Lectures 3&4: Facet into Multiple Views

Tamara Munzner
Department of Computer Science
University of British Columbia

DSCI 532: Data Visualization II
Lectures 3&4: 27 & 29 March 2017

https://github.ubc.ca/ubc-mds-2016/DSCI_532_viz-2_students

How?

Encode

Arrange

- Express
- Separate
- Order
- Align
- Use

Map

from categorical and ordered attributes

- Color
  - *Hue*
  - *Saturation*
  - *Luminance*
- Size, Angle, Curvature, ...
- Shape
- Motion

Direction, Rate, Frequency, ...

Manipulate

- Change
- Select
- Navigate

Facet

- Juxtapose
- Partition
- Superimpose

Reduce

- Filter
- Aggregate
- Embed

What?

Why?

How?

How to handle complexity: 1 previous strategy + 3 more

→ *Derive*

- derive new data to show within view
- change view over time
- facet across multiple views
- reduce items/attributes within single view

Manipulate

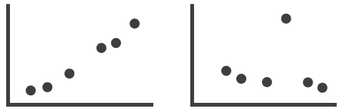
→ Change

→ Select

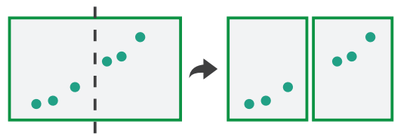
→ Navigate

Facet

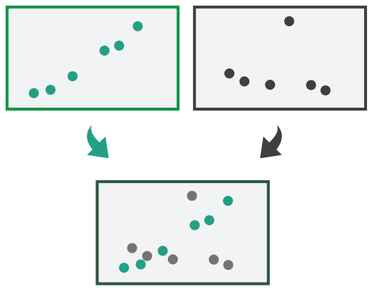
→ Juxtapose



→ Partition



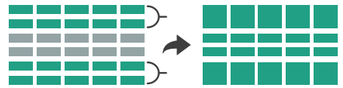
→ Superimpose



Reduce

→ Filter

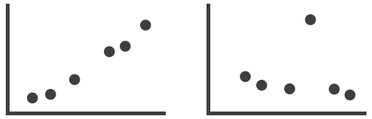
→ Aggregate



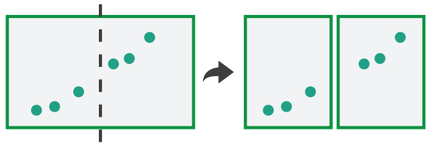
→ Embed

Facet

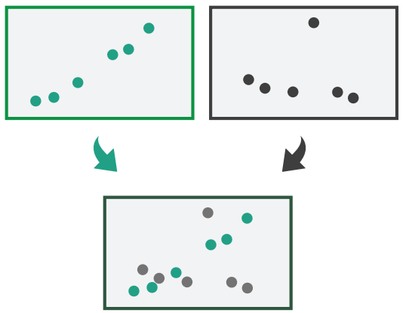
Juxtapose



Partition



Superimpose



Juxtapose and coordinate views

- linked views
  - simultaneously visible multiple views
  - linked together such that actions in one view affect the others

➔ Share Encoding: Same/Different

➔ *Linked Highlighting*

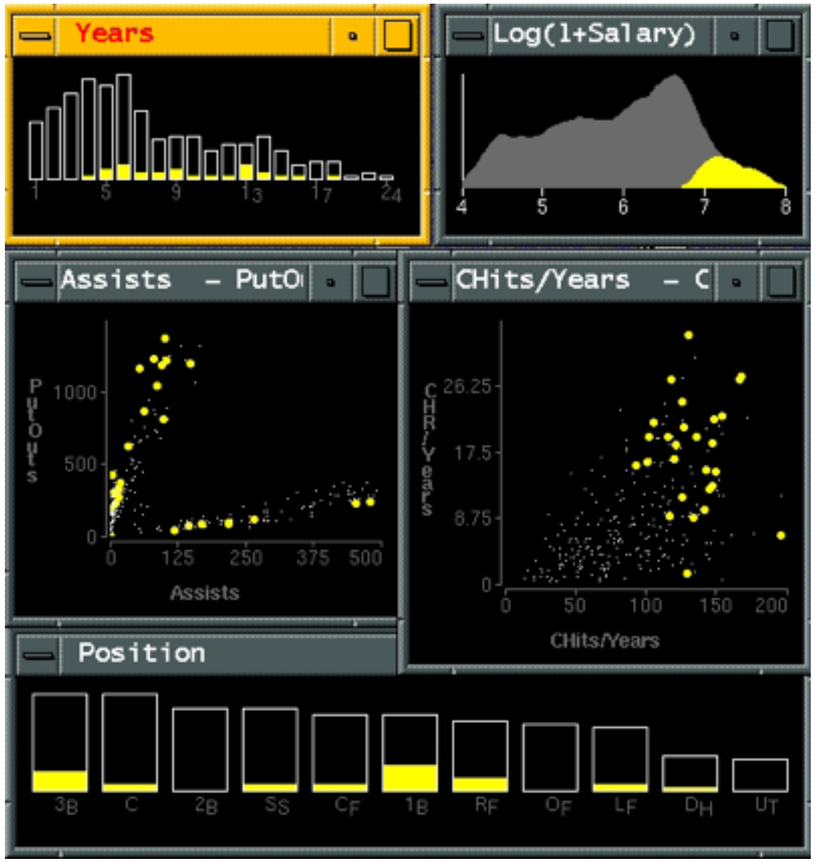
➔ Share Data: All/Subset/None

➔ Share Navigation

Idiom: **Linked highlighting**

System: **EDV**

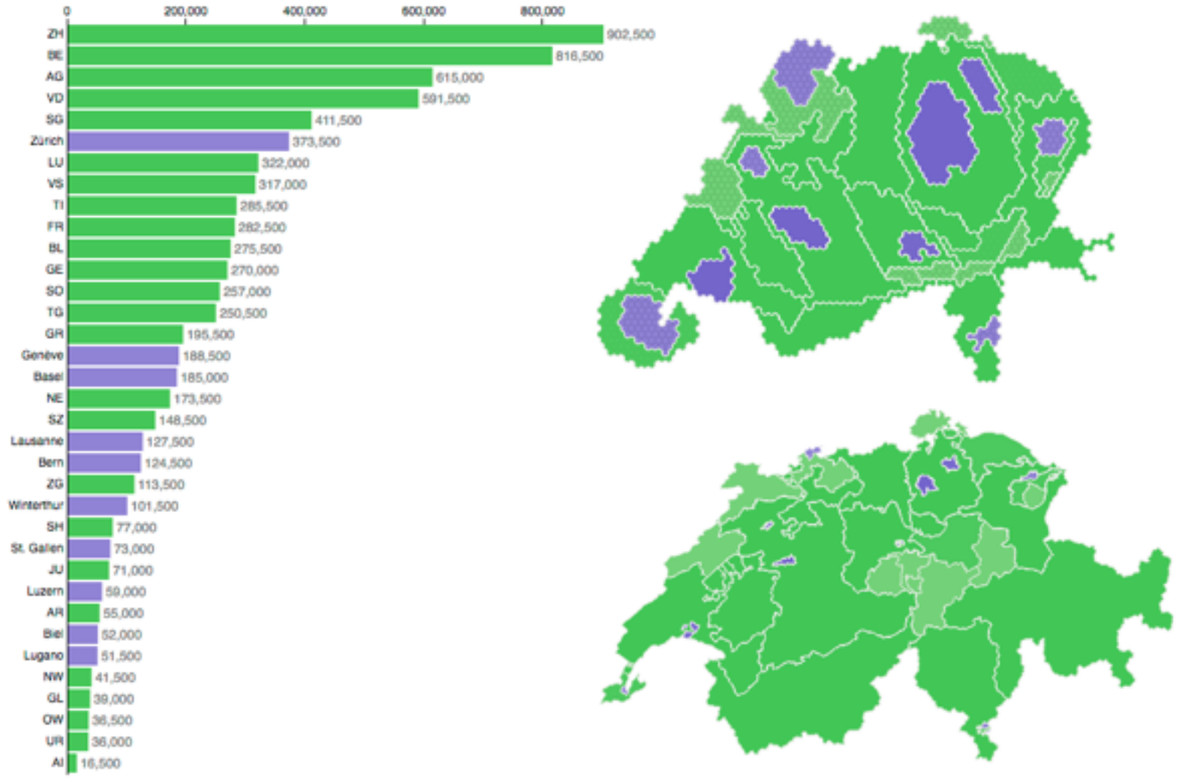
- see how regions contiguous in one view are distributed within another
  - powerful and pervasive interaction idiom
- encoding: different
  - **multiform**
    - rationale: single monolithic view has strong limits on number of attributes that can be shown simultaneously
- data: all shared

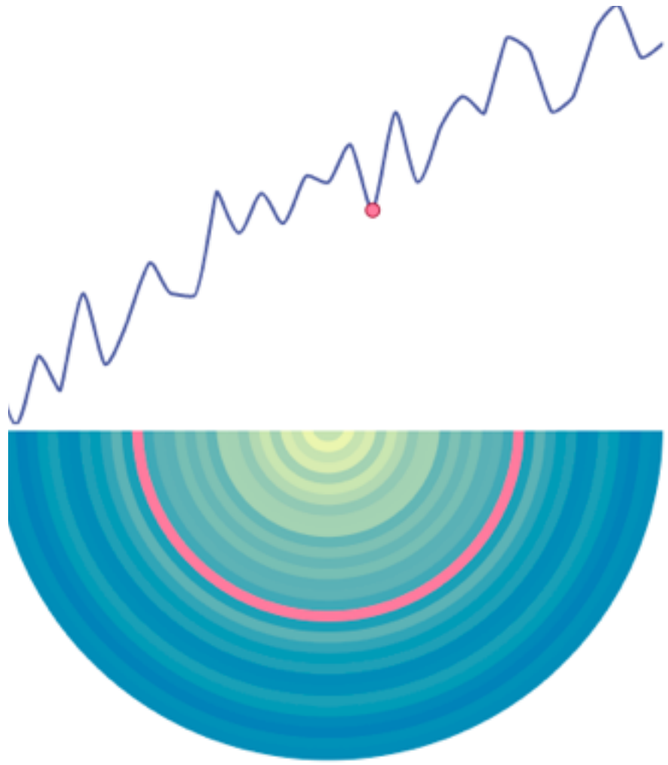


[Visual Exploration of Large Structured Datasets. Wills. Proc. New Techniques and Trends in Statistics (NTTS), pp. 237–246. IOS Press, 1995.]

Linked views

- unidirectional vs bidirectional linking



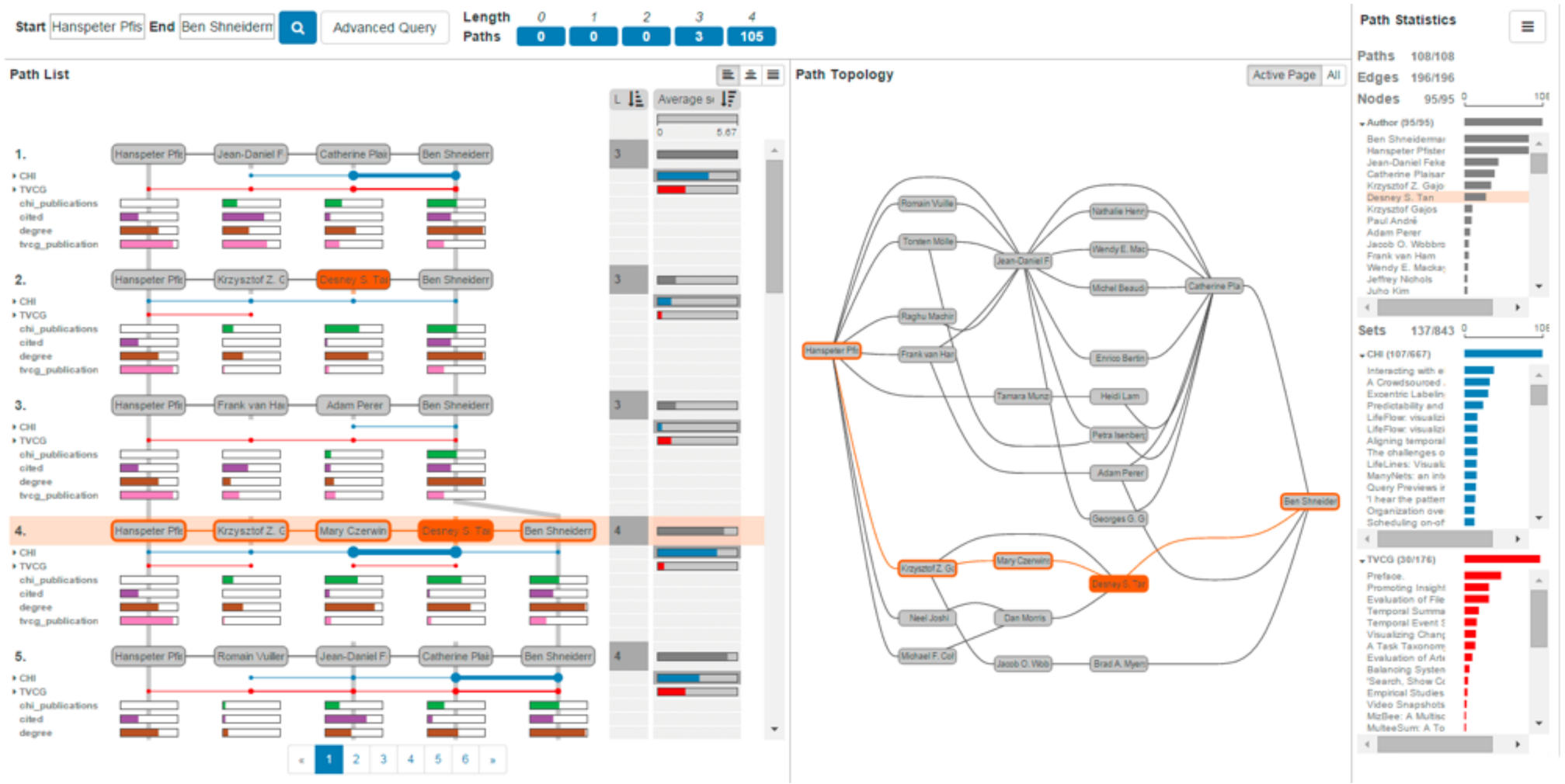


http://www.ralphstraumann.ch/projects/swiss-population-cartogram/

http://peterbeshai.com/linked-highlighting-react-d3-reflux/

Complex linked multiform views

System: **Pathfinder**



https://www.youtube.com/watch?v=aZF7AC8aNXo

Idiom: **bird's-eye maps**

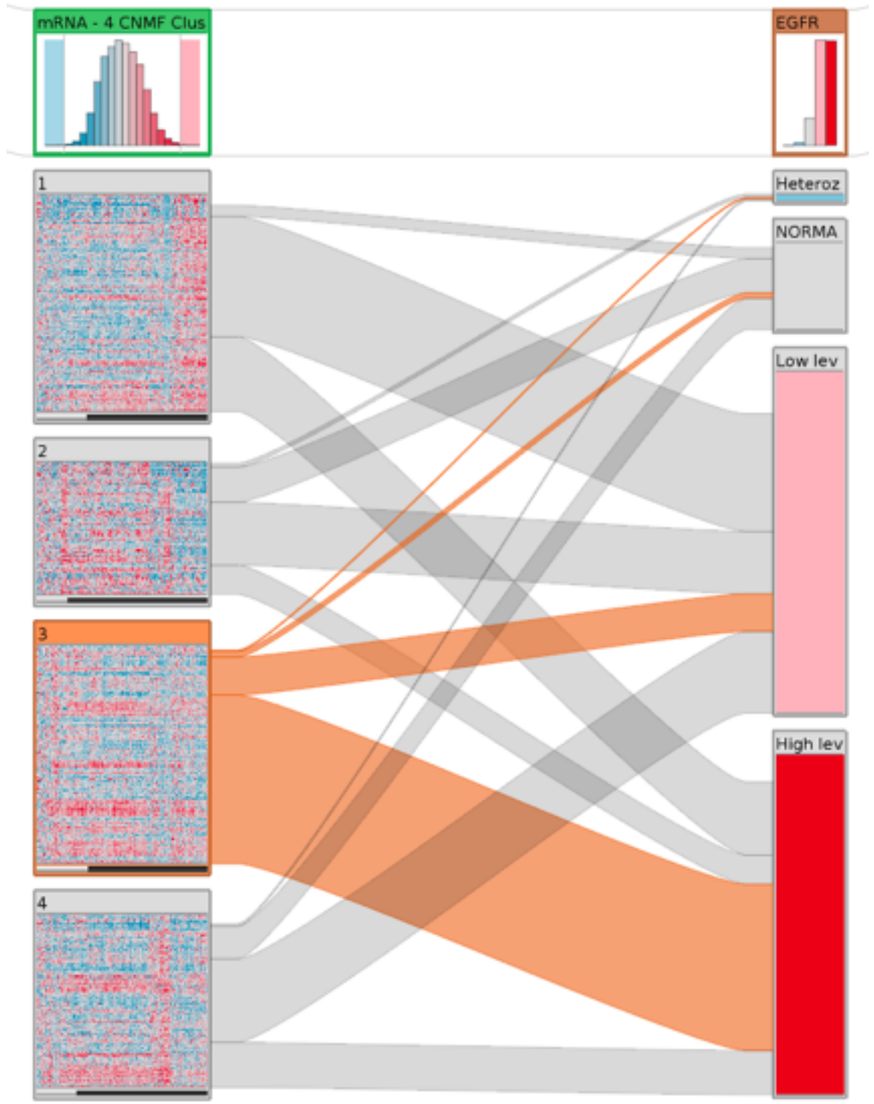
System: **Google Maps**

- encoding: same
- data: subset shared
- navigation: shared
  - bidirectional linking
- differences
  - viewpoint
  - (size)
- ***overview-detail***

[A Review of Overview+Detail, Zooming, and Focus+Context Interfaces. Cockburn, Karlson, and Bederson. ACM Computing Surveys 41:1 (2008), 1–31.]

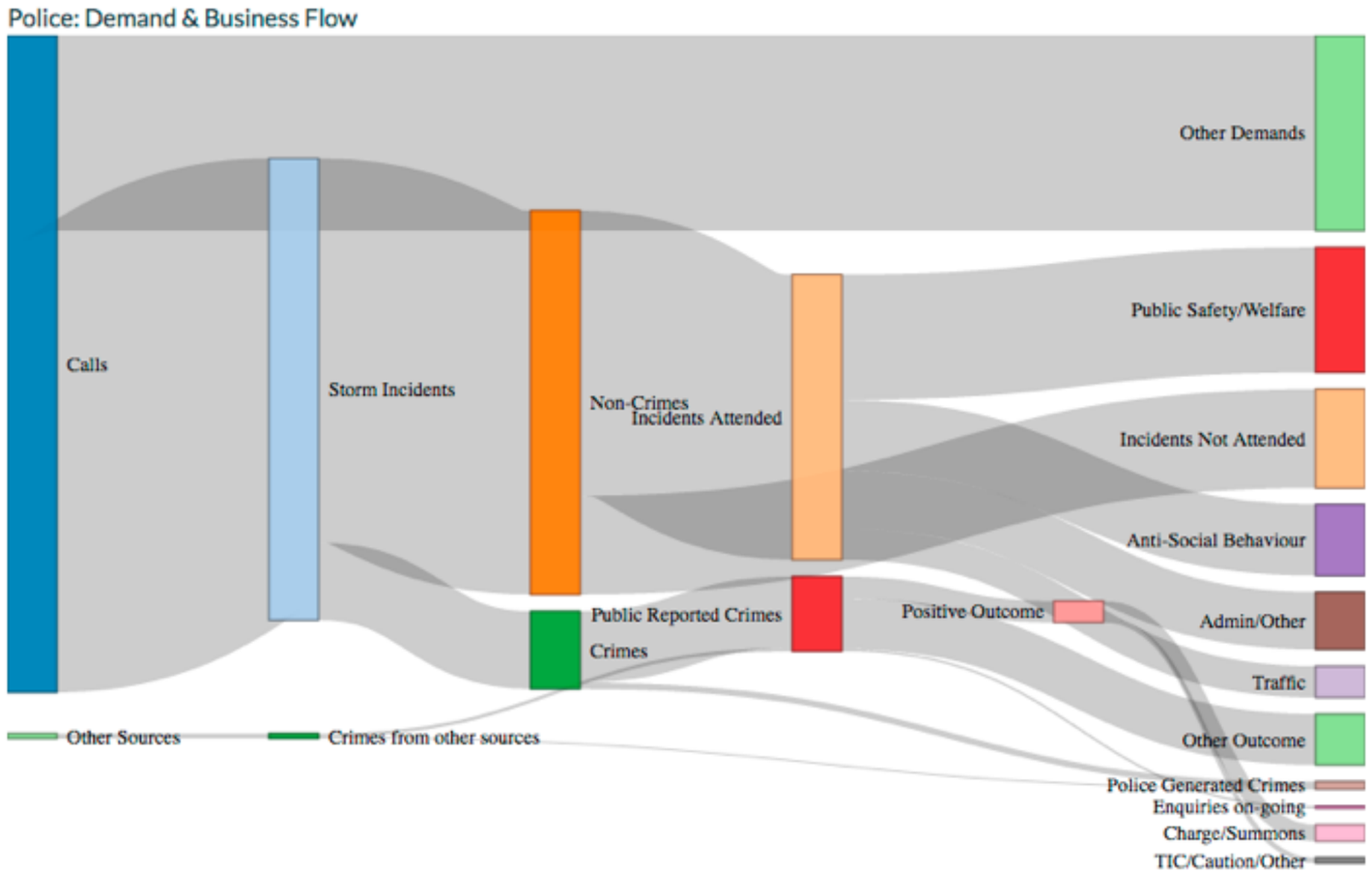
Overview-detail

System: **StratomeX**



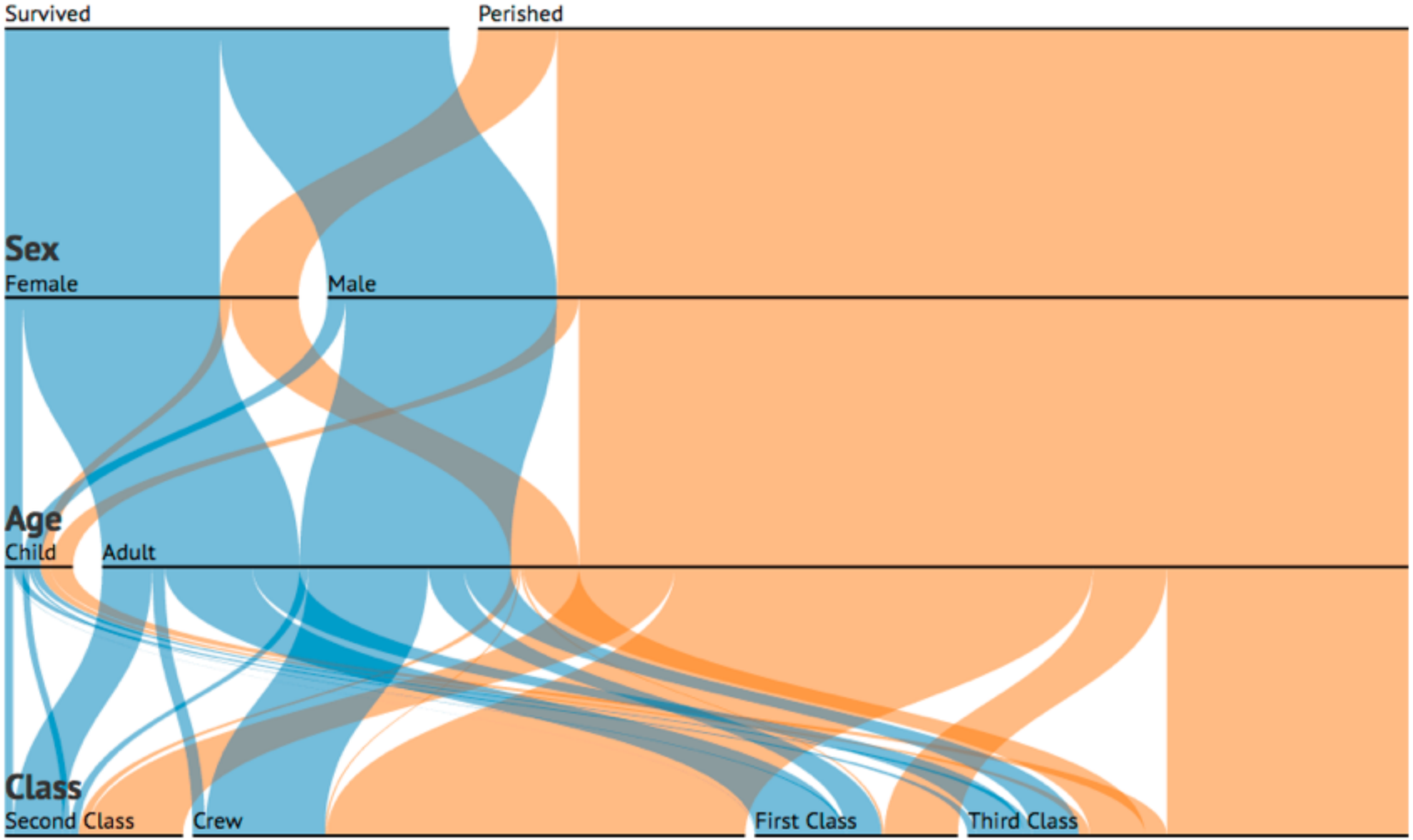
https://www.youtube.com/watch?v=UcKDbGqHsdE

Shiny example



https://gallery.shinyapps.io/TSupplyDemand/

Idiom: **Parallel sets**

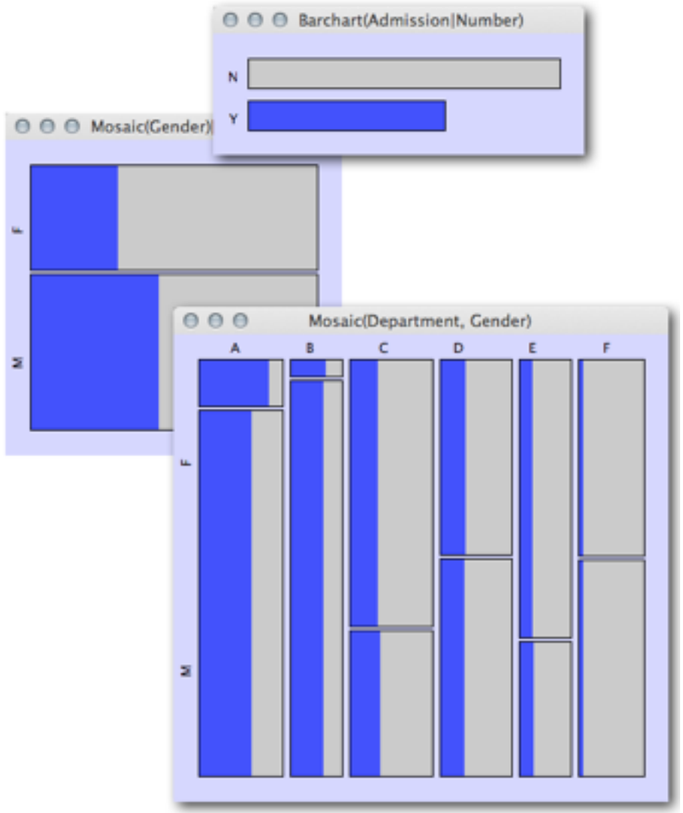


https://www.jasondavies.com/parallel-sets/

https://eagereyes.org/parallel-sets

Idiom: **Mosaic plots**

System: **Mondrian**



http://www.theusrus.de/blog/understanding-mosaic-plots/

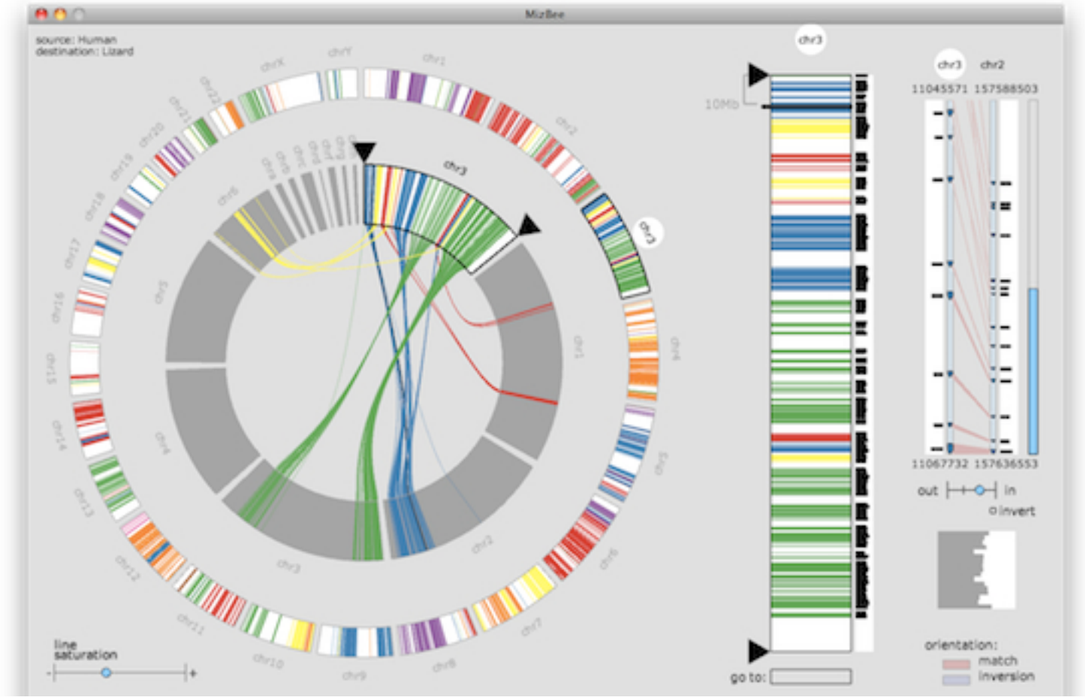
http://www.theusrus.de/Mondrian/

http://www.theusrus.de/blog/making-movies/

Overview-detail

System: **MizBee**

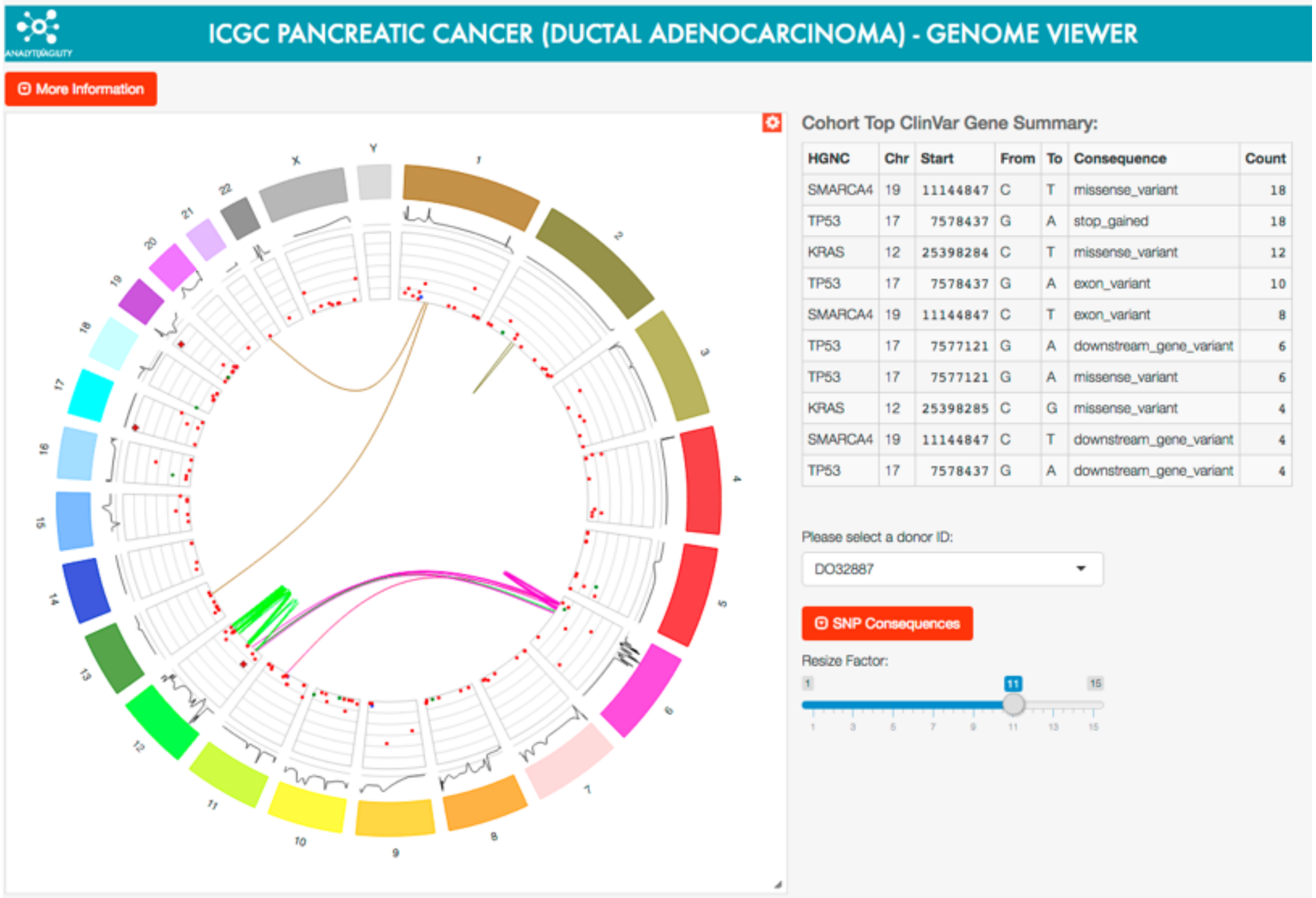
- multiscale: three viewing levels
  - tooling: processing (modern version: p5js.org)



https://www.youtube.com/watch?v=86p7brwuz2g

Shiny example

- APGI genome browser
  - tooling: R/Shiny
  - interactivity
    - tooltip detail on demand on hover
    - expand/contract chromosomes
    - expand/contract control panes

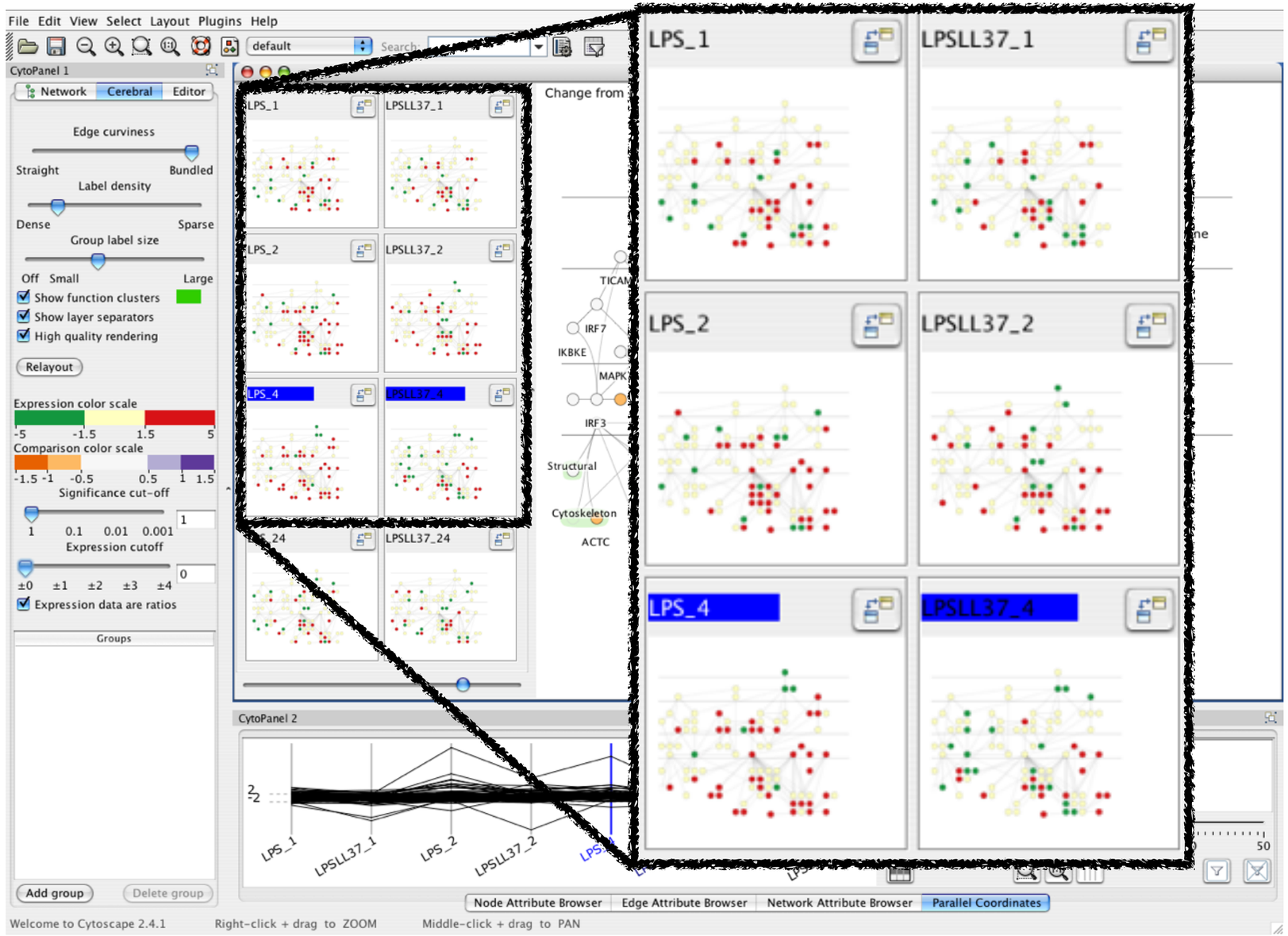


https://gallery.shinyapps.io/genome_browser/

Idiom: **Small multiples**

System: **Cerebral**

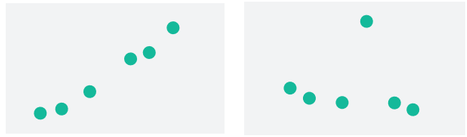
- encoding: same
- data: none shared
  - different attributes for node colors
  - (same network layout)
- navigation: shared



https://www.youtube.com/watch?v=76HhG1FQngI&t=2s

[Cerebral:Visualizing Multiple Experimental Conditions on a Graph with Biological Context. Barsky, Munzner, Gardy, and Kincaid. IEEE Trans. Visualization and Computer Graphics (Proc. InfoVis 2008) 14:6 (2008), 1253–1260.]

Coordinate views: Design choice interaction

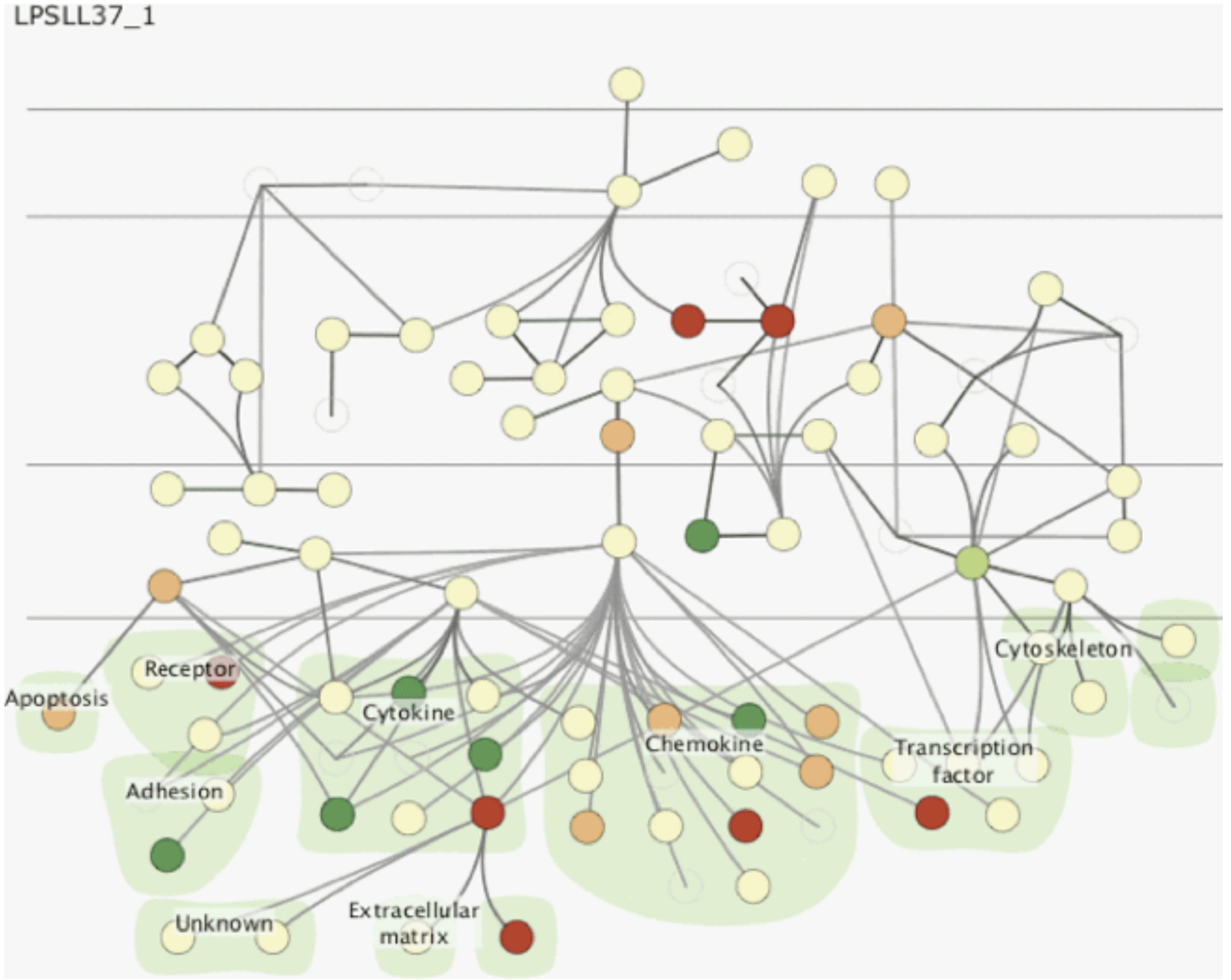
		Data		
		All	Subset	None
Encoding	Same	Redundant	 Overview/ Detail	 Small Multiples
	Different	 Multiform	 Multiform, Overview/ Detail	No Linkage

- why juxtapose views?
  - benefits: eyes vs memory
    - lower cognitive load to move eyes between 2 views than remembering previous state with single changing view
  - costs: display area, 2 views side by side each have only half the area of one view

Why not animation?

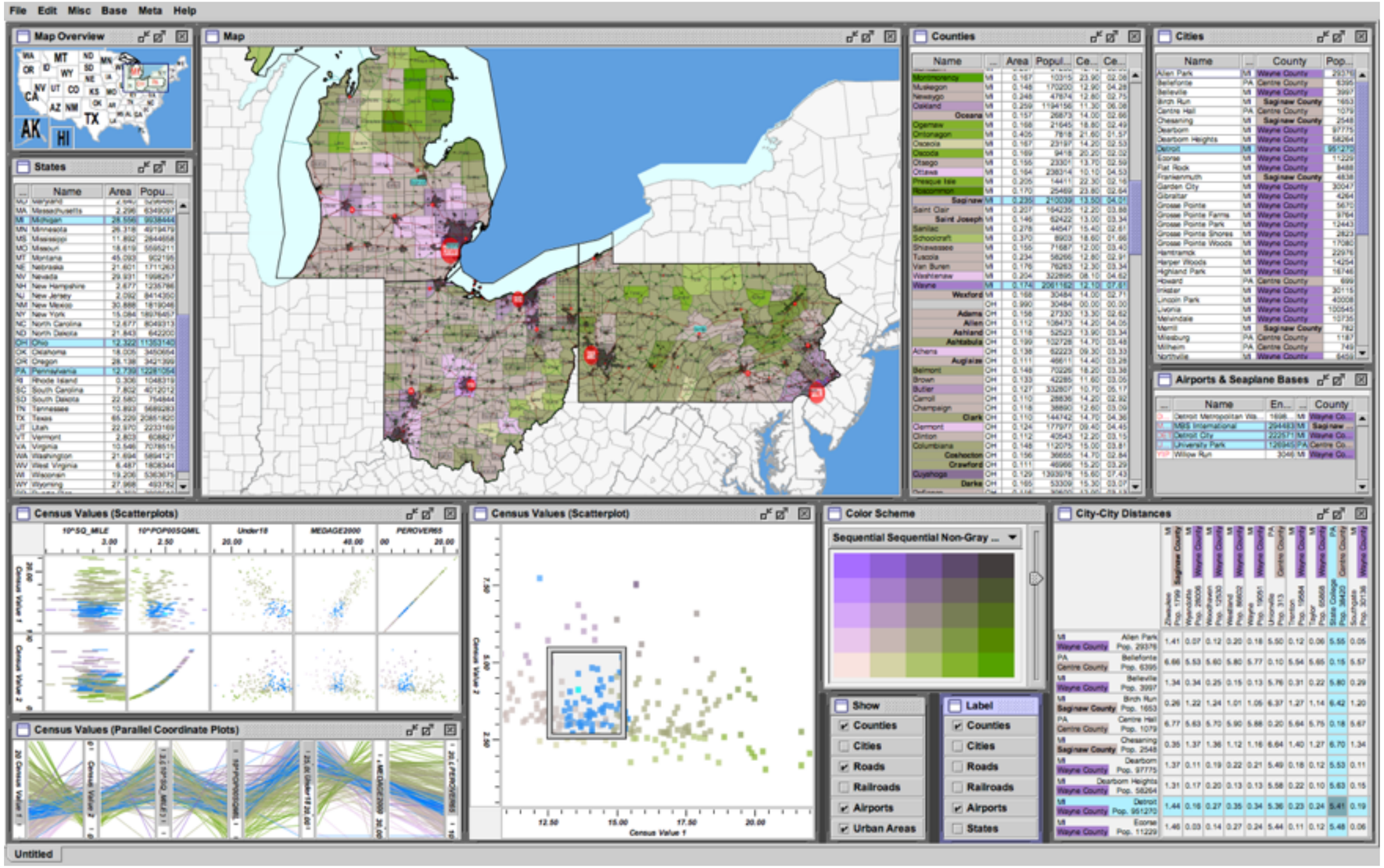
- disparate frames and regions: comparison difficult
  - –vs contiguous frames
  - –vs small region
  - –vs coherent motion of group

- safe special case
  - –animated transitions



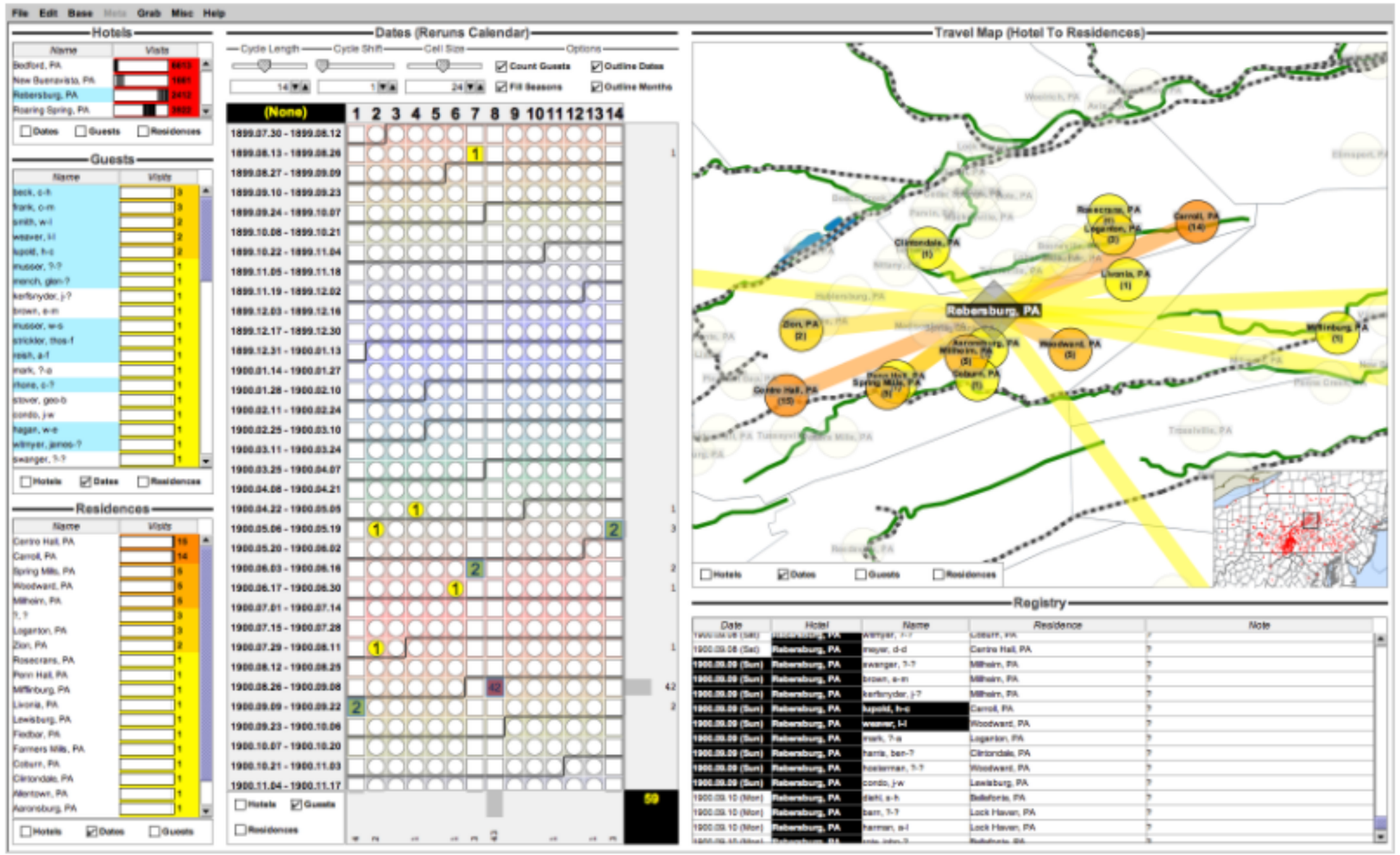
System: **Improvise**

- investigate power of multiple views
  - pushing limits on view count, interaction complexity
  - how many is ok?
    - open research question
  - reorderable lists
    - easy lookup
    - useful when linked to other encodings



[Building Highly-Coordinated Visualizations In Improvise. Weaver. Proc. IEEE Symp. Information Visualization (InfoVis), pp. 159–166, 2004.]

Video: Visual Analysis of Historical Hotel Visitation Patterns

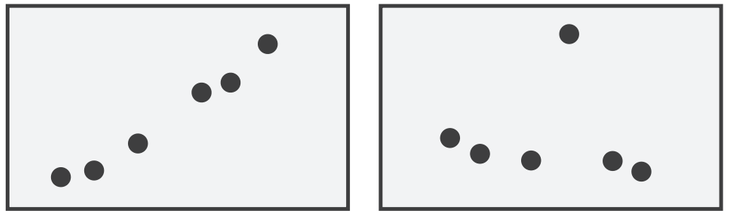


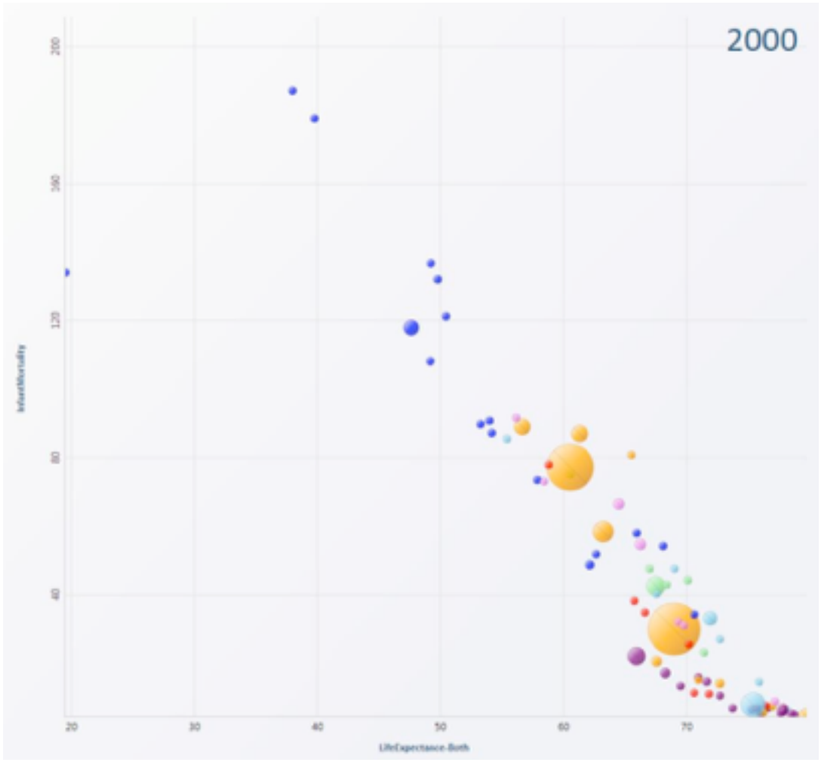
https://www.youtube.com/watch?v=Tzsv6wkZoiQ

http://www.cs.ou.edu/~weaver/improvise/examples/hotels/

Partition into views

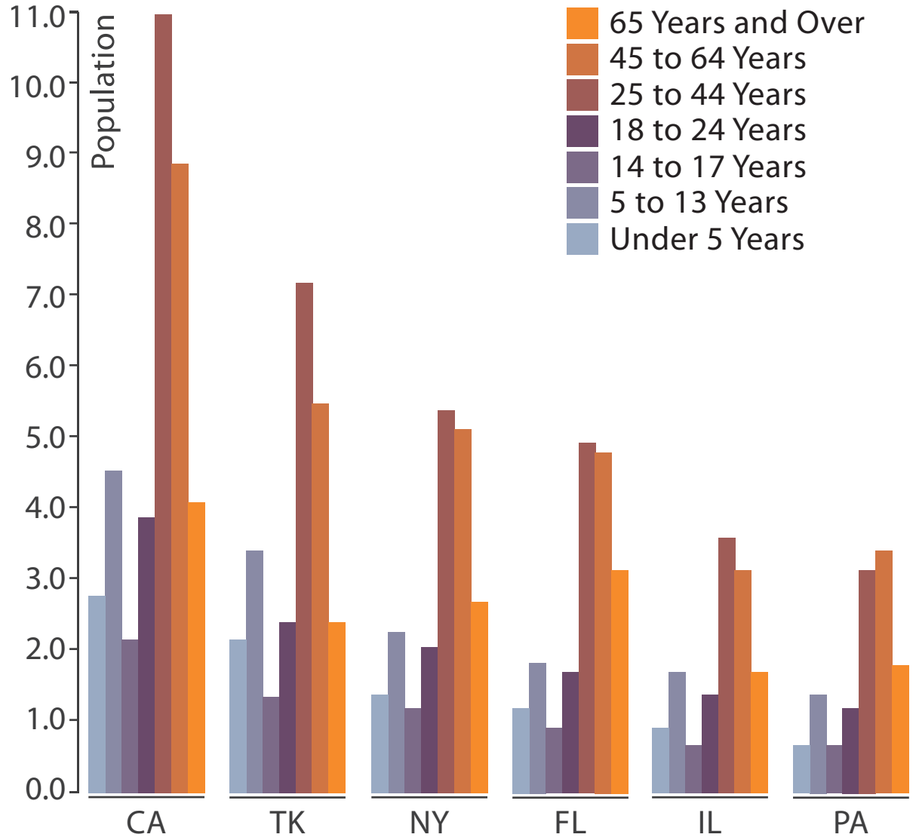
- how to divide data between views ➔ **Partition into Side-by-Side Views**
  - split into regions by attributes
  - encodes association between items using spatial proximity
  - order of splits has major implications for what patterns are visible
- no strict dividing line
  - ***view:*** *big/detailed*
    - contiguous region in which visually encoded data is shown on the display
  - ***glyph:*** *small/iconic*
    - object with internal structure that arises from multiple marks



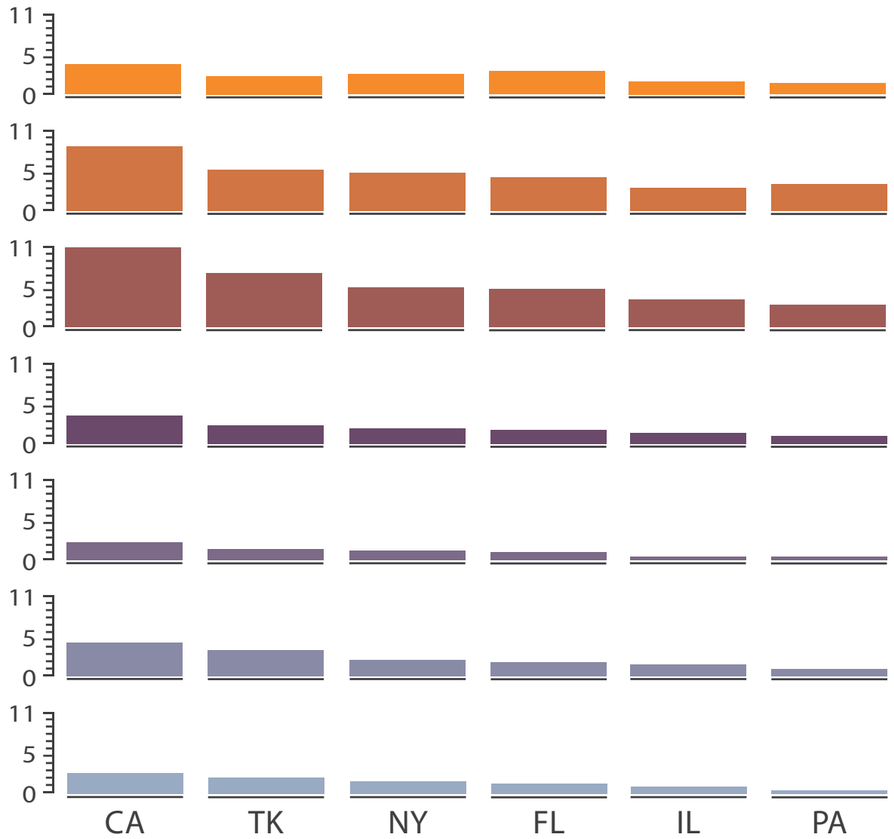


Partitioning: List alignment

- single bar chart with grouped bars
  - split by state into regions
    - complex glyph within each region showing all ages
  - compare: easy within state, hard across ages

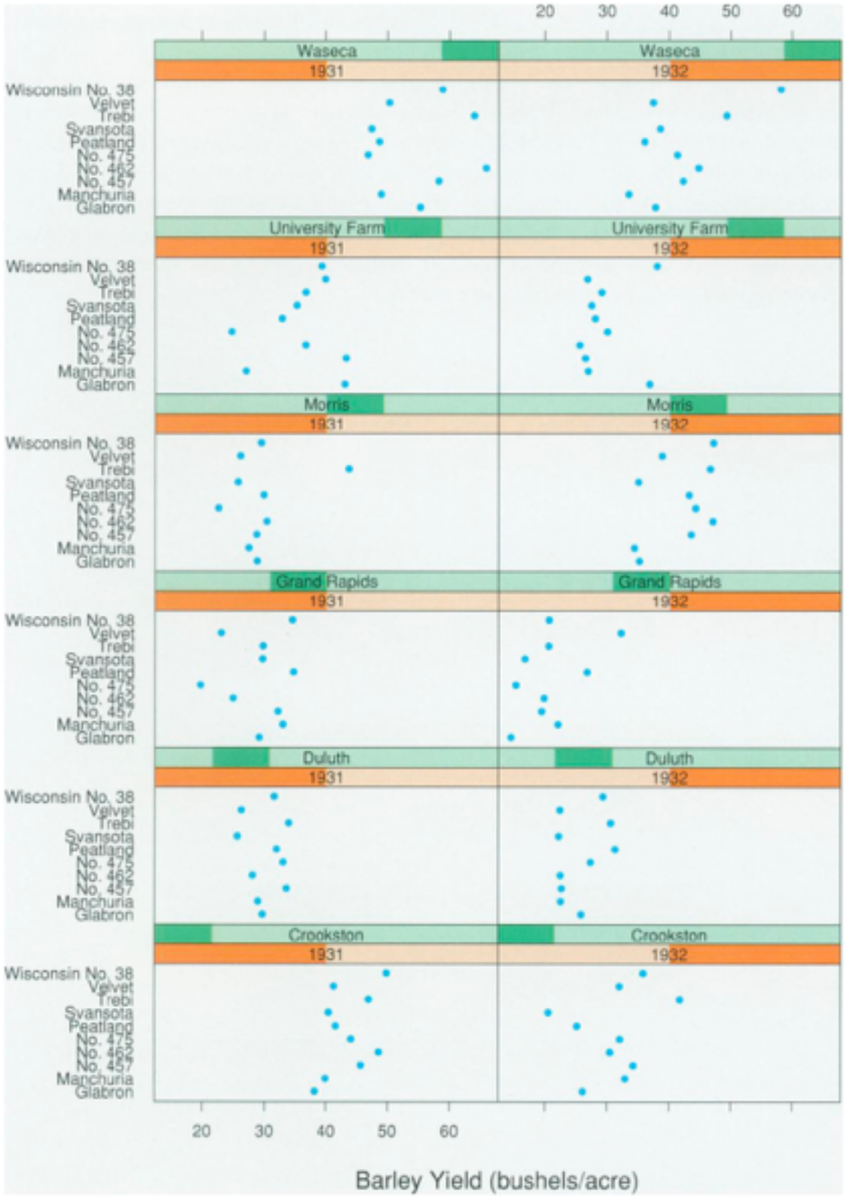


- small-multiple bar charts
  - split by age into regions
    - one chart per region
  - compare: easy within age, harder across states



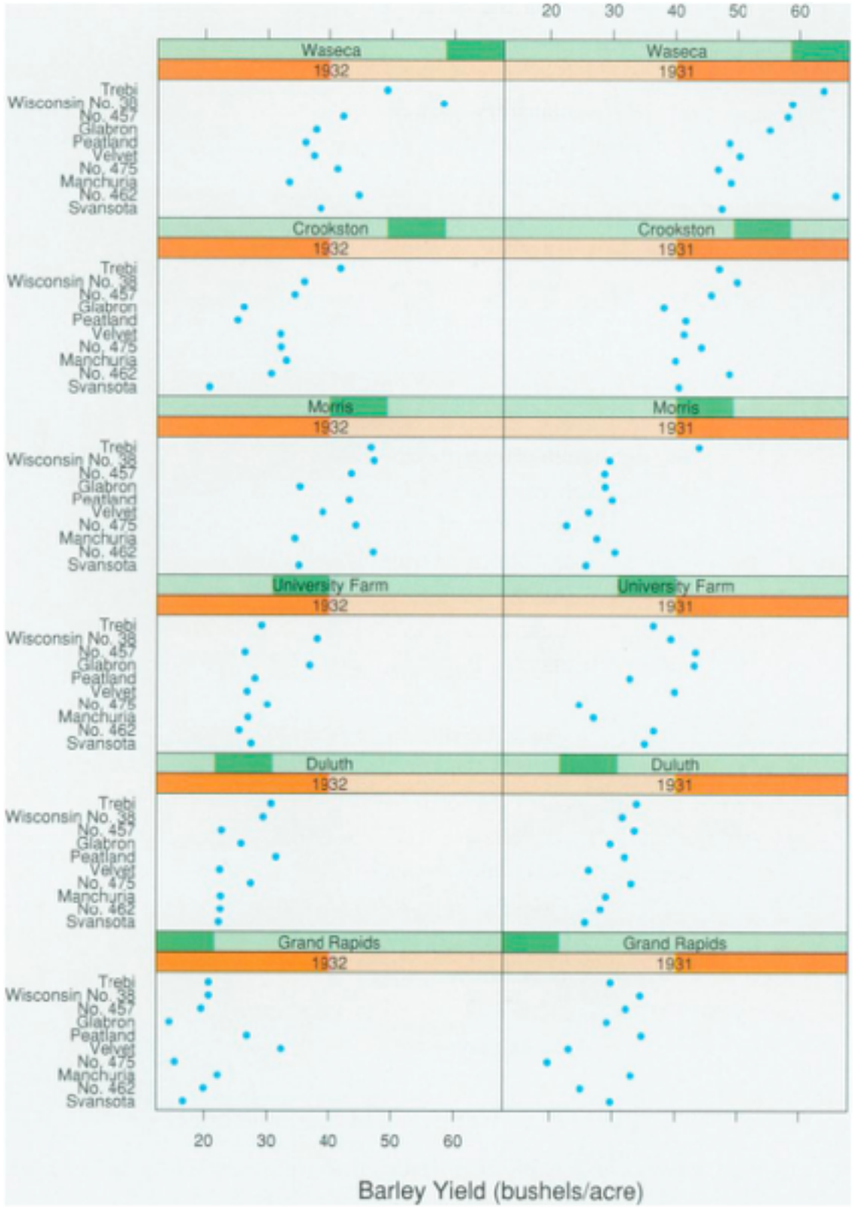
Idiom: **Trellis plots**

- matrix alignment for small multiple plots
  - same issues as alignment for marks within plot!
- partition by
  - year for columns
  - site for rows (alphabetical)
- within pane
  - variety for vertical axis
  - yield for vertical position



Idiom: **Trellis plots**

- main effects ordering
  - order small-multiples plots based on derived data to see trends
  - order plots by median values
  - shared vertical axis within each plot ordered by median values within varieties

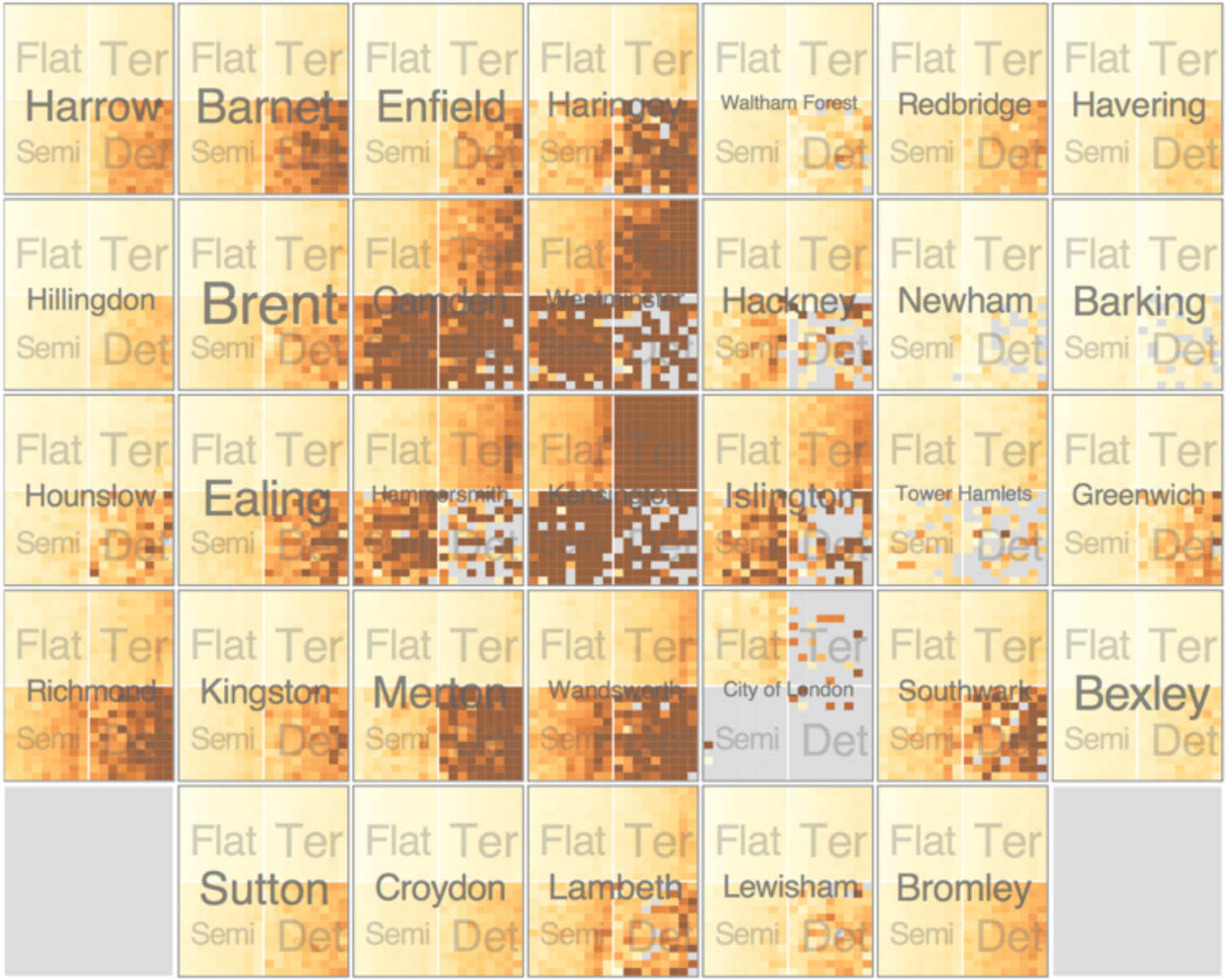


Partitioning: Recursive subdivision

System: **HIVE**

- split by neighborhood
- then by type
- then time
  - years as rows
  - months as columns
- color by price

- neighborhood patterns
  - where it's expensive
  - where you pay much more for detached type



[Configuring Hierarchical Layouts to Address Research Questions. Slingsby, Dykes, and Wood. IEEE Transactions on Visualization and Computer Graphics (Proc. InfoVis 2009) 15:6 (2009), 977–984.]

Partitioning: Recursive subdivision

System: **HIVE**

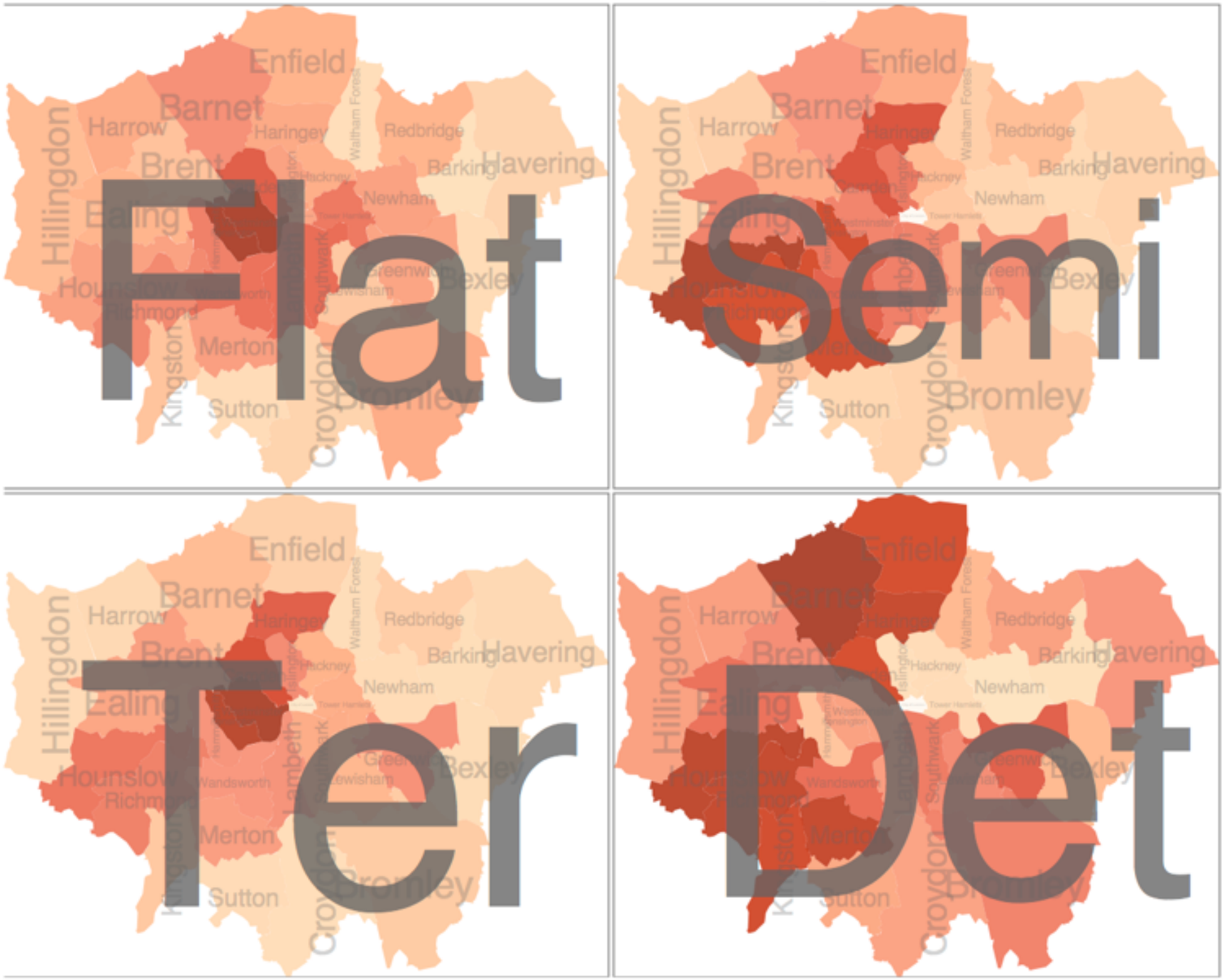
- switch order of splits
  - type then neighborhood
- switch color
  - by price variation
- type patterns
  - within specific type, which neighborhoods inconsistent

[Configuring Hierarchical Layouts to Address Research Questions. Slingsby, Dykes, and Wood. IEEE Transactions on Visualization and Computer Graphics (Proc. InfoVis 2009) 15:6 (2009), 977–984.]

Partitioning: Recursive subdivision

System: **HIVE**

- different encoding for second-level regions
  - choropleth maps

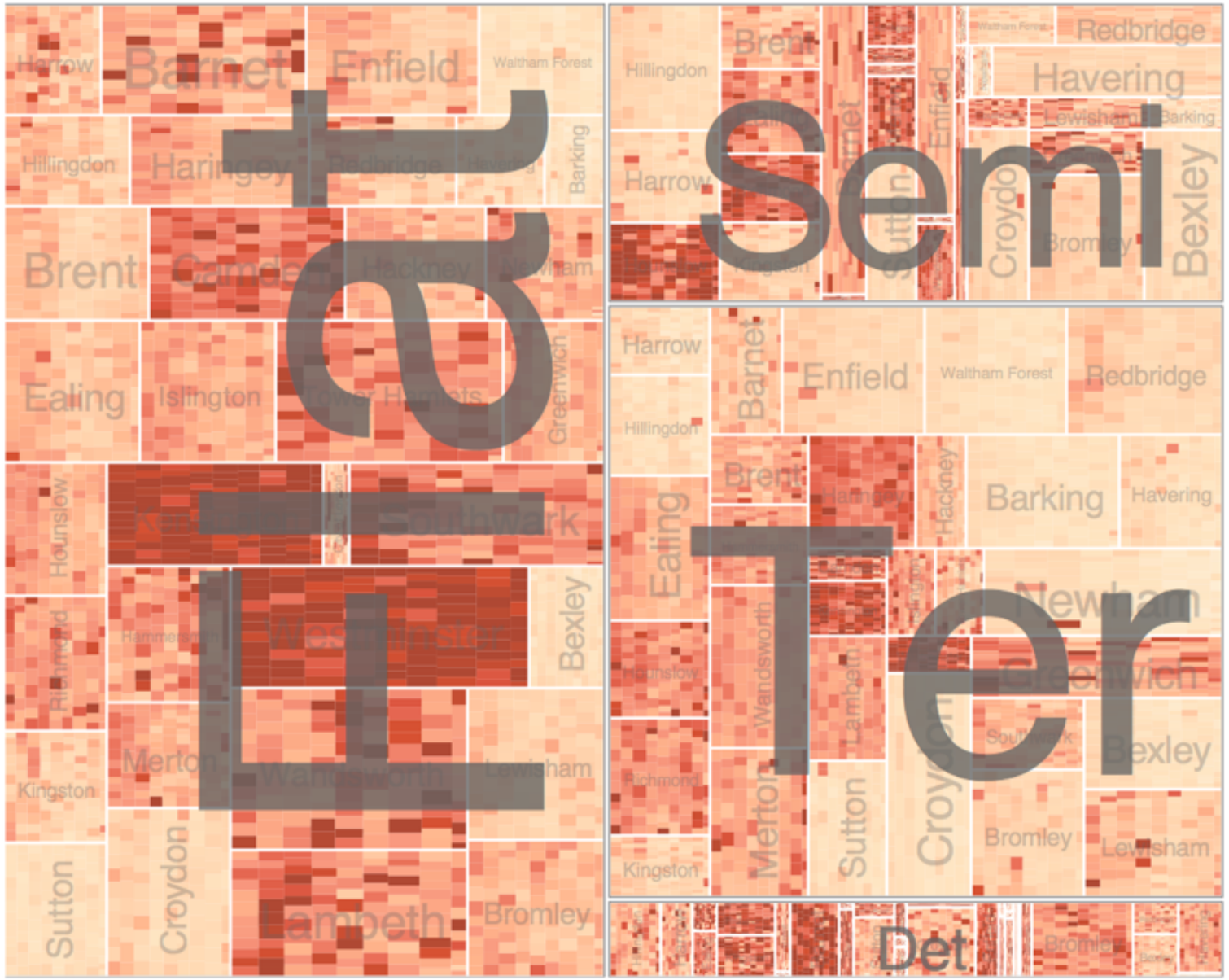


[Configuring Hierarchical Layouts to Address Research Questions. Slingsby, Dykes, and Wood. IEEE Transactions on Visualization and Computer Graphics (Proc. InfoVis 2009) 15:6 (2009), 977–984.]

Partitioning: Recursive subdivision

System: **HIVE**

- size regions by sale counts
  - not uniformly
- result: treemap

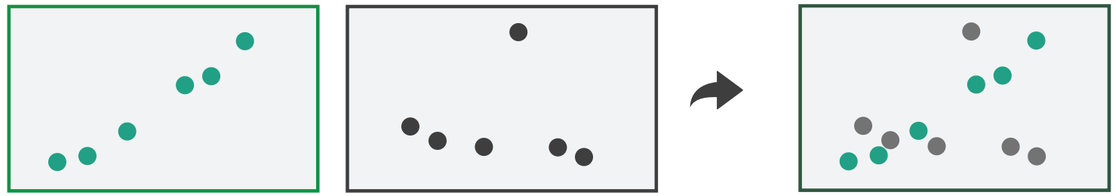


[Configuring Hierarchical Layouts to Address Research Questions. Slingsby, Dykes, and Wood. IEEE Transactions on Visualization and Computer Graphics (Proc. InfoVis 2009) 15:6 (2009), 977–984.]

Superimpose layers

- *layer*: set of objects spread out over region
  - each set is visually distinguishable group
  - extent: whole view
- design choices
  - how many layers, how to distinguish?
    - encode with different, nonoverlapping channels
    - two layers achieveable, three with careful design
  - small static set, or dynamic from many possible?

Superimpose Layers



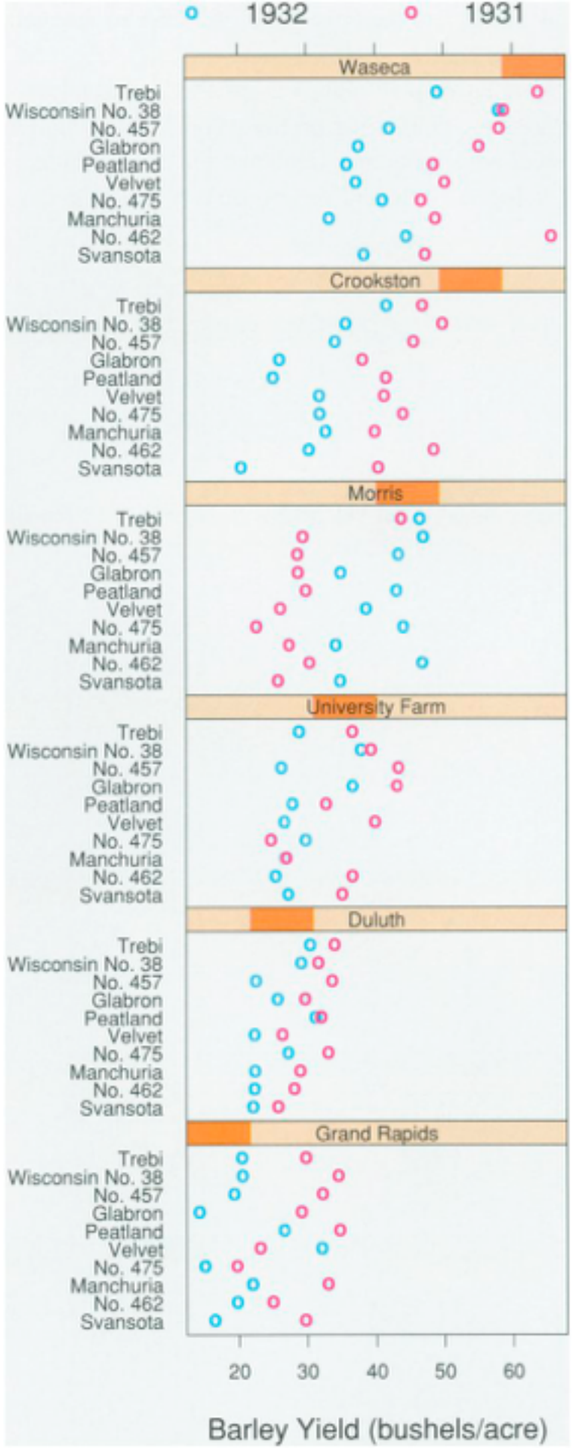
Static visual layering

- foreground layer: roads
  - hue, size distinguishing main from minor
  - high luminance contrast from background
- background layer: regions
  - desaturated colors for water, parks, land areas
- user can selectively focus attention
- "get it right in black and white"
  - check luminance contrast with greyscale view

[Get it right in black and white. Stone. 2010. http://www.stonesc.com/wordpress/2010/03/get-it-right-in-black-and-white]

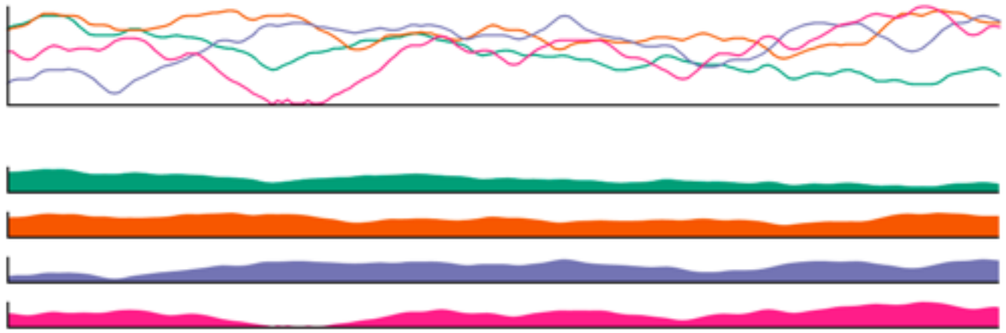
Idiom: **Trellis plots**

- superimpose within same frame
  - color code by year

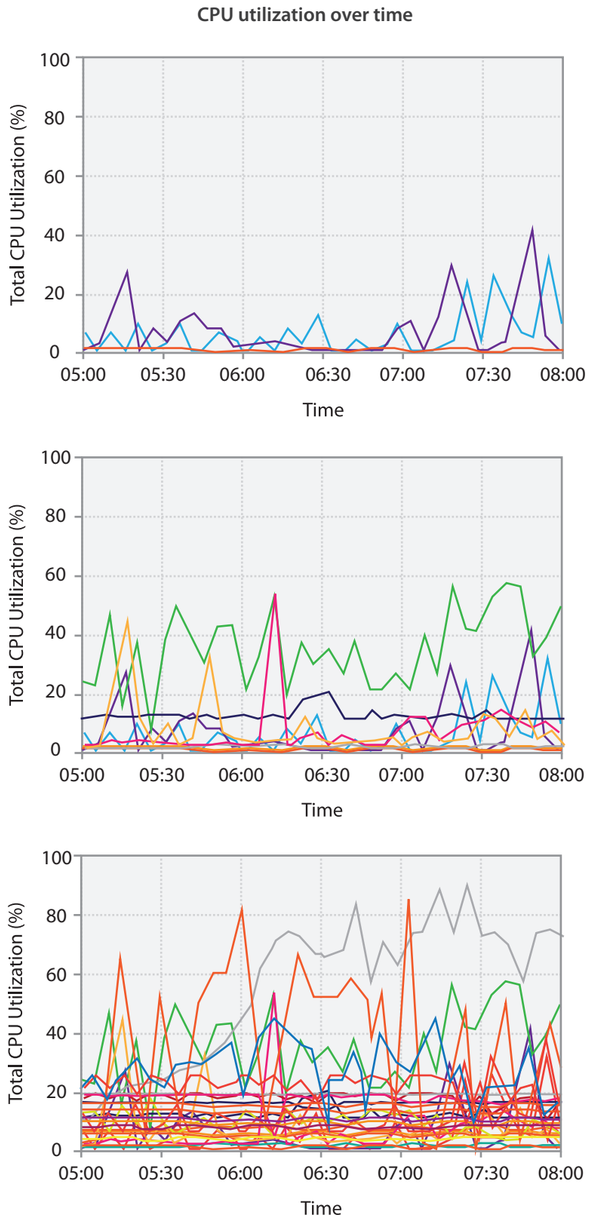


Superimposing limits

- few layers, but many lines
  - up to a few dozen
  - but not hundreds
- superimpose vs juxtapose: empirical study
  - superimposed for local, multiple for global
  - tasks
    - local: maximum, global: slope, discrimination
  - same screen space for all multiples vs single superimposed

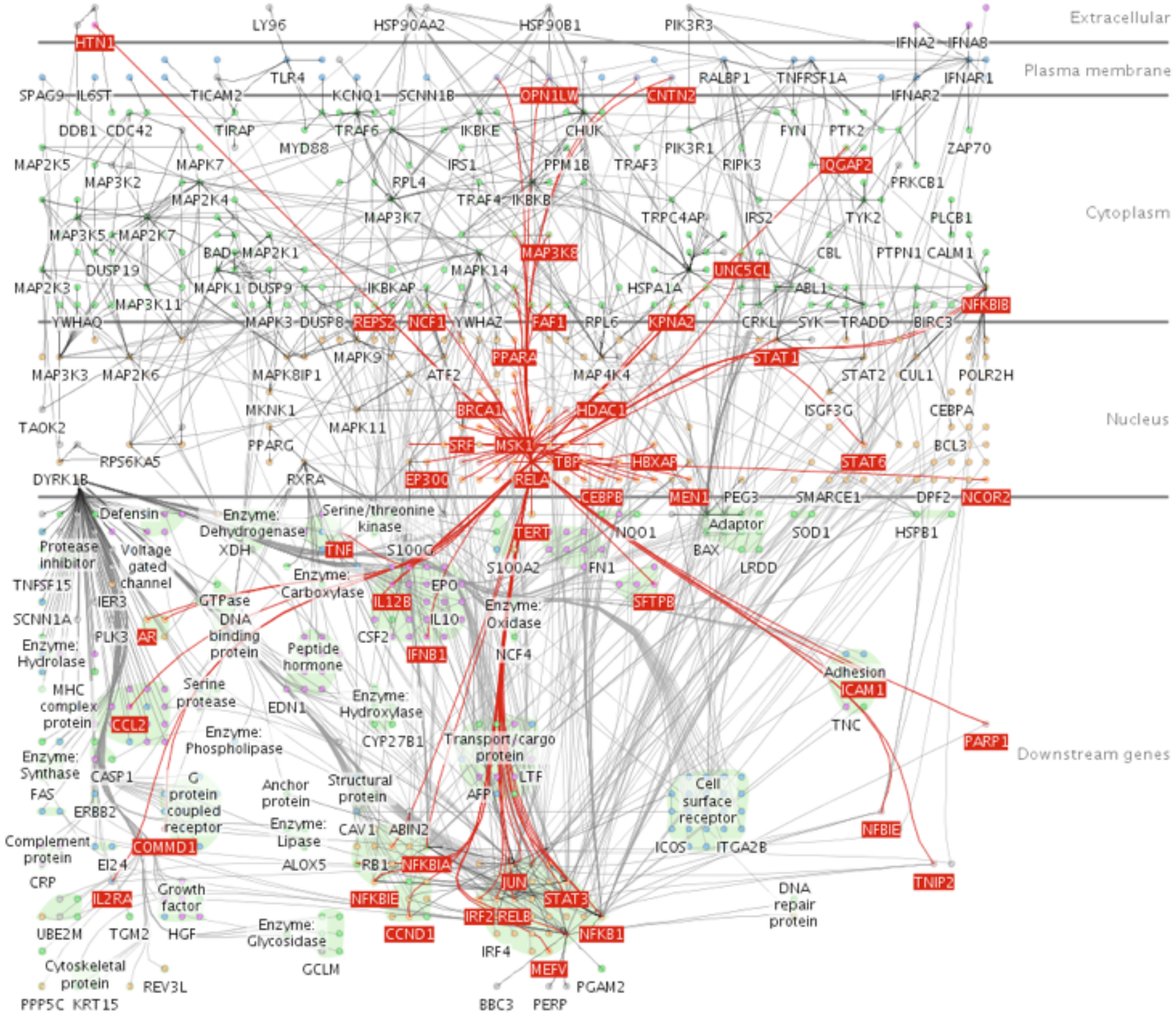


[Graphical Perception of Multiple Time Series. Javed, McDonnel, and Elmqvist. IEEE Transactions on Visualization and Computer Graphics (Proc. IEEE InfoVis 2010) 16:6 (2010), 927–934.]



Dynamic visual layering

- interactive, from selection
  - –lightweight: click
  - –very lightweight: hover
- ex: 1-hop neighbors

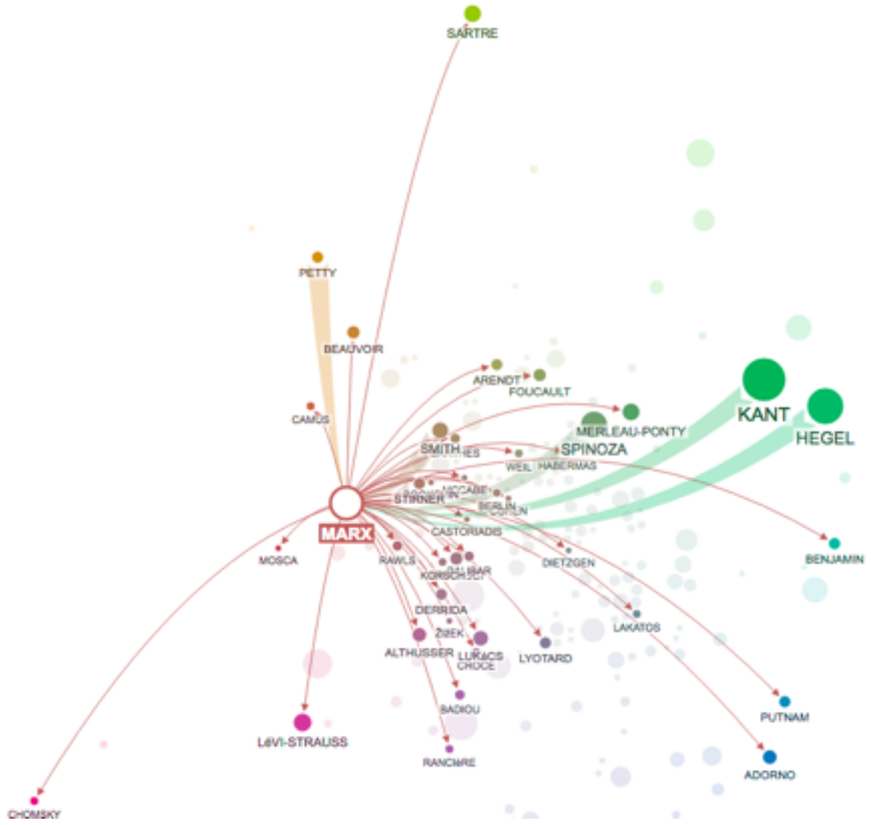


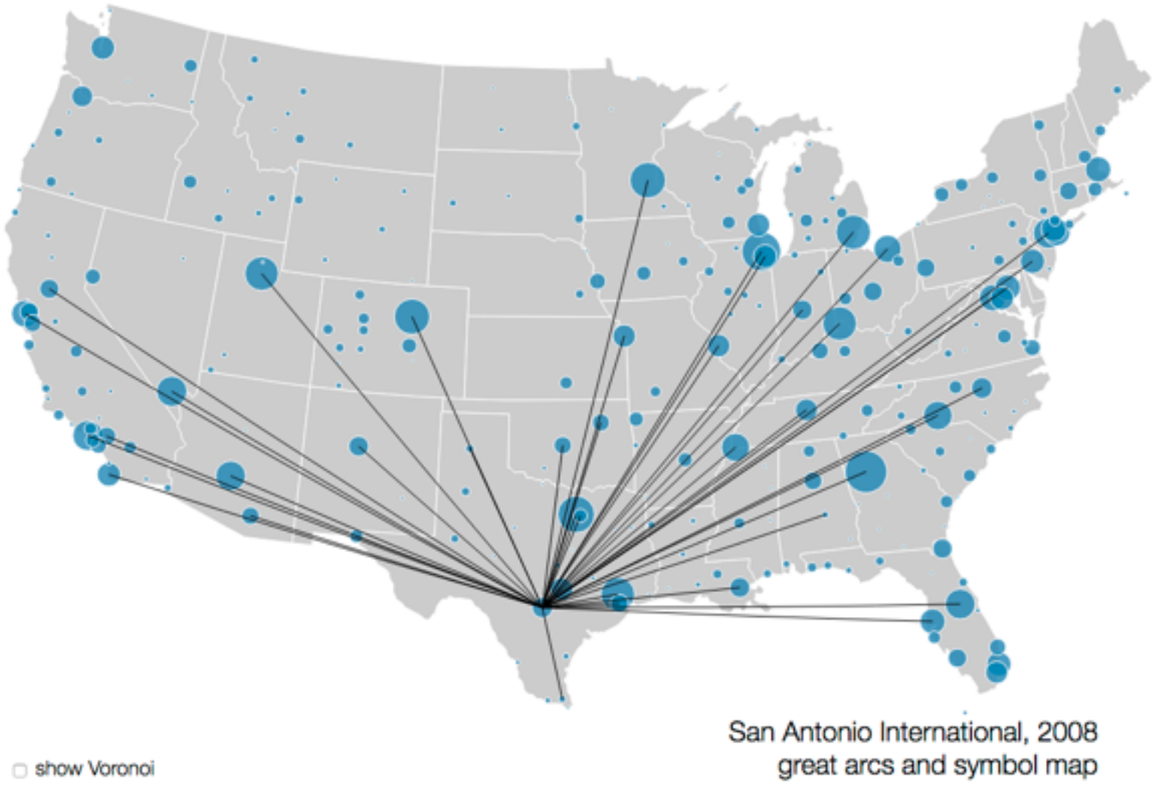
[Cerebral: a Cytoscape plugin for layout of and interaction with biological networks using subcellular localization annotation. Barsky, Gardy, Hancock, and Munzner. Bioinformatics 23:8 (2007), 1040–1042.]

System: **Cerebral**

Dynamic visual layering

- one-hop neighbour highlighting demos: click vs hover





http://mariandoerk.de/edgemaps/demo/

http://mbostock.github.io/d3/talk/20111116/airports.html

Further reading

- Visualization Analysis and Design. Munzner. AK Peters Visualization Series, CRC Press, 2014.
  - *Chap 12: Facet Into Multiple Views*
- *A Review of Overview+Detail, Zooming, and Focus+Context Interfaces*. Cockburn, Karlson, and Bederson. ACM Computing Surveys 41:1 (2008), 1–31.
- *A Guide to Visual Multi-Level Interface Design From Synthesis of Empirical Study Evidence*. Lam and Munzner. Synthesis Lectures on Visualization Series, Morgan Claypool, 2010.
- *Zooming versus multiple window interfaces: Cognitive costs of visual comparisons*. Plumlee and Ware. ACM Trans. on Computer-Human Interaction (ToCHI) 13:2 (2006), 179–209.
- *Exploring the Design Space of Composite Visualization*. Javed and Elmqvist. Proc. Pacific Visualization Symp. (PacificVis), pp. 1–9, 2012.
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