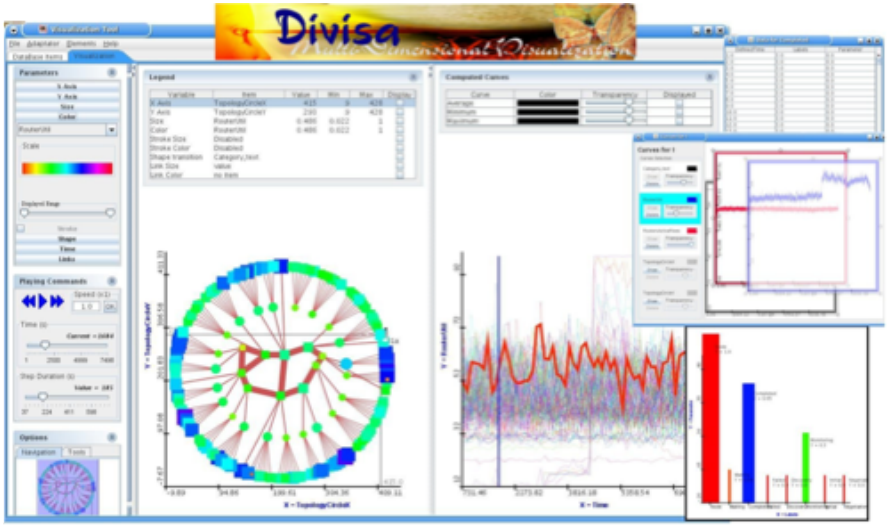
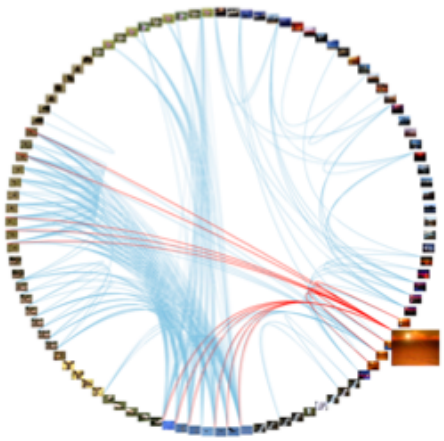


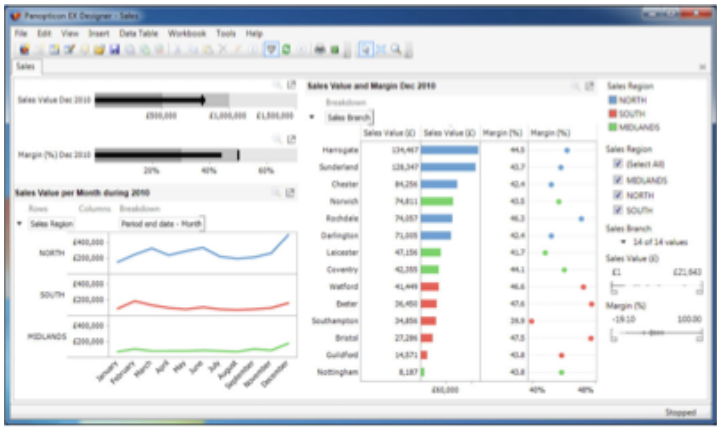
IAT 355

Multiple dimensions, multiple views

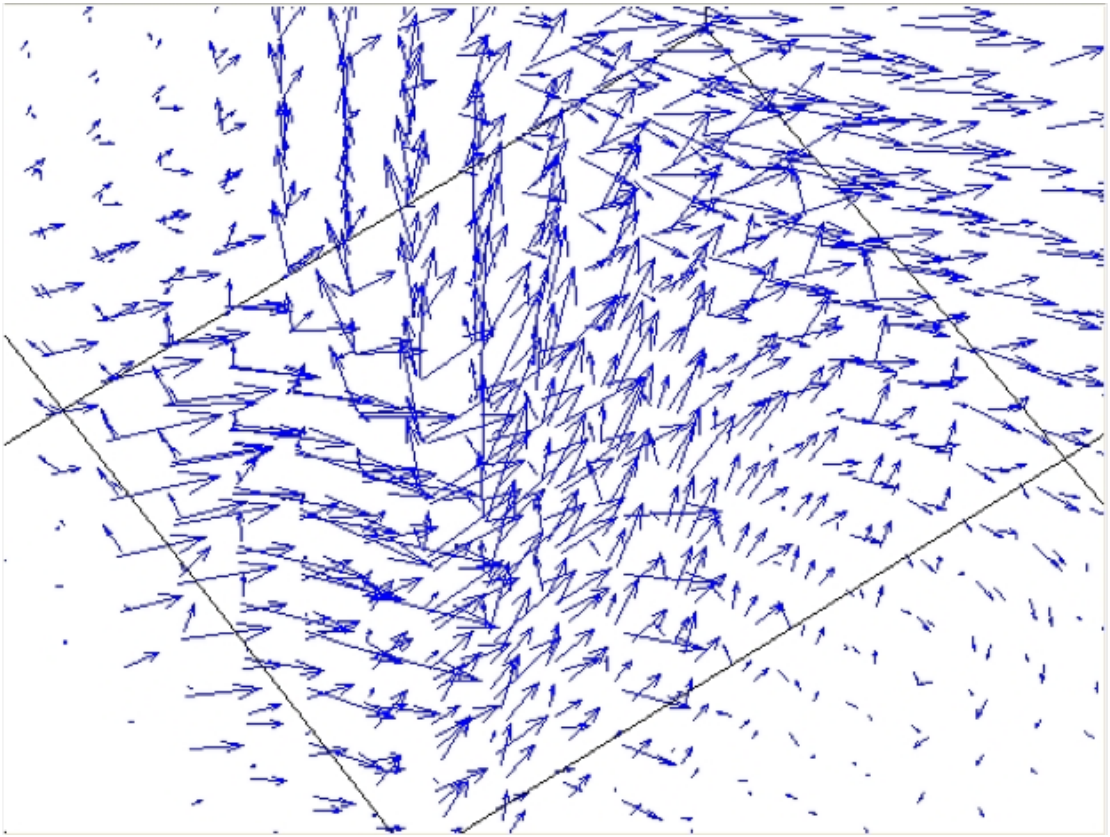
Lyn Bartram

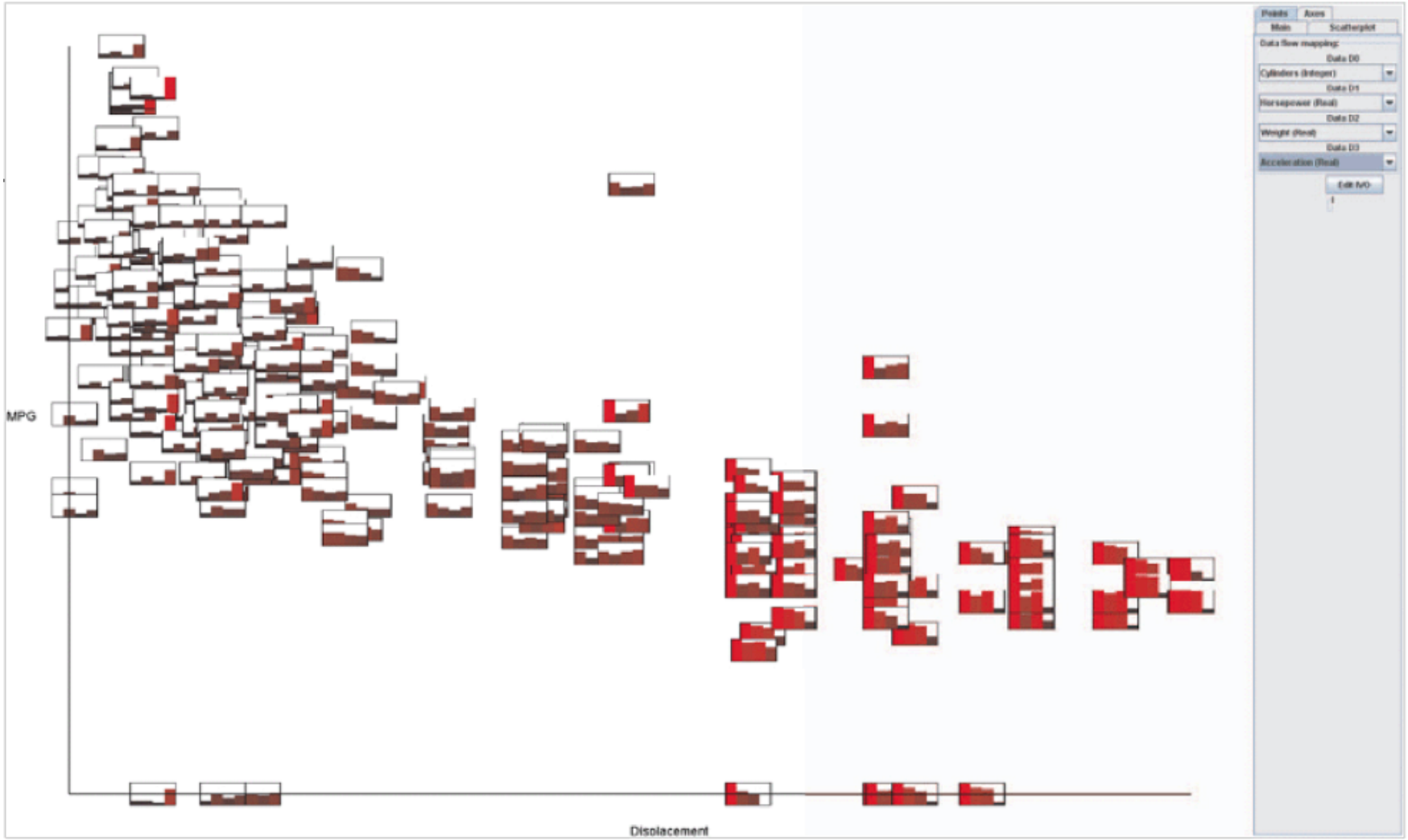
SFU





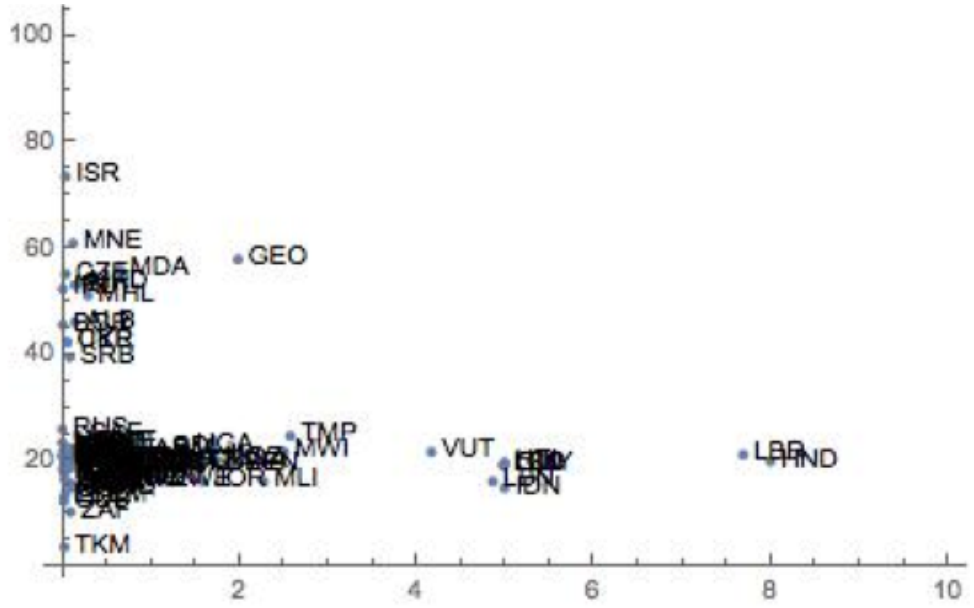
Multidimensional representation: glyphs




MPG
Displacement
Points
Axes
Main
Scatterplot
Data flow mapping:
Data D0
Cylinders (Integer)
Data D1
Horsepower (Real)
Data D2
Weight (Real)
Data D3
Acceleration (Real)
Edit IVO

Overplotting

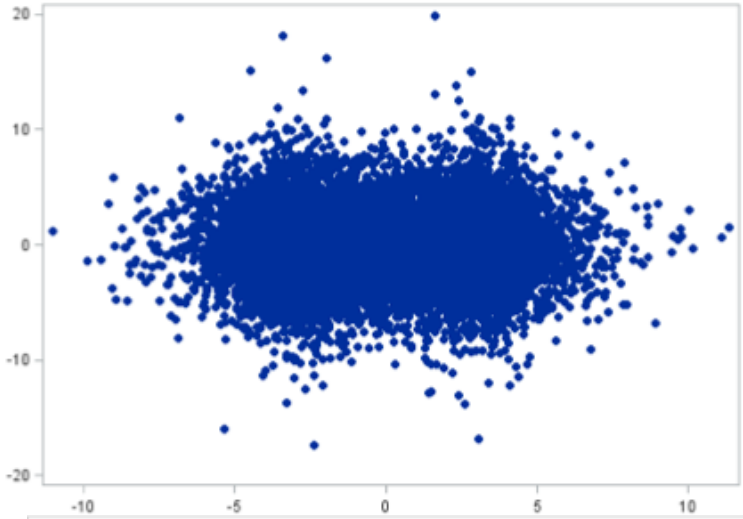
- At some point there are just too many points

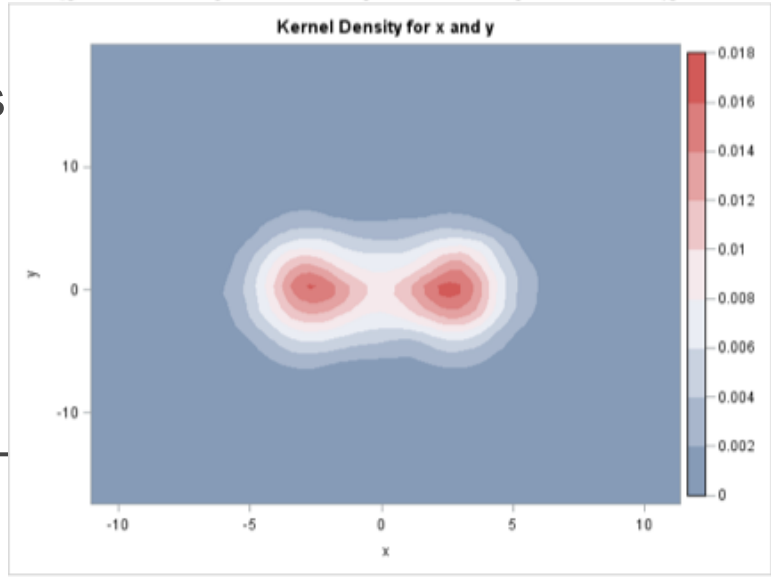


Reducing overplotting

- Reduce size of objects
- Remove fill colour
- Change shape from container (eg circle) to non-container (X)
- *Jitter* the data
- Make data objects transparent
- Transform the data into density measures (KDE, heatmaps)

- White space challenges vis
- Graphical tricks only go so far.





Approaches to reducing complexity

1. Deriving new data (statistics, choosing a design idiom)
2. Navigating through the information space
   - (change over time)

3. Reorganizing the dimension layout
4. Faceting the data/ dimensions into coordinated views
   - Change by using space

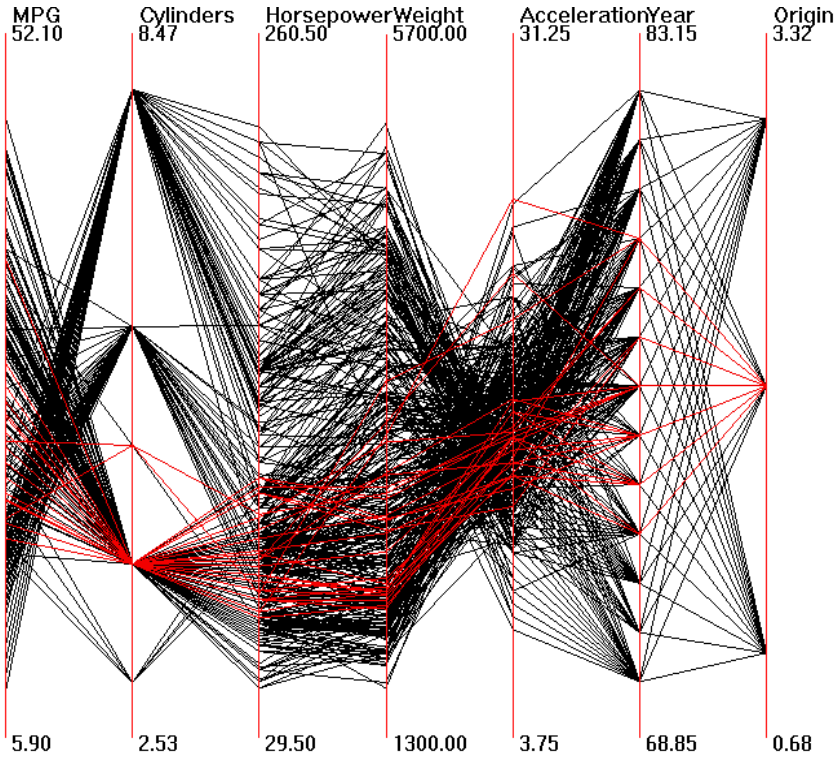
5. Reducing the data in the view
6. Embedding focus and context in single view

Reduce complexity: redistribute data

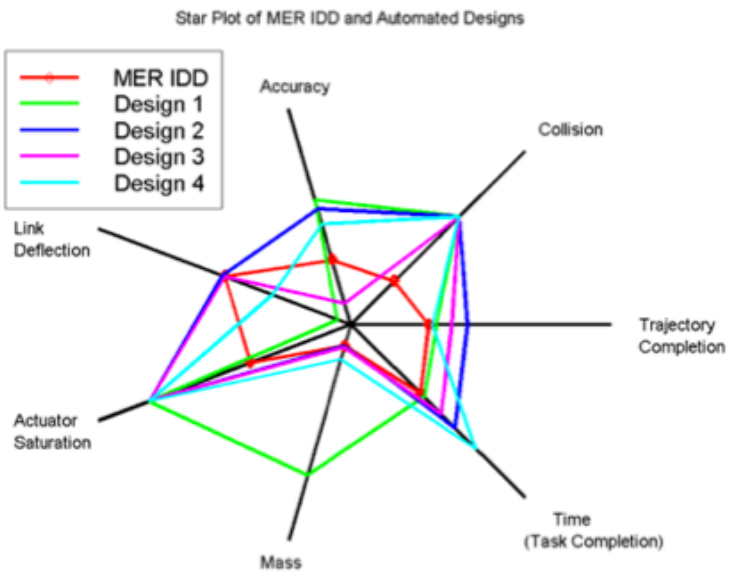
- Dimensional reorganization
- Dimensional embedding
- Dimensional subsetting : *faceting*

Dimensional reorganization

- Parallel coordinates

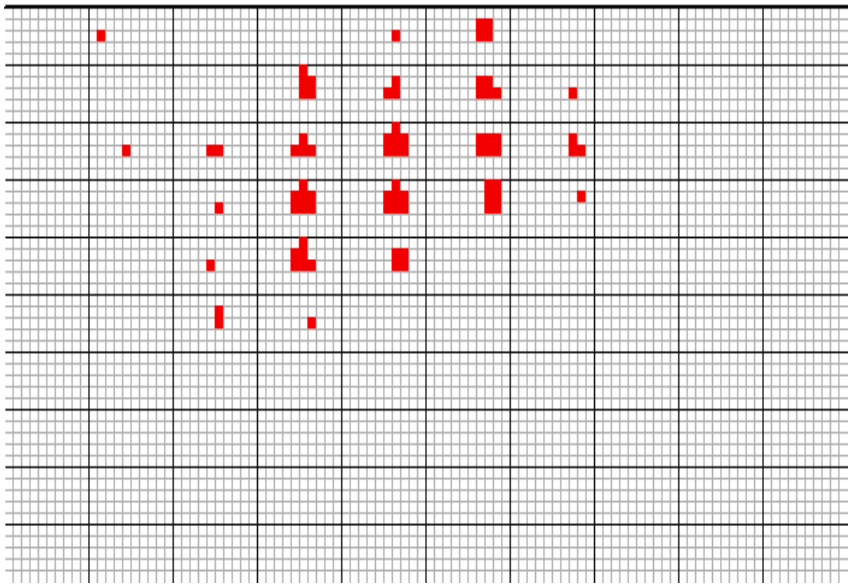


- Radar/star plots



Dimensional Embedding

- Dimensional stacking divides data space into bins
- Each N-D bin has a unique 2-D screen bin
- Screen space recursively divided based on bin count for each dimension
- Clusters and trends manifested as repeated patterns



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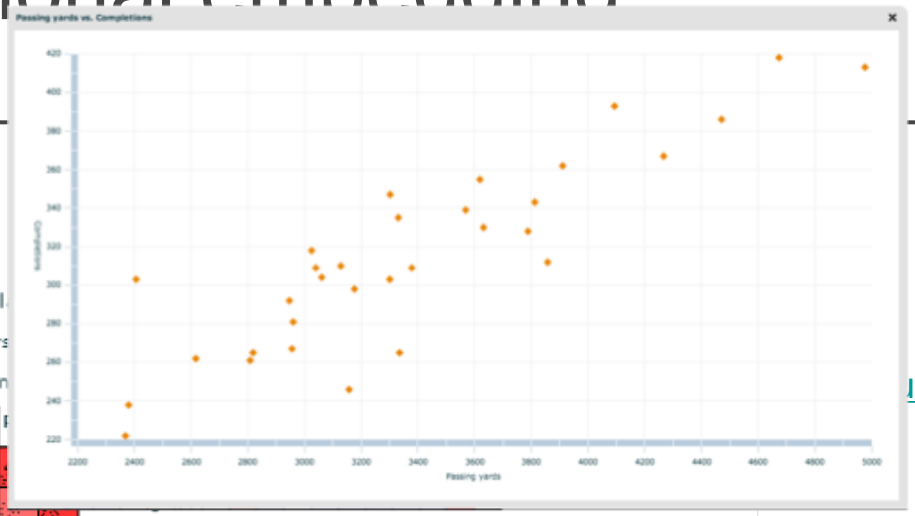
Dimensional embedding



ualizing NFL 2008

Bertin's Three Levels of Reading

- Elementary: single value

- Intermediate: relationships between values

- Global: relationships of the whole

But what's the core problem?

So much data …..

So many dimensions ….

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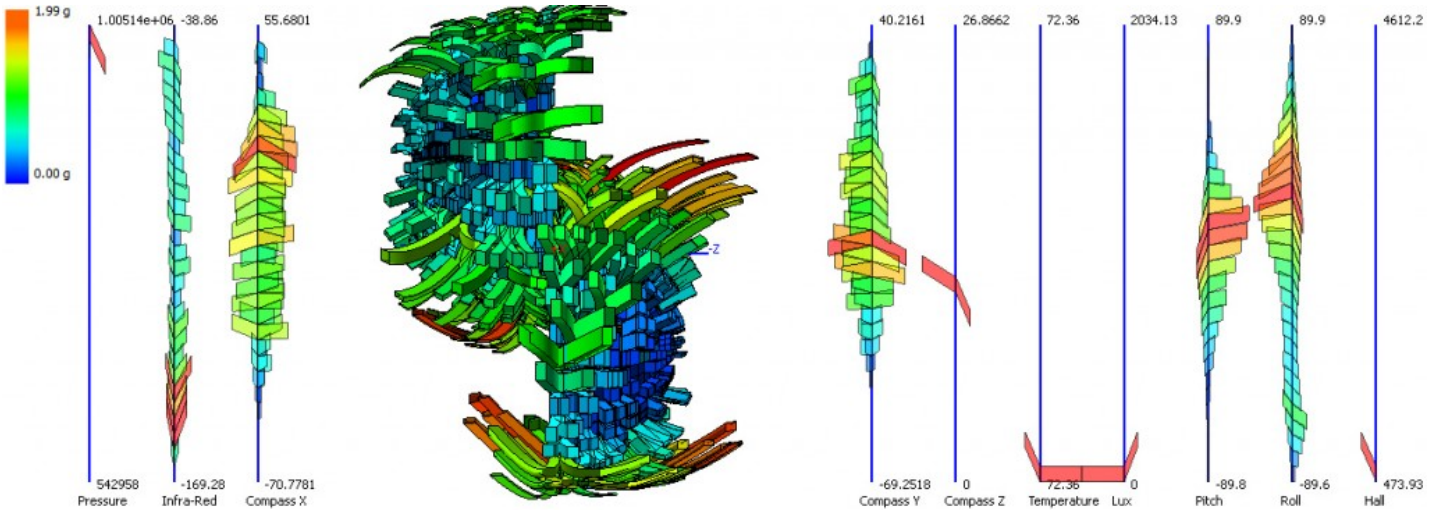
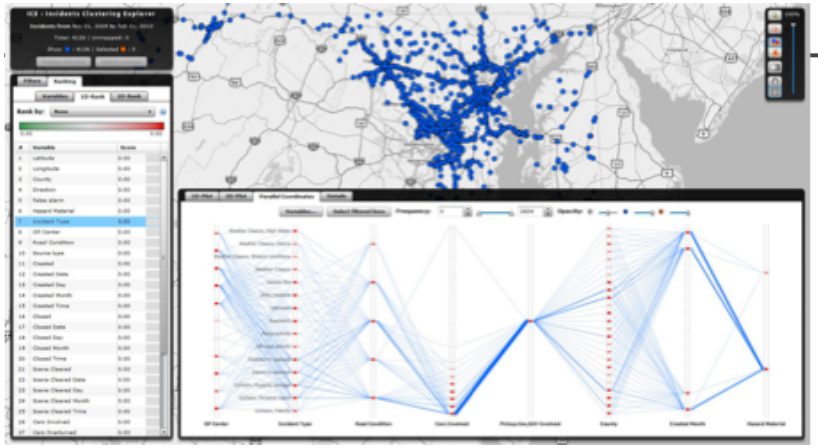
Way too much information

- multidimensional view
  - Compound idioms



Solution: Multiple views



Incident Clustering Explorer, University of Maryland

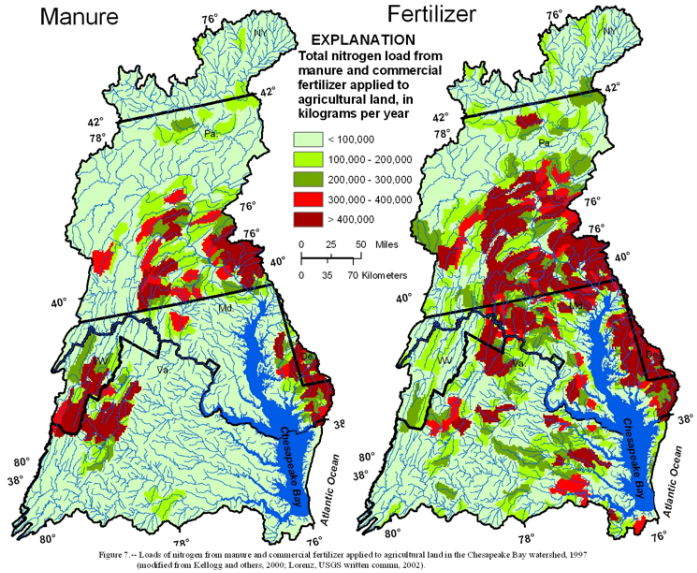


Figure 7. -- Loads of nitrogen from manure and commercial fertilizer applied to agricultural land in the Chesapeake Bay watershed, 1997 (modified from Kellogg and others, 2000; Lorenz, USGS written comm, 2002).

Nutrients inputs to Chesapeake Bay Water Quality

http://dougmccune.com/blog/2011/04/26/visualizing-time-with-the-double-time-bar-chart/

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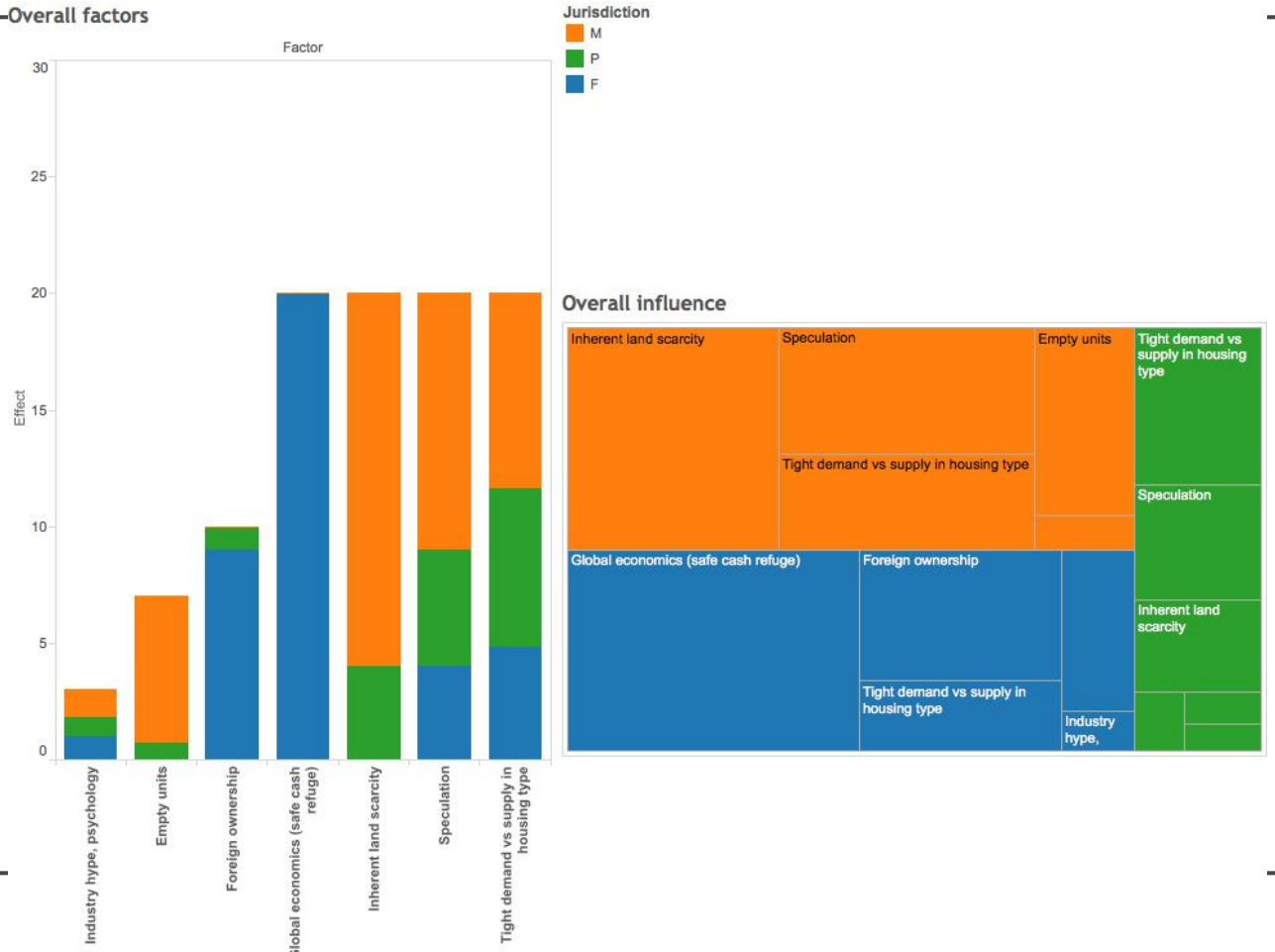
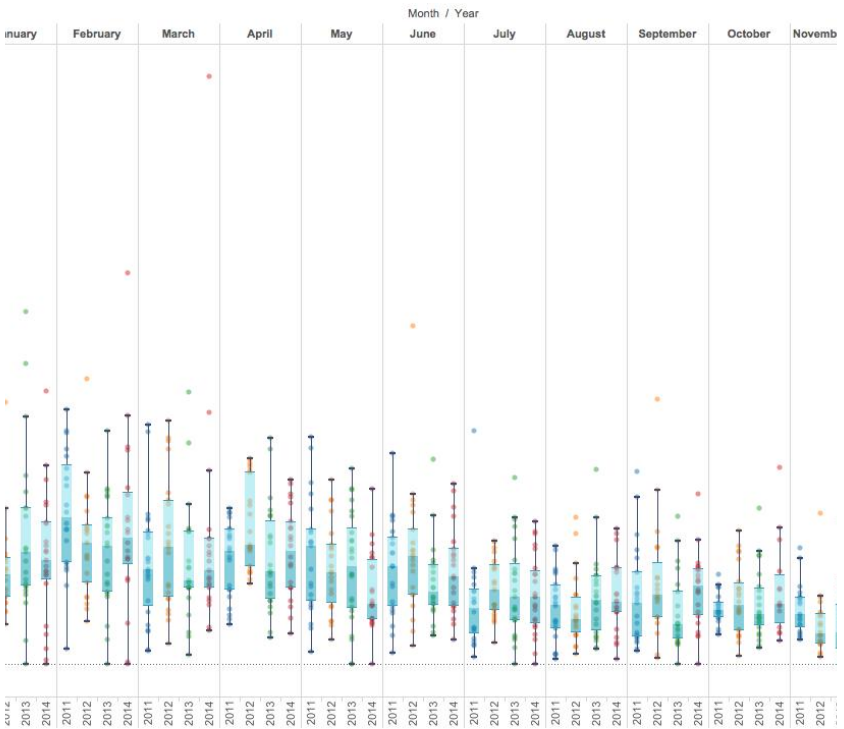
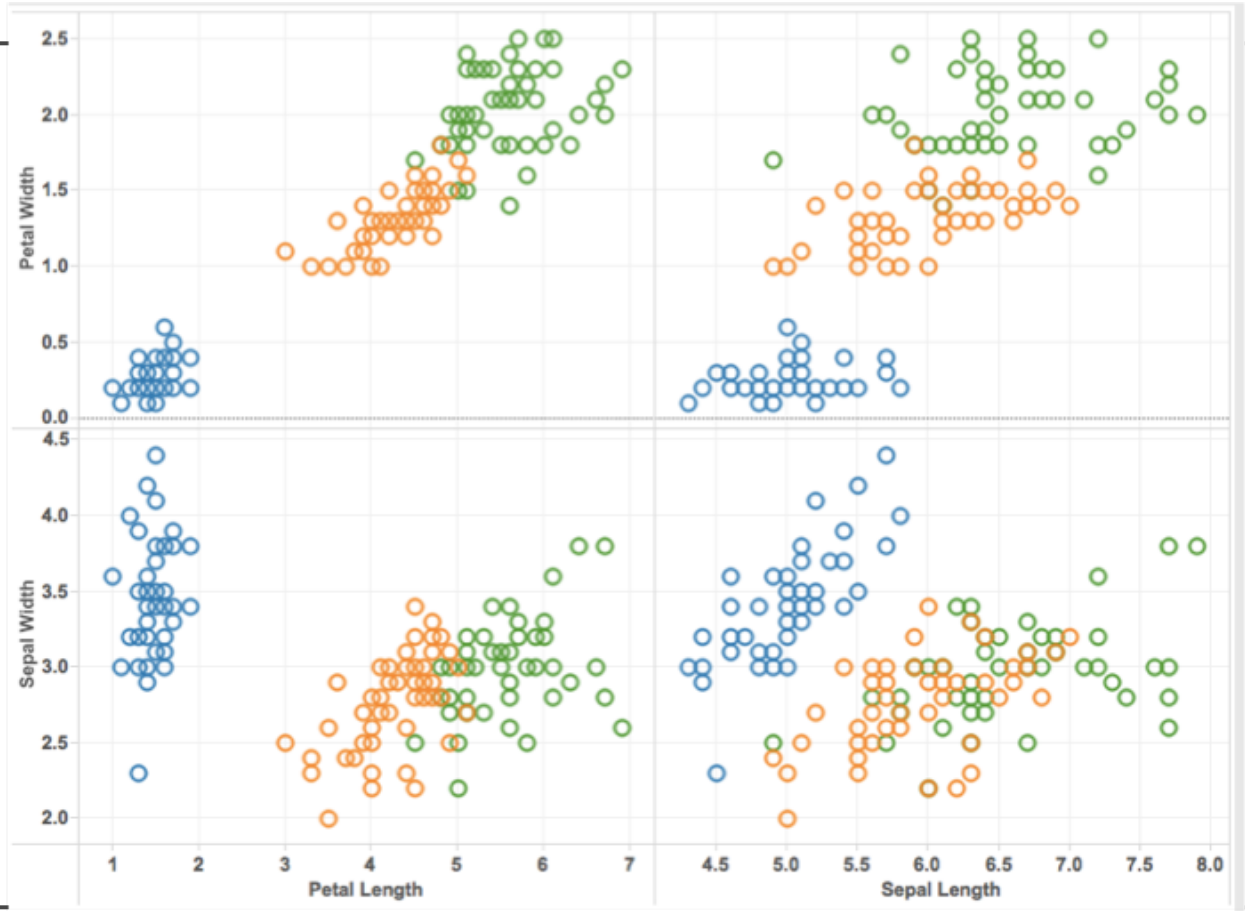
Same data, different encoding



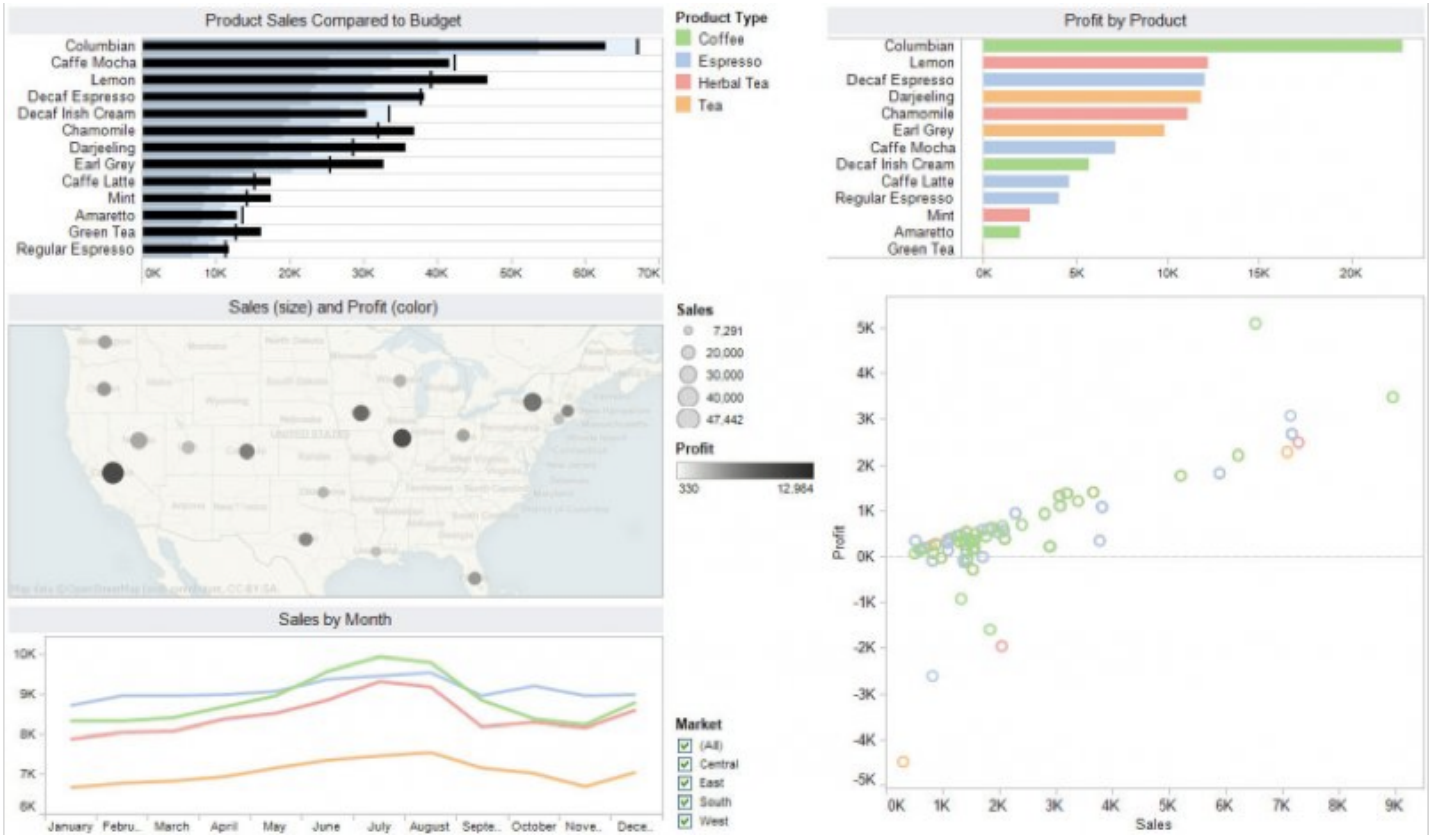
Same data (different levels of detail), different encoding



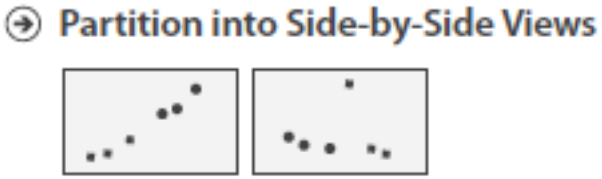
same encoding, different subsets (by dimension)



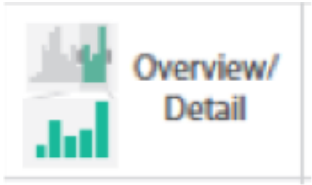
Different subsets, different encoding



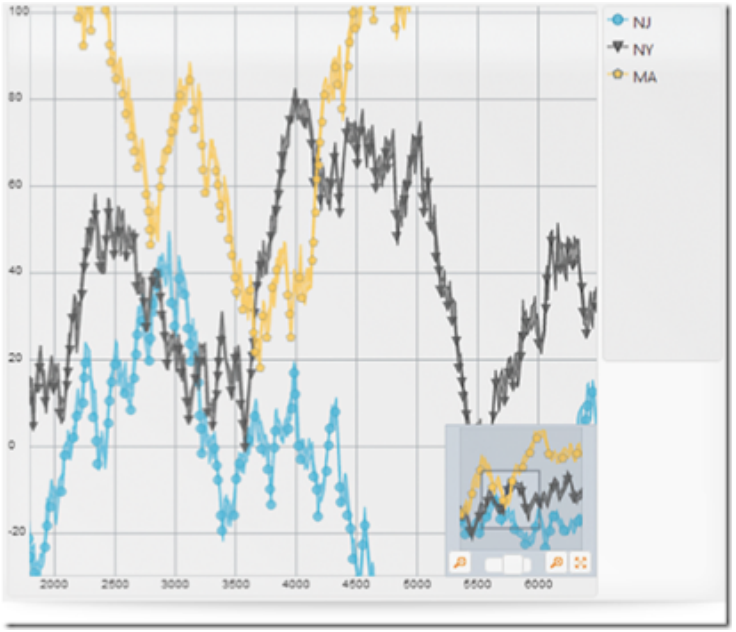
Data and View Facets



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



Overview and detail: subset data, same encoding

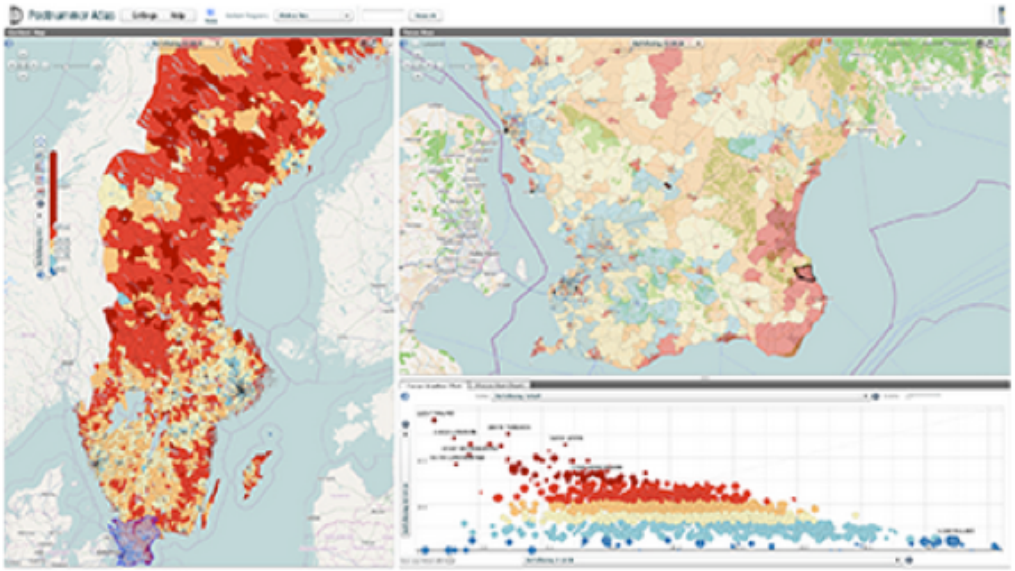


Infragistics,
http://www.infragistics.com/community/blogs/taz_abdeali/archive/2012/03/13/netadvantage-for-jquery-2012-volume-1-sneak-peek.aspx

http://www.wikiviz.org/wiki/Overview_plus_detail

Faceting data: multiform overview and detail

Postnummer- och SAMS-atlasen



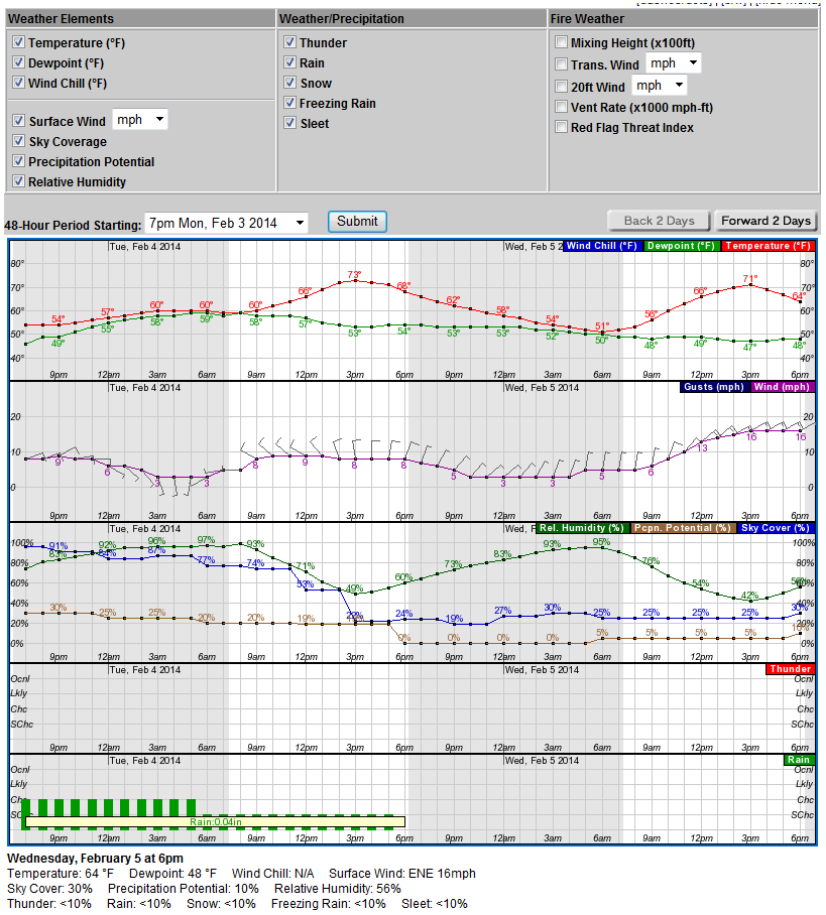
GAV HTML5 TOOLKIT, Linkoping University

Small Multiples

Subsetting dimensions

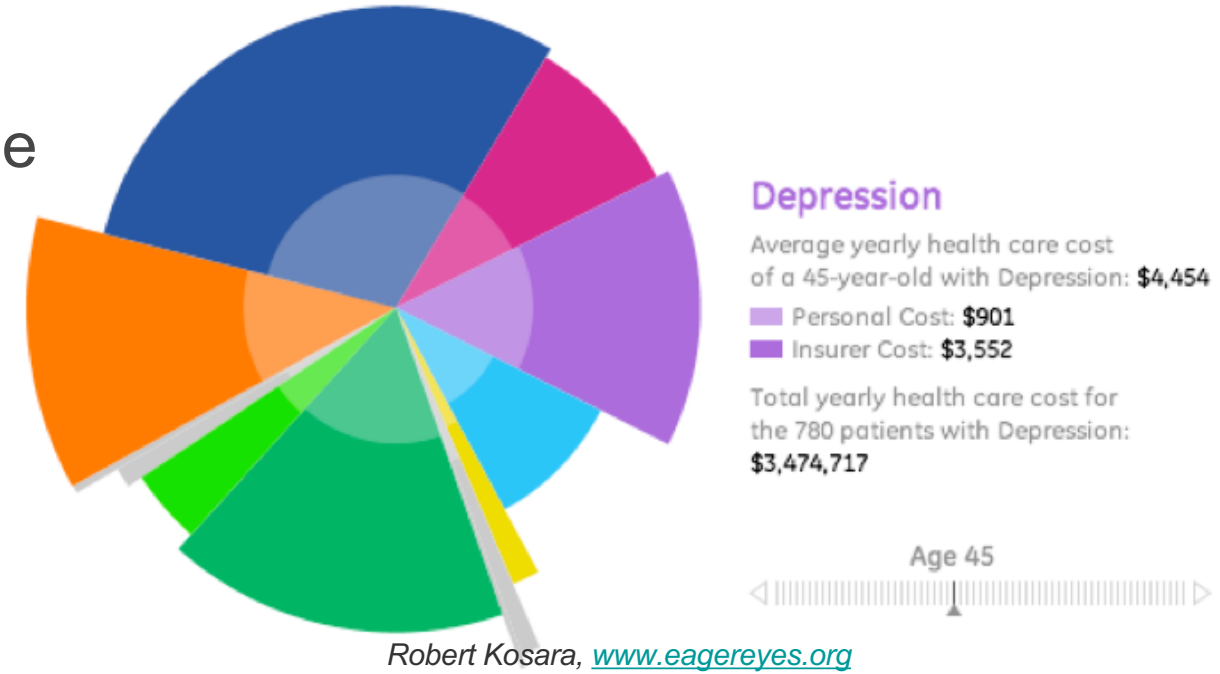
- "splitting" dimensions across linked views

- Small multiples
- Trellis displays
- Scatterplot matrices



Multiform: Small multiples

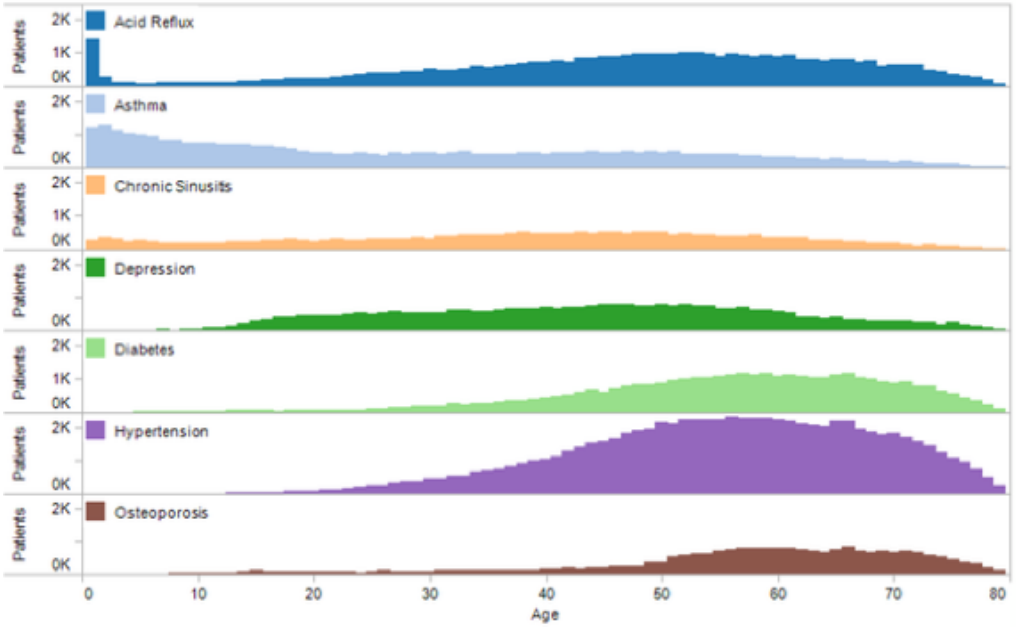
- Splits dimensions across multiple views



Robert Kosara, www.eagereyes.org

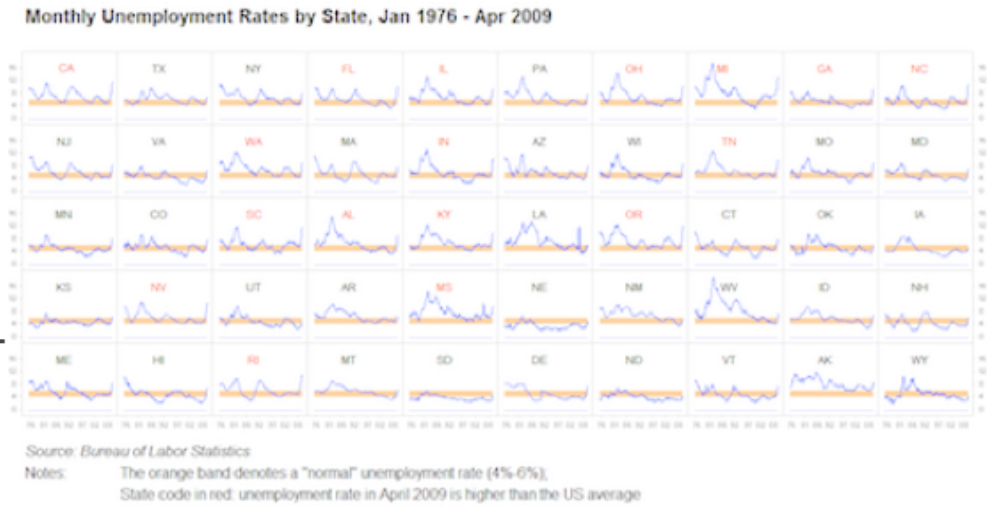
Multiform: Small multiples

- Splits dimensions across multiple views



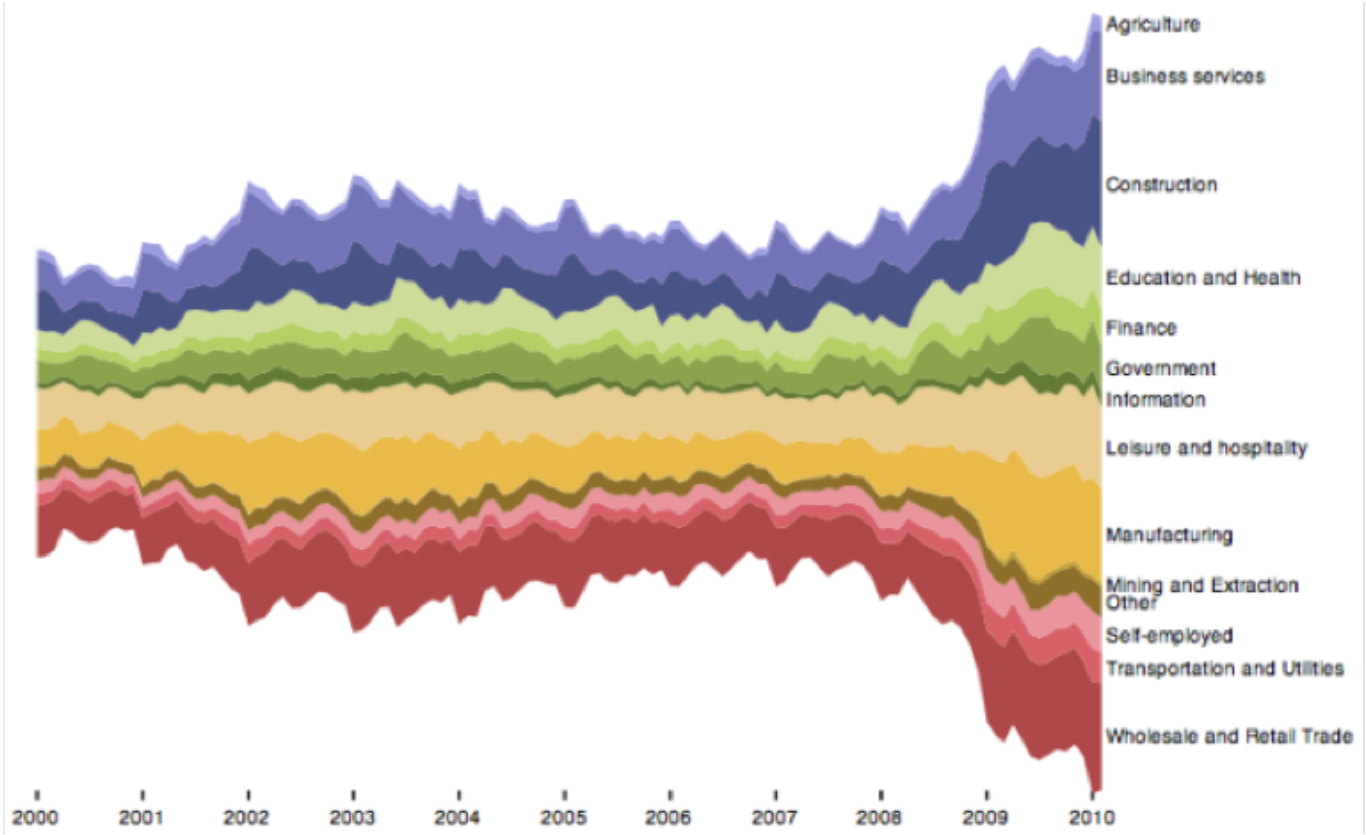
Robert Kosara, www.eagereyes.org

Small multiples



- use the same basic graphic or chart to display difference slices of a data set
- rich, multi-dimensional data without trying to cram all that information into a single, overly-complex chart.
- Singular design reduces decoding effort.
- E. Tufte “The Visual Display of Quantitative Information,” p. 42 and “Envisioning Information,” p. 29

Why doesn't this work?

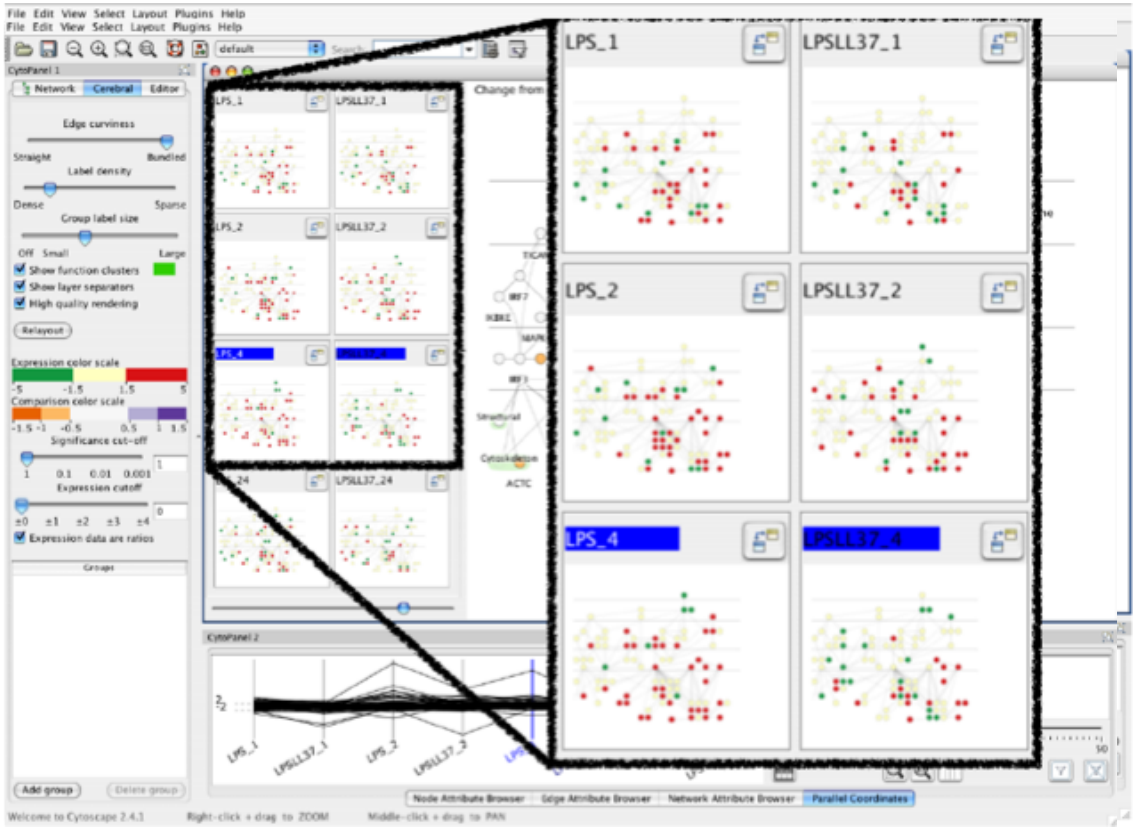


J. Heer, M. Bostock and V. Ogievetsky, A Tour Through the Visualization Zoo.

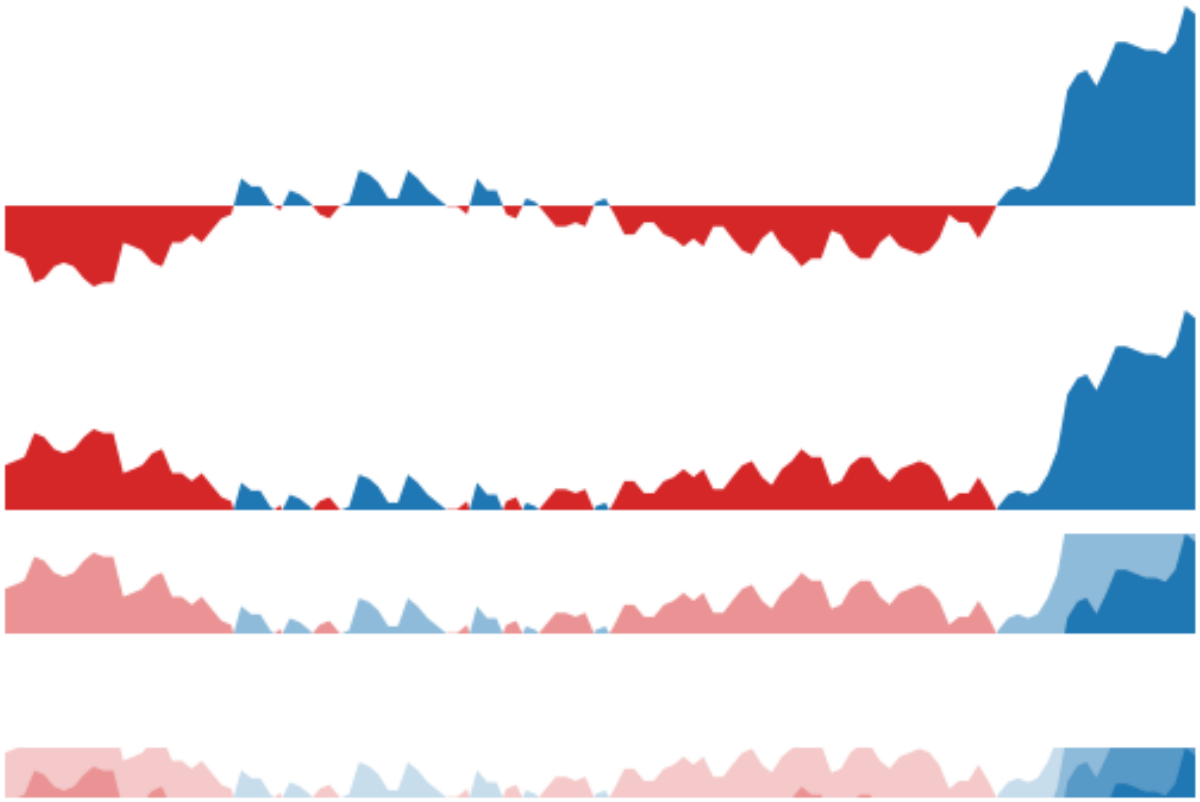
Small multiples

Small multiples

- Same encoding
- Data split



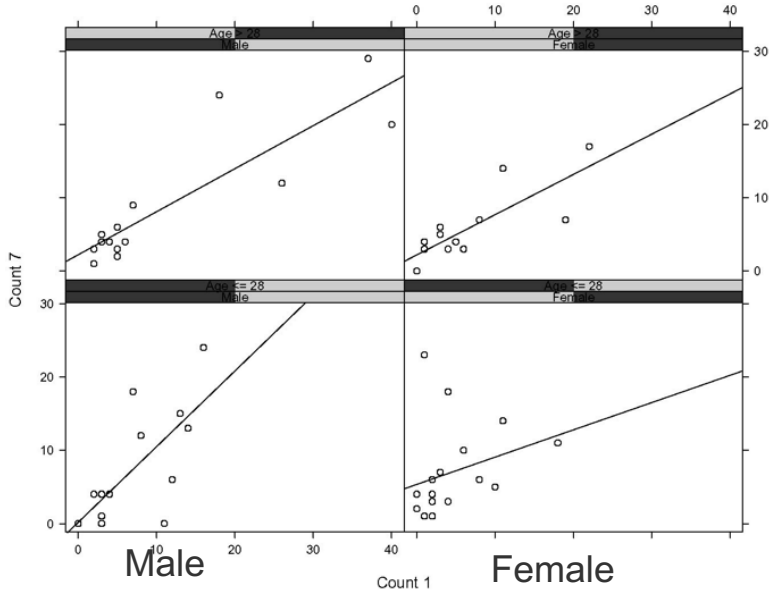
Horizon graphs



Trellis Plot

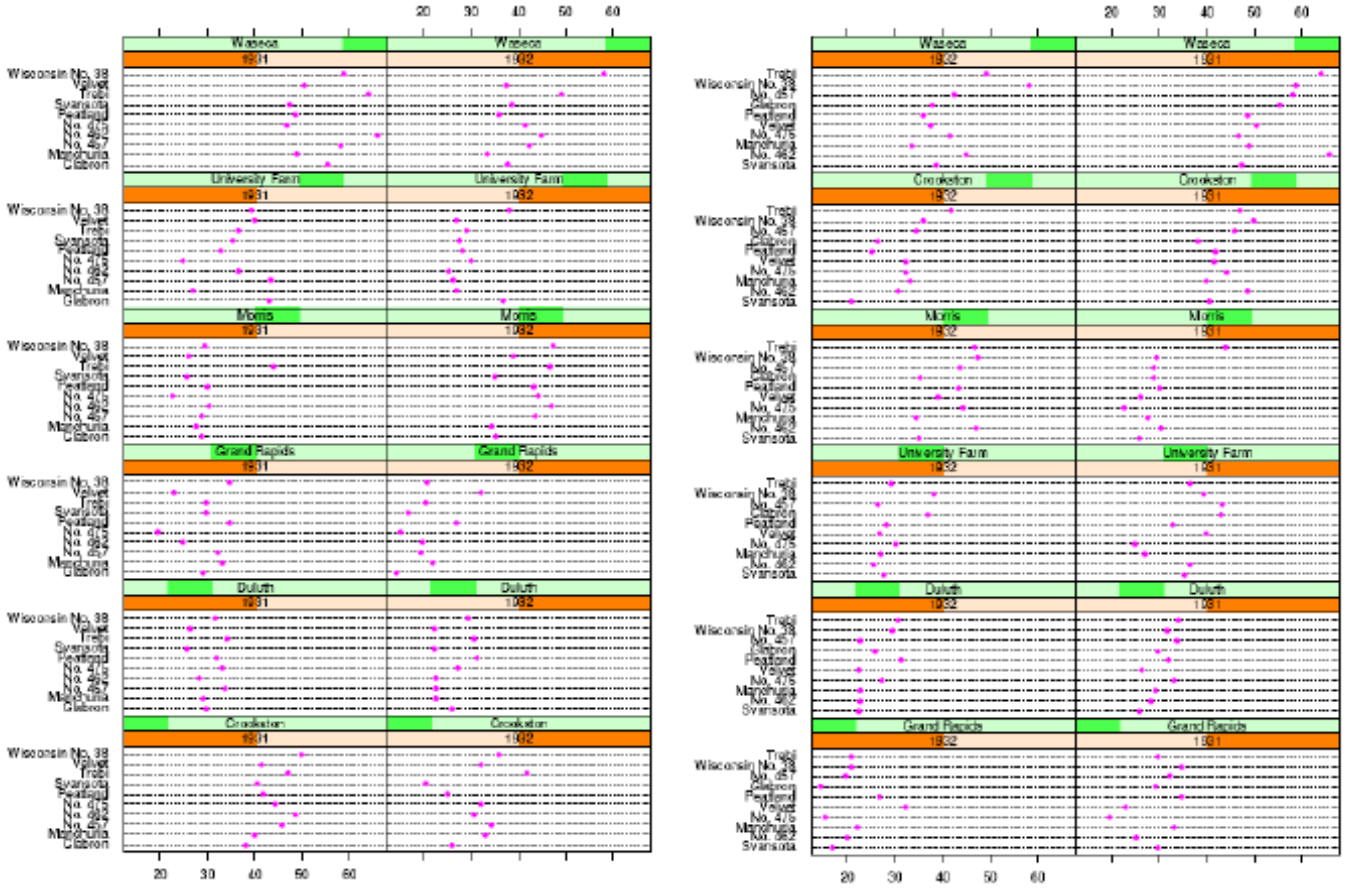
- Small multiples subsets across more than one dimensions

- Two dimensions:
- Age
- Gender



Trellis plots

- Sorting helps see different patterns in the data

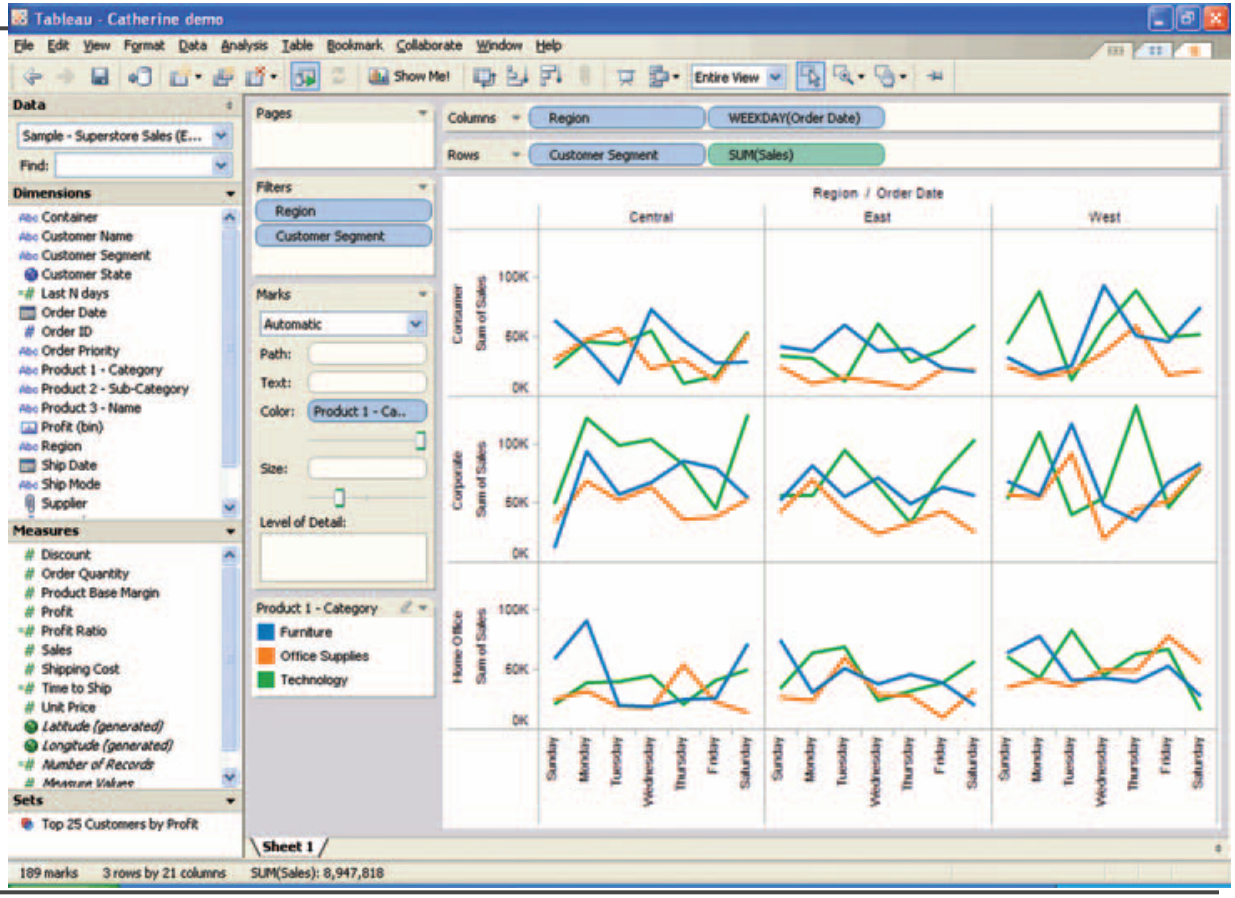


[The Visual Design and Control of Trellis Display. Becker, Cleveland, and Shyu. JCSG 5:123-155 1996]

Small multiples

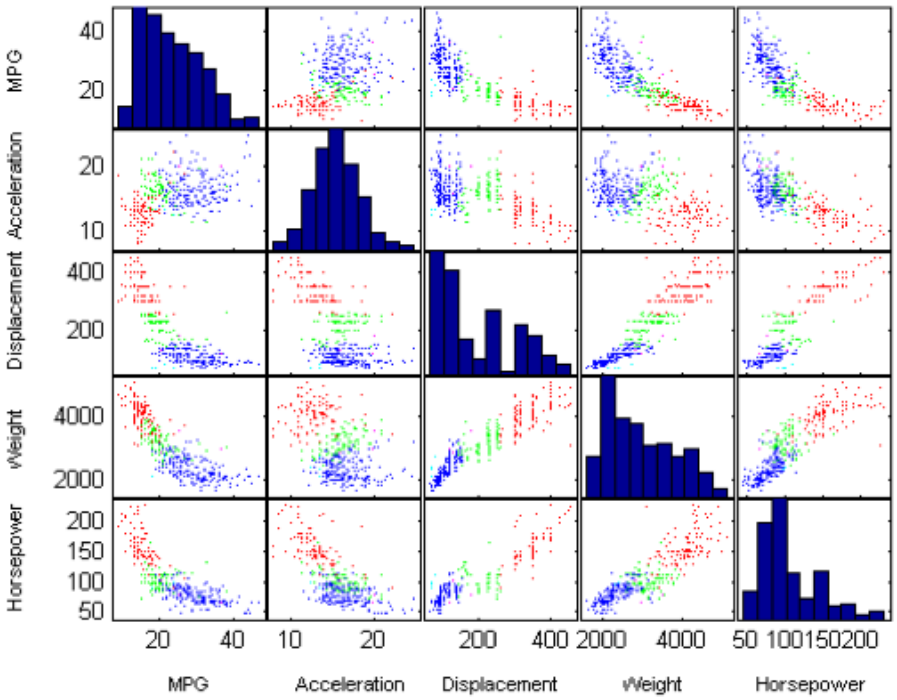
Often called most underused vis solution

- Issues/?



Small multiples matrix

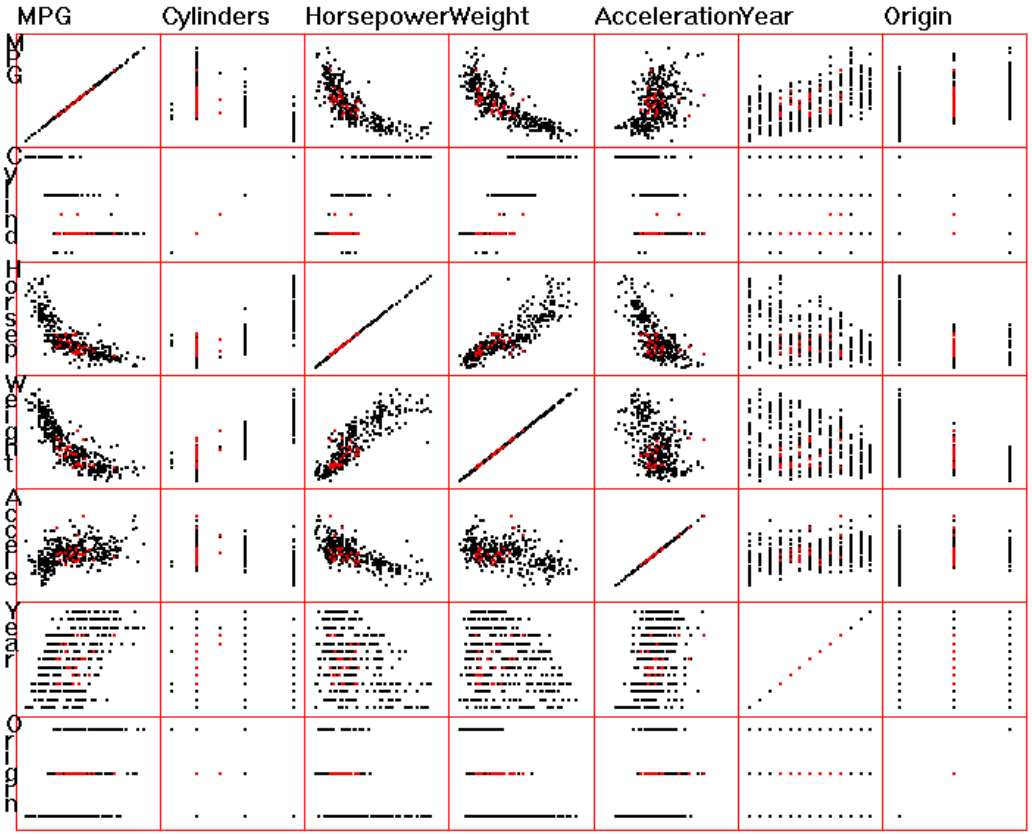
- n-dimensional data set
- subset the data into categories to compare the patterns between subsets
- Lay out small multiples in sequential or 2d ordered grid



Adapted from M. Ward

Scatterplot matrix

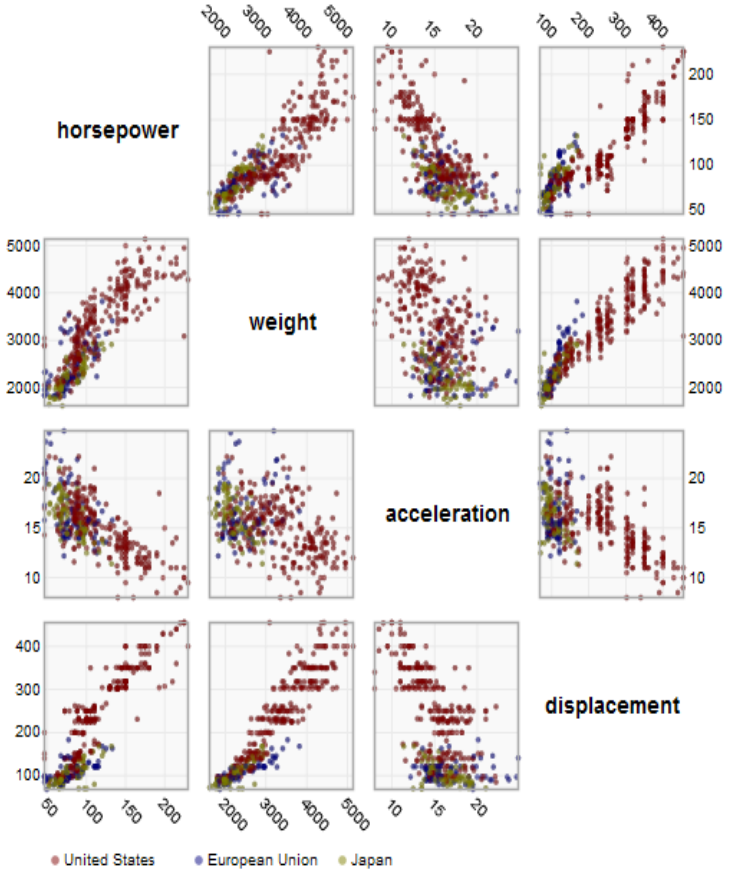
- all pairwise plots
- Selection allows linkage between views
- Clusters, trends, and correlations readily discerned between pairs of dimensions
- Issues?



Adapted from M. Ward

Scatter plot matrices

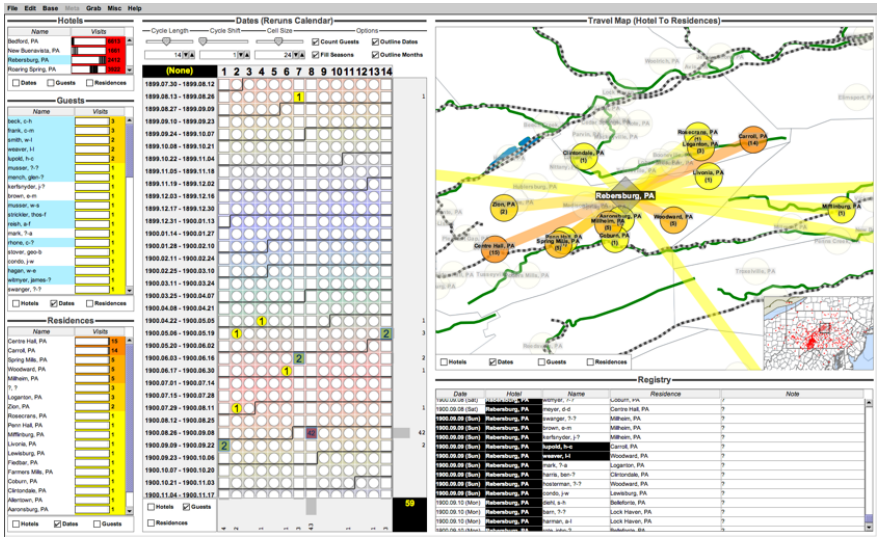
- More elegant layout sacrifices alignment but improves indexing
- Layout is important
- Density

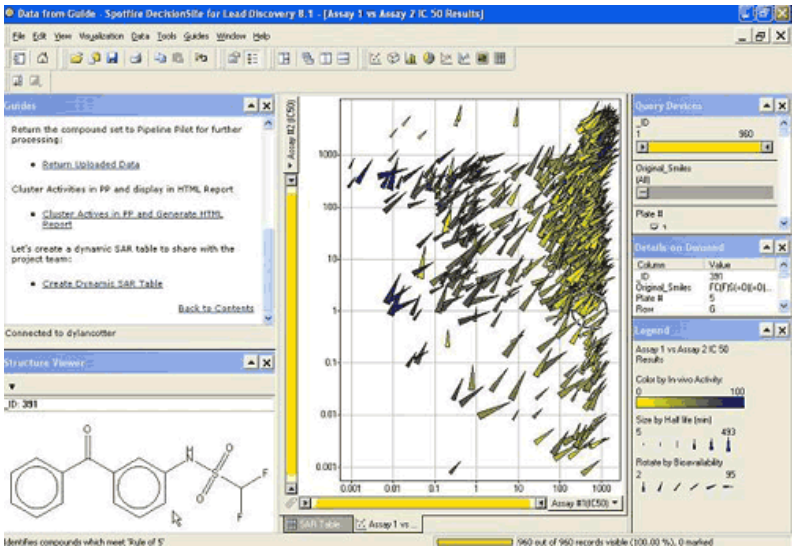


Multiform

Multiform views

- Improvise [Weaver]
- Spotfire [Ahlberg]



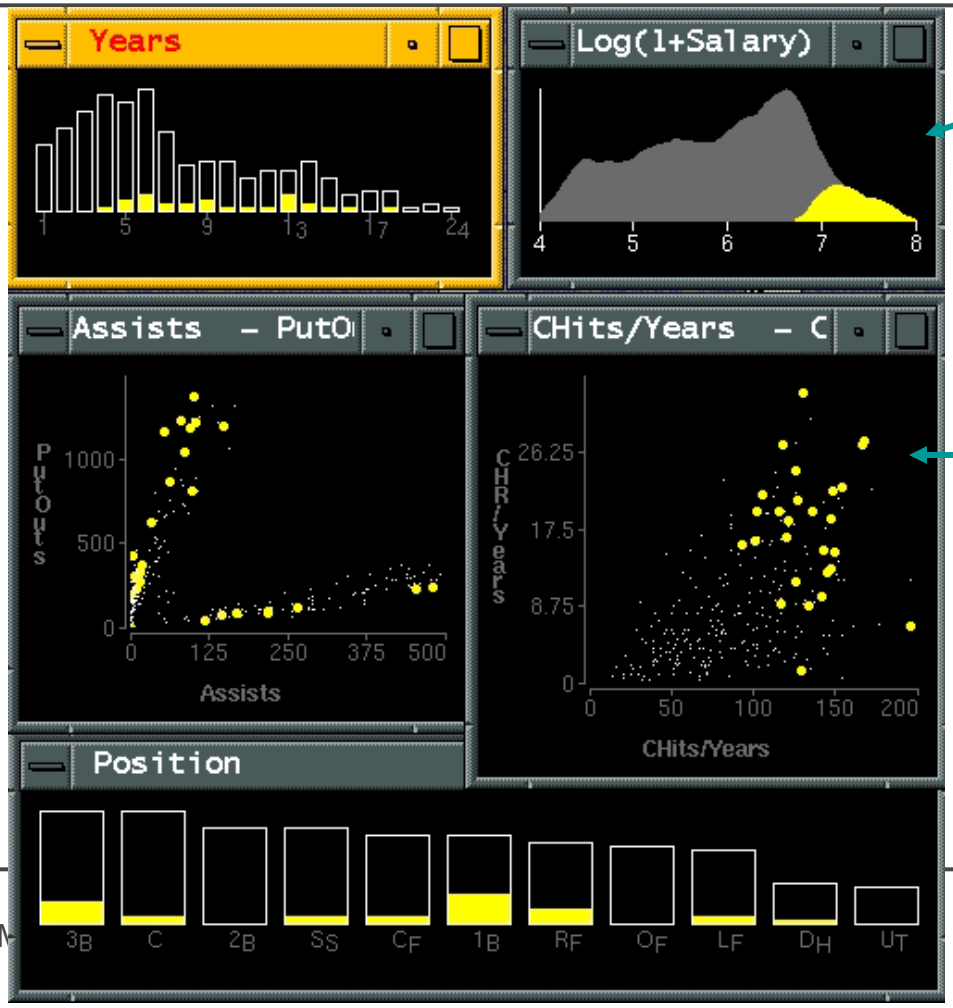


Snap-together visualizations

Multiform

Multiform views

how long in majors



select high salaries

avg assists vs avg putouts (fielding ability)

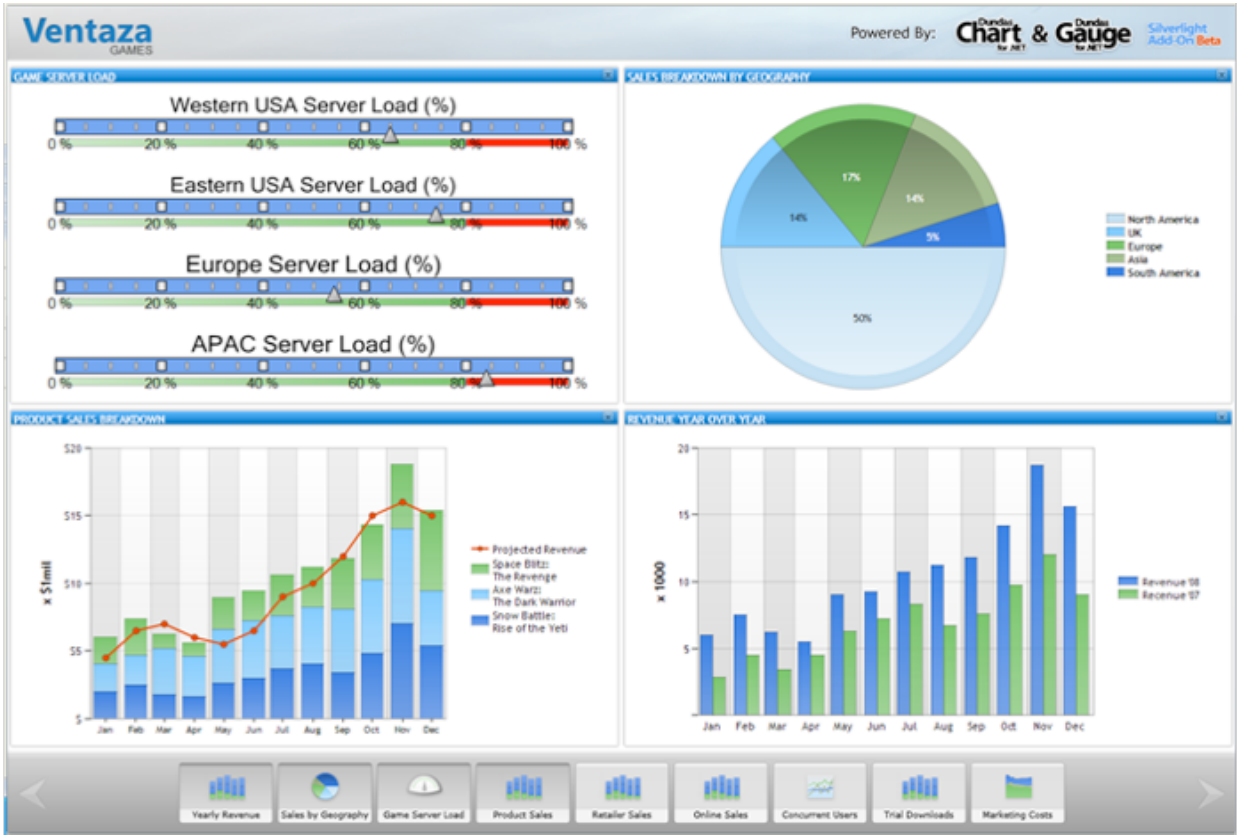
avg career HRs vs avg career hits (batting ability)

distribution of positions played

[Eick & Wills 95]

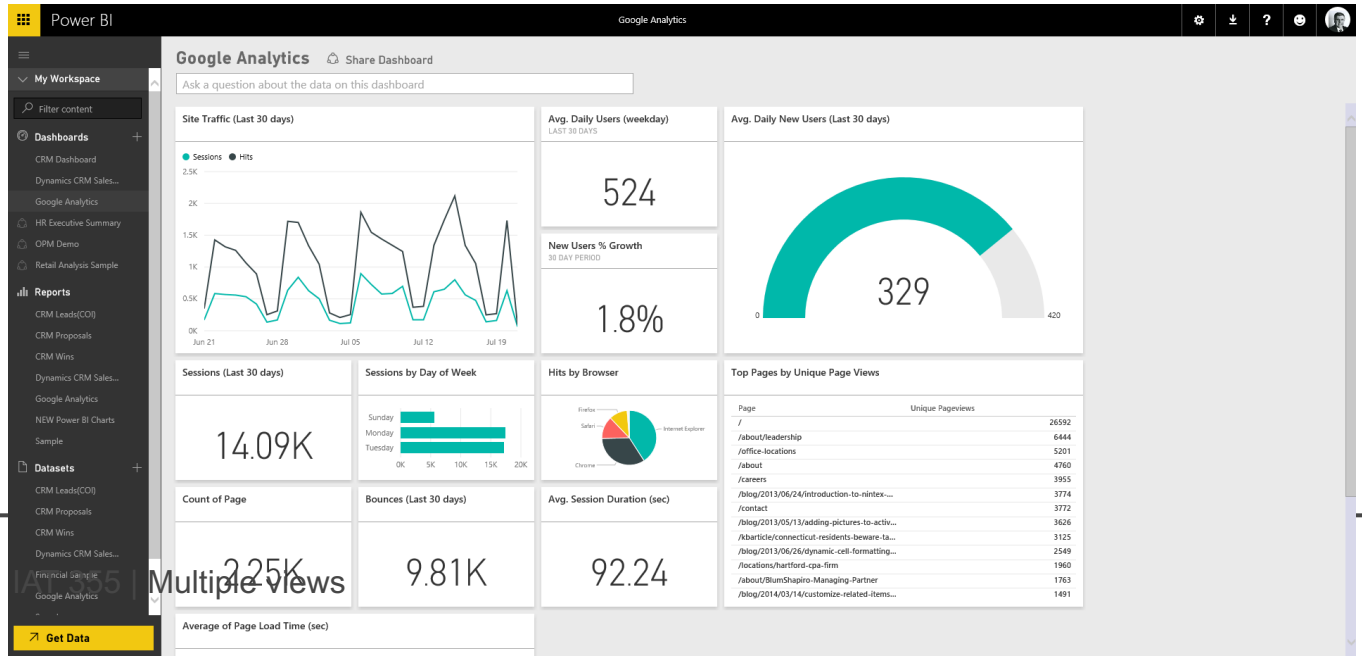
Multiform

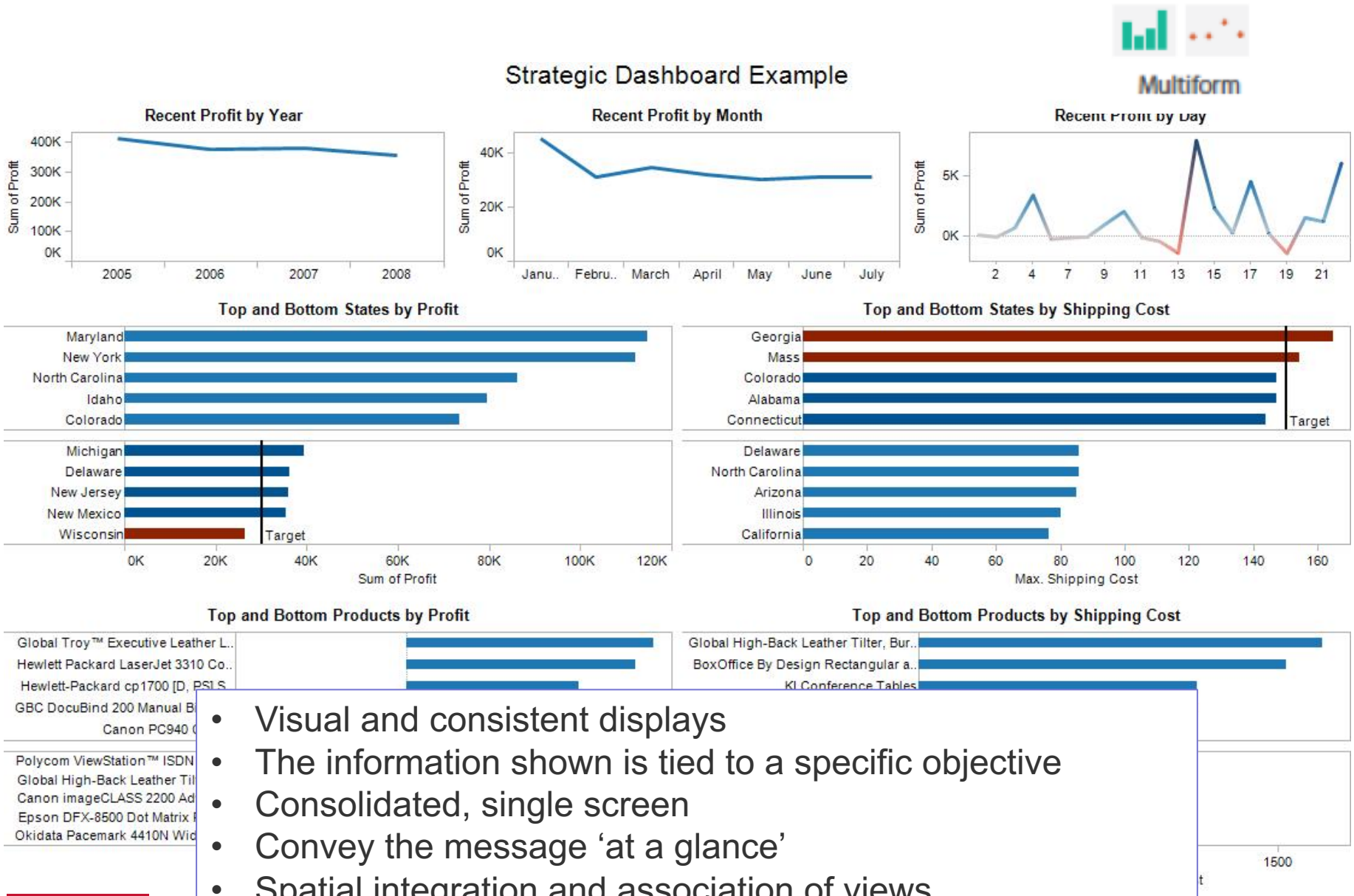
Information dashboards



What is a “Dashboard”?

- *A dashboard is a visual display of the most important information needed to achieve one or more objectives, consolidated and arranged on a single screen so the information can be monitored at a glance.* -Stephen Few (March 20. 2004) “Dashboard Confusion” Intelligent Enterprise

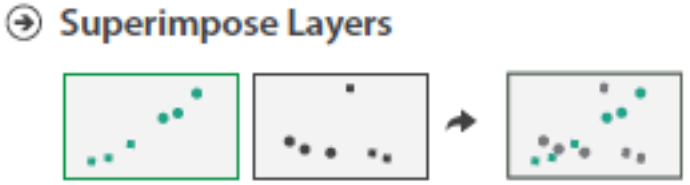




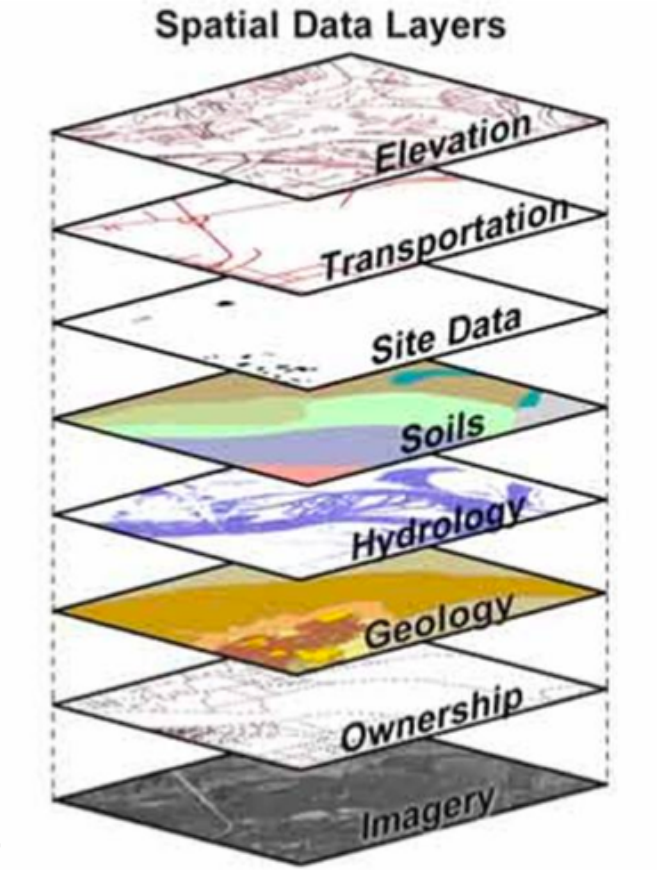
- Visual and consistent displays
- The information shown is tied to a specific objective
- Consolidated, single screen
- Convey the message ‘at a glance’
- Spatial integration and association of views

Slide courtesy of Jock Mackinlay, Tableau Software

Layering

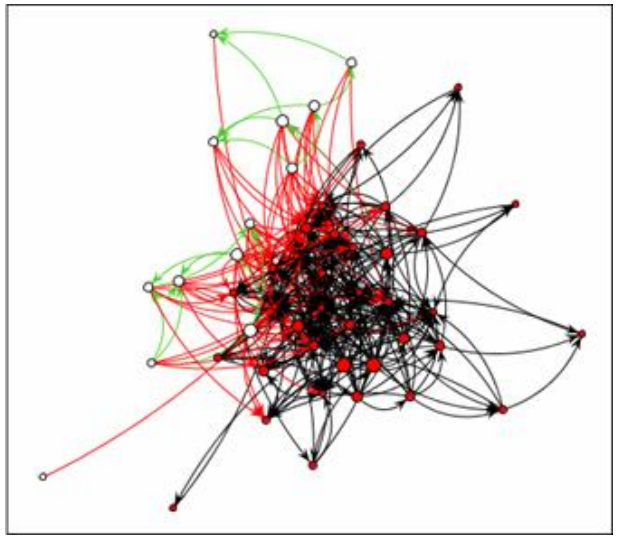


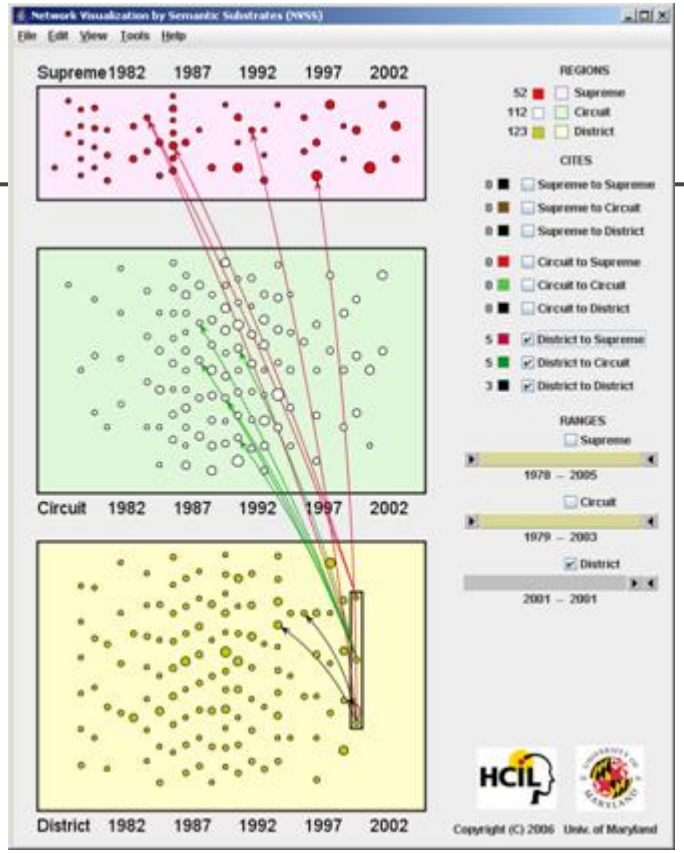
- Overlay facets
- Very common in spatial data
  - Common reference
  - Set geometry



Layering

- Multiform, small multiples

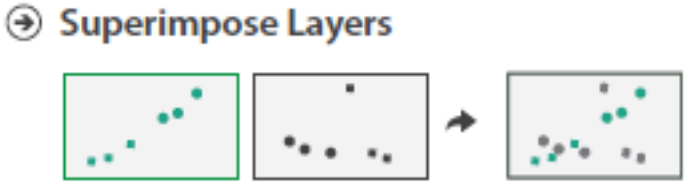




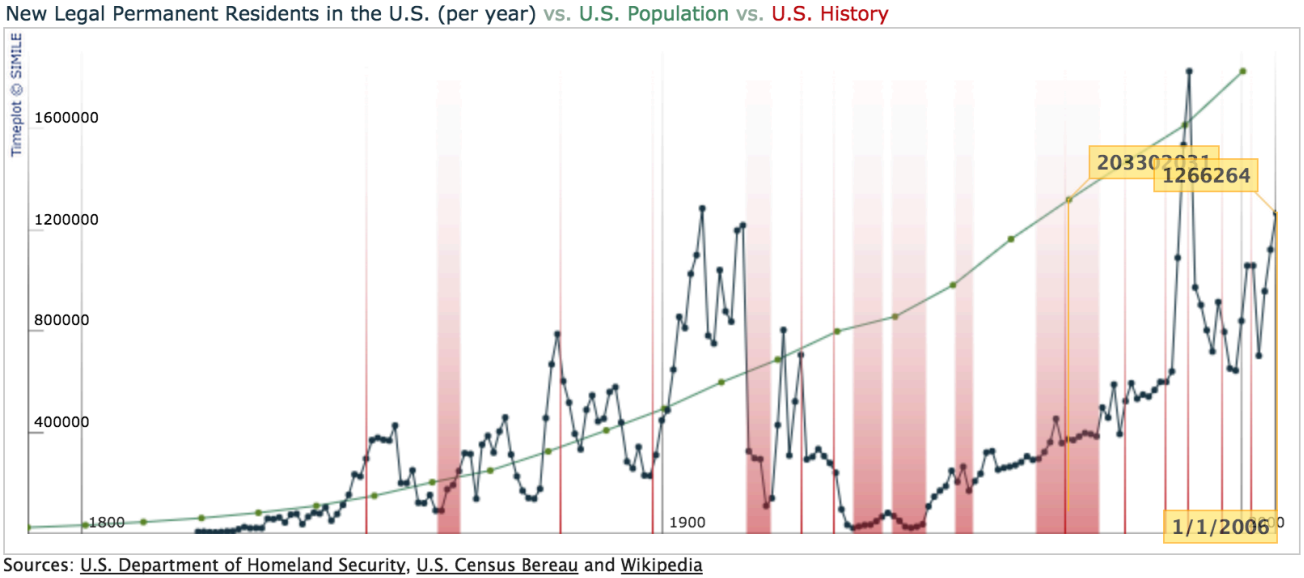
http://hcil.cs.umd.edu/video/2006/substrates.mpg

Shneiderman & Aris, Network Visualization by Semantic Substrates, IEEE TVCG 2006

Layering

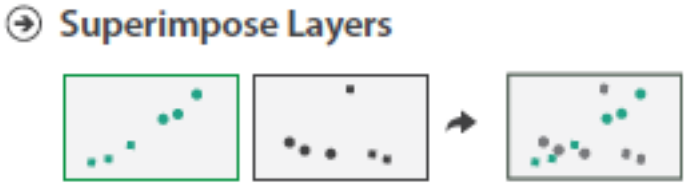


- Overlay facets
- Issues?

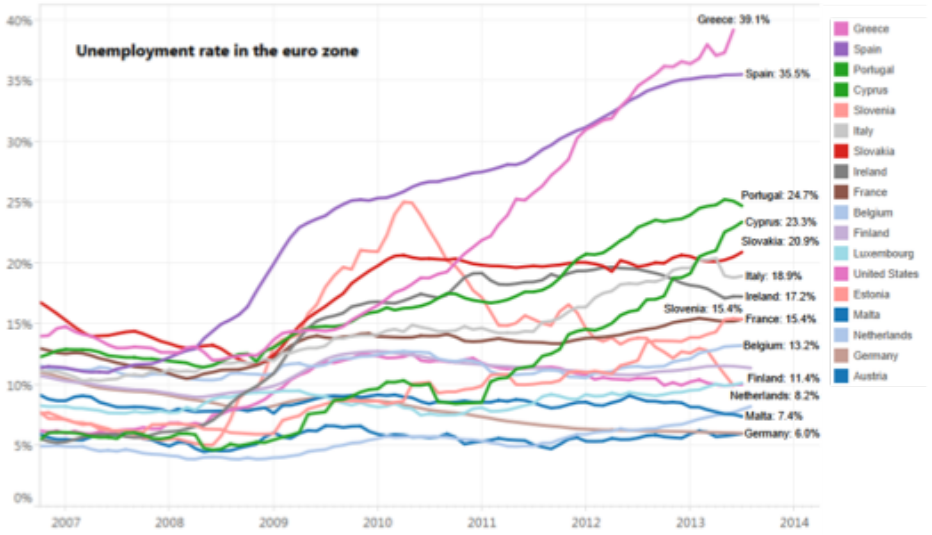


TimePlot, http://www.simile-widgets.org/timeplot/

Design Choices

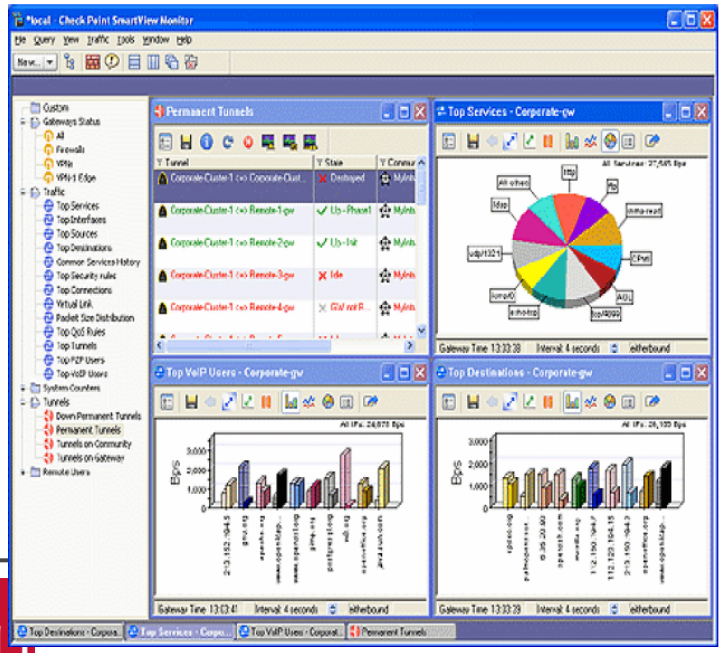


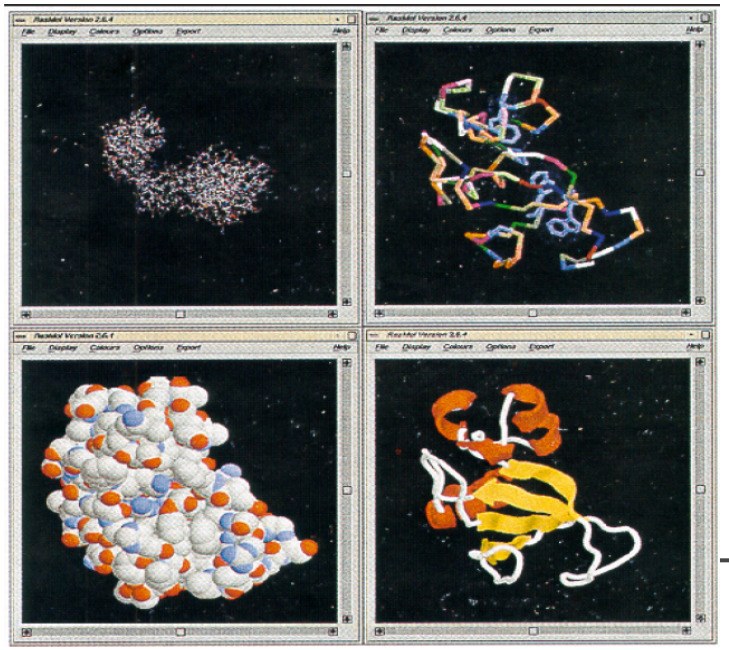
- Partitioning elements
- How many layers
  - How important to determine layers?
- How to make them distinguishable?
- Are layers static or dynamic?
  - Examples?



Multiple Views

- "Guidelines for Using Multiple Views in Information Visualization"
  - Baldonado, Woodruff and Kichinsky AVI 00





Multiple Views: 8 Guidelines

- Rule of Diversity:
  - Use multiple views when there is a diversity of attributes
- Rule of Complementarity:
  - Multiple views should bring out correlations and/or disparities
- Rule of Decomposition: “Divide and conquer”.
  - Help users visualize relevant chunks of complex data
- Rule of Parsimony:
  - Use multiple views minimally

8 Guidelines Cont'd

- Rule of Space/Time Resource
  - Optimization: Balance spatial and temporal benefits of presenting and using the views
- Rule of Self Evidence:
  - Use cues to make relationships apparent.
- Rule of Consistency:
  - Keep views and state of multiple views consistent
- Rule of attention management:
  - Use perceptual techniques to focus user attention