

ARC²S Group

Applied Research on Computational Complex Systems

Data Interaction

Prof. Giancarlo **Ruffo**

“Analisi e Visualizzazione di Reti Complesse” (9 credits)

Laurea Magistrale in **Informatica**

Università degli Studi di Torino

A.A. 2018/19

@giaruffo





Stephen Few

Now You See It
Analytics Press, 2009

Chapter 4: Analytical Interaction and Navigation
Chapter 5: Analytical Techniques and Practices

INTRODUCTION

Data Analysis

Data analysis, like experimentation, must be considered as an open-ended, highly interactive, iterative process, whose actual steps are selected segments of a stubbornly branching, tree-like pattern of possible actions.

Types of Navigation

- **Directed Navigation**
 - Have a specific question
 - Search for an answer
 - Produce an answer
- **Exploratory Navigation**



Types of Navigation

- **Directed Navigation**
 - Have a specific question
 - Search for an answer
 - Produce an answer
- **Exploratory Navigation**
 - Explore data
 - Find something interesting
 - Ask a question...



Types of Navigation

- **Question:**
 - Which type of navigation is information visualization well-suited for?

Types of Navigation

- **Question:**
 - Which type of navigation is information visualization well-suited for?
- **Answer:**
 - Exploratory Navigation

Observation and Spy Craft

- Broad Awareness
 - Overview
 - Awareness of abnormalities
- Close Observation and Analysis
 - Shift focus on abnormality
 - Analyze abnormality

Shneiderman's Mantra



Ben Shneiderman. 1996. The Eyes Have It: A Task by Data Type Taxonomy for Information Visualizations. In Proceedings of the 1996 IEEE Symposium on Visual Languages (VL '96). IEEE Computer Society, Washington, DC, USA, 336

Readings in Information Visualization: Using Vision to Think
By Stuart K. Card, Jock D. Mackinlay, and Ben Shneiderman, Academic Press, San Diego, California, 1999, p625

Shneiderman's Mantra

- **Overview**
 - Reduces search time
 - Allows detection of overall patterns
 - Allows user to choose next move
- **Zoom and Filter**
 - Iteratively narrow focus
 - Remove extraneous information
- **Details On-Demand**
 - Drill down to details

Types of Representations

- **Static Representations**
 - No Interactivity
- **Manipulable Representations**
 - Manipulate view of data
 - Actions include zoom, pan, rotate, etc.
- **Transformable Representations**
 - Manipulate input data
 - Actions include filter, average, etc.

Manipulable Representations

- **Exploration**
 - Zooming, rotation, scrolling/panning, sorting
- **Overview + Details**
 - Two separate views
- **Focus + Context**
 - One integrated view without occlusion
 - Focus shown in greater detail
 - Context shown in reduced detail

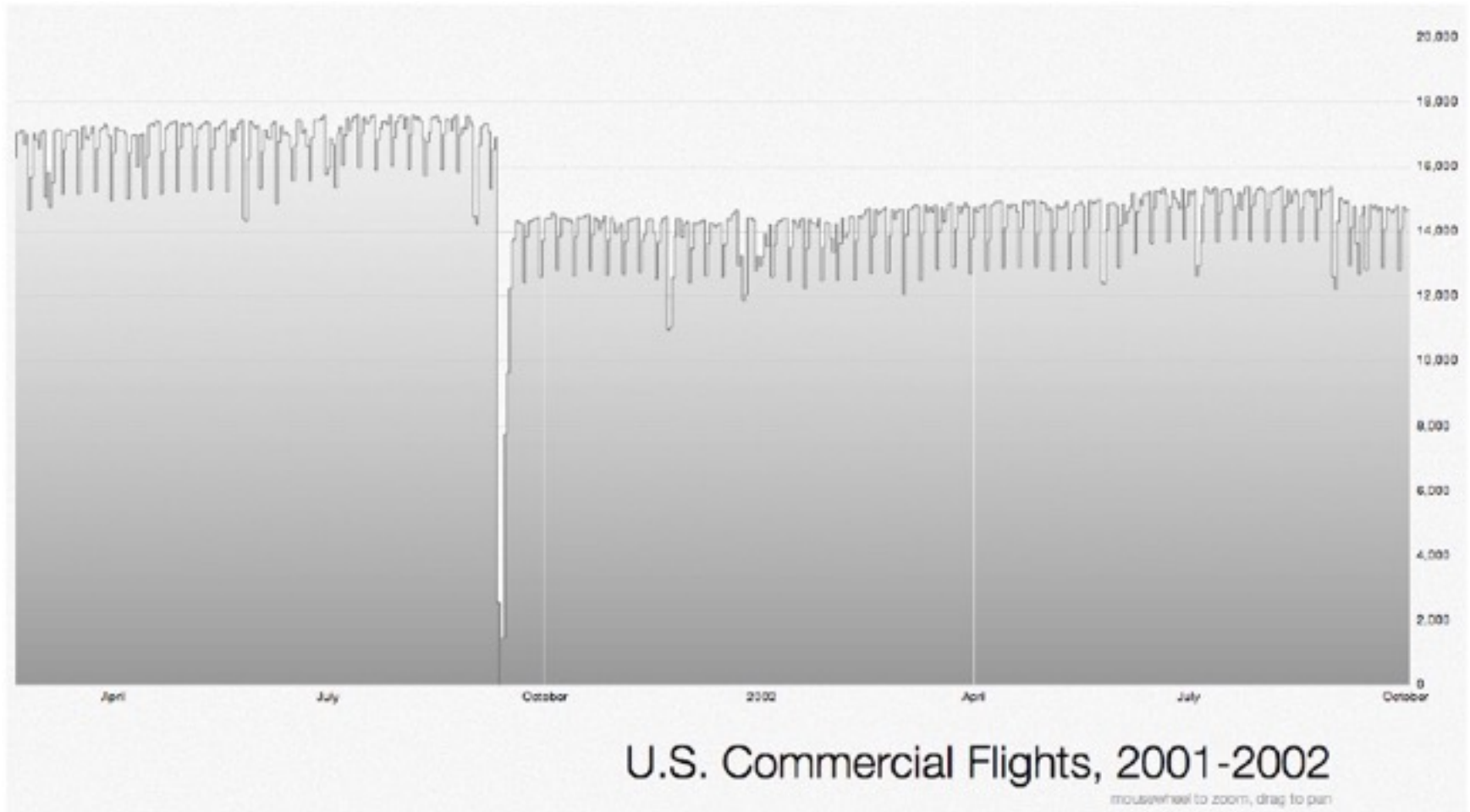
EXPLORATION

Manipulable Representations

Exploration

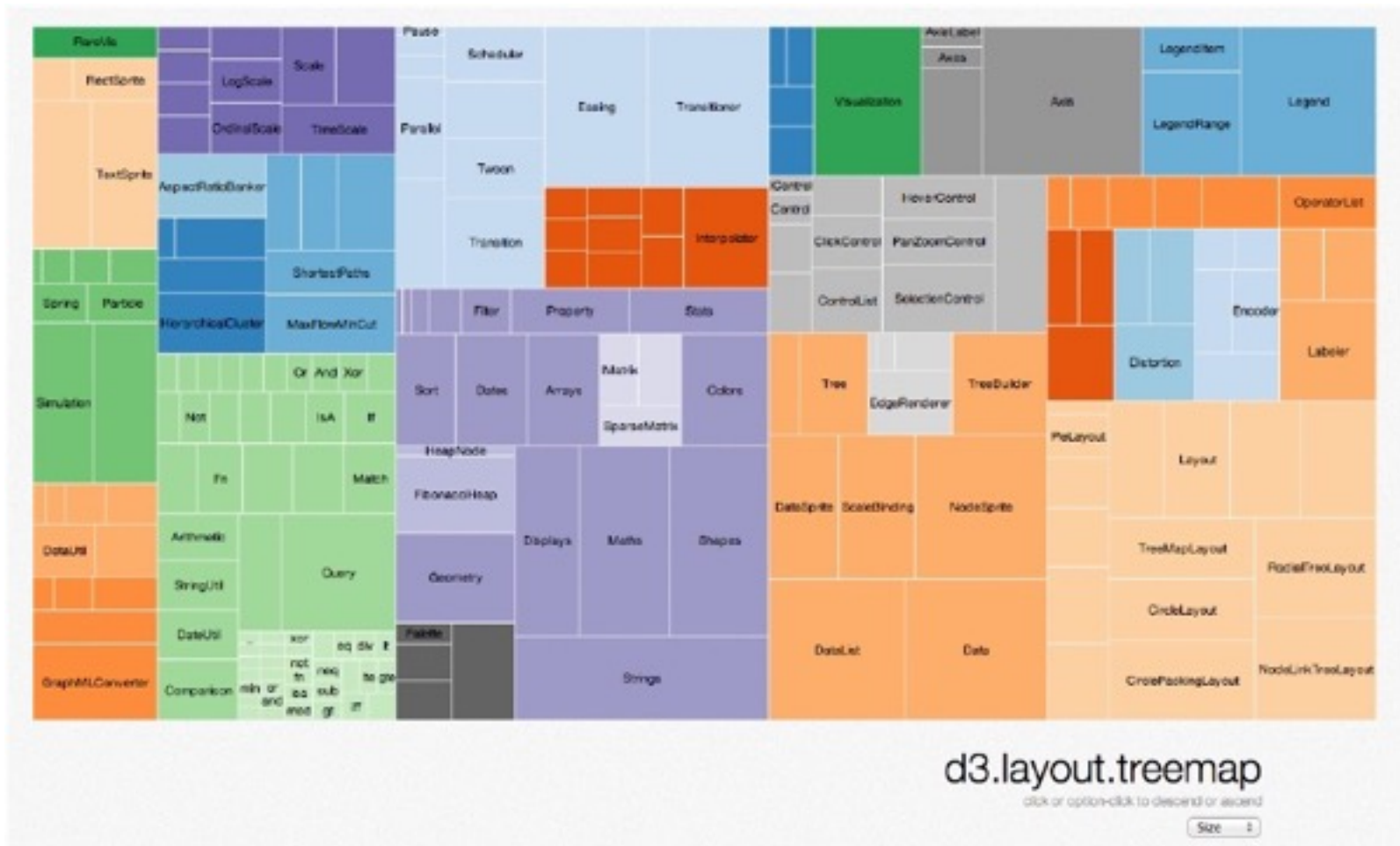
- Operations
 - Zooming
 - Panning or scrolling
 - Rotating
 - Other
- Considerations
 - Avoid blinking (change blindness)
 - Keep transitions smooth to maintain context

Zooming, Panning



<http://mbostock.github.com/d3/talk/20111018/area-gradient.html>

Drill Down via Zooming

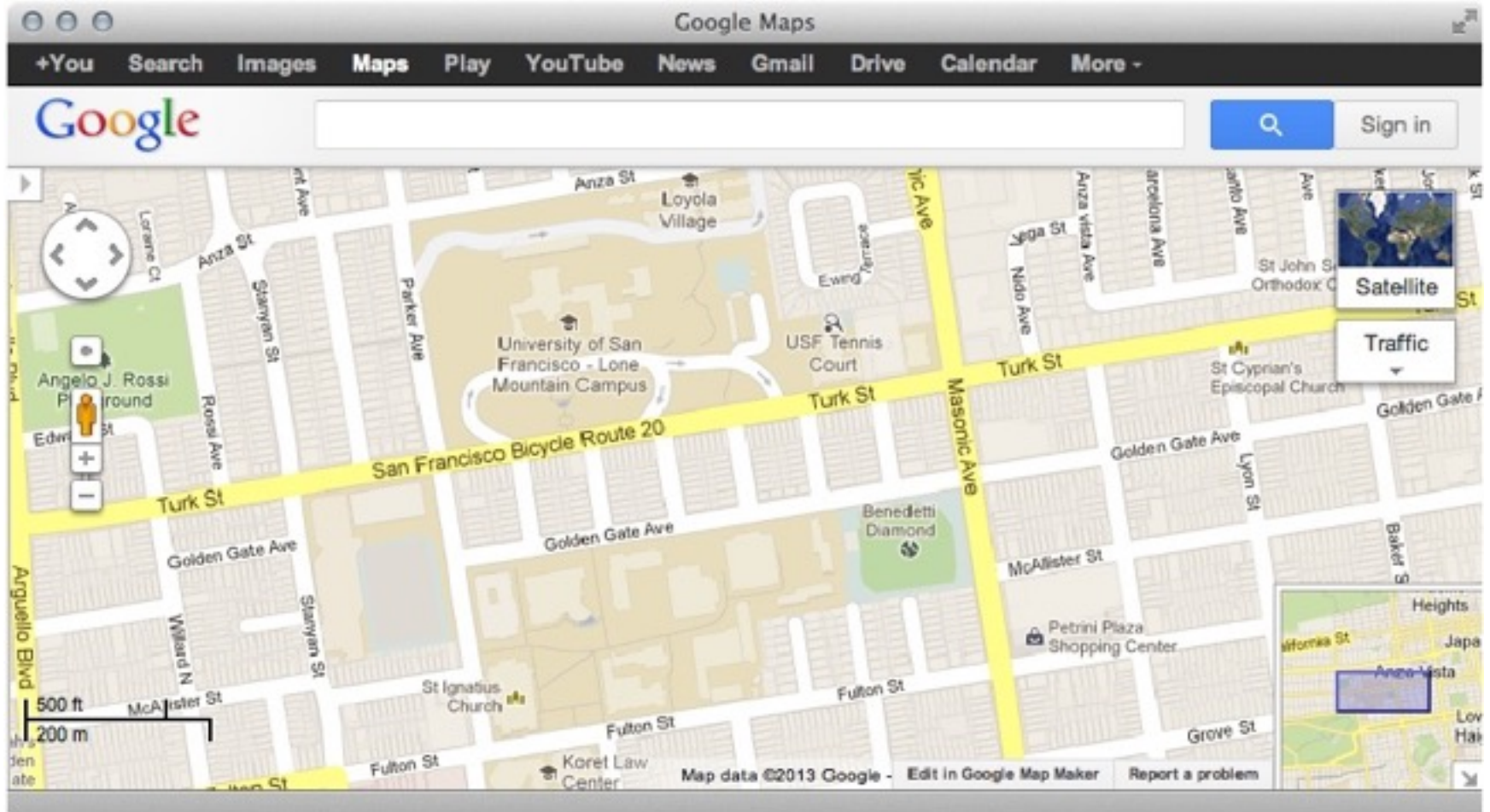


<http://mbostock.github.com/d3/talk/20111018/treemap.html>

OVERVIEW + DETAIL

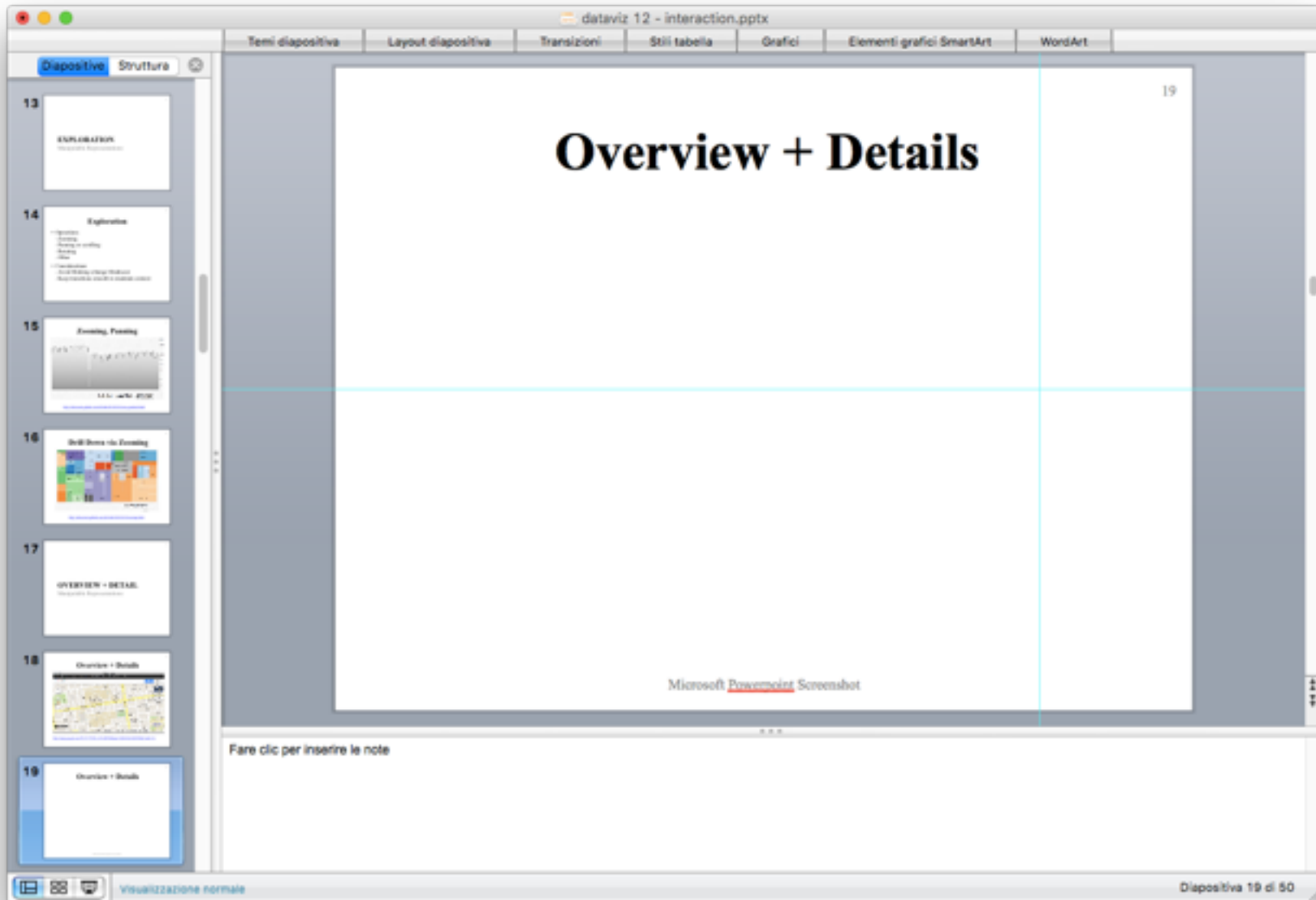
Manipulable Representations

Overview + Details

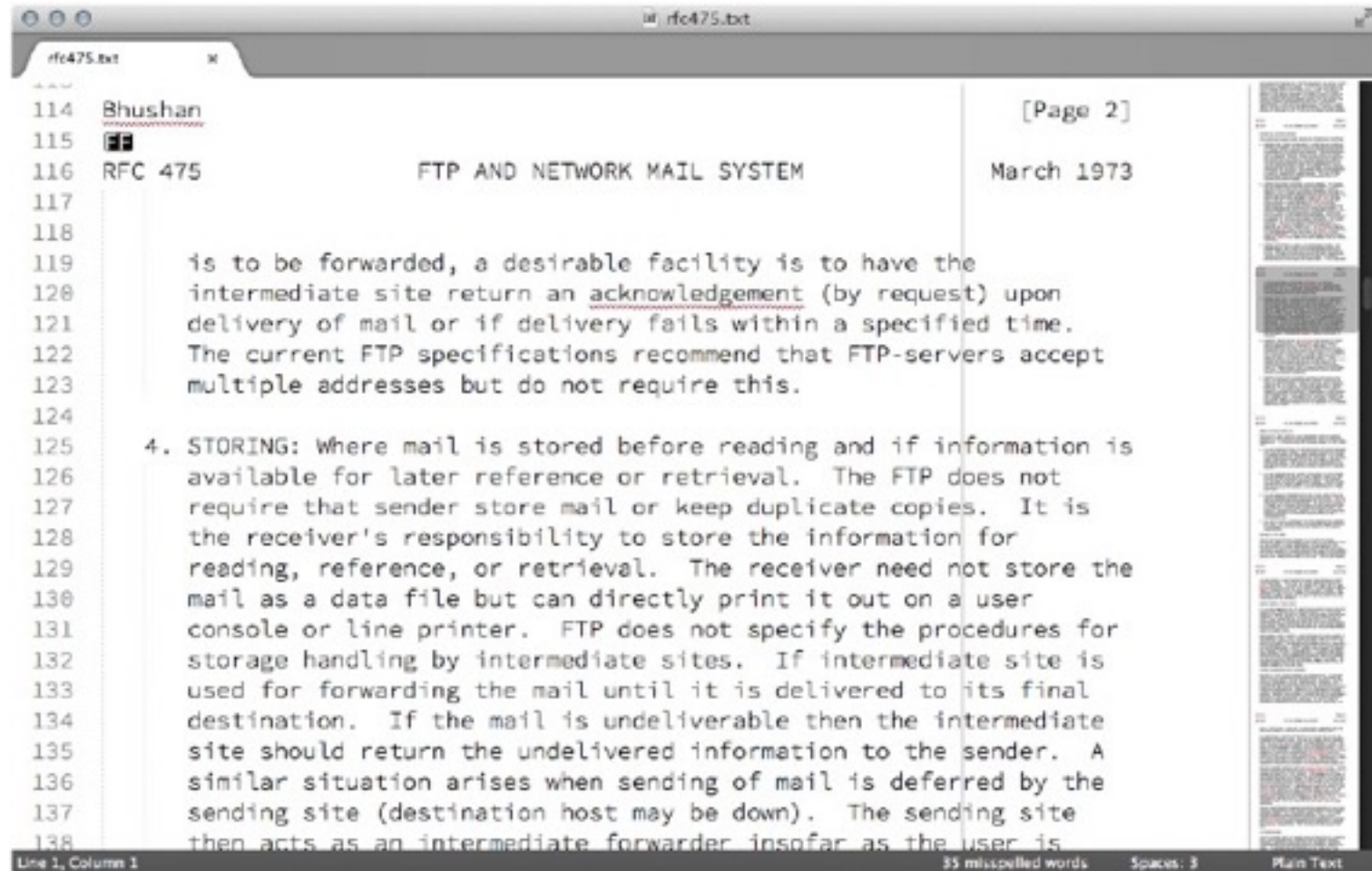


<http://maps.google.com/?ll=37.777635,-122.445502&spn=0.006106,0.009999&t=m&z=16>

Overview + Details



Sublime Text



```
rfc475.txt
114 Bhushan
115
116 RFC 475 FTP AND NETWORK MAIL SYSTEM March 1973
117
118
119 is to be forwarded, a desirable facility is to have the
120 intermediate site return an acknowledgement (by request) upon
121 delivery of mail or if delivery fails within a specified time.
122 The current FTP specifications recommend that FTP-servers accept
123 multiple addresses but do not require this.
124
125 4. STORING: Where mail is stored before reading and if information is
126 available for later reference or retrieval. The FTP does not
127 require that sender store mail or keep duplicate copies. It is
128 the receiver's responsibility to store the information for
129 reading, reference, or retrieval. The receiver need not store the
130 mail as a data file but can directly print it out on a user
131 console or line printer. FTP does not specify the procedures for
132 storage handling by intermediate sites. If intermediate site is
133 used for forwarding the mail until it is delivered to its final
134 destination. If the mail is undeliverable then the intermediate
135 site should return the undelivered information to the sender. A
136 similar situation arises when sending of mail is deferred by the
137 sending site (destination host may be down). The sending site
138 then acts as an intermediate forwarder insofar as the user is
```

Line 1, Column 1 35 misspelled words Spaces: 3 Plain Text

<http://www.sublimetext.com/>

FOCUS + CONTEXT

Manipulable Representations

Fisheye Distortion

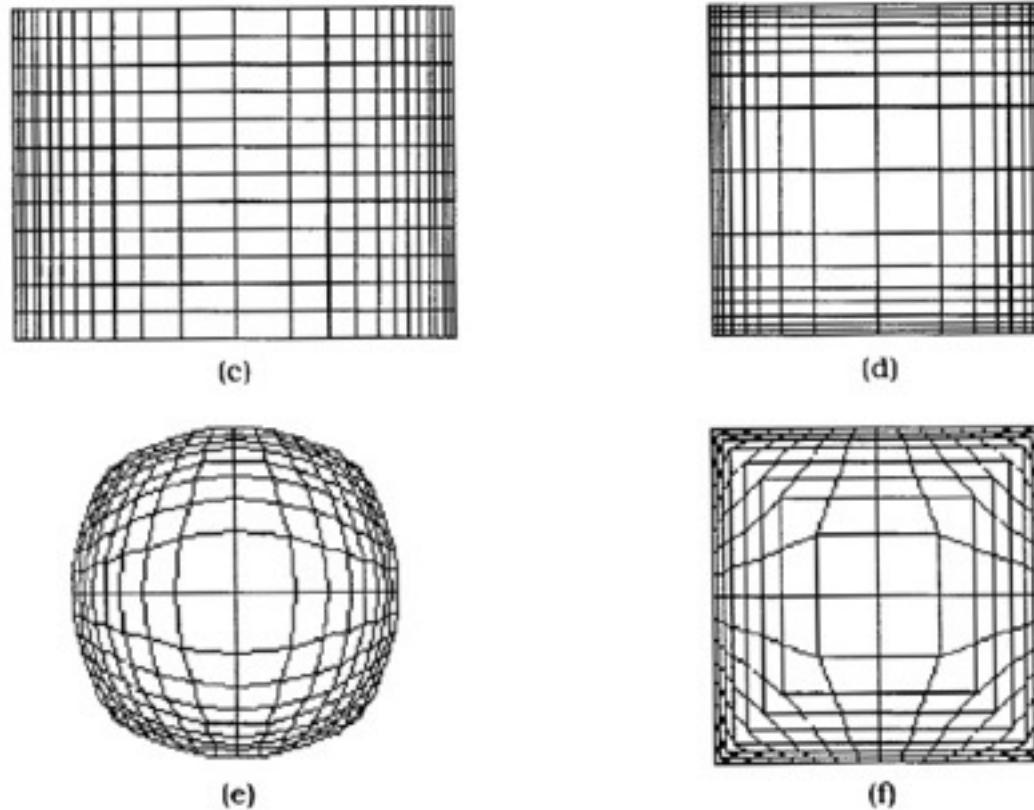
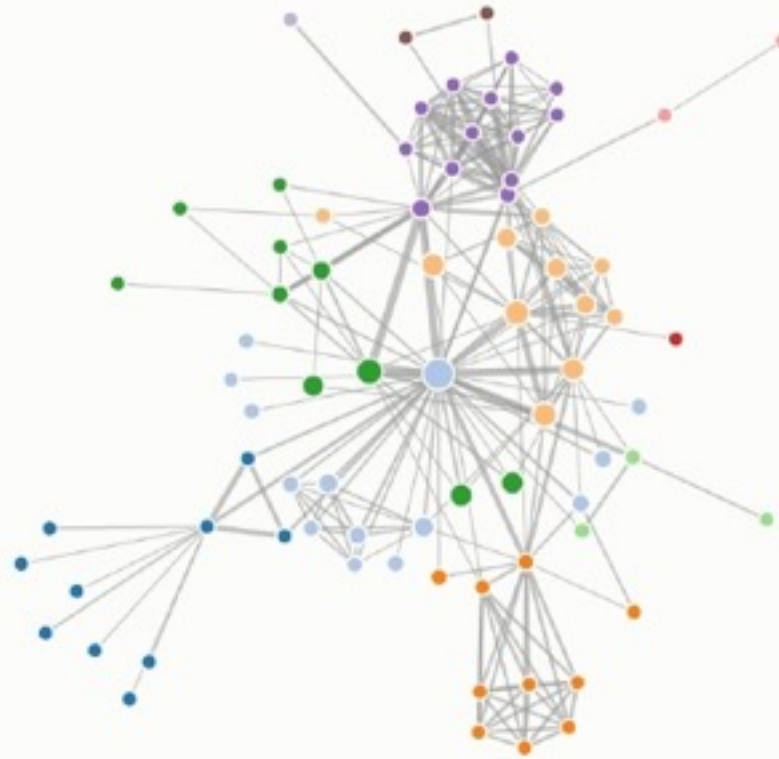


Fig. 11. The Fisheye View: (a) a typical transformation function; (b) the corresponding magnification function; (c) the application of the Fisheye View in one dimension; (d) a Cartesian Fisheye View in two dimensions; (e) a polar Fisheye View; (f) a normalized polar Fisheye View.

“Are view and Taxonomy of Distortion-Oriented Presentation Techniques” by Y.K. Leung and M.D. Apperley

Fisheye Distortion



<http://bost.ocks.org/mike/fisheye/>

Hyperbolic Tree

- Components diminish in size as move outwards
 - Uses fish eye distortion
- Focus changed by clicking a node
 - Node moves to center and increases in size
 - Other nodes move to edges and decrease in size
- Allows display of large hierarchical trees without loss of focus and context

http://www.sigchi.org/chi95/Electronic/documnts/papers/jl_bdy.htm

Inspiration



http://www.sigchi.org/chi95/Electronic/documnts/papers/jl_bdy.htm

Hypertree Demo

Hypertree - Tree Animation

phillogb.github.com/jit/static/v20/jit/Examples/Hypertree/example1.html

Tree Animation

A static JSON Tree structure is used as input for this animation.

Clicking on a node should move the tree and center that node.

The centered node's children are displayed in a relations list in the right column.

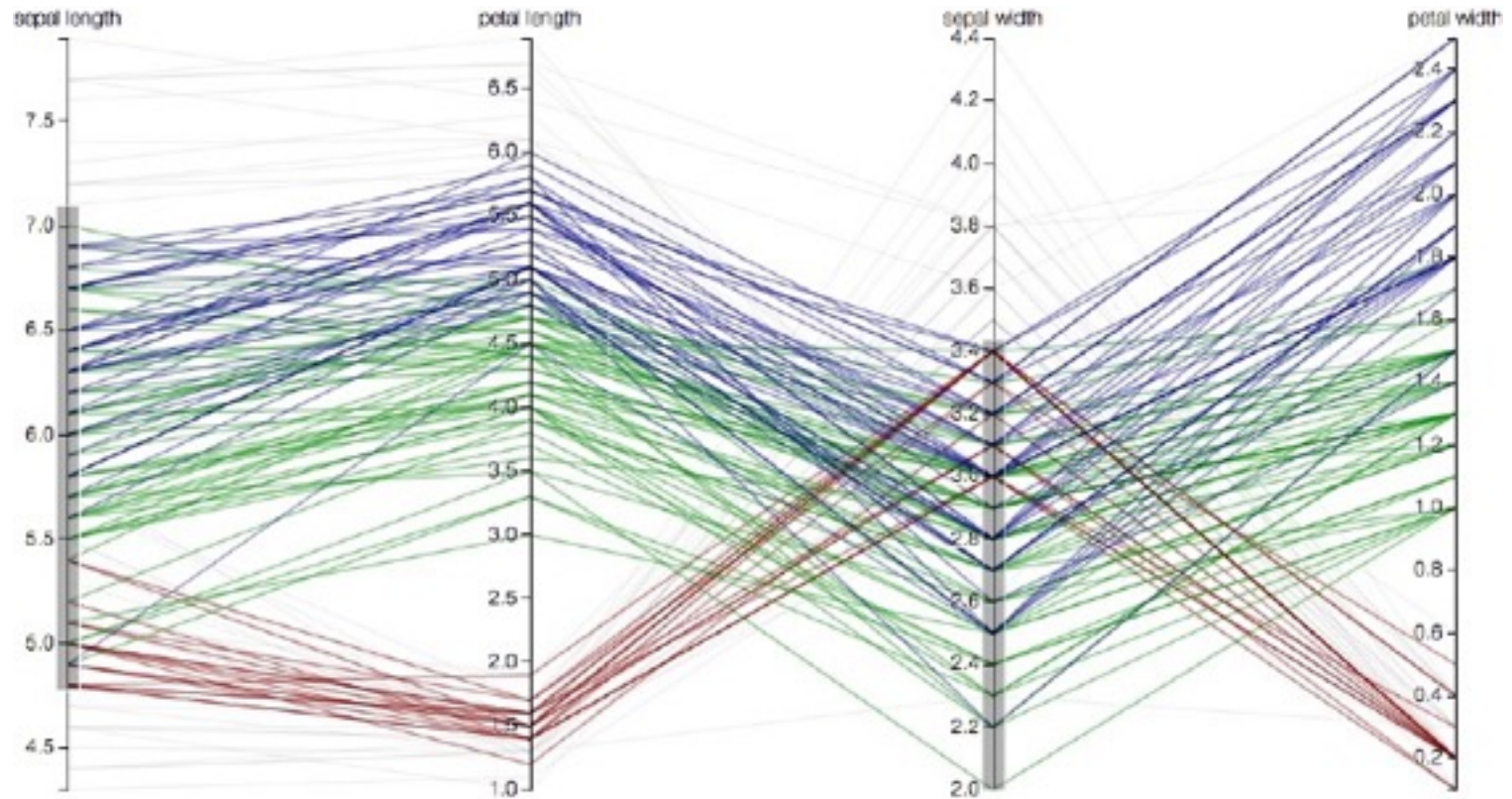
[See the Example Code](#)

Connections:

- Jerome Dillon (relation: member of band)
- Charlie Clouser (relation: member of band)
- James Woolley (relation: member of band)
- Jeff Ward (relation: member of band)
- Richard Patrick (relation: member of band)
- Trent Reznor (relation: member of band)
- Chris Vrenna (relation: member of band)
- Aaron North (relation: member of band)
- Jeordie White (relation: member of band)
- Robin Finck (relation: member of band)
- Donny Lohner (relation: member of band)

<http://phillogb.github.com/jit/static/v20/Jit/Examples/Hypertree/example1.html>

Brushing



- *Iris setosa*
- *Iris versicolor*
- *Iris virginica*

Edgar Anderson's *Iris* data set
parallel coordinates

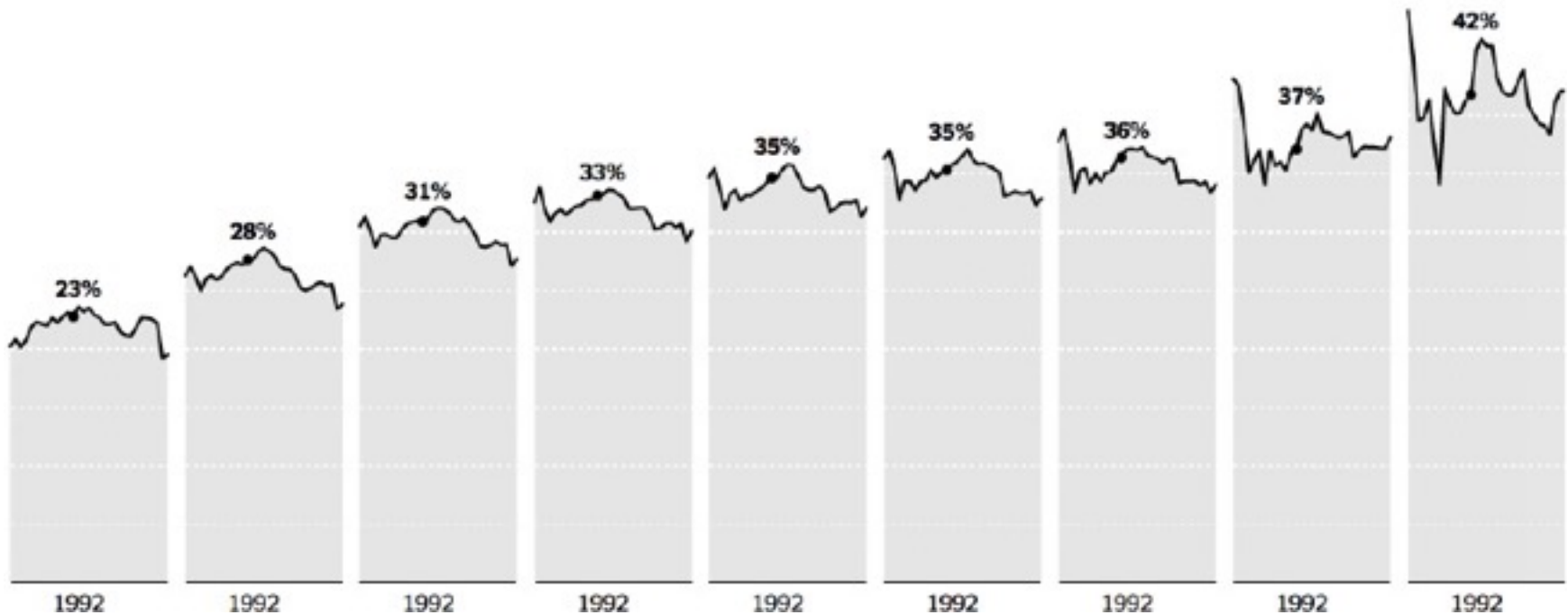
<http://mbostock.github.com/d3/talk/20111116/iris-parallel.html>

Linked Views



Tax rates have fallen for most Americans, especially high earners.

Share of yearly income paid in federal, state and local taxes, by income bracket.

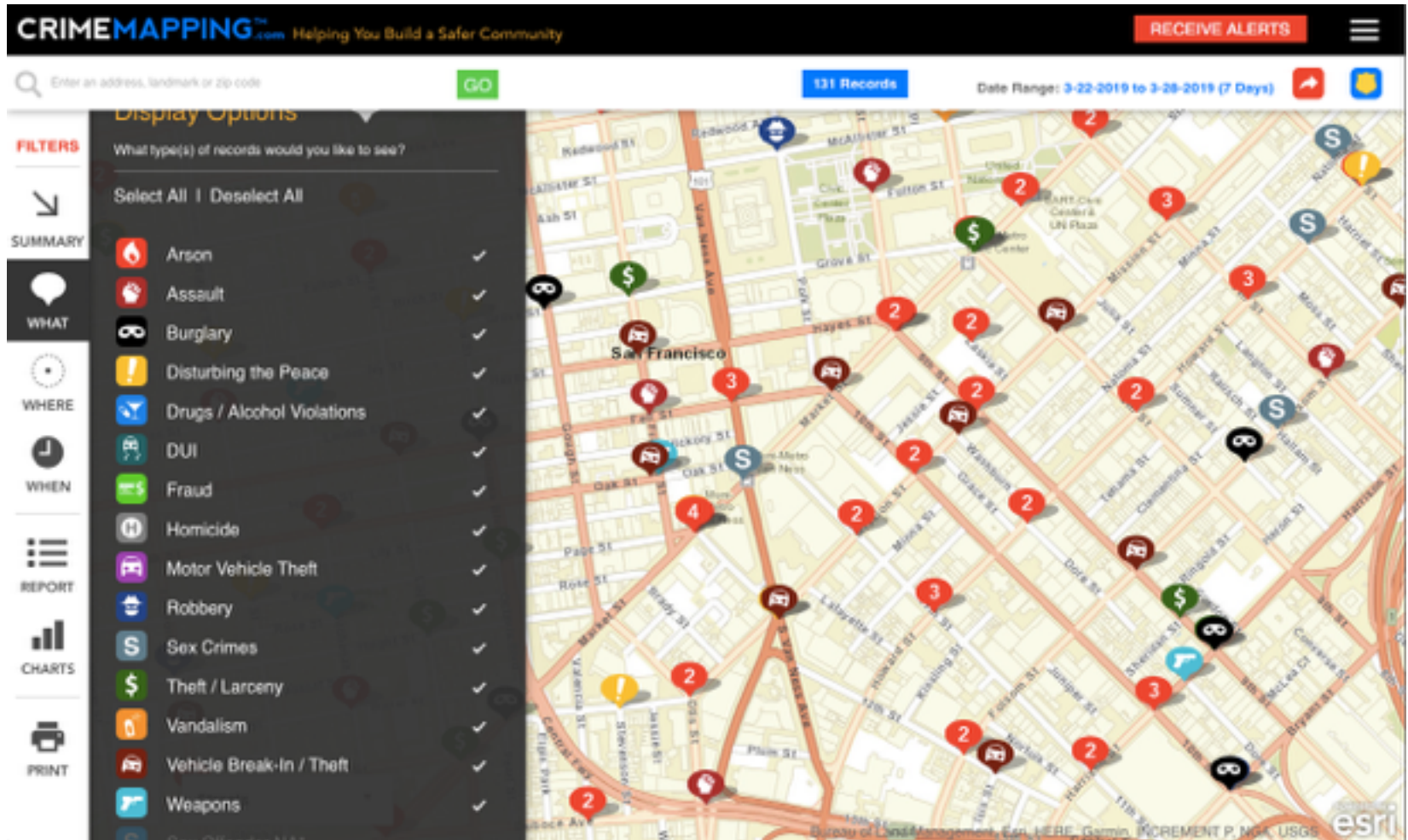


<https://www.nytimes.com/2012/11/30/us/most-americans-face-lower-tax-burden-than-in-the-80s.html>

DATA TRANSFORMATIONS

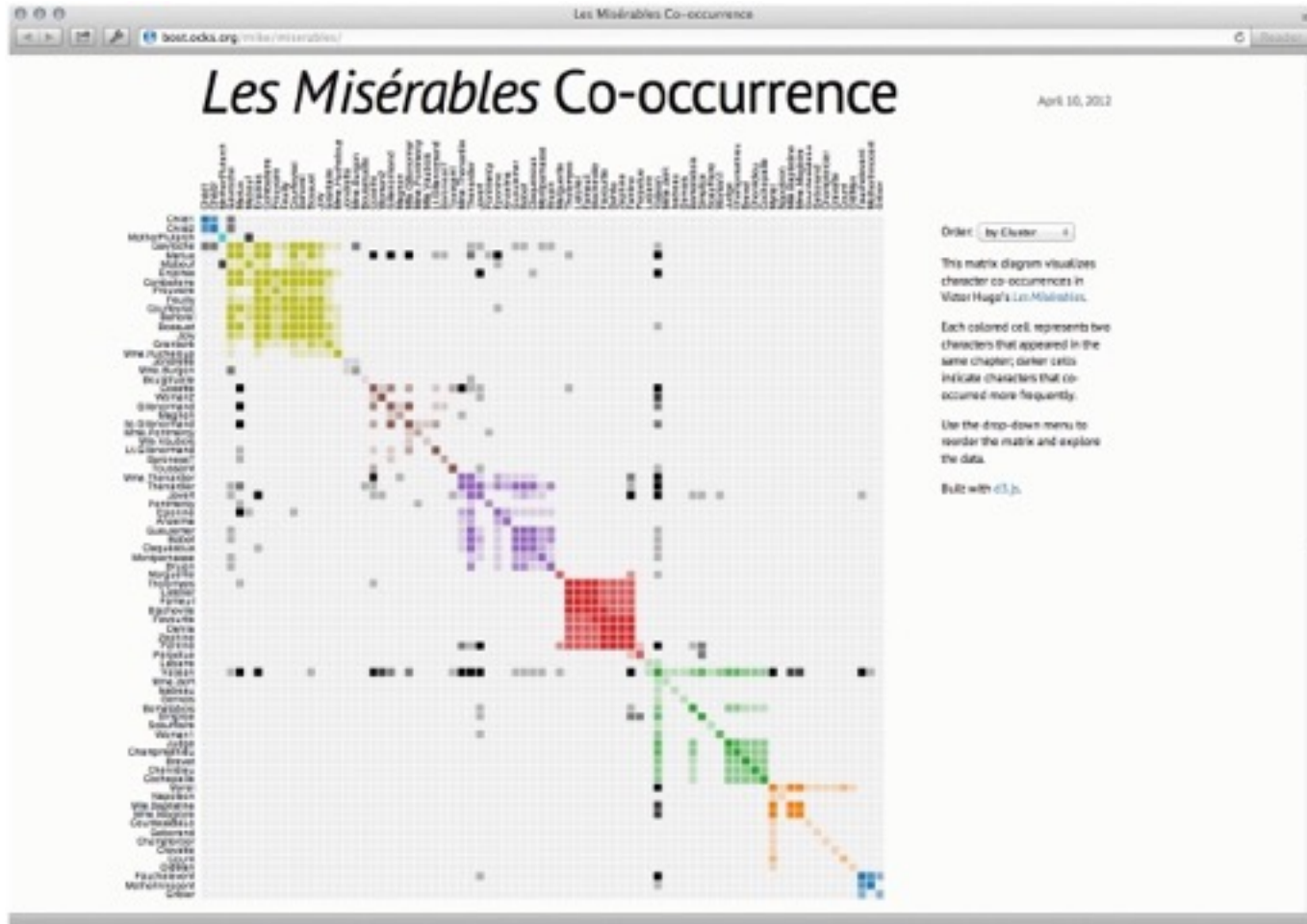
Transformable Representations

Filtering



<https://www.crimemapping.com/map/ca/sanfrancisco>

Sorting

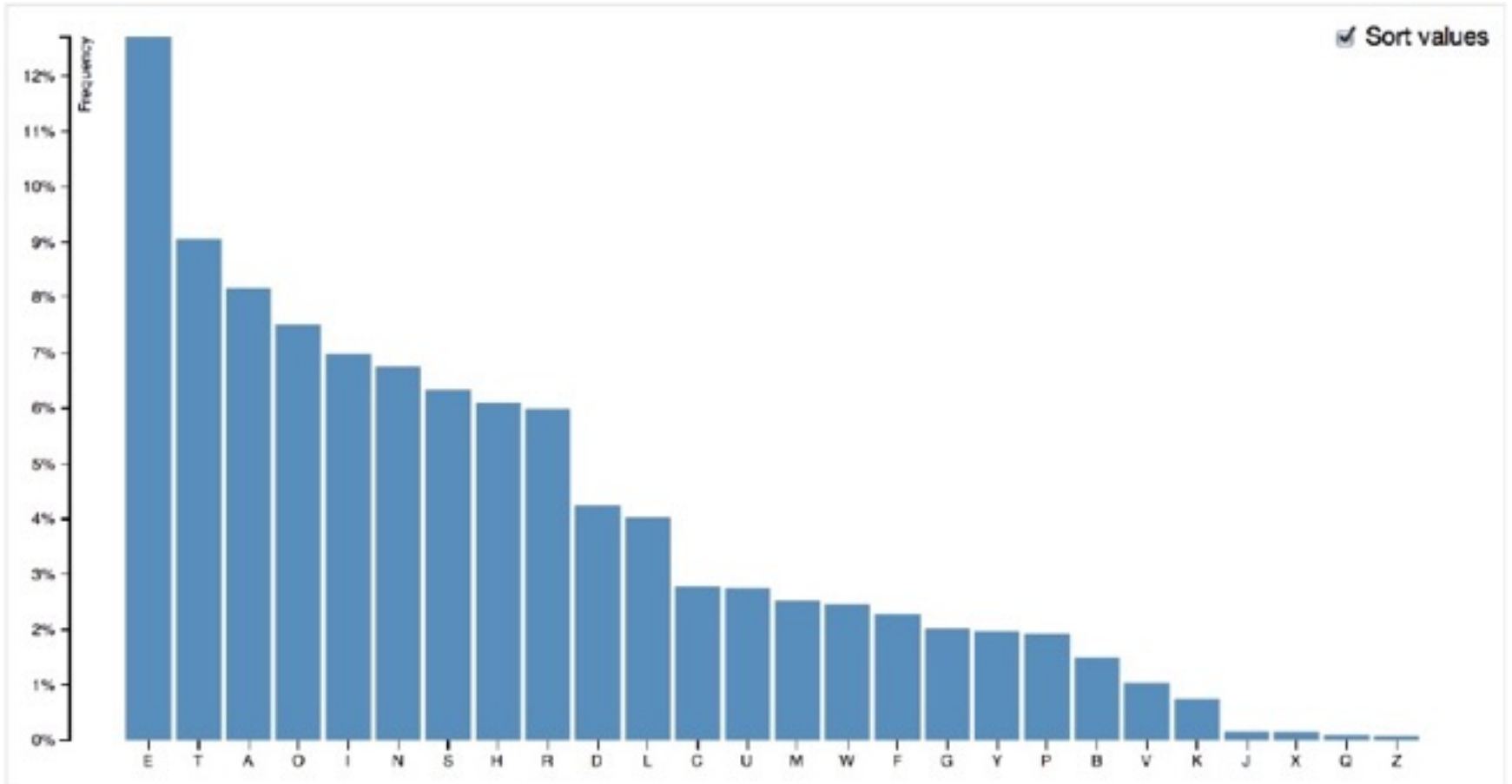


<http://bost.ocks.org/mike/miserables/>

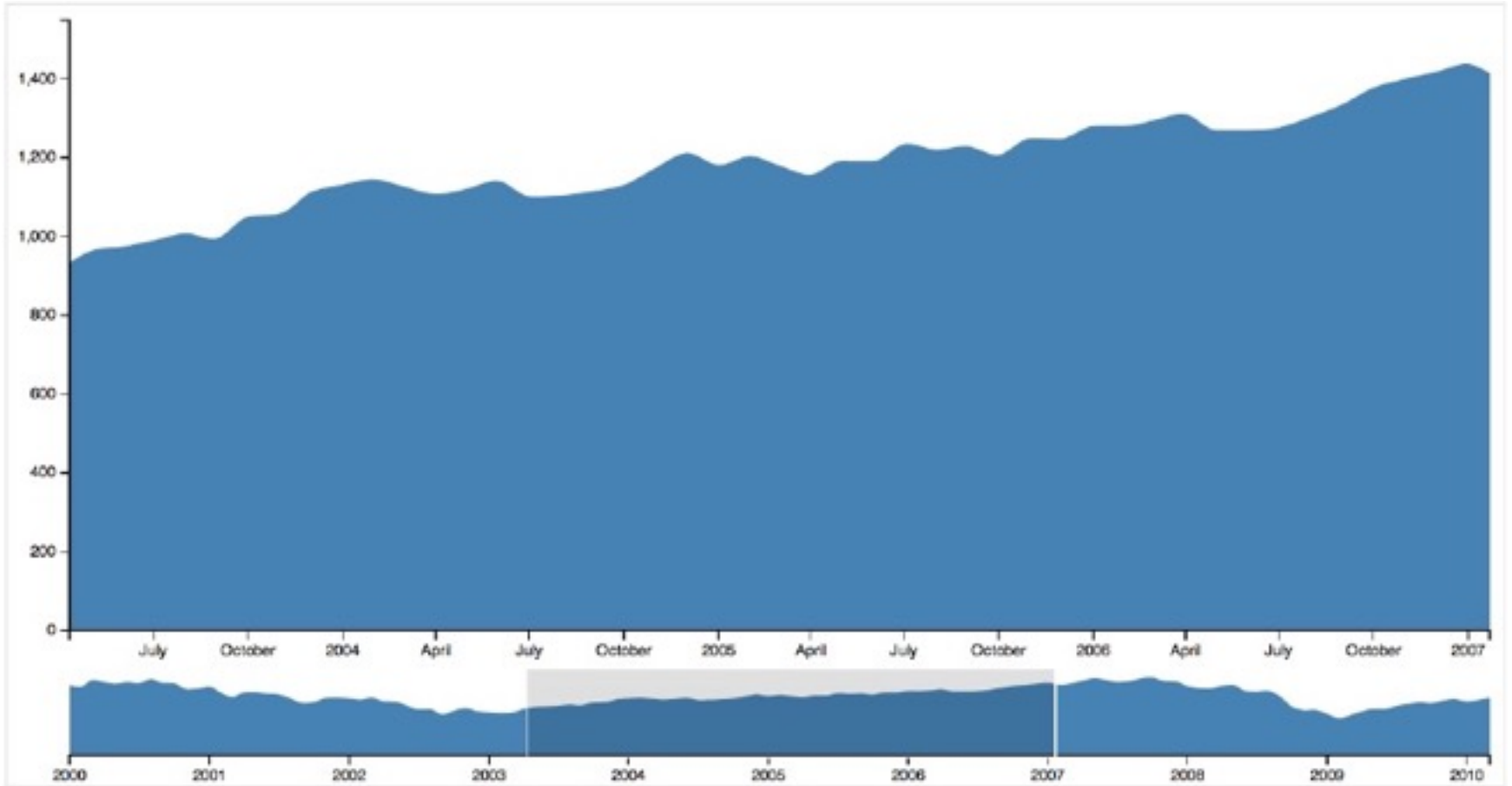
EXAMPLES

Data: Drill Down, Filtering, Sorting

View: Overview+Detail, Focus+Context?

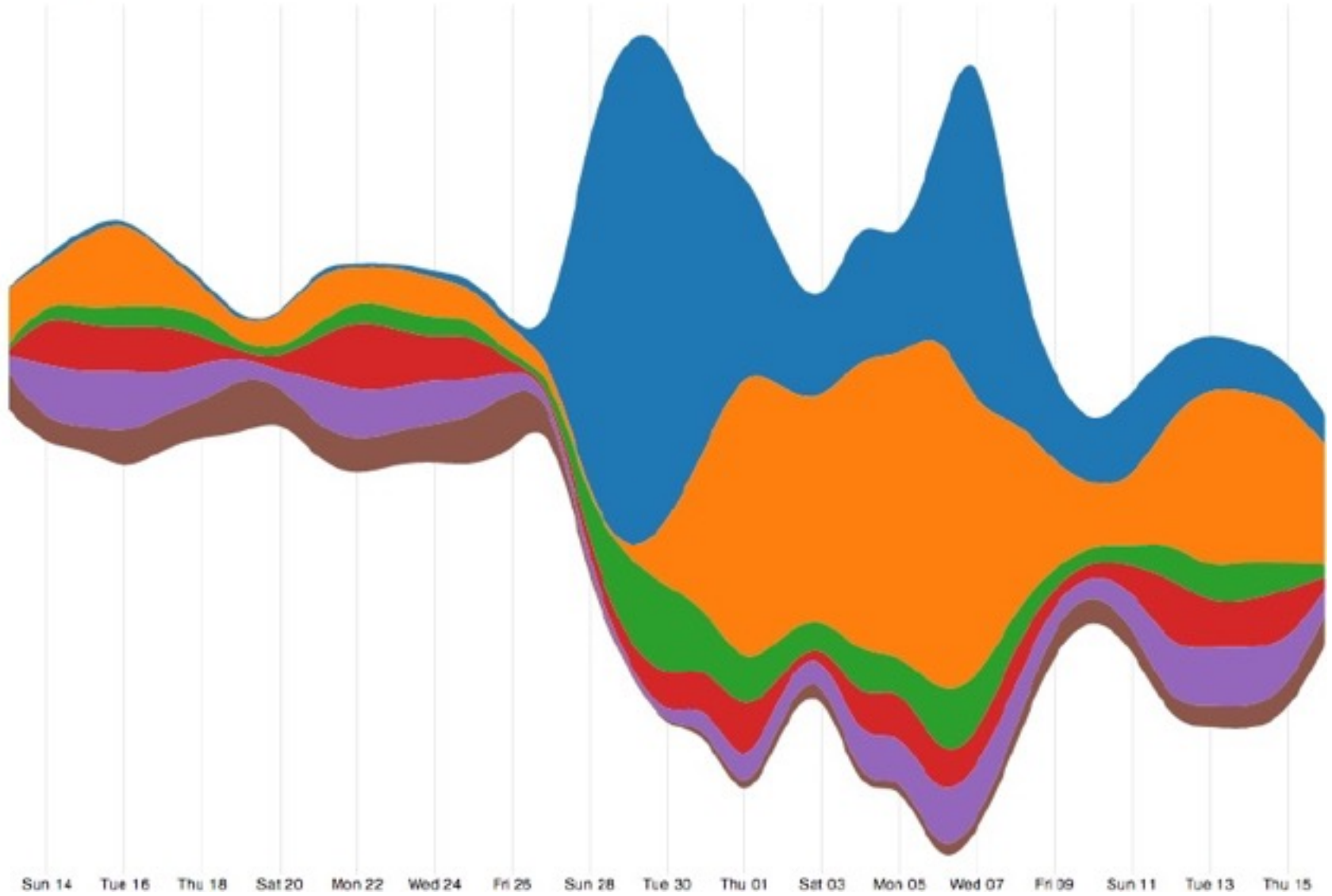


<http://blocks.org/mbostock/3885705>



<http://bl.ocks.org/mbostock/1667367>

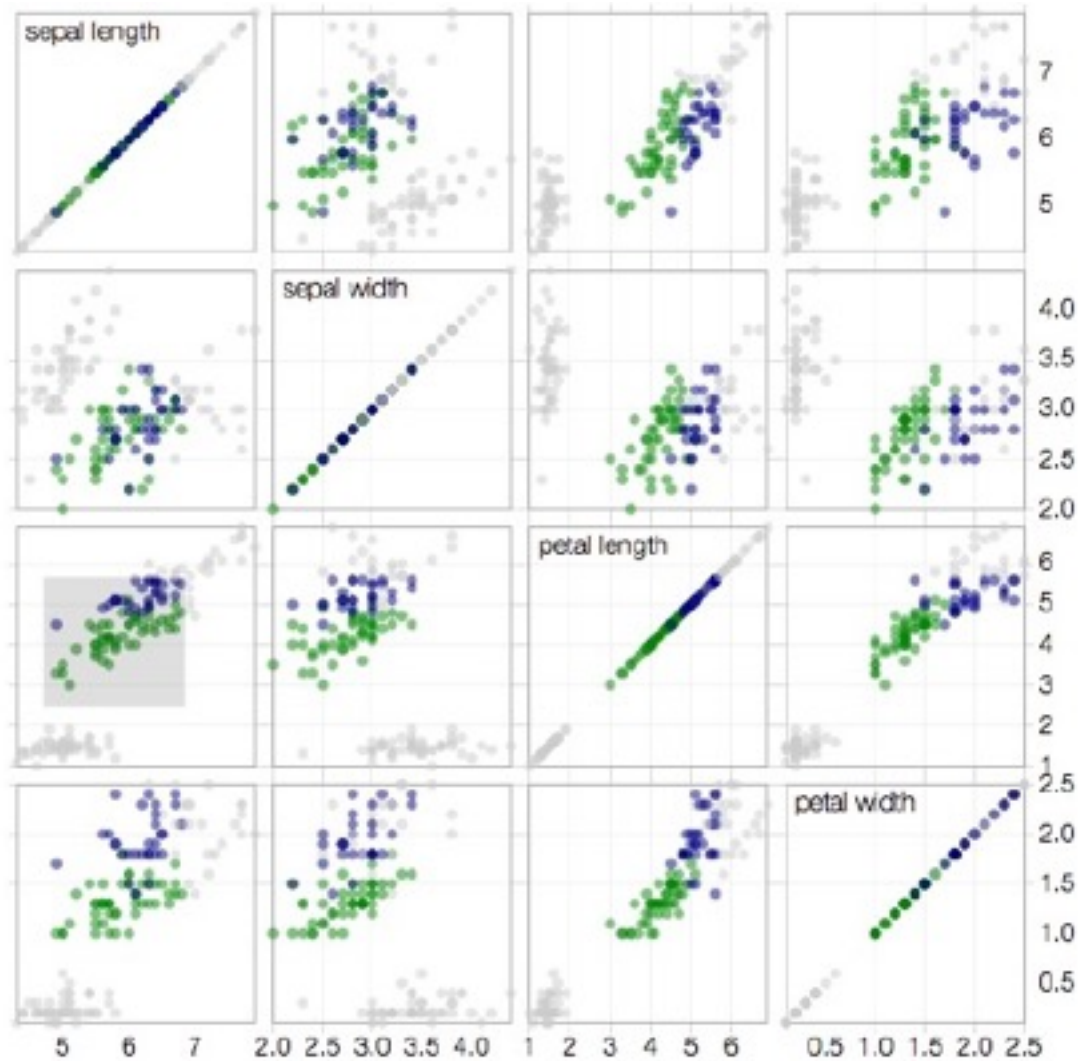
Streamgraph Stacked Area Area



http://projects.flowingdata.com/tut/chart_transitions_demo/



<http://bl.ocks.org/mbostock/1306365>

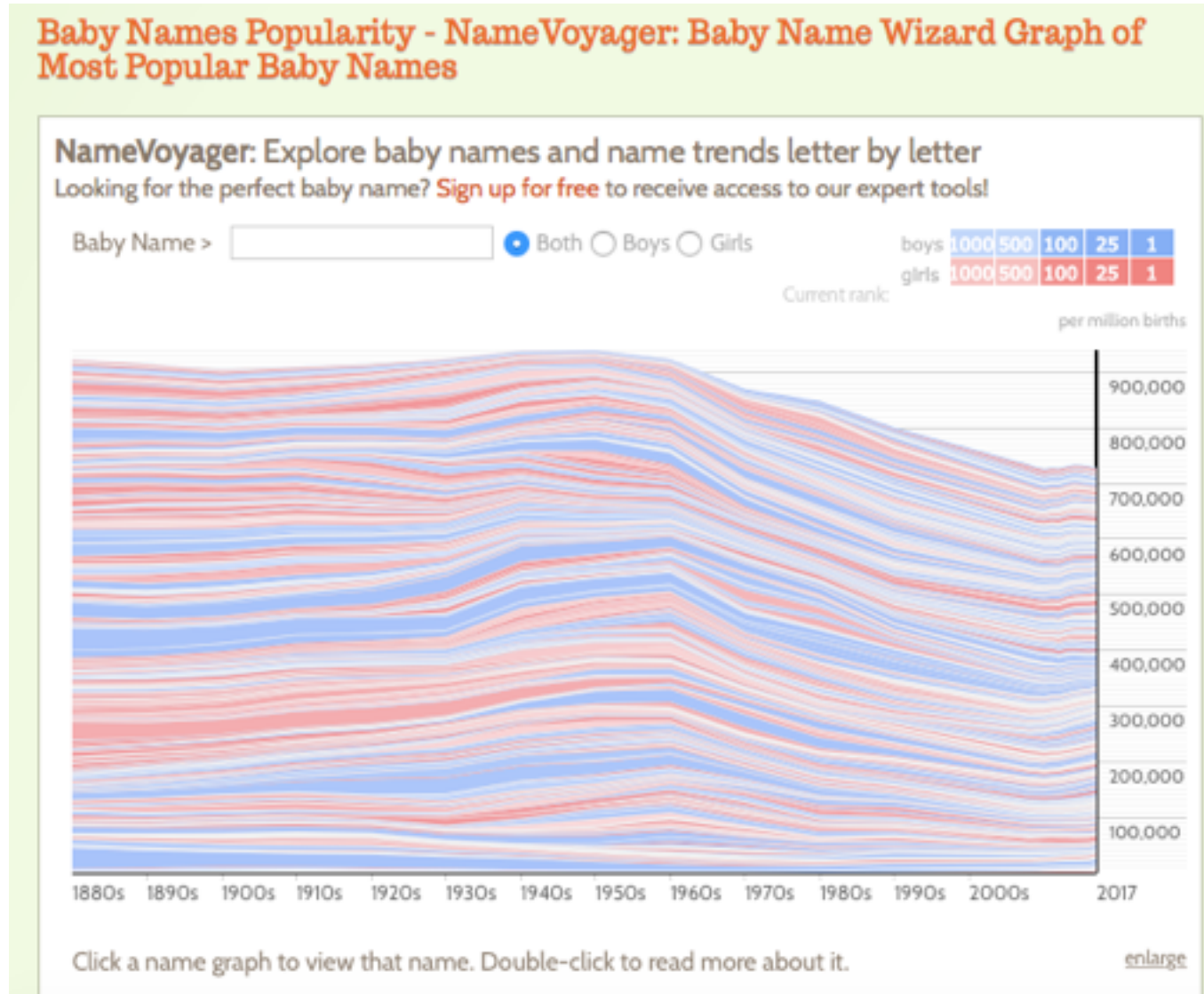


- *Iris setosa*
- *Iris versicolor*
- *Iris virginica*

Edgar Anderson's *Iris* data set
scatterplot matrix

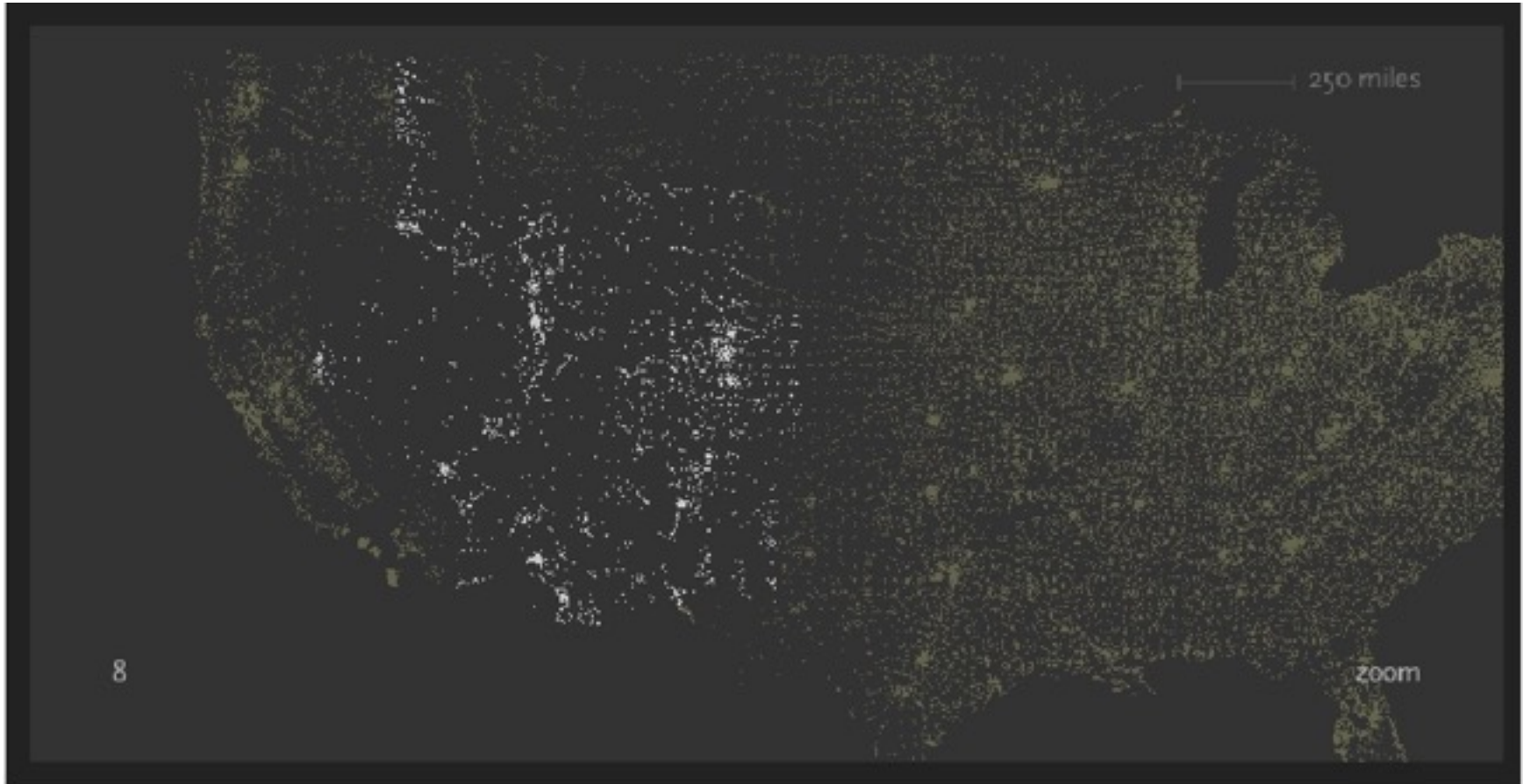
<http://mbostock.github.com/d3/talk/20111116/iris-splom.html>

Baby Name Voyager



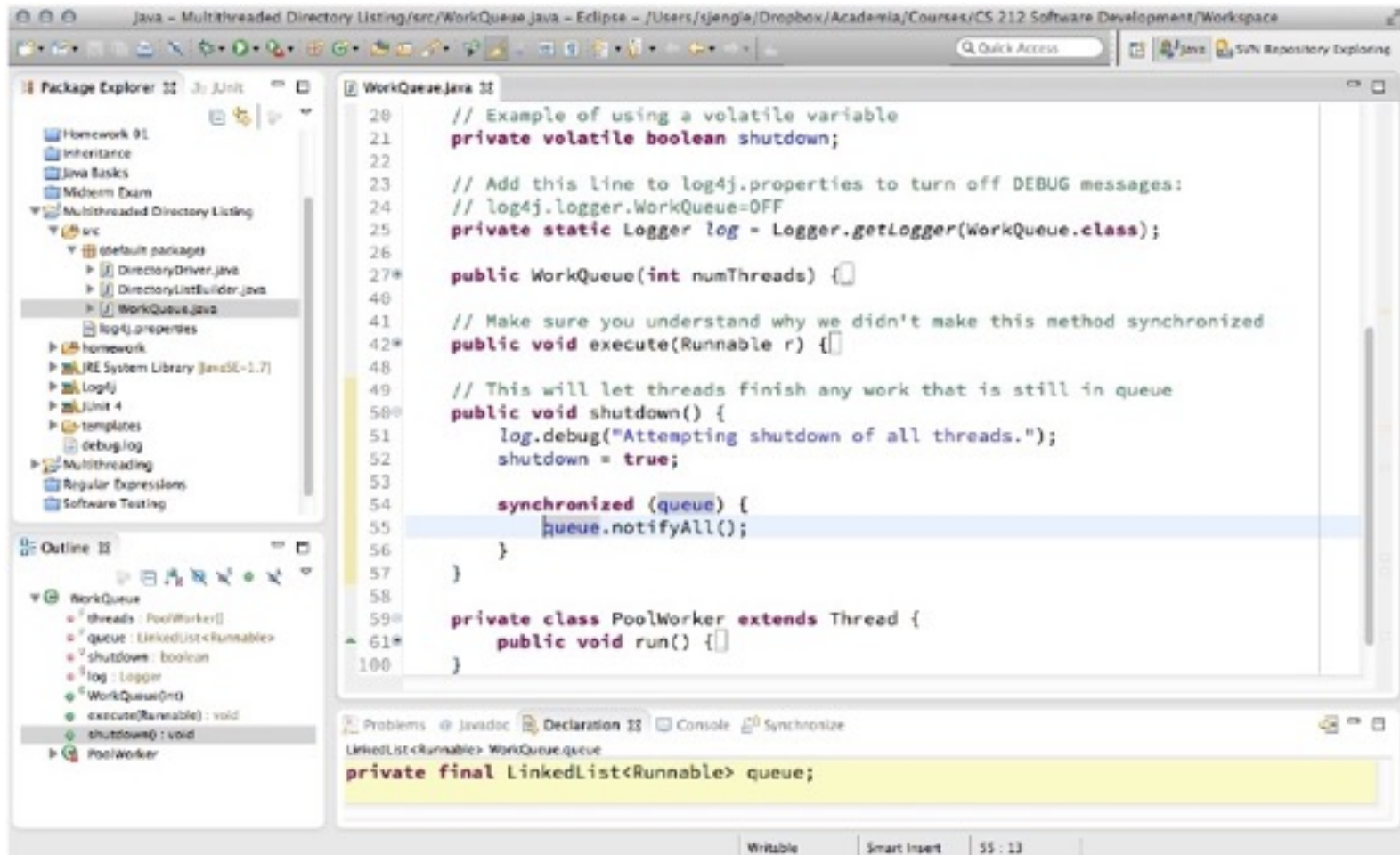
<http://www.babynamewizard.com/voyager#prefix=&sw=both&exact=false>

Zip Codes

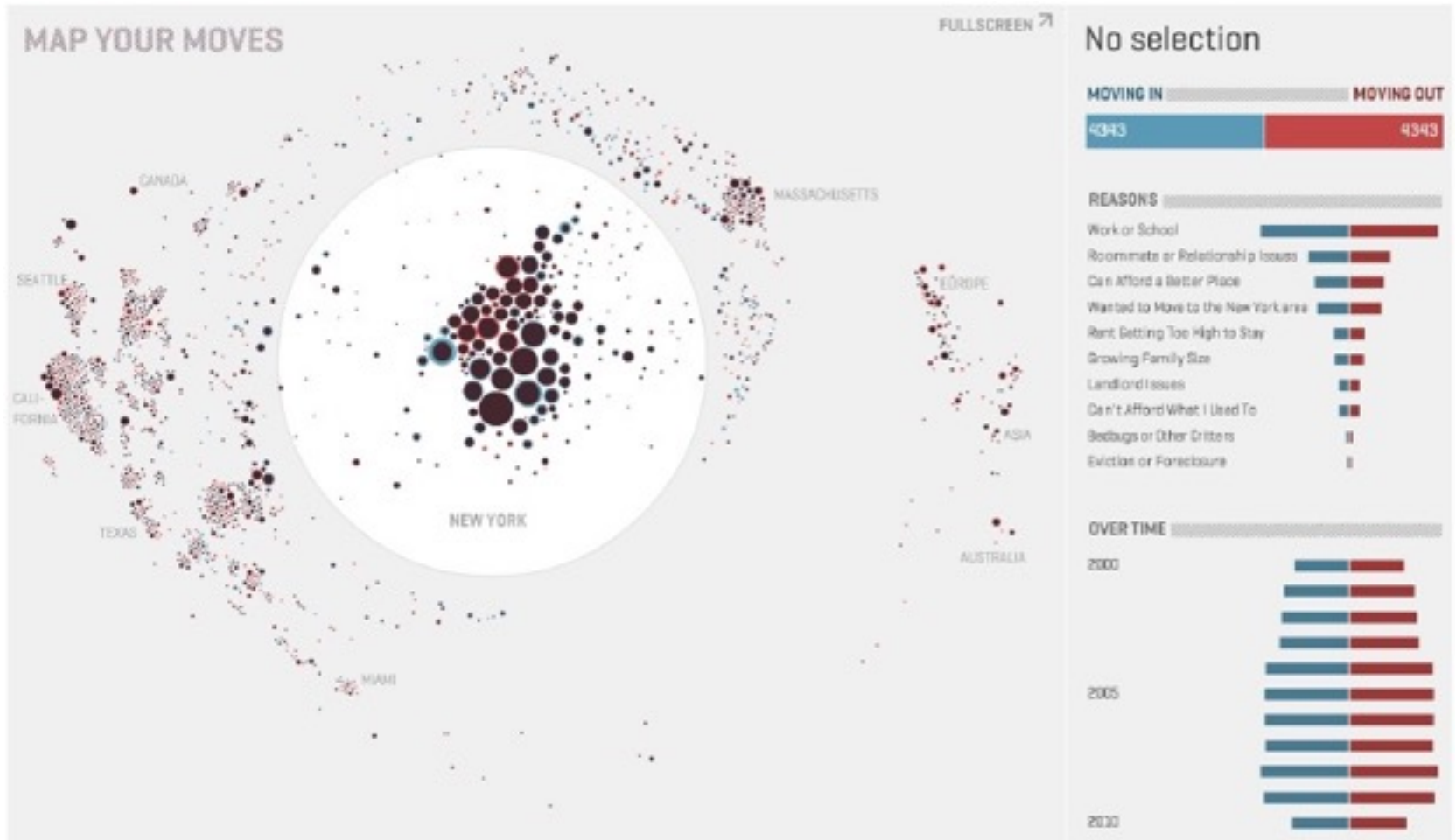


<http://benfry.com/zipdecode/>

Eclipse

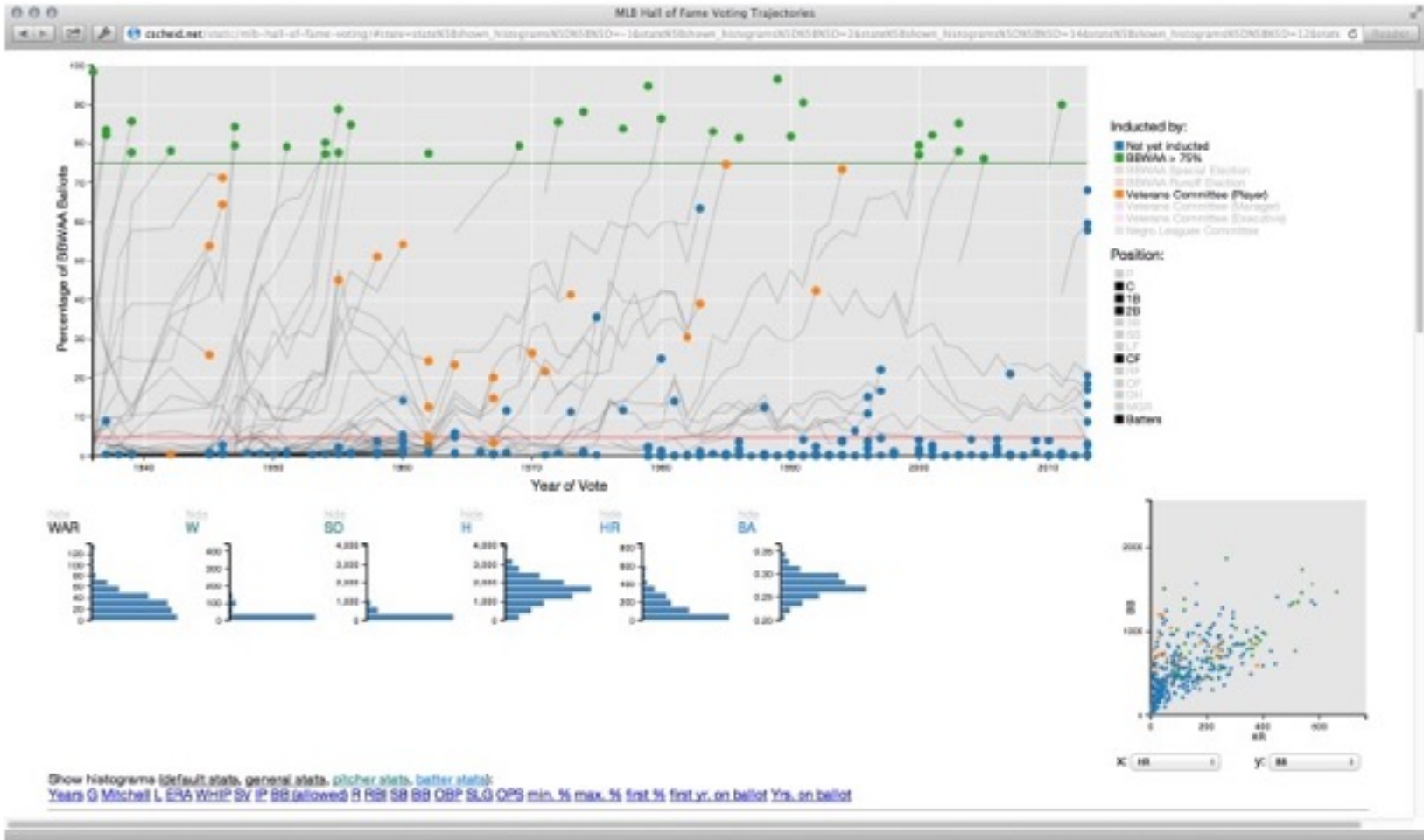


Map Your Moves



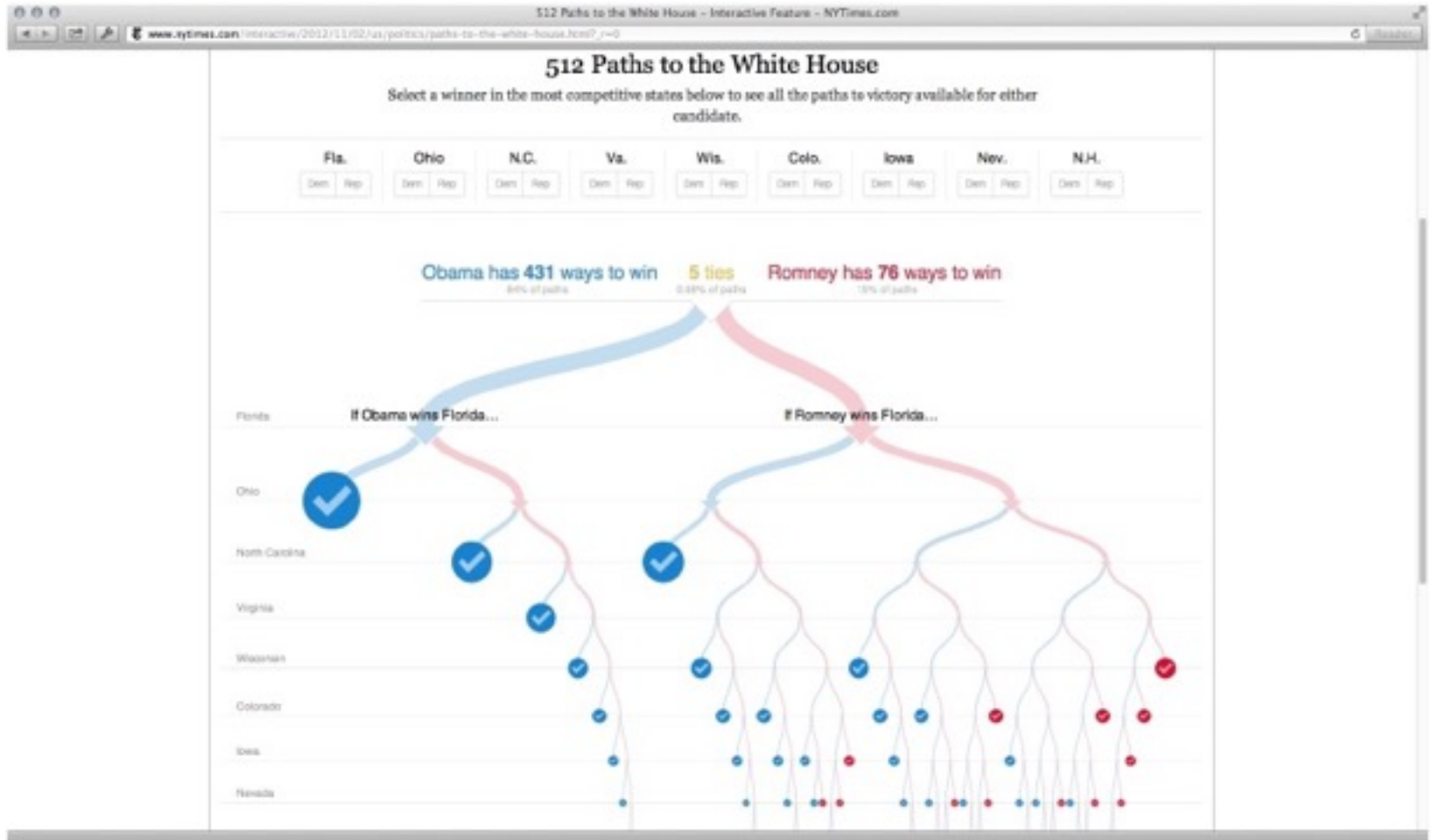
<http://moritz.stefaner.eu/projects/map%20your%20moves/>

MLB Hall of Fame Voting



<http://cscheid.net/static/mlb-hall-of-fame-voting/>

512 Paths to the White House



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

Other resources

- Stephen Few, “Now You See It: Simple Visualization Techniques for Quantitative Analysis,” Analytics Press, California, 2009.
- Riccardo Mazza, “Introduction to Information Visualization,” Springer-Verlag, London, 2009.
- Andy Cockburn, Amy Karlson, and Benjamin B. Bederson, “A Review of Overview+Detail, Zooming, and Focus+Context Interfaces,” ACM Computing Surveys, Volume 41, Number 1, Article 2, December 2008.
- Jeffery Heer and Ben Shneiderman, “Interactive Dynamics for Visual Analytics,” ACM Queue, Volume 10, Number 2, February 2012.

QUESTIONS?

*Thanks to
Sophie J. Engle
San Francisco University*

for ideas, suggestions, slides, links, and much other stuff