Ch 13: Reduce Items and Attributes
Ch 14: Embed: Focus+Context

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CPSC 547, Information Visualization
Day 15: 28 February 2017

http://www.cs.ubc.ca/~tmm/courses/547-17

News

- topic/date assignments out soon
  - got last straggler just minutes ago
- marks for pitches and L12/L13/L14 out soon

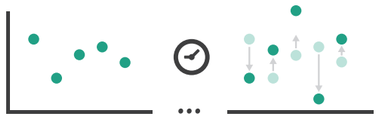
- next time
  - I'll discuss presentation expectations
    - and give example presentation
  - new room! in Forestry (2424 Main Mall), Room 2300 A

- reminder: meetings due by Fri 5pm
- reminder: proposals due by Mon 5pm

Idiom design choices: Part 2

Manipulate

- Change



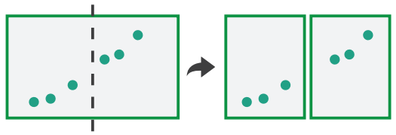
- Select

- Navigate

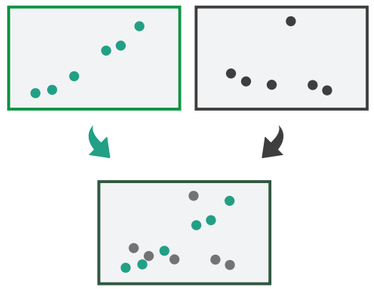
Facet

- Juxtapose

- Partition



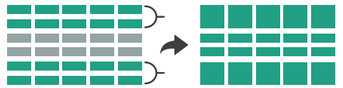
- Superimpose



Reduce

- Filter

- Aggregate



- Embed

Reduce items and attributes

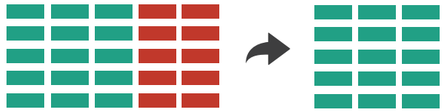
- reduce/increase: inverses
- filter
  - pro: straightforward and intuitive
    - to understand and compute
  - con: out of sight, out of mind
- aggregation
  - pro: inform about whole set
  - con: difficult to avoid losing signal
- not mutually exclusive
  - combine filter, aggregate
  - combine reduce, change, facet

Reducing Items and Attributes

Filter

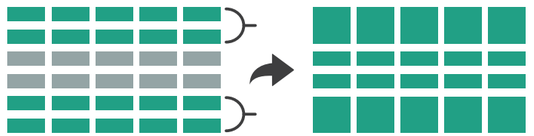
→ Items

→ Attributes

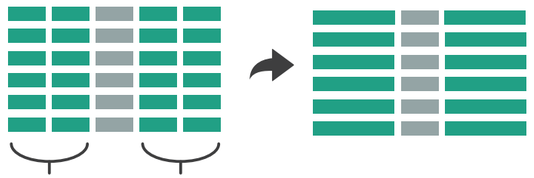


Aggregate

→ Items



→ Attributes



Reduce

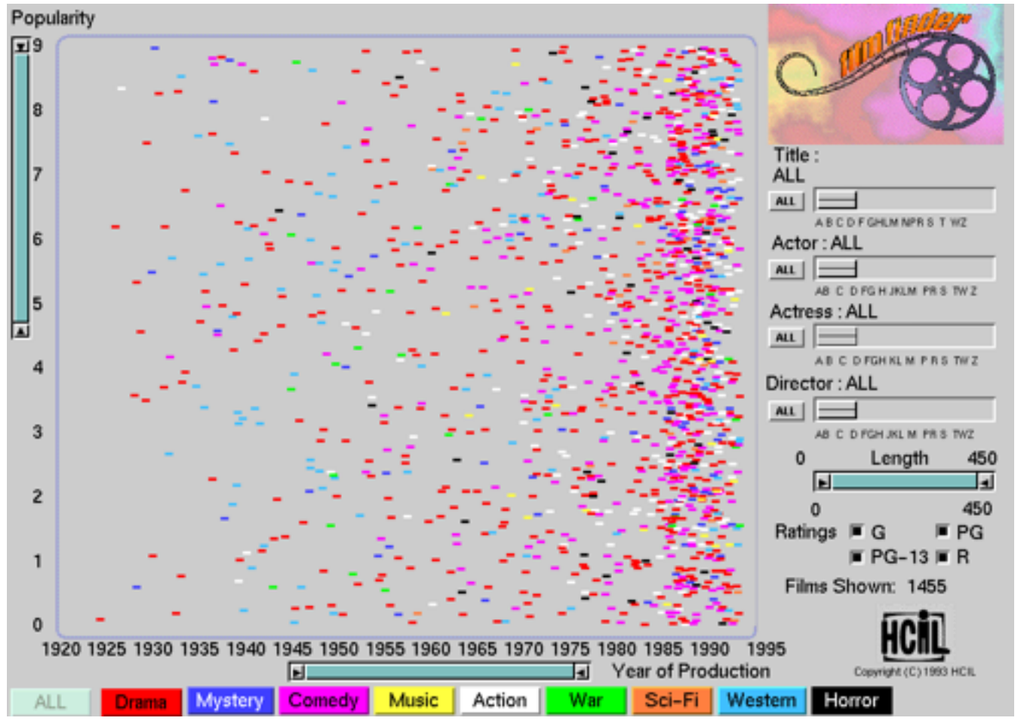
Filter

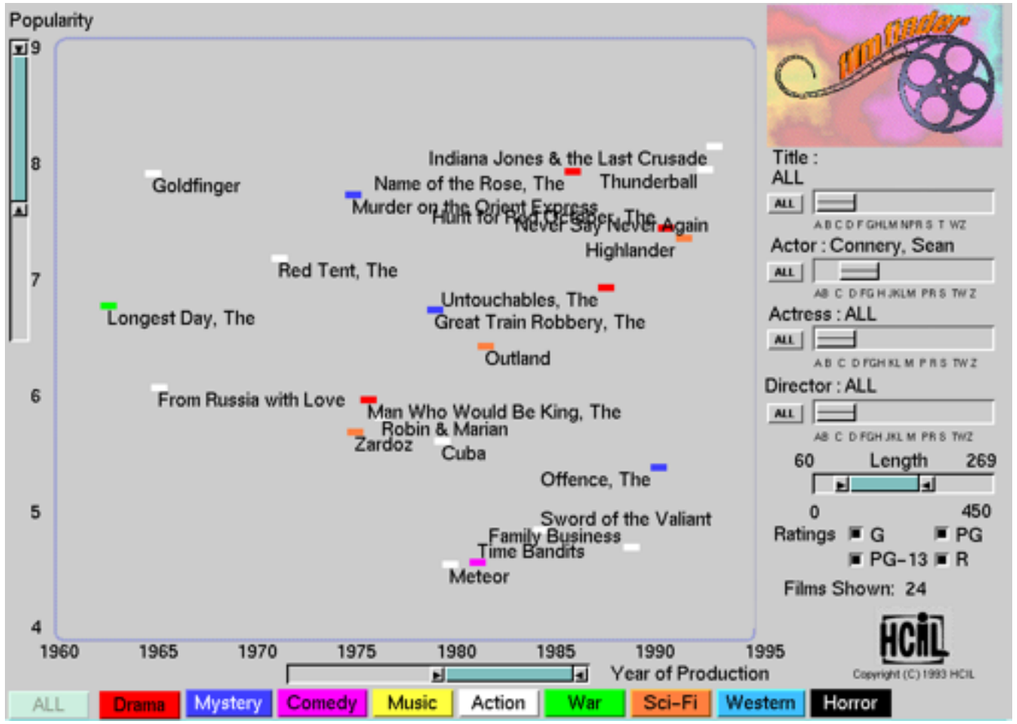
Aggregate

Embed

Idiom: **dynamic filtering** System: **FilmFinder**

- item filtering
- browse through tightly coupled interaction
  - –alternative to queries that might return far too many or too few

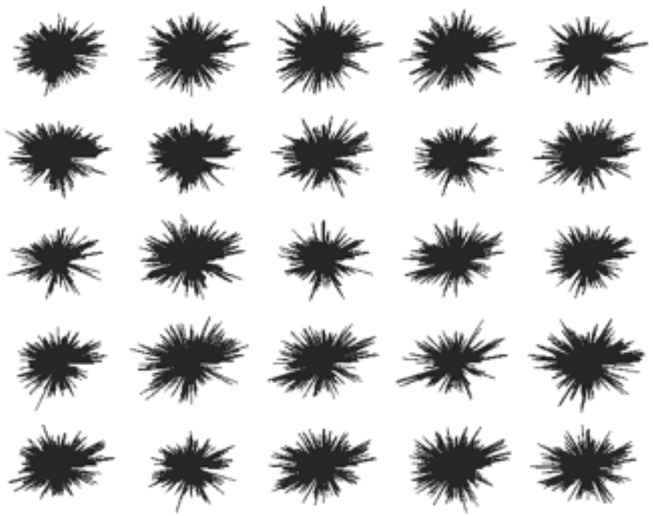


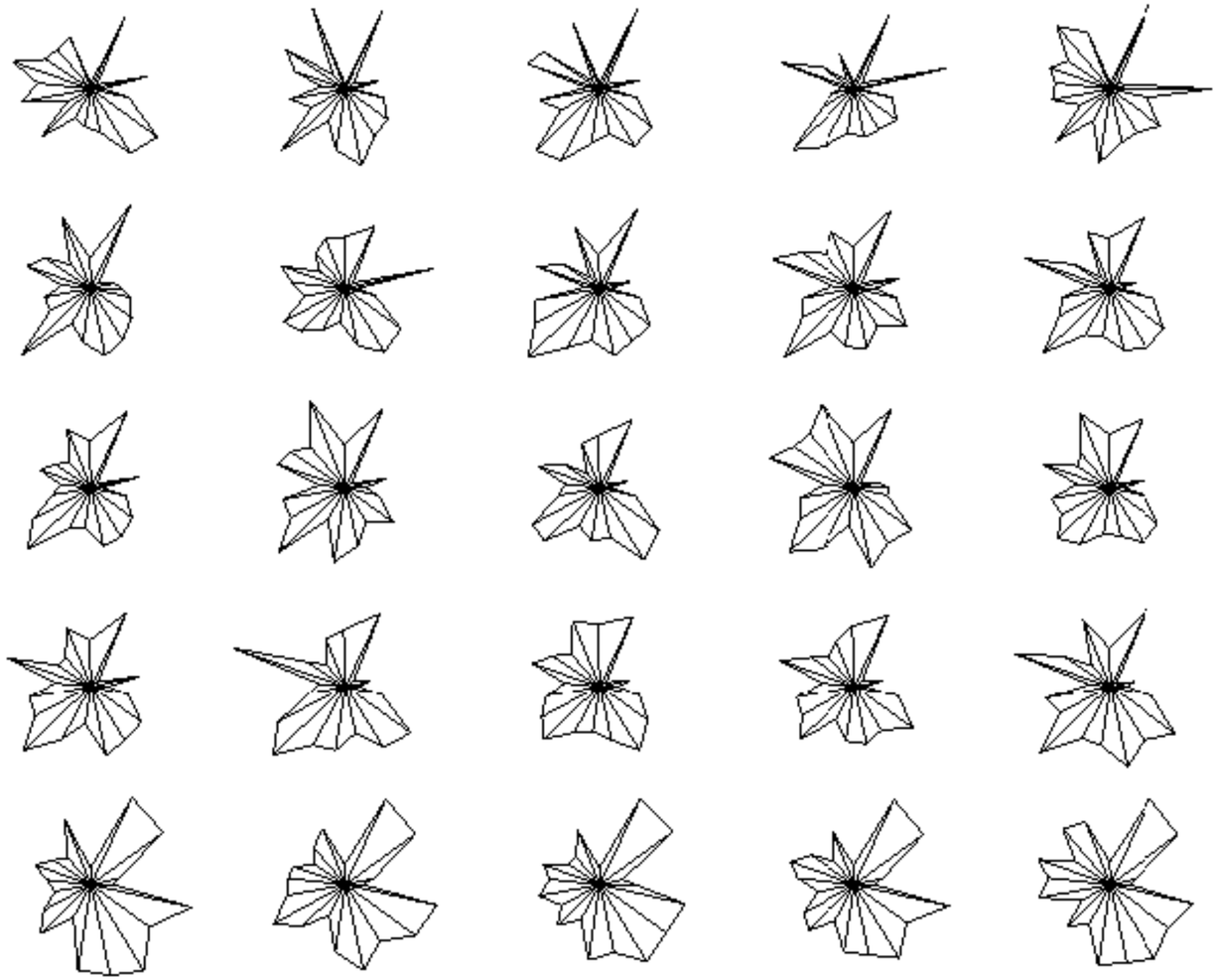


[Visual information seeking:Tight coupling of dynamic query filters with starfield displays. Ahlberg and Shneiderman. Proc.ACM Conf. on Human Factors in Computing Systems (CHI), pp. 313–317, 1994.]

Idiom: **DOSFA**

- attribute filtering
- encoding: star glyphs

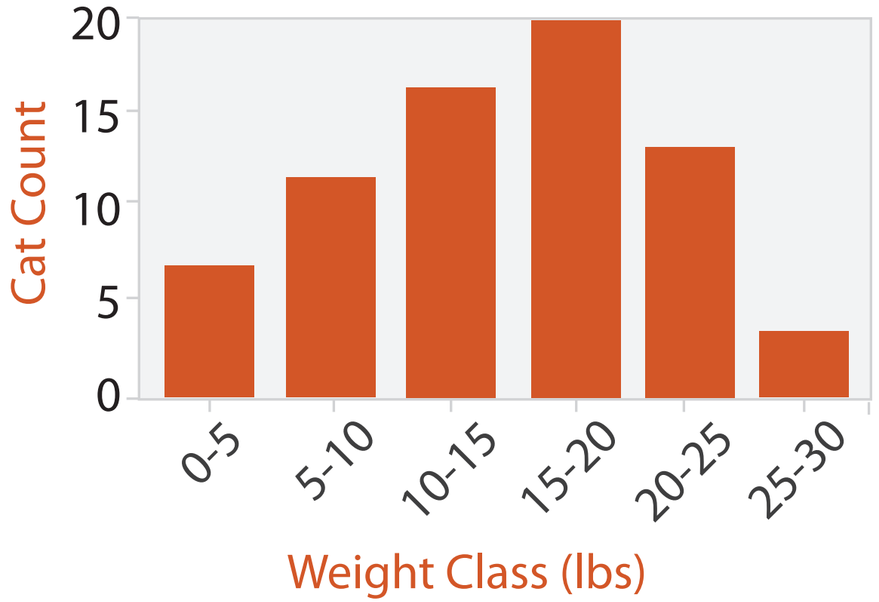




[Interactive Hierarchical Dimension Ordering, Spacing and Filtering for Exploration Of High Dimensional Datasets. Yang, Peng, Ward, and. Rundensteiner. Proc. IEEE Symp. Information Visualization (InfoVis), pp. 105–112, 2003.]

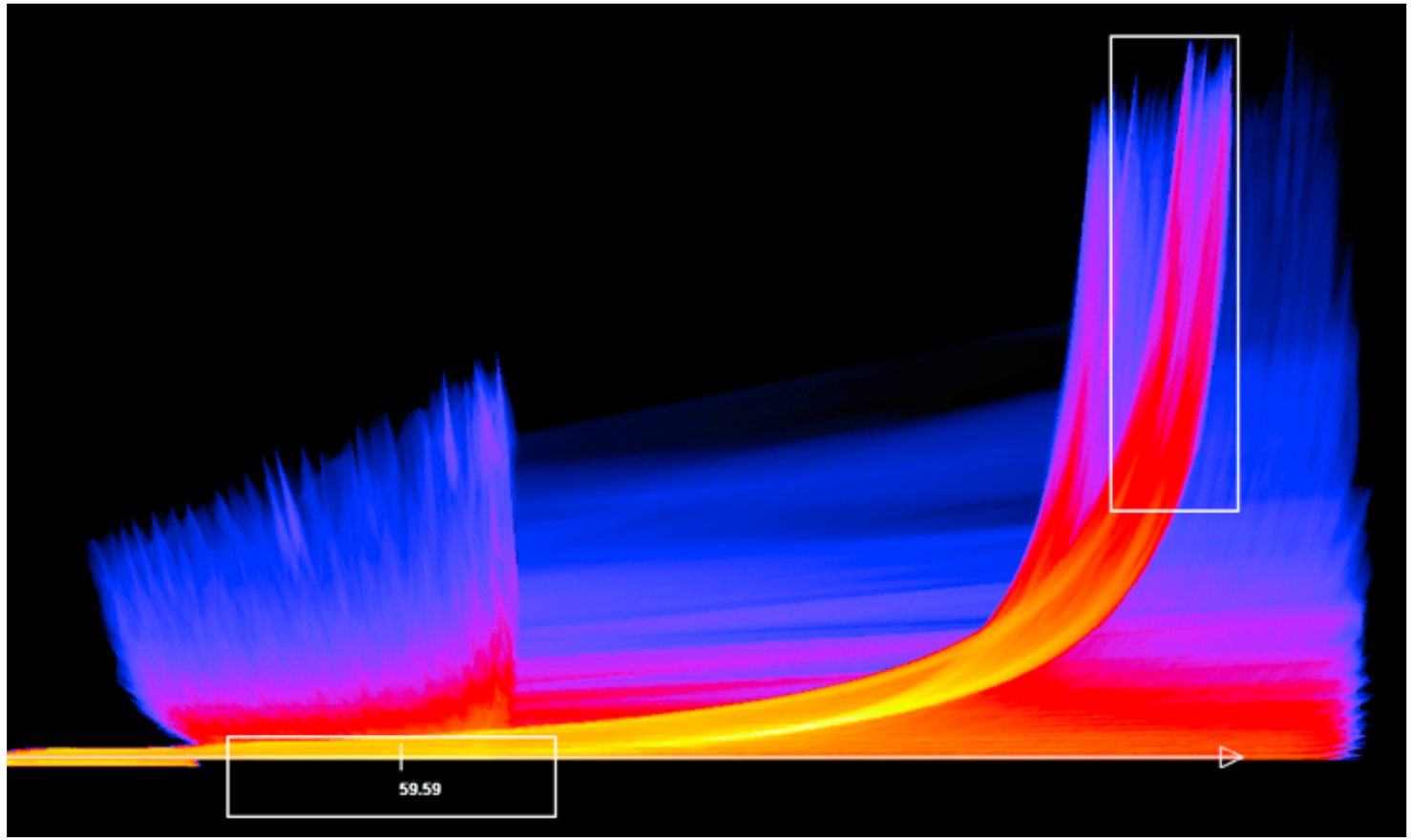
Idiom: **histogram**

- static item aggregation
- task: find distribution
- data: table
- derived data
  - new table: keys are bins, values are counts
- bin size crucial
  - pattern can change dramatically depending on discretization
  - opportunity for interaction: control bin size on the fly



Continuous scatterplot

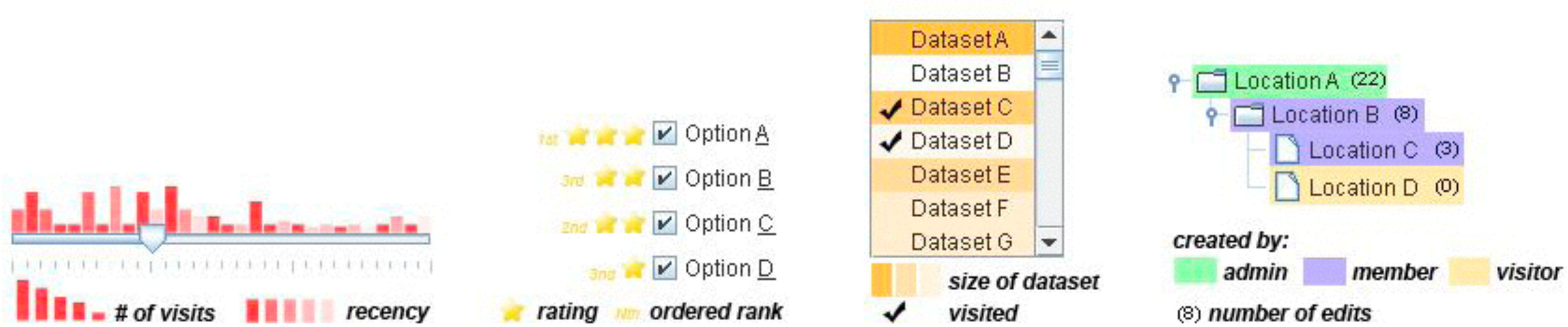
- static item aggregation
- data: table
- derived data: table
  - key attribs x,y for pixels
  - quant attrib: overplot density
- dense space-filling 2D matrix
- color: sequential categorical hue + ordered luminance colormap



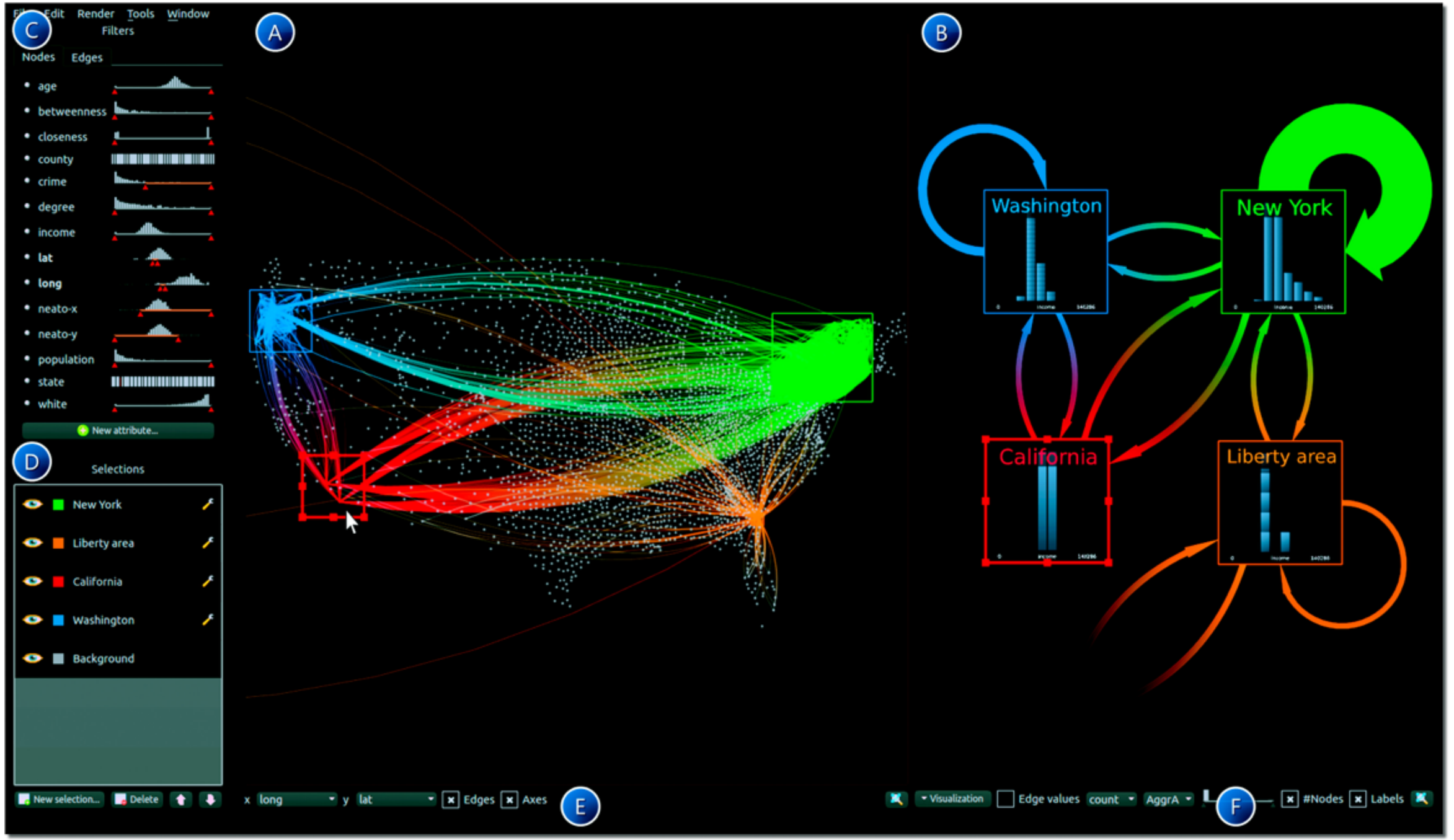
[Continuous Scatterplots. Bachthaler and Weiskopf. IEEE TVCG (Proc. Vis 08) 14:6 (2008), 1428–1435. 2008.]

Idiom: **scented widgets**

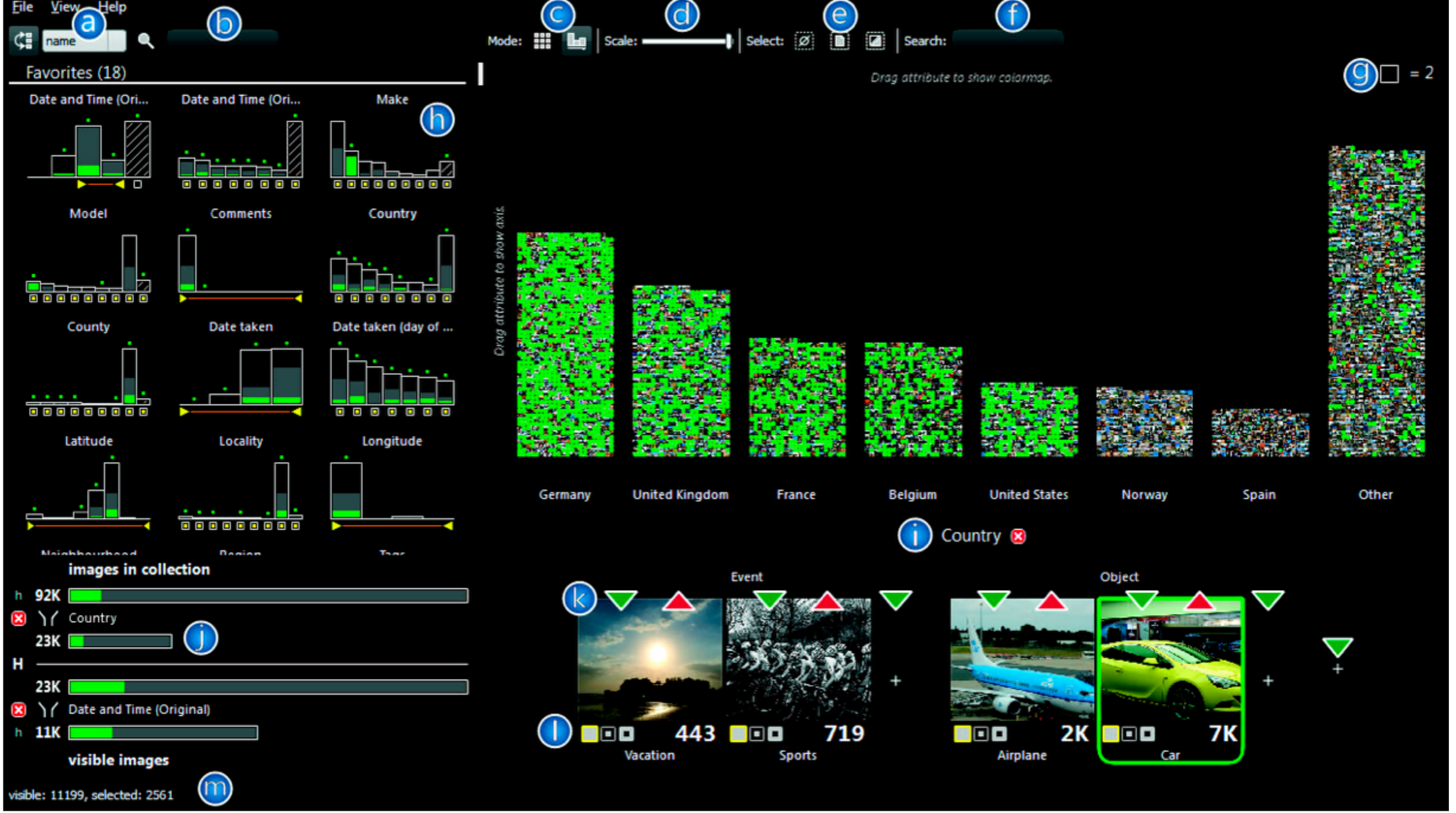
- augment widgets for filtering to show ***information scent***
  - cues to show whether value in drilling down further vs looking elsewhere
- concise, in part of screen normally considered control panel



[Scented Widgets: Improving Navigation Cues with Embedded Visualizations. Willett, Heer, and Agrawala. IEEE Trans. Visualization and Computer Graphics (Proc. InfoVis 2007) 13:6 (2007), 1129–1136.]



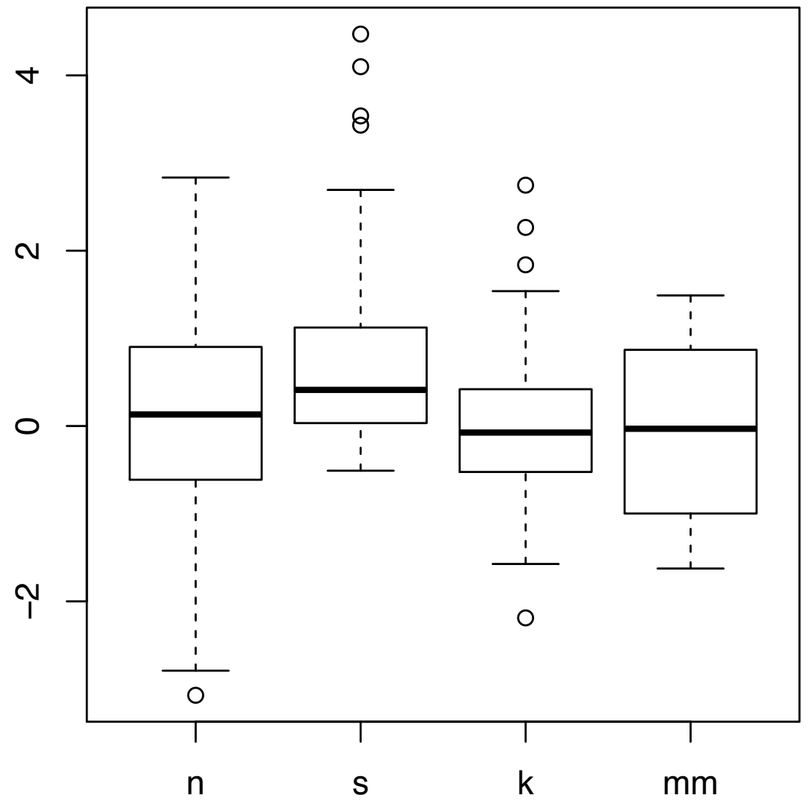
[Multivariate Network Exploration and Presentation: From Detail to Overview via Selections and Aggregations. van den Elzen and van Wijk, TVCG 20(12) 2014.]



[ICLIC: Interactive categorization of large image collections. van der Corput and van Wijk. Proc. PacificVis 2016.]

Idiom: **boxplot**

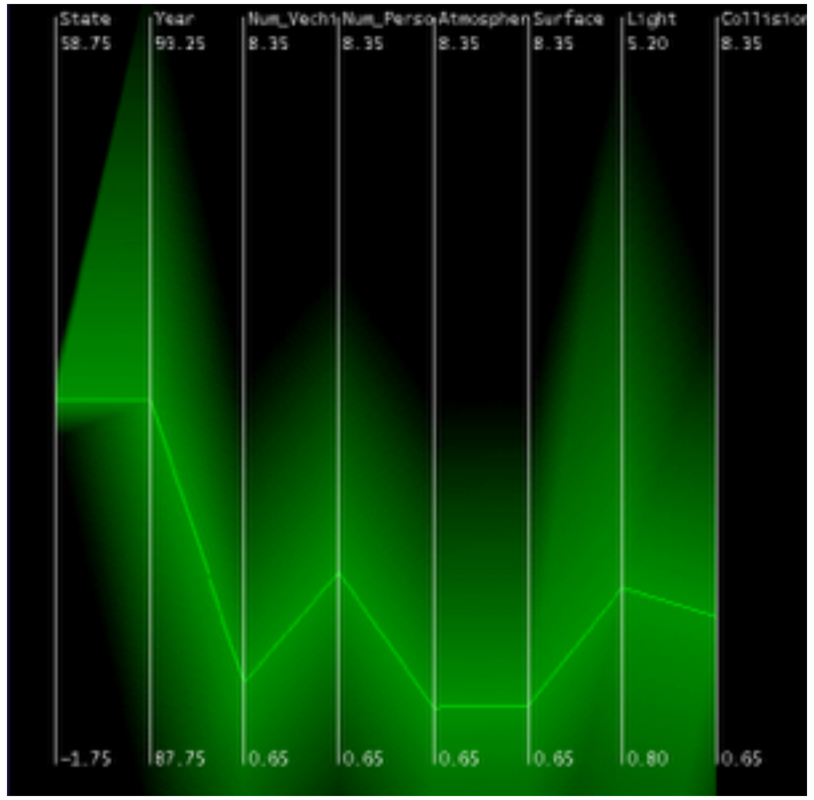
- static item aggregation
- task: find distribution
- data: table
- derived data
  - 5 quant attribs
    - median: central line
    - lower and upper quartile: boxes
    - lower upper fences: whiskers
      - values beyond which items are outliers
  - outliers beyond fence cutoffs explicitly shown

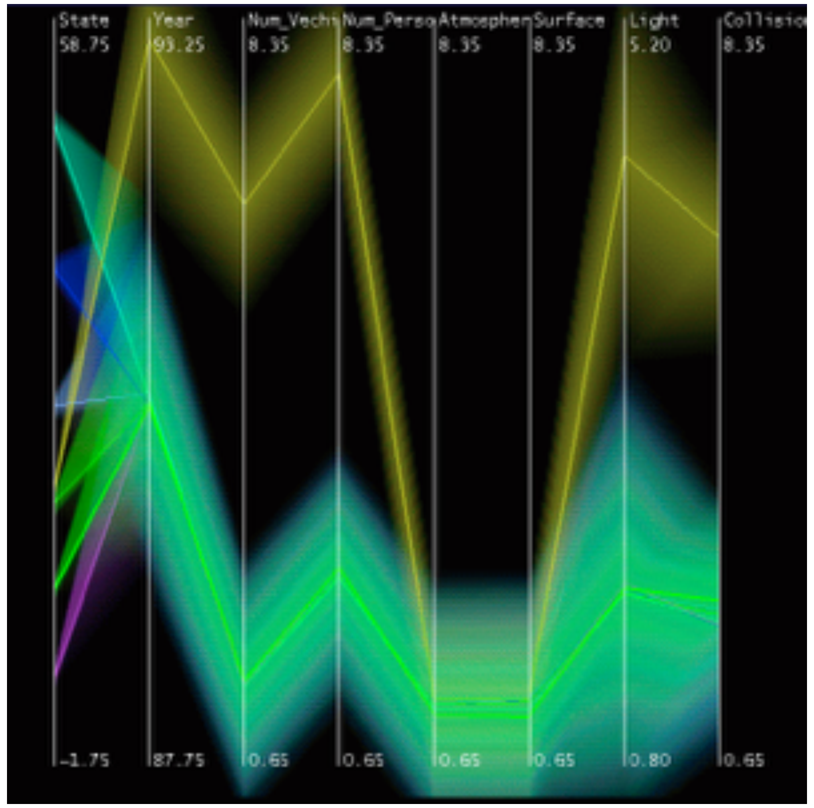


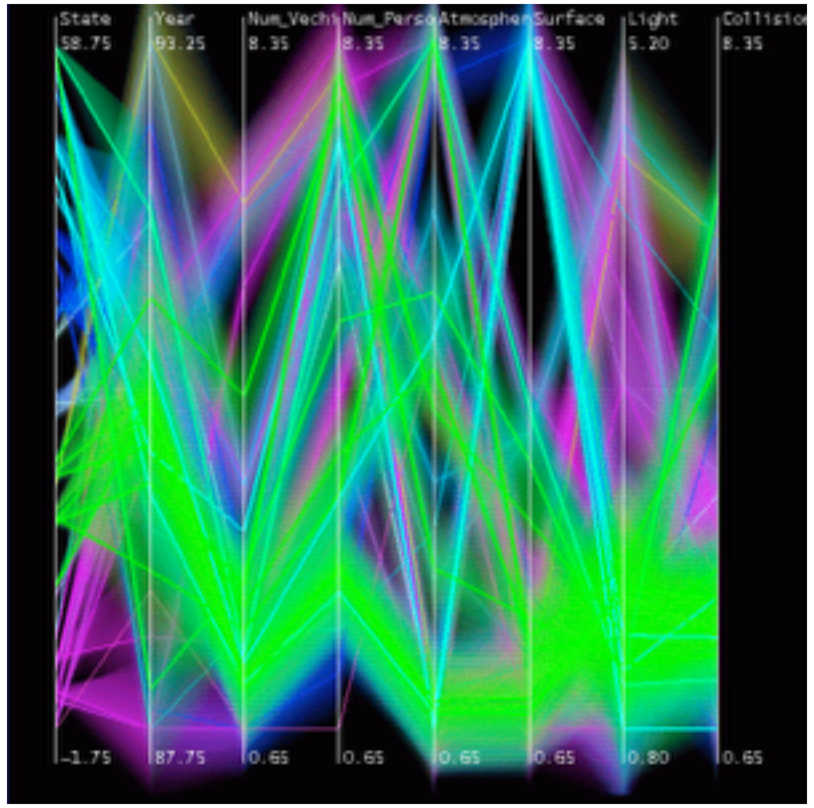
[40 years of boxplots. Wickham and Stryjewski. 2012. had.co.nz]

Idiom: **Hierarchical parallel coordinates**

- dynamic item aggregation
- derived data: *hierarchical clustering*
- encoding:
  - –cluster band with variable transparency, line at mean, width by min/max values
  - –color by proximity in hierarchy



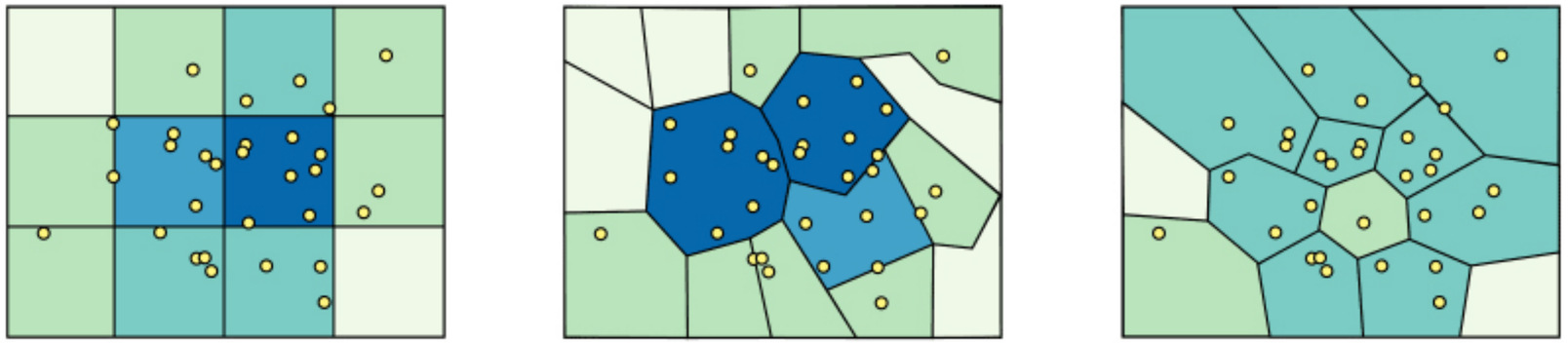




[Hierarchical Parallel Coordinates for Exploration of Large Datasets. Fua, Ward, and Rundensteiner. Proc. IEEE Visualization Conference (Vis '99), pp. 43– 50, 1999.]

Spatial aggregation

- MAUP: Modifiable Areal Unit Problem
  - gerrymandering (manipulating voting district boundaries) is one example!



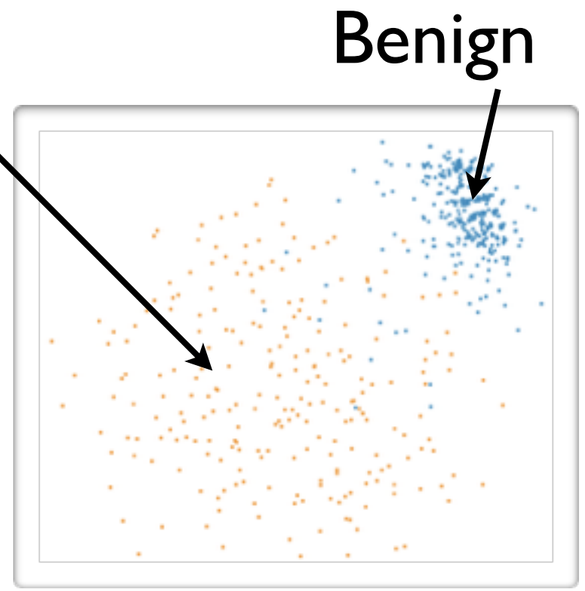
[http://www.e-education.psu/edu/geog486/l4_p7.html, Fig 4.cg.6]

Dimensionality reduction

- attribute aggregation
  - derive low-dimensional target space from high-dimensional measured space
  - use when you can't directly measure what you care about
    - true dimensionality of dataset conjectured to be smaller than dimensionality of measurements
    - latent factors, hidden variables

Tumor
Measurement Data

→ DR →



data: 9D measured space

derived data: 2D target space

Dimensionality reduction for documents

Task 1

In
HD data

Out
2D data

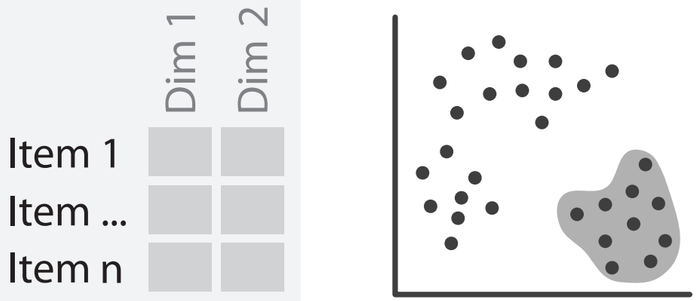
What?

- In High-dimensional data
- Out 2D data

Why?

- Produce
- Derive

Task 2



In
2D data

Out
Scatterplot
Clusters & points

What?

- In 2D data
- Out Scatterplot
- Out Clusters & points

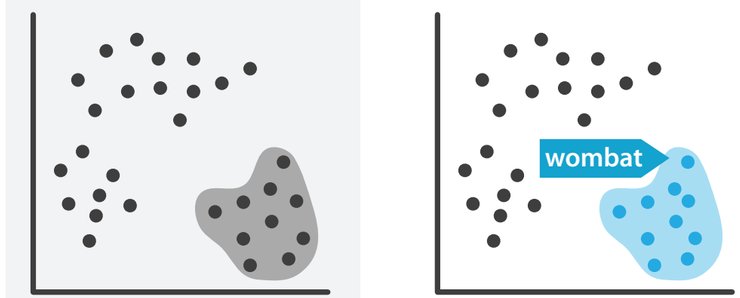
Why?

- Discover
- Explore
- Identify

How?

- Encode
- Navigate
- Select

Task 3



In
Scatterplot
Clusters & points

Out
Labels for clusters

What?

- In Scatterplot
- In Clusters & points
- Out Labels for clusters

Why?

- Produce
- Annotate

Dimensionality vs attribute reduction

- vocab use in field not consistent
  - dimension/attribute
- attribute reduction: reduce set with filtering
  - includes orthographic projection
- dimensionality reduction: create smaller set of new dims/attribs
  - typically implies dimensional aggregation, not just filtering
  - vocab: projection/mapping

Further reading

- Visualization Analysis and Design. Munzner. AK Peters Visualization Series, CRC Press, 2014.
  - *Chap 13: Reduce Items and Attributes*
- *Hierarchical Aggregation for Information Visualization: Overview, Techniques and Design Guidelines*. Elmqvist and Fekete. IEEE Transactions on Visualization and Computer Graphics 16:3 (2010), 439–454.
- *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.

Embed: Focus+Context

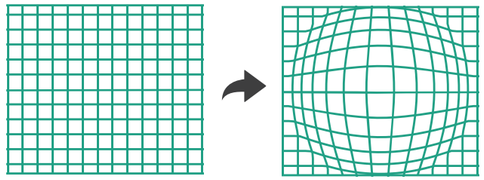
- combine information within single view
- elide
  - selectively filter and aggregate
- superimpose layer
  - local lens
- distortion design choices
  - region shape: radial, rectilinear, complex
  - how many regions: one, many
  - region extent: local, global
  - interaction metaphor

Embed

Elide Data

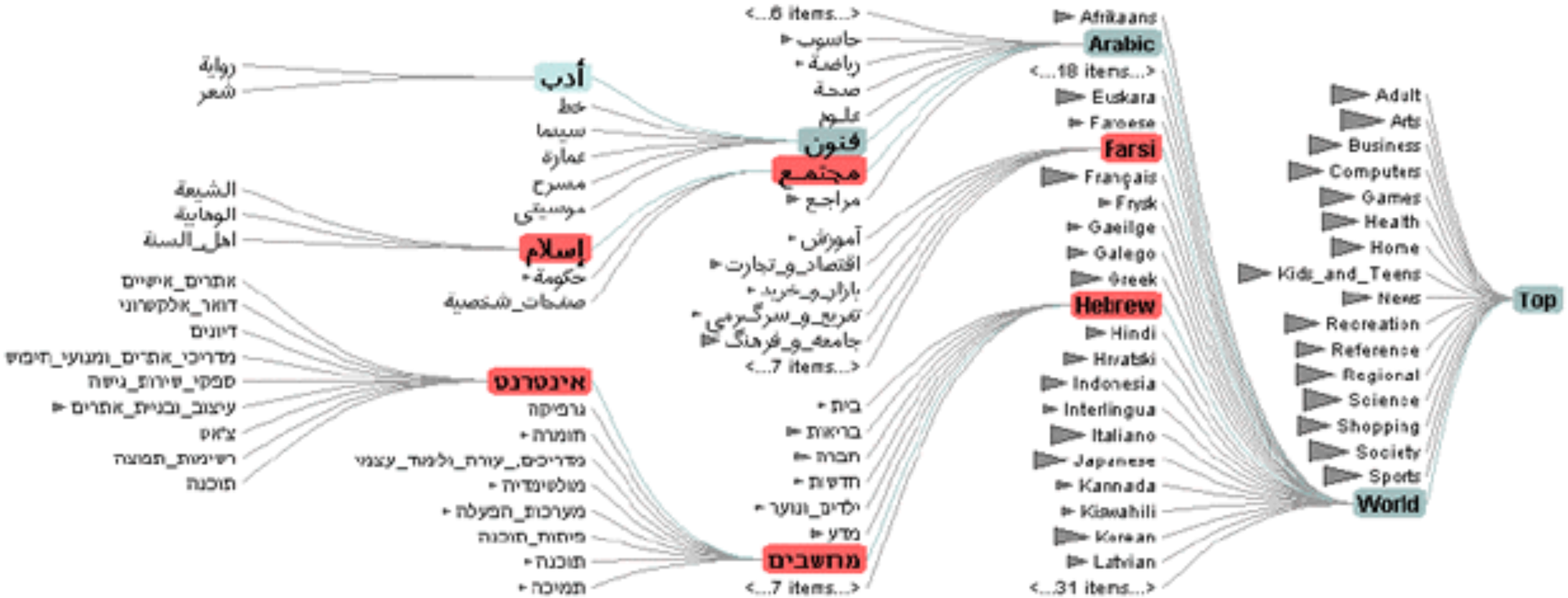
Superimpose Layer

Distort Geometry



Idiom: **DOITrees Revisited**

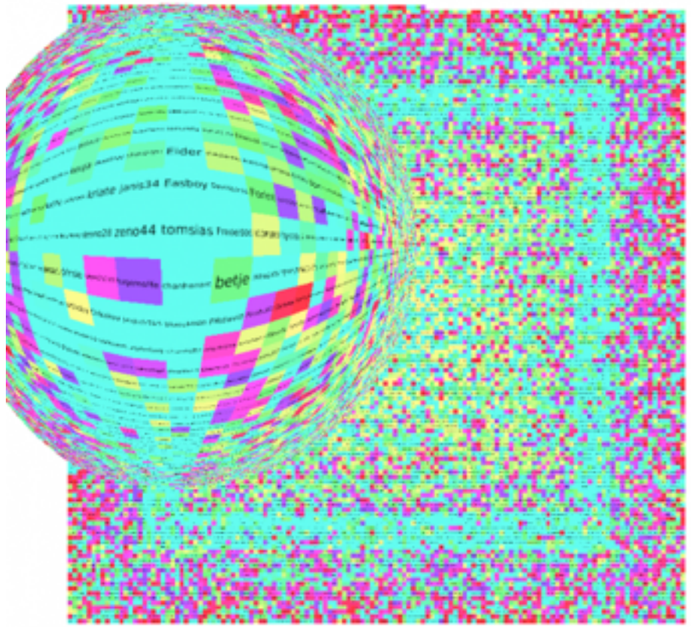
- elide
  - some items dynamically filtered out
  - some items dynamically aggregated together
  - some items shown in detail

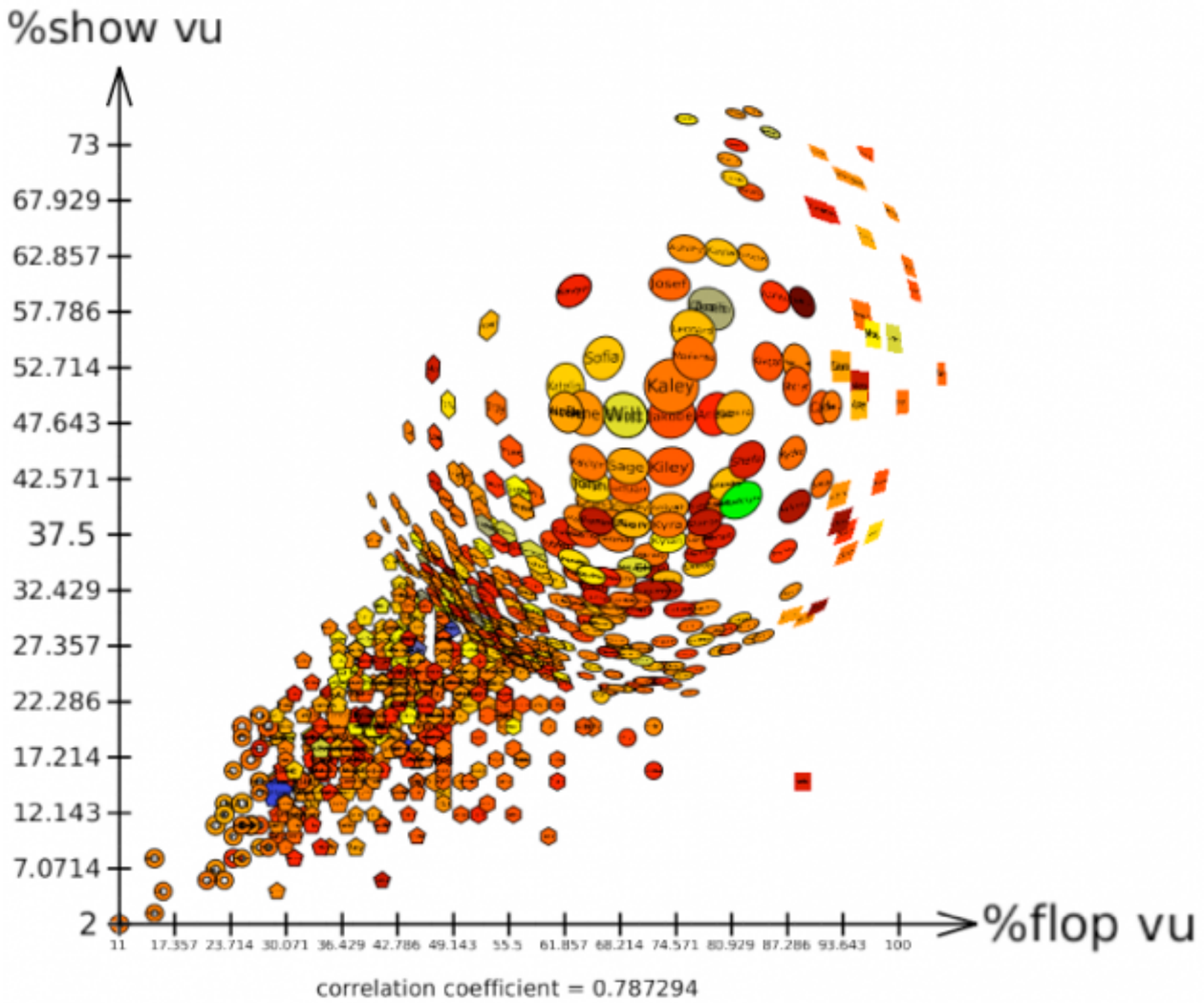


[DOITrees Revisited: Scalable, Space-Constrained Visualization of Hierarchical Data. Heer and Card. Proc. Advanced Visual Interfaces (AVI), pp. 421–424, 2004.]

Idiom: **Fisheye Lens**

- distort geometry
  - shape: radial
  - focus: single extent
  - extent: local
  - metaphor: draggable lens

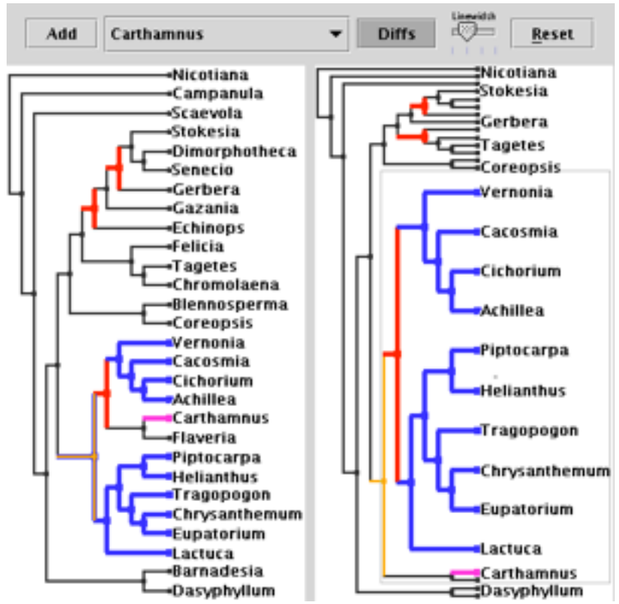




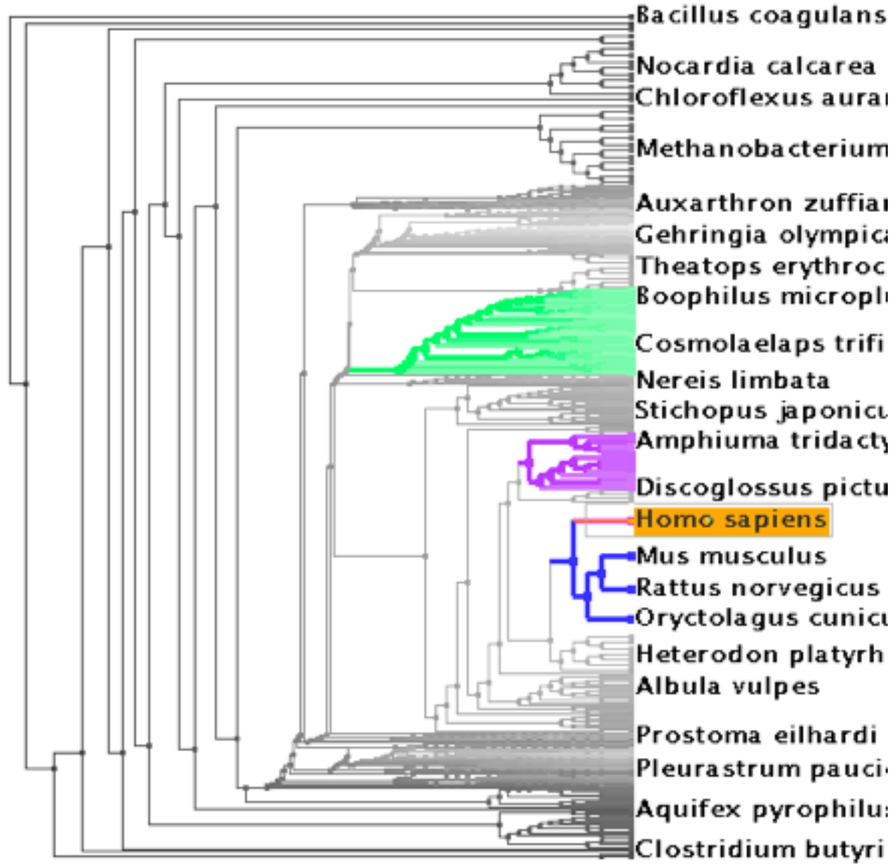
http://tulip.labri.fr/TulipDrupal/?q=node/351
http://tulip.labri.fr/TulipDrupal/?q=node/371

Idiom: **Stretch and Squish Navigation**

- distort geometry
  - shape: rectilinear
  - foci: multiple
  - impact: global
  - metaphor: stretch and squish, borders fixed



System: **TreeJuxtaposer**



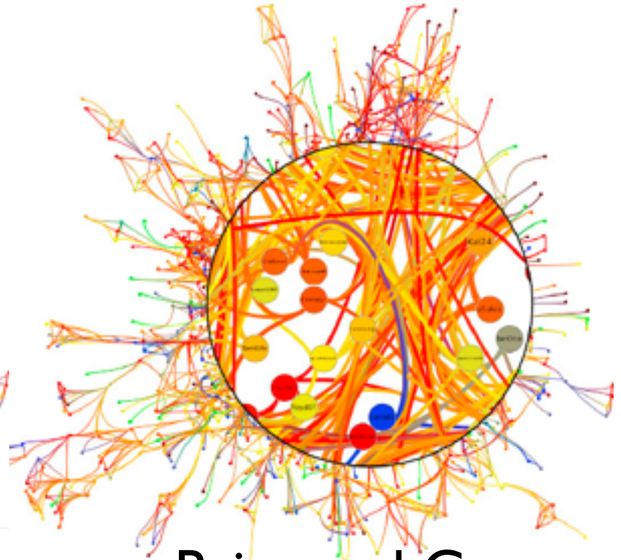
[TreeJuxtaposer: Scalable Tree Comparison Using Focus+Context With Guaranteed Visibility. Munzner, Guimbretiere, Tasiran, Zhang, and Zhou. ACM Transactions on Graphics (Proc. SIGGRAPH) 22:3 (2003), 453– 462.]

Distortion costs and benefits

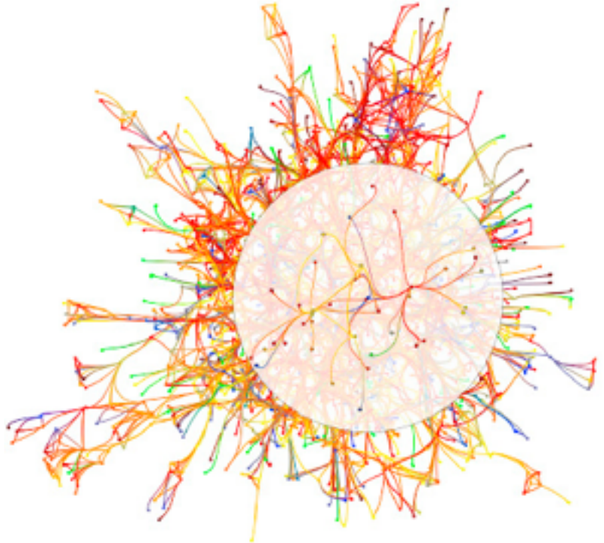
- benefits
  - combine focus and context information in single view
- costs
  - length comparisons impaired
    - network/tree topology comparisons unaffected: connection, containment
  - effects of distortion unclear if original structure unfamiliar
  - object constancy/tracking maybe impaired

fisheye lens

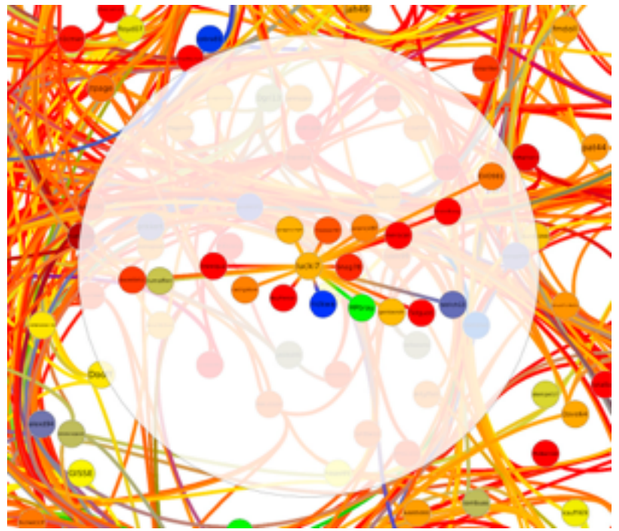
magnifying lens



neighborhood layering



Bring and Go



[Living Flows: Enhanced Exploration of Edge-Bundled Graphs Based on GPU-Intensive Edge Rendering. Lambert, Auber, and Melançon. Proc. Intl. Conf. Information Visualisation (IV), pp. 523–530, 2010.]

Further reading

- Visualization Analysis and Design. Munzner. AK Peters / CRC Press, Oct 2014.
  - *Chap 14: Embed: Focus+Context*

- *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.
- *Hierarchical Aggregation for Information Visualization: Overview, Techniques and Design Guidelines*. Elmqvist and Fekete. IEEE Transactions on Visualization and Computer Graphics 16:3 (2010), 439–454.
- *A Fisheye Follow-up: Further Reflection on Focus + Context*. Furnas. Proc. ACM Conf. Human Factors in Computing Systems (CHI), pp. 999–1008, 2006.

Next Time

- Thu Mar 2, to read
  - VAD Ch. 15: Case Studies
    - several examples of analysis with full framework

- reminders:
  - meetings due by Fri Mar 3, 5pm
  - proposals due by Mon Mar 6, 5pm