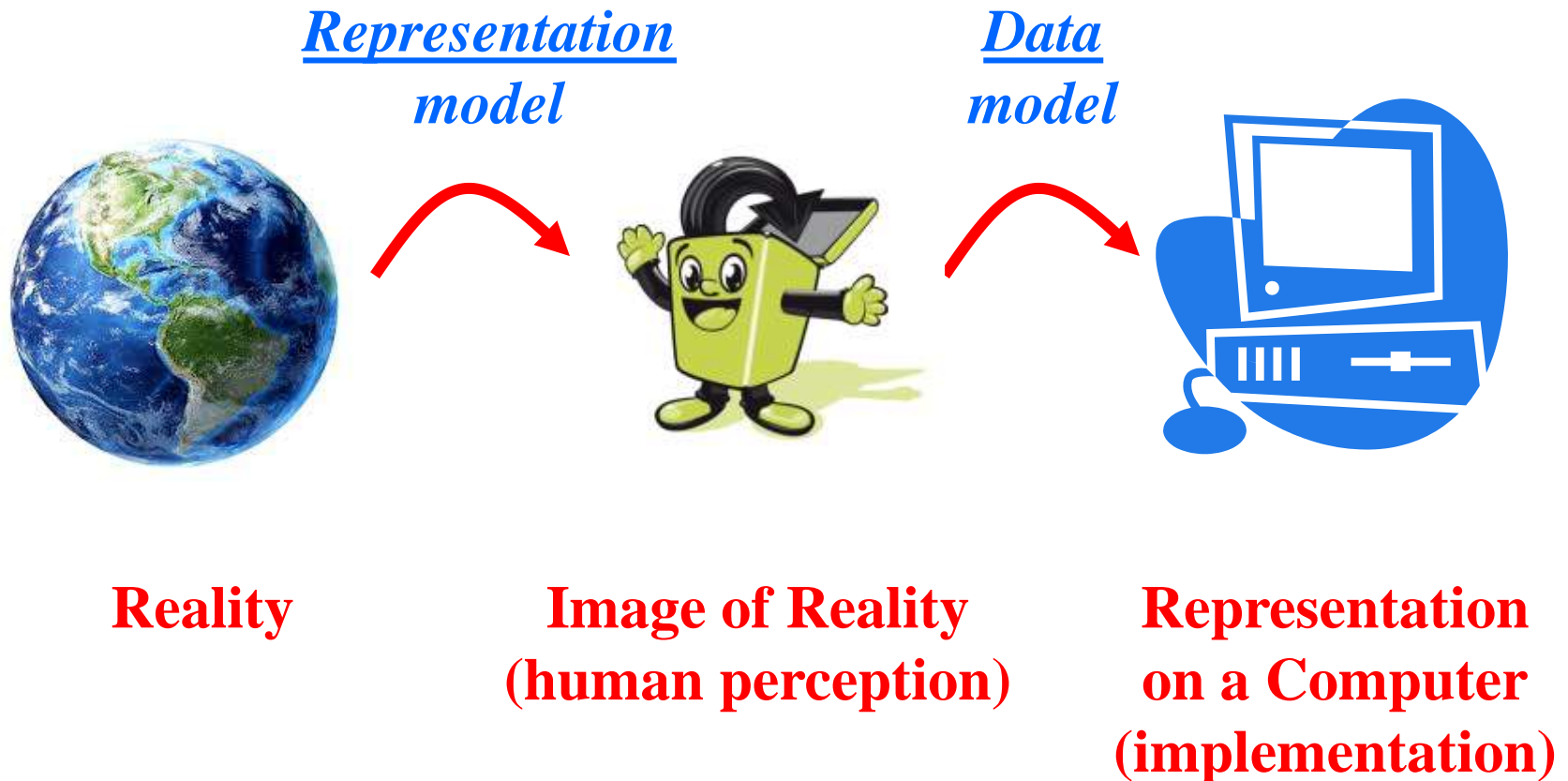
Emmanuel Stefanakis

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

# Models...

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- Representation of **Reality**...



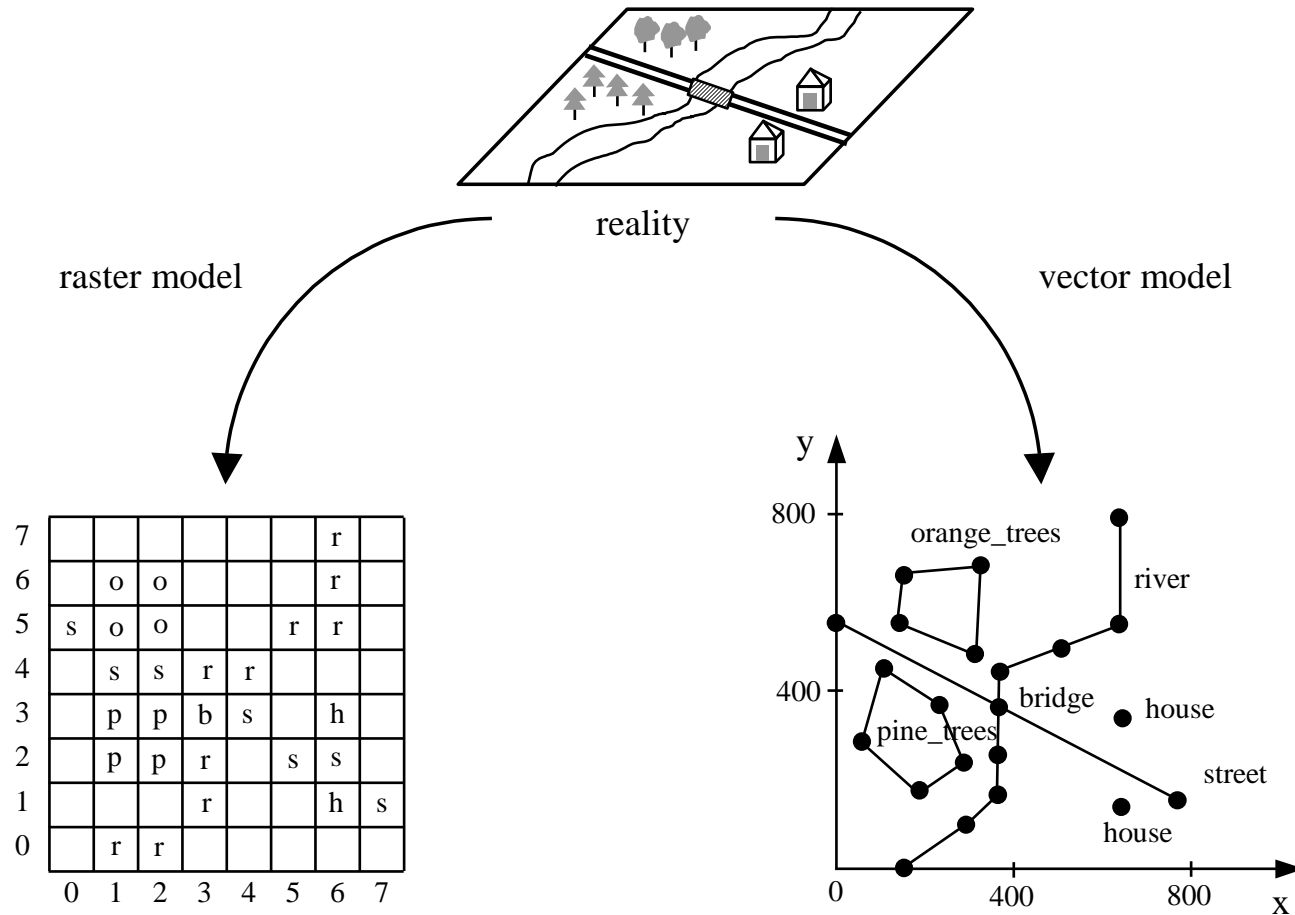
# Data Models

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- The representation of reality in a computer
- Two basic data models...
  - **vector** model
    - basic construct: the vector
  - **raster** model
    - basic construct: the cell (pixel)

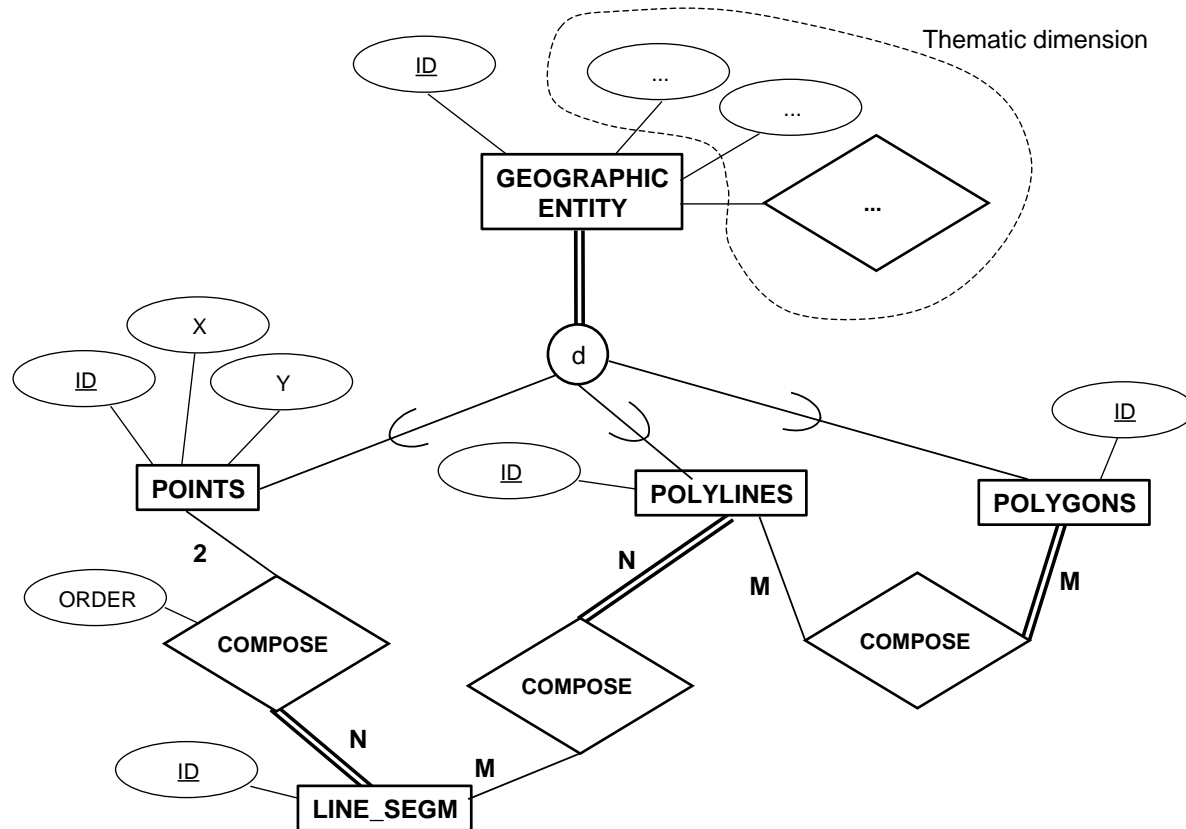
# Data Models

- Two basic data models...



# Data Models

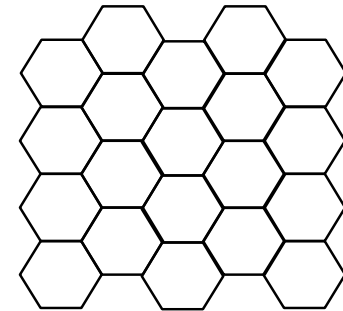
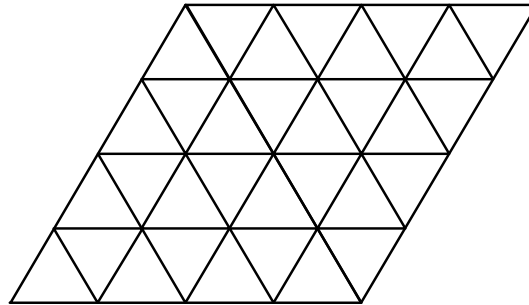
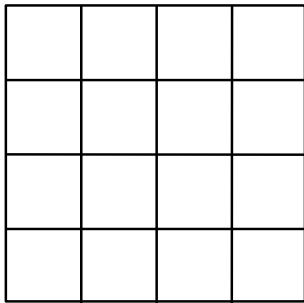
- Conceptual Modeling ...
  - an example (vector representation)...



# Data Models

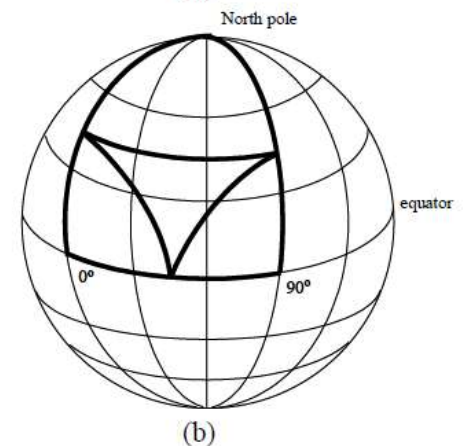
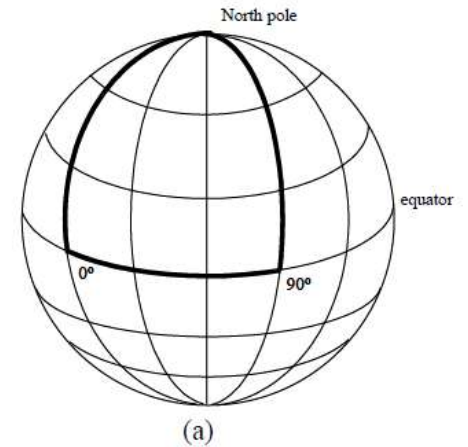
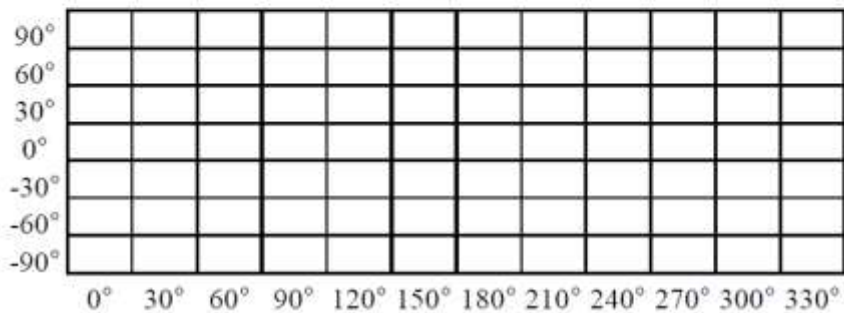
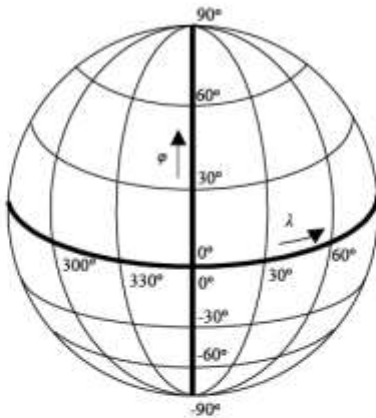
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- Raster models...
  - Pixels
    - Different tessellations (partitioning of space)



# Data Models

- Raster models...
  - Spherical surface (partitioning)



# Data Models

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- The representation of reality in a computer
  - is accompanied with an **abstraction**
    - **discretization of space**
- Both representation models ignore it...
  - continuous fields ...
    - assume a **infinite** number of **locations**...
  - discrete entities ...
    - assume an **infinite** number of **points** to represent linear objects (e.g., the seashore)



# Raster Model - Discrete representation

- Problems from the discrete representation...
  - Pixel size is ... significant → **Resolution**
  - Only one value is stored per pixel
    - e.g. the average or dominant value
      - of elevation or vegetation...



Land or River?

# Vector Model - Discrete representation

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- Problems from the discrete representation...
  - The coordinates  $(\varphi, \lambda)$  describing a location
    - have a limited number of digits
      - when stored in computer memory

» e.g.,  $\varphi = 45.2345$   
 $\lambda = -66.3456$

# Vector Model - Discrete representation

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- Problems from the discrete representation...
  - provided two lines ( $ax+by+c=0$ )
    - A :  $4x - 7y = 0$
    - B :  $3x + 7y = 21$
  - their intersection ...

$$\begin{bmatrix} 4 & -7 \\ 3 & 7 \end{bmatrix} \cdot \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 0 \\ 21 \end{bmatrix} \Rightarrow \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 0,142857 & 0,142857 \\ -0,06122 & 0,081633 \end{bmatrix} \cdot \begin{bmatrix} 0 \\ 21 \end{bmatrix} \Rightarrow \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 3 \\ 1,714286 \end{bmatrix}$$

# Vector Model - Discrete representation

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- Problems from the discrete representation...
  - if s/w represent real numbers with 5 decimal digits

- intersection point ...

$$K_5(3, 1.71429)$$

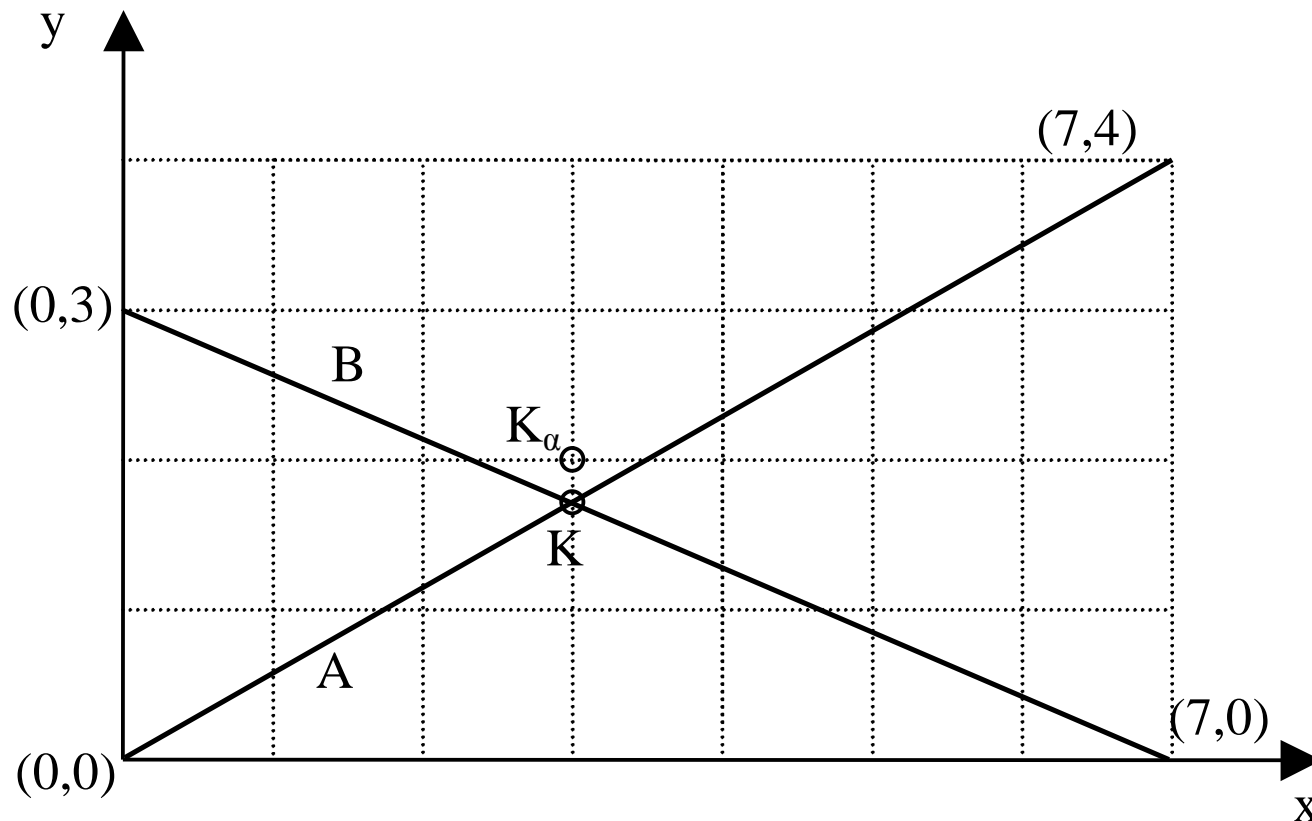
- however ...

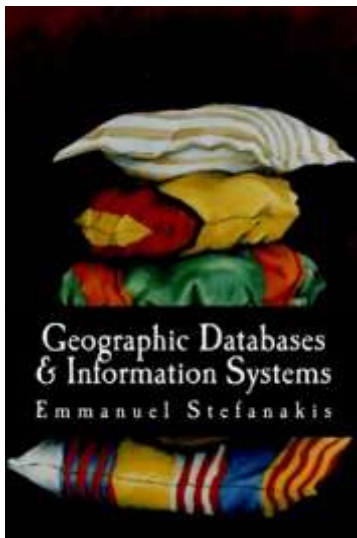
$$4x - 7y = 4*3 - 7 * 1.71429 = 0.00003 \neq 0,00000$$

# Vector Model - Discrete representation

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- The calculated intersection does not belong to the lines (!)





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