

CSC 444: Data Visualization

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TA: Youhao Wei

Course Website: <https://cscheid.net/courses/fal16/cs444>
Piazza: <https://piazza.com/arizona/fall2016/cs444/home>
email: fall2016cs444@cs.arizona.edu

Office Hours: Tuesdays, 1-3PM, GS734
Otherwise by appointment only

Before we start

- **Read the syllabus:** <https://cscheid.net/courses/fal16/cs444/syllabus.html>
 - Many small programming assignments (50%), one midterm (20%), one final (30%)
- **First assignment has been posted!**
 - https://cscheid.net/courses/fal16/cs444/assignment_1.html

Vis is both ubiquitous and subtle

- Frank Anscombe,
“Graphs in Statistical
Analysis”

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

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/fal16/cs444/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
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
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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
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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 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

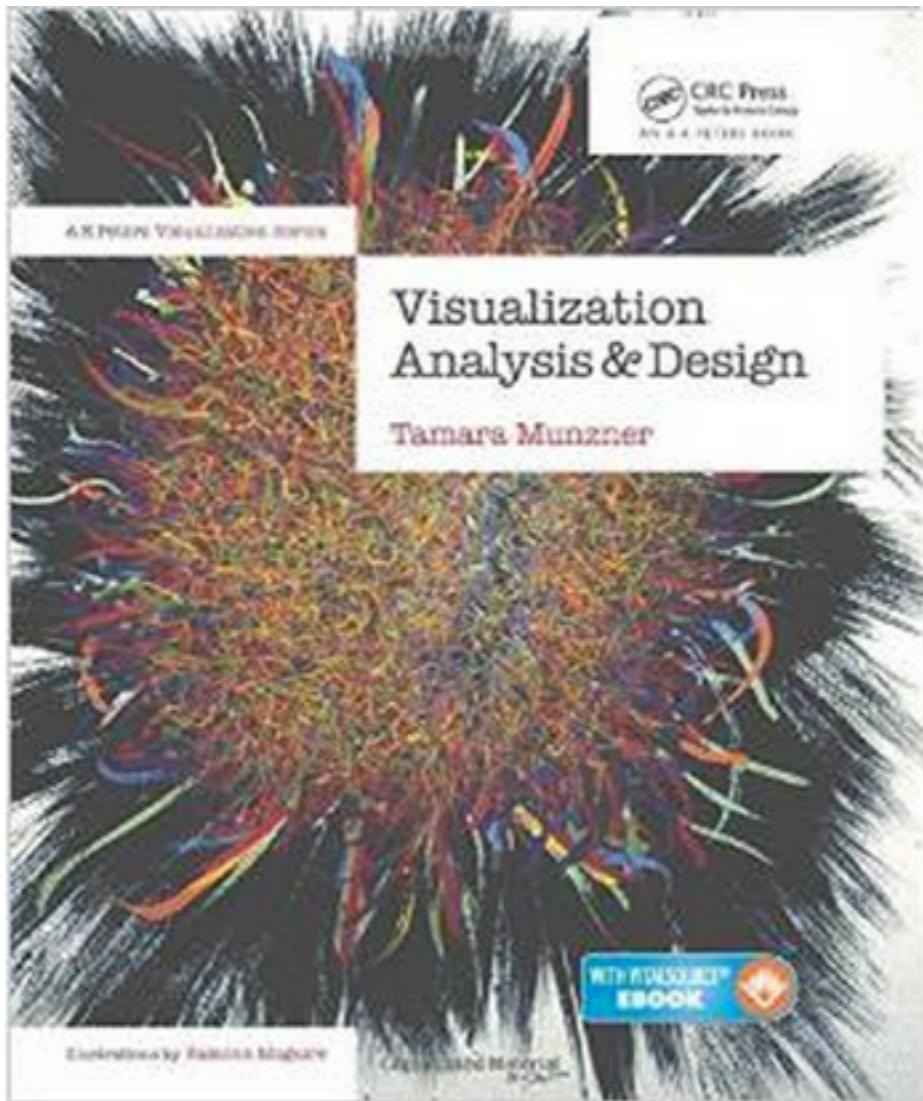
- Performance grade:
 - $\geq 90\%$: A, $\geq 80\%$: B, $\geq 70\%$: C, $\geq 60\%$: D, $< 50\%$: F

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

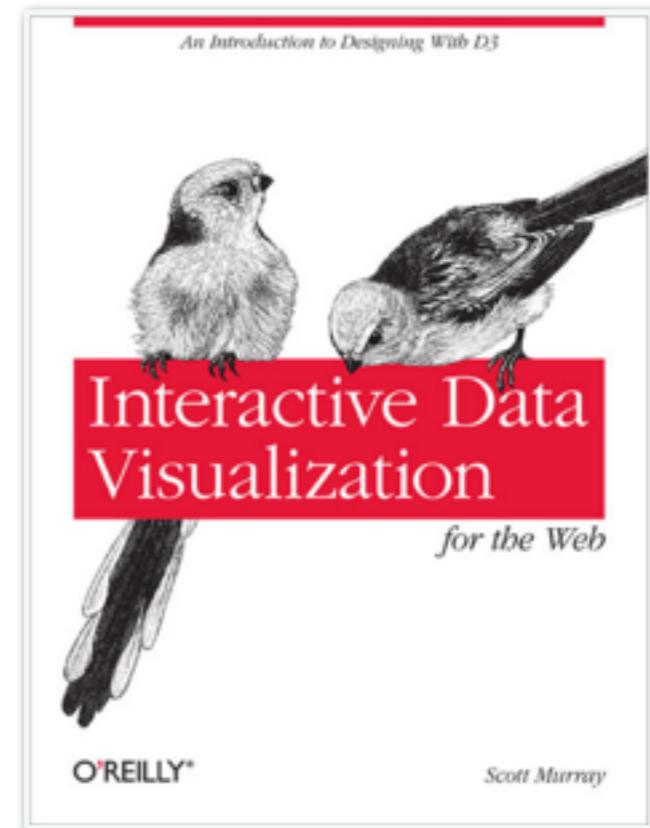
- **No required textbook**, but you won't regret buying Munzner's "Visualization Analysis and Design"



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

Textbook

- You will also probably make good use of Scott Murray's "Interactive Visualization for the Web"
- Full version available online for free! <http://chimera.labs.oreilly.com/books/1230000000345/index.html>

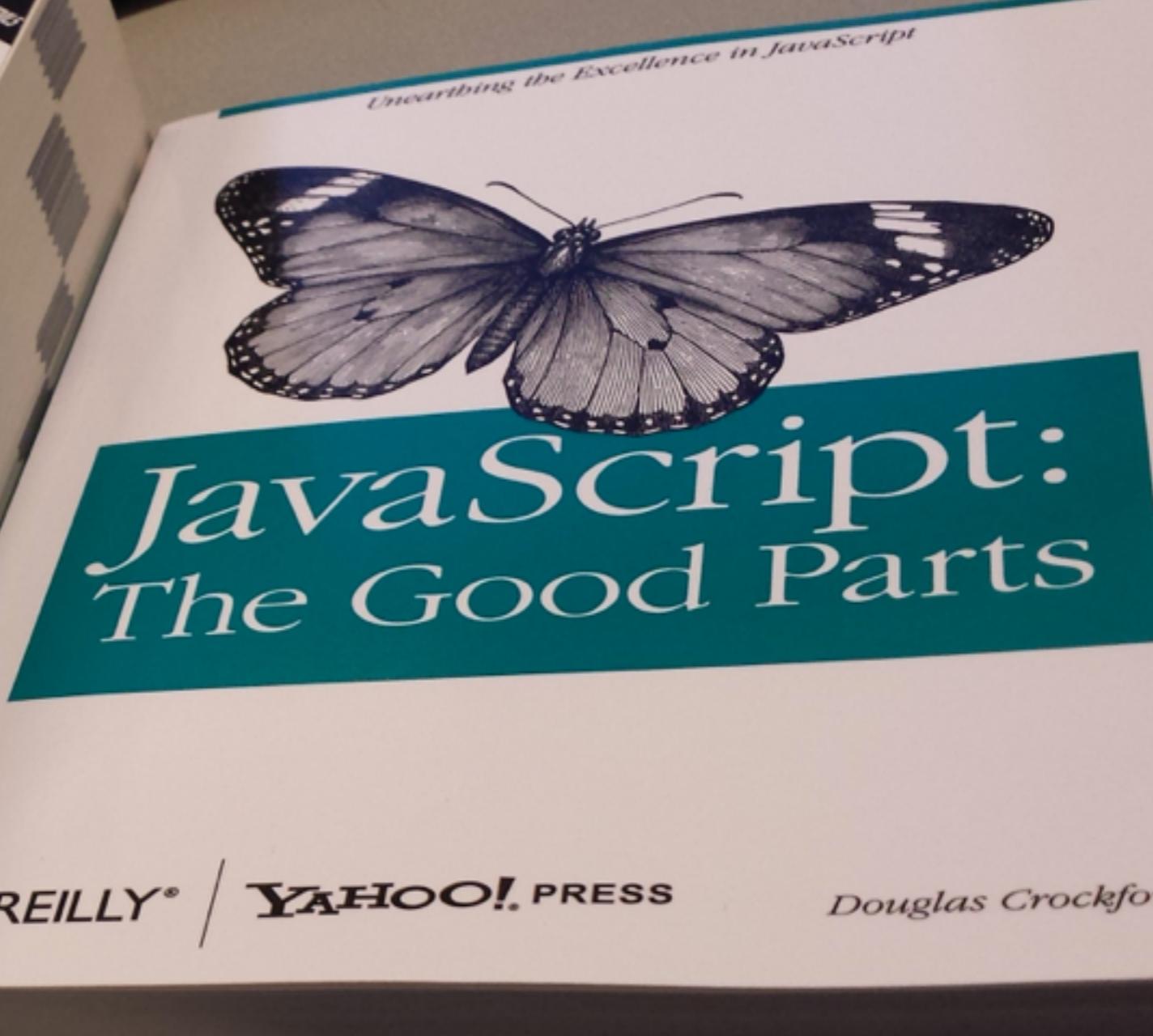
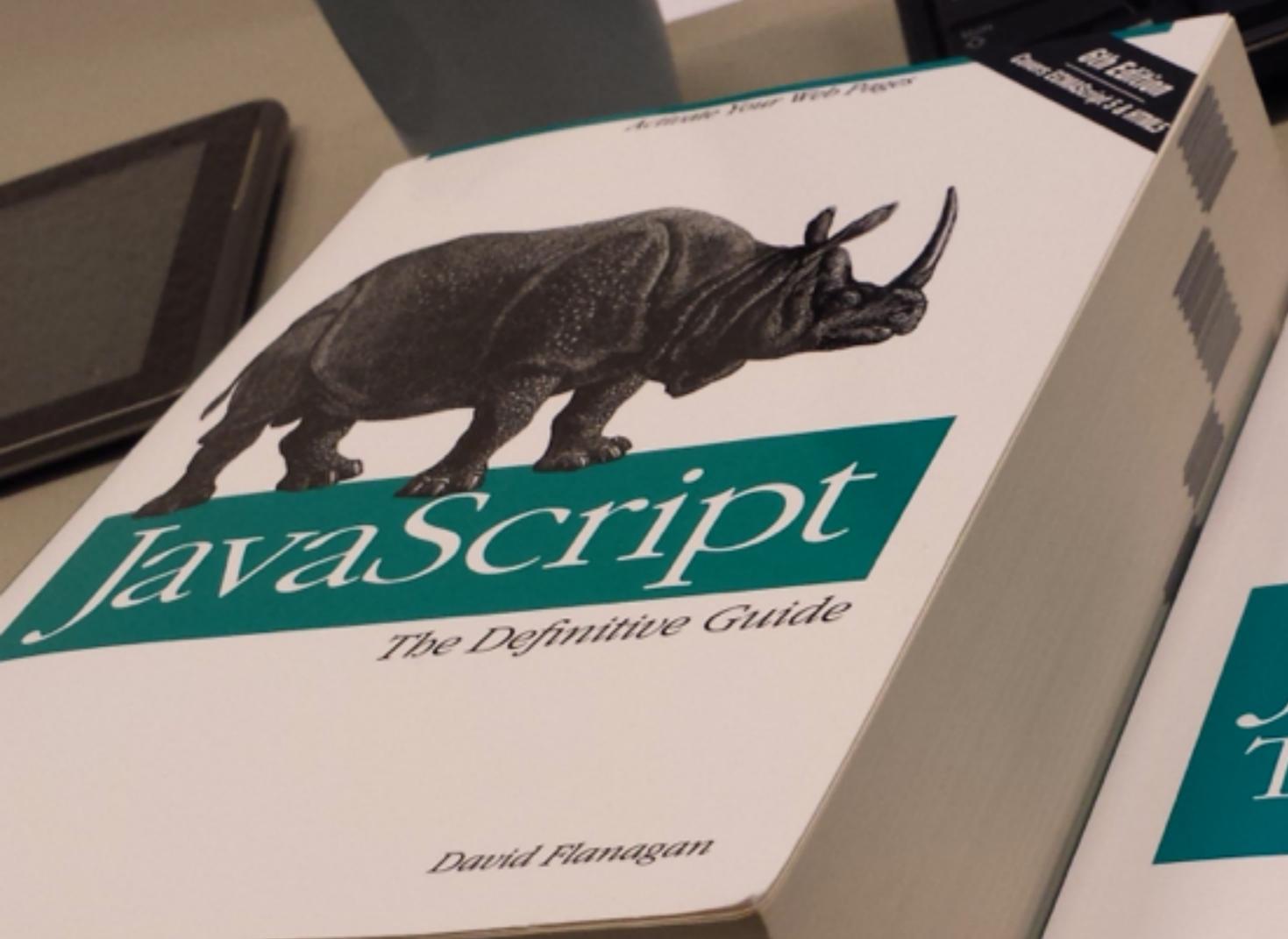


Important Vis Books

- 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



O'REILLY® | YAHOO! PRESS

Douglas Crockf

<http://bit.ly/1swfb5p>

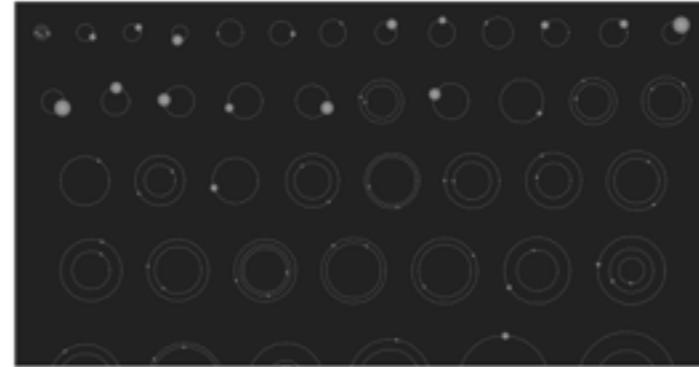
<http://i.imgur.com/wR3ZxfB.jpg>

Stick with it, though!

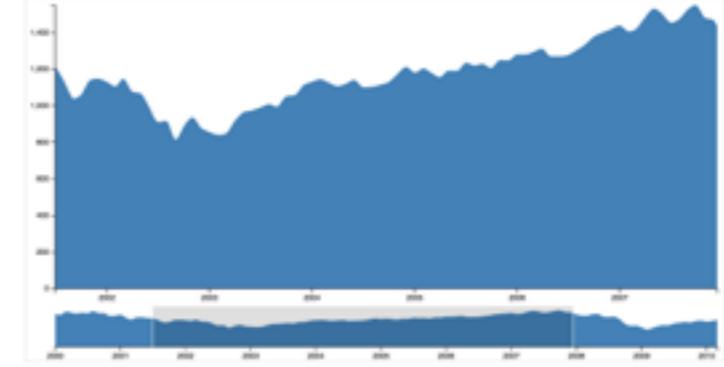
Hierarchical Edge Bundling



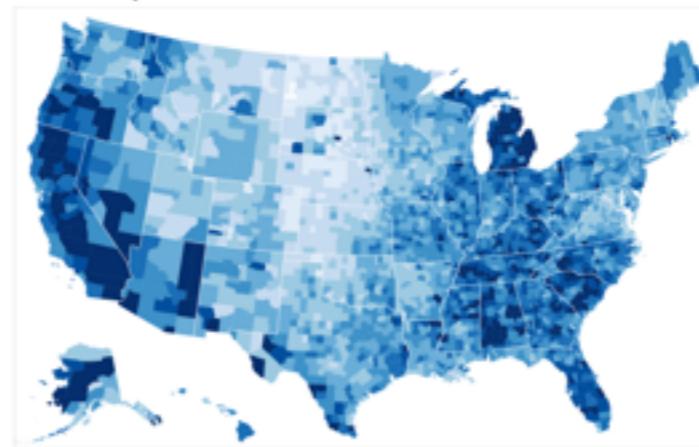
Kepler's Tally



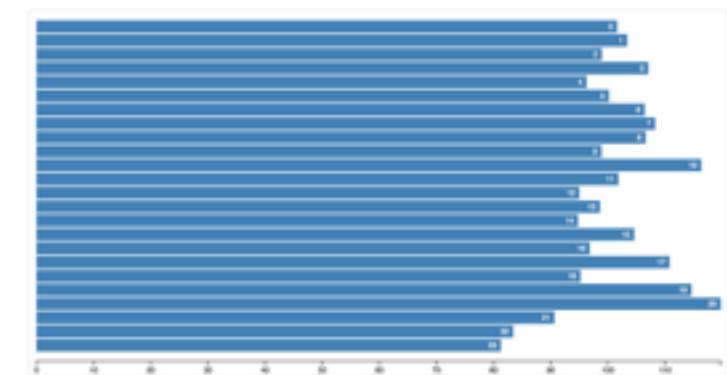
Focus+Context via Brushing



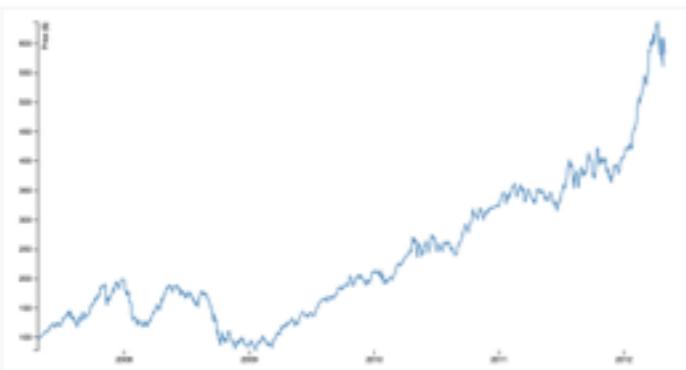
Choropleth



Sortable Bar Chart



X-Value Mouseover



<http://bl.ocks.org/mbostock>

Good reasons to choose the web stack:

It's ubiquitous

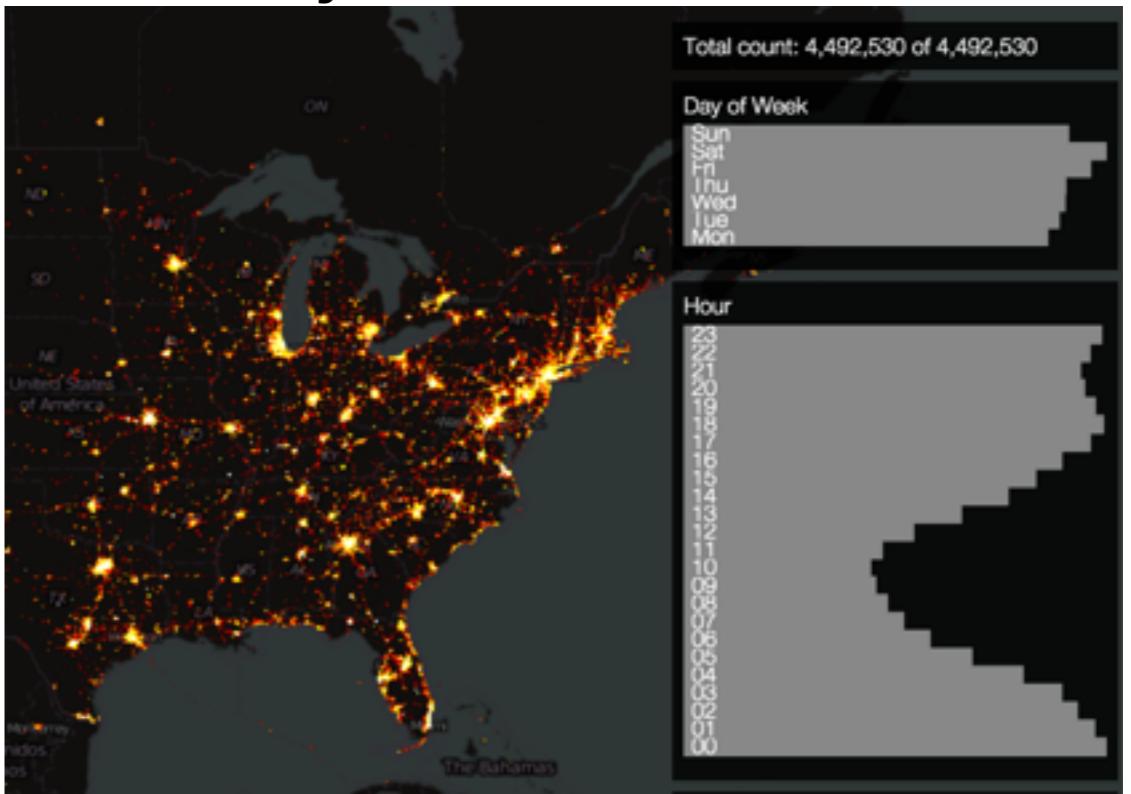


apple.com



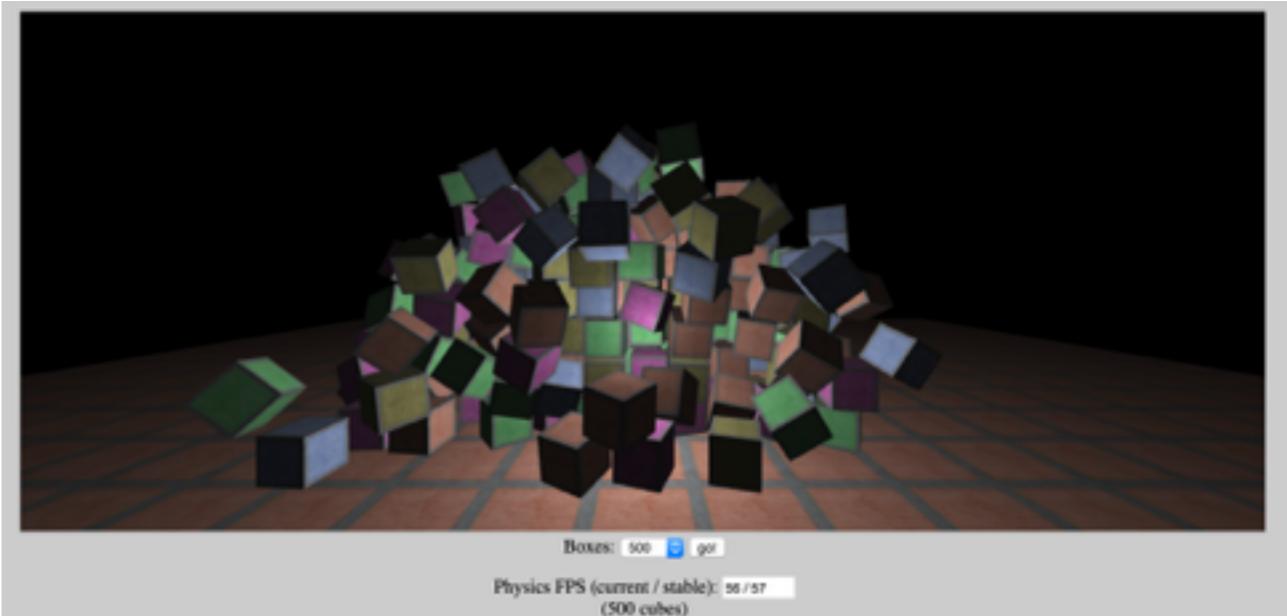
arstechnica.com

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/fal16/cs444/lectures/lecture1/boundary/>

Change Blindness

(photosensitive epilepsy? please look away.)

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

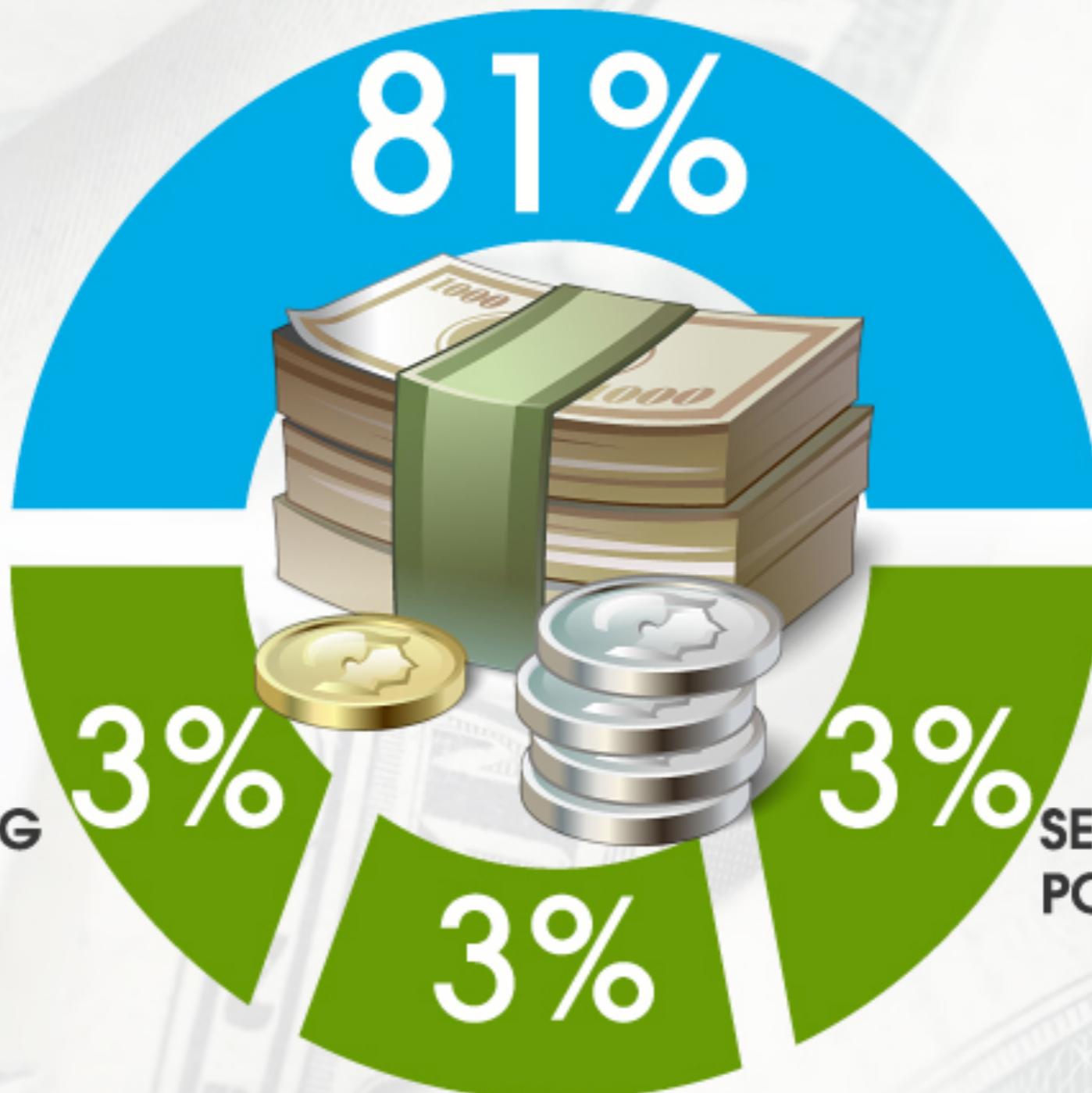
Respect the math in
the data

Not everything you can do with data makes sense

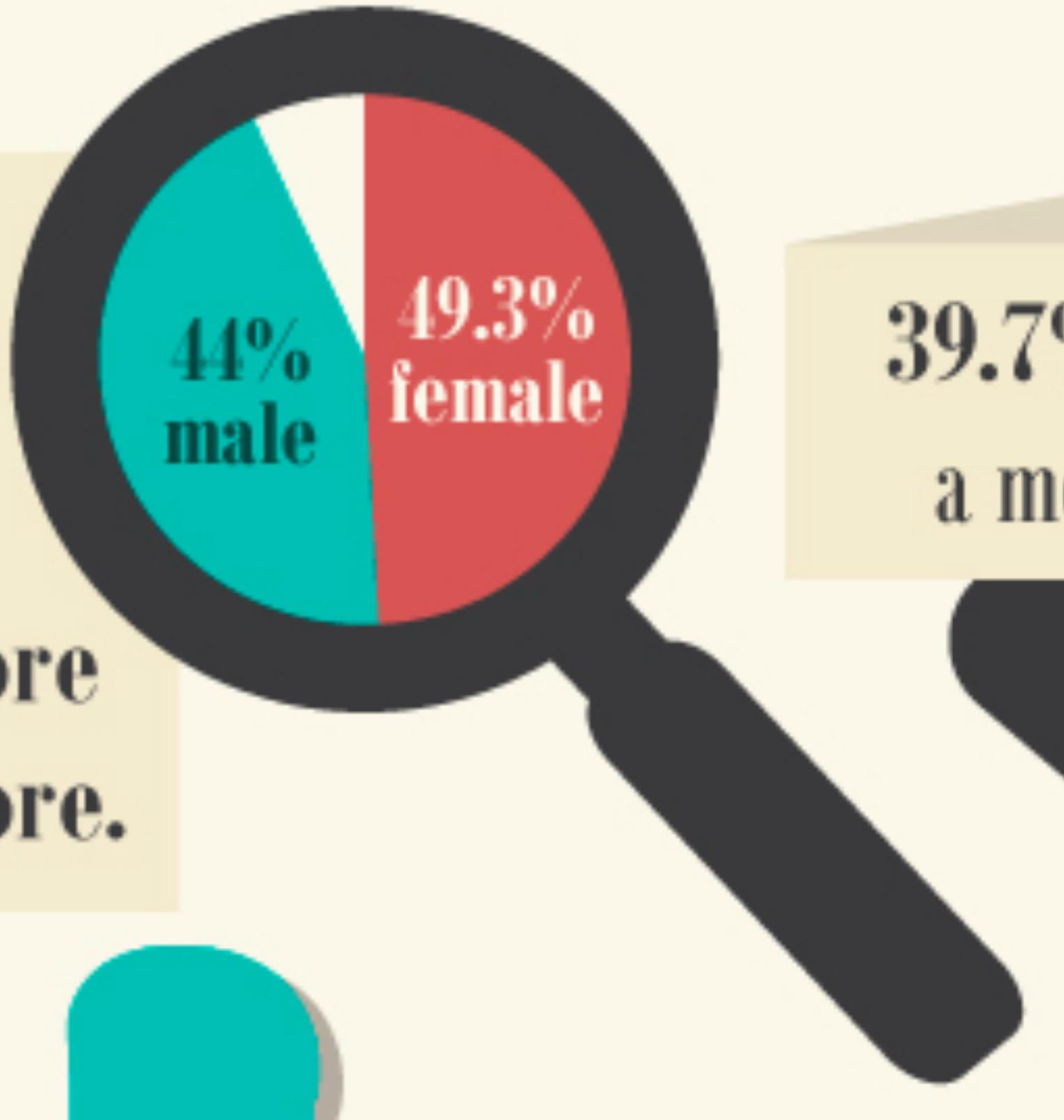
WHAT ACTUALLY BORROWERS DO DEVOID OF GETTING PAYDAY LOANS



CUT BACK ON DAILY EXPENDITURES



Almost half of all shoppers will research on their mobile device before purchasing in a store.



TOWN OF
Snowmass Village

ESTABLISHED

1967

ELEVATION

8388

POPULATION

2826

TOTAL

13,181

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/spr14/cs444/lectures/week1.html>

CS 444/544 Summary

- 4 weeks of mechanics, 5 weeks of principles, 6 weeks of techniques
- ~1 small assignment a week, 1 midterm, 1 project

Course website: [**http://cscheid.net/courses/fal16/cs444**](http://cscheid.net/courses/fal16/cs444)

Today's lecture:

[**http://cscheid.net/courses/spr15/cs444/lectures/week1.html**](http://cscheid.net/courses/spr15/cs444/lectures/week1.html)