Interactive Views

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Upcoming
- Foundations 3: out Thu Jan 30, due Wed Feb 5 6pm
- Programming 2: out Thu Jan 30, due Wed Feb 12 6pm
- D3 videos/readings week 4
  - The General Update Pattern of D3.js (60 min)
  - Interaction with Undirected Data Flow (16 min)
- Read Reusable D3 Components
- Quiz 4, due by Fri Jan 31, 8am

How to handle complexity: 1 previous strategy + 3 more
- Change order/arrangement
- what: simple table
- how: data-driven reordering
- why: find extreme values, trends
[Sortable Bar Chart](https://bl.ocks.org/mbostock/3885705)

Idiom: Change order/arrangement
• animated transition
– network drilldown/rollup
15
[Collapsible Tree](https://bl.ocks.org/mbostock/4339083)

Idiom: Animated transitions - visual encoding change
• smooth transition from one state to another
  - smoothest: to jump cuts, supports semantic change
  - best case for animation
  - staging to reduce cognitive load
• example: animated transitions in statistical data graphics

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

Idiom: Re-encode
System: Tableau

Change Order
• what: simple table
• why: find extreme values, trends

Idiom: Re-order
System: DataStripes

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

Idiom: Change parameters
• widgets and controls
  - slider, buttons, radio buttons, checkboxes, dropdowns/combos

Idiom: Change view over time
• derive new data to show within view
• change view over time
• facet across multiple views
• reduce items/attributes within single view

Idiom: Animated transitions
• smooth interpolation from one state to another
  - smoothest: to jump cuts, supports semantic change
  - staging to reduce cognitive load
• example: hierarchical bar chart
  - add detail during transition to new level of detail

Quiz 4, due by Fri Jan 31, 8am

Manipulate

Idiom: Change over time
• change any of the other choices
  - encoding itself
  - parameters
    - arrange: rearrange, reorder
    - aggregation level, what is filtered...
  - interaction entails change

Idiom: Derive
• change any of the other choices

Interactive Views

Information Visualization

Lect 8/9/10, 30 Jan & 4/6 Feb 2020
Department of Computer Science
Tamara Munzner

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Manipulate

Change View Over Time
Select
Navigate
Item Reduction
Zoom
Pan/Translate
Constrained
Geometric or Semantic
Attribute Reduction
Slice
Cut
Project

Selection

- selection: basic operation for most interaction
- design choices
  - how many selection types?
  - interaction modalities
    - mouse & keyboard on desktop?
      - familiar & intuitive, from standard web browsing
      - changes which items are visible within view
      - more up-to-date/interactive
    - gestures from video / sensors?
      - minor advantage of computer-based vs paper-based visualization
      - interactivity: movements vs direct user actions
      - hard to control for user

Highlighting

- highlight: change visual encoding for selection targets
  - visual feedback closely tied to but separable from selection (interaction)
  - changes how items are visible within view
  - camera metaphor
    - pan/translate/scroll
    - more up-to-downways
  - changes which items are visible within view

Tooltips

- popup information for selection
  - hover or click
  - can provide useful additional detail on demand
  - a rollover or tooltip, assume nobody will see it. If it’s important, make it explicit.

Idiom: Scrolling/telling

- how: navigate page by scrolling (panning down)
- pros:
  - familiar & intuitive, from standard web browsing
- cost:
  - full-screen mode may lack affordances
  - scrolling, no direct access
  - unexpected behaviour
  - continuous control for discrete steps

Rule of thumb: Responsiveness is required

- visual feedback: three rough categories
  - 1-2 seconds: skeletal processing
    - response after mouseup, button press
    - human reaction time
  - 3-5 seconds: brief tasks
    - bounded response after dialog box
  - 10 seconds: long operations
    - mental model of heavyweight operation (file load)

Tooltips

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  - hover or click
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Idiom: Animated transition + constrained navigation

- example: icicle plot
  - transition into containing mark causes aspect ratio (shape) change
  - change shape (ex: from solid to dashed line for link mark)

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Interaction technology

- what to do for design?
  - mouse & keyboard on desktop?
  - large screen, fewer, multiple clicks
  - small screen, no hover, just tap
  - gestures from video / sensors?
  - ergonomic reality: mouse bombastic
- eye tracking!

Idiom: Animated transition + constrained navigation

- example: icicle plot
  - transition into containing mark causes aspect ratio (shape) change

Navigate: Changing viewpoint/visibility

- change viewpoint
  - moves which items are visible within view
  - camera metaphor
    - pan/translate/scroll
    - more up-to-downways

Navigate: Unconstrained vs constrained

- unconstrained navigation
  - easy to implement for designer
  - hard to control for user
  - easy to over/under-shoot

- constrained navigation
  - typically uses animated transitions
  - trajectory automatically computed based on selection
  - just click; selection ends up framed nicely in final view

Interaction benefits

- interaction pros
  - major advantage of computer-based vs paper-based visualization
    - flexible, powerful, intuitive
  - exploratory data analysis: change as you go during analysis process
  - fluid task switching defines visual encoding; supports different tasks
  - animated transitions provide excellent support
  - 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
  - no visible functionality may be difficult to discover (lack of affordances)
- users may not interact as planned by designer
  - NYTimes shows ~90% don’t interact beyond scrolling - Aisch, 2016
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

System: HIVE
Partitioning: List alignment
• single bar chart with grouped bars
– split by state into regions
– compare glyph within each region showing all ages
– compare easy within state, hard across ages
• small-multiple bar charts
– split by age into regions
– use chart per region
– compare easy within age, harder across states

Superimpose layers
• layer: set of objects spread out over region
– each set is visually distinguishable group
– systemic whole view
– design choices
– how many layers, how to distinguish?
• encode with different, nonoverlapping channels
• two layers schematic, three with careful design
• small static set, or dynamic from many possible?

Static visual layering
• foreground layer: roads
– hue, size distinguishing man 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

Dynamic visual layering
• interactive based on selection
• one-hop neighbour highlighting demos: click vs hover (lightweight)

System: Improvise
• investigate power of multiple views
• push into area of view count, interaction complexity
• how many is ok?
• open research
• colorblindness
• useful when linked to other encodings

Partition into views
• how to divide data between views
– split into regions by attributes
– encode association between items using spatial proximity
– order of splits has major implications for what patterns are visible
• no strict dividing line
– view: high-level
– contiguous region in which visually encoded data is shown on the display
– glyph: small-space
• object with internal structure that arises from multiple marks

System: HIVE
Partitioning: Recursive subdivision
• different encoding for second-level regions
– choropleth maps

Partition into Side-by-Side Views
• single bar chart with grouped bars
– split by state into regions
– compare glyph within each region showing all ages
– compare easy within state, hard across ages

System: Improvise
Partitioning: List alignment
• single bar chart with grouped bars
– split by state into regions
– compare glyph within each region showing all ages
– compare easy within state, hard across ages

System: HIVE
Partitioning: Recursive subdivision
• size regions by size counts
– not uniformly
• result: treemap

Idiom: Trellis plots
• superimpose within same frame
– color code by year
• partitioning
– split by site, rows are wheat varieties
• main-effects ordering
– derive value of median for group, use to order
– order rows within view by vary median
– order views themselves by site median

Credits
• Visualization Analysis and Design (Ch 11, 12)
• Alex Lee & Miriah Meyer: http://designcourse.net/