Information Visualization (Geographic Maps)

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Upcoming
• Programming 2: due Wed, Feb 11, 11:59pm
• Project team formation: due Fri, Feb 14, 11:59pm
• Programming 3: due Thu Feb 13, due Wed Mar 4 11:59pm
• Foundations 4: due Thu Feb 13, due Wed Feb 26 11:59pm
• D3 videos/readings week 4
   - Color and Size legends with D3.js (30 min)
   - Scatter Plot with Mavis (46 min)
   - Circles on a Map (42 min)
   - Line Charts with Multiple Lines (42 min)
• Quiz 6, due by Fri Feb 14, 8am

Spatial Data
• Given spatial position is the attribute of primary importance
• Central tasks revolve around understanding spatial relationships
• State borders on a map, shape of a brain region, etc.

We use geographic visualization when:
(1) The data contains geographical attributes
(2) Visualizing spatial relationships is an important task

A dataset may contain geographical information and yet creating a geographical visualization may not be relevant.

Key question:
Does the given spatial position matter for my task?
» Spatial position is the most effective visual channel and we don’t want to waste it for non-relevant spatial information.
» A geo map is not always the best or only solution.

That said, there is an advantage of maps over other representations … Which?

… familiarity!
» People know where something on a map is (assuming they are familiar with the region).
» Maps act as an index from spatial to semantic information and vice versa.
» Visually encode given spatial geometry as marks using 2D position channels.

John Snow’s Cholera Map
• London, 1854
• Cholera outbreak was a mystery
• Snow mapped deaths as bars on a geo map
• Cases clustered around a water pump
• One part of a detailed statistical analysis

Geographic Map
• London, 1854
• Cholera outbreak was a mystery
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• One part of a detailed statistical analysis

Interlocking marks
• shape coded
• area coded
• position coded

Density Maps (Annual Precipitation in Canada)
• Diverging color scheme
• Data transformation necessary to turn discrete data into continuous data
• Typically using some density estimation function

Activity: Sketching
• For each state in the U.S., we have an obesity rate. Sketch (really only sketch) three ideas how you would encode that information geographically.
• 6 min
• Socrative: Answer true when you’re done!

Choropleth Maps

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**Illiteracy / School Attendance**

- Choropleth map created by Charles Dupin in 1826
- Data is often collected and aggregated by geographical regions
- Quantitative attribute encoded as color over regions
- Region is determined by using given geographic geometry

**Activity: Discuss**
- Discuss with your neighbour what the pros and cons of a choropleth map are.
- 3 min

**Choropleth Map: Pros & Cons**

- **Pros**
  - Well established visualization (no learning curve)
  - Easy to read and understand
  - Much of our geo data is reported by enumeration units (e.g., Census)
- **Cons**
  - Most effective visual variable used for geographic location
  - Visual significance of a coloured map may not correspond to the effects in the data ("Lie Factor")
  - Color palette choice has a huge influence on the result

**U.S. Poverty Map**

**Cartograms**

- Sized circles represent quantity of interest per geographic region
- Geometric shapes in place of geographic area

**Contiguous Cartogram: Population**

Cartograms distort the shape of geographic regions so that the area directly encodes a data variable

**Contiguous Cartogram: Derive New Marks**

- Interlocking marks: shape, area, and position coded
- Derive new interlocking marks based on the combination of the original interlocking marks and a new quantitative attribute.
- Algorithm to create new marks
  - Target size
  - Shape as close to the original as possible
  - Maintaining the constraints of relative position and contiguous boundaries with their neighbours

**Dorling Cartogram**

- Sized circles represent quantity of interest per geographic region
- Geometric shapes in place of geographic area

**Demers Cartogram**

- Variation of Dorling’s Cartogram using rectangles
Grid Cartogram
- Uniform-sized shapes arranged in grid
- Maintain approximate spatial position and arrangement

Hexagonal Cartogram

Dot Density Maps
- Visualize distribution of a phenomenon by placing dots
- One symbol represents one object or a constant number of objects
- Goal: See spatial patterns, clusters
- Disadvantage: Difficult to extract quantities

Attention: Many dot maps primarily show the population density with which the target variable is correlated, instead of the effect of interest.

Symbol Maps
- A symbol is used to represent aggregated data
- Keep original spatial geometry in the background
- Often a good alternative to choropleth maps

Symbol Maps with Glyphs

Topographic Map
- Data
  - Geographic geometry
  - Scalar spatial field
    - 1 quant attribute per grid cell
- Derived data
  - Isoline geometry
    - Isocontours computed for specific levels of scalar values

Mercator Projection
- Heavily distorts country sizes; particularly close to the poles.

Map Layers
- London Tube Lines
- Hyde Park

Tile Maps
- Open source: leaflet.js framework with Open Street Map tiles
- We can add symbols or D3 visualization as a superimposed layer

D3 Geo Projections
- github.com/d3/d3-geo-projection

There is much much more to cartography than this. We discussed only a few common/popular techniques today.
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Credits

• Visualization Analysis and Design (Ch 8)
• Heer et al.: A Tour Through the Visualization Zoo
  https://homes.cs.washington.edu/~jheer/zoo/
• Enrico Bertini, NYU Tandon
• Pfister, Harvard University
  http://cs171.org/