Lectures 7&8: Usability & Case Studies

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DSCI 532: Data Visualization II
Lectures 7&8: 10 & 12 April 2017

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

Guerilla/Discount Usability

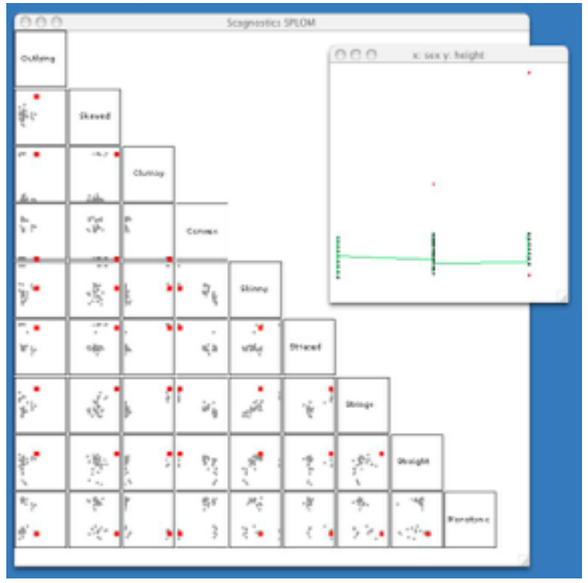
- grab a few people and watch them use your interface
  - even 3-5 gives substantial coverage of major usability problems
  - agile/lean qualitative, vs formal quantitative user studies
    - goal is not statistical significance!
- think-aloud protocol
  - contextual inquiry (conversations back and forth) vs fly on the wall (you're silent)
- normally: generate tasks, scenarios
  - shortcut in this week's lab, since whole cohort understands data/scenario

Further reading

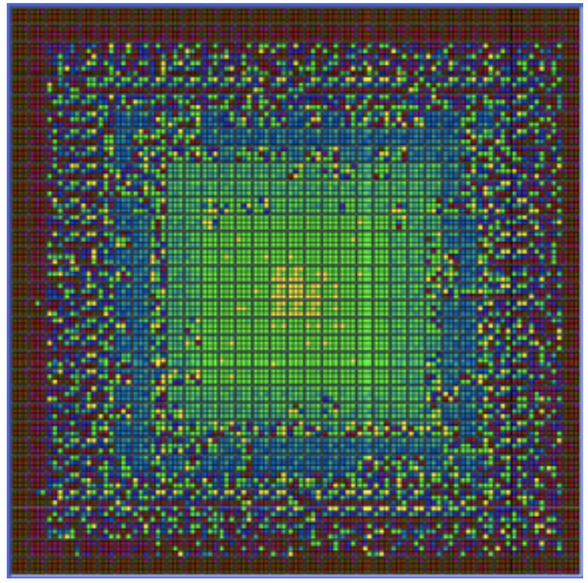
- 7 Step Guide to Guerrilla Usability Testing, Markus Piper
  - https://userbrain.net/blog/7-step-guide-guerrilla-usability-testing-diy-usability-testing-method
- The Art of Guerrilla Usability Testing, David Peter Simon
  - http://www.uxbooth.com/articles/the-art-of-guerrilla-usability-testing/
- Discount Usability: 20 Years, Jakob Nielsen
  - https://www.nngroup.com/articles/discount-usability-20-years/
- Interaction Design: Beyond Human-Computer Interaction
  - Preece, Sharp, Rogers. Wiley, 4th edition, 2015.
- About Face: The Essentials of Interaction Design
  - Cooper, Reimann, Cronin, Noessel. Wiley, 4th edition, 2014.
- Task-Centered User Interface Design. Lewis & Rieman, 1994
  - http://hcibib.org/tcuid/
- Designing with the Mind in Mind. Jeff Johnson. Morgan Kaufmann, 2nd, 2014.

Analysis Case Studies

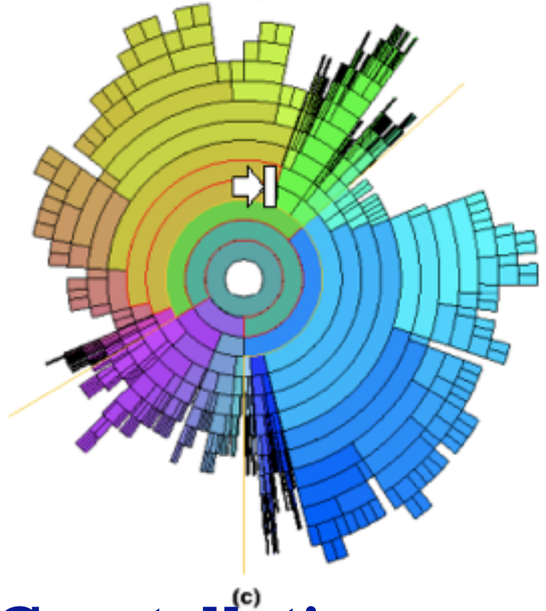
Scagnostics



VisDB

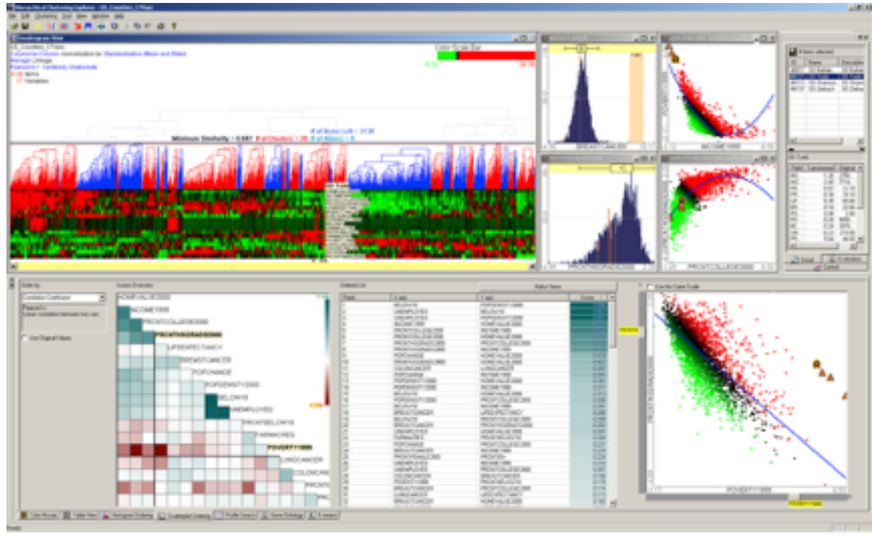


InterRing



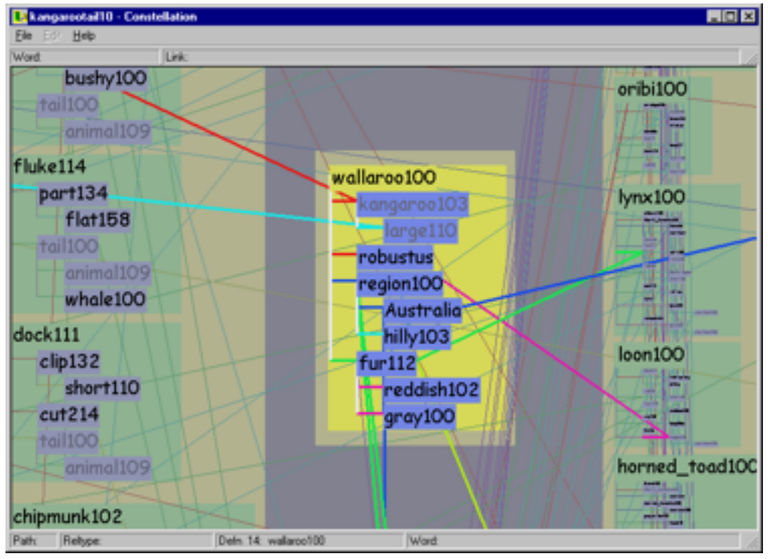
(c)

HCE



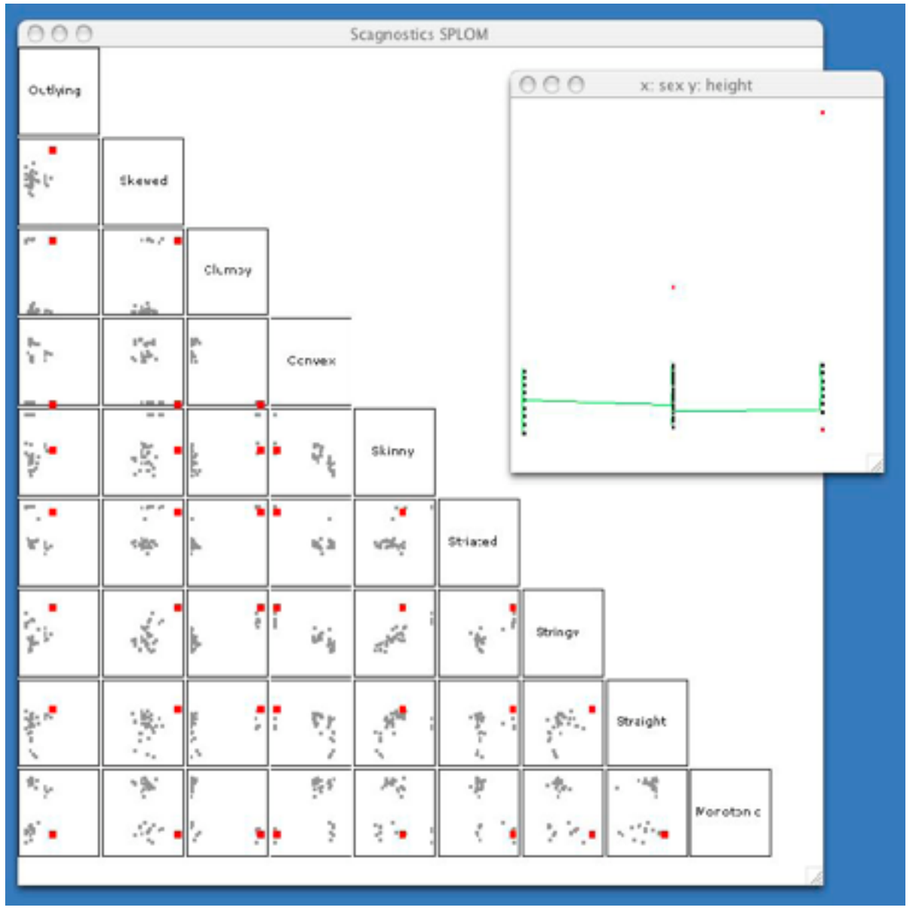
PivotGraph

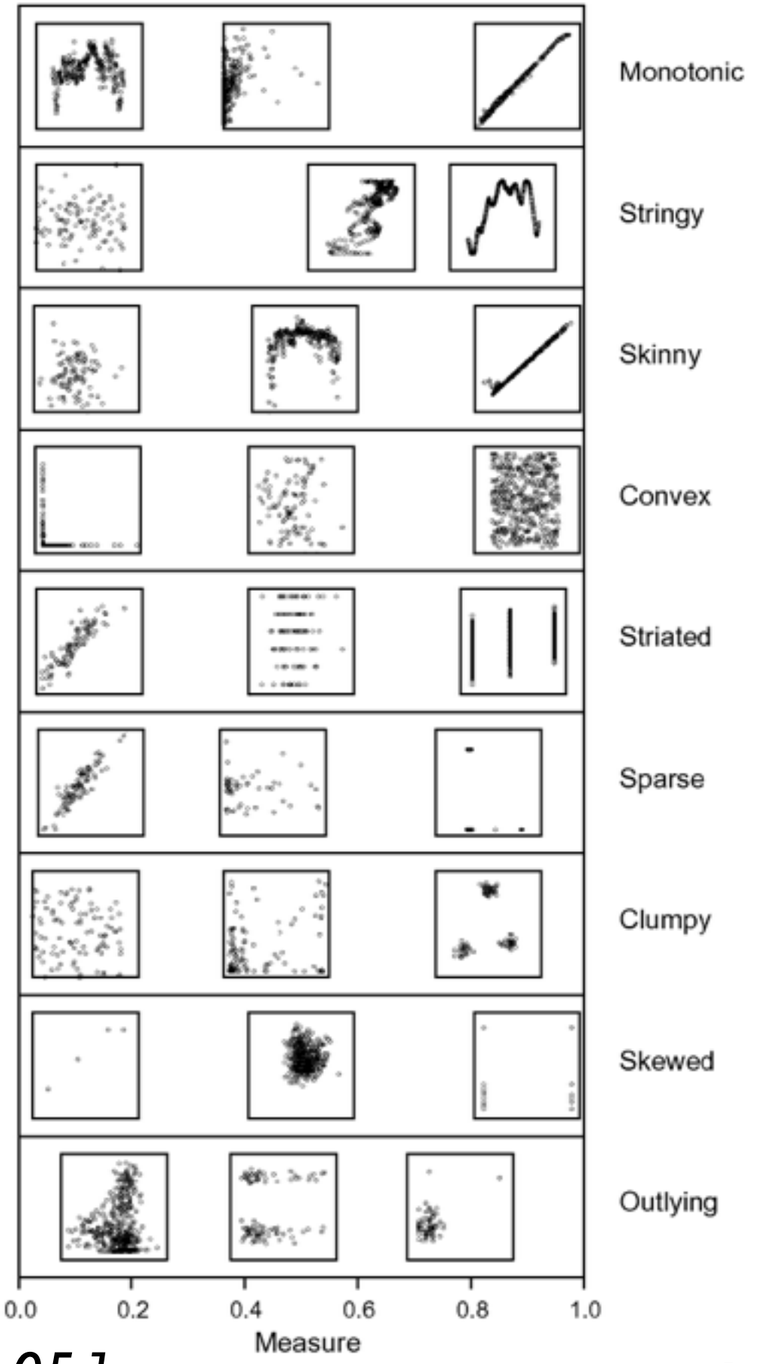
Constellation



Graph-Theoretic Scagnostics

- scatterplot diagnostics
  - scagnostics SPLOM: each point is one original scatterplot





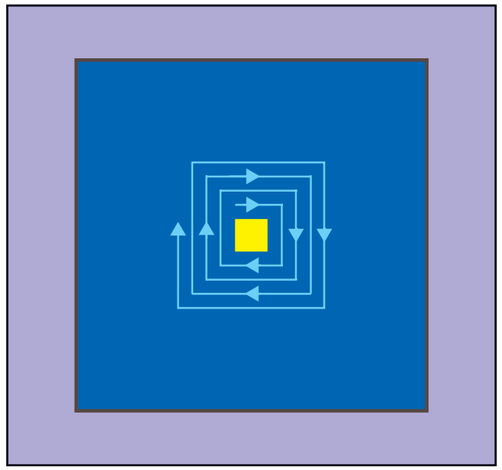
[Graph-Theoretic Scagnostics Wilkinson, Anand, and Grossman. Proc InfoVis 05.]

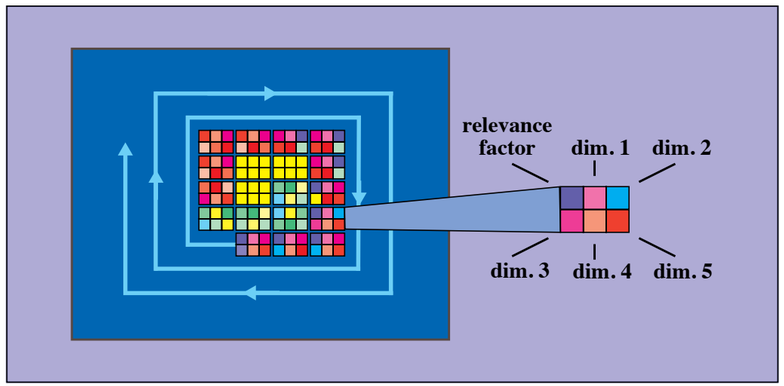
Scagnostics analysis

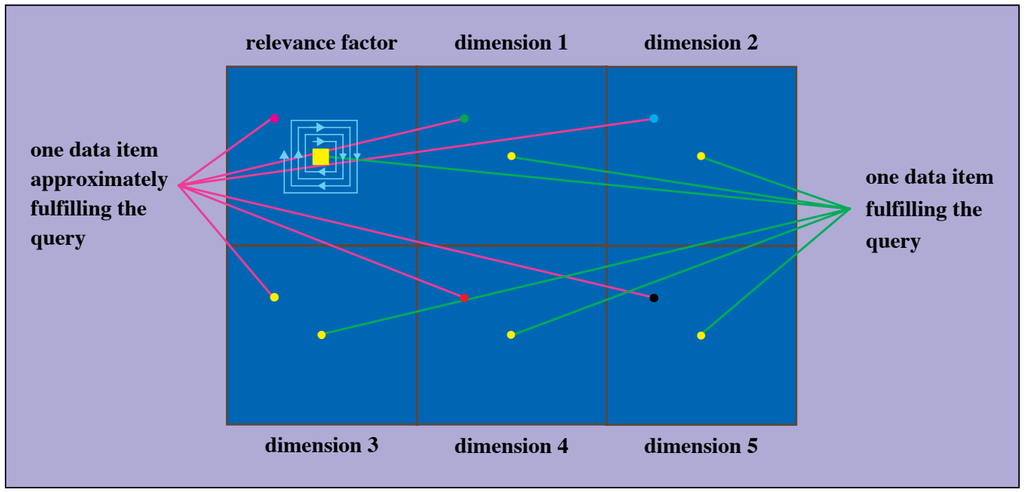
System	**Scagnostics**
What: Data	Table.
What: Derived	Nine quantitative attributes per scatterplot (pairwise combination of original attributes).
Why: Tasks	Identify, compare, and summarize; distributions and correlation.
How: Encode	Scatterplot, scatterplot matrix.
How: Manipulate	Select.
How: Facet	Juxtaposed small-multiple views coordinated with linked highlighting, popup detail view.
Scale	Original attributes: dozens.

VisDB

- table: draw pixels sorted, colored by relevance
- group by attribute or partition by attribute into multiple views



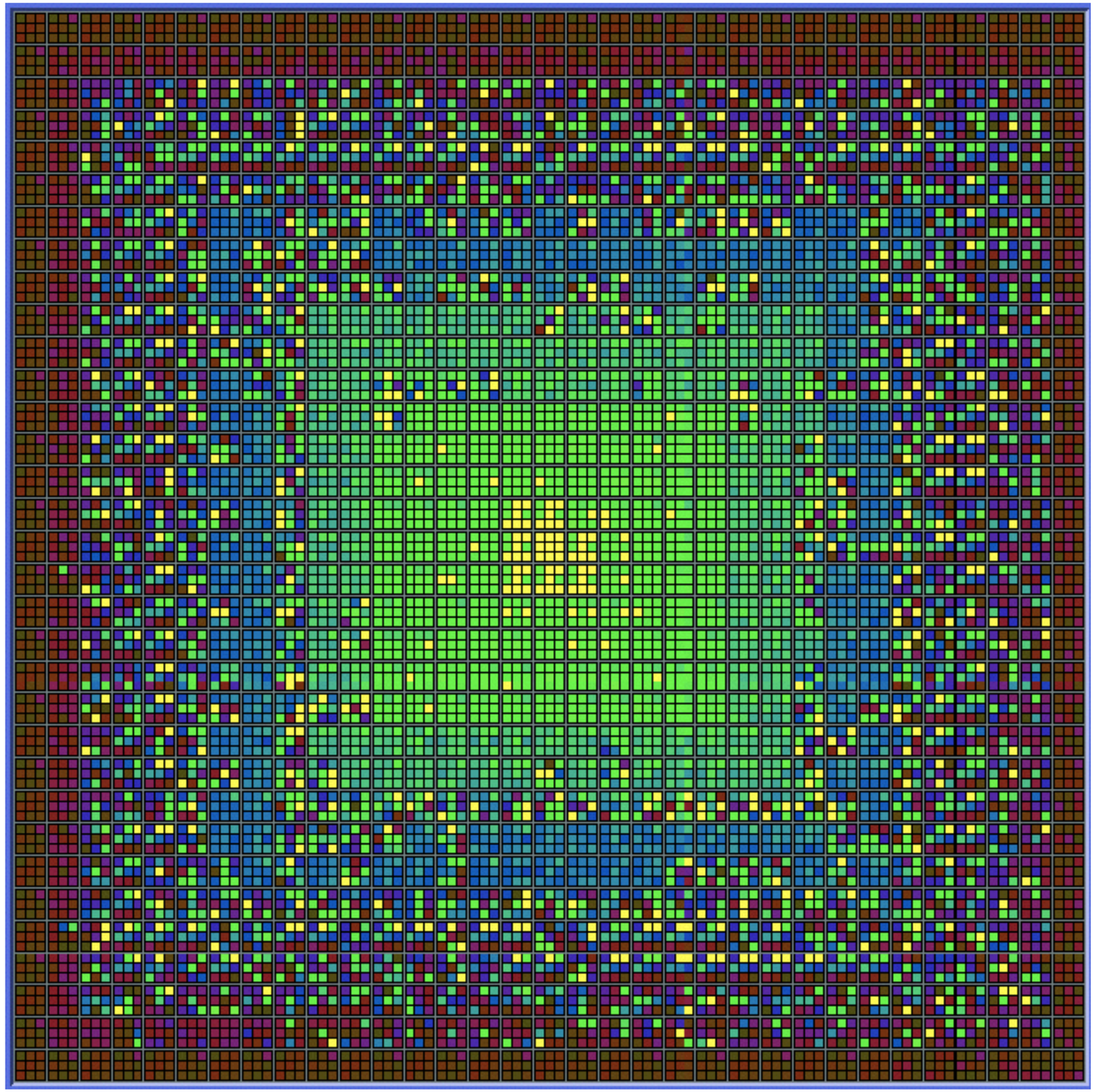




[VisDB: Database Exploration using Multidimensional Visualization, Keim and Kriegel, IEEE CG&A, 1994]

VisDB Results

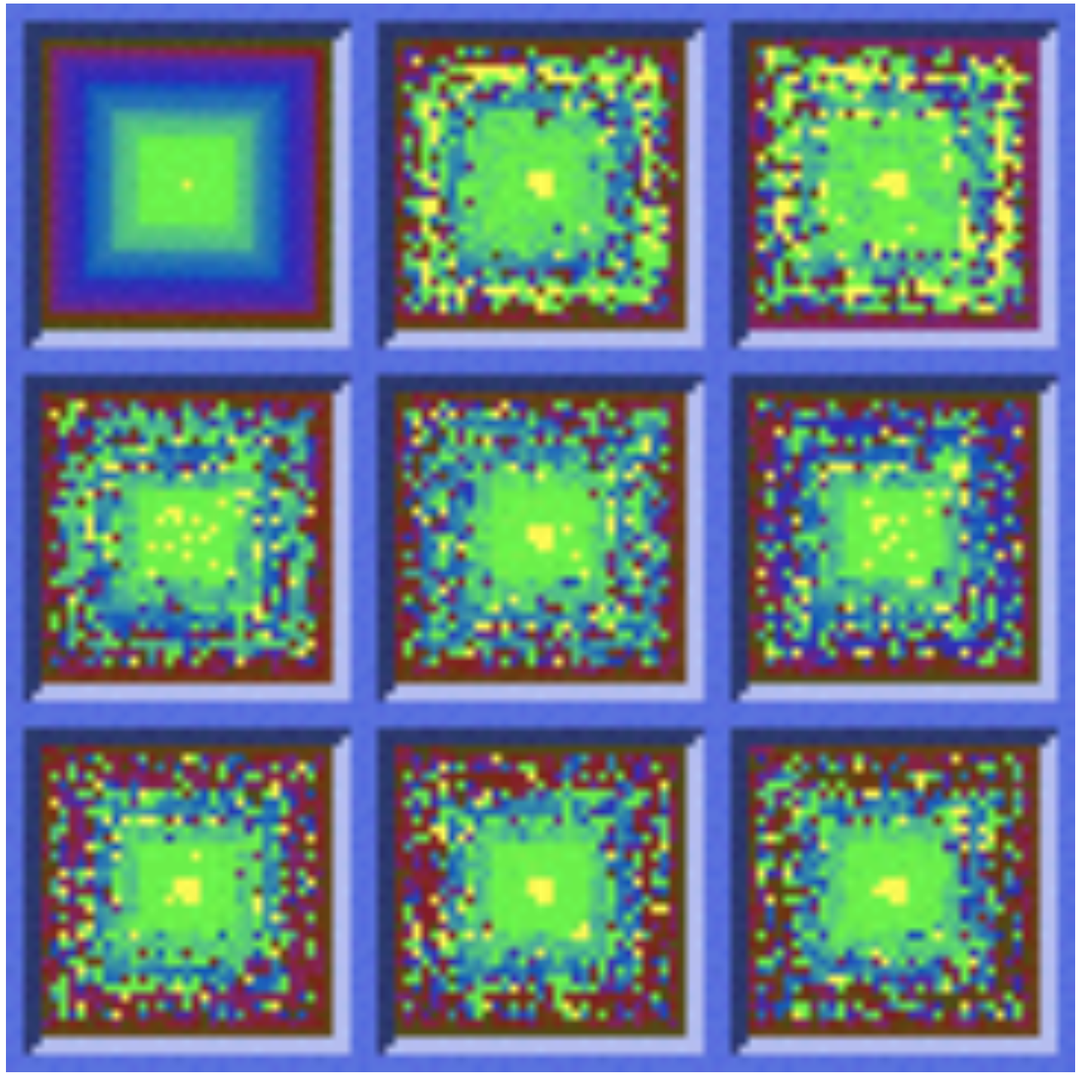
- partition into many small regions: dimensions grouped together



[VisDB: Database Exploration using Multidimensional Visualization, Keim and Kriegel, IEEE CG&A, 1994]

VisDB Results

- partition into small number of views
  - inspect each attribute



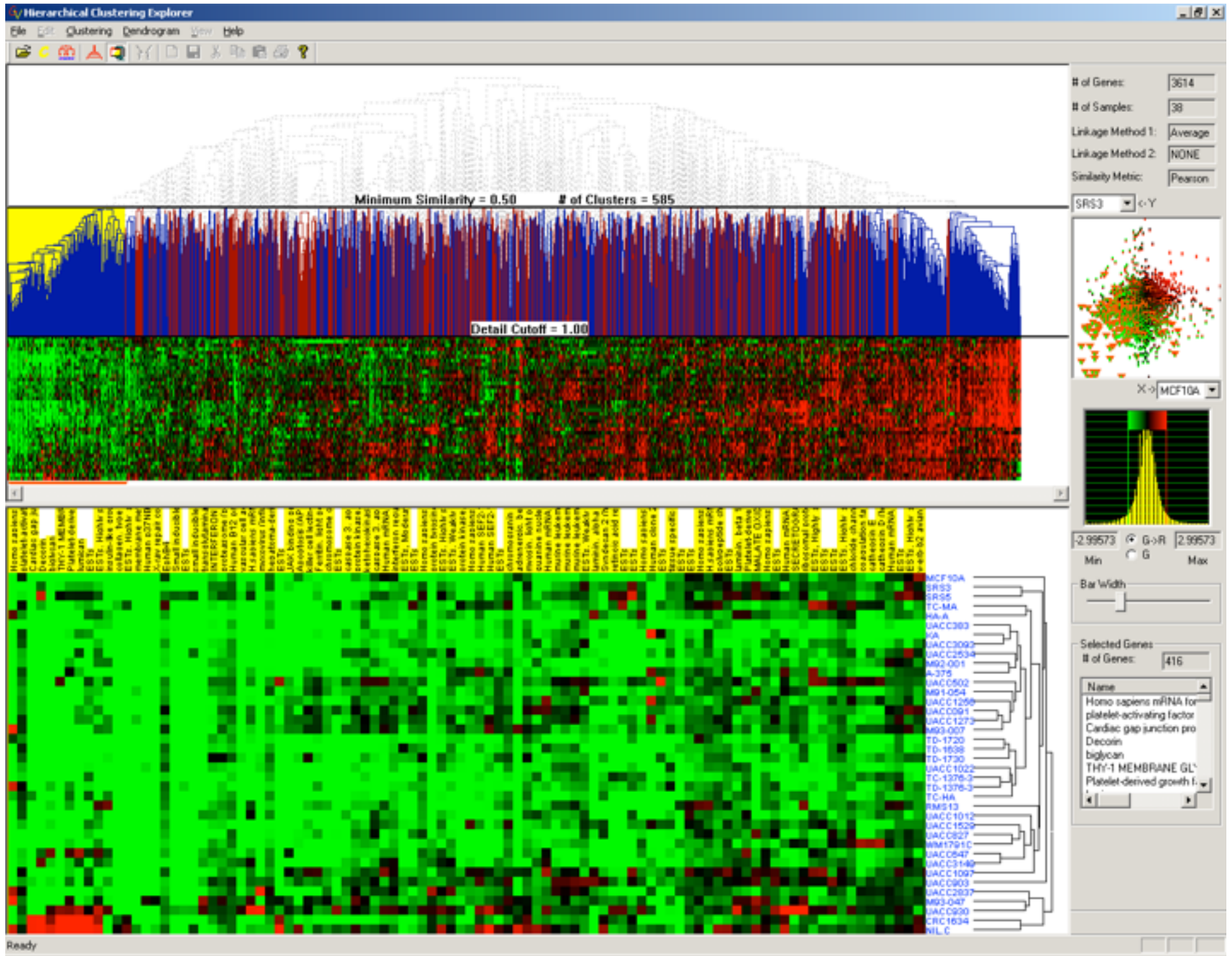
[VisDB: Database Exploration using Multidimensional Visualization, Keim and Kriegel, IEEE CG&A, 1994]

VisDB Analysis

System	**VisDB**
What: Data	Table (database) with k attributes; query returning table subset (database query).
What: Derived	$k+1$ quantitative attributes per original item: query relevance for the k original attributes plus overall relevance.
Why: Tasks	Characterize distribution within attribute, find groups of similar values within attribute, find outliers within attribute, find correlation between attributes, find similar items.
How: Encode	Dense, space-filling; area marks in spiral layout; colormap: categorical hues and ordered luminance.
How: Facet	Layout 1: partition by attribute into per-attribute views, small multiples. Layout 2: partition by items into per-item glyphs.
How: Reduce	Filtering
Scale	Attributes: one dozen. Total items: several million. Visible items (using multiple views, in total): one million. Visible items (using glyphs): 100,000

Hierarchical Clustering Explorer

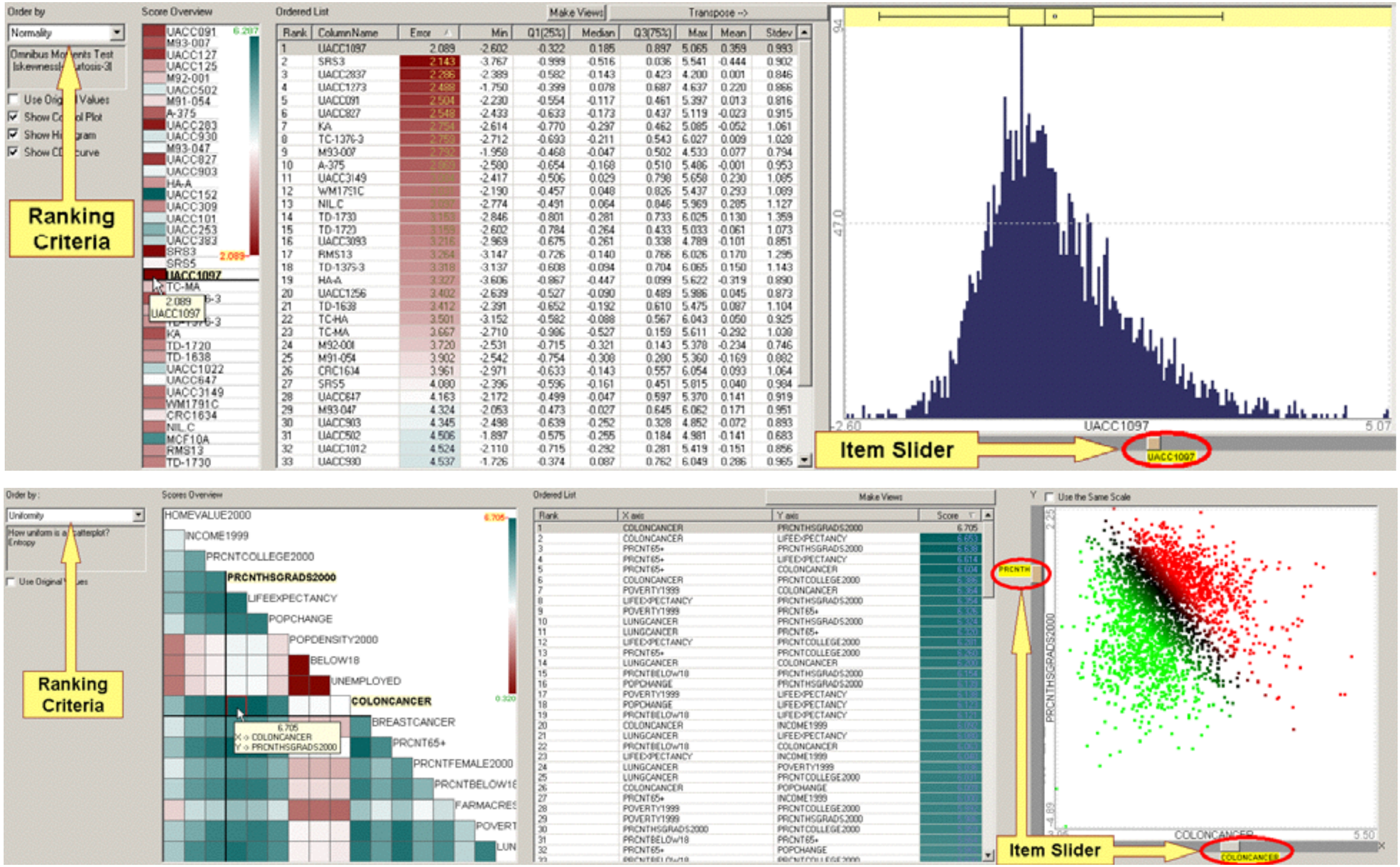
- heatmap, dendrogram
- multiple views



[Interactively Exploring Hierarchical Clustering Results. Seo and Shneiderman, IEEE Computer 35(7): 80-86 (2002)]

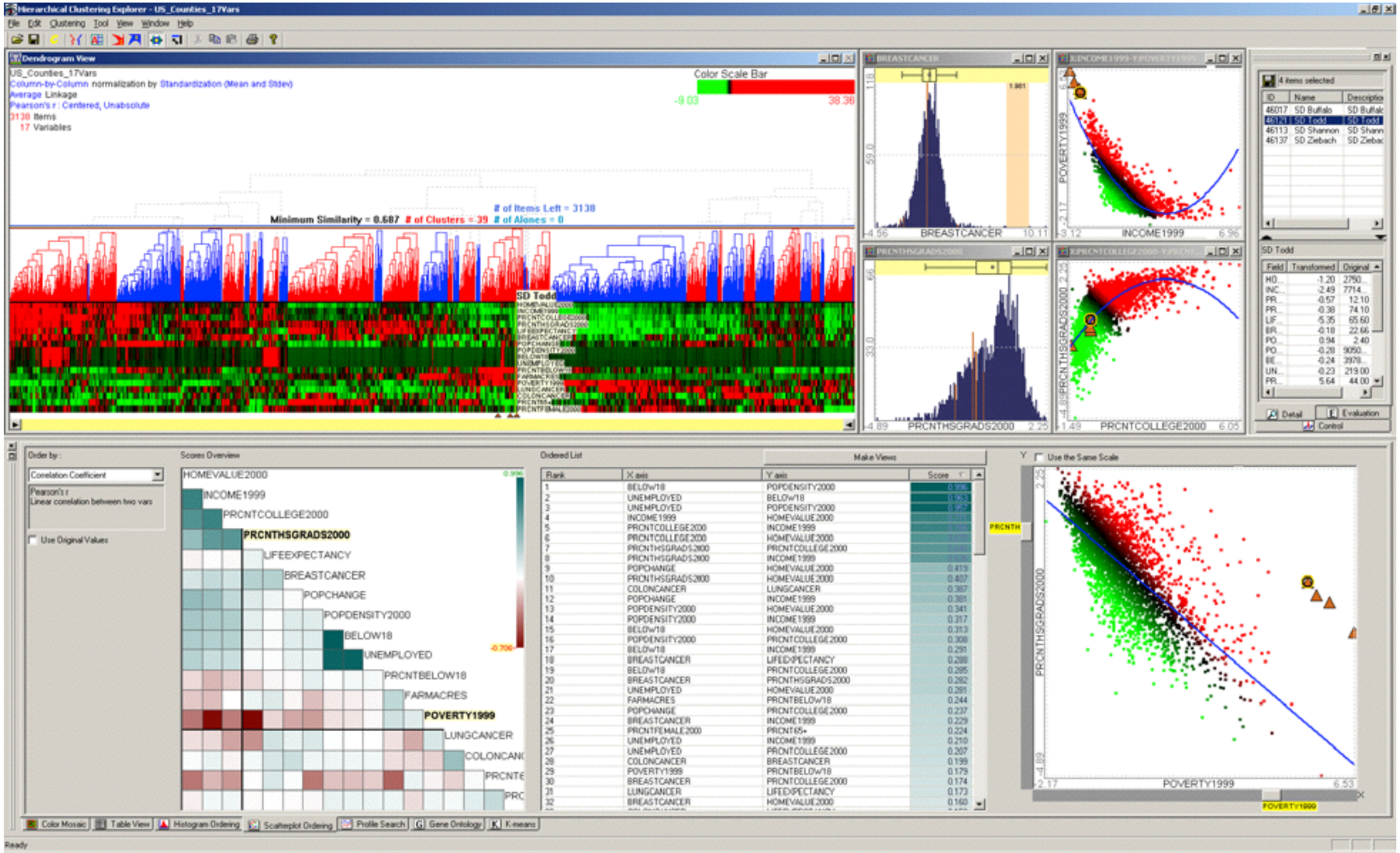
HCE

- rank by feature idiom
  - 1D list
  - 2D matrix



A rank-by-feature framework for interactive exploration of multidimensional data. Seo and Shneiderman. Information Visualization 4(2): 96-113 (2005)

HCE

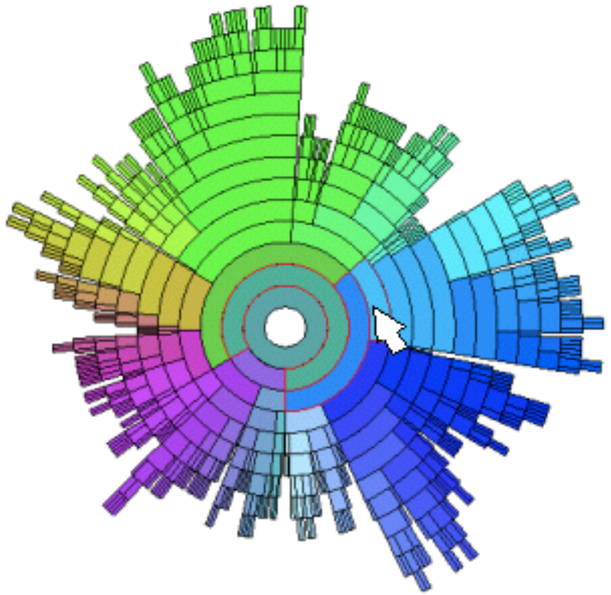


A rank-by-feature framework for interactive exploration of multidimensional data. Seo and Shneiderman. Information Visualization 4(2): 96-113 (2005)

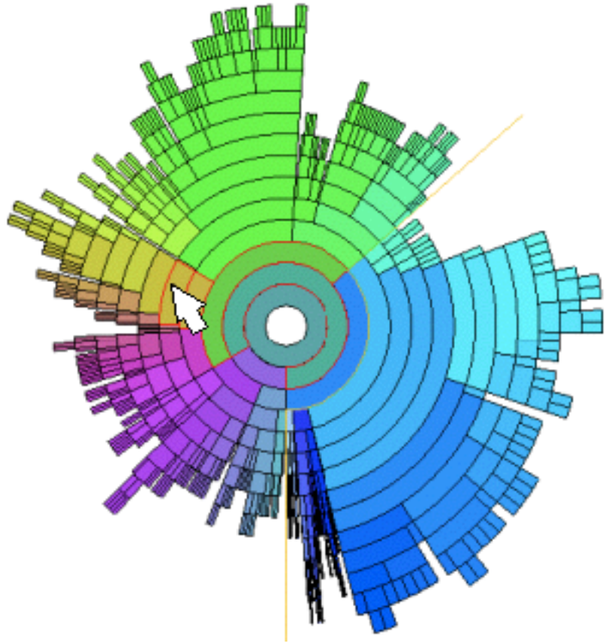
HCE Analysis

System	Hierarchical Clustering Explorer (HCE)
What: Data	Multidimensional table: two categorical key attributes (genes, conditions); one quantitative value attribute (gene activity level in condition).
What: Derived	Hierarchical clustering of table rows and columns (for cluster heatmap); quantitative derived attributes for each attribute and pairwise attribute combination; quantitative derived attribute for each ranking criterion and original attribute combination.
Why: Tasks	Find correlation between attributes; find clusters, gaps, outliers, trends within items.
How: Encode	Cluster heatmap, scatterplots, histograms, boxplots. Rank-by-feature overviews: continuous diverging colormaps on area marks in reorderable 2D matrix or 1D list alignment.
How: Reduce	Dynamic filtering; dynamic aggregation.
How: Manipulate	Navigate with pan/scroll.
How: Facet	Multiform with linked highlighting and shared spatial position; overview–detail with selection in overview populating detail view.
Scale	Genes (key attribute): 20,000. Conditions (key attribute): 80. Gene activity in condition (quantitative value attribute): 20,000 × 80 = 1,600,000.

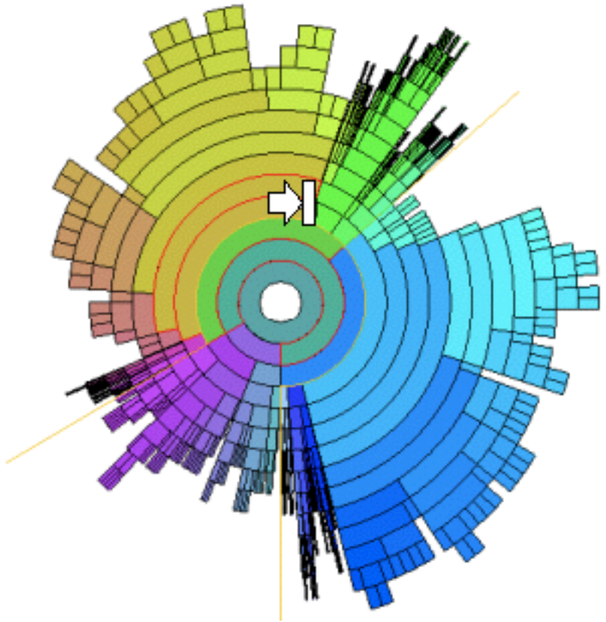
InterRing



original hierarchy



blue subtree expanded



tan subtree expanded

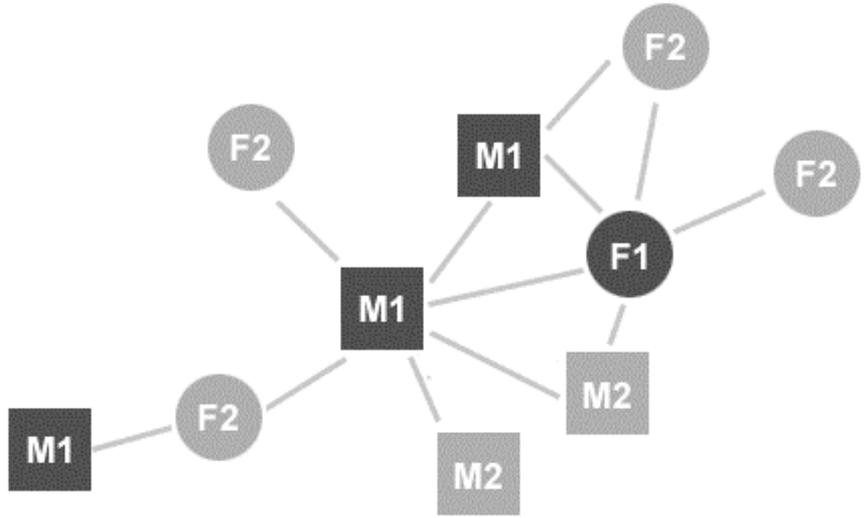
[InterRing: An Interactive Tool for Visually Navigating and Manipulating Hierarchical Structures. Yang, Ward, Rundensteiner. Proc. InfoVis 2002, p 77-84.]

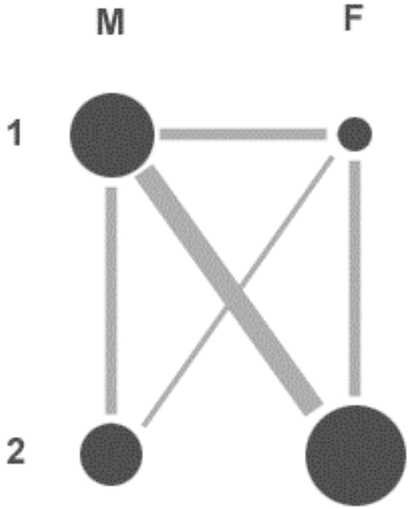
InterRing Analysis

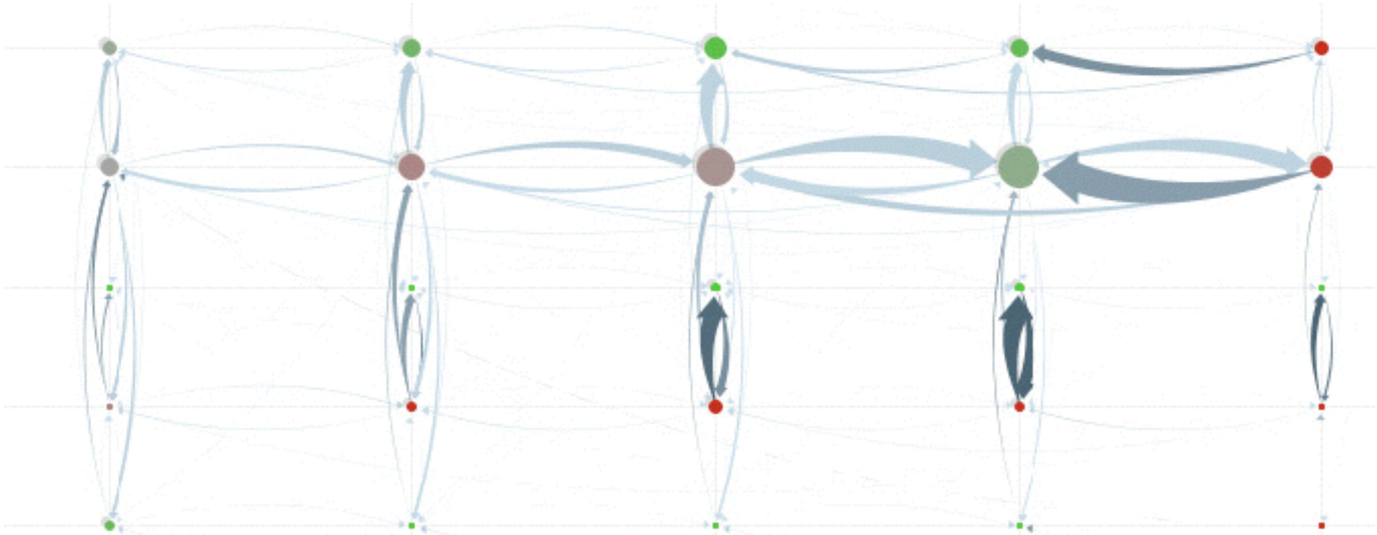
System	**InterRing**
What: Data	Tree.
Why: Tasks	Selection, rollup/drilldown, hierarchy editing.
How: Encode	Radial, space-filling layout. Color by tree structure.
How: Facet	Linked coloring and highlighting.
How: Reduce	Embed: distort; multiple foci.
Scale	Nodes: hundreds if labeled, thousands if dense. Levels in tree: dozens.

PivotGraph

- derived rollup network

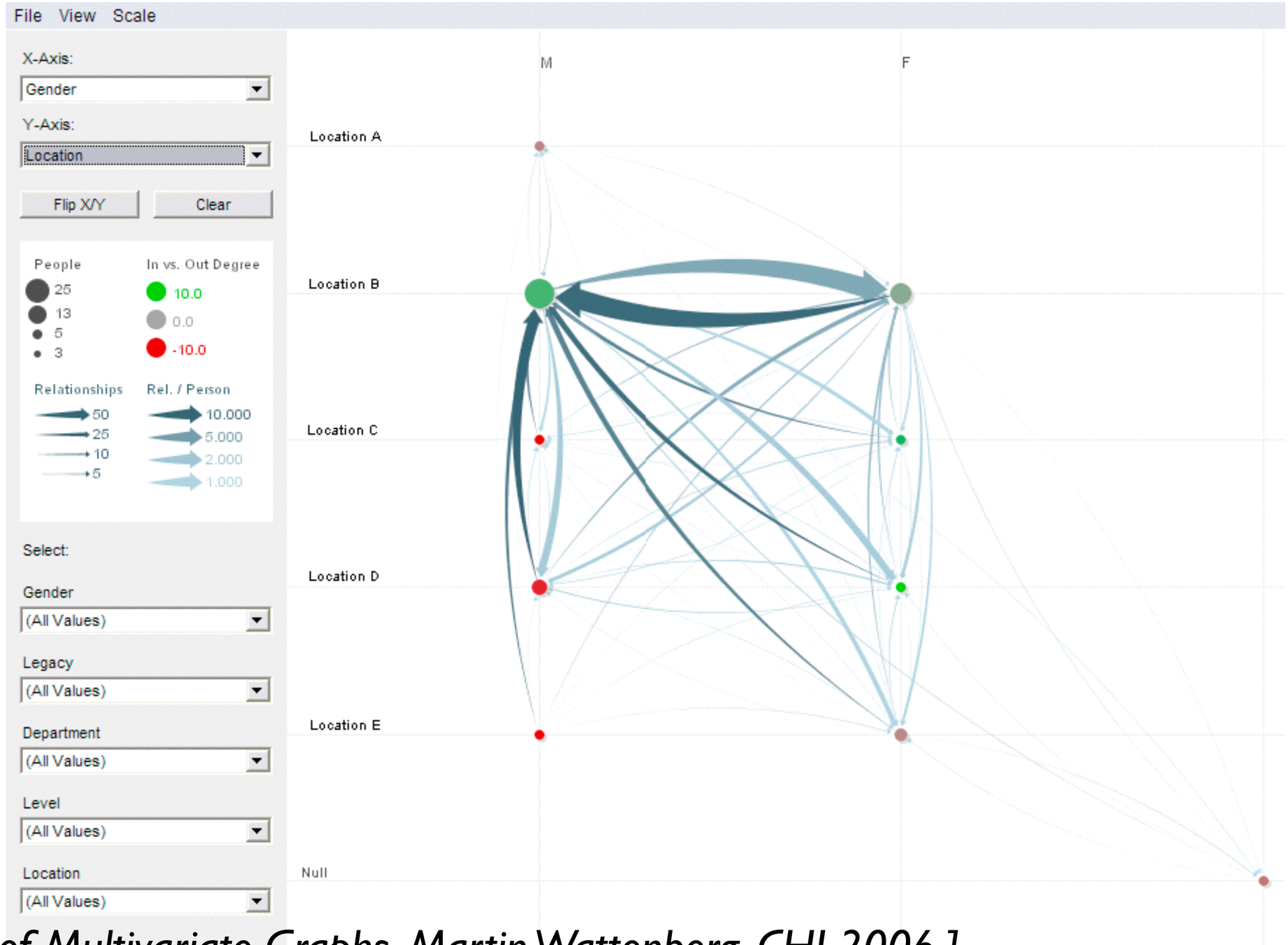






[Visual Exploration of Multivariate Graphs, Martin Wattenberg, CHI 2006.]

PivotGraph



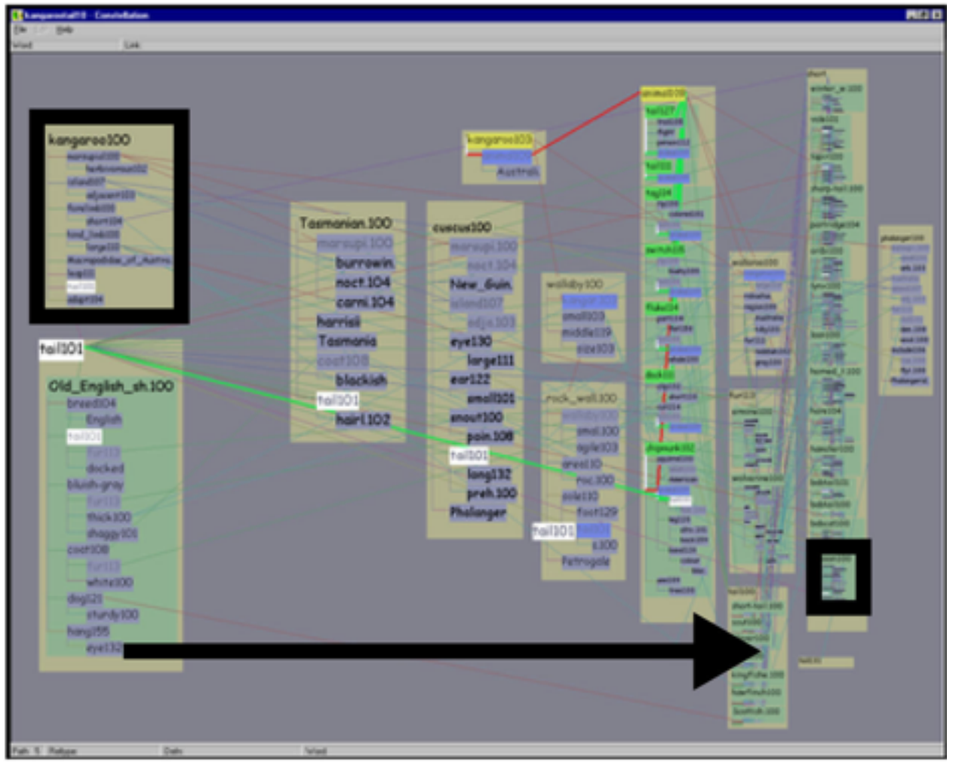
[Visual Exploration of Multivariate Graphs, Martin Wattenberg, CHI 2006.]

PivotGraph Analysis

Idiom	**PivotGraph**
What: Data	Network.
What: Derived	Derived network of aggregate nodes and links by roll-up into two chosen attributes.
Why: Tasks	Cross-attribute comparison of node groups.
How: Encode	Nodes linked with connection marks, size.
How: Manipulate	Change: animated transitions.
How: Reduce	Aggregation, filtering.
Scale	Nodes/links in original network: unlimited. Roll-up attributes: 2. Levels per roll-up attribute: several, up to one dozen.

Analysis example: Constellation

- data
  - multi-level network
    - node: word
    - link: words used in same dictionary definition
    - subgraph for each definition
      - not just hierarchical clustering
  - paths through network
    - query for high-weight paths between 2 nodes
      - quant attrib: plausibility

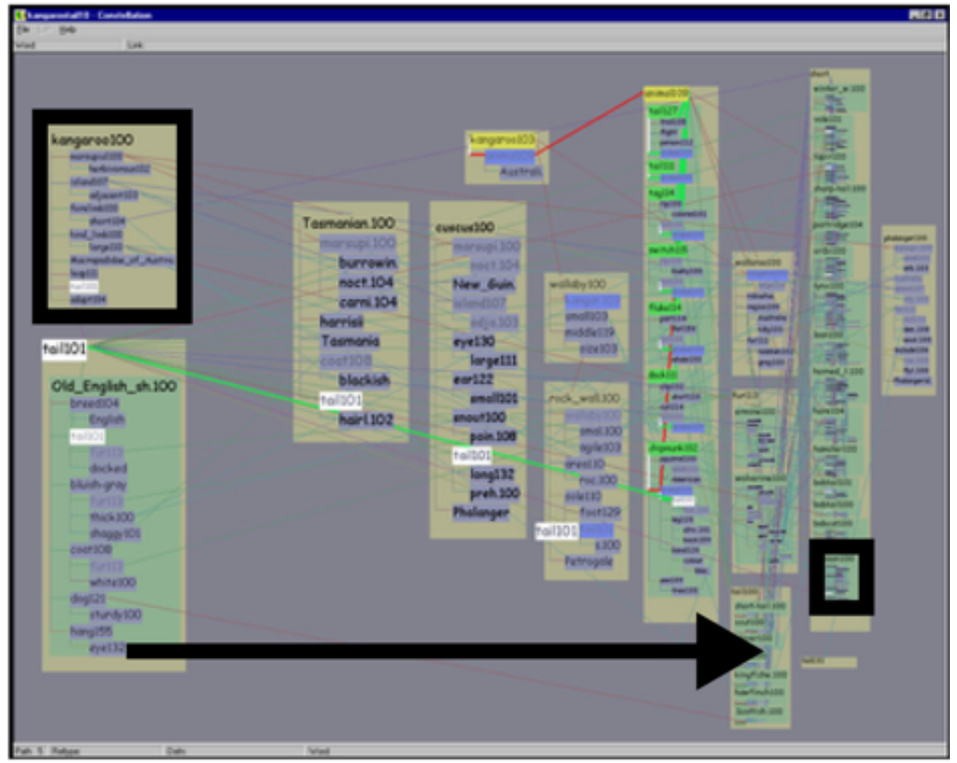


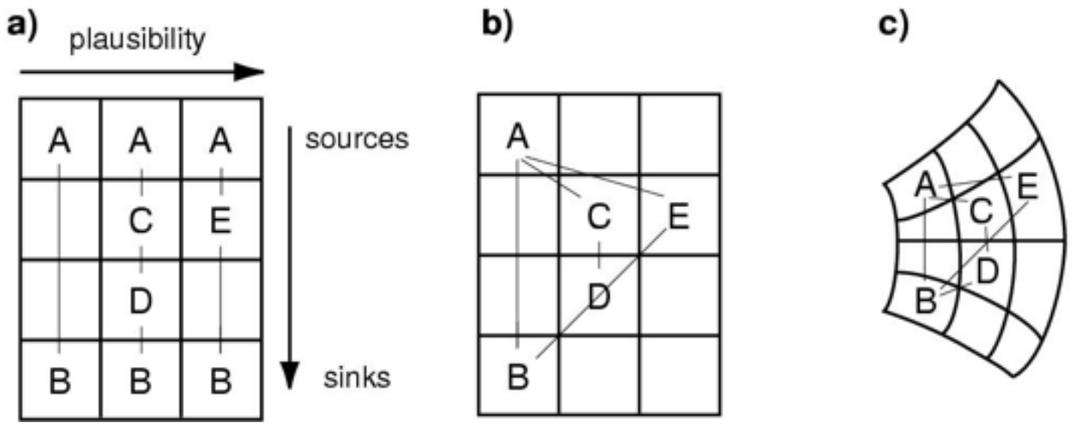
[Interactive Visualization of Large Graphs and Networks. Munzner. Ph.D. Dissertation, Stanford University, June 2000.]

[Constellation: A Visualization Tool For Linguistic Queries from MindNet. Munzner, Guimbretière and Robertson. Proc. IEEE Symp. InfoVis1999, p.132-135.]

Using space: Constellation

- visual encoding
  - link connection marks between words
  - link containment marks to indicate subgraphs
  - encode plausibility with horiz spatial position
  - encode source/sink for query with vert spatial position
- spatial layout
  - curvilinear grid: more room for longer low-plausibility paths

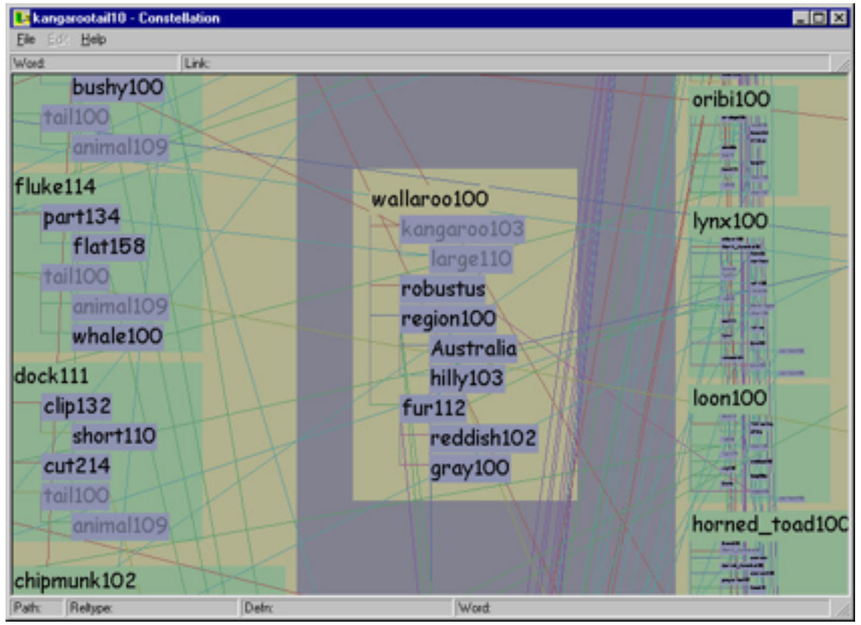


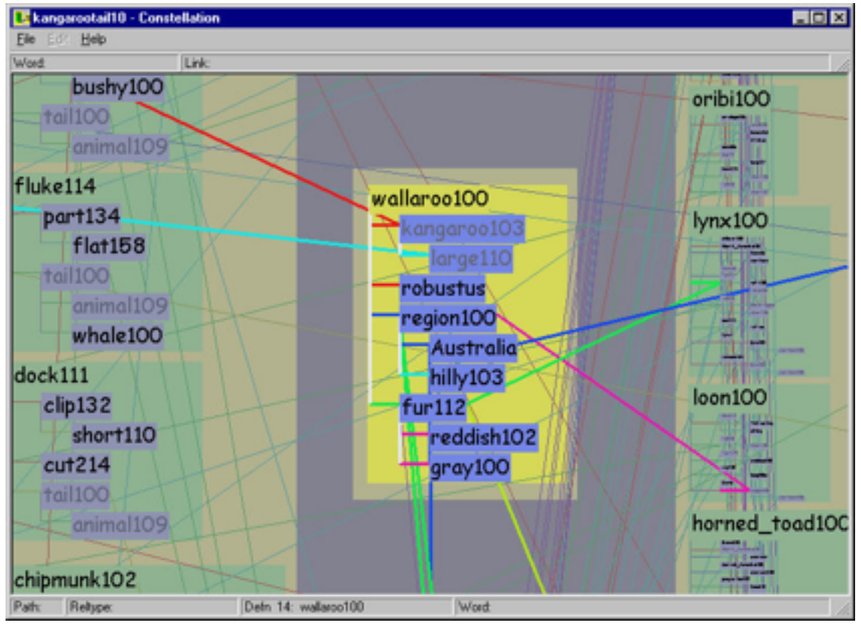


[Interactive Visualization of Large Graphs and Networks. Munzner. Ph.D. Dissertation, Stanford University, June 2000.]

Using space: Constellation

- edge crossings
  - cannot easily minimize instances, since position constrained by spatial encoding
  - instead: minimize perceptual impact
- views: superimposed layers
  - dynamic foreground/background layers on mouseover, using color
  - four kinds of constellations
    - definition, path, link type, word
      - not just 1-hop neighbors





https://youtu.be/7sJC3QVpSkQ

[Interactive Visualization of Large Graphs and Networks. Munzner. Ph.D. Dissertation, Stanford University, June 2000.]

Constellation Analysis

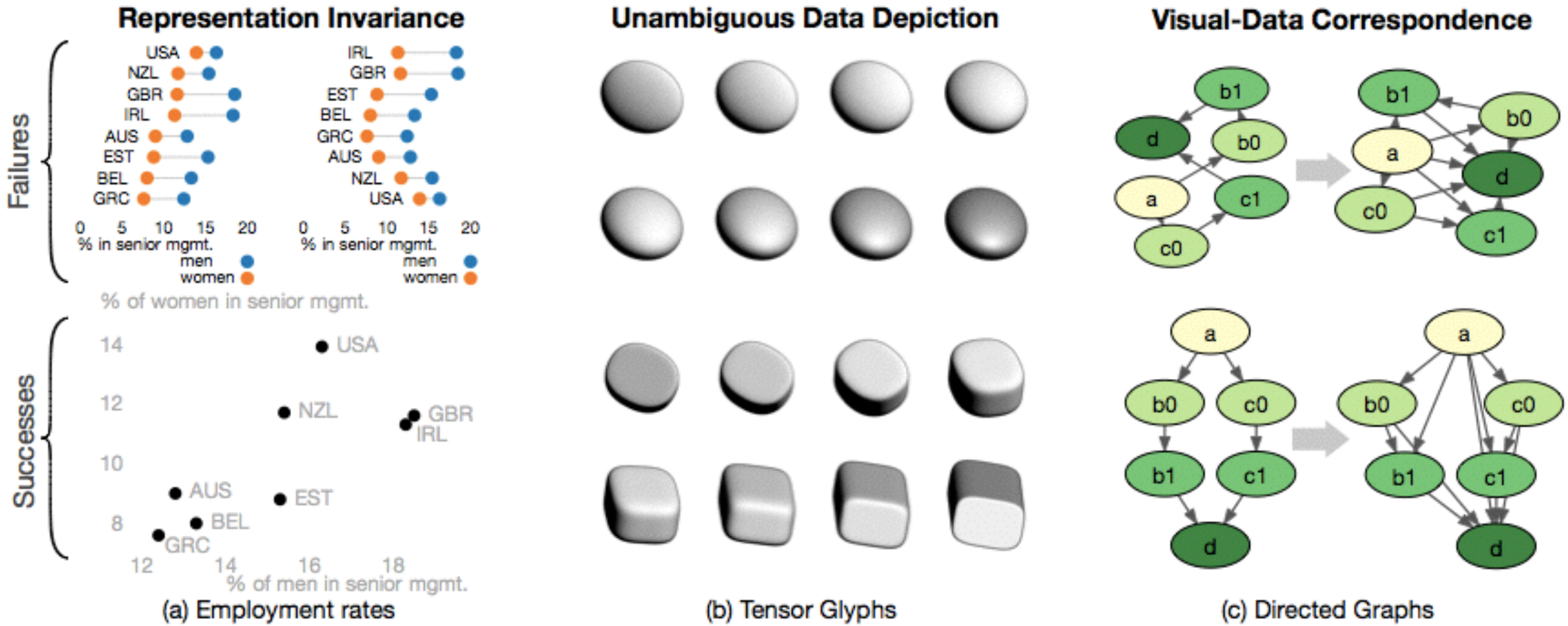
System	**Constellation**
What: Data	Three-level network of paths, subgraphs (definitions), and nodes (word senses).
Why: Tasks	Discover/verify: browse and locate types of paths, identify and compare.
How: Encode	Containment and connection link marks, horizontal spatial position for plausibility attribute, vertical spatial position for order within path, color links by type.
How: Manipulate	Navigate: semantic zooming. Change: Animated transitions.
How: Reduce	Superimpose dynamic layers.
Scale	Paths: 10–50. Subgraphs: 1–30 per path. Nodes: several thousand.

What-Why-How Analysis

- this approach is not the only way to analyze visualizations!
  - one specific framework intended to help you think
  - other frameworks support different ways of thinking
    - following: one interesting example

Algebraic Process for Visualization Design

- which mathematical structures in data are preserved and reflected in vis
  - negation, permutation, symmetry, invariance



[Fig 1. An Algebraic Process for Visualization Design. Carlos Scheidegger and Gordon Kindlmann. IEEE TVCG (Proc. InfoVis 2014), 20(12):2181-2190.]

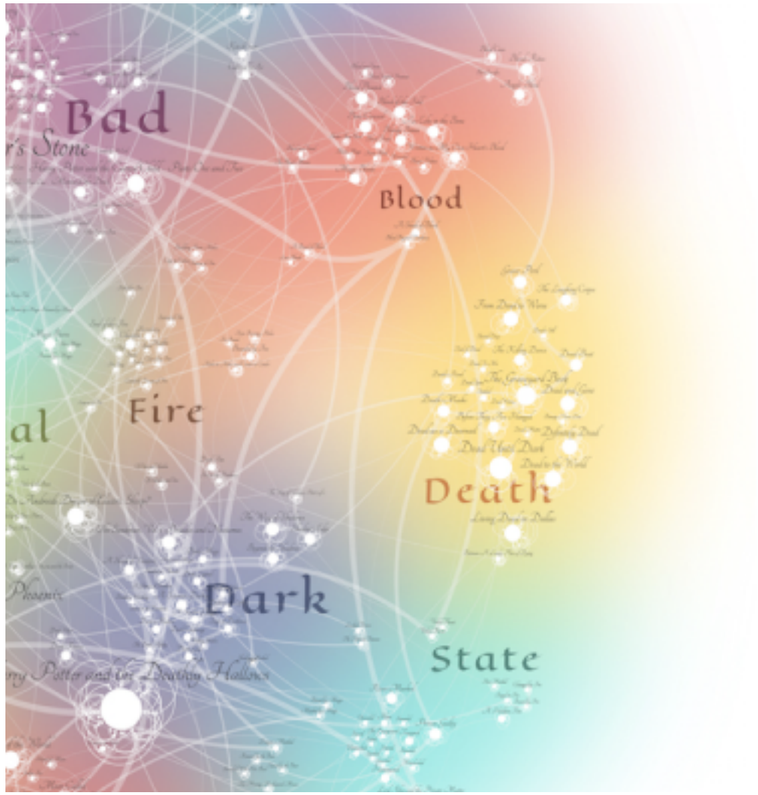
Algebraic process: Vocabulary

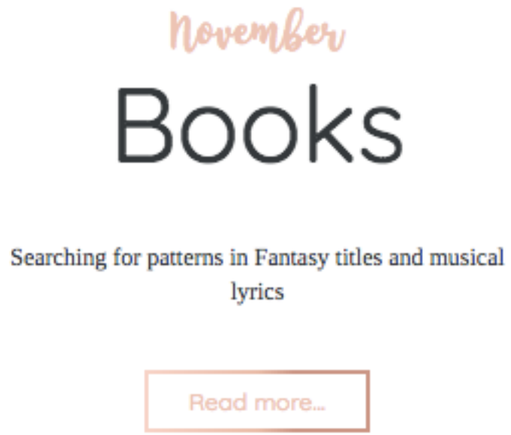
- **invariance** violation: single dataset, many visualizations
  - **hallucinator**
- **unambiguity** violation: many datasets, same vis
  - data change invisible to viewer
    - **confuser**
- **correspondence** violation:
  - can't see change of data in vis
    - **jumbler**
  - salient change in vis not due to significant change in data
    - **misleader**
  - match mathematical structure in data with visual perception
- we can X the data; can we Y the image?
  - are important data changes well-matched with obvious visual changes?

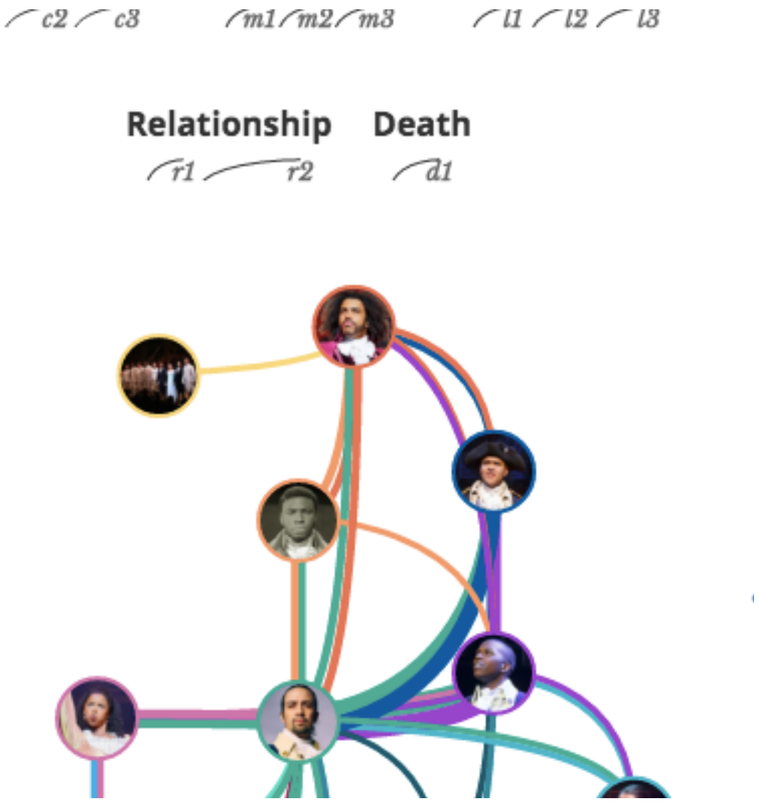
Visual Design Process In Depth: **Dear Data**

http://www.dear-data.com/by-week/

Visual Design Process In Depth: **Data Sketches**

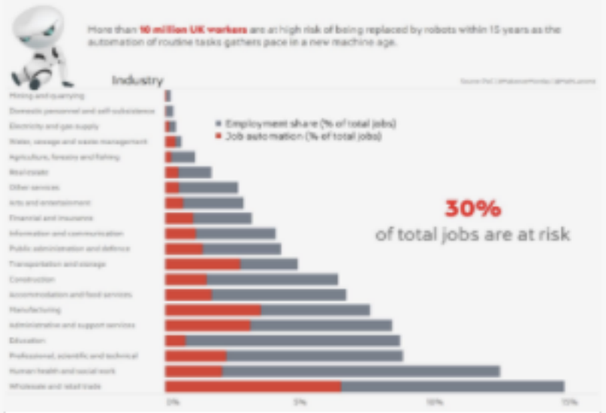






http://www.datasketch.es/

Redesign En Masse: **Makeover Mondays**



Week 14 – Millions of UK workers at risk of being replaced by robots

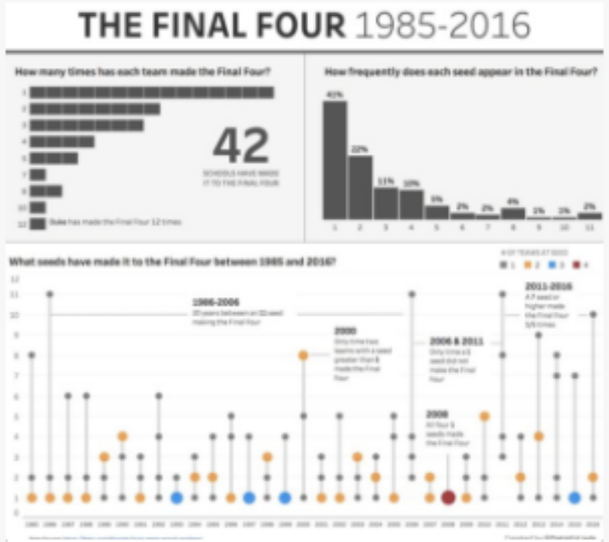
Apr 7, 2017

During week 14 we looked at job automation and the potential impact of robots and AI on the UK employment market.

Week 13 – The Secret of Success

Mar 31, 2017

Week 13 took a look at a Russian survey about the secret of success. Dot plot, bump charts, bar charts, radar charts. This week had it all! Plus seven lessons to take on board.



Week 12 – March Madness

Mar 24, 2017

We looked at March Madness data for week 12, highlighting the phenomenon that is US college basketball. Quite a few vizzes showed the passion that

http://www.makeovermonday.co.uk/blog/