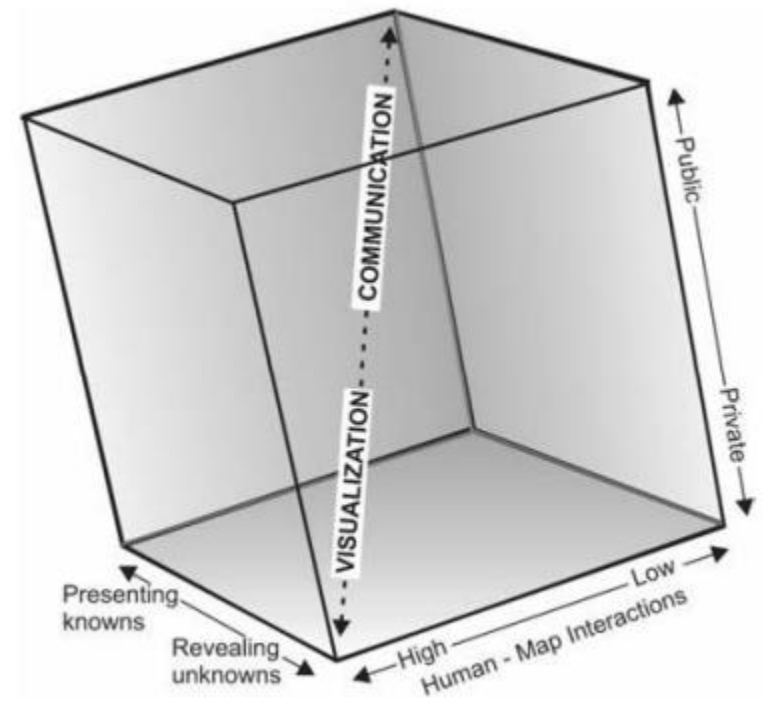
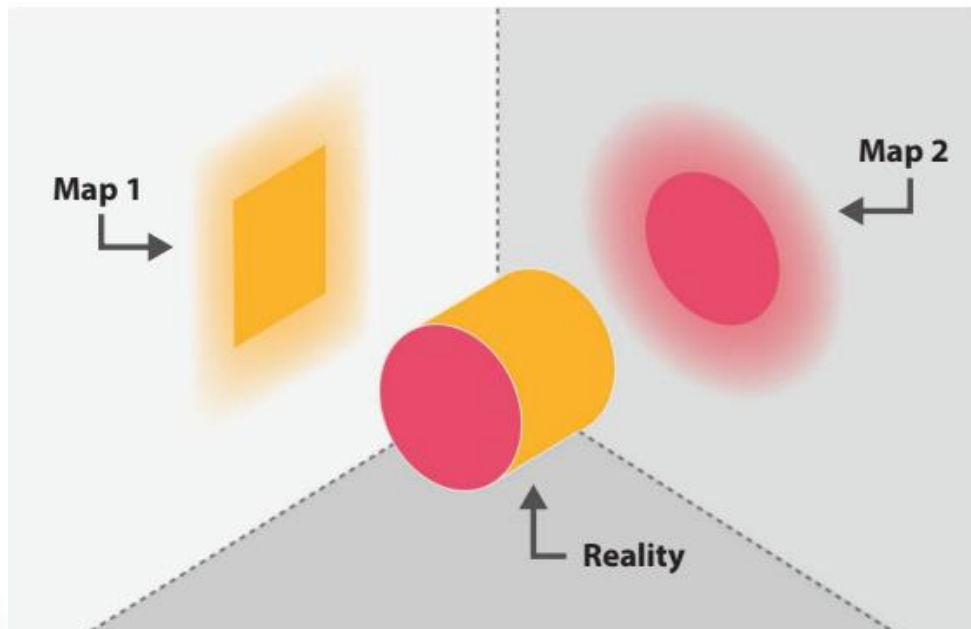


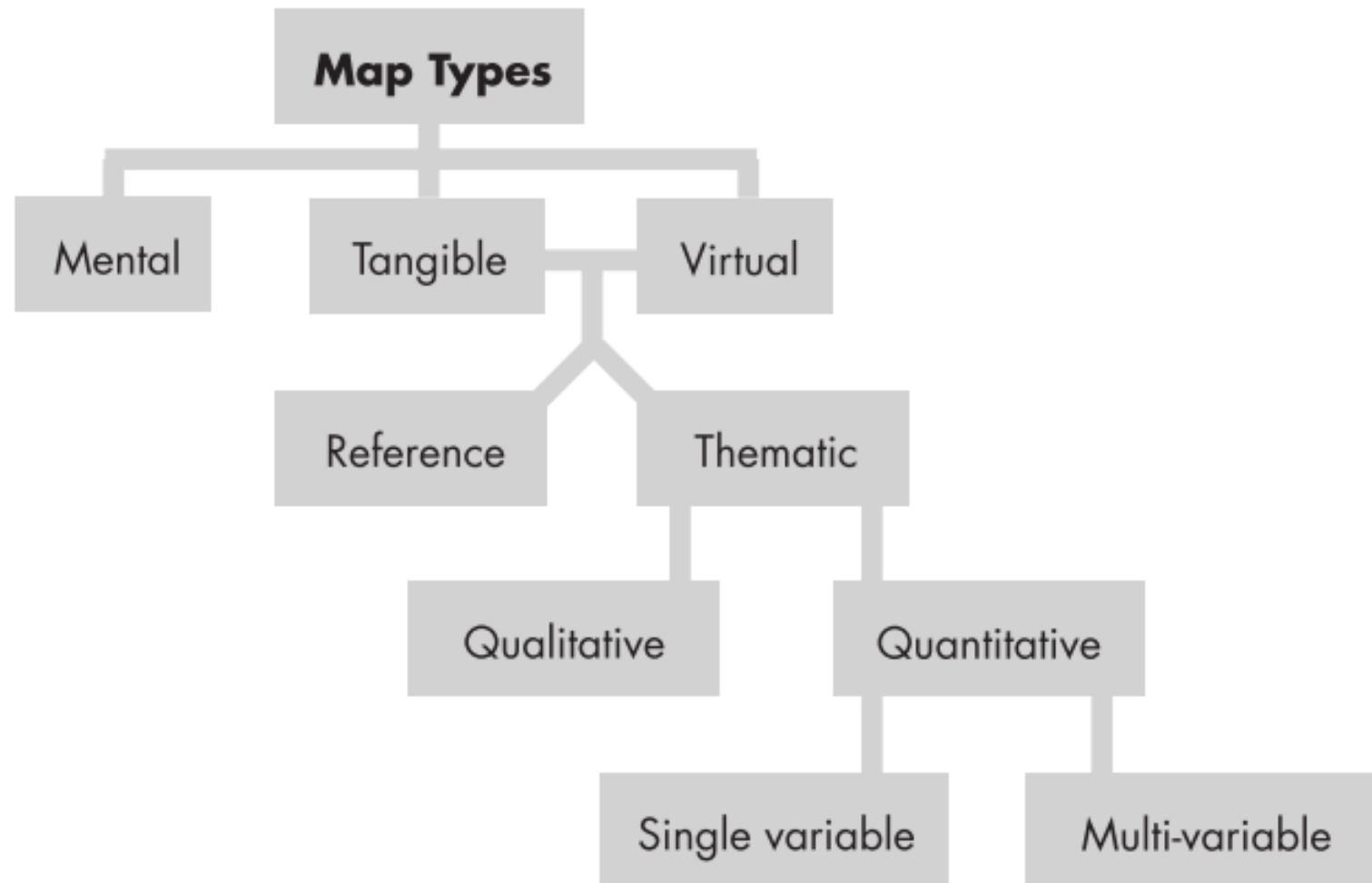
# Cartography, Visualization,

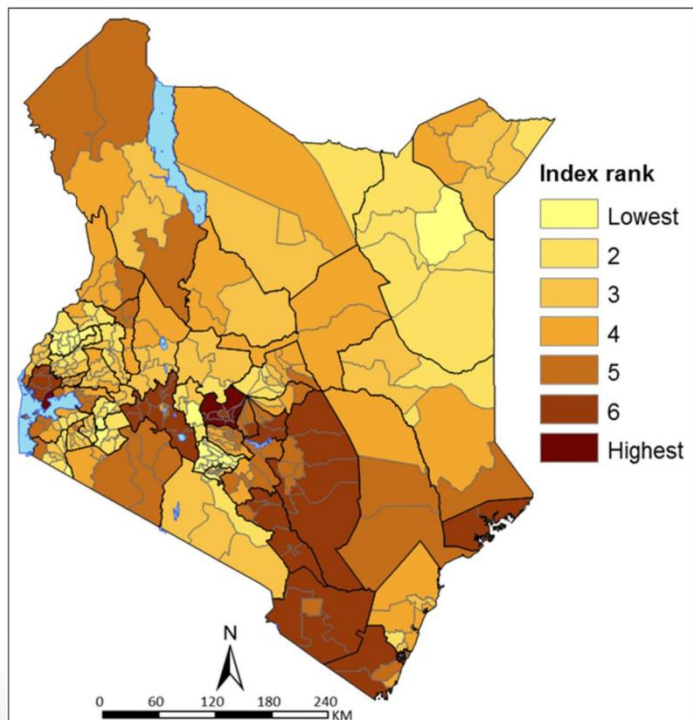
the art, science and technology of making maps, together with their study as scientific documents and works of art

Geovisualization; the representation of data in a viewable medium or format

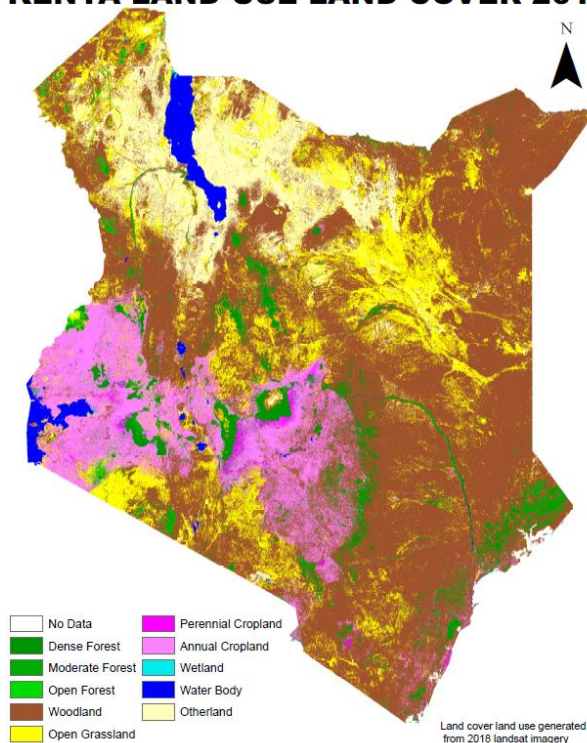


# Map

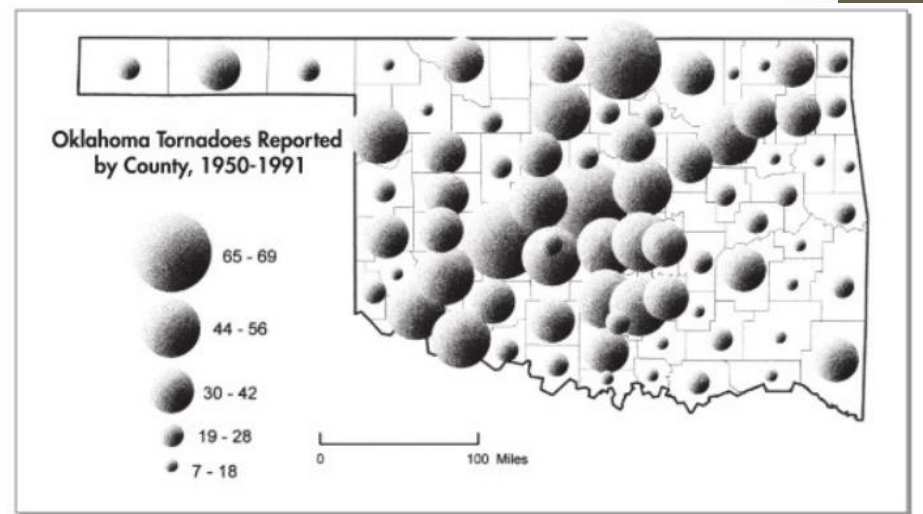




## KENYA LAND USE LAND COVER 2018



Land cover land use generated from 2018 landsat imagery







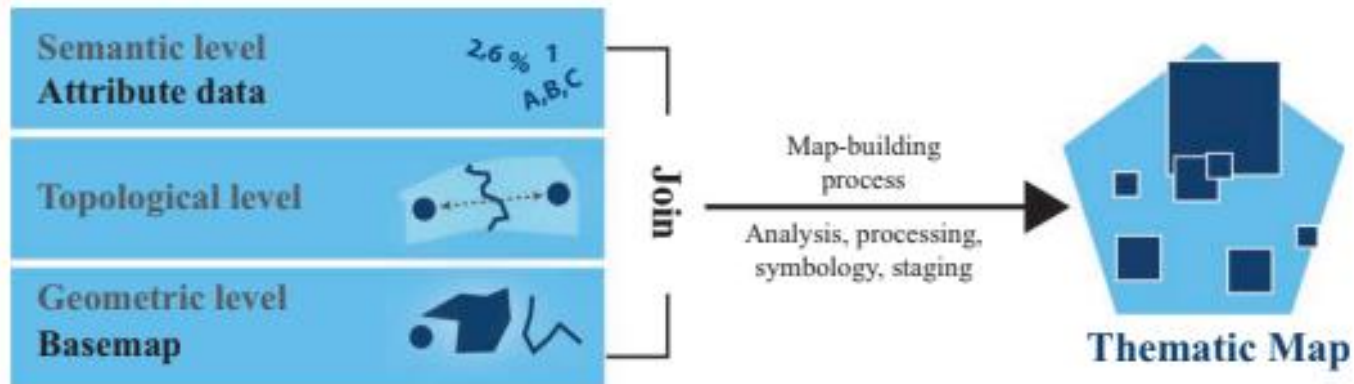
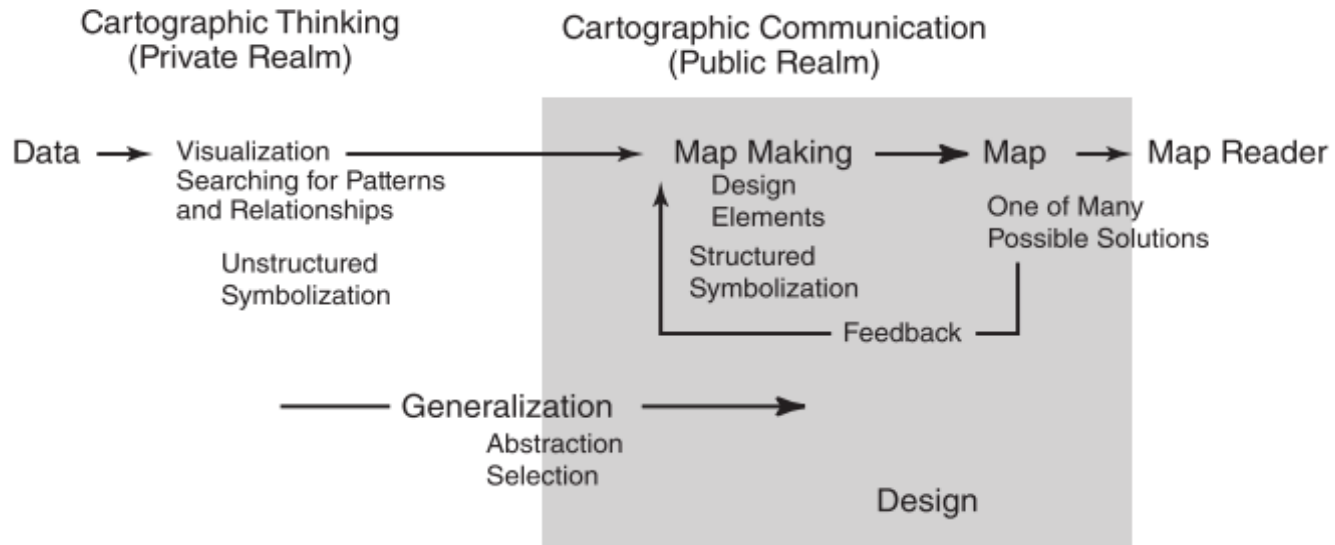
# Maps

- +Data storage; to provide information; storage
- +Visualization; show the spatial relationships of features
- +Communication; Audience



Maps are limited; Generalization, Scale, Spatial data; Projections

# Cartography



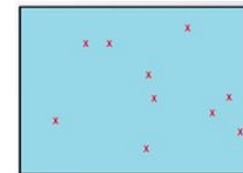
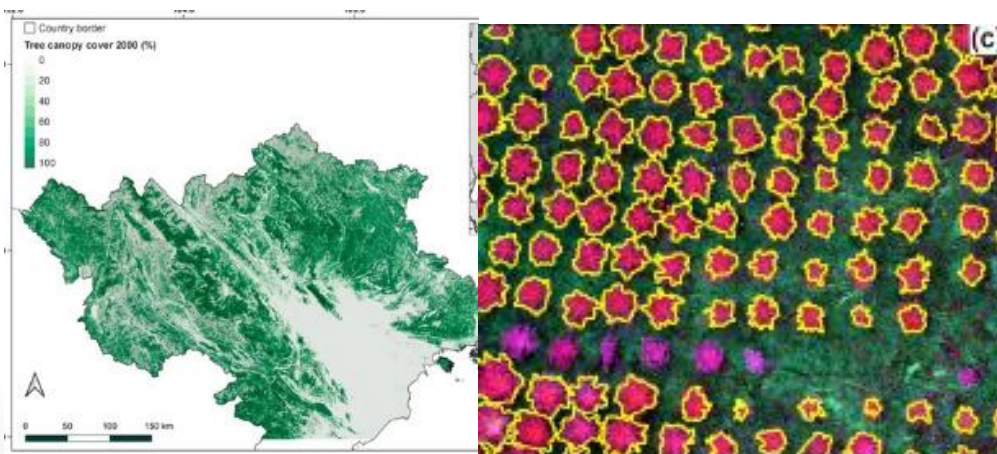
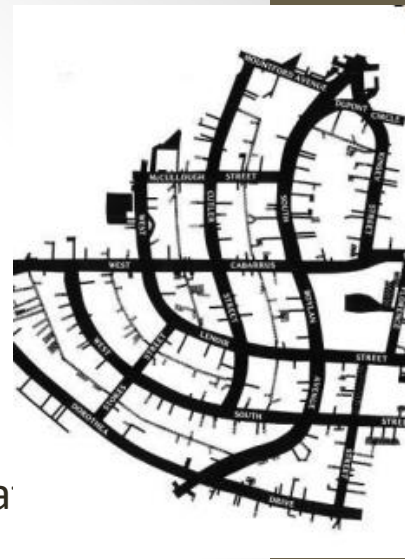
# MAPPABLE DATA

Data are records of observations of phenomena

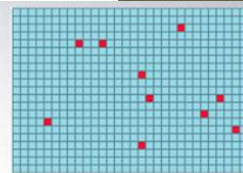
- primary data secondary or tertiary data
- qualitative (differences in kind); nominal
- quantitative (differences/levels in amount); ordinal, interval, and ratio
- Vector [geometry] & Raster [pixel] Data
- Transforming Data; Total Averages Densities Rates
- Data Accuracy

Are the facts accurate? When were the data collected? Does detail vary across the data set? What are the assumptions behind the data? a trustworthy source?

- Metadata Copyright Copyleft
- Aggregate or individual



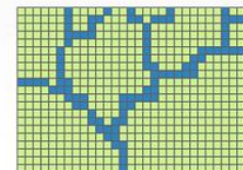
Point features



Raster point features



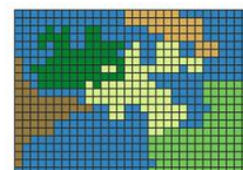
Line features



Raster line features

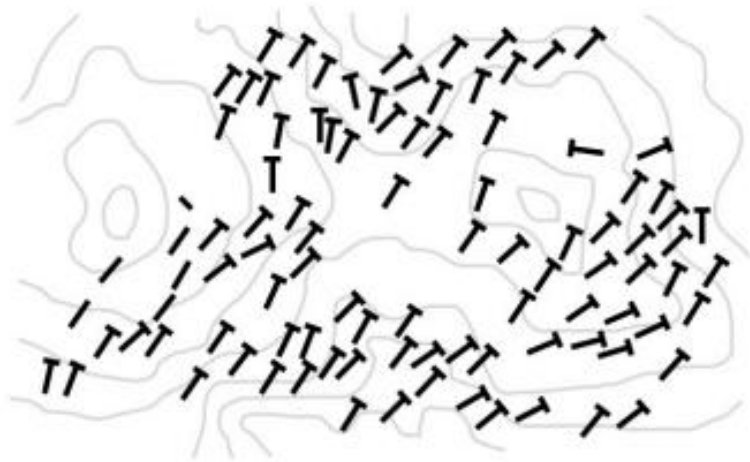















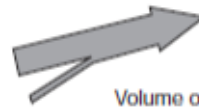






Polygon features



Raster polygon features

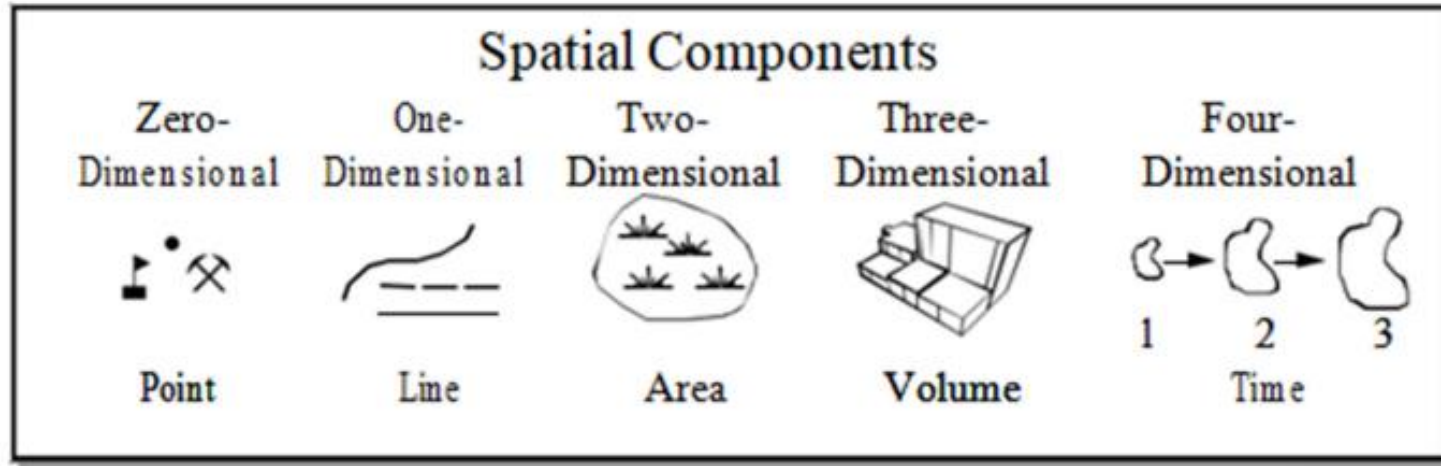
# MAPPABLE DATA



|                       | Nominal Measurement                                                                                                                                                                                                                                                                   | Ordinal Measurement                                                                                                                                                                                                                                                                                                   | Interval/Ratio                                                                                                                    |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| POINT SYMBOLS         |  Building<br> City<br> Mountain    |  Village<br> Town<br> City                                         | Population<br> 1,000,000<br>500,000<br>250,000 |
| LINE SYMBOLS          |  Road<br> Railroad<br> Trail |  Heavy-Duty Road<br> Medium-Duty Road<br> Light-Duty Road |  Volume of Traffic                           |
| AREA / VOLUME SYMBOLS |  Grassland<br> Orchard                                                                                          |  High-Density<br> Medium-Density<br> Low-Density          | Population Per Sq. Mi.<br> 100<br>25<br>0    |

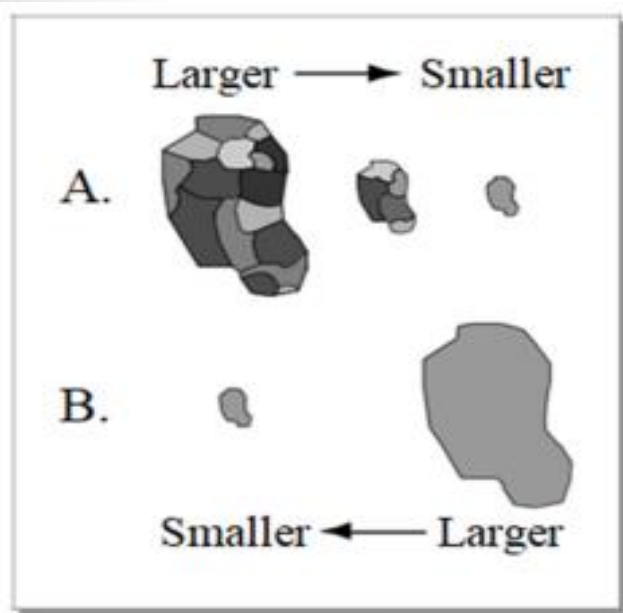


# MAPPABLE DATA

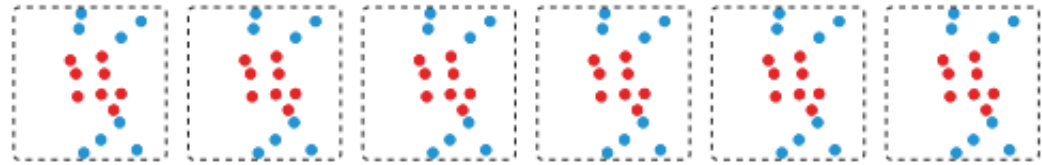


- Location
- Xristic view
- Time
- Transformations

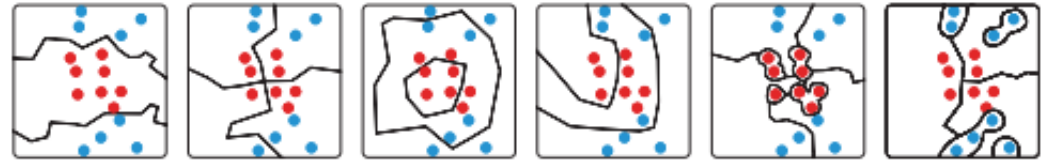
| Data Type  | Examples                                                                                                                                                                                                                |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Point Data | Number of shoppers at a mall<br>Number of students enrolled at an elementary school<br>Temperature measured at the local airport<br>Dollar value of your home<br>Value of damage caused by a tornado that hit your town |
| Line Data  | Traffic flow in vehicles per day<br>Stream discharge<br>Movement of a commodity exported to various locations                                                                                                           |
| Area Data  | Population density in people per square mile<br>Crop yield in bushel per acre<br>Acreage of various county land-use categories<br>Precipitation from a storm event                                                      |



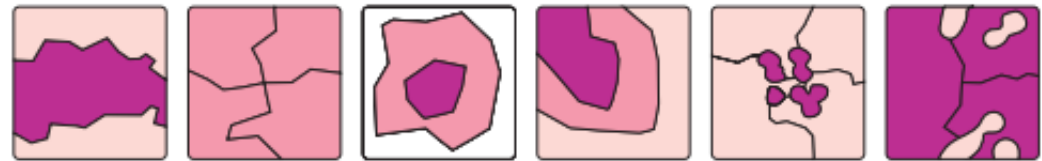
### 1) A Single Geographical Reality



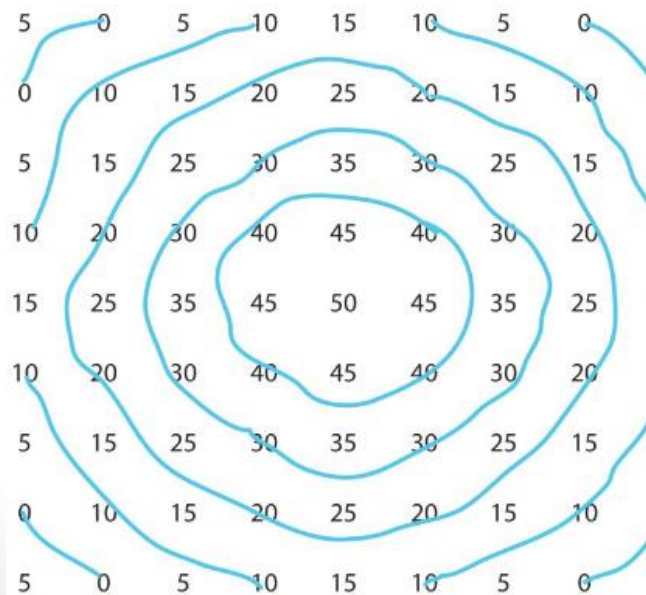
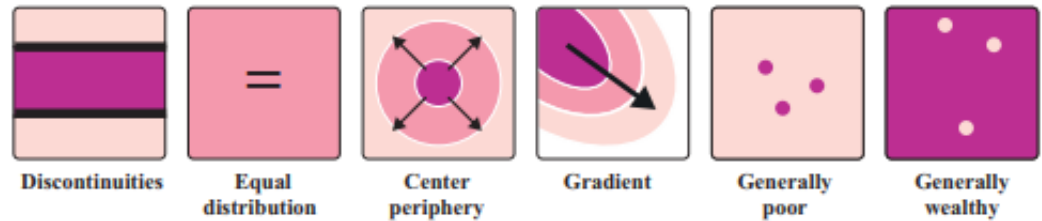
### 2) Several Different Modes of Subdivision



### 3) Different Resulting Maps



### 4) A variety of Spatial Messages



**a) Characteristic View**

**Qualitative**

versus

**Quantitative**

Mine

Tons of coal

Airport

Number of aircraft

River

Volume of water

Forest

Board feet of timber

Farms

Acres of farmland

**b) Spatial View**

**Discrete**

versus

**Continuous**

Temperature at your home

Temperature across the United States

Precipitation at the airport

Precipitation in the Southeast

Elevation of the bridge

Topographic surface

**c) Attribute View**

**Totals**

versus

**Derived**

Total population

People per square kilometer

Ohio immigrants to Minnesota

Ohio immigrants to Minnesota as a  
percentage of all Minnesota immigrants

Employment in mining

Mining employment as a percentage  
of all employment










































# DATA MEASUREMENT










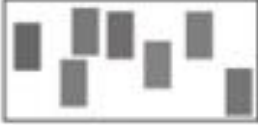






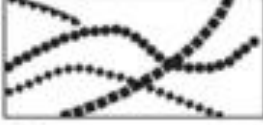





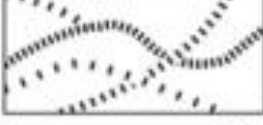




- Nominal; descriptive
- Ordinal; rank “greater than” or “less than
- Interval; distance between ranks
- Ratio ; absolute, having a known starting point




























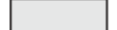













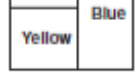

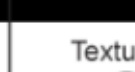



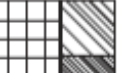
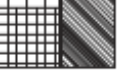






























## SYMBOLS

- Abstract or Replicative
- Selection & Design
- Geographic phenomena
- purpose
- Map users
- Conventions
- compatibility

| Qualitative<br>By Location and Nature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                            | Quantitative<br>By Location and Amount             |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|--|
| Point Symbols                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                            |                                                    |  |
|  Ship Wreck<br> School<br> Church<br> Building<br> Mine<br> Bench Mark<br> Airport<br><br>   Towns and Cities |                | Presence                                           |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                | Length                                             |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                | Area                                               |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                | Volume                                             |  |
| Line Symbols                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                            |                                                    |  |
|  <br>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | One-Dimensional<br>                                                                                                                                                                                                                                                     | Relative Position                                  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Two-Dimensional<br>                                                                                                                                                                                                                                                     | Width                                              |  |
| Area Symbols                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                            |                                                    |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <br>   | Bounded By Isolines<br><br>Bounded By Non-Isolines |  |

|             | Point                                                                               | Line                                                                                 | Area                                                                                  |
|-------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Size        |    |    |    |
| Value       |    |    |    |
| Hue         |    |    |    |
| Saturation  |    |    |    |
| Orientation |    |    |    |
| Shape       |    |    |    |
| Arrangement |   |   |   |
| Texture     |  |  |  |
| Focus       |  |  |  |

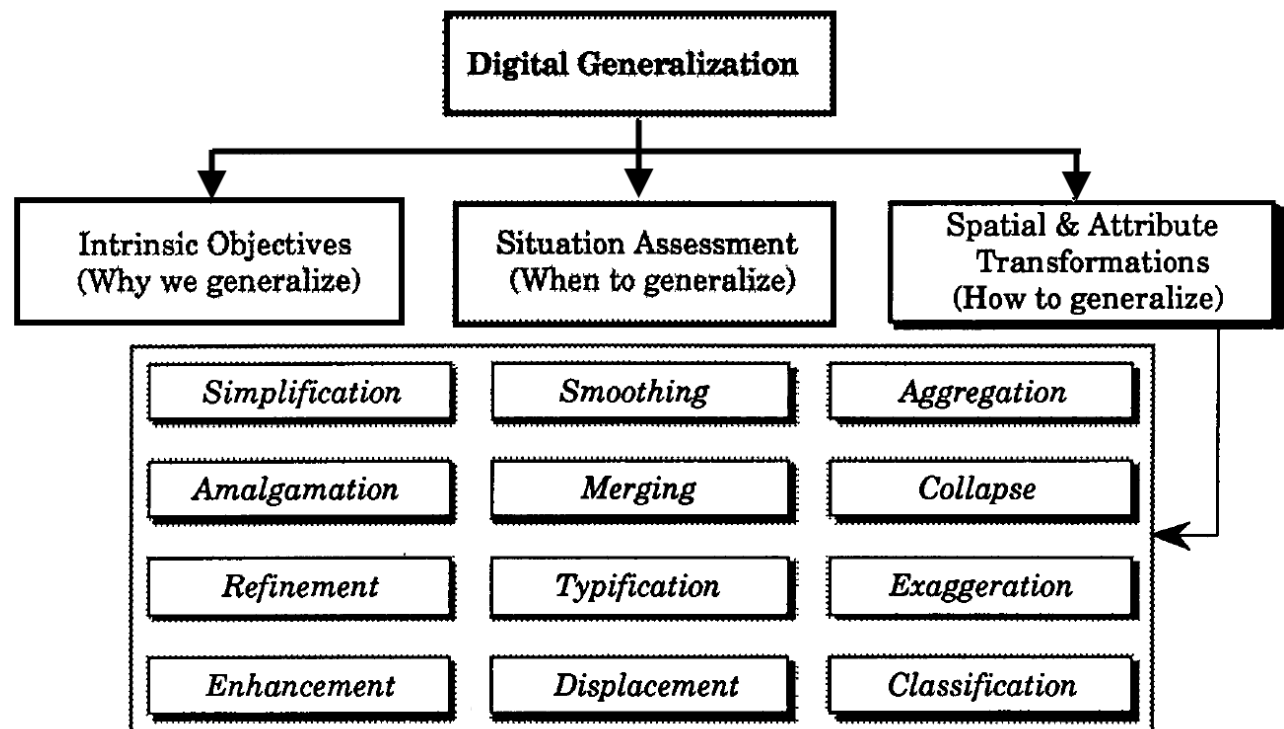
|               | FORM/SHAPE                                                                                                                                                                                                                                                  | SIZE                                                                                                                                                                                                                                                        | HUE                                                                                                                                                                                                                                                                                                                                                  | VALUE                                                                                                                                                                                                                                                             | PATTERN/TEXTURE                                                                                                                                                                                                                                                   | ORIENTATION                                                                                                                                                                                                                                                       |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| POINT SYMBOLS | <br><br>  | <br><br>  | <br><br>                                                                                           | <br><br>  | <br><br>  | <br><br>  |
| LINE SYMBOLS  | <br><br> | <br><br> | <br><br>                                                                                       | <br><br> | <br><br> | <br><br> |
| AREA SYMBOLS  | <br>                                                                                      | <br>                                                                                      | <br><br><br> | <br><br> | <br><br> | <br><br> |

| Graphic Variable Examples                                                                                                                                                                                                                                         |  |  |                                                                                                                                                                                                                                                                        |  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| Location                                                                                                                                                                                                                                                          |  |  | Texture                                                                                                                                                                                                                                                                |  |  |
| <br><br>       |  |  | <br><br>       |  |  |
| Size                                                                                                                                                                                                                                                              |  |  | Color Hue                                                                                                                                                                                                                                                              |  |  |
| <br><br>   |  |  | <br><br>    |  |  |
| Shape                                                                                                                                                                                                                                                             |  |  | Color Lightness                                                                                                                                                                                                                                                        |  |  |
| <br><br> |  |  | <br><br> |  |  |
| Orientation                                                                                                                                                                                                                                                       |  |  | Color Saturation                                                                                                                                                                                                                                                       |  |  |
| <br><br> |  |  | <br><br> |  |  |

# ABSTRACTION AND GENERALIZATION

- 1 A pragmatic objective: enhancing the readability of the map
2. A scientific objective: removing any graphic overload (noise)
3. An aesthetic objective: a pre-defined graphic style.

- I Selection
- II Classification
- III Simplification
- IV Symbolization

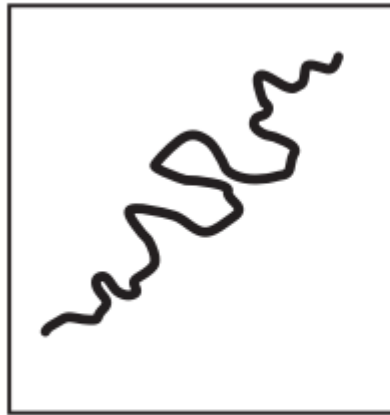




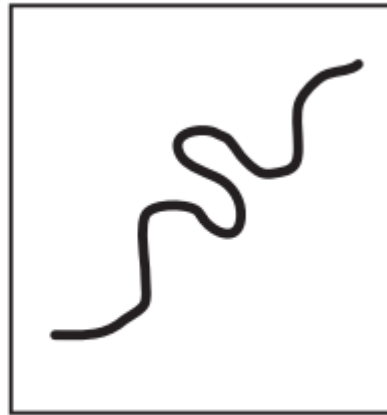
| Operator                                                                                                                     | Before | After                             |
|------------------------------------------------------------------------------------------------------------------------------|--------|-----------------------------------|
| <b>(a) Smoothing</b><br>Reduce angularity of the map object.                                                                 |        |                                   |
| <b>(b) Collapse</b><br>Reduce dimensionality of map object (area to point, linear polygon to line).                          |        |                                   |
| <b>(c) Displacement</b><br>Small movement of map objects in order to minimise overlap.                                       |        |                                   |
| <b>(d) Enhancement</b><br>Emphasize characteristics of map feature and meet minimum legibility requirements.                 |        |                                   |
| <b>(e) Typification</b><br>Replacement of a group of map features with a prototypical subset.                                |        |                                   |
| <b>(f) Text Placement</b><br>Non overlapping unambiguous placement of text.                                                  |        |                                   |
| <b>(g) Symbolization</b><br>Change of symbology according to theme (pictorial, iconic), or reduce space required for symbol. |        | i)            ii)            iii) |

| Spatial and Attribute Transformations (Generalization Operators) | Representation in the Original Map                 | Representation in the Generalized Map |                |
|------------------------------------------------------------------|----------------------------------------------------|---------------------------------------|----------------|
|                                                                  | At Scale of the Original Map                       | At 50% Scale                          |                |
| <b>Simplification</b>                                            |                                                    |                                       |                |
| <b>Smoothing</b>                                                 |                                                    |                                       |                |
| <b>Aggregation</b>                                               |                                                    |                                       |                |
| <b>Amalgamation</b>                                              |                                                    |                                       |                |
| <b>Merge</b>                                                     |                                                    |                                       |                |
| <b>Collapse</b>                                                  |                                                    |                                       |                |
| <b>Refinement</b>                                                |                                                    |                                       |                |
| <b>Typification</b>                                              |                                                    |                                       |                |
| <b>Exaggeration</b>                                              |                                                    |                                       |                |
| <b>Enhancement</b>                                               |                                                    |                                       |                |
| <b>Displacement</b>                                              |                                                    |                                       |                |
| <b>Classification</b>                                            | 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20 | 1-5, 6-10, 11-15, 16-20               | Not Applicable |

| Spatial Operator                                                                                   | Original Map                    | Generalized Map                 |
|----------------------------------------------------------------------------------------------------|---------------------------------|---------------------------------|
| <b>Simplification</b><br>Selectively reducing the number of points required to represent an object | <br>15 points to represent line | <br>13 points to represent line |
| <b>Smoothing</b><br>Reducing angularity of angles between lines                                    |                                 |                                 |
| <b>Aggregation</b><br>Grouping point locations and representing them as areal objects              |                                 |                                 |
| <b>Amalgamation</b><br>Grouping of individual areal features into a larger element                 |                                 |                                 |
| <b>Collapse</b><br>Replacing an object's physical details with a symbol representing the object    |                                 |                                 |
| <b>Merging</b><br>Grouping of line features                                                        |                                 |                                 |
| <b>Refinement</b><br>Selecting specific portions of an object to represent the entire object       |                                 |                                 |
| <b>Exaggeration</b><br>To amplify a specific portion of an object                                  |                                 |                                 |
| <b>Enhancement</b><br>To elevate the message imparted by the object                                |                                 |                                 |
| <b>Displacement</b><br>Separating objects                                                          |                                 |                                 |



Less simplified



More simplified

