

# Data Visualization (CSCI 627/490)

---

## Marks and Channels

Dr. David Koop

# Quiz

# Quiz

---

1. If we start with a selection  $s$  of two rectangles joined with data items 2 and 4, respectively, what is `s.data([2, 3, 7], d => d).enter()`?
- (a) `[3, 7]`
  - (b) `[2, 3, 7]`
  - (c) `[]`
  - (d) `[7]`

# Quiz

---

2. Which d3 call is used to set the x, y, width, and height for a collection of rectangles?
- (a) `attr`
  - (b) `style`
  - (c) `prop`
  - (d) `setProperty`

# Quiz

---

3. Which element servers as the base for child elements like `rect`, `circle`, and `line`?

- (a) `<canvas>`
- (b) `<diagram>`
- (c) `<svg>`
- (d) `<img>`

# Quiz

---

4. Which SVG element enables transforms to be applied to all of its descendants?

- (a) `<g>`
- (b) `<axis>`
- (c) `<group>`
- (d) `<transform>`

# Quiz

---

5. Which d3 call would you use to locate all rectangles in a document?

(a) `d3.select("rect")`

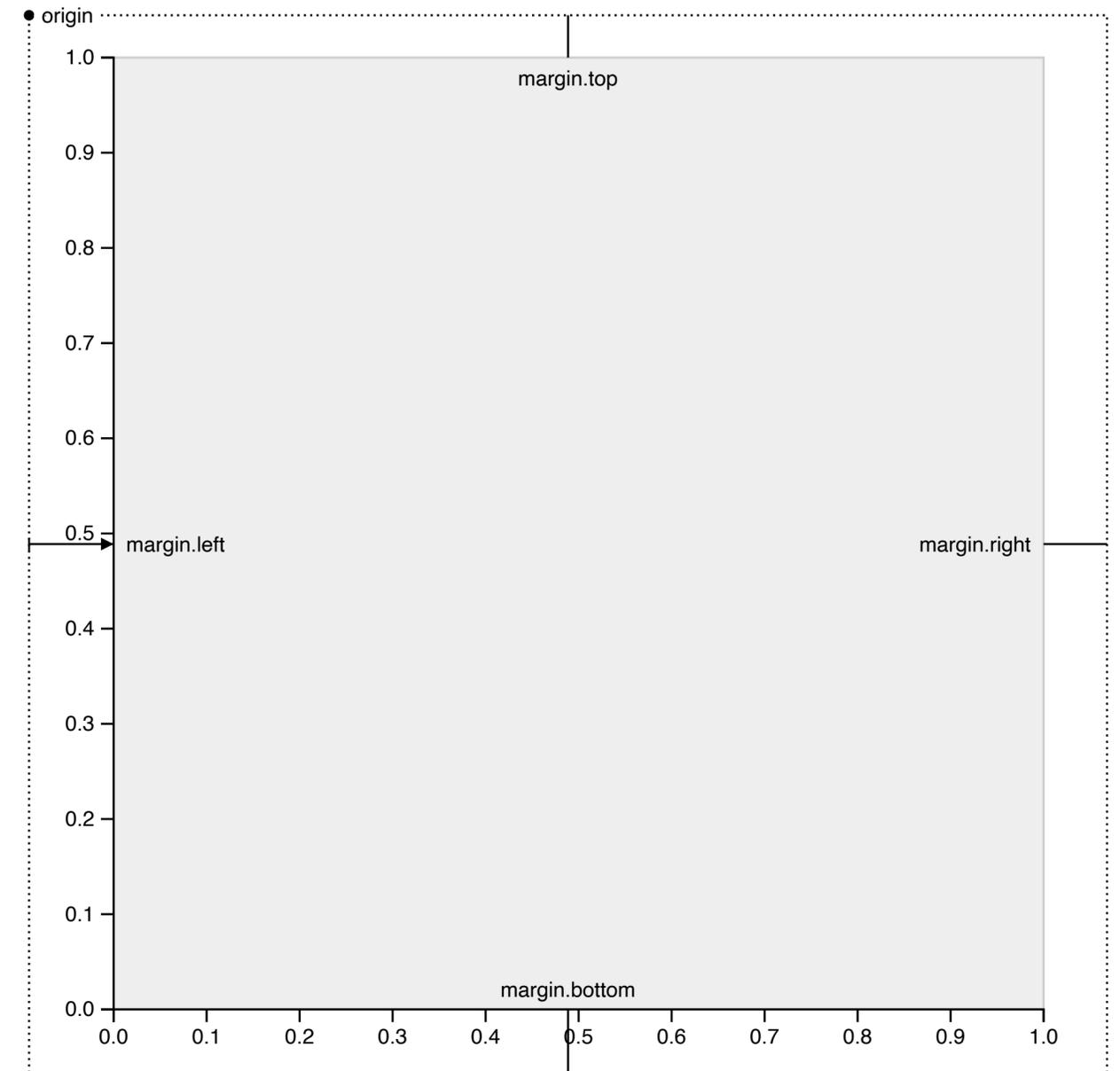
(b) `d3.querySelectorAll("rect")`

(c) `d3.join("rect")`

(d) `d3.selectAll("rect")`

# D3 Margin Convention

- Observable Notebook
- Three Bar Charts:
  - Similar Solution
  - With Axes and Scales
  - With Objects and Margin Convention
- More on Margin Convention:
  - <https://observablehq.com/@d3/margin-convention>



[M. Bostock]

# Toward Reusable Charts

---

- D3 does not provide "standard" charts
- E.g. there is no `barchart` method
- What is a standard chart?
  - "Should you expose the underlying scales and axes, or encapsulate them with chart-specific representations?"
  - "Should your chart support interaction and animation automatically?"
  - "Should the user be able to reach into your chart and tweak some aspect of its behavior?"

[Towards Reusable Charts, M. Bostock, 2012]

# Project Proposal

---

- Explore the listed project datasets
- Consider a group
- Submit proposal
  - Dataset including attributes with classifications
  - Tasks (make sure they are visualization tasks)
  - Initial sketch
- Goal: Interesting questions that allow different designs
- If you are doing research and can tie this project in, please contact me

# Assignment 3

---

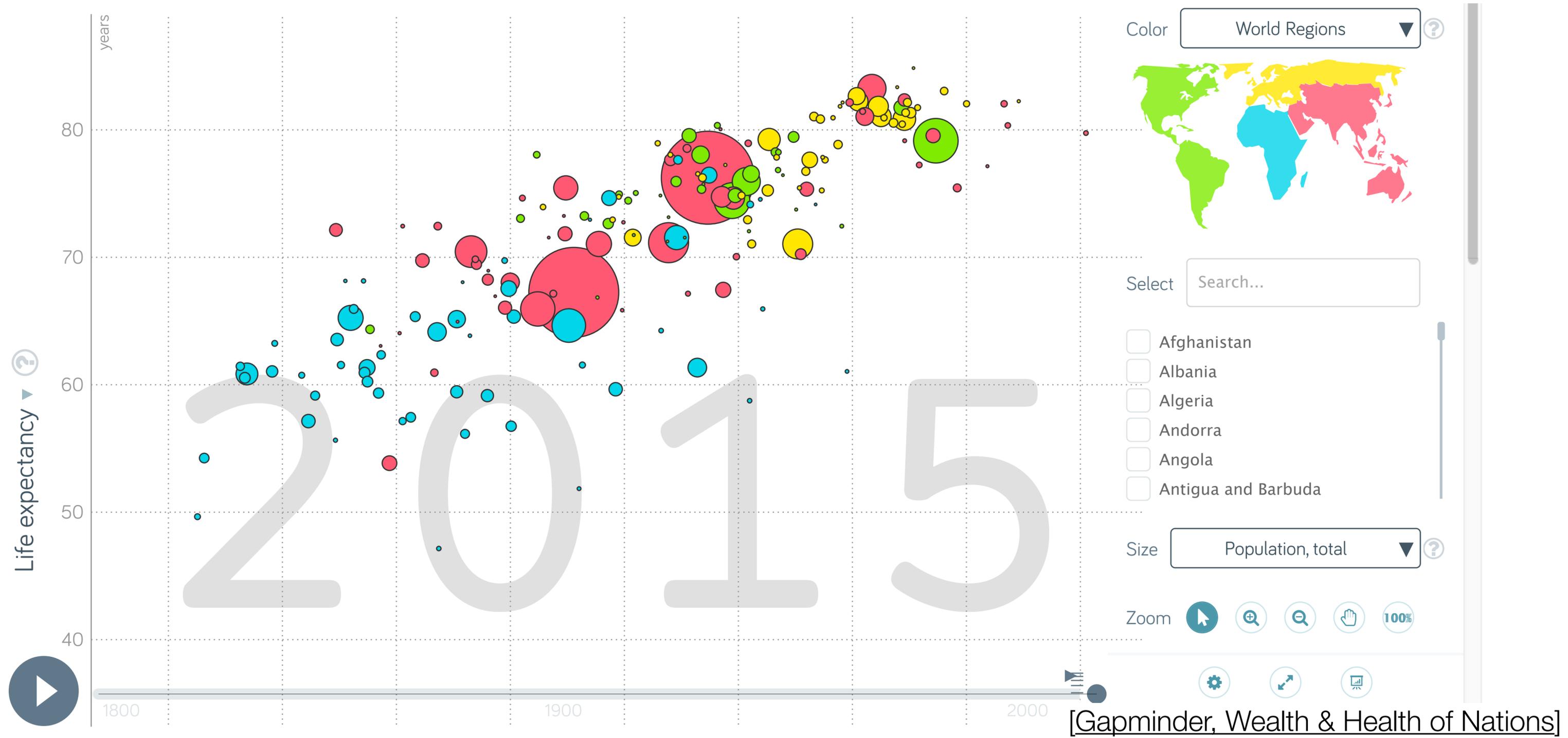
- Forthcoming
- Create the same visualization using
  - Tableau Public
  - Observable Plot
  - D3

# Visual Encoding

- How should we visualize this data?

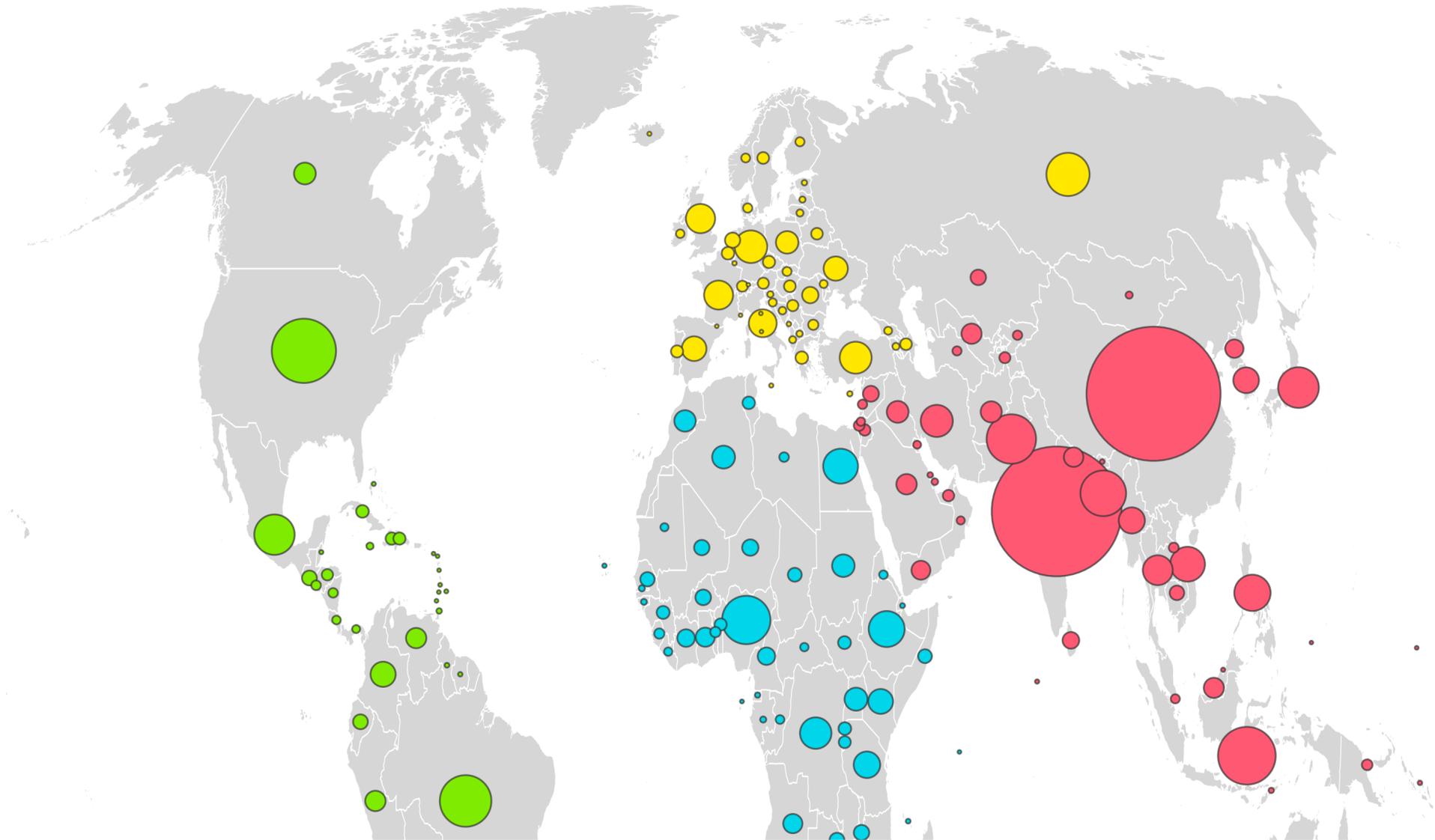
Name	Region	Population	Life Expectancy	Income
China	East Asia & Pacific	1335029250	73.28	7226.07
India	South Asia	1140340245	64.01	2731
United States	America	306509345	79.43	41256.08
Indonesia	East Asia & Pacific	228721000	71.17	3818.08
Brazil	America	193806549	72.68	9569.78
Pakistan	South Asia	176191165	66.84	2603
Bangladesh	South Asia	156645463	66.56	1492
Nigeria	Sub-Saharan Africa	141535316	48.17	2158.98
Japan	East Asia & Pacific	127383472	82.98	29680.68
Mexico	America	111209909	76.47	11250.37
Philippines	East Asia & Pacific	94285619	72.1	3203.97
Vietnam	East Asia & Pacific	86970762	74.7	2679.34
Germany	Europe & Central Asia	82338100	80.08	31191.15
Ethiopia	Sub-Saharan Africa	79996293	55.69	812.16
Turkey	Europe & Central Asia	72626967	72.06	8040.78

# Potential Solution



# Another Solution

Size: Population, total ?



Color World Regions ?



Select Search...

- Afghanistan
- Albania
- Algeria
- Andorra
- Angola
- Antigua and Barbuda
- Argentina
- Armenia
- Australia

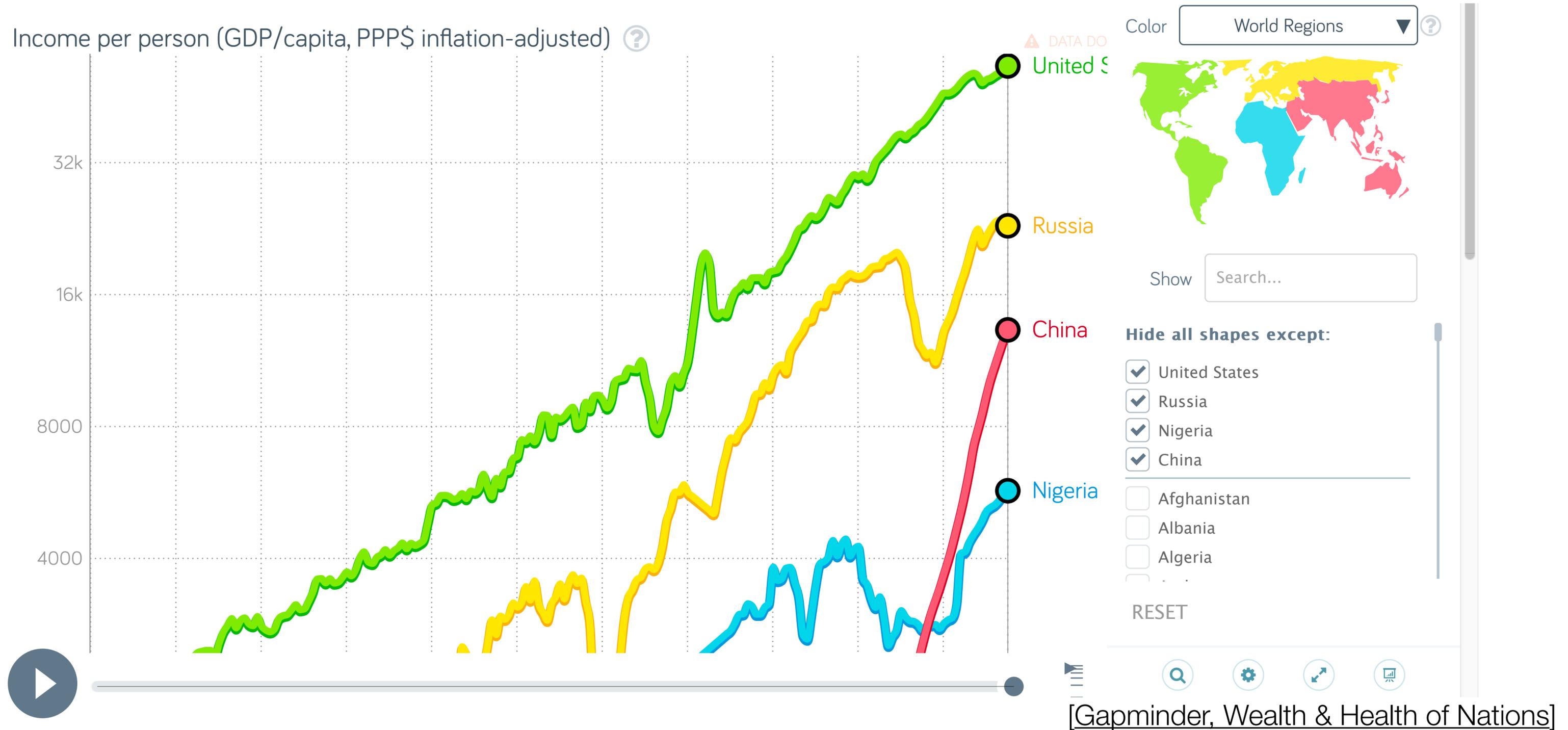
Size Population, total ?



[Gapminder, Wealth & Health of Nations]

What about change over years?

# Another Solution showing trends over time

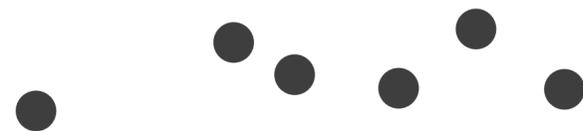


# Visual Encoding

---

- How do we encode data visually?
  - **Marks** are the basic graphical elements in a visualization
  - **Channels** are ways to control the appearance of the marks
- Marks classified by dimensionality:

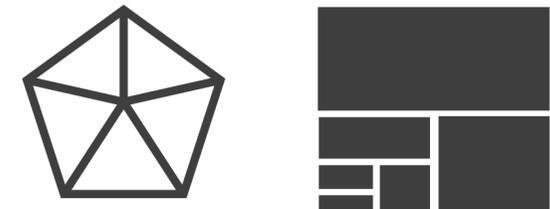
➔ **Points**



➔ **Lines**

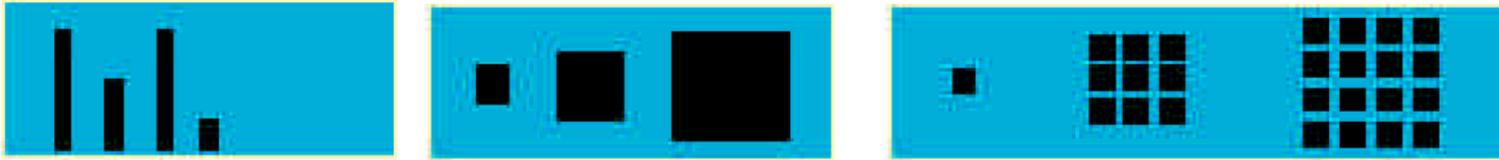
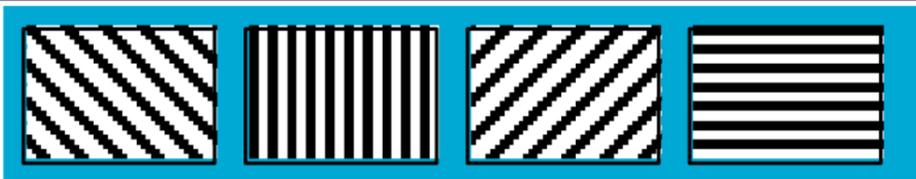
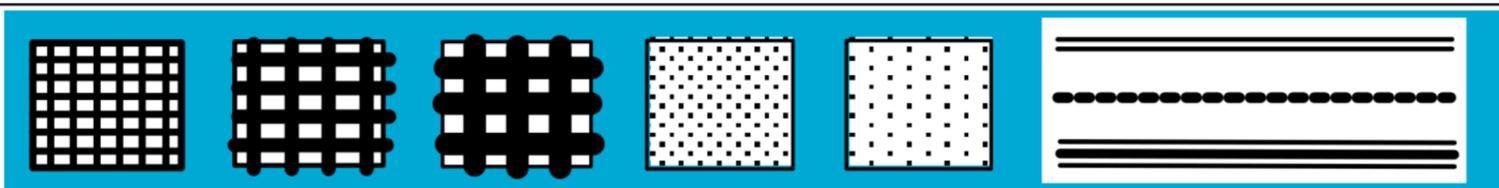


➔ **Areas**



- Also can have surfaces, volumes
- Think of marks as a mathematical definition, or if familiar with tools like Adobe Illustrator or Inkscape, the path & point definitions

# Bertin - Visual Variables

Bertin's Original Visual Variables	
<b>Position</b> changes in the x, y location	
<b>Size</b> change in length, area or repetition	
<b>Shape</b> infinite number of shapes	
<b>Value</b> changes from light to dark	
<b>Colour</b> changes in hue at a given value	
<b>Orientation</b> changes in alignment	
<b>Texture</b> variation in 'grain'	

# Visual Channels

## → Position

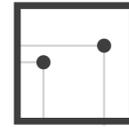
→ Horizontal



→ Vertical



→ Both



## → Color



## → Shape



## → Tilt



## → Size

→ Length



→ Area



→ Volume



[Munzner (ill. Maguire), 2014]

# Visual Attributes Survey

## Table of Visual Attributes

Richard Brath  
v. Sept 2013

		Information Visualization Researchers										Vision Rsch	Shape Rsch
		Bertin 1967	Cleveland 1985	MacKinlay 1986	MacEachren 1995	Wilkinson 1999	Ware 2000	Mazza 2009	Illiinsky 2012	Chen, Florida 2013	Preattentive Perception	Brath 2009/2011	
<b>Trans- form</b>	Position	X	X	X	X	X	X	X	X	X			
	Length		X	X			X	X	X	X	X		
	Size (Area)	X	X	X	X	X	X	X	X	X	X		
	Orientation	X		X	X	X	X	X	X	X	X		
	Volume		X	X			X						
<b>Shape</b>	Shape	X		X	X	X	X	X	X	X		X	
	Angle		X	X						X		X	
	Curvature										X	X	
	Mark										X	X	
	Line Ending							X	X	3	X	X	
	Closure									X	X	X	
	Local Warp											X	
	Edge Type									1,2		X	
	Corner Type									3		X	
	Icon, glyph, etc									4			
<b>Colour</b>	Brightness	X		X	X	X	X	X	X	X	X		
	Hue	X	X	X	X	X	X	X	X	X	X		
	Saturation			X	X	X	X	X	X	X			

[R. Brath]

# More Visual Attributes

Table of Visual Attributes Richard Brath v. Sept 2013		Information Visualization Researchers									Vision Rsch	Shape Rsch
		Bertin 1967	Cleveland 1985	MacKinlay 1986	MacEachren 1995	Wilkinson 1999	Ware 2000	Mazza 2009	Illiinsky 2012	Chen, Floridi 2013	Preattentive Perception	Brath 2009/2011
<b>Texture</b>	Granularity	X		X	X	X	X	X	X			
	Pattern					X	X	X	X			
	Orientation					X	X					
<b>Relation</b>	Connection			X				X	X	X		
	Containment			X				X	X			
<b>Optics</b>	Blur				X	X				X		
	Transparency				X	X				X		
	Stereo Depth									X		
	Concavity								X	X		
	Light Direction								X	X		
	Shadow								X			
	Partial occlusion								X			
	<b>Move-ment</b>	Flicker					X			X	X	
Speed						X			X	X		
Direction									X	X		
<b>Misc</b>	Numerosity								X	X		
	Spatial Grouping								X	X		
	Arrangement				X							
	Resolution				X							
	Artistic Effects									X		
	Text Labels							X	X	X		

[R. Brath]

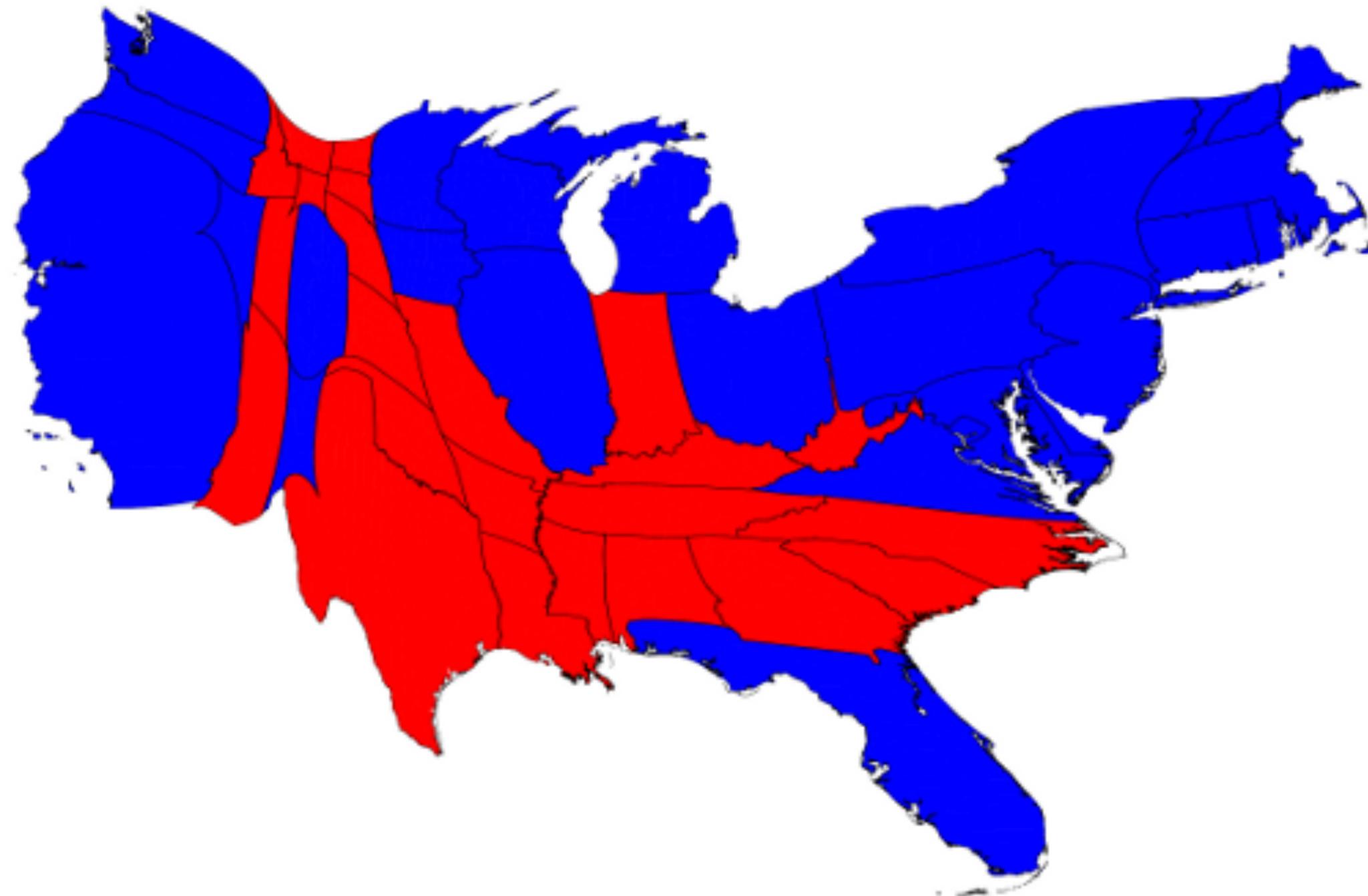
# Channels

---

- Usually map an attribute to a single channel
  - Could use multiple channels but...
  - **Limited** number of channels
- Restrictions on size and shape
  - Points are nothing but location so size and shape are ok
  - Lines have a length, cannot easily encode attribute as length
  - Maps with boundaries have area, changing size can be problematic

# Cartograms

---



[Election Results by Population, M. Newman, 2012]