Geographic Information Systems 2018/19
Week 5, Topic 1

Mark Foley
School of Computing
DIT, Kevin Street

mark.foley@dit.ie

In this session...

Data display and cartography

- Cartographic representations
- Types of quantitative maps
- Map design
- Typography
- Map production

Map as output

Output: not the final goal of GIS but the starting point for informed decision-making or problem-solving

Map: the most common form of output (but not the only one)

Understanding of basic principles of map design necessary for effective communication of information and ideas

Understanding of the complexity of the map design process helps appreciate the power of maps as a visualisation tool

Map design

Map design is a visual plan to achieve a goal. A well-designed map is balanced, coherent, ordered, and interesting to look at, whereas a poorly designed map is confusing and disoriented. Map design is both an **art** and **science**.

Cartographers usually study map design from the perspectives of *layout* and *visual hierarchy*.

Layout deals with the arrangement and composition of various map elements on a map. Major concerns with layout are focus, order, and balance.

Visual hierarchy is the process of developing a visual plan to introduce the 3-D effect or depth to maps.

Common map elements

Title

Body

Legend

North arrow

Scale bar

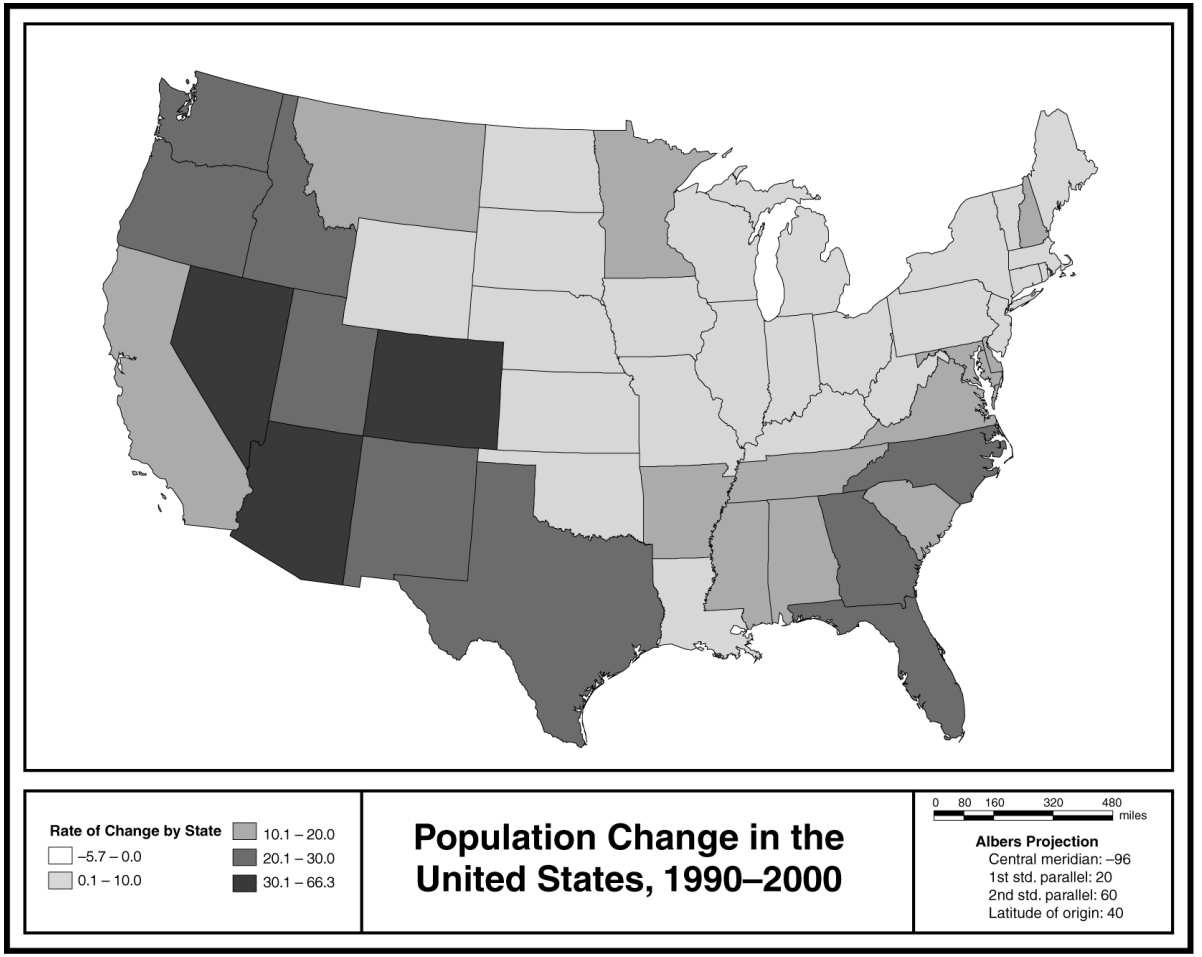
Acknowledgements

Neatline/border

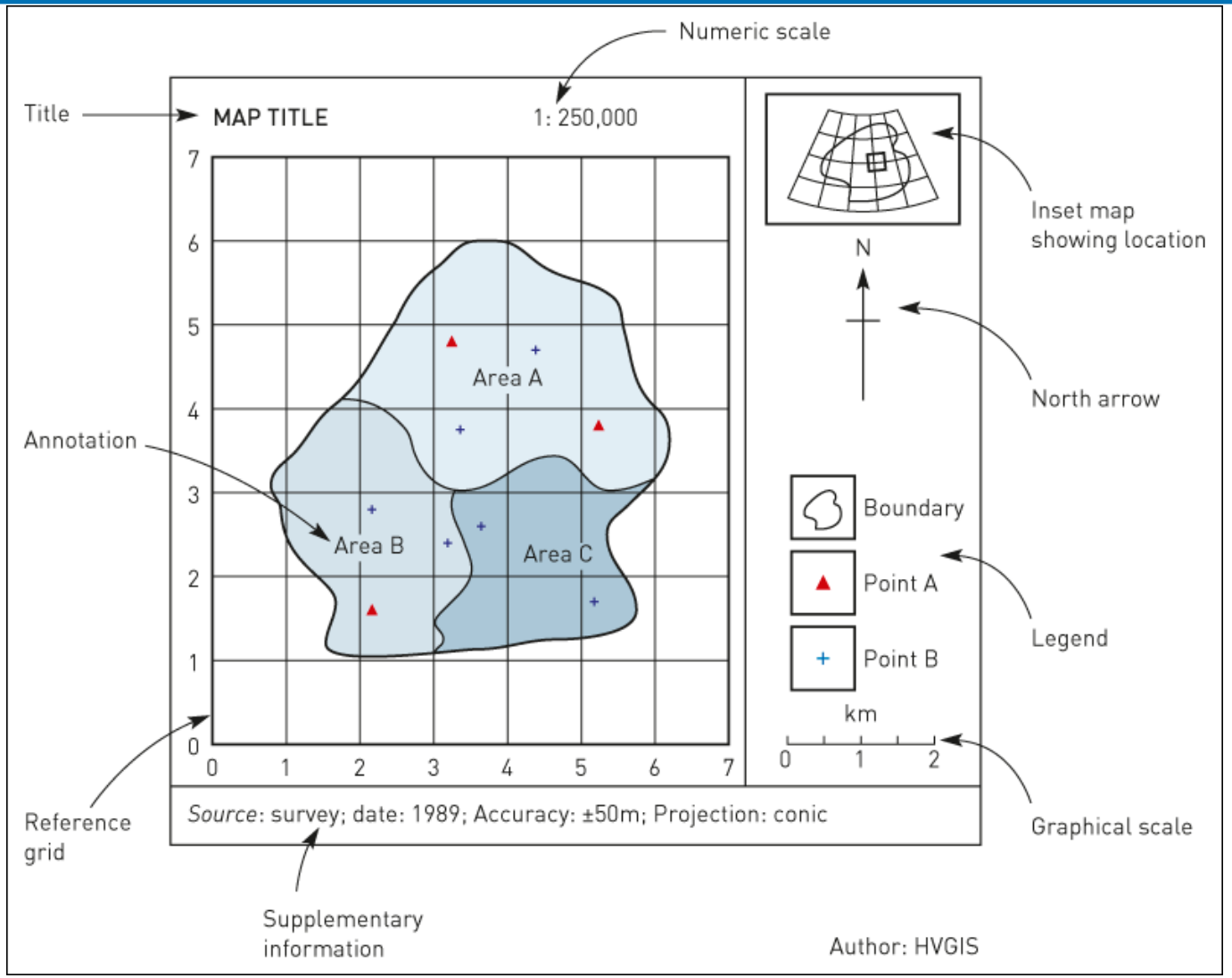
Graticule/grid

Projection information

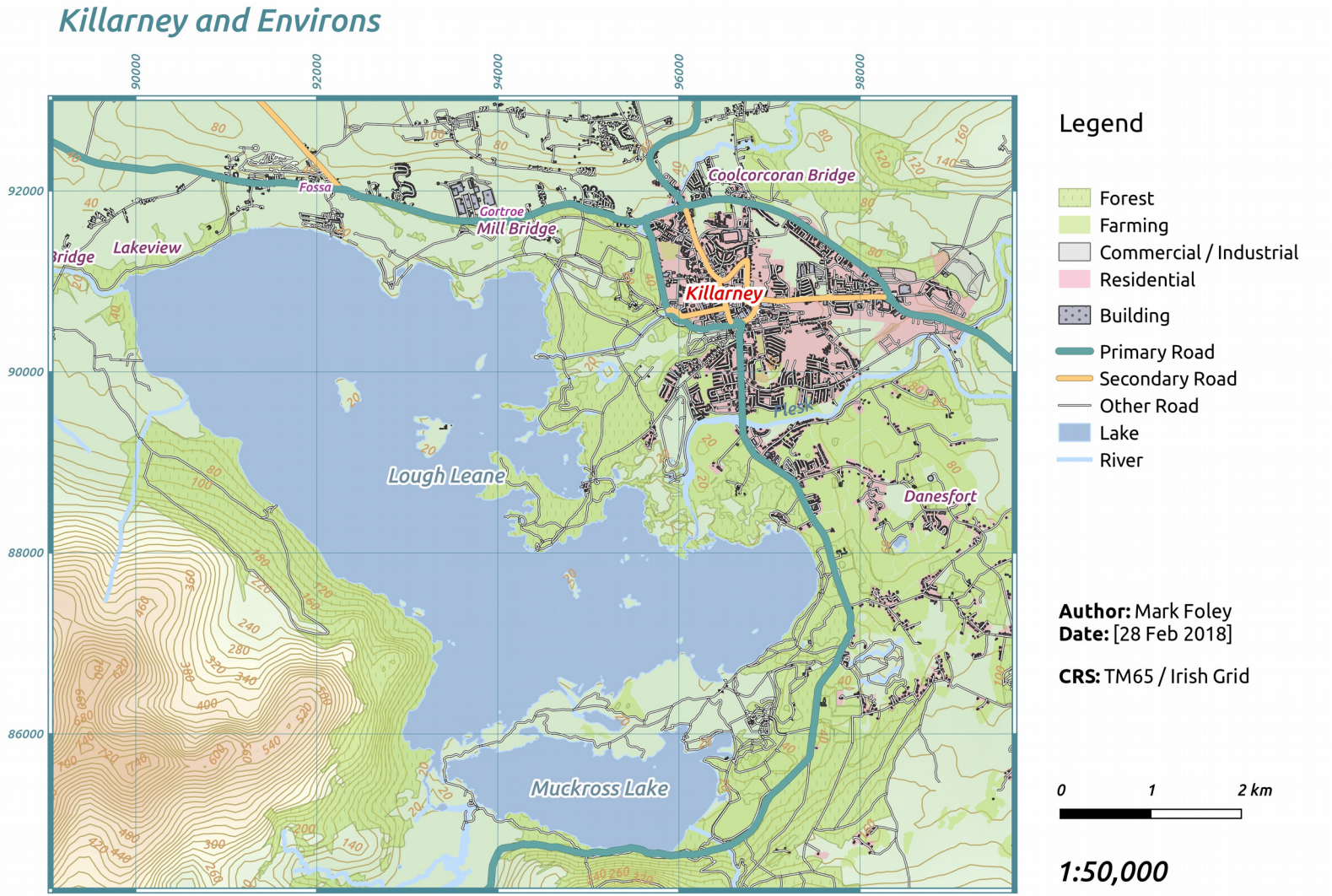
Inset map



Common map elements (a more general example)



Another example
(without any claim regarding artistic merit!)

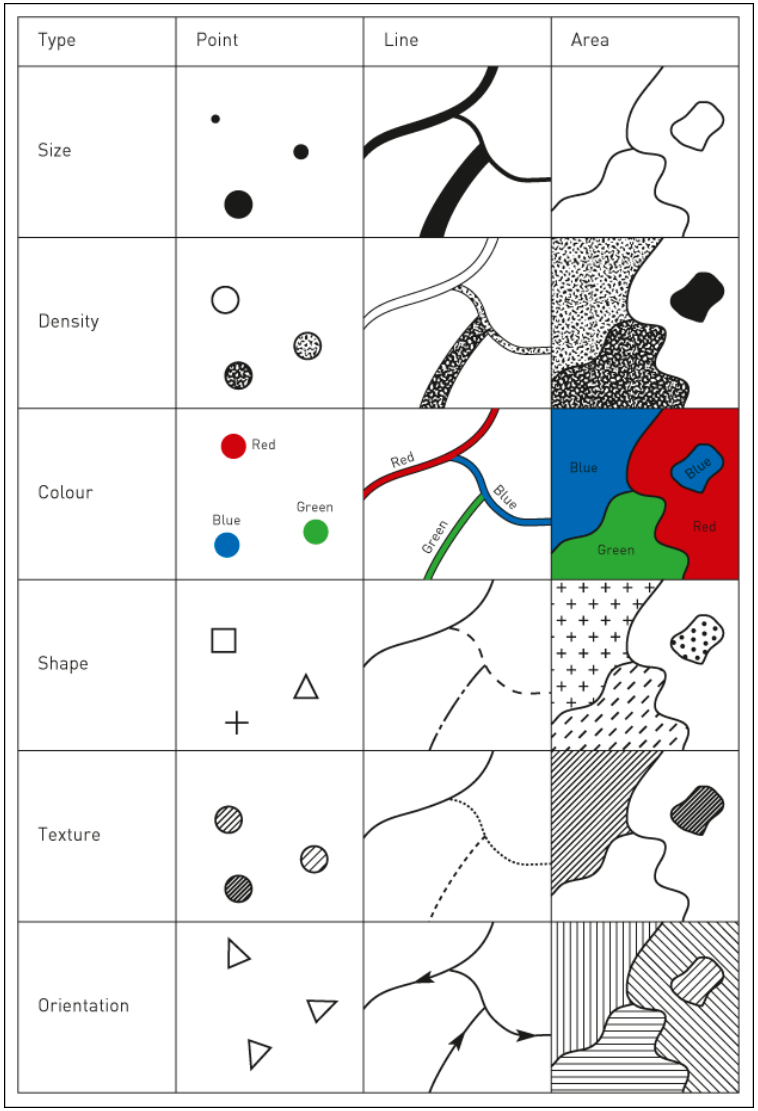


Map design elements

- Frame of reference
  - Need to fix map location in 'real-world' space
  - Grids & graticules
  - North arrow
  - Numeric / graphical scale
  - Inset map
- Projection used
  - Projection can affect basic measurement such as area and distance
- Features to be mapped
- Level of generalisation
  - May need to remove unnecessary features
  - May need to offset for clarity
- Annotation used
- Symbolism employed
  - Use of colour (Ski run example)
  - Use of shape
  - Shading and texture
- Legend

Cartographic representation

- Spatial features and map symbols
  - Map symbol indicates location
  - *Visual variable* with the symbol shows its attributes
  - Choosing map symbols and visual variables is a major part of map making
- Choice of symbol for vector data indicated by type (point, linestring, polygon)
  - This rule does not apply to volumetric or aggregate data
  - Volumetric: can use “3D” surfaces and/or isolines
  - Aggregate: assign to centre of area, possibly use point symbols (if you’re not creating a choropleth map)



Use of colour

Hue

- Distinguish one colour from another e.g. red from blue

Value

- “Lightness” of colour, black at lower end, white at upper
- Darker Implies importance

Chroma (saturation)

- Richness
- Fully saturated is pure, low saturation approaches gray

Rule of thumb

- Hue (as a visual variable) better suited for qualitative (nominal) data
- Value & chroma better suited for quantitative data (ordinal, interval, ratio)

Many schemes possible

- “Colorbrewer”
- Built in to GIS software

Classification schemes

Equal Interval: arranges a set of attribute values into groups that contain an equal range of values. This can help show different groups when they are close in size. However, this doesn't often occur in geographic phenomena. Take the range of your data (maximum - minimum) and divide by your chosen number of categories.

Quantile: divides the attribute values equally into a predefined number of classes. The attribute values are added up, then divided into the predetermined number of classes. In order to do this, you take the number of total observations and divide that by the number of classes resulting in the number of observations in each class. One of the advantages to using this method is that the classes are easy to compute and each class is equally represented on the map. Ordinal data can be easily classified using this method since the class assignment of quantiles is based on ranked data

Jenks Natural Breaks: The Jenks Natural Breaks Classification,(or Optimization) system is a data classification method designed to optimize the arrangement of a set of values into "natural" classes. This is done by seeking to minimize the average deviation from the class mean while maximizing the deviation from the means of the other groups. The method reduces the variance within classes and maximizes the variance between classes.

Geometric Interval: This classification method is used for visualizing continuous data that is not distributed normally. This method was designed to work on data that contains excessive duplicate values, e.g., 35% of the features have the same value.

Standard Deviation: The Standard Deviation Classification method finds the mean value of the observations then places class breaks above and below the mean at intervals of either .25, .5, or 1 standard deviation until all the data values are contained within the classes. This classification method shows how much the feature's attribute value varies from the mean. Using a diverging color scheme to illustrate these values is useful to emphasize which observations are above the mean and which observations are below the mean.

Types of quantitative map

Dot map

Uniform point symbols, each symbol represents a unit value

Choropleth map

Use of shading and/or colour to symbolize derived data on administrative units

Dasymetric map

Like choropleth but derives zones based on grouping of homogeneous values

Graduated symbol

Use of different size symbol to indicate value such as population

Chart map

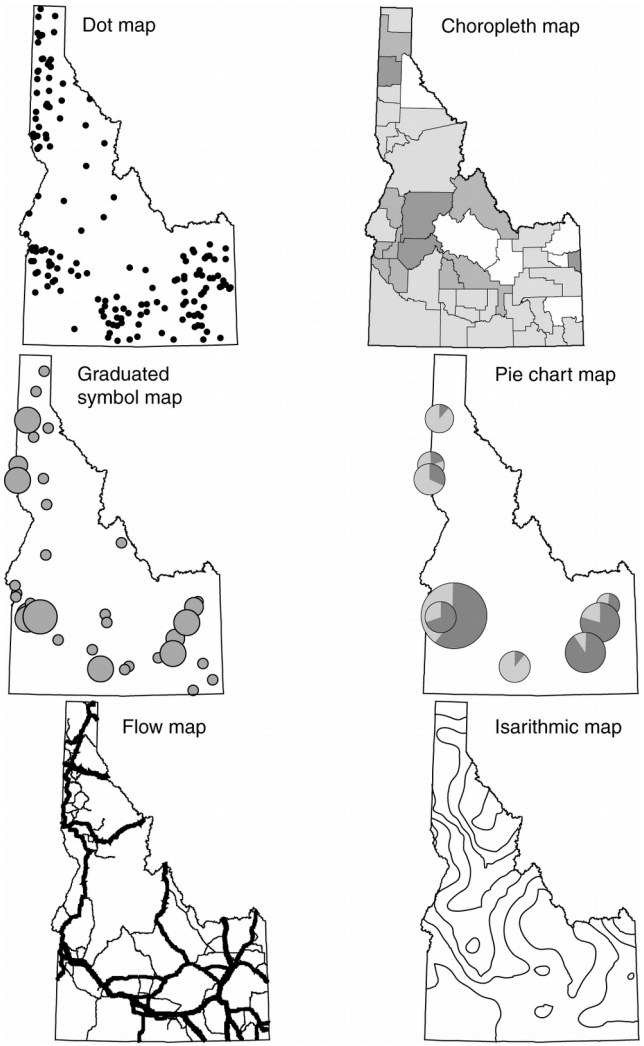
Variation of graduated symbol using pie or bar charts

Flow map

Displays flow or spatial interaction such ass stream flow, traffic, migration etc.

Isarithmic map

Uses isolines to represent a surface



Typography and text placement

Typography

Text is needed for almost every map element. Mapmakers treat text as a map symbol because, like point, line, or area symbols, text can have many type variations.

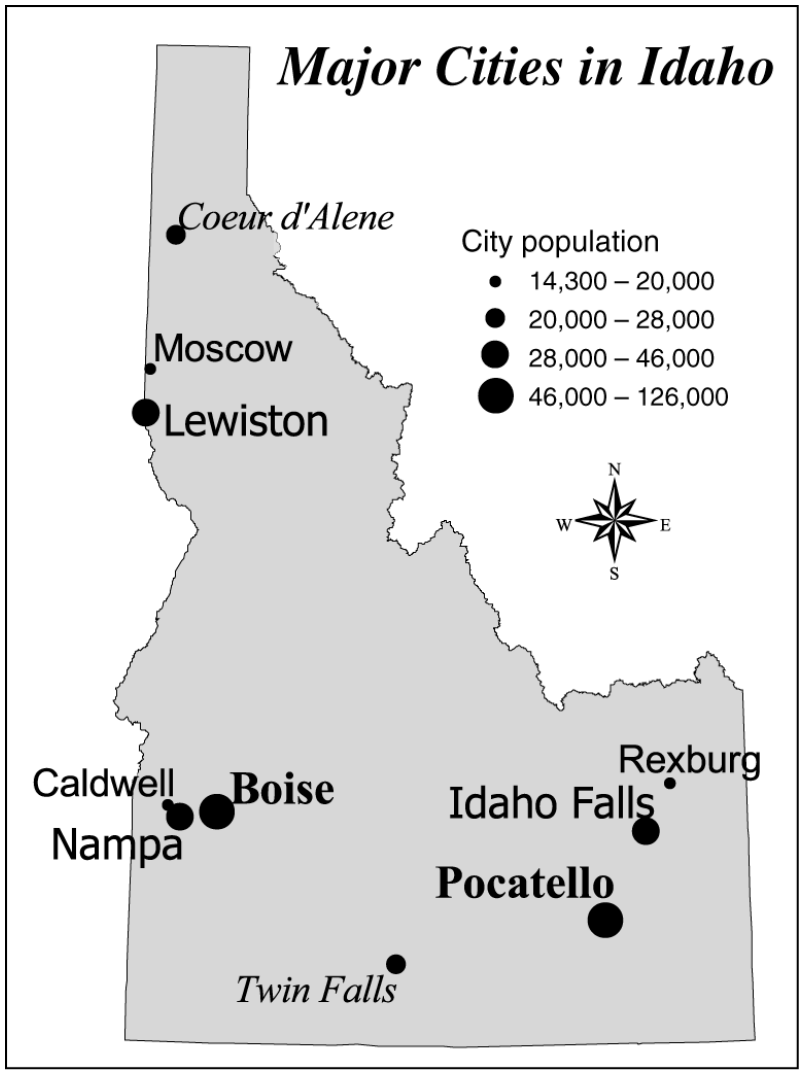
Selection of Type Variations

Cartographers recommend legibility, harmony, and conventions for selection of type variations.

Mapmakers can generally achieve harmony by adopting only one or two typefaces on a map.

Bad use of typefaces

The look of the map is not harmonious because of too many typefaces.



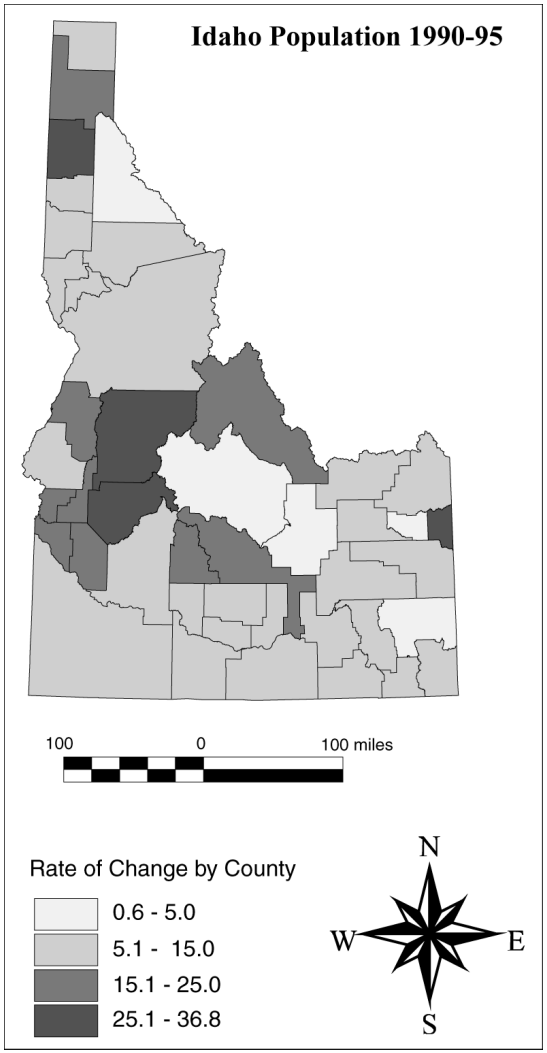
Text placement / dynamic labelling

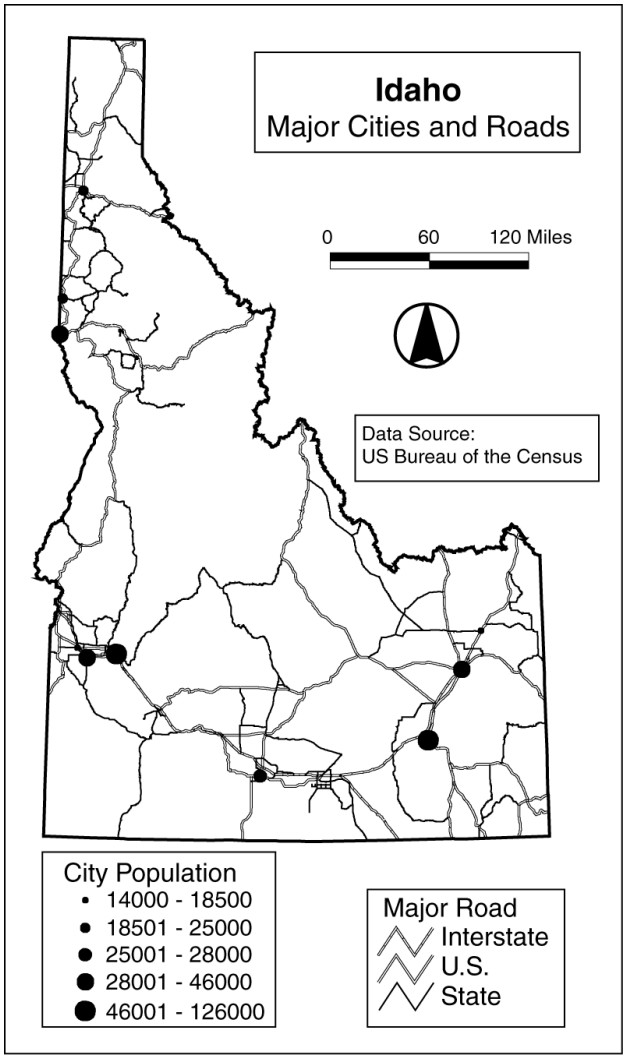
Design

Poorly balanced map (left)

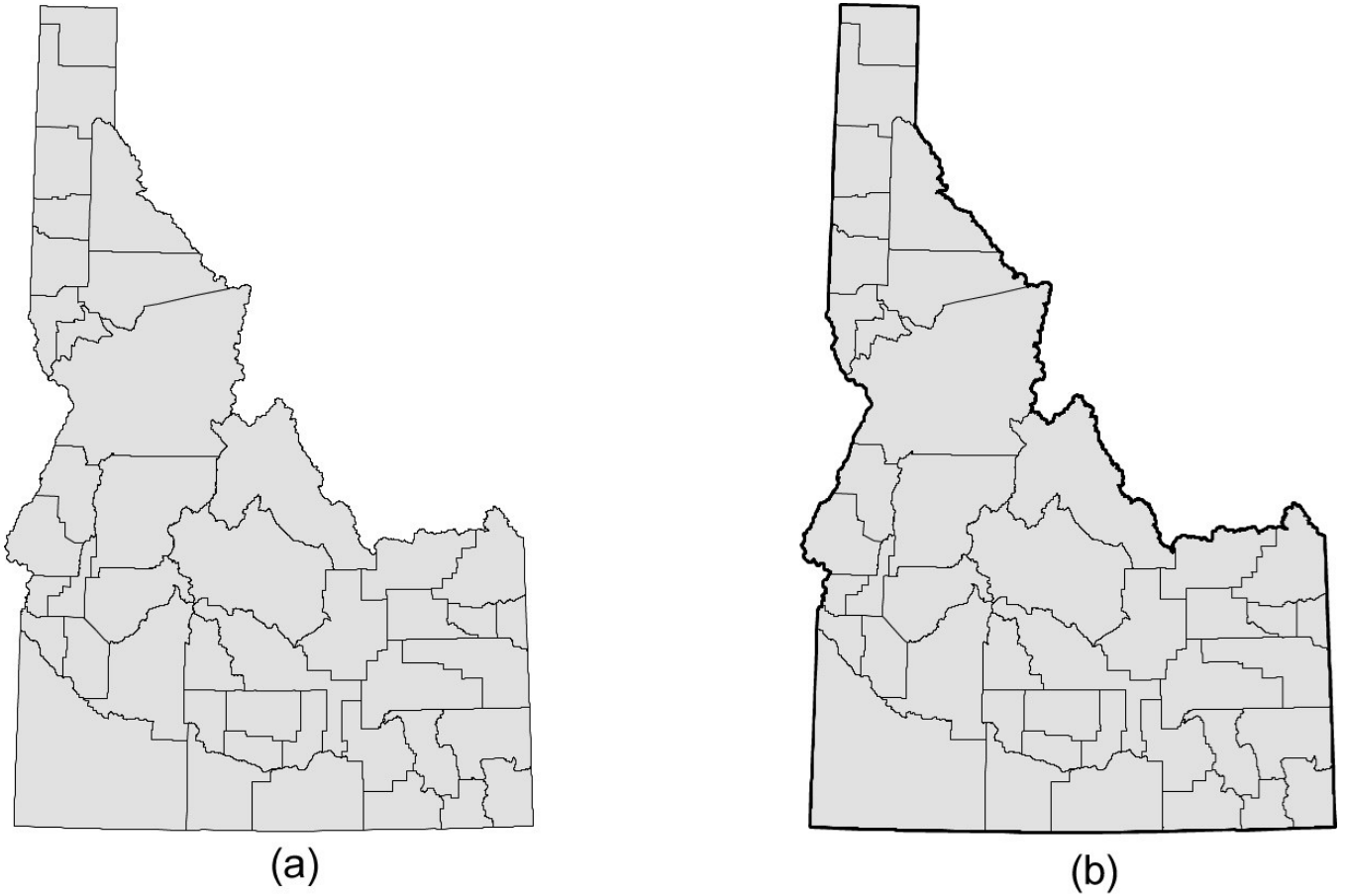
Confusing map (right)

- A map looks confusing if it uses too many boxes to highlight individual elements.



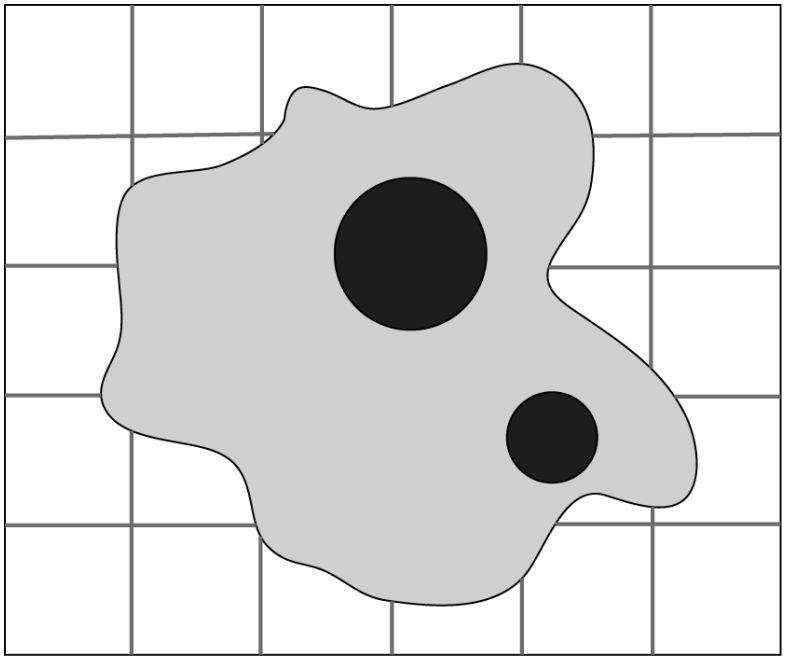


Contrast

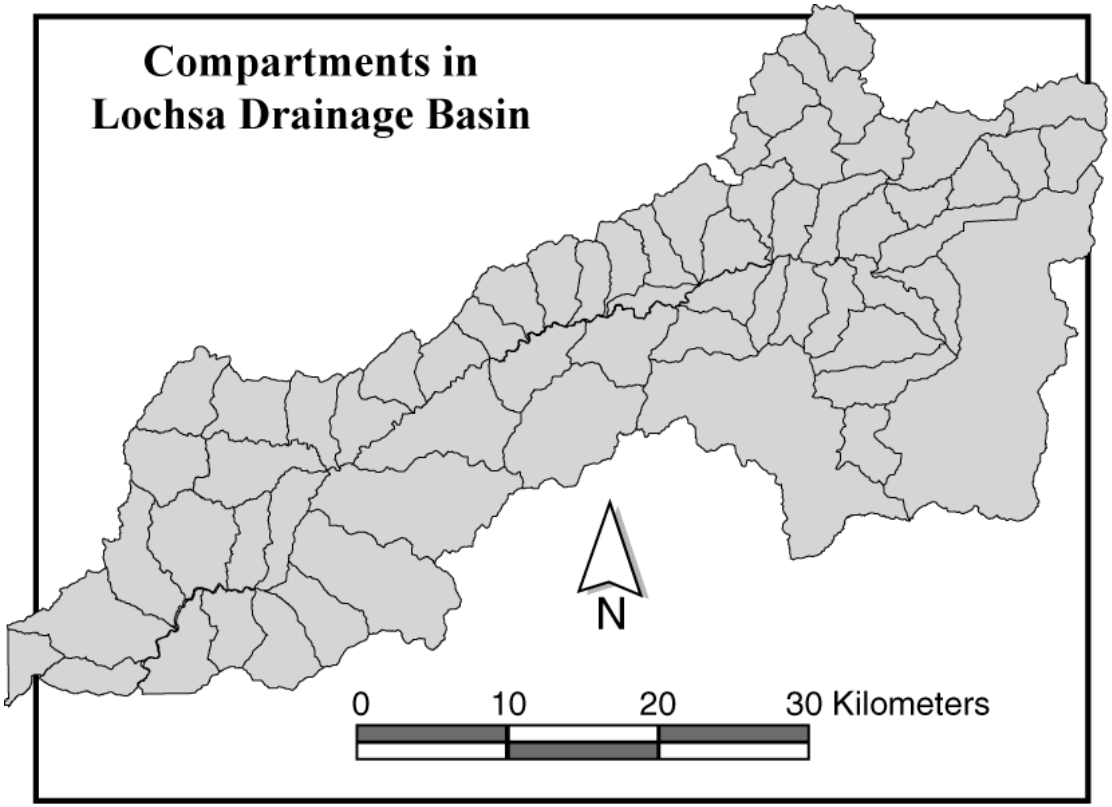


Contrast is missing in (a), whereas the line contrast makes the state outline look more important than the county boundaries in (b).

Visual hierarchy examples



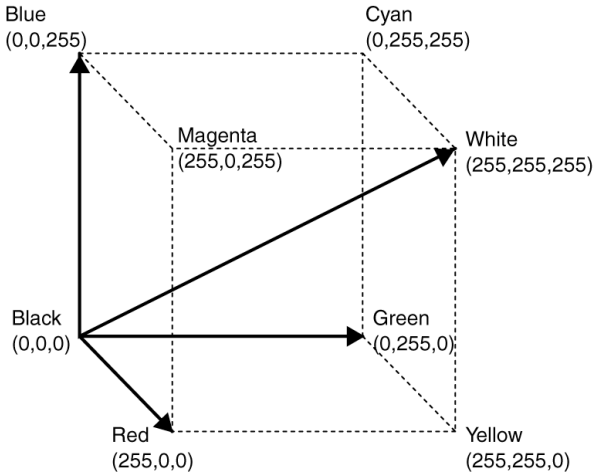
A visual hierarchy example. The two black circles are on top (closest to the map reader), followed by the gray polygon and the grid.



The interposition effect in map design

Colour models

A color model is a system for creating a full range of colours from a small set of primary colours. There are two types of colour models: additive and subtractive. Additive color models use light to display color, while subtractive color models use printing inks. The most common color models that graphic designers work with are the CMYK model for printing and the RGB model for computer display.



RGB

The RGB color model is an additive color model. In this case red, green and blue light are added together in various combinations to reproduce a wide spectrum of colors. The primary purpose of the RGB color model is for the display of images in electronic systems, such as on television screens and computer monitors and it's also used in digital photography.

For web-page design the colors used are commonly specified using RGB. Today, with the predominance of 24-bit displays, it enables most users to see 16.7 million colors of HTML RGB code.

CYMK

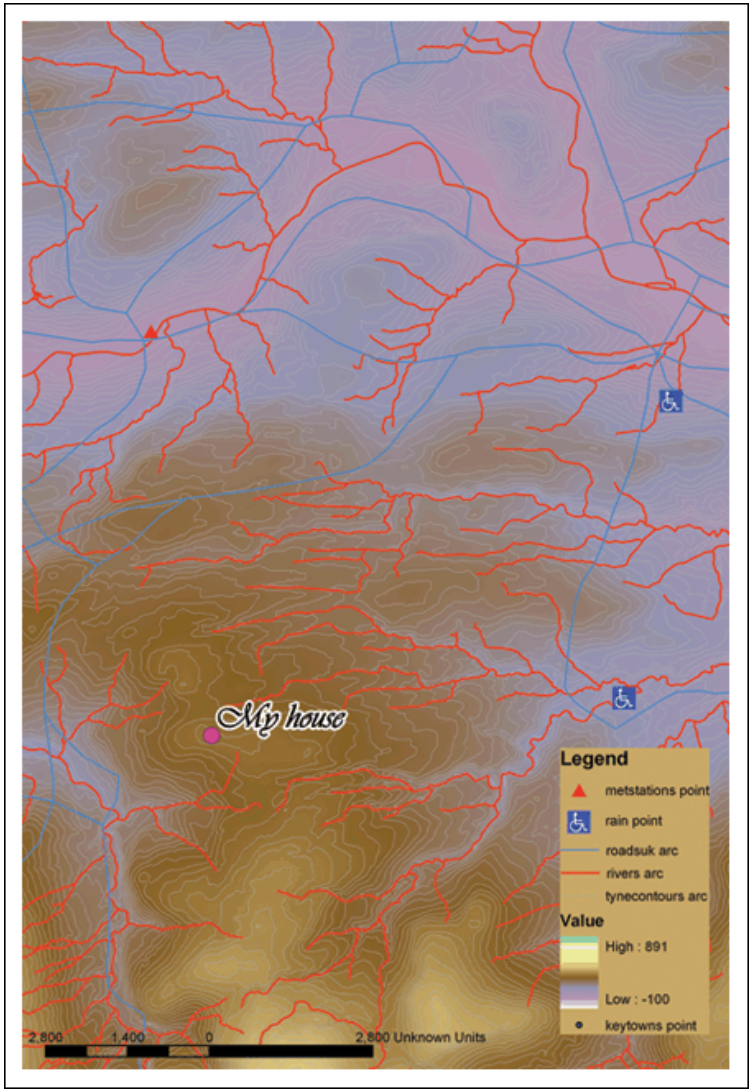
The CMYK color model (four-color process) is a subtractive color model. Primarily used in printing, CMYK works by partially or completely masking colors on a white background. The printed ink reduces the light that would otherwise be reflected. That's why this model is called subtractive because inks 'subtract' brightness from a white background from four colors: cyan, magenta, yellow and black.

HSV

HSV, which stands for hue, saturation and value, depicts three-dimensional color. HSV seeks to depict relationships between colors, and improve upon the RGB color model. If you think about HSV as a wheel, the center axis goes from white at the top to black at the bottom, with other neutral colors in between. The angle from the axis depicts the hue, the distance from the axis depicts saturation, and the distance along the axis depicts value.

Example of poor quality

Spot the mistakes



Coming next...

Data acquisition, transformation & accuracy

Acquisition

- Sources of spatial data

Transformation

- Line simplification
- Vector to/from Raster

Accuracy

- Standards
- Error handling