CSC 444: Data Visualization

Instructor: Carlos Scheidegger
TA: Jordan Siaha

Course Website: **https://cscheid.net/courses/fall-2019/csc444**
Piazza: **https://piazza.com/arizona/fall2019/csc444/home**
email: **cscheid+fall19csc444@cs.arizona.edu**

Office Hours: Tuesdays, 2-4PM, GS734
Otherwise by appointment only
(I'm happy to talk with you about **anything**,
but I'm not always on my office)

Before we start

- **Let's read the syllabus: https://cscheid.net/courses/fall-2019/csc444/syllabus.html**
  - Many small programming assignments (50%), one midterm exam (20%), one final exam (30%)

- **First assignment has been posted!**
  - **https://cscheid.net/courses/fall-2019/csc444/assignment_1.html**

Before we start

- Mental Health and Wellness

- There are many resources available to you at UA
- Do not hesitate to contact CAPS or advising@cs. if you are struggling or want to talk someone

Vis is both ubiquitous and subtle

I		II		III		IV	
x	y	x	y	x	y	x	y
10.0	8.04	10.0	9.14	10.0	7.46	8.0	6.58
8.0	6.95	8.0	8.14	8.0	6.77	8.0	5.76
13.0	7.58	13.0	8.74	13.0	12.74	8.0	7.71
9.0	8.81	9.0	8.77	9.0	7.11	8.0	8.84
11.0	8.33	11.0	9.26	11.0	7.81	8.0	8.47
14.0	9.96	14.0	8.10	14.0	8.84	8.0	7.04
6.0	7.24	6.0	6.13	6.0	6.08	8.0	5.25
4.0	4.26	4.0	3.10	4.0	5.39	19.0	12.50
12.0	10.84	12.0	9.13	12.0	8.15	8.0	5.56
7.0	4.82	7.0	7.26	7.0	6.42	8.0	7.91
5.0	5.68	5.0	4.74	5.0	5.73	8.0	6.89

- Frank Anscombe, “Graphs in Statistical Analysis”

Activity: **let's try to make sense of this data**

- Think about what you'd try, 1 minute
- Gather in small groups, talk
- Share with everyone

What did we try?

- https://cscheid.net/courses/fall-2019/csc444/lectures/lecture1/anscombe/

Something interesting just happened: isn't this a visualization too?!

I		II		III		IV	
x	y	x	y	x	y	x	y
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8.0	6.95	8.0	8.14	8.0	6.77	8.0	5.76
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9.0	8.81	9.0	8.77	9.0	7.11	8.0	8.84
11.0	8.33	11.0	9.26	11.0	7.81	8.0	8.47
14.0	9.96	14.0	8.10	14.0	8.84	8.0	7.04
6.0	7.24	6.0	6.13	6.0	6.08	8.0	5.25
4.0	4.26	4.0	3.10	4.0	5.39	19.0	12.50
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The way in which data is presented changes how we consume it, **drastically**.

You will learn how—and how not—to build interactive data visualizations

Three main themes

- **Mechanics**: how do I build a visualization?
  - Javascript, CSS, HTML, d3
- **Principles**: why should I build it in this way?
  - mathematical and perceptual arguments
- **Techniques**: how do I turn principles and mechanics into an actual visualization?
  - algorithms, software libraries

Assessment

- One **small assignment per week**, 50% weight
  - ~2-5 hours per assignment
- One closed-book **midterm**, 20% weight
  - hour-long
- One closed-book **final, comprehensive exam**, 30% weight
- Class participation, 5% weight
  - piazza counts

Grading

- Performance grade:
  - ≥90%: A, ≥80%: B, ≥70%: C, ≥60%: D, <50%: F

Plagiarism and Academic Conduct Policy

- Unless I state otherwise, you are allowed to use any open source library you want in your projects, **provided that you give it credit**.
    - Assignments will be small
- If you pass off someone else's work as yours, **that's plagiarism**.
    - The penalty for plagiarism always includes a referral to the college, and ranges from an automatic zero in the assignment to an automatic F in the course to expulsion from the university.
- Don't do it.
    - **Don't do it.**

Textbook

- **No required textbook**, but you won't regret buying Munzner's "Visualization Analysis and Design"

- Available in digital form from UA library as well

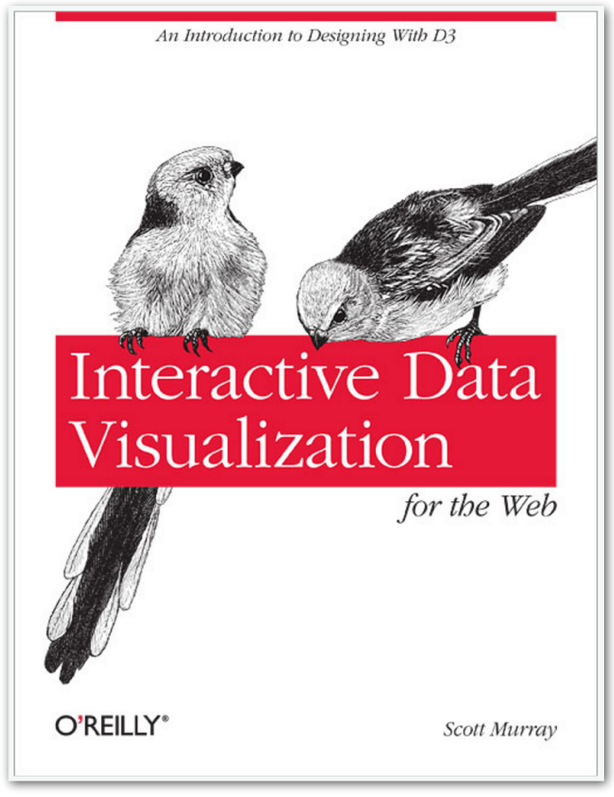
- All required reading material will be given in lecture notes, webpages, and research papers

http://www.amazon.com/Visualization-Analysis-Design-AK-Peters/dp/1466508914

Textbook

- You will also probably make good use of Scott Murray's "Interactive Visualization for the Web"

- Available through O'Reilly Safari on campus (see course website for details)



Important Vis Books

- William Cleveland, **The Elements of Graphing Data**, **Visualizing Data**
- John W. Tukey, **Exploratory Data Analysis**
- Jacques Bertin, **Semiology of Graphics**
- Edward Tufte, **The Visual Display of Quantitative Information**, **Visual Explanations**, **Envisioning Information**
- Colin Ware, **Information Visualization**
- Come take a look at them during office hours if you're curious; **they're not cheap :(**

Mechanics

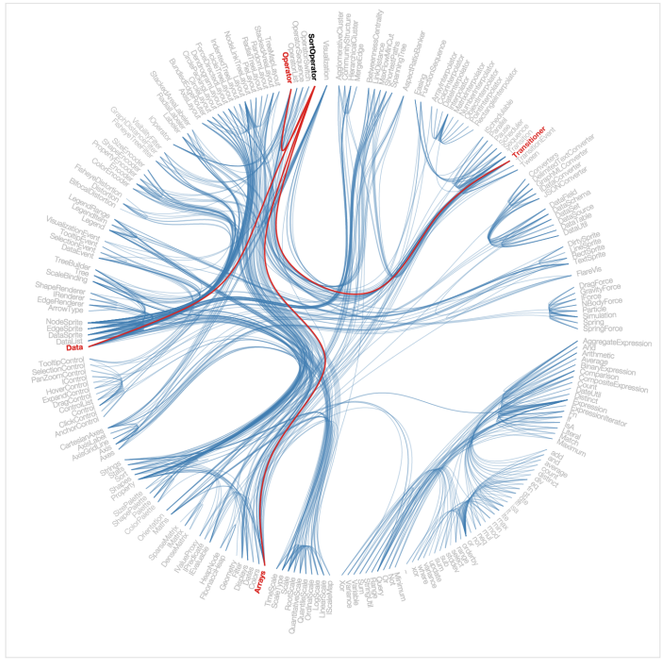
- Writing programs: we will use the web technology stack

  - Javascript, SVG, CSS, HTML, d3

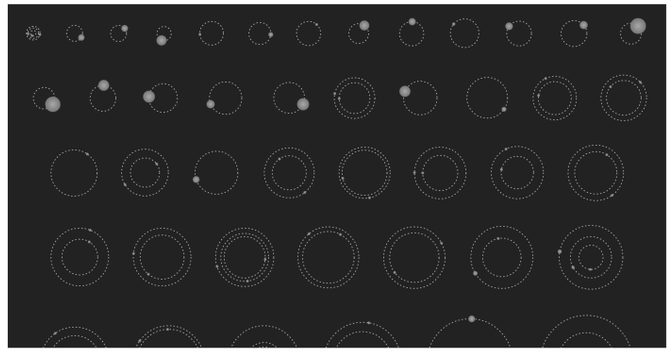
http://bit.ly/1swfb5p
http://i.imgur.com/wR3ZxfB.jpg

Stick with it, though!

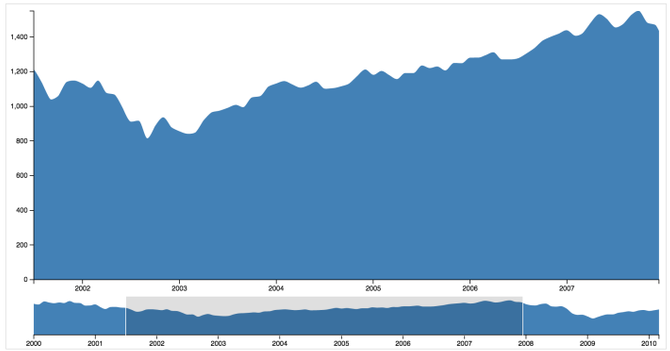
Hierarchical Edge Bundling



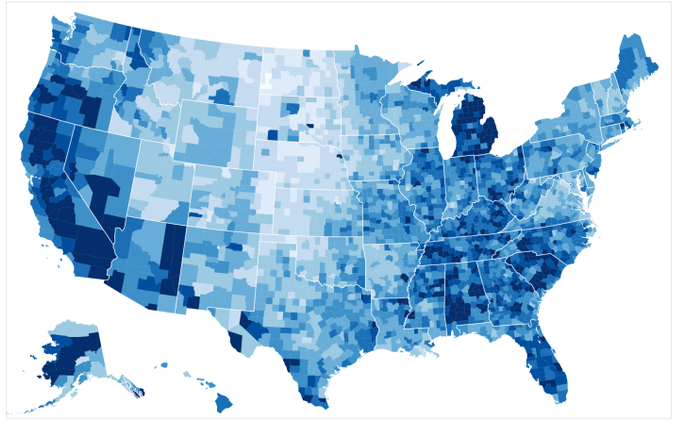
Kepler's Tally



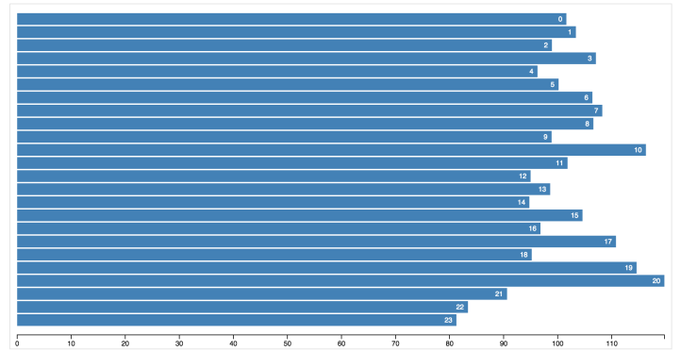
Focus+Context via Brushing



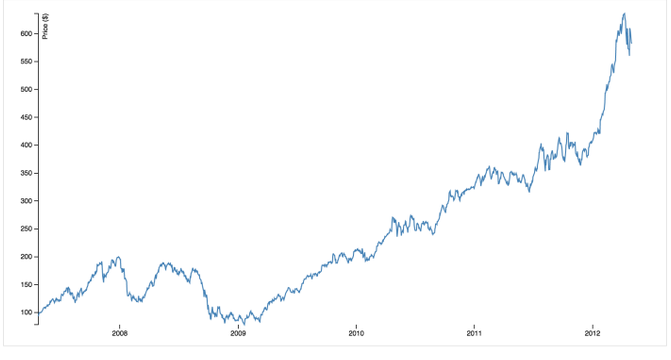
Choropleth



Sortable Bar Chart



X-Value Mouseover



http://bl.ocks.org/mbostock

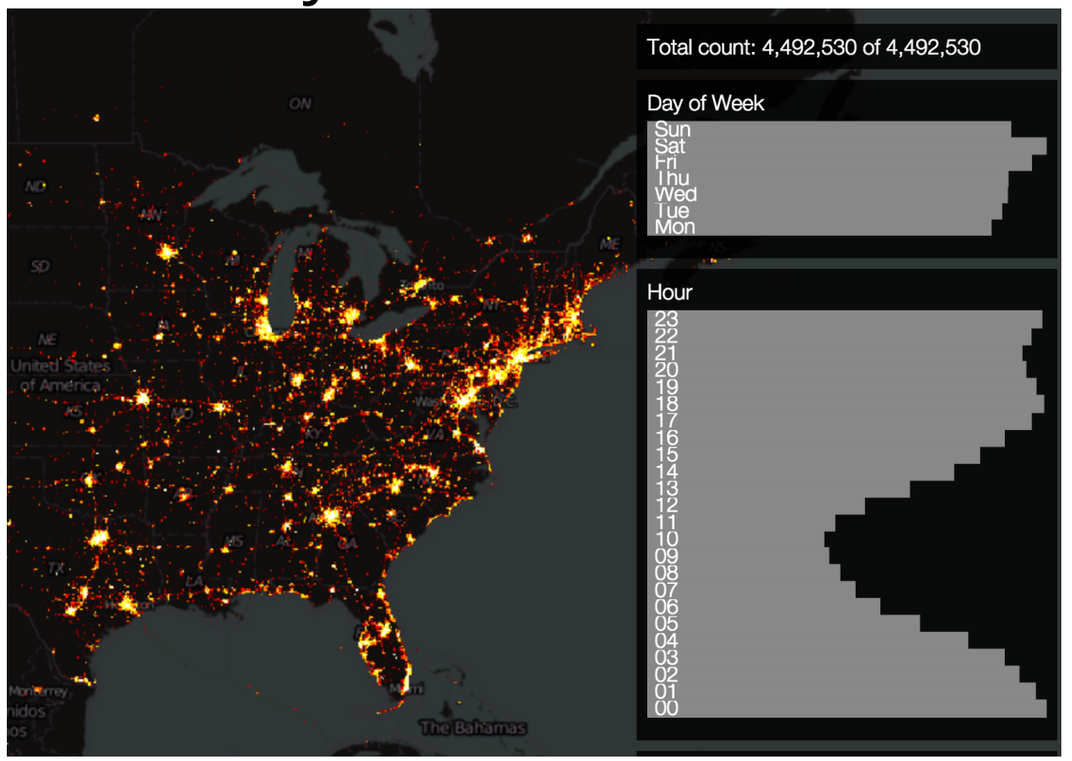
Good reasons to choose the web stack:

It’s ubiquitous

apple.com

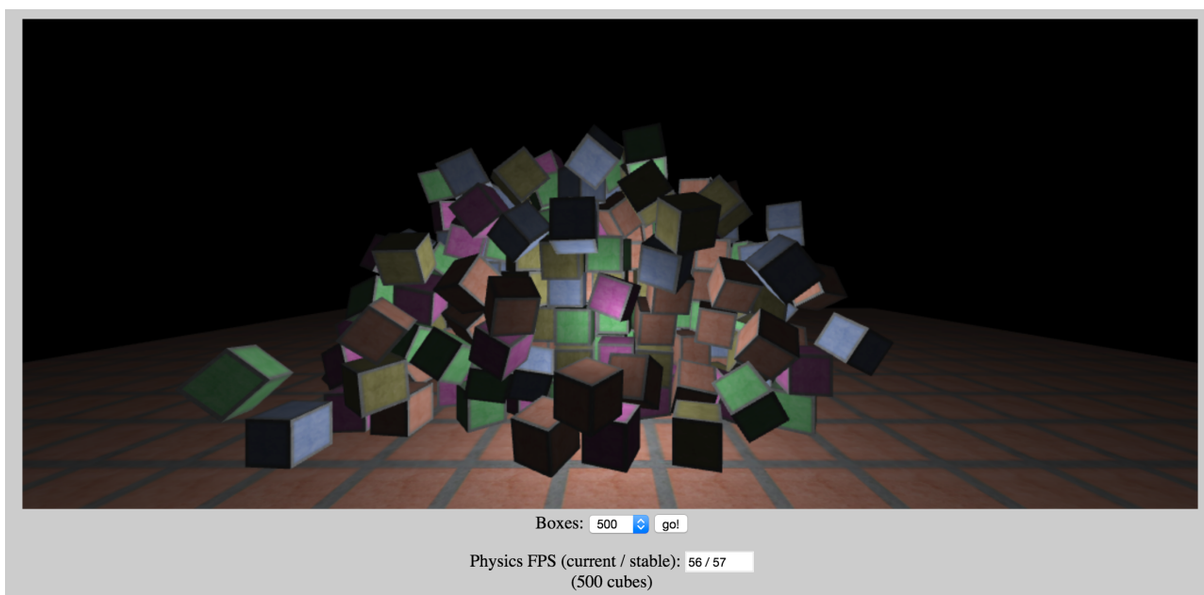
arstechnica.com

It’s easy to talk to a server



nanocubes.net

It’s fast!



Principles

Building a visualization is fundamentally about tradeoffs. Principles help us understand these tradeoffs, and make informed decisions

Pre-attentive Processing

Examples from Christopher Healey's excellent resource
http://www.csc.ncsu.edu/faculty/healey/PP/

Demo: https://cscheid.net/courses/fal18/csc444/lectures/lecture1/boundary/

Change Blindness

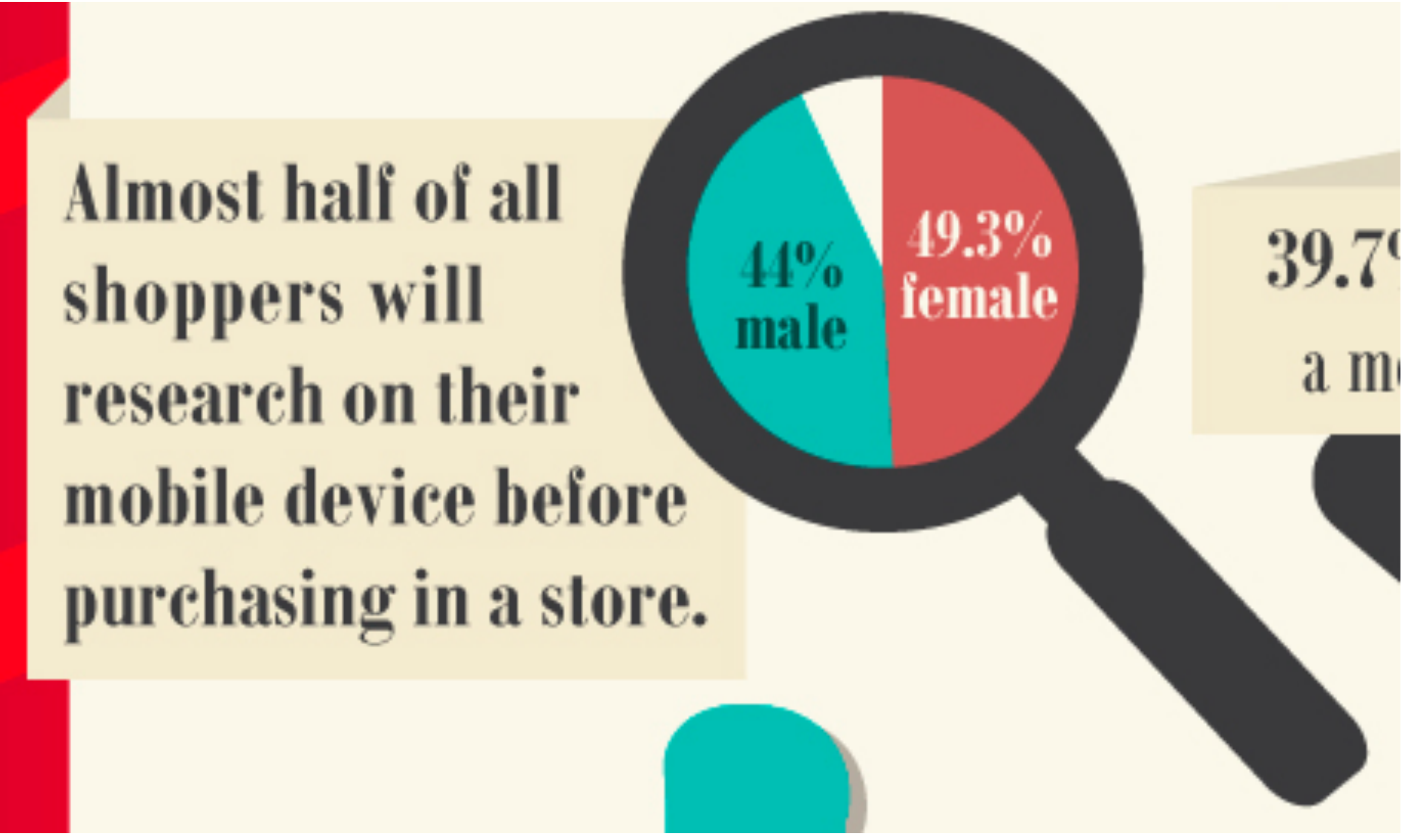
(photosensitive epilepsy? please look away.)

http://www.csc.ncsu.edu/faculty/healey/PP/

Respect the math in the data

Not everything you can do with data makes sense

http://imgur.com/gNefvUG/

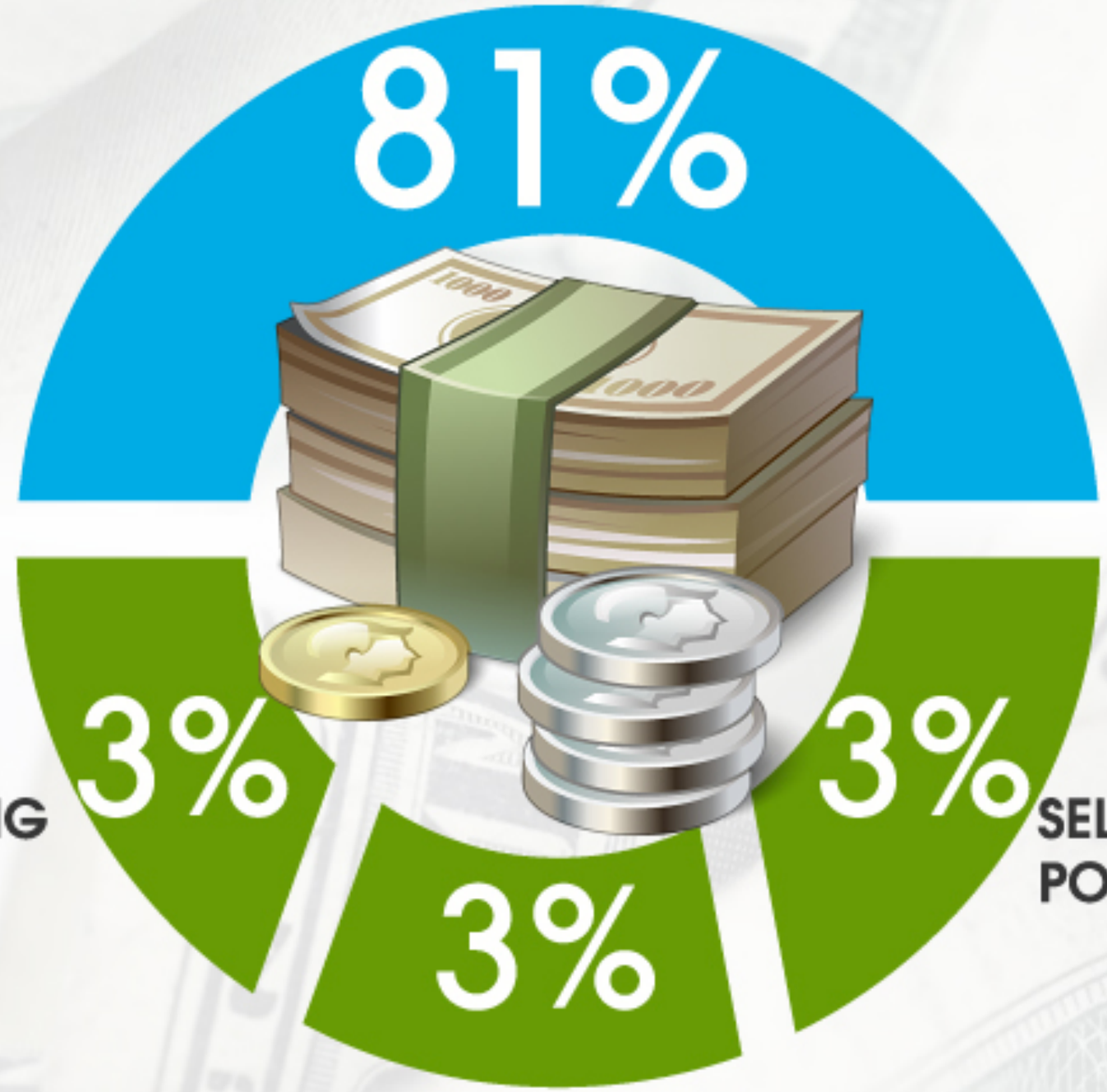


http://viz.wtf/post/107998162170/6-7-gender-neutral#notes

WHAT ACTUALLY

BORROWERS DO DEVOID OF GETTING PAYDAY LOANS

CUT BACK ON DAILY EXPENDITURES



DELAY PAYING SOME BILLS

SELL PERSONAL POSSESSIONS

RELY ON FRIENDS OR FAMILY

http://viz.wtf/post/107440754050/how-payday-loans-add-up#notes

Techniques

How do we turn the mechanics and principles into an actual, working visualization?

Linked views

demo: http://square.github.io/crossfilter/

Treemaps

demo: GrandPerspective

A tour of visualization and visual thinking

http://cscheid.net/courses/fall-2019/csc444/lectures/lecture1.html

CSC 444 Summary

- 4 weeks of mechanics, 5 weeks of principles, 6 weeks of techniques

- ~1 small assignment a week, 1 midterm, 1 final exam

Course website: **https://cscheid.net/courses/fall-2019/csc444**

Today's lecture:
https://cscheid.net/courses/fall-2019/csc444/lectures/week1.html