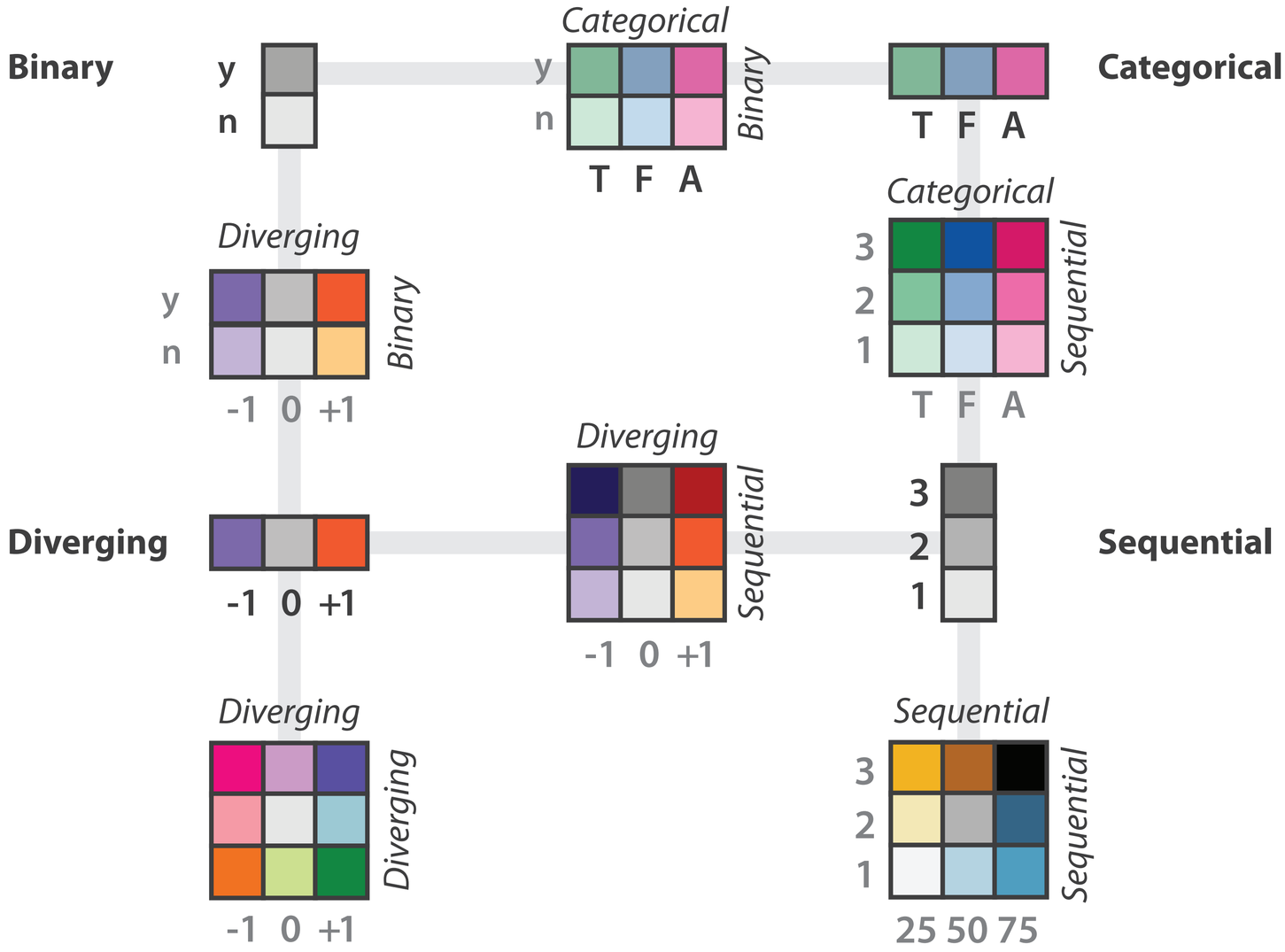
Data Visualization (CSCI 627/490)

Maps & Networks

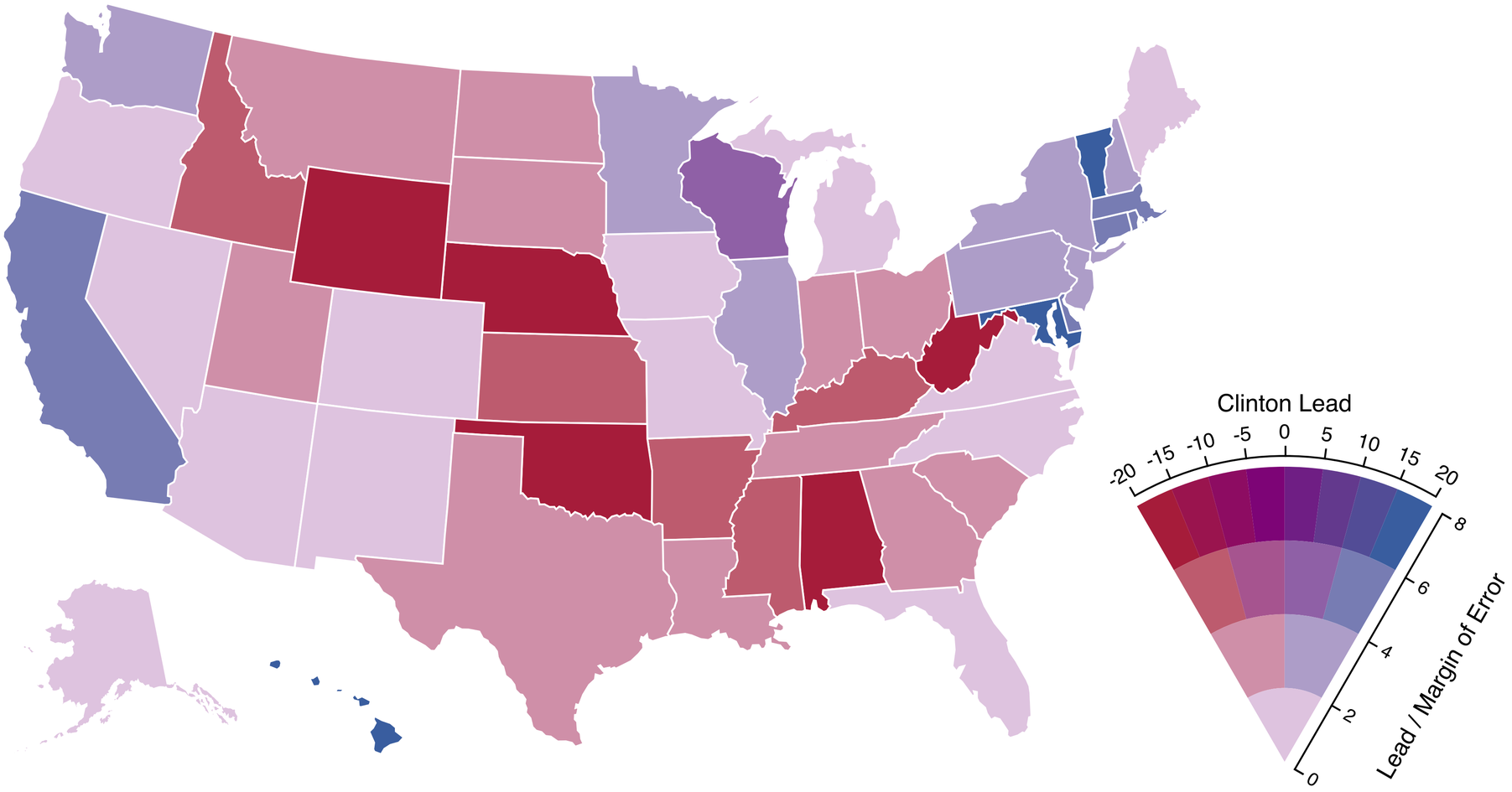
Dr. David Koop

Bivariate Colormaps



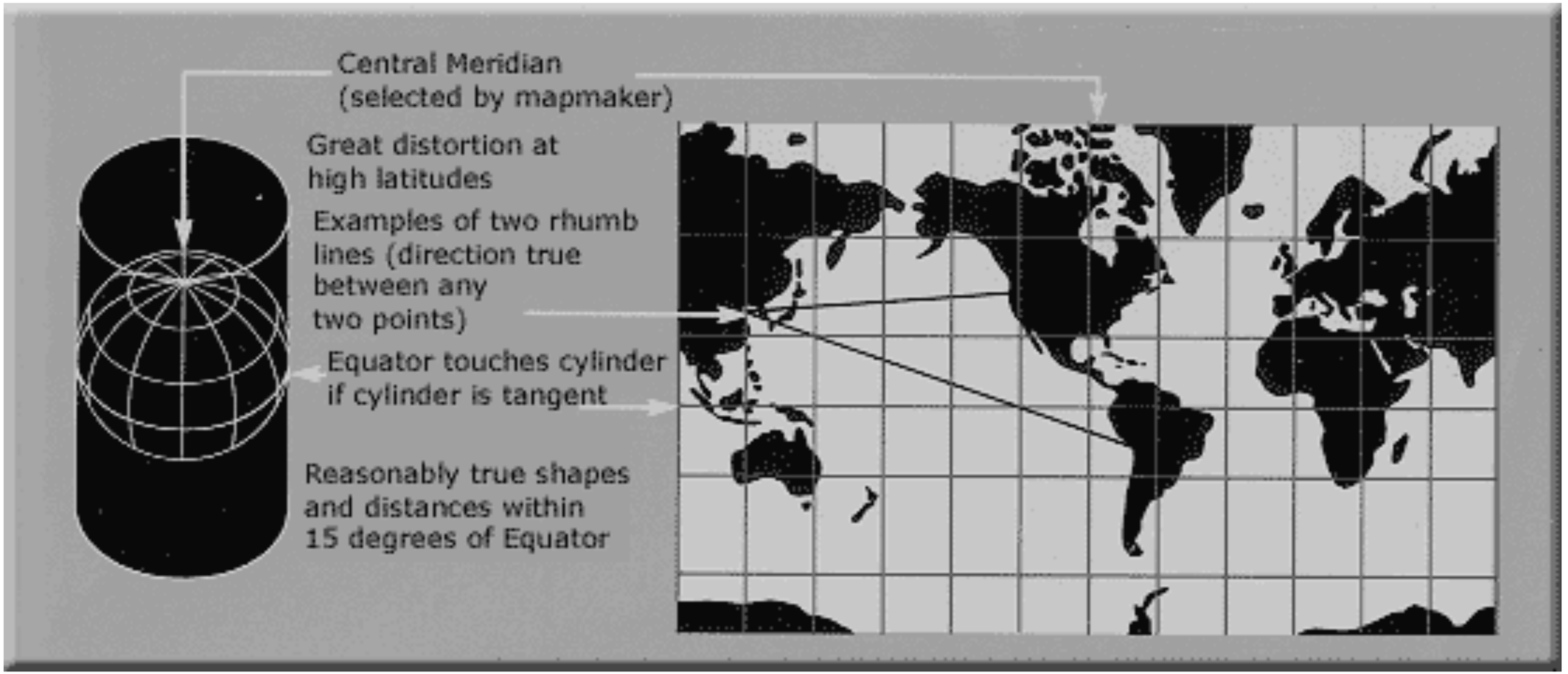
[Munzner (ill. Maguire), 2014]

Value-Suppressing Uncertainty Palette



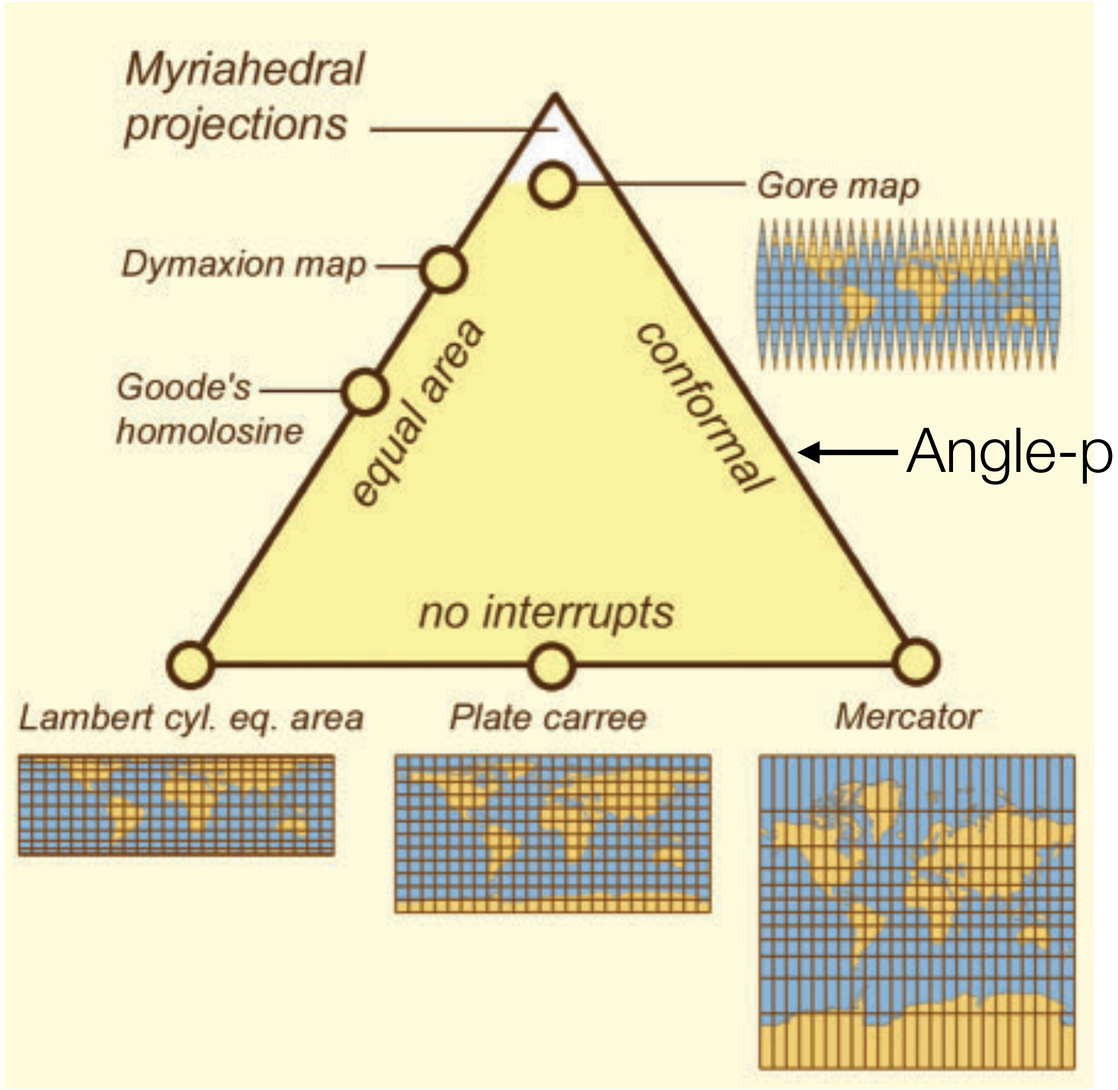
[Correll et al., 2018]

Geographic Data: 3D to 2D: Projection



[USGS Map Projections]

Projection Classification



[J. van Wijk, 2008]

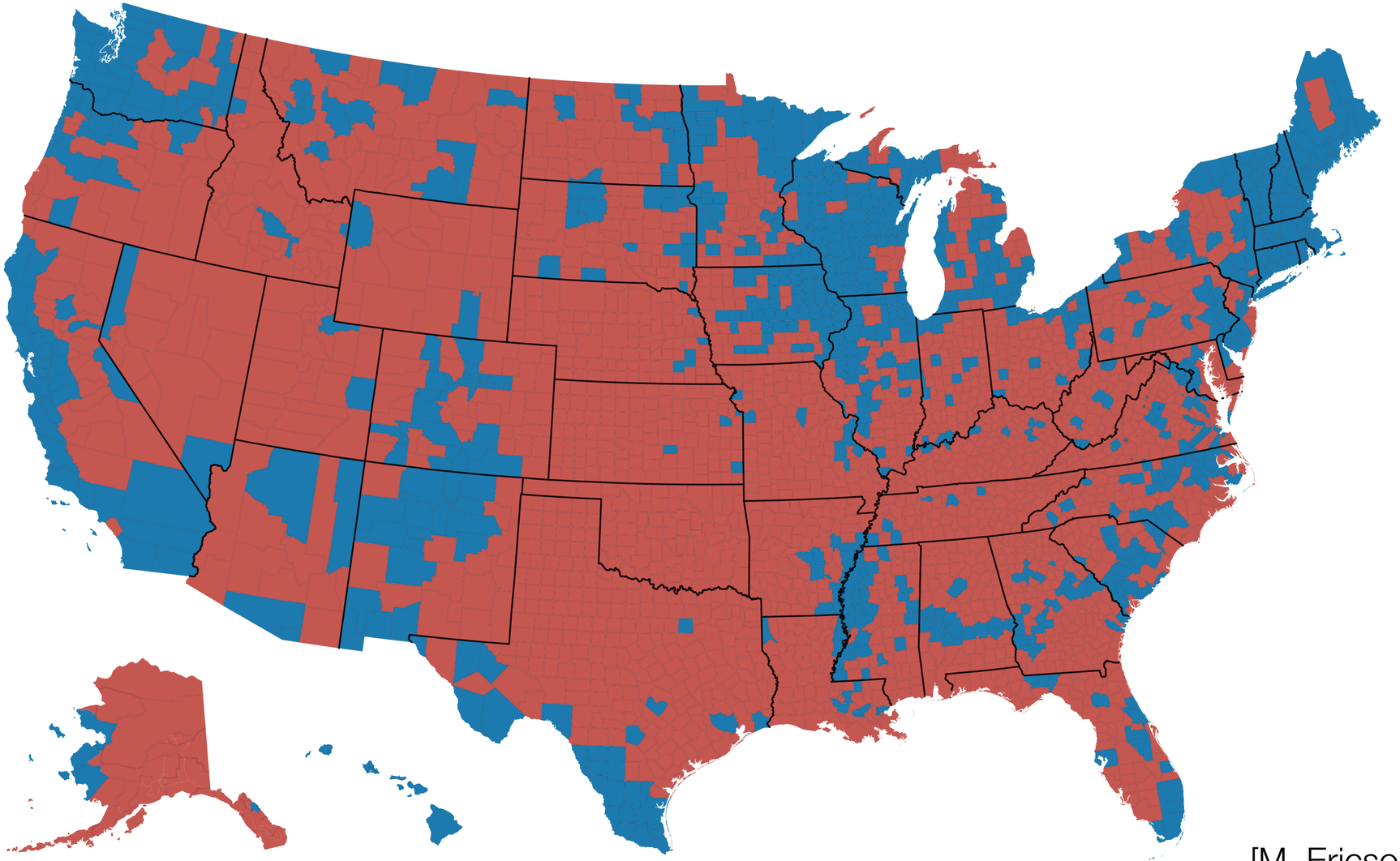
Project Proposal

- Two Possibilities:
  - Create an interactive visualization
  - Work on a research project
- Dataset Choices
  - US Food Safety Data
  - Illinois Hospital Report Card
  - NFL Data
  - US Register of Introduced and Invasive Species
  - Others?
- Proposal Due Wednesday

Assignment 4

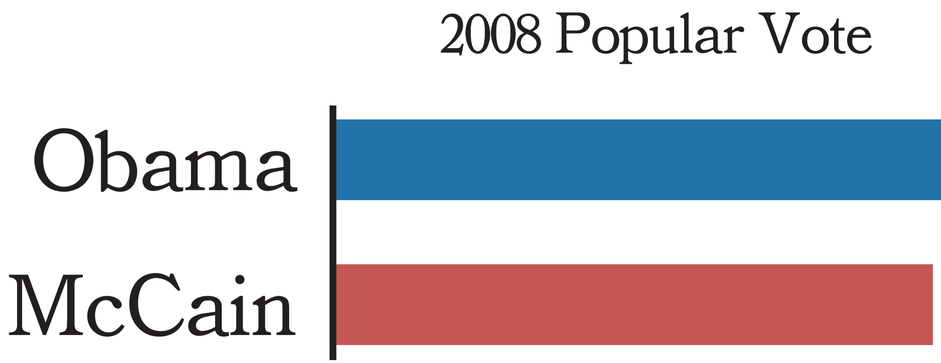
- To be announced soon

Choropleth (Two Hues)



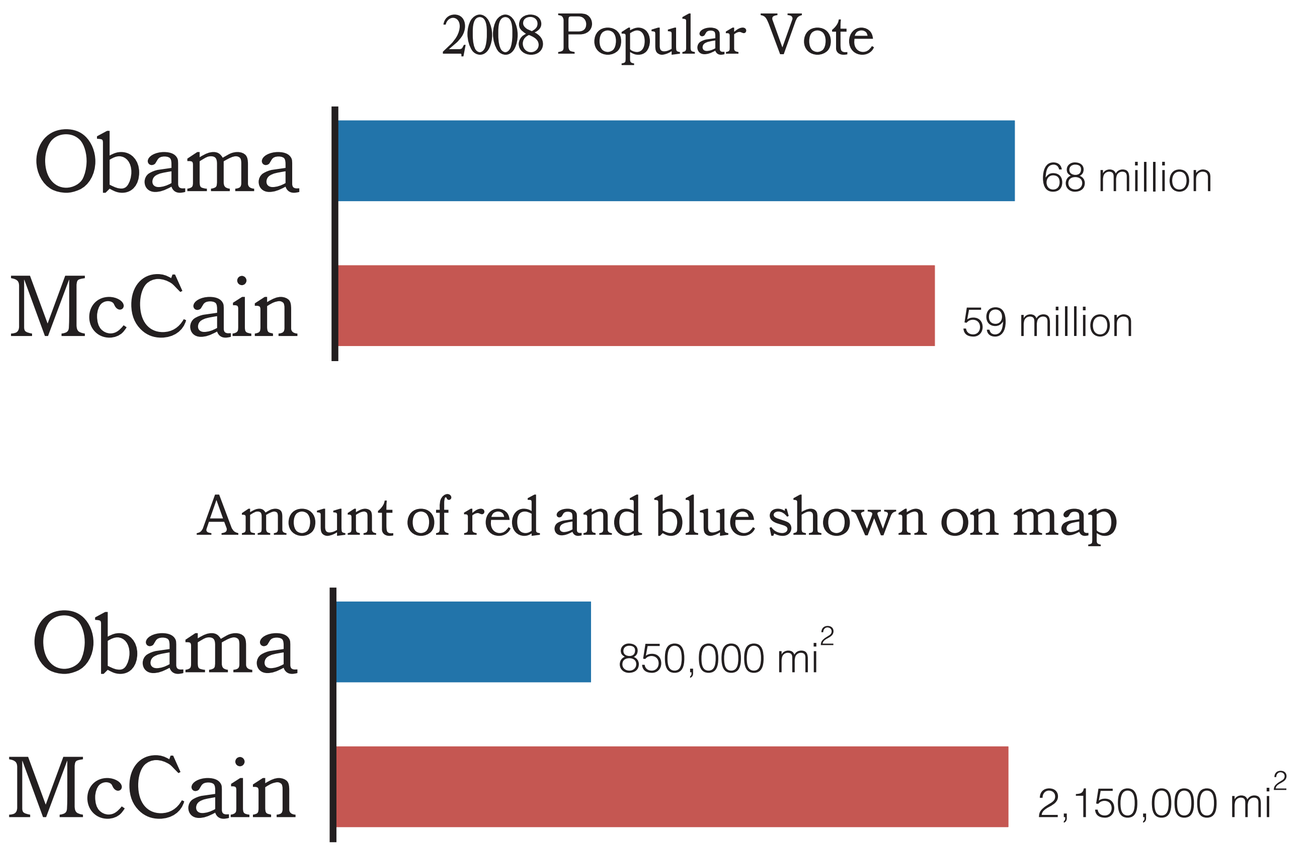
[M. Ericson, New York Times]

Problem?



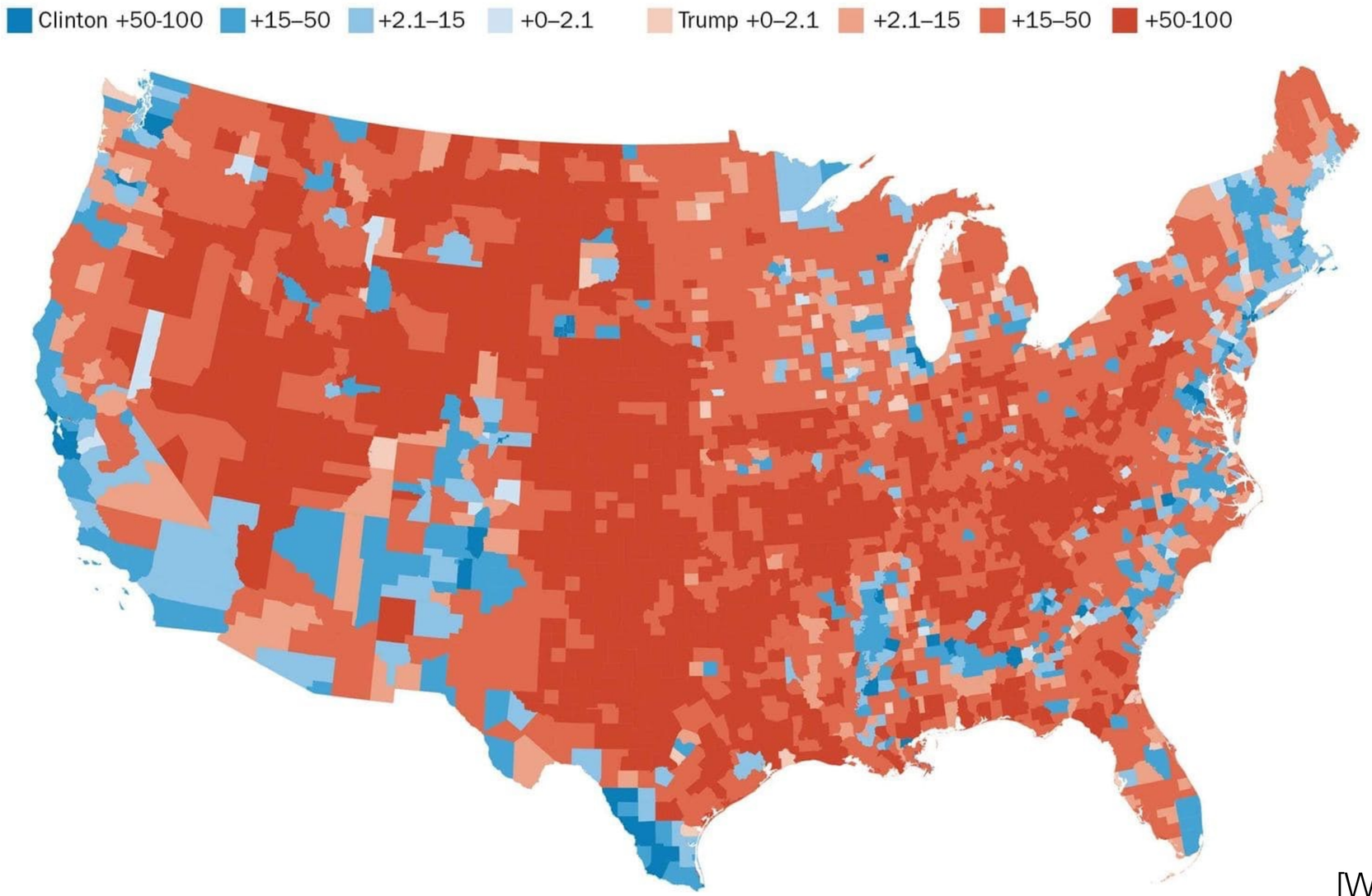
[M. Ericson, New York Times]

Problem?



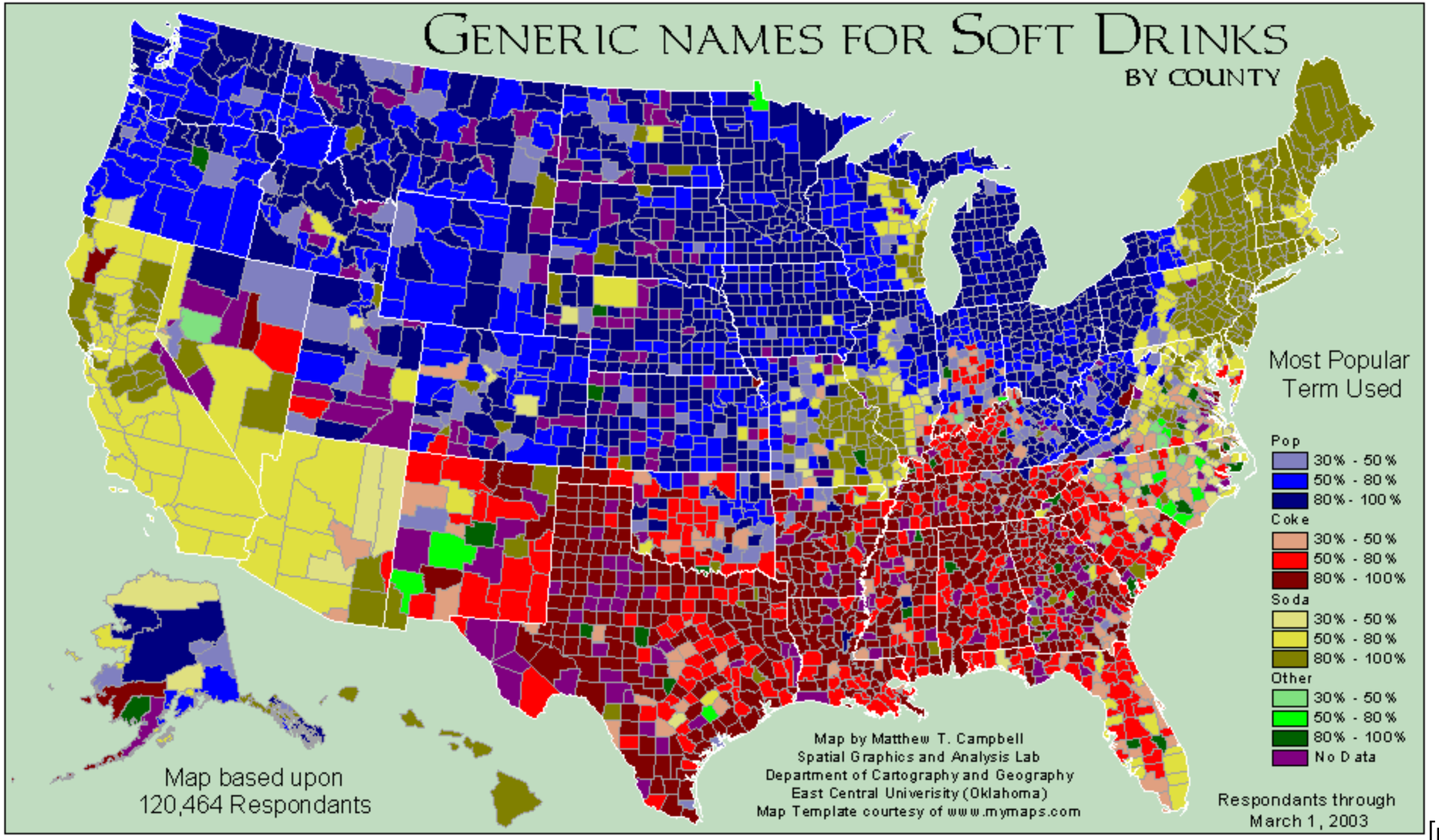
[M. Ericson, New York Times]

Adding Saturation



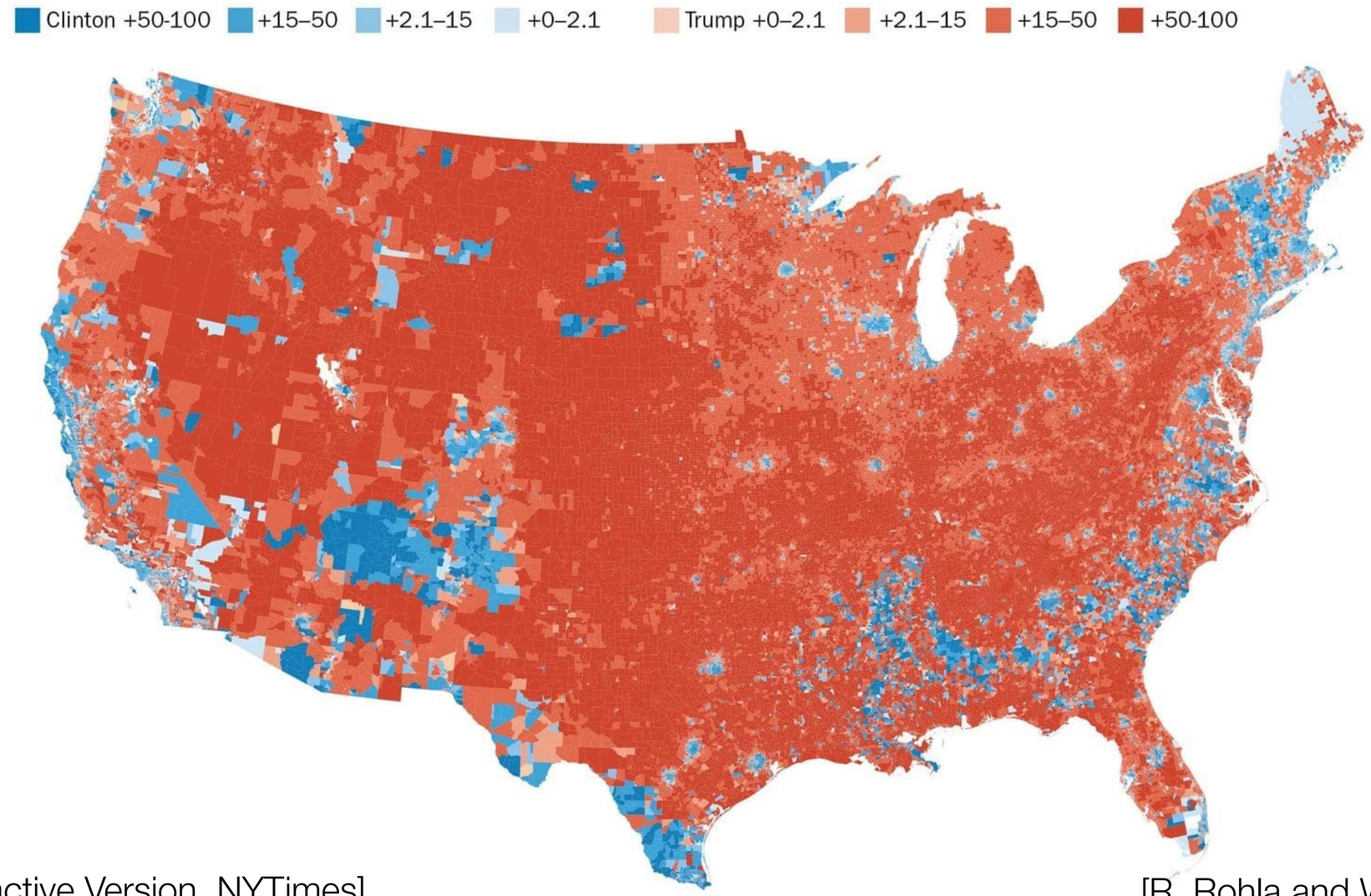
[Washington Post, 2018]

Area Marks and Color Hue & Saturation



[popvssoda.com]

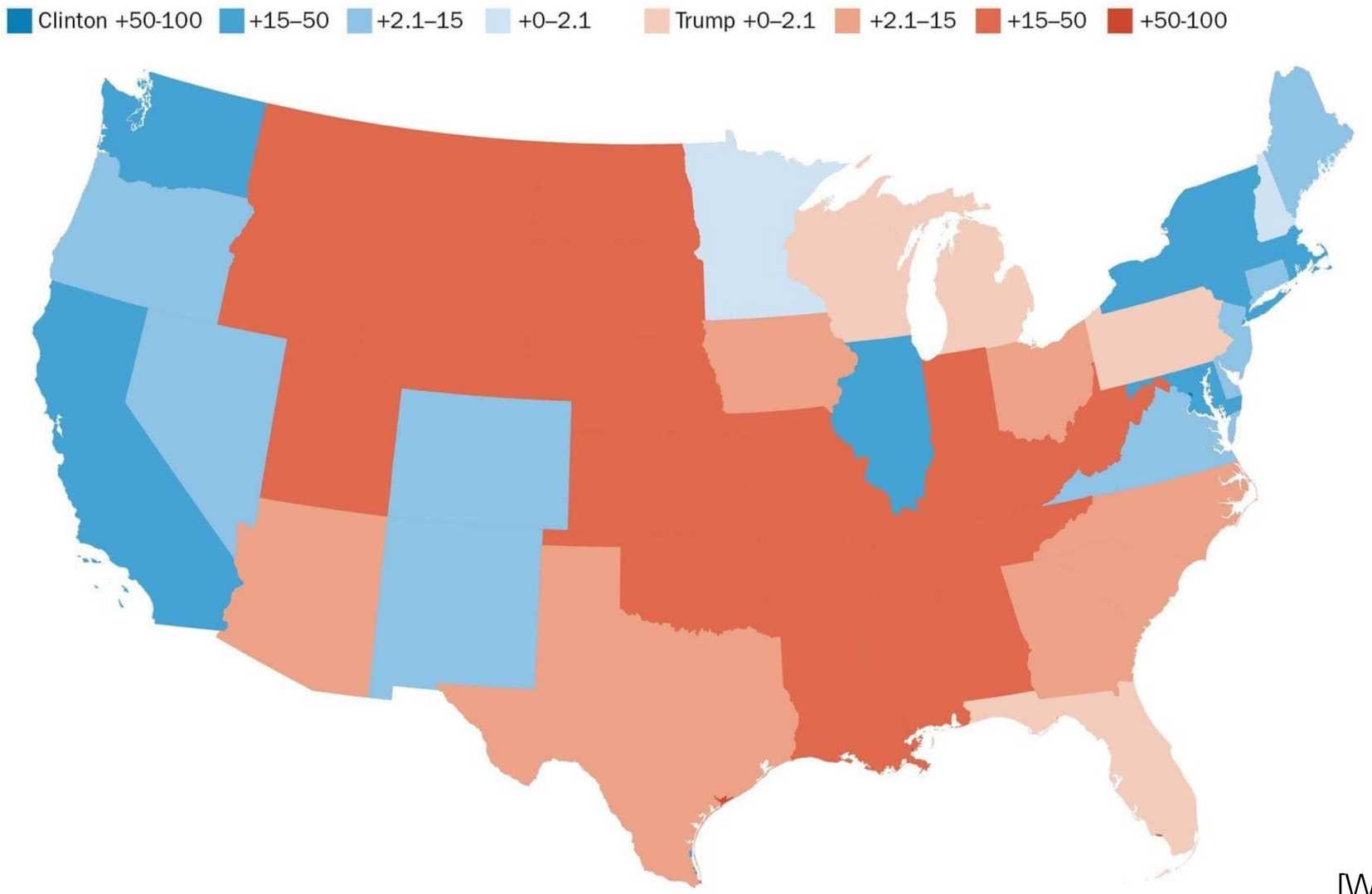
Aggregation: 2016 Election by Precinct



[Interactive Version, NYTimes]

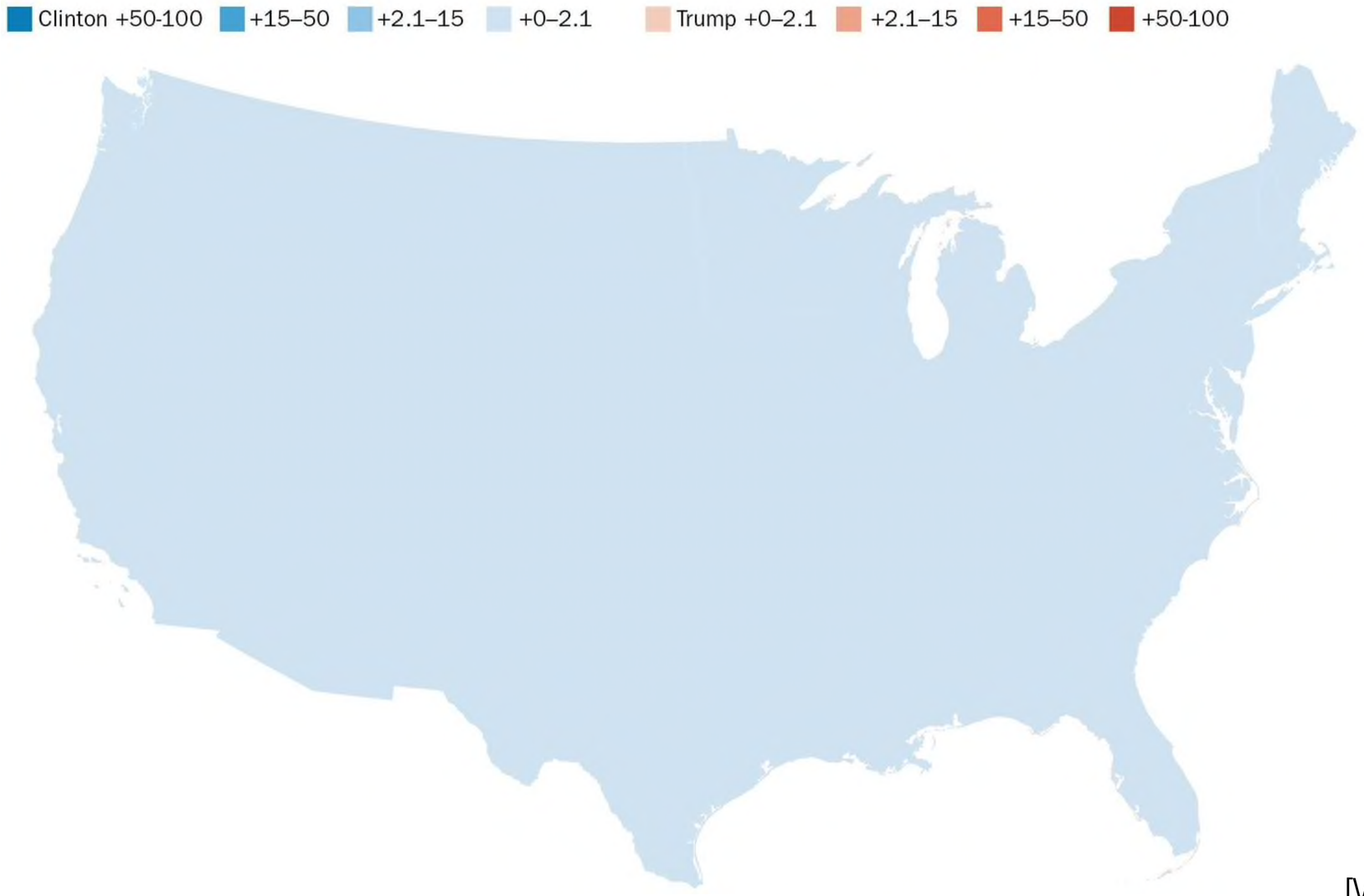
[R. Rohla and Washington Post, 2018]

Aggregation: 2016 Election by State



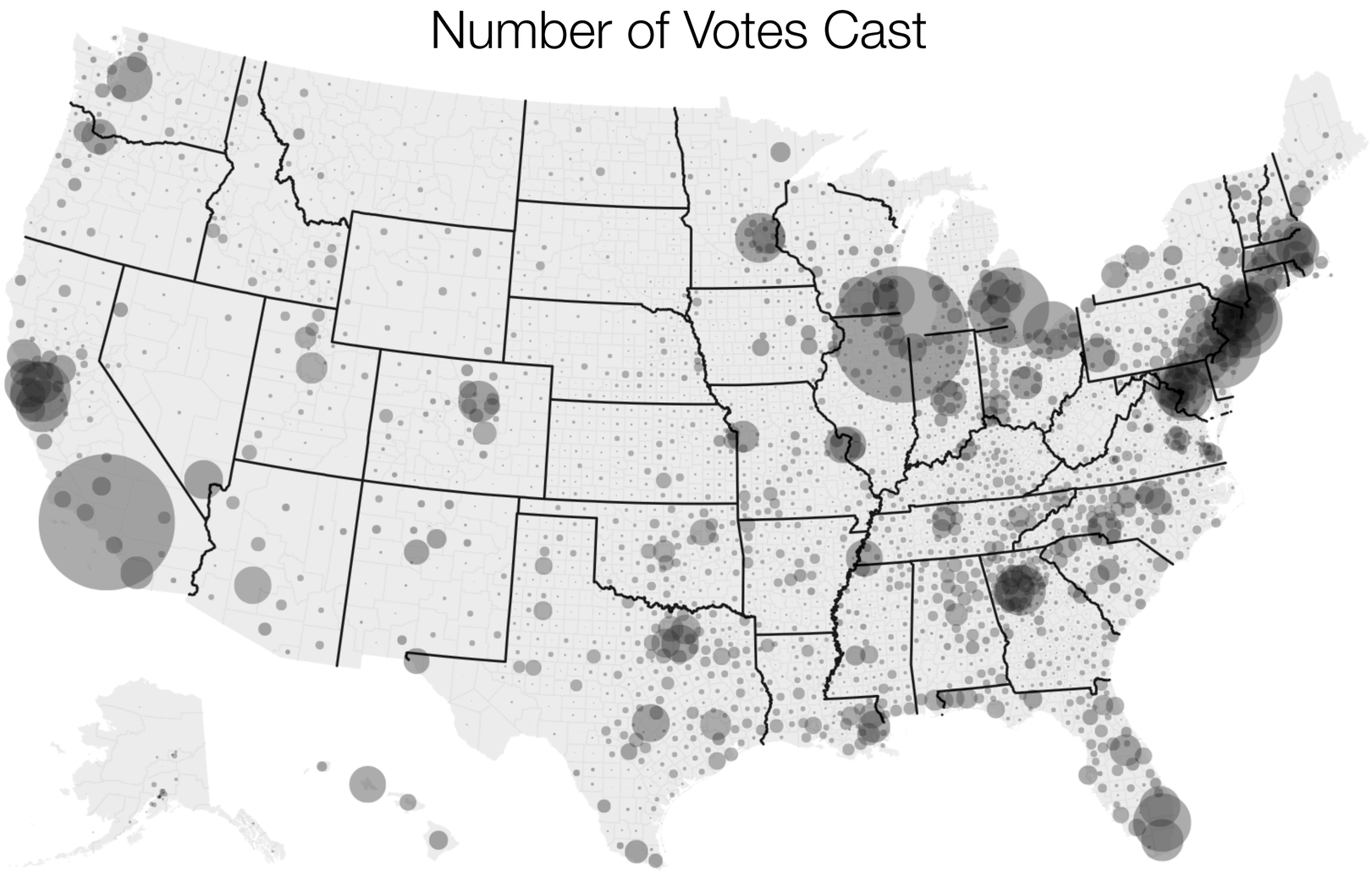
[Washington Post, 2018]

Aggregation: 2016 Election by Country



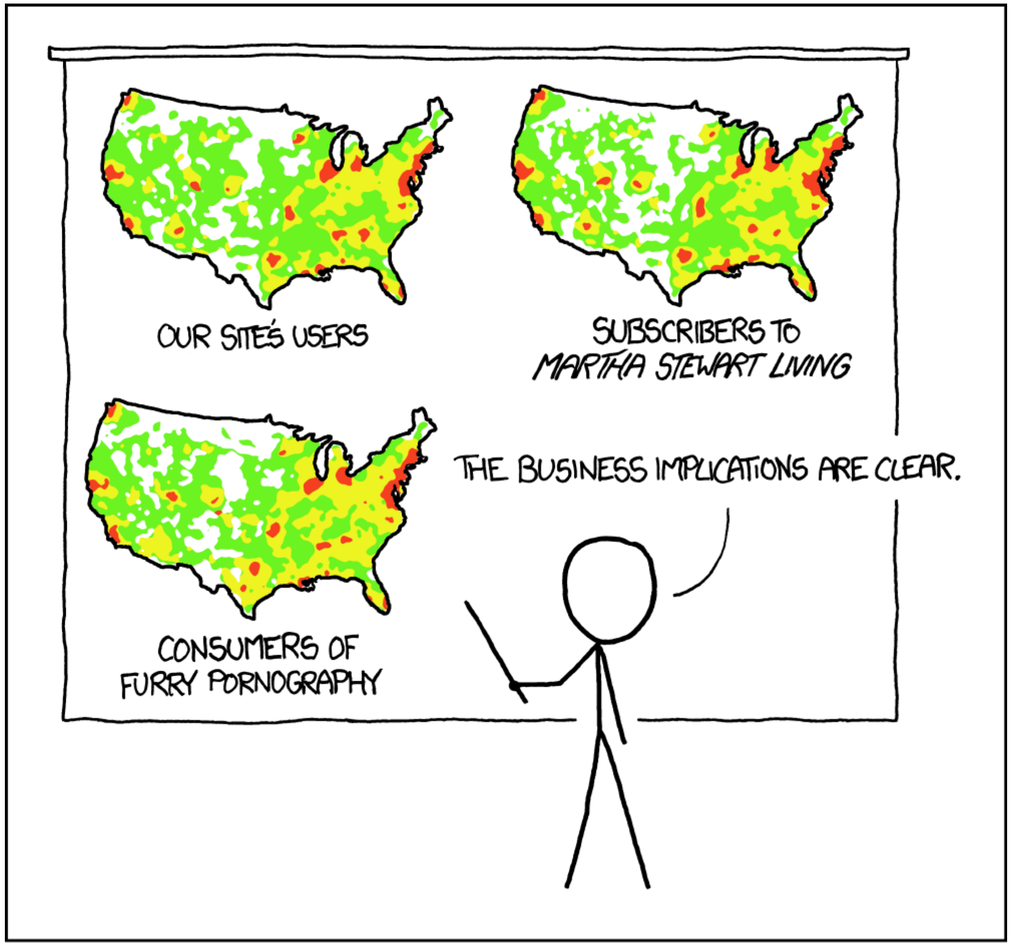
[Washington Post, 2018]

Maps: What trends do you see?



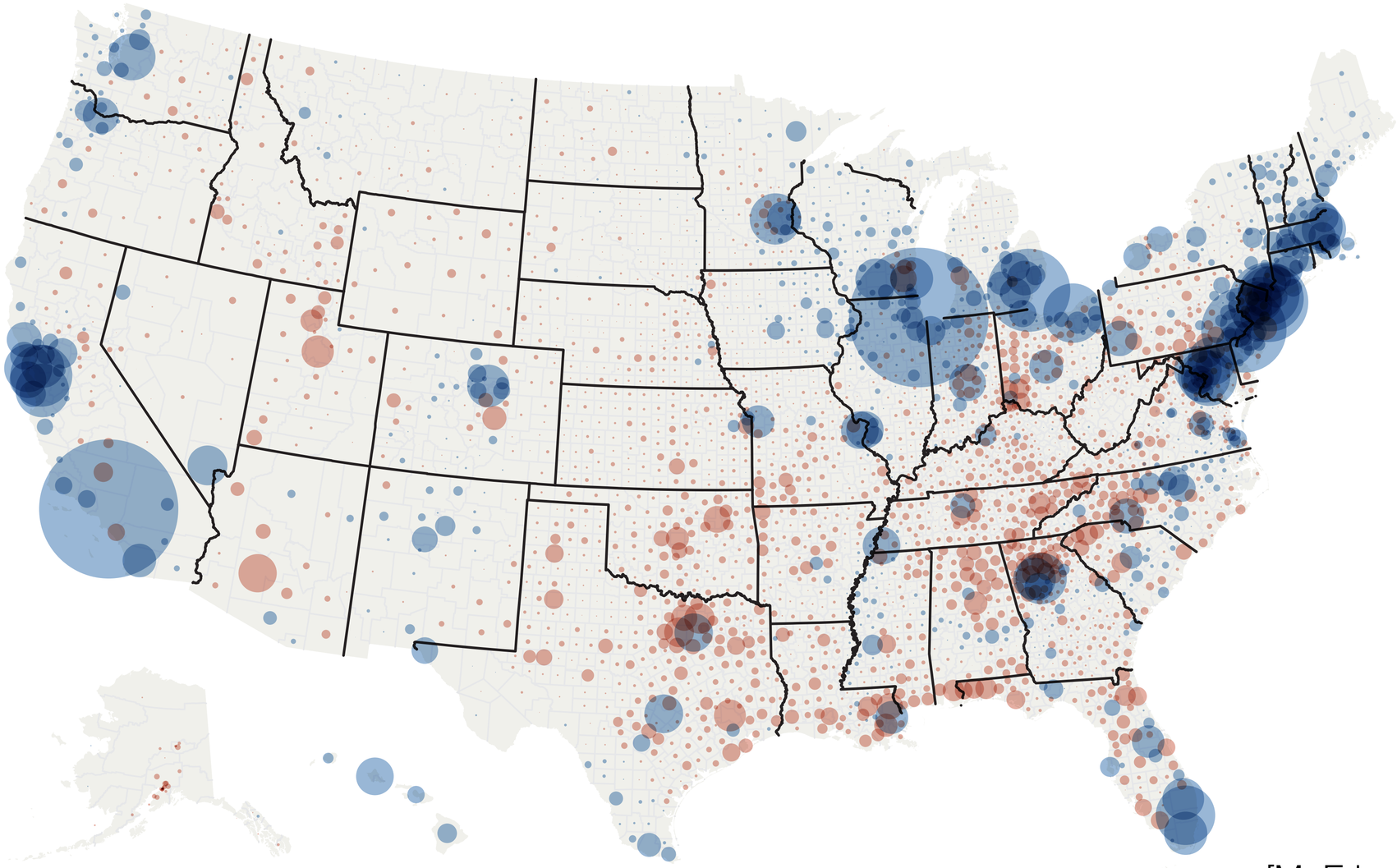
[Desaturated by D. Koop, M. Ericson, New York Times]

Don't Just Create Population Maps!



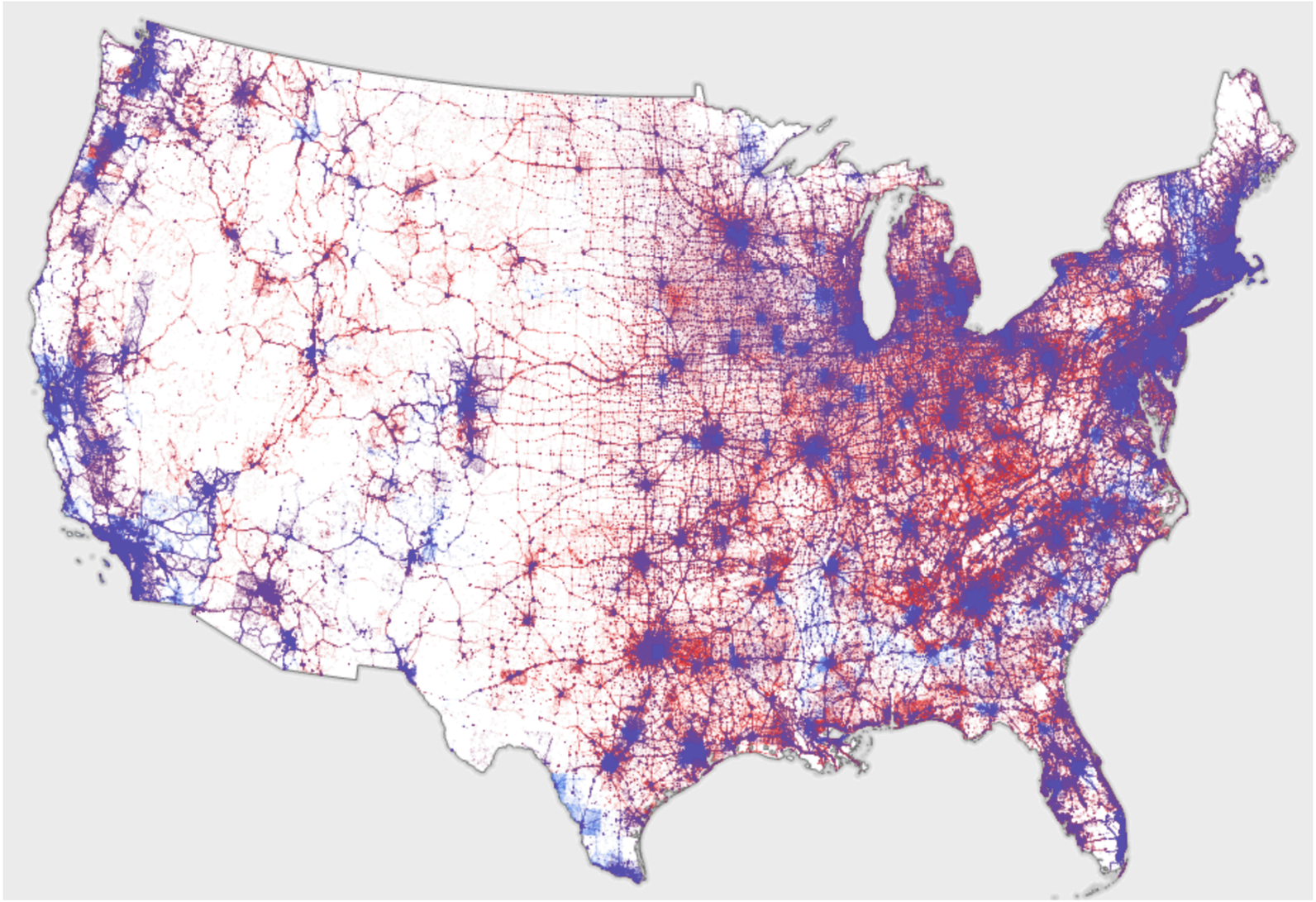
[xkcd]

Size Encoding



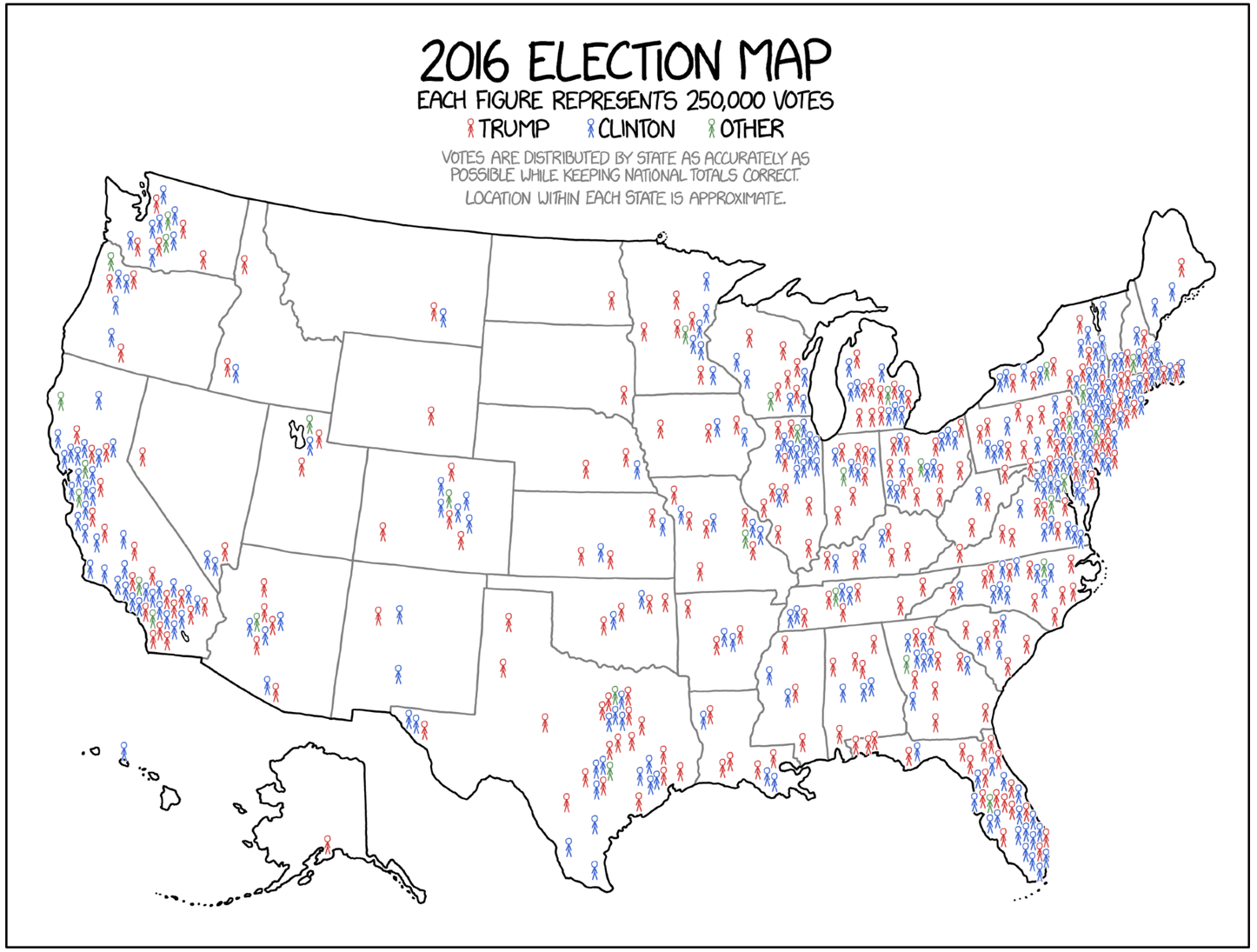
[M. Ericson, New York Times]

Dasymetric Dot Density



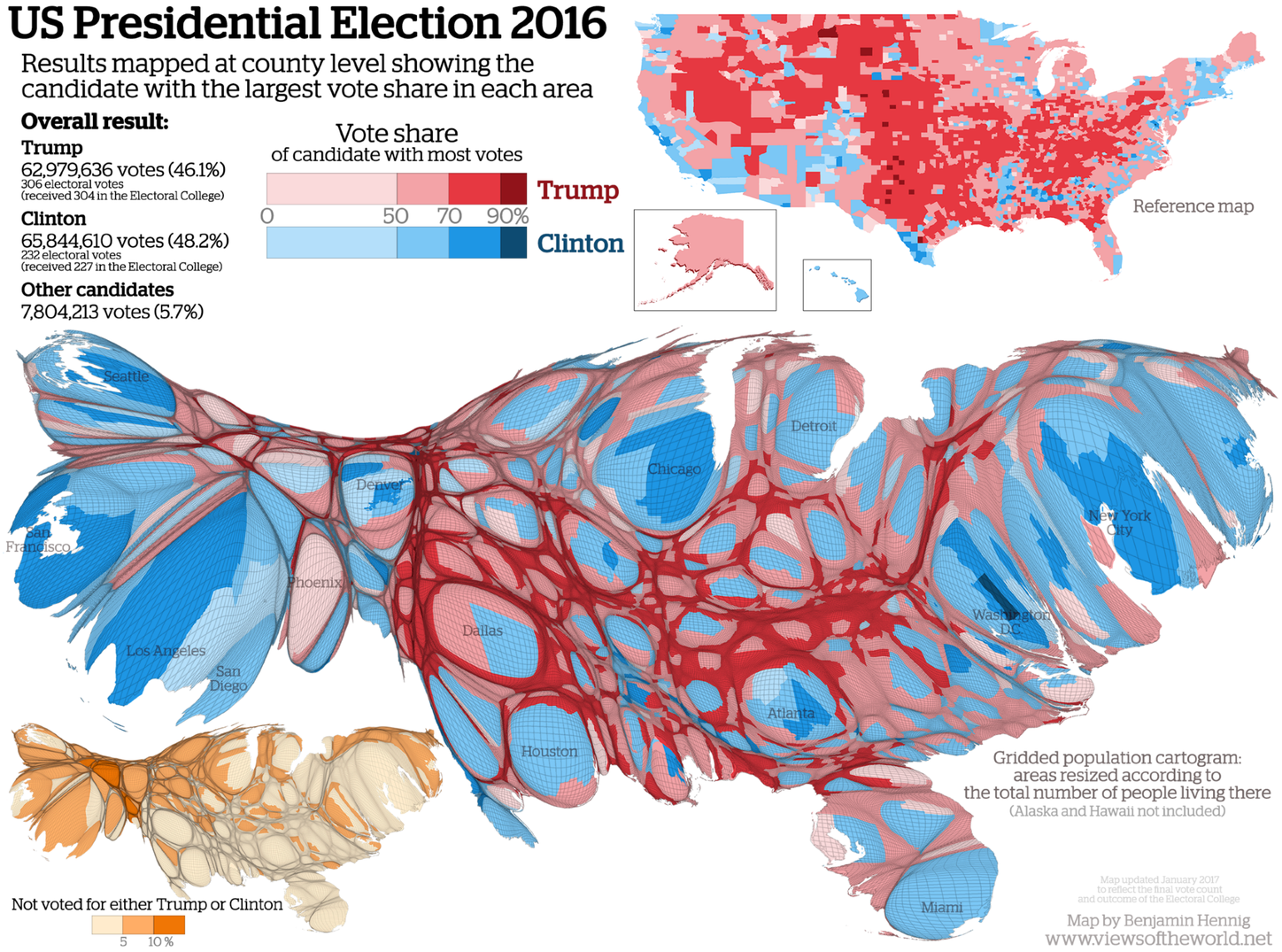
[K. Field]

Glyphs: xkcd's Map



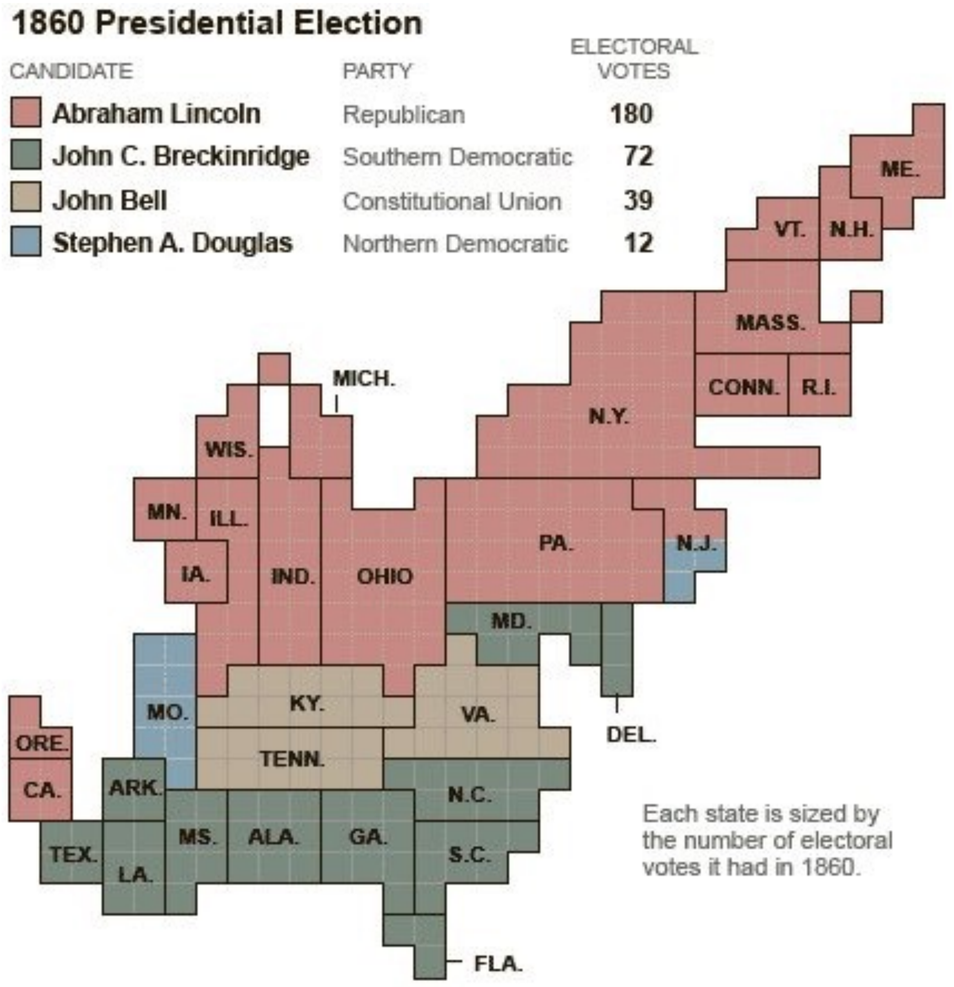
[xkcd]

Cartograms



[B. Hennig]

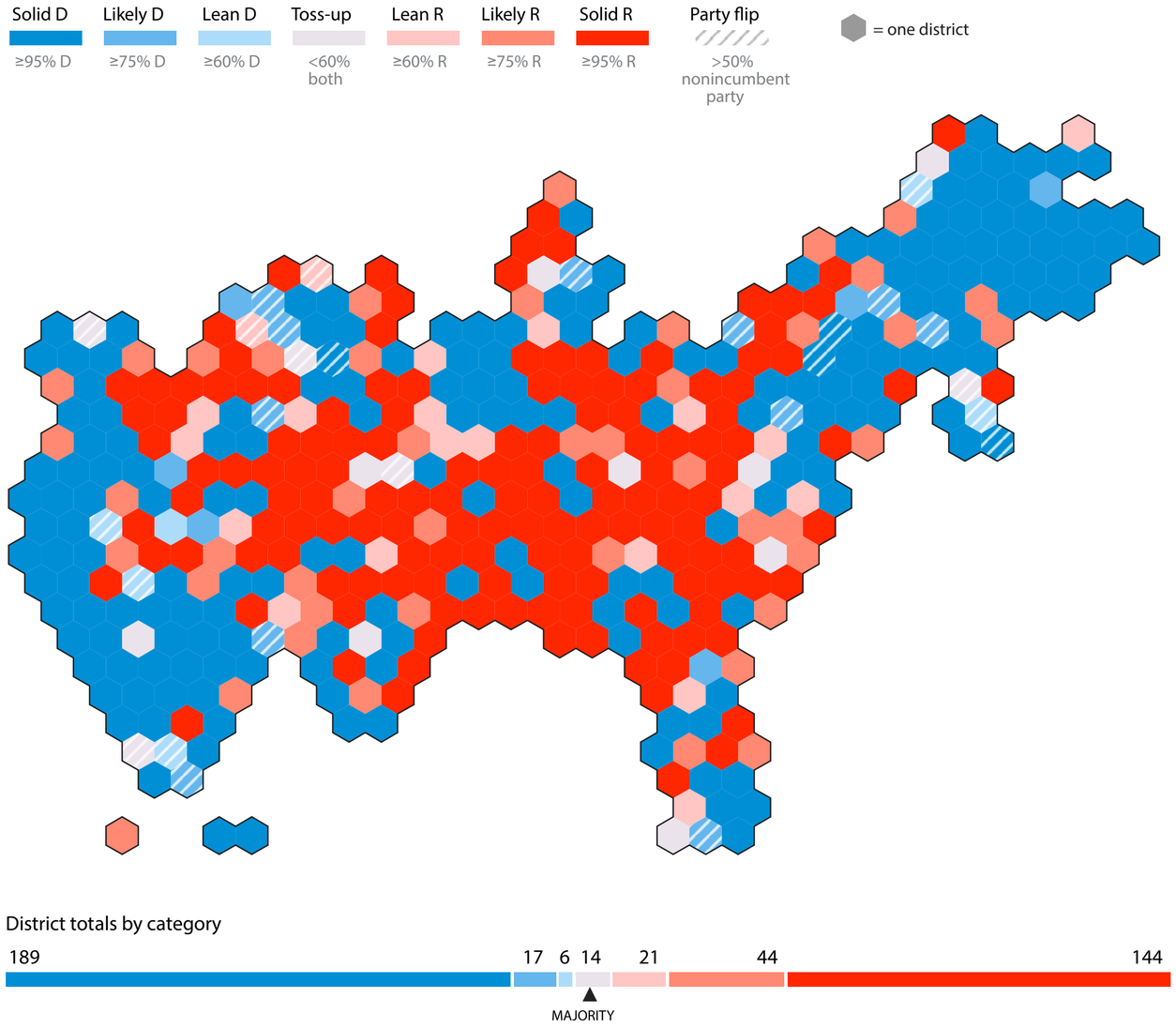
Cartograms



- Data: geographic geometry data & **two** quantitative attributes (one part-of-whole)
- Derived data: new geometry derived from the part-of-whole attribute
- Tasks: trends, comparisons, part-of-whole
- How: area marks from derived geometry, color hue/saturation/luminance
- Scalability: thousands of regions
- Design choices:
  - Colormap
  - Geometric deformation

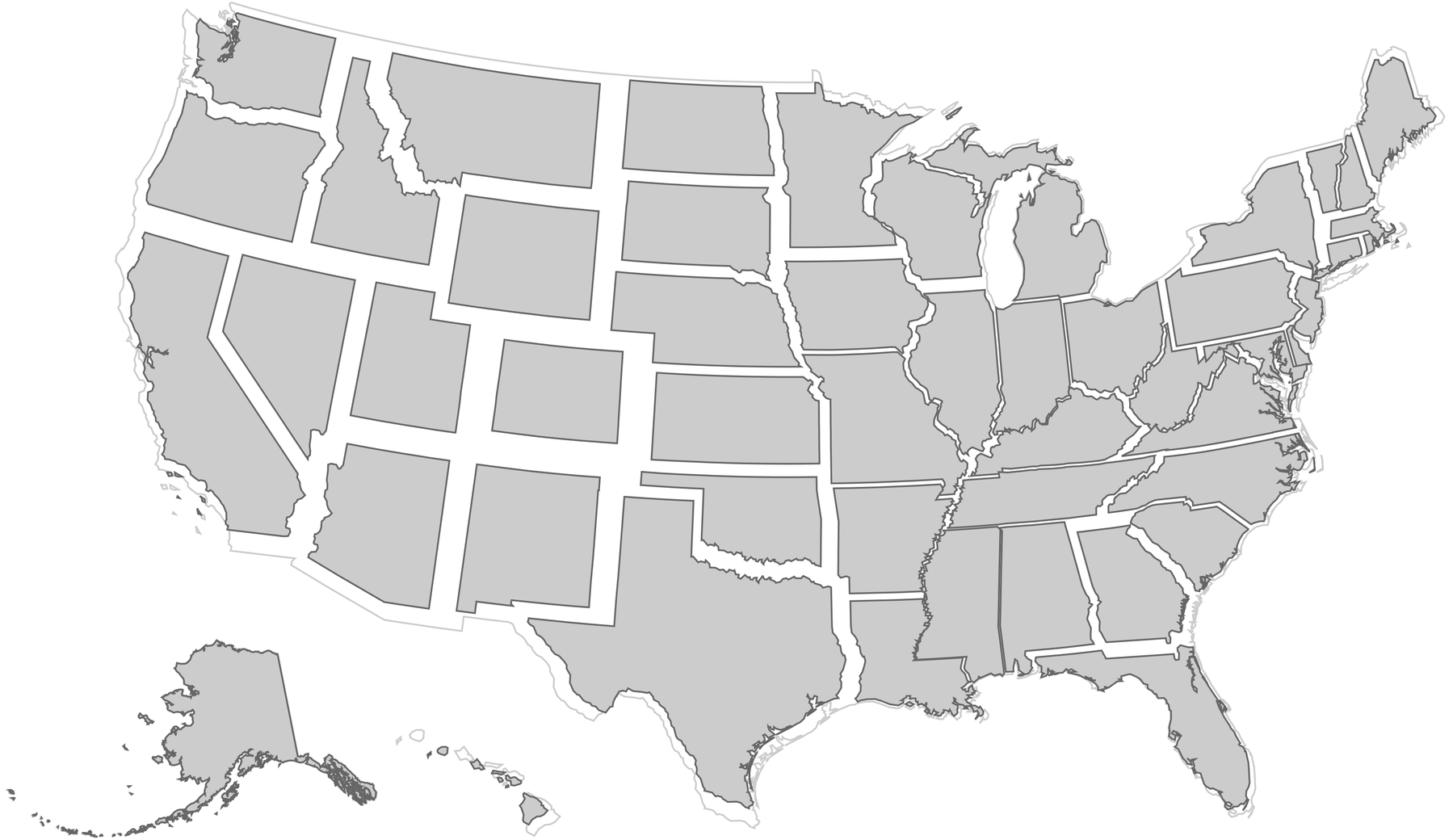
[New York Times]

Hexagonal Cartogram



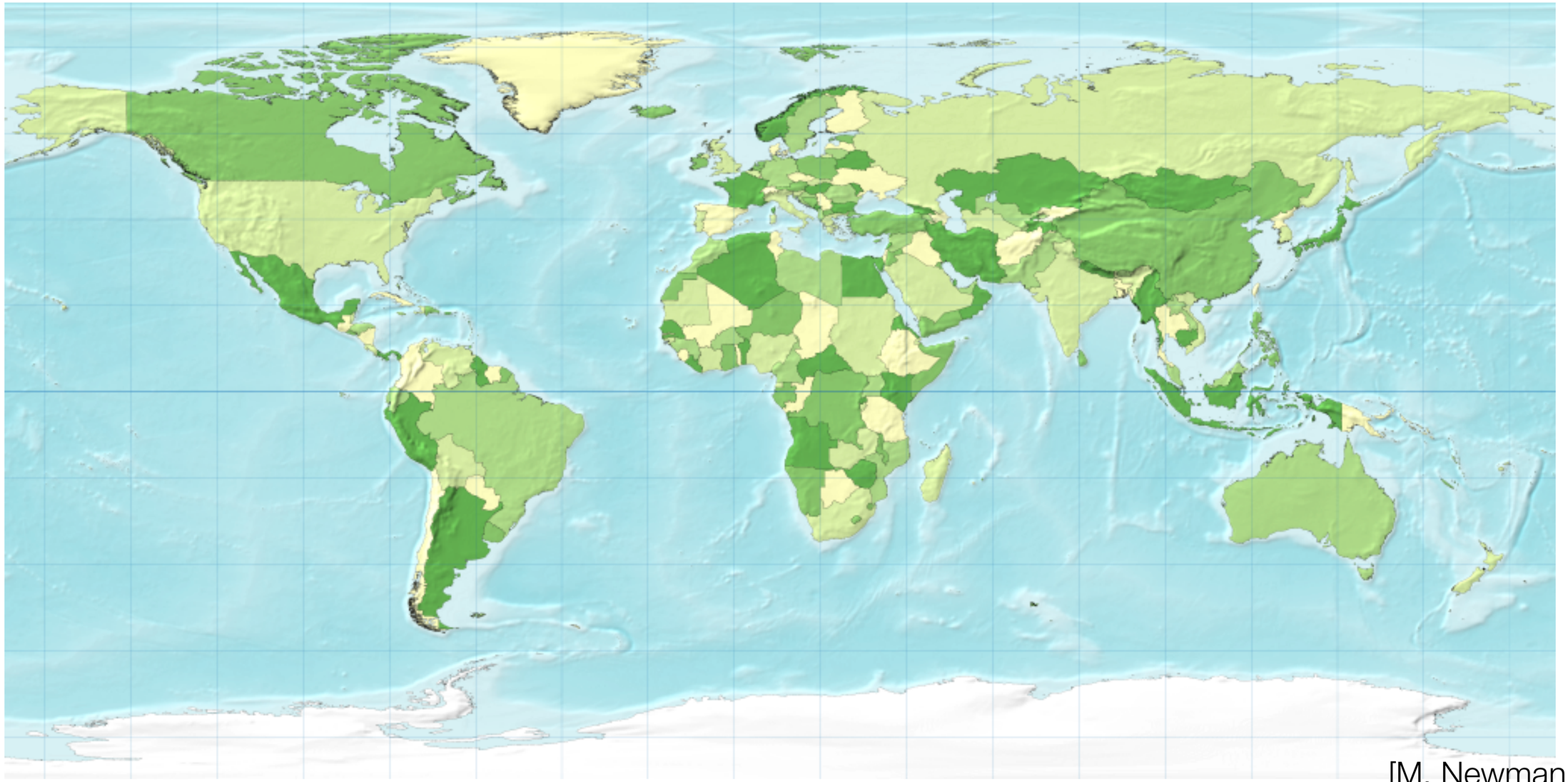
[FiveThirtyEight, 2018]

Non-Contiguous Cartogram



[M. Bostock, 2012]

World Cartograms

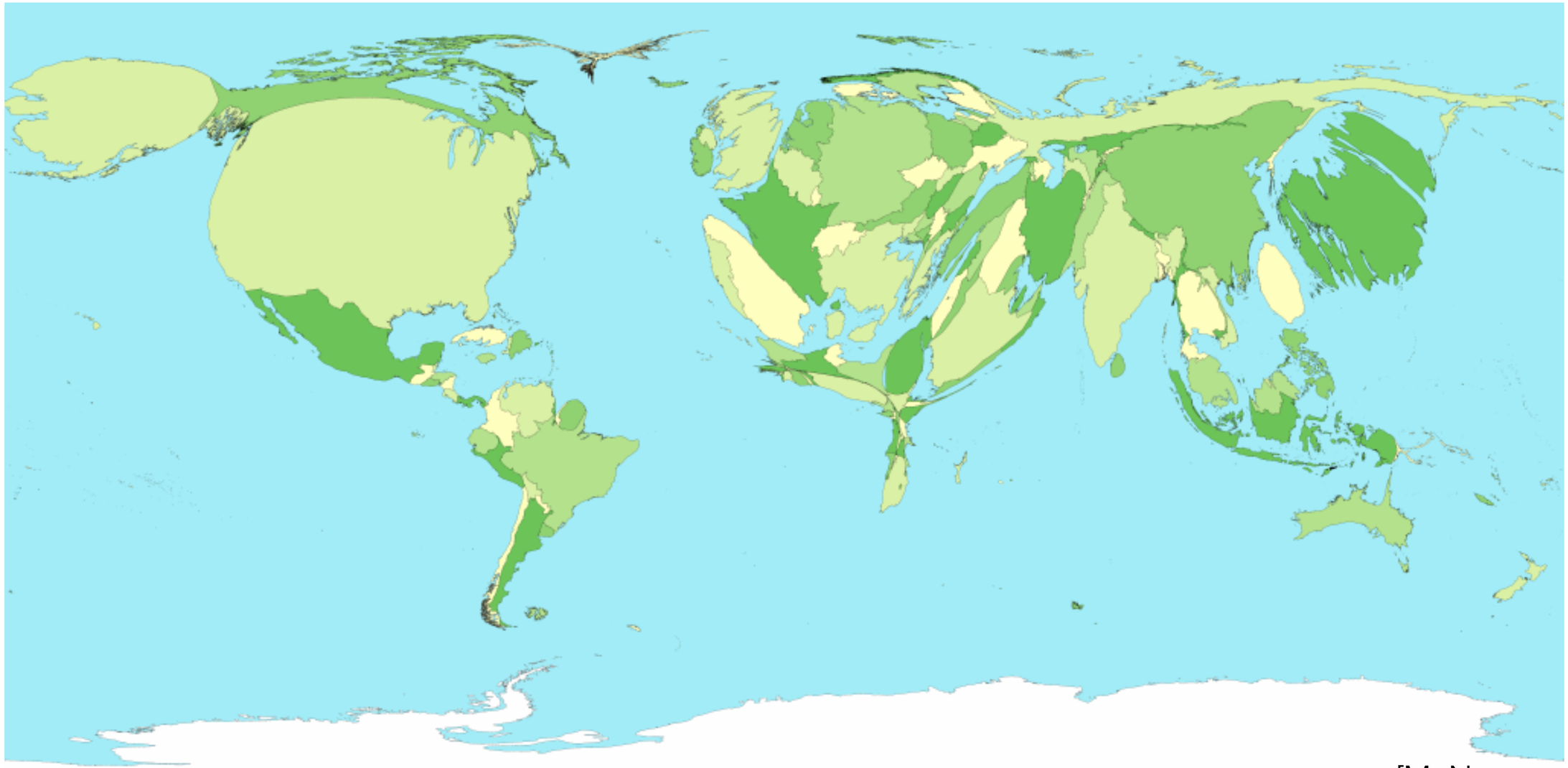


[M. Newman, 2009]

World Population

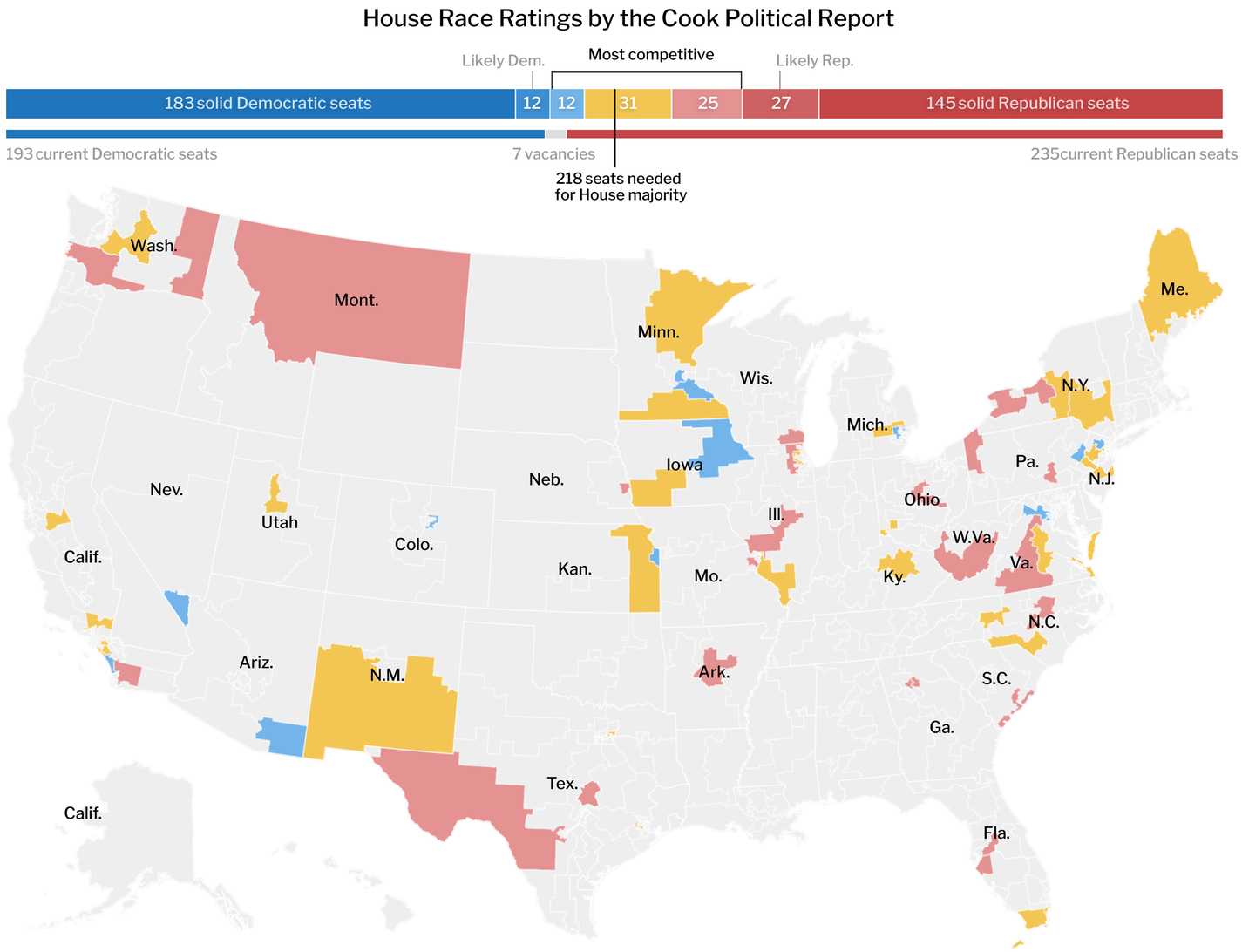
[M. Newman, 2009]

World Energy Consumption



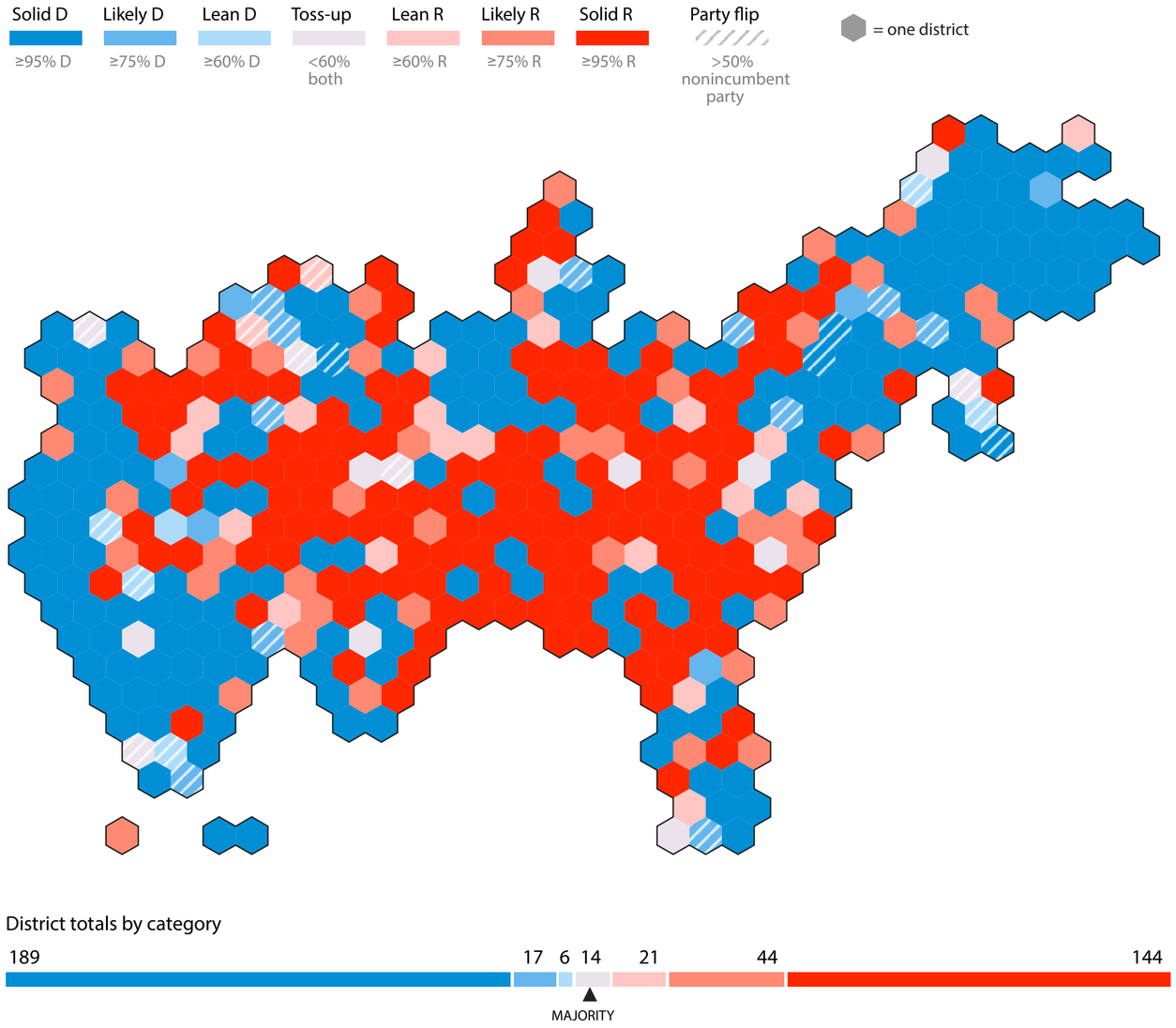
[M. Newman, 2009]

House Races: Map?



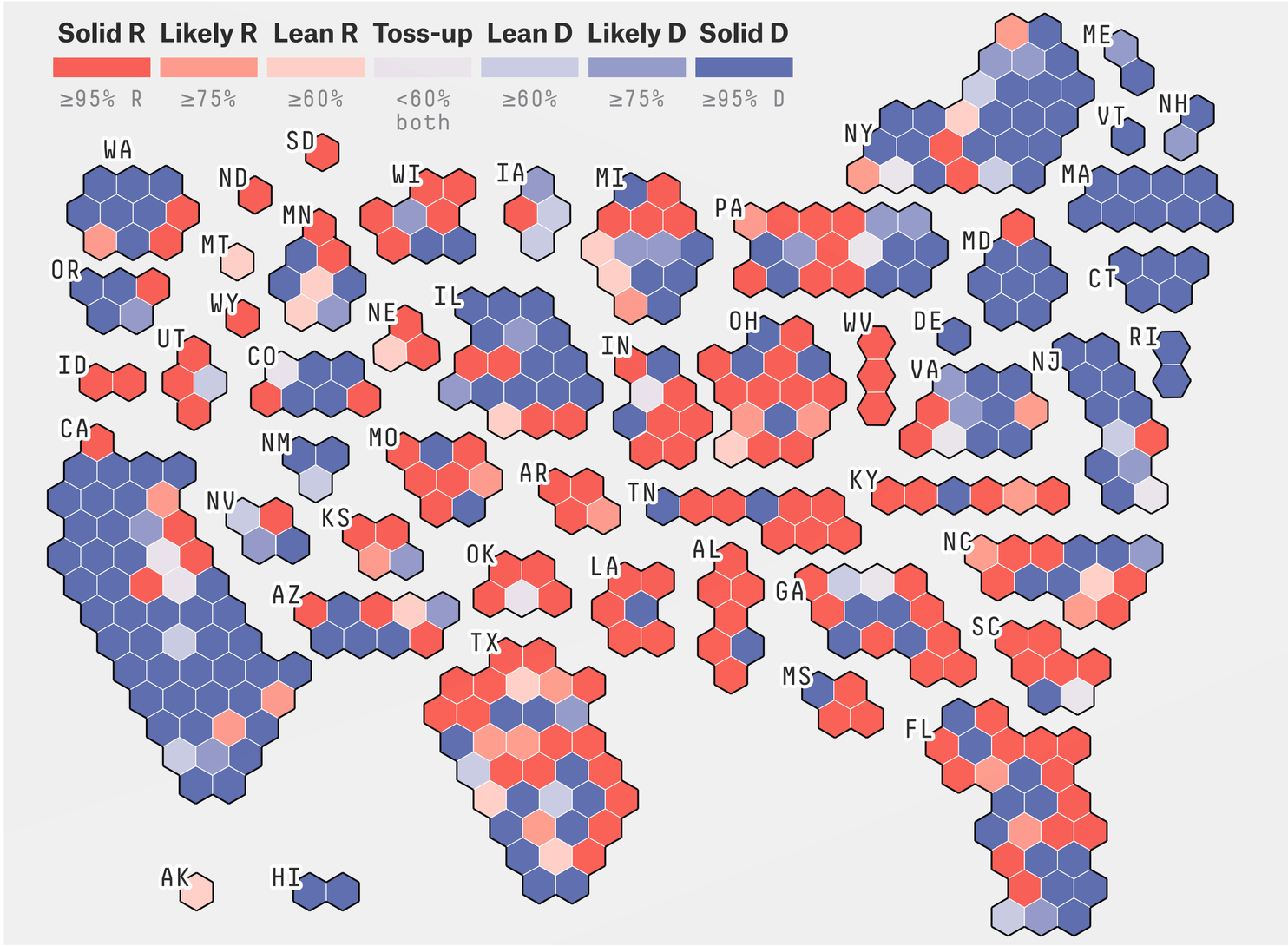
[New York Times, 2018]

House Races: Cartogram?



[FiveThirtyEight, 2018]

House Races: Non-Contiguous "Cartogram"



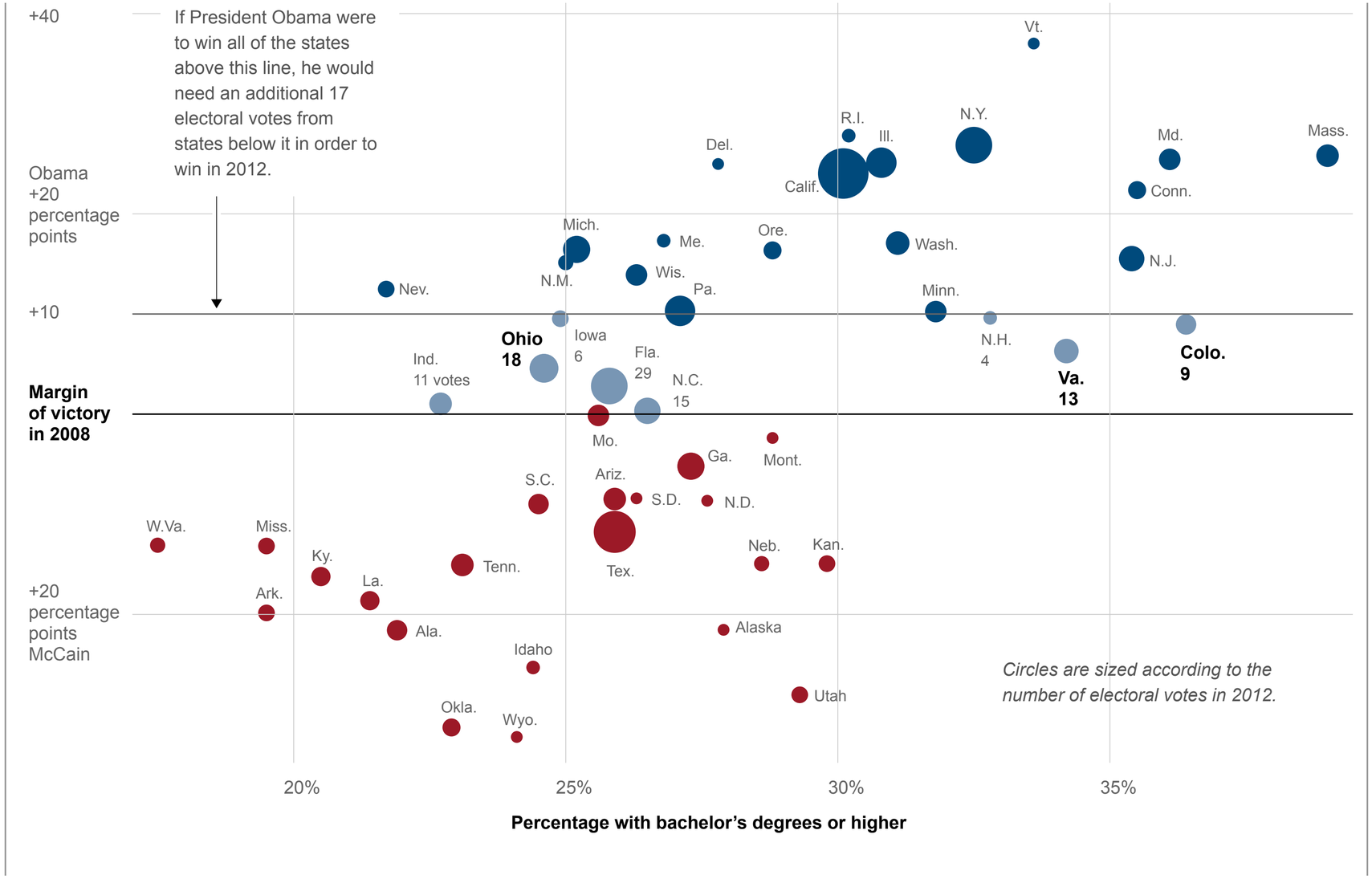
[FiveThirtyEight, 2020]

Maps Aren't Always Best: Close House Races

12 Lean Democratic		31 Tossups		25 Lean Republican	
AZ-02	Open (McSally)	CA-10	Denham	AR-02	Hill
CA-49	Open (Issa)	CA-25	Knight	CA-50	Hunter
CO-06	Coffman	CA-39	Open (Royce)	FL-15	Open (Ross)
IA-01	Blum	CA-45	Walters	FL-16	Buchanan
KS-03	Yoder	CA-48	Rohrabacher	GA-06	Handel
MI-11	Open (Trott)	FL-26	Curbelo	GA-07	Woodall
MN-02	Lewis	FL-27	Open (Ros-Lehtinen)	IL-13	Davis
MN-03	Paulsen	IL-06	Roskam	IL-14	Hultgren
NV-03	Open (Rosen)	IL-12	Bost	MO-02	Wagner
NJ-11	Open (Frelinghuysen)	IA-03	Young	MT-AL	Gianforte
PA-07	Vacant (formerly Dent)	KS-02	Open (Jenkins)	NE-02	Bacon
VA-10	Comstock	KY-06	Barr	NY-24	Katko

[New York Times, 2018]

Maps Aren't Always Best: Obama Targets



[NYTimes]

D3 Map Examples

Networks

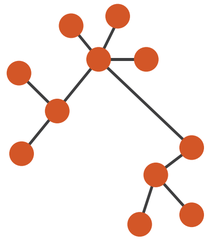
- Why not graphs?
  - Bar graph
  - Graphing functions in mathematics
- Network: nodes and edges connecting the nodes
- Formally, G = (V,E) is a set of nodes V and a set of edges E where each edge connects two nodes.
- Nodes == items, edges connect items
- **Both** nodes and edges may have **attributes**

Arrange Networks and Trees

Node–Link Diagrams

Connection Marks

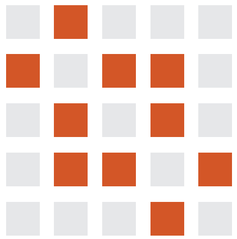
✔ NETWORKS ✔ TREES



Adjacency Matrix

Derived Table

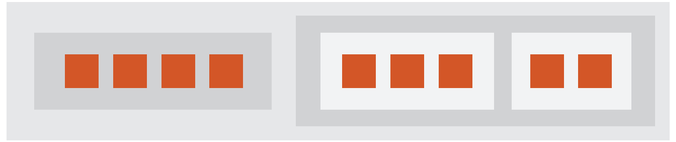
✔ NETWORKS ✔ TREES



Enclosure

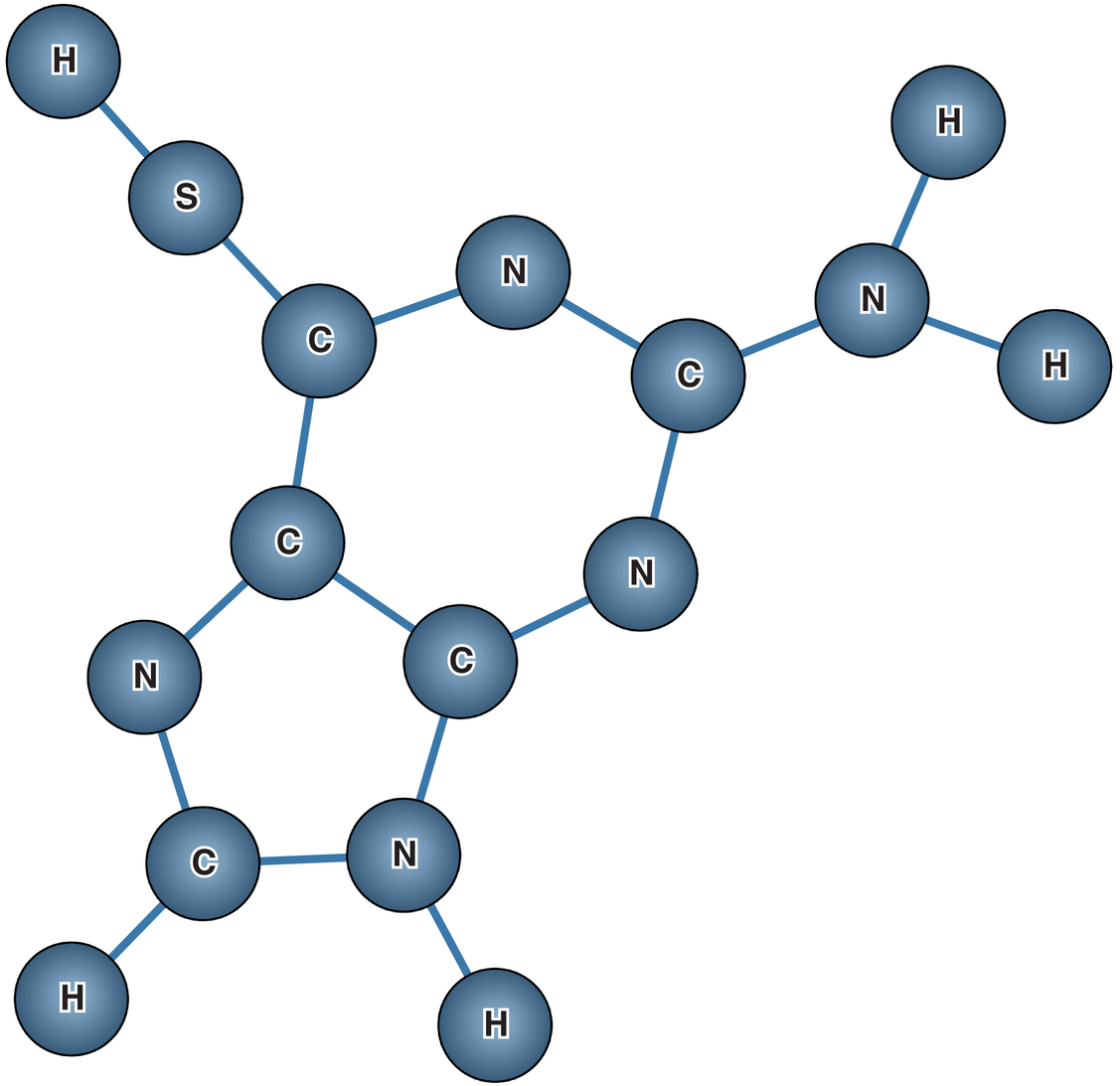
Containment Marks

✘ NETWORKS ✔ TREES

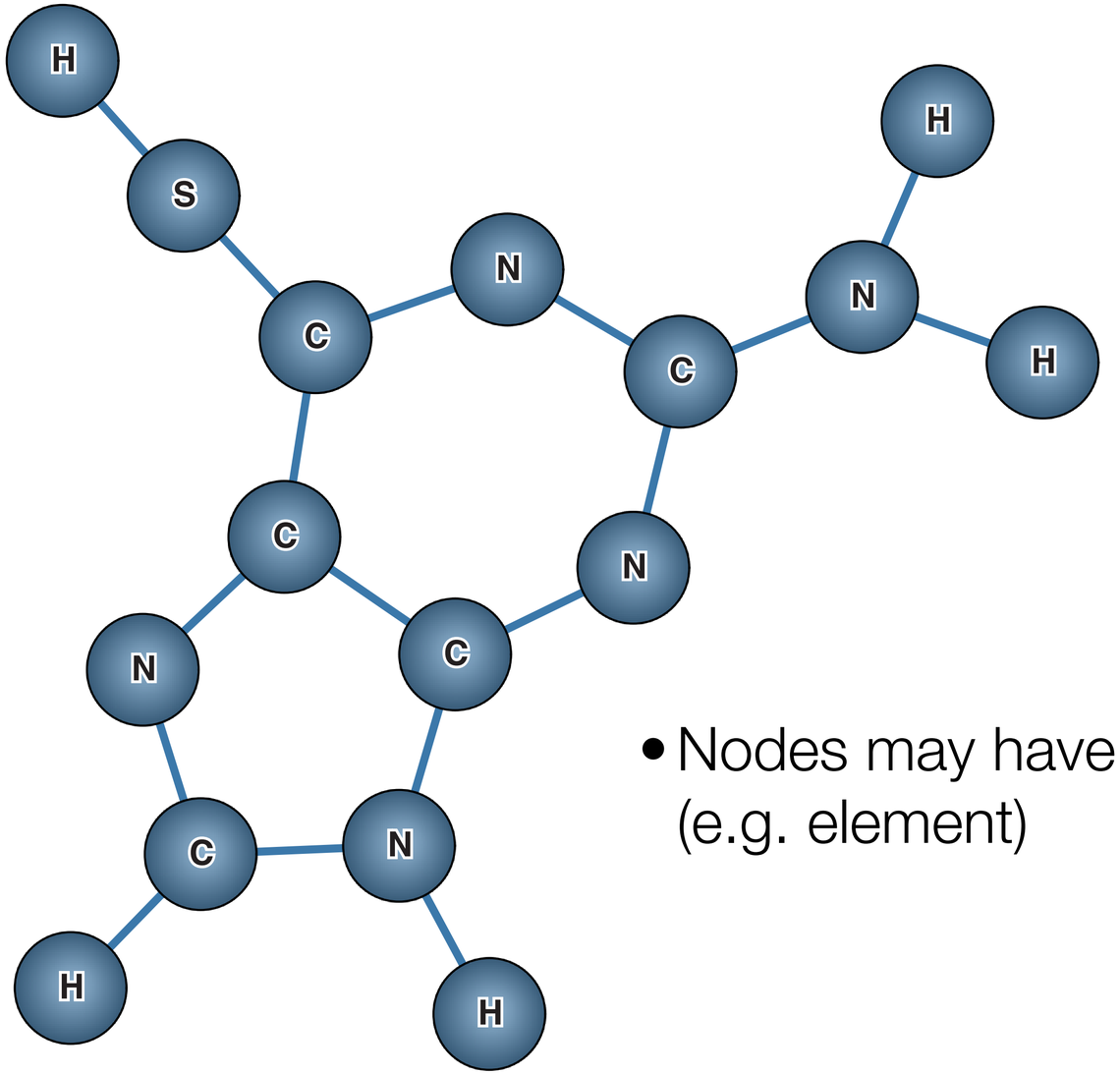


[Munzner (ill. Maguire), 2014]

Molecule Graph

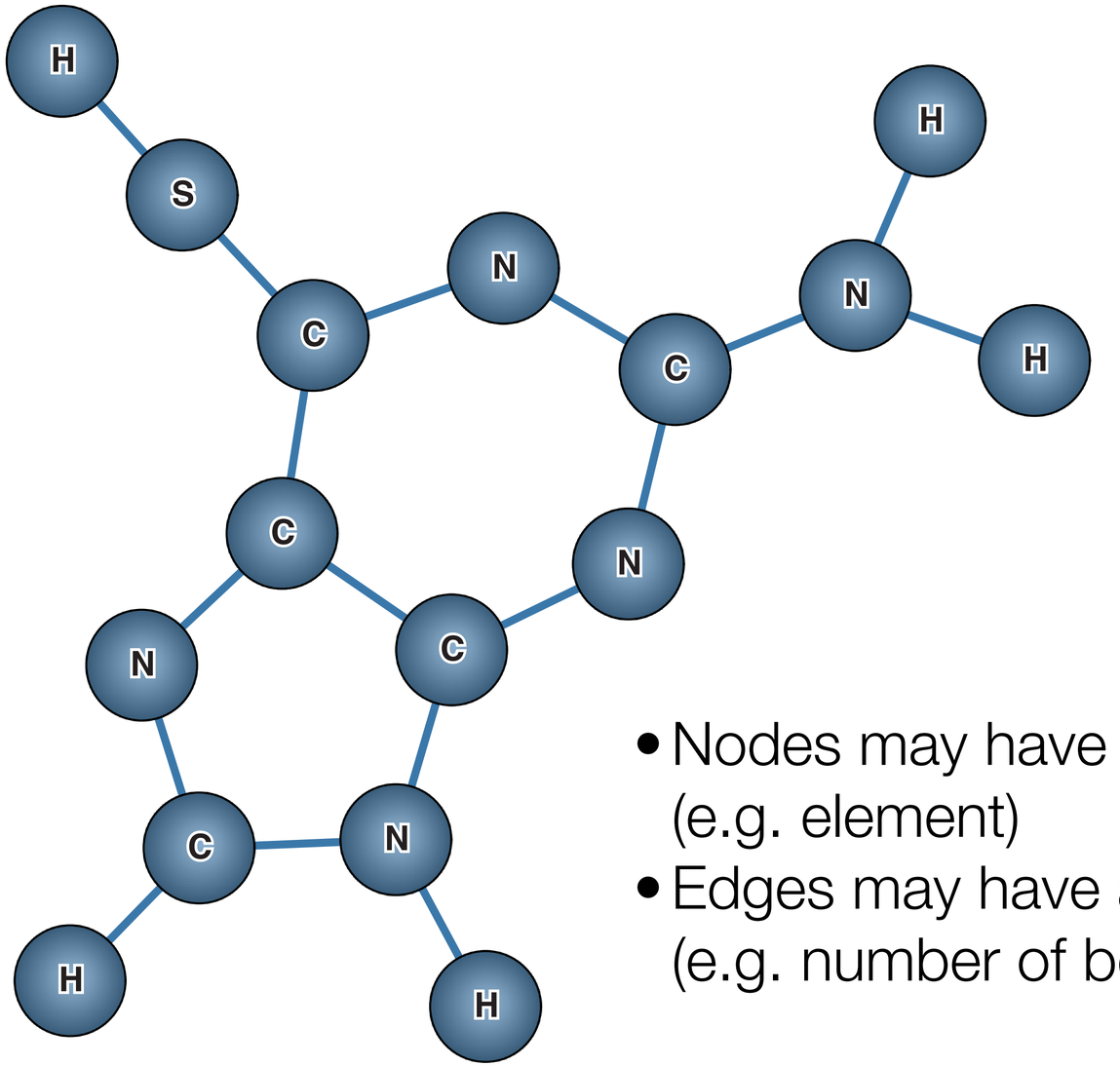


Molecule Graph



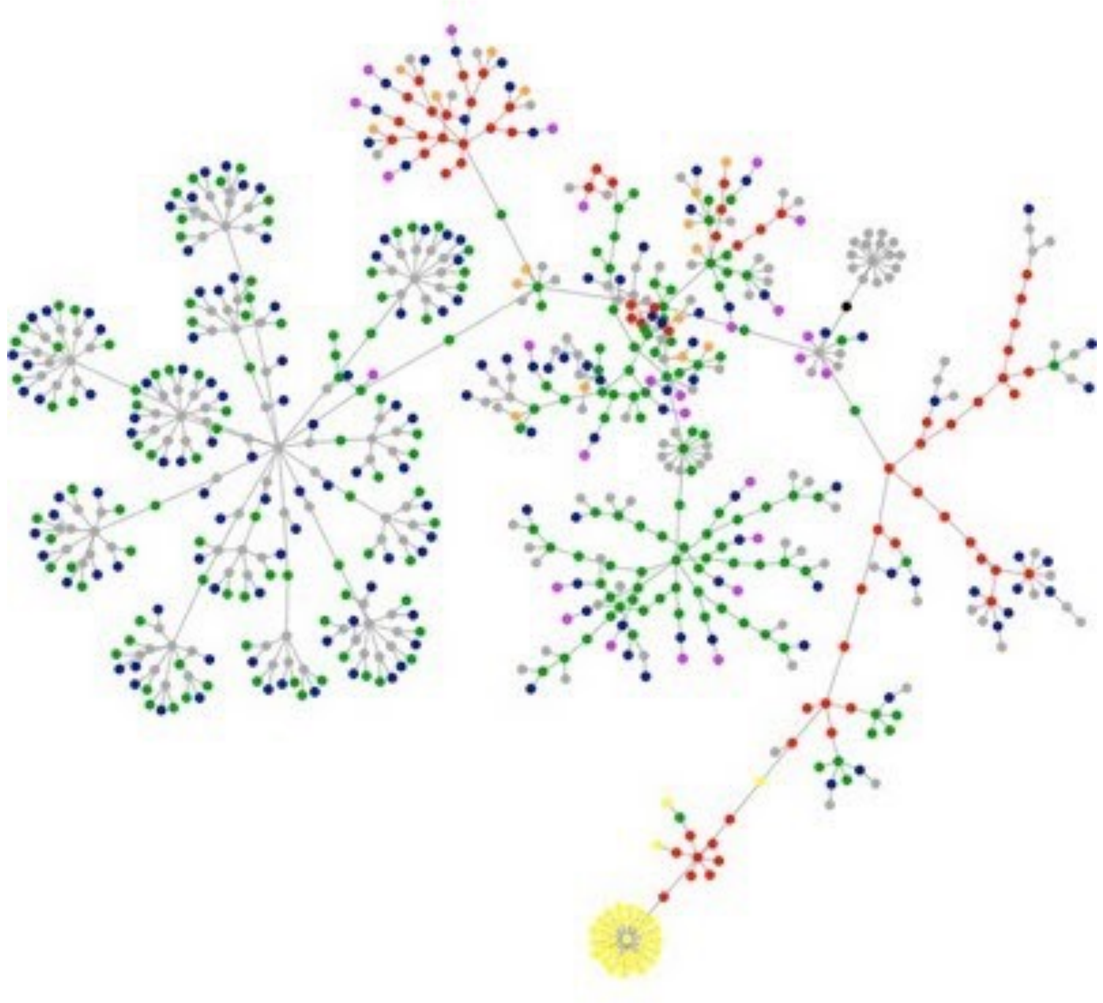
- Nodes may have attributes (e.g. element)

Molecule Graph



- Nodes may have attributes (e.g. element)
- Edges may have attributes (e.g. number of bonds)

Web Sites as Graphs (amazon.com)



[M. Salathe, 2006]

Social Networks

[P. Butler, 2010]

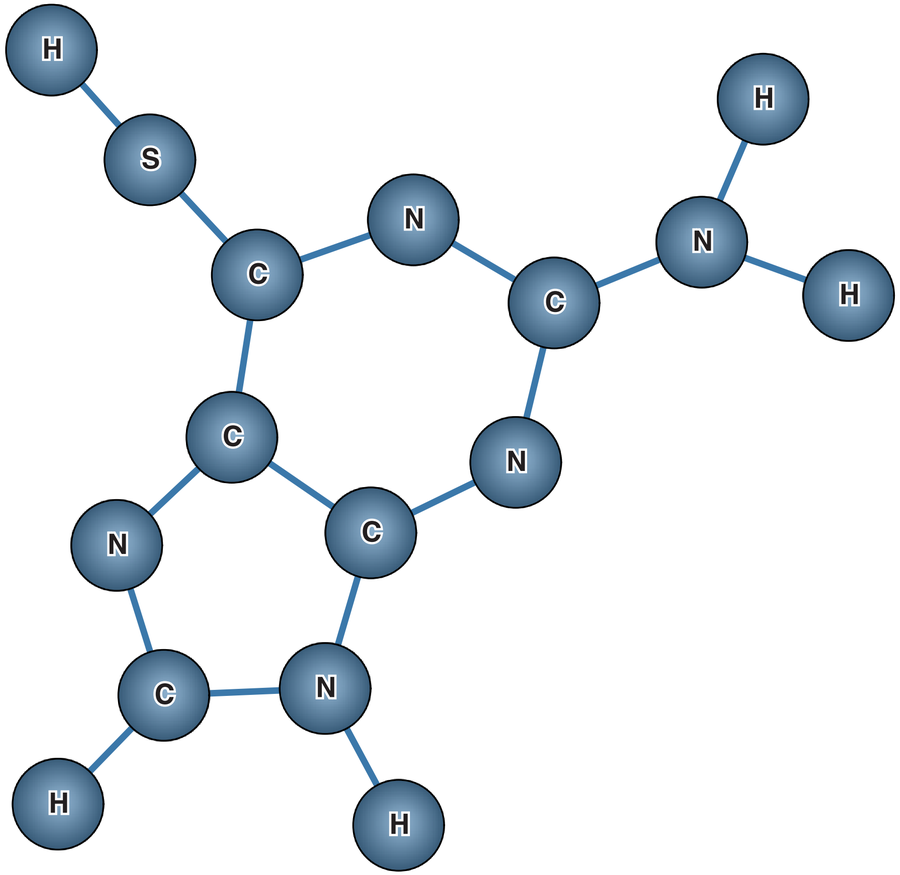
Networks as Data

Nodes

ID	Atom	Electrons	Protons
0	N	7	7
1	C	6	6
2	S	16	16
3	C	6	6
4	N	7	7

Edges

ID1	ID2	Bonds
0	1	1
1	2	1
1	3	2
3	4	1

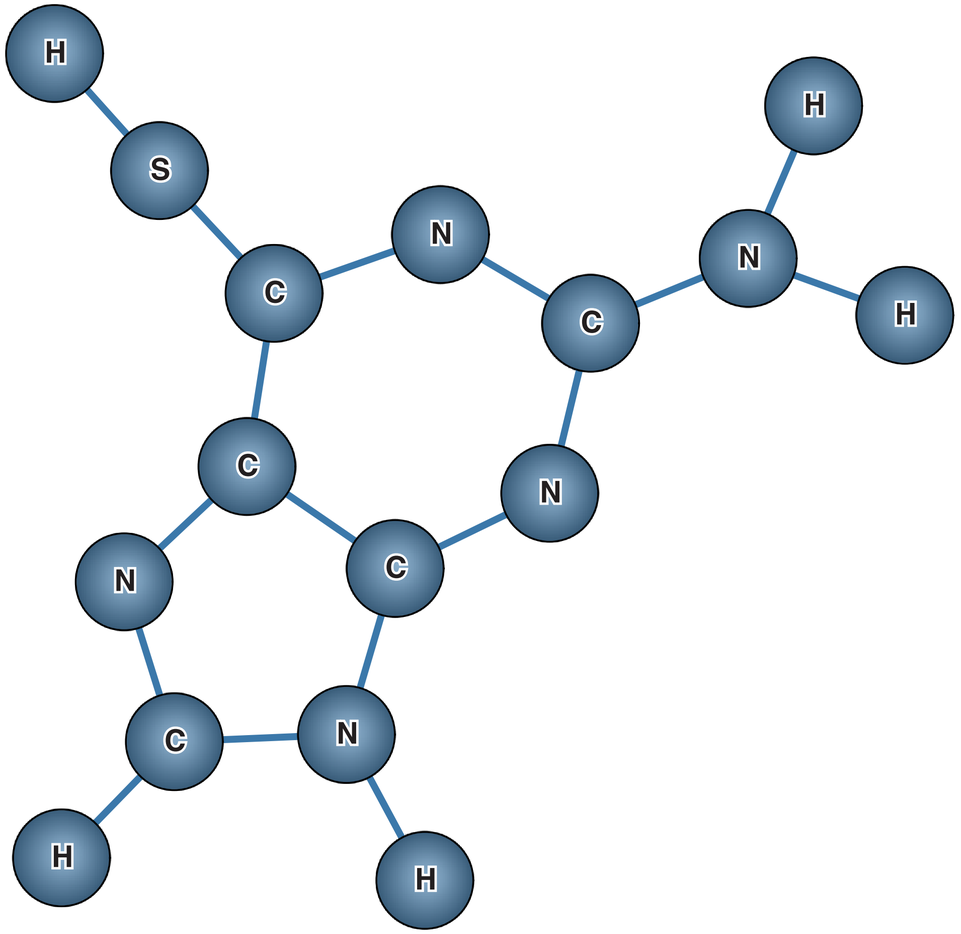


Node-Link Diagrams

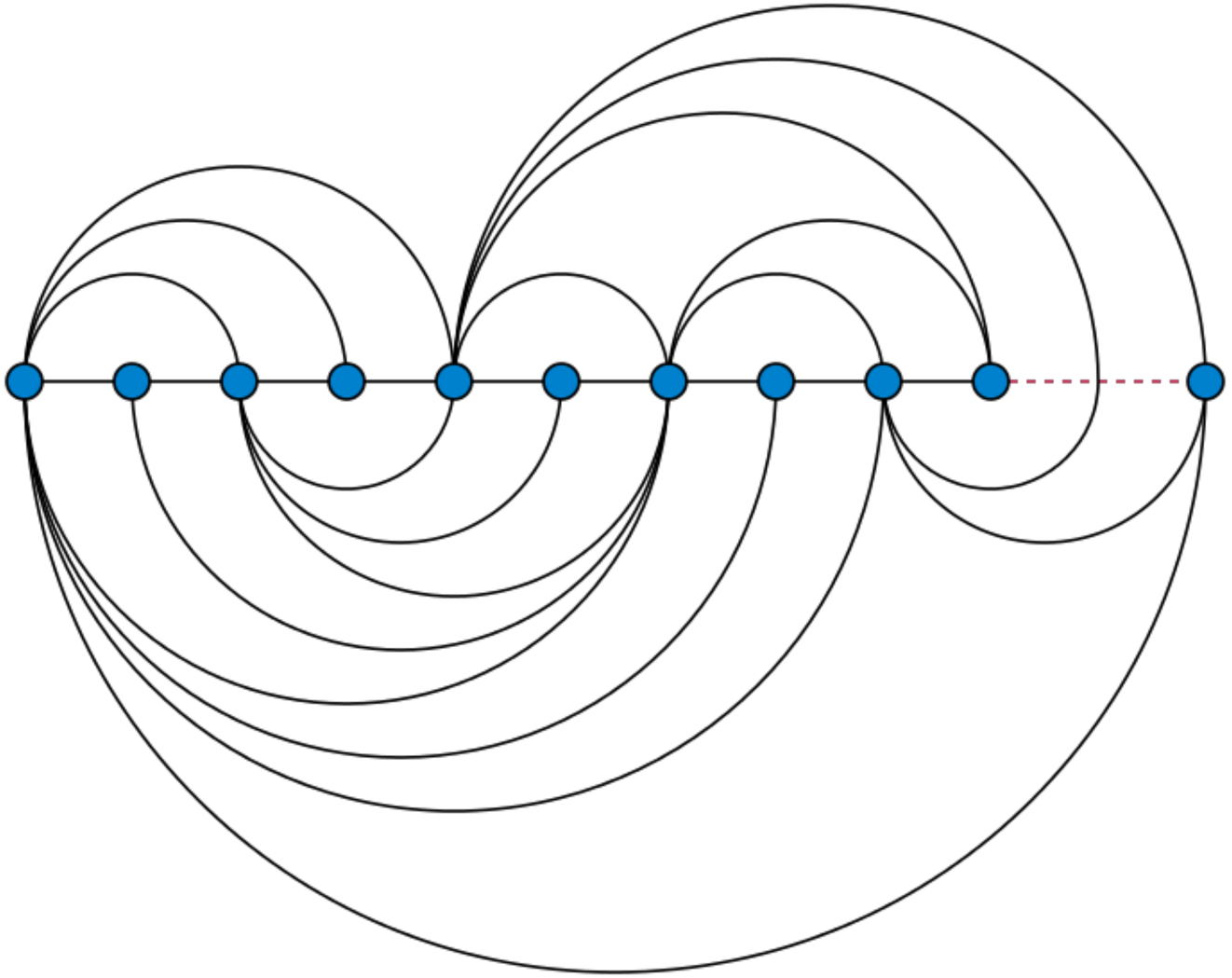
- Data: nodes and edges
- Task: understand connectivity, paths, structure (topology)
- Encoding: nodes as point marks, connections as line marks
- Scalability: hundreds

- …but high **density** of links can be problematic!

- Issue with the encoding?



Arc Diagram



[D. Eppstein, 2013]

Network Layout

- Need to use spatial position when designing network visualizations
- Otherwise, nodes can **occlude** each other, links hard to distinguish
- How?
  - With bar charts, we could order using an attribute…
  - With networks, we want to be able to see connectivity and topology (not in the data usually)
- Possible metrics:
  - Edge crossings
  - Node overlaps
  - Total area