Information Visualization
Manipulate Interactive, Facet into Multiple, Scalable Insets
Ex: Complexity Families
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Week 9, 2 Nov 2022
https://www.cs.ubc.ca/~tmm/courses/547-22

- Plan for today
  - small group exercises
    - Complexity Families
  - backlog reading Q&A
    - WA/NV
  - this week reading Q&A
    - chap Manipulate Interactive, Multiple Views. paper: Scalable Insets
  - reminder: post-class office hours
    - if you want discussion of your project proposal feedback
      - especially if it told you to talk with me
    - all of you should have gotten written comments by email

- Upcoming
  - next week (W10): reading week, no class, no readings, no async discussion
    - work on projects!
  - week after (W11)
    - light: async reading/discussion
      - 1 reading: Ch 13. Redux
    - due Tue 3pm: project updates
      - in-class project peer reviews
      - each team will be reached with one another, will post on Piazza before Tue 3pm
      - read other team’s written update before class
  - review: critique B; than A critique A
  - review discussion/thoughts in IRC
  - in-class mini-lecture & Q/A catchup

- How to handle complexity: 1 previous strategy
  - how: data-driven reordering
  - why: find extreme values, trends

- Idiom: Change parameters
  - widgets and controls
    - sliders, buttons, radio buttons, checkboxes, dropdowns/toggle buttons
  - pros
    - clear affordances, self-documenting (with labels)
  - cons
    - uses screen space
  - design choices
    - separated vs interleaved
    - controls vs canvas

- Idiom: Change order/arrangement
  - what: simple table
  - how: data-driven reordering by selecting column
  - why: find extreme values, trends

- Idiom: Reorder
  - what: table with many attributes
  - why: find correlations between attributes

- Idiom: Change alignment
  - stacked bars
  - easy to compare
    - first segment
    - total bar
  - align to different segments
  - supports flexible comparison

- Idiom: Re-encode
  - derive new data to show within view
  - change view over time
  - facet across multiple views

- How to handle complexity: 1 previous strategy + 2 more
  - device: Change order/arrangement
    - how: data-driven reordering by selecting column
    - why: find extreme values, trends
  - device: Change parameters
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      - sliders, buttons, radio buttons, checkboxes, dropdowns/toggle buttons
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- Upcoming
  - week after that (W12)
    - async: last week of reading / discussion
      - Ch 14. Embedded Focus+Context

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- This week reading Q&A
- Async: no readings/discussion
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Idiom: Animated transitions - visual encoding change
• smooth transition from one state to another
  – alternative to jump cuts, supports item tracking
  – best case for animation
  – staging to reduce cognitive load

• animated transition – network drilldown/rollup

Idiom: Navigate: Changing viewpoint/visibility
• how: navigate page by scrolling (panning down)
  – familiar & intuitive, from standard web browsing
  – linear (up and down) vs possible overload of click-based interface choices
  – score: full-screen mode may look awkwardness
  – scrolling for direct access
  – unexpected behaviour
  – continuous control for discrete steps

Idiom: Animated transition - tree detail
• animated transition
  – network drilldown/rollup

Idiom: Animated transition + constrained navigation
• example: geographic map
  – simple zoom, only viewpoint changes, shapes preserved

Interaction technology
• what do you design for?
  – mouse & keyboard on desktop?
  – large screens, hover, multiple dots
  – touch interaction on mobile?
  – small screen, no hover, just tap
  – gestures from videos / sensors?
  – ergonomic reality vs movie bombastic
  – eye tracking?

Selection
• selection: basic operation for most interaction
  – how many selection types?
  – interaction modality:
    – click/tap ( heavyweight )
    – hover ( lightweight )
  – proximity beyond click/tap ( touching vs nearby vs distant
  – application semantics
    – adding vs selection set vs replacing selection

Manipulate

Highlighting
• highlight change visual encoding for selection targets
  – design choices:
    – feedback closely tied to but separable from selection
    – design choices: typical visual channels
      – change interface color
      – hot/cold existing color coding
      – add outline mark
      – change size (as increase outline mark linewidth)
      – change shape ( ex: from solid to dashed line for link mark)
    – unusual channels: motion
      – motion usually avoid for single view
      – with multiple views, could part draw attention to other views

Interaction benefits
• interaction pros
  – major advantage of computer-based vs paper-based visualization
  – empirical evidence that animated transitions help people stay oriented

Interaction limitations
• interaction has a time cost
  – sometimes minor, sometimes significant
  – degenerates to human-powered search in worst case
  – remembering previous state imposes cognitive load
  – controls may take screen real estate
  – or invisible functionality may be difficult to discover ( lack of affordances )
  – users may not interact as planned by designer
  – NYTimes logs show ~90% don’t interact beyond scrollytelling

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Visualization Analysis & Design

Interactive Views (Ch 11/12) II

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Questions?

How to handle complexity: 1 previous strategy + 2 more

• Derive
• Change
• Justuxtapose
• Select
• Partition
• Navigate
• Juxtapose and coordinate views
  - Share Encoding: Same/Different
  - Linked highlighting
  - Share Data: All/Subset/None
  - Share Navigation

Idiom: Juxtapose and coordinate views
  • encoding: same or different
  • data: subset shared
  • navigation: shared
  • other differences
  - encoding: same or different
  - data: subset shared
  - navigation: shared
  - other differences

Interactive small multiples
  • linked highlighting: analogous item/attribute across views
  — same year highlighted across all charts if hover over any chart

Example: Combining many interaction idioms

System: Buckets
  • multisets
  • multidirectional linked highlighting of small multiples
  • tooltips

Juxtapose views: tradeoffs
  • juxtapose costs
  • display area
  • 2 views side by side, each has only half the area of one view

Linked views: Directionality
  • unidirectional or bidirectional linking
  — bidirectional almost always better!

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### View coordination: Design choices

<table>
<thead>
<tr>
<th>Encoding</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td></td>
</tr>
<tr>
<td>Subset</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>

#### Idiom: Trellis plots

- few layers, more lines
- up to a dozen lines
- but not hundreds
- superimpose within same frame: empirical study
- same size: all multiples, vs single superimposed
- superimposed: local tasks
- juxtaposed: global tasks, esp. for many charts

#### System: Reorderable lists

- set views
- easy linking
- suitable when linked to other views
- many views in ask vs two outputs?
- open research question

#### System: Improvise

- juxtapose
- partition
- superimpose

#### Facet

- Juxtapose
- Partition
- Superimpose

#### Static visual layering

- foreground/road
- hue, size distinguishing man from mirror
- high luminance contrast from background
- background/layer: regions
- deinterlaced colors for water, parks, land areas
- user can selectively focus attention

#### Dynamic visual layering

- interactive, based on selection
- one-hop neighbour highlighting
  - click (heavyweight)
  - hover (fast)

#### Superimposing limits (static)

- superimpose: within same frame
  - color code by year
  - partitioning
  - split by state, rows are barby varieties
  - main-effects ordering
  - derive value of median for group
  - order rows within view by variety median
  - order views themselves by state median

### Juxtapose vs animate

- animate: hard to follow if many scattered changes or many frames
- easy special case: animated transitions
- juxtapose: easier to compare across small multiples—different conditions (color, same gene (lens))

### Partition into views

- how to divide data between views
- split into region by strata
- encodes association between items

### Partitioning: Recursive subdivision

- split by neighbourhood
  - by type
  - flat, terrains, semi-detached, detached
  - then time
  - months in calendars
  - color by price
  - neighbourhood patterns
  - where it is expensive
  - how you pay much more for detached type

### Partitioning: Grouped vs small-multiple bars

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

### Superimposing layers

- layer: set of objects spread out over region
  - each set is visually distinguishable
  - across: whole view
  - design choices
  - how many layers, how to distinguish?
  - merge with different, non-overlapping channels
  - two layers achievable, three with careful design
  - small static set, or dynamic from many possible?

### System: Hive

- flat, semi, term, det

## Configuring Hierarchical Layouts to Address Research Questions

- Slingsby, Dykes, and Wood.
- Get it right in black and white.
- Trellis plots
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## Example of Trellis Display

- Building High-Dimensional Visualization: Perumal

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