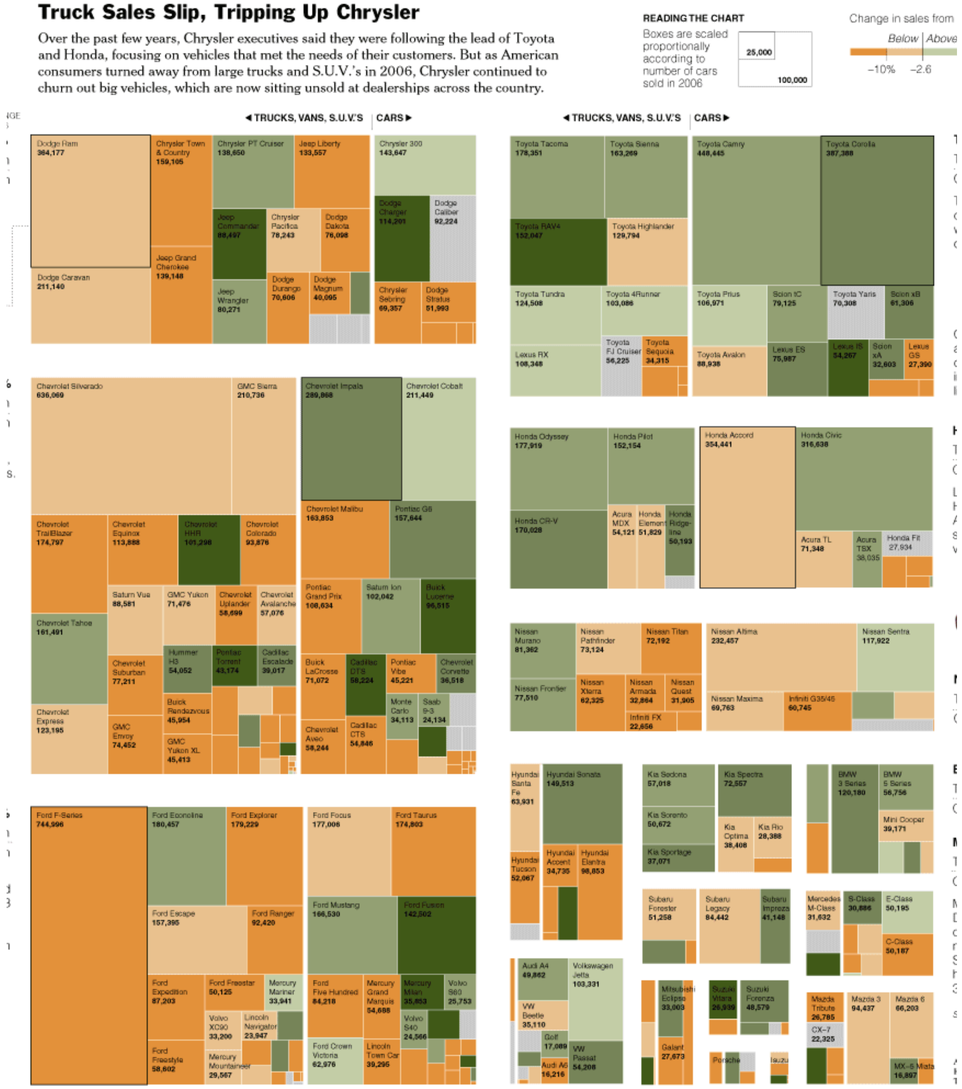
Data Visualization (CSCI 627/490)

Multiple Views & Filtering

Dr. David Koop

Treemap

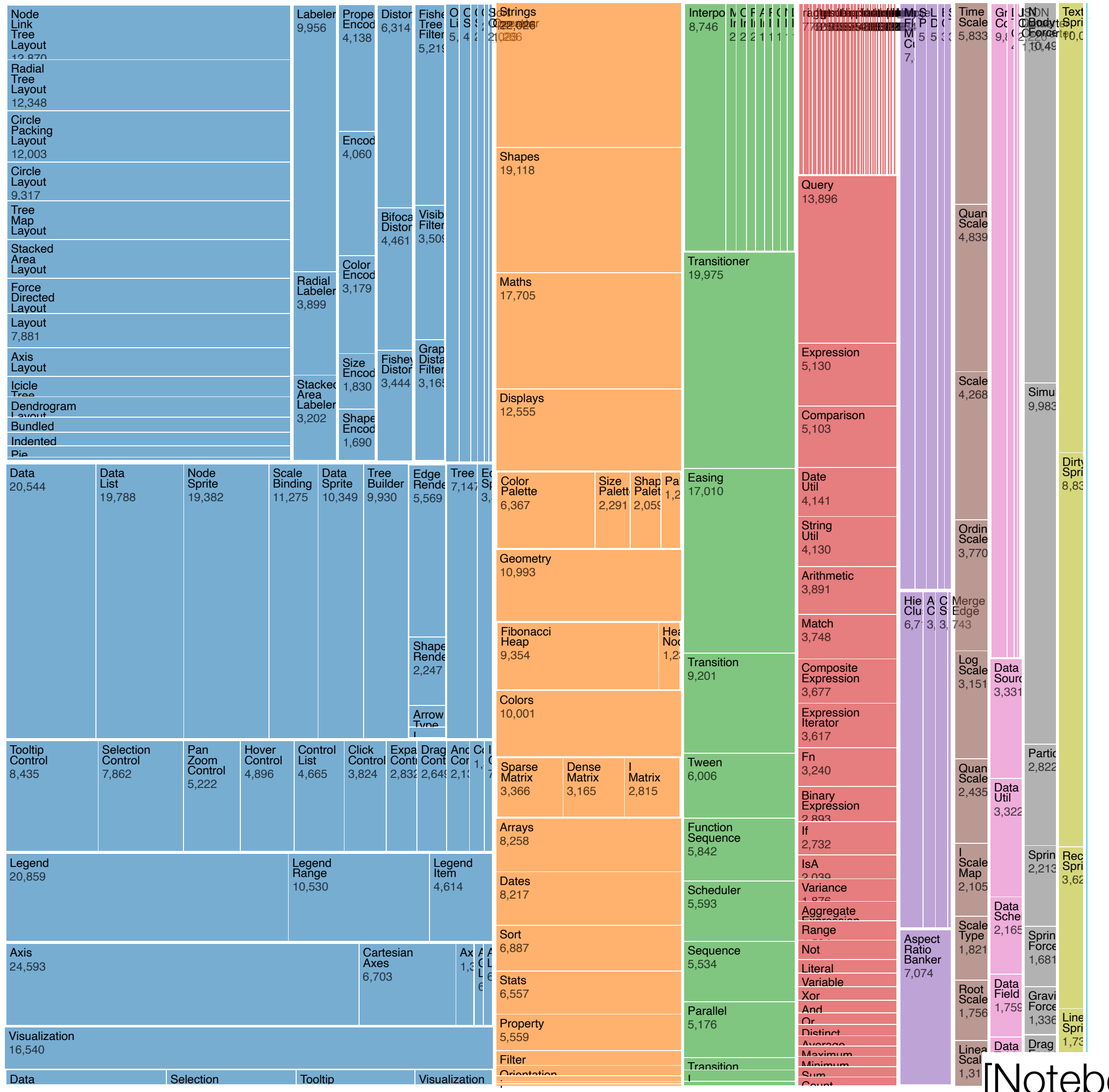


- Containment marks instead of connection marks—show hierarchy
- Encodes some quantitative attribute of the items as the **size** of the rectangles
- Not as easy to see the intermediate rectangles (hierarchy)
- Scalability: millions of leaf nodes and links possible

[A. Cox and H. Fairfield, NYTimes, 2012]

Treemap Layouts: Slice & Dice

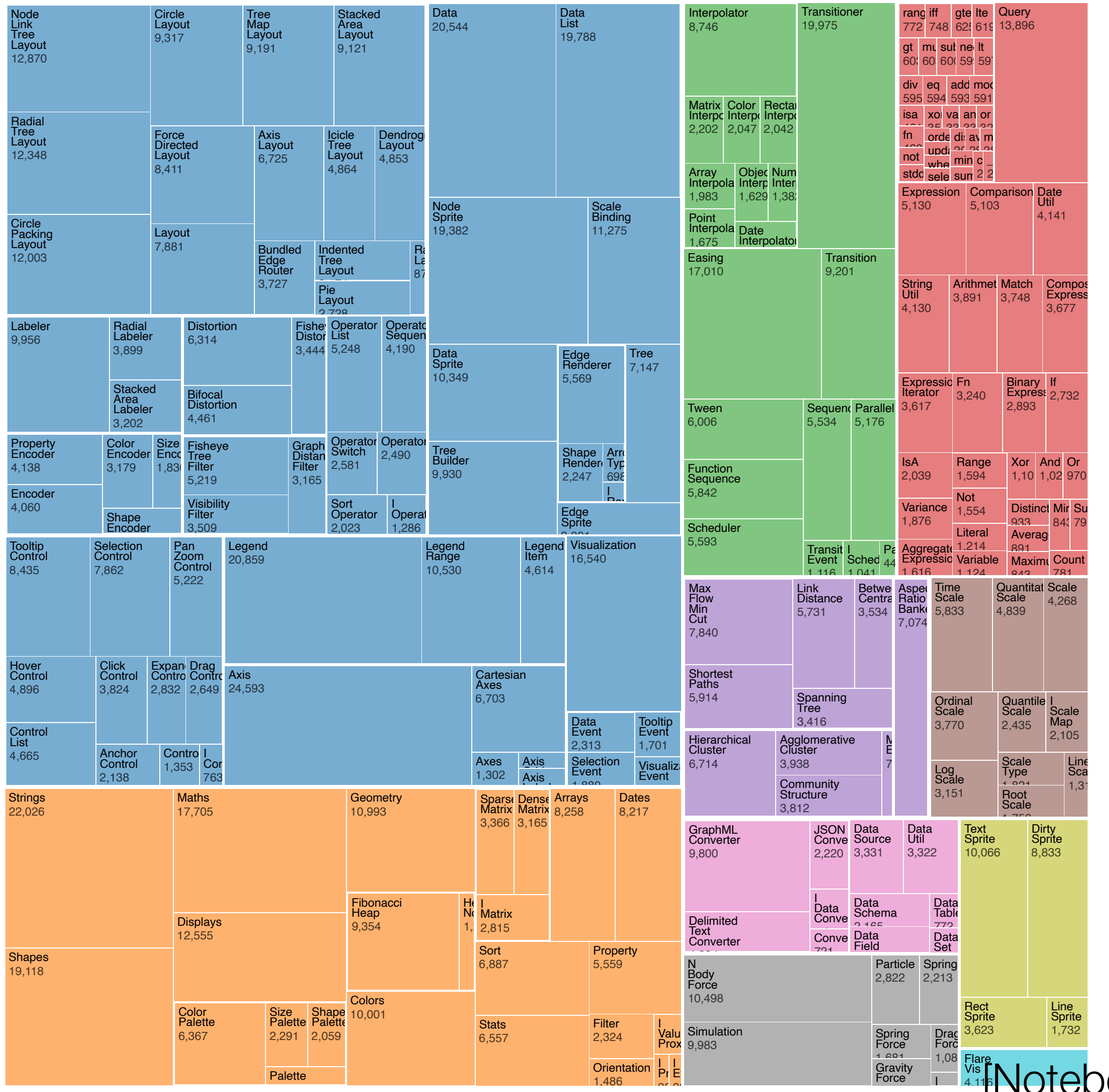
- Split at each level into strips
- At each step, orientation of division (horizontal/vertical) changes
- Better, but some rectangles still have bad aspect ratio



[Notebook]

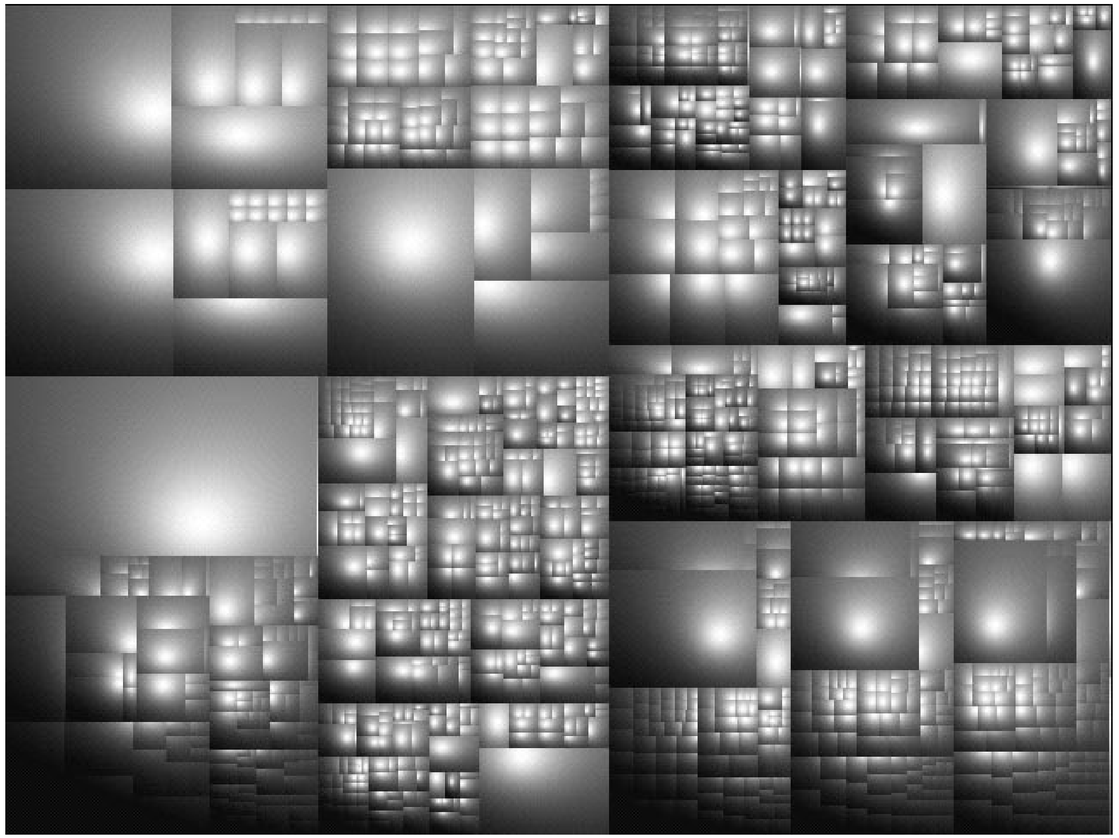
Treemap Layouts: Squarify

- Slice & Dice and Strip can lead to bad **aspect ratios**
- Solution: Strip only uses rows, allow columns to be used, too
- Choose divisions (x/y) based on the width/height of region in order to maintain good aspect ratios
  - Use left and right side
  - Process large rectangles first
- Ordering not preserved which may cause issues if the data is updated

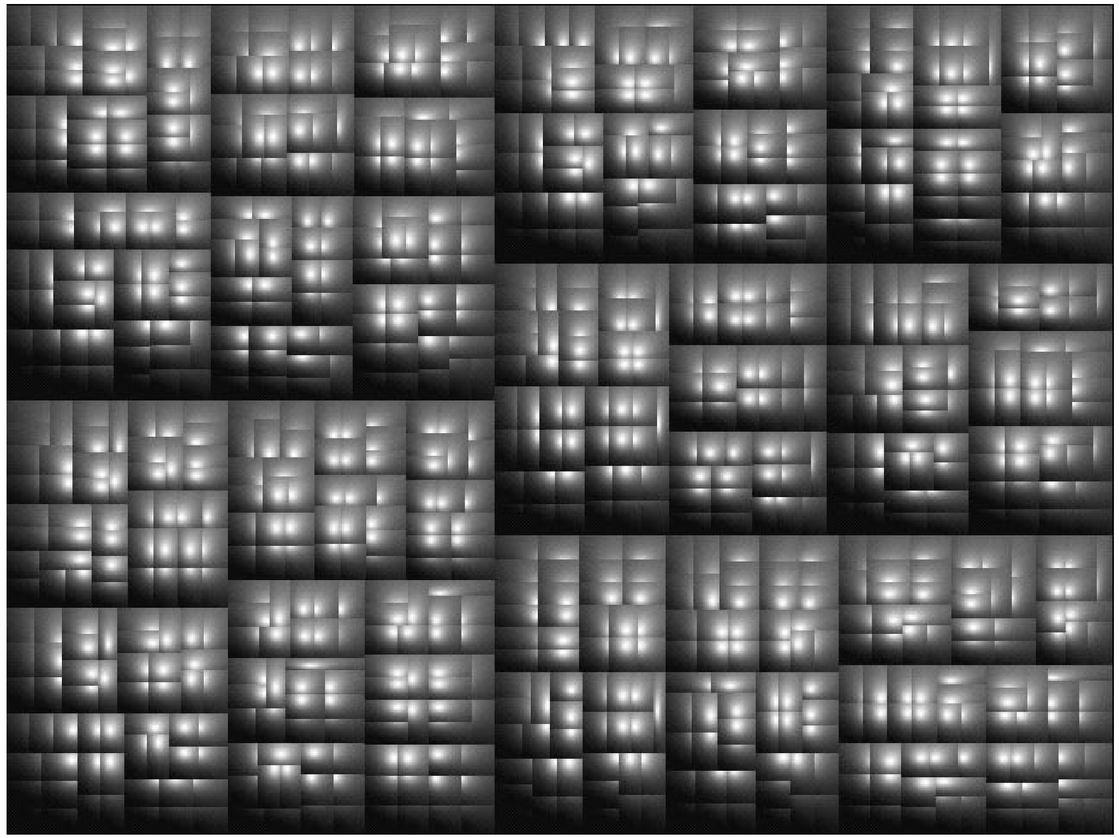


[Notebook]

Squarified + Cushioned Treemaps



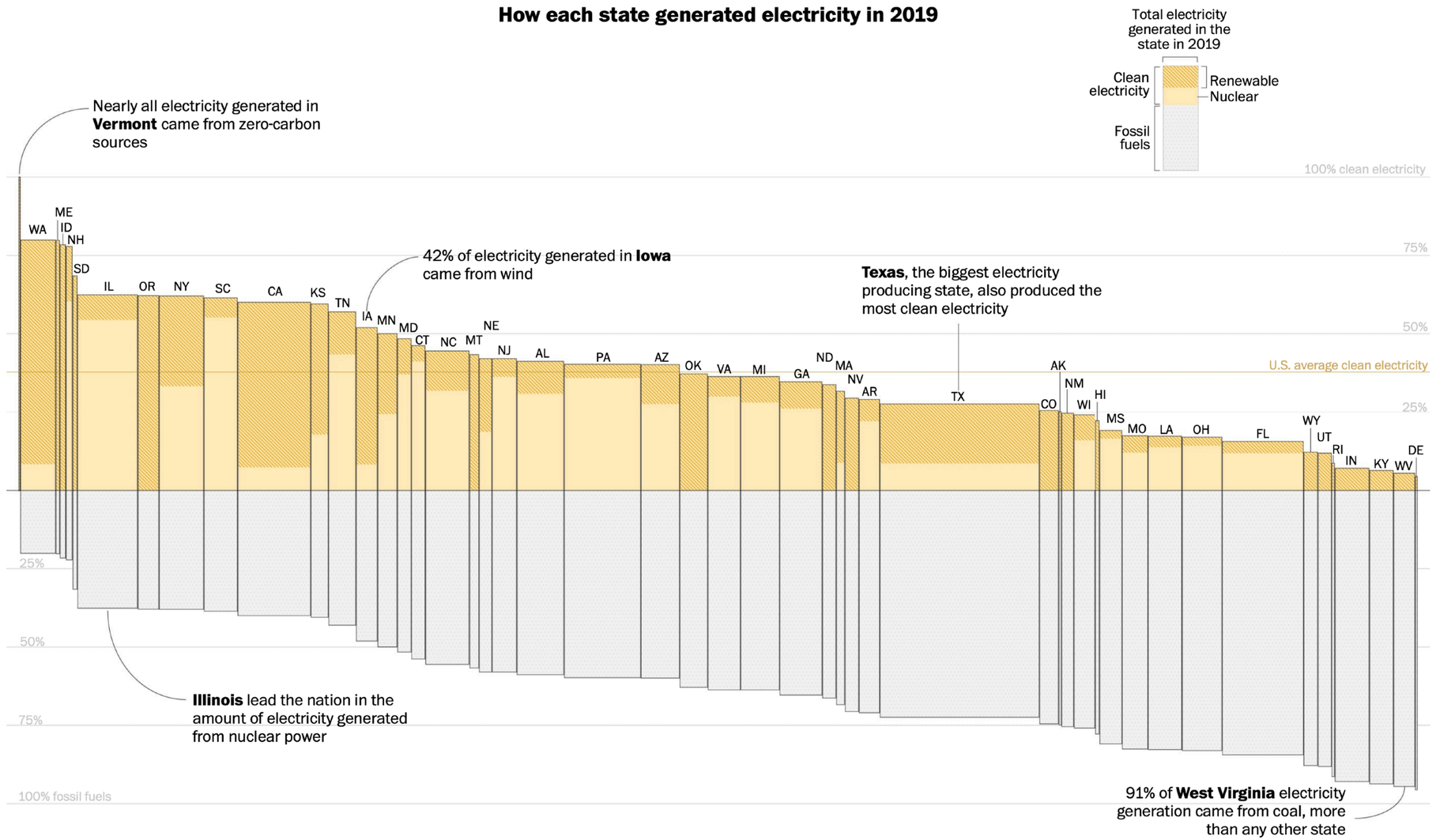
(a) File system



(b) Organization

[Brus et al., 1999]

Variations: Marimekko Chart



[J. Muyskens, Washington Post]

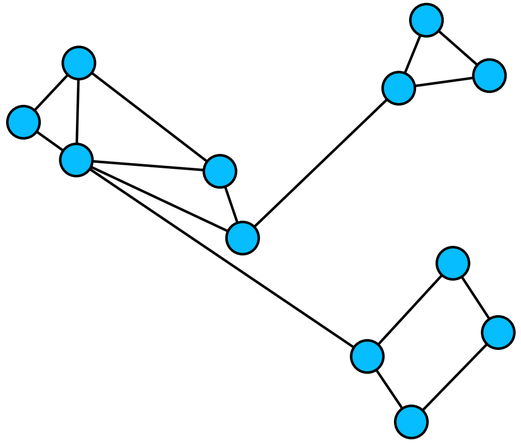
Nested Circles

- Looks more like cluster diagram, but shows hierarchy
- Containment shown by the layering of semi-transparent circles
- Labeling becomes more difficult

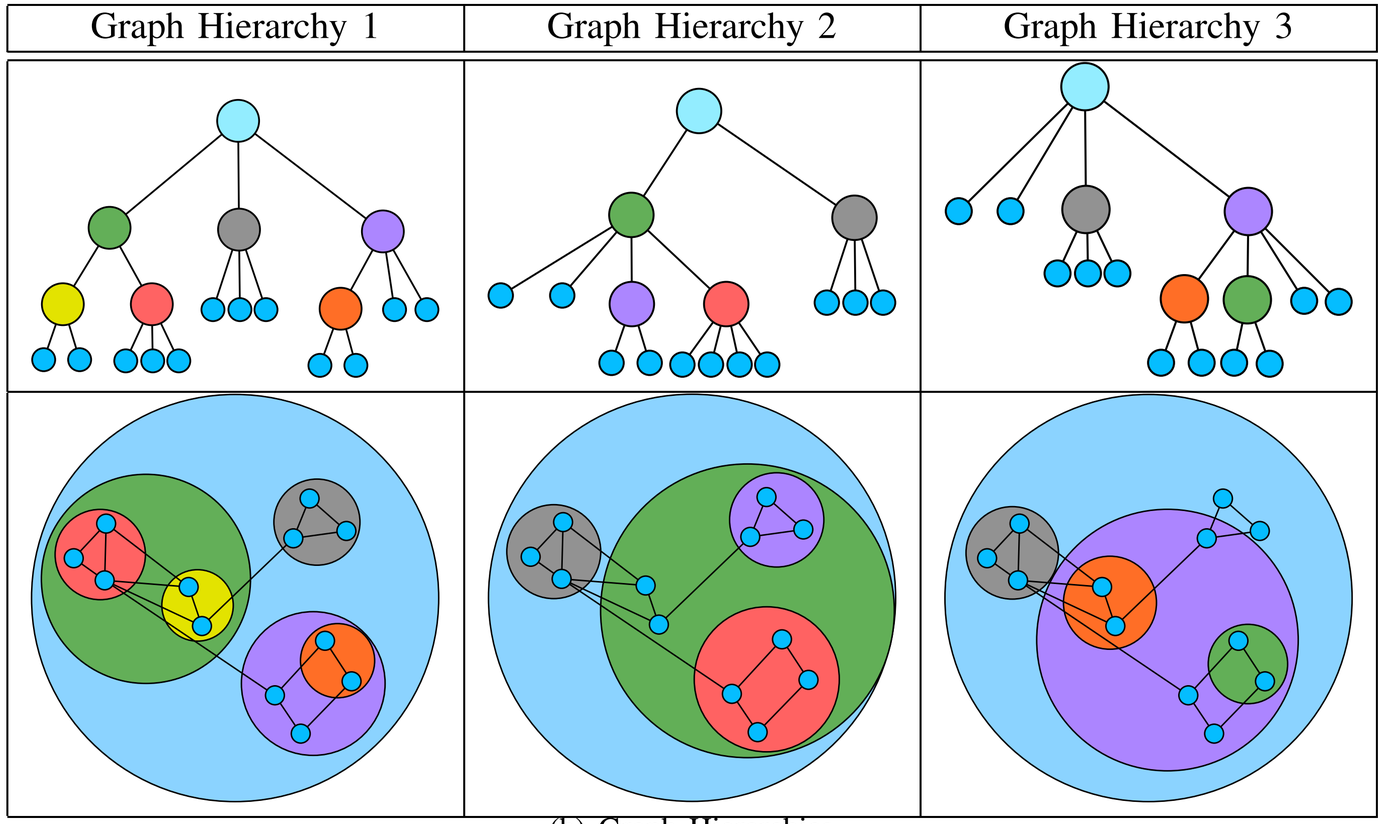
[Bostock, 2012]

Compound Networks

- Add a hierarchy to the network (e.g. from clustering)
- GrouseFlocks: uses nested circles with colors



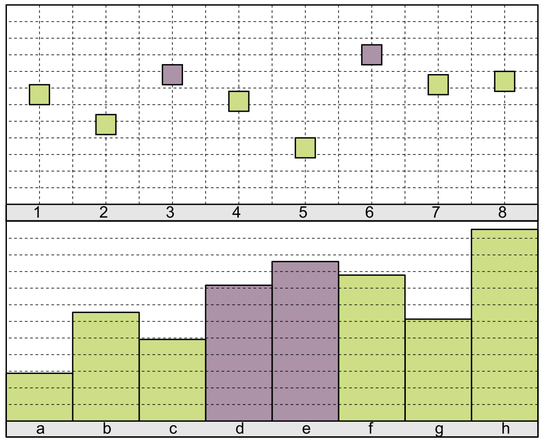
(a) Input Graph



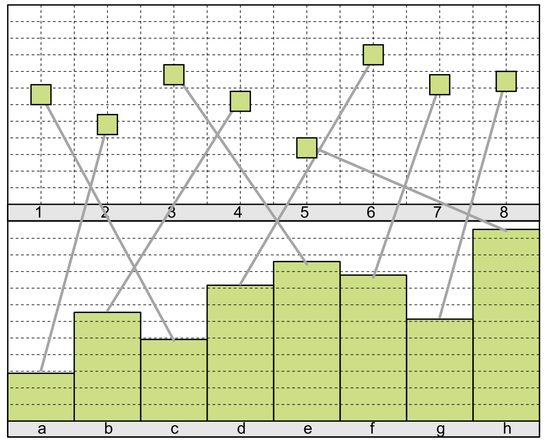
(b) Graph Hierarchies

[Archambault et al., 2008]

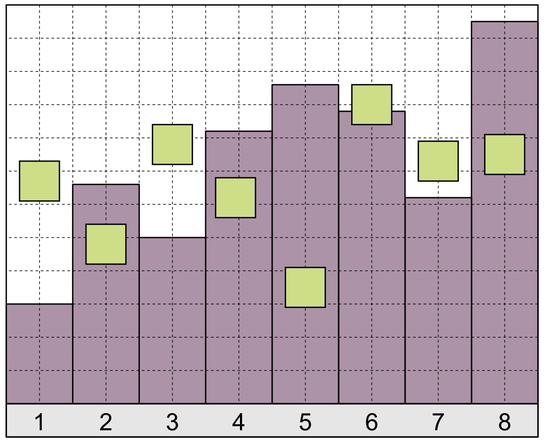
Composite Visualization Techniques



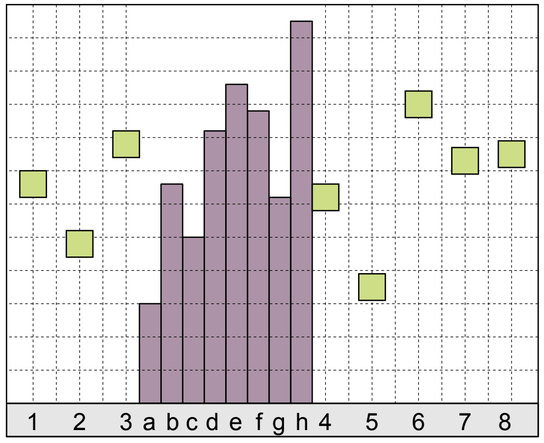
(a) Juxtaposed views.



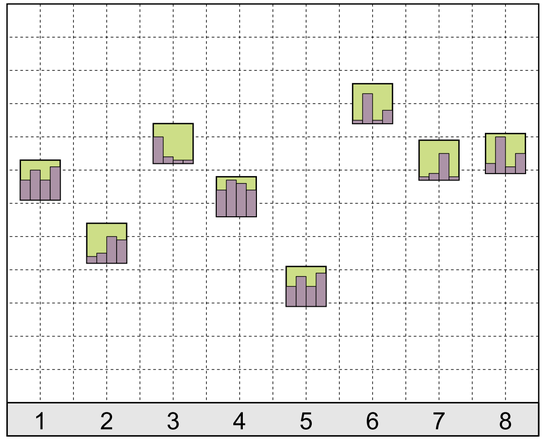
(b) Integrated views.



(c) Superimposed views.



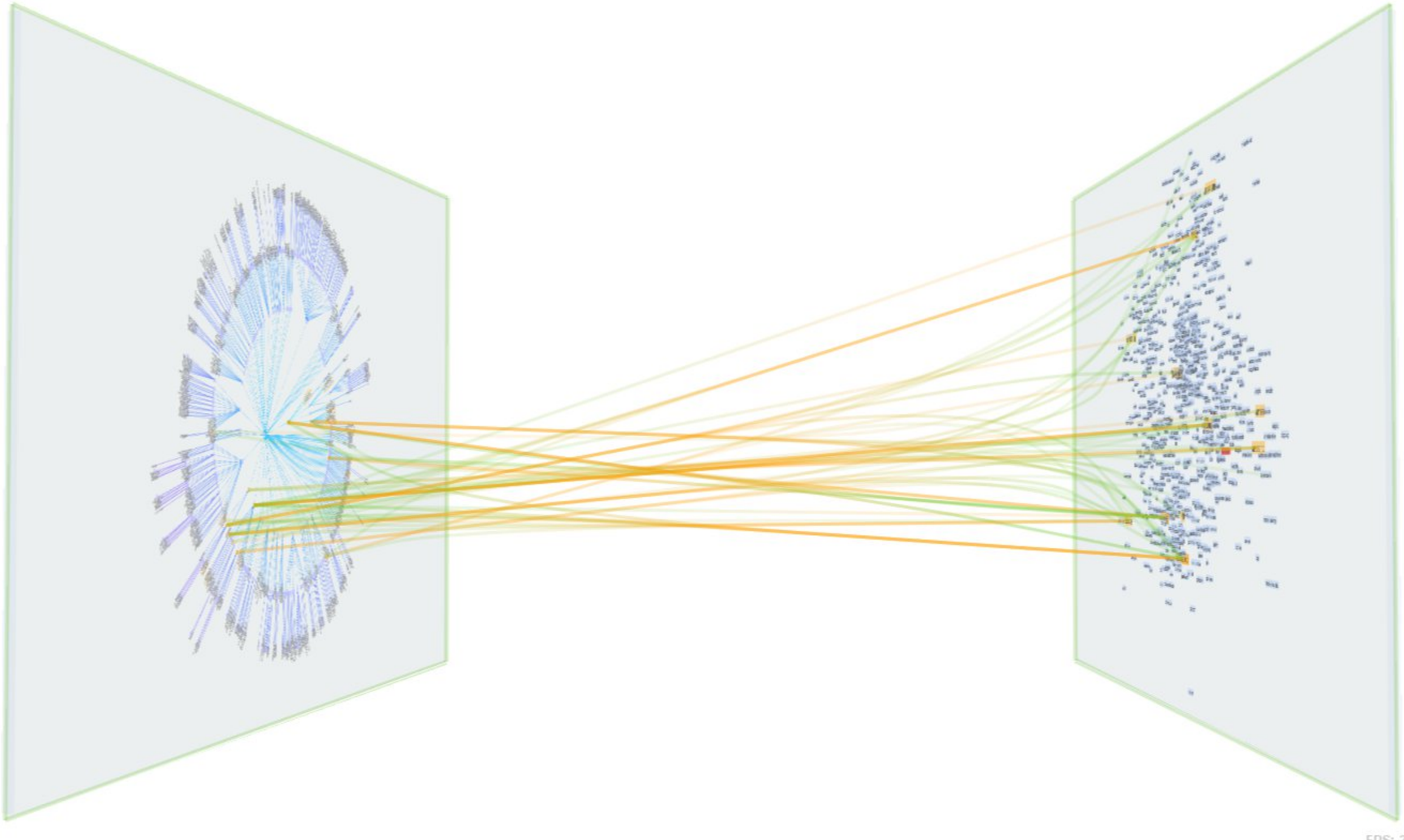
(d) Overloaded views.



(e) Nested views.

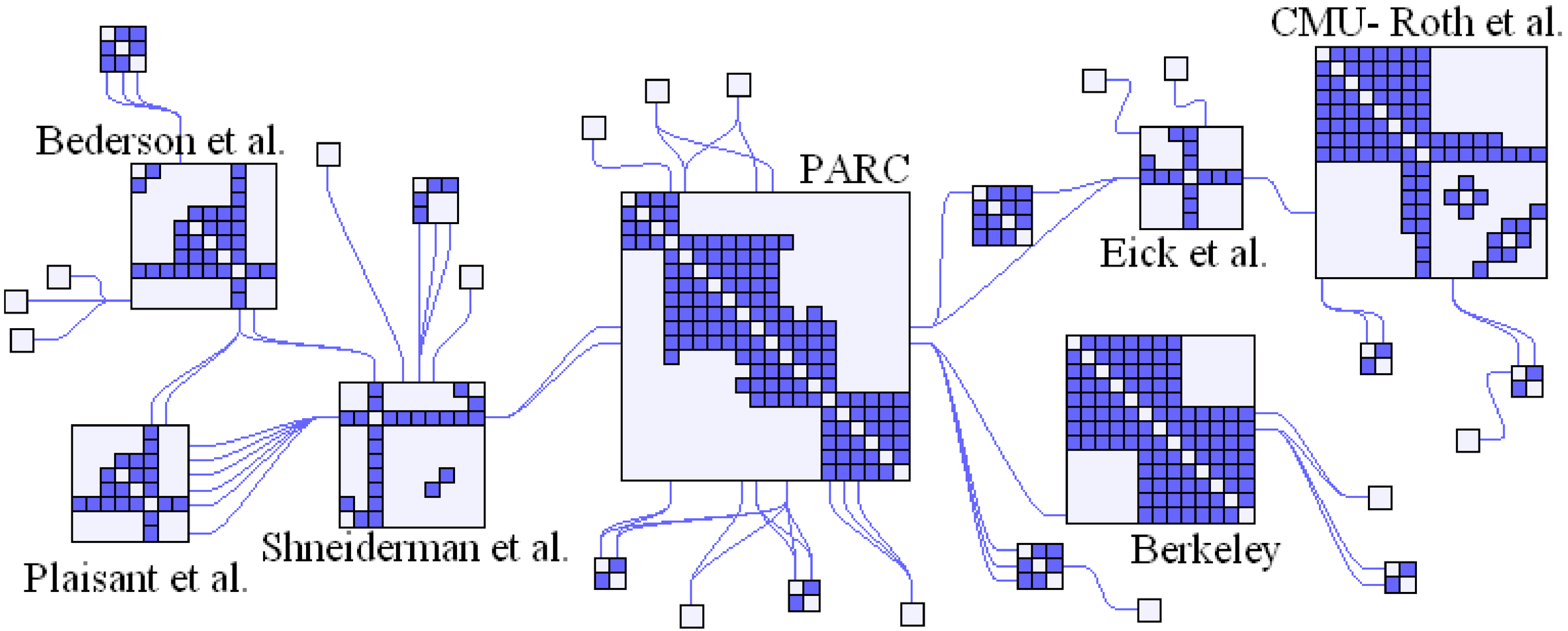
[W. Javed and N. Elmqvist, 2012]

What is this technique?



[VisLink, Collins and Carpendale, 2007]

What is this technique?

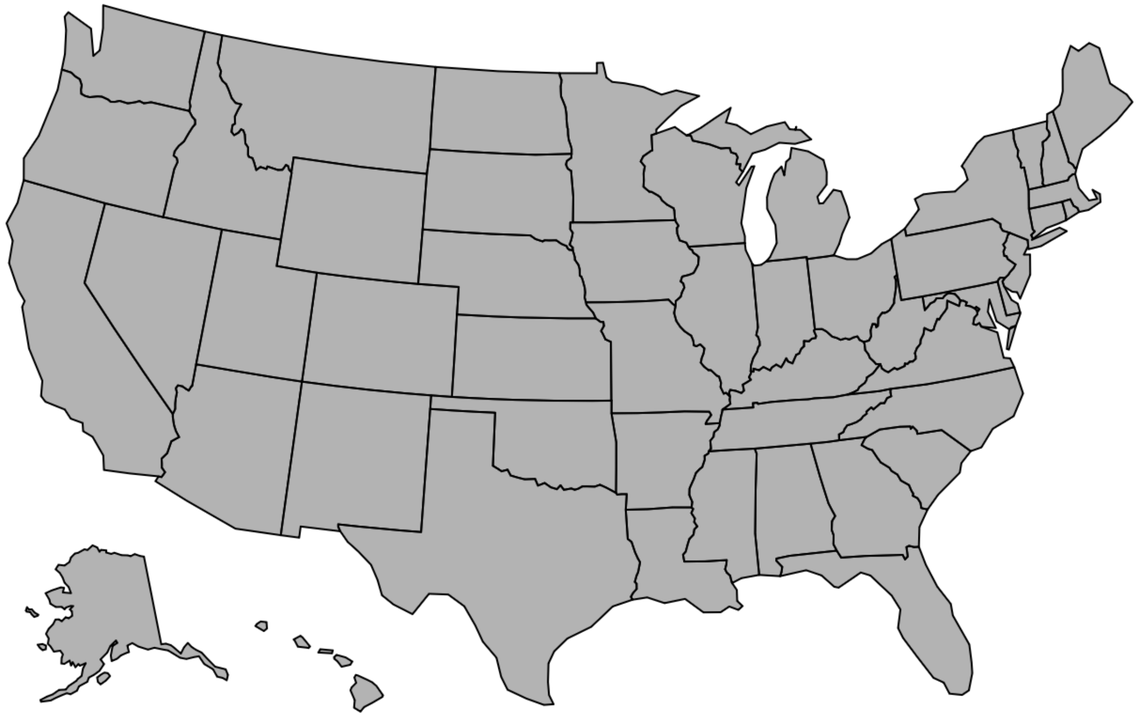


[NodeTrix, N. Henry et al., 2007]

Project Designs

- Proposal feedback up on Blackboard
  - Be creative: https://xeno.graphics/
- Designs:
  - Three different good designs
  - One bad design
  - Sketch these
  - Settle on a design and start implementing

Assignment 4



- Choropleth Maps
  - Use D3 for Part 1
  - Can use either D3 or Plot for Part 2
  - Make sure the colormap is appropriate!
- Treemap [627]
- Two resources:
  - Courselet (Plot in python)
  - Observable Notebook on Maps

Multiple Views

- Facet (noun and verb)
  - particular aspect or feature of something
  - to split
- Partition visualization into views/layers
  - Either juxtapose (side-by-side), superimpose (layer), nest, etc.
  - Depends on data and encoding
  - Generally, superimposing does not scale as well
  - Multiple views eats display space (either large screens or small visualizations)

Multiple Views

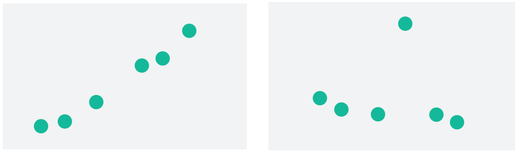
- Share Encoding: Same/Different
  - *Linked Highlighting*

- Share Data: All/Subset/None

- Share Navigation

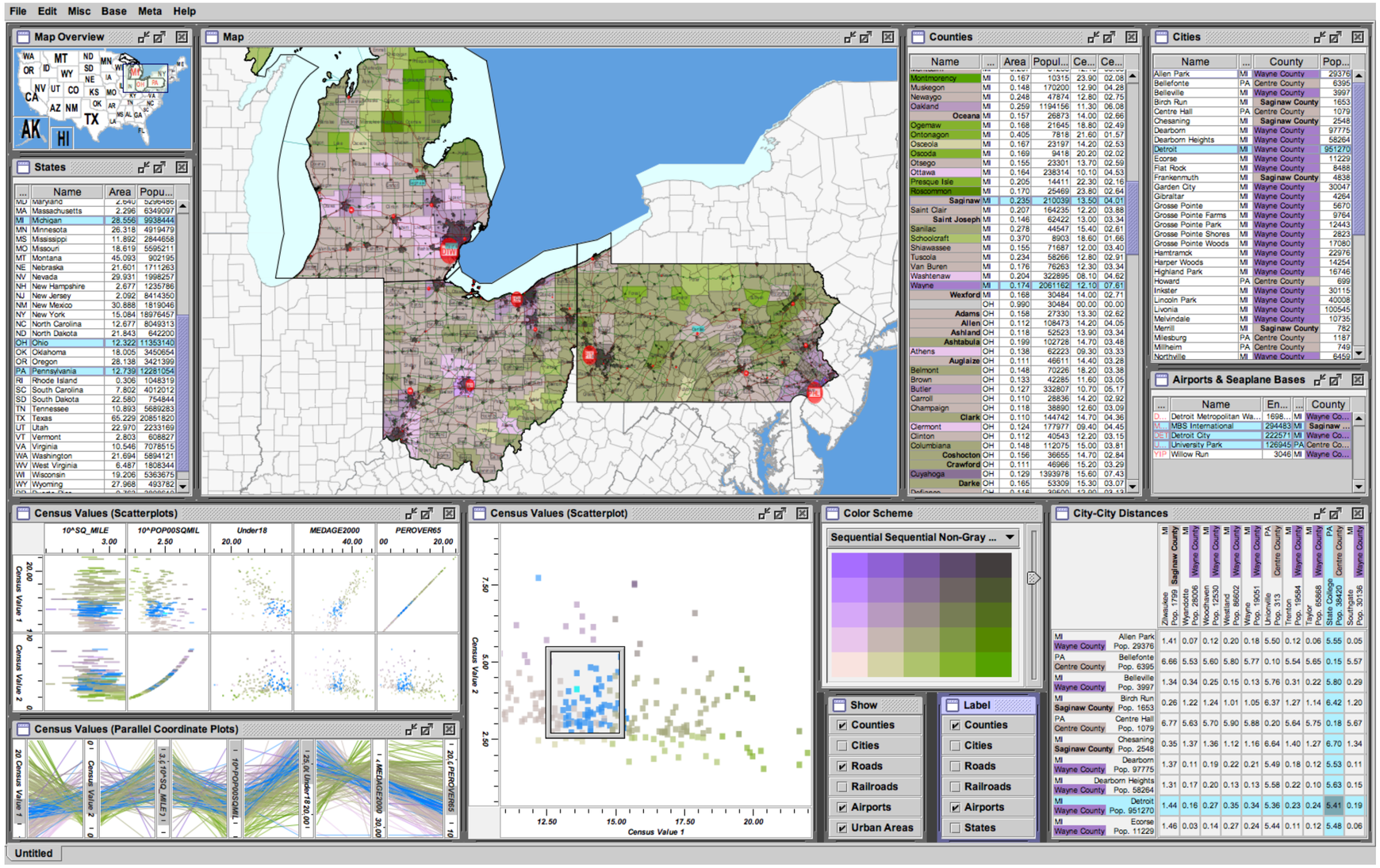
[Munzner (ill. Maguire), 2014]

Multiple Views

		Data		
		All	Subset	None
Encoding	Same	Redundant	 Overview/ Detail	 Small Multiples
	Different	 Multiform	 Multiform, Overview/ Detail	No Linkage

[Munzner (ill. Maguire), 2014]

Multiform



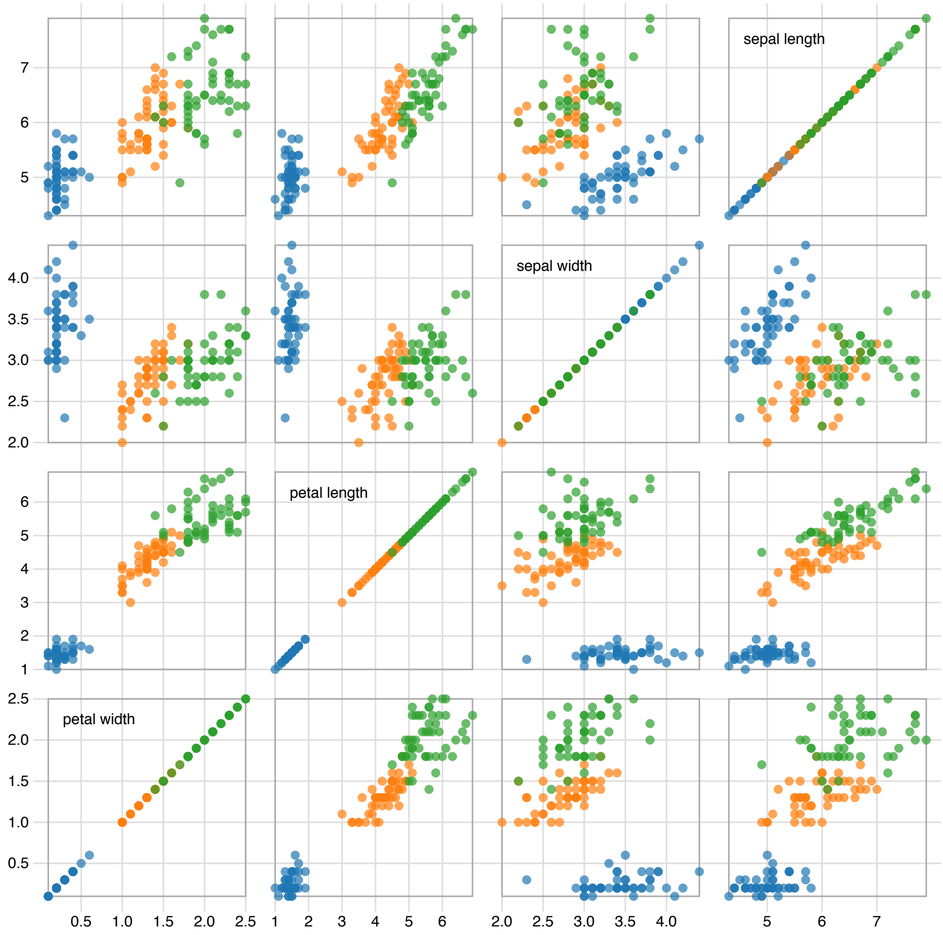
[Improvise, Weaver, 2004]

Multiform Views

- The same data visualized in different ways
- Does not need to be a totally different encoding (all choices need not be disjoint), e.g. horizontal positions could be the same
- One view becomes cluttered with too many attributes
- Consumes more screen space
- Allows greater separability between channels

Small Multiples

- Same encoding, but different data in each view (e.g. SPLOM)

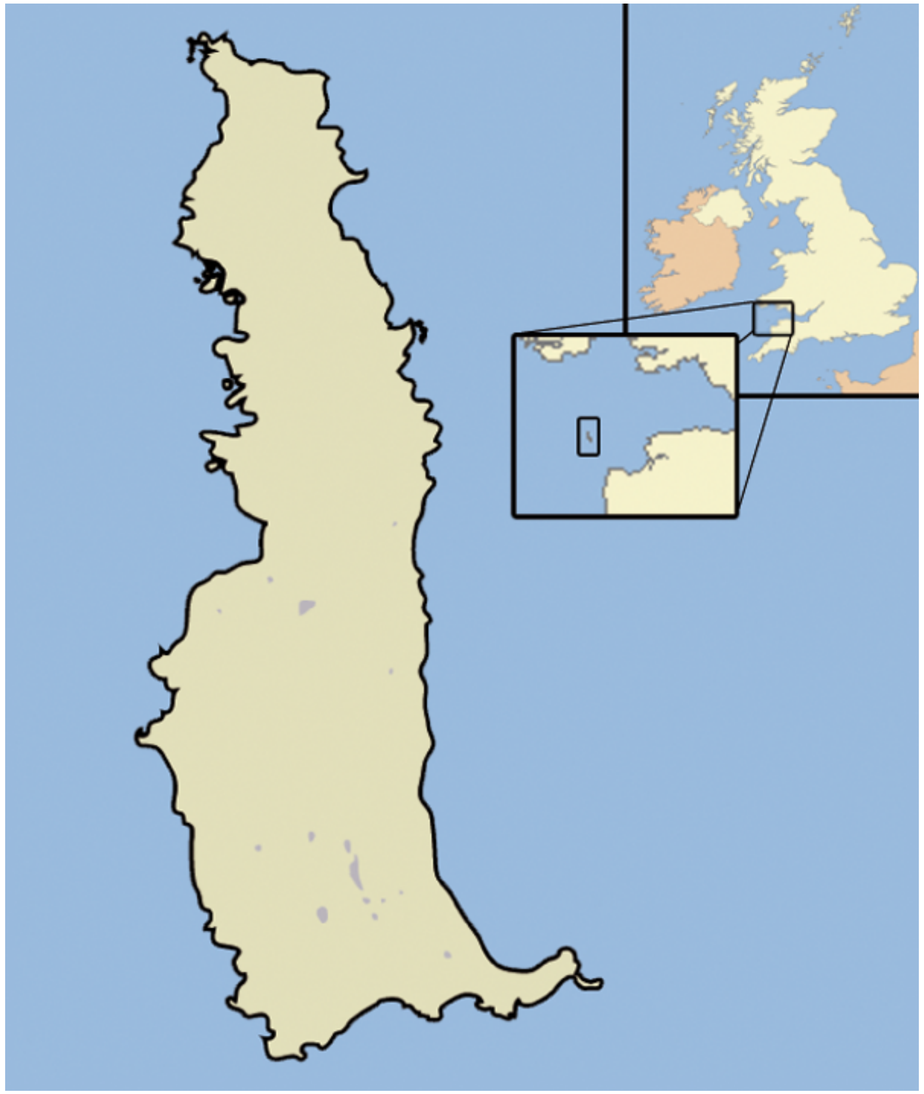


[M. Bostock]

Shneiderman's Mantra

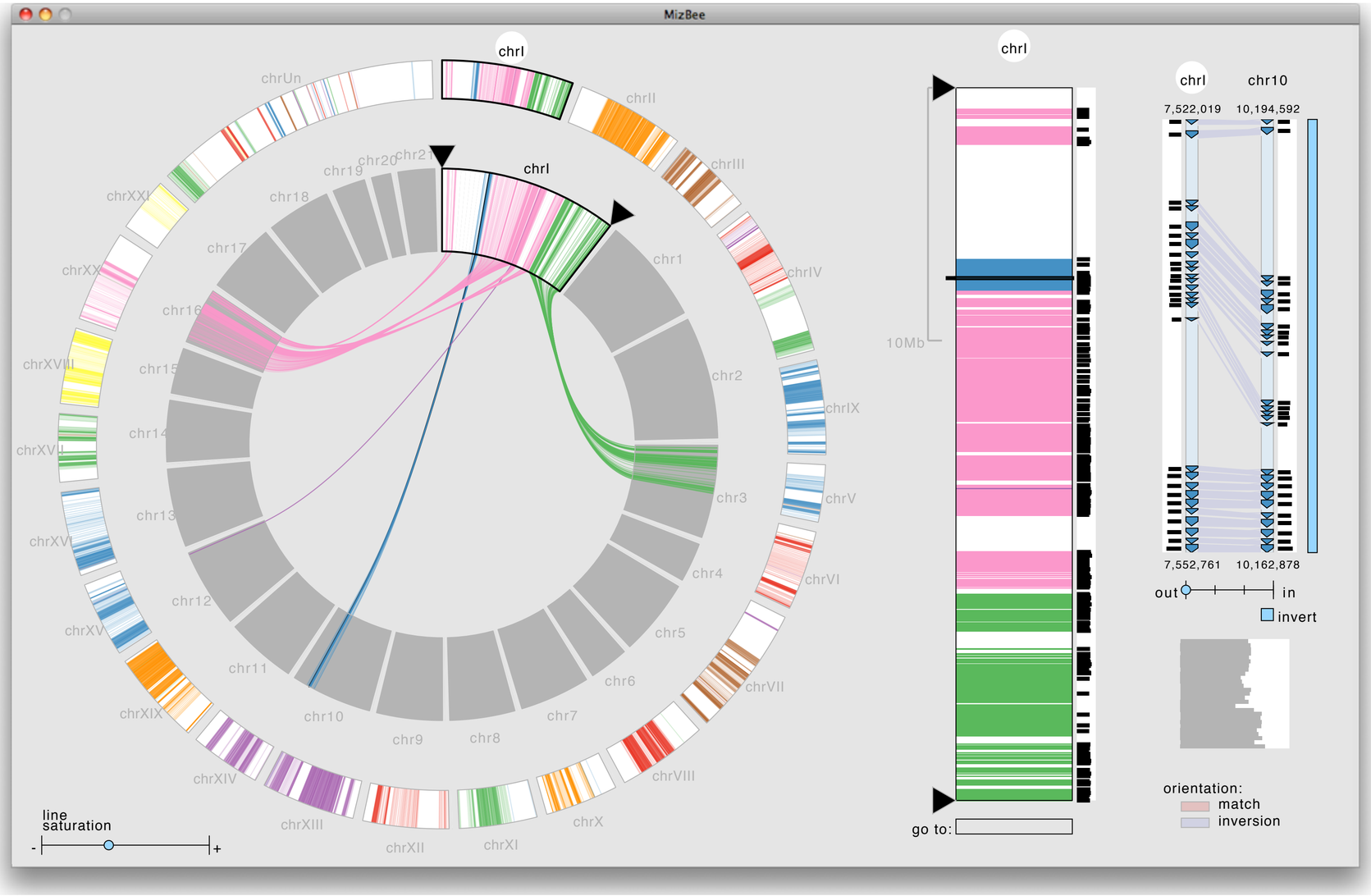
- Visual Information-Seeking Mantra [B. Shneiderman, 1996]:
  - Overview first
  - Zoom and filter (Chapter 13)
  - Details on demand
- Goal of the overview is to **summarize** all of the data
- Want specific **details** about some aspect(s) of the data, need another view/ layer
  - May be permanent: side-by-side
  - May be a popup layer: often opaque or separated
- (see textbook Ch. 6.7)

Overview-Detail View



[Wikipedia]

Overview-Detail (Different Encoding)



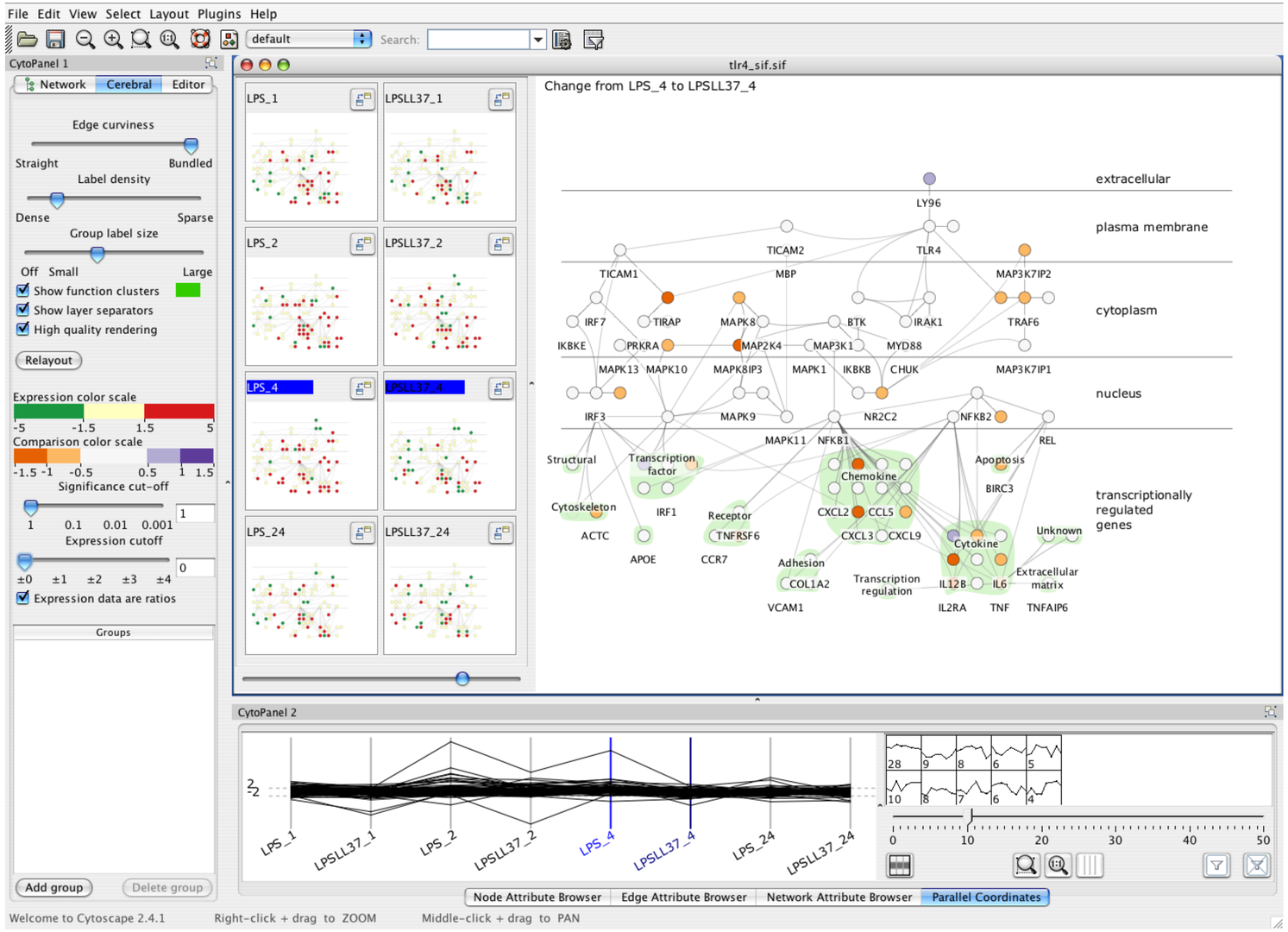
[M. Meyer et al.]

Overview-Detail (with Zoom-Filter)

- Detail involves some subset of the full dataset
- Involves user selection or filtering of some type

- How question: includes facet
- Examples:
  - Maps: partition into two views with same encoding, overview-detail
  - MizBee: partition into multiple views, coordinated with linked highlighting, overview+detail of genes

Multiform & Small Multiples (Cerebral)



[Barsky et al., 2008]

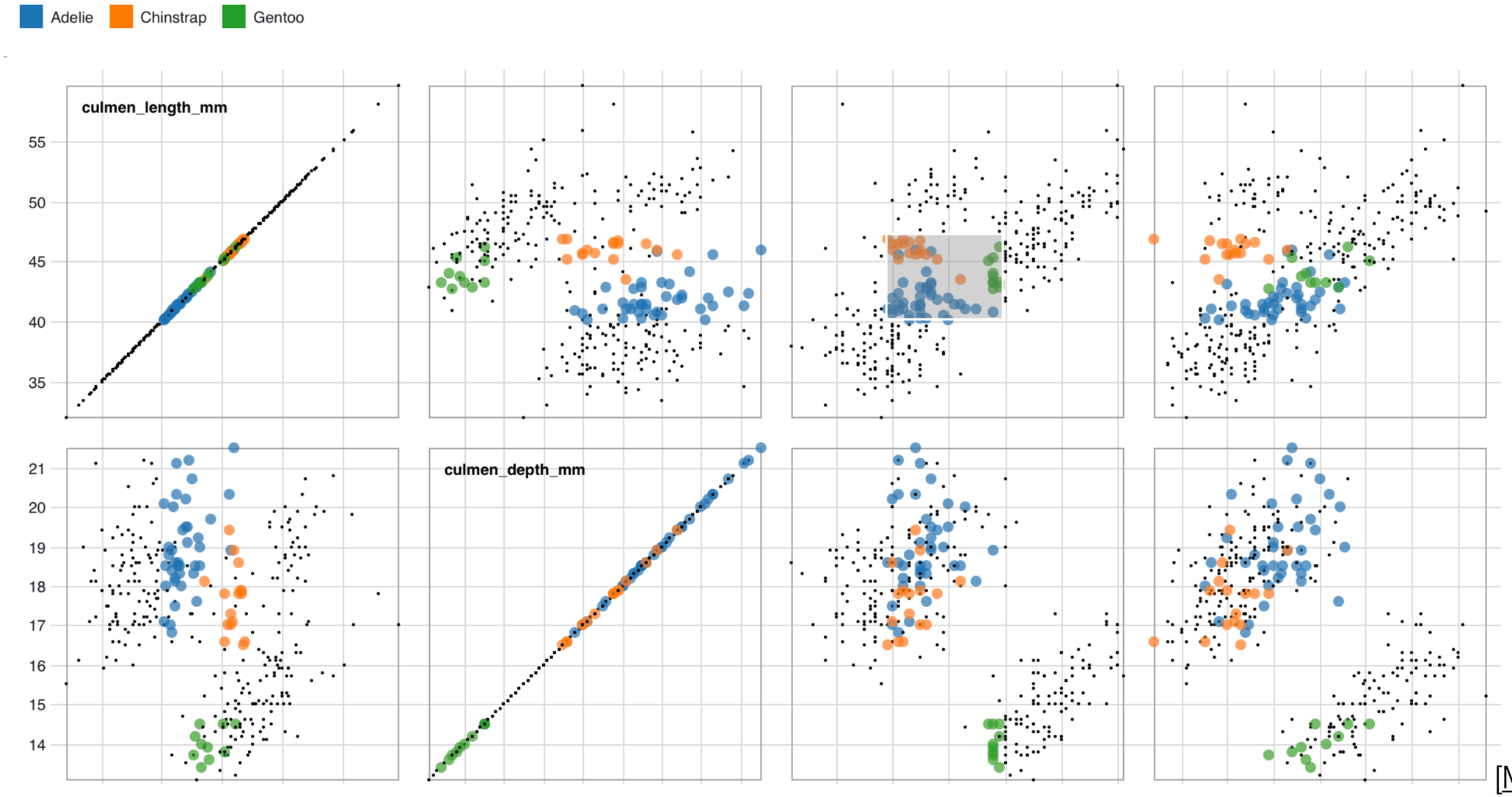
Navigation across multiple views

- Often navigation in one view updates navigation in another
- Example: Maps: overview shifts as you move around in detail view
- Selections in one view may trigger selections in another

Interaction with Multiform & Small Multiples

- Key interaction with multiform and small multiples: **brushing**
  - also called linked highlighting
- Want to understand correspondences between representation in the different views

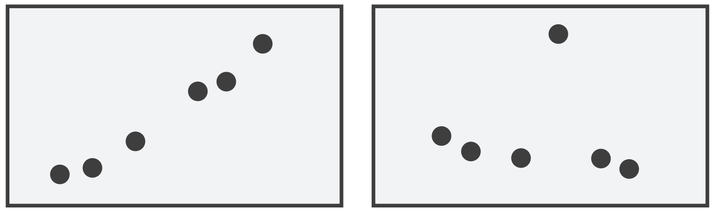
Brushing



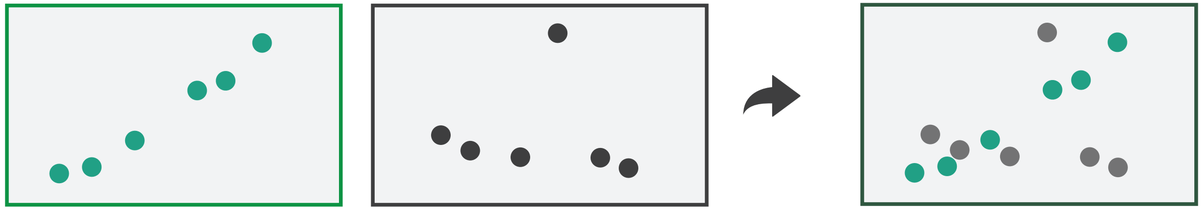
[M. Bostock]

Multiple Views

Partition into Side-by-Side Views



Superimpose Layers



[Munzner (ill. Maguire), 2014]

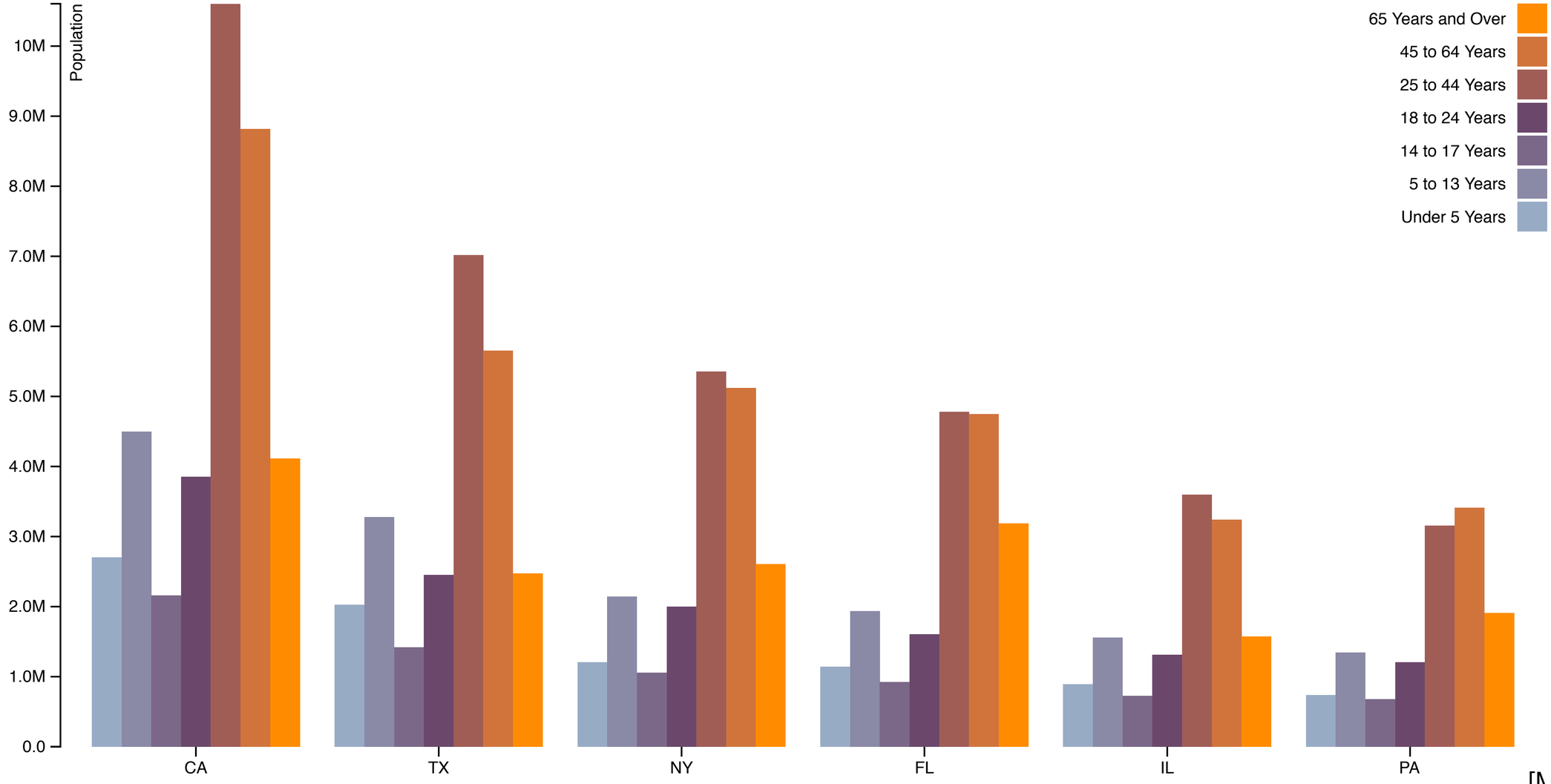
Partitioned Views

- Split dataset into groups and visualize each group
- Extremes: one item per group, one group for all items
- Can be a hierarchy
  - Order: which splits are more "related"?
  - Which attributes are used to split? usually categorical

Glyphs, Views, and Regions

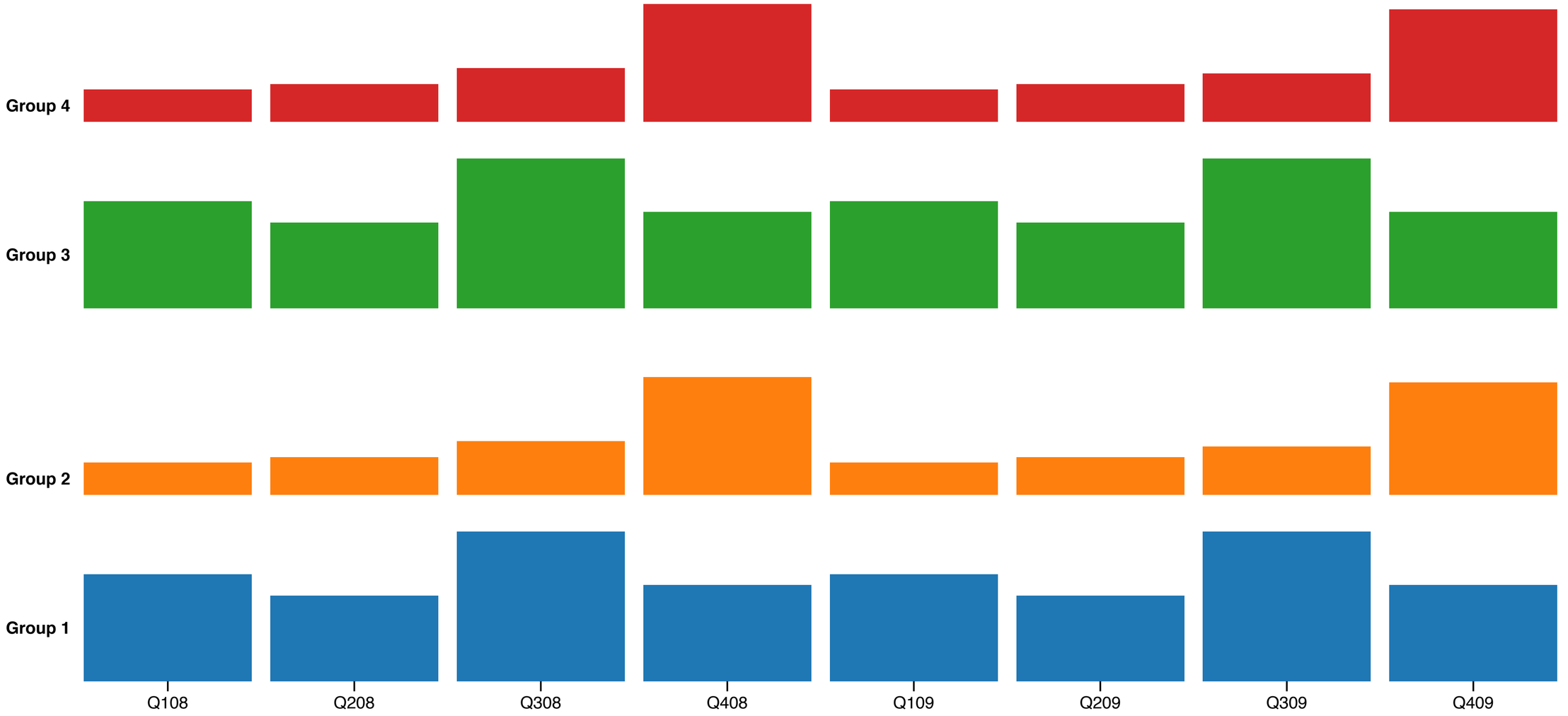
- Glyphs are composed of multiple marks
- Views are a contiguous region of space
- A region is usually associated with a group of data
- Blurry lines of distinction between them

Example: Grouped Bar Chart



[M. Bostock]

Example: Small Multiples Bar Chart

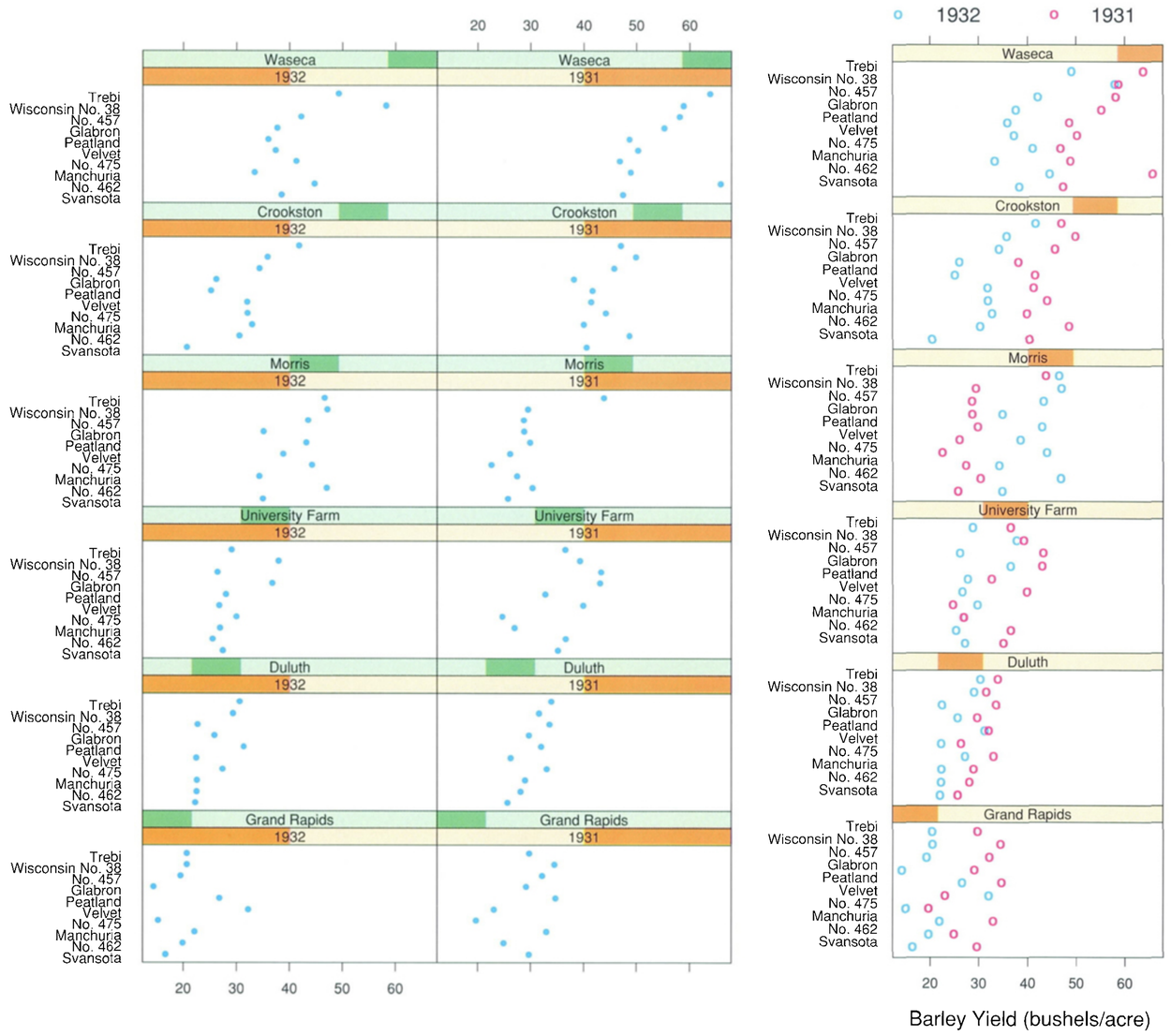


[M. Bostock]

Matrix Alignment & Recursive Subdivision

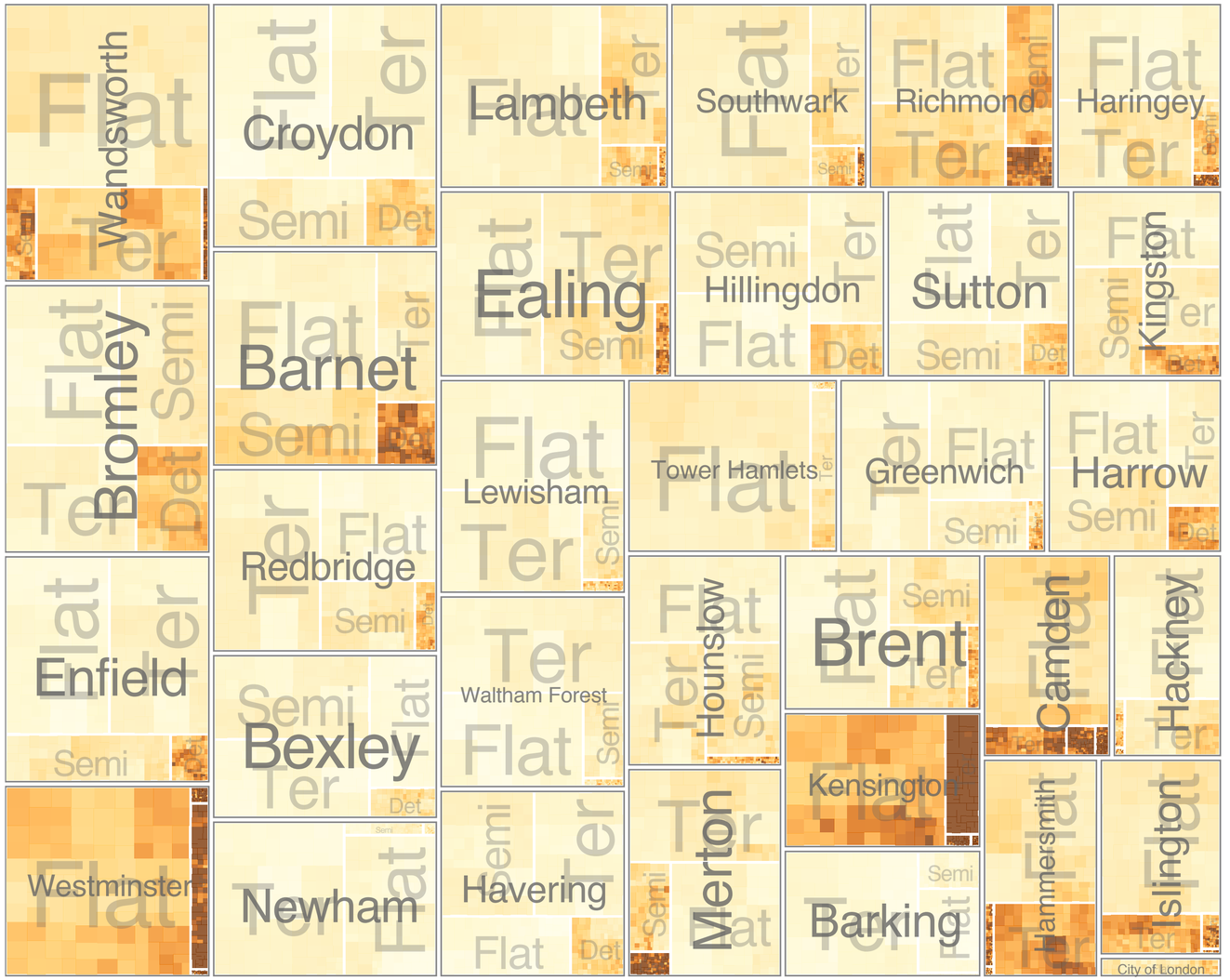
- Matrix Alignment:
  - regions are placed in a matrix alignment
  - splits go to rows and columns
  - main-effects ordering: use summary statistic to determine order of categorical attribute
- Recursive subdivision:
  - Designed for exploration
  - Involves hierarchy
  - User drives the ways data is broken down in recursive manner

Example: Trellis Matrix Alignment



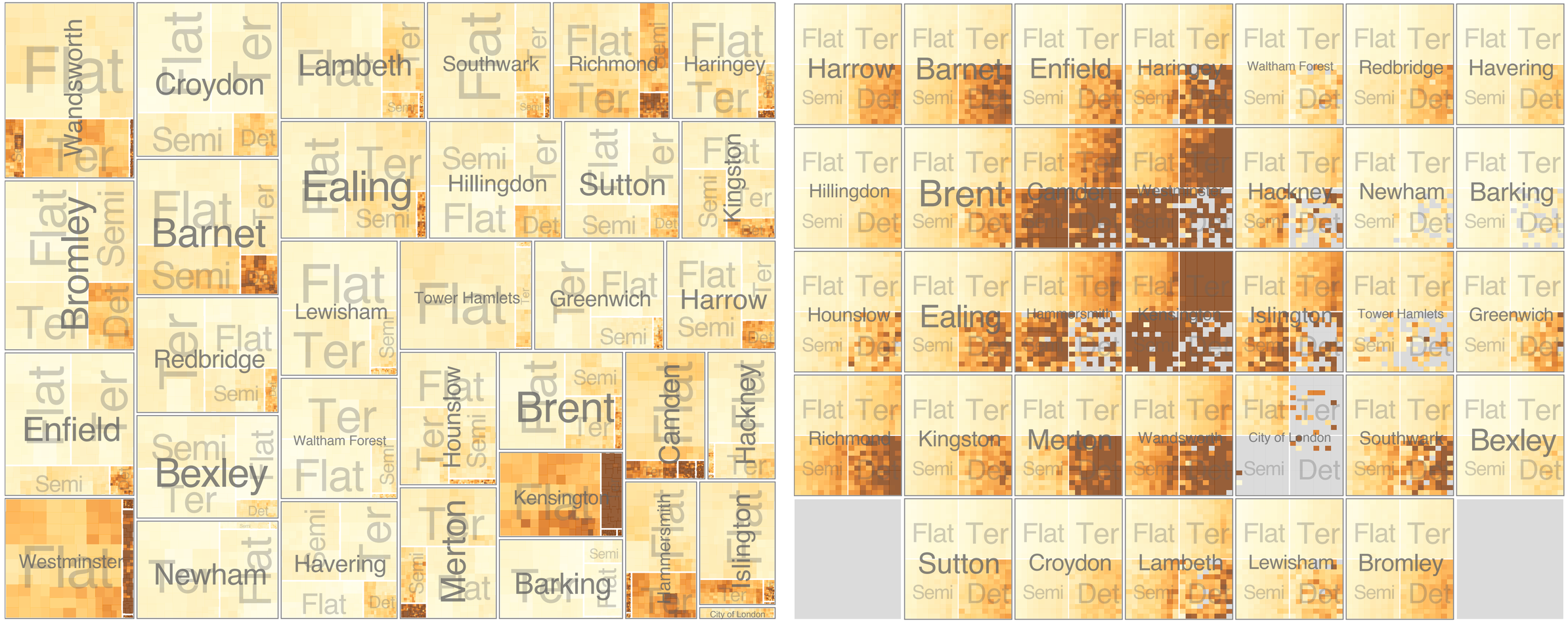
[Becker et al., 1996]

Recursive Subdivision



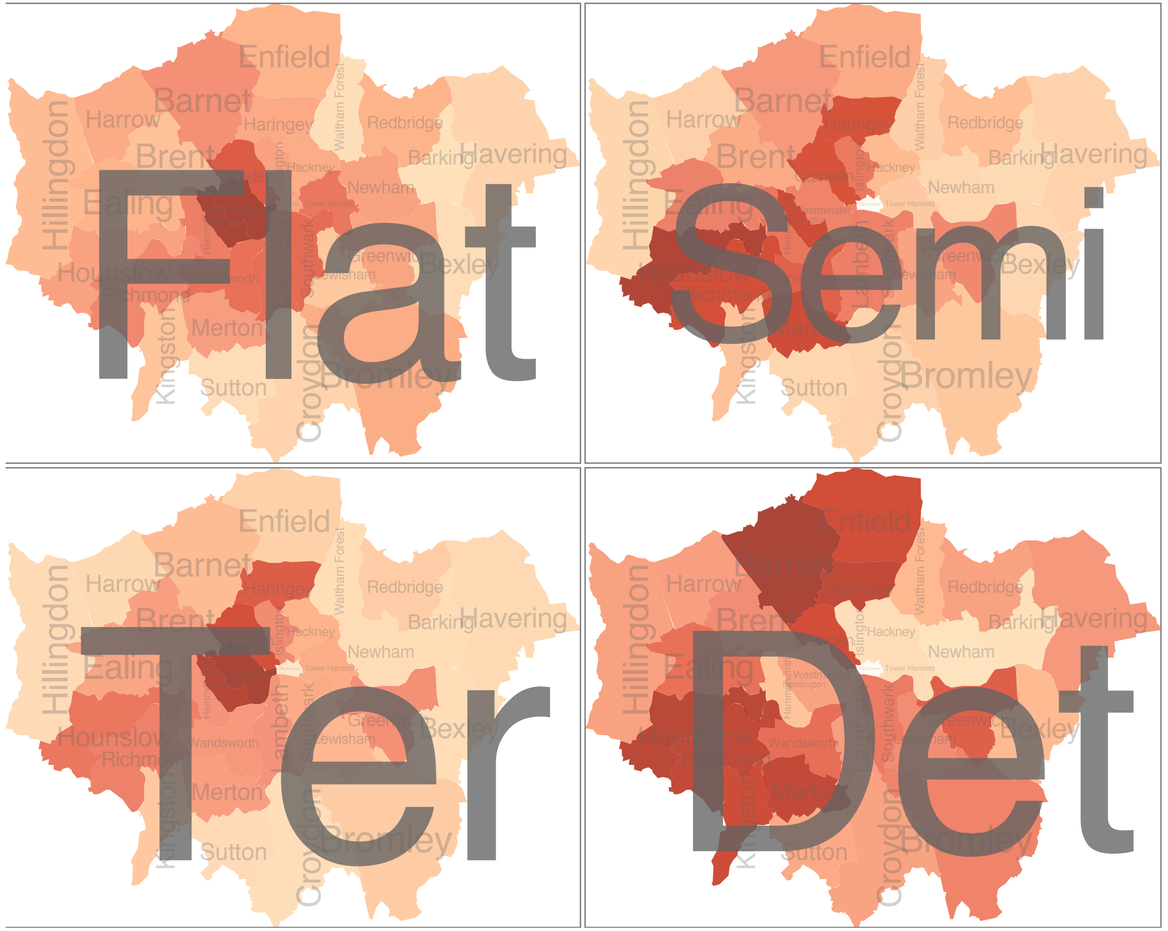
[Slingsby et al., 2009]

Example: HiVE System



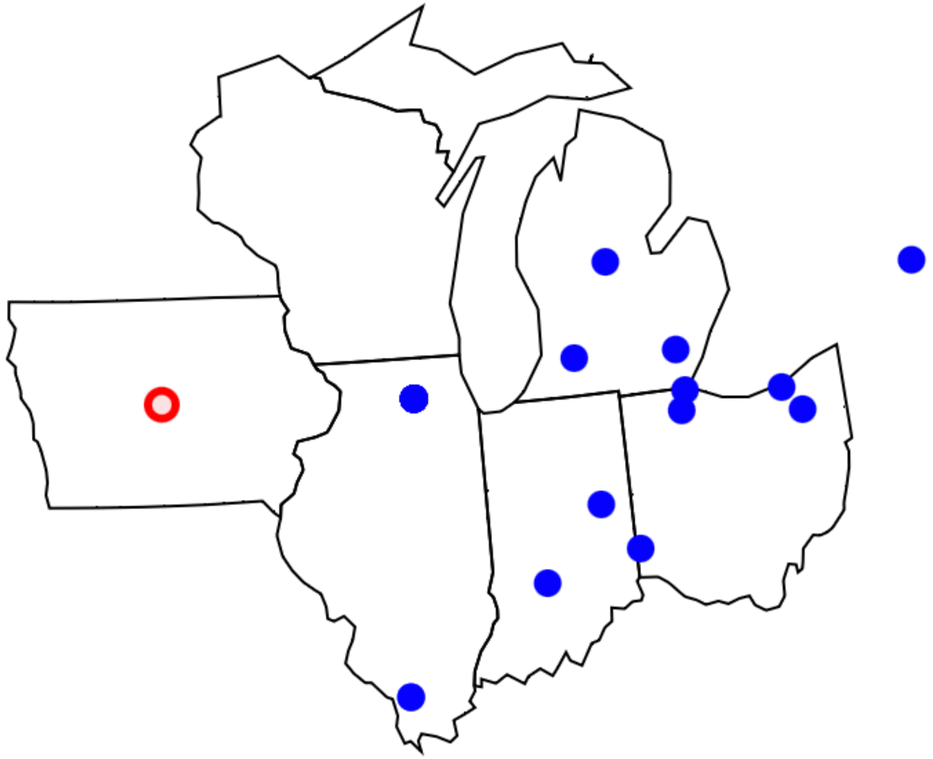
[Slingsby et al., 2009]

Example: HiVE System



[Slingsby et al., 2009]

Linked Highlighting Example



Date	Opponent	Result	Site
Nov 8, 2018	Yale	W 89–80	DeKalb, IL
Nov 11, 2018	at Iowa State	L 60–70	Ames, IA
Nov 18, 2018	Northern Iowa	W 70–59	DeKalb, IL
Nov 25, 2018	at Indiana	L 73–91	Bloomington, IN
Nov 28, 2018	North Dakota State	W 81–63	DeKalb, IL
Dec 1, 2018	at Montana	L 70–86	Missoula, MT
Dec 2, 2018	vs. Nevada	W 98–69	Missoula, MT
Dec 7, 2018	at Southern Illinois	L 73–82	Carbondale, IL
Dec 8, 2018	vs. Western Illinois	W 86–61	Carbondale, IL
Dec 17, 2018	Eastern Illinois	W 78–59	DeKalb, IL
Dec 21, 2018	Chicago State	W 114–52	DeKalb, IL
Dec 31, 2018	Brown	W 109–102	DeKalb, IL
Jan 5, 2019	Miami (OH)	W 82–71	DeKalb, IL
Jan 9, 2019	at Kent State	L 78–87	Kent, OH