

Lecture 7: Single View Methods

Information Visualization
CSPC 533C, Fall 2011

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Required Readings

Chapter 5: Single View Methods

Trellis paper moved to Multiple Views on Monday

Further Reading

Milestones in the History of Thematic Cartography, Statistical Graphics, and Data Visualization. Friendly and Denis.
<http://www.math.yorku.ca/SCS/Gallery/milestones/>

Bars and Lines: A Study of Graphic Communication. Zacks and Tversky. Memory and Cognition 27(6):1073-1079, 1999.

Multi-Scale Banking to 45 Degrees. Heer and Agrawala. IEEE TVCG 12(5) (Proc. InfoVis 2006), Sep/Oct 2006, pages 701-708.

Overview Use in Multiple Visual Information Resolution Interfaces. Lam, Munzner, and Kincaid. Proc. InfoVis 2007.

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

Principles, Methods, and Techniques...

- part 1: principles (3 chapters)
 - why underlying many design decisions
 - data, visual encoding, interaction
- part 2: methods (4 chapters)
 - what are the axes of the (current) design space
 - taxonomy of design considerations
 - how many views? single, multiple
 - how to reduce what's shown? data, dimensions
- part 3: techniques (3 lectures [= 4 chapters...])
 - analyze techniques by which methods/principles used
 - tables, graphs, (text/log), spatial
 - grouped by data type to follow nested model
 - technique level design happens after data type chosen at abstraction level

... and Practice

- part 4: practice (2 lectures)
 - problem identification and task abstraction
 - validation at problem, abstraction, technique levels
 - research process/papers

Experiment

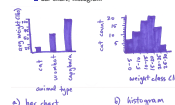
- which lecture style works best?
- summarize chapters thoroughly
 - last several lectures
 - if book doing its job, maybe other choices viable!
- summarize lightly
 - also bring up other ideas/approaches
 - more time for discussion
 - trying this today
- end of class: get feedback from you

Single View Methods

- all information integrated in one view
 - basic visual encodings
 - spatial position
 - color
 - other channels
 - pixel-oriented techniques
 - visual layering
 - global compositing
 - item-level stacking
 - glyphs

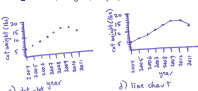
Spatial Position

- most statistical graphics
 - bar chart, histogram



Spatial Position

- most statistical graphics
 - bar chart, histogram, dot plot, line chart

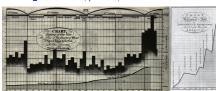


Statistical Graphics

- heavy focus on spatial position for visual encoding
- long history for paper-based views of data
 - springboard for infovis
<http://www.datavis.ca/milestones/>
 - many ways to make interactive (more later)
 - many ways to refine/improve/combine

Line Charts

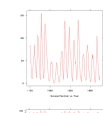
- invented by William Playfair (1759-1823)
 - also bar charts, pie charts, ...



http://teleport.open.ac.uk/files.php/1877/Ma1202_2001.png
<http://www.research.att.com/~csli/trellis/images/playfair-wireless.gif>

Banking to 45 Degrees

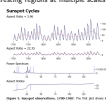
- previous work by Cleveland
- perceptual principle: most accurate angle judgement at 45 degrees
- pick line graph aspect ratio (height/width) accordingly



<http://www.research.att.com/~csli/trellis/bankplot.html>

Multiscale Banking to 45

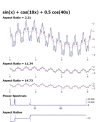
- frequency domain analysis
- find interesting regions at multiple scales



[Multi-Scale Banking to 45 Degrees. Heer and Agrawala. Proc InfoVis 2006
<http://doi.ieeecomputesociety.org/10.1109/InfoVis.2006.10>]

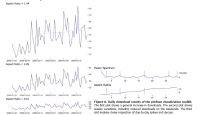
Choosing Aspect Ratios

- FFT the data, smooth by convolve with Gaussian
- find interesting spikes/ranges in power spectrum
- call nearby regions if too similar, ensure overview shown
- create trend curves for each aspect ratio



Multiscale Banking to 45

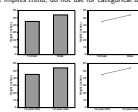
Download of the perfect bank!



[Multi-Scale Banking to 45 Degrees. Heer and Agrawala. Proc InfoVis 2006
<http://www.research.att.com/~csli/trellis/bankplot.html>]

Bar vs Line Charts

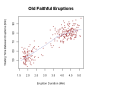
- line implies trend, do not use for categorical data



[Fig 2. Zacks and Tversky. Bars and Lines: A Study of Graphic Communication. Memory and Cognition 27(6):1073-1079, 1999.]

Scatterplots

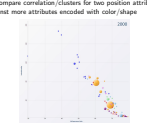
- encode two input variables with spatial position
 - show positive/negative/no correlation between variables
 - show clusters: clumpiness/density, shape, overlap



[http://upload.wikimedia.org/wikipedia/commons/0/0f/OldFaithful.jpg]

Scatterplots


- or compare correlation/clusters for two position attributes against more attributes encoded with color/shape



[Fig. 1: Robertson et al. Effectiveness of Animation in Trend Visualization. IEEE Trans. on Visualization and Computer Graphics. 14(5):1324-1332 (Proc. InfoVis04), 2004.]

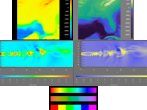
Colormap Taxonomy

- <http://www.colorbrewer.org>



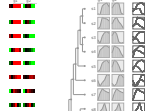
[Brewer, www.personal.psu.edu/~tony/vis/vis2003/ColorScl/Schema.html]

Rainbows: The Good, The Bad, The Ugly




[Fig. 3: Riggs and Tenish. Data visualization: the end of the rainbow. IEEE Spectrums. 32(12):30-38 1995.] [Fig. 2.1: Bergman and Riggs and Tenish. A Rule-based Tool for Analyzing Colormap Selection. Proc. IEEE Vis 1995, p. 118-125.] [Webinars: <http://www.ccs.cmu.edu/~gh/learnFac/>]

Accuracy/InfoDensity Tradeoff: Position/Color



[Fig. 4b.4: Mayer et al. PathVis: A Tool for Comparison Functional Genomics. Proc. EuroVis 10, p. 1043-1052.]

Tradeoff: Empirical Study

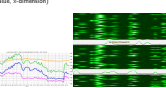


[Fig. 3. Lam, Manton, and Kincaid. Overview Use in Multiple Visual Information Resolution Interfaces. Proc. InfoVis 2007.]

Study: Control Room Scenario

Which location has the highest power surge for the given time period? (find extreme value, y-dimension)

A fault occurred at the beginning of this recording, and resulted in a temporary power surge. Which location is affected the earliest? (find extreme value, x-dimension)



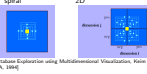
[Lam, Manton, and Kincaid. Overview Use in Multiple Visual Information Resolution Interfaces. Proc. InfoVis 2007.]

Study: Findings

- tasks
 - Max: simple, local, no comparison
 - Min: complex, dispersed, no comparison
 - Shape: complex, local, comparison
 - Compare: simple, local, comparison
- results
 - low-res / high-density used:
 - simple/local targets
 - (other findings about focus-i-context vs overview/detail)
- see also horizon graphs study

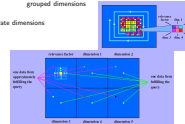
Pixel-Oriented Methods: VisDB

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



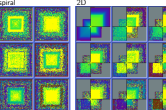
[VisDB: Database Exploration using Multidimensional Visualization, Kain and Krieger, IEEE CG&A, 1996.]

VisDB Windows



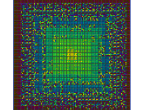
[VisDB: Database Exploration using Multidimensional Visualization, Kain and Krieger, IEEE CG&A, 1996.]

VisDB Results: Separate Dimensions



[VisDB: Database Exploration using Multidimensional Visualization, Kain and Krieger, IEEE CG&A, 1996.]

VisDB Results: Grouped Dimensions




[VisDB: Database Exploration using Multidimensional Visualization, Kain and Krieger, IEEE CG&A, 1996.]

Visual Layering

- beyond simple use of visual channels
- method variants
 - global compositing: everything superimposed
 - item-level stacking
- major consideration
 - static layers: disjoint ranges in channels safest
 - dynamic/interactive layers: more freedom

Visual Layering: Constellation

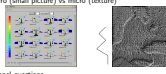
- global compositing, dynamic layers
- video



[Mazon: Constellation: Linguistic Semantic Networks. Interactive Visualization of Large Graphs and Networks (INFOVIS) Chapter 5. Stanford University, 2003, pp. 87-122. http://graphics.stanford.edu/papers/mazon_constellation/]

Glyphs

- compound marks
- macro (small picture) vs micro (texture)



- channel questions
 - separability
 - effectiveness principle: importance matching

[Fig. 9: Information Rich Glyphs for Software Management, IEEE CG&A 18:4 1996.] [Fig. 2: Smith and Cristofari and Bergman. Interactive data exploration with a supercomputer. Proc. IEEE Visualization (InfoVis) 1998, p. 248-256.]

Questions/Discussion

Experiment: Feedback

- which lecture style works best?
- summarize chapters thoroughly
 - last several lectures
 - if book doing its job, maybe other choices viable!
- summarize lightly
 - more time for other/further ideas/approaches
 - more time for discussion
 - trying this today
- your preferences?

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Reading For Next Time

Chapter 6: Multiple View Methods

The Visual Design and Control of Trellis Display. R. A. Becker, W. S. Cleveland, and M. J. Shyu (1996). *Journal of Computational and Statistical Graphics*, 5:123-155.

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