Data Visualization (CIS/DSC 468)

Interaction

Dr. David Koop
Good: Data magnitude $\Leftrightarrow$ Mark magnitude

[Flowing Data, 2012]
Tufte's Lie Factor

• Size of effect = (2nd value - 1st value) / (1st value)
• Lie factor = (size of effect in graphic) / (size of effect in data)
• In the graphic:

\[
\text{Lie Factor} = \frac{5.3 - 0.6}{0.6} = \frac{27.5 - 18}{18} = 14.8
\]
Maximize Data-to-Ink Ratio

[Graph showing male and female data distribution across different income brackets]

[Diagram with bars representing different categories and income brackets]

[via A. Lex]
Avoid Chartjunk
Assignment 3

- Soccer data
  - Draw two choropleth maps
  - Use the same function for both!
  - Draw a teammate graph using force-directed layout
  - Use d3.queue to load data, code provided
Map Example

- [http://codepen.io/dakoop/pen/ZeRMvr](http://codepen.io/dakoop/pen/ZeRMvr)
Interaction Overview

- **Change over Time**

- **Select**

- **Navigate**
  - **Item Reduction**
    - **Zoom**
      - Geometric or Semantic
    - **Pan/Translate**
    - **Constrained**
  - **Attribute Reduction**
    - **Slice**
    - **Cut**
    - **Project**

[Munzner (ill. Maguire), 2014]
Sorting

• Allow user to find patterns by reordering the data
• Do this with tabular data all the time
• Note that ordered attributes don't really need sorting
  - We can compare these attributes no matter what order
  - Instead, sort categorical attribute based on an ordered attribute
Example: LineUp

[Gratzl et al., 2013]
Example: LineUp

[Gratzl et al., 2013]
Animation: Jump Cut vs. Animated Transitions

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Animation: Jump Cut vs. Animated Transitions
Animation: Jump Cut vs. Animated Transitions

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### Animation: Jump Cut vs. Animated Transitions

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Animated Transitions

[http://bl.ocks.org/mbostock/3943967]
Animated Transitions

[http://bl.ocks.org/mbostock/3943967]
Animated Transitions

• "Jump cuts" are hard to follow
• Animations help users maintain sense of context between two states
• Empirical study showed that they work (Heer & Robertson, 2007)
Selection

- Selection is often used to initiate other changes
- User needs to select something to drive the next change
- What can be a selection target?
  - Items, links, attributes, (views)
- How?
  - mouse click, mouse hover, touch
  - keyboard modifiers, right/left mouse click, force
- Selection modes:
  - Single, multiple
  - Contiguous? (all together in one region)
Highlighting

- Selection is the user action
- Feedback is important!
- How? Change selected item's visual encoding
  - Change color: want to achieve visual popout
  - Add outline mark: allows original color to be preserved
  - Change size (line width)
  - Add motion: marching ants
Highlighting

• Selection is the user action
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• How? Change selected item's visual encoding
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Highlighting

Selection Outcomes

- Selection is usually a part of an action sequence
- Can filter, aggregate, reorder selected items
Responsiveness Required

- Delays are perceived by users
- Visual feedback
  - Show the user they did something (highlighting, etc)
  - Interaction should happen quick!
- Latency: mouse click versus mouse hover
- Popup versus detail displays
Interaction Latency

- The Effects of Interactive Latency on Exploratory Visual Analysis, Z. Liu and J. Heer, 2014
- Brush & link, select, pan, zoom

- 500ms added latency causes significant cost
  - decreases user activity and dataset coverage
  - reduces rate of observations, generalizations, and hypotheses
Interaction Overview

- **Change over Time**
  ![Diagram of change over time]

- **Select**
  ![Diagram of select]

- **Navigate**
  - **Item Reduction**
    - **Zoom**
      - Geometric or Semantic
    ![Diagram of zoom]
  - **Pan/Translate**
    ![Diagram of pan/translate]
  - **Constrained**
    ![Diagram of constrained]
  - **Attribute Reduction**
    - **Slice**
    ![Diagram of slice]
    - **Cut**
    ![Diagram of cut]
    - **Project**
    ![Diagram of project]

[Munzner (ill. Maguire), 2014]
Navigation

- Fix the layout of all visual elements but provide methods for the viewpoint to change
- Camera analogy: only certain features visible in a frame
  - Zooming
  - Panning (aka scrolling)
  - Translating
  - Rotating (rare in 2D, important in 3D)
Navigation

Navigate

Item Reduction

- Zoom
  Geometric or Semantic

- Pan/Translate

- Constrained

Attribute Reduction

- Slice

- Cut

- Project

[Munzner (ill. Maguire), 2014]
Zooming

[http://bl.ocks.org/3680999]
Geometric Zooming

[http://bl.ocks.org/3680999]
Zooming

[http://bl.ocks.org/3680957]
Semantic Zooming

[http://bl.ocks.org/3680957]
Zooming

- Geometric Zooming: just like a camera
- Semantic Zooming: visual appearance of objects can change at different scales
- LiveRAC Example: (focus + context)

[McLachlan et al., 2008]
Navigation Constraints

• **Unconstrained** navigation: walking around in the world or an immersive 3D environment
  - Fairly standard in computer games to go where you want
  - Constrained by walls, objects (collision detection)

• Constrained navigation:
  - 3D: camera must be right-side up
  - Limit pan/zoom to certain areas
  - Comes up often with **multiple views**: want to show an area in one view that corresponds to a selection in another view
van Wijk Smooth Zooming

van Wijk Smooth Zooming