Lecture 9: Item Reduction Methods

Information Visualization

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Chapter 7: Item Reduction Methods

Further Reading

Space-Scale Diagrams: Understanding Multiscale Interfaces George Furnas and Ben Bederson, Proc SIGCHI 95.


Data Reduction

- how to reduce amount of stuff to draw?
  - crosscuts view composition considerations

- item reduction
  - this time
  - rows of table

- attribute reduction
  - next time
  - columns of table
Item Reduction Methods

- filtering and navigation
  - leave some things out
- aggregation
  - merge things together
- overviews
  - temporal through nav
  - separate dedicated view
  - focus + context
    - selective filtering
    - geometric distortion
    - distortion costs/benefits
Filtering and Navigation

- **filter**: choose which items to show/hide
  - **widgets**: sliders, buttons, lists

- **navigation**: filter based on viewpoint
  - **unconstrained / constrained nav**
    - constrained: anim trans to new viewpoint
  - **geometric / semantic zoom**

- **straightforward / nonliteral**
Space-Scale Diagrams

- reasoning about navigation and trajectories

Figure 1. The basic construction of a Space-Scale diagram from a 2D picture.

[Space-Scale Diagrams: Understanding Multiscale Interfaces. George Furnas and Ben Bederson, Proc SIGCHI '95. ]
Viewing Window

[Space-Scale Diagrams: Understanding Multiscale Interfaces. George Furnas and Ben Bederson, Proc SIGCHI ’95.]
[Space-Scale Diagrams: Understanding Multiscale Interfaces. George Furnas and Ben Bederson, Proc SIGCHI '95.]
Pan-Zoom Trajectories

[Space-Scale Diagrams: Understanding Multiscale Interfaces. George Furnas and Ben Bederson, Proc SIGCHI '95.]
Shortest Path

[Space-Scale Diagrams: Understanding Multiscale Interfaces. George Furnas and Ben Bederson, Proc SIGCHI '95.]
[Space-Scale Diagrams: Understanding Multiscale Interfaces. George Furnas and Ben Bederson, Proc SIGCHI '95.]
Smooth and Efficient Zooming

- uw space: \( u = \text{pan}, \ w = \text{zoom} \)
  - horiz axis: cross-section through objects
  - point = camera at height \( w \) above object
  - path = camera path

Optimal Paths Through Space

- at each step, cross same number of ellipses
- cross minimal number of ellipses total

[Space-Scale Diagrams: Understanding Multiscale Interfaces. George Furnas and Ben Bederson, Proc SIGCHI '95.]
Pad++

- "infinitely" zoomable user interface (ZUI)

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George Furnas and Ben Bederson, Proc SIGCHI '95.
OrthoZoom: Multiscale Navigation

- scale/zoom ratio target
  - index of difficulty: \( \text{ID} = \log(1 + D/W) \)
  - \( D = \) target distance, \( W = \) target size

- control area larger than graphical representation
  - zoom factor is orthogonal cursor-slider distance

OrthoZoom

- multi-scale table of contents [video]

Aggregation

- combine items (vs. eliminate them with filtering)
- derived attributes: min/max/avg/sum (SQL)
- challenge: avoid averaging out signal
Overviews

- strategies: both filter and aggregate
  - simple: geometric zoomout
  - complex: aggregation
- methods
  - temporal through nav
  - separate dedicated view
  - embedded/integrated focus+context
Survey

- taxonomy
  - overview+detail: spatial separation
  - zooming: temporal separation
  - focus+context: integrated/embedded
  - cue-based: selectively highlight/suppress
    - crosscutting
    - differs from book taxonomy

- structure
  - describe technique
  - empirical study results
    - low-level task: target acquisition
    - high-level task: explore search space

Overview+Detail Issues

- linked navigation
  - shortcut navigation, thumbnail to detail
  - explore overview without changing detail
    - if fully synchronized could not explore
  - detail changes immediately shown in overview
- their defn: lens as O+D
  - since O and D separated in z/depth
  - nonstandard usage; I consider F+C

Zooming

- geometric zooming
  - hard to make intuitive zoomout control
- semantic zooming
  - different representations at different scales
  - zoomable user interfaces (ZUIs)
- space-scale diagrams
- challenge: stability
Focus+Context

- integrate focus and context in single view

Focus + Context

- selective filtering
- geometric distortion
- distortion: costs/benefits
F+C Formalism: Degree of Interest

- DOI: \( I(x) - D(x,y) \)
  - \( I \): (a priori) interest
  - \( D \): distance, semantic or spatial
  - \( x \): data element
  - \( y \): current focus

- DOI for selective presentation vs. for distortion
- infer DOI through interaction vs. explicit selection
- single vs. multiple foci

**F+C Elision: SpaceTree**

- focus+context tree (like DOI Trees Revisited)
  - selective filtering w/ elision

- semantic zooming / aggregation
  - demo
F+C Distortion: 3D Perspective

- move part of surface closer to eye
- Perspective Wall

Space-Scale Diagrams: Understanding Multiscale Interfaces
George Furnas and Ben Bederson, Proc SIGCHI '95.
2D Hyperbolic Trees

- fisheye effect from hyperbolic geometry
- video: open-video.org/details.php?videoid=4567

Distortion Challenges

- unsuitable if must make relative spatial judgements (length)
  - graph topology as least problematic case
- overhead of tracking distortion
  - constrained and predictable maybe safest
- how to visually communicate distortion
  - gridlines, shading
- target acquisition problem
  - lens displacing items away from screen location
- mixed results comparing to separate views, temporal nav
- fisheye followup: concern with enthusiasm over distortion
  - *what* is being shown: selective filtering
  - *how* it is shown: distortion as one possibility
F+C Without Distortion

- specialized hardware

Chapter 8: Attribute Reduction Methods

Reminders

- Project meetings due 10/19
  - two weeks from today
- Office hours today after class (5-6)
  - or schedule specific meeting time by email