

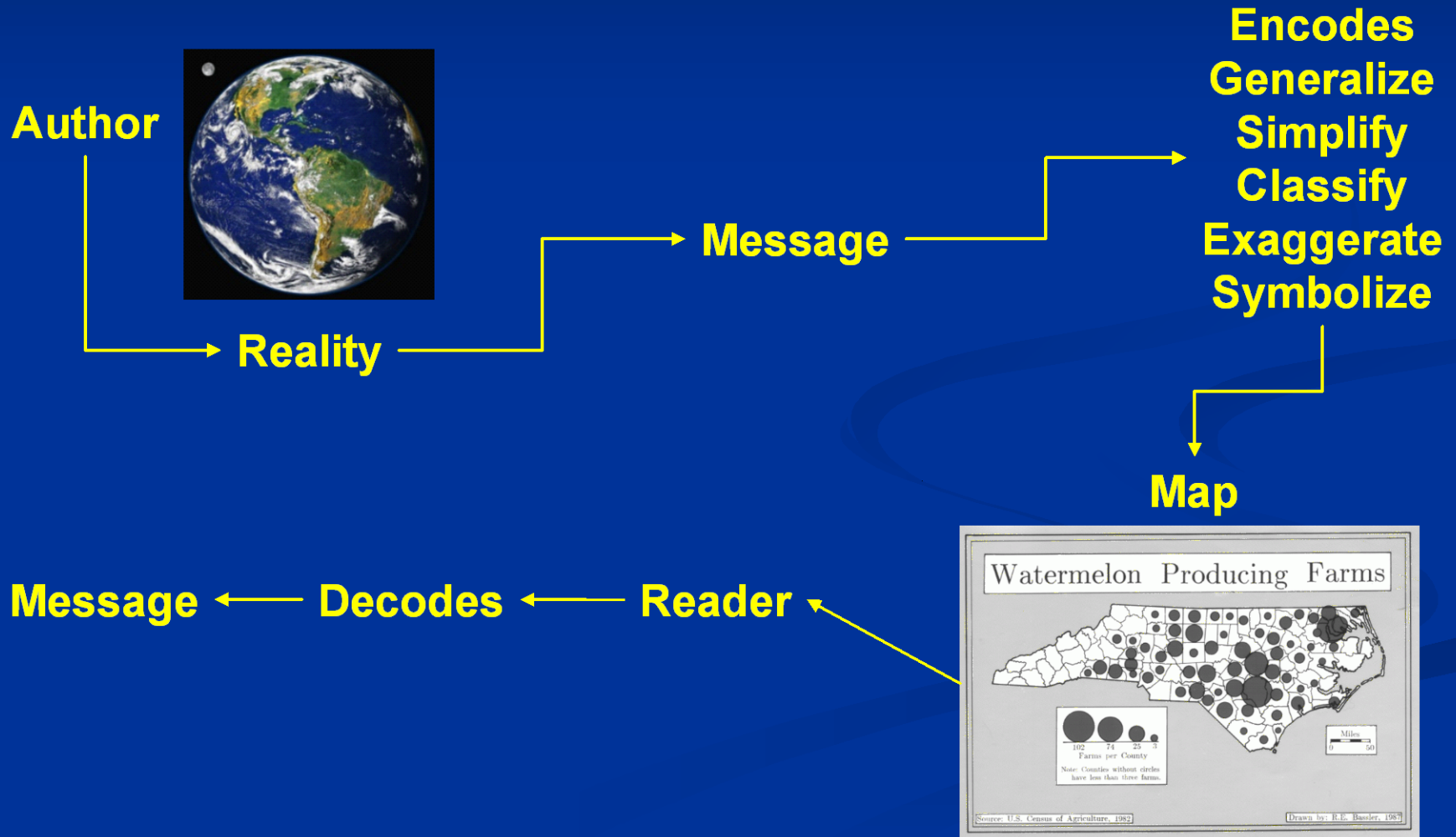


The Hidden “C” in GIS – Maps Gone Bad

Rod Bassler, GIS Coordinator
North Dakota
State Water Commission
2004

Cartography

Maps as a Communication Medium



Cartography

Maps as a Communication Medium

**Bad Maps, Bad Maps, What'cha Gonna Do,
What'cha Gonna Do When They Come For
You?**

“... Internet map servers are taking map design from the hands of cartographers and the result is the worst kinds of carto-crimes, as I call them. Great data, great idea, terrible execution!” – Martin von Wyss

Cartography

Maps as a Communication Medium

Why do we use Maps? Maps are popular because:

- They simplify the complexities of the world

- They have a strong visual impact

- They are convenient to use

- They are considered a credible source of information

Map Elements

Just what are the basic elements of a map?

Purpose

Titles and Subtitles

Legends or Keys

Scales

Text

Balance and Layout

Symbols

Map Elements

Titles and Subtitles

- 1) **DO NOT INCLUDE THE WORD “MAP” IN THE TITLE!!!**
- 2) **Keep it simple and about the subject**

Alien Sitings
Burleigh County
Burleigh County, North Dakota

- 3) **The subtitle should enhance or clarify the title**
- 4) **The subtitle should be a smaller type size**
- 5) **Should be prominent but not dominant**

Map Elements

Map Legend

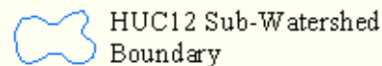
- 1) **DO NOT USE “LEGEND” AS THE TITLE!!!**
- 2) **Should not contain any elements that are not on the map**
- 3) **Should be subordinate to the title**
- 4) **Describes all the symbols on the map; provide good definitions**
- 5) **Layout should be hierarchically and logically structured**

Map Elements

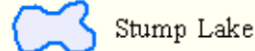
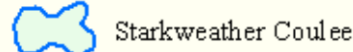
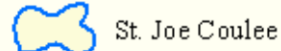
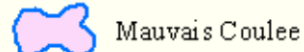
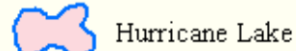
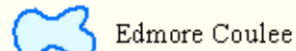
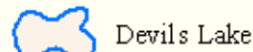
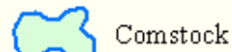
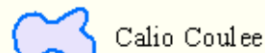
Map Legend – An Example

Map Features

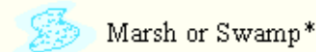
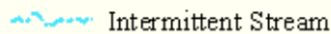
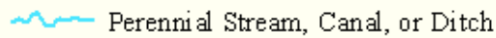
Major Basins and Sub-Watersheds



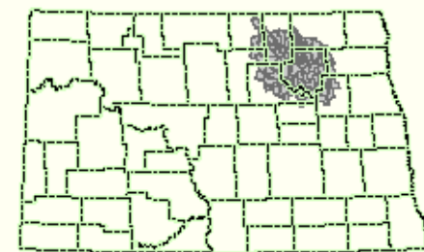
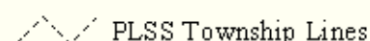
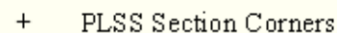
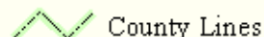
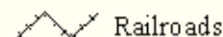
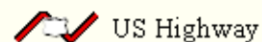
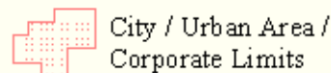
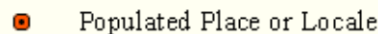
Administrative Basin Delineations



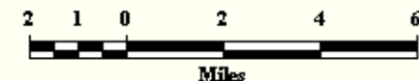
Water Features * Showing flooding extents circa 2003



Additional Map Features



Devils Lake Basin, Northeast North Dakota



Scale 1:158,400

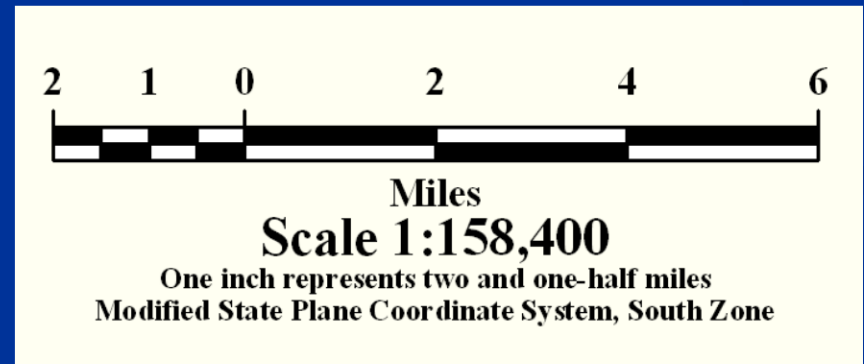
One inch represents two and one-half miles
Modified State Plane Coordinate System, South Zone



Map Elements

Map Scale – Representative Fraction

- 1) Is the ratio between two points measured on a map and the corresponding distance measured on the ground
- 2) A Representative Fraction is unit-less
- 3) 1:24,000 1:63,360
1:100,000 1:126,720
1:500,000



Map Elements

Map Scale – Verbal

- 1) States the scale definition in simple terms
- 2) Ex. One Inch Represents One Mile
- 3) Pay attention to terms such as “Equals”, “Represents”, and “Approximately”
- 4) 1:63,360 – One Inch Represents One Mile
- 5) 1:500,000 – One Inch Represents Approximately Eight Miles (actually 7.891414141 miles)

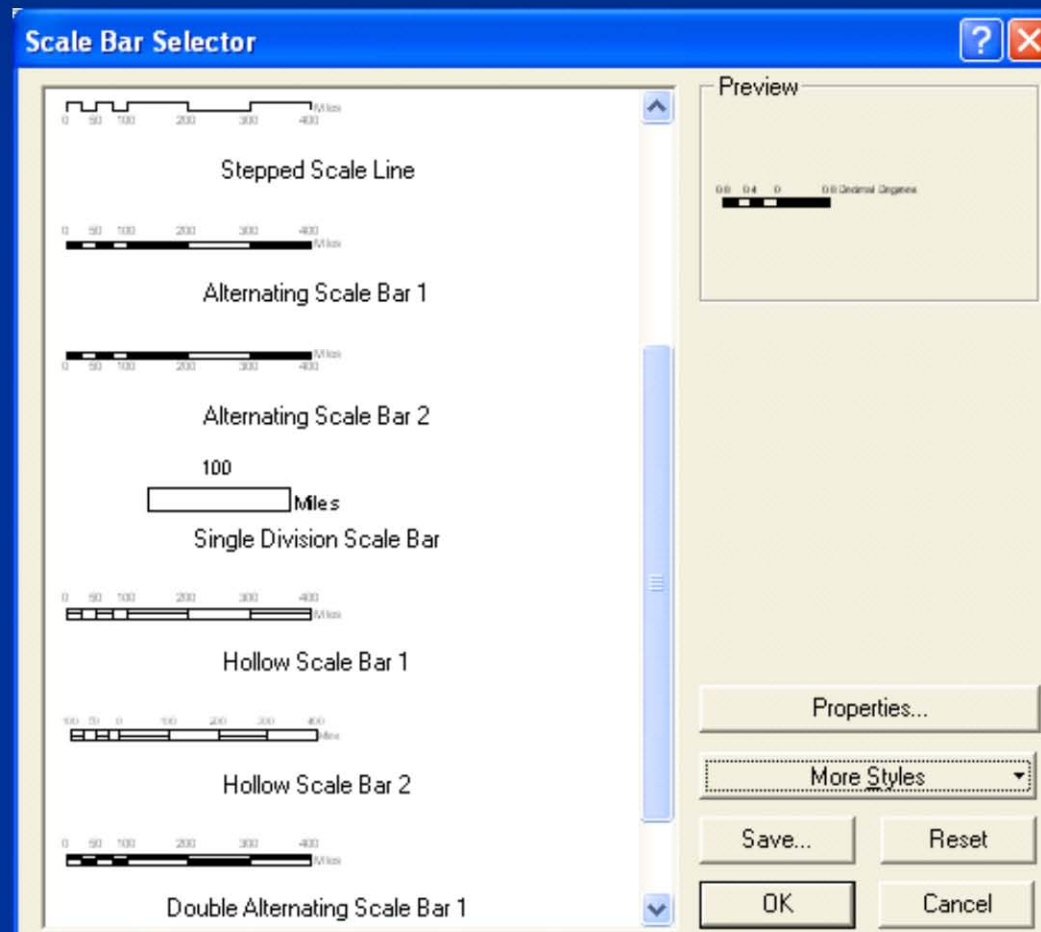
Map Elements

Map Scale - Graphic

- 1) Make sure you have the units displayed
- 2) Make sure you have a graphical scale on maps that may be reproduced at different scales
- 3) Use units that are most likely to be used by the reader

Map Elements

Map Scale - Graphic



Map Elements

Map Scale – The Layout



Miles

Scale 1:158,400

One inch represents two and one-half miles

Modified State Plane Coordinate System, South Zone

Typography

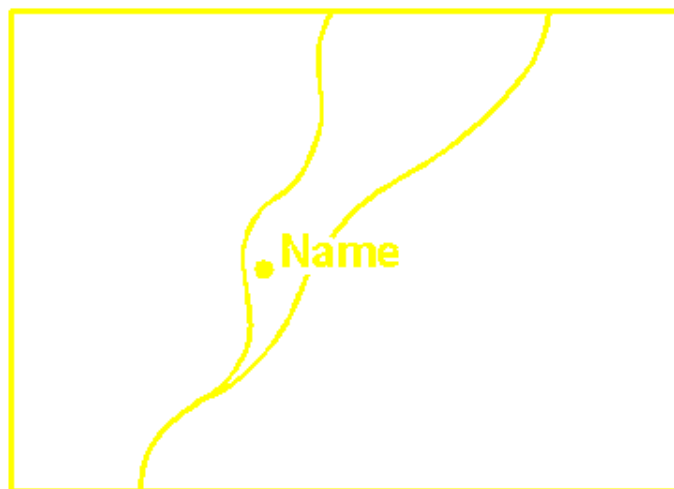
- 1) Type must always be legible and clear;
6 to 8pt type is smallest that should be used
- 2) Type can have a hierarchical component;
bold/dark/larger sizes suggest importance
- 3) *Italicized type can suggest movement*
- 4) Try to space lettering across the entire feature
- 5) How about coloring the text the same as the symbol you are labeling

Typography



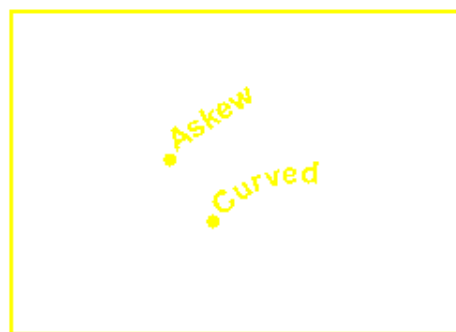
Typography

Type should not fall across a linear symbol, but if necessary the line should be interrupted.



Typography

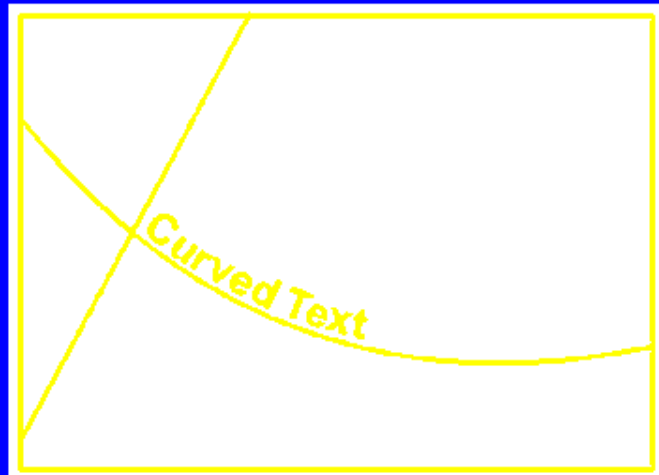
Lettering generally should be aligned horizontally and not obliquely. If you cannot align it horizontally, curving the lettering is acceptable.



M A R Y L A N D M A R Y L A N D

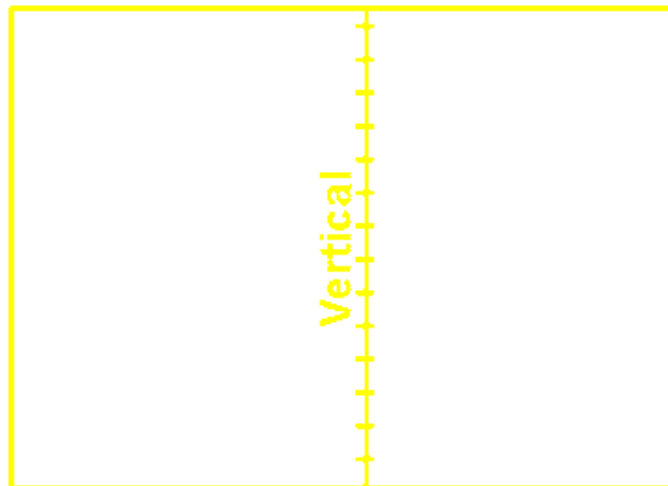
Typography

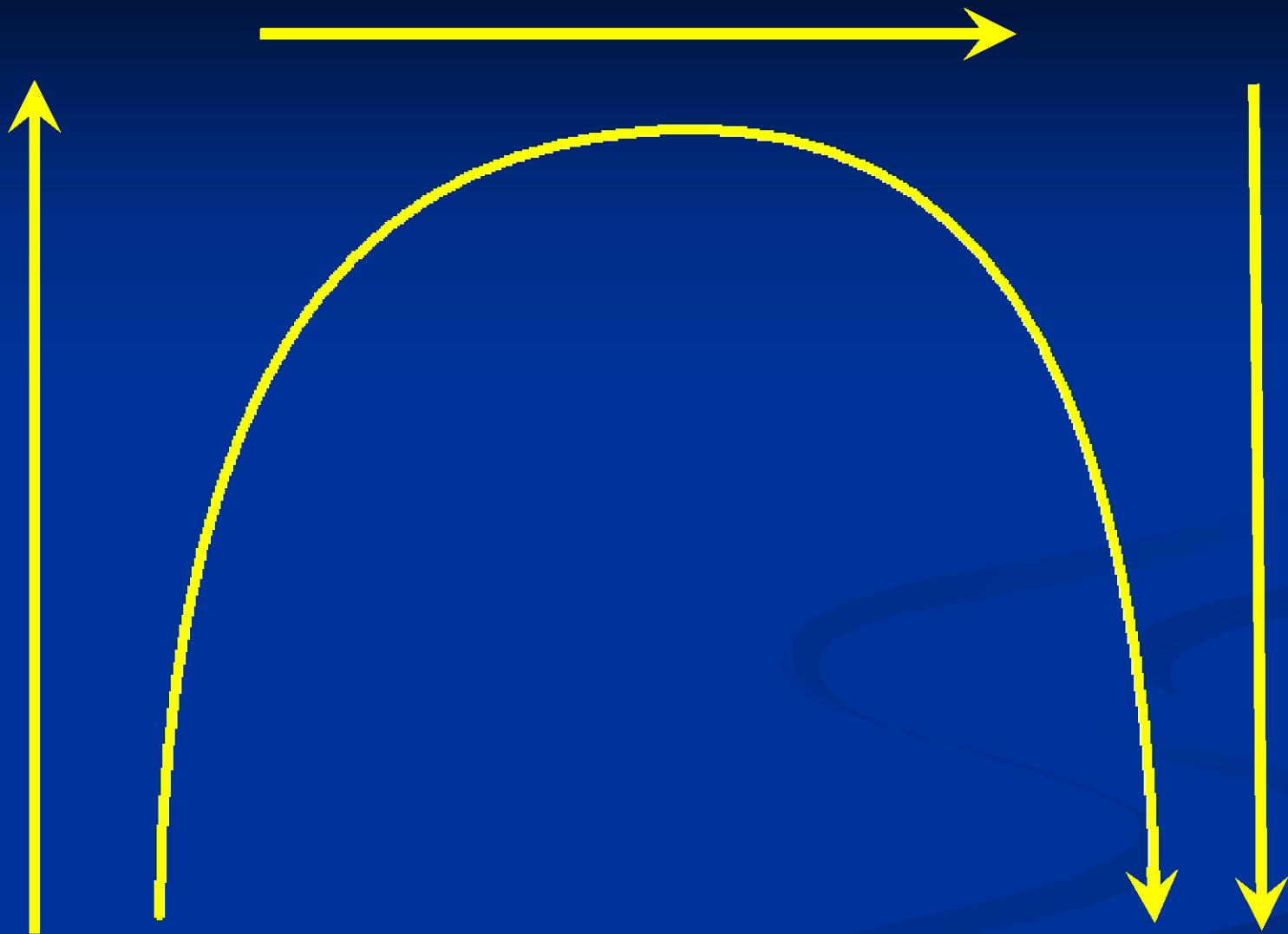
If curved parallels appear on the map, the curvature of the graticule is often strong enough to place the type along the parallel.



Typography

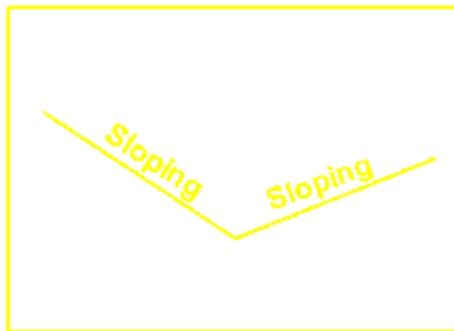
Vertically placed type should be placed so that it can be read from the left side of the page.





Typography

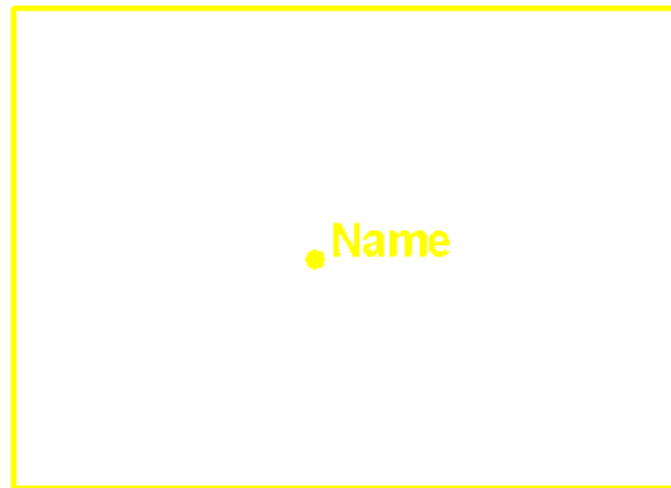
If lettering is on a diagonal, it should be placed so that it will “fall on its feet” if it is swung into the horizontal position.



Upside down word placement should not be used

Typography

The point symbol should be seen first and its identification should be located to its right.



Third First
Fourth • Second

Fifth
•
Sixth

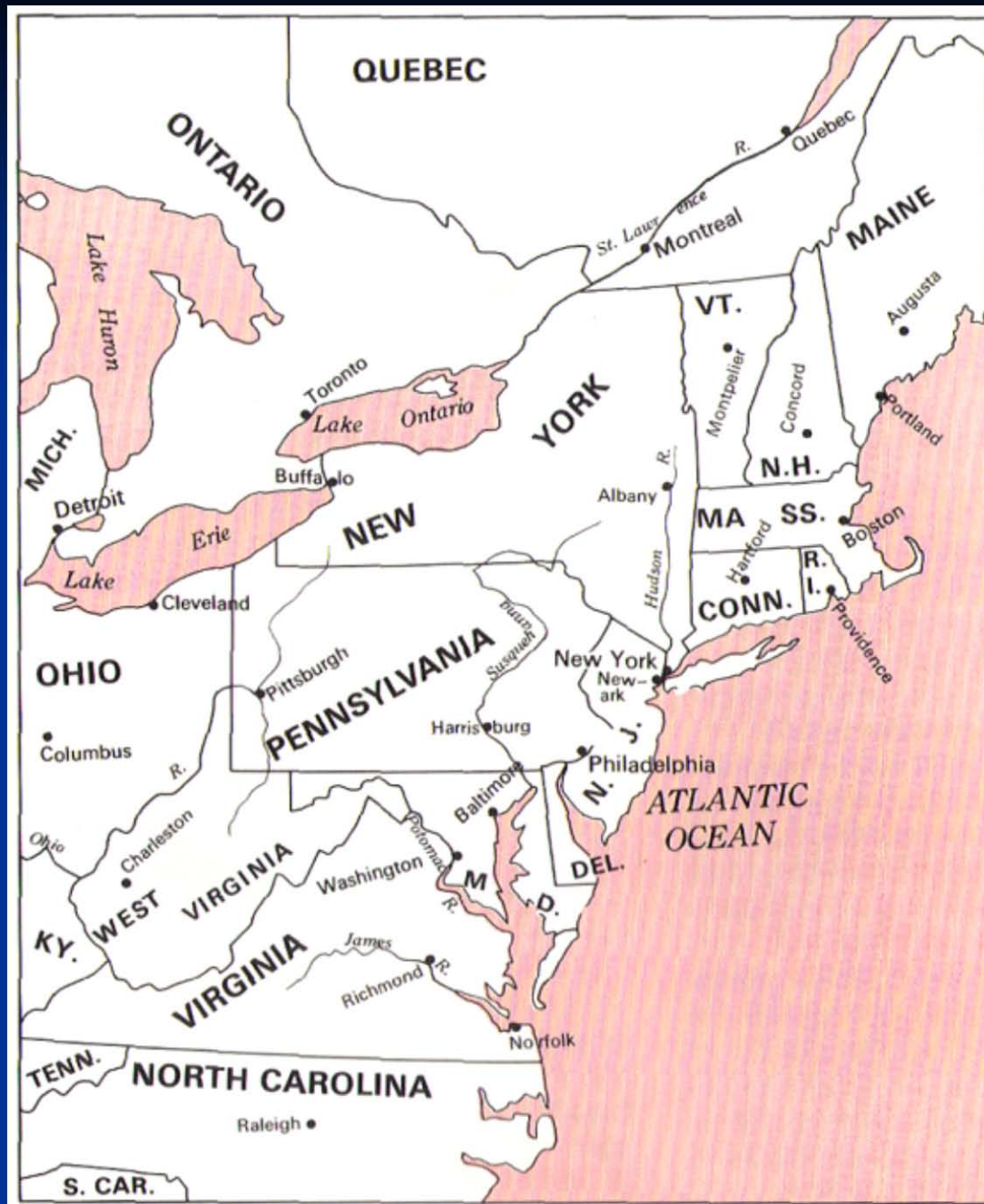
Curved • Curved
Curved • Curved

Name • • Name
Name • • Name
Leader





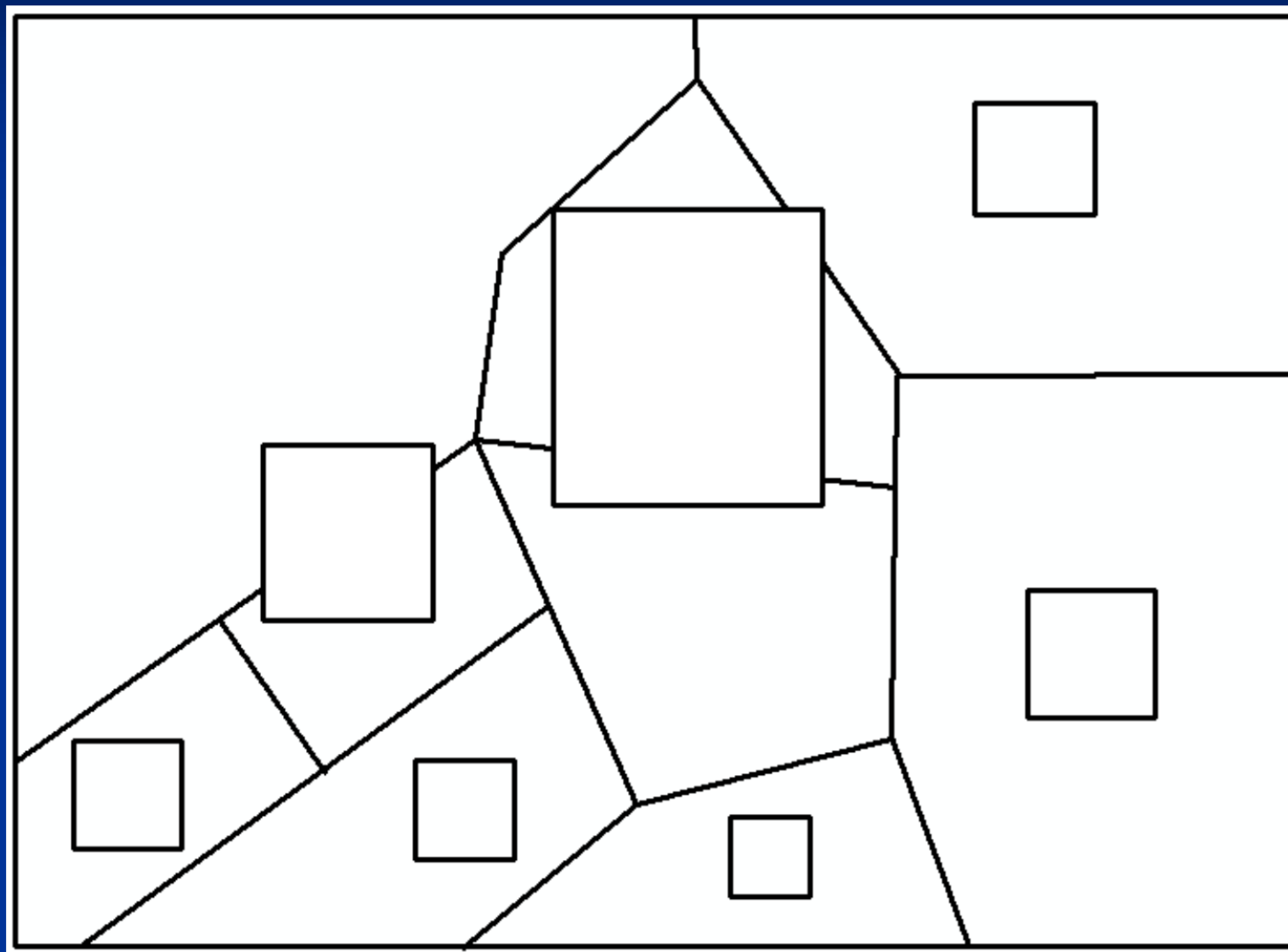
Robinson, et al.



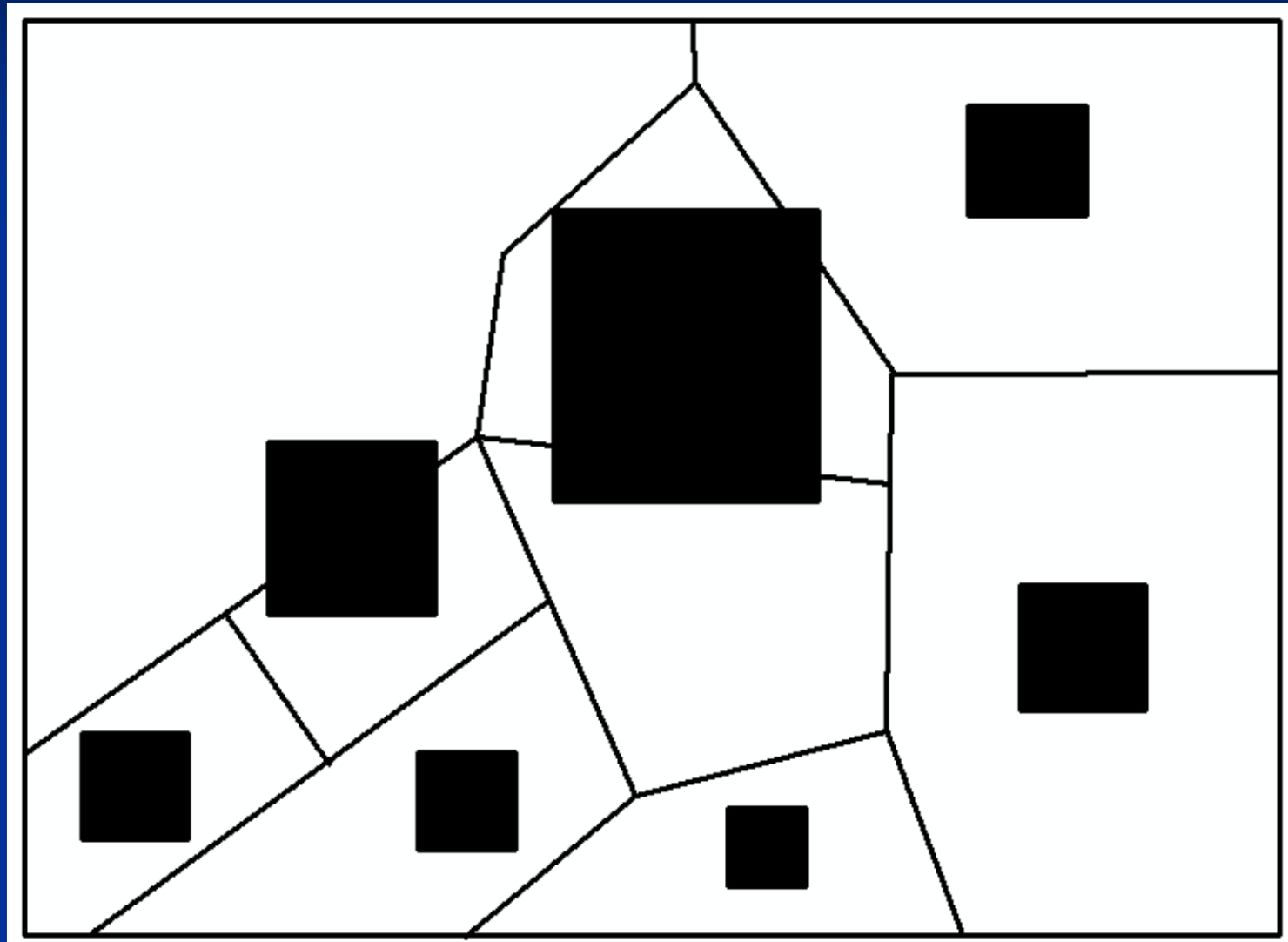


Robinson, et al.

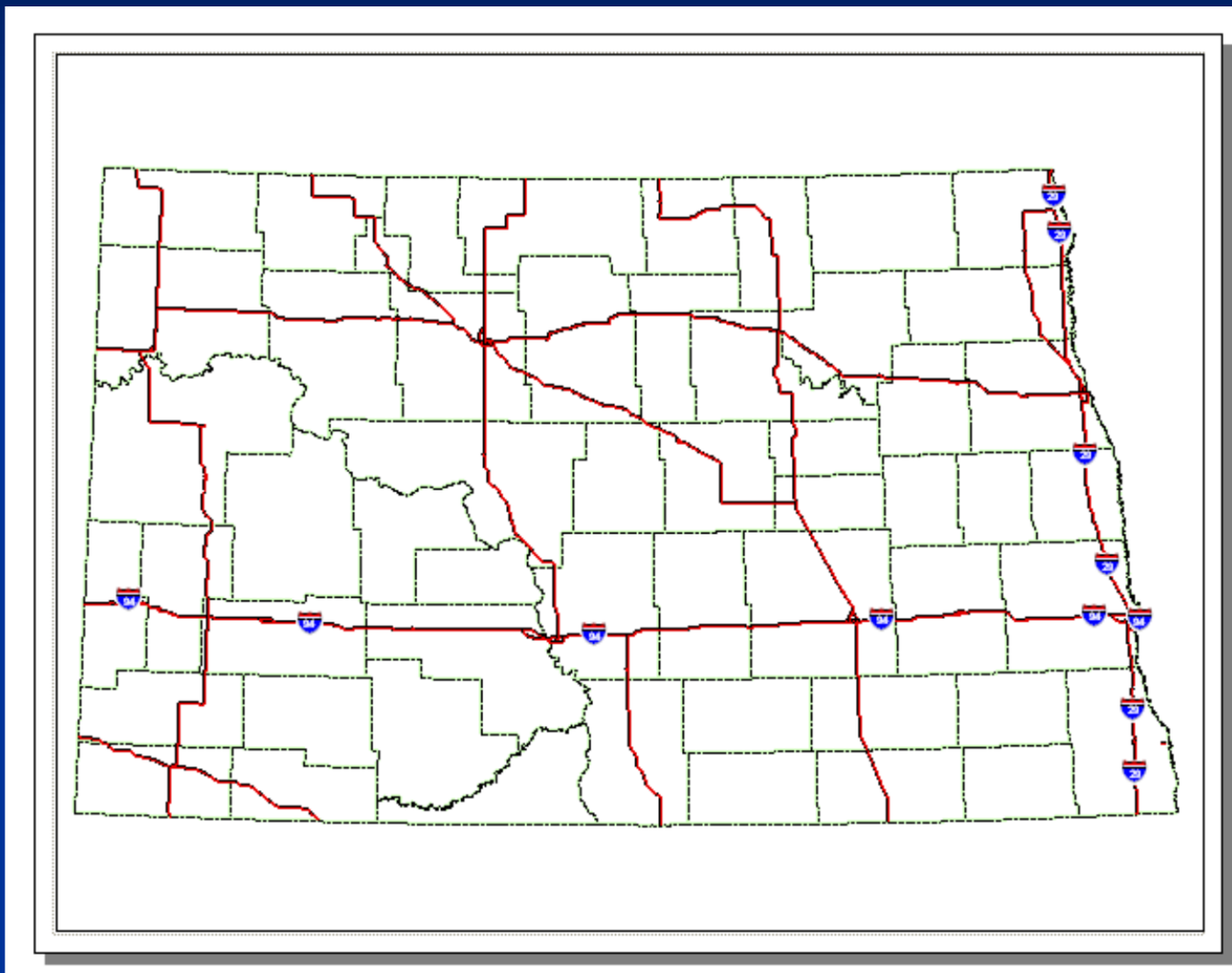
Map Layout – Figure/Ground



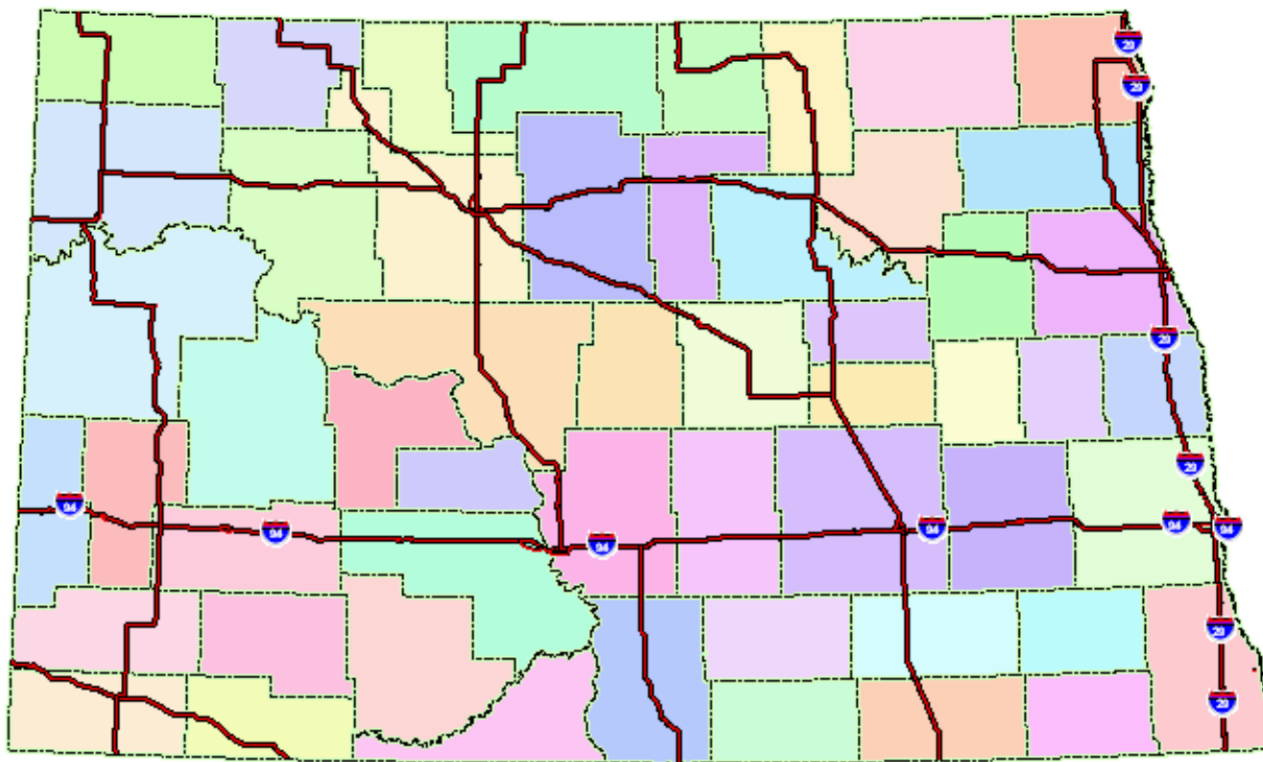
Map Layout – Figure/Ground



Map Layout – Figure/Ground

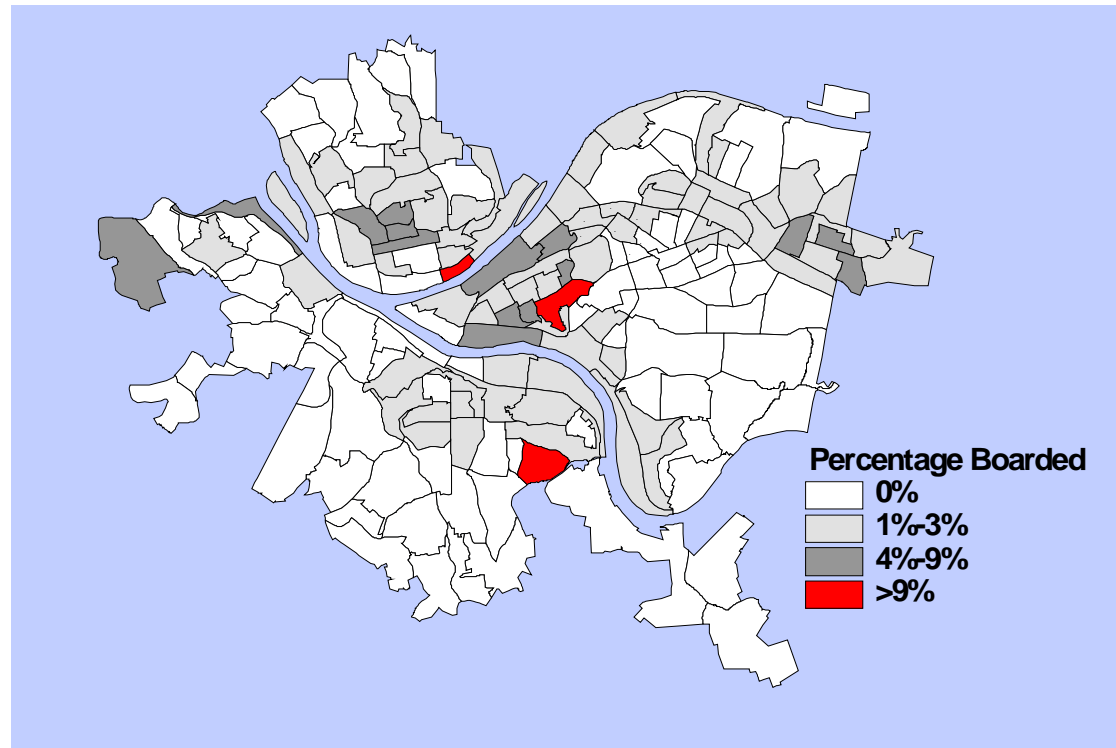


Map Layout – Figure/Ground



GIS Lecture 2 - 2nd E.g.

Map Design

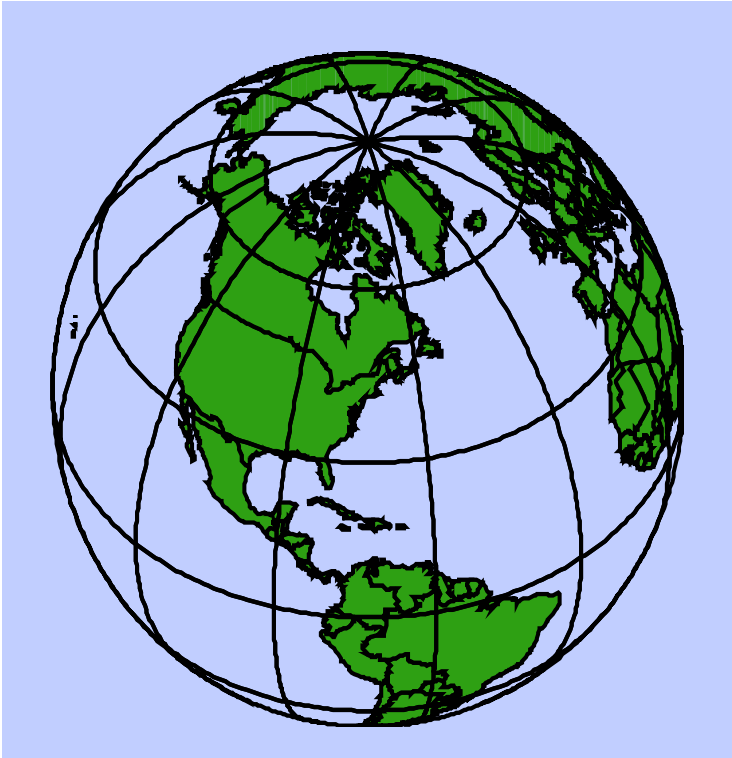


Outline

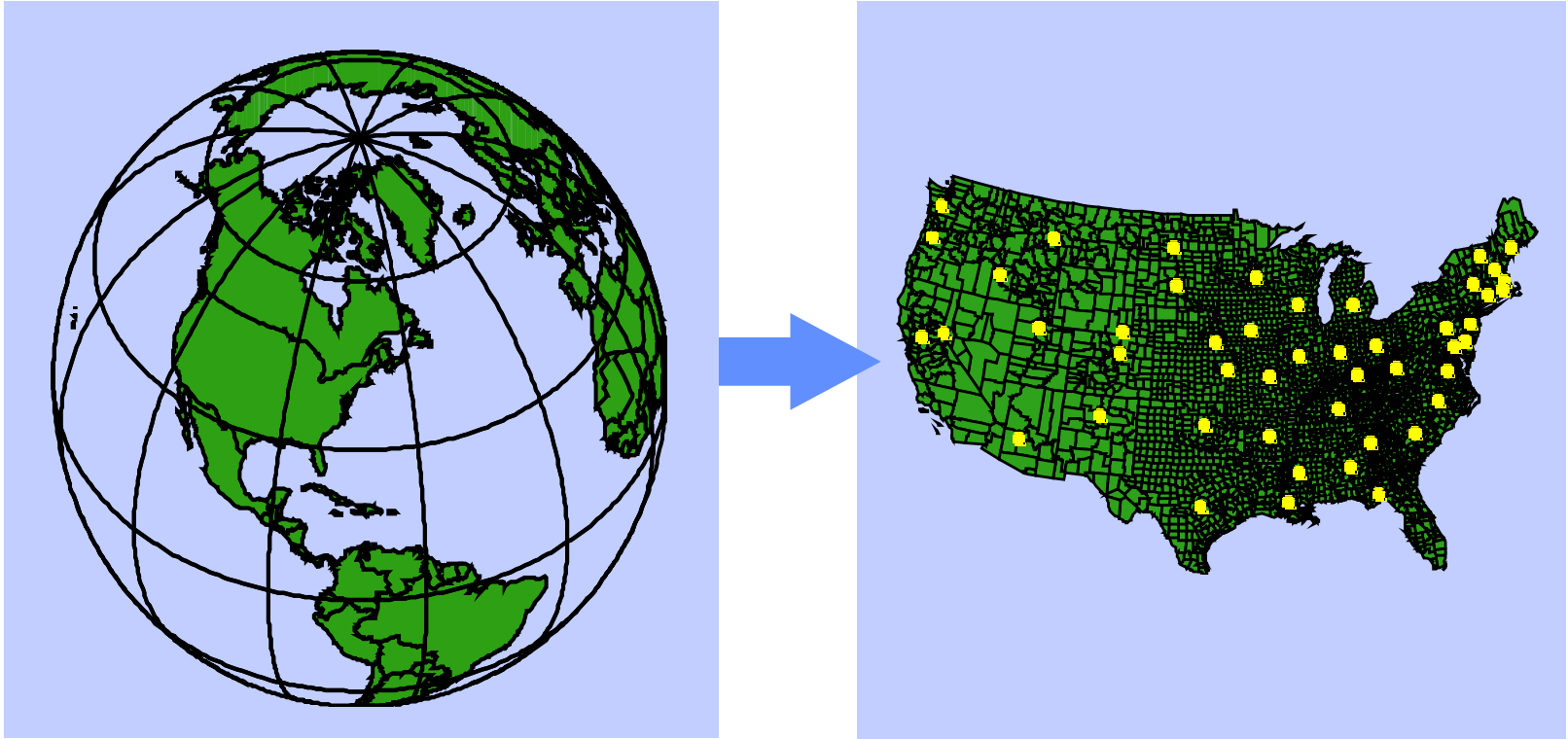
- Vector GIS
- Graphic Elements
- Colors
- Graphical Hierarchy
- Choropleth Maps
- Map Layers
- Scale Thresholds
- Hyperlinks

Vector GIS

Graphic Features on the World



GIS Map



Vector GIS

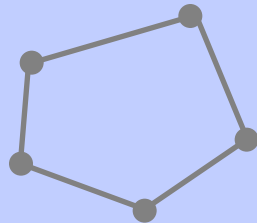
Point



Line



Polygon



Points

Data Attached to Points



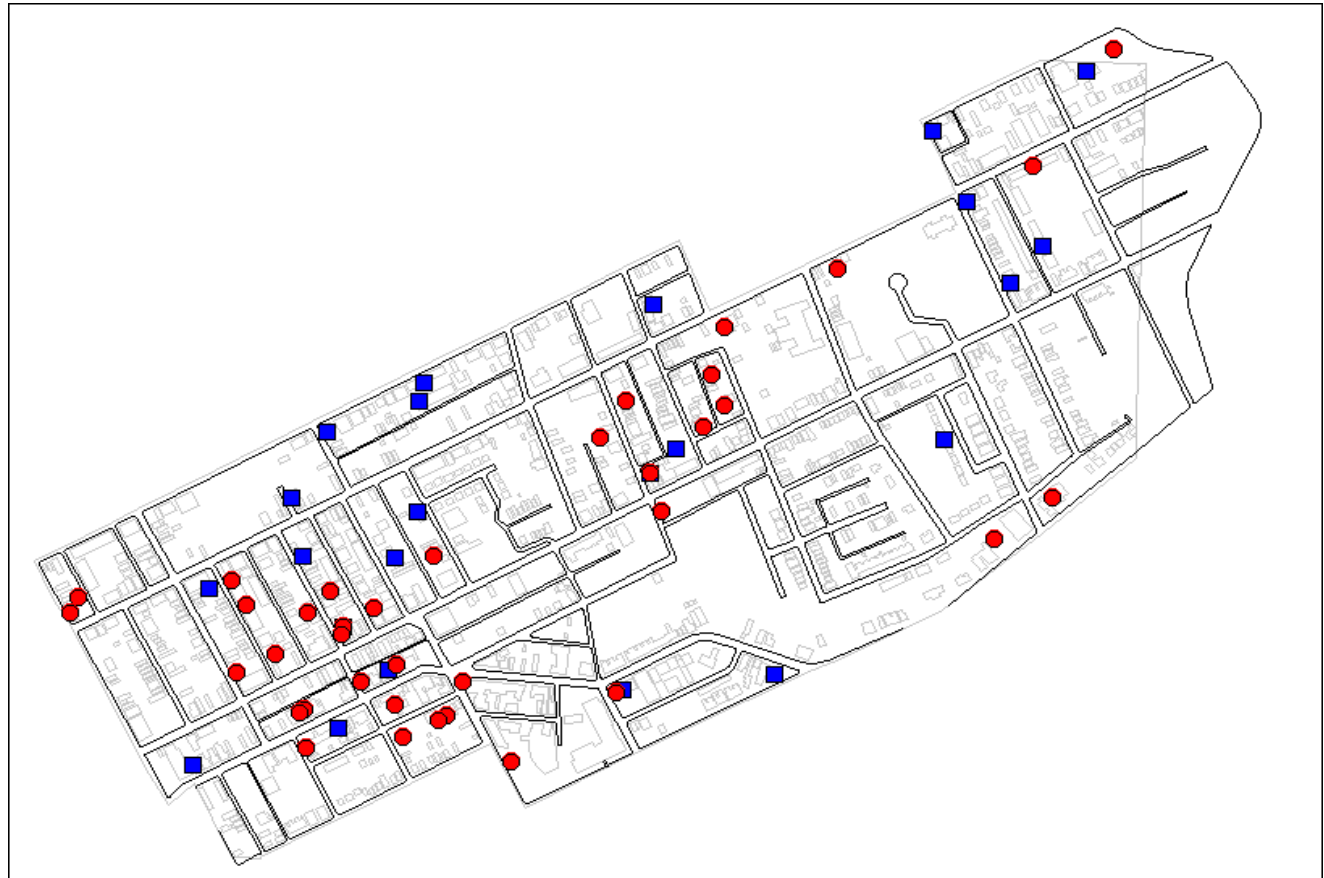
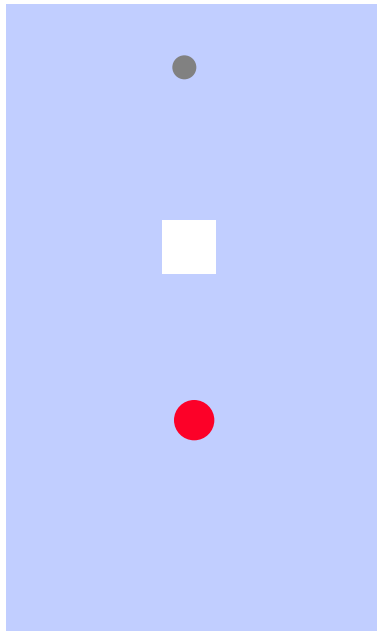
Attributes of MID911 Point										
DATE	TIME	EVENT_NUM	CCR	NATURE CO	ZONE_NU	ITEM004	ITEM003	ITEM002	ITEM001	C
920720	45845	20795706	177400	ROBPER	Z2	-1	-1	-1	20795706	
920720	192154	20796607	177863	DRUGS	Z2	-1	-1	-1	20796607	
920808	104555	20825677	195203	BUR	Z2	-1	-1	-1	20825677	
920701	233252	20766845	160203	AUTTHE	Z2	-1	-1	-1	20766845	
920701	231200	20766812	160183	AUTTHE	Z2	-1	-1	-1	20766812	
920723	41028	20700151	180010	ASS	Z2	-1	-1	-1	20700151	
920801	105022	20814840	188640	ASS	Z2	-1	-1	-1	20814840	
920819	83816	20842346	205175	AUT	Z2	-1	-1	-1	20842346	
920811	12149	20829870	197662	BURRES	Z2	-1	-1	-1	20829870	
920805	30810	20820486	192100	AUT	Z2	-1	-1	-1	20820486	

Record: 0 Show: All Selected Records (0 out of 274 Selected.) Options



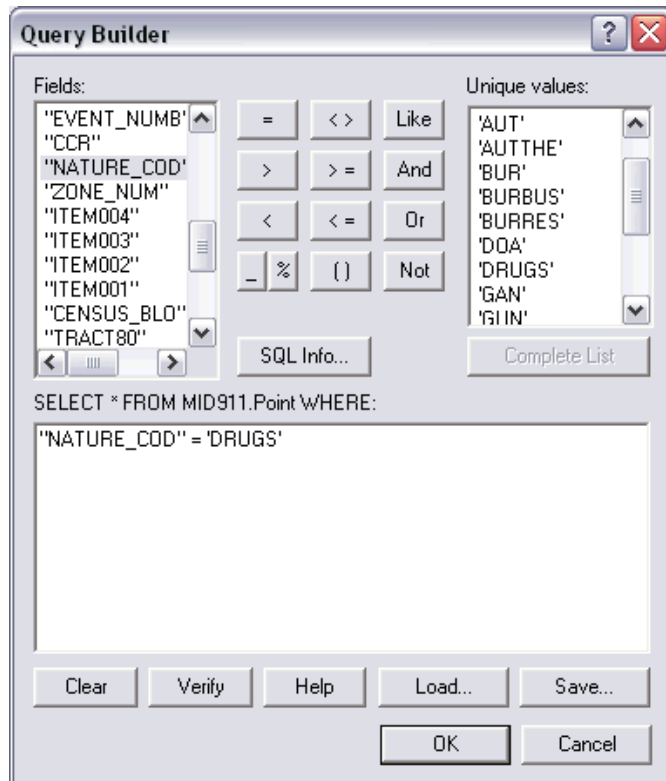
Points

Same data displayed as two different points



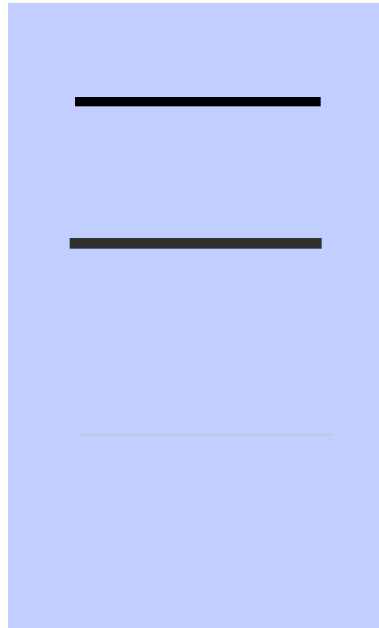
Queries and Restrictions

- Restricts the features to a specific subset





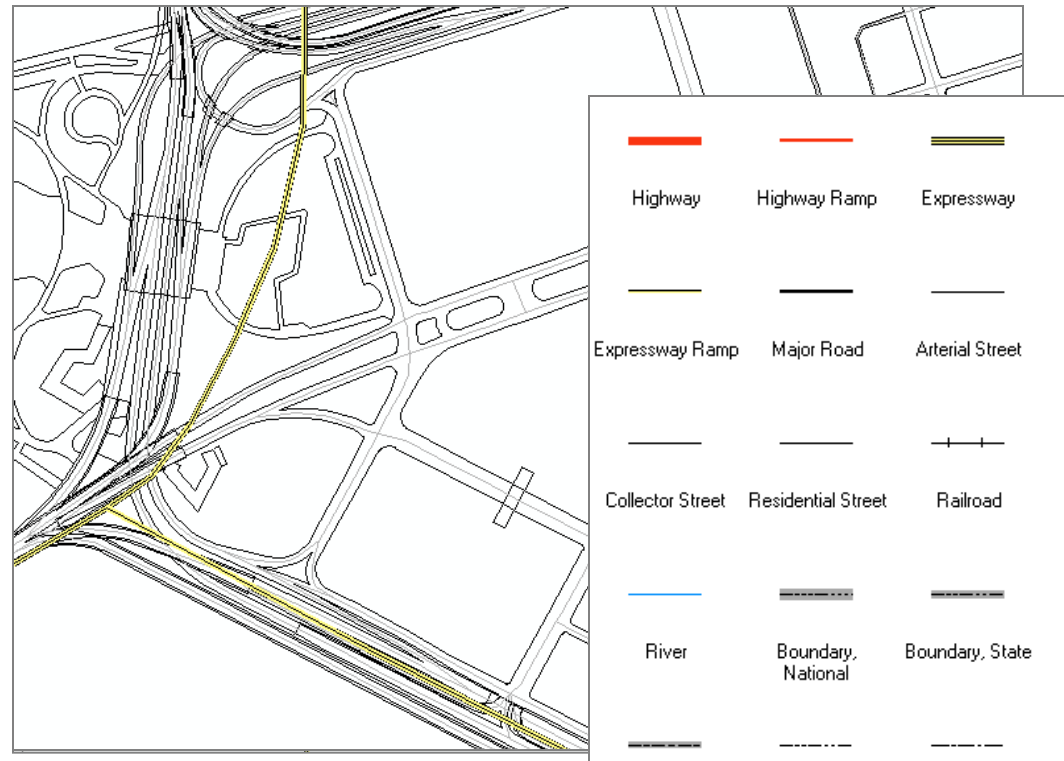
Lines



Roads

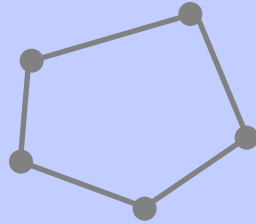
Conditions, Major Streets

Curbs



Polygons

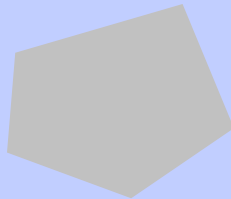
Polygons



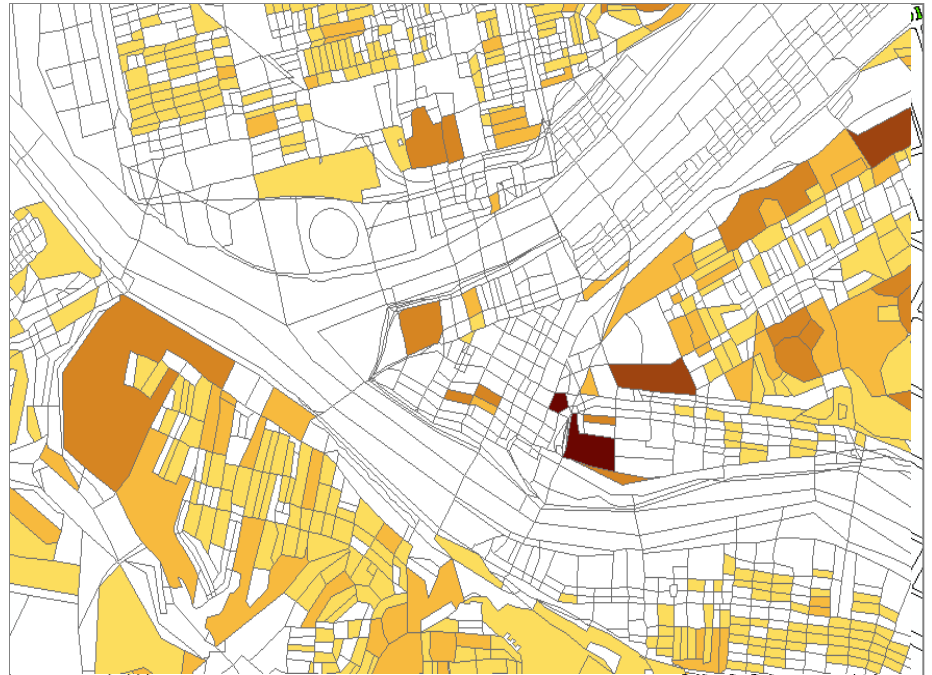
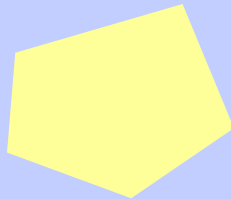
Green
Spaces



Buildings



Census
Tracts
or Blocks



Graphic Elements



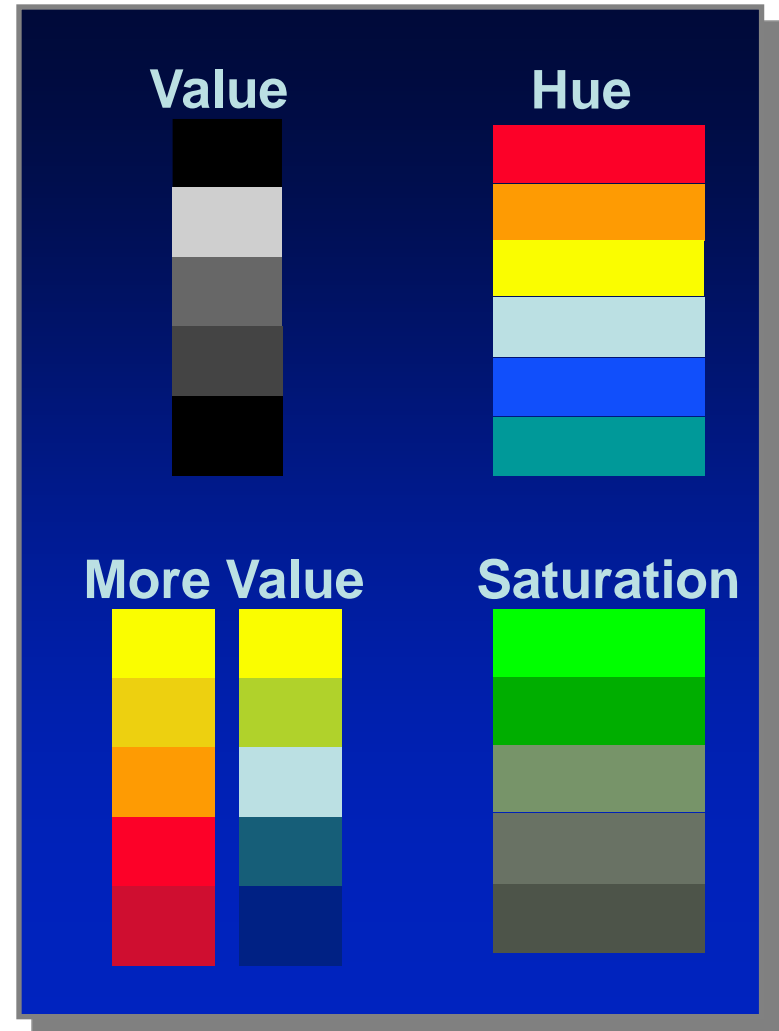
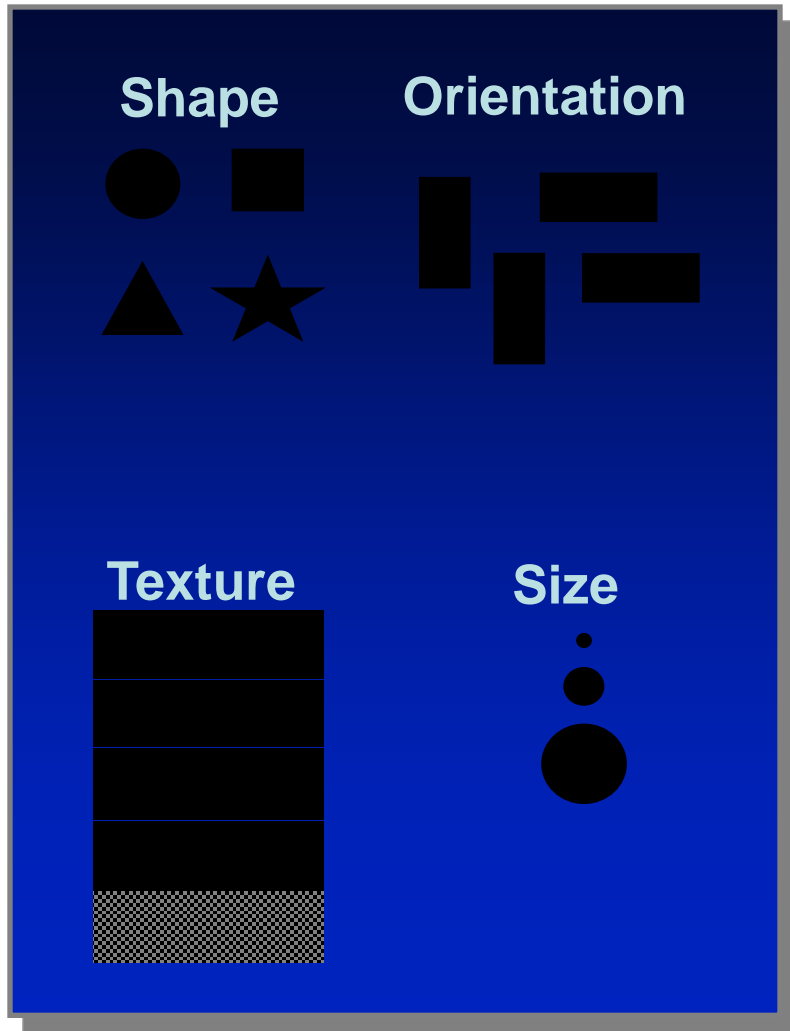
Jacques Bertin

Visualization Information

“What should be printed to facilitate “communication”, that is, to tell others what we know without a loss of information”

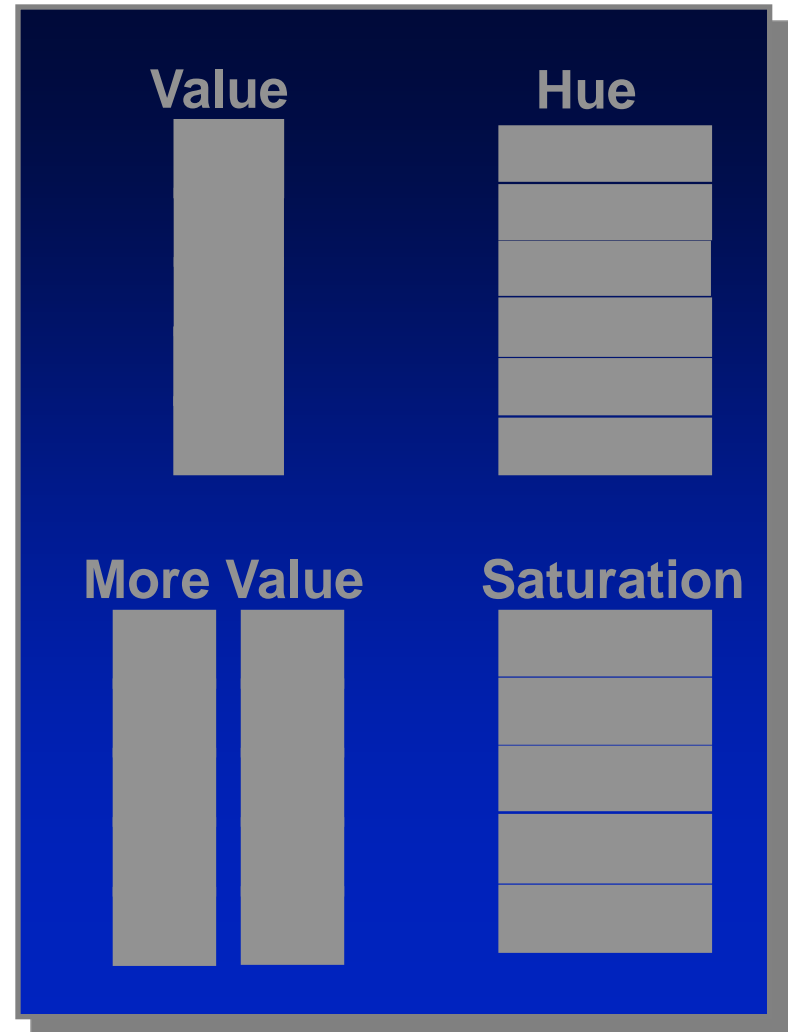
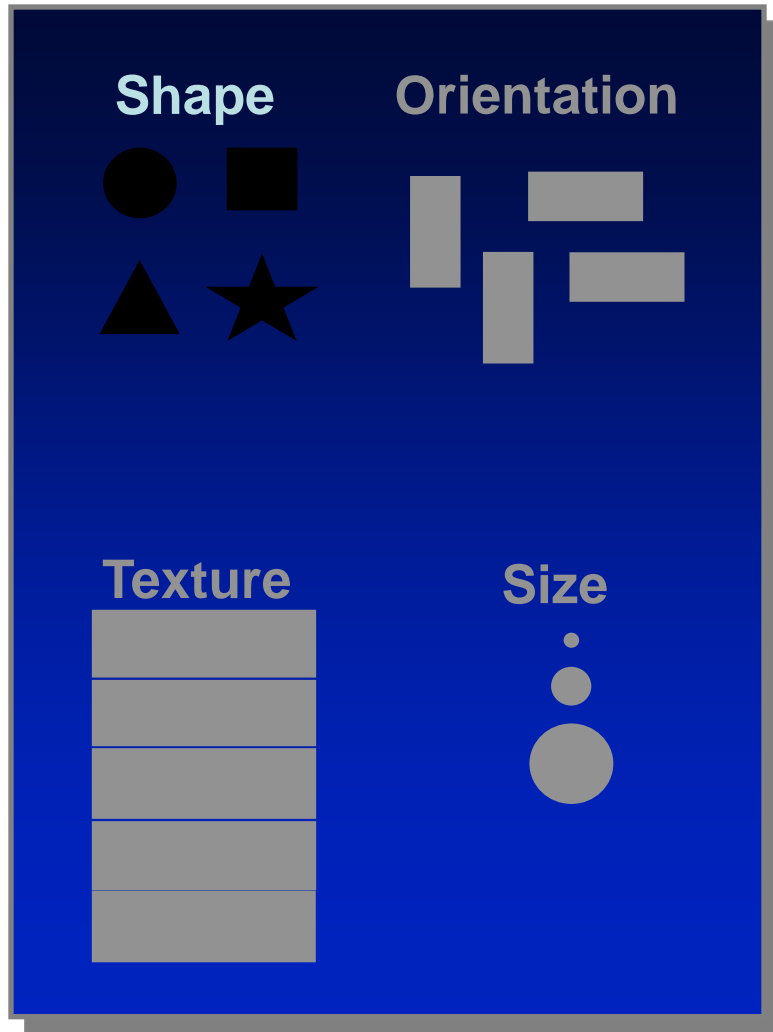
-Jacques Bertin, Paris, February 1983

Bertin's Graphic Variables

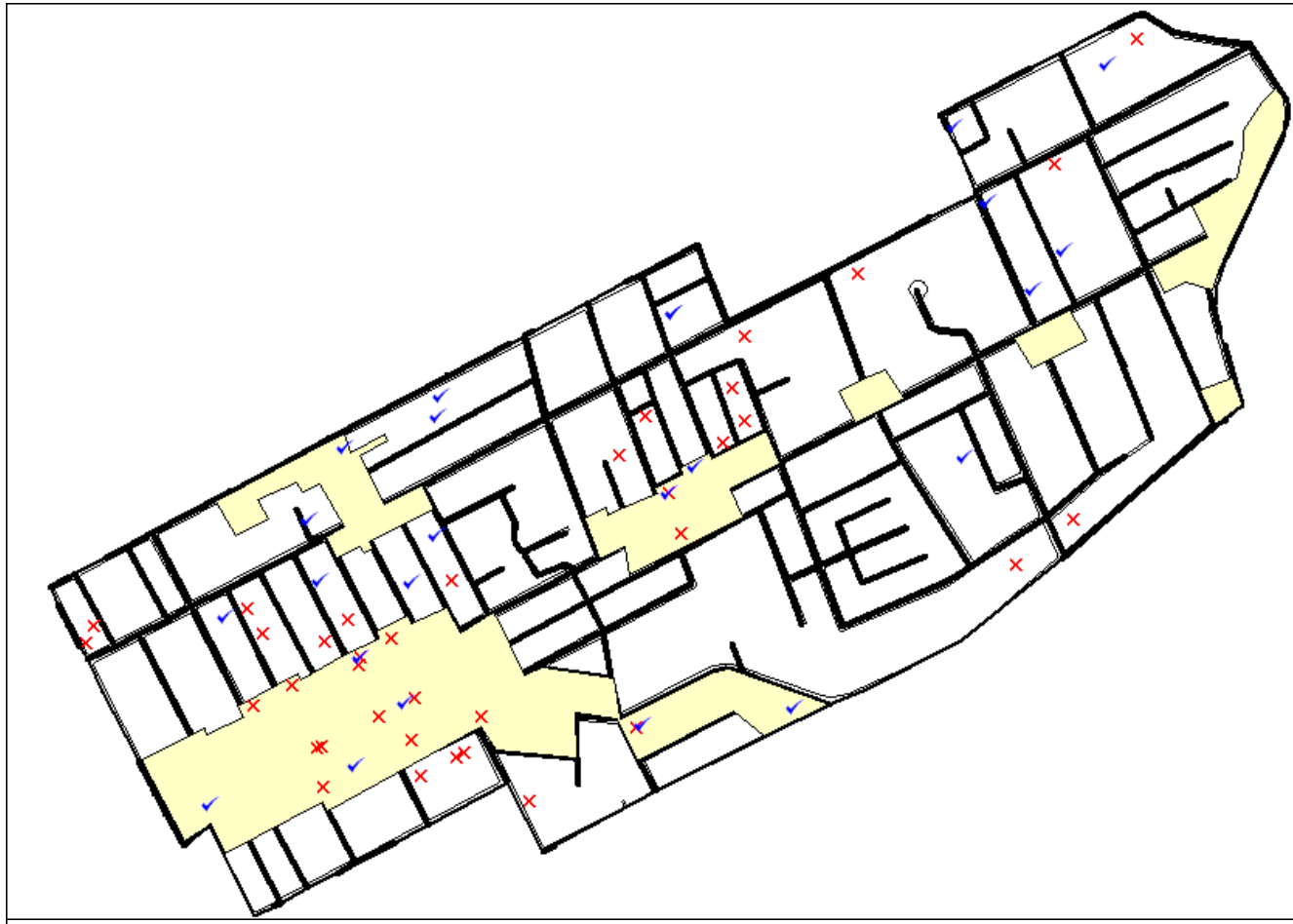




Point Symbols



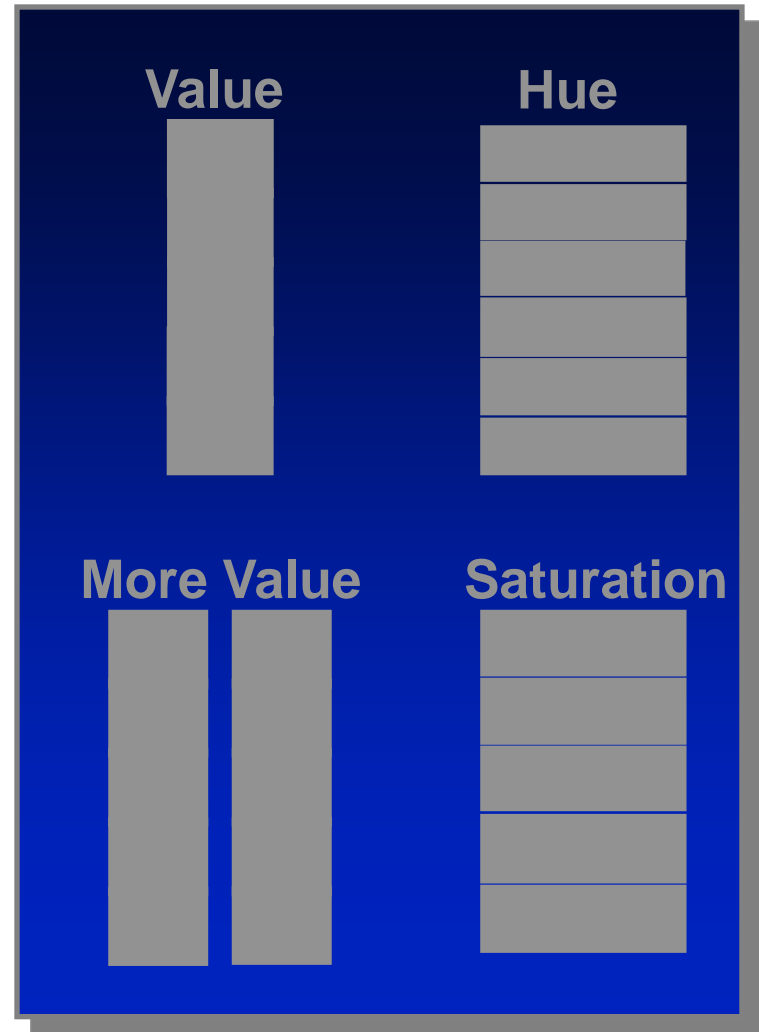
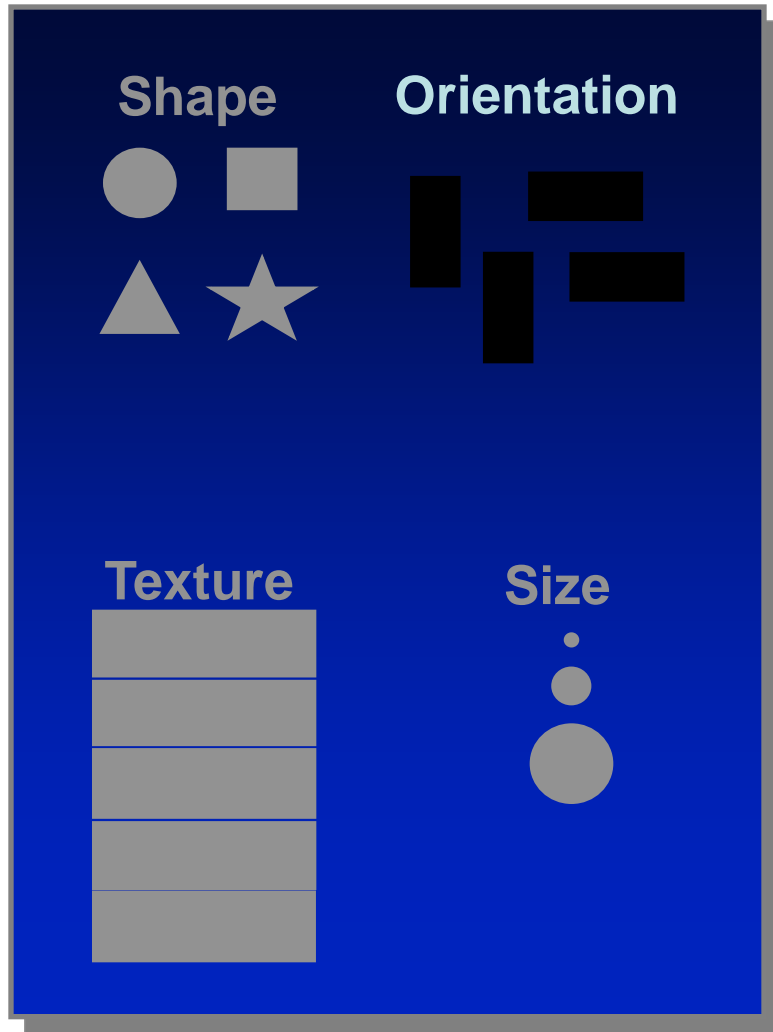
Use Solid Point Markers



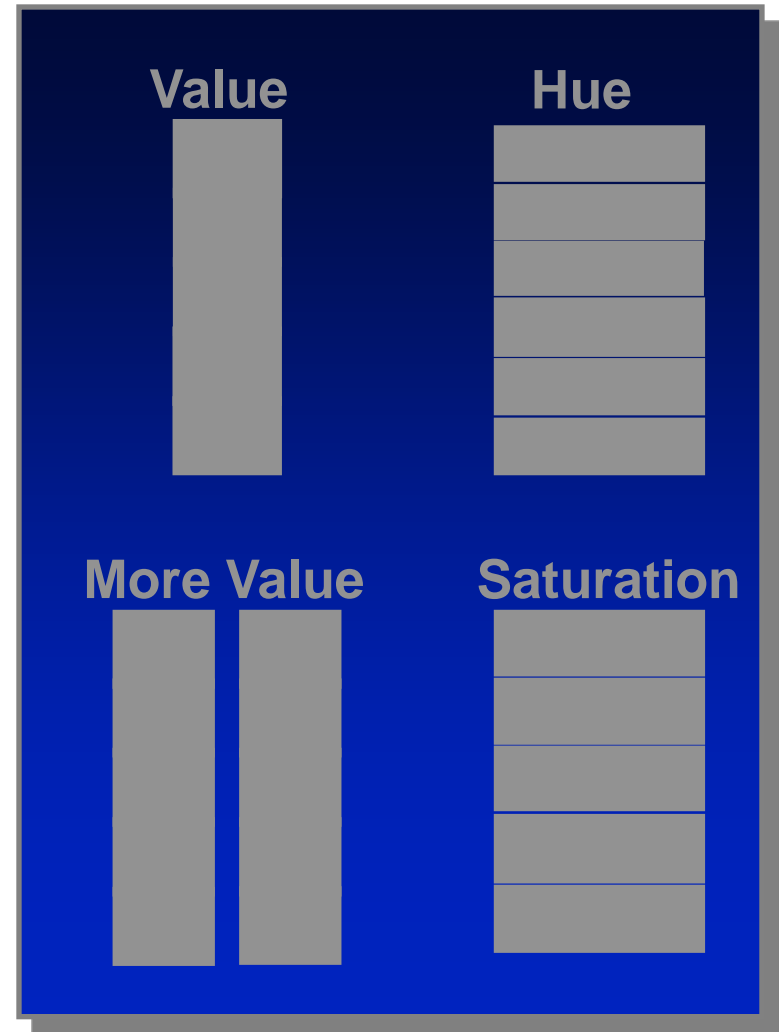
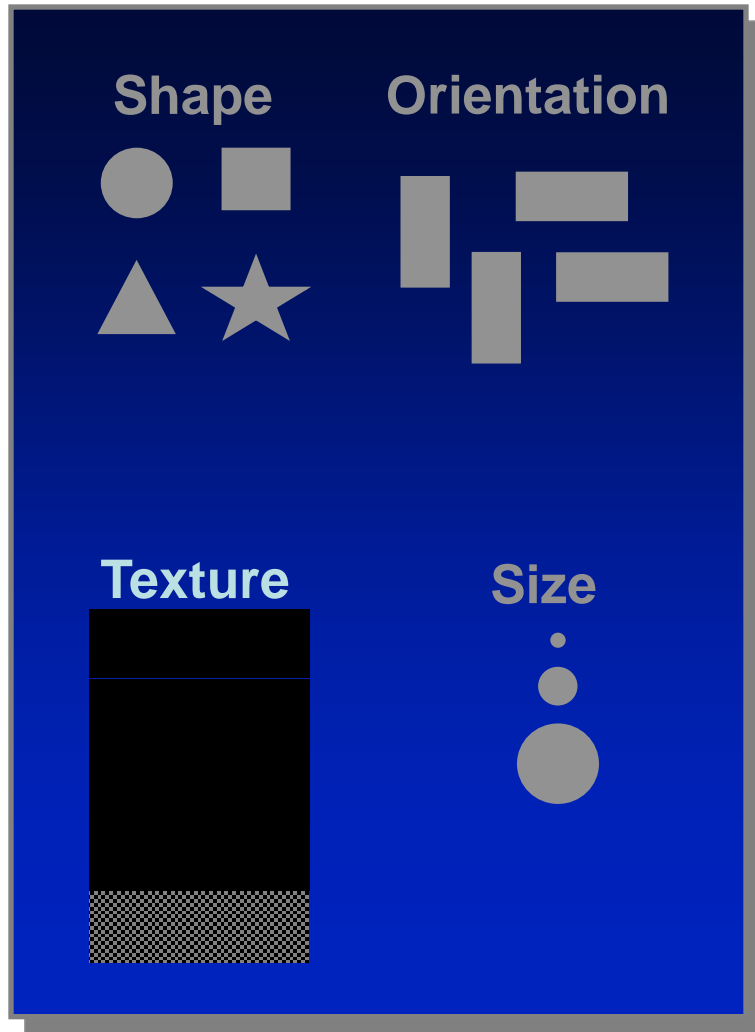
Use Three to Seven Categories Max.



Orientation

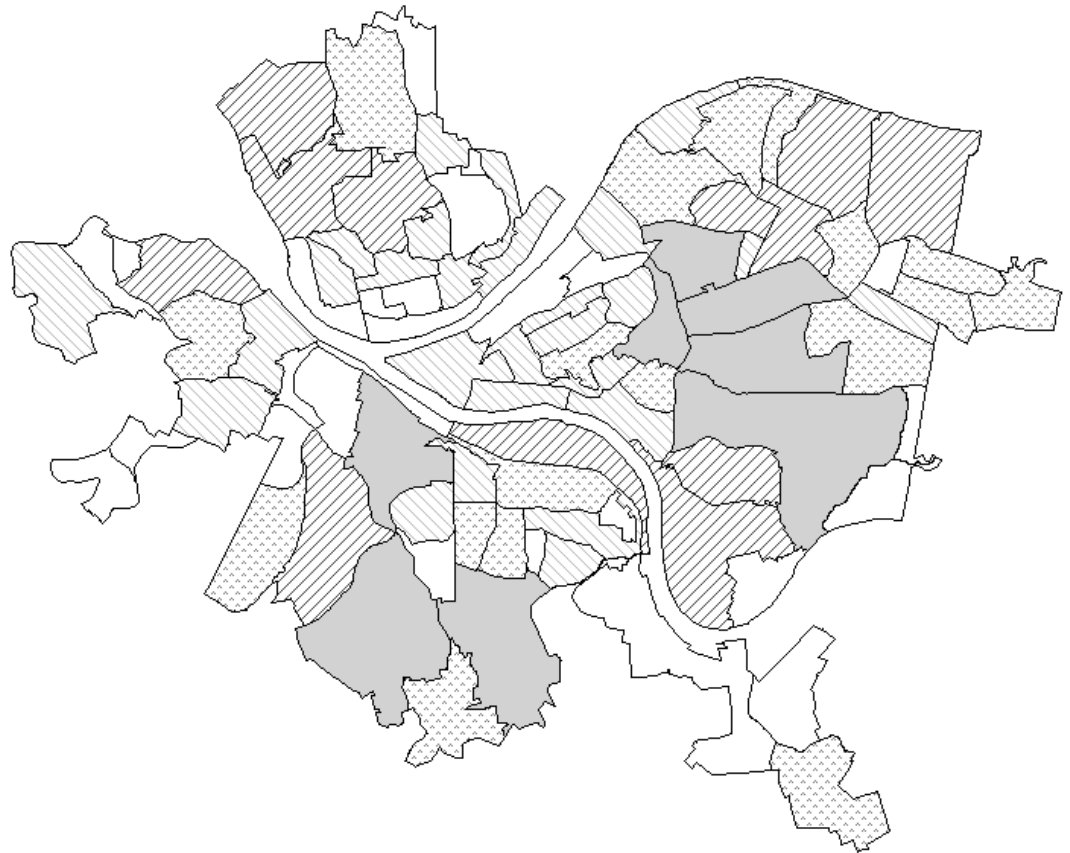


Polygon Symbols



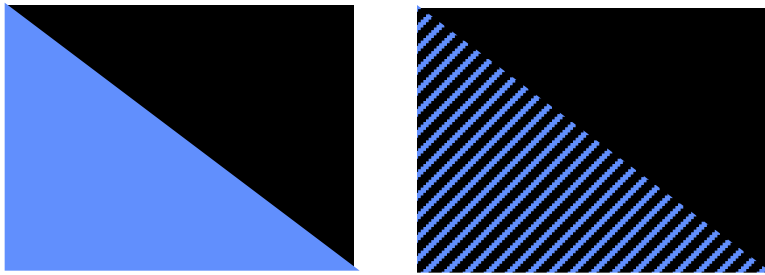
Texture

- Black and White Prints
- Polygons
- Large Areas



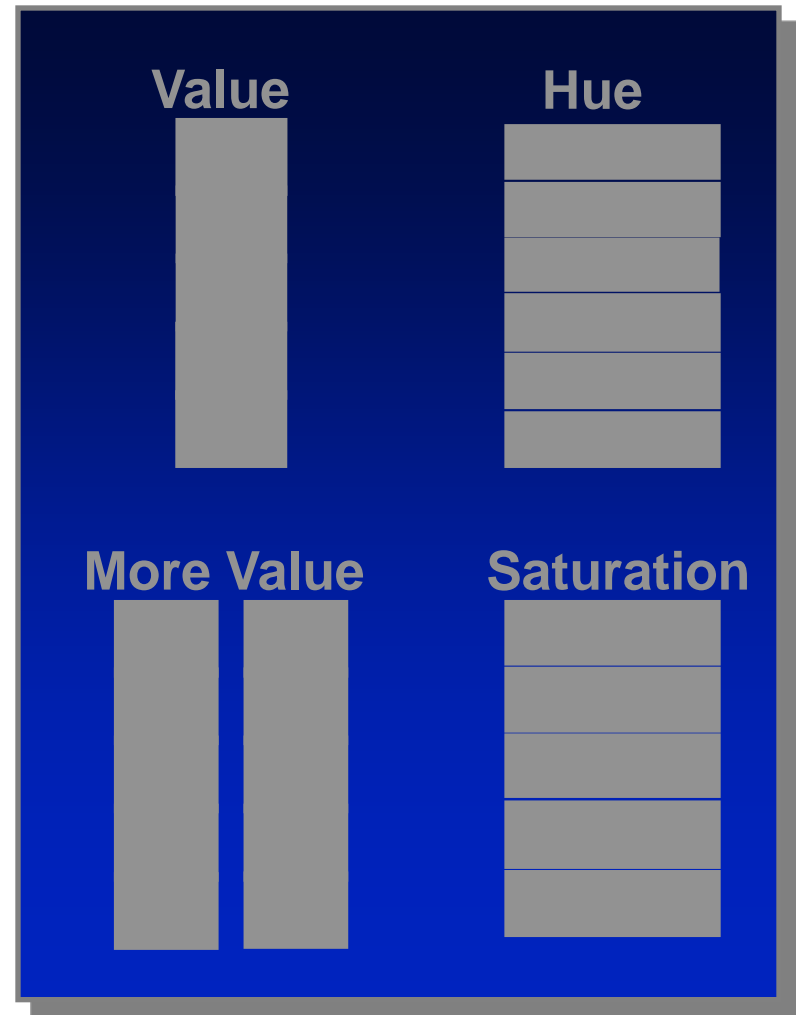
Texture

- Brings object to the front (figure)
 - long wavelength hues
 - coarse texture





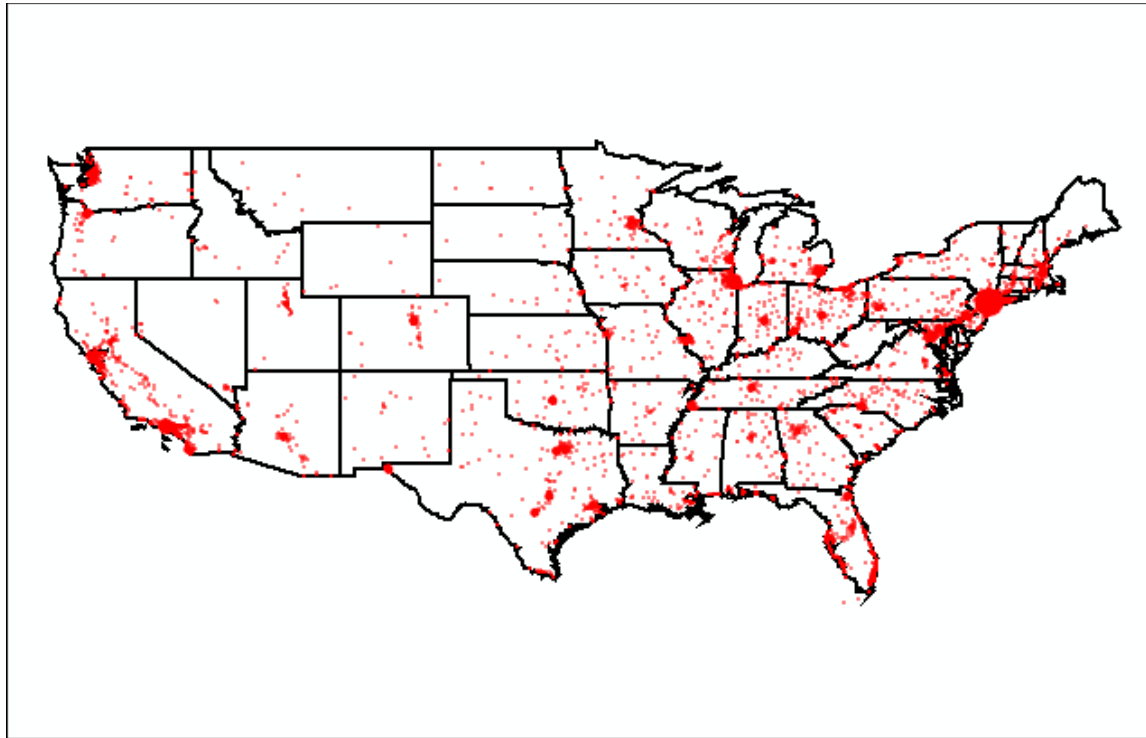
Size – Point Symbols



Size

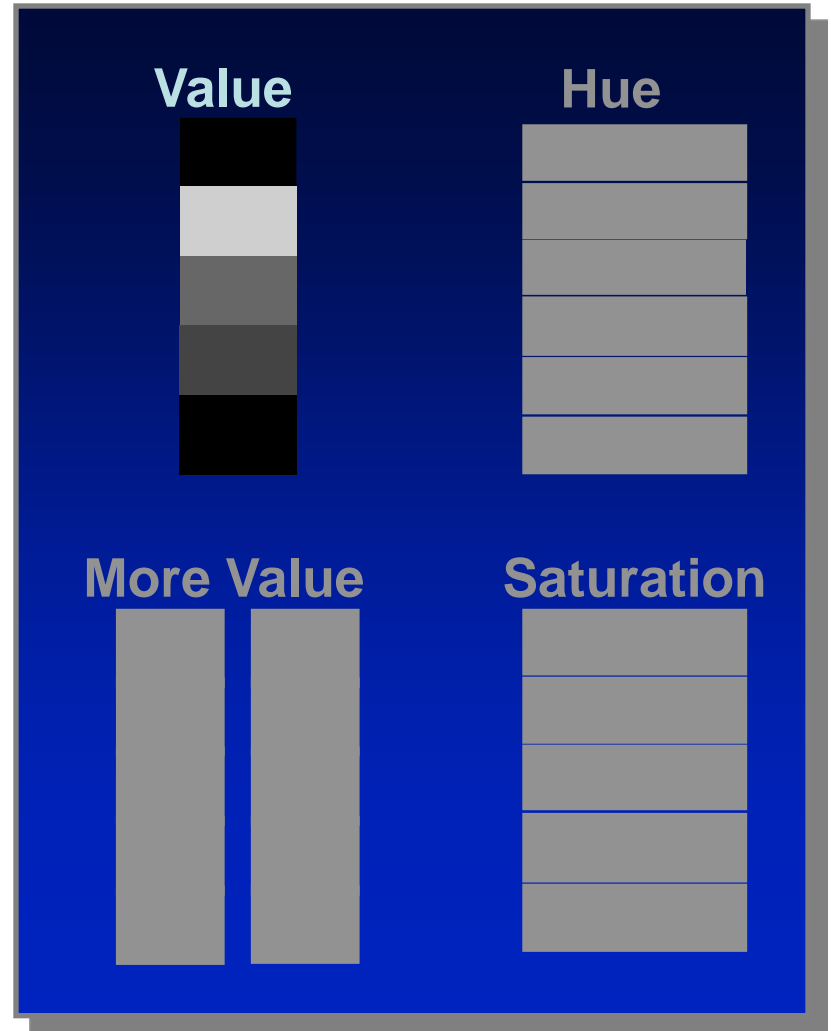
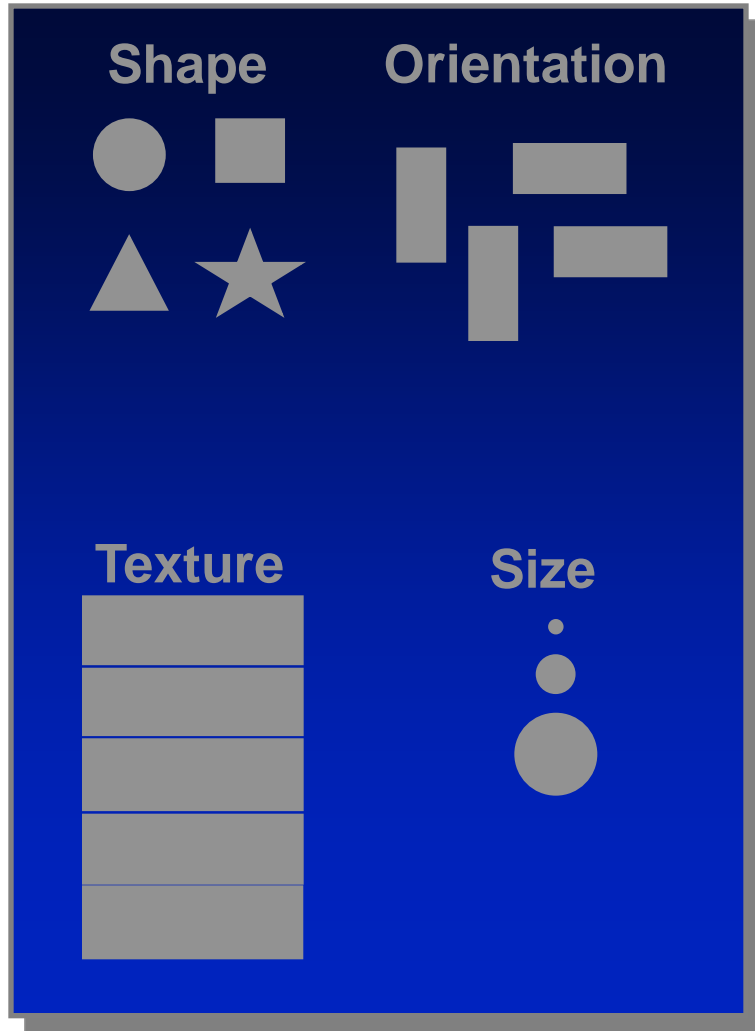
Graduated Symbols

Show Size or Amount





Values





Values

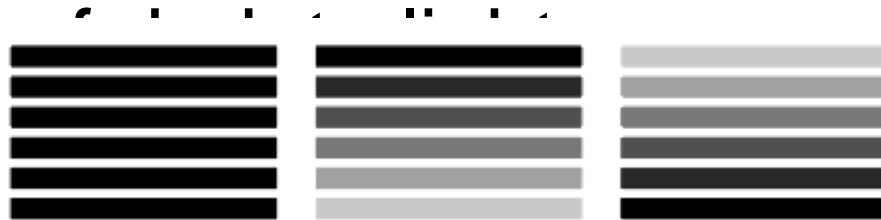
- Increase/Decrease Contrast
- The greater the difference in value between an object and its background, the greater the contrast.



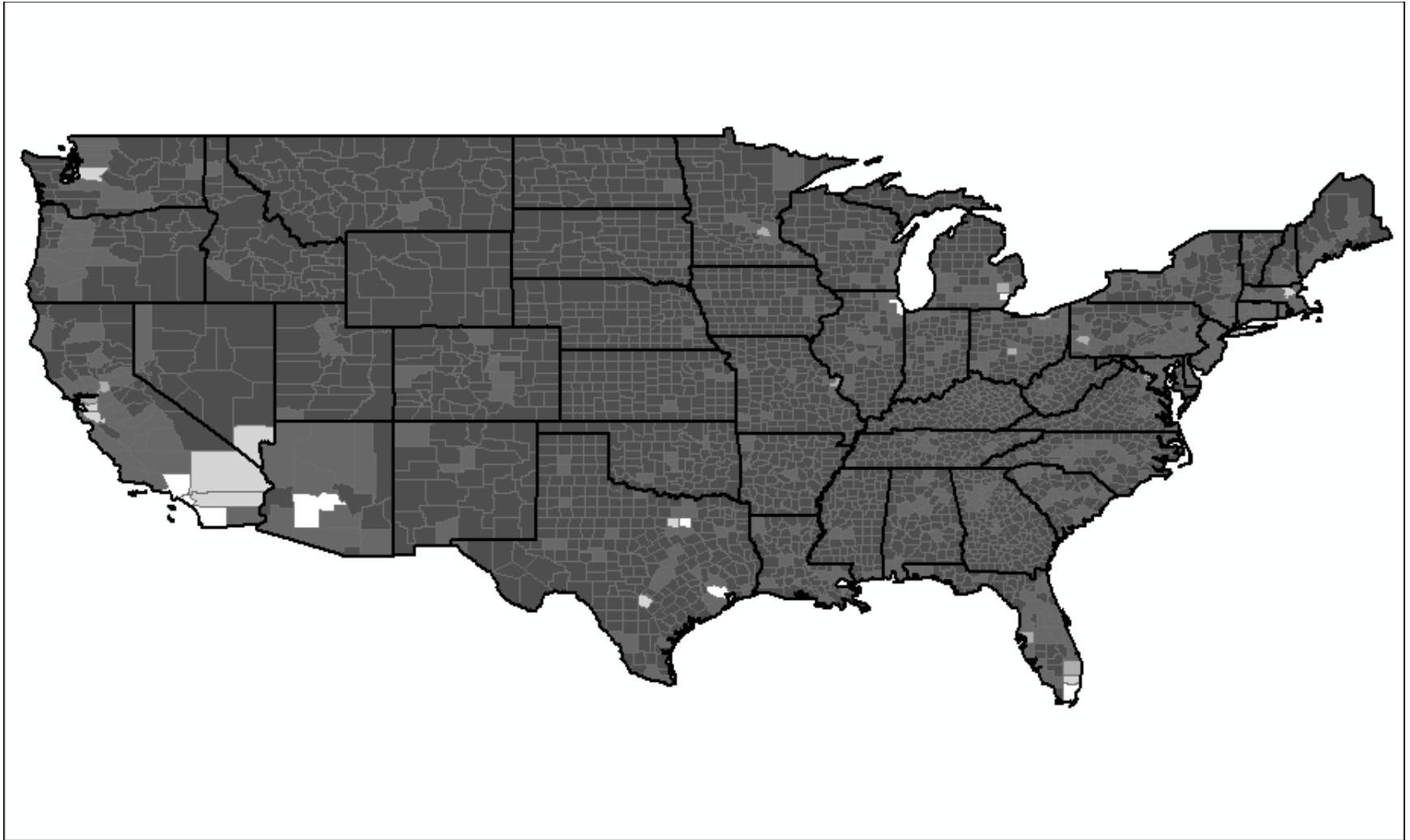


Values

- By creating a pattern of dark to light values, even when the objects are equal in shape and size, it leads the eye in the direction

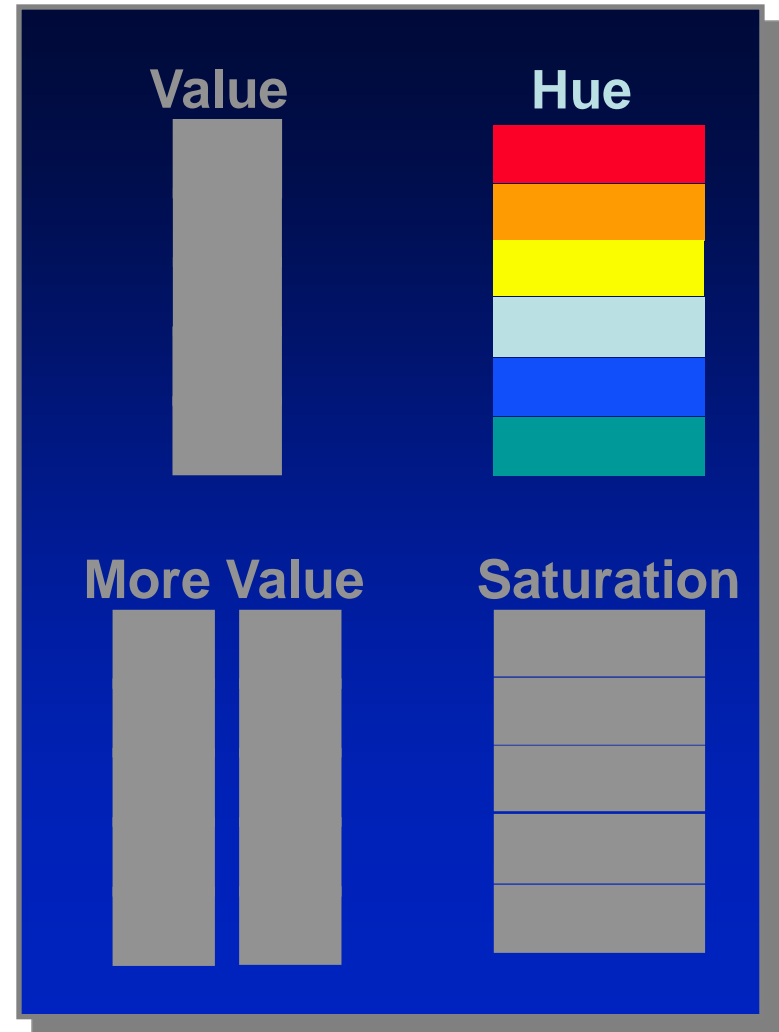
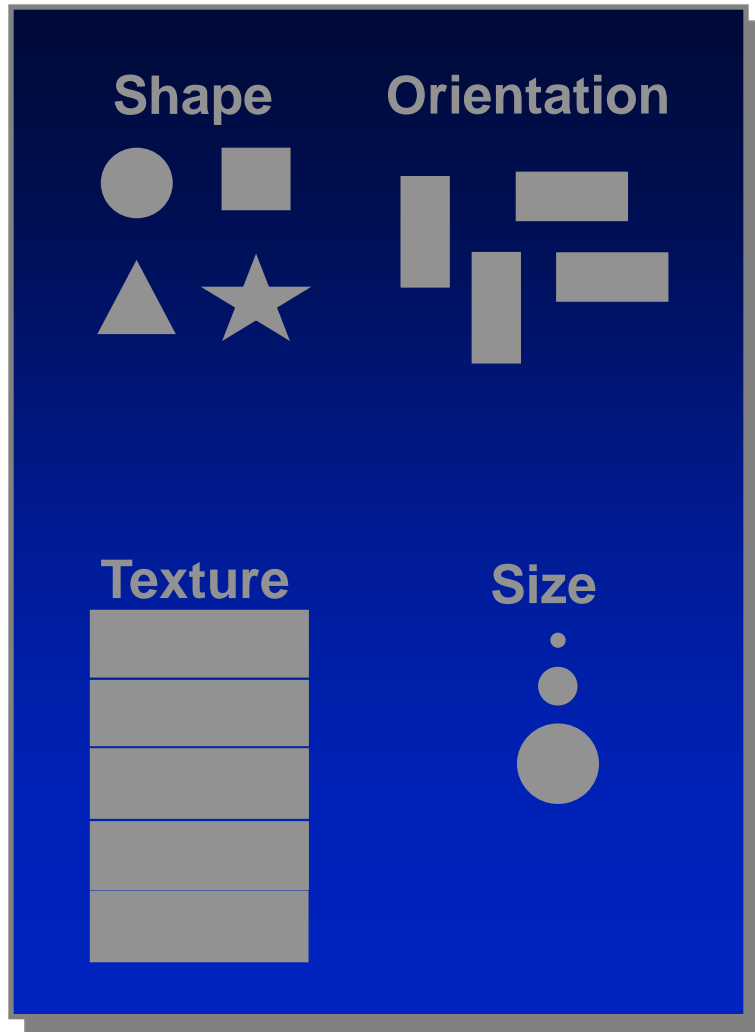


Values

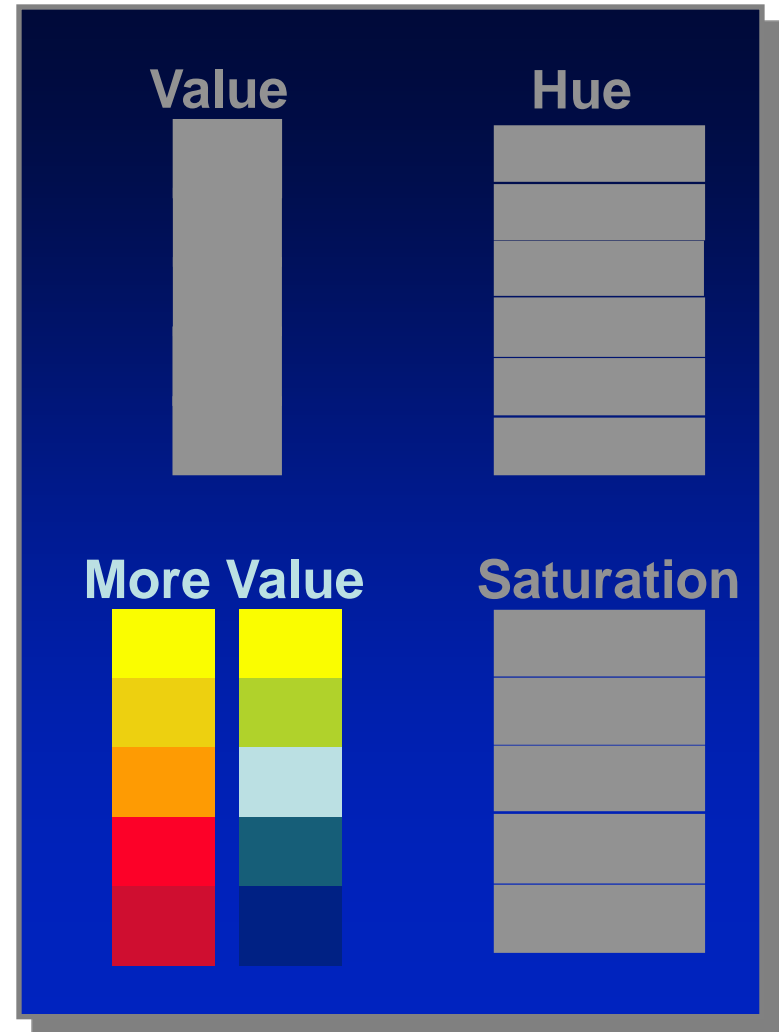
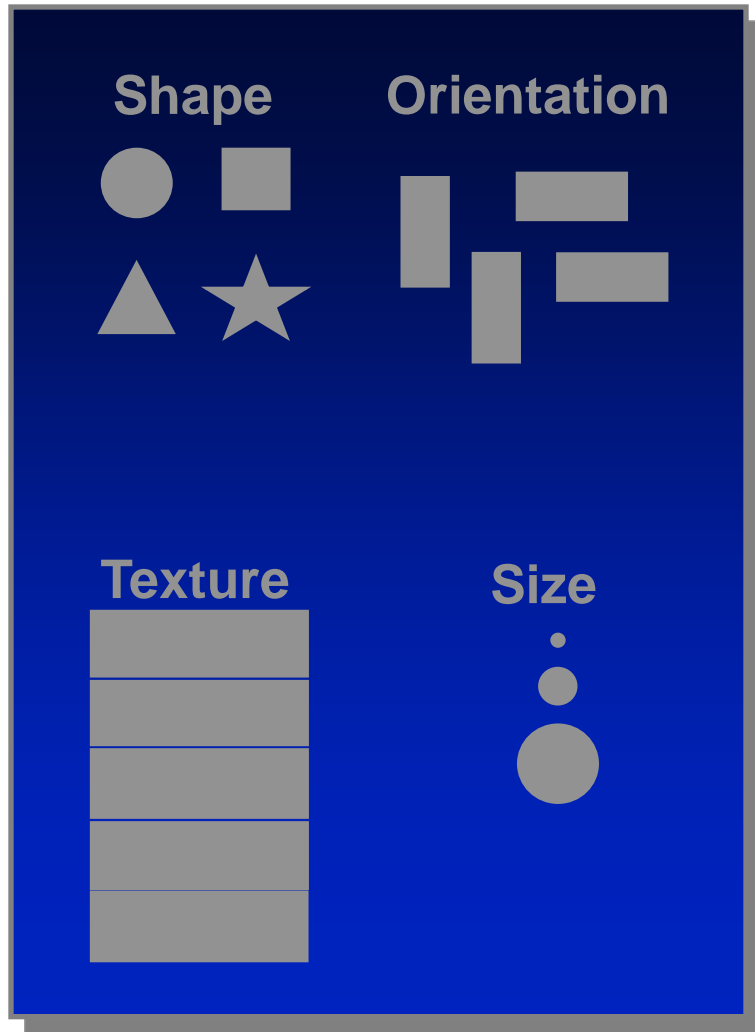




Color Hues

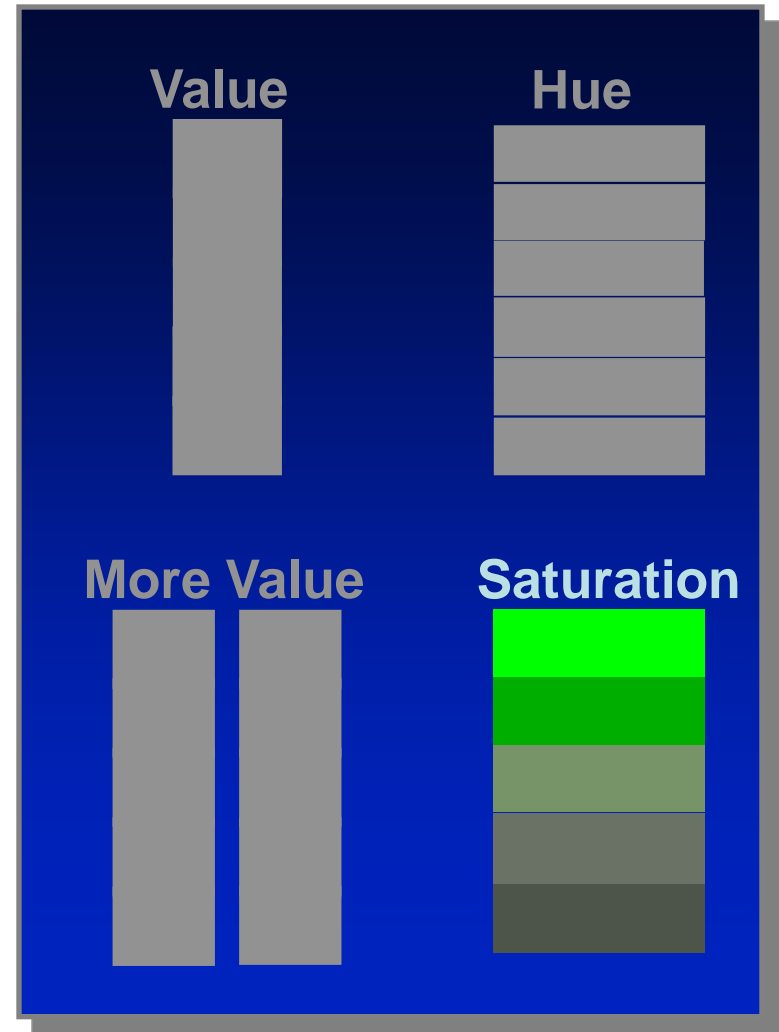
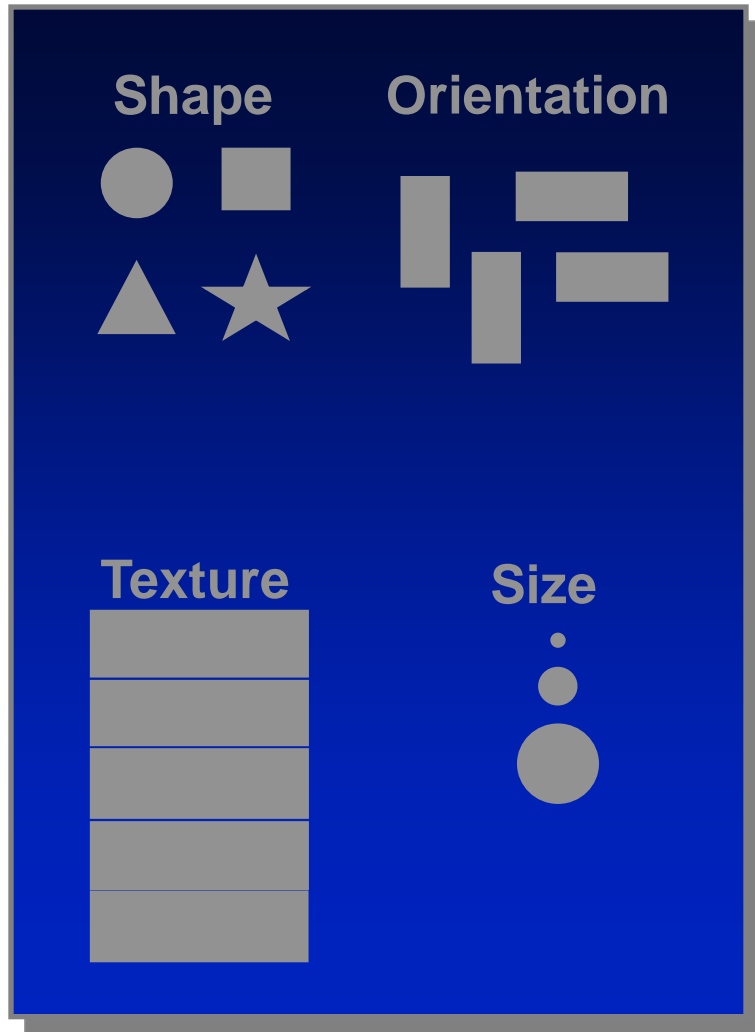


Color Values



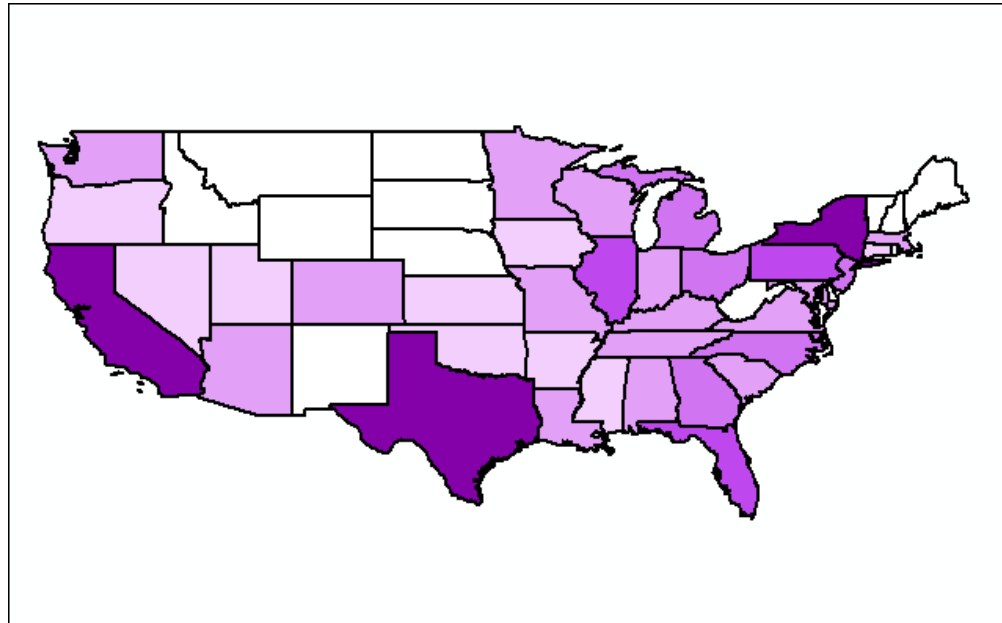


Saturation



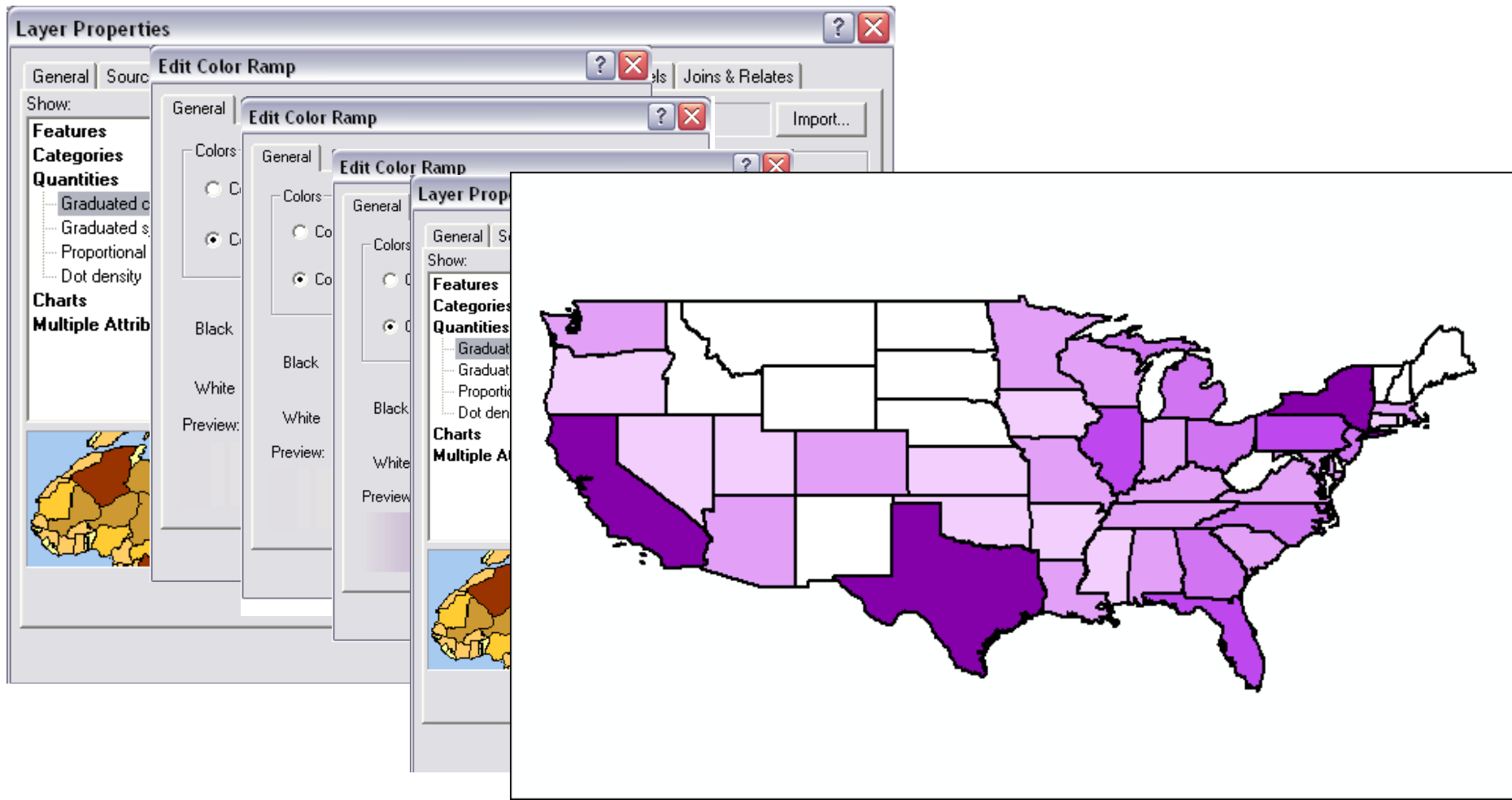
Saturation

- You can change the saturation of a hue by adding black (shadow) or white (light). The amount of saturation gives us our shades and tints.



Saturation

- Customize the Properties...of a layer



Color

Color Hues and Values

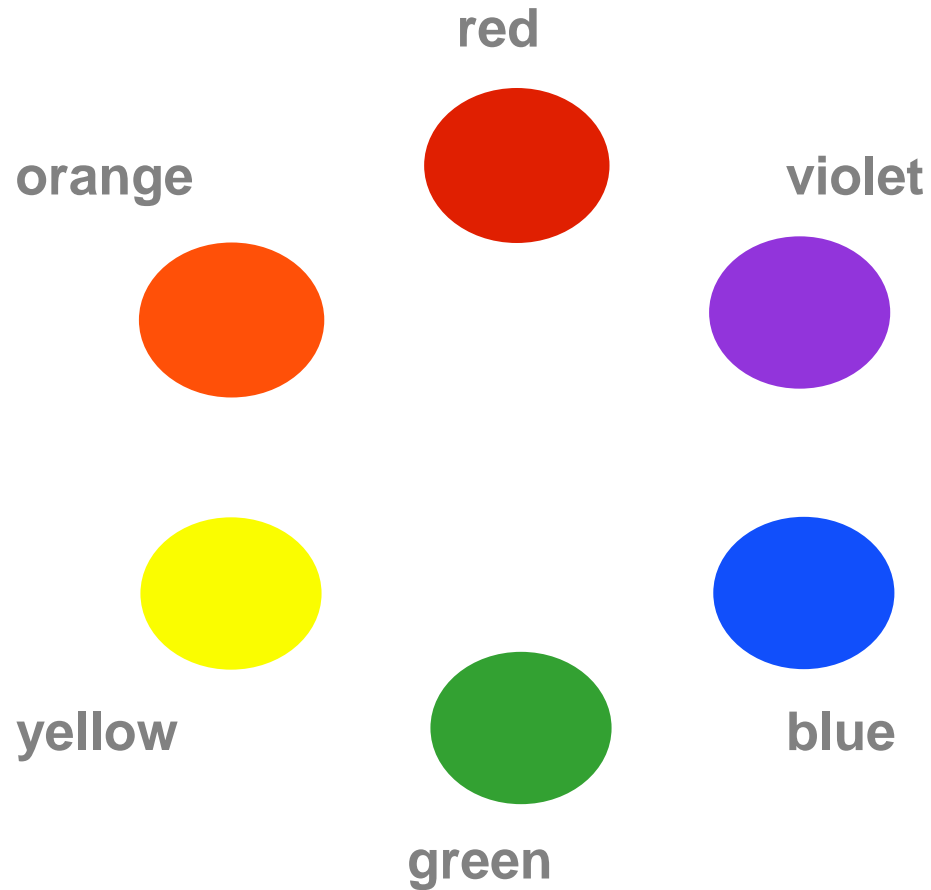
Each of individual color is a hue

Colors have meaning (i.e. cool colors, warm colors, political meanings)

- Cool colors calming
- Warm colors exciting
- Cool colors appear smaller than warm colors and they visually recede on the page so red can visually overpower and stand out over blue even if used in equal amounts.



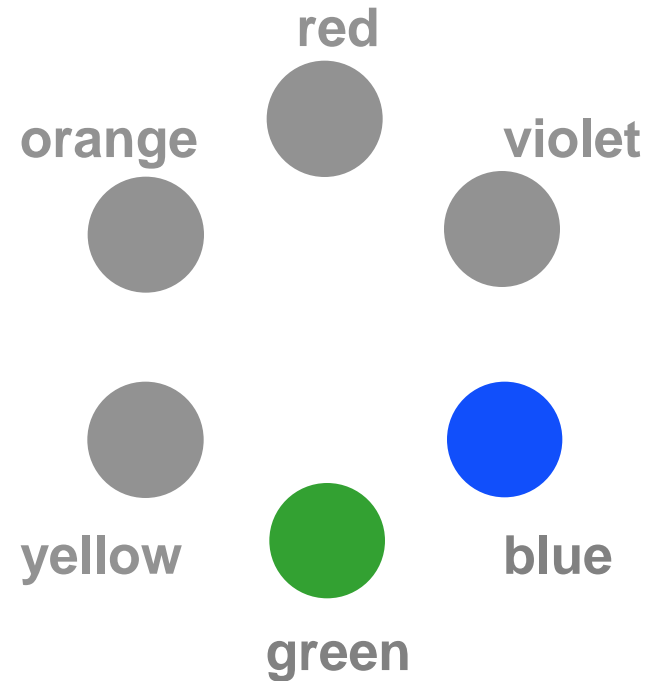
Color Wheel





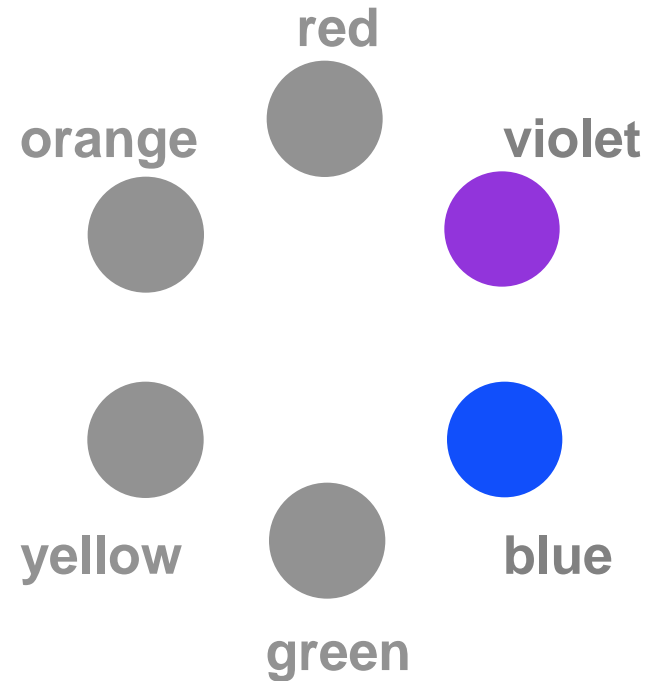
Color Wheel

- Harmony
 - two adjacent hues



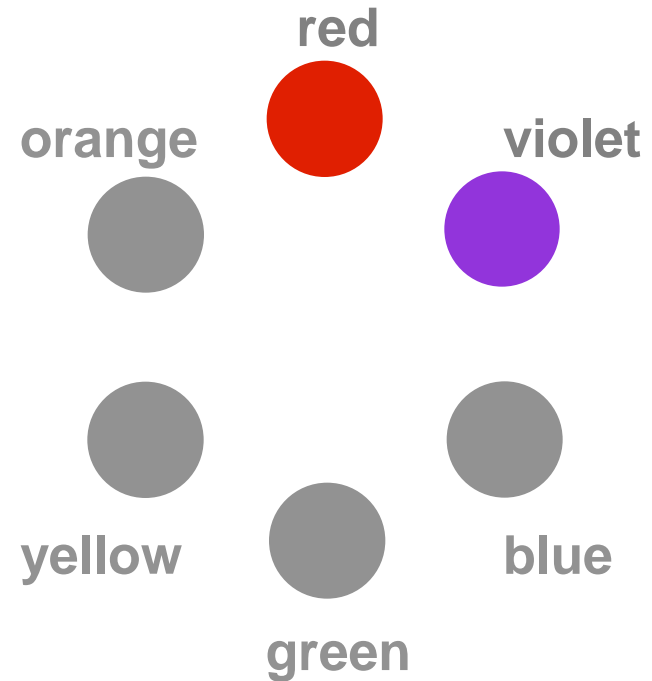
Color Wheel

- Harmony
 - two adjacent hues



Color Wheel

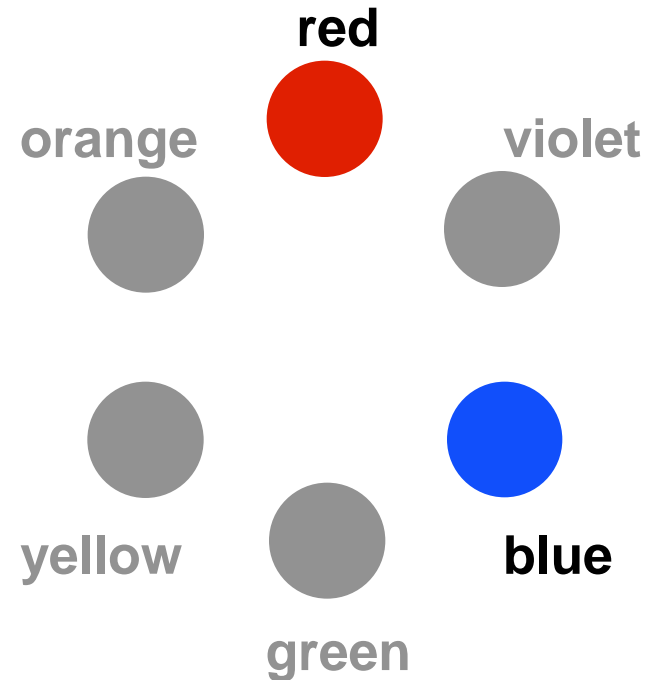
- Harmony
 - two adjacent hues





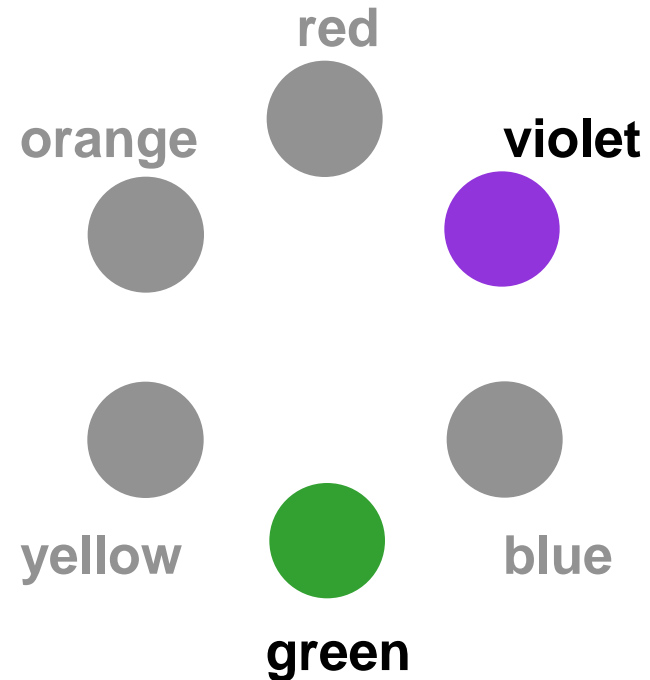
Color Wheel

- Harmony
 - two adjacent hues
- Contrast
 - two hues with one hue skipped in between



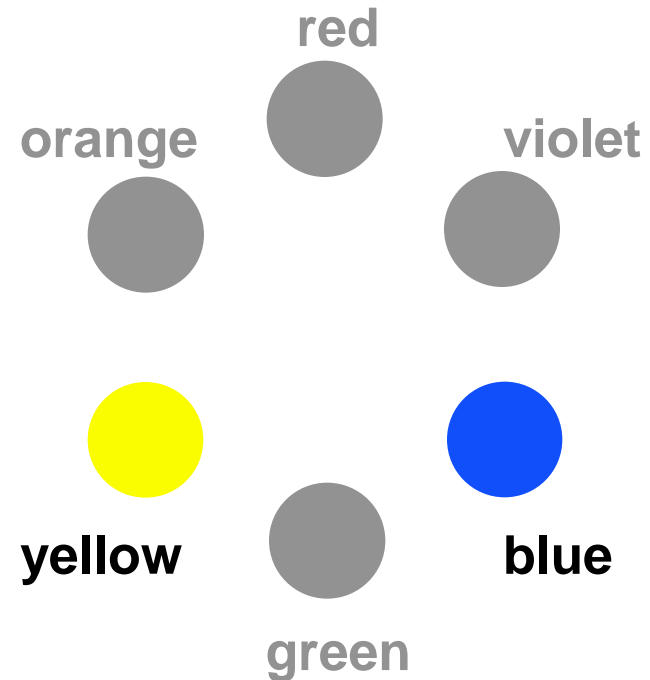
Color Wheel

- Harmony
 - two adjacent hues
- Contrast
 - two hues with one hue skipped in between



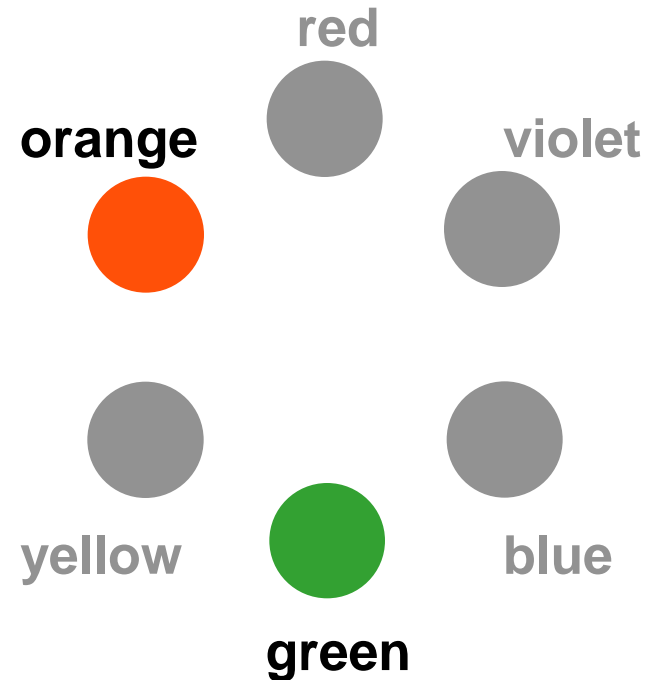
Color Wheel

- Harmony
 - two adjacent hues
- Contrast
 - two hues with one hue skipped in between

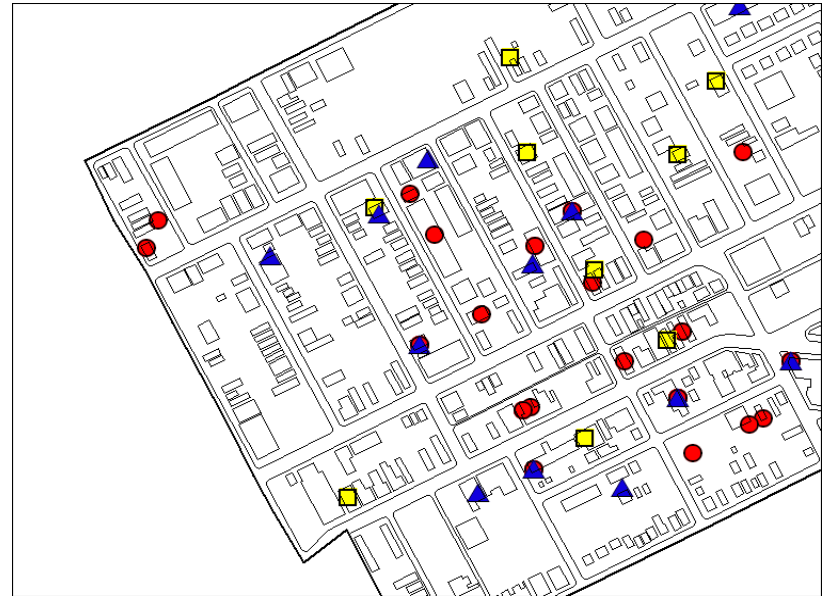


Color Wheel

- Harmony
 - two adjacent hues
- Contrast
 - two hues with one hue skipped in between



Non-Contrasting vs. Contrasting



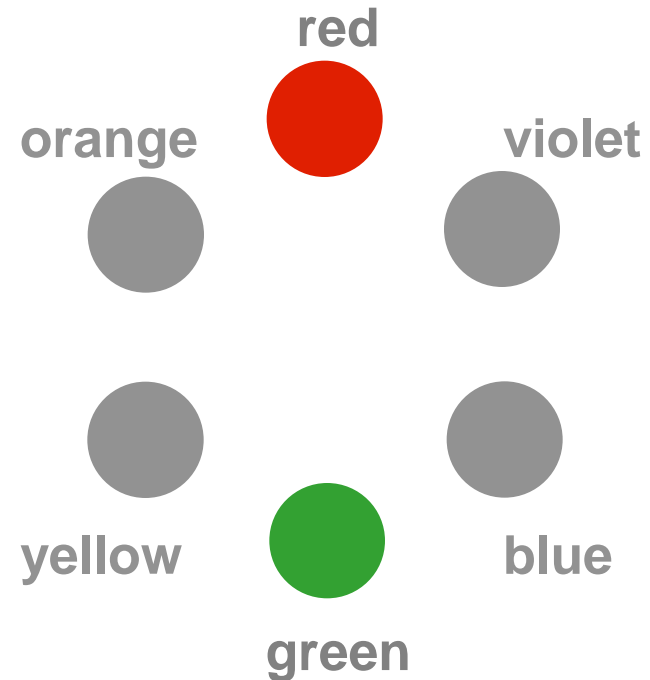


Color Wheel

- Harmony
 - two adjacent hues
- Contrast
 - two hues with one hue skipped in between

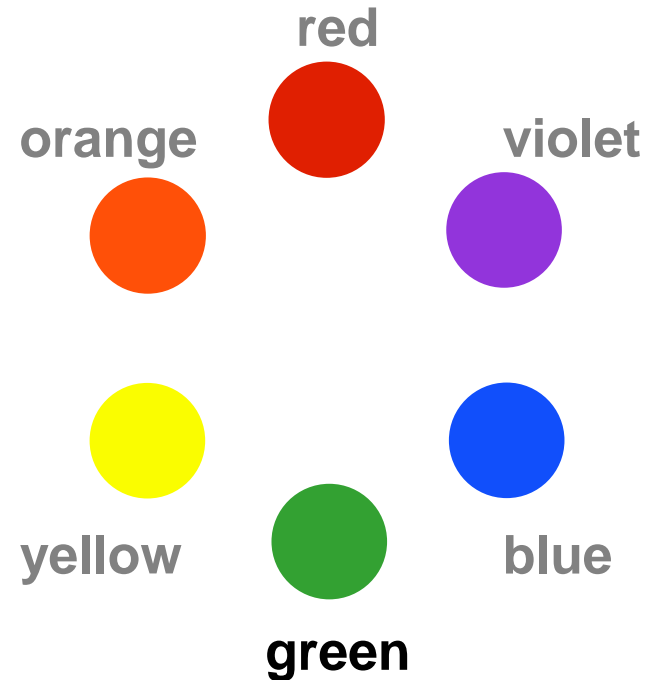
Clash

- Opposites



Color Wheel Review

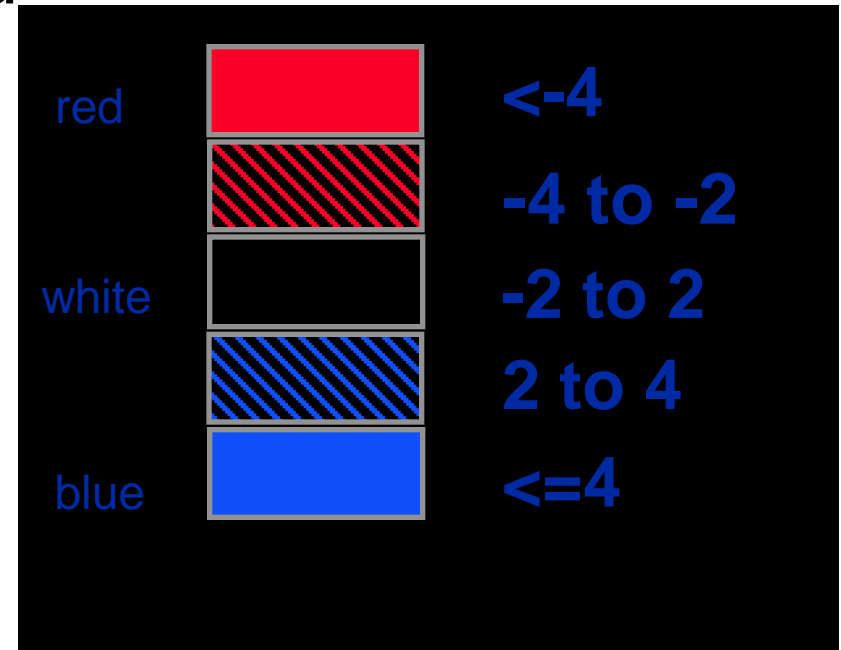
- Harmony
 - two adjacent hues
 - Contrast
 - two hues with one hue skipped in between
- Clash
- Opposites



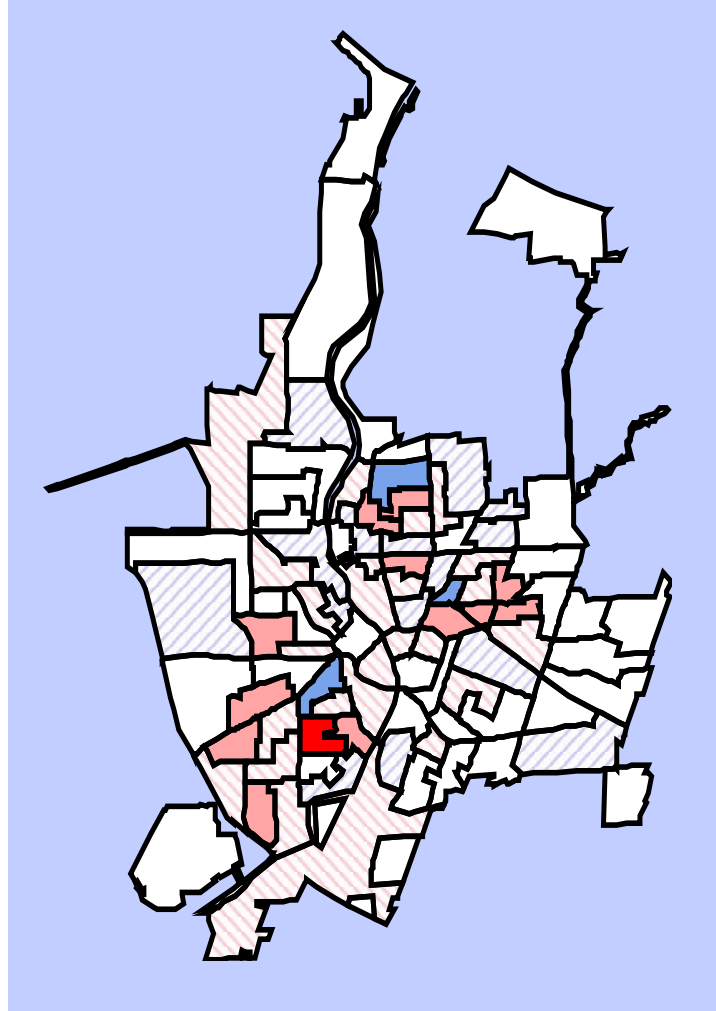
Double-Ended Scales

- Extremes Emphasized

- critical value of zero
- e.g., regression residuals, time change
- blue and red contrast
- white center is ground



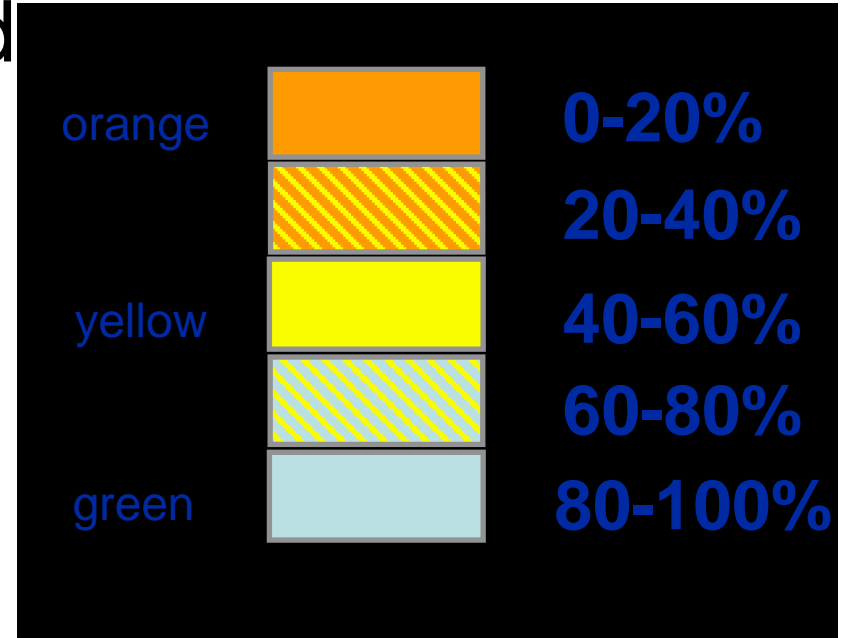
Change Map



Double-Ended Scales

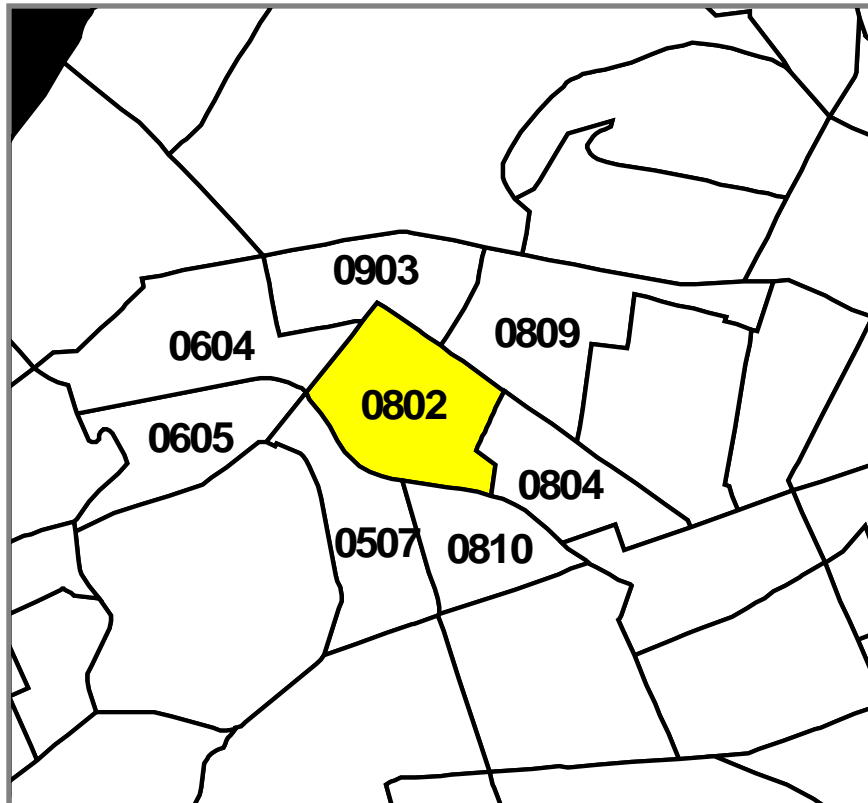
- Balance Emphasized

- 50% is desired
- yellow contrasts with white paper
- green and orange contrast

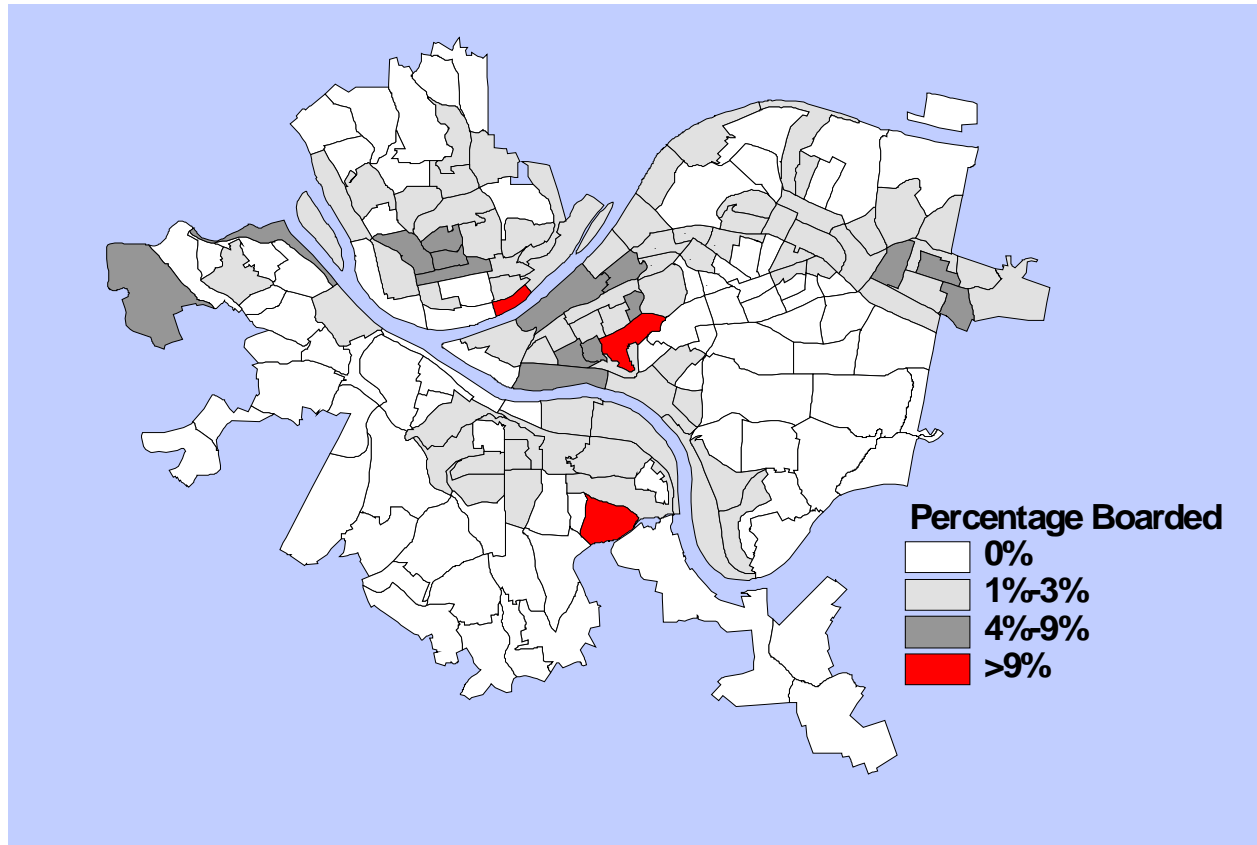


Color Spot

White background allows yellow color spot to be visualized



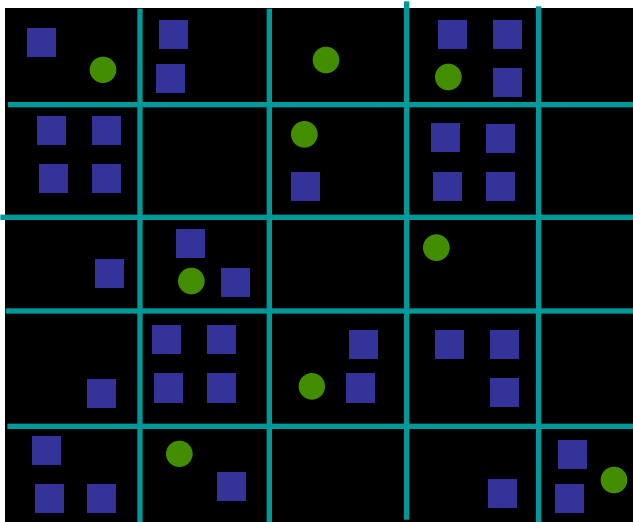
Color Spot Ramps



Graphical Hierarchy

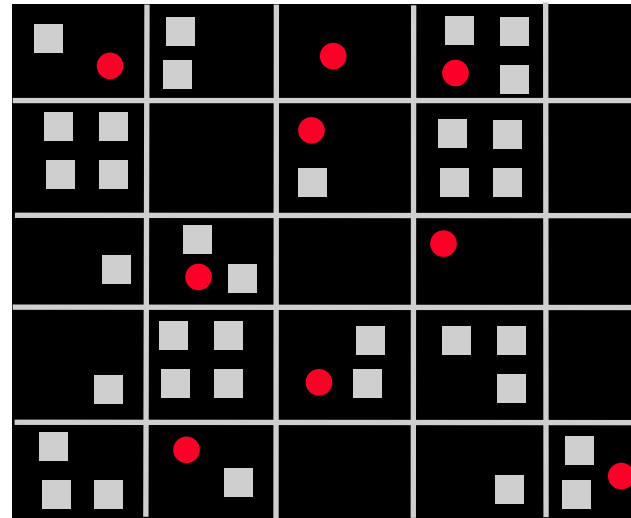
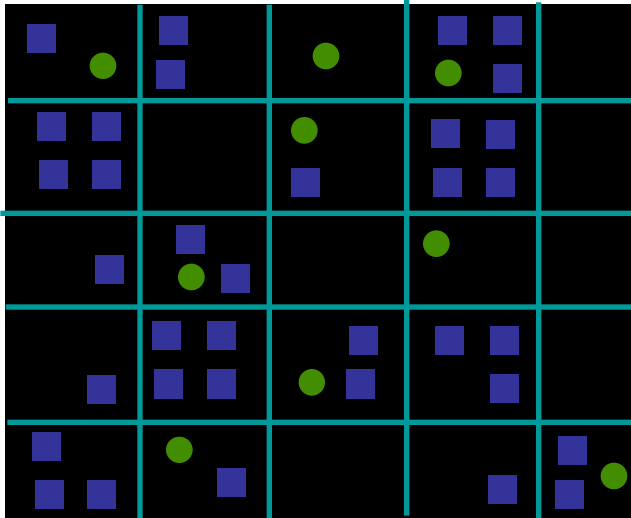
Graphical Hierarchy

- Goal
 - direct attention toward or away from available Information



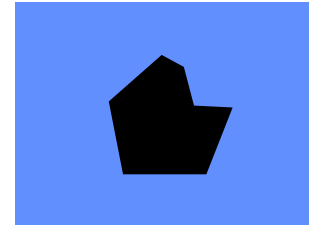
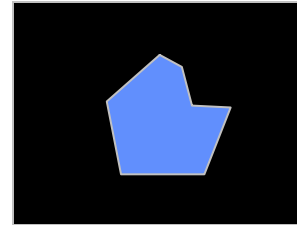
Graphical Hierarchy

- Goal
 - direct attention toward or away from available Information
- Figure-Ground
 - visual separation of a scene into recognizable *figures* and inconspicuous *background (ground)*



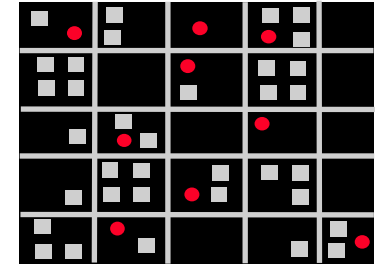
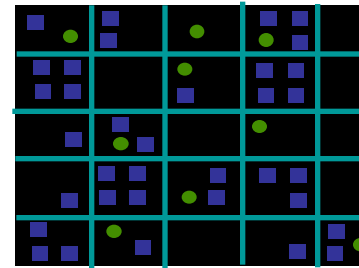
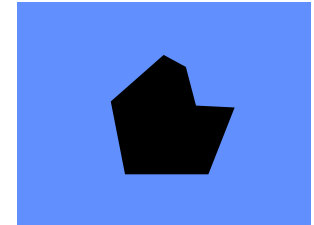
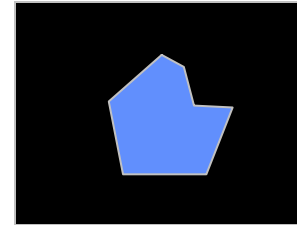
Graphical Hierarchy

- Ground
 - larger of two contrasting areas



Graphical Hierarchy

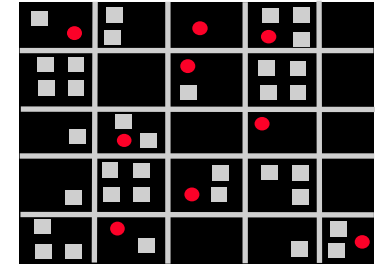
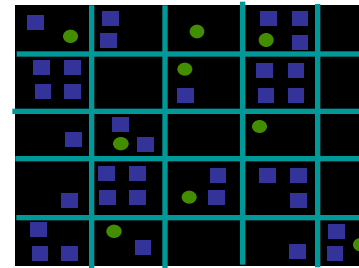
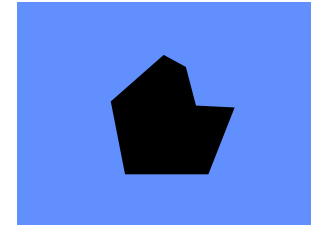
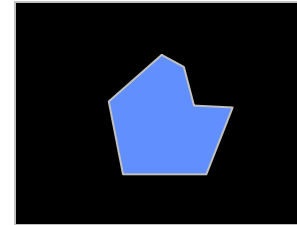
- Ground
 - larger of two contrasting areas
 - grays, light browns, heavily saturated hues



Graphical Hierarchy

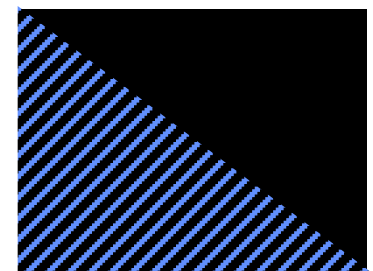
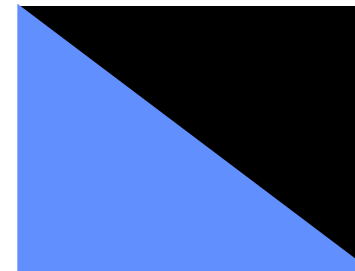
- Ground

- larger of two contrasting areas
- grays, light browns, heavily saturated hues



- Figure

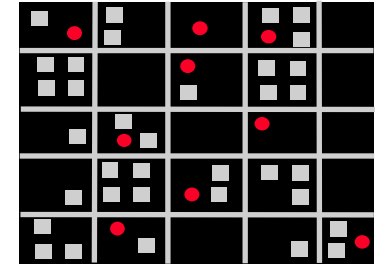
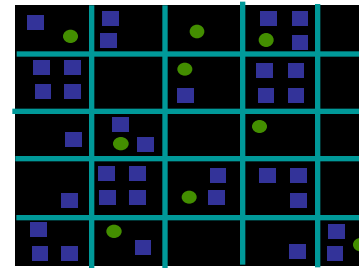
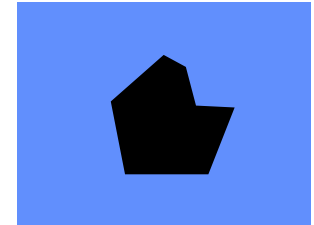
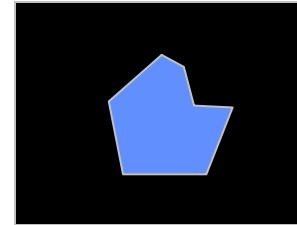
- long wavelength hues
- coarse texture



Graphical Hierarchy

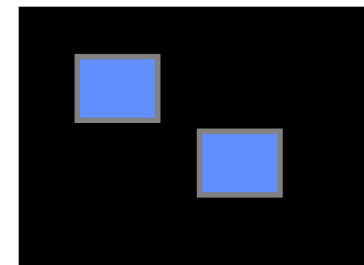
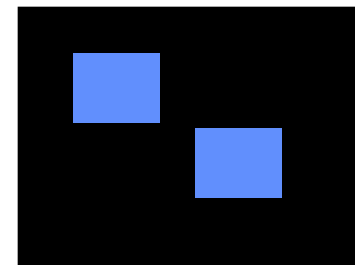
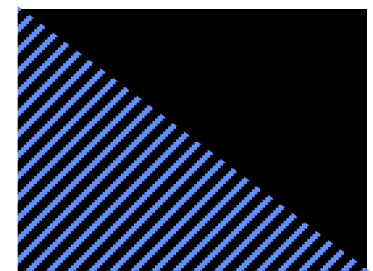
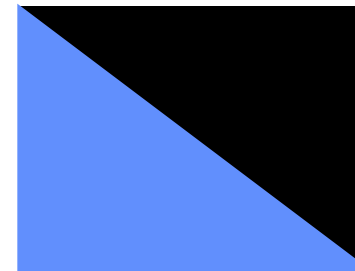
- Ground

- larger of two contrasting areas
- grays, light browns, heavily saturated hues



- Figure

- long wavelength hues
- coarse texture
- strong edge

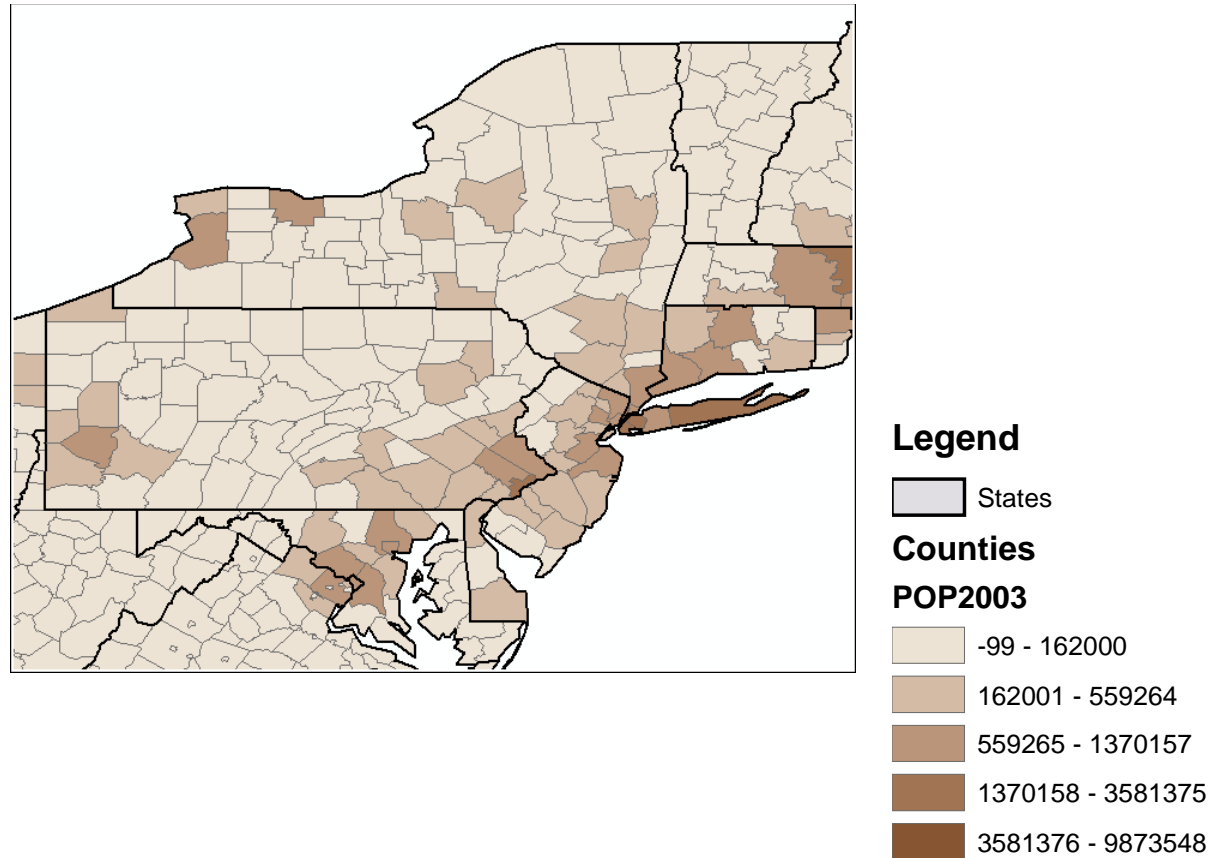




Choropleth Maps

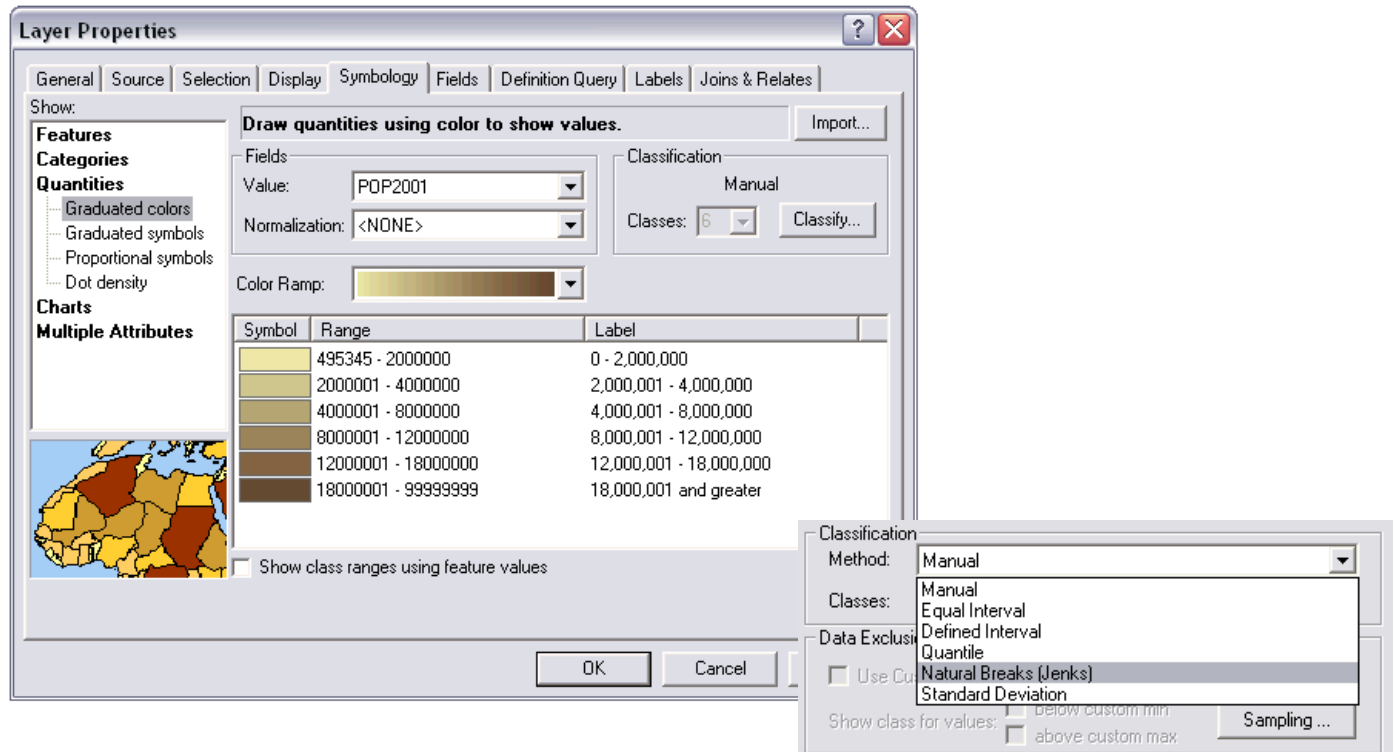
Choropleth Maps

Map using different colors or patterns
to show different values over space



Classifications

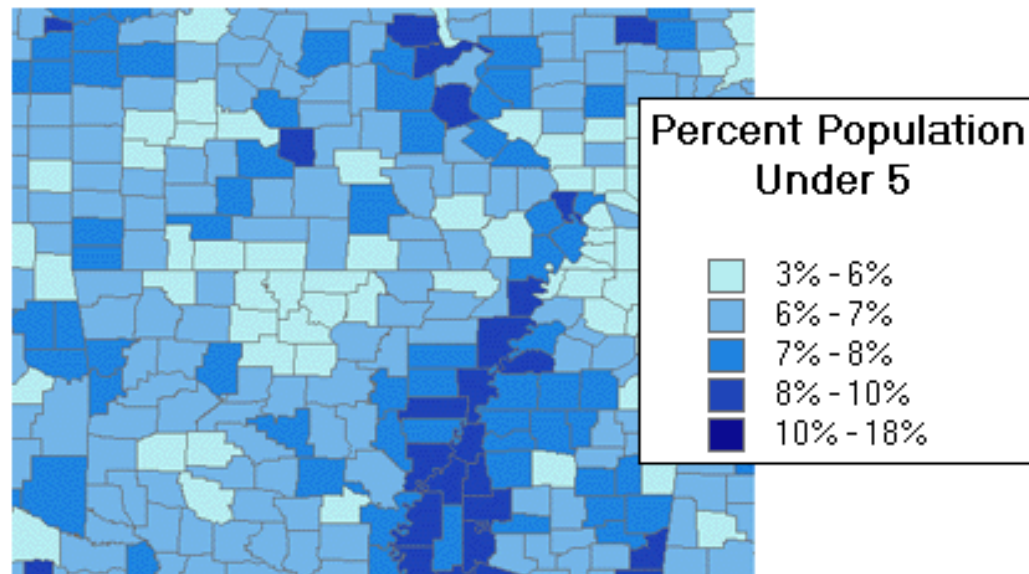
- Process of placing data into groups that have a similar characteristic or value



Natural Breaks

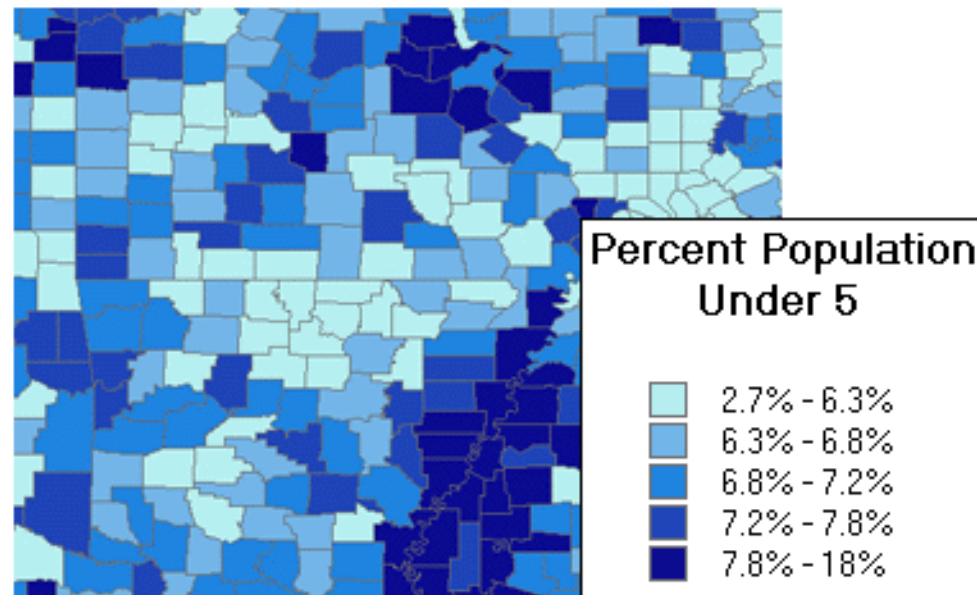
Classes are based on natural groupings inherent in the data

Looks for where there are big jumps in data



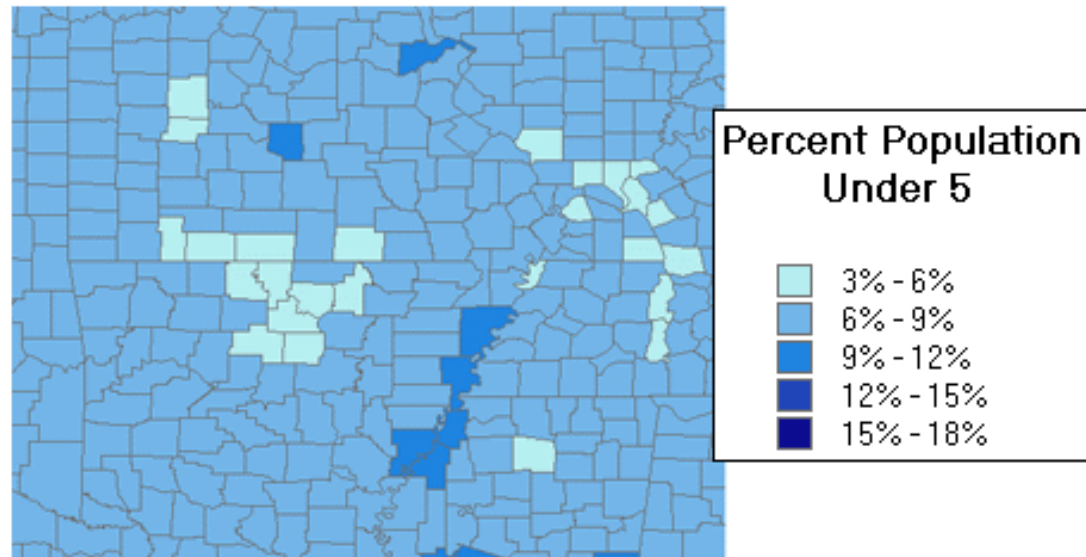
Quantiles

Each class contains an equal number of features
Good for linearly distributed data



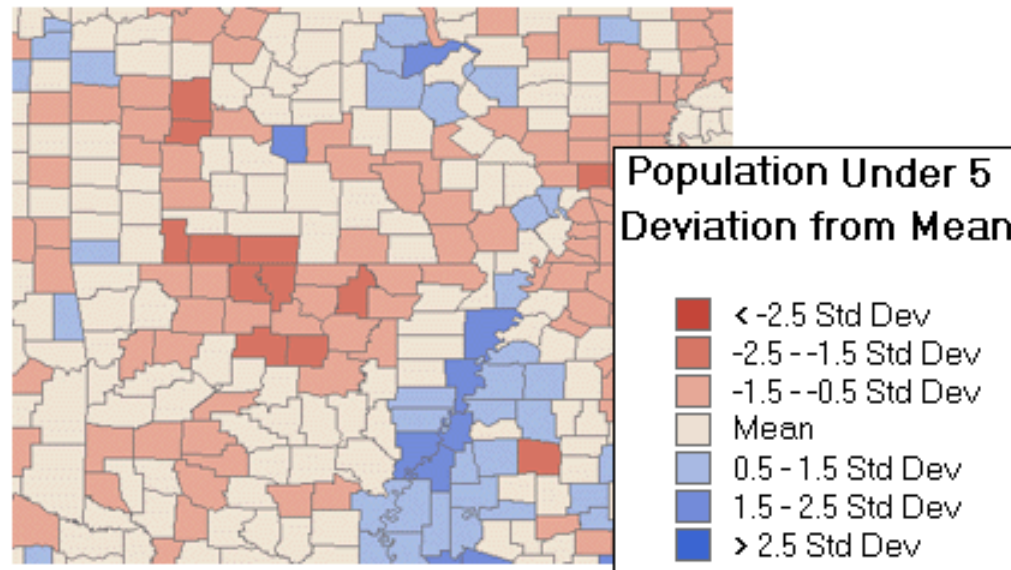
Equal Interval

Divides the range of attribute values into equal-sized Subranges (e.g. 0–100, 101–200, and 201–300)



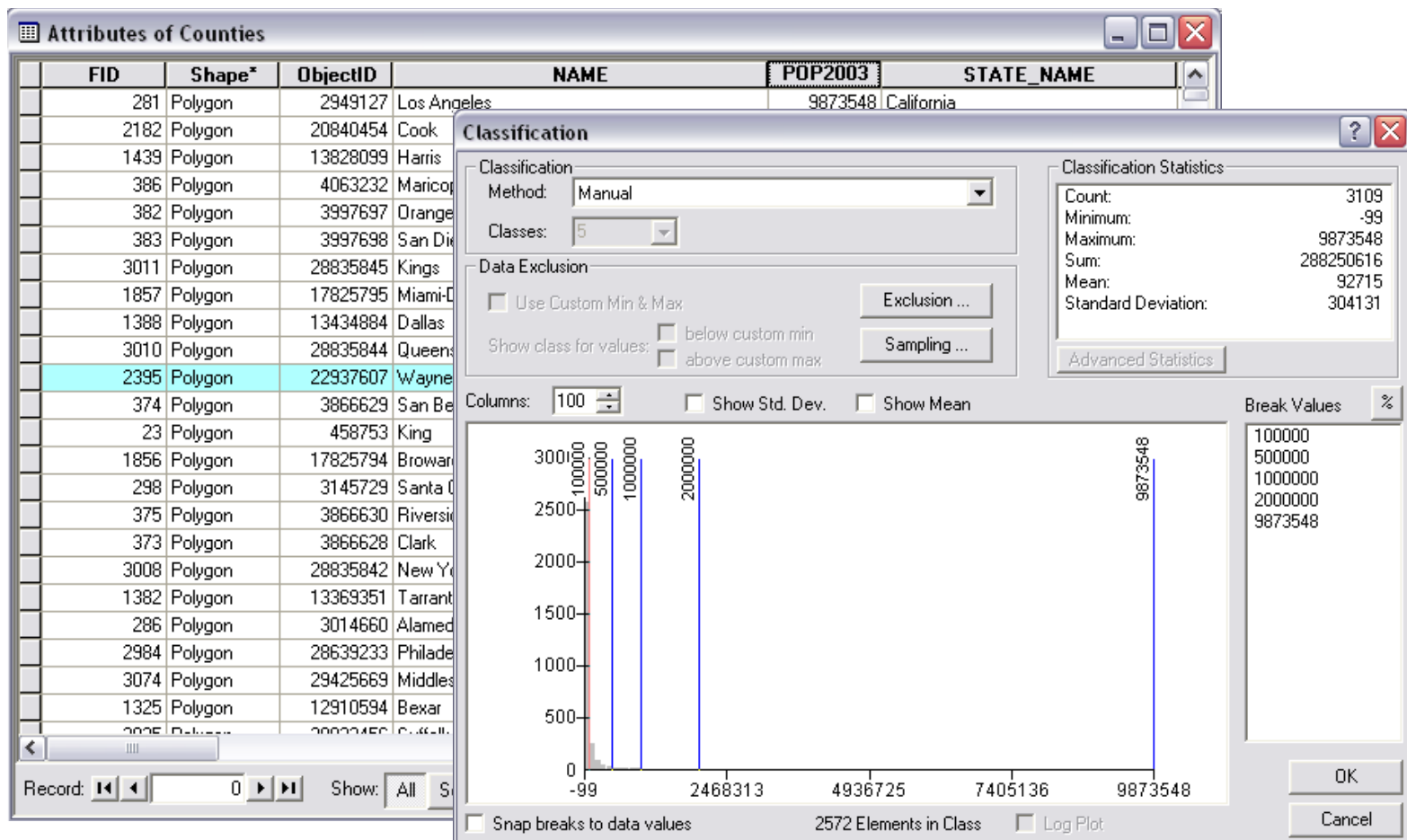
Standard Deviation

Calculates the mean of the data distribution and then maps one or two standard deviations above or below the mean



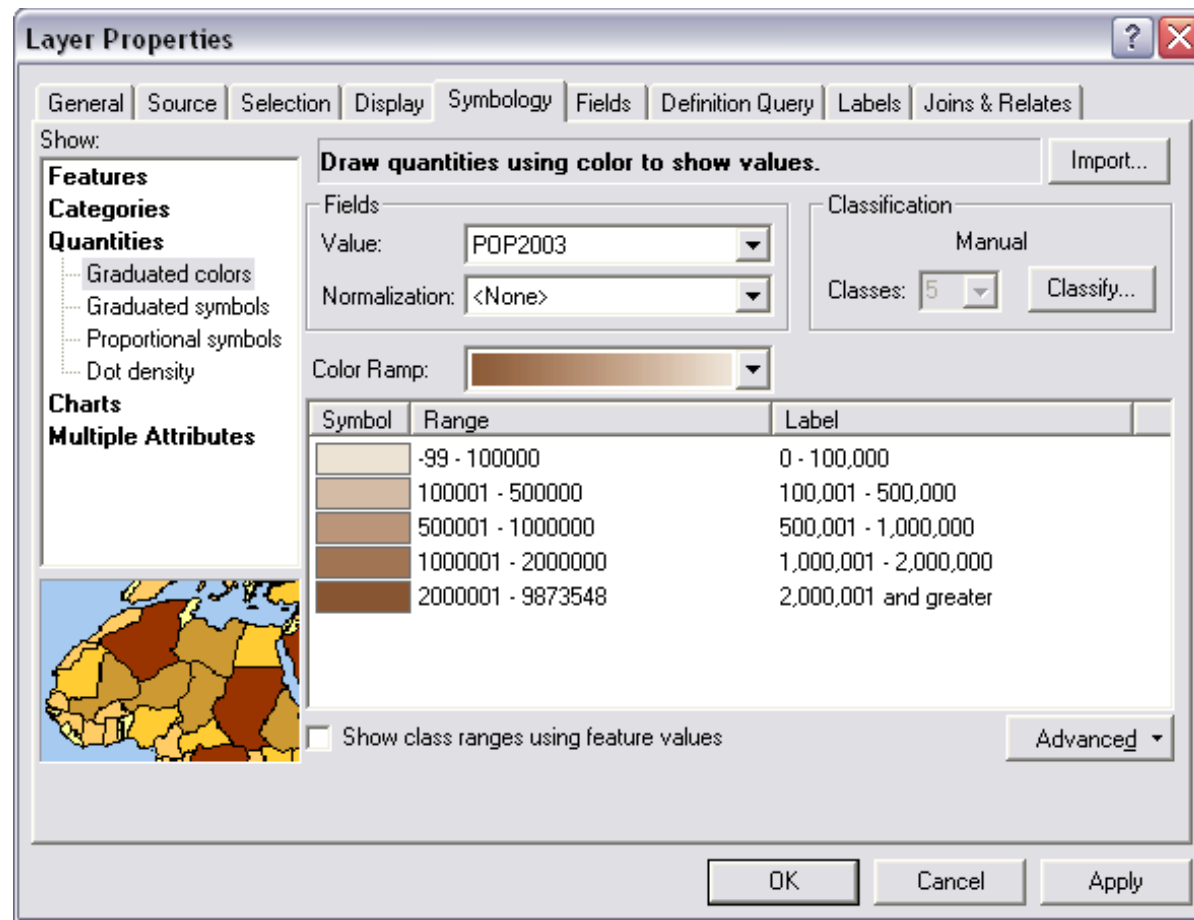
Custom Scales

Know your data!

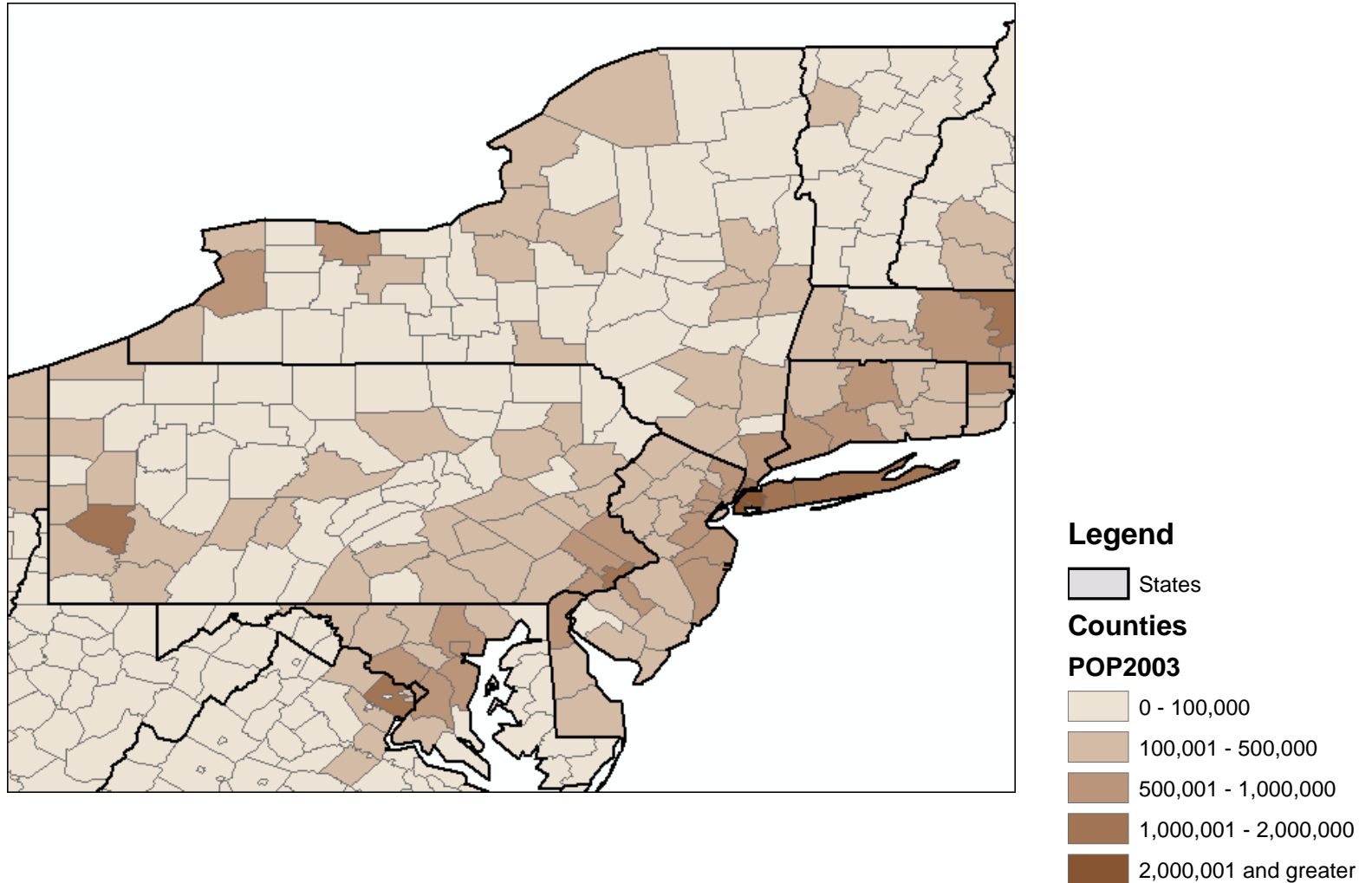


Custom Scales

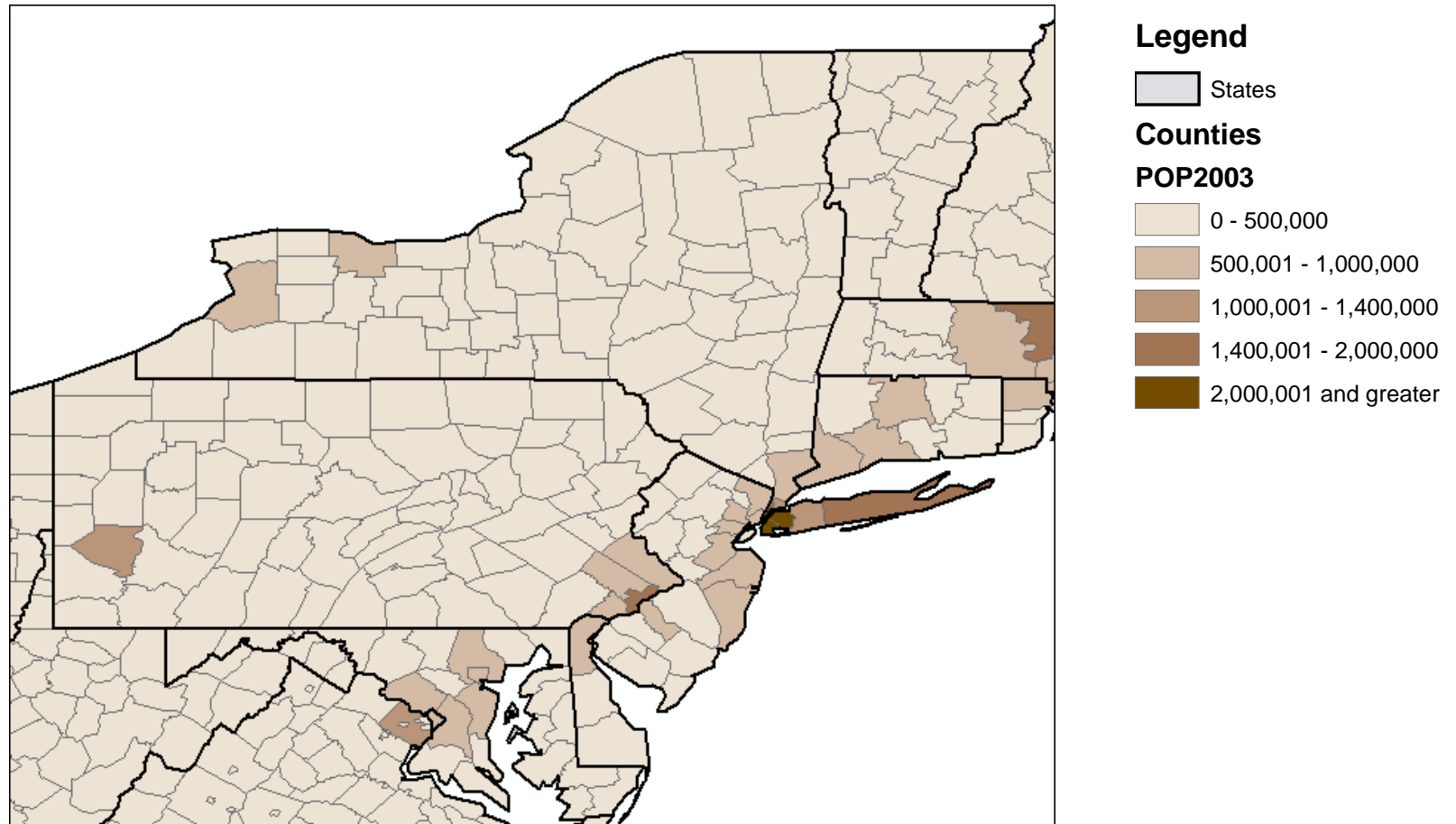
- Edit the legend



Custom Scales



Custom Scales





Normalizing Data

Divides one numeric attribute by another in order to minimize differences in values based on the size of areas or number of features in each area

Examples:

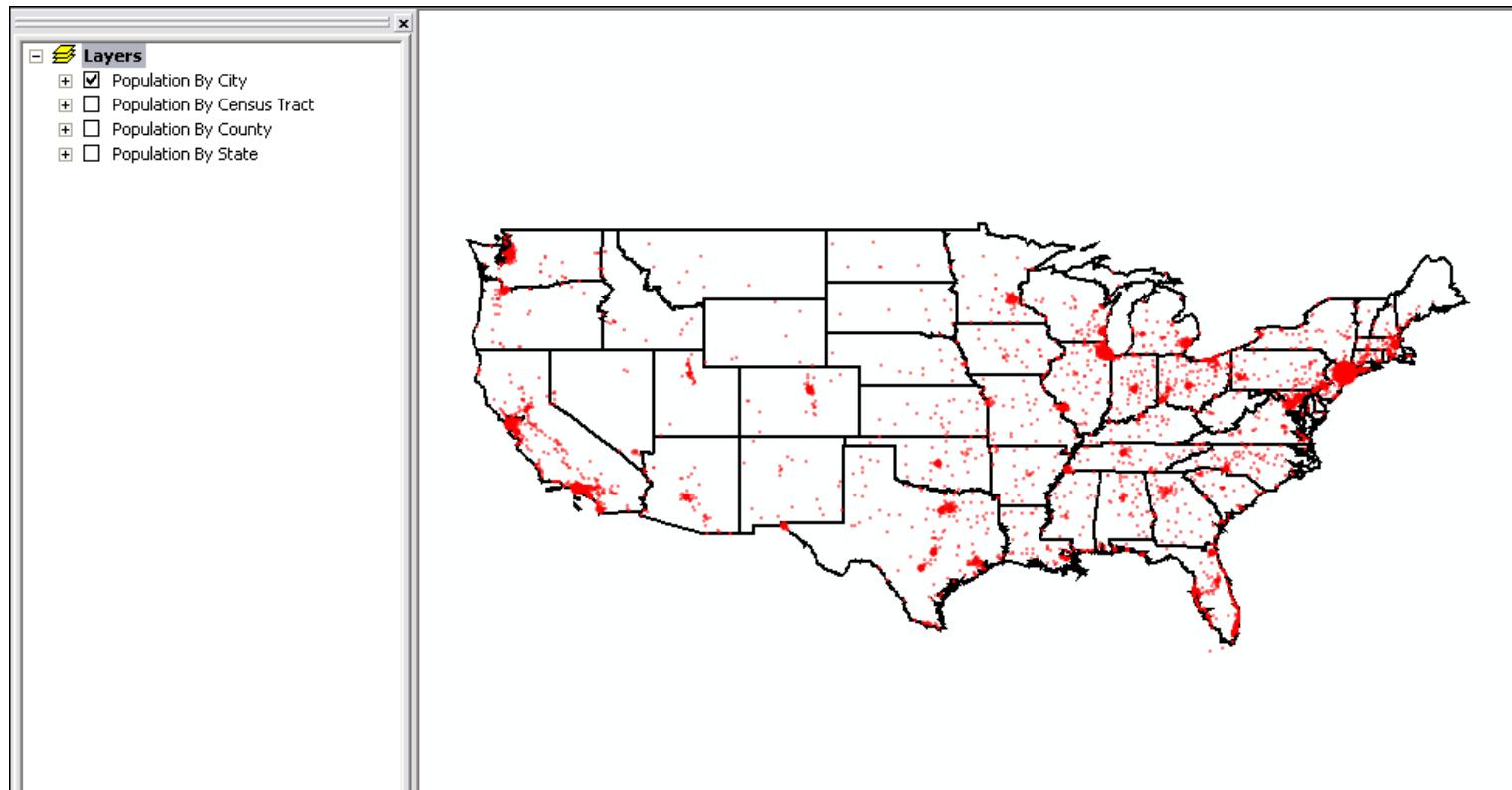
- Dividing the 18- to 30-year-old population by the total population yields the percentage of people aged 18–30
- Dividing a value by the area of the feature yields a value per unit area, or density

Map Layers, Scale Thresholds, and Hyperlinks

Map Layers

Organizes your layers

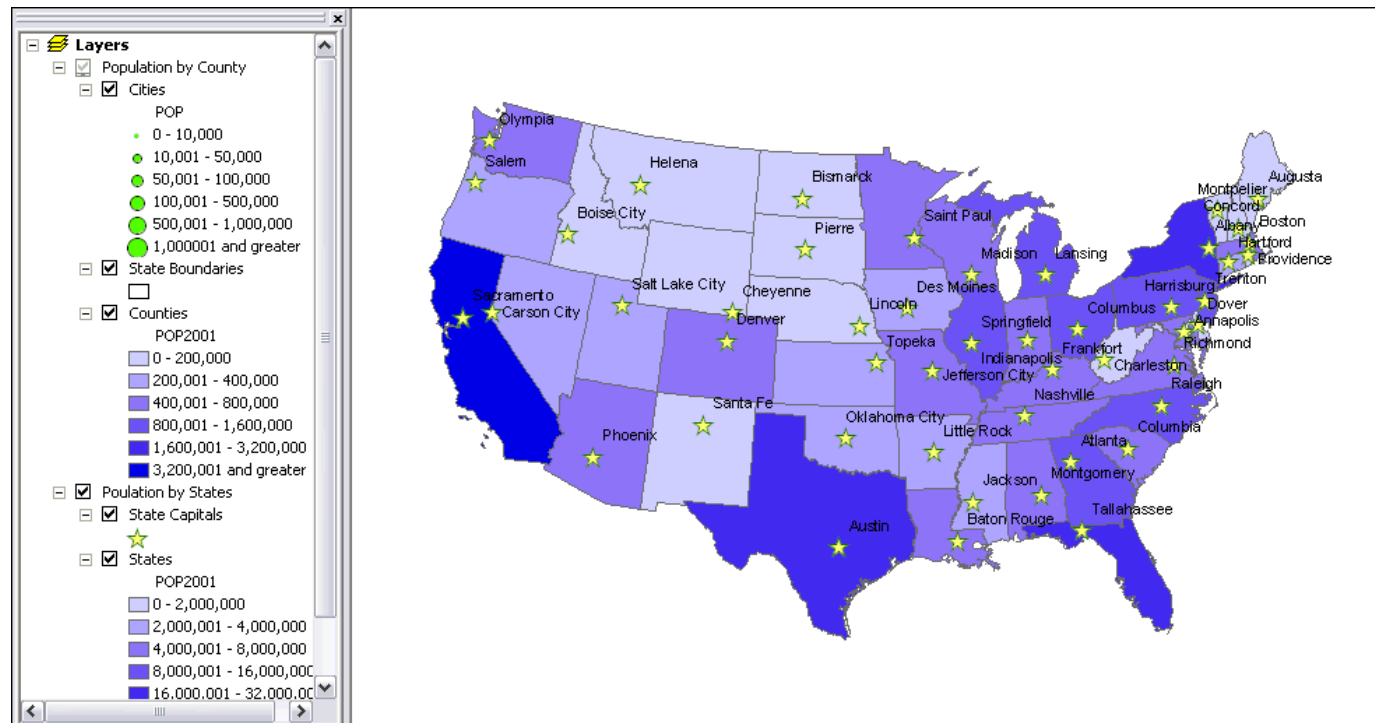
Group logically and rename



Scale Thresholds

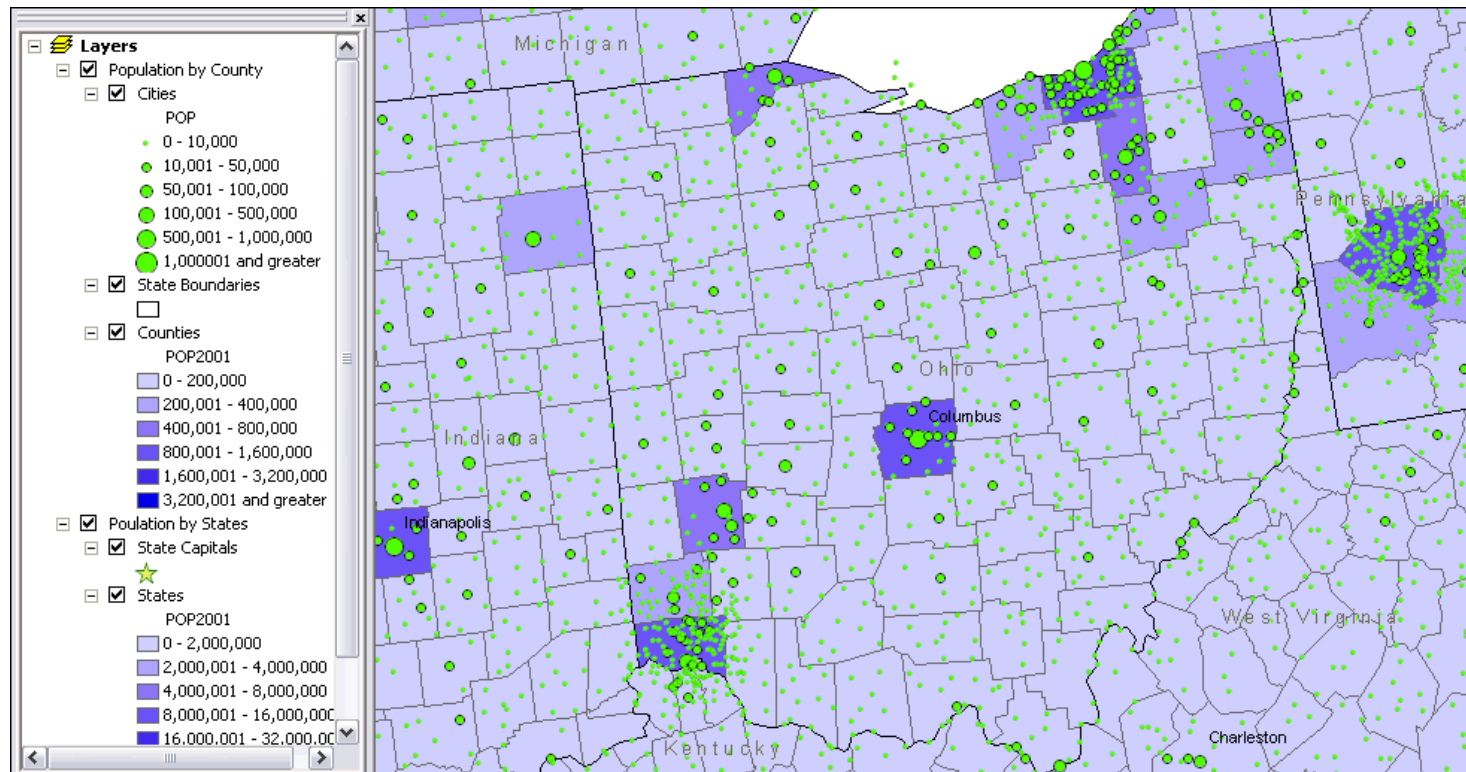
Minimum Scale Range

- If you zoom out beyond this scale, the layer will not be visible



Scale Thresholds

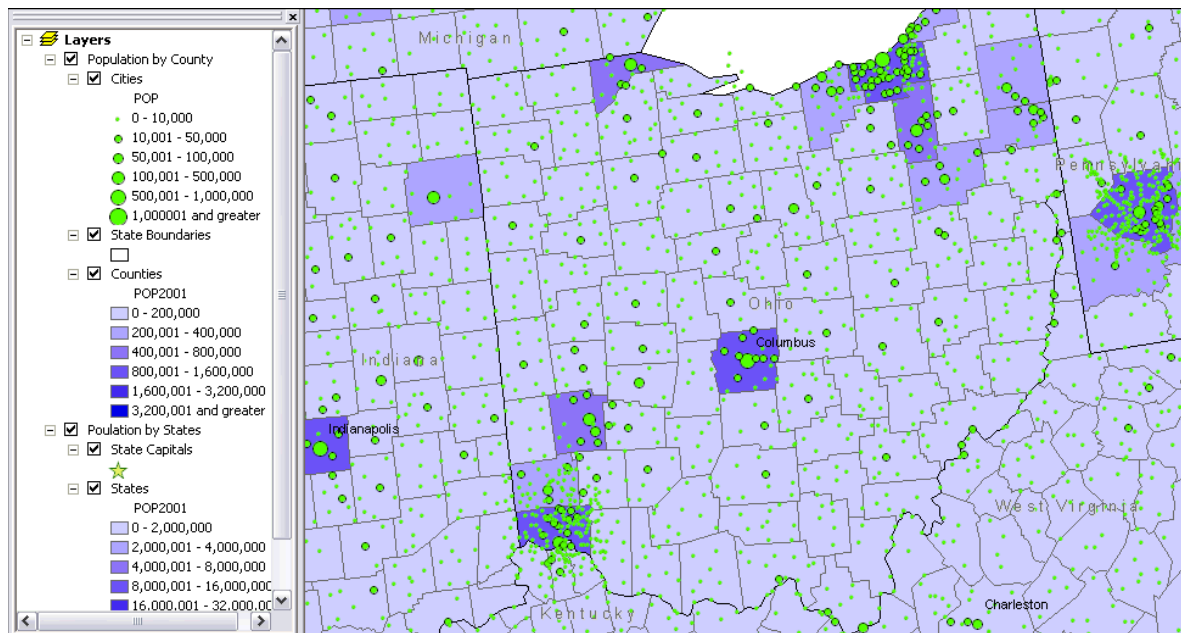
When you zoom in, the layers are visible



Scale Thresholds

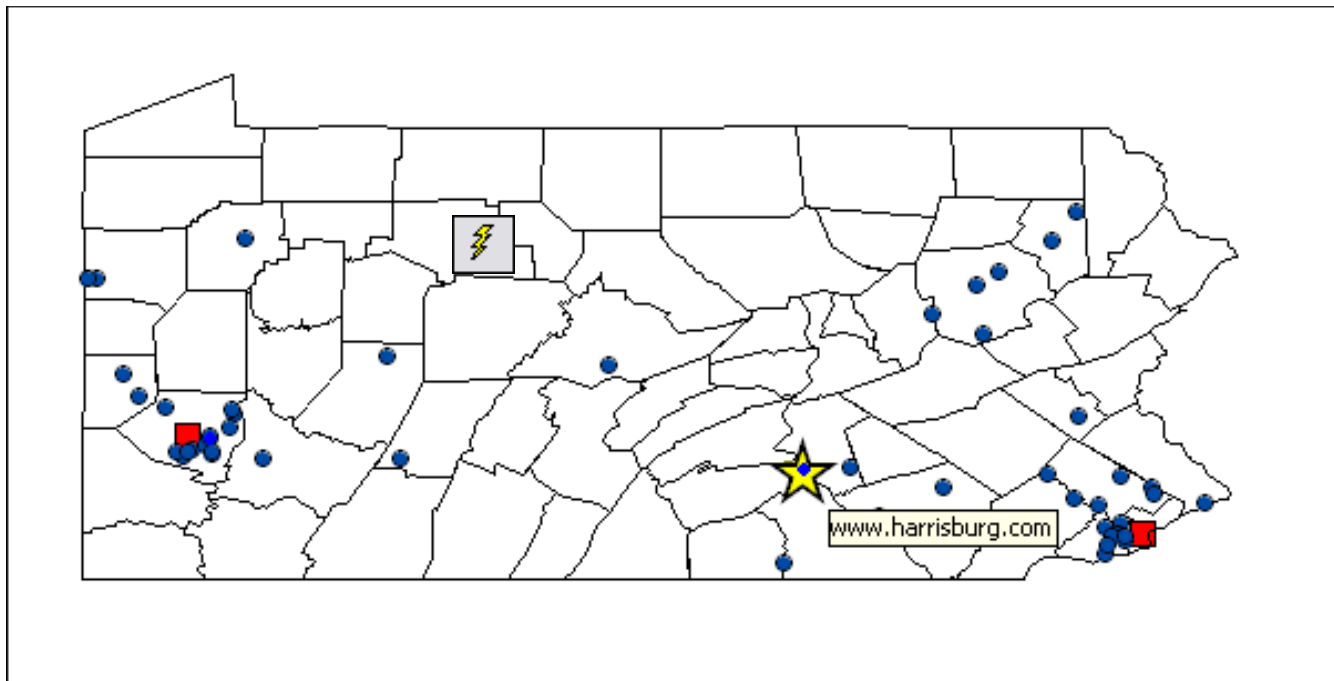
Maximum Scale Range

- If you zoom in beyond this scale, the layer will not be visible
- State Capitals not visible at this scale



Hyperlinks

Links images, documents, WEB pages, etc. via features on a map



Summary

- Vector GIS
- Graphic Elements
- Colors
- Graphical Hierarchy
- Choropleth Maps
- Map Layers
- Scale Thresholds
- Hyperlinks