Spatial Visualization, Cartography - I

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Maps

General-Reference Map

Thematic Maps

Maps

General-Reference Map

General-reference maps display objects from the geographical environment – contain features like mountains, rivers, lakes, roads, houses, etc. Topographic maps are clear examples of general-reference maps.

Thematic Maps

A thematic map is used to visualize the spatial pattern of data related to a particular theme or attribute. Possible attributes include population density, family income, and import/export.

Thematic Maps

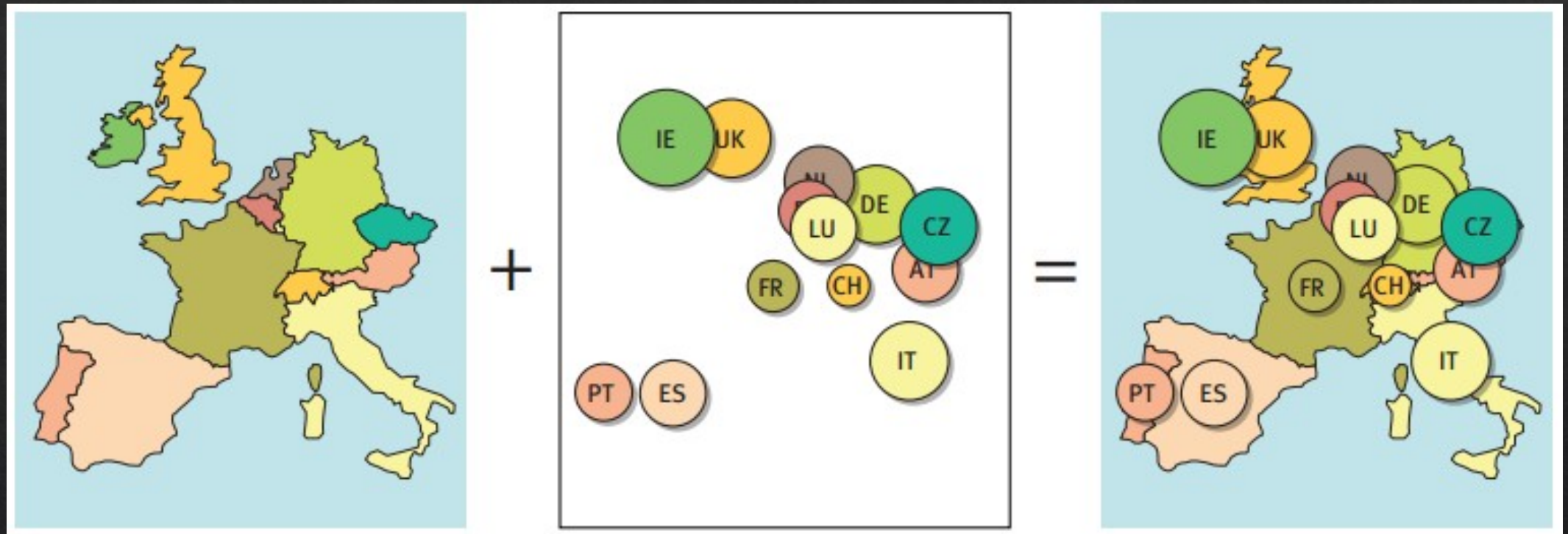


Figure 1.2 A thematic map (right) consists of a base map (left) and a thematic overlay (middle). This map shows the GDP drop in 2009 as percentage change on 2008.

courtesy: Kevin Verbeek

Potential Solutions?

Given a set of circles, find a good order to render them so that we get the most visibility.

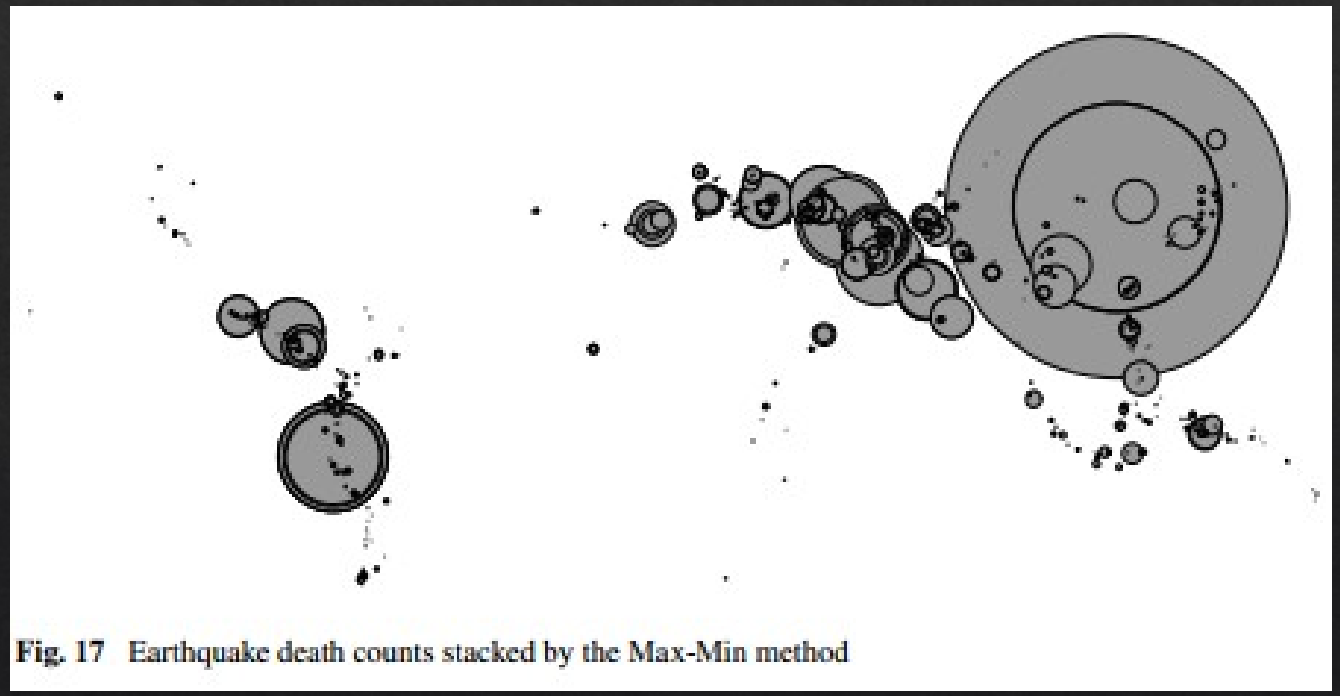


Fig. 17 Earthquake death counts stacked by the Max-Min method

Define your own visibility and heuristic algorithms!

Types of Thematic Maps

Thematic Maps

Qualitative Map	Quantitative Maps

Thematic Maps

Qualitative Map

Qualitative thematic maps show only the spatial distribution, relation, or location of a given attribute.

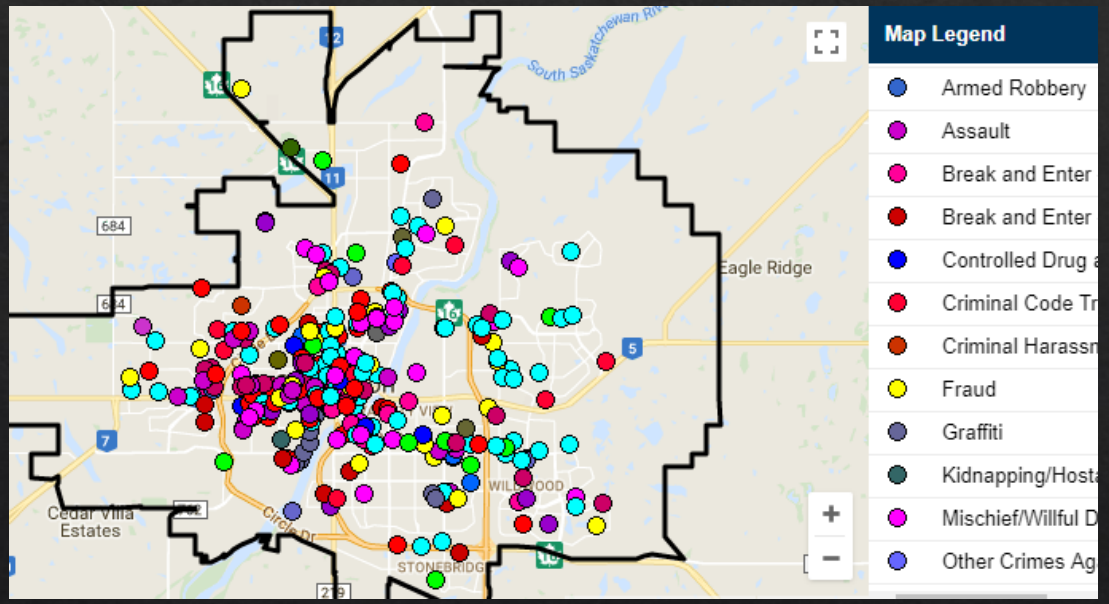
Locations of traffic incidents in Saskatoon over the last month

Quantitative Maps

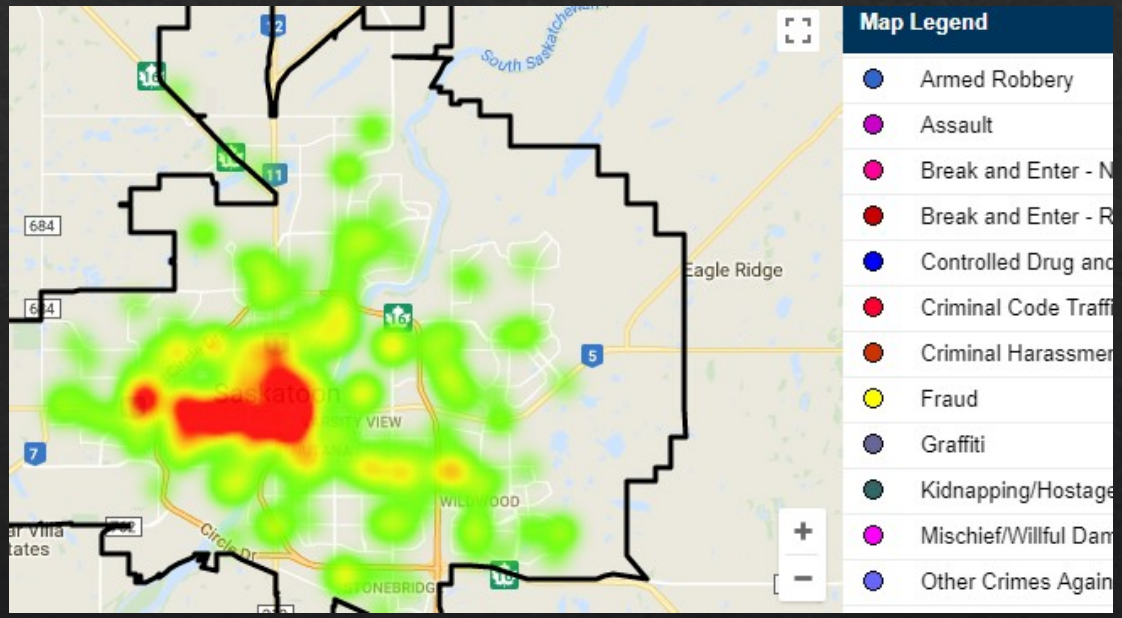
A quantitative map shows how the spatial aspects of numerical data related to a given attribute.

Frequency of traffic incidents in each neighborhood

Thematic Maps



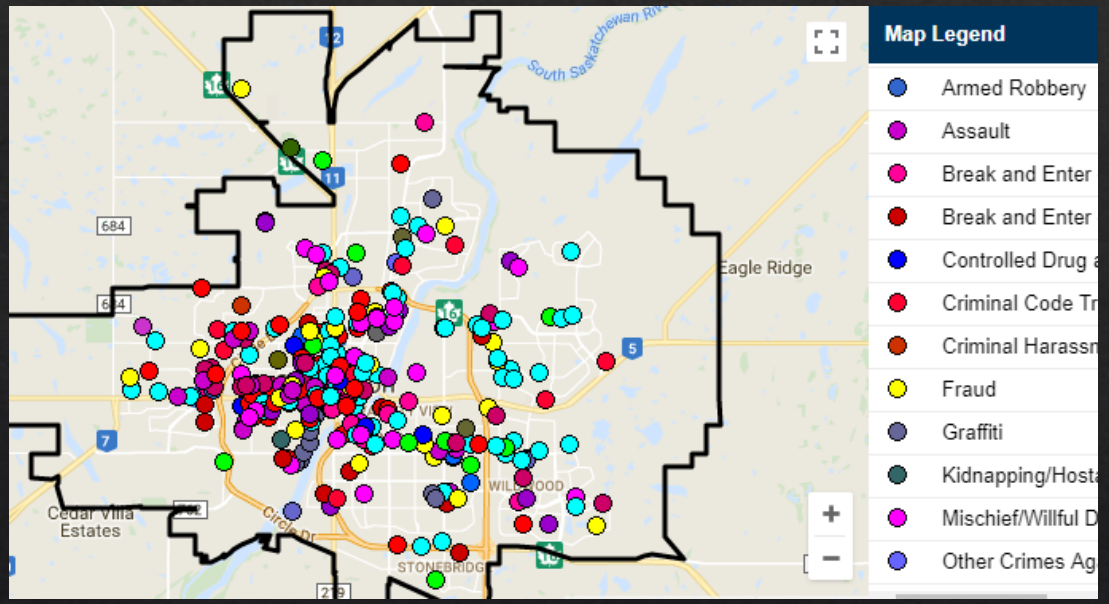
month



neighborhood

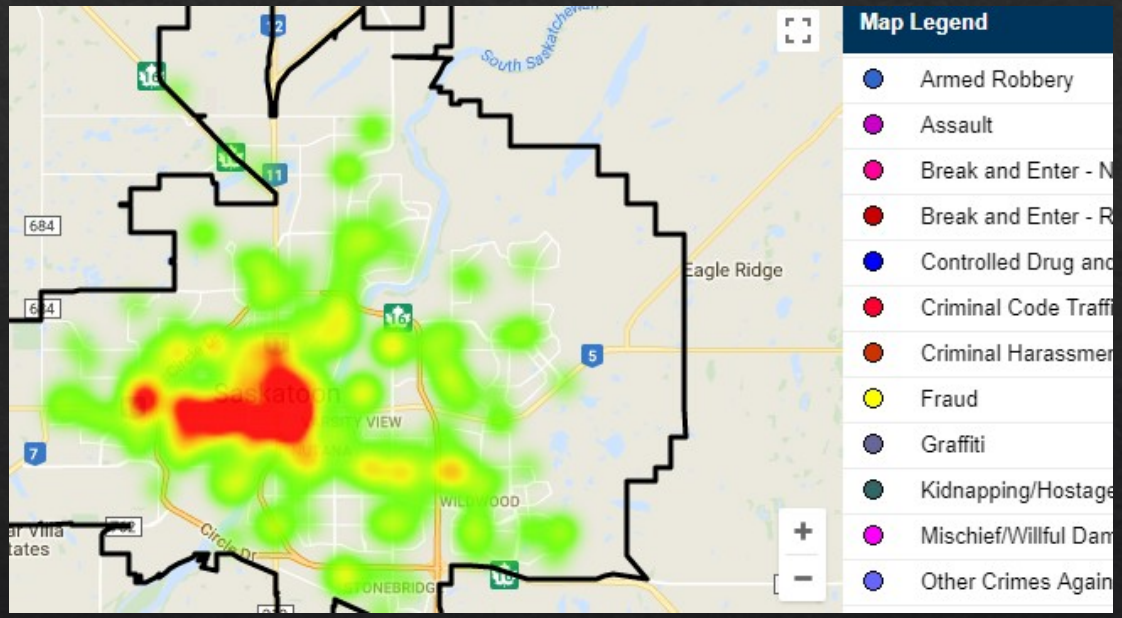
Thematic Maps

Qualitative Map



month

Quantitative Maps



neighborhood

Thematic Maps (Choropleth)

The regions of the map are shaded or patterned according to their data values.

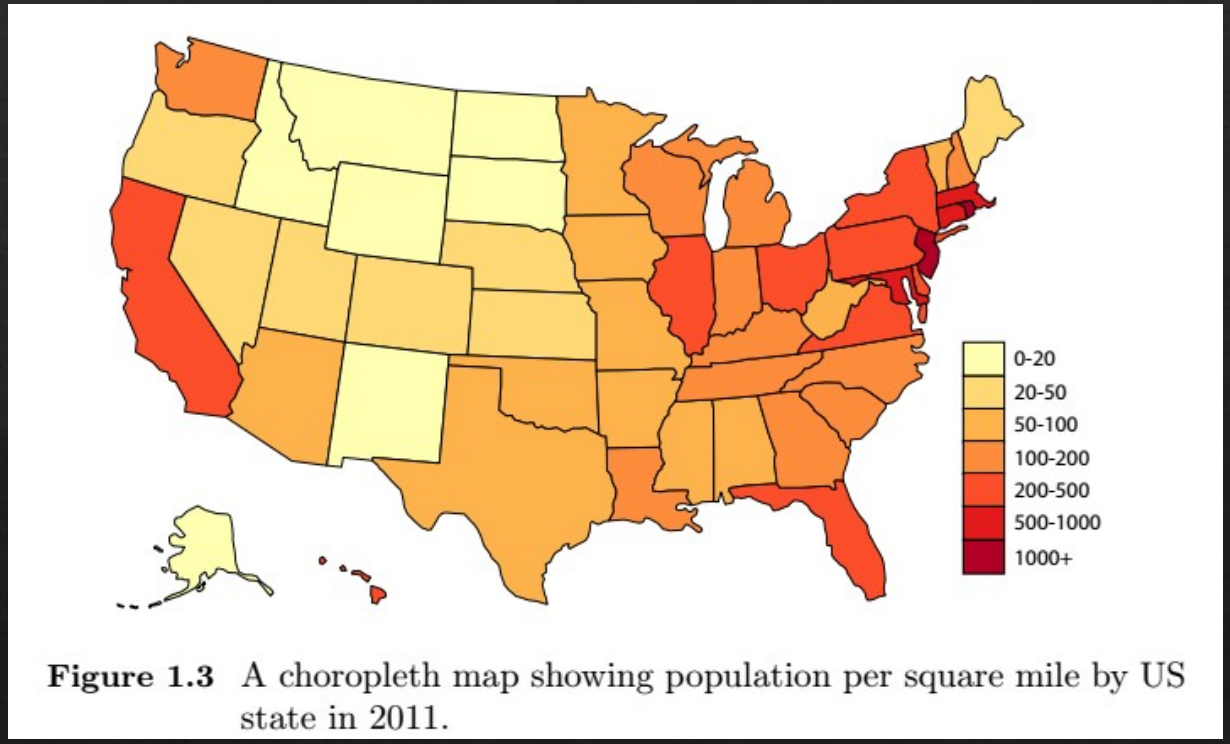


Figure 1.3 A choropleth map showing population per square mile by US state in 2011.

Thematic Maps (Choropleth)

- Very intuitive mapping technique
- The association between regions and data values is immediate

Any weak point?

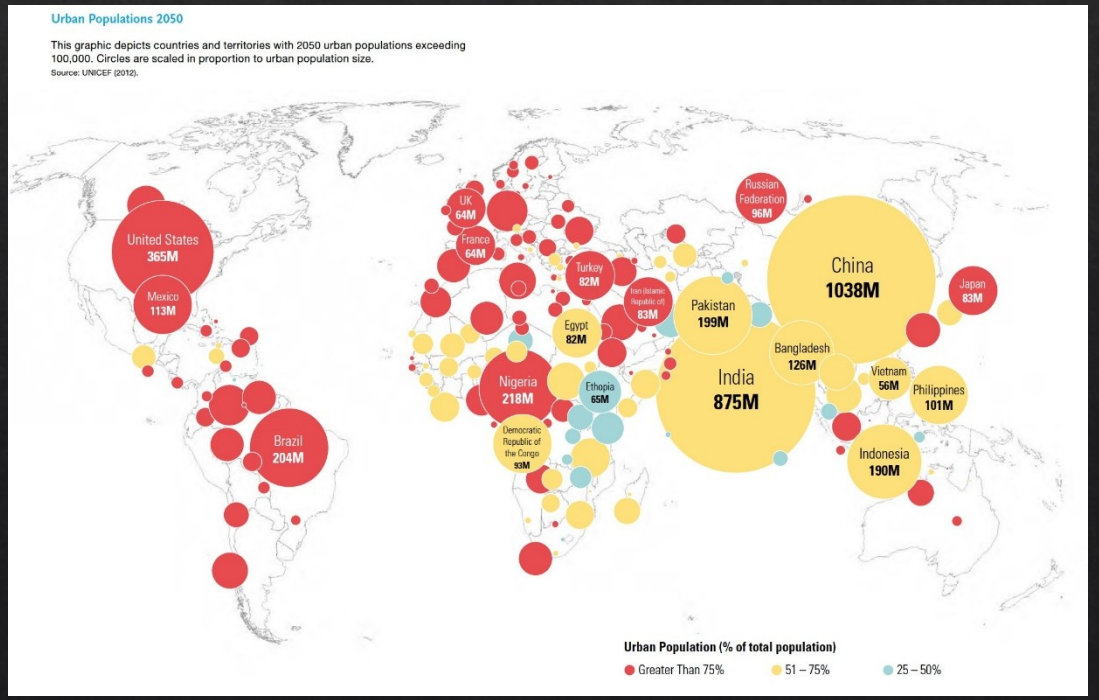
Thematic Maps (Choropleth)

- Ill-suited to visualize absolute values
  - E.g., each region representing the difference between adult and children count
  - Users tend to mentally integrate over the region areas

- Large regions tend to be overemphasized
  - should be used only for regions of near-uniform size
  - Better if data is uniformly distributed within each region

Thematic Maps (Proportional symbol maps)

Proportional symbol maps or graduated symbol maps place scaled symbols or diagrams directly on the base map, often on the centroid of the regions



courtesy: Kevin Verbeek

Thematic Maps (Proportional symbol maps)

Proportional symbol maps or graduated symbol maps place scaled symbols or diagrams directly on the base map, often on the centroid of the regions

Since symbols tend to have simple shapes, their areas can be estimated comparatively easily

Large symbols associated with small regions can make it difficult to determine which region a symbol is associated with and to accurately judge its size.

Cartographic visualization

Cartographic visualization involves the creation of maps for data-exploration (often interactive), to find spatial patterns in the data

Thematic Maps (Cartograms)

Cartograms or value-by-area maps scale the regions of the base
map such that the area of each region represents its
data v

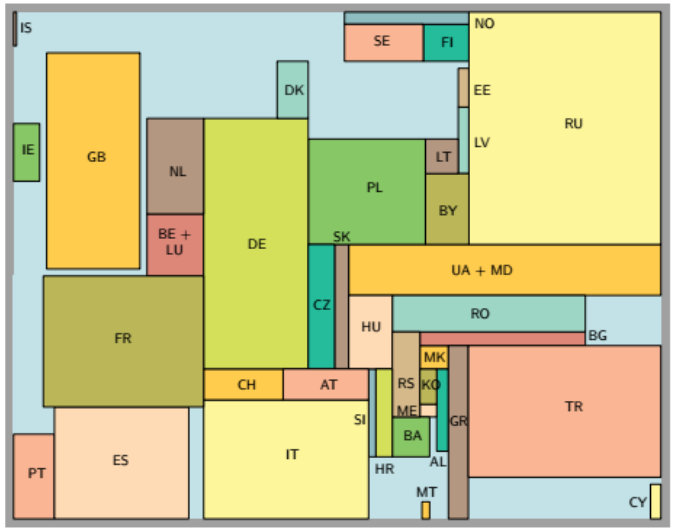
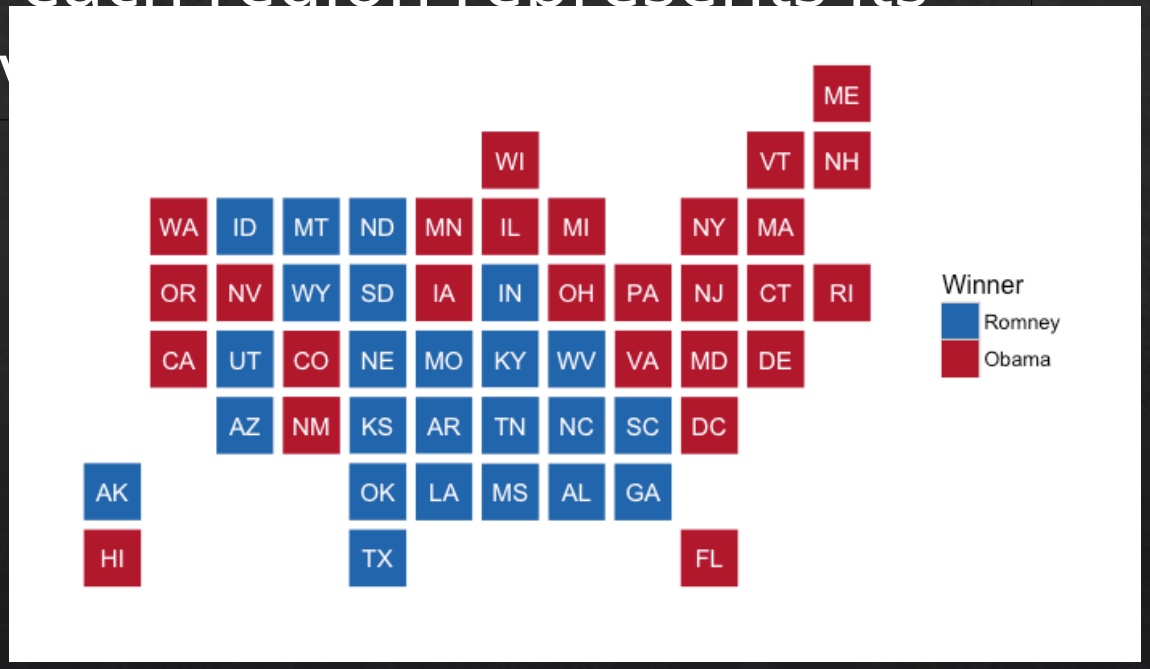


Figure 1.4 A rectangular cartogram showing the population of European countries in 2011 [28].



The thematic layer and base map are merged into one, as the data is represented by deforming the base map

courtesy: Kevin Verbeek

Thematic Maps (Cartograms)

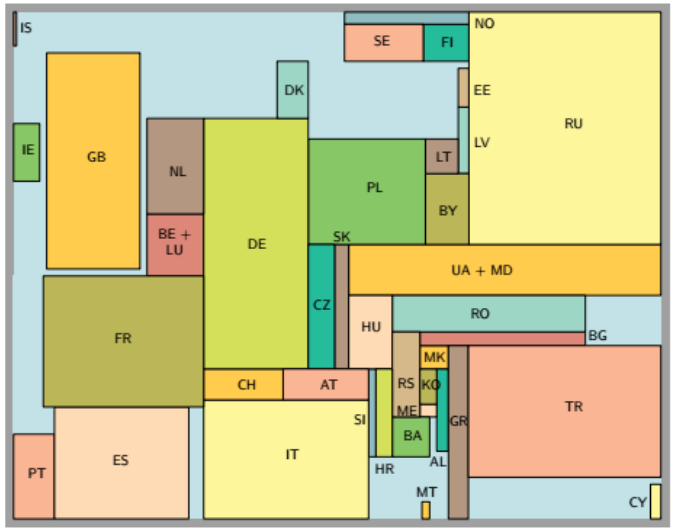


Figure 1.4 A rectangular cartogram showing the population of European countries in 2011 [28].

Two properties are important:

(i) how easy is it to recognize a region (by shape or relative position), and

(ii) how easy is it to estimate the area of a region.

Thematic Maps (Cartograms)

Contiguous Cartogram

Deformed regions so that the desired sizes can be obtained and the adjacencies kept

- Adjacencies help in recognizing the different regions.
- contiguous area cartograms perform best if the data values are somewhat related to the area of the input regions

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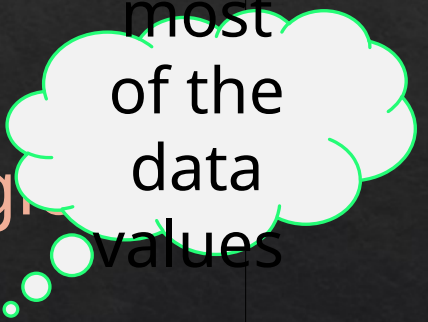


Thematic Maps (Cartograms)

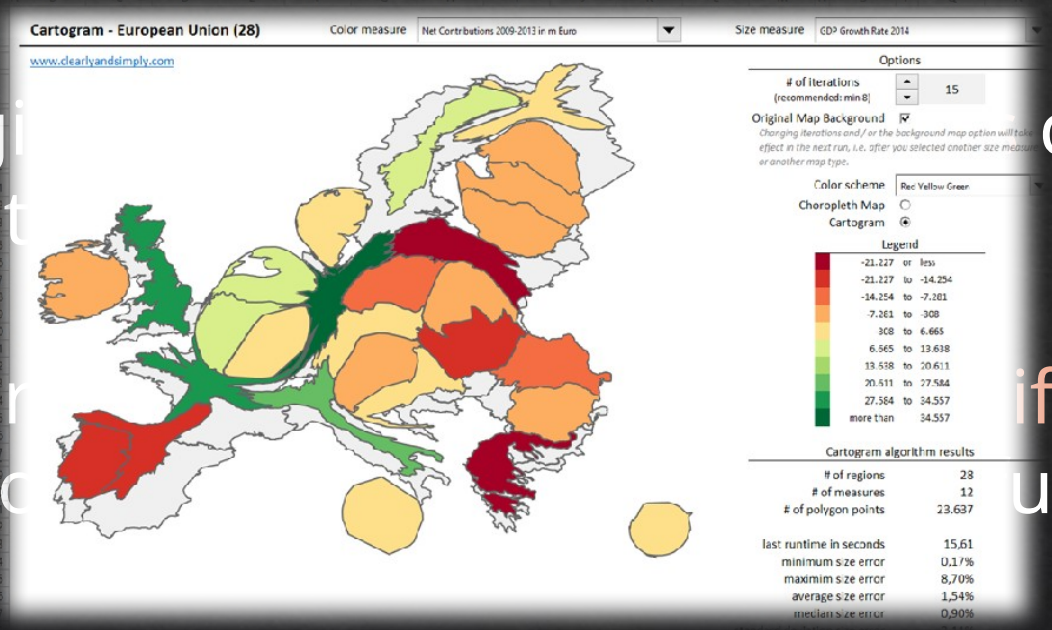
Contiguous Cartogram

Deformed regions so that the desired sizes can be obtained and the adjacencies kept

- Since each region must be shown, it is difficult to threshold to concentrate on a meaningful subset.
- Sometimes, can be quite hard to compare sizes of regions in a contiguous cartogram, since regions often have different shapes.

Thematic Maps (Cartograms)

Contiguous Cartogram



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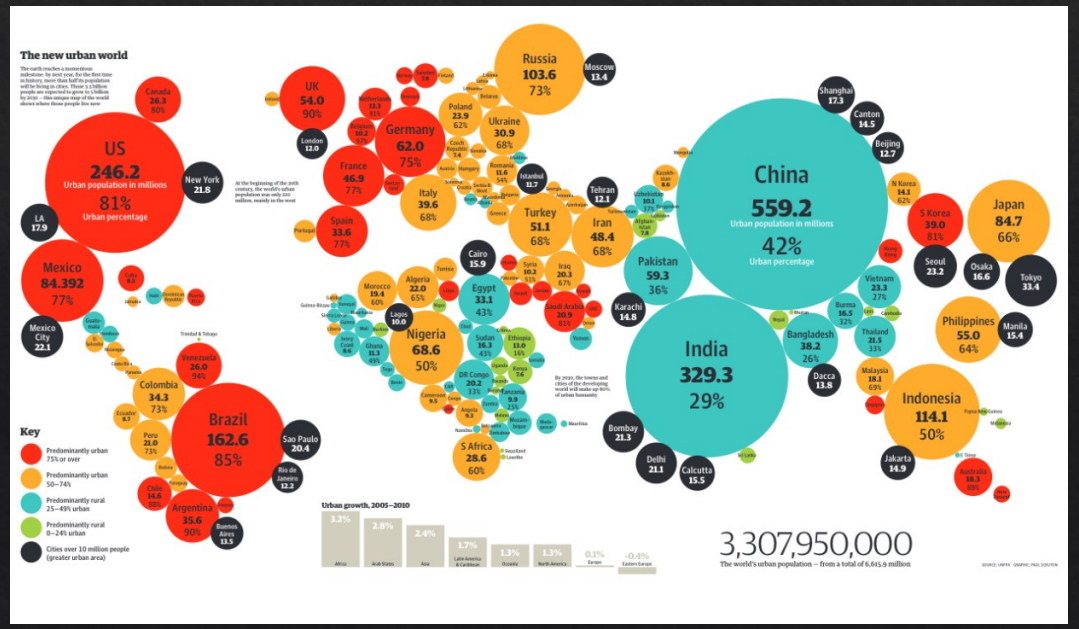
Thematic Maps (Cartograms)

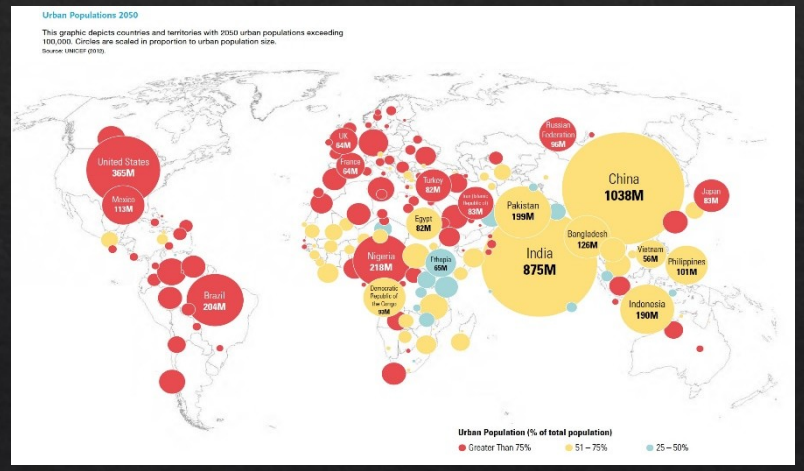
Circular Cartogram – Dorling' 96

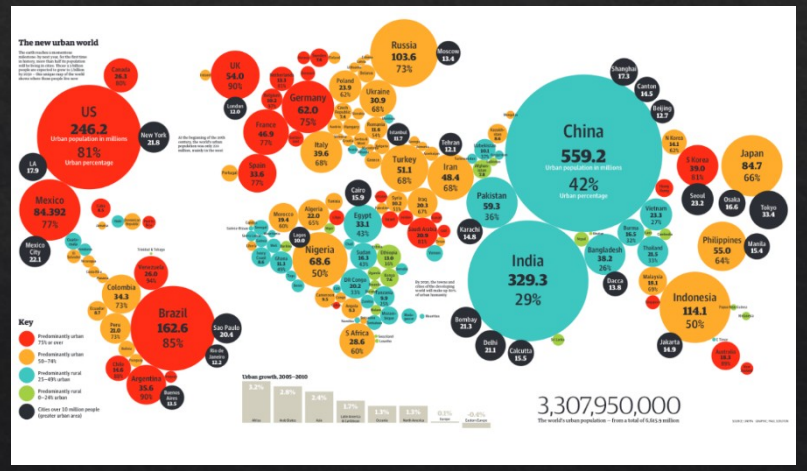
The circles are placed without overlap and in such a way that region adjacencies and relative positions are maintained as well as possible.



Resolving Conflicts!

You got a set of overlapping circles from a proportional symbol maps, now you want to get a non-overlapping circular diagram without changing the radii.





Design your best heuristic algorithm!

Thematic Maps (Cartograms)

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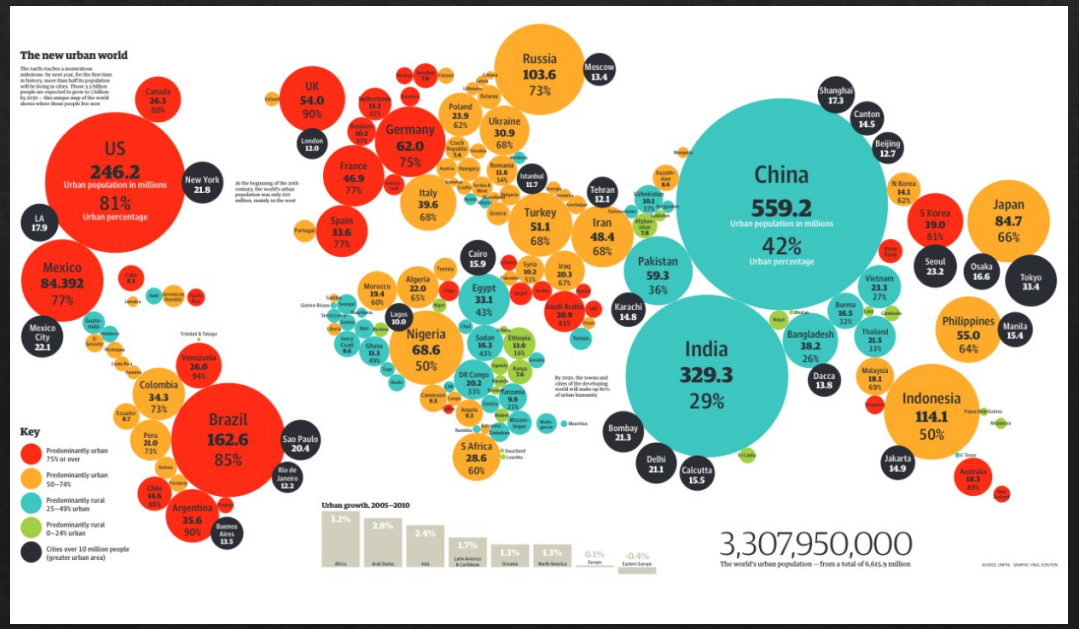


Thematic Maps (Cartograms)

Circular Cartogram – Dorling' 96

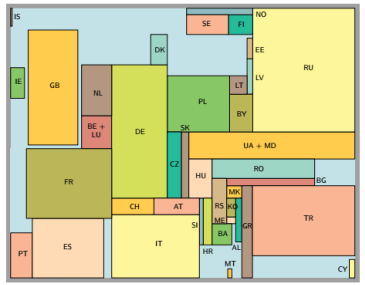
The circles are placed without overlap and in such a way that region adjacencies and relative positions are maintained as well as possible.

- Easy area estimation
- Very hard or even impossible to properly maintain adjacencies and relative positions!

Thematic Maps (Cartograms)

Rectangular Cartogram – Raisz 1934

The rectangles are placed without overlap and in such a way
that region adjacencies and relative positions are maintained as well as possi



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- Easy area estimation
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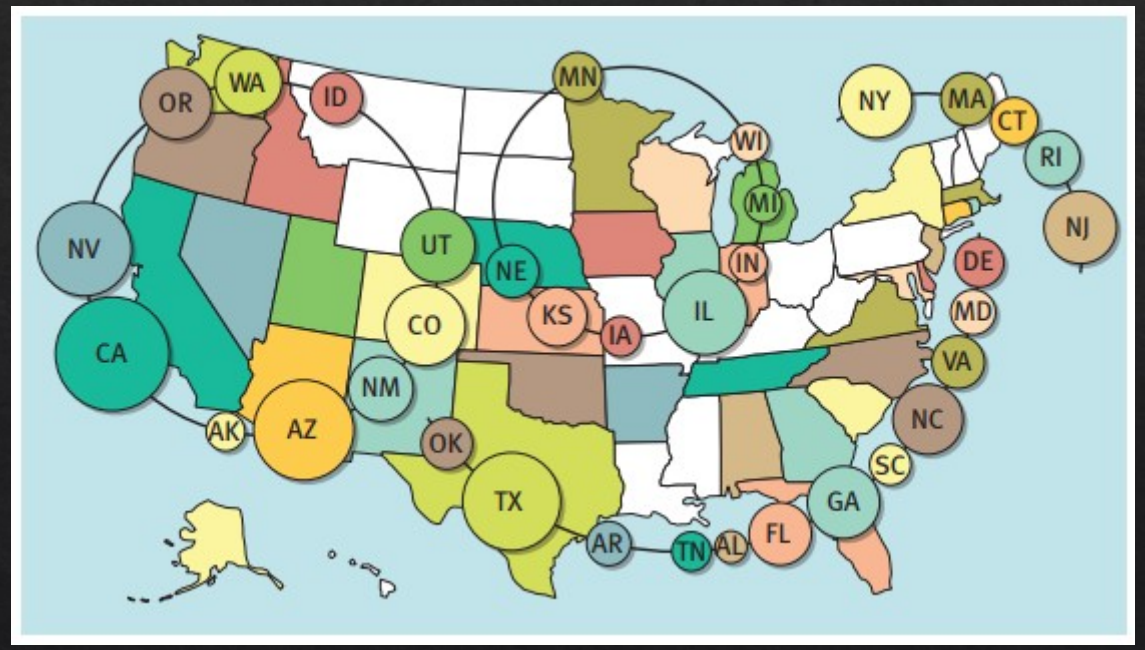
Thematic Maps

Necklace Map (Speckmann and Verbeek, 2010)
Attempt to overcome the problem of representing large data values with small regions using necklaces



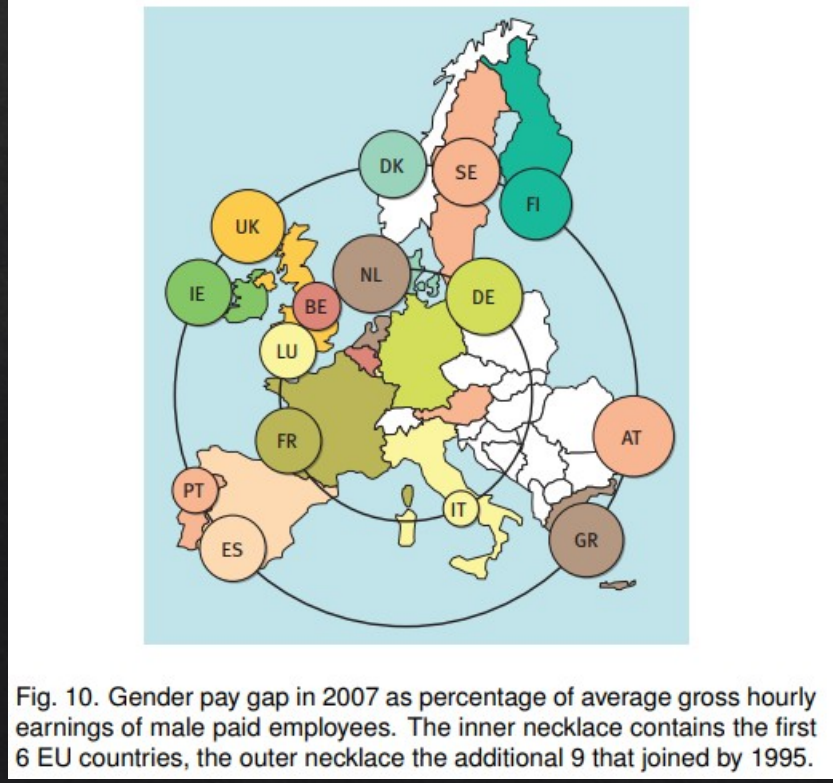


Fig. 10. Gender pay gap in 2007 as percentage of average gross hourly earnings of male paid employees. The inner necklace contains the first 6 EU countries, the outer necklace the additional 9 that joined by 1995.

Thematic Maps

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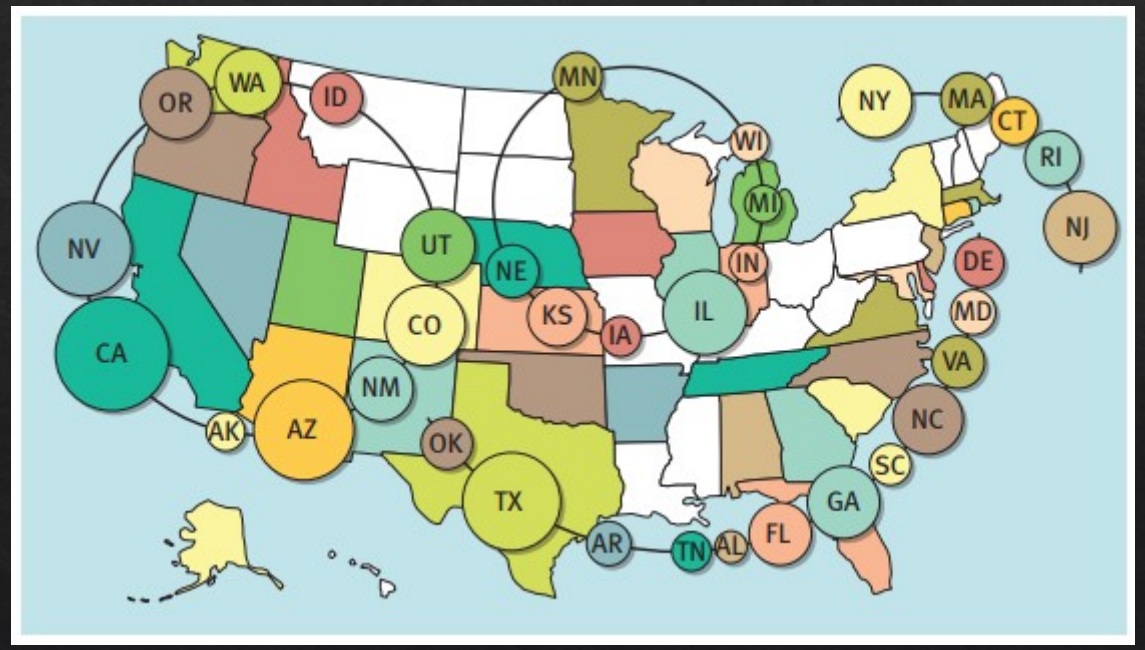

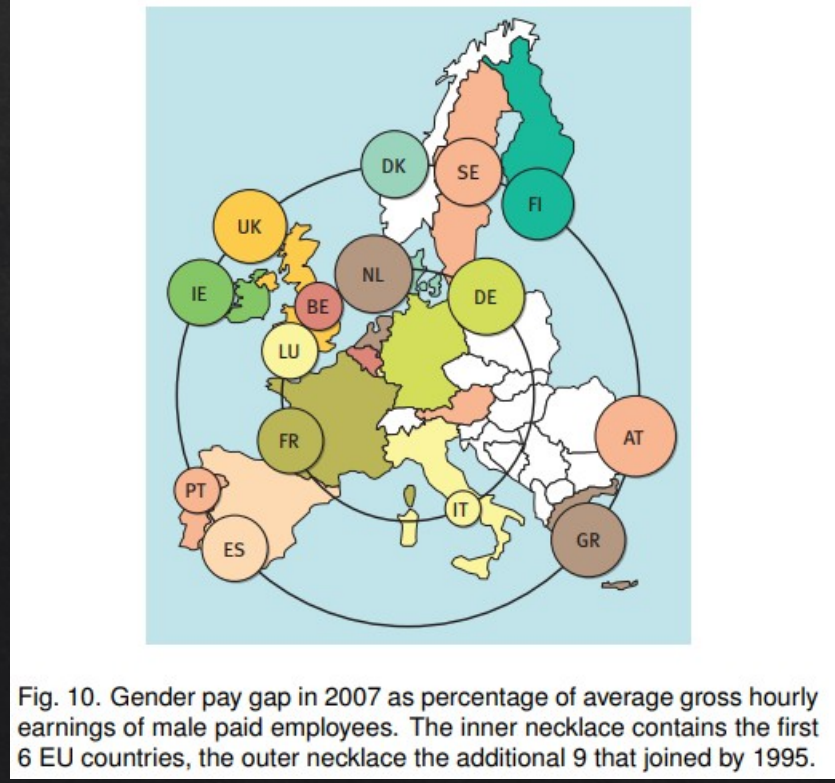

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Thematic Maps

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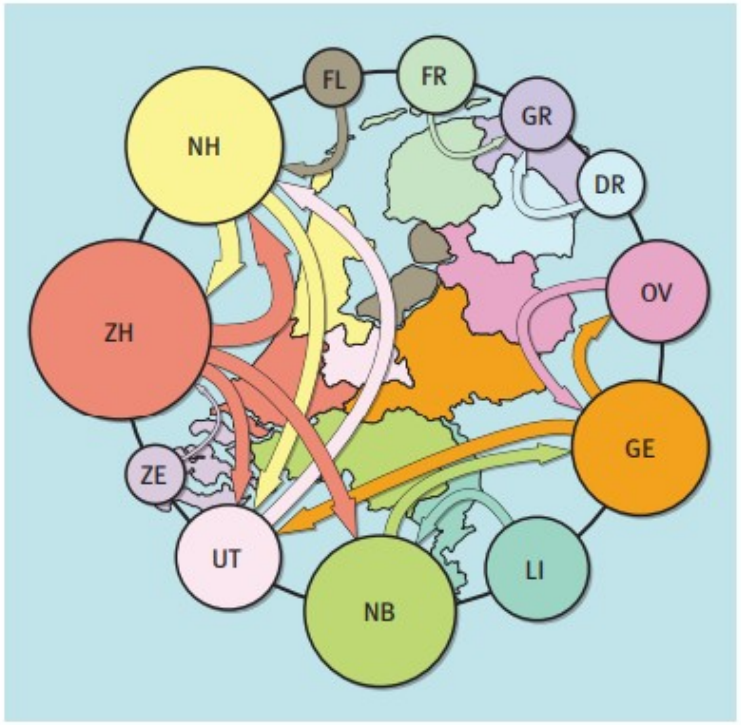

Fig. 11. Population of and relocation between the provinces of the Netherlands in 2005.

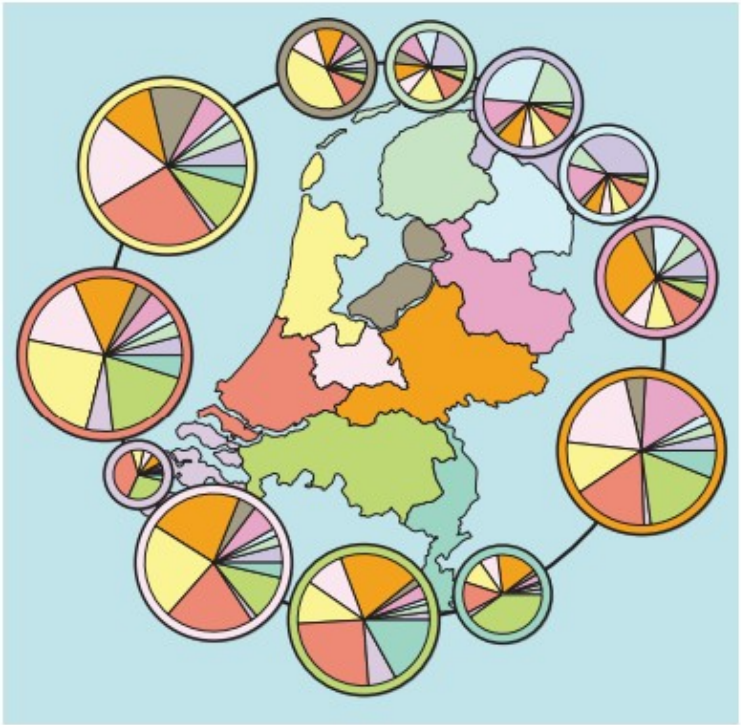

Fig. 12. Number of inhabitants moving to another province. The color of each "pizza slice" indicates the destination, the "pizza crust" the origin.

courtesy: Kevin Verbeek

Thematic Maps

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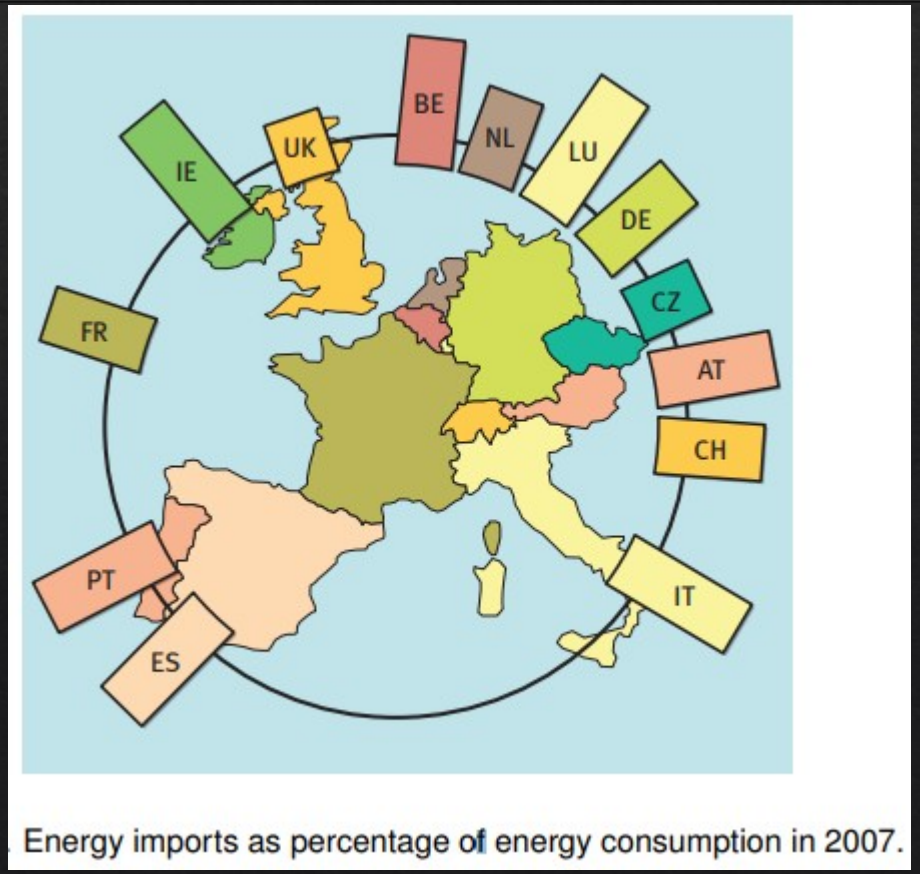


Energy imports as percentage of energy consumption in 2007.

Thematic Maps

Necklace Map

- Clear and uncluttered appearance
- Linear ordering of symbols makes it easy to estimate and compare symbol sizes correctly
- Visualize data sets well even if not proportional to region sizes
- Trade-off among symbols sizes and the spatial relation, distribution of symbols per necklace.
- Better to use several necklaces instead of just one necklace.

Thematic Maps

Schematic Map

Visualize a set of nodes and edges (for example, highway or metro networks) in simplified form to communicate connectivity information as effectively as possible.

Figure 1.5 A metro map of the London Underground produced by the method in [108].

courtesy: Kevin Verbeek

Thematic Maps

Schematic Map

- Edges of a schematic map are often drawn using few orientations (like horizontal, vertical, and sometimes diagonal) and with as few links as possible.
- Many schematic maps deviate substantially from the underlying geography

Thematic Maps

Flow Map

Visualize the movement of objects, such as people or goods, between geographic regions --- typically quantitative

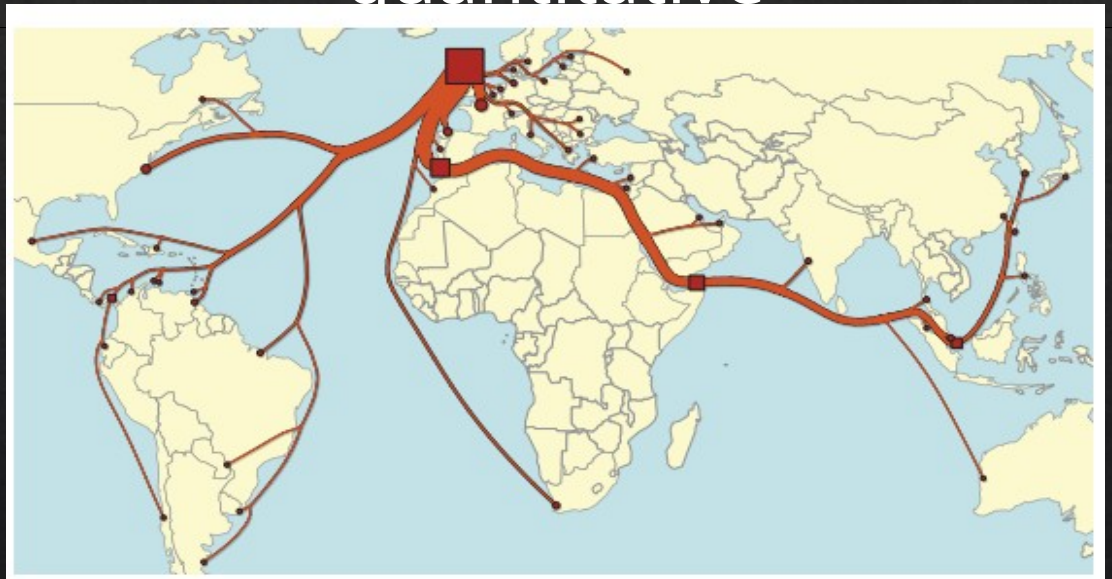


Figure 1.6 A flow map showing top 50 whisky exports from Scotland in 2009 by volume.

courtesy: Kevin Verbeek

Flow Map

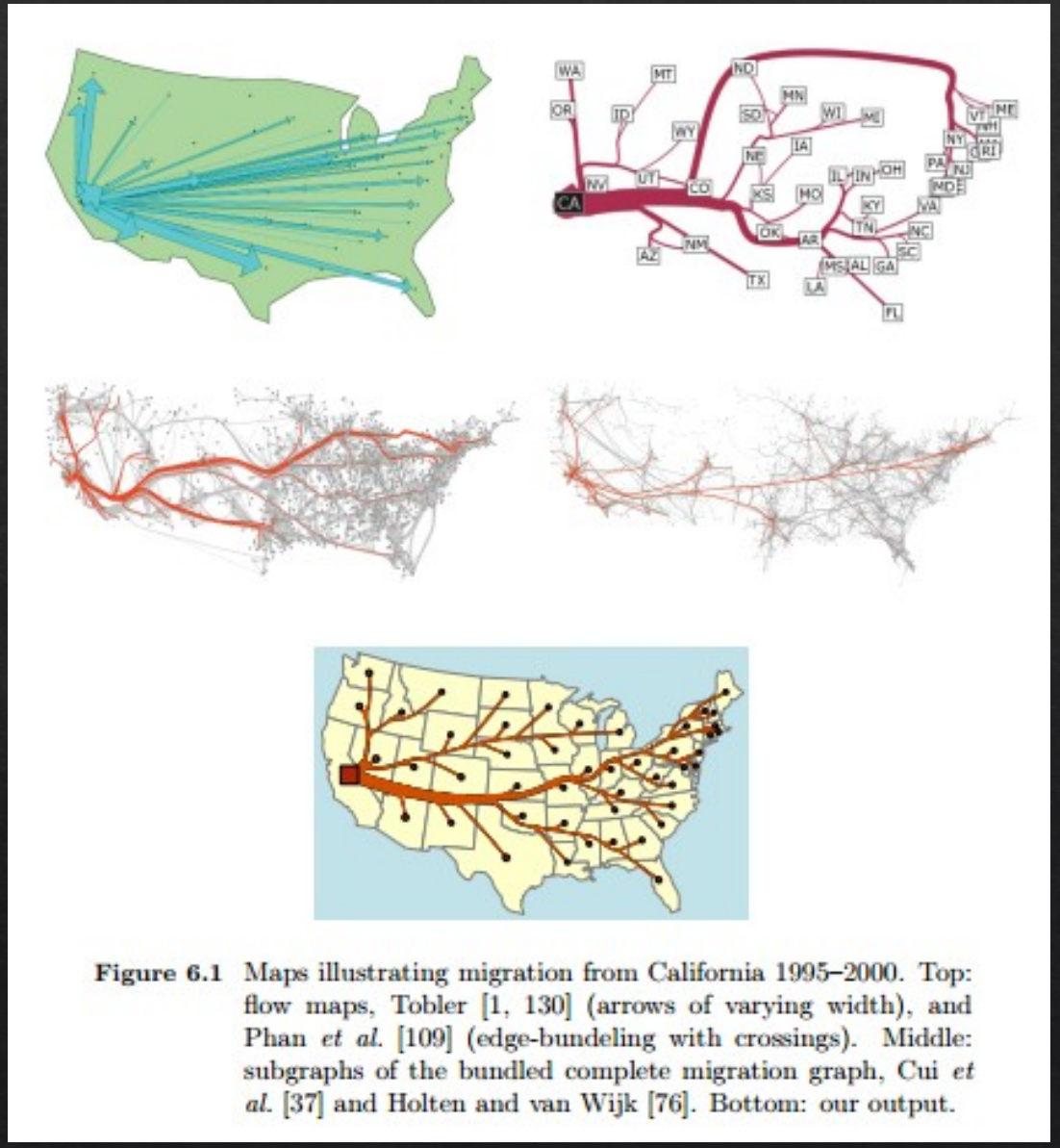


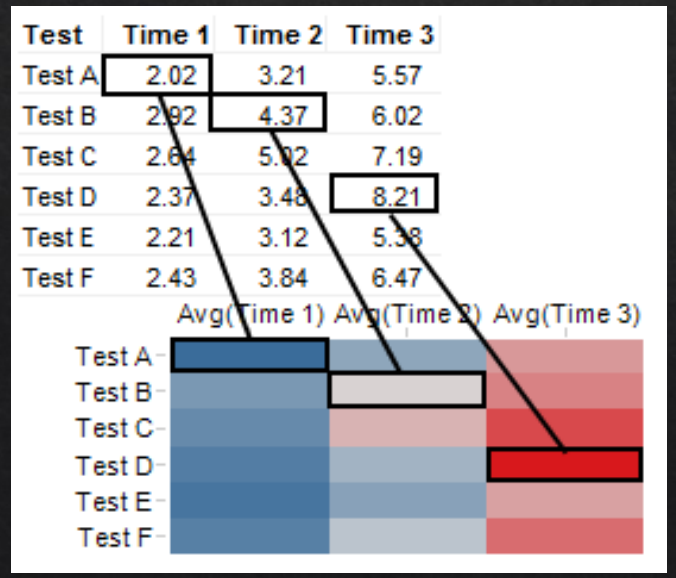
Figure 6.1 Maps illustrating migration from California 1995–2000. Top: flow maps, Tobler [1, 130] (arrows of varying width), and Phan *et al.* [109] (edge-bundeling with crossings). Middle: subgraphs of the bundled complete migration graph, Cui *et al.* [37] and Holten and van Wijk [76]. Bottom: our output.

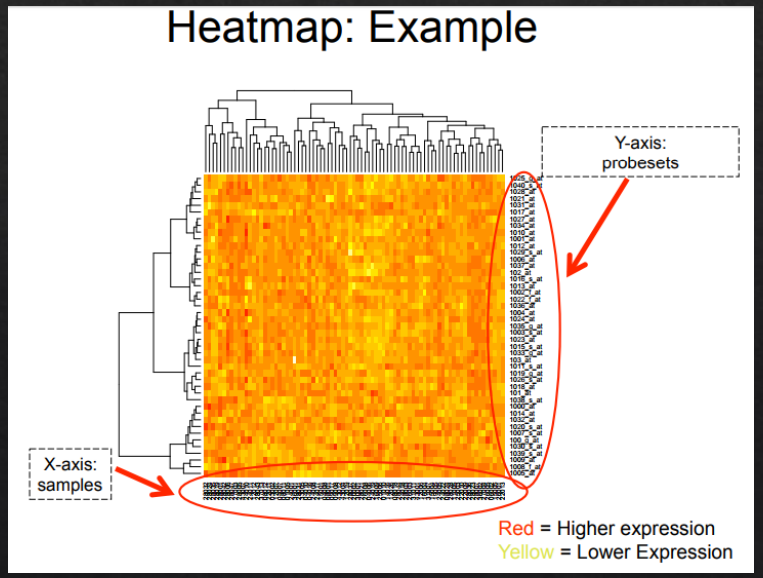
courtesy: Kevin Verbeek

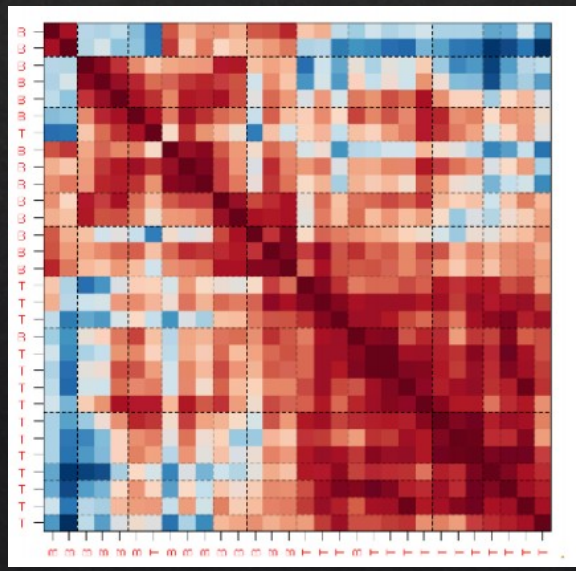
~~Thematic Maps~~

Heat Map

A heat map is a graphical representation of data where the values taken by a variable in a two-dimensional map are represented as colors







- Heatmap shows the distance between genes
- Dotted lines: "breaks" between clusters

Is this a heat map?

Infrared camera: an image
using infrared radiation

Is it confusing?

Heat Map

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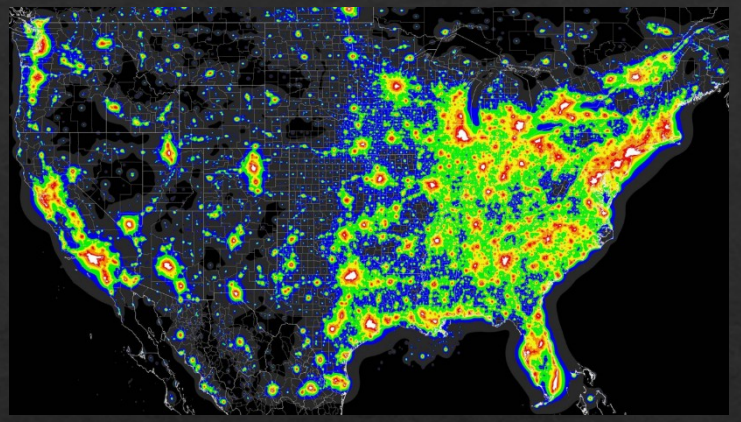


Choropleth

The regions of the map are shaded or patterned according to their data values.

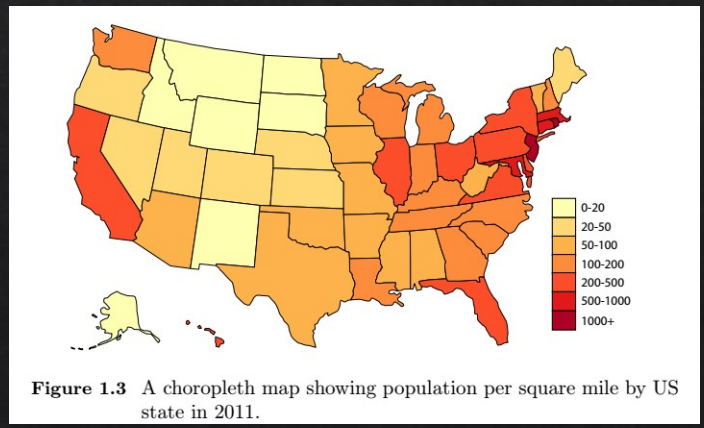
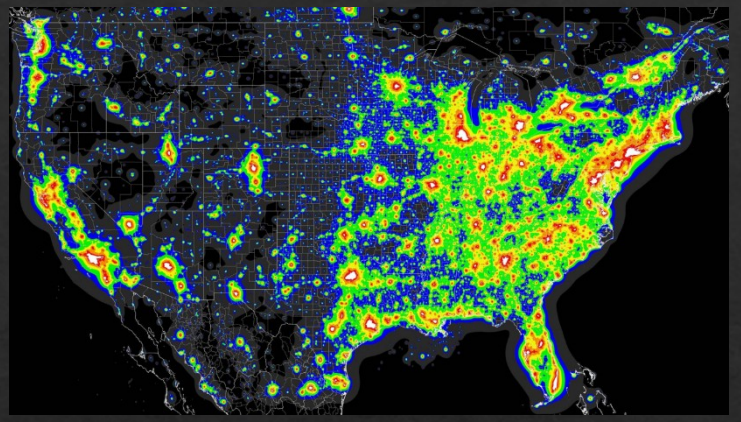


Figure 1.3 A choropleth map showing population per square mile by US state in 2011.

Is it confusing?

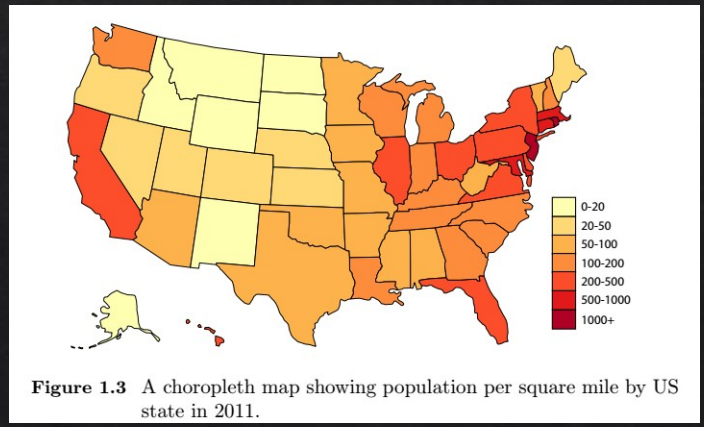
Heat Map

- The unit is the cell of a regular grid overlaid on map by you
- Colors are often controlled algorithmically



Choropleth

- The unit is usually given, known or non-uniform
- Colors are often specified as a set of discrete set of colors



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