Ch 12: Facet Across Multiple Views
Paper: BallotMaps

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CPSC 547, Information Visualization
Day 13: 14 February 2017

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

News

- pitches: email slides by noon Thu (Subject: 547 pitch)
  - 3 min per pitch (http://www.cs.ubc.ca/~tmm/courses/547-17/projectdesc.html#pitches page updated)
    - do practice!
  - say explicitly if actively looking for partner
  - if you're sure you're already partnered, then second person should build after what first person says. tell me when you send slides so you're back to back
  - external people will go at the end
- Thu to read
  - VAD Ch. 13: Reduce Items and Attributes
  - no second reading, use time to think about projects, prepare/practice your pitches
- reminder: no class next week (reading week!)
- presentation length update: 25 min slot (20 min present, 5 min discuss)

Exercise followup

- groups discuss solutions
- we discuss BallotMaps published solution

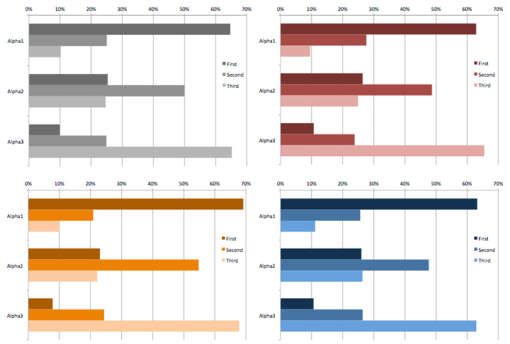
BallotMaps

- ballots in the UK are alphabetically ordered
  - govt: not sufficient to affect electoral outcome
  - researcher hunch: it matters!
- how to support visual exploration of dataset
  - Greater London elections 2010
  - geographic location, candidate name, alphabetical position in ballot, # candidate votes, party, elected/lost
  - compare geographic regions of voting and spatial position of candidate name on ballot paper
  - color coding will not save the day

[BallotMaps: Detecting name bias in alphabetically ordered ballot papers. Wood, J., Badawood, D., Dykes, J. & Slingsby, A. (2011). IEEE Transactions on Visualization and Computer Graphics, 17(12), pp. 2384-2391.]

Deriving data: BallotMaps

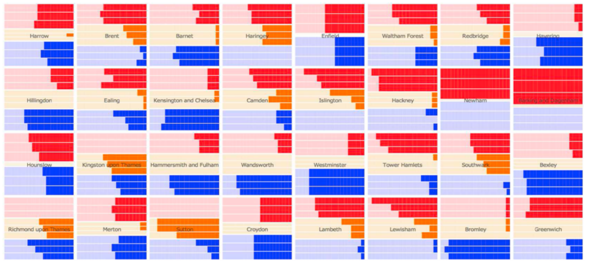
- deriving new data
  - alphabetical position within the party
  - vote order within party
  - (#, % of party votes)
- bars all same length if name order bias does not exist
  - hmmmm



[Fig 5. BallotMaps: Detecting name bias in alphabetically ordered ballot papers Wood, Badawood, Dykes, Slingsby. IEEE Trans. Visualization and Computer Graphics (Proc. InfoVis 2011), 17(12): 2384-2381, 2011]

Deriving data: BallotMaps

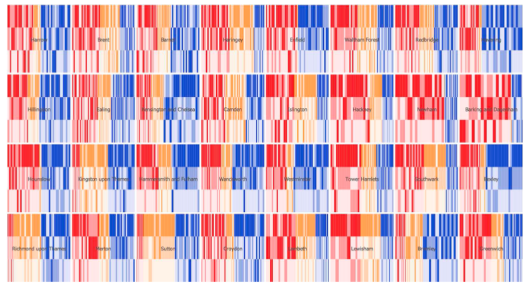
- BallotMap showing electoral success (or otherwise) of each candidate for the three main parties in wards (small rectangles) in each London borough (grid squares) in the 2010 local government elections. Vertical ordering of candidates within each borough is by ballot paper position within party (top row first, middle row second, bottom row third).
- bias exists in regions where systematic structure in bar lengths visible
  - yes in some
  - no in others



[Fig 1, BallotMaps: Detecting name bias in alphabetically ordered ballot papers Wood, Badawood, Dykes, Slingsby. IEEE Trans. Visualization and Computer Graphics (Proc. InfoVis 2011), 17(12): 2384-2381, 2011]

BallotMaps

- alpha position within party (vertical position) and voting rank within party for the three main parties in each ward (vertical bars) in each borough (grid squares)
- if no name order bias existed, dark and light cells randomly distributed
- voting data show that darker cells (indicating a candidate most votes within their party) are more common in the upper third (listed first on the ballot paper within their party) and lighter cells (least their on the ballot paper)



[Fig 4. BallotMaps: Detecting name bias in alphabetically ordered ballot papers Wood, Badawood, Dykes, Slingsby. IEEE Trans. Visualization and Computer Graphics (Proc. InfoVis 2011), 17(12): 2384-2381, 2011]

BallotMaps

- derived data
  - signed chi
    - take into account multiple parties
  - residual
    - take into account alphabetical bias
      - "name order bias"

Table 2. Secondary derived variables constructed for visual exploration in HiDE

Name	Votes	Combined
Alpha position in party (1-3)	# party votes	Signed chi
	% of party vote	Residual
	Vote order in party (1-3)	

The signed chi statistic [25] was calculated to give an indication as to the variation in votes acquired by candidates relating to issues other than party affiliation as

$$\chi = \frac{obs - exp}{\sqrt{exp}} \quad (1)$$

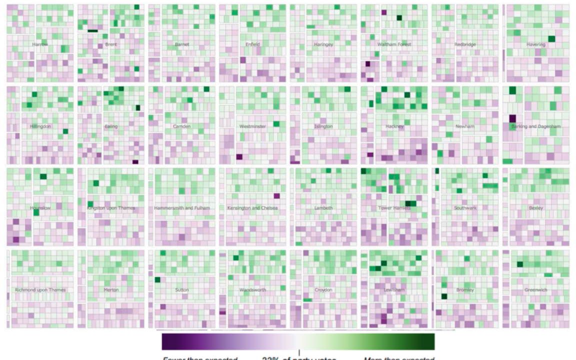
where the expected number of votes for each candidate was one third of the total party votes for their ward (each candidate in the sample stood in a ward with two other candidates from the same party) and

the observed value was the actual number of votes received by the candidate. Thus positive values of χ indicate that the candidate received more than the expected number of votes if only political party was assumed to influence candidate choice, while negative values indicate fewer than expected votes were received.

The residual measure was designed to identify anomalies that did not show name ordering bias and was calculated as the difference between the percentage of party votes received by a candidate and that expected for an average candidate with the same 'alpha' (alphabetical) position with their party. Thus while the chi statistic assesses the degree of name order bias, the residual identifies candidates that have greater or fewer votes than predicted given their party affiliation having taken any name order bias into account.

Deriving data: BallotMaps

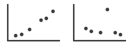
- does inferred ethnicity of name matter?
  - English/Celtic on right
  - "foreign" on left
  - derived: more/fewer votes than expected
- degree of name order bias shown by strength of green/purple separation
  - varies by region and name ethnicity



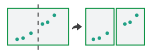
[BallotMaps: Detecting name bias in alphabetically ordered ballot papers Wood, Badawood, Dykes, Slingsby. IEEE Trans. Visualization and Computer Graphics (Proc. InfoVis 2011), 17(12): 2384-2381, 2011]

Facet

→ **Juxtapose**



→ **Partition**



→ **Superimpose**

Juxtapose and coordinate views

→ Share Encoding: Same/Different

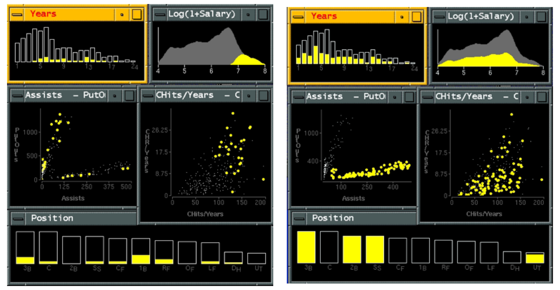
→ *Linked Highlighting*

→ Share Data: All/Subset/None

→ Share Navigation

Idiom: **Linked highlighting** System: **EDV**

- see how regions contiguous in one view are distributed within another
  - powerful and pervasive interaction idiom
- encoding: different
  - *multiform*
- data: all shared



[Visual Exploration of Large Structured Datasets. Wills. Proc. New Techniques and Trends in Statistics (NTTS), pp. 237–246. IOS Press, 1995.]

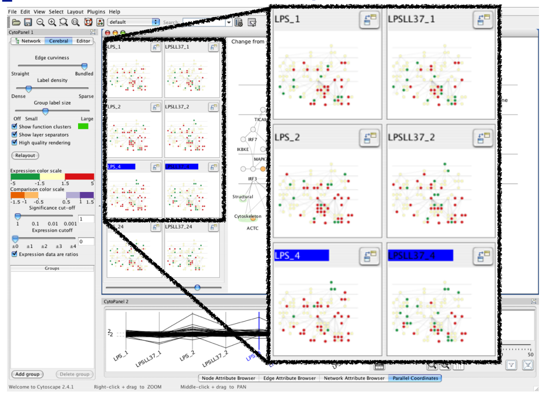
Idiom: **bird's-eye maps** System: **Google Maps**

- encoding: same
- data: subset shared
- navigation: shared
  - bidirectional linking
- differences
  - viewpoint
  - (size)
- ***overview-detail***

[A Review of Overview+Detail, Zooming, and Focus+Context Interfaces. Cockburn, Karlson, and Bederson. ACM Computing Surveys 41:1 (2008), 1–31.]

Idiom: **Small multiples** System: **Cerebral**

- encoding: same
- data: none shared
  - different attributes for node colors
  - (same network layout)
- navigation: shared



[Cerebral: Visualizing Multiple Experimental Conditions on a Graph with Biological Context. Barsky, Munzner, Gardy, and Kincaid. IEEE Trans. Visualization and Computer Graphics (Proc. InfoVis 2008) 14:6 (2008), 1253–1260.]

Coordinate views: Design choice interaction

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

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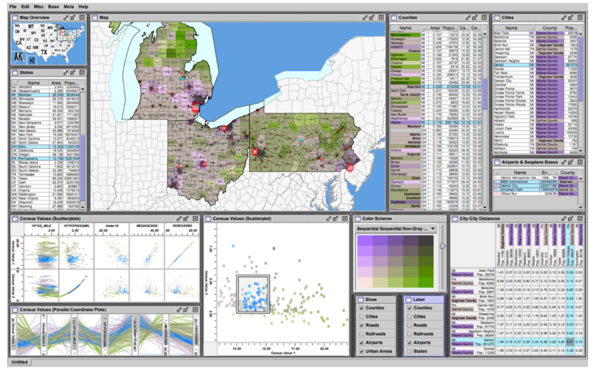
Juxtapose design choices

- design choices
  - view count
    - few vs many
      - how many is too many? open research question
  - view visibility
    - always side by side vs temporary popups
  - view arrangement
    - user managed vs system arranges/aligns
- why juxtapose views?
  - benefits: eyes vs memory
    - lower cognitive load to move eyes between 2 views than remembering previous state with 1
  - costs: display area
    - 2 views side by side each have only half the area of 1 view

System: **Improvise**

- investigate power of multiple views
  - pushing limits on view count, interaction complexity
  - reorderable lists
    - easy lookup
    - useful when linked to other encodings

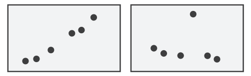


[Building Highly-Coordinated Visualizations In Improvise. Weaver. Proc. IEEE Symp. Information Visualization (InfoVis), pp. 159–166, 2004.]

Partition into views

- how to divide data between views
  - encodes association between items using spatial proximity
  - major implications for what patterns are visible
  - split according to attributes
- design choices
  - how many splits
    - all the way down: one mark per region?
    - stop earlier, for more complex structure within region?
  - order in which attribs used to split
  - how many views

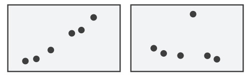
Partition into Side-by-Side Views



Views and glyphs

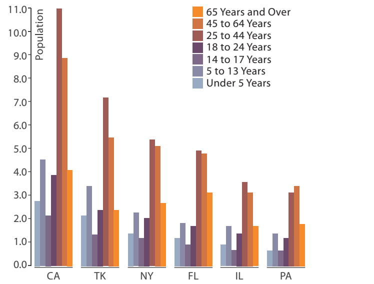
- *view*
  - contiguous region in which visually encoded data is shown on the display
- *glyph*
  - object with internal structure that arises from multiple marks
- no strict dividing line
  - view: big/detailed
  - glyph: small/iconic

Partition into Side-by-Side Views

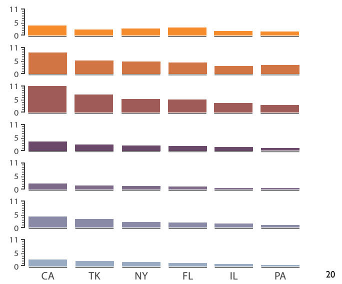


Partitioning: List alignment

- single bar chart with grouped bars
  - split by state into regions
    - complex glyph within each region showing all ages
  - compare: easy within state, hard across ages



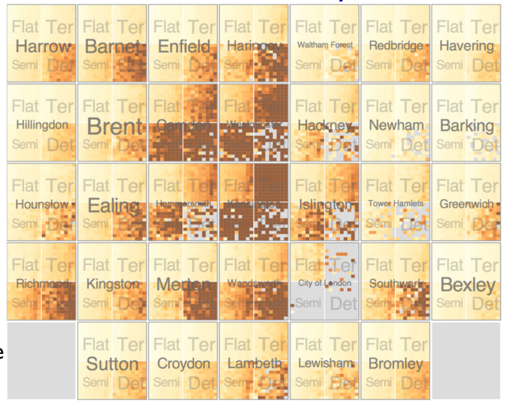
- small-multiple bar charts
  - split by age into regions
    - one chart per region
  - compare: easy within age, harder across states



Partitioning: Recursive subdivision

System: **HIVE**

- split by neighborhood
- then by type
- then time
  - years as rows
  - months as columns
- color by price
- neighborhood patterns
  - where it's expensive
  - where you pay much more for detached type



[Configuring Hierarchical Layouts to Address Research Questions. Slingsby, Dykes, and Wood. IEEE Transactions on Visualization and Computer Graphics (Proc. InfoVis 2009) 15:6 (2009), 977–984.]

Partitioning: Recursive subdivision

System: **HIVE**

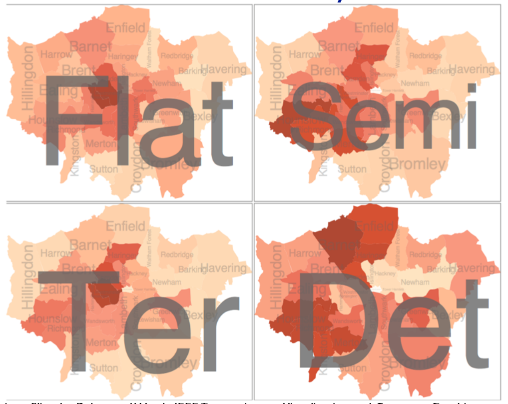
- switch order of splits
  - type then neighborhood
- switch color
  - by price variation
- type patterns
  - within specific type, which neighborhoods inconsistent

[Configuring Hierarchical Layouts to Address Research Questions. Slingsby, Dykes, and Wood. IEEE Transactions on Visualization and Computer Graphics (Proc. InfoVis 2009) 15:6 (2009), 977–984.]

Partitioning: Recursive subdivision

System: **HIVE**

- different encoding for second-level regions
  - choropleth maps

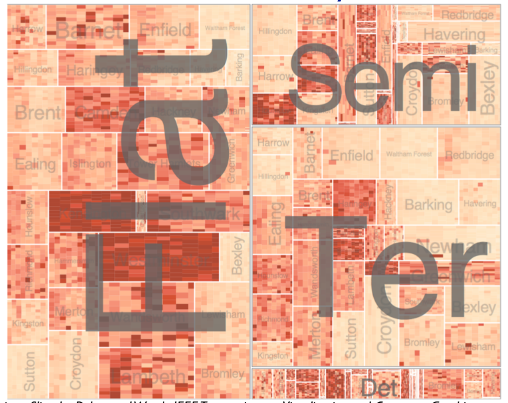


[Configuring Hierarchical Layouts to Address Research Questions. Slingsby, Dykes, and Wood. IEEE Transactions on Visualization and Computer Graphics (Proc. InfoVis 2009) 15:6 (2009), 977–984.]

Partitioning: Recursive subdivision

System: **HIVE**

- size regions by sale counts
  - not uniformly
- result: treemap

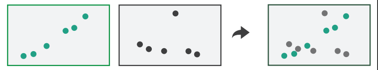


[Configuring Hierarchical Layouts to Address Research Questions. Slingsby, Dykes, and Wood. IEEE Transactions on Visualization and Computer Graphics (Proc. InfoVis 2009) 15:6 (2009), 977–984.]

Superimpose layers

- *layer*: set of objects spread out over region
  - each set is visually distinguishable group
  - extent: whole view
- design choices
  - how many layers?
  - how are layers distinguished?
  - small static set or dynamic from many possible?
  - how partitioned?
    - heavyweight with attribs vs lightweight with selection
- distinguishable layers
  - encode with different, nonoverlapping channels
    - two layers achieveable, three with careful design

Superimpose Layers



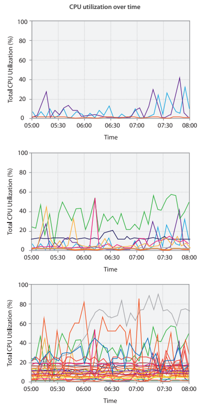
Static visual layering

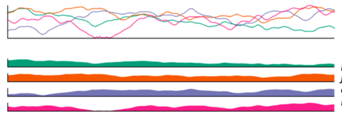
- foreground layer: roads
  - hue, size distinguishing main from minor
  - high luminance contrast from background
- background layer: regions
  - desaturated colors for water, parks, land areas
- user can selectively focus attention
- "get it right in black and white"
  - check luminance contrast with greyscale view

[Get it right in black and white. Stone. 2010. http://www.stonesc.com/wordpress/2010/03/get-it-right-in-black-and-white]

Superimposing limits

- few layers, but many lines
  - up to a few dozen
  - but not hundreds
- superimpose vs juxtapose: empirical study
  - superimposed for local visual, multiple for global
  - same screen space for all multiples, single superimposed
  - tasks
    - local: maximum, global: slope, discrimination



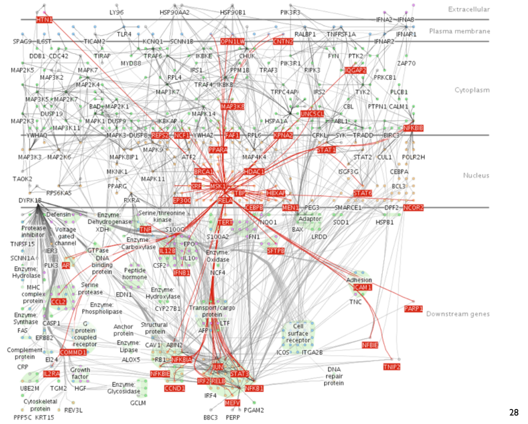


[Graphical Perception of Multiple Time Series. Javed, McDonnel, and Elmqvist. IEEE Transactions on Visualization and Computer Graphics (Proc. IEEE InfoVis 2010) 16:6 (2010), 927–934.]

Dynamic visual layering

System: **Cerebral**

- interactive, from selection
  - lightweight: click
  - very lightweight: hover
- ex: 1-hop neighbors



[Cerebral: a Cytoscape plugin for layout of and interaction with biological networks using subcellular localization annotation. Barsky, Gardy, Hancock, and Munzner. Bioinformatics 23:8 (2007), 1040–1042.]

Further reading

- Visualization Analysis and Design. Munzner. AK Peters / CRC Press, Oct 2014.
  - *Chap 12: Facet Into Multiple Views*
- *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.
- *Zooming versus multiple window interfaces: Cognitive costs of visual comparisons.* Plumlee and Ware. ACM Trans. on Computer-Human Interaction (ToCHI) 13:2 (2006), 179–209.
- *Exploring the Design Space of Composite Visualization.* Javed and Elmqvist. Proc. Pacific Visualization Symp. (PacificVis), pp. 1–9, 2012.
- *Visual Comparison for Information Visualization.* Gleicher, Albers, Walker, Jusufi, Hansen, and Roberts. Information Visualization 10:4 (2011), 289–309.
- *Guidelines for Using Multiple Views in Information Visualizations.* Baldonado, Woodruff, and Kuchinsky. In Proc. ACM Advanced Visual Interfaces (AVI), pp. 110–119, 2000.
- *Cross-Filtered Views for Multidimensional Visual Analysis.* Weaver. IEEE Trans. Visualization and Computer Graphics 16:2 (Proc. InfoVis 2010), 192–204, 2010.
- *Linked Data Views.* Wills. In Handbook of Data Visualization, Computational Statistics, edited by Unwin, Chen, and Härdle, pp. 216–241. Springer-Verlag, 2008.
- *Glyph-based Visualization: Foundations, Design Guidelines, Techniques and Applications.* Borgo, Kehrer, Chung, Maguire, Laramee, Hauser, Ward, and Chen. In Eurographics State of the Art Reports, pp. 39–63, 2013.