

Information Visualization (Geographic) Maps

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Lect 11, 11 Feb 2020
<https://www.cs.ubc.ca/~tmm/courses/436V-20>

Upcoming

- **Programming 2: due Wed, Feb 11, 11:59pm**
- **Project team formation: due Fri, Feb 14, 11:59pm**
Canvas → People → Groups
- Programming 3: out Thu Feb 13, due Wed Mar 4 11:59pm
- Foundations 4: out 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 Menus [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 focus on **geographical data** but not all spatial data is geographical.

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.

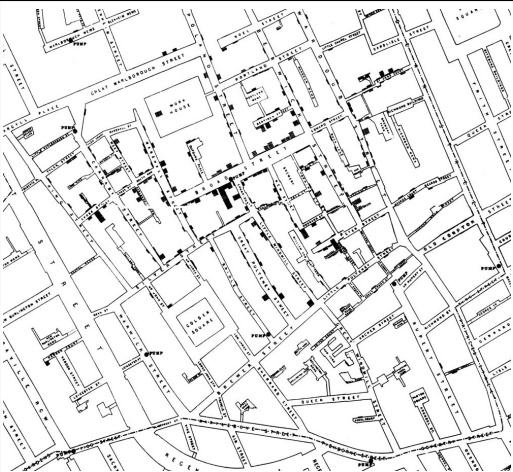
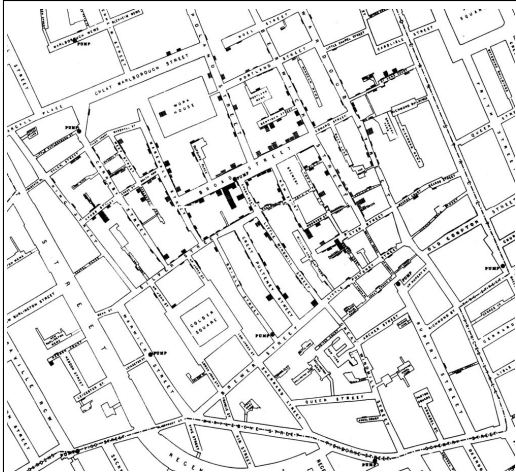
Key question:
Does the given spatial position matter for my task?

- » *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?**

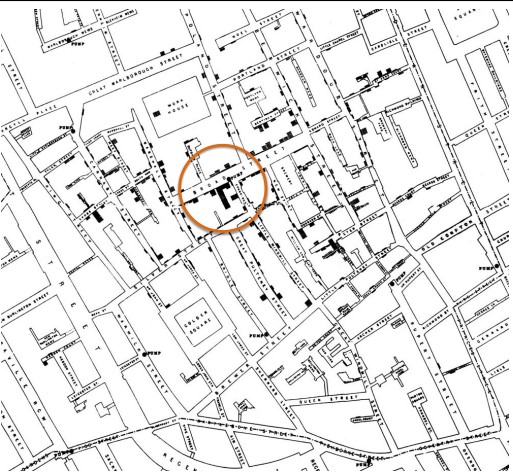
... familiarity!

- » 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



John Snow's Cholera Map

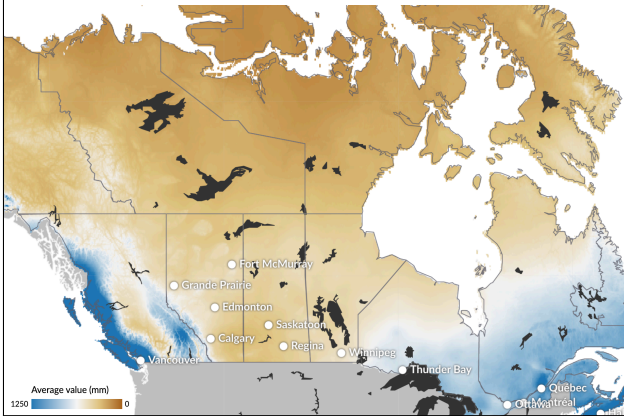
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Geographic Map



Interlocking marks
• **shape** coded
• **area** coded
• **position** coded

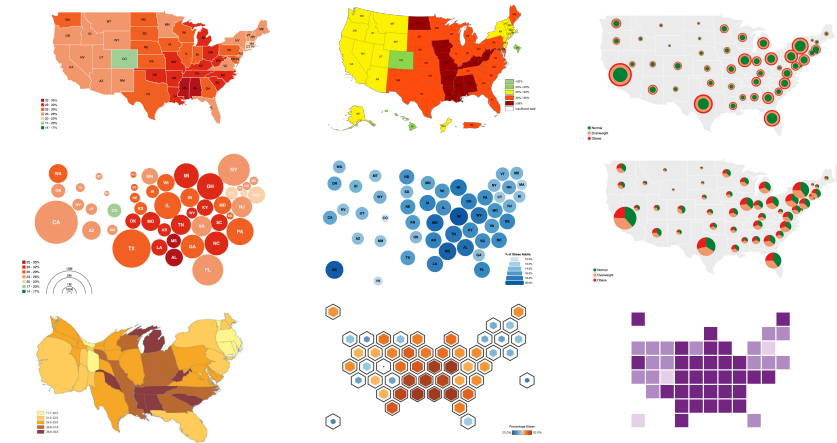
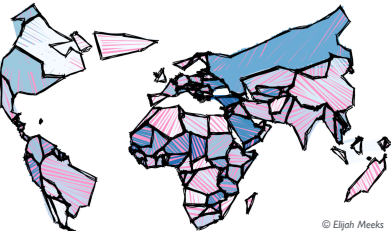
Density Maps (Annual Precipitation in Canada)



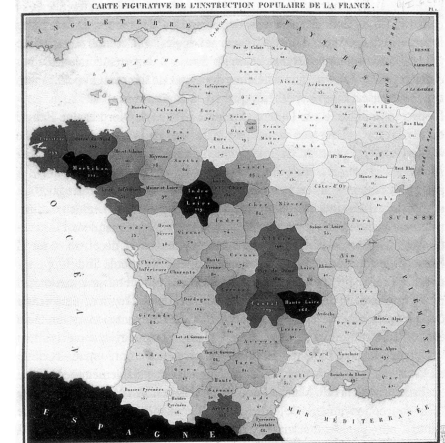
- Diverging color scheme
- Data transformation necessary to turn *discrete* data into *continuous* data
- Typically using some *density estimation function*

Activity: Sketching

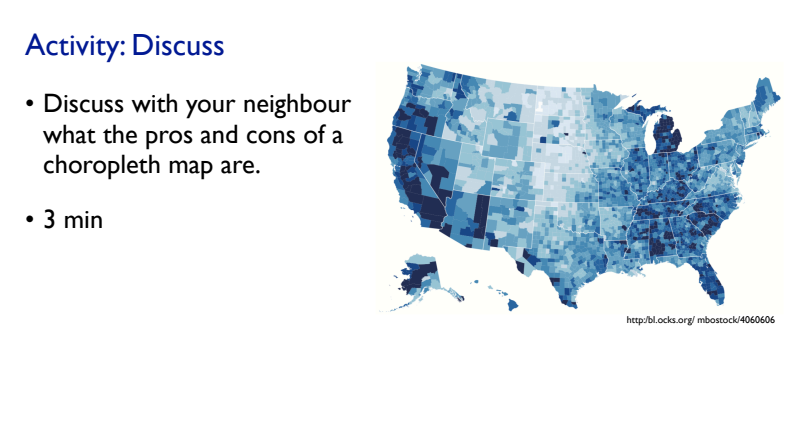
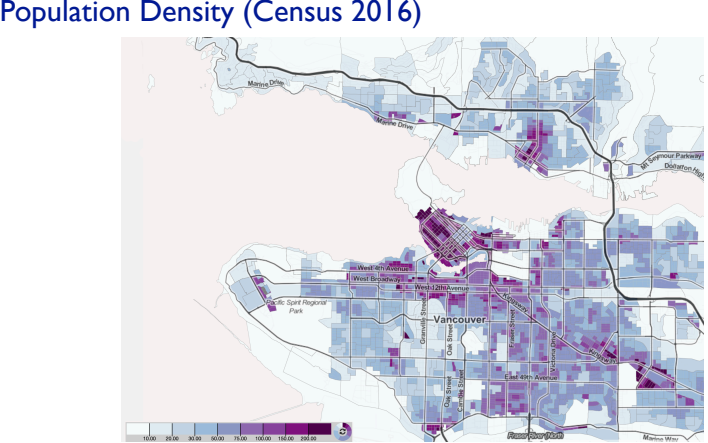
- For each state in the U.S., we have an obesity rate. Sketch (really only sketch) **three** ideas how you would encode that information *geographically*.
- 6 min
- Socrative: Answer *true* when you're done!



Choropleth Maps

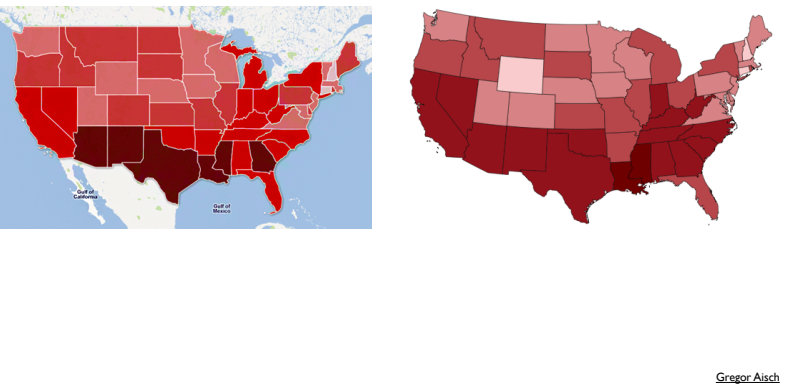


- ### Illiteracy / School Attendance
- Choropleth map created by Charles Dupin in 1826
 - Data is often collected and aggregated by geographical regions
 - Quantitative attribute encoded as color over regions
 - Region is determined by using given geographic geometry

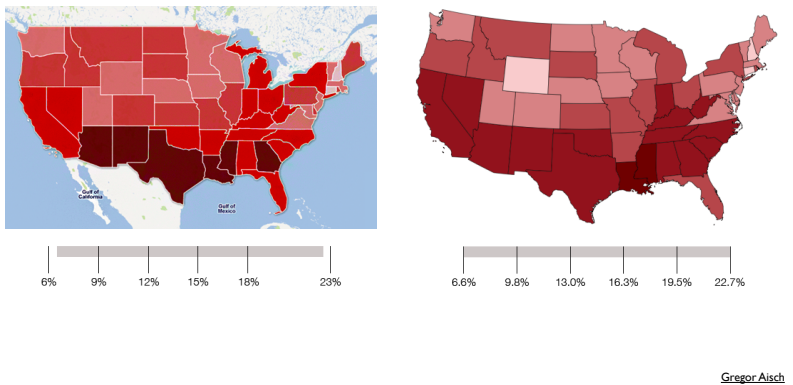


- ### Choropleth Map: Pros & Cons
- Pros
 - Well established visualization (no learning curve)
 - Easy to read and understand
 - Much of our geo data is reported by enumeration units (e.g. Census)
 - Cons
 - Most effective visual variable used for geographic location
 - Visual significance of a coloured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

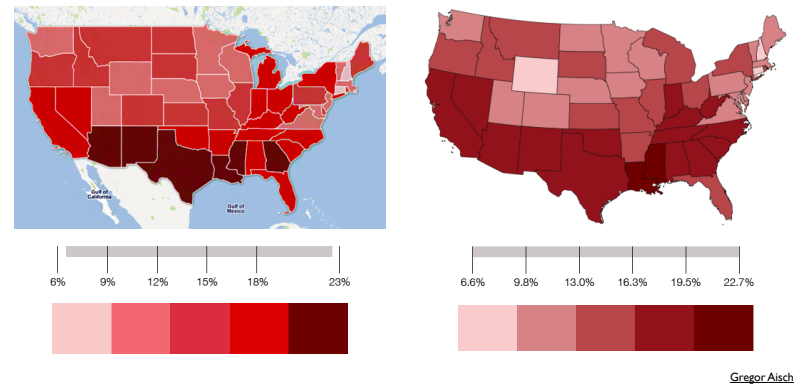
U.S. Poverty Map



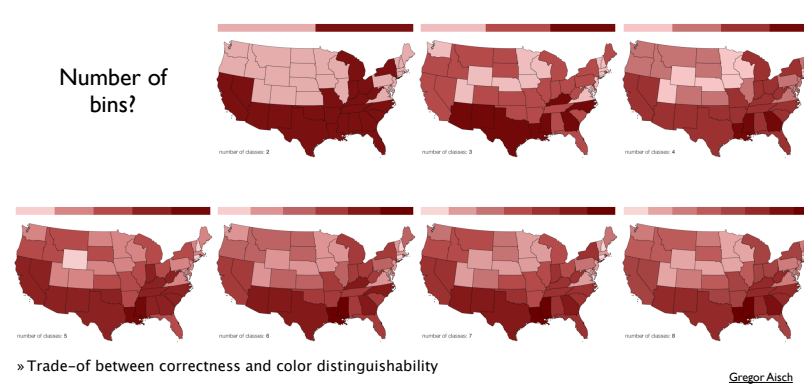
U.S. Poverty Map



U.S. Poverty Map

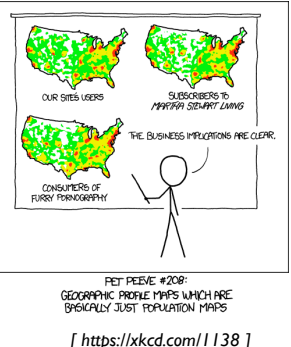


U.S. Poverty Map

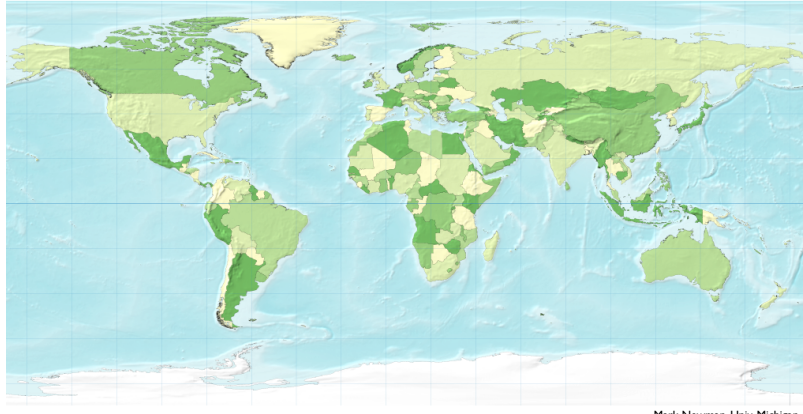


Choropleth Maps: Recommendations

- Only use when central task is understanding spatial relationships
- Show only one variable at a time
- Normalization
 - Common error is to encode raw data values (such as population) rather than using normalized values (unemployed people per 100 citizens, mean family income, ...).
 - You can also derive ratios, such as population growth between 2010 and 2020.
- Be careful when choosing colors & bins



Cartograms

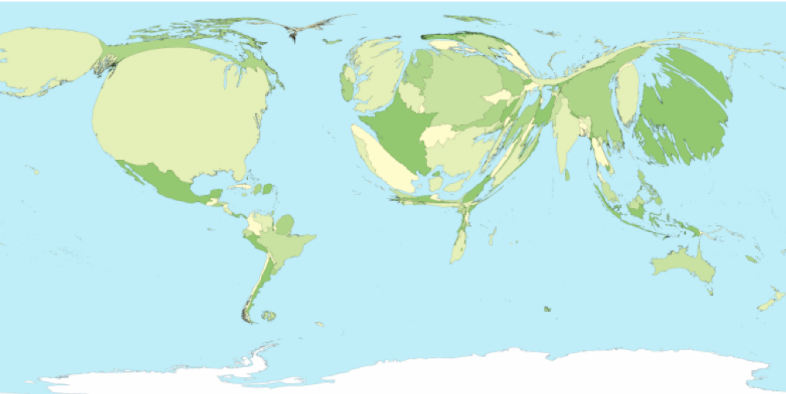


Contiguous Cartogram: Population

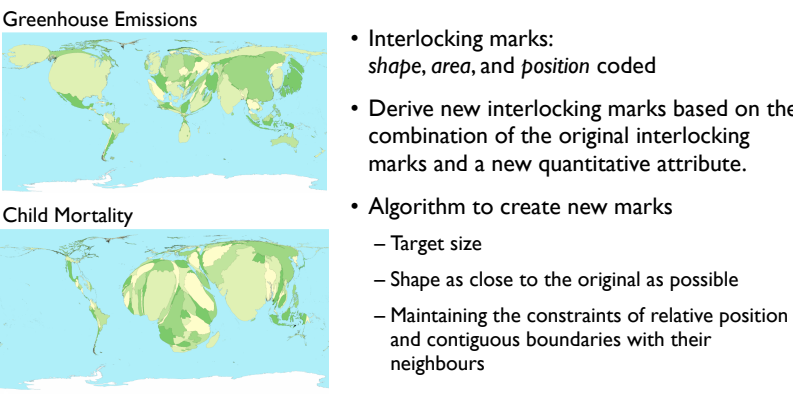


Cartograms distort the shape of geographic regions so that the area directly encodes a data variable

Contiguous Cartogram: GDP (Gross Domestic Product)

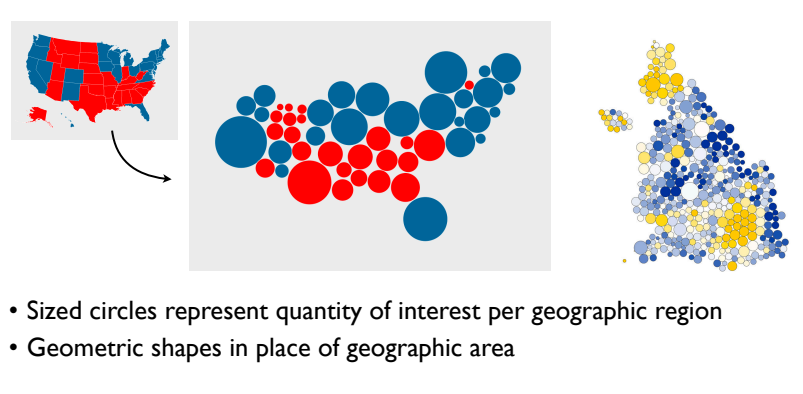


Contiguous Cartogram: Derive New Marks



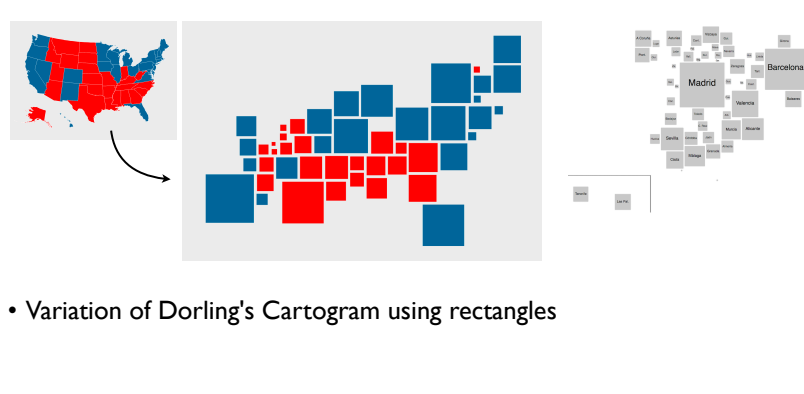
- Interlocking marks: *shape, area, and position* coded
- Derive new interlocking marks based on the combination of the original interlocking marks and a new quantitative attribute.
- Algorithm to create new marks
 - Target size
 - Shape as close to the original as possible
 - Maintaining the constraints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

Dorling Cartogram



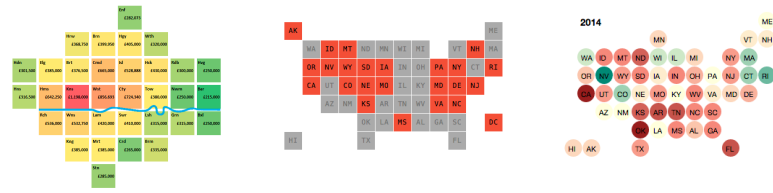
- Sized circles represent quantity of interest per geographic region
- Geometric shapes in place of geographic area

Demers Cartogram



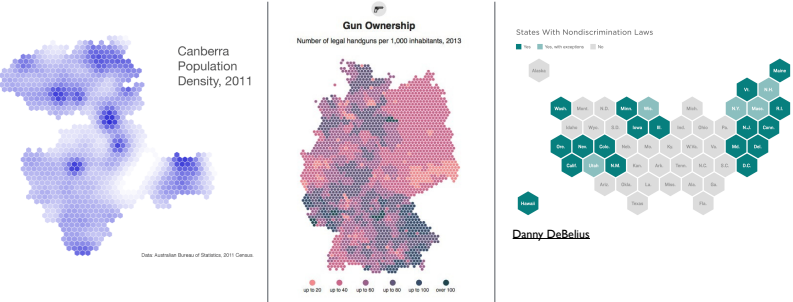
- Variation of Dorling's Cartogram using rectangles

Grid Cartogram



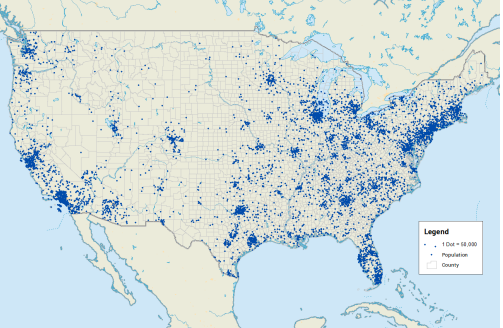
- Uniform-sized shapes arranged in grid
- Maintain approximate spatial position and arrangement

Hexagonal Cartogram

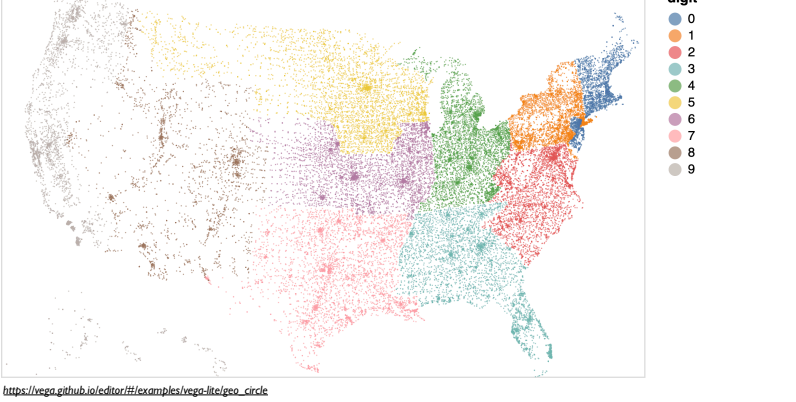


Dot Density Maps

- 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



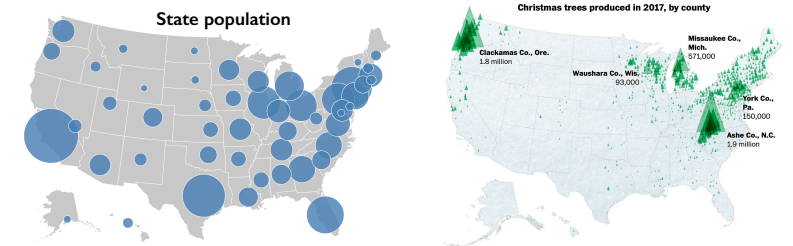
Dot Density Map: One Dot per Zipcode in the U.S.



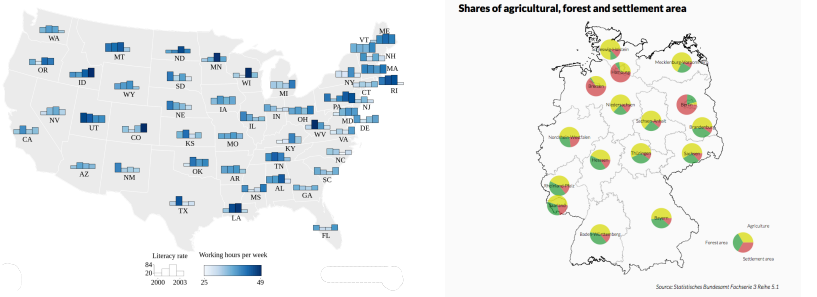
Attention: Many dot maps primarily show the population density with which the target variable is correlated, instead of the effect of interest.

Symbol Maps

- A symbol is used to represent aggregated data (we can use the size, shape, and color channels)
- Keep original spatial geometry in the background
- Often a good alternative to choropleth maps

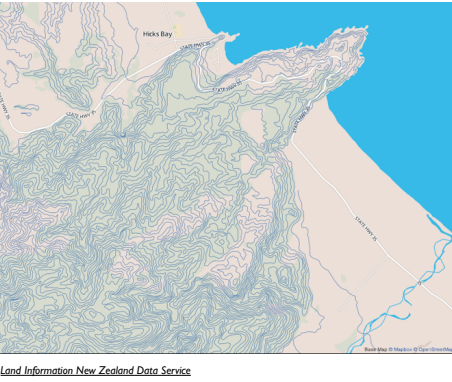


Symbol Maps with Glyphs

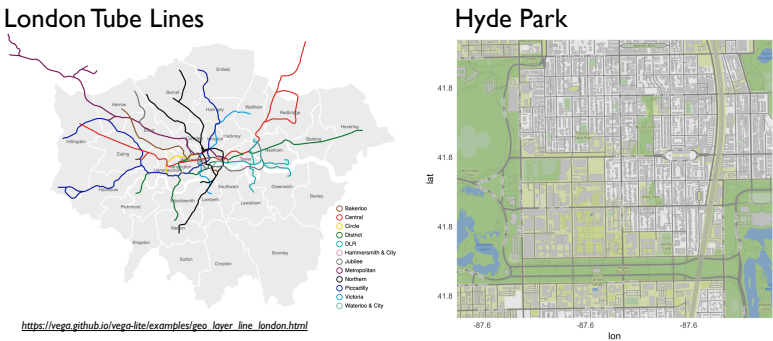


Topographic Map

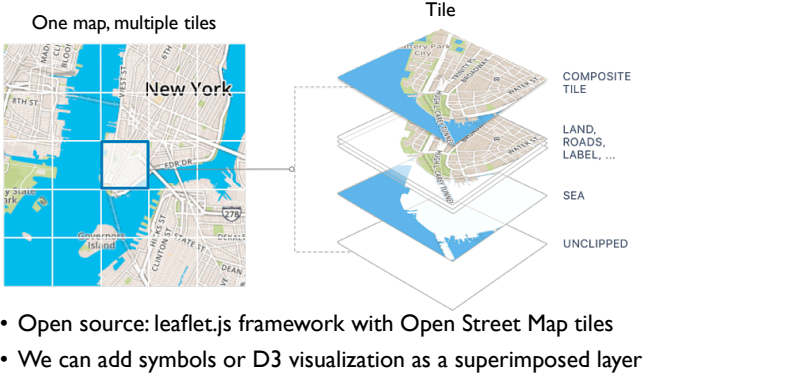
- Data
- Geographic geometry
 - Scalar spatial field
 - 1 quant attribute per grid cell
- Derived data
- Isoline geometry
 - Isocontours computed for specific levels of scalar values



Map Layers

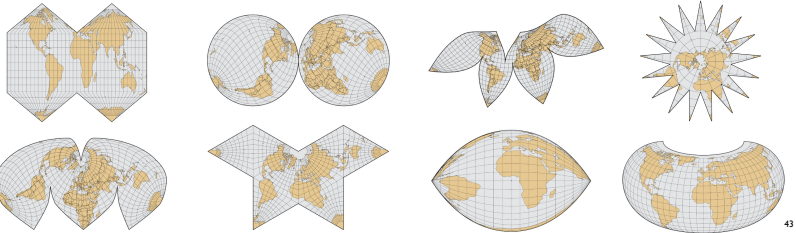


Tile Maps

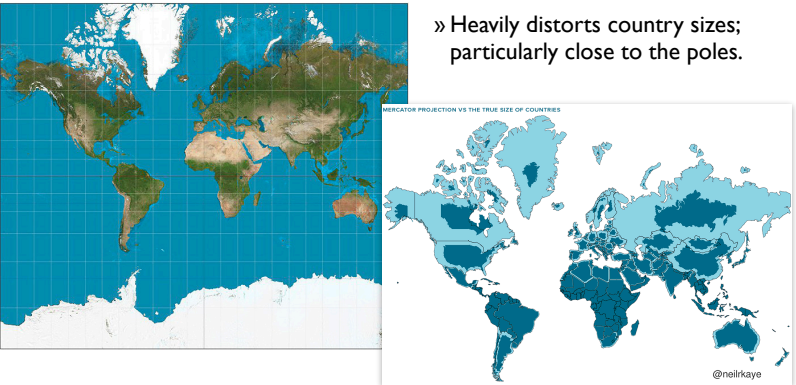


Map Projections

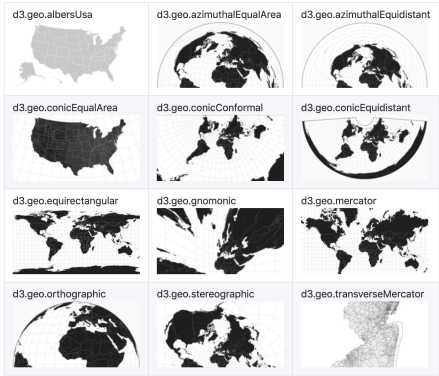
- Mathematical functions that map the 3D surface geometry of the Earth to 2D maps.
- All projections of a sphere on a plane necessarily distort the surface in some way.
- Interactive: philobg.github.io/page/myriahedral/ and jasondavies.com/maps/



Mercator Projection

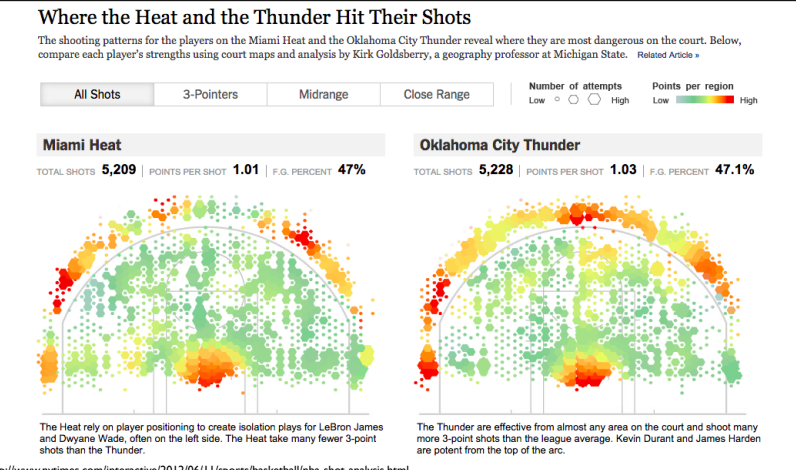


D3 Geo Projections



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/files/zoo/>
- Enrico Bertini, NYU Tandon
- Pfister, Harvard University
<http://cs171.org/>