
METIS DATA SCIENCE BOOK CAMP

# DATA VISUALIZATION & D3 SUPER POWERS

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Metis Data Science Bootcamp
May 12th, 2015

# SEBASTIAN GUTIERREZ

- Specializes in Actionable Data Visualizations
- Organizes of NYC D3.js Meetup
- Corporate training & consulting in D3 & Data Viz
- Author of “Data Scientists at Work” book
- DashingD3js.com (D3.js training website)
- DataScienceWeekly.org (weekly newsletter)

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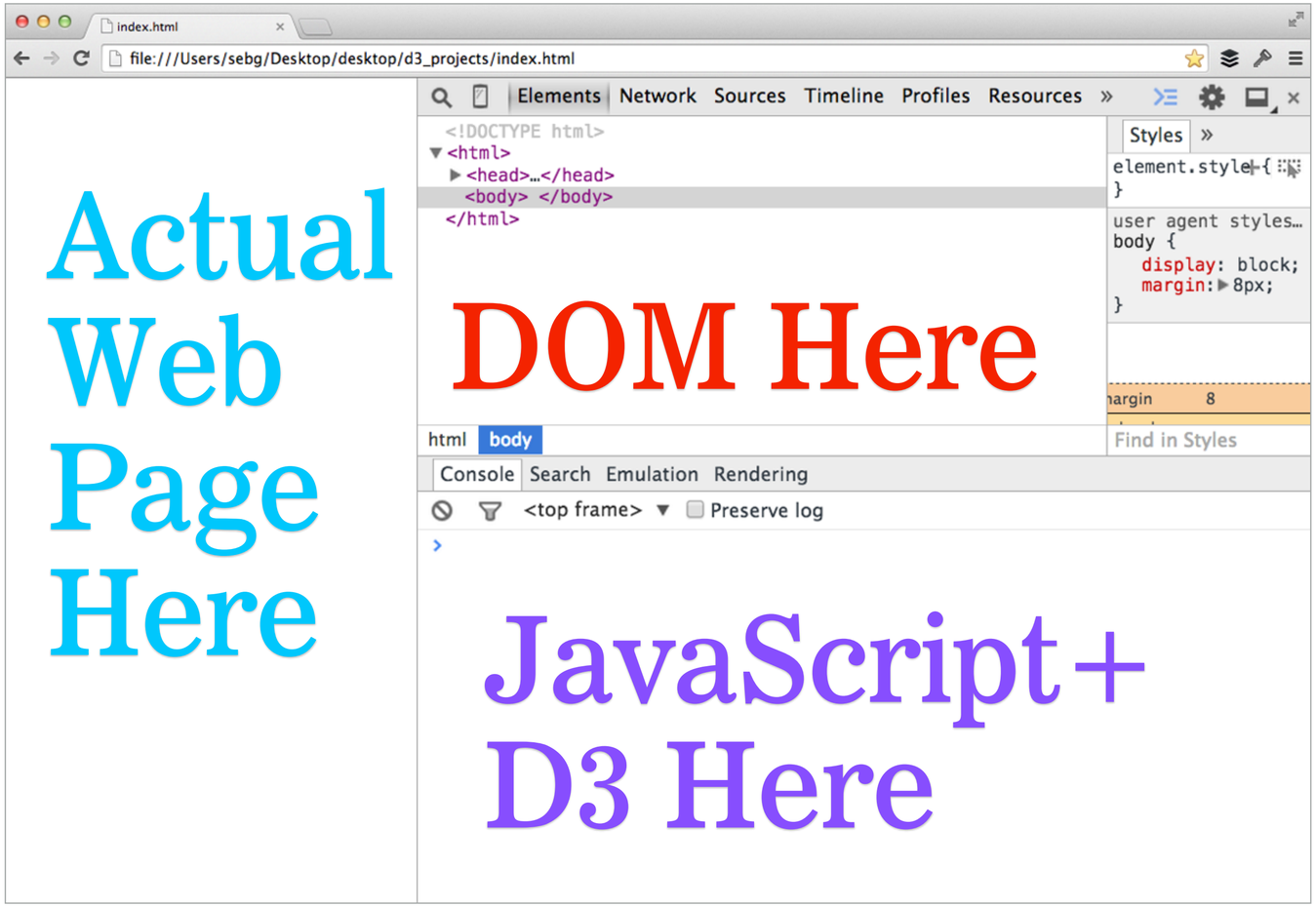
# WEBSITE FOR LINKS, FILE, & CODE

- PDF of this presentation: http://bit.ly/20150512-metis-d3-pdf
- Files for this presentation: http://bit.ly/20150512-metis-d3-files

# CHROME + DEVELOPER TOOLS

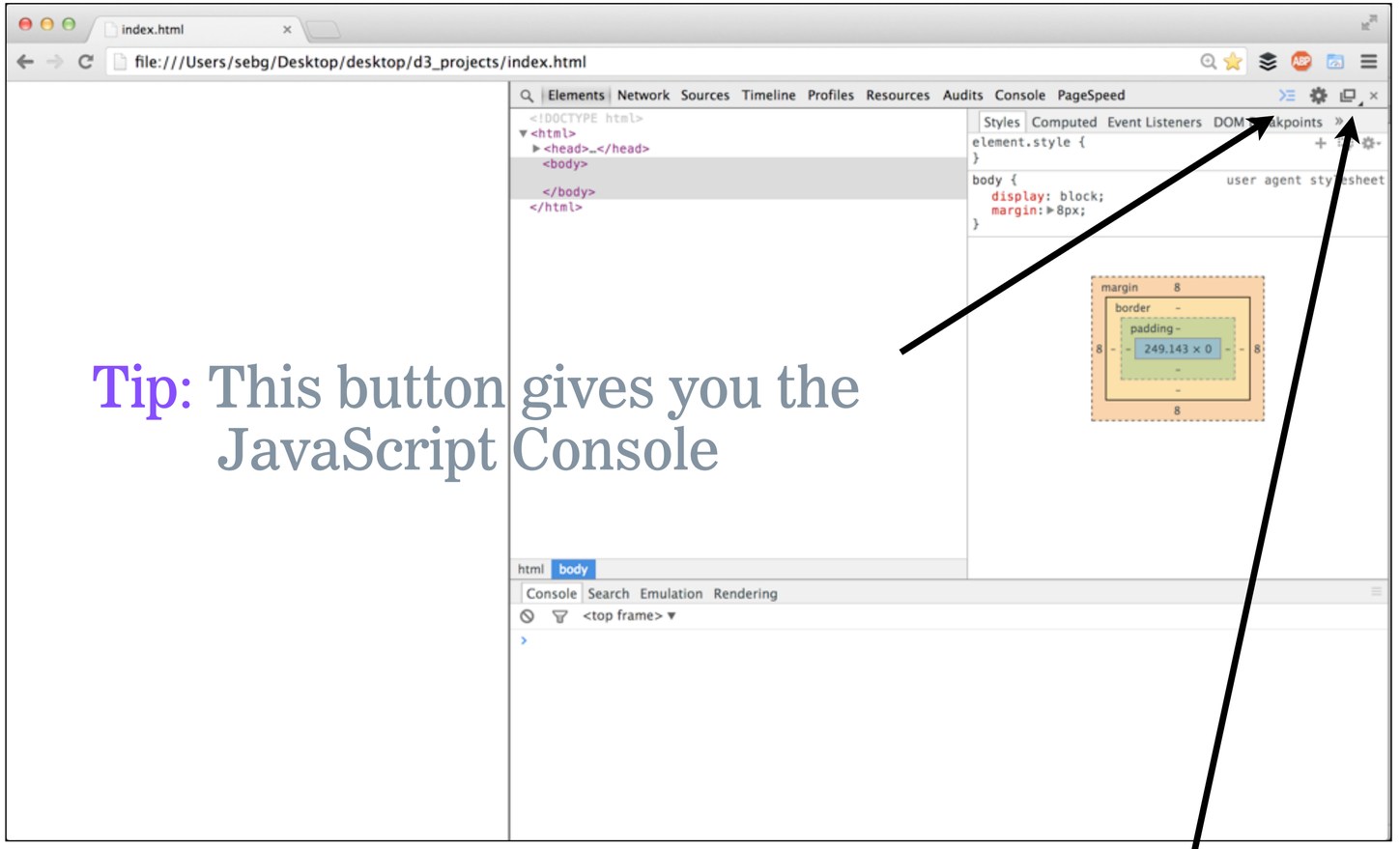


# EXERCISE: CHROME

## 1. Get Google Chrome
https://www.google.com/chrome

## 2. Open Up Chrome Dev Tools
View -> Developer -> Developer Tools

## 3. Setup Screen As Pictured
a) Press the Elements button
b) Press the button for the JS Console
c) Press and hold the button for the way to orient the JS Console / Elements




Tip: This button gives you the JavaScript Console

Tip: Hold this button down to see different ways to setup JavaScript Console

# AGENDA

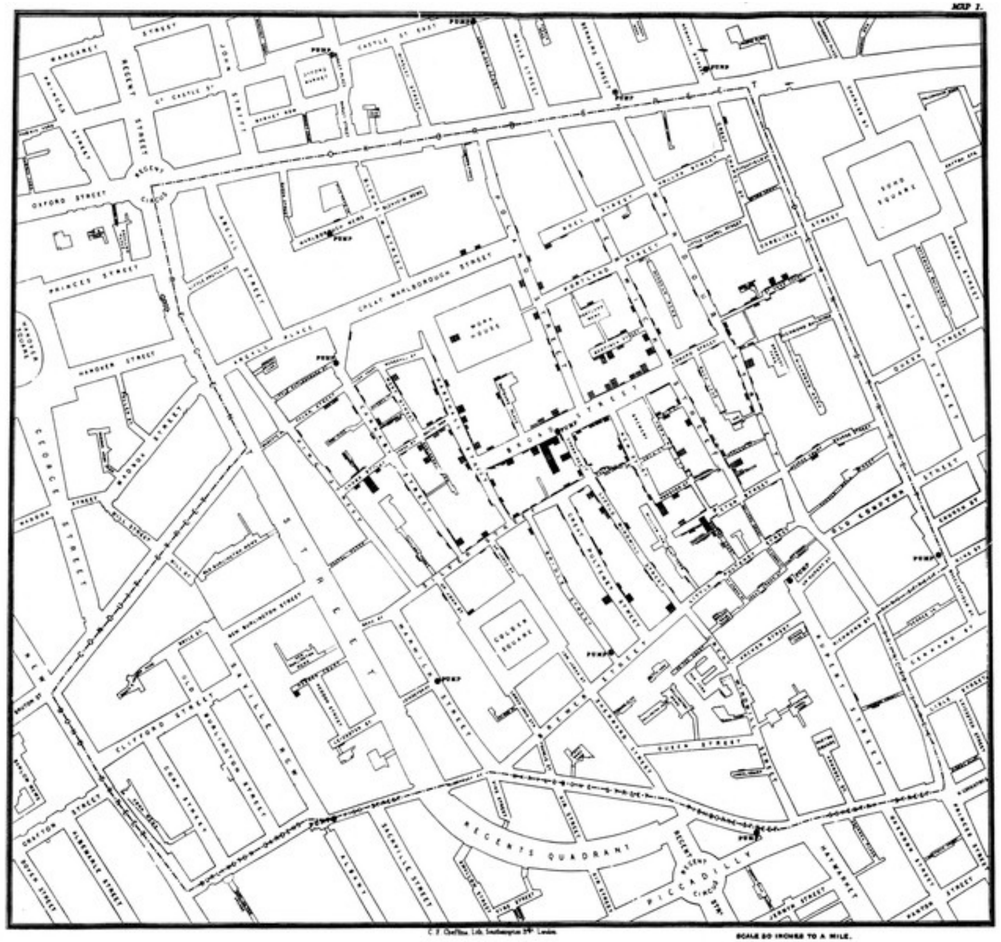
1. What is Data Visualization
2. D3 as a Data Visualization Tool
3. D3 Examples & bl.ocks.org
4. D3 Layouts
5. Conclusion

# SECTION 1
# WHAT IS DATA VISUALIZATION

# PUBLIC HEALTH TOOL

## John Snow's Map of the 1854 Broad Street Cholera Outbreak

Showed Cholera was being spread by water coming from a Broad Street Water Pump.

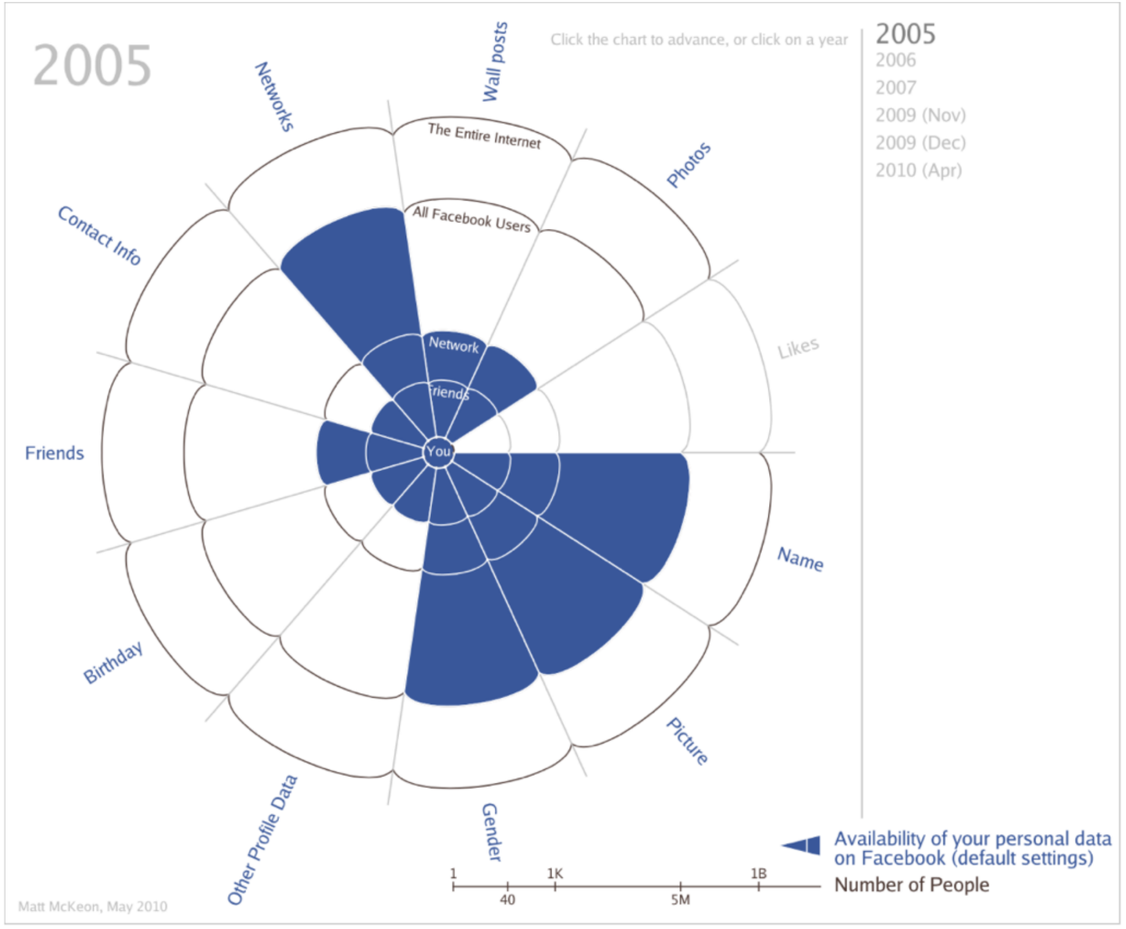



Source:
http://en.wikipedia.org/wiki/1854_Broad_Street_cholera_outbreak

# PUBLIC / PRIVACY TOOL

## How Public Your Personal Data is On Facebook By Default

Evolution of Facebook Default Privacy Settings



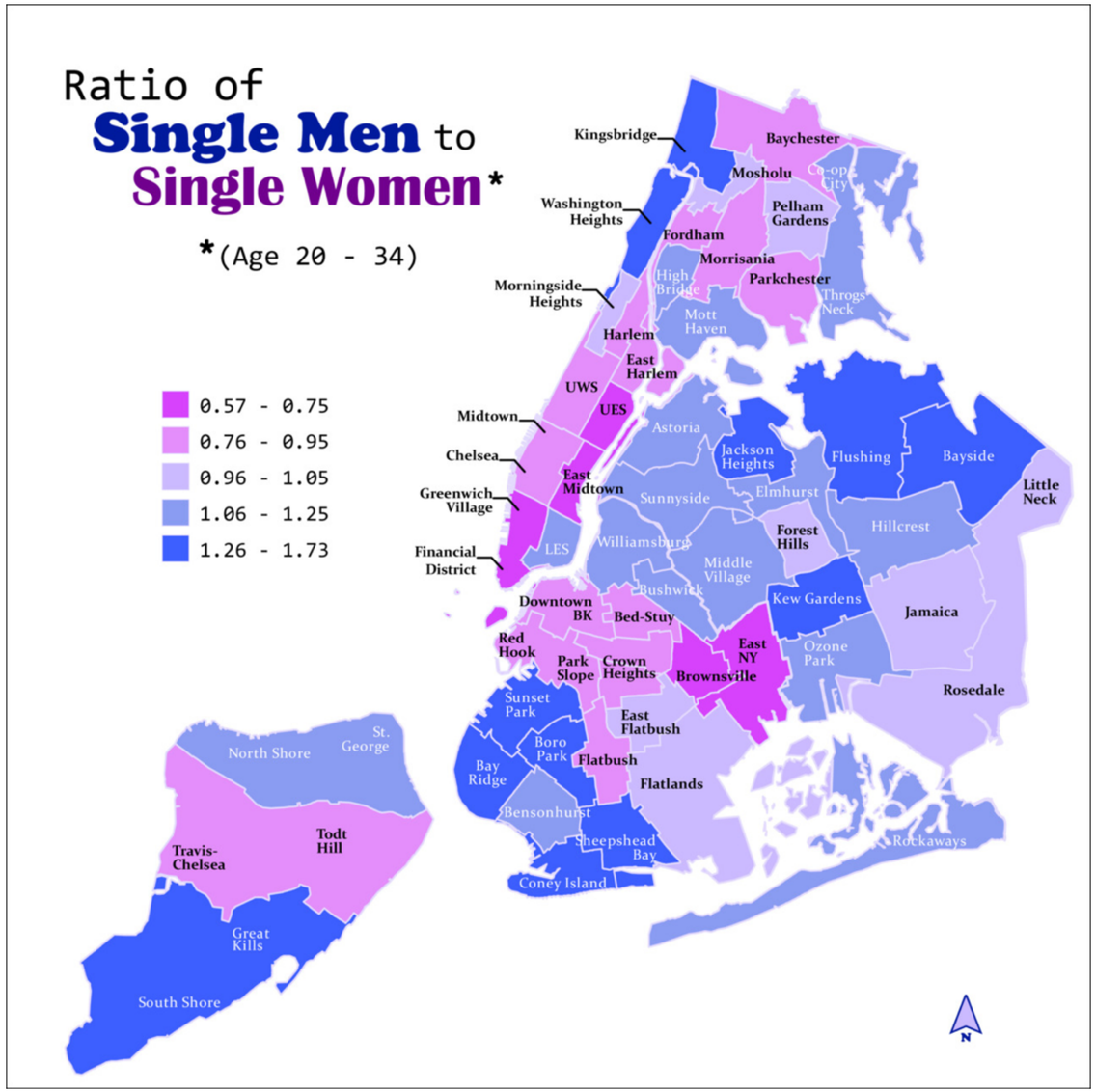

Source:
http://mattmckeon.com/facebook-privacy/

# DATING TOOL

## NYCEDC

## Ratio of Single Men to Single Women (Age 20 - 34)

New York City's population is 53% female and 47% male. Using Census data, NYCEDC analyzed only the population who are never married singles between the ages of 20 and 34.



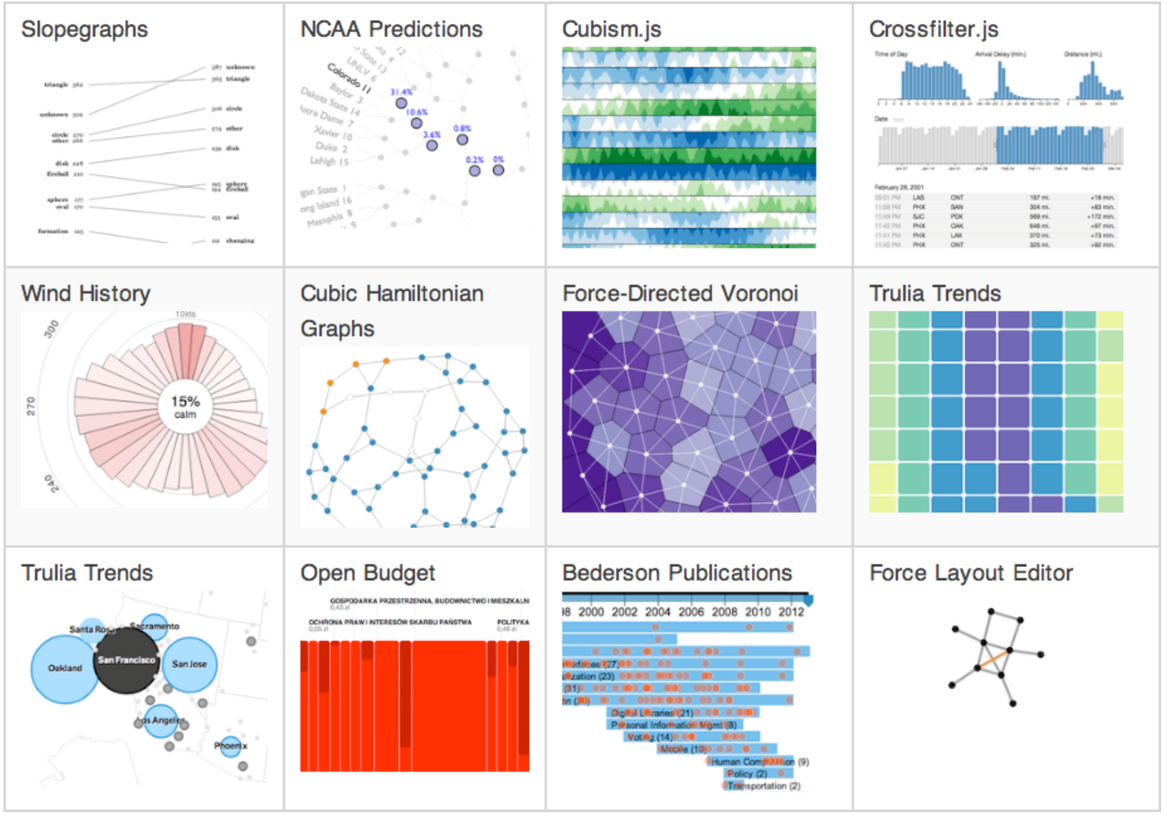

Source:
http://nycedc.tumblr.com/post/16175652438/ratio-of-single-men-to-single-women-in-nyc-new

# DATA VISUALIZATION IS A TOOL

## Everything Generates Data

Visualizing this data leads to understanding.

- Sports
- Commerce
- Weather
- Real Estate
- Publications
- Social Media
- Etc.....




Source:
https://github.com/mbostock/d3/wiki/Gallery

# DATA VIZ GUIDES THINKING

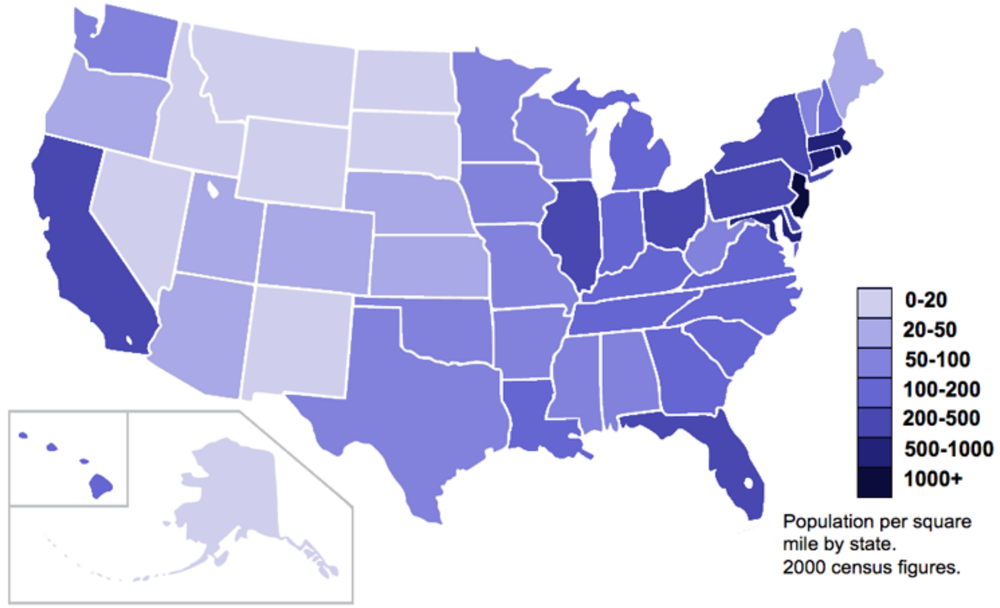
## Data in Columns & Rows
Audience has to think hard

A39 | Maryland

| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 20 | Alaska | D-3 | R-3 | R-3 | R-3 | R-3 | R-3 | R-3 |
| 21 | Arizona | R-5 | R-5 | R-6 | R-6 | R-6 | R-7 | R-7 |
| 22 | Arkansas | D-6 | (\1) | R-6 | D-6 | R-6 | R-6 | R-6 |
| 23 | California | D-40 | R-40 | R-45 | R-45 | R-45 | R-47 | R-47 |
| 24 | Colorado | D-6 | R-6 | R-7 | R-7 | R-7 | R-8 | R-8 |
| 25 | Connecticut | D-8 | D-8 | R-8 | R-8 | R-8 | R-8 | R-8 |
| 26 | Delaware | D-3 | R-3 | R-3 | D-3 | R-3 | R-3 | R-3 |
| 27 | District of Columbia | D-3 | D-3 | D-3 | D-3 | D-3 | D-3 | D-3 |
| 28 | Florida | D-14 | R-14 | R-17 | D-17 | R-17 | R-21 | R-21 |
| 29 | Georgia | R-12 | (\1) | R-12 | D-12 | D-12 | R-12 | R-12 |
| 30 | Hawaii | D-4 | D-4 | R-4 | D-4 | D-4 | R-4 | D-4 |
| 31 | Idaho | D-4 | R-4 | R-4 | R-4 | R-4 | R-4 | R-4 |
| 32 | Illinois | D-26 | R-26 | R-26 | R-26 | R-26 | R-24 | R-24 |
| 33 | Indiana | D-13 | R-13 | R-13 | R-13 | R-13 | R-12 | R-12 |
| 34 | Iowa | D-9 | R-9 | R-8 | R-8 | R-8 | R-8 | D-8 |
| 35 | Kansas | D-7 | R-7 | R-7 | R-7 | R-7 | R-7 | R-7 |
| 36 | Kentucky | D-9 | R-9 | R-9 | D-9 | R-9 | R-9 | R-9 |
| 37 | Louisiana | R-10 | (\1) | R-10 | D-10 | R-10 | R-10 | R-10 |
| 38 | Maine | D-4 | D-4 | R-4 | R-4 | R-4 | R-4 | R-4 |
| 39 | Maryland | D-10 | D-10 | R-10 | D-10 | D-10 | R-10 | R-10 |
| 40 | Massachusetts | D-14 | D-14 | D-14 | D-14 | R-14 | R-13 | D-13 |
| 41 | Michigan | D-21 | D-21 | R-21 | R-21 | R-21 | R-20 | R-20 |
| 42 | Minnesota | D-10 | D-10 | R-10 | D-10 | D-10 | D-10 | D-10 |
| 43 | Mississippi | R-7 | (\1) | R-7 | D-7 | R-7 | R-7 | R-7 |
| 44 | Missouri | D-12 | R-12 | R-12 | D-12 | R-12 | R-11 | R-11 |
| 45 | Montana | D-4 | R-4 | R-4 | R-4 | R-4 | R-4 | R-4 |
| 46 | Nebraska | D-5 | R-5 | R-5 | R-5 | R-5 | R-5 | R-5 |
| 47 | Nevada | D-3 | R-3 | R-3 | R-3 | R-3 | R-4 | R-4 |
| 48 | New Hampshire | D-4 | R-4 | R-4 | R-4 | R-4 | R-4 | R-4 |
| 49 | New Jersey | D-17 | R-17 | R-17 | R-17 | R-17 | R-16 | R-16 |
| 50 | New Mexico | D-4 | R-4 | R-4 | R-4 | R-4 | R-5 | R-5 |

Source:
http://www.census.gov

## Data Visualization
Audience has to think less hard




Source:
http://commons.wikimedia.org/wiki/File:US_2000_census_population_density_map_by_state.svg

# "RAW DATA" IS HARD TO READ

**Anscombe's quartet**

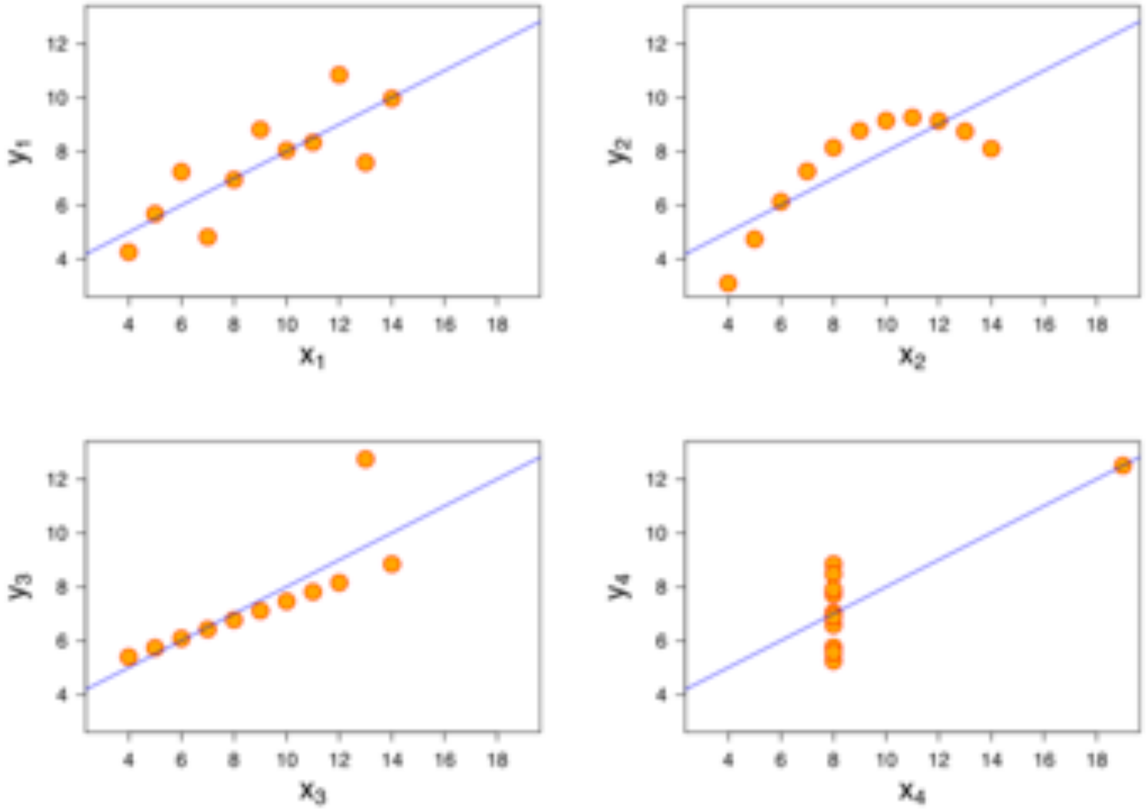
| I | | II | | III | | IV | |
|---|---|---|---|---|---|---|---|
| x | y | x | y | x | y | x | y |
| 10.0 | 8.04 | 10.0 | 9.14 | 10.0 | 7.46 | 8.0 | 6.58 |
| 8.0 | 6.95 | 8.0 | 8.14 | 8.0 | 6.77 | 8.0 | 5.76 |
| 13.0 | 7.58 | 13.0 | 8.74 | 13.0 | 12.74 | 8.0 | 7.71 |
| 9.0 | 8.81 | 9.0 | 8.77 | 9.0 | 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 |

- Mean of x: 9
- Variance of x: 11
- Mean of y: 7.50
- Variance of y: 4.12
- Correlation between x and y: 0.816
- Linear regression line for each case:
  $y = 3.00 + 0.500 * x$

# DATA VIZ DRIVES INTUITION OF DATA

**Anscombe's quartet**

| 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 |

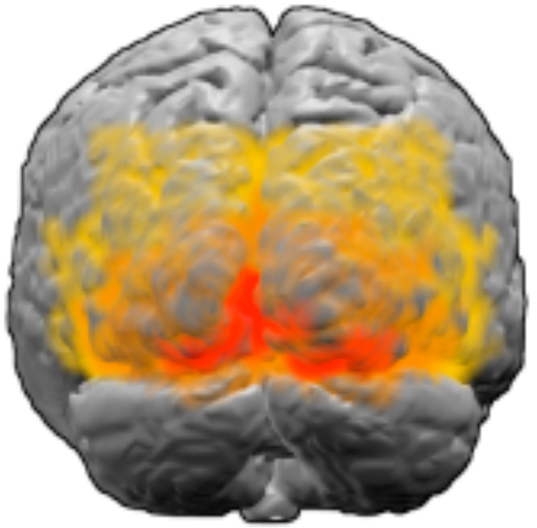


# DATA VIZ USES VISUAL CORTEX

66% of stimuli reaching the brain are visual (Zaltman 1996)

50% of brain devoted to processing visual images (Bates & Cleese 2001)

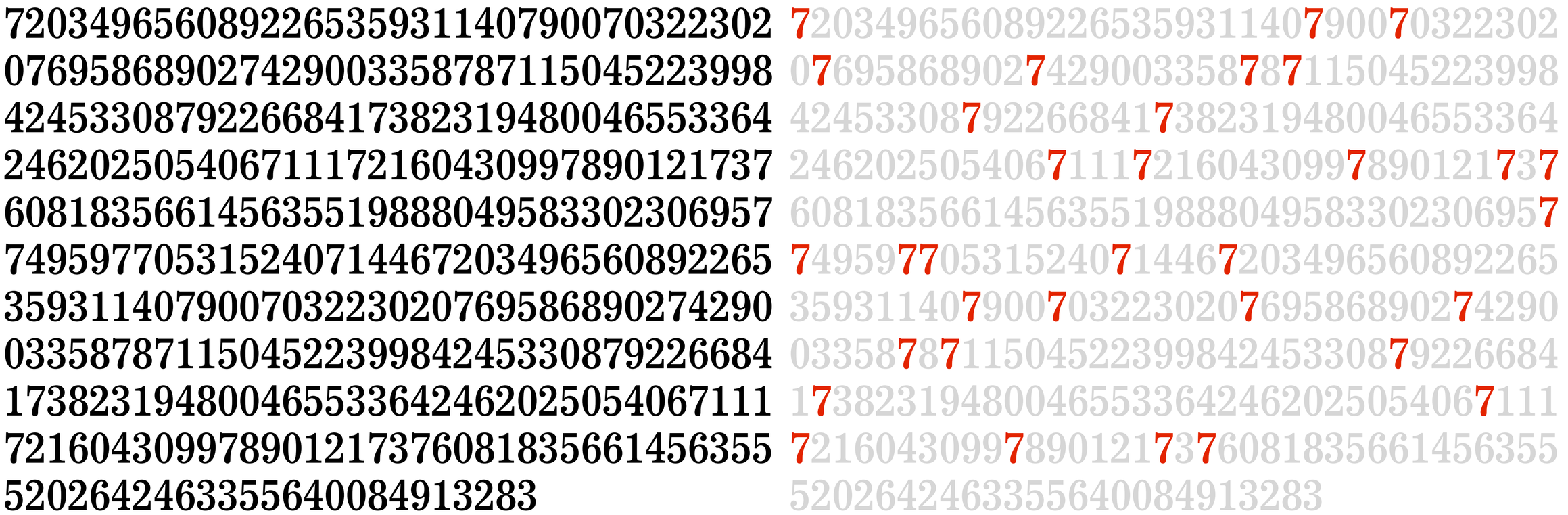
80% of learning is visually based (American Optometric Assoc. 1991)



Eye Image Source:
http://www.flickr.com/photos/orangeacid/234358923/

Brain Image Source:
http://en.wikipedia.org/wiki/File:Brodmann_areas_17_18_19.png

# DATA VIZ USES BRAIN'S SHORTCUTS



# BRAIN'S PRE-ATTENTIVE PROPERTIES

COLOR HUE

ORIENTATION

TEXTURE

POSITION & ALIGNMENT

COLOR BRIGHTNESS

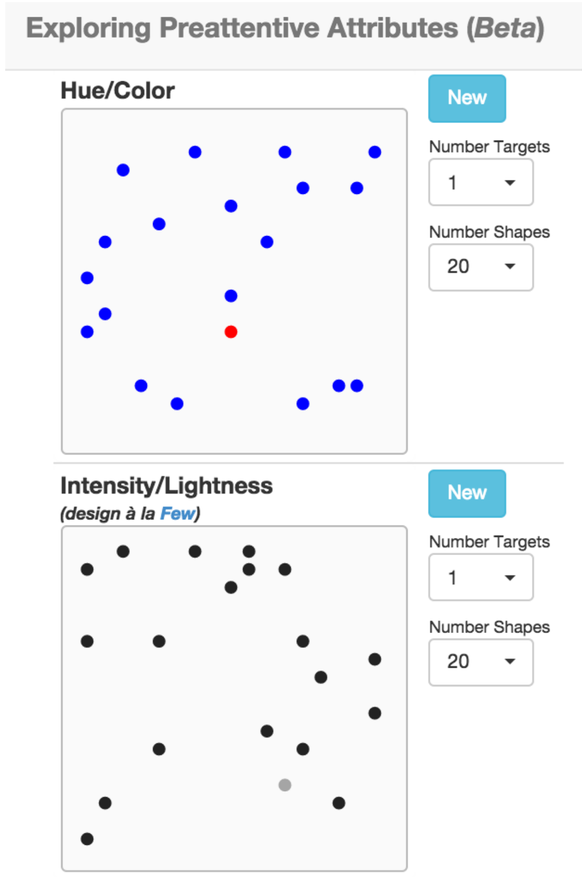
COLOR SATURATION

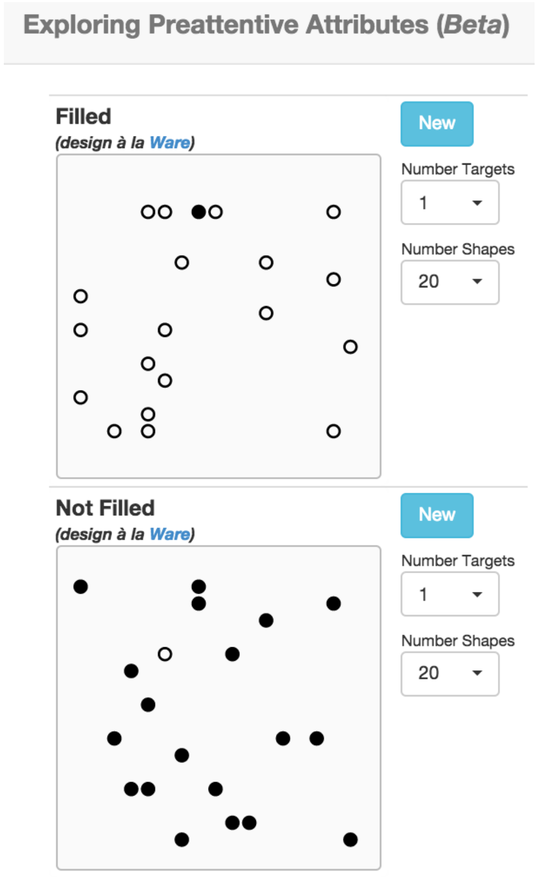
SIZE

SHAPE

# D3 EXAMPLES OF PRE-ATTENTIVE PROPERTIES

http://learnforeverlearn.com/preattentive/



# DATA VISUALIZATION IS A...

- Tool
- That helps guide thinking
- When trying to “understand” / “develop intuition about” data
- That uses the Visual Cortex
- To take advantage of the brain’s shortcuts
- And pre-attentive properties
- To achieve a goal.

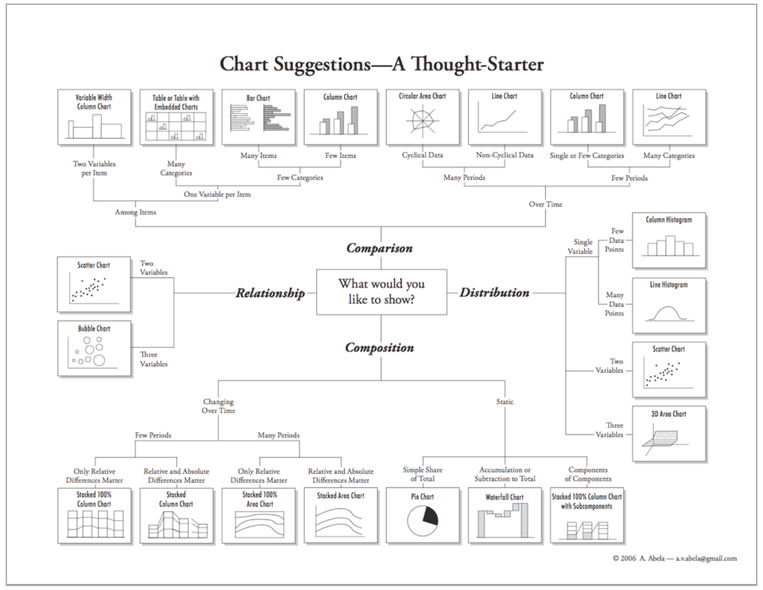
# SEVEN MAIN TYPES OF DATA VIZ GOALS

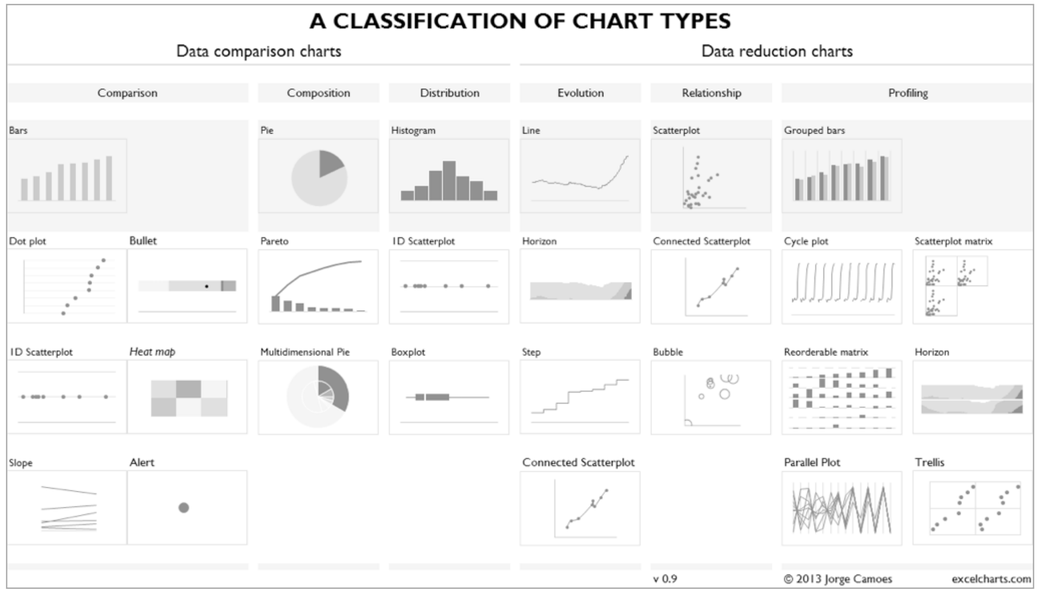
Visual Encoding Depends on your goal -

- Time / Evolution
- Drill down
- Zoom out
- Contrast
- Intersections
- Factors
- Outliers

Source:
https://twitter.com/dataremixed

# VISUALLY ENCODING YOUR GOAL




- Comparison
- Distribution
- Composition
- Relationship

Source:
© A. Abela - a.v.abela@gmail.com

Comparison
- Comparison
- Composition
- Distribution

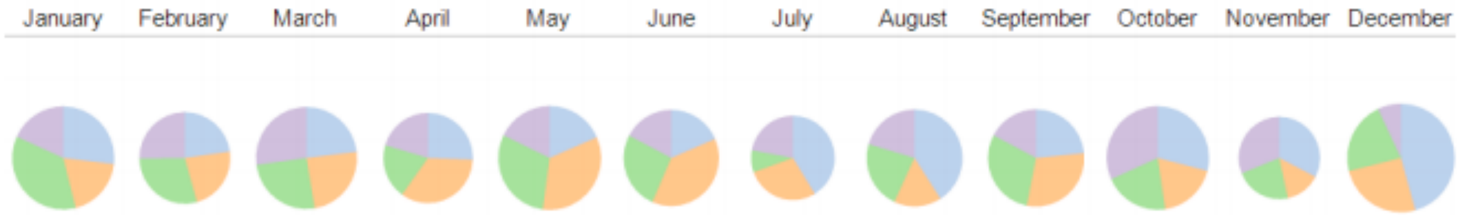
Reduction
- Evolution
- Relationship
- Profiling

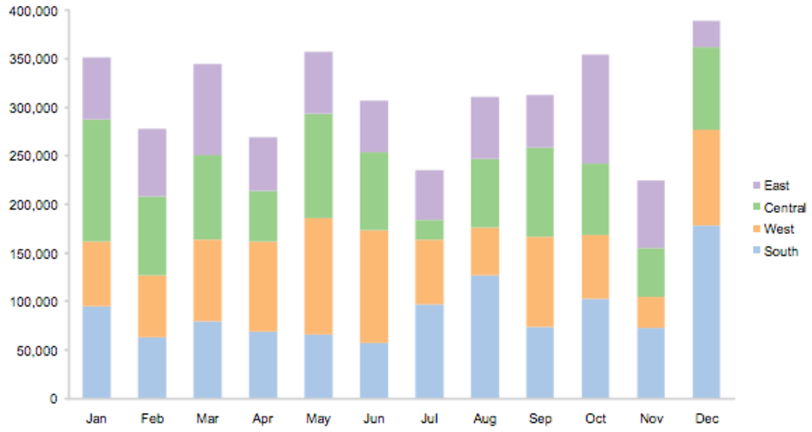
Source:
excelcharts.com

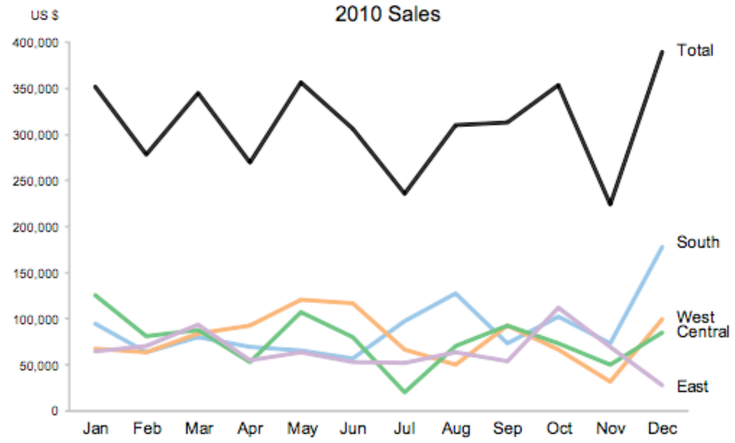
# VISUAL ENCODING EFFECTIVENESS

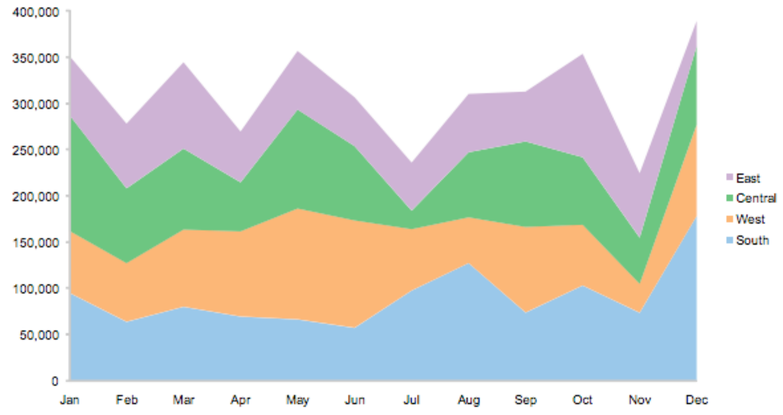
## Depends on you goal

12 Months of Sales
- By Region
- By Month




Source:
Enrico Bertini, Assistant Professor at NYU-Poly (@filwd)

# PURPOSE, DATA, AND AUDIENCE

Seth Godin

Three questions to ask your marketing team

Q1 - Who are you trying to reach?

Q2 - Why do they decide to support us?

Q3 - What do you need in order to make this happen more often?

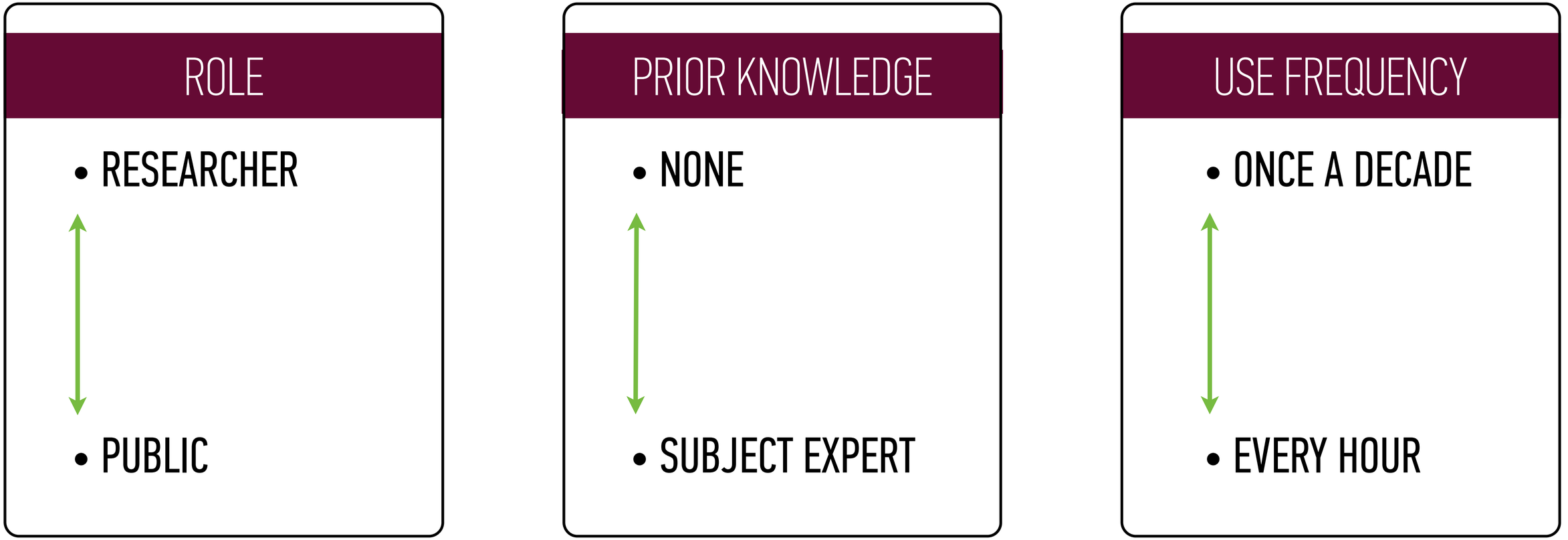
Three questions to ask of your data visualization

Q1 - Who are you trying to reach? (Audience)

Q2 - Why do they decide to support us? (Purpose)

Q3 - What do you need in order to make this happen? (Data)

# NEED TO KNOW – AUDIENCE



# NEED TO KNOW – HOW IT IS VIEWED

## PRINT

- BLACK AND WHITE?
- SOME COLOR?
- ALL COLOR?

## WEB

- INTERACTIVE?
- NON-INTERACTIVE?

## VIDEO

- NEWS SEGMENT?
- COMMERCIAL?
- SHOW?

## PRESENTATION

- GUIDED?
- UNGUIDED?

# NEED TO KNOW – AVAILABLE DATA

## PRIMARY

- YOU COLLECT IT
- YOU OWN IT
- NOBODY ELSE HAS IT

## SECONDARY

- OTHERS COLLECT IT
- OTHERS OWN IT
- EVERYONE HAS IT

## GENERATED

- FROM PRIMARY
- FROM SECONDARY
- FROM COMBINATION

# NEED TO KNOW – GOAL / PURPOSE / WIN

## HYPOTHESIS

WHAT ARE WE
TRYING TO SHOW?

## GOAL

HOW DO WE KNOW
IF WE ACHIEVED IT?

## PARAMETERS

WHAT ARE THE
BOUNDARIES?

# AUDIENCE VIEWS DATA VIZ, THEN WHAT

Seth Godin

- What are you trying to tell me?
- What do you want me to do now?

Source:
http://www.sethgodin.com/

# DATA VISUALIZATION IS A...

- Tool
- That helps guide thinking
- When trying to “understand” / “develop intuition about” data
- That uses the Visual Cortex
- To take advantage of the brain’s shortcuts (pre-attentive properties)
- So that you / your audience can achieve a goal / purpose
- Without thinking too much

# SECTION 2
# D3 AS A DATA VISUALIZATION TOOL

# D3 MADE BY DATA VIZ EXPERTS

2005: Prefuse (Java, Heer @ Berkeley)

2007: Flare (ActionScript, Heer @ Berkeley)

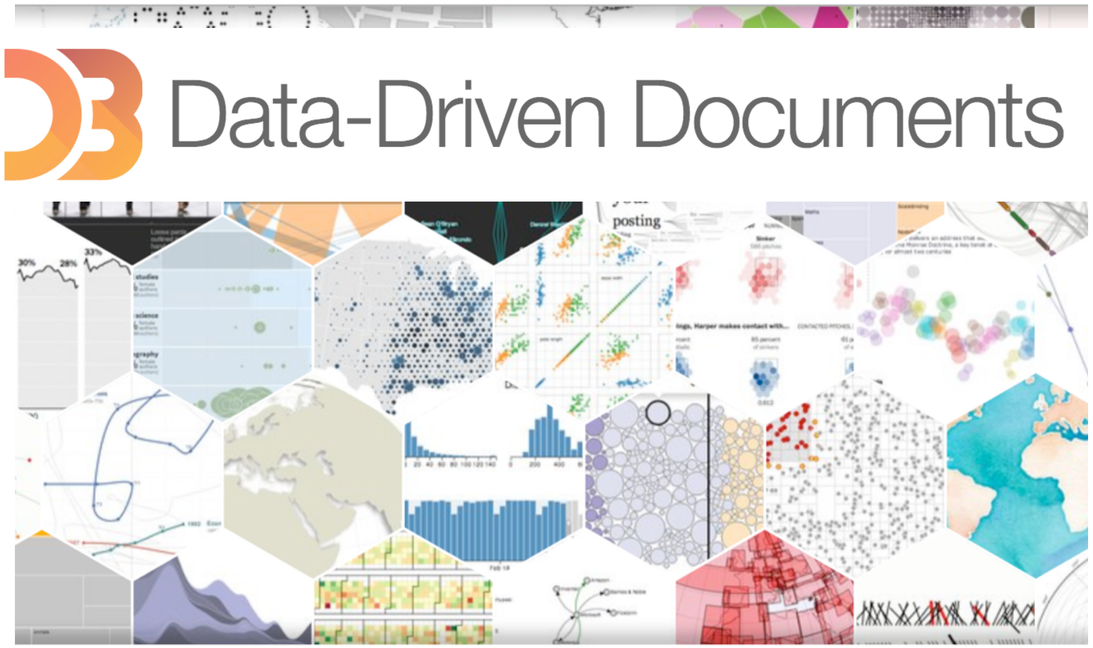
2009: Protovis (JavaScript, Heer & Bostock @ Stanford)

2011: D3 (JavaScript, Heer & Bostock @ Stanford)

TLDR:
very smart people thought very hard
about data visualization for a very long time

Source:
http://anna.ps/talks/fel/#/4

# D3.JS KEY POINTS




- Manipulate Document (DOM)
- Data-Driven
- Visualization Components

Source: http://d3js.org

# DOCUMENT MANIPULATION

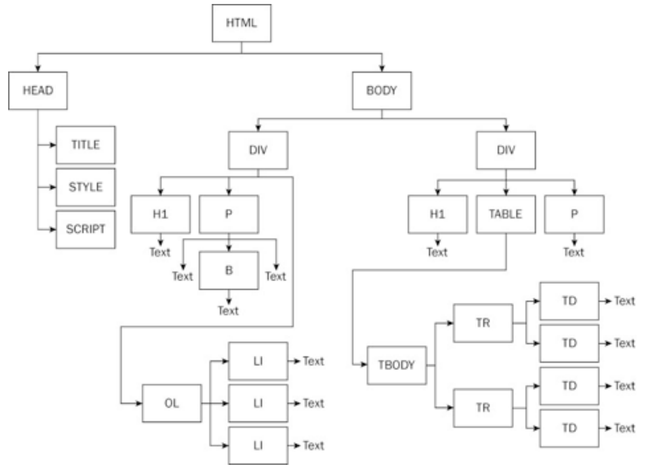
- Manipulate Document (DOM)
- Data-Driven
- Visualization Components

→

- Create Instructions
- Modify Instructions
- Remove Instructions

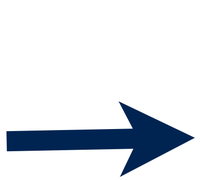
XML, HTML, & SVG

<tag attribute=value ...> ... </tag>



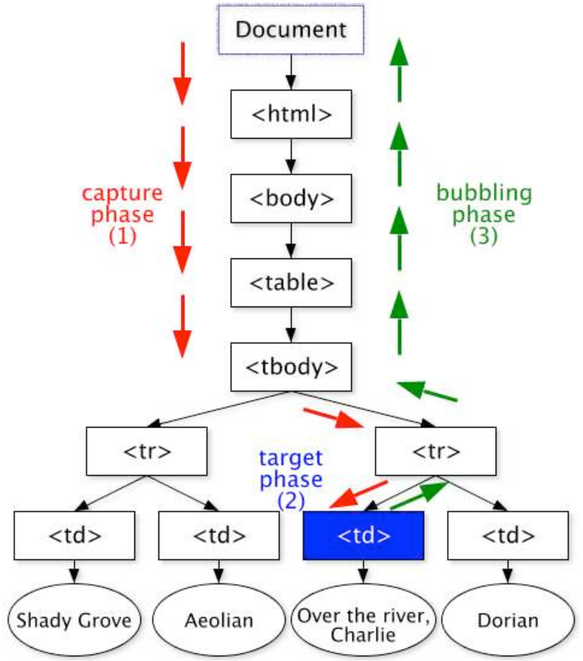
# DATA-DRIVEN

- Manipulate Document (DOM)
- Data-Driven
- Visualization Components



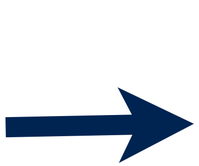
# data.tsv

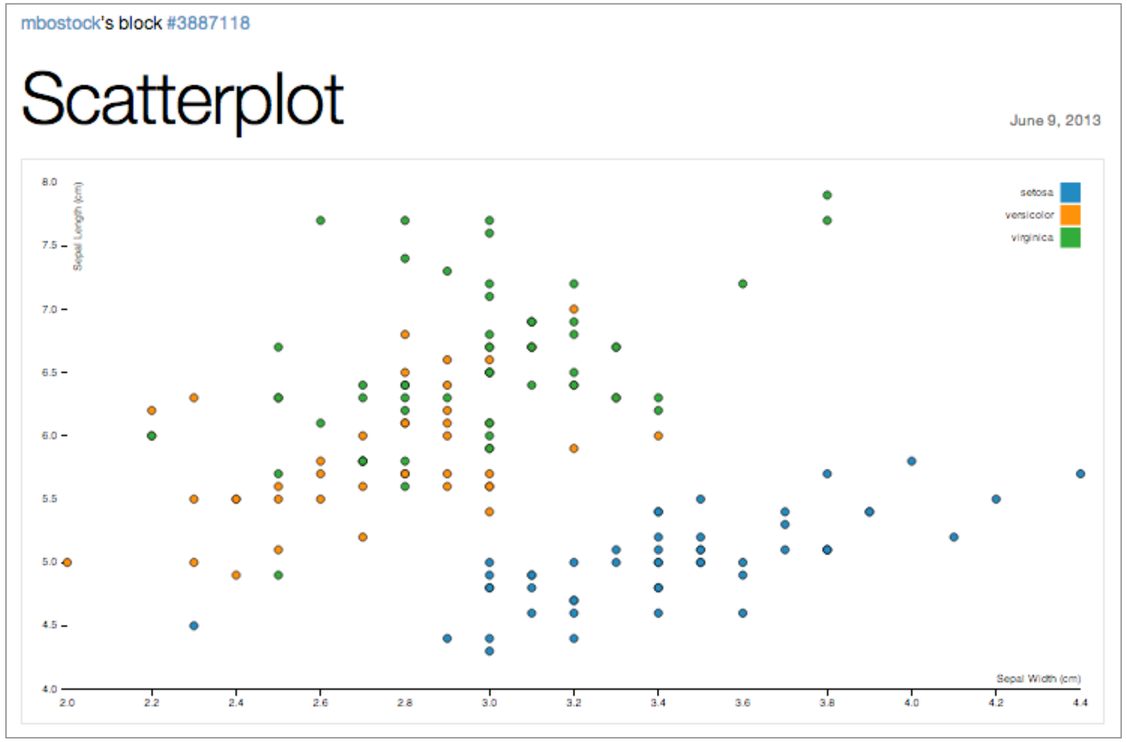
| sepalLength | sepalWidth | petalLength | petalWidth | species |
|---|---|---|---|---|
| 5.1 | 3.5 | 1.4 | 0.2 | setosa |
| 4.9 | 3.0 | 1.4 | 0.2 | setosa |
| 4.7 | 3.2 | 1.3 | 0.2 | setosa |
| 4.6 | 3.1 | 1.5 | 0.2 | setosa |
| 5.0 | 3.6 | 1.4 | 0.2 | setosa |
| 5.4 | 3.9 | 1.7 | 0.4 | setosa |
| 4.6 | 3.4 | 1.4 | 0.3 | setosa |
| 5.0 | 3.4 | 1.5 | 0.2 | setosa |
| 4.4 | 2.9 | 1.4 | 0.2 | setosa |
| 4.9 | 3.1 | 1.5 | 0.1 | setosa |
| 5.4 | 3.7 | 1.5 | 0.2 | setosa |
| 4.8 | 3.4 | 1.6 | 0.2 | setosa |
| 4.8 | 3.0 | 1.4 | 0.1 | setosa |
| 4.3 | 3.0 | 1.1 | 0.1 | setosa |
| 5.8 | 4.0 | 1.2 | 0.2 | setosa |
| 5.7 | 4.4 | 1.5 | 0.4 | setosa |
| 5.4 | 3.9 | 1.3 | 0.4 | setosa |
| 5.1 | 3.5 | 1.4 | 0.3 | setosa |
| 5.7 | 3.8 | 1.7 | 0.3 | setosa |
| 5.1 | 3.8 | 1.5 | 0.3 | setosa |
| 5.4 | 3.4 | 1.7 | 0.2 | setosa |
| 5.1 | 3.7 | 1.5 | 0.4 | setosa |
| 4.6 | 3.6 | 1.0 | 0.2 | setosa |
| 5.1 | 3.3 | 1.7 | 0.5 | setosa |
| 4.8 | 3.4 | 1.9 | 0.2 | setosa |
| 5.0 | 3.0 | 1.6 | 0.2 | setosa |
| 5.0 | 3.4 | 1.6 | 0.4 | setosa |
| 5.2 | 3.5 | 1.5 | 0.2 | setosa |
| 5.2 | 3.4 | 1.4 | 0.2 | setosa |
| 4.7 | 3.2 | 1.6 | 0.2 | setosa |
| 4.8 | 3.1 | 1.6 | 0.2 | setosa |
| 5.4 | 3.4 | 1.5 | 0.4 | setosa |
| 5.2 | 4.1 | 1.5 | 0.1 | setosa |
| 5.5 | 4.2 | 1.4 | 0.2 | setosa |
| 4.9 | 3.1 | 1.5 | 0.2 | setosa |
| 5.0 | 3.2 | 1.2 | 0.2 | setosa |
| 5.5 | 3.5 | 1.3 | 0.2 | setosa |
| 4.9 | 3.6 | 1.4 | 0.1 | setosa |
| 4.4 | 3.0 | 1.3 | 0.2 | setosa |
| 5.1 | 3.4 | 1.5 | 0.2 | setosa |
| 5.0 | 3.5 | 1.3 | 0.3 | setosa |
| 4.5 | 2.3 | 1.3 | 0.3 | setosa |
| 4.4 | 3.2 | 1.3 | 0.2 | setosa |
| 5.0 | 3.5 | 1.6 | 0.6 | setosa |
| 5.1 | 3.8 | 1.9 | 0.4 | setosa |
| 4.8 | 3.0 | 1.4 | 0.3 | setosa |
| 5.1 | 3.8 | 1.6 | 0.2 | setosa |
| 4.6 | 3.2 | 1.4 | 0.2 | setosa |
| 5.3 | 3.7 | 1.5 | 0.2 | setosa |
| 5.0 | 3.3 | 1.4 | 0.2 | setosa |



# PRE-BUILT VISUALIZATION HELPERS

- Manipulate Document (DOM)
- Data-Driven
- Visualization Components






http://bl.ocks.org/mbostock/3887118

# MANY LIBRARIES BUILT ON / USE D3

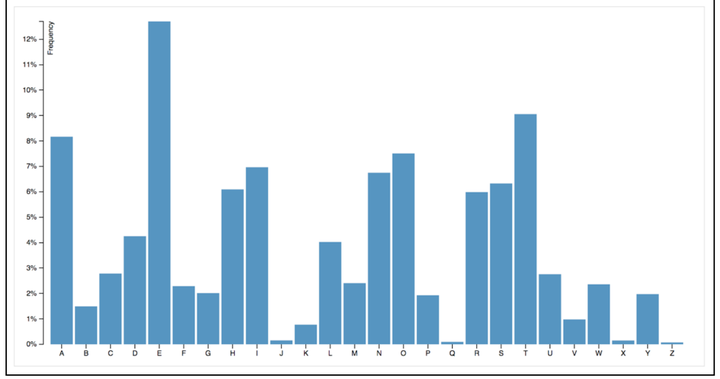
| | | |
|---|---|---|
| Cubism.js | n3-charts | Bokeh |
| NVD3.js | C3.js | Dimple.js |
| d3.chart | Visual Sedimentation | xCharts |
| Graphene | Raw | DVL |
| Rickshaw | rCharts | DC.js |
| Crossfilter.js | d4.js | Many Others... |

Source:
http://mikemcdearmon.com/portfolio/techposts/data-visualization-base-on-d3-js

# BASIC CHARTS

mbostock's block #3885304

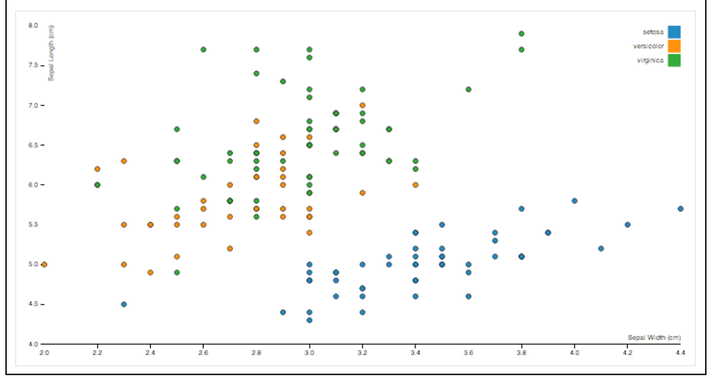
## Bar Chart




mbostock's block #3887118

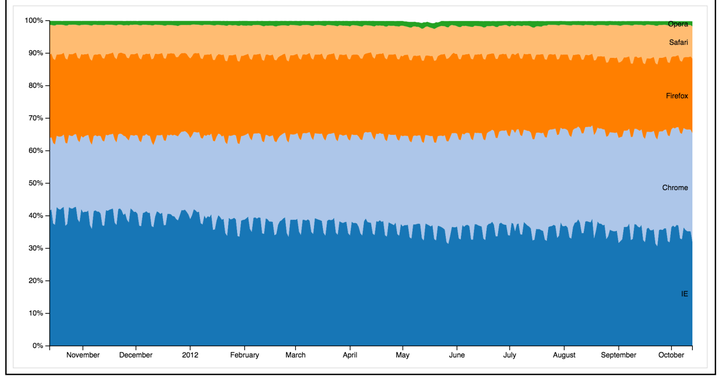
## Scatterplot

June 9, 2013



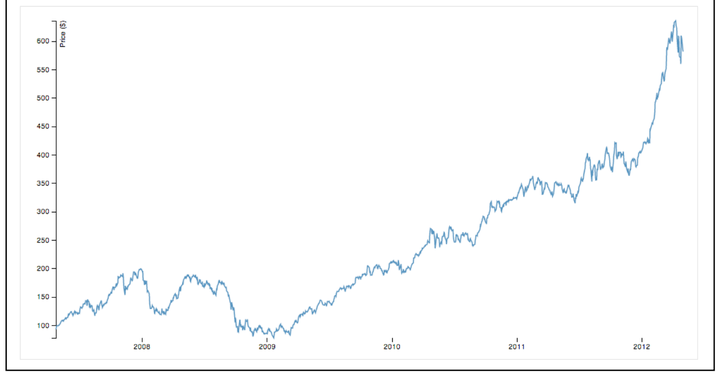

mbostock's block #3885211 October 13, 2012

## Stacked Area Chart



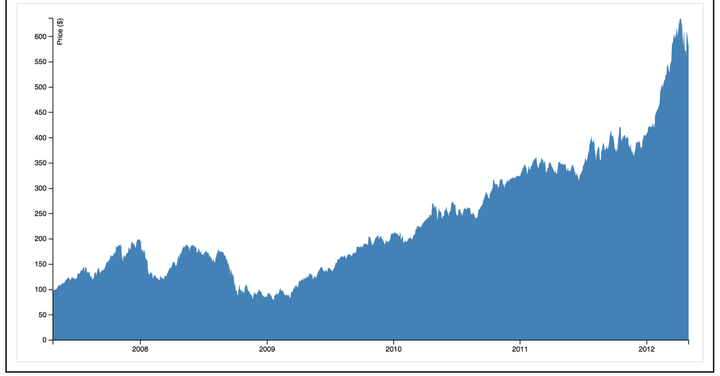

mbostock's block #3883245

## Line Chart



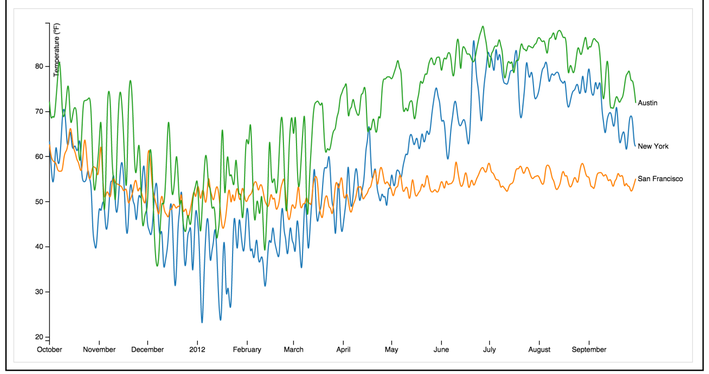

mbostock's block #3883195 October 13, 2012

## Area Chart




mbostock's block #3884955 October 13, 2012

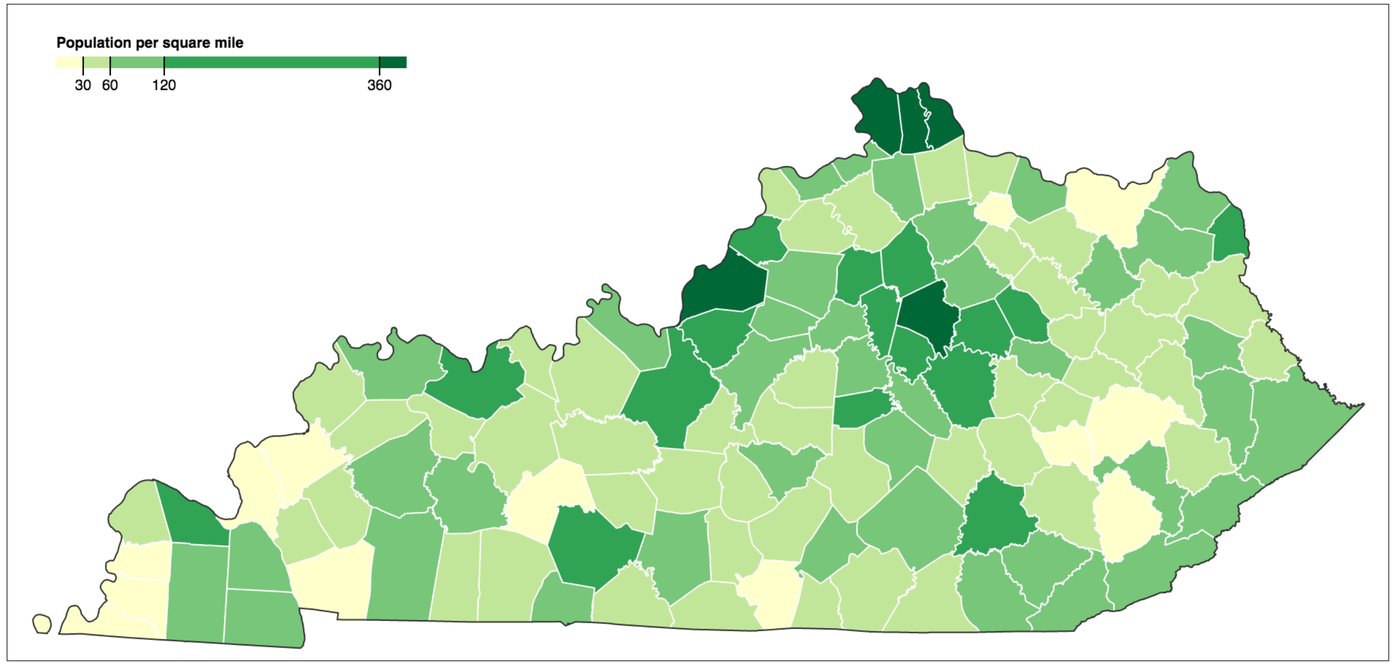
## Multi-Series Line Chart



# CHOROPLETH MAPS

Kentucky Population Density

http://bl.ocks.org/mbostock/5144735



# D3 ALLOWS US TO EXPLOIT THE VISUAL INFORMATION SEEKING MANTRA

**Overview first**

**Zoom and filter**

**Details on demand**

Source:
Ben Shneiderman, The Eyes Have It: A Task by Data Type Taxonomy for Information Visualizations. In Proceedings of the IEEE Symposium on Visual Languages, pages 336-343, Washington. IEEE Computer Society Press, 1996.

# ONLINE CHARTS / DATA VISUALIZATION

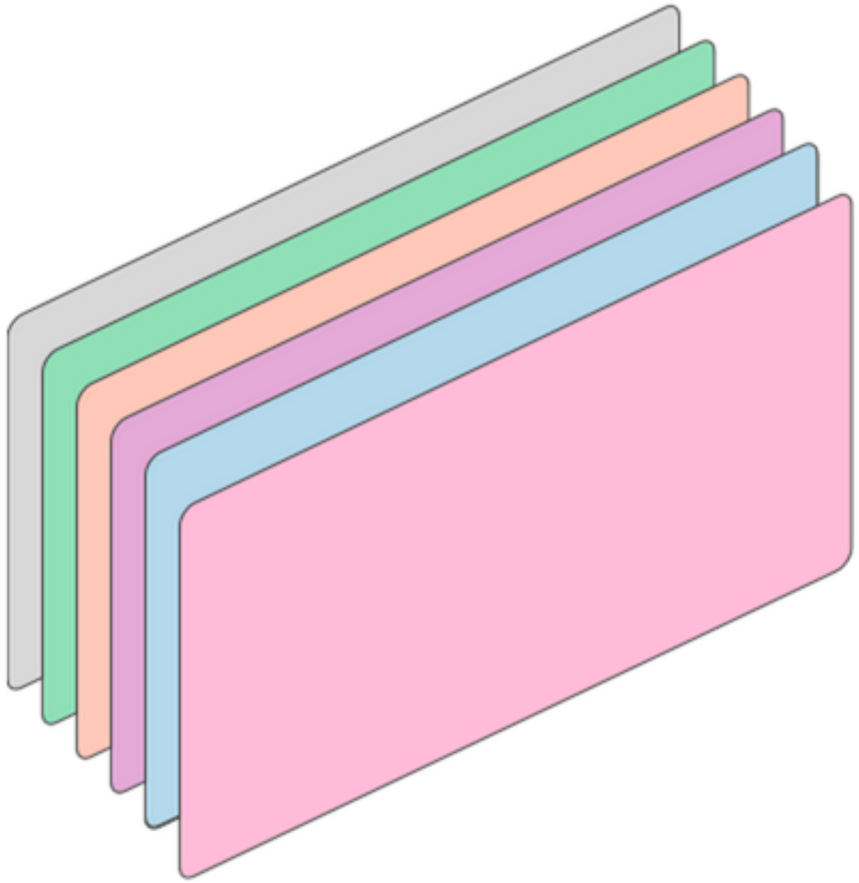


Chart +
Mouseover / tool tips
Data filters (ie date pickers...)
Different modes of data display
Data export
Drilldown for more specific charts

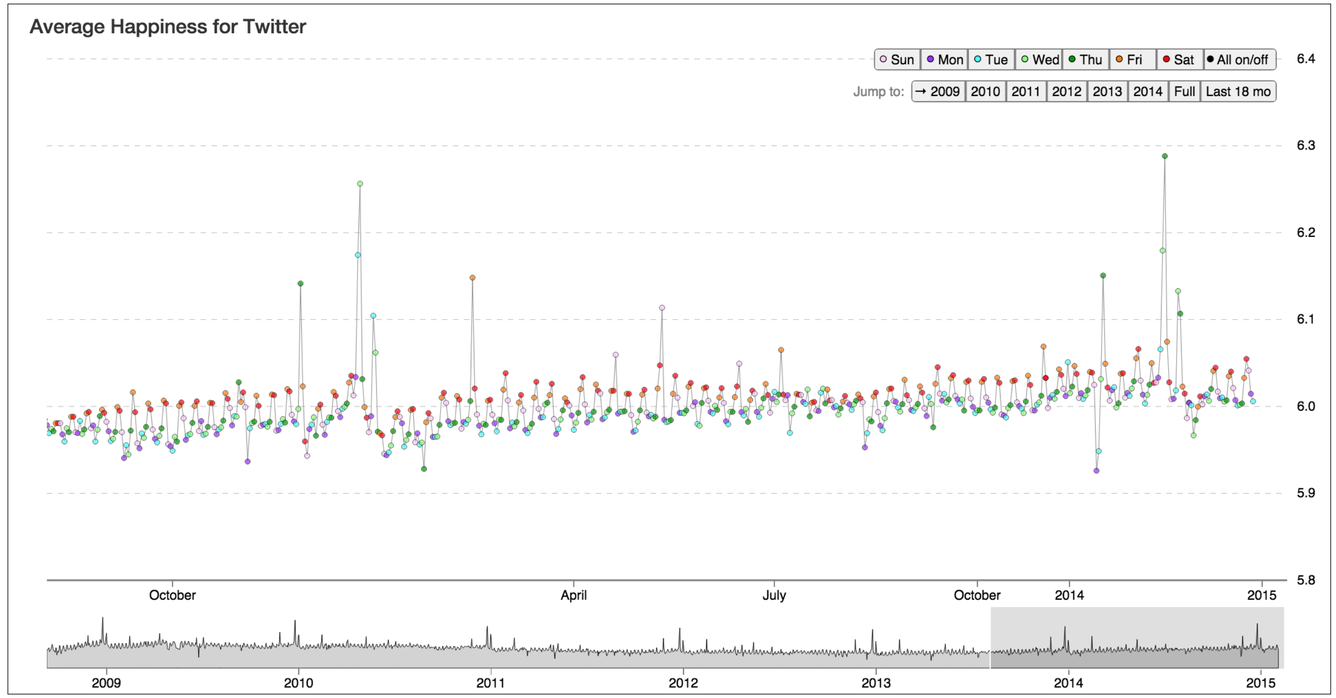
Source:
http://www.jeromecukier.net/blog/2015/02/07/charts-in-the-age-of-the-web/

# INTERACTIVE LINE / AREA CHARTS

Hedonometer - Average happiness for twitter

With hedonometer.org we've created an instrument that measures the happiness of large populations in real time.

http://hedonometer.org/index.html

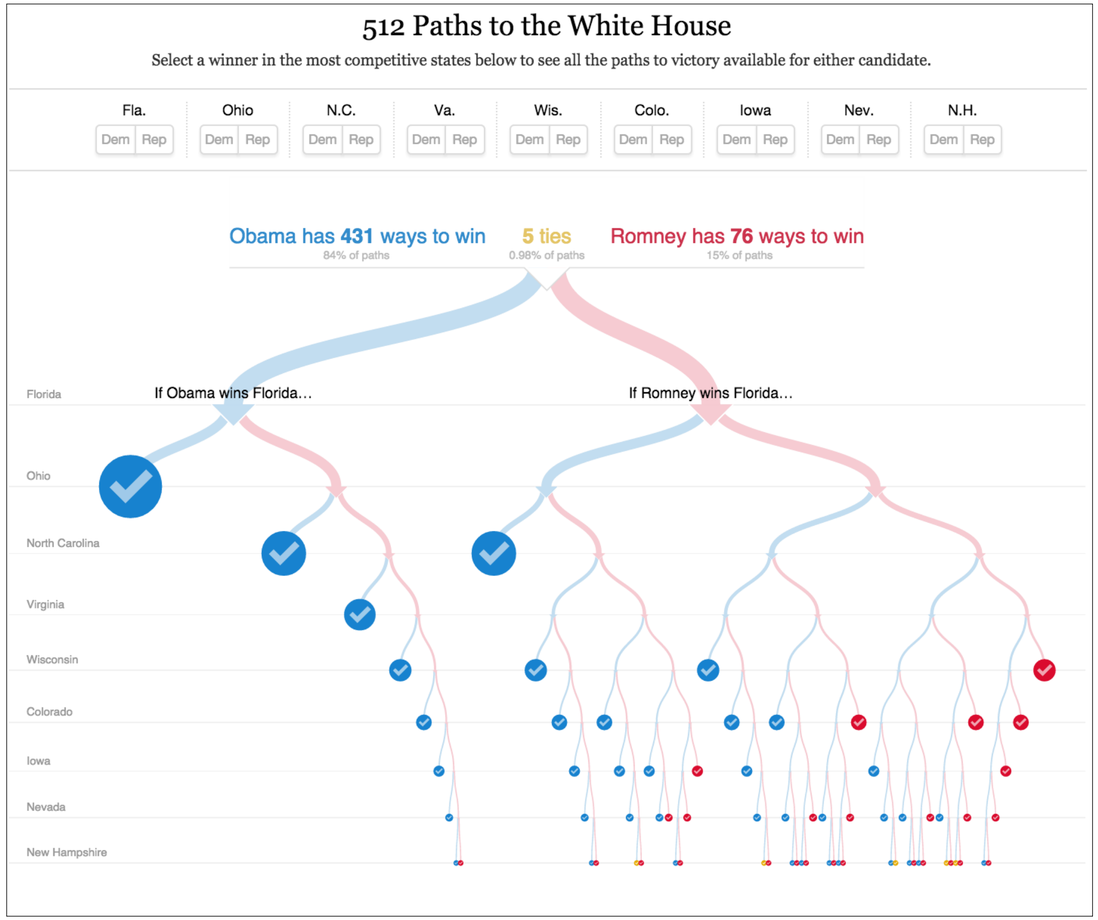


# EXPLORATORY VISUALIZATIONS

512 Paths To The White House

2012 Political Tool to select a winner in the most competitive states below to see all the paths to victory available for either candidate

http://www.nytimes.com/interactive/2012/11/02/us/politics/paths-to-the-white-house.html

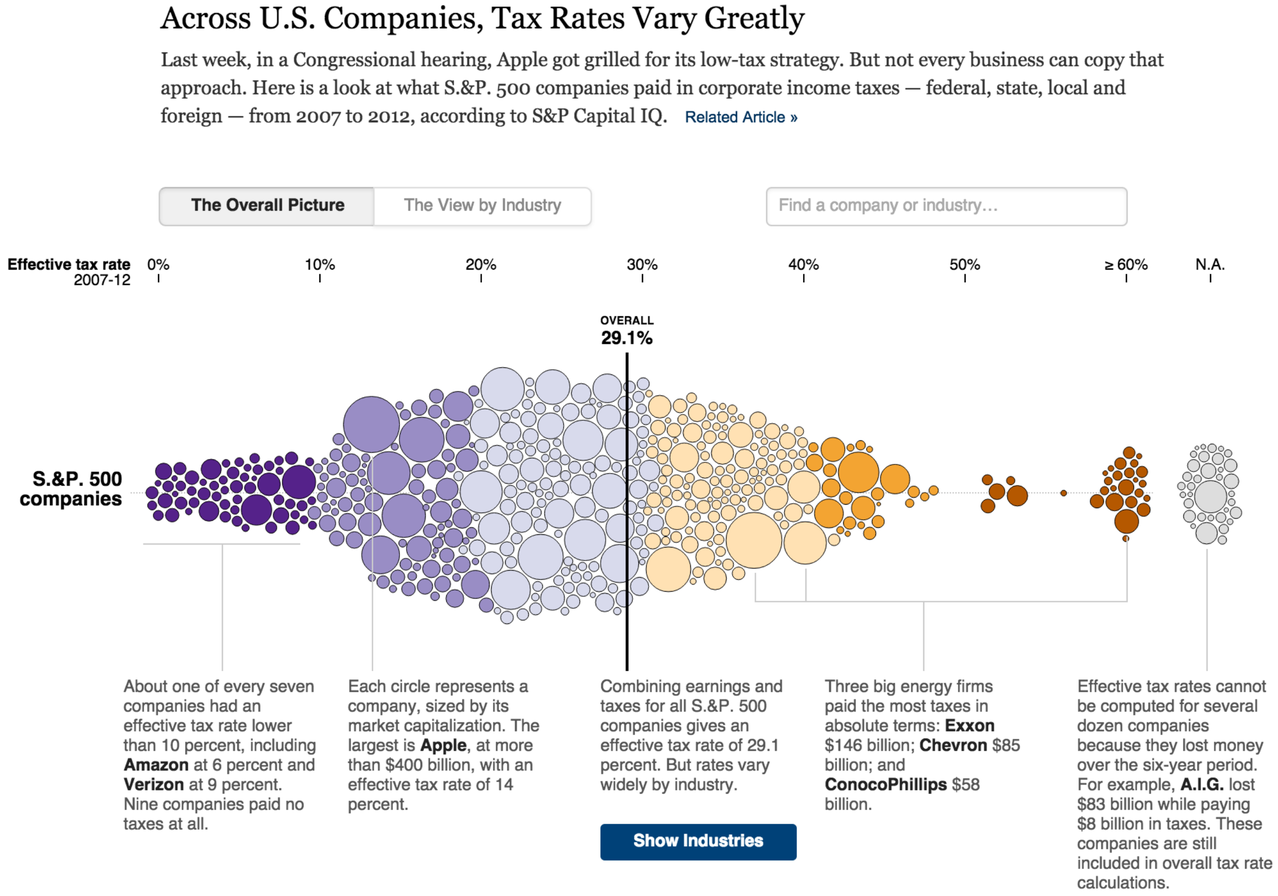


# EXPLANATORY VISUALIZATIONS

S&P Corporate Tax Rate Chart

Here is a look at what S.&P. 500 companies paid in corporate income taxes — federal, state, local and foreign — from 2007 to 2012, according to S&P Capital IQ

http://www.nytimes.com/interactive/2013/05/25/sunday-review/corporate-taxes.html



# EXPERIMENTAL VISUALIZATIONS

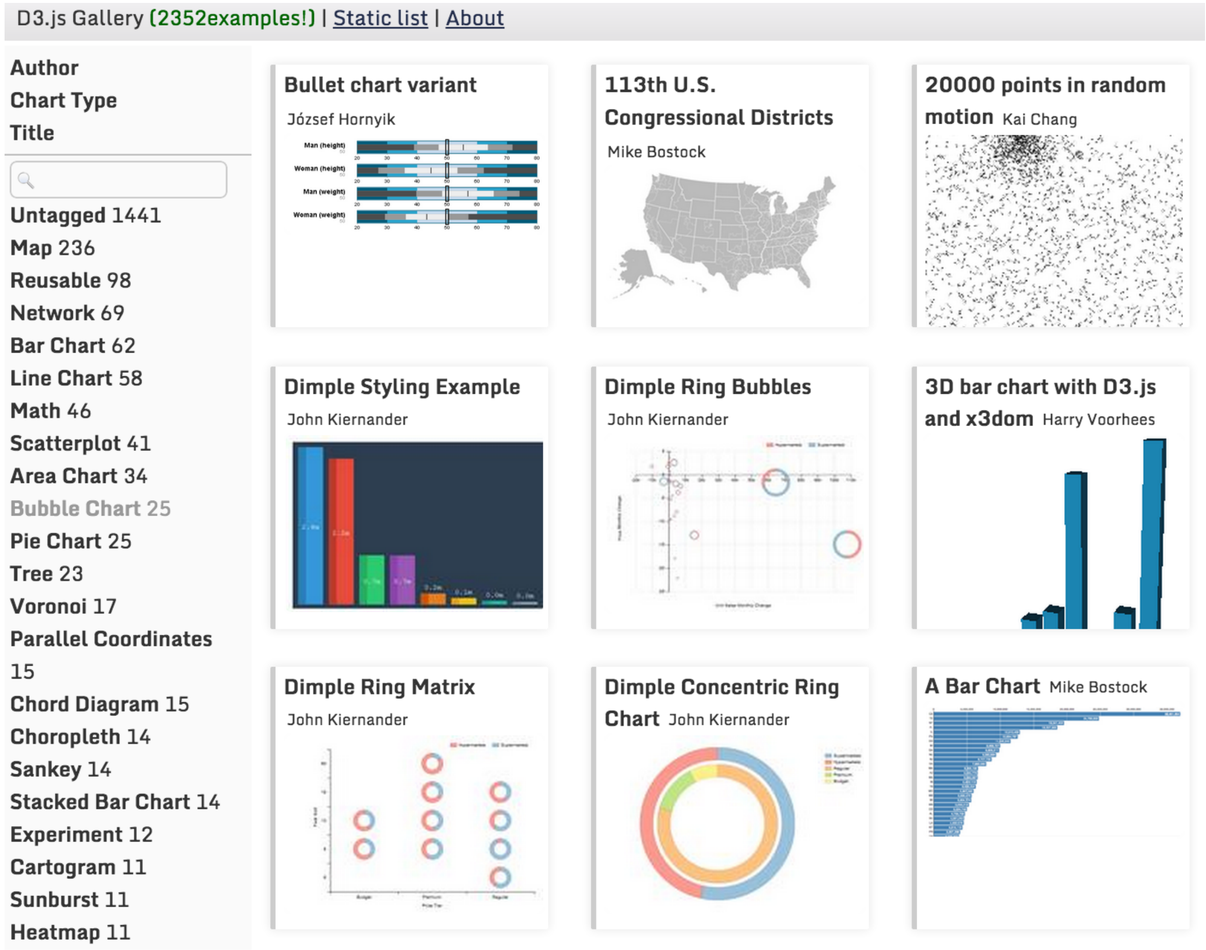
Is It Better to Rent or Buy?

The choice between buying a home and renting one is among the biggest financial decisions that many adults make…

http://www.nytimes.com/interactive/2014/upshot/buy-rent-calculator.html

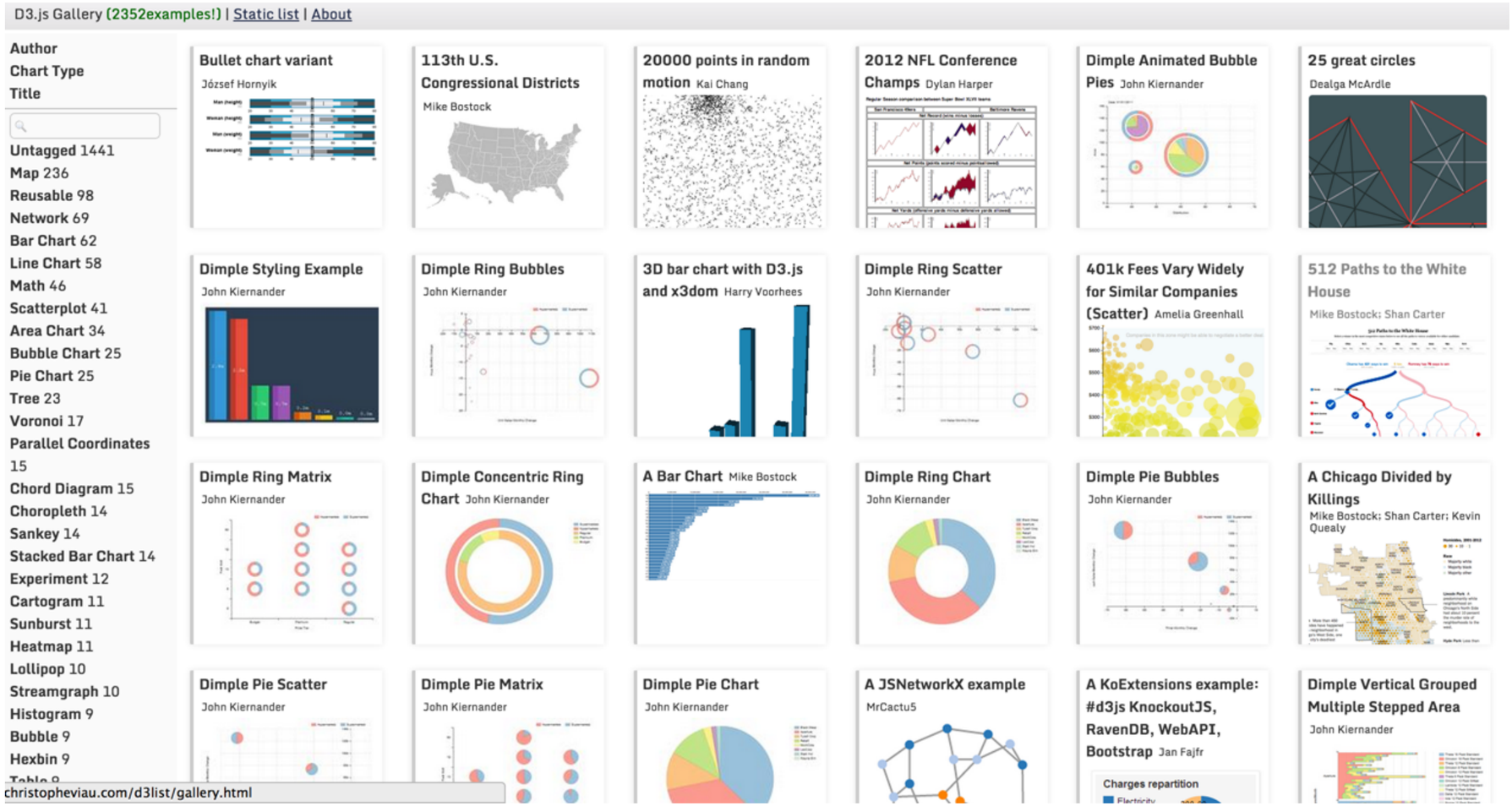
# 1000's OF EXAMPLES AVAILABLE

http://christopheviau.com/d3list/gallery.html



# SECTION 3
# D3 EXAMPLES & bl.ocks.org

# D3 EXAMPLES = shortcut!



# BL.OCKS.ORG

1. Mike Bostock Scatterplot Example
   http://bl.ocks.org/mbostock/raw/3887118/
2. See the code, data files, png at GitHub:
   https://gist.github.com/mbostock/3887118/

Discuss:
How to get the files
How to run the files

# MIKE'S BL.OCKS.ORG BLOCK'S

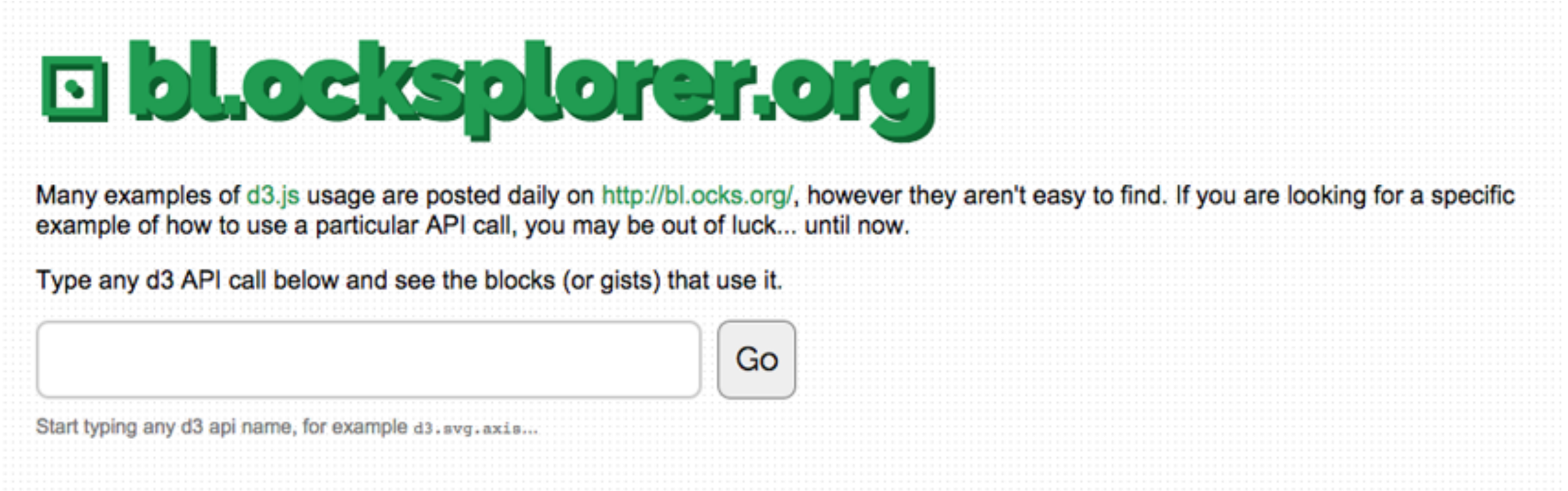
1. Mike Bostock Scatterplot Example

   http://bl.ocks.org/mbostock/
2. See the code, data files, png at GitHub:

   https://gist.github.com/mbostock/

# BL.OCKSPLORER.ORG

=> bl.ocksplorer.org, lets you search blocks by d3 API Call…




Source:
http://bl.ocksplorer.org/

# EXERCISE: BL.OCKS.ORG SCATTERPLOT

Go to https://gist.github.com/
Name file index.html
Paste base.html code into it from http://bit.ly/20150512-metis-d3-files
Click add file button
Name file aquarium.json
Paste aquarium.json data into it from http://bit.ly/20150512-metis-d3-files
Click on "Create secret Gist" (yellow) button
URL will be => https://gist.github.com/anonymous/[XXXXXXXXXXXXXXXXXXXX]
Go to http://bl.ocks.org/
paste the "anonymous/[XXXXXXXXXXXXXXXXXXXX]" part after the "/" of the URL
Click on "Open in a new window." link underneath empty rectangle
In developer window:

```
d3.json("aquarium.json", function(error, data) {
  console.log(data);
});
```

Discuss:
Why go to the trouble?

# SECTION 4
# D3 LAYOUTS

# DATA VISUALIZATION EXPERTS

2005: Prefuse (Java, Heer @ Berkeley)

2007: Flare (ActionScript, Heer @ Berkeley)

2009: Protovis (JavaScript, Heer & Bostock @ Stanford)

2011: D3 (JavaScript, Heer & Bostock @ Stanford)

TLDR:
very smart people thought very hard
about data visualization for a very long time

Source:
http://anna.ps/talks/fel/#/4

# D3 LAYOUTS

## Layouts

> Wiki ▸ API Reference ▸ Layouts

See one of:

- Bundle - apply Holten's *hierarchical bundling algorithm* to edges.
- Chord - produce a chord diagram from a matrix of relationships.
- Cluster - cluster entities into a dendrogram.
- Force - position linked nodes using physical simulation.
- Hierarchy - derive a custom hierarchical layout implementation.
- Histogram - compute the distribution of data using quantized bins.
- Pack - produce a hierarchical layout using recursive circle-packing.
- Partition - recursively partition a node tree into a sunburst or icicle.
- Pie - compute the start and end angles for arcs in a pie or donut chart.
- Stack - compute the baseline for each series in a stacked bar or area chart.
- Tree - position a tree of nodes tidily.
- Treemap - use recursive spatial subdivision to display a tree of nodes.

# LAYOUT: BUNDLE

## Layouts

Wiki ▸ API Reference ▸ Layouts

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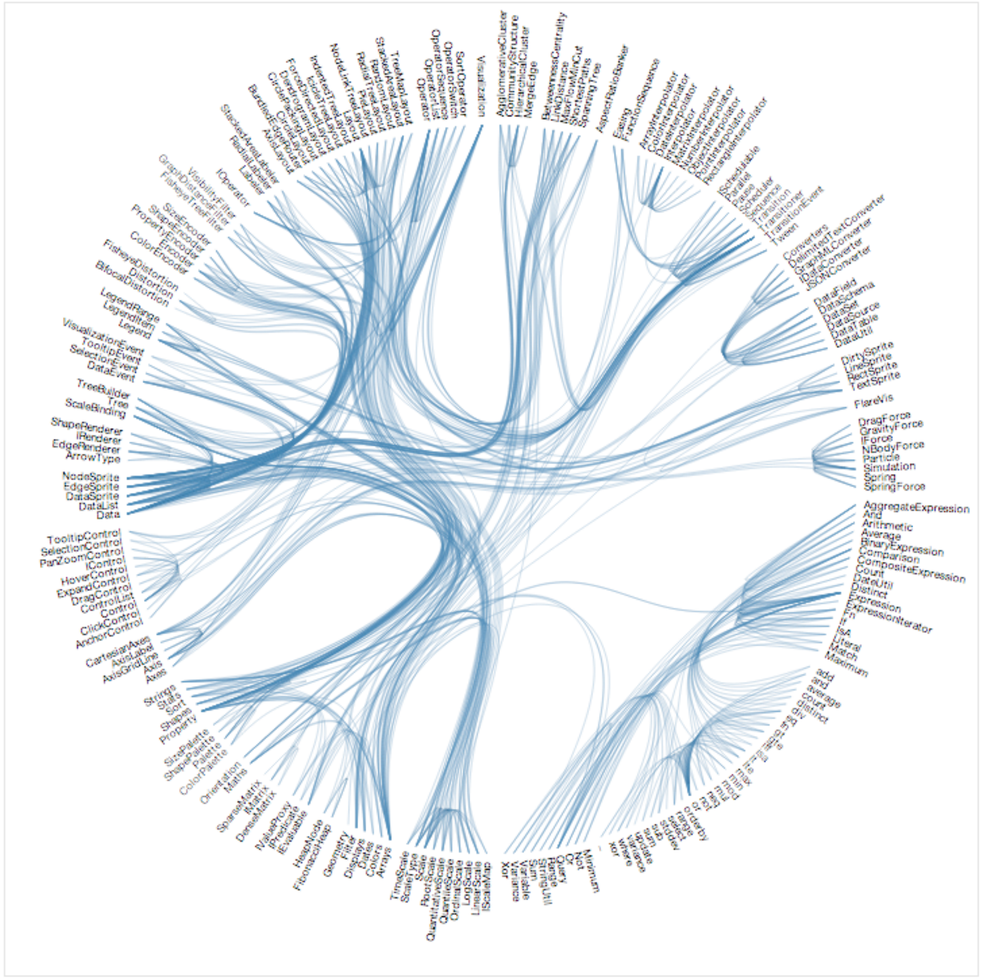
Hierarchical Edge Bundling



Source:
http://bl.ocks.org/mbostock/1044242

# LAYOUT: CHORD

## Layouts

Wiki ▸ API Reference ▸ Layouts

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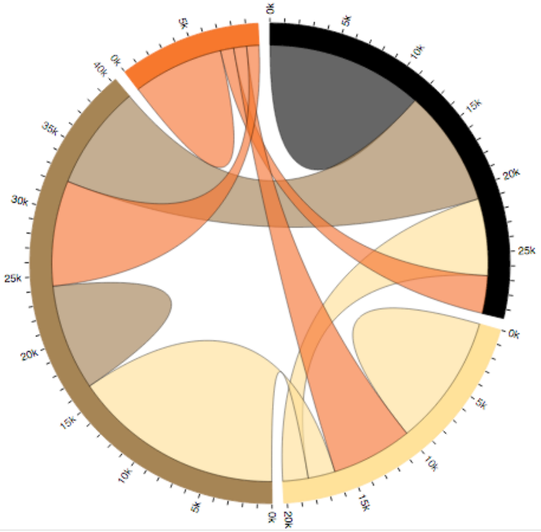
Chord Diagram




Source:
http://bl.ocks.org/mbostock/4062006

# LAYOUT: CLUSTER

## Layouts

Wiki ▸ API Reference ▸ Layouts

See one of:

- Bundle - apply Holten's *hierarchical bundling algorithm* to edges.
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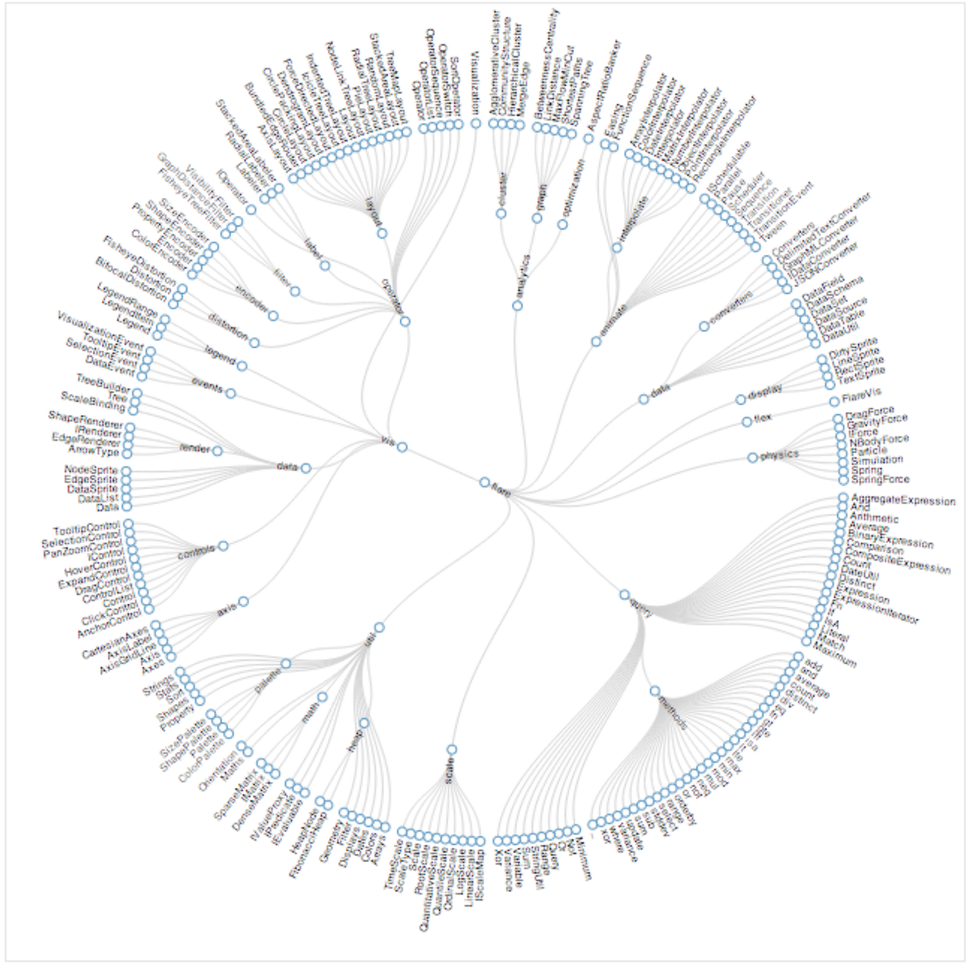
- Treemap - use recursive spatial subdivision to display a tree of nodes.

Cluster Dendrogram



Source:
http://bl.ocks.org/mbostock/4339607

# LAYOUT: FORCE

## Layouts

Wiki ▸ API Reference ▸ Layouts

See one of:

- Bundle - apply Holten's *hierarchical bundling algorithm* to edges.
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Force-Directed Graph

Source:
http://bl.ocks.org/mbostock/4062045

# LAYOUT: HIERARCHY

## Layouts

Wiki ▸ API Reference ▸ Layouts

See one of:

- Bundle - apply Holten's *hierarchical bundling algorithm* to edges.
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- Treemap - use recursive spatial subdivision to display a tree of nodes.

- Cluster
- Pack
- Partition
- Tree
- Treemap

Source:
https://github.com/mbostock/d3/wiki/Hierarchy-Layout

# LAYOUT: HISTOGRAM

## Layouts

Wiki ▸ API Reference ▸ Layouts

See one of:

- Bundle - apply Holten's *hierarchical bundling algorithm* to edges.
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- Histogram - compute the distribution of data using quantized bins.
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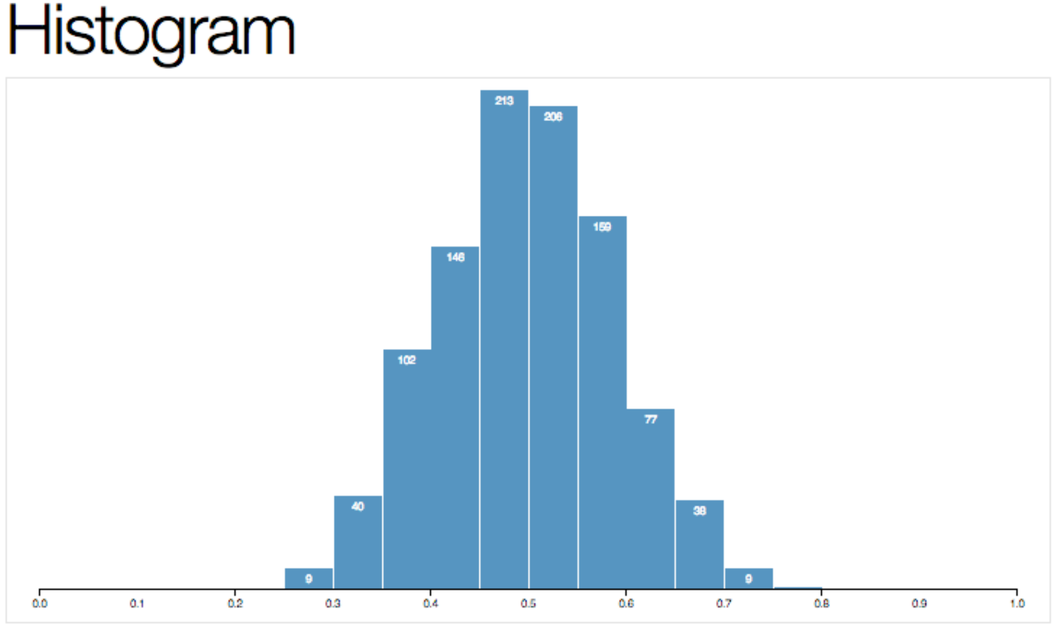
- Stack - compute the baseline for each series in a stacked bar or area chart.
- Tree - position a tree of nodes tidily.
- Treemap - use recursive spatial subdivision to display a tree of nodes.




Source:
http://bl.ocks.org/mbostock/3048450

# LAYOUT: PACK

## Layouts

Wiki ▸ API Reference ▸ Layouts

See one of:

- Bundle - apply Holten's *hierarchical bundling algorithm* to edges.
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- Histogram - compute the distribution of data using quantized bins.
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- Treemap - use recursive spatial subdivision to display a tree of nodes.

Circle Packing

Source:
http://bl.ocks.org/mbostock/4063530

# LAYOUT: PARTITION

## Layouts

Wiki ▸ API Reference ▸ Layouts

See one of:

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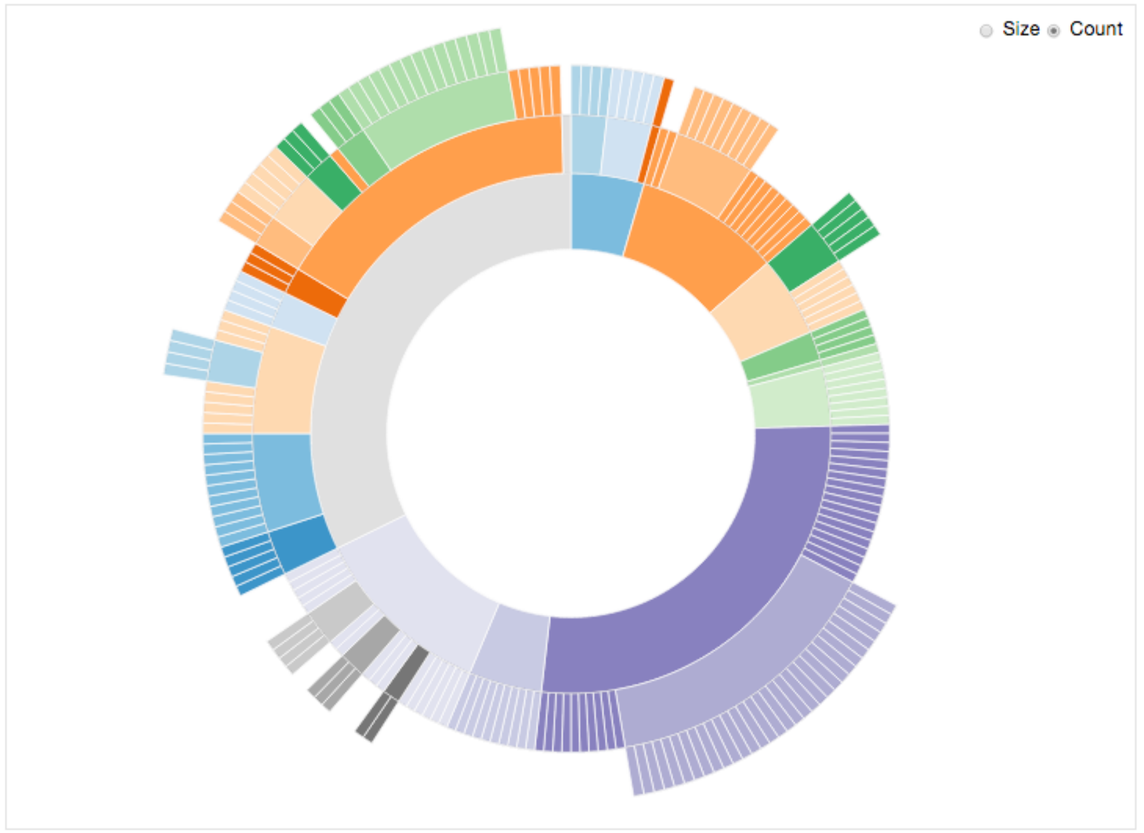
Sunburst Partition




Source:
http://bl.ocks.org/mbostock/4063423

# LAYOUT: PIE

## Layouts

Wiki ▸ API Reference ▸ Layouts

See one of:

- Bundle - apply Holten's *hierarchical bundling algorithm* to edges.
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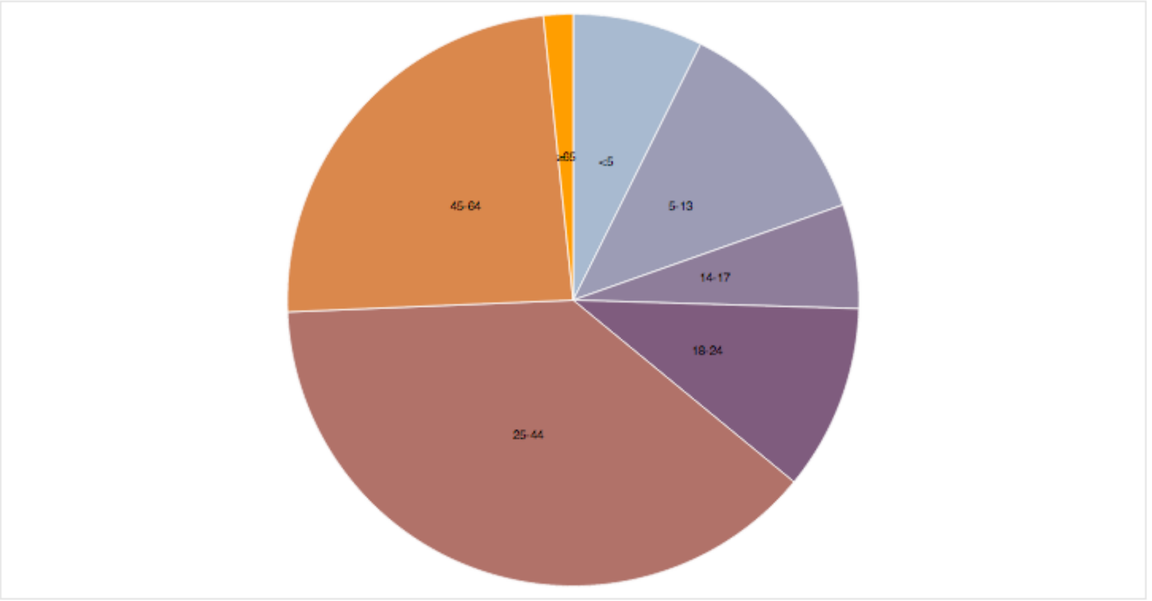
- Treemap - use recursive spatial subdivision to display a tree of nodes.

Pie Chart




Source:
http://bl.ocks.org/mbostock/3887235

# LAYOUT: STACK

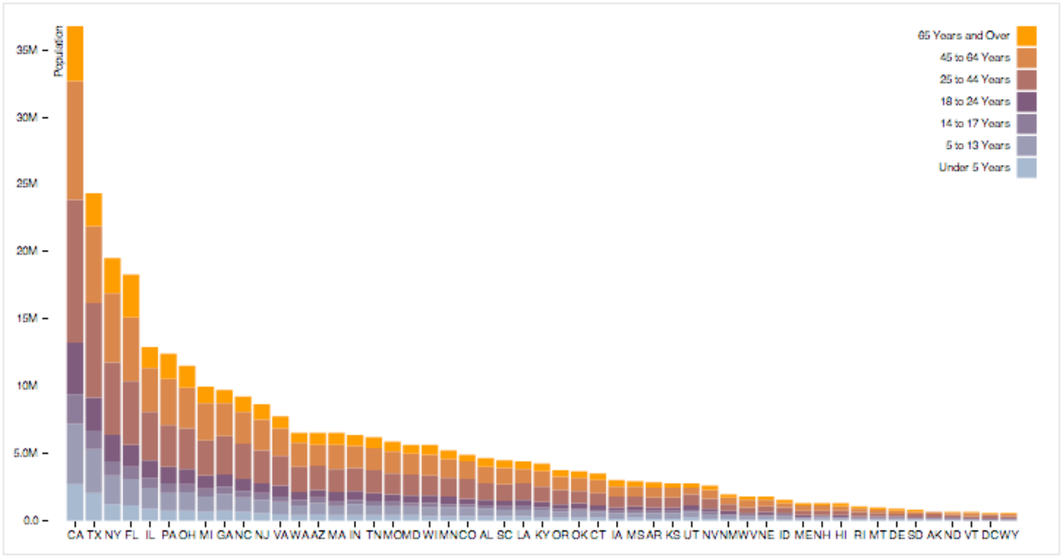
## Layouts

Wiki ▸ API Reference ▸ Layouts

See one of:

- Bundle - apply Holten's *hierarchical bundling algorithm* to edges.
- Chord - produce a chord diagram from a matrix of relationships.
- Cluster - cluster entities into a dendrogram.
- Force - position linked nodes using physical simulation.
- Hierarchy - derive a custom hierarchical layout implementation.
- Histogram - compute the distribution of data using quantized bins.
- Pack - produce a hierarchical layout using recursive circle-packing.
- Partition - recursively partition a node tree into a sunburst or icicle.
- Pie - compute the start and end angles for arcs in a pie or donut chart.
- Stack - compute the baseline for each series in a stacked bar or area chart.
- Tree - position a tree of nodes tidily.
- Treemap - use recursive spatial subdivision to display a tree of nodes.

## Stacked Bar Chart




Source: http://bl.ocks.org/mbostock/3886208

# LAYOUT: TREE

## Layouts

Wiki ▸ API Reference ▸ Layouts

See one of:

- Bundle - apply Holten's *hierarchical bundling algorithm* to edges.
- Chord - produce a chord diagram from a matrix of relationships.
- Cluster - cluster entities into a dendrogram.
- Force - position linked nodes using physical simulation.
- Hierarchy - derive a custom hierarchical layout implementation.
- Histogram - compute the distribution of data using quantized bins.
- Pack - produce a hierarchical layout using recursive circle-packing.
- Partition - recursively partition a node tree into a sunburst or icicle.
- Pie - compute the start and end angles for arcs in a pie or donut chart.
- Stack - compute the baseline for each series in a stacked bar or area chart.
- Tree - position a tree of nodes tidily.
- Treemap - use recursive spatial subdivision to display a tree of nodes.

## Radial Reingold–Tilford Tree

Source:
http://bl.ocks.org/mbostock/4063550

# LAYOUT: TREEMAP

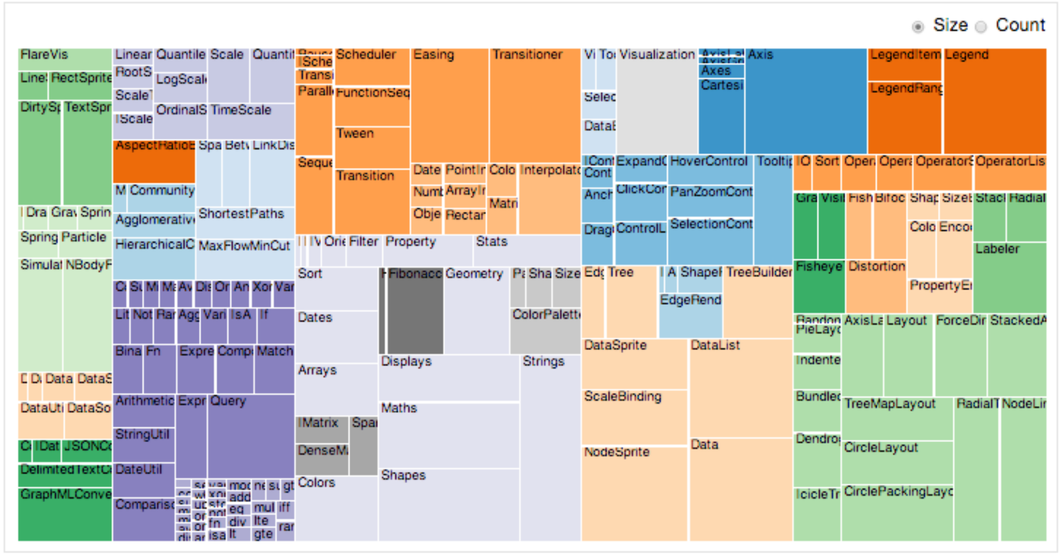
## Layouts

Wiki ▸ API Reference ▸ Layouts

See one of:

- Bundle - apply Holten's *hierarchical bundling algorithm* to edges.
- Chord - produce a chord diagram from a matrix of relationships.
- Cluster - cluster entities into a dendrogram.
- Force - position linked nodes using physical simulation.
- Hierarchy - derive a custom hierarchical layout implementation.
- Histogram - compute the distribution of data using quantized bins.
- Pack - produce a hierarchical layout using recursive circle-packing.
- Partition - recursively partition a node tree into a sunburst or icicle.
- Pie - compute the start and end angles for arcs in a pie or donut chart.
- Stack - compute the baseline for each series in a stacked bar or area chart.
- Tree - position a tree of nodes tidily.
- Treemap - use recursive spatial subdivision to display a tree of nodes.

Treemap

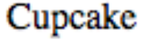



Source:
http://bl.ocks.org/mbostock/4063582

# D3 PLUGINS


| | |
|---|---|
| box | Add missing semicolons. |
| bullet | Link to vertical demo. |
| chernoff | Remove redundant svg: prefixes. |
| cubehelix | Restore example. |
| fisheye | Remove a few unused variables. |
| force_labels | Add missing semicolons. |
| geo | Slightly prettier link. |
| geodesic | Fix bug with flipped triangles. |
| geom | Update geom/contour/README.md |
| graph | removed traverse |
| hexbin | Include hexbin grid coordinates. |
| hive | Move to top-level directory. |
| horizon | Remove horizon.duration. |
| interpolate-zoom | Add deprecation notice. |
| jsonp | Fix token replacement in jsonp plugin |
| keybinding | Update keybinding with improvements from iD project |
| longscroll | Shorten. |
| qq | Add qq plugin. |
| rollup | Create README.md |
| sankey | Add demo links. |
| simplify | Remove obsolete d3.simplify plugin. |
| superformula | Add superformula plugin. |
| urlencode | Add missing semicolons. |
| LICENSE | Update copyright year. |
| README.md | Add an example (d3.svg.hive). |

# D3 & SVG BASIC SHAPES

| Shape | SVG Construction | D3 Construction |
|---|---|---|
|  | <svg width="100" height="100"><br><circle cx="35" cy="35" r="25" /><br></svg> | d3.select("svg").append("circle")<br>.attr("cx", "35").attr("cy", "35").attr("r", "25"); |
|  | <svg width="100" height="100"><br><rect x="10" y="10" width="50" height="50" /><br></svg> | d3.select("svg").append("rect")<br>.attr("x", "10").attr("y", "10").attr("height", "50").attr("width", "50"); |
|  | <svg width="100" height="100"><br><ellipse cx="25" cy="25" rx="15" ry="10" /><br></svg> | d3.select("svg").append("ellipse")<br>.attr("cx", "35").attr("cy", "35").attr("rx", "15").attr("ry", "25"); |
|  | <svg width="50" height="50"><br><line x1="10" y1="10" x2="50" y2="50"<br>stroke-width="3" stroke="black" /><br></svg> | d3.select("svg").append("line")<br>.attr("x1", 10).attr("y1", 10).attr("x2", 50).attr("y2", 50)<br>.attr("stroke-width", 3).attr("stroke", "black"); |
|  | <svg width="50" height="50"><br><text x="25" y="25">Cupcake</text><br></svg> | d3.select("svg").append("text")<br>.attr("x","25").attr("y","25").text("Cupcake"); |
|  | <svg width="50" height="50"><br><path d="M10,10L50,50" stroke-width="3" stroke="black"><br></path><br></svg> | d3.select("svg").append("path")<br>.attr("d", "M10,10L50,50")<br>.attr("stroke-width", 3).attr("stroke", "black"); |

# SVG PATH MINI-LANGUAGE

| Command | Parameters | Repeatable | Explanation |
|---|---|---|---|
| Pen Command | | | |
| M ( m ) | x, y | Yes | **moveto**<br>Move the pen to a new location. No line is drawn. All path data must begin with a 'moveto' command. |
| Line Commands | | | |
| L ( l ) | x, y | Yes | **lineto**<br>Draw a line from the current point to the point (x,y). |
| H ( h ) | x | Yes | **horizontal lineto**<br>Draw a horizontal line from the current point to x. |
| V ( v ) | y | Yes | **vertical lineto**<br>Draw a horizontal line from the current point to y. |
| Cubic Bezier Curve Commands | | | |
| C ( c ) | x1 y1 x2 y2 x y | Yes | **curveto**<br>Draw a cubic Bézier curve from the current point to the point (x,y) using (x1,y1) as the control point at the beginning of the curve and (x2,y2) as the control point at the end of the curve. |
| S ( s ) | x2 y2 x y | Yes | **shorthand/smooth curveto**<br>Draw a cubic Bézier curve from the current point to (x,y). The first control point is assumed to be the reflection of the last control point on the previous command relative to the current point. (x2,y2) is the second control point (i.e., the control point at the end of the curve). |

| Command | Parameters | Repeatable | Explanation |
|---|---|---|---|
| Quadratic Bezier Curve Commands | | | |
| Q ( q ) | x1 y1 x y | Yes | **quadratic Bézier curveto**<br>Draw a quadratic Bézier curve from the current point to (x,y) using (x1,y1) as the control point. |
| T ( t ) | x y | Yes | **Shorthand/smooth quadratic Bézier curveto**<br>Draw a quadratic Bézier curve from the current point to (x,y). The control point is assumed to be the reflection of the control point on the previous command relative to the current point. |
| Elliptical Arc Curve Command | | | |
| A ( a ) | rx ry x-axis-rotation large-arc-flag sweep-flag x y | Yes | **elliptical arc**<br>Draws an elliptical arc from the current point to (x, y). The size and orientation of the ellipse are defined by two radii (rx, ry) and an x-axis-rotation, which indicate how the ellipse as a whole is rotated relative to the current SVG coordinate system. The center (cx, cy) of the ellipse is calculated automatically to satisfy the constraints imposed by the other parameters. large-arc-flag and sweep-flag contribute to the automatic calculations and help determine how the arc is drawn. |
| End Path Command | | | |
| Z ( z ) | none | No | **closepath**<br>Closes the path. A line is drawn from the last point to the first point drawn. |

# SET OF POINTS -> GENERATE A PATH

| Shape | SVG Construction | D3 Construction |
|---|---|---|
|  | <svg width="50" height="50"><br><path d="M10,10L50,50" stroke-width="3" stroke="black"><br></path><br></svg> | d3.select("svg").append("path")<br>.attr("d", "M10,10L50,50")<br>.attr("stroke-width", 3).attr("stroke", "black"); |

```
var lineData = [ { "x": 10,   "y": 10},  { "x": 50,  "y": 50}];


// "M10,10L50,50"
```

# D3 SVG LINE GENERATOR

```
var lineFunction = d3.svg.line()
        .x(function(d) { return d.x; })
        .y(function(d) { return d.y; })
        .interpolate("linear");

var lineData = [ { "x": 10,   "y": 10},  { "x": 50,  "y": 50}];

lineFunction(lineData);
// returns "M10,10L50,50"
```

ACCESSOR FUNCTIONS

# D3 SVG PATH DATA GENERATOR OPTIONS

- linear - piecewise linear segments, as in a polyline.
- linear-closed - close the linear segments to form a polygon.
- step - alternate between horizontal and vertical segments, as in a step function.
- step-before - alternate between vertical and horizontal segments, as in a step function.
- step-after - alternate between horizontal and vertical segments, as in a step function.
- basis - a B-spline, with control point duplication on the ends.
- basis-open - an open B-spline; may not intersect the start or end.
- basis-closed - a closed B-spline, as in a loop.
- bundle - equivalent to *basis*, except the *tension* parameter is used to straighten the spline.
- cardinal - a Cardinal spline, with control point duplication on the ends.
- cardinal-open - an open Cardinal spline; may not intersect the start or end, but will intersect other control points.
- cardinal-closed - a closed Cardinal spline, as in a loop.
- monotone - cubic interpolation that preserves monotonicity in *y*.

Source:
https://github.com/mbostock/d3/wiki/SVG-Shapes#wiki-line

# USING D3 SVG LINE PATH GENERATOR

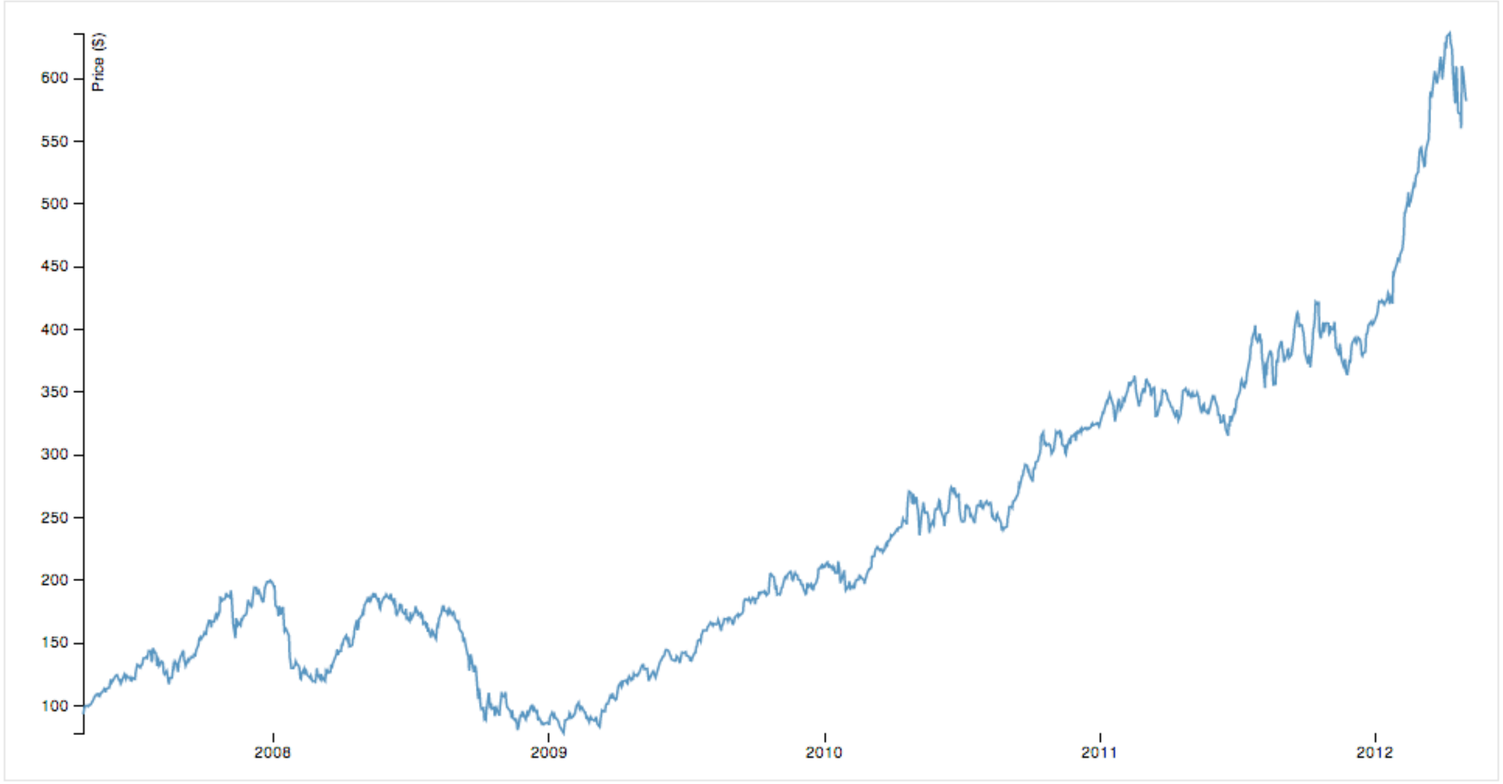
| Shape | SVG Construction | D3 Construction |
|---|---|---|
|  | <svg width="50" height="50"><br><path d="M10,10L50,50" stroke-width="3" stroke="black"><br></path><br></svg> | d3.select("svg").append("path")<br>.attr("d", "M10,10L50,50")<br>.attr("stroke-width", 3).attr("stroke", "black"); |

```
var lineFunction = d3.svg.line()
      .x(function(d) { return d.x; })
      .y(function(d) { return d.y; })
      .interpolate("linear");

var lineData = [ { "x": 10,   "y": 10},  { "x": 50,  "y": 50}];

lineFunction(lineData);
// returns "M10,10L50,50"

d3.select("svg").append("path")
   .attr("d", lineFunction(lineData))
   .attr("stroke-width", 3).attr("stroke", "black");
```

# SVG PATH DATA GENERATOR EXAMPLE

mbostock's block #3883245 October 13, 2012

## Line Chart




1280
Point Objects
And Connecting
Lines
Graphed Easily

Source:
http://bl.ocks.org/mbostock/3883245

# D3 SVG PATH GENERATOR – PATH TAG

```
<!DOCTYPE html>
▼<html>
  ▶<head>…</head>
  ▼<body style>
    <script src="http://d3js.org/d3.v3.js"></script>
    ▶<script>…</script>
    ▼<svg width="960" height="500">
      ▼<g transform="translate(50,20)">
        ▶<g class="x axis" transform="translate(0,450)">…</g>
        ▶<g class="y axis">…</g>
         <path class="line" d=
         "M890,43.6266867372721 66L889.5147219193021,42.1348314
       </g>
     </svg>
   </body>
</html>
```

Instead of 1279 SVG <line ... /> elements
It is One SVG <path ... /> element

Source:
http://bl.ocks.org/mbostock/3883245

# MAKING A PIE CHART

## Layouts

Wiki ▸ API Reference ▸ Layouts

See one of:

- Bundle - apply Holten's *hierarchical bundling algorithm* to edges.
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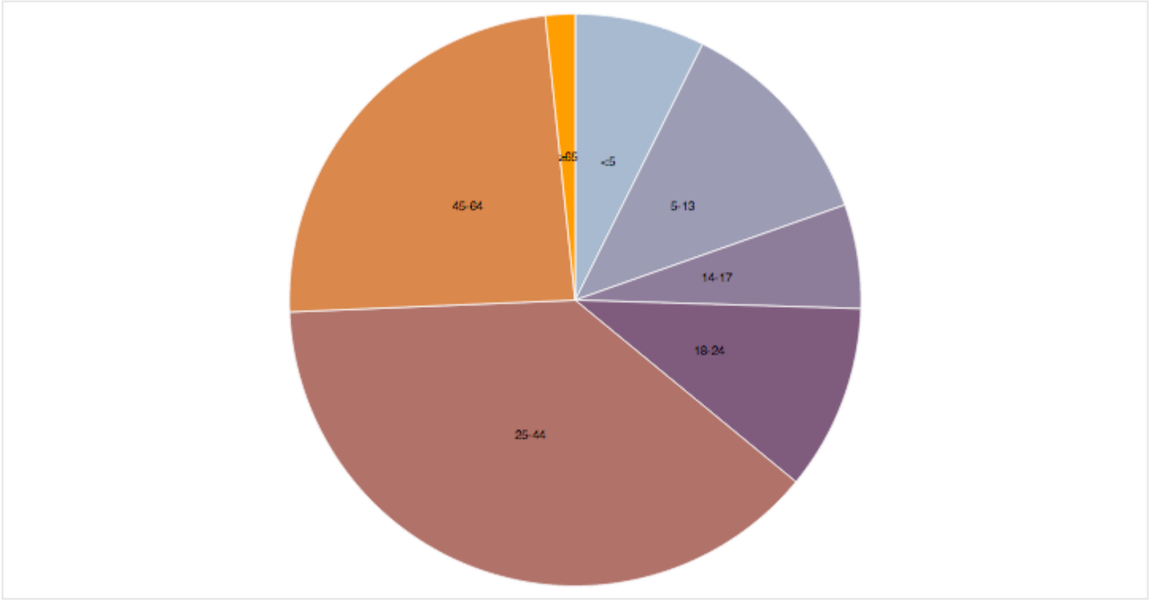
- Force - position linked nodes using physical simulation.
- Hierarchy - derive a custom hierarchical layout implementation.
- Histogram - compute the distribution of data using quantized bins.
- Pack - produce a hierarchical layout using recursive circle-packing.
- Partition - recursively partition a node tree into a sunburst or icicle.
- Pie - compute the start and end angles for arcs in a pie or donut chart.
- Stack - compute the baseline for each series in a stacked bar or area chart.
- Tree - position a tree of nodes tidily.
- Treemap - use recursive spatial subdivision to display a tree of nodes.

## Pie Chart




Source:
http://bl.ocks.org/mbostock/3887235

# D3 SVG SHAPE GENERATOR – ARC

```
var arc = d3.svg.arc()
    .innerRadius(20)
    .outerRadius(100)
    .startAngle(function(d, i) { return d.start; })
    .endAngle(function(d, i) { return d.start + d.size; });

var data = [{start: 0, size: 1.57079633}];

arc(data[0]);
// returns "M0,-100A100,100 0 0,1 100,3.2051035159241787e-7L20,6.410207031848357e-8A20,20 0 0,0 0,-20Z"
```

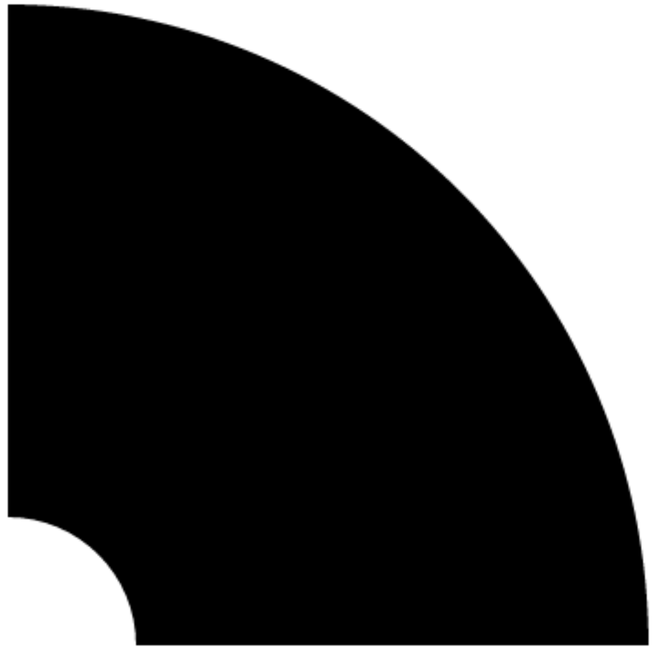
Pixels from Center of “Circle”

Radians From Top of “Circle”

Source: https://github.com/mbostock/d3/wiki/SVG-Shapes

# D3 SVG ARC EXAMPLE

```
var data = [{start: 0, size: 1.57079633}];

var arc = d3.svg.arc()
    .innerRadius(20)
    .outerRadius(100)
    .startAngle(function(d, i) { return d.start; })
    .endAngle(function(d, i) { return d.start + d.size; });

var chart = d3.select("body").append("svg")
    .attr("class", "chart")
  .append("g")
    .attr("transform", "translate(0,100)");

chart.selectAll("path")
    .data(data)
  .enter().append("path")
    .attr("d", arc);
```



Discuss
Why transform, translate?

# EXERCISE: SVG ARC GENERATOR – 1 ARC

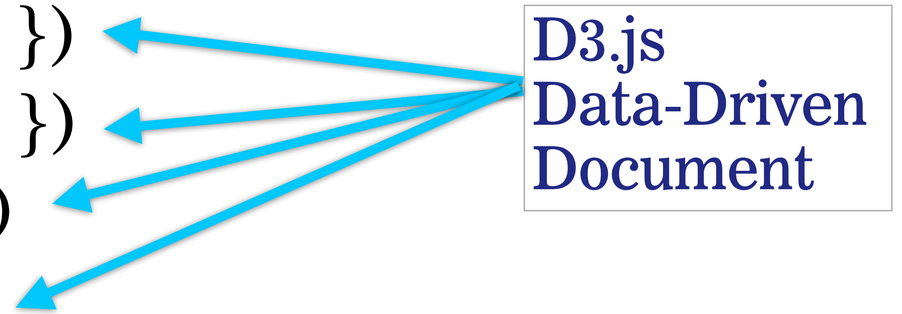
```
var data = [{start: 0, size: 3.14159}];

var arc = d3.svg.arc()
    .innerRadius(80)
    .outerRadius(100)
    .startAngle(function(d, i) { return d.start; })
    .endAngle(function(d, i) { return d.start + d.size; });

var chart = d3.select("body").append("svg").attr("height", 600)
    .attr("class", "chart")
  .append("g")
    .attr("transform", "translate(50,100)");

chart.selectAll("path")
    .data(data)
  .enter().append("path")
    .attr("d", arc);
```

Discuss:
Radius
Angles, size, arc…

Use base.html

# DATA-DRIVEN SVG SHAPE GENERATOR

```
var arc = d3.svg.arc()
    .innerRadius(function(d, i) { return ...; })
    .outerRadius(function(d, i) { return ...; })
    .startAngle(function(d, i) { return ...; })
    .endAngle(function(d, i) { return ...; });
```



# EXERCISE: SVG ARC GENERATOR – RADII

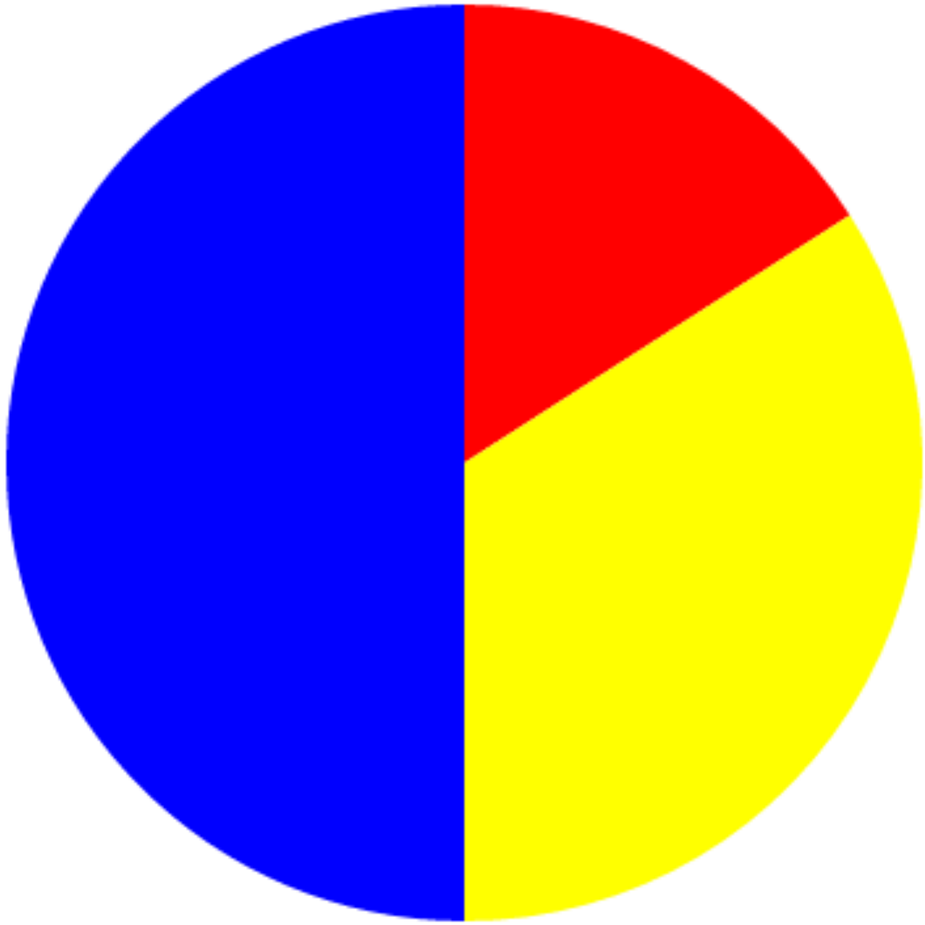
```
var data = [ {start: 0, size: 2,      inner: 50, outer: 100, color: "green"},
             {start: 2, size: 2,      inner: 25, outer: 150, color: "blue"},
             {start: 4, size: 2.28, inner: 75, outer: 125, color: "red"}];

var arc = d3.svg.arc()
    .innerRadius(function(d, i) { return d.inner; })
    .outerRadius(function(d, i) { return d.outer; })
    .startAngle(function(d, i) { return d.start; })
    .endAngle(function(d, i) { return d.start + d.size; });

var chart = d3.select("body").append("svg").attr("height", 600)
    .attr("class", "chart")
  .append("g")
    .attr("transform", "translate(150,200)");

chart.selectAll("path")
    .data(data)
  .enter().append("path")
    .style("fill", function(d, i) { return d.color; })
    .attr("d", arc);
```

Discuss:
inner
outer

Use base.html

# PIE CHART IS MADE UP OF ARCS

- 3 Arcs
- 1 arc - red
- 1 arc - yellow
- 1 arc - blue
- All have same inner radius
- All have same outer radius
- 3 Arcs add up to 100% of circle
- Each arc has a different starting and ending point



# PIE CHART LAYOUT DOES MATH FOR US

## Layouts

Wiki ▸ API Reference ▸ Layouts

See one of:

- Bundle - apply Holten's *hierarchical bundling algorithm* to edges.
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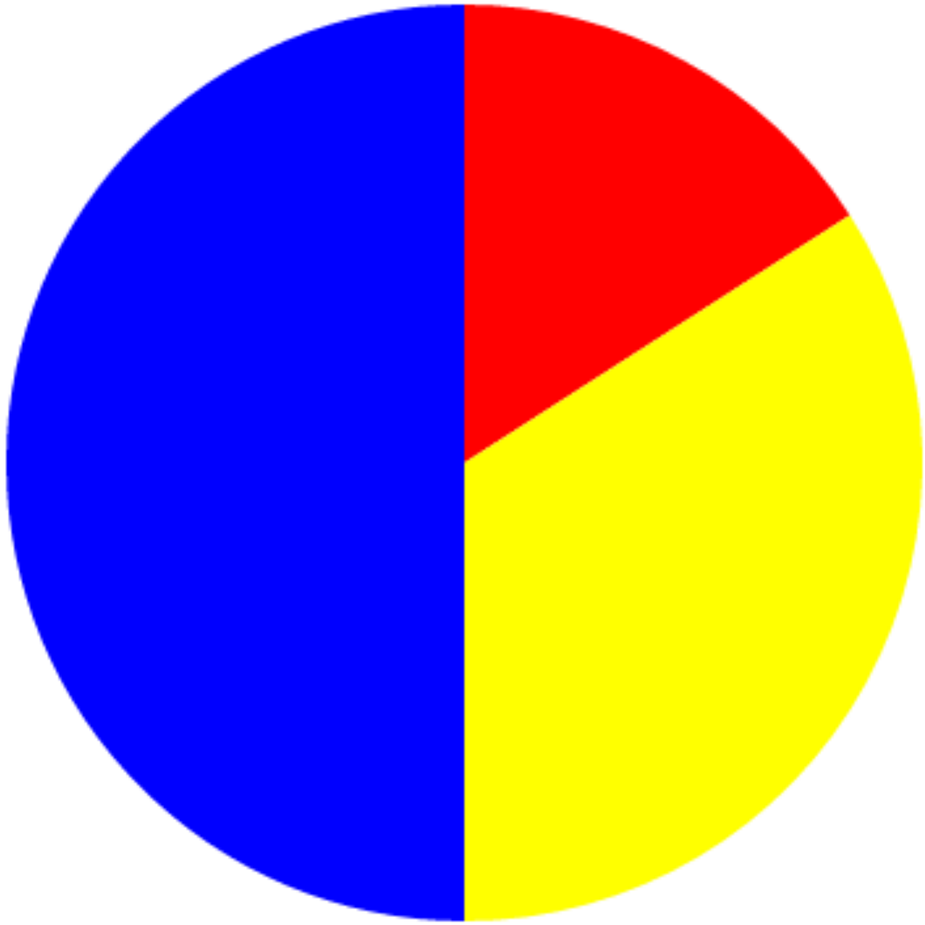
- Tree - position a tree of nodes tidily.
- Treemap - use recursive spatial subdivision to display a tree of nodes.



# PIE LAYOUT - COMPUTES ARC ANGLES FROM DATA

```
> var data = [ {amount: 1, color: "red"  },
               {amount: 2, color: "green"},
               {amount: 3, color: "blue" }];
  undefined
> var pie = d3.layout.pie()
      .sort(null)
      .value(function(d) { return d.amount; });
  undefined
> pie(data)
  [▼Object i                          , ▼Object i                          , ▼Object i                          ]
     ▶data: Object                       ▶data: Object                       ▶data: Object
      endAngle: 1.0471975511965976        endAngle: 3.141592653589793         endAngle: 6.283185307179586
      startAngle: 0                       startAngle: 1.0471975511965976      startAngle: 3.141592653589793
      value: 1                            value: 2                            value: 3
     ▶__proto__: Object                  ▶__proto__: Object                  ▶__proto__: Object
>
```

# EXERCISE: PIE LAYOUT ARC GENERATOR

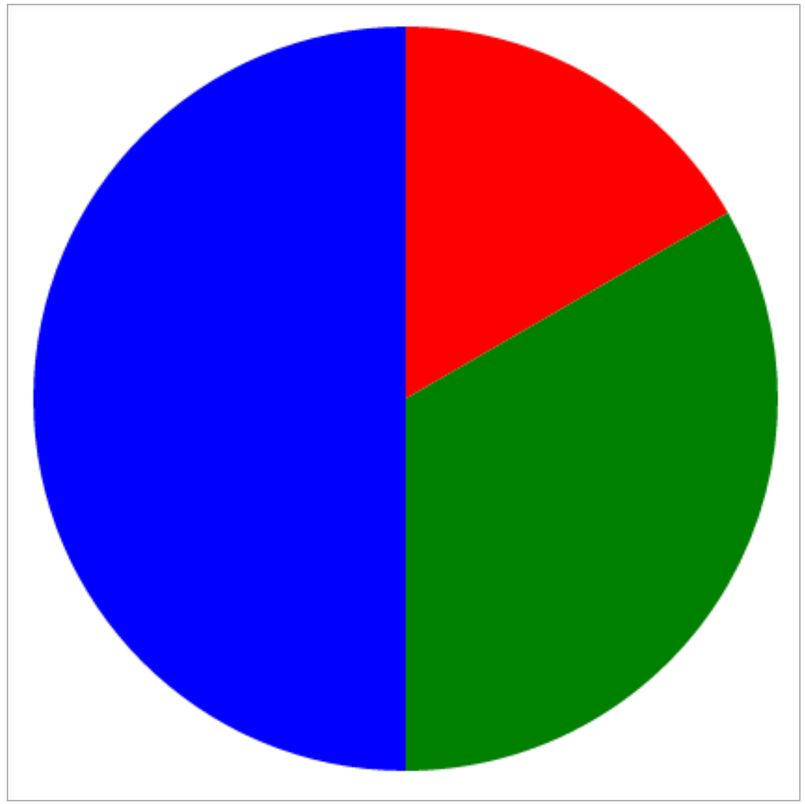
```
var data = [
    {amount: 0.75},
    {amount: 2.5},
    {amount: 3.75}
];

var pie = d3.layout.pie()
      .sort(null)
      .value(function(d) { return d.amount; });

console.table(pie(data));
```

Discuss:
sort & null
console.table

Use base.html

# PIE LAYOUT + D3 SVG ARC GENERATOR

```
var data = [ {amount: 1, color: "red"  },
             {amount: 2, color: "green"},
             {amount: 3, color: "blue" }];

var arc = d3.svg.arc()
    .innerRadius(0)
    .outerRadius(100);

var pie = d3.layout.pie().sort(null)
    .value(function(d) { return d.amount; });

var chart = d3.select("body").append("svg")
    .attr("width", 400).attr("height", 400)
  .append("g")
    .attr("transform", "translate(100,100)");

var arcGs = chart.selectAll(".arc")
    .data(pie(data))
  .enter().append("g")
    .attr("class", "arc");

arcGs.append("path")
    .attr("d", arc)
    .style("fill", function(d, i) { return d.data.color; });
```



Discuss
arc vs d.data.color

# EXERCISE: PIE CHART GENERATION

```
var data = [ {amount: 10, color: "red"}, {amount: 20, color: "green"}, {amount: 5, color: "blue"}];

var arc = d3.svg.arc()
    .innerRadius(0)
    .outerRadius(100);

var pie = d3.layout.pie()
    .sort(null)
    .value(function(d) { return d.amount; });

var chart = d3.select("body").append("svg").attr("height", 600).append("g")
    .attr("transform", "translate(100,100)");

var arcGs = chart.selectAll(".arc")
    .data(pie(data))
  .enter().append("g");

arcGs.append("path")
    .attr("d", arc)
    .style("fill", function(d, i) { return d.data.color; });
```

Discuss:
Radius, Angles, Size, arc
d.data.color

Use base.html

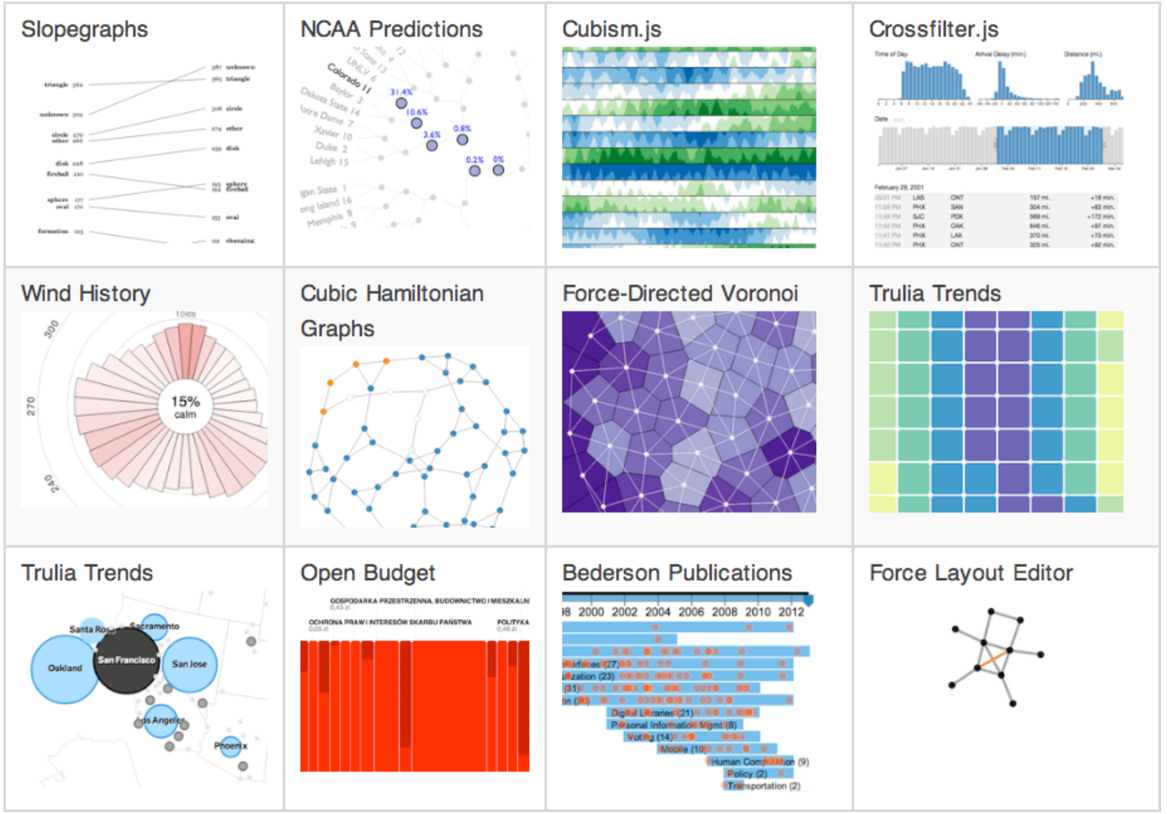
# SECTION 5
# CONCLUSION

# DATA VISUALIZATION IS A TOOL

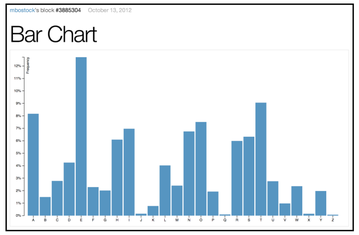
## Everything Generates Data

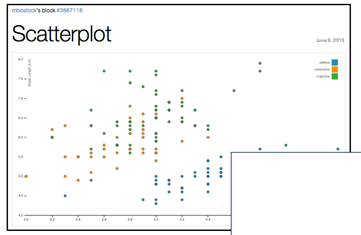
Visualizing this data leads to understanding.

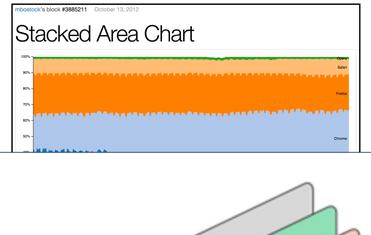
- Sports
- Commerce
- Weather
- Real Estate
- Publications
- Social Media
- Etc.....

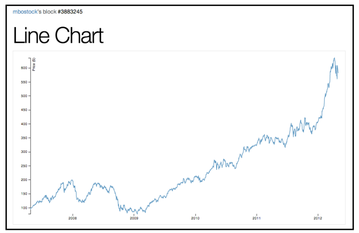


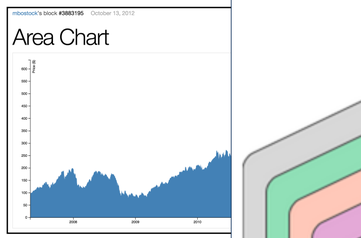
# D3 IS A DATA VISUALIZATION TOOL

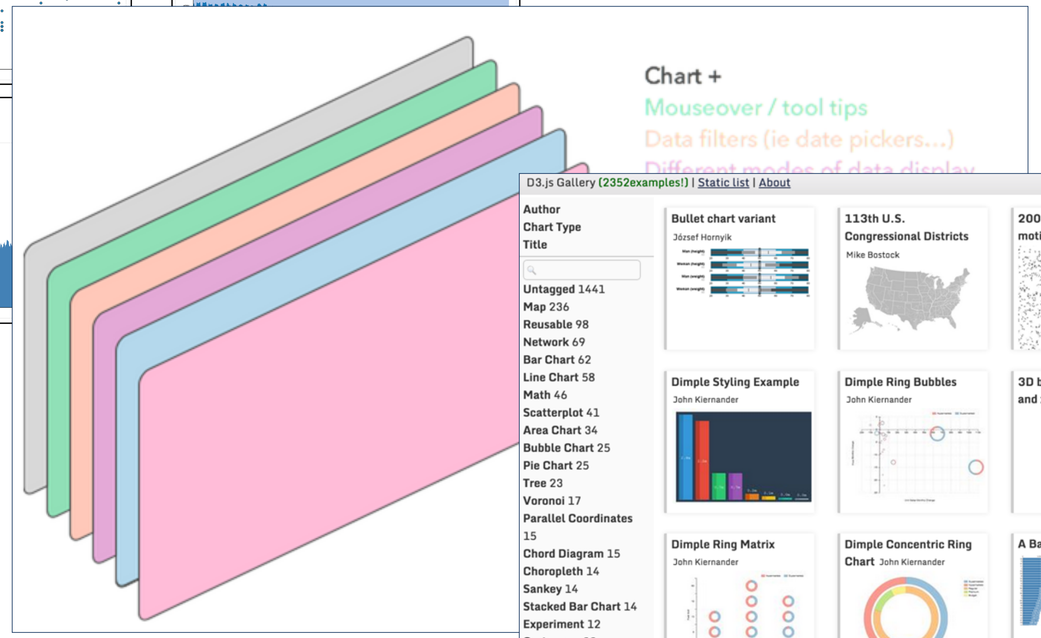


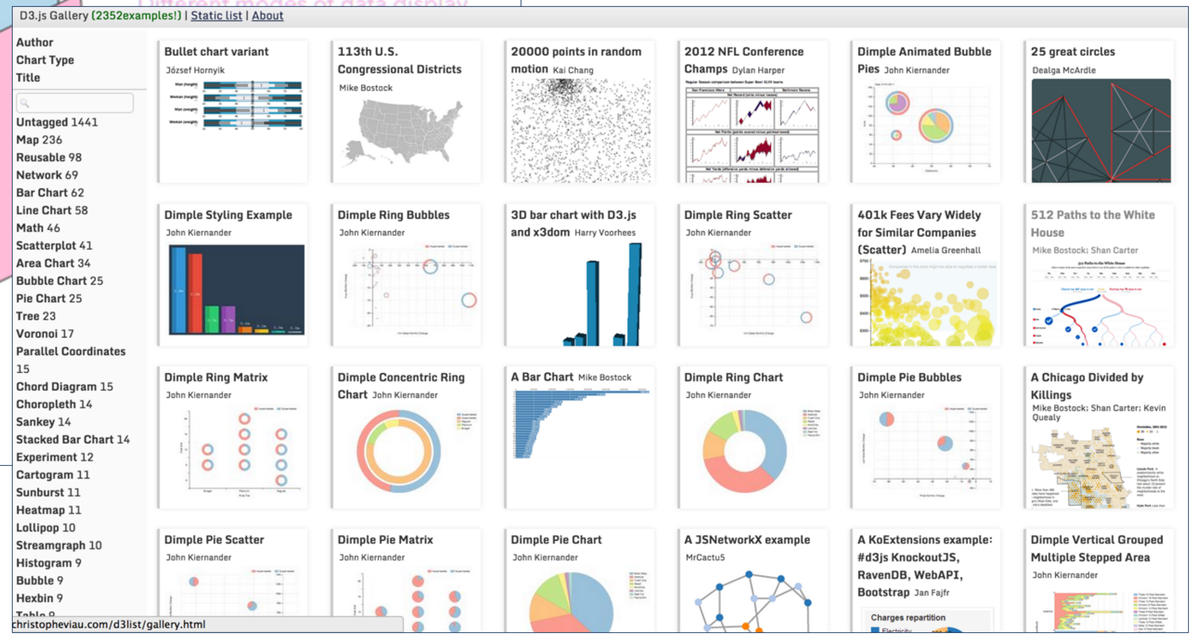



# D3 EXAMPLES & bl.ocks.org

=> bl.ocksplorer.org, lets you search blocks by d3 API Call…

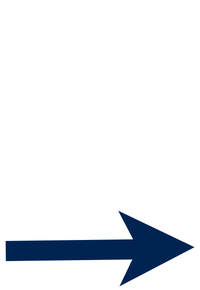
# D3 LAYOUTS

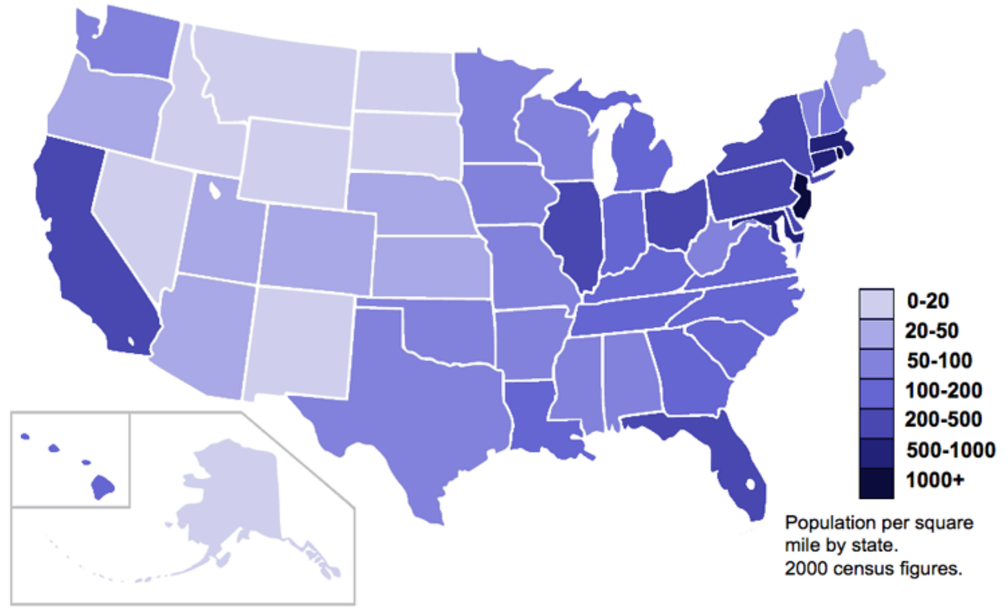

| | |
|---|---|
| box | Add missing semicolons. |
| bullet | Link to vertical demo. |
| chernoff | Remove redundant svg: prefixes. |
| cubehelix | Restore example. |
| fisheye | Remove a few unused variables. |
| force_labels | Add missing semicolons. |
| geo | Slightly prettier link. |
| geodesic | Fix bug with flipped triangles. |
| geom | Update geom/contour/README.md |
| graph | removed traverse |
| hexbin | Include hexbin grid coordinates. |
| hive | Move to top-level directory. |
| horizon | Remove horizon.duration. |
| interpolate-zoom | Add deprecation notice. |
| jsonp | Fix token replacement in jsonp plugin |
| keybinding | Update keybinding with improvements from iD project |
| longscroll | Shorten. |
| qq | Add qq plugin. |
| rollup | Create README.md |
| sankey | Add demo links. |
| simplify | Remove obsolete d3.simplify plugin. |
| superformula | Add superformula plugin. |
| urlencode | Add missing semicolons. |
| LICENSE | Update copyright year. |
| README.md | Add an example (d3.svg.hive). |

# DON'T MAKE YOUR AUDIENCE THINK

A39 Maryland

| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 20 | Alaska | D-3 | R-3 | R-3 | R-3 | R-3 | R-3 | R-3 |
| 21 | Arizona | R-5 | R-5 | R-6 | R-6 | R-6 | R-7 | R-7 |
| 22 | Arkansas | D-6 | (\1) | R-6 | D-6 | R-6 | R-6 | R-6 |
| 23 | California | D-40 | R-40 | R-45 | R-45 | R-45 | R-47 | R-47 |
| 24 | Colorado | D-6 | R-6 | R-7 | R-7 | R-7 | R-8 | R-8 |
| 25 | Connecticut | D-8 | D-8 | R-8 | R-8 | R-8 | R-8 | R-8 |
| 26 | Delaware | D-3 | R-3 | R-3 | D-3 | R-3 | R-3 | R-3 |
| 27 | District of Columbia | D-3 | D-3 | D-3 | D-3 | D-3 | D-3 | D-3 |
| 28 | Florida | D-14 | R-14 | R-17 | D-17 | R-17 | R-21 | R-21 |
| 29 | Georgia | R-12 | (\1) | R-12 | D-12 | D-12 | R-12 | R-12 |
| 30 | Hawaii | D-4 | D-4 | R-4 | D-4 | D-4 | R-4 | D-4 |
| 31 | Idaho | D-4 | R-4 | R-4 | R-4 | R-4 | R-4 | R-4 |
| 32 | Illinois | D-26 | R-26 | R-26 | R-26 | R-26 | R-24 | R-24 |
| 33 | Indiana | D-13 | R-13 | R-13 | R-13 | R-13 | R-12 | R-12 |
| 34 | Iowa | D-9 | R-9 | R-8 | R-8 | R-8 | R-8 | D-8 |
| 35 | Kansas | D-7 | R-7 | R-7 | R-7 | R-7 | R-7 | R-7 |
| 36 | Kentucky | D-9 | R-9 | R-9 | D-9 | R-9 | R-9 | R-9 |
| 37 | Louisiana | R-10 | (\1) | R-10 | D-10 | R-10 | R-10 | R-10 |
| 38 | Maine | D-4 | D-4 | R-4 | R-4 | R-4 | R-4 | R-4 |
| 39 | Maryland | D-10 | D-10 | R-10 | D-10 | D-10 | R-10 | R-10 |
| 40 | Massachusetts | D-14 | D-14 | D-14 | D-14 | R-14 | R-13 | D-13 |
| 41 | Michigan | D-21 | D-21 | R-21 | R-21 | R-21 | R-20 | R-20 |
| 42 | Minnesota | D-10 | D-10 | R-10 | D-10 | D-10 | D-10 | D-10 |
| 43 | Mississippi | R-7 | (\1) | R-7 | D-7 | R-7 | R-7 | R-7 |
| 44 | Missouri | D-12 | R-12 | R-12 | D-12 | R-12 | R-11 | R-11 |
| 45 | Montana | D-4 | R-4 | R-4 | R-4 | R-4 | R-4 | R-4 |
| 46 | Nebraska | D-5 | R-5 | R-5 | R-5 | R-5 | R-5 | R-5 |
| 47 | Nevada | D-3 | R-3 | R-3 | R-3 | R-3 | R-4 | R-4 |
| 48 | New Hampshire | D-4 | R-4 | R-4 | R-4 | R-4 | R-4 | R-4 |
| 49 | New Jersey | D-17 | R-17 | R-17 | R-17 | R-17 | R-16 | R-16 |
| 50 | New Mexico | D-4 | R-4 | R-4 | R-4 | R-4 | R-5 | R-5 |






Source:
http://www.census.gov

Source:
http://commons.wikimedia.org/wiki/File:US_2000_census_population_density_map_by_state.svg

# D3 RESOURCES

http://dashingd3js.com

http://bost.ocks.org/mike/

http://www.jasondavies.com

http://vallandingham.me/vis/

http://alignedleft.com/tutorials/d3/

http://christopheviau.com/d3list/gallery.html

https://github.com/mbostock/d3/wiki/API-Reference

http://www.jeromecukier.net/wp-content/uploads/2012/10/d3-cheat-sheet.pdf

# DATA VISUALIZATION RESOURCES

http://wtfviz.net/

http://stamen.com/

http://thumbsupviz.com/

http://idl.cs.washington.edu/

https://twitter.com/DashingD3js

http://annkemery.com/dataviz-checklist/

http://www.visual-literacy.org/periodic_table/periodic_table.html

http://visualoop.com/13484/the-30-data-viz-blogs-you-cant-miss-in-one-place

# QUESTIONS: ASK – HAPPY TO HELP!

## CONTACT:

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@DASHINGD3JS