A complex network graph with numerous small, multi-colored nodes (blue, green, red, yellow) connected by a dense web of thin, multi-colored lines. The graph is centered in the upper portion of the slide.

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 stubbily branching, tree-like pattern of possible actions.

Types of Navigation

- **Directed Navigation**
- **Exploratory Navigation**

Types of Navigation

- **Directed Navigation**

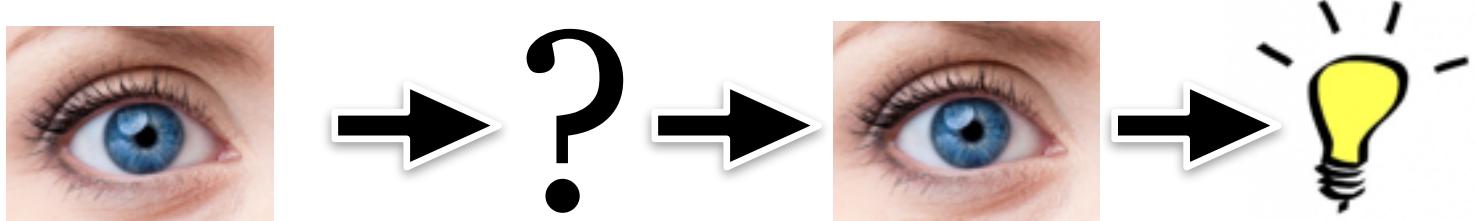
- Have a specific question
- Search for an answer
- Produce an answer



- **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

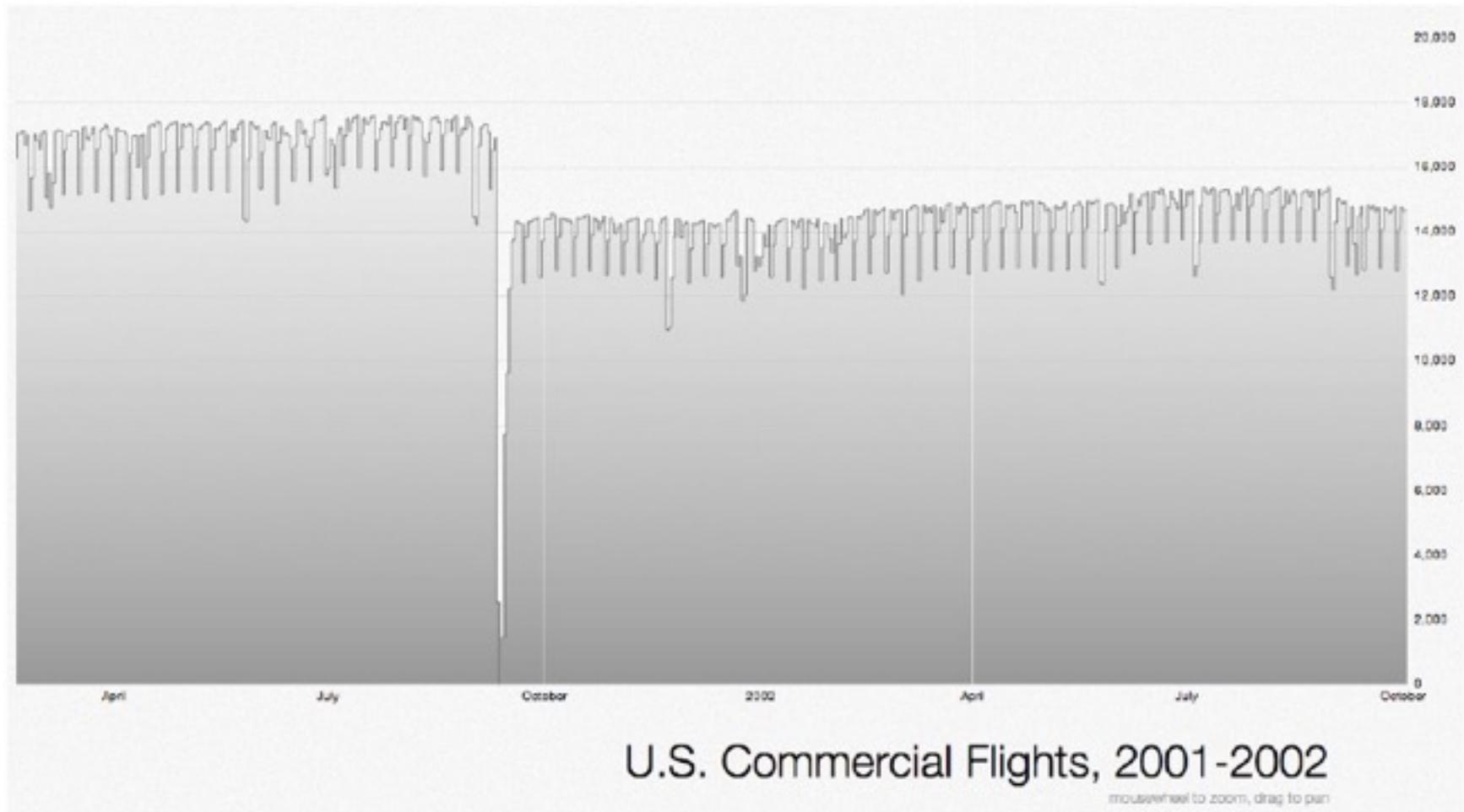
EXPLORATION

Manipulable Representations

Exploration

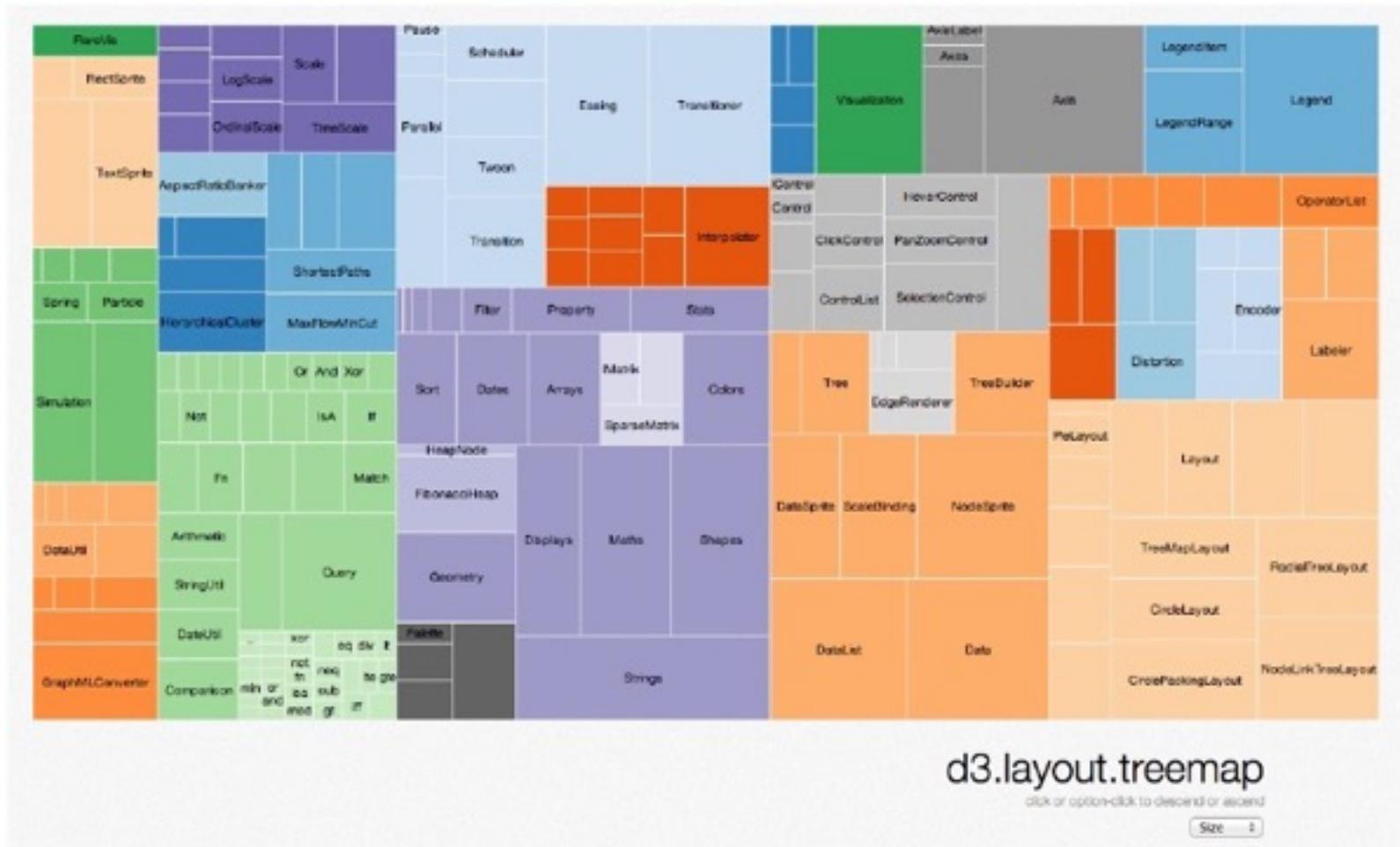
- Operations
 - Zooming
 - Panning or scrolling
 - Rotating
 - Other
- Considerations
 - Avoid blinking (change blindness)
 - Keep transitions smooth to maintain context

Zooming, Panning



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

Drill Down via Zooming

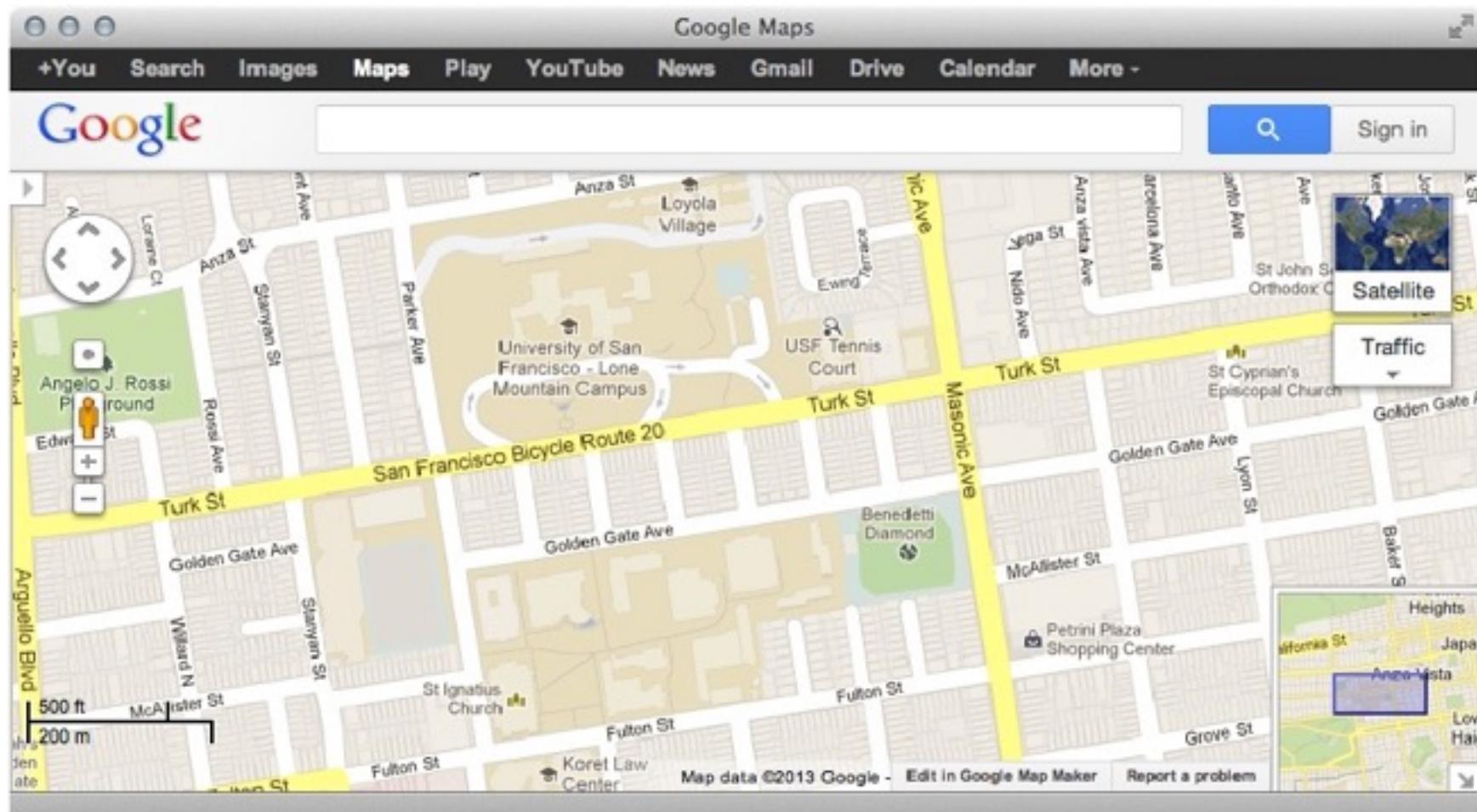


<http://mbostock.github.com/d3/talk/20111018/treemap.html>

OVERVIEW + DETAIL

Manipulable Representations

Overview + Details



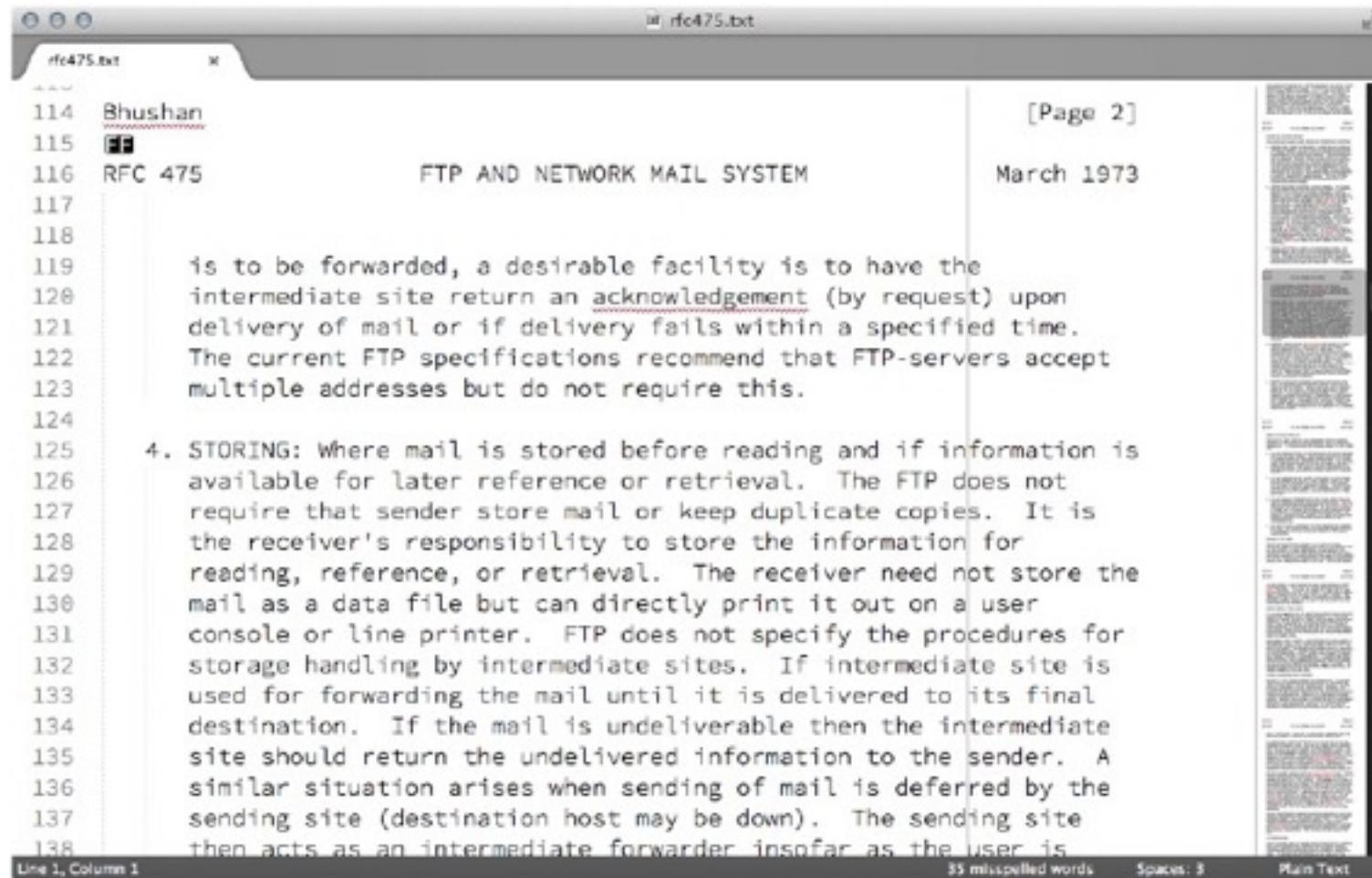
<http://maps.google.com/?ll=37.777635,-122.445502&spn=0.006106,0.009999&t=m&z=16>

Overview + Details

The screenshot shows a Microsoft PowerPoint window with the title bar "dataviz 12 - interaction.pptx". The ribbon menu is visible with tabs like "Temi diapositiva", "Layout diapositiva", "Transizioni", "Stili tabella", "Grafici", "Elementi grafici SmartArt", and "WordArt". The "Disapositive" tab is selected. On the left, a vertical thumbnail gallery displays nine slides numbered 13 to 19. Slide 13 is titled "EXPLORATION". Slides 14 and 15 show "Exploration" and "Zooming, Panning" respectively, with small preview images. Slides 16 and 17 show "Detail View via Drilling" and "OVERVIEW + DETAIL" with preview images. Slides 18 and 19 show "Overview + Details" with preview images. The main slide area contains the text "Overview + Details" and a caption "Microsoft Powerpoint Screenshot". The status bar at the bottom indicates "Fare clic per inserire le note" and "Dispositivo 19 di 50".

Microsoft Powerpoint Screenshot

Sublime Text



The screenshot shows a Sublime Text window with the file 'rfc475.txt' open. The content of the file is as follows:

```
114 Bhushan
115
116 RFC 475          FTP AND NETWORK MAIL SYSTEM      [Page 2]      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
```

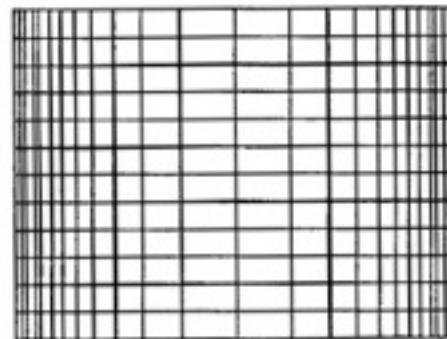
Line 1, Column 1 35 misspelled words Spaces: 3 Plain Text

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

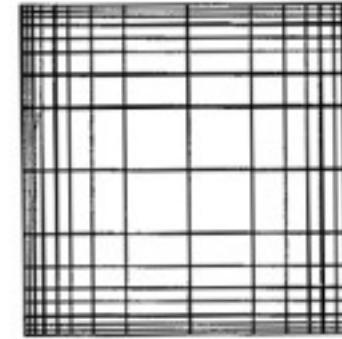
FOCUS + CONTEXT

Manipulable Representations

Fisheye Distortion



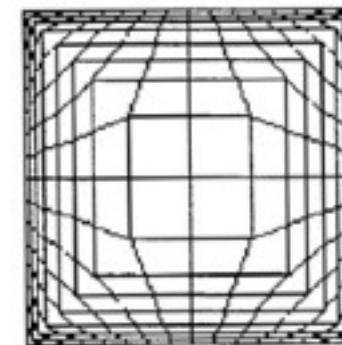
(c)



(d)



(e)

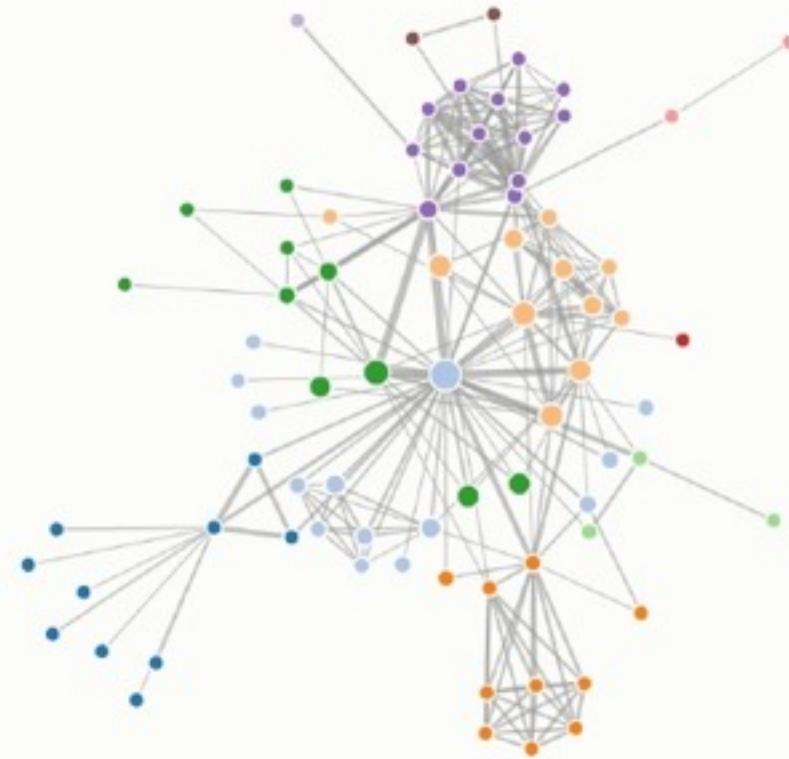


(f)

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



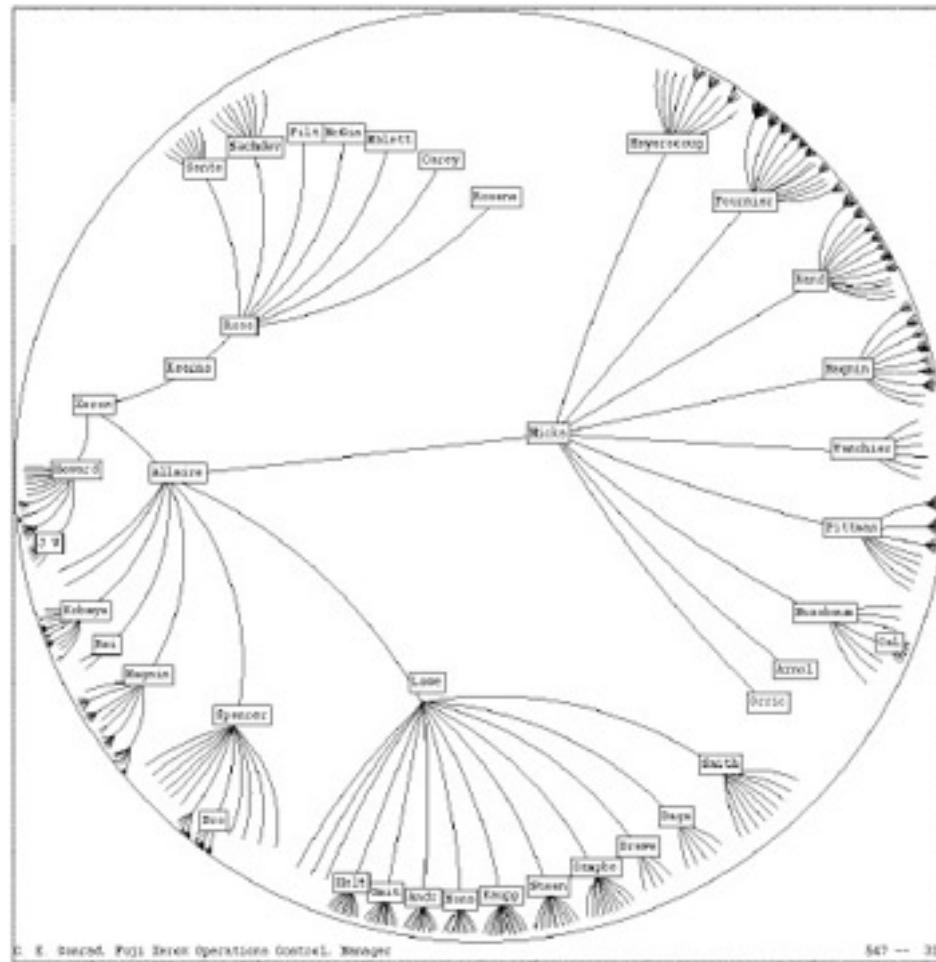
<http://bostocks.org/mike/fishey/>

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

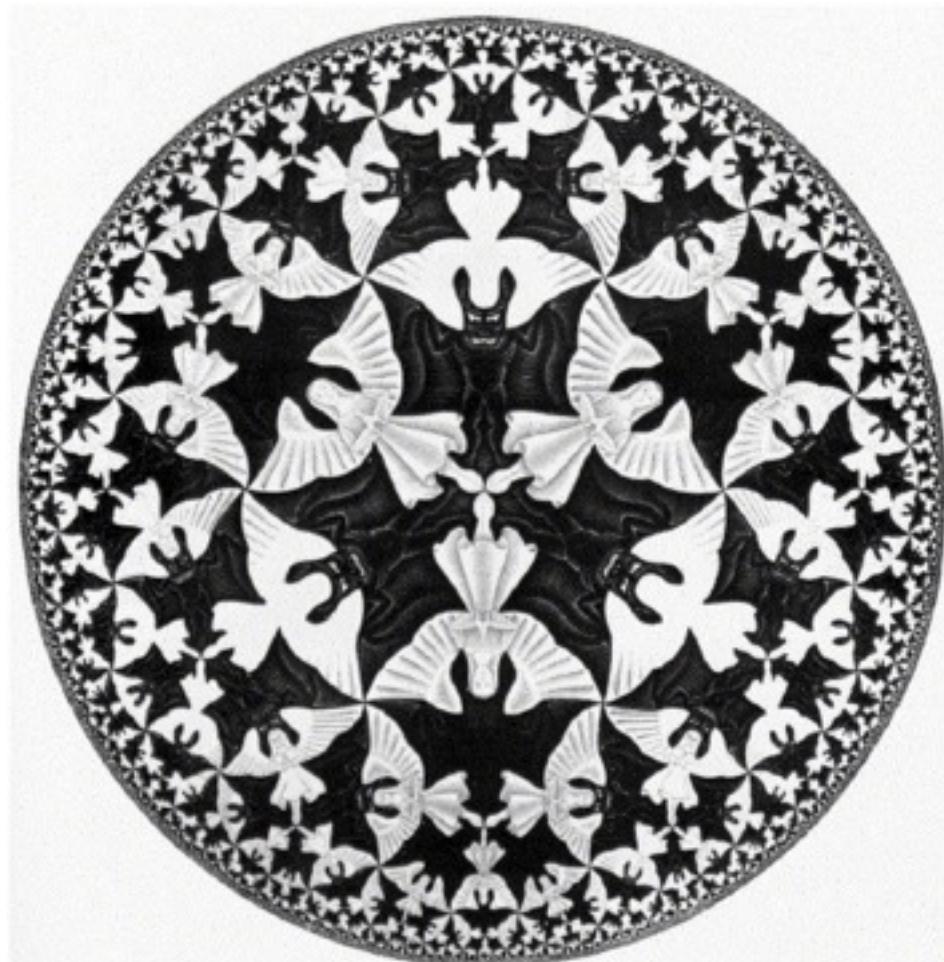
http://www.sigchi.org/chi95/Electronic/documents/papers/jl_bdy.htm

Hyperbolic Tree



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

Inspiration



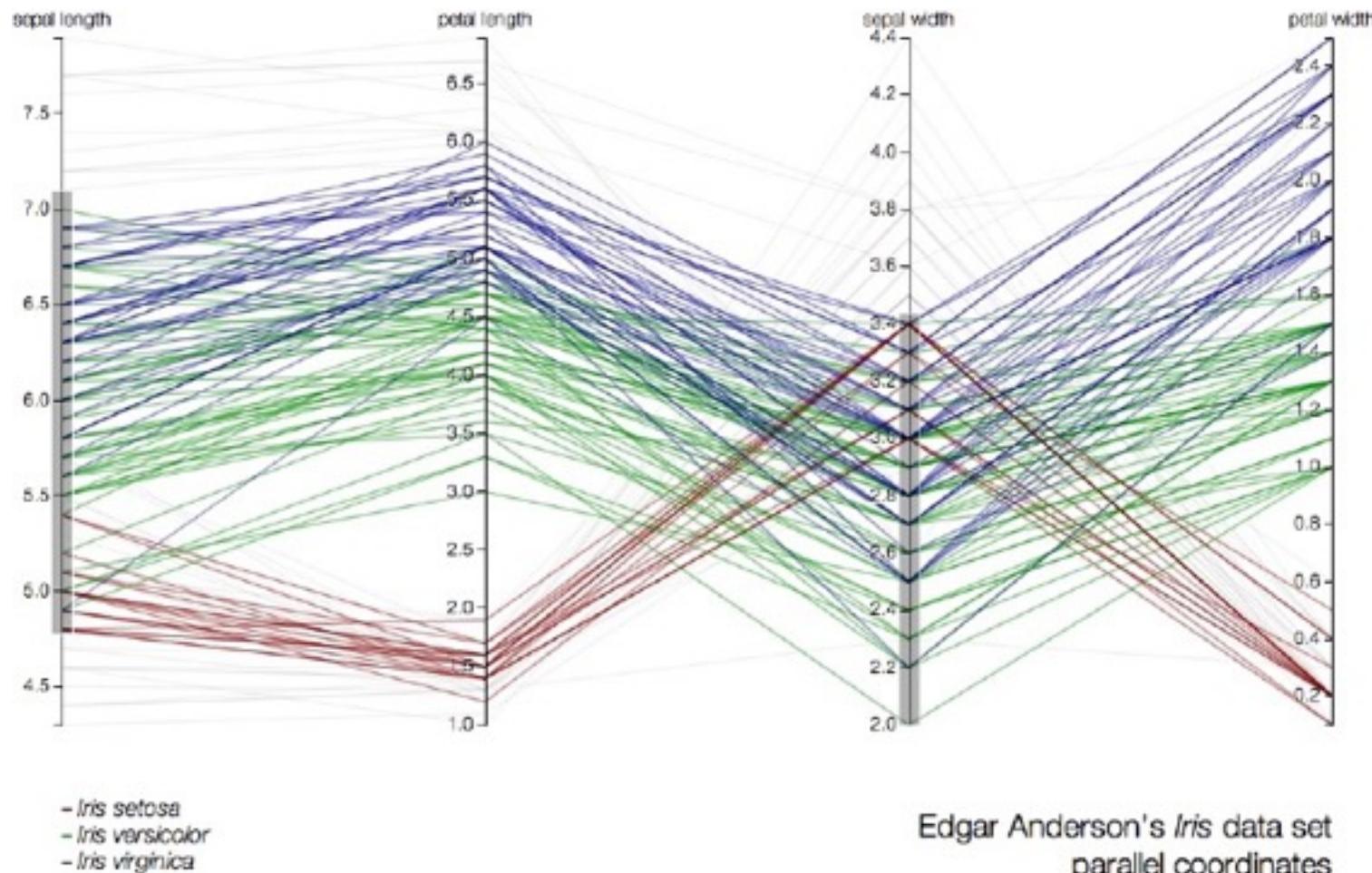
http://www.sigchi.org/chi95/Electronic/documents/papers/jl_bdy.htm

Hypertree Demo



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

Brushing



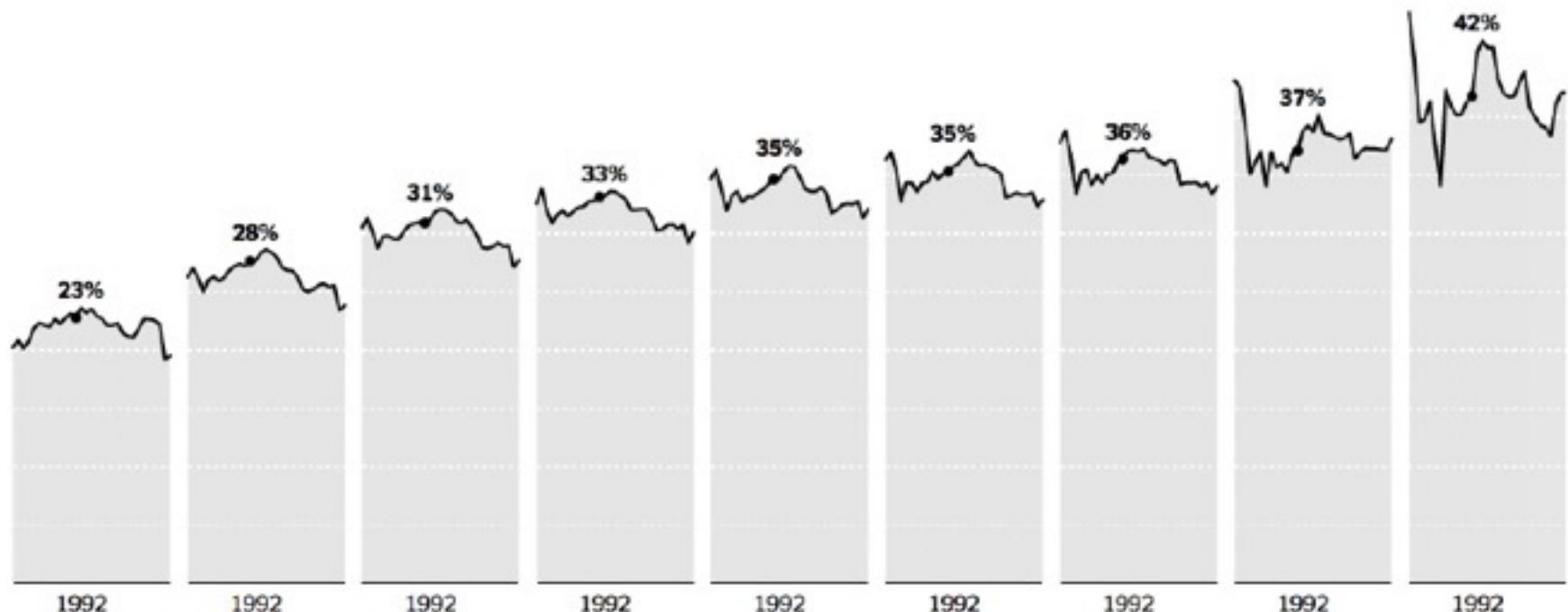
<http://mbostock.github.com/d3/talk/20111116/iris-parallel.html>

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.

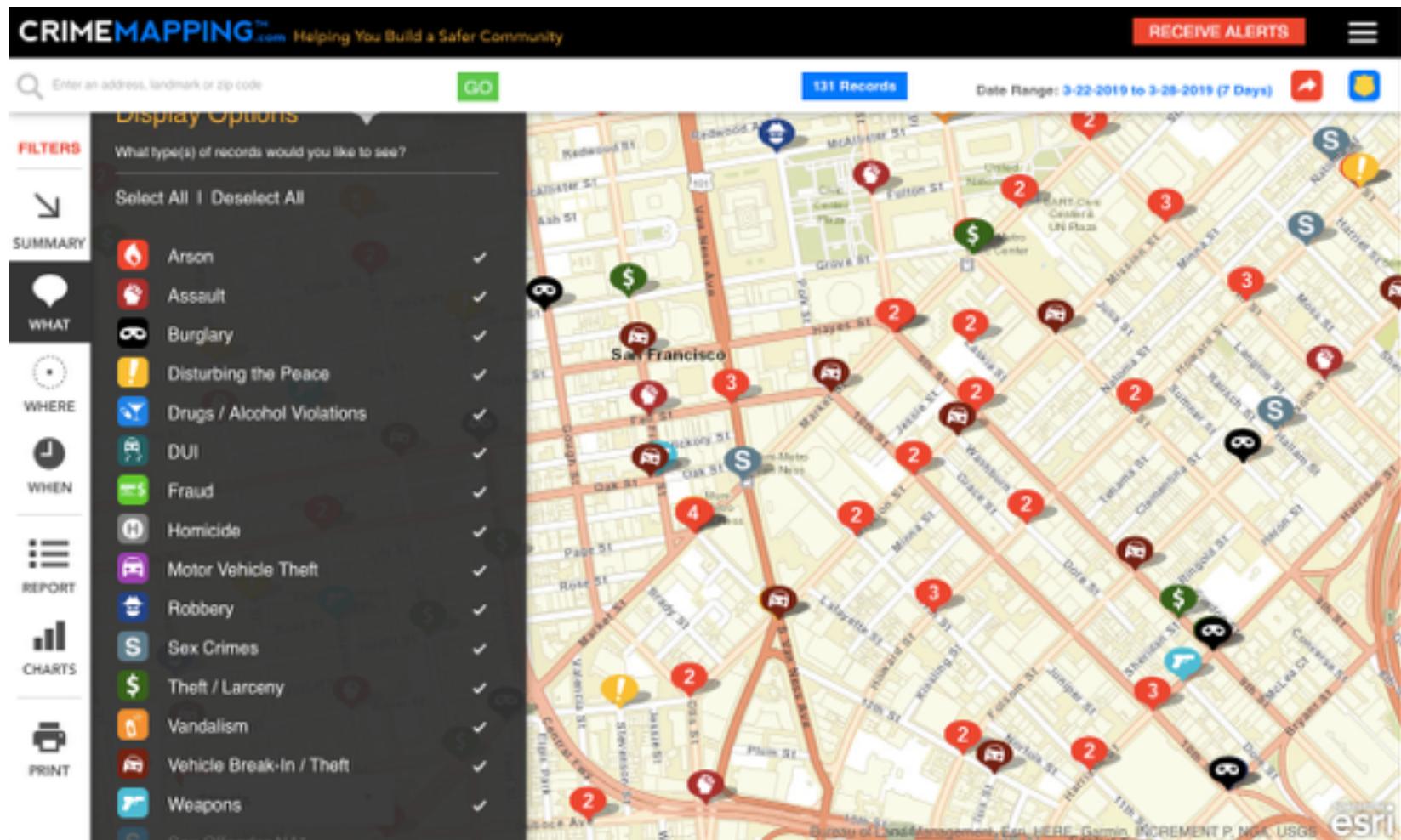


<https://www.nytimes.com/2012/11/30/us/most-americans-face-lower-tax-burden-than-in-the-80s.html>

DATA TRANSFORMATIONS

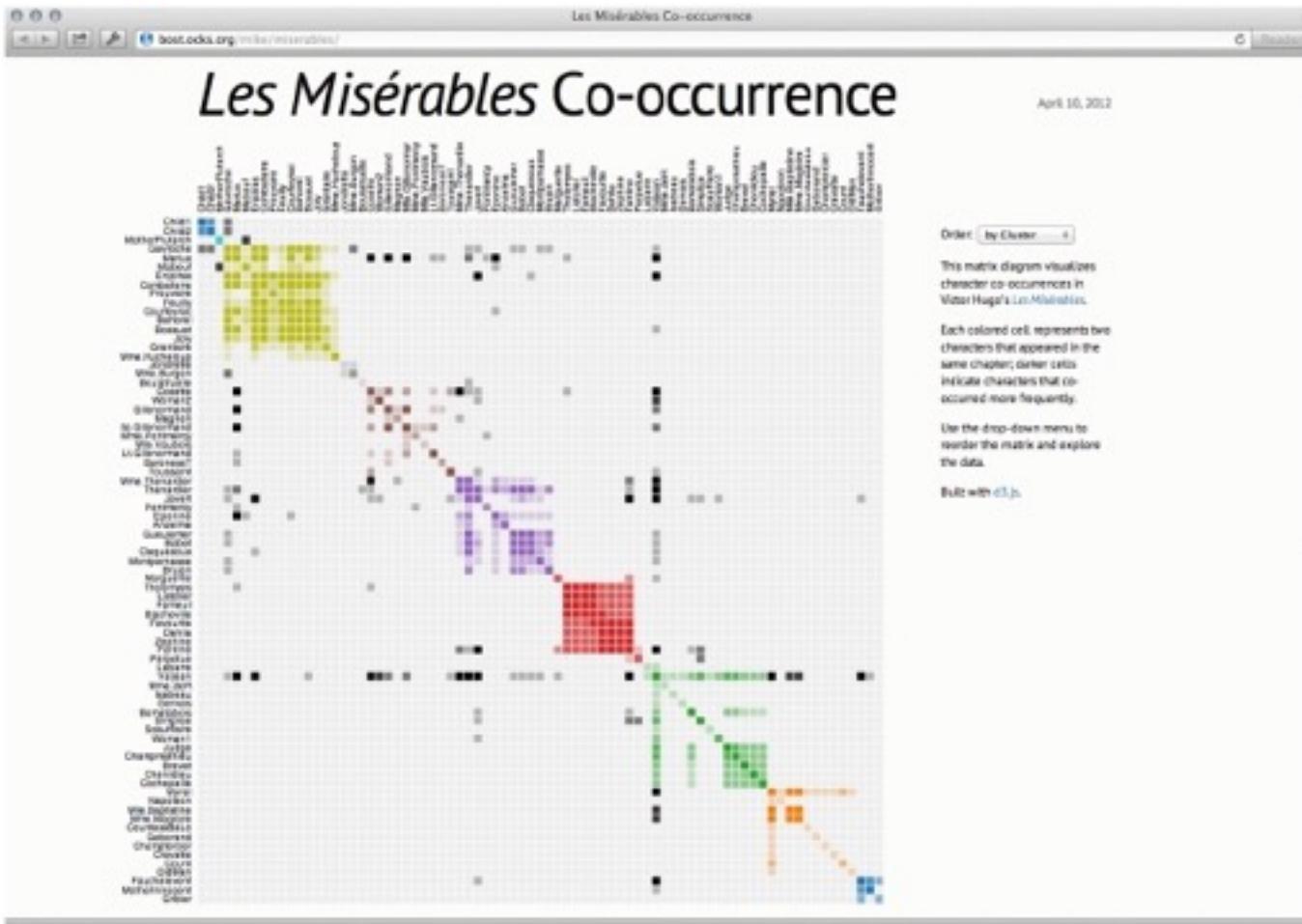
Transformable Representations

Filtering



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

Sorting

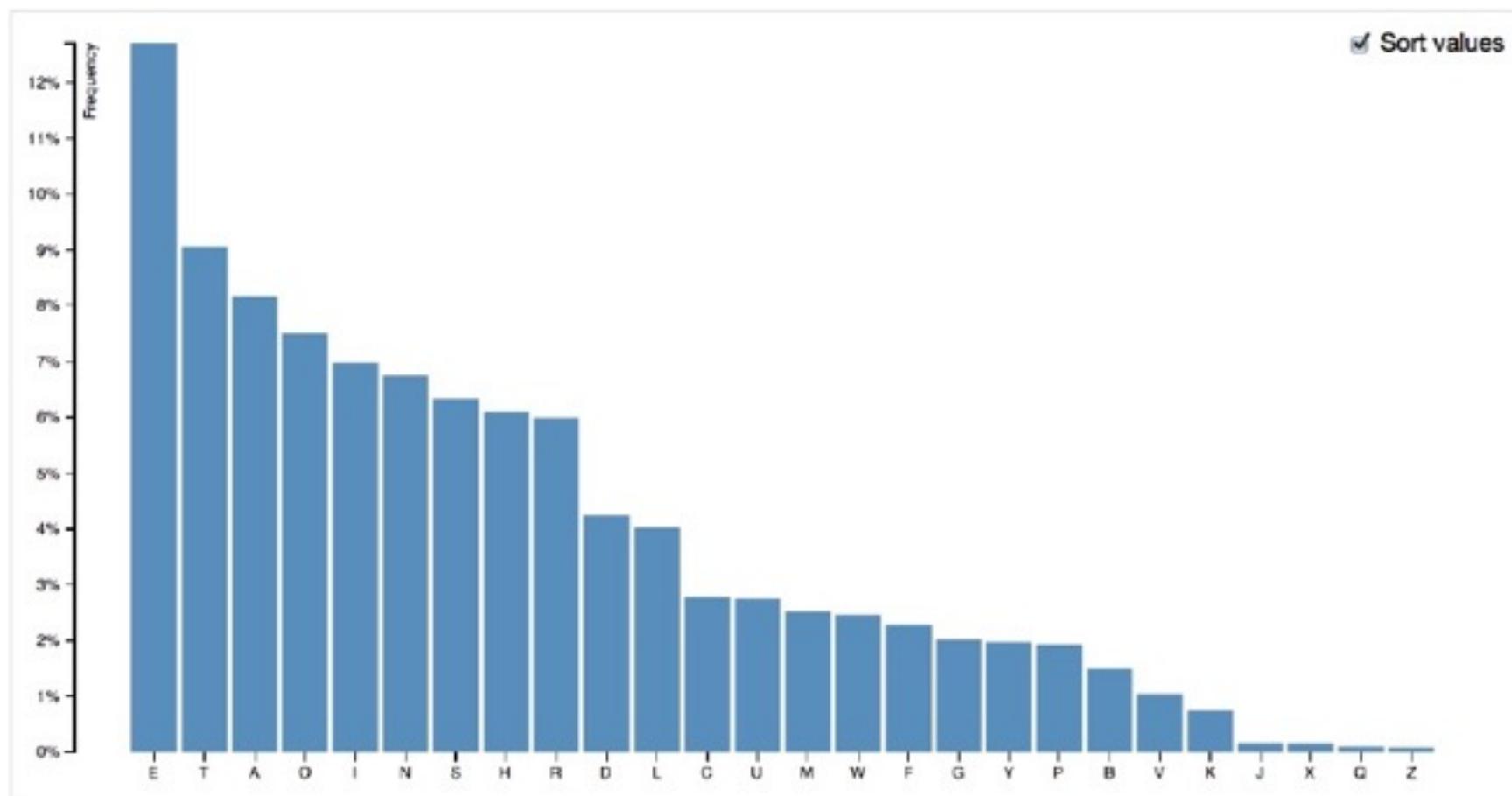


<http://bost.ocks.org/mike/miserables/>

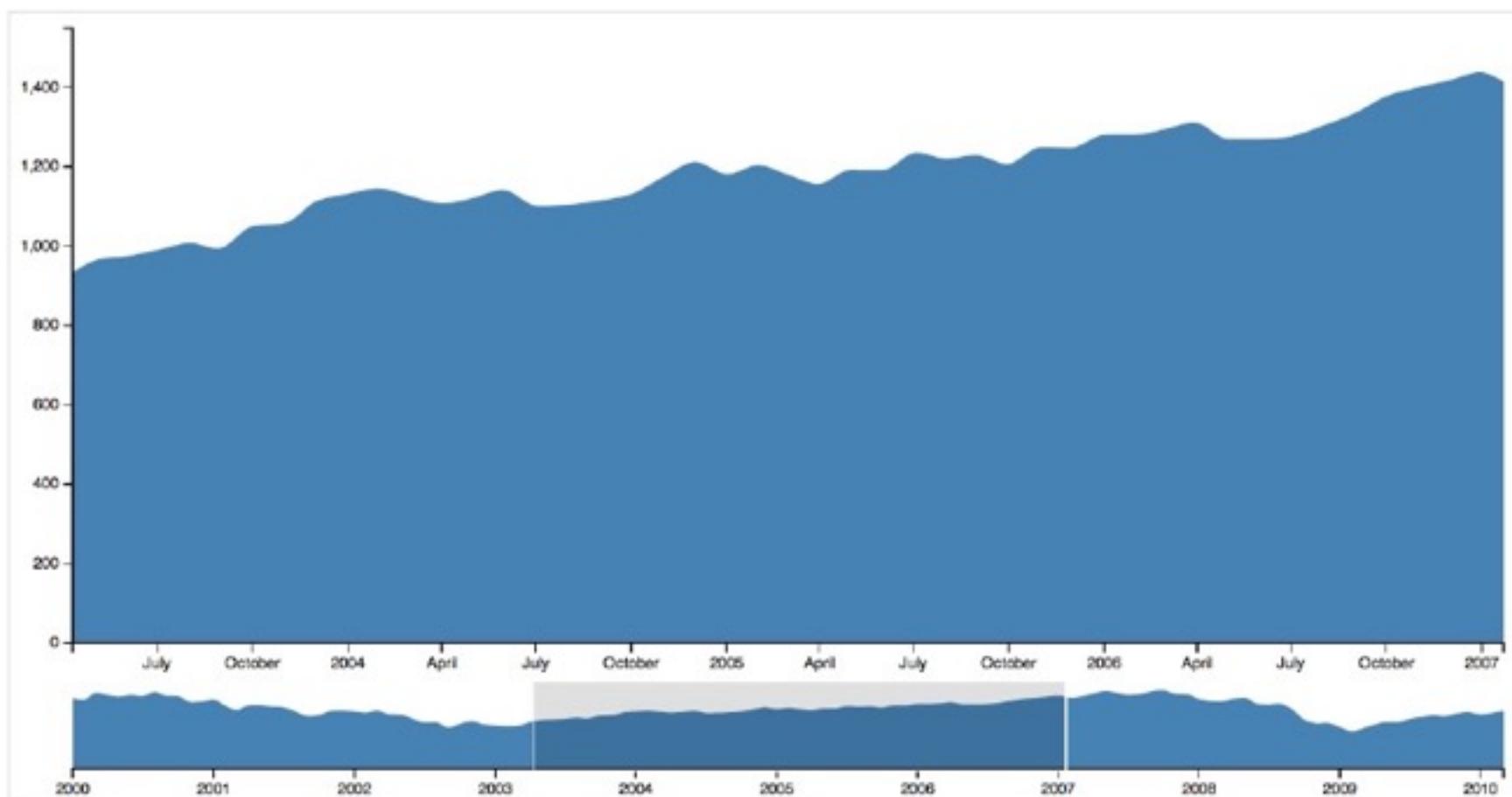
EXAMPLES

Data: Drill Down, Filtering, Sorting

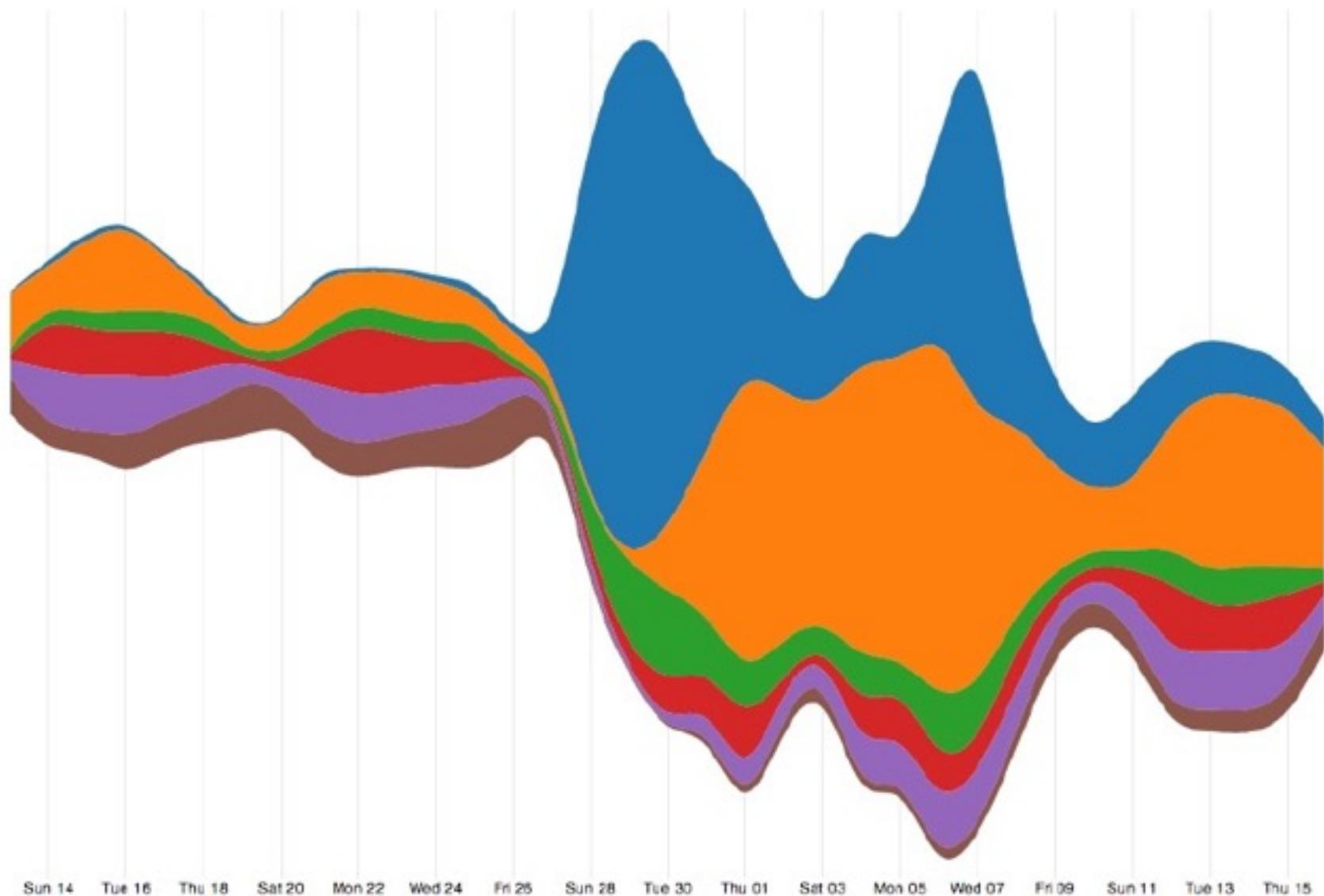
View: Overview+Detail, Focus+Context?



<http://bl.ocks.org/mbostock/3885705>



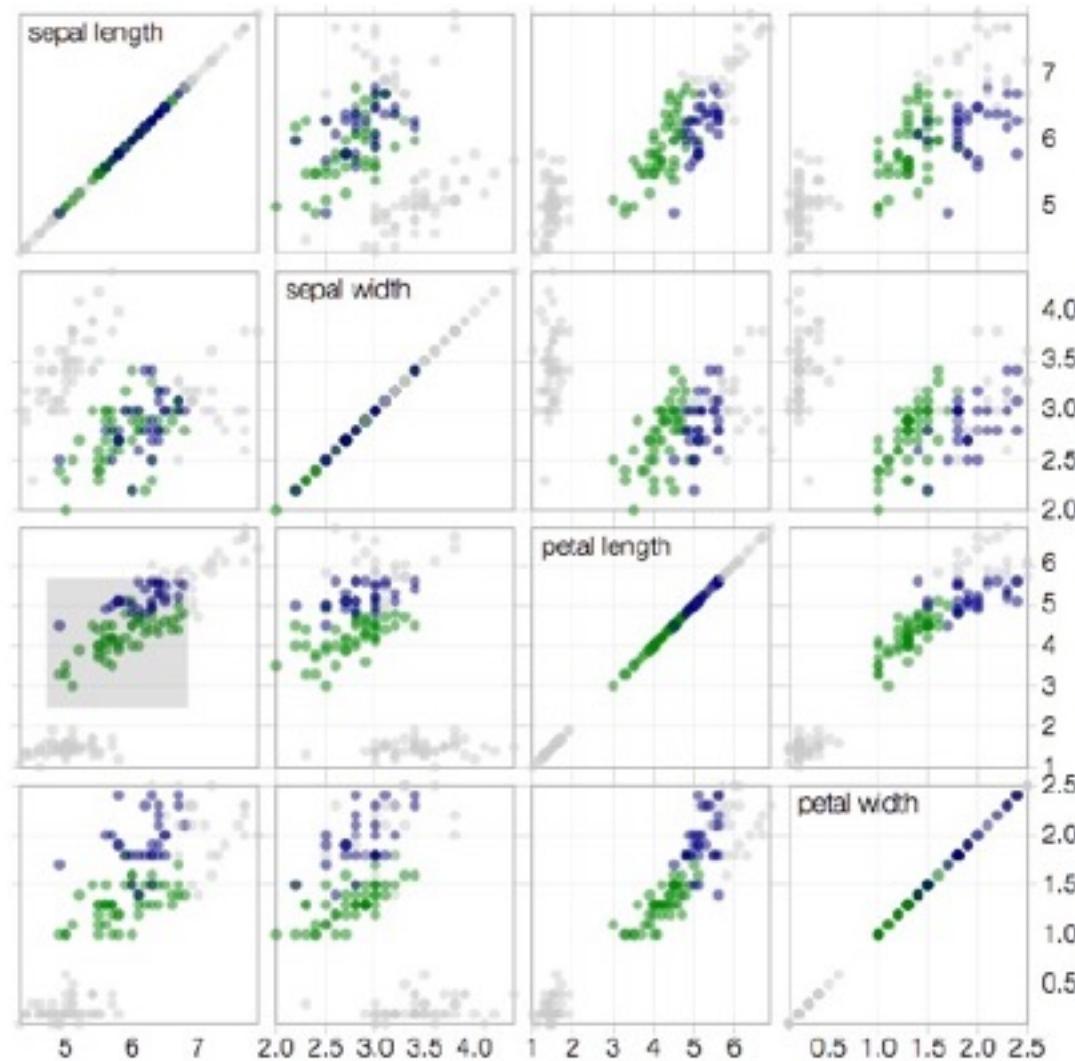
<http://bl.ocks.org/mbostock/1667367>

[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

Baby Names Popularity - NameVoyager: Baby Name Wizard Graph of Most Popular Baby Names

NameVoyager: Explore baby names and name trends letter by letter

Looking for the perfect baby name? [Sign up for free](#) to receive access to our expert tools!

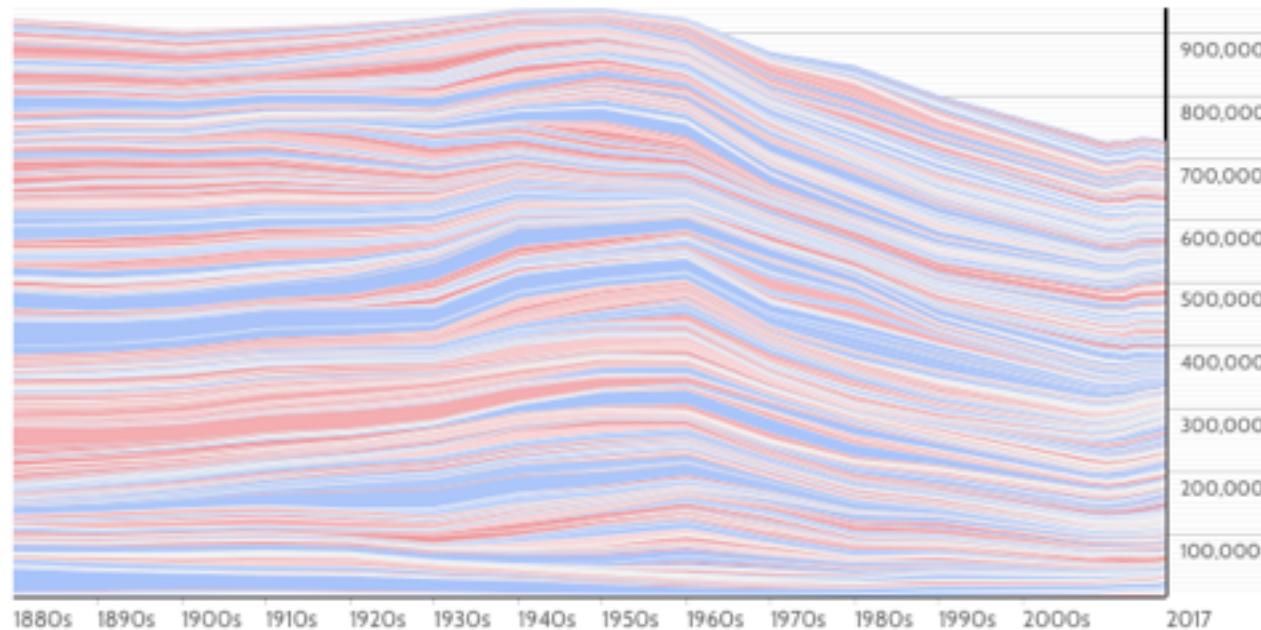
Baby Name >

Both Boys Girls

boys	1000	500	100	25	1
girls	1000	500	100	25	1

Current rank:

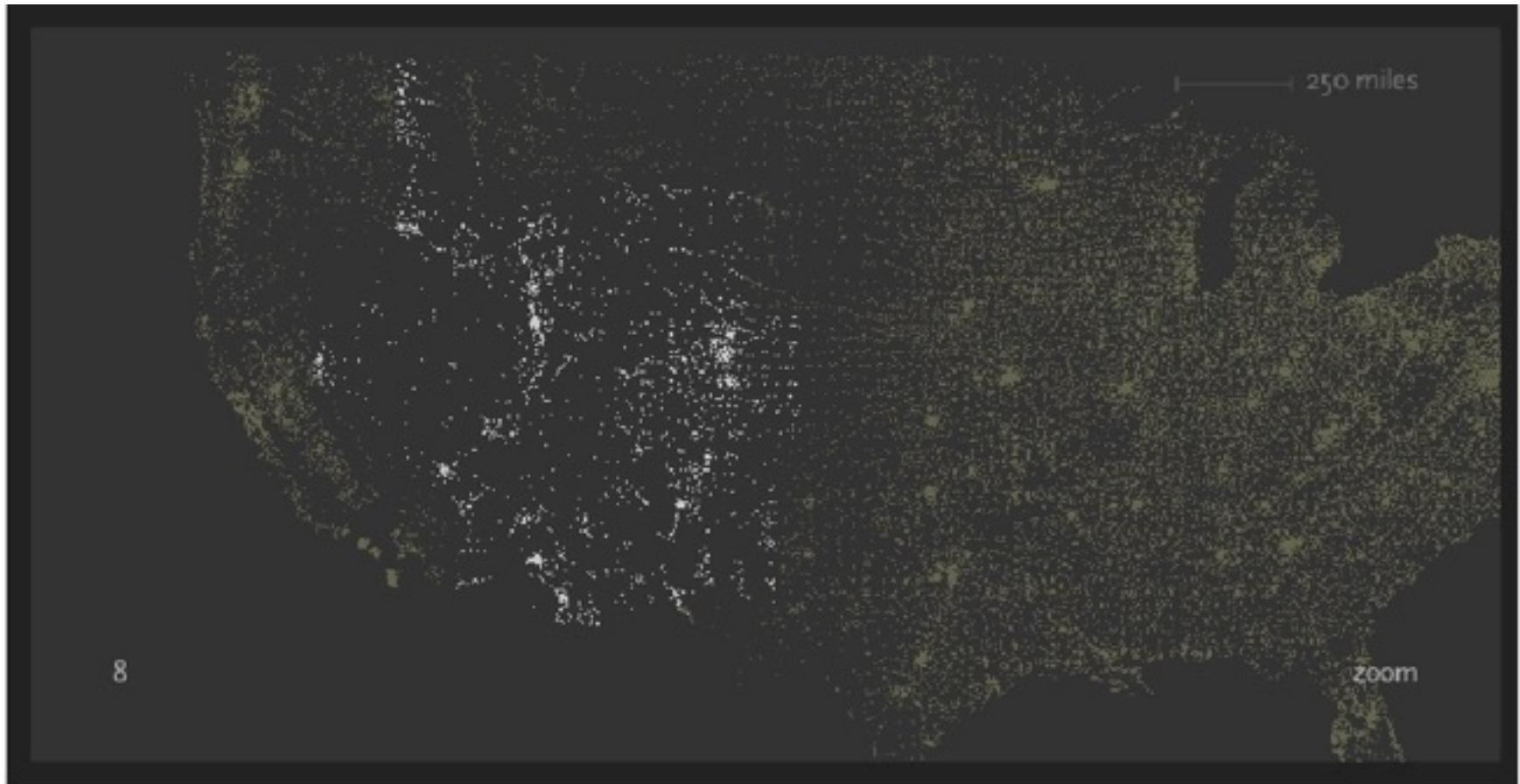
per million births



Click a name graph to view that name. Double-click to read more about it.

[enlarge](#)

Zip Codes



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

Eclipse

The screenshot shows the Eclipse IDE interface with the following details:

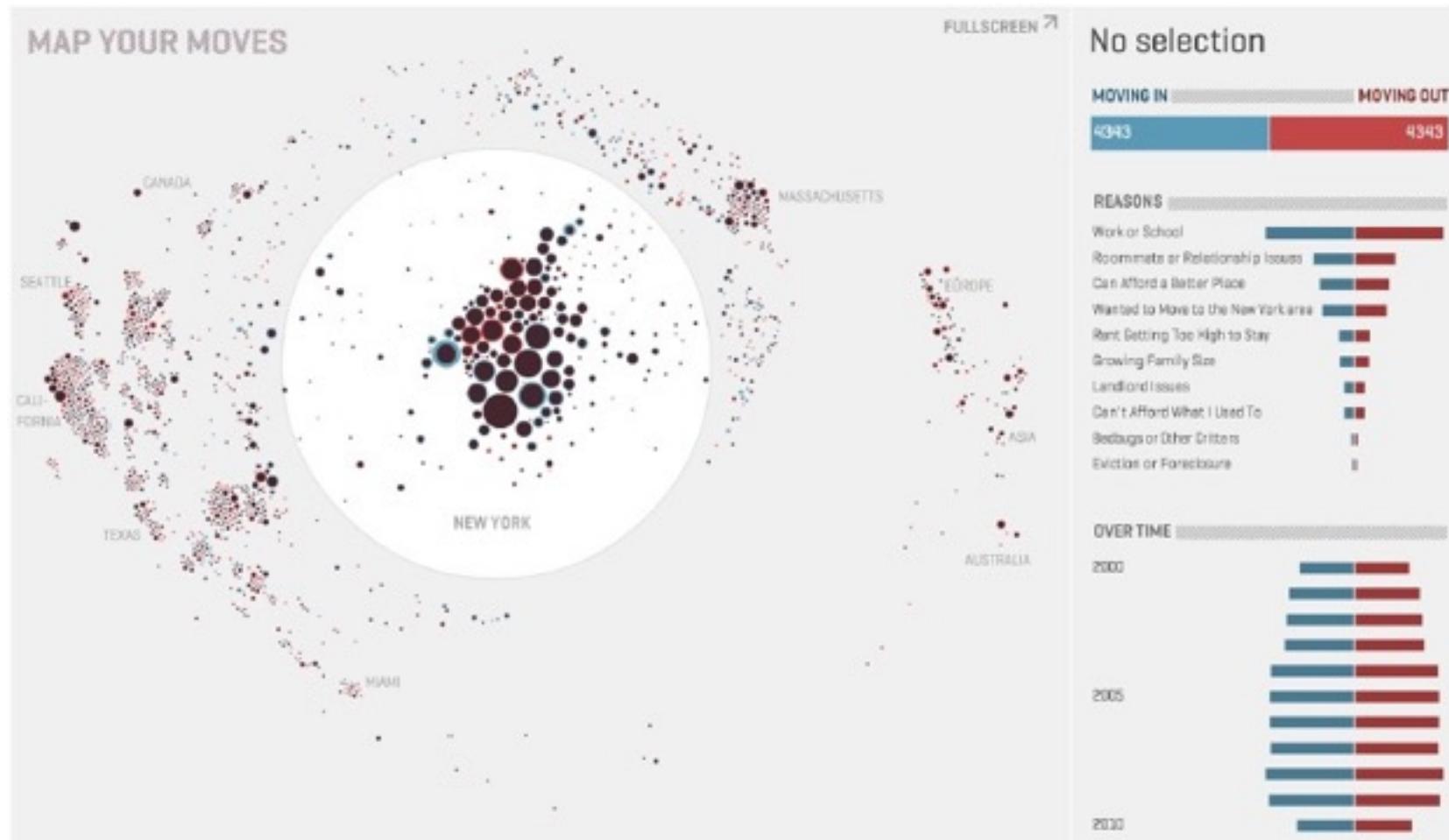
- Title Bar:** Java - Multithreaded Directory Listing/src/WorkQueue.java - Eclipse - /Users/sjengle/Dropbox/Academia/Courses/CS 212 Software Development/Workspace
- Left Sidebar (Package Explorer):**
 - Homework 01
 - Inheritance
 - Java Basics
 - Midterm Exam
 - Multithreaded Directory Listing
 - src
 - default package
 - DirectoryDriver.java
 - DirectoryListBuilder.java
 - WorkQueue.java
 - log4j.properties
 - homework
 - JRE System Library [JavaSE-1.7]
 - Log4j
 - JUnit 4
 - templates
 - debug.log
 - Multithreading
 - Regular Expressions
 - Software Testing
- Central Area (Java Editor):**

```

28  // Example of using a volatile variable
29  private volatile boolean shutdown;
30
31  // Add this line to log4j.properties to turn off DEBUG messages:
32  // log4j.logger.WorkQueue=OFF
33  private static Logger log = Logger.getLogger(WorkQueue.class);
34
35  public WorkQueue(int numThreads) {
36
37      // Make sure you understand why we didn't make this method synchronized
38      public void execute(Runnable r) {
39
40          // This will let threads finish any work that is still in queue
41          public void shutdown() {
42              log.debug("Attempting shutdown of all threads.");
43              shutdown = true;
44
45              synchronized (queue) {
46                  queue.notifyAll();
47              }
48
49          }
50
51      }
52
53
54      private class PoolWorker extends Thread {
55          public void run() {
56
57      }
58
59  }
60
61
62
63
64
65
66
67
68
69
69
70
71
72
73
74
75
76
77
78
79
79
80
81
82
83
84
85
86
87
88
89
89
90
91
92
93
94
95
96
97
98
99
100 }
```
- Bottom Status Bar:** Writable | Smart Insert | 55 / 13

<http://www.eclipse.org/>

Map Your Moves



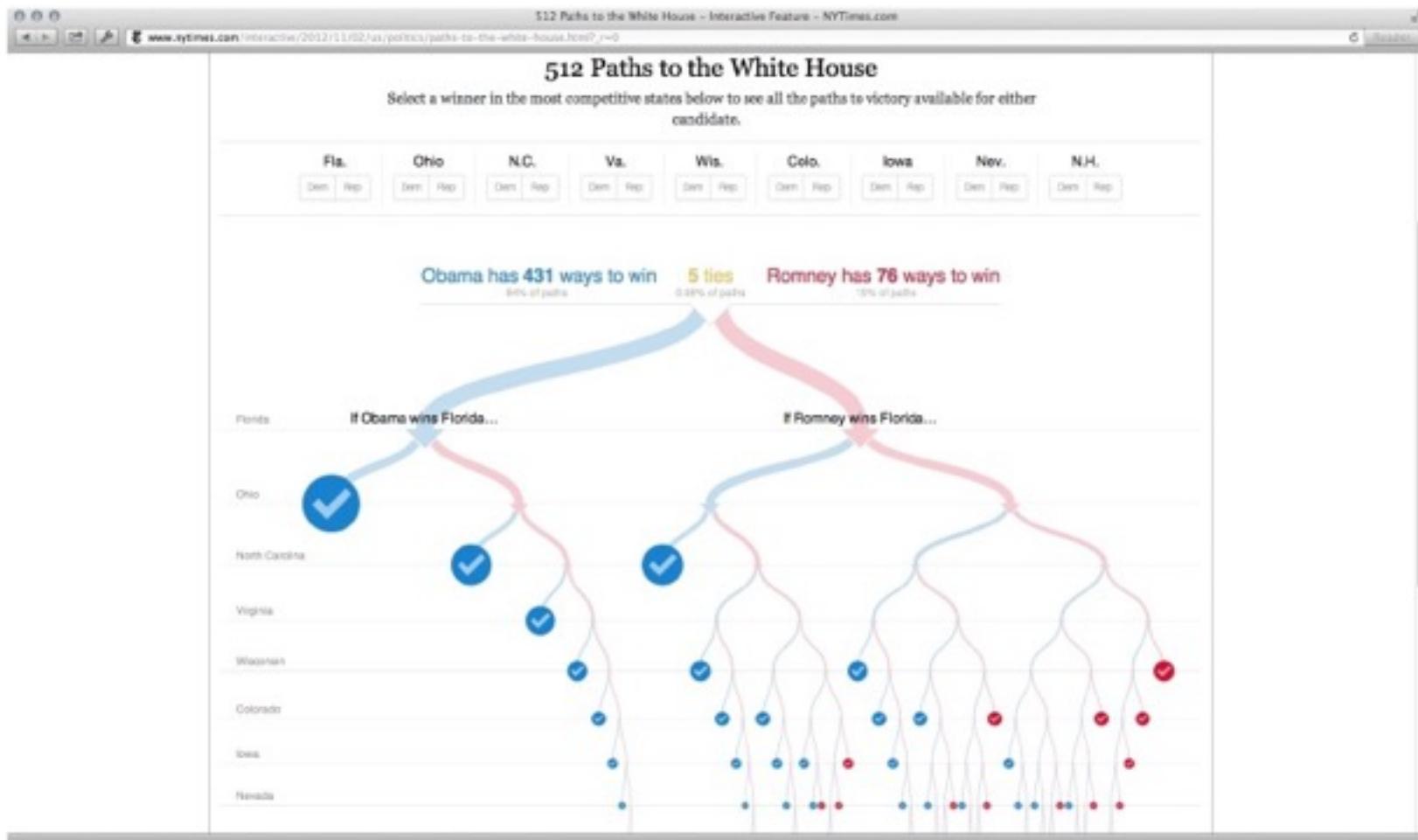
<http://moritz.stefaner.eu/projects/map%20your%20moves/>

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
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San Francisco University*

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