

Data Visualization (CSCI 627/490)

Multiple Views & Filtering

Dr. David Koop

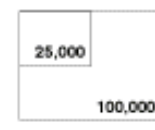
Treemap

Truck Sales Slip, Tripping Up Chrysler

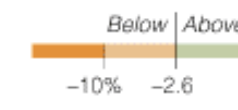
Over the past few years, Chrysler executives said they were following the lead of Toyota and Honda, focusing on vehicles that met the needs of their customers. But as American consumers turned away from large trucks and S.U.V.'s in 2006, Chrysler continued to churn out big vehicles, which are now sitting unsold at dealerships across the country.

READING THE CHART

Boxes are scaled proportionally according to number of cars sold in 2006



Change in sales from

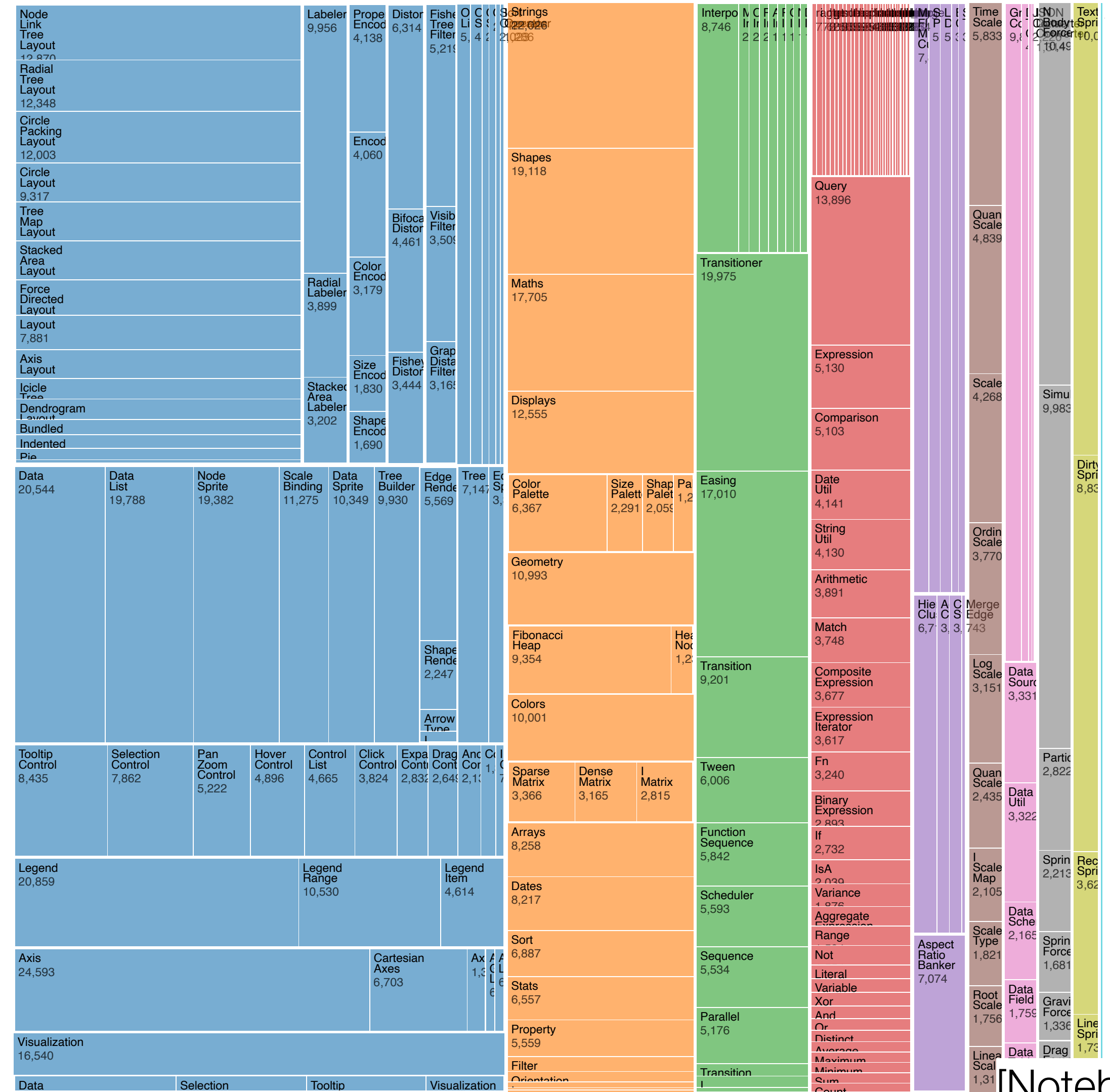


- Containment marks instead of connection marks – show hierarchy
- Encodes some quantitative attribute of the items as the **size** of the rectangles
- Not as easy to see the intermediate rectangles (hierarchy)
- Scalability: millions of leaf nodes and links possible

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

Treemap Layouts: Slice & Dice

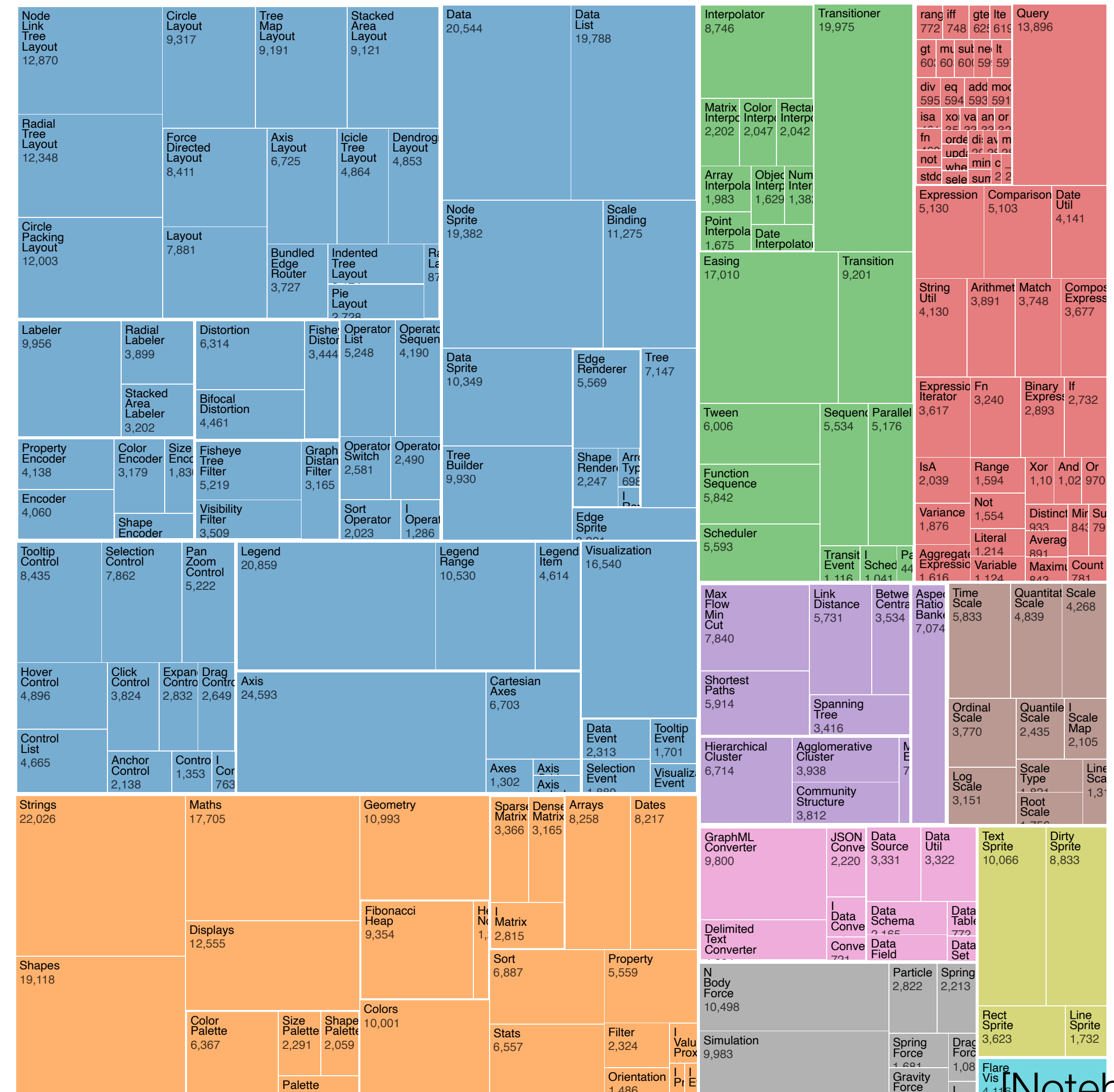
- Split at each level into strips
- At each step, orientation of division (horizontal/vertical) changes
- Better, but some rectangles still have bad aspect ratio



[Notebook]

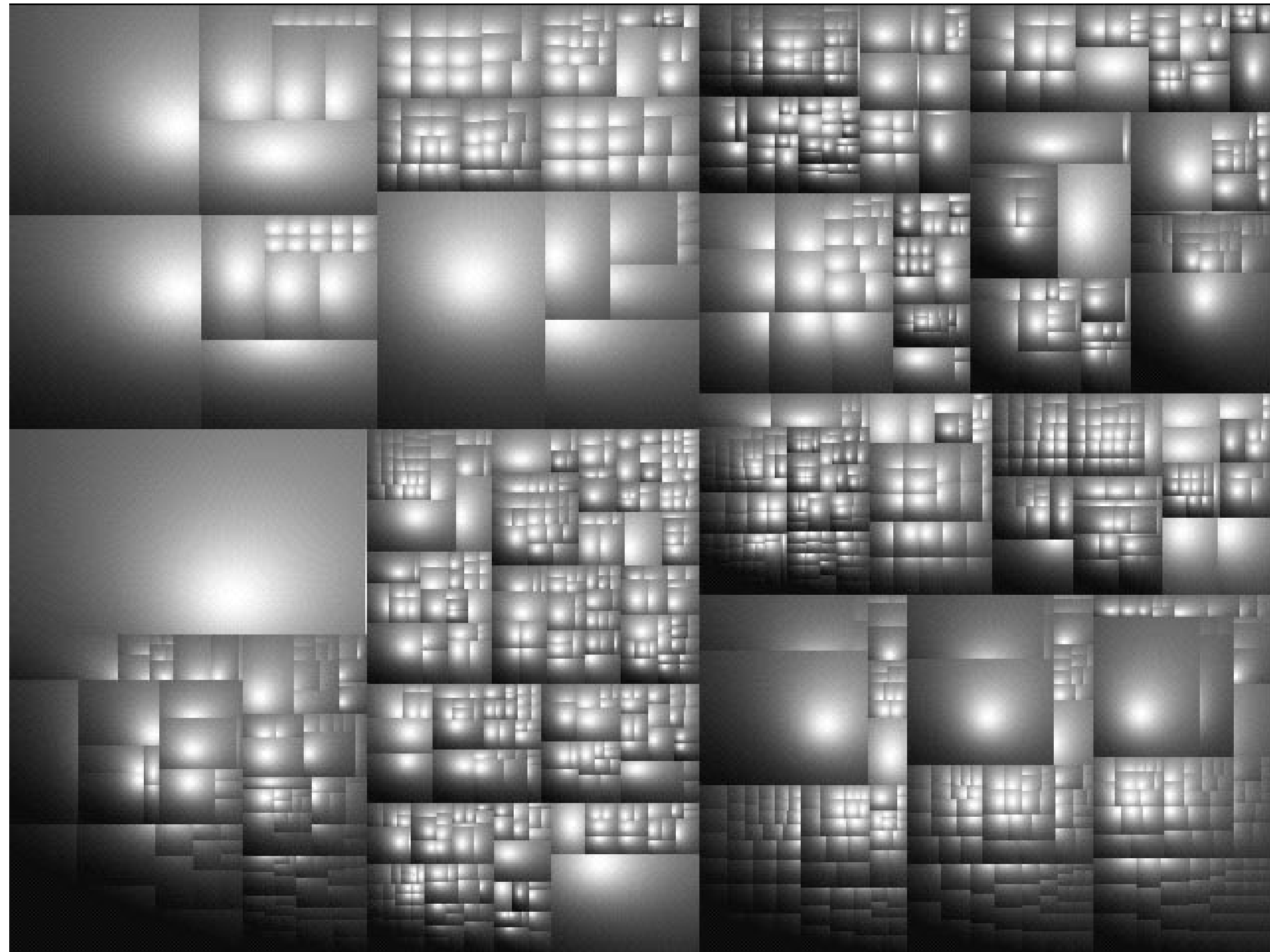
Treemap Layouts: Squarify

- 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

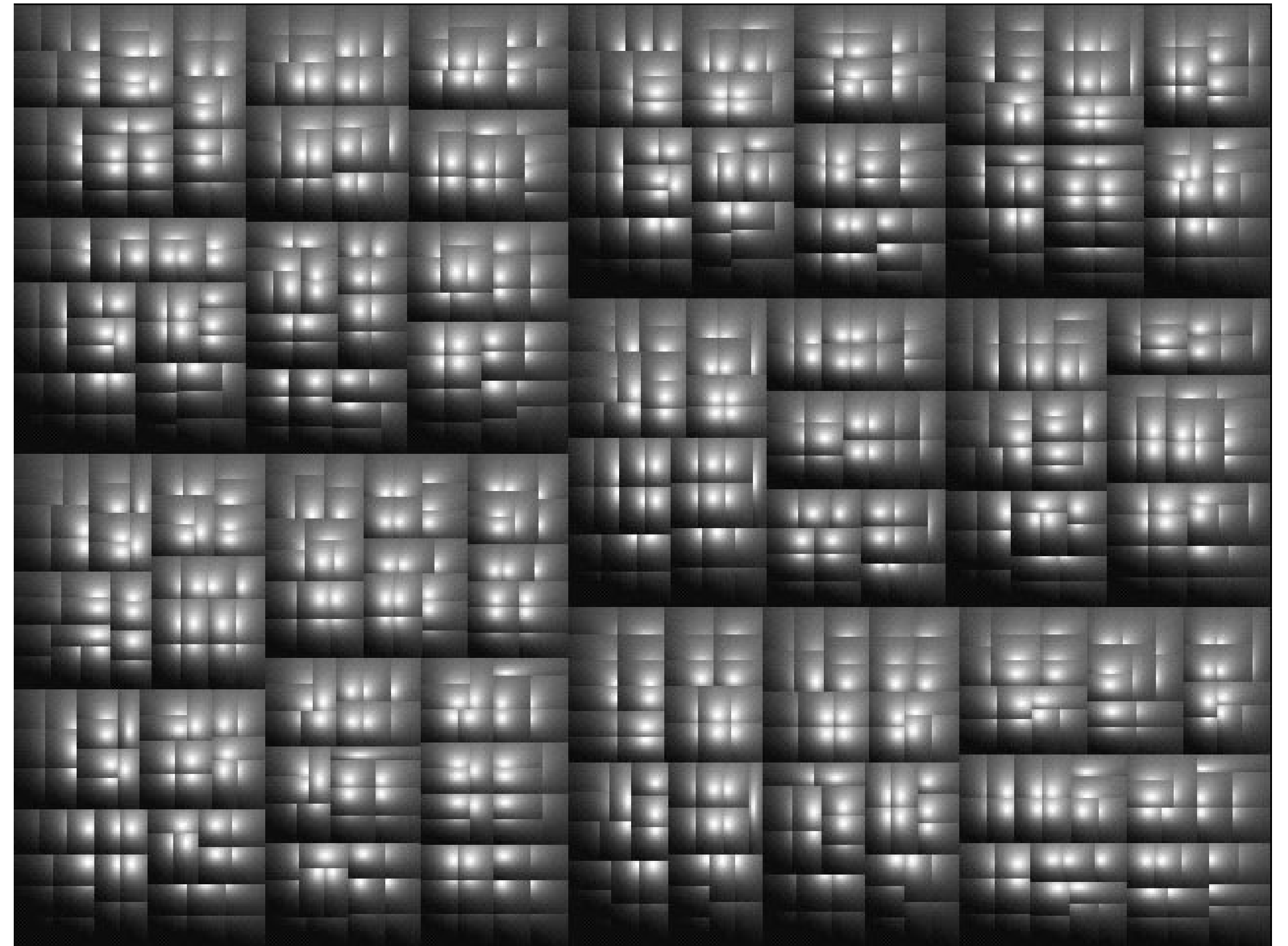


[Notebook]

Squarified + Cushioned Treemaps



(a) File system

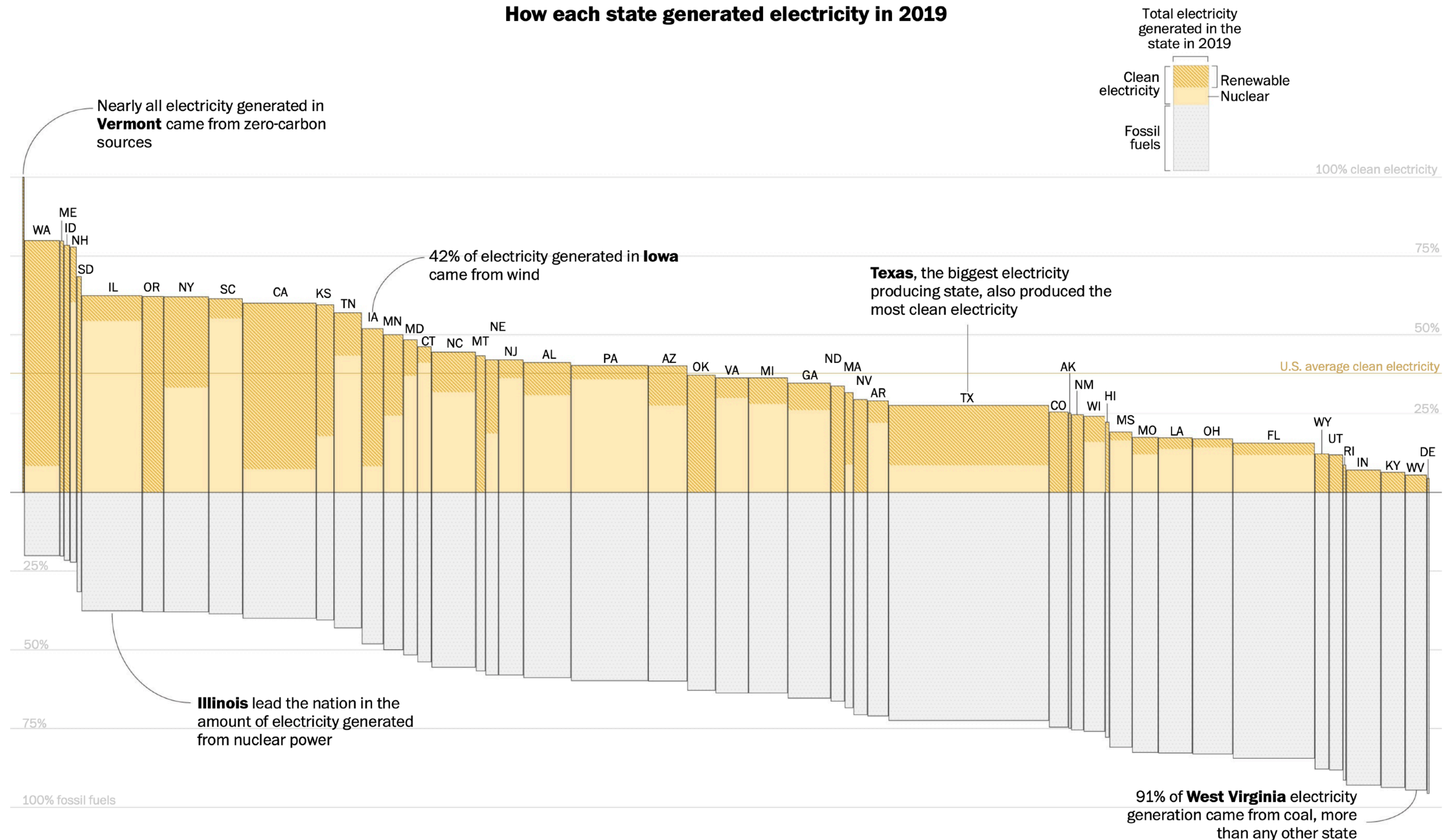


(b) Organization

[Brus et al., 1999]

Variations: Marimekko Chart

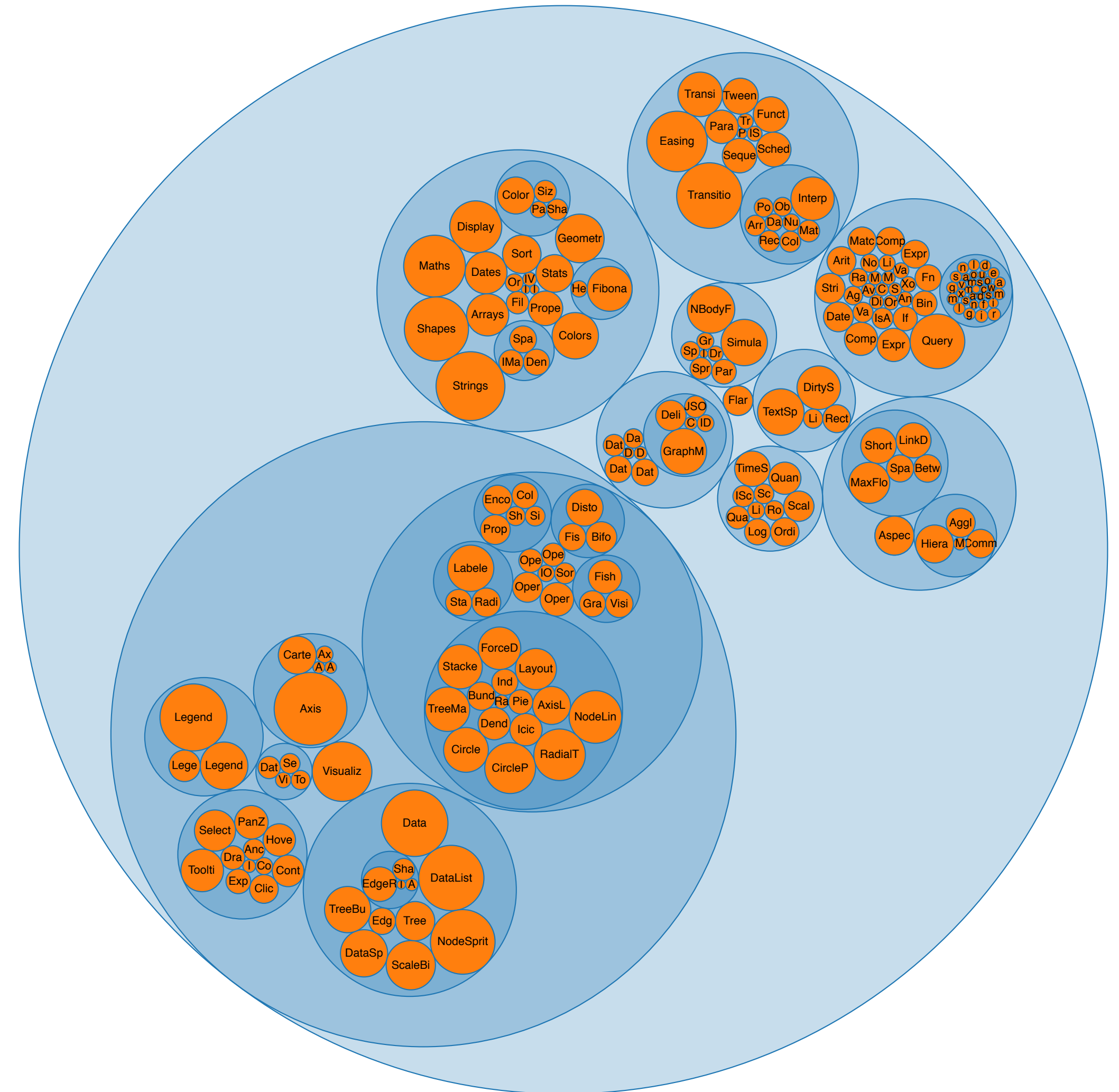
How each state generated electricity in 2019



[J. Muyskens, [Washington Post](#)]

Nested Circles

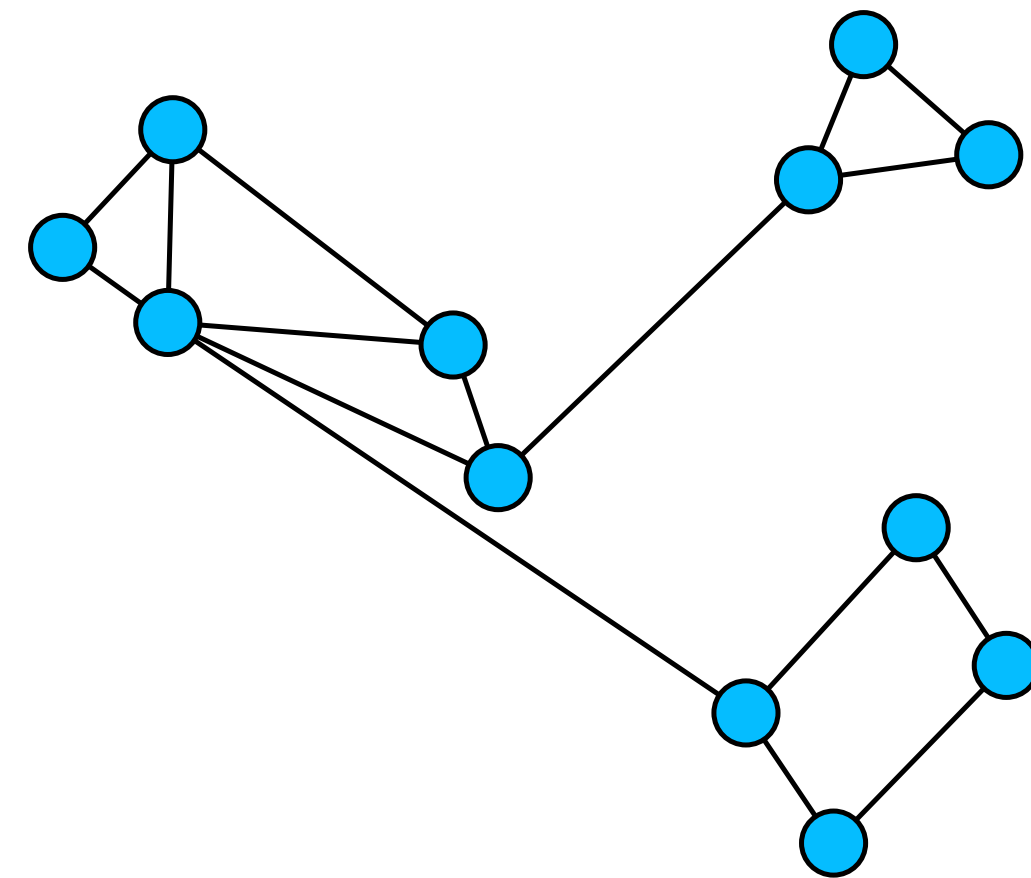
- Looks more like cluster diagram, but shows hierarchy
- Containment shown by the layering of semi-transparent circles
- Labeling becomes more difficult



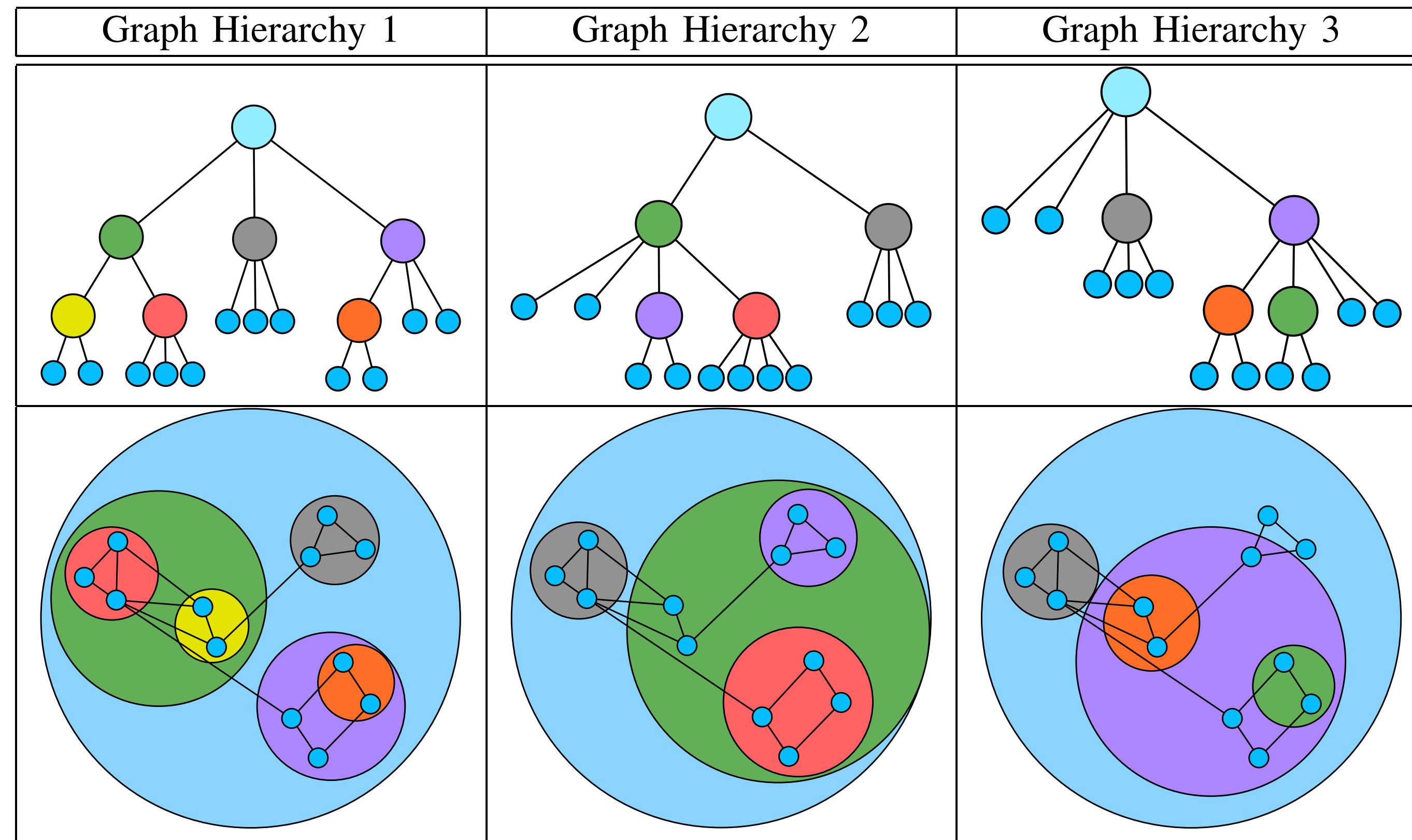
[Bostock, 2012]

Compound Networks

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



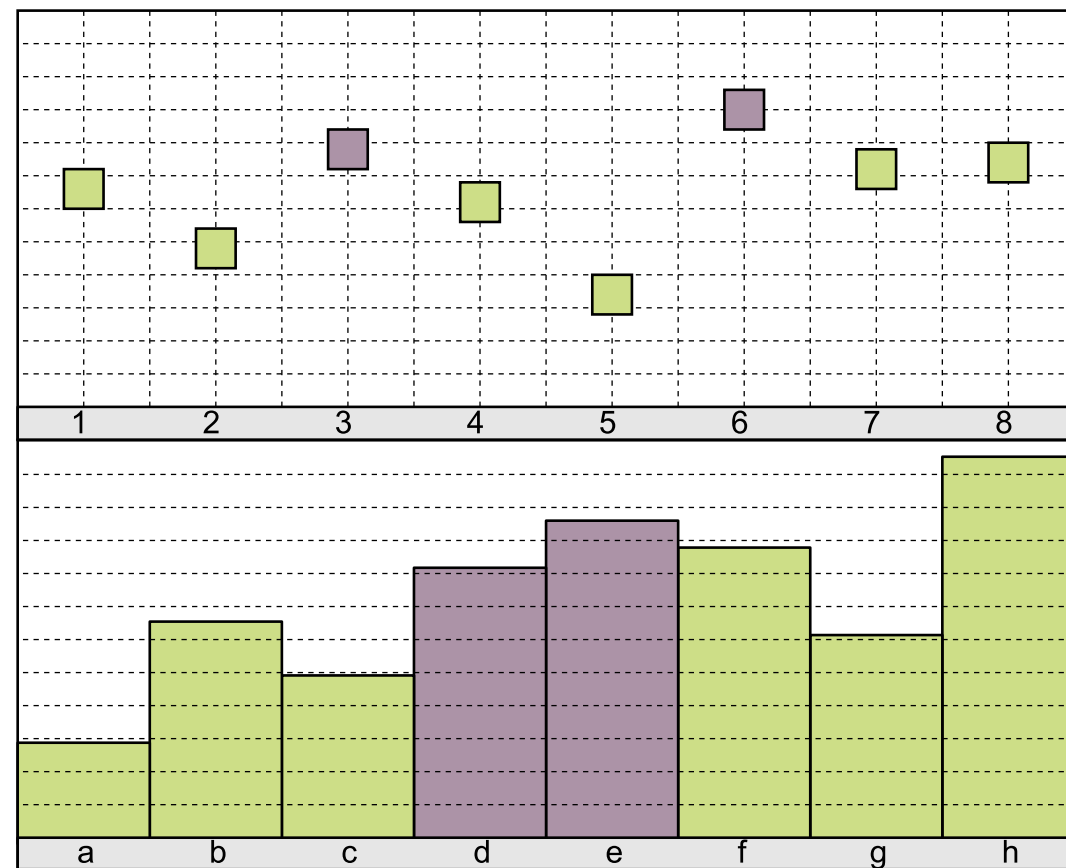
(a) Input Graph



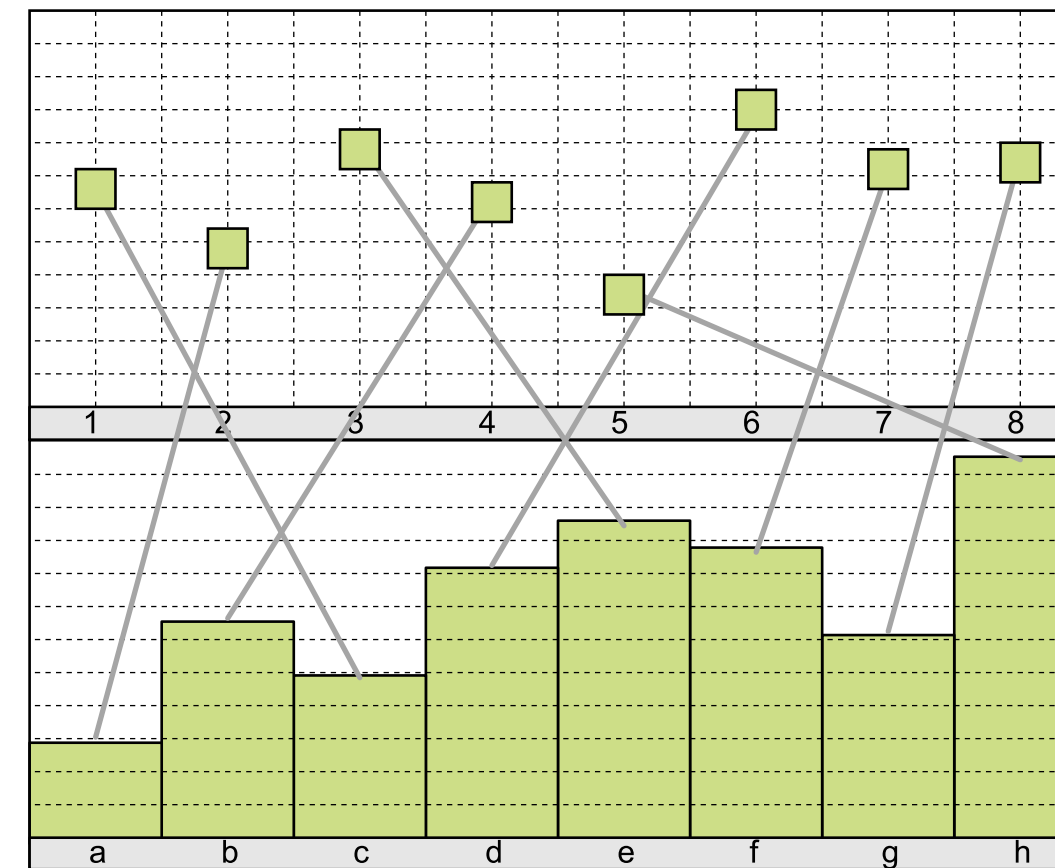
(b) Graph Hierarchies

[Archambault et al., 2008]

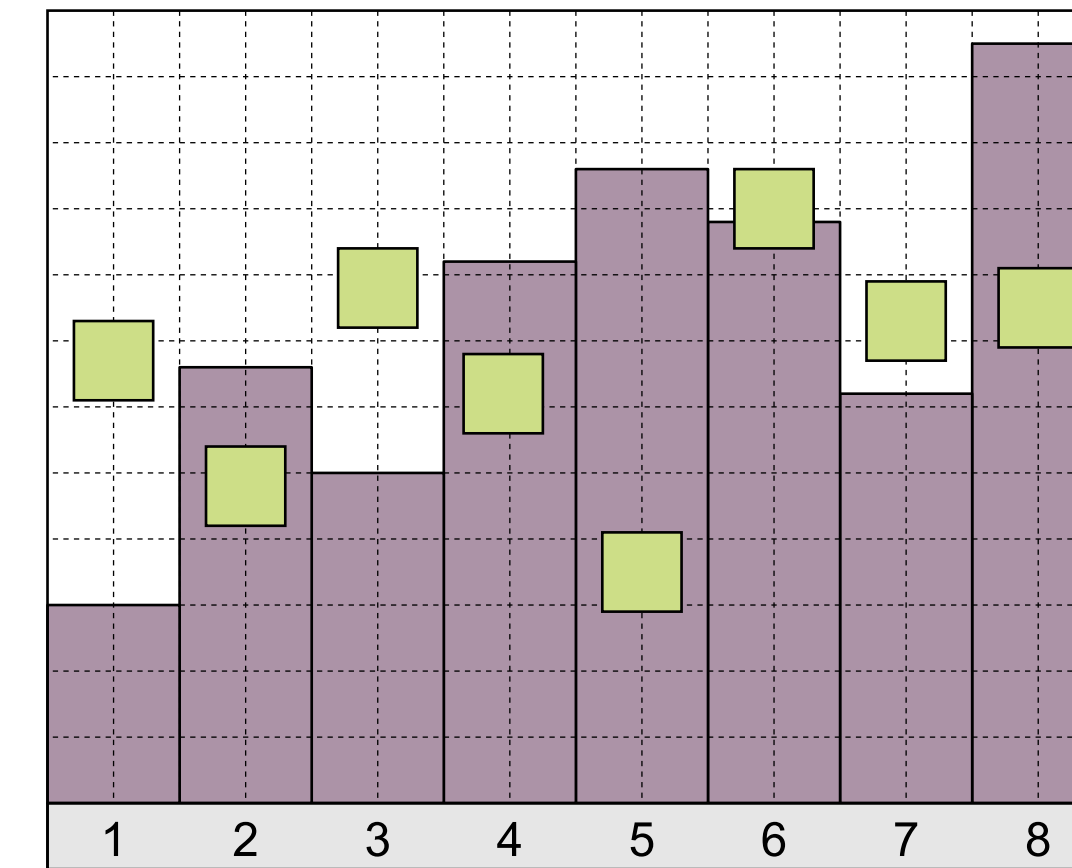
Composite Visualization Techniques



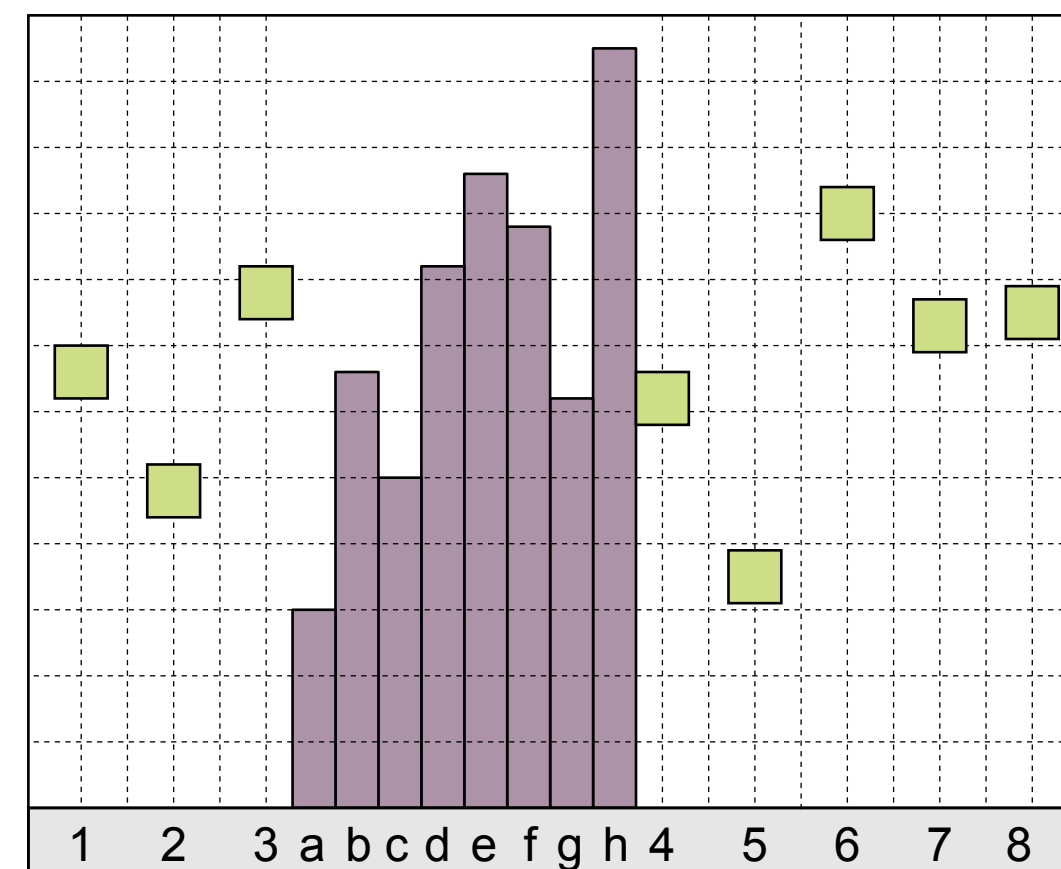
(a) Juxtaposed views.



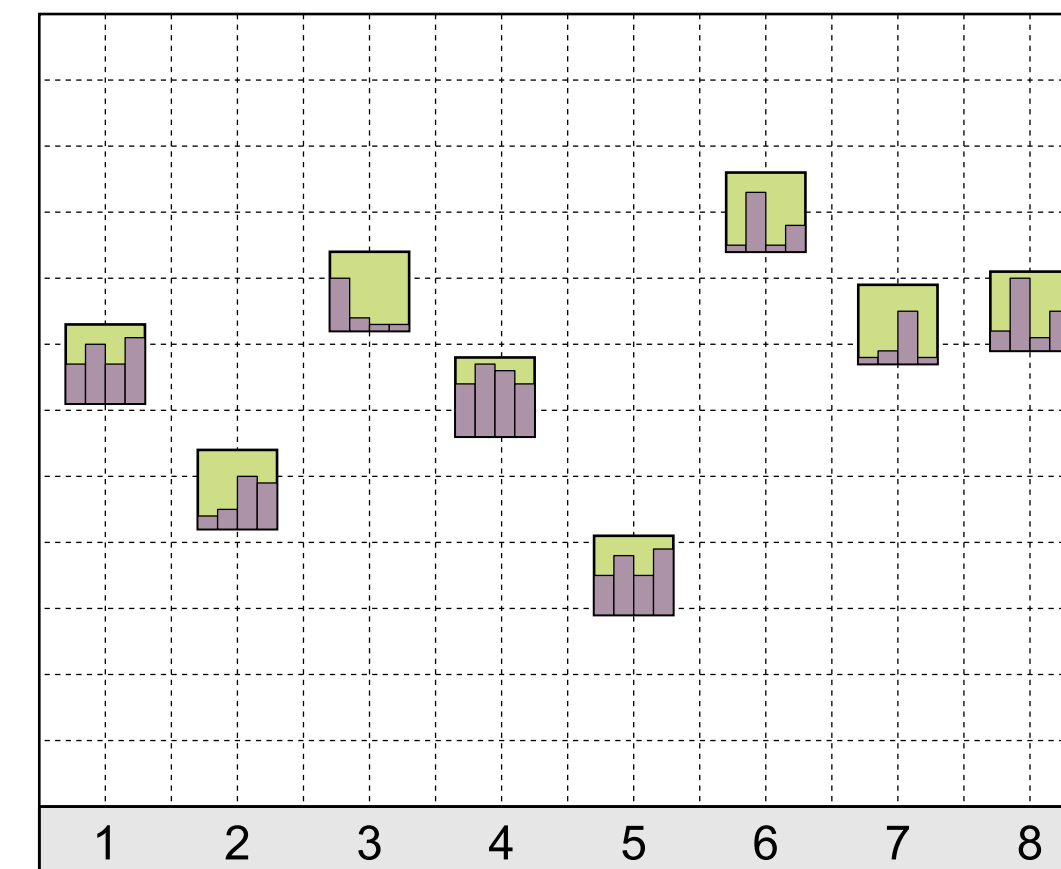
(b) Integrated views.



(c) Superimposed views.



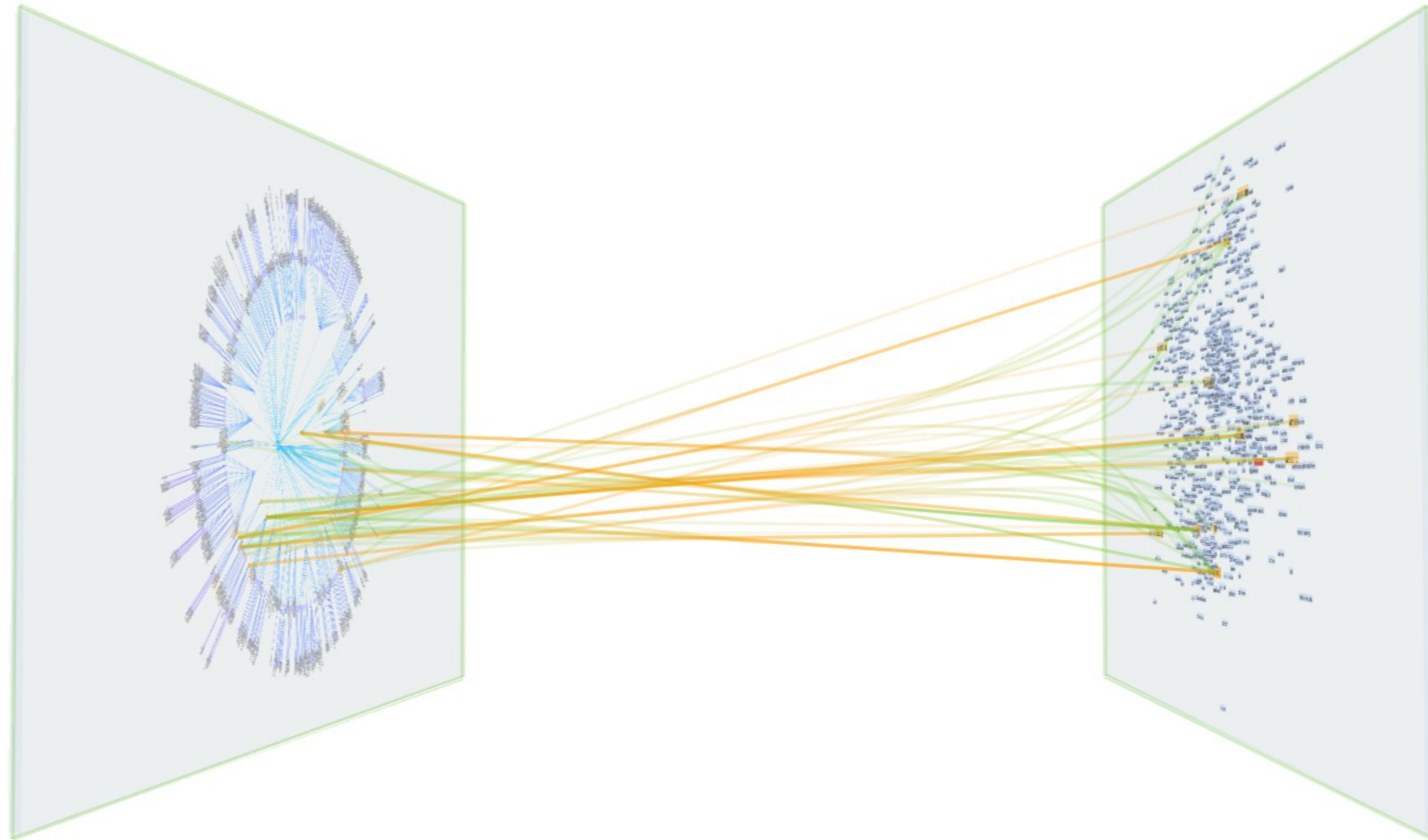
(d) Overloaded views.



(e) Nested views.

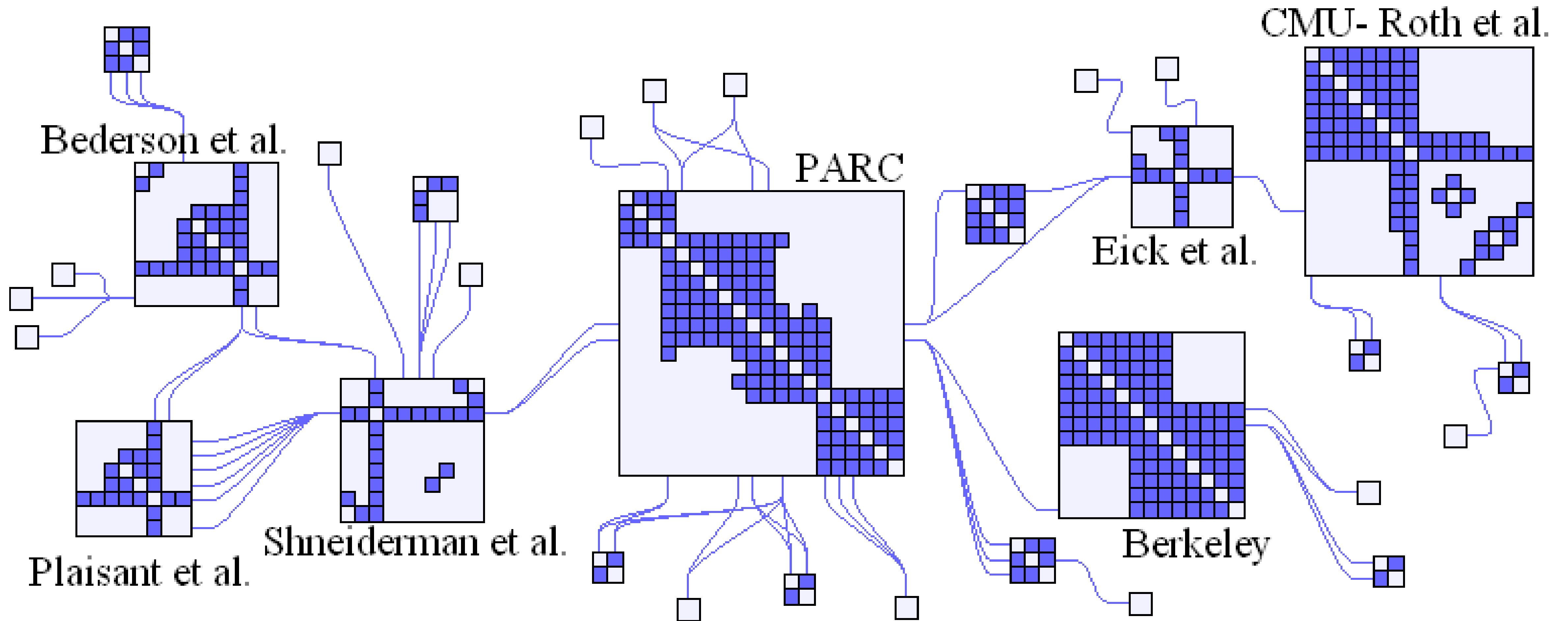
[W. Javed and N. Elmqvist, 2012]

What is this technique?



[VisLink, Collins and Carpendale, 2007]

What is this technique?

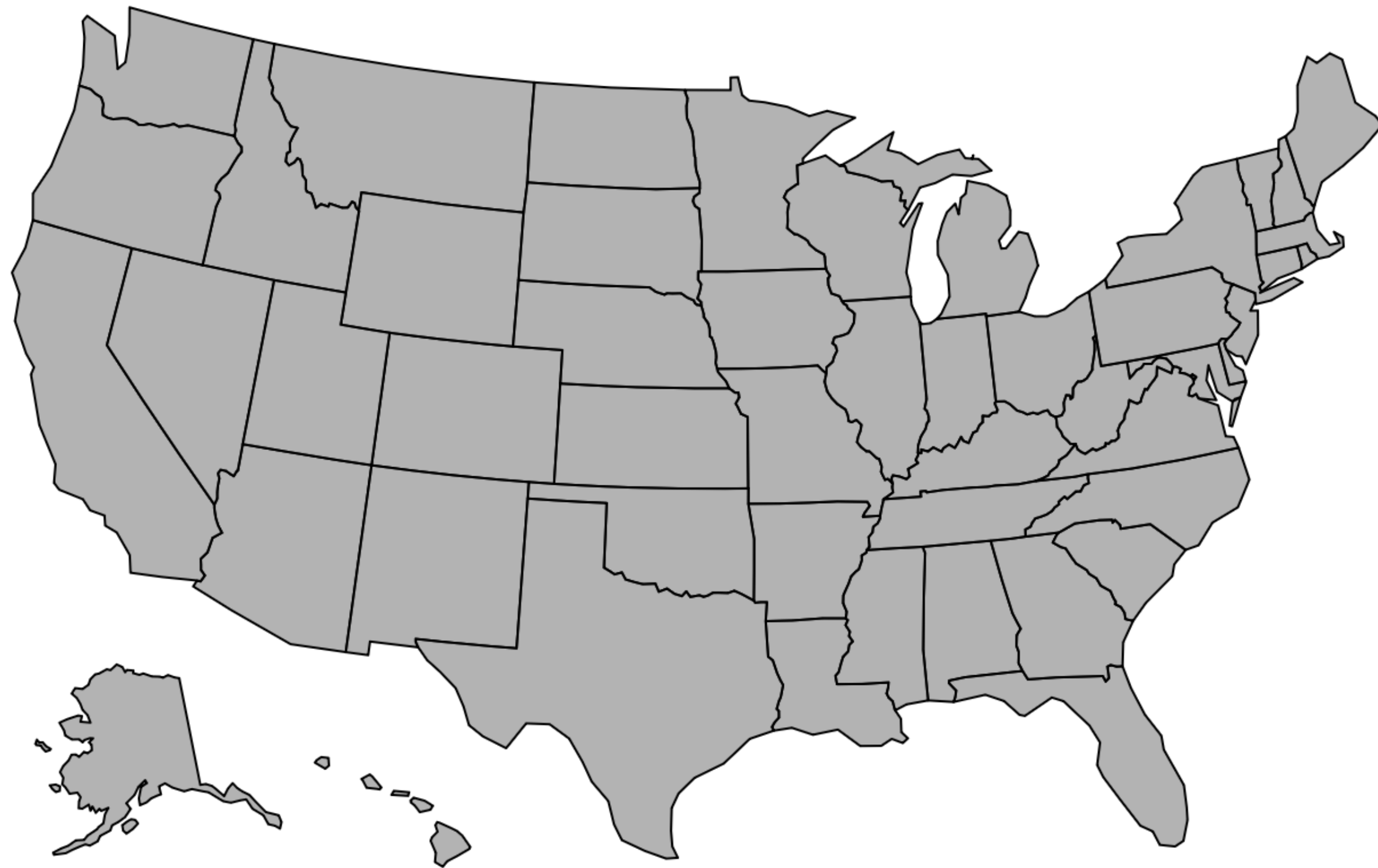


[NodeTrix, N. Henry et al., 2007]

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

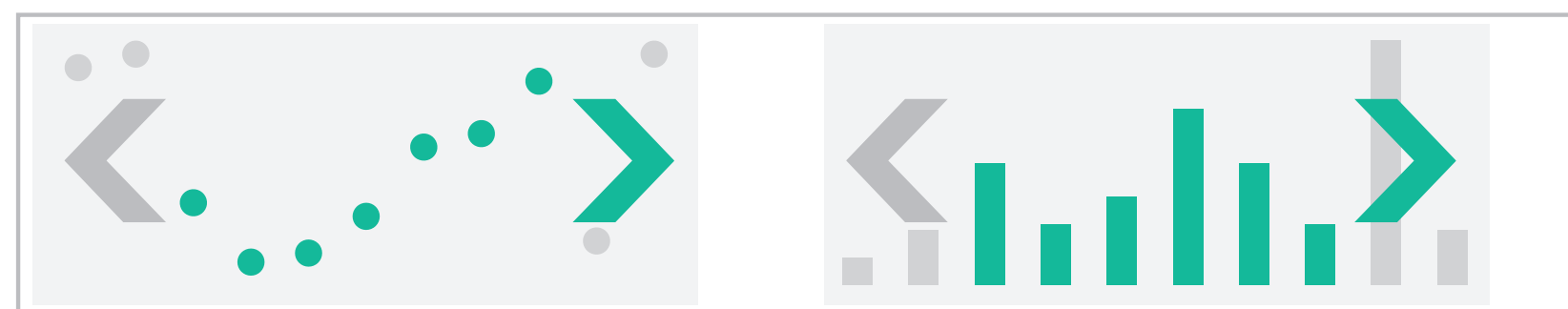
→ *Linked Highlighting*



→ Share Data: All/Subset/None


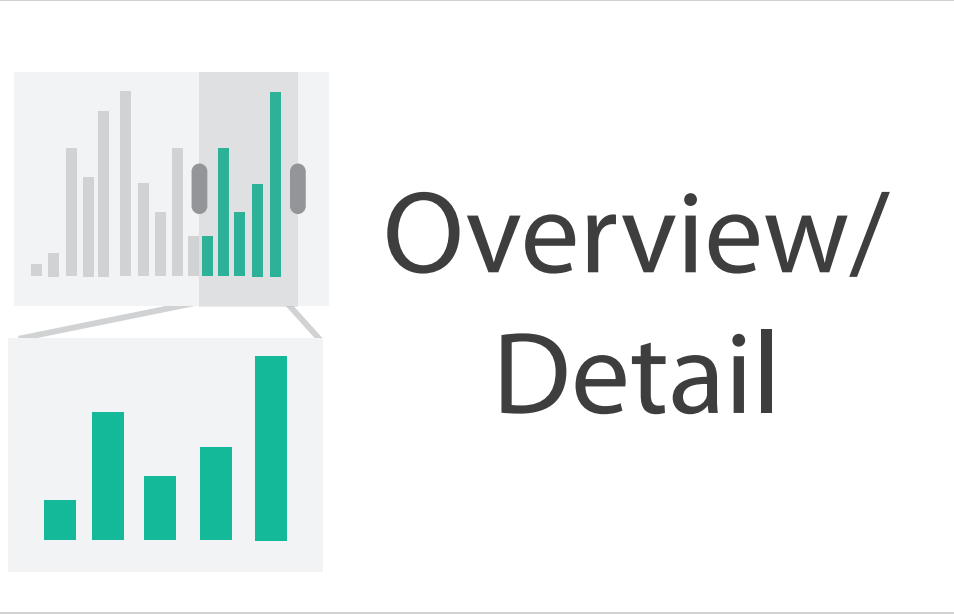
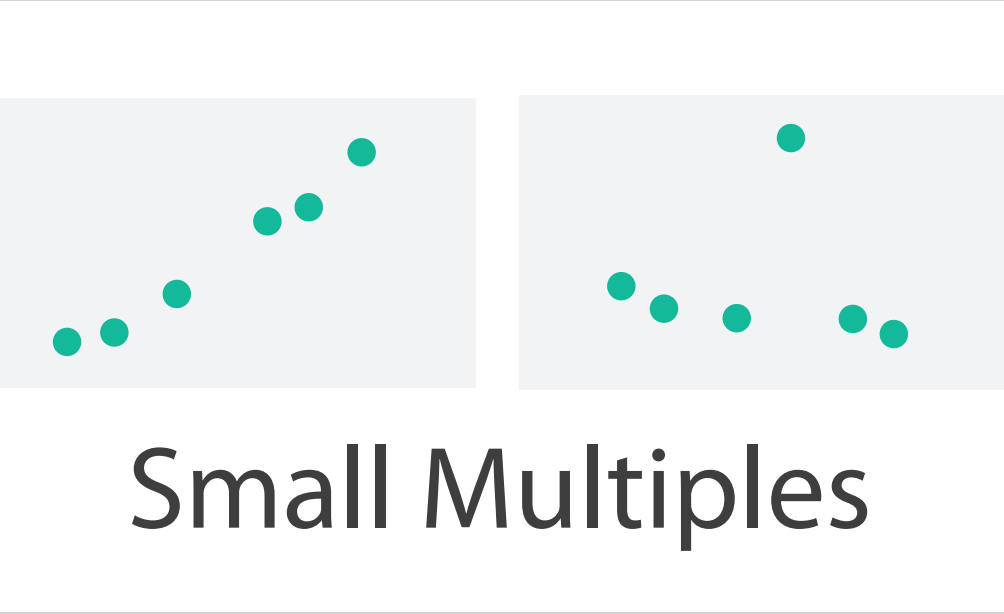

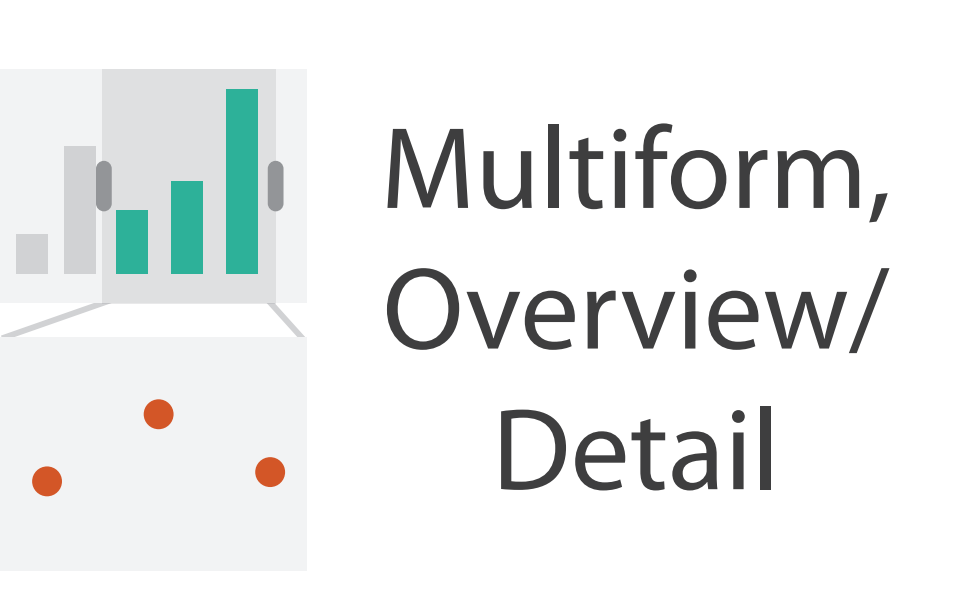



→ Share Navigation



[Munzner (ill. Maguire), 2014]

Multiple Views

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

[Munzner (ill. Maguire), 2014]

Multiform

The screenshot displays a GIS application window with the following components:

- Map Overview:** A small map of the United States with Michigan highlighted.
- States:** A table listing all 50 US states with columns for Name, Area, and Population.
- Map:** A detailed map of Michigan showing county boundaries and various data layers.
- Counties:** A table listing Michigan counties with columns for Name, Area, Population, and other metrics.
- Cities:** A table listing cities in Michigan with columns for Name, County, and Population.
- Airports & Seaplane Bases:** A table listing airports and seaplane bases with columns for Name, Elevation, and County.
- Census Values (Scatterplots):** A grid of scatterplots showing relationships between different census variables.
- Census Values (Scatterplot):** A larger scatterplot showing a specific relationship between two census variables.
- Color Scheme:** A panel for selecting a color scheme for the map, currently set to 'Sequential Non-Gray'.
- City-City Distances:** A table showing distances between various cities.
- Legend/Show/Label:** Panels for controlling the visibility and labeling of map features like Counties, Cities, Roads, Railroads, Airports, and Urban Areas.

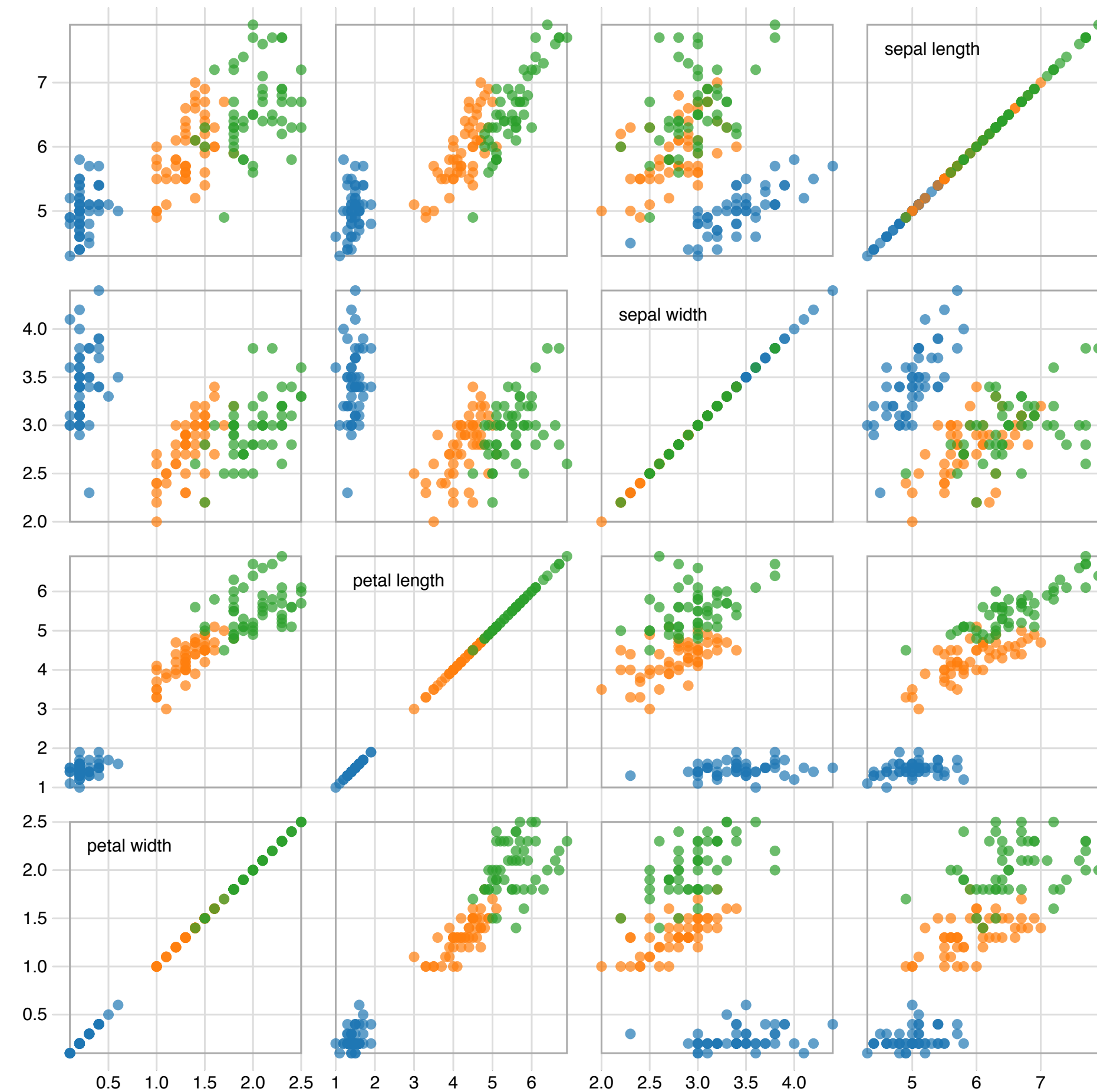
[Improvise, Weaver, 2004]

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)

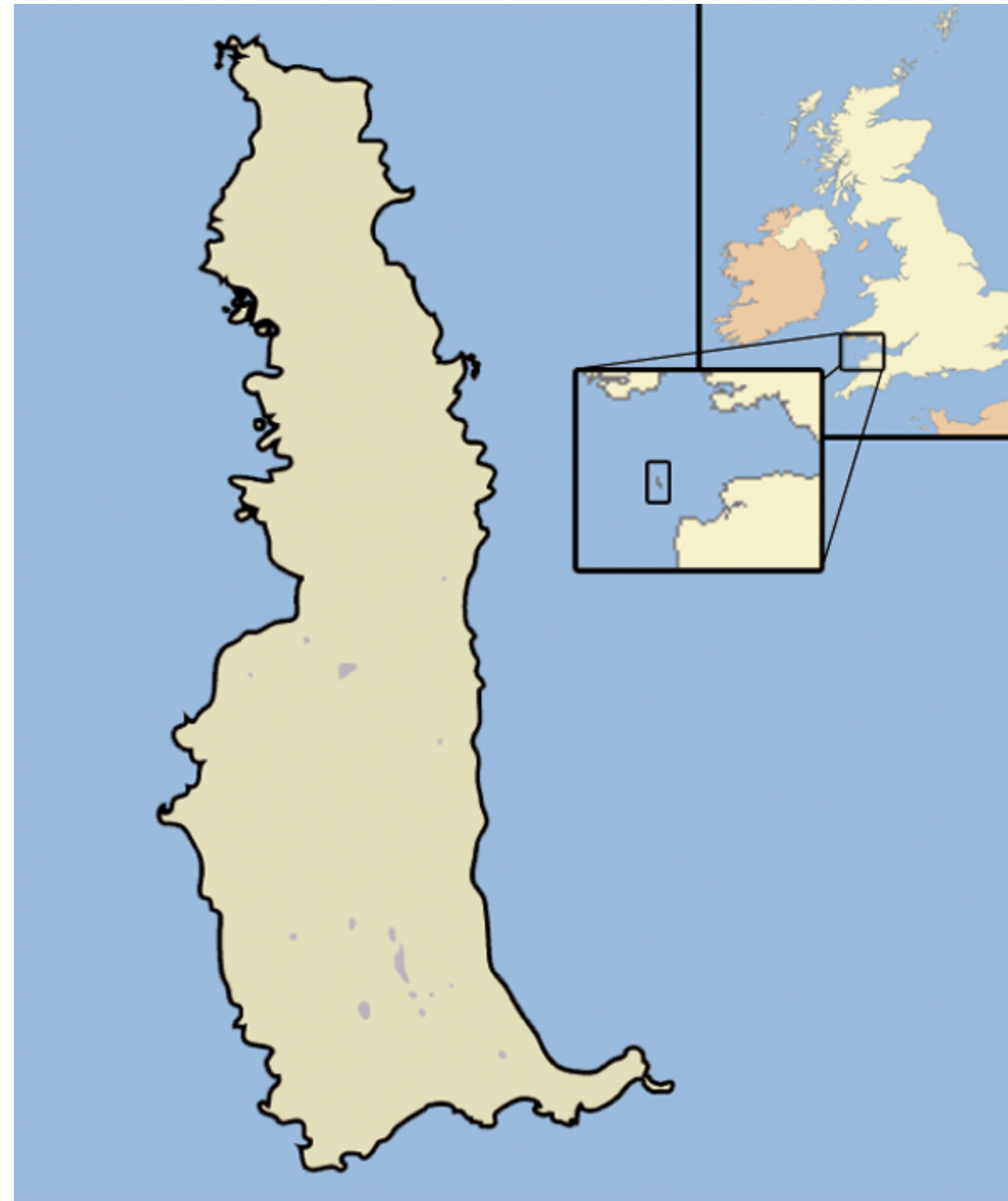


[M. Bostock]

Shneiderman's Mantra

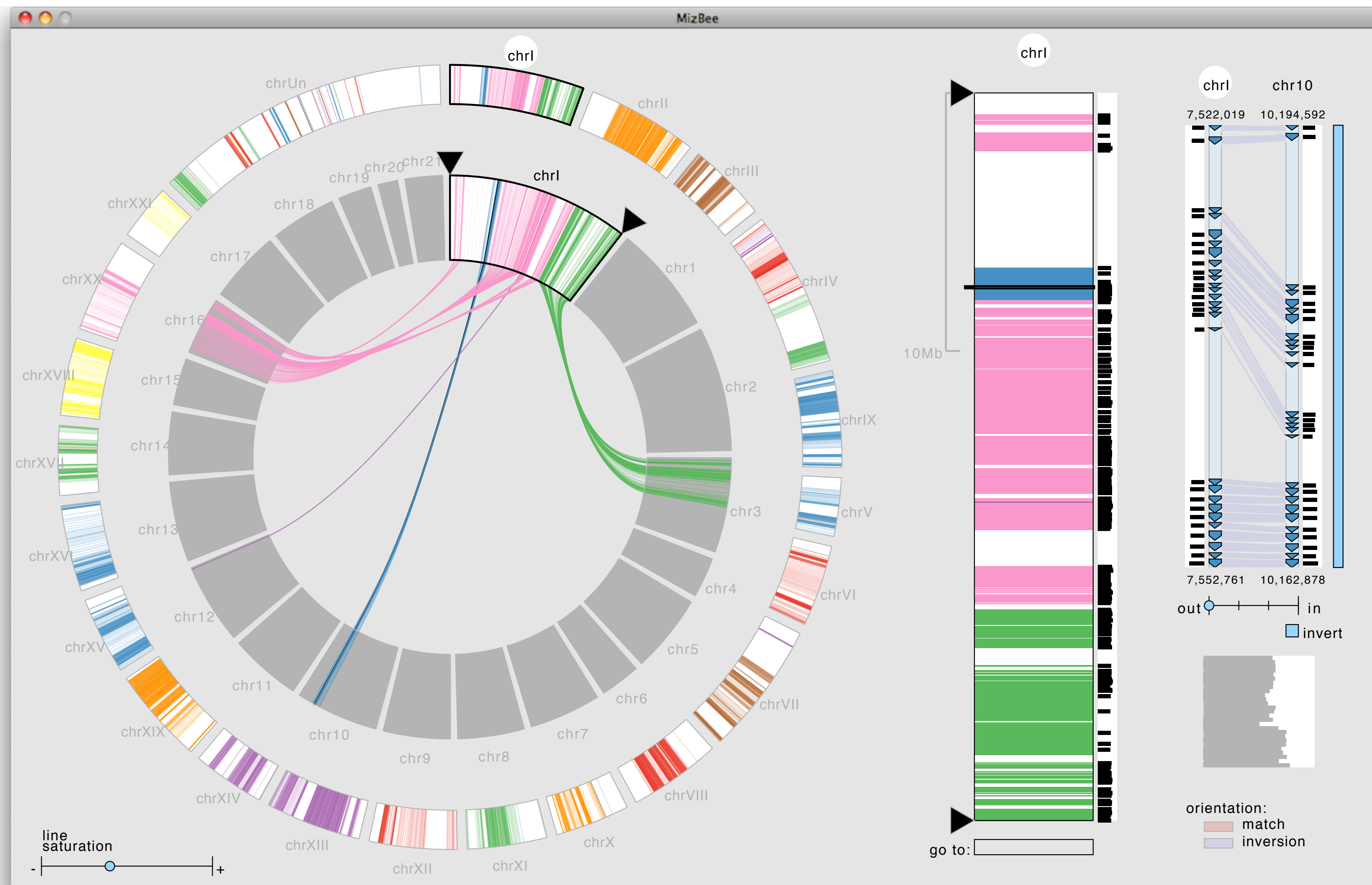
- Visual Information-Seeking Mantra [B. Shneiderman, 1996]:
 - Overview first
 - Zoom and filter (Chapter 13)
 - Details on demand
- Goal of the overview is to **summarize** all of the data
- Want specific **details** about some aspect(s) of the data, need another view/layer
 - May be permanent: side-by-side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

Overview-Detail View



[Wikipedia]

Overview-Detail (Different Encoding)

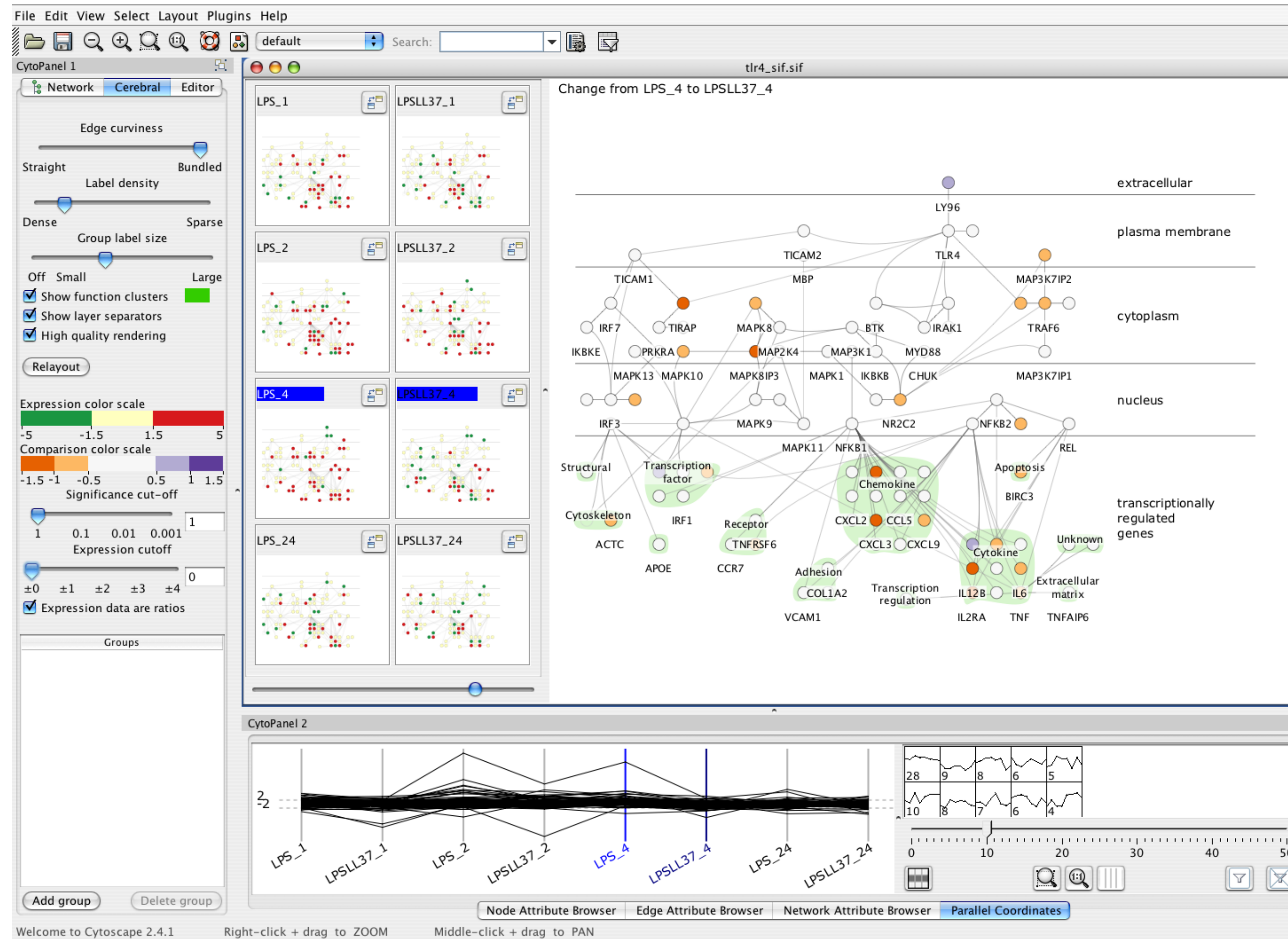


[M. Meyer et al.]

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

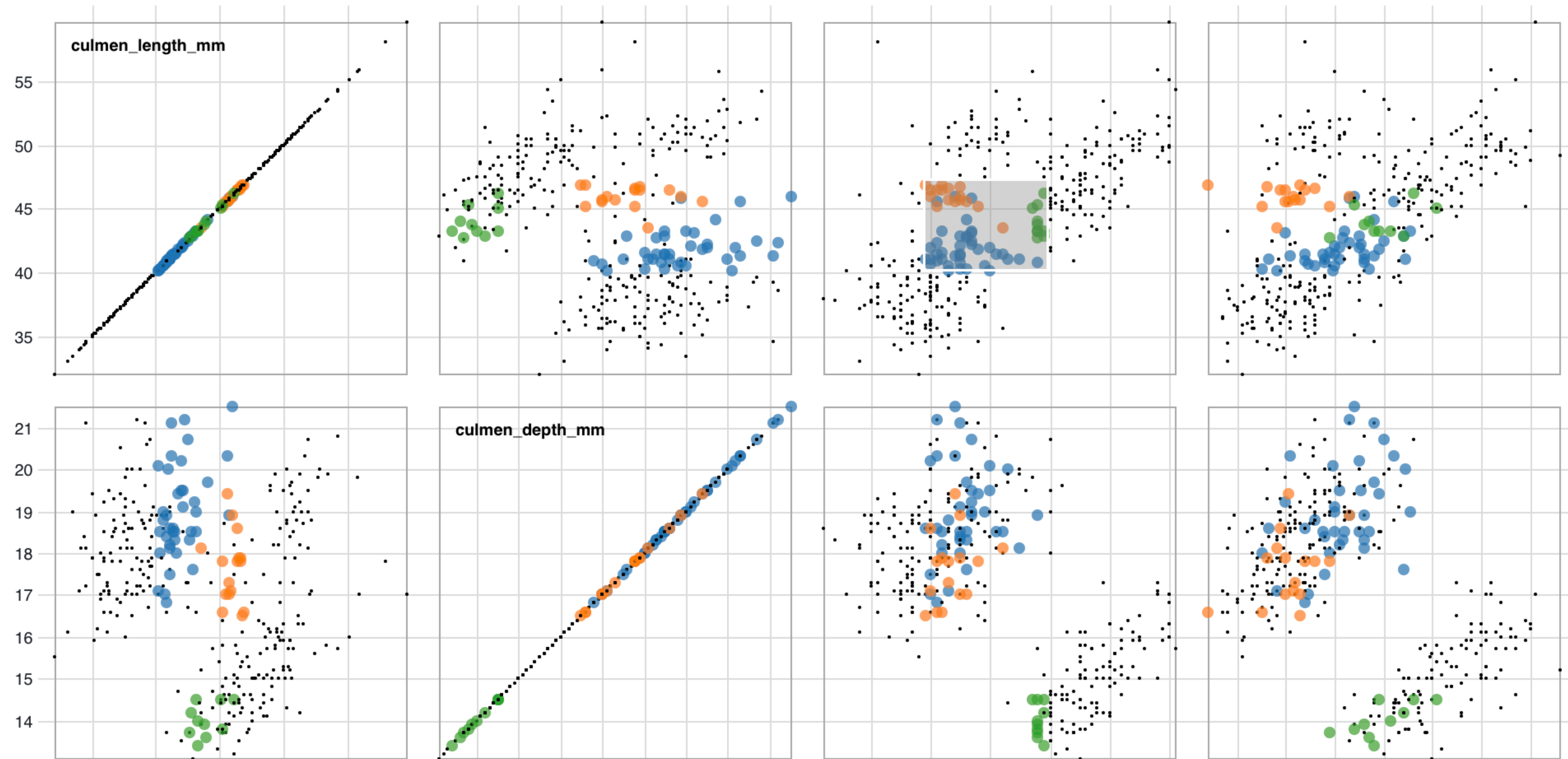
- Often navigation in one view updates navigation in another
- Example: Maps: overview shifts as you move around in detail view
- Selections in one view may trigger selections in another

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

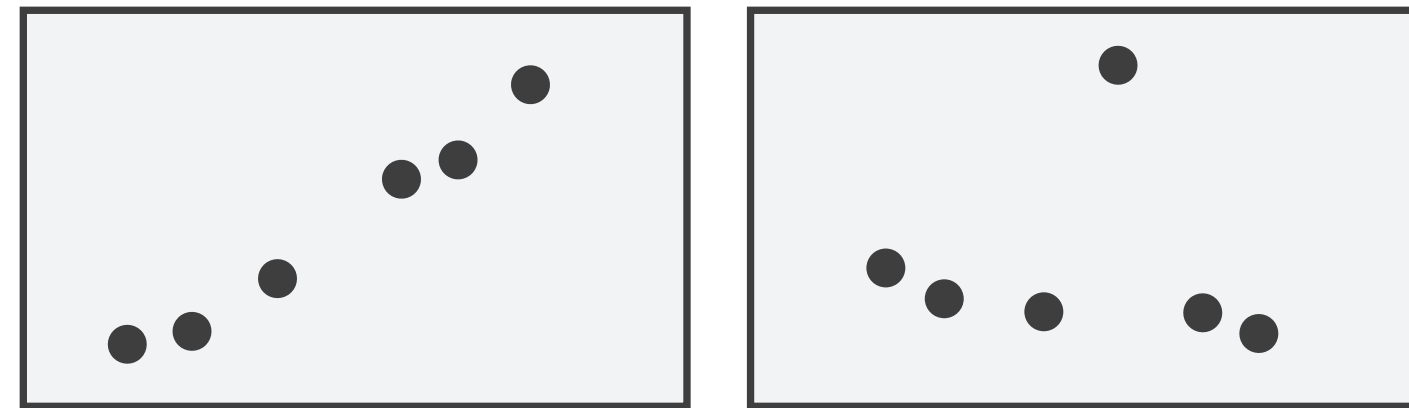
■ Adelie ■ Chinstrap ■ Gentoo



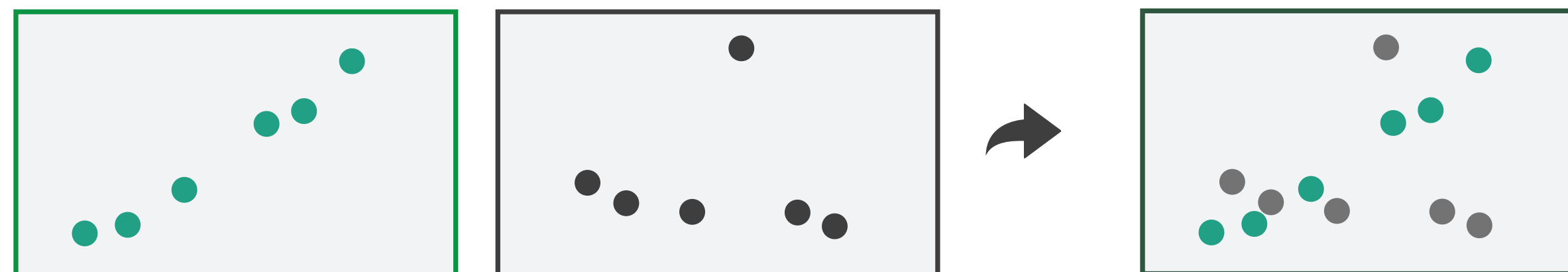
[M. Bostock]

Multiple Views

➔ Partition into Side-by-Side Views



➔ Superimpose Layers



[Munzner (ill. Maguire), 2014]

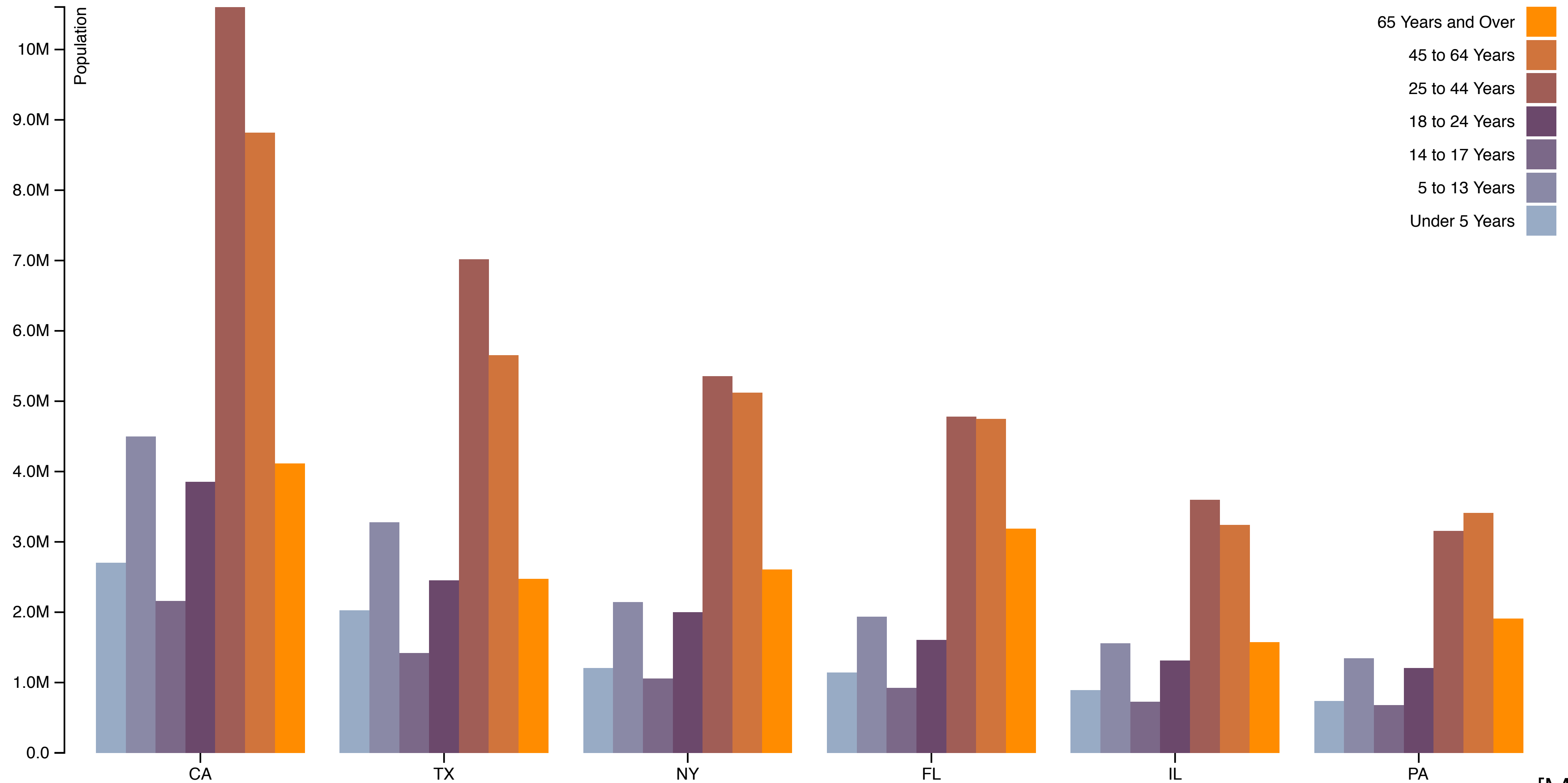
Partitioned Views

- 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

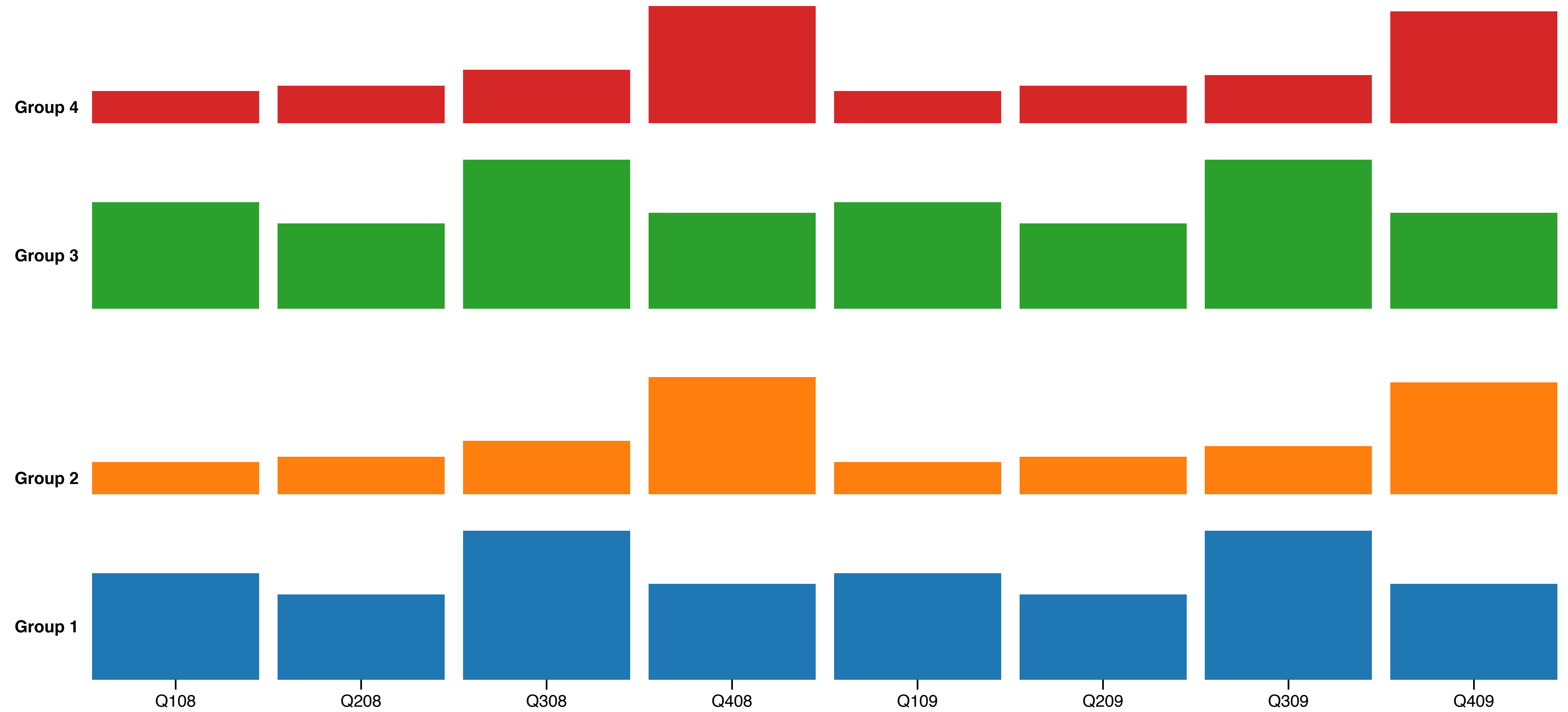
- Glyphs are composed of multiple marks
- Views are a contiguous region of space
- A region is usually associated with a group of data
- Blurry lines of distinction between them

Example: Grouped Bar Chart



[M. Bostock]

Example: Small Multiples Bar Chart

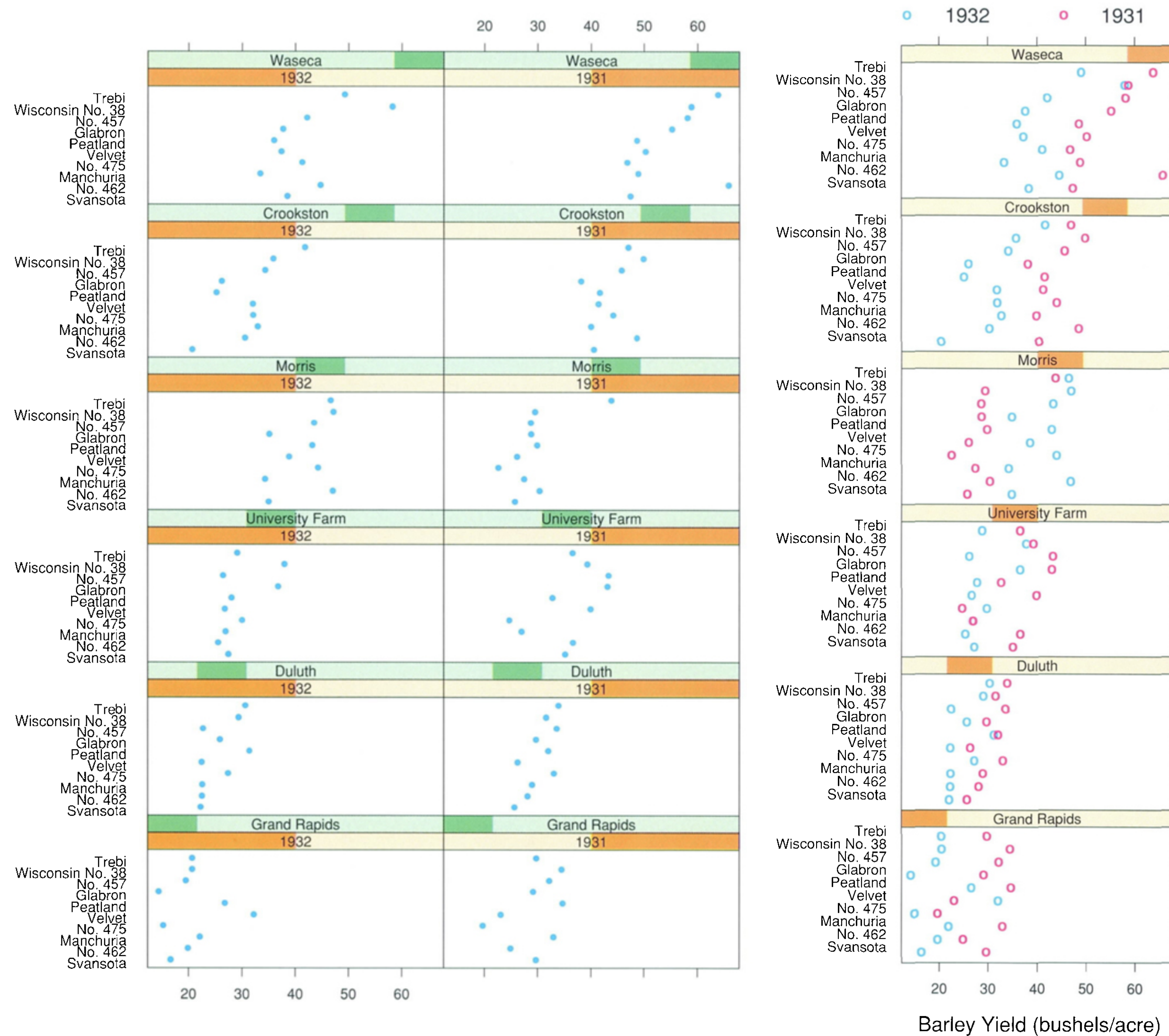


[M. Bostock]

Matrix Alignment & Recursive Subdivision

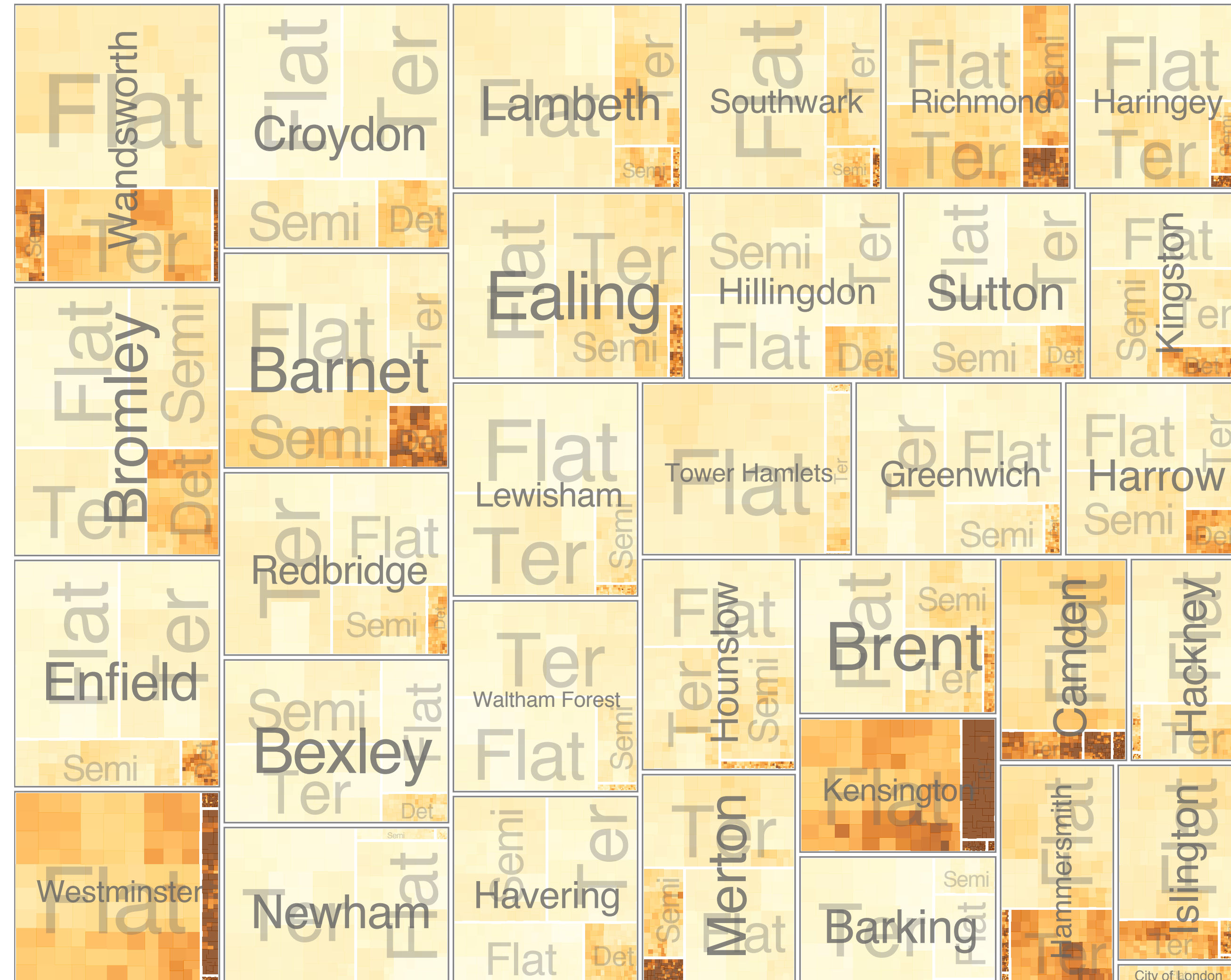
- Matrix Alignment:
 - regions are placed in a matrix alignment
 - splits go to rows and columns
 - main-effects ordering: use summary statistic to determine order of categorical attribute
- Recursive subdivision:
 - Designed for exploration
 - Involves hierarchy
 - User drives the ways data is broken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

Example: Trellis Matrix Alignment



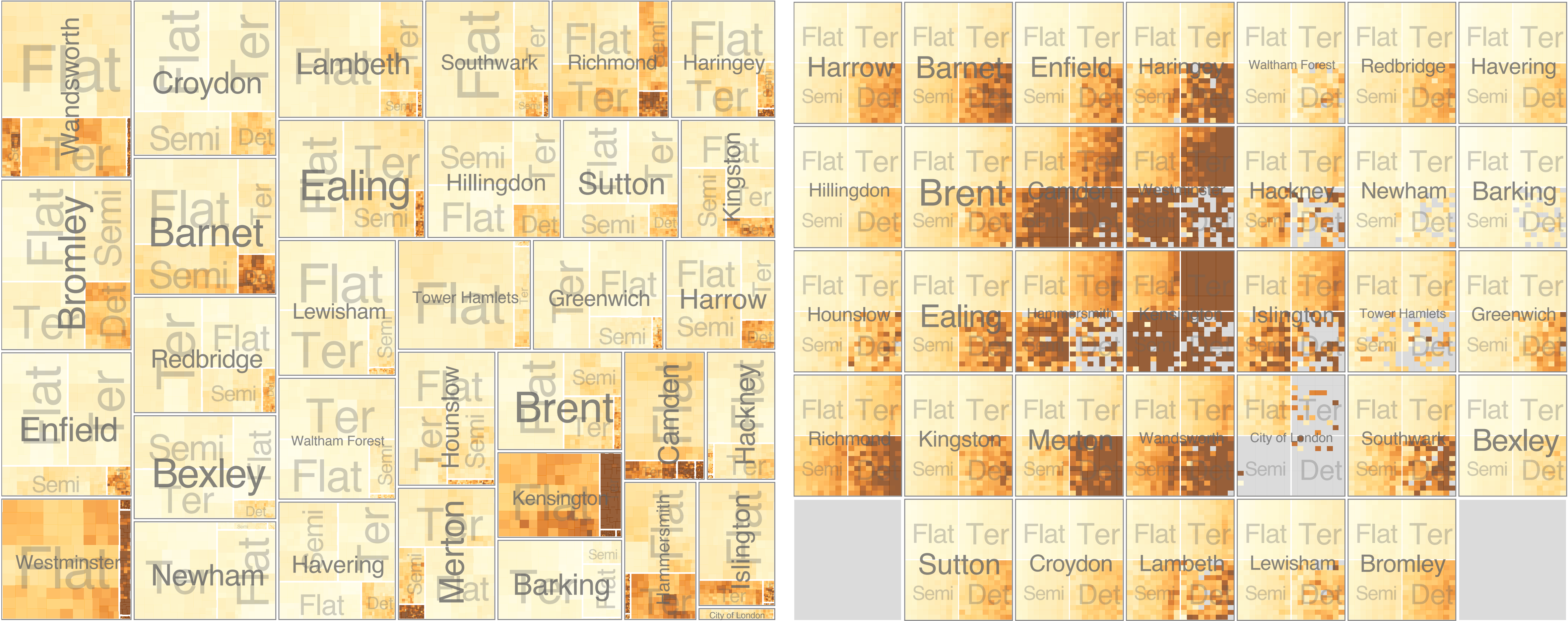
[Becker et al., 1996]

Recursive Subdivision



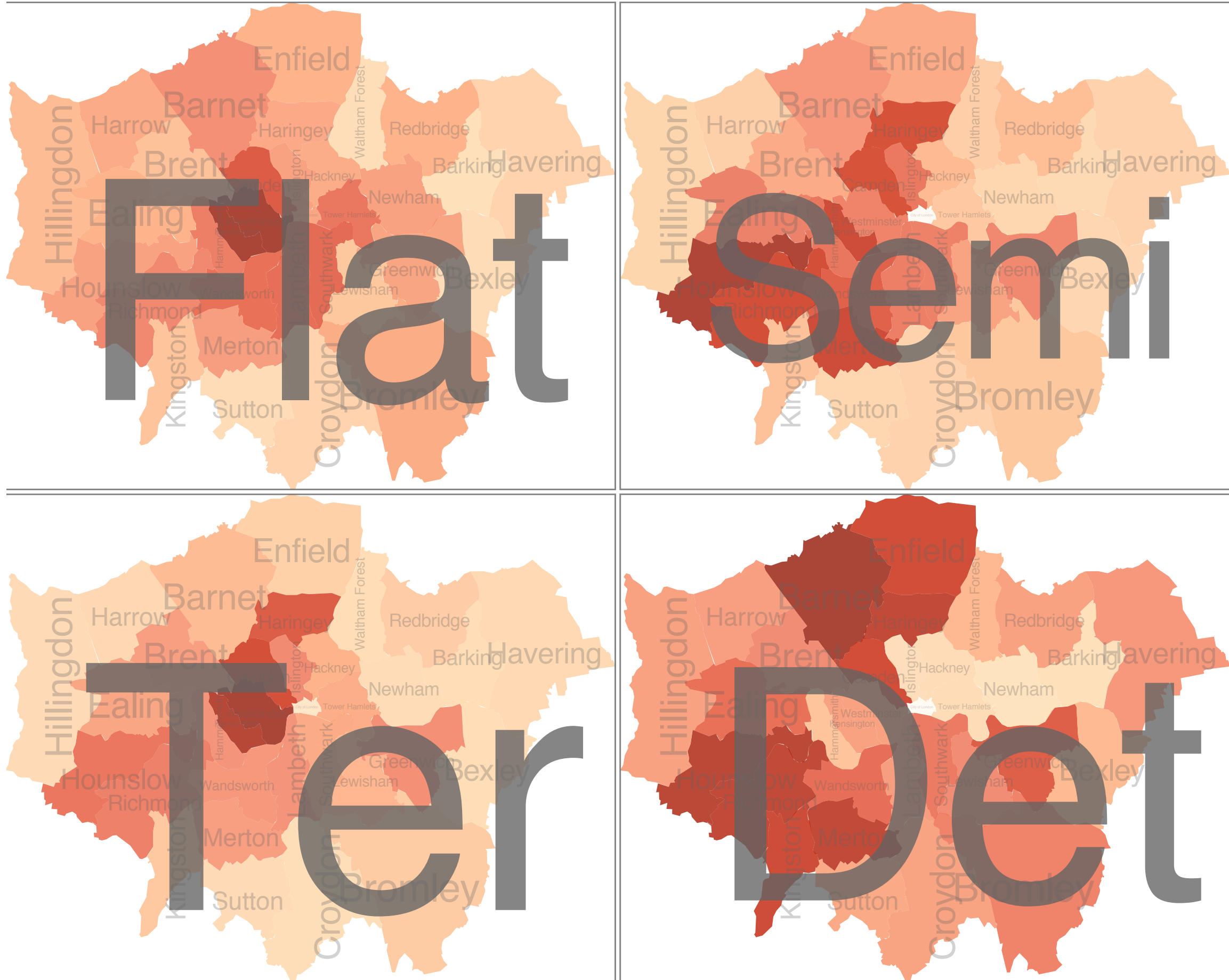
[Slingsby et al., 2009]

Example: HiVE System



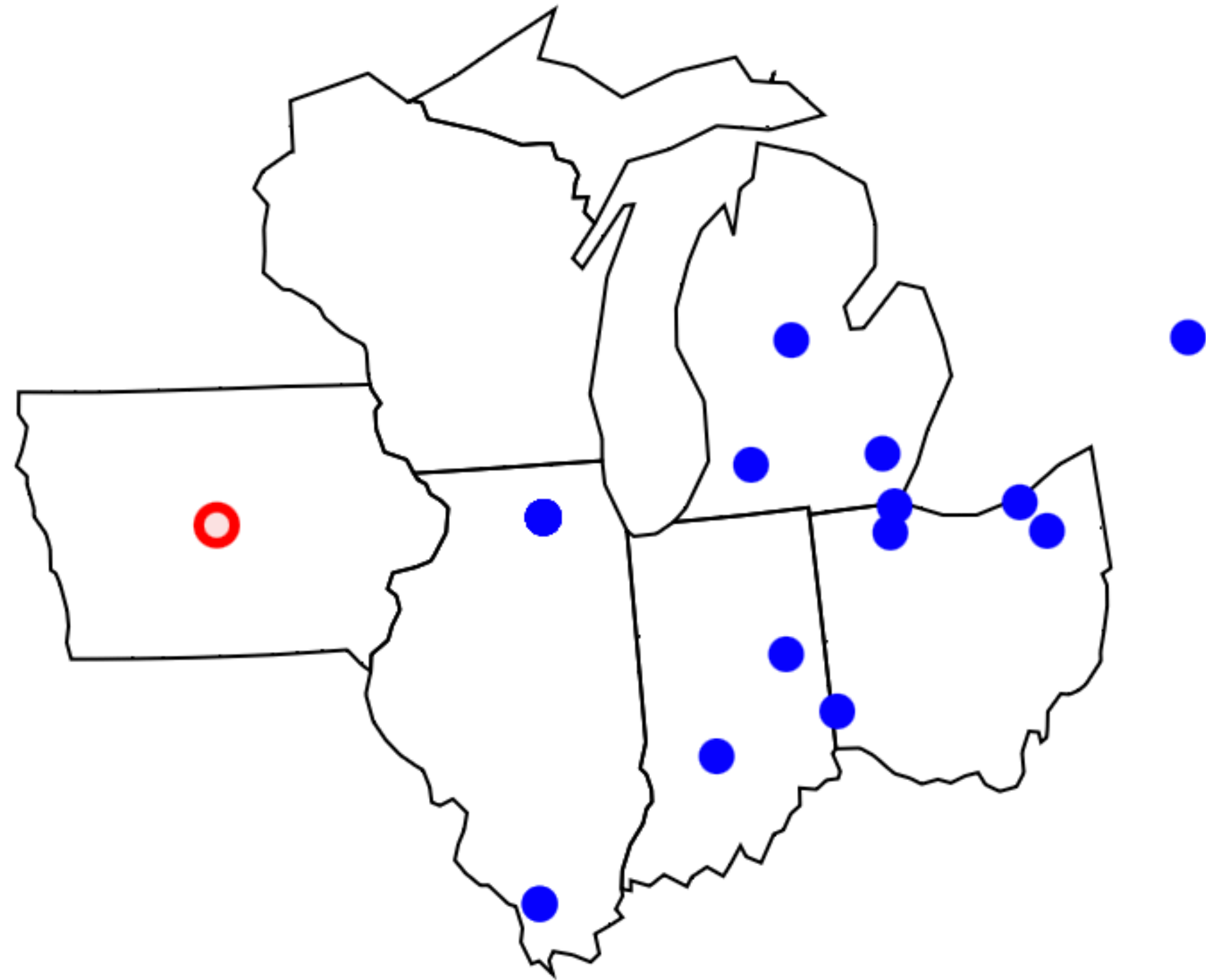
[Slingsby et al., 2009]

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