

Lecture 9: Space/Layers/Order

Information Visualization
CPSC 533C, Fall 2009

Tamara Munzner

UBC Computer Science

Mon, 5 October 2009

News

- no class next week (Mon Tgiving, Wed also no class)
- project meetings required by Fri Oct 23
 - I'm gone all next week
 - so only 2 weeks left - this one + week after next!

Readings Covered

Ware, Chapter 8: Space Perception and the Display of Data in Space

Tufte, Chapter 3: Layering and Separation

Hierarchical Edge Bundles: Visualization of Adjacency Relations in Hierarchical Data. Danny Holten, Proc. InfoVis06, to appear
http://www.win.tue.nl/~dholten/papers/bundles_infovis.pdf

Tufte, Chapter 6: Narratives of Space and Time

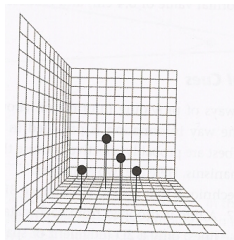
VisDB: Database Exploration using Multidimensional Visualization, Daniel A. Keim and Hans-Peter Kriegel, IEEE CG&A, 1994
<http://www.dbs.informatik.uni-muenchen.de/dbs/projekt/papers/visdb.ps>

Ware: Space Perception

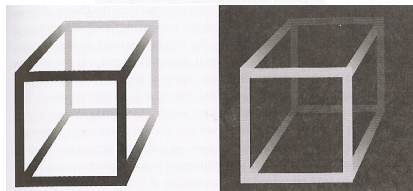
- static
 - occlusion
 - perspective projection
 - linear, texture gradient
 - depth of field
 - atmospheric (fog, depth cueing)
 - lighting and shadows
 - shape from shading
 - cast shadows
- moving
 - structure-from-motion
 - motion parallax (head motion)
- binocular
 - binocular disparity (stereopsis)
 - convergence
 - amount eyes rotate toward center of interest
 - like optical range finder

Ware: Space Perception

- droplines,
- background grids

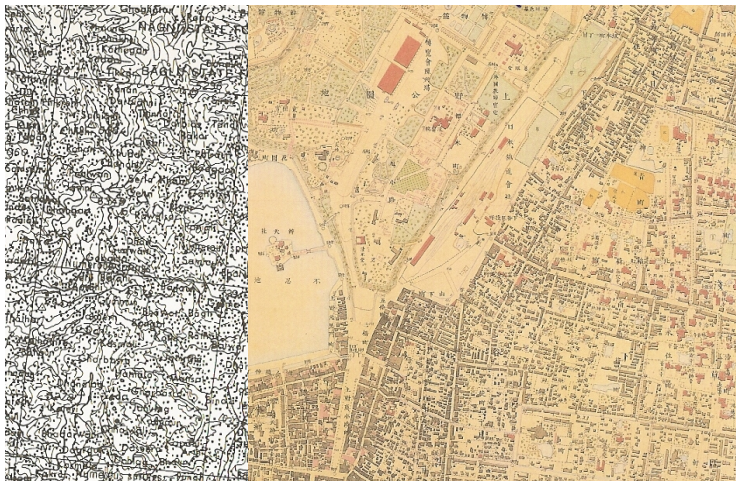


- depth cueing



[Ware, Information Visualization: Perception for Design, Chap 8]

Layering And Separation



[Tuft, Envisioning Information, Chap 3]

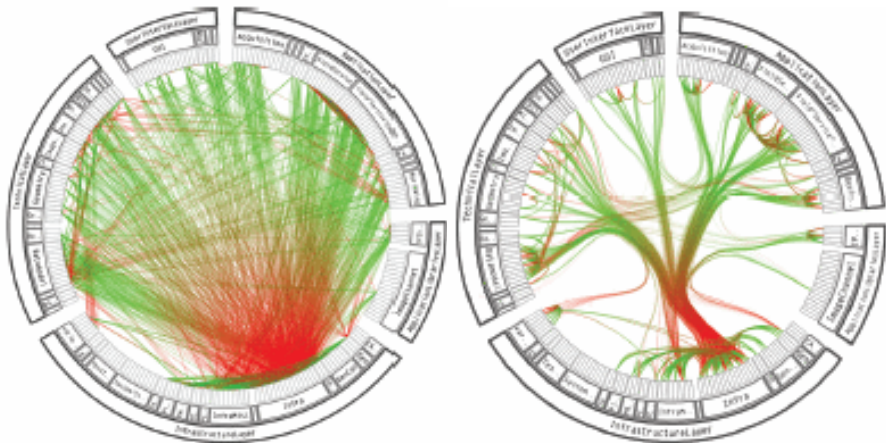
Visual Clutter

- subtler background than foreground



[Tuft, Envisioning Information, Chap 3]

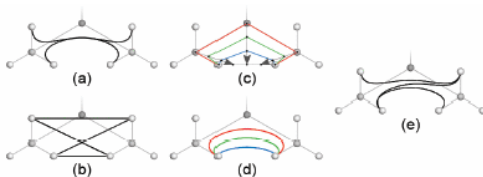
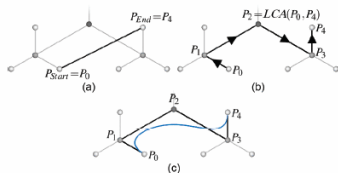
Hierarchical Edge Bundles



[Hierarchical Edge Bundles: Visualization of Adjacency Relations in Hierarchical Data. Danny Holten, Proc. InfoVis06.]

Hierarchical Edge Bundles

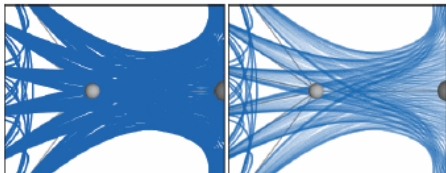
- bundle by hierarchy using splines



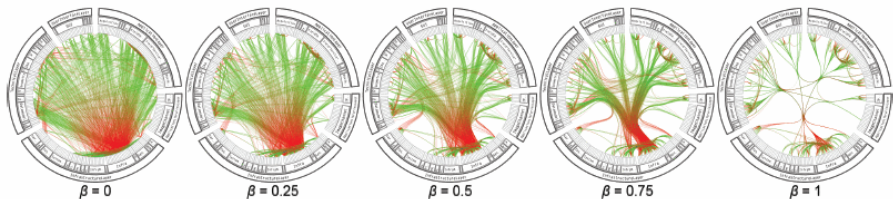
[Hierarchical Edge Bundles: Visualization of Adjacency Relations in Hierarchical Data. Danny Holten, Proc. InfoVis06.]

Hierarchical Edge Bundles

- alpha blending



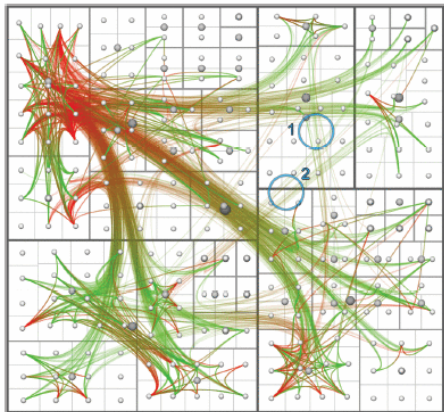
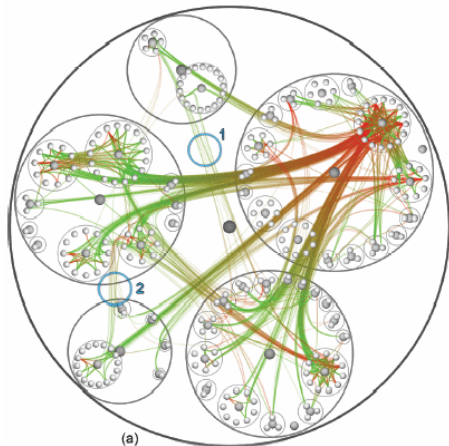
- bundling strength



[Hierarchical Edge Bundles: Visualization of Adjacency Relations in Hierarchical Data.
Danny Holten, Proc. InfoVis06.]

Hierarchical Edge Bundling

- (mostly) agnostic to layout



[Hierarchical Edge Bundles: Visualization of Adjacency Relations in Hierarchical Data.
Danny Holten, Proc. InfoVis06.]

Critique

- flexible and general idea
- simple - after you see it
- successful example of creating foreground layer

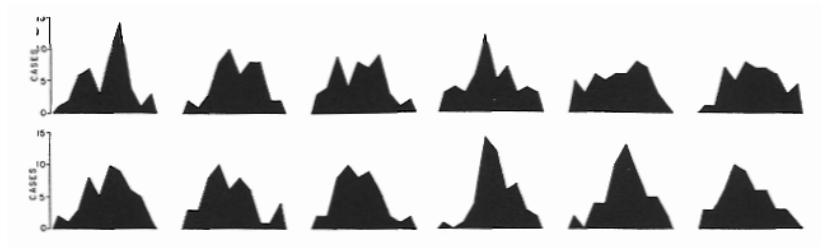
Space vs. Time: Showing Change

literal

abstract

← →
time for time space for time

- small multiples: show time using space
 - overview: show each time step in array
 - compare: side-by-side easier than temporal
 - external cognition instead of internal memory



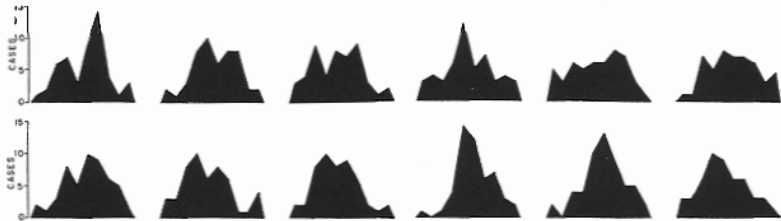
Space vs. Time: Showing Change

literal

abstract

← →
time for time space for time

- small multiples: show time using space
 - overview: show each time step in array
 - compare: side-by-side easier than temporal
 - external cognition instead of internal memory
 - general technique, not just for temporal changes



Space vs. Time: Showing Change

literal

abstract

← →
time for time space for time

- small multiples: show time using space
 - also can be good for showing process



[www.geom.uiuc.edu/graphics/pix/Video_Productions/Outside_In/postcard.comp.html]

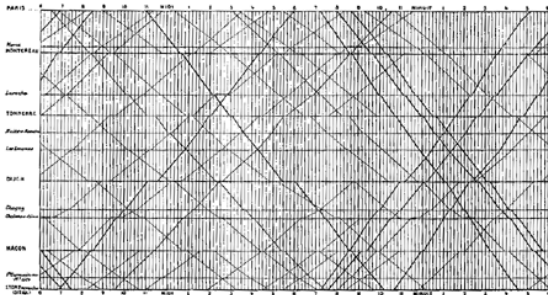
Animation vs. Small Multiples

- Tversky argument: intuition that animation helps is wrong
 - meta-review of previous studies
 - often more info shown in animation view so not a fair comparison
 - carefully chosen segmentation into small multiples better than animation if equivalent information shown

[Animation: Can It Facilitate? Barbara Tversky, Julie Morrison, Mireille Betrancourt. International Journal of Human Computer Studies 57:4, pp 247-262, 2002.]

Derived Spaces: Slope

- narrative of space and time
- Marey train schedule, 1885
 - horizontal line length: stop length
 - slope: speed
 - intersection: time/place of crossing



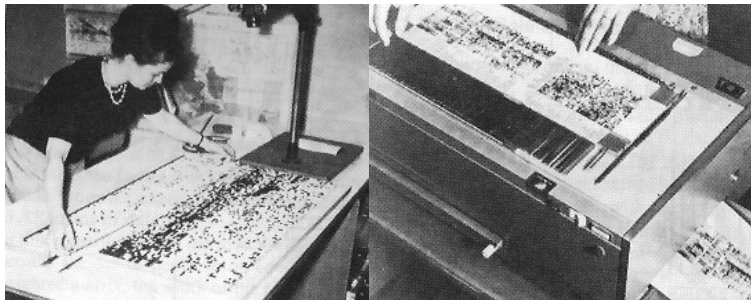
[Tufte I p 31, www.nap.edu/html/hs_math/images/tl_f8.gif]

Sorting and Ordering

- derived spaces for ordering
- spatial position as strongest perceptual cue
- finding the right order
 - automatically
 - through exploration

Manual Ordering: Bertin

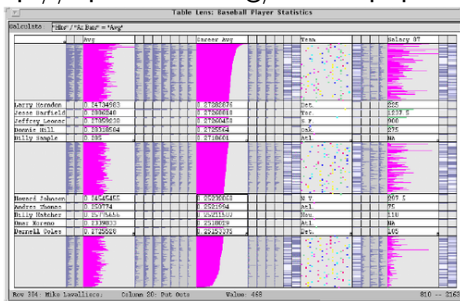
- reorderable matrices - manually!



[Bertin, Graphics and Graphic Information Processing, p 34]

Interactive Ordering: Table Lens

- click to sort by columns
- also, is focus+context approach
- video: <http://open-video.org/details.php?videoid=8304>



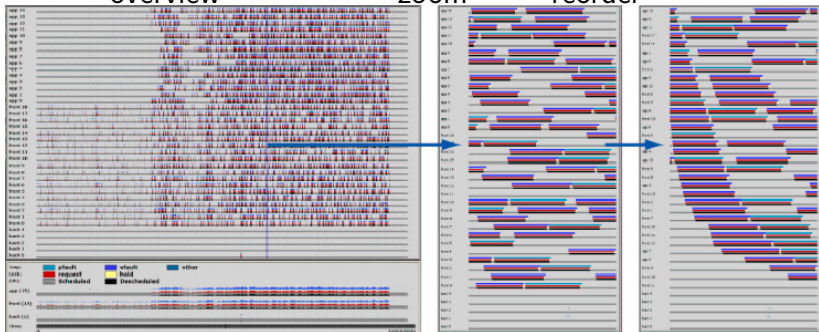
Interactive Ordering: Rivet

- performance analysis of parallel system
- order: machine name vs. lock acquisition time

overview

zoom

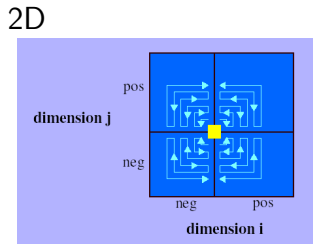
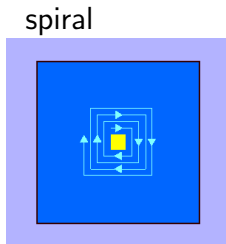
reorder



[Bosch, Performance Analysis and Visualization of Parallel Systems Using SimOS and Rivet: A Case Study, HPCA6, 2000.
graphics.stanford.edu/papers/rivet_argus]

VisDB: Spacefilling Pixels

- how to draw pixels?
 - sort, color by relevance
- local ordering

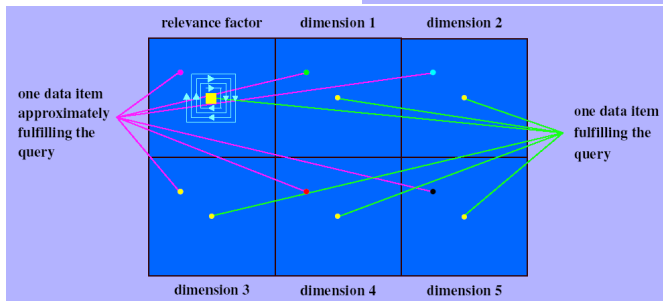
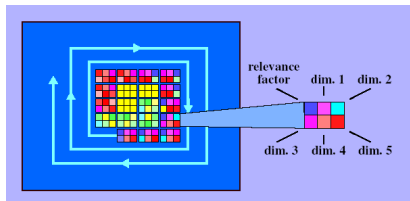


[VisDB: Database Exploration using Multidimensional Visualization, Keim and Kriegel, IEEE CG&A, 1994 www.dbs.informatik.uni-muenchen.de/dbs/projekt/papers/visdb.ps]

VisDB Windows

grouped dimensions

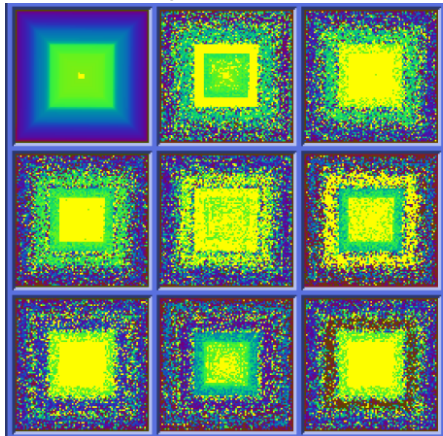
separate dimensions



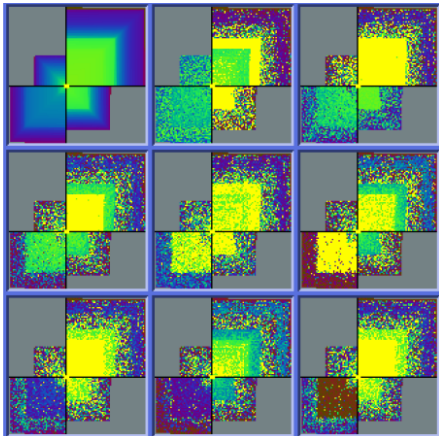
[VisDB: Database Exploration using Multidimensional Visualization, Keim and Kriegel, IEEE CG&A, 1994 www.dbs.informatik.uni-muenchen.de/dbs/projekt/papers/visdb.ps]

VisDB Results: Separate Dimensions

spiral

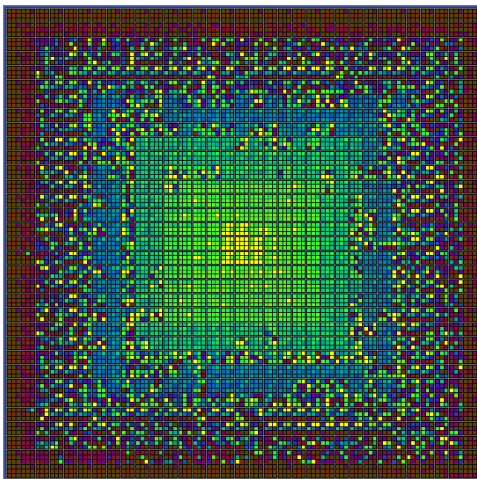


2D



[VisDB: Database Exploration using Multidimensional Visualization, Keim and Kriegel, IEEE CG&A, 1994 www.dbs.informatik.uni-muenchen.de/dbs/projekt/papers/visdb.ps]

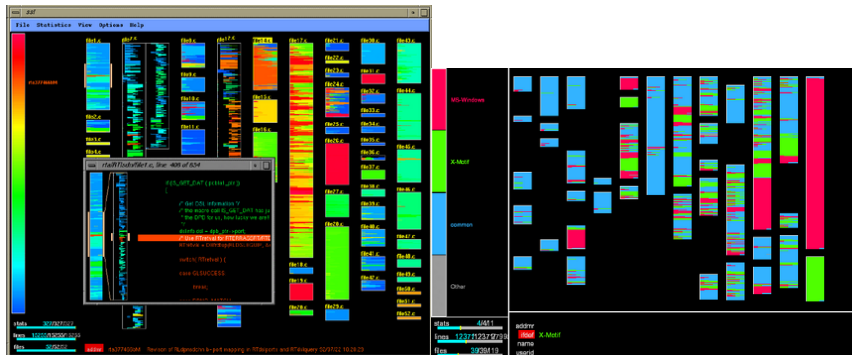
VisDB Results: Grouped Dimensions



[VisDB: Database Exploration using Multidimensional Visualization, Keim and Kriegel, IEEE CG&A, 1994 www.dbs.informatik.uni-muenchen.de/dbs/projekt/papers/visdb.ps]

Another Pixel-Oriented Example

- SeeSoft from AT&T



[Ball and Eick, Software Visualization in the Large, IEEE Computer 29:4, 1996 citeseer.nj.nec.com/ball96software.html]

VisDB Critique

- pixel-oriented methods have power
- but studies needed
 - are spacefilling curves understandable
 - when does visual complexity overwhelm

Readings For Next Time

Tufte, Chapter 2: Micro/Macro Readings

Ware, Chapter 10: Interacting with Visualizations: second half, p 325-345

A review of overview+detail, zooming, and focus+context interfaces.
Andy Cockburn, Amy Karlson, and Benjamin B. Bederson. ACM Computing Surveys 41(1), 2008.

OrthoZoom Scroller: 1D Multi-Scale Navigation. Catherine Appert and Jean-Daniel Fekete. Proc. SIGCHI 06, pp 21-30.