Making Maps With GIS

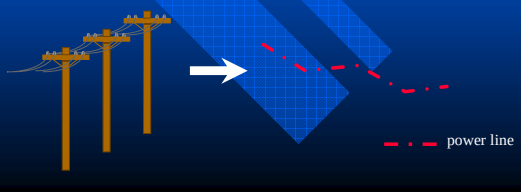
Getting Started with GIS
Chapter 8

Making Maps With GIS

8.1 The Parts of a Map
8.2 Choosing a Map Type
8.3 Designing the Map

What is a map?

- "A graphic depiction of all or part of a geographic realm in which the real-world features have been replaced by symbols in their correct spatial location at a reduced scale."



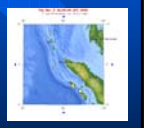
The cartographer's paradox

- Complete accuracy & completeness
  - Position
  - Attribute
  - Timely
  - Scientific rigor
- Effective communication
- Easy to read and interpret (intuitive)
- Hard to misread (fault tolerant)

Producer's Responsibility

Map function in GIS





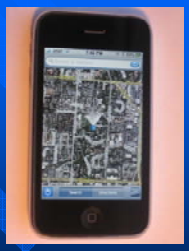

- Storage
- Temporary communication
- Intermediate check of data
- Final report
- Use in the field

- **To be effective, must be correctly designed and constructed**

The Parts of a Map: Map Elements

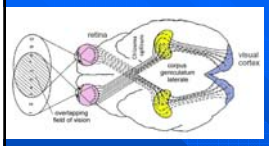
The medium is the message

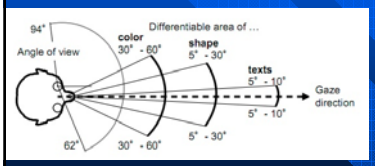
Paper
Film
Mylar
Monitor
Projection
Broadcast TV
Internet

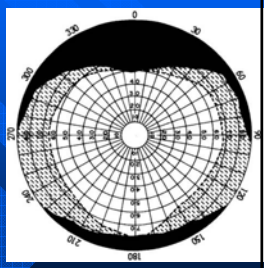



THE DISPLAY IS PART OF THE SYMBOLIZATION

Human vision: Acuity, focus, FOV, stereo





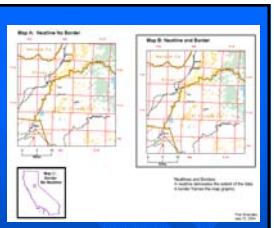


Cartographic Elements

- Medium
- Figure
- Ground
- Reference information

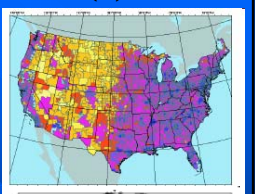
Cartographic Elements (2)

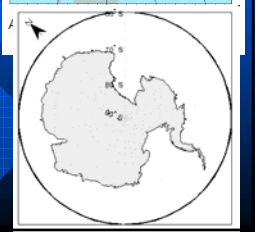
- Border and "collar"
- Neatline
- Insets
  - Scale up
  - Scale down
- Metadata e.g. index
- Off-map references



Cartographic Elements (3)

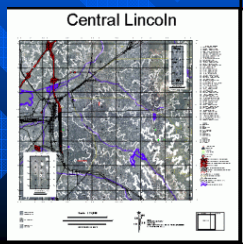
- Page coordinates
- Ground elements
- Graticule/Grid
- North arrow





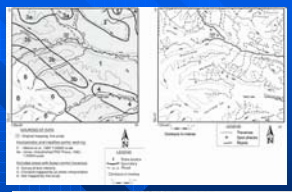
Cartographic Elements (4)

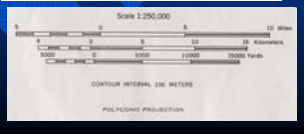
- Figure
- Point/Line/Area symbols
- Text
- Place Names
- Title



Cartographic Elements (5)

- Reference Information
- Scale
- Projection(s)
- Sources (2)
- Credits
- Legend
- Reliability





Map "impact"

- Distribution of Employment by State 2010
- USA: Employment Distribution 2010
- **U.S. Employment: 2010 Distribution**
- America at Work
- Where the Jobs are Today
- America's Great Recession

Text: Selection and Placement

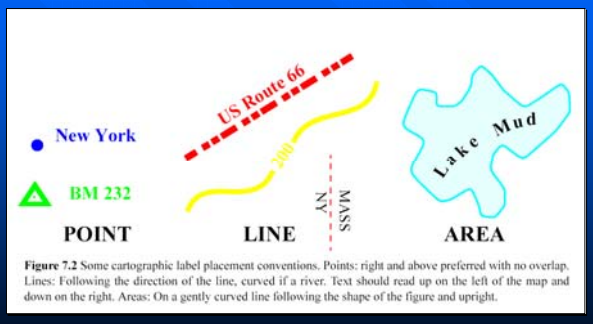


Figure 7.2 Some cartographic label placement conventions. Points: right and above preferred with no overlap. Lines: Following the direction of the line, curved if a river. Text should read up on the left of the map and down on the right. Areas: On a gently curved line following the shape of the figure and upright.

Choosing Elements

- Map research
- Map compilation
- Selection
- Placement
- Layout
- Tools in GIS not ideal: Usually default layouts

Choosing a Map Type

- Cartographers have designed hundreds of map types: methods of cartographic representation
- Not all GISs allow all types
- Most have a set of basic types
- Depends heavily on the dimension of the data to be shown in the map figure

Choosing the Wrong Type

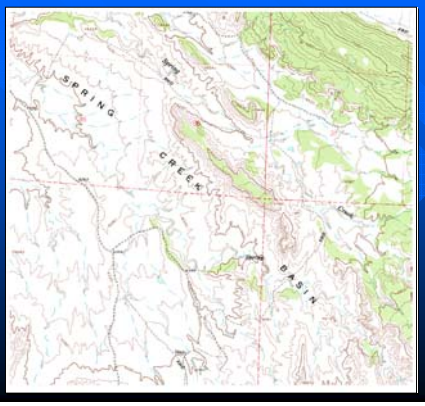
- Fairly common GIS error
- Due to lack of knowledge about cartographic options
- Can still have perfect symbolization
- Possibility of misinformation
- Definite reduction in communication effectiveness

Map Types: Point Data

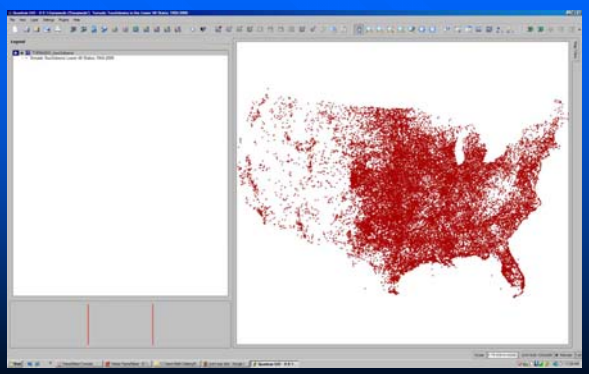
- Reference
- Topographic
- Dot
- Picture Symbol
- Graduated Symbol

Reference Map

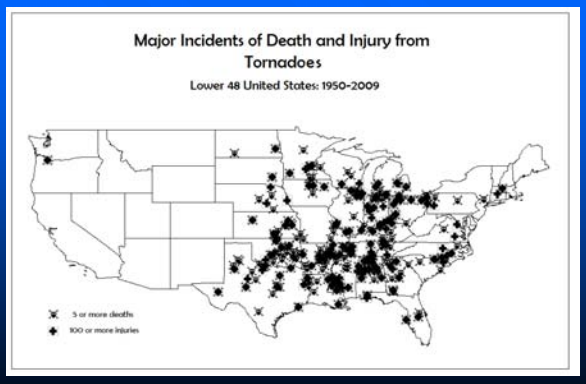
Topographic Map



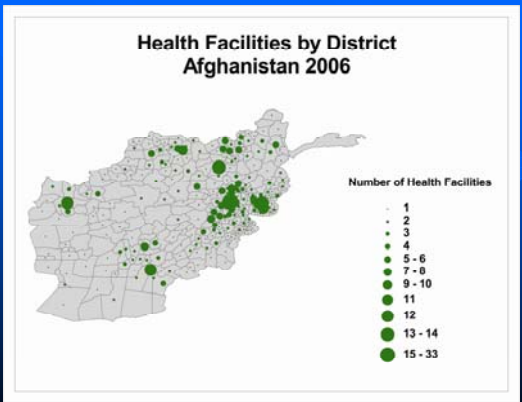
Dot Map



Picture Symbol Map



Graduated Symbol Map

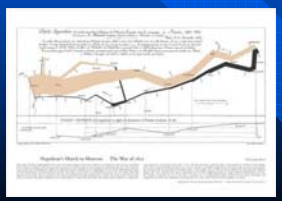


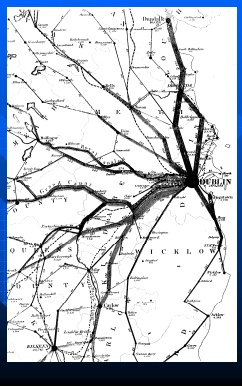
Map Types: Line Data

- Network
- Flow
- Isopleth
- Reference

Origin of Flow Maps

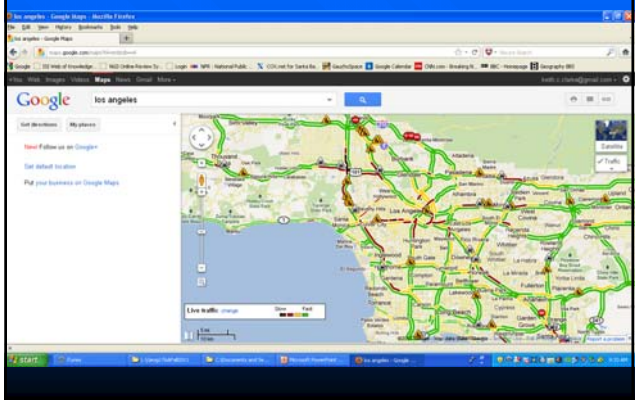
Harness, H. D. (1837). *Atlas to Accompany the Second Report of the Railway Commissioners, Ireland*. Dublin: Irish Railway Commission.
Minard, C. 1869. Napoleon's retreat from Moscow





Flow Maps

Symbolizing flows

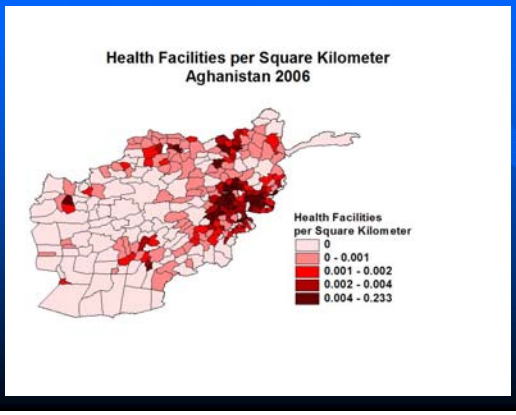


Flow Map: Truck traffic

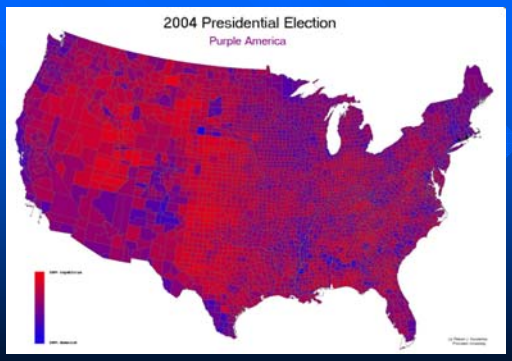
Map Types: Area Data

- Choropleth
- Area qualitative
- Stepped surface
- Hypsometric
- Dasymetric
- Cartogram
- Reference

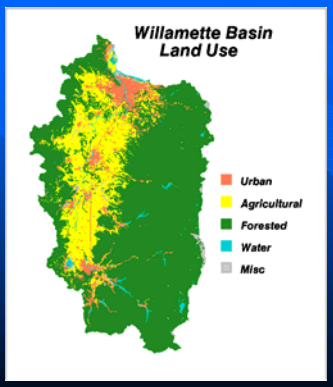
Choropleth



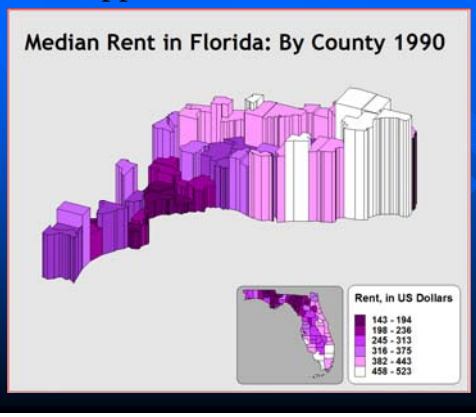
Continuous/Unclassed Choropleth



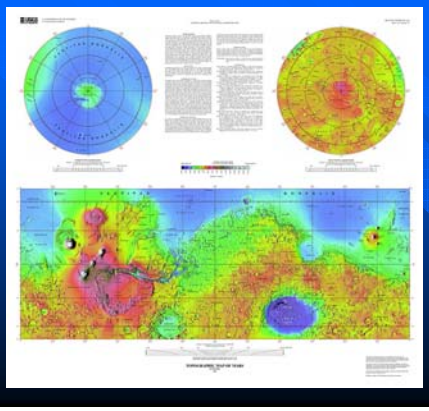
Area Qualitative Map



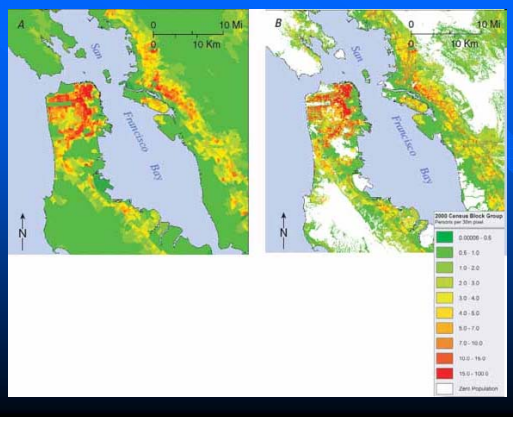
Stepped Statistical Surface



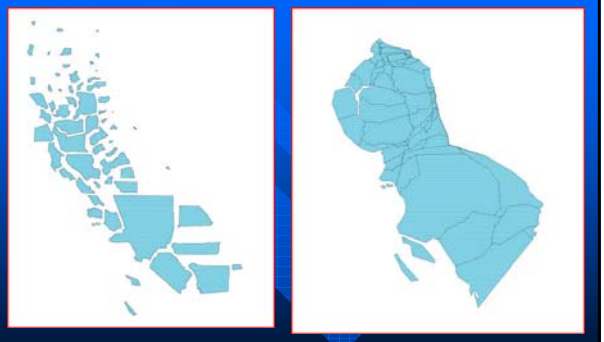
Hypsometric map



Dasymetric



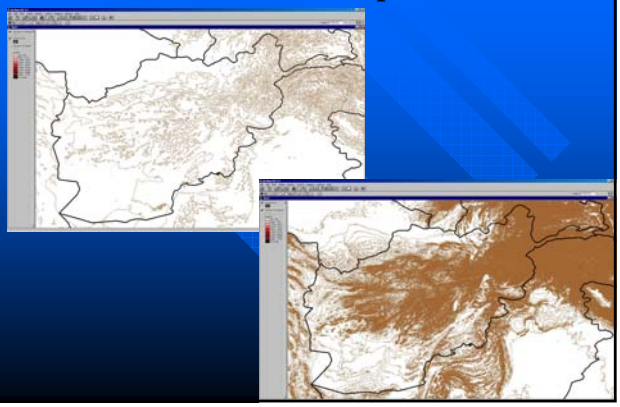
Cartograms



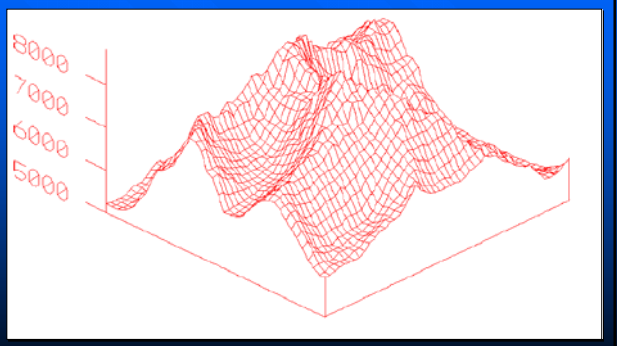
Map Types: Volume Data

- [Isopleth, Stepped Surface, Hypsometric]
- Gridded fishnet
- Realistic perspective
- Hill-shaded
- Image map

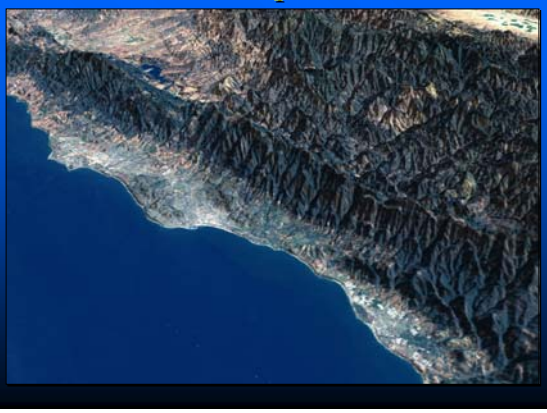
Isoline Map



Fishnet or Gridded Perspective View



Realistic Perspective View



Hill-shaded Relief Map

Image Map

Map Types: Time

- Multiple views
- Animation
  - Moving map
  - Fly thru
  - Fly by

Cartographic Animations

http://www.ncgia.ucsb.edu/projects/gig/v2/AboutAblImages/gores3h_growth.gif

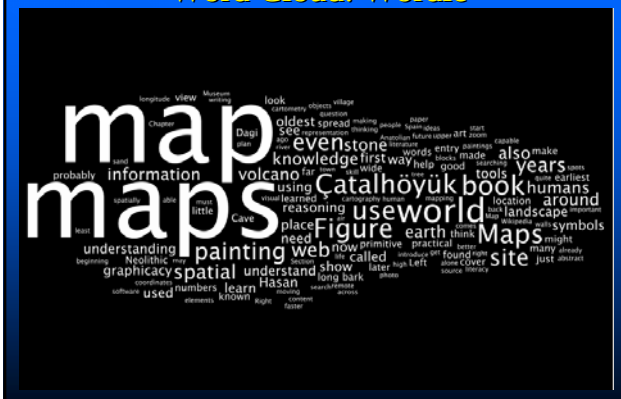
http://www.aaronkoblin.com/work/faa/us.html

Spatialization: SOM

7 Visualization of 2,220 conference abstracts with simultaneous overlay of three levels of a hierarchical clustering tree of SOM neurons: 10-cluster solution (red); 25-cluster solution (green); and 100-cluster solution (black). Cluster labels are scaled according to rank within the respective cluster.

Skupin, A. (2002) A Cartographic Approach to Visualizing Conference Abstracts. *IEEE Computer Graphics and Applications*. 22 (1): 50 - 58.

Word Cloud: Wordle



Map Type and Dimensionality

POINT	LINE	AREA	VOLUME
Dot Map [1] Picture Symbol Map [1] Graduated Symbol Map [2]	Network Map [1] Flow Map [2]	Choropleth Map [2][3] Area Qualitative [3] Stepped Statistical Surface [2] Image map [1]	Isoline Map [2] Hypsometric Map [2][3] Gridded Fishnet [2] Realistic Perspective [2] Hill Shaded Map
← Reference Map [1][4] Topographic Map [1][2][3][4] →			

Figure 7.16 Types of maps sorted by dimension of features and type of attribute. [1] Feature present, [2] number attribute, [3] categorical attribute, [4] text present.

Choosing Types

- Check the data
  - Continuous
  - Discrete
  - Accuracy & Precision
  - Reliability
- Dimension (Point, Line, Area, Volume)
- Scale of Measurement (Nominal etc.)
- GIS capability
- May need to supplement GIS software

Data Scaling (Stevens)

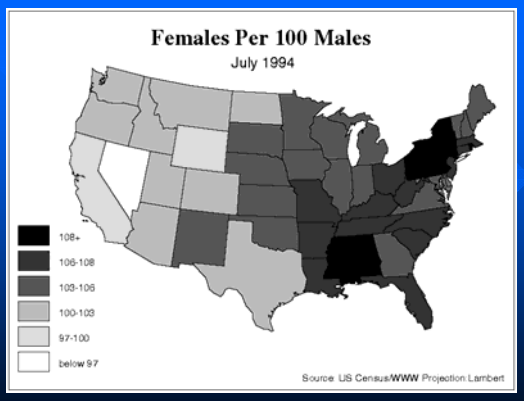
- Nominal (Name of a place)
- Ordinal (Small, med., large town)
- Interval (Arbitrary zero e.g. Sea Level)
- Ratio (Absolute zero e.g. dollars, densities)

Example: Choropleth Mapping

- Data should be AREA (e.g. States)
- Data should not suffer from area effect.
- Population?
- Per capita Income?
- Elevation? Temperature?
- Boundaries unambiguous.
- Areas non-overlapping.

Classification

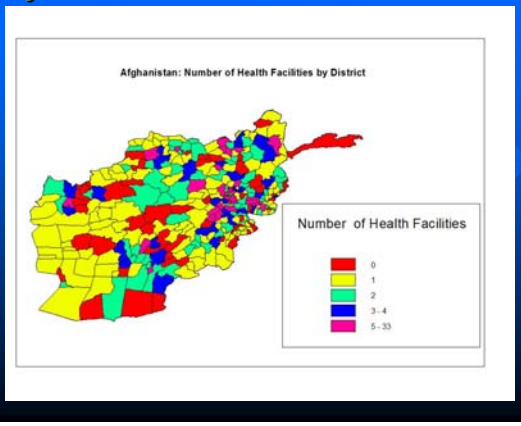
- Equal Interval
- Natural groups
- N-tiles
- Equal or unequal?
- Logarithmic? Linear? Discontinuous?
- How many classes?
- Non-overlapping, distinctive groups.



The Need for Design

- To appear professional and avoid errors, GIS maps should reflect cartographic knowledge about map design
- A map has a visual grammar or structure that must be understood and used if the best map design is desired
- Cartographic convention (e.g. forests should be green)

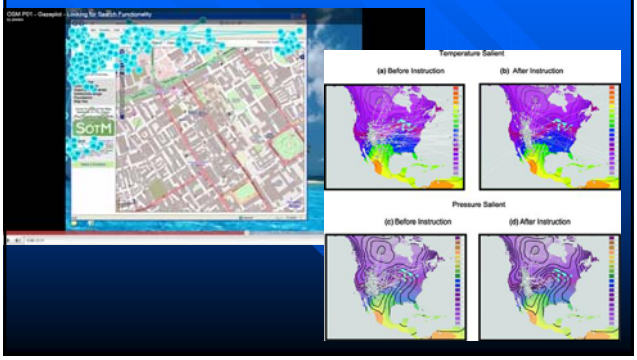
Symbolization Errors with a GIS



Map Design

- A GIS map is designed in a process called the design loop
- Good map design requires that map elements be placed in a balanced arrangement within the neat line
- Remember the human vision properties

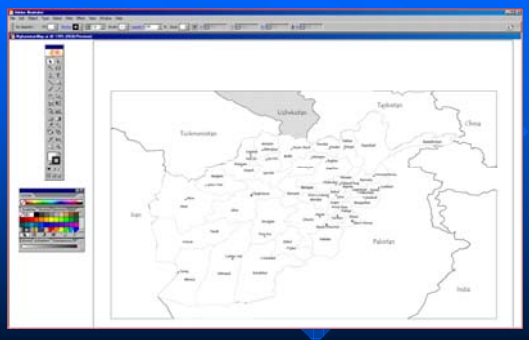
Eye tracking research



The Design Loop

- Create map layout as macro
- Draw on screen (proof plot)
- Look
- Edit macro
- Repeat until happy
- Make final plot

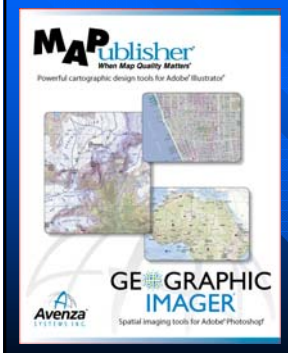
Graphic Editors



Graphic Editor Software

- Vector
  - Adobe Illustrator
  - CorelDraw
  - Freehand
  - Inkscape
- Raster
  - Photoshop
  - CorelPhotoPaint
  - GIMP 2.0

Third Party Design Software

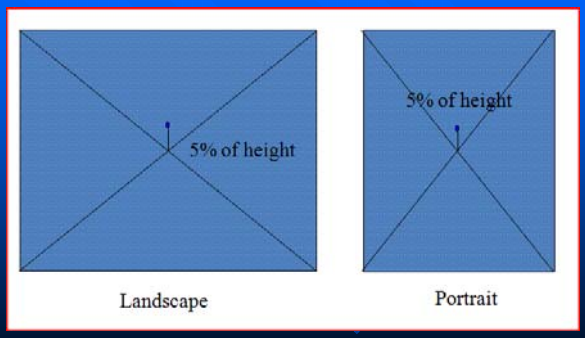


Map Design (2)

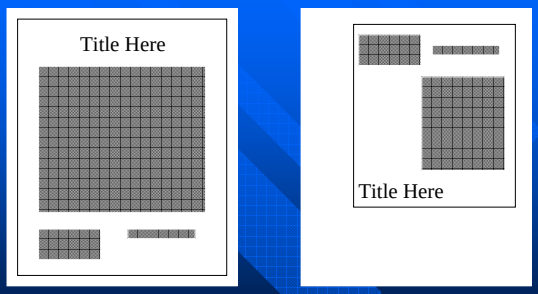
Visual balance is affected by:

- the "weight" of the symbols
- the visual hierarchy of the symbols and elements
- the location of the elements with respect to each other and the visual center of the map

Visual center

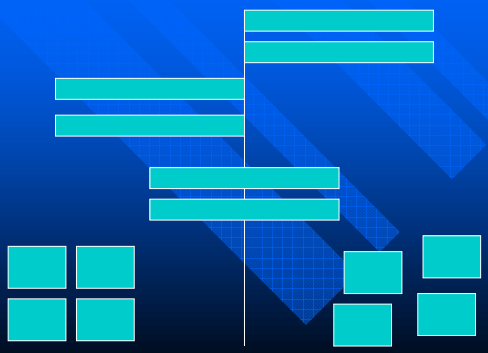


Visual Layout

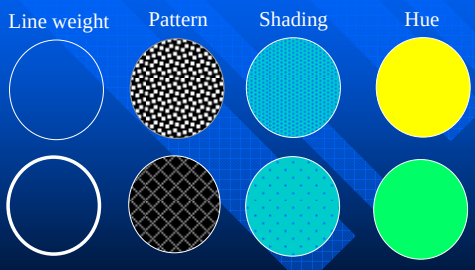


Eye expects (1) balance and (2) alignment

Alignment



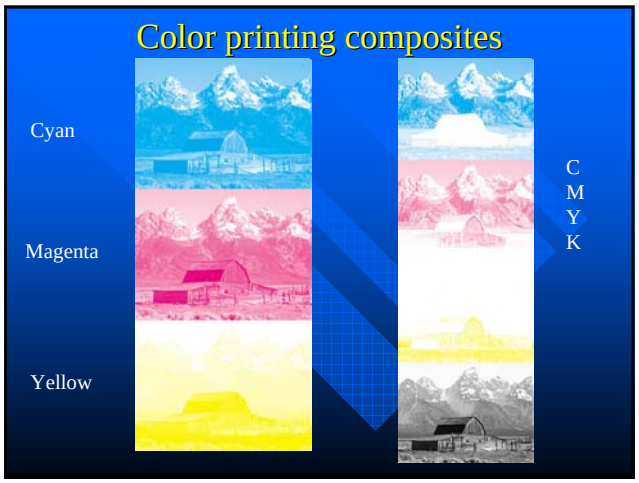
Symbol “weight”



Color and Map Design

- Color is a complex visual variable and in a GIS is specified by RGB or HSI (CMYK 4-color) values
- Red, Green, Blue are additive primaries
- Magenta, Cyan and Yellow are subtractive primaries
- May support transparency layer
- Saturation and Intensity map better onto values than hue
- Figure/ground relationship critical

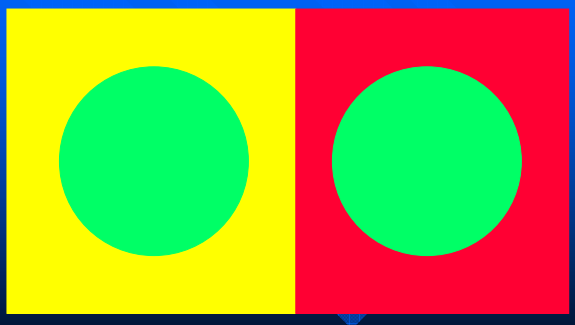
Color printing composites



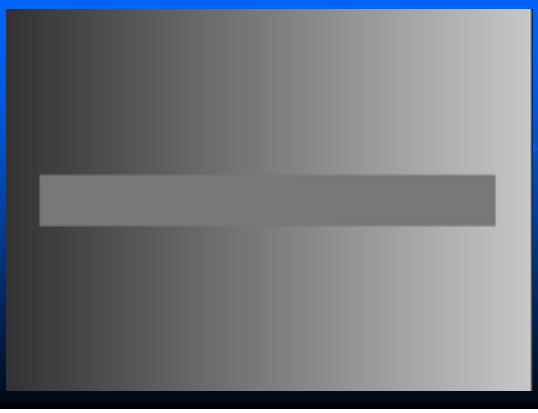
GE Transparency/Opacity

Dimensions of Color

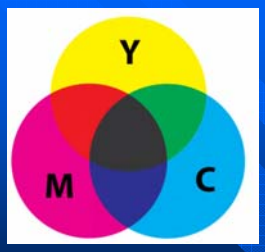
Simultaneous Contrast



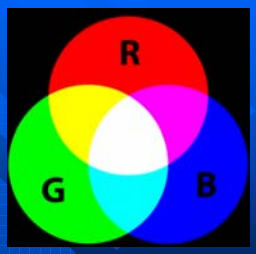
Simultaneous Contrast Illusion



Color Primaries

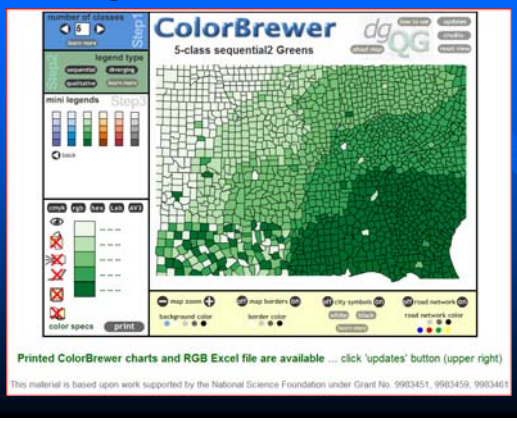


Subtractive color



Additive color

Design Assistance: ColorBrewer



Text placement

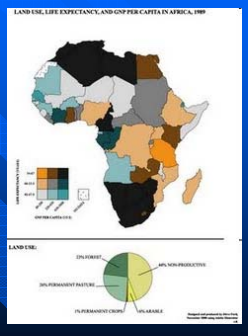
Scale and Generalization

- Smaller scale means fewer features
- Smaller scale means smoother features
- Smaller scale means combining features
- Smaller scale means displacing features
- Often scales are mixed or over-generalized

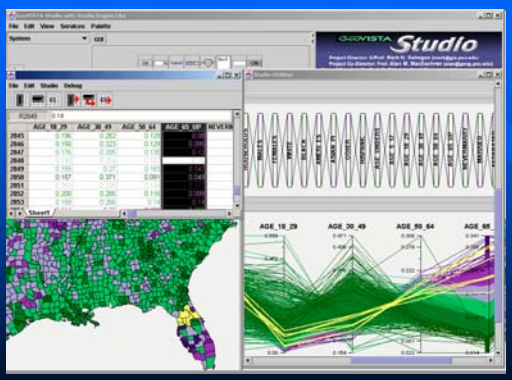
Multivariate data

Small multiples

Mixing Symbols



Geovisualization software



Visual analytics:

the science of analytic reasoning, facilitated by interactive visual interfaces.

- http://viz.in.tu.se/gav/gav/1.174303/GAV-Demo.png
- http://www.natural-environment.com/images/blog/space_junk_2.jpg
- http://kottkegae.appspot.com/images/taxi-flow-nyc.jpg
- http://ajnavo.net/Images/InfoVis_smallZ.gif
- http://2.bp.blogspot.com/_JnzW19Cnnuf/SuMDNgGCI2I/AAAAAAAAAAB/3DGaPnuW7-Q/s1600-h/GriffeyWordle.png
- http://www.perceptualedge.com/blog/wp-content/uploads/2009/01/horizon-graph-large.jpg

Map Design and GIS

- When a GIS map is the result of a complex analytical or modeling process, good design is essential for understanding
- The map is what distinguishes GIS as a different approach to the management of information
- So extra care should be taken to improve the final maps that a GIS generates in a GIS task

Coming next…

- How to pick a GIS