# Information Visualization
# Rules of Thumb 2, Next Steps

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***Lect 25, 7 Apr 2020***

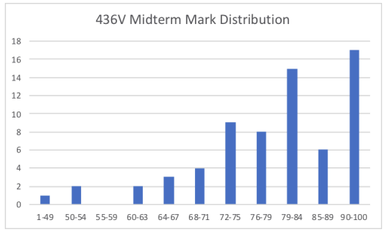
**https://www.cs.ubc.ca/~tmm/courses/436V-20**

## 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






## 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



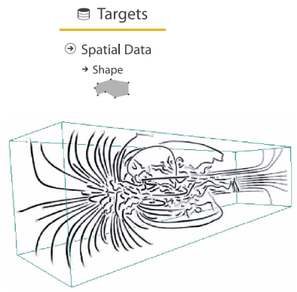
## Rules of Thumb Summary

- 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

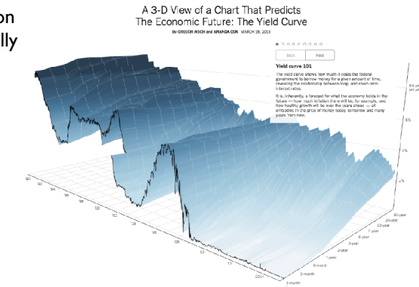



*[Image-Based Streamline Generation and Rendering. Li and Shen. IEEE Trans. Visualization and Computer Graphics (TVCG) 13:3 (2007), 630–640.]*



## Justified 3D: Economic growth curve

- constrained navigation steps through carefully designed viewpoints

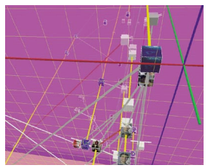



*http://www.nytimes.com/interactive/2015/03/19/upshot/3d-yield-curve-economic-growth.html*



## 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

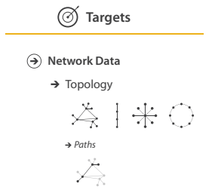


*[WEBPATH-a three dimensional Web history. Frecon and Smith. Proc. InfoVis 1999]*



## 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





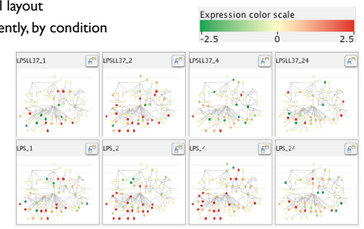

## Eyes beat memory

- 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




## Eyes beat memory example: Cerebral

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

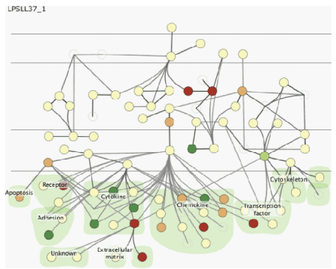



*[Cerebral: Visualizing Multiple Experimental Conditions on a Graph with Biological Context. Barsky, Munzner, Gardy, and Kincaid. IEEE Trans. Visualization and Computer Graphics (Proc. InfoVis 2008) 14:6 (2008), 1253–1260.]*



## 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





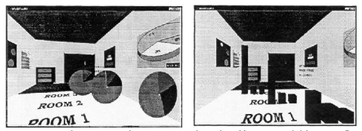

## Change blindness

- 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




*[Development of an information visualization tool using virtual reality. Kirner and Martins. Proc. Symp. Applied Computing 2000]*

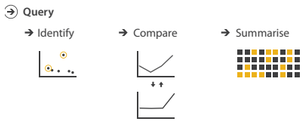


## Overview first, zoom and filter, details on demand

- influential mantra from Shneiderman

*[The Eyes Have It: A Task by Data Type Taxonomy for Information Visualizations. Shneiderman. Proc. IEEE Visual Languages, pp. 336–343, 1996.]*

- overview = summary
  - microcosm of full vis design problem

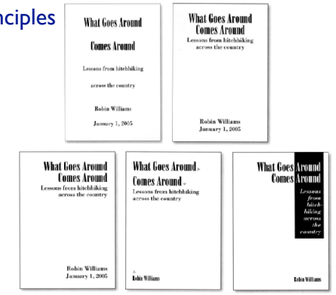


## Function first, form next

- 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



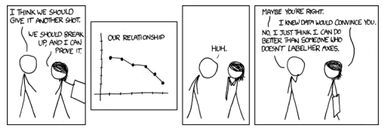

- proximity
  - – do group related items together
  - – avoid equal whitespace between unrelated
- alignment
  - – do find/make strong line, stick to it
  - – avoid automatic centering
- repetition
  - – do unify by pushing existing consistencies
- contrast
  - – if not identical, then very different
  - – avoid similar

- buy now and read cover to cover - very practical, worth your time, fast read!
  *The Non-Designer's Design Book, 4th ed. Robin Williams, Peachpit Press, 2015.*



## 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

- Visualization Analysis and Design. Tamara Munzner. CRC Press, 2014.
  - –*Chap 6: Rules of Thumb*
- The Non-Designer's Design Book. 3rd edition. Robin Williams. Peachpit Press, 2008.



# 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



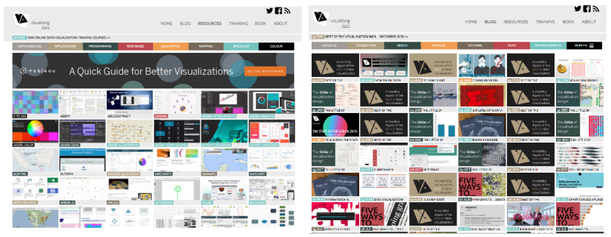
## Beyond D3

- 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://source.opennews.org/articles/what-i-learned-recreating-one-chart-using-24-tools/
  - – https://lisacharlotterost.de/datavistools-revisited
  - – datawrapper, highcharts



## Other resources: Andy Kirk's Visualizing Data

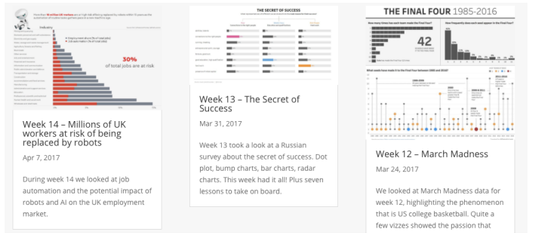
http://www.visualisingdata.com/resources/ https://www.visualisingdata.com/blog/






## Redesign En Masse: **Makeover Mondays**

- easy entry point (Tableau focus)




http://www.makeovermonday.co.uk/blog/



## Visual Design Process In Depth: **Dear Data**

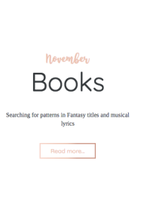
- inspiring celebration of data humanism

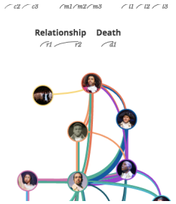

http://www.dear-data.com/by-week/ Giorgia Lupi and Stefanie Posavec



## Visual Design Process In Depth: **Data Sketches**

- detailed process notes, from sketching through coding


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.datavisualizationsociety.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

**@tamaramunzner**




## Fare well

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