Lectures 3&4: Facet into Multiple Views

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

Arrange → Express → Separate

Order → Align

Use

Map from **categorical** and **ordered** attributes

- Color
  - Hue
  - Saturation
  - Luminance

- Size, Angle, Curvature, ...

- Shape
  - + ● ■ △

- Motion
  - Direction, Rate, Frequency, ...

Manipulate

- Change
  - Hue

- Select
  - Partition

- Navigate
  - Superimpose

Facet

- Juxtapose

Reduce

- Filter
  - Aggregate

What?

Why?

How?
How to handle complexity: 1 previous strategy + 3 more

- Derive
  - derive new data to show within view
  - change view over time
  - facet across multiple views
  - reduce items/attributes within single view

Manipulate
- Change
- Select
- Navigate

Facet
- Juxtapose
- Partition
- Superimpose

Reduce
- Filter
- Aggregate
- Embed
Facet

- **Juxtapose**

- **Partition**

- **Superimpose**
Juxtapose and coordinate views

• linked views
  • simultaneously visible multiple views
  • linked together such that actions in one view affect the others

➤ Share Encoding: Same/Different

➤ Linked Highlighting

➤ Share Data: All/Subset/None

➤ Share Navigation
**Idiom: Linked highlighting**

- see how regions contiguous in one view are distributed within another
  - powerful and pervasive interaction idiom

- encoding: different
  - multiform
   - rationale: single monolithic view has strong limits on number of attributes that can be shown simultaneously

- data: all shared

Linked views

- unidirectional vs bidirectional linking

http://www.ralphstraumann.ch/projects/swiss-population-cartogram/
http://peterbeshai.com/linked-highlighting-react-d3-reflux/
Complex linked multiform views

System: Pathfinder

https://www.youtube.com/watch?v=aZF7AC8aNXo
Idiom: **bird’s-eye maps**

- encoding: same
- data: subset shared
- navigation: shared
  - bidirectional linking

- differences
  - viewpoint
  - (size)

- **overview-detail**

(System: **Google Maps**)

Overview-detail

https://www.youtube.com/watch?v=UcKDbGqHsdE
Shiny example

https://gallery.shinyapps.io/TSupplyDemand/
Idiom: **Parallel sets**

https://www.jasondavies.com/parallel-sets/

https://eagereyes.org/parallel-sets
Idiom: **Mosaic plots**

System: **Mondrian**

http://www.theusrus.de/blog/understanding-mosaic-plots/

http://www.theusrus.de/Mondrian/

http://www.theusrus.de/blog/making-movies/
Overview-detail

- multiscale: three viewing levels
  - tooling: processing (modern version: p5js.org)

https://www.youtube.com/watch?v=86p7brwuz2g
Shiny example

- APGI genome browser
  - tooling: R/Shiny
  - interactivity
    - tooltip detail on demand on hover
    - expand/contract chromosomes
    - expand/contract control panes

https://gallery.shinyapps.io/genome_browser/
Idiom: Small multiples

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

System: Cerebral

https://www.youtube.com/watch?v=76HhG1FQngI&t=2s

### Coordinate views: Design choice interaction

<table>
<thead>
<tr>
<th>Encoding</th>
<th>Data</th>
<th>Data</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All</td>
<td>Subset</td>
<td>None</td>
</tr>
<tr>
<td>Same</td>
<td>Redundant</td>
<td>Overview/Detail</td>
<td>Small Multiples</td>
</tr>
<tr>
<td>Different</td>
<td>Multiform</td>
<td>Multiform, Overview/Detail</td>
<td>No Linkage</td>
</tr>
</tbody>
</table>

• **why juxtapose views?**
  – benefits: eyes vs memory
    • lower cognitive load to move eyes between 2 views than remembering previous state with single changing view
  – costs: display area, 2 views side by side each have only half the area of one view
Why not animation?

- disparate frames and regions: comparison difficult
  - vs contiguous frames
  - vs small region
  - vs coherent motion of group

- safe special case
  - animated transitions
System: **Improvise**

- investigate power of multiple views
  - pushing limits on view count, interaction complexity
  - how many is ok?
    - open research question
- reorderable lists
  - easy lookup
  - useful when linked to other encodings

Video: Visual Analysis of Historical Hotel Visitation Patterns

https://www.youtube.com/watch?v=Tzsv6wkZoiQ

http://www.cs.ou.edu/~weaver/improvise/examples/hotels/
Partition into views

• how to divide data between views
  – split into regions by attributes
  – encodes association between items using spatial proximity
  – order of splits has major implications for what patterns are visible

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

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
Idiom: **Trellis plots**

- matrix alignment for small multiple plots
  - same issues as alignment for marks within plot!
- partition by
  - year for columns
  - site for rows (alphabetical)
- within pane
  - variety for vertical axis
  - yield for vertical position
Idiom: **Trellis plots**

- main effects ordering
  - order small-multiples plots based on derived data to see trends
  - order plots by median values
  - shared vertical axis within each plot ordered by median values within varieties
Partitioning: Recursive subdivision

- 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

Partitioning: Recursive subdivision

- switch order of splits
  - type then neighborhood

- switch color
  - by price variation

- type patterns
  - within specific type, which neighborhoods inconsistent
Partitioning: Recursive subdivision

- different encoding for second-level regions
  - choropleth maps

Partitioning: Recursive subdivision

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

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 to distinguish?
    • encode with different, nonoverlapping channels
    • two layers achievable, three with careful design
  – small static set, or dynamic from many possible?
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

Idiom: **Trellis plots**

- superimpose within same frame
  - color code by year
Superimposing limits

• few layers, but many lines
  – up to a few dozen
  – but not hundreds

• superimpose vs juxtapose: empirical study
  – superimposed for local, multiple for global
  – tasks
    • local: maximum, global: slope, discrimination
    – same screen space for all multiples vs single superimposed

Dynamic visual layering

- interactive, from selection
  - lightweight: click
  - very lightweight: hover

- ex: 1-hop neighbors

Dynamic visual layering

• one-hop neighbour highlighting demos: click vs hover

Further reading

  – Chap 12: Facet Into Multiple Views


