Information Visualization
Rules of Thumb 2, Next Steps

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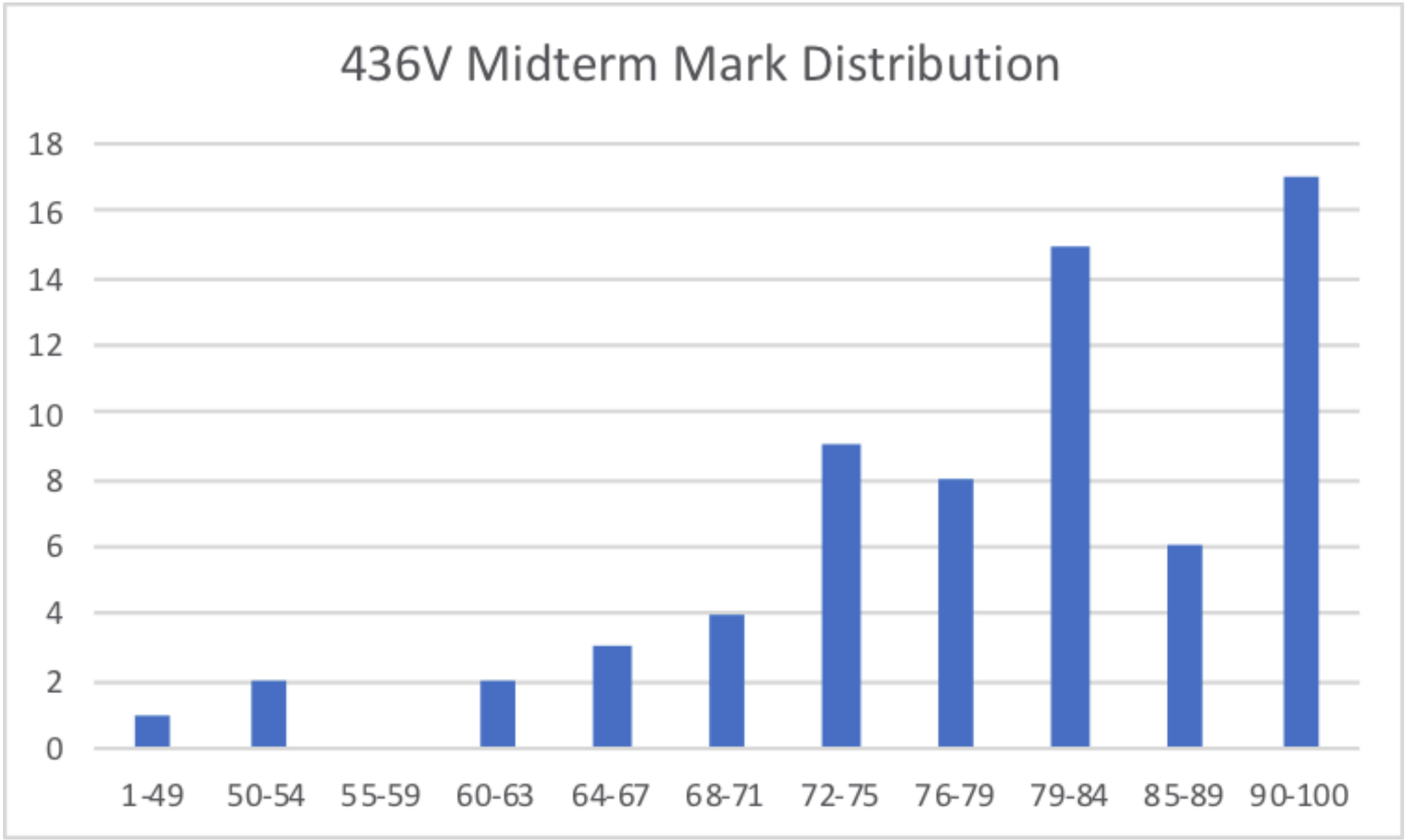
Lect 25, 7 Apr 2020

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

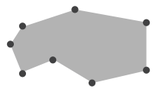
Justified 3D: shape perception

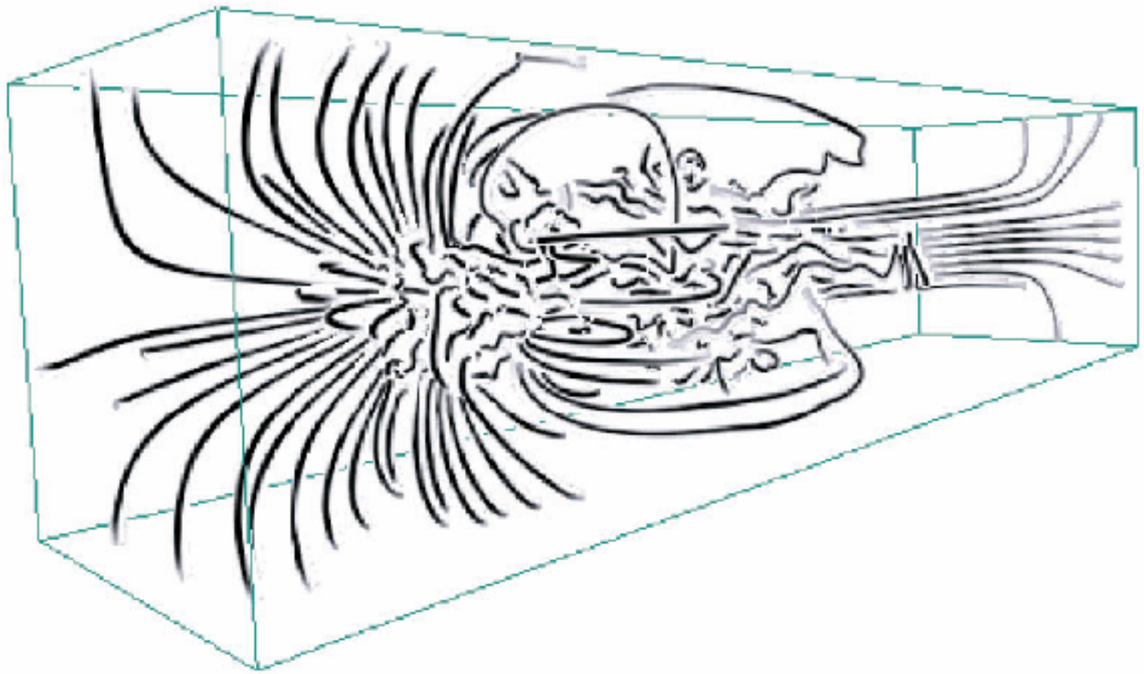
- benefits outweigh costs when task is shape perception for 3D spatial data
  - interactive navigation supports synthesis across many viewpoints

Targets

Spatial Data

→ Shape

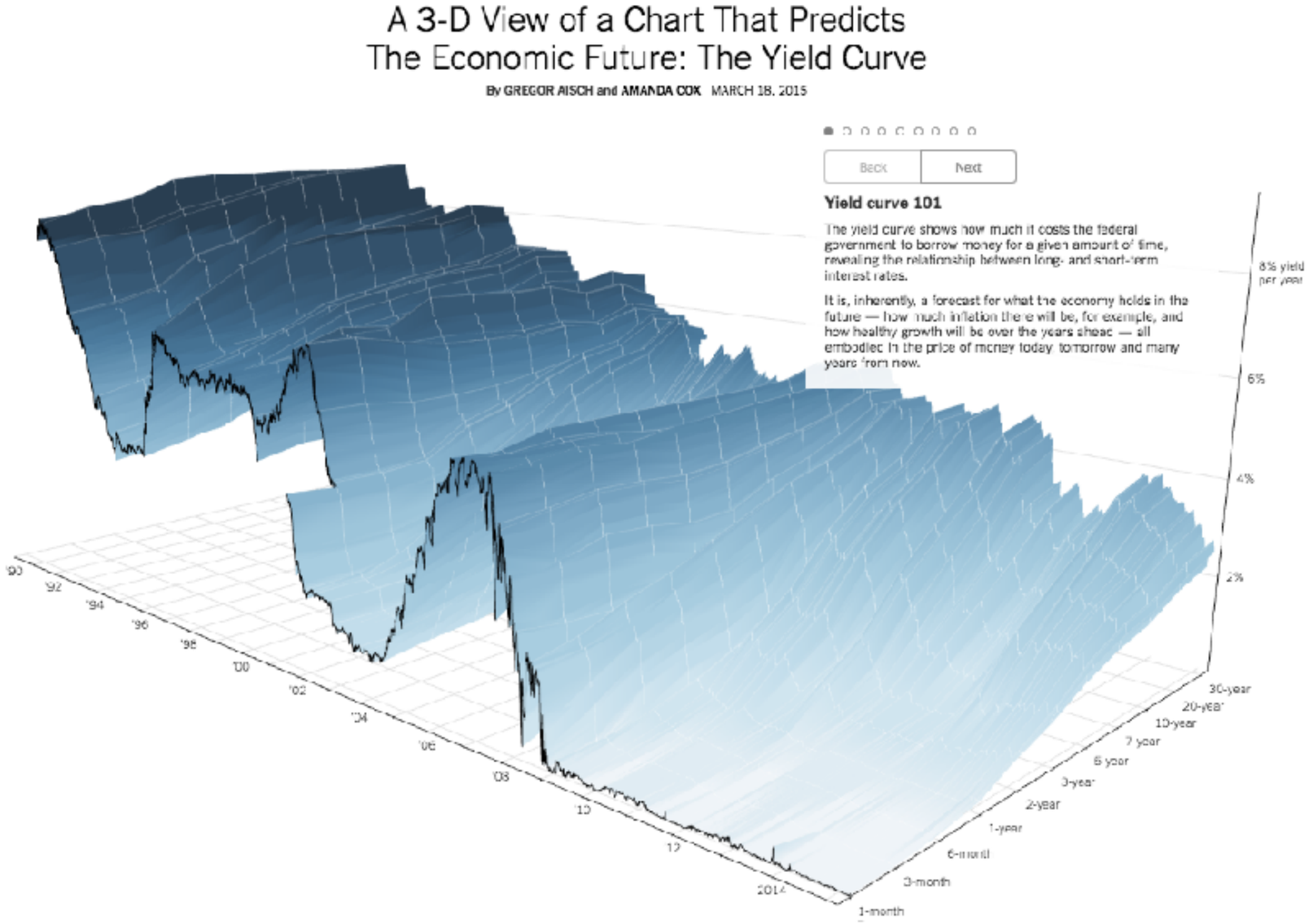




[Image-Based Streamline Generation and Rendering. Li and Shen. IEEE Trans. Visualization and Computer Graphics (TVCG) 13:3 (2007), 630–640.]

Justified 3D: Economic growth curve

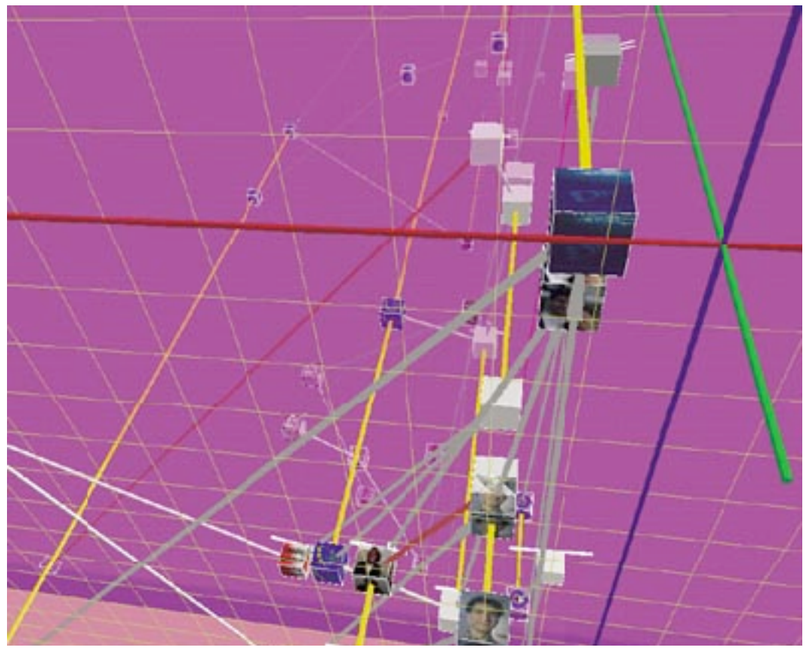
- constrained navigation steps through carefully designed viewpoints



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]

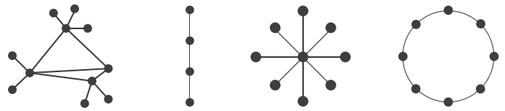
No unjustified 2D

- 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

Targets

Network Data

→ Topology



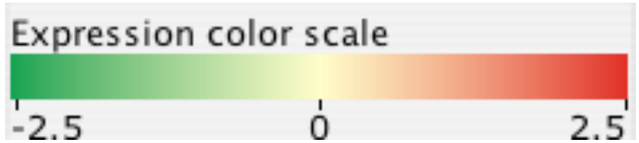
→ *Paths*

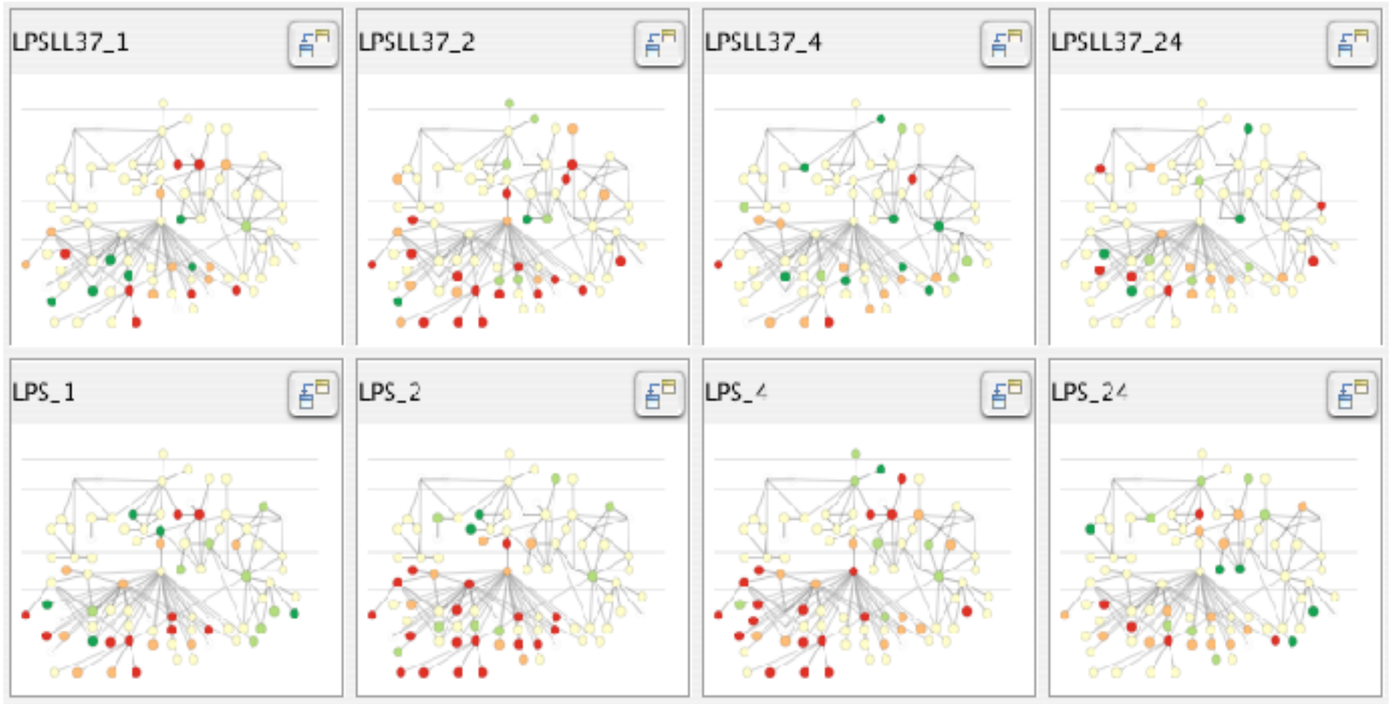
Eyes beat memory

- 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



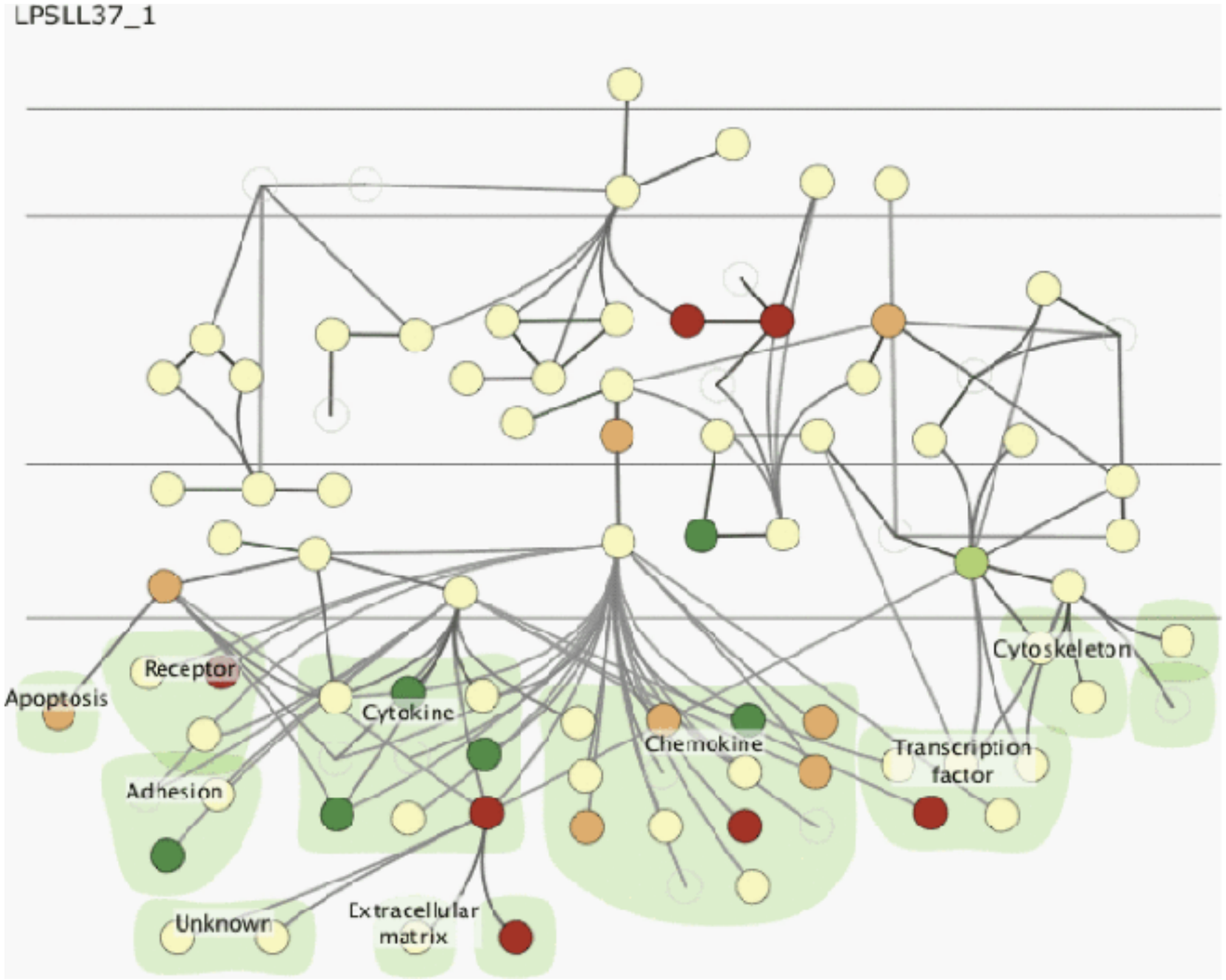


[Cerebral: Visualizing Multiple Experimental Conditions on a Graph with Biological Context. Barsky, Munzner, Gardy, and Kincaid. IEEE Trans. Visualization and Computer Graphics (Proc. InfoVis 2008) 14:6 (2008), 1253–1260.]

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

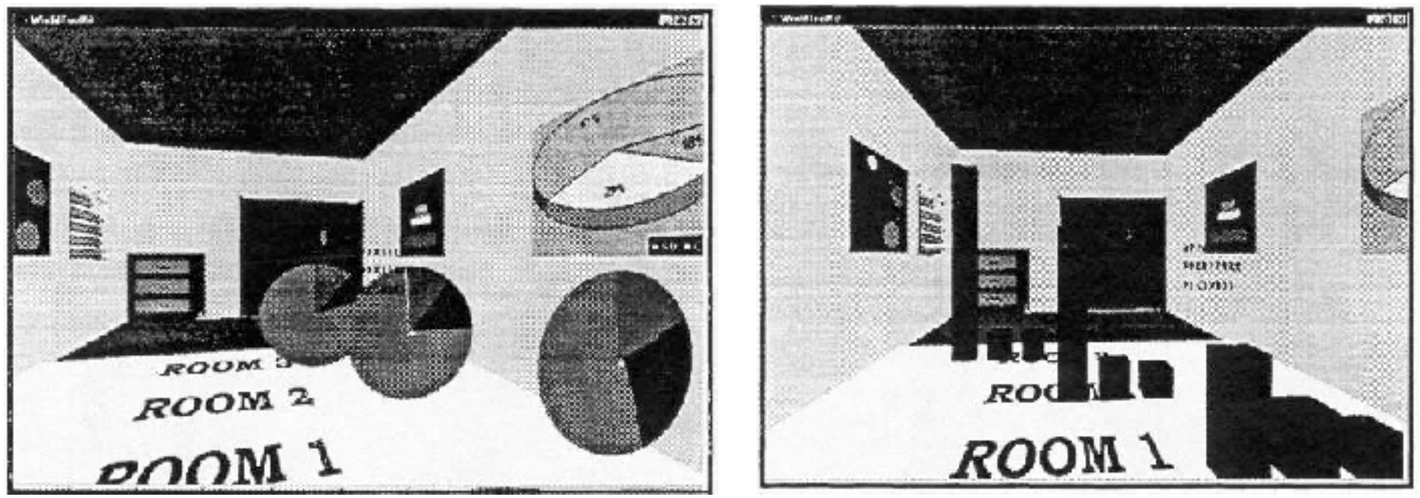


Change blindness

- 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



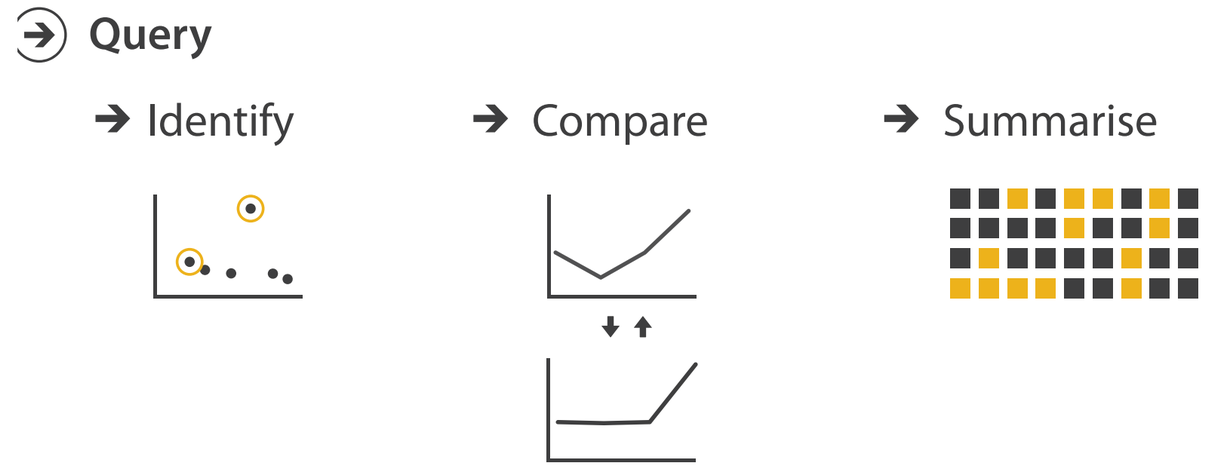
[Development of an information visualization tool using virtual reality. Kirner and Martins. Proc. Symp. Applied Computing 2000]

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



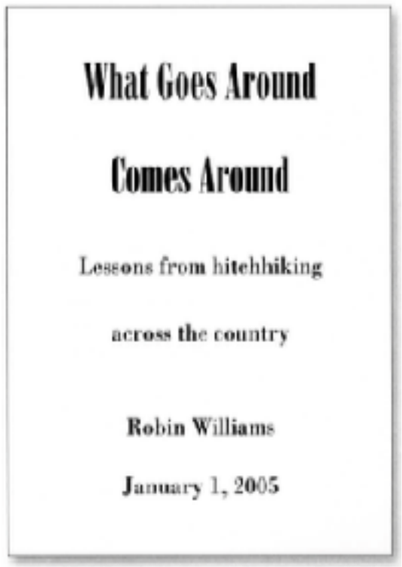
Function first, form next

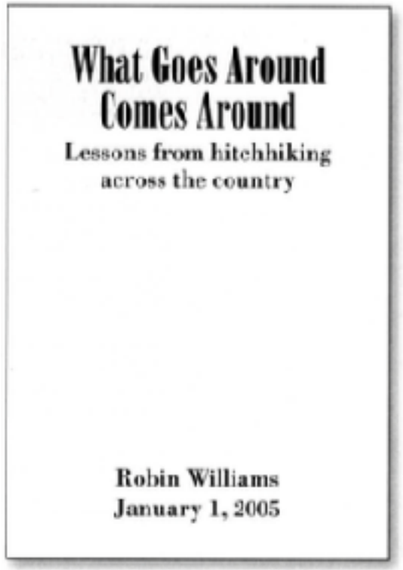
- start with focus on functionality
  - possible to improve aesthetics later on, as refinement
  - if no expertise in-house, find good graphic designer to work with
  - aesthetics do matter: another level of function
    - visual hierarchy, alignment, flow
    - Gestalt principles in action
      - *(not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

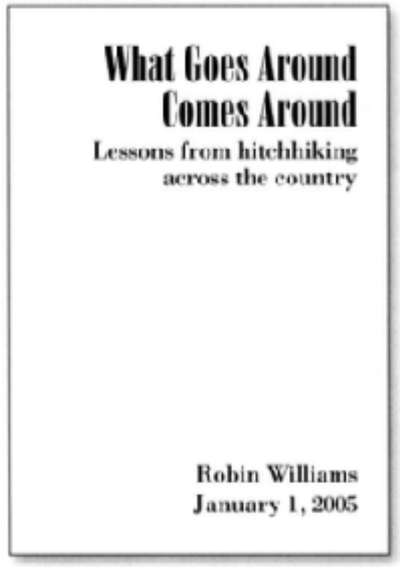
- dangerous to start with aesthetics
  - usually impossible to add function retroactively

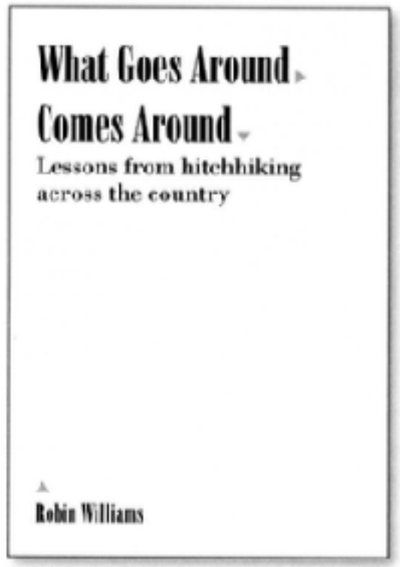
Form: Basic graphic design principles

- 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





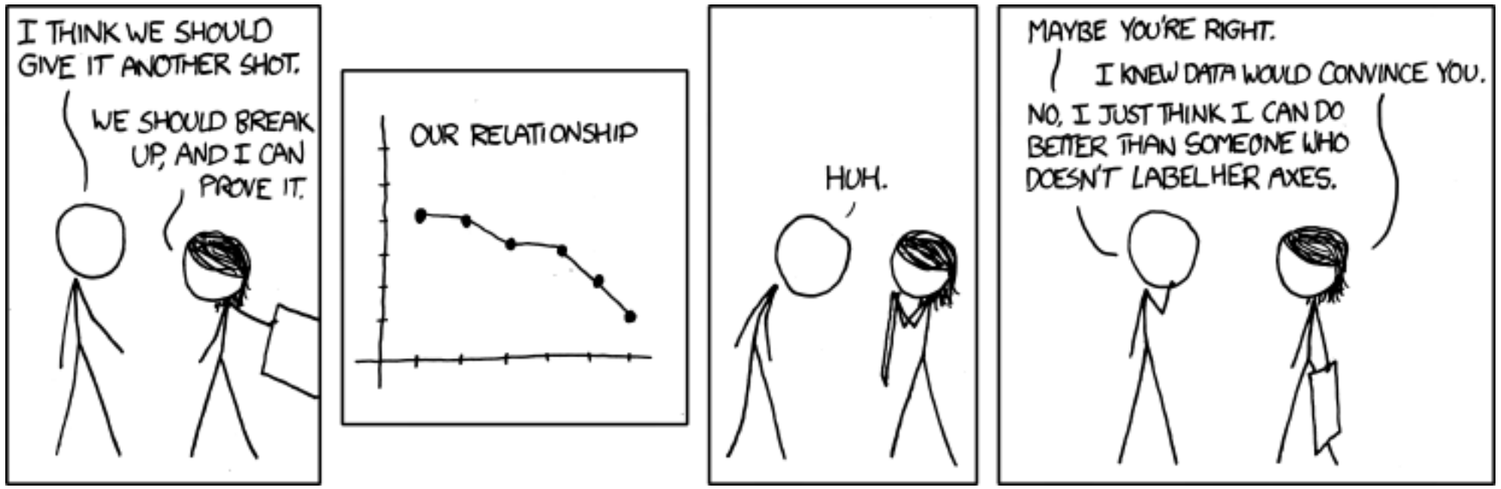




- buy now and read cover to cover - very practical, worth your time, fast read!
  The Non-Designer's Design Book, 4th ed. Robin Williams, Peachpit Press, 2015.

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

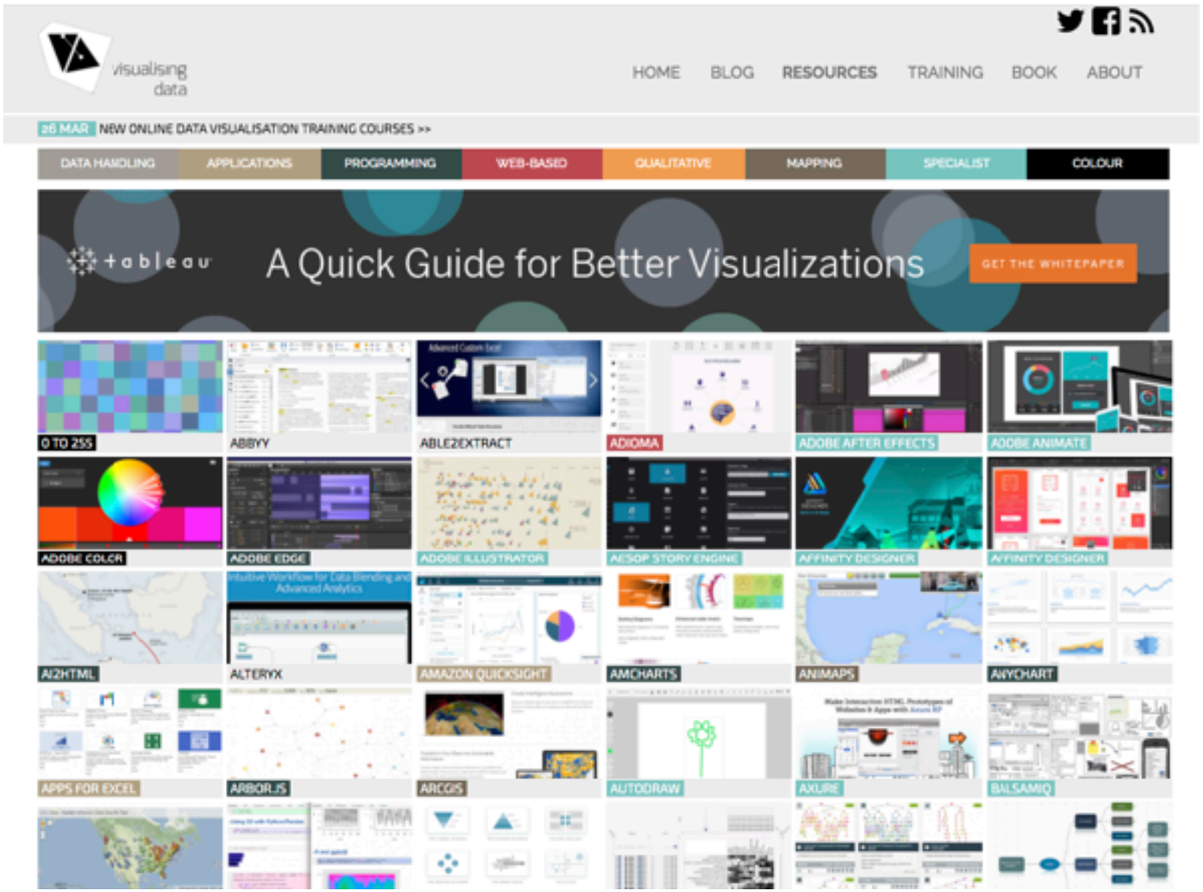
- many visualization environments/ecosystems
  - D3, R, python, Processing, Tableau, (Excel), charting libraries
- D3.js: interactive browser-based visualization
  - substantial learning curve but you won't hit a wall
  - Observable gallery, Viau gallery
  - layer on top: Vega-Lite
- R: scripting & data 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

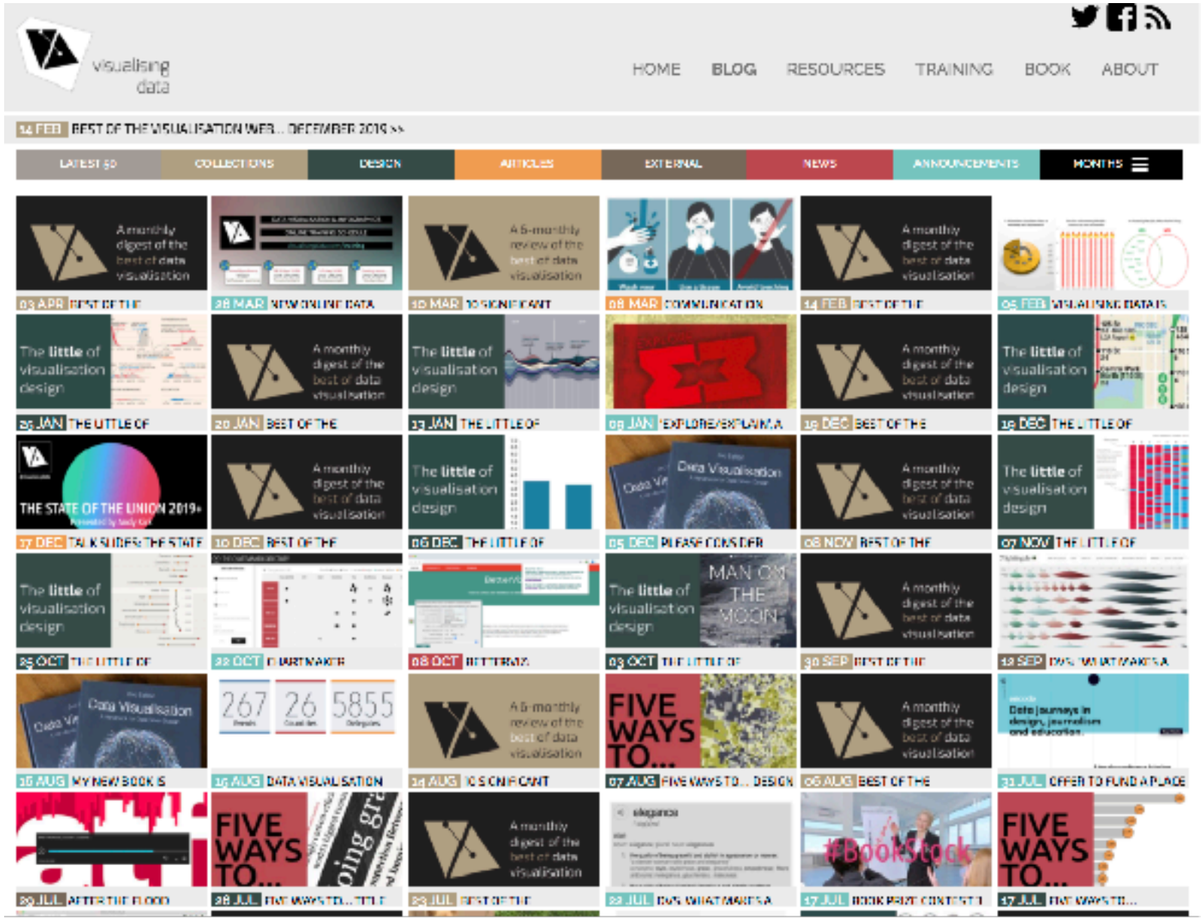
Beyond D3

- 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

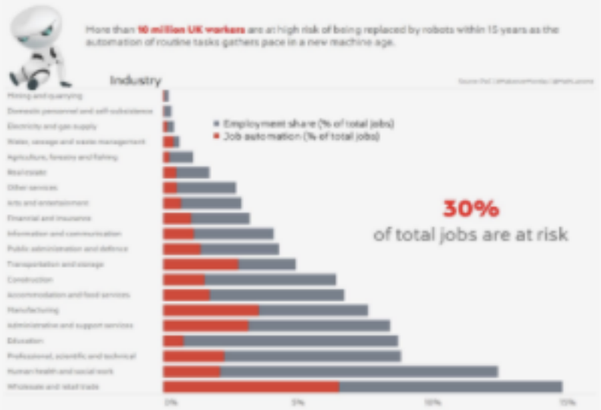
http://www.visualisingdata.com/resources/ https://www.visualisingdata.com/blog/





Redesign En Masse: **Makeover Mondays**

- easy entry point (Tableau focus)



Week 14 – Millions of UK workers at risk of being replaced by robots

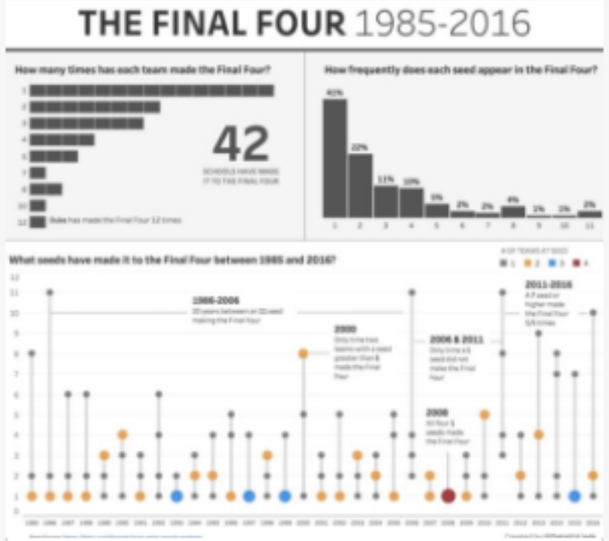
Apr 7, 2017

During week 14 we looked at job automation and the potential impact of robots and AI on the UK employment market.

Week 13 – The Secret of Success

Mar 31, 2017

Week 13 took a look at a Russian survey about the secret of success. Dot plot, bump charts, bar charts, radar charts. This week had it all! Plus seven lessons to take on board.



Week 12 – March Madness

Mar 24, 2017

We looked at March Madness data for week 12, highlighting the phenomenon that is US college basketball. Quite a few vizzes showed the passion that

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

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

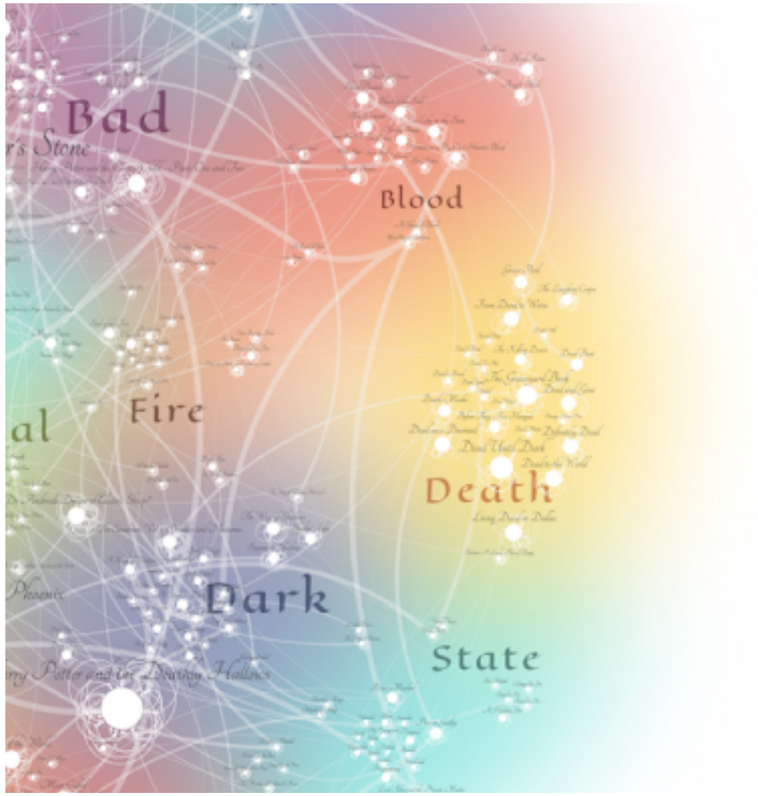
- inspiring celebration of data humanism

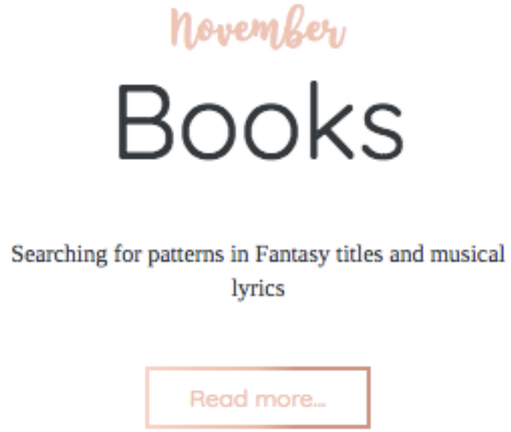
http://www.dear-data.com/by-week/

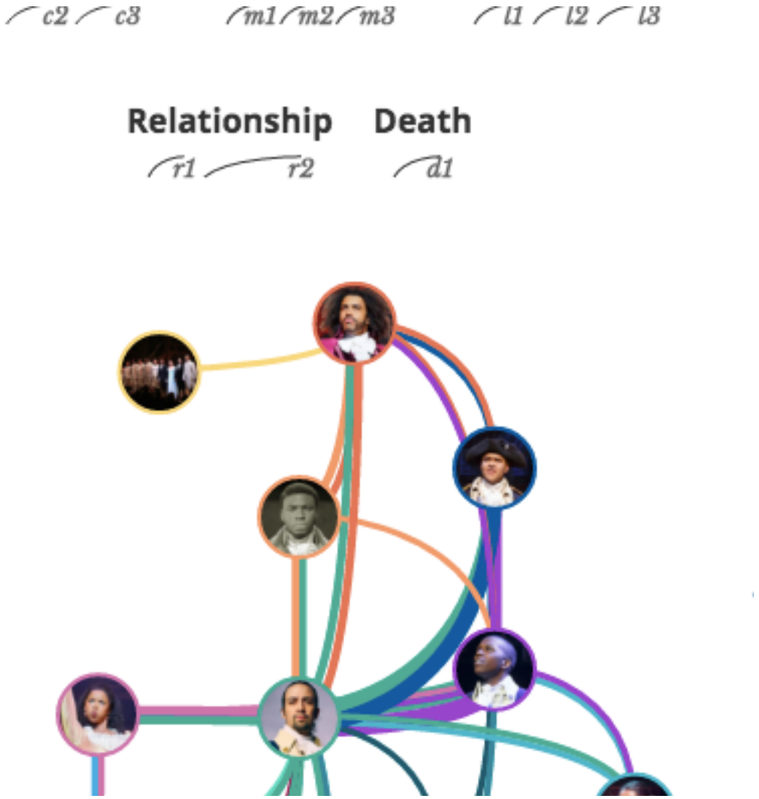
Giorgia Lupi and Stefanie Posavec

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

- detailed process notes, from sketching through coding







http://www.datasketch.es/

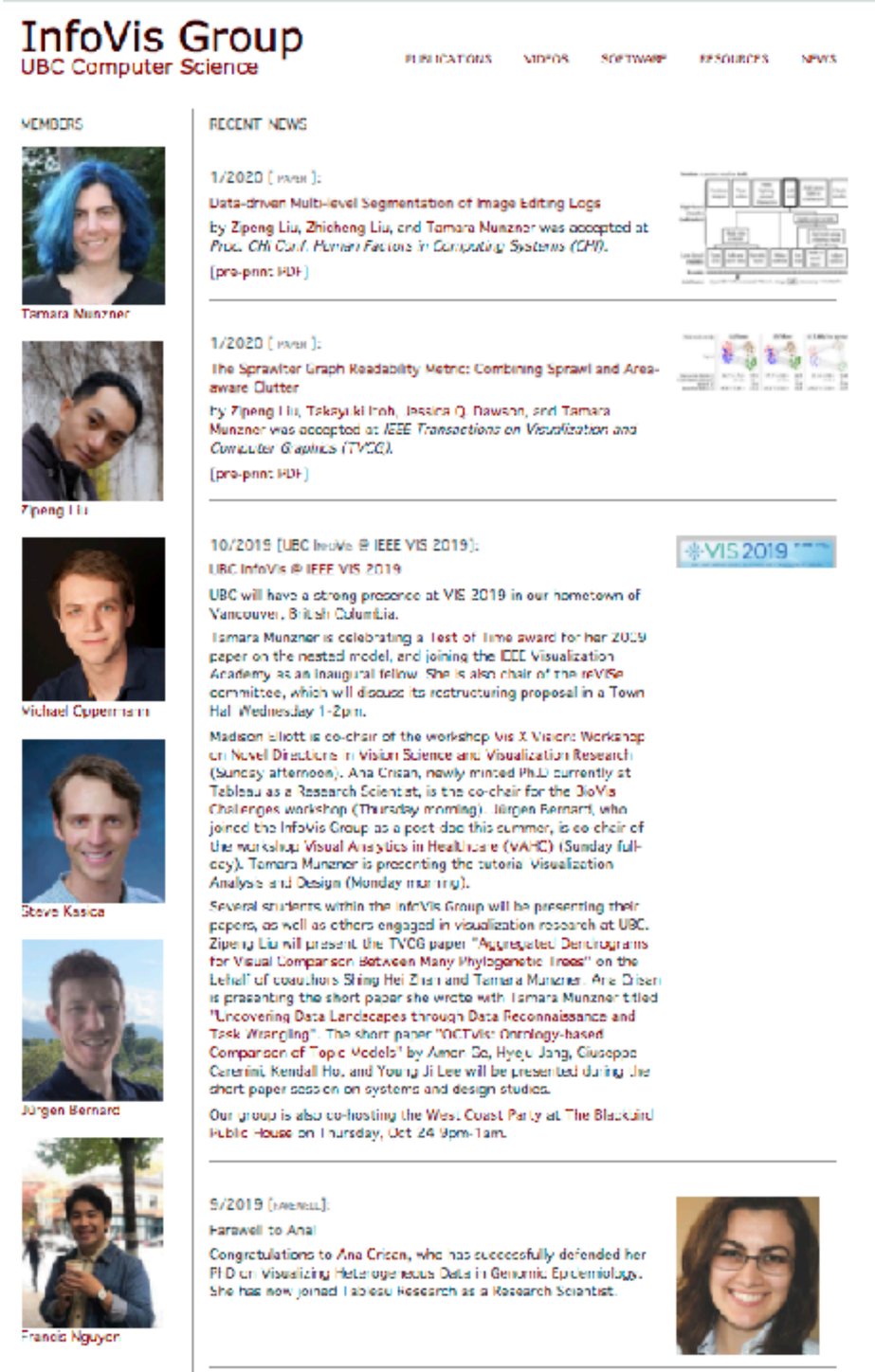
Shirley Wu and Nadieh Brehmer

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



InfoVis Group
UBC Computer Science

PUBLICATIONS VIDEOS SOFTWARE RESOURCES NEWS

MEMBERS

Tamara Munzner

Zipeng Liu

Michael Oppermann

Steve Kasica

Jürgen Bernard

Francis Nguyen

RECENT NEWS

1/2020 [PAPER]:
Data-driven Multi-level Segmentation of Image Editing Logs
by Zipeng Liu, Zhicheng Liu, and Tamara Munzner was accepted at *Proc. CHI Conf. Human Factors in Computing Systems (CHI)*.
[pre-print: PDF]

1/2020 [PAPER]:
The Sprawler Graph Readability Metric: Combining Sprawl and Area-aware Clutter
by Zipeng Liu, Takayuki Itoh, Jessica Q. Dawson, and Tamara Munzner was accepted at *IEEE Transactions on Visualization and Computer Graphics (TVCG)*.
[pre-print: PDF]

10/2019 [UBC InfoVis @ IEEE VIS 2019]:
UBC InfoVis @ IEEE VIS 2019
UBC will have a strong presence at VIS 2019 in our hometown of Vancouver, British Columbia.
Tamara Munzner is celebrating a Test of Time award for her 2009 paper on the nested model, and joining the IEEE Visualization Academy as an inaugural fellow. She is also chair of the IEEVIS committee, which will discuss its restructuring proposal in a Town Hall Wednesday 1-2p.m.
Madison Elliott is co-chair of the workshop Vis X Vision: Workshop on Novel Directions in Vision Science and Visualization Research (Sunday afternoon). Ana Crisan, newly minted PhD currently at Tableau as a Research Scientist, is the co-chair for the BioVis Challenges workshop (Thursday morning). Jürgen Bernard, who joined the InfoVis Group as a post doc this summer, is co-chair of the workshop Visual Analytics in Healthcare (VAHC) (Sunday full-day). Tamara Munzner is presenting the tutorial Visualization Analysis and Design (Monday morning).
Several students within the InfoVis Group will be presenting their papers, as well as others engaged in visualization research at UBC. Zipeng Liu will present the TVCG paper "Aggregated Dendrograms for Visual Comparison Between Many Phylogenetic Trees" on the behalf of coauthors Shing Hei Zhan and Tamara Munzner. Arie Olsen is presenting the short paper she wrote with Tamara Munzner titled "Uncovering Data Landscapes through Data Reconnaissance and Task Wrangling". The short paper "OWLTutor: Ontology-based Comparison of Topic Models" by Aimon Qa, Hyeju Jang, Giuseppe Carenini, Kendall Hu, and Young Ji Lee will be presented during the short paper session on systems and design studies.
Our group is also co-hosting the West Coast Party at The Blackbird Public House on Thursday, Oct 24 9pm-1am.

5/2019 [FAREWELL]:
Farewell to Ana!
Congratulations to Ana Crisan, who has successfully defended her PhD on Visualizing Heterogeneous Data in Genomic Epidemiology. She has now joined Tableau Research as a Research Scientist.

@tamaramunzner

Fare well

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