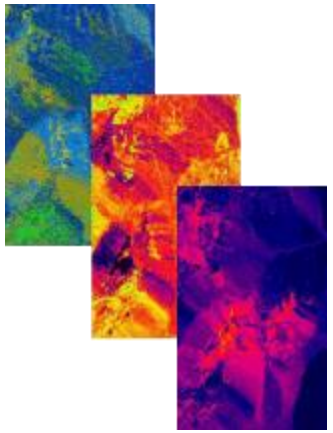
Geog 1502
Mapping Our World

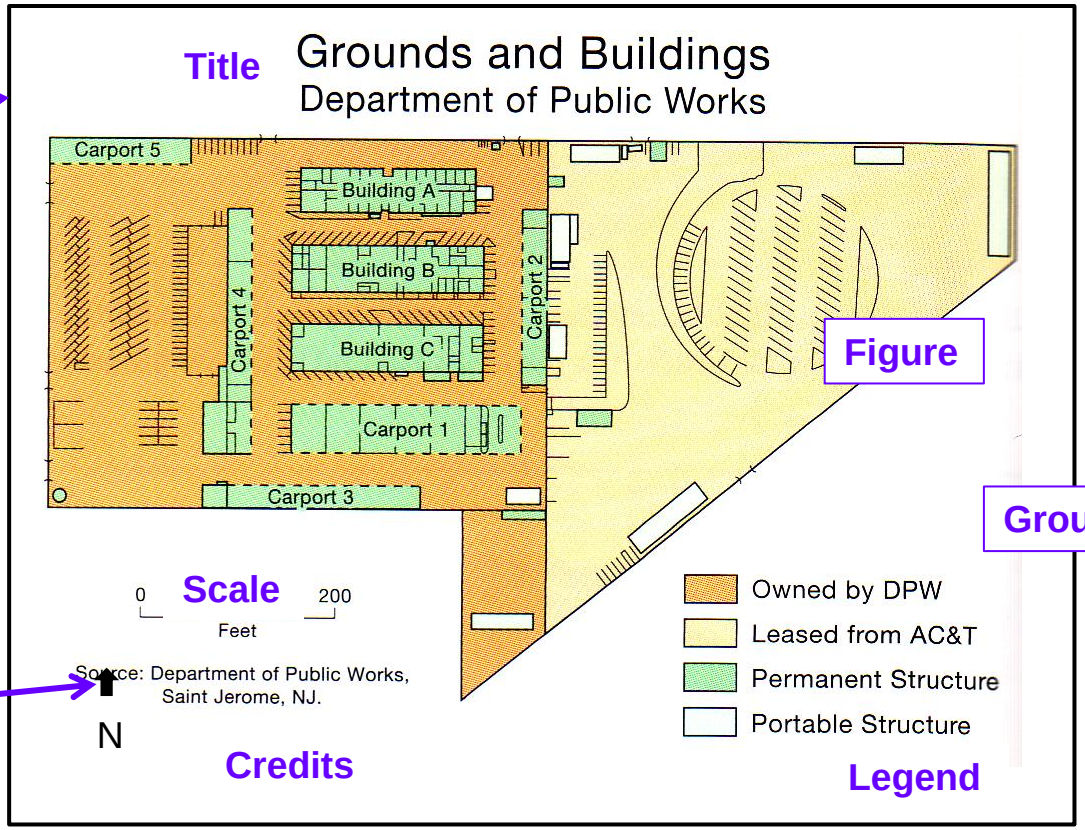


Overview

- Map elements
- Design principles
  - Hierarchy
  - Balance
- Symbolization essentials
  - Geometry
  - Attributes
  - Visual variables

Mapping is an art and a science. The science part concerns data and projections and many other aspects of mapping. The art part concerns how cartographers make choices and use many different tools to create useful and lovely maps. We look at basic map elements, design principles, and symbolization.

Map Elements



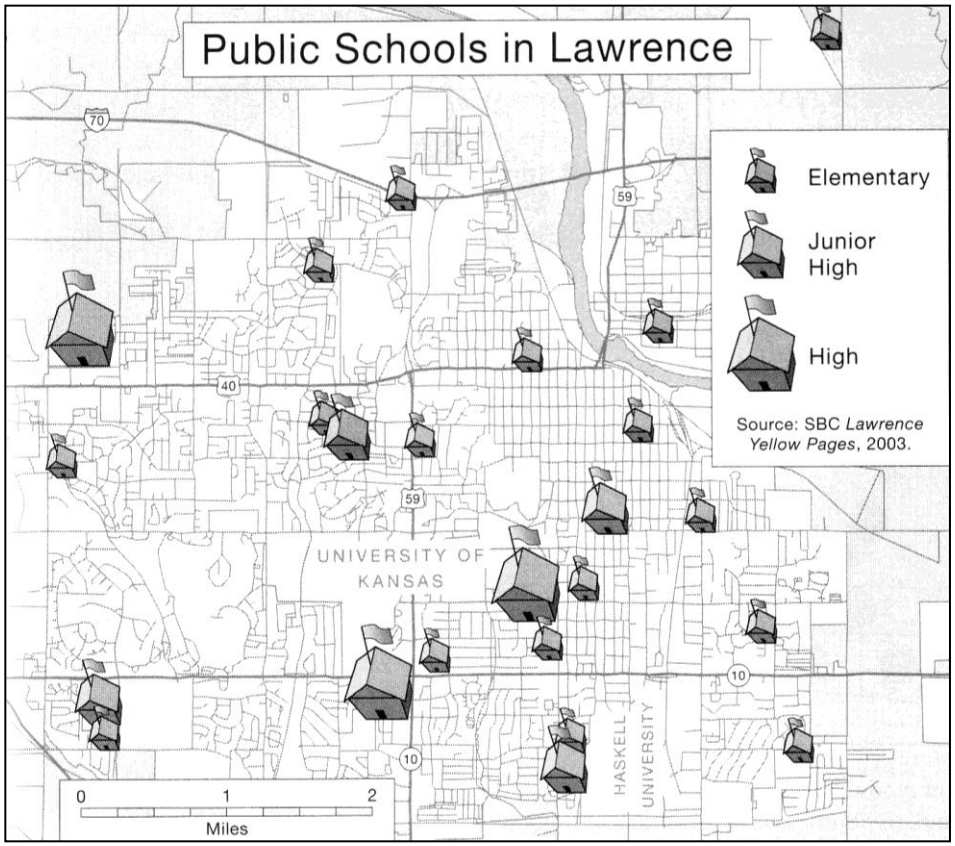
Most maps share key elements. The three primary ones are the figure (the thing or place being mapped), ground (or background), and frame. Most maps also have a north arrow, scale bar, credits, and legend (a key or guide).

Key Design Principles

- Hierarchy: Important map information is emphasized via position on map and visual variables
- Balance: Visually balance organization of map elements

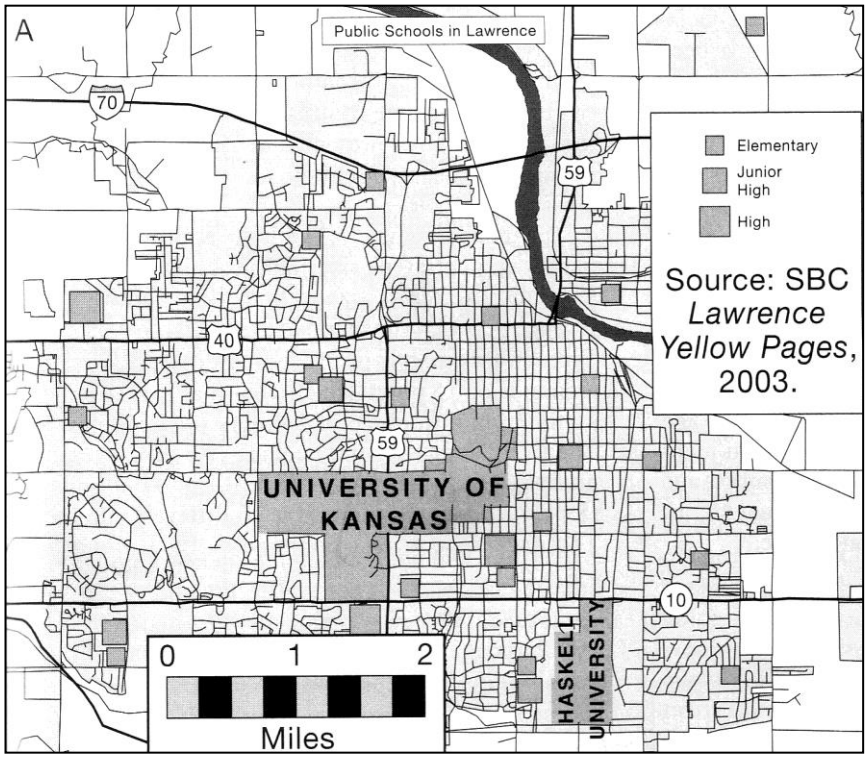
Much of the ‘art’ part of the ‘art and science’ of cartography involves map design. There are many different design principles but two in particular are important: hierarchy and balance. Hierarchy means that important map information is emphasized, while balance means that map elements are arrayed in space in a way that uses the map area effectively and pleasingly.

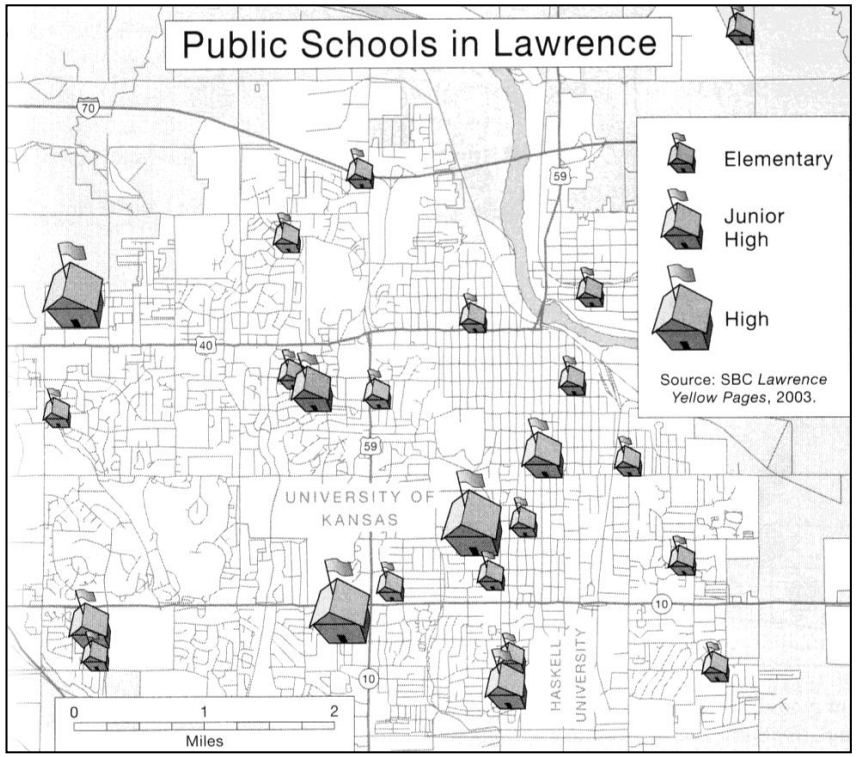
Design Principle I: Hierarchy



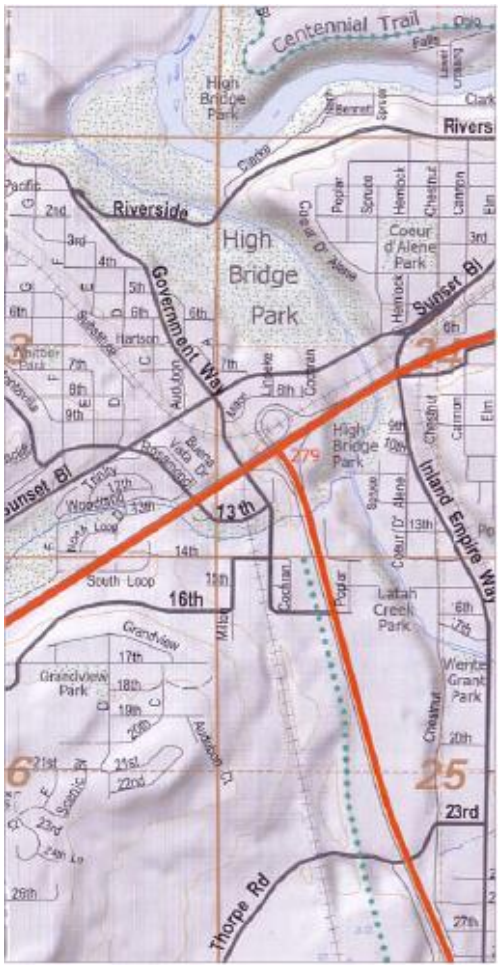
Hierarchy means that important map information is emphasized via position on a map and via visual variables such as size or shape (more on these below). In general, people tend to focus more attention on the top left of a map and less on the bottom right. So, as seen in this map, we put important elements, such as the title, on top. We tend to put legends and scale more towards the bottom and right.

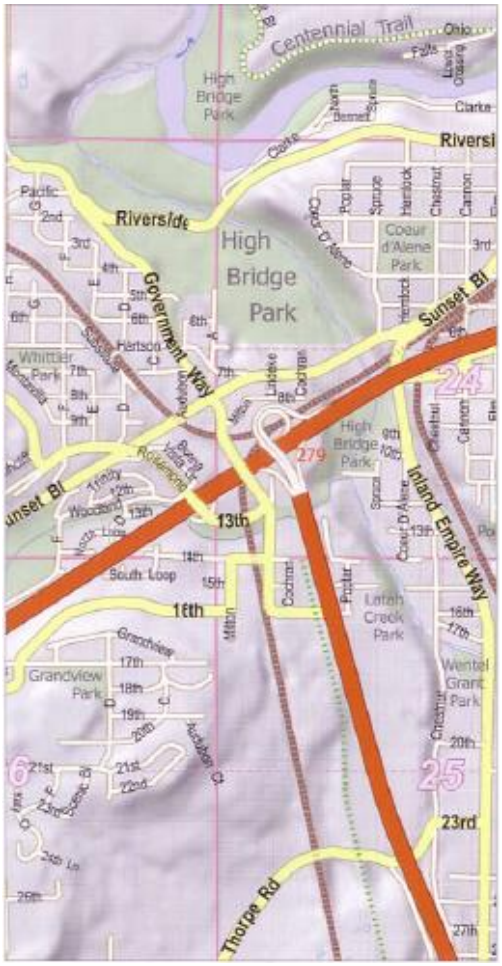
Design Principle I: Hierarchy

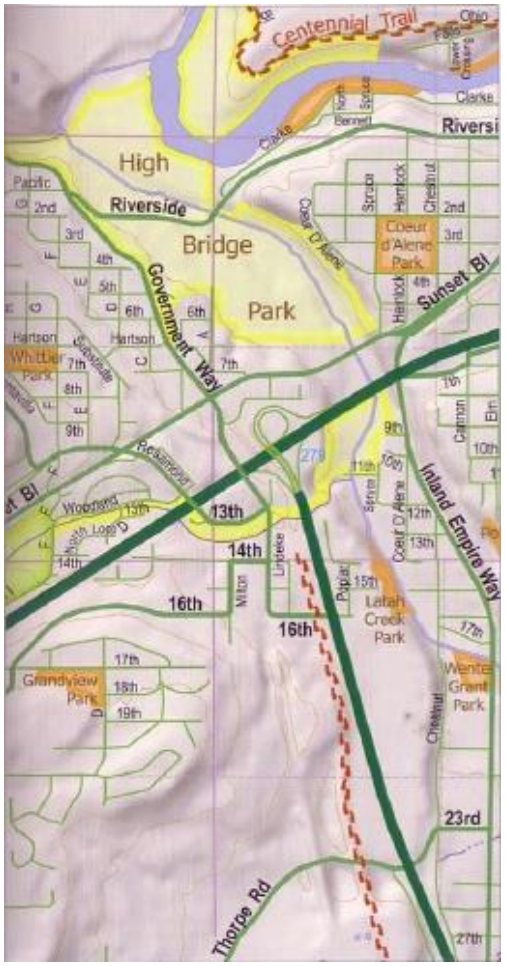




Visual variables, as we explore below, refer to tools like size and shape. The map on the right is better with visual variables. The title is larger because it is more important and the scale bar is smaller because it is less important. School locations are indicated with a school symbols, instead of squares, and they get bigger with the grades served by them (elementary, junior high, and high school).

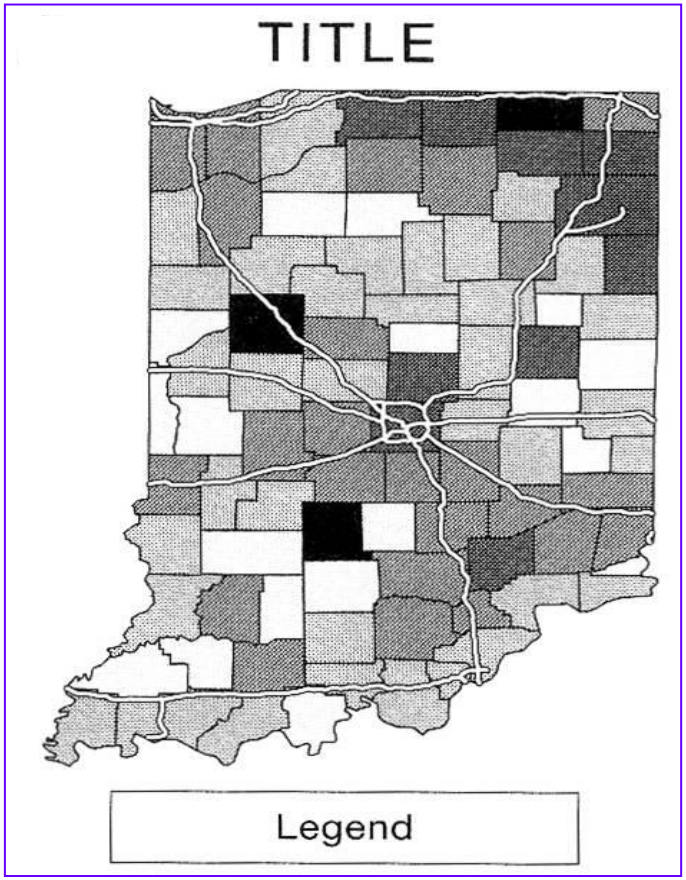






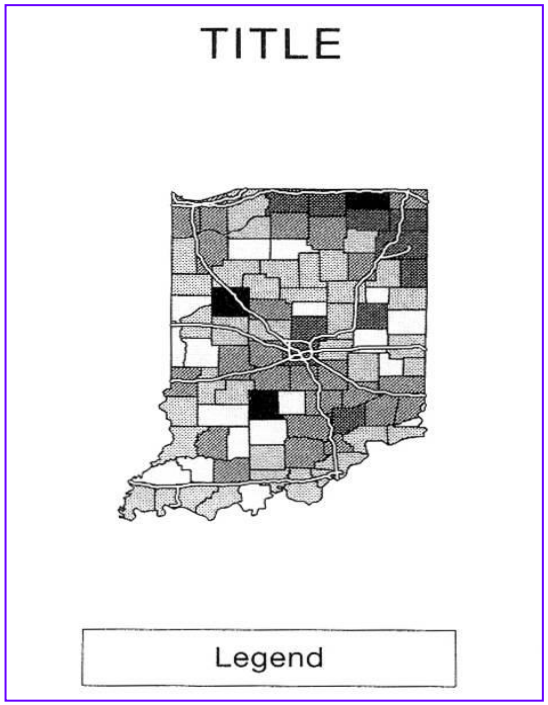
These three maps of Spokane, Washington use different colors. The left map is a regular sort of reference map, where color is used sparingly. The center map is for driving, so it highlights important roads with color and wider lines. The right map is for biking, so it emphasizes biking routes and locations like parks that are better for biking.

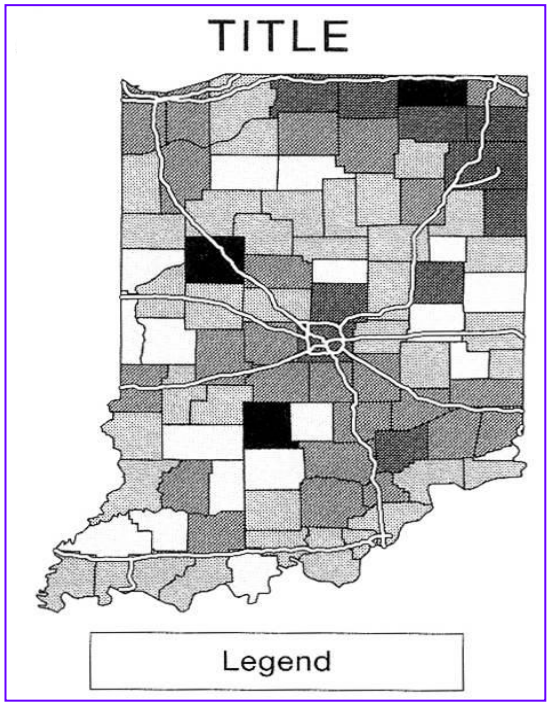
Design Principle II: Balance

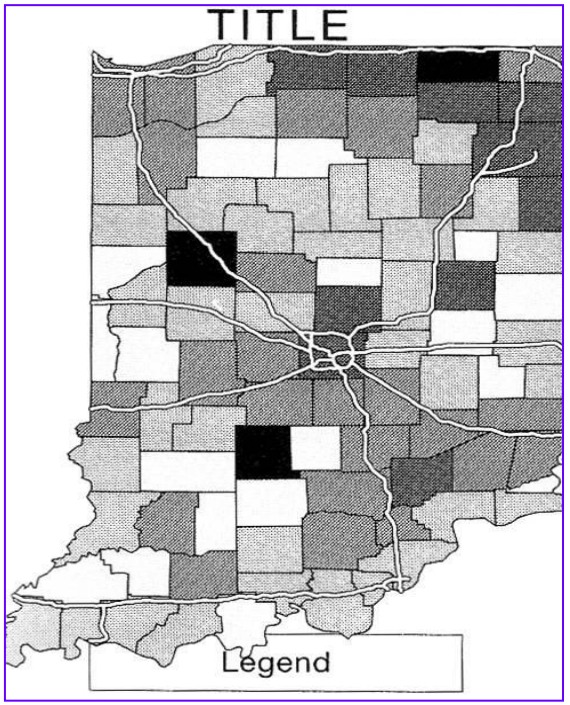


Balance involves arraying map elements in space in a way that uses the map area effectively and pleasingly. This can be subjective, but usually involves using white space well. In this map, for example, the figure should be largest part but empty map spaces count too. The cartographer has left whitespace around each of the elements.

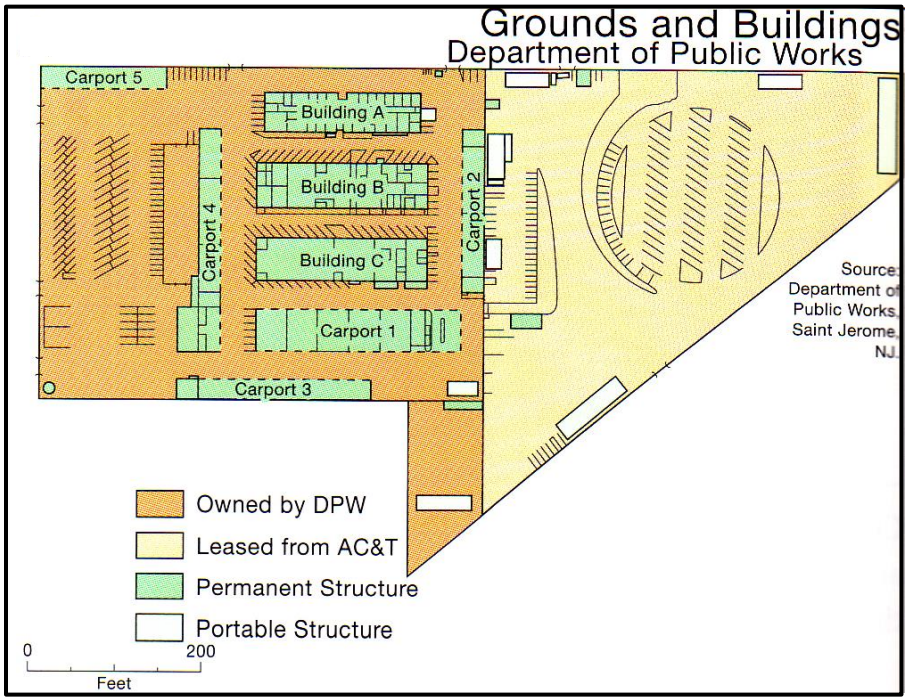
Design Principle II: Balance

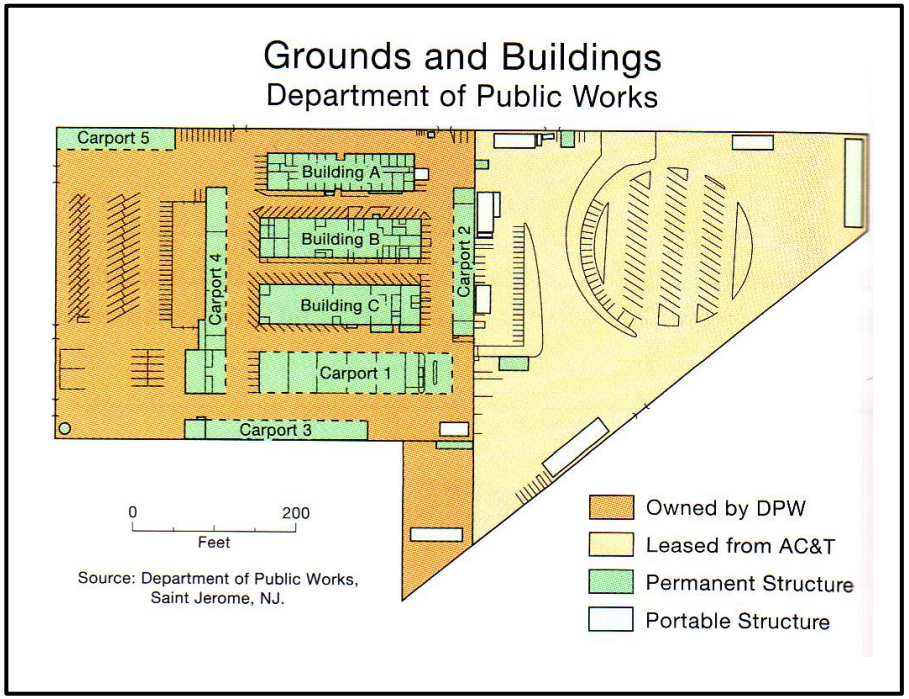






Compare the previous map (now in the center) with these other maps. The map on the left has left a lot of whitespace and the figure is only a bit larger than the title and legend. The map on the right has jammed in these elements to the point where they overlap.



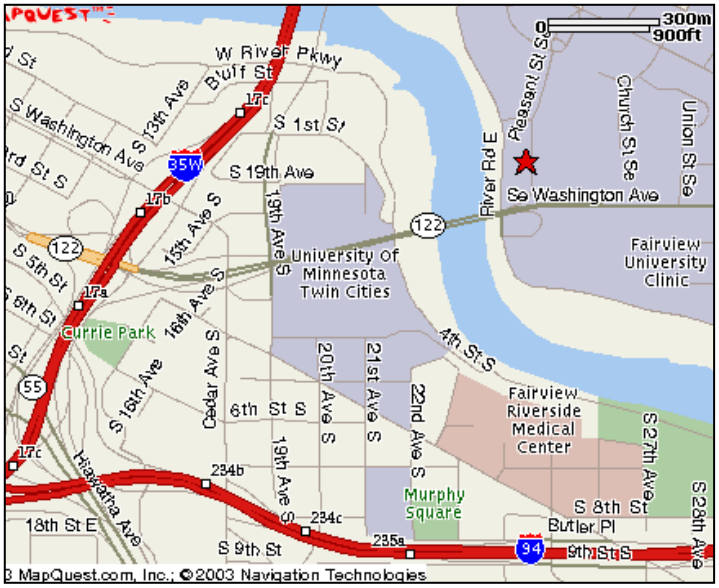


Compare these two maps. Can you identify several ways in which they differ? Generally speaking, cartographers would probably prefer the map on the right. Why?

Symbolization

Where is this?

The image above shows many features but it is too busy and crowded. Remember! All maps are smaller than what they portray. Only a limited number of features can be mapped, and only these features are symbolized. What you see is what you get.



It’s the West Bank of U of M!

The map on the right has much less data than the image on the left. The map on the right is more useful because it drops much of the noise and symbolizes important things like roads and regions.

Where is this?

Here is a harder example. What does this image portray?

Montreal! Again, the map on the right has much less data than the image, but is arguably much more useful. By dropping some kinds of information and highlighting others, the map is more useful than the image.

Symbolization Essentials

Geometry

Point

Line

Area

Visual Variables

Shape

Size

Hue

Value

Symbolization

We will look at two major components of symbolization: geometry and visual variables.

Symbolization Essentials

Geometry

Point

Line

Area

Visual Variables

Shape

Size

Hue

Value

Symbolization

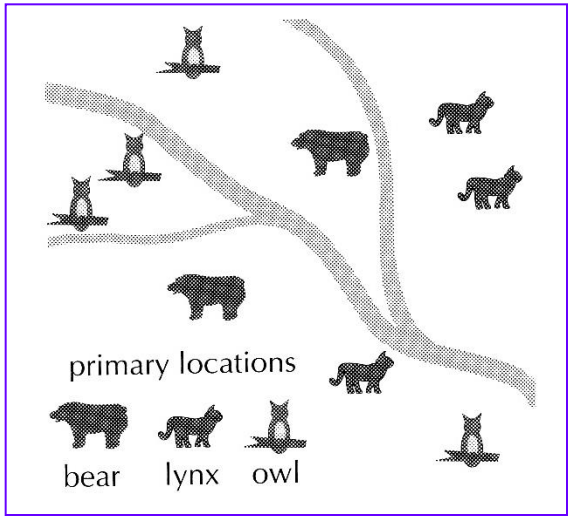
Note that there are many others we don't cover, including texture, saturation, orientation, text, ….Geometry and visual variables are the most basic components of symbolization.

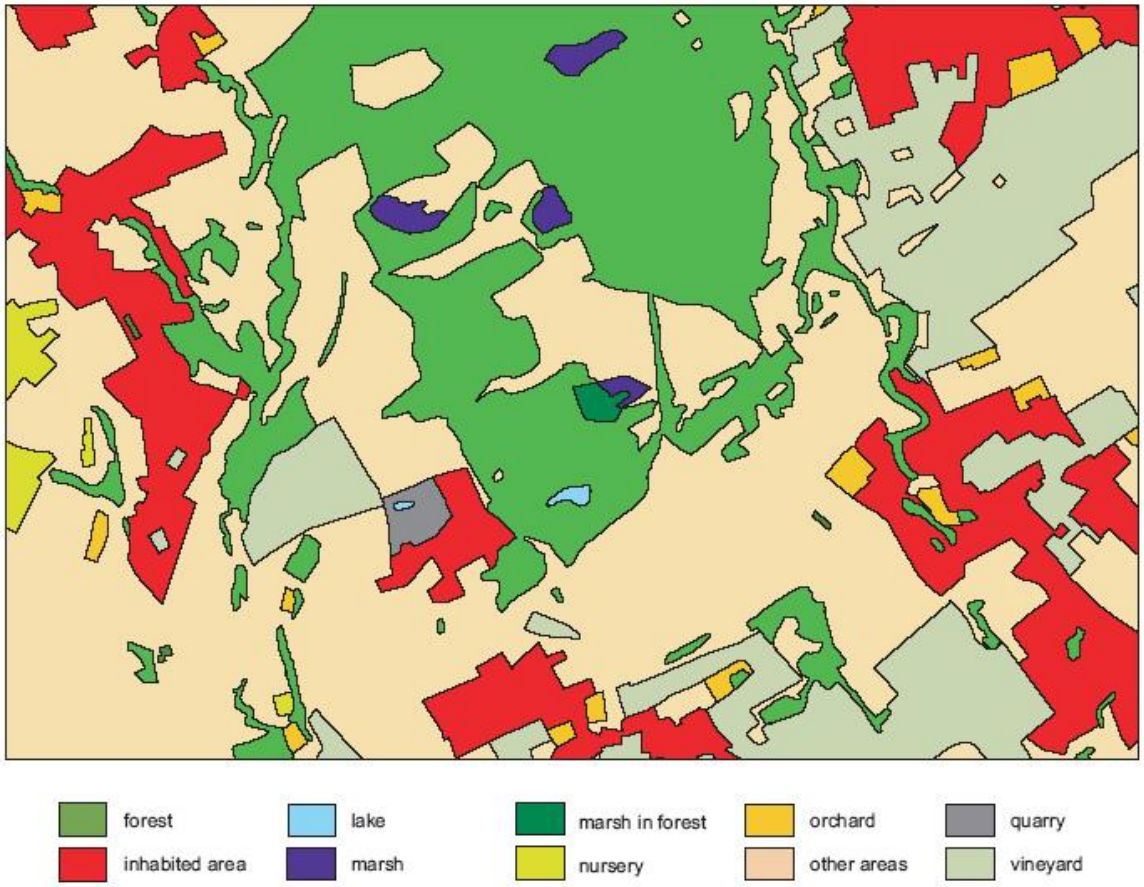
Quantitative vs. Qualitative Data

- Qualitative data deal with quality of things or places; differences in kind or existence
- Quantitative data deal in measurements or quantities that deal with differences in amount

But first, a quick look at how we tend to treat qualitative and quantitative data differently.

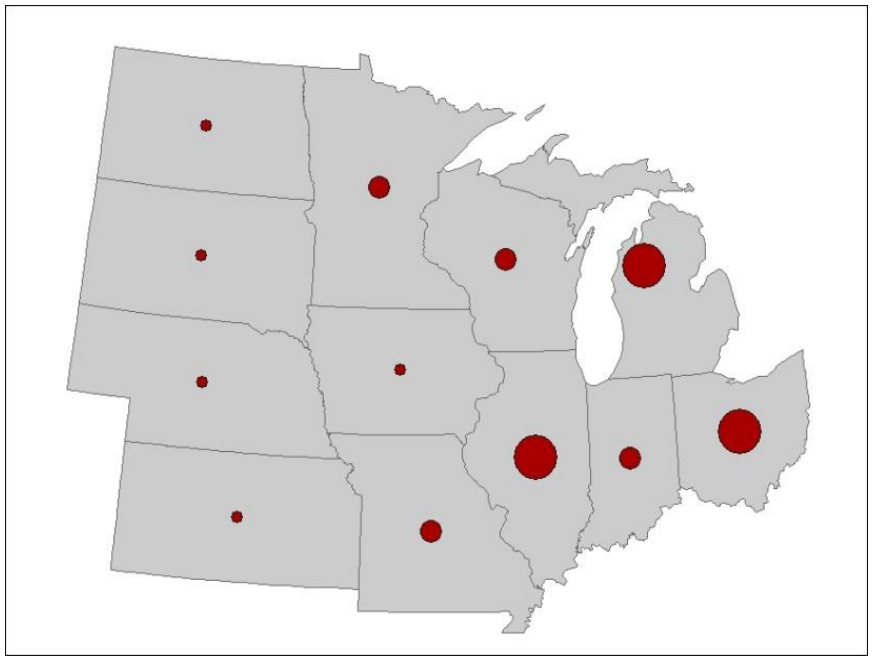
Quality: Different or same?

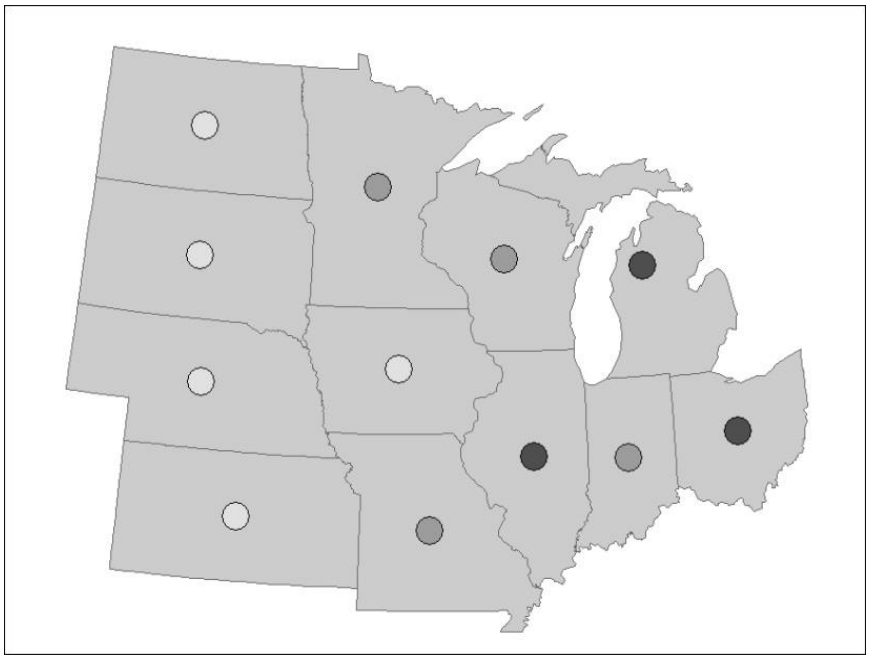




Qualitative data deal with quality of things or places; differences in kind or existence. These maps the location of qualitative attributes. The left map shows the location of animals (but says nothing about how many, which would quantitative) while the map on the right shows the location and kind of land use.

Quantity: More or less?





Quantitative data deal in measurements or quantities that deal with differences in amount. These two maps show measures of population in the US Midwest.

Geometry

Point

Line

Area

Visual Variables

Shape

Size

Hue

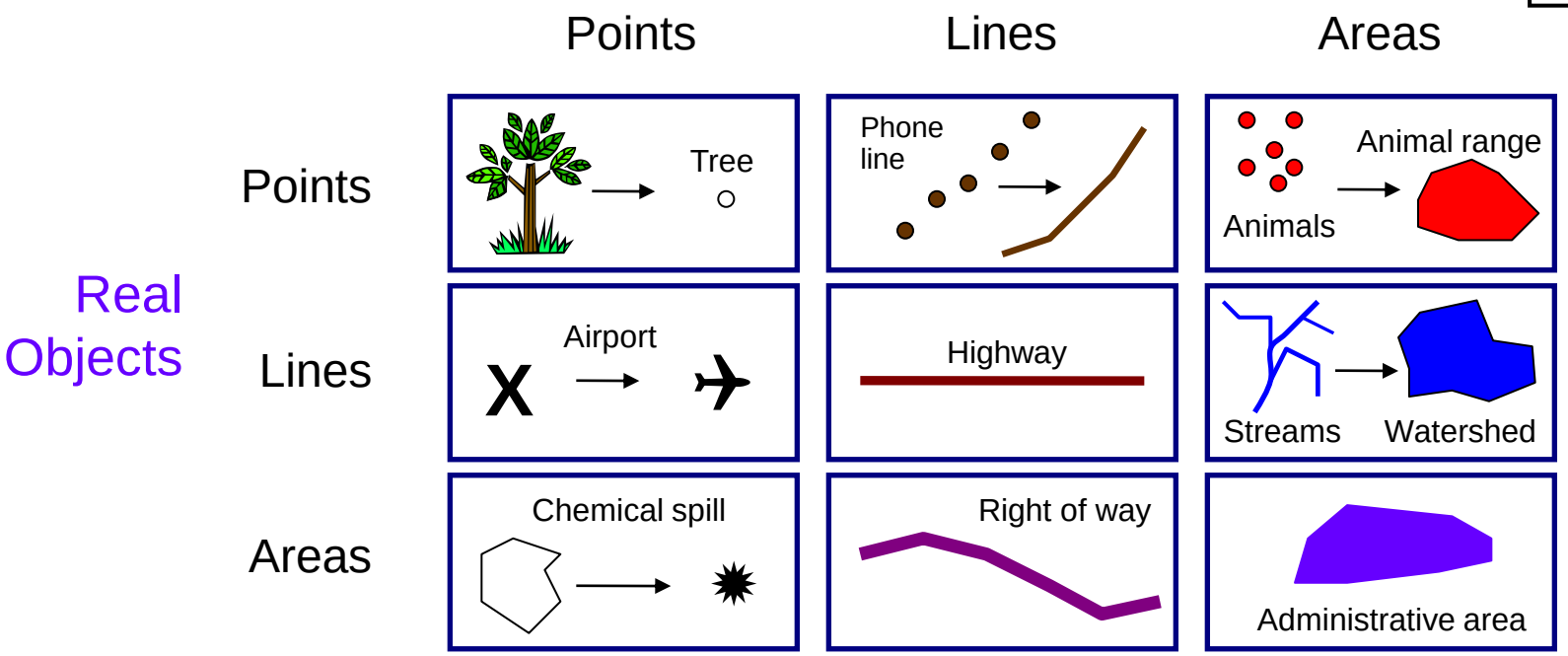
Value

Symbolization

Now we look at a little geometry. Geometry can be a complex topic but here we focus on three simple things: points, lines, and areas.

Geometry
Point
Line
Area

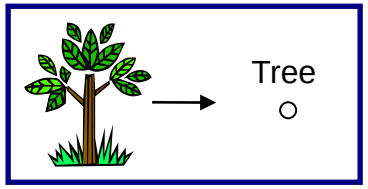
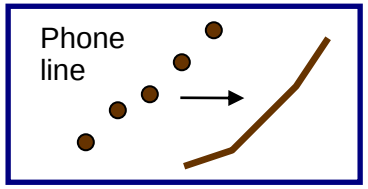
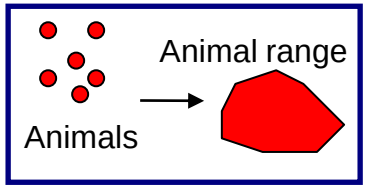
Cartographic Representation



Cartographers can use points, lines, and areas to represent real-world objects that are also essentially points, lines and objects.

Geometry
Point
Line
Area

Cartographic Representation

		Points	Lines	Areas
Real Objects	Points			

A tree in real life, when seen from high above, can look like a small dot that is easy to represent as a point on the map. The posts holding up a phone line (which are often dead trees) could be represented as points, but could also be represented by a line. Biologists, when mapping individual animals that move around, find it easier to show the general area where animals live.

Geometry

Point

Line

Area

Visual Variables

Shape

Size

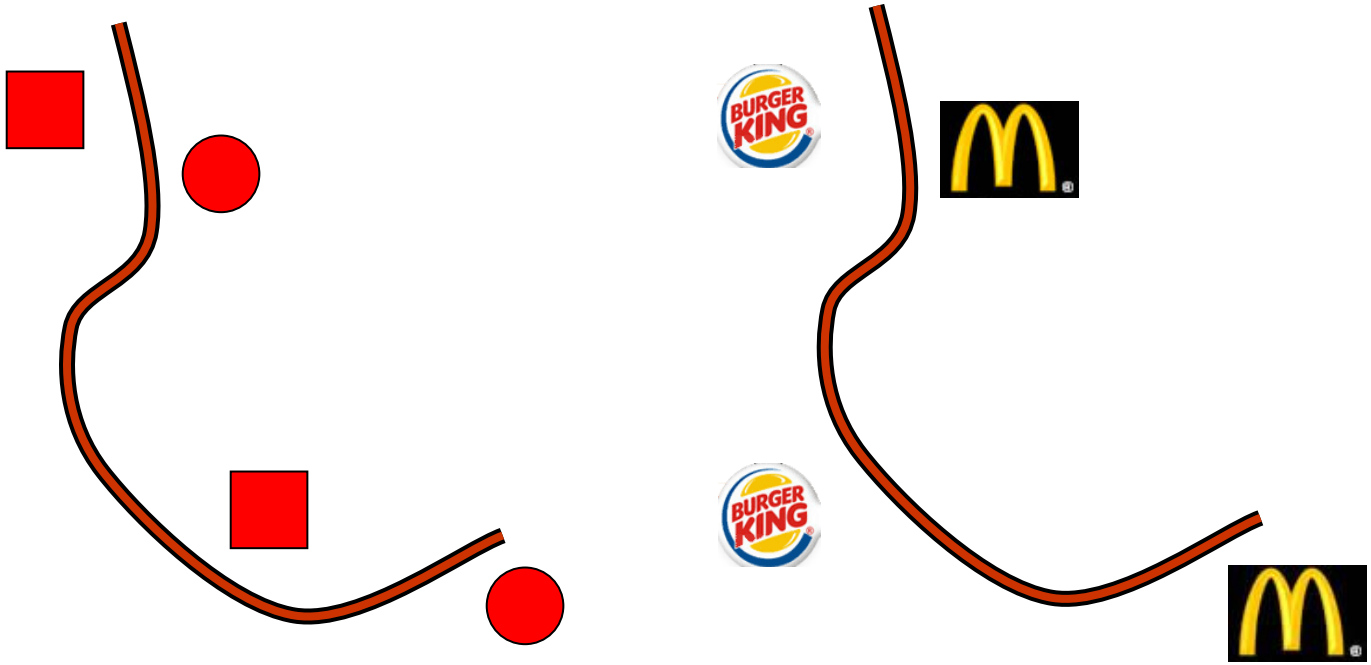
Hue

Value

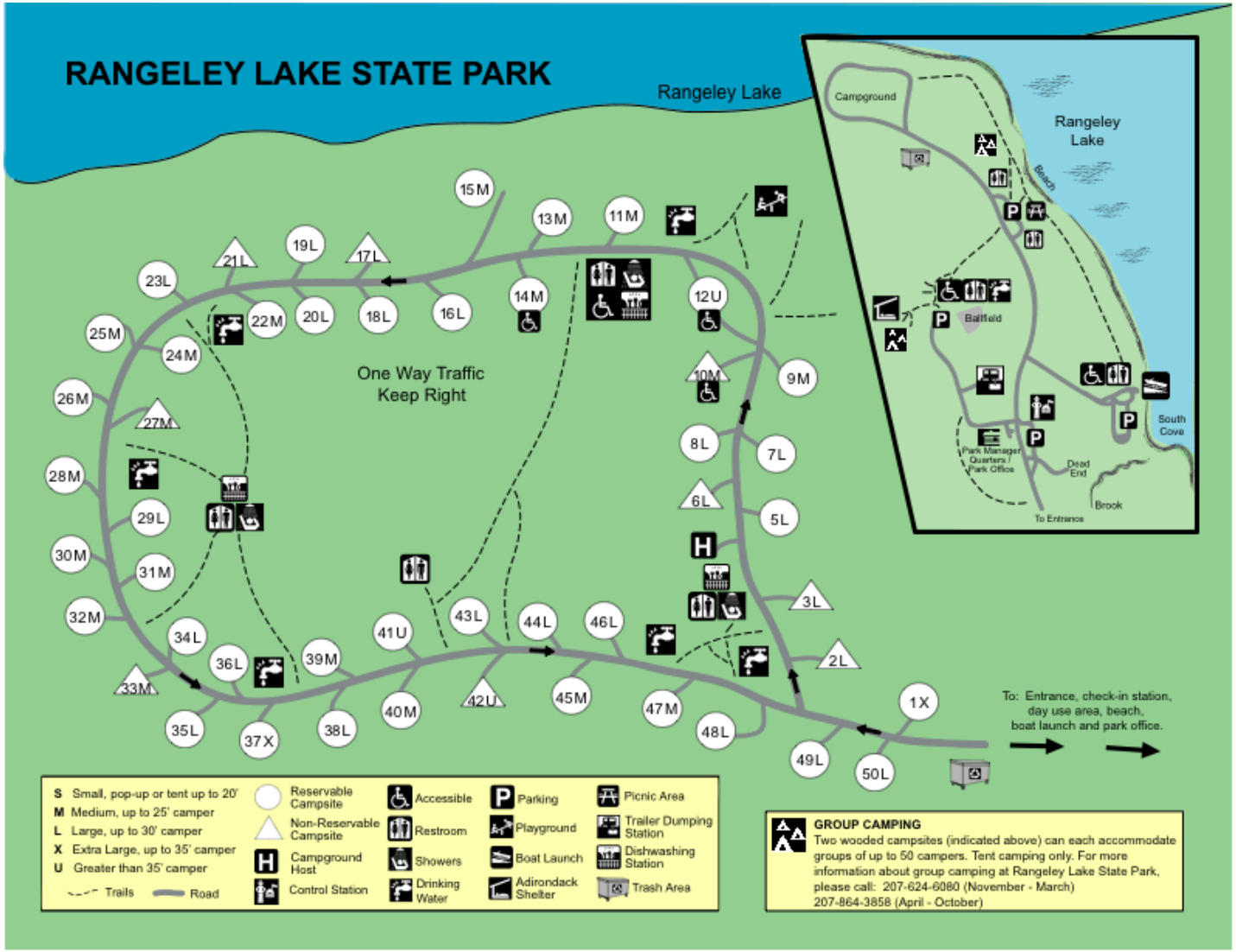
Symbolization

Now, we look at visual variables, which refer to visual elements that the cartographer can vary (this is why we call them variables). Note that there are many others we don't cover.

Vis Var
Shape
Size
Hue
Value



Shape often indicates difference in kind (or qualitative information). Shape can be very powerful because it often means something to the map viewer. A map could represent restaurant locations with simple shapes, like the circles and squares on the left, or it could represent the restaurants with the shapes that are most directly associated with the firms (here, logos).

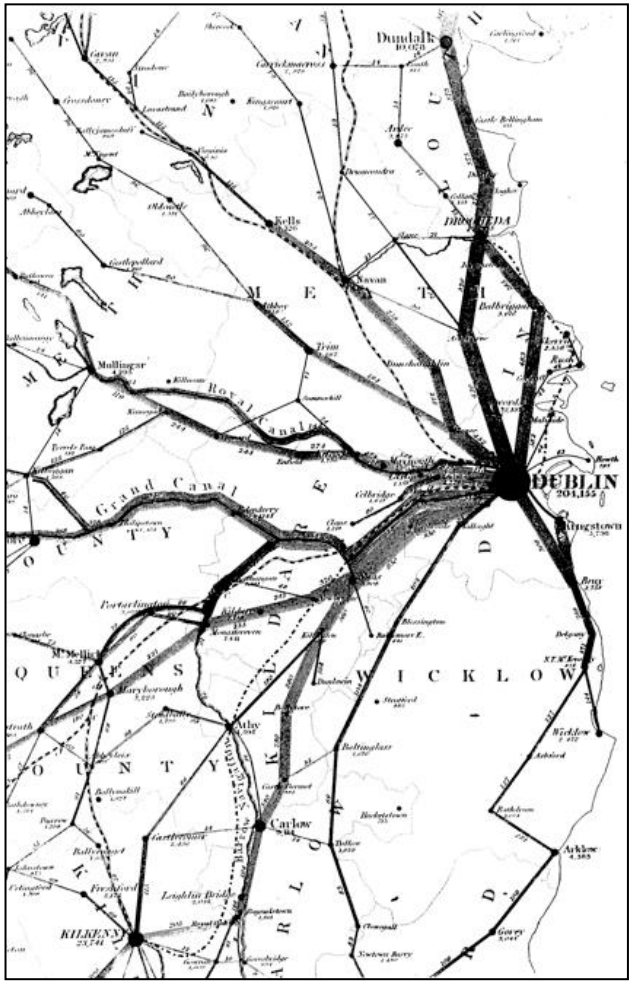


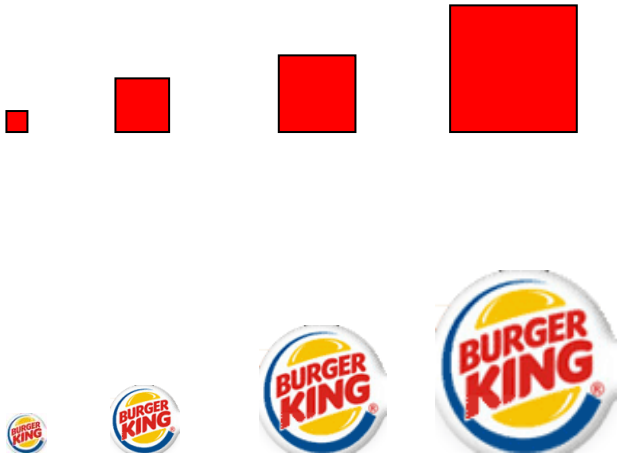
Vis Var
Shape
Size
Hue
Value

This map of a park uses differing shapes to represent locations of facilities. Some are very well known, such as the symbols for restrooms or playgrounds. This helps the cartographer because it imparts information more readily to the user. This maps also uses different basic shapes (here, circles and triangles) for two kinds of campgrounds.

Large mapping companies like Google use shapes in their maps to represent features without words. Shapes are small, so they fit well on a map, and often (but not always) work across languages and cultures.

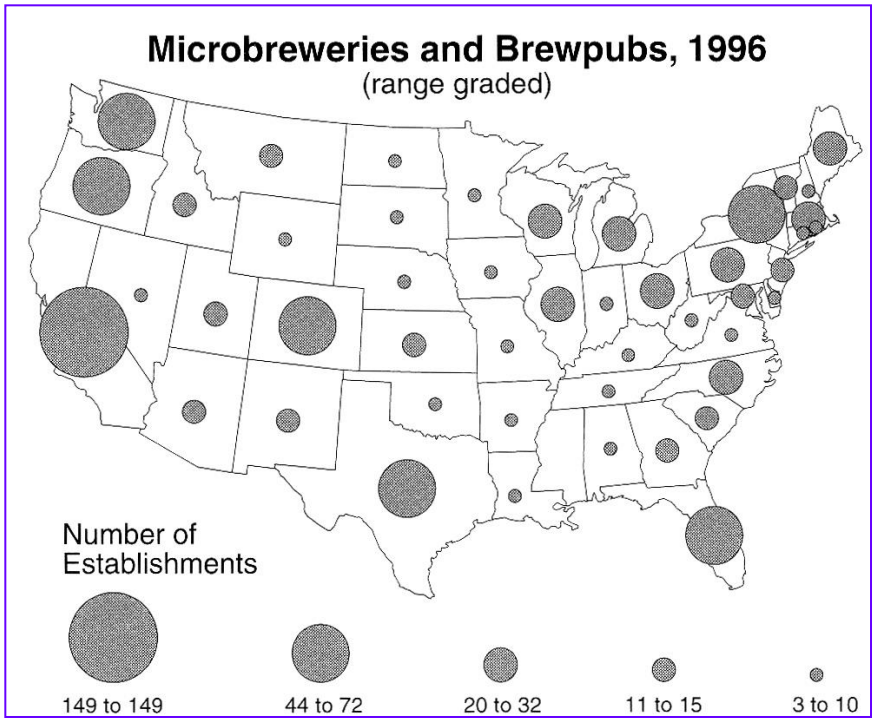
Vis Var
Shape
Size
Hue
Value

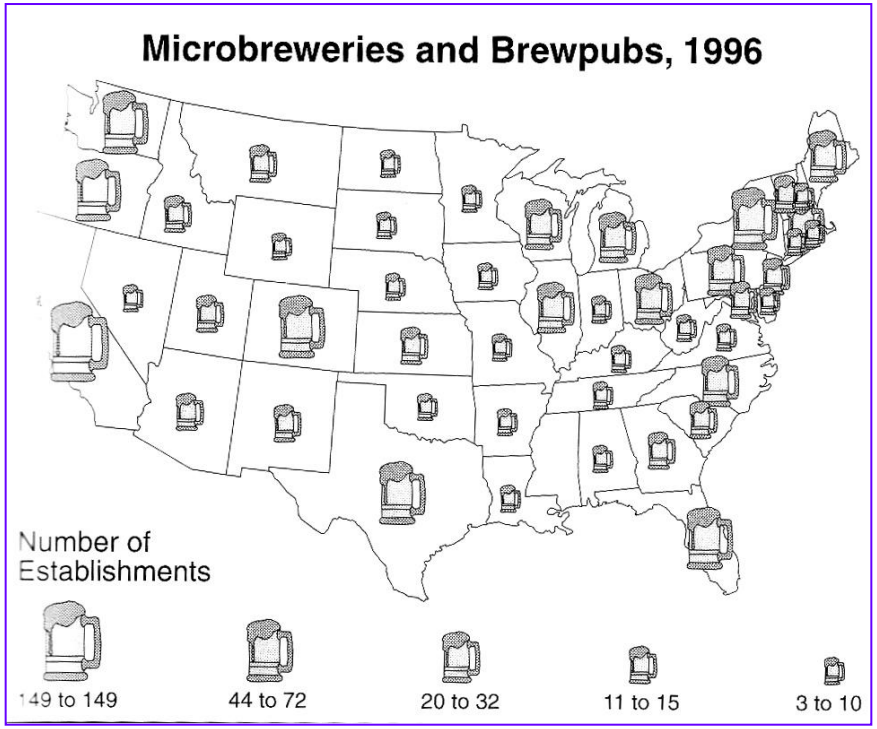




Size often indicates difference in value (or quantitative information). Generally, large sizes are represent high or important values while small sizes represent low or less important values. We saw the map on the left earlier. It represents the flows of transportation to and from Dublin, Ireland. The width (the size) of each line is proportional to the number of people being carried on trains.

Vis Var
Shape
Size
Hue
Value





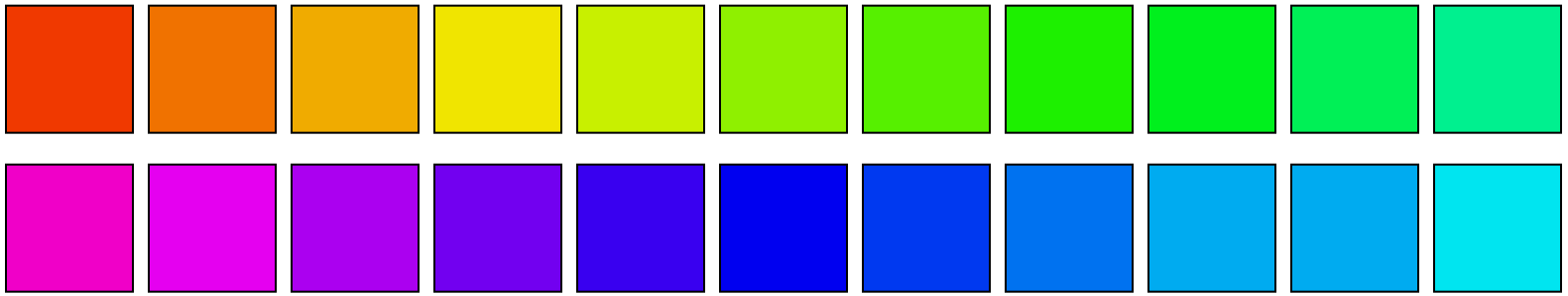
Both of these maps use size to indicate the number of microbreweries and brewpubs in the US by state in 1996. The map on the left uses graduated circles, where larger circles represent more establishments. The map on the right does the same, except with beer steins. This is an example of combining size and shape to create a more evocative map.

2009

2011

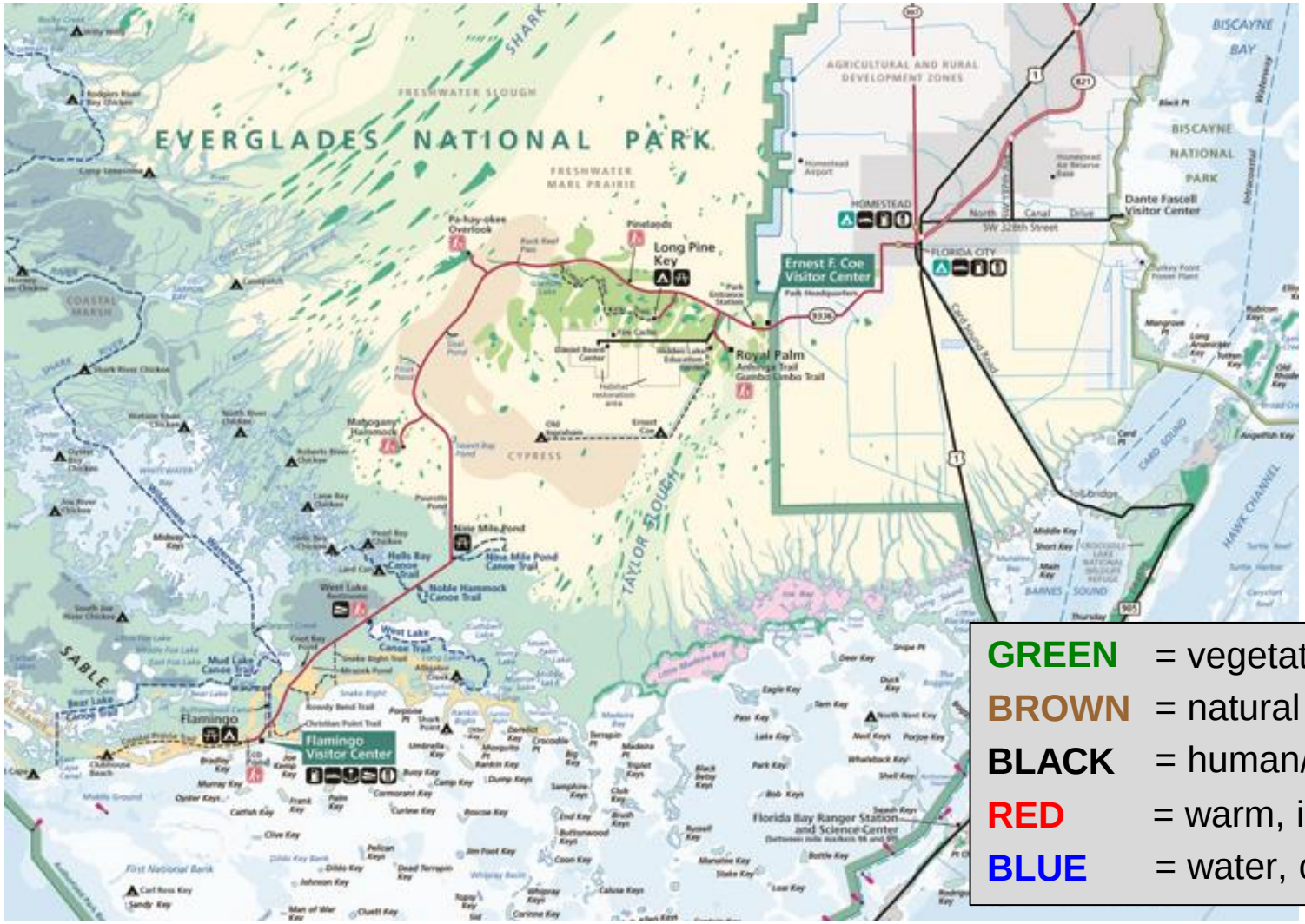
You can see how Google Maps have been revised over time as their cartographers got better at using size and shape, such as using a palette symbol for a museum in Sydney (2011). This is also an example of where they used the design principles of hierarchy (the size of text changed, as did the width of some streets) and balance (fewer bigger roads and other symbols jammed together).

Vis Var
Shape
Size
Hue
Value



Hue is what people usually mean by ‘color’. We have been using the term ‘color’ up to now when we mean ‘hue’. Hue is a powerful tool for cartographers, but beware, it is hard for the average user to match more than 15 hues in a map to separate categories. It would be hard to easily distinguish among the shades of blue seen above, for example, if they were all over a map.

Vis Var
Shape
Size
Hue
Value



GREEN = vegetation

BROWN = natural

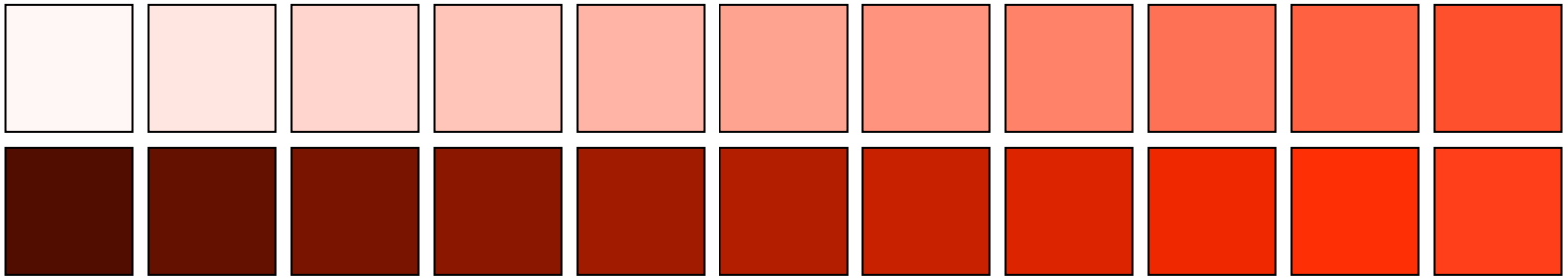
BLACK = human/cultural

RED = warm, important, increase

BLUE = water, cold, decrease

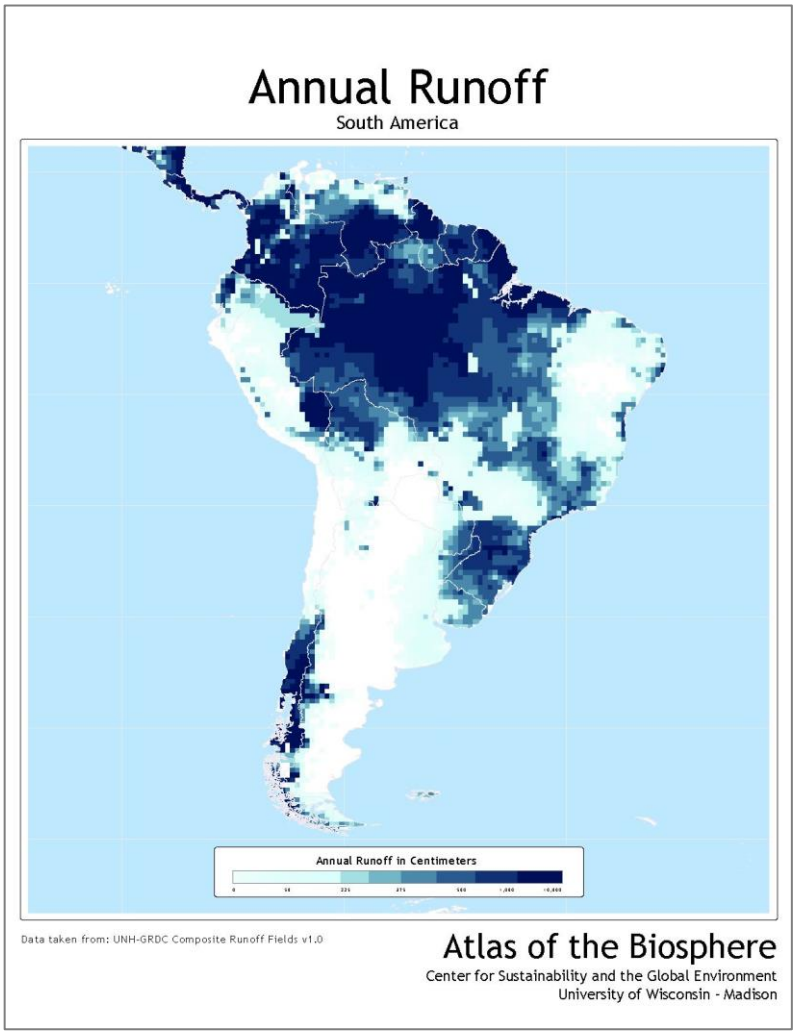
Hue is based on psychological and social factors because we associate certain colors with certain real-world features. In this map of the Everglades in Florida, blue is used to indicate water while green is often used to represent vegetation. Red is used to highlight certain areas.

Vis Var
Shape
Size
Hue
Value



Value is the darkness/lightness of a hue. It is hard for the average person to distinguish among more than about 8 different values. For that reason, we tend to use fewer than 8 levels of value for the same hue on a map. Here we see different values of the hue red.

Vis Var
Shape
Size
Hue
Value



Value can be very useful for showing quantitative differences within a single measure of something. This map shows run off (or the amount of water that moves over the land from precipitation) for South America. The darker the value, the more runoff.

Geometry

Point

Line

Area

Visual Variables

Shape

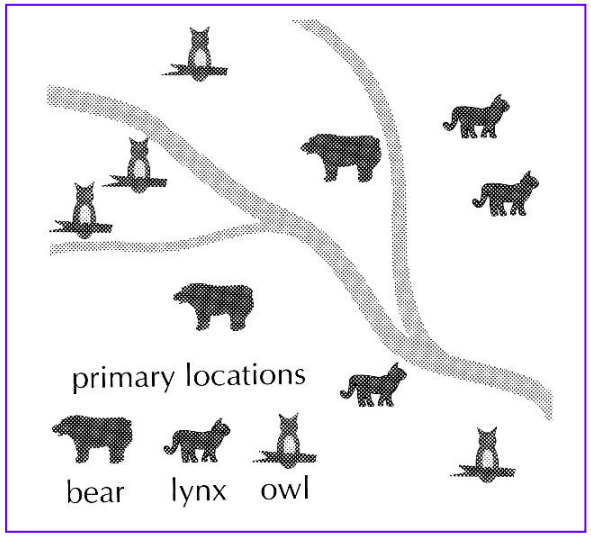
Size

Hue

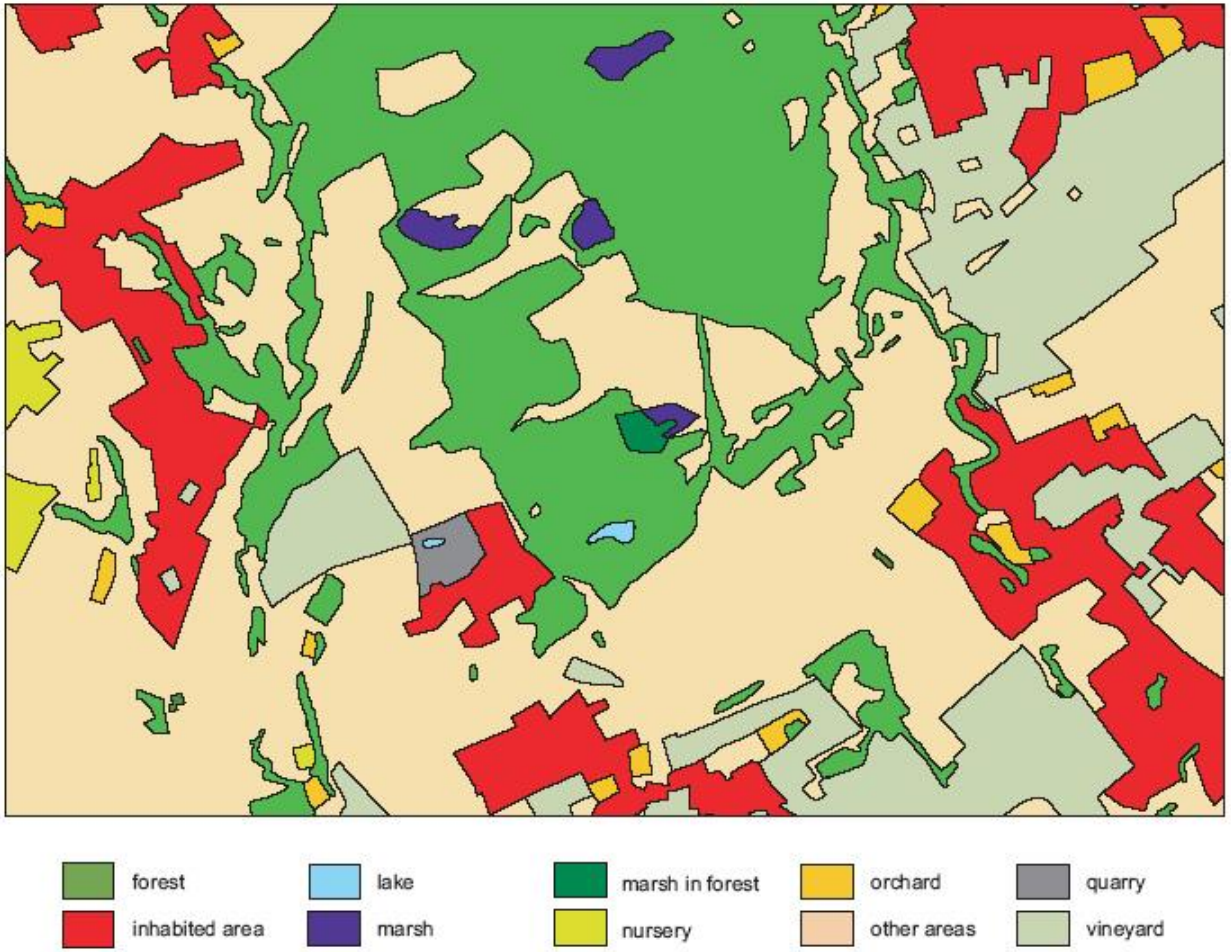
Value

Symbolization

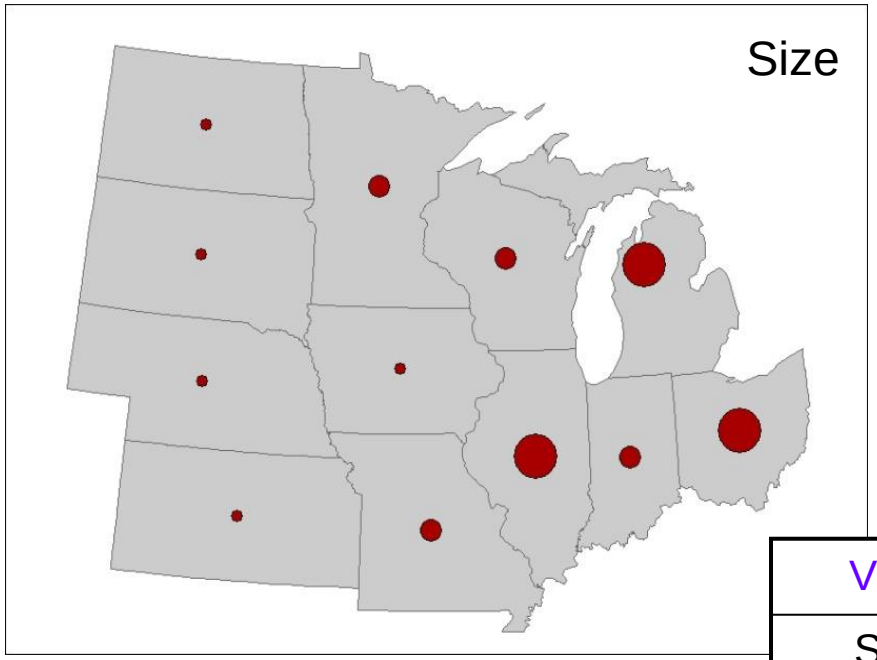
Finally, we look at attributes. Remember that attributes are the characteristics of things on a map. We tend to use visual variables differently depending on whether we are mapping qualitative or quantitative attributes.

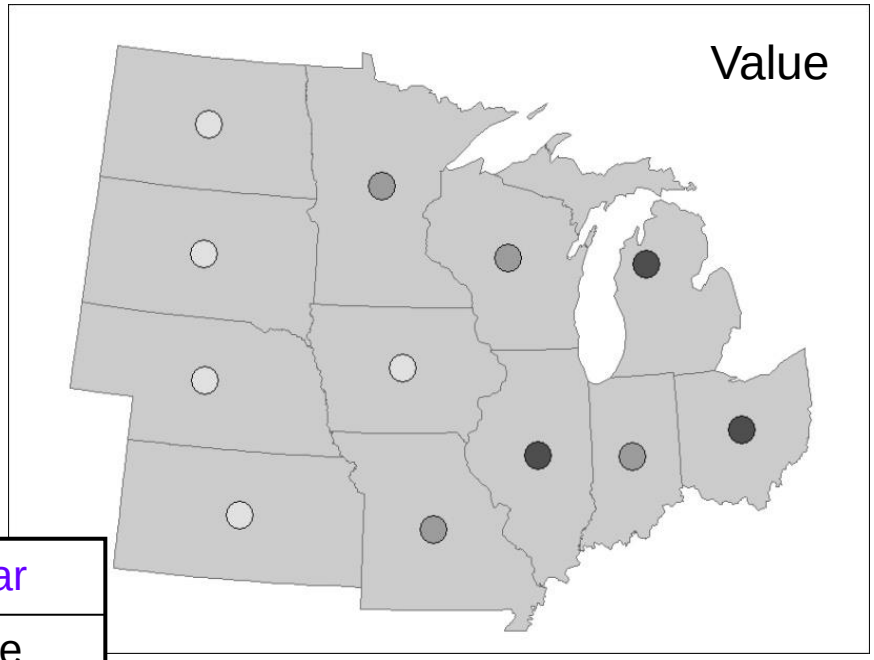


Vis Var
Shape
Size
Hue
Value



Recall that qualitative data deal with quality of things or places; differences in kind or existence. The visual variables of shape and hue are excellent for qualitative data. Here, shapes represent the locations of different kinds of animals, while hue illustrates the locations of differing land uses. Note that some of these hues also carry common meanings, such as blue for water or green for forests.





Vis Var
Shape
Size
Hue
Value

Quantitative data deal in measurements or quantities that deal with differences in amount. Size and value are well-suited to represent quantitative differences. These two maps show measures of population in the US Midwest using circles of varying size (left) and of varying value (right)

Geometry

Point

Line

Area

Visual Variables

Shape

Size

Hue

Value

Symbolization

To recap, symbolization can be a very complex topic but here we focus on three simple kinds of geometry (points, lines, and areas) and four visual variables (shape, size, hue, and value).

Conclusion

- Design principles
  - Hierarchy
  - Balance
- Symbolization essentials
  - Geometry
  - Visual variables

The cartographer has many tools, but among these, most important are two key design principles (hierarchy and balance) and two symbolization essentials (geometry and visual variables).