



# Beautifying GIS: A Refresher on Cartography

Christopher Morgan

# Outline

- Message
- Audience
- Medium

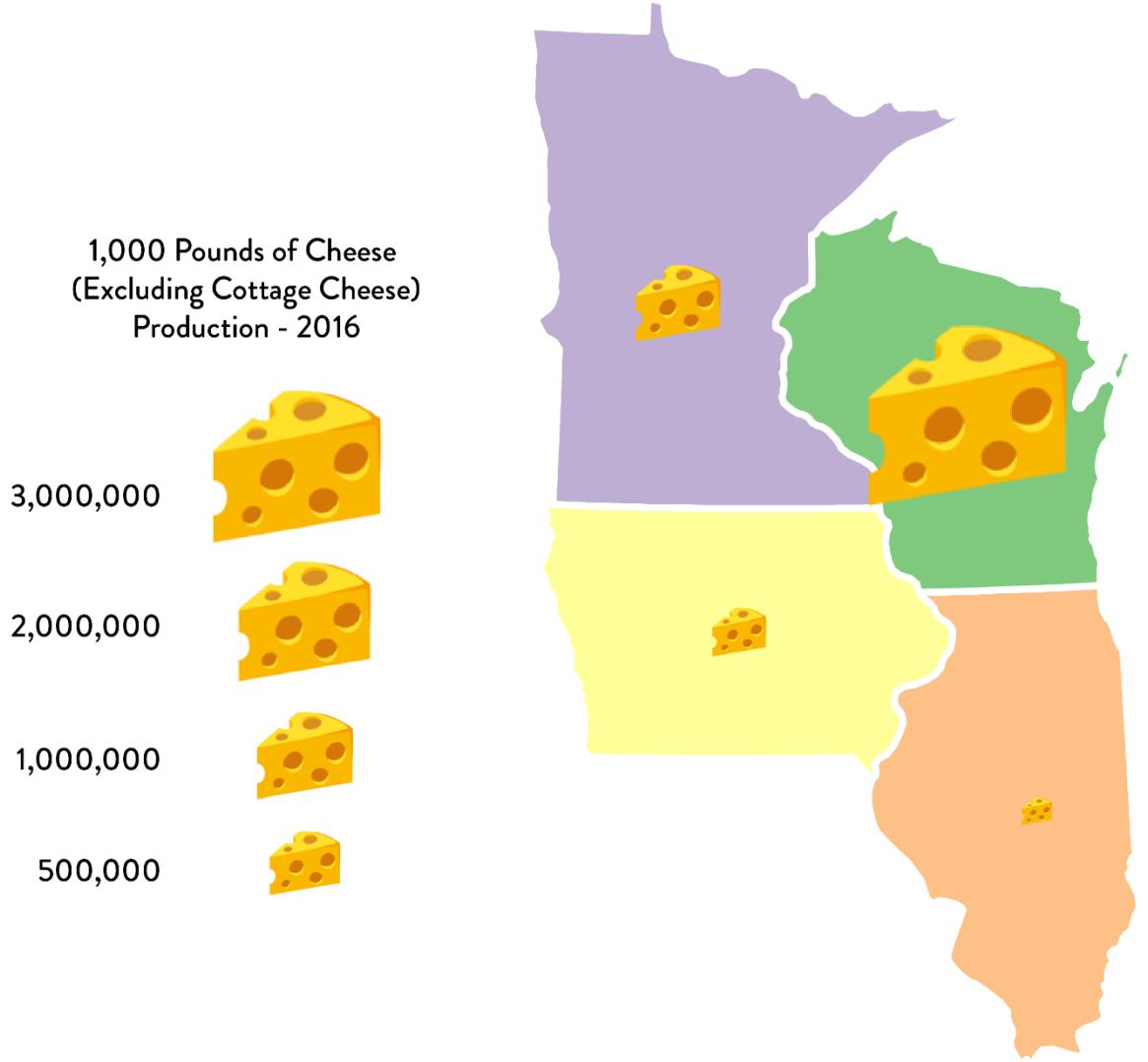
THEN

- Labels
- Symbology
- Colors
- Visual Hierarchy

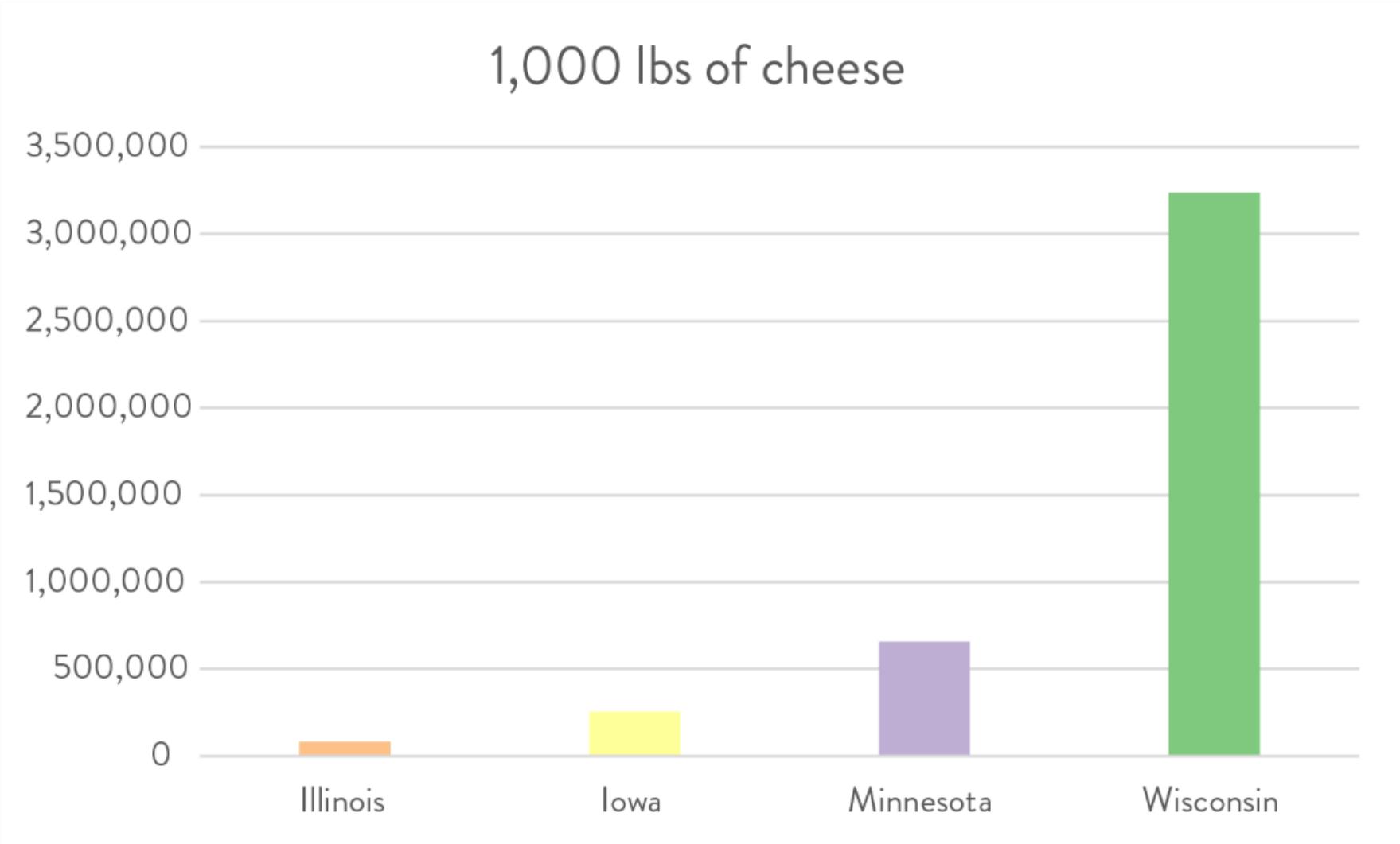
# Your Message

- Reflect on what you're trying to convey
- Consider yourself a GIS person? You're probably biased
  - A map isn't always the best messenger – in some instances, a graph, drawing, or photo can be more effective
  - Some information might be sensitive in a geographic context

# Cheese Production by State - Map

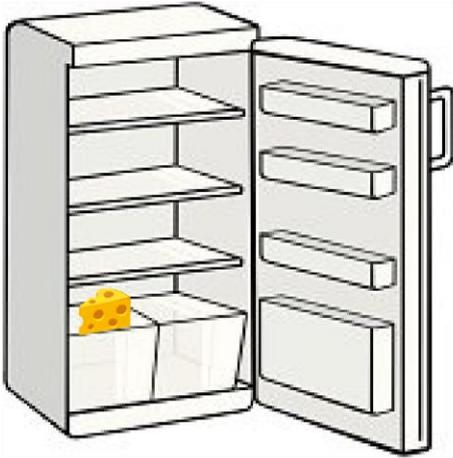


# Cheese Production by State - Graph

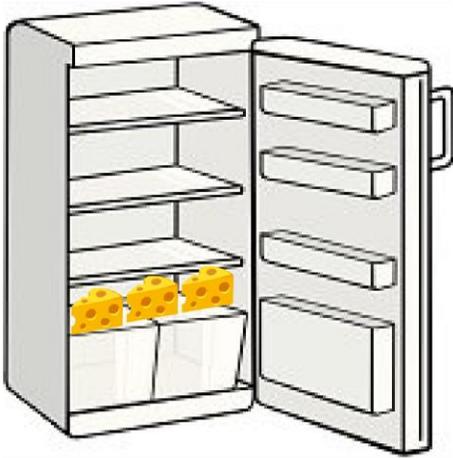


# Cheese Production by State - Drawing

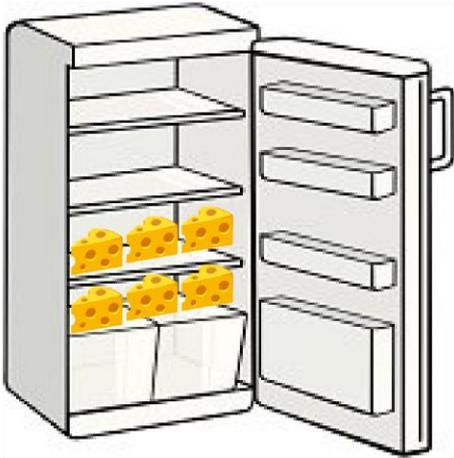
IL



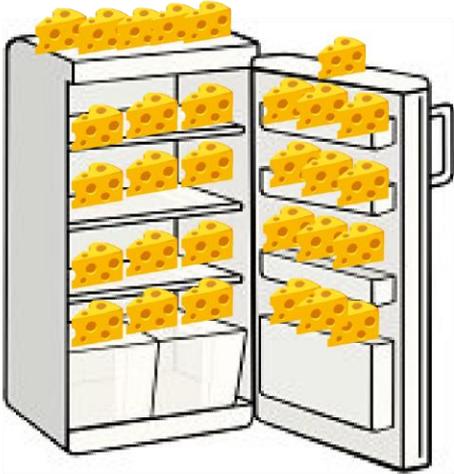
IA



MN



WI



# Cheese Production by State - Image



# Your Audience

- Who are they?
  - Are they a child or an adult?
  - Are they familiar with the area being depicted?
- What level of expertise do they have?
  - Are they a member of the public?
  - Are they an expert in your field?
  - Are they someone in your agency, but maybe not as much of a subject expert as you?

# Simplicity

- As a general rule, include only the bare minimum amount of information needed to successfully convey your message
- This applies more to members of the general public
  - Need just enough reference info to recognize area depicted
  - Include only pertinent info on your message's topic

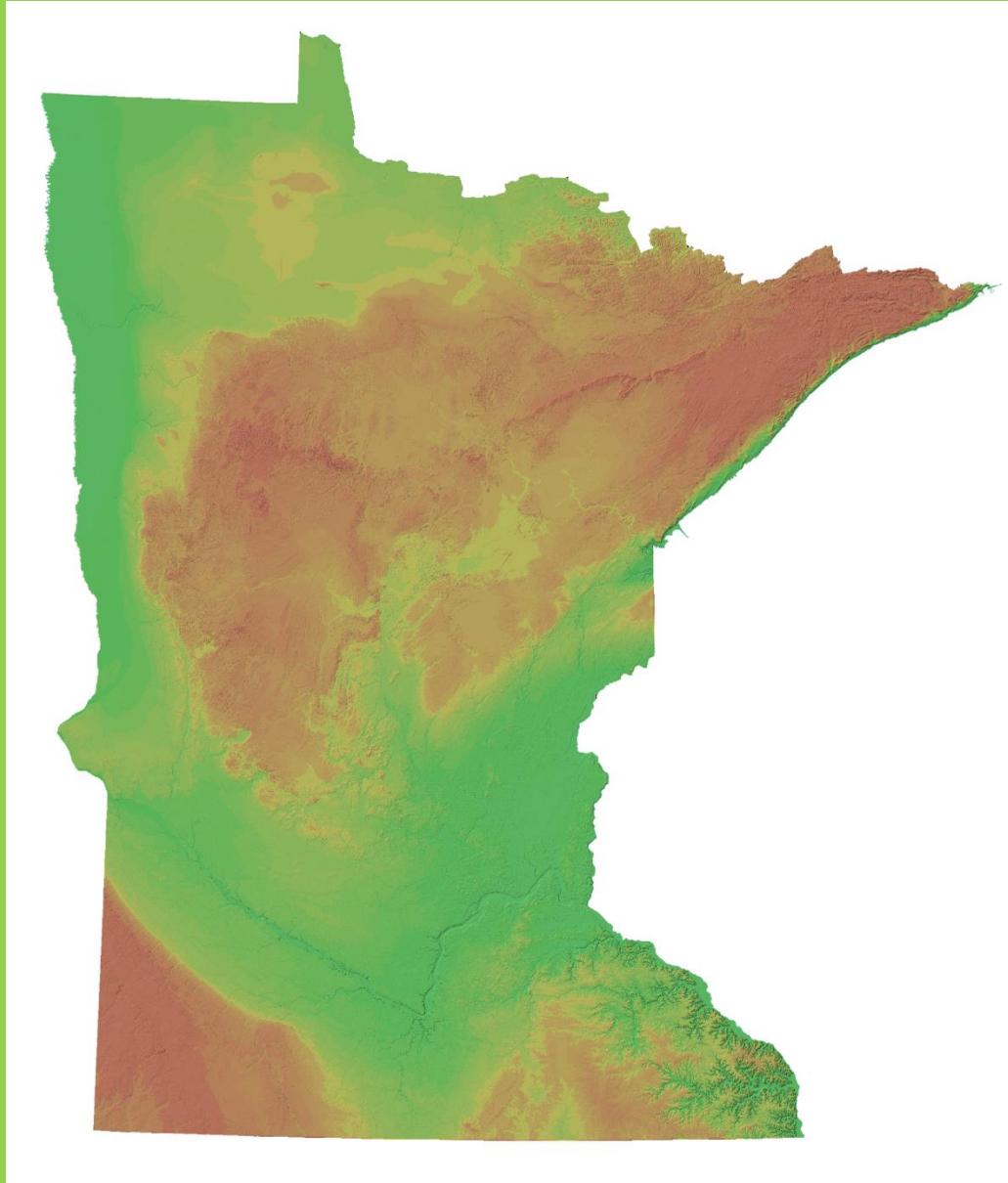
# General Public

- More supporting info on periphery of map explaining content and symbols
- Less information, fewer variables, less detail
- Follow conventions to increase comprehension

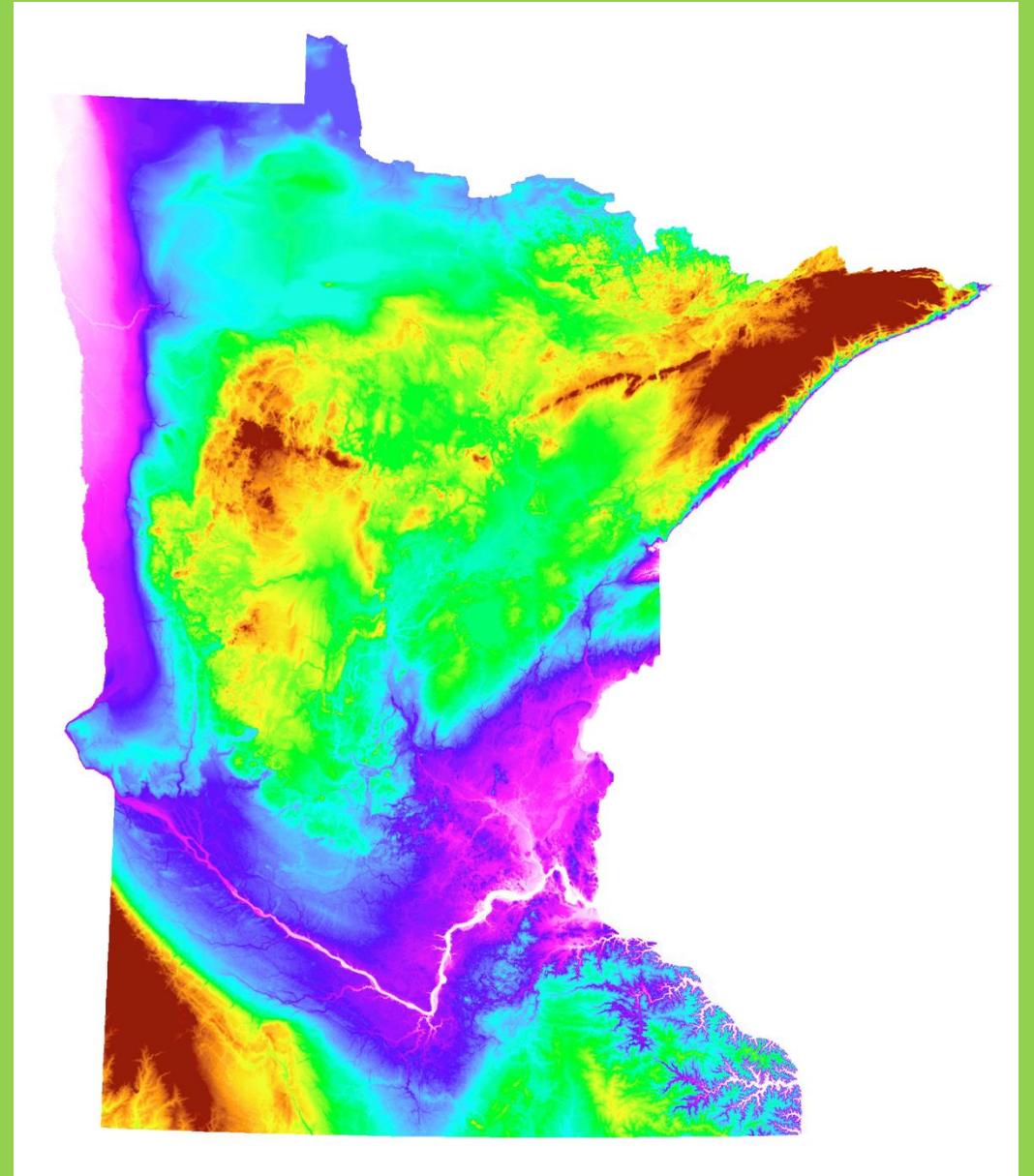
# Experts

- Less supporting info on periphery of map explaining content and symbols
- More information, more variables, more detail
- Follow conventions of experts in your field
  - Elevation generally goes green → brown → grey as you go low to high

# Digital Elevation Model



Conventional Elevation Gradient



Conventional Temperature Gradient

# How are you going to show it?

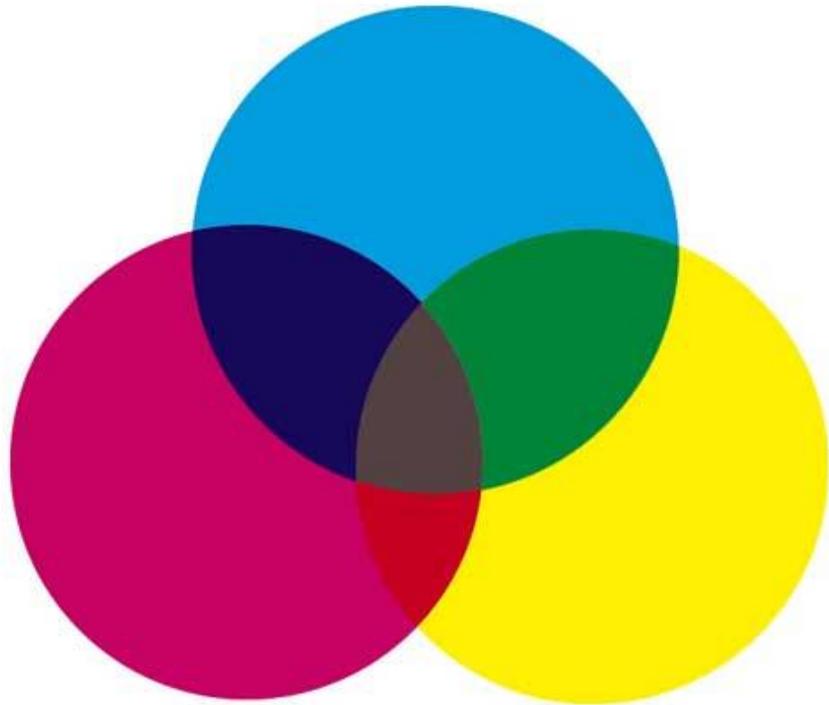
- The medium of your final product is also very important!
- Your map could end up on:
  - a single sheet of paper
  - a poster
  - a cell phone screen
  - a computer screen
  - a projected slide like this
  - maybe even a protest sign or yard sign

# Medium

- You might not have total control of how your map ends up being used, but...
  - You at least know what you're designing it for (hopefully)
  - You can speculate as to how your map might be used once it's out of your hands, and then design accordingly

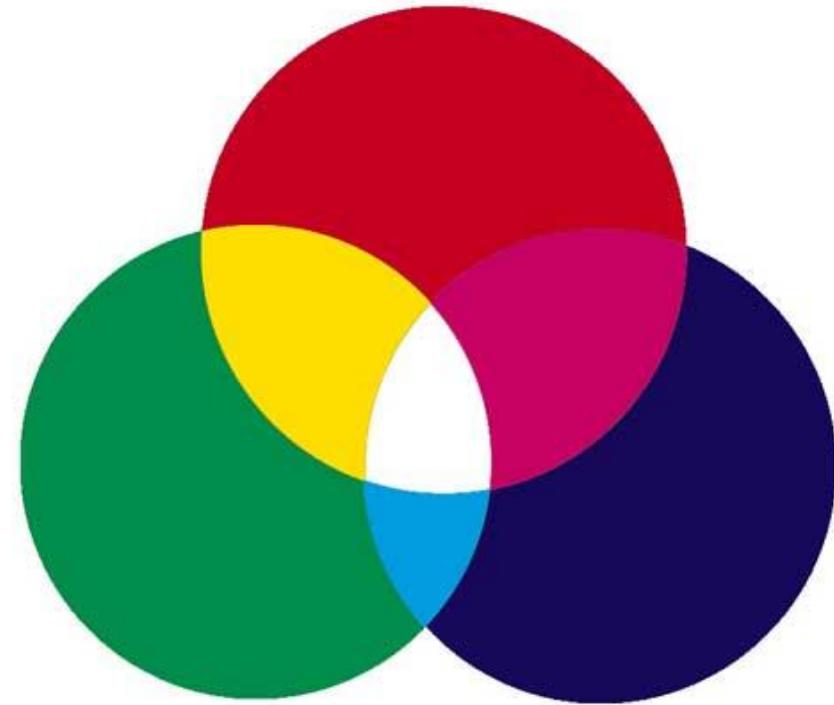
How  
do  
I  
design  
accordingly?

# CMYK vs. RGB



Subtractive color (CMYK)

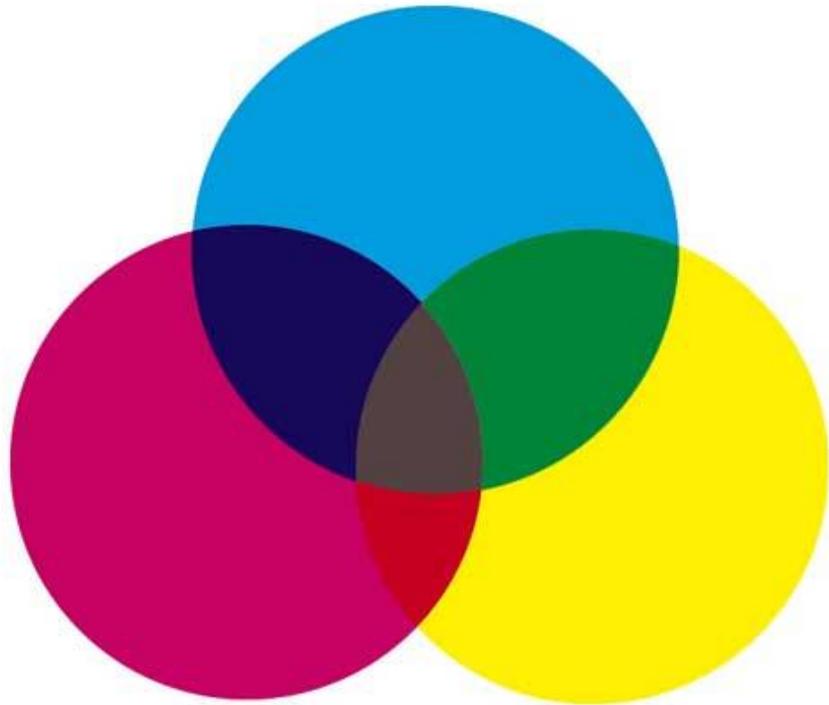
*Print*



Additive Color (RGB)

*Screen*

# CMYK vs. RGB

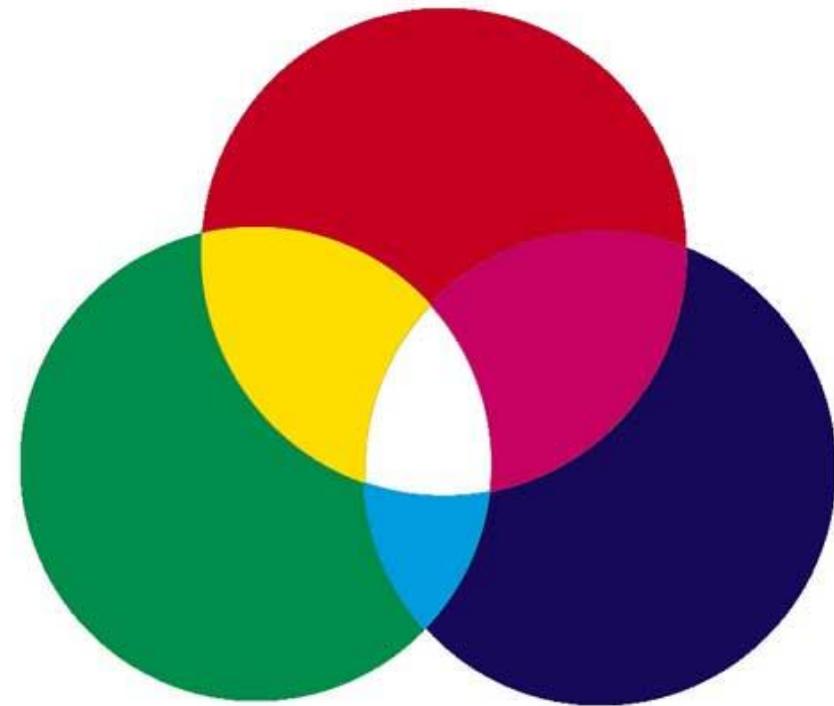


Subtractive color (CMYK)

- If there's any chance your map will end up being printed, design it in CMYK

# CMYK vs. RGB

- You can always save a copy of your project in RGB in the “Export for web” function
- Or if you know it will only ever be on the web, feel free to design in RGB



Additive Color (RGB)

# Font Size Minimums

- Print

- 10 pt font

- Screen

- 14 pt font

- Absolute Minimum

- 6 pt font (for fine print)

- Example

- Example

- Example

(but keep in mind that two typefaces at the same font size can be quite different in actual size)

moving  
past  
parameters...

...but  
keeping  
with  
typography

# Typeface vs. Font

Typeface – unique style of characters

Font – the embodiment of that style in individual characters

The Roman (or "Regular"), Italic, Bold, Semibold, Regular Display/Subhead/Text/Caption, Extended, Condensed, etc., of a typeface are all fonts within the same typeface.

Typeface

Font

Times New Roman

Regular

*Italic*

**Bold**

***Bold Italic***

# Typeface vs. Font Analogy

“Use "typeface" when you'd use "song" (e.g. "I love that song/typeface ..."), and "font" when you'd use "track" ("... so I'm going to buy the track/font for it")”.

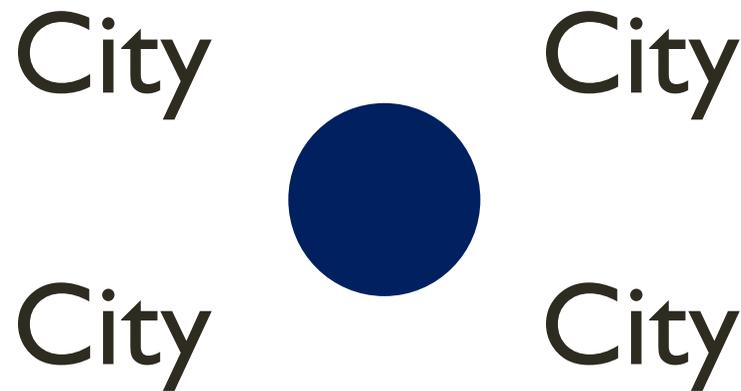
-FontFeed.com

# Map Lettering Conventions

- Prioritize the position of point feature labels: 1) above and to the right, then 2) below and to the right, then 3) above and to the left, then 4) below and to the left. Positioning directly above, below, or to the sides is not preferred.
- Visually center and increase the letter-spacing of labels within area features to reinforce their size/shape.
- Use uppercase to label area features.
- Categorize cultural and physical features using sans serif and serif fonts.
- Label water features blue and in an italic font.
- Distinguish ranked categories by at least two points when label sizes are small.
- Don't rotate labels upside-down.
- If necessary, use one serif and one sans serif font, but don't use more than one sans serif font on the map.

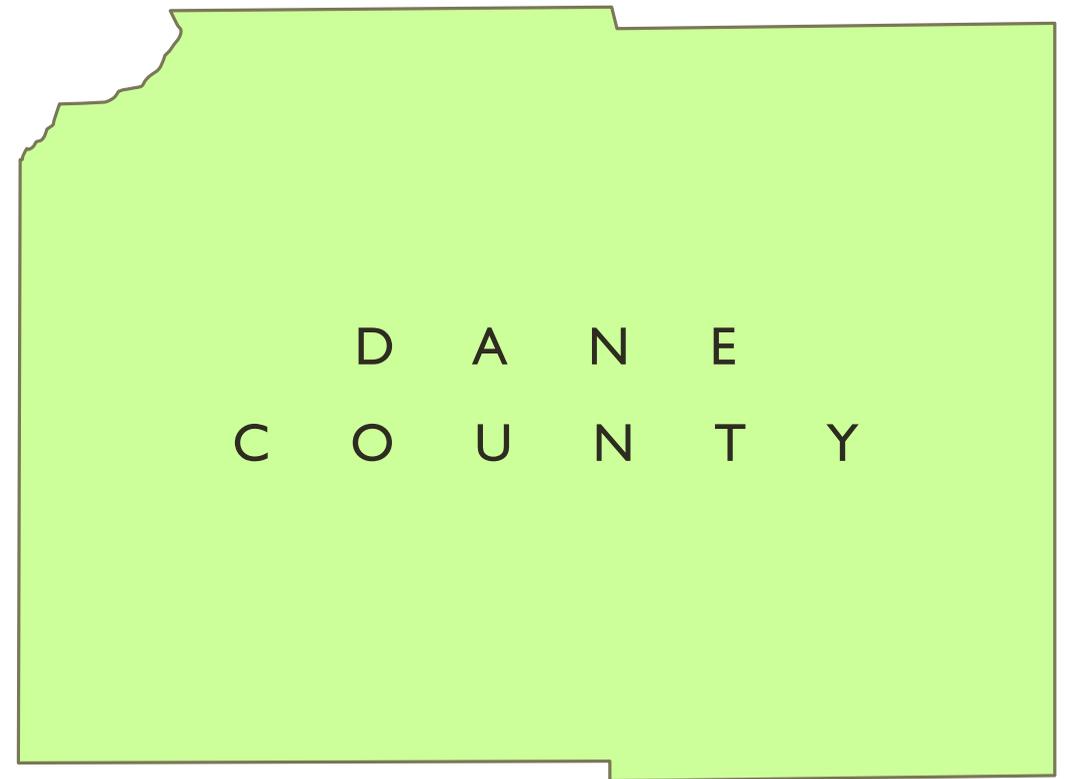
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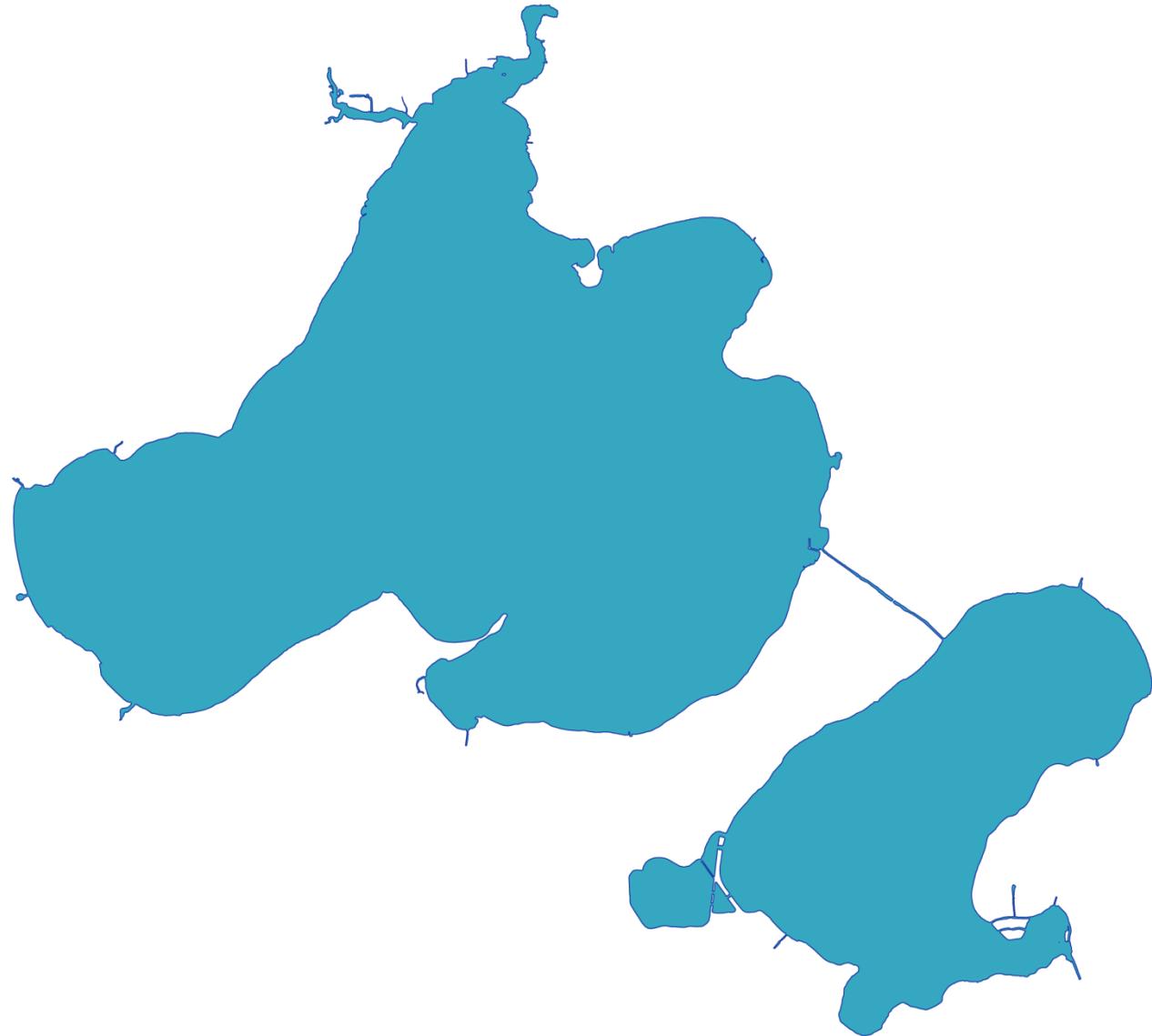


# Map Lettering Conventions

- General rule of thumb:
  - Cultural features: Sans-Serif
  - Natural features: Serif
- The idea is that the serifs have an added level of complexity or irregularity, like nature
- Sans-serif typefaces are neater, like the straight lines of buildings and the built-world

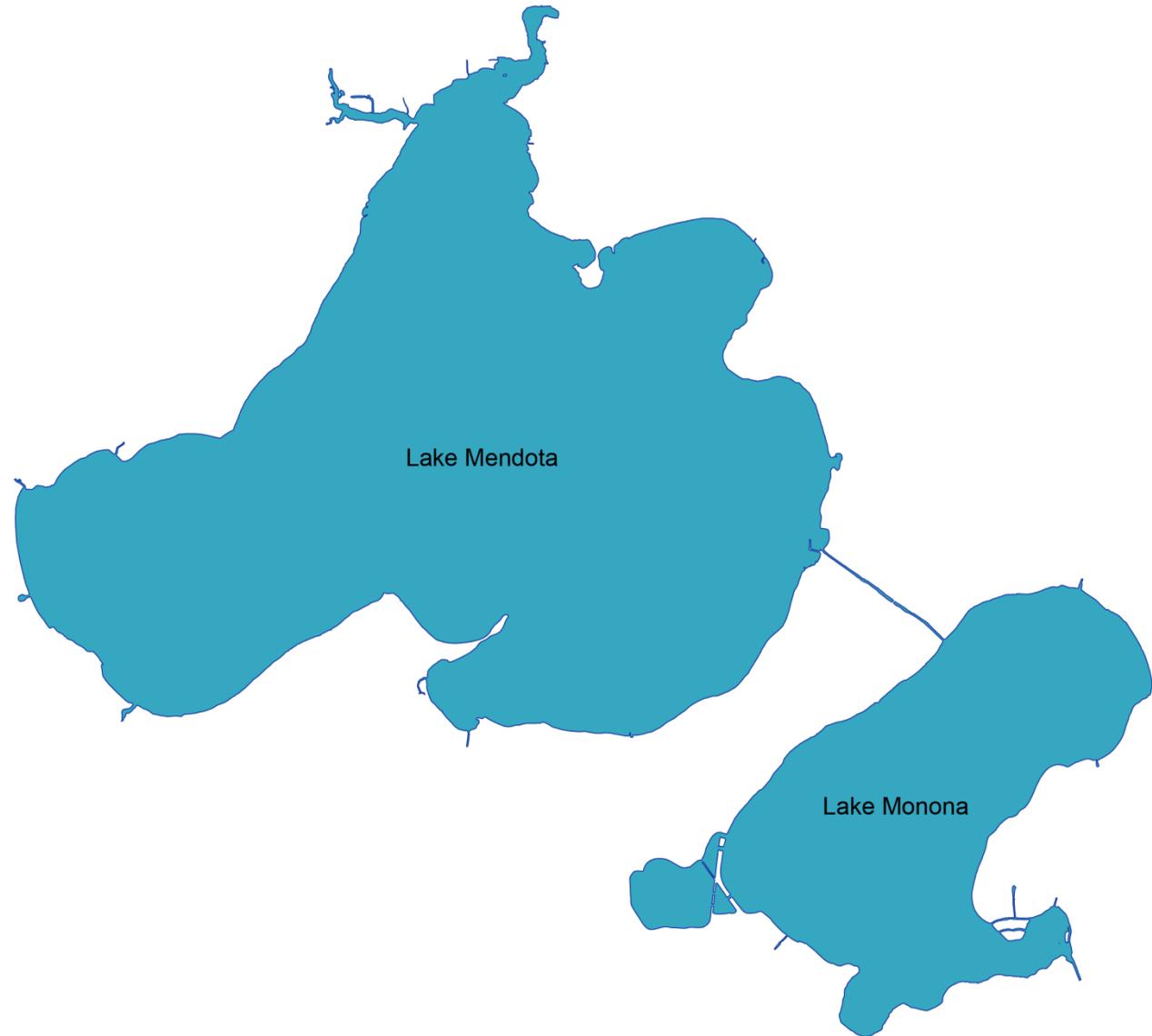
# Map Lettering Conventions

- Label water features blue and in an italic font



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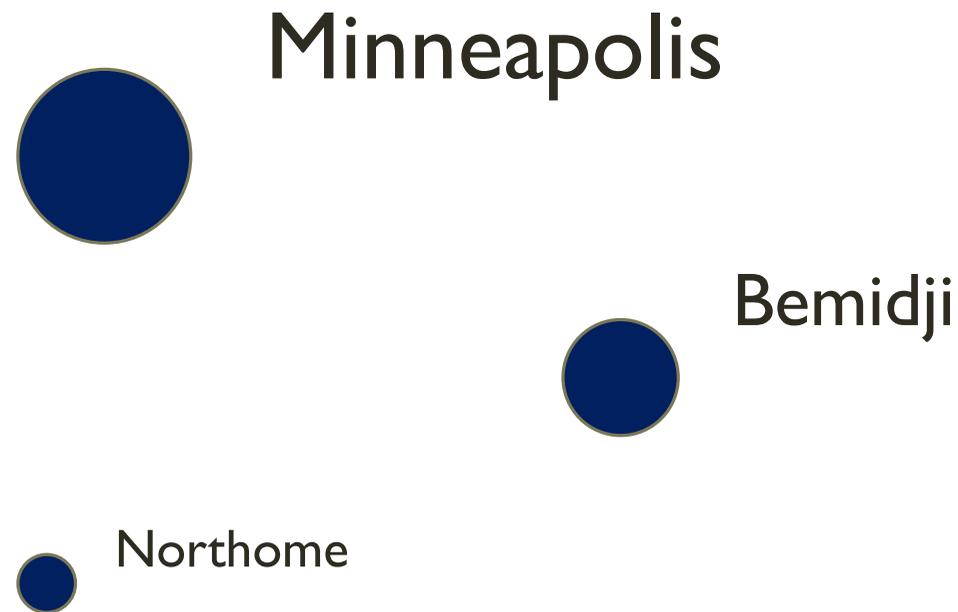
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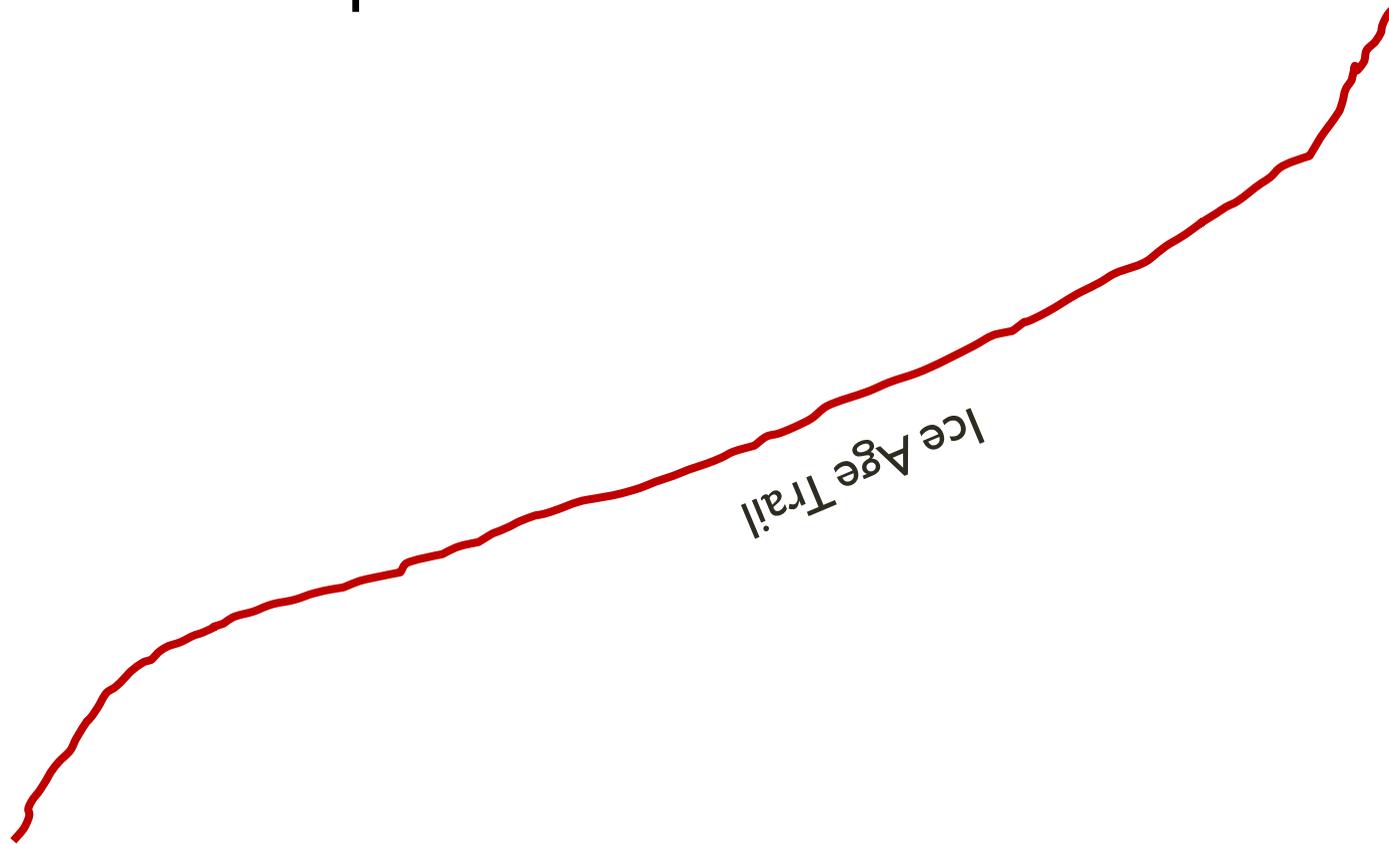
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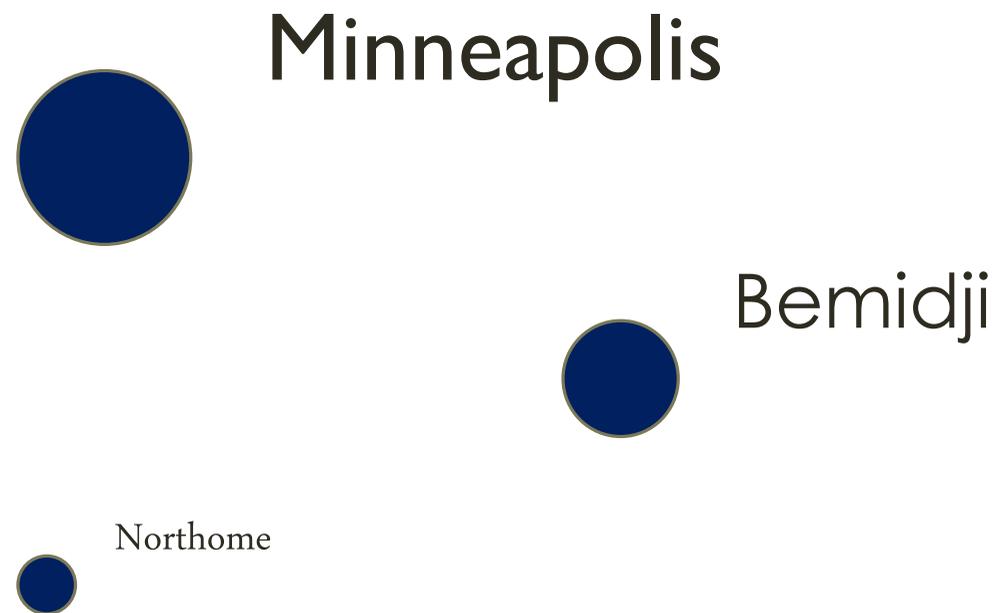
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# Map Lettering Conventions

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# Data Types

- Nominal
- Ordinal
- Interval
- Ratio

# Data Types

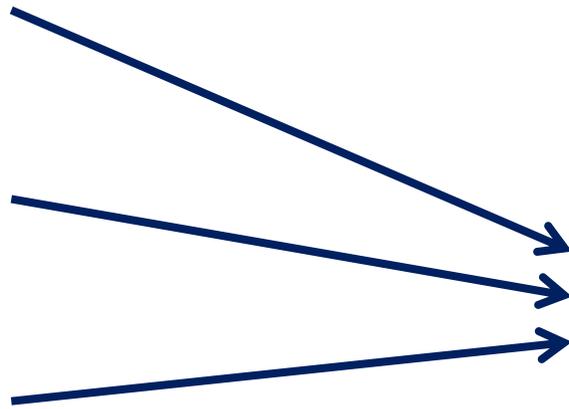
- **Nominal** 
  - Ordinal
  - Interval
  - Ratio
- Qualitative**
- Quantitative

# Data Types

- Nominal
- Ordinal
- Interval
- Ratio

Qualitative

Quantitative



# Data Types

- **Nominal** (also known as categorical or qualitative data)
  - Categories that are inherently unorderable  
(dominant religion, soil types, or land-use categories)
  - No numbers attached to them, not rankable
  - Merely different kinds of things

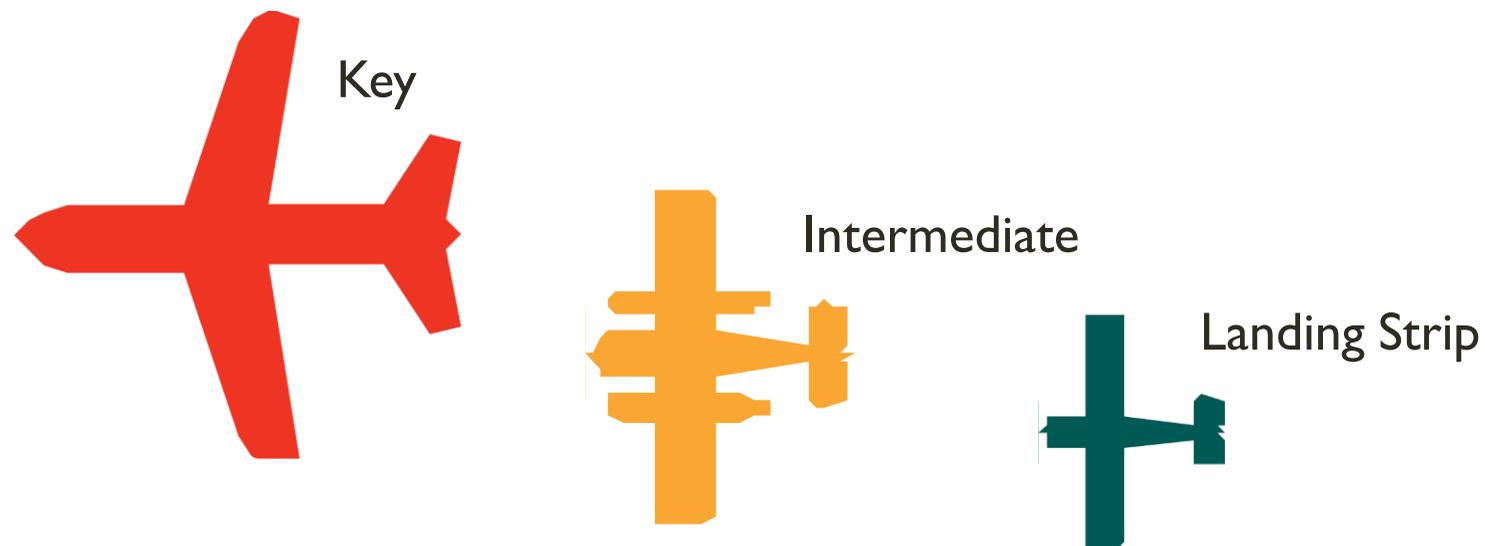


# Data Types

- **Ordinal**

- inherently orderable categorical data

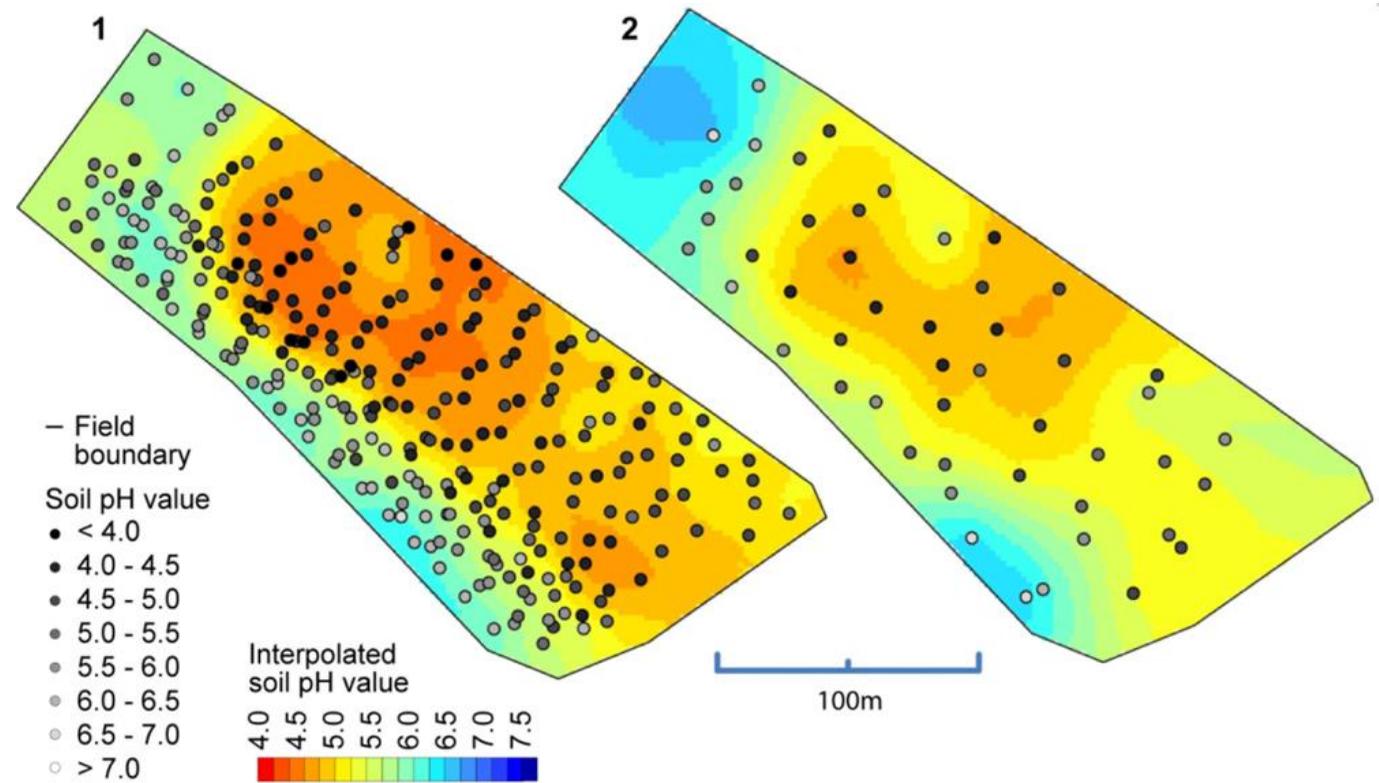
Shirt sizes (S / M / L / XL), flood risk (low risk / medium risk / high risk) or age (young / middle aged / old)



# Data Types

- Interval

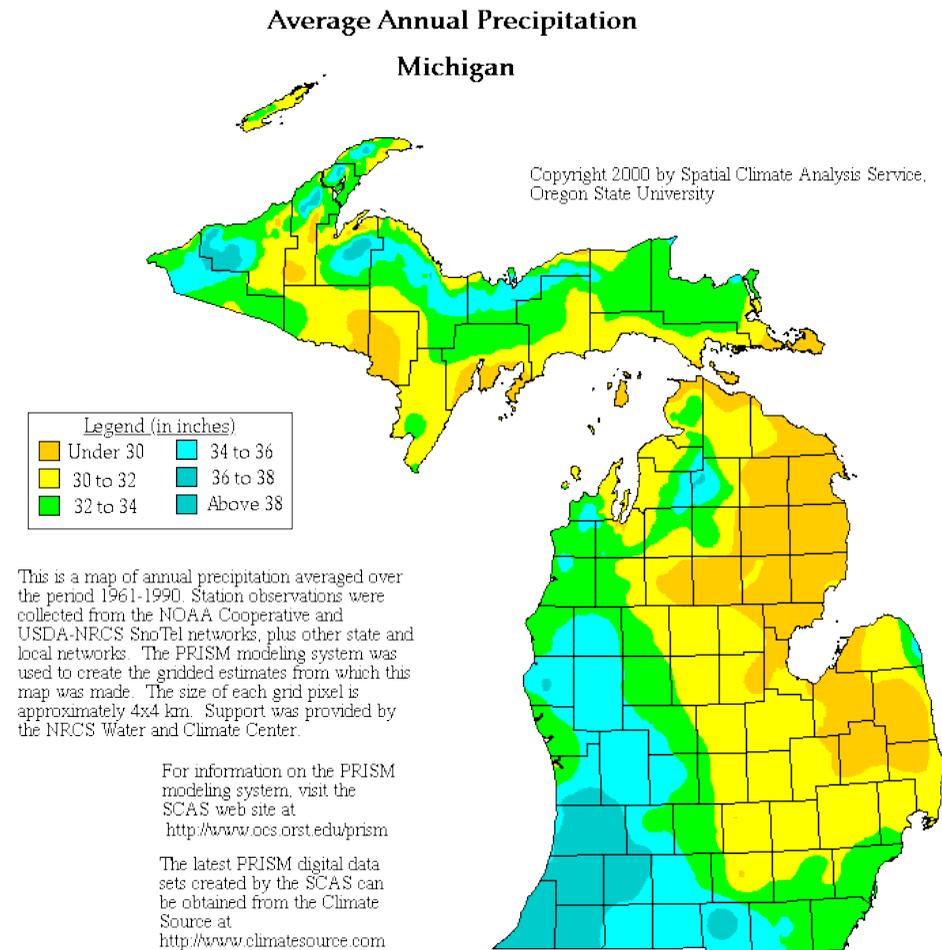
- Distinctions of order with measurable differences among the ordered data, but no absolute zero (e.g. temperature  $F^{\circ}$ , pH)
- Arbitrary scale



# Data Types

- **Ratio**

Distinctions of order with measurable differences between the ordered data and an absolute zero (e.g. age, distance, weight, and volume)

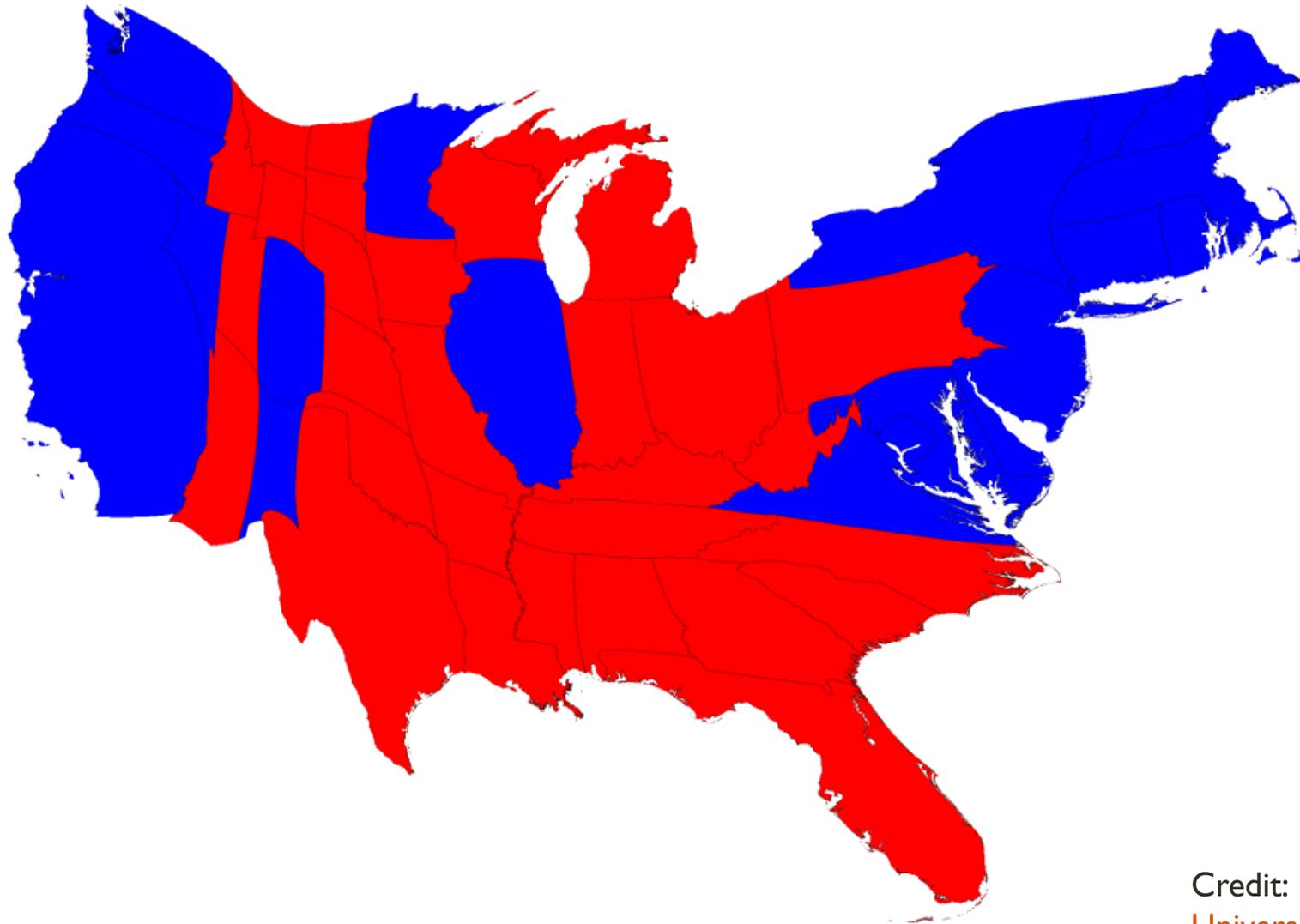


# Visual Variables

|                        | <i>Points</i>   | <i>Lines</i>   | <i>Areas</i>  | <i>Best to show</i>                               |
|------------------------|---|--|---|---|
| <i>Shape</i>           |    | <i>possible, but too weird to show</i>   | <i>cartogram</i>  | <i>qualitative differences</i>                    |
| <i>Size</i>            |    |    | <i>cartogram</i>  | <i>quantitative differences</i>                   |
| <i>Color Hue</i>       |   |   |   | <i>qualitative differences</i>                    |
| <i>Color Value</i>     |  |  |  | <i>quantitative differences</i>                   |
| <i>Color Intensity</i> |  |  |  | <i>qualitative differences</i>                    |
| <i>Texture</i>         |  |  |  | <i>qualitative &amp; quantitative differences</i> |

Credit:  
John Krygier  
and Denis Wood

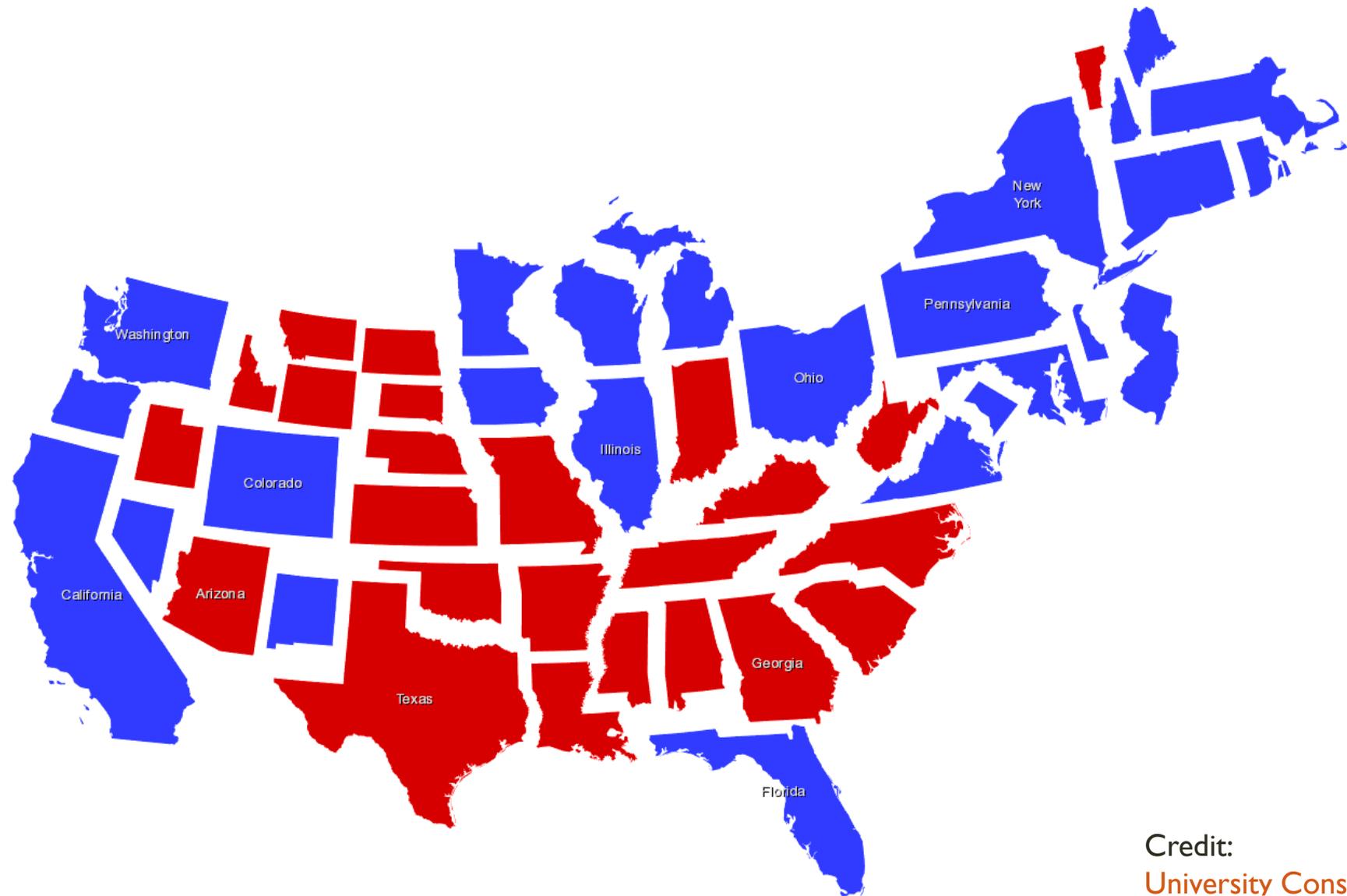
# Cartogram



Credit:  
University of Michigan



# Non-contiguous Cartogram



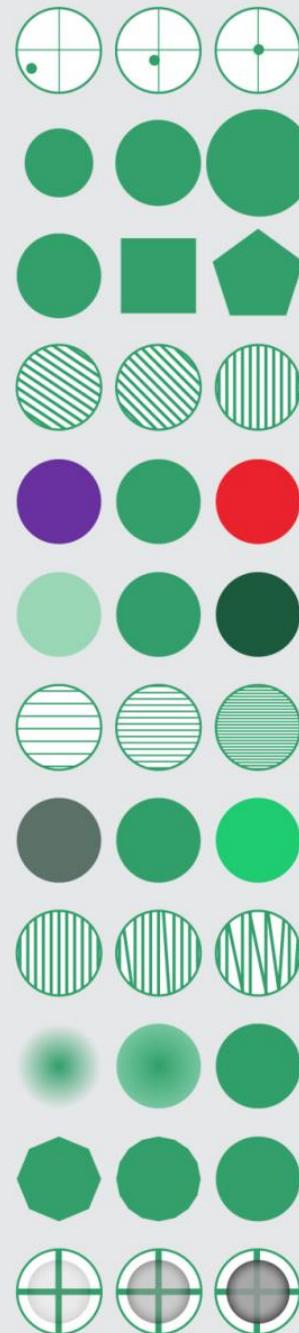
Credit:  
University Consortium for GIS

# Visual Variables

|                        | <i>Points</i>   | <i>Lines</i>   | <i>Areas</i>  | <i>Best to show</i>                               |
|------------------------|---|--|---|---|
| <i>Shape</i>           |    | <i>possible, but too weird to show</i>   | <i>cartogram</i>  | <i>qualitative differences</i>                    |
| <i>Size</i>            |    |    | <i>cartogram</i>  | <i>quantitative differences</i>                   |
| <i>Color Hue</i>       |   |   |   | <i>qualitative differences</i>                    |
| <i>Color Value</i>     |  |  |  | <i>quantitative differences</i>                   |
| <i>Color Intensity</i> |  |  |  | <i>qualitative differences</i>                    |
| <i>Texture</i>         |  |  |  | <i>qualitative &amp; quantitative differences</i> |

Credit:  
John Krygier  
and Denis Wood

ground  $\longleftrightarrow$  figure



visual variable variations

|                  | associative | selective | nominal (non-ordered) | ordinal (ordered) | numerical (quantitative) |
|------------------|-------------|-----------|-----------------------|-------------------|--------------------------|
| location         | Y           | Y         | G                     | G                 | G                        |
| size             | N           | Y         | G                     | G                 | G                        |
| shape            | Y           | N         | G                     | P                 | P                        |
| orientation      | Y           | Y         | G                     | M                 | M                        |
| color hue        | Y           | Y         | G                     | M                 | M                        |
| color value      | N           | Y         | P                     | G                 | M                        |
| texture          | Y           | Y         | G                     | M                 | M                        |
| color saturation | hatched     | hatched   | P                     | G                 | M                        |
| arrangement      | hatched     | hatched   | M                     | P                 | P                        |
| crispness        | hatched     | hatched   | P                     | G                 | P                        |
| resolution       | hatched     | hatched   | P                     | G                 | P                        |
| transparency     | hatched     | hatched   | M                     | G                 | P                        |

Y=yes; N=no; G=good; M=marginal; P=poor; hatched=n/a

# Visual Variables, cont.

Credit:  
A.M. MacEachren, R. E. Roth, et al.

*“Life imitates Art far more than  
Art imitates Life”*

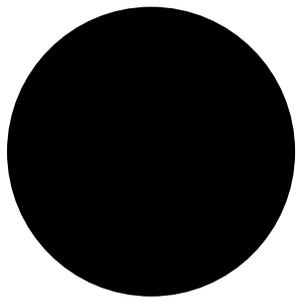
**-Oscar Wilde**

# Regardless of which one imitates the other more...

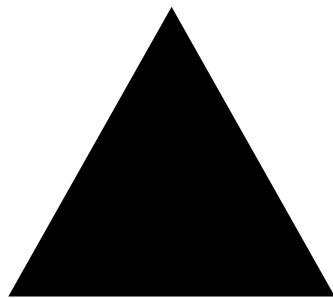
- Imitate the learned world whenever possible
- Graphical User Interfaces (GUIs) try to do the same thing
  -  Initially designed to resemble a list – now ingrained in us thanks to mobile apps
- Resemblance and Conventions matter – your map should be as intuitive as possible
- Symbols should invoke the feature or phenomena that they represent
  -  = airport
  -  = battle

# Resemblance

You might have some sort of design constraints that limit you to basic shapes and black ink



Oak

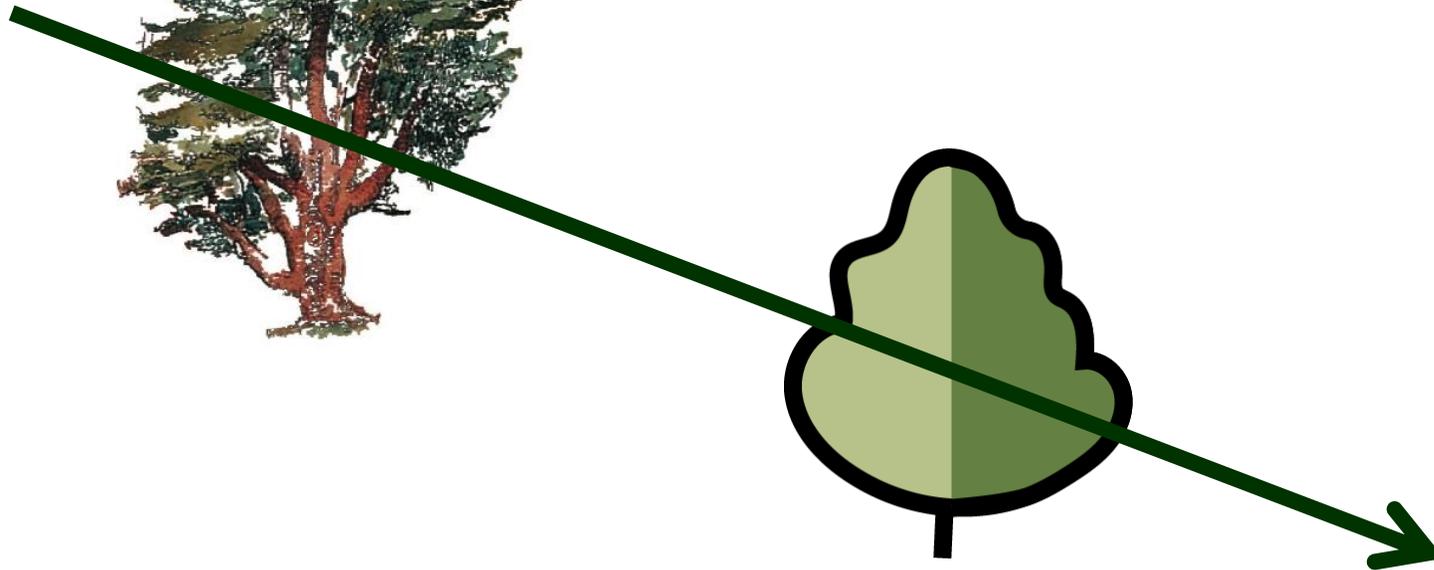
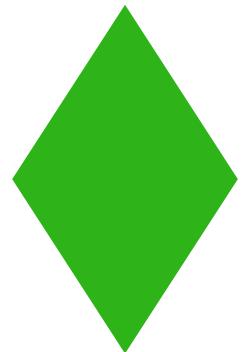
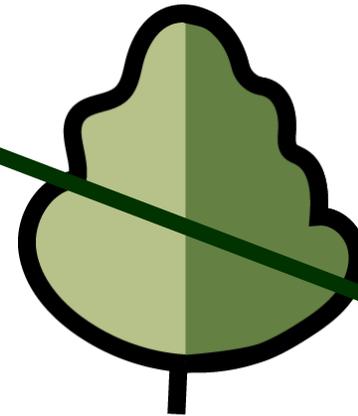
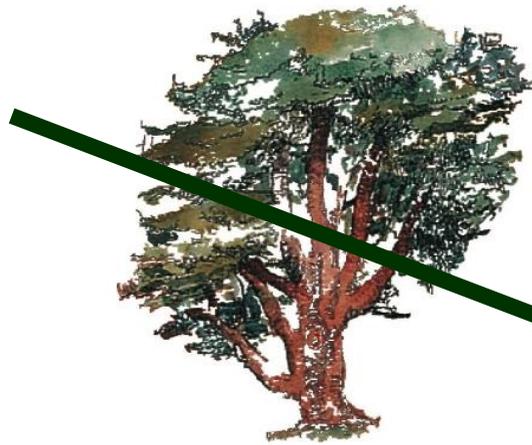


Pine

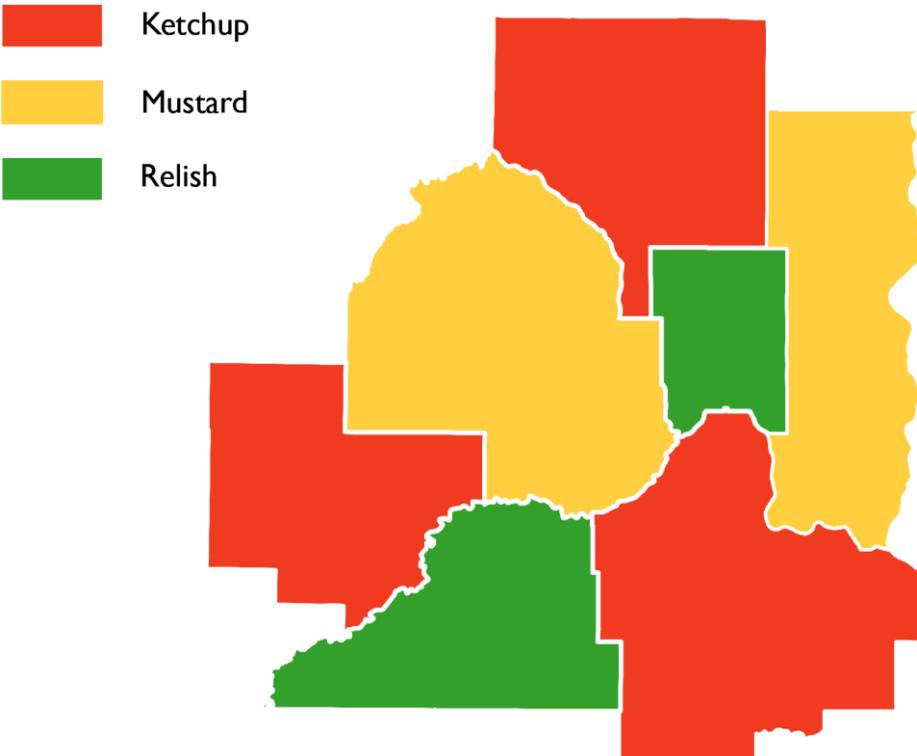
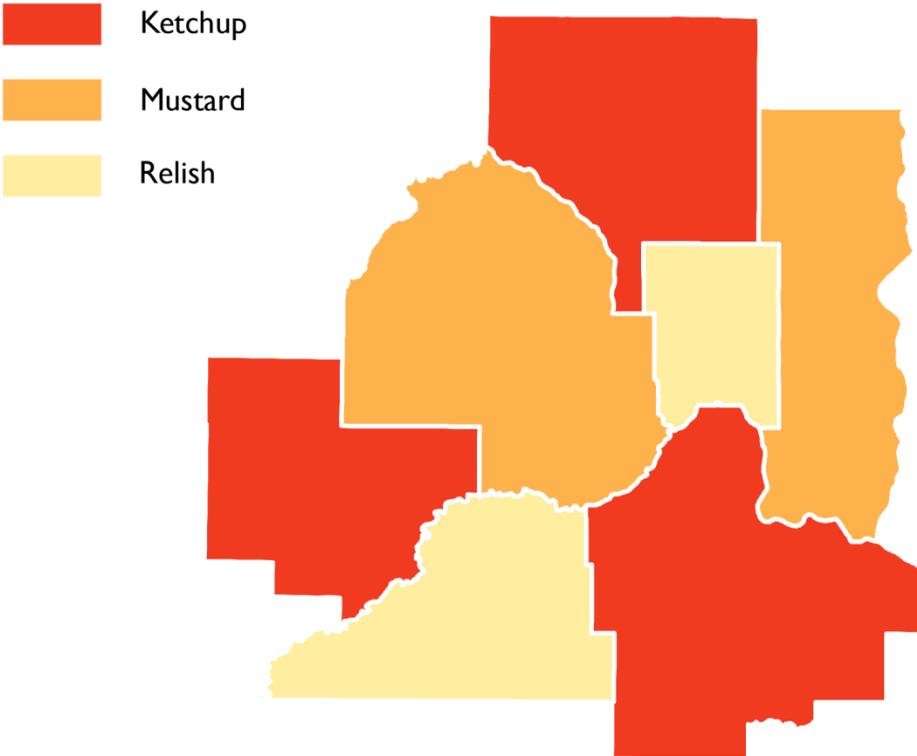


Maple

# Spectrum of Abstraction



# Resemblance



# Symbolization

- ESRI has a large enough symbol library that your needs will probably be met, but don't rule out looking elsewhere or designing your own



# Colors in Western culture



**Blue:** water, cool, positive numbers, serenity, purity, depth



**Green:** vegetation, lowlands, forests, youth, spring, nature, peace



**Red:** warm, important, negative numbers, action, anger, danger, power, warning



**Yellow/tan:** dry, lack of vegetation, intermediate elevation, heat



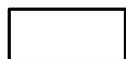
**Orange:** harvest, fall, abundance, fire, attention, action, warning



**Brown:** landforms (mountains, hills), contours, earthy, dirty, warm



**Purple:** dignity, royalty, sorrow, despair, richness, elegant,



**White:** purity, clean, faith, illness, life, charity, absence, light



**Black:** mystery, strength, heaviness, death, nighttime, presence



**Gray:** quiet, reserved, sophisticated, controlled, light, bland, dull

# Color-blindness



# Color Palettes

- It's ideal to have colors match the mood or aesthetic that your map is trying to reflect
- But contrast and accessibility is also important

**C O L O R B R E W E R 2 . 0** is your friend

[colorbrewer2.org](http://colorbrewer2.org)

# Visual Arrangement



Not so good



# Visual Arrangement



**AUTHORITY!!!**

The visual center of a map is slightly above the actual center  
(so like just about here)

Balance and symmetry is good

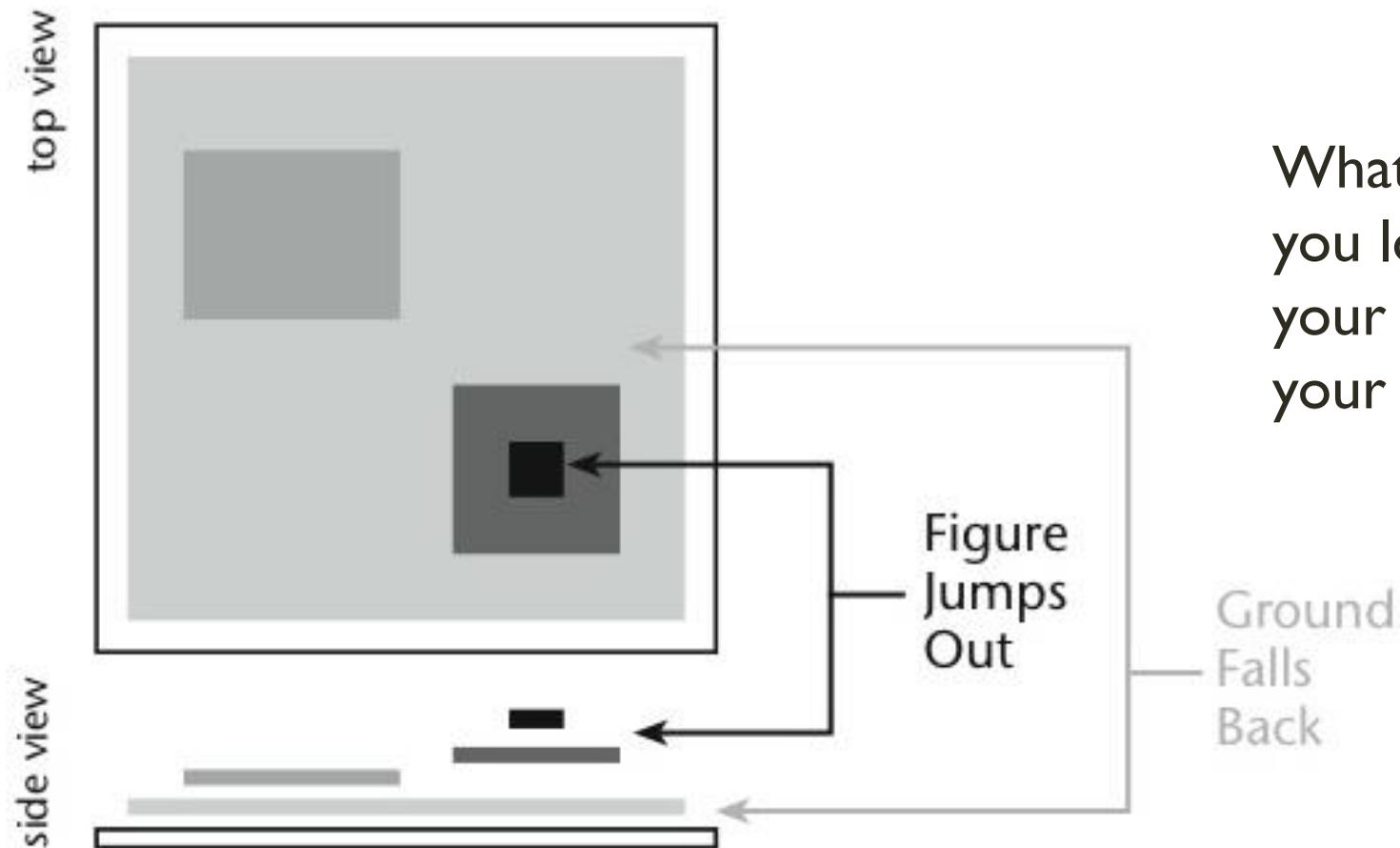
Since our language reads top to bottom, left to right, assume that's the same way your user will move across the map. If there are pieces of your map that should be digested first, put them in the upper left corner

**Better!**



# Figure-Ground

## Figure-Ground



What stands out to you if you look to the side of your map and view it with your peripheral vision?

# Visual Hierarchy

- “Cartographic Problematic” – idea that there’s only so much that you can depict on a given medium
  - (where interactive maps become handy)
- Only include pertinent information
- Make your message the part that  ‘POPS’
- Information that’s necessary, but not the focus of the map should be “noticed, not announced”
- The most important feature of your map should be observed first, next most important feature second, and so on...

# Visual Hierarchy - examples

- 'Great Lakes Transit'
- Minnesota Aviation Navigational Aids
- A Cultural Tour of Ireland
- Commercial Air Service in Minnesota



*Thank You*



Any Questions?