Information Visualization
Rules of Thumb 2, Next Steps

Tamara Munzner
Department of Computer Science
University of British Columbia

Lect 25, 7 Apr 2020

https://www.cs.ubc.ca/~tmm/courses/436V-20
News

• Restructuring: no Foundations 5/6 exercises, no final exam
  – 24% marks spread: +5% midterm, +10% final project, +6% prog ex, -1% found ex
  – more fully embrace project-based nature of course

• Milestone 3: formally due Wed Apr 8 11:59pm
  – announced Apr 6: two new grace days for all teams
    so can turn in without penalty until Fri Apr 10 11:59pm
  – draft rubric released

• M3 demo signups through Canvas Calendar
  – in a hurry? Sat Apr 11
  – during the week? Tue Apr 14 & Wed Apr 15
  – 8-10 min slots at +10 min (X:10 or X:40)
Midterm marks distribution

436V Midterm Mark Distribution

- 1-49
- 50-54
- 55-59
- 60-63
- 64-67
- 68-71
- 72-75
- 76-79
- 79-84
- 85-89
- 90-100
Evaluations

• reminder if you haven't filled out yet
  – **Professor eval**
    • please do fill out the official eval, important! only 10/70 so far :-(
    • they don't have access to what you wrote in the mid-semester evals for me
  – **TA evals**
    • use course "CPSC 436V", section "201"
    • please fill out two times, for each of the two TAs

  – Michael Oppermann
  – Zipeng Liu
Rules of Thumb 2
Rules of Thumb Summary

• No unjustified 3D
• No unjustified 2D
• Eyes beat memory
• Resolution over immersion
• Overview first, zoom and filter, details on demand
• Responsiveness is required
• Function first, form next
Justified 3D: shape perception

• benefits outweigh costs when task is shape perception for 3D spatial data
  – interactive navigation supports synthesis across many viewpoints

Justified 3D: Economic growth curve

• constrained navigation steps through carefully designed viewpoints

No unjustified 3D

- 3D legitimate for true 3D spatial data
- 3D needs very careful justification for abstract data
  - enthusiasm in 1990s, but now skepticism
  - be especially careful with 3D for point clouds or networks

No unjustified 2D

• consider whether network data requires 2D spatial layout
  – especially if reading text is central to task!
  – arranging as network means lower information density and harder label lookup compared to text lists

• benefits outweigh costs when topological structure/context important for task
  – be especially careful for search results, document collections, ontologies
Eyes beat memory

• principle: external cognition vs. internal memory
  – easy to compare by moving eyes between side-by-side views
  – harder to compare visible item to memory of what you saw

• implications for animation
  – great for choreographed storytelling
  – great for transitions between two states
  – poor for many states with changes everywhere
    • consider small multiples instead

 literal
animation show time with time

 abstract
small multiples show time with space
Eyes beat memory example: Cerebral

- small multiples: one graph instance per experimental condition
  - same spatial layout
  - color differently, by condition

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
Change blindness

• if attention is directed elsewhere, even drastic changes not noticeable
  – remember door experiment?

• change blindness demos
  – mask in between images
    https://youtu.be/bh_9XFzbWV8
Resolution beats immersion

- immersion typically not helpful for abstract data
  - do not need sense of presence or stereoscopic 3D
  - desktop also better for workflow integration
- resolution much more important: pixels are the scarcest resource
- virtual reality for abstract data difficult to justify thus far
  - but stay tuned with second wave, AR (augmented reality) has more promise

Overview first, zoom and filter, details on demand

• influential mantra from Shneiderman


• overview = summary
  – microcosm of full vis design problem
Function first, form next

• start with focus on functionality
  – possible to improve aesthetics later on, as refinement
  – if no expertise in-house, find good graphic designer to work with
  – aesthetics do matter: another level of function
    – visual hierarchy, alignment, flow
    – Gestalt principles in action
      – (not covered in this class)

• dangerous to start with aesthetics
  – usually impossible to add function retroactively
Form: Basic graphic design principles

• proximity
  – do group related items together
  – avoid equal whitespace between unrelated

• alignment
  – do find/make strong line, stick to it
  – avoid automatic centering

• repetition
  – do unify by pushing existing consistencies

• contrast
  – if not identical, then very different
  – avoid similar

• buy now and read cover to cover - very practical, worth your time, fast read!
Best practices: Labelling

• make visualizations as self-documenting as possible
  – meaningful & useful title, labels, legends
    • axes and panes/subwindows should have labels
      – and axes should have good mix/max boundary tick marks
    • everything that’s plotted should have a legend
      – and own header/labels if not redundant with main title
  • use reasonable numerical format
    – avoid scientific notation in most cases

[https://xkcd.com/833/]
Rules of Thumb Summary

• No unjustified 3D
  – Power of the plane
  – Disparity of depth
  – Occlusion hides information
  – Perspective distortion dangers
  – Tilted text isn’t legible

• No unjustified 2D

• Eyes beat memory

• Resolution over immersion

• Overview first, zoom and filter, details on demand

• Function first, form next
Credits

  – Chap 6: Rules of Thumb

Next Steps
Videos last week

• many great conferences with free videos online
  – broadly accessible: OpenVisConf, Eyeo, InformationPlus
  – cutting-edge technical research: IEEE VIS

• big idea behind my choices
  – broad universe beyond basic chart types
  – foundations gives you the theory to find your way
  – D3 gives you a technical path to get there
Beyond D3

- many visualization environments/ecosystems
  - D3, R, python, Processing, Tableau, (Excel), charting libraries

- D3.js: interactive browser-based visualization
  - substantial learning curve but you won't hit a wall
  - Observable gallery, Viau gallery
  - layer on top: Vega-Lite

- R: scripting & data analysis environment, heavily used in science
  - heavily used in science, especially static graphics
  - R/Shiny: some interaction
  - tidyverse & ggplot2: active and welcoming visualization community (RStudio)

- python
  - matplotlib, seaborn, Altair
  - dramatic tour
Beyond D3

• many visualization environments/ecosystems
  – D3, R, python, Processing, Tableau, (Excel), charting libraries

• Processing
  – p5.js, programming for artists

• Tableau: GUI application, drag and drop + macros
  – free one-year license for students
  – powerful, but also substantial learning curve

• Excel: most widely used visualization environment (sigh)

• charting libraries
  – https://lisacharlotterost.de/datavistools-revisited
  – datawrapper, highcharts
Other resources: Andy Kirk's Visualizing Data

http://www.visualisingdata.com/resources/  
https://www.visualisingdata.com/blog/
Redesign En Masse: **Makeover Mondays**

- easy entry point (Tableau focus)

http://www.makeovermonday.co.uk/blog/
Visual Design Process In Depth: **Dear Data**

- inspiring celebration of data humanism

http://www.dear-data.com/by-week/ Giorgia Lupi and Stefanie Posavec
Visual Design Process In Depth: **Data Sketches**

- detailed process notes, from sketching through coding

[Image of network visualization]

[Image of network visualization]

http://www.datasketch.es/

Shirley Wu and Nadieh Brehmer
Pathways for more participation

• join Viz@UBC
  – https://dfp.ubc.ca/initiatives/viz-ubc
  – get on visatubc-announce email list (send mail to vizatubc-info@cs.ubc.ca)
  – talk series

• join Vancouver Visualization meetup
  – https://www.meetup.com/Vancouver-Data-Visualization/
  – 4K members

• join Data Visualization Society
  – https://www.datavvisualizationsociety.com/
  – one year old, 10K+ members around the world
  – resources, jobs board, super-active Slack incl local groups, challenges, ...
  – Medium articles: Nightingale
My own research

• papers, videos, software, talks, courses

http://www.cs.ubc.ca/group/infovis
http://www.cs.ubc.ca/~tmm
Fare well

• best wishes for staying safe and healthy
  – in these chaotic times